

# 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

NODE=MXXX005

NODE=M014

### $f_0(500)$

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

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

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

NODE=M014PP

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

| 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                                          |
| $(440 \pm 8) - i(212 \pm 15)$                                                 | <sup>19</sup> PELAEZ        | 04A  | RVUE $\pi\pi \rightarrow \pi\pi$                          |
| $(533 \pm 25) - i(249 \pm 25)$                                                | <sup>20</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>21</sup> ISHIDA        | 01   | $\Upsilon(3S) \rightarrow \Upsilon \pi\pi$                |
| $610 \pm 14 - i620 \pm 26$                                                    | <sup>22</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>23</sup> DOBADO        | 97   | RVUE Compilation                                          |
| $(602 \pm 26) - i(196 \pm 27)$                                                | <sup>24</sup> ISHIDA        | 97   | $\pi\pi \rightarrow \pi\pi$                               |
| $(537 \pm 20) - i(250 \pm 17)$                                                | <sup>25</sup> KAMINSKI      | 97B  | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}, 4\pi$          |
| $470 - i250$                                                                  | <sup>26,27</sup> TORNQVIST  | 96   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi, \eta\pi$ |
| $387 - i305$                                                                  | <sup>27,28</sup> JANSSEN    | 95   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}$                |
| $420 - i370$                                                                  | <sup>29</sup> ACHASOV       | 94   | RVUE $\pi\pi \rightarrow \pi\pi$                          |
| $(506 \pm 10) - i(247 \pm 3)$                                                 | KAMINSKI                    | 94   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}$                |

OCCUR=2

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|                                 |               |          |                                                  |
|---------------------------------|---------------|----------|--------------------------------------------------|
| 370 — $i356$                    | 30 ZOU        | 94B RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}$            |
| 408 — $i342$                    | 27,30 ZOU     | 93 RVUE  | $\pi\pi \rightarrow \pi\pi, K\bar{K}$            |
| 470 — $i208$                    | 31 VANBEVEREN | 86 RVUE  | $\pi\pi \rightarrow \pi\pi, K\bar{K}, \eta\eta,$ |
| $(750 \pm 50) - i(450 \pm 50)$  | 32 ESTABROOKS | 79 RVUE  | $\dots$                                          |
| $(660 \pm 100) - i(320 \pm 70)$ | PROTOPOP...   | 73 HBC   | $\pi\pi \rightarrow \pi\pi, K\bar{K}$            |
| 650 — $i370$                    | 33 BASDEVANT  | 72 RVUE  | $\pi\pi \rightarrow \pi\pi$                      |

<sup>1</sup> S-matrix pole; 8595 events.

<sup>2</sup> 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 PROTOPOPESCU 73.

<sup>3</sup> Uses the  $K_{e4}$  data of BATLEY 10C and the  $\pi N \rightarrow \pi\pi N$  data of HYAMS 73, GRAYER 74, and PROTOPOPESCU 73.

<sup>4</sup> Analytic continuation using Roy equations.

<sup>5</sup> Analytic continuation using GKPY equations.

<sup>6</sup> Using Roy equations.

<sup>7</sup> 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.

<sup>8</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>9</sup> From the  $K_{e4}$  data of BATLEY 08A and  $\pi N \rightarrow \pi\pi N$  data of HYAMS 73.

<sup>10</sup> From the  $K_{e4}$  data of BATLEY 08A and  $\pi N \rightarrow \pi\pi N$  data of PROTOPOPESCU 73, GRAYER 74, and ESTABROOKS 74.

<sup>11</sup> From a mean of three different  $f_0(500)$  parametrizations. Uses 40k events.

<sup>12</sup> From an isobar model using 2.6k events.

<sup>13</sup> Reanalysis of ABLIKIM 04A, PISLAK 01, and HYAMS 73 data.

<sup>14</sup> Using the N/D method.

<sup>15</sup> From the solution of the Roy equation (ROY 71) for the isoscalar S-wave and using a phase-shift analysis of HYAMS 73 and PROTOPOPESCU 73 data.

<sup>16</sup> Reanalysis of the data from PROTOPOPESCU 73, ESTABROOKS 74, GRAYER 74, ROSSELET 77, PISLAK 03, and AKHMETSHIN 04.

<sup>17</sup> From a mean of six different analyses and  $f_0(500)$  parameterizations.

<sup>18</sup> 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.

<sup>19</sup> Reanalysis of data from PROTOPOPESCU 73, ESTABROOKS 74, GRAYER 74, and COHEN 80 in the unitarized ChPT model.

<sup>20</sup> From a combined analysis of HYAMS 73, AUGUSTIN 89, AITALA 01B, and PISLAK 01.

<sup>21</sup> A similar analysis (KOMADA 01) finds  $(580^{+79}_{-30}) - i(190^{+107}_{-49})$  MeV.

<sup>22</sup> 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.

<sup>23</sup> Using the inverse amplitude method and data of ESTABROOKS 73, GRAYER 74, and PROTOPOPESCU 73.

<sup>24</sup> Reanalysis of data from HYAMS 73, GRAYER 74, SRINIVASAN 75, and ROSSELET 77 using the interfering amplitude method.

<sup>25</sup> Average and spread of 4 variants ("up" and "down") of KAMINSKI 97B 3-channel model.

<sup>26</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>27</sup> Demonstrates explicitly that  $f_0(500)$  and  $f_0(1370)$  are two different poles.

<sup>28</sup> Analysis of data from FALVARD 88.

<sup>29</sup> Analysis of data from OCHS 73, ESTABROOKS 75, ROSSELET 77, and MUKHIN 80.

<sup>30</sup> Analysis of data from OCHS 73, GRAYER 74, and ROSSELET 77.

<sup>31</sup> Coupled-channel analysis using data from PROTOPOPESCU 73, HYAMS 73, HYAMS 75, GRAYER 74, ESTABROOKS 74, ESTABROOKS 75, FROGGATT 77, CORDEEN 79, BISWAS 81.

<sup>32</sup> Analysis of data from APEL 72C, GRAYER 74, CASON 76, PAWLICKI 77. Includes spread and errors of 4 solutions.

<sup>33</sup> Analysis of data from BATON 70, BENSINGER 71, COLTON 71, BAILLON 72, PROTOPOPESCU 73, and WALKER 67.

NODE=M014PP;LINKAGE=I

NODE=M014PP;LINKAGE=AD

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NODE=M014PP;LINKAGE=MO

NODE=M014PP;LINKAGE=ME

NODE=M014PP;LINKAGE=MN

NODE=M014PP;LINKAGE=CA

NODE=M014PP;LINKAGE=AP

NODE=M014PP;LINKAGE=AL

NODE=M014PP;LINKAGE=BO

NODE=M014PP;LINKAGE=BU

NODE=M014PP;LINKAGE=AN

NODE=M014PP;LINKAGE=CL

NODE=M014PP;LINKAGE=ZH

NODE=M014PP;LINKAGE=AB

NODE=M014PP;LINKAGE=GA

NODE=M014PP;LINKAGE=PE

NODE=M014PP;LINKAGE=PS

NODE=M014PP;LINKAGE=KI

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NODE=M014PP;LINKAGE=DO

NODE=M014PP;LINKAGE=AA

NODE=M014PP;LINKAGE=E

NODE=M014PP;LINKAGE=B

NODE=M014PP;LINKAGE=G

NODE=M014PP;LINKAGE=C

NODE=M014PP;LINKAGE=D

NODE=M014PP;LINKAGE=F

NODE=M014PP;LINKAGE=BV

NODE=M014PP;LINKAGE=A

NODE=M014PP;LINKAGE=J

## $f_0(500)$ 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. • • •

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

NODE=M014M

NODE=M014M

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|         |                 |    |                                                                                                            |
|---------|-----------------|----|------------------------------------------------------------------------------------------------------------|
| 759± 5  | 37 TROYAN       | 98 | 5.2 $np \rightarrow np\pi^+\pi^-$                                                                          |
| 780±30  | ALDE            | 97 | GAM2 450 $pp \rightarrow pp\pi^0\pi^0$                                                                     |
| 585±20  | 38 ISHIDA       | 97 | $\pi\pi \rightarrow \pi\pi$                                                                                |
| 761±12  | 39 SVEC         | 96 | RVUE 6–17 $\pi N_{\text{polar}} \rightarrow \pi^+\pi^-N$                                                   |
| ~ 860   | 40,41 TORNQVIST | 96 | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi, \eta\pi$                                                  |
| 1165±50 | 42,43 ANISOVICH | 95 | RVUE $\pi^-p \rightarrow \pi^0\pi^0n, \bar{p}p \rightarrow \pi^0\pi^0\pi^0, \pi^0\pi^0\eta, \pi^0\eta\eta$ |
| ~ 1000  | 44 ACHASOV      | 94 | RVUE $\pi\pi \rightarrow \pi\pi$                                                                           |
| 414±20  | 39 AUGUSTIN     | 89 | DM2                                                                                                        |

<sup>34</sup> Statistical uncertainty only.

<sup>35</sup> A similar analysis (KOMADA 01) finds  $526^{+48}_{-37}$  MeV.

<sup>36</sup> From the best fit of the Dalitz plot.

<sup>37</sup>  $6\sigma$  effect, no PWA.

<sup>38</sup> Reanalysis of data from HYAMS 73, GRAYER 74, SRINIVASAN 75, and ROSSELET 77 using the interfering amplitude method.

<sup>39</sup> Breit-Wigner fit to S-wave intensity measured in  $\pi N \rightarrow \pi^-\pi^+N$  on polarized targets. The fit does not include  $f_0(980)$ .

<sup>40</sup> 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.

<sup>41</sup> Also observed by ASNER 00 in  $\tau^- \rightarrow \pi^-\pi^0\pi^0\nu_\tau$  decays.

<sup>42</sup> 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.

<sup>43</sup> The pole is on Sheet III. Demonstrates explicitly that  $f_0(500)$  and  $f_0(1370)$  are two different poles.

<sup>44</sup> Analysis of data from OCHS 73, ESTABROOKS 75, ROSSELET 77, and MUKHIN 80.

NODE=M014M;LINKAGE=UT

NODE=M014M;LINKAGE=KI

NODE=M014M;LINKAGE=KK

NODE=M014M;LINKAGE=TN

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 |
|-------------------------------|-------------|------|---------|
| <b>(400–700) OUR ESTIMATE</b> |             |      |         |

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

|                           |                 |     |                                                                                                            |
|---------------------------|-----------------|-----|------------------------------------------------------------------------------------------------------------|
| 335± 67                   | 45 MURAMATSU    | 02  | CLEO $e^+e^- \approx 10$ GeV                                                                               |
| 324 $^{+42}_{-40} \pm 21$ | AITALA          | 01B | E791 $D^+ \rightarrow \pi^-\pi^+\pi^+$                                                                     |
| 372 $^{+229}_{-95}$       | 46 ISHIDA       | 01  | $\Upsilon(3S) \rightarrow \Upsilon\pi\pi$                                                                  |
| 540                       | 47 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                    | 48 TROYAN       | 98  | 5.2 $np \rightarrow np\pi^+\pi^-$                                                                          |
| 780± 60                   | ALDE            | 97  | GAM2 450 $pp \rightarrow pp\pi^0\pi^0$                                                                     |
| 385± 70                   | 49 ISHIDA       | 97  | $\pi\pi \rightarrow \pi\pi$                                                                                |
| 290± 54                   | 50 SVEC         | 96  | RVUE 6–17 $\pi N_{\text{polar}} \rightarrow \pi^+\pi^-N$                                                   |
| ~ 880                     | 51,52 TORNQVIST | 96  | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi, \eta\pi$                                                  |
| 460± 40                   | 53,54 ANISOVICH | 95  | RVUE $\pi^-p \rightarrow \pi^0\pi^0n, \bar{p}p \rightarrow \pi^0\pi^0\pi^0, \pi^0\pi^0\eta, \pi^0\eta\eta$ |
| ~ 3200                    | 55 ACHASOV      | 94  | RVUE $\pi\pi \rightarrow \pi\pi$                                                                           |
| 494± 58                   | 50 AUGUSTIN     | 89  | DM2                                                                                                        |

<sup>45</sup> Statistical uncertainty only.

<sup>46</sup> A similar analysis (KOMADA 01) finds  $301^{+145}_{-100}$  MeV.

<sup>47</sup> From the best fit of the Dalitz plot.

<sup>48</sup>  $6\sigma$  effect, no PWA.

<sup>49</sup> Reanalysis of data from HYAMS 73, GRAYER 74, SRINIVASAN 75, and ROSSELET 77 using the interfering amplitude method.

<sup>50</sup> Breit-Wigner fit to S-wave intensity measured in  $\pi N \rightarrow \pi^-\pi^+N$  on polarized targets. The fit does not include  $f_0(980)$ .

<sup>51</sup> 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.

<sup>52</sup> Also observed by ASNER 00 in  $\tau^- \rightarrow \pi^-\pi^0\pi^0\nu_\tau$  decays.

<sup>53</sup> 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.

<sup>54</sup> The pole is on Sheet III. Demonstrates explicitly that  $f_0(500)$  and  $f_0(1370)$  are two different poles.

<sup>55</sup> 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

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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                                                                                                                                                                                       | 56 DAI              | 14A | RVUE | Compilation                                       |  |
| 1.7 ± 0.4                                                                                                                                                                                         | 57 HOFERICHTER11    |     | RVUE | Compilation                                       |  |
| 3.08 ± 0.82                                                                                                                                                                                       | 58 MENNESSIER 11    |     | RVUE | Compilation                                       |  |
| 2.08 ± 0.2 $^{+0.07}_{-0.04}$                                                                                                                                                                     | 59 MOUSSALLAM11     |     | RVUE | Compilation                                       |  |
| 2.08                                                                                                                                                                                              | 60 MAO              | 09  | RVUE | Compilation                                       |  |
| 1.2 ± 0.4                                                                                                                                                                                         | 61 BERNABEU         | 08  | RVUE |                                                   |  |
| 3.9 ± 0.6                                                                                                                                                                                         | 58 MENNESSIER 08    |     | RVUE | $\gamma\gamma \rightarrow \pi^+\pi^-, \pi^0\pi^0$ |  |
| 1.8 ± 0.4                                                                                                                                                                                         | 62 OLLER            | 08  | RVUE | Compilation                                       |  |
| 1.68 ± 0.15                                                                                                                                                                                       | 62,63 OLLER         | 08A | RVUE | Compilation                                       |  |
| 3.1 ± 0.5                                                                                                                                                                                         | 64,65 PENNINGTON 08 |     | RVUE | Compilation                                       |  |
| 2.4 ± 0.4                                                                                                                                                                                         | 65,66 PENNINGTON 08 |     | RVUE | Compilation                                       |  |
| 4.1 ± 0.3                                                                                                                                                                                         | 67 PENNINGTON 06    |     | RVUE | $\gamma\gamma \rightarrow \pi^0\pi^0$             |  |
| 3.8 ± 1.5                                                                                                                                                                                         | 68,69 BOGLIONE      | 99  | RVUE | $\gamma\gamma \rightarrow \pi^+\pi^-, \pi^0\pi^0$ |  |
| 5.4 ± 2.3                                                                                                                                                                                         | 68 MORGAN           | 90  | RVUE | $\gamma\gamma \rightarrow \pi^+\pi^-, \pi^0\pi^0$ |  |
| 10 ± 6                                                                                                                                                                                            | COURAU              | 86  | DM1  | $e^+e^- \rightarrow \pi^+\pi^- e^+e^-$            |  |
| 56 Using dispersive analysis with phases from GARCIA-MARTIN 11A and BUETTIKER 04 as input.                                                                                                        |                     |     |      |                                                   |  |
| 57 Using Roy-Steiner equations with $\pi\pi$ phase shifts from an update of COLANGELO 01 and from GARCIA-MARTIN 11A.                                                                              |                     |     |      |                                                   |  |
| 58 Using an analytic K-matrix model.                                                                                                                                                              |                     |     |      |                                                   |  |
| 59 Using dispersion integral with phase input from Roy equations and data from MARSISKE 90, BOYER 90, BEHREND 92, UEHARA 08A, and MORI 07.                                                        |                     |     |      |                                                   |  |
| 60 Used dispersion theory. The value quoted used the $f_0(500)$ pole position of $457 - i276$ MeV.                                                                                                |                     |     |      |                                                   |  |
| 61 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.                              |                     |     |      |                                                   |  |
| 62 Using twice-subtracted dispersion integrals.                                                                                                                                                   |                     |     |      |                                                   |  |
| 63 Supersedes OLLER 08.                                                                                                                                                                           |                     |     |      |                                                   |  |
| 64 Solution A (preferred solution based on $\chi^2$ -analysis).                                                                                                                                   |                     |     |      |                                                   |  |
| 65 Dispersion theory based amplitude analysis of BOYER 90, MARSISKE 90, BEHREND 92, and MORI 07.                                                                                                  |                     |     |      |                                                   |  |
| 66 Solution B (worse than solution A; still acceptable when systematic uncertainties are included).                                                                                               |                     |     |      |                                                   |  |
| 67 Using unitarity and the $\sigma$ pole position from CAPRINI 06.                                                                                                                                |                     |     |      |                                                   |  |
| 68 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 $f_2(1270)$ . |                     |     |      |                                                   |  |
| 69 Supersedes MORGAN 90.                                                                                                                                                                          |                     |     |      |                                                   |  |

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NODE=M014W2;LINKAGE=P2

NODE=M014W2;LINKAGE=PE

NODE=M014W2;LINKAGE=A

NODE=M014W2;LINKAGE=BL

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|             |     |                              |                                                |                             |                      |
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| ASNER       | 00  | PR D61 012002                | D.M. Asner <i>et al.</i>                       | (CLEO Collab.)              | REFID=47339          |
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| 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          |
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| OLLER       | 99C | PR D60 074023                | J.A. Oller, E. Oset                            |                             | REFID=47386          |
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| LOCHER      | 98  | EPJ C4 317                   | M.P. Locher <i>et al.</i>                      | (PSI)                       | REFID=46372          |
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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          |
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| 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          |
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| ESTABROOKS  | 79  | PR D19 2678                  | P. Estabrooks                                  | (CARL)                      | REFID=20375          |
| FROGGATT    | 77  | NP B129 89                   | C.D. Froggatt, J.L. Petersen                   | (GLAS, NORD)                | REFID=21072          |
| PAWLICKI    | 77  | PR D15 3196                  | A.J. Pawlicki <i>et al.</i>                    | (ANL) IJ                    | REFID=20367          |
| ROSSELET    | 77  | PR D15 574                   | L. Rosselet <i>et al.</i>                      | (GEVA, SACL)                | REFID=11004          |
| CASON       | 76  | PRL 36 1485                  | N.M. Cason <i>et al.</i>                       | (NDAM, ANL) IJ              | REFID=21064          |
| 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          |
| 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          |
| GRAYER      | 74  | NP B75 189                   | G. Grayer <i>et al.</i>                        | (CERN, MPIM)                | REFID=20113          |
| ESTABROOKS  | 73  | Tallahassee                  | P.G. Estabrooks <i>et al.</i>                  | (CERN, MPIM)                | REFID=20345          |
| 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          |
| PROTOPOP... | 73  | PR D7 1279                   | S.D. Protopopescu <i>et al.</i>                | (LBL)                       | REFID=20108          |
| APEL        | 72C | PL 41B 542                   | W.D. Apel <i>et al.</i>                        | (KARLK, KARLE, PISA)        | REFID=21013          |
| BAILLON     | 72  | PL 38B 555                   | P.H. Baillon <i>et al.</i>                     | (SLAC)                      | 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          |

$\rho(770)$ 

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

See the related review(s):

 $\rho(770)$  $\rho(770)$  MASS

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

NEUTRAL ONLY,  $e^{+}e^{-}$ 

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

<sup>1</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>2</sup> A combined fit of AKHMETSHIN 07, AULCHENKO 06, and AULCHENKO 05.

<sup>3</sup> Supersedes ACHASOV 05A.

<sup>4</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>5</sup> Using the GOUNARIS 68 parametrization with the complex phase of the  $\rho$ - $\omega$  interference.

<sup>6</sup> Update of AKHMETSHIN 02.

<sup>7</sup> Assuming  $m_{\rho^{+}} = m_{\rho^{-}}$ ,  $\Gamma_{\rho^{+}} = \Gamma_{\rho^{-}}$ .

<sup>8</sup> From the GOUNARIS 68 parametrization of the pion form factor.

<sup>9</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>10</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>11</sup> Assuming  $m_{\rho^{+}} = m_{\rho^{-}} = m_{\rho^0}$ ,  $\Gamma_{\rho^{+}} = \Gamma_{\rho^{-}} = \Gamma_{\rho^0}$ .

<sup>12</sup> Without limitations on masses and widths.

<sup>13</sup> Assuming  $m_{\rho^0} = m_{\rho^{\pm}}$ ,  $g_{\rho^0\pi\pi} = g_{\rho^{\pm}\pi\pi}$ .

<sup>14</sup> Using the data of BARKOV 85 in the hidden local symmetry model.

<sup>15</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>16</sup> A fit of BARKOV 85 data assuming the direct  $\omega\pi\pi$  coupling.

<sup>17</sup> Applying the S-matrix formalism to the BARKOV 85 data.

<sup>18</sup> Includes BARKOV 85 data. Model-dependent width definition.

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

| VALUE (MeV)                      | EVTS  | DOCUMENT ID  | TECN | CHG  | COMMENT                                                |
|----------------------------------|-------|--------------|------|------|--------------------------------------------------------|
| <b>775.11 ± 0.34 OUR AVERAGE</b> |       |              |      |      |                                                        |
| 774.6 ± 0.2 ± 0.5                | 5.4M  | 1,2 FUJIKAWA | 08   | BELL | $\pm$ $\tau^{-} \rightarrow \pi^{-}\pi^0\nu_{\tau}$    |
| 775.5 ± 0.7                      |       | 2,3 SCHAEAL  | 05C  | ALEP | $\tau^{-} \rightarrow \pi^{-}\pi^0\nu_{\tau}$          |
| 775.5 ± 0.5 ± 0.4                | 1.98M | 4 ALOISIO    | 03   | KLOE | $1.02 e^{+}e^{-} \rightarrow$<br>$\pi^{+}\pi^{-}\pi^0$ |
| 775.1 ± 1.1 ± 0.5                | 87k   | 5,6 ANDERSON | 00A  | CLE2 | $\tau^{-} \rightarrow \pi^{-}\pi^0\nu_{\tau}$          |

NODE=M009

NODE=M009205

NODE=M009205

NODE=M009M0

NODE=M009M0

OCCUR=2

OCCUR=3

OCCUR=3

NODE=M009M0;LINKAGE=LE

NODE=M009M0;LINKAGE=AK

NODE=M009M0;LINKAGE=AC

NODE=M009M0;LINKAGE=SN

NODE=M009M0;LINKAGE=GS

NODE=M009M0;LINKAGE=PT

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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

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

|                                            |  |                           |     |        |                                              |
|--------------------------------------------|--|---------------------------|-----|--------|----------------------------------------------|
| 761.60±0.95                                |  | <sup>7</sup> BARTOS       | 17A | RVUE   | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$    |
| 774.8 ±0.6 ±0.4 1.98M                      |  | <sup>8</sup> ALOISIO      | 03  | KLOE - | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 776.3 ±0.6 ±0.7 1.98M                      |  | <sup>8</sup> ALOISIO      | 03  | KLOE + | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 773.9 ±2.0 <sup>+0.3</sup> <sub>-1.0</sub> |  | <sup>9</sup> SANZ-CILLERO | 03  | RVUE   | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$    |
| 774.5 ±0.7 ±1.5 500k                       |  | <sup>4</sup> ACHASOV      | 02  | SND ±  | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 775.1 ±0.5                                 |  | <sup>10</sup> PICH        | 01  | RVUE   | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$    |

OCCUR=2

OCCUR=3

OCCUR=2

<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> 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±0.3±1.2</b> | 600k | <sup>1</sup> ABELE | 99E  | CBAR 0± | 0.0 $\bar{p} p \rightarrow \pi^+ \pi^- \pi^0$ |

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

<sup>1</sup> Mass errors enlarged by us to  $\Gamma/\sqrt{N}$ ; 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.

OCCUR=2

NODE=M009M2;LINKAGE=Z

NODE=M009M2;LINKAGE=X

NODE=M009M2;LINKAGE=A

## NEUTRAL ONLY, PHOTOPRODUCED

| VALUE (MeV)                         | EVTS  | DOCUMENT ID             | TECN | COMMENT                                         |
|-------------------------------------|-------|-------------------------|------|-------------------------------------------------|
| <b>769.0± 1.0 OUR AVERAGE</b>       |       |                         |      |                                                 |
| 771 ± 2 <sup>+2</sup> <sub>-1</sub> | 63.5k | <sup>1</sup> ABRAMOWICZ | 12   | ZEUS $e p \rightarrow e \pi^+ \pi^- p$          |
| 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 $\gamma + \text{Pb}$                       |

• • • 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.

NODE=M009M0P

NODE=M009M0P

OCCUR=2

OCCUR=2

NODE=M009M0P;LINKAGE=AB

NODE=M009M0P;LINKAGE=B5

NODE=M009M0P;LINKAGE=B6

**NEUTRAL ONLY, OTHER REACTIONS**

| VALUE (MeV)       | EVTS               | DOCUMENT ID                                                 | TECN | CHG | COMMENT                                    |
|-------------------|--------------------|-------------------------------------------------------------|------|-----|--------------------------------------------|
| <b>769.0 ±0.9</b> | <b>OUR AVERAGE</b> | 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 | 0   |                                            |
| 769 ±3            |                    | <sup>4</sup> WICKLUND 78                                    | ASPK | 0   | $3,4,6 \pi^\pm N$                          |
| 768 ±1            | 76000              | DEUTSCH... 76                                               | HBC  | 0   | $16 \pi^+ p$                               |
| 767 ±4            | 4100               | ENGLER 74                                                   | DBC  | 0   | $6 \pi^+ n \rightarrow \pi^+\pi^- p$       |
| 775 ±4            | 32000              | <sup>2</sup> PROTOPOP... 73                                 | HBC  | 0   | $7.1 \pi^+ p, t < 0.4$                     |
| 764 ±3            | 6800               | <sup>5</sup> RATCLIFF 72                                    | ASPK | 0   | $15 \pi^- p, t < 0.3$                      |
| 774 ±3            | 1700               | REYNOLDS 69                                                 | HBC  | 0   | $2.26 \pi^- p$                             |
| 769.2 ±1.5        | 13300              | <sup>6</sup> PISUT 68                                       | RVUE | 0   | $1.7-3.2 \pi^- p, t < 10$                  |

• • • 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 | $0.0 \bar{p}p \rightarrow \pi^+\pi^-\pi^0$ |
| 777 ±2             | 4943  | <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 | 0 | $17 \pi^- p$ polarized                     |
| 769.5 ±0.7         |       | <sup>2,3</sup> LANG 79       | RVUE | 0 |                                            |
| 770 ±9             |       | <sup>3</sup> ESTABROOKS 74   | RVUE | 0 | $17 \pi^- p \rightarrow \pi^+\pi^- n$      |
| 773.5 ±1.7         | 11200 | <sup>14</sup> JACOBS 72      | HBC  | 0 | $2.8 \pi^- p$                              |
| 775 ±3             | 2250  | <sup>15</sup> HYAMS 68       | OSPK | 0 | $11.2 \pi^- p$                             |

<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.

<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  
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

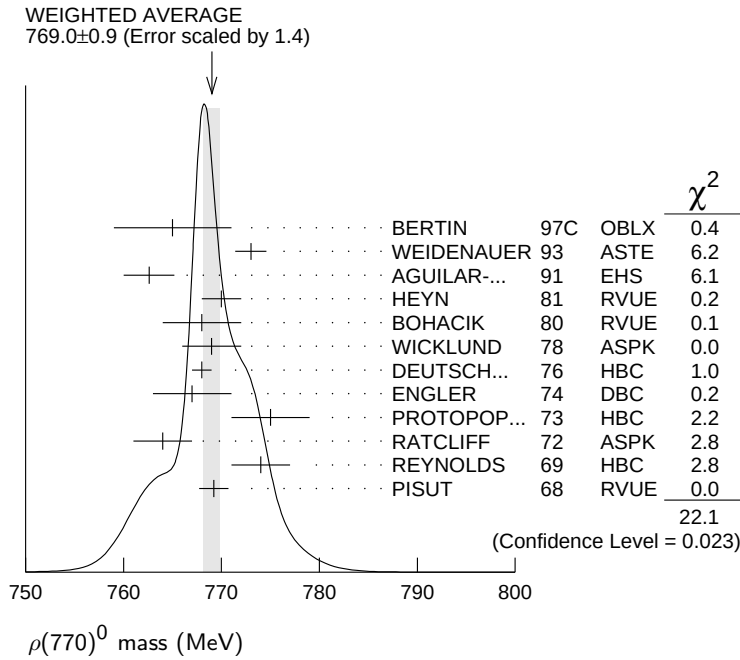
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NODE=M009M0R;LINKAGE=CL

NODE=M009M0R;LINKAGE=BL  
NODE=M009M0R;LINKAGE=A1  
NODE=M009M0R;LINKAGE=QQ  
NODE=M009M0R;LINKAGE=G

NODE=M009M0R;LINKAGE=Z  
NODE=M009M0R;LINKAGE=02





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

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> SCHAEEL                                        | 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>$\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |

NODE=M009D

<sup>1</sup> 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. Supersedes BARATE 97M.

NODE=M009D;LINKAGE=SC

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

NODE=M009D;LINKAGE=CH

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

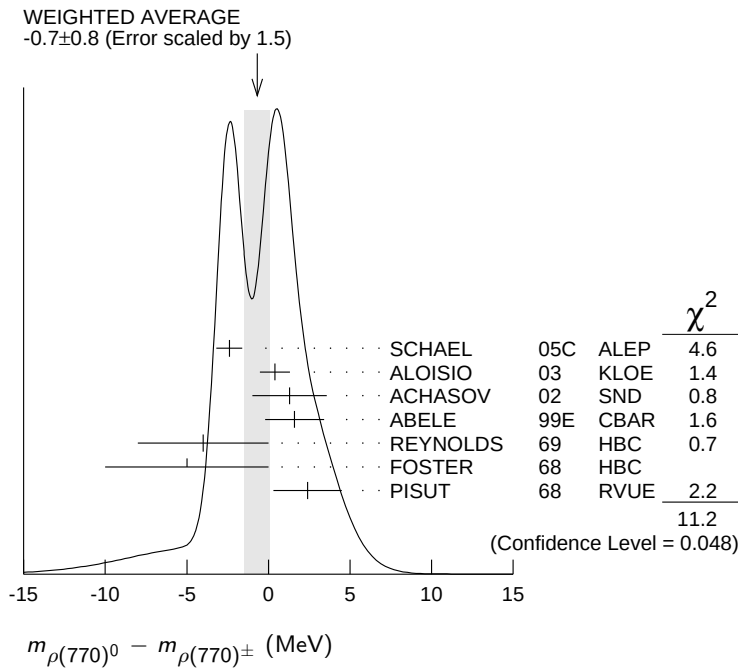
NODE=M009D;LINKAGE=A

<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.

NODE=M009D;LINKAGE=R

<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=B



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

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID          | TECN | CHG  | 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=M009D1

NODE=M009D;LINKAGE=WO

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

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,  $q = q_r$ .

| <i>VALUE</i> (GeV <sup>-1</sup> )                                            | <i>DOCUMENT ID</i>   | <i>TECN</i> | <i>CHG</i> | <i>COMMENT</i> |                        |
|------------------------------------------------------------------------------|----------------------|-------------|------------|----------------|------------------------|
| <b>5.3<sup>+0.9</sup><sub>-0.7</sub></b>                                     | <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

NODE=M009R

NODE=M009R;LINKAGE=01

### $\rho(770)$ WIDTH

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

NODE=M009220

NODE=M009220

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

| VALUE (MeV)                                                                   | EVTS               | DOCUMENT ID                                                 | TECN | CHG  | COMMENT                                           |
|-------------------------------------------------------------------------------|--------------------|-------------------------------------------------------------|------|------|---------------------------------------------------|
| <b>147.8 ±0.9</b>                                                             | <b>OUR AVERAGE</b> | Error includes scale factor of 2.0. See the ideogram below. |      |      |                                                   |
| 149.59±0.67                                                                   |                    | <sup>1</sup> LEES                                           | 12G  | BABR | $e^+e^- \rightarrow \pi^+\pi^-\gamma$             |
| 145.98±0.75±0.50                                                              | 900k               | <sup>2</sup> AKHMETSHIN                                     | 07   |      | $e^+e^- \rightarrow \pi^+\pi^-$                   |
| 146.1 ±0.8 ±1.5                                                               | 800k               | <sup>3,4</sup> ACHASOV                                      | 06   | SND  | $e^+e^- \rightarrow \pi^+\pi^-$                   |
| 143.85±1.33±0.80                                                              | 114k               | <sup>5,6</sup> AKHMETSHIN                                   | 04   | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-$                   |
| 147.3 ±1.5 ±0.7                                                               | 1.98M              | <sup>7</sup> ALOISIO                                        | 03   | KLOE | $1.02 \frac{e^+e^-}{\pi^+\pi^-\pi^0} \rightarrow$ |
| 151.1 ±2.6 ±3.0                                                               | 500k               | <sup>7</sup> ACHASOV                                        | 02   | SND  | 0                                                 |
|                                                                               |                    |                                                             |      |      | $1.02 \frac{e^+e^-}{\pi^+\pi^-\pi^0} \rightarrow$ |
| 150.5 ±3.0                                                                    |                    | <sup>8</sup> BARKOV                                         | 85   | OLYA | 0                                                 |
|                                                                               |                    |                                                             |      |      | $e^+e^- \rightarrow \pi^+\pi^-$                   |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                    |                                                             |      |      |                                                   |
| 144.06±0.85                                                                   |                    | <sup>9</sup> BARTOS                                         | 17   | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$                   |
| 144.56±0.80                                                                   |                    | <sup>10</sup> BARTOS                                        | 17A  | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$                   |
| 143.9 ±1.3 ±1.1                                                               | 1.98M              | <sup>11</sup> ALOISIO                                       | 03   | KLOE | $1.02 \frac{e^+e^-}{\pi^+\pi^-\pi^0} \rightarrow$ |
| 147.4 ±1.5 ±0.7                                                               | 1.98M              | <sup>12</sup> ALOISIO                                       | 03   | KLOE | $1.02 \frac{e^+e^-}{\pi^+\pi^-\pi^0} \rightarrow$ |

NODE=M009W0

NODE=M009W0

OCCUR=2

OCCUR=3

|                 |      |    |            |    |      |                                                   |
|-----------------|------|----|------------|----|------|---------------------------------------------------|
| 149.8 ±2.2 ±2.0 | 500k | 13 | ACHASOV    | 02 | SND  | 1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$         |
| 147.9 ±1.5 ±7.5 |      | 14 | BENAYOUN   | 98 | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$ ,<br>$\mu^+\mu^-$ |
| 153.5 ±1.3 ±4.6 |      | 15 | GARDNER    | 98 | RVUE | 0.28–0.92 $e^+e^- \rightarrow \pi^+\pi^-$         |
| 145.0 ±1.7      |      | 16 | O'CONNELL  | 97 | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$                   |
| 142.5 ±3.5      |      | 17 | BERNICA    | 94 | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$                   |
| 138 ±1          |      | 18 | GESHKEN... | 89 | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$                   |

OCCUR=3

<sup>1</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>2</sup> A combined fit of AKHMETSHIN 07, AULCHENKO 06, and AULCHENKO 05.

<sup>3</sup> Supersedes ACHASOV 05A.

<sup>4</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>5</sup> Using the GOUNARIS 68 parametrization with the complex phase of the  $\rho$ - $\omega$  interference.

<sup>6</sup> From a fit in the energy range 0.61 to 0.96 GeV. Update of AKHMETSHIN 02.

<sup>7</sup> Assuming  $m_{\rho^+} = m_{\rho^-}$ ,  $\Gamma_{\rho^+} = \Gamma_{\rho^-}$ .

<sup>8</sup> From the GOUNARIS 68 parametrization of the pion form factor.

<sup>9</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>10</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>11</sup> Assuming  $m_{\rho^+} = m_{\rho^-} = m_{\rho^0}$ ,  $\Gamma_{\rho^+} = \Gamma_{\rho^-} = \Gamma_{\rho^0}$ .

<sup>12</sup> Without limitations on masses and widths.

<sup>13</sup> Assuming  $m_{\rho^0} = m_{\rho^\pm}$ ,  $g_{\rho^0\pi\pi} = g_{\rho^\pm\pi\pi}$ .

<sup>14</sup> Using the data of BARKOV 85 in the hidden local symmetry model.

<sup>15</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>16</sup> A fit of BARKOV 85 data assuming the direct  $\omega\pi\pi$  coupling.

<sup>17</sup> Applying the S-matrix formalism to the BARKOV 85 data.

<sup>18</sup> Includes BARKOV 85 data. Model-dependent width definition.

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

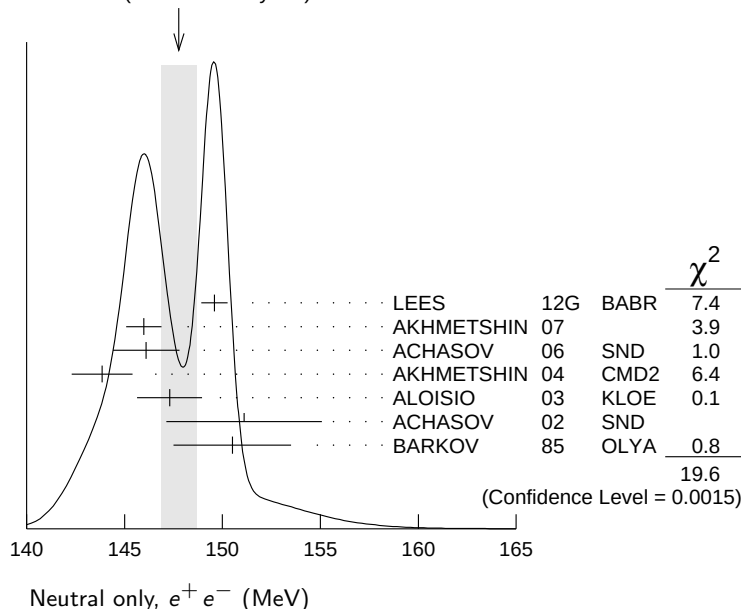
NODE=M009W;LINKAGE=G8

NODE=M009W;LINKAGE=AB

NODE=M009W;LINKAGE=AA

NODE=M009W;LINKAGE=F

WEIGHTED AVERAGE  
147.8±0.9 (Error scaled by 2.0)



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

| VALUE (MeV)       | EVTS               | DOCUMENT ID      | TECN | CHG | COMMENT                                   |
|-------------------|--------------------|------------------|------|-----|-------------------------------------------|
| <b>149.1 ±0.8</b> | <b>OUR FIT</b>     |                  |      |     |                                           |
| <b>149.1 ±0.8</b> | <b>OUR AVERAGE</b> |                  |      |     |                                           |
| 148.1 ±0.4 ±1.7   | 5.4M               | 1,2 FUJIKAWA 08  | BELL | ±   | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |
| 149.0 ±1.2        |                    | 2,3 SCHAEAL 05C  | ALEP |     | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |
| 149.9 ±2.3 ±2.0   | 500k               | 4 ACHASOV 02     | SND  | ±   | 1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 150.4 ±1.4 ±1.4   | 87k                | 5,6 ANDERSON 00A | CLE2 |     | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |

NODE=M009W5  
NODE=M009W5

OCCUR=2

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

|                                            |                           |     |        |                                              |
|--------------------------------------------|---------------------------|-----|--------|----------------------------------------------|
| 139.90±0.46                                | <sup>7</sup> BARTOS       | 17A | RVUE   | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$    |
| 143.7 ±1.3 ±1.2 1.98M                      | <sup>4</sup> ALOISIO      | 03  | KLOE ± | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 142.9 ±1.3 ±1.4 1.98M                      | <sup>8</sup> ALOISIO      | 03  | KLOE − | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 144.7 ±1.4 ±1.2 1.98M                      | <sup>8</sup> ALOISIO      | 03  | KLOE + | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 150.2 ±2.0 <sup>+0.7</sup> <sub>−1.6</sub> | <sup>9</sup> SANZ-CILLERO | 03  | RVUE   | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$    |
| 150.9 ±2.2 ±2.0 500k                       | <sup>10</sup> ACHASOV     | 02  | SND    | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |

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

### MIXED CHARGES, OTHER REACTIONS

| VALUE (MeV)      | EVTS | DOCUMENT ID        | TECN | CHG  | COMMENT                                             |
|------------------|------|--------------------|------|------|-----------------------------------------------------|
| <b>149.5±1.3</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.

NODE=M009W;LINKAGE=LB

### CHARGED ONLY, HADROPRODUCED

| VALUE (MeV)                   | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------------------------|------|-------------|------|-----|---------|
| <b>150.2± 2.4 OUR FIT</b>     |      |             |      |     |         |
| <b>150.2± 2.4 OUR AVERAGE</b> |      |             |      |     |         |

|            |      |                      |    |        |                                                         |
|------------|------|----------------------|----|--------|---------------------------------------------------------|
| 152.8± 4.3 |      | ABELE                | 97 | CBAR   | $\bar{p} n \rightarrow \pi^- \pi^0 \pi^0$               |
| 155 ±11    | 2.9k | <sup>1</sup> CAPRARO | 87 | SPEC − | $200 \pi^- \text{Cu} \rightarrow \pi^- \pi^0 \text{Cu}$ |
| 154 ±20    | 967  | <sup>1</sup> CAPRARO | 87 | SPEC − | $200 \pi^- \text{Pb} \rightarrow \pi^- \pi^0 \text{Pb}$ |
| 150 ± 5    |      | HUSTON               | 86 | SPEC + | $202 \pi^+ \text{A} \rightarrow \pi^+ \pi^0 \text{A}$   |
| 146 ±12    | 6.5k | <sup>2</sup> BYERLY  | 73 | OSPK − | $5 \pi^- p$                                             |
| 148.2± 4.1 | 9.6k | <sup>3</sup> PISUT   | 68 | RVUE − | $1.7\text{--}3.2 \pi^- p, t < 10$                       |
| 146 ±13    | 900  | EISNER               | 67 | HBC −  | $4.2 \pi^- p, t < 10$                                   |

OCCUR=2

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

|            |  |                      |    |      |                                  |
|------------|--|----------------------|----|------|----------------------------------|
| 137.0± 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

NODE=M009W2;LINKAGE=A

### NEUTRAL ONLY, PHOTOPRODUCED

| VALUE (MeV)                   | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------------------------|------|-------------|------|---------|
| <b>151.7± 2.6 OUR AVERAGE</b> |      |             |      |         |

|              |       |                         |     |      |                                   |
|--------------|-------|-------------------------|-----|------|-----------------------------------|
| 155 ± 5 ± 2  | 63.5k | <sup>1</sup> ABRAMOWICZ | 12  | ZEUS | $e p \rightarrow e \pi^+ \pi^- p$ |
| 146 ± 3 ± 13 | 79k   | <sup>2</sup> BREITWEG   | 98B | ZEUS | $50\text{--}100 \gamma p$         |
| 150.9± 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 | $50\text{--}100 \gamma p$                  |
| 147 ±11    |      | GLADDING              | 73  | CNTR | $2.9\text{--}4.7 \gamma p$                 |
| 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 | $\gamma + \text{Pb}$                       |

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 | CHG | COMMENT                                    |              |
|-------------------------------------------------------------------------------|--------------------|-------------------------------------|------|-----|--------------------------------------------|--------------|
| <b>150.9 ± 1.7</b>                                                            | <b>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 | 0   |                                            |              |
| 152 ± 9                                                                       |                    | <sup>3</sup> WICKLUND 78            | ASPK | 0   | 3,4,6 $\pi^\pm pN$                         |              |
| 154 ± 2                                                                       | 76000              | DEUTSCH...                          | 76   | HBC | 0                                          | 16 $\pi^+ p$ |
| 157 ± 8                                                                       | 6800               | <sup>4</sup> RATCLIFF 72            | ASPK | 0   | 15 $\pi^- p$ , $t < 0.3$                   |              |
| 143 ± 8                                                                       | 1700               | REYNOLDS 69                         | HBC  | 0   | 2.26 $\pi^- p$                             |              |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                    |                                     |      |     |                                            |              |
| 150.85 ± 0.55 ± 0.67970k                                                      |                    | <sup>5</sup> ABLIKIM 18C            | BES3 |     | $\eta'(958) \rightarrow \gamma\pi^+\pi^-$  |              |
| 150.18 ± 0.55 ± 0.65970k                                                      |                    | <sup>6</sup> ABLIKIM 18C            | BES3 |     | $\eta'(958) \rightarrow \gamma\pi^+\pi^-$  |              |
| 147.0 ± 2.5                                                                   | 600k               | <sup>7</sup> ABELE 99E              | CBAR | 0   | 0.0 $\bar{p}p \rightarrow \pi^+\pi^-\pi^0$ |              |
| 146 ± 3                                                                       | 4943               | <sup>8</sup> ADAMS 97               | E665 |     | 470 $\mu p \rightarrow \mu XB$             |              |
| 160.0 <sup>+</sup> 4.1<br><sub>- 4.0</sub>                                    |                    | <sup>9</sup> CHABAUD 83             | ASPK | 0   | 17 $\pi^- p$ polarized                     |              |
| 155 ± 1                                                                       |                    | <sup>10</sup> HEYN 81               | RVUE | 0   | $\pi$ form factor                          |              |
| 148.0 ± 1.3                                                                   |                    | <sup>1,2</sup> LANG 79              | RVUE | 0   |                                            |              |
| 146 ± 14                                                                      | 4100               | ENGLER 74                           | DBC  | 0   | 6 $\pi^+ n \rightarrow \pi^+\pi^- p$       |              |
| 143 ± 13                                                                      |                    | <sup>2</sup> ESTABROOKS 74          | RVUE | 0   | 17 $\pi^- p \rightarrow \pi^+\pi^- n$      |              |
| 160 ± 10                                                                      | 32000              | <sup>1</sup> PROTOPOP... 73         | HBC  | 0   | 7.1 $\pi^+ p$ , $t < 0.4$                  |              |
| 145 ± 12                                                                      | 2250               | <sup>3,11</sup> HYAMS 68            | OSPK | 0   | 11.2 $\pi^- p$                             |              |
| 163 ± 15                                                                      | 13300              | <sup>12</sup> PISUT 68              | RVUE | 0   | 1.7–3.2 $\pi^- p$ , $t < 10$               |              |

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

|                          |       |                             |      |   |                                            |
|--------------------------|-------|-----------------------------|------|---|--------------------------------------------|
| 150.85 ± 0.55 ± 0.67970k |       | <sup>5</sup> ABLIKIM 18C    | BES3 |   | $\eta'(958) \rightarrow \gamma\pi^+\pi^-$  |
| 150.18 ± 0.55 ± 0.65970k |       | <sup>6</sup> ABLIKIM 18C    | BES3 |   | $\eta'(958) \rightarrow \gamma\pi^+\pi^-$  |
| 147.0 ± 2.5              | 600k  | <sup>7</sup> ABELE 99E      | CBAR | 0 | $0.0 \bar{p}p \rightarrow \pi^+\pi^-\pi^0$ |
| 146 ± 3                  | 4943  | <sup>8</sup> ADAMS 97       | E665 |   | $470 \mu p \rightarrow \mu XB$             |
| 160.0 + 4.1<br>- 4.0     |       | <sup>9</sup> CHABAUD 83     | ASPK | 0 | $17 \pi^- p$ polarized                     |
| 155 ± 1                  |       | <sup>10</sup> HEYN 81       | RVUE | 0 | $\pi$ form factor                          |
| 148.0 ± 1.3              |       | <sup>1,2</sup> LANG 79      | RVUE | 0 |                                            |
| 146 ± 14                 | 4100  | ENGLER 74                   | DBC  | 0 | $6 \pi^+ n \rightarrow \pi^+\pi^-p$        |
| 143 ± 13                 |       | <sup>2</sup> ESTABROOKS 74  | RVUE | 0 | $17 \pi^- p \rightarrow \pi^+\pi^-n$       |
| 160 ± 10                 | 32000 | <sup>1</sup> PROTOPOP... 73 | HBC  | 0 | $7.1 \pi^+ p, t < 0.4$                     |
| 145 ± 12                 | 2250  | <sup>3,11</sup> HYAMS 68    | OSPK | 0 | $11.2 \pi^- p$                             |
| 163 ± 15                 | 13300 | <sup>12</sup> PISUT 68      | RVUE | 0 | $1.7-3.2 \pi^- p, t < 10$                  |

<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=M009W0R  
NODE=M009W0R

OCCUR=2

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 | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |

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

|             |  |                         |      |                                                                            |
|-------------|--|-------------------------|------|----------------------------------------------------------------------------|
| 4.66 ± 0.85 |  | <sup>3</sup> BARTOS 17A | RVUE | $e^+ e^- \rightarrow \pi^+ \pi^-, \tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |
|-------------|--|-------------------------|------|----------------------------------------------------------------------------|

<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> 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=M009W6  
NODE=M009W6

NODE=M009W6;LINKAGE=SC

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

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

| 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=M009W16  
NODE=M009W16

NODE=M009W16;LINKAGE=WO

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

NODE=M009225;NODE=M009

|                                          | Mode                     | Fraction ( $\Gamma_i/\Gamma$ )                   | Scale factor/<br>Confidence level |
|------------------------------------------|--------------------------|--------------------------------------------------|-----------------------------------|
| $\Gamma_1$                               | $\pi\pi$                 | $\sim 100$                                       | %                                 |
| <b><math>\rho(770)^\pm</math> decays</b> |                          |                                                  |                                   |
| $\Gamma_2$                               | $\pi^\pm\pi^0$           | $\sim 100$                                       | %                                 |
| $\Gamma_3$                               | $\pi^\pm\gamma$          | $(4.5 \pm 0.5) \times 10^{-4}$                   | S=2.2                             |
| $\Gamma_4$                               | $\pi^\pm\eta$            | $< 6$                                            | $\times 10^{-3}$ CL=84%           |
| $\Gamma_5$                               | $\pi^\pm\pi^+\pi^-\pi^0$ | $< 2.0$                                          | $\times 10^{-3}$ CL=84%           |
| <b><math>\rho(770)^0</math> decays</b>   |                          |                                                  |                                   |
| $\Gamma_6$                               | $\pi^+\pi^-$             | $\sim 100$                                       | %                                 |
| $\Gamma_7$                               | $\pi^+\pi^-\gamma$       | $(9.9 \pm 1.6) \times 10^{-3}$                   | S=1.4                             |
| $\Gamma_8$                               | $\pi^0\gamma$            | $(4.7 \pm 0.6) \times 10^{-4}$                   |                                   |
| $\Gamma_9$                               | $\eta\gamma$             | $(3.00 \pm 0.21) \times 10^{-4}$                 |                                   |
| $\Gamma_{10}$                            | $\pi^0\pi^0\gamma$       | $(4.5 \pm 0.8) \times 10^{-5}$                   |                                   |
| $\Gamma_{11}$                            | $\mu^+\mu^-$             | [a] $(4.55 \pm 0.28) \times 10^{-5}$             | $\times 10^{-5}$ CL=90%           |
| $\Gamma_{12}$                            | $e^+e^-$                 | [a] $(4.72 \pm 0.05) \times 10^{-5}$             |                                   |
| $\Gamma_{13}$                            | $\pi^+\pi^-\pi^0$        | $(1.01^{+0.54}_{-0.36} \pm 0.34) \times 10^{-4}$ |                                   |
| $\Gamma_{14}$                            | $\pi^+\pi^-\pi^+\pi^-$   | $(1.8 \pm 0.9) \times 10^{-5}$                   |                                   |
| $\Gamma_{15}$                            | $\pi^+\pi^-\pi^0\pi^0$   | $(1.6 \pm 0.8) \times 10^{-5}$                   | $\times 10^{-5}$ CL=90%           |
| $\Gamma_{16}$                            | $\pi^0e^+e^-$            | $< 1.2$                                          |                                   |
| $\Gamma_{17}$                            | $\eta e^+e^-$            |                                                  |                                   |

DESIG=1;OUR EVAL;→ UNCHECKED ←

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

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

LINKAGE=MD2

**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.

|          |                                                                   |
|----------|-------------------------------------------------------------------|
| $x_3$    | $\left  \begin{array}{cc} -100 & \\ 15 & -15 \end{array} \right $ |
| $\Gamma$ | $\begin{array}{cc} & x_2 \quad x_3 \end{array}$                   |

|            | Mode            | Rate (MeV)        | Scale factor |
|------------|-----------------|-------------------|--------------|
| $\Gamma_2$ | $\pi^\pm\pi^0$  | $150.2 \pm 2.4$   | 2.3          |
| $\Gamma_3$ | $\pi^\pm\gamma$ | $0.068 \pm 0.007$ |              |

DESIG=11

DESIG=3

**CONSTRAINED FIT INFORMATION**

An overall fit to the total width, a partial width, and 7 branching ratios uses 22 measurements and one constraint to determine 9 parameters. The overall fit has a  $\chi^2 = 9.5$  for 14 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.

|          |       |       |       |       |          |          |          |          |  |
|----------|-------|-------|-------|-------|----------|----------|----------|----------|--|
| $x_7$    | -100  |       |       |       |          |          |          |          |  |
| $x_8$    | -4    | 0     |       |       |          |          |          |          |  |
| $x_9$    | -1    | 0     | 1     |       |          |          |          |          |  |
| $x_{10}$ | -1    | 0     | 0     | 0     |          |          |          |          |  |
| $x_{11}$ | 2     | -3    | 0     | 0     | 0        |          |          |          |  |
| $x_{12}$ | 0     | 0     | -8    | -9    | 0        | 0        |          |          |  |
| $x_{14}$ | -1    | 0     | 0     | 0     | 0        | 0        | 0        |          |  |
| $\Gamma$ | 0     | 0     | 4     | 5     | 0        | 0        | -54      | 0        |  |
|          | $x_6$ | $x_7$ | $x_8$ | $x_9$ | $x_{10}$ | $x_{11}$ | $x_{12}$ | $x_{14}$ |  |

|               | Mode                      | Rate (MeV)                | Scale factor |
|---------------|---------------------------|---------------------------|--------------|
| $\Gamma_6$    | $\pi^+ \pi^-$             | 147.5 $\pm$ 0.9           |              |
| $\Gamma_7$    | $\pi^+ \pi^- \gamma$      | 1.48 $\pm$ 0.24           |              |
| $\Gamma_8$    | $\pi^0 \gamma$            | 0.070 $\pm$ 0.009         | 1.4          |
| $\Gamma_9$    | $\eta \gamma$             | 0.0447 $\pm$ 0.0032       |              |
| $\Gamma_{10}$ | $\pi^0 \pi^0 \gamma$      | 0.0066 $\pm$ 0.0012       |              |
| $\Gamma_{11}$ | $\mu^+ \mu^-$             | [a] 0.0068 $\pm$ 0.0004   |              |
| $\Gamma_{12}$ | $e^+ e^-$                 | [a] 0.00704 $\pm$ 0.00006 |              |
| $\Gamma_{14}$ | $\pi^+ \pi^- \pi^+ \pi^-$ | 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

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

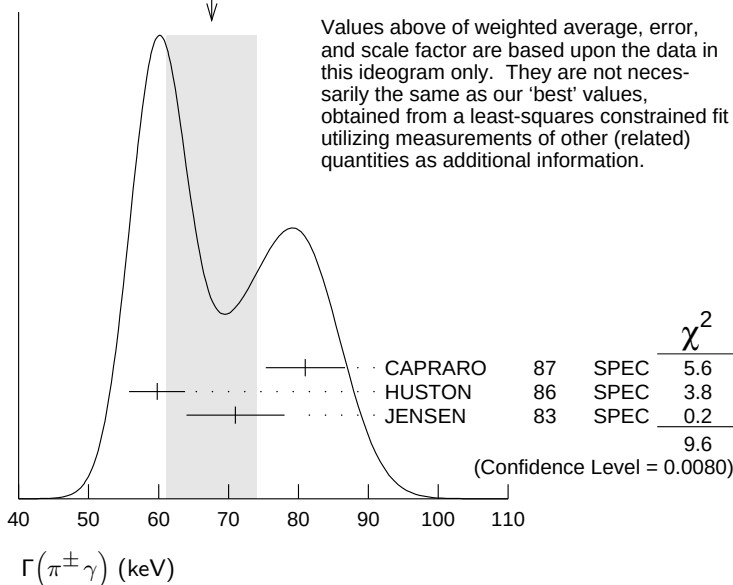
### $\Gamma_3$

| 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)



$\Gamma(e^+e^-)$  $\Gamma_{12}$ 

| VALUE (keV)                                                                   | EVTS | DOCUMENT ID                  | TECN | COMMENT                                     |
|-------------------------------------------------------------------------------|------|------------------------------|------|---------------------------------------------|
| <b>7.04 ±0.06 OUR FIT</b>                                                     |      |                              |      |                                             |
| <b>7.04 ±0.06 OUR AVERAGE</b>                                                 |      |                              |      |                                             |
| 7.048±0.057±0.050                                                             | 900k | <sup>1</sup> AKHMETSHIN 07   |      | $e^+e^- \rightarrow \pi^+\pi^-$             |
| 7.06 ±0.11 ±0.05                                                              | 114k | <sup>2,3</sup> AKHMETSHIN 04 | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-$             |
| 6.77 ±0.10 ±0.30                                                              |      | BARKOV 85                    | OLYA | $e^+e^- \rightarrow \pi^+\pi^-$             |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                              |      |                                             |
| 7.12 ±0.02 ±0.11                                                              | 800k | <sup>4</sup> ACHASOV 06      | SND  | $e^+e^- \rightarrow \pi^+\pi^-$             |
| 6.3 ±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

 $\Gamma(\pi^0\gamma)$  $\Gamma_8$ 

| VALUE (keV)                                                                   | EVTS  | DOCUMENT ID             | TECN | COMMENT                                    |
|-------------------------------------------------------------------------------|-------|-------------------------|------|--------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                         |      |                                            |
| 77±17±11                                                                      | 36500 | <sup>1</sup> ACHASOV 03 | SND  | 0.60–0.97 $e^+e^- \rightarrow \pi^0\gamma$ |
| 121±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

 $\Gamma(\eta\gamma)$  $\Gamma_9$ 

| VALUE (keV)                                                                   | DOCUMENT ID              | TECN | COMMENT                         |
|-------------------------------------------------------------------------------|--------------------------|------|---------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                          |      |                                 |
| 62±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

 $\Gamma(\pi^+\pi^-\pi^+\pi^-)$  $\Gamma_{14}$ 

| VALUE (keV)                                                                   | EVTS | DOCUMENT ID   | TECN | COMMENT                                            |
|-------------------------------------------------------------------------------|------|---------------|------|----------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |               |      |                                                    |
| 2.8±1.4±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

 $\Gamma(e^+e^-) / \Gamma_{\text{total}} \times \Gamma(\pi^+\pi^-) / \Gamma_{\text{total}}$  $\Gamma_{12} / \Gamma \times \Gamma_6 / \Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | EVTS | DOCUMENT ID               | TECN | COMMENT                         |
|-------------------------------------------------------------------------------|------|---------------------------|------|---------------------------------|
| <b>4.876±0.023±0.064</b>                                                      | 800k | <sup>1,2</sup> ACHASOV 06 | SND  | $e^+e^- \rightarrow \pi^+\pi^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                           |      |                                 |
| 4.72 ±0.02                                                                    |      | <sup>3</sup> BENAYOUN 10  | RVUE | 0.4–1.05 $e^+e^-$               |

<sup>1</sup> Supersedes ACHASOV 05A.

<sup>2</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>3</sup> A simultaneous fit of  $e^+e^- \rightarrow \pi^+\pi^-, \pi^+\pi^-\pi^0, \pi^0\gamma, \eta\gamma$  data.

NODE=M009G4  
NODE=M009G4

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

NODE=M009G4;LINKAGE=BE

 $\Gamma(e^+e^-) / \Gamma_{\text{total}} \times \Gamma(\eta\gamma) / \Gamma_{\text{total}}$  $\Gamma_{12} / \Gamma \times \Gamma_9 / \Gamma$ 

| VALUE (units $10^{-8}$ )                                                      | EVTS  | DOCUMENT ID                   | TECN | COMMENT                                   |
|-------------------------------------------------------------------------------|-------|-------------------------------|------|-------------------------------------------|
| <b>1.42±0.10 OUR FIT</b>                                                      |       |                               |      |                                           |
| <b>1.45±0.12 OUR AVERAGE</b>                                                  |       |                               |      |                                           |
| 1.32±0.14±0.08                                                                | 33k   | <sup>1</sup> ACHASOV 07B      | SND  | 0.6–1.38 $e^+e^- \rightarrow \eta\gamma$  |
| 1.50±0.65±0.09                                                                | 17.4k | <sup>2</sup> AKHMETSHIN 05    | CMD2 | 0.60–1.38 $e^+e^- \rightarrow \eta\gamma$ |
| 1.61±0.20±0.11                                                                | 23k   | <sup>3,4</sup> AKHMETSHIN 01B | CMD2 | $e^+e^- \rightarrow \eta\gamma$           |
| 1.85±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±0.02                                                                     |       | <sup>6</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> 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  
NODE=M009G1

NODE=M009G1;LINKAGE=AH

NODE=M009G;LINKAGE=AH  
NODE=M009G;LINKAGE=AK  
NODE=M009G;LINKAGE=BQ

NODE=M009G;LINKAGE=LP  
NODE=M009G1;LINKAGE=BE



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

$$\Gamma_{12}/\Gamma \times \Gamma_8/\Gamma$$

| VALUE (units $10^{-8}$ )      | EVTS | DOCUMENT ID              | TECN | COMMENT                                                     |
|-------------------------------|------|--------------------------|------|-------------------------------------------------------------|
| <b>2.22 ±0.29 OUR FIT</b>     |      |                          |      | Error includes scale factor of 1.4.                         |
| <b>2.22 ±0.26 OUR AVERAGE</b> |      |                          |      | Error includes scale factor of 1.3. See the ideogram below. |
| 1.98 ±0.22 ±0.10              |      | <sup>1</sup> ACHASOV 16A | SND  | 0.60-1.38 $e^+e^- \rightarrow \pi^0\gamma$                  |
| 2.90 $^{+0.60}_{-0.55}$ ±0.18 | 18k  | AKHMETSHIN 05            | CMD2 | 0.60-1.38 $e^+e^- \rightarrow \pi^0\gamma$                  |
| 2.37 ±0.53 ±0.33              | 36k  | <sup>2</sup> ACHASOV 03  | SND  | 0.60-0.97 $e^+e^- \rightarrow \pi^0\gamma$                  |
| 3.61 ±0.74 ±0.49              | 10k  | <sup>3</sup> DOLINSKY 89 | ND   | $e^+e^- \rightarrow \pi^0\gamma$                            |

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

1.875 ±0.026 <sup>4</sup> BENAYOUN 10 RVUE 0.4-1.05  $e^+e^-$

<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> 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  $(-10.2 \pm 7.0)^\circ$ .

<sup>3</sup> Recalculated by us from the cross section in the peak.

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

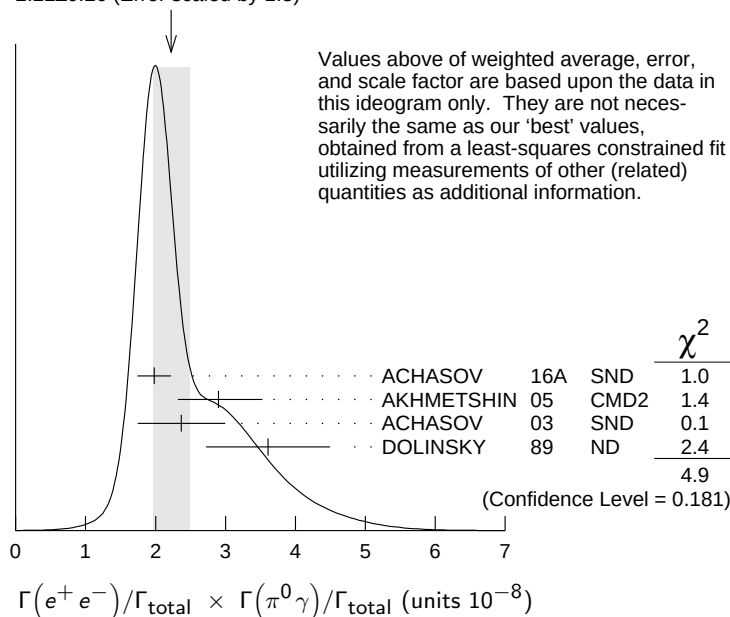
NODE=M009G2  
NODE=M009G2

NODE=M009G2;LINKAGE=B

NODE=M009G;LINKAGE=SH

NODE=M009G2;LINKAGE=LP  
NODE=M009G2;LINKAGE=BE

WEIGHTED AVERAGE  
2.22±0.26 (Error scaled by 1.3)



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

$$\Gamma_{12}/\Gamma \times \Gamma_{13}/\Gamma$$

| VALUE (units $10^{-9}$ )      | EVTS | DOCUMENT ID              | TECN | COMMENT                                        |
|-------------------------------|------|--------------------------|------|------------------------------------------------|
| <b>0.903 ±0.076</b>           |      | <sup>1</sup> BENAYOUN 10 | RVUE | 0.4-1.05 $e^+e^-$                              |
| 4.58 $^{+2.46}_{-1.64}$ ±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

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

$$\Gamma_4/\Gamma_1$$

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

NODE=M009R4  
NODE=M009R4

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

$$\Gamma_5/\Gamma_1$$

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

NODE=M009R1  
NODE=M009R1

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

35 ± 40 JAMES 66 HBC + 2.1  $\pi^+ p$

$\Gamma(\mu^+\mu^-)/\Gamma(\pi^+\pi^-)$  $\Gamma_{11}/\Gamma_6$ VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

**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  $\begin{smallmatrix} +1.6 \\ -3.6 \end{smallmatrix}$ <sup>1</sup> ROTHWELL

69

CNTR

Photoproduction

5.6 ±1.5

<sup>2</sup> WEHMANN

69

OSPK

12  $\pi^- \text{C, Fe}$ 9.7  $\begin{smallmatrix} +3.1 \\ -3.3 \end{smallmatrix}$ <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.<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.<sup>4</sup> HYAMS 67's mass resolution is 20 MeV. The  $\omega$  region was excluded.

NODE=M009R5;LINKAGE=R

NODE=M009R5;LINKAGE=W

NODE=M009R5;LINKAGE=01

NODE=M009R5;LINKAGE=H

 $\Gamma(e^+e^-)/\Gamma(\pi\pi)$  $\Gamma_{12}/\Gamma_1$ VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

• • • 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.<sup>2</sup> Barkov excludes Auslander and Benaksas for large statistical and systematic errors.

NODE=M009R;LINKAGE=KS

NODE=M009R3;LINKAGE=01

 $\Gamma(\eta\gamma)/\Gamma_{\text{total}}$  $\Gamma_9/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

CHG COMMENT

**3.00±0.21 OUR FIT****2.90±0.32 OUR AVERAGE**

2.79±0.34±0.03 33k

<sup>1</sup> ACHASOV

07B

SND

0.6–1.38  $e^+e^- \rightarrow \eta\gamma$ 

3.6 ±0.9

<sup>2</sup> ANDREWS

77

CNTR

0 6.7–10  $\gamma\text{Cu}$ 

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

3.21±1.39±0.20 17.4k

<sup>3,4</sup> AKHMETSHIN

05

CMD2

0.60–1.38  $e^+e^- \rightarrow \eta\gamma$ 

3.39±0.42±0.23

<sup>2,5,6</sup> AKHMETSHIN

01B

CMD2

 $e^+e^- \rightarrow \eta\gamma$ 1.9  $\begin{smallmatrix} +0.6 \\ -0.8 \end{smallmatrix}$ <sup>7</sup> BENAYOUN

96

RVUE

0.54–1.04  $e^+e^- \rightarrow \eta\gamma$ 

4.0 ±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;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

 $\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{14}/\Gamma$ VALUE (units  $10^{-5}$ )

CL% EVTS

DOCUMENT ID

TECN

COMMENT

**1.8±0.9 OUR FIT****1.8±0.9±0.3**

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. • • •

&lt;20

90

KURDADZE

88

OLYA

 $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$  $\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma(\pi\pi)$  $\Gamma_{14}/\Gamma_1$ VALUE (units  $10^{-4}$ )

CL%

DOCUMENT ID

TECN

CHG

COMMENT

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

&lt;15

90

ERBE

69

HBC

0

2.5–5.8  $\gamma p$ 

&lt;20

CHUNG

68

HBC

0

3.2,4.2  $\pi^- p$ 

&lt;20

90

HUSON

68

HLBC

0

16.0  $\pi^- p$ 

&lt;80

JAMES

66

HBC

0

2.1  $\pi^+ p$ 

NODE=M009R11

NODE=M009R11

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

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

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

|                                 |      |                      |     |      |                                                |
|---------------------------------|------|----------------------|-----|------|------------------------------------------------|
| $1.01^{+0.54}_{-0.36} \pm 0.34$ | 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=M009R10  
NODE=M009R10

NODE=M009R;LINKAGE=NS

 $\Gamma(\pi^+\pi^-\pi^0)/\Gamma(\pi\pi)$  $\Gamma_{13}/\Gamma_1$ 

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

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

|             |    |                     |    |      |                                    |
|-------------|----|---------------------|----|------|------------------------------------|
| $\sim 0.01$ |    | 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  $I = 1, 2, \text{ or } 3$  for the  $3\pi$  system.

NODE=M009R6  
NODE=M009R6

NODE=M009R6;LINKAGE=G

 $\Gamma(\pi^+\pi^-\pi^0\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{15}/\Gamma$ 

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

**$1.60 \pm 0.74 \pm 0.18$**  <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 | $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0$ |

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

NODE=M009R8  
NODE=M009R8

NODE=M009R8;LINKAGE=AC

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

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

**$0.0099 \pm 0.0016$  OUR FIT**

**$0.0099 \pm 0.0016$**

<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 | $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |

<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.

NODE=M009R12  
NODE=M009R12

OCCUR=2

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

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

| 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

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

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

**<1.2** 90 ACHASOV 08 SND  $0.36-0.97 e^+e^- \rightarrow \pi^0e^+e^-$

• • • 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

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

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

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

<0.7 AKHMETSHIN 05A CMD2  $0.72-0.84 e^+e^-$

NODE=M009R16  
NODE=M009R16

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

EVTS

DOCUMENT ID

TECN

COMMENT

 $\Gamma_{10}/\Gamma$ 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

 **$\rho(770)$  REFERENCES**

NODE=M009

|              |      |                                |                                       |                             |                     |
|--------------|------|--------------------------------|---------------------------------------|-----------------------------|---------------------|
| ABLIKIM      | 18C  | PRL 120 242003                 | M. Ablikim <i>et al.</i>              | (BES III Collab.)           | REFID=58843         |
| ABLIKIM      | 17   | PRL 118 012001                 | M. Ablikim <i>et al.</i>              | (BES III 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>              | (BES III 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         |
| 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   | 05   | 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. 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         |
| AKHMETSHIN   | 04B  | PL B580 119                    | R.R. Akhmetshin <i>et al.</i>         | (Novosibirsk CMD-2 Collab.) | REFID=49610         |
| 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         |
|              |      | Translated from ZETFP 72 411.  |                                       |                             |                     |
| ACHASOV      | 00G  | JETPL 71 355                   | M.N. Achasov <i>et al.</i>            | (Novosibirsk SND Collab.)   | REFID=47929         |
|              |      | Translated from ZETFP 71 519.  |                                       |                             |                     |
| AKHMETSHIN   | 00   | PL B475 190                    | R.R. Akhmetshin <i>et al.</i>         | (Novosibirsk CMD-2 Collab.) | REFID=47421         |
| ANDERSON     | 00A  | PR D61 112002                  | S. Anderson <i>et al.</i>             | (CLEO Collab.)              | REFID=47468         |
| ABELE        | 99E  | PL B469 270                    | A. Abele <i>et al.</i>                | (Crystal Barrel Collab.)    | REFID=47414         |
| BENAYOUN     | 98   | EPJ C2 269                     | M. Benayoun <i>et al.</i>             | (IPNP, NOVO, ADLD+)         | REFID=45859         |
| BREITWEG     | 98B  | EPJ C2 247                     | J. Breitweg <i>et al.</i>             | (ZEUS Collab.)              | REFID=46354         |
| GARDNER      | 98   | PR D57 2716                    | S. Gardner, H.B. O'Connell            |                             | REFID=46366         |
|              |      | Also PR D62 019903 (err.)      | S. Gardner, H.B. O'Connell            |                             | REFID=47981         |
| ABELE        | 97   | PL B391 191                    | A. Abele <i>et al.</i>                | (Crystal Barrel Collab.)    | REFID=45415         |
| ADAMS        | 97   | ZPHY C74 237                   | M.R. Adams <i>et al.</i>              | (E665 Collab.)              | REFID=45533         |
| 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         |
| BOGOLYUB...  | 97   | PAN 60 46                      | M.Y. Bogolyubsky <i>et al.</i>        | (MOSU, SERP)                | REFID=45393         |
|              |      | Translated from YAF 60 53.     |                                       |                             |                     |

|              |     |                                                   |                                          |                                 |                      |
|--------------|-----|---------------------------------------------------|------------------------------------------|---------------------------------|----------------------|
| O'CONNELL    | 97  | NP A623 559                                       | H.B. O'Connell <i>et al.</i>             | (ADLD)                          | REFID=45860          |
| BENAYOUN     | 96  | ZPHY C72 221                                      | M. Benayoun <i>et al.</i>                | (IPNP, NOVO)                    | REFID=45753          |
| BERNICA      | 94  | PR D50 4454                                       | A. Bernica, G. Lopez Castro, J. Pestieau | (LOUV+)                         | REFID=44097          |
| WEIDENAUER   | 93  | ZPHY C59 387                                      | P. Weidenauer <i>et al.</i>              | (ASTERIX Collab.)               | REFID=43585          |
| AGUILAR-...  | 91  | ZPHY C50 405                                      | M. Aguilar-Benitez <i>et al.</i>         | (LEBC-EHS Collab.)              | REFID=41637          |
| 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          |
| ANTIPOV      | 89  | ZPHY C42 185                                      | Y.M. Antipov <i>et al.</i>               | (SERP, JINR, BGNA+)             | REFID=40739          |
| BISELLO      | 89  | PL B220 321                                       | D. Bisello <i>et al.</i>                 | (DM2 Collab.)                   | REFID=40740          |
| DOLINSKY     | 89  | ZPHY C42 511                                      | S.I. Dolinsky <i>et al.</i>              | (NOVO)                          | REFID=41003          |
| DUBNICKA     | 89  | JP G15 1349                                       | S. Dubnicka <i>et al.</i>                | (JINR, SLOV)                    | REFID=44082          |
| GESHKEN...   | 89  | ZPHY C45 351                                      | B.V. Geshkenbein                         | (ITEP)                          | REFID=41017          |
| KURDADZE     | 88  | JETPL 47 512                                      | L.M. Kurdadze <i>et al.</i>              | (NOVO)                          | REFID=41121          |
| VASSERMAN    | 88  | Translated from ZETFP 47 432.<br>SJNP 47 1035     | I.B. Vasserman <i>et al.</i>             | (NOVO)                          | REFID=41019          |
| VASSERMAN    | 88B | Translated from YAF 47 1635.<br>SJNP 48 480       | I.B. Vasserman <i>et al.</i>             | (NOVO)                          | REFID=41020          |
| AULCHENKO    | 87C | Translated from YAF 48 753.<br>IYF 87-90 Preprint | V.M. Aulchenko <i>et al.</i>             | (NOVO)                          | REFID=41370          |
| CAPRARO      | 87  | NP B288 659                                       | L. Capraro <i>et al.</i>                 | (CLER, FRAS, MILA+)             | REFID=40003          |
| BRAMON       | 86  | PL B173 97                                        | A. Bramon, J. Casulleras                 | (BARC)                          | REFID=22102          |
| HUSTON       | 86  | PR D33 3199                                       | J. Huston <i>et al.</i>                  | (ROCH, FNAL, MINN)              | REFID=20137          |
| KURDADZE     | 86  | JETPL 43 643                                      | L.M. Kurdadze <i>et al.</i>              | (NOVO)                          | REFID=40287          |
| BARKOV       | 85  | NP B256 365                                       | L.M. Barkov <i>et al.</i>                | (NOVO)                          | REFID=20134          |
| DRUZHININ    | 84  | PL 144B 136                                       | V.P. Druzhinin <i>et al.</i>             | (NOVO)                          | REFID=20561          |
| CHABAUD      | 83  | NP B223 1                                         | V. Chabaud <i>et al.</i>                 | (CERN, CRAC, MPIM)              | REFID=20131          |
| JENSEN       | 83  | PR D27 26                                         | T. Jensen <i>et al.</i>                  | (ROCH, FNAL, MINN)              | REFID=20132          |
| HEYN         | 81  | ZPHY C7 169                                       | M.F. Heyn, C.B. Lang                     | (GRAZ)                          | REFID=20129          |
| BOHACIK      | 80  | PR D21 1342                                       | J. Bohacik, H. Kuhnelt                   | (SLOW, WIEN)                    | REFID=20128          |
| LANG         | 79  | PR D19 956                                        | C.B. Lang, A. Mas-Parareda               | (GRAZ)                          | REFID=20126          |
| BARTALUCCI   | 78  | NC 44A 587                                        | S. Bartalucci <i>et al.</i>              | (DESY, FRAS)                    | REFID=20122          |
| WICKLUND     | 78  | PR D17 1197                                       | A.B. Wicklund <i>et al.</i>              | (ANL)                           | REFID=20124          |
| ANDREWS      | 77  | PRL 38 198                                        | D.E. Andrews <i>et al.</i>               | (ROCH)                          | REFID=20120          |
| DEUTSCH...   | 76  | NP B103 426                                       | M. Deutschmann <i>et al.</i>             | (AACH3, BERL, BONN+)            | REFID=20119          |
| ENGLER       | 74  | PR D10 2070                                       | A. Engler <i>et al.</i>                  | (CMU, CASE)                     | REFID=20110          |
| ESTABROOKS   | 74  | NP B79 301                                        | P.G. Estabrooks, A.D. Martin             | (DURH)                          | REFID=20111          |
| GRAYER       | 74  | NP B75 189                                        | G. Grayer <i>et al.</i>                  | (CERN, MPIM)                    | REFID=20113          |
| RATCLIFF     | 74  | Private Comm.                                     |                                          |                                 | REFID=40128; ERROR=3 |
| BYERLY       | 73  | PR D7 637                                         | W.L. Byerly <i>et al.</i>                | (MICH)                          | REFID=20104          |
| GLADDING     | 73  | PR D8 3721                                        | G.E. Gladding <i>et al.</i>              | (HARV)                          | REFID=20106          |
| 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          |
| BALLAM       | 72  | PR D5 545                                         | J. Ballam <i>et al.</i>                  | (SLAC, LBL, TUFTS)              | REFID=20094          |
| BENAKSAS     | 72  | PL 39B 289                                        | D. Benaksas <i>et al.</i>                | (ORSAY)                         | REFID=20096          |
| JACOBS       | 72  | PR D6 1291                                        | L.D. Jacobs                              | (SACL)                          | REFID=20101          |
| RATCLIFF     | 72  | PL 38B 345                                        | B.N. Ratcliff <i>et al.</i>              | (SLAC)                          | REFID=20102          |
| ABRAMS       | 71  | PR D4 653                                         | G.S. Abrams <i>et al.</i>                | (LBL)                           | REFID=20090          |
| ALVENSLEB... | 70  | PRL 24 786                                        | H. Alvensleben <i>et al.</i>             | (DESY)                          | REFID=20085          |
| BIGGS        | 70  | PRL 24 1197                                       | P.J. Biggs <i>et al.</i>                 | (DARE)                          | REFID=20087          |
| ERBE         | 69  | PR 188 2060                                       | R. Erbe <i>et al.</i>                    | (German Bubble Chamber Collab.) | REFID=20074          |
| MALAMUD      | 69  | Argonne Conf. 93                                  | E.I. Malamud, P.E. Schlein               | (UCLA)                          | REFID=20077          |
| REYNOLDS     | 69  | PR 184 1424                                       | B.G. Reynolds <i>et al.</i>              | (FSU)                           | REFID=20080          |
| ROTHWELL     | 69  | PRL 23 1521                                       | P.L. Rothwell <i>et al.</i>              | (NEAS)                          | REFID=20082          |
| WEHMANN      | 69  | PR 178 2095                                       | A.A. Wehmann <i>et al.</i>               | (HARV, CASE, SLAC+)             | REFID=20084          |
| ARMENISE     | 68  | NC 54A 999                                        | N. Armenise <i>et al.</i>                | (BARI, BGNA, FIRZ+)             | REFID=20054          |
| BATON        | 68  | PR 176 1574                                       | J.P. Baton, G. Laurens                   | (SACL)                          | REFID=20056          |
| CHUNG        | 68  | PR 165 1491                                       | S.U. Chung <i>et al.</i>                 | (LRL)                           | REFID=20059          |
| FOSTER       | 68  | NP B6 107                                         | M. Foster <i>et al.</i>                  | (CERN, CDEF)                    | REFID=20061          |
| GOUNARIS     | 68  | PRL 21 244                                        | G.J. Gounaris, J.J. Sakurai              |                                 | REFID=48054          |
| HUSON        | 68  | PL 28B 208                                        | R. Huson <i>et al.</i>                   | (ORSAY, MILA, UCLA)             | REFID=20062          |
| HYAMS        | 68  | NP B7 1                                           | B.D. Hyams <i>et al.</i>                 | (CERN, MPIM)                    | REFID=20063          |
| LANZEROTTI   | 68  | PR 166 1365                                       | L.J. Lanzerotti <i>et al.</i>            | (HARV)                          | REFID=20068          |
| PISUT        | 68  | NP B6 325                                         | J. Pisut, M. Roos                        | (CERN)                          | REFID=20070          |
| ASBURY       | 67B | PRL 19 865                                        | J.G. Asbury <i>et al.</i>                | (DESY, COLU)                    | REFID=20038          |
| BACON        | 67  | PR 157 1263                                       | T.C. Bacon <i>et al.</i>                 | (BNL)                           | REFID=20039          |
| EISNER       | 67  | PR 164 1699                                       | R.L. Eisner <i>et al.</i>                | (PURD)                          | REFID=20046          |
| HUWE         | 67  | PL 24B 252                                        | D.O. Huwe <i>et al.</i>                  | (COLU)                          | REFID=20049          |
| HYAMS        | 67  | PL 24B 634                                        | B.D. Hyams <i>et al.</i>                 | (CERN, MPIM)                    | REFID=20050          |
| MILLER       | 67B | PR 153 1423                                       | D.H. Miller <i>et al.</i>                | (PURD)                          | REFID=20051          |
| ALFF-...     | 66  | PR 145 1072                                       | C. Alff-Steinberger <i>et al.</i>        | (COLU, RUTG)                    | REFID=10762          |
| FERBEL       | 66  | PL 21 111                                         | T. Ferbel                                | (ROCH)                          | REFID=20028          |
| HAGOPIAN     | 66  | PR 145 1128                                       | V. Hagopian <i>et al.</i>                | (PENN, SACL)                    | REFID=20030          |
| HAGOPIAN     | 66B | PR 152 1183                                       | V. Hagopian, Y.L. Pan                    | (PENN, LRL)                     | REFID=20031          |
| JACOBS       | 66B | UCRL 16877                                        | L.D. Jacobs                              | (LRL)                           | REFID=20033          |
| JAMES        | 66  | PR 142 896                                        | F.E. James, H.L. Kraybill                | (YALE, BNL)                     | REFID=10770          |
| ROSS         | 66  | PR 149 1172                                       | M. Ross, L. Stodolsky                    |                                 | REFID=46380          |
| SOEDING      | 66  | PL B19 702                                        | P. Soeding                               |                                 | REFID=46385          |
| WEST         | 66  | PR 149 1089                                       | E. West <i>et al.</i>                    | (WISC)                          | REFID=20035          |
| BLIEDEN      | 65  | PL 19 444                                         | H.R. Blieden <i>et al.</i>               | (CERN MMS Collab.)              | REFID=20016          |
| CARMONY      | 64  | PRL 12 254                                        | D.D. Carmony <i>et al.</i>               | (UCB)                           | REFID=20578          |
| GOLDHABER    | 64  | PRL 12 336                                        | G. Goldhaber <i>et al.</i>               | (LRL, UCB)                      | REFID=20013          |
| ABOLINS      | 63  | PRL 11 381                                        | M.A. Abolins <i>et al.</i>               | (UCSD)                          | REFID=20006          |

$\omega(782)$ 

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

NODE=M001

 **$\omega(782)$  MASS**

NODE=M001M

NODE=M001M

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID                                                 | TECN | COMMENT                                                |
|-------------------------------------------------------------------------------|-------|-------------------------------------------------------------|------|--------------------------------------------------------|
| <b>782.65±0.12 OUR AVERAGE</b>                                                |       | Error includes scale factor of 1.9. See the ideogram below. |      |                                                        |
| 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 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$         |
| 782.7 ±0.1 ±1.5                                                               | 19500 | WURZINGER 95                                                | SPEC | 1.33 $p d \rightarrow {}^3\text{He} \omega$            |
| 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 | $\bar{p} p \rightarrow 2\pi^+ 2\pi^-\pi^0$             |
| 782.2 ±0.4                                                                    | 1488  | KURDADZE 83B                                                | OLYA | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$                   |
| 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. ● ● ● |       |                                                             |      |                                                        |
| 781.91±0.24                                                                   |       | <sup>6</sup> LEES 12G                                       | BABR | $e^+e^- \rightarrow \pi^+\pi^-\gamma$                  |
| 781.78±0.10                                                                   |       | <sup>7</sup> BARKOV 87                                      | CMD  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$                   |
| 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 $p \bar{p} \rightarrow K_1 K_1 \omega$             |
| 783.7 ±1.0                                                                    | 3583  | <sup>8</sup> COYNE 71                                       | HBC  | 3.7 $\pi^+ p \rightarrow \rho \pi^+ \pi^+ \pi^- \pi^0$ |
| 784.1 ±1.2                                                                    | 750   | ABRAMOVI... 70                                              | HBC  | 3.9 $\pi^- p$                                          |
| 783.2 ±1.6                                                                    |       | <sup>9</sup> BIGGS 70B                                      | CNTR | <4.1 $\gamma C \rightarrow \pi^+ \pi^- C$              |
| 782.4 ±0.5                                                                    | 2400  | BIZZARRI 69                                                 | HBC  | 0.0 $\bar{p} p$                                        |

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> 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>7</sup> Systematic uncertainties underestimated.<sup>8</sup> From best-resolution sample of COYNE 71.<sup>9</sup> From  $\omega-\rho$  interference in the  $\pi^+\pi^-$  mass spectrum assuming  $\omega$  width 12.6 MeV.

NODE=M001M;LINKAGE=PT

NODE=M001M;LINKAGE=VH

NODE=M001M;LINKAGE=S1

NODE=M001M;LINKAGE=S2

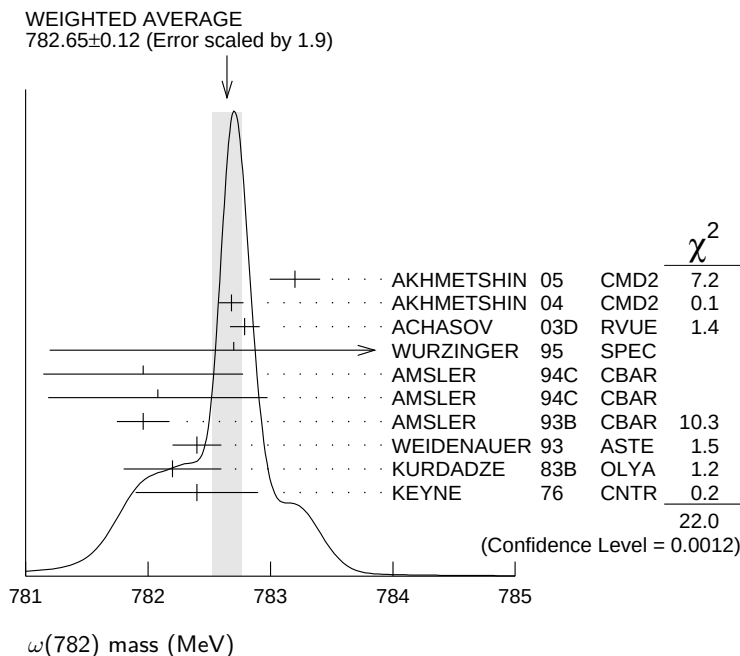
NODE=M001M;LINKAGE=B

NODE=M001M;LINKAGE=LE

NODE=M001M;LINKAGE=KB

NODE=M001M;LINKAGE=D

NODE=M001M;LINKAGE=F



### $\omega(782)$ WIDTH

NODE=M001W

| VALUE (MeV)                                                                   | EVTs  | DOCUMENT ID     | TECN | COMMENT                                        |
|-------------------------------------------------------------------------------|-------|-----------------|------|------------------------------------------------|
| <b>8.49±0.08 OUR AVERAGE</b>                                                  |       |                 |      |                                                |
| 8.68±0.23±0.10                                                                | 11200 | 1 AKHMETSHIN 04 | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$           |
| 8.68±0.04±0.15                                                                | 1.2M  | 2 ACHASOV 03D   | RVUE | 0.44–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 8.2 ±0.3                                                                      | 19500 | WURZINGER 95    | SPEC | 1.33 $pd \rightarrow {}^3\text{He}\omega$      |
| 8.4 ±0.1                                                                      |       | 3 AULCHENKO 87  | ND   | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$           |
| 8.30±0.40                                                                     |       | BARKOV 87       | CMD  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$           |
| 9.8 ±0.9                                                                      | 1488  | KURDADZE 83B    | OLYA | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$           |
| 9.0 ±0.8                                                                      | 433   | CORDIER 80      | DM1  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$           |
| 9.1 ±0.8                                                                      | 451   | BENAKSAS 72B    | OSPK | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$           |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |       |                 |      |                                                |
| 8.13±0.45                                                                     |       | 4 LEES 12G      | BABR | $e^+e^- \rightarrow \pi^+\pi^-\gamma$          |
| 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 | 5 KEYNE 76      | CNTR | $\pi^-p \rightarrow \omega n$                  |
| 13.3 ±2                                                                       | 418   | AGUILAR-... 72B | HBC  | 3.9,4.6 $K^-p$                                 |
| 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 $p\bar{p} \rightarrow K_1^0 K_1^0 \omega$  |
| 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

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> Relativistic Breit-Wigner includes radiative corrections.

<sup>4</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>5</sup> Observed by threshold-crossing technique. Mass resolution = 4.8 MeV FWHM.

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

NODE=M001W;LINKAGE=D  
NODE=M001W;LINKAGE=LE

NODE=M001W;LINKAGE=B

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

NODE=M001215;NODE=M001

| Mode                                                      | Fraction ( $\Gamma_i/\Gamma$ )           | Scale factor/<br>Confidence level |
|-----------------------------------------------------------|------------------------------------------|-----------------------------------|
| $\Gamma_1 \quad \pi^+\pi^-\pi^0$                          | (89.3 ±0.6) %                            |                                   |
| $\Gamma_2 \quad \pi^0\gamma$                              | ( 8.40±0.22) %                           | S=1.8                             |
| $\Gamma_3 \quad \pi^+\pi^-$                               | ( 1.53±0.06) %                           |                                   |
| $\Gamma_4 \quad \text{neutrals (excluding } \pi^0\gamma)$ | ( 7 $\frac{+7}{-4}$ ) × 10 <sup>-3</sup> | S=1.1                             |
| $\Gamma_5 \quad \eta\gamma$                               | ( 4.5 ±0.4 ) × 10 <sup>-4</sup>          | S=1.1                             |

DESIG=1

DESIG=3

DESIG=2

DESIG=13

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 |
| $\Gamma_9$    | $e^+ e^-$                 | $(7.36 \pm 0.15) \times 10^{-5}$ | S=1.5  | 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 | $< 2.2 \times 10^{-4}$ | CL=90% | NODE=M001;CLUMP=A |
| $\Gamma_{18}$ | $2\pi^0$     | C | $< 2.2 \times 10^{-4}$ | CL=90% | DESIG=9           |
| $\Gamma_{19}$ | $3\pi^0$     | C | $< 2.3 \times 10^{-4}$ | CL=90% | DESIG=193         |
| $\Gamma_{20}$ | invisible    |   | $< 7 \times 10^{-5}$   | CL=90% | DESIG=16          |
|               |              |   |                        |        | DESIG=194         |

### CONSTRAINED FIT INFORMATION

An overall fit to 15 branching ratios uses 55 measurements and one constraint to determine 10 parameters. The overall fit has a  $\chi^2 = 57.0$  for 46 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.

|          |       |       |       |       |       |       |       |       |          |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|----------|
| $x_2$    | 28    |       |       |       |       |       |       |       |          |
| $x_3$    | -9    | -3    |       |       |       |       |       |       |          |
| $x_4$    | -95   | -55   | 0     |       |       |       |       |       |          |
| $x_5$    | 7     | 15    | -1    | -12   |       |       |       |       |          |
| $x_6$    | -1    | 0     | 0     | 0     | 0     |       |       |       |          |
| $x_7$    | 0     | 0     | 0     | 0     | 0     | 0     |       |       |          |
| $x_9$    | -35   | -70   | 3     | 52    | -22   | 0     | 0     |       |          |
| $x_{13}$ | 1     | 3     | 0     | -2    | 0     | 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=M001W1NODE=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 |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**0.60 ±0.02 OUR EVALUATION**

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

|                   |       |                              |      |                                                |
|-------------------|-------|------------------------------|------|------------------------------------------------|
| 0.591±0.015       | 11200 | <sup>1,2</sup> AKHMETSHIN 04 | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$           |
| 0.653±0.003±0.021 | 1.2M  | <sup>3</sup> ACHASOV 03D     | RVUE | $0.44-2.00 e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 0.600±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 |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**6.56±0.12 OUR FIT** Error includes scale factor of 1.6.**6.38±0.10 OUR AVERAGE** Error includes scale factor of 1.1.

|                |       |                            |      |                                                      |
|----------------|-------|----------------------------|------|------------------------------------------------------|
| 6.24±0.11±0.08 | 11.2k | <sup>1</sup> AKHMETSHIN 04 | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$                 |
| 6.70±0.06±0.27 |       | AUBERT,B                   | 04N  | BABR $10.6 e^+e^- \rightarrow \pi^+\pi^-\pi^0\gamma$ |
| 6.74±0.04±0.24 | 1.2M  | <sup>2,3</sup> ACHASOV 03D | RVUE | $0.44-2.00 e^+e^- \rightarrow \pi^+\pi^-\pi^0$       |
| 6.37±0.35      |       | <sup>2</sup> DOLINSKY 89   | ND   | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$                 |
| 6.45±0.24      |       | <sup>2</sup> BARKOV 87     | CMD  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$                 |
| 5.79±0.42      | 1488  | <sup>2</sup> KURDADZE 83B  | OLYA | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$                 |
| 5.89±0.54      | 433   | <sup>2</sup> CORDIER 80    | DM1  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$                 |
| 7.54±0.84      | 451   | <sup>2</sup> BENAJSAS 72B  | OSPK | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$                 |

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

6.20±0.13 <sup>4</sup> BENAYOUN 10 RVUE 0.4–1.05  $e^+e^-$ <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.

NODE=M001G2

NODE=M001G2

NODE=M001G;LINKAGE=PT

NODE=M001G;LINKAGE=LP

NODE=M001G;LINKAGE=VH

NODE=M001G2;LINKAGE=BE

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

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

**6.18 ±0.11 OUR FIT** Error includes scale factor of 1.6.**6.37 ±0.09 OUR AVERAGE**

|                   |     |                          |      |                                            |
|-------------------|-----|--------------------------|------|--------------------------------------------|
| 6.336±0.056±0.089 |     | <sup>1</sup> ACHASOV 16A | SND  | $0.60-1.38 e^+e^- \rightarrow \pi^0\gamma$ |
| 6.47 ±0.14 ±0.39  | 18k | AKHMETSHIN 05            | CMD2 | $0.60-1.38 e^+e^- \rightarrow \pi^0\gamma$ |
| 6.50 ±0.11 ±0.20  | 36k | <sup>2</sup> ACHASOV 03  | SND  | $0.60-0.97 e^+e^- \rightarrow \pi^0\gamma$ |
| 6.34 ±0.21 ±0.21  | 10k | <sup>3</sup> DOLINSKY 89 | ND   | $e^+e^- \rightarrow \pi^0\gamma$           |

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

6.80 ±0.13 <sup>4</sup> BENAYOUN 10 RVUE 0.4–1.05  $e^+e^-$ <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> 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  $(-10.2 \pm 7.0)^\circ$ .<sup>3</sup> Recalculated by us from the cross section in the peak.<sup>4</sup> A simultaneous fit of  $e^+e^- \rightarrow \pi^+\pi^-, \pi^+\pi^-\pi^0, \pi^0\gamma, \eta\gamma$  data.

NODE=M001G4

NODE=M001G4

NODE=M001G4;LINKAGE=A

NODE=M001G;LINKAGE=SH

NODE=M001G4;LINKAGE=LP

NODE=M001G4;LINKAGE=BE

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

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

**1.225±0.058±0.041** 800k <sup>1</sup> ACHASOV 06 SND  $e^+e^- \rightarrow \pi^+\pi^-$ 

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

1.166±0.036 <sup>2</sup> BENAYOUN 13 RVUE 0.4–1.05  $e^+e^-$ 1.05 ±0.08 <sup>3</sup> DAVIER 13 RVUE  $e^+e^- \rightarrow \pi^+\pi^-(\gamma)$ <sup>1</sup> Supersedes ACHASOV 05A.<sup>2</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>3</sup> From  $e^+e^- \rightarrow \pi^+\pi^-(\gamma)$  data of LEES 12G.

NODE=M001G5

NODE=M001G5

NODE=M001G5;LINKAGE=AC

NODE=M001G5;LINKAGE=B

NODE=M001G5;LINKAGE=A

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

$$\Gamma_9/\Gamma \times \Gamma_5/\Gamma$$

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 <sup>1</sup>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 <sup>2</sup>AKHMETSHIN 05 CMD2 0.60–1.38  $e^+e^- \rightarrow \eta\gamma$

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

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

4.50±0.10 <sup>5</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> 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

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

$$\Gamma_9/\Gamma \times \Gamma_{15}/\Gamma$$

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

**4.3±1.8±2.2** 4.5M <sup>1</sup>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

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

$$\Gamma_1/\Gamma$$

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 <sup>1</sup>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 <sup>2,3</sup>ACHASOV 03D RVUE 0.44–2.00  $e^+e^- \rightarrow \pi^+\pi^-\pi^0$

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

0.8942±0.0062 <sup>3</sup>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 <sup>1</sup>ACHASOV 16A SND 0.60–1.38  $e^+e^- \rightarrow \pi^0\gamma$

8.09±0.14 <sup>2</sup>AMBROSINO 08G KLOE  $e^+e^- \rightarrow \pi^+\pi^-\pi^0, 2\pi^0\gamma$

9.06±0.20±0.57 18k <sup>3,4</sup>AKHMETSHIN 05 CMD2 0.60–1.38  $e^+e^- \rightarrow \pi^0\gamma$

9.34±0.15±0.31 36k <sup>4</sup>ACHASOV 03 SND 0.60–0.97  $e^+e^- \rightarrow \pi^0\gamma$

8.65±0.16±0.42 1.2M <sup>5,6</sup>ACHASOV 03D RVUE 0.44–2.00  $e^+e^- \rightarrow \pi^+\pi^-\pi^0$

8.39±0.24 9k <sup>7</sup>BENAYOUN 96 RVUE  $e^+e^- \rightarrow \pi^0\gamma$

8.88±0.62 10k <sup>4</sup>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=M001R28

NODE=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

$\Gamma(\pi^0\gamma)/\Gamma(\pi^+\pi^-\pi^0)$  $\Gamma_2/\Gamma_1$ 

NODE=M001R3  
NODE=M001R3

| VALUE (units $10^{-2}$ )                                                      | DOCUMENT ID                         | TECN     | COMMENT                                            |
|-------------------------------------------------------------------------------|-------------------------------------|----------|----------------------------------------------------|
| <b>9.41±0.23 OUR FIT</b>                                                      | Error includes scale factor of 2.0. |          |                                                    |
| <b>9.05±0.27 OUR AVERAGE</b>                                                  | Error includes scale factor of 1.8. |          |                                                    |
| 8.97±0.16                                                                     | AMBROSINO                           | 08G KLOE | $e^+e^- \rightarrow \pi^+\pi^-\pi^0, 2\pi^0\gamma$ |
| 9.94±0.36±0.38                                                                | <sup>1</sup> AULCHENKO              | 00A SND  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0, 2\pi^0\gamma$ |
| 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                                                                 | <sup>2,3</sup> ACHASOV              | 03D RVUE | $0.44-2.00 e^+e^- \rightarrow \pi^+\pi^-\pi^0$     |
| 9.9 ±0.7                                                                      | <sup>2</sup> 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;LINKAGE=AL

NODE=M001R3;LINKAGE=VL  
NODE=M001R3;LINKAGE=VW

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

See also  $\Gamma(\pi^+\pi^-)/\Gamma(\pi^+\pi^-\pi^0)$ .

NODE=M001R15

NODE=M001R15  
NODE=M001R15

| VALUE (units $10^{-2}$ )                                                                       | EVTS  | DOCUMENT ID             | TECN     | COMMENT                                                                                                    |
|------------------------------------------------------------------------------------------------|-------|-------------------------|----------|------------------------------------------------------------------------------------------------------------|
| <b>1.53±0.06 OUR FIT</b>                                                                       |       |                         |          |                                                                                                            |
| [(1.53 <sup>+0.11</sup> <sub>-0.13</sub> ) × 10 <sup>-2</sup> OUR 2018 FIT Scale factor = 1.2] |       |                         |          |                                                                                                            |
| <b>1.51±0.07 OUR AVERAGE</b>                                                                   |       |                         |          | Error includes scale factor of 1.1. [(1.49 ± 0.13) × 10 <sup>-2</sup> OUR 2018 AVERAGE Scale factor = 1.3] |
| 1.52±0.08                                                                                      |       | <sup>1</sup> HANHART    | 18 RVUE  | $e^+e^- \rightarrow \pi^+\pi^-$                                                                            |
| 1.46±0.12±0.02                                                                                 | 900k  | <sup>2</sup> AKHMETSHIN | 07       | $e^+e^- \rightarrow \pi^+\pi^-$                                                                            |
| 1.30±0.24±0.05                                                                                 | 11.2k | <sup>3</sup> AKHMETSHIN | 04 CMD2  | $e^+e^- \rightarrow \pi^+\pi^-$                                                                            |
| 2.38 <sup>+1.77</sup> <sub>-0.90</sub> ±0.18                                                   | 5.4k  | <sup>4</sup> 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  | $e^+e^- \rightarrow \pi^+\pi^-$                                                                            |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●                  |       |                         |          |                                                                                                            |
| 1.24±0.21±0.06                                                                                 | 970k  | <sup>5,6</sup> ABLIKIM  | 18C BES3 | $\eta'(958) \rightarrow \gamma\pi^+\pi^-$                                                                  |
| 1.23±0.21±0.06                                                                                 | 970k  | <sup>7,8</sup> ABLIKIM  | 18C BES3 | $\eta'(958) \rightarrow \gamma\pi^+\pi^-$                                                                  |
| 1.75±0.11                                                                                      | 4.5M  | <sup>9</sup> ACHASOV    | 05A SND  | $e^+e^- \rightarrow \pi^+\pi^-$                                                                            |
| 2.01±0.29                                                                                      |       | <sup>10</sup> BENAYOUN  | 03 RVUE  | $e^+e^- \rightarrow \pi^+\pi^-$                                                                            |
| 1.9 ±0.3                                                                                       |       | <sup>11</sup> GARDNER   | 99 RVUE  | $e^+e^- \rightarrow \pi^+\pi^-$                                                                            |
| 2.3 ±0.4                                                                                       |       | <sup>12</sup> BENAYOUN  | 98 RVUE  | $e^+e^- \rightarrow \pi^+\pi^-, \mu^+\mu^-$                                                                |
| 1.0 ±0.11                                                                                      |       | <sup>13</sup> 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>                                                         |       | <sup>14</sup> BIGGS     | 70B CNTR | $4.2\gamma C \rightarrow \pi^+\pi^-C$                                                                      |

<sup>1</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 evaluation for  $\Gamma(\omega \rightarrow e^+e^-)$ .

<sup>2</sup> A combined fit of AKHMETSHIN 07, AULCHENKO 06, and AULCHENKO 05.

<sup>3</sup> Update of AKHMETSHIN 02.

<sup>4</sup> From the  $m_{\pi^+\pi^-}$  spectrum taking into account the interference of the  $\rho\pi$  and  $\omega\pi$  amplitudes.

<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> 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  $B(\eta'(958) \rightarrow \omega\gamma) = (2.62 \pm 0.13) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>7</sup> From a fit to  $\pi^+\pi^-$  mass using  $\rho(770)$  (parametrized with the Gounaris-Sakurai approach),  $\omega(782)$ , and  $\rho(1450)$  components.

<sup>8</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  $B(\eta'(958) \rightarrow \omega\gamma) = (2.62 \pm 0.13) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NEW

NEW

OCCUR=2

OCCUR=3

NODE=M001R15;LINKAGE=D

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

<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.

### $\Gamma(\pi^+ \pi^-)/\Gamma(\pi^+ \pi^- \pi^0)$ $\Gamma_3/\Gamma_1$

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

| VALUE                                             | DOCUMENT ID             | TECN | COMMENT                              |
|---------------------------------------------------|-------------------------|------|--------------------------------------|
| <b>0.0171 ± 0.0007 OUR FIT</b>                    |                         |      |                                      |
| [0.0172 ± 0.0014 OUR 2018 FIT Scale factor = 1.2] |                         |      |                                      |
| <b>0.026 ± 0.005 OUR AVERAGE</b>                  |                         |      |                                      |
| 0.021 <sup>+0.028</sup> <sub>-0.009</sub>         | <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 <sup>+0.009</sup> <sub>-0.01</sub>          | <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.

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

| 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.

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

| VALUE                                                                         | EVTS | DOCUMENT ID | TECN | COMMENT             |
|-------------------------------------------------------------------------------|------|-------------|------|---------------------|
| <b>0.091 ± 0.006 OUR FIT</b>                                                  |      |             |      |                     |
| <b>0.081 ± 0.011 OUR AVERAGE</b>                                              |      |             |      |                     |
| 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 $\pi^- p$ |

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

| VALUE                                                                         | EVTS | DOCUMENT ID | TECN | COMMENT                                             |
|-------------------------------------------------------------------------------|------|-------------|------|-----------------------------------------------------|
| <b>0.102 ± 0.008 OUR FIT</b>                                                  |      |             |      |                                                     |
| <b>0.103 <sup>+0.011</sup><sub>-0.010</sub> OUR AVERAGE</b>                   |      |             |      |                                                     |
| 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 $K^- p \rightarrow \Lambda \text{MM}$ |
| 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 $K^- p$                                     |

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

| 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 $\pi^- p \rightarrow n \text{MM}$ |
| > 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.

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

| VALUE                        | DOCUMENT ID | TECN | COMMENT            |
|------------------------------|-------------|------|--------------------|
| <b>0.100 ± 0.008 OUR FIT</b> |             |      |                    |
| <b>0.124 ± 0.021</b>         | FELDMAN     | 67C  | OSPK 1.2 $\pi^- p$ |

NODE=M001R;LINKAGE=SN  
 NODE=M001R;LINKAGE=BY  
 NODE=M001R15;LINKAGE=H4  
 NODE=M001R15;LINKAGE=Q  
 NODE=M001R15;LINKAGE=F  
 NODE=M001R15;LINKAGE=B

NODE=M001R2  
 NODE=M001R2  
 NODE=M001R2  
 NEW

NODE=M001R2;LINKAGE=A

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

NODE=M001R33  
 NODE=M001R33

NODE=M001R;LINKAGE=KL

NODE=M001R14  
 NODE=M001R14

NODE=M001R1  
 NODE=M001R1

NODE=M001R18  
 NODE=M001R18

NODE=M001R18;LINKAGE=D

NODE=M001R9  
 NODE=M001R9

$\Gamma(\eta\gamma)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

| VALUE (units $10^{-4}$ ) | 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 $^{+2.5}_{-1.8}$ |  | <sup>2</sup> ANDREWS | 77  | CNTR 6.7–10 $\gamma\text{Cu}$           |

• • • 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 $^{+2.59}_{-1.83} \pm 0.28$ | 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 $^{+2.41}_{-2.55}$          | 3525  | <sup>2,8</sup> BENAYOUN   | 96  | RVUE $e^+e^- \rightarrow \eta\gamma$           |
| 7.3 ±2.9                         |       | <sup>2,4</sup> DOLINSKY   | 89  | ND $e^+e^- \rightarrow \eta\gamma$             |

<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  $B(\omega(782) \rightarrow e^+e^-) = (7.36 \pm 0.15) \times 10^{-5}$ . 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=M001R19  
NODE=M001R19NODE=M001R;LINKAGE=EA  
NODE=M001R19;LINKAGE=A  
NODE=M001R19;LINKAGE=AONODE=M001R13;LINKAGE=WL  
NODE=M001R19;LINKAGE=AK  
NODE=M001R19;LINKAGE=TS

NODE=M001R;LINKAGE=CS

NODE=M001R19;LINKAGE=A1

 $\Gamma(\eta\gamma)/\Gamma(\pi^0\gamma)$  $\Gamma_5/\Gamma_2$ 

| 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  
NODE=M001R11NODE=M001R11;LINKAGE=A  
NODE=M001R11;LINKAGE=K $\Gamma(\pi^0 e^+ e^-)/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

| 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 $\Gamma(\pi^0 \mu^+ \mu^-)/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ 

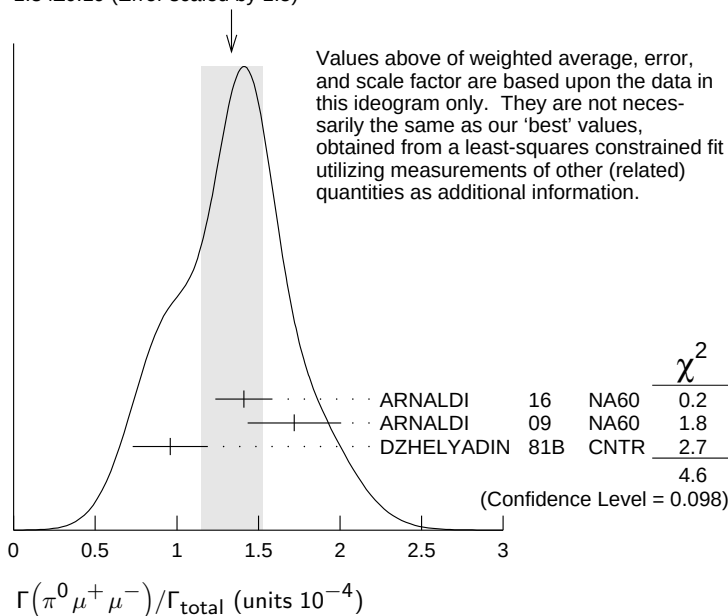
| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**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)



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

$\Gamma_8/\Gamma$

| VALUE (units $10^{-5}$ )                                                      | DOCUMENT ID    | TECN | COMMENT             |
|-------------------------------------------------------------------------------|----------------|------|---------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                |      |                     |
| <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                                           |
|-------------------------------------------------------------------------------|-------|-------------------|------|---------------------------------------------------|
| <b>0.736±0.015 OUR FIT</b> Error includes scale factor of 1.5.                |       |                   |      |                                                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                   |      |                                                   |
| 0.700±0.016                                                                   | 11200 | 1,2 AKHMETSHIN 04 | CMD2 | $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$           |
| 0.752±0.004±0.024                                                             | 1.2M  | 2,3 ACHASOV 03D   | RVUE | 0.44-2.00 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 0.714±0.036                                                                   |       | 2 DOLINSKY 89     | ND   | $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$           |
| 0.72 ±0.03                                                                    |       | 2 BARKOV 87       | CMD  | $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$           |
| 0.64 ±0.04                                                                    | 1488  | 2 KURDADZE 83B    | OLYA | $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$           |
| 0.675±0.069                                                                   | 433   | 2 CORDIER 80      | DM1  | $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$           |
| 0.83 ±0.10                                                                    | 451   | 2 BENAKSAS 72B    | OSPK | $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$           |
| 0.77 ±0.06                                                                    |       | 4 AUGUSTIN 69D    | OSPK | $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$           |
| 0.65 ±0.13                                                                    | 33    | 5 ASTVACAT... 68  | OSPK | Assume SU(3)+mixing                               |

NODE=M001R13  
NODE=M001R13

<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 |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

|                     |    |             |      |                                               |
|---------------------|----|-------------|------|-----------------------------------------------|
| $<1 \times 10^{-3}$ | 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**

|                             |     |                             |      |                                                    |
|-----------------------------|-----|-----------------------------|------|----------------------------------------------------|
| $6.4^{+2.4}_{-2.0} \pm 0.8$ | 190 | <sup>1</sup> AKHMETSHIN 04B | CMD2 | 0.6–0.97 $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$  |
| $6.6^{+1.4}_{-1.3} \pm 0.6$ | 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. • • •

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

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 |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

**7.9±1.3 OUR FIT****8.5±2.9**

• • • 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

 $\Gamma(\pi^0\pi^0\gamma)/\Gamma(\text{neutrals})$  $\Gamma_{13}/(\Gamma_2+\Gamma_4)$ 

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

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

|           |    |                       |      |                                   |
|-----------|----|-----------------------|------|-----------------------------------|
| 0.22±0.07 |    | <sup>1</sup> DAKIN 72 | OSPK | 1.4 $\pi^- p \rightarrow n \pi^0$ |
| <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 |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**7.4±1.8 OUR FIT****7.4±1.8 OUR AVERAGE**

|                       |      |                          |      |                                          |
|-----------------------|------|--------------------------|------|------------------------------------------|
| $6.6 \pm 1.4 \pm 1.7$ | 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     | EVS | DOCUMENT ID             | TECN | COMMENT              |
|-----------|-----|-------------------------|------|----------------------|
| 1.2 ± 0.6 | 30  | <sup>1</sup> DZHELYADIN | 79   | CNTR 25–33 $\pi^- p$ |

NODE=M001R20  
 NODE=M001R20

<sup>1</sup> Superseded by DZHELYADIN 81B result above.

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 $\pi^- p \rightarrow 3\gamma n$  |

NODE=M001R27  
 NODE=M001R27

<sup>1</sup> From direct  $3\gamma$  decay search.

NODE=M001R27;LINKAGE=A

 $\Gamma(\eta\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{17}/\Gamma$ 

| Violates C conservation. |     |             |      |                                           |
|--------------------------|-----|-------------|------|-------------------------------------------|
| VALUE                    | CL% | DOCUMENT ID | TECN | COMMENT                                   |
| <0.001                   | 90  | ALDE        | 94B  | GAM2 38 $\pi^- p \rightarrow \eta\pi^0 n$ |

NODE=M001R25  
 NODE=M001R25  
 NODE=M001R25

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

| VALUE                                                                         | CL% | DOCUMENT ID         | TECN | COMMENT                                                  |
|-------------------------------------------------------------------------------|-----|---------------------|------|----------------------------------------------------------|
| <b>&lt;0.016</b>                                                              | 90  | <sup>1</sup> FLATTE | 66   | HBC 1.2 – 1.7 $K^- p \rightarrow \Lambda \pi^+ \pi^- MM$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                     |      |                                                          |
| <0.045                                                                        | 95  | JACQUET             | 69B  | HLBC 2.05 $\pi^+ p \rightarrow \pi^+ p \omega$           |

NODE=M001R8  
 NODE=M001R8

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

NODE=M001R8;LINKAGE=A

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

| Violates C conservation. |     |                        |      |                                         |
|--------------------------|-----|------------------------|------|-----------------------------------------|
| 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

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

| Violates C conservation and Bose-Einstein statistics. |     |             |      |                                      |
|-------------------------------------------------------|-----|-------------|------|--------------------------------------|
| 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

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

| Violates C conservation. |     |             |      |                                        |
|--------------------------|-----|-------------|------|----------------------------------------|
| VALUE                    | CL% | DOCUMENT ID | TECN | COMMENT                                |
| $<3 \times 10^{-4}$      | 90  | PROKOSHKIN  | 95   | GAM2 38 $\pi^- p \rightarrow 3\pi^0 n$ |

NODE=M001R26  
 NODE=M001R26  
 NODE=M001R26

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

| Violates C conservation. |     |             |      |                                      |
|--------------------------|-----|-------------|------|--------------------------------------|
| 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

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

| Violates C conservation. |     |             |      |                                    |
|--------------------------|-----|-------------|------|------------------------------------|
| VALUE                    | CL% | DOCUMENT ID | TECN | COMMENT                            |
| <0.009                   | 90  | BARBERIS    | 01   | 450 $pp \rightarrow pf 3\pi^0 p_s$ |

NODE=M001R31  
 NODE=M001R31  
 NODE=M001R31



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

| VALUE                 | CL% | DOCUMENT ID | TECN     | COMMENT                                                               |
|-----------------------|-----|-------------|----------|-----------------------------------------------------------------------|
| $<8.1 \times 10^{-5}$ | 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

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  $\Lambda = M_\rho \approx 0.770$  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

NODE=M001230

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

| VALUE (GeV)                                                                                                                                            | EVTS | DOCUMENT ID          | TECN     | COMMENT                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|--------------------------------------|
| <b>0.670 <math>\pm</math> 0.006 OUR AVERAGE</b>                                                                                                        |      |                      |          |                                      |
| 0.6707 $\pm$ 0.0039 $\pm$ 0.0056                                                                                                                       |      | <sup>1</sup> ARNALDI | 16 NA60  | 400 GeV ( $p$ -A) collisions         |
| 0.668 $\pm$ 0.009 $\pm$ 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 $\pm$ 0.03                                                                                                                                        |      | DZHELYADIN           | 81B CNTR | 25-33 $\pi^- p \rightarrow \omega n$ |
| <sup>1</sup> ARNALDI 16 reports $\Lambda^{-2}(\omega) = 2.223 \pm 0.026 \pm 0.037$ GeV <sup>-2</sup> which we converted to the quoted $\Lambda$ value. |      |                      |          |                                      |
| <sup>2</sup> ARNALDI 09 reports $\Lambda^{-2}(\omega) = 2.24 \pm 0.06 \pm 0.02$ GeV <sup>-2</sup> which we converted to the quoted $\Lambda$ value.    |      |                      |          |                                      |

NODE=M001LAM  
 NODE=M001LAM

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 <math>\pm</math> 0.037</b>                                                                                                               | 1.1k | <sup>1</sup> ADLARSON | 17B A2MM | $\gamma p \rightarrow \omega p$ |
| <sup>1</sup> ADLARSON 17B reports $\Lambda^{-2}(\omega \pi^0) = 1.99 \pm 0.21$ GeV <sup>-2</sup> 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  $|\text{matrix element}|^2 \propto P(1 + 2\alpha Z + 2\beta Z^{3/2} \sin(3\phi) + 2\gamma Z^2 + O(Z^{5/2}))$  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 <math>\pm</math> 0.008 OUR AVERAGE</b>                                                                                                                         |      |                      |           |                                                                                     |
| [0.15 $\pm$ 0.04 OUR 2018 AVERAGE]                                                                                                                                      |      |                      |           |                                                                                     |
| 0.1321 $\pm$ 0.0067 $\pm$ 0.0046                                                                                                                                        | 260k | <sup>1</sup> ABLIKIM | 18AD BES3 | $J/\psi \rightarrow \omega \eta$                                                    |
| 0.147 $\pm$ 0.036                                                                                                                                                       | 44k  | ADLARSON             | 17 WASA   | $\alpha$ in $p d \rightarrow {}^3\text{He } \omega$ ,<br>$pp \rightarrow pp \omega$ |
| <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

NODE=M001A00

NODE=M001A00  
 NEW

NODE=M001A00;LINKAGE=A

 $\omega(782)$  REFERENCES

|           |      |                               |                                       |                                |
|-----------|------|-------------------------------|---------------------------------------|--------------------------------|
| ABLIKIM   | 18AD | PR D98 112007                 | M. Ablikim <i>et al.</i>              | (BES III Collab.)              |
| ABLIKIM   | 18C  | PRL 120 242003                | M. Ablikim <i>et al.</i>              | (BES III Collab.)              |
| ABLIKIM   | 18S  | PR D98 032001                 | M. Ablikim <i>et al.</i>              | (BES III Collab.)              |
| HANHART   | 18   | EPJ C78 450                   | C. Hanhart <i>et al.</i>              |                                |
| ADLARSON  | 17   | PL B770 418                   | P. Adlarson <i>et al.</i>             | (WASA-at-COSY Collab.)         |
| ADLARSON  | 17B  | PR C95 035208                 | P. Adlarson <i>et al.</i>             | (A2 Collab. at MAMI)           |
| ANASTASI  | 17   | PL B767 485                   | A. Anastasi <i>et al.</i>             | (KLOE-2 Collab.)               |
| ABLIKIM   | 16B  | PL B753 103                   | M. Ablikim <i>et al.</i>              | (BES III Collab.)              |
| ACHASOV   | 16A  | PR D93 092001                 | M.N. Achasov <i>et al.</i>            | (SND Collab.)                  |
| ARNALDI   | 16   | PL B757 437                   | R. Arnaldi <i>et al.</i>              | (NA60 Collab.)                 |
| PDG       | 15   | RPP 2015 at pdg.lbl.gov       |                                       | (PDG Collab.)                  |
| ACHASOV   | 13   | PR D88 054013                 | M.N. Achasov <i>et al.</i>            | (SND Collab.)                  |
| BABUSCI   | 13D  | PL B720 336                   | D. Babusci <i>et al.</i>              | (CATA, CALB, BARI)             |
| BENAYOUN  | 13   | EPJ C73 2453                  | M. Benayoun, P. David, L. DelBuono    | (PARIN, BERLIN+)               |
| DAVIER    | 13   | EPJ C73 2597                  | M. Davier <i>et al.</i>               |                                |
| LEES      | 12G  | PR D86 032013                 | J.P. Lees <i>et al.</i>               | (BABAR Collab.)                |
| NIECKNIG  | 12   | EPJ C72 2014                  | F. Niecknig, B. Kubis, S.P. Schneider | (BONN)                         |
| 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.)                  |
|           |      | Translated from ZETF 136 442. |                                       |                                |
| ARNALDI   | 09   | PL B677 260                   | 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.)                  |
|           |      | Translated from ZETF 134 80.  |                                       |                                |

NODE=M001

REFID=59498  
 REFID=58843  
 REFID=58971  
 REFID=59186  
 REFID=57907  
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 REFID=55584  
 REFID=55337  
 REFID=55357  
 REFID=55499  
 REFID=54299  
 REFID=54305  
 REFID=16683  
 REFID=53212  
 REFID=53101  
 REFID=52720  
 REFID=53136  
 REFID=53001  
 REFID=52258

|              |     |                                |                                             |                             |             |
|--------------|-----|--------------------------------|---------------------------------------------|-----------------------------|-------------|
| AMBROSINO    | 08G | PL B669 223                    | F. Ambrosino <i>et al.</i>                  | (KLOE Collab.)              | REFID=52573 |
| 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 |
| ACHASOV      | 06A | Translated from ZETF 130 437.  |                                             |                             |             |
| AULCHENKO    | 06  | PR D74 014016                  | M.N. Achasov <i>et al.</i>                  | (SND Collab.)               | REFID=51133 |
|              |     | JETPL 84 413                   | V.M. Aulchenko <i>et al.</i>                | (Novosibirsk CMD-2 Collab.) | REFID=51513 |
| ACHASOV      | 05A | Translated from ZETFP 84 491.  |                                             |                             |             |
|              |     | JETP 101 1053                  | M.N. Achasov <i>et al.</i>                  | (Novosibirsk SND Collab.)   | REFID=51045 |
| AKHMETSHIN   | 05  | Translated from ZETF 128 1201. |                                             |                             |             |
| AKHMETSHIN   | 05A | PL B605 26                     | R.R. Akhmetshin <i>et al.</i>               | (Novosibirsk CMD-2 Collab.) | REFID=50330 |
| AULCHENKO    | 05  | PL B613 29                     | R.R. Akhmetshin <i>et al.</i>               | (Novosibirsk CMD-2 Collab.) | REFID=50508 |
|              |     | JETPL 82 743                   | V.M. Aulchenko <i>et al.</i>                | (Novosibirsk CMD-2 Collab.) | REFID=51060 |
| AKHMETSHIN   | 04  | Translated from ZETFP 82 841.  |                                             |                             |             |
| AKHMETSHIN   | 04B | PL B578 285                    | R.R. Akhmetshin <i>et al.</i>               | (Novosibirsk CMD-2 Collab.) | REFID=49609 |
| AUBERT,B     | 04N | PL B580 119                    | R.R. Akhmetshin <i>et al.</i>               | (Novosibirsk CMD-2 Collab.) | REFID=49610 |
| PDG          | 04  | PR D70 072004                  | B. Aubert <i>et al.</i>                     | (BABAR Collab.)             | REFID=50184 |
| ACHASOV      | 03  | PL B592 1                      | S. Eidelman <i>et al.</i>                   | (PDG Collab.)               | REFID=49653 |
| ACHASOV      | 03D | PL B559 171                    | M.N. Achasov <i>et al.</i>                  | (Novosibirsk SND Collab.)   | REFID=49187 |
| ALOISIO      | 03  | PR D68 052006                  | M.N. Achasov <i>et al.</i>                  | (Novosibirsk SND Collab.)   | REFID=49577 |
| BENAYOUN     | 03  | PL B561 55                     | A. Aloisio <i>et al.</i>                    | (KLOE Collab.)              | REFID=49404 |
| ACHASOV      | 02E | EPJ C29 397                    | M. Benayoun <i>et al.</i>                   |                             | REFID=49477 |
| ACHASOV      | 02F | PR D66 032001                  | M.N. Achasov <i>et al.</i>                  | (Novosibirsk SND Collab.)   | REFID=48815 |
| AKHMETSHIN   | 02  | PL B537 201                    | M.N. Achasov <i>et al.</i>                  | (Novosibirsk SND Collab.)   | REFID=48816 |
| ALOISIO      | 02D | PL B527 161                    | R.R. Akhmetshin <i>et al.</i>               | (Novosibirsk CMD-2 Collab.) | REFID=48565 |
| HEISTER      | 02C | PL B537 21                     | A. Aloisio <i>et al.</i>                    | (KLOE Collab.)              | REFID=48824 |
| ACHASOV      | 01E | PL B528 19                     | A. Heister <i>et al.</i>                    | (ALEPH Collab.)             | REFID=48564 |
| AKHMETSHIN   | 01B | PR D63 072002                  | M.N. Achasov <i>et al.</i>                  | (Novosibirsk SND Collab.)   | REFID=48311 |
| BARBERIS     | 01  | PL B509 217                    | R.R. Akhmetshin <i>et al.</i>               | (Novosibirsk CMD-2 Collab.) | REFID=48167 |
| ACHASOV      | 00  | PL B507 14                     | D. Barberis <i>et al.</i>                   |                             | REFID=48324 |
| ACHASOV      | 00D | EPJ C12 25                     | M.N. Achasov <i>et al.</i>                  | (Novosibirsk SND Collab.)   | REFID=47417 |
|              |     | JETPL 72 282                   | M.N. Achasov <i>et al.</i>                  | (Novosibirsk SND Collab.)   | REFID=47882 |
| ACHASOV      | 00G | Translated from ZETFP 72 411.  |                                             |                             |             |
|              |     | JETPL 71 355                   | M.N. Achasov <i>et al.</i>                  | (Novosibirsk SND Collab.)   | REFID=47929 |
| AKHMETSHIN   | 00C | Translated from ZETFP 71 519.  |                                             |                             |             |
| AULCHENKO    | 00A | PL B476 33                     | R.R. Akhmetshin <i>et al.</i>               | (Novosibirsk CMD-2 Collab.) | REFID=47423 |
|              |     | JETP 90 927                    | V.M. Aulchenko <i>et al.</i>                | (Novosibirsk SND Collab.)   | REFID=47953 |
| CASE         | 00  | Translated from ZETF 117 1067. |                                             |                             |             |
| ACHASOV      | 99E | PR D61 032002                  | T. Case <i>et al.</i>                       | (Crystal Barrel Collab.)    | REFID=47409 |
| GARDNER      | 99  | PL B462 365                    | M.N. Achasov <i>et al.</i>                  | (Novosibirsk SND Collab.)   | REFID=47391 |
| BENAYOUN     | 98  | PR D59 076002                  | S. Gardner, H.B. O'Connell                  |                             | REFID=46919 |
| ABELE        | 97E | EPJ C2 269                     | M. Benayoun <i>et al.</i>                   | (IPNP, NOVO, ADL+)          | REFID=45859 |
| BENAYOUN     | 96  | PL B411 361                    | A. Abele <i>et al.</i>                      | (Crystal Barrel Collab.)    | REFID=45755 |
| PROKOSHKIN   | 95  | ZPHY C72 221                   | M. Benayoun <i>et al.</i>                   | (IPNP, NOVO)                | REFID=45753 |
|              |     | PD 40 273                      | Y.D. Prokoshkin, V.D. Samoilenko            | (SERP)                      | REFID=44616 |
| WURZINGER    | 95  | Translated from DANS 342 610.  |                                             |                             |             |
| ALDE         | 94B | PR C51 443                     | R. Wurzinger <i>et al.</i>                  | (BONN, ORSAY, SACL+)        | REFID=45209 |
| AMSLER       | 94C | PL B340 122                    | D.M. Alde <i>et al.</i>                     | (SERP, BELG, LANL, LAPP+)   | REFID=44100 |
| ALDE         | 93  | PL B327 425                    | C. Amsler <i>et al.</i>                     | (Crystal Barrel Collab.)    | REFID=44091 |
|              |     | PAN 56 1229                    | D.M. Alde <i>et al.</i>                     | (SERP, LAPP, LANL, BELG+)   | REFID=43603 |
| Also         |     | Translated from YAF 56 137.    |                                             |                             |             |
| AMSLER       | 93B | ZPHY C61 35                    | D.M. Alde <i>et al.</i>                     | (SERP, LAPP, LANL, BELG+)   | REFID=43790 |
| WEIDENAUER   | 93  | PL B311 362                    | C. Amsler <i>et al.</i>                     | (Crystal Barrel Collab.)    | REFID=43602 |
| ANTONELLI    | 92  | ZPHY C59 387                   | P. Weidenauer <i>et al.</i>                 | (ASTERIX Collab.)           | REFID=43585 |
| DOLINSKY     | 91  | ZPHY C56 15                    | 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. Bitjukov <i>et al.</i>                 | (SERP)                      | REFID=41021 |
| DOLINSKY     | 88  | Translated from YAF 47 1258.   |                                             |                             |             |
|              |     | SJNP 48 277                    | S.I. Dolinsky <i>et al.</i>                 | (NOVO)                      | REFID=41022 |
| KURDADZE     | 88  | Translated from YAF 48 442.    |                                             |                             |             |
|              |     | JETPL 47 512                   | L.M. Kurdadze <i>et al.</i>                 | (NOVO)                      | REFID=41121 |
| AULCHENKO    | 87  | Translated from ZETFP 47 432.  |                                             |                             |             |
| BARKOV       | 87  | PL B186 432                    | V.M. Aulchenko <i>et al.</i>                | (NOVO)                      | REFID=40007 |
|              |     | JETPL 46 164                   | L.M. Barkov <i>et al.</i>                   | (NOVO)                      | REFID=40280 |
| KURDADZE     | 86  | Translated from ZETFP 46 132.  |                                             |                             |             |
|              |     | JETPL 43 643                   | L.M. Kurdadze <i>et al.</i>                 | (NOVO)                      | REFID=40287 |
| BARKOV       | 85  | Translated from ZETFP 43 497.  |                                             |                             |             |
| DRUZHININ    | 84  | NP B256 365                    | L.M. Barkov <i>et al.</i>                   | (NOVO)                      | REFID=20134 |
| KURDADZE     | 83B | PL 144B 136                    | V.P. Druzhinin <i>et al.</i>                | (NOVO)                      | REFID=20561 |
|              |     | JETPL 36 274                   | A.M. Kurdadze <i>et al.</i>                 | (NOVO)                      | REFID=20244 |
| DZHELYADIN   | 81B | Translated from ZETFP 36 221.  |                                             |                             |             |
| CORDIER      | 80  | PL 102B 296                    | R.I. Dzheilyadin <i>et al.</i>              | (SERP)                      | REFID=20242 |
| DZHELYADIN   | 80  | NP B172 13                     | A. Cordier <i>et al.</i>                    | (LALO)                      | REFID=20240 |
| ROOS         | 80  | PL 94B 548                     | R.I. Dzheilyadin <i>et al.</i>              | (SERP)                      | REFID=10831 |
| BENKHEIRI    | 79  | LNC 27 321                     | M. Roos, A. Pellinen                        | (HELS)                      | REFID=20241 |
| DZHELYADIN   | 79  | NP B150 268                    | P. Benkheiri <i>et al.</i>                  | (EPOL, CERN, CDEF+)         | REFID=20238 |
| COOPER       | 78B | PL 84B 143                     | R.I. Dzheilyadin <i>et al.</i>              | (SERP)                      | REFID=20239 |
| QUENZER      | 78  | NP B146 1                      | A.M. Cooper <i>et al.</i>                   | (TATA, CERN, CDEF+)         | REFID=20235 |
| VANAPEL...   | 78  | PL 76B 512                     | A. Quenzer <i>et al.</i>                    | (LALO)                      | REFID=20123 |
| WICKLUND     | 78  | NP B133 245                    | G.W. van Apeldoorn <i>et al.</i>            | (ZEEM)                      | REFID=20234 |
| ANDREWS      | 77  | PR D17 1197                    | A.B. Wicklund <i>et al.</i>                 | (ANL)                       | REFID=20124 |
| GESSAROLI    | 77  | PRL 38 198                     | D.E. Andrews <i>et al.</i>                  | (ROCH)                      | REFID=20120 |
| KEYNE        | 76  | NP B126 382                    | R. Gessaroli <i>et al.</i>                  | (BGNA, FIRZ, GENO+)         | REFID=20230 |
| Also         |     | PR D14 28                      | J. Keyne <i>et al.</i>                      | (LOIC, SHMP)                | REFID=20226 |
| KALBFLEISCH  | 75  | PR D8 2789                     | D.M. Binnie <i>et al.</i>                   | (LOIC, SHMP)                | REFID=20216 |
| AGUILAR...   | 72B | PR D11 987                     | G.R. Kalbfleisch, R.C. Strand, J.W. Chapman | (BNL+)                      | REFID=20223 |
| APEL         | 72B | PR D6 29                       | M. Aguilar-Benitez <i>et al.</i>            | (BNL)                       | REFID=20205 |
| BASILE       | 72B | PL 41B 234                     | W.D. Apel <i>et al.</i>                     | (KARLK, KARLE, PISA)        | REFID=20206 |
| BENAKSAS     | 72  | Phil. Conf. 153                | M. Basile <i>et al.</i>                     | (CERN)                      | REFID=20207 |
| BENAKSAS     | 72B | PL 39B 289                     | D. Benaksas <i>et al.</i>                   | (ORSAY)                     | REFID=20096 |
| BENAKSAS     | 72C | PL 42B 507                     | D. Benaksas <i>et al.</i>                   | (ORSAY)                     | REFID=20209 |
| BORENSTEIN   | 72  | PL 42B 511                     | D. Benaksas <i>et al.</i>                   | (ORSAY)                     | REFID=20517 |
| BROWN        | 72  | PR D5 1559                     | S.R. Borenstein <i>et al.</i>               | (BNL, MICH)                 | REFID=20215 |
| DAKIN        | 72  | PL 42B 117                     | R.M. Brown <i>et al.</i>                    | (ILL, ILLC)                 | REFID=20211 |
| RATCLIFF     | 72  | PR D6 2321                     | J.T. Dakin <i>et al.</i>                    | (PRIN)                      | REFID=20212 |
| ALVENSLEB... | 71C | PL 38B 345                     | B.N. Ratcliff <i>et al.</i>                 | (SLAC)                      | REFID=20102 |
| BALDIN       | 71  | PRL 27 888                     | H. Alvensleben <i>et al.</i>                | (DESY)                      | REFID=20193 |
|              |     | SJNP 13 758                    | A.B. Baldin <i>et al.</i>                   | (ITEP)                      | REFID=20195 |
|              |     | Translated from YAF 13 1318.   |                                             |                             |             |

|                                      |     |                               |                                  |                     |
|--------------------------------------|-----|-------------------------------|----------------------------------|---------------------|
| BEHREND                              | 71  | PRL 27 61                     | H.J. Behrend <i>et al.</i>       | (ROCH, CORN, FNAL)  |
| BIZZARRI                             | 71  | NP B27 140                    | R. Bizzarri <i>et al.</i>        | (CERN, CDEF)        |
| COYNE                                | 71  | NP B32 333                    | D.G. Coyne <i>et al.</i>         | (LRL)               |
| MOFFEIT                              | 71  | NP B29 349                    | K.C. Moffeit <i>et al.</i>       | (LRL, UCB, SLAC+)   |
| ABRAMOVI...                          | 70  | NP B20 209                    | M. Abramovich <i>et al.</i>      | (CERN)              |
| BIGGS                                | 70B | PRL 24 1201                   | P.J. Biggs <i>et al.</i>         | (DARE)              |
| BIZZARRI                             | 70  | PRL 25 1385                   | R. Bizzarri <i>et al.</i>        | (ROMA, SYRA)        |
| ROOS                                 | 70  | DNPL/R7 173                   | M. Roos                          | (CERN)              |
| Proc. Daresbury Study Weekend No. 1. |     |                               |                                  |                     |
| AUGUSTIN                             | 69D | PL 28B 513                    | J.E. Augustin <i>et al.</i>      | (ORSAY)             |
| BIZZARRI                             | 69  | NP B14 169                    | R. Bizzarri <i>et al.</i>        | (CERN, CDEF)        |
| DEINET                               | 69B | PL 30B 426                    | W. Deinet <i>et al.</i>          | (KARL, CERN)        |
| JACQUET                              | 69B | NC 63A 743                    | F. Jacquet <i>et al.</i>         | (EPOL, BERG)        |
| WILSON                               | 69  | Private Comm.                 | R. Wilson                        | (HARV)              |
| Also                                 |     | PR 178 2095                   | A.A. Wehmann <i>et al.</i>       | (HARV, CASE, SLAC+) |
| ASTVACAT...                          | 68  | PL 27B 45                     | R.G. Astvatsaturov <i>et al.</i> | (JINR, MOSU)        |
| BOLLINI                              | 68C | NC 56A 531                    | D. Bollini <i>et al.</i>         | (CERN, BGNA, STRB)  |
| GOUNARIS                             | 68  | PRL 21 244                    | G.J. Gounaris, J.J. Sakurai      |                     |
| BARASH                               | 67B | PR 156 1399                   | N. Barash <i>et al.</i>          | (COLU)              |
| FELDMAN                              | 67C | PR 159 1219                   | M. Feldman <i>et al.</i>         | (PENN)              |
| DIGIUGNO                             | 66B | NC 44A 1272                   | G. Di Giugno <i>et al.</i>       | (NAPL, FRAS, TRST)  |
| FLATTE                               | 66  | PR 145 1050                   | S.M. Flatte <i>et al.</i>        | (LRL)               |
| JAMES                                | 66  | PR 142 896                    | F.E. James, H.L. Kraybill        | (YALE, BNL)         |
| BARBARO-...                          | 65  | PRL 14 279                    | A. Barbaro-Galtieri, R.D. Tripp  | (LRL)               |
| BARMIN                               | 64  | JETP 18 1289                  | V.V. Barmin <i>et al.</i>        | (ITEP)              |
|                                      |     | Translated from ZETF 45 1879. |                                  |                     |
| KRAEMER                              | 64  | PR 136 B496                   | R.W. Kraemer <i>et al.</i>       | (JHU, NWES, WOOD)   |
| BUSCHBECK                            | 63  | Siena Conf. 1 166             | B. Buschbeck <i>et al.</i>       | (VIEN, CERN, ANIK)  |

REFID=20197  
REFID=20198  
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REFID=20157  
REFID=10770  
REFID=20152  
REFID=20149

REFID=10755  
REFID=20146

NODE=M002

$\eta'(958)$

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

### $\eta'(958)$ 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 $K^- p$                                             |

<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.

OCCUR=2

OCCUR=2

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>0.196 ±0.009 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 |           |
|---------------|-------------------------------------------------------------|--------------------------------------|------------------|-----------|
| $\Gamma_1$    | $\pi^+\pi^-\eta$                                            | $(42.6 \pm 0.7) \%$                  |                  | DESIG=1   |
| $\Gamma_2$    | $\rho^0\gamma$ (including non-resonant $\pi^+\pi^-\gamma$ ) | $(28.9 \pm 0.5) \%$                  |                  | DESIG=9   |
| $\Gamma_3$    | $\rho^0\gamma$                                              |                                      |                  | DESIG=213 |
| $\Gamma_4$    | $\pi^0\pi^0\eta$                                            | $(22.8 \pm 0.8) \%$                  |                  | DESIG=2   |
| $\Gamma_5$    | $\omega\gamma$                                              | $(2.62 \pm 0.13) \%$                 |                  | DESIG=7   |
| $\Gamma_6$    | $\omega e^+e^-$                                             | $(2.0 \pm 0.4) \times 10^{-4}$       |                  | DESIG=205 |
| $\Gamma_7$    | $\gamma\gamma$                                              | $(2.22 \pm 0.08) \%$                 |                  | DESIG=6   |
| $\Gamma_8$    | $3\pi^0$                                                    | $(2.54 \pm 0.18) \times 10^{-3}$     |                  | DESIG=8   |
| $\Gamma_9$    | $\mu^+\mu^-\gamma$                                          | $(1.09 \pm 0.27) \times 10^{-4}$     |                  | DESIG=20  |
| $\Gamma_{10}$ | $\pi^+\pi^-\mu^+\mu^-$                                      | $< 2.9 \times 10^{-5}$               | 90%              | DESIG=201 |
| $\Gamma_{11}$ | $\pi^+\pi^-\pi^0$                                           | $(3.61 \pm 0.17) \times 10^{-3}$     |                  | DESIG=121 |
| $\Gamma_{12}$ | $(\pi^+\pi^-\pi^0)$ S-wave                                  | $(3.8 \pm 0.5) \times 10^{-3}$       |                  | DESIG=211 |
| $\Gamma_{13}$ | $\pi^\mp\rho^\pm$                                           | $(7.4 \pm 2.3) \times 10^{-4}$       |                  | DESIG=210 |
| $\Gamma_{14}$ | $\pi^0\rho^0$                                               | $< 4 \%$                             | 90%              | DESIG=18  |
| $\Gamma_{15}$ | $2(\pi^+\pi^-)$                                             | $(8.4 \pm 0.9) \times 10^{-5}$       |                  | DESIG=131 |
| $\Gamma_{16}$ | $\pi^+\pi^-2\pi^0$                                          | $(1.8 \pm 0.4) \times 10^{-4}$       |                  | 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 |
| $\Gamma_{22}$ | $\pi^+\pi^-e^+e^-$                                          | $(2.4^{+1.3}_{-1.0}) \times 10^{-3}$ |                  | DESIG=10  |
| $\Gamma_{23}$ | $\pi^+e^-\nu_e + \text{c.c.}$                               | $< 2.1 \times 10^{-4}$               | 90%              | DESIG=204 |
| $\Gamma_{24}$ | $\gamma e^+e^-$                                             | $(4.73 \pm 0.30) \times 10^{-4}$     |                  | 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 |
| $\Gamma_{27}$ | $4\pi^0$                                                    | $< 3.2 \times 10^{-4}$               | 90%              | DESIG=26  |
| $\Gamma_{28}$ | $e^+e^-$                                                    | $< 5.6 \times 10^{-9}$               | 90%              | DESIG=150 |
| $\Gamma_{29}$ | invisible                                                   | $< 5 \times 10^{-4}$                 | 90%              | DESIG=200 |

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

NODE=M002;CLUMP=B

|               |                   |         |                        |     |           |
|---------------|-------------------|---------|------------------------|-----|-----------|
| $\Gamma_{30}$ | $\pi^+\pi^-$      | $P, CP$ | $< 1.8 \times 10^{-5}$ | 90% | DESIG=111 |
| $\Gamma_{31}$ | $\pi^0\pi^0$      | $P, CP$ | $< 4 \times 10^{-4}$   | 90% | DESIG=25  |
| $\Gamma_{32}$ | $\pi^0e^+e^-$     | $C$ [a] | $< 1.4 \times 10^{-3}$ | 90% | DESIG=16  |
| $\Gamma_{33}$ | $\eta e^+e^-$     | $C$ [a] | $< 2.4 \times 10^{-3}$ | 90% | DESIG=17  |
| $\Gamma_{34}$ | $3\gamma$         | $C$     | $< 1.1 \times 10^{-4}$ | 90% | DESIG=23  |
| $\Gamma_{35}$ | $\mu^+\mu^-\pi^0$ | $C$ [a] | $< 6.0 \times 10^{-5}$ | 90% | DESIG=22  |
| $\Gamma_{36}$ | $\mu^+\mu^-\eta$  | $C$ [a] | $< 1.5 \times 10^{-5}$ | 90% | DESIG=21  |
| $\Gamma_{37}$ | $e\mu$            | $LF$    | $< 4.7 \times 10^{-4}$ | 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 16 branching ratios uses 46 measurements and one constraint to determine 9 parameters. The overall fit has a  $\chi^2 = 62.7$  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.

|          |       |       |       |       |       |       |          |          |
|----------|-------|-------|-------|-------|-------|-------|----------|----------|
| $x_2$    | -3    |       |       |       |       |       |          |          |
| $x_4$    | -76   | -58   |       |       |       |       |          |          |
| $x_5$    | -10   | -13   | 1     |       |       |       |          |          |
| $x_7$    | -27   | -24   | 29    | -1    |       |       |          |          |
| $x_8$    | -23   | -18   | 28    | 0     | 8     |       |          |          |
| $x_{11}$ | 0     | -1    | -1    | 0     | -1    | 0     |          |          |
| $x_{22}$ | -5    | -6    | -5    | -1    | -3    | -2    | 0        |          |
| $\Gamma$ | 24    | 4     | -17   | 3     | -71   | -4    | 1        | 3        |
|          | $x_1$ | $x_2$ | $x_4$ | $x_5$ | $x_7$ | $x_8$ | $x_{11}$ | $x_{22}$ |

| Mode                                                                      | Rate (MeV)                                  |           |
|---------------------------------------------------------------------------|---------------------------------------------|-----------|
| $\Gamma_1$ $\pi^+ \pi^- \eta$                                             | 0.084 $\pm$ 0.004                           | DESIG=1   |
| $\Gamma_2$ $\rho^0 \gamma$ (including non-resonant $\pi^+ \pi^- \gamma$ ) | 0.0567 $\pm$ 0.0027                         | DESIG=9   |
| $\Gamma_4$ $\pi^0 \pi^0 \eta$                                             | 0.0448 $\pm$ 0.0023                         | DESIG=2   |
| $\Gamma_5$ $\omega \gamma$                                                | 0.00514 $\pm$ 0.00035                       | DESIG=7   |
| $\Gamma_7$ $\gamma \gamma$                                                | 0.00436 $\pm$ 0.00013                       | DESIG=6   |
| $\Gamma_8$ $3\pi^0$                                                       | (5.0 $\pm$ 0.4) $\times 10^{-4}$            | DESIG=8   |
| $\Gamma_{11}$ $\pi^+ \pi^- \pi^0$                                         | (7.1 $\pm$ 0.5) $\times 10^{-4}$            | DESIG=121 |
| $\Gamma_{22}$ $\pi^+ \pi^- e^+ e^-$                                       | (4.6 $\pm^{+2.5}_{-1.9}$ ) $\times 10^{-4}$ | DESIG=10  |

## $\eta'(958)$ PARTIAL WIDTHS

NODE=M002220

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

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

**4.36 $\pm$ 0.14 OUR FIT****4.28 $\pm$ 0.19 OUR AVERAGE**

|                                                                               |      |                       |          |                                                  |
|-------------------------------------------------------------------------------|------|-----------------------|----------|--------------------------------------------------|
| 4.17 $\pm$ 0.10 $\pm$ 0.27                                                    | 2000 | <sup>1</sup> ACCIARRI | 98Q L3   | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \gamma$ |
| 4.53 $\pm$ 0.29 $\pm$ 0.51                                                    | 266  | KARCH                 | 92 CBAL  | $e^+ e^- \rightarrow e^+ e^- \eta \pi^0 \pi^0$   |
| 3.61 $\pm$ 0.13 $\pm$ 0.48                                                    |      | <sup>2</sup> BEHREND  | 91 CELL  | $e^+ e^- \rightarrow e^+ e^- \eta'(958)$         |
| 4.6 $\pm$ 1.1 $\pm$ 0.6                                                       | 23   | BARU                  | 90 MD1   | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \gamma$ |
| 4.57 $\pm$ 0.25 $\pm$ 0.44                                                    |      | BUTLER                | 90 MRK2  | $e^+ e^- \rightarrow e^+ e^- \eta'(958)$         |
| 5.08 $\pm$ 0.24 $\pm$ 0.71                                                    | 547  | <sup>3</sup> ROE      | 90 ASP   | $e^+ e^- \rightarrow e^+ e^- 2\gamma$            |
| 3.8 $\pm$ 0.7 $\pm$ 0.6                                                       | 34   | AIHARA                | 88C TPC  | $e^+ e^- \rightarrow e^+ e^- \eta \pi^+ \pi^-$   |
| 4.9 $\pm$ 0.5 $\pm$ 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 $\pm$ 0.6 $\pm$ 0.9                                                       | 143  | <sup>5</sup> GIDAL    | 87 MRK2  | $e^+ e^- \rightarrow e^+ e^- \eta \pi^+ \pi^-$   |
| 4.0 $\pm$ 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;LINKAGE=AC  
 NODE=M002W4;LINKAGE=K1  
 NODE=M002W4;LINKAGE=K2  
 NODE=M002W4;LINKAGE=K3  
 NODE=M002W4;LINKAGE=C  
 NODE=M002W4;LINKAGE=A

$\Gamma(e^+e^-)$  $\Gamma_{28}$ 

| VALUE (eV)                                                                    | CL% | DOCUMENT ID             | TECN | COMMENT                                        |
|-------------------------------------------------------------------------------|-----|-------------------------|------|------------------------------------------------|
| $<1.1 \times 10^{-3}$                                                         | 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. • • • |     |                         |      |                                                |
| $<2.0 \times 10^{-3}$                                                         | 90  | <sup>2</sup> ACHASOV    | 15   | SND $0.958 e^+e^- \rightarrow \pi\pi\eta$      |
| $<2.4 \times 10^{-3}$                                                         | 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

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.

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

| VALUE (keV)                                                                   | EVTS | DOCUMENT ID | TECN | COMMENT                                           |
|-------------------------------------------------------------------------------|------|-------------|------|---------------------------------------------------|
| <b>1.26±0.04 OUR FIT</b>                                                      |      |             |      |                                                   |
| <b>1.26±0.07 OUR AVERAGE</b>                                                  |      |             |      | Error includes scale factor of 1.2.               |
| $1.09 \pm 0.04 \pm 0.13$                                                      |      | BEHREND     | 91   | CELL $e^+e^- \rightarrow e^+e^-\rho(770)^0\gamma$ |
| $1.35 \pm 0.09 \pm 0.21$                                                      |      | AIHARA      | 87   | TPC $e^+e^- \rightarrow e^+e^-\rho\gamma$         |
| $1.13 \pm 0.04 \pm 0.13$                                                      | 867  | ALBRECHT    | 87B  | ARG $e^+e^- \rightarrow e^+e^-\rho\gamma$         |
| $1.53 \pm 0.09 \pm 0.21$                                                      |      | ALTHOFF     | 84E  | TASS $e^+e^- \rightarrow e^+e^-\rho\gamma$        |
| $1.14 \pm 0.08 \pm 0.11$                                                      | 243  | BERGER      | 84B  | PLUT $e^+e^- \rightarrow e^+e^-\rho\gamma$        |
| $1.73 \pm 0.34 \pm 0.35$                                                      | 95   | JENNI       | 83   | MRK2 $e^+e^- \rightarrow e^+e^-\rho\gamma$        |
| $1.49 \pm 0.13 \pm 0.027$                                                     | 213  | BARTEL      | 82B  | JADE $e^+e^- \rightarrow e^+e^-\rho\gamma$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |      |                                                   |
| $1.85 \pm 0.31 \pm 0.24$                                                      | 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>1.00±0.05 OUR FIT</b>                                                      |                           |      |                                                |
| <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. • • • |                           |      |                                                |
| $0.95 \pm 0.05 \pm 0.08$                                                      | <sup>2</sup> KARCH        | 90   | CBAL $e^+e^- \rightarrow e^+e^-\eta\pi^0\pi^0$ |
| $1.00 \pm 0.08 \pm 0.10$                                                      | <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

 $\Gamma(\pi^+\pi^-\eta) \times \Gamma(e^+e^-) / \Gamma_{\text{total}}$  $\Gamma_1\Gamma_{28}/\Gamma$ 

| 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

 $\eta'(958) \text{ BRANCHING RATIOS}$ 

NODE=M002230

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

| VALUE                                                                                      | EVTS | DOCUMENT ID         | TECN | COMMENT                                                 |
|--------------------------------------------------------------------------------------------|------|---------------------|------|---------------------------------------------------------|
| <b>0.426±0.007 OUR FIT</b>                                                                 |      |                     |      |                                                         |
| • • • We do not use the following data for averages, fits, limits, etc. • • •              |      |                     |      |                                                         |
| $0.424 \pm 0.011 \pm 0.004$                                                                | 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. |      |                     |      |                                                         |
| <b>0.1196±0.0019 OUR FIT</b>                                                               |      |                     |      |                                                         |
| • • • We do not use the following data for averages, fits, limits, etc. • • •              |      |                     |      |                                                         |
| $0.123 \pm 0.014$                                                                          | 107  | RITTENBERG          | 69   | HBC $1.7-2.7 K^-p$                                      |
| $0.10 \pm 0.04$                                                                            | 10   | LONDON              | 66   | HBC $2.24 K^-p \rightarrow \Lambda 2\pi^+ 2\pi^- \pi^0$ |
| $0.07 \pm 0.04$                                                                            | 7    | BADIER              | 65B  | HBC $3 K^-p$                                            |

NODE=M002R47  
NODE=M002R47

NODE=M002R47;LINKAGE=PE

 $\Gamma(\pi^+\pi^-\eta(\text{charged decay})) / \Gamma_{\text{total}}$  $0.2810\Gamma_1/\Gamma$ NODE=M002R3  
NODE=M002R3

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

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

**0.307±0.005 OUR FIT**

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

|             |     |            |    |     |                |
|-------------|-----|------------|----|-----|----------------|
| 0.314±0.026 | 281 | RITTENBERG | 69 | HBC | 1.7–2.7 $K^-p$ |
|-------------|-----|------------|----|-----|----------------|

NODE=M002R1  
NODE=M002R1

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

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

**0.289±0.005 OUR FIT**

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

|                   |      |                     |     |      |                                                 |
|-------------------|------|---------------------|-----|------|-------------------------------------------------|
| 0.287±0.007±0.004 | 0.2k | <sup>1</sup> PEDLAR | 09  | CLEO | $J/\psi \rightarrow \gamma\eta'$                |
| 0.329±0.033       | 298  | RITTENBERG          | 69  | HBC  | 1.7–2.7 $K^-p$                                  |
| 0.2 ±0.1          | 20   | LONDON              | 66  | HBC  | 2.24 $K^-p \rightarrow \Lambda\pi^+\pi^-\gamma$ |
| 0.34 ±0.09        | 35   | BADIER              | 65B | HBC  | 3 $K^-p$                                        |

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

NODE=M002R6  
NODE=M002R6

NODE=M002R6;LINKAGE=PE

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

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

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

|                 |      |                      |     |      |                                           |
|-----------------|------|----------------------|-----|------|-------------------------------------------|
| 33.34±0.06±1.60 | 970k | <sup>1</sup> ABLIKIM | 18C | BES3 | $\eta'(958) \rightarrow \gamma\pi^+\pi^-$ |
| 34.43±0.52±1.97 | 970k | <sup>2</sup> ABLIKIM | 18C | BES3 | $\eta'(958) \rightarrow \gamma\pi^+\pi^-$ |

<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  
NODE=M002R66

OCCUR=2

NODE=M002R66;LINKAGE=A  
NODE=M002R66;LINKAGE=B

$$\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))/\Gamma(\pi^+\pi^-\eta) \quad \Gamma_2/\Gamma_1$$

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

**0.679±0.017 OUR FIT**

**0.683±0.020 OUR AVERAGE**

|                   |         |     |      |                                  |
|-------------------|---------|-----|------|----------------------------------|
| 0.677±0.024±0.011 | PEDLAR  | 09  | CLE3 | $J/\psi \rightarrow \eta'\gamma$ |
| 0.69 ±0.03        | ABLIKIM | 06E | BES2 | $J/\psi \rightarrow \eta'\gamma$ |

NODE=M002R43  
NODE=M002R43

$$\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))/\Gamma(\pi^+\pi^-\eta(\text{neutral decay})) \quad \Gamma_2/0.714\Gamma_1$$

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

**0.951±0.024 OUR FIT**

**0.97 ±0.09 OUR AVERAGE**

|            |     |           |     |      |                                                        |
|------------|-----|-----------|-----|------|--------------------------------------------------------|
| 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  | $2.2K^-p \rightarrow \Lambda X^0$                      |
| 1.11 ±0.18 | 192 | JACOBS    | 73  | HBC  | $2.9K^-p \rightarrow \Lambda X^0$                      |

NODE=M002R27  
NODE=M002R27

$$\Gamma(\pi^0\pi^0\eta)/\Gamma_{\text{total}} \quad \Gamma_4/\Gamma$$

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

**0.228±0.008 OUR FIT**

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

|                   |      |                     |    |      |                                  |
|-------------------|------|---------------------|----|------|----------------------------------|
| 0.235±0.013±0.004 | 3.2k | <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=M002R48  
NODE=M002R48

NODE=M002R48;LINKAGE=PE

$$\Gamma(\pi^0\pi^0\eta(3\pi^0\text{ decay}))/\Gamma_{\text{total}} \quad 0.321\Gamma_4/\Gamma$$

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

**0.0733±0.0026 OUR FIT**

• • • 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

$$\Gamma(\pi^0\pi^0\eta)/\Gamma(\pi^+\pi^-\eta) \quad \Gamma_4/\Gamma_1$$

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

**0.536±0.026 OUR FIT**

|                   |        |    |      |                                  |
|-------------------|--------|----|------|----------------------------------|
| 0.555±0.043±0.013 | PEDLAR | 09 | CLE3 | $J/\psi \rightarrow \eta'\gamma$ |
|-------------------|--------|----|------|----------------------------------|

NODE=M002R45  
NODE=M002R45

$$\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))/\Gamma(\pi\pi\eta) \quad \Gamma_2/(\Gamma_1+\Gamma_4)$$

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

**0.442±0.012 OUR FIT**

|                  |          |     |      |                                  |
|------------------|----------|-----|------|----------------------------------|
| 0.43 ±0.02 ±0.02 | BARBERIS | 98C | OMEG | 450 $pp \rightarrow p_f\eta'p_s$ |
|------------------|----------|-----|------|----------------------------------|

• • • 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

**2.62±0.13 OUR FIT**

**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  $J/\psi \rightarrow \gamma\eta'$

<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  
NODE=M002R49

## $\Gamma(\omega\gamma)/\Gamma(\pi^+\pi^-\eta)$ $\Gamma_5/\Gamma_1$

VALUE EVTS DOCUMENT ID TECN COMMENT

**0.0615±0.0033 OUR FIT**

**0.055 ±0.007 ±0.001** 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

**0.115±0.007 OUR FIT**

**0.147±0.016** ALDE 87B GAM2  $38 \pi^- p \rightarrow n4\gamma$

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  $J/\psi \rightarrow \eta'\gamma$

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

NODE=M002R60  
NODE=M002R60

NODE=M002R60;LINKAGE=A

## $\Gamma(\omega e^+ e^-)/\Gamma_{\text{total}}$ $\Gamma_6/\Gamma$

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

**1.97±0.34±0.17** 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

**0.425±0.011 OUR FIT**

• • • 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

**0.0886±0.0026 OUR FIT**

• • • 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

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

VALUE EVTS DOCUMENT ID TECN COMMENT

**0.3926±0.0035 OUR FIT**

• • • 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

**2.22±0.08 OUR FIT**

**2.00±0.15 OUR AVERAGE**

$1.98^{+0.31}_{-0.27} \pm 0.07$  114 <sup>1</sup> WICHT 08 BELL  $B^\pm \rightarrow K^\pm\gamma\gamma$

2.00±0.18 <sup>2</sup> STANTON 80 SPEC  $8.45 \pi^- p \rightarrow n\pi^+\pi^-2\gamma$

NODE=M002R19  
NODE=M002R19



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

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

<sup>1</sup> WICHT 08 reports  $[\Gamma(\eta'(958) \rightarrow \gamma\gamma)/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \eta' K^+)] = (1.40 \begin{smallmatrix} +0.16+0.15 \\ -0.15-0.12 \end{smallmatrix}) \times 10^{-6}$  which we divide by our best value  $B(B^+ \rightarrow \eta' K^+) = (7.06 \pm 0.25) \times 10^{-5}$ . 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;LINKAGE=W1

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

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

| VALUE                          | DOCUMENT ID | TECN | COMMENT                                | $\Gamma_7/\Gamma_1$ |
|--------------------------------|-------------|------|----------------------------------------|---------------------|
| <b>0.0522 ± 0.0022 OUR FIT</b> |             |      |                                        |                     |
| <b>0.053 ± 0.004 ± 0.001</b>   | PEDLAR      | 09   | CLE3 $J/\psi \rightarrow \eta' \gamma$ |                     |

NODE=M002R46  
NODE=M002R46

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

| VALUE                          | DOCUMENT ID | TECN | COMMENT                                | $\Gamma_7/\Gamma_2$ |
|--------------------------------|-------------|------|----------------------------------------|---------------------|
| <b>0.0768 ± 0.0033 OUR FIT</b> |             |      |                                        |                     |
| <b>0.080 ± 0.008</b>           | ABLIKIM     | 06E  | BES2 $J/\psi \rightarrow \eta' \gamma$ |                     |

NODE=M002R42  
NODE=M002R42

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

| VALUE                            | DOCUMENT ID                         | TECN | COMMENT                                 | $\Gamma_7/\Gamma_4$ |
|----------------------------------|-------------------------------------|------|-----------------------------------------|---------------------|
| <b>0.097 ± 0.004 OUR FIT</b>     |                                     |      |                                         |                     |
| <b>0.105 ± 0.010 OUR AVERAGE</b> | 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

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

| VALUE                        | EVTS | DOCUMENT ID | TECN | COMMENT | $\Gamma_7/0.714\Gamma_4$ |
|------------------------------|------|-------------|------|---------|--------------------------|
| <b>0.136 ± 0.006 OUR FIT</b> |      |             |      |         |                          |

NODE=M002R28  
NODE=M002R28

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

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

### $\Gamma(\text{neutrals})/\Gamma_{\text{total}}$

| VALUE                        | EVTS | DOCUMENT ID | TECN | COMMENT | $(0.714\Gamma_4 + 0.09\Gamma_5 + \Gamma_7)/\Gamma$ |
|------------------------------|------|-------------|------|---------|----------------------------------------------------|
| <b>0.188 ± 0.006 OUR FIT</b> |      |             |      |         |                                                    |

NODE=M002R5  
NODE=M002R5

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

|                   |     |            |    |      |                                 |
|-------------------|-----|------------|----|------|---------------------------------|
| $0.185 \pm 0.022$ | 535 | BASILE     | 71 | CNTR | $1.6 \pi^- p \rightarrow n X^0$ |
| $0.189 \pm 0.026$ | 123 | RITTENBERG | 69 | HBC  | $1.7-2.7 K^- p$                 |

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

| VALUE (units $10^{-3}$ )       | EVTS | DOCUMENT ID | TECN | COMMENT | $\Gamma_8/\Gamma$ |
|--------------------------------|------|-------------|------|---------|-------------------|
| <b>2.54 ± 0.18 OUR FIT</b>     |      |             |      |         |                   |
| <b>3.57 ± 0.26 OUR AVERAGE</b> |      |             |      |         |                   |

NODE=M002R55  
NODE=M002R55

|                             |      |                      |     |      |                                     |
|-----------------------------|------|----------------------|-----|------|-------------------------------------|
| $3.522 \pm 0.082 \pm 0.254$ | 2015 | ABLIKIM              | 17  | BES3 | $J/\psi \rightarrow \gamma(3\pi^0)$ |
| $4.79 \pm 0.59 \pm 1.14$    | 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. • • •

|                          |     |                      |     |      |                                     |
|--------------------------|-----|----------------------|-----|------|-------------------------------------|
| $3.56 \pm 0.22 \pm 0.34$ | 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;LINKAGE=A  
NODE=M002R55;LINKAGE=B

### $\Gamma(3\pi^0)/\Gamma(\pi^0\pi^0\eta)$

| VALUE (units $10^{-4}$ )   | EVTS | DOCUMENT ID | TECN | COMMENT | $\Gamma_8/\Gamma_4$ |
|----------------------------|------|-------------|------|---------|---------------------|
| <b>111 ± 8 OUR FIT</b>     |      |             |      |         |                     |
| <b>78 ± 10 OUR AVERAGE</b> |      |             |      |         |                     |

NODE=M002R32  
NODE=M002R32

|             |     |       |     |      |                                       |
|-------------|-----|-------|-----|------|---------------------------------------|
| $86 \pm 19$ | 235 | BLIK  | 08  | GAMS | $32 \pi^- p \rightarrow \eta' n$      |
| $74 \pm 15$ |     | ALDE  | 87B | GAM2 | $38 \pi^- p \rightarrow n 6\gamma$    |
| $75 \pm 18$ |     | BINON | 84  | GAM2 | $30-40 \pi^- p \rightarrow n 6\gamma$ |

### $\Gamma(\mu^+\mu^-\gamma)/\Gamma(\gamma\gamma)$

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT | $\Gamma_9/\Gamma_7$                    |
|--------------------------|------|-------------|------|---------|----------------------------------------|
| <b>4.9 ± 1.2</b>         | 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 $^{+1.1}_{-0.9}$ ± 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 | $J/\psi \rightarrow \gamma(\pi^+\pi^-\pi^0)$ |
|--------------------|------|----------------------|-----|------|----------------------------------------------|

<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.

NODE=M002R21  
NODE=M002R21

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

 $\Gamma((\pi^+\pi^-\pi^0) \text{ S-wave})/\Gamma_{\text{total}}$  $\Gamma_{12}/\Gamma$ 

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

|                            |      |                      |    |      |                                              |
|----------------------------|------|----------------------|----|------|----------------------------------------------|
| <b>37.63 ± 0.77 ± 5.00</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.

NODE=M002R63  
NODE=M002R63

NODE=M002R63;LINKAGE=A

 $\Gamma(\pi^\mp\rho^\pm)/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ 

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

|                           |      |                      |    |      |                                              |
|---------------------------|------|----------------------|----|------|----------------------------------------------|
| <b>7.44 ± 0.60 ± 2.23</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.

NODE=M002R62  
NODE=M002R62

NODE=M002R62;LINKAGE=A

 $\Gamma(\pi^+\pi^-\pi^0)/\Gamma(\pi^+\pi^-\eta)$  $\Gamma_{11}/\Gamma_1$ 

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

**8.5 ± 0.4 OUR FIT**

|                                                  |    |                   |    |      |                                  |
|--------------------------------------------------|----|-------------------|----|------|----------------------------------|
| <b>8.28 <math>^{+2.49}_{-2.12}</math> ± 0.04</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  $^{+6}_{-5}$  ± 2) × 10<sup>-3</sup> 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=M002R01  
NODE=M002R01

NODE=M002R01;LINKAGE=NA

 $\Gamma(\pi^0\rho^0)/\Gamma_{\text{total}}$  $\Gamma_{14}/\Gamma$ 

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

|       |    |            |    |     |            |
|-------|----|------------|----|-----|------------|
| <0.04 | 90 | RITTENBERG | 65 | HBC | 2.7 $K^-p$ |
|-------|----|------------|----|-----|------------|

NODE=M002R10  
NODE=M002R10

 $\Gamma(2(\pi^+\pi^-))/\Gamma_{\text{total}}$  $\Gamma_{15}/\Gamma$ 

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

**8.4 ± 0.9 OUR AVERAGE** [(8.6 ± 0.9) × 10<sup>-5</sup> OUR 2018 AVERAGE]

|                        |     |                      |     |      |                                  |
|------------------------|-----|----------------------|-----|------|----------------------------------|
| <b>8.4 ± 0.9 ± 0.3</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 | 1.7–2.7 $K^-p$ |
|-------|----|------------|----|-----|----------------|

NODE=M002R24  
NODE=M002R24

NEW

<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  $B(J/\psi(1S) \rightarrow \gamma\eta'(958)) = (5.21 \pm 0.17) \times 10^{-3}$ . 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.

NODE=M002R24;LINKAGE=A

NODE=M002R24;LINKAGE=NA

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

$\Gamma_{15}/\Gamma_1$

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID       | TECN    | COMMENT                          |
|--------------------------|-----|-------------------|---------|----------------------------------|
| <b>&lt;0.6</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  $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$ .

NODE=M002R04  
 NODE=M002R04

NODE=M002R04;LINKAGE=NA

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

$\Gamma_{16}/\Gamma$

| VALUE (units $10^{-4}$ )                | CL% | EVTS | DOCUMENT ID          | TECN     | COMMENT                          |
|-----------------------------------------|-----|------|----------------------|----------|----------------------------------|
| <b><math>1.8 \pm 0.4 \pm 0.1</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  $[\Gamma(\eta'(958) \rightarrow \pi^+\pi^-2\pi^0)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta'(958))]$   
 $= (9.38 \pm 1.79 \pm 0.89) \times 10^{-7}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \gamma\eta'(958)) = (5.21 \pm 0.17) \times 10^{-3}$ . 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.

NODE=M002R51  
 NODE=M002R51

NODE=M002R51;LINKAGE=A

NODE=M002R51;LINKAGE=NA

### $\Gamma(\pi^+\pi^-2\pi^0)/\Gamma(\pi^+\pi^-\eta)$

$\Gamma_{16}/\Gamma_1$

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

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

NODE=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  $1.7-2.7 K^- p$

NODE=M002R22  
 NODE=M002R22

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

$\Gamma_{18}/\Gamma$

| VALUE            | CL% | DOCUMENT ID       | TECN    | COMMENT                          |
|------------------|-----|-------------------|---------|----------------------------------|
| <b>&lt;0.002</b> | 90  | <sup>1</sup> NAIK | 09 CLEO | $J/\psi \rightarrow \gamma\eta'$ |
| <0.01            | 90  | RITTENBERG 69     | HBC     | $1.7-2.7 K^- p$                  |

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

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

NODE=M002R23  
 NODE=M002R23

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 | $J/\psi \rightarrow \gamma\eta'$ |

<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  
 NODE=M002R06

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  | $K^- p \rightarrow \Lambda 2(\pi^+\pi^-) + \text{MM}$ |

• • • 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  $K^- p \rightarrow \Lambda 2(\pi^+\pi^-)$

<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  
 NODE=M002R07

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 | $J/\psi \rightarrow \gamma\eta'$ |
| <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  
 NODE=M002R08

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 |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

**2.4  $\pm 1.3$   
-1.0** 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 $\pm 1.2$<br>-0.9 $\pm 0.5$ |     | <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 |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**5.5  $\pm 3.0$   
-2.2** OUR FIT

**5.52  $\pm 3.00$   
-2.30  $\pm 0.03$**  8 <sup>1</sup> NAIK 09 CLEO  $J/\psi \rightarrow \gamma\eta'$

<sup>1</sup> NAIK 09 reports  $[\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\pi^+\pi^-)/\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\eta)] / [B(\eta \rightarrow 2\gamma)] = (14 \pm 7 \pm 3) \times 10^{-3}$  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                          |
|-----------------------------------------|------|-------------|----------|----------------------------------|
| <b>7.2 <math>\pm 0.4 \pm 0.5</math></b> | 429  | ABLIKIM     | 130 BES3 | $J/\psi \rightarrow \gamma\eta'$ |

NODE=M002R56  
 NODE=M002R56

 $\Gamma(\pi^+e^-\nu_e + \text{c.c.})/\Gamma(\pi^+\pi^-\eta)$  $\Gamma_{23}/\Gamma_1$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                        |
|--------------------------|-----|-------------|----------|--------------------------------|
| <b>&lt;5.0</b>           | 90  | ABLIKIM     | 13G BES3 | $J/\psi \rightarrow \phi\eta'$ |

NODE=M002R54  
 NODE=M002R54

 $\Gamma(\gamma e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_{24}/\Gamma$ 

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

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

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

NODE=M002R40  
 NODE=M002R40

 $\Gamma(\gamma e^+e^-)/\Gamma(\gamma\gamma)$  $\Gamma_{24}/\Gamma_7$ 

| VALUE (units $10^{-2}$ )                   | EVTs | DOCUMENT ID | TECN     | COMMENT                            |
|--------------------------------------------|------|-------------|----------|------------------------------------|
| <b>2.13 <math>\pm 0.09 \pm 0.07</math></b> | 864  | ABLIKIM     | 150 BES3 | $J/\psi \rightarrow \gamma e^+e^-$ |

NODE=M002R00  
 NODE=M002R00

 $\Gamma(\pi^0\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_{25}/\Gamma$ 

| VALUE (units $10^{-3}$ )                   | EVTs | DOCUMENT ID | TECN     | COMMENT                          |
|--------------------------------------------|------|-------------|----------|----------------------------------|
| <b>3.20 <math>\pm 0.07 \pm 0.23</math></b> | 3.4k | ABLIKIM     | 17T BES3 | $J/\psi \rightarrow \gamma\eta'$ |

NODE=M002R64  
 NODE=M002R64

 $\Gamma(\pi^0\gamma\gamma(\text{non resonant}))/\Gamma_{\text{total}}$  $\Gamma_{26}/\Gamma$ 

| VALUE (units $10^{-4}$ )                   | EVTs | DOCUMENT ID | TECN     | COMMENT                          |
|--------------------------------------------|------|-------------|----------|----------------------------------|
| <b>6.16 <math>\pm 0.64 \pm 0.67</math></b> | 655  | ABLIKIM     | 17T BES3 | $J/\psi \rightarrow \gamma\eta'$ |

NODE=M002R65  
 NODE=M002R65

 $\Gamma(\pi^0\gamma\gamma)/\Gamma(\pi^0\pi^0\eta)$  $\Gamma_{25}/\Gamma_4$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                          |
|--------------------------|-----|-------------|----------|----------------------------------|
| <b>&lt;37</b>            | 90  | ALDE        | 87B GAM2 | 38 $\pi^-p \rightarrow n4\gamma$ |

NODE=M002R35  
 NODE=M002R35

$\Gamma(4\pi^0)/\Gamma_{\text{total}}$ 

| VALUE                  | CL% | DOCUMENT ID | TECN | COMMENT                            |
|------------------------|-----|-------------|------|------------------------------------|
| $< 3.2 \times 10^{-4}$ | 90  | DONSKOV 14  | GAM4 | $32.5 \pi^- p \rightarrow \eta' n$ |

 $\Gamma_{27}/\Gamma$ 

NODE=M002R58  
 NODE=M002R58

 $\Gamma(4\pi^0)/\Gamma(\pi^0\pi^0\eta)$ 

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

 $\Gamma_{27}/\Gamma_4$ 

NODE=M002R37  
 NODE=M002R37

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

|        |    |          |      |                                    |
|--------|----|----------|------|------------------------------------|
| $< 23$ | 90 | ALDE 87B | GAM2 | $38 \pi^- p \rightarrow n 8\gamma$ |
|--------|----|----------|------|------------------------------------|

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

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

 $\Gamma_{28}/\Gamma$ 

NODE=M002R39  
 NODE=M002R39

|                        |    |                         |     |                                       |
|------------------------|----|-------------------------|-----|---------------------------------------|
| $< 5.6 \times 10^{-9}$ | 90 | <sup>1</sup> 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 | <sup>2</sup> 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  $B(\eta \rightarrow \gamma\gamma) = (39.41 \pm 0.20)\%$ .

NODE=M002R39;LINKAGE=B

NODE=M002R39;LINKAGE=A

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

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

 $\Gamma_{29}/\Gamma$ 

NODE=M002R52  
 NODE=M002R52

• • • 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  $\Gamma_{29}/\Gamma_1$  from NAIK 09.

NODE=M002R52;LINKAGE=NA

 $\Gamma(\text{invisible})/\Gamma(\gamma\gamma)$ 

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

 $\Gamma_{29}/\Gamma_7$ 

NODE=M002R44  
 NODE=M002R44

|         |    |            |      |                                |
|---------|----|------------|------|--------------------------------|
| $< 2.4$ | 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 | $J/\psi \rightarrow \phi\eta'$ |
|----------|----|-------------|-----|--------------------------------|

 $\Gamma(\text{invisible})/\Gamma(\pi^+\pi^-\eta)$ 

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

 $\Gamma_{29}/\Gamma_1$ 

NODE=M002R09  
 NODE=M002R09

• • • 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  $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$ .

NODE=M002R09;LINKAGE=NA

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

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

 $\Gamma_{30}/\Gamma$ 

NODE=M002R20  
 NODE=M002R20

|          |    |                       |      |                                         |
|----------|----|-----------------------|------|-----------------------------------------|
| $< 0.18$ | 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 | $1.7\text{--}2.7 K^- p$ |
|---------|----|---------------|-----|-------------------------|

<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  $B(J/\psi(1S) \rightarrow \gamma\eta'(958)) = 5.21 \times 10^{-3}$ .

<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.

OCCUR=2

NODE=M002R20;LINKAGE=A  
 NODE=M002R20;LINKAGE=AL

NODE=M002R20;LINKAGE=MO  
 NODE=M002R20;LINKAGE=MR

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

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

 $\Gamma_{31}/\Gamma$ 

NODE=M002R53  
 NODE=M002R53

|                                 |                                                       |  |  |  |
|---------------------------------|-------------------------------------------------------|--|--|--|
| $< 4 \times 10^{-4}$ (CL = 90%) | $[< 5 \times 10^{-4}$ (CL = 90%) OUR 2018 BEST LIMIT] |  |  |  |
|---------------------------------|-------------------------------------------------------|--|--|--|

|                      |    |                          |      |                                       |
|----------------------|----|--------------------------|------|---------------------------------------|
| $< 4 \times 10^{-4}$ | 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  $B(J/\psi(1S) \rightarrow \gamma\eta'(958)) = 5.21 \times 10^{-3}$ .

NODE=M002R53;LINKAGE=AL

$\Gamma(\pi^0\pi^0)/\Gamma(\pi^0\pi^0\eta)$  $\Gamma_{31}/\Gamma_4$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                 |
|--------------------------|-----|-------------|------|-----------------------------------------|
| <45                      | 90  | ALDE        | 87B  | GAM2 $38 \pi^- p \rightarrow n 4\gamma$ |

NODE=M002R36  
 NODE=M002R36

 $\Gamma(\pi^0 e^+ e^-)/\Gamma_{\text{total}}$  $\Gamma_{32}/\Gamma$ 

| 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 $2.7 K^- p$     |

NODE=M002R8  
 NODE=M002R8

 $\Gamma(\eta e^+ e^-)/\Gamma_{\text{total}}$  $\Gamma_{33}/\Gamma$ 

| 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=M002R9  
 NODE=M002R9

 $\Gamma(3\gamma)/\Gamma(\pi^0\pi^0\eta)$  $\Gamma_{34}/\Gamma_4$ 

| 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

 $\Gamma(\mu^+ \mu^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{35}/\Gamma$ 

| 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

 $\Gamma(\mu^+ \mu^- \eta)/\Gamma_{\text{total}}$  $\Gamma_{36}/\Gamma$ 

| 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

 $\Gamma(e\mu)/\Gamma_{\text{total}}$  $\Gamma_{37}/\Gamma$ 

| 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

 $Re(\alpha)$  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

**$Im(\alpha)$  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 | $\eta' \rightarrow \eta \pi^+ \pi^-$                |

<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  
NODE=M002IA0

OCCUR=2

NODE=M002IA0;LINKAGE=AB  
NODE=M002IA0;LINKAGE=AMNODE=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=M002C0NODE=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, JACOBS 73, and DANBURG 73.NODE=M002D0  
NODE=M002D0

OCCUR=2

NODE=M002D0;LINKAGE=AB  
NODE=M002D0;LINKAGE=AMNODE=M002D0;LINKAGE=AL  
NODE=M002D0;LINKAGE=KA **$\eta'(958) \rightarrow \eta \pi \pi$  DECAY PARAMETERS**

NODE=M002227

$$|\text{MATRIX ELEMENT}|^2 \propto 1 + a Y + b Y^2 + c X + d X^2$$

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

**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   | $27 \pi^- p \rightarrow \eta' n,$<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.<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   | $27 \pi^- p \rightarrow \eta' n,$<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.

<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=M002DPC

NODE=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>-0.03 ±0.04 OUR AVERAGE</b>                                                |      |                |      |                                                   |
| -0.019±0.056                                                                  |      | AIHARA 87      | TPC  | $2\gamma \rightarrow \pi^+\pi^-\gamma$            |
| -0.069±0.078                                                                  | 295  | GRIGORIAN 75   | STRC | $2.1 \pi^- p$                                     |
| 0.00 ±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 ±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.

NODE=M002FFL

NODE=M002FFL

| VALUE (GeV <sup>-2</sup> )   | EVTS | DOCUMENT ID              | TECN | COMMENT                                |
|------------------------------|------|--------------------------|------|----------------------------------------|
| <b>1.62±0.17 OUR AVERAGE</b> |      |                          |      |                                        |
| 1.60±0.17±0.08               | 864  | <sup>1</sup> ABLIKIM 150 | BES3 | $J/\psi \rightarrow \gamma e^+ e^-$    |
| 1.7 ±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;LINKAGE=A

 **$\eta'(958)$  REFERENCES**

NODE=M002

|                   |                              |                                            |                          |                     |
|-------------------|------------------------------|--------------------------------------------|--------------------------|---------------------|
| ABLIKIM 18        | PR D97 012003                | M. Ablikim <i>et al.</i>                   | (BES III Collab.)        | REFID=58711         |
| ABLIKIM 18C       | PRL 120 242003               | M. Ablikim <i>et al.</i>                   | (BES III 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         |
| AAIJ 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>                   | (BES III Collab.)        | REFID=57650         |
| ABLIKIM 17T       | PR D96 012005                | M. Ablikim <i>et al.</i>                   | (BES III Collab.)        | REFID=58013         |
| ABLIKIM 16M       | PR D93 072008                | M. Ablikim <i>et al.</i>                   | (BES III Collab.)        | REFID=57511         |
| ABLIKIM 15AD      | PR D92 051101                | M. Ablikim <i>et al.</i>                   | (BES III Collab.)        | REFID=56983         |
| ABLIKIM 15G       | PR D92 012014                | M. Ablikim <i>et al.</i>                   | (BES III Collab.)        | REFID=56602         |
| ABLIKIM 15O       | PR D92 012001                | M. Ablikim <i>et al.</i>                   | (BES III Collab.)        | REFID=56780         |
| ABLIKIM 15P       | PR D92 012007                | M. Ablikim <i>et al.</i>                   | (BES III 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>                   | (BES III 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>                   | (BES III Collab.)        | REFID=54829         |
| ABLIKIM 13G       | PR D87 032006                | M. Ablikim <i>et al.</i>                   | (BES III Collab.)        | REFID=54952         |
| ABLIKIM 13O       | PR D87 092011                | M. Ablikim <i>et al.</i>                   | (BES III Collab.)        | REFID=55388         |
| ABLIKIM 13U       | PR D88 091502                | M. Ablikim <i>et al.</i>                   | (BES III Collab.)        | REFID=55582         |
| ABLIKIM 12E       | PRL 108 182001               | M. Ablikim <i>et al.</i>                   | (BES III 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>                   | (BES III Collab.)        | REFID=53646         |
| ABLIKIM 11G       | PR D84 032006                | M. Ablikim <i>et al.</i>                   | (BES III 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           | Translated from YAF 72 258.  |                                            |                          |                     |
| PEDLAR 09         | PRL 102 061801               | P. Naik <i>et al.</i>                      | (CLEO Collab.)           | REFID=52678         |
| BLIK 08           | PR D79 111101                | T.K. Pedlar <i>et al.</i>                  | (CLEO Collab.)           | REFID=52998         |
| LIBBY 08          | PAN 71 2124                  | A. Blik <i>et al.</i>                      | (GAMS-4 $\pi$ Collab.)   | REFID=52663         |
| WICHT 08          | Translated from YAF 71 2161. |                                            |                          |                     |
| DOROFEEV 07       | PRL 101 182002               | J. Libby <i>et al.</i>                     | (CLEO Collab.)           | REFID=52591         |
| MORI 07A          | PL B662 323                  | J. Wicht <i>et al.</i>                     | (BELLE Collab.)          | REFID=52204         |
| ABLIKIM 06E       | PL B651 22                   | V. Dorofeev <i>et al.</i>                  | (VES Collab.)            | REFID=51711         |
| ABLIKIM 06Q       | JPSJ 76 074102               | T. Mori <i>et al.</i>                      | (BELLE Collab.)          | REFID=51691         |
| AMELIN 05A        | PR D73 052008                | M. Ablikim <i>et al.</i>                   | (BES Collab.)            | REFID=51057         |
| AMSLE 04B         | PRL 97 202002                | M. Ablikim <i>et al.</i>                   | (BES Collab.)            | REFID=51487         |
| BAI 04J           | PAN 68 372                   | D.V. Amelin <i>et al.</i>                  | (VES Collab.)            | REFID=50766         |
| BRIERE 00         | Translated from YAF 68 401.  |                                            |                          |                     |
| ACCARRI 98Q       | EPJ C33 23                   | C. Amsler <i>et al.</i>                    | (Crystal Barrel Collab.) | REFID=51079         |
| BARBERIS 98C      | PL B594 47                   | J.Z. Bai <i>et al.</i>                     | (BES Collab.)            | REFID=50167         |
| WURZINGER 96      | PRL 84 26                    | R. Briere <i>et al.</i>                    | (CLEO Collab.)           | REFID=47410         |
| PDG 94            | PL B418 399                  | M. Acciarri <i>et al.</i>                  | (L3 Collab.)             | REFID=46316         |
| AMSLE 93          | PL B440 225                  | D. Barberis <i>et al.</i>                  | (WA 102 Collab.)         | REFID=46346         |
| BELADIDZE 92C     | PL B374 283                  | R. Wurzinger <i>et al.</i>                 | (BONN, ORSAY, SACL+)     | REFID=44992         |
| KARCH 92          | PR D50 1173                  | L. Montanet <i>et al.</i>                  | (CERN, LBL, BOST+)       | REFID=43653         |
| ARMSTRONG 91B     | ZPHY C58 175                 | C. Amsler <i>et al.</i>                    | (Crystal Barrel Collab.) | REFID=43311         |
| BEHREND 91        | SJNP 55 1535                 | G.M. Beladidze, S.I. Bitukov, G.V. Borisov | (SERP+)                  | REFID=43175         |
| AUGUSTIN 90       | Translated from YAF 55 2748. |                                            |                          |                     |
| BARU 90           | ZPHY C54 33                  | K. Karch <i>et al.</i>                     | (Crystal Ball Collab.)   | REFID=42170         |
| BUTLER 90         | ZPHY C52 389                 | T.A. Armstrong <i>et al.</i>               | (ATHU, BARI, BIRM+)      | REFID=41862         |
| KARCH 90          | ZPHY C49 401                 | H.J. Behrend <i>et al.</i>                 | (CELLO Collab.)          | REFID=41497         |
| ROE 90            | PR D42 10                    | J.E. Augustin <i>et al.</i>                | (DM2 Collab.)            | REFID=41352         |
| AIHARA 88C        | ZPHY C48 581                 | S.E. Baru <i>et al.</i>                    | (MD-1 Collab.)           | REFID=41366         |
| VOROBIEV 88       | PR D42 1368                  | F. Butler <i>et al.</i>                    | (Mark II Collab.)        | REFID=41363         |
|                   | PL B249 353                  | K. Karch <i>et al.</i>                     | (Crystal Ball Collab.)   | REFID=41377         |
|                   | PR D41 17                    | N.A. Roe <i>et al.</i>                     | (ASP Collab.)            | REFID=41014         |
|                   | PR D38 1                     | H. Aihara <i>et al.</i>                    | (TPC-2 $\gamma$ Collab.) | REFID=40564         |
|                   | SJNP 48 273                  | P.V. Vorobiev <i>et al.</i>                | (NOVO)                   | REFID=41023         |
|                   | Translated from YAF 48 436.  |                                            |                          |                     |

|             |     |                              |                                             |                             |
|-------------|-----|------------------------------|---------------------------------------------|-----------------------------|
| WILLIAMS    | 88  | PR D38 1365                  | D.A. Williams <i>et al.</i>                 | (Crystal Ball Collab.)      |
| AIHARA      | 87  | PR D35 2650                  | H. Aihara <i>et al.</i>                     | (TPC-2 $\gamma$ Collab.) JP |
| ALBRECHT    | 87B | PL B199 457                  | H. Albrecht <i>et al.</i>                   | (ARGUS Collab.)             |
| ALDE        | 87B | ZPHY C36 603                 | D.M. Alde <i>et al.</i>                     | (LANL, BELG, SERP, LAPP)    |
| ANTREASYAN  | 87  | PR D36 2633                  | D. Antreasyan <i>et al.</i>                 | (Crystal Ball Collab.)      |
| GIDAL       | 87  | PRL 59 2012                  | G. Gidal <i>et al.</i>                      | (LBL, SLAC, HARV)           |
| ALDE        | 86  | PL B177 115                  | D.M. Alde <i>et al.</i>                     | (SERP, BELG, LANL, LAPP)    |
| BARTEL      | 85E | PL 160B 421                  | W. Bartel <i>et al.</i>                     | (JADE Collab.)              |
| LANDSBERG   | 85  | PRPL 128 301                 | L.G. Landsberg                              | (SERP)                      |
| ALTHOFF     | 84E | PL 147B 487                  | M. Althoff <i>et al.</i>                    | (TASSO Collab.)             |
| BERGER      | 84B | PL 142B 125                  | C. Berger                                   | (PLUTO Collab.)             |
| BINON       | 84  | PL 140B 264                  | F.G. Binon <i>et al.</i>                    | (SERP, BELG, LAPP+)         |
| JENNI       | 83  | PR D27 1031                  | P. Jenni <i>et al.</i>                      | (SLAC, LBL)                 |
| BARTEL      | 82B | PL 113B 190                  | W. Bartel <i>et al.</i>                     | (JADE Collab.)              |
| BEHREND     | 82C | PL 114B 378                  | H.J. Behrend <i>et al.</i>                  | (CELLO Collab.)             |
| Also        |     | PL 125B 518 (erratum)        | H.J. Behrend <i>et al.</i>                  | (CELLO Collab.)             |
| DZHELYADIN  | 81  | PL 105B 239                  | R.I. Dzhelyadin <i>et al.</i>               | (SERP)                      |
| STANTON     | 80  | PL B92 353                   | N.R. Stanton <i>et al.</i>                  | (OSU, CARL, MCGI+)          |
| VIKTOROV    | 80  | SJNP 32 520                  | V.A. Viktorov <i>et al.</i>                 | (SERP)                      |
|             |     | Translated from YAF 32 1005. |                                             |                             |
| APEL        | 79  | PL 83B 131                   | W.D. Apel, K.H. Augenstein, E. Bertolucci   | (KARLK+)                    |
| BINNIE      | 79  | PL 83B 141                   | D.M. Binnie <i>et al.</i>                   | (LOIC)                      |
| ZANFINO     | 77  | PRL 38 930                   | C. Zafino <i>et al.</i>                     | (CARL, MCGI, OHIO+)         |
| GRIGORIAN   | 75  | NP B91 232                   | A. Grigorian <i>et al.</i>                  | (+)                         |
| KALBFLEISCH | 75  | PR D11 987                   | G.R. Kalbfleisch, R.C. Strand, J.W. Chapman | (BNL+)                      |
| DUANE       | 74  | PRL 32 425                   | A. Duane <i>et al.</i>                      | (LOIC, SHMP)                |
| KALBFLEISCH | 74  | PR D10 916                   | G.R. Kalbfleisch                            | (BNL)                       |
| DANBURG     | 73  | PR D8 3744                   | J.S. Danburg <i>et al.</i>                  | (BNL, MICH) JP              |
| JACOBS      | 73  | PR D8 18                     | S.M. Jacobs <i>et al.</i>                   | (BRAN, UMD, SYRA+) JP       |
| AGUILAR-... | 72B | PR D6 29                     | M. Aguilar-Benitez <i>et al.</i>            | (BNL)                       |
| APEL        | 72  | PL 40B 680                   | W.D. Apel <i>et al.</i>                     | (KARLK, KARLE, PISA)        |
| DALPIAZ     | 72  | PL 42B 377                   | P.F. Dalpiaz <i>et al.</i>                  | (CERN)                      |
| BASILE      | 71  | NC 3A 371                    | M. Basile <i>et al.</i>                     | (CERN, BGNA, STRB)          |
| HARVEY      | 71  | PRL 27 885                   | E.H. Harvey <i>et al.</i>                   | (MINN, MICH)                |
| BENSINGER   | 70  | PL 33B 505                   | J.R. Bensinger <i>et al.</i>                | (WISC)                      |
| RITTENBERG  | 69  | Thesis UCRL 18863            | A. Rittenberg                               | (LRL) I                     |
| DAVIS       | 68  | PL 27B 532                   | R. Davis <i>et al.</i>                      | (NWES, ANL)                 |
| LONDON      | 66  | PR 143 1034                  | G.W. London <i>et al.</i>                   | (BNL, SYRA) IJP             |
| BADIER      | 65B | PL 17 337                    | J. Badier <i>et al.</i>                     | (EPOL, SACL, AMST)          |
| RITTENBERG  | 65  | PRL 15 556                   | A. Rittenberg, G.R. Kalbfleisch             | (LRL, BNL)                  |
| DAUBER      | 64  | PRL 13 449                   | P.M. Dauber <i>et al.</i>                   | (UCLA) JP                   |
| KALBFLEISCH | 64B | PRL 13 349                   | G.R. Kalbfleisch, O.I. Dahl, A. Rittenberg  | (LRL) JP                    |

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NODE=M003

$f_0(980)$

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

See also the minireview on scalar mesons under  $f_0(500)$ . (See the index for the page number.)

NODE=M003

### $f_0(980)$ MASS

NODE=M003M1

| VALUE (MeV)                                                                   | EVTS         | DOCUMENT ID                   | TECN     | COMMENT                                                 |
|-------------------------------------------------------------------------------|--------------|-------------------------------|----------|---------------------------------------------------------|
| <b>990 <math>\pm 20</math> OUR ESTIMATE</b>                                   |              |                               |          |                                                         |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |              |                               |          |                                                         |
| 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 | $J/\psi \rightarrow \gamma 3\pi$                        |
| 1003 $^{+5}_{-27}$                                                            |              | <sup>1,2</sup> GARCIA-MAR..11 | RVUE     | Compilation                                             |
| 996 $\pm 7$                                                                   |              | <sup>1,3</sup> GARCIA-MAR..11 | RVUE     | Compilation                                             |
| 996 $^{+4}_{-14}$                                                             |              | <sup>4</sup> MOUSSALLAM11     | RVUE     | Compilation                                             |
| 981 $\pm 43$                                                                  |              | <sup>5</sup> MENNESSIER 10    | RVUE     | Compilation                                             |
| 1030 $^{+30}_{-10}$                                                           |              | <sup>6</sup> ANISOVICH 09     | RVUE     | 0.0 $\bar{p}p, \pi N$                                   |
| 977 $^{+11}_{-9} \pm 1$                                                       | 44           | <sup>7</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>8</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>9</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>10</sup> AMBROSINO 07    | KLOE     | 1.02 $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$           |
| 973 $\pm 3$                                                                   | 262 $\pm 30$ | <sup>11</sup> AUBERT          | 07AkBABR | 10.6 $e^+ e^- \rightarrow \phi \pi^+ \pi^- \gamma$      |
| 970 $\pm 7$                                                                   | 54 $\pm 9$   | <sup>11</sup> AUBERT          | 07AkBABR | 10.6 $e^+ e^- \rightarrow \phi \pi^0 \pi^0 \gamma$      |
| 953 $\pm 20$                                                                  | 2.6k         | <sup>12</sup> BONVICINI 07    | CLEO     | $D^+ \rightarrow \pi^- \pi^+ \pi^+$                     |
| 985.6 $^{+1.2}_{-1.5} {}^{+1.1}_{-1.6}$                                       |              | <sup>13</sup> MORI 07         | BELL     | 10.6 $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^-$          |
| 983.0 $\pm 0.6^{+4.0}_{-3.0}$                                                 |              | <sup>14</sup> AMBROSINO 06B   | KLOE     | 1.02 $e^+ e^- \rightarrow \pi^+ \pi^- \gamma$           |

OCCUR=2

OCCUR=2

OCCUR=2

NODE=M003M1  
→ UNCHECKED ←

|                                          |      |       |             |     |      |                                                                                                                                                  |         |
|------------------------------------------|------|-------|-------------|-----|------|--------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 977.3 ± 0.9 <sup>+</sup> <sub>-4.3</sub> |      | 15    | AMBROSINO   | 06B | KLOE | 1.02 e <sup>+</sup> e <sup>-</sup> → π <sup>+</sup> π <sup>-</sup> γ                                                                             | OCCUR=2 |
| 950 ± 9                                  | 4286 | 16    | GARMASH     | 06  | BELL | B <sup>+</sup> → K <sup>+</sup> π <sup>+</sup> π <sup>-</sup>                                                                                    |         |
| 965 ± 10                                 |      | 17    | ABLIKIM     | 05  | BES2 | J/ψ → φπ <sup>+</sup> π <sup>-</sup> ,<br>φK <sup>+</sup> K <sup>-</sup>                                                                         |         |
| 1031 ± 8                                 |      | 18    | ANISOVICH   | 03  | RVUE |                                                                                                                                                  |         |
| 1037 ± 31                                |      |       | TIKHOMIROV  | 03  | SPEC | 40.0 π <sup>-</sup> C → K <sub>S</sub> <sup>0</sup> K <sub>S</sub> <sup>0</sup> K <sub>L</sub> <sup>0</sup> X                                    |         |
| 973 ± 1                                  | 2438 | 19    | ALOISIO     | 02D | KLOE | e <sup>+</sup> e <sup>-</sup> → π <sup>0</sup> π <sup>0</sup> γ                                                                                  |         |
| 977 ± 3 ± 2                              | 848  | 20    | AITALA      | 01A | E791 | D <sup>+</sup> → π <sup>-</sup> π <sup>+</sup> π <sup>+</sup>                                                                                    |         |
| 969.8 ± 4.5                              | 419  | 21    | ACHASOV     | 00H | SND  | e <sup>+</sup> e <sup>-</sup> → π <sup>0</sup> π <sup>0</sup> γ                                                                                  |         |
| 985 <sup>+</sup> <sub>-12</sub>          | 419  | 22,23 | ACHASOV     | 00H | SND  | e <sup>+</sup> e <sup>-</sup> → π <sup>0</sup> π <sup>0</sup> γ                                                                                  | OCCUR=2 |
| 976 ± 5 ± 6                              |      | 24    | AKHMETSHIN  | 99B | CMD2 | e <sup>+</sup> e <sup>-</sup> → π <sup>+</sup> π <sup>-</sup> γ                                                                                  |         |
| 977 ± 3 ± 6                              | 268  | 24    | AKHMETSHIN  | 99C | CMD2 | e <sup>+</sup> e <sup>-</sup> → π <sup>0</sup> π <sup>0</sup> γ                                                                                  |         |
| 975 ± 4 ± 6                              |      | 25    | AKHMETSHIN  | 99C | CMD2 | e <sup>+</sup> e <sup>-</sup> → π <sup>0</sup> π <sup>0</sup> γ                                                                                  | OCCUR=2 |
| 975 ± 4 ± 6                              |      | 26    | AKHMETSHIN  | 99C | CMD2 | e <sup>+</sup> e <sup>-</sup> → π <sup>+</sup> π <sup>-</sup> γ,<br>π <sup>0</sup> π <sup>0</sup> γ                                              | OCCUR=3 |
| 985 ± 10                                 |      |       | BARBERIS    | 99  | OMEG | 450 pp → p <sub>S</sub> p <sub>f</sub> K <sup>+</sup> K <sup>-</sup>                                                                             |         |
| 982 ± 3                                  |      |       | BARBERIS    | 99B | OMEG | 450 pp → p <sub>S</sub> p <sub>f</sub> π <sup>+</sup> π <sup>-</sup>                                                                             |         |
| 982 ± 3                                  |      |       | BARBERIS    | 99C | OMEG | 450 pp → p <sub>S</sub> p <sub>f</sub> π <sup>0</sup> π <sup>0</sup>                                                                             |         |
| 987 ± 6 ± 6                              |      | 27    | BARBERIS    | 99D | OMEG | 450 pp → K <sup>+</sup> K <sup>-</sup> ,<br>π <sup>+</sup> π <sup>-</sup>                                                                        |         |
| 989 ± 15                                 |      |       | BELLAZZINI  | 99  | GAM4 | 450 pp → ppπ <sup>0</sup> π <sup>0</sup>                                                                                                         |         |
| 991 ± 3                                  |      | 28    | KAMINSKI    | 99  | RVUE | ππ → ππ, K <sup>-</sup> K <sup>-</sup> , σσ                                                                                                      |         |
| ~ 980                                    |      | 28    | OLLER       | 99  | RVUE | ππ → ππ, K <sup>-</sup> K <sup>-</sup>                                                                                                           |         |
| ~ 993.5                                  |      |       | OLLER       | 99B | RVUE | ππ → ππ, K <sup>-</sup> K <sup>-</sup>                                                                                                           |         |
| ~ 987                                    |      | 28    | OLLER       | 99C | RVUE | ππ → ππ, K <sup>-</sup> K <sup>-</sup> , ηη                                                                                                      |         |
| 957 ± 6                                  |      | 29    | ACKERSTAFF  | 98Q | OPAL | Z → f <sub>0</sub> X                                                                                                                             |         |
| 960 ± 10                                 |      |       | ALDE        | 98  | GAM4 |                                                                                                                                                  |         |
| 1015 ± 15                                |      | 28    | ANISOVICH   | 98B | RVUE | Compilation                                                                                                                                      |         |
| 1008                                     |      | 30    | LOCHER      | 98  | RVUE | ππ → ππ, K <sup>-</sup> K <sup>-</sup>                                                                                                           |         |
| 955 ± 10                                 |      | 29    | ALDE        | 97  | GAM2 | 450 pp → ppπ <sup>0</sup> π <sup>0</sup>                                                                                                         |         |
| 994 ± 9                                  |      | 31    | BERTIN      | 97C | OBLX | 0.0 p̄p → π <sup>+</sup> π <sup>-</sup> π <sup>0</sup>                                                                                           |         |
| 993.2 ± 6.5 ± 6.9                        |      | 32    | ISHIDA      | 96  | RVUE | ππ → ππ, K <sup>-</sup> K <sup>-</sup>                                                                                                           |         |
| 1006                                     |      |       | TORNQVIST   | 96  | RVUE | ππ → ππ, K <sup>-</sup> K <sup>-</sup> , Kπ,<br>ηπ                                                                                               |         |
| 997 ± 5                                  | 3k   | 33    | ALDE        | 95B | GAM2 | 38 π <sup>-</sup> p → π <sup>0</sup> π <sup>0</sup> n                                                                                            |         |
| 960 ± 10                                 | 10k  | 34    | ALDE        | 95B | GAM2 | 38 π <sup>-</sup> p → π <sup>0</sup> π <sup>0</sup> n                                                                                            | OCCUR=2 |
| 994 ± 5                                  |      |       | AMSLER      | 95B | CBAR | 0.0 p̄p → 3π <sup>0</sup>                                                                                                                        |         |
| ~ 996                                    |      | 35    | AMSLER      | 95D | CBAR | 0.0 p̄p → π <sup>0</sup> π <sup>0</sup> π <sup>0</sup> ,<br>π <sup>0</sup> ηη, π <sup>0</sup> π <sup>0</sup> η                                   |         |
| 987 ± 6                                  |      | 36    | ANISOVICH   | 95  | RVUE |                                                                                                                                                  |         |
| 1015                                     |      |       | JANSSEN     | 95  | RVUE | ππ → ππ, K <sup>-</sup> K <sup>-</sup>                                                                                                           |         |
| 983                                      |      | 37    | BUGG        | 94  | RVUE | p̄p → η2π <sup>0</sup>                                                                                                                           |         |
| 973 ± 2                                  |      | 38    | KAMINSKI    | 94  | RVUE | ππ → ππ, K <sup>-</sup> K <sup>-</sup>                                                                                                           |         |
| 988                                      |      | 39    | ZOU         | 94B | RVUE |                                                                                                                                                  |         |
| 988 ± 10                                 |      | 40    | MORGAN      | 93  | RVUE | ππ(K <sup>-</sup> K <sup>-</sup> ) → ππ(K <sup>-</sup> K <sup>-</sup> ),<br>J/ψ → φππ(K <sup>-</sup> K <sup>-</sup> ),<br>D <sub>S</sub> → π(ππ) |         |
| 971.1 ± 4.0                              |      | 29    | AGUILAR-... | 91  | EHS  | 400 pp                                                                                                                                           |         |
| 979 ± 4                                  |      | 41    | ARMSTRONG   | 91  | OMEG | 300 pp → ppππ,<br>ppK <sup>-</sup> K <sup>-</sup>                                                                                                |         |
| 956 ± 12                                 |      |       | BREAKSTONE  | 90  | SFM  | pp → ppπ <sup>+</sup> π <sup>-</sup>                                                                                                             |         |
| 959.4 ± 6.5                              |      | 29    | AUGUSTIN    | 89  | DM2  | J/ψ → ωπ <sup>+</sup> π <sup>-</sup>                                                                                                             |         |
| 978 ± 9                                  |      | 29    | ABACHI      | 86B | HRS  | e <sup>+</sup> e <sup>-</sup> → π <sup>+</sup> π <sup>-</sup> X                                                                                  |         |
| 985.0 <sup>+</sup> <sub>-39.0</sub>      |      |       | ETKIN       | 82B | MPS  | 23 π <sup>-</sup> p → n2K <sub>S</sub> <sup>0</sup>                                                                                              |         |
| 974 ± 4                                  |      | 41    | GIDAL       | 81  | MRK2 | J/ψ → π <sup>+</sup> π <sup>-</sup> X                                                                                                            |         |
| 975                                      |      | 42    | ACHASOV     | 80  | RVUE |                                                                                                                                                  |         |
| 986 ± 10                                 |      | 41    | AGUILAR-... | 78  | HBC  | 0.7 p̄p → K <sub>S</sub> <sup>0</sup> K <sub>S</sub> <sup>0</sup>                                                                                |         |
| 969 ± 5                                  |      | 41    | LEEPER      | 77  | ASPK | 2-2.4 π <sup>-</sup> p →<br>π <sup>+</sup> π <sup>-</sup> n, K <sup>+</sup> K <sup>-</sup> n                                                     |         |
| 987 ± 7                                  |      | 41    | BINNIE      | 73  | CNTR | π <sup>-</sup> p → nMM                                                                                                                           |         |
| 1012 ± 6                                 |      | 43    | GRAYER      | 73  | ASPK | 17 π <sup>-</sup> p → π <sup>+</sup> π <sup>-</sup> n                                                                                            |         |
| 1007 ± 20                                |      | 43    | HYAMS       | 73  | ASPK | 17 π <sup>-</sup> p → π <sup>+</sup> π <sup>-</sup> n                                                                                            |         |
| 997 ± 6                                  |      | 43    | PROTOPOP... | 73  | HBC  | 7 π <sup>+</sup> p → π <sup>+</sup> pπ <sup>+</sup> π <sup>-</sup>                                                                               |         |

- <sup>1</sup> Quoted number refers to real part of pole position.
- <sup>2</sup> Analytic continuation using Roy equations. Uses the  $K_{e4}$  data of BATLEY 10C and the  $\pi N \rightarrow \pi\pi N$  data of HYAMS 73, GRAYER 74, and PROTOPODESCU 73.
- <sup>3</sup> Analytic continuation using GKPY equations. Uses the  $K_{e4}$  data of BATLEY 10C and the  $\pi N \rightarrow \pi\pi N$  data of HYAMS 73, GRAYER 74, and PROTOPODESCU 73.
- <sup>4</sup> Pole position. Used Roy equations.
- <sup>5</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>6</sup> On sheet II in a 2-pole solution. The other pole is found on sheet III at  $(850-100i)$  MeV
- <sup>7</sup> Using a relativistic Breit-Wigner function and taking into account the finite  $D_s$  mass.
- <sup>8</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>9</sup> In the kaon-loop fit.
- <sup>10</sup> In the no-structure fit.
- <sup>11</sup> Systematic errors not estimated.
- <sup>12</sup> FLATTE 76 parameterization.  $g_{f_0 \pi \pi} = 329 \pm 96$  MeV/c<sup>2</sup> assuming  $g_{f_0 K \bar{K}}/g_{f_0 \pi \pi} = 2$ .
- <sup>13</sup> Breit-Wigner mass. Using finite width corrections according to FLATTE 76 and ACHASOV 05, and the ratio  $g_{f_0 K K}/g_{f_0 \pi \pi} = 4.21 \pm 0.25 \pm 0.21$  from ABLIKIM 05.
- <sup>14</sup> In the kaon-loop fit following formalism of ACHASOV 89.
- <sup>15</sup> In the no-structure fit assuming a direct coupling of  $\phi$  to  $f_0 \gamma$ .
- <sup>16</sup> FLATTE 76 parameterization. Supersedes GARMASH 05.
- <sup>17</sup> FLATTE 76 parameterization,  $g_{f_0 K \bar{K}}/g_{f_0 \pi \pi} = 4.21 \pm 0.25 \pm 0.21$ .
- <sup>18</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>19</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.
- <sup>20</sup> Coupled-channel Breit-Wigner, couplings  $g_\pi = 0.09 \pm 0.01 \pm 0.01$ ,  $g_K = 0.02 \pm 0.04 \pm 0.03$ .
- <sup>21</sup> Supersedes ACHASOV 98i. Using the model of ACHASOV 89.
- <sup>22</sup> Supersedes ACHASOV 98i.
- <sup>23</sup> In the “narrow resonance” approximation.
- <sup>24</sup> Assuming  $\Gamma(f_0) = 40$  MeV.
- <sup>25</sup> From a narrow pole fit taking into account  $f_0(980)$  and  $f_0(1200)$  intermediate mechanisms.
- <sup>26</sup> From the combined fit of the photon spectra in the reactions  $e^+ e^- \rightarrow \pi^+ \pi^- \gamma$ ,  $\pi^0 \pi^0 \gamma$ .
- <sup>27</sup> Supersedes BARBERIS 99 and BARBERIS 99B
- <sup>28</sup> T-matrix pole.
- <sup>29</sup> From invariant mass fit.
- <sup>30</sup> On sheet II in a 2 pole solution. The other pole is found on sheet III at  $(1039-93i)$  MeV.
- <sup>31</sup> On sheet II in a 2 pole solution. The other pole is found on sheet III at  $(963-29i)$  MeV.
- <sup>32</sup> Reanalysis of data from HYAMS 73, GRAYER 74, SRINIVASAN 75, and ROSSELET 77 using the interfering amplitude method.
- <sup>33</sup> At high  $|t|$ .
- <sup>34</sup> At low  $|t|$ .
- <sup>35</sup> 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.
- <sup>36</sup> Combined fit of ALDE 95B, ANISOVICH 94, AMSLER 94D.
- <sup>37</sup> On sheet II in a 2 pole solution. The other pole is found on sheet III at  $(996-103i)$  MeV.
- <sup>38</sup> From sheet II pole position.
- <sup>39</sup> 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.
- <sup>40</sup> On sheet II in a 2 pole solution. The other pole is found on sheet III at  $(978-28i)$  MeV.
- <sup>41</sup> From coupled channel analysis.
- <sup>42</sup> Coupled channel analysis with finite width corrections.
- <sup>43</sup> Included in AGUILAR-BENITEZ 78 fit.

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 NODE=M003M1;LINKAGE=MU  
 NODE=M003M1;LINKAGE=ME  
  
 NODE=M003M1;LINKAGE=AO  
 NODE=M003M1;LINKAGE=EC  
 NODE=M003M1;LINKAGE=UE  
  
 NODE=M003M1;LINKAGE=AK  
 NODE=M003M1;LINKAGE=AS  
 NODE=M003M1;LINKAGE=NS  
  
 NODE=M003M1;LINKAGE=BO  
 NODE=M003M1;LINKAGE=MO  
  
 NODE=M003M1;LINKAGE=AB  
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 NODE=M003M1;LINKAGE=KM  
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 NODE=M003M1;LINKAGE=K  
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 NODE=M003M1;LINKAGE=B  
 NODE=M003M1;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

NODE=M003W1

→ UNCHECKED ←

VALUE (MeV) EVTS DOCUMENT ID TECN COMMENT

### 10 to 100 OUR ESTIMATE

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

|                                                                               |          |                    |     |      |                                                                                                                        |         |
|-------------------------------------------------------------------------------|----------|--------------------|-----|------|------------------------------------------------------------------------------------------------------------------------|---------|
| 15.3 ± 4.7                                                                    | 424      | ABLIKIM            | 15P | BES3 | $J/\psi \rightarrow K^+ K^- 3\pi$                                                                                      | OCCUR=2 |
| 9.5 ± 1.1                                                                     | 706      | ABLIKIM            | 12E | BES3 | $J/\psi \rightarrow \gamma 3\pi$                                                                                       |         |
| 42 + <sup>20</sup> / <sub>-16</sub>                                           |          | 1,2 GARCIA-MAR..11 |     | RVUE | Compilation                                                                                                            | OCCUR=2 |
| 50 + <sup>20</sup> / <sub>-12</sub>                                           |          | 2,3 GARCIA-MAR..11 |     | RVUE | Compilation                                                                                                            |         |
| 48 + <sup>22</sup> / <sub>-6</sub>                                            |          | 4 MOUSSALLAM11     |     | RVUE | Compilation                                                                                                            | OCCUR=2 |
| 36 ± 22                                                                       |          | 5 MENNESSIER 10    |     | RVUE | Compilation                                                                                                            |         |
| 70 + <sup>20</sup> / <sub>-32</sub>                                           |          | 6 ANISOVICH 09     |     | RVUE | 0.0 $\bar{p}p$ , $\pi N$                                                                                               | OCCUR=2 |
| 91 + <sup>30</sup> / <sub>-22</sub> ± 3                                       | 44       | 7 ECKLUND 09       |     | CLEO | 4.17 $e^+ e^- \rightarrow D_s^- D_s^{*+} + \text{c.c.}$                                                                |         |
| 66.9 ± 2.2 + <sup>17.6</sup> / <sub>-12.5</sub>                               |          | 8 UEHARA 08A       |     | BELL | 10.6 $e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$                                                                         | OCCUR=2 |
| 65 ± 13                                                                       | 262 ± 30 | 9 AUBERT 07AK      |     | BABR | 10.6 $e^+ e^- \rightarrow \phi \pi^+ \pi^- \gamma$                                                                     |         |
| 81 ± 21                                                                       | 54 ± 9   | 9 AUBERT 07AK      |     | BABR | 10.6 $e^+ e^- \rightarrow \phi \pi^0 \pi^0 \gamma$                                                                     | OCCUR=2 |
| 51.3 + <sup>20.8</sup> / <sub>-17.7</sub> + <sup>13.2</sup> / <sub>-3.8</sub> |          | 10 MORI 07         |     | BELL | 10.6 $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^-$                                                                         |         |
| 61 ± 9 + <sup>14</sup> / <sub>-8</sub>                                        | 2584     | 11 GARMASH 05      |     | BELL | $B^+ \rightarrow K^+ \pi^+ \pi^-$                                                                                      | OCCUR=2 |
| 64 ± 16                                                                       |          | 12 ANISOVICH 03    |     | RVUE |                                                                                                                        |         |
| 121 ± 23                                                                      |          | TIKHOMIROV 03      |     | SPEC | 40.0 $\pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$                                                                         | OCCUR=2 |
| ~ 70                                                                          |          | 13 BRAMON 02       |     | RVUE | 1.02 $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$                                                                          |         |
| 44 ± 2 ± 2                                                                    | 848      | 14 AITALA 01A      |     | E791 | $D_s^+ \rightarrow \pi^- \pi^+ \pi^+$                                                                                  | OCCUR=2 |
| 201 ± 28                                                                      | 419      | 15 ACHASOV 00H     |     | SND  | $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$                                                                               |         |
| 122 ± 13                                                                      | 419      | 16,17 ACHASOV 00H  |     | SND  | $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$                                                                               | OCCUR=2 |
| 56 ± 20                                                                       |          | 18 AKHMETSHIN 99C  |     | CMD2 | $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$                                                                               |         |
| 65 ± 20                                                                       |          | BARBERIS 99        |     | OMEG | 450 $pp \rightarrow p_S p_f K^+ K^-$                                                                                   | OCCUR=2 |
| 80 ± 10                                                                       |          | BARBERIS 99B       |     | OMEG | 450 $pp \rightarrow p_S p_f \pi^+ \pi^-$                                                                               |         |
| 80 ± 10                                                                       |          | BARBERIS 99C       |     | OMEG | 450 $pp \rightarrow p_S p_f \pi^0 \pi^0$                                                                               | OCCUR=2 |
| 48 ± 12 ± 8                                                                   |          | 19 BARBERIS 99D    |     | OMEG | 450 $pp \rightarrow K^+ K^-, \pi^+ \pi^-$                                                                              |         |
| 65 ± 25                                                                       |          | BELLAZZINI 99      |     | GAM4 | 450 $pp \rightarrow pp \pi^0 \pi^0$                                                                                    | OCCUR=2 |
| 71 ± 14                                                                       |          | 20 KAMINSKI 99     |     | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}, \sigma\sigma$                                                                    |         |
| ~ 28                                                                          |          | 20 OLLER 99        |     | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                                                                  | OCCUR=2 |
| ~ 25                                                                          |          | OLLER 99B          |     | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                                                                  |         |
| ~ 14                                                                          |          | 20 OLLER 99C       |     | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}, \eta\eta$                                                                        | OCCUR=2 |
| 70 ± 20                                                                       |          | ALDE 98            |     | GAM4 |                                                                                                                        |         |
| 86 ± 16                                                                       |          | 20 ANISOVICH 98B   |     | RVUE | Compilation                                                                                                            | OCCUR=2 |
| 54                                                                            |          | 21 LOCHER 98       |     | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                                                                  |         |
| 69 ± 15                                                                       |          | 22 ALDE 97         |     | GAM2 | 450 $pp \rightarrow pp \pi^0 \pi^0$                                                                                    | OCCUR=2 |
| 38 ± 20                                                                       |          | 23 BERTIN 97C      |     | OBLX | 0.0 $\bar{p}p \rightarrow \pi^+ \pi^- \pi^0$                                                                           |         |
| ~ 100                                                                         |          | 24 ISHIDA 96       |     | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                                                                  | OCCUR=2 |
| 34                                                                            |          | TORNQVIST 96       |     | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi, \eta\pi$                                                                   |         |
| 48 ± 10                                                                       | 3k       | 25 ALDE 95B        |     | GAM2 | 38 $\pi^- p \rightarrow \pi^0 \pi^0 n$                                                                                 | OCCUR=2 |
| 95 ± 20                                                                       | 10k      | 26 ALDE 95B        |     | GAM2 | 38 $\pi^- p \rightarrow \pi^0 \pi^0 n$                                                                                 |         |
| 26 ± 10                                                                       |          | AMSLER 95B         |     | CBAR | 0.0 $\bar{p}p \rightarrow 3\pi^0$                                                                                      | OCCUR=2 |
| ~ 112                                                                         |          | 27 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                                                                       |          | 28 ANISOVICH 95    |     | RVUE |                                                                                                                        | OCCUR=2 |
| 30                                                                            |          | JANSSEN 95         |     | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                                                                  |         |
| 74                                                                            |          | 29 BUGG 94         |     | RVUE | $\bar{p}p \rightarrow \eta 2\pi^0$                                                                                     | OCCUR=2 |
| 29 ± 2                                                                        |          | 30 KAMINSKI 94     |     | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                                                                  |         |
| 46                                                                            |          | 31 ZOU 94B         |     | RVUE |                                                                                                                        | OCCUR=2 |
| 48 ± 12                                                                       |          | 32 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                                                                   |          | 22 AGUILAR-... 91  |     | EHS  | 400 $pp$                                                                                                               | OCCUR=2 |
| 72 ± 8                                                                        |          | 33 ARMSTRONG 91    |     | OMEG | 300 $pp \rightarrow pp\pi\pi, ppK\bar{K}$                                                                              |         |

|                |                |         |                                                  |
|----------------|----------------|---------|--------------------------------------------------|
| 110 ± 30       | BREAKSTONE90   | SFM     | $pp \rightarrow pp\pi^+\pi^-$                    |
| 29 ± 13        | 22 ABACHI      | 86B HRS | $e^+e^- \rightarrow \pi^+\pi^-X$                 |
| 120 ± 281 ± 20 | ETKIN          | 82B MPS | $23 \pi^- p \rightarrow n2K_S^0$                 |
| 28 ± 10        | 33 GIDAL       | 81 MRK2 | $J/\psi \rightarrow \pi^+\pi^-X$                 |
| 70 to 300      | 34 ACHASOV     | 80 RVUE |                                                  |
| 100 ± 80       | 35 AGUILAR-... | 78 HBC  | $0.7 \bar{p}p \rightarrow K_S^0 K_S^0$           |
| 30 ± 8         | 33 LEEPER      | 77 ASPK | $2-2.4 \pi^- p \rightarrow \pi^+\pi^-n, K^+K^-n$ |
| 48 ± 14        | 33 BINNIE      | 73 CNTR | $\pi^- p \rightarrow nMM$                        |
| 32 ± 10        | 36 GRAYER      | 73 ASPK | $17 \pi^- p \rightarrow \pi^+\pi^-n$             |
| 30 ± 10        | 36 HYAMS       | 73 ASPK | $17 \pi^- p \rightarrow \pi^+\pi^-n$             |
| 54 ± 16        | 36 PROTOPOP... | 73 HBC  | $7 \pi^+ p \rightarrow \pi^+ p\pi^+\pi^-$        |

<sup>1</sup> Analytic continuation using Roy equations. Uses the  $K_{e4}$  data of BATLEY 10C and the  $\pi N \rightarrow \pi\pi N$  data of HYAMS 73, GRAYER 74, and PROTOPODESCU 73.

<sup>2</sup> Quoted number refers to twice imaginary part of pole position.

<sup>3</sup> Analytic continuation using GKPY equations. Uses the  $K_{e4}$  data of BATLEY 10C and the  $\pi N \rightarrow \pi\pi N$  data of HYAMS 73, GRAYER 74, and PROTOPODESCU 73.

<sup>4</sup> Pole position. Used Roy equations.

<sup>5</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>6</sup> On sheet II in a 2-pole solution. The other pole is found on sheet III at (850–100i) MeV

<sup>7</sup> Using a relativistic Breit-Wigner function and taking into account the finite  $D_s$  mass.

<sup>8</sup> Breit-Wigner  $\pi\pi$  width. Using finite width corrections according to FLATTE 76 and ACHASOV 05, and the ratio  $g_{f_0 K K}/g_{f_0 \pi\pi} = 0$ .

<sup>9</sup> Systematic errors not estimated.

<sup>10</sup> Breit-Wigner  $\pi\pi$  width. 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.

<sup>11</sup> Breit-Wigner, solution 1, PWA ambiguous.

<sup>12</sup> K-matrix pole from combined analysis of  $\pi^- p \rightarrow \pi^0 \pi^0 n$ ,  $\pi^- p \rightarrow K \bar{K} n$ ,  $\pi^+\pi^- \rightarrow \pi^+\pi^-$ ,  $\bar{p}p \rightarrow \pi^0 \pi^0 \pi^0$ ,  $\pi^0 \pi^0 \eta$ ,  $\pi^0 \pi^0 \eta$ ,  $\pi^+\pi^- \pi^0$ ,  $K^+K^- \pi^0$ ,  $K_S^0 K_S^0 \pi^0$ ,  $K^+K_S^0 \pi^-$  at rest,  $\bar{p}n \rightarrow \pi^- \pi^- \pi^+$ ,  $K_S^0 K^- \pi^0$ ,  $K_S^0 K_S^0 \pi^-$  at rest.

<sup>13</sup> Using the data of AKHMETSHIN 99C, ACHASOV 00H, and ALOISIO 02D.

<sup>14</sup> Breit-Wigner width.

<sup>15</sup> Supersedes ACHASOV 98i. Using the model of ACHASOV 89.

<sup>16</sup> Supersedes ACHASOV 98i.

<sup>17</sup> In the “narrow resonance” approximation.

<sup>18</sup> From the combined fit of the photon spectra in the reactions  $e^+e^- \rightarrow \pi^+\pi^-\gamma$ ,  $\pi^0 \pi^0 \gamma$ .

<sup>19</sup> Supersedes BARBERIS 99 and BARBERIS 99B

<sup>20</sup> T-matrix pole.

<sup>21</sup> On sheet II in a 2 pole solution. The other pole is found on sheet III at (1039–93i) MeV.

<sup>22</sup> From invariant mass fit.

<sup>23</sup> On sheet II in a 2 pole solution. The other pole is found on sheet III at (963–29i) MeV.

<sup>24</sup> Reanalysis of data from HYAMS 73, GRAYER 74, SRINIVASAN 75, and ROSSELET 77 using the interfering amplitude method.

<sup>25</sup> At high  $|t|$ .

<sup>26</sup> At low  $|t|$ .

<sup>27</sup> 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.

<sup>28</sup> Combined fit of ALDE 95B, ANISOVICH 94,

<sup>29</sup> On sheet II in a 2 pole solution. The other pole is found on sheet III at (996–103i) MeV.

<sup>30</sup> From sheet II pole position.

<sup>31</sup> 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.

<sup>32</sup> On sheet II in a 2 pole solution. The other pole is found on sheet III at (978–28i) MeV.

<sup>33</sup> From coupled channel analysis.

<sup>34</sup> Coupled channel analysis with finite width corrections.

<sup>35</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>36</sup> Included in AGUILAR-BENITEZ 78 fit.

NODE=M003W1;LINKAGE=GC

NODE=M003W1;LINKAGE=GI

NODE=M003W1;LINKAGE=GM

NODE=M003W1;LINKAGE=MU

NODE=M003W1;LINKAGE=ME

NODE=M003W1;LINKAGE=AO

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NODE=M003W;LINKAGE=B

NODE=M003W;LINKAGE=C

NODE=M003W;LINKAGE=R

**$f_0(980)$  DECAY MODES**

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $\pi\pi$       | seen                           |
| $\Gamma_2$ $K\bar{K}$     | seen                           |
| $\Gamma_3$ $\gamma\gamma$ | seen                           |
| $\Gamma_4$ $e^+e^-$       |                                |

NODE=M003215;NODE=M003

DESIG=2;OUR EVAL;→ UNCHECKED ←  
 DESIG=1;OUR EVAL;→ UNCHECKED ←  
 DESIG=5;OUR EVAL;→ UNCHECKED ←  
 DESIG=4

 **$f_0(980)$  PARTIAL WIDTHS**

| $\Gamma(\gamma\gamma)$ |             |      |         |  | $\Gamma_3$ |
|------------------------|-------------|------|---------|--|------------|
| VALUE (keV)            | DOCUMENT ID | TECN | COMMENT |  |            |

**0.31  $^{+0.05}_{-0.04}$  OUR AVERAGE**

|                                                                               |                           |     |      |                                                   |  |
|-------------------------------------------------------------------------------|---------------------------|-----|------|---------------------------------------------------|--|
| 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 $\pm 0.01$                                                               | <sup>5</sup> MENNESSIER   | 11  | RVUE |                                                   |  |
| 0.29 $\pm 0.21^{+0.02}_{-0.07}$                                               | <sup>6</sup> MOUSSALLAM   | 11  | RVUE | Compilation                                       |  |
| 0.42                                                                          | <sup>7,8</sup> PENNINGTON | 08  | RVUE | Compilation                                       |  |
| 0.10                                                                          | <sup>8,9</sup> PENNINGTON | 08  | RVUE | Compilation                                       |  |
| 0.28 $^{+0.09}_{-0.13}$                                                       | <sup>10</sup> BOGLIONE    | 99  | RVUE | $\gamma\gamma \rightarrow \pi^+\pi^-, \pi^0\pi^0$ |  |
| 0.29 $\pm 0.07 \pm 0.12$                                                      | <sup>11,12</sup> BOYER    | 90  | MRK2 | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-$             |  |
| 0.31 $\pm 0.14 \pm 0.09$                                                      | <sup>11,12</sup> MARSISKE | 90  | CBAL | $e^+e^- \rightarrow e^+e^-\pi^0\pi^0$             |  |
| 0.63 $\pm 0.14$                                                               | <sup>13</sup> MORGAN      | 90  | RVUE | $\gamma\gamma \rightarrow \pi^+\pi^-, \pi^0\pi^0$ |  |

<sup>1</sup> Using dispersive analysis with phases from GARCIA-MARTIN 11A and BUETTAKER 04 as input.<sup>2</sup> Using finite width corrections according to FLATTE 76 and ACHASOV 05, and the ratio  $g_{f_0} K K / g_{f_0} \pi\pi = 0$ .<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.<sup>4</sup> OEST 90 quote systematic errors  $^{+0.08}_{-0.18}$ . We use  $\pm 0.18$ . Observed 60 events.<sup>5</sup> Uses an analytic K-matrix model. Compilation.<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.<sup>7</sup> Solution A (preferred solution based on  $\chi^2$ -analysis).<sup>8</sup> Dispersion theory based amplitude analysis of BOYER 90, MARSISKE 90, BEHREND 92, and MORI 07.<sup>9</sup> Solution B (worse than solution A; still acceptable when systematic uncertainties are included).<sup>10</sup> Supersedes MORGAN 90.<sup>11</sup> From analysis allowing arbitrary background unconstrained by unitarity.<sup>12</sup> Data included in MORGAN 90, BOGLIONE 99 analyses.<sup>13</sup> From amplitude analysis of BOYER 90 and MARSISKE 90, data corresponds to resonance parameters  $m = 989$  MeV,  $\Gamma = 61$  MeV.

NODE=M003220

NODE=M003W4  
NODE=M003W4

OCCUR=2

NODE=M003W4;LINKAGE=D

NODE=M003W4;LINKAGE=UE

NODE=M003W4;LINKAGE=MO

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NODE=M003W4;LINKAGE=ME  
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NODE=M003W4;LINKAGE=P3

NODE=M003W4;LINKAGE=P2

NODE=M003W4;LINKAGE=BL  
NODE=M003W4;LINKAGE=B  
NODE=M003W4;LINKAGE=C  
NODE=M003W4;LINKAGE=A

| $\Gamma(e^+e^-)$ |     |             |      |         | $\Gamma_4$ |
|------------------|-----|-------------|------|---------|------------|
| VALUE (eV)       | CL% | DOCUMENT ID | TECN | COMMENT |            |

**<8.4** 90 VOROBYEV 88 ND  $e^+e^- \rightarrow \pi^0\pi^0$ NODE=M003W3  
NODE=M003W3 **$f_0(980)$  BRANCHING RATIOS**

| $\Gamma(\pi\pi)/[\Gamma(\pi\pi) + \Gamma(K\bar{K})]$ |     |             |      |         | $\Gamma_1/(\Gamma_1+\Gamma_2)$ |
|------------------------------------------------------|-----|-------------|------|---------|--------------------------------|
| VALUE                                                | EVS | DOCUMENT ID | TECN | COMMENT |                                |

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

|                         |      |                        |     |      |                                                                                   |
|-------------------------|------|------------------------|-----|------|-----------------------------------------------------------------------------------|
| 0.52 $\pm 0.12$         | 9.9k | <sup>1</sup> AUBERT    | 06O | BABR | $B^\pm \rightarrow K^\pm \pi^\pm \pi^\mp$                                         |
| 0.75 $^{+0.11}_{-0.13}$ |      | <sup>2</sup> ABLIKIM   | 05Q | BES2 | $\chi_{c0} \rightarrow 2\pi^+ 2\pi^-, \pi^+\pi^-\pi^+\pi^-, \pi^+\pi^-\pi^+\pi^-$ |
| 0.84 $\pm 0.02$         |      | <sup>3</sup> ANISOVICH | 02D | SPEC | Combined fit                                                                      |
| $\sim 0.68$             |      | OLLER                  | 99B | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                             |
| 0.67 $\pm 0.09$         |      | <sup>4</sup> LOVERRE   | 80  | HBC  | $4 \pi^- p \rightarrow n 2 K_S^0$                                                 |
| 0.81 $^{+0.09}_{-0.04}$ |      | <sup>4</sup> CASON     | 78  | STRC | $7 \pi^- p \rightarrow n 2 K_S^0$                                                 |
| 0.78 $\pm 0.03$         |      | <sup>4</sup> WETZEL    | 76  | OSPK | $8.9 \pi^- p \rightarrow n 2 K_S^0$                                               |

NODE=M003225

NODE=M003R1  
NODE=M003R1

- <sup>1</sup> Recalculated by us using  $\Gamma(K^+ K^-) / \Gamma(\pi^+ \pi^-) = 0.69 \pm 0.32$  from AUBERT 060 and isospin relations.
- <sup>2</sup> Using data from ABLIKIM 04G.
- <sup>3</sup> From a combined K-matrix analysis of Crystal Barrel ( $0. \rho \bar{p} \rightarrow \pi^0 \pi^0 \pi^0, \pi^0 \eta \eta, \pi^0 \pi^0 \eta$ ), 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>4</sup> Measure  $\pi\pi$  elasticity assuming two resonances coupled to the  $\pi\pi$  and  $K\bar{K}$  channels only.

NODE=M003R1;LINKAGE=AU

NODE=M003R1;LINKAGE=AB

NODE=M003R;LINKAGE=CH

NODE=M003R1;LINKAGE=B

NODE=M003

 **$f_0(980)$  REFERENCES**

|               |      |                              |                                                |                             |                     |
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| DAI           | 14A  | PR D90 036004                | L.-Y. Dai, M.R. Pennington                     | (CEBAF)                     | REFID=55923         |
| ABLIKIM       | 12E  | PRL 108 182001               | M. Ablikim <i>et al.</i>                       | (BES III Collab.)           | REFID=54270         |
| GARCIA-MAR... | 11   | PRL 107 072001               | R. Garcia-Martin <i>et al.</i>                 | (MADR, CRAC)                | REFID=16761         |
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| MENNESSIER    | 11   | PL B696 40                   | G. Mennessier, S. Narison, X.-G. Wang          |                             | REFID=53637         |
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| BATLEY        | 10C  | EPJ C70 635                  | J.R. Batley <i>et al.</i>                      | (CERN NA48/2 Collab.)       | REFID=53567         |
| MENNESSIER    | 10   | PL B688 59                   | G. Mennessier, S. Narison, X.-G. Wang          |                             | REFID=53657         |
| ANISOVICH     | 09   | IJMP A24 2481                | V.V. Anisovich, A.V. Sarantsev                 |                             | REFID=52719         |
| ECKLUND       | 09   | PR D80 052009                | K.M. Ecklund <i>et al.</i>                     | (CLEO Collab.)              | REFID=53041         |
| BATLEY        | 08A  | EPJ C54 411                  | J.R. Batley <i>et al.</i>                      | (CERN NA48/2 Collab.)       | REFID=52487         |
| PENNINGTON    | 08   | EPJ C56 1                    | M.R. Pennington <i>et al.</i>                  |                             | REFID=52303         |
| UEHARA        | 08A  | PR D78 052004                | S. Uehara <i>et al.</i>                        | (BELLE Collab.)             | REFID=52309         |
| AMBROSINO     | 07   | EPJ C49 473                  | F. Ambrosino <i>et al.</i>                     | (KLOE Collab.)              | REFID=51616         |
| AUBERT        | 07AK | PR D76 012008                | B. Aubert <i>et al.</i>                        | (BABAR Collab.)             | REFID=51908         |
| 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         |
| AMBROSINO     | 06B  | PL B634 148                  | F. Ambrosino <i>et al.</i>                     | (KLOE Collab.)              | REFID=51043         |
| AUBERT        | 06O  | PR D74 032003                | B. Aubert <i>et al.</i>                        | (BABAR Collab.)             | REFID=51141         |
| GARMASH       | 06   | PRL 96 251803                | A. Garmash <i>et al.</i>                       | (BELLE Collab.)             | REFID=51162         |
| 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         |
| ACHASOV       | 05   | PR D72 013006                | N.N. Achasov, G.N. Shestakov                   |                             | REFID=50762         |
| GARMASH       | 05   | PR D71 092003                | A. Garmash <i>et al.</i>                       | (BELLE Collab.)             | REFID=50641         |
| ABLIKIM       | 04G  | PR D70 092002                | M. Ablikim <i>et al.</i>                       | (BES Collab.)               | REFID=50187         |
| BUETTiker     | 04   | EPJ C33 409                  | P. Buettiker, S. Descotes-Genon, B. Moussallam |                             | REFID=56428;ERROR=6 |
| ANISOVICH     | 03   | EPJ A16 229                  | V.V. Anisovich <i>et al.</i>                   |                             | REFID=49401         |
| TIKHOMIROV    | 03   | PAN 66 828                   | G.D. Tikhomirov <i>et al.</i>                  |                             | REFID=49423         |
|               |      | Translated from YAF 66 860.  |                                                |                             |                     |
| ALOISIO       | 02D  | PL B537 21                   | A. Aloisio <i>et al.</i>                       | (KLOE Collab.)              | REFID=48824         |
| ANISOVICH     | 02D  | PAN 65 1545                  | V.V. Anisovich <i>et al.</i>                   |                             | REFID=48831         |
|               |      | Translated from YAF 65 1583. |                                                |                             |                     |
| BRAMON        | 02   | EPJ C26 253                  | A. Bramon <i>et al.</i>                        |                             | REFID=49178         |
| ACHASOV       | 01F  | PR D63 094007                | N.N. Achasov, V.V. Gubin                       | (Novosibirsk SND Collab.)   | REFID=48312         |
| AITALA        | 01A  | PRL 86 765                   | E.M. Aitala <i>et al.</i>                      | (FNAL E791 Collab.)         | REFID=48004         |
| AITALA        | 01B  | PRL 86 770                   | E.M. Aitala <i>et al.</i>                      | (FNAL E791 Collab.)         | REFID=48005         |
| ACHASOV       | 00H  | PL B485 349                  | M.N. Achasov <i>et al.</i>                     | (Novosibirsk SND Collab.)   | REFID=47930         |
| AKHMETSHIN    | 99B  | PL B462 371                  | R.R. Akhmetshin <i>et al.</i>                  | (Novosibirsk CMD-2 Collab.) | REFID=47392         |
| AKHMETSHIN    | 99C  | PL B462 380                  | R.R. Akhmetshin <i>et al.</i>                  | (Novosibirsk CMD-2 Collab.) | REFID=47393         |
| 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         |
| BARBERIS      | 99D  | PL B462 462                  | D. Barberis <i>et al.</i>                      | (Omega Expt.)               | REFID=47395         |
| BELLAZZINI    | 99   | PL B467 296                  | R. Bellazzini <i>et al.</i>                    |                             | REFID=47400         |
| BOGLIONE      | 99   | EPJ C9 11                    | M. Boglione, M.R. Pennington                   |                             | REFID=46931         |
| 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         |
| 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         |
| 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. |                                                |                             |                     |
| LOCHER        | 98   | EPJ C4 317                   | M.P. Locher <i>et al.</i>                      | (PSI)                       | REFID=46372         |
| ALDE          | 97   | PL B397 350                  | 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         |
| JANSSEN       | 95   | PR D52 2690                  | G. Janssen <i>et al.</i>                       | (STON, ADLD, 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         |
| BEHREND       | 92   | ZPHY C56 381                 | H.J. Behrend                                   | (CELLO Collab.)             | REFID=43172         |
| 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         |
| MORGAN        | 90   | ZPHY C48 623                 | D. Morgan, M.R. Pennington                     | (RAL, DURH)                 | REFID=41583         |
| 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         |
|               |      | Translated from YAF 48 436.  |                                                |                             |                     |



|             |     |                              |                                             |                          |
|-------------|-----|------------------------------|---------------------------------------------|--------------------------|
| ABACHI      | 86B | PRL 57 1990                  | S. Abachi <i>et al.</i>                     | (PURD, ANL, IND, MICH+)  |
| ETKIN       | 82B | PR D25 1786                  | A. Etkin <i>et al.</i>                      | (BNL, CUNY, TUFTS, VAND) |
| GIDAL       | 81  | PL 107B 153                  | G. Gidal <i>et al.</i>                      | (SLAC, LBL)              |
| ACHASOV     | 80  | SJNP 32 566                  | N.N. Achasov, S.A. Devyanin, G.N. Shestakov | (NOVM)                   |
|             |     | Translated from YAF 32 1098. |                                             |                          |
| COHEN       | 80  | PR D22 2595                  | D. Cohen <i>et al.</i>                      | (ANL) IJP                |
| LOVERRE     | 80  | ZPHY C6 187                  | P.F. Loverre <i>et al.</i>                  | (CERN, CDEF, MADR+) IJP  |
| AGUILAR...  | 78  | NP B140 73                   | M. Aguilar-Benitez <i>et al.</i>            | (MADR, BOMB+)            |
| CASON       | 78  | PRL 41 271                   | N.M. Cason <i>et al.</i>                    | (NDAM, ANL)              |
| LEEPER      | 77  | PR D16 2054                  | R.J. Leeper <i>et al.</i>                   | (ISU)                    |
| ROSSELET    | 77  | PR D15 574                   | L. Rosselet <i>et al.</i>                   | (GEVA, SACL)             |
| FLATTE      | 76  | PL 63B 224                   | S.M. Flatte                                 | (CERN)                   |
| WETZEL      | 76  | NP B115 208                  | W. Wetzel <i>et al.</i>                     | (ETH, CERN, LOIC)        |
| SRINIVASAN  | 75  | PR D12 681                   | V. Srinivasan <i>et al.</i>                 | (NDAM, ANL)              |
| GRAYER      | 74  | NP B75 189                   | G. Grayer <i>et al.</i>                     | (CERN, MPIM)             |
| BINNIE      | 73  | PRL 31 1534                  | D.M. Binnie <i>et al.</i>                   | (LOIC, SHMP)             |
| GRAYER      | 73  | Tallahassee                  | G. Grayer <i>et al.</i>                     | (CERN, MPIM)             |
| HYAMS       | 73  | NP B64 134                   | B.D. Hyams <i>et al.</i>                    | (CERN, MPIM)             |
| PROTOPOP... | 73  | PR D7 1279                   | S.D. Protopopescu <i>et al.</i>             | (LBL)                    |

REFID=20394  
REFID=20390  
REFID=20386  
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REFID=20368  
REFID=20370  
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REFID=20446  
REFID=20362  
REFID=21062  
REFID=20113  
REFID=20343  
REFID=20347  
REFID=20107  
REFID=20108

NODE=M036

**$a_0(980)$**

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

See our minireview on scalar mesons under  $f_0(500)$ . (See the index for the page number.)

NODE=M036

### $a_0(980)$ MASS

NODE=M036205

VALUE (MeV) DOCUMENT ID  
**980±20 OUR ESTIMATE** Mass determination very model dependent

NODE=M036MX  
→ UNCHECKED ←

#### $\eta\pi$ FINAL STATE ONLY

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID                | TECN | CHG    | COMMENT                                                |
|-------------------------------------------------------------------------------|-------|----------------------------|------|--------|--------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                            |      |        |                                                        |
| 982.5 ± 1.6 ± 1.1                                                             | 16.9k | <sup>1</sup> AMBROSINO     | 09F  | KLOE   | 1.02 $e^+e^- \rightarrow \eta\pi^0\gamma$              |
| 986 ± 4                                                                       |       | ANISOVICH                  | 09   | RVUE   | 0.0 $\bar{p}p, \pi N$                                  |
| 982.3 + 0.6 + 3.1<br>- 0.7 - 4.7                                              |       | <sup>2</sup> UEHARA        | 09A  | BELL   | $\gamma\gamma \rightarrow \pi^0\eta$                   |
| 987.4 ± 1.0 ± 3.0                                                             |       | <sup>3,4</sup> BUGG        | 08A  | RVUE 0 | $\bar{p}p \rightarrow \pi^0\pi^0\eta$                  |
| 989.1 ± 1.0 ± 3.0                                                             |       | <sup>4,5</sup> BUGG        | 08A  | RVUE 0 | $\bar{p}p \rightarrow \pi^0\pi^0\eta$                  |
| 985 ± 4 ± 6                                                                   | 318   | ACHARD                     | 02B  | L3     | 183-209 $e^+e^- \rightarrow e^+e^-\eta\pi^+\pi^-$      |
| 995 + 52<br>- 10                                                              | 36    | <sup>6</sup> ACHASOV       | 00F  | SND    | $e^+e^- \rightarrow \eta\pi^0\gamma$                   |
| 994 + 33<br>- 8                                                               | 36    | <sup>7</sup> ACHASOV       | 00F  | SND    | $e^+e^- \rightarrow \eta\pi^0\gamma$                   |
| 975 ± 7                                                                       |       | BARBERIS                   | 00H  |        | 450 $pp \rightarrow p_f\eta\pi^0p_s$                   |
| 988 ± 8                                                                       |       | BARBERIS                   | 00H  |        | 450 $pp \rightarrow \Delta_f^{++}\eta\pi^-p_s$         |
| ~ 1055                                                                        |       | <sup>8</sup> OLLER         | 99   | RVUE   | $\eta\pi, K\bar{K}$                                    |
| ~ 1009.2                                                                      |       | <sup>8</sup> OLLER         | 99B  | RVUE   | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                  |
| 993.1 ± 2.1                                                                   |       | <sup>9</sup> TEIGE         | 99   | B852   | 18.3 $\pi^-p \rightarrow \eta\pi^+\pi^-n$              |
| 988 ± 6                                                                       |       | <sup>8</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 ± 1.23 ± 0.34                                                          |       | AMSLER                     | 94C  | CBAR   | 0.0 $\bar{p}p \rightarrow \omega\eta\pi^0$             |
| 982 ± 2                                                                       |       | <sup>10</sup> AMSLER       | 92   | CBAR   | 0.0 $\bar{p}p \rightarrow \eta\eta\pi^0$               |
| 984 ± 4                                                                       | 1040  | <sup>10</sup> ARMSTRONG    | 91B  | OMEG ± | 300 $pp \rightarrow pp\eta\pi^+\pi^-$                  |
| 976 ± 6                                                                       |       | ATKINSON                   | 84E  | OMEG ± | 25-55 $\gamma p \rightarrow \eta\pi n$                 |
| 986 ± 3                                                                       | 500   | <sup>11</sup> EVANGELIS... | 81   | OMEG ± | 12 $\pi^-p \rightarrow \eta\pi^+\pi^-\pi^-p$           |
| 990 ± 7                                                                       | 145   | <sup>11</sup> GURTU        | 79   | HBC ±  | 4.2 $K^-p \rightarrow \Lambda\eta 2\pi$                |
| 980 ± 11                                                                      | 47    | CONFORTO                   | 78   | OSPK - | 4.5 $\pi^-p \rightarrow pX^-$                          |
| 978 ± 16                                                                      | 50    | CORDEN                     | 78   | OMEG ± | 12-15 $\pi^-p \rightarrow n\eta 2\pi$                  |
| 977 ± 7                                                                       |       | GRASSLER                   | 77   | HBC -  | 16 $\pi^\mp p \rightarrow p\eta 3\pi$                  |
| 989 ± 4                                                                       | 70    | WELLS                      | 75   | HBC -  | 3.1-6 $K^-p \rightarrow \Lambda\eta 2\pi$              |
| 972 ± 10                                                                      | 150   | DEFOIX                     | 72   | HBC ±  | 0.7 $\bar{p}p \rightarrow 7\pi$                        |
| 970 ± 15                                                                      | 20    | BARNES                     | 69C  | HBC -  | 4-5 $K^-p \rightarrow \Lambda\eta 2\pi$                |
| 980 ± 10                                                                      |       | CAMPBELL                   | 69   | DBC ±  | 2.7 $\pi^+d$                                           |
| 980 ± 10                                                                      | 15    | MILLER                     | 69B  | HBC -  | 4.5 $K^-N \rightarrow \eta\pi\Lambda$                  |
| 980 ± 10                                                                      | 30    | AMMAR                      | 68   | HBC ±  | 5.5 $K^-p \rightarrow \Lambda\eta 2\pi$                |

OCCUR=2

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- <sup>1</sup> Using the model of ACHASOV 89 and ACHASOV 03B.
- <sup>2</sup> From a fit with the S-wave amplitude including two interfering Breit-Wigners plus a background term.
- <sup>3</sup> Parameterizes couplings to  $\bar{K}K$ ,  $\pi\eta$ , and  $\pi\eta'$ .
- <sup>4</sup> Using AMSLER 94D and ABELE 98.
- <sup>5</sup> From the T-matrix pole on sheet II.
- <sup>6</sup> Using the model of ACHASOV 89. Supersedes ACHASOV 98B.
- <sup>7</sup> Using the model of JAFFE 77. Supersedes ACHASOV 98B.
- <sup>8</sup> T-matrix pole.
- <sup>9</sup> Breit-Wigner fit, average between  $a_0^\pm$  and  $a_0^0$ . The fit favors a slightly heavier  $a_0^\pm$ .
- <sup>10</sup> From a single Breit-Wigner fit.
- <sup>11</sup> From  $f_1(1285)$  decay.

 **$K\bar{K}$  ONLY**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN | CHG    | COMMENT                                              |
|-------------------------------------------------------------------------------|------|------------------------|------|--------|------------------------------------------------------|
| <b>925 ± 5 ± 8</b>                                                            | 190k | <sup>1</sup> AAIJ      | 16N  | LHCB   | $D^0 \rightarrow K_S^0 K^\pm \pi^\mp$                |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                        |      |        |                                                      |
| ~ 1053                                                                        |      | <sup>2</sup> OLLER     | 99C  | RVUE   | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                |
| 982 ± 3                                                                       |      | <sup>3</sup> ABELE     | 98   | CBAR   | $0.0 \bar{p}p \rightarrow K_L^0 K^\pm \pi^\mp$       |
| 975 ± 15                                                                      |      | BERTIN                 | 98B  | OBLX ± | $0.0 \bar{p}p \rightarrow K^\pm K_S \pi^\mp$         |
| 976 ± 6                                                                       | 316  | DEBILLY                | 80   | HBC ±  | $1.2\text{--}2 \bar{p}p \rightarrow f_1(1285)\omega$ |
| 1016 ± 10                                                                     | 100  | <sup>4</sup> ASTIER    | 67   | HBC ±  | $0.0 \bar{p}p$                                       |
| 1003.3 ± 7.0                                                                  | 143  | <sup>5</sup> ROSENFELD | 65   | RVUE ± |                                                      |

- <sup>1</sup> Using a two-channel resonance parametrization with couplings fixed to ABELE 98.
- <sup>2</sup> T-matrix pole.
- <sup>3</sup> T-matrix pole on sheet II, the pole on sheet III is at 1006-i49 MeV.
- <sup>4</sup> ASTIER 67 includes data of BARLOW 67, CONFORTO 67, ARMENTEROS 65.
- <sup>5</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. • • • |      |                                                                                                                        |      |            |                                                                |
| 75.6 $\pm$ 1.6 $\begin{smallmatrix} +17.4 \\ -10.0 \end{smallmatrix}$         |      | <sup>1</sup> UEHARA                                                                                                    | 09A  | BELL       | $\gamma\gamma \rightarrow \pi^0 \eta$                          |
| 80.2 $\pm$ 3.8 $\pm$ 5.4                                                      |      | <sup>2</sup> BUGG                                                                                                      | 08A  | RVUE 0     | $\bar{p}p \rightarrow \pi^0 \pi^0 \eta$                        |
| 50 $\pm$ 13 $\pm$ 4                                                           | 318  | ACHARD                                                                                                                 | 02B  | L3         | $183\text{--}209 e^+ e^- \rightarrow e^+ e^- \eta \pi^+ \pi^-$ |
| 72 $\pm$ 16                                                                   |      | BARBERIS                                                                                                               | 00H  |            | $450 p\bar{p} \rightarrow p_f \eta \pi^0 p_s$                  |
| 61 $\pm$ 19                                                                   |      | BARBERIS                                                                                                               | 00H  |            | $450 p\bar{p} \rightarrow \Delta_f^{++} \eta \pi^- p_s$        |
| $\sim$ 42                                                                     |      | <sup>3</sup> OLLER                                                                                                     | 99   | RVUE       | $\eta\pi, K\bar{K}$                                            |
| $\sim$ 112                                                                    |      | <sup>3</sup> OLLER                                                                                                     | 99B  | RVUE       | $\pi\pi \rightarrow \eta\pi, K\bar{K}$                         |
| 71 $\pm$ 7                                                                    |      | TEIGE                                                                                                                  | 99   | B852       | $18.3 \pi^- p \rightarrow \eta \pi^+ \pi^- n$                  |
| 92 $\pm$ 20                                                                   |      | <sup>3</sup> ANISOVICH                                                                                                 | 98B  | RVUE       | Compilation                                                    |
| 65 $\pm$ 10                                                                   |      | <sup>4</sup> BERTIN                                                                                                    | 98B  | OBLX $\pm$ | $0.0 \bar{p}p \rightarrow K^\pm K_S \pi^\mp$                   |
| $\sim$ 100                                                                    |      | TORNQVIST                                                                                                              | 96   | RVUE       | $\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi, \eta\pi$           |
| 202                                                                           |      | JANSSEN                                                                                                                | 95   | RVUE       | $\eta\pi \rightarrow \eta\pi, K\bar{K}, K\pi, \eta\pi$         |
| 54.12 $\pm$ 0.34 $\pm$ 0.12                                                   |      | AMSLER                                                                                                                 | 94C  | CBAR       | $0.0 \bar{p}p \rightarrow \omega \eta \pi^0$                   |
| 54 $\pm$ 10                                                                   |      | <sup>5</sup> AMSLER                                                                                                    | 92   | CBAR       | $0.0 \bar{p}p \rightarrow \eta \eta \pi^0$                     |
| 95 $\pm$ 14                                                                   | 1040 | <sup>5</sup> ARMSTRONG                                                                                                 | 91B  | OMEG $\pm$ | $300 p\bar{p} \rightarrow p\bar{p} \eta \pi^+ \pi^-$           |
| 62 $\pm$ 15                                                                   | 500  | <sup>6</sup> EVANGELIS...                                                                                              | 81   | OMEG $\pm$ | $12 \pi^- p \rightarrow \eta \pi^+ \pi^- \pi^- p$              |
| 60 $\pm$ 20                                                                   | 145  | <sup>6</sup> GURTU                                                                                                     | 79   | HBC $\pm$  | $4.2 K^- p \rightarrow \Lambda \eta 2\pi$                      |
| 60 $\begin{smallmatrix} +50 \\ -30 \end{smallmatrix}$                         | 47   | CONFORTO                                                                                                               | 78   | OSPK $-$   | $4.5 \pi^- p \rightarrow p X^-$                                |
| 86.0 $\begin{smallmatrix} +60.0 \\ -50.0 \end{smallmatrix}$                   | 50   | CORDEN                                                                                                                 | 78   | OMEG $\pm$ | $12\text{--}15 \pi^- p \rightarrow n \eta 2\pi$                |
| 44 $\pm$ 22                                                                   |      | GRASSLER                                                                                                               | 77   | HBC $-$    | $16 \pi^\mp p \rightarrow p \eta 3\pi$                         |
| 80 to 300                                                                     |      | <sup>7</sup> FLATTE                                                                                                    | 76   | RVUE $-$   | $4.2 K^- p \rightarrow \Lambda \eta 2\pi$                      |
| 16.0 $\begin{smallmatrix} +25.0 \\ -16.0 \end{smallmatrix}$                   | 70   | WELLS                                                                                                                  | 75   | HBC $-$    | $3.1\text{--}6 K^- p \rightarrow \Lambda \eta 2\pi$            |
| 30 $\pm$ 5                                                                    | 150  | DEFOIX                                                                                                                 | 72   | HBC $\pm$  | $0.7 \bar{p}p \rightarrow 7\pi$                                |
| 40 $\pm$ 15                                                                   |      | CAMPBELL                                                                                                               | 69   | DBC $\pm$  | $2.7 \pi^+ d$                                                  |
| 60 $\pm$ 30                                                                   | 15   | MILLER                                                                                                                 | 69B  | HBC $-$    | $4.5 K^- N \rightarrow \eta \pi \Lambda$                       |
| 80 $\pm$ 30                                                                   | 30   | AMMAR                                                                                                                  | 68   | HBC $\pm$  | $5.5 K^- p \rightarrow \Lambda \eta 2\pi$                      |

NODE=M036M1;LINKAGE=AM  
 NODE=M036M1;LINKAGE=UE

NODE=M036M1;LINKAGE=BP  
 NODE=M036M1;LINKAGE=BU  
 NODE=M036M1;LINKAGE=BT  
 NODE=M036M1;LINKAGE=V1  
 NODE=M036M1;LINKAGE=M2  
 NODE=M036M1;LINKAGE=AN

NODE=M036M1;LINKAGE=BF  
 NODE=M036M1;LINKAGE=A  
 NODE=M036M1;LINKAGE=R

NODE=M036M2  
 NODE=M036M2

NODE=M036M2;LINKAGE=B  
 NODE=M036M2;LINKAGE=AN  
 NODE=M036M2;LINKAGE=Q  
 NODE=M036M2;LINKAGE=A  
 NODE=M036M2;LINKAGE=S

NODE=M036210

NODE=M036W1  
 → UNCHECKED ←

OCCUR=2

- <sup>1</sup> From a fit with the S-wave amplitude including two interfering Breit-Wigners plus a background term.  
<sup>2</sup> From the T-matrix pole on sheet II, using AMSLER 94D and ABELE 98.  
<sup>3</sup> T-matrix pole.  
<sup>4</sup> The  $\eta\pi$  width.  
<sup>5</sup> From a single Breit-Wigner fit.  
<sup>6</sup> From  $f_1(1285)$  decay.  
<sup>7</sup> Using a two-channel resonance parametrization of GAY 76B data.

 **$K\bar{K}$  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. • • •

|             |     |                        |     |      |                                       |
|-------------|-----|------------------------|-----|------|---------------------------------------|
| $\sim 24$   |     | <sup>2</sup> OLLER     | 99C | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}$ |
| $\sim 25$   | 100 | <sup>3</sup> ASTIER    | 67  | HBC  | $\pm$                                 |
| $57 \pm 13$ | 143 | <sup>4</sup> ROSENFELD | 65  | RVUE | $\pm$                                 |

<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.

NODE=M036W1;LINKAGE=UE

NODE=M036W1;LINKAGE=BU  
 NODE=M036W1;LINKAGE=AN  
 NODE=M036W1;LINKAGE=BE  
 NODE=M036W1;LINKAGE=A  
 NODE=M036W1;LINKAGE=R  
 NODE=M036W1;LINKAGE=F

NODE=M036W2  
 NODE=M036W2

NODE=M036W2;LINKAGE=Q  
 NODE=M036W2;LINKAGE=AN  
 NODE=M036W2;LINKAGE=A  
 NODE=M036W2;LINKAGE=S

NODE=M036215;NODE=M036

 **$a_0(980)$  DECAY MODES**

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------|--------------------------------|
| $\Gamma_1 \quad \eta\pi$      | seen                           |
| $\Gamma_2 \quad K\bar{K}$     | seen                           |
| $\Gamma_3 \quad \rho\pi$      |                                |
| $\Gamma_4 \quad \gamma\gamma$ | seen                           |
| $\Gamma_5 \quad e^+e^-$       |                                |

DESIG=1;OUR EST;→ UNCHECKED ←  
 DESIG=3;OUR EST;→ UNCHECKED ←  
 DESIG=2  
 DESIG=5;OUR EST;→ UNCHECKED ←  
 DESIG=6

 **$a_0(980)$  PARTIAL WIDTHS** **$\Gamma(\gamma\gamma)$**  **$\Gamma_4$** 

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

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

|                 |                     |    |      |
|-----------------|---------------------|----|------|
| $0.30 \pm 0.10$ | <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.

NODE=M036217

NODE=M036W4  
 NODE=M036W4

NODE=M036W4;LINKAGE=A

 **$a_0(980) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$**  **$\Gamma(\eta\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$**  **$\Gamma_1\Gamma_4/\Gamma$** 

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

**$0.21 \begin{smallmatrix} +0.08 \\ -0.04 \end{smallmatrix}$  OUR AVERAGE**

|                                                                              |    |                     |     |      |                                      |
|------------------------------------------------------------------------------|----|---------------------|-----|------|--------------------------------------|
| $0.128 \begin{smallmatrix} +0.003 +0.502 \\ -0.002 -0.043 \end{smallmatrix}$ |    | <sup>1</sup> UEHARA | 09A | BELL | $\gamma\gamma \rightarrow \pi^0\eta$ |
| $0.28 \pm 0.04 \pm 0.10$                                                     | 44 | OEST                | 90  | JADE | $e^+e^- \rightarrow e^+e^-\pi^0\eta$ |
| $0.19 \pm 0.07 \begin{smallmatrix} +0.10 \\ -0.07 \end{smallmatrix}$         |    | 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=M036220

NODE=M036G1  
 NODE=M036G1

NODE=M036G1;LINKAGE=UE

 **$\Gamma(\eta\pi) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$**  **$\Gamma_1\Gamma_5/\Gamma$** 

| 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** **$\Gamma(K\bar{K})/\Gamma(\eta\pi)$**  **$\Gamma_2/\Gamma_1$** 

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

**$0.183 \pm 0.024$  OUR AVERAGE** 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 | $450 p p \rightarrow p_f f_1(1285) p_s$        |

NODE=M036225

NODE=M036R2  
 NODE=M036R2

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

|                          |                        |     |           |                                         |
|--------------------------|------------------------|-----|-----------|-----------------------------------------|
| 1.20 $\pm 0.15$          | <sup>4</sup> ANISOVICH | 09  | RVUE      | 0.0 $\bar{p}p, \pi N$                   |
| 1.05 $\pm 0.07 \pm 0.05$ | <sup>5</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 $\bar{p} \rightarrow 7\pi$          |

$\Gamma(\rho\pi)/\Gamma(\eta\pi)$

$\rho\pi$  forbidden.

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

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

|       |    |       |    |           |                                              |
|-------|----|-------|----|-----------|----------------------------------------------|
| <0.25 | 70 | AMMAR | 70 | HBC $\pm$ | 4.1,5.5 $K^- p \rightarrow \Lambda\eta 2\pi$ |
|-------|----|-------|----|-----------|----------------------------------------------|

<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  $\pi^0 \pi^0 \eta$  from AMSLER 94D.

<sup>3</sup> From the decay of  $f_1(1285)$ .

<sup>4</sup> This is a ratio of couplings.

<sup>5</sup> A ratio of couplings, using AMSLER 94D and ABELE 98. Supersedes BUGG 94.

NODE=M036R1

NODE=M036R1

NODE=M036R1

NODE=M036R;LINKAGE=BG

NODE=M036R2;LINKAGE=Q

NODE=M036R2;LINKAGE=L

NODE=M036R2;LINKAGE=AN

NODE=M036R2;LINKAGE=BU

## $a_0(980)$ REFERENCES

NODE=M036

|                  |     |                                            |                                |                           |             |
|------------------|-----|--------------------------------------------|--------------------------------|---------------------------|-------------|
| AAIJ             | 16N | PR D93 052018                              | R. Aaij <i>et al.</i>          | (LHCb Collab.)            | REFID=57273 |
| AMBROSINO        | 09F | PL B681 5                                  | F. Ambrosino <i>et al.</i>     | (KLOE Collab.)            | REFID=53105 |
| ANISOVICH        | 09  | IJMP A24 2481                              | V.V. Anisovich, A.V. Sarantsev |                           | REFID=52719 |
| UEHARA           | 09A | PR D80 032001                              | S. Uehara <i>et al.</i>        | (BELLE Collab.)           | REFID=53002 |
| BUGG             | 08A | PR D78 074023                              | D.V. Bugg                      | (LOQM)                    | REFID=52578 |
| ACHASOV          | 03B | PR D68 014006                              | N.N. Achsaov, A.V. Kiselev     |                           | REFID=49476 |
| BARGIOTTI        | 03  | EPJ C26 371                                | M. Bargiotti <i>et al.</i>     | (OBELIX Collab.)          | REFID=49217 |
| 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 |
| BARBERIS         | 98C | Translated from UFN 168 481.               | D. Barberis <i>et al.</i>      | (WA 102 Collab.)          | REFID=46346 |
| BERTIN           | 98B | PL B440 225                                | A. Bertin <i>et al.</i>        | (OBELIX Collab.)          | REFID=46351 |
| TORNQVIST        | 96  | PL B434 180                                | N.A. Tornqvist, M. Roos        | (HELS)                    | REFID=44507 |
| JANSEN           | 95  | PRL 76 1575                                | G. Janssen <i>et al.</i>       | (STON, ADLD, JULI)        | REFID=44508 |
| AMSLER           | 94C | PR D52 2690                                | C. Amsler <i>et al.</i>        | (Crystal Barrel Collab.)  | REFID=44091 |
| AMSLER           | 94D | PL B327 425                                | C. Amsler <i>et al.</i>        | (Crystal Barrel Collab.)  | REFID=44093 |
| BUGG             | 94  | PL B333 277                                | D.V. Bugg <i>et al.</i>        | (LOQM)                    | REFID=44078 |
| AMSLER           | 92  | PR D50 4412                                | C. Amsler <i>et al.</i>        | (Crystal Barrel Collab.)  | REFID=43169 |
| ARMSTRONG        | 91B | PL B291 347                                | T.A. Armstrong <i>et al.</i>   | (ATHU, BARI, BIRM+)       | REFID=41862 |
| OEST             | 90  | ZPHY C52 389                               | T. Oest <i>et al.</i>          | (JADE Collab.)            | REFID=41358 |
| ACHASOV          | 89  | ZPHY C47 343                               | N.N. Achasov, V.N. Ivanchenko  |                           | REFID=48021 |
| VOROBYEV         | 88  | NP B315 465                                | P.V. Vorobiev <i>et al.</i>    | (NOVO)                    | REFID=41023 |
| ANTREASYAN       | 86  | SJNP 48 273                                | D. Antreasyan <i>et al.</i>    | (Crystal Ball Collab.)    | REFID=20469 |
| ATKINSON         | 84E | PR D33 1847                                | M. Atkinson <i>et al.</i>      | (BONN, CERN, GLAS+)       | REFID=20624 |
| EVANGELIS...     | 81  | PL 138B 459                                | C. Evangelista <i>et al.</i>   | (BARI, BONN, CERN+)       | REFID=20462 |
| DEBILLY          | 80  | NP B178 197                                | L. de Billy <i>et al.</i>      | (CURIN, LAUS, NEUC+)      | REFID=20461 |
| GURTU            | 79  | NP B176 1                                  | A. Gurtu <i>et al.</i>         | (CERN, ZEEM, NIJM, OXF)   | REFID=20456 |
| CONFORTO         | 78  | NP B151 181                                | B. Conforto <i>et al.</i>      | (RHEL, TINTO, CHIC+)      | REFID=20451 |
| CORDEN           | 78  | LNC 23 419                                 | M.J. Corden <i>et al.</i>      | (BIRM, RHEL, TELA+)       | REFID=20452 |
| GRASSLER         | 77  | NP B144 253                                | H. Grassler <i>et al.</i>      | (AACH3, BERL, BONN+)      | REFID=20447 |
| JAFFE            | 77  | NP B121 189                                | R. Jaffe                       | (MIT)                     | REFID=43673 |
| FLATTE           | 76  | PR D15 267,281                             | S.M. Flatte                    | (CERN)                    | REFID=20446 |
| GAY              | 76B | PL 63B 224                                 | J.B. Gay <i>et al.</i>         | (CERN, AMST, NIJM) JP     | REFID=20445 |
| WELLS            | 75  | PL 63B 220                                 | J. Wells <i>et al.</i>         | (OXF)                     | REFID=20444 |
| DEFOIX           | 72  | NP B101 333                                | C. Defoix <i>et al.</i>        | (CDEF, CERN)              | REFID=20435 |
| AMMAR            | 70  | NP B44 125                                 | R. Ammar <i>et al.</i>         | (KANS, NWES, ANL, WISC)   | REFID=20428 |
| BARNES           | 69C | PR D2 430                                  | V.E. Barnes <i>et al.</i>      | (BNL, SYRA)               | REFID=20418 |
| CAMPBELL         | 69  | PRL 23 610                                 | J.H. Campbell <i>et al.</i>    | (PURD)                    | REFID=20419 |
| MILLER           | 69B | PRL 22 1204                                | D.H. Miller <i>et al.</i>      | (PURD)                    | REFID=20424 |
| Also             |     | PL 29B 255                                 | W.L. Yen <i>et al.</i>         | (PURD)                    | REFID=20425 |
| AMMAR            | 68  | PR 188 2011                                | R. Ammar <i>et al.</i>         | (NWES, ANL)               | REFID=20412 |
| ASTIER           | 67  | PRL 21 1832                                | A. Astier <i>et al.</i>        | (CDEF, CERN, IRAD)        | REFID=20405 |
| Includes data of |     | BARLOW 67, CONFORTO 67, and ARMENTEROS 65. |                                |                           |             |
| BARLOW           | 67  | PL 25B 294                                 | J. Barlow <i>et al.</i>        | (CERN, CDEF, IRAD, LIPV)  | REFID=20041 |
| CONFORTO         | 67  | NC 50A 701                                 | G. Conforto <i>et al.</i>      | (CERN, CDEF, IPNP+)       | REFID=20411 |
| ARMENTEROS       | 65  | NP B3 469                                  | R. Armenteros <i>et al.</i>    | (CERN, CDEF)              | REFID=20396 |
| ROSENFELD        | 65  | PL 17 344                                  | A.H. Rosenfeld                 | (LRL)                     | REFID=20399 |
|                  |     | Oxford Conf. 58                            |                                |                           |             |

$\phi(1020)$ 

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

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  | $e^+e^- \rightarrow K^+K^-,$<br>$K_S^0 K_L^0$               |
| 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     | $0.98-1.06 e^+e^- \rightarrow$<br>$\pi^+\pi^-\pi^0$         |
| 1019.52 ±0.05 ±0.05                                                           | 17.4k | AKHMETSHIN 05               | CMD2     | $0.60-1.38 e^+e^- \rightarrow$<br>$\eta\gamma$              |
| 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  | $e^+e^- \rightarrow K^+K^-,$<br>$K_S K_L, \pi^+\pi^-\pi^0$  |
| 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     | $e^+e^- \rightarrow \pi^+\pi^- \geq$<br>$2\gamma$           |
| 1019.51 ±0.07 ±0.10                                                           | 11169 | AKHMETSHIN 98               | CMD2     | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$                        |
| 1019.5 ±0.4                                                                   |       | BARBERIS                    | 98 OMEG  | $450 pp \rightarrow$<br>$pp2K^+2K^-$                        |
| 1019.42 ±0.06                                                                 | 55600 | AKHMETSHIN 95               | CMD2     | $e^+e^- \rightarrow$ hadrons                                |
| 1019.7 ±0.3                                                                   | 2012  | DAVENPORT                   | 86 MPSF  | $400 pA \rightarrow 4KX$                                    |
| 1019.7 ±0.1 ±0.1                                                              | 5079  | ALBRECHT                    | 85D ARG  | $10 e^+e^- \rightarrow$<br>$K^+K^-X$                        |
| 1019.3 ±0.1                                                                   | 1500  | ARENTON                     | 82 AEMS  | $11.8$ polar. $pp \rightarrow$<br>$KK$                      |
| 1019.67 ±0.17                                                                 | 25080 | <sup>8</sup> PELLINEN       | 82 RVUE  |                                                             |
| 1019.52 ±0.13                                                                 | 3681  | BUKIN                       | 78C OLYA | $e^+e^- \rightarrow$ hadrons                                |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |       |                             |          |                                                             |
| 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>9</sup> AKHMETSHIN 08  | CMD2     | $1.02 e^+e^- \rightarrow$<br>$K^+K^-$                       |
| 1019.63 ±0.07                                                                 | 12540 | <sup>10</sup> AUBERT,B      | 05J BABR | $D^0 \rightarrow \bar{K}^0 K^+K^-$                          |
| 1019.8 ±0.7                                                                   |       | ARMSTRONG                   | 86 OMEG  | $85 \pi^+ / pp \rightarrow$<br>$\pi^+ / p4Kp$               |
| 1020.1 ±0.11                                                                  | 5526  | <sup>10</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>11</sup> DIJKSTRA      | 86 SPEC  | $100-200 \pi^\pm, \bar{p}, p,$<br>$K^\pm, \text{ on Be}$    |
| 1020.9 ±0.2                                                                   |       | <sup>10</sup> FRAME         | 86 OMEG  | $13 K^+ p \rightarrow \phi K^+ p$                           |
| 1021.0 ±0.2                                                                   |       | <sup>10</sup> ARMSTRONG     | 83B OMEG | $18.5 K^- p \rightarrow$<br>$K^- K^+ \Lambda$               |
| 1020.0 ±0.5                                                                   |       | <sup>10</sup> ARMSTRONG     | 83B OMEG | $18.5 K^- p \rightarrow$<br>$K^- K^+ \Lambda$               |
| 1019.7 ±0.3                                                                   |       | <sup>10</sup> BARATE        | 83 GOLI  | $190 \pi^- \text{Be} \rightarrow 2\mu X$                    |
| 1019.8 ±0.2 ±0.5                                                              | 766   | IVANOV                      | 81 OLYA  | $1-1.4 e^+e^- \rightarrow$<br>$K^+K^-$                      |
| 1019.4 ±0.5                                                                   | 337   | COOPER                      | 78B HBC  | $0.7-0.8 \bar{p}p \rightarrow$<br>$K_S^0 K_L^0 \pi^+ \pi^-$ |
| 1020 ±1                                                                       | 383   | <sup>10</sup> BALDI         | 77 CNTR  | $10 \pi^- p \rightarrow \pi^- \phi p$                       |
| 1018.9 ±0.6                                                                   | 800   | COHEN                       | 77 ASPK  | $6 \pi^\pm N \rightarrow$<br>$K^+ K^- N$                    |
| 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  | $2 \gamma p \rightarrow p K^+ K^-$                          |
| 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>12</sup> AGUILAR-...   | 72B HBC  | $3.9, 4.6 K^- p \rightarrow$<br>$\Lambda K^+ K^-$           |
| 1019.9 ±0.5                                                                   | 100   | <sup>12</sup> AGUILAR-...   | 72B HBC  | $3.9, 4.6 K^- p \rightarrow$<br>$K^- p K^+ K^-$             |
| 1020.4 ±0.5                                                                   | 131   | COLLEY                      | 72 HBC   | $10 K^+ p \rightarrow K^+ p \phi$                           |
| 1019.9 ±0.3                                                                   | 410   | STOTTLE...                  | 71 HBC   | $2.9 K^- p \rightarrow$<br>$\Sigma / \Lambda K \bar{K}$     |

OCCUR=2

OCCUR=2

OCCUR=2

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> Strongly correlated with AKHMETSHIN 04.
- <sup>10</sup> Systematic errors not evaluated.
- <sup>11</sup> Weighted and scaled average of 12 measurements of DIJKSTRA 86.
- <sup>12</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=AH

NODE=M004M;LINKAGE=A

NODE=M004M;LINKAGE=B

NODE=M004M;LINKAGE=D

 **$\phi(1020)$  WIDTH**

NODE=M004W

NODE=M004W

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID                         | TECN     | COMMENT                                                                    |
|-------------------------------------------------------------------------------|-------|-------------------------------------|----------|----------------------------------------------------------------------------|
| <b>4.249<math>\pm</math>0.013 OUR AVERAGE</b>                                 |       | Error includes scale factor of 1.1. |          |                                                                            |
| 4.245 $\pm$ 0.013                                                             | 2.3M  | <sup>1</sup> KOZYREV                | 18 CMD3  | $e^+e^- \rightarrow K^+K^-, K_S^0 K_L^0$                                   |
| 4.205 $\pm$ 0.103 $\pm$ 0.067                                                 | 28k   | <sup>2</sup> LEES                   | 14H BABR | $e^+e^- \rightarrow K_S^0 K_L^0 \gamma$                                    |
| 4.29 $\pm$ 0.04 $\pm$ 0.07                                                    |       | <sup>3</sup> LEES                   | 13Q BABR | $e^+e^- \rightarrow K^+K^-\gamma$                                          |
| 4.30 $\pm$ 0.06 $\pm$ 0.17                                                    | 105k  | AKHMETSHIN 06                       | CMD2     | 0.98–1.06 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$                             |
| 4.280 $\pm$ 0.033 $\pm$ 0.025                                                 | 272k  | <sup>4</sup> AKHMETSHIN 04          | CMD2     | $e^+e^- \rightarrow K_L^0 K_S^0$                                           |
| 4.21 $\pm$ 0.04                                                               | 1900k | <sup>5</sup> ACHASOV                | 01E SND  | $e^+e^- \rightarrow K^+K^-, K_S K_L, \pi^+\pi^-\pi^0$                      |
| 4.44 $\pm$ 0.09                                                               | 55600 | AKHMETSHIN 95                       | CMD2     | $e^+e^- \rightarrow$ hadrons                                               |
| 4.5 $\pm$ 0.7                                                                 | 1500  | ARENTON                             | 82 AEMS  | 11.8 polar. $pp \rightarrow KK$                                            |
| 4.2 $\pm$ 0.6                                                                 | 766   | <sup>6</sup> IVANOV                 | 81 OLYA  | 1–1.4 $e^+e^- \rightarrow K^+K^-$                                          |
| 4.3 $\pm$ 0.6                                                                 |       | <sup>6</sup> CORDIER                | 80 DM1   | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$                                       |
| 4.36 $\pm$ 0.29                                                               | 3681  | <sup>6</sup> BUKIN                  | 78C OLYA | $e^+e^- \rightarrow$ hadrons                                               |
| 4.4 $\pm$ 0.6                                                                 | 984   | <sup>6</sup> BESCH                  | 74 CNTR  | $2\gamma p \rightarrow pK^+K^-$                                            |
| 4.67 $\pm$ 0.72                                                               | 681   | <sup>6</sup> BALAKIN                | 71 OSPK  | $e^+e^- \rightarrow$ hadrons                                               |
| 4.09 $\pm$ 0.29                                                               |       | BIZOT                               | 70 OSPK  | $e^+e^- \rightarrow$ hadrons                                               |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                                     |          |                                                                            |
| 4.249 $\pm$ 0.015                                                             | 1.7M  | KOZYREV                             | 18 CMD3  | $e^+e^- \rightarrow K^+K^-$                                                |
| 4.240 $\pm$ 0.017                                                             | 610k  | KOZYREV                             | 16 CMD3  | $e^+e^- \rightarrow K_S^0 K_L^0$                                           |
| 4.37 $\pm$ 0.02                                                               |       | LEES                                | 13F BABR | $D^+ \rightarrow K^+K^-\pi^+$                                              |
| 4.24 $\pm$ 0.02 $\pm$ 0.03                                                    | 542k  | <sup>7</sup> AKHMETSHIN 08          | CMD2     | 1.02 $e^+e^- \rightarrow K^+K^-$                                           |
| 4.28 $\pm$ 0.13                                                               | 12540 | <sup>8</sup> AUBERT,B               | 05J BABR | $D^0 \rightarrow \bar{K}^0 K^+ K^-$                                        |
| 4.45 $\pm$ 0.06                                                               | 271k  | DIJKSTRA                            | 86 SPEC  | 100 $\pi^-$ Be                                                             |
| 3.6 $\pm$ 0.8                                                                 | 337   | <sup>6</sup> COOPER                 | 78B HBC  | 0.7–0.8 $\bar{p}p \rightarrow K_S^0 K_L^0 \pi^+\pi^-$                      |
| 4.5 $\pm$ 0.50                                                                | 1300  | <sup>6,8</sup> AKERLOF              | 77 SPEC  | 400 $pA \rightarrow K^+K^-X$                                               |
| 4.5 $\pm$ 0.8                                                                 | 500   | <sup>6,8</sup> AYRES                | 74 ASPK  | 3–6 $\pi^- p \rightarrow K^+K^-n, K^-p \rightarrow K^+K^-\Lambda/\Sigma^0$ |
| 3.81 $\pm$ 0.37                                                               |       | COSME                               | 74B OSPK | $e^+e^- \rightarrow K_L^0 K_S^0$                                           |
| 3.8 $\pm$ 0.7                                                                 | 454   | <sup>6</sup> BORENSTEIN 72          | HBC      | 2.18 $K^-p \rightarrow K\bar{K}n$                                          |

OCCUR=2

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=AH

NODE=M004W;LINKAGE=A

- <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> Strongly correlated with AKHMETSHIN 04.
- <sup>8</sup> Systematic errors not evaluated.

**$\phi(1020)$  DECAY MODES**

NODE=M004215;NODE=M004

| Mode                                             |                                   | Fraction ( $\Gamma_i/\Gamma$ )               | Scale factor/<br>Confidence level |                                                          |
|--------------------------------------------------|-----------------------------------|----------------------------------------------|-----------------------------------|----------------------------------------------------------|
| $\Gamma_1$                                       | $K^+ K^-$                         | (49.2 $\pm$ 0.5 ) %                          | S=1.3                             | DESIG=1                                                  |
| $\Gamma_2$                                       | $K_L^0 K_S^0$                     | (34.0 $\pm$ 0.4 ) %                          | S=1.3                             | DESIG=2                                                  |
| $\Gamma_3$                                       | $\rho\pi + \pi^+\pi^-\pi^0$       | (15.24 $\pm$ 0.33 ) %                        | S=1.2                             | DESIG=24                                                 |
| $\Gamma_4$                                       | $\rho\pi$                         |                                              |                                   | DESIG=16                                                 |
| $\Gamma_5$                                       | $\pi^+\pi^-\pi^0$                 |                                              |                                   | DESIG=3                                                  |
| $\Gamma_6$                                       | $\eta\gamma$                      | ( 1.303 $\pm$ 0.025 ) %                      | S=1.2                             | DESIG=4                                                  |
| $\Gamma_7$                                       | $\pi^0\gamma$                     | ( 1.30 $\pm$ 0.05 ) $\times 10^{-3}$         |                                   | DESIG=7                                                  |
| $\Gamma_8$                                       | $\ell^+\ell^-$                    | —                                            |                                   | DESIG=256;OUR EVAL; $\rightarrow$ UNCHECKED $\leftarrow$ |
| $\Gamma_9$                                       | $e^+e^-$                          | ( 2.973 $\pm$ 0.034 ) $\times 10^{-4}$       | S=1.3                             | DESIG=5                                                  |
| $\Gamma_{10}$                                    | $\mu^+\mu^-$                      | ( 2.86 $\pm$ 0.19 ) $\times 10^{-4}$         |                                   | DESIG=6                                                  |
| $\Gamma_{11}$                                    | $\eta e^+e^-$                     | ( 1.08 $\pm$ 0.04 ) $\times 10^{-4}$         |                                   | DESIG=17                                                 |
| $\Gamma_{12}$                                    | $\pi^+\pi^-$                      | ( 7.3 $\pm$ 1.3 ) $\times 10^{-5}$           |                                   | DESIG=8                                                  |
| $\Gamma_{13}$                                    | $\omega\pi^0$                     | ( 4.7 $\pm$ 0.5 ) $\times 10^{-5}$           |                                   | DESIG=25                                                 |
| $\Gamma_{14}$                                    | $\omega\gamma$                    | < 5 %                                        | CL=84%                            | DESIG=10                                                 |
| $\Gamma_{15}$                                    | $\rho\gamma$                      | < 1.2 $\times 10^{-5}$                       | CL=90%                            | DESIG=12                                                 |
| $\Gamma_{16}$                                    | $\pi^+\pi^-\gamma$                | ( 4.1 $\pm$ 1.3 ) $\times 10^{-5}$           |                                   | DESIG=9                                                  |
| $\Gamma_{17}$                                    | $f_0(980)\gamma$                  | ( 3.22 $\pm$ 0.19 ) $\times 10^{-4}$         | S=1.1                             | DESIG=20                                                 |
| $\Gamma_{18}$                                    | $\pi^0\pi^0\gamma$                | ( 1.12 $\pm$ 0.06 ) $\times 10^{-4}$         |                                   | DESIG=19                                                 |
| $\Gamma_{19}$                                    | $\pi^+\pi^-\pi^+\pi^-$            | ( 3.9 $^{+2.8}_{-2.2}$ ) $\times 10^{-6}$    |                                   | DESIG=15                                                 |
| $\Gamma_{20}$                                    | $\pi^+\pi^+\pi^-\pi^-\pi^0$       | < 4.6 $\times 10^{-6}$                       | CL=90%                            | DESIG=14                                                 |
| $\Gamma_{21}$                                    | $\pi^0 e^+ e^-$                   | ( 1.33 $^{+0.07}_{-0.10}$ ) $\times 10^{-5}$ |                                   | DESIG=21                                                 |
| $\Gamma_{22}$                                    | $\pi^0\eta\gamma$                 | ( 7.27 $\pm$ 0.30 ) $\times 10^{-5}$         | S=1.5                             | DESIG=22                                                 |
| $\Gamma_{23}$                                    | $a_0(980)\gamma$                  | ( 7.6 $\pm$ 0.6 ) $\times 10^{-5}$           |                                   | DESIG=23                                                 |
| $\Gamma_{24}$                                    | $K^0\bar{K}^0\gamma$              | < 1.9 $\times 10^{-8}$                       | CL=90%                            | DESIG=257                                                |
| $\Gamma_{25}$                                    | $\eta'(958)\gamma$                | ( 6.22 $\pm$ 0.21 ) $\times 10^{-5}$         |                                   | DESIG=194                                                |
| $\Gamma_{26}$                                    | $\eta\pi^0\pi^0\gamma$            | < 2 $\times 10^{-5}$                         | CL=90%                            | DESIG=195                                                |
| $\Gamma_{27}$                                    | $\mu^+\mu^-\gamma$                | ( 1.4 $\pm$ 0.5 ) $\times 10^{-5}$           |                                   | DESIG=196                                                |
| $\Gamma_{28}$                                    | $\rho\gamma\gamma$                | < 1.2 $\times 10^{-4}$                       | CL=90%                            | DESIG=250                                                |
| $\Gamma_{29}$                                    | $\eta\pi^+\pi^-$                  | < 1.8 $\times 10^{-5}$                       | CL=90%                            | DESIG=255                                                |
| $\Gamma_{30}$                                    | $\eta\mu^+\mu^-$                  | < 9.4 $\times 10^{-6}$                       | CL=90%                            | DESIG=26                                                 |
| $\Gamma_{31}$                                    | $\eta U \rightarrow \eta e^+ e^-$ | < 1 $\times 10^{-6}$                         | CL=90%                            | DESIG=259                                                |
| $\Gamma_{32}$                                    | invisible                         | < 1.7 $\times 10^{-4}$                       | CL=90%                            | DESIG=260                                                |
| <b>Lepton Family number (LF) violating modes</b> |                                   |                                              |                                   |                                                          |
| $\Gamma_{33}$                                    | $e^\pm\mu^\mp$                    | LF < 2 $\times 10^{-6}$                      | CL=90%                            | NODE=M004;CLUMP=A<br>DESIG=258                           |

**CONSTRAINED FIT INFORMATION**

An overall fit to 30 branching ratios uses 82 measurements and one constraint to determine 14 parameters. The overall fit has a  $\chi^2 = 63.7$  for 69 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.

|          |          |          |          |       |       |       |          |          |          |          |  |
|----------|----------|----------|----------|-------|-------|-------|----------|----------|----------|----------|--|
| $x_2$    | -78      |          |          |       |       |       |          |          |          |          |  |
| $x_3$    | -59      | -4       |          |       |       |       |          |          |          |          |  |
| $x_6$    | -23      | 19       | 6        |       |       |       |          |          |          |          |  |
| $x_7$    | -15      | 14       | 4        | 10    |       |       |          |          |          |          |  |
| $x_9$    | 54       | -52      | -17      | -38   | -27   |       |          |          |          |          |  |
| $x_{10}$ | -7       | 7        | 2        | 5     | 3     | -13   |          |          |          |          |  |
| $x_{12}$ | -3       | 3        | 1        | 2     | 2     | -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

NODE=M004218

#### $\Gamma(\eta\gamma)$

 $\Gamma_6$ 

| 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 $e^+ e^- \rightarrow \eta\gamma$ |

NODE=M004W6  
NODE=M004W6

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

 $\Gamma_7$ 

| 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 $e^+ e^- \rightarrow \pi^0\gamma$ |

NODE=M004W7  
NODE=M004W7

#### $\Gamma(\ell^+\ell^-)$

 $\Gamma_8$ 

| 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. |                        |      |                                             |

NODE=M004W5  
NODE=M004W5

NODE=M004W5;LINKAGE=AM

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

 $\Gamma_9$ 

| VALUE (keV)                                      | DOCUMENT ID                         | TECN | COMMENT                                 |
|--------------------------------------------------|-------------------------------------|------|-----------------------------------------|
| <b>1.27 <math>\pm 0.04</math> OUR EVALUATION</b> |                                     |      |                                         |
| <b>1.251 <math>\pm 0.021</math> OUR AVERAGE</b>  | 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 $1.02 e^+ e^- \rightarrow \phi$    |

NODE=M004W8  
NODE=M004W8  
→ UNCHECKED ←

<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  $0.99741 \pm 0.00007$ .

NODE=M004W8;LINKAGE=AK

<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.

NODE=M004W8;LINKAGE=AM



$$(\Gamma(e^+e^-) \times \Gamma(\mu^+\mu^-))^{\frac{1}{2}} \quad (\Gamma_9\Gamma_{10})^{\frac{1}{2}}$$

| 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

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

| VALUE (keV)                     | EVTS | DOCUMENT ID | TECN | COMMENT                                |
|---------------------------------|------|-------------|------|----------------------------------------|
| <b>0.6340 ± 0.0070 ± 0.0039</b> | 1    | 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

$$\Gamma(K_L^0 K_S^0) \times \Gamma(e^+e^-) / \Gamma_{\text{total}} \quad \Gamma_2\Gamma_9/\Gamma$$

| VALUE (keV)                     | EVTS | DOCUMENT ID | TECN | COMMENT                                          |
|---------------------------------|------|-------------|------|--------------------------------------------------|
| <b>0.4200 ± 0.0033 ± 0.0123</b> | 28k  | 1           | 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

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

| VALUE (units 10 <sup>-5</sup> ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|------|-------------|------|---------|
|---------------------------------|------|-------------|------|---------|

**14.63 ± 0.29 OUR FIT** Error includes scale factor of 1.5.

**14.6 ± 0.5 OUR AVERAGE** Error includes scale factor of 1.8. See the ideogram below.

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  $e^+e^- \rightarrow K^+K^-$

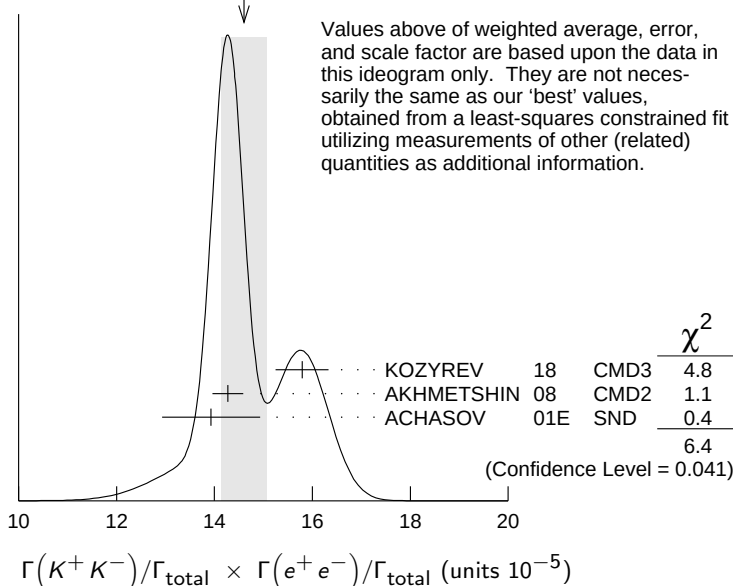
13.93 ± 0.14 ± 0.99 1000k <sup>1</sup>ACHASOV 01E SND  $e^+e^- \rightarrow K^+K^-, K_S^0 K_L^0, \pi^+\pi^-\pi^0$

NODE=M004G10  
NODE=M004G10

<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

WEIGHTED AVERAGE  
14.6 ± 0.5 (Error scaled by 1.8)



$$\Gamma(K_L^0 K_S^0)/\Gamma_{\text{total}} \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$$

$$\Gamma_2/\Gamma \times \Gamma_9/\Gamma$$

| 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 | $e^+ e^- \rightarrow K_S^+ K_L^-, K_S^- K_L^+, \pi^+ \pi^- \pi^0$ |

<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  $K^+ K^-$ ,  $K_S K_L$ ,  $\pi^+ \pi^- \pi^0$ , 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  | $e^+ e^- \rightarrow K^+ K^-, K_S K_L, \pi^+ \pi^- \pi^0$ |
| 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  $K^+ K^-$ ,  $K_S K_L$ ,  $\pi^+ \pi^- \pi^0$ , 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>3.87 <math>\pm 0.07</math> OUR FIT</b>                                     | Error includes scale factor of 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  $B(\eta \rightarrow \pi^+ \pi^- \pi^0) = (23.1 \pm 0.5) \times 10^{-2}$ .

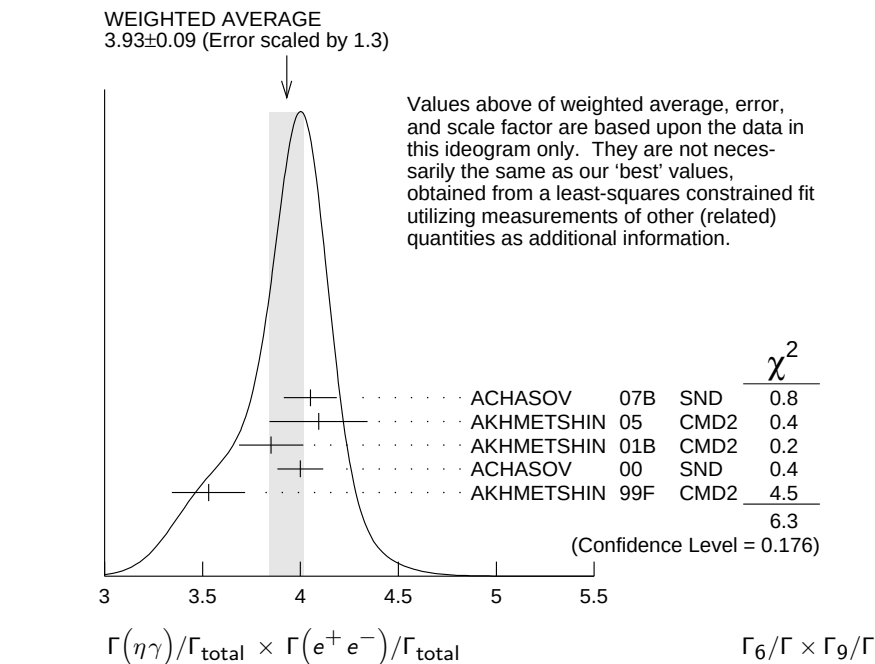
<sup>8</sup> A simultaneous fit of  $e^+ e^- \rightarrow \pi^+ \pi^-, \pi^+ \pi^- \pi^0, \pi^0 \gamma, \eta\gamma$  data.

NODE=M004G2  
NODE=M004G2

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 |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**3.88±0.14 OUR FIT**

**3.87±0.15 OUR AVERAGE**

|                                             |     |            |     |      |                                            |
|---------------------------------------------|-----|------------|-----|------|--------------------------------------------|
| 4.04±0.09±0.19                              | 1   | ACHASOV    | 16A | SND  | 0.60–1.38 $e^+e^- \rightarrow \pi^0\gamma$ |
| 3.75±0.11±0.29                              | 18k | AKHMETSHIN | 05  | CMD2 | 0.60–1.38 $e^+e^- \rightarrow \pi^0\gamma$ |
| 3.67±0.10 <sup>+0.27</sup> <sub>–0.25</sub> | 2   | ACHASOV    | 00  | SND  | $e^+e^- \rightarrow \pi^0\gamma$           |

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

4.29±0.11 <sup>3</sup> BENAYOUN 10 RVUE 0.4–1.05  $e^+e^-$

<sup>1</sup> From the VMD model with the interfering  $\rho(770)$ ,  $\omega(782)$ ,  $\phi(1020)$  resonances, and an additional resonance describing the total contribution of the  $\rho(1450)$  and  $\omega(1420)$  states. Supersedes ACHASOV 00.

<sup>2</sup> From the  $\pi^0 \rightarrow 2\gamma$  decay and using  $B(\pi^0 \rightarrow 2\gamma) = (98.798 \pm 0.032) \times 10^{-2}$ .

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

NODE=M004G3  
NODE=M004G3

NODE=M004G3;LINKAGE=B

NODE=M004G3;LINKAGE=A  
NODE=M004G3;LINKAGE=BE

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

$$\Gamma_{10}/\Gamma \times \Gamma_9/\Gamma$$

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

**8.5 <sup>+0.5</sup><sub>–0.6</sub> OUR FIT**

**8.8 ±0.9 OUR AVERAGE** Error includes scale factor of 1.5. See the ideogram below.

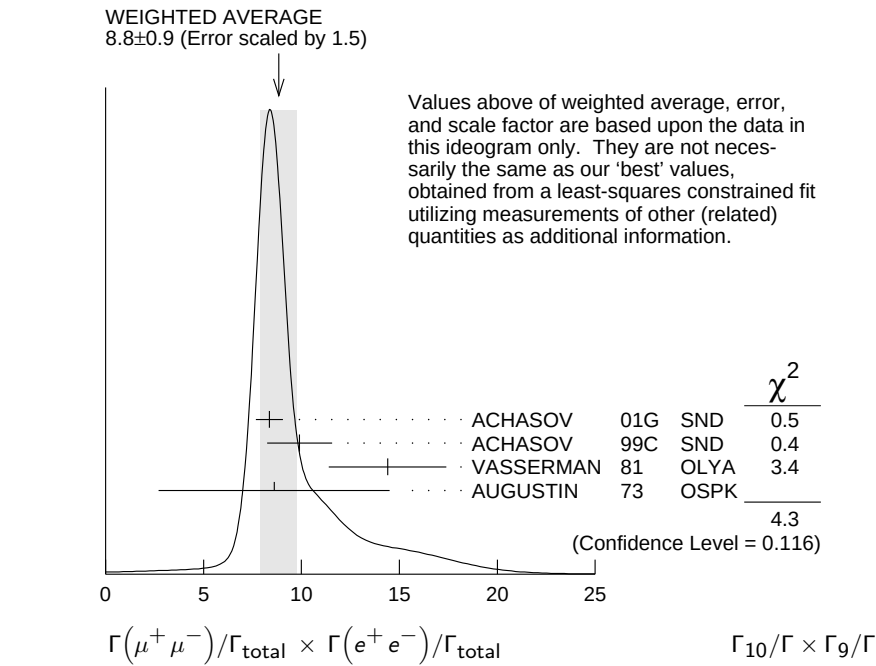
|                |   |           |     |      |                                 |
|----------------|---|-----------|-----|------|---------------------------------|
| 8.36±0.59±0.37 |   | ACHASOV   | 01G | SND  | $e^+e^- \rightarrow \mu^+\mu^-$ |
| 9.9 ±1.4 ±0.9  | 1 | ACHASOV   | 99C | SND  | $e^+e^- \rightarrow \mu^+\mu^-$ |
| 14.4 ±3.0      | 2 | VASSERMAN | 81  | OLYA | $e^+e^- \rightarrow \mu^+\mu^-$ |
| 8.6 ±5.9       | 2 | AUGUSTIN  | 73  | OSPK | $e^+e^- \rightarrow \mu^+\mu^-$ |

<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=M004G5  
NODE=M004G5

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  $B(\omega(782) \rightarrow \pi^+\pi^-\pi^0) = (89.3 \pm 0.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

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>                       |                        |         |                                       |
| 3.33 <sup>+0.04+0.19</sup> <sub>-0.09-0.20</sub> | <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  | $3.9, 4.6 K^-p$                             |

• • • 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

$\Gamma(\eta\gamma)/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

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

**1.303±0.025 OUR FIT** Error includes scale factor of 1.2.**1.26 ±0.04 OUR AVERAGE**

|                                                                               |       |                            |     |      |                                           |
|-------------------------------------------------------------------------------|-------|----------------------------|-----|------|-------------------------------------------|
| 1.246±0.025±0.057                                                             | 10k   | <sup>1</sup> ACHASOV       | 98F | SND  | $e^+e^- \rightarrow 7\gamma$              |
| 1.18 ±0.11                                                                    | 279   | <sup>2</sup> AKHMETSHIN    | 95  | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-3\gamma$    |
| 1.30 ±0.06                                                                    |       | <sup>3</sup> DRUZHININ     | 84  | ND   | $e^+e^- \rightarrow 3\gamma$              |
| 1.4 ±0.2                                                                      |       | <sup>4</sup> DRUZHININ     | 84  | ND   | $e^+e^- \rightarrow 6\gamma$              |
| 0.88 ±0.20                                                                    | 290   | KURDADZE                   | 83C | OLYA | $e^+e^- \rightarrow 3\gamma$              |
| 1.35 ±0.29                                                                    |       | ANDREWS                    | 77  | CNTR | 6.7–10 $\gamma$ Cu                        |
| 1.5 ±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 ±0.02 ±0.02                                                              |       | <sup>5</sup> AKHMETSHIN    | 11  | CMD2 | 1.02 $e^+e^- \rightarrow \eta\gamma$      |
| 1.36 ±0.05 ±0.02                                                              | 33k   | <sup>6</sup> ACHASOV       | 07B | SND  | 0.6–1.38 $e^+e^- \rightarrow \eta\gamma$  |
| 1.373±0.014±0.085                                                             | 17.4k | <sup>7,8</sup> AKHMETSHIN  | 05  | CMD2 | 0.60–1.38 $e^+e^- \rightarrow \eta\gamma$ |
| 1.287±0.013±0.063                                                             |       | <sup>9,10</sup> AKHMETSHIN | 01B | CMD2 | $e^+e^- \rightarrow \eta\gamma$           |
| 1.338±0.012±0.052                                                             |       | <sup>11</sup> ACHASOV      | 00  | SND  | $e^+e^- \rightarrow \eta\gamma$           |
| 1.18 ±0.03 ±0.06                                                              | 2200  | <sup>12</sup> AKHMETSHIN   | 99F | CMD2 | $e^+e^- \rightarrow \eta\gamma$           |
| 1.21 ±0.07                                                                    |       | <sup>13</sup> BENAYOUN     | 96  | RVUE | 0.54–1.04 $e^+e^- \rightarrow \eta\gamma$ |

<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  $B(\phi(1020) \rightarrow e^+e^-) = (2.973 \pm 0.034) \times 10^{-4}$ . 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  
NODE=M004R11

OCCUR=2

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=BQNODE=M004R;LINKAGE=GA  
NODE=M004R;LINKAGE=FF  
NODE=M004R;LINKAGE=TS $\Gamma(\pi^0\gamma)/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ 

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

**1.30 ±0.05 OUR FIT****1.31 ±0.13 OUR AVERAGE**

|            |    |           |    |      |                              |
|------------|----|-----------|----|------|------------------------------|
| 1.30 ±0.13 |    | DRUZHININ | 84 | ND   | $e^+e^- \rightarrow 3\gamma$ |
| 1.4 ±0.5   | 32 | COSME     | 76 | OSPK | $e^+e^-$                     |

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

|                                                 |     |                           |     |      |                                            |
|-------------------------------------------------|-----|---------------------------|-----|------|--------------------------------------------|
| 1.367±0.072                                     |     | <sup>1</sup> ACHASOV      | 16A | SND  | 0.60–1.38 $e^+e^- \rightarrow \pi^0\gamma$ |
| 1.258±0.037±0.077                               | 18k | <sup>2,3</sup> AKHMETSHIN | 05  | CMD2 | 0.60–1.38 $e^+e^- \rightarrow \pi^0\gamma$ |
| 1.226±0.036 <sup>+0.096</sup> <sub>-0.089</sub> |     | <sup>4</sup> ACHASOV      | 00  | SND  | $e^+e^- \rightarrow \pi^0\gamma$           |
| 1.26 ±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 $\Gamma(\eta\gamma)/\Gamma(\pi^0\gamma)$  $\Gamma_6/\Gamma_7$ 

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

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

|                                          |         |    |     |                                              |
|------------------------------------------|---------|----|-----|----------------------------------------------|
| 10.9±0.3 <sup>+0.7</sup> <sub>-0.8</sub> | ACHASOV | 00 | SND | $e^+e^- \rightarrow \eta\gamma, \pi^0\gamma$ |
|------------------------------------------|---------|----|-----|----------------------------------------------|

NODE=M004R42  
NODE=M004R42

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

| VALUE (units $10^{-4}$ )      | EVTS                                | DOCUMENT ID             | TECN    | COMMENT                                                   |
|-------------------------------|-------------------------------------|-------------------------|---------|-----------------------------------------------------------|
| <b>2.973±0.034 OUR FIT</b>    | Error includes scale factor of 1.3. |                         |         |                                                           |
| <b>2.98 ±0.07 OUR AVERAGE</b> | 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    | $e^+e^- \rightarrow \text{hadrons}$                       |
| 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

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                                      |
|-------------------------------------------------------------------------------|---------------------------|------|----------------------------------------------|
| <b>2.86±0.19 OUR FIT</b>                                                      |                           |      |                                              |
| <b>2.5 ±0.4 OUR AVERAGE</b>                                                   |                           |      |                                              |
| 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                               |
|-------------------------------------------------------------------------------|------|----------------------------|------|---------------------------------------|
| <b>1.08 ±0.04 OUR AVERAGE</b>                                                 |      |                            |      |                                       |
| 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 <sup>+0.8</sup> <sub>-0.6</sub>                                           | 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±0.21                                | 2438  | <sup>3</sup> ALOISIO     | 02D | KLOE | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 3.5 ±0.3 <sup>+1.3</sup> <sub>-0.5</sub> | 419   | <sup>4,5</sup> ACHASOV   | 00H | SND  | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 1.93±0.46±0.50                           | 27188 | <sup>6</sup> AKHMETSHIN  | 99B | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |
| 3.05±0.25±0.72                           | 268   | <sup>7</sup> AKHMETSHIN  | 99C | CMD2 | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 1.5 ±0.5                                 | 268   | <sup>8</sup> AKHMETSHIN  | 99C | CMD2 | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 3.42±0.30±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<sup>+0.15</sup><sub>-0.16</sub> OUR FIT** Error includes scale factor of 1.1.

**2.6 ±0.2 <sup>+0.8</sup><sub>-0.3</sub>** 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;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 ±0.06 OUR AVERAGE**

1.07 <sup>+0.01</sup><sub>-0.03</sub> <sup>+0.06</sup><sub>-0.06</sub> <sup>1</sup> AMBROSINO 07 KLOE  $e^+e^- \rightarrow \pi^0\pi^0\gamma$

1.08 ±0.17 ±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 ±0.03 ±0.05 2438 ALOISIO 02D KLOE  $e^+e^- \rightarrow \pi^0\pi^0\gamma$

1.158±0.093±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 ±0.04 OUR FIT**

**0.865±0.070±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 ±0.08 ±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 ±2.7 ±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±1.74±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 |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

**1.33<sup>+0.07</sup><sub>-0.10</sub> OUR AVERAGE**

|                                                                               |      |                         |     |      |                                    |
|-------------------------------------------------------------------------------|------|-------------------------|-----|------|------------------------------------|
| 1.35 ± 0.05 <sup>+0.05</sup> <sub>-0.10</sub>                                 | 9.5k | <sup>1</sup> ANASTASI   | 16B | KLOE | $e^+e^- \rightarrow \pi^0 e^+ e^-$ |
| 1.01 ± 0.28 ± 0.29                                                            | 52   | <sup>2</sup> ACHASOV    | 02D | SND  | $e^+e^- \rightarrow \pi^0 e^+ e^-$ |
| 1.22 ± 0.34 ± 0.21                                                            | 46   | <sup>3</sup> 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 |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

**7.27 ± 0.30 OUR AVERAGE** Error includes scale factor of 1.5. See the ideogram below.

|                    |       |                        |     |      |                                           |
|--------------------|-------|------------------------|-----|------|-------------------------------------------|
| 7.06 ± 0.22        | 16.9k | <sup>1</sup> AMBROSINO | 09F | KLOE | $1.02 e^+e^- \rightarrow \eta\pi^0\gamma$ |
| 8.51 ± 0.51 ± 0.57 | 607   | <sup>2</sup> ALOISIO   | 02C | KLOE | $e^+e^- \rightarrow \eta\pi^0\gamma$      |
| 7.96 ± 0.60 ± 0.40 | 197   | <sup>3</sup> ALOISIO   | 02C | KLOE | $e^+e^- \rightarrow \eta\pi^0\gamma$      |
| 8.8 ± 1.4 ± 0.9    | 36    | <sup>4</sup> ACHASOV   | 00F | SND  | $e^+e^- \rightarrow \eta\pi^0\gamma$      |
| 9.0 ± 2.4 ± 1.0    | 80    | AKHMETSHIN             | 99C | CMD2 | $e^+e^- \rightarrow \eta\pi^0\gamma$      |

OCCUR=2

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

|                    |       |                          |     |      |                                           |
|--------------------|-------|--------------------------|-----|------|-------------------------------------------|
| 7.01 ± 0.10 ± 0.20 | 13.3k | <sup>2,5</sup> AMBROSINO | 09F | KLOE | $1.02 e^+e^- \rightarrow \eta\pi^0\gamma$ |
| 7.12 ± 0.13 ± 0.22 | 3.6k  | <sup>3,6</sup> 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   | $e^+e^- \rightarrow \pi^0\eta\gamma$      |

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.

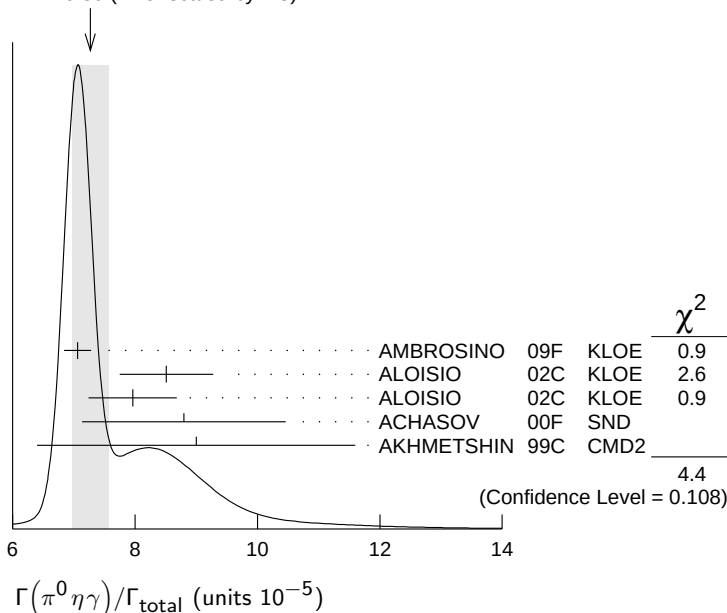
<sup>5</sup> Using  $B(\phi \rightarrow \eta\gamma) = (1.304 \pm 0.025)\%$ ,  $B(\eta \rightarrow 3\pi^0) = (32.56 \pm 0.23)\%$ , and  $B(\eta \rightarrow \gamma\gamma) = (39.31 \pm 0.20)\%$ .

<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)



$\Gamma(a_0(980)\gamma)/\Gamma_{\text{total}}$  $\Gamma_{23}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | EVTS | DOCUMENT ID          | TECN     | COMMENT                              |
|-------------------------------------------------------------------------------|-----|------|----------------------|----------|--------------------------------------|
| <b>7.6<math>\pm</math>0.6 OUR FIT</b>                                         |     |      |                      |          |                                      |
| <b>7.6<math>\pm</math>0.6 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

 $\Gamma(f_0(980)\gamma)/\Gamma(a_0(980)\gamma)$  $\Gamma_{17}/\Gamma_{23}$ 

| VALUE                         | DOCUMENT ID          | TECN     | COMMENT                              |
|-------------------------------|----------------------|----------|--------------------------------------|
| <b>6.1<math>\pm</math>0.6</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

 $\Gamma(K^0\bar{K}^0\gamma)/\Gamma_{\text{total}}$  $\Gamma_{24}/\Gamma$ 

| VALUE                                      | CL% | DOCUMENT ID | TECN     | COMMENT                                 |
|--------------------------------------------|-----|-------------|----------|-----------------------------------------|
| <b>&lt;1.9 <math>\times 10^{-8}</math></b> | 90  | AMBROSINO   | 09C KLOE | $e^+e^- \rightarrow K_S^0 K_S^0 \gamma$ |

NODE=M004R48  
NODE=M004R48 $\Gamma(\eta'(958)\gamma)/\Gamma_{\text{total}}$  $\Gamma_{25}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | EVTS | DOCUMENT ID             | TECN     | COMMENT                                                |
|-------------------------------------------------------------------------------|-----|------|-------------------------|----------|--------------------------------------------------------|
| <b>6.22<math>\pm</math>0.21 OUR FIT</b>                                       |     |      |                         |          |                                                        |
| <b>6.22<math>\pm</math>0.30 OUR AVERAGE</b>                                   |     |      |                         |          |                                                        |
| 6.22 $\pm$ 0.27 $\pm$ 0.12                                                    |     | 3407 | <sup>1</sup> AMBROSINO  | 07A KLOE | 1.02 $e^+e^- \rightarrow \pi^+\pi^-7\gamma$            |
| 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 $e^+e^- \rightarrow \pi^+\pi^-3\gamma$            |
| 8.2 $^{+2.1}_{-1.9} \pm 1.1$                                                  |     | 21   | <sup>4</sup> AKHMETSHIN | 00B CMD2 | $e^+e^- \rightarrow \pi^+\pi^-3\gamma$                 |
| 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   | $e^+e^- \rightarrow \pi^+\pi^-3\gamma$                 |
| <11                                                                           |     | 90   | AULCHENKO               | 98 SND   | $e^+e^- \rightarrow 7\gamma$                           |
| 12 $^{+7}_{-5} \pm 2$                                                         |     | 6    | <sup>4</sup> AKHMETSHIN | 97B CMD2 | $e^+e^- \rightarrow \pi^+\pi^-3\gamma$                 |
| <41                                                                           |     | 90   | DRUZHININ               | 87 ND    | $e^+e^- \rightarrow \gamma\eta\pi^+\pi^-$              |

<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  
NODE=M004R25

OCCUR=2

OCCUR=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

 $\Gamma(\eta'(958)\gamma)/\Gamma(K_L^0 K_S^0)$  $\Gamma_{25}/\Gamma_2$ 

| VALUE (units $10^{-4}$ )                          | EVTS | DOCUMENT ID             | TECN     | COMMENT                                                |
|---------------------------------------------------|------|-------------------------|----------|--------------------------------------------------------|
| <b>1.83<math>\pm</math>0.06 OUR FIT</b>           |      |                         |          |                                                        |
| <b>1.46<math>^{+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****4.77±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 $\phi \rightarrow P e^+ e^-$ DECAYS

In the one-pole approximation the electromagnetic transition form factor for  $\phi \rightarrow P e^+ e^-$  ( $P = \pi, \eta$ ) 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 $^{+0.09}_{-0.08}$                                                                       | 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

|            |     |                         |                                       |                           |                     |
|------------|-----|-------------------------|---------------------------------------|---------------------------|---------------------|
| ABLIKIM    | 18S | PR D98 032001           | M. Ablikim <i>et al.</i>              | (BES III Collab.)         | REFID=58971         |
| KOZYREV    | 18  | PL B779 64              | E.A. Kozyrev <i>et al.</i>            | (CMD3 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         |
| ANASTASI   | 16B | PL B757 362             | A. Anastasi <i>et al.</i>             | (KLOE-2 Collab.)          | REFID=57399         |
| KOZYREV    | 16  | PL B760 314             | E.A. Kozyrev <i>et al.</i>            | (CMD3 Collab.)            | REFID=57514         |
| BABUSCI    | 15  | PL B742 1               | D. Babusci <i>et al.</i>              | (KLOE-2 Collab.)          | REFID=56374         |
| PDG        | 15  | RPP 2015 at pdg.lbl.gov |                                       | (PDG Collab.)             | REFID=56977;ERROR=7 |
| LEES       | 14H | PR D89 092002           | J.P. Lees <i>et al.</i>               | (BABAR Collab.)           | REFID=55940         |
| PDG        | 14  | CP C38 070001           | K. Olive <i>et al.</i>                | (PDG Collab.)             | REFID=55687         |
| BABUSCI    | 13B | PL B720 111             | D. Babusci <i>et al.</i>              | (KLOE-2 Collab.)          | REFID=55068         |
| BENAYOUN   | 13  | EPJ C73 2453            | M. Benayoun, P. David, L. DelBuono    | (PARIN, BERLIN+)          | REFID=55357         |
| LEES       | 13F | PR D87 052010           | J.P. Lees <i>et al.</i>               | (BABAR Collab.)           | REFID=55127         |
| LEES       | 13Q | PR D88 032013           | J.P. Lees <i>et al.</i>               | (BABAR Collab.)           | REFID=55404         |
| ARCHILLI   | 12  | PL B706 251             | F. Archilli <i>et al.</i>             | (KLOE-2 Collab.)          | REFID=53951         |
| BENAYOUN   | 12  | EPJ C72 1848            | M. Benayoun <i>et al.</i>             |                           | REFID=54281         |
| NIECKNIG   | 12  | EPJ C72 2014            | F. Niecknig, B. Kubis, S.P. Schneider | (BONN)                    | REFID=54305         |
| PDG        | 12  | PR D86 010001           | J. Beringer <i>et al.</i>             | (PDG Collab.)             | REFID=54066         |
| AKHMETSHIN | 11  | PL B695 412             | R.R. Akhmetshin <i>et al.</i>         | (CMD2 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         |
| AMBROSINO  | 09F | PL B681 5               | F. Ambrosino <i>et al.</i>            | (KLOE Collab.)            | REFID=53105         |
| AKHMETSHIN | 08  | PL B669 217             | R.R. Akhmetshin <i>et al.</i>         | (CMD-2 Collab.)           | REFID=52572         |
| AMBROSINO  | 08G | PL B669 223             | F. Ambrosino <i>et al.</i>            | (KLOE Collab.)            | REFID=52573         |
| AULCHENKO  | 08  | JETPL 88 85             | V. Aulchenko <i>et al.</i>            | (CMD-2 Collab.)           | REFID=52268         |

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 |
| DUBYSKIY    | 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 |
|             |     | Translated from ZETF 124 28.   |                                                |                             |             |
| 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 |
|             |     | Translated from ZETFP 75 539.  |                                                |                             |             |
| 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 |
| ALOISIO     | 02E | PL B541 45                     | A. Aloisio <i>et al.</i>                       | (KLOE Collab.)              | REFID=48825 |
| FISCHBACH   | 02  | PL B526 355                    | E. Fischbach, A.W. Overhauser, B. Woodahl      |                             | REFID=48575 |
| GOKALP      | 02  | JP G28 2783                    | A. Gokalp <i>et al.</i>                        |                             | REFID=49167 |
| ACHASOV     | 01B | PL B504 275                    | M.N. Achasov <i>et al.</i>                     | (Novosibirsk SND Collab.)   | REFID=48111 |
| ACHASOV     | 01E | PR D63 072002                  | M.N. Achasov <i>et al.</i>                     | (Novosibirsk SND Collab.)   | REFID=48311 |
| ACHASOV     | 01F | PR D63 094007                  | N.N. Achasov, V.V. Gubin                       | (Novosibirsk SND Collab.)   | REFID=48312 |
| ACHASOV     | 01G | PRL 86 1698                    | M.N. Achasov <i>et al.</i>                     | (Novosibirsk SND Collab.)   | REFID=48315 |
| AITALA      | 01B | PRL 86 770                     | E.M. Aitala <i>et al.</i>                      | (FNAL E791 Collab.)         | REFID=48005 |
| AKHMETSHIN  | 01  | PL B501 191                    | R.R. Akhmetshin <i>et al.</i>                  | (Novosibirsk CMD-2 Collab.) | REFID=48110 |
| AKHMETSHIN  | 01B | PL B509 217                    | R.R. Akhmetshin <i>et al.</i>                  | (Novosibirsk CMD-2 Collab.) | REFID=48167 |
| AKHMETSHIN  | 01C | PL B503 237                    | R.R. Akhmetshin <i>et al.</i>                  | (Novosibirsk CMD-2 Collab.) | REFID=48323 |
| BENAYOUN    | 01  | EPJ C22 503                    | M. Benayoun, H.B. O'Connell                    |                             | REFID=48570 |
| ACHASOV     | 00  | EPJ C12 25                     | M.N. Achasov <i>et al.</i>                     | (Novosibirsk SND Collab.)   | REFID=47417 |
| ACHASOV     | 00B | JETP 90 17                     | M.N. Achasov <i>et al.</i>                     | (Novosibirsk SND Collab.)   | REFID=47425 |
|             |     | Translated from ZETF 117 22.   |                                                |                             |             |
| ACHASOV     | 00C | PL B474 188                    | M.N. Achasov <i>et al.</i>                     | (Novosibirsk SND Collab.)   | REFID=47431 |
| ACHASOV     | 00D | JETPL 72 282                   | M.N. Achasov <i>et al.</i>                     | (Novosibirsk SND Collab.)   | REFID=47882 |
|             |     | Translated from ZETFP 72 411.  |                                                |                             |             |
| ACHASOV     | 00E | NP B569 158                    | M.N. Achasov <i>et al.</i>                     | (Novosibirsk SND Collab.)   | REFID=47927 |
| ACHASOV     | 00F | PL B479 53                     | M.N. Achasov <i>et al.</i>                     | (Novosibirsk SND Collab.)   | REFID=47928 |
| ACHASOV     | 00H | PL B485 349                    | M.N. Achasov <i>et al.</i>                     | (Novosibirsk SND Collab.)   | REFID=47930 |
| AKHMETSHIN  | 00B | PL B473 337                    | R.R. Akhmetshin <i>et al.</i>                  | (Novosibirsk CMD-2 Collab.) | REFID=47422 |
| AKHMETSHIN  | 00E | PL B491 81                     | R.R. Akhmetshin <i>et al.</i>                  | (Novosibirsk CMD-2 Collab.) | REFID=47936 |
| AKHMETSHIN  | 00F | PL B494 26                     | R.R. Akhmetshin <i>et al.</i>                  | (Novosibirsk CMD-2 Collab.) | REFID=47937 |
| AULCHENKO   | 00A | JETP 90 927                    | V.M. Aulchenko <i>et al.</i>                   | (Novosibirsk SND Collab.)   | REFID=47953 |
|             |     | Translated from ZETF 117 1067. |                                                |                             |             |
| 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 |
| ACHASOV     | 99  | PL B449 122                    | M.N. Achasov <i>et al.</i>                     |                             | REFID=46896 |
| ACHASOV     | 99C | PL B456 304                    | M.N. Achasov <i>et al.</i>                     |                             | REFID=46939 |
| AKHMETSHIN  | 99B | PL B462 371                    | R.R. Akhmetshin <i>et al.</i>                  | (Novosibirsk CMD-2 Collab.) | REFID=47392 |
| AKHMETSHIN  | 99C | PL B462 380                    | R.R. Akhmetshin <i>et al.</i>                  | (Novosibirsk CMD-2 Collab.) | REFID=47393 |
| AKHMETSHIN  | 99D | PL B466 385                    | R.R. Akhmetshin <i>et al.</i>                  |                             | REFID=47397 |
| Also        |     | PL B508 217 (errat.)           | R.R. Akhmetshin <i>et al.</i>                  | (Novosibirsk CMD-2 Collab.) | REFID=48328 |
| 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 |
|             |     | Translated from ZETFP 69 87.   |                                                |                             |             |
| ACHASOV     | 98B | PL B438 441                    | M.N. Achasov <i>et al.</i>                     | (Novosibirsk SND Collab.)   | REFID=46317 |
| ACHASOV     | 98F | JETPL 68 573                   | M.N. Achasov <i>et al.</i>                     | (Novosibirsk SND Collab.)   | REFID=46321 |
| ACHASOV     | 98I | PL B440 442                    | M.N. Achasov <i>et al.</i>                     |                             | REFID=46600 |
| 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)                     |
| CORDIER                                 | 79  | PL 81B 389                 | A. Cordier <i>et al.</i>                    | (LALO)                     |
| BUKIN                                   | 78B | SJNP 27 521                | A.D. Bukin <i>et al.</i>                    | (NOVO)                     |
|                                         |     | Translated from YAF 27 985 |                                             |                            |
| BUKIN                                   | 78C | SJNP 27 516                | A.D. Bukin <i>et al.</i>                    | (NOVO)                     |
|                                         |     | Translated from YAF 27 976 |                                             |                            |
| COOPER                                  | 78B | NP B146 1                  | A.M. Cooper <i>et al.</i>                   | (TATA, CERN, CDEF+)        |
| LOSTY                                   | 78  | NP B133 38                 | M.J. Losty <i>et al.</i>                    | (CERN, AMST, NIJM+)        |
| AKERLOF                                 | 77  | PRL 39 861                 | C.W. Akerlof <i>et al.</i>                  | (FNAL, MICH, PURD)         |
| ANDREWS                                 | 77  | PRL 38 198                 | D.E. Andrews <i>et al.</i>                  | (ROCH)                     |
| BALDI                                   | 77  | PL 68B 381                 | R. Baldi <i>et al.</i>                      | (GEVA)                     |
| CERRADA                                 | 77B | NP B126 241                | M. Cerrada <i>et al.</i>                    | (AMST, CERN, NIJM+)        |
| COHEN                                   | 77  | PRL 38 269                 | D. Cohen <i>et al.</i>                      | (ANL)                      |
| LAVEN                                   | 77  | NP B127 43                 | H. Laven <i>et al.</i>                      | (AACH3, BERL, CERN, LOIC+) |
| LYONS                                   | 77  | NP B125 207                | L. Lyons, A.M. Cooper, A.G. Clark           | (OXF)                      |
| COSME                                   | 76  | PL 63B 352                 | G. Cosme <i>et al.</i>                      | (ORSAY)                    |
| KALBFLEISCH                             | 76  | PR D13 22                  | G.R. Kalbfleisch, R.C. Strand, J.W. Chapman | (BNL+)                     |
| PARROUR                                 | 76  | PL 63B 357                 | G. Parrou <i>et al.</i>                     | (ORSAY)                    |
| PARROUR                                 | 76B | PL 63B 362                 | G. Parrou <i>et al.</i>                     | (ORSAY)                    |
| KALBFLEISCH                             | 75  | PR D11 987                 | G.R. Kalbfleisch, R.C. Strand, J.W. Chapman | (BNL+)                     |
| AYRES                                   | 74  | PRL 32 1463                | D.S. Ayres <i>et al.</i>                    | (ANL)                      |
| BESCH                                   | 74  | NP B70 257                 | H.J. Besch <i>et al.</i>                    | (BONN)                     |
| COSME                                   | 74  | PL 48B 155                 | G. Cosme <i>et al.</i>                      | (ORSAY)                    |
| COSME                                   | 74B | PL 48B 159                 | G. Cosme <i>et al.</i>                      | (ORSAY)                    |
| DEGROOT                                 | 74  | NP B74 77                  | A.J. de Groot <i>et al.</i>                 | (AMST, NIJM)               |
| AUGUSTIN                                | 73  | PRL 30 462                 | J.E. Augustin <i>et al.</i>                 | (ORSAY)                    |
| BALLAM                                  | 73  | PR D7 3150                 | J. Ballam <i>et al.</i>                     | (SLAC, LBL)                |
| BINNIE                                  | 73B | PR D8 2789                 | D.M. Binnie <i>et al.</i>                   | (LOIC, SHMP)               |
| AGUILAR-...                             | 72B | PR D6 29                   | M. Aguilar-Benitez <i>et al.</i>            | (BNL)                      |
| ALVENSLEB...                            | 72  | PRL 28 66                  | H. Alvensleben <i>et al.</i>                | (MIT, DESY)                |
| BORENSTEIN                              | 72  | PR D5 1559                 | S.R. Borenstein <i>et al.</i>               | (BNL, MICH)                |
| COLLEY                                  | 72  | NP B50 1                   | D.C. Colley <i>et al.</i>                   | (BIRM, GLAS)               |
| BALAKIN                                 | 71  | PL 34B 328                 | V.E. Balakin <i>et al.</i>                  | (NOVO)                     |
| CHATELUS                                | 71  | Thesis LAL 1247            | Y. Chatelus                                 | (STRB)                     |
| Also                                    |     | PL 32B 416                 | J.C. Bizot <i>et al.</i>                    | (ORSAY)                    |
| HAYES                                   | 71  | PR D4 899                  | S. Hayes <i>et al.</i>                      | (CORN)                     |
| STOTTLE...                              | 71  | Thesis ORO 2504 170        | A.R. Stottlemeyer                           | (UMD)                      |
| BIZOT                                   | 70  | PL 32B 416                 | J.C. Bizot <i>et al.</i>                    | (ORSAY)                    |
| Also                                    |     | Liverpool Sym. 69          | J.P. Perez-y-Jorba                          |                            |
| EARLES                                  | 70  | PRL 25 1312                | D.R. Earles <i>et al.</i>                   | (NEAS)                     |
| LINDSEY                                 | 66  | PR 147 913                 | J.S. Lindsey, G. Smith                      | (LRL)                      |
| LONDON                                  | 66  | PR 143 1034                | G.W. London <i>et al.</i>                   | (BNL, SYRA) IGJPC          |
| BADIER                                  | 65B | PL 17 337                  | J. Badier <i>et al.</i>                     | (EPOL, SACL, AMST)         |
| LINDSEY                                 | 65  | PRL 15 221                 | J.S. Lindsey, G.A. Smith                    | (LRL)                      |
| LINDSEY 65 data included in LINDSEY 66. |     |                            |                                             |                            |
| SCHLEIN                                 | 63  | PRL 10 368                 | P.E. Schlein <i>et al.</i>                  | (UCLA) IGJP                |

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NODE=M030M;LINKAGE=C  
  
NODE=M030W  
  
NODE=M030W  
→ UNCHECKED ←  
  
OCCUR=2  
  
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NODE=M030W;LINKAGE=C

# $h_1(1170)$

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

## $h_1(1170)$ MASS

| VALUE (MeV)                                                                           | DOCUMENT ID             | TECN | CHG    | COMMENT                                     |
|---------------------------------------------------------------------------------------|-------------------------|------|--------|---------------------------------------------|
| <b>1170±20 OUR ESTIMATE</b>                                                           |                         |      |        |                                             |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●         |                         |      |        |                                             |
| 1168± 4                                                                               | ANDO                    | 92   | SPEC   | $8 \pi^- p \rightarrow \pi^+ \pi^- \pi^0 n$ |
| 1166± 5±3                                                                             | <sup>1</sup> 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.                                             |                         |      |        |                                             |

## $h_1(1170)$ WIDTH

| VALUE (MeV)                                                                           | DOCUMENT ID             | TECN | CHG    | COMMENT                                     |
|---------------------------------------------------------------------------------------|-------------------------|------|--------|---------------------------------------------|
| <b>360±40 OUR ESTIMATE</b>                                                            |                         |      |        |                                             |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●         |                         |      |        |                                             |
| 345± 6                                                                                | ANDO                    | 92   | SPEC   | $8 \pi^- p \rightarrow \pi^+ \pi^- \pi^0 n$ |
| 375± 6±34                                                                             | <sup>3</sup> 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.                                             |                         |      |        |                                             |



**$h_1(1170)$  DECAY MODES**

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------|--------------------------------|
| $\Gamma_1 \quad \rho\pi$ | seen                           |

 **$h_1(1170)$  BRANCHING RATIOS**

| $\Gamma(\rho\pi)/\Gamma_{\text{total}}$                                       |             |      |         | $\Gamma_1/\Gamma$                                |
|-------------------------------------------------------------------------------|-------------|------|---------|--------------------------------------------------|
| 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    | $8 \pi p \rightarrow 3 \pi n$                    |

 **$h_1(1170)$  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)            |

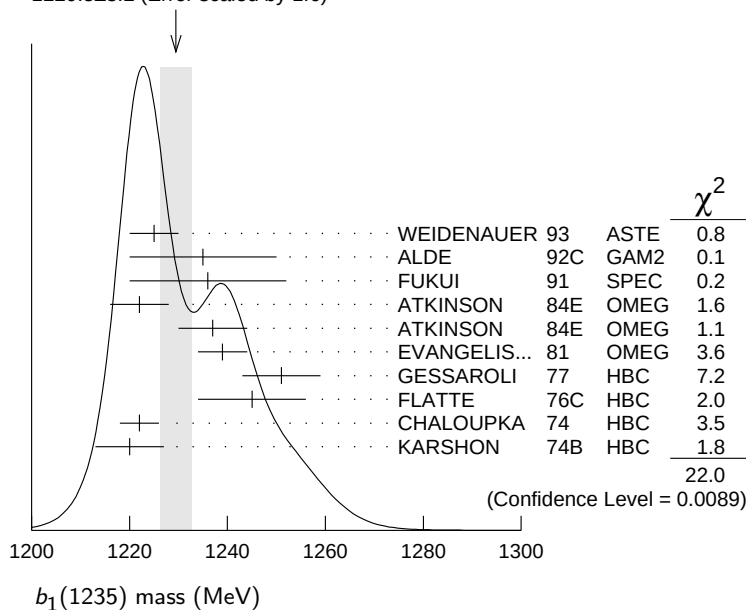
 **$b_1(1235)$** 

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

 **$b_1(1235)$  MASS**

| 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 + | $200 \pi^+ Z \rightarrow Z \pi \omega$        |

WEIGHTED AVERAGE  
1229.5±3.2 (Error scaled by 1.6)



NODE=M030215;NODE=M030

DESIG=1;OUR EST;→ UNCHECKED ←

NODE=M030220

NODE=M030R1  
NODE=M030R1

NODE=M030

REFID=43171  
REFID=20574  
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REFID=20571

NODE=M011

NODE=M011M

NODE=M011M

OCCUR=2

**$b_1(1235)$  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 | 0   | 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                           |                  |
| $\Gamma_6$ $(K\bar{K})^\pm \pi^0$                                     | < 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

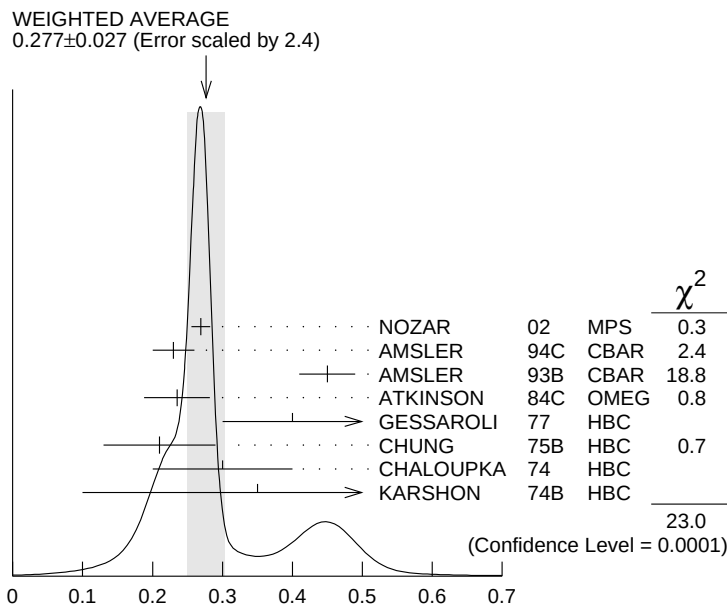
| $\Gamma(\pi^\pm \gamma)$ |             |      |     |                                        | $\Gamma_2$ |
|--------------------------|-------------|------|-----|----------------------------------------|------------|
| VALUE (keV)              | DOCUMENT ID | TECN | CHG | COMMENT                                |            |
| <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 ratio in decay of  $b_1(1235) \rightarrow \omega \pi$

### $b_1(1235)$ D-wave/S-wave AMPLITUDE PHASE DIFFERENCE IN DECAY OF $b_1(1235) \rightarrow \omega \pi$

NODE=M011PH

| VALUE (°)           | DOCUMENT ID | TECN | CHG | COMMENT                                   |
|---------------------|-------------|------|-----|-------------------------------------------|
| <b>10.5±2.4±3.9</b> | NOZAR       | 02   | MPS | — 18 $\pi^- p \rightarrow \omega \pi^- p$ |

NODE=M011PH

### $b_1(1235)$ BRANCHING RATIOS

NODE=M011230

#### $\Gamma(\eta\rho)/\Gamma(\omega\pi)$

#### $\Gamma_3/\Gamma_1$

| VALUE           | DOCUMENT ID | TECN | CHG  | COMMENT          |
|-----------------|-------------|------|------|------------------|
| <b>&lt;0.10</b> | ATKINSON    | 84D  | OMEG | 20–70 $\gamma p$ |

NODE=M011R9  
NODE=M011R9

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

#### $\Gamma_4/\Gamma_1$

| VALUE          | DOCUMENT ID | TECN | CHG | COMMENT         |
|----------------|-------------|------|-----|-----------------|
| <b>&lt;0.5</b> | ABOLINS     | 63   | HBC | + 3.5 $\pi^+ p$ |

NODE=M011R1  
NODE=M011R1

#### $\Gamma(K^*(892)^\pm K^\mp)/\Gamma_{\text{total}}$

#### $\Gamma_5/\Gamma$

| VALUE       | DOCUMENT ID          | TECN | CHG  | COMMENT                                        |
|-------------|----------------------|------|------|------------------------------------------------|
| <b>seen</b> | <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

#### $\Gamma((K\bar{K})^\pm \pi^0)/\Gamma(\omega\pi)$

#### $\Gamma_6/\Gamma_1$

| VALUE           | CL% | DOCUMENT ID | TECN | CHG | COMMENT           |
|-----------------|-----|-------------|------|-----|-------------------|
| <b>&lt;0.08</b> | 90  | BALTAY      | 67   | HBC | ± 0.0 $\bar{p} p$ |

NODE=M011R6  
NODE=M011R6

#### $\Gamma(K_S^0 K_L^0 \pi^\pm)/\Gamma(\omega\pi)$

#### $\Gamma_7/\Gamma_1$

| VALUE           | CL% | DOCUMENT ID | TECN | CHG | COMMENT           |
|-----------------|-----|-------------|------|-----|-------------------|
| <b>&lt;0.06</b> | 90  | BALTAY      | 67   | HBC | ± 0.0 $\bar{p} p$ |

NODE=M011R8  
NODE=M011R8

#### $\Gamma(K_S^0 K_S^0 \pi^\pm)/\Gamma(\omega\pi)$

#### $\Gamma_8/\Gamma_1$

| VALUE           | CL% | DOCUMENT ID | TECN | CHG | COMMENT           |
|-----------------|-----|-------------|------|-----|-------------------|
| <b>&lt;0.02</b> | 90  | BALTAY      | 67   | HBC | ± 0.0 $\bar{p} p$ |

NODE=M011R7  
NODE=M011R7

#### $\Gamma(\phi\pi)/\Gamma(\omega\pi)$

#### $\Gamma_9/\Gamma_1$

| VALUE            | CL% | DOCUMENT ID | TECN | CHG  | COMMENT                                      |
|------------------|-----|-------------|------|------|----------------------------------------------|
| <b>&lt;0.004</b> | 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+)       |
| 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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REFID=20006

NODE=M010

 **$a_1(1260)$** 

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

See also our review under the  $a_1(1260)$  in PDG 06, Journal of Physics **G33** 1 (2006).

NODE=M010

 **$a_1(1260)$  MASS**

NODE=M010M

| VALUE (MeV)                                                                   | EVTS                | DOCUMENT ID                                                                  | TECN | COMMENT                                                                                         |
|-------------------------------------------------------------------------------|---------------------|------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------------------|
| <b>1230 ±40</b>                                                               | <b>OUR ESTIMATE</b> |                                                                              |      |                                                                                                 |
| <b>1299 +12<br/>-28</b>                                                       | <b>OUR AVERAGE</b>  | [1245 <sup>+10</sup> <sub>-16</sub> MeV OUR 2018 AVERAGE Scale factor = 1.1] |      |                                                                                                 |
| <b>1299 +12<br/>-28</b>                                                       | 46M                 | 1 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                                                                         | 18Ai | LHCB $D^0 \rightarrow K^\mp \pi^\pm \pi^\pm \pi^\mp$                                            |
| 1209 ± 4 +12<br>-9                                                            |                     | 2 MIKHASENKO                                                                 | 18   | RVUE $\tau^- \rightarrow \pi^- \pi^+ \pi^- \nu_\tau$                                            |
| 1225 ± 9 ±20                                                                  | 7k                  | 3 DARGENT                                                                    | 17   | RVUE $D^0 \rightarrow \pi^- \pi^+ \pi^- \pi^+$                                                  |
| 1255 ± 6 +7<br>-17                                                            | 420k                | 4 ALEKSEEV                                                                   | 10   | COMP 190 $\pi^- Pb \rightarrow \pi^- \pi^- \pi^+ Pb'$                                           |
| 1243 ±12 ±20                                                                  |                     | 5 AUBERT                                                                     | 07AU | BABR 10.6 $e^+ e^- \rightarrow \rho^0 \rho^\pm \pi^\mp \gamma$                                  |
| 1230-1270                                                                     | 6360                | 6 LINK                                                                       | 07A  | FOCS $D^0 \rightarrow \pi^- \pi^+ \pi^- \pi^+$                                                  |
| 1203 ± 3                                                                      |                     | 7 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                 | 8 ASNER                                                                      | 00   | CLE2 10.6 $e^+ e^- \rightarrow \tau^+ \tau^-$ , $\tau^- \rightarrow \pi^- \pi^0 \pi^0 \nu_\tau$ |
| 1255 ± 7 ± 6                                                                  | 5904                | 9 ABREU                                                                      | 98G  | DLPH $e^+ e^-$                                                                                  |
| 1207 ± 5 ± 8                                                                  | 5904                | 10 ABREU                                                                     | 98G  | DLPH $e^+ e^-$                                                                                  |
| 1196 ± 4 ± 5                                                                  | 5904                | 11,12 ABREU                                                                  | 98G  | DLPH $e^+ e^-$                                                                                  |
| 1240 ±10                                                                      |                     | BARBERIS                                                                     | 98B  | 450 $pp \rightarrow p_f \pi^+ \pi^- \pi^0 p_s$                                                  |
| 1262 ± 9 ± 7                                                                  |                     | 9,13 ACKERSTAFF                                                              | 97R  | OPAL $E_{cm}^{ee} = 88-94, \tau \rightarrow 3\pi \nu$                                           |
| 1210 ± 7 ± 2                                                                  |                     | 10,13 ACKERSTAFF                                                             | 97R  | OPAL $E_{cm}^{ee} = 88-94, \tau \rightarrow 3\pi \nu$                                           |
| 1211 ± 7 +50<br>-0                                                            |                     | 10 ALBRECHT                                                                  | 93C  | ARG $\tau^+ \rightarrow \pi^+ \pi^+ \pi^- \nu$                                                  |
| 1121 ± 8                                                                      |                     | 14 ANDO                                                                      | 92   | SPEC 8 $\pi^- p \rightarrow \pi^+ \pi^- \pi^0 n$                                                |
| 1242 ±37                                                                      |                     | 15 IVANOV                                                                    | 91   | RVUE $\tau \rightarrow \pi^+ \pi^+ \pi^- \nu$                                                   |
| 1260 ±14                                                                      |                     | 16 IVANOV                                                                    | 91   | RVUE $\tau \rightarrow \pi^+ \pi^+ \pi^- \nu$                                                   |
| 1250 ± 9                                                                      |                     | 17 IVANOV                                                                    | 91   | RVUE $\tau \rightarrow \pi^+ \pi^+ \pi^- \nu$                                                   |
| 1208 ±15                                                                      |                     | ARMSTRONG                                                                    | 90   | OMEG 300.0 $pp \rightarrow pp \pi^+ \pi^- \pi^0$                                                |
| 1220 ±15                                                                      |                     | 18 ISGUR                                                                     | 89   | RVUE $\tau^+ \rightarrow \pi^+ \pi^+ \pi^- \nu$                                                 |
| 1260 ±25                                                                      |                     | 19 BOWLER                                                                    | 88   | RVUE                                                                                            |
| 1166 ±18 ±11                                                                  |                     | BAND                                                                         | 87   | MAC $\tau^+ \rightarrow \pi^+ \pi^+ \pi^- \nu$                                                  |

NODE=M010M

NODE=M010M  
→ UNCHECKED ←

NEW

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  | $4.2 K^- p \rightarrow \Sigma 3\pi$          |

<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.

OCCUR=2

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### $a_1(1260)$ WIDTH

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                 | TECN | COMMENT                                                                                      |
|-------------------------------------------------------------------------------|------|-----------------------------|------|----------------------------------------------------------------------------------------------|
| <b>250 to 600 OUR ESTIMATE</b>                                                |      |                             |      |                                                                                              |
| <b>420 <math>\pm 35</math> OUR AVERAGE</b>                                    |      |                             |      |                                                                                              |
| [389 $\pm 29$ MeV OUR 2018 AVERAGE Scale factor = 1.3]                        |      |                             |      |                                                                                              |
| 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 $\pm 11$ $^{+89}_{-20}$                                                   |      | <sup>2</sup> MIKHASENKO     | 18   | RVUE $\tau^- \rightarrow \pi^- \pi^+ \pi^- \nu_\tau$                                         |
| 367 $\pm 9$ $^{+28}_{-25}$                                                    | 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 $10.6 e^+ e^- \rightarrow \rho^0 \pi^\pm \pi^\mp \gamma$                                |
| 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 $E_{\text{cm}}^{\text{e}} = 88\text{--}94, \tau \rightarrow 3\pi \nu$                   |

NODE=M010W

NODE=M010W  
→ UNCHECKED ←  
NEW

OCCUR=2

OCCUR=3

|     |                  |                |       |            |     |      |                                                               |         |
|-----|------------------|----------------|-------|------------|-----|------|---------------------------------------------------------------|---------|
| 457 | $\pm 15$         | $\pm 17$       | 12,15 | ACKERSTAFF | 97R | OPAL | $E_{\text{cm}}^{\text{ee}} = 88-94, \tau \rightarrow 3\pi\nu$ | OCCUR=2 |
| 446 | $\pm 21$         | $+140$<br>$-0$ | 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 | $+228$<br>$-143$ |                | 17    | IVANOV     | 91  | RVUE | $\tau \rightarrow \pi^+ \pi^+ \pi^- \nu$                      |         |
| 298 | $+40$<br>$-34$   |                | 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 | $+132$<br>$-120$ | $\pm 54$       |       | 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.

NODE=M010W;LINKAGE=Q  
NODE=M010W;LINKAGE=S

NODE=M010W;LINKAGE=R  
NODE=M010W;LINKAGE=AU  
NODE=M010W;LINKAGE=LI  
NODE=M010W;LINKAGE=GO  
NODE=M010W;LINKAGE=DR

NODE=M010W;LINKAGE=B6  
NODE=M010W;LINKAGE=WE  
NODE=M010W;LINKAGE=WB  
NODE=M010W;LINKAGE=KS  
NODE=M010W;LINKAGE=IM

NODE=M010W;LINKAGE=A1  
NODE=M010W;LINKAGE=F1  
NODE=M010W;LINKAGE=X  
NODE=M010W;LINKAGE=P  
NODE=M010W;LINKAGE=I  
NODE=M010W;LINKAGE=L  
NODE=M010W;LINKAGE=M  
NODE=M010W;LINKAGE=K  
NODE=M010W;LINKAGE=G  
NODE=M010W;LINKAGE=D  
NODE=M010W;LINKAGE=F

## $a_1(1260)$ DECAY MODES

NODE=M010215;NODE=M010

| 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** **$\Gamma(\pi\gamma)$**  **$\Gamma_{14}$** 

| VALUE (keV)                     | DOCUMENT ID | TECN     | COMMENT                          |
|---------------------------------|-------------|----------|----------------------------------|
| <b><math>640 \pm 246</math></b> | ZIELINSKI   | 84C SPEC | 200 $\pi^+ Z \rightarrow Z 3\pi$ |

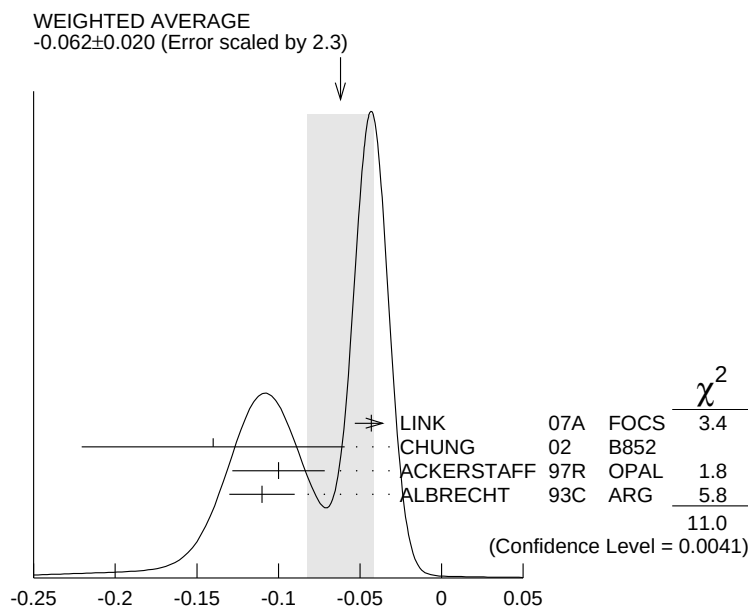
NODE=M010220

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                                        |
|--------------------------------------------------|-------------------------------------------------------------|----------|------------------------------------------------|
| <b><math>-0.062 \pm 0.020</math> OUR AVERAGE</b> | Error includes scale factor of 2.3. See the ideogram below. |          |                                                |
| $-0.043 \pm 0.009 \pm 0.005$                     | LINK                                                        | 07A FOCS | $D^0 \rightarrow \pi^- \pi^+ \pi^- \pi^+$      |
| $-0.14 \pm 0.04 \pm 0.07$                        | <sup>1</sup> CHUNG                                          | 02 B852  | $18.3 \pi^- p \rightarrow \pi^+ \pi^- \pi^- p$ |
| $-0.10 \pm 0.02 \pm 0.02$                        | <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  | $\tau^+ \rightarrow \pi^+ \pi^+ \pi^- \nu$     |

NODE=M010DS

<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=X $D$ -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 | $10.6 e^+ e^- \rightarrow \tau^+ \tau^-$ ,<br>$\tau^- \rightarrow \pi^- \pi^0 \pi^0 \nu_\tau$ |

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 | $10.6 e^+ e^- \rightarrow \tau^+ \tau^-$ ,<br>$\tau^- \rightarrow \pi^- \pi^0 \pi^0 \nu_\tau$ |

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 | $10.6 e^+ e^- \rightarrow \tau^+ \tau^-$ ,<br>$\tau^- \rightarrow \pi^- \pi^0 \pi^0 \nu_\tau$ |

NODE=M010R7  
NODE=M010R7

$\Gamma((\rho(1450)\pi)_{D\text{-wave}}, \rho \rightarrow \pi\pi)/\Gamma_{\text{total}} \quad \Gamma_5/\Gamma$ 

| 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

 $\Gamma(f_0(500)\pi, f_0 \rightarrow \pi\pi)/\Gamma_{\text{total}} \quad \Gamma_6/\Gamma$ 

| 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

 $\Gamma(f_0(500)\pi, f_0 \Rightarrow \pi\pi)/\Gamma((\rho\pi)_{S\text{-wave}}, \rho \Rightarrow \pi\pi) \quad \Gamma_6/\Gamma_2$ 

| 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

 $\Gamma(f_0(980)\pi, f_0 \rightarrow \pi\pi)/\Gamma_{\text{total}} \quad \Gamma_7/\Gamma$ 

| 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

 $\Gamma(f_0(1370)\pi, f_0 \rightarrow \pi\pi)/\Gamma_{\text{total}} \quad \Gamma_8/\Gamma$ 

| 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

 $\Gamma(f_2(1270)\pi, f_2 \rightarrow \pi\pi)/\Gamma_{\text{total}} \quad \Gamma_9/\Gamma$ 

| 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

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

| VALUE | DOCUMENT ID  | COMMENT                                         |
|-------|--------------|-------------------------------------------------|
| seen  | BARBERIS 98B | $450 p p \rightarrow p_f \pi^+ \pi^- \pi^0 p_s$ |

NODE=M010R00  
NODE=M010R00

 $\Gamma(\pi^0 \pi^0 \pi^0)/\Gamma(\pi^+ \pi^- \pi^0) \quad \Gamma_{11}/\Gamma_{10}$ 

| VALUE                                                                         | CL% | DOCUMENT ID | COMMENT                                 |
|-------------------------------------------------------------------------------|-----|-------------|-----------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |                                         |
| $< 0.008$                                                                     | 90  | 7 BARBERIS  | 01 $450 p p \rightarrow p_f 3\pi^0 p_s$ |

NODE=M010R15  
NODE=M010R15

 $\Gamma(K^*(892)K)/\Gamma_{\text{total}} \quad \Gamma_{13}/\Gamma$ 

| 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

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|--------------|------|------------------------------|----------------------------------------|------------------------------|
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| COAN         | 04   | PRL 92 232001                | T.E. Coan <i>et al.</i>                | (CLEO Collab.)               |
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| SALVINI      | 04   | EPJ C35 21                   | P. Salvini <i>et al.</i>               | (OBELIX Collab.)             |
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| ANDO         | 92   | PL B291 496                  | A. Ando <i>et al.</i>                  | (KEK, KYOT, NIRS, SAGA+)     |
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| 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

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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 ± $\frac{1}{2}$ ± 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. • • • |       |                          |          |                                                          |
| 1259 ± 4 ± 4                                                                  | 1.7k  | <sup>9,10</sup> DOBBS    | 15       | $J/\psi \rightarrow \gamma\pi^+\pi^-$                    |
| 1267 ± 4 ± 3                                                                  | 1.5k  | <sup>9,10</sup> DOBBS    | 15       | $\psi(2S) \rightarrow \gamma\pi^+\pi^-$                  |
| 1270 ± 8                                                                      |       | <sup>11</sup> ANISOVICH  | 09 RVUE  | $0.0\bar{p}p, \pi N$                                     |
| 1277 ± 6                                                                      | 870   | <sup>12</sup> SCHEGELSKY | 06A RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$                   |
| 1251 ± 10                                                                     |       | TIKHOMIROV               | 03 SPEC  | $40.0\pi^-C \rightarrow K_S^0 K_S^0 K_L^0 X$             |
| 1260 ± 10                                                                     |       | <sup>13</sup> ALDE       | 97 GAM2  | $450pp \rightarrow pp\pi^0\pi^0$                         |
| 1278 ± 6                                                                      |       | <sup>13</sup> GRYGOREV   | 96 SPEC  | $40\pi^-N \rightarrow K_S^0 K_S^0 X$                     |
| 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  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0 X$                   |
| 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>14</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=C  
 NODE=M005M;LINKAGE=D  
 NODE=M005M;LINKAGE=AN  
 NODE=M005M;LINKAGE=SC  
 NODE=M005M;LINKAGE=QQ  
 NODE=M005M;LINKAGE=J

<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> Using CLEO-c data but not authored by the CLEO Collaboration.

<sup>10</sup> From a fit to a Breit-Wigner line shape with fixed  $\Gamma = 185$  MeV.

<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.

<sup>14</sup> JOHNSON 68 includes BONDAR 63, LEE 64, DERADO 65, EISNER 67.

**$f_2(1270)$  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 ± 1.9 ± 1.8                                                             |       | <sup>1</sup> BOGOLYUB... | 13  | SPEC | $7\pi^+(K^+,p)A \rightarrow n\gamma + X$                 |  |
| 175 <sup>+6</sup> <sub>-4</sub> ± 10                                          |       | <sup>2</sup> ABLIKIM     | 06v | BES2 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\pi^+\pi^-$ |  |
| 190 ± 20                                                                      |       | ABLIKIM                  | 05  | BES2 | $J/\psi \rightarrow \phi\pi^+\pi^-$                      |  |
| 171 ± 10                                                                      |       | ALDE                     | 98  | GAM4 | $100\pi^-p \rightarrow \pi^0\pi^0n$                      |  |
| 204 ± 20                                                                      |       | <sup>3</sup> BERTIN      | 97c | OBLX | $0.0\bar{p}p \rightarrow \pi^+\pi^-\pi^0$                |  |
| 192 ± 5                                                                       | 200k  | PROKOSHKIN               | 94  | GAM2 | $38\pi^-p \rightarrow \pi^0\pi^0n$                       |  |
| 180 ± 24                                                                      |       | AGUILAR-...              | 91  | EHS  | $400pp$                                                  |  |
| 169 ± 9                                                                       | 5730  | <sup>4</sup> AUGUSTIN    | 89  | DM2  | $e^+e^- \rightarrow 5\pi$                                |  |
| 150 ± 30                                                                      | 400   | <sup>4</sup> ALDE        | 87  | GAM4 | $100\pi^-p \rightarrow 4\pi^0n$                          |  |
| 186 <sup>+9</sup> <sub>-2</sub>                                               |       | <sup>5</sup> LONGACRE    | 86  | MPS  | $22\pi^-p \rightarrow n2K_S^0$                           |  |
| 179.2 <sup>+6.9</sup> <sub>-6.6</sub>                                         |       | <sup>6</sup> CHABAUD     | 83  | ASPK | $17\pi^-p$ polarized                                     |  |
| 160 ± 11                                                                      |       | DENNEY                   | 83  | LASS | $10\pi^+N$                                               |  |
| 196 ± 10                                                                      | 3k    | APEL                     | 82  | CNTR | $25\pi^-p \rightarrow n2\pi^0$                           |  |
| 152 ± 9                                                                       |       | <sup>7</sup> CASON       | 82  | STRC | $8\pi^+p \rightarrow \Delta^{++}\pi^0\pi^0$              |  |
| 186 ± 27                                                                      | 11600 | GIDAL                    | 81  | MRK2 | $J/\psi$ decay                                           |  |
| 216 ± 13                                                                      |       | <sup>8</sup> CORDEN      | 79  | OMEG | $12-15\pi^-p \rightarrow n2\pi$                          |  |
| 190 ± 10                                                                      | 10k   | APEL                     | 75  | NICE | $40\pi^-p \rightarrow n2\pi^0$                           |  |
| 192 ± 16                                                                      | 4600  | ENGLER                   | 74  | DBC  | $6\pi^+n \rightarrow \pi^+\pi^-p$                        |  |
| 183 ± 15                                                                      | 5300  | FLATTE                   | 71  | HBC  | $7\pi^+p \rightarrow \Delta^{++}f_2$                     |  |
| 196 ± 30                                                                      |       | <sup>4</sup> STUNTEBECK  | 70  | HBC  | $8\pi^-p, 5.4\pi^+d$                                     |  |
| 216 ± 20                                                                      | 1960  | <sup>4</sup> ARMENISE    | 68  | DBC  | $5.1\pi^+n \rightarrow p\pi^+MM^-$                       |  |
| 128 ± 27                                                                      |       | <sup>4</sup> BOESEBECK   | 68  | HBC  | $8\pi^+p$                                                |  |
| 176 ± 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. ● ● ● |       |                          |     |      |                                                          |  |
| 194 ± 36                                                                      |       | <sup>10</sup> ANISOVICH  | 09  | RVUE | $0.0\bar{p}p, \pi N$                                     |  |
| 195 ± 15                                                                      | 870   | <sup>11</sup> SCHEGELSKY | 06A | RVUE | $\gamma\gamma \rightarrow K_S^0K_S^0$                    |  |
| 121 ± 26                                                                      |       | TIKHOMIROV               | 03  | SPEC | $40.0\pi^-C \rightarrow K_S^0K_S^0K_L^0X$                |  |
| 187 ± 20                                                                      |       | <sup>12</sup> ALDE       | 97  | GAM2 | $450pp \rightarrow pp\pi^0\pi^0$                         |  |
| 184 ± 10                                                                      |       | <sup>12</sup> GRYGOREV   | 96  | SPEC | $40\pi^-N \rightarrow K_S^0K_S^0X$                       |  |
| 200 ± 10                                                                      |       | AKER                     | 91  | CBAR | $0.0\bar{p}p \rightarrow 3\pi^0$                         |  |
| 240 ± 40                                                                      | 3k    | BINON                    | 83  | GAM2 | $38\pi^-p \rightarrow n2\eta$                            |  |
| 187 ± 30                                                                      | 650   | <sup>4</sup> ANTIPOV     | 77  | CIBS | $25\pi^-p \rightarrow p3\pi$                             |  |
| 225 ± 38                                                                      | 16000 | DEUTSCH...               | 76  | HBC  | $16\pi^+p$                                               |  |
| 166 ± 28                                                                      | 600   | <sup>4</sup> TAKAHASHI   | 72  | HBC  | $8\pi^-p \rightarrow n2\pi$                              |  |
| 173 ± 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> 4-poles, 5-channel K matrix fit.

<sup>11</sup> From analysis of L3 data at 91 and 183–209 GeV.

<sup>12</sup> Systematic uncertainties not estimated.

NODE=M005W;LINKAGE=C

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NODE=M005W;LINKAGE=QA

NODE=M005W;LINKAGE=T

NODE=M005W;LINKAGE=L

NODE=M005W;LINKAGE=R

NODE=M005W;LINKAGE=Q

NODE=M005W;LINKAGE=U

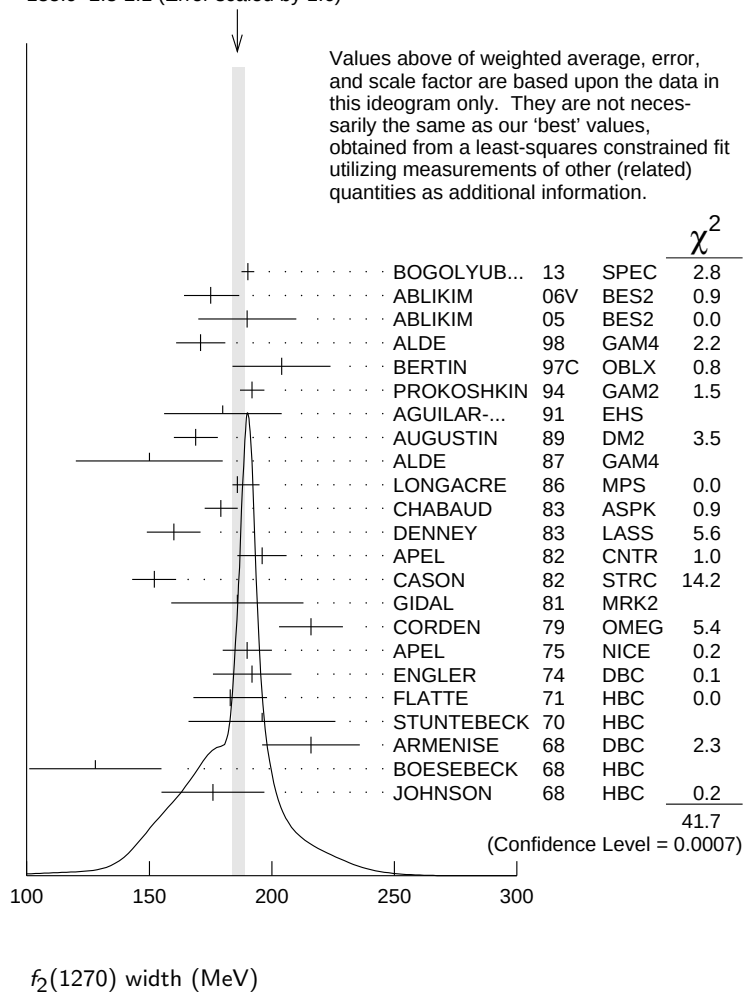
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NODE=M005W;LINKAGE=AN

NODE=M005W;LINKAGE=SC

NODE=M005W;LINKAGE=QQ

WEIGHTED AVERAGE  
185.9±2.8-2.1 (Error scaled by 1.6)



### $f_2(1270)$ 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

DESIG=1

DESIG=3

DESIG=4

DESIG=2

DESIG=7

DESIG=9

DESIG=8

NODE=M005220

| $\Gamma(\pi\pi)$ | VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT | $\Gamma_1$ |
|------------------|-------------|------|-------------|------|---------|------------|
|------------------|-------------|------|-------------|------|---------|------------|

NODE=M005W1  
NODE=M005W1

**157.2 $^{+4.0}_{-1.1}$  OUR FIT**

**157.0 $^{+6.0}_{-1.0}$**  <sup>1</sup> LONGACRE 86 MPS 22  $\pi^- p \rightarrow n 2K_S^0$

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

152  $\pm 8$  870 <sup>2</sup> SCHEGELSKY 06A RVUE  $\gamma\gamma \rightarrow K_S^0 K_S^0$

| $\Gamma(K\bar{K})$ | VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT | $\Gamma_3$ |
|--------------------|-------------|------|-------------|------|---------|------------|
|--------------------|-------------|------|-------------|------|---------|------------|

NODE=M005W4  
NODE=M005W4

**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  $\pi^- p \rightarrow n 2K_S^0$

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

7.5  $\pm 2.0$  870 <sup>2</sup> SCHEGELSKY 06A RVUE  $\gamma\gamma \rightarrow K_S^0 K_S^0$

| $\Gamma(\eta\eta)$ | VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT | $\Gamma_5$ |
|--------------------|-------------|------|-------------|------|---------|------------|
|--------------------|-------------|------|-------------|------|---------|------------|

NODE=M005W7  
NODE=M005W7

**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  $\pi^- p \rightarrow n 2K_S^0$

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

1.8  $\pm 0.4$  870 <sup>2</sup> SCHEGELSKY 06A RVUE  $\gamma\gamma \rightarrow K_S^0 K_S^0$

| $\Gamma(\gamma\gamma)$ | VALUE (keV) | EVTs | DOCUMENT ID | TECN | COMMENT | $\Gamma_7$ |
|------------------------|-------------|------|-------------|------|---------|------------|
|------------------------|-------------|------|-------------|------|---------|------------|

NODE=M005W8  
NODE=M005W8

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).

| $\Gamma(\gamma\gamma)$ | VALUE (keV) | EVTs | DOCUMENT ID | TECN | COMMENT | $\Gamma_7$ |
|------------------------|-------------|------|-------------|------|---------|------------|
|------------------------|-------------|------|-------------|------|---------|------------|

NODE=M005W8

**2.6  $\pm 0.5$  OUR FIT** Error includes scale factor of 1.4.

**2.93 $\pm 0.40$**  <sup>3</sup> DAI 14A RVUE Compilation

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

|                                             |      |     |                |      |                                                     |
|---------------------------------------------|------|-----|----------------|------|-----------------------------------------------------|
| 3.14±0.20                                   |      | 4,5 | PENNINGTON 08  | RVUE | Compilation                                         |
| 3.82±0.30                                   |      | 5,6 | PENNINGTON 08  | RVUE | Compilation                                         |
| 2.55±0.15                                   | 870  | 2   | 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                              |      | 7   | YABUKI 95      | VNS  |                                                     |
| 2.58±0.13 <sup>+0.36</sup> <sub>-0.27</sub> |      | 8   | BEHREND 92     | CELL | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^-$           |
| 3.10±0.35±0.35                              |      | 9   | 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                                   |      | 10  | 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                               |      | 11  | 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                               |      | 12  | 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                              |      | 13  | 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    |      | 14  | 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                                    |      | 15  | BERGER 80B     | PLUT | $e^+ e^-$                                           |

OCCUR=2  
OCCUR=3

OCCUR=2

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

$\Gamma_{10}$

| VALUE (eV)      | CL% | DOCUMENT ID | TECN    | COMMENT                           |
|-----------------|-----|-------------|---------|-----------------------------------|
| <b>&lt;0.11</b> | 90  | ACHASOV     | 00K SND | $e^+ e^- \rightarrow \pi^0 \pi^0$ |

NODE=M005W9  
NODE=M005W9

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

|      |    |             |    |                                   |
|------|----|-------------|----|-----------------------------------|
| <1.7 | 90 | VOROBYEV 88 | ND | $e^+ e^- \rightarrow \pi^0 \pi^0$ |
|------|----|-------------|----|-----------------------------------|

- From a partial-wave analysis of data using a K-matrix formalism with 5 poles.
- From analysis of L3 data at 91 and 183–209 GeV and using SU(3) relations.
- 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.
- Solution A (preferred solution based on  $\chi^2$ -analysis).
- Dispersion theory based amplitude analysis of BOYER 90, MARSISKE 90, BEHREND 92, and MORI 07.
- Solution B (worse than solution A; still acceptable when systematic uncertainties are included).
- With a narrow scalar state around 1220 MeV.
- Using a unitarized model with a 300 - 500 keV wide scalar at 1100 MeV.
- Using the unitarized model of LYTH 85.
- 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.
- Radiative corrections modify the partial widths; for instance the COURAU 84 value becomes  $2.66 \pm 0.21$  in the calculation of LANDRO 86.
- Using the MENNESSIER 83 model.
- Superseded by BOYER 90.
- If helicity = 2 assumption is not made.
- Using mass, width and  $B(f_2(1270) \rightarrow 2\pi)$  from PDG 78.

NODE=M005PW;LINKAGE=L  
NODE=M005W1;LINKAGE=SC  
NODE=M005W8;LINKAGE=A

NODE=M005W8;LINKAGE=P1  
NODE=M005W8;LINKAGE=P3

NODE=M005W8;LINKAGE=P2

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

$f_2(1270) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$

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±0.020 OUR FIT</b> |             |                  | Error includes scale factor of 1.3.   |
| <b>0.091±0.007±0.027</b>   | 1           | ALBRECHT 90G ARG | $e^+ e^- \rightarrow e^+ e^- K^+ K^-$ |

NODE=M005G1  
NODE=M005G1

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

|                   |   |                  |                                       |
|-------------------|---|------------------|---------------------------------------|
| 0.104±0.007±0.072 | 2 | ALBRECHT 90G ARG | $e^+ e^- \rightarrow e^+ e^- K^+ K^-$ |
|-------------------|---|------------------|---------------------------------------|

OCCUR=2

<sup>1</sup> Using an incoherent background.

<sup>2</sup> Using a coherent background.

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                                  |
|------------------------------|---------------------|----------|------------------------------------------|
| $11.5^{+1.8+4.5}_{-2.0-3.7}$ | <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                                    |
|------------------------------|-------------|----------|--------------------------------------------|
| $3.7 \pm 0.3^{+15.9}_{-2.9}$ | 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

 $\Gamma(\pi\pi)/\Gamma_{\text{total}}$ 
 $\Gamma_1/\Gamma$ 

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

$0.842^{+0.029}_{-0.009}$  OUR FIT Error includes scale factor of 1.1.

$0.837 \pm 0.020$  OUR AVERAGE

|                   |     |         |         |                                          |
|-------------------|-----|---------|---------|------------------------------------------|
| $0.849 \pm 0.025$ |     | 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 $\pi^- p \rightarrow \pi^+ \pi^- n$ |

 $\Gamma(\pi^+ \pi^- 2\pi^0)/\Gamma(\pi\pi)$ 
 $\Gamma_2/\Gamma_1$ 

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 |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

$0.091^{+0.014}_{-0.040}$  OUR FIT Error includes scale factor of 1.2.

$0.15 \pm 0.06$  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  $\pi^+ n \rightarrow p f_2$

 $\Gamma(K\bar{K})/\Gamma(\pi\pi)$ 
 $\Gamma_3/\Gamma_1$ 

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 |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

$0.054^{+0.005}_{-0.006}$  OUR FIT Error includes scale factor of 2.7.

$0.041^{+0.004}_{-0.005}$  OUR AVERAGE

|                                                                               |                          |     |      |                                               |
|-------------------------------------------------------------------------------|--------------------------|-----|------|-----------------------------------------------|
| $0.045 \pm 0.01$                                                              | <sup>1</sup> BARGIOTTI   | 03  | OBLX | $\bar{p}p$                                    |
| $0.037^{+0.008}_{-0.021}$                                                     | ETKIN                    | 82B | MPS  | $23 \pi^- p \rightarrow n 2K_S^0$             |
| $0.045 \pm 0.009$                                                             | 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 | $1\text{--}2.2 \pi^- p \rightarrow K^+ K^- n$ |
| $0.030 \pm 0.005$                                                             | <sup>3</sup> MARTIN      | 79  | RVUE |                                               |
| $0.027 \pm 0.009$                                                             | <sup>4</sup> POLYCHRO... | 79  | STRC | $7 \pi^- p \rightarrow n 2K_S^0$              |
| $0.025 \pm 0.015$                                                             | EMMS                     | 75D | DBC  | $4 \pi^+ n \rightarrow p f_2$                 |
| $0.031 \pm 0.012$                                                             | 20 ADERHOLZ              | 69  | HBC  | $8 \pi^+ p \rightarrow K^+ K^- \pi^+ p$       |

NODE=M005R10  
NODE=M005R10

NODE=M005R2  
NODE=M005R2  
NODE=M005R2

NODE=M005R3  
NODE=M005R3  
NODE=M005R3

$\Gamma(2\pi^+2\pi^-)/\Gamma(\pi\pi)$  $\Gamma_4/\Gamma_1$ 

| VALUE                                     | EVTS                                | DOCUMENT ID | TECN    | COMMENT                                |
|-------------------------------------------|-------------------------------------|-------------|---------|----------------------------------------|
| <b>0.033±0.005 OUR FIT</b>                | Error includes scale factor of 1.2. |             |         |                                        |
| <b>0.033±0.004 OUR AVERAGE</b>            | Error includes scale factor of 1.1. |             |         |                                        |
| 0.024±0.006                               | 160                                 | EMMS        | 75D DBC | $4\pi^+n \rightarrow pf_2$             |
| 0.051±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                                 | LOUIE       | 74 HBC  | $3.9\pi^-p \rightarrow nf_2$           |
| 0.037±0.007                               | 154                                 | ANDERSON    | 73 DBC  | $6\pi^+n \rightarrow pf_2$             |
| 0.047±0.013                               |                                     | OH          | 70 HBC  | $1.26\pi^-p \rightarrow \pi^+\pi^-n$   |

NODE=M005R1  
 NODE=M005R1

 $\Gamma(\eta\eta)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

| VALUE (units 10 <sup>-3</sup> ) | DOCUMENT ID                         | TECN | COMMENT                           |
|---------------------------------|-------------------------------------|------|-----------------------------------|
| <b>4.0±0.8 OUR FIT</b>          | Error includes scale factor of 2.1. |      |                                   |
| <b>2.9±0.5 OUR AVERAGE</b>      |                                     |      |                                   |
| 2.7±0.7                         | BINON 05                            | GAMS | $33\pi^-p \rightarrow \eta\eta n$ |
| 2.8±0.7                         | ALDE 86D                            | GAM4 | $100\pi^-p \rightarrow 2\eta n$   |
| 5.2±1.7                         | BINON 83                            | GAM2 | $38\pi^-p \rightarrow 2\eta n$    |

NODE=M005R7  
 NODE=M005R7

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

| VALUE                                                                         | CL% | DOCUMENT ID  | TECN | COMMENT                                |
|-------------------------------------------------------------------------------|-----|--------------|------|----------------------------------------|
| <b>0.003±0.001</b>                                                            |     | BARBERIS 00E | 450  | $pp \rightarrow p_f\eta\eta p_s$       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |              |      |                                        |
| <0.05                                                                         | 95  | EDWARDS 82F  | CBAL | $e^+e^- \rightarrow e^+e^-2\eta$       |
| <0.016                                                                        | 95  | EMMS 75D     | DBC  | $4\pi^+n \rightarrow pf_2$             |
| <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                          |
|------------------------------|----------|-------------|------|----------------------------------|
| <b>0.0030±0.0010 OUR FIT</b> |          |             |      |                                  |
| <b>0.003 ±0.001</b>          | 400 ± 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 <sup>-5</sup> )                                               | DOCUMENT ID | TECN | COMMENT                                   |
|-------------------------------------------------------------------------------|-------------|------|-------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                           |
| 1.57±0.01 <sup>+1.39</sup> <sub>-0.14</sub>                                   | UEHARA 08A  | BELL | $10.6e^+e^- \rightarrow e^+e^-\pi^0\pi^0$ |

NODE=M005R13  
 NODE=M005R13

 $\Gamma(\eta\pi\pi)/\Gamma(\pi\pi)$  $\Gamma_8/\Gamma_1$ 

| VALUE            | CL% | DOCUMENT ID | TECN | COMMENT                    |
|------------------|-----|-------------|------|----------------------------|
| <b>&lt;0.010</b> | 95  | EMMS 75D    | DBC  | $4\pi^+n \rightarrow pf_2$ |

NODE=M005R5  
 NODE=M005R5

 $\Gamma(K^0K^-\pi^+ + \text{c.c.})/\Gamma(\pi\pi)$  $\Gamma_9/\Gamma_1$ 

| VALUE            | CL% | DOCUMENT ID | TECN | COMMENT                    |
|------------------|-----|-------------|------|----------------------------|
| <b>&lt;0.004</b> | 95  | EMMS 75D    | DBC  | $4\pi^+n \rightarrow pf_2$ |

NODE=M005R4  
 NODE=M005R4

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

| VALUE (units 10 <sup>-10</sup> ) | CL% | DOCUMENT ID | TECN | COMMENT                         |
|----------------------------------|-----|-------------|------|---------------------------------|
| <b>&lt;6</b>                     | 90  | ACHASOV 00K | SND  | $e^+e^- \rightarrow \pi^0\pi^0$ |

NODE=M005R12  
 NODE=M005R12

<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=M005R;LINKAGE=BG  
 NODE=M005R3;LINKAGE=D  
 NODE=M005R3;LINKAGE=F  
 NODE=M005R3;LINKAGE=M

 $f_2(1270)$  REFERENCES

NODE=M005

|                |                              |                                 |                     |
|----------------|------------------------------|---------------------------------|---------------------|
| DOBBS 15       | PR D91 052006                | S. Dobbs <i>et al.</i>          | (NWES)              |
| DAI 14A        | PR D90 036004                | L.-Y. Dai, M.R. Pennington      | (CEBAF)             |
| BOGOLYUB... 13 | PAN 76 1324                  | M.Yu. Bogolyubsky <i>et al.</i> | (HYPERON-M Collab.) |
|                | Translated from YAF 76 1389. |                                 |                     |
| UEHARA 13      | PTEP 2013 123C01             | S. Uehara <i>et al.</i>         | (BELLE Collab.)     |
| UEHARA 10A     | PR D82 114031                | S. Uehara <i>et al.</i>         | (BELLE Collab.)     |
| ANISOVICH 09   | IJMP A24 2481                | V.V. Anisovich, A.V. Sarantsev  |                     |
| UEHARA 09      | PR D79 052009                | S. Uehara <i>et al.</i>         | (BELLE Collab.)     |
| PDG 08         | PL B667 1                    | C. Amsler <i>et al.</i>         | (PDG Collab.)       |
| PENNINGTON 08  | EPJ C56 1                    | M.R. Pennington <i>et al.</i>   |                     |
| UEHARA 08A     | PR D78 052004                | S. Uehara <i>et al.</i>         | (BELLE Collab.)     |
| MORI 07        | PR D75 051101                | T. Mori <i>et al.</i>           | (BELLE Collab.)     |
| ABLIKIM 06V    | PL B642 441                  | M. Ablikim <i>et al.</i>        | (BES Collab.)       |
| SCHEGELSKY 06A | EPJ A27 207                  | V.A. Schegelsky <i>et al.</i>   |                     |
| ABLIKIM 05     | PL B607 243                  | M. Ablikim <i>et al.</i>        | (BES Collab.)       |
| BINON 05       | PAN 68 960                   | F. Binon <i>et al.</i>          |                     |
|                | Translated from YAF 68 998.  |                                 |                     |

REFID=56805  
 REFID=55923  
 REFID=55585  
 REFID=55592  
 REFID=53641  
 REFID=52719  
 REFID=52761  
 REFID=52166  
 REFID=52303  
 REFID=52309  
 REFID=51652  
 REFID=51507  
 REFID=51185  
 REFID=50450  
 REFID=50780



|             |     |                               |                                            |                             |             |
|-------------|-----|-------------------------------|--------------------------------------------|-----------------------------|-------------|
| ABLIKIM     | 04E | PL B603 138                   | M. Ablikim <i>et al.</i>                   | (BES Collab.)               | REFID=50174 |
| BARGIOTTI   | 03  | EPJ C26 371                   | M. Bargiotti <i>et al.</i>                 | (OBELIX Collab.)            | REFID=49217 |
| TIKHOMIROV  | 03  | PAN 66 828                    | G.D. Tikhomirov <i>et al.</i>              |                             | REFID=49423 |
|             |     | Translated from YAF 66 860.   |                                            |                             |             |
| ACHASOV     | 00K | PL B492 8                     | M.N. Achasov <i>et al.</i>                 | (Novosibirsk SND Collab.)   | REFID=47933 |
| BARBERIS    | 00E | PL B479 59                    | D. Barberis <i>et al.</i>                  | (WA 102 Collab.)            | REFID=47961 |
| BOGLIONE    | 99  | EPJ C9 11                     | M. Boggione, M.R. Pennington               |                             | REFID=46931 |
| 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.   |                                            |                             |             |
| ALDE        | 97  | PL B397 350                   | 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 |
| GRYGOREV    | 96  | PAN 59 2105                   | V.K. Grigoriev, O.N. Baloshin, B.P. Barkov | (ITEP)                      | REFID=45566 |
|             |     | Translated from YAF 59 2187.  |                                            |                             |             |
| YABUKI      | 95  | JPSJ 64 435                   | F. Yabuki <i>et al.</i>                    | (VENUS Collab.)             | REFID=46384 |
| PROKOSHIN   | 94  | PD 39 420                     | Y.D. Prokoshkin, A.A. Kondashov            | (SERP)                      | REFID=44094 |
|             |     | Translated from DANS 336 613. |                                            |                             |             |
| BEHREND     | 92  | ZPHY C56 381                  | H.J. Behrend                               | (CELLO Collab.)             | REFID=43172 |
| BLINOV      | 92  | ZPHY C53 33                   | A.E. Blinov <i>et al.</i>                  | (NOVO)                      | REFID=41858 |
| AGUILAR-... | 91  | ZPHY C50 405                  | M. Aguilar-Benitez <i>et al.</i>           | (LEBC-EHS Collab.)          | REFID=41637 |
| AKER        | 91  | PL B260 249                   | E. Aker <i>et al.</i>                      | (Crystal Barrel Collab.)    | REFID=41587 |
| ADACHI      | 90D | PL B234 185                   | I. Adachi <i>et al.</i>                    | (TOPAZ Collab.)             | REFID=41345 |
| ALBRECHT    | 90G | ZPHY C48 183                  | H. Albrecht <i>et al.</i>                  | (ARGUS Collab.)             | REFID=41374 |
| 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 |
| MORGAN      | 90  | ZPHY C48 623                  | D. Morgan, M.R. Pennington                 | (RAL, DURH)                 | REFID=41583 |
| 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 |
|             |     | Translated from YAF 48 436.   |                                            |                             |             |
| 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 |
| ABACHI      | 86B | PRL 57 1990                   | S. Abachi <i>et al.</i>                    | (PURD, ANL, IND, MICH+)     | REFID=20394 |
| AIHARA      | 86B | PRL 57 404                    | H. Aihara <i>et al.</i>                    | (TPC-2 $\gamma$ Collab.)    | REFID=20764 |
| ALDE        | 86D | NP B269 485                   | D.M. Alde <i>et al.</i>                    | (BELG, LAPP, SERP, CERN+)   | REFID=20765 |
| LANDRO      | 86  | PL B172 445                   | M. Landro, K.J. Mork, H.A. Olsen           | (UTRO)                      | REFID=20767 |
| LONGACRE    | 86  | PL B177 223                   | R.S. Longacre <i>et al.</i>                | (BNL, BRAN, CUNY+)          | REFID=20768 |
| LYTH        | 85  | JP G11 459                    | D.H. Lyth                                  |                             | REFID=42169 |
| BEHREND     | 84B | ZPHY C23 223                  | H.J. Behrend <i>et al.</i>                 | (CELLO Collab.)             | REFID=20757 |
| BERGER      | 84  | ZPHY C26 199                  | C. Berger <i>et al.</i>                    | (PLUTO Collab.)             | REFID=20760 |
| COURAU      | 84  | PL 147B 227                   | A. Courau <i>et al.</i>                    | (CIT, SLAC)                 | REFID=20758 |
| SMITH       | 84C | PR D30 851                    | J.R. Smith <i>et al.</i>                   | (SLAC, LBL, HARV)           | REFID=20759 |
| BINON       | 83  | NC 78A 313                    | F.G. Binon <i>et al.</i>                   | (BELG, LAPP, SERP+)         | REFID=20750 |
| Also        |     | 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)          | REFID=20131 |
| DENNEY      | 83  | PR D28 2726                   | D.L. Denney <i>et al.</i>                  | (IOWA, MICH)                | REFID=20754 |
| MENNESSIER  | 83  | ZPHY C16 241                  | G. Mennessier                              | (MONP)                      | REFID=20393 |
| APEL        | 82  | NP B201 197                   | W.D. Apel <i>et al.</i>                    | (KARLK, KARLE, PISA, SERP+) | REFID=20745 |
| CASON       | 82  | PRL 48 1316                   | N.M. Cason <i>et al.</i>                   | (NDAM, ANL)                 | REFID=20746 |
| EDWARDS     | 82F | PL 110B 82                    | C. Edwards <i>et al.</i>                   | (CIT, HARV, PRIN+)          | REFID=20747 |
| ETKIN       | 82B | PR D25 1786                   | A. Etkin <i>et al.</i>                     | (BNL, CUNY, TUFTS, VAND)    | REFID=20390 |
| BRANDELIK   | 81B | ZPHY C10 117                  | R. Brandelik <i>et al.</i>                 | (TASSO Collab.)             | REFID=20741 |
| CHABAUD     | 81  | APP B12 575                   | V. Chabaud <i>et al.</i>                   | (CERN, CRAC, MPIM)          | REFID=20742 |
| GIDAL       | 81  | PL 107B 153                   | G. Gidal <i>et al.</i>                     | (SLAC, LBL)                 | REFID=20386 |
| ROUSSARIE   | 81  | PL 105B 304                   | A. Roussarie <i>et al.</i>                 | (SLAC, LBL)                 | REFID=20388 |
| BERGER      | 80B | PL 94B 254                    | C. Berger <i>et al.</i>                    | (PLUTO Collab.)             | REFID=20736 |
| COSTA       | 80  | NP B175 402                   | G. Costa <i>et al.</i>                     | (BARI, BONN, CERN, GLAS+)   | REFID=20737 |
| LOVERRE     | 80  | ZPHY C6 187                   | P.F. Loverre <i>et al.</i>                 | (CERN, CDEF, MADR+)         | REFID=20382 |
| CORDEN      | 79  | NP B157 250                   | M.J. Corden <i>et al.</i>                  | (BIRM, RHEL, TELA+)         | REFID=20374 |
| MARTIN      | 79  | NP B158 520                   | A.D. Martin, E.N. Ozmutlu                  | (DURH)                      | REFID=20377 |
| POLYCHRO... | 79  | PR D19 1317                   | V.A. Polychronakos <i>et al.</i>           | (NDAM, ANL)                 | REFID=20378 |
| PDG         | 78  | PL 75B 1                      | C. Bricman <i>et al.</i>                   |                             | REFID=40124 |
| ANTIPOV     | 77  | NP B119 45                    | Y.M. Antipov <i>et al.</i>                 | (SERP, GEVA)                | REFID=20728 |
| PAWLUCKI    | 77  | PR D15 3196                   | A.J. Pawlicki <i>et al.</i>                | (ANL)                       | REFID=20367 |
| DEUTSCH...  | 76  | NP B103 426                   | M. Deutschmann <i>et al.</i>               | (AACH3, BERL, BONN+)        | REFID=20119 |
| APEL        | 75  | PL 57B 398                    | W.D. Apel <i>et al.</i>                    | (KARLK, KARLE, PISA, SERP+) | REFID=20720 |
| EMMS        | 75D | NP B96 155                    | M.J. Emms <i>et al.</i>                    | (BIRM, DURH, RHEL)          | REFID=20721 |
| EISENBERG   | 74  | PL 52B 239                    | Y. Eisenberg <i>et al.</i>                 | (REHO)                      | REFID=20715 |
| ENGLER      | 74  | PR D10 2070                   | A. Engler <i>et al.</i>                    | (CMU, CASE)                 | REFID=20110 |
| LOUIE       | 74  | PL 48B 385                    | J. Louie <i>et al.</i>                     | (SACL, CERN)                | REFID=20719 |
| ANDERSON    | 73  | PRL 31 562                    | J.C. Anderson <i>et al.</i>                | (CMU, CASE)                 | REFID=20710 |
| TAKAHASHI   | 72  | PR D6 1266                    | K. Takahashi <i>et al.</i>                 | (TOHOK, PENN, NDAM+)        | REFID=20103 |
| BEAUPRE     | 71  | NP B28 77                     | J.V. Beaupre <i>et al.</i>                 | (AACH, BERL, CERN)          | REFID=20698 |
| FLATTE      | 71  | PL 34B 551                    | S.M. Flatte <i>et al.</i>                  | (LBL)                       | REFID=20700 |
| ARMENISE    | 70  | LNC 4 199                     | N. Armenise <i>et al.</i>                  | (BARI, BGNA, FIRZ)          | REFID=20693 |
| OH          | 70  | PR D1 2494                    | B.Y. Oh <i>et al.</i>                      | (WISC, TNTO) JP             | REFID=20335 |
| 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 |
| ARMENISE    | 68  | NC 54A 999                    | N. Armenise <i>et al.</i>                  | (BARI, BGNA, FIRZ+)         | REFID=20054 |
| ASCOLI      | 68D | PRL 21 1712                   | G. Ascoli <i>et al.</i>                    | (ILL)                       | REFID=20681 |
| BOESEBECK   | 68  | NP B4 501                     | K. Boesebeck <i>et al.</i>                 | (AACH, BERL, CERN)          | REFID=20585 |
| JOHNSON     | 68  | PR 176 1651                   | P.B. Johnson <i>et al.</i>                 | (NDAM, PURD, SLAC)          | REFID=20065 |
| EISNER      | 67  | PR 164 1699                   | R.L. Eisner <i>et al.</i>                  | (PURD)                      | REFID=20046 |
| DERADO      | 65  | PRL 14 872                    | I. Derado <i>et al.</i>                    | (NDAM)                      | REFID=20668 |
| LEE         | 64  | PRL 12 342                    | Y.Y. Lee <i>et al.</i>                     | (MICH)                      | REFID=20663 |
| BONDAR      | 63  | PL 5 153                      | L. Bondar <i>et al.</i>                    | (AACH, BIRM, BONN, DESY+)   | REFID=20657 |

$f_1(1285)$ 

$$J^G(J^{PC}) = 0^+(1^{++})$$

NODE=M008

 $f_1(1285)$  MASS

NODE=M008M

NODE=M008M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                                                 | TECN      | COMMENT                                                                       |
|-------------------------------------------------------------------------------|------|-------------------------------------------------------------|-----------|-------------------------------------------------------------------------------|
| <b>1281.9 ± 0.5 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                                                         |      | <sup>1</sup> LEES                                           | 12X BABR  | $\tau^- \rightarrow \pi^- f_1(1285) \nu_\tau$                                 |
| 1285.1 ± 1.0 <sup>+1.6</sup> <sub>-0.3</sub>                                  |      | <sup>2</sup> 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 $pp \rightarrow pp2(\pi^+ \pi^-)$                                         |
| 1281 ± 1                                                                      |      | BARBERIS                                                    | 97C OMEG  | 450 $pp \rightarrow pp K_S^0 K^\pm \pi^\mp$                                   |
| 1280 ± 2                                                                      |      | <sup>3</sup> ANTINORI                                       | 95 OMEG   | 300,450 $pp \rightarrow pp2(\pi^+ \pi^-)$                                     |
| 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 $pp \rightarrow K \bar{K} \pi pp$                                         |
| 1278 ± 2                                                                      |      | ARMSTRONG                                                   | 89G OMEG  | 85 $\pi^+ p \rightarrow 4\pi \pi p, pp \rightarrow 4\pi pp$                   |
| 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 $\pi^+ p \rightarrow K \bar{K} \pi \pi p, pp \rightarrow K \bar{K} \pi pp$ |
| 1286 ± 1                                                                      |      | CHAUVAT                                                     | 84 SPEC   | ISR 31.5 $pp$                                                                 |
| 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. ● ● ● |      |                                                             |           |                                                                               |
| 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   | $pp \rightarrow p_{\text{slow}} (K_S^0 K^+ \pi^-) p_{\text{fast}}$            |
| 1282.8 ± 0.6                                                                  |      | <sup>5</sup> SOSA                                           | 99 SPEC   | $pp \rightarrow p_{\text{slow}} (K_S^0 K^- \pi^+) p_{\text{fast}}$            |
| 1270 ± 10                                                                     |      | AMELIN                                                      | 95 VES    | 37 $\pi^- N \rightarrow \pi^- \pi^+ \pi^- \gamma N$                           |
| 1280 ± 2                                                                      |      | ABATZIS                                                     | 94 OMEG   | 450 $pp \rightarrow pp2(\pi^+ \pi^-)$                                         |
| 1282 ± 4                                                                      |      | ARMSTRONG                                                   | 93C E760  | $\bar{p}p \rightarrow \pi^0 \eta \eta \rightarrow 6\gamma$                    |
| 1270 ± 6 ± 10                                                                 |      | ARMSTRONG                                                   | 92C OMEG  | 300 $pp \rightarrow pp \pi^+ \pi^- \gamma$                                    |
| 1281 ± 1                                                                      |      | ARMSTRONG                                                   | 89E OMEG  | 300 $pp \rightarrow pp2(\pi^+ \pi^-)$                                         |
| 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 $\pi^- p \rightarrow K \bar{K} \pi X$                                     |

OCCUR=2

|           |     |                      |    |      |                                                |
|-----------|-----|----------------------|----|------|------------------------------------------------|
| 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 $\pi^- p \rightarrow n2\gamma 2\pi$        |
| 1271 ± 10 | 34  | CORDEN               | 78 | OMEG | 12-15 $\pi^- p \rightarrow$<br>$K^+ K^- \pi n$ |
| 1295 ± 12 | 85  | CORDEN               | 78 | OMEG | 12-15 $\pi^- p \rightarrow n5\pi$              |
| 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 $\pi^+ p \rightarrow p6\pi$                  |
| 1283 ± 6  |     | BOESEBECK            | 71 | HBC  | 16.0 $\pi p \rightarrow p5\pi$                 |
| 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

<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.

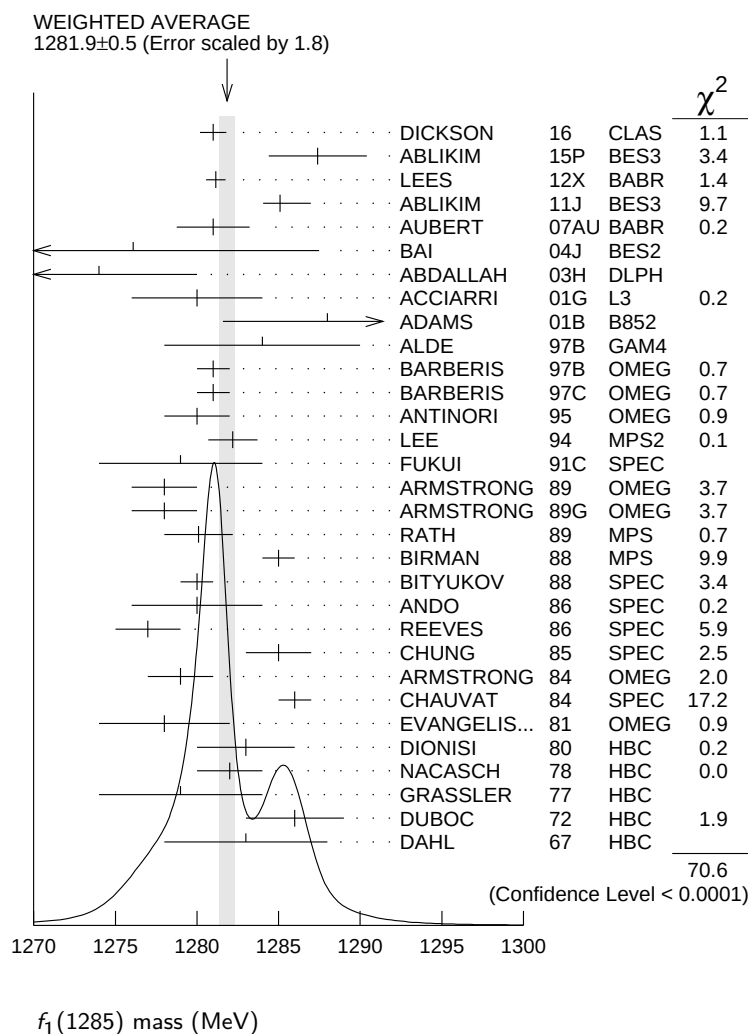
<sup>5</sup> No systematic error given.

<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.

NODE=M008M;LINKAGE=LE  
 NODE=M008M;LINKAGE=BL  
 NODE=M008M;LINKAGE=B  
 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 $\gamma p \rightarrow \eta \pi^+ \pi^- p$         |

NODE=M008W

|                                           |      |                       |      |      |                                                                               |
|-------------------------------------------|------|-----------------------|------|------|-------------------------------------------------------------------------------|
| 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 $pp \rightarrow ppK_S^0 K^\pm \pi^\mp$                                    |
| 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 $p\bar{p} \rightarrow KK\pi X$                                            |
| 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 $p\bar{p} \rightarrow K\bar{K}3\pi$                                  |

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

|                                      |     |                      |     |      |                                                                      |
|--------------------------------------|-----|----------------------|-----|------|----------------------------------------------------------------------|
| 32.4± 5.8                            |     | <sup>4</sup> AAIJ    | 14Y | LHCB | $\bar{B}^0(s) \rightarrow J/\psi 2(\pi^+\pi^-)$                      |
| 18.2± 1.2                            |     | <sup>4</sup> SOSA    | 99  | SPEC | $pp \rightarrow p_{\text{slow}} (K_S^0 K^+ \pi^-)$                   |
| 19.4± 1.5                            |     | <sup>4</sup> SOSA    | 99  | SPEC | $pp \xrightarrow{P_{\text{fast}}} p_{\text{slow}} (K_S^0 K^- \pi^+)$ |
| 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 $\pi^+ p \rightarrow 4\pi\pi p, pp \rightarrow 4\pi pp$           |
| 17.9±10.9                            | 60  | RATH                 | 89  | MPS  | 21.4 $\pi^- p \rightarrow K_S^0 K_S^0 \pi^0 n$                       |
| 14 <sup>+20</sup> <sub>-14</sub> ±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                                 |     | <sup>5</sup> 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 | <sup>6</sup> DEFOIX  | 72  | HBC  | 0.7 $p\bar{p} \rightarrow 7\pi$                                      |
| 46 ± 9                               | 180 | <sup>6</sup> DUBOC   | 72  | HBC  | 1.2 $p\bar{p} \rightarrow 2K4\pi$                                    |
| 37 ± 5                               | 500 | <sup>7</sup> 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                               |     | <sup>6</sup> LORSTAD | 69  | HBC  | 0.7 $p\bar{p}, 4,5\text{-body}$                                      |
| 35 ±10                               |     | <sup>6</sup> DAHL    | 67  | HBC  | 1.6-4.2 $\pi^- p$                                                    |

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.

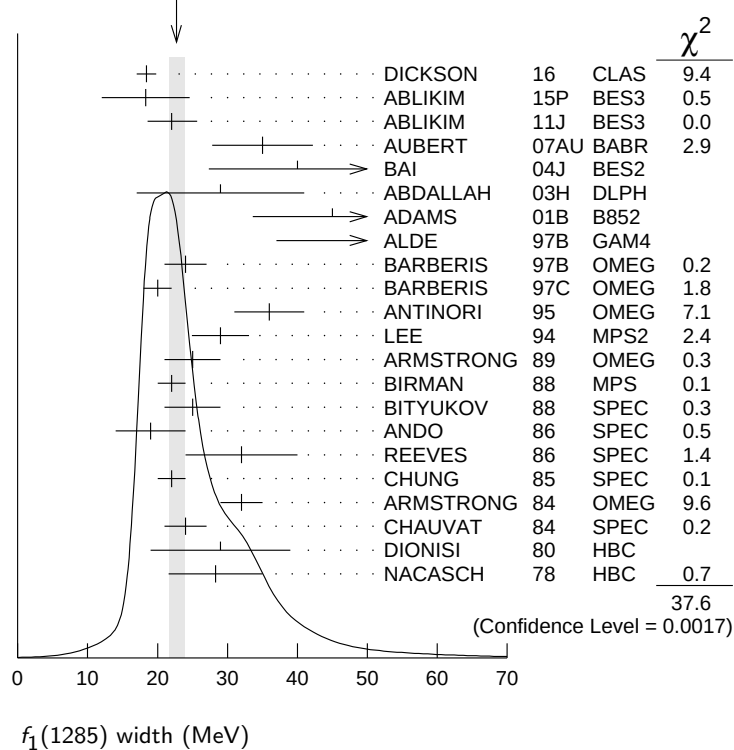
<sup>5</sup> From phase shift analysis of  $\eta\pi^+\pi^-$  system.

<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±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 |           |
|----------------------------------------------------------------------|--------------------------------|-----------------------------------|-----------|
| $\Gamma_1$ $4\pi$                                                    | $(33.5^{+2.0}_{-1.8})\%$       | S=1.3                             | DESIG=21  |
| $\Gamma_2$ $\pi^0\pi^0\pi^+\pi^-$                                    | $(22.3^{+1.3}_{-1.2})\%$       | S=1.3                             | DESIG=22  |
| $\Gamma_3$ $2\pi^+2\pi^-$                                            | $(11.2^{+0.7}_{-0.6})\%$       | S=1.3                             | DESIG=20  |
| $\Gamma_4$ $\rho^0\pi^+\pi^-$                                        | $(11.2^{+0.7}_{-0.6})\%$       | S=1.3                             | 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 |
| $\Gamma_8$ $\eta\pi\pi$                                              | $(52.0^{+1.8}_{-2.1})\%$       | 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   |
| $\Gamma_{11}$ $K\bar{K}\pi$                                          | $(9.1 \pm 0.4)\%$              | 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 |
| $\Gamma_{15}$ $\gamma\rho^0$                                         | $(5.3 \pm 1.2)\%$              | S=2.9                             | DESIG=13  |
| $\Gamma_{16}$ $\phi\gamma$                                           | $(7.5 \pm 2.7) \times 10^{-4}$ |                                   | DESIG=10  |
| $\Gamma_{17}$ $\gamma\gamma^*$                                       |                                |                                   | DESIG=9   |
| $\Gamma_{18}$ $\gamma\gamma$                                         |                                |                                   | DESIG=8   |

## CONSTRAINED FIT INFORMATION

An overall fit to 7 branching ratios uses 19 measurements and one constraint to determine 5 parameters. The overall fit has a  $\chi^2 = 33.5$  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.

|          |       |       |          |          |
|----------|-------|-------|----------|----------|
| $x_9$    | -28   |       |          |          |
| $x_{10}$ | -11   | -88   |          |          |
| $x_{11}$ | 34    | -11   | -5       |          |
| $x_{15}$ | -36   | -7    | -3       | -34      |
|          | $x_1$ | $x_9$ | $x_{10}$ | $x_{11}$ |

### $f_1(1285) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$

NODE=M008217

| $\Gamma(\eta\pi\pi) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$ |     | $\Gamma_8 \Gamma_{18} / \Gamma = (\Gamma_9 + \Gamma_{10}) \Gamma_{18} / \Gamma$ |      |                                                     |
|--------------------------------------------------------------------------|-----|---------------------------------------------------------------------------------|------|-----------------------------------------------------|
| 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

| $\Gamma(\eta\pi\pi) \times \Gamma(\gamma\gamma^*) / \Gamma_{\text{total}}$    |      | $\Gamma_8 \Gamma_{17} / \Gamma = (\Gamma_9 + \Gamma_{10}) \Gamma_{17} / \Gamma$ |      |                                                                           |
|-------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------|------|---------------------------------------------------------------------------|
| VALUE (keV)                                                                   | EVTs | DOCUMENT ID                                                                     | TECN | COMMENT                                                                   |
| <b>1.4 <math>\pm 0.4</math> 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 $183\text{--}209 \text{ e}^+ e^- \rightarrow e^+ e^- \eta \pi^+ \pi^-$ |

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

### $f_1(1285) \text{ BRANCHING RATIOS}$

NODE=M008220

| $\Gamma(K\bar{K}\pi)/\Gamma(4\pi)$ |                                     |      |         | $\Gamma_{11}/\Gamma_1$                      |
|------------------------------------|-------------------------------------|------|---------|---------------------------------------------|
| VALUE                              | DOCUMENT ID                         | TECN | COMMENT |                                             |
| <b>0.272±0.016 OUR FIT</b>         | Error includes scale factor of 1.3. |      |         |                                             |
| <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 $pp \rightarrow pp K_S^0 K^\pm \pi^\mp$ |
| 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 $\pi p \rightarrow 4\pi X$               |

NODE=M008R1  
NODE=M008R1<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;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                         |                                                |
| $0.223^{+0.013}_{-0.012}$ OUR FIT                       | Error includes scale factor of 1.3. |                                                |

NODE=M008R18  
NODE=M008R18

| $\Gamma(2\pi^+ 2\pi^-)/\Gamma_{\text{total}}$ |                                     | $\Gamma_3/\Gamma = \frac{1}{3}\Gamma_1/\Gamma$ |  |
|-----------------------------------------------|-------------------------------------|------------------------------------------------|--|
| VALUE                                         | DOCUMENT ID                         |                                                |  |
| $0.112^{+0.007}_{-0.006}$ OUR FIT             | Error includes scale factor of 1.3. |                                                |  |

NODE=M008R17  
NODE=M008R17

| $\Gamma(\rho^0 \pi^+ \pi^-)/\Gamma_{\text{total}}$ |                                     | $\Gamma_4/\Gamma = \frac{1}{3}\Gamma_1/\Gamma$ |  |
|----------------------------------------------------|-------------------------------------|------------------------------------------------|--|
| VALUE                                              | DOCUMENT ID                         |                                                |  |
| $0.112^{+0.007}_{-0.006}$ OUR FIT                  | Error includes scale factor of 1.3. |                                                |  |

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. • • • |             |      |                        |
| $1.0 \pm 0.4$                                                                 | 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                               |
|-------|-------------|---------------------------------------|
| seen  | 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                                 |
|--------------------------|-----|-------------|------|-----------------------------------------|
| <7                       | 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                                     |
|--------------------------|------|-----------------------|------|---------------------------------------------|
| $0.86 \pm 0.16 \pm 0.20$ | 2.3k | <sup>1</sup> DOROFEEV | 11   | VES $\pi^- N \rightarrow \pi^- f_1(1285) N$ |

NODE=M008R02  
NODE=M008R02

<sup>1</sup> Value obtained selecting the region corresponding to  $f_0(980)$  in the  $\pi^+ \pi^-$  mass spectrum.

NODE=M008R02;LINKAGE=DO

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

$$\Gamma_8 / \Gamma = (\Gamma_9 + \Gamma_{10}) / \Gamma$$

| VALUE                             | DOCUMENT ID                         |
|-----------------------------------|-------------------------------------|
| $0.520^{+0.018}_{-0.021}$ OUR FIT | 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 |
|--------------------------------|-------------------------------------|------|---------|
| $0.64^{+0.06}_{-0.05}$ OUR FIT | Error includes scale factor of 1.2. |      |         |
| $0.41 \pm 0.14$ OUR AVERAGE    |                                     |      |         |

NODE=M008R4  
NODE=M008R4

$0.37 \pm 0.11 \pm 0.11$  BOLTON 92 MRK3  $J/\psi \rightarrow \gamma f_1(1285)$

$0.64 \pm 0.40$  GURTU 79 HBC 4.2  $K^- p$

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

$0.93 \pm 0.30$  <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;LINKAGE=M

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

$$\Gamma_3 / \Gamma_8$$

| VALUE                    | DOCUMENT ID       | TECN | COMMENT                                            |
|--------------------------|-------------------|------|----------------------------------------------------|
| $0.28 \pm 0.02 \pm 0.02$ | <sup>1</sup> LEES | 12X  | BABR $\tau^- \rightarrow \pi^- f_1(1285) \nu_\tau$ |

NODE=M008R04  
NODE=M008R04

<sup>1</sup> Assuming  $B(f_1(1285) \rightarrow \pi \pi \eta) = 3/2 B(f_1(1285) \rightarrow \pi^+ \pi^- \eta)$ .

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 |
|-----------------------------|-----|-------------|------|---------|
| $0.72 \pm 0.08$ OUR FIT     |     |             |      |         |
| $0.72 \pm 0.07$ OUR AVERAGE |     |             |      |         |

NODE=M008R3  
NODE=M008R3

$0.74 \pm 0.02 \pm 0.09$  DICKSON 16 CLAS  $\gamma p \rightarrow f_1(1285) p$

$0.72 \pm 0.15$  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  $e^+ e^- \rightarrow e^+ e^- \eta \pi^+ \pi^-$

$0.28 \pm 0.07$  ALDE 97B GAM4 100  $\pi^- p \rightarrow \eta \pi^0 \pi^0 n$

$1.0 \pm 0.3$  GRASSLER 77 HBC 16  $\pi^\mp p$

$$\Gamma(K \bar{K} \pi) / \Gamma(\eta \pi \pi)$$

$$\Gamma_{11} / \Gamma_8 = \Gamma_{11} / (\Gamma_9 + \Gamma_{10})$$

| VALUE                         | DOCUMENT ID                         | TECN | COMMENT |
|-------------------------------|-------------------------------------|------|---------|
| $0.176 \pm 0.012$ OUR FIT     | Error includes scale factor of 1.1. |      |         |
| $0.176 \pm 0.012$ OUR AVERAGE |                                     |      |         |

NODE=M008R2  
NODE=M008R2

$0.216 \pm 0.010 \pm 0.031$  DICKSON 16 CLAS  $\gamma p \rightarrow f_1(1285) p$

$0.166 \pm 0.01 \pm 0.008$  BARBERIS 98C OMEG 450  $pp \rightarrow p_f f_1(1285) p_s$

$0.42 \pm 0.15$  GURTU 79 HBC 4.2  $K^- p$

$0.5 \pm 0.2$  <sup>1</sup> CORDEN 78 OMEG 12-15  $\pi^- p$

$0.20 \pm 0.08$  <sup>2</sup> DEFOIX 72 HBC 0.7  $\bar{p} p \rightarrow 7\pi$

$0.16 \pm 0.08$  CAMPBELL 69 DBC 2.7  $\pi^+ d$

OCCUR=2

<sup>1</sup> CORDEN 78 assumes low-mass  $\eta \pi \pi$  region is dominantly  $1^{++}$ . See BARBERIS 98C and MANAK 00A for discussion.

NODE=M008R2;LINKAGE=CD

<sup>2</sup>  $K \bar{K}$  system characterized by the  $I = 1$  threshold enhancement. (See under  $a_0(980)$ ).

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 $e^+e^- \rightarrow e^+e^-K_S^0K^\pm\pi^\mp$ |

<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                              |
|-------------------------|------|--------------------------|------|--------------------------------------|
| <b>0.30±0.055±0.074</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. 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                              |
|-----------------|-----|-------------|------|--------------------------------------|
| <b>&lt;0.31</b> | 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                                         |
|--------------------------|-------------------------------------|-------------|------|-------------------------------------------------|
| <b>5.3±1.2 OUR FIT</b>   | Error includes scale factor of 2.9. |             |      |                                                 |
| <b>2.8±0.7±0.6</b>       |                                     | AMELIN 95   | VES  | 37 $\pi^-N \rightarrow \pi^-\pi^+\pi^-\gamma N$ |

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

<5 95 BITYUKOV 91B SPEC 32  $\pi^-p \rightarrow \pi^+\pi^-\gamma n$

NODE=M008R15  
NODE=M008R15

 $\Gamma(\gamma\rho^0)/\Gamma(2\pi^+2\pi^-)$ 
 $\Gamma_{15}/\Gamma_3 = \Gamma_{15}/\frac{1}{3}\Gamma_1$ 

| VALUE                    | DOCUMENT ID                         | TECN | COMMENT                                     |
|--------------------------|-------------------------------------|------|---------------------------------------------|
| <b>0.48±0.13 OUR FIT</b> | Error includes scale factor of 2.5. |      |                                             |
| <b>0.45±0.18</b>         | <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>9.7±1.9 OUR FIT</b>     | Error includes scale factor of 2.4.                         |      |         |
| <b>8.5±2.0 OUR AVERAGE</b> | Error includes scale factor of 2.2. See the ideogram below. |      |         |

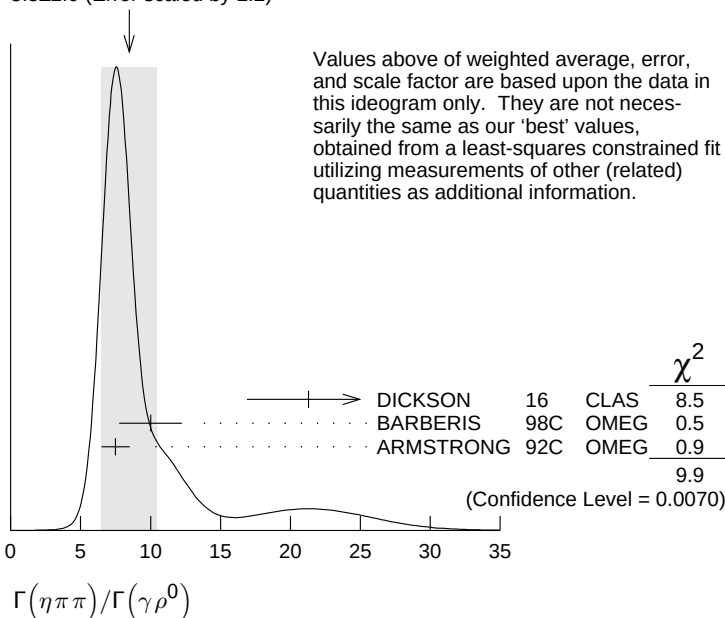
|              |                            |          |                                                       |
|--------------|----------------------------|----------|-------------------------------------------------------|
| 21.3±4.4     | DICKSON 16                 | CLAS     | $\gamma p \rightarrow f_1(1285)p$                     |
| 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  $B(J/\psi \rightarrow \gamma f_1(1285) \rightarrow \gamma K\bar{K}\pi) < 0.72 \times 10^{-3}$ .

 $\Gamma(\phi\gamma)/\Gamma(K\bar{K}\pi)$  $\Gamma_{16}/\Gamma_{11}$ 

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

**0.82±0.21±0.20** 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  $\pi^- N \rightarrow \pi^- \pi^+ \pi^- \gamma N$

 **$f_1(1285)$  REFERENCES**

|                             |      |                       |                                      |                                 |
|-----------------------------|------|-----------------------|--------------------------------------|---------------------------------|
| DICKSON                     | 16   | PR C93 065202         | R. Dickson <i>et al.</i>             | (JLab CLAS Collab.)             |
| ABLIKIM                     | 15P  | PR D92 012007         | M. Ablikim <i>et al.</i>             | (BES III Collab.)               |
| AAIJ                        | 14Y  | PRL 112 091802        | R. Aaij <i>et al.</i>                | (LHCb Collab.)                  |
| LEES                        | 12X  | PR D86 092010         | J.P. Lees <i>et al.</i>              | (BABAR Collab.)                 |
| ABLIKIM                     | 11J  | PRL 107 182001        | M. Ablikim <i>et al.</i>             | (BES III Collab.)               |
| DOROFEEV                    | 11   | EPJ A47 68            | V. Dorofeev <i>et al.</i>            | (SERP, MIPT)                    |
| PDG                         | 10   | JP G37 075021         | K. Nakamura <i>et al.</i>            | (PDG Collab.)                   |
| ACHARD                      | 07   | JHEP 0703 018         | P. Achard <i>et al.</i>              | (L3 Collab.)                    |
| AUBERT                      | 07AU | PR D76 092005         | B. Aubert <i>et al.</i>              | (BABAR Collab.)                 |
| BAI                         | 04J  | PL B594 47            | J.Z. Bai <i>et al.</i>               | (BES Collab.)                   |
| ABDALLAH                    | 03H  | PL B569 129           | J. Abdallah <i>et al.</i>            | (DELPHI Collab.)                |
| ACHARD                      | 02B  | PL B526 269           | P. Achard <i>et al.</i>              | (L3 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.)              |
| BARBERIS                    | 00C  | PL B471 440           | D. Barberis <i>et al.</i>            | (WA 102 Collab.)                |
| MANAK                       | 00A  | PR D62 012003         | J.J. Manak <i>et al.</i>             | (BNL E852 Collab.)              |
| SOSA                        | 99   | PRL 83 913            | M. Sosa <i>et al.</i>                |                                 |
| BARBERIS                    | 98C  | PL B440 225           | D. Barberis <i>et al.</i>            | (WA 102 Collab.)                |
| ALDE                        | 97B  | PAN 60 386            | D. Alde <i>et al.</i>                | (GAMS Collab.)                  |
| Translated from YAF 60 458. |      |                       |                                      |                                 |
| 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.)                |
| AMELIN                      | 95   | ZPHY C66 71           | D.V. Amelin <i>et al.</i>            | (VES Collab.)                   |
| ANTINORI                    | 95   | PL B353 589           | F. Antinori <i>et al.</i>            | (ATHU, BARI, BIRM+)             |
| ABATZIS                     | 94   | PL B324 509           | S. Abatzis <i>et al.</i>             | (ATHU, BARI, BIRM+)             |
| LEE                         | 94   | PL B323 227           | J.H. Lee <i>et al.</i>               | (BNL, IND, KYUN, MASD+)         |
| ARMSTRONG                   | 93C  | PL B307 394           | T.A. Armstrong <i>et al.</i>         | (FNAL, FERR, GENO+)             |
| ARMSTRONG                   | 92C  | ZPHY C54 371          | T.A. Armstrong <i>et al.</i>         | (ATHU, BARI, BIRM+)             |
| BOLTON                      | 92   | PL B278 495           | T. Bolton <i>et al.</i>              | (Mark III Collab.)              |
| BITYUKOV                    | 91B  | SJNP 54 318           | S.I. Bityukov <i>et al.</i>          | (SERP)                          |
| Translated from YAF 54 529. |      |                       |                                      |                                 |
| FUKUI                       | 91C  | PL B267 293           | S. Fukui <i>et al.</i>               | (SUGI, NAGO, KEK, KYOT+)        |
| COFFMAN                     | 90   | PR D41 1410           | D.M. Coffman <i>et al.</i>           | (Mark III Collab.)              |
| ARMSTRONG                   | 89   | PL B221 216           | T.A. Armstrong <i>et al.</i>         | (CERN, CDEF, BIRM+) JPC         |
| ARMSTRONG                   | 89E  | PL B228 536           | T.A. Armstrong, M. Benayoun          | (ATHU, BARI, BIRM+)             |
| ARMSTRONG                   | 89G  | ZPHY C43 55           | T.A. Armstrong <i>et al.</i>         | (CERN, BIRM, BARI+)             |
| RATH                        | 89   | PR D40 693            | M.G. Rath <i>et al.</i>              | (NDAM, BRAN, BNL, CUNY+)        |
| AIHARA                      | 88B  | PL B209 107           | H. Aihara <i>et al.</i>              | (TPC-2 $\gamma$ Collab.)        |
| BIRMAN                      | 88   | PRL 61 1557           | A. Birman <i>et al.</i>              | (BNL, FSU, IND, MASD) JP        |
| BITYUKOV                    | 88   | PL B203 327           | S.I. Bityukov <i>et al.</i>          | (SERP)                          |
| MIR                         | 88   | Photon-Photon 88, 126 | R. Mir                               | (Mark III Collab.)              |
| Conference                  |      |                       |                                      |                                 |
| ALDE                        | 87   | PL B198 286           | D.M. Alde <i>et al.</i>              | (LANL, BRUX, SERP, LAPP)        |
| BECKER                      | 87   | PRL 59 186            | J.J. Becker <i>et al.</i>            | (Mark III Collab.)              |
| GIDAL                       | 87   | PRL 59 2012           | G. Gidal <i>et al.</i>               | (LBL, SLAC, HARV)               |
| ANDO                        | 86   | PRL 57 1296           | A. Ando <i>et al.</i>                | (KEK, KYOT, NIRS, SAGA+) IJP    |
| REEVES                      | 86   | PR D34 1960           | D.F. Reeves <i>et al.</i>            | (FLOR, BNL, IND+) JP            |
| CHUNG                       | 85   | PRL 55 779            | S.U. Chung <i>et al.</i>             | (BNL, FLOR, IND+) JP            |
| ARMSTRONG                   | 84   | PL 146B 273           | T.A. Armstrong <i>et al.</i>         | (ATHU, BARI, BIRM+) JP          |
| BITYUKOV                    | 84B  | PL 144B 133           | S.I. Bityukov <i>et al.</i>          | (SERP)                          |
| CHAUVAT                     | 84   | PL 148B 382           | P. Chauvat <i>et al.</i>             | (CERN, CLER, UCLA+)             |
| TORNQVIST                   | 82B  | NP B203 268           | N.A. Tornqvist                       | (HELS)                          |
| EVANGELIS...                | 81   | NP B178 197           | C. Evangelista <i>et al.</i>         | (BARI, BONN, CERN+)             |
| BROMBERG                    | 80   | PR D22 1513           | C.M. Bromberg <i>et al.</i>          | (CIT, FNAL, ILLC+)              |
| DIONISI                     | 80   | NP B169 1             | C. Dionisi <i>et al.</i>             | (CERN, MADR, CDEF+)             |
| GURTU                       | 79   | NP B151 181           | A. Gurtu <i>et al.</i>               | (CERN, ZEEM, NIJM, OXF)         |
| STANTON                     | 79   | PRL 42 346            | N.R. Stanton <i>et al.</i>           | (OSU, CARL, MCGI+) JP           |
| CORDEN                      | 78   | NP B144 253           | M.J. Corden <i>et al.</i>            | (BIRM, RHEL, TELA+) JP          |
| NACASCH                     | 78   | NP B135 203           | R. Nacasch <i>et al.</i>             | (PARIS, MADR, CERN)             |
| GRASSLER                    | 77   | NP B121 189           | H. Grassler <i>et al.</i>            | (AACH3, BERL, BONN+)            |
| DEFOIX                      | 72   | NP B44 125            | C. Defoix <i>et al.</i>              | (CDEF, CERN)                    |
| DUBOC                       | 72   | NP B46 429            | J. Duboc <i>et al.</i>               | (PARIS, LIVP)                   |
| THUN                        | 72   | PRL 28 1733           | R. Thun <i>et al.</i>                | (STON, NEAS)                    |
| BARDADIN....                | 71   | PR D4 2711            | M. Bardadin-Otwinowska <i>et al.</i> | (WARS)                          |
| BOESEBECK                   | 71   | PL 34B 659            | K. Boesebeck                         | (AACH, BERL, BONN, CERN, CRAC+) |
| CAMPBELL                    | 69   | PRL 22 1204           | J.H. Campbell <i>et al.</i>          | (PURD)                          |
| LORSTAD                     | 69   | NP B14 63             | B. Lorstad <i>et al.</i>             | (CDEF, CERN) JP                 |
| D'ANDLAU                    | 68   | NP B5 693             | C. d'Andlau <i>et al.</i>            | (CDEF, CERN, IRAD+) IJP         |
| DAHL                        | 67   | PR 163 1377           | O.I. Dahl <i>et al.</i>              | (LRL) IJP                       |

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 NODE=M008R12

NODE=M008R12;LINKAGE=F

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 NODE=M008R9

NODE=M008

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 REFID=20419  
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 REFID=20897  
 REFID=20321

**$\eta(1295)$** 

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

See also the mini-review under  $\eta(1405)$ 

NODE=M037

NODE=M037

NODE=M037M

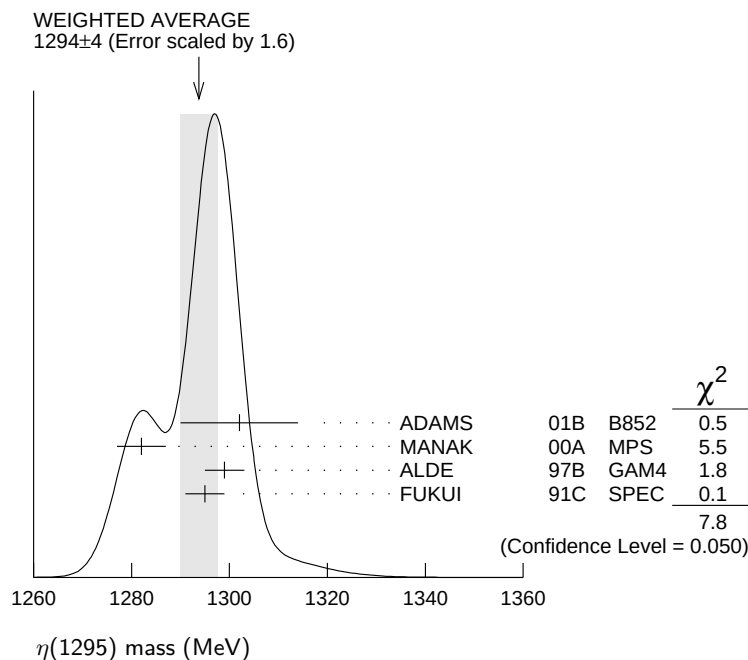
NODE=M037M

 **$\eta(1295)$  MASS**

| VALUE (MeV)                                | EVTS                                                        | DOCUMENT ID | TECN     | COMMENT                                       |
|--------------------------------------------|-------------------------------------------------------------|-------------|----------|-----------------------------------------------|
| <b><math>1294 \pm 4</math> OUR AVERAGE</b> | Error includes scale factor of 1.6. See the ideogram below. |             |          |                                               |
| $1302 \pm 9 \pm 8$                         | 20k                                                         | ADAMS       | 01B B852 | 18 GeV $\pi^- p \rightarrow K^+ K^- \pi^0 n$  |
| $1282 \pm 5$                               | 9082                                                        | MANAK       | 00A MPS  | 18 $\pi^- p \rightarrow \eta \pi^+ \pi^- n$   |
| $1299 \pm 4$                               | 2100                                                        | ALDE        | 97B GAM4 | 100 $\pi^- p \rightarrow \eta \pi^0 \pi^0 n$  |
| $1295 \pm 4$                               |                                                             | FUKUI       | 91C SPEC | 8.95 $\pi^- p \rightarrow \eta \pi^+ \pi^- n$ |

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

|              |                       |    |      |                                              |
|--------------|-----------------------|----|------|----------------------------------------------|
| $1264 \pm 8$ | <sup>1</sup> AUGUSTIN | 90 | DM2  | $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$ |
| $\sim 1275$  | 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><math>55 \pm 5</math> OUR AVERAGE</b> |      |             |          |                                               |
| $57 \pm 23 \pm 21$                       | 20k  | ADAMS       | 01B B852 | 18 GeV $\pi^- p \rightarrow K^+ K^- \pi^0 n$  |
| $66 \pm 13$                              | 9082 | MANAK       | 00A MPS  | 18 $\pi^- p \rightarrow \eta \pi^+ \pi^- n$   |
| $53 \pm 6$                               |      | 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 $\pi^- p \rightarrow \eta \pi^0 \pi^0 n$ |
| $44 \pm 20$ | <sup>2</sup> AUGUSTIN | 90   | DM2      | $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$ |
| $\sim 70$   | 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

 **$\Gamma(\eta\pi^+\pi^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$   $\Gamma_1\Gamma_3/\Gamma$** NODE=M037G2  
NODE=M037G2

| VALUE (keV)                                                                   | CL% | DOCUMENT ID | TECN    | COMMENT                                           |
|-------------------------------------------------------------------------------|-----|-------------|---------|---------------------------------------------------|
| <b>&lt;0.066</b>                                                              | 95  | ACCIARRI    | 01G L3  | 183–202 $e^+e^- \rightarrow e^+e^-\eta\pi^+\pi^-$ |
| • • • 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 | $e^+e^- \rightarrow e^+e^-\eta\pi\pi$             |

 **$\Gamma(K\bar{K}\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$   $\Gamma_7\Gamma_3/\Gamma$** NODE=M037G3  
NODE=M037G3

| VALUE (keV) | CL% | DOCUMENT ID | TECN    | COMMENT                                           |
|-------------|-----|-------------|---------|---------------------------------------------------|
| <0.014      | 90  | 3,4 AHOHE   | 05 CLE2 | 10.6 $e^+e^- \rightarrow e^+e^-K_S^0K^\pm\pi^\mp$ |

<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

 **$\Gamma(a_0(980)\pi)/\Gamma_{\text{total}}$   $\Gamma_2/\Gamma$** NODE=M037R1  
NODE=M037R1

| 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 $\pi^-p \rightarrow K^+\bar{K}^0\pi^-n$              |
| large                                                                         | ANDO        | 86 SPEC | 8 $\pi^-p \rightarrow \eta\pi^+\pi^-n$                 |
| large                                                                         | STANTON     | 79 CNTR | 8.4 $\pi^-p \rightarrow n\eta 2\pi$                    |

 **$\Gamma(a_0(980)\pi)/\Gamma(\eta\pi^0\pi^0)$   $\Gamma_2/\Gamma_4$** NODE=M037R2  
NODE=M037R2

| VALUE            | DOCUMENT ID       | TECN     | COMMENT                                  |
|------------------|-------------------|----------|------------------------------------------|
| <b>0.65±0.10</b> | <sup>5</sup> ALDE | 97B GAM4 | 100 $\pi^-p \rightarrow \eta\pi^0\pi^0n$ |

<sup>5</sup> Assuming that  $a_0(980)$  decays only to  $\eta\pi$ .

NODE=M037R2;LINKAGE=A

 **$\Gamma(\eta(\pi\pi)_{S\text{-wave}})/\Gamma(\eta\pi^0\pi^0)$   $\Gamma_5/\Gamma_4$** NODE=M037R4  
NODE=M037R4

| VALUE            | DOCUMENT ID | TECN     | COMMENT                                  |
|------------------|-------------|----------|------------------------------------------|
| <b>0.35±0.10</b> | ALDE        | 97B GAM4 | 100 $\pi^-p \rightarrow \eta\pi^0\pi^0n$ |

 **$\Gamma(a_0(980)\pi)/\Gamma(\sigma\eta)$   $\Gamma_2/\Gamma_6$** NODE=M037R5  
NODE=M037R5

| VALUE            | EVTS | DOCUMENT ID | TECN    | COMMENT                                 |
|------------------|------|-------------|---------|-----------------------------------------|
| <b>0.48±0.22</b> | 9082 | MANAK       | 00A MPS | 18 $\pi^-p \rightarrow \eta\pi^+\pi^-n$ |

 **$\eta(1295)$  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        |

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 REFID=20887

$\pi(1300)$ 

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

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

π(1300) BRANCHING RATIOS

NODE=M058220

| Γ(π(ππ) <i>S-wave</i> )/Γ(ρπ)                                                 |     |      | Γ <sub>2</sub> /Γ <sub>1</sub> |      |                                                |
|-------------------------------------------------------------------------------|-----|------|--------------------------------|------|------------------------------------------------|
| VALUE                                                                         | CL% | EVTs | DOCUMENT ID                    | TECN | COMMENT                                        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |      |                                |      |                                                |
| 2.2 ± 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                                           |

NODE=M058R1  
NODE=M058R1

<sup>6</sup> Uses multichannel Aitchison-Bowler model (BOWLER 75). Uses data from DAUM 80 and DANKOWYCH 81.

NODE=M058R1;LINKAGE=E

π(1300) REFERENCES

NODE=M058

|            |     |               |                               |                           |
|------------|-----|---------------|-------------------------------|---------------------------|
| DARGENT    | 17  | JHEP 1705 143 | P. dArgent <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+)       |
| 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+) |
| BOWLER     | 75  | NP B97 227    | M.G. Bowler <i>et al.</i>     | (OXFTP, DARE)             |

REFID=58121  
REFID=51186  
REFID=53226  
REFID=48837  
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REFID=45418  
REFID=45763  
REFID=45011  
REFID=20881  
REFID=21134  
REFID=20870  
REFID=21130  
REFID=20572  
REFID=20872  
REFID=20868  
REFID=20571

$a_2(1320)$

$$I^G(J^{PC}) = 1^-(2^{++})$$

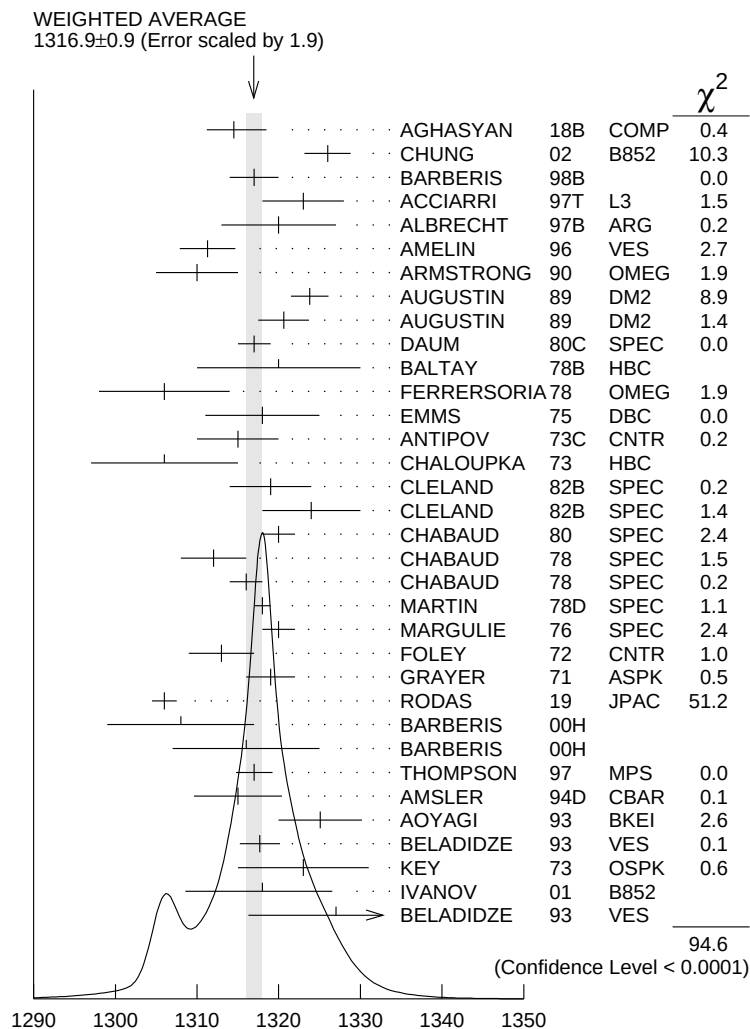
NODE=M012

a<sub>2</sub>(1320) MASS

NODE=M012205

| VALUE (MeV)                                                                                      | DOCUMENT ID                                               |
|--------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>1316.9±0.9 OUR AVERAGE</b>                                                                    | Includes data from the 4 datablocks that follow this one. |
| Error includes scale factor of 1.9. See the ideogram below. $[1318.3^{+0.5}_{-0.6}$ MeV OUR 2018 |                                                           |
| AVERAGE Scale factor = 1.2]                                                                      |                                                           |

NODE=M012M0  
NEW



THE IDEOGRAM SUBTITLE IS MISSING.

ERROR=8

### 3π 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± 1.3 OUR AVERAGE** Error includes scale factor of 1.4. See the ideogram below.  
[1319.0<sup>+1.0</sup><sub>-1.3</sub> MeV OUR 2018 AVERAGE Scale factor = 1.4]

NEW

|                                        |       |              |             |     |        |                                                 |
|----------------------------------------|-------|--------------|-------------|-----|--------|-------------------------------------------------|
| 1314.5 <sup>+4.0</sup> <sub>-3.3</sub> | 46M   | <sup>1</sup> | AGHASYAN    | 18B | COMP   | 190 $\pi^- p \rightarrow \pi^- \pi^- \pi^+ p$   |
| 1326 ± 2 ± 2                           |       |              | CHUNG       | 02  | B852   | 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$  |
| 1317 ± 3                               |       |              | BARBERIS    | 98B |        | 450 $p p \rightarrow p_f \pi^+ \pi^- \pi^0 p_s$ |
| 1323 ± 4 ± 3                           |       |              | ACCIARRI    | 97T | L3     | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \pi^0$ |
| 1320 ± 7                               |       |              | ALBRECHT    | 97B | ARG    | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \pi^0$ |
| 1311.3± 1.6± 3.0                       | 72.4k |              | AMELIN      | 96  | VES    | 36 $\pi^- p \rightarrow \pi^+ \pi^- \pi^0 n$    |
| 1310 ± 5                               |       |              | ARMSTRONG   | 90  | OMEG 0 | 300.0 $p p \rightarrow p p \pi^+ \pi^- \pi^0$   |
| 1323.8± 2.3                            | 4022  |              | AUGUSTIN    | 89  | DM2 ±  | $J/\psi \rightarrow \rho^\pm a_2^\mp$           |
| 1320.6± 3.1                            | 3562  |              | AUGUSTIN    | 89  | DM2 0  | $J/\psi \rightarrow \rho^0 a_2^0$               |
| 1317 ± 2                               | 25k   | <sup>2</sup> | DAUM        | 80C | SPEC - | 63,94 $\pi^- p \rightarrow 3\pi p$              |
| 1320 ± 10                              | 1097  | <sup>2</sup> | BALTAY      | 78B | HBC +0 | 15 $\pi^+ p \rightarrow p 4\pi$                 |
| 1306 ± 8                               |       |              | FERRERSORIA | 78  | OMEG - | 9 $\pi^- p \rightarrow p 3\pi$                  |

OCCUR=2

|                                                                               |                 |                           |     |      |   |                                                  |
|-------------------------------------------------------------------------------|-----------------|---------------------------|-----|------|---|--------------------------------------------------|
| 1318 ± 7                                                                      | 1.6k            | <sup>2</sup> EMMS         | 75  | DBC  | 0 | $4 \pi^+ n \rightarrow p(3\pi)^0$                |
| 1315 ± 5                                                                      |                 | <sup>2</sup> ANTIPOV      | 73c | CNTR | — | $25,40 \pi^- p \rightarrow p \eta \pi^-$         |
| 1306 ± 9                                                                      | 1580            | CHALOUKPA                 | 73  | HBC  | — | $3.9 \pi^- p$                                    |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                 |                           |     |      |   |                                                  |
| 1321 ± 1                                                                      | $\frac{+0}{-7}$ | <sup>3</sup> ALEKSEEV     | 10  | COMP |   | $190 \pi^- Pb \rightarrow \pi^- \pi^- \pi^+ Pb'$ |
| 1300 ± 2                                                                      | ±4              | <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 | $15 \pi^+ p \rightarrow \Delta 3\pi$             |
| 1309 ± 5                                                                      | 5k              | BINNIE                    | 71  | MMS  | — | $\pi^- p$ near $a_2$ thresh-<br>old              |
| 1299 ± 6                                                                      | 28k             | BOWEN                     | 71  | MMS  | — | $5 \pi^- p$                                      |
| 1300 ± 6                                                                      | 24k             | BOWEN                     | 71  | MMS  | + | $5 \pi^+ p$                                      |
| 1309 ± 4                                                                      | 17k             | BOWEN                     | 71  | MMS  | — | $7 \pi^- p$                                      |
| 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.

OCCUR=2

OCCUR=2

OCCUR=2

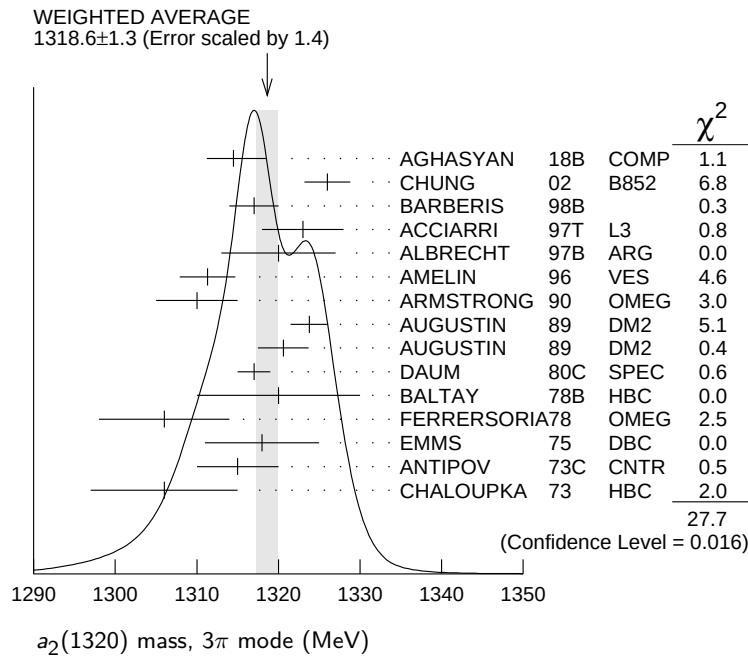
OCCUR=3

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.

NODE=M012M2

NODE=M012M2

**1318.1± 0.7 OUR AVERAGE**

|          |       |                        |     |      |   |                                        |
|----------|-------|------------------------|-----|------|---|----------------------------------------|
| 1319 ± 5 | 4700  | <sup>1,2</sup> CLELAND | 82B | SPEC | + | $50 \pi^+ p \rightarrow K_S^0 K^+ p$   |
| 1324 ± 6 | 5200  | <sup>1,2</sup> CLELAND | 82B | SPEC | — | $50 \pi^- p \rightarrow K_S^0 K^- p$   |
| 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 | — | $18.8 \pi^- p \rightarrow K^- K_S^0 p$ |
| 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 | — | $17.2 \pi^- p \rightarrow K^- K_S^0 p$ |

OCCUR=2

OCCUR=3

OCCUR=2

• • • 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.

**1312.2 ± 2.8 OUR AVERAGE** Error includes scale factor of 2.6. See the ideogram below.  
[1317.7 ± 1.4 MeV OUR 2018 AVERAGE]

|                    |              |          |     |      |                                                   |
|--------------------|--------------|----------|-----|------|---------------------------------------------------|
| 1306.0 ± 0.8 ± 1.3 | <sup>1</sup> | RODAS    | 19  | JPAC | 191 $\pi^- p \rightarrow \eta^{(\prime)} \pi^- p$ |
| 1308 ± 9           |              | BARBERIS | 00H |      | 450 $p p \rightarrow p_f \eta \pi^0 p_s$          |
| 1316 ± 9           |              | BARBERIS | 00H |      | 450 $p p \rightarrow$                             |

NEW

OCCUR=2

|                    |              |           |     |      |                                              |
|--------------------|--------------|-----------|-----|------|----------------------------------------------|
|                    |              |           |     |      | $\Delta_f^{++} \eta \pi^- p_s$               |
| 1317 ± 1 ± 2       |              | THOMPSON  | 97  | MPS  | 18 $\pi^- p \rightarrow \eta \pi^- p$        |
| 1315 ± 5 ± 2       | <sup>2</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>3</sup> | KEY       | 73  | OSPK | 6 $\pi^- p \rightarrow p \pi^- \eta$         |

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

|                   |                |           |     |        |                                                             |
|-------------------|----------------|-----------|-----|--------|-------------------------------------------------------------|
| 1307 ± 1 ± 6      | <sup>4</sup>   | JACKURA   | 18  | JPAC   | $\pi^- p \rightarrow \eta \pi^- p$                          |
| 1315 ± 12         | <sup>5</sup>   | ADOLPH    | 15  | COMP   | 191 $\pi^- p \rightarrow \eta^{(\prime)} \pi^- p$           |
| 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 |                | DELFOSE   | 81  | SPEC + | $\pi^\pm p \rightarrow p \pi^\pm \eta$                      |
| 1330.7 ± 2.4 1653 |                | DELFOSE   | 81  | SPEC - | $\pi^\pm p \rightarrow p \pi^\pm \eta$                      |
| 1324 ± 8 6200     | <sup>3,6</sup> | CONFORTO  | 73  | OSPK - | 6 $\pi^- p \rightarrow p \pi^- \eta$                        |

OCCUR=2

<sup>1</sup> The coupled-channel analysis of both the  $\eta\pi$  and  $\eta'\pi$  systems using ADOLPH 15data. The mass is extracted from the T-matrix pole.

<sup>2</sup> The systematic error of 2 MeV corresponds to the spread of solutions.

<sup>3</sup> Error includes 5 MeV systematic mass-scale error.

<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> Missing mass with enriched MMS =  $\eta\pi^-$ ,  $\eta = 2\gamma$ .

NODE=M012M3;LINKAGE=C

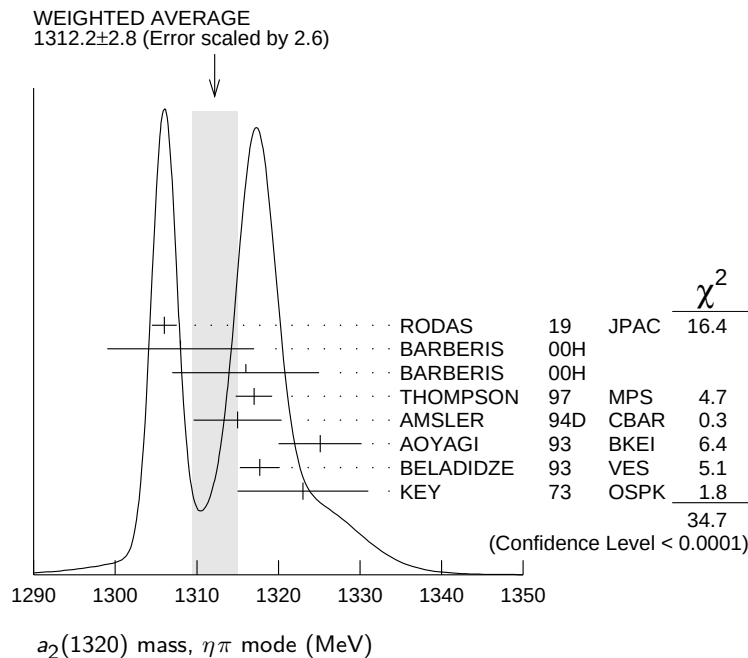
NODE=M012M3;LINKAGE=DD

NODE=M012M3;LINKAGE=E

NODE=M012M3;LINKAGE=B

NODE=M012M3;LINKAGE=A

NODE=M012M3;LINKAGE=M

 **$\eta'\pi$  MODE**

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

The data in this block is included in the average printed for a previous datablock.

**1322 ± 7 OUR AVERAGE**

|                                      |           |    |      |                                        |
|--------------------------------------|-----------|----|------|----------------------------------------|
| 1318 ± 8 <sup>+3</sup> <sub>-5</sub> | IVANOV    | 01 | B852 | 18 $\pi^- p \rightarrow \eta' \pi^- p$ |
| 1327.0 ± 10.7                        | BELADIDZE | 93 | VES  | 37 $\pi^- N \rightarrow \eta' \pi^- N$ |

NODE=M012M4

NODE=M012M4



**$a_2(1320)$  WIDTH**

NODE=M012210

**3 $\pi$  MODE**

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

 NODE=M012W1  
 NODE=M012W1
**105.0 $^{+1.7}_{-1.9}$  OUR AVERAGE**

NEW

[105.0 $^{+1.6}_{-1.9}$  MeV OUR 2018 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 $p p \rightarrow p_f \pi^+ \pi^- \pi^0 p_s$ |
| 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 $p p \rightarrow p p \pi^+ \pi^- \pi^0$   |
| 107.0 $\pm 9.7$         | 4022  | AUGUSTIN                  | 89  | DM2 $\pm$ | $J/\psi \rightarrow \rho^\pm a_2^\mp$           |
| 118.5 $\pm 12.5$        | 3562  | AUGUSTIN                  | 89  | DM2 0     | $J/\psi \rightarrow \rho^0 a_2^0$               |
| 97 $\pm 5$              |       | <sup>2</sup> EVANGELIS... | 81  | OMEG -    | 12 $\pi^- p \rightarrow 3\pi p$                 |
| 96 $\pm 9$              | 25k   | <sup>2</sup> DAUM         | 80C | SPEC -    | 63,94 $\pi^- p \rightarrow 3\pi p$              |
| 110 $\pm 15$            | 1097  | <sup>2</sup> BALTAY       | 78B | HBC +0    | 15 $\pi^+ p \rightarrow p 4\pi$                 |
| 112 $\pm 18$            | 1.6k  | <sup>2</sup> EMMS         | 75  | DBC 0     | 4 $\pi^+ n \rightarrow p(3\pi)^0$               |
| 122 $\pm 14$            | 1.2k  | <sup>2,3</sup> WAGNER     | 75  | HBC 0     | 7 $\pi^+ p \rightarrow \Delta^{++}(3\pi)^0$     |
| 115 $\pm 15$            |       | <sup>2</sup> ANTIPOV      | 73C | CNTR -    | 25,40 $\pi^- p \rightarrow p \eta \pi^-$        |
| 99 $\pm 15$             | 1580  | CHALOUPKA                 | 73  | HBC -     | 3.9 $\pi^- p$                                   |
| 105 $\pm 5$             | 28k   | BOWEN                     | 71  | MMS -     | 5 $\pi^- p$                                     |
| 99 $\pm 5$              | 24k   | BOWEN                     | 71  | MMS +     | 5 $\pi^+ p$                                     |
| 103 $\pm 5$             | 17k   | BOWEN                     | 71  | MMS -     | 7 $\pi^- p$                                     |

OCCUR=2

OCCUR=2

OCCUR=3

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

|                    |      |                         |     |        |                                                  |
|--------------------|------|-------------------------|-----|--------|--------------------------------------------------|
| 110 $\pm 2 \pm 15$ | 420k | <sup>4</sup> ALEKSEEV   | 10  | COMP   | 190 $\pi^- p \rightarrow \pi^- \pi^- \pi^+ p b'$ |
| 117 $\pm 6 \pm 20$ | 18k  | <sup>5</sup> SCHEGELSKY | 06  | RVUE 0 | $\gamma \gamma \rightarrow \pi^+ \pi^- \pi^0$    |
| 120 $\pm 40$       |      | CONDO                   | 93  | SHF    | $\gamma p \rightarrow n \pi^+ \pi^+ \pi^-$       |
| 115 $\pm 14$       | 490  | BALTAY                  | 78B | HBC 0  | 15 $\pi^+ p \rightarrow \Delta 3\pi$             |
| 72 $\pm 16$        | 5k   | BINNIE                  | 71  | MMS -  | $\pi^- p$ near $a_2$ thresh-<br>old              |
| 79 $\pm 12$        | 941  | ALSTON-...              | 70  | HBC +  | 7.0 $\pi^+ p \rightarrow 3\pi p$                 |

OCCUR=2

OCCUR=2

<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. **$K\bar{K}$  AND  $\eta\pi$  MODES**

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

**107  $\pm 5$  OUR ESTIMATE****112.5 $\pm 1.2$  OUR AVERAGE** Includes data from the 2 datablocks that follow this one.[110.4  $\pm 1.7$  MeV OUR 2018 AVERAGE]

NODE=M012W0

NODE=M012W0

→ UNCHECKED ←

NEW

 **$K\bar{K}$  MODE**

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

NODE=M012W2

NODE=M012W2

The data in this block is included in the average printed for a previous datablock.

**109.8 $\pm 2.4$  OUR AVERAGE**

|              |       |                        |     |        |                                        |
|--------------|-------|------------------------|-----|--------|----------------------------------------|
| 112 $\pm 20$ | 4700  | <sup>1,2</sup> CLELAND | 82B | SPEC + | 50 $\pi^+ p \rightarrow K_S^0 K^+ p$   |
| 120 $\pm 25$ | 5200  | <sup>1,2</sup> CLELAND | 82B | SPEC - | 50 $\pi^- p \rightarrow K_S^0 K^- p$   |
| 106 $\pm 4$  | 4000  | CHABAUD                | 80  | SPEC - | 17 $\pi^- A \rightarrow K_S^0 K^- A$   |
| 126 $\pm 11$ | 11000 | CHABAUD                | 78  | SPEC - | 9.8 $\pi^- p \rightarrow K^- K_S^0 p$  |
| 101 $\pm 8$  | 4730  | CHABAUD                | 78  | SPEC - | 18.8 $\pi^- p \rightarrow K^- K_S^0 p$ |
| 113 $\pm 4$  |       | <sup>1,3</sup> MARTIN  | 78D | SPEC - | 10 $\pi^- p \rightarrow K_S^0 K^- p$   |
| 105 $\pm 8$  | 2724  | <sup>3</sup> MARGULIE  | 76  | SPEC - | 23 $\pi^- p \rightarrow K^- K_S^0 p$   |
| 113 $\pm 19$ | 730   | FOLEY                  | 72  | CNTR - | 20.3 $\pi^- p \rightarrow K^- K_S^0 p$ |
| 123 $\pm 13$ | 1500  | <sup>3</sup> GRAYER    | 71  | ASPK - | 17.2 $\pi^- p \rightarrow K^- K_S^0 p$ |

OCCUR=2

OCCUR=3

OCCUR=2

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

|     |          |      |                         |     |      |   |                                        |
|-----|----------|------|-------------------------|-----|------|---|----------------------------------------|
| 120 | $\pm 15$ | 870  | <sup>4</sup> SCHEGELSKY | 06A | RVUE | 0 | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |
| 121 | $\pm 51$ | 1000 | <sup>1,2</sup> CLELAND  | 82B | SPEC | + | $30 \pi^+ p \rightarrow K_S^0 K^+ p$   |
| 110 | $\pm 18$ | 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.

NODE=M012W3  
NODE=M012W3

### 113.4 $\pm$ 1.3 OUR AVERAGE

[111.1  $\pm$  2.4 MeV OUR 2018 AVERAGE]

|                           |                     |     |      |     |                                                |
|---------------------------|---------------------|-----|------|-----|------------------------------------------------|
| 114.4 $\pm$ 1.6 $\pm$ 0.0 | <sup>1</sup> RODAS  | 19  | JPAC | 191 | $\pi^- p \rightarrow \eta^{(\prime)} \pi^- p$  |
| 115 $\pm$ 20              | BARBERIS            | 00H |      | 450 | $p p \rightarrow p_f \eta \pi^0 p_s$           |
| 112 $\pm$ 14              | BARBERIS            | 00H |      | 450 | $p p \rightarrow \Delta_f^{++} \eta \pi^- p_s$ |
| 112 $\pm$ 3 $\pm$ 2       | <sup>2</sup> AMSLER | 94D | CBAR | 0.0 | $\bar{p} p \rightarrow \pi^0 \pi^0 \eta$       |
| 103 $\pm$ 6 $\pm$ 3       | BELADIDZE           | 93  | VES  | 37  | $\pi^- N \rightarrow \eta \pi^- N$             |
| 112.2 $\pm$ 5.7           | 2561 DELFOSSE       | 81  | SPEC | +   | $\pi^\pm p \rightarrow p \pi^\pm \eta$         |
| 116.6 $\pm$ 7.7           | 1653 DELFOSSE       | 81  | SPEC | -   | $\pi^\pm p \rightarrow p \pi^\pm \eta$         |
| 108 $\pm$ 9               | 1000 KEY            | 73  | OSPK | -   | $6 \pi^- p \rightarrow p \pi^- \eta$           |

NEW

OCCUR=2

OCCUR=2

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

|                     |                       |     |      |                                                               |
|---------------------|-----------------------|-----|------|---------------------------------------------------------------|
| 112 $\pm$ 1 $\pm$ 8 | <sup>3</sup> JACKURA  | 18  | JPAC | $\pi^- p \rightarrow \eta \pi^- p$                            |
| 119 $\pm$ 14        | <sup>4</sup> ADOLPH   | 15  | COMP | $191 \pi^- p \rightarrow \eta^{(\prime)} \pi^- p$             |
| 110 $\pm$ 4         | ANISOVICH             | 09  | RVUE | $\bar{p} p, \pi N$                                            |
| 127 $\pm$ 2 $\pm$ 2 | <sup>5</sup> THOMPSON | 97  | MPS  | $18 \pi^- p \rightarrow \eta \pi^- p$                         |
| 118 $\pm$ 10        | ARMSTRONG             | 93C | E760 | 0 $\bar{p} p \rightarrow \pi^0 \eta \eta \rightarrow 6\gamma$ |
| 104 $\pm$ 9         | 6200 CONFORTO         | 73  | OSPK | - $6 \pi^- p \rightarrow p \pi^- \eta$                        |

<sup>1</sup> The coupled-channel analysis of both the  $\eta\pi$  and  $\eta'\pi$  systems using ADOLPH 15data. The width is extracted from the T-matrix pole.

<sup>2</sup> The systematic error of 2 MeV corresponds to the spread of solutions.

<sup>3</sup> Superseded by RODAS 19.

<sup>4</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>5</sup> Resolution is not unfolded.

<sup>6</sup> Missing mass with enriched MMS =  $\eta\pi^-$ ,  $\eta = 2\gamma$ .

NODE=M012W3;LINKAGE=E

NODE=M012W3;LINKAGE=DD  
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 $\pm$ 25 OUR AVERAGE

|                       |           |    |      |                                        |
|-----------------------|-----------|----|------|----------------------------------------|
| 140 $\pm$ 35 $\pm$ 20 | IVANOV    | 01 | B852 | $18 \pi^- p \rightarrow \eta' \pi^- p$ |
| 106 $\pm$ 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 $\pm$ 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 $\pm$ 1.2 ) %                  |                                   |
| $\Gamma_6$ $\omega\pi\pi$    | (10.6 $\pm$ 3.2 ) %                  | S=1.3                             |
| $\Gamma_7$ $K\bar{K}$        | ( 4.9 $\pm$ 0.8 ) %                  |                                   |
| $\Gamma_8$ $\eta'(958)\pi$   | ( 5.5 $\pm$ 0.9 ) $\times 10^{-3}$   |                                   |
| $\Gamma_9$ $\pi^\pm \gamma$  | ( 2.91 $\pm$ 0.27 ) $\times 10^{-3}$ |                                   |
| $\Gamma_{10}$ $\gamma\gamma$ | ( 9.4 $\pm$ 0.7 ) $\times 10^{-6}$   |                                   |
| $\Gamma_{11}$ $e^+ e^-$      | < 5 $\times 10^{-9}$                 | 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  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$ , 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.

|       |       |       |       |
|-------|-------|-------|-------|
| $x_5$ | 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 ± 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 <sup>+2.0</sup> <sub>-1.5</sub> | 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 ± 6 ± 42 |  | <sup>1</sup> ADOLPH | 14 | COMP | - 190 $\pi^- \text{Pb} \rightarrow \pi^+ \pi^- \pi^- \text{Pb}'$ |
|--------------|--|---------------------|----|------|------------------------------------------------------------------|

|               |      |              |      |  |                                               |
|---------------|------|--------------|------|--|-----------------------------------------------|
| 284 ± 25 ± 25 | 7.1k | MOLCHANOV 01 | SELX |  | 600 $\pi^- A \rightarrow \pi^+ \pi^- \pi^- A$ |
|---------------|------|--------------|------|--|-----------------------------------------------|

|          |  |             |      |   |               |
|----------|--|-------------|------|---|---------------|
| 295 ± 60 |  | CIHANGIR 82 | SPEC | + | 200 $\pi^+ A$ |
|----------|--|-------------|------|---|---------------|

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

|           |  |                  |    |      |                  |
|-----------|--|------------------|----|------|------------------|
| 461 ± 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 ± 0.05 ± 0.09 |  | ACCIARRI | 97T | L3 | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \pi^0$ |
|--------------------|--|----------|-----|----|-------------------------------------------------|

|                    |  |          |     |     |                                                 |
|--------------------|--|----------|-----|-----|-------------------------------------------------|
| 0.96 ± 0.03 ± 0.13 |  | ALBRECHT | 97B | ARG | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \pi^0$ |
|--------------------|--|----------|-----|-----|-------------------------------------------------|

|                    |    |      |    |     |                                                 |
|--------------------|----|------|----|-----|-------------------------------------------------|
| 1.26 ± 0.26 ± 0.18 | 36 | BARU | 90 | MD1 | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \pi^0$ |
|--------------------|----|------|----|-----|-------------------------------------------------|

|                    |     |         |     |      |                                                   |
|--------------------|-----|---------|-----|------|---------------------------------------------------|
| 1.00 ± 0.07 ± 0.15 | 415 | BEHREND | 90C | CELL | 0 $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \pi^0$ |
|--------------------|-----|---------|-----|------|---------------------------------------------------|

|                    |  |        |    |      |                                                 |
|--------------------|--|--------|----|------|-------------------------------------------------|
| 1.03 ± 0.13 ± 0.21 |  | BUTLER | 90 | MRK2 | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \pi^0$ |
|--------------------|--|--------|----|------|-------------------------------------------------|

|                    |    |      |    |      |                                          |
|--------------------|----|------|----|------|------------------------------------------|
| 1.01 ± 0.14 ± 0.22 | 85 | OEST | 90 | JADE | $e^+ e^- \rightarrow e^+ e^- \pi^0 \eta$ |
|--------------------|----|------|----|------|------------------------------------------|

|                    |    |                      |    |      |                                      |
|--------------------|----|----------------------|----|------|--------------------------------------|
| 0.90 ± 0.27 ± 0.15 | 56 | <sup>1</sup> ALTHOFF | 86 | TASS | 0 $e^+ e^- \rightarrow e^+ e^- 3\pi$ |
|--------------------|----|----------------------|----|------|--------------------------------------|

|                    |  |                         |    |      |                                            |
|--------------------|--|-------------------------|----|------|--------------------------------------------|
| 1.14 ± 0.20 ± 0.26 |  | <sup>2</sup> ANTREASYAN | 86 | CBAL | 0 $e^+ e^- \rightarrow e^+ e^- \pi^0 \eta$ |
|--------------------|--|-------------------------|----|------|--------------------------------------------|

|                    |  |        |     |      |                                      |
|--------------------|--|--------|-----|------|--------------------------------------|
| 1.06 ± 0.18 ± 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 ± 0.19 <sup>+0.42</sup> <sub>-0.11</sub> | 35 | <sup>1</sup> BEHREND | 82C | CELL | 0 $e^+ e^- \rightarrow e^+ e^- 3\pi$ |
|-----------------------------------------------|----|----------------------|-----|------|--------------------------------------|

|                    |    |                      |     |      |                                            |
|--------------------|----|----------------------|-----|------|--------------------------------------------|
| 0.77 ± 0.18 ± 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                                    |
|-------------------------------------------------------------------------------|------|----------------------------|------|--------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                            |      |                                            |
| $0.65 \pm 0.02 \pm 0.02$                                                      | 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                                   |
|-------------------------------------------------------------------------------|---------------------|------|-------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                     |      |                                           |
| $0.145^{+0.097}_{-0.034}$                                                     | <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  $3.4^{+2.3}_{-1.1}\%$ .

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><math>0.126 \pm 0.007 \pm 0.028</math></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. • • • |                       |      |                                       |
| $0.081 \pm 0.006 \pm 0.027$                                                   | <sup>2</sup> ALBRECHT | 90G  | ARG $e^+e^- \rightarrow e^+e^-K^+K^-$ |

NODE=M012G1  
 NODE=M012G1

<sup>1</sup> Using an incoherent background.

OCCUR=2

<sup>2</sup> Using a coherent background.

NODE=M012G1;LINKAGE=A  
 NODE=M012G1;LINKAGE=B

 $a_2(1320)$  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><math>16.5^{+1.2}_{-2.4}</math></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><math>0.207 \pm 0.018</math> OUR FIT</b>     |      |             |      |      |                  |
| <b><math>0.213 \pm 0.020</math> OUR AVERAGE</b> |      |             |      |      |                  |
| 0.18 ± 0.05                                     |      | FORINO      | 76   | HBC  | 11 $\pi^- p$     |
| 0.22 ± 0.05                                     | 52   | ANTIPOV     | 73   | CNTR | — 40 $\pi^- p$   |
| $0.211 \pm 0.044$                               | 149  | CHALOUPKA   | 73   | HBC  | — 3.9 $\pi^- p$  |
| $0.246 \pm 0.042$                               | 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><math>0.15 \pm 0.05</math> OUR FIT</b> Error includes scale factor of 1.3.                             |      |                        |      |     |                   |
| <b><math>0.15 \pm 0.05</math> OUR AVERAGE</b> Error includes scale factor of 1.3. See the ideogram below. |      |                        |      |     |                   |
| $0.28 \pm 0.09$                                                                                           | 60   | DIAZ                   | 74   | DBC | 0 6 $\pi^+ n$     |
| $0.18 \pm 0.08$                                                                                           |      | <sup>1</sup> KARSHON   | 74   | HBC | Avg. of above two |
| $0.10 \pm 0.05$                                                                                           | 279  | <sup>2</sup> CHALOUPKA | 73   | HBC | — 3.9 $\pi^- p$   |

NODE=M012R12  
 NODE=M012R12

OCCUR=3

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

|                 |     |                      |    |     |   |                 |
|-----------------|-----|----------------------|----|-----|---|-----------------|
| $0.29 \pm 0.08$ | 140 | <sup>1</sup> KARSHON | 74 | HBC | 0 | $4.9 \pi^+ p$   |
| $0.10 \pm 0.04$ | 60  | <sup>1</sup> KARSHON | 74 | HBC | + | $4.9 \pi^+ p$   |
| $0.19 \pm 0.08$ |     | DEFOIX               | 73 | HBC | 0 | $0.7 \bar{p} p$ |

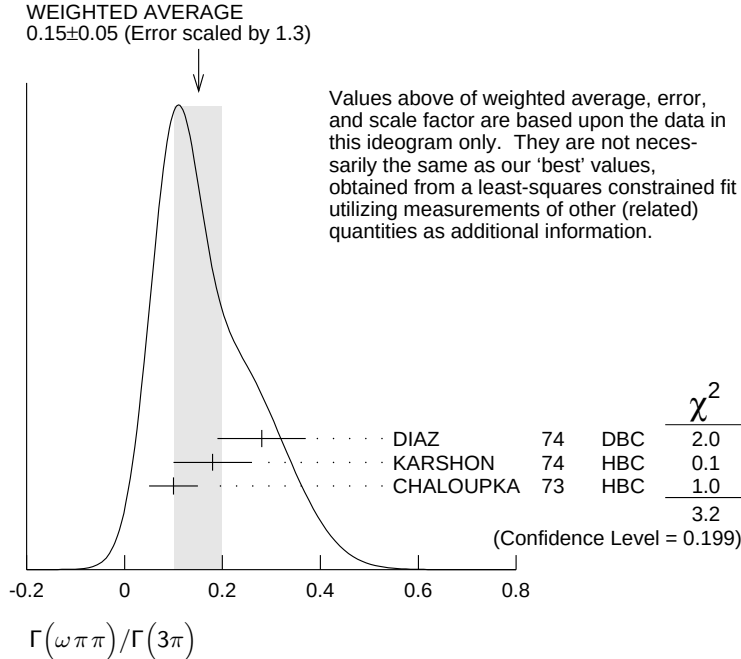
OCCUR=2

<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.

NODE=M012R12;LINKAGE=K

<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=01



$\Gamma(K\bar{K}) / \Gamma(3\pi)$

$\Gamma_7 / \Gamma_1$

| VALUE                                       | EVTS | DOCUMENT ID | TECN | CHG  | COMMENT |
|---------------------------------------------|------|-------------|------|------|---------|
| <b><math>0.070 \pm 0.012</math> OUR FIT</b> |      |             |      |      |         |
| <b><math>0.078 \pm 0.017</math></b>         |      | CHABAUD     | 78   | RVUE |         |

NODE=M012R1  
NODE=M012R1

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

|                   |     |                          |     |      |   |                                               |
|-------------------|-----|--------------------------|-----|------|---|-----------------------------------------------|
| $0.011 \pm 0.003$ |     | <sup>1</sup> BERTIN      | 98B | OBLX |   | $0.0 \bar{p} p \rightarrow K^\pm K_s \pi^\mp$ |
| $0.056 \pm 0.014$ | 50  | <sup>2</sup> CHALOUPKA   | 73  | HBC  | - | $3.9 \pi^- p$                                 |
| $0.097 \pm 0.018$ | 113 | <sup>2</sup> ALSTON-...  | 71  | HBC  | + | $7.0 \pi^+ p$                                 |
| $0.06 \pm 0.03$   |     | <sup>2</sup> ABRAMOVI... | 70B | HBC  | - | $3.93 \pi^- p$                                |
| $0.054 \pm 0.022$ |     | <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;LINKAGE=BE  
NODE=M012R1;LINKAGE=C

$\Gamma(K\bar{K}) / \Gamma(\eta \pi)$

$\Gamma_7 / \Gamma_5$

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

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

|                 |                     |     |      |                                               |
|-----------------|---------------------|-----|------|-----------------------------------------------|
| $0.08 \pm 0.02$ | <sup>1</sup> BERTIN | 98B | OBLX | $0.0 \bar{p} p \rightarrow K^\pm K_s \pi^\mp$ |
|-----------------|---------------------|-----|------|-----------------------------------------------|

<sup>1</sup> Using  $\eta \pi \pi$  data from AMSLER 94D.

NODE=M012R14  
NODE=M012R14

NODE=M012R14;LINKAGE=BE

$\Gamma(\eta \pi) / [\Gamma(3\pi) + \Gamma(\eta \pi) + \Gamma(K\bar{K})]$

$\Gamma_5 / (\Gamma_1 + \Gamma_5 + \Gamma_7)$

| VALUE                                           | EVTS | DOCUMENT ID | TECN | CHG | COMMENT               |
|-------------------------------------------------|------|-------------|------|-----|-----------------------|
| <b><math>0.162 \pm 0.012</math> OUR FIT</b>     |      |             |      |     |                       |
| <b><math>0.140 \pm 0.028</math> OUR AVERAGE</b> |      |             |      |     |                       |
| $0.13 \pm 0.04$                                 |      | ESPIGAT     | 72   | HBC | $\pm$ $0.0 \bar{p} p$ |
| $0.15 \pm 0.04$                                 | 34   | BARNHAM     | 71   | HBC | $+$ $3.7 \pi^+ p$     |

NODE=M012R2  
NODE=M012R2

$$\Gamma(K\bar{K})/[\Gamma(3\pi) + \Gamma(\eta\pi) + \Gamma(K\bar{K})]$$

$$\Gamma_7/(\Gamma_1 + \Gamma_5 + \Gamma_7)$$

| <u>VALUE</u>                                                                  | <u>EVTS</u> | <u>DOCUMENT ID</u>   | <u>TECN</u> | <u>CHG</u> | <u>COMMENT</u> |                 |
|-------------------------------------------------------------------------------|-------------|----------------------|-------------|------------|----------------|-----------------|
| <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 $\bar{p} p$ |

<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  
NODE=M012R8

OCCUR=2

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±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

$$\Gamma(\eta'(958)\pi)/\Gamma(3\pi)$$

$$\Gamma_8/\Gamma_1$$

| <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. ● ● ● |            |                    |             |            |                 |
| <0.011                                                                        | 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 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 ±0.02                     | ADOLPH                 | 15   | COMP 191 $\pi^- p \rightarrow \eta^{(\prime)} \pi^- p$ |
| 0.032±0.009                    | ABELE                  | 97C  | CBAR 0.0 $\bar{p} p \rightarrow \pi^0 \pi^0 \eta'$     |
| 0.047±0.010±0.004              | <sup>1</sup> BELADIDZE | 93   | VES 37 $\pi^- N \rightarrow a_2^- N$                   |
| 0.034±0.008±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

|            |     |                |                                |                            |
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| 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.)          |
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| 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.)  |
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| BERTIN     | 98B | PL B434 180    | A. Bertin <i>et al.</i>        | (OBELIX Collab.)           |

NODE=M012

REFID=59554  
REFID=59471  
REFID=59003  
REFID=56385  
REFID=55911  
REFID=53356  
REFID=52719  
REFID=53002  
REFID=51186  
REFID=51185  
REFID=48837  
REFID=48317  
REFID=48559  
REFID=47933  
REFID=47964  
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REFID=46351

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|--------------|------|----------------------------|----------------------------------------|---------------------------|-------------|
| ABELE        | 97C  | PL B404 179                | A. Abele <i>et al.</i>                 | (Crystal Barrel Collab.)  | REFID=45531 |
| ACCIARRI     | 97T  | PL B413 147                | M. Acciarri <i>et al.</i>              | (L3 Collab.)              | REFID=45761 |
| ALBRECHT     | 97B  | ZPHY C74 469               | H. Albrecht <i>et al.</i>              | (ARGUS Collab.)           | REFID=45418 |
| THOMPSON     | 97   | PRL 79 1630                | D.R. Thompson <i>et al.</i>            | (BNL E852 Collab.)        | REFID=45584 |
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| AMSLER       | 94D  | PL B333 277                | C. Amsler <i>et al.</i>                | (Crystal Barrel Collab.)  | REFID=44093 |
| AOYAGI       | 93   | PL B314 246                | H. Aoyagi <i>et al.</i>                | (BKEI Collab.)            | REFID=43599 |
| ARMSTRONG    | 93C  | PL B307 394                | T.A. Armstrong <i>et al.</i>           | (FNAL, FERR, GENO+)       | REFID=43587 |
| BELADIDZE    | 93   | PL B313 276                | G.M. Beladidze <i>et al.</i>           | (VES Collab.)             | REFID=43598 |
| CONDO        | 93   | PR D48 3045                | G.T. Condo <i>et al.</i>               | (SLAC Hybrid Collab.)     | REFID=43600 |
| ALDE         | 92B  | ZPHY C54 549               | D.M. Alde <i>et al.</i>                | (SERP, BELG, LANL, LAPP+) | REFID=41852 |
| BELADIDZE    | 92   | ZPHY C54 235               | G.M. Beladidze <i>et al.</i>           | (VES Collab.)             | REFID=42171 |
| ALBRECHT     | 90G  | ZPHY C48 183               | H. Albrecht <i>et al.</i>              | (ARGUS Collab.)           | REFID=41374 |
| ARMSTRONG    | 90   | ZPHY C48 213               | T.A. Armstrong, M. Benayoun, W. Beusch | (WA76 Coll.)              | REFID=41375 |
| BARU         | 90   | ZPHY C48 581               | S.E. Baru <i>et al.</i>                | (MD-1 Collab.)            | 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 |
| VOROBIEV     | 88   | SJNP 48 273                | P.V. Vorobiev <i>et al.</i>            | (NOVO)                    | REFID=41023 |
|              |      | Translated from YAF 48 436 |                                        |                           |             |
| ALTHOFF      | 86   | ZPHY C31 537               | M. Althoff <i>et al.</i>               | (TASSO Collab.)           | REFID=21287 |
| ANTREASYAN   | 86   | NP D33 1847                | D. Antreasyan <i>et al.</i>            | (Crystal Ball Collab.)    | REFID=20469 |
| BERGER       | 84C  | PL 149B 427                | C. Berger <i>et al.</i>                | (PLUTO Collab.)           | REFID=21286 |
| 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 |
| CIHANGIR     | 82   | PL 117B 123                | S. Cihangir <i>et al.</i>              | (FNAL, MINN, ROCH)        | REFID=21280 |
| CLELAND      | 82B  | NP B208 228                | W.E. Cleland <i>et al.</i>             | (DURH, GEVA, LAUS+)       | REFID=21281 |
| EDWARDS      | 82F  | PL 110B 82                 | C. Edwards <i>et al.</i>               | (CIT, HARV, PRIN+)        | REFID=20747 |
| DELFOSE      | 81   | NP B183 349                | A. Delfosse <i>et al.</i>              | (GEVA, LAUS)              | REFID=21277 |
| EVANGELIS... | 81   | NP B178 197                | C. Evangelista <i>et al.</i>           | (BARI, BONN, CERN+)       | REFID=20462 |
| CHABAUD      | 80   | NP B175 189                | V. Chabaud <i>et al.</i>               | (CERN, MPIM, AMST)        | REFID=21274 |
| DAUM         | 80C  | PL 99B 276                 | C. Daum <i>et al.</i>                  | (AMST, CERN, CRAC, MPIM+) | REFID=21275 |
| BALTAY       | 78B  | PR D17 62                  | C. Baltay <i>et al.</i>                | (COLU, BING)              | REFID=21265 |
| CHABAUD      | 78   | NP B145 349                | V. Chabaud <i>et al.</i>               | (CERN, MPIM)              | REFID=21267 |
| FERRERSORIA  | 78   | PL 74B 287                 | A. Ferrer Soria <i>et al.</i>          | (ORSAY, CERN, CDEF+)      | REFID=21270 |
| HYAMS        | 78   | NP B146 303                | B.D. Hyams <i>et al.</i>               | (CERN, MPIM, ATEN)        | REFID=21271 |
| MARTIN       | 78D  | PL 74B 417                 | A.D. Martin <i>et al.</i>              | (DURH, GEVA) JP           | REFID=21272 |
| MAY          | 77   | PR D16 1983                | E.N. May <i>et al.</i>                 | (ROCH, CORN)              | REFID=20450 |
| FORINO       | 76   | NC 35A 465                 | A. Forino <i>et al.</i>                | (BGNA, FIRZ, GENO, MILA+) | REFID=21259 |
| MARGULIE     | 76   | PR D14 667                 | M. Margulies <i>et al.</i>             | (BNL, CUNY)               | REFID=21261 |
| EMMS         | 75   | PL 58B 117                 | M.J. Emms <i>et al.</i>                | (BIRM, DURH, RHEL) JP     | REFID=21254 |
| WAGNER       | 75   | PL 58B 201                 | F. Wagner, M. Tabak, D.M. Chew         | (LBL) JP                  | REFID=20843 |
| DIAZ         | 74   | PRL 32 260                 | J. Diaz <i>et al.</i>                  | (CASE, CMU)               | REFID=21248 |
| KARSHON      | 74   | PRL 32 852                 | U. Karshon <i>et al.</i>               | (REHO)                    | REFID=21249 |
| ANTIPOV      | 73   | NP B63 175                 | Y.M. Antipov <i>et al.</i>             | (CERN, SERP) JP           | REFID=21238 |
| ANTIPOV      | 73C  | NP B63 153                 | Y.M. Antipov <i>et al.</i>             | (CERN, SERP) JP           | REFID=20817 |
| CHALOUPKA    | 73   | PL 44B 211                 | V. Chaloupka <i>et al.</i>             | (CERN)                    | REFID=21242 |
| CONFORTO     | 73   | PL 45B 154                 | G. Conforto <i>et al.</i>              | (EFI, FNAL, TNTO+)        | REFID=21243 |
| DEFOIX       | 73   | PL 43B 141                 | C. Defoix <i>et al.</i>                | (CDEF)                    | REFID=21244 |
| EISENSTEIN   | 73   | PR D7 278                  | L. Eisenstein <i>et al.</i>            | (ILL)                     | REFID=21245 |
| KEY          | 73   | PRL 30 503                 | A.W. Key <i>et al.</i>                 | (TNTO, EFI, FNAL, WISC)   | REFID=21246 |
| TOET         | 73   | NP B63 248                 | D.Z. Toet <i>et al.</i>                | (NIJM, BONN, DURH, TORI)  | REFID=20714 |
| DAMERI       | 72   | NC 9A 1                    | M. Dameri <i>et al.</i>                | (GENO, MILA, SACL)        | REFID=20338 |
| EISENBERG    | 72   | PR D5 15                   | Y. Eisenberg <i>et al.</i>             | (REHO, SLAC, TELA)        | REFID=20098 |
| ESPIGAT      | 72   | NP B36 93                  | P. Espigat <i>et al.</i>               | (CERN, CDEF)              | REFID=21232 |
| FOLEY        | 72   | PR D6 747                  | K.J. Foley <i>et al.</i>               | (BNL, CUNY)               | REFID=21233 |
| ALSTON-...   | 71   | PL 34B 156                 | M. Alston-Garnjost <i>et al.</i>       | (LRL)                     | REFID=21214 |
| BARNHAM      | 71   | PRL 26 1494                | K.W.J. Barnham <i>et al.</i>           | (LBL)                     | REFID=21215 |
| BINNIE       | 71   | PL 36B 257                 | D.M. Binnie <i>et al.</i>              | (LOIC, SHMP)              | REFID=21217 |
| BOWEN        | 71   | PRL 26 1663                | D.R. Bowen <i>et al.</i>               | (NEAS, STON)              | REFID=21219 |
| GRAYER       | 71   | PL 34B 333                 | G. Grayer <i>et al.</i>                | (CERN, MPIM)              | REFID=21223 |
| ABRAMOVI...  | 70B  | NP B23 466                 | M. Abramovich <i>et al.</i>            | (CERN) JP                 | REFID=21195 |
| ALSTON-...   | 70   | PL 33B 607                 | M. Alston-Garnjost <i>et al.</i>       | (LRL)                     | REFID=21196 |
| BOECKMANN    | 70   | NP B16 221                 | K. Boeckmann <i>et al.</i>             | (BONN, DURH, NIJM+)       | REFID=21202 |
| ASCOLI       | 68   | PRL 20 1321                | G. Ascoli <i>et al.</i>                | (ILL) JP                  | REFID=21171 |
| BOESEBECK    | 68   | NP B4 501                  | K. Boesebeck <i>et al.</i>             | (AACH, BERL, CERN)        | REFID=20585 |
| CHUNG        | 68   | PR 165 1491                | S.U. Chung <i>et al.</i>               | (LRL)                     | REFID=20059 |
| CONTE        | 67   | NC 51A 175                 | F. Conte <i>et al.</i>                 | (GENO, HAMB, MILA, SACL)  | REFID=21166 |

**$f_0(1370)$** 

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

See also the mini-reviews on scalar mesons under  $f_0(500)$  (see the index for the page number) and 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(150–250)</math> OUR ESTIMATE</b>                       |                          |      |                                                                      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                          |      |                                                                      |
| $(1290 \pm 50) - i(170^{+20}_{-40})$                                          | <sup>1</sup> ANISOVICH   | 09   | RVUE $0.0 \bar{p}p, \pi N$                                           |
| $(1373 \pm 15) - i(137 \pm 10)$                                               | <sup>2</sup> BARGIOTTI   | 03   | OBLX $\bar{p}p$                                                      |
| $(1302 \pm 17) - i(166 \pm 18)$                                               | <sup>3</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 $pp \rightarrow K^+ K^-, \pi^+ \pi^-$                       |
| $(1406 \pm 19) - i(80 \pm 6)$                                                 | <sup>4</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 $pp \rightarrow pp2(\pi^+ \pi^-)$                           |
| $(1548 \pm 40) - i(560 \pm 40)$                                               | 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>5</sup> AMSLER      | 95B  | CBAR $\bar{p}p \rightarrow 3\pi^0$                                   |
| $(1360 \pm 35) - i(150–300)$                                                  | <sup>5</sup> AMSLER      | 95C  | CBAR $\bar{p}p \rightarrow \pi^0 \eta\eta$                           |
| $(1390 \pm 30) - i(190 \pm 40)$                                               | <sup>6</sup> AMSLER      | 95D  | CBAR $\bar{p}p \rightarrow 3\pi^0, \pi^0 \eta\eta, \pi^0 \pi^0 \eta$ |
| 1346 – $i249$                                                                 | <sup>7,8</sup> JANSSEN   | 95   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}$                           |
| 1214 – $i168$                                                                 | <sup>8,9</sup> TORNQVIST | 95   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi, \eta\pi$            |
| 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>10</sup> BUGG       | 94   | RVUE $\bar{p}p \rightarrow 3\pi^0, \eta\eta\pi^0, \eta\pi^0 \pi^0$   |
| $(1430 \pm 5) - i(73 \pm 13)$                                                 | <sup>11</sup> KAMINSKI   | 94   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}$                           |
| 1420 – $i220$                                                                 | <sup>12</sup> AU         | 87   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}$                           |

OCCUR=2

OCCUR=2

OCCUR=2

OCCUR=2

- <sup>1</sup> Another pole is found at  $(1510 \pm 130) - i(800^{+100}_{-150})$  MeV.
- <sup>2</sup> Coupled channel analysis of  $\pi^+ \pi^- \pi^0, K^+ K^- \pi^0$ , and  $K^\pm K_S^0 \pi^\mp$ .
- <sup>3</sup> Average between  $\pi^+ \pi^- 2\pi^0$  and  $2(\pi^+ \pi^-)$ .
- <sup>4</sup> T-matrix pole on sheet – – –.
- <sup>5</sup> Supersedes ANISOVICH 94.
- <sup>6</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>7</sup> Analysis of data from FALVARD 88.
- <sup>8</sup> The pole is on Sheet III. Demonstrates explicitly that  $f_0(500)$  and  $f_0(1370)$  are two different poles.
- <sup>9</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>10</sup> Reanalysis of ANISOVICH 94 data.
- <sup>11</sup> T-matrix pole on sheet III.
- <sup>12</sup> Analysis of data from OCHS 73, GRAYER 74, BECKER 79, and CASON 83.

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. ● ● ● |      |                         |      |                                                |
| $1360 \pm 31 \pm 28$                                                          | 430  | <sup>1,2</sup> DOBBS 15 |      | $J/\psi \rightarrow \gamma K^+ K^-$            |
| $1350 \pm 48 \pm 15$                                                          | 168  | <sup>1,2</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> Using CLEO-c data but not authored by the CLEO Collaboration.<sup>2</sup> From a fit to a Breit-Wigner line shape with fixed  $\Gamma = 346$  MeV.NODE=M147M2  
NODE=M147M2

OCCUR=2

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**

|                    |                    |             |
|--------------------|--------------------|-------------|
| <u>VALUE (MeV)</u> | <u>DOCUMENT ID</u> | <u>TECN</u> |
|--------------------|--------------------|-------------|

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

1306 ± 20

<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=M147M5  
NODE=M147M5

NODE=M147M;LINKAGE=KM

 **$f_0(1370)$  BREIT-WIGNER WIDTH**

NODE=M147210

|                    |                    |
|--------------------|--------------------|
| <u>VALUE (MeV)</u> | <u>DOCUMENT ID</u> |
|--------------------|--------------------|

**200 to 500 OUR ESTIMATE**

NODE=M147W  
→ UNCHECKED ←

 **$\pi\pi$  MODE**

|                    |             |                    |             |                |
|--------------------|-------------|--------------------|-------------|----------------|
| <u>VALUE (MeV)</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--------------------|-------------|--------------------|-------------|----------------|

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

|                                                                             |      |                          |     |      |                                                       |
|-----------------------------------------------------------------------------|------|--------------------------|-----|------|-------------------------------------------------------|
| 300 ± 80                                                                    |      | <sup>1</sup> AUBERT      | 09L | BABR | $B^\pm \rightarrow \pi^\pm \pi^\pm \pi^\mp$           |
| 90 <sup>+</sup> <sub>1-</sub> 2 <sup>+</sup> <sub>1-</sub> 50 <sub>22</sub> |      | <sup>2</sup> UEHARA      | 08A | BELL | 10.6 $e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$        |
| 298 ± 21                                                                    | 2.6k | BONVICINI                | 07  | CLEO | $D^+ \rightarrow \pi^- \pi^+ \pi^+$                   |
| 126 ± 25                                                                    | 4286 | <sup>3</sup> GARMASH     | 06  | BELL | $B^+ \rightarrow K^+ \pi^+ \pi^-$                     |
| 265 ± 40                                                                    |      | ABLIKIM                  | 05  | BES2 | $J/\psi \rightarrow \phi \pi^+ \pi^-$                 |
| 350 ± 100 <sup>+</sup> <sub>60</sub>                                        |      | ABLIKIM                  | 05Q | BES2 | $\psi(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^-$     |
| 173 ± 32 ± 6                                                                | 848  | AITALA                   | 01A | E791 | $D_s^+ \rightarrow \pi^- \pi^+ \pi^+$                 |
| 222 ± 20                                                                    |      | BARBERIS                 | 99B | OMEG | 450 $pp \rightarrow p_s p_f \pi^+ \pi^-$              |
| 255 ± 60                                                                    |      | BELLAZZINI               | 99  | GAM4 | 450 $pp \rightarrow pp \pi^0 \pi^0$                   |
| 190 ± 50                                                                    |      | ALDE                     | 98  | GAM4 | 100 $\pi^- p \rightarrow \pi^0 \pi^0 n$               |
| 323 ± 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 ± 33                                                                    |      | ARMSTRONG                | 91  | OMEG | 300 $pp \rightarrow pp \pi\pi, pp K \bar{K}$          |
| 285 ± 60                                                                    |      | BREAKSTONE               | 90  | SFM  | 62 $pp \rightarrow pp \pi^+ \pi^-$                    |
| 460 ± 50                                                                    |      | AKESSON                  | 86  | SPEC | 63 $pp \rightarrow pp \pi^+ \pi^-$                    |
| ~ 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**

|                    |                    |             |                |
|--------------------|--------------------|-------------|----------------|
| <u>VALUE (MeV)</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--------------------|--------------------|-------------|----------------|

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

|                                                  |  |               |     |      |                                                |
|--------------------------------------------------|--|---------------|-----|------|------------------------------------------------|
| 121 ± 15                                         |  | VLADIMIRSK... | 06  | SPEC | 40 $\pi^- p \rightarrow K_S^0 K_S^0 n$         |
| 55 ± 26                                          |  | TIKHOMIROV    | 03  | SPEC | 40.0 $\pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$ |
| 250 ± 80                                         |  | BOLONKIN      | 88  | SPEC | 40 $\pi^- p \rightarrow K_S^0 K_S^0 n$         |
| 118 <sup>+</sup> <sub>16</sub> 138 <sub>16</sub> |  | ETKIN         | 82B | MPS  | 23 $\pi^- p \rightarrow n 2 K_S^0$             |
| 160 ± 30                                         |  | WICKLUND      | 80  | SPEC | 6 $\pi N \rightarrow K^+ K^- N$                |
| ~ 150                                            |  | POLYCHRO...   | 79  | STRC | 7 $\pi^- p \rightarrow n 2 K_S^0$              |

NODE=M147W2  
NODE=M147W2

 **$4\pi$  MODE  $2(\pi\pi)_S + \rho\rho$** 

|                    |             |                    |             |                |
|--------------------|-------------|--------------------|-------------|----------------|
| <u>VALUE (MeV)</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--------------------|-------------|--------------------|-------------|----------------|

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

|          |      |                      |    |      |                                                |
|----------|------|----------------------|----|------|------------------------------------------------|
| 275 ± 55 |      | ABELE                | 01 | CBAR | 0.0 $\bar{p} d \rightarrow \pi^- 4\pi^0 p$     |
| 375 ± 61 |      | AMSLER               | 94 | CBAR | 0.0 $\bar{p} p \rightarrow \pi^+ \pi^- 3\pi^0$ |
| 398 ± 26 |      | ADAMO                | 93 | OBLX | $\bar{n} p \rightarrow 3\pi^+ 2\pi^-$          |
| 310 ± 50 |      | GASPERO              | 93 | DBC  | 0.0 $\bar{p} n \rightarrow 2\pi^+ 3\pi^-$      |
| ~ 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. • • • |                     |          |                                             |
| $484^{+246+246}_{-170-263}$                                                   | <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    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------|
| • • • 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                           |
| $\Gamma_7 2(\pi\pi)_{S\text{-wave}}$ | 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

 **$f_0(1370) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$**  **$\Gamma(\eta\eta) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$**  **$\Gamma_{10} \Gamma_{15} / \Gamma$** 

| VALUE (eV)                                                                    | DOCUMENT ID         | TECN     | COMMENT                                     |
|-------------------------------------------------------------------------------|---------------------|----------|---------------------------------------------|
| • • • 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=M147225

NODE=M147G01  
NODE=M147G01

NODE=M147G01;LINKAGE=UE

**$f_0(1370)$  BRANCHING RATIOS**

NODE=M147220

| $\Gamma(\pi\pi)/\Gamma_{\text{total}}$                                        |     |                     |      | $\Gamma_1/\Gamma$                              |
|-------------------------------------------------------------------------------|-----|---------------------|------|------------------------------------------------|
| VALUE                                                                         | CL% | DOCUMENT ID         | TECN | COMMENT                                        |
| • • • 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                                                     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |  |             |      |                                                             |
| >0.72                                                                         |  | GASPERO     | 93   | DBC $0.0 \bar{p}n \rightarrow \text{hadrons}$               |

NODE=M147R4  
NODE=M147R4

| $\Gamma(4\pi^0)/\Gamma(4\pi)$                                                 |  |                      |      | $\Gamma_3/\Gamma_2$                           |
|-------------------------------------------------------------------------------|--|----------------------|------|-----------------------------------------------|
| VALUE                                                                         |  | DOCUMENT ID          | TECN | COMMENT                                       |
| • • • 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  
NODE=M147R12

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                                                         |
| • • • 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  
NODE=M147R5

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                                                         |
| • • • 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  
NODE=M147R6

NODE=M147R6;LINKAGE=A

| $\Gamma(\rho\rho)/\Gamma(4\pi)$                                               |  |             |      | $\Gamma_6/\Gamma_2$                    |
|-------------------------------------------------------------------------------|--|-------------|------|----------------------------------------|
| VALUE                                                                         |  | DOCUMENT ID | TECN | COMMENT                                |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |  |             |      |                                        |
| $0.26 \pm 0.07$                                                               |  | ABELE       | 01B  | CBAR $0.0 \bar{p}d \rightarrow 5\pi p$ |

NODE=M147R17  
NODE=M147R17

| $\Gamma(2(\pi\pi)_{S\text{-wave}})/\Gamma(\pi\pi)$                            |  |                    |      | $\Gamma_7/\Gamma_1$                            |
|-------------------------------------------------------------------------------|--|--------------------|------|------------------------------------------------|
| VALUE                                                                         |  | DOCUMENT ID        | TECN | COMMENT                                        |
| • • • 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=M147R15  
NODE=M147R15

NODE=M147R;LINKAGE=KZ

| $\Gamma(2(\pi\pi)_{S\text{-wave}})/\Gamma(4\pi)$                              |  |             |      | $\Gamma_7/\Gamma_2$                    |
|-------------------------------------------------------------------------------|--|-------------|------|----------------------------------------|
| VALUE                                                                         |  | DOCUMENT ID | TECN | COMMENT                                |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |  |             |      |                                        |
| $0.51 \pm 0.09$                                                               |  | ABELE       | 01B  | CBAR $0.0 \bar{p}d \rightarrow 5\pi p$ |

NODE=M147R16  
NODE=M147R16

| $\Gamma(\rho\rho)/\Gamma(2(\pi\pi)_{S\text{-wave}})$                          |  |             |      | $\Gamma_6/\Gamma_7$                            |
|-------------------------------------------------------------------------------|--|-------------|------|------------------------------------------------|
| VALUE                                                                         |  | DOCUMENT ID | TECN | COMMENT                                        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |  |             |      |                                                |
| large                                                                         |  | BARBERIS    | 00C  | $450 pp \rightarrow p_f 4\pi p_s$              |
| $1.6 \pm 0.2$                                                                 |  | AMSLER      | 94   | CBAR $\bar{p}p \rightarrow \pi^+ \pi^- 3\pi^0$ |
| $\sim 0.65$                                                                   |  | GASPERO     | 93   | DBC $0.0 \bar{p}n \rightarrow \text{hadrons}$  |

NODE=M147R10  
NODE=M147R10

OCCUR=2

| $\Gamma(\pi(1300)\pi)/\Gamma(4\pi)$                                           |  |             |      | $\Gamma_8/\Gamma_2$                    |
|-------------------------------------------------------------------------------|--|-------------|------|----------------------------------------|
| 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 $0.0 \bar{p}d \rightarrow 5\pi p$ |

NODE=M147R18  
NODE=M147R18

$\Gamma(a_1(1260)\pi)/\Gamma(4\pi)$  $\Gamma_9/\Gamma_2$ 

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                                |
|-------------------------------------------------------------------------------|-------------|------|----------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                        |
| 0.06±0.02                                                                     | ABELE       | 01B  | CBAR 0.0 $\bar{p}d \rightarrow 5\pi p$ |

NODE=M147R19  
 NODE=M147R19

 $\Gamma(\eta\eta)/\Gamma(4\pi)$  $\Gamma_{10}/\Gamma_2 = \Gamma_{10}/(\Gamma_3+\Gamma_4+\Gamma_5)$ 

| 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 $pp \rightarrow p_f \eta \eta p_S$ |

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

 $\Gamma(K\bar{K})/\Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ 

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT |
|-------------------------------------------------------------------------------|-------------|------|---------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |         |
| 0.35±0.13                                                                     | BUGG        | 96   | RVUE    |

NODE=M147R11  
 NODE=M147R11

 $\Gamma(K\bar{K})/\Gamma(\pi\pi)$  $\Gamma_{11}/\Gamma_1$ 

| VALUE                                                                         | DOCUMENT ID            | TECN | COMMENT                                                  |
|-------------------------------------------------------------------------------|------------------------|------|----------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                        |      |                                                          |
| 0.08±0.08                                                                     | ABLIKIM                | 05   | BES2 $J/\psi \rightarrow \phi \pi^+ \pi^-, \phi K^+ K^-$ |
| 0.91±0.20                                                                     | <sup>1</sup> BARGIOTTI | 03   | OBLX $\bar{p}p$                                          |
| 0.12±0.06                                                                     | <sup>2</sup> ANISOVICH | 02D  | SPEC Combined fit                                        |
| 0.46±0.15±0.11                                                                | BARBERIS               | 99D  | OMEG 450 $pp \rightarrow K^+ K^-, \pi^+ \pi^-$           |

NODE=M147R13  
 NODE=M147R13

<sup>1</sup> Coupled channel analysis of  $\pi^+ \pi^- \pi^0$ ,  $K^+ K^- \pi^0$ , and  $K_S^0 \pi^\pm$ .

<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

 $\Gamma(K\bar{K}n\pi)/\Gamma_{\text{total}}$  $\Gamma_{12}/\Gamma$ 

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                                       |
|-------------------------------------------------------------------------------|-------------|------|-----------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                               |
| <0.03                                                                         | GASPERO     | 93   | DBC 0.0 $\bar{p}n \rightarrow \text{hadrons}$ |

NODE=M147R20  
 NODE=M147R20

 $\Gamma(6\pi)/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ 

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                                       |
|-------------------------------------------------------------------------------|-------------|------|-----------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                               |
| <0.22                                                                         | GASPERO     | 93   | DBC 0.0 $\bar{p}n \rightarrow \text{hadrons}$ |

NODE=M147R21  
 NODE=M147R21

 $\Gamma(\omega\omega)/\Gamma_{\text{total}}$  $\Gamma_{14}/\Gamma$ 

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                                       |
|-------------------------------------------------------------------------------|-------------|------|-----------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                               |
| <0.13                                                                         | GASPERO     | 93   | DBC 0.0 $\bar{p}n \rightarrow \text{hadrons}$ |

NODE=M147R22  
 NODE=M147R22

 $f_0(1370)$  REFERENCES

NODE=M147

|               |     |                              |                                  |                  |
|---------------|-----|------------------------------|----------------------------------|------------------|
| DOBBS         | 15  | PR D91 052006                | S. Dobbs <i>et al.</i>           | (NWES)           |
| OCHS          | 13  | JP G40 043001                | W. Ochs                          |                  |
| UEHARA        | 10A | PR D82 114031                | S. Uehara <i>et al.</i>          | (BELLE Collab.)  |
| ANISOVICH     | 09  | IJMP A24 2481                | V.V. Anisovich, A.V. Sarantsev   |                  |
| AUBERT        | 09L | PR D79 072006                | B. Aubert <i>et al.</i>          | (BABAR Collab.)  |
| PDG           | 08  | PL B667 1                    | C. Amsler <i>et al.</i>          | (PDG Collab.)    |
| UEHARA        | 08A | PR D78 052004                | S. Uehara <i>et al.</i>          | (BELLE Collab.)  |
| BONVICINI     | 07  | PR D76 012001                | G. Bonvicini <i>et al.</i>       | (CLEO Collab.)   |
| BUGG          | 07A | JP G34 151                   | D.V. Bugg <i>et al.</i>          |                  |
| GARMASH       | 07  | PR D75 012006                | A. Garmash <i>et al.</i>         | (BELLE Collab.)  |
| GARMASH       | 06  | PRL 96 251803                | A. Garmash <i>et al.</i>         | (BELLE Collab.)  |
| PDG           | 06  | JP G33 1                     | W.-M. Yao <i>et al.</i>          | (PDG Collab.)    |
| VLADIMIRSK... | 06  | PAN 69 493                   | V.V. Vladimirovsky <i>et al.</i> | (ITEP, Moscow)   |
|               |     | Translated from YAF 69 515.  |                                  |                  |
| ABLIKIM       | 05  | PL B607 243                  | M. Ablikim <i>et al.</i>         | (BES Collab.)    |
| ABLIKIM       | 05Q | PR D72 092002                | M. Ablikim <i>et al.</i>         | (BES Collab.)    |
| GARMASH       | 05  | PR D71 092003                | A. Garmash <i>et al.</i>         | (BELLE Collab.)  |
| ANISOVICH     | 03  | EPJ A16 229                  | V.V. Anisovich <i>et al.</i>     |                  |
| BARGIOTTI     | 03  | EPJ C26 371                  | M. Bargiotti <i>et al.</i>       | (OBELIX Collab.) |
| TIKHOMIROV    | 03  | PAN 66 828                   | G.D. Tikhomirov <i>et al.</i>    |                  |
|               |     | Translated from YAF 66 860.  |                                  |                  |
| ANISOVICH     | 02D | PAN 65 1545                  | V.V. Anisovich <i>et al.</i>     |                  |
|               |     | Translated from YAF 65 1583. |                                  |                  |

REFID=56805  
 REFID=55367  
 REFID=53641  
 REFID=52719  
 REFID=52723  
 REFID=52166  
 REFID=52309  
 REFID=51721  
 REFID=53252  
 REFID=51594  
 REFID=51162  
 REFID=51004  
 REFID=51191  
 REFID=50450  
 REFID=50958  
 REFID=50641  
 REFID=49401  
 REFID=49217  
 REFID=49423  
 REFID=48831

|             |     |                                          |                                       |                              |             |
|-------------|-----|------------------------------------------|---------------------------------------|------------------------------|-------------|
| 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 |
| BARBERIS    | 99D | PL B462 462                              | D. Barberis <i>et al.</i>             | (Omega Expt.)                | REFID=47395 |
| 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 |
| ANISOVICH   | 98B | Translated from YAF 62 446<br>SPU 41 419 | V.V. Anisovich <i>et al.</i>          |                              | REFID=46331 |
| 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 |
| JANSSSEN    | 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                            | (ROMAI) JPC                  | 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 |
| 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 |
| 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 |
| 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 |

**$h_1(1415)$** 

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

was  $h_1(1380)$ 

NODE=M109

 **$h_1(1415)$  MASS**

NODE=M109M

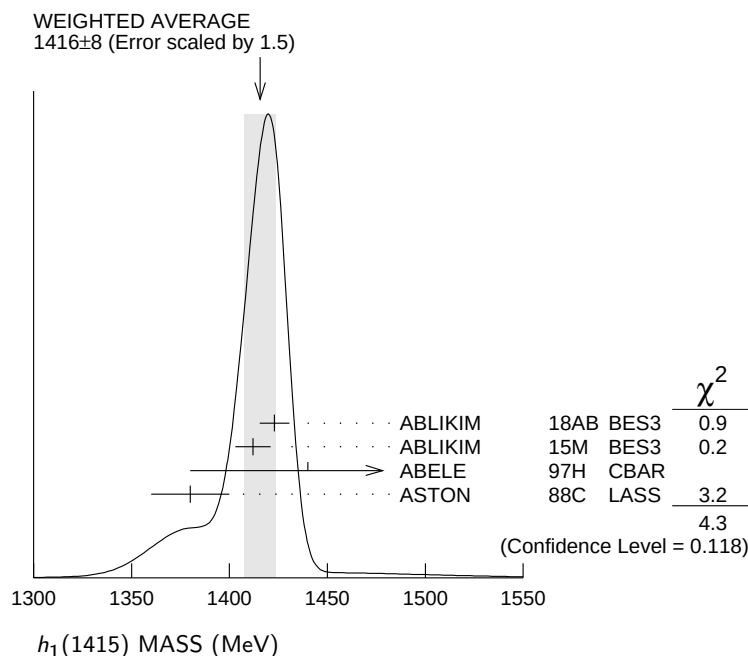
| VALUE (MeV)                    | EVTS               | DOCUMENT ID                                                                                                            | TECN      | COMMENT                                                                                              |
|--------------------------------|--------------------|------------------------------------------------------------------------------------------------------------------------|-----------|------------------------------------------------------------------------------------------------------|
| <b><math>1416 \pm 8</math></b> | <b>OUR AVERAGE</b> | Error includes scale factor of 1.5. See the ideogram below.<br>[1407 $\pm$ 12 MeV OUR 2018 AVERAGE Scale factor = 1.5] |           |                                                                                                      |
| $1423 \pm 2.1 \pm 7.3$         | 2249               | <sup>1</sup> ABLIKIM                                                                                                   | 18AB BES3 | $J/\psi \rightarrow \eta' h_1 \rightarrow \eta' K^* \bar{K}$                                         |
| $1412 \pm 4 \pm 8$             |                    | <sup>1</sup> ABLIKIM                                                                                                   | 15M BES3  | $\psi(2S) \rightarrow \gamma \chi_{c1,2} \rightarrow$<br>$\gamma \phi (h_1 \rightarrow K^* \bar{K})$ |
| $1440 \pm 60$                  |                    | ABELE                                                                                                                  | 97H CBAR  | $\bar{p} p \rightarrow K_L^0 K_S^0 \pi^0 \pi^0$                                                      |
| $1380 \pm 20$                  |                    | ASTON                                                                                                                  | 88C LASS  | $11 K^- p \rightarrow$<br>$K_S^0 K^\pm \pi^\mp \Lambda$                                              |

NODE=M109M

NEW

<sup>1</sup> Final states  $K^+ K^- \pi^0$  and  $K_S K^\pm \pi^\mp$ 

NODE=M109M;LINKAGE=A

 **$h_1(1415)$  WIDTH**

NODE=M109W

| VALUE (MeV)                   | EVTS               | DOCUMENT ID                        | TECN      | COMMENT                                                                                              |
|-------------------------------|--------------------|------------------------------------|-----------|------------------------------------------------------------------------------------------------------|
| <b><math>90 \pm 15</math></b> | <b>OUR AVERAGE</b> | [89 $\pm$ 23 MeV OUR 2018 AVERAGE] |           |                                                                                                      |
| $90.3 \pm 9.8 \pm 17.5$       | 2249               | <sup>1</sup> ABLIKIM               | 18AB BES3 | $J/\psi \rightarrow \eta' h_1 \rightarrow \eta' K^* \bar{K}$                                         |
| $84 \pm 12 \pm 40$            |                    | <sup>1</sup> ABLIKIM               | 15M BES3  | $\psi(2S) \rightarrow \gamma \chi_{c1,2} \rightarrow$<br>$\gamma \phi (h_1 \rightarrow K^* \bar{K})$ |
| $170 \pm 80$                  |                    | ABELE                              | 97H CBAR  | $\bar{p} p \rightarrow K_L^0 K_S^0 \pi^0 \pi^0$                                                      |
| $80 \pm 30$                   |                    | ASTON                              | 88C LASS  | $11 K^- p \rightarrow$<br>$K_S^0 K^\pm \pi^\mp \Lambda$                                              |

NODE=M109W

NEW

<sup>1</sup> Final states  $K^+ K^- \pi^0$  and  $K_S K^\pm \pi^\mp$ 

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> | (BES III Collab.)        |
| ABLIKIM | 15M PR D91 112008  | M. Ablikim <i>et al.</i> | (BES III Collab.)        |
| ABELE   | 97H PL B415 280    | A. Abele <i>et al.</i>   | (Crystal Barrel Collab.) |
| ASTON   | 88C PL B201 573    | D. Aston <i>et al.</i>   | (SLAC, NAGO, CINC, INUS) |

REFID=59456  
REFID=56778  
REFID=45765  
REFID=40282

$\pi_1(1400)$ 

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

NODE=M111

NODE=M111

See also the mini-review under non- $q\bar{q}$  candidates in PDG 06, Journal of Physics **G33** 1 (2006).

 **$\pi_1(1400)$  MASS**

NODE=M111M

NODE=M111M

| 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. • • • |       |                                                             |      |        |                                              |
| 1323.1 ± 4.6                                                                  |       | <sup>2</sup> AOYAGI                                         | 93   | BKEI   | $\pi^- p \rightarrow \eta \pi^- p$           |
| 1406 ±20                                                                      |       | <sup>3</sup> ALDE                                           | 88B  | GAM4 0 | $100 \pi^- p \rightarrow \eta \pi^0 n$       |

<sup>1</sup> Natural parity exchange, questioned by DZIERBA 03.

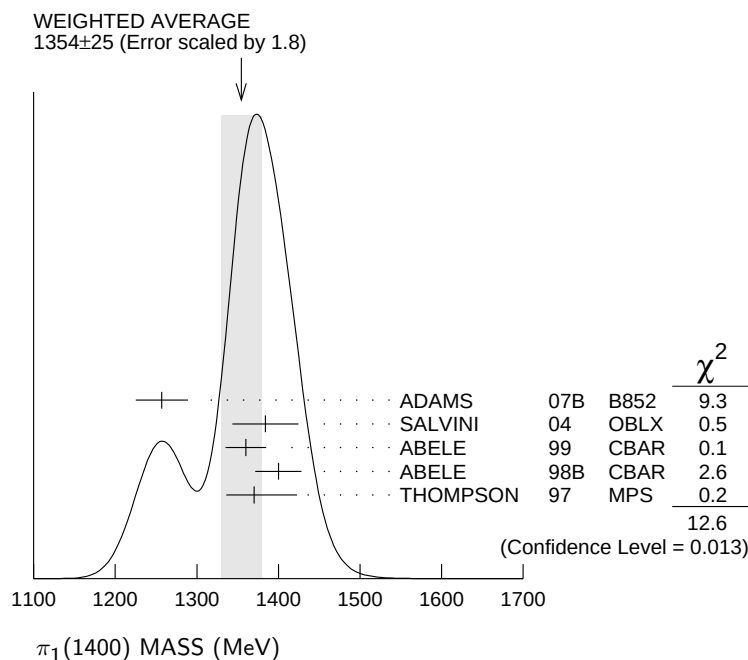
<sup>2</sup> Unnatural parity exchange.

<sup>3</sup> Seen in the  $P_0$ -wave intensity of the  $\eta \pi^0$  system, unnatural parity exchange.

NODE=M111M;LINKAGE=B

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>4</sup> THOMPSON | 97   | MPS    | $18 \pi^- p \rightarrow \eta \pi^- p$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                       |      |        |                                              |
| 143.2 ±12.5                                                                   |       | <sup>5</sup> AOYAGI   | 93   | BKEI   | $\pi^- p \rightarrow \eta \pi^- p$           |
| 180 ±20                                                                       |       | <sup>6</sup> ALDE     | 88B  | GAM4 0 | $100 \pi^- p \rightarrow \eta \pi^0 n$       |

<sup>4</sup> Resolution is not unfolded, natural parity exchange, questioned by DZIERBA 03.

<sup>5</sup> Unnatural parity exchange.

<sup>6</sup> Seen in the  $P_0$ -wave intensity of the  $\eta \pi^0$  system, unnatural parity exchange.

NODE=M111W;LINKAGE=QQ

NODE=M111W;LINKAGE=C

NODE=M111W;LINKAGE=A



**$\pi_1(1400)$  DECAY MODES**

NODE=M111215;NODE=M111

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------|--------------------------------|
| $\Gamma_1 \quad \eta\pi^0$    | seen                           |
| $\Gamma_2 \quad \eta\pi^-$    | seen                           |
| $\Gamma_3 \quad \eta'\pi$     |                                |
| $\Gamma_4 \quad \rho(770)\pi$ |                                |

DESIG=1;OUR EST;→ UNCHECKED ←  
 DESIG=4;OUR EST;→ UNCHECKED ←  
 DESIG=3  
 DESIG=5

 **$\pi_1(1400)$  BRANCHING RATIOS**

NODE=M111220

| $\Gamma(\eta\pi^0)/\Gamma_{\text{total}}$                                     |                   |      |        | $\Gamma_1/\Gamma$                     |
|-------------------------------------------------------------------------------|-------------------|------|--------|---------------------------------------|
| 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>7</sup> BUGG | 94   | RVUE   | $\bar{p}p \rightarrow \eta 2\pi^0$    |
| not seen                                                                      | <sup>8</sup> APEL | 81   | NICE 0 | $40 \pi^- p \rightarrow \eta\pi^0 n$  |

NODE=M111R1  
 NODE=M111R1

<sup>7</sup> Using Crystal Barrel data.<sup>8</sup> A general fit allowing  $S$ ,  $D$ , and  $P$  waves (including  $m=0$ ) is not done because of limited statistics.

NODE=M111R1;LINKAGE=C  
 NODE=M111R1;LINKAGE=B

| $\Gamma(\eta\pi^-)/\Gamma_{\text{total}}$                                     |              |      |                                     | $\Gamma_2/\Gamma$ |
|-------------------------------------------------------------------------------|--------------|------|-------------------------------------|-------------------|
| VALUE                                                                         | DOCUMENT ID  | TECN | COMMENT                             |                   |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |              |      |                                     |                   |
| possibly seen                                                                 | BELADIDZE 93 | VES  | $37\pi^- N \rightarrow \eta\pi^- N$ |                   |

NODE=M111R4  
 NODE=M111R4

| $\Gamma(\eta'\pi)/\Gamma(\eta\pi^0)$                                          |     |              |      | $\Gamma_3/\Gamma_1$                 |
|-------------------------------------------------------------------------------|-----|--------------|------|-------------------------------------|
| VALUE                                                                         | CL% | DOCUMENT ID  | TECN | COMMENT                             |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |     |              |      |                                     |
| <0.80                                                                         | 95  | BOUTEMEUR 90 | GAM4 | $100 \pi^- p \rightarrow 4\gamma n$ |

NODE=M111R3  
 NODE=M111R3

| $\Gamma(\rho(770)\pi)/\Gamma_{\text{total}}$                                  |              |      |  | $\Gamma_4/\Gamma$ |
|-------------------------------------------------------------------------------|--------------|------|--|-------------------|
| VALUE                                                                         | DOCUMENT ID  | TECN |  |                   |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |              |      |  |                   |
| not seen                                                                      | AGHASYAN 18B | COMP |  |                   |

NODE=M111R00  
 NODE=M111R00

 **$\pi_1(1400)$  REFERENCES**

NODE=M111

|                |                             |                                |                                |
|----------------|-----------------------------|--------------------------------|--------------------------------|
| 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. Boutemur, 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)                   |

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

**$\eta(1405)$** 

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

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**

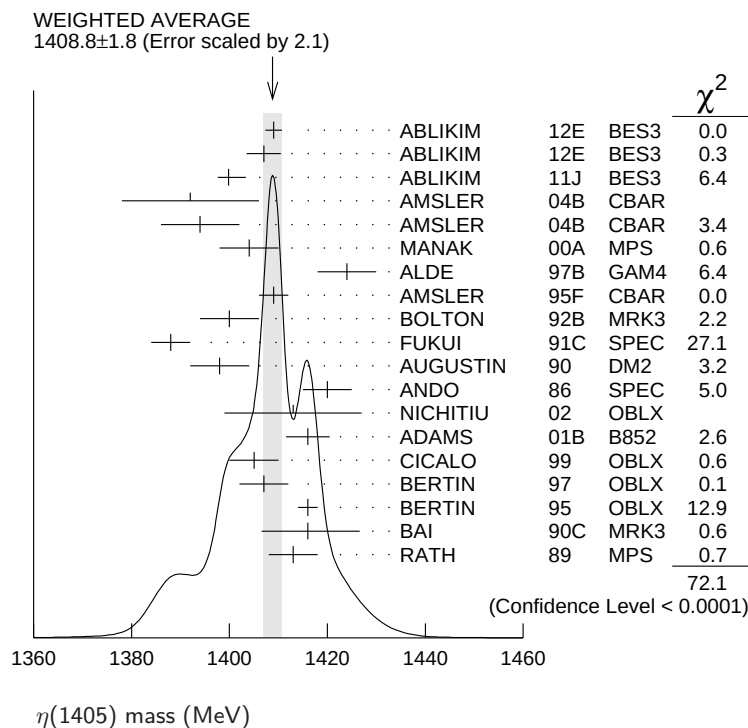
NODE=M027205

NODE=M027MX

VALUE (MeV)

DOCUMENT ID

**1408.8 $\pm$ 1.8 OUR AVERAGE** Includes data from the 2 datablocks that follow this one.  
Error includes scale factor of 2.1. 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

**1406.2 $\pm$  2.3 OUR AVERAGE** Error includes scale factor of 2.2. 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            | 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. • • •

|              |   |        |          |                                                   |
|--------------|---|--------|----------|---------------------------------------------------|
| 1385 $\pm$ 7 |   | BAI    | 99 BES   | $J/\psi \rightarrow \gamma\eta\pi^+\pi^-$         |
| 1409 $\pm$ 3 | 4 | AMSLER | 95F CBAR | $0 \bar{p}p \rightarrow \pi^+\pi^-\pi^0\pi^0\eta$ |

<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.

OCCUR=2

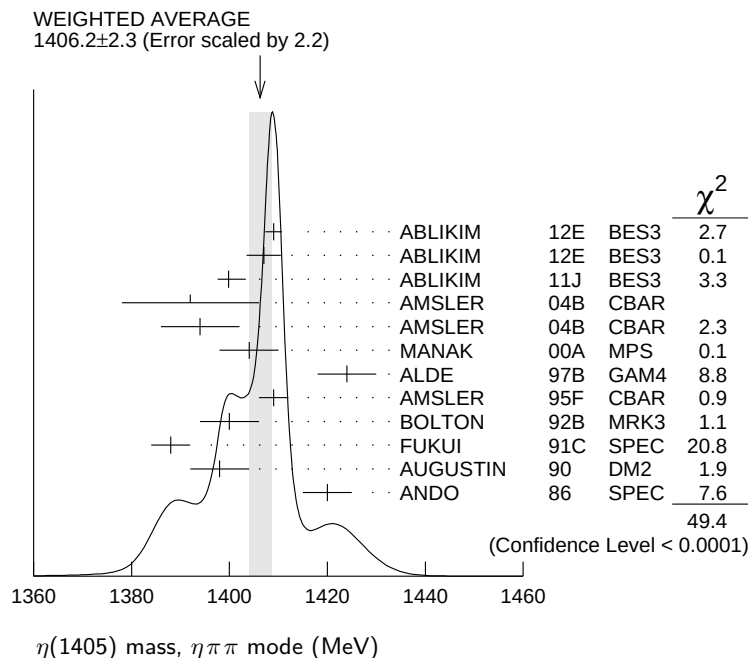
OCCUR=2

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 $^{+7}_{-5}$ | 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

|                   |          |        |          |                                                       |
|-------------------|----------|--------|----------|-------------------------------------------------------|
| <b>1390±12</b>    | 235 ± 91 | AMSLER | 04B CBAR | 0 $\bar{p}p \rightarrow \pi^+ \pi^- \pi^+ \pi^- \eta$ |
| <b>1424±10±11</b> | 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 | $J/\psi \rightarrow \pi^+ \pi^- 2\gamma$      |

<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  $\eta(1405)$ .

OCCUR=4

NODE=M027M2;LINKAGE=E  
NODE=M027M2;LINKAGE=X

### $4\pi$ MODE

VALUE (MeV) EVTS DOCUMENT ID TECN COMMENT

|         |      |                      |         |                                                 |
|---------|------|----------------------|---------|-------------------------------------------------|
| 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

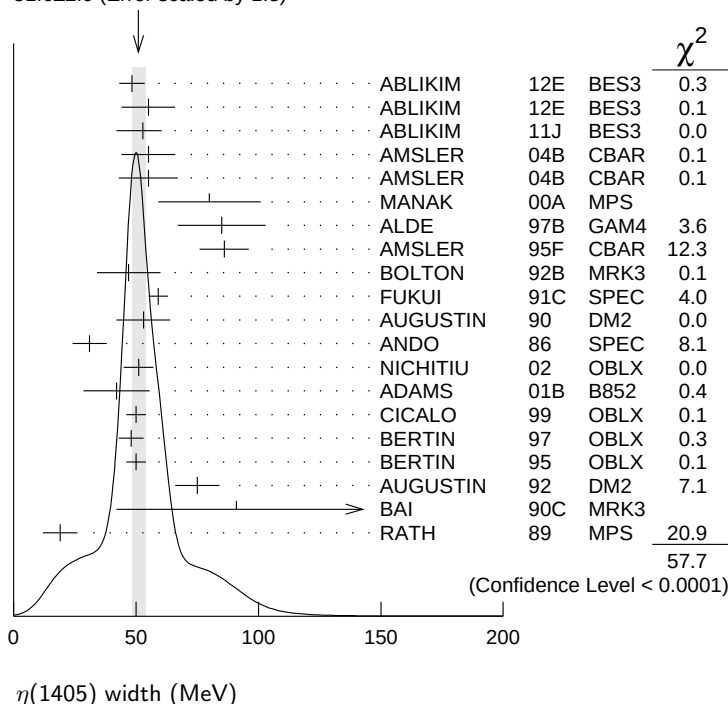
 **$\eta(1405)$  WIDTH**

NODE=M027210

VALUE (MeV) DOCUMENT ID  
**51.0 $\pm$ 2.9 OUR AVERAGE** Includes data from the 2 datablocks that follow this one. Error includes scale factor of 1.8. See the ideogram below.

NODE=M027WX

WEIGHTED AVERAGE  
51.0 $\pm$ 2.9 (Error scaled by 1.8)

 **$\eta\pi\pi$  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

**54  $\pm$  4 OUR AVERAGE** Error includes scale factor of 1.6. 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 | $J/\psi \rightarrow \omega(\eta \pi^+ \pi^-)$         |
| $55 \pm 11$                  | $900 \pm 375$ | AMSLER               | 04B CBAR | $0 \bar{p}p \rightarrow \pi^+ \pi^- \pi^+ \pi^- \eta$ |

OCCUR=2

|        |            |                       |          |                                                          |
|--------|------------|-----------------------|----------|----------------------------------------------------------|
| 55 ±12 | 6.6 ± 2.0k | AMSLER                | 04B CBAR | $0 \bar{p} p \rightarrow \pi^+ \pi^- \pi^0 \pi^0 \gamma$ |
| 80 ±21 | 9082       | MANAK                 | 00A MPS  | $18 \pi^- p \rightarrow \eta \pi^+ \pi^- n$              |
| 85 ±18 | 2200       | 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. • • •

|        |  |                     |          |                                                        |
|--------|--|---------------------|----------|--------------------------------------------------------|
| 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.

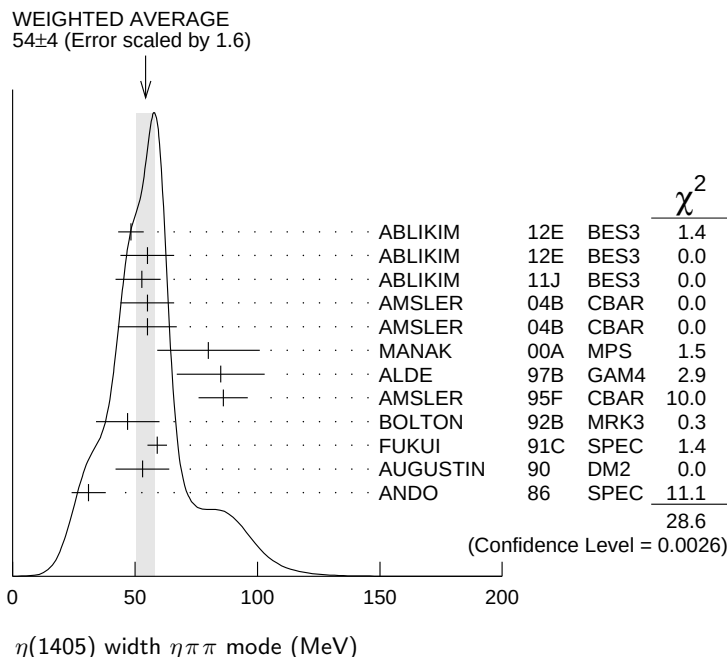
OCCUR=2

NODE=M027W1;LINKAGE=BL

NODE=M027W1;LINKAGE=A1

NODE=M027W1;LINKAGE=D1

NODE=M027W1;LINKAGE=A



### $K \bar{K} \pi$ 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.

|                                |                                                             |                       |          |                                                             |
|--------------------------------|-------------------------------------------------------------|-----------------------|----------|-------------------------------------------------------------|
| <b>48± 4 OUR AVERAGE</b>       | 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  $a_0(980) \pi^1 \pi^+$  cannot be excluded.

NODE=M027W4

NODE=M027W4

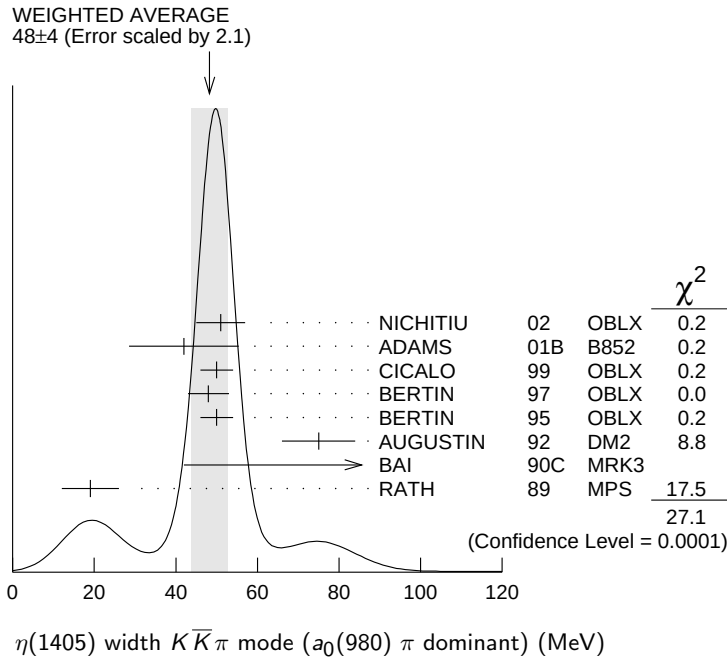
OCCUR=2

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>64 ±18</b>                                                                 | 235 ± 91 | AMSLER               | 04B CBAR | $0 \bar{p} p \rightarrow \pi^+ \pi^- \pi^+ \pi^- \gamma$ |
| <b>101.0 ± 8.8 ± 8.8</b>                                                      | 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                                                   |
|-------------------------------------------------------------------------------|----------|------------------------|----------|-----------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |          |                        |          |                                                           |
| 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 | $J/\psi \rightarrow \omega K_S^0 K^+ \pi^- + \text{c.c.}$ |
| 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  $\bar{p}p \rightarrow \pi^+\pi^-\pi^\pm\pi^\mp K^0$

~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><math>0.0152 \pm 0.0038</math></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 (units $10^{-3}$ )                 | DOCUMENT ID          | TECN | COMMENT                                               |
|------------------------------------------|----------------------|------|-------------------------------------------------------|
| <b><math>&lt; 1.78</math></b>            | <sup>1</sup> ABLIKIM | 180  | BES3 $\psi(2S) \rightarrow \pi^+ \pi^- \gamma \gamma$ |
| <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 $0.9-1.2 \bar{p}p \rightarrow \eta 3\pi^0$ |
| <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><math>&lt; 0.58</math></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> Assuming constructive interference between $X(1835)$ and $\eta(1405)/\eta(1475)$ decays to $\gamma\phi$ . Also see $\eta(1475)$ . ABLIKIM 18I reports the inverse as $11.10 \pm 3.5$ .                                                    |     |                      |      |                                                    |
| <sup>2</sup> Assuming destructive interference between $X(1835)$ and $\eta(1405)/\eta(1475)$ decays to $\gamma\phi$ . 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                     | 18I  | PR D97 051101  | M. Ablikim <i>et al.</i>     | (BES III Collab.)            | REFID=58893 |
| ABLIKIM                     | 18O  | PR D97 072014  | M. Ablikim <i>et al.</i>     | (BES III Collab.)            | REFID=58925 |
| ABLIKIM                     | 17AJ | PR D96 112008  | M. Ablikim <i>et al.</i>     | (BES III Collab.)            | REFID=58322 |
| ABLIKIM                     | 13M  | PR D87 092006  | M. Ablikim <i>et al.</i>     | (BES III Collab.)            | REFID=55386 |
| ABLIKIM                     | 12E  | PRL 108 182001 | M. Ablikim <i>et al.</i>     | (BES III Collab.)            | REFID=54270 |
| ABLIKIM                     | 11J  | PRL 107 182001 | M. Ablikim <i>et al.</i>     | (BES III 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 |

**$a_1(1420)$** 

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

NODE=M230

OMITTED FROM SUMMARY TABLE

 **$a_1(1420)$  MASS**

NODE=M230M

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

NODE=M230M

|                              |                                                           |  |  |  |
|------------------------------|-----------------------------------------------------------|--|--|--|
| $1411^{+4}_{-5}$ OUR AVERAGE | [1414 <sup>+15</sup> <sub>-13</sub> MeV OUR 2018 AVERAGE] |  |  |  |
|------------------------------|-----------------------------------------------------------|--|--|--|

NEW

|                  |     |                       |     |                                                    |
|------------------|-----|-----------------------|-----|----------------------------------------------------|
| $1411^{+4}_{-5}$ | 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 <sup>+15</sup> <sub>-13</sub> |  | <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;LINKAGE=C  
 NODE=M230M;LINKAGE=A  
 NODE=M230M;LINKAGE=B

 **$a_1(1420)$  WIDTH**

NODE=M230W

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

NODE=M230W

|                               |                                                         |  |  |  |
|-------------------------------|---------------------------------------------------------|--|--|--|
| $161^{+11}_{-14}$ OUR AVERAGE | [153 <sup>+8</sup> <sub>-23</sub> MeV OUR 2018 AVERAGE] |  |  |  |
|-------------------------------|---------------------------------------------------------|--|--|--|

NEW

|                   |     |                       |     |                                                    |
|-------------------|-----|-----------------------|-----|----------------------------------------------------|
| $161^{+11}_{-14}$ | 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 <sup>+8</sup> <sub>-23</sub> |  | <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;LINKAGE=D  
 NODE=M230W;LINKAGE=A  
 NODE=M230W;LINKAGE=C

 **$a_1(1420)$  DECAY MODES**

NODE=M230215;NODE=M230

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------|--------------------------------|
| $\Gamma_1$ $f_0(980)\pi$ | seen                           |

DESIG=1

 **$a_1(1420)$  BRANCHING RATIOS**

NODE=M230220

| $\Gamma(f_0(980)\pi)/\Gamma_{\text{total}}$ | $\Gamma_1/\Gamma$ |
|---------------------------------------------|-------------------|
|---------------------------------------------|-------------------|

NODE=M230R01  
 NODE=M230R01

|      |                     |     |                                                    |
|------|---------------------|-----|----------------------------------------------------|
| 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;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

$f_1(1420)$ 

$$I^G(J^{PC}) = 0^+(1^{++})$$

See the minireview under  $\eta(1405)$ .

NODE=M006

NODE=M006

NODE=M006M2

NODE=M006M2

 **$f_1(1420)$  MASS**

| VALUE (MeV)                                                                                            | EVTs | DOCUMENT ID                         | TECN     | COMMENT                                                        |
|--------------------------------------------------------------------------------------------------------|------|-------------------------------------|----------|----------------------------------------------------------------|
| <b>1426.4 ± 0.9 OUR AVERAGE</b>                                                                        |      | Error includes scale factor of 1.1. |          |                                                                |
| 1434 ± 5 ± 5                                                                                           | 133  | <sup>1</sup> ACHARD                 | 07 L3    | 183–209 $e^+e^- \rightarrow e^+e^-K_S^0K^\pm\pi^\mp$           |
| 1426 ± 6                                                                                               | 711  | ABDALLAH                            | 03H DLPH | 91.2 $e^+e^- \rightarrow K_S^0K^\pm\pi^\mp + X$                |
| 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 $\pi^-p \rightarrow K^+K^-\pi^0n$                       |
| 1426 ± 1                                                                                               |      | BARBERIS                            | 97C OMEG | 450 $pp \rightarrow ppK_S^0K^\pm\pi^\mp$                       |
| 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 | $J/\psi \rightarrow \gamma K_S^0K^\pm\pi^\mp$                  |
| 1425 ± 10                                                                                              | 17   | BEHREND                             | 89 CELL  | $\gamma\gamma \rightarrow K_S^0K^\pm\pi^\mp$                   |
| 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  | $pp \rightarrow p_{\text{slow}}(K_S^0K^+\pi^-)p_{\text{fast}}$ |
| 1433.4 ± 0.8                                                                                           |      | <sup>5</sup> SOSA                   | 99 SPEC  | $pp \rightarrow p_{\text{slow}}(K_S^0K^-\pi^+)p_{\text{fast}}$ |
| 1435 ± 9                                                                                               |      | PROKOSHKIN                          | 97B GAM4 | 100 $\pi^-p \rightarrow \eta\pi^0\pi^0n$                       |
| 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 $K^-p \rightarrow K^+K^-\pi^0Y$                             |

<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.

OCCUR=2

NODE=M006M2;LINKAGE=CH  
 NODE=M006M2;LINKAGE=C  
 NODE=M006M2;LINKAGE=B  
 NODE=M006M2;LINKAGE=A  
 NODE=M006M2;LINKAGE=N1

 **$f_1(1420)$  WIDTH**

| VALUE (MeV)                   | EVTs | DOCUMENT ID            | TECN     | COMMENT                                                 |
|-------------------------------|------|------------------------|----------|---------------------------------------------------------|
| <b>54.9 ± 2.6 OUR AVERAGE</b> |      |                        |          |                                                         |
| 51 ± 14                       | 711  | ABDALLAH               | 03H DLPH | 91.2 $e^+e^- \rightarrow K_S^0K^\pm\pi^\mp + X$         |
| 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 $\pi^-p \rightarrow K^+K^-\pi^0n$                |
| 58 ± 4                        |      | BARBERIS               | 97C OMEG | 450 $pp \rightarrow ppK_S^0K^\pm\pi^\mp$                |
| 45 ± 10                       |      | BERTIN                 | 97 OBLX  | 0.0 $\bar{p}p \rightarrow K^\pm(K^0)\pi^\mp\pi^+\pi^-$  |
| 58 ± 10                       |      | <sup>6</sup> ARMSTRONG | 92E OMEG | 85,300 $\pi^+p, pp \rightarrow \pi^+p, pp(K\bar{K}\pi)$ |

NODE=M006W

NODE=M006W

|                                                                               |      |            |          |                                                                          |
|-------------------------------------------------------------------------------|------|------------|----------|--------------------------------------------------------------------------|
| 129 ±41                                                                       |      | 7 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 $p\bar{p}$                                                      |
| 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                                                                    |      | 8 SOSA     | 99 SPEC  | $p\bar{p} \rightarrow p_{\text{slow}} (K_S^0 K^+ \pi^-) p_{\text{fast}}$ |
| 58.8 ± 3.3                                                                    |      | 8 SOSA     | 99 SPEC  | $p\bar{p} \rightarrow p_{\text{slow}} (K_S^0 K^- \pi^+) p_{\text{fast}}$ |
| 90 ±25                                                                        |      | PROKOSHKIN | 97B GAM4 | 100 $\pi^- p \rightarrow \eta \pi^0 \pi^0 n$                             |
| 58 ± 8                                                                        | 389  | ARMSTRONG  | 89 OMEG  | 300 $p\bar{p} \rightarrow K \bar{K} \pi p p$                             |
| 62 ± 5                                                                        | 1520 | ARMSTRONG  | 84 OMEG  | 85 $\pi^+ p, p\bar{p} \rightarrow (\pi^+, p)(K \bar{K} \pi) p$           |
| ~ 50                                                                          |      | BITYUKOV   | 84 SPEC  | 32 $K^- p \rightarrow K^+ K^- \pi^0 \gamma$                              |
| 6 This result supersedes ARMSTRONG 84, ARMSTRONG 89.                          |      |            |          |                                                                          |
| 7 From fit to the $K^*(892) K 1^{++}$ partial wave.                           |      |            |          |                                                                          |
| 8 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   | 9,10 ACHARD | 07 L3    | 183–209 $e^+ e^- \rightarrow e^+ e^- K_S^0 K^\pm \pi^\mp$ |
| 3.0±0.9±0.7                                                                   |     | 11,12 | 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                                                                   |     | 11,13 | 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  | $e^+ e^- \rightarrow e^+ e^- K \bar{K} \pi$               |

NODE=M006220

NODE=M006G2  
 NODE=M006G2

- 9 From a fit with a width fixed at 55 MeV.  
 10 The form factor parameter from the fit is 926 ± 78 MeV.  
 11 Assume a  $\rho$ -pole form factor.  
 12 A  $\phi$ -pole form factor gives considerably smaller widths.  
 13 Published value divided by 2.

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                                                     |
|-------------------------------------------------------------------------------|-----|-------------|------|-------------------------------------------------------------|
| <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 $0.7 \bar{p} p$                                         |

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                                      |
|-------------------------------------------------------------------------------|-----|-------------|------|----------------------------------------------|
| <b><math>0.04 \pm 0.01 \pm 0.01</math></b>                                    |     | BARBERIS    | 98C  | OMEG $450 p p \rightarrow p_f f_1(1420) p_s$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                              |
| $<0.04$                                                                       | 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                            |
|------------------------------|-----|-------------|------|------------------------------------|
| <b><math>&lt;0.62</math></b> | 95  | ARMSTRONG   | 89G  | OMEG $85 \pi p \rightarrow 4\pi X$ |

NODE=M006R8  
NODE=M006R8 **$\Gamma(\rho^0\gamma)/\Gamma_{\text{total}}$**  **$\Gamma_7/\Gamma$** 

| <u>VALUE</u>                                                                   | <u>CL%</u> | <u>DOCUMENT ID</u>      | <u>TECN</u> | <u>COMMENT</u>                               |
|--------------------------------------------------------------------------------|------------|-------------------------|-------------|----------------------------------------------|
| <0.08                                                                          | 95         | <sup>15</sup> ARMSTRONG | 92C         | SPEC 300 $pp \rightarrow pp\pi^+\pi^-\gamma$ |
| <sup>15</sup> Using the data on the $\overline{K}K\pi$ 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                                      |
|------------------------------|-----|-------------|------|----------------------------------------------|
| <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

 $\omega(1420)$ 

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

 **$\omega(1420)$  MASS**

NODE=M125M

| VALUE (MeV)                     | EVTS | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|------|-------------|------|---------|
| <b>(1400-1450) OUR ESTIMATE</b> |      |             |      |         |

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  $\omega(1650)$ .
- <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>(180-250) OUR ESTIMATE</b>                                                 |       |                             |      |                                                     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                             |      |                                                     |
| 104 ± 35 ± 10                                                                 | 824   | <sup>1</sup> AKHMETSHIN 17A | CMD3 | 1.4-2.0 $e^+e^- \rightarrow \omega\eta$             |
| 880 ± 170                                                                     | 13.1k | <sup>2</sup> AULCHENKO 15A  | SND  | 1.05-1.80 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$      |
| 480 ± 180                                                                     |       | <sup>3</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>4</sup> ACHASOV 03D    | RVUE | 0.44-2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$      |
| 199 ± 15                                                                      |       | <sup>5</sup> HENNER 02      | RVUE | 1.2-2.0 $e^+e^- \rightarrow \rho\pi, \omega\pi\pi$  |
| 188 ± 45                                                                      | 177   | <sup>6</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>7</sup> CLEGG 94       | RVUE |                                                     |
| 174 ± 59                                                                      | 315   | <sup>8</sup> ANTONELLI 92   | DM2  | 1.34-2.4 $e^+e^- \rightarrow \rho\pi$               |

NODE=M125W

NODE=M125W  
→ UNCHECKED ←

- <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  $\omega(1650)$ .
- <sup>3</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>4</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>5</sup> Using results of CORDIER 81 and preliminary data of DOLINSKY 91 and ANTONELLI 92.
- <sup>6</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>7</sup> From a fit to two Breit-Wigner functions and using the data of DOLINSKY 91 and ANTONELLI 92.
- <sup>8</sup> From a fit to two Breit-Wigner functions interfering between them and with the  $\omega, \phi$  tails with fixed (+, -, +) phases.

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  $\omega(1650)$ .<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. • • • |      |                             |         |                                            |
| $5.0 \pm 2.6 \pm 0.3$                                                         | 824  | <sup>1</sup> AKHMETSHIN 17A | CMD3    | $1.4-2.0 e^+ e^- \rightarrow \omega\eta$   |
| $1.6^{+0.9}_{-0.7}$                                                           | 898  | <sup>2</sup> ACHASOV        | 16B SND | $1.34-2.00 e^+ e^- \rightarrow \omega\eta$ |

<sup>1</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  $\Gamma(\omega(1420) \rightarrow \omega\eta) / \Gamma_{\text{total}} \times \Gamma(\omega(1420) \rightarrow e^+ e^-) = 5.3 \pm 1.6 \text{ eV}$ .<sup>2</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=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

 $\omega(1420) \text{ BRANCHING RATIOS}$ 

NODE=M125225

 $\Gamma(\omega\pi\pi) / \Gamma_{\text{total}}$  $\Gamma_2 / \Gamma$ NODE=M125R2  
NODE=M125R2

| VALUE                                                                         | DOCUMENT ID         | TECN    | COMMENT                                             |
|-------------------------------------------------------------------------------|---------------------|---------|-----------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                     |         |                                                     |
| $0.301 \pm 0.029$<br>possibly seen                                            | <sup>1</sup> HENNER | 02 RVUE | $1.2-2.0 e^+ e^- \rightarrow \rho\pi, \omega\pi\pi$ |
|                                                                               | AKHMETSHIN 00D      | CMD2    | $e^+ e^- \rightarrow \omega\pi^+ \pi^-$             |



$\Gamma(\omega\pi\pi)/\Gamma(b_1(1235)\pi)$ 

| 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 $p\bar{p} \rightarrow \omega\pi^0\pi^0\pi^0$ |
|-----------|------|-----------|----------|--------------------------------------------------|

 $\Gamma_2/\Gamma_4$ 

NODE=M125R1  
NODE=M125R1

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

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

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

|             |                     |    |      |                                                    |
|-------------|---------------------|----|------|----------------------------------------------------|
| 0.699±0.029 | <sup>1</sup> HENNER | 02 | RVUE | 1.2–2.0 $e^+e^- \rightarrow \rho\pi, \omega\pi\pi$ |
|-------------|---------------------|----|------|----------------------------------------------------|

 $\Gamma_1/\Gamma$ 

NODE=M125R3  
NODE=M125R3

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

| 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 $e^+e^- \rightarrow \rho\pi, \omega\pi\pi$ |

 $\Gamma_5/\Gamma$ 

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

|                               |      |               |                                |                             |
|-------------------------------|------|---------------|--------------------------------|-----------------------------|
| 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)                      |

NODE=M125

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

**$a_0(1450)$** 

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

See minireview on scalar mesons under  $f_0(500)$ .

NODE=M149

NODE=M149

NODE=M149M

NODE=M149M

NEW

 **$a_0(1450)$  MASS**

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID            | TECN     | COMMENT                                                                         |
|-------------------------------------------------------------------------------|-------|------------------------|----------|---------------------------------------------------------------------------------|
| <b>1467 ±14 OUR AVERAGE</b>                                                   |       |                        |          |                                                                                 |
| [1474 ± 19 MeV OUR 2018 AVERAGE]                                              |       |                        |          |                                                                                 |
| 1458 ±14 ±15                                                                  | 190k  | AAIJ                   | 16N LHCb | $D^0 \rightarrow K_S^0 K^\pm \pi^\mp$                                           |
| 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. • • • |       |                        |          |                                                                                 |
| 1515 ±30                                                                      |       | <sup>2</sup> ANISOVICH | 09 RVUE  | $0.0 \bar{p}p, \pi N$                                                           |
| $1316.8^{+0.7+24.7}_{-1.0-4.6}$                                               |       | <sup>3</sup> UEHARA    | 09A BELL | $\gamma\gamma \rightarrow \pi^0 \eta$                                           |
| 1432 ±13 ±25                                                                  |       | <sup>4</sup> BUGG      | 08A RVUE | $\bar{p}p$                                                                      |
| 1477 ±10                                                                      | 80k   | <sup>5</sup> UMAN      | 06 E835  | $5.2 \bar{p}p \rightarrow \eta \eta \pi^0$                                      |
| $1441^{+40}_{-15}$                                                            | 35280 | <sup>2</sup> BAKER     | 03 SPEC  | $\bar{p}p \rightarrow \omega \pi^+ \pi^- \pi^0$                                 |
| 1303 ±16                                                                      |       | <sup>6</sup> BARGIOTTI | 03 OBLX  | $\bar{p}p$                                                                      |
| 1296 ±10                                                                      |       | <sup>7</sup> AMSLER    | 02 CBAR  | $0.9 \bar{p}p \rightarrow \pi^0 \pi^0 \eta$                                     |
| 1565 ±30                                                                      |       | <sup>7</sup> ANISOVICH | 98B RVUE | Compilation                                                                     |
| 1290 ±10                                                                      |       | <sup>8</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>9</sup> CASON     | 76       |                                                                                 |

<sup>1</sup> Coupled-channel analysis of AMSLER 95B, AMSLER 95C, and AMSLER 94D.<sup>2</sup> From the pole position.<sup>3</sup> May be a different state.<sup>4</sup> Using data from AMSLER 94D, ABELE 98, and BAKER 03. Supersedes BUGG 94.<sup>5</sup> Statistical error only.<sup>6</sup> Coupled channel analysis of  $\pi^+ \pi^- \pi^0$ ,  $K^+ K^- \pi^0$ , and  $K^\pm K_S^0 \pi^\mp$ .<sup>7</sup> T-matrix pole.<sup>8</sup> Not confirmed by BUGG 08A.<sup>9</sup> Isospin 0 not excluded.

NODE=M149M;LINKAGE=AB

NODE=M149M;LINKAGE=PP

NODE=M149M;LINKAGE=UE

NODE=M149M;LINKAGE=BU

NODE=M149M;LINKAGE=ST

NODE=M149M;LINKAGE=BG

NODE=M149M;LINKAGE=AN

NODE=M149M;LINKAGE=BE

NODE=M149M;LINKAGE=CC

 **$a_0(1450)$  WIDTH**

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID            | TECN     | COMMENT                                                                         |
|-------------------------------------------------------------------------------|-------|------------------------|----------|---------------------------------------------------------------------------------|
| <b>271 ±11 OUR AVERAGE</b>                                                    |       |                        |          |                                                                                 |
| [265 ± 13 MeV OUR 2018 AVERAGE]                                               |       |                        |          |                                                                                 |
| 282 ±12 ±13                                                                   | 190k  | AAIJ                   | 16N LHCb | $D^0 \rightarrow K_S^0 K^\pm \pi^\mp$                                           |
| 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. • • • |       |                        |          |                                                                                 |
| 230 ±36                                                                       |       | <sup>2</sup> ANISOVICH | 09 RVUE  | $0.0 \bar{p}p, \pi N$                                                           |
| $65.0^{+2.1+99.1}_{-5.4-32.6}$                                                |       | <sup>3</sup> UEHARA    | 09A BELL | $\gamma\gamma \rightarrow \pi^0 \eta$                                           |
| 196 ±10 ±10                                                                   |       | <sup>4</sup> BUGG      | 08A RVUE | $\bar{p}p$                                                                      |
| 267 ±11                                                                       | 80k   | <sup>5</sup> UMAN      | 06 E835  | $5.2 \bar{p}p \rightarrow \eta \eta \pi^0$                                      |
| 110 ±14                                                                       | 35280 | <sup>2</sup> BAKER     | 03 SPEC  | $\bar{p}p \rightarrow \omega \pi^+ \pi^- \pi^0$                                 |
| 92 ±16                                                                        |       | <sup>6</sup> BARGIOTTI | 03 OBLX  | $\bar{p}p$                                                                      |
| 81 ±21                                                                        |       | <sup>7</sup> AMSLER    | 02 CBAR  | $0.9 \bar{p}p \rightarrow \pi^0 \pi^0 \eta$                                     |
| 292 ±40                                                                       |       | <sup>7</sup> ANISOVICH | 98B RVUE | Compilation                                                                     |
| 80 ± 5                                                                        |       | <sup>8</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>9</sup> CASON     | 76       |                                                                                 |

NODE=M149W

NODE=M149W

NEW

- <sup>1</sup> Coupled-channel analysis of AMSLER 95B, AMSLER 95C, and AMSLER 94D.  
<sup>2</sup> From the pole position.  
<sup>3</sup> May be a different state.  
<sup>4</sup> Using data from AMSLER 94D, ABELE 98, and BAKER 03. Supersedes BUGG 94.  
<sup>5</sup> Statistical error only.  
<sup>6</sup> Coupled channel analysis of  $\pi^+\pi^-\pi^0$ ,  $K^+K^-\pi^0$ , and  $K^\pm K_S^0 \pi^\mp$ .  
<sup>7</sup> T-matrix pole.  
<sup>8</sup> Not confirmed by BUGG 08A.  
<sup>9</sup> Isospin 0 not excluded.

NODE=M149W;LINKAGE=AB  
 NODE=M149W;LINKAGE=PP  
 NODE=M149W;LINKAGE=UE  
 NODE=M149W;LINKAGE=BU  
 NODE=M149W;LINKAGE=ST  
 NODE=M149W;LINKAGE=BG  
 NODE=M149W;LINKAGE=AN  
 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.                               |                                                                           |

NODE=M149220

NODE=M149R1  
 NODE=M149R1

NODE=M149R1;LINKAGE=A

| $\Gamma(K\bar{K})/\Gamma(\pi\eta)$              | $\Gamma_3/\Gamma_1$                                                       |
|-------------------------------------------------|---------------------------------------------------------------------------|
| VALUE                                           | DOCUMENT ID TECN COMMENT                                                  |
| <b>0.88±0.23</b>                                | <sup>1</sup> ABELE 98 CBAR $0.0 \bar{p}p \rightarrow K_L^0 K^\pm \pi^\mp$ |
| <sup>1</sup> Using $\pi^0\eta$ from AMSLER 94D. |                                                                           |

NODE=M149R2  
 NODE=M149R2

NODE=M149R2;LINKAGE=A

| $\Gamma(\omega\pi\pi)/\Gamma(\pi\eta)$                                                                                                                                                         | $\Gamma_4/\Gamma_1$                                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| VALUE EVTS                                                                                                                                                                                     | DOCUMENT ID TECN COMMENT                                                      |
| <b>10.7±2.3</b>                                                                                                                                                                                | 35280 <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**

|           |     |                              |                                |                                |
|-----------|-----|------------------------------|--------------------------------|--------------------------------|
| 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=57273  
REFID=52719  
REFID=53002  
REFID=52578  
REFID=51063  
REFID=49414  
REFID=49217  
REFID=48580  
REFID=48308  
REFID=45863  
REFID=46331  
  
REFID=46351  
REFID=45531  
REFID=45076  
REFID=44377  
REFID=44440  
REFID=44441  
REFID=44093  
REFID=44078  
REFID=20391  
REFID=22446  
REFID=21064

 **$\rho(1450)$** 

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

See the related review(s):

 $\rho(1450)$  and  $\rho(1700)$ 

NODE=M105

 **$\rho(1450)$  MASS**

NODE=M105205

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=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. • • •

|         |      |                         |     |      |                                               |
|---------|------|-------------------------|-----|------|-----------------------------------------------|
| 1500±10 | 7.4k | <sup>1</sup> ACHASOV    | 18  | SND  | 1.22–2.00 $e^+e^- \rightarrow \eta\pi^+\pi^-$ |
| 1497±14 |      | <sup>2</sup> AKHMETSHIN | 01B | CMD2 | $e^+e^- \rightarrow \eta\gamma$               |
| 1421±15 |      | <sup>3</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> 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>2</sup> Using the data of AKHMETSHIN 01B on  $e^+e^- \rightarrow \eta\gamma$ , AKHMETSHIN 00D and ANTONELLI 88 on  $e^+e^- \rightarrow \eta\pi^+\pi^-$ .

<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=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 $\gamma p \rightarrow \omega\pi^0 p$        |

NODE=M105M3

NODE=M105M3

OCCUR=2

- <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.

#### 4 $\pi$ MODE

| VALUE (MeV)                                                                   | DOCUMENT ID            | TECN | COMMENT                                             |
|-------------------------------------------------------------------------------|------------------------|------|-----------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                        |      |                                                     |
| 1435 $\pm$ 40                                                                 | ABELE                  | 01B  | CBAR $0.0 \bar{p}n \rightarrow 2\pi^- 2\pi^0 \pi^+$ |
| 1350 $\pm$ 50                                                                 | ACHASOV                | 97   | RVUE $e^+e^- \rightarrow 2(\pi^+\pi^-)$             |
| 1449 $\pm$ 4                                                                  | <sup>1</sup> ARMSTRONG | 89E  | OMEG 300 $pp \rightarrow pp2(\pi^+\pi^-)$           |

- <sup>1</sup> Not clear whether this observation has  $l=1$  or 0.

#### $\pi\pi$ MODE

| VALUE (MeV)                                                                   | EVTS                 | DOCUMENT ID              | TECN | COMMENT                                                 |
|-------------------------------------------------------------------------------|----------------------|--------------------------|------|---------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                      |                          |      |                                                         |
| 1326.35 $\pm$ 3.46                                                            |                      | <sup>1</sup> BARTOS      | 17   | RVUE $e^+e^- \rightarrow \pi^+\pi^-$                    |
| 1342.31 $\pm$ 46.62                                                           |                      | <sup>2</sup> BARTOS      | 17A  | RVUE $e^+e^- \rightarrow \pi^+\pi^-$                    |
| 1373.83 $\pm$ 11.37                                                           |                      | <sup>3</sup> BARTOS      | 17A  | RVUE $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$          |
| 1429 $\pm$ 41                                                                 | 20K                  | <sup>4</sup> LEES        | 17C  | BABR $J/\psi \rightarrow \pi^+\pi^-\pi^0$               |
| 1350 $\pm$ 20                                                                 | $+20$<br>$-30$ 63.5k | <sup>5</sup> ABRAMOWICZ  | 12   | ZEUS $ep \rightarrow e\pi^+\pi^-\pi^0$                  |
| 1493 $\pm$ 15                                                                 |                      | <sup>6</sup> LEES        | 12G  | BABR $e^+e^- \rightarrow \pi^+\pi^-\gamma$              |
| 1446 $\pm$ 7                                                                  | $\pm 28$ 5.4M        | <sup>7,8</sup> FUJIKAWA  | 08   | BELL $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$          |
| 1328 $\pm$ 15                                                                 |                      | <sup>9</sup> SCHAEEL     | 05C  | ALEP $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$          |
| 1406 $\pm$ 15                                                                 | 87k                  | <sup>7,10</sup> ANDERSON | 00A  | CLE2 $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$          |
| $\sim 1368$                                                                   |                      | <sup>11</sup> ABELE      | 99C  | CBAR $0.0 \bar{p}d \rightarrow \pi^+\pi^-\pi^-\pi^0$    |
| 1348 $\pm$ 33                                                                 |                      | BERTIN                   | 98   | OBLX $0.05-0.405 \bar{n}p \rightarrow 2\pi^+\pi^-\pi^0$ |
| 1411 $\pm$ 14                                                                 |                      | <sup>12</sup> ABELE      | 97   | CBAR $\bar{p}n \rightarrow \pi^-\pi^0\pi^0$             |
| 1370 $+90$<br>$-70$                                                           |                      | ACHASOV                  | 97   | RVUE $e^+e^- \rightarrow \pi^+\pi^-$                    |
| 1359 $\pm$ 40                                                                 |                      | <sup>10</sup> BERTIN     | 97C  | OBLX $0.0 \bar{p}p \rightarrow \pi^+\pi^-\pi^0$         |
| 1282 $\pm$ 37                                                                 |                      | BERTIN                   | 97D  | OBLX $0.05 \bar{p}p \rightarrow 2\pi^+ 2\pi^-$          |
| 1424 $\pm$ 25                                                                 |                      | BISELLO                  | 89   | DM2 $e^+e^- \rightarrow \pi^+\pi^-$                     |
| 1265.5 $\pm$ 75.3                                                             |                      | DUBNICKA                 | 89   | RVUE $e^+e^- \rightarrow \pi^+\pi^-$                    |
| 1292 $\pm$ 17                                                                 |                      | <sup>13</sup> KURDADZE   | 83   | OLYA $0.64-1.4 e^+e^- \rightarrow \pi^+\pi^-$           |

- <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 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.
- <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=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

NODE=M105M6

NODE=M105M6

NODE=M105M6;LINKAGE=A

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=M105M;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

**$K\bar{K}$  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> AAIJ  | 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  
NODE=M105M7

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 DUB-NICKA 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**

| 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=M105210

NODE=M105W0  
→ UNCHECKED ←

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. • • •

|          |      |                             |      |      |                                                  |
|----------|------|-----------------------------|------|------|--------------------------------------------------|
| 280 ± 20 | 7.4k | <sup>1</sup> ACHASOV        | 18   | SND  | 1.22-2.00 $e^+ e^- \rightarrow \eta \pi^+ \pi^-$ |
| 226 ± 44 |      | <sup>2</sup> AKHMETSHIN 01B | CMD2 |      | $e^+ e^- \rightarrow \eta \gamma$                |
| 211 ± 31 |      | <sup>3</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> 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>2</sup> Using the data of AKHMETSHIN 01B on  $e^+ e^- \rightarrow \eta \gamma$ , AKHMETSHIN 00D and ANTONELLI 88 on  $e^+ e^- \rightarrow \eta \pi^+ \pi^-$ .

<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=M105W1  
NODE=M105W1

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>-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 $\gamma p \rightarrow \omega \pi^0 p$          |

NODE=M105W3  
NODE=M105W3

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.

<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.

#### 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 $\bar{p}n \rightarrow 2\pi^- 2\pi^0 \pi^+$ |

#### $\pi\pi$ 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                                                                      | $^{+40}_{-45}$ 63.5k | <sup>5</sup> ABRAMOWICZ  | 12 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 $\bar{n}p \rightarrow \pi^+\pi^+\pi^-\pi^0$ |
| 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 $e^+e^- \rightarrow \pi^+\pi^-$               |

<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 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.

<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=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

NODE=M105W66

NODE=M105W66

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=M105W;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



**$K\bar{K}$  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 ± | $0.0 \bar{p} p \rightarrow K^+ K^- \pi^0$ |

<sup>1</sup> Using the GOUNARIS 68 parameterization with fixed mass.<sup>2</sup> K-matrix pole. Isospin not determined, could be  $\omega(1420)$ .NODE=M105W7  
NODE=M105W7NODE=M105W7;LINKAGE=A  
NODE=M105W7;LINKAGE=AN **$K\bar{K}^*(892) + \text{c.c.}$  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 $e^+ e^- \rightarrow K\bar{K}^*(892)\gamma$ |

NODE=M105W8  
NODE=M105W8 **$\Gamma_{\rho(1450)^0} = \Gamma_{\rho(1450)^\pm}$** 

| 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>$\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |

<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=M105DW  
NODE=M105DW

NODE=M105DW;LINKAGE=A

 **$\rho(1450)$  DECAY MODES**

| Mode                                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-----------------------------------------------|--------------------------------|
| $\Gamma_1$ $\pi\pi$                           | seen                           |
| $\Gamma_2$ $\pi^+ \pi^-$                      | seen                           |
| $\Gamma_3$ $4\pi$                             | seen                           |
| $\Gamma_4$ $\omega\pi$                        |                                |
| $\Gamma_5$ $a_1(1260)\pi$                     |                                |
| $\Gamma_6$ $h_1(1170)\pi$                     |                                |
| $\Gamma_7$ $\pi(1300)\pi$                     |                                |
| $\Gamma_8$ $\rho\rho$                         |                                |
| $\Gamma_9$ $\rho(\pi\pi)S\text{-wave}$        |                                |
| $\Gamma_{10}$ $e^+ e^-$                       | 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                       |
| $\Gamma_{22}$ $\pi^0 \gamma$                  |                                |

NODE=M105215;NODE=M105

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 ←  
 DESIG=22

 **$\rho(1450) \Gamma(i)\Gamma(e^+ e^-)/\Gamma(\text{total})$** 

| $\Gamma(\pi\pi) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$                 | DOCUMENT ID           | TECN | COMMENT                                         | $\Gamma_1 \Gamma_{10}/\Gamma$ |
|-------------------------------------------------------------------------------|-----------------------|------|-------------------------------------------------|-------------------------------|
| • • • 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=M105220

NODE=M105G3  
NODE=M105G3NODE=M105G3;LINKAGE=B  
NODE=M105G3;LINKAGE=KD

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

$$\Gamma_{11}\Gamma_{10}/\Gamma$$

| VALUE (eV)                                                                    | DOCUMENT ID                 | TECN    | COMMENT                             |
|-------------------------------------------------------------------------------|-----------------------------|---------|-------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                             |         |                                     |
| 210±24±10                                                                     | <sup>1</sup> LEES           | 18 BABR | $e^+e^- \rightarrow \eta\pi^+\pi^-$ |
| 74±20                                                                         | <sup>2</sup> AKHMETSHIN 00D | CMD2    | $e^+e^- \rightarrow \eta\pi^+\pi^-$ |
| 91±19                                                                         | ANTONELLI                   | 88 DM2  | $e^+e^- \rightarrow \eta\pi^+\pi^-$ |

<sup>1</sup> Includes non-resonant contribution. The selected fit model includes three  $\rho$  excited states. Model uncertainty is 20%.

<sup>2</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=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±0.5±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

$$\Gamma(K\bar{K}^*(892)+\text{c.c.}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$$

$$\Gamma_{15}\Gamma_{10}/\Gamma$$

| 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 $e^+e^- \rightarrow K\bar{K}^*(892)\gamma$ |

NODE=M105G8  
NODE=M105G8

$$\rho(1450) \Gamma(i)/\Gamma(\text{total}) \times \Gamma(e^+e^-)/\Gamma(\text{total})$$

NODE=M105230

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

$$\Gamma_4/\Gamma \times \Gamma_{10}/\Gamma$$

| VALUE (units $10^{-6}$ )                                                      | 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 $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 5.3±0.4                                                                       | 7815  | <sup>2</sup> ACHASOV | 13 SND  | 1.05-2.00 $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |

<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> 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  
NODE=M105R05

OCCUR=3

NODE=M105R05;LINKAGE=A

NODE=M105R05;LINKAGE=AC

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

$$\Gamma_{11}/\Gamma \times \Gamma_{10}/\Gamma$$

| VALUE (units $10^{-7}$ )                                                      | 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 $e^+e^- \rightarrow \eta\pi^+\pi^-$ |
| 4.3 <sup>+1.1</sup> <sub>-0.9</sub> ±0.2                                      | 4.9k | <sup>2</sup> AULCHENKO | 15 SND | 1.22-2.00 $e^+e^- \rightarrow \eta\pi^+\pi^-$ |

<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.

<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  
NODE=M105R00

NODE=M105R00;LINKAGE=B

NODE=M105R00;LINKAGE=A

$$\Gamma(f_0(500)\gamma)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$$

$$\Gamma_{18}/\Gamma \times \Gamma_{10}/\Gamma$$

| VALUE (units $10^{-9}$ ) | CL% | DOCUMENT ID | TECN   | COMMENT                               |
|--------------------------|-----|-------------|--------|---------------------------------------|
| <4.0                     | 90  | ACHASOV     | 11 SND | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |

NODE=M105R01  
NODE=M105R01

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

$$\Gamma_{16}/\Gamma \times \Gamma_{10}/\Gamma$$

| VALUE (units $10^{-9}$ )                                                      | 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 $e^+e^- \rightarrow \pi^0\gamma$ |

<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=M105R17  
NODE=M105R17

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 $10^{-9}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                   |
|--------------------------|-----|-------------|------|-------------------------------------------|
| <2.6                     | 90  | ACHASOV     | 11   | SND $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |

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 $10^{-9}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                   |
|--------------------------|-----|-------------|------|-------------------------------------------|
| <3.5                     | 90  | ACHASOV     | 11   | SND $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |

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 $10^{-9}$ ) | CL% | DOCUMENT ID          | TECN | COMMENT                                   |
|--------------------------|-----|----------------------|------|-------------------------------------------|
| <0.8                     | 90  | <sup>1</sup> ACHASOV | 11   | SND $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |

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

NODE=M105225

$$\Gamma(\pi\pi)/\Gamma(4\pi) \quad \Gamma_1/\Gamma_3$$

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

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

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 ABLE 97.

NODE=M105R15  
NODE=M105R15

NODE=M105R;LINKAGE=BL  
NODE=M105R;LINKAGE=LK

$$\Gamma(K^+K^-)/\Gamma(\pi^+\pi^-) \quad \Gamma_{14}/\Gamma_2$$

| 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.

NODE=M105R08  
NODE=M105R08

NODE=M105R08;LINKAGE=A

$$\Gamma(\omega\pi)/\Gamma_{\text{total}} \quad \Gamma_4/\Gamma$$

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

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

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.

NODE=M105R5  
NODE=M105R5

NODE=M105R5;LINKAGE=A

$$\Gamma(\pi\pi)/\Gamma(\omega\pi) \quad \Gamma_1/\Gamma_4$$

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

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

~ 0.32 CLEGG 94 RVUE

NODE=M105R6  
NODE=M105R6

$$\Gamma(\omega\pi)/\Gamma(4\pi) \quad \Gamma_4/\Gamma_3$$

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

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

<0.14 CLEGG 88 RVUE

NODE=M105R3  
NODE=M105R3

$$\Gamma(a_1(1260)\pi)/\Gamma(4\pi) \quad \Gamma_5/\Gamma_3$$

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

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

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.

NODE=M105R10  
NODE=M105R10

NODE=M105R10;LINKAGE=BL

$$\Gamma(h_1(1170)\pi)/\Gamma(4\pi) \quad \Gamma_6/\Gamma_3$$

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

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

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.

NODE=M105R11  
NODE=M105R11

NODE=M105R11;LINKAGE=BL

$$\Gamma(\pi(1300)\pi)/\Gamma(4\pi) \quad \Gamma_7/\Gamma_3$$

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

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

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.

NODE=M105R12  
NODE=M105R12

NODE=M105R12;LINKAGE=BL

$\Gamma(\rho\rho)/\Gamma(4\pi)$  $\Gamma_8/\Gamma_3$ 

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

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

|                 |                    |     |                                       |
|-----------------|--------------------|-----|---------------------------------------|
| $0.11 \pm 0.05$ | <sup>1</sup> ABELE | 01B | CBAR $0.0 \bar{p} n \rightarrow 5\pi$ |
|-----------------|--------------------|-----|---------------------------------------|

<sup>1</sup>  $\omega\pi$  not included.

NODE=M105R13  
NODE=M105R13

NODE=M105R13;LINKAGE=BL

 $\Gamma(\rho(\pi\pi)_{S\text{-wave}})/\Gamma(4\pi)$  $\Gamma_9/\Gamma_3$ 

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

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

|                 |                    |     |                                       |
|-----------------|--------------------|-----|---------------------------------------|
| $0.17 \pm 0.09$ | <sup>1</sup> ABELE | 01B | CBAR $0.0 \bar{p} n \rightarrow 5\pi$ |
|-----------------|--------------------|-----|---------------------------------------|

<sup>1</sup>  $\omega\pi$  not included.

NODE=M105R14  
NODE=M105R14

NODE=M105R14;LINKAGE=BL

 $\Gamma(\eta\gamma)/\Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ 

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

|             |    |                      |    |                                                        |
|-------------|----|----------------------|----|--------------------------------------------------------|
| <b>seen</b> | 35 | <sup>1</sup> ACHASOV | 14 | SND $1.15\text{--}2.00 e^+ e^- \rightarrow \eta\gamma$ |
|-------------|----|----------------------|----|--------------------------------------------------------|

• • • 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

 $\Gamma(\eta\rho)/\Gamma(\omega\pi)$  $\Gamma_{11}/\Gamma_4$ 

| 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 $1.22\text{--}2.00 e^+ e^- \rightarrow \eta\pi^+\pi^-$ |
| $\sim 0.24$       | <sup>3</sup> DONNACHIE   | 91 | RVUE                                                       |
| $>2$              | FUKUI                    | 91 | SPEC $8.95 \pi^- p \rightarrow \omega\pi^0 n$              |

<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

 $\Gamma(\pi\pi)/\Gamma(\eta\rho)$  $\Gamma_1/\Gamma_{11}$ 

| 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 $1.22\text{--}2.00 e^+ e^- \rightarrow \eta\pi^+\pi^-$ |
|---------------|------------------------|----|------------------------------------------------------------|

<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

 $\Gamma(a_2(1320)\pi)/\Gamma_{\text{total}}$  $\Gamma_{12}/\Gamma$ 

| 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=M105R9  
NODE=M105R9

 $\Gamma(K\bar{K})/\Gamma(\omega\pi)$  $\Gamma_{13}/\Gamma_4$ 

| 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

 $\Gamma(K\bar{K}^*(892)+\text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{15}/\Gamma$ 

| 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=M105R16  
NODE=M105R16

 $\Gamma(\eta\gamma)/\Gamma_{\text{total}}$  $\Gamma_{17}/\Gamma$ 

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

|             |    |                      |    |                                                        |
|-------------|----|----------------------|----|--------------------------------------------------------|
| <b>seen</b> | 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=M105R06  
NODE=M105R06

NODE=M105R06;LINKAGE=A

$\rho(1450)$  REFERENCES

NODE=M105

|            |      |                               |                               |                                 |             |
|------------|------|-------------------------------|-------------------------------|---------------------------------|-------------|
| ACHASOV    | 18   | PR D97 012008                 | M.N. Achasov <i>et al.</i>    | (SND Collab.)                   | REFID=58785 |
| LEES       | 18   | PR D97 052007                 | J.P. Lees <i>et al.</i>       | (BABAR Collab.)                 | REFID=58900 |
| 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 |
| LEES       | 17C  | PR D95 072007                 | J.P. Lees <i>et al.</i>       | (BABAR Collab.)                 | REFID=57981 |
| AAIJ       | 16N  | PR D93 052018                 | R. Aaij <i>et al.</i>         | (LHCb Collab.)                  | REFID=57273 |
| ABLIKIM    | 16C  | PL B753 629                   | M. Ablikim <i>et al.</i>      | (BES III Collab.)               | REFID=57138 |
| ACHASOV    | 16D  | PR D94 112001                 | M.N. Achasov <i>et al.</i>    | (SND Collab.)                   | REFID=57618 |
| AULCHENKO  | 15   | PR D91 052013                 | V.M. Aulchenko <i>et al.</i>  | (SND Collab.)                   | REFID=56793 |
| MATVIENKO  | 15   | PR D92 012013                 | D. Matvienko <i>et al.</i>    | (BELLE Collab.)                 | REFID=56601 |
| ACHASOV    | 14   | PR D90 032002                 | M.N. Achasov <i>et al.</i>    | (SND Collab.)                   | REFID=55912 |
| PDG        | 14   | CP C38 070001                 | K. Olive <i>et al.</i>        | (PDG Collab.)                   | REFID=55687 |
| ACHASOV    | 13   | PR D88 054013                 | M.N. Achasov <i>et al.</i>    | (SND Collab.)                   | REFID=55584 |
| ABRAMOWICZ | 12   | EPJ C72 1869                  | H. Abramowicz <i>et al.</i>   | (ZEUS Collab.)                  | REFID=54274 |
| ACHASOV    | 12   | JETPL 94 734                  | M.N. Achasov <i>et al.</i>    |                                 | REFID=54275 |
|            |      | Translated from ZETFP 94 796. |                               |                                 |             |
| 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 |
| SCHAEI     | 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 |
| 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 B460 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 |

**$\eta(1475)$** 

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

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  
 NEW
 **$\eta(1475)$  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.<br>[1476 ± 4 MeV OUR 2018 AVERAGE Scale factor = 1.3] |      |                      |          |                                                          |
| 1469 ± 14 ± 13                                                                                                                                | 74   | ACHARD               | 07 L3    | 183-209 $e^+e^- \rightarrow e^+e^- K_S^0 K^\pm \pi^\mp$  |
| 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   | $J/\psi \rightarrow \gamma K \bar{K} \pi$                |

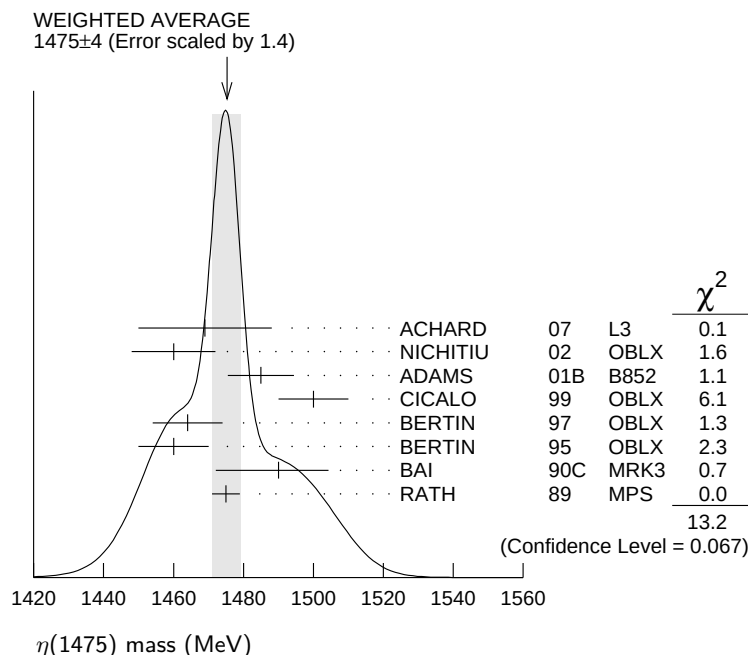
 OCCUR=2  
 OCCUR=2

OCCUR=2

NODE=M175M5;LINKAGE=B

NODE=M175M5;LINKAGE=A

<sup>1</sup> From a fit to  $\gamma \phi$  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**

| VALUE (MeV)                                                                                                                               | EVTS | DOCUMENT ID | TECN     | COMMENT                                                    |
|-------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|------------------------------------------------------------|
| <b>90 ± 9 OUR AVERAGE</b> Error includes scale factor of 1.6. See the ideogram below.<br>[85 ± 9 MeV OUR 2018 AVERAGE Scale factor = 1.5] |      |             |          |                                                            |
| 67 ± 18 ± 7                                                                                                                               | 74   | ACHARD      | 07 L3    | 183-209 $e^+e^- \rightarrow e^+e^- K_S^0 K^\pm \pi^\mp$    |
| 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 $\pi^- p \rightarrow n K_S^0 K_S^0 \pi^0$             |

NODE=M175W5

 NODE=M175W5  
 NEW

 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  | $J/\psi \rightarrow \gamma K \bar{K} \pi$    |

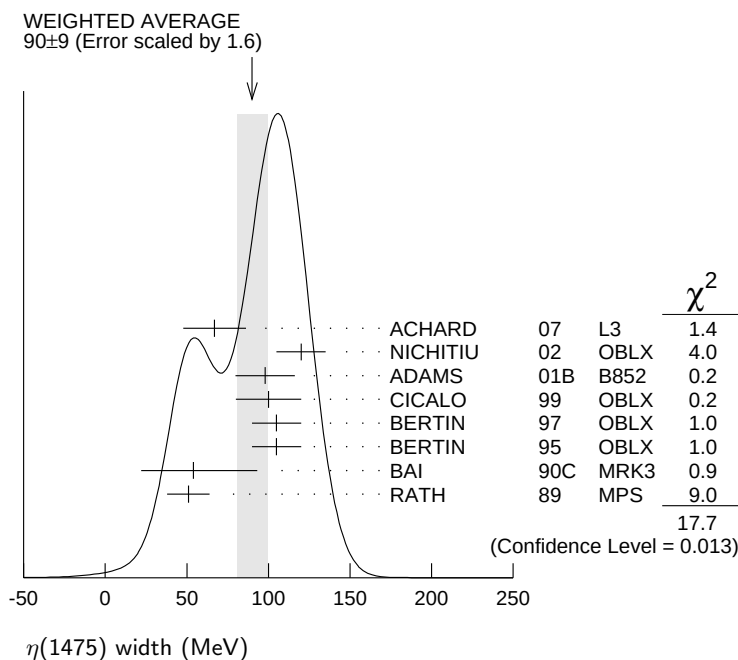
<sup>1</sup> From a fit to  $\gamma\phi$  mass. Angular analysis consistent with  $J^{PC} = 0^{-+}$ . Other  $J^{PC}$  not excluded.

<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 | DOCUMENT ID         | TECN    | COMMENT                                              |
| <b>0.23±0.05±0.05</b>                                                         |     | 74   | <sup>1</sup> ACHARD | 07 L3   | 183–209 $e^+e^- \rightarrow e^+e^-K_S^0K^\pm\pi^\mp$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |     |      |                     |         |                                                      |
| < 0.089                                                                       | 90  | 2,3  | AHOHE               | 05 CLE2 | 10.6 $e^+e^- \rightarrow e^+e^-K_S^0K^\pm\pi^\mp$    |

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

<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

### $\eta(1475)$ BRANCHING RATIOS

| $\Gamma(K\bar{K}^*(892)+\text{c.c.})/\Gamma(K\bar{K}\pi)$ |             |      |         | $\Gamma_2/\Gamma_1$ |
|-----------------------------------------------------------|-------------|------|---------|---------------------|
| VALUE                                                     | DOCUMENT ID | TECN | COMMENT |                     |

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

|                 |                      |    |     |                                                   |
|-----------------|----------------------|----|-----|---------------------------------------------------|
| $0.50 \pm 0.10$ | <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  $\eta(1405)$ .

NODE=M175225

NODE=M175R1  
 NODE=M175R1

NODE=M175R;LINKAGE=BL

$$\Gamma(K\bar{K}^*(892) + \text{c.c.}) / [\Gamma(K\bar{K}^*(892) + \text{c.c.}) + \Gamma(a_0(980)\pi)] \quad \Gamma_2/(\Gamma_2 + \Gamma_3)$$

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

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

|       |    |         |     |      |                                           |
|-------|----|---------|-----|------|-------------------------------------------|
| <0.25 | 90 | EDWARDS | 82E | CBAL | $J/\psi \rightarrow K^+ K^- \pi^0 \gamma$ |
|-------|----|---------|-----|------|-------------------------------------------|

$$\Gamma(\gamma\gamma)/\Gamma(K\bar{K}\pi)$$

$$\Gamma_4/\Gamma_1$$

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

|       |                      |     |      |                                                         |
|-------|----------------------|-----|------|---------------------------------------------------------|
| <1.27 | <sup>1</sup> ABLIKIM | 180 | BES3 | $\psi(2S) \rightarrow \pi^+ \pi^- \gamma \gamma \gamma$ |
|-------|----------------------|-----|------|---------------------------------------------------------|

<sup>1</sup> Using results from BAI 00D.

$$\Gamma(\gamma\phi(1020))/\Gamma_{\text{total}}$$

$$\Gamma_6/\Gamma$$

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

|               |                      |     |      |                                               |
|---------------|----------------------|-----|------|-----------------------------------------------|
| possibly seen | <sup>1</sup> ABLIKIM | 181 | BES3 | $J/\psi \rightarrow \gamma \gamma \phi(1020)$ |
|---------------|----------------------|-----|------|-----------------------------------------------|

<sup>1</sup> Seen as a peak in  $\gamma\phi$  mass. Angular analysis consistent with  $J^{PC} = 0^{-+}$ . Other  $J^{PC}$  not excluded. Also see  $\eta(1405)$ .

## $\eta(1475)$ REFERENCES

|          |     |                |                            |                          |
|----------|-----|----------------|----------------------------|--------------------------|
| ABLIKIM  | 181 | PR D97 051101  | M. Ablikim <i>et al.</i>   | (BES III Collab.)        |
| ABLIKIM  | 180 | PR D97 072014  | M. Ablikim <i>et al.</i>   | (BES III Collab.)        |
| ABLIKIM  | 15T | PRL 115 091803 | M. Ablikim <i>et al.</i>   | (BES III 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)       |

$f_0(1500)$

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

See also 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.  
[1504 ± 6 MeV OUR 2018 AVERAGE Scale factor = 1.3]

|           |                         |     |      |                                                                                  |
|-----------|-------------------------|-----|------|----------------------------------------------------------------------------------|
| 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 | $0.05-0.405 \bar{n} p \rightarrow \pi^+ \pi^+ \pi^-$                             |
| 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 | $0.0 \bar{p} p \rightarrow \pi^0 \pi^0 \pi^0, \pi^0 \eta \eta, \pi^0 \pi^0 \eta$ |

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

|                                                                                                            |                        |      |      |                                                             |
|------------------------------------------------------------------------------------------------------------|------------------------|------|------|-------------------------------------------------------------|
| 1465 ± 18                                                                                                  | <sup>4</sup> ROPERTZ   | 18   | RVUE | $\bar{B}_s^0 \rightarrow J/\psi(\pi^+ \pi^- / K^+ K^-)$     |
| 1447 ± 16 ± 13                                                                                             | <sup>5,6</sup> DOBBS   | 15   |      | $J/\psi \rightarrow \gamma \pi^+ \pi^-$                     |
| 1442 ± 9 ± 4                                                                                               | <sup>5,6</sup> DOBBS   | 15   |      | $\psi(2S) \rightarrow \gamma \pi^+ \pi^-$                   |
| 1460.9 ± 2.9                                                                                               | <sup>7</sup> AAIJ      | 14BR | LHCB | $\bar{B}_s^0 \rightarrow J/\psi \pi^+ \pi^-$                |
| 1468 $\begin{smallmatrix} +14 \\ -15 \end{smallmatrix}$ $\begin{smallmatrix} +23 \\ -74 \end{smallmatrix}$ | <sup>8</sup> ABLIKIM   | 13N  | BES3 | $e^+ e^- \rightarrow J/\psi \rightarrow \gamma \eta \eta$   |
| 1486 ± 10                                                                                                  | <sup>1</sup> ANISOVICH | 09   | RVUE | $0.0 \bar{p} p, \pi N$                                      |
| 1470 ± 60                                                                                                  | <sup>9</sup> KLEMP     | 08   | E791 | $D_s^+ \rightarrow \pi^- \pi^+ \pi^+$                       |
| 1470 $\begin{smallmatrix} +6 \\ -7 \end{smallmatrix}$ $\begin{smallmatrix} +72 \\ -255 \end{smallmatrix}$  | <sup>10</sup> UEHARA   | 08A  | BELL | $10.6 e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$              |
| 1466 ± 6 ± 20                                                                                              | <sup>11</sup> ABLIKIM  | 06V  | BES2 | $e^+ e^- \rightarrow J/\psi \rightarrow \gamma \pi^+ \pi^-$ |
| 1495 ± 4                                                                                                   | AMSLER                 | 06   | CBAR | $0.9 \bar{p} p \rightarrow K^+ K^- \pi^0$                   |
| 1539 ± 20                                                                                                  | AUBERT                 | 060  | BABR | $B^+ \rightarrow K^+ K^+ K^-$                               |

NODE=M175R6  
NODE=M175R6

NODE=M175R01  
NODE=M175R01

NODE=M175R01;LINKAGE=A

NODE=M175R00  
NODE=M175R00

NODE=M175R00;LINKAGE=A

NODE=M175

REFID=58893  
REFID=58925  
REFID=56785  
REFID=51698  
REFID=50764  
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REFID=49649  
REFID=47954  
REFID=47394  
REFID=45417  
REFID=44614  
REFID=41584  
REFID=41578  
REFID=40924  
REFID=21314  
REFID=20407

NODE=M152

NODE=M152

NODE=M152M

NODE=M152M  
NEW

OCCUR=2



|                 |      |       |               |     |      |                                                    |                                                                  |         |
|-----------------|------|-------|---------------|-----|------|----------------------------------------------------|------------------------------------------------------------------|---------|
| 1473 ± 5        | 80k  | 11,12 | UMAN          | 06  | E835 | 5.2                                                | $\bar{p}p \rightarrow \eta\eta\pi^0$                             |         |
| 1478 ± 6        |      |       | VLADIMIRSK... | 06  | SPEC | 40                                                 | $\pi^- p \rightarrow K_S^0 K_S^0 n$                              |         |
| 1493 ± 7        |      | 11    | BINON         | 05  | GAMS | 33                                                 | $\pi^- p \rightarrow \eta\eta n$                                 |         |
| 1524 ± 14       | 1400 | 13    | GARMASH       | 05  | BELL | $B^+ \rightarrow K^+ K^+ K^-$                      |                                                                  |         |
| 1489 + 8<br>- 4 |      | 14    | ANISOVICH     | 03  | RVUE |                                                    |                                                                  |         |
| 1490 ± 30       |      | 11    | ABELE         | 01  | CBAR | 0.0                                                | $\bar{p}d \rightarrow \pi^- 4\pi^0 p$                            |         |
| 1497 ± 10       |      | 11    | BARBERIS      | 99  | OMEG | 450                                                | $pp \rightarrow p_S p_f K^+ K^-$                                 |         |
| 1502 ± 10       |      | 11    | BARBERIS      | 99B | OMEG | 450                                                | $pp \rightarrow p_S p_f \pi^+ \pi^-$                             |         |
| 1502 ± 12 ± 10  |      | 15    | BARBERIS      | 99D | OMEG | 450                                                | $pp \rightarrow K^+ K^-, \pi^+ \pi^-$                            |         |
| 1530 ± 45       |      | 11    | BELLAZZINI    | 99  | GAM4 | 450                                                | $pp \rightarrow pp\pi^0\pi^0$                                    |         |
| 1505 ± 18       |      | 11    | FRENCH        | 99  |      | 300                                                | $pp \rightarrow p_f(K^+ K^-)p_S$                                 |         |
| 1447 ± 27       |      | 16    | KAMINSKI      | 99  | RVUE |                                                    | $\pi\pi \rightarrow \pi\pi, K\bar{K}, \sigma\sigma$              |         |
| 1580 ± 80       |      | 11    | ALDE          | 98  | GAM4 | 100                                                | $\pi^- p \rightarrow \pi^0\pi^0 n$                               |         |
| 1499 ± 8        |      | 1     | ANISOVICH     | 98B | RVUE |                                                    | Compilation                                                      |         |
| ~ 1520          |      |       | REYES         | 98  | SPEC | 800                                                | $pp \rightarrow p_S p_f K_S^0 K_S^0$                             |         |
| 1510 ± 20       |      | 1     | BARBERIS      | 97B | OMEG | 450                                                | $pp \rightarrow pp2(\pi^+ \pi^-)$                                |         |
| ~ 1475          |      |       | FRABETTI      | 97D | E687 | $D_s^\pm \rightarrow \pi^\mp \pi^\pm \pi^\pm$      |                                                                  |         |
| ~ 1505          |      |       | ABELE         | 96  | CBAR | 0.0                                                | $\bar{p}p \rightarrow 5\pi^0$                                    |         |
| 1515 ± 20       |      |       | ABELE         | 96B | CBAR | 0.0                                                | $\bar{p}p \rightarrow \pi^0 K_L^0 K_L^0$                         |         |
| 1500 ± 8        |      | 1     | ABELE         | 96C | RVUE |                                                    | Compilation                                                      |         |
| 1460 ± 20       | 120  | 11    | AMELIN        | 96B | VES  | 37                                                 | $\pi^- A \rightarrow \eta\eta\pi^- A$                            |         |
| 1500 ± 8        |      |       | BUGG          | 96  | RVUE |                                                    |                                                                  |         |
| 1500 ± 15       |      | 17    | AMSLER        | 95B | CBAR | 0.0                                                | $\bar{p}p \rightarrow 3\pi^0$                                    |         |
| 1505 ± 15       |      | 18    | AMSLER        | 95C | CBAR | 0.0                                                | $\bar{p}p \rightarrow \eta\eta\pi^0$                             | OCCUR=2 |
| 1445 ± 5        |      | 19    | ANTINORI      | 95  | OMEG | 300,450                                            | $pp \rightarrow pp2(\pi^+ \pi^-)$                                |         |
| 1497 ± 30       |      | 11    | ANTINORI      | 95  | OMEG | 300,450                                            | $pp \rightarrow pp\pi^+ \pi^-$                                   | OCCUR=2 |
| ~ 1505          |      |       | BUGG          | 95  | MRK3 | $J/\psi \rightarrow \gamma\pi^+ \pi^- \pi^+ \pi^-$ |                                                                  |         |
| 1446 ± 5        |      | 11    | ABATZIS       | 94  | OMEG | 450                                                | $pp \rightarrow pp2(\pi^+ \pi^-)$                                |         |
| 1545 ± 25       |      | 11    | AMSLER        | 94E | CBAR | 0.0                                                | $\bar{p}p \rightarrow \pi^0 \eta \eta'$                          |         |
| 1520 ± 25       |      | 1,20  | ANISOVICH     | 94  | CBAR | 0.0                                                | $\bar{p}p \rightarrow 3\pi^0, \pi^0 \eta \eta$                   |         |
| 1505 ± 20       |      | 1,21  | BUGG          | 94  | RVUE |                                                    | $\bar{p}p \rightarrow 3\pi^0, \eta \eta \pi^0, \eta \pi^0 \pi^0$ |         |
| 1560 ± 25       |      | 11    | AMSLER        | 92  | CBAR | 0.0                                                | $\bar{p}p \rightarrow \pi^0 \eta \eta$                           |         |
| 1550 ± 45 ± 30  |      | 11    | BELADIDZE     | 92C | VES  | 36                                                 | $\pi^- \text{Be} \rightarrow \pi^- \eta' \eta \text{Be}$         |         |
| 1449 ± 4        |      | 11    | ARMSTRONG     | 89E | OMEG | 300                                                | $pp \rightarrow pp2(\pi^+ \pi^-)$                                |         |
| 1610 ± 20       |      | 11    | ALDE          | 88  | GAM4 | 300                                                | $\pi^- N \rightarrow \pi^- N 2\eta$                              |         |
| ~ 1525          |      |       | ASTON         | 88D | LASS | 11                                                 | $K^- p \rightarrow K_S^0 K_S^0 \Lambda$                          |         |
| 1570 ± 20       | 600  | 11    | ALDE          | 87  | GAM4 | 100                                                | $\pi^- p \rightarrow 4\pi^0 n$                                   |         |
| 1575 ± 45       |      | 22    | ALDE          | 86D | GAM4 | 100                                                | $\pi^- p \rightarrow 2\eta n$                                    |         |
| 1568 ± 33       |      | 11    | BINON         | 84C | GAM2 | 38                                                 | $\pi^- p \rightarrow \eta \eta' n$                               |         |
| 1592 ± 25       |      | 11    | BINON         | 83  | GAM2 | 38                                                 | $\pi^- p \rightarrow 2\eta n$                                    |         |
| 1525 ± 5        |      | 11    | 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 of 3 channel unitary model fit to data from AAIJ 14BR and AAIJ 17V extracted using Pade approximants.

<sup>5</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

<sup>6</sup> From a fit to a Breit-Wigner line shape with fixed  $\Gamma = 109$  MeV.

<sup>7</sup> Solution I, statistical error only.

<sup>8</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.

<sup>9</sup> Reanalysis of AITALA 01A data. This state could also be  $f_0(1370)$ .

<sup>10</sup> Breit-Wigner mass. May also be the  $f_0(1370)$ .

<sup>11</sup> Breit-Wigner mass.

<sup>12</sup> Statistical error only.

<sup>13</sup> Breit-Wigner, solution 1, PWA ambiguous.

<sup>14</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>15</sup> Supersedes BARBERIS 99 and BARBERIS 99B.

<sup>16</sup> T-matrix pole on sheet  $--+$ .

<sup>17</sup> T-matrix pole, supersedes ANISOVICH 94.

<sup>18</sup> T-matrix pole, supersedes ANISOVICH 94 and AMSLER 92.

NODE=M152M;LINKAGE=PP

NODE=M152M;LINKAGE=PC

NODE=M152M;LINKAGE=AB

NODE=M152M;LINKAGE=H

NODE=M152M;LINKAGE=F

NODE=M152M;LINKAGE=G

NODE=M152M;LINKAGE=I

NODE=M152M;LINKAGE=C

NODE=M152M;LINKAGE=KL

NODE=M152M;LINKAGE=UE

NODE=M152M;LINKAGE=E

NODE=M152M;LINKAGE=ST

NODE=M152M;LINKAGE=GA

NODE=M152M;LINKAGE=KM

NODE=M152M;LINKAGE=BD

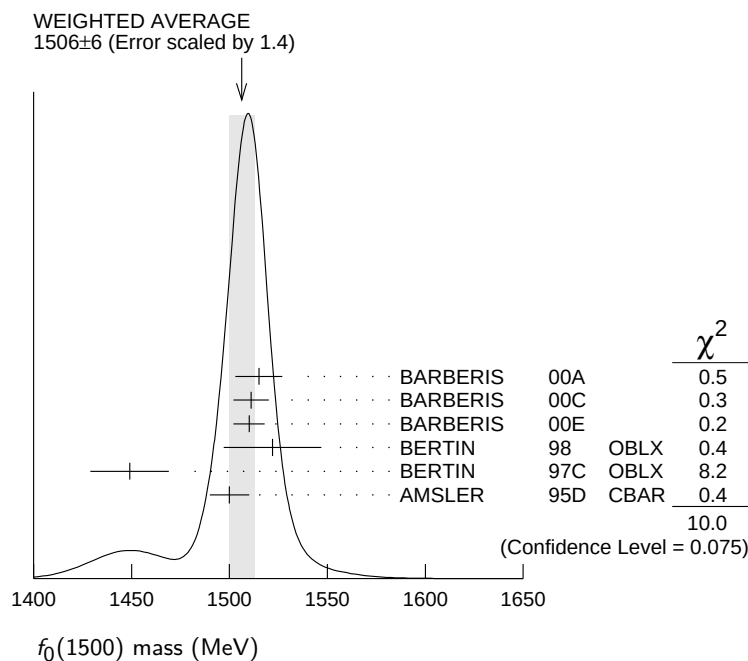
NODE=M152M;LINKAGE=TK

NODE=M152M;LINKAGE=D

NODE=M152M;LINKAGE=D1

- 19 Supersedes ABATZIS 94, ARMSTRONG 89E. Breit-Wigner mass.  
 20 From a simultaneous analysis of the annihilations  $\bar{p}p \rightarrow 3\pi^0, \pi^0\eta\eta$ .  
 21 Reanalysis of ANISOVICH 94 data.  
 22 From central value and spread of two solutions. Breit-Wigner mass.

NODE=M152M;LINKAGE=B  
 NODE=M152M;LINKAGE=A  
 NODE=M152M;LINKAGE=C1  
 NODE=M152M;LINKAGE=AZ



### $f_0(1500)$ WIDTH

NODE=M152W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID             | TECN      | COMMENT                                                                         |
|-------------------------------------------------------------------------------|------|-------------------------|-----------|---------------------------------------------------------------------------------|
| <b><math>112 \pm 9</math> OUR AVERAGE</b>                                     |      |                         |           |                                                                                 |
| [109 $\pm$ 7 MeV OUR 2018 AVERAGE]                                            |      |                         |           |                                                                                 |
| $110 \pm 24$                                                                  |      | <sup>1</sup> BARBERIS   | 00A       | 450 $pp \rightarrow p_f \eta \eta p_s$                                          |
| $102 \pm 18$                                                                  |      | <sup>1,2</sup> BARBERIS | 00C       | 450 $pp \rightarrow p_f 4\pi p_s$                                               |
| $110 \pm 16$                                                                  |      | <sup>1</sup> BARBERIS   | 00E       | 450 $pp \rightarrow p_f \eta \eta p_s$                                          |
| $108 \pm 33$                                                                  |      | <sup>1</sup> BERTIN     | 98 OBLX   | 0.05–0.405 $\bar{n}p \rightarrow \pi^+ \pi^+ \pi^-$                             |
| $114 \pm 30$                                                                  |      | <sup>1</sup> BERTIN     | 97C OBLX  | 0.0 $\bar{p}p \rightarrow \pi^+ \pi^- \pi^0$                                    |
| $154 \pm 30$                                                                  |      | <sup>3</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. • • • |      |                         |           |                                                                                 |
| $100 \pm 18$                                                                  |      | <sup>4</sup> ROPERTZ    | 18 RVUE   | $\bar{B}_s^0 \rightarrow J/\psi (\pi^+ \pi^- / K^+ K^-)$                        |
| $124 \pm 7$                                                                   |      | <sup>5</sup> AAIJ       | 14BR LHCB | $\bar{B}_s^0 \rightarrow J/\psi \pi^+ \pi^-$                                    |
| $136^{+41+28}_{-26-100}$                                                      | 5.5k | <sup>6</sup> ABLIKIM    | 13N BES3  | $e^+ e^- \rightarrow J/\psi \rightarrow \gamma \eta \eta$                       |
| $114 \pm 10$                                                                  |      | <sup>1</sup> ANISOVICH  | 09 RVUE   | 0.0 $\bar{p}p, \pi N$                                                           |
| $90^{+2+50}_{-1-22}$                                                          |      | <sup>7</sup> UEHARA     | 08A BELL  | 10.6 $e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$                                  |
| $108^{+14}_{-11} \pm 25$                                                      |      | <sup>8</sup> 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  | <sup>8,9</sup> UMAN     | 06 E835   | 5.2 $\bar{p}p \rightarrow \eta \eta \pi^0$                                      |
| $119 \pm 10$                                                                  |      | VLADIMIRSK..            | 06 SPEC   | 40 $\pi^- p \rightarrow K_S^0 K_S^0 n$                                          |
| $90 \pm 15$                                                                   |      | <sup>8</sup> BINON      | 05 GAMS   | 33 $\pi^- p \rightarrow \eta \eta n$                                            |
| $136 \pm 23$                                                                  | 1400 | <sup>10</sup> GARMASH   | 05 BELL   | $B^+ \rightarrow K^+ K^+ K^-$                                                   |
| $102 \pm 10$                                                                  |      | <sup>11</sup> ANISOVICH | 03 RVUE   |                                                                                 |
| $140 \pm 40$                                                                  |      | <sup>8</sup> ABELE      | 01 CBAR   | 0.0 $\bar{p}d \rightarrow \pi^- 4\pi^0 p$                                       |
| $104 \pm 25$                                                                  |      | <sup>8</sup> BARBERIS   | 99 OMEG   | 450 $pp \rightarrow p_s p_f K^+ K^-$                                            |
| $131 \pm 15$                                                                  |      | <sup>8</sup> BARBERIS   | 99B OMEG  | 450 $pp \rightarrow p_s p_f \pi^+ \pi^-$                                        |
| $98 \pm 18 \pm 16$                                                            |      | <sup>12</sup> BARBERIS  | 99D OMEG  | 450 $pp \rightarrow K^+ K^-, \pi^+ \pi^-$                                       |
| $160 \pm 50$                                                                  |      | <sup>8</sup> BELLAZZINI | 99 GAM4   | 450 $pp \rightarrow pp \pi^0 \pi^0$                                             |
| $100 \pm 33$                                                                  |      | <sup>8</sup> FRENCH     | 99        | 300 $pp \rightarrow p_f (K^+ K^-) p_s$                                          |
| $108 \pm 46$                                                                  |      | <sup>13</sup> KAMINSKI  | 99 RVUE   | $\pi \pi \rightarrow \pi \pi, K \bar{K}, \sigma \sigma$                         |
| $280 \pm 100$                                                                 |      | <sup>8</sup> ALDE       | 98 GAM4   | 100 $\pi^- p \rightarrow \pi^0 \pi^0 n$                                         |
| $130 \pm 20$                                                                  |      | <sup>1</sup> ANISOVICH  | 98B RVUE  | Compilation                                                                     |

NODE=M152W  
 NEW

|                                 |     |                           |     |      |         |                                                              |
|---------------------------------|-----|---------------------------|-----|------|---------|--------------------------------------------------------------|
| 120± 35                         |     | <sup>1</sup> BARBERIS     | 97B | OMEG | 450     | $p\bar{p} \rightarrow p\bar{p}2(\pi^+\pi^-)$                 |
| ~ 100                           |     | FRABETTI                  | 97D | E687 |         | $D_s^\pm \rightarrow \pi^\mp \pi^\pm \pi^\pm$                |
| ~ 169                           |     | ABELE                     | 96  | CBAR | 0.0     | $\bar{p}p \rightarrow 5\pi^0$                                |
| 105± 15                         |     | ABELE                     | 96B | CBAR | 0.0     | $\bar{p}p \rightarrow \pi^0 K_L^0 K_L^0$                     |
| 100± 30                         | 120 | <sup>8</sup> AMELIN       | 96B | VES  | 37      | $\pi^- A \rightarrow \eta\eta\pi^- A$                        |
| 132± 15                         |     | BUGG                      | 96  | RVUE |         |                                                              |
| 120± 25                         |     | <sup>14</sup> AMSLER      | 95B | CBAR | 0.0     | $\bar{p}p \rightarrow 3\pi^0$                                |
| 120± 30                         |     | <sup>15</sup> AMSLER      | 95C | CBAR | 0.0     | $\bar{p}p \rightarrow \eta\eta\pi^0$                         |
| 65± 10                          |     | <sup>16</sup> ANTINORI    | 95  | OMEG | 300,450 | $p\bar{p} \rightarrow p\bar{p}2(\pi^+\pi^-)$                 |
| 199± 30                         |     | <sup>8</sup> ANTINORI     | 95  | OMEG | 300,450 | $p\bar{p} \rightarrow p\bar{p}\pi^+\pi^-$                    |
| 56± 12                          |     | <sup>8</sup> ABATZIS      | 94  | OMEG | 450     | $p\bar{p} \rightarrow p\bar{p}2(\pi^+\pi^-)$                 |
| 100± 40                         |     | <sup>8</sup> AMSLER       | 94E | CBAR | 0.0     | $\bar{p}p \rightarrow \pi^0\eta\eta'$                        |
| 148 <sup>+</sup> <sub>-25</sub> |     | <sup>1,17</sup> ANISOVICH | 94  | CBAR | 0.0     | $\bar{p}p \rightarrow 3\pi^0, \pi^0\eta\eta$                 |
| 150± 20                         |     | <sup>1,18</sup> BUGG      | 94  | RVUE |         | $\bar{p}p \rightarrow 3\pi^0, \eta\eta\pi^0, \eta\pi^0\pi^0$ |
| 245± 50                         |     | <sup>8</sup> AMSLER       | 92  | CBAR | 0.0     | $\bar{p}p \rightarrow \pi^0\eta\eta$                         |
| 153± 67± 50                     |     | <sup>8</sup> BELADIDZE    | 92C | VES  | 36      | $\pi^- \text{Be} \rightarrow \pi^- \eta' \eta \text{Be}$     |
| 78± 18                          |     | <sup>8</sup> ARMSTRONG    | 89E | OMEG | 300     | $p\bar{p} \rightarrow p\bar{p}2(\pi^+\pi^-)$                 |
| 170± 40                         |     | <sup>8</sup> ALDE         | 88  | GAM4 | 300     | $\pi^- N \rightarrow \pi^- N 2\eta$                          |
| 150± 20                         | 600 | <sup>8</sup> ALDE         | 87  | GAM4 | 100     | $\pi^- p \rightarrow 4\pi^0 n$                               |
| 265± 65                         |     | <sup>19</sup> ALDE        | 86D | GAM4 | 100     | $\pi^- p \rightarrow 2\eta n$                                |
| 260± 60                         |     | <sup>8</sup> BINON        | 84C | GAM2 | 38      | $\pi^- p \rightarrow \eta\eta' n$                            |
| 210± 40                         |     | <sup>8</sup> BINON        | 83  | GAM2 | 38      | $\pi^- p \rightarrow 2\eta n$                                |
| 101± 13                         |     | <sup>8</sup> 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 of 3 channel unitary model fit to data from AAIJ 14BR and AAIJ 17V extracted using Pade approximants.

<sup>5</sup> Solution I, statistical error only.

<sup>6</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.

<sup>7</sup> Breit-Wigner width. May also be the  $f_0(1370)$ .

<sup>8</sup> Breit-Wigner width.

<sup>9</sup> Statistical error only.

<sup>10</sup> Breit-Wigner, solution 1, PWA ambiguous.

<sup>11</sup> K-matrix pole from combined analysis of  $\pi^-p \rightarrow \pi^0\pi^0n$ ,  $\pi^-p \rightarrow K\bar{K}n$ ,  $\pi^+\pi^- \rightarrow \pi^+\pi^-$ ,  $\bar{p}p \rightarrow \pi^0\pi^0\pi^0$ ,  $\pi^0\eta\eta$ ,  $\pi^0\pi^0\eta$ ,  $\pi^+\pi^-\pi^0$ ,  $K^+K^-\pi^0$ ,  $K_S^0K_S^0\pi^0$ ,  $K^+K_S^0\pi^-$  at rest,  $\bar{p}n \rightarrow \pi^-\pi^-\pi^+$ ,  $K_S^0K^-\pi^0$ ,  $K_S^0K_S^0\pi^-$  at rest.

<sup>12</sup> Supersedes BARBERIS 99 and BARBERIS 99B.

<sup>13</sup> T-matrix pole on sheet  $--+$ .

<sup>14</sup> T-matrix pole, supersedes ANISOVICH 94.

<sup>15</sup> T-matrix pole, supersedes ANISOVICH 94 and AMSLER 92.

<sup>16</sup> Supersedes ABATZIS 94, ARMSTRONG 89E. Breit-Wigner mass.

<sup>17</sup> From a simultaneous analysis of the annihilations  $\bar{p}p \rightarrow 3\pi^0, \pi^0\eta\eta$ .

<sup>18</sup> Reanalysis of ANISOVICH 94 data.

<sup>19</sup> From central value and spread of two solutions. Breit-Wigner mass.

OCCUR=2

OCCUR=2

NODE=M152W;LINKAGE=PP

NODE=M152W;LINKAGE=PC

NODE=M152W;LINKAGE=AB

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

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

NODE=M152215;NODE=M152

## $f_0(1500)$ DECAY MODES

| Mode                           | Fraction ( $\Gamma_i/\Gamma$ ) | Scale factor |
|--------------------------------|--------------------------------|--------------|
| $\Gamma_1$ $\pi\pi$            | (34.5±2.2) %                   | 1.2          |
| $\Gamma_2$ $\pi^+\pi^-$        | seen                           |              |
| $\Gamma_3$ $2\pi^0$            | seen                           |              |
| $\Gamma_4$ $4\pi$              | (48.9±3.3) %                   | 1.2          |
| $\Gamma_5$ $4\pi^0$            | seen                           |              |
| $\Gamma_6$ $2\pi^+2\pi^-$      | seen                           |              |
| $\Gamma_7$ $2(\pi\pi)$ S-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±0.9) %                   | 1.1          |
| $\Gamma_{12}$ $\eta\eta'(958)$ | ( 2.2±0.8) %                   | 1.4          |
| $\Gamma_{13}$ $K\bar{K}$       | ( 8.5±1.0) %                   | 1.1          |
| $\Gamma_{14}$ $\gamma\gamma$   | not seen                       |              |

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  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \delta x_j)$ , 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 |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

NODE=M152G1  
NODE=M152G1

• • • 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   | $\gamma\gamma \rightarrow K_S^0 K_S^0, E_{\text{cm}}^{\text{ee}} = 91, 183-209 \text{ GeV}$ |
| <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;LINKAGE=UE

### $f_0(1500) \text{ BRANCHING RATIOS}$

NODE=M152220

$\Gamma(\pi\pi) / \Gamma_{\text{total}}$   $\Gamma_1 / \Gamma$

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

NODE=M152R8  
NODE=M152R8

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

|                   |      |    |      |
|-------------------|------|----|------|
| $0.454 \pm 0.104$ | BUGG | 96 | RVUE |
|-------------------|------|----|------|

$\Gamma(\pi^+ \pi^-) / \Gamma_{\text{total}}$   $\Gamma_2 / \Gamma$

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

NODE=M152R10  
NODE=M152R10

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  $D_s^\pm \rightarrow \pi^\mp \pi^\pm \pi^\pm$

$\Gamma(4\pi) / \Gamma(\pi\pi)$   $\Gamma_4 / \Gamma_1$

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

NODE=M152R6  
NODE=M152R6

**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.

|                 |          |     |                                    |
|-----------------|----------|-----|------------------------------------|
| $1.37 \pm 0.16$ | BARBERIS | 00D | $450 p p \rightarrow p_f 4\pi p_s$ |
|-----------------|----------|-----|------------------------------------|

|               |                     |    |      |
|---------------|---------------------|----|------|
| $2.1 \pm 0.6$ | <sup>1</sup> AMSLER | 98 | RVUE |
|---------------|---------------------|----|------|

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

|               |                        |     |                   |
|---------------|------------------------|-----|-------------------|
| $2.1 \pm 0.2$ | <sup>2</sup> ANISOVICH | 02D | SPEC Combined fit |
|---------------|------------------------|-----|-------------------|

|               |                    |    |                                         |
|---------------|--------------------|----|-----------------------------------------|
| $3.4 \pm 0.8$ | <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

$\Gamma(2(\pi\pi) s\text{-wave}) / \Gamma(\pi\pi)$   $\Gamma_7 / \Gamma_1$

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

NODE=M152R14  
NODE=M152R14

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

|                 |                    |    |                                                 |
|-----------------|--------------------|----|-------------------------------------------------|
| $0.42 \pm 0.26$ | <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

$\Gamma(2(\pi\pi) s\text{-wave}) / \Gamma(4\pi)$   $\Gamma_7 / \Gamma_4$

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

NODE=M152R15  
NODE=M152R15

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

|                 |       |     |                                         |
|-----------------|-------|-----|-----------------------------------------|
| $0.26 \pm 0.07$ | ABELE | 01B | CBAR $0.0 \bar{p} d \rightarrow 5\pi p$ |
|-----------------|-------|-----|-----------------------------------------|

$\Gamma(\rho\rho)/\Gamma(4\pi)$  $\Gamma_8/\Gamma_4$ 

| 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 $\bar{p}d \rightarrow 5\pi p$ |

NODE=M152R16  
 NODE=M152R16

 $\Gamma(\rho\rho)/\Gamma(2(\pi\pi)_{S\text{-wave}})$  $\Gamma_8/\Gamma_7$ 

| VALUE                                                            | DOCUMENT ID | COMMENT                                             |
|------------------------------------------------------------------|-------------|-----------------------------------------------------|
| <b>2.87±0.34 OUR AVERAGE</b> Error includes scale factor of 1.1. |             |                                                     |
| 3.3 ±0.5                                                         | BARBERIS    | 00C 450 $pp \rightarrow p_f \pi^+ \pi^- 2\pi^0 p_s$ |
| 2.6 ±0.4                                                         | BARBERIS    | 00C 450 $pp \rightarrow p_f 2(\pi^+ \pi^-) p_s$     |

NODE=M152R11  
 NODE=M152R11

OCCUR=2

 $\Gamma(\pi(1300)\pi)/\Gamma(4\pi)$  $\Gamma_9/\Gamma_4$ 

| 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 $\bar{p}d \rightarrow 5\pi p$ |

NODE=M152R17  
 NODE=M152R17

 $\Gamma(a_1(1260)\pi)/\Gamma(4\pi)$  $\Gamma_{10}/\Gamma_4$ 

| 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 $\bar{p}d \rightarrow 5\pi p$ |

NODE=M152R18  
 NODE=M152R18

 $\Gamma(\eta\eta)/\Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ 

| 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 $\pi^- p \rightarrow 2\eta n$          |

NODE=M152R1  
 NODE=M152R1

 $\Gamma(\eta\eta)/\Gamma(\pi\pi)$  $\Gamma_{11}/\Gamma_1$ 

| VALUE                                                                                                        | DOCUMENT ID            | TECN | COMMENT                                                                             |
|--------------------------------------------------------------------------------------------------------------|------------------------|------|-------------------------------------------------------------------------------------|
| <b>0.173±0.024 OUR FIT</b> Error includes scale factor of 1.1. [0.145±0.027 OUR 2018 FIT Scale factor = 1.5] |                        |      |                                                                                     |
| <b>0.175±0.027 OUR AVERAGE</b>                                                                               |                        |      |                                                                                     |
| [0.14 ± 0.04 OUR 2018 AVERAGE Scale factor = 1.7]                                                            |                        |      |                                                                                     |
| 0.18 ±0.03                                                                                                   | BARBERIS               | 00E  | 450 $pp \rightarrow p_f \eta\eta p_s$                                               |
| 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 $\bar{p}p \rightarrow \eta\eta\pi^0$                                       |

NODE=M152R13  
 NODE=M152R13

NEW

NEW

<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=M152R3;LINKAGE=AB  
 NODE=M152R;LINKAGE=CH

NODE=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                               |
|--------------------------------------------------------------------------------------------------------------|------------------------|------|---------------------------------------|
| <b>0.064±0.022 OUR FIT</b> Error includes scale factor of 1.4. [0.055±0.024 OUR 2018 FIT Scale factor = 1.8] |                        |      |                                       |
| <b>0.095±0.026</b>                                                                                           | BARBERIS               | 00A  | 450 $pp \rightarrow p_f \eta\eta p_s$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                |                        |      |                                       |
| 0.005±0.003                                                                                                  | <sup>1</sup> ANISOVICH | 02D  | SPEC Combined fit                     |

NODE=M152R12  
 NODE=M152R12

NEW

<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;LINKAGE=CH

$\Gamma(\eta\eta'(958))/\Gamma(\eta\eta)$  $\Gamma_{12}/\Gamma_{11}$ 

| VALUE                                                                         | DOCUMENT ID                                                                          | TECN | COMMENT                                       |
|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|------|-----------------------------------------------|
| <b>0.37±0.13 OUR FIT</b>                                                      | Error includes scale factor of 1.5. [0.38 ± 0.16 OUR 2018 FIT<br>Scale factor = 1.9] |      |                                               |
| <b>0.29±0.10</b>                                                              | <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=M152R2  
 NEW

NODE=M152R2;LINKAGE=A  
 NODE=M152R2;LINKAGE=CH

 $\Gamma(K\bar{K})/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ 

| VALUE                                                                         | DOCUMENT ID | TECN    |
|-------------------------------------------------------------------------------|-------------|---------|
| • • • 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                                           |
|-------------------------------------------------------------------------------|----------------------------------|------|---------------------------------------------------|
| <b>0.246±0.025 OUR FIT</b>                                                    | [0.246 ± 0.026 OUR 2018 FIT]     |      |                                                   |
| <b>0.236±0.026 OUR AVERAGE</b>                                                | [0.241 ± 0.028 OUR 2018 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 $\bar{p}p \rightarrow K^0 K^\pm \pi^\mp$ |
| 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 $pp \rightarrow K^+ K^-, \pi^+ \pi^-$    |

<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=M152R7  
 NEW

NEW

NODE=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. [1.69 ± 0.33 OUR 2018 FIT<br>Scale factor = 1.4] |                         |      |                                                  |
| <b>1.85±0.41</b>                                                              |                                                                                      | BARBERIS                | 00E  | 450 $pp \rightarrow p_f \eta \eta p_S$           |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                                                                      |                         |      |                                                  |
| 1.5 ±0.6                                                                      |                                                                                      | <sup>1</sup> ANISOVICH  | 02D  | SPEC Combined fit                                |
| <0.4                                                                          | 90                                                                                   | <sup>2</sup> PROKOSHKIN | 91   | GAM4 300 $\pi^- p \rightarrow \pi^- p \eta \eta$ |
| <0.6                                                                          |                                                                                      | <sup>3</sup> 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  
 NEW

NODE=M152R4;LINKAGE=CH

NODE=M152R4;LINKAGE=BZ  
 NODE=M152R4;LINKAGE=A

 $f_0(1500)$  REFERENCES

NODE=M152

|                              |      |               |                                       |                   |
|------------------------------|------|---------------|---------------------------------------|-------------------|
| ROPERTZ                      | 18   | EPJ C78 1000  | S. Ropertz, C. Hanhart, B. Kubis      | (BONN, JULI)      |
| AAIJ                         | 17V  | JHEP 1708 037 | R. Aaij <i>et al.</i>                 | (LHCb Collab.)    |
| DOBBS                        | 15   | PR D91 052006 | S. Dobbs <i>et al.</i>                | (NWES)            |
| AAIJ                         | 14BR | PR D89 092006 | R. Aaij <i>et al.</i>                 | (LHCb Collab.)    |
| ABLIKIM                      | 13N  | PR D87 092009 | Ablikim M. <i>et al.</i>              | (BES III Collab.) |
| ANISOVICH                    | 09   | IJMP A24 2481 | V.V. Anisovich, A.V. Sarantsev        |                   |
| KLEMP                        | 08   | EPJ C55 39    | E. Klempt, M. Matveev, A.V. Sarantsev | (BONN+)           |
| UEHARA                       | 08A  | PR D78 052004 | S. Uehara <i>et al.</i>               | (BELLE Collab.)   |
| ABLIKIM                      | 06V  | PL B642 441   | M. Ablikim <i>et al.</i>              | (BES Collab.)     |
| AMSLER                       | 06   | PL B639 165   | C. Amsler <i>et al.</i>               | (CBAR Collab.)    |
| AUBERT                       | 06O  | PR D74 032003 | B. Aubert <i>et al.</i>               | (BABAR 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.  |      |               |                                       |                   |
| BINON                        | 05   | PAN 68 960    | F. Binon <i>et al.</i>                |                   |
| Translated from YAF 68 998.  |      |               |                                       |                   |
| GARMASH                      | 05   | PR D71 092003 | A. Garmash <i>et al.</i>              | (BELLE Collab.)   |
| ANISOVICH                    | 03   | EPJ A16 229   | V.V. Anisovich <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                    | 02D  | PAN 65 1545   | V.V. Anisovich <i>et al.</i>          |                   |
| Translated from YAF 65 1583. |      |               |                                       |                   |

NODE=M152

REFID=59332  
 REFID=57828  
 REFID=56805  
 REFID=56035  
 REFID=55387  
 REFID=52719  
 REFID=52286  
 REFID=52309  
 REFID=51507  
 REFID=51136  
 REFID=51141  
 REFID=51063  
 REFID=51191

REFID=50780

REFID=50641  
 REFID=49401  
 REFID=49217  
 REFID=48580  
 REFID=48831

|            |     |                               |                                            |                           |             |
|------------|-----|-------------------------------|--------------------------------------------|---------------------------|-------------|
| 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 |
| ACCIARRI   | 01H | PL B501 173                   | M. Acciarri <i>et al.</i>                  | (L3 Collab.)              | REFID=48321 |
| AITALA     | 01A | PRL 86 765                    | E.M. Aitala <i>et al.</i>                  | (FNAL E791 Collab.)       | REFID=48004 |
| BARATE     | 00E | PL B472 189                   | R. Barate <i>et al.</i>                    | (ALEPH Collab.)           | REFID=47428 |
| BARBERIS   | 00A | PL B471 429                   | D. Barberis <i>et al.</i>                  | (WA 102 Collab.)          | REFID=47957 |
| BARBERIS   | 00C | PL B471 440                   | D. Barberis <i>et al.</i>                  | (WA 102 Collab.)          | REFID=47959 |
| BARBERIS   | 00D | PL B474 423                   | D. Barberis <i>et al.</i>                  | (WA 102 Collab.)          | REFID=47960 |
| BARBERIS   | 00E | PL B479 59                    | D. Barberis <i>et al.</i>                  | (WA 102 Collab.)          | REFID=47961 |
| 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 |
| BELLAZZINI | 99  | PL B467 296                   | R. Bellazzini <i>et al.</i>                |                           | REFID=47400 |
| FRENCH     | 99  | PL B460 213                   | B. French <i>et al.</i>                    | (WA76 Collab.)            | REFID=47491 |
| KAMINSKI   | 99  | EPJ C9 141                    | R. Kaminski, L. Lesniak, B. Loiseau        | (CRAC, PARIN)             | REFID=46927 |
| ABELE      | 98  | PR D57 3860                   | A. Abele <i>et al.</i>                     | (Crystal Barrel Collab.)  | REFID=45863 |
| 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 |
| AMSLER     | 98  | Translated from YAF 62 446.   | C. Amsler                                  |                           | REFID=46601 |
| ANISOVICH  | 98B | RMP 70 1293                   | V.V. Anisovich <i>et al.</i>               |                           | REFID=46331 |
|            |     | SPU 41 419                    |                                            |                           |             |
| BERTIN     | 98  | Translated from UFN 168 481.  | A. Bertin <i>et al.</i>                    | (OBELIX Collab.)          | REFID=45782 |
| REYES      | 98  | PR D57 55                     | M.A. Reyes <i>et al.</i>                   |                           | REFID=46378 |
| BARBERIS   | 97B | PRL 81 4079                   | D. Barberis <i>et al.</i>                  | (WA 102 Collab.)          | REFID=45758 |
| BERTIN     | 97C | PL B413 217                   | A. Bertin <i>et al.</i>                    | (OBELIX Collab.)          | REFID=45701 |
| FRABETTI   | 97D | PL B408 476                   | P.L. Frabetti <i>et al.</i>                | (FNAL E687 Collab.)       | REFID=45554 |
| ABELE      | 96  | PL B407 79                    | A. Abele <i>et al.</i>                     | (Crystal Barrel Collab.)  | REFID=45011 |
| ABELE      | 96B | PL B380 453                   | A. Abele <i>et al.</i>                     | (Crystal Barrel Collab.)  | REFID=45038 |
| ABELE      | 96C | PL B385 425                   | A. Abele <i>et al.</i>                     | (Crystal Barrel Collab.)  | REFID=45076 |
| AMELIN     | 96C | NP A609 562                   | A. Abele <i>et al.</i>                     | (Crystal Barrel Collab.)  | REFID=44725 |
|            |     | PAN 59 976                    | D.V. Amelin <i>et al.</i>                  | (SERP, TBIL)              |             |
| BUGG       | 96  | Translated from YAF 59 1021.  | D.V. Bugg, A.V. Sarantsev, B.S. Zou        | (LOQM, PNPI)              | REFID=45094 |
| AMSLER     | 95B | NP B471 59                    | C. Amsler <i>et al.</i>                    | (Crystal Barrel Collab.)  | REFID=44377 |
| AMSLER     | 95C | PL B342 433                   | C. Amsler <i>et al.</i>                    | (Crystal Barrel Collab.)  | REFID=44440 |
| AMSLER     | 95D | PL B353 571                   | C. Amsler <i>et al.</i>                    | (Crystal Barrel Collab.)  | REFID=44441 |
| AMSLER     | 95D | PL B355 425                   | C. Amsler <i>et al.</i>                    | (Crystal Barrel Collab.)  | REFID=44437 |
| ANTINORI   | 95  | PL B353 589                   | F. Antinori <i>et al.</i>                  | (ATHU, BARI, BIRM+)       | REFID=44438 |
| BUGG       | 95  | PL B353 378                   | D.V. Bugg <i>et al.</i>                    | (LOQM, PNPI, WASH)        | REFID=44090 |
| ABATZIS    | 94  | PL B324 509                   | S. Abatzis <i>et al.</i>                   | (ATHU, BARI, BIRM+)       | REFID=44091 |
| AMSLER     | 94C | PL B327 425                   | C. Amsler <i>et al.</i>                    | (Crystal Barrel Collab.)  | REFID=44093 |
| AMSLER     | 94D | PL B333 277                   | C. Amsler <i>et al.</i>                    | (Crystal Barrel Collab.)  | REFID=44080 |
| AMSLER     | 94E | PL B340 259                   | C. Amsler <i>et al.</i>                    | (Crystal Barrel Collab.)  | REFID=43659 |
| ANISOVICH  | 94  | PL B323 233                   | V.V. Anisovich <i>et al.</i>               | (Crystal Barrel Collab.)  | REFID=44078 |
| BUGG       | 94  | PR D50 4412                   | D.V. Bugg <i>et al.</i>                    | (LOQM)                    | REFID=43169 |
| AMSLER     | 92  | PL B291 347                   | C. Amsler <i>et al.</i>                    | (Crystal Barrel Collab.)  | REFID=43175 |
| BELADIDZE  | 92C | SJNP 55 1535                  | G.M. Beladidze, S.I. Bitukov, G.V. Borisov | (SERP+)                   |             |
|            |     | Translated from YAF 55 2748.  | Y.D. Prokoshkin                            | (GAM2, GAM4 Collab.)      | REFID=41719 |
| PROKOSHKIN | 91  | SPD 36 155                    |                                            |                           |             |
|            |     | Translated from DANS 316 900. | T.A. Armstrong, M. Benayoun                | (ATHU, BARI, BIRM+)       | REFID=41011 |
| ARMSTRONG  | 89E | PL B228 536                   | D.M. Alde <i>et al.</i>                    | (SERP, BELG, LANL, LAPP+) | REFID=40283 |
| ALDE       | 88  | PL B201 160                   | D. Aston <i>et al.</i>                     | (SLAC, NAGO, CINC, INUS)  | REFID=40330 |
| ASTON      | 88D | NP B301 525                   | D.M. Alde <i>et al.</i>                    | (LANL, BRUX, SERP, LAPP)  | REFID=40221 |
| ALDE       | 87  | PL B198 286                   | D.M. Alde <i>et al.</i>                    | (BELG, LAPP, SERP, CERN+) | REFID=20765 |
| ALDE       | 86D | NP B269 485                   | F.G. Binon <i>et al.</i>                   | (BELG, LAPP, SERP+)       | REFID=21418 |
| BINON      | 84C | NC 80A 363                    | F.G. Binon <i>et al.</i>                   | (BELG, LAPP, SERP+)       | REFID=20750 |
| BINON      | 83  | NC 78A 313                    | F.G. Binon <i>et al.</i>                   | (BELG, LAPP, SERP+)       | REFID=20751 |
| Also       |     | SJNP 38 561                   | F.G. Binon <i>et al.</i>                   |                           |             |
|            |     | Translated from YAF 38 934.   | L. Gray <i>et al.</i>                      | (SYRA)                    | REFID=21370 |
| GRAY       | 83  | PR D27 307                    | A. Etkin <i>et al.</i>                     | (BNL, CUNY, TUFTS, VAND)  | REFID=20390 |
| ETKIN      | 82B | PR D25 1786                   | D. Cohen <i>et al.</i>                     | (ANL)                     | REFID=20381 |
| COHEN      | 80  | PR D22 2595                   |                                            |                           |             |

NODE=M084

**$f_1(1510)$**

$I^G(J^{PC}) = 0^+(1^{++})$

OMITTED FROM SUMMARY TABLE  
See the minireview under  $\eta(1405)$ .

NODE=M084

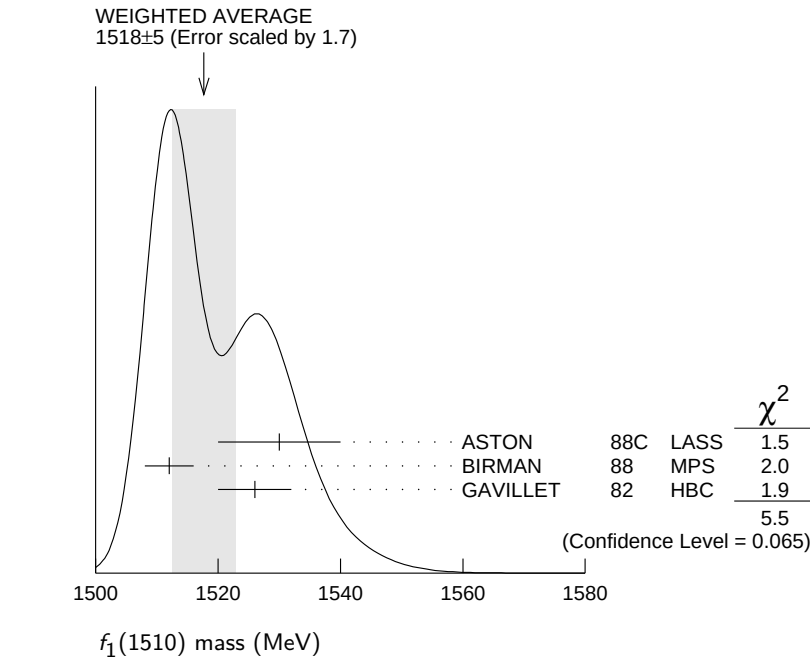
NODE=M084M

NODE=M084M

**$f_1(1510)$  MASS**

| VALUE (MeV)                                                                   | EVTs | DOCUMENT ID                                                 | TECN     | COMMENT                                               |
|-------------------------------------------------------------------------------|------|-------------------------------------------------------------|----------|-------------------------------------------------------|
| <b>1518± 5 OUR AVERAGE</b>                                                    |      | Error includes scale factor of 1.7. See the ideogram below. |          |                                                       |
| 1530±10                                                                       |      | ASTON                                                       | 88C LASS | 11 $K^-p \rightarrow K_S^0 K^\pm \pi^\mp \Lambda$     |
| 1512± 4                                                                       | 600  | <sup>1</sup> BIRMAN                                         | 88 MPS   | 8 $\pi^-p \rightarrow K^+ \bar{K}^0 \pi^- n$          |
| 1526± 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. • • • |      |                                                             |          |                                                       |
| ~ 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**

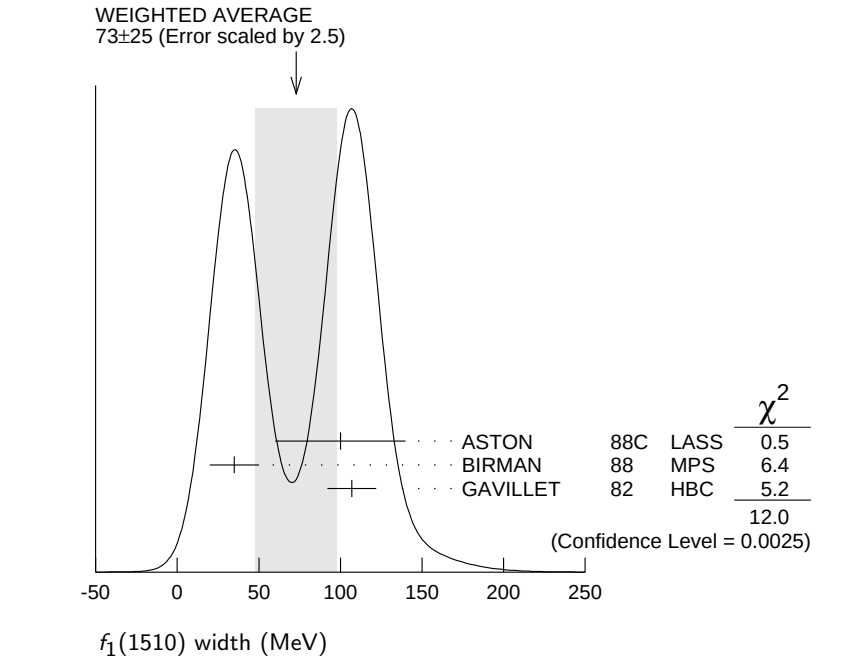
NODE=M084W

NODE=M084W

| VALUE (MeV)                                                             | EVTs | DOCUMENT ID                                                 | TECN     | COMMENT                                           |
|-------------------------------------------------------------------------|------|-------------------------------------------------------------|----------|---------------------------------------------------|
| <b>73±25 OUR AVERAGE</b>                                                |      | Error includes scale factor of 2.5. See the ideogram below. |          |                                                   |
| 100±40                                                                  |      | ASTON                                                       | 88C LASS | 11 $K^-p \rightarrow K_S^0 K^\pm \pi^\mp \Lambda$ |
| 35±15                                                                   | 600  | <sup>3</sup> BIRMAN                                         | 88 MPS   | 8 $\pi^-p \rightarrow K^+ \bar{K}^0 \pi^- n$      |
| 107±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>  | (BES III 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=M013205

VALUE (MeV)DOCUMENT ID

**1525±5 OUR ESTIMATE** This is only an educated guess; the error given is larger than the error on the average of the published values.

NODE=M013MX

→ UNCHECKED ←

### PRODUCED BY PION BEAM

VALUE (MeV)EVTSDOCUMENT IDTECNCOMMENT

• • • 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 $^{+10}_{-2}$ |    | <sup>1</sup> LONGACRE | 86 | MPS  | 22 $\pi^- p \rightarrow K_S^0 K_S^0 n$         |
| 1496 $^{+9}_{-8}$  |    | <sup>2</sup> CHABAUD  | 81 | ASPK | 6 $\pi^- p \rightarrow K^+ K^- n$              |
| 1497 $^{+8}_{-9}$  |    | 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 $\pi^- p \rightarrow K_S^0 K_S^0 n$        |

NODE=M013M1  
NODE=M013M1

OCCUR=2

### PRODUCED BY $K^\pm$ BEAM

VALUE (MeV)EVTSDOCUMENT IDTECNCOMMENT

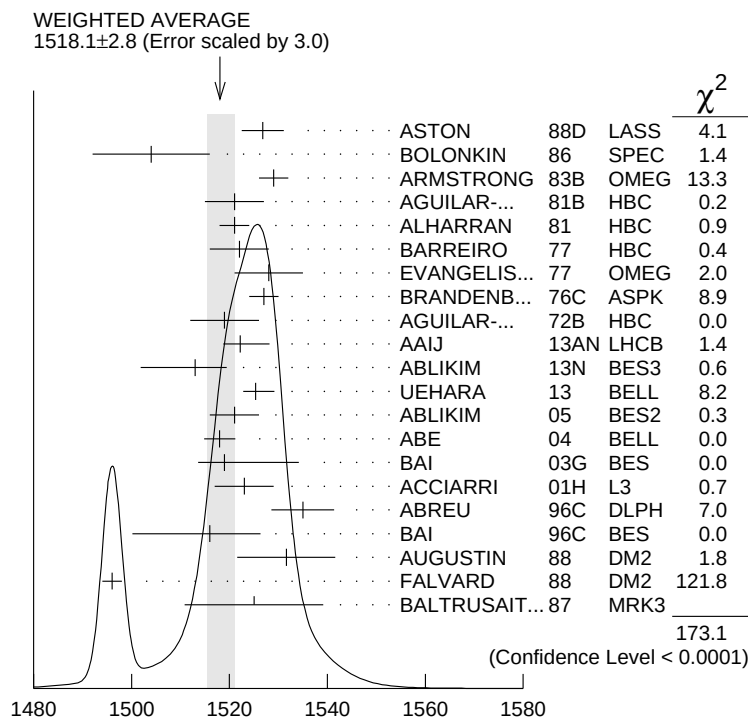
**1518.1± 2.8 OUR AVERAGE** Includes data from the datablock that follows this one. Error includes scale factor of 3.0. See the ideogram below. [1523.3 ± 1.1 MeV OUR 2018 AVERAGE Scale factor = 1.1]

NODE=M013M2  
NODE=M013M2  
NEW

|             |     |              |     |      |                                                         |
|-------------|-----|--------------|-----|------|---------------------------------------------------------|
| 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 |    | <sup>4</sup> BARKOV | 99 | SPEC | 40 $K^- p \rightarrow K_S^0 K_S^0 y$                    |



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  $\pm 5$   
 $\pm 4$  OUR AVERAGE** Error includes scale factor of 3.8. See the ideogram

below. [1521.9 $^{+1.8}_{-1.5}$  MeV OUR 2018 AVERAGE Scale factor = 1.1]

NEW

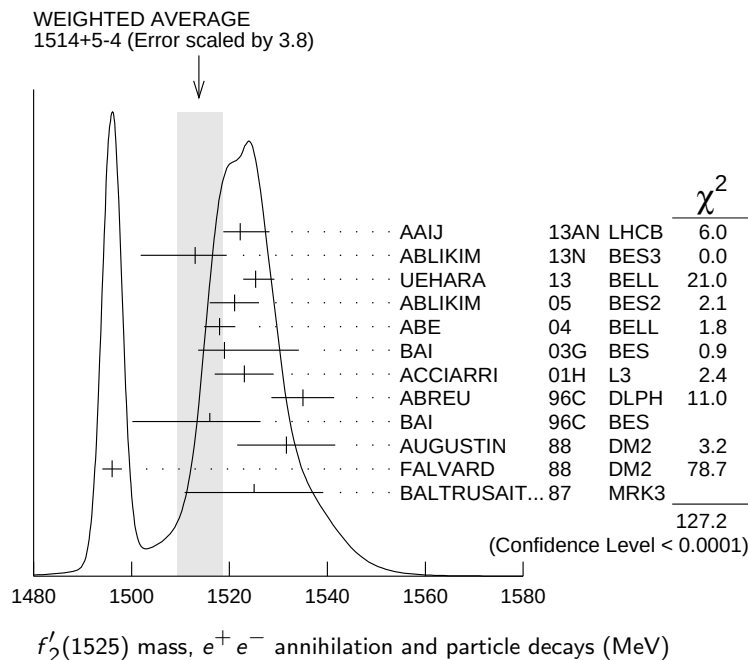
|                                             |                |           |                                                        |
|---------------------------------------------|----------------|-----------|--------------------------------------------------------|
| 1522.2 $\pm 2.8$<br>$\pm 2.0$               | AAIJ           | 13AN LHCB | $\bar{B}_s^0 \rightarrow J/\psi K^+ K^-$               |
| 1513 $\pm 5$<br>$\pm 10$                    | 5 ABLIKIM      | 13N BES3  | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\eta\eta$ |
| 1525.3 $^{+1.2}_{-1.4}$<br>$^{+3.7}_{-2.1}$ | UEHARA         | 13 BELL   | $\gamma\gamma \rightarrow K_S^0 K_S^0$                 |
| 1521 $\pm 5$                                | ABLIKIM        | 05 BES2   | $J/\psi \rightarrow \phi K^+ K^-$                      |
| 1518 $\pm 1$<br>$\pm 3$                     | ABE            | 04 BELL   | 10.6 $e^+e^- \rightarrow e^+e^- K^+ K^-$               |
| 1519 $\pm 2$<br>$\pm 5$                     | BAI            | 03G BES   | $J/\psi \rightarrow \gamma K \bar{K}$                  |
| 1523 $\pm 6$                                | 331 6 ACCIARRI | 01H L3    | 91, 183-209 $e^+e^- \rightarrow e^+e^- K_S^0 K_S^0$    |
| 1535 $\pm 5$<br>$\pm 4$                     | ABREU          | 96C DLPH  | $Z^0 \rightarrow K^+ K^- + X$                          |
| 1516 $\pm 5$<br>$\pm 15$                    | BAI            | 96C BES   | $J/\psi \rightarrow \gamma K^+ K^-$                    |
| 1531.6 $\pm 10.0$                           | AUGUSTIN       | 88 DM2    | $J/\psi \rightarrow \gamma K^+ K^-$                    |
| 1496 $\pm 2$                                | 7 FALVARD      | 88 DM2    | $J/\psi \rightarrow \phi K^+ K^-$                      |
| 1525 $\pm 10$<br>$\pm 10$                   | BALTRUSAIT..87 | MRK3      | $J/\psi \rightarrow \gamma K^+ K^-$                    |

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

|                         |                   |          |                                                 |
|-------------------------|-------------------|----------|-------------------------------------------------|
| 1532 $\pm 3$<br>$\pm 6$ | 644 8,9 DOBBS     | 15       | $J/\psi \rightarrow \gamma K^+ K^-$             |
| 1557 $\pm 9$<br>$\pm 3$ | 113 8,9 DOBBS     | 15       | $\psi(2S) \rightarrow \gamma K^+ K^-$           |
| 1526 $\pm 7$            | 29 10 LEES        | 14H BABR | $e^+e^- \rightarrow K_S^0 K_S^0 K^+ K^- \gamma$ |
| 1523 $\pm 5$            | 870 11 SCHEGELSKY | 06A RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$          |
| 1515 $\pm 5$            | 12 FALVARD        | 88 DM2   | $J/\psi \rightarrow \phi K^+ K^-$               |

OCCUR=2

OCCUR=2



### PRODUCED IN $\bar{p}p$ ANNIHILATION

| VALUE (MeV)                                                                   | DOCUMENT ID     | TECN | COMMENT                                                       |
|-------------------------------------------------------------------------------|-----------------|------|---------------------------------------------------------------|
| <b>1512± 4 OUR AVERAGE</b>                                                    |                 |      |                                                               |
| [1508 ± 9 MeV OUR 2003 AVERAGE]                                               |                 |      |                                                               |
| 1513± 4                                                                       | AMSLER 06       | CBAR | 0.9 $\bar{p}p \rightarrow K^+ K^- \pi^0$                      |
| 1508± 9                                                                       | 13 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. • • • |                 |      |                                                               |
| 1530± 12                                                                      | 14 ANISOVICH 09 | RVUE | 0.0 $\bar{p}p, \pi N$                                         |

NODE=M013M9  
NODE=M013M9  
NEW

### CENTRAL PRODUCTION

| VALUE (MeV)    | DOCUMENT ID | TECN | COMMENT                              |
|----------------|-------------|------|--------------------------------------|
| <b>1515±15</b> | BARBERIS 99 | OMEG | 450 $pp \rightarrow p_s p_f K^+ K^-$ |

NODE=M013M4  
NODE=M013M4

### PRODUCED IN $e p$ COLLISIONS

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID    | TECN | COMMENT                        |
|-------------------------------------------------------------------------------|------|----------------|------|--------------------------------|
| <b>1512±3+1.4<br/>-0.5</b>                                                    | 15   | 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<br>-8                                                                  | 84   | 16 CHEKANOV 04 | ZEUS | $ep \rightarrow K_S^0 K_S^0 X$ |

NODE=M013M10  
NODE=M013M10

- 1 From a partial-wave analysis of data using a K-matrix formalism with 5 poles.
- 2 CHABAUD 81 is a reanalysis of PAWLICKI 77 data.
- 3 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.
- 4 Systematic errors not estimated.
- 5 From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.
- 6 Supersedes ACCIARRI 95J.
- 7 From an analysis including interference with  $f_0(1710)$ .
- 8 Using CLEO-c data but not authored by the CLEO Collaboration.
- 9 From a fit to a Breit-Wigner line shape with fixed  $\Gamma = 73$  MeV.
- 10 From a fit to a Breit-Wigner line shape plus a second-order polynomial function. Systematic errors not evaluated.
- 11 From analysis of L3 data at 91 and 183–209 GeV.
- 12 From an analysis ignoring interference with  $f_0(1710)$ .
- 13 T-matrix pole.
- 14 4-poles, 5-channel K matrix fit.
- 15 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.
- 16 Systematic errors not estimated.

NODE=M013M;LINKAGE=L  
NODE=M013M;LINKAGE=D  
NODE=M013M;LINKAGE=N

NODE=M013M2;LINKAGE=SK  
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  
NODE=M013M;LINKAGE=TT  
NODE=M013M9;LINKAGE=AN  
NODE=M013M10;LINKAGE=HE

NODE=M013M10;LINKAGE=CH

**$f'_2(1525)$  WIDTH**

NODE=M013210

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

NODE=M013WX

 **$73^{+6}_{-5}$  OUR FIT** **$76 \pm 10$** 

PDG 90 For fitting

**PRODUCED BY PION BEAM**NODE=M013W1  
NODE=M013W1

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

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

|                    |                   |      |                                                |
|--------------------|-------------------|------|------------------------------------------------|
| 102 ± 42           | TIKHOMIROV 03     | SPEC | 40.0 $\pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$ |
| 108 $^{+5}_{-2}$   | 17 LONGACRE 86    | MPS  | 22 $\pi^- p \rightarrow K_S^0 K_S^0 n$         |
| 69 $^{+22}_{-16}$  | 18 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 ± 42           | 19 CORDEN 79      | OMEG | 12-15 $\pi^- p \rightarrow \pi^+ \pi^- n$      |
| 92 $^{+39}_{-22}$  | 20 POLYCHRO... 79 | STRC | 7 $\pi^- p \rightarrow n K_S^0 K_S^0$          |

OCCUR=2

**PRODUCED BY  $K^\pm$  BEAM**NODE=M013W2  
NODE=M013W2

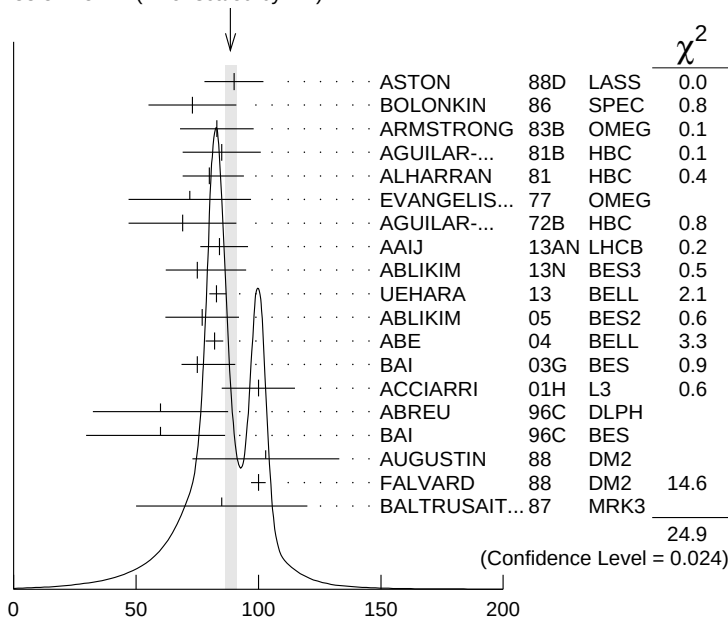
| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**$88.5^{+2.5}_{-2.2}$  OUR AVERAGE** Includes data from the datablock that follows this one. Error includes scale factor of 1.4. See the ideogram below. [ $81.4^{+2.2}_{-1.9}$  MeV OUR 2018 AVERAGE]

NEW

|                                                                               |                  |     |      |                                                          |
|-------------------------------------------------------------------------------|------------------|-----|------|----------------------------------------------------------|
| 90 ± 12                                                                       | ASTON            | 88D | LASS | 11 $K^- p \rightarrow K_S^0 K_S^0 \Lambda$               |
| 73 ± 18                                                                       | BOLONKIN         | 86  | SPEC | 40 $K^- p \rightarrow K_S^0 K_S^0 Y$                     |
| 83 ± 15                                                                       | ARMSTRONG        | 83B | OMEG | 18.5 $K^- p \rightarrow K^- K^+ \Lambda$                 |
| 85 ± 16                                                                       | 650 AGUILAR-...  | 81B | HBC  | 4.2 $K^- p \rightarrow \Lambda K^+ K^-$                  |
| 80 $^{+14}_{-11}$                                                             | 572 ALHARRAN     | 81  | HBC  | 8.25 $K^- p \rightarrow \Lambda K \bar{K}$               |
| 72 ± 25                                                                       | 166 EVANGELIS... | 77  | OMEG | 10 $K^- p \rightarrow K^+ K^- (\Lambda, \Sigma)$         |
| 69 ± 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 $^{+25}_{-16}$                                                             | 61 BINON         | 07  | GAMS | 32.5 $K^- p \rightarrow \eta \eta (\Lambda / \Sigma^0)$  |
| 75 ± 20                                                                       | 21 BARKOV        | 99  | SPEC | 40 $K^- p \rightarrow K_S^0 K_S^0 y$                     |
| 62 $^{+19}_{-14}$                                                             | 123 BARREIRO     | 77  | HBC  | 4.15 $K^- p \rightarrow \Lambda K_S^0 K_S^0$             |
| 61 ± 8                                                                        | 120 BRANDENB...  | 76C | ASPK | 13 $K^- p \rightarrow K^+ K^- (\Lambda, \Sigma)$         |

WEIGHTED AVERAGE  
88.5±2.5-2.2 (Error scaled by 1.4)

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=M013W3  
NODE=M013W3

**$89.2^{+3.4}_{-3.0}$  OUR AVERAGE** Error includes scale factor of 1.8. See the ideogram below.

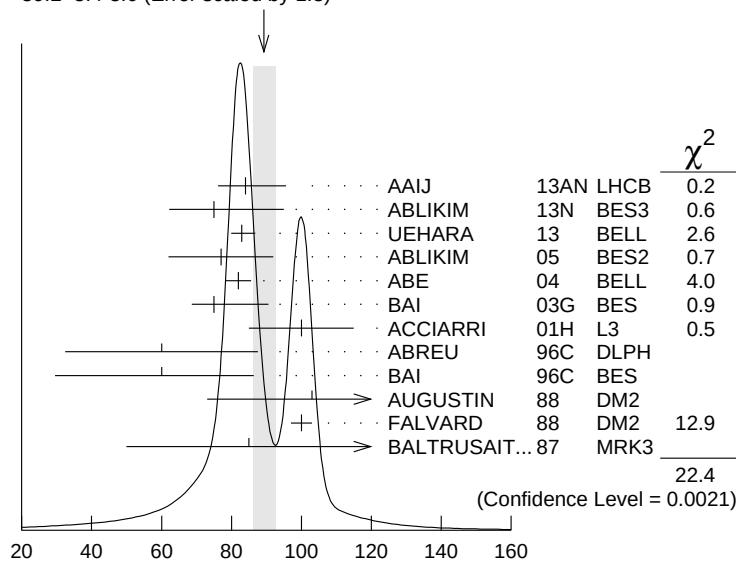
NEW

[ $81.4^{+2.4}_{-2.0}$  MeV OUR 2018 AVERAGE]

|                                                                               |                   |      |      |                                                        |
|-------------------------------------------------------------------------------|-------------------|------|------|--------------------------------------------------------|
| 84 $\pm$ 6 $^{+10}_{-5}$                                                      | AAIJ              | 13AN | LHCB | $\bar{B}_s^0 \rightarrow J/\psi K^+ K^-$               |
| 75 $^{+12}_{-10}$ $^{+16}_{-8}$                                               | 5.5k 22 ABLIKIM   | 13N  | BES3 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\eta\eta$ |
| 82.9 $^{+2.1}_{-2.2}$ $^{+3.3}_{-2.0}$                                        | 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 $^{+15}_{-5}$                                                      | BAI               | 03G  | BES  | $J/\psi \rightarrow \gamma K \bar{K}$                  |
| 100 $\pm$ 15                                                                  | 331 23 ACCIARRI   | 01H  | L3   | $91, 183-209 e^+e^- \rightarrow e^+e^- K_S^0 K_S^0$    |
| 60 $\pm$ 20 $\pm$ 19                                                          | ABREU             | 96C  | DLPH | $Z^0 \rightarrow K^+ K^- + X$                          |
| 60 $\pm$ 23 $^{+13}_{-20}$                                                    | BAI               | 96C  | BES  | $J/\psi \rightarrow \gamma K^+ K^-$                    |
| 103 $\pm$ 30                                                                  | AUGUSTIN          | 88   | DM2  | $J/\psi \rightarrow \gamma K^+ K^-$                    |
| 100 $\pm$ 3                                                                   | 24 FALVARD        | 88   | DM2  | $J/\psi \rightarrow \phi K^+ K^-$                      |
| 85 $\pm$ 35                                                                   | BALTRUSAIT..87    | MRK3 |      | $J/\psi \rightarrow \gamma K^+ K^-$                    |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                   |      |      |                                                        |
| 37 $\pm$ 12                                                                   | 29 25 LEES        | 14H  | BABR | $e^+e^- \rightarrow K_S^0 K_S^0 K^+ K^- \gamma$        |
| 104 $\pm$ 10                                                                  | 870 26 SCHEGELSKY | 06A  | RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$                 |
| 62 $\pm$ 10                                                                   | 27 FALVARD        | 88   | DM2  | $J/\psi \rightarrow \phi K^+ K^-$                      |

OCCUR=2

WEIGHTED AVERAGE  
 $89.2 \pm 3.4 - 3.0$  (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 |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

**$77 \pm 5$  OUR AVERAGE**

[ $79 \pm 8$  MeV OUR 2018 AVERAGE]

|                                                                               |              |    |      |                                                               |
|-------------------------------------------------------------------------------|--------------|----|------|---------------------------------------------------------------|
| 76 $\pm$ 6                                                                    | AMSLER       | 06 | CBAR | $0.9 \bar{p}p \rightarrow K^+ K^- \pi^0$                      |
| 79 $\pm$ 8                                                                    | 28 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. • • • |              |    |      |                                                               |
| 128 $\pm$ 20                                                                  | 29 ANISOVICH | 09 | RVUE | $0.0 \bar{p}p, \pi N$                                         |

NODE=M013W9  
NODE=M013W9  
NEW

**CENTRAL PRODUCTION**

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

**$70 \pm 25$**  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                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|---------|--------------------------------|
| $83 \pm 9^{+5}_{-4}$                                                                                                                                                                             | 30   | 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   | 31 CHEKANOV | 04 ZEUS | $ep \rightarrow K_S^0 K_S^0 X$ |
| 17 From a partial-wave analysis of data using a K-matrix formalism with 5 poles.                                                                                                                 |      |             |         |                                |
| 18 CHABAUD 81 is a reanalysis of PAWLICKI 77 data.                                                                                                                                               |      |             |         |                                |
| 19 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.            |      |             |         |                                |
| 20 From a fit to the $D$ with $f_2(1270)$ - $f_2'(1525)$ interference. Mass fixed at 1516 MeV.                                                                                                   |      |             |         |                                |
| 21 Systematic errors not estimated.                                                                                                                                                              |      |             |         |                                |
| 22 From partial wave analysis including all possible combinations of $0^{++}$ , $2^{++}$ , and $4^{++}$ resonances.                                                                              |      |             |         |                                |
| 23 Supersedes ACCIARRI 95J.                                                                                                                                                                      |      |             |         |                                |
| 24 From an analysis including interference with $f_0(1710)$ .                                                                                                                                    |      |             |         |                                |
| 25 From a fit to a Breit-Wigner line shape plus a second-order polynomial function. Systematic errors not evaluated.                                                                             |      |             |         |                                |
| 26 From analysis of L3 data at 91 and 183–209 GeV.                                                                                                                                               |      |             |         |                                |
| 27 From an analysis ignoring interference with $f_0(1710)$ .                                                                                                                                     |      |             |         |                                |
| 28 T-matrix pole.                                                                                                                                                                                |      |             |         |                                |
| 29 4-poles, 5-channel K matrix fit.                                                                                                                                                              |      |             |         |                                |
| 30 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. |      |             |         |                                |
| 31 Systematic errors not estimated.                                                                                                                                                              |      |             |         |                                |

NODE=M013W10  
 NODE=M013W10

NODE=M013W;LINKAGE=L  
 NODE=M013W;LINKAGE=D  
 NODE=M013W;LINKAGE=N

NODE=M013W;LINKAGE=M  
 NODE=M013W2;LINKAGE=SK  
 NODE=M013W3;LINKAGE=A

NODE=M013W;LINKAGE=HA  
 NODE=M013W;LINKAGE=F2  
 NODE=M013W3;LINKAGE=B

NODE=M013W3;LINKAGE=SC  
 NODE=M013W;LINKAGE=F1  
 NODE=M013W;LINKAGE=TT  
 NODE=M013W9;LINKAGE=AN  
 NODE=M013W10;LINKAGE=HE

NODE=M013W10;LINKAGE=CH

 **$f_2'(1525)$  DECAY MODES**

NODE=M013215;NODE=M013

| Mode                                       | Fraction ( $\Gamma_i/\Gamma$ )   |
|--------------------------------------------|----------------------------------|
| $\Gamma_1$ $K\bar{K}$                      | $(88.7 \pm 2.2) \%$              |
| $\Gamma_2$ $\eta\eta$                      | $(10.4 \pm 2.2) \%$              |
| $\Gamma_3$ $\pi\pi$                        | $(8.2 \pm 1.5) \times 10^{-3}$   |
| $\Gamma_4$ $K\bar{K}^*(892) + \text{c.c.}$ |                                  |
| $\Gamma_5$ $\pi K\bar{K}$                  |                                  |
| $\Gamma_6$ $\pi\pi\eta$                    |                                  |
| $\Gamma_7$ $\pi^+\pi^+\pi^-\pi^-$          |                                  |
| $\Gamma_8$ $\gamma\gamma$                  | $(1.10 \pm 0.14) \times 10^{-6}$ |

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  $\chi^2 = 14.3$  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    |       |       |
| $x_8$    | −6    | 6     | 1     |       |
| $\Gamma$ | −23   | 23    | −1    | −56   |
|          | $x_1$ | $x_2$ | $x_3$ | $x_8$ |

| Mode                      | Rate (MeV)                     |
|---------------------------|--------------------------------|
| $\Gamma_1$ $K\bar{K}$     | $65^{+5}_{-4}$                 |
| $\Gamma_2$ $\eta\eta$     | $7.6 \pm 1.8$                  |
| $\Gamma_3$ $\pi\pi$       | $0.60 \pm 0.12$                |
| $\Gamma_8$ $\gamma\gamma$ | $(8.1 \pm 0.9) \times 10^{-5}$ |

DESIG=2  
 DESIG=4  
 DESIG=1  
 DESIG=8

$f'_2(1525)$  PARTIAL WIDTHS $\Gamma(K\bar{K})$  $\Gamma_1$ 

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

**65<sup>+5</sup><sub>-4</sub> OUR FIT**

|                                |             |    |     |                                        |
|--------------------------------|-------------|----|-----|----------------------------------------|
| 63 <sup>+6</sup> <sub>-5</sub> | 32 LONGACRE | 86 | MPS | 22 $\pi^- p \rightarrow K_S^0 K_S^0 n$ |
|--------------------------------|-------------|----|-----|----------------------------------------|

 $\Gamma(\eta\eta)$  $\Gamma_2$ 

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

**7.6 $\pm$ 1.8 OUR FIT**

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

|                                |             |               |     |                                             |
|--------------------------------|-------------|---------------|-----|---------------------------------------------|
| 5.0 $\pm$ 0.8                  | 870         | 33 SCHEGELSKY | 06A | RVUE $\gamma\gamma \rightarrow K_S^0 K_S^0$ |
| 24 <sup>+3</sup> <sub>-1</sub> | 32 LONGACRE | 86            | MPS | 22 $\pi^- p \rightarrow K_S^0 K_S^0 n$      |

 $\Gamma(\pi\pi)$  $\Gamma_3$ 

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

**0.60 $\pm$ 0.12 OUR FIT**

|                                     |             |    |     |                                        |
|-------------------------------------|-------------|----|-----|----------------------------------------|
| 1.4 <sup>+1.0</sup> <sub>-0.5</sub> | 32 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 <sup>+1.0</sup> <sub>-0.2</sub> | 870 | 33 SCHEGELSKY | 06A | RVUE $\gamma\gamma \rightarrow K_S^0 K_S^0$ |
|-------------------------------------|-----|---------------|-----|---------------------------------------------|

 $\Gamma(\gamma\gamma)$  $\Gamma_8$ 

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

**0.081 $\pm$ 0.009 OUR FIT**

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

|                 |     |               |     |                                             |
|-----------------|-----|---------------|-----|---------------------------------------------|
| 0.13 $\pm$ 0.03 | 870 | 33 SCHEGELSKY | 06A | RVUE $\gamma\gamma \rightarrow K_S^0 K_S^0$ |
|-----------------|-----|---------------|-----|---------------------------------------------|

32 From a partial-wave analysis of data using a K-matrix formalism with 5 poles.

33 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. $f'_2(1525)$   $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$  $\Gamma(K\bar{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_1\Gamma_8/\Gamma$ 

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

**0.072  $\pm$ 0.007 OUR FIT****0.072  $\pm$ 0.007 OUR AVERAGE**

|                                                                               |                 |     |      |                                         |
|-------------------------------------------------------------------------------|-----------------|-----|------|-----------------------------------------|
| 0.048 <sup>+0.067</sup> <sub>-0.008</sub> <sup>+0.108</sup> <sub>-0.012</sub> | UEHARA          | 13  | BELL | $\gamma\gamma \rightarrow K_S^0 K_S^0$  |
| 0.0564 $\pm$ 0.0048 $\pm$ 0.0116                                              | ABE             | 04  | BELL | 10.6 $e^+e^- \rightarrow e^+e^- K^+K^-$ |
| 0.076 $\pm$ 0.006 $\pm$ 0.011                                                 | 331 34 ACCIARRI | 01H | L3   | $e^+e^- \rightarrow e^+e^- K_S^0 K_S^0$ |
| 0.067 $\pm$ 0.008 $\pm$ 0.015                                                 | 35 ALBRECHT     | 90G | ARG  | $e^+e^- \rightarrow e^+e^- K^+K^-$      |
| 0.11 <sup>+0.03</sup> <sub>-0.02</sub> $\pm$ 0.02                             | BEHREND         | 89C | CELL | $e^+e^- \rightarrow e^+e^- K_S^0 K_S^0$ |
| 0.10 <sup>+0.04</sup> <sub>-0.03</sub> <sup>+0.03</sup> <sub>-0.02</sub>      | BERGER          | 88  | PLUT | $e^+e^- \rightarrow e^+e^- K_S^0 K_S^0$ |
| 0.12 $\pm$ 0.07 $\pm$ 0.04                                                    | 35 AIHARA       | 86B | TPC  | $e^+e^- \rightarrow e^+e^- K^+K^-$      |
| 0.11 $\pm$ 0.02 $\pm$ 0.04                                                    | 35 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 $\pm$ 0.0050 $\pm$ 0.0077 | 36 ALBRECHT | 90G | ARG | $e^+e^- \rightarrow e^+e^- K^+K^-$ |
|----------------------------------|-------------|-----|-----|------------------------------------|

34 Supersedes ACCIARRI 95J. From analysis of L3 data at 91 and 183–209 GeV,

35 Using an incoherent background.

36 Using a coherent background.

 $f'_2(1525)$  BRANCHING RATIOS $\Gamma(\eta\eta)/\Gamma_{\text{total}}$  $\Gamma_2/\Gamma$ 

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

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

|      |        |     |      |                                           |
|------|--------|-----|------|-------------------------------------------|
| seen | UEHARA | 10A | BELL | 10.6 $e^+e^- \rightarrow e^+e^- \eta\eta$ |
|------|--------|-----|------|-------------------------------------------|

|                 |              |    |      |                                            |
|-----------------|--------------|----|------|--------------------------------------------|
| 0.10 $\pm$ 0.03 | 37 PROKOSHIN | 91 | GAM4 | 300 $\pi^- p \rightarrow \pi^- p \eta\eta$ |
|-----------------|--------------|----|------|--------------------------------------------|

37 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=M013220

NODE=M013W6  
NODE=M013W6NODE=M013W7  
NODE=M013W7NODE=M013W5  
NODE=M013W5NODE=M013W8  
NODE=M013W8NODE=M013PW;LINKAGE=L  
NODE=M013W8;LINKAGE=SC

NODE=M013223

NODE=M013G1  
NODE=M013G1

OCCUR=2

NODE=M013G;LINKAGE=HA  
NODE=M013G1;LINKAGE=A  
NODE=M013G1;LINKAGE=B

NODE=M013225

NODE=M013R8  
NODE=M013R8

NODE=M013R8;LINKAGE=B



$\Gamma(\eta\eta)/\Gamma(K\bar{K})$  $\Gamma_2/\Gamma_1$ 

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

**0.118±0.028 OUR FIT****0.115±0.028 OUR AVERAGE**

|                                                                               |    |    |           |     |                                                          |
|-------------------------------------------------------------------------------|----|----|-----------|-----|----------------------------------------------------------|
| 0.119±0.015±0.036                                                             | 61 | 38 | BINON     | 07  | GAMS 32.5 $K^- p \rightarrow \eta\eta(\Lambda/\Sigma^0)$ |
| 0.11 ± 0.04                                                                   |    | 39 | PROKOSHIN | 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 $pp \rightarrow p_f \eta\eta p_s$                    |
| < 0.50                                                                        |    |    | BARNES    | 67  | HBC 4.6,5.0 $K^- p$                                      |

<sup>38</sup> Using the compilation of the cross sections for  $f'_2(1525)$  production in  $K^- p$  collisions from ASTON 88D.

<sup>39</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  
NODE=M013R3

NODE=M013R3;LINKAGE=BI

NODE=M013R3;LINKAGE=B

 $\Gamma(\pi\pi)/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma$ 

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

**0.0082±0.0016 OUR FIT****0.0075±0.0016 OUR AVERAGE**

|                                                                               |    |       |             |     |                                                       |
|-------------------------------------------------------------------------------|----|-------|-------------|-----|-------------------------------------------------------|
| 0.007 ± 0.002                                                                 |    |       | COSTA       | 80  | OMEG 10 $\pi^- p \rightarrow K^+ K^- n$               |
| 0.027 $^{+0.071}_{-0.013}$                                                    |    | 40    | GORLICH     | 80  | ASPK 17,18 $\pi^- p$                                  |
| 0.0075±0.0025                                                                 |    | 40,41 | MARTIN      | 79  | RVUE                                                  |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |    |       |             |     |                                                       |
| < 0.06                                                                        | 95 |       | AGUILAR-... | 81B | HBC 4.2 $K^- p \rightarrow \Lambda K^+ K^-$           |
| 0.19 ± 0.03                                                                   |    |       | CORDEN      | 79  | OMEG 12-15 $\pi^- p \rightarrow \pi^+ \pi^- n$        |
| < 0.045                                                                       | 95 |       | BARREIRO    | 77  | HBC 4.15 $K^- p \rightarrow \Lambda K_S^0 K_S^0$      |
| 0.012 ± 0.004                                                                 |    | 40    | PAWLICKI    | 77  | SPEC 6 $\pi N \rightarrow K^+ K^- N$                  |
| < 0.063                                                                       | 90 |       | BRANDENB... | 76C | ASPK 13 $K^- p \rightarrow K^+ K^- (\Lambda, \Sigma)$ |
| < 0.0086                                                                      |    | 40    | BEUSCH      | 75B | OSPK 8.9 $\pi^- p \rightarrow K^0 \bar{K}^0 n$        |

<sup>40</sup> Assuming that the  $f'_2(1525)$  is produced by an one-pion exchange production mechanism.

<sup>41</sup> MARTIN 79 uses the PAWLICKI 77 data with different input value of the  $f'_2(1525) \rightarrow K\bar{K}$  branching ratio.

NODE=M013R1  
NODE=M013R1

NODE=M013R1;LINKAGE=C

NODE=M013R1;LINKAGE=D

 $\Gamma(\pi\pi)/\Gamma(K\bar{K})$  $\Gamma_3/\Gamma_1$ 

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

**0.0092±0.0018 OUR FIT****0.075 ± 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

 $\Gamma(\pi\pi\eta)/\Gamma(K\bar{K})$  $\Gamma_6/\Gamma_1$ 

| 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                 |

NODE=M013R4  
NODE=M013R4

 $\Gamma(\pi^+ \pi^+ \pi^- \pi^-)/\Gamma(K\bar{K})$  $\Gamma_7/\Gamma_1$ 

| 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 $K^- p$ |
|--------|----|--|-------------|-----|---------------------|

NODE=M013R6  
NODE=M013R6

**$f_2'(1525)$  REFERENCES**

NODE=M013

|               |      |                               |                                  |                           |             |
|---------------|------|-------------------------------|----------------------------------|---------------------------|-------------|
| 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>         | (BES III 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>          | (CBAR 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                    | Translated from YAF 66 860.      |                           | REFID=48580 |
| ACCIARRI      | 01H  | EPJ C23 29                    | C. Amsler <i>et al.</i>          |                           | REFID=48321 |
| BARBERIS      | 00E  | PL B501 173                   | M. Acciarri <i>et al.</i>        | (L3 Collab.)              | REFID=47961 |
| BARBERIS      | 99   | PL B479 59                    | D. Barberis <i>et al.</i>        | (WA 102 Collab.)          | REFID=46921 |
| BARKOV        | 99   | PL B453 305                   | D. Barberis <i>et al.</i>        | (Omega Expt.)             | REFID=47379 |
| ABREU         | 96C  | JETPL 70 248                  | B.P. Barkov <i>et al.</i>        |                           | REFID=44671 |
| BAI           | 96C  | Translated from ZETFP 70 242. | P. Abreu <i>et al.</i>           | (DELPHI Collab.)          | REFID=45169 |
| ACCIARRI      | 95J  | PL B379 309                   | J.Z. Bai <i>et al.</i>           | (BES Collab.)             | REFID=44615 |
| PROKOSHIN     | 91   | PRL 77 3959                   | M. Acciarri <i>et al.</i>        | (L3 Collab.)              | REFID=41719 |
| ALBRECHT      | 90G  | SPD 36 155                    | Y.D. Prokoshkin                  | (GAM2, GAM4 Collab.)      | REFID=41374 |
| PDG           | 90   | Translated from DANS 316 900. | H. Albrecht <i>et al.</i>        | (ARGUS Collab.)           | REFID=40744 |
| BEHREND       | 89C  | ZPHY C48 183                  | J.J. Hernandez <i>et al.</i>     | (IFIC, BOST, CIT+)        | REFID=40915 |
| ASTON         | 88D  | PL B239 1                     | H.J. Behrend <i>et al.</i>       | (CELLO Collab.)           | REFID=40330 |
| AUGUSTIN      | 88   | NP B301 525                   | D. Aston <i>et al.</i>           | (SLAC, NAGO, CINC, INUS)  | REFID=40574 |
| BERGER        | 88   | PRL 60 2238                   | J.E. Augustin <i>et al.</i>      | (DM2 Collab.)             | REFID=40566 |
| FALVARD       | 88   | ZPHY C37 329                  | C. Berger <i>et al.</i>          | (PLUTO Collab.)           | REFID=40576 |
| AUGUSTIN      | 87   | PR D38 2706                   | A. Falvard <i>et al.</i>         | (CLER, FRAS, LALO+)       | REFID=40268 |
| BALTRUSAIT... | 87   | ZPHY C36 369                  | J.E. Augustin <i>et al.</i>      | (LALO, CLER, FRAS+)       | REFID=40010 |
| AIHARA        | 86B  | PR D35 2077                   | R.M. Baltrusaitis <i>et al.</i>  | (Mark III Collab.)        | REFID=20764 |
| BOLONKIN      | 86   | PRL 57 404                    | H. Aihara <i>et al.</i>          | (TPC-2 $\gamma$ Collab.)  | REFID=44646 |
| LONGACRE      | 86   | SJNP 43 776                   | B.V. Bolonkin <i>et al.</i>      | (ITEP) JP                 | REFID=20768 |
| ALTHOFF       | 83   | Translated from YAF 43 1211.  | R.S. Longacre <i>et al.</i>      | (BNL, BRAN, CUNY+)        | REFID=21408 |
| ARMSTRONG     | 83B  | PL B177 223                   | M. Althoff <i>et al.</i>         | (TASSO Collab.)           | REFID=20558 |
| AGUILAR-...   | 81B  | PL 121B 216                   | T.A. Armstrong <i>et al.</i>     | (BARI, BIRM, CERN+)       | REFID=21104 |
| ALHARRAN      | 81   | NP B224 193                   | M. Aguilar-Benitez <i>et al.</i> | (CERN, CDEF+)             | REFID=21403 |
| CHABAUD       | 81   | NP B191 26                    | S. Al-Harran <i>et al.</i>       | (BIRM, CERN, GLAS+)       | REFID=20742 |
| COSTA         | 80   | APP B12 575                   | V. Chabaud <i>et al.</i>         | (CERN, CRAC, MPIM)        | REFID=20737 |
| GORLICH       | 80   | NP B175 402                   | G. Costa <i>et al.</i>           | (BARI, BONN, CERN, GLAS+) | REFID=20738 |
| CORDEN        | 79   | NP B174 16                    | L. Gorlich <i>et al.</i>         | (CRAC, MPIM, CERN+)       | REFID=20374 |
| MARTIN        | 79   | NP B157 250                   | M.J. Corden <i>et al.</i>        | (BIRM, RHEL, TELA+) JP    | REFID=20377 |
| POLYCHRO...   | 79   | NP B158 520                   | A.D. Martin, E.N. Ozmutlu        | (DURH)                    | REFID=20378 |
| BARREIRO      | 77   | PR D19 1317                   | V.A. Polychronakos <i>et al.</i> | (NDAM, ANL)               | REFID=21392 |
| EVANGELIS...  | 77   | NP B121 237                   | F. Barreiro <i>et al.</i>        | (CERN, AMST, NIJ+)        | REFID=20540 |
| PAWLICKI      | 77   | NP B127 384                   | C. Evangelista <i>et al.</i>     | (BARI, BONN, CERN+)       | REFID=20367 |
| BRANDENB...   | 76C  | PR D15 3196                   | A.J. Pawlicki <i>et al.</i>      | (ANL) IJP                 | REFID=20225 |
| BEUSCH        | 75B  | NP B104 413                   | G.W. Brandenburg <i>et al.</i>   | (SLAC)                    | REFID=21390 |
| AGUILAR-...   | 72B  | PL 60B 101                    | W. Beusch <i>et al.</i>          | (CERN, ETH)               | REFID=20205 |
| AMMAR         | 67   | PR D6 29                      | M. Aguilar-Benitez <i>et al.</i> | (BNL)                     | REFID=21382 |
| BARNES        | 67   | PRL 19 1071                   | R. Ammar <i>et al.</i>           | (NWES, ANL) JP            | REFID=21383 |
| CRENNELL      | 66   | PRL 19 964                    | V.E. Barnes <i>et al.</i>        | (BNL, SYRA) IJPC          | REFID=20317 |
|               |      | PRL 16 1025                   | D.J. Crennell <i>et al.</i>      | (BNL) I                   |             |

**$f_2(1565)$** 

$$I^G(J^{PC}) = 0^+(2^{++})$$

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

NEW

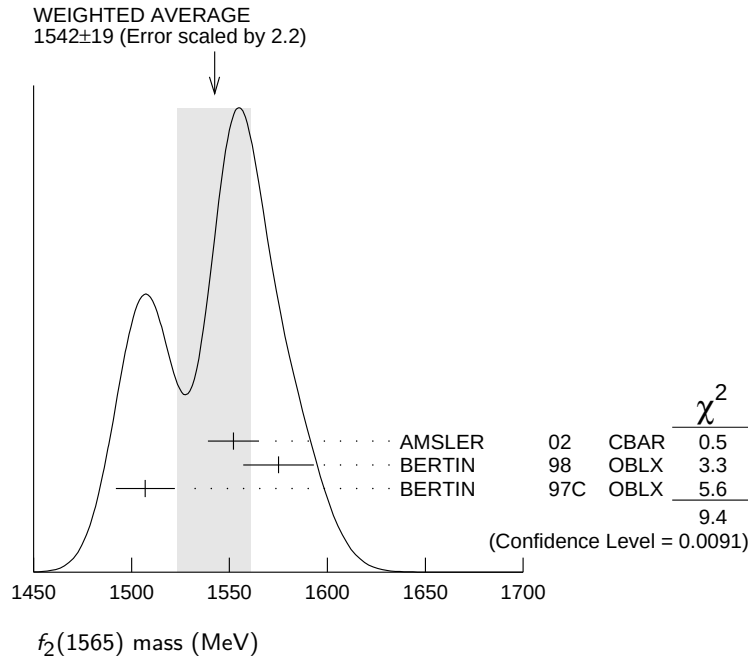
| VALUE (MeV)                                                                                                                                   | DOCUMENT ID             | TECN | COMMENT                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|------|--------------------------------------------------------------------------------------|
| <b>1542±19 OUR AVERAGE</b> Error includes scale factor of 2.2. See the ideogram below.<br>[1562 ± 13 MeV OUR 2018 AVERAGE Scale factor = 2.1] |                         |      |                                                                                      |
| 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

| VALUE (MeV)                                                                   | DOCUMENT ID   | TECN     | COMMENT                                                                         |
|-------------------------------------------------------------------------------|---------------|----------|---------------------------------------------------------------------------------|
| <b>122± 13 OUR AVERAGE</b>                                                    |               |          |                                                                                 |
| [134 ± 8 MeV OUR 2018 AVERAGE]                                                |               |          |                                                                                 |
| 113± 23                                                                       | 11 AMSLER     | 02 CBAR  | 0.9 $\bar{p}p \rightarrow \pi^0 \eta \eta, \pi^0 \pi^0 \pi^0$                   |
| 119± 24                                                                       | 11 BERTIN     | 98 OBLX  | 0.05–0.405 $\bar{n}p \rightarrow \pi^+ \pi^+ \pi^-$                             |
| 130± 20                                                                       | 11 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                                                                       | 12 ANISOVICH  | 09 RVUE  | 0.0 $\bar{p}p, \pi N$                                                           |
| 140± 11                                                                       | 13,14 AMELIN  | 06 VES   | 36 $\pi^- p \rightarrow \omega \omega n$                                        |
| 130± 20±40                                                                    | 14 AMELIN     | 00 VES   | 37 $\pi^- p \rightarrow \eta \pi^+ \pi^- n$                                     |
| 180± 60                                                                       | 15 ABELE      | 96C RVUE | Compilation                                                                     |
| ~ 142                                                                         | 16 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>                                               | 17 ANISOVICH  | 94 CBAR  | 0.0 $\bar{p}p \rightarrow 3\pi^0, \eta \eta \pi^0$                              |
| 130± 10                                                                       | 18 ADAMO      | 93 OBLX  | $\bar{n}p \rightarrow \pi^+ \pi^+ \pi^-$                                        |
| 148± 27                                                                       | 19 ARMSTRONG  | 93C E760 | $\bar{p}p \rightarrow \pi^0 \eta \eta \rightarrow 6\gamma$                      |
| 103± 15                                                                       | 19 ARMSTRONG  | 93D E760 | $\bar{p}p \rightarrow 3\pi^0 \rightarrow 6\gamma$                               |
| 111± 10                                                                       | 19 ARMSTRONG  | 93D E760 | $\bar{p}p \rightarrow \eta \pi^0 \pi^0 \rightarrow 6\gamma$                     |
| ~ 206                                                                         | 20 WEIDENAUER | 93 ASTE  | 0.0 $\bar{p}N \rightarrow 3\pi^- 2\pi^+$                                        |
| 132± 37                                                                       | 19 ADAMO      | 92 OBLX  | $\bar{n}p \rightarrow \pi^+ \pi^+ \pi^-$                                        |
| 120± 10                                                                       | 21 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 $\bar{p}N \rightarrow 3\pi^- 2\pi^+$                                        |

11 T-matrix pole.

12 On sheet II in a two-pole solution.

13 Supersedes the  $\omega\omega$  state of BELADIDZE 92B earlier assigned to the  $f_2(1640)$ .

14 Breit-Wigner width.

15 T-matrix pole, large coupling to  $\rho\rho$  and  $\omega\omega$ , could be  $f_2(1640)$ .

16 Coupled-channel analysis of AMSLER 95B, AMSLER 95C, and AMSLER 94D.

17 From a simultaneous analysis of the annihilations  $\bar{p}p \rightarrow 3\pi^0, \pi^0 \eta \eta$  including AKER 91 data.

18 Supersedes ADAMO 92.

19  $J^P$  not determined, could be partly  $f_0(1500)$ .

20  $J^P$  not determined.

21 Superseded by AMSLER 95B.

NODE=M123W

NODE=M123W

NEW

OCCUR=2

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 ( $\Gamma_i/\Gamma$ ) |
|-------------------------------|--------------------------------|
| $\Gamma_1 \quad \pi\pi$       | seen                           |
| $\Gamma_2 \quad \pi^+\pi^-$   | seen                           |
| $\Gamma_3 \quad \pi^0\pi^0$   | seen                           |
| $\Gamma_4 \quad \rho^0\rho^0$ | seen                           |
| $\Gamma_5 \quad 2\pi^+2\pi^-$ | seen                           |
| $\Gamma_6 \quad \eta\eta$     | seen                           |
| $\Gamma_7 \quad \omega\omega$ | seen                           |
| $\Gamma_8 \quad K\bar{K}$     | seen                           |
| $\Gamma_9 \quad \gamma\gamma$ | 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 | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |            |
| $\Gamma(K\bar{K})$                                                                                                                                                  |      |                              |      |                                        | $\Gamma_8$ |
| 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

 **$f_2(1565)$  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  
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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><math>1570 \pm 36 \pm 62</math></b> | 54   | <sup>1</sup> AUBERT   | 08S  | BABR $10.6 e^+ e^- \rightarrow \phi \pi^0 \gamma$ |
| <b><math>1480 \pm 40</math></b>        |      | <sup>2</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> Systematic errors not estimated.

NODE=M188M

NODE=M188M

NODE=M188M;LINKAGE=AU  
NODE=M188M;LINKAGE=BI

 **$\rho(1570)$  WIDTH**

| VALUE (MeV)                           | EVTS | DOCUMENT ID           | TECN | COMMENT                                           |
|---------------------------------------|------|-----------------------|------|---------------------------------------------------|
| <b><math>144 \pm 75 \pm 43</math></b> | 54   | <sup>3</sup> AUBERT   | 08S  | BABR $10.6 e^+ e^- \rightarrow \phi \pi^0 \gamma$ |
| <b><math>130 \pm 60</math></b>        |      | <sup>4</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>3</sup> From the fit with two resonances.

<sup>4</sup> Systematic errors not estimated.

NODE=M188W

NODE=M188W

NODE=M188W;LINKAGE=AU  
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                                   |
| $3.5 \pm 0.9 \pm 0.3$                                                         |     | 54   | <sup>5</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>6</sup> AULCHENKO    | 87B ND   | $e^+e^- \rightarrow K_S^0 K_L^0 \pi^0$    |
| <sup>5</sup> From the fit with two resonances.                                |     |      |                           |          |                                           |
| <sup>6</sup> Using mass and width of BITYUKOV 87.                             |     |      |                           |          |                                           |

NODE=M188225

NODE=M188G01  
NODE=M188G01

NODE=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                                        |
| not seen                                                                      |     |  | 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>7</sup> DONNACHIE | 91 RVUE  |                                                |
| <sup>7</sup> Using data from BISELLO 91B, DOLINSKY 86, and ALBRECHT 87L.      |     |  |                        |          |                                                |
| $\Gamma(\phi\pi)/\Gamma(\omega\pi)$                                           |     |  | $\Gamma_2/\Gamma_3$    |          |                                                |
| 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=M188220

NODE=M188R01  
NODE=M188R01

NODE=M188R01;LINKAGE=DO

NODE=M188R02  
NODE=M188R02

| $\rho(1570) \text{ REFERENCES}$ |     |                       |                              |  |                          |
|---------------------------------|-----|-----------------------|------------------------------|--|--------------------------|
| 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. Bityukov <i>et al.</i>  |  | (SERP)                   |
| DOLINSKY                        | 86  | PL B174 453           | S.I. Dolinsky <i>et al.</i>  |  | (NOVO)                   |

NODE=M188

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                               |
| $1594 \pm 15^{+10}_{-60}$ |  |  | 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                               |
| $384 \pm 60^{+70}_{-100}$ |  |  | EUGENIO     | 01 SPEC | $18 \pi^- p \rightarrow \omega\eta n$ |

NODE=M166W

NODE=M166W

| $h_1(1595) \text{ DECAY MODES}$ |              |  |                                |  |  |
|---------------------------------|--------------|--|--------------------------------|--|--|
| Mode                            |              |  | Fraction ( $\Gamma_i/\Gamma$ ) |  |  |
| $\Gamma_1$                      | $\omega\eta$ |  | 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

$\pi_1(1600)$ 

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

NODE=M164

 $\pi_1(1600)$  MASS

NODE=M164M

NODE=M164M

NEW

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                                                                     | TECN     | COMMENT                                           |
|-------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------|----------|---------------------------------------------------|
| <b>1660<math>\pm</math> 15<math>\pm</math> 11 OUR AVERAGE</b>                 |      | Error includes scale factor of 1.2. [1662 $\pm$ 8 $\pm$ 9 MeV OUR 2018 AVERAGE] |          |                                                   |
| 1564 $\pm$ 24 $\pm$ 86                                                        |      | <sup>1</sup> RODAS                                                              | 19 JPAC  | 191 $\pi^- p \rightarrow \eta^{(\prime)} \pi^- p$ |
| 1600 $\pm$ 110 $\pm$ 60                                                       | 46M  | <sup>2</sup> AGHASYAN                                                           | 18B COMP | 190 $\pi^- p \rightarrow \pi^- \pi^- \pi^+ p$     |
| 1664 $\pm$ 8 $\pm$ 10                                                         | 145k | <sup>3</sup> LU                                                                 | 05 B852  | 18 $\pi^- p \rightarrow \omega \pi^- \pi^0 p$     |
| 1709 $\pm$ 24 $\pm$ 41                                                        | 69k  | <sup>4</sup> KUHN                                                               | 04 B852  | 18 $\pi^- p \rightarrow \eta \pi^+ \pi^- \pi^- p$ |
| 1597 $\pm$ 10 $\pm$ 45 $\pm$ 10                                               |      | <sup>4</sup> IVANOV                                                             | 01 B852  | 18 $\pi^- p \rightarrow \eta' \pi^- p$            |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                                                                 |          |                                                   |
| 1660 $\pm$ 10 $\pm$ 64 $\pm$ 0                                                | 420k | <sup>5</sup> ALEKSEEV                                                           | 10 COMP  | 190 $\pi^- Pb \rightarrow \pi^- \pi^- \pi^+ Pb'$  |
| 1593 $\pm$ 8 $\pm$ 29 $\pm$ 47                                                |      | <sup>4,6</sup> ADAMS                                                            | 98B B852 | 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$    |

- <sup>1</sup> The coupled-channel analysis of both the  $\eta\pi$  and  $\eta'\pi$  systems using ADOLPH 15data. The mass is extracted from the T-matrix pole.
- <sup>2</sup> Statistical error negligible.
- <sup>3</sup> May be a different state: natural and unnatural parity exchanges.
- <sup>4</sup> Natural parity exchange.
- <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=D

NODE=M164M;LINKAGE=B  
 NODE=M164M;LINKAGE=LU  
 NODE=M164M;LINKAGE=A  
 NODE=M164M;LINKAGE=C  
 NODE=M164M;LINKAGE=DZ

 $\pi_1(1600)$  WIDTH

NODE=M164W

NODE=M164W

NEW

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                                                                                                        | TECN     | COMMENT                                           |
|-------------------------------------------------------------------------------|------|--------------------------------------------------------------------------------------------------------------------|----------|---------------------------------------------------|
| <b>257<math>\pm</math> 60 OUR AVERAGE</b>                                     |      | Error includes scale factor of 1.9. See the ideogram below. [241 $\pm$ 40 MeV OUR 2018 AVERAGE Scale factor = 1.4] |          |                                                   |
| 492 $\pm$ 54 $\pm$ 102                                                        |      | <sup>1</sup> RODAS                                                                                                 | 19 JPAC  | 191 $\pi^- p \rightarrow \eta^{(\prime)} \pi^- p$ |
| 580 $\pm$ 100 $\pm$ 230                                                       | 46M  | <sup>2</sup> AGHASYAN                                                                                              | 18B COMP | 190 $\pi^- p \rightarrow \pi^- \pi^- \pi^+ p$     |
| 185 $\pm$ 25 $\pm$ 28                                                         | 145k | <sup>3</sup> LU                                                                                                    | 05 B852  | 18 $\pi^- p \rightarrow \omega \pi^- \pi^0 p$     |
| 403 $\pm$ 80 $\pm$ 115                                                        | 69k  | <sup>4</sup> KUHN                                                                                                  | 04 B852  | 18 $\pi^- p \rightarrow \eta \pi^+ \pi^- \pi^- p$ |
| 340 $\pm$ 40 $\pm$ 50                                                         |      | <sup>4</sup> IVANOV                                                                                                | 01 B852  | 18 $\pi^- p \rightarrow \eta' \pi^- p$            |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                                                                                                    |          |                                                   |
| 269 $\pm$ 21 $\pm$ 42 $\pm$ 64                                                | 420k | <sup>5</sup> ALEKSEEV                                                                                              | 10 COMP  | 190 $\pi^- Pb \rightarrow \pi^- \pi^- \pi^+ Pb'$  |
| 168 $\pm$ 20 $\pm$ 150 $\pm$ 12                                               |      | <sup>4,6</sup> ADAMS                                                                                               | 98B B852 | 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$    |

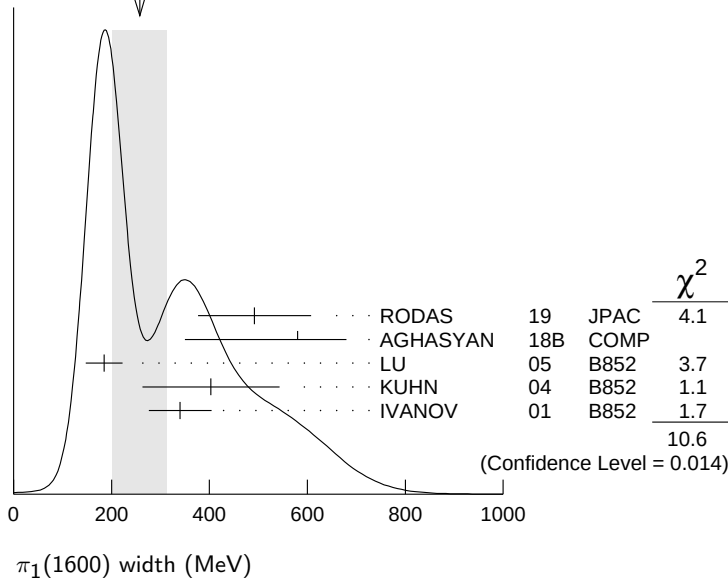
- <sup>1</sup> The coupled-channel analysis of both the  $\eta\pi$  and  $\eta'\pi$  systems using ADOLPH 15data. The width is extracted from the T-matrix pole.
- <sup>2</sup> Statistical error negligible.
- <sup>3</sup> May be a different state: natural and unnatural parity exchanges.
- <sup>4</sup> Natural parity exchange.
- <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;LINKAGE=D

NODE=M164W;LINKAGE=B  
 NODE=M164W;LINKAGE=LU  
 NODE=M164W;LINKAGE=A  
 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 $\pi^-\pi^-\pi^+\pi^0$          |
| • • • 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 $\pi^-p \rightarrow \pi^-\pi^0\pi^0p$ 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 $\pi^-p \rightarrow \pi^-\pi^0\pi^0p$ 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 $\pi^-p \rightarrow \omega\pi^-\pi^0p$    |
| <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

$\Gamma(f_1(1285)\pi)/\Gamma(\eta'(958)\pi^-)$  $\Gamma_6/\Gamma_5$ 

| VALUE            | EVT5 | 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.)  |
| 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=50459  
REFID=49773  
REFID=49414  
REFID=48837  
REFID=48317  
REFID=46610

NODE=M161

 $a_1(1640)$ 

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

Possibly seen in the study of the hadronic structure in decay  $\tau \rightarrow 3\pi\nu_\tau$  (ABREU 98G and ASNER 00).

NODE=M161

 $a_1(1640)$  MASS

| VALUE (MeV)                         | EVT5  | DOCUMENT ID                                                                             | TECN     | COMMENT                                          |
|-------------------------------------|-------|-----------------------------------------------------------------------------------------|----------|--------------------------------------------------|
| <b>1655± 16 OUR AVERAGE</b>         |       | Error includes scale factor of 1.2. [1654 ± 19 MeV OUR 2018 AVERAGE Scale factor = 1.3] |          |                                                  |
| 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                            | 35280 | <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  
NEWNODE=M161M;LINKAGE=A  
NODE=M161M;LINKAGE=KB $a_1(1640)$  WIDTH

| VALUE (MeV)                        | EVT5  | DOCUMENT ID                                                                                                    | TECN     | COMMENT                                          |
|------------------------------------|-------|----------------------------------------------------------------------------------------------------------------|----------|--------------------------------------------------|
| <b>254± 40 OUR AVERAGE</b>         |       | Error includes scale factor of 1.8. See the ideogram below. [240 ± 27 MeV OUR 2018 AVERAGE Scale factor = 1.2] |          |                                                  |
| 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                            | 35280 | <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 $\bar{p} p \rightarrow 4\pi^0$              |

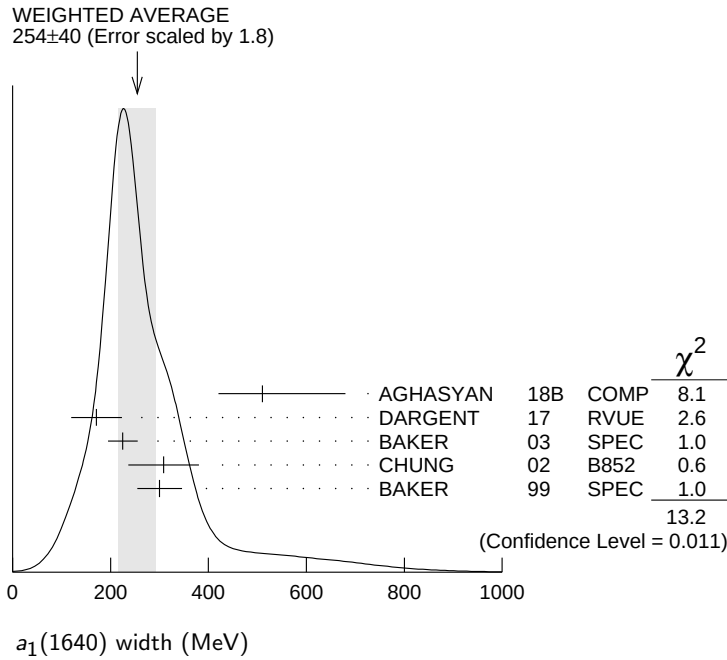
• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |  |         |         |                                              |
|---------|--|---------|---------|----------------------------------------------|
| 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  
NEWNODE=M161W;LINKAGE=A  
NODE=M161W;LINKAGE=KB



### $a_1(1640)$ 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<sub>1</sub>(1640) REFERENCES

|                              |     |               |                           |                         |
|------------------------------|-----|---------------|---------------------------|-------------------------|
| AGHASYAN                     | 18B | PR D98 092003 | M.Aghasyan <i>et al.</i>  | (COMPASS Collab.)       |
| DARGENT                      | 17  | JHEP 1705 143 | P. dArgent <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<sub>2</sub>(1640)

$I^G(J^{PC}) = 0^+(2^{++})$

NODE=M117

OMITTED FROM SUMMARY TABLE

f<sub>2</sub>(1640) MASS

NODE=M117M

NODE=M117M

| VALUE (MeV)                                                                   | DOCUMENT ID                         | TECN | COMMENT                                                  |
|-------------------------------------------------------------------------------|-------------------------------------|------|----------------------------------------------------------|
| <b>1639± 6 OUR AVERAGE</b>                                                    | Error includes scale factor of 1.2. |      |                                                          |
| 1620± 16                                                                      | BUGG                                | 95   | MRK3 $J/\psi \rightarrow \gamma \pi^+ \pi^- \pi^+ \pi^-$ |
| 1647± 7                                                                       | ADAMO                               | 92   | OBLX $\bar{n} p \rightarrow 3 \pi^+ 2 \pi^-$             |
| 1635± 7                                                                       | ALDE                                | 90   | GAM2 $38 \pi^- p \rightarrow \omega \omega n$            |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                     |      |                                                          |
| 1640± 5                                                                       | AMSLER                              | 06   | CBAR $0.9 \bar{p} p \rightarrow K^+ K^- \pi^0$           |
| 1659± 6                                                                       | VLADIMIRSK...                       | 06   | SPEC $40 \pi^- p \rightarrow K_S^0 K_S^0 n$              |
| 1643± 7                                                                       | <sup>1</sup> ALDE                   | 89B  | GAM2 $38 \pi^- p \rightarrow \omega \omega n$            |
| <sup>1</sup> Superseded by ALDE 90.                                           |                                     |      |                                                          |

NODE=M117M;LINKAGE=BB

f<sub>2</sub>(1640) WIDTH

NODE=M117W

NODE=M117W

| VALUE (MeV)                                                                   | CL%                                 | DOCUMENT ID   | TECN | COMMENT                                                  |
|-------------------------------------------------------------------------------|-------------------------------------|---------------|------|----------------------------------------------------------|
| <b>99<sup>+60</sup><sub>-40</sub> OUR AVERAGE</b>                             | Error includes scale factor of 2.9. |               |      |                                                          |
| 140 <sup>+60</sup> <sub>-20</sub>                                             |                                     | BUGG          | 95   | MRK3 $J/\psi \rightarrow \gamma \pi^+ \pi^- \pi^+ \pi^-$ |
| 58±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± 9                                                                         |                                     | AMSLER        | 06   | CBAR $0.9 \bar{p} p \rightarrow K^+ K^- \pi^0$           |
| 152±18                                                                        |                                     | VLADIMIRSK... | 06   | SPEC $40 \pi^- p \rightarrow K_S^0 K_S^0 n$              |
| < 70                                                                          | 90                                  | ALDE          | 90   | GAM2 $38 \pi^- p \rightarrow \omega \omega n$            |

f<sub>2</sub>(1640) DECAY MODES

NODE=M117215;NODE=M117

| Mode                       | Fraction (Γ <sub>i</sub> /Γ) |
|----------------------------|------------------------------|
| Γ <sub>1</sub> ωω          | seen                         |
| Γ <sub>2</sub> 4π          | seen                         |
| Γ <sub>3</sub> K $\bar{K}$ | seen                         |

DESIG=1;OUR EST;→ UNCHECKED ←  
DESIG=2;OUR EST;→ UNCHECKED ←  
DESIG=3

f<sub>2</sub>(1640) BRANCHING RATIOS

NODE=M117220

NODE=M117R2  
NODE=M117R2

| Γ(K $\bar{K}$ )/Γ <sub>total</sub> | DOCUMENT ID | TECN | COMMENT                                        | Γ <sub>3</sub> /Γ |
|------------------------------------|-------------|------|------------------------------------------------|-------------------|
| seen                               | AMSLER      | 06   | CBAR $0.9 \bar{p} p \rightarrow K^+ K^- \pi^0$ |                   |

f<sub>2</sub>(1640) REFERENCES

NODE=M117

|                             |     |             |                                |                                 |
|-----------------------------|-----|-------------|--------------------------------|---------------------------------|
| AMSLER                      | 06  | PL B639 165 | C. Amsler <i>et al.</i>        | (CBAR 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

$$\Gamma(K\bar{K}\pi)/\Gamma(a_2(1320)\pi) \quad \Gamma_2/\Gamma_1$$

| VALUE            | DOCUMENT ID           | TECN | COMMENT                                 |
|------------------|-----------------------|------|-----------------------------------------|
| <b>0.07±0.03</b> | <sup>1</sup> BARBERIS | 97C  | OMEG 450 $pp \rightarrow ppK\bar{K}\pi$ |

NODE=M154R1  
 NODE=M154R1

<sup>1</sup> Using  $2(\pi^+ \pi^-)$  data from BARBERIS 97B.

NODE=M154R1;LINKAGE=A

$$\Gamma(a_2(1320)\pi)/\Gamma(a_0(980)\pi) \quad \Gamma_1/\Gamma_5$$

| 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 $pp \rightarrow p_f \eta \pi^+ \pi^- p_s$ |

NODE=M154R3  
 NODE=M154R3

<sup>2</sup> Reanalysis of ADOMEIT 96 and ANISOVICH 00E.

NODE=M154R3;LINKAGE=AN

$$\Gamma(f_2(1270)\eta)/\Gamma_{\text{total}} \quad \Gamma_6/\Gamma$$

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

$\omega(1650)$ 

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

NODE=M126

 $\omega(1650)$  MASS

NODE=M126M

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

**1670± 30 OUR ESTIMATE**

NODE=M126M

→ UNCHECKED ←

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

|                                      |       |                             |      |                                                          |
|--------------------------------------|-------|-----------------------------|------|----------------------------------------------------------|
| 1671± 6±10                           | 824   | <sup>1</sup> AKHMETSHIN 17A | CMD3 | 1.4–2.0 $e^+e^- \rightarrow \omega\eta$                  |
| 1660± 10                             | 898   | <sup>2</sup> ACHASOV 16B    | SND  | 1.34–2.00 $e^+e^- \rightarrow \omega\eta$                |
| 1680± 10                             | 13.1k | <sup>3</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>4</sup> ACHASOV 03D    | RVUE | 0.44–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$           |
| 1619± 5                              |       | <sup>5</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>6</sup> AKHMETSHIN 00D | CMD2 | $e^+e^- \rightarrow \omega\pi^+\pi^-$                    |
| 1820 <sup>+190</sup> <sub>–150</sub> |       | <sup>7</sup> ACHASOV 98H    | RVUE | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$                     |
| 1840 <sup>+100</sup> <sub>–70</sub>  |       | <sup>8</sup> ACHASOV 98H    | RVUE | $e^+e^- \rightarrow \omega\pi^+\pi^-$                    |
| 1780 <sup>+170</sup> <sub>–300</sub> |       | <sup>9</sup> ACHASOV 98H    | RVUE | $e^+e^- \rightarrow K^+K^-$                              |
| ~ 2100                               |       | <sup>10</sup> ACHASOV 98H   | RVUE | $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp$                 |
| 1606± 9                              |       | <sup>11</sup> CLEGG 94      | RVUE |                                                          |
| 1662± 13                             | 750   | <sup>12</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 | $e^+e^- \rightarrow 3\pi$                                |

OCCUR=2

OCCUR=2

OCCUR=3

OCCUR=4

OCCUR=5

OCCUR=4

<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  $\omega(1420)$ ,  $\omega(1650)$ , and  $\phi(1680)$ .<sup>3</sup> From a fit with contributions from  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ , and  $\omega(1650)$ .<sup>4</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>5</sup> Using results of CORDIER 81 and preliminary data of DOLINSKY 91 and ANTONELLI 92.<sup>6</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>7</sup> Using data from BARKOV 87, DOLINSKY 91, and ANTONELLI 92.<sup>8</sup> Using the data from ANTONELLI 92.<sup>9</sup> Using the data from IVANOV 81 and BISELLO 88B.<sup>10</sup> Using the data from BISELLO 91C.<sup>11</sup> From a fit to two Breit-Wigner functions and using the data of DOLINSKY 91 and ANTONELLI 92.<sup>12</sup> From the combined fit of the  $\rho\pi$  and  $\omega\pi\pi$  final states.

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**

NODE=M126W

→ UNCHECKED ←

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

|                                          |       |                             |      |                                                    |
|------------------------------------------|-------|-----------------------------|------|----------------------------------------------------|
| 113± 9± 10                               | 824   | <sup>1</sup> AKHMETSHIN 17A | CMD3 | 1.4–2.0 $e^+e^- \rightarrow \omega\eta$            |
| 110± 20                                  | 898   | <sup>2</sup> ACHASOV 16B    | SND  | 1.34–2.00 $e^+e^- \rightarrow \omega\eta$          |
| 310± 30                                  | 13.1k | <sup>3</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>+200</sup> <sub>–150</sub> ±130 | 1.2M  | <sup>4</sup> ACHASOV 03D    | RVUE | 0.44–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$     |
| 250± 14                                  |       | <sup>5</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>6</sup> AKHMETSHIN 00D | CMD2 | $e^+e^- \rightarrow \omega\pi^+\pi^-$              |
| 113 ± 20 |     | <sup>7</sup> CLEGG 94       | RVUE |                                                    |
| 280 ± 24 | 750 | <sup>8</sup> ANTONELLI 92   | DM2  | $1.34-2.4e^+e^- \rightarrow \rho\pi, \omega\pi\pi$ |
| 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 | $e^+e^- \rightarrow 3\pi$                          |

OCCUR=2  
OCCUR=5  
OCCUR=4

<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  $\omega(1420)$ ,  $\omega(1650)$ , and  $\phi(1680)$ .

<sup>3</sup> From a fit with contributions from  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ , and  $\omega(1650)$ .

<sup>4</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>5</sup> Using results of CORDIER 81 and preliminary data of DOLINSKY 91 and ANTONELLI 92.

<sup>6</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>7</sup> From a fit to two Breit-Wigner functions and using the data of DOLINSKY 91 and ANTONELLI 92.

<sup>8</sup> From the combined fit of the  $\rho\pi$  and  $\omega\pi\pi$  final states.

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

### $\omega(1650)$ DECAY MODES

NODE=M126215;NODE=M126

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $\rho\pi$      | seen                           |
| $\Gamma_2$ $\omega\pi\pi$ | seen                           |
| $\Gamma_3$ $\omega\eta$   | seen                           |
| $\Gamma_4$ $e^+e^-$       | seen                           |
| $\Gamma_5$ $\pi^0\gamma$  | not seen                       |

DESIG=1;OUR EST;→ UNCHECKED ←  
DESIG=2;OUR EST;→ UNCHECKED ←  
DESIG=4;OUR EST;→ UNCHECKED ←  
DESIG=3;OUR EST;→ UNCHECKED ←  
DESIG=5

### $\omega(1650) \Gamma(i)\Gamma(e^+e^-)/\Gamma^2(\text{total})$

NODE=M126230

| $\Gamma(\rho\pi)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ | $\Gamma_1/\Gamma \times \Gamma_4/\Gamma$ |
|-------------------------------------------------------------------------------------|------------------------------------------|
| VALUE (units $10^{-6}$ )                                                            | EVTS                                     |

• • • 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 $\begin{smallmatrix} +0.4 \\ -0.1 \end{smallmatrix}$ ± 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  | $1.34-2.4e^+e^- \rightarrow \rho\pi, \omega\pi\pi$ |

NODE=M126G3  
NODE=M126G3

| $\Gamma(\omega\pi\pi)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ | $\Gamma_2/\Gamma \times \Gamma_4/\Gamma$ |
|------------------------------------------------------------------------------------------|------------------------------------------|
| VALUE (units $10^{-7}$ )                                                                 | EVTS                                     |

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

|                 |      |                             |      |                                                     |
|-----------------|------|-----------------------------|------|-----------------------------------------------------|
| 7.0 ± 0.5       |      | AUBERT 07AU                 | BABR | $10.6 e^+e^- \rightarrow \omega\pi^+\pi^-\gamma$    |
| 4.1 ± 0.9 ± 1.3 | 1.2M | <sup>2,3</sup> ACHASOV 03D  | RVUE | $0.44-2.00 e^+e^- \rightarrow \pi^+\pi^-\pi^0$      |
| 5.40 ± 0.95     |      | <sup>8</sup> AKHMETSHIN 00D | CMD2 | $1.2-1.38 e^+e^- \rightarrow \omega\pi^+\pi^-$      |
| 3.18 ± 0.80     |      | <sup>4,5</sup> CLEGG 94     | RVUE |                                                     |
| 6.07 ± 0.61     | 750  | <sup>6,7</sup> ANTONELLI 92 | DM2  | $1.34-2.4 e^+e^- \rightarrow \rho\pi, \omega\pi\pi$ |

NODE=M126G4  
NODE=M126G4

| $\Gamma(\omega\eta)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ | $\Gamma_3/\Gamma \times \Gamma_4/\Gamma$ |
|----------------------------------------------------------------------------------------|------------------------------------------|
| VALUE (units $10^{-7}$ )                                                               | CL% EVTS                                 |

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

|                 |     |                              |      |                                            |
|-----------------|-----|------------------------------|------|--------------------------------------------|
| 4.5 ± 0.3 ± 0.3 | 824 | <sup>9</sup> AKHMETSHIN 17A  | CMD3 | $1.4-2.0 e^+e^- \rightarrow \omega\eta$    |
| 4.4 ± 0.5       | 898 | <sup>10</sup> ACHASOV 16B    | SND  | $1.34-2.00 e^+e^- \rightarrow \omega\eta$  |
| 5.7 ± 0.6       | 13  | AUBERT 06D                   | BABR | $10.6 e^+e^- \rightarrow \omega\eta\gamma$ |
| <60             | 90  | <sup>11</sup> AKHMETSHIN 03B | CMD2 | $e^+e^- \rightarrow \eta\pi^0\gamma$       |

NODE=M126G5  
NODE=M126G5

- <sup>1</sup> From a fit with contributions from  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ , and  $\omega(1650)$ .
- <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.
- <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 of the interfering  $\omega(1420)$  and  $\omega(1650)$  with a relative phase of  $\pi$  and other parameters floating. From an alternative fit  $\Gamma(\omega(1650) \rightarrow \omega\eta)/\Gamma_{\text{total}} \times \Gamma(\omega(1650) \rightarrow e^+e^-) = 51 \pm 3 \text{ eV}$ .
- <sup>10</sup> From a fit with contributions from  $\omega(1420)$ ,  $\omega(1650)$ , and  $\phi(1680)$ .
- <sup>11</sup>  $\omega(1650)$  mass and width fixed at 1700 MeV and 250 MeV, respectively.

### $\omega(1650)$ BRANCHING RATIOS

$\Gamma(\rho\pi)/\Gamma_{\text{total}}$   $\Gamma_1/\Gamma$

| 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 $e^+e^- \rightarrow \rho\pi, \omega\pi\pi$ |

$\Gamma(\omega\pi\pi)/\Gamma_{\text{total}}$   $\Gamma_2/\Gamma$

| 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 0.44–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$     |
| $0.620 \pm 0.014$ |      | <sup>2</sup> HENNER  | 02  | RVUE 1.2–2.0 $e^+e^- \rightarrow \rho\pi, \omega\pi\pi$ |

$\Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_4/\Gamma$

| 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>2,3</sup> ACHASOV | 03D | RVUE 0.44–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$     |
| $32 \pm 1$ |      | <sup>2</sup> HENNER    | 02  | RVUE 1.2–2.0 $e^+e^- \rightarrow \rho\pi, \omega\pi\pi$ |

$\Gamma(\pi^0\gamma)/\Gamma_{\text{total}}$   $\Gamma_5/\Gamma$

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

not seen <sup>4</sup> ACHASOV 10D SND 1.075–2.0  $e^+e^- \rightarrow \pi^0\gamma$

- <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  $\rho(1700)$ . The width of the highest mass effective resonance is fixed at 315 MeV.
- <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.
- <sup>3</sup> Calculated by us from the cross section at the peak.

### $\omega(1650)$ REFERENCES

|                |                              |                               |                             |
|----------------|------------------------------|-------------------------------|-----------------------------|
| 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.) |

NODE=M126G3;LINKAGE=A  
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 NODE=M126G5;LINKAGE=KH

NODE=M126225

NODE=M126R3  
 NODE=M126R3

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 NODE=M126R2

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 NODE=M126R4

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 REFID=49577  
 REFID=49406  
 REFID=48815  
 REFID=49177  
 REFID=48311  
 REFID=48010  
 REFID=47935



|           |     |                               |                                |                           |
|-----------|-----|-------------------------------|--------------------------------|---------------------------|
| 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=47391  
REFID=46323  
REFID=44081  
REFID=43168  
REFID=41867  
REFID=41369  
REFID=40581  
REFID=40280  
  
REFID=21502  
REFID=21586  
REFID=20553  
REFID=21584  
REFID=21475

NODE=M045

 $\omega_3(1670)$ 

$$I^G(J^{PC}) = 0^-(3^{--})$$

 $\omega_3(1670)$  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   | $8.2 K^- p \text{ backward}$                 |
| 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   | $8.2 K^- p \text{ backward}$                 |
| 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. ● ● ● |      |             |        |                                  |
| $0.71 \pm 0.27$                                                               | 100  | DIAZ        | 74 DBC | $6 \pi^+ n \rightarrow p 5\pi^0$ |

NODE=M045R3  
NODE=M045R3 $\Gamma(b_1(1235)\pi)/\Gamma(\rho\pi)$  $\Gamma_3/\Gamma_1$ 

| VALUE         | DOCUMENT ID | TECN   | COMMENT                          |
|---------------|-------------|--------|----------------------------------|
| possibly seen | DIAZ        | 74 DBC | $6 \pi^+ n \rightarrow p 5\pi^0$ |

NODE=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

NODE=M045

|            |     |             |                                    |                        |
|------------|-----|-------------|------------------------------------|------------------------|
| 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. Kalekar | (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+)    |

REFID=44649  
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REFID=21520  
REFID=21269  
REFID=20537  
REFID=20843  
REFID=21248  
REFID=21515  
REFID=21512  
REFID=20800  
REFID=20783 $\pi_2(1670)$ 

$$I^G(J^{PC}) = 1^-(2^-+)$$

NODE=M034

 $\pi_2(1670)$  MASS

NODE=M034M

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

NODE=M034M

**$1670.6^{+2.9}_{-1.2}$  OUR AVERAGE** Error includes scale factor of 1.3. See the ideogram below. [1672.2  $\pm$  3.0 MeV OUR 2018 AVERAGE Scale factor = 1.4]

NEW

|      |                  |      |                           |     |        |                                                              |
|------|------------------|------|---------------------------|-----|--------|--------------------------------------------------------------|
| 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 $p p \rightarrow p_f 3\pi^0 p_s$                         |
| 1687 | $\pm 9 \pm 15$   |      | AMELIN                    | 99  | VES    | 37 $\pi^- A \rightarrow \omega \pi^- \pi^0 A^*$              |
| 1669 | $\pm 4$          |      | BARBERIS                  | 98B |        | 450 $p p \rightarrow p_f \rho \pi p_s$                       |
| 1670 | $\pm 4$          |      | BARBERIS                  | 98B |        | 450 $p p \rightarrow p_f f_2(1270) \pi p_s$                  |
| 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 $\pi^+ p \rightarrow p 3\pi$                              |

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

OCCUR=2

|      |                     |      |                       |     |        |                                                  |
|------|---------------------|------|-----------------------|-----|--------|--------------------------------------------------|
| 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 $\pi^- p \rightarrow p \pi_2$               |

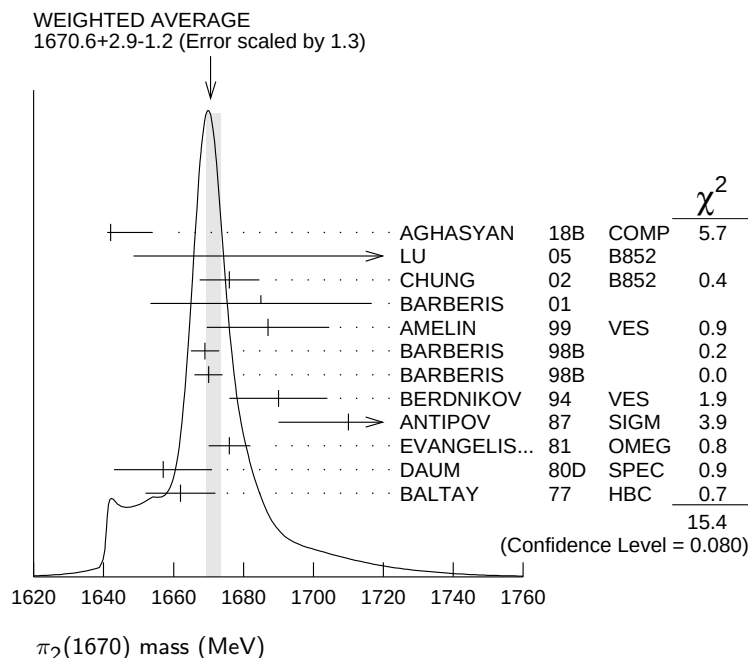
OCCUR=2

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.
- <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=A  
 NODE=M034M;LINKAGE=F2  
 NODE=M034M;LINKAGE=P  
 NODE=M034M;LINKAGE=D

NODE=M034M;LINKAGE=B  
 NODE=M034M;LINKAGE=AX  
 NODE=M034M;LINKAGE=R2  
 NODE=M034M;LINKAGE=S2  
 NODE=M034M;LINKAGE=L



### $\pi_2(1670)$ WIDTH

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

**258 $\pm$  8** **OUR AVERAGE** Error includes scale factor of 1.2. [260  $\pm$  9 MeV OUR 2018  
 AVERAGE Scale factor = 1.2]

|                        |      |                            |     |      |                                                 |
|------------------------|------|----------------------------|-----|------|-------------------------------------------------|
| 311 $\pm$ 12           | 46M  | <sup>10</sup> 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   |      | <sup>11</sup> CHUNG        | 02  | B852 | 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$  |
| 265 $\pm$ 30 $\pm$ 40  |      | BARBERIS                   | 01  |      | 450 $p p \rightarrow p_f 3\pi^0 p_s$            |
| 168 $\pm$ 43 $\pm$ 53  |      | AMELIN                     | 99  | VES  | 37 $\pi^- A \rightarrow \omega \pi^- \pi^0 A^*$ |
| 268 $\pm$ 15           |      | BARBERIS                   | 98B |      | 450 $p p \rightarrow p_f \rho \pi p_s$          |
| 256 $\pm$ 15           |      | BARBERIS                   | 98B |      | 450 $p p \rightarrow p_f f_2(1270) \pi p_s$     |
| 190 $\pm$ 50           |      | <sup>12</sup> 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           |      | <sup>12</sup> EVANGELIS... | 81  | OMEG | 12 $\pi^- p \rightarrow 3\pi p$                 |
| 219 $\pm$ 20           |      | <sup>12,13</sup> DAUM      | 80D | SPEC | 63-94 $\pi p \rightarrow 3\pi X$                |
| 285 $\pm$ 60           | 2000 | <sup>12</sup> 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 $\pm$ 22  | 420k | <sup>14</sup> ALEKSEEV | 10  | COMP | 190 $\pi^- P b \rightarrow \pi^- \pi^- \pi^+ P b'$ |
| 310 $\pm$ 20          |      | <sup>15</sup> 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          |      | <sup>11</sup> BELLINI  | 85  | SPEC | 40 $\pi^- A \rightarrow \pi^- \pi^+ \pi^- A$       |

NODE=M034W

NODE=M034W

NEW

OCCUR=2

|         |                       |     |      |                                              |         |
|---------|-----------------------|-----|------|----------------------------------------------|---------|
| 404±108 | <sup>16</sup> BELLINI | 85  | SPEC | 40 $\pi^- A \rightarrow \pi^- \pi^+ \pi^- A$ | OCCUR=2 |
| 330± 90 | <sup>17</sup> BELLINI | 85  | SPEC | 40 $\pi^- A \rightarrow \pi^- \pi^+ \pi^- A$ | OCCUR=3 |
| 312± 50 | <sup>18</sup> DAUM    | 81B | SPEC | 63,94 $\pi^- p$                              |         |
| 270± 60 | <sup>12</sup> ASCOLI  | 73  | HBC  | 5-25 $\pi^- p \rightarrow p \pi_2$           |         |

<sup>10</sup> Statistical error negligible.

<sup>11</sup> From  $f_2(1270)\pi$  decay.

<sup>12</sup> From a fit to  $J^P = 2^- f_2(1270)\pi$  partial wave.

<sup>13</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>14</sup> Superseded by AGHASYAN 2018B.

<sup>15</sup>  $J^PC$  ambiguous.

<sup>16</sup> From  $\rho\pi$  decay.

<sup>17</sup> From  $\sigma\pi$  decay.

<sup>18</sup> 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±1.4) %                   |                  |
| $\Gamma_2$ $\pi^+ \pi^- \pi^0$             |                                |                  |
| $\Gamma_3$ $\pi^0 \pi^0 \pi^0$             |                                |                  |
| $\Gamma_4$ $f_2(1270)\pi$                  | (56.3±3.2) %                   |                  |
| $\Gamma_5$ $\rho\pi$                       | (31 ±4 ) %                     |                  |
| $\Gamma_6$ $\sigma\pi$                     | (10 ±4 ) %                     |                  |
| $\Gamma_7$ $\pi(\pi\pi)_S$ -wave           | ( 8.7±3.4) %                   |                  |
| $\Gamma_8$ $\pi^\pm \pi^+ \pi^-$           | (53 ±4 ) %                     |                  |
| $\Gamma_9$ $K\bar{K}^*(892) + \text{c.c.}$ | ( 4.2±1.4) %                   |                  |
| $\Gamma_{10}$ $\omega\rho$                 | ( 2.7±1.1) %                   |                  |
| $\Gamma_{11}$ $\pi^\pm \gamma$             | ( 7.0±1.2) × 10 <sup>-4</sup>  |                  |
| $\Gamma_{12}$ $\gamma\gamma$               | < 2.8 × 10 <sup>-7</sup>       | 90%              |
| $\Gamma_{13}$ $\eta\pi$                    | < 5 %                          |                  |
| $\Gamma_{14}$ $\pi^\pm 2\pi^+ 2\pi^-$      | < 5 %                          |                  |
| $\Gamma_{15}$ $\rho(1450)\pi$              | < 3.6 × 10 <sup>-3</sup>       | 97.7%            |
| $\Gamma_{16}$ $b_1(1235)\pi$               | < 1.9 × 10 <sup>-3</sup>       | 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  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \delta x_j)$ , 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

| $\Gamma(\pi^\pm \gamma)$                                                                                                                                      |                      |      |      |                                                                | $\Gamma_{11}$ |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------|------|----------------------------------------------------------------|---------------|
| VALUE (keV)                                                                                                                                                   | DOCUMENT ID          | TECN | CHG  | COMMENT                                                        |               |
| <b>181±11±27</b>                                                                                                                                              | <sup>19</sup> ADOLPH | 14   | COMP | 190 $\pi^- \text{Pb} \rightarrow \pi^+ \pi^- \pi^- \text{Pb}'$ |               |
| <sup>19</sup> 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  | <sup>20</sup> 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  | <sup>20</sup> 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 $\pm 0.3 \pm 0.12$                                                        |     | <sup>21</sup> BEHREND  | 90C  | CELL | 0 $e^+e^- \rightarrow e^+e^-\pi^+\pi^-\pi^0$ |
| 1.3 $\pm 0.3 \pm 0.2$                                                         |     | <sup>22</sup> BEHREND  | 90C  | CELL | 0 $e^+e^- \rightarrow e^+e^-\pi^+\pi^-\pi^0$ |

<sup>20</sup> Decaying into  $f_2(1270)\pi$  and  $\rho\pi$ .<sup>21</sup> Constructive interference between  $f_2(1270)\pi, \rho\pi$  and background.<sup>22</sup> 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  | <sup>23</sup> SCHEGELSKY | 06   | RVUE $\gamma\gamma \rightarrow \pi^+\pi^-\pi^0$ |
| <sup>23</sup> 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±0.07 OUR AVERAGE</b>                                                  | [0.19 ± 0.06 OUR 2018 AVERAGE] |      |                                                     |
| <b>0.17±0.02±0.07</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±0.10                                                                     | <sup>24,25</sup> BAKER         | 99   | SPEC 1.94 $\bar{p} p \rightarrow 4\pi^0$            |

NODE=M034R15  
NODE=M034R15  
NEW $\frac{1}{2}\Gamma(\rho\pi)/\Gamma(\pi^+\pi^-\pi^-)$  $\frac{1}{2}\Gamma_5/\Gamma_8 = \frac{1}{2}\Gamma_5/(0.565\Gamma_4 + \frac{1}{2}\Gamma_5 + 0.624\Gamma_7)$ 

| 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>                                             | <sup>26</sup> 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 $0.565\Gamma(f_2(1270)\pi)/\Gamma(\pi^+\pi^-\pi^-)$  $0.565\Gamma_4/\Gamma_8 = 0.565\Gamma_4/(0.565\Gamma_4 + \frac{1}{2}\Gamma_5 + 0.624\Gamma_7)$ (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 $\pm 0.04$                                                               | <sup>26</sup> 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>0.10±0.04 OUR FIT</b> |             |          |                 |
| <b>0.10±0.05</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>0.075±0.025 OUR FIT</b> |              |          |     |                                          |
| <b>0.075±0.025</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>0.027±0.004±0.010</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>&lt;0.09</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>&lt;0.10</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>&lt;0.0036</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>&lt;0.0019</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

$$D\text{-wave}/S\text{-wave RATIO FOR } \pi_2(1670) \rightarrow f_2(1270)\pi$$

| VALUE                                                                         | DOCUMENT ID | TECN     | COMMENT                             |
|-------------------------------------------------------------------------------|-------------|----------|-------------------------------------|
| <b>-0.18±0.06</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±0.10                                                                     | 26 DAUM     | 81B SPEC | 63,94 $\pi^- p$                     |

NODE=M034R14

NODE=M034R14

$$F\text{-wave}/P\text{-wave RATIO FOR } \pi_2(1670) \rightarrow \rho\pi$$

| VALUE                  | DOCUMENT ID | TECN    | COMMENT                                        |
|------------------------|-------------|---------|------------------------------------------------|
| <b>-0.72±0.07±0.14</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  | SJNP 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 B9B 285                   | C. Daum <i>et al.</i>              | (AMST, CERN, CRAC, MPIM+) JP      |
| BALTAY       | 77  | PRL 39 591                   | C. Baltay, C.V. Cautis, M. Kalekar | (COLU) JP                         |
| ASCOLI       | 73  | PR D7 669                    | G. Ascoli                          | (ILL, TATO, 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=40004  
REFID=47490

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REFID=21573  
REFID=20847  
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                                                                  |
|-------------------------------------------------------------------------------|------|-------------------------|----------|--------------------------------------------------------------------------|
| <b>1680±20 OUR ESTIMATE</b>                                                   |      |                         |          |                                                                          |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                         |          |                                                                          |
| 1700±23                                                                       | 2k   | <sup>1</sup> ACHASOV    | 18A SND  | 1.3–2.0 $e^+e^- \rightarrow K_S^0 K_L^0 \pi^0$                           |
| 1674±12±6                                                                     | 6.2k | <sup>2</sup> LEES       | 14H BABR | $e^+e^- \rightarrow K_S^0 K_L^0 \gamma$                                  |
| 1733±10±10                                                                    |      | <sup>3</sup> LEES       | 12F BABR | 10.6 $e^+e^- \rightarrow \phi \pi^+ \pi^- \gamma$                        |
| 1689±7±10                                                                     | 4.8k | <sup>4</sup> SHEN       | 09 BELL  | 10.6 $e^+e^- \rightarrow K^+ K^- \pi^+ \pi^- \gamma$                     |
| 1709±20±43                                                                    |      | <sup>5</sup> AUBERT     | 08S BABR | 10.6 $e^+e^- \rightarrow$ hadrons                                        |
| 1623±20                                                                       | 948  | <sup>6</sup> AKHMETSHIN | 03 CMD2  | 1.05–1.38 $e^+e^- \rightarrow K_L^0 K_S^0$                               |
| ~1500                                                                         |      | <sup>7</sup> ACHASOV    | 98H RVUE | $e^+e^- \rightarrow \pi^+ \pi^- \pi^0, \omega \pi^+ \pi^-,$<br>$K^+ K^-$ |
| ~1900                                                                         |      | <sup>8</sup> ACHASOV    | 98H RVUE | $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp$                                 |
| 1700±20                                                                       |      | <sup>9</sup> CLEGG      | 94 RVUE  | $e^+e^- \rightarrow K^+ K^-, K_S^0 K \pi$                                |
| 1657±27                                                                       | 367  | BISELLO                 | 91C DM2  | $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp$                                 |
| 1655±17                                                                       |      | <sup>10</sup> BISELLO   | 88B DM2  | $e^+e^- \rightarrow K^+ K^-$                                             |
| 1680±10                                                                       |      | <sup>11</sup> BUON      | 82 DM1   | $e^+e^- \rightarrow$ hadrons                                             |
| 1677±12                                                                       |      | <sup>12</sup> MANE      | 82 DM1   | $e^+e^- \rightarrow K_S^0 K \pi$                                         |

OCCUR=4

- Assuming the  $K \bar{K}^*(892) + \text{c.c.}$  dynamics. Systematic uncertainties not estimated.
- Using a vector meson dominance model with contribution from  $\phi(1020)$ ,  $\phi(1680)$ , and higher mass excitations of  $\rho(770)$  and  $\omega(782)$ .
- Using events with  $\pi\pi$  invariant mass less than 0.85 GeV.
- From a fit with two incoherent Breit-Wigners.
- 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.
- From the combined fit of AKHMETSHIN 03 and MANE 81 also including  $\rho$ ,  $\omega$ , and  $\phi$ . Neither isospin nor flavor structure known.
- Using data from IVANOV 81, BARKOV 87, BISELLO 88B, DOLINSKY 91, and ANTONELLI 92.
- Using the data from BISELLO 91C.
- Using BISELLO 88B and MANE 82 data.
- From global fit including  $\rho$ ,  $\omega$ ,  $\phi$  and  $\rho(1700)$  assume mass 1570 MeV and width 510 MeV for  $\rho$  radial excitation.
- 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.
- Fit to one channel only, neglecting interference with  $\omega$ ,  $\rho(1700)$ .

NODE=M067M1;LINKAGE=C  
NODE=M067M1;LINKAGE=B

NODE=M067M1;LINKAGE=A  
NODE=M067M1;LINKAGE=SH  
NODE=M067M1;LINKAGE=AU

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

**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  
NODE=M067M2

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)                                                                   | EVS  | 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. • • • |      |                         |      |                                                                                                                  |
| 300 ± 50                                                                      | 2k   | <sup>1</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>2</sup> LEES       | 14H  | BABR $e^+e^- \rightarrow K_S^0 K_L^0 \gamma$                                                                     |
| 300 ± 15 ± 37                                                                 |      | <sup>3</sup> LEES       | 12F  | BABR 10.6 $e^+e^- \rightarrow \phi \pi^+ \pi^- \gamma$                                                           |
| 211 ± 14 ± 19                                                                 | 4.8k | <sup>4</sup> SHEN       | 09   | BELL 10.6 $e^+e^- \rightarrow K^+ K^- \pi^+ \pi^- \gamma$                                                        |
| 322 ± 77 ± 160                                                                |      | <sup>5</sup> AUBERT     | 08S  | BABR 10.6 $e^+e^- \rightarrow \text{hadrons}$                                                                    |
| 139 ± 60                                                                      | 948  | <sup>6</sup> AKHMETSHIN | 03   | CMD2 1.05–1.38 $e^+e^- \rightarrow K_L^0 K_S^0$                                                                  |
| 300 ± 60                                                                      |      | <sup>7</sup> CLEGG      | 94   | RVUE $e^+e^- \rightarrow K^+ K^-, K_S^0 K \pi$                                                                   |
| 146 ± 55                                                                      | 367  | <sup>8</sup> BISELLO    | 91C  | DM2 $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp$                                                                     |
| 207 ± 45                                                                      |      | <sup>8</sup> BISELLO    | 88B  | DM2 $e^+e^- \rightarrow K^+ K^-$                                                                                 |
| 185 ± 22                                                                      |      | <sup>9</sup> BUON       | 82   | DM1 $e^+e^- \rightarrow \text{hadrons}$                                                                          |
| 102 ± 36                                                                      |      | <sup>10</sup> MANE      | 82   | DM1 $e^+e^- \rightarrow K_S^0 K \pi$                                                                             |

<sup>1</sup> Assuming the  $K \bar{K}^*(892) + \text{c.c.}$  dynamics. Systematic uncertainties not estimated.

<sup>2</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>3</sup> Using events with  $\pi\pi$  invariant mass less than 0.85 GeV.

<sup>4</sup> From a fit with two incoherent Breit-Wigners.

<sup>5</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>6</sup> From the combined fit of AKHMETSHIN 03 and MANE 81 also including  $\rho$ ,  $\omega$ , and  $\phi$ . Neither isospin nor flavor structure known.

<sup>7</sup> Using BISELLO 88B and MANE 82 data.

<sup>8</sup> From global fit including  $\rho$ ,  $\omega$ ,  $\phi$  and  $\rho(1700)$

<sup>9</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>10</sup> Fit to one channel only, neglecting interference with  $\omega$ ,  $\rho(1700)$ .

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  
NODE=M067W;LINKAGE=E  
NODE=M067W;LINKAGE=C

NODE=M067W;LINKAGE=D

**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  
NODE=M067W2

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                           |
| $\Gamma_{10}$ $\eta\gamma$                 | seen                           |
| $\Gamma_{11}$ $K^+K^-\pi^0$                |                                |

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=13  
 DESIG=2

 **$\phi(1680) \Gamma(i)\Gamma(e^+e^-)/\Gamma(\text{total})$** 

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  $\Gamma(I)/\text{total}$ .

NODE=M067220

 **$\Gamma(K_L^0 K_S^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_4\Gamma_5/\Gamma$** 

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

NODE=M067A00  
 NODE=M067A00

• • • 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;LINKAGE=A

 **$\Gamma(\phi\pi\pi) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_7\Gamma_5/\Gamma$** 

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

NODE=M067G02  
 NODE=M067G02

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

|             |      |          |                                                |
|-------------|------|----------|------------------------------------------------|
| 4.2±0.2±0.3 | LEES | 12F BABR | $10.6 e^+e^- \rightarrow \phi\pi^+\pi^-\gamma$ |
|-------------|------|----------|------------------------------------------------|

 **$\phi(1680) \Gamma(i)\Gamma(e^+e^-)/\Gamma^2(\text{total})$** 

NODE=M067223

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

 **$\Gamma(K_L^0 K_S^0)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_4/\Gamma \times \Gamma_5/\Gamma$** 

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

NODE=M067G5  
 NODE=M067G5

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

|             |     |                            |      |                                                    |
|-------------|-----|----------------------------|------|----------------------------------------------------|
| 0.131±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=M067G;LINKAGE=GK

 **$\Gamma(K\bar{K}^*(892) + \text{c.c.})/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_1/\Gamma \times \Gamma_5/\Gamma$** 

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

NODE=M067G6  
 NODE=M067G6

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

|                |                     |                      |         |                                                               |
|----------------|---------------------|----------------------|---------|---------------------------------------------------------------|
| 1.15±0.16±0.01 | <sup>1</sup> AUBERT | 08S                  | BABR    | $10.6 e^+e^- \rightarrow K\bar{K}^*(892)\gamma + \text{c.c.}$ |
| 3.29±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;LINKAGE=AU

NODE=M067G;LINKAGE=GL

 **$\Gamma(\phi\pi\pi)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_7/\Gamma \times \Gamma_5/\Gamma$** 

| VALUE (units $10^{-7}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

NODE=M067G01  
 NODE=M067G01

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

|                |      |                   |         |                                                  |
|----------------|------|-------------------|---------|--------------------------------------------------|
| 1.86±0.14±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;LINKAGE=SH

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

$$\Gamma_9/\Gamma \times \Gamma_5/\Gamma$$

VALUE (units  $10^{-6}$ )

DOCUMENT ID

TECN

COMMENT

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

$0.43 \pm 0.10 \pm 0.09$  <sup>1</sup> AUBERT 08S BABR  $10.6 e^+ e^- \rightarrow \phi \eta \gamma$

<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.

NODE=M067G7  
NODE=M067G7

NODE=M067G7;LINKAGE=AU

### $\phi(1680)$ BRANCHING RATIOS

NODE=M067225

$$\Gamma(K \bar{K}^*(892) + \text{c.c.})/\Gamma(K_S^0 K \pi)$$

$$\Gamma_1/\Gamma_2$$

VALUE

DOCUMENT ID

TECN

COMMENT

dominant

MANE

82

DM1

 $e^+ e^- \rightarrow K_S^0 K^\pm \pi^\mp$ 

NODE=M067R3  
NODE=M067R3

$$\Gamma(K \bar{K})/\Gamma(K \bar{K}^*(892) + \text{c.c.})$$

$$\Gamma_3/\Gamma_1$$

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

$$\Gamma(\omega \pi \pi)/\Gamma(K \bar{K}^*(892) + \text{c.c.})$$

$$\Gamma_6/\Gamma_1$$

VALUE

DOCUMENT ID

TECN

COMMENT

&lt;0.10

BUON

82

DM1

 $e^+ e^-$ 

NODE=M067R1  
NODE=M067R1

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

$$\Gamma_9/\Gamma$$

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

$$\Gamma(\eta\phi)/\Gamma(K \bar{K}^*(892) + \text{c.c.})$$

$$\Gamma_9/\Gamma_1$$

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

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

$$\Gamma_{10}/\Gamma$$

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

|            |      |               |                                                |                                 |
|------------|------|---------------|------------------------------------------------|---------------------------------|
| 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>                        | (CBAR 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=58883  
REFID=55912  
REFID=55940  
REFID=54298  
REFID=54066  
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REFID=52242  
REFID=51908  
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REFID=49172  
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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 $\pm$ 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 $\pm$  4 OUR AVERAGE**

|                                                                               |     |                           |     |      |   |                                        |
|-------------------------------------------------------------------------------|-----|---------------------------|-----|------|---|----------------------------------------|
| 1677 $\pm$ 14                                                                 |     | EVANGELIS...              | 81  | OMEG | — | 12 $\pi^- p \rightarrow 2\pi p$        |
| 1679 $\pm$ 11                                                                 | 476 | BALTAY                    | 78B | HBC  | 0 | 15 $\pi^+ p \rightarrow \pi^+ \pi^- n$ |
| 1678 $\pm$ 12                                                                 | 175 | <sup>1</sup> ANTIPOV      | 77  | CIBS | 0 | 25 $\pi^- p \rightarrow p 3\pi$        |
| 1690 $\pm$ 7                                                                  | 600 | <sup>1</sup> ENGLER       | 74  | DBC  | 0 | 6 $\pi^+ n \rightarrow \pi^+ \pi^- p$  |
| 1693 $\pm$ 8                                                                  |     | <sup>2</sup> GRAYER       | 74  | ASPK | 0 | 17 $\pi^- p \rightarrow \pi^+ \pi^- n$ |
| 1678 $\pm$ 12                                                                 |     | MATTHEWS                  | 71C | DBC  | 0 | 7 $\pi^+ N$                            |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                           |     |      |   |                                        |
| 1734 $\pm$ 10                                                                 |     | <sup>3</sup> CORDEN       | 79  | OMEG |   | 12–15 $\pi^- p \rightarrow n 2\pi$     |
| 1692 $\pm$ 12                                                                 |     | <sup>2,4</sup> ESTABROOKS | 75  | RVUE |   | 17 $\pi^- p \rightarrow \pi^+ \pi^- n$ |
| 1737 $\pm$ 23                                                                 |     | ARMENISE                  | 70  | DBC  | 0 | 9 $\pi^+ N$                            |
| 1650 $\pm$ 35                                                                 | 122 | BARTSCH                   | 70B | HBC  | + | 8 $\pi^+ p \rightarrow N 2\pi$         |
| 1687 $\pm$ 21                                                                 |     | STUNTEBECK                | 70  | HDBC | 0 | 8 $\pi^- p, 5.4 \pi^+ d$               |
| 1683 $\pm$ 13                                                                 |     | ARMENISE                  | 68  | DBC  | 0 | 5.1 $\pi^+ d$                          |
| 1670 $\pm$ 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 $\pm$  4 OUR AVERAGE**

|               |    |                       |     |      |   |                                      |
|---------------|----|-----------------------|-----|------|---|--------------------------------------|
| 1699 $\pm$ 5  |    | ALPER                 | 80  | CNTR | 0 | 62 $\pi^- p \rightarrow K^+ K^- n$   |
| 1698 $\pm$ 12 | 6k | <sup>5,6</sup> MARTIN | 78D | SPEC |   | 10 $\pi p \rightarrow K_S^0 K^- p$   |
| 1692 $\pm$ 6  |    | BLUM                  | 75  | ASPK | 0 | 18.4 $\pi^- p \rightarrow n K^+ K^-$ |
| 1690 $\pm$ 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 $\pm$ 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 $\pm$  5 OUR AVERAGE** Error includes scale factor of 1.1.

|               |     |                           |     |      |   |                                        |
|---------------|-----|---------------------------|-----|------|---|----------------------------------------|
| 1694 $\pm$ 6  |     | <sup>8</sup> EVANGELIS... | 81  | OMEG | — | 12 $\pi^- p \rightarrow p 4\pi$        |
| 1665 $\pm$ 15 | 177 | BALTAY                    | 78B | HBC  | + | 15 $\pi^+ p \rightarrow p 4\pi$        |
| 1670 $\pm$ 10 |     | THOMPSON                  | 74  | HBC  | + | 13 $\pi^+ p$                           |
| 1687 $\pm$ 20 |     | CASON                     | 73  | HBC  | — | 8,18.5 $\pi^- p$                       |
| 1685 $\pm$ 14 |     | <sup>9</sup> CASON        | 73  | HBC  | — | 8,18.5 $\pi^- p$                       |
| 1680 $\pm$ 40 | 144 | BARTSCH                   | 70B | HBC  | + | 8 $\pi^+ p \rightarrow N 4\pi$         |
| 1689 $\pm$ 20 | 102 | <sup>9</sup> BARTSCH      | 70B | HBC  | + | 8 $\pi^+ p \rightarrow N 2p$           |
| 1705 $\pm$ 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 $\pm$ 10 |    | <sup>10</sup> EVANGELIS... | 81 | OMEG | — | 12 $\pi^- p \rightarrow p 4\pi$  |
| 1673 $\pm$ 9  |    | <sup>11</sup> EVANGELIS... | 81 | OMEG | — | 12 $\pi^- p \rightarrow p 4\pi$  |
| 1733 $\pm$ 9  | 66 | <sup>9</sup> KLIGER        | 74 | HBC  | — | 4.5 $\pi^- p \rightarrow p 4\pi$ |
| 1630 $\pm$ 15 |    | HOLMES                     | 72 | HBC  | + | 10–12 $K^+ p$                    |
| 1720 $\pm$ 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.

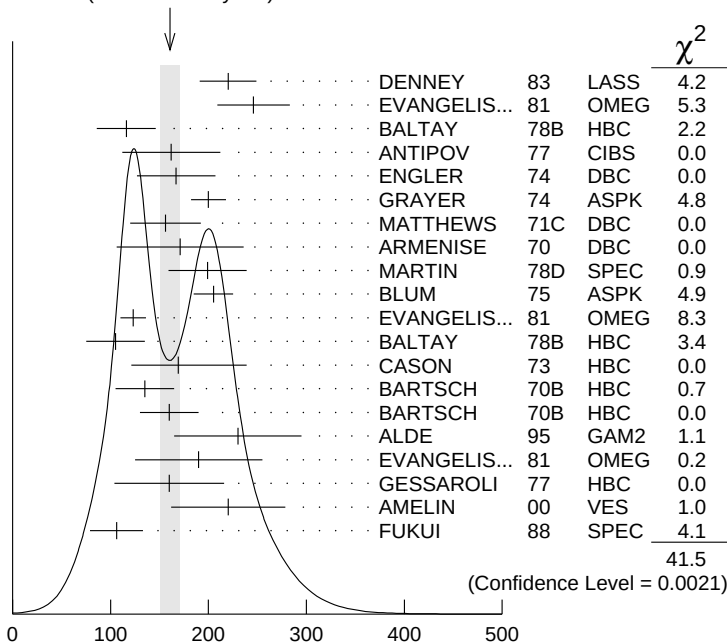
### $\rho_3(1690)$ WIDTH

### $2\pi, K\bar{K},$ 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.

WEIGHTED AVERAGE  
161 ± 10 (Error scaled by 1.5)



$\rho_3(1690)$  width,  $2\pi, K\bar{K},$  and  $K\bar{K}\pi$  modes (MeV)

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.

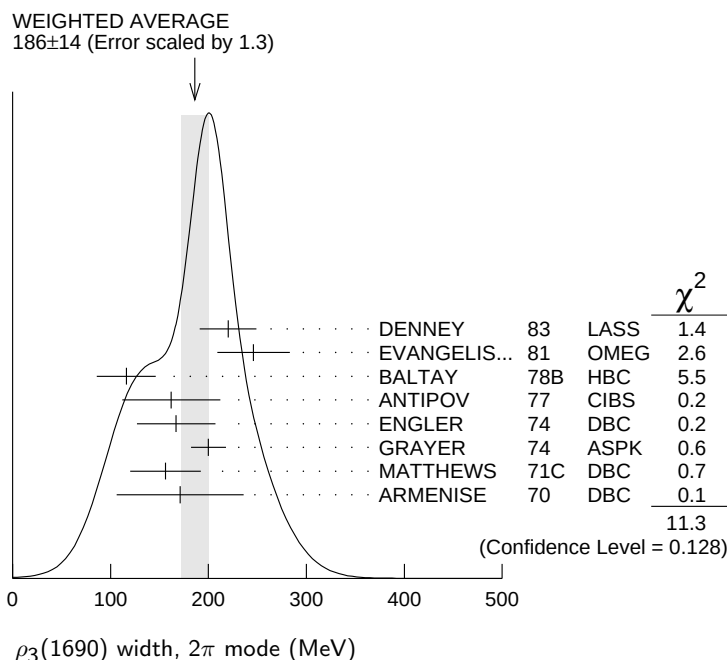
|              |     |              |     |      |                                          |
|--------------|-----|--------------|-----|------|------------------------------------------|
| 220 $\pm$ 29 |     | DENNEY       | 83  | LASS | 10 $\pi^+ N$                             |
| 246 $\pm$ 37 |     | 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 $\pi^- p \rightarrow p 3\pi$        |
| 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 $\pi^- p \rightarrow n 2\pi$     |
| 240 $\pm$ 30        |     | 16,18 ESTABROOKS | 75  | RVUE | 17 $\pi^- p \rightarrow \pi^+ \pi^- n$ |
| 180 $\pm$ 30        | 122 | BARTSCH          | 70B | HBC  | 8 $\pi^+ p \rightarrow N 2\pi$         |
| 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 $\pi^- p \rightarrow n K^+ K^-$ |
| 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                           |              |
|               | Excluding $2\rho$ and $a_2(1320)\pi$ . |                                |              |
| $\Gamma_{10}$ | $a_2(1320)\pi$                         | 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  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \delta x_j)$ , 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

**0.236 $\pm$ 0.013 OUR FIT****0.243 $\pm$ 0.013 OUR AVERAGE**

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

**0.35 $\pm$ 0.11** 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

**0.332 $\pm$ 0.026 OUR FIT** Error includes scale factor of 1.1.

**0.30  $\pm$  0.10** 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 |
|-------|-------------|------|-----|---------|
|-------|-------------|------|-----|---------|

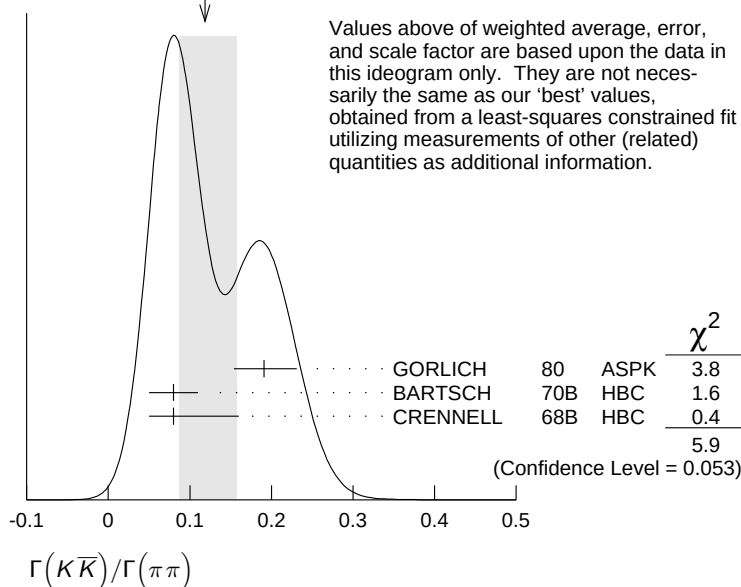
**0.067±0.011 OUR FIT** Error includes scale factor of 1.2.

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;LINKAGE=T

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

| VALUE                                                                         | CL% | DOCUMENT ID | TECN | CHG | COMMENT |                                  |
|-------------------------------------------------------------------------------|-----|-------------|------|-----|---------|----------------------------------|
| <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 $\pi^+ p \rightarrow p 4\pi$  |
| <0.09                                                                         |     | KLIGER      | 74   | HBC | −       | 4.5 $\pi^- p \rightarrow p 4\pi$ |

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 $\Gamma(\eta\pi)/\Gamma(\pi^\pm\pi^+\pi^-\pi^0)$  $\Gamma_{13}/\Gamma_2$ 

| VALUE                                                                         | DOCUMENT ID | TECN | CHG | COMMENT      |
|-------------------------------------------------------------------------------|-------------|------|-----|--------------|
| • • • 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>0.0158 ± 0.0026 OUR FIT</b> Error includes scale factor of 1.2. |             |      |     |         |
| <b>0.0130 ± 0.0024 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

 $\Gamma(\omega\pi)/[\Gamma(\omega\pi) + \Gamma(\rho\rho)]$  $\Gamma_3/(\Gamma_3 + \Gamma_{11})$ 

| VALUE                                                                         | DOCUMENT ID | TECN | CHG | COMMENT                   |
|-------------------------------------------------------------------------------|-------------|------|-----|---------------------------|
| ● ● ● 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 $\Gamma(\eta\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ 

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |                                               |
|--------------|--------------------|-------------|----------------|-----------------------------------------------|
| 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.)              |
| ALDE                        | 95  | ZPHY C66 379 | D.M. Alde <i>et al.</i>       | (GAMS Collab.) JP          |
| ALDE                        | 92C | ZPHY C54 553 | D.M. Alde <i>et al.</i>       | (BELG, SERP, KEK, LANL+)   |
| FUKUI                       | 88  | PL B202 441  | S. Fukui <i>et al.</i>        | (SUGI, NAGO, KEK, KYOT+)   |
| DENNEY                      | 83  | PR D28 2726  | D.L. Denney <i>et al.</i>     | (IOWA, MICH)               |
| EVANGELIS...                | 81  | NP B178 197  | C. Evangelista <i>et al.</i>  | (BARI, BONN, CERN+)        |
| ALPER                       | 80  | PL 94B 422   | B. Alper <i>et al.</i>        | (AMST, CERN, CRAC, MPIM+)  |
| COSTA                       | 80  | NP B175 402  | G. Costa <i>et al.</i>        | (BARI, BONN, CERN, GLAS+)  |
| GORLICH                     | 80  | NP B174 16   | L. Gorlich <i>et al.</i>      | (CRAC, MPIM, CERN+)        |
| BECKER                      | 79  | NP B151 46   | H. Becker <i>et al.</i>       | (MPIM, CERN, ZEEM, CRAC)   |
| CORDEN                      | 79  | NP B157 250  | M.J. Corden <i>et al.</i>     | (BIRM, RHEL, TELA+) JP     |
| BALTAY                      | 78B | PR D17 62    | C. Baltay <i>et al.</i>       | (COLU, BING)               |
| MARTIN                      | 78B | NP B140 158  | A.D. Martin <i>et al.</i>     | (DURH, GEVA)               |
| MARTIN                      | 78D | PL 74B 417   | A.D. Martin <i>et al.</i>     | (DURH, GEVA)               |
| ANTIPOV                     | 77  | NP B119 45   | Y.M. Antipov <i>et al.</i>    | (SERP, GEVA)               |
| GESSAROLI                   | 77  | NP B126 382  | R. Gessaroli <i>et al.</i>    | (BGNA, FIRZ, GENO+)        |
| BLUM                        | 75  | PL 57B 403   | W. Blum <i>et al.</i>         | (CERN, MPIM) JP            |
| ESTABROOKS                  | 75  | NP B95 322   | P.G. Estabrooks, A.D. Martin  | (DURH)                     |
| HYAMS                       | 75  | NP B100 205  | B.D. Hyams <i>et al.</i>      | (CERN, MPIM)               |
| ENGLER                      | 74  | PR D10 2070  | A. Engler <i>et al.</i>       | (CMU, CASE)                |
| GRAYER                      | 74  | NP B75 189   | G. Grayer <i>et al.</i>       | (CERN, MPIM)               |
| KLIGER                      | 74  | SJNP 19 428  | G.K. Kliger <i>et al.</i>     | (ITEP)                     |
| Translated from YAF 19 839. |     |              |                               |                            |
| OREN                        | 74  | NP B71 189   | Y. Oren <i>et al.</i>         | (ANL, OXF)                 |
| THOMPSON                    | 74  | NP B69 220   | G. Thompson <i>et al.</i>     | (PURD)                     |
| CASON                       | 73  | PR D7 1971   | N.M. Cason <i>et al.</i>      | (NDAM)                     |
| BOWEN                       | 72  | PRL 29 890   | D.R. Bowen <i>et al.</i>      | (NEAS, STON)               |
| HOLMES                      | 72  | PR D6 3336   | R. Holmes <i>et al.</i>       | (ROCH)                     |
| BALLAM                      | 71B | PR D3 2606   | J. Ballam <i>et al.</i>       | (SLAC)                     |
| MATTHEWS                    | 71C | NP B33 1     | J.A.J. Matthews <i>et al.</i> | (TNT0, WISC) JP            |
| ARMENISE                    | 70  | LNC 4 199    | N. Armenise <i>et al.</i>     | (BARI, BGNA, FIRZ)         |
| BARNHAM                     | 70  | PRL 24 1083  | K.W.J. Barnham <i>et al.</i>  | (BIRM)                     |
| BARTSCH                     | 70B | NP B22 109   | J. Bartsch <i>et al.</i>      | (AACH, BERL, CERN)         |
| CASO                        | 70  | LNC 3 707    | C. Caso <i>et al.</i>         | (GENO, HAMB, MILA, SACL)   |
| 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+)       |
| ANDERSON                    | 69  | PRL 22 1390  | E.W. Anderson <i>et al.</i>   | (BNL, CMU)                 |
| ARMENISE                    | 68  | NC 54A 999   | N. Armenise <i>et al.</i>     | (BARI, BGNA, FIRZ+) I      |
| BALTAY                      | 68  | PRL 20 887   | C. Baltay <i>et al.</i>       | (COLU, ROCH, RUTG, YALE) I |
| CASO                        | 68  | NC 54A 983   | C. Caso <i>et al.</i>         | (GENO, HAMB, MILA, SACL)   |
| CRENNELL                    | 68B | PL 28B 136   | D.J. Crennell <i>et al.</i>   | (BNL)                      |
| JOHNSTON                    | 68  | PRL 20 1414  | T.F. Johnston <i>et al.</i>   | (TNT0, WISC) IJP           |
| FOCACCI                     | 66  | PRL 17 890   | M.N. Focacci <i>et al.</i>    | (CERN)                     |
| GOLDBERG                    | 65  | PL 17 354    | M. Goldberg <i>et al.</i>     | (CERN, EPOL, ORSAY+)       |

NODE=M015

REFID=47432  
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REFID=41859  
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REFID=20402  
REFID=21601

NODE=M065

 $\rho(1700)$ 

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

See the related review(s):

 $\rho(1450)$  and  $\rho(1700)$  $\rho(1700)$  MASS

NODE=M065205

 $\eta\rho^0$  AND  $\pi^+\pi^-$  MODES

VALUE (MeV)

DOCUMENT ID

1720±20 OUR ESTIMATE

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. • • •

|         |      |                      |    |      |                                               |
|---------|------|----------------------|----|------|-----------------------------------------------|
| 1840±10 | 7.4k | <sup>1</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>2</sup> FUKUI   | 88 | SPEC | 8.95 $\pi^-p \rightarrow \eta\pi^+\pi^-n$     |

<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.

<sup>2</sup> Assuming  $\rho^+ f_0(1370)$  decay mode interferes with  $a_1(1260)^+\pi$  background. From a two Breit-Wigner fit.

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.

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

|                     |                |                |      |      |                                            |
|---------------------|----------------|----------------|------|------|--------------------------------------------|
| 1770.54 ± 5.49      |                | 1 BARTOS       | 17   | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$            |
| 1718.50 ± 65.44     |                | 2 BARTOS       | 17A  | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$            |
| 1766.80 ± 52.36     |                | 3 BARTOS       | 17A  | RVUE | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$  |
| 1644 ± 36           | 20K            | 4 LEES         | 17C  | BABR | $J/\psi \rightarrow \pi^+\pi^-\pi^0$       |
| 1780 ± 20           | $+^{15}_{-20}$ | 5 ABRAMOWICZ12 | ZEUS |      | $ep \rightarrow e\pi^+\pi^-p$              |
| 1861 ± 17           |                | 6 LEES         | 12G  | BABR | $e^+e^- \rightarrow \pi^+\pi^-\gamma$      |
| 1728 ± 17           | ± 89           | 7,8 FUJIKAWA   | 08   | BELL | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$  |
| 1780 $+^{37}_{-29}$ |                | 9 ABELE        | 97   | CBAR | $\bar{p}n \rightarrow \pi^- \pi^0 \pi^0$   |
| 1719 ± 15           |                | 9 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                |                | 10 ERKAL       | 85   | RVUE | $20-70 \gamma p \rightarrow \gamma\pi$     |
| 1550 ± 70           |                | ABE            | 84B  | HYBR | $20 \gamma p \rightarrow \pi^+\pi^-p$      |
| 1590 ± 20           |                | 11 ASTON       | 80   | OMEG | $20-70 \gamma p \rightarrow p2\pi$         |
| 1600 ± 10           |                | 12 ATIYA       | 79B  | SPEC | $50 \gamma C \rightarrow C2\pi$            |
| 1598 $+^{24}_{-22}$ |                | BECKER         | 79   | ASPK | $17 \pi^- p$ polarized                     |
| 1659 ± 25           |                | 10 LANG        | 79   | RVUE |                                            |
| 1575                |                | 10 MARTIN      | 78C  | RVUE | $17 \pi^- p \rightarrow \pi^+\pi^-n$       |
| 1610 ± 30           |                | 10 FROGGATT    | 77   | RVUE | $17 \pi^- p \rightarrow \pi^+\pi^-n$       |
| 1590 ± 20           |                | 13 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 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>  $|F_\pi(0)|^2$  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.

NODE=M065M1;LINKAGE=C

NODE=M065M1;LINKAGE=D

NODE=M065M1;LINKAGE=E

NODE=M065M1;LINKAGE=A

NODE=M065M1;LINKAGE=AB

NODE=M065M1;LINKAGE=LE

NODE=M065M1;LINKAGE=FU

NODE=M065M1;LINKAGE=GO

NODE=M065M;LINKAGE=QQ

NODE=M065M;LINKAGE=P

NODE=M065M;LINKAGE=M

NODE=M065M;LINKAGE=R

NODE=M065M;LINKAGE=H

NODE=M065M8

NODE=M065M8

 **$\pi\omega$  MODE**

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

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

|              |      |           |     |      |                                                 |
|--------------|------|-----------|-----|------|-------------------------------------------------|
| 1708 ± 41    | 7815 | 1 ACHASOV | 13  | SND  | $1.05-2.00 e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 1550 to 1620 |      | 2 ACHASOV | 00i | SND  | $e^+e^- \rightarrow \pi^0\pi^0\gamma$           |
| 1580 to 1710 |      | 3 ACHASOV | 00i | SND  | $e^+e^- \rightarrow \pi^0\pi^0\gamma$           |
| 1710 ± 90    |      | ACHASOV   | 97  | RVUE | $e^+e^- \rightarrow \omega\pi^0$                |

OCCUR=2

<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  $\tau^- \rightarrow \omega\pi^-\nu_\tau$ .

NODE=M065M8;LINKAGE=AC

NODE=M065M;LINKAGE=I1

NODE=M065M;LINKAGE=I2

**$K\bar{K}$  MODE**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN | CHG   | COMMENT                                   |
|-------------------------------------------------------------------------------|------|------------------------|------|-------|-------------------------------------------|
| 1541 $\pm 12$ $\pm 33$ 190k                                                   |      | <sup>1</sup> AAIJ 16N  | LHCB |       | $D^0 \rightarrow K_S^0 K^\pm \pi^\mp$     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                        |      |       |                                           |
| 1740.8 $\pm 22.2$                                                             | 27k  | <sup>2</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> Using the GOUNARIS 68 parameterization with a fixed width. Value is average using different  $K\pi$  S-wave parametrizations in fit.

<sup>2</sup> K-matrix pole. Isospin not determined, could be  $\omega(1650)$  or  $\phi(1680)$ .

NODE=M065M2  
NODE=M065M2

NODE=M065M2;LINKAGE=A

NODE=M065M2;LINKAGE=AN

 **$2(\pi^+\pi^-)$  MODE**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID               | TECN | COMMENT                                  |
|-------------------------------------------------------------------------------|------|---------------------------|------|------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                           |      |                                          |
| 1851 $\pm 27$<br>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 | $20-70 \gamma p \rightarrow p 4\pi$      |
| 1654 $\pm 25$                                                                 |      | <sup>3</sup> DIBIANCA 81  | DBC  | $\pi^+ d \rightarrow p p 2(\pi^+ \pi^-)$ |
| 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 | $50 \gamma C \rightarrow C 4\pi^\pm$     |
| 1570 $\pm 60$                                                                 | 65   | <sup>5</sup> ALEXANDER 75 | HBC  | $7.5 \gamma p \rightarrow p 4\pi$        |
| 1550 $\pm 60$                                                                 |      | <sup>2</sup> CONVERSI 74  | OSPK | $e^+ e^- \rightarrow 2(\pi^+ \pi^-)$     |
| 1550 $\pm 50$                                                                 | 160  | SCHACHT 74                | STRC | $5.5-9 \gamma p \rightarrow p 4\pi$      |
| 1450 $\pm 100$                                                                | 340  | SCHACHT 74                | STRC | $9-18 \gamma p \rightarrow p 4\pi$       |
| 1430 $\pm 50$                                                                 | 400  | BINGHAM 72B               | HBC  | $9.3 \gamma p \rightarrow p 4\pi$        |

<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.

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

 **$\pi^+\pi^-\pi^0\pi^0$  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 | $20-70 \gamma p$ |

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

$$m_{\rho(1700)^0} = m_{\rho(1700)^\pm}$$

NODE=M065DM

NODE=M065DM

| 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;LINKAGE=A

 **$\rho(1700)$  WIDTH**

NODE=M065210

 **$\eta\rho^0$  AND  $\pi^+\pi^-$  MODES**

| VALUE (MeV)                | DOCUMENT ID |
|----------------------------|-------------|
| 250 $\pm 100$ OUR ESTIMATE |             |

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.

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

|        |      |                      |    |      |                                                        |
|--------|------|----------------------|----|------|--------------------------------------------------------|
| 132±40 | 7.4k | <sup>1</sup> ACHASOV | 18 | SND  | $1.22\text{--}2.00\ e^+e^- \rightarrow \eta\pi^+\pi^-$ |
| 150±30 |      | ANTONELLI            | 88 | DM2  | $e^+e^- \rightarrow \eta\pi^+\pi^-$                    |
| 282±44 |      | <sup>2</sup> FUKUI   | 88 | SPEC | $8.95\ \pi^-p \rightarrow \eta\pi^+\pi^-n$             |

<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.

<sup>2</sup> Assuming  $\rho^+ f_0(1370)$  decay mode interferes with  $a_1(1260)^+\pi$  background. From a two Breit-Wigner fit.

NODE=M065W6  
NODE=M065W6

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.

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

|                  |                                                    |       |                           |      |                               |                                                 |
|------------------|----------------------------------------------------|-------|---------------------------|------|-------------------------------|-------------------------------------------------|
| 268.98± 11.40    |                                                    |       | <sup>1</sup> BARTOS       | 17   | RVUE                          | $e^+e^- \rightarrow \pi^+\pi^-$                 |
| 489.58± 16.95    |                                                    |       | <sup>2</sup> BARTOS       | 17A  | RVUE                          | $e^+e^- \rightarrow \pi^+\pi^-$                 |
| 414.71±119.48    |                                                    |       | <sup>3</sup> BARTOS       | 17A  | RVUE                          | $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$         |
| 109 ± 19         | 20K                                                |       | <sup>4</sup> LEES         | 17C  | BABR                          | $J/\psi \rightarrow \pi^+\pi^-\pi^0$            |
| 310 ± 30         | $\begin{smallmatrix} +25 \\ -35 \end{smallmatrix}$ | 63.5k | <sup>5</sup> ABRAMOWICZ12 | ZEUS | $ep \rightarrow e\pi^+\pi^-p$ |                                                 |
| 316 ± 26         |                                                    |       | <sup>6</sup> LEES         | 12G  | BABR                          | $e^+e^- \rightarrow \pi^+\pi^-\gamma$           |
| 164 ± 21         | $\begin{smallmatrix} +89 \\ -26 \end{smallmatrix}$ | 5.4M  | <sup>7,8</sup> FUJIKAWA   | 08   | BELL                          | $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$         |
| 275 ± 45         |                                                    |       | <sup>9</sup> ABELE        | 97   | CBAR                          | $\bar{p}n \rightarrow \pi^-\pi^0\pi^0$          |
| 310 ± 40         |                                                    |       | <sup>9</sup> BERTIN       | 97C  | OBLX                          | $0.0\ \bar{p}p \rightarrow \pi^+\pi^-\pi^0$     |
| 400 ±100         |                                                    |       | CLEGG                     | 94   | RVUE                          | $e^+e^- \rightarrow \pi^+\pi^-$                 |
| 224 ± 22         |                                                    |       | BISELLO                   | 89   | DM2                           | $e^+e^- \rightarrow \pi^+\pi^-$                 |
| 242.5 ±163.0     |                                                    |       | DUBNICKA                  | 89   | RVUE                          | $e^+e^- \rightarrow \pi^+\pi^-$                 |
| 620 ± 60         |                                                    |       | GESHKEN...                | 89   | RVUE                          |                                                 |
| <315             |                                                    |       | <sup>10</sup> ERKAL       | 85   | RVUE                          | $20\text{--}70\ \gamma p \rightarrow \gamma\pi$ |
| 280 + 30<br>- 80 |                                                    |       | ABE                       | 84B  | HYBR                          | $20\ \gamma p \rightarrow \pi^+\pi^-p$          |
| 230 ± 80         |                                                    |       | <sup>11</sup> ASTON       | 80   | OMEG                          | $20\text{--}70\ \gamma p \rightarrow p2\pi$     |
| 283 ± 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 ± 34         |                                                    |       | <sup>10</sup> LANG        | 79   | RVUE                          |                                                 |
| 340              |                                                    |       | <sup>10</sup> MARTIN      | 78C  | RVUE                          | $17\ \pi^-p \rightarrow \pi^+\pi^-n$            |
| 300 ±100         |                                                    |       | <sup>10</sup> FROGGATT    | 77   | RVUE                          | $17\ \pi^-p \rightarrow \pi^+\pi^-n$            |
| 180 ± 50         |                                                    |       | <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.

<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  $\rho\text{--}\omega$  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.

NODE=M065W1  
NODE=M065W1

OCCUR=2

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

**$K\bar{K}$  MODE**

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

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

|              |      |                    |     |        |                                          |
|--------------|------|--------------------|-----|--------|------------------------------------------|
| 187.2 ± 26.7 | 27k  | <sup>1</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> K-matrix pole. Isospin not determined, could be  $\omega(1650)$  or  $\phi(1680)$ .

NODE=M065W2  
NODE=M065W2

NODE=M065W2;LINKAGE=AN

**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 $\gamma p \rightarrow p 4\pi$      |
| 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 $\gamma C \rightarrow C 4\pi^\pm$     |
| 340 ± 160 | 65  | <sup>5</sup> ALEXANDER | 75  | HBC  | 7.5 $\gamma p \rightarrow p 4\pi$        |
| 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 $\gamma p \rightarrow p 4\pi$      |
| 850 ± 200 | 340 | <sup>6</sup> SCHACHT   | 74  | STRC | 9–18 $\gamma p \rightarrow p 4\pi$       |
| 650 ± 100 | 400 | BINGHAM                | 72B | HBC  | 9.3 $\gamma p \rightarrow p 4\pi$        |

<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.

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

 **$\pi^+ \pi^- \pi^0 \pi^0$  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 $\gamma p$ |
|----------|----------|-----|-----------------------|

NODE=M065W5  
NODE=M065W5

 **$\omega \pi^0$  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=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                           |
| $\Gamma_{13}$ $K\bar{K}^*(892)+c.c.$ | 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

| $\Gamma(2(\pi^+\pi^-)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$           | $\Gamma_2\Gamma_{17}/\Gamma$                        |
|-------------------------------------------------------------------------------|-----------------------------------------------------|
| VALUE (keV)                                                                   | DOCUMENT ID TECN COMMENT                            |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                                     |
| $2.6 \pm 0.2$                                                                 | DELCOURT 81B DM1 $e^+e^- \rightarrow 2(\pi^+\pi^-)$ |
| $2.83 \pm 0.42$                                                               | BACCI 80 FRAG $e^+e^- \rightarrow 2(\pi^+\pi^-)$    |

NODE=M065G2

NODE=M065G2

| $\Gamma(\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$              | $\Gamma_{11}\Gamma_{17}/\Gamma$                                   |
|-------------------------------------------------------------------------------|-------------------------------------------------------------------|
| 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 $e^+e^- \rightarrow \pi^+\pi^-$      |
| $0.029^{+0.016}_{-0.012}$                                                     | KURDADZE 83 OLYA $0.64\text{--}1.4 e^+e^- \rightarrow \pi^+\pi^-$ |

NODE=M065G4

NODE=M065G4

<sup>1</sup> Using total width = 220 MeV.

NODE=M065G4;LINKAGE=B

| $\Gamma(K\bar{K}^*(892)+c.c.) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$    | $\Gamma_{13}\Gamma_{17}/\Gamma$    |
|-------------------------------------------------------------------------------|------------------------------------|
| VALUE (keV)                                                                   | DOCUMENT ID TECN COMMENT           |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                    |
| $0.305 \pm 0.071$                                                             | <sup>1</sup> BIZOT 80 DM1 $e^+e^-$ |

NODE=M065G10

NODE=M065G10

<sup>1</sup> Model dependent.

NODE=M065G;LINKAGE=M

| $\Gamma(\eta\rho) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$                | $\Gamma_{14}\Gamma_{17}/\Gamma$                               |
|-------------------------------------------------------------------------------|---------------------------------------------------------------|
| VALUE (eV)                                                                    | DOCUMENT ID TECN COMMENT                                      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                                               |
| $84 \pm 26 \pm 4$                                                             | <sup>1</sup> LEES 18 BABR $e^+e^- \rightarrow \eta\pi^+\pi^-$ |
| $7 \pm 3$                                                                     | ANTONELLI 88 DM2 $e^+e^- \rightarrow \eta\pi^+\pi^-$          |

NODE=M065G11

NODE=M065G11

<sup>1</sup> Includes non-resonant contribution. The selected fit model includes three  $\rho$  excited states. Model uncertainty is 80%.

NODE=M065G11;LINKAGE=A

| $\Gamma(K\bar{K}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$                | $\Gamma_{16}\Gamma_{17}/\Gamma$    |
|-------------------------------------------------------------------------------|------------------------------------|
| VALUE (keV)                                                                   | DOCUMENT ID TECN COMMENT           |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                    |
| $0.035 \pm 0.029$                                                             | <sup>1</sup> BIZOT 80 DM1 $e^+e^-$ |

NODE=M065G5

NODE=M065G5

<sup>1</sup> Model dependent.

NODE=M065G5;LINKAGE=M

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

$$\Gamma_3\Gamma_{17}/\Gamma$$

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

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

$$\Gamma_{18}/\Gamma \times \Gamma_{17}/\Gamma$$

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.

NODE=M065R01  
NODE=M065R01

OCCUR=4

NODE=M065R01;LINKAGE=B

NODE=M065R01;LINKAGE=AC

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

$$\Gamma_{14}/\Gamma \times \Gamma_{17}/\Gamma$$

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

$$\Gamma(\rho\pi\pi)/\Gamma(4\pi)$$

$$\Gamma_3/\Gamma_1$$

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. • • •

~ 1.0 DELCOURT 81B DM1 e<sup>+</sup>e<sup>-</sup> → 2(π<sup>+</sup>π<sup>-</sup>)

0.7 ±0.1 500 SCHACHT 74 STRC 5.5–18 γp → p4π

0.80 <sup>1</sup> BINGHAM 72B HBC 9.3 γp → p4π

<sup>1</sup> The ππ 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 γp

<0.15 ATKINSON 82 OMEG 0 20–70 γp → p4π

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±0.05 <sup>1</sup> ABELE 01B CBAR 0.0  $\bar{p}n \rightarrow 5\pi$

<sup>1</sup> ωπ 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±0.06 <sup>1</sup> ABELE 01B CBAR 0.0  $\bar{p}n \rightarrow 5\pi$

<sup>1</sup> ωπ 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. • • •

|                           |                        |     |                                              |
|---------------------------|------------------------|-----|----------------------------------------------|
| $0.287^{+0.043}_{-0.042}$ | BECKER                 | 79  | ASPK $17 \pi^- p$ polarized                  |
| 0.15 to 0.30              | <sup>1</sup> MARTIN    | 78C | RVUE $17 \pi^- p \rightarrow \pi^+\pi^- n$   |
| <0.20                     | <sup>2</sup> COSTA...  | 77B | RVUE $e^+e^- \rightarrow 2\pi, 4\pi$         |
| 0.30 $\pm 0.05$           | <sup>1</sup> FROGGATT  | 77  | RVUE $17 \pi^- p \rightarrow \pi^+\pi^- n$   |
| <0.15                     | <sup>3</sup> EISENBERG | 73  | HBC $5 \pi^+ p \rightarrow \Delta^{++} 2\pi$ |
| 0.25 $\pm 0.05$           | <sup>4</sup> HYAMS     | 73  | ASPK $17 \pi^- p \rightarrow \pi^+\pi^- n$   |

<sup>1</sup> From phase shift analysis of HYAMS 73 data.

<sup>2</sup> Estimate using unitarity, time reversal invariance, Breit-Wigner.

<sup>3</sup> Estimated using one-pion-exchange model.

<sup>4</sup> Included in BECKER 79 analysis.

NODE=M065R5  
NODE=M065R5

NODE=M065R5;LINKAGE=P  
NODE=M065R5;LINKAGE=C  
NODE=M065R5;LINKAGE=E  
NODE=M065R5;LINKAGE=H

 $\Gamma(\pi^+\pi^-)/\Gamma(2(\pi^+\pi^-))$  $\Gamma_{11}/\Gamma_2$ 

| 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

 $\Gamma(K\bar{K}^*(892)+\text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ 

| 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

 $\Gamma(K\bar{K}^*(892)+\text{c.c.})/\Gamma(2(\pi^+\pi^-))$  $\Gamma_{13}/\Gamma_2$ 

| 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

$$\Gamma(\pi^+\pi^- \text{ neutrals})/\Gamma(2(\pi^+\pi^-)) \quad (\Gamma_5+\Gamma_6+0.714\Gamma_{14})/\Gamma_2$$

| 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

$$\Gamma(a_2(1320)\pi)/\Gamma_{\text{total}} \quad \Gamma_{15}/\Gamma$$

| 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

$$\Gamma(K\bar{K})/\Gamma(2(\pi^+\pi^-)) \quad \Gamma_{16}/\Gamma_2$$

| 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   | $9.3 \gamma p$                |
| <sup>1</sup> Assuming $\rho(1700)$ and $\omega$ radial excitations to be degenerate in mass. |     |                           |      |     |                               |

NODE=M065R4  
NODE=M065R4

NODE=M065R4;LINKAGE=D

$$\Gamma(K\bar{K})/\Gamma(K\bar{K}^*(892)+\text{c.c.}) \quad \Gamma_{16}/\Gamma_{13}$$

| 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

$$\Gamma(\pi^0\omega)/\Gamma_{\text{total}} \quad \Gamma_{18}/\Gamma$$

| 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 | $e^+e^- \rightarrow \omega \pi^0$           |

NODE=M065R13  
NODE=M065R13

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

| VALUE    | DOCUMENT ID              | TECN | COMMENT                                     |
|----------|--------------------------|------|---------------------------------------------|
| not seen | <sup>1</sup> ACHASOV 10D | SND  | $1.075-2.0 e^+e^- \rightarrow \pi^0 \gamma$ |

NODE=M065R02  
NODE=M065R02

<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=M065R02;LINKAGE=A

## $\rho(1700)$ REFERENCES

|                               |                  |                               |                             |
|-------------------------------|------------------|-------------------------------|-----------------------------|
| 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>      | (BES III 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>    |                             |
| Translated from ZETFP 94 796. |                  |                               |                             |
| LEES 12G                      | PR D86 032013    | J.P. Lees <i>et al.</i>       | (BABAR Collab.)             |
| AMBROSINO 11A                 | PL B700 102      | F. Ambrosino <i>et al.</i>    | (KLOE Collab.)              |
| 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 072006    | 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.)   |
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| COAN 04                       | PRL 92 232001    | T.E. Coan <i>et al.</i>       | (CLEO Collab.)              |
| FRABETTI 04                   | PL B578 290      | P.L. Frabetti <i>et al.</i>   | (FNAL E687 Collab.)         |
| AKHMETSHIN 03B                | PL B562 173      | 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.)   |
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| 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.)               |

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|            |     |                   |                                              |                                 |
|------------|-----|-------------------|----------------------------------------------|---------------------------------|
| 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  | PL 108B 55        | 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)                         |
| Also       |     | PL 109B 129       | A. Cordier <i>et al.</i>                     | (LALO)                          |
| DIBIANCA   | 81  | PR D23 595        | F.A. di Bianca <i>et al.</i>                 | (CASE, CMU)                     |
| ASTON      | 80  | PL 92B 215        | D. Aston                                     | (BONN, CERN, EPOL, GLAS, LANC+) |
| BACCI      | 80  | PL 95B 139        | C. Bacci <i>et al.</i>                       | (ROMA, FRAS)                    |
| BIZOT      | 80  | Madison Conf. 546 | J.C. Bizot <i>et al.</i>                     | (LALO, MONP)                    |
| KILLIAN    | 80  | PR D21 3005       | T.J. Killian <i>et al.</i>                   | (CORN)                          |
| ATIYA      | 79B | PRL 43 1691       | M.S. Atiya <i>et al.</i>                     | (COLU, ILL, FNAL)               |
| BECKER     | 79  | NP B151 46        | H. Becker <i>et al.</i>                      | (MPIM, CERN, ZEEM, CRAC)        |
| LANG       | 79  | PR D19 956        | C.B. Lang, A. Mas-Parada                     | (GRAZ)                          |
| MARTIN     | 78C | ANP 114 1         | A.D. Martin, M.R. Pennington                 | (CERN)                          |
| COSTA...   | 77B | PL 71B 345        | B. Costa de Beauregard, B. Pire, T.N. Truong | (EPOL)                          |
| FROGGATT   | 77  | NP B129 89        | C.D. Froggatt, J.L. Petersen                 | (GLAS, NORD)                    |
| ALEXANDER  | 75  | PL 57B 487        | G. Alexander <i>et al.</i>                   | (TELA)                          |
| BALLAM     | 74  | NP B76 375        | J. Ballam <i>et al.</i>                      | (SLAC, LBL, MPIM)               |
| CONVERSI   | 74  | PL 52B 493        | M. Conversi <i>et al.</i>                    | (ROMA, FRAS)                    |
| SCHACHT    | 74  | NP B81 205        | P. Schacht <i>et al.</i>                     | (MPIM)                          |
| DAVIER     | 73  | NP B58 31         | M. Davier <i>et al.</i>                      | (SLAC)                          |
| EISENBERG  | 73  | PL 43B 149        | Y. Eisenberg <i>et al.</i>                   | (REHO)                          |
| HYAMS      | 73  | NP B64 134        | B.D. Hyams <i>et al.</i>                     | (CERN, MPIM)                    |
| BINGHAM    | 72B | PL 41B 635        | H.H. Bingham <i>et al.</i>                   | (LBL, UCB, SLAC) IGJP           |
| JACOB      | 72  | PR D5 1847        | M. Jacob, R. Slansky                         |                                 |
| GOUNARIS   | 68  | PRL 21 244        | G.J. Gounaris, J.J. Sakurai                  |                                 |

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$a_2(1700)$

$$I^G(J^{PC}) = 1^-(2^{++})$$

NODE=M162

### $a_2(1700)$ MASS

NODE=M162M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID             | TECN     | COMMENT                                                                   |
|-------------------------------------------------------------------------------|------|-------------------------|----------|---------------------------------------------------------------------------|
| <b>1705±40 OUR AVERAGE</b>                                                    |      |                         |          |                                                                           |
| [1732 ± 9 MeV OUR 2018 AVERAGE Scale factor = 1.2]                            |      |                         |          |                                                                           |
| 1722±15±67                                                                    |      | <sup>1</sup> RODAS      | 19 JPAC  | 191 $\pi^- p \rightarrow \eta^{(\prime)} \pi^- p$                         |
| 1698±44                                                                       |      | <sup>2</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. • • • |      |                         |          |                                                                           |
| 1681 <sup>+22</sup> <sub>-35</sub>                                            | 46M  | <sup>3,4</sup> AGHASYAN | 18B COMP | 190 $\pi^- p \rightarrow \pi^- \pi^- \pi^+ p$                             |
| 1720±10±60                                                                    |      | <sup>5</sup> JACKURA    | 18 JPAC  | $\pi^- p \rightarrow \eta \pi^- p$                                        |
| 1726±12±25                                                                    |      | <sup>4</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>6</sup> SCHEGELSKY | 06 RVUE  | $\gamma \gamma \rightarrow \pi^+ \pi^- \pi^0$                             |
| 1702± 7                                                                       | 80k  | <sup>7</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>8</sup> ACCIARRI   | 01H L3   | $\gamma \gamma \rightarrow K_S^0 K_S^0, E_{cm}^{ee} = 91,$<br>183–209 GeV |
| 1660±40                                                                       |      | <sup>4</sup> ABELE      | 99B CBAR | 1.94 $\bar{p} p \rightarrow \pi^0 \eta \eta$                              |
| ~ 1775                                                                        |      | <sup>9</sup> GRYGOREV   | 99 SPEC  | 40 $\pi^- p \rightarrow K_S^0 K_S^0 n$                                    |
| 1752±21± 4                                                                    |      | ACCIARRI                | 97T L3   | $\gamma \gamma \rightarrow \pi^+ \pi^- \pi^0$                             |

NODE=M162M  
 NEW

- <sup>1</sup> The coupled-channel analysis of both the  $\eta\pi$  and  $\eta'\pi$  systems using ADOLPH 15data.  
The mass is extracted from the T-matrix pole.  
<sup>2</sup> T-matrix pole.  
<sup>3</sup> Statistical error negligible.  
<sup>4</sup> Breit-Wigner mass.  
<sup>5</sup> Superseded by RODAS 19.  
<sup>6</sup> From analysis of L3 data at 183–209 GeV.  
<sup>7</sup> Statistical error only.  
<sup>8</sup> Spin 2 dominant, isospin not determined, could also be  $I=1$ .  
<sup>9</sup> Possibly two  $J^P = 2^+$  resonances with isospins 0 and 1.

NODE=M162M;LINKAGE=C

NODE=M162M;LINKAGE=TT  
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 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>258 ± 40 OUR AVERAGE</b>                                                   |      |                         |          |                                                                                         |
| [193 ± 27 MeV OUR 2018 AVERAGE Scale factor = 1.3]                            |      |                         |          |                                                                                         |
| 247 ± 17 ± 63                                                                 |      | <sup>1</sup> RODAS      | 19 JPAC  | 191 $\pi^- p \rightarrow \eta^{(\prime)} \pi^- p$                                       |
| 265 ± 55                                                                      |      | <sup>2</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. • • • |      |                         |          |                                                                                         |
| 436 <sup>+</sup> <sub>-16</sub>                                               | 46M  | <sup>3,4</sup> AGHASYAN | 18B COMP | 190 $\pi^- p \rightarrow \pi^- \pi^- \pi^+ p$                                           |
| 280 ± 10 ± 70                                                                 |      | <sup>5</sup> JACKURA    | 18 JPAC  | $\pi^- p \rightarrow \eta \pi^- p$                                                      |
| 190 ± 18 ± 30                                                                 |      | <sup>4</sup> ABLIKIM    | 17K BES3 | $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$                                          |
| 270 <sup>+</sup> <sub>-20</sub>                                               |      | ANISOVICH               | 09 RVUE  | 0.0 $\bar{p} p, \pi N$                                                                  |
| 336 ± 20 ± 20                                                                 | 18k  | <sup>6</sup> SCHEGELSKY | 06 RVUE  | $\gamma \gamma \rightarrow \pi^+ \pi^- \pi^0$                                           |
| 417 ± 19                                                                      | 80k  | <sup>7</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>8</sup> ACCIARRI   | 01H L3   | $\gamma \gamma \rightarrow K_S^0 K_S^0, E_{\text{cm}}^{\text{ee}} = 91,$<br>183–209 GeV |
| 280 ± 70                                                                      |      | <sup>4</sup> ABELE      | 99B CBAR | 1.94 $\bar{p} p \rightarrow \pi^0 \eta \eta$                                            |
| 150 ± 110 ± 34                                                                |      | ACCIARRI                | 97T L3   | $\gamma \gamma \rightarrow \pi^+ \pi^- \pi^0$                                           |

- <sup>1</sup> The coupled-channel analysis of both the  $\eta\pi$  and  $\eta'\pi$  systems using ADOLPH 15data.  
The width is extracted from the T-matrix pole.  
<sup>2</sup> T-matrix pole.  
<sup>3</sup> Statistical error negligible.  
<sup>4</sup> Breit-Wigner width.  
<sup>5</sup> Superseded by RODAS 19.  
<sup>6</sup> From analysis of L3 data at 183–209 GeV.  
<sup>7</sup> Statistical error only.  
<sup>8</sup> Spin 2 dominant, isospin not determined, could also be  $I=1$ .

NODE=M162W;LINKAGE=C

NODE=M162W;LINKAGE=TT  
 NODE=M162W;LINKAGE=B  
 NODE=M162W;LINKAGE=E  
 NODE=M162W;LINKAGE=D  
 NODE=M162W;LINKAGE=SC  
 NODE=M162W;LINKAGE=ST  
 NODE=M162W;LINKAGE=HA

 **$a_2(1700)$  DECAY MODES**

NODE=M162215;NODE=M162

| Mode                           | Fraction ( $\Gamma_i/\Gamma$ )   |
|--------------------------------|----------------------------------|
| $\Gamma_1$ $\eta\pi$           | (3.7 ± 1.0 ) %                   |
| $\Gamma_2$ $\gamma\gamma$      | (1.16 ± 0.27) × 10 <sup>-6</sup> |
| $\Gamma_3$ $\rho\pi$           | seen                             |
| $\Gamma_4$ $f_2(1270)\pi$      | seen                             |
| $\Gamma_5$ $K\bar{K}$          | (1.9 ± 1.2 ) %                   |
| $\Gamma_6$ $\omega\pi^- \pi^0$ | seen                             |
| $\Gamma_7$ $\omega\rho$        | seen                             |

DESIG=4

DESIG=1

DESIG=2;OUR EVAL;→ UNCHECKED ←

DESIG=3;OUR EVAL;→ UNCHECKED ←

DESIG=5

DESIG=6;OUR EVAL;→ UNCHECKED ←

DESIG=7;OUR EVAL;→ UNCHECKED ←

 **$a_2(1700)$  PARTIAL WIDTHS**

NODE=M162220

 **$\Gamma(\eta\pi)$**  **$\Gamma_1$** 

| VALUE (MeV)      | EVTS | DOCUMENT ID             | TECN     | COMMENT                                |
|------------------|------|-------------------------|----------|----------------------------------------|
| <b>9.5 ± 2.0</b> | 870  | <sup>1</sup> SCHEGELSKY | 06A RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |

NODE=M162W3  
 NODE=M162W3

 **$\Gamma(\gamma\gamma)$**  **$\Gamma_2$** 

| VALUE (keV)        | EVTS | DOCUMENT ID             | TECN     | COMMENT                                |
|--------------------|------|-------------------------|----------|----------------------------------------|
| <b>0.30 ± 0.05</b> | 870  | <sup>1</sup> SCHEGELSKY | 06A RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |

NODE=M162W2  
 NODE=M162W2

$\Gamma(K\bar{K})$  $\Gamma_5$ 

| VALUE (MeV)    | EVTs | DOCUMENT ID                 | TECN | COMMENT                                |
|----------------|------|-----------------------------|------|----------------------------------------|
| <b>5.0±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.

NODE=M162W1  
NODE=M162W1

NODE=M162W1;LINKAGE=SC

 $a_2(1700) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$ 

NODE=M162225

$$\left[ \Gamma(\rho\pi) + \Gamma(f_2(1270)\pi) \right] \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad (\Gamma_3 + \Gamma_4)\Gamma_2/\Gamma$$

| VALUE (keV)           | EVTs | DOCUMENT ID | TECN   | COMMENT                                      |
|-----------------------|------|-------------|--------|----------------------------------------------|
| <b>0.29±0.04±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 <sup>+0.12</sup> <sub>-0.08</sub> ± 0.10 | 18k | <sup>1</sup> SCHEGELSKY 06 | RVUE | $\gamma\gamma \rightarrow \pi^+ \pi^- \pi^0$ |
|-----------------------------------------------|-----|----------------------------|------|----------------------------------------------|

NODE=M162G1  
NODE=M162G1

 $\Gamma(K\bar{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_5\Gamma_2/\Gamma$ 

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

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

|                  |                       |         |                                                                                                  |
|------------------|-----------------------|---------|--------------------------------------------------------------------------------------------------|
| 20.6 ± 4.2 ± 4.6 | <sup>2</sup> ABE      | 04 BELL | 10.6 e <sup>+</sup> e <sup>-</sup> → e <sup>+</sup> e <sup>-</sup> K <sup>+</sup> K <sup>-</sup> |
| 49 ± 11 ± 13     | <sup>3</sup> ACCIARRI | 01H L3  | $\gamma\gamma \rightarrow K_S^0 K_S^0$ , $E_{\text{cm}}^{\text{ee}} = 91$ ,<br>183–209 GeV       |

<sup>1</sup> From analysis of L3 data at 183–209 GeV.

<sup>2</sup> Assuming spin 2.

<sup>3</sup> Spin 2 dominant, isospin not determined, could also be  $I=1$ .

NODE=M162G2  
NODE=M162G2

NODE=M162G1;LINKAGE=SC  
NODE=M162G2;LINKAGE=AB  
NODE=M162G;LINKAGE=HA

 $a_2(1700)$  BRANCHING RATIOS

NODE=M162235

 $\Gamma(\rho\pi)/\Gamma(f_2(1270)\pi)$  $\Gamma_3/\Gamma_4$ 

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

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

|                 |     |                            |      |                                              |
|-----------------|-----|----------------------------|------|----------------------------------------------|
| 3.4 ± 0.4 ± 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.

NODE=M162R01  
NODE=M162R01

NODE=M162R01;LINKAGE=SC

 $a_2(1700)$  REFERENCES

NODE=M162

|            |     |                             |                                |                            |
|------------|-----|-----------------------------|--------------------------------|----------------------------|
| 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>       | (BES III 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.)               |

REFID=59554  
REFID=59471  
REFID=59003  
REFID=57953  
REFID=56385  
REFID=52719  
REFID=51186  
REFID=51185  
REFID=51063  
REFID=50459  
REFID=49650  
REFID=48580  
REFID=48321  
REFID=46904  
REFID=46909  
REFID=45761

**$f_0(1710)$** 

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

See our mini-review in the 2004 edition of this *Review*, Physics Letters **B592** 1 (2004). See also the mini-review on scalar mesons under  $f_0(500)$  (see the index for the page number).

NODE=M068

NODE=M068

 **$f_0(1710)$  MASS**

NODE=M068M

OUR EVALUATION below is based on T-matrix poles from BARBERIS 00E and BARBERIS 99D.

NODE=M068M

VALUE (MeV)    EVTS    DOCUMENT ID    TECN    COMMENT  
**1704 ± 12    OUR EVALUATION**

NODE=M068M  
 → UNCHECKED ←

**1732 ± 9    OUR AVERAGE** Error includes scale factor of 1.6. See the ideogram below.  
 [1723 ± 6 MeV OUR 2018 AVERAGE Scale factor = 1.6]

NEW

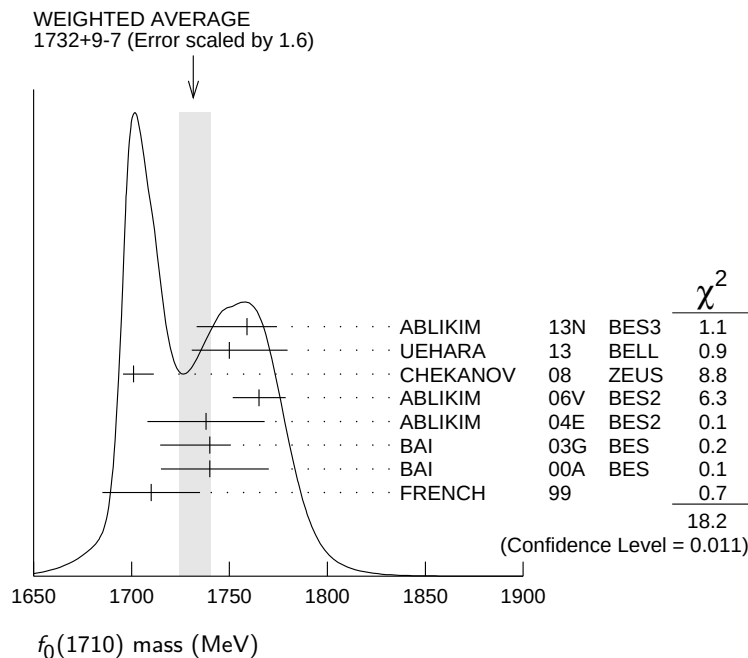
|                                                                               |                |      |                         |     |      |                                                            |
|-------------------------------------------------------------------------------|----------------|------|-------------------------|-----|------|------------------------------------------------------------|
| 1759 ± 6                                                                      | $^{+14}_{-25}$ | 5.5k | <sup>1</sup> ABLIKIM    | 13N | BES3 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\eta\eta$     |
| 1750 ± 6                                                                      | $^{+29}_{-18}$ |      | <sup>2</sup> UEHARA     | 13  | BELL | $\gamma\gamma \rightarrow K_S^0 K_S^0$                     |
| 1701 ± 5                                                                      | $^{+9}_{-2}$   | 4k   | <sup>3</sup> CHEKANOV   | 08  | ZEUS | $e p \rightarrow K_S^0 K_S^0 X$                            |
| 1765 ± 4                                                                      | $\pm 13$       |      | <sup>4</sup> ABLIKIM    | 06V | BES2 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\pi^+\pi^-$   |
| 1738 ± 30                                                                     |                |      | ABLIKIM                 | 04E | BES2 | $J/\psi \rightarrow \omega K^+ K^-$                        |
| 1740 ± 4                                                                      | $^{+10}_{-25}$ |      | BAI                     | 03G | BES  | $J/\psi \rightarrow \gamma K \bar{K}$                      |
| 1740 ± 30                                                                     | $^{+30}_{-25}$ |      | BAI                     | 00A | BES  | $J/\psi \rightarrow \gamma(\pi^+\pi^-\pi^+\pi^-)$          |
| 1710 ± 25                                                                     |                |      | <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. ● ● ● |                |      |                         |     |      |                                                            |
| 1744 ± 7                                                                      | $\pm 5$        | 381  | <sup>6,7</sup> DOBBS    | 15  |      | $J/\psi \rightarrow \gamma\pi^+\pi^-$                      |
| 1705 ± 11                                                                     | $\pm 5$        | 237  | <sup>6,7</sup> DOBBS    | 15  |      | $\psi(2S) \rightarrow \gamma\pi^+\pi^-$                    |
| 1706 ± 4                                                                      | $\pm 5$        | 1.0k | <sup>6,7</sup> DOBBS    | 15  |      | $J/\psi \rightarrow \gamma K^+ K^-$                        |
| 1690 ± 8                                                                      | $\pm 3$        | 349  | <sup>6,7</sup> DOBBS    | 15  |      | $\psi(2S) \rightarrow \gamma K^+ K^-$                      |
| 1750 ± 13                                                                     |                |      | AMSLER                  | 06  | CBAR | $1.64 \bar{p} p \rightarrow K^+ K^- \pi^0$                 |
| 1747 ± 5                                                                      |                | 80k  | <sup>4,8</sup> 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 ± 40                                                                     | $^{+40}_{-30}$ |      | <sup>9</sup> ABLIKIM    | 05  | BES2 | $J/\psi \rightarrow \phi\pi^+\pi^-$                        |
| 1760 ± 15                                                                     | $^{+15}_{-10}$ |      | <sup>9</sup> ABLIKIM    | 05Q | BES2 | $\psi(2S) \rightarrow \gamma\pi^+\pi^- K^+ K^-$            |
| 1670 ± 20                                                                     |                |      | <sup>4</sup> BINON      | 05  | GAMS | $33 \pi^- p \rightarrow \eta\eta n$                        |
| 1732 ± 15                                                                     |                |      | <sup>10</sup> 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 | <sup>11</sup> NICHITIU  | 02  | OBLX | $0 \bar{p} p \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$        |
| 1698 ± 18                                                                     |                |      | <sup>12</sup> BARBERIS  | 00E |      | $450 p p \rightarrow p_f \eta\eta p_s$                     |
| 1770 ± 12                                                                     |                |      | <sup>13</sup> ANISOVICH | 99B | SPEC | $0.6-1.2 p \bar{p} \rightarrow \eta\eta\pi^0$              |
| 1730 ± 15                                                                     |                |      | BARBERIS                | 99  | OMEG | $450 p p \rightarrow p_s p_f K^+ K^-$                      |
| 1750 ± 20                                                                     |                |      | BARBERIS                | 99B | OMEG | $450 p p \rightarrow p_s p_f \pi^+ \pi^-$                  |
| 1710 ± 12                                                                     | $\pm 11$       |      | <sup>14</sup> BARBERIS  | 99D | OMEG | $450 p p \rightarrow K^+ K^-, \pi^+ \pi^-$                 |
| 1750 ± 30                                                                     |                |      | <sup>15</sup> ANISOVICH | 98B | RVUE | Compilation                                                |
| 1720 ± 39                                                                     |                |      | BAI                     | 98H | BES  | $J/\psi \rightarrow \gamma\pi^0 \pi^0$                     |
| 1775 ± 1.5                                                                    |                | 57   | <sup>16</sup> BARKOV    | 98  |      | $\pi^- p \rightarrow K_S^0 K_S^0 n$                        |
| 1690 ± 11                                                                     |                |      | <sup>17</sup> ABREU     | 96C | DLPH | $Z^0 \rightarrow K^+ K^- + X$                              |
| 1696 ± 5                                                                      | $^{+9}_{-34}$  |      | <sup>18</sup> BAI       | 96C | BES  | $J/\psi \rightarrow \gamma K^+ K^-$                        |
| 1781 ± 8                                                                      | $^{+10}_{-31}$ |      | BAI                     | 96C | BES  | $J/\psi \rightarrow \gamma K^+ K^-$                        |
| 1768 ± 14                                                                     |                |      | BALOSHIN                | 95  | SPEC | $40 \pi^- C \rightarrow K_S^0 K_S^0 X$                     |
| 1750 ± 15                                                                     |                |      | <sup>19</sup> BUGG      | 95  | MRK3 | $J/\psi \rightarrow \gamma\pi^+\pi^-\pi^+\pi^-$            |
| 1620 ± 16                                                                     |                |      | <sup>18</sup> BUGG      | 95  | MRK3 | $J/\psi \rightarrow \gamma\pi^+\pi^-\pi^+\pi^-$            |
| 1748 ± 10                                                                     |                |      | <sup>20</sup> ARMSTRONG | 93C | E760 | $\bar{p} p \rightarrow \pi^0 \eta\eta \rightarrow 6\gamma$ |
| ~ 1750                                                                        |                |      | BREAKSTONE              | 93  | SFM  | $p p \rightarrow p p \pi^+ \pi^- \pi^+ \pi^-$              |
| 1744 ± 15                                                                     |                |      | <sup>21</sup> ALDE      | 92D | GAM2 | $38 \pi^- p \rightarrow \eta\eta n$                        |
| 1713 ± 10                                                                     |                |      | <sup>22</sup> ARMSTRONG | 89D | OMEG | $300 p p \rightarrow p p K^+ K^-$                          |

OCCUR=2  
 OCCUR=3  
 OCCUR=4

OCCUR=2

OCCUR=2

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |       |              |     |      |                                                  |                                     |                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------|-----|------|--------------------------------------------------|-------------------------------------|-----------------------|
| 1706±10                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 22    | ARMSTRONG    | 89D | OMEG | 300                                              | $pp \rightarrow pp K_S^0 K_S^0$     | OCCUR=2               |
| 1707±10                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 20    | AUGUSTIN     | 88  | DM2  | $J/\psi \rightarrow \gamma K^+ K^-, K_S^0 K_S^0$ |                                     |                       |
| 1700±15                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 18    | 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 23    | FALVARD      | 88  | DM2  | $J/\psi \rightarrow \phi K^+ K^-, K_S^0 K_S^0$   |                                     |                       |
| 1690± 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 24    | FALVARD      | 88  | DM2  | $J/\psi \rightarrow \phi K^+ K^-, K_S^0 K_S^0$   |                                     | OCCUR=2               |
| 1698±15                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 20    | AUGUSTIN     | 87  | DM2  | $J/\psi \rightarrow \gamma \pi^+ \pi^-$          |                                     |                       |
| 1720±10 ±10                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 18    | BALTRUSAIT.. | 87  | MRK3 | $J/\psi \rightarrow \gamma K^+ K^-$              |                                     |                       |
| 1755± 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 25    | ALDE         | 86C | GAM2 | 38                                               | $\pi^- p \rightarrow n 2\eta$       |                       |
| 1730 <sup>+</sup> <sub>-10</sub>                                                                                                                                                                                                                                                                                                                                                                                                                                           | 26    | LONGACRE     | 86  | RVUE | 22                                               | $\pi^- p \rightarrow n 2K_S^0$      |                       |
| 1742±15                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 20    | 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 27,28 | EDWARDS      | 82D | CBAL | $J/\psi \rightarrow \gamma 2\eta$                |                                     |                       |
| 1730±10 ±20                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 29    | 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.                                                                                                                                                                                                                                                                                                                                              |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=D  |
| <sup>2</sup> Spin 0 favored over spin 2.                                                                                                                                                                                                                                                                                                                                                                                                                                   |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=H  |
| <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=M068M;LINKAGE=HE |
| <sup>4</sup> Breit-Wigner mass.                                                                                                                                                                                                                                                                                                                                                                                                                                            |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=BW |
| <sup>5</sup> $J^P = 0^+$ , supersedes by ARMSTRONG 89D.                                                                                                                                                                                                                                                                                                                                                                                                                    |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=C3 |
| <sup>6</sup> Using CLEO-c data but not authored by the CLEO Collaboration.                                                                                                                                                                                                                                                                                                                                                                                                 |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=F  |
| <sup>7</sup> From a fit to a Breit-Wigner line shape with fixed $\Gamma = 135$ MeV.                                                                                                                                                                                                                                                                                                                                                                                        |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=G  |
| <sup>8</sup> Systematic errors not estimated.                                                                                                                                                                                                                                                                                                                                                                                                                              |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=CH |
| <sup>9</sup> This state may be different from $f_0(1710)$ , see CLOSE 05.                                                                                                                                                                                                                                                                                                                                                                                                  |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=AB |
| <sup>10</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. |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=KM |
| <sup>11</sup> Decaying to $f_0(1370) \pi \pi$ .                                                                                                                                                                                                                                                                                                                                                                                                                            |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=NC |
| <sup>12</sup> T-matrix pole.                                                                                                                                                                                                                                                                                                                                                                                                                                               |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=TP |
| <sup>13</sup> Not seen by AMSLER 02.                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=NS |
| <sup>14</sup> Supersedes BARBERIS 99 and BARBERIS 99B.                                                                                                                                                                                                                                                                                                                                                                                                                     |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=BD |
| <sup>15</sup> T-matrix pole, assuming $J^P = 0^+$                                                                                                                                                                                                                                                                                                                                                                                                                          |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=AN |
| <sup>16</sup> No $J^{PC}$ determination.                                                                                                                                                                                                                                                                                                                                                                                                                                   |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=4A |
| <sup>17</sup> No $J^{PC}$ determination, width not determined.                                                                                                                                                                                                                                                                                                                                                                                                             |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=A4 |
| <sup>18</sup> $J^P = 2^+$ .                                                                                                                                                                                                                                                                                                                                                                                                                                                |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=A3 |
| <sup>19</sup> From a fit to the $0^+$ partial wave.                                                                                                                                                                                                                                                                                                                                                                                                                        |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=Q0 |
| <sup>20</sup> No $J^{PC}$ determination.                                                                                                                                                                                                                                                                                                                                                                                                                                   |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=A1 |
| <sup>21</sup> ALDE 92D combines all the GAMS-2000 data.                                                                                                                                                                                                                                                                                                                                                                                                                    |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=AA |
| <sup>22</sup> $J^P = 2^+$ , superseded by FRENCH 99.                                                                                                                                                                                                                                                                                                                                                                                                                       |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=C  |
| <sup>23</sup> From an analysis ignoring interference with $f_2'(1525)$ .                                                                                                                                                                                                                                                                                                                                                                                                   |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=A  |
| <sup>24</sup> From an analysis including interference with $f_2'(1525)$ .                                                                                                                                                                                                                                                                                                                                                                                                  |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=B  |
| <sup>25</sup> Superseded by ALDE 92D.                                                                                                                                                                                                                                                                                                                                                                                                                                      |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=BB |
| <sup>26</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.                                                                                                                                                                                                                                                                                                        |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=A9 |
| <sup>27</sup> $J^P = 2^+$ preferred.                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=B2 |
| <sup>28</sup> From fit neglecting nearby $f_2'(1525)$ . Replaced by BLOOM 83.                                                                                                                                                                                                                                                                                                                                                                                              |       |              |     |      |                                                  |                                     | NODE=M068M;LINKAGE=E  |
| <sup>29</sup> Superseded by LONGACRE 86.                                                                                                                                                                                                                                                                                                                                                                                                                                   |       |              |     |      |                                                  |                                     | 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

**123 ± 18 OUR EVALUATION**

NODE=M068W

→ UNCHECKED ←

**147 ± 12 OUR AVERAGE** Error includes scale factor of 1.2. [139 ± 8 MeV OUR 2018 AVERAGE Scale factor = 1.1]

NEW

|          |                |      |   |          |     |      |                                                          |
|----------|----------------|------|---|----------|-----|------|----------------------------------------------------------|
| 172 ± 10 | $^{+32}_{-16}$ | 5.5k | 1 | ABLIKIM  | 13N | BES3 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\eta\eta$   |
| 139 ± 11 | $^{+96}_{-50}$ |      | 2 | UEHARA   | 13  | BELL | $\gamma\gamma \rightarrow K_S^0 K_S^0$                   |
| 100 ± 24 | $^{+7}_{-22}$  | 4k   | 3 | CHEKANOV | 08  | ZEUS | $ep \rightarrow K_S^0 K_S^0 X$                           |
| 145 ± 8  | ±69            |      | 4 | ABLIKIM  | 06V | BES2 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\pi^+\pi^-$ |
| 125 ± 20 |                |      |   | ABLIKIM  | 04E | BES2 | $J/\psi \rightarrow \omega K^+ K^-$                      |
| 166 ± 5  | $^{+15}_{-10}$ |      |   | BAI      | 03G | BES  | $J/\psi \rightarrow \gamma K \bar{K}$                    |
| 120 ± 50 | $^{+50}_{-40}$ |      |   | BAI      | 00A | BES  | $J/\psi \rightarrow \gamma(\pi^+\pi^-\pi^+\pi^-)$        |
| 105 ± 34 |                |      | 5 | FRENCH   | 99  |      | 300 $pp \rightarrow p_f(K^+K^-)p_s$                      |

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

|           |                |      |       |               |     |      |                                                    |
|-----------|----------------|------|-------|---------------|-----|------|----------------------------------------------------|
| 148 ± 40  | $^{+40}_{-30}$ |      |       | AMSLER        | 06  | CBAR | $1.64 \bar{p}p \rightarrow K^+ K^- \pi^0$          |
| 188 ± 13  |                | 80k  | 4,6   | 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 ± 60  | $^{+60}_{-30}$ |      | 7     | ABLIKIM       | 05  | BES2 | $J/\psi \rightarrow \phi\pi^+\pi^-$                |
| 125 ± 25  | $^{+10}_{-15}$ |      | 4     | ABLIKIM       | 05Q | BES2 | $\psi(2S) \rightarrow \gamma\pi^+\pi^- K^+ K^-$    |
| 260 ± 50  |                |      | 4     | BINON         | 05  | GAMS | $33 \pi^- p \rightarrow \eta\eta n$                |
| 144 ± 30  |                |      | 8,9   | ANISOVICH     | 03  | RVUE |                                                    |
| 320 ± 50  | $^{+50}_{-20}$ |      | 9,10  | ANISOVICH     | 03  | RVUE |                                                    |
| 102 ± 26  |                |      |       | TIKHOMIROV    | 03  | SPEC | $40.0 \pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$     |
| 267 ± 44  |                | 3651 | 11    | NICHITIU      | 02  | OBLX | $0 \bar{p}p \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$ |
| 120 ± 26  |                |      | 12    | BARBERIS      | 00E |      | $450 pp \rightarrow p_f \eta \eta p_s$             |
| 220 ± 40  |                |      | 13,14 | ANISOVICH     | 99B | SPEC | $0.6-1.2 p\bar{p} \rightarrow \eta\eta\pi^0$       |
| 100 ± 25  |                |      |       | BARBERIS      | 99  | OMEG | $450 pp \rightarrow p_s p_f K^+ K^-$               |
| 160 ± 30  |                |      |       | BARBERIS      | 99B | OMEG | $450 pp \rightarrow p_s p_f \pi^+ \pi^-$           |
| 126 ± 16  | ±18            |      | 12,15 | BARBERIS      | 99D | OMEG | $450 pp \rightarrow K^+ K^-, \pi^+ \pi^-$          |
| 250 ± 140 |                |      | 16    | ANISOVICH     | 98B | RVUE | Compilation                                        |
| 30 ± 7    |                | 57   | 17    | BARKOV        | 98  |      | $\pi^- p \rightarrow K_S^0 K_S^0 n$                |
| 103 ± 18  | $^{+30}_{-11}$ |      | 18    | BAI           | 96C | BES  | $J/\psi \rightarrow \gamma K^+ K^-$                |

OCCUR=2



|                                       |                 |     |      |                                                             |         |
|---------------------------------------|-----------------|-----|------|-------------------------------------------------------------|---------|
| 85 ± 24 <sup>+22</sup> <sub>-19</sub> | 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                              | 19 BUGG         | 95  | MRK3 | $J/\psi \rightarrow \gamma \pi^+ \pi^- \pi^+ \pi^-$         |         |
| 160 <sup>+60</sup> <sub>-20</sub>     | 18 BUGG         | 95  | MRK3 | $J/\psi \rightarrow \gamma \pi^+ \pi^- \pi^+ \pi^-$         | OCCUR=2 |
| 264 ± 25                              | 20 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                           | 21 ALDE         | 92D | GAM2 | $38 \pi^- p \rightarrow \eta \eta N^*$                      |         |
| 181 ± 30                              | 22 ARMSTRONG    | 89D | OMEG | $300 p p \rightarrow p p K^+ K^-$                           |         |
| 104 ± 30                              | 22 ARMSTRONG    | 89D | OMEG | $300 p p \rightarrow p p K_S^0 K_S^0$                       | OCCUR=2 |
| 166.4 ± 33.2                          | 20 AUGUSTIN     | 88  | DM2  | $J/\psi \rightarrow \gamma K^+ K^-, K_S^0 K_S^0$            |         |
| 30 ± 20                               | 18 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                              | 23 FALVARD      | 88  | DM2  | $J/\psi \rightarrow \phi K^+ K^-, K_S^0 K_S^0$              |         |
| 184 ± 6                               | 24 FALVARD      | 88  | DM2  | $J/\psi \rightarrow \phi K^+ K^-, K_S^0 K_S^0$              | OCCUR=2 |
| 136 ± 28                              | 20 AUGUSTIN     | 87  | DM2  | $J/\psi \rightarrow \gamma \pi^+ \pi^-$                     |         |
| 130 ± 20                              | 18 BALTRUSAIT.. | 87  | MRK3 | $J/\psi \rightarrow \gamma K^+ K^-$                         |         |
| 122 <sup>+74</sup> <sub>-15</sub>     | 25 LONGACRE     | 86  | RVUE | $22 \pi^- p \rightarrow n 2 K_S^0$                          |         |
| 57 ± 38                               | 26 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 <sup>+100</sup> <sub>-70</sub>    | 27,28 EDWARDS   | 82D | CBAL | $J/\psi \rightarrow \gamma 2\eta$                           |         |
| 200 <sup>+156</sup> <sub>-9</sub>     | 29 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.

<sup>4</sup> Breit-Wigner width.

<sup>5</sup>  $J^P = 0^+$ , supersedes by ARMSTRONG 89D.

<sup>6</sup> Systematic errors not estimated.

<sup>7</sup> This state may be different from  $f_0(1710)$ , see CLOSE 05.

<sup>8</sup> (Solution I)

<sup>9</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>10</sup> (Solution I)

<sup>11</sup> Decaying to  $f_0(1370)\pi\pi$ .

<sup>12</sup> T-matrix pole.

<sup>13</sup>  $J^P = 0^+$ .

<sup>14</sup> Not seen by AMSLER 02.

<sup>15</sup> Supersedes BARBERIS 99 and BARBERIS 99B.

<sup>16</sup> T-matrix pole, assuming  $J^P = 0^+$

<sup>17</sup> No  $J^{PC}$  determination.

<sup>18</sup>  $J^P = 2^+$ .

<sup>19</sup> From a fit to the  $0^+$  partial wave.

<sup>20</sup> No  $J^{PC}$  determination.

<sup>21</sup> ALDE 92D combines all the GAMS-2000 data.

<sup>22</sup>  $J^P = 2^+$ , ( $0^+$  excluded).

<sup>23</sup> From an analysis ignoring interference with  $f_2'(1525)$ .

<sup>24</sup> From an analysis including interference with  $f_2'(1525)$ .

<sup>25</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>26</sup> No  $J^{PC}$  determination.

<sup>27</sup>  $J^P = 2^+$  preferred.

<sup>28</sup> From fit neglecting nearby  $f_2'(1525)$ . Replaced by BLOOM 83.

<sup>29</sup> From an amplitude analysis of the  $K_S^0 K_S^0$  system, superseded by LONGACRE 86.

NODE=M068W;LINKAGE=F

NODE=M068W;LINKAGE=G

NODE=M068W;LINKAGE=HE

NODE=M068W;LINKAGE=BW

NODE=M068W;LINKAGE=C3

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

**$f_0(1710)$  DECAY MODES**

NODE=M068215;NODE=M068

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $K\bar{K}$     | seen                           |
| $\Gamma_2$ $\eta\eta$     | seen                           |
| $\Gamma_3$ $\pi\pi$       | seen                           |
| $\Gamma_4$ $\gamma\gamma$ | seen                           |
| $\Gamma_5$ $\omega\omega$ | seen                           |

DESIG=2;OUR EST;→ UNCHECKED ←  
 DESIG=1;OUR EST;→ UNCHECKED ←  
 DESIG=5;OUR EST;→ UNCHECKED ←  
 DESIG=6;OUR EST;→ UNCHECKED ←  
 DESIG=4

 **$f_0(1710) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$** 

NODE=M068220

| $\Gamma(K\bar{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ |     |             |      | $\Gamma_1\Gamma_4/\Gamma$                   |
|----------------------------------------------------------------------|-----|-------------|------|---------------------------------------------|
| VALUE (eV)                                                           | CL% | DOCUMENT ID | TECN | COMMENT                                     |
| $12^{+3}_{-2} + 227_8$                                               |     | UEHARA      | 13   | BELL $\gamma\gamma \rightarrow K^0_S K^0_S$ |

NODE=M068G2  
 NODE=M068G2

• • • 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.

NODE=M068G2;LINKAGE=F

| $\Gamma(\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ |     |                     |      |         | $\Gamma_3\Gamma_4/\Gamma$             |
|--------------------------------------------------------------------|-----|---------------------|------|---------|---------------------------------------|
| VALUE (keV)                                                        | CL% | DOCUMENT ID         | TECN | COMMENT |                                       |
| <0.82                                                              | 95  | <sup>1</sup> BARATE | 00E  | ALEP    | $\gamma\gamma \rightarrow \pi^+\pi^-$ |

NODE=M068G3  
 NODE=M068G3

<sup>1</sup> Assuming spin 0.

NODE=M068G;LINKAGE=Z

 **$f_0(1710)$  BRANCHING RATIOS**

NODE=M068225

| $\Gamma(K\bar{K})/\Gamma_{\text{total}}$                                      |             |                       |             |                                       | $\Gamma_1/\Gamma$                  |
|-------------------------------------------------------------------------------|-------------|-----------------------|-------------|---------------------------------------|------------------------------------|
| <i>VALUE</i>                                                                  | <i>EVTS</i> | <i>DOCUMENT ID</i>    | <i>TECN</i> | <i>COMMENT</i>                        |                                    |
| ● ● ● 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                                   | $22 \pi^- p \rightarrow n 2 K_S^0$ |

NODE=M068R2  
 NODE=M068R2

<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.

OCCUR=2

NODE=M068R2;LINKAGE=A  
 NODE=M068R;LINKAGE=L

| $\Gamma(\eta\eta)/\Gamma_{\text{total}}$                                      |                          |             | $\Gamma_2/\Gamma$ |
|-------------------------------------------------------------------------------|--------------------------|-------------|-------------------|
| <u>VALUE</u>                                                                  | <u>DOCUMENT ID</u>       | <u>TECN</u> |                   |
| ● ● ● 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        |                   |

NODE=M068R1  
 NODE=M068R1

• • • 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;LINKAGE=L

| $\Gamma(\pi\pi)/\Gamma_{\text{total}}$                                        |             |                       |             |                                                                     | $\Gamma_3/\Gamma$ |
|-------------------------------------------------------------------------------|-------------|-----------------------|-------------|---------------------------------------------------------------------|-------------------|
| <u>VALUE</u>                                                                  | <u>EVTS</u> | <u>DOCUMENT ID</u>    | <u>TECN</u> | <u>COMMENT</u>                                                      |                   |
| ● ● ● 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                                                                |                   |

NODE=M068R5  
 NODE=M068R5

• • • 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                                                                |

OCCUR=2

<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;LINKAGE=A  
 NODE=M068R5;LINKAGE=L

$\Gamma(\pi\pi)/\Gamma(K\bar{K})$  $\Gamma_3/\Gamma_1$ 

| VALUE                                                                         | CL%                | DOCUMENT ID                                                                                   | TECN         | COMMENT                                                          |
|-------------------------------------------------------------------------------|--------------------|-----------------------------------------------------------------------------------------------|--------------|------------------------------------------------------------------|
| <b>0.23±0.05</b>                                                              | <b>OUR AVERAGE</b> | Error includes scale factor of 1.2. [0.41 <sup>+0.11</sup> <sub>-0.17</sub> OUR 2018 AVERAGE] |              |                                                                  |
| 0.64±0.27 ±0.18                                                               |                    | LEES                                                                                          | 18A BABR     | $\Upsilon(1S) \rightarrow \gamma\pi^+\pi^-$ ,<br>$\gamma K^+K^-$ |
| 0.41 <sup>+0.11</sup> <sub>-0.17</sub>                                        |                    | ABLIKIM                                                                                       | 06V BES2     | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\pi^+\pi^-$         |
| 0.2 ±0.024±0.036                                                              |                    | BARBERIS                                                                                      | 99D OMEG 450 | $p\bar{p} \rightarrow K^+K^-, \pi^+\pi^-$                        |
| 0.39±0.14                                                                     |                    | ARMSTRONG                                                                                     | 91 OMEG 300  | $p\bar{p} \rightarrow p\bar{p}\pi\pi, p\bar{p}K\bar{K}$          |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                    |                                                                                               |              |                                                                  |
| 0.32±0.14                                                                     |                    | ALBALADEJO                                                                                    | 08 RVUE      |                                                                  |
| < 0.11                                                                        | 95                 | <sup>1</sup> ABLIKIM                                                                          | 04E BES2     | $J/\psi \rightarrow \omega K^+K^-$                               |
| 5.8 <sup>+9.1</sup> <sub>-5.5</sub>                                           |                    | <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. $\Gamma(\eta\eta)/\Gamma(K\bar{K})$  $\Gamma_2/\Gamma_1$ 

| VALUE                                                                                                                                                                                                                                                              | CL% | DOCUMENT ID             | TECN     | COMMENT                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------------------------|----------|--------------------------------------------|
| <b>0.48±0.15</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. • • •                                                                                                                                                                                      |     |                         |          |                                            |
| 0.46 <sup>+0.70</sup> <sub>-0.38</sub>                                                                                                                                                                                                                             |     | <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.                                                                                                                                                                                                |     |                         |          |                                            |

 $\Gamma(\omega\omega)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

| VALUE       | EVTS | DOCUMENT ID | TECN    | COMMENT                                 |
|-------------|------|-------------|---------|-----------------------------------------|
| <b>seen</b> | 180  | ABLIKIM     | 06H BES | $J/\psi \rightarrow \gamma\omega\omega$ |

 $f_0(1710)$  REFERENCES

|                              |     |                  |                                  |                   |             |
|------------------------------|-----|------------------|----------------------------------|-------------------|-------------|
| 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                      | 13N | PR D87 092009    | Ablikim M. <i>et al.</i>         | (BES III Collab.) | REFID=55387 |
| UEHARA                       | 13  | PTEP 2013 123C01 | S. Uehara <i>et al.</i>          | (BELLE Collab.)   | REFID=55592 |
| 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                      | 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>          | (CBAR 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. 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 |
| 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 |
| PDG                          | 04  | PL B592 1        | S. Eidelman <i>et al.</i>        | (PDG Collab.)     | REFID=49653 |
| 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.   |     |                  |                                  |                   |             |

NODE=M068R6  
NODE=M068R6

NEW

NODE=M068R;LINKAGE=AB  
NODE=M068R;LINKAGE=CHNODE=M068R7  
NODE=M068R7

NODE=M068R7;LINKAGE=CH

NODE=M068R;LINKAGE=A

NODE=M068R3  
NODE=M068R3

NODE=M068

|                 |     |                               |                                 |                          |
|-----------------|-----|-------------------------------|---------------------------------|--------------------------|
| BUGG            | 95  | PL B353 378                   | D.V. Bugg <i>et al.</i>         | (LOQM, PNPI, WASH)       |
| ARMSTRONG       | 93C | PL B307 394                   | T.A. Armstrong <i>et al.</i>    | (FNAL, FERR, GENO+)      |
| BREAKSTONE      | 93  | ZPHY C58 251                  | A.M. Breakstone <i>et al.</i>   | (IOWA, CERN, DORT+)      |
| ALDE            | 92D | PL B284 457                   | D.M. Alde <i>et al.</i>         | (GAM2 Collab.)           |
| Also            |     | SJNP 54 451                   | D.M. Alde <i>et al.</i>         | (GAM2 Collab.)           |
| ARMSTRONG       | 91  | Translated from YAF 54 745    | T.A. Armstrong <i>et al.</i>    | (ATHU, BARI, BIRM+)      |
| PROKOSHKIN      | 91  | ZPHY C51 351                  | Y.D. Prokoshkin                 | (GAM2, GAM4 Collab.)     |
|                 |     | SPD 36 155                    |                                 |                          |
|                 |     | Translated from DANS 316 900. |                                 |                          |
| ALBRECHT        | 90G | ZPHY C48 183                  | H. Albrecht <i>et al.</i>       | (ARGUS Collab.)          |
| ARMSTRONG       | 89D | PL B227 186                   | T.A. Armstrong, M. Benayoun     | (ATHU, BARI, BIRM+)      |
| BEHREND         | 89C | ZPHY C43 91                   | H.J. Behrend <i>et al.</i>      | (CELLO Collab.)          |
| AUGUSTIN        | 88  | PRL 60 2238                   | J.E. Augustin <i>et al.</i>     | (DM2 Collab.)            |
| BOLONKIN        | 88  | NP B309 426                   | B.V. Bolonkin <i>et al.</i>     | (ITEP, SERP)             |
| FALVARD         | 88  | PR D38 2706                   | A. Falvard <i>et al.</i>        | (CLER, FRAS, LALO+)      |
| AUGUSTIN        | 87  | ZPHY C36 369                  | J.E. Augustin <i>et al.</i>     | (LALO, CLER, FRAS+)      |
| BALTRUSAITIS... | 87  | PR D35 2077                   | R.M. Baltrusaitis <i>et al.</i> | (Mark III Collab.)       |
| ALDE            | 86C | PL B182 105                   | D.M. Alde <i>et al.</i>         | (SERP, BELG, LANL, LAPP) |
| LONGACRE        | 86  | PL B177 223                   | R.S. Longacre <i>et al.</i>     | (BNL, BRAN, CUNY+)       |
| ALTHOFF         | 85B | ZPHY C29 189                  | M. Althoff <i>et al.</i>        | (TASSO Collab.)          |
| WILLIAMS        | 84  | PR D30 877                    | E.G.H. Williams <i>et al.</i>   | (VAND, NDAM, TUFTS+)     |
| BLOOM           | 83  | ARNS 33 143                   | E.D. Bloom, C. Peck             | (SLAC, CIT)              |
| BURKE           | 82  | PRL 49 632                    | D.L. Burke <i>et al.</i>        | (LBL, SLAC)              |
| EDWARDS         | 82D | PRL 48 458                    | C. Edwards <i>et al.</i>        | (CIT, HARV, PRIN+)       |
| ETKIN           | 82B | PR D25 1786                   | A. Etkin <i>et al.</i>          | (BNL, CUNY, TUFTS, VAND) |
| ETKIN           | 82C | PR D25 2446                   | A. Etkin <i>et al.</i>          | (BNL, CUNY, TUFTS, VAND) |

REFID=44438  
REFID=43587  
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REFID=21682  
REFID=21676  
REFID=21677  
REFID=20390  
REFID=20391

NODE=M114

$\eta(1760)$

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

#### 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

| 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.

NODE=M114M

NODE=M114M

OCCUR=2

NODE=M114M;LINKAGE=ZA  
NODE=M114M;LINKAGE=MA  
NODE=M114M;LINKAGE=ZH  
NODE=M114M;LINKAGE=A

#### $\eta(1760)$ WIDTH

| 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.

NODE=M114W

NODE=M114W

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 |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

NODE=M114G01

NODE=M114G01

|                              |     |                    |          |                                                 |
|------------------------------|-----|--------------------|----------|-------------------------------------------------|
| $28.2^{+7.9}_{-7.5} \pm 3.7$ | 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 | $e^+ e^- \rightarrow e^+ e^- \eta' \pi^+ \pi^-$ |
|-----------------------------|----|---------------------|----------|-------------------------------------------------|

OCCUR=2

|                        |     |                     |          |                                                 |
|------------------------|-----|---------------------|----------|-------------------------------------------------|
| $18^{+13}_{-10} \pm 5$ | 315 | <sup>11</sup> ZHANG | 12A BELL | $e^+ e^- \rightarrow e^+ e^- \eta' \pi^+ \pi^-$ |
|------------------------|-----|---------------------|----------|-------------------------------------------------|

OCCUR=3

<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;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 |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

NODE=M114R01

NODE=M114R01

|      |         |         |                                           |
|------|---------|---------|-------------------------------------------|
| seen | BISELLO | 89B DM2 | $J/\psi \rightarrow \gamma 2\pi^+ 2\pi^-$ |
|------|---------|---------|-------------------------------------------|

 **$\Gamma(\pi^+ \pi^- 2\pi^0)/\Gamma_{\text{total}}$**  **$\Gamma_3/\Gamma$** 

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

NODE=M114R02

NODE=M114R02

|      |         |         |                                                |
|------|---------|---------|------------------------------------------------|
| seen | BISELLO | 89B DM2 | $J/\psi \rightarrow \gamma \pi^+ \pi^- 2\pi^0$ |
|------|---------|---------|------------------------------------------------|

 **$\Gamma(\rho^0 \rho^0)/\Gamma_{\text{total}}$**  **$\Gamma_4/\Gamma$** 

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

NODE=M114R03

NODE=M114R03

|      |         |         |                                           |
|------|---------|---------|-------------------------------------------|
| seen | BISELLO | 89B DM2 | $J/\psi \rightarrow \gamma \rho^0 \rho^0$ |
|------|---------|---------|-------------------------------------------|

|      |                |      |                                           |
|------|----------------|------|-------------------------------------------|
| seen | BALTRUSAIT..86 | MRK3 | $J/\psi \rightarrow \gamma \rho^0 \rho^0$ |
|------|----------------|------|-------------------------------------------|

 **$\Gamma(\rho^+ \rho^-)/\Gamma_{\text{total}}$**  **$\Gamma_5/\Gamma$** 

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

NODE=M114R04

NODE=M114R04

|      |         |         |                                           |
|------|---------|---------|-------------------------------------------|
| seen | BISELLO | 89B DM2 | $J/\psi \rightarrow \gamma \rho^+ \rho^-$ |
|------|---------|---------|-------------------------------------------|

|      |                |      |                                           |
|------|----------------|------|-------------------------------------------|
| seen | BALTRUSAIT..86 | MRK3 | $J/\psi \rightarrow \gamma \rho^+ \rho^-$ |
|------|----------------|------|-------------------------------------------|

 **$\Gamma(\omega\omega)/\Gamma_{\text{total}}$**  **$\Gamma_6/\Gamma$** 

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

NODE=M114R06

NODE=M114R06

|      |         |        |                                   |
|------|---------|--------|-----------------------------------|
| seen | BISELLO | 87 DM2 | $J/\psi \rightarrow \omega\omega$ |
|------|---------|--------|-----------------------------------|

|      |                 |      |                                         |
|------|-----------------|------|-----------------------------------------|
| seen | BALTRUSAIT..85C | MRK3 | $J/\psi \rightarrow \gamma\omega\omega$ |
|------|-----------------|------|-----------------------------------------|

 **$\Gamma(\gamma\gamma)/\Gamma(\omega\omega)$**  **$\Gamma_8/\Gamma_6$** 

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

NODE=M114R08

NODE=M114R08

|         |                       |          |                                                       |
|---------|-----------------------|----------|-------------------------------------------------------|
| $<2.48$ | <sup>12</sup> ABLIKIM | 180 BES3 | $\psi(2S) \rightarrow \pi^+ \pi^- \gamma\gamma\gamma$ |
|---------|-----------------------|----------|-------------------------------------------------------|

<sup>12</sup> Using results from ABLIKIM 06H.

NODE=M114R08;LINKAGE=A

 **$\eta(1760)$  REFERENCES**

NODE=M114

|                   |             |               |                                 |                     |
|-------------------|-------------|---------------|---------------------------------|---------------------|
| ABLIKIM           | 180         | PR D97 072014 | M. Ablikim <i>et al.</i>        | (BES III 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

**$\pi(1800)$** 

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

See the related review on "Non- $q\bar{q}$  mesons." **$\pi(1800)$  MASS**

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

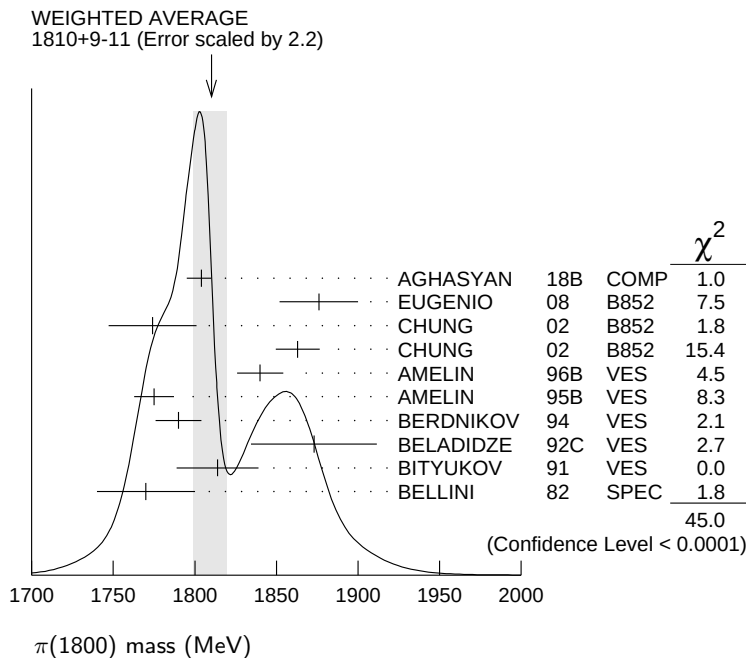
**1810<sup>+9</sup><sub>-11</sub> OUR AVERAGE** Error includes scale factor of 2.2. See the ideogram below.

[1812 ± 12 MeV OUR 2018 AVERAGE Scale factor = 2.3]

|                                  |          |                        |     |      |                                                     |
|----------------------------------|----------|------------------------|-----|------|-----------------------------------------------------|
| 1804 <sup>+6</sup> <sub>-9</sub> | 46M      | <sup>1</sup> AGHASYAN  | 18B | COMP | 190 $\pi^- p \rightarrow \pi^- \pi^- \pi^+ p$       |
| 1876 ± 18 ± 16                   | 4k       | <sup>2</sup> EUGENIO   | 08  | B852 | 18 $\pi^- p \rightarrow \eta \eta \pi^- p$          |
| 1774 ± 18 ± 20                   |          | <sup>3</sup> CHUNG     | 02  | B852 | 18.3 $\pi^- p \rightarrow$<br>$\pi^+ \pi^- \pi^- p$ |
| 1863 ± 9 ± 10                    |          | <sup>4</sup> CHUNG     | 02  | B852 | 18.3 $\pi^- p \rightarrow$<br>$\pi^+ \pi^- \pi^- p$ |
| 1840 ± 10 ± 10                   | 1200     | AMELIN                 | 96B | VES  | 37 $\pi^- A \rightarrow \eta \eta \pi^- A$          |
| 1775 ± 7 ± 10                    |          | <sup>5</sup> AMELIN    | 95B | VES  | 36 $\pi^- A \rightarrow \pi^+ \pi^- \pi^- A$        |
| 1790 ± 14                        |          | <sup>6</sup> BERDNIKOV | 94  | VES  | 37 $\pi^- A \rightarrow$<br>$K^+ K^- \pi^- A$       |
| 1873 ± 33 ± 20                   |          | BELADIDZE              | 92C | VES  | 36 $\pi^- Be \rightarrow \pi^- \eta' \eta Be$       |
| 1814 ± 10 ± 23                   | 426 ± 57 | BITYUKOV               | 91  | VES  | 36 $\pi^- C \rightarrow \pi^- \eta \eta C$          |
| 1770 ± 30                        | 1100     | BELLINI                | 82  | SPEC | 40 $\pi^- A \rightarrow 3\pi A$                     |

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

|                                       |      |                       |    |      |                                                       |
|---------------------------------------|------|-----------------------|----|------|-------------------------------------------------------|
| 1785 ± 9 <sup>+12</sup> <sub>-6</sub> | 420k | <sup>7</sup> ALEKSEEV | 10 | COMP | 190 $\pi^- Pb \rightarrow$<br>$\pi^- \pi^- \pi^+ Pb'$ |
| 1737 ± 5 ± 15                         |      | AMELIN                | 99 | VES  | 37 $\pi^- A \rightarrow \omega \pi^- \pi^0 A^*$       |

<sup>1</sup> Statistical error negligible.<sup>2</sup> From a single-pole fit.<sup>3</sup> In the  $f_0(980)\pi$  wave.<sup>4</sup> In the  $f_0(500)\pi$  wave.<sup>5</sup> From a fit to  $J^{PC} = 0^-+ f_0(980)\pi, f_0(1370)\pi$  waves.<sup>6</sup> From a fit to  $J^{PC} = 0^-+ K_0^*(1430)K^-$  and  $f_0(980)\pi^-$  waves.<sup>7</sup> Superseded by AGHASYAN 2018B. **$\pi(1800)$  WIDTH**

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

**215<sup>+7</sup><sub>-8</sub> OUR AVERAGE**

NODE=M075

NODE=M075

NODE=M075M

NODE=M075M

NEW

OCCUR=2

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

NEW

[208 ± 12 MeV OUR 2018 AVERAGE]

|                                                                               |              |                         |     |      |                                                             |
|-------------------------------------------------------------------------------|--------------|-------------------------|-----|------|-------------------------------------------------------------|
| $220^{+8}_{-11}$                                                              | 46M          | <sup>8</sup> AGHASYAN   | 18B | COMP | 190 $\pi^- p \rightarrow \pi^- \pi^- \pi^+ p$               |
| $221 \pm 26 \pm 38$                                                           | 4k           | <sup>9</sup> EUGENIO    | 08  | B852 | 18 $\pi^- p \rightarrow \eta \eta \pi^- p$                  |
| $223 \pm 48 \pm 50$                                                           |              | <sup>10</sup> CHUNG     | 02  | B852 | 18.3 $\pi^- p \rightarrow$<br>$\pi^+ \pi^- \pi^- p$         |
| $191 \pm 21 \pm 20$                                                           |              | <sup>11</sup> CHUNG     | 02  | B852 | 18.3 $\pi^- p \rightarrow$<br>$\pi^+ \pi^- \pi^- p$         |
| $210 \pm 30 \pm 30$                                                           | 1200         | AMELIN                  | 96B | VES  | 37 $\pi^- A \rightarrow \eta \eta \pi^- A$                  |
| $190 \pm 15 \pm 15$                                                           |              | <sup>12</sup> AMELIN    | 95B | VES  | 36 $\pi^- A \rightarrow \pi^+ \pi^- \pi^- A$                |
| $210 \pm 70$                                                                  |              | <sup>13</sup> BERDNIKOV | 94  | VES  | 37 $\pi^- A \rightarrow$<br>$K^+ K^- \pi^- A$               |
| $225 \pm 35 \pm 20$                                                           |              | BELADIDZE               | 92C | VES  | 36 $\pi^- \text{Be} \rightarrow \pi^- \eta' \eta \text{Be}$ |
| $205 \pm 18 \pm 32$                                                           | $426 \pm 57$ | BITYUKOV                | 91  | VES  | 36 $\pi^- C \rightarrow \pi^- \eta \eta C$                  |
| $310 \pm 50$                                                                  | 1100         | BELLINI                 | 82  | SPEC | 40 $\pi^- A \rightarrow 3\pi A$                             |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |              |                         |     |      |                                                             |
| $208 \pm 22^{+21}_{-37}$                                                      | 420k         | <sup>14</sup> ALEKSEEV  | 10  | COMP | 190 $\pi^- Pb \rightarrow$<br>$\pi^- \pi^- \pi^+ Pb'$       |
| $259 \pm 19 \pm 6$                                                            |              | AMELIN                  | 99  | VES  | 37 $\pi^- A \rightarrow \omega \pi^- \pi^0 A^*$             |

<sup>8</sup> Statistical error negligible.<sup>9</sup> From a single-pole fit.<sup>10</sup> In the  $f_0(980)\pi$  wave.<sup>11</sup> In the  $f_0(500)\pi$  wave.<sup>12</sup> From a fit to  $J^{PC} = 0^- + f_0(980)\pi, f_0(1370)\pi$  waves.<sup>13</sup> From a fit to  $J^{PC} = 0^- + K_0^*(1430)K^-$  and  $f_0(980)\pi^-$  waves.<sup>14</sup> Superseded by AGHASYAN 2018B.

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 ( $\Gamma_i/\Gamma$ ) |
|---------------------------------------|--------------------------------|
| $\Gamma_1$ $\pi^+ \pi^- \pi^-$        | seen                           |
| $\Gamma_2$ $f_0(500)\pi^-$            | seen                           |
| $\Gamma_3$ $f_0(980)\pi^-$            | seen                           |
| $\Gamma_4$ $f_0(1370)\pi^-$           | seen                           |
| $\Gamma_5$ $f_0(1500)\pi^-$           | not seen                       |
| $\Gamma_6$ $\rho \pi^-$               | not seen                       |
| $\Gamma_7$ $\eta \eta \pi^-$          | seen                           |
| $\Gamma_8$ $a_0(980)\eta$             | seen                           |
| $\Gamma_9$ $a_2(1320)\eta$            | not seen                       |
| $\Gamma_{10}$ $f_2(1270)\pi$          | not seen                       |
| $\Gamma_{11}$ $f_0(1370)\pi^-$        | not seen                       |
| $\Gamma_{12}$ $f_0(1500)\pi^-$        | seen                           |
| $\Gamma_{13}$ $\eta \eta' (958)\pi^-$ | seen                           |
| $\Gamma_{14}$ $K_0^*(1430)K^-$        | seen                           |
| $\Gamma_{15}$ $K^*(892)K^-$           | 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

| $\Gamma(f_0(980)\pi^-)/\Gamma(f_0(500)\pi^-)$ |                     |      |         | $\Gamma_3/\Gamma_2$                            |
|-----------------------------------------------|---------------------|------|---------|------------------------------------------------|
| VALUE                                         | DOCUMENT ID         | TECN | COMMENT |                                                |
| <b><math>0.44 \pm 0.08 \pm 0.38</math></b>    | <sup>15</sup> CHUNG | 02   | B852    | 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$ |

NODE=M075R11  
 NODE=M075R11

| $\Gamma(f_0(980)\pi^-)/\Gamma(f_0(1370)\pi^-)$ |                      |      |     | $\Gamma_3/\Gamma_4$                          |
|------------------------------------------------|----------------------|------|-----|----------------------------------------------|
| VALUE                                          | DOCUMENT ID          | TECN | CHG | COMMENT                                      |
| <b><math>1.7 \pm 1.3</math></b>                | <sup>16</sup> AMELIN | 95B  | VES | 36 $\pi^- A \rightarrow \pi^+ \pi^- \pi^- A$ |

NODE=M075R5  
 NODE=M075R5

| $\Gamma(f_0(1370)\pi^-)/\Gamma_{\text{total}}$ |             |      |      | $\Gamma_4/\Gamma$               |
|------------------------------------------------|-------------|------|------|---------------------------------|
| VALUE                                          | DOCUMENT ID | TECN | CHG  | COMMENT                         |
| <b>seen</b>                                    | BELLINI     | 82   | SPEC | 40 $\pi^- A \rightarrow 3\pi A$ |

NODE=M075R1  
 NODE=M075R1

| $\Gamma(f_0(1500)\pi^-)/\Gamma_{\text{total}}$ |             |      |         | $\Gamma_5/\Gamma$                              |
|------------------------------------------------|-------------|------|---------|------------------------------------------------|
| VALUE                                          | DOCUMENT ID | TECN | COMMENT |                                                |
| <b>not seen</b>                                | CHUNG       | 02   | B852    | 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$ |

NODE=M075R12  
 NODE=M075R12

$\Gamma(\rho\pi^-)/\Gamma_{\text{total}}$ 
 $\Gamma_6/\Gamma$ 

| VALUE    | DOCUMENT ID | TECN | CHG | COMMENT                         |
|----------|-------------|------|-----|---------------------------------|
| not seen | BELLINI 82  | SPEC | —   | $40 \pi^- A \rightarrow 3\pi A$ |

NODE=M075R2  
NODE=M075R2

 $\Gamma(\rho\pi^-)/\Gamma(f_0(980)\pi^-)$ 
 $\Gamma_6/\Gamma_3$ 

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

 $\Gamma(\eta\eta\pi^-)/\Gamma(\pi^+\pi^-\pi^-)$ 
 $\Gamma_7/\Gamma_1$ 

| VALUE                                                                         | EVTS | DOCUMENT ID              | TECN | CHG | COMMENT                                  |
|-------------------------------------------------------------------------------|------|--------------------------|------|-----|------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                          |      |     |                                          |
| $0.5 \pm 0.1$                                                                 | 1200 | <sup>16</sup> AMELIN 96B | VES  | —   | $37 \pi^- A \rightarrow \eta\eta\pi^- A$ |

NODE=M075R8  
NODE=M075R8

 $\Gamma(a_2(1320)\eta)/\Gamma_{\text{total}}$ 
 $\Gamma_9/\Gamma$ 

| VALUE    | DOCUMENT ID | TECN | COMMENT                                  |
|----------|-------------|------|------------------------------------------|
| not seen | EUGENIO 08  | B852 | $18 \pi^- p \rightarrow \eta\eta\pi^- p$ |

NODE=M075R13  
NODE=M075R13

 $\Gamma(f_2(1270)\pi)/\Gamma_{\text{total}}$ 
 $\Gamma_{10}/\Gamma$ 

| VALUE    | DOCUMENT ID | TECN | COMMENT                                  |
|----------|-------------|------|------------------------------------------|
| not seen | EUGENIO 08  | B852 | $18 \pi^- p \rightarrow \eta\eta\pi^- p$ |

NODE=M075R14  
NODE=M075R14

 $\Gamma(f_0(1370)\pi^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{11}/\Gamma$ 

| VALUE    | DOCUMENT ID | TECN | COMMENT                                  |
|----------|-------------|------|------------------------------------------|
| not seen | 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                                  |
|-------|--------------|------|-----|------------------------------------------|
| seen  | 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                                  |
|----------|--------------|------|-----|------------------------------------------|
| not seen | 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

|               |                              |                                             |                    |
|---------------|------------------------------|---------------------------------------------|--------------------|
| 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.)      |
| AMELIN 96B    | Translated from YAF 62 487.  |                                             |                    |
|               | 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. Bitjukov, G.V. Borisov | (SERP+)            |
|               | Translated from YAF 55 2748. |                                             |                    |
| BITYUKOV 91   | PL B268 137                  | S.I. Bitjukov <i>et al.</i>                 | (SERP, TBIL)       |
| BELLINI 82    | PRL 48 1697                  | G. Bellini <i>et al.</i>                    | (MILA, BGNA, JINR) |

NODE=M075

REFID=59471  
REFID=53356  
REFID=52160  
REFID=48837  
REFID=48318  
REFID=46910  
  
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 OUR AVERAGE</b> Error includes scale factor of 1.4. See the ideogram below. |      |                       |          |                                                        |
| 1822 <sup>+29+66</sup> <sub>-24-57</sub>                                               | 5.5k | <sup>1</sup> ABLIKIM  | 13N BES3 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\eta\eta$ |
| 1737±9 <sup>+198</sup> <sub>-65</sub>                                                  |      | <sup>2</sup> UEHARA   | 10A BELL | 10.6 $e^+e^- \rightarrow e^+e^-\eta\eta$               |
| 1800±30                                                                                | 40   | ALDE                  | 88D GAM4 | 300 $\pi^-p \rightarrow \pi^-p4\pi^0$                  |
| 1806±10                                                                                | 1600 | ALDE                  | 87 GAM4  | 100 $\pi^-p \rightarrow 4\pi^0n$                       |
| 1870±40                                                                                |      | <sup>3</sup> ALDE     | 86D GAM4 | 100 $\pi^-p \rightarrow \eta\eta n$                    |
| 1857 <sup>+35</sup> <sub>-24</sub>                                                     |      | <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. • • •          |      |                       |          |                                                        |
| 1858 <sup>+18</sup> <sub>-71</sub>                                                     |      | <sup>5</sup> LONGACRE | 86 RVUE  | Compilation                                            |
| 1799±15                                                                                |      | <sup>6</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 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> From a partial-wave analysis of data using a K-matrix formalism with 5 poles. Includes compilation of several other experiments.

<sup>6</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

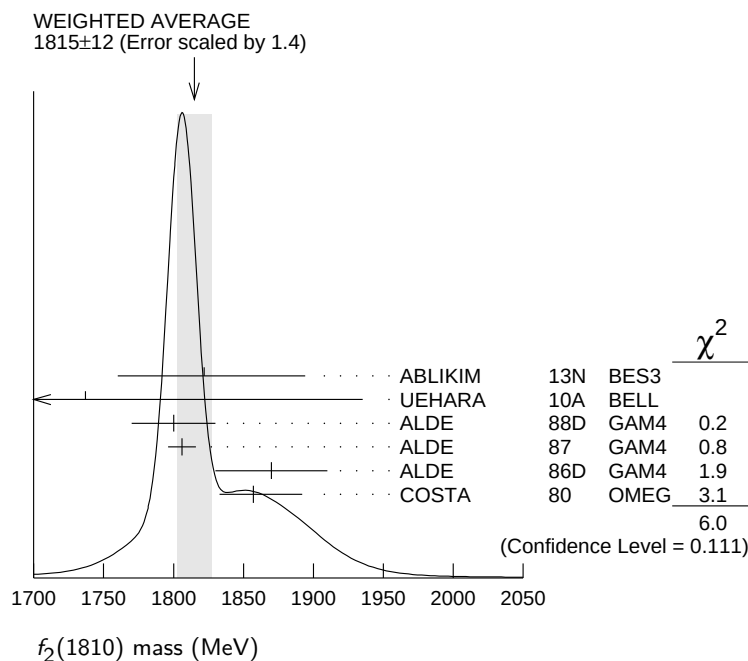
NODE=M038M;LINKAGE=UE

NODE=M038M;LINKAGE=F

NODE=M038M;LINKAGE=A

NODE=M038M;LINKAGE=L

NODE=M038M;LINKAGE=P1

 **$f_2(1810)$  WIDTH**

| VALUE (MeV)                                                                           | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                |
|---------------------------------------------------------------------------------------|------|----------------------|----------|--------------------------------------------------------|
| <b>197±22 OUR AVERAGE</b> Error includes scale factor of 1.5. See the ideogram below. |      |                      |          |                                                        |
| 229 <sup>+52+88</sup> <sub>-42-155</sub>                                              | 5.5k | <sup>7</sup> ABLIKIM | 13N BES3 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\eta\eta$ |
| 228 <sup>+21+234</sup> <sub>-20-153</sub>                                             |      | <sup>8</sup> UEHARA  | 10A BELL | 10.6 $e^+e^- \rightarrow e^+e^-\eta\eta$               |
| 160±30                                                                                | 40   | ALDE                 | 88D GAM4 | 300 $\pi^-p \rightarrow \pi^-p4\pi^0$                  |

NODE=M038W

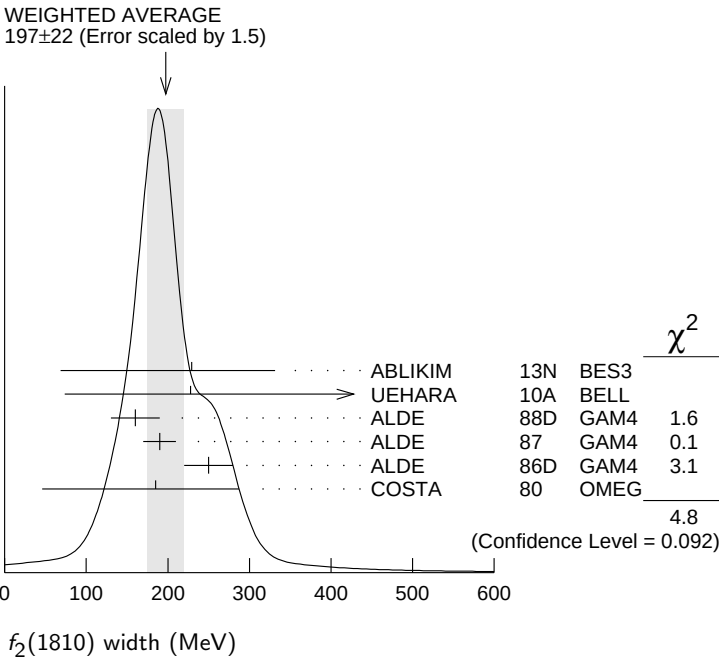
NODE=M038W

|                                     |      |                     |     |      |     |                                  |
|-------------------------------------|------|---------------------|-----|------|-----|----------------------------------|
| 190± 20                             | 1600 | ALDE                | 87  | GAM4 | 100 | $\pi^- p \rightarrow 4\pi^0 n$   |
| 250± 30                             |      | <sup>9</sup> ALDE   | 86D | GAM4 | 100 | $\pi^- p \rightarrow \eta\eta n$ |
| 185 <sup>+102</sup> <sub>-139</sub> |      | <sup>10</sup> COSTA | 80  | OMEG | 10  | $\pi^- p \rightarrow K^+ K^- n$  |

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

|                                   |                        |    |      |                                                 |
|-----------------------------------|------------------------|----|------|-------------------------------------------------|
| 388 <sup>+15</sup> <sub>-21</sub> | <sup>11</sup> LONGACRE | 86 | RVUE | Compilation                                     |
| 280 <sup>+42</sup> <sub>-35</sub> | <sup>12</sup> CASON    | 82 | STRC | $8 \pi^+ p \rightarrow \Delta^{++} \pi^0 \pi^0$ |

- <sup>7</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.  
<sup>8</sup> Breit-Wigner width. Could also be the  $f_2(1910)$ .  
<sup>9</sup> Seen in only one solution.  
<sup>10</sup> Error increased by spread of two solutions. Included in LONGACRE 86 global analysis.  
<sup>11</sup> From a partial-wave analysis of data using a K-matrix formalism with 5 poles. Includes compilation of several other experiments.  
<sup>12</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 ( $\Gamma_i/\Gamma$ ) |
|-------------------------|--------------------------------|
| $\Gamma_1 \pi\pi$       |                                |
| $\Gamma_2 \eta\eta$     | seen                           |
| $\Gamma_3 4\pi^0$       | seen                           |
| $\Gamma_4 K^+ K^-$      |                                |
| $\Gamma_5 \gamma\gamma$ | seen                           |

**$f_2(1810) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$**

| $\Gamma(\eta\eta) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$ |                      |      |         | $\Gamma_2 \Gamma_5 / \Gamma$                |
|------------------------------------------------------------------------|----------------------|------|---------|---------------------------------------------|
| VALUE (eV)                                                             | DOCUMENT ID          | TECN | COMMENT |                                             |
| 5.2 <sup>+0.9+37.3</sup> <sub>-0.8-4.5</sub>                           | <sup>13</sup> UEHARA | 10A  | BELL    | 10.6 $e^+ e^- \rightarrow e^+ e^- \eta\eta$ |

- <sup>13</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=M038W;LINKAGE=B

NODE=M038W;LINKAGE=UE  
NODE=M038W;LINKAGE=F  
NODE=M038W;LINKAGE=A  
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 ←

NODE=M038225

NODE=M038G01  
NODE=M038G01

NODE=M038G01;LINKAGE=UE

**$f_2(1810)$  BRANCHING RATIOS**

NODE=M038220

| $\Gamma(\pi\pi)/\Gamma_{\text{total}}$                                        | DOCUMENT ID            | TECN | COMMENT                                                             | $\Gamma_1/\Gamma$ |
|-------------------------------------------------------------------------------|------------------------|------|---------------------------------------------------------------------|-------------------|
| VALUE                                                                         |                        |      |                                                                     |                   |
| • • • 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>14</sup> LONGACRE | 86   | RVUE Compilation                                                    |                   |
| $0.44 \pm 0.03$                                                               | <sup>15</sup> CASON    | 82   | STRC $8 \pi^+ p \rightarrow \Delta^{++} \pi^0 \pi^0$                |                   |

<sup>14</sup> From a partial-wave analysis of data using a K-matrix formalism with 5 poles. Includes compilation of several other experiments.

<sup>15</sup> Included in LONGACRE 86 global analysis.

NODE=M038R2;LINKAGE=L

NODE=M038R;LINKAGE=C

| $\Gamma(\eta\eta)/\Gamma_{\text{total}}$                                      | DOCUMENT ID            | TECN | COMMENT                                           | $\Gamma_2/\Gamma$ |
|-------------------------------------------------------------------------------|------------------------|------|---------------------------------------------------|-------------------|
| VALUE                                                                         |                        |      |                                                   |                   |
| 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>16</sup> LONGACRE | 86   | RVUE Compilation                                  |                   |

<sup>16</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

| $\Gamma(\pi\pi)/\Gamma(4\pi^0)$                                               | DOCUMENT ID | TECN | COMMENT                                 | $\Gamma_1/\Gamma_3$ |
|-------------------------------------------------------------------------------|-------------|------|-----------------------------------------|---------------------|
| VALUE                                                                         |             |      |                                         |                     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                         |                     |
| <0.75                                                                         | ALDE        | 87   | GAM4 $100 \pi^- p \rightarrow 4\pi^0 n$ |                     |

NODE=M038R4  
NODE=M038R4

| $\Gamma(4\pi^0)/\Gamma(\eta\eta)$                                             | DOCUMENT ID | TECN | COMMENT                                 | $\Gamma_3/\Gamma_2$ |
|-------------------------------------------------------------------------------|-------------|------|-----------------------------------------|---------------------|
| VALUE                                                                         |             |      |                                         |                     |
| • • • 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

| $\Gamma(K^+ K^-)/\Gamma_{\text{total}}$                                       | DOCUMENT ID            | TECN | COMMENT                                 | $\Gamma_4/\Gamma$ |
|-------------------------------------------------------------------------------|------------------------|------|-----------------------------------------|-------------------|
| VALUE                                                                         |                        |      |                                         |                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                        |      |                                         |                   |
| $0.003^{+0.019}_{-0.002}$                                                     | <sup>17</sup> LONGACRE | 86   | RVUE Compilation                        |                   |
| seen                                                                          | COSTA                  | 80   | OMEG $10 \pi^- p \rightarrow K^+ K^- n$ |                   |

NODE=M038R1  
NODE=M038R1

<sup>17</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

|            |     |                               |                               |                           |
|------------|-----|-------------------------------|-------------------------------|---------------------------|
| ABLIKIM    | 13N | PR D87 092009                 | Ablikim M. <i>et al.</i>      | (BES III 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)                    |
|            |     | Translated from DANS 353 323. |                               |                           |
| ALDE       | 88D | SJNP 47 810                   | D.M. Alde <i>et al.</i>       | (SERP, BELG, LANL, LAPP+) |
|            |     | Translated from YAF 47 1273.  |                               |                           |
| 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+)        |
| 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+) |

REFID=55387  
REFID=53641  
REFID=52166  
REFID=48580  
REFID=45386  
  
REFID=44652  
  
REFID=40221  
REFID=20765  
REFID=20768  
REFID=20746  
REFID=20737

**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

<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  $\gamma \phi$  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 unconfirmed states  $\gamma X(2120)$ , and  $\gamma X(2370)$ , for  $M(p\bar{p}) < 2.8$  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

| VALUE (MeV)                                                              | CL% EVTS | DOCUMENT ID          | TECN     | COMMENT                                       |
|--------------------------------------------------------------------------|----------|----------------------|----------|-----------------------------------------------|
| <b>242<sup>+14</sup><sub>-15</sub> OUR AVERAGE</b>                       |          |                      |          |                                               |
| 245.2 $\pm$ 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> $\pm$ 62 <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                                 |      | 2   | ABLIKIM   | 18I | BES3 | $J/\psi \rightarrow \gamma \gamma \phi(1020)$ |
| 273.5 ± 21.4 <sup>+6.1</sup> <sub>-64.0</sub> |      | 3   | 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   | 4   | ABLIKIM   | 12D | BES3 | $J/\psi \rightarrow \gamma p \bar{p}$         |
| 190 ± 9 <sup>+38</sup> <sub>-36</sub>         | 4265 | 5   | ABLIKIM   | 11C | BES3 | $J/\psi \rightarrow \gamma \pi^+ \pi^- \eta'$ |
| 57 ± 12 <sup>+19</sup> <sub>-4</sub>          |      | 6   | ABLIKIM   | 11J | BES3 | $J/\psi \rightarrow \omega(\eta \pi^+ \pi^-)$ |
| 0 <sup>+44</sup> <sub>-0</sub>                | 231  | 7,8 | 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   | 8,9 | ABLIKIM   | 05R | BES2 | $J/\psi \rightarrow \gamma p \bar{p}$         |
| < 30                                          |      | 8   | BAI       | 03F | BES2 | $J/\psi \rightarrow \gamma p \bar{p}$         |

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

<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  $\gamma \phi$  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 unconfirmed states  $\gamma X(2120)$ , and  $\gamma X(2370)$ , for  $M(p \bar{p}) < 2.8$  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.

### 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 |                              |

NODE=M085G01  
NODE=M085G01

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

|       |    |   |       |     |      |                                                 |
|-------|----|---|-------|-----|------|-------------------------------------------------|
| <35.6 | 90 | 1 | ZHANG | 12A | BELL | $e^+ e^- \rightarrow e^+ e^- \eta' \pi^+ \pi^-$ |
| <83   | 90 | 2 | 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 |                     |

NODE=M085R01  
NODE=M085R01

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

|       |         |     |      |                                               |
|-------|---------|-----|------|-----------------------------------------------|
| 0.333 | ABLIKIM | 05R | BES2 | $J/\psi \rightarrow \gamma \pi^+ \pi^- \eta'$ |
|-------|---------|-----|------|-----------------------------------------------|

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

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

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

|           |                      |     |                                                   |
|-----------|----------------------|-----|---------------------------------------------------|
| 6.7 ± 1.8 | <sup>1</sup> ABLIKIM | 15T | BES3 $J/\psi \rightarrow \gamma K_S^0 K_S^0 \eta$ |
|-----------|----------------------|-----|---------------------------------------------------|

<sup>1</sup> Using results from ABLIKIM 05R.

NODE=M085R00  
NODE=M085R00

NODE=M085R00;LINKAGE=A

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

| 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

 $\Gamma(\gamma \phi(1020)) / \Gamma_{\text{total}}$ 

| 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  $\gamma \phi$  mass. Angular analysis consistent with  $J^{PC} = 0^{-+}$ . Other  $J^{PC}$  not excluded.

NODE=M085R04  
NODE=M085R04

NODE=M085R04;LINKAGE=A

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

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

|                 |                      |     |                                                              |
|-----------------|----------------------|-----|--------------------------------------------------------------|
| <b>&lt;9.80</b> | <sup>1</sup> ABLIKIM | 180 | 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

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

| 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>         | (BES III Collab.)     |
| ABLIKIM       | 18O | PR D97 072014  | M. Ablikim <i>et al.</i>         | (BES III Collab.)     |
| ABLIKIM       | 16J | PRL 117 042002 | M. Ablikim <i>et al.</i>         | (BES III Collab.)     |
| ABLIKIM       | 15T | PRL 115 091803 | M. Ablikim <i>et al.</i>         | (BES III Collab.)     |
| ABLIKIM       | 13U | PR D88 091502  | M. Ablikim <i>et al.</i>         | (BES III Collab.)     |
| ABLIKIM       | 12D | PRL 108 112003 | M. Ablikim <i>et al.</i>         | (BES III 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>         | (BES III Collab.)     |
| ABLIKIM       | 11J | PRL 107 182001 | M. Ablikim <i>et al.</i>         | (BES III Collab.)     |
| ABLIKIM       | 10G | CP C34 421     | M. Ablikim <i>et al.</i>         | (BES III 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  
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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

$\eta_2(1870)$ 

$$I^G(J^{PC}) = 0^+(2^-+)$$

Needs confirmation.

NODE=M101

NODE=M101

NODE=M101M

NODE=M101M

 $\eta_2(1870)$  MASS

| 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   | $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$  |

 $\eta_2(1870)$  WIDTH

| 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

NODE=M101W

 $\eta_2(1870)$  DECAY MODES

| 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                           |

NODE=M101225;NODE=M101

DESIG=1

DESIG=4

DESIG=8

DESIG=2

DESIG=9

 $\eta_2(1870)$  BRANCHING RATIOS $\Gamma(a_2(1320)\pi)/\Gamma(f_2(1270)\eta)$   $\Gamma_2/\Gamma_3$ 

| 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=M101230

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

**1876<sup>+17</sup><sub>-4</sub> OUR AVERAGE** Error includes scale factor of 1.3. See the ideogram below.

NEW

[1895 ± 16 MeV OUR 2018 AVERAGE]

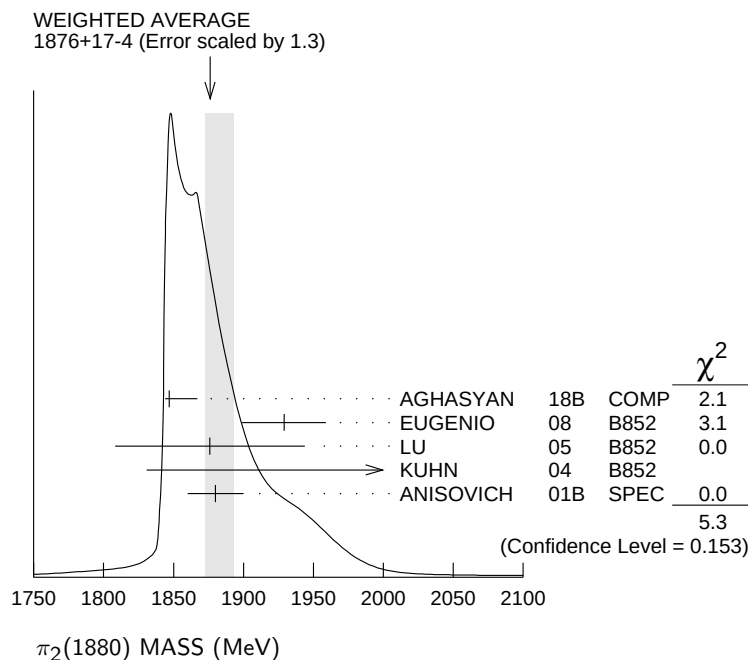
|                                   |      |                       |     |      |                                                   |
|-----------------------------------|------|-----------------------|-----|------|---------------------------------------------------|
| 1847 <sup>+20</sup> <sub>-3</sub> | 46M  | <sup>1</sup> AGHASYAN | 18B | COMP | 190 $\pi^- p \rightarrow \pi^- \pi^- \pi^+ p$     |
| 1929 ± 24 ± 18                    | 4k   | EUGENIO               | 08  | B852 | 18 $\pi^- p \rightarrow \eta \eta \pi^- p$        |
| 1876 ± 11 ± 67                    | 145k | LU                    | 05  | B852 | 18 $\pi^- p \rightarrow \omega \pi^- \pi^0 p$     |
| 2003 ± 88 ± 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 ± 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

**241 ± 23 OUR AVERAGE**

NEW

[235 ± 34 MeV OUR 2018 AVERAGE]

|                                   |      |                       |     |      |                                                   |
|-----------------------------------|------|-----------------------|-----|------|---------------------------------------------------|
| 246 <sup>+33</sup> <sub>-28</sub> | 46M  | <sup>2</sup> AGHASYAN | 18B | COMP | 190 $\pi^- p \rightarrow \pi^- \pi^- \pi^+ p$     |
| 323 ± 87 ± 43                     | 4k   | EUGENIO               | 08  | B852 | 18 $\pi^- p \rightarrow \eta \eta \pi^- p$        |
| 146 ± 17 ± 62                     | 145k | LU                    | 05  | B852 | 18 $\pi^- p \rightarrow \omega \pi^- \pi^0 p$     |
| 306 ± 132 ± 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 ± 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 | $e^+e^- \rightarrow \text{hadrons}$                |

<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.

OCCUR=2

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 | $e^+e^- \rightarrow \text{hadrons}$                |

<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

OCCUR=2

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 <sup>-8</sup> )                                               | EVTs | DOCUMENT ID         | TECN     | COMMENT                                                |
|-------------------------------------------------------------------------------|------|---------------------|----------|--------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                     |          |                                                        |
| 4.2±1.2±0.8                                                                   | 54   | <sup>7</sup> AUBERT | 08S BABR | 10.6 e <sup>+</sup> e <sup>-</sup> → $\phi\pi^0\gamma$ |
| <sup>7</sup> From the fit with two resonances.                                |      |                     |          |                                                        |

NODE=M170215

NODE=M170B01  
NODE=M170B01

NODE=M170B01;LINKAGE=AU

NODE=M170225;NODE=M170

$\rho(1900)$  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                       |

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 ←

$\rho(1900)$  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 | $e^+e^- \rightarrow \text{hadrons}$      |

NODE=M170230

NODE=M170R1  
NODE=M170R1

$\rho(1900)$  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          |                     |

NODE=M170

REFID=55370  
REFID=52242  
REFID=51047  
REFID=49614  
REFID=48576  
REFID=48350  
REFID=44633  
REFID=49668

$f_2(1910)$

$I^G(J^{PC}) = 0^+(2^{++})$

NODE=M142

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.

NODE=M142

$f_2(1910)$  MASS

NODE=M142205

NODE=M142MX

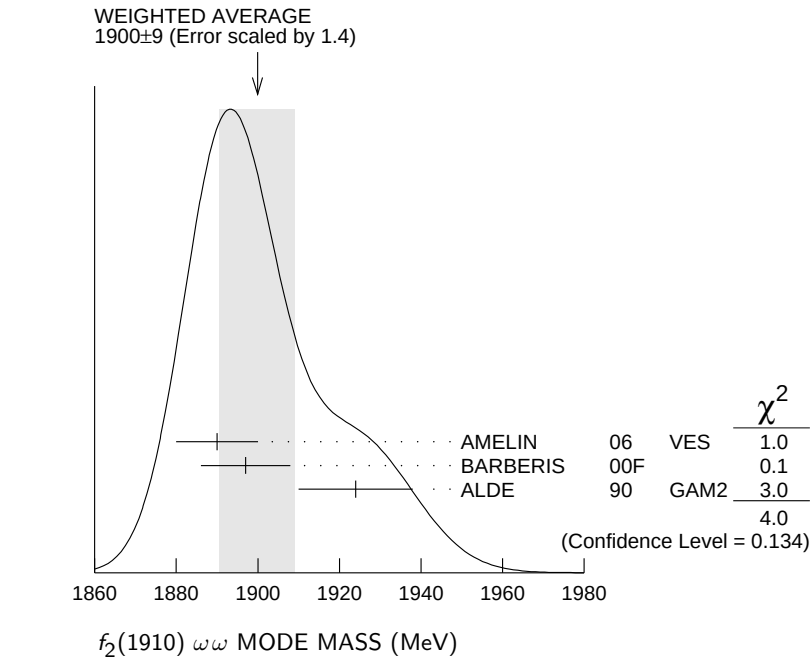
$f_2(1910)$   $\omega\omega$  MODE

| VALUE (MeV)                                                                                                                                  |              | DOCUMENT ID  | TECN | COMMENT                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|------|------------------------------------------|
| <b>1900± 9 OUR AVERAGE</b> Error includes scale factor of 1.4. See the ideogram below.<br>[1903 ± 9 MeV OUR 2018 AVERAGE Scale factor = 1.5] |              |              |      |                                          |
| 1890±10                                                                                                                                      | <sup>1</sup> | AMELIN 06    | VES  | $36 \pi^- p \rightarrow \omega\omega n$  |
| 1897±11                                                                                                                                      |              | BARBERIS 00F |      | $450 pp \rightarrow p_f\omega\omega p_S$ |
| 1924±14                                                                                                                                      |              | ALDE 90      | GAM2 | $38 \pi^- p \rightarrow \omega\omega n$  |

NODE=M142M2  
NODE=M142M2  
NEW

<sup>1</sup>Supersedes BELADIDZE 92B.

NODE=M142M2;LINKAGE=AM



**$f_2(1910) \eta\eta'$  MODE**

| VALUE (MeV)                                                                   | DOCUMENT ID            | TECN | COMMENT                                    |
|-------------------------------------------------------------------------------|------------------------|------|--------------------------------------------|
| 1934±16                                                                       | <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

NODE=M142M3;LINKAGE=KS  
NODE=M142M3;LINKAGE=AN

**$f_2(1910) K^+ K^-$  MODE**

| VALUE (MeV) | DOCUMENT ID         | TECN | COMMENT                                         |
|-------------|---------------------|------|-------------------------------------------------|
| 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=M142M4  
NODE=M142M4

NODE=M142M4;LINKAGE=A

**$f_2(1910)$  WIDTH**

NODE=M142210

NODE=M142WX

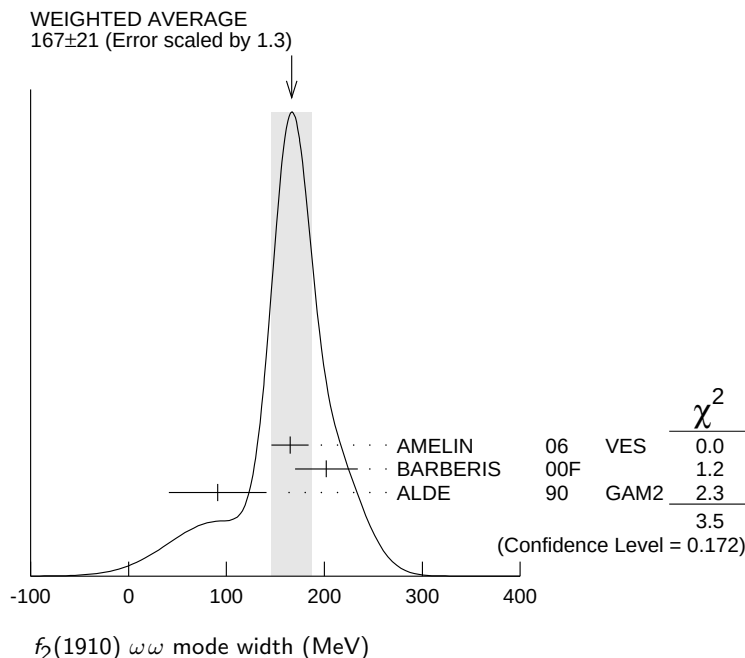
**$f_2(1910) \omega\omega$  MODE**

| VALUE (MeV)                                        | DOCUMENT ID                                                 | TECN    | COMMENT                                   |
|----------------------------------------------------|-------------------------------------------------------------|---------|-------------------------------------------|
| <b>167±21 OUR AVERAGE</b>                          | Error includes scale factor of 1.3. See the ideogram below. |         |                                           |
| [196 ± 31 MeV OUR 2018 AVERAGE Scale factor = 2.3] |                                                             |         |                                           |
| 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  
NEW

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

### $f_2(1910) K^+ K^-$ 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

$$\Gamma(K_S^0 K_S^0)/\Gamma(\eta\eta')$$

$$\Gamma_3/\Gamma_6$$

| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT                                  |
|-------------------------------------------------------------------------------|-----|-------------|------|------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                          |
| <0.066                                                                        | 90  | BALOSHIN    | 86   | SPEC $40\pi p \rightarrow K_S^0 K_S^0 n$ |

NODE=M142R7  
NODE=M142R7

$$\Gamma(\eta\eta)/\Gamma(\eta\eta')$$

$$\Gamma_4/\Gamma_6$$

| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT                                  |
|-------------------------------------------------------------------------------|-----|-------------|------|------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                          |
| <0.05                                                                         | 90  | ALDE        | 91B  | GAM2 $38\pi^- p \rightarrow \eta\eta' n$ |

NODE=M142R6  
NODE=M142R6

$$\Gamma(\omega\omega)/\Gamma(\eta\eta')$$

$$\Gamma_5/\Gamma_6$$

| VALUE                                                                         | DOCUMENT ID  | COMMENT                                    |
|-------------------------------------------------------------------------------|--------------|--------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |              |                                            |
| $2.6 \pm 0.6$                                                                 | BARBERIS 00F | 450 $pp \rightarrow p_f \omega \omega p_S$ |

NODE=M142R10  
NODE=M142R10

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

$$\Gamma_7/\Gamma$$

| 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 $\pi^- p \rightarrow \eta' \eta' n$   |

NODE=M142R8  
NODE=M142R8

$$\Gamma(\rho\rho)/\Gamma(\omega\omega)$$

$$\Gamma_8/\Gamma_5$$

| VALUE                                                                         | DOCUMENT ID  | COMMENT                                    |
|-------------------------------------------------------------------------------|--------------|--------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |              |                                            |
| $2.6 \pm 0.4$                                                                 | BARBERIS 00F | 450 $pp \rightarrow p_f \omega \omega p_S$ |

NODE=M142R9  
NODE=M142R9

$$\Gamma(f_2(1270)\eta)/\Gamma(a_2(1320)\pi)$$

$$\Gamma_{10}/\Gamma_9$$

| VALUE              | DOCUMENT ID               | TECN | COMMENT             |
|--------------------|---------------------------|------|---------------------|
| <b>0.09 ± 0.05</b> | <sup>1</sup> ANISOVICH 11 | SPEC | 0.9–1.94 $p\bar{p}$ |

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>      | (CBAR 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> |                           |
| 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

**$a_0(1950)$** 

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

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

| $\Gamma(K\bar{K})/\Gamma_{\text{total}}$                     | VALUE | EVTS | DOCUMENT ID       | TECN     | COMMENT                                                       | $\Gamma_1/\Gamma$ |
|--------------------------------------------------------------|-------|------|-------------------|----------|---------------------------------------------------------------|-------------------|
| 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-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

**$f_2(1950)$** 

$$I^G(J^{PC}) = 0^+(2^{++})$$

NODE=M135

 **$f_2(1950)$  MASS**

NODE=M135M

| VALUE (MeV)                                                                   | DOCUMENT ID                                                 | TECN | COMMENT                                                        |
|-------------------------------------------------------------------------------|-------------------------------------------------------------|------|----------------------------------------------------------------|
| <b>1944±12 OUR AVERAGE</b>                                                    | Error includes scale factor of 1.5. 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 $pp \rightarrow pp4\pi$                                    |
| 1940±22                                                                       | <sup>2</sup> BARBERIS                                       | 00C  | 450 $pp \rightarrow pp2\pi2\pi^0$                              |
| 1960±30                                                                       | BARBERIS                                                    | 97B  | OMEG 450 $pp \rightarrow pp2(\pi^+\pi^-)$                      |
| 1918±12                                                                       | ANTINORI                                                    | 95   | OMEG 300,450 $pp \rightarrow pp2(\pi^+\pi^-)$                  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                                             |      |                                                                |
| 2038 <sup>+13+12</sup> <sub>-11-73</sub>                                      | <sup>3</sup> UEHARA                                         | 09   | BELL 10.6 $e^+e^- \rightarrow e^+e^-\pi^0\pi^0$                |
| 1930±25                                                                       | <sup>4</sup> BINON                                          | 05   | GAMS 33 $\pi^-p \rightarrow \eta\eta n$                        |
| 1980± 2±14                                                                    | ABE                                                         | 04   | BELL 10.6 $e^+e^- \rightarrow e^+e^-K^+K^-$                    |
| 1867±46                                                                       | <sup>5</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 1.35–1.94 $p\bar{p} \rightarrow \eta\eta\pi^0$            |
| ~ 1990                                                                        | <sup>6</sup> OAKDEN                                         | 94   | RVUE 0.36–1.55 $\bar{p}p \rightarrow \pi\pi$                   |
| 1950±15                                                                       | <sup>7</sup> ASTON                                          | 91   | LASS 11 $K^-p \rightarrow \Lambda K\bar{K}\pi\pi$              |

NODE=M135M

OCCUR=2

<sup>1</sup> Decaying into  $\pi^+\pi^-2\pi^0$ .<sup>2</sup> Decaying into  $2(\pi^+\pi^-)$ .<sup>3</sup> Taking into account  $f_4(2050)$ .<sup>4</sup> First solution, PWA is ambiguous.<sup>5</sup> T-matrix pole.<sup>6</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>7</sup> Cannot determine spin to be 2.

NODE=M135M;LINKAGE=A4

NODE=M135M;LINKAGE=B4

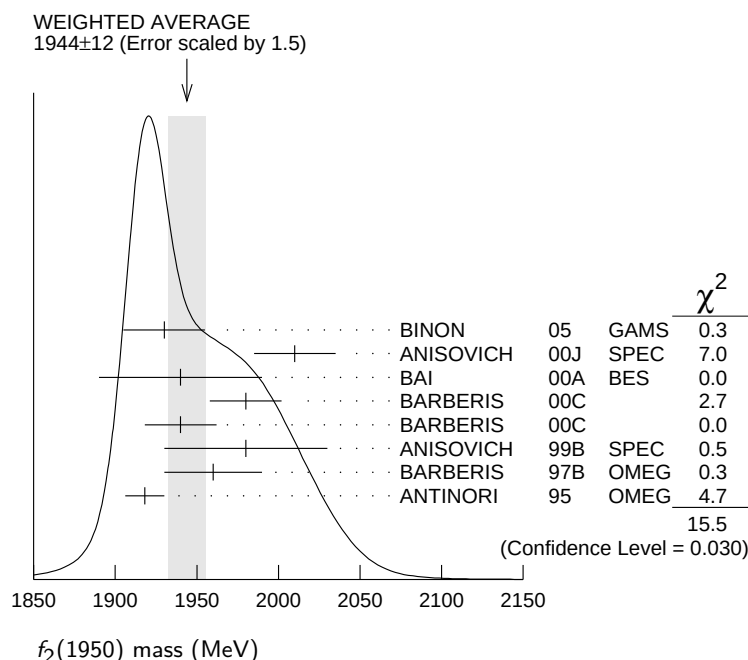
NODE=M135M;LINKAGE=UE

NODE=M135M;LINKAGE=BI

NODE=M135M;LINKAGE=TT

NODE=M135M;LINKAGE=BB

NODE=M135M;LINKAGE=A

 **$f_2(1950)$  WIDTH**

NODE=M135W

| VALUE (MeV)                        | DOCUMENT ID           | TECN | COMMENT                                               |
|------------------------------------|-----------------------|------|-------------------------------------------------------|
| <b>472± 18 OUR AVERAGE</b>         |                       |      |                                                       |
| 380 <sup>+120</sup> <sub>-90</sub> | BAI                   | 00A  | BES $J/\psi \rightarrow \gamma(\pi^+\pi^-\pi^+\pi^-)$ |
| 520± 50                            | <sup>8</sup> BARBERIS | 00C  | 450 $pp \rightarrow pp4\pi$                           |
| 485± 55                            | <sup>9</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 $pp \rightarrow pp2(\pi^+\pi^-)$         |

NODE=M135W

OCCUR=2



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

|                                      |                      |     |      |                                                                |
|--------------------------------------|----------------------|-----|------|----------------------------------------------------------------|
| $441^{+27}_{-25} - 192^{+28}_{-192}$ | <sup>10</sup> UEHARA | 09  | BELL | $10.6 e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$                 |
| $450 \pm 50$                         | <sup>11</sup> BINON  | 05  | GAMS | $33 \pi^- p \rightarrow \eta \eta n$                           |
| $297 \pm 12 \pm 6$                   | ABE                  | 04  | BELL | $10.6 e^+ e^- \rightarrow e^+ e^- K^+ K^-$                     |
| $385 \pm 58$                         | <sup>12</sup> AMSLER | 02  | CBAR | $0.9 \bar{p} p \rightarrow \pi^0 \eta \eta, \pi^0 \pi^0 \pi^0$ |
| $495 \pm 35$                         | ANISOVICH            | 00J | SPEC |                                                                |
| $500 \pm 100$                        | ANISOVICH            | 99B | SPEC | $1.35-1.94 p \bar{p} \rightarrow \eta \eta \pi^0$              |
| $\sim 100$                           | <sup>13</sup> OAKDEN | 94  | RVUE | $0.36-1.55 \bar{p} p \rightarrow \pi \pi$                      |
| $250 \pm 50$                         | <sup>14</sup> ASTON  | 91  | LASS | $11 K^- p \rightarrow \Lambda K \bar{K} \pi \pi$               |

<sup>8</sup> Decaying into  $\pi^+ \pi^- 2\pi^0$ .

<sup>9</sup> Decaying into  $2(\pi^+ \pi^-)$ .

<sup>10</sup> Taking into account  $f_4(2050)$ .

<sup>11</sup> First solution, PWA is ambiguous.

<sup>12</sup> T-matrix pole.

<sup>13</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>14</sup> Cannot determine spin to be 2.

NODE=M135W;LINKAGE=A4

NODE=M135W;LINKAGE=B4

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

| 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                           |
| $\Gamma_{12}$ $\rho \bar{\rho}$      | seen                           |

NODE=M135215;NODE=M135

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

## $f_2(1950) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$

| $\Gamma(K \bar{K}) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$ | $\Gamma_{10} \Gamma_{11} / \Gamma$ |
|-------------------------------------------------------------------------|------------------------------------|
| VALUE (eV)                                                              | DOCUMENT ID TECN COMMENT           |

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

|                    |                   |    |      |                                            |
|--------------------|-------------------|----|------|--------------------------------------------|
| $122 \pm 4 \pm 26$ | <sup>15</sup> ABE | 04 | BELL | $10.6 e^+ e^- \rightarrow e^+ e^- K^+ K^-$ |
|--------------------|-------------------|----|------|--------------------------------------------|

<sup>15</sup> Assuming spin 2.

NODE=M135225

NODE=M135G1

NODE=M135G1

NODE=M135G1;LINKAGE=AB

| $\Gamma(\pi\pi) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$ | $\Gamma_2 \Gamma_{11} / \Gamma$ |
|----------------------------------------------------------------------|---------------------------------|
| VALUE                                                                | DOCUMENT ID TECN COMMENT        |

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

|                                 |                      |    |      |                                                |
|---------------------------------|----------------------|----|------|------------------------------------------------|
| $162^{+69}_{-42} - 1137_{-204}$ | <sup>16</sup> UEHARA | 09 | BELL | $10.6 e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$ |
|---------------------------------|----------------------|----|------|------------------------------------------------|

<sup>16</sup> Taking into account  $f_4(2050)$ .

NODE=M135G2

NODE=M135G2

NODE=M135G2;LINKAGE=UE

## $f_2(1950)$ BRANCHING RATIOS

| $\Gamma(K^*(892) \bar{K}^*(892)) / \Gamma_{\text{total}}$ | $\Gamma_1 / \Gamma$                                              |
|-----------------------------------------------------------|------------------------------------------------------------------|
| VALUE                                                     | DOCUMENT ID TECN CHG COMMENT                                     |
| seen                                                      | ASTON 91 LASS 0 11 $K^- p \rightarrow \Lambda K \bar{K} \pi \pi$ |

NODE=M135220

NODE=M135R1

NODE=M135R1

| $\Gamma(a_2(1320) \pi) / \Gamma_{\text{total}}$ | $\Gamma_7 / \Gamma$      |
|-------------------------------------------------|--------------------------|
| VALUE                                           | DOCUMENT ID TECN COMMENT |

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

|               |          |     |      |                                                |
|---------------|----------|-----|------|------------------------------------------------|
| not seen      | BARBERIS | 00B |      | $450 p p \rightarrow p_f \eta \pi^+ \pi^- p_s$ |
| not seen      | BARBERIS | 00C |      | $450 p p \rightarrow p_f 4\pi p_s$             |
| possibly seen | BARBERIS | 97B | OMEG | $450 p p \rightarrow p p 2(\pi^+ \pi^-)$       |

NODE=M135R3

NODE=M135R3

$\Gamma(\eta\eta)/\Gamma(4\pi)$ 

| 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 $p\bar{p} \rightarrow p_f \eta \eta p_S$ |
|-----------------------|----|----------|--------------------------------------------------|

 $\Gamma_9/\Gamma_5$ 

NODE=M135R5  
NODE=M135R5

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

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

|                  |        |    |                                                                    |
|------------------|--------|----|--------------------------------------------------------------------|
| <b>0.14±0.05</b> | AMSLER | 02 | CBAR 0.9 $\bar{p}p \rightarrow \pi^0 \eta \eta, \pi^0 \pi^0 \pi^0$ |
|------------------|--------|----|--------------------------------------------------------------------|

 $\Gamma_9/\Gamma_3$ 

NODE=M135R6  
NODE=M135R6

 $\Gamma(p\bar{p})/\Gamma_{\text{total}}$ 

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

|             |     |           |    |                                              |
|-------------|-----|-----------|----|----------------------------------------------|
| <b>seen</b> | 111 | ALEXANDER | 10 | CLEO $\psi(2S) \rightarrow \gamma p \bar{p}$ |
|-------------|-----|-----------|----|----------------------------------------------|

 $\Gamma_{12}/\Gamma$ 

NODE=M135R07  
NODE=M135R07

 $f_2(1950)$  REFERENCES

|           |     |                             |                              |                     |
|-----------|-----|-----------------------------|------------------------------|---------------------|
| 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> |                     |
| 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+) |
| 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.)      |

NODE=M135

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

 $\rho_3(1990)$ 

$$I^G(J^{PC}) = 1^+(3^--)$$

OMITTED FROM SUMMARY TABLE

NODE=M167

 $\rho_3(1990)$  MASS

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

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

|               |                        |    |                                                                                  |
|---------------|------------------------|----|----------------------------------------------------------------------------------|
| $1982 \pm 14$ | <sup>1</sup> ANISOVICH | 02 | SPEC 0.6–1.9 $p\bar{p} \rightarrow \omega \pi^0, \omega \eta \pi^0, \pi^+ \pi^-$ |
|---------------|------------------------|----|----------------------------------------------------------------------------------|

|             |       |    |                                    |
|-------------|-------|----|------------------------------------|
| $\sim 2007$ | 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

NODE=M167M;LINKAGE=AY

 $\rho_3(1990)$  WIDTH

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

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

|              |                        |    |                                                                                  |
|--------------|------------------------|----|----------------------------------------------------------------------------------|
| $188 \pm 24$ | <sup>2</sup> ANISOVICH | 02 | SPEC 0.6–1.9 $p\bar{p} \rightarrow \omega \pi^0, \omega \eta \pi^0, \pi^+ \pi^-$ |
|--------------|------------------------|----|----------------------------------------------------------------------------------|

|            |       |    |                                    |
|------------|-------|----|------------------------------------|
| $\sim 287$ | 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

NODE=M167W;LINKAGE=AY

 $\rho_3(1990)$  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> |        |
| HASAN     | 94  | PL B334 215 | A. Hasan, D.V. Bugg          | (LOQM) |

NODE=M167

REFID=48828  
REFID=48327  
REFID=48349  
REFID=47950  
REFID=44103

$\pi_2(2005)$ 

$$J^{PC} = 1^-(2^-+)$$

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

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  | $22 \pi^- p \rightarrow 2 \phi n$      |
| <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

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  | $22 \pi^- p \rightarrow 2 \phi n$      |
| <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

NODE=M106R01

NODE=M106R01

| $\Gamma(K\bar{K})/\Gamma_{\text{total}}$ | DOCUMENT ID     | TECN | COMMENT                                | $\Gamma_2/\Gamma$ |
|------------------------------------------|-----------------|------|----------------------------------------|-------------------|
| seen                                     | VLADIMIRSK...06 | SPEC | $40 \pi^- p \rightarrow K_S^0 K_S^0 n$ |                   |

$f_2(2010)$  REFERENCES

NODE=M106

REFID=51191

REFID=40580

REFID=40285

REFID=21871

REFID=21869

REFID=21866

REFID=21867

|                  |                             |                                |                |
|------------------|-----------------------------|--------------------------------|----------------|
| 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)    |

**$f_0(2020)$** 

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

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.

NODE=M156

NODE=M156

NODE=M156M

NODE=M156M

NODE=M156M;LINKAGE=PC

NODE=M156M;LINKAGE=PP

NODE=M156M;LINKAGE=A

NODE=M156M;LINKAGE=ST

 **$f_0(2020)$  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.

NODE=M156W

NODE=M156W

NODE=M156W;LINKAGE=PC

NODE=M156W;LINKAGE=PP

NODE=M156W;LINKAGE=A

NODE=M156W;LINKAGE=ST

 **$f_0(2020)$  DECAY MODES**

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $\rho\pi\pi$   | seen                           |
| $\Gamma_2$ $\pi^0\pi^0$   | seen                           |
| $\Gamma_3$ $\rho\rho$     | seen                           |
| $\Gamma_4$ $\omega\omega$ | seen                           |
| $\Gamma_5$ $\eta\eta$     | seen                           |

DESIG=1;OUR EST;→ UNCHECKED ←

DESIG=2;OUR EST;→ UNCHECKED ←

DESIG=3;OUR EST;→ UNCHECKED ←

DESIG=4;OUR EST;→ UNCHECKED ←

DESIG=5

 **$f_0(2020)$  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. ● ● ● |             |         |                                            |                                          |
| $\sim 3$                                                                      | 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 $\bar{p}p \rightarrow \eta\eta\pi^0$ |

NODE=M156220

NODE=M156R1

NODE=M156R1

NODE=M156R01

NODE=M156R01

 **$f_0(2020)$  REFERENCES**

|               |                            |                                  |                  |
|---------------|----------------------------|----------------------------------|------------------|
| ROPERTZ 18    | EPJ C78 1000               | S. Ropertz, C. Hanhart, B. Kubis | (BONN, JULI)     |
| AAIJ 17V      | JHEP 1708 037              | R. Aaij <i>et al.</i>            | (LHCb Collab.)   |
| AAIJ 14BR     | PR D89 092006              | R. Aaij <i>et al.</i>            | (LHCb Collab.)   |
| UMAN 06       | PR D73 052009              | I. Uman <i>et al.</i>            | (FNAL E835)      |
| ANISOVICH 00J | PL B491 47                 | A.V. Anisovich <i>et al.</i>     |                  |
| BARBERIS 00C  | PL B471 440                | D. Barberis <i>et al.</i>        | (WA 102 Collab.) |
| BARBERIS 00F  | PL B484 198                | D. Barberis <i>et al.</i>        | (WA 102 Collab.) |
| 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.)   |
| BARBERIS 97B  | Translated from YAF 62 446 | D. Barberis <i>et al.</i>        | (WA 102 Collab.) |
|               | PL B413 217                |                                  |                  |

NODE=M156

REFID=59332

REFID=57828

REFID=56035

REFID=51063

REFID=47950

REFID=47959

REFID=47962

REFID=46605

REFID=46914

REFID=45758

NODE=M017

 **$a_4(1970)$** 

$$I^G(J^{PC}) = 1^-(4^{++})$$

was  $a_4(2040)$  **$a_4(1970)$  MASS**

NODE=M017M

VALUE (MeV) EVTS DOCUMENT ID TECN CHG COMMENT  
**1967±16 OUR AVERAGE** Error includes scale factor of 2.1. See the ideogram below.  
 [1995<sup>+10</sup><sub>-8</sub> MeV OUR 2018 AVERAGE Scale factor = 1.1]

NODE=M017M

NEW

|                                       |      |                       |     |      |                                                   |
|---------------------------------------|------|-----------------------|-----|------|---------------------------------------------------|
| 1935 <sup>+11</sup> <sub>-13</sub>    | 46M  | <sup>1</sup> AGHASYAN | 18B | COMP | 190 $\pi^- p \rightarrow \pi^- \pi^- \pi^+ p$     |
| 1900 <sup>+80</sup> <sub>-20</sub>    |      | ADOLPH                | 15  | COMP | 191 $\pi^- p \rightarrow \eta^{(\prime)} \pi^- p$ |
| 1985±10±13                            | 145k | LU                    | 05  | B852 | 18 $\pi^- p \rightarrow \omega \pi^- \pi^0 p$     |
| 1996±25±43                            |      | CHUNG                 | 02  | B852 | 18.3 $\pi^- p \rightarrow 3\pi p$                 |
| 2000±40 <sup>+60</sup> <sub>-20</sub> |      | IVANOV                | 01  | B852 | 18 $\pi^- p \rightarrow \eta' \pi^- p$            |
| 2010±20                               |      | <sup>2</sup> DONSKOV  | 96  | GAM2 | 0 38 $\pi^- p \rightarrow \eta \pi^0 n$           |
| 2040±30                               |      | <sup>3</sup> CLELAND  | 82B | SPEC | ± 50 $\pi p \rightarrow K_S^0 K^\pm p$            |

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

|                                      |      |                        |     |      |                                                             |
|--------------------------------------|------|------------------------|-----|------|-------------------------------------------------------------|
| 1885±13 <sup>+50</sup> <sub>-2</sub> | 420k | <sup>4</sup> ALEKSEEV  | 10  | COMP | 190 $\pi^- Pb \rightarrow \pi^- \pi^- \pi^+ Pb'$            |
| 2004±6                               | 80k  | <sup>5</sup> UMAN      | 06  | E835 | 5.2 $\bar{p} p \rightarrow \eta \eta \pi^0$                 |
| 2005 <sup>+25</sup> <sub>-45</sub>   |      | <sup>6</sup> ANISOVICH | 01F | SPEC | 2.0 $\bar{p} p \rightarrow 3\pi^0, \pi^0 \eta, \pi^0 \eta'$ |
| 1944±8±50                            |      | <sup>7</sup> AMELIN    | 99  | VES  | 37 $\pi^- A \rightarrow \omega \pi^- \pi^0 A^*$             |
| 1903±10                              |      | <sup>8</sup> BALDI     | 78  | SPEC | - 10 $\pi^- p \rightarrow p K_S^0 K^-$                      |
| 2030±50                              |      | <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=M017M;LINKAGE=B

NODE=M017M;LINKAGE=A

NODE=M017M;LINKAGE=C

NODE=M017M;LINKAGE=D

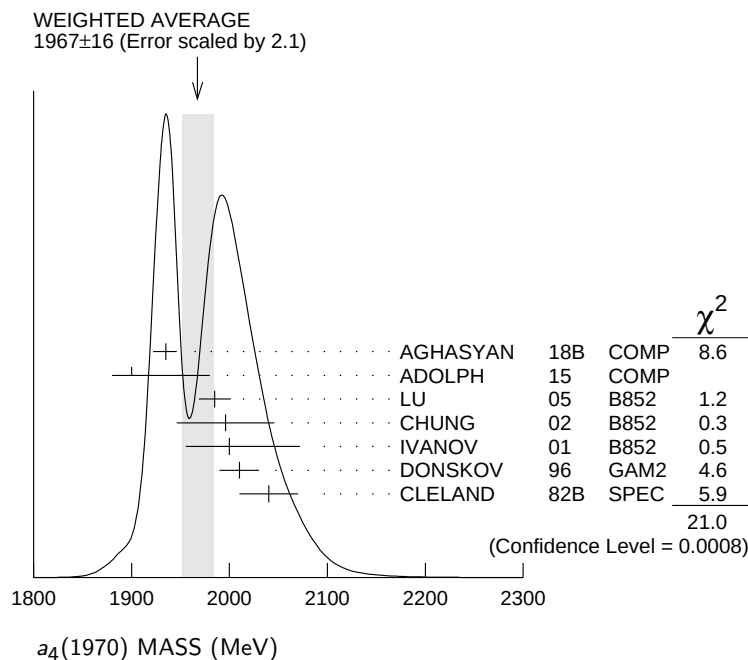
NODE=M017M;LINKAGE=ST

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

### 324<sup>+15</sup><sub>-18</sub> OUR AVERAGE

[257<sup>+25</sup><sub>-23</sub> MeV OUR 2018 AVERAGE Scale factor = 1.3]

|                                             |      |                       |     |            |                                                   |
|---------------------------------------------|------|-----------------------|-----|------------|---------------------------------------------------|
| 333 <sup>+16</sup> <sub>-21</sub>           | 46M  | <sup>1</sup> AGHASYAN | 18B | COMP       | 190 $\pi^- p \rightarrow \pi^- \pi^- \pi^+ p$     |
| 300 <sup>+80</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>+70</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>+46</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

NEW

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

| 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                           |

NODE=M017215;NODE=M017

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

| $\Gamma(K \bar{K})/\Gamma_{\text{total}}$         | $\Gamma_1/\Gamma$                                        |
|---------------------------------------------------|----------------------------------------------------------|
| VALUE                                             | DOCUMENT ID TECN CHG COMMENT                             |
| seen                                              | BALDI 78 SPEC $\pm$ 10 $\pi^- p \rightarrow K_S^0 K^- p$ |
| $\Gamma(\pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}$ | $\Gamma_2/\Gamma$                                        |
| VALUE                                             | DOCUMENT ID TECN CHG COMMENT                             |
| seen                                              | CORDEN 78C OMEG 0 15 $\pi^- p \rightarrow 3\pi n$        |
| $\Gamma(\rho \pi)/\Gamma(f_2(1270) \pi)$          | $\Gamma_3/\Gamma_4$                                      |
| VALUE                                             | EVTS DOCUMENT ID TECN COMMENT                            |

1.7<sup>+0.9</sup><sub>-0.8</sub> OUR AVERAGE Error includes scale factor of 3.7. [1.1  $\pm$  0.28 OUR 2018 AVERAGE]

|                                     |     |                       |     |      |                                               |
|-------------------------------------|-----|-----------------------|-----|------|-----------------------------------------------|
| 2.9 <sup>+0.6</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=M017220

NODE=M017R1  
NODE=M017R1

NODE=M017R2  
NODE=M017R2

NODE=M017R4  
NODE=M017R4

NEW

NODE=M017R4;LINKAGE=A

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

| VALUE | DOCUMENT ID | TECN | CHG  | COMMENT                                |
|-------|-------------|------|------|----------------------------------------|
| seen  | DONSKOV     | 96   | GAM2 | 0 38 $\pi^- p \rightarrow \eta\pi^0 n$ |

 $\Gamma_7/\Gamma$ 

NODE=M017R3  
NODE=M017R3

 $\Gamma(\eta'(958)\pi)/\Gamma(\eta\pi)$ 

| VALUE     | DOCUMENT ID | TECN | COMMENT                                               |
|-----------|-------------|------|-------------------------------------------------------|
| 0.23±0.07 | ADOLPH      | 15   | COMP 191 $\pi^- p \rightarrow \eta^{(\prime)}\pi^- p$ |

 $\Gamma_8/\Gamma_7$ 

NODE=M017R01  
NODE=M017R01

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

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT                                          |
|-------|------|-------------|------|--------------------------------------------------|
| seen  | 145k | LU          | 05   | B852 18 $\pi^- p \rightarrow \omega\pi^-\pi^0 p$ |

 $\Gamma_6/\Gamma$ 

NODE=M017R5  
NODE=M017R5

 **$a_4(1970)$  REFERENCES**

|           |     |                              |                              |                        |
|-----------|-----|------------------------------|------------------------------|------------------------|
| 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 |

NODE=M017

REFID=59471  
REFID=56385  
REFID=53356  
REFID=51063  
REFID=50459  
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REFID=48317  
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REFID=46903  
REFID=46902  
REFID=45207

REFID=21281  
REFID=21783  
REFID=20859

 $f_4(2050)$ 

$$I^G(J^{PC}) = 0^+(4^{++})$$

NODE=M016

 **$f_4(2050)$  MASS**

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 $\pi^- p \rightarrow n2\eta$              |
| 2020±20                            | 40k  | <sup>2</sup> BINON                                          | 84B  | GAM2 38 $\pi^- p \rightarrow n2\pi^0$              |
| 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 $\pi^- p \rightarrow n2K_S^0$               |
| 2020±30                            | 700  | APEL                                                        | 75   | NICE 40 $\pi^- p \rightarrow n2\pi^0$              |
| 2050±25                            |      | BLUM                                                        | 75   | ASPK 18.4 $\pi^- p \rightarrow nK^+K^-$            |

• • • 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 | $N\bar{N} \rightarrow \pi\pi$                                                           |
| ~ 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 $\pi^- p \rightarrow n2\pi$                                                       |
| 1988±7                                    | EVANGELIS...           | 79B | OMEG | 10 $\pi^- p \rightarrow K^+K^-n$                                                        |
| 1922±14                                   | <sup>11</sup> ANTIPOV  | 77  | CIBS | 25 $\pi^- p \rightarrow p3\pi$                                                          |

OCCUR=2

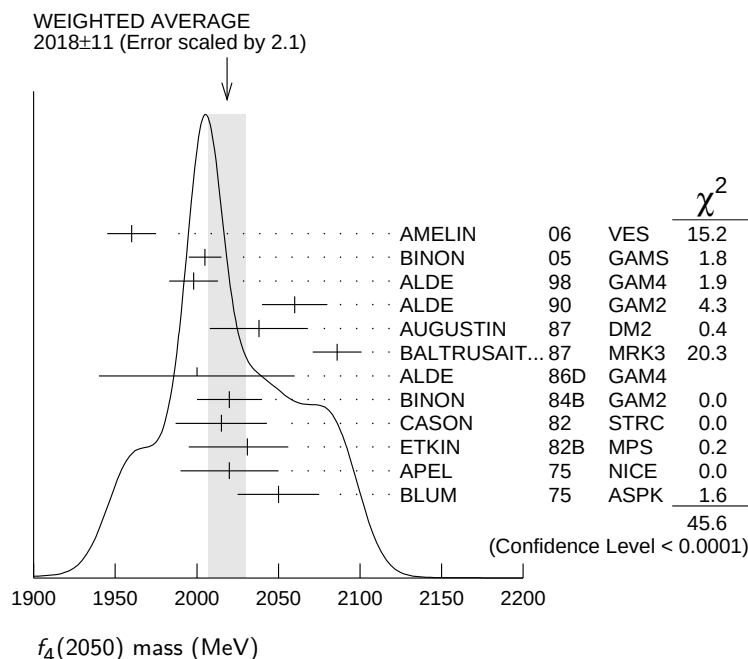


- 1 From the first PWA solution.
- 2 From a partial-wave analysis of the data.
- 3 From an amplitude analysis of the reaction  $\pi^+\pi^-\rightarrow 2\pi^0$ .
- 4 K matrix pole.
- 5 Taking into account the  $f_2(1950)$ . Helicity-2 production favored.
- 6 Energy-dependent analysis.
- 7 Single energy analysis.
- 8 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.
- 9 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.
- 10  $I(J^P)=0(4^+)$  from amplitude analysis assuming one-pion exchange.
- 11 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



### $f_4(2050)$ 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 $\pi^-\pi^+\rightarrow\omega\omega n$                 |
| 340± 80                            | 12   | BINON                                                       | 05 GAMS  | 33 $\pi^-\pi^+\rightarrow\eta\eta n$                     |
| 395± 40                            |      | ALDE                                                        | 98 GAM4  | 100 $\pi^-\pi^+\rightarrow\pi^0\pi^0 n$                  |
| 170± 60                            |      | ALDE                                                        | 90 GAM2  | 38 $\pi^-\pi^+\rightarrow\omega\omega n$                 |
| 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 $\pi^-\pi^+\rightarrow n2\eta$                       |
| 240± 40                            | 40k  | 13 BINON                                                    | 84B GAM2 | 38 $\pi^-\pi^+\rightarrow n2\pi^0$                       |
| 190± 14                            |      | DENNEY                                                      | 83 LASS  | 10 $\pi^+\pi^-\pi^+\pi^-$                                |
| 186 <sup>+103</sup> <sub>-58</sub> |      | 14 CASON                                                    | 82 STRC  | 8 $\pi^+\pi^-\pi^+\pi^-\rightarrow\Delta^{++}\pi^0\pi^0$ |
| 305 <sup>+36</sup> <sub>-119</sub> |      | ETKIN                                                       | 82B MPS  | 23 $\pi^-\pi^+\rightarrow n2K_S^0$                       |
| 180± 60                            | 700  | APEL                                                        | 75 NICE  | 40 $\pi^-\pi^+\rightarrow n2\pi^0$                       |
| 225 <sup>+120</sup> <sub>-70</sub> |      | BLUM                                                        | 75 ASPK  | 18.4 $\pi^-\pi^+\rightarrow nK^+K^-$                     |

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

|                                        |    |           |          |                                                                                       |
|----------------------------------------|----|-----------|----------|---------------------------------------------------------------------------------------|
| 260± 40                                | 15 | ANISOVICH | 09 RVUE  | 0.0 $\bar{p}p, \pi N$                                                                 |
| 453± 20 <sup>+31</sup> <sub>-129</sub> | 16 | 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                                  | 17 | MARTIN    | 98 RVUE  | $N\bar{N}\rightarrow\pi\pi$                                                           |
| ~ 200                                  | 18 | MARTIN    | 97 RVUE  | $\bar{N}N\rightarrow\pi\pi$                                                           |
| ~ 60                                   | 19 | OAKDEN    | 94 RVUE  | 0.36-1.55 $\bar{p}p\rightarrow\pi\pi$                                                 |

- ~ 80

243± 16

140± 15

263± 57

100± 28

107± 56
- 20 OAKDEN

21 ALPER

21 ROZANSKA

21 CORDEN

EVANGELIS...

22 ANTIPOV
- 94 RVUE

80 CNTR

80 SPRK

79 OMEG

79B OMEG

77 CIBS
- 0.36-1.55  $\bar{p}p \rightarrow \pi\pi$

62  $\pi^- p \rightarrow K^+ K^- n$

18  $\pi^- p \rightarrow p\bar{p}n$

12-15  $\pi^- p \rightarrow n2\pi$

10  $\pi^- p \rightarrow K^+ K^- n$

25  $\pi^- p \rightarrow p3\pi$

12 From the first PWA solution.

13 From a partial-wave analysis of the data.

14 From an amplitude analysis of the reaction  $\pi^+\pi^- \rightarrow 2\pi^0$ .

15 K matrix pole.

16 Taking into account the  $f_2(1950)$ . Helicity-2 production favored.

17 Energy-dependent analysis.

18 Single energy analysis.

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.

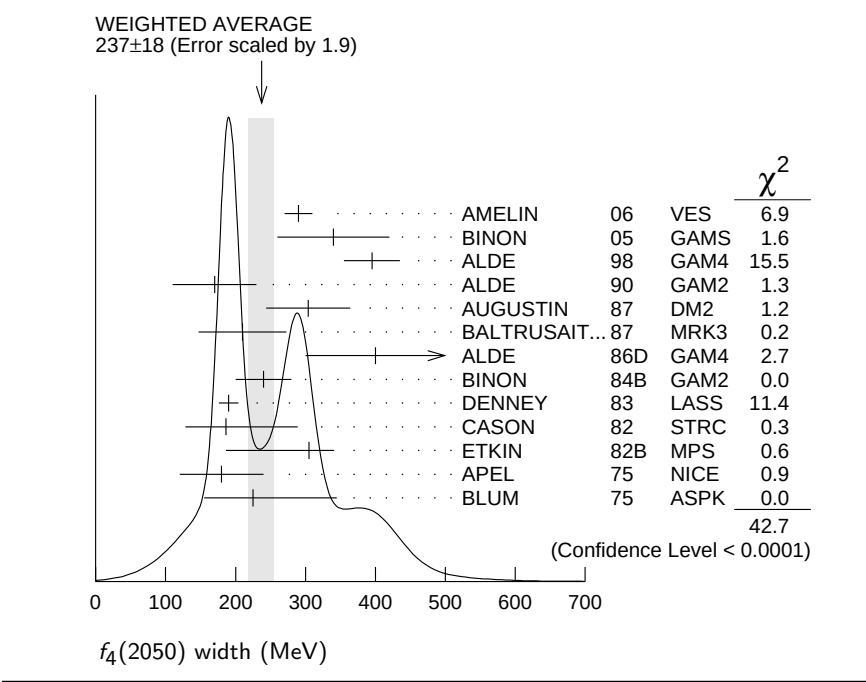
22 Width errors enlarged by us to  $4\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.

OCCUR=2

NODE=M016W;LINKAGE=BI  
NODE=M016W;LINKAGE=N  
NODE=M016W;LINKAGE=NN  
NODE=M016W;LINKAGE=KM  
NODE=M016W;LINKAGE=UE  
NODE=M016W;LINKAGE=RB  
NODE=M016W;LINKAGE=BR  
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 ( $\Gamma_i/\Gamma$ )     |
|------------|----------------|------------------------------------|
| $\Gamma_1$ | $\omega\omega$ | seen                               |
| $\Gamma_2$ | $\pi\pi$       | $(17.0\pm1.5)\%$                   |
| $\Gamma_3$ | $K\bar{K}$     | $(6.8^{+3.4}_{-1.8})\times10^{-3}$ |
| $\Gamma_4$ | $\eta\eta$     | $(2.1\pm0.8)\times10^{-3}$         |
| $\Gamma_5$ | $4\pi^0$       | $< 1.2\%$                          |
| $\Gamma_6$ | $\gamma\gamma$ |                                    |
| $\Gamma_7$ | $a_2(1320)\pi$ | 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. • • •      |     |            |             |         |                                                |
| $23.1^{+3.6}_{-3.3} + 70.5_{-15.6}$                                                |     |            | 23 UEHARA   | 09 BELL | $10.6 e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$ |
| <1100                                                                              | 95  | $13 \pm 4$ | OEST        | 90 JADE | $e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$      |
| <sup>23</sup> Taking into account the $f_2(1950)$ . Helicity-2 production favored. |     |            |             |         |                                                |

NODE=M016G3  
NODE=M016G3

NODE=M016G3;LINKAGE=UE

### $f_4(2050)$ BRANCHING RATIOS

| $\Gamma(\omega\omega)/\Gamma_{\text{total}}$                                  |             |        |                                             |  | $\Gamma_1/\Gamma$ |
|-------------------------------------------------------------------------------|-------------|--------|---------------------------------------------|--|-------------------|
| VALUE                                                                         | DOCUMENT ID | TECN   | COMMENT                                     |  |                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |        |                                             |  |                   |
| seen                                                                          | AMELIN      | 06 VES | $36 \pi^- p \rightarrow \omega\omega n$     |  |                   |
| not seen                                                                      | BARBERIS    | 00F    | $450 p p \rightarrow p_f \omega \omega p_s$ |  |                   |

NODE=M016225

NODE=M016R7  
NODE=M016R7

| $\Gamma(\omega\omega)/\Gamma(\pi\pi)$ |             |         |                                         |  | $\Gamma_1/\Gamma_2$ |
|---------------------------------------|-------------|---------|-----------------------------------------|--|---------------------|
| VALUE                                 | DOCUMENT ID | TECN    | COMMENT                                 |  |                     |
| <b>1.5±0.3</b>                        | ALDE        | 90 GAM2 | $38 \pi^- p \rightarrow \omega\omega n$ |  |                     |

NODE=M016R5  
NODE=M016R5

| $\Gamma(\pi\pi)/\Gamma_{\text{total}}$    |             |          |                                                 |  | $\Gamma_2/\Gamma$ |
|-------------------------------------------|-------------|----------|-------------------------------------------------|--|-------------------|
| VALUE                                     | DOCUMENT ID | TECN     | COMMENT                                         |  |                   |
| <b>0.170±0.015 OUR AVERAGE</b>            |             |          |                                                 |  |                   |
| 0.18 ±0.03                                | 24 BINON    | 83C GAM2 | $38 \pi^- p \rightarrow n4\gamma$               |  |                   |
| 0.16 ±0.03                                | 24 CASON    | 82 STRC  | $8 \pi^+ p \rightarrow \Delta^{++} \pi^0 \pi^0$ |  |                   |
| 0.17 ±0.02                                | 24 CORDEN   | 79 OMEG  | $12-15 \pi^- p \rightarrow n2\pi$               |  |                   |
| <sup>24</sup> Assuming one pion exchange. |             |          |                                                 |  |                   |

NODE=M016R1  
NODE=M016R1

NODE=M016R1;LINKAGE=A

| $\Gamma(K\bar{K})/\Gamma(\pi\pi)$           |             |         |                                  |  | $\Gamma_3/\Gamma_2$ |
|---------------------------------------------|-------------|---------|----------------------------------|--|---------------------|
| VALUE                                       | DOCUMENT ID | TECN    | COMMENT                          |  |                     |
| <b>0.04<sup>+0.02</sup><sub>-0.01</sub></b> | ETKIN       | 82B MPS | $23 \pi^- p \rightarrow n2K_S^0$ |  |                     |

NODE=M016R2  
NODE=M016R2

| $\Gamma(\eta\eta)/\Gamma_{\text{total}}$ |             |          |                                    |  | $\Gamma_4/\Gamma$ |
|------------------------------------------|-------------|----------|------------------------------------|--|-------------------|
| VALUE (units $10^{-3}$ )                 | DOCUMENT ID | TECN     | COMMENT                            |  |                   |
| <b>2.1±0.8</b>                           | ALDE        | 86D GAM4 | $100 \pi^- p \rightarrow n4\gamma$ |  |                   |

NODE=M016R3  
NODE=M016R3

| $\Gamma(4\pi^0)/\Gamma_{\text{total}}$ |             |         |                                    |  | $\Gamma_5/\Gamma$ |
|----------------------------------------|-------------|---------|------------------------------------|--|-------------------|
| VALUE                                  | DOCUMENT ID | TECN    | COMMENT                            |  |                   |
| <b>&lt;0.012</b>                       | ALDE        | 87 GAM4 | $100 \pi^- p \rightarrow 4\pi^0 n$ |  |                   |

NODE=M016R4  
NODE=M016R4

| $\Gamma(a_2(1320)\pi)/\Gamma_{\text{total}}$ |             |        |                                             |  | $\Gamma_7/\Gamma$ |
|----------------------------------------------|-------------|--------|---------------------------------------------|--|-------------------|
| VALUE                                        | DOCUMENT ID | TECN   | COMMENT                                     |  |                   |
| seen                                         | AMELIN      | 00 VES | $37 \pi^- p \rightarrow \eta \pi^+ \pi^- n$ |  |                   |

NODE=M016R6  
NODE=M016R6

### $f_4(2050)$ REFERENCES

|                             |     |               |                                 |                             |    |
|-----------------------------|-----|---------------|---------------------------------|-----------------------------|----|
| ANISOVICH                   | 09  | IJMP A24 2481 | V.V. Anisovich, A.V. Sarantsev  |                             |    |
| UEHARA                      | 09  | PR D79 052009 | S. Uehara <i>et al.</i>         | (BELLE Collab.)             |    |
| AMELIN                      | 06  | PAN 69 690    | D.V. Amelin <i>et al.</i>       | (VES Collab.)               |    |
| Translated from YAF 69 715  |     |               |                                 |                             |    |
| BINON                       | 05  | PAN 68 960    | F. Binon <i>et al.</i>          |                             |    |
| Translated from YAF 68 998  |     |               |                                 |                             |    |
| 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>    |                             |    |
| BARBERIS                    | 00F | PL B484 198   | D. Barberis <i>et al.</i>       | (WA 102 Collab.)            |    |
| ALDE                        | 98  | EPJ A3 361    | D. Alde <i>et al.</i>           | (GAM4 Collab.)              |    |
| Also PAN 62 405             |     |               |                                 |                             |    |
| Translated from YAF 62 446  |     |               |                                 |                             |    |
| MARTIN                      | 98  | PR C57 3492   | B.R. Martin <i>et al.</i>       |                             |    |
| MARTIN                      | 97  | PR C56 1114   | B.R. Martin, G.C. Oades         | (LOUC, AARH)                |    |
| KLOET                       | 96  | PR D53 6120   | W.M. Kloet, F. Myhrer           | (RUTG, NORD)                |    |
| OAKDEN                      | 94  | NP A574 731   | M.N. Oakden, M.R. Pennington    | (DURH)                      |    |
| ALDE                        | 90  | PL B241 600   | D.M. Alde <i>et al.</i>         | (SERP, BELG, LANL, LAPP+)   |    |
| OEST                        | 90  | ZPHY C47 343  | T. Oest <i>et al.</i>           | (JADE Collab.)              |    |
| ALDE                        | 87  | PL B198 286   | D.M. Alde <i>et al.</i>         | (LANL, BRUX, SERP, LAPP)    |    |
| AUGUSTIN                    | 87  | ZPHY C36 369  | J.E. Augustin <i>et al.</i>     | (LALO, CLER, FRAS+)         |    |
| BALTRUSAITIS...             | 86D | PR D35 2077   | R.M. Baltrusaitis <i>et al.</i> | (Mark III Collab.)          |    |
| ALDE                        | 86D | NP B269 485   | D.M. Alde <i>et al.</i>         | (BELG, LAPP, SERP, CERN+)   |    |
| ALTHOFF                     | 85B | ZPHY C29 189  | M. Althoff <i>et al.</i>        | (TASSO Collab.)             |    |
| BINON                       | 84B | LNC 39 41     | F.G. Binon <i>et al.</i>        | (SERP, BELG, LAPP)          |    |
| BINON                       | 83C | SJNP 38 723   | F.G. Binon <i>et al.</i>        | (SERP, BRUX+)               |    |
| Translated from YAF 38 1199 |     |               |                                 |                             |    |
| DENNEY                      | 83  | PR D28 2726   | D.L. Denney <i>et al.</i>       | (IOWA, MICH)                |    |
| CASON                       | 82  | PRL 48 1316   | N.M. Cason <i>et al.</i>        | (NDAM, ANL)                 |    |
| ETKIN                       | 82B | PR D25 1786   | A. Etkin <i>et al.</i>          | (BNL, CUNY, TUFTS, VAND)    |    |
| ALPER                       | 80  | PL 94B 422    | B. Alper <i>et al.</i>          | (AMST, CERN, CRAC, MPIM+)   |    |
| ROZANSKA                    | 80  | NP B162 505   | M. Rozanska <i>et al.</i>       | (MPIM, CERN)                |    |
| CORDEN                      | 79  | NP B157 250   | M.J. Corden <i>et al.</i>       | (BIRM, RHEL, TELA+)         | JP |
| EVANGELIS...                | 79B | NP B154 381   | C. Evangelista <i>et al.</i>    | (BARI, BONN, CERN+)         |    |
| ANTIPOV                     | 77  | NP B119 45    | Y.M. Antipov <i>et al.</i>      | (SERP, GEVA)                |    |
| APEL                        | 75  | PL 57B 398    | W.D. Apel <i>et al.</i>         | (KARLK, KARLE, PISA, SERP+) | JP |
| BLUM                        | 75  | PL 57B 403    | W. Blum <i>et al.</i>           | (CERN, MPIM)                | JP |

NODE=M016

REFID=52719  
REFID=52761  
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REFID=21774

REFID=20374

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REFID=20728

REFID=20720

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± 29 OUR AVERAGE</b>                                                   |                     |          |                                              |
| 2090± 30                                                                      | <sup>1</sup> AMELIN | 95B VES  | $36 \pi^- A \rightarrow \pi^+ \pi^- \pi^- A$ |
| 2100± 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**

|                                                                                  |                    |             |                |                     |
|----------------------------------------------------------------------------------|--------------------|-------------|----------------|---------------------|
| $\Gamma(\rho\pi)/\Gamma(3\pi)$                                                   |                    |             |                | $\Gamma_2/\Gamma_1$ |
| <u>VALUE</u>                                                                     | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |                     |
| <b>0.19±0.05</b>                                                                 | <sup>5</sup> DAUM  | 81B         | CNTR           | 63,94 $\pi^- p$     |
| $\Gamma(f_2(1270)\pi)/\Gamma(3\pi)$                                              |                    |             |                | $\Gamma_3/\Gamma_1$ |
| <u>VALUE</u>                                                                     | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |                     |
| <b>0.36±0.09</b>                                                                 | <sup>5</sup> DAUM  | 81B         | CNTR           | 63,94 $\pi^- p$     |
| $\Gamma((\pi\pi)_S\pi)/\Gamma(3\pi)$                                             |                    |             |                | $\Gamma_4/\Gamma_1$ |
| <u>VALUE</u>                                                                     | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |                     |
| <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> |                    |             |                |                     |
| <u>VALUE</u>                                                                     | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |                     |
| <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                                                                                |
|-------------------------------------------------------------------------------|------|------------------------|----------|----------------------------------------------------------------------------------------|
| <b>2101 ± 7 OUR AVERAGE</b>                                                   |      |                        |          |                                                                                        |
| 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                                                                                |
|-------------------------------------------------------------------------------|------|------------------------|----------|----------------------------------------------------------------------------------------|
| <b>224<sup>+</sup><sub>-21</sub> ± 23 OUR AVERAGE</b>                         |      |                        |          |                                                                                        |
| Error includes scale factor of 1.3. See the ideogram below.                   |      |                        |          |                                                                                        |
| 273 <sup>+</sup> <sub>-24</sub> ± 27 <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.

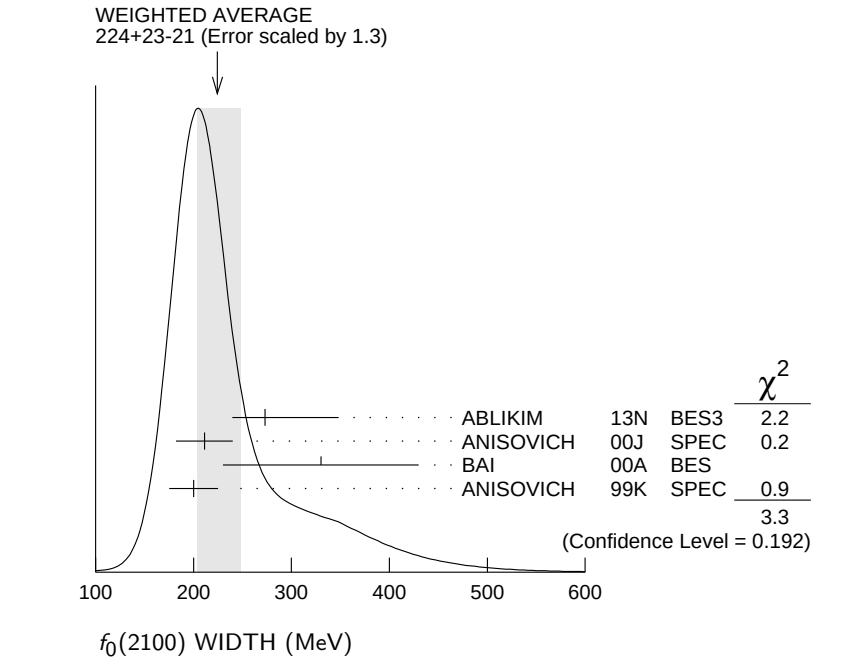
NODE=M168W

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>     | (BES III 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> |                    |
| 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

$f_2(2150)$  MASS

NODE=M042205

$f_2(2150)$  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.

NODE=M042M;LINKAGE=ST

$\eta\eta$  MODE

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

The data in this block is included in the average printed for a previous datablock.

NODE=M042M3  
NODE=M042M3

**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 $pp \rightarrow pp2\eta$ |
| 2130±35                                                                       | SINGOVSKI              | 94  | GAM4 450 $pp \rightarrow pp2\eta$                                              |
| • • • 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.

NODE=M042M3;LINKAGE=K3  
NODE=M042M3;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. • • •                             |                      |      |      |                                           |
| $2135 \pm 20 \pm 45$                                                                                      | <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. |                      |      |      |                                           |

NODE=M042M4  
 NODE=M042M4

NODE=M042M4;LINKAGE=AD

 **$\bar{p}p \rightarrow \pi\pi$** 

| VALUE (MeV)                                                                                                                                                                                                                                                                                                                                                                                                                | DOCUMENT ID         | TECN | COMMENT                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------|----------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                                                                                                                              |                     |      |                                              |
| $\sim 2090$                                                                                                                                                                                                                                                                                                                                                                                                                | <sup>5</sup> OAKDEN | 94   | RVUE $0.36-1.55 \bar{p}p \rightarrow \pi\pi$ |
| $\sim 2120$                                                                                                                                                                                                                                                                                                                                                                                                                | <sup>6</sup> OAKDEN | 94   | RVUE $0.36-1.55 \bar{p}p \rightarrow \pi\pi$ |
| $\sim 2170$                                                                                                                                                                                                                                                                                                                                                                                                                | <sup>7</sup> MARTIN | 80B  | RVUE                                         |
| $\sim 2150$                                                                                                                                                                                                                                                                                                                                                                                                                | <sup>7</sup> MARTIN | 80C  | RVUE                                         |
| $\sim 2150$                                                                                                                                                                                                                                                                                                                                                                                                                | <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.                                                                                                                                                                                                                                                                                                                                                   |                     |      |                                              |

NODE=M042M1  
 NODE=M042M1

OCCUR=2

NODE=M042M1;LINKAGE=B

NODE=M042M1;LINKAGE=BB  
 NODE=M042M1;LINKAGE=P  
 NODE=M042M1;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. • • • |                           |      |      |                                            |
| $2139^{+8}_{-9}$                                                              | <sup>9</sup> EVANGELIS... | 97   | SPEC | $0.6-2.4 \bar{p}p \rightarrow K_S^0 K_S^0$ |
| $\sim 2190$                                                                   | <sup>9</sup> CUTTS        | 78B  | CNTR | $0.97-3 \bar{p}p \rightarrow \bar{N}N$     |
| $2155 \pm 15$                                                                 | <sup>9,10</sup> COUPLAND  | 77   | CNTR | 0 $0.7-2.4 \bar{p}p \rightarrow \bar{p}p$  |
| $2193 \pm 2$                                                                  | <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 $\bar{T}$ region by ALSPECTOR 73.         |                           |      |      |                                            |

NODE=M042M2  
 NODE=M042M2

NODE=M042M2;LINKAGE=I  
 NODE=M042M2;LINKAGE=E  
 NODE=M042M2;LINKAGE=M

 **$K\bar{K}$  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 $450 p\bar{p} \rightarrow p_S p_f K^+ K^-$ |

NODE=M042M5  
 NODE=M042M5

 **$f_2(2150)$  WIDTH**

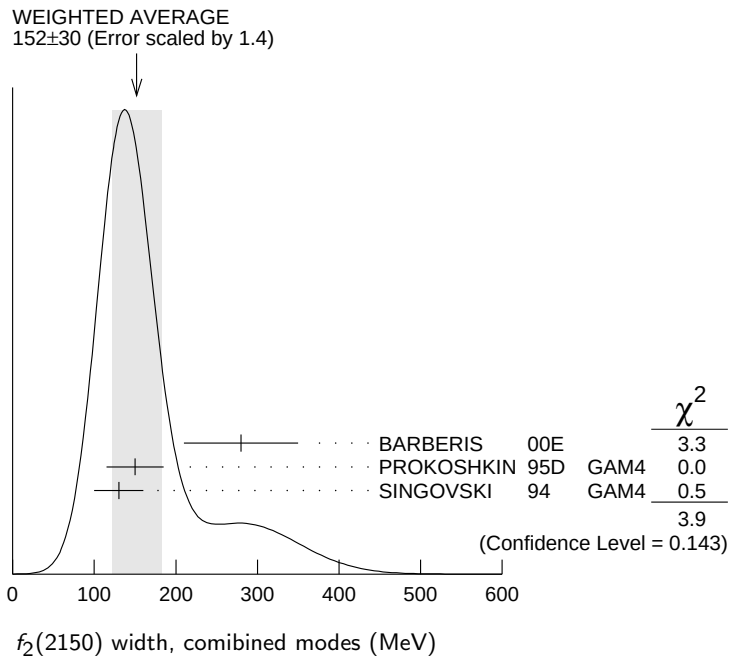
NODE=M042210

 **$f_2(2150)$  WIDTH, COMBINED MODES (MeV)**

| VALUE (MeV)                                                                                                                                   | EVS | DOCUMENT ID        | TECN | COMMENT                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------|------|-----------------------------------------------|
| <b>152±30 OUR AVERAGE</b> Includes data from the datablock that follows 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. • • •                                                                 |     |                    |      |                                               |
| $182 \pm 11$                                                                                                                                  | 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  
 NODE=M042W

NODE=M042W;LINKAGE=ST

 **$\eta\eta$  MODE**

VALUE (MeV) DOCUMENT ID TECN COMMENT

The data in this block is included in the average printed for a previous datablock.

**152±30 OUR AVERAGE** Error includes scale factor of 1.4. See the ideogram below.

280±70 BARBERIS 00E 450  $pp \rightarrow p_f \eta \eta p_s$   
 150±35 PROKOSHKIN 95D GAM4 300  $\pi^- N \rightarrow \pi^- N 2\eta$ ,  
 450  $pp \rightarrow pp 2\eta$   
 130±30 SINGOVSKI 94 GAM4 450  $pp \rightarrow pp 2\eta$

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

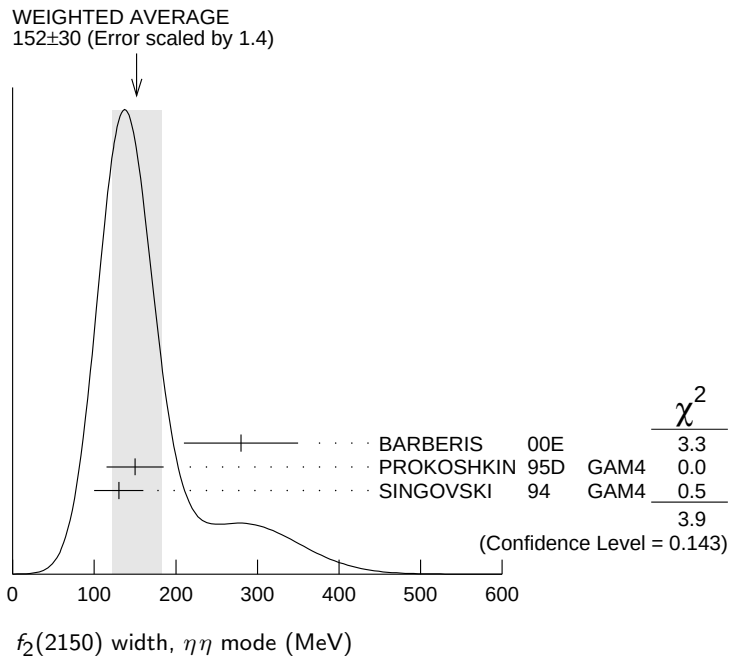
310±50 <sup>13</sup> ABELE 99B CBAR 1.94  $\bar{p}p \rightarrow \pi^0 \eta \eta$   
 203±10 <sup>14</sup> ARMSTRONG 93C E760  $\bar{p}p \rightarrow \pi^0 \eta \eta \rightarrow 6\gamma$

<sup>13</sup> Spin not determined.

<sup>14</sup> No  $J^{PC}$  determination.

NODE=M042W3  
 NODE=M042W3

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 |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

**250 OUR ESTIMATE**

• • • 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. • • •

|                  |                            |    |      |                                            |
|------------------|----------------------------|----|------|--------------------------------------------|
| $56^{+31}_{-16}$ | <sup>19</sup> EVANGELIS... | 97 | SPEC | 0.6–2.4 $\bar{p}p \rightarrow K_S^0 K_S^0$ |
| $135 \pm 75$     | <sup>20,21</sup> COUPLAND  | 77 | CNTR | 0 0.7–2.4 $\bar{p}p \rightarrow \bar{p}p$  |
| $98 \pm 8$       | <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;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. • • •

|              |               |     |      |                                            |
|--------------|---------------|-----|------|--------------------------------------------|
| $91 \pm 62$  | VLADIMIRSK... | 06  | SPEC | 40 $\pi^- p \rightarrow K_S^0 K_S^0 n$     |
| $150 \pm 30$ | ABLIKIM       | 04E | BES2 | $J/\psi \rightarrow \omega K^+ K^-$        |
| $270 \pm 50$ | BARBERIS      | 99  | OMEG | 450 $p\bar{p} \rightarrow p_s p_f K^+ K^-$ |

NODE=M042W5  
NODE=M042W5

 **$f_2(2150)$  DECAY MODES**

NODE=M042215;NODE=M042

| 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                           |

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 |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

**1.28 ± 0.23** 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  
NODE=M042R1

NODE=M042R1;LINKAGE=A

 **$\Gamma(\pi\pi)/\Gamma(\eta\eta)$**  **$\Gamma_1/\Gamma_2$** 

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

• • • 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 |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

**0.79 ± 0.11** <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

$\Gamma(p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

| VALUE | EVTS | DOCUMENT ID  | TECN | COMMENT                                 |
|-------|------|--------------|------|-----------------------------------------|
| seen  | 73   | ALEXANDER 10 | CLEO | $\psi(2S) \rightarrow \gamma p \bar{p}$ |

NODE=M042R04  
 NODE=M042R04

 $f_2(2150)$  REFERENCES

|                  |                               |                                  |                          |
|------------------|-------------------------------|----------------------------------|--------------------------|
| 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)             |

NODE=M042

REFID=53525  
 REFID=51063  
 REFID=51191

REFID=50174  
 REFID=47945  
 REFID=47961  
 REFID=46904  
 REFID=46921  
 REFID=45687  
 REFID=45685  
 REFID=45202  
 REFID=45212  
 REFID=44647

REFID=44103  
 REFID=45210  
 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

| VALUE (MeV)                                                                   | DOCUMENT ID        | TECN      | COMMENT                                                |
|-------------------------------------------------------------------------------|--------------------|-----------|--------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                    |           |                                                        |
| $2254 \pm 22$                                                                 | <sup>1</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   | $e^+e^- \rightarrow \pi^+\pi^-, K^+K^-$                |
| $2110 \pm 50$                                                                 | <sup>2</sup> CLEGG | 90 RVUE   | $e^+e^- \rightarrow 3(\pi^+\pi^-), 2(\pi^+\pi^-\pi^0)$ |

NODE=M032M3  
 NODE=M032M3

OCCUR=2

 $\bar{p}p \rightarrow \pi\pi$ 

| 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>3</sup> OAKDEN | 94 RVUE  | $0.36\text{--}1.55 \bar{p}p \rightarrow \pi\pi$ |
| $\sim 2170$                                                                   | <sup>4</sup> MARTIN | 80B RVUE |                                                 |
| $\sim 2100$                                                                   | <sup>4</sup> MARTIN | 80C RVUE |                                                 |

NODE=M032M1  
 NODE=M032M1

 $S$ -CHANNEL  $\bar{N}N$ 

| VALUE (MeV)                                                                   | DOCUMENT ID              | TECN     | COMMENT                                                                         |
|-------------------------------------------------------------------------------|--------------------------|----------|---------------------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                          |          |                                                                                 |
| $2110 \pm 35$                                                                 | <sup>5</sup> ANISOVICH   | 02 SPEC  | $0.6\text{--}1.9 p\bar{p} \rightarrow \omega\pi^0, \omega\eta\pi^0, \pi^+\pi^-$ |
| $\sim 2190$                                                                   | <sup>6</sup> CUTTS       | 78B CNTR | $0.97\text{--}3 \bar{p}p \rightarrow \bar{N}N$                                  |
| $2155 \pm 15$                                                                 | <sup>6,7</sup> COUPLAND  | 77 CNTR  | $0.7\text{--}2.4 \bar{p}p \rightarrow \bar{p}p$                                 |
| $2193 \pm 2$                                                                  | <sup>6,8</sup> ALSPECTOR | 73 CNTR  | $\bar{p}p$ S channel                                                            |
| $2190 \pm 10$                                                                 | <sup>9</sup> ABRAMS      | 70 CNTR  | S channel $\bar{p}N$                                                            |

NODE=M032M2  
 NODE=M032M2

**$\pi^- p \rightarrow \omega \pi^0 n$** 

| 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 $\pi^- p \rightarrow \omega \pi^0 n$ |

<sup>1</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>2</sup> Includes ATKINSON 85.

<sup>3</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>4</sup>  $I(J^P) = 1(1^-)$  from simultaneous analysis of  $p\bar{p} \rightarrow \pi^- \pi^+$  and  $\pi^0 \pi^0$ .

<sup>5</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

<sup>6</sup> Isospins 0 and 1 not separated.

<sup>7</sup> From a fit to the total elastic cross section.

<sup>8</sup> Referred to as  $T$  or  $\bar{T}$  region by ALSPECTOR 73.

<sup>9</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=M032M4  
NODE=M032M4

NODE=M032M3;LINKAGE=LE

NODE=M032M3;LINKAGE=A  
NODE=M032M1;LINKAGE=CC

NODE=M032M;LINKAGE=P  
NODE=M032M;LINKAGE=AY

NODE=M032M;LINKAGE=I  
NODE=M032M;LINKAGE=E  
NODE=M032M;LINKAGE=M  
NODE=M032M;LINKAGE=B

 **$\rho(2150)$  WIDTH**

NODE=M032210

 **$e^+ e^-$  PRODUCED**

| VALUE (MeV)                                                                   | DOCUMENT ID         | TECN | COMMENT                                                         |
|-------------------------------------------------------------------------------|---------------------|------|-----------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                     |      |                                                                 |
| 109 ± 76                                                                      | <sup>10</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>11</sup> CLEGG | 90   | RVUE $e^+ e^- \rightarrow 3(\pi^+ \pi^-), 2(\pi^+ \pi^- \pi^0)$ |

NODE=M032W3  
NODE=M032W3

OCCUR=2

 **$\bar{p}p \rightarrow \pi\pi$** 

| 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>12</sup> OAKDEN | 94   | RVUE 0.36–1.55 $\bar{p}p \rightarrow \pi\pi$ |
| ~ 250                                                                         | <sup>13</sup> MARTIN | 80B  | RVUE                                         |
| ~ 200                                                                         | <sup>13</sup> MARTIN | 80C  | RVUE                                         |

NODE=M032W1  
NODE=M032W1

**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>14</sup> ANISOVICH   | 02   | SPEC 0.6–1.9 $p\bar{p} \rightarrow \omega \pi^0, \omega \eta \pi^0, \pi^+ \pi^-$ |
| 135 ± 75                                                                      | <sup>15,16</sup> COUPLAND | 77   | CNTR 0.7–2.4 $\bar{p}p \rightarrow \bar{p}p$                                     |
| 98 ± 8                                                                        | <sup>16</sup> ALSPECTOR   | 73   | CNTR $\bar{p}p$ S channel                                                        |
| ~ 85                                                                          | <sup>17</sup> ABRAMS      | 70   | CNTR S channel $\bar{p}N$                                                        |

NODE=M032W2  
NODE=M032W2

 **$\pi^- p \rightarrow \omega \pi^0 n$** 

| VALUE (MeV)                                                                   | DOCUMENT ID | TECN | COMMENT                                       |
|-------------------------------------------------------------------------------|-------------|------|-----------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                               |
| 320 ± 70                                                                      | ALDE        | 95   | GAM2 38 $\pi^- p \rightarrow \omega \pi^0 n$  |
| ~ 300                                                                         | ALDE        | 92C  | GAM4 100 $\pi^- p \rightarrow \omega \pi^0 n$ |

NODE=M032W4  
NODE=M032W4

<sup>10</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>11</sup> Includes ATKINSON 85.

<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>  $I(J^P) = 1(1^-)$  from simultaneous analysis of  $p\bar{p} \rightarrow \pi^- \pi^+$  and  $\pi^0 \pi^0$ .

<sup>14</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

<sup>15</sup> From a fit to the total elastic cross section.

<sup>16</sup> Isospins 0 and 1 not separated.

<sup>17</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=M032W3;LINKAGE=LE

NODE=M032W3;LINKAGE=A  
NODE=M032W1;LINKAGE=CC

NODE=M032W;LINKAGE=P  
NODE=M032W;LINKAGE=AY

NODE=M032W;LINKAGE=E  
NODE=M032W;LINKAGE=I  
NODE=M032W;LINKAGE=B

**$\rho(2150)$  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                           |
| $\Gamma_{10}$ $\rho\bar{\rho}$   |                                |

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

 **$\rho(2150)$   $\Gamma(i)\Gamma(e^+e^-)/\Gamma^2(\text{total})$** 

$$\Gamma(f_1(1285)\pi^+\pi^-)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_7/\Gamma \times \Gamma_1/\Gamma$$

| VALUE (units $10^{-7}$ )                | DOCUMENT ID          | TECN      | COMMENT                                             |
|-----------------------------------------|----------------------|-----------|-----------------------------------------------------|
| <b><math>3.1 \pm 0.6 \pm 0.5</math></b> | <sup>18</sup> AUBERT | 07AU BABR | $10.6 e^+e^- \rightarrow f_1(1285)\pi^+\pi^-\gamma$ |

<sup>18</sup> Calculated by us from the reported value of cross section at the peak.

NODE=M032230

NODE=M032G01

NODE=M032G01

NODE=M032G01;LINKAGE=AU

$$\Gamma(\eta'\pi^+\pi^-)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_6/\Gamma \times \Gamma_1/\Gamma$$

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

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

|               |                      |           |                                                 |
|---------------|----------------------|-----------|-------------------------------------------------|
| $4.9 \pm 1.9$ | <sup>19</sup> AUBERT | 07AU BABR | $10.6 e^+e^- \rightarrow \eta'\pi^+\pi^-\gamma$ |
|---------------|----------------------|-----------|-------------------------------------------------|

<sup>19</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**

|           |      |               |                              |                          |
|-----------|------|---------------|------------------------------|--------------------------|
| 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> |                          |
| 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=54299

REFID=52049

REFID=48828

REFID=48327

REFID=48349

REFID=47950

REFID=45212

REFID=44371

REFID=44103

REFID=45210

REFID=41859

REFID=41894

REFID=41355

REFID=22000

REFID=21838

REFID=21837

REFID=21733

REFID=21830

REFID=21824

REFID=21813

REFID=21807

REFID=21805

REFID=48054

$\phi(2170)$ 

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

Observed by AUBERT,BE 06D in the initial-state radiation process  
 $e^+e^- \rightarrow \phi f_0(980)\gamma$ .

NODE=M103

NODE=M103

 $\phi(2170)$  MASS

NODE=M103M

NODE=M103M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID              | TECN      | COMMENT                                          |
|-------------------------------------------------------------------------------|------|--------------------------|-----------|--------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                          |           |                                                  |
| 2135 $\pm 8 \pm 9$                                                            | 95   | ABLIKIM                  | 19I BES3  | $e^+e^- \rightarrow \eta\phi f_0(980)$           |
| 2239.2 $\pm 7.1 \pm 11.3$                                                     |      | <sup>1</sup> ABLIKIM     | 19L BES3  | $e^+e^- \rightarrow K^+K^-$                      |
| 2200 $\pm 6 \pm 5$                                                            | 471  | ABLIKIM                  | 15H BES3  | $J/\psi \rightarrow \eta\phi\pi^+\pi^-$          |
| 2180 $\pm 8 \pm 8$                                                            |      | <sup>2,3</sup> LEES      | 12F BABR  | 10.6 $e^+e^- \rightarrow \phi\pi^+\pi^-\gamma$   |
| 2079 $\pm 13 \pm 79_{-28}$                                                    | 4.8k | <sup>4</sup> SHEN        | 09 BELL   | 10.6 $e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$ |
| 2186 $\pm 10 \pm 6$                                                           | 52   | ABLIKIM                  | 08F BES   | $J/\psi \rightarrow \eta\phi f_0(980)$           |
| 2125 $\pm 22 \pm 10$                                                          | 483  | AUBERT                   | 08S BABR  | 10.6 $e^+e^- \rightarrow \phi\eta\gamma$         |
| 2192 $\pm 14$                                                                 | 116  | <sup>5</sup> AUBERT      | 07AK BABR | 10.6 $e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$ |
| 2169 $\pm 20$                                                                 | 149  | <sup>5</sup> AUBERT      | 07AK BABR | 10.6 $e^+e^- \rightarrow K^+K^-\pi^0\pi^0\gamma$ |
| 2175 $\pm 10 \pm 15$                                                          | 201  | <sup>3,6</sup> AUBERT,BE | 06D BABR  | 10.6 $e^+e^- \rightarrow K^+K^-\pi\pi\gamma$     |

<sup>1</sup> The observed structure can be due to both the  $\phi(2170)$  and  $\rho(2150)$ .

<sup>2</sup> Fit includes interference with the  $\phi(1680)$ .

<sup>3</sup> From the  $\phi f_0(980)$  component.

<sup>4</sup> From a fit with two incoherent Breit-Wigners.

<sup>5</sup> From the  $K^+K^- f_0(980)$  component.

<sup>6</sup> Superseded by LEES 12F.

OCCUR=2

NODE=M103M;LINKAGE=C  
 NODE=M103M;LINKAGE=A  
 NODE=M103M;LINKAGE=AB  
 NODE=M103M;LINKAGE=SH  
 NODE=M103M;LINKAGE=AU  
 NODE=M103M;LINKAGE=B

 $\phi(2170)$  WIDTH

NODE=M103W

NODE=M103W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID               | TECN      | COMMENT                                          |
|-------------------------------------------------------------------------------|------|---------------------------|-----------|--------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                           |           |                                                  |
| 104 $\pm 24 \pm 12$                                                           | 95   | ABLIKIM                   | 19I BES3  | $e^+e^- \rightarrow \eta\phi f_0(980)$           |
| 139.8 $\pm 12.3 \pm 20.6$                                                     |      | <sup>7</sup> ABLIKIM      | 19L BES3  | $e^+e^- \rightarrow K^+K^-$                      |
| 104 $\pm 15 \pm 15$                                                           | 471  | ABLIKIM                   | 15H BES3  | $J/\psi \rightarrow \eta\phi\pi^+\pi^-$          |
| 77 $\pm 15 \pm 10$                                                            |      | <sup>8,9</sup> LEES       | 12F BABR  | 10.6 $e^+e^- \rightarrow \phi\pi^+\pi^-\gamma$   |
| 192 $\pm 23 \pm 25_{-61}$                                                     | 4.8k | <sup>10</sup> SHEN        | 09 BELL   | 10.6 $e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$ |
| 65 $\pm 23 \pm 17$                                                            | 52   | ABLIKIM                   | 08F BES   | $J/\psi \rightarrow \eta\phi f_0(980)$           |
| 61 $\pm 50 \pm 13$                                                            | 483  | AUBERT                    | 08S BABR  | 10.6 $e^+e^- \rightarrow \phi\eta\gamma$         |
| 71 $\pm 21$                                                                   | 116  | <sup>11</sup> AUBERT      | 07AK BABR | 10.6 $e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$ |
| 102 $\pm 27$                                                                  | 149  | <sup>11</sup> AUBERT      | 07AK BABR | 10.6 $e^+e^- \rightarrow K^+K^-\pi^0\pi^0\gamma$ |
| 58 $\pm 16 \pm 20$                                                            | 201  | <sup>9,12</sup> AUBERT,BE | 06D BABR  | 10.6 $e^+e^- \rightarrow K^+K^-\pi\pi\gamma$     |

<sup>7</sup> The observed structure can be due to both the  $\phi(2170)$  and  $\rho(2150)$ .

<sup>8</sup> Fit includes interference with the  $\phi(1680)$ .

<sup>9</sup> From the  $\phi f_0(980)$  component.

<sup>10</sup> From a fit with two incoherent Breit-Wigners.

<sup>11</sup> From the  $K^+K^- f_0(980)$  component.

<sup>12</sup> Superseded by LEES 12F.

OCCUR=2

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                           |
| $\Gamma_2$ $\phi\eta$                                    |                                |
| $\Gamma_3$ $\phi\pi\pi$                                  |                                |
| $\Gamma_4$ $\phi f_0(980)$                               | seen                           |
| $\Gamma_5$ $K^+K^-\pi^+\pi^-$                            |                                |
| $\Gamma_6$ $K^+K^-f_0(980) \rightarrow K^+K^-\pi^+\pi^-$ | seen                           |
| $\Gamma_7$ $K^+K^-\pi^0\pi^0$                            |                                |
| $\Gamma_8$ $K^+K^-f_0(980) \rightarrow K^+K^-\pi^0\pi^0$ | seen                           |
| $\Gamma_9$ $K^{*0}K^\pm\pi^\mp$                          | not seen                       |
| $\Gamma_{10}$ $K^*(892)^0\bar{K}^*(892)^0$               | not seen                       |

DESIG=1;OUR EVAL; $\rightarrow$  UNCHECKED  $\leftarrow$   
DESIG=5  
DESIG=9  
DESIG=2;OUR EVAL; $\rightarrow$  UNCHECKED  $\leftarrow$   
DESIG=3  
DESIG=6  
DESIG=4  
DESIG=7  
DESIG=8  
DESIG=10

 $\phi(2170) \Gamma(i)\Gamma(e^+e^-)/\Gamma(\text{total})$ 

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. • • •      |                           |
| $1.7 \pm 0.7 \pm 1.3$ 483 AUBERT 08S BABR 10.6 $e^+e^- \rightarrow \phi\eta\gamma$ |                           |

NODE=M103G2  
NODE=M103G2

| $\Gamma(\phi f_0(980)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$                                                                                            | $\Gamma_4\Gamma_1/\Gamma$ |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| VALUE (eV) EVTS DOCUMENT ID TECN COMMENT                                                                                                                       |                           |
| $2.3 \pm 0.3 \pm 0.3$ 13,14 LEES 12F BABR 10.6 $e^+e^- \rightarrow \phi\pi^+\pi^-\gamma$                                                                       |                           |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                  |                           |
| $2.5 \pm 0.8 \pm 0.4$ 201 14,15 AUBERT,BE 06D BABR 10.6 $e^+e^- \rightarrow K^+K^-\pi\pi\gamma$                                                                |                           |
| <sup>13</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>14</sup> From the $\phi f_0(980)$ component.                                                                                                              |                           |
| <sup>15</sup> Superseded by LEES 12F.                                                                                                                          |                           |

NODE=M103G1  
NODE=M103G1

NODE=M103G1;LINKAGE=A

NODE=M103G1;LINKAGE=AB  
NODE=M103G1;LINKAGE=B

 $\phi(2170) \Gamma(i)\Gamma(e^+e^-)/\Gamma^2(\text{total})$ 

NODE=M103220

| $\Gamma(\phi\pi\pi)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$                                                  | $\Gamma_3/\Gamma \times \Gamma_1/\Gamma$ |
|-----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| VALUE (units $10^{-7}$ ) EVTS DOCUMENT ID TECN COMMENT                                                                                  |                                          |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                           |                                          |
| $1.65 \pm 0.15 \pm 0.18$ 4.8k <sup>16</sup> SHEN 09 BELL 10.6 $e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$                               |                                          |
| <sup>16</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

NODE=M103225

| $\Gamma(K^+K^-f_0(980) \rightarrow K^+K^-\pi^+\pi^-)/\Gamma_{\text{total}}$ | $\Gamma_6/\Gamma$    |
|-----------------------------------------------------------------------------|----------------------|
| VALUE DOCUMENT ID TECN COMMENT                                              |                      |
| seen AUBERT 07AK BABR 10.6 $e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$      |                      |
| $\Gamma(K^+K^-f_0(980) \rightarrow K^+K^-\pi^0\pi^0)/\Gamma_{\text{total}}$ | $\Gamma_8/\Gamma$    |
| VALUE DOCUMENT ID TECN COMMENT                                              |                      |
| seen AUBERT 07AK BABR 10.6 $e^+e^- \rightarrow K^+K^-\pi^0\pi^0\gamma$      |                      |
| $\Gamma(K^{*0}K^\pm\pi^\mp)/\Gamma_{\text{total}}$                          | $\Gamma_9/\Gamma$    |
| VALUE DOCUMENT ID TECN COMMENT                                              |                      |
| not seen AUBERT 07AK BABR 10.6 GeV $e^+e^-$                                 |                      |
| $\Gamma(K^*(892)^0\bar{K}^*(892)^0)/\Gamma_{\text{total}}$                  | $\Gamma_{10}/\Gamma$ |
| VALUE DOCUMENT ID TECN COMMENT                                              |                      |
| not seen ABLIKIM 10C BES2 $J/\psi \rightarrow \eta K^+\pi^- K^-\pi^+$       |                      |

NODE=M103R01  
NODE=M103R01

NODE=M103R02  
NODE=M103R02

NODE=M103R03  
NODE=M103R03

NODE=M103R04  
NODE=M103R04

 $\phi(2170)$  REFERENCES

NODE=M103

|                                                                      |  |
|----------------------------------------------------------------------|--|
| ABLIKIM 19I PR D99 012014 M. Ablikim <i>et al.</i> (BES III Collab.) |  |
| ABLIKIM 19L PR D99 032001 M. Ablikim <i>et al.</i> (BES III Collab.) |  |
| ABLIKIM 15H PR D91 052017 M. Ablikim <i>et al.</i> (BES III 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.)  |  |

REFID=59605  
REFID=59612  
REFID=56773  
REFID=54298  
REFID=53349  
REFID=53000  
REFID=52154  
REFID=52242  
REFID=51908  
REFID=51511

**$f_0(2200)$** 

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

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**

NODE=M112M

| VALUE (MeV)                                                                   | EVT5 | DOCUMENT ID           | TECN     | COMMENT                                           |
|-------------------------------------------------------------------------------|------|-----------------------|----------|---------------------------------------------------|
| <b>2189±13 OUR AVERAGE</b>                                                    |      |                       |          |                                                   |
| 2170±20 <sup>+10</sup> <sub>-15</sub>                                         |      | ABLIKIM               | 05Q BES2 | $\psi(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^-$ |
| 2197±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±12± 8                                                                    | 381  | <sup>2,3</sup> DOBBS  | 15       | $J/\psi \rightarrow \gamma K^+ K^-$               |
| 2188±17±16                                                                    | 203  | <sup>2,3</sup> DOBBS  | 15       | $\psi(2S) \rightarrow \gamma K^+ K^-$             |
| 2210±50                                                                       |      | <sup>4</sup> BINON    | 05 GAMS  | $33 \pi^- p \rightarrow \eta \eta n$              |
| ~ 2122                                                                        |      | HASAN                 | 94 RVUE  | $\bar{p} p \rightarrow \pi \pi$                   |
| ~ 2321                                                                        |      | HASAN                 | 94 RVUE  | $\bar{p} p \rightarrow \pi \pi$                   |

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  $\Gamma = 238$  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**

NODE=M112W

| VALUE (MeV)                                                                   | DOCUMENT ID           | TECN     | COMMENT                                           |
|-------------------------------------------------------------------------------|-----------------------|----------|---------------------------------------------------|
| <b>238±50 OUR AVERAGE</b> Error includes scale factor of 1.2.                 |                       |          |                                                   |
| 220±60 <sup>+40</sup> <sub>-45</sub>                                          | ABLIKIM               | 05Q BES2 | $\psi(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^-$ |
| 201±51                                                                        | <sup>5</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. • • • |                       |          |                                                   |
| 380±90                                                                        | <sup>6</sup> BINON    | 05 GAMS  | $33 \pi^- p \rightarrow \eta \eta n$              |
| ~ 273                                                                         | HASAN                 | 94 RVUE  | $\bar{p} p \rightarrow \pi \pi$                   |
| ~ 223                                                                         | HASAN                 | 94 RVUE  | $\bar{p} p \rightarrow \pi \pi$                   |

NODE=M112W

OCCUR=2

<sup>5</sup> Cannot determine spin to be 0.<sup>6</sup> First solution, PWA is ambiguous.

NODE=M112W;LINKAGE=A  
 NODE=M112W;LINKAGE=BI

 **$f_0(2200)$  REFERENCES**

NODE=M112

|          |     |                             |                             |               |
|----------|-----|-----------------------------|-----------------------------|---------------|
| 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.) |

REFID=56805  
 REFID=50958  
 REFID=50780  
 REFID=44103  
 REFID=40917  
 REFID=40574

**$f_J(2220)$** 

$$J^{PC} = 0^+(2^{++} \text{ or } 4^{++})$$

OMITTED FROM SUMMARY TABLE

Needs confirmation. See our mini-review in the 2004 edition of this Review, PDG 04.

NODE=M082

NODE=M082

 **$f_J(2220)$  MASS**

NODE=M082M

NODE=M082M

| 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     | $e^+e^- \rightarrow \gamma K_S^0 K_S^0$                    |
| • • • 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.<br><sup>2</sup> $J^{PC} = 2^{++}$ . Systematic uncertainties not evaluated |      |                              |          |                                                            |

OCCUR=2

OCCUR=3

OCCUR=4

OCCUR=2

NODE=M082M;LINKAGE=A  
NODE=M082M;LINKAGE=VL **$f_J(2220)$  WIDTH**

NODE=M082W

NODE=M082W

| 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     | $e^+e^- \rightarrow \gamma K_S^0 K_S^0$                    |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |      |                              |          |                                                            |
| 8.6 ± 2.5                                                                     |     |      | <sup>1</sup> VLADIMIRSK...08 | SPEC     | $40 \pi^-p \rightarrow K_S^0 K_S^0 n + m\pi^0$             |
| <80                                                                           | 90  |      | ALDE                         | 87C GAM2 | $38 \pi^-p \rightarrow \eta'\eta n$                        |
| <sup>1</sup> $J^{PC} = 2^{++}$ . Systematic uncertainties not evaluated       |     |      |                              |          |                                                            |

OCCUR=2

OCCUR=3

OCCUR=4

OCCUR=2

NODE=M082W;LINKAGE=VL

 **$f_J(2220)$  DECAY MODES**

NODE=M082215;NODE=M082

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1 \pi\pi$         | not seen                       |
| $\Gamma_2 \pi^+\pi^-$     | not seen                       |
| $\Gamma_3 K\bar{K}$       | not seen                       |
| $\Gamma_4 p\bar{p}$       | not seen                       |
| $\Gamma_5 \gamma\gamma$   | not seen                       |
| $\Gamma_6 \eta\eta'(958)$ | seen                           |
| $\Gamma_7 \phi\phi$       | not seen                       |
| $\Gamma_8 \eta\eta$       | 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 | $\gamma\gamma \rightarrow K_S^0 K_S^0, E_{\text{cm}}^{\text{ee}} = 91, 183-209 \text{ GeV}$ |

• • • 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 | $\gamma\gamma, K\bar{K}\pi$            |

 $\Gamma(\pi\pi) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$  $\Gamma_1 \Gamma_5 / \Gamma$ 

| 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=M082G3NODE=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 | $1.4-1.5 p\bar{p} \rightarrow \pi^0 \pi^0$ |

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

|           |    |                    |         |                                              |
|-----------|----|--------------------|---------|----------------------------------------------|
| < (11-42) | 99 | <sup>2</sup> HASAN | 96 SPEC | $1.35-1.55 p\bar{p} \rightarrow \pi^+ \pi^-$ |
|-----------|----|--------------------|---------|----------------------------------------------|

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 | $1.1-2.0 p\bar{p} \rightarrow \phi\phi$ |

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 | $1.4-1.5 p\bar{p} \rightarrow \eta\eta$ |

<sup>1</sup> For  $J^P = 2^+$  in the mass range 2222-2240 MeV and the total width between 10 and 20 MeV.<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.<sup>3</sup> For  $J^P = 2^+$ , the mass of 2235 MeV and the total width of 15 MeV.NODE=M082GG3  
NODE=M082GG3

NODE=M082GG;LINKAGE=A

NODE=M082GG;LINKAGE=B

NODE=M082GG;LINKAGE=C

 $f_J(2220) \text{ BRANCHING RATIOS}$ 

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 | $\psi(2S) \rightarrow \gamma\pi\pi$ |

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.NODE=M082R00  
NODE=M082R00

OCCUR=2

NODE=M082R00;LINKAGE=A

 $\Gamma(K\bar{K}) / \Gamma_{\text{total}}$  $\Gamma_3 / \Gamma$ 

| VALUE    | DOCUMENT ID           | 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                                                        |
|---------------|-------------|---------|----------------------------------------------------------------|
| $1.0 \pm 0.5$ | 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 $10^{-4}$ ) | 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   | $1.96-2.40 p\bar{p} \rightarrow K_S^0 K_S^0$ |
| < 1.1    | 99.7 | <sup>3</sup> BARNES       | 93 SPEC   | $1.3-1.57 p\bar{p} \rightarrow K_S^0 K_S^0$  |
| < 2.6    | 99.7 | <sup>3</sup> BARDIN       | 87 CNTR   | $1.3-1.5 p\bar{p} \rightarrow K^+ K^-$       |
| < 3.6    | 99.7 | <sup>3</sup> SCULLI       | 87 CNTR   | $1.29-1.55 p\bar{p} \rightarrow K^+ K^-$     |

NODE=M082R1  
NODE=M082R1

<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  $\Gamma = 30\text{--}35$  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. Vladimirovsky <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

REFID=48321

REFID=48558

REFID=46326

REFID=46342

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

NODE=M115

 $\eta(2225)$ 

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

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

 **$\eta(2225)$  MASS**

NODE=M115M

NODE=M115M

| VALUE (MeV)                                      | EVTS         | DOCUMENT ID          | TECN | COMMENT                                              |
|--------------------------------------------------|--------------|----------------------|------|------------------------------------------------------|
| <b><math>2221^{+13}_{-10}</math> OUR AVERAGE</b> |              |                      |      |                                                      |
| $2216^{+4+21}_{-5-11}$                           |              | <sup>1</sup> ABLIKIM | 16N  | BES3 $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$     |
| $2240^{+30+30}_{-20-20}$                         | $196 \pm 19$ | ABLIKIM              | 08I  | BES $J/\psi \rightarrow \gamma K^+ K^- K_S^0 K_L^0$  |
| $2230 \pm 25 \pm 15$                             |              | BAI                  | 90B  | MRK3 $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$     |
| $2214 \pm 20 \pm 13$                             |              | 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. • • •

 $\sim 2220$  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).

OCCUR=2

NODE=M115M;LINKAGE=B

 **$\eta(2225)$  WIDTH**

NODE=M115W

NODE=M115W

| VALUE (MeV)                                                                   | EVTS         | DOCUMENT ID          | TECN | COMMENT                                             |
|-------------------------------------------------------------------------------|--------------|----------------------|------|-----------------------------------------------------|
| <b><math>185^{+40}_{-20}</math> OUR AVERAGE</b>                               |              |                      |      |                                                     |
| $185^{+12+43}_{-14-17}$                                                       |              | <sup>1</sup> ABLIKIM | 16N  | BES3 $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$    |
| $190 \pm 30^{+60}_{-40}$                                                      | $196 \pm 19$ | ABLIKIM              | 08I  | BES $J/\psi \rightarrow \gamma K^+ K^- K_S^0 K_L^0$ |
| $150^{+300}_{-60} \pm 60$                                                     |              | BAI                  | 90B  | MRK3 $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$    |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |              |                      |      |                                                     |
| $\sim 80$                                                                     |              | 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               | (BES III 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

NODE=M044

$\rho_3(2250)$

$$I^G(J^{PC}) = 1^{+}(3^{-})$$

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  $K\bar{K}$

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

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

|             |                     |     |        |                                                 |
|-------------|---------------------|-----|--------|-------------------------------------------------|
| $\sim 2232$ | HASAN               | 94  | RVUE   | $\bar{p}p \rightarrow \pi\pi$                   |
| $\sim 2090$ | <sup>1</sup> OAKDEN | 94  | RVUE   | $0.36\text{--}1.55 \bar{p}p \rightarrow \pi\pi$ |
| $\sim 2250$ | <sup>2</sup> MARTIN | 80B | RVUE   |                                                 |
| $\sim 2300$ | <sup>2</sup> MARTIN | 80C | RVUE   |                                                 |
| $\sim 2140$ | <sup>3</sup> CARTER | 78B | CNTR 0 | $0.7\text{--}2.4 \bar{p}p \rightarrow K^- K^+$  |
| $\sim 2150$ | <sup>4</sup> CARTER | 77  | CNTR 0 | $0.7\text{--}2.4 \bar{p}p \rightarrow \pi\pi$   |

<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>  $I(J^P) = 1(3^-)$  from simultaneous analysis of  $p\bar{p} \rightarrow \pi^-\pi^+$  and  $\pi^0\pi^0$ .

<sup>3</sup>  $I = 0, 1$ .  $J^P = 3^-$  from Barrelet-zero analysis.

<sup>4</sup>  $I(J^P) = 1(3^-)$  from amplitude analysis.

NODE=M044M1  
NODE=M044M1

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>5</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>6</sup> CUTTS       | 78B | CNTR   | $0.97\text{--}3 \bar{p}p \rightarrow \bar{N}N$                                  |
| $2155 \pm 15$ | <sup>6,7</sup> COUPLAND  | 77  | CNTR 0 | $0.7\text{--}2.4 \bar{p}p \rightarrow \bar{p}p$                                 |
| $2193 \pm 2$  | <sup>6,8</sup> ALSPECTOR | 73  | CNTR   | $\bar{p}p$ S channel                                                            |
| $2190 \pm 10$ | <sup>9</sup> ABRAMS      | 70  | CNTR   | S channel $\bar{p}N$                                                            |

<sup>5</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

<sup>6</sup> Isospins 0 and 1 not separated.

<sup>7</sup> From a fit to the total elastic cross section.

<sup>8</sup> Referred to as  $T$  or  $T$  region by ALSPECTOR 73.

<sup>9</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=M044M2  
NODE=M044M2

NODE=M044M;LINKAGE=AY

NODE=M044M2;LINKAGE=I  
NODE=M044M2;LINKAGE=E  
NODE=M044M2;LINKAGE=M  
NODE=M044M2;LINKAGE=B

$\pi^- p \rightarrow \eta\pi\pi$

| 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  $K\bar{K}$** 

| VALUE (MeV)                                                                   | DOCUMENT ID          | TECN | CHG    | COMMENT                                 |
|-------------------------------------------------------------------------------|----------------------|------|--------|-----------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                      |      |        |                                         |
| ~ 220                                                                         | HASAN                | 94   | RVUE   | $\bar{p}p \rightarrow \pi\pi$           |
| ~ 60                                                                          | <sup>10</sup> OAKDEN | 94   | RVUE   | 0.36–1.55 $\bar{p}p \rightarrow \pi\pi$ |
| ~ 250                                                                         | <sup>11</sup> MARTIN | 80B  | RVUE   |                                         |
| ~ 200                                                                         | <sup>11</sup> MARTIN | 80C  | RVUE   |                                         |
| ~ 150                                                                         | <sup>12</sup> CARTER | 78B  | CNTR 0 | 0.7–2.4 $\bar{p}p \rightarrow K^- K^+$  |
| ~ 200                                                                         | <sup>13</sup> CARTER | 77   | CNTR 0 | 0.7–2.4 $\bar{p}p \rightarrow \pi\pi$   |

<sup>10</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>11</sup>  $I(J^P) = 1(3^-)$  from simultaneous analysis of  $p\bar{p} \rightarrow \pi^-\pi^+$  and  $\pi^0\pi^0$ .

<sup>12</sup>  $I = 0, 1$ .  $J^P = 3^-$  from Barrelet-zero analysis.

<sup>13</sup>  $I(J^P) = 1(3^-)$  from amplitude analysis.

NODE=M044W1  
NODE=M044W1

NODE=M044W1;LINKAGE=CC

NODE=M044W1;LINKAGE=P  
NODE=M044W1;LINKAGE=K  
NODE=M044W1;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. • • • |                           |      |        |                                                                               |
| 160 ± 25                                                                      | <sup>14</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>15,16</sup> COUPLAND | 77   | CNTR 0 | 0.7–2.4 $\bar{p}p \rightarrow \bar{p}p$                                       |
| 98 ± 8                                                                        | <sup>16</sup> ALSPECTOR   | 73   | CNTR   | $\bar{p}p$ S channel                                                          |
| ~ 85                                                                          | <sup>17</sup> ABRAMS      | 70   | CNTR   | S channel $\bar{p}N$                                                          |

<sup>14</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

<sup>15</sup> From a fit to the total elastic cross section.

<sup>16</sup> Isospins 0 and 1 not separated.

<sup>17</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=M044W2  
NODE=M044W2

NODE=M044W;LINKAGE=AY

NODE=M044W2;LINKAGE=E  
NODE=M044W2;LINKAGE=I  
NODE=M044W2;LINKAGE=B

 **$\pi^- p \rightarrow \eta\pi\pi$** 

| 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 $\pi^- p \rightarrow \eta\pi^+\pi^- n$ |

NODE=M044W3  
NODE=M044W3

 **$\rho_3(2250)$  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> |                     |
| 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> |                     |
| 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=M044

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

 $\Gamma(K\bar{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_2\Gamma_3/\Gamma$ 

| VALUE (eV)                                                                    | DOCUMENT ID      | TECN    | COMMENT                                    |
|-------------------------------------------------------------------------------|------------------|---------|--------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                  |         |                                            |
| 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 $0.7-2.4 \bar{p}p \rightarrow \pi\pi$  |

<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  
NODE=M041M1NODE=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> |             |         |

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

|               |          |     |                                            |
|---------------|----------|-----|--------------------------------------------|
| $2332 \pm 15$ | BARBERIS | 00F | 450 $pp \rightarrow p_f \omega \omega p_S$ |
|---------------|----------|-----|--------------------------------------------|

NODE=M041M4  
NODE=M041M4  
→ UNCHECKED ← **$f_4(2300)$  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 $0.7-2.4 \bar{p}p \rightarrow \pi\pi$  |

<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  
NODE=M041W1NODE=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 $0.7-2.4 \bar{p}p \rightarrow \bar{p}p$ |
| $165^{+18}_{-8}$                                                                                                                                                                | <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**

| $\Gamma(\rho\rho)/\Gamma(\omega\omega)$                                       | DOCUMENT ID | COMMENT                                      | $\Gamma_1/\Gamma_2$ |
|-------------------------------------------------------------------------------|-------------|----------------------------------------------|---------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |                                              |                     |
| $2.8 \pm 0.5$                                                                 | BARBERIS    | 00F 450 $pp \rightarrow p_f\omega\omega p_s$ |                     |

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> |                      |
| 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> |
| 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.

## $f_2(2340)$ DECAY MODES

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1 \quad \phi\phi$ | seen                           |
| $\Gamma_2 \quad \eta\eta$ | seen                           |

## $f_2(2340)$ BRANCHING RATIOS

| $\Gamma(\eta\eta)/\Gamma_{\text{total}}$ | DOCUMENT ID | TECN | COMMENT | $\Gamma_2/\Gamma$                        |
|------------------------------------------|-------------|------|---------|------------------------------------------|
| VALUE                                    |             |      |         |                                          |
| 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>   | (BES III Collab.)  | REFID=55387 |
| UMAN       | 06  | PR D73 052009 | I. Uman <i>et al.</i>      | (FNAL E835)        | REFID=51063 |
| ETKIN      | 88  | PL B201 568   | A. Etkin <i>et al.</i>     | (BNL, CUNY)        | REFID=40285 |
| BOOTH      | 86  | NP B273 677   | P.S.L. Booth <i>et al.</i> | (LIVP, GLAS, CERN) | REFID=21870 |
| ETKIN      | 85  | PL 165B 217   | A. Etkin <i>et al.</i>     | (BNL, CUNY)        | REFID=21871 |
| LINDENBAUM | 84  | CNPP 13 285   | S.J. Lindenbaum            | (CUNY)             | REFID=21869 |

$\rho_5(2350)$

$$I^G(J^{PC}) = 1^+(5^{--})$$

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>2330<math>\pm</math>35</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. • • • |                     |      |        |                                                |
| $\sim 2303$                                                                   | HASAN               | 94   | RVUE   | $\bar{p}p \rightarrow \pi\pi$                  |
| $\sim 2300$                                                                   | <sup>1</sup> MARTIN | 80B  | RVUE   |                                                |
| $\sim 2250$                                                                   | <sup>1</sup> MARTIN | 80C  | RVUE   |                                                |
| $\sim 2500$                                                                   | <sup>2</sup> CARTER | 78B  | CNTR 0 | $0.7\text{--}2.4 \bar{p}p \rightarrow K^- K^+$ |
| $\sim 2480$                                                                   | <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    |                                                                                           |
| $\sim 2380$                                                                   | <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 | $\bar{p}(pn), K^* K 2\pi$                                                                 |

NODE=M108W;LINKAGE=A

NODE=M108W;LINKAGE=C

NODE=M108W;LINKAGE=ST

NODE=M108215;NODE=M108

DESIG=1;OUR EST; $\rightarrow$  UNCHECKED  $\leftarrow$   
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

**$\pi^- p \rightarrow K^+ K^- n$** 

| 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 $\pi^0 \pi^0$ .<br><sup>2</sup> $I = 0(1)$ ; $J^P = 5^-$ from Barrelet-zero analysis.<br><sup>3</sup> $I(J^P) = 1(5^-)$ from amplitude analysis.<br><sup>4</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.<br><sup>5</sup> Isospins 0 and 1 not separated.<br><sup>6</sup> From a fit to the total elastic cross section.<br><sup>7</sup> Referred to as $U$ or $U$ region by ALSPECTOR 73.<br><sup>8</sup> For $I = 1 \bar{N}N$ .<br><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** **$\pi^- p \rightarrow \omega \pi^0 n$** 

| VALUE (MeV) | DOCUMENT ID | TECN | CHG  | COMMENT                                 |
|-------------|-------------|------|------|-----------------------------------------|
| 400 ± 100   | ALDE        | 95   | GAM2 | 38 $\pi^- p \rightarrow \omega \pi^0 n$ |

NODE=M033210

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 $p\bar{p} \rightarrow \omega \pi^0$ ,<br>$\omega \eta \pi^0$ , $\pi^+ \pi^-$ |
| 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 $\pi^0 \pi^0$ .<br><sup>11</sup> $I = 0(1)$ ; $J^P = 5^-$ from Barrelet-zero analysis.<br><sup>12</sup> $I(J^P) = 1(5^-)$ from amplitude analysis.<br><sup>13</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.<br><sup>14</sup> From a fit to the total elastic cross section.<br><sup>15</sup> Isospins 0 and 1 not separated.<br><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> |                           |
| 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

 $f_6(2510)$ 

$$I^G(J^{PC}) = 0^+(6^{++})$$

OMITTED FROM SUMMARY TABLE

Needs confirmation.

NODE=M089

NODE=M089

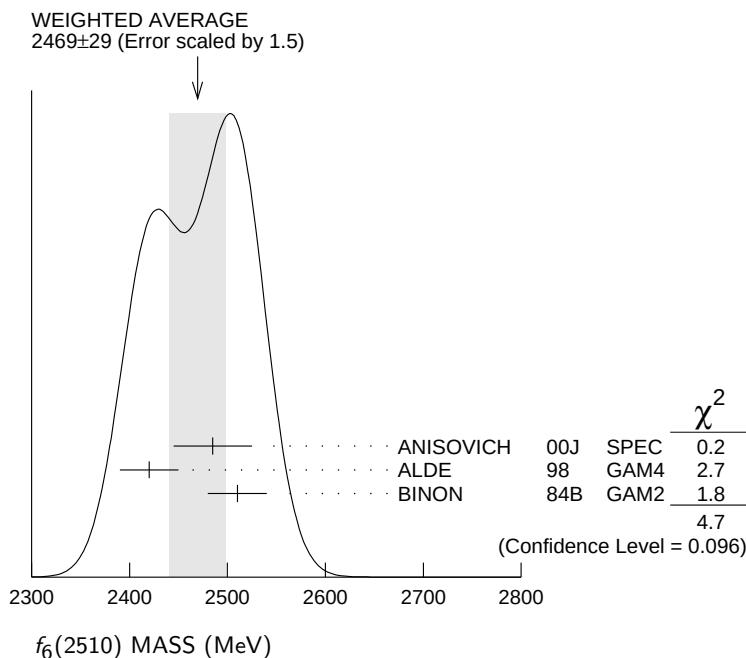
 $f_6(2510)$  MASS

NODE=M089M

| VALUE (MeV)                                                                                                               | DOCUMENT ID                                                 | TECN | COMMENT                                      |
|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|------|----------------------------------------------|
| <b>2469±29 OUR AVERAGE</b>                                                                                                | Error includes scale factor of 1.5. See the ideogram below. |      |                                              |
| 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. |                                                             |      |                                              |

NODE=M089M

NODE=M089M;LINKAGE=AN

 $f_6(2510)$  WIDTH

NODE=M089W

| VALUE (MeV)                                                                                                               | DOCUMENT ID                         | TECN | COMMENT                                      |
|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------|------|----------------------------------------------|
| <b>283±40 OUR AVERAGE</b>                                                                                                 | Error includes scale factor of 1.1. |      |                                              |
| 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. |                                     |      |                                              |

NODE=M089W

NODE=M089W;LINKAGE=AN

f<sub>0</sub>(2510) DECAY MODES

NODE=M089215;NODE=M089

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------|--------------------------------|
| $\Gamma_1 \quad \pi \pi$ | (6.0±1.0) %                    |

DESIG=1

f<sub>0</sub>(2510) BRANCHING RATIOS

NODE=M089220

| $\Gamma(\pi\pi)/\Gamma_{\text{total}}$                                |                    |      |         |                                    | $\Gamma_1/\Gamma$ |
|-----------------------------------------------------------------------|--------------------|------|---------|------------------------------------|-------------------|
| VALUE                                                                 | DOCUMENT ID        | TECN | COMMENT |                                    |                   |
| 0.06±0.01                                                             | <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. |                    |      |         |                                    |                   |

NODE=M089R1  
NODE=M089R1

NODE=M089R1;LINKAGE=A

f<sub>0</sub>(2510) REFERENCES

NODE=M089

|           |     |                              |                              |                       |
|-----------|-----|------------------------------|------------------------------|-----------------------|
| ANISOVICH | 00B | NP A662 319                  | A.V. Anisovich <i>et al.</i> |                       |
| ANISOVICH | 00J | PL B491 47                   | A.V. Anisovich <i>et al.</i> |                       |
| 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)                |

REFID=47942  
REFID=47950  
REFID=46903  
REFID=46926  
REFID=47416  
REFID=47472  
REFID=46605  
REFID=46914  
  
REFID=21780  
REFID=40288  
  
REFID=44705

OTHER LIGHT MESONS

NODE=MXXX015

Further States

NODE=M300

OMITTED FROM SUMMARY TABLE

This section contains states observed by a single group or states poorly established that thus need confirmation.

NODE=M300

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±7±9                                                                 | 64 ± 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=M300K08  
NODE=M300K08

NODE=M300K08;LINKAGE=AB

| <b>X(1070)</b> $I^G(J^{PC}) = ?^?(0^{++})$ |             |  |                              |                                                 |         |
|--------------------------------------------|-------------|--|------------------------------|-------------------------------------------------|---------|
| MASS (MeV)                                 | WIDTH (MeV) |  | DOCUMENT ID                  |                                                 | COMMENT |
| 1072±1                                     | 3.5 ± 0.5   |  | <sup>2</sup> VLADIMIRSK...08 | 40 $\pi^- p \rightarrow K_S^0 K_S^0 n + m\pi^0$ |         |
| <sup>2</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±4                                                 | 111 ± 8 ± 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± 8                                                       | 237 ± 20                             |              | VLADIMIRSK...06 | SPEC | 40 $\pi^- p \rightarrow K_S^0 K_S^0 n$ |
| 1480 <sup>+100</sup> <sub>-150</sub>                          | 1030 <sup>+ 80</sup> <sub>-170</sub> | <sup>3</sup> | ANISOVICH 03    | SPEC |                                        |
| 1530 <sup>+ 90</sup> <sub>-250</sub>                          | 560 ± 40                             | <sup>4</sup> | ANISOVICH 03    | SPEC |                                        |

NODE=M300J98  
NODE=M300J98

OCCUR=2

<sup>3</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>4</sup>K-matrix pole from combined analysis of  $\pi^- p \rightarrow \pi^0 \pi^0 n$ ,  $\pi^- p \rightarrow K \bar{K} n$ ,  $\bar{p} p \rightarrow \pi^0 \pi^0 \pi^0$ ,  $\pi^0 \eta \eta$ ,  $\pi^0 \pi^0 \eta$  at rest.

NODE=M300;LINKAGE=KM

NODE=M300;LINKAGE=MK

| <b>X(1420)</b> $I^G(J^{PC}) = 2^+(0^{++})$ |             |             |      |         |                                             |
|--------------------------------------------|-------------|-------------|------|---------|---------------------------------------------|
| MASS (MeV)                                 | WIDTH (MeV) | DOCUMENT ID | TECN | COMMENT |                                             |
| 1420±20                                    | 160 ± 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±3                                     | 6.0 ± 2.5   | <sup>5</sup> VLADIMIRSK...08 | 40      | $\pi^- p \rightarrow K_S^0 K_S^0 n + m\pi^0$ |  |
| <sup>5</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 <sup>+49+98</sup> <sub>-55-91</sub>                                                                                                                                                                                                            | 818 <sup>+22+64</sup> <sub>-23-133</sub> | <sup>6</sup> ABLIKIM | 06S  | BES     | $J/\psi \rightarrow K^+ K^- \pi^0$ |
| <sup>6</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  
NODE=M300J08

NODE=M300J08;LINKAGE=AB

| <b>X(1600)</b> $I^G(J^{PC}) = 2^+(2^{++})$ |             |                           |      |         |                                              |
|--------------------------------------------|-------------|---------------------------|------|---------|----------------------------------------------|
| MASS (MeV)                                 | WIDTH (MeV) | DOCUMENT ID               | TECN | COMMENT |                                              |
| 1600±100                                   | 400 ± 200   | <sup>7</sup> ALBRECHT 91F | ARG  | 10.2    | $e^+ e^- \rightarrow e^+ e^- 2(\pi^+ \pi^-)$ |
| <sup>7</sup> Our estimate.                 |             |                           |      |         |                                              |

NODE=M300J99  
NODE=M300J99

NODE=M300J99;LINKAGE=A

| <b>X(1650)</b> $I^G(J^{PC}) = 0^-(?^{?-})$ |             |      |               |      |                                         |
|--------------------------------------------|-------------|------|---------------|------|-----------------------------------------|
| 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> $I^G(J^{PC}) = ?^?(?^{?+})$ |                 |      |                 |      |                                        |
|--------------------------------------------|-----------------|------|-----------------|------|----------------------------------------|
| 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> $I^G(J^{PC}) = ?^?(1^{--})$ |                   |             |      |         |                                         |
|--------------------------------------------|-------------------|-------------|------|---------|-----------------------------------------|
| MASS (MeV)                                 | WIDTH (MeV)       | DOCUMENT ID | TECN | COMMENT |                                         |
| 1753.5±1.5±2.3                             | 122.2 ± 6.2 ± 8.0 | LINK        | 02K  | FOCS    | 20-160 $\gamma p \rightarrow K^+ K^- p$ |

NODE=M300J94  
NODE=M300J94

| <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> |     |             |      |      |  |
|-------------------------------------------------------------------------------------------------------------------------|-----|-------------|------|------|--|
| VALUE                                                                                                                   | CL% | DOCUMENT ID | TECN |      |  |
| <0.065                                                                                                                  | 90  | LINK        | 02K  | FOCS |  |

NODE=M300B5  
NODE=M300B5

| <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> |     |             |      |      |  |
|-----------------------------------------------------------------------------------------------------------------------|-----|-------------|------|------|--|
| VALUE                                                                                                                 | CL% | DOCUMENT ID | TECN |      |  |
| <0.183                                                                                                                | 90  | LINK        | 02K  | FOCS |  |

NODE=M300B6  
NODE=M300B6

| <b>f<sub>2</sub>(1750)</b> $I^G(J^{PC}) = 0^+(2^{++})$ |             |      |                             |      |                                         |
|--------------------------------------------------------|-------------|------|-----------------------------|------|-----------------------------------------|
| MASS (MeV)                                             | WIDTH (MeV) | EVTS | DOCUMENT ID                 | TECN | COMMENT                                 |
| 1755±10                                                | 67 ± 12     | 870  | <sup>8</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>9</sup> SCHEGELSKY 06A | RVUE | $\gamma \gamma \rightarrow K_S^0 K_S^0$ |  |

NODE=M300JA1  
NODE=M300JA1

$\Gamma(\gamma\gamma)$ 

| VALUE (keV)     | EVTs | DOCUMENT ID                 | TECN | COMMENT                                |
|-----------------|------|-----------------------------|------|----------------------------------------|
| $0.13 \pm 0.04$ | 870  | <sup>9</sup> SCHEGELSKY 06A | RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |

NODE=M300JA2  
NODE=M300JA2

 $\Gamma(\pi\pi)$ 

| VALUE (MeV)   | EVTs | DOCUMENT ID                 | TECN | COMMENT                                |
|---------------|------|-----------------------------|------|----------------------------------------|
| $1.3 \pm 1.0$ | 870  | <sup>9</sup> SCHEGELSKY 06A | RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |

NODE=M300JA3  
NODE=M300JA3

 $\Gamma(\eta\eta)$ 

| VALUE (MeV)   | EVTs | DOCUMENT ID                 | TECN | COMMENT                                |
|---------------|------|-----------------------------|------|----------------------------------------|
| $2.0 \pm 0.5$ | 870  | <sup>9</sup> SCHEGELSKY 06A | RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |

NODE=M300JA4  
NODE=M300JA4

<sup>8</sup> From analysis of L3 data at 91 and 183–209 GeV.

<sup>9</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

 $X(1775) \quad I^G(J^{PC}) = 1^-(?^-+)$ 

| MASS (MeV)    | WIDTH (MeV)  | DOCUMENT ID | TECN | COMMENT                                          |
|---------------|--------------|-------------|------|--------------------------------------------------|
| $1763 \pm 20$ | $192 \pm 60$ | CONDO 91    | SHF  | $\gamma p \rightarrow (p\pi^+)(\pi^+\pi^-\pi^-)$ |
| $1787 \pm 18$ | $118 \pm 60$ | CONDO 91    | SHF  | $\gamma p \rightarrow n\pi^+\pi^+\pi^-$          |

NODE=M300J60  
NODE=M300J60

OCCUR=2

 $f_0(1800) \quad I^G(J^{PC}) = 0^+(0^++)$ 

| MASS (MeV)                | WIDTH (MeV)             | DOCUMENT ID           | TECN | COMMENT                                    |
|---------------------------|-------------------------|-----------------------|------|--------------------------------------------|
| $1795 \pm 7^{+23}_{-20}$  | $95 \pm 10^{+78}_{-82}$ | ABLIKIM               | 13J  | BES3 $J/\psi \rightarrow \gamma\omega\phi$ |
| $1812^{+19}_{-26} \pm 18$ | $105 \pm 20 \pm 28$     | <sup>10</sup> ABLIKIM | 06J  | BES2 $J/\psi \rightarrow \gamma\omega\phi$ |

NODE=M300K29  
NODE=M300K29

<sup>10</sup> Not seen by LIU 09 in  $B^\pm \rightarrow K^\pm \omega\phi$ .

NODE=M300K29;LINKAGE=AB

 $X(1850 - 3100) \quad I^G(J^{PC}) = ?^?(1^{--})$ 

| $\Gamma(e^+e^-) \cdot B(X \rightarrow \text{hadrons})$ (eV) | CL% | DOCUMENT ID           | TECN | COMMENT                                  |
|-------------------------------------------------------------|-----|-----------------------|------|------------------------------------------|
| $< 120$                                                     | 90  | <sup>11</sup> ANASHIN | 11   | KEDR $e^+e^- \rightarrow \text{hadrons}$ |

NODE=M300K28  
NODE=M300K28

<sup>11</sup> This limit is center-of-mass energy dependent. We quote the most stringent one.

NODE=M300K28;LINKAGE=AN

 $X(1855) \quad I^G(J^{PC}) = ?^?(???)$ 

| MASS (MeV)     | WIDTH (MeV) | DOCUMENT ID | TECN | COMMENT                                 |
|----------------|-------------|-------------|------|-----------------------------------------|
| $1856.6 \pm 5$ | $20 \pm 5$  | BRIDGES     | 86D  | SPEC $0. \bar{p}d \rightarrow \pi\pi N$ |

NODE=M300J31  
NODE=M300J31

 $X(1870) \quad I^G(J^{PC}) = ?^?(2^{??})$ 

| MASS (MeV)    | WIDTH (MeV)  | DOCUMENT ID | TECN | COMMENT                                |
|---------------|--------------|-------------|------|----------------------------------------|
| $1870 \pm 40$ | $250 \pm 30$ | ALDE        | 86D  | GAM4 $100 \pi^- p \rightarrow 2\eta X$ |

NODE=M300J45  
NODE=M300J45

 $a_3(1875) \quad I^G(J^{PC}) = 1^-(3^{++})$ 

| MASS (MeV)           | WIDTH (MeV)           | DOCUMENT ID | TECN | COMMENT                                           |
|----------------------|-----------------------|-------------|------|---------------------------------------------------|
| $1874 \pm 43 \pm 96$ | $385 \pm 121 \pm 114$ | CHUNG       | 02   | B852 $18.3 \pi^- p \rightarrow \pi^+\pi^-\pi^- p$ |

NODE=M300J95  
NODE=M300J95

 $B(a_3(1875) \rightarrow f_2(1270)\pi)/B(a_3(1875) \rightarrow \rho\pi)$ 

| VALUE         | DOCUMENT ID         | TECN | COMMENT                                           |
|---------------|---------------------|------|---------------------------------------------------|
| $0.8 \pm 0.2$ | <sup>12</sup> CHUNG | 02   | B852 $18.3 \pi^- p \rightarrow \pi^+\pi^-\pi^- p$ |

NODE=M300B7  
NODE=M300B7

<sup>12</sup> Using the observable fractions of 50.0%  $\rho\pi$ , 56.5%  $f_2\pi$ , and 11.8%  $\rho_3\pi$ .

NODE=M300B;LINKAGE=C1

 $B(a_3(1875) \rightarrow \rho_3(1690)\pi)/B(a_3(1875) \rightarrow \rho\pi)$ 

| VALUE         | DOCUMENT ID         | TECN | COMMENT                                           |
|---------------|---------------------|------|---------------------------------------------------|
| $0.9 \pm 0.3$ | <sup>13</sup> CHUNG | 02   | B852 $18.3 \pi^- p \rightarrow \pi^+\pi^-\pi^- p$ |

NODE=M300B8  
NODE=M300B8

<sup>13</sup> Using the observable fractions of 50.0%  $\rho\pi$ , 56.5%  $f_2\pi$ , and 11.8%  $\rho_3\pi$ .

NODE=M300B8;LINKAGE=C1

| <b><math>a_1(1930)</math> <math>I^G(J^{PC}) = 1^-(1^{++})</math></b> |             |             |          |                                                          |  |
|----------------------------------------------------------------------|-------------|-------------|----------|----------------------------------------------------------|--|
| 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><math>X(1935)</math> <math>I^G(J^{PC}) = 1^+(1^{-?})</math></b> |             |              |         |                                       |  |
|--------------------------------------------------------------------|-------------|--------------|---------|---------------------------------------|--|
| 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><math>\rho_2(1940)</math> <math>I^G(J^{PC}) = 1^+(2^{--})</math></b> |             |                         |         |                                                                         |  |
|-------------------------------------------------------------------------|-------------|-------------------------|---------|-------------------------------------------------------------------------|--|
| MASS (MeV)                                                              | WIDTH (MeV) | DOCUMENT ID             | TECN    | COMMENT                                                                 |  |
| 1940 ± 40                                                               | 155 ± 40    | <sup>14</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>14</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

NODE=M300J85;LINKAGE=AY

| <b><math>\omega_3(1945)</math> <math>I^G(J^{PC}) = 0^-(3^{--})</math></b> |             |                         |          |                                                             |  |
|---------------------------------------------------------------------------|-------------|-------------------------|----------|-------------------------------------------------------------|--|
| MASS (MeV)                                                                | WIDTH (MeV) | DOCUMENT ID             | TECN     | COMMENT                                                     |  |
| 1945 ± 20                                                                 | 115 ± 22    | <sup>15</sup> ANISOVICH | 02B SPEC | 0.6–1.9 $p\bar{p} \rightarrow \omega\eta, \omega\pi^0\pi^0$ |  |

NODE=M300J65  
NODE=M300J65

<sup>15</sup> From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B.

NODE=M300J65;LINKAGE=AZ

| <b><math>a_2(1950)</math> <math>I^G(J^{PC}) = 1^-(2^{++})</math></b> |                                   |                         |          |                      |  |
|----------------------------------------------------------------------|-----------------------------------|-------------------------|----------|----------------------|--|
| MASS (MeV)                                                           | WIDTH (MeV)                       | DOCUMENT ID             | TECN     | COMMENT              |  |
| 1950 <sup>+30</sup> <sub>-70</sub>                                   | 180 <sup>+30</sup> <sub>-70</sub> | <sup>16</sup> ANISOVICH | 01F SPEC | 1.96–2.41 $\bar{p}p$ |  |

NODE=M300K24  
NODE=M300K24

<sup>16</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>17</sup> ANISOVICH | 02B SPEC | 0.6–1.9 $p\bar{p} \rightarrow \omega\eta, \omega\pi^0\pi^0$ |  |

NODE=M300J79  
NODE=M300J79

<sup>17</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>18</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>18</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>19</sup> ANISOVICH | 02B SPEC | 0.6–1.9 $p\bar{p} \rightarrow \omega\eta, \omega\pi^0\pi^0$ |  |

NODE=M300J64  
NODE=M300J64

<sup>19</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>X(1975)</b> $I^G(J^{PC}) = ??(???)$ |             |      |             |      |                                          |
|----------------------------------------|-------------|------|-------------|------|------------------------------------------|
| 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></b> $I^G(J^{PC}) = 0^-(2^--)$ |             |              |      |         |                                                             |
|--------------------------------------------------------------|-------------|--------------|------|---------|-------------------------------------------------------------|
| MASS (MeV)                                                   | WIDTH (MeV) | DOCUMENT ID  | TECN | COMMENT |                                                             |
| 1975 ± 20                                                    | 175 ± 25    | 20 ANISOVICH | 02B  | SPEC    | 0.6–1.9 $p\bar{p} \rightarrow \omega\eta, \omega\pi^0\pi^0$ |

<sup>20</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></b> $I^G(J^{PC}) = 1^-(2^{++})$ |                |      |                          |      |                                                  |
|-----------------------------------------------------------|----------------|------|--------------------------|------|--------------------------------------------------|
| MASS (MeV)                                                | WIDTH (MeV)    | EVTS | DOCUMENT ID              | TECN | COMMENT                                          |
| 2050 ± 10 ± 40                                            | 190 ± 22 ± 100 | 18k  | <sup>21</sup> SCHEGELSKY | 06   | RVUE $\gamma\gamma \rightarrow \pi^+\pi^-\pi^0$  |
| 2003 ± 10 ± 19                                            | 249 ± 23 ± 32  |      | LU                       | 05   | B852 18 $\pi^- p \rightarrow \omega\pi^-\pi^0 p$ |

NODE=M300J2  
NODE=M300J2

<sup>21</sup> From analysis of L3 data at 183–209 GeV.

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>22</sup> SCHEGELSKY | 06   | RVUE    | $\gamma\gamma \rightarrow \pi^+\pi^-\pi^0$ |

<sup>22</sup> From analysis of L3 data at 183–209 GeV.

NODE=M300J2G  
NODE=M300J2G

NODE=M300J2G;LINKAGE=SC

| <b><math>\rho(2000)</math></b> $I^G(J^{PC}) = 1^+(1^{--})$ |             |                    |      |         |                               |
|------------------------------------------------------------|-------------|--------------------|------|---------|-------------------------------|
| MASS (MeV)                                                 | WIDTH (MeV) | DOCUMENT ID        | TECN | COMMENT |                               |
| 2000 ± 30                                                  | 260 ± 45    | <sup>23</sup> BUGG | 04C  | RVUE    | Compilation                   |
| ~ 1988                                                     | ~ 244       | HASAN              | 94   | RVUE    | $\bar{p}p \rightarrow \pi\pi$ |

NODE=M300J77  
NODE=M300J77

<sup>23</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>X(2000)</b> $I^G(J^{PC}) = 1^-(?^{?+})$ |             |                         |      |      |                                                   |
|--------------------------------------------|-------------|-------------------------|------|------|---------------------------------------------------|
| MASS (MeV)                                 | WIDTH (MeV) | DOCUMENT ID             | TECN | CHG  | COMMENT                                           |
| 1964 ± 35                                  | 225 ± 50    | <sup>24</sup> ARMSTRONG | 93D  | E760 | $\bar{p}p \rightarrow 3\pi^0 \rightarrow 6\gamma$ |
| ~ 2100                                     | ~ 500       | <sup>24</sup> ANTIPOV   | 77   | CIBS | – 25 $\pi^- p \rightarrow p\pi^-\rho_3$           |
| 2214 ± 15                                  | 355 ± 21    | <sup>25</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>24</sup> Cannot determine spin to be 3.

<sup>25</sup> BALTAY 77 favors  $J^P = ,3^+$ .

NODE=M300K01;LINKAGE=AA  
NODE=M300K01;LINKAGE=B

| <b>X(2000)</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 |      |  |
| 2010 $^{+35}_{-60}$                                        | 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    | $\pi p \rightarrow p \bar{p} \pi(\pi)$ |

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>26</sup> ANISOVICH | 02B  | SPEC    | 0.6–1.9 $p \bar{p} \rightarrow \omega \eta, \omega \pi^0 \pi^0$ |

<sup>26</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>27</sup> ANISOVICH | 02   | SPEC    | 0.6–1.9 $p \bar{p} \rightarrow \omega \pi^0, \omega \eta \pi^0, \pi^+ \pi^-$ |

<sup>27</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>28</sup> ANISOVICH | 01F  | SPEC    | 1.96–2.41 $\bar{p} p$ |

<sup>28</sup> From the combined analysis of ANISOVICH 99C, ANISOVICH 99E, and ANISOVICH 01F.

NODE=M300K23  
NODE=M300K23

NODE=M300K23;LINKAGE=AN

| <b><math>a_3(2030)</math></b> $I^G(J^{PC}) = 1^-(3^{++})$ |             |                         |      |         |                       |
|-----------------------------------------------------------|-------------|-------------------------|------|---------|-----------------------|
| MASS (MeV)                                                | WIDTH (MeV) | DOCUMENT ID             | TECN | COMMENT |                       |
| 2031 ± 12                                                 | 150 ± 18    | <sup>29</sup> ANISOVICH | 01F  | SPEC    | 1.96–2.41 $\bar{p} p$ |

<sup>29</sup> From the combined analysis of ANISOVICH 99C, ANISOVICH 99E, and ANISOVICH 01F.

NODE=M300K20  
NODE=M300K20

NODE=M300K20;LINKAGE=AN

| <b><math>\eta_2(2030)</math></b> $I^G(J^{PC}) = 0^+(2^{-+})$ |               |             |      |         |
|--------------------------------------------------------------|---------------|-------------|------|---------|
| 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>30</sup> ANISOVICH | 11   | SPEC    | 0.9–1.94 $p \bar{p}$ |  |

<sup>30</sup> Reanalysis of ADOMEIT 96 and ANISOVICH 00E.

NODE=M300B1  
NODE=M300B1

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>31</sup> ANISOVICH | 11   | SPEC    | 0.9–1.94 $p \bar{p}$ |  |

<sup>31</sup> Reanalysis of ADOMEIT 96 and ANISOVICH 00E.

NODE=M300B2  
NODE=M300B2

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>32</sup> ANISOVICH | 11   | SPEC    | 0.9–1.94 $p \bar{p}$ |  |

<sup>32</sup> Reanalysis of ADOMEIT 96 and ANISOVICH 00E.

NODE=M300B3  
NODE=M300B3

NODE=M300B3;LINKAGE=AN

| <b><math>f_3(2050)</math></b> $I^G(J^{PC}) = 0^+(3^{++})$ |             |             |      |         |                                              |
|-----------------------------------------------------------|-------------|-------------|------|---------|----------------------------------------------|
| 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></b> $I^G(J^{PC}) = 0^+(0^{++})$ |             |                      |      |         |                                           |
|-----------------------------------------------------------|-------------|----------------------|------|---------|-------------------------------------------|
| MASS (MeV)                                                | WIDTH (MeV) | DOCUMENT ID          | TECN | COMMENT |                                           |
| ~ 2050                                                    | ~ 120       | <sup>33</sup> OAKDEN | 94   | RVUE    | 0.36–1.55 $p \bar{p} \rightarrow \pi \pi$ |
| ~ 2060                                                    | ~ 50        | <sup>33</sup> OAKDEN | 94   | RVUE    | 0.36–1.55 $p \bar{p} \rightarrow \pi \pi$ |

NODE=M300J59  
NODE=M300J59

OCCUR=2

<sup>33</sup>See SEMENOV 99 and KLOET 96.

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>34</sup> ABLIKIM | 04J  | BES2    | $J/\psi \rightarrow K^- p \bar{\Lambda}$ |
| <sup>34</sup> From a fit in the region $M_{p\bar{\Lambda}} - M_p - M_{\Lambda} < 150$ MeV. <i>S</i> -wave in the $p\bar{\Lambda}$ system preferred.<br>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  
NODE=M300J01

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><math>B(a_1(2095) \rightarrow f_1(1285)\pi) / B(a_1(2095) \rightarrow a_1(1260))</math></b> |      |             |      |         |                                               |
|------------------------------------------------------------------------------------------------|------|-------------|------|---------|-----------------------------------------------|
| VALUE                                                                                          | EVTS | DOCUMENT ID | TECN | COMMENT |                                               |
| 3.18 ± 0.64                                                                                    | 69k  | KUHN        | 04   | B852    | 18 $\pi^- p \rightarrow \eta\pi^+\pi^-\pi^-p$ |

NODE=M300B03  
NODE=M300B03

| <b><math>\eta(2100)</math> <math>I^G(J^{PC}) = 0^+(0^-+)</math></b> |                                           |      |                       |      |                                                  |
|---------------------------------------------------------------------|-------------------------------------------|------|-----------------------|------|--------------------------------------------------|
| MASS (MeV)                                                          | WIDTH (MeV)                               | EVTS | DOCUMENT ID           | TECN | COMMENT                                          |
| 2050 <sup>+30+75</sup> <sub>-24-26</sub>                            | 250 <sup>+36+181</sup> <sub>-30-164</sub> |      | <sup>35</sup> ABLIKIM | 16N  | BES3 $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$ |
| 2103 ± 50                                                           | 187 ± 75                                  | 586  | <sup>36</sup> BISELLO | 89B  | DM2 $J/\psi \rightarrow 4\pi\gamma$              |

NODE=M300J48  
NODE=M300J48

<sup>35</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>36</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)</math> <math>I^G(J^{PC}) = ?^?(0^{??})</math></b> |             |             |      |         |                                   |
|--------------------------------------------------------------------|-------------|-------------|------|---------|-----------------------------------|
| MASS (MeV)                                                         | WIDTH (MeV) | DOCUMENT ID | TECN | COMMENT |                                   |
| 2100 ± 40                                                          | 250 ± 40    | ALDE        | 86D  | GAM4    | 100 $\pi^- p \rightarrow 2\eta X$ |

NODE=M300J49  
NODE=M300J49

| <b><math>X(2110)</math> <math>I^G(J^{PC}) = 1^+(3^-?)</math></b> |             |              |      |         |                                       |
|------------------------------------------------------------------|-------------|--------------|------|---------|---------------------------------------|
| MASS (MeV)                                                       | WIDTH (MeV) | DOCUMENT ID  | TECN | COMMENT |                                       |
| 2110 ± 10                                                        | 330 ± 20    | EVANGELIS... | 79   | OMEG    | 10,16 $\pi^- p \rightarrow \bar{p}pn$ |

NODE=M300J36  
NODE=M300J36

| <b><math>f_2(2140)</math> <math>I^G(J^{PC}) = 0^+(2^++)</math></b> |             |      |             |      |                               |
|--------------------------------------------------------------------|-------------|------|-------------|------|-------------------------------|
| MASS (MeV)                                                         | WIDTH (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT                       |
| 2141 ± 12                                                          | 49 ± 28     | 389  | GREEN       | 86   | MPSF 400 $pA \rightarrow 4KX$ |

NODE=M300J50  
NODE=M300J50

| <b>X(2150)</b> $I^G(J^{PC}) = ?^?(2^{+?})$ |             |             |      |         |                                      |
|--------------------------------------------|-------------|-------------|------|---------|--------------------------------------|
| MASS (MeV)                                 | WIDTH (MeV) | DOCUMENT ID | TECN | COMMENT |                                      |
| 2150 ± 10                                  | 260 ± 10    | ROZANSKA    | 80   | SPRK    | 18 $\pi^- p \rightarrow p \bar{p} n$ |

NODE=M300J38  
NODE=M300J38

| <b>a<sub>2</sub>(2175)</b> $I^G(J^{PC}) = 1^-(2^{++})$ |                                   |             |      |         |                                                             |
|--------------------------------------------------------|-----------------------------------|-------------|------|---------|-------------------------------------------------------------|
| MASS (MeV)                                             | WIDTH (MeV)                       | DOCUMENT ID | TECN | COMMENT |                                                             |
| 2175 ± 40                                              | 310 <sup>+90</sup> <sub>-45</sub> | ANISOVICH   | 01F  | SPEC    | 2.0 $\bar{p} p \rightarrow 3\pi^0, \pi^0 \eta, \pi^0 \eta'$ |

NODE=M300J88  
NODE=M300J88

| <b>η(2190)</b> $I^G(J^{PC}) = 0^+(0^{-+})$ |             |             |      |         |  |
|--------------------------------------------|-------------|-------------|------|---------|--|
| MASS (MeV)                                 | WIDTH (MeV) | DOCUMENT ID | TECN | COMMENT |  |
| 2190 ± 50                                  | 850 ± 100   | BUGG        | 99   | BES     |  |

NODE=M300J13  
NODE=M300J13

| <b>ω<sub>2</sub>(2195)</b> $I^G(J^{PC}) = 0^-(2^{--})$                            |             |              |      |         |                                                                 |
|-----------------------------------------------------------------------------------|-------------|--------------|------|---------|-----------------------------------------------------------------|
| MASS (MeV)                                                                        | WIDTH (MeV) | DOCUMENT ID  | TECN | COMMENT |                                                                 |
| 2195 ± 30                                                                         | 225 ± 40    | 37 ANISOVICH | 02B  | SPEC    | 0.6–1.9 $p \bar{p} \rightarrow \omega \eta, \omega \pi^0 \pi^0$ |
| 37 From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B. |             |              |      |         |                                                                 |

NODE=M300J82  
NODE=M300J82

NODE=M300J82;LINKAGE=AZ

| <b>ω(2205)</b> $I^G(J^{PC}) = 0^-(1^{--})$                                        |             |              |      |         |                                                                 |
|-----------------------------------------------------------------------------------|-------------|--------------|------|---------|-----------------------------------------------------------------|
| MASS (MeV)                                                                        | WIDTH (MeV) | DOCUMENT ID  | TECN | COMMENT |                                                                 |
| 2205 ± 30                                                                         | 350 ± 90    | 38 ANISOVICH | 02B  | SPEC    | 0.6–1.9 $p \bar{p} \rightarrow \omega \eta, \omega \pi^0 \pi^0$ |
| 38 From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B. |             |              |      |         |                                                                 |

NODE=M300J80  
NODE=M300J80

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    | 39 ANISOVICH | 02B  | SPEC    | 0.6–1.9 $p \bar{p} \rightarrow \omega \eta, \omega \pi^0 \pi^0$ |
| 39 From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B. |             |              |      |         |                                                                 |

NODE=M300J27  
NODE=M300J27

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> | 40 ANISOVICH | 02   | SPEC    | 0.6–1.9 $p \bar{p} \rightarrow \omega \pi^0, \omega \eta \pi^0, \pi^+ \pi^-$ |
| 40 From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02. |                                    |              |      |         |                                                                              |

NODE=M300J70  
NODE=M300J70

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    | 41 ANISOVICH | 02   | SPEC    | 0.6–1.9 $p \bar{p} \rightarrow \omega \pi^0, \omega \eta \pi^0, \pi^+ \pi^-$ |
| 41 From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02. |             |              |      |         |                                                                              |

NODE=M300J74  
NODE=M300J74

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    | 42 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>42</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

NODE=M300J87;LINKAGE=AY

| <b><math>f_2(2240)</math> <math>I^G(J^{PC}) = 0^+(2^{++})</math></b>          |             |                             |      |                               |
|-------------------------------------------------------------------------------|-------------|-----------------------------|------|-------------------------------|
| MASS (MeV)                                                                    | WIDTH (MeV) | DOCUMENT ID                 | TECN | COMMENT                       |
| 2240 ± 15                                                                     | 241 ± 30    | <sup>43</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>43</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><math>b_3(2245)</math> <math>I^G(J^{PC}) = 1^+(3^{+-})</math></b> |             |                        |      |  |
|----------------------------------------------------------------------|-------------|------------------------|------|--|
| MASS (MeV)                                                           | WIDTH (MeV) | DOCUMENT ID            | TECN |  |
| 2245 ± 50                                                            | 320 ± 70    | <sup>44</sup> BUGG 04C | RVUE |  |

NODE=M300K10  
NODE=M300K10

<sup>44</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

NODE=M300K10;LINKAGE=AY

| <b><math>\eta_2(2250)</math> <math>I^G(J^{PC}) = 0^+(2^{-+})</math></b> |             |               |      |  |
|-------------------------------------------------------------------------|-------------|---------------|------|--|
| MASS (MeV)                                                              | WIDTH (MeV) | DOCUMENT ID   | TECN |  |
| 2248 ± 20                                                               | 280 ± 20    | ANISOVICH 00I | SPEC |  |
| 2267 ± 14                                                               | 290 ± 50    | ANISOVICH 00J | SPEC |  |

NODE=M300J17  
NODE=M300J17

| <b><math>\pi_4(2250)</math> <math>I^G(J^{PC}) = 1^-(4^{-+})</math></b> |             |               |      |                                                          |
|------------------------------------------------------------------------|-------------|---------------|------|----------------------------------------------------------|
| MASS (MeV)                                                             | WIDTH (MeV) | DOCUMENT ID   | TECN | COMMENT                                                  |
| 2250 ± 15                                                              | 215 ± 25    | ANISOVICH 01F | SPEC | 2.0 $p\bar{p} \rightarrow 3\pi^0, \pi^0\eta, \pi^0\eta'$ |

NODE=M300J73  
NODE=M300J73

| <b><math>\omega_4(2250)</math> <math>I^G(J^{PC}) = 0^-(4^{--})</math></b> |             |                             |      |                                                             |
|---------------------------------------------------------------------------|-------------|-----------------------------|------|-------------------------------------------------------------|
| MASS (MeV)                                                                | WIDTH (MeV) | DOCUMENT ID                 | TECN | COMMENT                                                     |
| 2250 ± 30                                                                 | 150 ± 50    | <sup>45</sup> ANISOVICH 02B | SPEC | 0.6–1.9 $p\bar{p} \rightarrow \omega\eta, \omega\pi^0\pi^0$ |

NODE=M300J84  
NODE=M300J84

<sup>45</sup> From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B.

NODE=M300J84;LINKAGE=AZ

| <b><math>\omega_5(2250)</math> <math>I^G(J^{PC}) = 0^-(5^{--})</math></b> |             |                       |      |  |
|---------------------------------------------------------------------------|-------------|-----------------------|------|--|
| MASS (MeV)                                                                | WIDTH (MeV) | DOCUMENT ID           | TECN |  |
| 2250 ± 70                                                                 | 320 ± 95    | <sup>46</sup> BUGG 04 | RVUE |  |

NODE=M300K11  
NODE=M300K11

<sup>46</sup> From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B.

NODE=M300;LINKAGE=AZ

| <b><math>\omega_3(2255)</math> <math>I^G(J^{PC}) = 0^-(3^{--})</math></b> |             |                             |      |                                                             |
|---------------------------------------------------------------------------|-------------|-----------------------------|------|-------------------------------------------------------------|
| MASS (MeV)                                                                | WIDTH (MeV) | DOCUMENT ID                 | TECN | COMMENT                                                     |
| 2255 ± 15                                                                 | 175 ± 30    | <sup>47</sup> ANISOVICH 02B | SPEC | 0.6–1.9 $p\bar{p} \rightarrow \omega\eta, \omega\pi^0\pi^0$ |

NODE=M300J66  
NODE=M300J66

<sup>47</sup> From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B.

NODE=M300J66;LINKAGE=AZ

| <b><math>a_4(2255)</math> <math>I^G(J^{PC}) = 1^-(4^{++})</math></b> |                                    |                             |      |                                          |
|----------------------------------------------------------------------|------------------------------------|-----------------------------|------|------------------------------------------|
| MASS (MeV)                                                           | WIDTH (MeV)                        | DOCUMENT ID                 | TECN | COMMENT                                  |
| 2237 ± 5                                                             | 291 ± 12                           | UMAN 06                     | E835 | 5.2 $p\bar{p} \rightarrow \eta\eta\pi^0$ |
| 2255 ± 40                                                            | 330 <sup>+110</sup> <sub>-50</sub> | <sup>48</sup> ANISOVICH 01F | SPEC | 1.96–2.41 $p\bar{p}$                     |

NODE=M300K21  
NODE=M300K21

<sup>48</sup> From the combined analysis of ANISOVICH 99C, ANISOVICH 99E, and ANISOVICH 01F.

NODE=M300K21;LINKAGE=AN

| <b><math>a_2(2255)</math> <math>I^G(J^{PC}) = 1^-(2^{++})</math></b> |             |                             |      |                      |
|----------------------------------------------------------------------|-------------|-----------------------------|------|----------------------|
| MASS (MeV)                                                           | WIDTH (MeV) | DOCUMENT ID                 | TECN | COMMENT              |
| 2255 ± 20                                                            | 230 ± 15    | <sup>49</sup> ANISOVICH 01G | SPEC | 1.96–2.41 $p\bar{p}$ |

NODE=M300K22  
NODE=M300K22

<sup>49</sup> From the combined analysis of ANISOVICH 99C, ANISOVICH 99E, ANISOVICH 01F, and ANISOVICH 01G.

NODE=M300K22;LINKAGE=AN

| <b>X(2260)</b> $I^G(J^{PC}) = 0^+(4^{+?})$ |             |              |      |         |                                         |
|--------------------------------------------|-------------|--------------|------|---------|-----------------------------------------|
| MASS (MeV)                                 | WIDTH (MeV) | DOCUMENT ID  | TECN | COMMENT |                                         |
| 2260 ± 20                                  | 400 ± 100   | EVANGELIS... | 79   | OMEG    | 10,16 $\pi^- p \rightarrow \bar{p} p n$ |

NODE=M300J40  
NODE=M300J40

| <b><math>\rho(2270)</math></b> $I^G(J^{PC}) = 1^+(1^{--})$ |             |                         |      |         |                                                                         |
|------------------------------------------------------------|-------------|-------------------------|------|---------|-------------------------------------------------------------------------|
| MASS (MeV)                                                 | WIDTH (MeV) | DOCUMENT ID             | TECN | COMMENT |                                                                         |
| 2265 ± 40                                                  | 325 ± 80    | <sup>50</sup> ANISOVICH | 02   | SPEC    | 0.6–1.9 $p\bar{p} \rightarrow \omega\pi^0, \omega\eta\pi^0, \pi^+\pi^-$ |
| 2280 ± 50                                                  | 440 ± 110   | ATKINSON                | 85   | OMEG    | 20–70 $\gamma p \rightarrow p\omega\pi^+\pi^-\pi^0$                     |

<sup>50</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

NODE=M300J86  
NODE=M300J86

NODE=M300J86;LINKAGE=AY

| <b><math>a_1(2270)</math></b> $I^G(J^{PC}) = 1^-(1^{++})$ |                    |             |      |         |                                                          |
|-----------------------------------------------------------|--------------------|-------------|------|---------|----------------------------------------------------------|
| MASS (MeV)                                                | WIDTH (MeV)        | DOCUMENT ID | TECN | COMMENT |                                                          |
| 2270 $^{+55}_{-40}$                                       | 305 $^{+70}_{-40}$ | ANISOVICH   | 01F  | SPEC    | 2.0 $\bar{p}p \rightarrow 3\pi^0, \pi^0\eta, \pi^0\eta'$ |

NODE=M300J72  
NODE=M300J72

| <b><math>h_3(2275)</math></b> $I^G(J^{PC}) = 0^-(3^{+-})$ |             |                         |      |         |                                                             |
|-----------------------------------------------------------|-------------|-------------------------|------|---------|-------------------------------------------------------------|
| MASS (MeV)                                                | WIDTH (MeV) | DOCUMENT ID             | TECN | COMMENT |                                                             |
| 2275 ± 25                                                 | 190 ± 45    | <sup>51</sup> ANISOVICH | 02B  | SPEC    | 0.6–1.9 $p\bar{p} \rightarrow \omega\eta, \omega\pi^0\pi^0$ |

<sup>51</sup> From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B.

NODE=M300J28  
NODE=M300J28

NODE=M300J28;LINKAGE=AZ

| <b><math>a_3(2275)</math></b> $I^G(J^{PC}) = 1^-(3^{++})$ |                     |                         |      |         |                      |
|-----------------------------------------------------------|---------------------|-------------------------|------|---------|----------------------|
| MASS (MeV)                                                | WIDTH (MeV)         | DOCUMENT ID             | TECN | COMMENT |                      |
| 2275 ± 35                                                 | 350 $^{+100}_{-50}$ | <sup>52</sup> ANISOVICH | 01G  | SPEC    | 1.96–2.41 $\bar{p}p$ |

<sup>52</sup> From the combined analysis of ANISOVICH 99C, ANISOVICH 99E, ANISOVICH 01F, and ANISOVICH 01G.

NODE=M300K19  
NODE=M300K19

NODE=M300K19;LINKAGE=AN

| <b><math>\pi_2(2285)</math></b> $I^G(J^{PC}) = 1^-(2^{-+})$ |               |                         |      |         |                     |
|-------------------------------------------------------------|---------------|-------------------------|------|---------|---------------------|
| MASS (MeV)                                                  | WIDTH (MeV)   | DOCUMENT ID             | TECN | COMMENT |                     |
| 2285 ± 20 ± 25                                              | 250 ± 20 ± 25 | <sup>53</sup> ANISOVICH | 11   | SPEC    | 0.9–1.94 $p\bar{p}$ |

<sup>53</sup> Reanalysis of ADOEIT 96 and ANISOVICH 00E.

NODE=M300K25  
NODE=M300K25

NODE=M300K25;LINKAGE=AN

| <b><math>\omega_3(2285)</math></b> $I^G(J^{PC}) = 0^-(3^{--})$ |             |                         |      |         |                                                             |
|----------------------------------------------------------------|-------------|-------------------------|------|---------|-------------------------------------------------------------|
| MASS (MeV)                                                     | WIDTH (MeV) | DOCUMENT ID             | TECN | COMMENT |                                                             |
| 2278 ± 28                                                      | 224 ± 50    | <sup>54</sup> BUGG      | 04A  | RVUE    |                                                             |
| 2285 ± 60                                                      | 230 ± 40    | <sup>55</sup> ANISOVICH | 02B  | SPEC    | 0.6–1.9 $p\bar{p} \rightarrow \omega\eta, \omega\pi^0\pi^0$ |

<sup>54</sup> Partial wave analysis of the data on  $p\bar{p} \rightarrow \bar{\Lambda}\Lambda$  from BARNES 00.  
<sup>55</sup> From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B.

NODE=M300J83  
NODE=M300J83

NODE=M300J83;LINKAGE=BU  
NODE=M300J83;LINKAGE=AZ

| <b><math>\omega(2290)</math></b> $I^G(J^{PC}) = 0^-(1^{--})$ |             |                    |      |         |  |
|--------------------------------------------------------------|-------------|--------------------|------|---------|--|
| MASS (MeV)                                                   | WIDTH (MeV) | DOCUMENT ID        | TECN | COMMENT |  |
| 2290 ± 20                                                    | 275 ± 35    | <sup>56</sup> BUGG | 04A  | RVUE    |  |

<sup>56</sup> Partial wave analysis of the data on  $p\bar{p} \rightarrow \bar{\Lambda}\Lambda$  from BARNES 00.

NODE=M300J02  
NODE=M300J02

NODE=M300J02;LINKAGE=BU

| <b><math>f_2(2295)</math></b> $I^G(J^{PC}) = 0^+(2^{++})$ |             |                         |      |         |                      |
|-----------------------------------------------------------|-------------|-------------------------|------|---------|----------------------|
| MASS (MeV)                                                | WIDTH (MeV) | DOCUMENT ID             | TECN | COMMENT |                      |
| 2293 ± 13                                                 | 216 ± 37    | <sup>57</sup> ANISOVICH | 00J  | SPEC    | 1.92–2.41 $p\bar{p}$ |

<sup>57</sup> From the combined analysis of ANISOVICH 99C, ANISOVICH 99F, ANISOVICH 99J, ANISOVICH 99K, and ANISOVICH 00B. See also ANISOVICH 12.

NODE=M300K27  
NODE=M300K27

NODE=M300K27;LINKAGE=AN

| <b><math>f_3(2300)</math></b> $I^G(J^{PC}) = 0^+(3^{++})$ |             |                    |      |         |  |
|-----------------------------------------------------------|-------------|--------------------|------|---------|--|
| MASS (MeV)                                                | WIDTH (MeV) | DOCUMENT ID        | TECN | COMMENT |  |
| 2334 ± 25                                                 | 200 ± 20    | <sup>58</sup> BUGG | 04A  | RVUE    |  |

NODE=M300J19  
NODE=M300J19

<sup>58</sup> Partial wave analysis of the data on  $p\bar{p} \rightarrow \bar{\Lambda}\Lambda$  from BARNES 00.

NODE=M300J19;LINKAGE=BU

| $f_1(2310)$ | $I^G(J^{PC}) = 0^+(1^{++})$ |             |      |         |  |
|-------------|-----------------------------|-------------|------|---------|--|
| MASS (MeV)  | WIDTH (MeV)                 | DOCUMENT ID | TECN | COMMENT |  |
| 2310 ± 60   | 255 ± 70                    | ANISOVICH   | 00J  | SPEC    |  |

NODE=M300J23  
NODE=M300J23

| $\eta(2320)$                                                                                                                                                     | $I^G(J^{PC}) = 0^+(0^{-+})$ |                         |      |         |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-------------------------|------|---------|--|
| MASS (MeV)                                                                                                                                                       | WIDTH (MeV)                 | DOCUMENT ID             | TECN | COMMENT |  |
| 2320 ± 15                                                                                                                                                        | 230 ± 35                    | <sup>59</sup> ANISOVICH | 00M  | SPEC    |  |
| <sup>59</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=M300J18  
NODE=M300J18

NODE=M300;LINKAGE=B

| $\eta_4(2330)$ | $I^G(J^{PC}) = 0^+(4^{-+})$ |             |      |         |                                           |
|----------------|-----------------------------|-------------|------|---------|-------------------------------------------|
| 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

| $\omega(2330)$ | $I^G(J^{PC}) = 0^-(1^{--})$ |             |      |         |                                                      |
|----------------|-----------------------------|-------------|------|---------|------------------------------------------------------|
| 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

| <b>X(2340)</b>                                                                                                                                                                   |                    | $I^G(J^{PC}) = ??(???)$ |                      |             |                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------------|----------------------|-------------|----------------|
| <u>MASS (MeV)</u>                                                                                                                                                                | <u>WIDTH (MeV)</u> | <u>EVTS</u>             | <u>DOCUMENT ID</u>   | <u>TECN</u> | <u>COMMENT</u> |
| 2340 ± 20                                                                                                                                                                        | 180 ± 60           | 126                     | <sup>60</sup> BALTAY | 75          | HBC            |
| 15 $\pi^+ p \rightarrow p 5\pi$                                                                                                                                                  |                    |                         |                      |             |                |
| <sup>60</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=M300J54  
NODE=M300J54

NODE=M300J;LINKAGE=B1

| $\pi(2360)$ | $I^G(J^{PC}) = 1^-(0^{-+})$ |             |      |         |                                                          |
|-------------|-----------------------------|-------------|------|---------|----------------------------------------------------------|
| 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

| $X(2360)$  | $I^G(J^{PC}) = ??(4^{+?})$ |             |      |         |                                    |
|------------|----------------------------|-------------|------|---------|------------------------------------|
| 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

| $X(2440)$  | $I^G(J^{PC}) = ??(5^{-?})$ |             |      |         |                                    |
|------------|----------------------------|-------------|------|---------|------------------------------------|
| 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

| $a_6(2450)$ | $I^G(J^{PC}) = 1^-(6^{++})$ |             |      |         |                                      |
|-------------|-----------------------------|-------------|------|---------|--------------------------------------|
| 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

| $X(2540)$                               | $I^G(J^{PC}) = 0^+(0^{++})$               |             |      |         |                                        |
|-----------------------------------------|-------------------------------------------|-------------|------|---------|----------------------------------------|
| MASS (MeV)                              | WIDTH (MeV)                               | DOCUMENT ID | TECN | COMMENT |                                        |
| 2539 ± 14 <sup>+38</sup> <sub>-14</sub> | 274 <sup>+77+126</sup> <sub>-61-163</sub> | UEHARA      | 13   | BELL    | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |

NODE=M300K30  
NODE=M300K30

| $\Gamma(\gamma\gamma) \times B(K\bar{K})$ |             |      |         |                                        |  |
|-------------------------------------------|-------------|------|---------|----------------------------------------|--|
| VALUE (eV)                                | DOCUMENT ID | TECN | COMMENT |                                        |  |
| 40 <sup>+9+17</sup> <sub>-7-40</sub>      | UEHARA      | 13   | BELL    | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |  |

NODE=M300K3G  
NODE=M300K3G

| $X(2632)$    | $I^G(J^{PC}) = ??(???)$ |                         |      |         |                                |
|--------------|-------------------------|-------------------------|------|---------|--------------------------------|
| MASS (MeV)   | WIDTH (MeV)             | DOCUMENT ID             | TECN | COMMENT |                                |
| 2635.2 ± 3.3 |                         | <sup>61</sup> EVDOKIMOV | 04   | SELX    | $X(2632) \rightarrow D^+ \eta$ |
| 2631.6 ± 2.1 | < 17                    | <sup>62</sup> EVDOKIMOV | 04   | SELX    | $X(2632) \rightarrow D^0 K^+$  |

NODE=M300J03  
NODE=M300J03

OCCUR=2

<sup>61</sup> From a mass difference to  $D^+$  of  $666.9 \pm 3.3$  MeV.

<sup>62</sup> From a mass difference to  $D^0$  of  $767.0 \pm 2.0$  MeV.

NODE=M300J03;LINKAGE=EV  
NODE=M300J03;LINKAGE=ED

**$B(X(2632) \rightarrow D^0 K^+)/B(X(2632) \rightarrow D_s^+ \eta)$** 

| VALUE           | DOCUMENT ID                | TECN |
|-----------------|----------------------------|------|
| $0.14 \pm 0.06$ | <sup>63</sup> EVDOKIMOV 04 | SELX |

<sup>63</sup> Possible interpretation of this decay pattern is discussed by YASUI 07.

NODE=M300B01  
NODE=M300B01

NODE=M300B01;LINKAGE=YA

 **$X(2680) \quad I^G(J^{PC}) = ?^?(???)$** 

| MASS (MeV)    | WIDTH (MeV) | DOCUMENT ID | TECN   | COMMENT                                         |
|---------------|-------------|-------------|--------|-------------------------------------------------|
| $2676 \pm 27$ | 150         | CASO        | 70 HBC | $11.2 \pi^- p \rightarrow \rho^- \pi^+ \pi^- p$ |

NODE=M300J55  
NODE=M300J55

 **$X(2710) \quad I^G(J^{PC}) = ?^?(6^{+?})$** 

| MASS (MeV)    | WIDTH (MeV)  | DOCUMENT ID | TECN    | COMMENT                              |
|---------------|--------------|-------------|---------|--------------------------------------|
| $2710 \pm 20$ | $170 \pm 40$ | ROZANSKA    | 80 SPRK | $18 \pi^- p \rightarrow p \bar{p} n$ |

NODE=M300J44  
NODE=M300J44

 **$X(2750) \quad I^G(J^{PC}) = ?^?(7^{-?})$** 

| MASS (MeV)    | WIDTH (MeV)  | DOCUMENT ID | TECN    | COMMENT                                  |
|---------------|--------------|-------------|---------|------------------------------------------|
| $2747 \pm 32$ | $195 \pm 75$ | DENNEY      | 83 LASS | $10 \pi^+ p \rightarrow K^+ K^- \pi^+ p$ |

NODE=M300J56  
NODE=M300J56

 **$f_6(3100) \quad I^G(J^{PC}) = 0^+(6^{++})$** 

| MASS (MeV)     | WIDTH (MeV)   | DOCUMENT ID | TECN    | COMMENT                              |
|----------------|---------------|-------------|---------|--------------------------------------|
| $3100 \pm 100$ | $700 \pm 130$ | BINON       | 05 GAMS | $33 \pi^- p \rightarrow \eta \eta n$ |

NODE=M300J06  
NODE=M300J06

 **$X(3250) \quad I^G(J^{PC}) = ?^?(???)$  3-Body Decays**

| MASS (MeV)          | WIDTH (MeV) | DOCUMENT ID | TECN    | COMMENT                                   |
|---------------------|-------------|-------------|---------|-------------------------------------------|
| $3250 \pm 8 \pm 20$ | $45 \pm 18$ | ALEEV       | 93 BIS2 | $X(3250) \rightarrow \Lambda \bar{p} K^+$ |
| $3265 \pm 7 \pm 20$ | $40 \pm 18$ | ALEEV       | 93 BIS2 | $X(3250) \rightarrow \bar{\Lambda} p K^-$ |

NODE=M300J57  
NODE=M300J57

OCCUR=2

 **$X(3250) \quad I^G(J^{PC}) = ?^?(???)$  4-Body Decays**

| MASS (MeV)          | WIDTH (MeV) | DOCUMENT ID | TECN    | COMMENT                                           |
|---------------------|-------------|-------------|---------|---------------------------------------------------|
| $3245 \pm 8 \pm 20$ | $25 \pm 11$ | ALEEV       | 93 BIS2 | $X(3250) \rightarrow \Lambda \bar{p} K^+ \pi^\pm$ |
| $3250 \pm 9 \pm 20$ | $50 \pm 20$ | ALEEV       | 93 BIS2 | $X(3250) \rightarrow \bar{\Lambda} p K^- \pi^\mp$ |
| $3270 \pm 8 \pm 20$ | $25 \pm 11$ | ALEEV       | 93 BIS2 | $X(3250) \rightarrow K_S^0 p \bar{p} K^\pm$       |

NODE=M300J58  
NODE=M300J58

OCCUR=2

OCCUR=3

 **$X(3350) \quad I^G(J^{PC}) = ?^?(???)$** 

| MASS (MeV)                | WIDTH (MeV)             | EVTS        | DOCUMENT ID                | TECN | COMMENT                                     |
|---------------------------|-------------------------|-------------|----------------------------|------|---------------------------------------------|
| $3350^{+10}_{-20} \pm 20$ | $70^{+40}_{-30} \pm 40$ | $50 \pm 10$ | <sup>64</sup> GABYSHEV 06A | BELL | $B^- \rightarrow \Lambda_c^+ \bar{p} \pi^-$ |

NODE=M300J09  
NODE=M300J09

<sup>64</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

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REFID=54955  
REFID=55592  
REFID=53961  
REFID=53932  
REFID=53631  
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# STRANGE MESONS

## ( $S = \pm 1$ , $C = B = 0$ )

$$K^+ = u\bar{s}, K^0 = d\bar{s}, \bar{K}^0 = \bar{d}s, K^- = \bar{u}s, \text{ similarly for } K^{*'}s$$

**$K_0^*(700)$**

$$I(J^P) = \frac{1}{2}(0^+)$$

also known as  $\kappa$ ; was  $K_0^*(800)$

Needs confirmation. See the mini-review on scalar mesons under  $f_0(500)$  (see the index for the page number).

### $K_0^*(700)$ T-Matrix Pole $\sqrt{s}$

| 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. • • • |                          |      |                                                          |
| $(670 \pm 18) - i(295 \pm 28)$                                                | <sup>1</sup> PELAEZ      | 17   | RVUE                                                     |
| $(764 \pm 63^{+71}_{-54}) - i(306 \pm 149^{+143}_{-85})$                      | <sup>2</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>3</sup> GUO         | 11B  | RVUE                                                     |
| $(849 \pm 77^{+18}_{-14}) - i(256 \pm 40^{+46}_{-22})$                        | <sup>2</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>4</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>5</sup> BONVICINI   | 08A  | CLEO $141k D^+ \rightarrow K^- \pi^+ \pi^+$              |
| $(841 \pm 30^{+81}_{-73}) - i(309 \pm 45^{+48}_{-72})$                        | <sup>2</sup> ABLIKIM     | 06C  | BES2 $25k J/\psi \rightarrow \bar{K}^*(892)^0 K^+ \pi^-$ |
| $(750^{+30}_{-55}) - i(342 \pm 60)$                                           | <sup>6</sup> BUGG        | 06   | RVUE                                                     |
| $(658 \pm 13) - i(279 \pm 12)$                                                | <sup>7</sup> DESCOTES-G. | 06   | RVUE $\pi K \rightarrow \pi K$                           |
| $(757 \pm 33) - i(279 \pm 41)$                                                | <sup>8</sup> GUO         | 06   | RVUE                                                     |
| $(694 \pm 53) - i(303 \pm 30)$                                                | <sup>9</sup> ZHOU        | 06   | RVUE $K p \rightarrow K^- \pi^+ n$                       |
| $(754 \pm 22) - i(230 \pm 27)$                                                | <sup>10</sup> PELAEZ     | 04A  | RVUE $K \pi \rightarrow K \pi$                           |
| $(594 \pm 79) - i(362 \pm 166)$                                               | <sup>9</sup> ZHENG       | 04   | RVUE $K^- p \rightarrow K^- \pi^+ n$                     |
| $(722 \pm 60) - i(386 \pm 50)$                                                | <sup>9</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 from Forward Dispersion Relations using sequences of Pade approximants .

<sup>2</sup> Extracted from Breit-Wigner parameters.

<sup>3</sup> Fit to scattering phase shifts using UChPT amplitudes with explicit resonances.

<sup>4</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>5</sup> From a complex pole included in the fit. Using parameters from the model that fits data best.

<sup>6</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>7</sup> Using Roy-Steiner equations (ROY 71) consistent with unitarity, analyticity and crossing symmetry constraints.

<sup>8</sup> From UChPT fitted to MERCER 71, BINGHAM 72 and ESTABROOKS 78. Amplitude shown to be consistent with data of ABLIKIM 06C.

<sup>9</sup> Reanalysis of ASTON 88 data.

<sup>10</sup> Reanalysis of data from LINGLIN 73, ESTABROOKS 78, and ASTON 88 using the Inverse Amplitude Method.

<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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→ UNCHECKED ←

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**$K_0^*(700)$  Breit-Wigner Mass**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN     | COMMENT                                         |
|-------------------------------------------------------------------------------|------|------------------------|----------|-------------------------------------------------|
| <b>824 ± 30 OUR AVERAGE</b>                                                   |      |                        |          |                                                 |
| 826 ± 49 <sup>+49</sup> <sub>-34</sub>                                        | 1.3k | <sup>1</sup> ABLIKIM   | 11B BES2 | $J/\psi \rightarrow K_S^0 K_S^0 \pi^+ \pi^-$    |
| 810 ± 68 <sup>+15</sup> <sub>-24</sub>                                        | 1.4k | <sup>2</sup> ABLIKIM   | 10E BES2 | $J/\psi \rightarrow K^\pm K_S^0 \pi^\mp \pi^0$  |
| 878 ± 23 <sup>+64</sup> <sub>-55</sub>                                        | 25k  | <sup>3</sup> ABLIKIM   | 06C BES2 | $J/\psi \rightarrow \bar{K}^*(892)^0 K^+ \pi^-$ |
| 797 ± 19 ± 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 ± 1.9                                                                   | 141k | <sup>6</sup> BONVICINI | 08A CLEO | $D^+ \rightarrow K^- \pi^+ \pi^+$               |
| 856 ± 17 ± 13                                                                 | 54k  | <sup>7</sup> LINK      | 07B FOCS | $D^+ \rightarrow K^- \pi^+ \pi^+$               |
| 855 ± 15                                                                      | 0.6k | <sup>8</sup> CAWLFIELD | 06A CLEO | $D^0 \rightarrow K^+ K^- \pi^0$                 |
| 905 <sup>+65</sup> <sub>-30</sub>                                             |      | <sup>9</sup> ISHIDA    | 97B RVUE | $11 K^- p \rightarrow K^- \pi^+ n$              |

NODE=M174M  
NODE=M174M

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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.

NODE=M174M;LINKAGE=LI

<sup>2</sup> From a fit including ten additional resonances and energy-independent Breit-Wigner width.

NODE=M174M;LINKAGE=BL

<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.

NODE=M174M;LINKAGE=EP

<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  $D^+ \rightarrow K^- \pi^+ \mu^+ \nu_\mu$ .

NODE=M174M;LINKAGE=A

<sup>5</sup> AUBERT 07T does not find evidence for the charged  $K_0^*(700)$  using 11k events of  $D^0 \rightarrow K^- K^+ \pi^0$ .

NODE=M174M;LINKAGE=AU

<sup>6</sup> Using parameters from the model that fits data best.

NODE=M174M;LINKAGE=C

<sup>7</sup> A Breit-Wigner mass and width.

NODE=M174M;LINKAGE=BW

<sup>8</sup> Breit-Wigner parameters. A significant S-wave can be also modeled as a non-resonant contribution.

NODE=M174M;LINKAGE=CA

<sup>9</sup> Reanalysis of ASTON 88 using interfering Breit-Wigner amplitudes.

NODE=M174M;LINKAGE=IS

 **$K_0^*(700)$  Breit-Wigner Width**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN     | COMMENT                                         |
|-------------------------------------------------------------------------------|------|------------------------|----------|-------------------------------------------------|
| <b>478 ± 50 OUR AVERAGE</b>                                                   |      |                        |          |                                                 |
| 449 ± 156 <sup>+144</sup> <sub>-81</sub>                                      | 1.3k | <sup>1</sup> ABLIKIM   | 11B BES2 | $J/\psi \rightarrow K_S^0 K_S^0 \pi^+ \pi^-$    |
| 536 ± 87 <sup>+106</sup> <sub>-47</sub>                                       | 1.4k | <sup>2</sup> ABLIKIM   | 10E BES2 | $J/\psi \rightarrow K^\pm K_S^0 \pi^\mp \pi^0$  |
| 499 ± 52 <sup>+55</sup> <sub>-87</sub>                                        | 25k  | <sup>3</sup> ABLIKIM   | 06C BES2 | $J/\psi \rightarrow \bar{K}^*(892)^0 K^+ \pi^-$ |
| 410 ± 43 ± 87                                                                 | 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. • • • |      |                        |          |                                                 |
| 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 <sup>+235</sup> <sub>-110</sub>                                           |      | <sup>9</sup> ISHIDA    | 97B RVUE | $11 K^- p \rightarrow K^- \pi^+ n$              |

NODE=M174W

NODE=M174W

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.

NODE=M174W;LINKAGE=LI

<sup>2</sup> From a fit including ten additional resonances and energy-independent Breit-Wigner width.

NODE=M174W;LINKAGE=BL

<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.

NODE=M174W;LINKAGE=EP

<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  $D^+ \rightarrow K^- \pi^+ \mu^+ \nu_\mu$ .

NODE=M174W;LINKAGE=A

<sup>5</sup> AUBERT 07T does not find evidence for the charged  $K_0^*(700)$  using 11k events of  $D^0 \rightarrow K^- K^+ \pi^0$ .

NODE=M174W;LINKAGE=AU

<sup>6</sup> Using parameters from the model that fits data best.

NODE=M174W;LINKAGE=C

<sup>7</sup> A Breit-Wigner mass and width.

NODE=M174W;LINKAGE=BW

<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.

NODE=M174W;LINKAGE=CA

<sup>9</sup> Reanalysis of ASTON 88 using interfering Breit-Wigner amplitudes.

NODE=M174W;LINKAGE=IS

**$K_0^*(700)$  REFERENCES**

|               |     |                        |                                        |                               |
|---------------|-----|------------------------|----------------------------------------|-------------------------------|
| PELAEZ        | 17  | EPJ C77 91             | J.R. Pelaez, A.Rodas, J.Ruiz de Elvira |                               |
| ABLIKIM       | 11B | PL B698 183            | M. Ablikim <i>et al.</i>               | (BES II Collab.)              |
| GUO           | 11B | PR D84 034005          | Z.-H. Guo, J.A. Oller                  |                               |
| ABLIKIM       | 10E | PL B693 88             | M. Ablikim <i>et al.</i>               | (BES II 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.)                |
| AUBERT        | 07T | PR D76 011102          | B. Aubert <i>et al.</i>                | (BABAR Collab.)               |
| EPIFANOV      | 07  | PL B654 65             | D. Epifanov <i>et al.</i>              | (BELLE 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)                        |
| CAWLFIELD     | 06A | PR D74 031108          | C. Cawfield <i>et al.</i>              | (CLEO Collab.)                |
| 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>                | (FNAL FOCUS Collab.)          |
| PELAEZ        | 04A | MPL A19 2879           | J.R. Pelaez                            |                               |
| 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>              | (FNAL E791 Collab.)           |
| LINK          | 02E | PL B535 43             | J.M. Link <i>et al.</i>                | (FNAL FOCUS Collab.)          |
| KOPP          | 01  | PR D63 092001          | S. Kopp <i>et al.</i>                  | (CLEO Collab.)                |
| ISHIDA        | 97B | PTP 98 621             | S. Ishida <i>et al.</i>                |                               |
| ASTON         | 88  | NP B296 493            | D. Aston <i>et al.</i>                 | (SLAC, NAGO, CINC, INUS)      |
| VANBEVEREN    | 86  | ZPHY C30 615           | E. van Beveren <i>et al.</i>           | (NIJM, BIEL)                  |
| ESTABROOKS    | 78  | NP B133 490            | P.G. Estabrooks <i>et al.</i>          | (MCGI, CARL, DURH+)           |
| LINGLIN       | 73  | NP B55 408             | D. Linglin                             | (CERN)                        |
| BINGHAM       | 72  | NP B41 1               | H.H. Bingham <i>et al.</i>             | (International $K^+$ Collab.) |
| MERCER        | 71  | NP B32 381             | R. Mercer <i>et al.</i>                | (JHU)                         |
| ROY           | 71  | PL 36B 353             | S.M. Roy                               |                               |

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 **$K^*(892)$** 

$$I(J^P) = \frac{1}{2}(1^-)$$

NODE=M018

 **$K^*(892)$  MASS**

NODE=M018205

**CHARGED ONLY, HADROPRODUCED**NODE=M018M1  
NODE=M018M1

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                | TECN | CHG | COMMENT                                          |
|-------------------------------------------------------------------------------|------|----------------------------|------|-----|--------------------------------------------------|
| <b>891.76±0.25 OUR AVERAGE</b>                                                |      |                            |      |     |                                                  |
| 893.2 ±0.1 ±1.0                                                               | 190k | <sup>1</sup> AAIJ 16N      | LHCB |     | $D^0 \rightarrow K_S^0 K^\pm \pi^\mp$            |
| 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>2</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>3</sup> DEBAERE 67B   | HBC  | +   | $3.5 K^+ p \rightarrow K^0 \pi^+ p$              |
| 891.0 ±1.2                                                                    | 1700 | <sup>4</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. ● ● ● |      |                            |      |     |                                                  |
| 895.6 ±0.8                                                                    | 4K   | <sup>5</sup> LEES 17C      | BABR |     | $J/\psi \rightarrow K_S^0 K^\pm \pi^\mp$         |
| 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>3,4</sup> CLELAND 82  | SPEC | +   | $30 K^+ p \rightarrow K_S^0 \pi^+ p$             |
| 896.0 ±1.1                                                                    | 3200 | <sup>3,4</sup> CLELAND 82  | SPEC | +   | $50 K^+ p \rightarrow K_S^0 \pi^+ p$             |
| 893 ±1                                                                        | 3600 | <sup>3,4</sup> CLELAND 82  | SPEC | -   | $50 K^+ p \rightarrow K_S^0 \pi^- p$             |
| 896.0 ±1.9                                                                    | 380  | DELFOSSSE 81               | SPEC | +   | $50 K^\pm p \rightarrow K^\pm \pi^0 p$           |
| 886.0 ±2.3                                                                    | 187  | DELFOSSSE 81               | SPEC | -   | $50 K^\pm p \rightarrow K^\pm \pi^0 p$           |
| 894.2 ±2.0                                                                    | 765  | <sup>3</sup> CLARK 73      | HBC  | -   | $3.13 K^- p \rightarrow \bar{K}^0 \pi^- p$       |
| 894.3 ±1.5                                                                    | 1150 | <sup>3,4</sup> CLARK 73    | HBC  | -   | $3.3 K^- p \rightarrow \bar{K}^0 \pi^- p$        |
| 892.0 ±2.6                                                                    | 341  | <sup>3</sup> SCHWEING...68 | HBC  | -   | $5.5 K^- p \rightarrow \bar{K}^0 \pi^- p$        |

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- <sup>1</sup> Average of fit results with different parametrizations for the  $K\pi$   $S$ -wave.  
<sup>2</sup> Inclusive reaction. Complicated background and phase-space effects.  
<sup>3</sup> Mass errors enlarged by us to  $\Gamma/\sqrt{N}$ . See note.  
<sup>4</sup> Number of events in peak reevaluated by us.  
<sup>5</sup> From a Dalitz plot analysis in an isobar model with charged and neutral  $K^*(892)$  masses and widths floating.  
<sup>6</sup>  $K$ -matrix pole.  
<sup>7</sup> From a partial wave amplitude analysis.

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### CHARGED ONLY, PRODUCED IN $\tau$ LEPTON DECAYS

| VALUE (MeV)                                                                   | EVTS | 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;LINKAGE=EF  
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NODE=M018M2  
 NODE=M018M2

### NEUTRAL ONLY

| VALUE (MeV)                                                                   | EVTS  | 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. • • • |       |                                                             |                                               |                                                   |
| 898.1 $\pm$ 1.0                                                               | 4K    | <sup>9</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>10</sup> MITCHELL 09A                                  | CLEO $D_s^+ \rightarrow K^+ K^- \pi^+$        |                                                   |
| 896.2 $\pm$ 0.3                                                               | 20k   | <sup>11</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                                        | $K^+ p \rightarrow K^+ \pi^- X$                   |

OCCUR=2

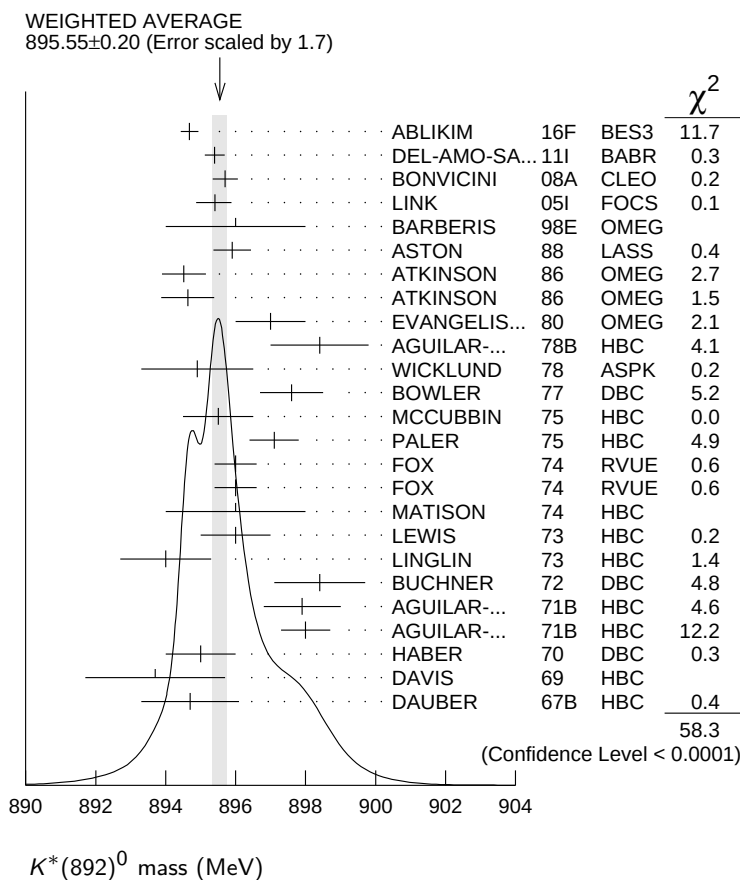
OCCUR=2

OCCUR=2

- <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.
- <sup>8</sup> Number of events in peak reevaluated by us.
- <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=M018M2;LINKAGE=B  
 NODE=M018M2;LINKAGE=DE  
 NODE=M018M2;LINKAGE=BO  
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 NODE=M018M2;LINKAGE=D  
 NODE=M018M2;LINKAGE=W  
 NODE=M018M2;LINKAGE=A

NODE=M018M2;LINKAGE=MI  
 NODE=M018M2;LINKAGE=NS



NODE=M018209

## $K^*(892)$ MASSES AND MASS DIFFERENCES

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:

$$\delta_{\min}(m) = \frac{\Gamma}{\sqrt{N}}, \quad \delta_{\min}(\Gamma) = 4 \frac{\Gamma}{\sqrt{N}}. \quad (1)$$

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><math>6.7 \pm 1.2</math> OUR AVERAGE</b> |      |                     |      |     |         |                                                  |
| $7.7 \pm 1.7$                               | 2980 | AGUILAR-...         | 78B  | HBC | $\pm 0$ | $0.76 \bar{p} p \rightarrow K^\mp K_S^0 \pi^\pm$ |
| $5.7 \pm 1.7$                               | 7338 | AGUILAR-...         | 71B  | HBC | $-0$    | $3.9, 4.6 K^- p$                                 |
| $6.3 \pm 4.1$                               | 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.

NODE=M018D;LINKAGE=W

 **$K^*(892)$  RANGE PARAMETER**

All from partial wave amplitude analyses.

NODE=M018R

NODE=M018R

NODE=M018R

| 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 $K^- p \rightarrow K^- \pi^+ n$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                             |      |      |                                             |
| 12.1 ±3.2 ±3.0                                                                |      | BIRD                        | 89   | LASS | - 11 $K^- p \rightarrow \bar{K}^0 \pi^- p$  |

<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.

NODE=M018R;LINKAGE=DE

NODE=M018R;LINKAGE=LI

 **$K^*(892)$  WIDTH**

NODE=M018215

**CHARGED ONLY, HADROPRODUCED**

NODE=M018W1

NODE=M018W1

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID              | TECN | CHG  | COMMENT                                            |
|-------------------------------------------------------------------------------|------|--------------------------|------|------|----------------------------------------------------|
| <b>50.3±0.8 OUR FIT</b>                                                       |      |                          |      |      |                                                    |
| <b>50.3±0.8 OUR AVERAGE</b>                                                   |      |                          |      |      |                                                    |
| 47.2±0.3±2.3                                                                  | 190k | <sup>1</sup> AAIJ        | 16N  | LHCB | $D^0 \rightarrow K_S^0 K^\pm \pi^\mp$              |
| 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>2</sup> COOPER      | 78   | HBC  | ± 0.76 $\bar{p} p \rightarrow (K\pi)^\pm X$        |
| 52.1±2.2                                                                      | 9000 | <sup>3</sup> PALER       | 75   | HBC  | - 14.3 $K^- p \rightarrow (K\pi)^- X$              |
| 46.3±6.7                                                                      | 765  | <sup>2</sup> CLARK       | 73   | HBC  | - 3.13 $K^- p \rightarrow \bar{K}^0 \pi^- p$       |
| 48.2±5.7                                                                      | 1150 | <sup>2,4</sup> CLARK     | 73   | HBC  | - 3.3 $K^- p \rightarrow \bar{K}^0 \pi^- p$        |
| 54.3±3.3                                                                      | 4404 | <sup>2</sup> AGUILAR-... | 71B  | HBC  | - 3.9,4.6 $K^- p \rightarrow (K\pi)^- p$           |
| 46 ±5                                                                         | 1700 | <sup>2,4</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. • • • |      |                          |      |      |                                                    |
| 43.6±1.3                                                                      | 4K   | <sup>5</sup> LEES        | 17C  | BABR | $J/\psi \rightarrow K_S^0 K^\pm \pi^\mp$           |
| 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>2,4</sup> CLELAND   | 82   | SPEC | + 30 $K^+ p \rightarrow K_S^0 \pi^+ p$             |
| 62.0±4.4                                                                      | 3200 | <sup>2,4</sup> CLELAND   | 82   | SPEC | + 50 $K^+ p \rightarrow K_S^0 \pi^+ p$             |
| 55 ±4                                                                         | 3600 | <sup>2,4</sup> CLELAND   | 82   | SPEC | - 50 $K^+ p \rightarrow K_S^0 \pi^- p$             |
| 62.6±3.8                                                                      | 380  | DELFOSSSE                | 81   | SPEC | + 50 $K^\pm p \rightarrow K^\pm \pi^0 p$           |
| 50.5±3.9                                                                      | 187  | DELFOSSSE                | 81   | SPEC | - 50 $K^\pm p \rightarrow K^\pm \pi^0 p$           |

OCCUR=2

OCCUR=2

OCCUR=2

OCCUR=3

OCCUR=2

<sup>1</sup> Average of fit results with different parametrizations for the  $K\pi$   $S$ -wave.<sup>2</sup> Width errors enlarged by us to  $4 \times \Gamma/\sqrt{N}$ ; see note.<sup>3</sup> Inclusive reaction. Complicated background and phase-space effects.<sup>4</sup> Number of events in peak reevaluated by us.<sup>5</sup> From a Dalitz plot analysis in an isobar model with charged and neutral  $K^*(892)$  masses and widths floating.<sup>6</sup>  $K$ -matrix pole.<sup>7</sup> From a partial wave amplitude analysis.

NODE=M018W1;LINKAGE=A

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NODE=M018W;LINKAGE=W

NODE=M018W1;LINKAGE=B

NODE=M018W1;LINKAGE=AN

NODE=M018W1;LINKAGE=F

**CHARGED ONLY, PRODUCED IN  $\tau$  LEPTON DECAYS**

NODE=M018W5

NODE=M018W5

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID           | TECN | COMMENT                                        |
|-------------------------------------------------------------------------------|------|-----------------------|------|------------------------------------------------|
| <b>46.2±0.6±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±1.1                                                                      |      | <sup>2</sup> BOITO    | 10   | RVUE $\tau^- \rightarrow K_S^0 \pi^- \nu_\tau$ |
| 46.2±0.4                                                                      |      | <sup>3,4</sup> BOITO  | 09   | RVUE $\tau^- \rightarrow K_S^0 \pi^- \nu_\tau$ |
| 47.5±0.4                                                                      |      | <sup>4,5</sup> JAMIN  | 08   | RVUE $\tau^- \rightarrow K_S^0 \pi^- \nu_\tau$ |
| 55 ±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;LINKAGE=EF  
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 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

**47.3 ±0.5 OUR FIT** Error includes scale factor of 1.9.

**47.3 ±0.5 OUR AVERAGE** Error includes scale factor of 2.0. See the ideogram below.

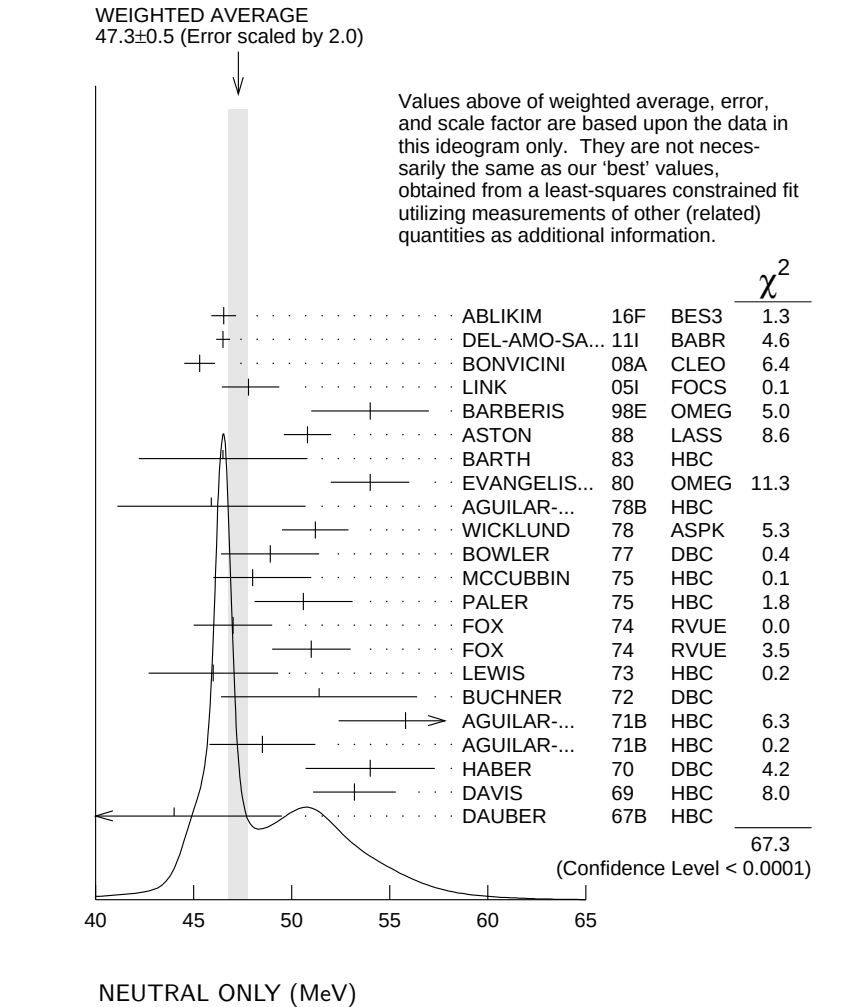
|                                                                               |       |                              |      |      |                                                        |
|-------------------------------------------------------------------------------|-------|------------------------------|------|------|--------------------------------------------------------|
| 46.53 ±0.56 ±0.31                                                             |       | <sup>1</sup> ABLIKIM         | 16F  | BES3 | $D^+ \rightarrow K^- \pi^+ e^+ \nu_e$                  |
| 46.5 ±0.3 ±0.2                                                                | 243k  | <sup>2</sup> DEL-AMO-SA..11I | BABR |      | $D^+ \rightarrow K^- \pi^+ e^+ \nu_e$                  |
| 45.3 ±0.5 ±0.6                                                                | 141k  | <sup>3</sup> BONVICINI       | 08A  | CLEO | $D^+ \rightarrow K^- \pi^+ \pi^+$                      |
| 47.79 ±0.86 <sup>+1.32</sup> <sub>-1.06</sub>                                 | 18k   | <sup>4</sup> LINK            | 05I  | FOCS | $D^+ \rightarrow K^- \pi^+ \mu^+ \nu_\mu$              |
| 54 ±3                                                                         |       | BARBERIS                     | 98E  | OMEG | $450 p p \rightarrow p_f p_s K^* \bar{K}^*$            |
| 50.8 ±0.8 ±0.9                                                                |       | ASTON                        | 88   | LASS | $11 K^- p \rightarrow K^- \pi^+ n$                     |
| 46.5 ±4.3                                                                     | 5900  | BARTH                        | 83   | HBC  | $70 K^+ p \rightarrow K^+ \pi^- X$                     |
| 54 ±2                                                                         | 28k   | EVANGELIS...                 | 80   | OMEG | $10 \pi^- p \rightarrow K^+ \pi^- (\Lambda, \Sigma)$   |
| 45.9 ±4.8                                                                     | 1180  | AGUILAR-...                  | 78B  | HBC  | $0.76 \bar{p} p \rightarrow K^\mp K_S^0 \pi^\pm$       |
| 51.2 ±1.7                                                                     |       | WICKLUND                     | 78   | ASPK | $3,4,6 K^\pm N \rightarrow (K\pi)^0 N$                 |
| 48.9 ±2.5                                                                     |       | BOWLER                       | 77   | DBC  | $5.4 K^+ d \rightarrow K^+ \pi^- p p$                  |
| 48 <sup>+3</sup> <sub>-2</sub>                                                | 3600  | MCCUBBIN                     | 75   | HBC  | $3.6 K^- p \rightarrow K^- \pi^+ n$                    |
| 50.6 ±2.5                                                                     | 22k   | <sup>5</sup> PALER           | 75   | HBC  | $14.3 K^- p \rightarrow (K\pi)^0 X$                    |
| 47 ±2                                                                         | 10k   | FOX                          | 74   | RVUE | $2 K^- p \rightarrow K^- \pi^+ n$                      |
| 51 ±2                                                                         |       | FOX                          | 74   | RVUE | $2 K^+ n \rightarrow K^+ \pi^- p$                      |
| 46.0 ±3.3                                                                     | 3186  | <sup>6</sup> LEWIS           | 73   | HBC  | $2.1-2.7 K^+ p \rightarrow K\pi\pi p$                  |
| 51.4 ±5.0                                                                     | 1700  | <sup>6</sup> BUCHNER         | 72   | DBC  | $4.6 K^+ n \rightarrow K^+ \pi^- p$                    |
| 55.8 <sup>+4.2</sup> <sub>-3.4</sub>                                          | 2934  | <sup>6</sup> AGUILAR-...     | 71B  | HBC  | $3.9,4.6 K^- p \rightarrow K^- \pi^+ n$                |
| 48.5 ±2.7                                                                     | 5362  | AGUILAR-...                  | 71B  | HBC  | $3.9,4.6 K^- p \rightarrow K^- \pi^+ \pi^- p$          |
| 54.0 ±3.3                                                                     | 4300  | <sup>6,7</sup> HABER         | 70   | DBC  | $3 K^- N \rightarrow K^- \pi^+ X$                      |
| 53.2 ±2.1                                                                     | 10k   | <sup>6</sup> DAVIS           | 69   | HBC  | $12 K^+ p \rightarrow K^+ \pi^- \pi^+ p$               |
| 44 ±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. ● ● ● |       |                              |      |      |                                                        |
| 52.6 ±1.7                                                                     | 4K    | <sup>8</sup> LEES            | 17C  | BABR | $J/\psi \rightarrow K_S^0 K^\pm \pi^\mp$               |
| 44.90 ±0.30                                                                   |       | LEES                         | 13F  | BABR | $D^+ \rightarrow K^+ K^- \pi^+$                        |
| 45.7 ±1.1 ±0.5                                                                | 14.4k | <sup>9</sup> MITCHELL        | 09A  | CLEO | $D_s^+ \rightarrow K^+ K^- \pi^+$                      |
| 50.6 ±0.9                                                                     | 20k   | <sup>10</sup> AUBERT         | 07AK | BABR | $10.6 e^+ e^- \rightarrow K^{*0} K^\pm \pi^\mp \gamma$ |

OCCUR=2

OCCUR=2

- <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> From a Dalitz plot analysis in an isobar model with charged and neutral  $K^*(892)$  masses and widths floating.  
<sup>9</sup> This value comes from a fit with  $\chi^2$  of 178/117.  
<sup>10</sup> Systematic uncertainties not estimated.

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 NODE=M018W2;LINKAGE=D  
 NODE=M018W2;LINKAGE=W  
 NODE=M018W2;LINKAGE=A  
 NODE=M018W2;LINKAGE=MI  
 NODE=M018W2;LINKAGE=NS



K\*(892) DECAY MODES

| Mode                              | Fraction (Γ <sub>i</sub> /Γ)      | Confidence level       |
|-----------------------------------|-----------------------------------|------------------------|
| Γ <sub>1</sub> K π                | ~ 100                             | %                      |
| Γ <sub>2</sub> (K π) <sup>±</sup> | ( 99.900±0.009 ) %                |                        |
| Γ <sub>3</sub> (K π) <sup>0</sup> | ( 99.754±0.021 ) %                |                        |
| Γ <sub>4</sub> K <sup>0</sup> γ   | ( 2.46 ±0.21 ) × 10 <sup>-3</sup> |                        |
| Γ <sub>5</sub> K <sup>±</sup> γ   | ( 1.00 ±0.09 ) × 10 <sup>-3</sup> |                        |
| Γ <sub>6</sub> K π π              | < 7                               | × 10 <sup>-4</sup> 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  $\chi^2 = 9.8$  for 12 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta p_i \delta p_j \rangle / (\delta p_i \delta p_j)$ , 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 <sub>5</sub> | -100           |                |
| Γ              | 18             | -18            |
|                | x <sub>2</sub> | x <sub>5</sub> |

| Mode                              | Rate (MeV)  |
|-----------------------------------|-------------|
| Γ <sub>2</sub> (K π) <sup>±</sup> | 50.2 ±0.8   |
| Γ <sub>5</sub> K <sup>±</sup> γ   | 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>1.00 <math>\pm</math> 0.09 OUR FIT</b>                                     |     |             |      |      |         |                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |      |         |                   |
| <1.6                                                                          | 95  | BEMPORAD    | 73   | CNTR | +       | 10–16 $K^+ A$     |

NODE=M018R2  
NODE=M018R2

| $\Gamma(K\pi\pi)/\Gamma((K\pi)^\pm)$                                          |     |             |      |     |                                        | $\Gamma_6/\Gamma_2$                       |
|-------------------------------------------------------------------------------|-----|-------------|------|-----|----------------------------------------|-------------------------------------------|
| VALUE                                                                         | CL% | DOCUMENT ID | TECN | CHG | COMMENT                                |                                           |
| <b>&lt; 7 <math>\times</math> 10<math>^{-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

|               |      |               |                                    |                           |             |
|---------------|------|---------------|------------------------------------|---------------------------|-------------|
| LEES          | 17C  | PR D95 072007 | J.P. Lees <i>et al.</i>            | (BABAR Collab.)           | REFID=57981 |
| 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>           | (BES III 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 |

|              |     |                     |                                              |                            |             |
|--------------|-----|---------------------|----------------------------------------------|----------------------------|-------------|
| 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 |
| 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, MCGL)               | 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, LIVP)   | 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 |

 $K_1(1270)$ 

$$I(J^P) = \frac{1}{2}(1^+)$$

### $K_1(1270)$ MASS

VALUE (MeV) \_\_\_\_\_ DOCUMENT ID \_\_\_\_\_

**1272±7 OUR AVERAGE** Includes data from the 2 datablocks that follow this one.

### 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  $K^- p \rightarrow \Xi^- (K\pi\pi)^+$

### 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** 1 DAUM 81C CNTR - 63  $K^- p \rightarrow K^- 2\pi p$

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

~ 1276 2 TORNQVIST 82B RVUE  
 ~ 1300 VERGEEST 79 HBC - 4.2  $K^- p \rightarrow (\bar{K}\pi\pi)^- p$   
 1289±25 3 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  $K^+ d$

<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=M028

NODE=M028205

NODE=M028MX

NODE=M028M2  
 NODE=M028M2

NODE=M028M3  
 NODE=M028M3

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                                              |
|-------------------------------------------------------------------------------|------|----------------------|------|------------------------------------------------------|
| <b>1248.1 ± 3.3 ± 1.4</b>                                                     |      | GULER                | 11   | BELL $B^+ \rightarrow J/\psi K^+ \pi^+ \pi^-$        |
| • • • 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 $^{+9}_{-10}$                                                            |      | <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  
NODE=M028M1NODE=M028M1;LINKAGE=AB  
NODE=M028M1;LINKAGE=A**PRODUCED IN  $\tau$  LEPTON DECAYS**

| VALUE (MeV)           | EVTS | DOCUMENT ID | TECN | CHG  | COMMENT                                       |
|-----------------------|------|-------------|------|------|-----------------------------------------------|
| <b>1254 ± 33 ± 34</b> | 7k   | ASNER       | 00B  | CLEO | $\tau^- \rightarrow K^- \pi^+ \pi^- \nu_\tau$ |

NODE=M028MT  
NODE=M028MT **$K_1(1270)$  WIDTH**

| 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.**87 ± 7 OUR AVERAGE** Includes data from the 2 datablocks that follow this one.

NODE=M028210

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 | ± | $13 K^\pm p \rightarrow (K \pi \pi)^\pm p$    |
| ~ 200    | BRANDENB...           | 76  | ASPK | ± | $13 K^\pm p \rightarrow (K \pi \pi)^\pm p$    |
| 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                                              |
|-------------------------------------------------------------------------------|------|----------------------|------|------------------------------------------------------|
| <b>119.5 ± 5.2 ± 6.7</b>                                                      |      | 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 $^{+7}_{-25}$                                                             |      | 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                                       |
|-------------------------------------------|------|-------------|------|------|-----------------------------------------------|
| <b>260 <math>^{+90}_{-70}</math> ± 80</b> | 7k   | ASNER       | 00B  | CLEO | $\tau^- \rightarrow K^- \pi^+ \pi^- \nu_\tau$ |

NODE=M028WT  
NODE=M028WT

**$K_1(1270)$  DECAY MODES**

NODE=M028215;NODE=M028

| Mode                            | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------|--------------------------------|
| $\Gamma_1 \quad K\rho$          | (42 $\pm$ 6 ) %                |
| $\Gamma_2 \quad K_0^*(1430)\pi$ | (28 $\pm$ 4 ) %                |
| $\Gamma_3 \quad K^*(892)\pi$    | (16 $\pm$ 5 ) %                |
| $\Gamma_4 \quad K\omega$        | (11.0 $\pm$ 2.0) %             |
| $\Gamma_5 \quad K f_0(1370)$    | ( 3.0 $\pm$ 2.0) %             |
| $\Gamma_6 \quad \gamma K^0$     | 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 $\pm$ 5 | MAZZUCATO | 79  | HBC  | +     | 4.2 $K^- p \rightarrow \Xi^- (K\pi\pi)^+$ |
| 75 $\pm$ 6 | CARNEGIE  | 77B | ASPK | $\pm$ | 13 $K^\pm p \rightarrow (K\pi\pi)^\pm p$  |

 **$\Gamma(K_0^*(1430)\pi)$   $\Gamma_2$** 

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

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

|            |          |     |      |       |                                          |
|------------|----------|-----|------|-------|------------------------------------------|
| 26 $\pm$ 6 | CARNEGIE | 77B | ASPK | $\pm$ | 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 $\pm$ 11 | MAZZUCATO | 79  | HBC  | +     | 4.2 $K^- p \rightarrow \Xi^- (K\pi\pi)^+$ |
| 2 $\pm$ 2   | CARNEGIE  | 77B | ASPK | $\pm$ | 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 $\pm$ 4  | MAZZUCATO | 79  | HBC  | +     | 4.2 $K^- p \rightarrow \Xi^- (K\pi\pi)^+$ |
| 24 $\pm$ 3 | CARNEGIE  | 77B | ASPK | $\pm$ | 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 $\pm$ 5 | CARNEGIE | 77B | ASPK | $\pm$ | 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 $\pm$ 6.1 $\pm$ 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 $\pm$ 0.06 | <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. • • •

|                   |                    |    |                                               |
|-------------------|--------------------|----|-----------------------------------------------|
| 0.584 $\pm$ 0.043 | <sup>2</sup> 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 $\pm$ 0.04 | <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. • • •

|                     |                    |    |                                               |
|---------------------|--------------------|----|-----------------------------------------------|
| 0.0201 $\pm$ 0.0064 | <sup>2</sup> 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                                       |
|-------------------------------------------------------------------------------|--------------------|------|-----------------------------------------------|
| <b>0.16 ± 0.05</b>                                                            | <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. • • • |                    |      |                                               |
| 0.171 ± 0.023                                                                 | <sup>2</sup> 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                                       |
|-------------------------------------------------------------------------------|--------------------|------|-----------------------------------------------|
| <b>0.11 ± 0.02</b>                                                            | <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. • • • |                    |      |                                               |
| 0.225 ± 0.052                                                                 | <sup>2</sup> 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                                    |
|-------|-----|-------------|------|--------------------------------------------|
| <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                                |
|--------------------|-------------------|------|----------------------------------------|
| <b>0.03 ± 0.02</b> | <sup>1</sup> DAUM | 81C  | CNTR 63 $K^- p \rightarrow K^- 2\pi p$ |

NODE=M028R5  
 NODE=M028R5

**D-wave/S-wave RATIO FOR  $K_1(1270) \rightarrow K^*(892)\pi$** 

| VALUE            | DOCUMENT ID       | TECN | COMMENT                                |
|------------------|-------------------|------|----------------------------------------|
| <b>1.0 ± 0.7</b> | <sup>1</sup> DAUM | 81C  | CNTR 63 $K^- p \rightarrow K^- 2\pi p$ |

NODE=M028R9  
 NODE=M028R9

<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                 | (HELSE)                       |
| 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, LIPP) JP   |
| 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  
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 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**

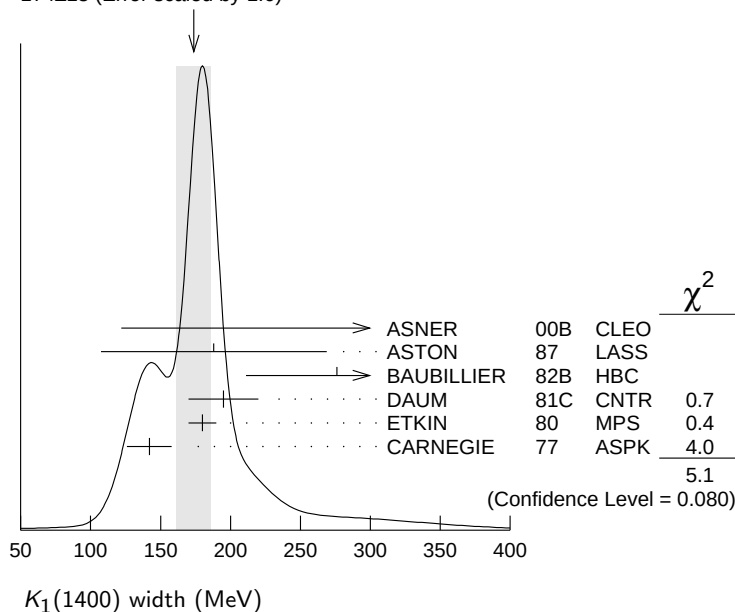
NODE=M064W

| 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

NODE=M064215;NODE=M064

| 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                           |

DESIG=1

DESIG=2

DESIG=8

DESIG=5

DESIG=7;OUR EST;→ UNCHECKED ←

DESIG=9;OUR EST;→ UNCHECKED ←

### $K_1(1400)$ PARTIAL WIDTHS

NODE=M064220

| $\Gamma(K^*(892)\pi)$      |                 |      |                             |                                          | $\Gamma_1$ |
|----------------------------|-----------------|------|-----------------------------|------------------------------------------|------------|
| VALUE (MeV)                | DOCUMENT ID     | TECN | CHG                         | COMMENT                                  |            |
| <b>117 ± 10</b>            | 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                                  |            |
| <b>2 ± 1</b>               | 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                                  |            |
| <b>23 ± 12</b>             | 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                     |                                          |            |
| <b>280.8 ± 23.2 ± 40.4</b> | ALAVI-HARATI02B | KTEV | $K + A \rightarrow K^* + A$ |                                          |            |

NODE=M064W1  
NODE=M064W1

NODE=M064W2  
NODE=M064W2

NODE=M064W5  
NODE=M064W5

NODE=M064W6  
NODE=M064W6

### $K_1(1400)$ BRANCHING RATIOS

NODE=M064225

| $\Gamma(K^*(892)\pi)/\Gamma_{\text{total}}$ |                       |      |                                   | $\Gamma_1/\Gamma$ |
|---------------------------------------------|-----------------------|------|-----------------------------------|-------------------|
| VALUE                                       | DOCUMENT ID           | TECN | COMMENT                           |                   |
| <b>0.94 ± 0.06</b>                          | <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                           |                   |
| <b>0.03 ± 0.03</b>                          | <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                           |                   |
| <b>0.02 ± 0.02</b>                          | <sup>8</sup> DAUM 81C | CNTR | 63 $K^- p \rightarrow K^- 2\pi p$ |                   |

NODE=M064R1  
NODE=M064R1

NODE=M064R2  
NODE=M064R2

NODE=M064R5  
NODE=M064R5

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

| VALUE            | DOCUMENT ID       | TECN | COMMENT                                |
|------------------|-------------------|------|----------------------------------------|
| <b>0.01±0.01</b> | <sup>8</sup> DAUM | 81C  | CNTR 63 $K^- p \rightarrow K^- 2\pi p$ |

 $\Gamma_4/\Gamma$ 

NODE=M064R3  
 NODE=M064R3

 $\Gamma(K_0^*(1430)\pi)/\Gamma_{\text{total}}$ 

| VALUE    | DOCUMENT ID       | TECN | COMMENT                                |
|----------|-------------------|------|----------------------------------------|
| not seen | <sup>8</sup> DAUM | 81C  | CNTR 63 $K^- p \rightarrow K^- 2\pi p$ |

 $\Gamma_5/\Gamma$ 

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 $K^- p \rightarrow K^- 2\pi p$ |

<sup>8</sup> Average from low and high  $t$  data.

NODE=M064R9  
 NODE=M064R9

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

NODE=M094

 **$K^*(1410)$** 

$$I(J^P) = \frac{1}{2}(1^-)$$

 **$K^*(1410)$  MASS**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID          | TECN | CHG  | COMMENT                                          |
|-------------------------------------------------------------------------------|------|----------------------|------|------|--------------------------------------------------|
| <b>1421± 9 OUR AVERAGE</b>                                                    |      |                      |      |      |                                                  |
| 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 | $D^0 \rightarrow K_S^0 (K^\pm \pi^\mp)$          |
| 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. • • • |      |                      |      |      |                                                  |
| 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 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$  |

<sup>1</sup> Using a parametrization for the  $K\pi$  S-wave similar to ASTON 88 with fixed resonance width.<sup>2</sup> Using a  $K\pi$  S-wave parametrization with resonant and non-resonant contributions.<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.

NODE=M094M

NODE=M094M

OCCUR=2

NODE=M094M;LINKAGE=A

NODE=M094M;LINKAGE=C  
 NODE=M094M;LINKAGE=BI

NODE=M094M;LINKAGE=NS

 **$K^*(1410)$  WIDTH**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID          | TECN | CHG  | COMMENT                                          |
|-------------------------------------------------------------------------------|------|----------------------|------|------|--------------------------------------------------|
| <b>236± 18 OUR AVERAGE</b>                                                    |      |                      |      |      |                                                  |
| 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 | $D^0 \rightarrow K_S^0 (K^\pm \pi^\mp)$          |
| 176± 52±22                                                                    |      | ASTON                | 88   | LASS | 0 11 $K^- p \rightarrow K^- \pi^+ n$             |
| 240± 18±12                                                                    |      | ASTON                | 87   | LASS | 0 11 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                      |      |      |                                                  |
| 198 <sup>+61</sup> <sub>-87</sub>                                             |      | <sup>2,3</sup> 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.

NODE=M094W

NODE=M094W

OCCUR=2

NODE=M094W;LINKAGE=A  
 NODE=M094W;LINKAGE=BI

NODE=M094W;LINKAGE=NS



**$K^*(1410)$  DECAY MODES**

NODE=M094215;NODE=M094

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|--------------------------|--------------------------------|------------------|
| $\Gamma_1$ $K^*(892)\pi$ | > 40 %                         | 95%              |
| $\Gamma_2$ $K\pi$        | ( $6.6 \pm 1.3$ ) %            |                  |
| $\Gamma_3$ $K\rho$       | < 7 %                          | 95%              |
| $\Gamma_4$ $\gamma K^0$  | < 2.2 $\times 10^{-4}$         | 90%              |

DESIG=2

DESIG=1

DESIG=3;OUR EST;→ UNCHECKED ←

DESIG=4

 **$K^*(1410)$  PARTIAL WIDTHS**

NODE=M094217

| $\Gamma(\gamma K^0)$ |     |                 | $\Gamma_4$ |                             |  |
|----------------------|-----|-----------------|------------|-----------------------------|--|
| VALUE (keV)          | CL% | DOCUMENT ID     | TECN       | COMMENT                     |  |
| <52.9                | 90  | ALAVI-HARATI02B | KTEV       | $K + A \rightarrow K^* + A$ |  |

NODE=M094W1

NODE=M094W1

 **$K^*(1410)$  BRANCHING RATIOS**

NODE=M094220

| $\Gamma(K\rho)/\Gamma(K^*(892)\pi)$ |     |             |      |      |                                          | $\Gamma_3/\Gamma_1$ |
|-------------------------------------|-----|-------------|------|------|------------------------------------------|---------------------|
| VALUE                               | CL% | DOCUMENT ID | TECN | CHG  | COMMENT                                  |                     |
| <b>&lt;0.17</b>                     | 95  | ASTON       | 84   | LASS | 0 11 $K^-p \rightarrow \bar{K}^0 2\pi n$ |                     |

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 |                                    |
| <b>0.066±0.010±0.008</b>             | ASTON             | 88   | LASS | 0       | 11 $K^- p \rightarrow K^- \pi^+ n$ |

NODE=M094R3

NODE=M094R3

 **$K^*(1410)$  REFERENCES**

NODE=M094

|              |     |               |                                    |                          |
|--------------|-----|---------------|------------------------------------|--------------------------|
| AAIJ         | 16N | PR D93 052018 | R. Aaij <i>et al.</i>              | (LHCb Collab.)           |
| BOITO        | 09  | EPJ C59 821   | D.R. Boito, R. Escrivano, 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           |

REFID=57273

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REFID=48822

REFID=41002

REFID=40262

REFID=40234

REFID=22689

REFID=22551

REFID=22545

**$K_0^*(1430)$** 

$$I(J^P) = \frac{1}{2}(0^+)$$

See our minireview in the 1994 edition and in this edition under the  $f_0(500)$ .

NODE=M019

NODE=M019

 **$K_0^*(1430)$  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  | $10 K^\pm p \rightarrow K_S^0 p$                       |

<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.

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NODE=M019M;LINKAGE=A

 **$K_0^*(1430)$  WIDTH**

NODE=M019W

NODE=M019W  
→ UNCHECKED ←

| 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  | $K p \rightarrow K^- \pi^+ n$                          |
| 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  | $K^- p \rightarrow K^- \pi^+ n$                        |
| ~ 316                                 | <sup>9</sup> BUGG        | 03 RVUE  | $11 K^- p \rightarrow K^- \pi^+ n$                     |
| ~ 350                                 | <sup>10</sup> LI         | 03 RVUE  | $11 K^- p \rightarrow K^- \pi^+ n$                     |
| 175 ±17 15k                           | <sup>11</sup> AITALA     | 02 E791  | $D^+ \rightarrow K^- \pi^+ \pi^+$                      |
| ~ 300                                 | <sup>12</sup> JAMIN      | 00 RVUE  | $K p \rightarrow K p$                                  |
| 196 ±45                               | <sup>13</sup> BARBERIS   | 98E OMEG | $450 p p \rightarrow$<br>$p_f p_s K^+ K^- \pi^+ \pi^-$ |
| 330 ±50                               | <sup>9</sup> ANISOVICH   | 97C RVUE | $11 K^- p \rightarrow K^- \pi^+ n$                     |
| ~ 320                                 | <sup>14</sup> TORNQVIST  | 96 RVUE  | $\pi \pi \rightarrow \pi \pi, K \bar{K}, K \pi$        |
| 294 ±23                               | ASTON                    | 88 LASS  | $11 K^- p \rightarrow K^- \pi^+ n$                     |
| ~ 200                                 | BAUBILLIER               | 84B HBC  | $8.25 K^- p \rightarrow \bar{K}^0 \pi^- p$             |
| 200 to 300                            | <sup>15</sup> ESTABROOKS | 78 ASPK  | $13 K^\pm p \rightarrow K^\pm \pi^\pm (n, \Delta)$     |

<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

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NODE=M019W;LINKAGE=LI  
NODE=M019W;LINKAGE=BW  
NODE=M019W;LINKAGE=BU

NODE=M019W;LINKAGE=ZU  
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NODE=M019W;LINKAGE=A1  
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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

| 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>3.4</sub> ) % |
| $\Gamma_3$ $K\eta'(958)$ | seen                                                                |

NODE=M019215;NODE=M019

DESIG=1

DESIG=2

DESIG=3

### $K_0^*(1430)$ BRANCHING RATIOS

| $\Gamma(K\pi)/\Gamma_{\text{total}}$ | $\Gamma_1/\Gamma$                                  |
|--------------------------------------|----------------------------------------------------|
| VALUE                                | DOCUMENT ID TECN CHG COMMENT                       |
| <b>0.93±0.04±0.09</b>                | ASTON 88 LASS 0 11 $K^- p \rightarrow K^- \pi^+ n$ |

NODE=M019220

NODE=M019R1  
NODE=M019R1

| $\Gamma(K\eta)/\Gamma(K\pi)$              | $\Gamma_2/\Gamma_1$                                                         |
|-------------------------------------------|-----------------------------------------------------------------------------|
| VALUE (%)                                 | EVTS DOCUMENT ID TECN COMMENT                                               |
| <b>9.2±2.5<sup>+</sup><sub>-2.5</sub></b> | 5.4k <sup>1</sup> LEES 14E BABR $\eta_c(1S) \rightarrow K^+ K^- \eta/\pi^0$ |

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**

|            |     |                        |                                |                          |
|------------|-----|------------------------|--------------------------------|--------------------------|
| ABLIKIM    | 14J | PR D89 074030          | M. Ablikim <i>et al.</i>       | (BES III 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)             |

NODE=M019

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REFID=47983  
REFID=46348  
REFID=45815  
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

 **$K_2^*(1430)$  MASS**

NODE=M022205

**CHARGED ONLY, WITH FINAL STATE  $K\pi$** 

| VALUE (MeV)                     | EVTS | DOCUMENT ID                         | TECN | CHG | COMMENT                                       |
|---------------------------------|------|-------------------------------------|------|-----|-----------------------------------------------|
| <b>1425.6 ± 1.5 OUR AVERAGE</b> |      | Error includes scale factor of 1.1. |      |     |                                               |
| 1420 ± 4                        | 1587 | BAUBILLIER 84B                      | HBC  | —   | 8.25 $K^- p \rightarrow \bar{K}^0 \pi^- p$    |
| 1436 ± 5.5                      | 400  | <sup>1,2</sup> CLELAND 82           | SPEC | +   | 30 $K^+ p \rightarrow K_S^0 \pi^+ p$          |
| 1430 ± 3.2                      | 1500 | <sup>1,2</sup> CLELAND 82           | SPEC | +   | 50 $K^+ p \rightarrow K_S^0 \pi^+ p$          |
| 1430 ± 3.2                      | 1200 | <sup>1,2</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>3</sup> MARTIN 78              | SPEC | +   | 10 $K^\pm p \rightarrow K_S^0 \pi p$          |
| 1423.8 ± 4.6                    |      | <sup>3</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>1,2</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>1</sup> LIND 69                | HBC  | +   | 9 $K^+ p \rightarrow K^0 \pi^+ p$             |
| 1427 ± 12                       | 63   | <sup>1</sup> SCHWEING... 68         | HBC  | —   | 5.5 $K^- p \rightarrow \bar{K} \pi N$         |
| 1423 ± 11.0                     | 39   | <sup>1</sup> BASSANO 67             | HBC  | —   | 4.6–5.0 $K^- p \rightarrow \bar{K}^0 \pi^- p$ |

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

|                |             |                      |      |   |                                          |
|----------------|-------------|----------------------|------|---|------------------------------------------|
| 1423.4 ± 2 ± 3 | 24809 ± 820 | <sup>4</sup> BIRD 89 | LASS | — | 11 $K^- p \rightarrow \bar{K}^0 \pi^- p$ |
|----------------|-------------|----------------------|------|---|------------------------------------------|

OCCUR=2

OCCUR=3

OCCUR=2

OCCUR=2

**NEUTRAL ONLY**

| VALUE (MeV)                     | EVTS | DOCUMENT ID                 | TECN | COMMENT                                        |
|---------------------------------|------|-----------------------------|------|------------------------------------------------|
| <b>1432.4 ± 1.3 OUR AVERAGE</b> |      |                             |      |                                                |
| 1431.2 ± 1.8 ± 0.7              |      | <sup>5</sup> ASTON 88       | LASS | 11 $K^- p \rightarrow K^- \pi^+ n$             |
| 1434 ± 4 ± 6                    |      | <sup>5</sup> ASTON 87       | LASS | 11 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |
| 1433 ± 6 ± 10                   |      | <sup>5</sup> ASTON 84B      | LASS | 11 $K^- p \rightarrow \bar{K}^0 2\pi n$        |
| 1471 ± 12                       |      | <sup>5</sup> BAUBILLIER 82B | HBC  | 8.25 $K^- p \rightarrow N K_S^0 \pi \pi$       |
| 1428 ± 3                        |      | <sup>5</sup> ASTON 81C      | LASS | 11 $K^- p \rightarrow K^- \pi^+ n$             |
| 1434 ± 2                        |      | <sup>5</sup> ESTABROOKS 78  | ASPK | 13 $K^\pm p \rightarrow p K \pi$               |
| 1440 ± 10                       |      | <sup>5</sup> BOWLER 77      | DBC  | 5.5 $K^+ d \rightarrow K \pi p p$              |

NODE=M022M4

NODE=M022M4

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

|              |            |                      |           |                                                       |
|--------------|------------|----------------------|-----------|-------------------------------------------------------|
| 1428.5 ± 3.9 | 1786 ± 127 | <sup>6</sup> 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 |            | <sup>7</sup> 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>1</sup> Errors enlarged by us to  $\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.

<sup>2</sup> Number of events in peak re-evaluated by us.

<sup>3</sup> Systematic error added by us.

<sup>4</sup> From a partial wave amplitude analysis.

<sup>5</sup> From phase shift or partial-wave analysis.

<sup>6</sup> Systematic errors not estimated.

<sup>7</sup> From pole extrapolation, using world  $K^+ p$  data summary tape.

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>98.5 ± 2.7 OUR FIT</b>              | Error includes scale factor of 1.1. |                        |         |     |                                           |
| <b>98.5 ± 2.9 OUR AVERAGE</b>          | Error includes scale factor of 1.1. |                        |         |     |                                           |
| 109 ± 22                               | 400                                 | <sup>8,9</sup> CLELAND | 82 SPEC | +   | 30 $K^+ p \rightarrow K_S^0 \pi^+ p$      |
| 124 ± 12.8                             | 1500                                | <sup>8,9</sup> CLELAND | 82 SPEC | +   | 50 $K^+ p \rightarrow K_S^0 \pi^+ p$      |
| 113 ± 12.8                             | 1200                                | <sup>8,9</sup> 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 $K^\pm p \rightarrow K_S^0 \pi p$      |
| 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 $K^- p$                           |

NODE=M022W1

NODE=M022W1

OCCUR=2

OCCUR=3

OCCUR=2

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

|            |     |                    |         |   |                                          |
|------------|-----|--------------------|---------|---|------------------------------------------|
| 98 ± 4 ± 4 | 25k | <sup>10</sup> BIRD | 89 LASS | - | 11 $K^- p \rightarrow \bar{K}^0 \pi^- p$ |
|------------|-----|--------------------|---------|---|------------------------------------------|

### NEUTRAL ONLY

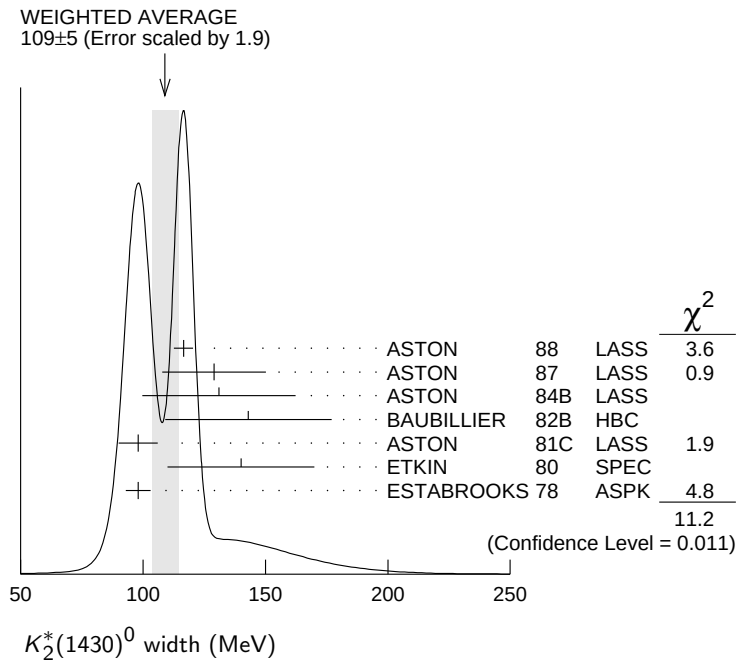
| VALUE (MeV)                | EVTS                                                        | DOCUMENT ID              | TECN     | COMMENT                                        |
|----------------------------|-------------------------------------------------------------|--------------------------|----------|------------------------------------------------|
| <b>109 ± 5 OUR AVERAGE</b> | Error includes scale factor of 1.9. See the ideogram below. |                          |          |                                                |
| 116.5 ± 3.6 ± 1.7          |                                                             | <sup>11</sup> ASTON      | 88 LASS  | 11 $K^- p \rightarrow K^- \pi^+ n$             |
| 129 ± 15 ± 15              |                                                             | <sup>11</sup> ASTON      | 87 LASS  | 11 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |
| 131 ± 24 ± 20              |                                                             | <sup>11</sup> ASTON      | 84B LASS | 11 $K^- p \rightarrow \bar{K}^0 2\pi n$        |
| 143 ± 34                   |                                                             | <sup>11</sup> BAUBILLIER | 82B HBC  | 8.25 $K^- p \rightarrow NK_S^0 \pi \pi$        |
| 98 ± 8                     |                                                             | <sup>11</sup> ASTON      | 81C LASS | 11 $K^- p \rightarrow K^- \pi^+ n$             |
| 140 ± 30                   |                                                             | <sup>11</sup> ETKIN      | 80 SPEC  | 6 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$  |
| 98 ± 5                     |                                                             | <sup>11</sup> ESTABROOKS | 78 ASPK  | 13 $K^\pm p \rightarrow pK\pi$                 |

NODE=M022W4

NODE=M022W4

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

|                                         |            |                       |           |                                                       |
|-----------------------------------------|------------|-----------------------|-----------|-------------------------------------------------------|
| 113.7 ± 9.2                             | 1786 ± 127 | <sup>12</sup> AUBERT  | 07AK BABR | 10.6 $e^+e^- \rightarrow K^{*0} K^\pm \pi^\mp \gamma$ |
| 125 ± 29                                | 300        | <sup>8</sup> 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                                 |            | <sup>13</sup> 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        | <sup>8</sup> CORDS    | 71 DBC    | 9 $K^+ n \rightarrow K^+ \pi^- p$                     |
| 101 ± 10                                | 2200       | DAVIS                 | 69 HBC    | 12 $K^+ p \rightarrow K^+ \pi^- \pi^+ p$              |



- <sup>8</sup> Errors enlarged by us to  $4\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.  
<sup>9</sup> Number of events in peak re-evaluated by us.  
<sup>10</sup> From a partial wave amplitude analysis.  
<sup>11</sup> From phase shift or partial-wave analysis.  
<sup>12</sup> Systematic errors not estimated.  
<sup>13</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**

| Mode       |                  | Fraction ( $\Gamma_i/\Gamma$ )       | Scale factor/<br>Confidence level |
|------------|------------------|--------------------------------------|-----------------------------------|
| $\Gamma_1$ | $K\pi$           | $(49.9 \pm 1.2) \%$                  |                                   |
| $\Gamma_2$ | $K^*(892)\pi$    | $(24.7 \pm 1.5) \%$                  |                                   |
| $\Gamma_3$ | $K^*(892)\pi\pi$ | $(13.4 \pm 2.2) \%$                  |                                   |
| $\Gamma_4$ | $K\rho$          | $(8.7 \pm 0.8) \%$                   | S=1.2                             |
| $\Gamma_5$ | $K\omega$        | $(2.9 \pm 0.8) \%$                   |                                   |
| $\Gamma_6$ | $K^+\gamma$      | $(2.4 \pm 0.5) \times 10^{-3}$       | 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%                            |

NODE=M022215;NODE=M022

DESIG=1  
DESIG=2  
DESIG=6  
DESIG=3  
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 31 measurements and one constraint to determine 8 parameters. The overall fit has a  $\chi^2 = 20.2$  for 24 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     | −13   | 0     |
|          | $x_1$ | $x_2$ | $x_3$ | $x_4$ | $x_5$ | $x_6$ | $x_7$ |

| Mode                        | Rate (MeV)             | Scale factor |
|-----------------------------|------------------------|--------------|
| $\Gamma_1$ $K\pi$           | $49.1 \pm 1.8$         |              |
| $\Gamma_2$ $K^*(892)\pi$    | $24.3 \pm 1.6$         |              |
| $\Gamma_3$ $K^*(892)\pi\pi$ | $13.2 \pm 2.2$         |              |
| $\Gamma_4$ $K\rho$          | $8.5 \pm 0.8$          | 1.2          |
| $\Gamma_5$ $K\omega$        | $2.9 \pm 0.8$          |              |
| $\Gamma_6$ $K^+\gamma$      | $0.24 \pm 0.05$        | 1.1          |
| $\Gamma_7$ $K\eta$          | $0.15^{+0.33}_{-0.10}$ | 1.3          |

### $K_2^*(1430)$ 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. |      |        |                                                         |
| <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  
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 |        | $K + A \rightarrow K^* + A$                             |
| • • • 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  
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>     |                          |      |            |                                    |
| <b><math>0.488 \pm 0.014</math> OUR AVERAGE</b> |                          |      |            |                                    |
| $0.485 \pm 0.006 \pm 0.020$                     | <sup>14</sup> ASTON      | 88   | LASS 0     | $11 K^- p \rightarrow K^- \pi^+ n$ |
| $0.49 \pm 0.02$                                 | <sup>14</sup> ESTABROOKS | 78   | ASPK $\pm$ | $13 K^\pm p \rightarrow p K \pi$   |

NODE=M022R1  
NODE=M022R1

#### $\Gamma(K^*(892)\pi)/\Gamma(K\pi)$

 $\Gamma_2/\Gamma_1$ 

| VALUE                                         | DOCUMENT ID | TECN | CHG      | COMMENT                                 |
|-----------------------------------------------|-------------|------|----------|-----------------------------------------|
| <b><math>0.496 \pm 0.034</math> OUR FIT</b>   |             |      |          |                                         |
| <b><math>0.47 \pm 0.04</math> OUR AVERAGE</b> |             |      |          |                                         |
| $0.44 \pm 0.09$                               | ASTON       | 84B  | LASS 0   | $11 K^- p \rightarrow \bar{K}^0 2\pi n$ |
| $0.62 \pm 0.19$                               | LAUSCHER    | 75   | HBC 0    | $10,16 K^- p \rightarrow K^- \pi^+ n$   |
| $0.54 \pm 0.16$                               | DEHM        | 74   | DBC 0    | $4.6 K^+ N$                             |
| $0.47 \pm 0.08$                               | AGUILAR-... | 71B  | HBC      | $3.9, 4.6 K^- p$                        |
| $0.47 \pm 0.10$                               | BASSANO     | 67   | HBC $-0$ | $4.6, 5.0 K^- p$                        |
| $0.45 \pm 0.13$                               | BADIER      | 65C  | HBC $-$  | $3 K^- p$                               |

NODE=M022R4  
NODE=M022R4

$\Gamma(K\omega)/\Gamma(K\pi)$  $\Gamma_5/\Gamma_1$ NODE=M022R5  
NODE=M022R5

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

**0.059±0.017 OUR FIT****0.070±0.035 OUR AVERAGE**

|            |              |     |     |                 |
|------------|--------------|-----|-----|-----------------|
| 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 |
|-------|-------------|------|-----|---------|
|-------|-------------|------|-----|---------|

**0.174±0.017 OUR FIT** Error includes scale factor of 1.2.**0.150<sup>+0.029</sup><sub>-0.017</sub> OUR AVERAGE**

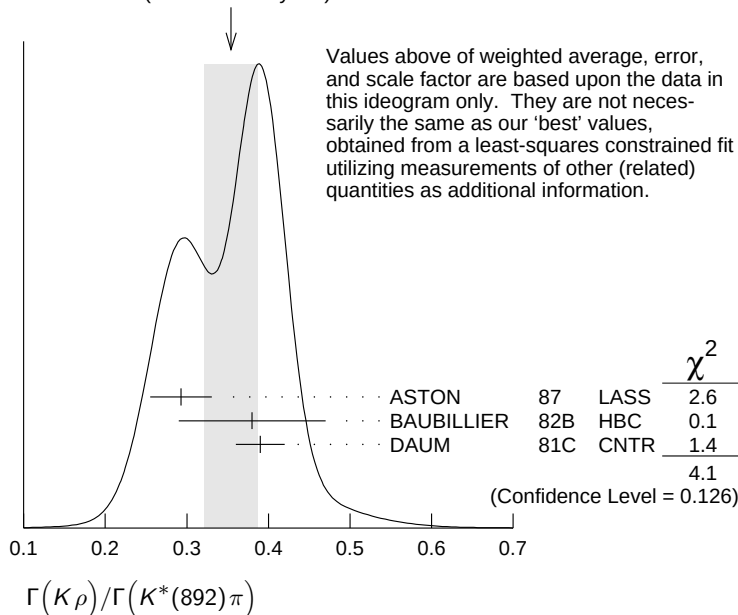
|                                        |             |     |      |                                           |
|----------------------------------------|-------------|-----|------|-------------------------------------------|
| 0.18 ±0.05                             | ASTON       | 84B | LASS | 0 11 $K^- p \rightarrow \bar{K}^0 2\pi n$ |
| 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 |
|-------|-------------|------|-----|---------|
|-------|-------------|------|-----|---------|

**0.350±0.031 OUR FIT** Error includes scale factor of 1.4.**0.354±0.033 OUR AVERAGE** 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 $K^- p \rightarrow N K_S^0 \pi \pi$       |
| 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 |
|-------|-------------|------|-----|---------|
|-------|-------------|------|-----|---------|

**0.118±0.034 OUR FIT****0.10 ±0.04** FIELD 67 HBC - 3.8  $K^- p$  $\Gamma(K\eta)/\Gamma(K^*(892)\pi)$  $\Gamma_7/\Gamma_2$ NODE=M022R9  
NODE=M022R9

| 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  $K^- p$  $\Gamma(K\eta)/\Gamma(K\pi)$  $\Gamma_7/\Gamma_1$ NODE=M022R10  
NODE=M022R10

| 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** 15 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 | 16 | BASSOMPIE... | 69  | HBC | 5.0 $K^+ p$     |
| <0.02  |    | BISHOP       | 69  | HBC | 3.5 $K^+ p$     |

### $\Gamma(K^*(892)\pi\pi)/\Gamma_{\text{total}}$ $\Gamma_3/\Gamma$

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

**0.134±0.022 OUR FIT**

**0.12 ±0.04** <sup>17</sup> GOLDBERG 76 HBC — 3  $K^- p \rightarrow p \bar{K}^0 \pi \pi$

NODE=M022R11  
NODE=M022R11

### $\Gamma(K^*(892)\pi\pi)/\Gamma(K\pi)$ $\Gamma_3/\Gamma_1$

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

**0.27±0.05 OUR FIT**

**0.21±0.08** <sup>16,17</sup> JONGEJANS 78 HBC — 4  $K^- p \rightarrow p \bar{K}^0 \pi \pi$

NODE=M022R12  
NODE=M022R12

### $\Gamma(K\omega\pi)/\Gamma_{\text{total}}$ $\Gamma_8/\Gamma$

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

**<0.72** 95 0 JONGEJANS 78 HBC 4  $K^- p \rightarrow p \bar{K}^0 4\pi$

NODE=M022R13  
NODE=M022R13

<sup>14</sup> From phase shift analysis.

<sup>15</sup> 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.

<sup>16</sup> Restated by us.

<sup>17</sup> 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

NODE=M022

|                                |                                                    |             |
|--------------------------------|----------------------------------------------------|-------------|
| AUBERT 07AK PR D76 012008      | B. Aubert <i>et al.</i> (BABAR Collab.)            | REFID=51908 |
| ALAVI-HARATI 02B PRL 89 072001 | A. Alavi-Harati <i>et al.</i> (FNAL KTeV Collab.)  | REFID=48822 |
| 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 |
| ASTON 88B PL B201 169          | D. Aston <i>et al.</i> (SLAC, NAGO, CINC, INUS)    | REFID=40281 |
| ASTON 87 NP B292 693           | D. Aston <i>et al.</i> (SLAC, NAGO, CINC, INUS)    | REFID=40234 |
| CARLSMITH 87 PR D36 3502       | D. Carlsmith <i>et al.</i> (EFI, SACL)             | REFID=40557 |
| ASTON 84B NP B247 261          | D. Aston <i>et al.</i> (SLAC, CARL, OTTA)          | REFID=22763 |
| BAUBILLIER 84B ZPHY C26 37     | M. Baubillier <i>et al.</i> (BIRM, CERN, GLAS+)    | REFID=22459 |
| BAUBILLIER 82B NP B202 21      | M. Baubillier <i>et al.</i> (BIRM, CERN, GLAS+)    | REFID=22551 |
| CIHANGIR 82 PL 117B 123        | S. Cihangir <i>et al.</i> (FNAL, MINN, ROCH)       | REFID=21280 |
| CLELAND 82 NP B208 189         | W.E. Cleland <i>et al.</i> (DURH, GEVA, LAUS+)     | REFID=22455 |
| ASTON 81C PL 106B 235          | D. Aston <i>et al.</i> (SLAC, CARL, OTTA) JP       | REFID=22821 |
| DAUM 81C NP B187 1             | C. Daum <i>et al.</i> (AMST, CERN, CRAC, MPIM+)    | REFID=22548 |
| TOAFF 81 PR D23 1500           | S. Toaff <i>et al.</i> (ANL, KANS)                 | REFID=22454 |
| ETKIN 80 PR D22 42             | A. Etkin <i>et al.</i> (BNL, CUNY) JP              | REFID=22545 |
| 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, NIJM+)     | REFID=22445 |
| MARTIN 78 NP B134 392          | A.D. Martin <i>et al.</i> (DURH, GEVA)             | REFID=22446 |
| BOWLER 77 NP B126 31           | M.G. Bowler <i>et al.</i> (OXF)                    | REFID=22437 |
| GOLDBERG 76 LNC 17 253         | J. Goldberg (HAIF)                                 | REFID=22742 |
| HENDRICK 76 NP B112 189        | K. Hendrickx <i>et al.</i> (MONS, SACL, PARIS+)    | REFID=22743 |
| LAUSCHER 75 NP B86 189         | P. Lauscher <i>et al.</i> (ABCLV Collab.) JP       | REFID=22582 |
| MCCUBBIN 75 NP B86 13          | N.A. McCubbin, L. Lyons (OXF)                      | REFID=22434 |
| DEHM 74 NP B75 47              | G. Dehm <i>et al.</i> (MPIM, BRUX, MONS, CERN)     | REFID=22736 |
| LINGLIN 73 NP B55 408          | D. Linglin (CERN)                                  | REFID=22428 |
| AGUILAR-... 71B PR D4 2583     | M. Aguilar-Benitez, R.L. Eisner, J.B. Kinson (BNL) | REFID=22408 |
| BARNHAM 71C NP B28 171         | K.W.J. Barnham <i>et al.</i> (BIRM, GLAS)          | REFID=22409 |
| CORDS 71 PR D4 1974            | D. Cords <i>et al.</i> (PURD, UCD, IUPU)           | REFID=22411 |
| BASSOMPIE... 69 NP B13 189     | G. Bassompierre <i>et al.</i> (CERN, BRUX) JP      | REFID=22710 |
| BISHOP 69 NP B9 403            | J.M. Bishop <i>et al.</i> (WISC)                   | REFID=22485 |
| 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 |
| LIND 69 NP B14 1               | V.G. Lind <i>et al.</i> (LRL) JP                   | REFID=22404 |
| SCHWEING... 68 PR 166 1317     | F. Schweingruber <i>et al.</i> (ANL, NWES)         | REFID=22398 |
| Also Thesis                    | F.L. Schweingruber (NWES, NWES)                    | REFID=22709 |
| BASSANO 67 PRL 19 968          | D. Bassano <i>et al.</i> (BNL, SYRA)               | REFID=22695 |
| FIELD 67 PL 24B 638            | J.H. Field <i>et al.</i> (UCSD)                    | REFID=22701 |
| BADIER 65C PL 19 612           | J. Badier <i>et al.</i> (EPOL, SACL, AMST)         | REFID=22690 |

**$K(1460)$** 

$$I(J^P) = \frac{1}{2}(0^-)$$

OMITTED FROM SUMMARY TABLE

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 | $K^\pm p \rightarrow K^+ 2\pi p$         |

<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 | $K^\pm p \rightarrow K^+ 2\pi p$         |

<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=M021W1

NODE=M021W2

NODE=M021W2

NODE=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

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 $K^- p$ |

 **$K_2(1580)$  WIDTH**

NODE=M039W

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 $K^- p$ |

 **$K_2(1580)$  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

| $\Gamma(K_2^*(1430)\pi)/\Gamma_{\text{total}}$ |                    |             |            |                |                  | $\Gamma_2/\Gamma$ |
|------------------------------------------------|--------------------|-------------|------------|----------------|------------------|-------------------|
| <u>VALUE</u>                                   | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>CHG</u> | <u>COMMENT</u> |                  |                   |
| <b>possibly seen</b>                           | 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>1629±7</b> | ~ 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>16<sup>+19</sup><sub>-16</sub></b> | ~ 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. Karnaukhov, C. Coca, V.I. Moroz  
Translated from YAF 61 252.

 **$K_1(1650)$** 

$$I(J^P) = \frac{1}{2}(1^+)$$

## OMITTED FROM SUMMARY TABLE

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>1672±50 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. • • • |      |                                     |      |        |                                   |
| ~ 1840                                                                        |      | ARMSTRONG                           | 83   | OMEG - | $18.5 K^- p \rightarrow 3 K p$    |
| ~ 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>158± 50 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. • • • |      |                   |      |        |                                   |
| ~ 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

 **$K^*(1680)$** 

$$I(J^P) = \frac{1}{2}(1^-)$$

NODE=M095

 **$K^*(1680)$  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 ( $\Gamma_i/\Gamma$ ) |
|------------|--------------------------------|
| $\Gamma_1$ | $K\pi$                         |
| $\Gamma_2$ | $K\rho$                        |
| $\Gamma_3$ | $K^*(892)\pi$                  |
| $\Gamma_4$ | $K\phi$                        |

(38.7±2.5) %

(31.4<sup>+5.0</sup><sub>-2.1</sub>) %(29.9<sup>+2.2</sup><sub>-5.0</sub>) %

seen

DESIG=1

DESIG=3

DESIG=2

DESIG=4

## 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  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \delta x_j)$ , 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

### $K^*(1680)$ REFERENCES

NODE=M095

|            |     |                |                               |                          |             |
|------------|-----|----------------|-------------------------------|--------------------------|-------------|
| AAIJ       | 17C | PRL 118 022003 | R. Aaij <i>et al.</i>         | (LHCb Collab.)           | REFID=57657 |
| Also       |     | PR D95 012002  | R. Aaij <i>et al.</i>         | (LHCb Collab.)           | REFID=57636 |
| 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 |
| ASTON      | 87  | NP B292 693    | D. Aston <i>et al.</i>        | (SLAC, NAGO, CINC, INUS) | REFID=40234 |
| ASTON      | 84  | PL 149B 258    | D. Aston <i>et al.</i>        | (SLAC, CARL, OTTA) JP    | REFID=22689 |
| ETKIN      | 80  | PR D22 42      | A. Etkin <i>et al.</i>        | (BNL, CUNY) JP           | REFID=22545 |
| ESTABROOKS | 78  | NP B133 490    | P.G. Estabrooks <i>et al.</i> | (MCGI, CARL, DURH+) JP   | REFID=22443 |

$K_2(1770)$

$$I(J^P) = \frac{1}{2}(2^-)$$

See our mini-review in the 2004 edition of this *Review*, PDG 04.

### $K_2(1770)$ MASS

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                | TECN      | CHG  | COMMENT                                        |
|-------------------------------------------------------------------------------|------|----------------------------|-----------|------|------------------------------------------------|
| <b>1773± 8 OUR AVERAGE</b>                                                    |      |                            |           |      |                                                |
| $1777 \pm 35^{+122}_{-77}$                                                    | 4289 | <sup>1</sup> AAIJ          | 17C       | LHCB | $B^+ \rightarrow J/\psi \phi K^+$              |
| $1773 \pm 8$                                                                  |      | <sup>2</sup> ASTON         | 93        | LASS | $11 K^- p \rightarrow K^- \omega p$            |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                            |           |      |                                                |
| $1743 \pm 15$                                                                 |      | TIKHOMIROV 03              | SPEC      |      | $40.0 \pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$ |
| $1810 \pm 20$                                                                 |      | FRAME 86                   | OMEG +    |      | $13 K^+ p \rightarrow \phi K^+ p$              |
| ~ 1730                                                                        |      | ARMSTRONG 83               | OMEG -    |      | $18.5 K^- p \rightarrow 3 K p$                 |
| ~ 1780                                                                        |      | <sup>3</sup> DAUM 81C      | CNTR -    |      | $63 K^- p \rightarrow K^- 2\pi p$              |
| $1710 \pm 15$                                                                 | 60   | CHUNG 74                   | HBC -     |      | $7.3 K^- p \rightarrow K^- \omega p$           |
| $1767 \pm 6$                                                                  |      | BLIEDEN 72                 | MMS -     |      | $11-16 K^- p$                                  |
| $1730 \pm 20$                                                                 | 306  | <sup>4</sup> FIRESTONE 72B | DBC +     |      | $12 K^+ d$                                     |
| $1765 \pm 40$                                                                 |      | <sup>5</sup> COLLEY 71     | HBC +     |      | $10 K^+ p \rightarrow K 2\pi N$                |
| 1740                                                                          |      | DENEGRI 71                 | DBC -     |      | $12.6 K^- d \rightarrow \bar{K} 2\pi d$        |
| $1745 \pm 20$                                                                 |      | AGUILAR-...                | 70C HBC - |      | $4.6 K^- p$                                    |
| $1780 \pm 15$                                                                 |      | BARTSCH 70C                | HBC -     |      | $10.1 K^- p$                                   |
| $1760 \pm 15$                                                                 |      | 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=M023

NODE=M023

NODE=M023M

NODE=M023M

NODE=M023M;LINKAGE=C  
 NODE=M023M;LINKAGE=A  
 NODE=M023M;LINKAGE=B  
 NODE=M023M;LINKAGE=P  
 NODE=M023M;LINKAGE=X

### $K_2(1770)$ WIDTH

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                | TECN      | CHG  | COMMENT                                        |
|-------------------------------------------------------------------------------|------|----------------------------|-----------|------|------------------------------------------------|
| <b>186± 14 OUR AVERAGE</b>                                                    |      |                            |           |      |                                                |
| $217 \pm 116^{+221}_{-154}$                                                   | 4289 | <sup>6</sup> AAIJ          | 17C       | LHCB | $B^+ \rightarrow J/\psi \phi K^+$              |
| $186 \pm 14$                                                                  |      | <sup>7</sup> ASTON         | 93        | LASS | $11 K^- p \rightarrow K^- \omega p$            |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                            |           |      |                                                |
| $147 \pm 70$                                                                  |      | TIKHOMIROV 03              | SPEC      |      | $40.0 \pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$ |
| $140 \pm 40$                                                                  |      | FRAME 86                   | OMEG +    |      | $13 K^+ p \rightarrow \phi K^+ p$              |
| ~ 220                                                                         |      | ARMSTRONG 83               | OMEG -    |      | $18.5 K^- p \rightarrow 3 K p$                 |
| ~ 210                                                                         |      | <sup>8</sup> DAUM 81C      | CNTR -    |      | $63 K^- p \rightarrow K^- 2\pi p$              |
| $110 \pm 50$                                                                  | 60   | CHUNG 74                   | HBC -     |      | $7.3 K^- p \rightarrow K^- \omega p$           |
| $100 \pm 26$                                                                  |      | BLIEDEN 72                 | MMS -     |      | $11-16 K^- p$                                  |
| $210 \pm 30$                                                                  | 306  | <sup>9</sup> FIRESTONE 72B | DBC +     |      | $12 K^+ d$                                     |
| $90 \pm 70$                                                                   |      | <sup>10</sup> COLLEY 71    | HBC +     |      | $10 K^+ p \rightarrow K 2\pi N$                |
| 130                                                                           |      | DENEGRI 71                 | DBC -     |      | $12.6 K^- d \rightarrow \bar{K} 2\pi d$        |
| $100 \pm 50$                                                                  |      | AGUILAR-...                | 70C HBC - |      | $4.6 K^- p$                                    |
| $138 \pm 40$                                                                  |      | BARTSCH 70C                | HBC -     |      | $10.1 K^- p$                                   |
| $50^{+40}_{-20}$                                                              |      | 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

NODE=M023W

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**

| Mode                        | Fraction ( $\Gamma_i/\Gamma$ ) |
|-----------------------------|--------------------------------|
| $\Gamma_1$ $K\pi\pi$        |                                |
| $\Gamma_2$ $K_2^*(1430)\pi$ | dominant                       |
| $\Gamma_3$ $K^*(892)\pi$    | seen                           |
| $\Gamma_4$ $K f_2(1270)$    | seen                           |
| $\Gamma_5$ $K f_0(980)$     |                                |
| $\Gamma_6$ $K\phi$          | seen                           |
| $\Gamma_7$ $K\omega$        | seen                           |

NODE=M023215;NODE=M023

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**

**$\Gamma(K_2^*(1430)\pi)/\Gamma(K\pi\pi)$**   **$\Gamma_2/\Gamma_1$**   
 ( $K_2^*(1430) \rightarrow K\pi$ )

| 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=M023220

NODE=M023R1

NODE=M023R1  
 NODE=M023R1

**$\Gamma(K^*(892)\pi)/\Gamma(K\pi\pi)$**   **$\Gamma_3/\Gamma_1$**

| VALUE       | DOCUMENT ID                                                             | TECN | COMMENT                                |
|-------------|-------------------------------------------------------------------------|------|----------------------------------------|
| • • •       | We do not use the following data for averages, fits, limits, etc. • • • |      |                                        |
| $\sim 0.23$ | DAUM                                                                    | 81C  | CNTR 63 $K^- p \rightarrow K^- 2\pi p$ |

NODE=M023R1;LINKAGE=P

NODE=M023R3  
 NODE=M023R3

**$\Gamma(K f_2(1270))/\Gamma(K\pi\pi)$**   **$\Gamma_4/\Gamma_1$**   
 ( $f_2(1270) \rightarrow \pi\pi$ )

| VALUE       | DOCUMENT ID                                                             | TECN | COMMENT                                |
|-------------|-------------------------------------------------------------------------|------|----------------------------------------|
| • • •       | We do not use the following data for averages, fits, limits, etc. • • • |      |                                        |
| $\sim 0.74$ | DAUM                                                                    | 81C  | CNTR 63 $K^- p \rightarrow K^- 2\pi p$ |

NODE=M023R4  
 NODE=M023R4  
 NODE=M023R4

**$\Gamma(K f_0(980))/\Gamma_{\text{total}}$**   **$\Gamma_5/\Gamma$**

| VALUE         | DOCUMENT ID                                                             | TECN | COMMENT                                             |
|---------------|-------------------------------------------------------------------------|------|-----------------------------------------------------|
| • • •         | We do not use the following data for averages, fits, limits, etc. • • • |      |                                                     |
| possibly seen | TIKHOMIROV                                                              | 03   | SPEC 40.0 $\pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$ |

NODE=M023R6  
 NODE=M023R6

**$\Gamma(K\phi)/\Gamma_{\text{total}}$**   **$\Gamma_6/\Gamma$**

| 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  
 NODE=M023R5

NODE=M023R5;LINKAGE=A

**$\Gamma(K\omega)/\Gamma_{\text{total}}$**   **$\Gamma_7/\Gamma$**

| VALUE | DOCUMENT ID | TECN | CHG | COMMENT                                |
|-------|-------------|------|-----|----------------------------------------|
| seen  | OTTER       | 81   | HBC | $\pm$ 8.25,10,16 $K^\pm p$             |
| seen  | CHUNG       | 74   | HBC | - 7.3 $K^- p \rightarrow K^- \omega p$ |

NODE=M023R2  
 NODE=M023R2

 **$K_2(1770)$  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.)                   |
| 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)                            |

NODE=M023

REFID=57657  
 REFID=57636  
 REFID=49653  
 REFID=49423

REFID=43597  
 REFID=20569  
 REFID=22801  
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 REFID=22549  
 REFID=22735  
 REFID=22788  
 REFID=22506  
 REFID=22785  
 REFID=22497  
 REFID=22782  
 REFID=22783  
 REFID=22784  
 REFID=22483



**$K_3^*(1780)$** 

$$I(J^P) = \frac{1}{2}(3^-)$$

NODE=M060

 **$K_3^*(1780)$  MASS**

NODE=M060M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                         | TECN | CHG  | COMMENT                                          |
|-------------------------------------------------------------------------------|------|-------------------------------------|------|------|--------------------------------------------------|
| <b>1776± 7 OUR AVERAGE</b>                                                    |      | Error includes scale factor of 1.1. |      |      |                                                  |
| 1781± 8± 4                                                                    |      | <sup>1</sup> ASTON                  | 88   | LASS | 0 11 $K^- p \rightarrow K^- \pi^+ n$             |
| 1740±14±15                                                                    |      | <sup>1</sup> ASTON                  | 87   | LASS | 0 11 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |
| 1779±11                                                                       |      | <sup>2</sup> BALDI                  | 76   | SPEC | + 10 $K^+ p \rightarrow K^0 \pi^+ p$             |
| 1776±26                                                                       |      | <sup>3</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>4</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>5</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 $K^- p \rightarrow K^- \pi^+ n$              |

<sup>1</sup> From energy-independent partial-wave analysis.<sup>2</sup> From a fit to  $Y_6^2$  moment.  $J^P = 3^-$  found.<sup>3</sup> Confirmed by phase shift analysis of ESTABROOKS 78, yields  $J^P = 3^-$ .<sup>4</sup> From a partial wave amplitude analysis.<sup>5</sup> From a fit to the  $Y_6^0$  moment.

NODE=M060M;LINKAGE=K  
 NODE=M060M;LINKAGE=M  
 NODE=M060M;LINKAGE=A  
 NODE=M060M;LINKAGE=F  
 NODE=M060M;LINKAGE=J

 **$K_3^*(1780)$  WIDTH**

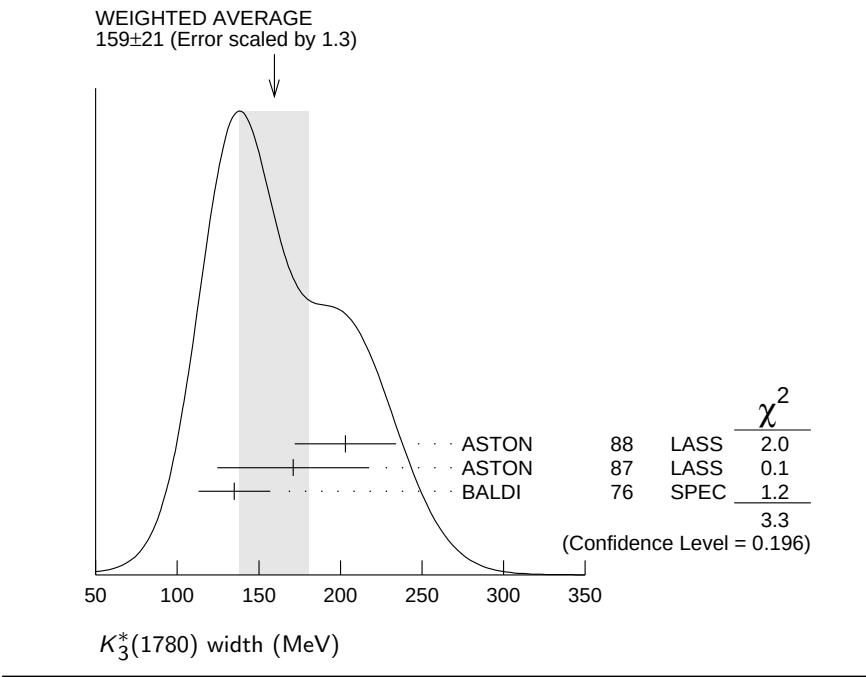
NODE=M060W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                                                 | TECN | CHG  | COMMENT                                          |
|-------------------------------------------------------------------------------|------|-------------------------------------------------------------|------|------|--------------------------------------------------|
| <b>159±21 OUR AVERAGE</b>                                                     |      | Error includes scale factor of 1.3. See the ideogram below. |      |      |                                                  |
| 203±30± 8                                                                     |      | <sup>6</sup> ASTON                                          | 88   | LASS | 0 11 $K^- p \rightarrow K^- \pi^+ n$             |
| 171±42±20                                                                     |      | <sup>6</sup> ASTON                                          | 87   | LASS | 0 11 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |
| 135±22                                                                        |      | <sup>7</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>8</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>9</sup> ASTON                                          | 81D  | LASS | 0 11 $K^- p \rightarrow K^- \pi^+ n$             |
| ~ 80                                                                          | 190  | TOAFF                                                       | 81   | HBC  | — 6.5 $K^- p \rightarrow \bar{K}^0 \pi^- p$      |
| 240±50                                                                        |      | ETKIN                                                       | 80   | MPS  | 0 6 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^-$    |
| 181±44                                                                        |      | <sup>10</sup> BEUSCH                                        | 78   | OMEG | 10 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$   |
| 96±31                                                                         |      | CHUNG                                                       | 78   | MPS  | 0 6 $K^- p \rightarrow K^- \pi^+ n$              |
| 270±70                                                                        |      | <sup>11</sup> BRANDENB...                                   | 76D  | ASPK | 0 13 $K^\pm p \rightarrow K^\pm \pi^\mp N$       |

NODE=M060W

- <sup>6</sup> From energy-independent partial-wave analysis.
- <sup>7</sup> From a fit to  $Y_6^2$  moment.  $J^P = 3^-$  found.
- <sup>8</sup> From a partial wave amplitude analysis.
- <sup>9</sup> From a fit to  $Y_6^0$  moment.
- <sup>10</sup> Errors enlarged by us to  $4\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.
- <sup>11</sup> ESTABROOKS 78 find that BRANDENBURG 76D data are consistent with 175 MeV width. Not averaged.

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 ± 9 ) %                    |                  |
| $\Gamma_2$ | $K^*(892)\pi$    | (20 ± 5 ) %                    |                  |
| $\Gamma_3$ | $K\pi$           | (18.8± 1.0) %                  |                  |
| $\Gamma_4$ | $K\eta$          | (30 ±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  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$ , 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.

|       |       |       |       |
|-------|-------|-------|-------|
| $x_2$ | 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                                      |                     |
| 1.52±0.23 OUR FIT                   |             |      |      |                                              |                     |
| 1.52±0.21±0.10                      | ASTON       | 87   | LASS | 0 11 $K^-p \rightarrow \bar{K}^0\pi^+\pi^-n$ |                     |

NODE=M060R5  
NODE=M060R5

$\Gamma(K^*(892)\pi)/\Gamma(K\pi)$  $\Gamma_2/\Gamma_3$ 

| VALUE                    | DOCUMENT ID | TECN | CHG  | COMMENT                                   |
|--------------------------|-------------|------|------|-------------------------------------------|
| <b>1.09±0.26 OUR FIT</b> |             |      |      |                                           |
| <b>1.09±0.26</b>         | ASTON       | 84B  | LASS | 0 11 $K^- p \rightarrow \bar{K}^0 2\pi n$ |

NODE=M060R7  
 NODE=M060R7

 $\Gamma(K\pi)/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma$ 

| VALUE                          | DOCUMENT ID | TECN | CHG  | COMMENT                              |
|--------------------------------|-------------|------|------|--------------------------------------|
| <b>0.188±0.010 OUR FIT</b>     |             |      |      |                                      |
| <b>0.188±0.010 OUR AVERAGE</b> |             |      |      |                                      |
| 0.187±0.008±0.008              | ASTON       | 88   | LASS | 0 11 $K^- p \rightarrow K^- \pi^+ n$ |
| 0.19 ±0.02                     | ESTABROOKS  | 78   | ASPK | 0 13 $K^\pm p \rightarrow K\pi N$    |

NODE=M060R4  
 NODE=M060R4

 $\Gamma(K\eta)/\Gamma(K\pi)$  $\Gamma_4/\Gamma_3$ 

| VALUE                   | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------------------|-------------|------|-----|---------|
| <b>1.6 ±0.7 OUR FIT</b> |             |      |     |         |

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

|            |                    |     |      |                                            |
|------------|--------------------|-----|------|--------------------------------------------|
| 0.41±0.050 | <sup>12</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>12</sup> This result supersedes ASTON 88B.

NODE=M060R8  
 NODE=M060R8

NODE=M060R8;LINKAGE=H

 $\Gamma(K_2^*(1430)\pi)/\Gamma(K^*(892)\pi)$  $\Gamma_5/\Gamma_2$ 

| VALUE           | CL% | DOCUMENT ID | TECN | CHG  | COMMENT                                          |
|-----------------|-----|-------------|------|------|--------------------------------------------------|
| <b>&lt;0.78</b> | 95  | ASTON       | 87   | LASS | 0 11 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |

NODE=M060R6  
 NODE=M060R6

 $K_3^*(1780)$  REFERENCES

NODE=M060

|             |     |             |                                |                             |
|-------------|-----|-------------|--------------------------------|-----------------------------|
| 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                   |

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

**$K_2(1820)$** 

$$I(J^P) = \frac{1}{2}(2^-)$$

See our mini-review in the 2004 edition of this *Review* (PDG 04) under  $K_2(1770)$ .

NODE=M146

NODE=M146

NODE=M146M

NODE=M146M

 **$K_2(1820)$  MASS**

| VALUE (MeV)                                                                                                                  | EVTs | DOCUMENT ID        | TECN     | COMMENT                            |
|------------------------------------------------------------------------------------------------------------------------------|------|--------------------|----------|------------------------------------|
| <b>1819±12 OUR AVERAGE</b>                                                                                                   |      |                    |          |                                    |
| 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.                                                          |      |                    |          |                                    |

NODE=M146M;LINKAGE=B  
 NODE=M146M;LINKAGE=A  
 NODE=M146M;LINKAGE=C

 **$K_2(1820)$  WIDTH**

| VALUE (MeV)                                                                                                                  | EVTs | DOCUMENT ID        | TECN     | COMMENT                            |
|------------------------------------------------------------------------------------------------------------------------------|------|--------------------|----------|------------------------------------|
| <b>264±34 OUR AVERAGE</b>                                                                                                    |      |                    |          |                                    |
| 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.                                                          |      |                    |          |                                    |

NODE=M146W

NODE=M146W

NODE=M146W;LINKAGE=A  
 NODE=M146W;LINKAGE=B  
 NODE=M146W;LINKAGE=C

 **$K_2(1820)$  DECAY MODES**

| 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                           |

NODE=M146215;NODE=M146

DESIG=5

DESIG=1;OUR EVAL;→ UNCHECKED ←

DESIG=2;OUR EVAL;→ UNCHECKED ←

DESIG=3;OUR EVAL;→ UNCHECKED ←

DESIG=6;OUR EVAL;→ UNCHECKED ←

DESIG=7

 **$K_2(1820)$  BRANCHING RATIOS**

| $\Gamma(K_2^*(1430)\pi)/\Gamma(K\pi\pi)$                                                                                     |             |                   |                                      | $\Gamma_2/\Gamma_1$               |
|------------------------------------------------------------------------------------------------------------------------------|-------------|-------------------|--------------------------------------|-----------------------------------|
| VALUE                                                                                                                        | DOCUMENT ID | TECN              | COMMENT                              |                                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                |             |                   |                                      |                                   |
| ~ 0.77                                                                                                                       | DAUM        | 81C CNTR          | $63K^- p \rightarrow \bar{K} 2\pi p$ |                                   |
| $\Gamma(K^*(892)\pi)/\Gamma(K\pi\pi)$                                                                                        |             |                   |                                      | $\Gamma_3/\Gamma_1$               |
| VALUE                                                                                                                        | DOCUMENT ID | TECN              | COMMENT                              |                                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                |             |                   |                                      |                                   |
| ~ 0.05                                                                                                                       | DAUM        | 81C CNTR          | $63K^- p \rightarrow \bar{K} 2\pi p$ |                                   |
| $\Gamma(K f_2(1270))/\Gamma(K\pi\pi)$                                                                                        |             |                   |                                      | $\Gamma_4/\Gamma_1$               |
| VALUE                                                                                                                        | DOCUMENT ID | TECN              | COMMENT                              |                                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                |             |                   |                                      |                                   |
| ~ 0.18                                                                                                                       | DAUM        | 81C CNTR          | $63K^- p \rightarrow \bar{K} 2\pi p$ |                                   |
| $\Gamma(K\phi)/\Gamma_{\text{total}}$                                                                                        |             |                   |                                      | $\Gamma_6/\Gamma$                 |
| VALUE                                                                                                                        | EVTs        | DOCUMENT ID       | TECN                                 | COMMENT                           |
| seen                                                                                                                         | 4289        | <sup>7</sup> AAIJ | 17C LHCb                             | $B^+ \rightarrow J/\psi \phi K^+$ |
| <sup>7</sup> From an amplitude analysis of the decay $B^+ \rightarrow J/\psi \phi K^+$ with a significance of 3.0 $\sigma$ . |             |                   |                                      |                                   |

NODE=M146220

NODE=M146R1  
 NODE=M146R1

NODE=M146R2  
 NODE=M146R2

NODE=M146R3  
 NODE=M146R3

NODE=M146R00  
 NODE=M146R00

NODE=M146R00;LINKAGE=A

K<sub>2</sub>(1820) 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.)            |
| 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+) |

NODE=M146

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.

NODE=M088

NODE=M088

K(1830) MASS

NODE=M088M

| VALUE (MeV)                | EVTs | DOCUMENT ID       | TECN | CHG  | COMMENT                           |
|----------------------------|------|-------------------|------|------|-----------------------------------|
| $1874 \pm 43^{+59}_{-115}$ | 4289 | <sup>1</sup> AAIJ | 17C  | LHCB | $B^+ \rightarrow J/\psi \phi K^+$ |

NODE=M088M

• • • 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  $3.5 \sigma$ .

NODE=M088M;LINKAGE=A

K(1830) WIDTH

NODE=M088W

| VALUE (MeV)                | EVTs | DOCUMENT ID       | TECN | CHG  | COMMENT                           |
|----------------------------|------|-------------------|------|------|-----------------------------------|
| $168 \pm 90^{+280}_{-104}$ | 4289 | <sup>2</sup> AAIJ | 17C  | LHCB | $B^+ \rightarrow J/\psi \phi K^+$ |

NODE=M088W

• • • 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  $3.5 \sigma$ .

NODE=M088W;LINKAGE=A

K(1830) DECAY MODES

NODE=M088215;NODE=M088

| Mode             |
|------------------|
| $\Gamma_1 K\phi$ |

DESIG=1

K(1830) REFERENCES

NODE=M088

|           |     |                |                              |                        |
|-----------|-----|----------------|------------------------------|------------------------|
| 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 |

REFID=57657  
REFID=57636  
REFID=22801

**$K_0^*(1950)$** 

$$I(J^P) = \frac{1}{2}(0^+)$$

OMITTED FROM SUMMARY TABLE

Seen in partial-wave analysis of the  $K^- \pi^+$  system. Needs confirmation.

NODE=M134

NODE=M134

 **$K_0^*(1950)$  MASS**

NODE=M134M

NODE=M134M

| VALUE (MeV)                                                                   | DOCUMENT ID            | TECN | CHG  | COMMENT                              |
|-------------------------------------------------------------------------------|------------------------|------|------|--------------------------------------|
| <b><math>1945 \pm 10 \pm 20</math></b>                                        | <sup>1</sup> ASTON     | 88   | LASS | 0 11 $K^- p \rightarrow K^- \pi^+ n$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                        |      |      |                                      |
| $1917 \pm 12$                                                                 | <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.

NODE=M134M;LINKAGE=A

NODE=M134M;LINKAGE=ZU

NODE=M134M;LINKAGE=A1

 **$K_0^*(1950)$  WIDTH**

NODE=M134W

NODE=M134W

| VALUE (MeV)                                                                   | DOCUMENT ID            | TECN | CHG  | COMMENT                              |
|-------------------------------------------------------------------------------|------------------------|------|------|--------------------------------------|
| <b><math>201 \pm 34 \pm 79</math></b>                                         | <sup>4</sup> ASTON     | 88   | LASS | 0 11 $K^- p \rightarrow K^- \pi^+ n$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                        |      |      |                                      |
| $145 \pm 38$                                                                  | <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=M134W;LINKAGE=A

NODE=M134W;LINKAGE=ZU

NODE=M134W;LINKAGE=A1

 **$K_0^*(1950)$  DECAY MODES**

NODE=M134215;NODE=M134

| Mode               | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------|--------------------------------|
| $\Gamma_1$ $K \pi$ | (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><math>0.52\pm0.08\pm0.12</math></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. • • • |                    |      |      |         |                                   |                   |
| $\sim 0.60$                                                                   | <sup>8</sup> ZHOU  | 06   | RVUE |         | $Kp \rightarrow K^- \pi^+ n$      |                   |

<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

**$K_2^*(1980)$** 

$$I(J^P) = \frac{1}{2}(2^+)$$

OMITTED FROM SUMMARY TABLE

Needs confirmation.

NODE=M104

NODE=M104

 **$K_2^*(1980)$  MASS**

NODE=M104M

NODE=M104M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID       | TECN | CHG  | COMMENT                                          |
|-------------------------------------------------------------------------------|------|-------------------|------|------|--------------------------------------------------|
| <b>1974±26 OUR AVERAGE</b>                                                    |      |                   |      |      |                                                  |
| 2073±94 <sup>+245</sup> <sub>-240</sub>                                       | 4289 | <sup>1</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> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi \phi K^+$  with a significance of 5.4  $\sigma$ .

NODE=M104M;LINKAGE=B

 **$K_2^*(1980)$  WIDTH**

NODE=M104W

NODE=M104W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID       | TECN | CHG  | COMMENT                                          |
|-------------------------------------------------------------------------------|------|-------------------|------|------|--------------------------------------------------|
| <b>376± 70 OUR AVERAGE</b>                                                    |      |                   |      |      |                                                  |
| 678±311 <sup>+1153</sup> <sub>-559</sub>                                      | 4289 | <sup>2</sup> AAIJ | 17C  | LHCB | $B^+ \rightarrow J/\psi \phi K^+$                |
| 373± 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± 70                                                                       |      | TIKHOMIROV        | 03   | SPEC | 40.0 $\pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$   |
| 398± 47                                                                       | 241  | BIRD              | 89   | LASS | - 11 $K^- p \rightarrow \bar{K}^0 \pi^- p$       |

<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;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                           |

DESIG=2

DESIG=3

DESIG=4

DESIG=5

 **$K_2^*(1980)$  BRANCHING RATIOS**

NODE=M104220

 **$\Gamma(K^*(892)\pi)/\Gamma_{\text{total}}$**   **$\Gamma_1/\Gamma$** NODE=M104R01  
NODE=M104R01

| VALUE         | DOCUMENT ID | TECN | COMMENT                                       |
|---------------|-------------|------|-----------------------------------------------|
| possibly seen | 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                                       |
|---------------|-------------|------|-----------------------------------------------|
| possibly seen | 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>1.49±0.24±0.09</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                                             |
|---------------|-------------|------|-----------------------------------------------------|
| possibly seen | TIKHOMIROV  | 03   | SPEC 40.0 $\pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$ |

 **$\Gamma(K\phi)/\Gamma_{\text{total}}$**   **$\Gamma_4/\Gamma$** NODE=M104R00  
NODE=M104R00

| VALUE | EVTS | DOCUMENT ID       | TECN | COMMENT                                |
|-------|------|-------------------|------|----------------------------------------|
| seen  | 4289 | <sup>3</sup> AAIJ | 17C  | LHCB $B^+ \rightarrow J/\psi \phi K^+$ |

<sup>3</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

**$K_2^*(1980)$  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.)           |
| 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> |                          |
| BIRD       | 89  | Translated from YAF 66 860. | P.F. Bird                     | (SLAC)                   |
| ASTON      | 87  | SLAC-332                    | D. Aston <i>et al.</i>        | (SLAC, NAGO, CINC, INUS) |
|            |     | NP B292 693                 |                               |                          |

NODE=M104

REFID=57657  
REFID=57636  
REFID=53668  
REFID=49423

REFID=41002  
REFID=40234

NODE=M035

 **$K_4^*(2045)$** 

$$I(J^P) = \frac{1}{2}(4^+)$$

 **$K_4^*(2045)$  MASS**

NODE=M035M

NODE=M035M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                         | TECN | CHG  | COMMENT                                  |
|-------------------------------------------------------------------------------|------|-------------------------------------|------|------|------------------------------------------|
| <b>2045 ± 9 OUR AVERAGE</b>                                                   |      | Error includes scale factor of 1.1. |      |      |                                          |
| 2062 ± 14 ± 13                                                                |      | <sup>1</sup> ASTON                  | 86   | LASS | 0 11 $K^- p \rightarrow K^- \pi^+ n$     |
| 2039 ± 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 ± 7                                                                      | 431  | TORRES                              | 86   | MPSF | 400 $pA \rightarrow 4KX$                 |
| 2088 ± 20                                                                     | 650  | BAUBILLIER                          | 82   | HBC  | — 8.25 $K^- p \rightarrow K_S^0 \pi^- p$ |
| 2115 ± 46                                                                     | 488  | CARMONY                             | 77   | HBC  | 0 9 $K^+ d \rightarrow K^+ \pi^+ s X$    |

<sup>1</sup> From a fit to all moments.<sup>2</sup> From a fit to 8 moments.<sup>3</sup> Number of events evaluated by us.<sup>4</sup> From energy-independent partial-wave analysis.

NODE=M035M;LINKAGE=E  
NODE=M035M;LINKAGE=B  
NODE=M035M;LINKAGE=W  
NODE=M035M;LINKAGE=D

 **$K_4^*(2045)$  WIDTH**

NODE=M035W

NODE=M035W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN | CHG  | COMMENT                                  |
|-------------------------------------------------------------------------------|------|------------------------|------|------|------------------------------------------|
| <b>198 ± 30 OUR AVERAGE</b>                                                   |      |                        |      |      |                                          |
| 221 ± 48 ± 27                                                                 |      | <sup>5</sup> ASTON     | 86   | LASS | 0 11 $K^- p \rightarrow K^- \pi^+ n$     |
| 189 ± 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 ± 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 ± 200                                                                     |      | CARMONY                | 77   | HBC  | 0 9 $K^+ d \rightarrow K^+ \pi^+ s X$    |

<sup>5</sup> From a fit to all moments.<sup>6</sup> From a fit to 8 moments.<sup>7</sup> Number of events evaluated by us.<sup>8</sup> From energy-independent partial-wave analysis.

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 ± 1.2) %                  |
| $\Gamma_2$ $K^*(892)\pi\pi$    | (9 ± 5) %                      |
| $\Gamma_3$ $K^*(892)\pi\pi\pi$ | (7 ± 5) %                      |
| $\Gamma_4$ $\rho K\pi$         | (5.7 ± 3.2) %                  |
| $\Gamma_5$ $\omega K\pi$       | (5.0 ± 3.0) %                  |
| $\Gamma_6$ $\phi K\pi$         | (2.8 ± 1.4) %                  |
| $\Gamma_7$ $\phi K^*(892)$     | (1.4 ± 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 $K^- p \rightarrow K^- \pi^+ n$ |                   |

NODE=M035R1  
NODE=M035R1



$\Gamma(K^*(892)\pi\pi)/\Gamma(K\pi)$ 

| VALUE            | DOCUMENT ID   | TECN | CHG | COMMENT                               |
|------------------|---------------|------|-----|---------------------------------------|
| <b>0.89±0.53</b> | BAUBILLIER 82 | HBC  | —   | 8.25 $K^- p \rightarrow p K_S^0 3\pi$ |

 $\Gamma_2/\Gamma_1$ 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 | 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 | 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

|               |             |                             |                          |
|---------------|-------------|-----------------------------|--------------------------|
| 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=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 $K^+ p \rightarrow \Lambda \bar{p} X$ |

NODE=M040W

NODE=M040W

• • • 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  |    | 2 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 $K^+ p$                                      |

$2 J^P = 2^-$  from moments analysis.

NODE=M040W;LINKAGE=Q

**$K_2(2250)$  DECAY MODES**

NODE=M040215;NODE=M040

| Mode       |                      |
|------------|----------------------|
| $\Gamma_1$ | $K \pi \pi$          |
| $\Gamma_2$ | $K f_2(1270)$        |
| $\Gamma_3$ | $K^*(892) f_0(980)$  |
| $\Gamma_4$ | $\rho \bar{\Lambda}$ |

DESIG=1  
DESIG=3  
DESIG=4  
DESIG=2

**$K_2(2250)$  REFERENCES**

NODE=M040

|              |     |                             |                                |                        |
|--------------|-----|-----------------------------|--------------------------------|------------------------|
| 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)                  |

REFID=49423  
REFID=22852  
REFID=22850  
REFID=22851  
REFID=22849  
REFID=22847

**$K_3(2320)$**

$I(J^P) = \frac{1}{2}(3^+)$

OMITTED FROM SUMMARY TABLE  
Seen in the  $J^P = 3^+$  wave of the antihyperon-nucleon system.  
Needs confirmation.

NODE=M090

NODE=M090

**$K_3(2320)$  MASS**

NODE=M090M

| VALUE (MeV)                | DOCUMENT ID     | TECN | CHG | COMMENT                                  |
|----------------------------|-----------------|------|-----|------------------------------------------|
| <b>2324±24 OUR AVERAGE</b> |                 |      |     |                                          |
| 2330±40                    | 1 ARMSTRONG 83C | OMEG | -   | 18 $K^- p \rightarrow \Lambda \bar{p} X$ |
| 2320±30                    | 1 CLELAND 81    | SPEC | ±   | 50 $K^+ p \rightarrow \Lambda \bar{p} X$ |

$1 J^P = 3^+$  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> | 2 ARMSTRONG 83C | OMEG | -   | 18 $K^- p \rightarrow \Lambda \bar{p} X$ |

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

|       |              |      |   |                                          |
|-------|--------------|------|---|------------------------------------------|
| ~ 250 | 2 CLELAND 81 | SPEC | ± | 50 $K^+ p \rightarrow \Lambda \bar{p} X$ |
|-------|--------------|------|---|------------------------------------------|

$2 J^P = 3^+$  from moments analysis.

NODE=M090W

NODE=M090W

NODE=M090W;LINKAGE=P

**$K_3(2320)$  DECAY MODES**

NODE=M090215;NODE=M090

| Mode       |                   |
|------------|-------------------|
| $\Gamma_1$ | $p \bar{\Lambda}$ |

DESIG=1

**$K_3(2320)$  REFERENCES**

NODE=M090

|           |     |             |                              |                     |
|-----------|-----|-------------|------------------------------|---------------------|
| 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+) |

REFID=22852  
REFID=22851

**$K_5^*(2380)$** 

$$I(J^P) = \frac{1}{2}(5^-)$$

OMITTED FROM SUMMARY TABLE

Needs confirmation.

 **$K_5^*(2380)$  MASS**

| VALUE (MeV)                            | DOCUMENT ID        | TECN | CHG  | COMMENT                              |
|----------------------------------------|--------------------|------|------|--------------------------------------|
| <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**

| VALUE (MeV)                           | DOCUMENT ID        | TECN | CHG  | COMMENT                              |
|---------------------------------------|--------------------|------|------|--------------------------------------|
| <b><math>178 \pm 37 \pm 32</math></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**

| VALUE (MeV)                                                                   | DOCUMENT ID          | TECN | CHG  | COMMENT                                      |
|-------------------------------------------------------------------------------|----------------------|------|------|----------------------------------------------|
| • • • 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 ± 11 OUR AVERAGE**

3060 ± 7 ± 20

<sup>1</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \Lambda\bar{p}\pi^+$ 

3056 ± 7 ± 20

<sup>1</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \bar{\Lambda}p\pi^-$ 

3055 ± 8 ± 20

<sup>1</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \Lambda\bar{p}\pi^-$ 

3045 ± 8 ± 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 ± 11 OUR AVERAGE**

3067 ± 6 ± 20

<sup>1</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \Lambda\bar{p}\pi^+\pi^+$ 

3060 ± 8 ± 20

<sup>1</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \Lambda\bar{p}\pi^+\pi^-$ 

3055 ± 7 ± 20

<sup>1</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \bar{\Lambda}p\pi^-\pi^-$ 

3052 ± 8 ± 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 ± 30

BOURQUIN 86 SPEC  $K(3100) \rightarrow \Lambda\bar{p}\pi^+\pi^+$ 

3115 ± 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 ± 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 ± 16

<sup>2</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \Lambda\bar{p}\pi^+$ 

36 ± 15

<sup>2</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \bar{\Lambda}p\pi^-$ 

50 ± 18

<sup>2</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \Lambda\bar{p}\pi^-$ 

30 ± 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 ± 8

<sup>2</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \Lambda\bar{p}\pi^+\pi^+$ 

28 ± 12

<sup>2</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \Lambda\bar{p}\pi^+\pi^-$ 

32 ± 15

<sup>2</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \bar{\Lambda}p\pi^-\pi^-$ 

30 ± 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**

NODE=M129

|           |    |                             |                             |                     |
|-----------|----|-----------------------------|-----------------------------|---------------------|
| 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+) |

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. [142.016±0.030 MeV OUR 2018 FIT Scale factor = 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

NEW

<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.

$$x_2 \quad \begin{vmatrix} -100 \\ x_1 \end{vmatrix}$$

### $D^*(2007)^0$ 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>         | (BES III 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 | $D^{*\pm} \rightarrow D^0 \pi^\pm,$                                       | OCCUR=2 |
| 145.4                                                                         | ±0.2   | 48    | <sup>4</sup> DERRICK   | 95  | ZEUS | $D^{*\pm} \rightarrow D^0 \pi^\pm,$                                       |         |
| 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 | $D^{*\pm} \rightarrow D^0 \pi^\pm \rightarrow (K^- \pi^+) \pi^\pm$        |         |
| 145.4266±0.0005±0.0019                                                        | 174.3k |       | LEES                   | 13X | BABR | $D^{*\pm} \rightarrow D^0 \pi^\pm \rightarrow (K^- 2\pi^+ \pi^-) \pi^\pm$ | OCCUR=2 |
| 145.44                                                                        | ±0.09  | 122   | <sup>4</sup> BREITWEG  | 97B | ZEUS | $D^{*\pm} \rightarrow D^0 \pi^\pm,$                                       |         |
| 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 | $D^{*\pm} \rightarrow D^0 \pi^\pm$                                        | OCCUR=3 |
| 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.                                  |        |       |                        |     |      |                                                                           |         |

### $m_{D^*(2010)^+} - m_{D^*(2007)^0}$

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

### $D^*(2010)^\pm$ WIDTH

| VALUE (keV)                                                                                       | CL%    | EVTS | DOCUMENT ID             | TECN     | COMMENT                                                                   |
|---------------------------------------------------------------------------------------------------|--------|------|-------------------------|----------|---------------------------------------------------------------------------|
| <b>83.4±1.8 OUR AVERAGE</b>                                                                       |        |      |                         |          |                                                                           |
| 83.3±1.2± 1.4                                                                                     | 312.8k |      | <sup>6</sup> LEES       | 13X BABR | $D^{*\pm} \rightarrow D^0 \pi^\pm \rightarrow (K \pi, K 3\pi) \pi^\pm$    |
| 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 | $D^{*\pm} \rightarrow D^0 \pi^\pm \rightarrow (K^- 2\pi^+ \pi^-) \pi^\pm$ |
| <131                                                                                              | 90     | 110  | BARLAG                  | 92B ACCM | $\pi^- 230 \text{ GeV}$                                                   |
| <sup>6</sup> Ignoring the electromagnetic contribution from $D^{*\pm} \rightarrow D^\pm \gamma$ . |        |      |                         |          |                                                                           |

### $D^*(2010)^\pm$ DECAY MODES

$D^*(2010)^-$  modes are charge conjugates of the modes below.

| 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) %                   |

NODE=M062DM;LINKAGE=AV  
NODE=M062DM;LINKAGE=A

NODE=M062EM

NODE=M062EM

NODE=M062EM;LINKAGE=P

NODE=M062W

NODE=M062W

OCCUR=3

OCCUR=2

NODE=M062W;LINKAGE=LE

NODE=M062225;NODE=M062

NODE=M062

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 (errat.) | 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  
REFID=46349  
REFID=45421  
REFID=45520  
REFID=45699  
REFID=44374  
REFID=44373  
REFID=42174  
REFID=43116  
REFID=43170  
REFID=41553  
REFID=41614  
REFID=40584  
REFID=40579  
REFID=11527  
REFID=22868  
REFID=22870  
REFID=22866  
REFID=22867  
REFID=22863  
REFID=11498  
REFID=22861  
REFID=22858  
REFID=11434  
REFID=11435

 **$D_0^*(2400)^0$** 

$$I(J^P) = \frac{1}{2}(0^+)$$

 $J^P = 0^+$  assignment favored (ABE 04D).

NODE=M178

NODE=M178

 **$D_0^*(2400)^0$  MASS**

NODE=M178M

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

**2300 ± 19 OUR AVERAGE**

[2318 ± 29 MeV OUR 2018 AVERAGE Scale factor = 1.7]

|                |      |        |           |                                   |
|----------------|------|--------|-----------|-----------------------------------|
| 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

NEW

NODE=M178M;LINKAGE=A

 **$D_0^*(2400)^0$  WIDTH**

NODE=M178W

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

**274 ± 40 OUR AVERAGE**

[267 ± 40 MeV OUR 2018 AVERAGE]

|               |      |        |           |                                   |
|---------------|------|--------|-----------|-----------------------------------|
| 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>2</sup> LINK | 04A FOCS | $\gamma$ A |
|---------------|------|-------------------|----------|------------|

<sup>2</sup> Possibly the feed-down from another state.

NODE=M178W

NEW

NODE=M178W;LINKAGE=A

 **$D_0^*(2400)^0$  DECAY MODES**

NODE=M178215;NODE=M178

| Mode                       | Fraction ( $\Gamma_i/\Gamma$ ) |
|----------------------------|--------------------------------|
| $\Gamma_1 \quad D^+ \pi^-$ | seen                           |

DESIG=1;OUR EVAL;→ UNCHECKED ←

 **$D_0^*(2400)^0$  REFERENCES**

NODE=M178

|        |      |               |                         |                 |
|--------|------|---------------|-------------------------|-----------------|
| 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.) |

REFID=52941  
REFID=50011  
REFID=49775

$$D_0^*(2400)^\pm$$

$$I(J^P) = \frac{1}{2}(0^+)$$

OMITTED FROM SUMMARY TABLE

 $J, P$  need confirmation.

NODE=M179

NODE=M179

 **$D_0^*(2400)^\pm$  MASS**

NODE=M179M

| VALUE (MeV)                                                                                                                                                                     | EVTS  | DOCUMENT ID       | TECN     | COMMENT                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------------|----------|-----------------------------------------|
| <b>2349 ± 7 OUR AVERAGE</b>                                                                                                                                                     |       |                   |          |                                         |
| [2351 ± 7 MeV OUR 2018 AVERAGE]                                                                                                                                                 |       |                   |          |                                         |
| 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 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> Modeling the $\pi^+ \pi^-$ $S$ -wave with the K-matrix formalism.                                                                                                  |       |                   |          |                                         |
| <sup>4</sup> Possibly the feed-down from another state.                                                                                                                         |       |                   |          |                                         |

NODE=M179M

NEW

OCCUR=2

NODE=M179M;LINKAGE=A

NODE=M179M;LINKAGE=B

NODE=M179M;LINKAGE=C

NODE=M179M;LINKAGE=D

 **$D_0^*(2400)^\pm$  WIDTH**

NODE=M179W

| VALUE (MeV)                                                                                                                                                                     | EVTS  | DOCUMENT ID       | TECN     | COMMENT                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------------|----------|-----------------------------------------|
| <b>221 ± 18 OUR AVERAGE</b>                                                                                                                                                     |       |                   |          |                                         |
| [230 ± 17 MeV OUR 2018 AVERAGE Scale factor = 1.1]                                                                                                                              |       |                   |          |                                         |
| 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 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> Modeling the $\pi^+ \pi^-$ $S$ -wave with the K-matrix formalism.                                                                                                  |       |                   |          |                                         |
| <sup>4</sup> Possibly the feed-down from another state.                                                                                                                         |       |                   |          |                                         |

NODE=M179W

NEW

OCCUR=2

NODE=M179W;LINKAGE=A

NODE=M179W;LINKAGE=B

NODE=M179W;LINKAGE=C

NODE=M179W;LINKAGE=D

 **$D_0^*(2400)^\pm$  DECAY MODES**

NODE=M179215;NODE=M179

| Mode                       | Fraction ( $\Gamma_i/\Gamma$ ) |
|----------------------------|--------------------------------|
| $\Gamma_1 \quad D^0 \pi^+$ | seen                           |

DESIG=1;OUR EVAL;→ UNCHECKED ←

 **$D_0^*(2400)^\pm$  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

**$D_1(2420)^0$** 
 $I(J^P) = \frac{1}{2}(1^+)$   
 $I$  needs confirmation.

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>2420.8 \pm 0.5</math> OUR FIT</b>                                    | Error includes scale factor of 1.3.                         |                           |           |                                            |
| <b><math>2420.5 \pm 0.6</math> OUR AVERAGE</b>                                | Error includes scale factor of 1.3. See the ideogram below. |                           |           |                                            |
| $2419.6 \pm 0.1 \pm 0.7$                                                      | 210k                                                        | AAIJ                      | 13CC LHCb | $pp \rightarrow D^{*+} \pi^- X$            |
| $2423.1 \pm 1.5^{+0.4}_{-1.0}$                                                | 2.7k                                                        | <sup>1</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>2</sup> ABE          | 04D BELL  | $B^- \rightarrow D^{*+} \pi^- \pi^-$       |
| $2421 \pm 1^{+1}_{-2} \pm 2$                                                  | 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>3</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>4</sup> ABREU        | 98M DLPH  | $e^+ e^-$                                  |

NODE=M097M

<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  $-1$ .

<sup>2</sup> Fit includes the contribution from  $D_1^*(2430)^0$ .

<sup>3</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.

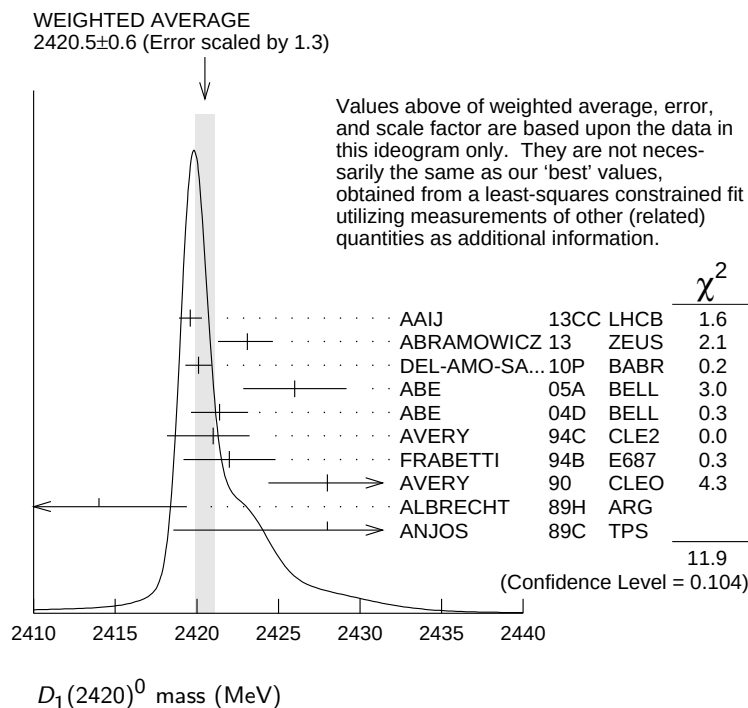
<sup>4</sup> No systematic error given.

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  $D^\pm, D^0, D_s^\pm, D^{*\pm}, D^{*0}, D_s^{*\pm}, D_1(2420)^0, D_2^{*}(2460)^0$ ,  
and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

NODE=M097DM

| VALUE                                                        | EVTS     | DOCUMENT ID | TECN    | COMMENT                                    |
|--------------------------------------------------------------|----------|-------------|---------|--------------------------------------------|
| <b>410.6±0.5 OUR FIT</b> Error includes scale factor of 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

### $D_1(2420)^0$ WIDTH

NODE=M097W

| VALUE (MeV)                                                                              | EVTS | DOCUMENT ID               | TECN      | COMMENT                                    |
|------------------------------------------------------------------------------------------|------|---------------------------|-----------|--------------------------------------------|
| <b>31.7± 2.5 OUR AVERAGE</b> Error includes scale factor of 3.5. See the ideogram below. |      |                           |           |                                            |
| 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>1</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>2</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   | $e^+ e^- \rightarrow D^{*+} \pi^- X$       |

NODE=M097W

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

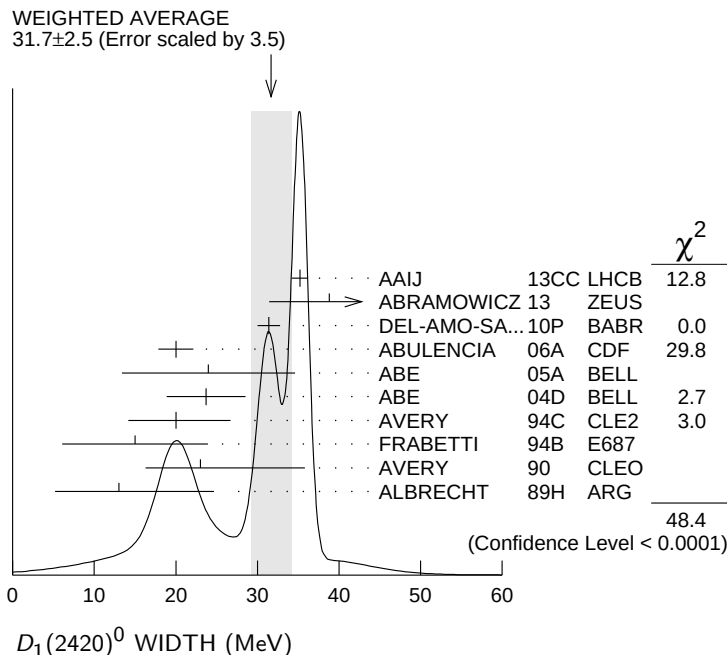
|                                           |          |          |         |                                       |
|-------------------------------------------|----------|----------|---------|---------------------------------------|
| 53.2± 7.2 <sup>+3.3</sup> <sub>-4.9</sub> | 3110±340 | CHEKANOV | 09 ZEUS | $e^\pm p \rightarrow D^{*+} \pi^- X$  |
| 58 ±14 ±10                                | 171      | ANJOS    | 89C TPS | $\gamma N \rightarrow D^{*+} \pi^- X$ |

<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.

<sup>2</sup> Fit includes the contribution from  $D_1^*(2430)^0$ .

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                           |
| $\Gamma_3$ $D^0 \rho^0$          |                                |

DESIG=1

DESIG=3;OUR EST;→ UNCHECKED ←

DESIG=4

|            |                       |          |
|------------|-----------------------|----------|
| $\Gamma_4$ | $D^0 f_0(500)$        |          |
| $\Gamma_5$ | $D_0^*(2400)^+ \pi^-$ |          |
| $\Gamma_6$ | $D^+ \pi^-$           | not seen |
| $\Gamma_7$ | $D^{*0} \pi^+ \pi^-$  | not seen |

DESIG=5  
DESIG=6  
DESIG=2;OUR EST;→ UNCHECKED ←  
DESIG=7;OUR EST;→ UNCHECKED ←

### $D_1(2420)^0$ BRANCHING RATIOS

$\Gamma(D^*(2010)^+ \pi^-) / \Gamma_{\text{total}}$   $\Gamma_1 / \Gamma$

| 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  | $\gamma N \rightarrow D^{*+} \pi^- X$ |

NODE=M097220

NODE=M097R1  
NODE=M097R1

$\Gamma(D^+ \pi^-) / \Gamma(D^*(2010)^+ \pi^-)$   $\Gamma_6 / \Gamma_1$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT                           |
|-------|-----|-------------|------|-----------------------------------|
| <0.24 | 90  | AVERY 90    | CLEO | $e^+ e^- \rightarrow D^+ \pi^- X$ |

NODE=M097R2  
NODE=M097R2

### $D_1(2420)^0$ POLARIZATION AMPLITUDE $A_{D_1}$

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  $D^* \rightarrow D \pi$ .

Unpolarized  $D_1$  decaying purely via  $D$ -wave is predicted to give  $A_{D_1} = 3$ .

NODE=M097PAH

NODE=M097PAH

| 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 ±0.6 ±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  | $e^+ e^- \rightarrow D^{*+} \pi^- X$    |

NODE=M097PAH

<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;LINKAGE=AR

NODE=M097PAH;LINKAGE=A  
NODE=M097PAH;LINKAGE=AU

NODE=M097PAH;LINKAGE=AV

### $D_1(2420)^0$ REFERENCES

|                   |      |               |                                  |                     |
|-------------------|------|---------------|----------------------------------|---------------------|
| 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. Ackerstaff <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=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  $D^{*0}(2007)\pi^+$ .  $J^P = 0^+$  ruled out.

NODE=M120

NODE=M120

NODE=M120M

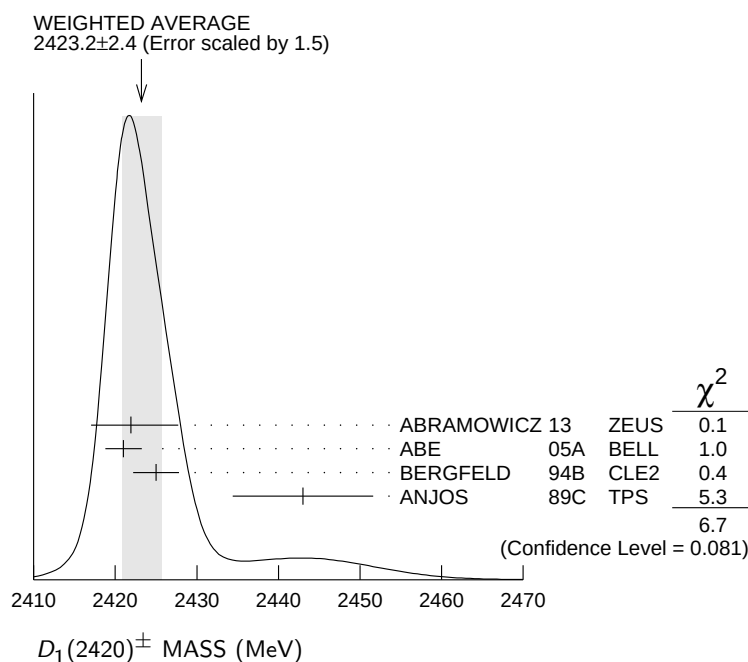
NODE=M120M

NODE=M120M;LINKAGE=AB

### $D_1(2420)^\pm$ MASS

| VALUE (MeV)                                    | EVTS | DOCUMENT ID                                                 | TECN     | COMMENT                                    |
|------------------------------------------------|------|-------------------------------------------------------------|----------|--------------------------------------------|
| <b><math>2423.2 \pm 2.4</math> OUR AVERAGE</b> |      | Error includes scale factor of 1.5. See the ideogram below. |          |                                            |
| $2421.9 \pm 4.7^{+3.4}_{-1.2}$                 | 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.



### $m_{D_1^*(2420)^\pm} - m_{D_1^*(2420)^0}$

| VALUE (MeV)                           | DOCUMENT ID | TECN     | COMMENT                             |
|---------------------------------------|-------------|----------|-------------------------------------|
| <b><math>4^{+2}_{-3} \pm 3</math></b> | BERGFELD    | 94B CLE2 | $e^+e^- \rightarrow \text{hadrons}$ |

NODE=M120DM

NODE=M120DM

### $D_1(2420)^\pm$ WIDTH

| VALUE (MeV)                              | EVTS | DOCUMENT ID | TECN     | COMMENT                                    |
|------------------------------------------|------|-------------|----------|--------------------------------------------|
| <b><math>25 \pm 6</math> OUR AVERAGE</b> |      |             |          |                                            |
| $21 \pm 5 \pm 8$                         | 124  | ABE         | 05A BELL | $\bar{B}^0 \rightarrow D^+\pi^+\pi^-\pi^-$ |
| $26^{+8}_{-7} \pm 4$                     | 146  | BERGFELD    | 94B CLE2 | $e^+e^- \rightarrow D^{*0}\pi^+ X$         |
| $41 \pm 19 \pm 8$                        | 190  | ANJOS       | 89C TPS  | $\gamma N \rightarrow D^0\pi^+ X^0$        |

NODE=M120W

NODE=M120W

**$D_1(2420)^\pm$  DECAY MODES**

$D_1^*(2420)^-$  modes are charge conjugates of modes below.

| Mode                             | Fraction ( $\Gamma_i/\Gamma$ ) |
|----------------------------------|--------------------------------|
| $\Gamma_1$ $D^*(2007)^0 \pi^+$   | seen                           |
| $\Gamma_2$ $D^+ \pi^+ \pi^-$     | seen                           |
| $\Gamma_3$ $D^+ \rho^0$          |                                |
| $\Gamma_4$ $D^+ f_0(500)$        |                                |
| $\Gamma_5$ $D_0^*(2400)^0 \pi^+$ |                                |
| $\Gamma_6$ $D^0 \pi^+$           | not seen                       |
| $\Gamma_7$ $D^{*+} \pi^+ \pi^-$  | not seen                       |

NODE=M120215;NODE=M120

NODE=M120

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**

| $\Gamma(D^*(2007)^0 \pi^+)/\Gamma_{\text{total}}$ | $\Gamma_1/\Gamma$                                     |
|---------------------------------------------------|-------------------------------------------------------|
| VALUE                                             | DOCUMENT ID TECN COMMENT                              |
| seen                                              | ANJOS 89C TPS $\gamma N \rightarrow D^0 \pi^+ \chi^0$ |

NODE=M120220

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  $A_{D_1}$** 

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  $D^* \rightarrow D \pi$ .

Unpolarized  $D_1$  decaying purely via  $D$ -wave is predicted to give  $A_{D_1} = 3$ .

NODE=M120PAH

NODE=M120PAH

|                                                                               |                                                                      |
|-------------------------------------------------------------------------------|----------------------------------------------------------------------|
| 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 $B^0 \rightarrow D_1^- \ell^+ \nu_\ell$ |

NODE=M120PAH

<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;LINKAGE=AU

 **$D_1(2420)^\pm$  REFERENCES**

|               |                |                             |                     |
|---------------|----------------|-----------------------------|---------------------|
| 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.) |

NODE=M120

REFID=54743

REFID=52929

REFID=50755

REFID=44099

REFID=40737



$D_1(2430)^0$ 

$$I(J^P) = \frac{1}{2}(1^+)$$

OMITTED FROM SUMMARY TABLE  
 $J = 1^+$  assignment favored (ABE 04D).

 $D_1(2430)^0$  MASS

| VALUE (MeV)                                                                   | DOCUMENT ID         | TECN     | COMMENT                                     |
|-------------------------------------------------------------------------------|---------------------|----------|---------------------------------------------|
| <b><math>2427 \pm 26 \pm 25</math></b>                                        | ABE                 | 04D BELL | $B^- \rightarrow D^{*+} \pi^- \pi^-$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                     |          |                                             |
| $2477 \pm 28$                                                                 | <sup>1</sup> AUBERT | 06L BABR | $\bar{B}^0 \rightarrow D^{*+} \omega \pi^-$ |
| <sup>1</sup> Systematic errors not estimated.                                 |                     |          |                                             |

 $D_1(2430)^0$  WIDTH

| VALUE (MeV)                                                                   | DOCUMENT ID         | TECN     | COMMENT                                     |
|-------------------------------------------------------------------------------|---------------------|----------|---------------------------------------------|
| <b><math>384^{+107}_{-75} \pm 74</math></b>                                   | 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>2</sup> Systematic errors not estimated.                                 |                     |          |                                             |

 $D_1(2430)^0$  DECAY MODES

| Mode                               | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------------------------------|--------------------------------|
| $\Gamma_1 \quad D^*(2010)^+ \pi^-$ | seen                           |

 $D_1(2430)^0$  REFERENCES

|        |     |               |                         |                 |
|--------|-----|---------------|-------------------------|-----------------|
| 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.) |

 $D_2^*(2460)^0$ 

$$I(J^P) = \frac{1}{2}(2^+)$$

$J^P = 2^+$  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.

 $D_2^*(2460)^0$  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.

| VALUE (MeV)                                      | EVTS                                                        | DOCUMENT ID               | TECN      | COMMENT                                |
|--------------------------------------------------|-------------------------------------------------------------|---------------------------|-----------|----------------------------------------|
| <b><math>2460.7 \pm 0.4</math> OUR FIT</b>       | Error includes scale factor of 3.1.                         |                           |           |                                        |
| <b><math>2460.56 \pm 0.35</math> OUR AVERAGE</b> | Error includes scale factor of 2.6. See the ideogram below. |                           |           |                                        |
| $2463.7 \pm 0.4 \pm 0.7$                         | 28k                                                         | <sup>1</sup> AAIJ         | 16AH LHCb | $B^- \rightarrow D^+ \pi^- \pi^-$      |
| $2460.4 \pm 0.4 \pm 1.2$                         | 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>2</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>3</sup> ABE          | 04D BELL  | $B^- \rightarrow D^+ \pi^- \pi^-$      |
| $2464.5 \pm 1.1 \pm 1.9$                         | 5.8k                                                        | <sup>3</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   | $\gamma N \rightarrow D^+ \pi^- X$     |

NODE=M180

NODE=M180

NODE=M180M

NODE=M180M

NODE=M180M;LINKAGE=AU

NODE=M180W

NODE=M180W

NODE=M180W;LINKAGE=AU

NODE=M180215;NODE=M180

DESIG=1;OUR EVAL;→ UNCHECKED ←

NODE=M180

REFID=51140  
REFID=50011

NODE=M119

NODE=M119

NODE=M119M

NODE=M119M

NODE=M119M

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>4</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>5</sup> ABREU    | 98M | DLPH | $e^{+} e^{-}$                               |
| 2466 $\pm 7$                      | 1    | ASRATYAN              | 95  | BEBC | 53,40 $\nu(\bar{\nu}) \rightarrow pX, dX$   |

<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 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  $D_0^{*}(2400)^0$ .

<sup>4</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>5</sup> No systematic error given.

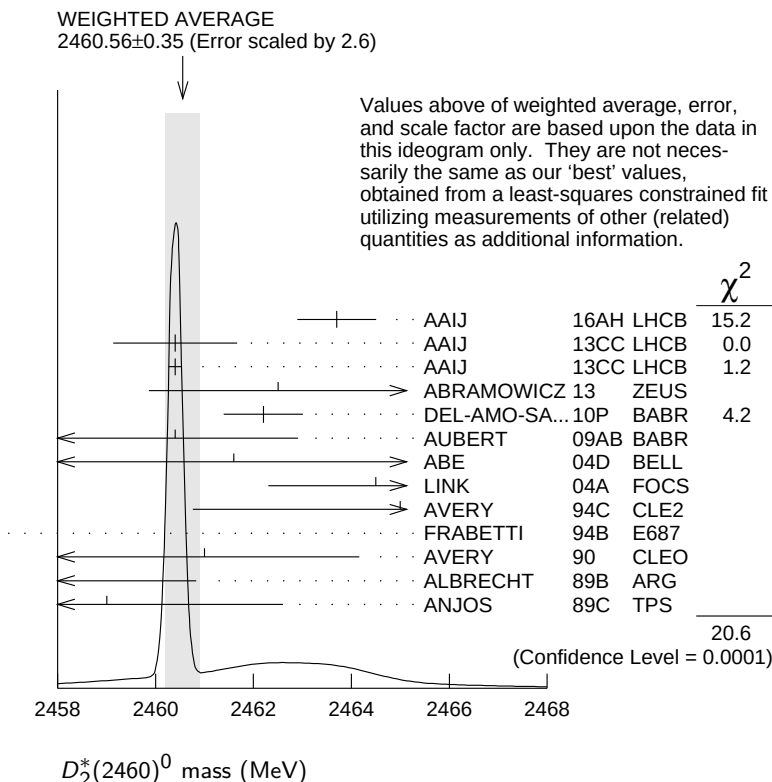
NODE=M119M;LINKAGE=B

NODE=M119M;LINKAGE=AR

NODE=M119M;LINKAGE=LI

NODE=M119M;LINKAGE=CH

NODE=M119M;LINKAGE=K



$$m_{D_2^{*0}} - m_{D^{+}}$$

NODE=M119DM

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

| VALUE (MeV)                                        | EVTS                                | DOCUMENT ID | TECN | COMMENT                                         |
|----------------------------------------------------|-------------------------------------|-------------|------|-------------------------------------------------|
| <b>591.0<math>\pm</math>0.4 OUR FIT</b>            | Error includes scale factor of 2.9. |             |      |                                                 |
| <b>593.9<math>\pm</math>0.6<math>\pm</math>0.5</b> | 20k                                 | ABULENCIA   | 06A  | CDF 1900 $p\bar{p} \rightarrow D^{+} \pi^{-} X$ |

NODE=M119DM

$$m_{D_2^{*0}} - m_{D^{*+}}$$

NODE=M119DM2

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

| VALUE (MeV)                                                | EVTS                                | DOCUMENT ID | TECN | COMMENT                                         |
|------------------------------------------------------------|-------------------------------------|-------------|------|-------------------------------------------------|
| <b>450.4<math>\pm</math>0.4 OUR FIT</b>                    | Error includes scale factor of 2.9. |             |      |                                                 |
| <b>458.8<math>\pm</math>3.7<math>^{+1.2}_{-1.3}</math></b> | 1560 $\pm$ 230                      | CHEKANOV    | 09   | ZEUS $e^{\pm} p \rightarrow D^{(*)+} \pi^{-} X$ |

NODE=M119DM2

**$D_2^*(2460)^0$  WIDTH**

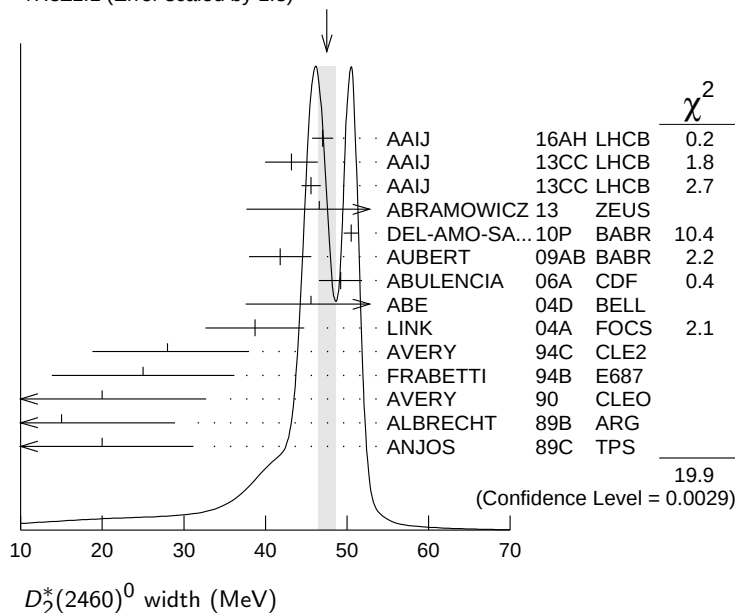
| VALUE (MeV)                                                     | EVTS | DOCUMENT ID                                                 | TECN      | COMMENT                                 |
|-----------------------------------------------------------------|------|-------------------------------------------------------------|-----------|-----------------------------------------|
| <b>47.5± 1.1 OUR AVERAGE</b>                                    |      | Error includes scale factor of 1.8. See the ideogram below. |           |                                         |
| 47.0± 0.8± 1.0                                                  | 28k  | <sup>6</sup> AAIJ                                           | 16AH LHCB | $B^- \rightarrow D^+ \pi^- \pi^-$       |
| 43.2± 1.2± 3.0                                                  | 82k  | AAIJ                                                        | 13CC LHCB | $pp \rightarrow D^{*+} \pi^- X$         |
| 45.6± 0.4± 1.1                                                  | 675k | AAIJ                                                        | 13CC LHCB | $pp \rightarrow D^+ \pi^- X$            |
| 46.6± 8.1 <sup>+</sup> <sub>7</sub> <sup>+</sup> <sub>3.8</sub> | 2.3k | <sup>7</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 $p\bar{p} \rightarrow D^+ \pi^- X$ |
| 45.6± 4.4± 6.7                                                  |      | <sup>8</sup> ABE                                            | 04D BELL  | $B^- \rightarrow D^+ \pi^- \pi^-$       |
| 38.7± 5.3± 2.9                                                  | 5.8k | <sup>8</sup> LINK                                           | 04A FOCS  | $\gamma A$                              |
| 28 <sup>+</sup> <sub>7</sub> <sup>+</sup> <sub>6</sub>          | 486  | AVERY                                                       | 94C CLE2  | $e^+ e^- \rightarrow D^+ \pi^- X$       |
| 25 ±10 ± 5                                                      | 128  | FRABETTI                                                    | 94B E687  | $\gamma Be \rightarrow D^+ \pi^- X$     |
| 20 <sup>+</sup> <sub>12</sub> <sup>+</sup> <sub>10</sub>        | 440  | AVERY                                                       | 90 CLEO   | $e^+ e^- \rightarrow D^{*+} \pi^- X$    |
| 15 <sup>+</sup> <sub>10</sub> <sup>+</sup> <sub>10</sub>        | 337  | ALBRECHT                                                    | 89B ARG   | $e^+ e^- \rightarrow D^+ \pi^- X$       |
| 20 ±10 ± 5                                                      | 153  | ANJOS                                                       | 89C TPS   | $\gamma N \rightarrow D^+ \pi^- X$      |

<sup>6</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>7</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>8</sup> Fit includes the contribution from  $D_0^*(2400)^0$ .

WEIGHTED AVERAGE  
47.5±1.1 (Error scaled by 1.8)

 **$D_2^*(2460)^0$  DECAY MODES**

$\bar{D}_2^*(2460)^0$  modes are charge conjugates of modes below.

| 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                       |

NODE=M119W

NODE=M119W

OCCUR=3

OCCUR=2

NODE=M119W;LINKAGE=D

NODE=M119W;LINKAGE=AR

NODE=M119W;LINKAGE=LI

NODE=M119215;NODE=M119

NODE=M119

CLUMP=A;DESIG=1

DESIG=2

DESIG=3;OUR EST;→ UNCHECKED ←

DESIG=4;OUR EST;→ UNCHECKED ←

**$D_2^*(2460)^0$  BRANCHING RATIOS**

| $\Gamma(D^+\pi^-)/\Gamma_{\text{total}}$ |      | $\Gamma_1/\Gamma$ |           |                                  |
|------------------------------------------|------|-------------------|-----------|----------------------------------|
| VALUE                                    | EVTS | DOCUMENT ID       | TECN      | COMMENT                          |
| 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=M119220

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       | <sup>9</sup> 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 <sup>+0.5</sup> <sub>-0.6</sub>                                     | 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  | $e^+e^- \rightarrow D^*\pi^-X$       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |            |                           |          |                                      |
| 1.9 ± 0.5                                                                     |            | ABE                       | 04D BELL | $B^- \rightarrow D^{(*)+}\pi^-\pi^-$ |

NODE=M119R3  
NODE=M119R3

<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  $-1$ .

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 | <sup>10</sup> AUBERT           | 09Y BABR | $B^+ \rightarrow D_2^0 \ell^+ \nu_\ell$ |

NODE=M119R01  
NODE=M119R01

<sup>10</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=M119R01;LINKAGE=AU

 **$D_2^*(2460)^0$  POLARIZATION AMPLITUDE  $A_{D_2}$** 

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

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 | <sup>11</sup> 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 <sup>+0.49</sup> <sub>-0.38</sub>                                       |      | <sup>12</sup> AVERY        | 94C CLE2 | $e^+e^- \rightarrow D^{*+}\pi^-X$    |

NODE=M119PAM

<sup>11</sup> From the combined fit of the  $M(D^+\pi^-)$  and  $M(D^{*+}\pi^-)$  distributions.

NODE=M119PAM;LINKAGE=AB

<sup>12</sup> Systematic uncertainties not estimated.

NODE=M119PAM;LINKAGE=AV

 **$D_2^*(2460)^0$  REFERENCES**

|               |      |                |                                  |                     |
|---------------|------|----------------|----------------------------------|---------------------|
| 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.)      |
| 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.) |

NODE=M119

REFID=57518  
REFID=55581  
REFID=54743  
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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 | $pp \rightarrow D^0 \pi^+ X$               |
| 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

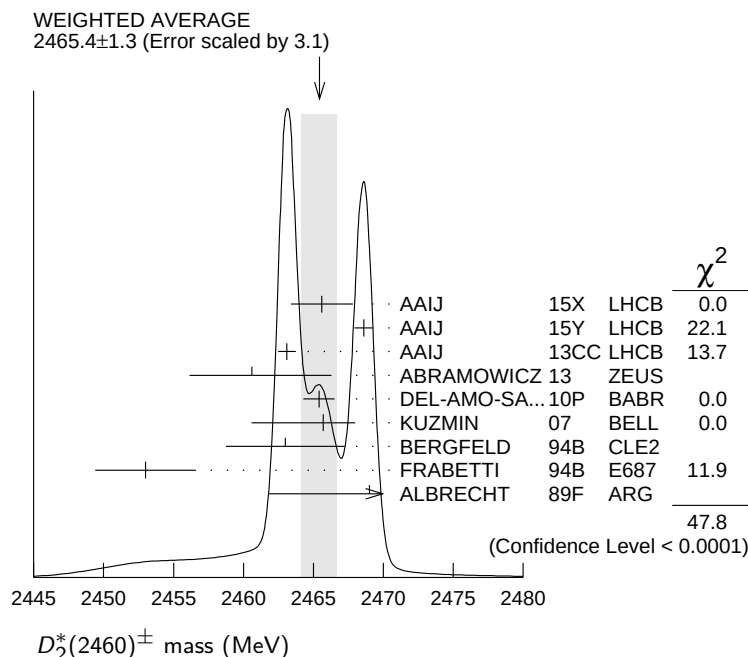
NODE=M150M;LINKAGE=B

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             |
| 1.2±0.4 OUR AVERAGE                    |      |             |      |                     |

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(2550)<sup>0</sup>

$I(J^P) = \frac{1}{2}(?^?)$

NODE=M198

OMITTED FROM SUMMARY TABLE

Unnatural parity according to the helicity analysis of DEL-AMO-SANCHEZ 10P and AAIJ 13CC. DEL-AMO-SANCHEZ 10P suggests  $J^P = 0^-$ .

NODE=M198

D(2550)<sup>0</sup> MASS

NODE=M198M

| VALUE (MeV)     | EVTS        | DOCUMENT ID                         | TECN      | COMMENT                              |
|-----------------|-------------|-------------------------------------|-----------|--------------------------------------|
| 2564 ±20        | OUR AVERAGE | Error includes scale factor of 3.9. |           |                                      |
| 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      | $e^+ e^- \rightarrow D^{*+} \pi^- X$ |

NODE=M198M

D(2550)<sup>0</sup> WIDTH

NODE=M198W

| VALUE (MeV)     | EVTS        | DOCUMENT ID      | TECN      | COMMENT                              |
|-----------------|-------------|------------------|-----------|--------------------------------------|
| 135 ±17         | OUR AVERAGE |                  |           |                                      |
| 177.5±17.8±46.0 | 60k         | AAIJ             | 13CC LHCB | $pp \rightarrow D^{*+} \pi^- X$      |
| 130 ±12 ±13     | 34k         | DEL-AMO-SA...10P | BABR      | $e^+ e^- \rightarrow D^{*+} \pi^- X$ |

NODE=M198W

D(2550)<sup>0</sup> DECAY MODES

NODE=M198215;NODE=M198

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------|--------------------------------|
| $\Gamma_1 \quad D^{*+} \pi^-$ | seen                           |

DESIG=1;OUR EVAL;→ UNCHECKED ←

D(2550)<sup>0</sup> POLARIZATION AMPLITUDE A<sub>D<sub>J</sub></sub>

NODE=M198PAM

A polarization amplitude A<sub>D<sub>J</sub></sub> is a parameter that depends on the initial polarization of the D<sub>J</sub>. For D<sub>J</sub> 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<sub>J</sub> rest frame between the two pions emitted in the D<sub>J</sub> → D\*<sup>+</sup>π and D\*<sup>+</sup> → Dπ decays.

NODE=M198PAM

| VALUE                                                                         | EVTS | DOCUMENT ID       | TECN      | COMMENT                         |
|-------------------------------------------------------------------------------|------|-------------------|-----------|---------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                   |           |                                 |
| 4.2±1.3                                                                       | 60k  | <sup>1</sup> AAIJ | 13CC LHCB | $pp \rightarrow D^{*+} \pi^- X$ |
| <sup>1</sup> Systematic uncertainty not estimated.                            |      |                   |           |                                 |

NODE=M198PAM

NODE=M198PAM;LINKAGE=A

D(2550)<sup>0</sup> REFERENCES

NODE=M198

|                   |        |               |                                  |                 |
|-------------------|--------|---------------|----------------------------------|-----------------|
| 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.) |

REFID=55581  
REFID=53534

**$D_J^*(2600)$** 

$$I(J^P) = \frac{1}{2}(?)^2$$

OMITTED FROM SUMMARY TABLE  
was  $D(2600)$

$J^P$  consistent with natural parity (DEL-AMO-SANCHEZ 10P,  
AAIJ 13CC).

NODE=M199

NODE=M199

 **$D_J^*(2600)$  MASS**

NODE=M199M

NODE=M199M

| VALUE (MeV)                 | EVTS | DOCUMENT ID                                                 | TECN      | CHG | COMMENT                           |
|-----------------------------|------|-------------------------------------------------------------|-----------|-----|-----------------------------------|
| <b>2623 ±12 OUR AVERAGE</b> |      | Error includes scale factor of 4.8. See the ideogram below. |           |     |                                   |
| 2681.1 ± 5.6 ± 14.0         | 28k  | <sup>1</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>2</sup> DEL-AMO-SA...10P                               | BABR      | +   | $e^+ e^- \rightarrow D^0 \pi^+ X$ |

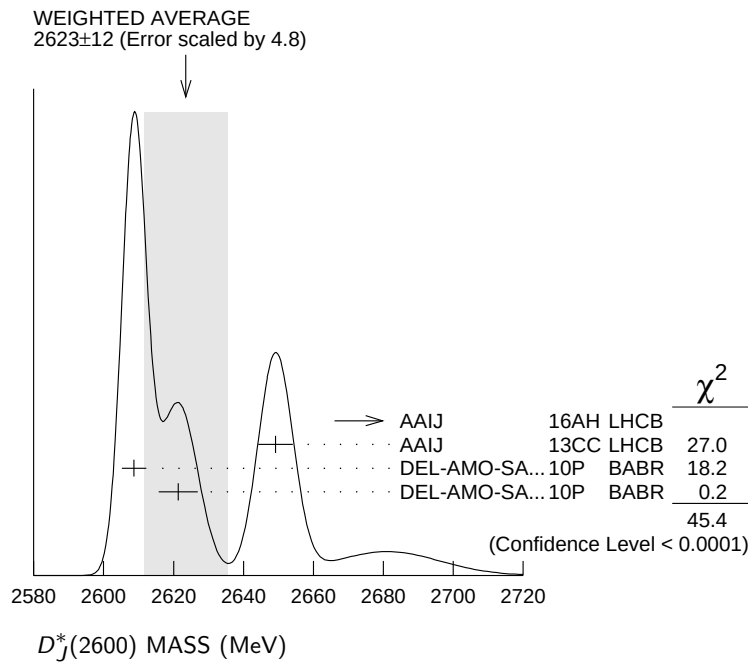
OCCUR=2

NODE=M199M;LINKAGE=A

<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> At a fixed width of 93 MeV.

NODE=M199M;LINKAGE=DE

 **$D_J^*(2600)$  WIDTH**

NODE=M199W

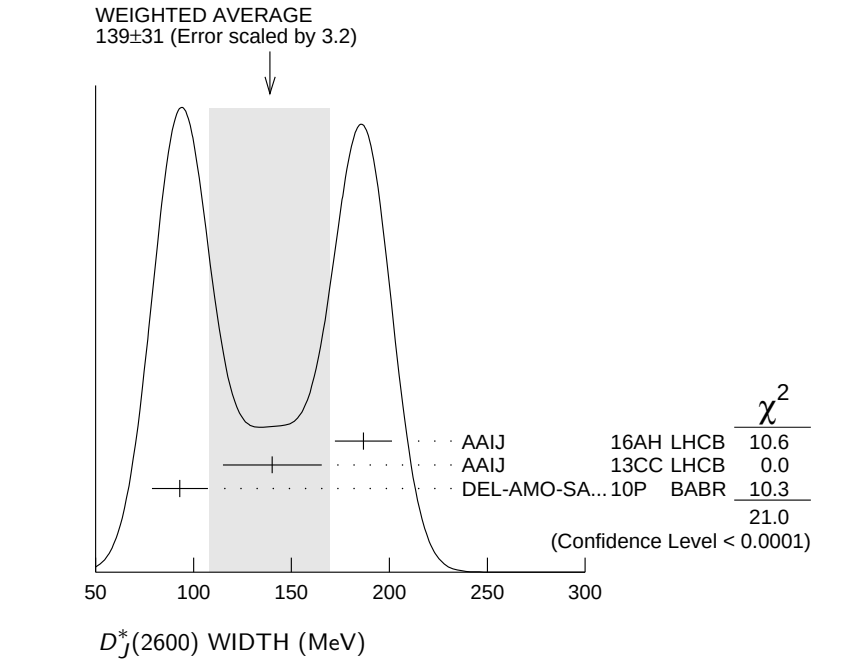
NODE=M199W

| VALUE (MeV)                | EVTS | DOCUMENT ID                                                 | TECN      | COMMENT                           |
|----------------------------|------|-------------------------------------------------------------|-----------|-----------------------------------|
| <b>139 ±31 OUR AVERAGE</b> |      | Error includes scale factor of 3.2. See the ideogram below. |           |                                   |
| 186.7 ± 8.5 ± 11.9         | 28k  | <sup>3</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>3</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;LINKAGE=A





**$D_J^*(2600)$  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 ←

**$D_J^*(2600)$  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

**$D_J^*(2600)$  REFERENCES**

|                                |                                  |                 |
|--------------------------------|----------------------------------|-----------------|
| 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=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.

 **$D^*(2640)^\pm$  MASS**

| VALUE (MeV)                          | EVTS        | DOCUMENT ID | TECN     | COMMENT                                    |
|--------------------------------------|-------------|-------------|----------|--------------------------------------------|
| <b><math>2637 \pm 2 \pm 6</math></b> | $66 \pm 14$ | ABREU       | 98M DLPH | $e^+ e^- \rightarrow D^{*+} \pi^+ \pi^- X$ |

 **$D^*(2640)^\pm$  WIDTH**

| 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**

$D^*(2640)^-$  modes are charge conjugates of modes below.

| Mode                                     | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------------------------------------|--------------------------------|
| $\Gamma_1 \quad D^*(2010)^+ \pi^+ \pi^-$ | seen                           |

 **$D^*(2640)^\pm$  REFERENCES**

|              |             |                           |                  |
|--------------|-------------|---------------------------|------------------|
| 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.) |

 **$D(2740)^0$** 

$$I(J^P) = \frac{1}{2}(??)$$

OMITTED FROM SUMMARY TABLE

$J^P$  consistent with unnatural parity (AAIJ 13CC).

 **$D(2740)^0$  MASS**

| VALUE (MeV)                                 | EVTS | DOCUMENT ID | TECN      | COMMENT                         |
|---------------------------------------------|------|-------------|-----------|---------------------------------|
| <b><math>2737.0 \pm 3.5 \pm 11.2</math></b> | 7.7k | AAIJ        | 13CC LHCB | $pp \rightarrow D^{*+} \pi^- X$ |

 **$D(2740)^0$  WIDTH**

| VALUE (MeV)                                | EVTS | DOCUMENT ID | TECN      | COMMENT                         |
|--------------------------------------------|------|-------------|-----------|---------------------------------|
| <b><math>73.2 \pm 13.4 \pm 25.0</math></b> | 7.7k | AAIJ        | 13CC LHCB | $pp \rightarrow D^{*+} \pi^- X$ |

 **$D(2740)^0$  DECAY MODES**

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------|--------------------------------|
| $\Gamma_1 \quad D^{*+} \pi^-$ | seen                           |

 **$D(2740)^0$  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> AAII | 13CC LHCB | $pp \rightarrow D^{*+} \pi^- X$ |

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

NODE=M158

NODE=M158

NODE=M158M

NODE=M158M

NODE=M158W

NODE=M158W

NODE=M158215;NODE=M158

NODE=M158

DESIG=1;OUR EST;→ UNCHECKED ←

NODE=M158

REFID=52733  
REFID=48296  
REFID=46315

NODE=M228

NODE=M228

NODE=M228M

NODE=M228M

NODE=M228W

NODE=M228W

NODE=M228215;NODE=M228

DESIG=1;OUR EVAL;→ UNCHECKED ←

NODE=M228PAM

NODE=M228PAM

NODE=M228PAM

NODE=M228PAM;LINKAGE=A

**$D(2740)^0$  REFERENCES**

AAIJ

13CC JHEP 1309 145

R. Aaij *et al.*

(LHCb Collab.)

NODE=M228

REFID=55581

NODE=M203

 **$D_3^*(2750)$** 

$$I(J^P) = \frac{1}{2}(3^-)$$

OMITTED FROM SUMMARY TABLE

$J^P$  determined by AAIJ 15Y from the Dalitz plot analysis of  $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$  decays.  $J^P$  consistent with natural parity (AAIJ 13CC).

NODE=M203

 **$D_3^*(2750)$  MASS**

NODE=M203M

NODE=M203M

| VALUE (MeV)                     | EVTS  | DOCUMENT ID                                                 | TECN      | CHG | COMMENT                                 |
|---------------------------------|-------|-------------------------------------------------------------|-----------|-----|-----------------------------------------|
| <b>2763.5 ± 3.4 OUR AVERAGE</b> |       | Error includes scale factor of 2.2. See the ideogram below. |           |     |                                         |
| 2775.5 ± 4.5 ± 6.5              | 28k   | <sup>1</sup> AAIJ                                           | 16AH LHCb |     | $B^- \rightarrow D^+ \pi^- \pi^-$       |
| 2798 ± 7 ± 7                    |       | <sup>2</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>3</sup> DEL-AMO-SA...10P                               | BABR      | 0   | $e^+ e^- \rightarrow D^{*+} \pi^- X$    |
| 2763.3 ± 2.3 ± 2.3              | 11.3k | <sup>3</sup> DEL-AMO-SA...10P                               | BABR      | 0   | $e^+ e^- \rightarrow D^+ \pi^- X$       |
| 2769.7 ± 3.8 ± 1.5              | 5.7k  | <sup>3,4</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>5</sup> AAIJ | 15Y LHCb |  | $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$ |
|----------------|--|-------------------|----------|--|-----------------------------------------|

<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, 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> Modeling the  $\pi^+ \pi^-$  S-wave with the Isobar formalism.

<sup>3</sup> The states observed in the  $D^* \pi$  and  $D \pi$  final states are not necessarily the same.

<sup>4</sup> At a fixed width of 60.9 MeV.

<sup>5</sup> Modeling the  $\pi^+ \pi^-$  S-wave with the K-matrix formalism.

OCCUR=2

OCCUR=3

OCCUR=2

OCCUR=3

OCCUR=2

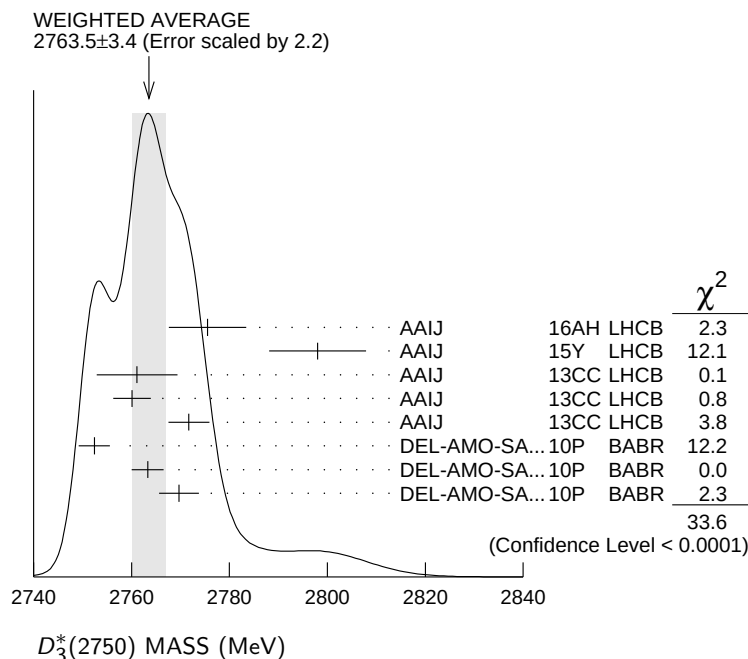
NODE=M203M;LINKAGE=C

NODE=M203M;LINKAGE=A

NODE=M203M;LINKAGE=DE

NODE=M203M;LINKAGE=DA

NODE=M203M;LINKAGE=B

 **$D_3^*(2750)$  WIDTH**

NODE=M203W

NODE=M203W

| VALUE (MeV)               | EVTS | DOCUMENT ID       | TECN      | CHG | COMMENT                                 |
|---------------------------|------|-------------------|-----------|-----|-----------------------------------------|
| <b>66 ± 5 OUR AVERAGE</b> |      |                   |           |     |                                         |
| 95.3 ± 9.6 ± 34.0         | 28k  | <sup>6</sup> AAIJ | 16AH LHCb |     | $B^- \rightarrow D^+ \pi^- \pi^-$       |
| 105 ± 18 ± 24             |      | <sup>7</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   | $pp \rightarrow D^+ \pi^- X$            |

OCCUR=2

|                                                                                                                                                                                                                                                                                                 |       |                               |             |                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------------------------|-------------|-----------------------------------------|
| 66.7 ± 6.6 ± 10.5                                                                                                                                                                                                                                                                               | 20k   | AAIJ                          | 13CC LHCb + | $pp \rightarrow D^0 \pi^+ X$            |
| 71 ± 6 ± 11                                                                                                                                                                                                                                                                                     | 23.5k | <sup>8</sup> DEL-AMO-SA...10P | BABR        | $e^+ e^- \rightarrow D^{*+} \pi^- X$    |
| 60.9 ± 5.1 ± 3.6                                                                                                                                                                                                                                                                                | 11.3k | <sup>8</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>9</sup> AAIJ             | 15Y LHCb    | $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$ |
| <sup>6</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>7</sup> Modeling the $\pi^+ \pi^-$ S-wave with the Isobar formalism.                                                                                                                                                                                                                       |       |                               |             |                                         |
| <sup>8</sup> The states observed in the $D^* \pi$ and $D \pi$ final states are not necessarily the same.                                                                                                                                                                                        |       |                               |             |                                         |
| <sup>9</sup> Modeling the $\pi^+ \pi^-$ S-wave with the K-matrix formalism.                                                                                                                                                                                                                     |       |                               |             |                                         |

OCCUR=4

OCCUR=2

OCCUR=2

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                           |

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>10</sup> DEL-AMO-SA...10P | BABR | $e^+ e^- \rightarrow D^{(*)+} \pi^- X$ |                     |

<sup>10</sup> The states observed in the  $D^* \pi$  and  $D \pi$  final states are not necessarily the same.

NODE=M203220

NODE=M203R01

NODE=M203R01

NODE=M203R01;LINKAGE=DE

 **$D_3^*(2750)$  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                              |
|--------------|-------|--------------------------------|------|--------------------------------------|
| −0.33 ± 0.28 | 23.5k | <sup>11</sup> DEL-AMO-SA...10P | BABR | $e^+ e^- \rightarrow D^{*+} \pi^- X$ |

<sup>11</sup> Systematic uncertainties not estimated. The states observed in the  $D^* \pi$  and  $D \pi$  final states are not necessarily the same.

NODE=M203PAM

NODE=M203PAM;LINKAGE=DE

 **$D_3^*(2750)$  REFERENCES**

|                   |                    |                                  |                   |
|-------------------|--------------------|----------------------------------|-------------------|
| 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.)   |

NODE=M203

REFID=57518

REFID=56609

REFID=55581

REFID=53534

**$D(3000)^0$** 

$$I(J^P) = \frac{1}{2}(?)$$

OMITTED FROM SUMMARY TABLE

Both natural- and unnatural-parity components observed depending on the decay mode (AAIJ 13CC).

NODE=M229

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 | $pp \rightarrow D^+ \pi^- X$      |

OCCUR=2

NODE=M229M;LINKAGE=D

<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.

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 | $pp \rightarrow D^+ \pi^- X$      |

OCCUR=2

NODE=M229W;LINKAGE=D

<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.

NODE=M229W;LINKAGE=A

NODE=M229W;LINKAGE=C

NODE=M229W;LINKAGE=B

 **$D(3000)^0$  DECAY MODES**

NODE=M229215;NODE=M229

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------|--------------------------------|
| $\Gamma_1 \quad D^{*+} \pi^-$ | 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 <i>et al.</i> | (LHCb Collab.) |
| AAIJ | 13CC JHEP 1309 145 | R. Aaij <i>et al.</i> | (LHCb Collab.) |

REFID=57518

REFID=55581

# CHARMED, STRANGE MESONS ( $C = S = \pm 1$ )

$$D_s^+ = c\bar{s}, D_s^- = \bar{c}s, \text{ similarly for } D_s^{*\pm}$$

$$D_s^{*\pm}$$

$$I(J^P) = 0(?)$$

$J^P$  is natural, width and decay modes consistent with  $1^-$ .

## $D_s^{*\pm}$ MASS

The fit includes  $D_s^\pm, D_s^0, D_s^{*\pm}, D^{*0}, D_s^{*\pm}, D_1(2420)^0, D_2^*(2460)^0$ , 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  $D_s^\pm, D_s^0, D_s^{*\pm}, D^{*0}, D_s^{*\pm}, D_1(2420)^0, D_2^*(2460)^0$ , 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 $e^+e^- \rightarrow \text{hadrons}$    |
| • • • 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 $E_{\text{cm}}^{\text{ee}} = 10.2 \text{ GeV}$ |
| • • • 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 $^{+0.020}_{-0.018}$ ± 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}</math> ± 1.0</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>                                                     |      |                       |          |                                                        |
| [2317.7 ± 0.6 MeV OUR 2018 FIT Scale factor = 1.1]                            |      |                       |          |                                                        |
| <b>2318.0±0.7 OUR AVERAGE</b>                                                 |      |                       |          |                                                        |
| [2318.0 ± 1.0 MeV OUR 2018 AVERAGE Scale factor = 1.4]                        |      |                       |          |                                                        |
| 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

NEW

NEW

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>                                                                                  |      |                         |          |               |
| [349.4 ± 0.6 MeV OUR 2018 FIT Scale factor = 1.1]                                                         |      |                         |          |               |
| <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  | BESSION                 | 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 $e^+e^-$ |
| <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

NEW

OCCUR=2

NODE=M172DM;LINKAGE=K3

NODE=M172DM;LINKAGE=A1

NODE=M172DM;LINKAGE=C1

NODE=M172DM;LINKAGE=A2

NODE=M172DM;LINKAGE=C2

### $D_{s0}^*(2317)^\pm$ WIDTH

| VALUE (MeV) | CL% | EVTS | DOCUMENT ID | TECN     | COMMENT                                 |
|-------------|-----|------|-------------|----------|-----------------------------------------|
| < 3.8       | 95  | 3180 | AUBERT      | 06P BABR | 10.6 $e^+e^- \rightarrow D_s^+ \pi^0 X$ |

NODE=M172W

NODE=M172W



• • • 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 | BESSION | 03  | CLE2 | 10.6 $e^+e^-$ |

### $D_{s0}^*(2317)^\pm$ DECAY MODES

$D_{s0}^*(2317)^-$  modes are charge conjugates of modes below.

| 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                       |                  |

NODE=M172215;NODE=M172

NODE=M172

DESIG=1

DESIG=2

DESIG=3

DESIG=4

DESIG=5

DESIG=6

DESIG=7;OUR EVAL;→ UNCHECKED ←

### $D_{s0}^*(2317)^\pm$ BRANCHING RATIOS

| $\Gamma(D_s^+ \pi^0)/\Gamma_{\text{total}}$ | $\Gamma_1/\Gamma$                                      |
|---------------------------------------------|--------------------------------------------------------|
| VALUE                                       | EVTS                                                   |
| $1.00^{+0.00+0.00}_{-0.14-0.14}$            | 47                                                     |
| DOCUMENT ID                                 | TECN                                                   |
| ABLIKIM                                     | 18J BES3                                               |
| COMMENT                                     | 4.6 $e^+e^- \rightarrow D_s^{*\pm} D_{s0}^*(2317)^\mp$ |

NODE=M172220

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%                 |
| <0.05                                      | 90                  |
| DOCUMENT ID                                | TECN                |
| MIKAMI                                     | 04 BELL             |
| COMMENT                                    | 10.6 $e^+e^-$       |

NODE=M172R5  
NODE=M172R5

• • • 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  $e^+e^-$

| $\Gamma(D_s^*(2112)^+ \gamma)/\Gamma(D_s^+ \pi^0)$ | $\Gamma_3/\Gamma_1$ |
|----------------------------------------------------|---------------------|
| VALUE                                              | CL%                 |
| <0.059                                             | 90                  |
| DOCUMENT ID                                        | TECN                |
| BESSION                                            | 03 CLE2             |
| COMMENT                                            | 10.6 $e^+e^-$       |

NODE=M172R6  
NODE=M172R6

• • • 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  $e^+e^-$

| $\Gamma(D_s^+ \gamma \gamma)/\Gamma(D_s^+ \pi^0)$ | $\Gamma_4/\Gamma_1$ |
|---------------------------------------------------|---------------------|
| VALUE                                             | CL%                 |
| <0.18                                             | 95                  |
| DOCUMENT ID                                       | TECN                |
| AUBERT                                            | 06P BABR            |
| COMMENT                                           | 10.6 $e^+e^-$       |

NODE=M172R7  
NODE=M172R7

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

not seen AUBERT 03G BABR 10.6  $e^+e^-$

| $\Gamma(D_s^*(2112)^+ \pi^0)/\Gamma(D_s^+ \pi^0)$ | $\Gamma_5/\Gamma_1$ |
|---------------------------------------------------|---------------------|
| VALUE                                             | CL%                 |
| <0.11                                             | 90                  |
| DOCUMENT ID                                       | TECN                |
| BESSION                                           | 03 CLE2             |
| COMMENT                                           | 10.6 $e^+e^-$       |

NODE=M172R8  
NODE=M172R8

| $\Gamma(D_s^+ \pi^+ \pi^-)/\Gamma(D_s^+ \pi^0)$ | $\Gamma_6/\Gamma_1$ |
|-------------------------------------------------|---------------------|
| VALUE                                           | CL%                 |
| <0.004                                          | 90                  |
| DOCUMENT ID                                     | TECN                |
| MIKAMI                                          | 04 BELL             |
| COMMENT                                         | 10.6 $e^+e^-$       |

NODE=M172R9  
NODE=M172R9

• • • 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  $e^+e^-$

$\Gamma(D_s^+ \pi^0 \pi^0) / \Gamma(D_s^+ \pi^0)$ 
 $\Gamma_7 / \Gamma_1$ 

| VALUE | CL% | DOCUMENT ID | TECN     | COMMENT        |
|-------|-----|-------------|----------|----------------|
| <0.25 | 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>  | (BES III 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

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

NODE=M173M

| VALUE (MeV)                                                                   | EVTS                                | DOCUMENT ID | TECN     | COMMENT                                         |
|-------------------------------------------------------------------------------|-------------------------------------|-------------|----------|-------------------------------------------------|
| <b>2459.5±0.6 OUR FIT</b>                                                     | Error includes scale factor of 1.1. |             |          |                                                 |
| <b>2459.6±0.9 OUR AVERAGE</b>                                                 | Error includes scale factor of 1.3. |             |          |                                                 |
| 2460.1±0.2±0.8                                                                | 1                                   | AUBERT      | 06P BABR | 10.6 $e^+ e^-$                                  |
| 2458.0±1.0±1.0                                                                | 195                                 | AUBERT      | 04E BABR | 10.6 $e^+ e^-$                                  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                     |             |          |                                                 |
| 2459.5±1.2±3.7                                                                | 920                                 | AUBERT      | 06P BABR | 10.6 $e^+ e^- \rightarrow D_s^+ \gamma X$       |
| 2458.6±1.0±2.5                                                                | 560                                 | AUBERT      | 06P BABR | 10.6 $e^+ e^- \rightarrow D_s^+ \pi^0 \gamma X$ |
| 2460.2±0.2±0.8                                                                | 123                                 | AUBERT      | 06P BABR | 10.6 $e^+ e^- \rightarrow D_s^+ \pi^+ \pi^- X$  |
| 2458.9±1.5                                                                    | 112                                 | 2 AUBERT,B  | 04S BABR | $B \rightarrow D_{s1}(2460)^+ \bar{D}^{(*)}$    |
| 2461.1±1.6                                                                    | 139                                 | 3 AUBERT,B  | 04S BABR | $B \rightarrow D_{s1}(2460)^+ \bar{D}^{(*)}$    |
| 2456.5±1.3±1.3                                                                | 126                                 | 4,5 MIKAMI  | 04 BELL  | 10.6 $e^+ e^-$                                  |
| 2459.5±1.3±2.0                                                                | 152                                 | 6,7 MIKAMI  | 04 BELL  | 10.6 $e^+ e^-$                                  |
| 2459.9±0.9±1.6                                                                | 60                                  | 6,7 MIKAMI  | 04 BELL  | 10.6 $e^+ e^-$                                  |
| 2459.2±1.6±2.0                                                                | 57                                  | KROKOVNY    | 03B BELL | 10.6 $e^+ e^-$                                  |

NODE=M173M

OCCUR=2

OCCUR=3

OCCUR=4

OCCUR=2

OCCUR=2

OCCUR=3

<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.

<sup>2</sup> Systematic errors not evaluated. From the decay to  $D_s^{*+} \pi^0$ .

<sup>3</sup> Systematic errors not evaluated. From the decay to  $D_s^+ \gamma$ .

<sup>4</sup> Not independent of the corresponding  $m_{D_{s1}(2460)^\pm} - m_{D_s^{*\pm}}$ .

<sup>5</sup> Using  $m_{D_s^{*+}} = 2112.4 \pm 0.7$  MeV.

<sup>6</sup> Not independent of the corresponding  $m_{D_{s1}(2460)^\pm} - m_{D_s^\pm}$ .

<sup>7</sup> Using  $m_{D_s^+} = 1968.5 \pm 0.6$  MeV.

NODE=M173M;LINKAGE=UB

NODE=M173M;LINKAGE=AU

NODE=M173M;LINKAGE=AB

NODE=M173M;LINKAGE=B1

NODE=M173M;LINKAGE=B2

NODE=M173M;LINKAGE=B3

NODE=M173M;LINKAGE=B4

### $m_{D_{s1}(2460)^\pm} - m_{D_s^{*\pm}}$

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=M173MD

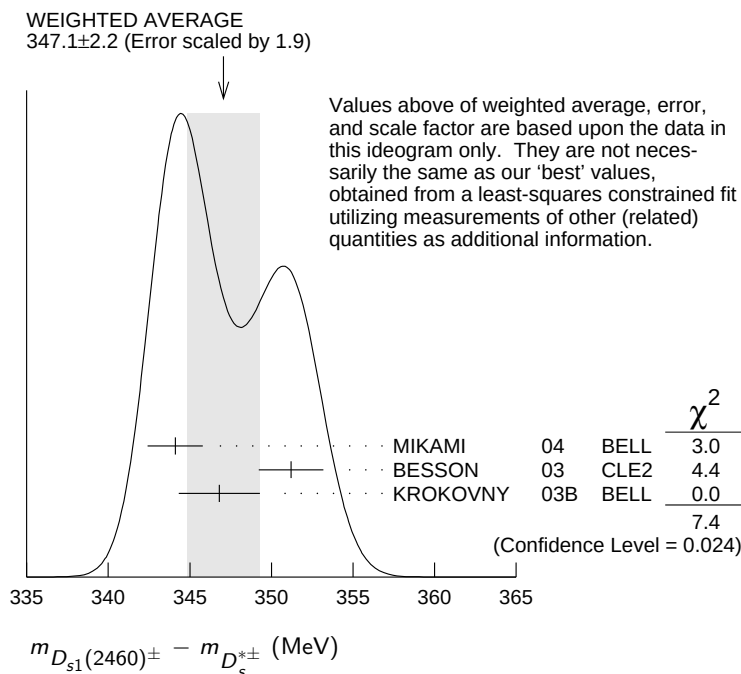
NODE=M173MD

| VALUE (MeV)                  | EVTS                                                        | DOCUMENT ID | TECN     | COMMENT        |
|------------------------------|-------------------------------------------------------------|-------------|----------|----------------|
| <b>347.3±0.7 OUR FIT</b>     | Error includes scale factor of 1.2.                         |             |          |                |
| <b>347.1±2.2 OUR AVERAGE</b> | Error includes scale factor of 1.9. See the ideogram below. |             |          |                |
| 344.1±1.3±1.1                | 126                                                         | MIKAMI      | 04 BELL  | 10.6 $e^+ e^-$ |
| 351.2±1.7±1.0                | 41                                                          | BESSION     | 03 CLE2  | 10.6 $e^+ e^-$ |
| 346.8±1.6±1.9                | 57                                                          | 8 KROKOVNY  | 03B BELL | 10.6 $e^+ e^-$ |

NODE=M173MD

<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  $D^{\pm}$ ,  $D^0$ ,  $D_s^{\pm}$ ,  $D_s^{*\pm}$ ,  $D_s^{*0}$ ,  $D_s^{*\pm}$ ,  $D_1(2420)^0$ ,  $D_2^*(2460)^0$ , and  $D_{s1}(2536)^{\pm}$  mass and mass difference measurements.

NODE=M173DM

NODE=M173DM

| VALUE (MeV)                  | EVTs                                | DOCUMENT ID          | TECN    | COMMENT       |
|------------------------------|-------------------------------------|----------------------|---------|---------------|
| <b>491.2±0.6 OUR FIT</b>     | Error includes scale factor of 1.1. |                      |         |               |
| <b>491.3±1.4 OUR AVERAGE</b> |                                     |                      |         |               |
| 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                                      |
|-------------------------------------------------------------------------------|-----|------|-------------|----------|----------------------------------------------|
| <b>&lt; 3.5</b>                                                               | 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

|            |                           |                          |
|------------|---------------------------|--------------------------|
| $\Gamma_5$ | $D_{s0}^*(2317)^+ \gamma$ | $(3.7^{+5.0}_{-2.4}) \%$ |
| $\Gamma_6$ | $D_s^+ \pi^0$             |                          |
| $\Gamma_7$ | $D_s^+ \pi^0 \pi^0$       |                          |
| $\Gamma_8$ | $D_s^+ \gamma \gamma$     |                          |

DESIG=5

DESIG=7

DESIG=8

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

$$\Gamma(D_{s0}^*(2317)^+\gamma)/\Gamma(D_s^{*+}\pi^0)$$

$$\Gamma_5/\Gamma_1$$

| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT                                 |
|-------------------------------------------------------------------------------|-----|-------------|------|-----------------------------------------|
| <b>&lt;0.22</b>                                                               | 95  | AUBERT      | 04E  | BABR 10.6 e <sup>+</sup> e <sup>-</sup> |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                         |
| <0.58                                                                         | 90  | BESSION     | 03   | CLE2 10.6 e <sup>+</sup> e <sup>-</sup> |

NODE=M173R5  
NODE=M173R5

$$\Gamma(D_s^{*+}\pi^0)/[\Gamma(D_s^{*+}\pi^0) + \Gamma(D_{s0}^*(2317)^+\gamma)]$$

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

| 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 <sup>+</sup> e <sup>-</sup> |

NODE=M173R7  
NODE=M173R7

$$\Gamma(D_s^+\gamma)/[\Gamma(D_s^{*+}\pi^0) + \Gamma(D_{s0}^*(2317)^+\gamma)]$$

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

| 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 <sup>+</sup> e <sup>-</sup> |

NODE=M173R8  
NODE=M173R8

$$\Gamma(D_s^+\pi^+\pi^-)/[\Gamma(D_s^{*+}\pi^0) + \Gamma(D_{s0}^*(2317)^+\gamma)]$$

$$\Gamma_3/(\Gamma_1+\Gamma_5)$$

| 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 <sup>+</sup> e <sup>-</sup> |

NODE=M173R9  
NODE=M173R9

$$\Gamma(D_s^{*+}\gamma)/[\Gamma(D_s^{*+}\pi^0) + \Gamma(D_{s0}^*(2317)^+\gamma)]$$

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

| VALUE           | CL% | DOCUMENT ID | TECN | COMMENT                                 |
|-----------------|-----|-------------|------|-----------------------------------------|
| <b>&lt;0.24</b> | 95  | AUBERT      | 06P  | BABR 10.6 e <sup>+</sup> e <sup>-</sup> |

NODE=M173R10  
NODE=M173R10

$$\Gamma(D_{s0}^*(2317)^+\gamma)/[\Gamma(D_s^{*+}\pi^0) + \Gamma(D_{s0}^*(2317)^+\gamma)]$$

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

| VALUE           | CL% | DOCUMENT ID | TECN | COMMENT                                 |
|-----------------|-----|-------------|------|-----------------------------------------|
| <b>&lt;0.25</b> | 95  | AUBERT      | 06P  | BABR 10.6 e <sup>+</sup> e <sup>-</sup> |

NODE=M173R11  
NODE=M173R11

$$\Gamma(D_s^+\pi^0)/[\Gamma(D_s^{*+}\pi^0) + \Gamma(D_{s0}^*(2317)^+\gamma)]$$

$$\Gamma_6/(\Gamma_1+\Gamma_5)$$

| VALUE            | CL% | DOCUMENT ID | TECN | COMMENT                                 |
|------------------|-----|-------------|------|-----------------------------------------|
| <b>&lt;0.042</b> | 95  | AUBERT      | 06P  | BABR 10.6 e <sup>+</sup> e <sup>-</sup> |

NODE=M173R12  
NODE=M173R12

$$\Gamma(D_s^+\pi^0\pi^0)/[\Gamma(D_s^{*+}\pi^0) + \Gamma(D_{s0}^*(2317)^+\gamma)]$$

$$\Gamma_7/(\Gamma_1+\Gamma_5)$$

| VALUE           | CL% | DOCUMENT ID | TECN | COMMENT                                 |
|-----------------|-----|-------------|------|-----------------------------------------|
| <b>&lt;0.68</b> | 95  | AUBERT      | 06P  | BABR 10.6 e <sup>+</sup> e <sup>-</sup> |

NODE=M173R13  
NODE=M173R13

$$\Gamma(D_s^+\gamma\gamma)/[\Gamma(D_s^{*+}\pi^0) + \Gamma(D_{s0}^*(2317)^+\gamma)]$$

$$\Gamma_8/(\Gamma_1+\Gamma_5)$$

| VALUE           | CL% | DOCUMENT ID | TECN | COMMENT                                 |
|-----------------|-----|-------------|------|-----------------------------------------|
| <b>&lt;0.33</b> | 95  | AUBERT      | 06P  | BABR 10.6 e <sup>+</sup> e <sup>-</sup> |

NODE=M173R14  
NODE=M173R14

### $D_{s1}(2460)^\pm$ REFERENCES

NODE=M173

|          |     |               |                           |                 |
|----------|-----|---------------|---------------------------|-----------------|
| AUBERT   | 06N | PR D74 031103 | B. Aubert <i>et al.</i>   | (BABAR 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.) |
| 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.) |

REFID=51142  
REFID=51144  
REFID=49747  
REFID=50195  
REFID=49629  
REFID=49583  
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>                                                   |      |                        |          |                                                            |
| [2535.10 ± 0.06 MeV OUR 2018 FIT]                                             |      |                        |          |                                                            |
| <b>2535.21±0.28 OUR AVERAGE</b>                                               |      |                        |          |                                                            |
| [2535.18 ± 0.24 MeV OUR 2018 AVERAGE]                                         |      |                        |          |                                                            |
| 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

NEW

NEW

OCCUR=2

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

<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  $D^{*} K$ .

 **$m_{D_{s1}(2536)^{\pm}} = m_{D_s^{*}(2111)}$** 

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

$$m_{D_{s1}(2536)^\pm} - m_{D^*(2010)^\pm}$$

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

NODE=M121DN

| VALUE (MeV)                                                                                                                               | EVTS     | DOCUMENT ID        | TECN     | COMMENT                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------|----------|--------------------|----------|-----------------------------------------------------|
| <b>524.85±0.04 OUR FIT</b>                                                                                                                |          |                    |          |                                                     |
| [524.84 ± 0.04 MeV OUR 2018 FIT]                                                                                                          |          |                    |          |                                                     |
| <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  | $e^\pm p \rightarrow D^{*+} K_S^0 X$ ,              |
| 525.3 ± 0.6 ± 0.1                                                                                                                         | 41       | HEISTER            | 02B ALEP | $D^{*0} K^+ X$<br>$e^+e^- \rightarrow D^{*+} K^0 X$ |
| 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  
NEW

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. [528.25 ± 0.05 MeV OUR 2018 FIT Scale factor = 1.1] |             |          |                                   |
| <b>528.68±0.28 OUR AVERAGE</b>     |                                                                                         |             |          |                                   |
| [528.1 ± 1.5 MeV OUR 2018 AVERAGE] |                                                                                         |             |          |                                   |
| 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  
NEW

NEW

OCCUR=2

$$D_{s1}(2536)^\pm \text{ WIDTH}$$

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 | $\gamma \text{Be} \rightarrow D^{*+} K^0 X$ , |
|                                                                               |          |                       |          | $D^{*0} K^+ X$                                |
| < 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

$$D_{s1}(2536)^+ \text{ DECAY MODES}$$

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          |
| $\Gamma_2$ $(D^*(2010)^+ K^0)_{S\text{-wave}}$ | 0.61 ± 0.09                    | DESIG=7          |
| $\Gamma_3$ $(D^*(2010)^+ K^0)_{D\text{-wave}}$ |                                | DESIG=9          |
| $\Gamma_4$ $D^+ \pi^- K^+$                     | 0.028±0.005                    | DESIG=8          |

|            |                     |                     |     |
|------------|---------------------|---------------------|-----|
| $\Gamma_5$ | $D^*(2007)^0 K^+$   | <b>DEFINED AS 1</b> |     |
| $\Gamma_6$ | $D^+ K^0$           | $<0.34$             | 90% |
| $\Gamma_7$ | $D^0 K^+$           | $<0.12$             | 90% |
| $\Gamma_8$ | $D_s^{*+} \gamma$   | possibly seen       |     |
| $\Gamma_9$ | $D_s^+ \pi^+ \pi^-$ | seen                |     |

DESIG=4

DESIG=2

DESIG=5

DESIG=3

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    | $e^\pm p \rightarrow D^{*+} K_S^0 X,$<br>$D^{*0} K^+ X$ |
| 1.32±0.47±0.23                                    | 92       | <sup>14</sup> HEISTER    | 02B  | ALEP    | $e^+ e^- \rightarrow D^{*+} K^0 X,$<br>$D^{*0} K^+ X$   |
| 1.9 $^{+1.1}_{-0.9}$ ±0.4                         | 35       | <sup>14</sup> ACKERSTAFF | 97W  | OPAL    | $e^+ e^- \rightarrow D^{*0} K^+ X,$<br>$D^{*+} K^0 X$   |
| 1.1 ±0.3                                          |          | ALEXANDER                | 93   | CLEO    | $e^+ e^- \rightarrow D^{*0} K^+ X, D^{*+} K^0 X$        |
| 1.4 ±0.3 ±0.2                                     |          | <sup>15</sup> ALBRECHT   | 92R  | ARG     | 10.4 $e^+ e^- \rightarrow D^{*0} K^+ X, D^{*+} K^0 X$   |

NODE=M121R6

NODE=M121R6

<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;LINKAGE=6A

NODE=M121R6;LINKAGE=A

| $\Gamma((D^*(2010)^+ K^0)_{S=wave})/\Gamma(D^*(2010)^+ K^0)$ |      |             |      |         | $\Gamma_2/\Gamma_1$                     |
|--------------------------------------------------------------|------|-------------|------|---------|-----------------------------------------|
| 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**

|            |     |                |                             |                     |
|------------|-----|----------------|-----------------------------|---------------------|
| ABLIKIM    | 19P | CP C43 031001  | M. Ablikim <i>et al.</i>    | (BES III Collab.)   |
| AUSHEV     | 11  | PR D83 051102  | T. Aushev <i>et al.</i>     | (BELLE Collab.)     |
| LEES       | 11B | PR D83 072003  | J.P. Lees <i>et al.</i>     | (BABAR Collab.)     |
| ABAZOV     | 09G | PRL 102 051801 | V.M. Abazov <i>et al.</i>   | (D0 Collab.)        |
| CHEKANOV   | 09  | EPJ C60 25     | S. Chekanov <i>et al.</i>   | (ZEUS Collab.)      |
| AUBERT     | 08B | PR D77 011102  | B. Aubert <i>et al.</i>     | (BABAR Collab.)     |
| BALAGURA   | 08  | PR D77 032001  | V. Balagura <i>et al.</i>   | (BELLE Collab.)     |
| AUBERT     | 06P | PR D74 032007  | B. Aubert <i>et al.</i>     | (BABAR Collab.)     |
| PDG        | 06  | JP G33 1       | W.-M. Yao <i>et al.</i>     | (PDG Collab.)       |
| HEISTER    | 02B | PL B526 34     | A. Heister <i>et al.</i>    | (ALEPH Collab.)     |
| ACKERSTAFF | 97W | ZPHY C76 425   | K. Ackerstaff <i>et al.</i> | (OPAL Collab.)      |
| ASRATYAN   | 94  | ZPHY C61 563   | A.E. Asratyan <i>et al.</i> | (BIRM, BELG, CERN+) |
| FRABETTI   | 94B | PRL 72 324     | P.L. Frabetti <i>et al.</i> | (FNAL E687 Collab.) |
| ALEXANDER  | 93  | PL B303 377    | J. Alexander <i>et al.</i>  | (CLEO Collab.)      |
| ALBRECHT   | 92R | PL B297 425    | H. Albrecht <i>et al.</i>   | (ARGUS Collab.)     |
| AVERY      | 90  | PR D41 774     | P. Avery, D. Besson         | (CLEO Collab.)      |
| ALBRECHT   | 89E | PL B230 162    | H. Albrecht <i>et al.</i>   | (ARGUS Collab.)     |
| ASRATYAN   | 88  | ZPHY C40 483   | A.E. Asratyan <i>et al.</i> | (ITEP, SERP)        |

NODE=M121

REFID=59617  
REFID=16505  
REFID=16773  
REFID=52652  
REFID=52733  
REFID=52120  
REFID=52133  
REFID=51144  
REFID=51004  
REFID=48562  
REFID=45788  
REFID=43667  
REFID=43687  
REFID=43316  
REFID=43179  
REFID=41013  
REFID=40914  
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

**$D_{s2}^*(2573)$  MASS**

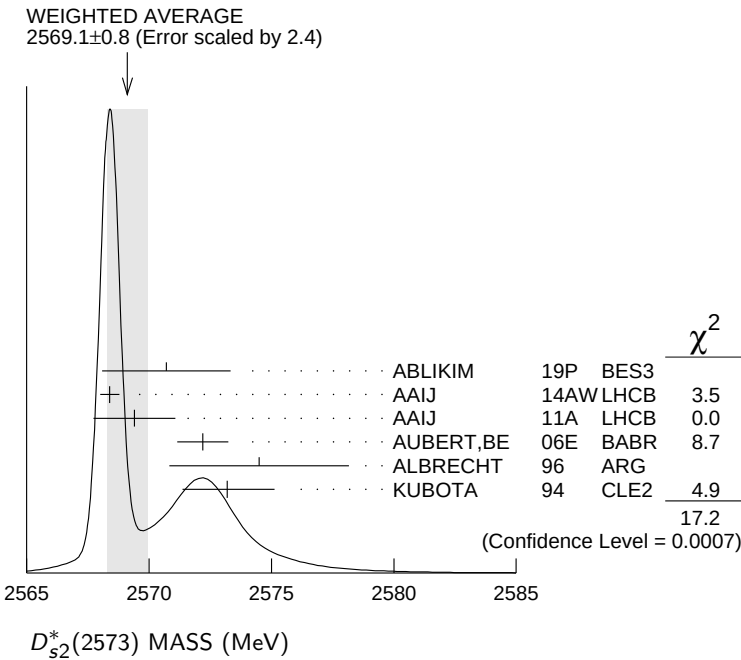
NODE=M148M

NODE=M148M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                                                 | TECN      | COMMENT                                          |
|-------------------------------------------------------------------------------|------|-------------------------------------------------------------|-----------|--------------------------------------------------|
| <b>2569.1 <math>\pm</math>0.8 OUR AVERAGE</b>                                 |      | Error includes scale factor of 2.4. See the ideogram below. |           |                                                  |
| 2570.7 $\pm$ 2.0 $\pm$ 1.7                                                    | 62   | <sup>1</sup> ABLIKIM                                        | 19P BES3  | 4.6 $e^+e^- \rightarrow D_s^+ \bar{D}^0 K^-$     |
| 2568.39 $\pm$ 0.29 $\pm$ 0.26                                                 |      | AAIJ                                                        | 14AW LHCB | $B_s^0 \rightarrow \bar{D}^0 K^- \pi^+$          |
| 2569.4 $\pm$ 1.6 $\pm$ 0.5                                                    | 82   | AAIJ                                                        | 11A LHCB  | $B_s \rightarrow D_{s2}^*(2573) \mu \bar{\nu} X$ |
| 2572.2 $\pm$ 0.3 $\pm$ 1.0                                                    |      | AUBERT,BE                                                   | 06E BABR  | $e^+e^- \rightarrow DKX$                         |
| 2574.5 $\pm$ 3.3 $\pm$ 1.6                                                    |      | ALBRECHT                                                    | 96 ARG    | $e^+e^- \rightarrow D^0 K^+ X$                   |
| 2573.2 $^{+1.7}_{-1.6}$ $\pm$ 0.9                                             | 217  | KUBOTA                                                      | 94 CLE2   | $e^+e^- \sim 10.5$ GeV                           |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                                             |           |                                                  |
| 2570.0 $\pm$ 4.3                                                              | 25   | <sup>2</sup> EVDOKIMOV                                      | 04 SELX   | 600 $\Sigma^- A \rightarrow D^0 K^+ X$           |
| 2568.6 $\pm$ 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  $m_{D^0} = 1864.5 \pm 0.5$  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

| 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

NODE=M148DM;LINKAGE=EV

 $D^*_{s2}(2573)$  WIDTH

NODE=M148W

| VALUE (MeV)                                                                   | EVTs | DOCUMENT ID            | TECN      | COMMENT                                          |
|-------------------------------------------------------------------------------|------|------------------------|-----------|--------------------------------------------------|
| <b>16.9±0.7 OUR AVERAGE</b>                                                   |      |                        |           |                                                  |
| [16.9 ± 0.8 MeV OUR 2018 AVERAGE]                                             |      |                        |           |                                                  |
| 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 | $B^0_s \rightarrow \bar{D}^0 K^- \pi^+$          |
| 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 $^{+5}_{-4}$ ±3                                                            | 217  | KUBOTA                 | 94 CLE2   | $e^+e^- \sim 10.5$ 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

NEW

NODE=M148W;LINKAGE=A  
NODE=M148W;LINKAGE=EV $D^*_{s2}(2573)^+$  DECAY MODES

NODE=M148215;NODE=M148

 $D^*_{s2}(2573)^-$  modes are charge conjugates of the modes below.

NODE=M148

| Mode                         | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------------------------|--------------------------------|
| $\Gamma_1$ $D^0 K^+$         | seen                           |
| $\Gamma_2$ $D^*(2007)^0 K^+$ | not seen                       |

DESIG=1

DESIG=2;OUR EVAL;→ UNCHECKED ←

 $D^*_{s2}(2573)^+$  BRANCHING RATIOS

NODE=M148220

| $\Gamma(D^0 K^+)/\Gamma_{\text{total}}$   |      |             |         | $\Gamma_1/\Gamma$   |                        |
|-------------------------------------------|------|-------------|---------|---------------------|------------------------|
| VALUE                                     | EVTs | DOCUMENT ID | TECN    | CHG                 | COMMENT                |
| <b>seen</b>                               | 217  | KUBOTA      | 94 CLE2 | ±                   | $e^+e^- \sim 10.5$ GeV |
| $\Gamma(D^*(2007)^0 K^+)/\Gamma(D^0 K^+)$ |      |             |         | $\Gamma_2/\Gamma_1$ |                        |
| VALUE                                     | CL%  | DOCUMENT ID | TECN    | CHG                 | COMMENT                |
| <b>&lt;0.33</b>                           | 90   | KUBOTA      | 94 CLE2 | +                   | $e^+e^- \sim 10.5$ GeV |

NODE=M148R2  
NODE=M148R2NODE=M148R1  
NODE=M148R1 $D^*_{s2}(2573)$  REFERENCES

NODE=M148

|           |      |                |                              |                   |
|-----------|------|----------------|------------------------------|-------------------|
| ABLIKIM   | 19P  | CP C43 031001  | M. Ablikim <i>et al.</i>     | (BES III 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.)    |

REFID=59617  
REFID=56105  
REFID=16665  
REFID=51512  
REFID=50337  
REFID=48562  
REFID=44631  
REFID=43781

$$D_{s1}^*(2700)^\pm$$

$$I(J^P) = 0(1^-)$$

NODE=M182

### $D_{s1}^*(2700)^+$ MASS

NODE=M182M

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

NODE=M182M

**2708.3<sup>+4.0</sup><sub>-3.4</sub> OUR AVERAGE**

|        |                              |                                    |                     |           |                                     |
|--------|------------------------------|------------------------------------|---------------------|-----------|-------------------------------------|
| 2699   | <sup>+14</sup> <sub>-7</sub> |                                    | <sup>1</sup> LEES   | 15C BABR  | $B \rightarrow D D^0 K^+$           |
| 2709.2 | $\pm 1.9 \pm 4.5$            | 52k                                | <sup>2</sup> AAIJ   | 12AU LHCB | $pp \rightarrow (DK)^+ X$ at 7 TeV  |
| 2710   | $\pm 2$                      | <sup>+12</sup> <sub>-7</sub> 10.4k | <sup>3</sup> AUBERT | 09AR BABR | $e^+ e^- \rightarrow D^{(*)} K X$   |
| 2708   | $\pm 9$                      | <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 | $\pm 8$ | <sup>+13</sup> <sub>-3</sub> | LEES                   | 15C BABR | $B^0 \rightarrow D^- D^0 K^+$       |
| 2707 | $\pm 8$ | $\pm 8$                      | LEES                   | 15C BABR | $B^+ \rightarrow \bar{D}^0 D^0 K^+$ |
| 2688 | $\pm 4$ | $\pm 3$                      | <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 |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

NODE=M182W

**120  $\pm 11$  OUR AVERAGE**

|       |                               |                                     |                     |           |                                     |
|-------|-------------------------------|-------------------------------------|---------------------|-----------|-------------------------------------|
| 127   | <sup>+24</sup> <sub>-19</sub> |                                     | <sup>5</sup> LEES   | 15C BABR  | $B \rightarrow D D^0 K^+$           |
| 115.8 | $\pm 7.3 \pm 12.1$            | 52k                                 | <sup>6</sup> AAIJ   | 12AU LHCB | $pp \rightarrow (DK)^+ X$ at 7 TeV  |
| 149   | $\pm 7$                       | <sup>+39</sup> <sub>-52</sub> 10.4k | <sup>7</sup> AUBERT | 09AR BABR | $e^+ e^- \rightarrow D^{(*)} K X$   |
| 108   | $\pm 23$                      | <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 | $\pm 24$ | <sup>+22</sup> <sub>-14</sub> | LEES                   | 15C BABR | $B^0 \rightarrow D^- D^0 K^+$       |
| 113 | $\pm 21$ | <sup>+20</sup> <sub>-16</sub> | LEES                   | 15C BABR | $B^+ \rightarrow \bar{D}^0 D^0 K^+$ |
| 112 | $\pm 7$  | $\pm 36$                      | <sup>8</sup> AUBERT,BE | 06E BABR | 10.6 $e^+ e^- \rightarrow DKX$      |

OCCUR=2

OCCUR=3

<sup>5</sup> From a combined analysis of  $B^0 \rightarrow D^- D^0 K^+$  and  $B^+ \rightarrow \bar{D}^0 D^0 K^+$ .

<sup>6</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>7</sup> From simultaneous fits to the two  $DK$  mass spectra and to the total  $D^* K$  mass spectrum.

<sup>8</sup> Superseded by AUBERT 09AR.

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**

| $\Gamma(D^*K)/\Gamma(DK)$                                                                          |       |                     |           | $\Gamma_4/\Gamma_1$            |
|----------------------------------------------------------------------------------------------------|-------|---------------------|-----------|--------------------------------|
| VALUE                                                                                              | EVTS  | DOCUMENT ID         | TECN      | COMMENT                        |
| <b><math>0.91 \pm 0.13 \pm 0.12</math></b>                                                         | 10.4k | <sup>9</sup> AUBERT | 09AR BABR | $e^+e^- \rightarrow D^{(*)}KX$ |
| <sup>9</sup> From the average of the corresponding ratios with $D^{(*)0}K^+$ and $D^{(*)+}K_S^0$ . |       |                     |           |                                |

NODE=M182225

NODE=M182R01  
NODE=M182R01

NODE=M182R01;LINKAGE=AU

| $\Gamma(D^{*0}K^+)/\Gamma(D^0K^+)$                                                      |      |                      |           | $\Gamma_5/\Gamma_2$            |
|-----------------------------------------------------------------------------------------|------|----------------------|-----------|--------------------------------|
| VALUE                                                                                   | EVTS | DOCUMENT ID          | TECN      | COMMENT                        |
| $0.88 \pm 0.14 \pm 0.14$                                                                | 7716 | <sup>10</sup> AUBERT | 09AR BABR | $e^+e^- \rightarrow D^{(*)}KX$ |
| <sup>10</sup> From the $D^{*0}K^+$ and $D^0K^+$ , where $D^{*0} \rightarrow D^0\pi^0$ . |      |                      |           |                                |

NODE=M182R02  
NODE=M182R02

NODE=M182R02;LINKAGE=AU

| $\Gamma(D^{*+}K_S^0)/\Gamma(D^+K_S^0)$                                                      |      |                      |           | $\Gamma_6/\Gamma_3$            |
|---------------------------------------------------------------------------------------------|------|----------------------|-----------|--------------------------------|
| VALUE                                                                                       | EVTS | DOCUMENT ID          | TECN      | COMMENT                        |
| $1.14 \pm 0.39 \pm 0.23$                                                                    | 2700 | <sup>11</sup> AUBERT | 09AR BABR | $e^+e^- \rightarrow D^{(*)}KX$ |
| <sup>11</sup> From the $D^{*+}K_S^0$ and $D^+K_S^0$ , where $D^{*+} \rightarrow D^+\pi^0$ . |      |                      |           |                                |

NODE=M182R03  
NODE=M182R03

NODE=M182R03;LINKAGE=AU

 **$D_{s1}^*(2700)^\pm$  REFERENCES**

|           |      |                |                            |                 |
|-----------|------|----------------|----------------------------|-----------------|
| LEES      | 15C  | PR D91 052002  | J.P. Lees <i>et al.</i>    | (BABAR Collab.) |
| 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.) |
| BRODZICKA | 08   | PRL 100 092001 | J. Brodzicka <i>et al.</i> | (BELLE Collab.) |
| AUBERT,BE | 06E  | PRL 97 222001  | B. Aubert <i>et al.</i>    | (BABAR Collab.) |

NODE=M182

REFID=56412  
REFID=54735  
REFID=53135  
REFID=52144  
REFID=51512

NODE=M196

 **$D_{s1}^*(2860)^\pm$**  $I(J^P) = 0(1^-)$ **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

 **$D_{s1}^*(2860)^+$  MASS**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN      | COMMENT                                 |
|-------------------------------------------------------------------------------|------|------------------------|-----------|-----------------------------------------|
| <b><math>2859 \pm 12 \pm 24</math></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. • • • |      |                        |           |                                         |
| $2866.1 \pm 1.0 \pm 6.3$                                                      | 36k  | <sup>2,3</sup> AAIJ    | 12AU LHCB | $pp \rightarrow (DK)^+X$ at 7 TeV       |
| $2862 \pm 2 \pm \frac{5}{2}$                                                  | 3122 | <sup>3,4</sup> AUBERT  | 09AR BABR | $e^+e^- \rightarrow D^{(*)}KX$          |
| $2856.6 \pm 1.5 \pm 5.0$                                                      |      | <sup>5</sup> AUBERT,BE | 06E BABR  | $e^+e^- \rightarrow DKX$                |

NODE=M196M

NODE=M196M

<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  $10\sigma$ .

NODE=M196M;LINKAGE=A

<sup>2</sup> From the combined fit of the  $D^+K_S^0$  and  $D^0K^+$  modes in the model including the  $D_{s2}^*(2573)^+$ ,  $D_{s1}^*(2700)^+$  and spin-0  $D_{sJ}^*(2860)^+$ .

NODE=M196M;LINKAGE=AA

<sup>3</sup> Possible contribution from the  $D_{s3}^*(2860)$  state.

NODE=M196M;LINKAGE=B

<sup>4</sup> From simultaneous fits to the two  $DK$  mass spectra and to the total  $D^*K$  mass spectrum.

NODE=M196M;LINKAGE=AB

<sup>5</sup> Superseded by AUBERT 09AR.

NODE=M196M;LINKAGE=AU

 **$D_{s1}^*(2860)^+$  WIDTH**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN      | COMMENT                                 |
|-------------------------------------------------------------------------------|------|------------------------|-----------|-----------------------------------------|
| <b><math>159 \pm 23 \pm 77</math></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. • • • |      |                        |           |                                         |
| $69.9 \pm 3.2 \pm 6.6$                                                        | 36k  | <sup>2,3</sup> AAIJ    | 12AU LHCB | $pp \rightarrow (DK)^+X$ at 7 TeV       |
| $48 \pm 3 \pm 6$                                                              | 3122 | <sup>3,4</sup> AUBERT  | 09AR BABR | $e^+e^- \rightarrow D^{(*)}KX$          |
| $47 \pm 7 \pm 10$                                                             |      | <sup>5</sup> AUBERT,BE | 06E BABR  | $e^+e^- \rightarrow DKX$                |

NODE=M196W

NODE=M196W

- <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><math>1.10 \pm 0.15 \pm 0.19</math></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

| $\Gamma(D^{*0} K^+)/\Gamma(D^0 K^+)$ |      |                     |           |                                   | $\Gamma_5/\Gamma_2$ |
|--------------------------------------|------|---------------------|-----------|-----------------------------------|---------------------|
| VALUE                                | EVTS | DOCUMENT ID         | TECN      | COMMENT                           |                     |
| $1.04 \pm 0.17 \pm 0.20$             | 2241 | <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=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                           |                     |
| $1.38 \pm 0.35 \pm 0.49$                 | 881  | <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=M196R03  
 NODE=M196R03

NODE=M196R03;LINKAGE=AU

 **$D_{s1}^*(2860)^\pm$  REFERENCES**

NODE=M196

|           |                     |                         |                   |
|-----------|---------------------|-------------------------|-------------------|
| 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.)   |

REFID=56105  
 REFID=54735  
 REFID=53135  
 REFID=51512

$D_{s3}^*(2860)^\pm$

$$I(J^P) = 0(3^-)$$

OMITTED FROM SUMMARY TABLE  
 $J^P$  consitent with  $3^-$  from angular analysis of AAIJ 14AW.

$D_{s3}^*(2860)^+$  MASS

| VALUE (MeV)                                                                                                                                                                                                                      | DOCUMENT ID       | TECN      | COMMENT                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------|-----------------------------------------|
| <b>2860.5±2.6±6.5</b>                                                                                                                                                                                                            | <sup>1</sup> AAIJ | 14AW LHCB | $B_s^0 \rightarrow \bar{D}^0 K^- \pi^+$ |
| <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 $\sigma$ . |                   |           |                                         |

$D_{s3}^*(2860)^+$  WIDTH

| VALUE (MeV)                                                                                                                                                                                                                      | DOCUMENT ID       | TECN      | COMMENT                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------|-----------------------------------------|
| <b>53±7±7</b>                                                                                                                                                                                                                    | <sup>1</sup> AAIJ | 14AW LHCB | $B_s^0 \rightarrow \bar{D}^0 K^- \pi^+$ |
| <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 $\sigma$ . |                   |           |                                         |

$D_{s3}^*(2860)^\pm$  REFERENCES

|      |                     |                       |                   |
|------|---------------------|-----------------------|-------------------|
| AAIJ | 14AW PRL 113 162001 | R. Aaij <i>et al.</i> | (LHCb Collab.) JP |
|------|---------------------|-----------------------|-------------------|

$D_{sJ}(3040)^\pm$

$$I(J^P) = 0(?^?)$$

OMITTED FROM SUMMARY TABLE  
Observed by AUBERT 09AR in inclusive production of  $D^* K$  in  $e^+ e^-$  annihilation.

$D_{sJ}(3040)^+$  MASS

| VALUE (MeV)                              | DOCUMENT ID | TECN      | COMMENT                       |
|------------------------------------------|-------------|-----------|-------------------------------|
| <b>3044±8<sup>+30</sup><sub>-5</sub></b> | AUBERT      | 09AR BABR | $e^+ e^- \rightarrow D^* K X$ |

$D_{sJ}(3040)^+$  WIDTH

| VALUE (MeV)                               | DOCUMENT ID | TECN      | COMMENT                       |
|-------------------------------------------|-------------|-----------|-------------------------------|
| <b>239±35<sup>+46</sup><sub>-42</sub></b> | AUBERT      | 09AR BABR | $e^+ e^- \rightarrow D^* K X$ |

$D_{sJ}(3040)^\pm$  DECAY MODES

| Mode       |                |
|------------|----------------|
| $\Gamma_1$ | $D^* K$        |
| $\Gamma_2$ | $D^{*0} K^+$   |
| $\Gamma_3$ | $D^{*+} K_S^0$ |

$D_{sJ}(3040)^\pm$  REFERENCES

|        |                    |                         |                 |
|--------|--------------------|-------------------------|-----------------|
| AUBERT | 09AR PR D80 092003 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
|--------|--------------------|-------------------------|-----------------|

NODE=M226

NODE=M226

NODE=M226M

NODE=M226M

NODE=M226M;LINKAGE=A

NODE=M226W

NODE=M226W

NODE=M226W;LINKAGE=A

NODE=M226

REFID=56105

NODE=M197

NODE=M197

NODE=M197M

NODE=M197M

NODE=M197W

NODE=M197W

NODE=M197215;NODE=M197

DESIG=1

DESIG=2

DESIG=3

NODE=M197

REFID=53135

# BOTTOM MESONS

## ( $B = \pm 1$ )

$B^+ = u\bar{b}$ ,  $B^0 = d\bar{b}$ ,  $\bar{B}^0 = \bar{d}b$ ,  $B^- = \bar{u}b$ , 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

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**

$400.5 \pm 1.8 \pm 3.1$  8K <sup>1</sup> AAIJ 15AB LHCB  $pp$  at 7, 8 TeV

$402 \pm 3 \pm 1$  <sub>-3</sub> <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  $m_{B_1(5721)^+} - m_{B^{*0}} - m_{\pi^+} = 262 \pm 3 \pm 1$  MeV which we adjusted by the  $\pi^+$  mass.

### $B_1(5721)^+$ WIDTH

VALUE (MeV)

EVTS

DOCUMENT ID

TECN

COMMENT

**$31 \pm 6$  OUR AVERAGE** Error includes scale factor of 1.1.

$29.1 \pm 3.6 \pm 4.3$  8K AAIJ 15AB LHCB  $pp$  at 7, 8 TeV

$49 \pm 12 \pm 2$  <sub>-10 -13</sub> AALTONEN 14I CDF  $p\bar{p}$  at 1.96 TeV

### $B_1(5721)^+$ DECAY MODES

Mode

Fraction ( $\Gamma_i/\Gamma$ )

$\Gamma_1$   $B^{*0}\pi^+$

seen

### $B_1(5721)^+$ BRANCHING RATIOS

$\Gamma(B^{*0}\pi^+)/\Gamma_{\text{total}}$

$\Gamma_1/\Gamma$

VALUE

EVTS

DOCUMENT ID

TECN

COMMENT

seen 8K AAIJ 15AB LHCB  $pp$  at 7, 8 TeV

**seen** AALTONEN 14I CDF  $p\bar{p}$  at 1.96 TeV

### $B_1(5721)^+$ REFERENCES

AAIJ 15AB JHEP 1504 024  
 AALTONEN 14I PR D90 012013

R. Aaij *et al.*  
 T. Aaltonen *et al.*

(LHCb Collab.)  
 (CDF Collab.)

NODE=M218

REFID=56628  
 REFID=56029

NODE=MXXX045

NODE=MXXX045

NODE=M218

NODE=M218

NODE=M218M

NODE=M218M

NODE=M218M

NODE=M218DM

NODE=M218DM

NODE=M218DM;LINKAGE=A

NODE=M218DM;LINKAGE=AA

NODE=M218W

NODE=M218W

NODE=M218215;NODE=M218

DESIG=1

NODE=M218220

NODE=M218R01  
 NODE=M218R01

$B_1(5721)^0$ 

$$I(J^P) = \frac{1}{2}(1^+)$$

$I, J, P$  need confirmation.

Quantum numbers shown are quark-model predictions.

 **$B_1(5721)^0$  MASS**

OUR FIT uses mass differences measurements listed below to determine the mass  $m_{B_1(5721)^0}$ .

| VALUE (MeV)                 | DOCUMENT ID                                                                            |
|-----------------------------|----------------------------------------------------------------------------------------|
| <b>5726.1 ± 1.3 OUR FIT</b> | Error includes scale factor of 1.2. [5726.0 ± 1.3 MeV OUR 2018 FIT Scale factor = 1.2] |

 **$m_{B_1^0} - m_{B^+}$** 

| VALUE (MeV)                                                                   | DOCUMENT ID                         | TECN    | COMMENT                |
|-------------------------------------------------------------------------------|-------------------------------------|---------|------------------------|
| <b>446.7 ± 1.3 OUR FIT</b>                                                    | Error includes scale factor of 1.2. |         |                        |
| <b>441.5 ± 2.4 ± 1.3</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. • • • |                                     |         |                        |
| 446.2 <sup>+1.9+1.0</sup> <sub>-2.1-1.2</sub>                                 | <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                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------------|-----------|------------------------|
| <b>401.4 ± 1.2 OUR FIT</b>                                                                                                                                                                                                                                                                               | Error includes scale factor of 1.2. |                       |           |                        |
| <b>402.8 ± 1.1 OUR AVERAGE</b>                                                                                                                                                                                                                                                                           |                                     |                       |           |                        |
| 403.4 ± 0.7 ± 1.5                                                                                                                                                                                                                                                                                        | 35K                                 | <sup>1</sup> AAIJ     | 15AB LHCb | $pp$ at 7, 8 TeV       |
| 402.3 ± 0.9 <sup>+1.1</sup> <sub>-1.2</sub>                                                                                                                                                                                                                                                              |                                     | <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.                                                                                                                                                    |                                     |                       |           |                        |

 **$B_1(5721)^0$  WIDTH**

| VALUE (MeV)                   | EVTS                                | DOCUMENT ID | TECN      | COMMENT                |
|-------------------------------|-------------------------------------|-------------|-----------|------------------------|
| <b>27.5 ± 3.4 OUR AVERAGE</b> | Error includes scale factor of 1.1. |             |           |                        |
| 30.1 ± 1.5 ± 3.5              | 35k                                 | AAIJ        | 15AB LHCb | $pp$ at 7, 8 TeV       |
| 23 ± 3 ± 4                    |                                     | AALTONEN    | 14I CDF   | $p\bar{p}$ at 1.96 TeV |

 **$B_1(5721)^0$  DECAY MODES**

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $B^{*+} \pi^-$ | dominant                       |

 **$B_1(5721)^0$  BRANCHING RATIOS**

| $\Gamma(B^{*+} \pi^-)/\Gamma_{\text{total}}$                                                                                        |      |                     |           |                        | $\Gamma_1/\Gamma$ |
|-------------------------------------------------------------------------------------------------------------------------------------|------|---------------------|-----------|------------------------|-------------------|
| VALUE                                                                                                                               | EVTS | DOCUMENT ID         | TECN      | COMMENT                |                   |
| seen                                                                                                                                | 35K  | AAIJ                | 15AB LHCb | $pp$ at 7, 8 TeV       |                   |
| dominant                                                                                                                            |      | AALTONEN            | 09D CDF   | $p\bar{p}$ at 1.96 TeV |                   |
| <b>dominant</b>                                                                                                                     |      | <sup>1</sup> ABAZOV | 07T D0    | $p\bar{p}$ at 1.96 TeV |                   |
| <sup>1</sup> Observed in $B_1^0 \rightarrow B^{*+} \pi^-$ with $B^{*+} \rightarrow B^+ \gamma$ and $B^+ \rightarrow J/\psi \pi^+$ . |      |                     |           |                        |                   |

 **$B_1(5721)^0$  REFERENCES**

|          |                    |                           |                |             |
|----------|--------------------|---------------------------|----------------|-------------|
| AAIJ     | 15AB JHEP 1504 024 | R. Aaij <i>et al.</i>     | (LHCb Collab.) | REFID=56628 |
| AALTONEN | 14I PR D90 012013  | T. Aaltonen <i>et al.</i> | (CDF Collab.)  | REFID=56029 |
| AALTONEN | 09D PRL 102 102003 | T. Aaltonen <i>et al.</i> | (CDF Collab.)  | REFID=52700 |
| ABAZOV   | 07T PRL 99 172001  | V.M. Abazov <i>et al.</i> | (D0 Collab.)   | REFID=52014 |

NODE=M183

NODE=M183

NODE=M183M

NODE=M183M

NODE=M183M

NEW

NODE=M183DM

NODE=M183DM

NODE=M183DM;LINKAGE=AA

NODE=M183DM2

NODE=M183DM2

NODE=M183DM2;LINKAGE=B

NODE=M183DM2;LINKAGE=AA

NODE=M183W

NODE=M183W

NODE=M183215;NODE=M183

DESIG=1

NODE=M183220

NODE=M183R01

NODE=M183R01

NODE=M183R01;LINKAGE=AB

NODE=M183



**$B_J^*(5732)$** 

$$I(J^P) = ?(??)$$

$I, J, P$  need confirmation.

OMITTED FROM SUMMARY TABLE

also known as  $B^{**}$ 

Signal can be interpreted as stemming from several narrow and broad resonances. Needs confirmation.

NODE=M151

NODE=M151

 **$B_J^*(5732)$  MASS**

NODE=M151M

NODE=M151M

| VALUE (MeV)                        | EVTS                                | DOCUMENT ID           | TECN     | COMMENT                   |
|------------------------------------|-------------------------------------|-----------------------|----------|---------------------------|
| <b>5698 ± 8 OUR AVERAGE</b>        | Error includes scale factor of 1.2. |                       |          |                           |
| 5710 ± 20                          |                                     | <sup>1</sup> AFFOLDER | 01F CDF  | $p\bar{p}$ at 1.8 TeV     |
| 5695 <sup>+17</sup> <sub>-19</sub> |                                     | <sup>2</sup> BARATE   | 98L ALEP | $e^+e^- \rightarrow Z$    |
| 5704 ± 4 ± 10                      | 1944                                | <sup>3</sup> BUSKULIC | 96D ALEP | $E_{cm}^{ee} = 88-94$ GeV |
| 5732 ± 5 ± 20                      | 2157                                | ABREU                 | 95B DLPH | $E_{cm}^{ee} = 88-94$ GeV |
| 5681 ± 11                          | 1738                                | AKERS                 | 95E OPAL | $E_{cm}^{ee} = 88-94$ GeV |
| 5713 ± 2                           |                                     | <sup>4</sup> ACCIARRI | 99N L3   | $e^+e^- \rightarrow Z$    |

• • • 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  $0.28 \pm 0.06 \pm 0.03$ .

<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  $5739^{+8+6}_{-11-4}$  MeV/ $c^2$  and the relative production rate of  $B(b \rightarrow B_2^* \rightarrow B^{(*)}\pi)/B(b \rightarrow B_{u,d}) = (31 \pm 9^{+6}_{-5})\%$ .

<sup>3</sup> Using  $m_{B\pi} - m_B = 424 \pm 4 \pm 10$  MeV.

<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=MF

NODE=M151M;LINKAGE=B

NODE=M151M;LINKAGE=A

NODE=M151M;LINKAGE=N

 **$B_J^*(5732)$  WIDTH**

NODE=M151W

NODE=M151W

| VALUE (MeV)                 | EVTS | DOCUMENT ID | TECN     | COMMENT                   |
|-----------------------------|------|-------------|----------|---------------------------|
| <b>128 ± 18 OUR AVERAGE</b> |      |             |          |                           |
| 145 ± 28                    | 2157 | ABREU       | 95B DLPH | $E_{cm}^{ee} = 88-94$ GeV |
| 116 ± 24                    | 1738 | AKERS       | 95E OPAL | $E_{cm}^{ee} = 88-94$ GeV |

 **$B_J^*(5732)$  DECAY MODES**

NODE=M151215;NODE=M151

| Mode                       | Fraction ( $\Gamma_i/\Gamma$ ) |
|----------------------------|--------------------------------|
| $\Gamma_1$ $B^*\pi + B\pi$ | seen                           |
| $\Gamma_2$ $B^*\pi(X)$     | [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

NODE=M151220

X refers to decay modes with or without additional accompanying decay particles.

| $\Gamma(B^*\pi(X))/\Gamma_{\text{total}}$          | DOCUMENT ID | TECN     | COMMENT                | $\Gamma_2/\Gamma$ |
|----------------------------------------------------|-------------|----------|------------------------|-------------------|
| VALUE                                              |             |          |                        |                   |
| <b>0.85<sup>+0.26</sup><sub>-0.27</sub> ± 0.12</b> | ABBIENDI    | 02E OPAL | $e^+e^- \rightarrow Z$ |                   |

NODE=M151R1  
NODE=M151R1

**$B_2^*(5732)$  REFERENCES**

|          |     |               |                           |                  |
|----------|-----|---------------|---------------------------|------------------|
| 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.)   |

NODE=M151

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=M219

NODE=M219

 **$B_2^*(5747)^+$  MASS**

OUR FIT uses  $m_{B^0}$  and  $m_{B_2^{*+}} - m_{B^0}$  to determine  $m_{B_2^*(5747)^+}$ .

NODE=M219M

NODE=M219M

NODE=M219M

VALUE (MeV) DOCUMENT ID  
**5737.2 ± 0.7 OUR FIT**

$$m_{B_2^{*+}} = m_{B^0}$$

NODE=M219DM

NODE=M219DM

| 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.

NODE=M219DM;LINKAGE=B

NODE=M219DM;LINKAGE=A

 **$B_2^*(5747)^+$  WIDTH**

NODE=M219W

NODE=M219W

| 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              |

 **$B_2^*(5747)^+$  DECAY MODES**

NODE=M219215;NODE=M219

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $B^0 \pi^+$    | seen                           |
| $\Gamma_2$ $B^{*0} \pi^+$ | seen                           |

DESIG=1

DESIG=2

 **$B_2^*(5747)^+$  BRANCHING RATIOS**

NODE=M219220

| $\Gamma(B^0 \pi^+)/\Gamma_{\text{total}}$                 | $\Gamma_1/\Gamma$   |
|-----------------------------------------------------------|---------------------|
| VALUE EVTS DOCUMENT ID TECN COMMENT                       |                     |
| seen 4K AAIJ 15AB LHCB $pp$ at 7, 8 TeV                   |                     |
| seen AALTONEN 14I CDF $p\bar{p}$ at 1.96 TeV              |                     |
| $\Gamma(B^{*0} \pi^+)/\Gamma_{\text{total}}$              | $\Gamma_2/\Gamma$   |
| VALUE EVTS DOCUMENT ID TECN COMMENT                       |                     |
| seen 4k AAIJ 15AB LHCB $pp$ at 7, 8 TeV                   |                     |
| $\Gamma(B^{*0} \pi^+)/\Gamma(B^0 \pi^+)$                  | $\Gamma_2/\Gamma_1$ |
| VALUE EVTS DOCUMENT ID TECN COMMENT                       |                     |
| <b>1.0 ± 0.5 ± 0.8</b> 4k AAIJ 15AB LHCB $pp$ at 7, 8 TeV |                     |

NODE=M219R01  
NODE=M219R01

NODE=M219R02  
NODE=M219R02

NODE=M219R03  
NODE=M219R03

**$B_2^*(5747)^+$  REFERENCES**AAIJ 15AB JHEP 1504 024  
AALTONEN 14I PR D90 012013R. Aaij *et al.*  
T. Aaltonen *et al.*(LHCb Collab.)  
(CDF Collab.)

NODE=M219

REFID=56628  
REFID=56029

NODE=M184

 **$B_2^*(5747)^0$**  $I(J^P) = \frac{1}{2}(2^+)$   
 $I, J, P$  need confirmation.

Quantum numbers shown are quark-model predictions.

NODE=M184

 **$B_2^*(5747)^0$  MASS**

NODE=M184M

OUR FIT uses  $m_{B^+}$ ,  $m_{B_1^0} - m_{B^+}$ , and  $m_{B_2^{*0}} - m_{B_1^0}$  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.

NODE=M184M

VALUE (MeV) DOCUMENT ID  
**5739.5 $\pm$ 0.7 OUR FIT** Error includes scale factor of 1.4.

NODE=M184M

 **$m_{B_2^{*0}} - m_{B_1^0}$** 

NODE=M184DM

VALUE (MeV) DOCUMENT ID TECN COMMENT  
**13.4 $\pm$ 1.4 OUR FIT** Error includes scale factor of 1.3. [13.5  $\pm$  1.4 MeV OUR 2018 FIT  
 Scale factor = 1.3]

NODE=M184DM

NEW

**26.2 $\pm$ 3.1 $\pm$ 0.9** <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<sup>+2.2+1.2</sup><sub>-2.5-1.4</sub> <sup>1</sup> AALTONEN 09D CDF Repl. by AALTONEN 14I

<sup>1</sup> Observed in  $B_2^{*0} \rightarrow B^{*+}\pi^-$  and  $B_2^{*0} \rightarrow B^+\pi^-$ .

NODE=M184DM;LINKAGE=AB

NODE=M184DM2

 **$m_{B_2^{*0}} - m_{B^+}$** 

VALUE (MeV) EVTS DOCUMENT ID TECN COMMENT  
**460.2  $\pm$ 0.6 OUR FIT** Error includes scale factor of 1.4.  
**459.9  $\pm$ 0.8 OUR AVERAGE** Error includes scale factor of 1.8.  
 460.18 $\pm$ 0.37 $\pm$ 0.33 17K <sup>1</sup> AAIJ 15AB LHCb  $p\bar{p}$  at 7, 8 TeV  
 457.5  $\pm$ 1.2 <sup>+0.8</sup><sub>-0.9</sub> <sup>2</sup> AALTONEN 14I CDF  $p\bar{p}$  at 1.96 TeV

NODE=M184DM2

<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.

NODE=M184DM2;LINKAGE=A

<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.

NODE=M184DM2;LINKAGE=AA

 **$B_2^*(5747)^0$  WIDTH**

NODE=M184W

NODE=M184W

VALUE (MeV) EVTS DOCUMENT ID TECN COMMENT  
**24.2 $\pm$ 1.7 OUR AVERAGE**  
 24.5 $\pm$ 1.0 $\pm$  1.5 17K AAIJ 15AB LHCb  $p\bar{p}$  at 7, 8 TeV  
 22 <sup>+3</sup><sub>-2</sub> <sup>+4</sup><sub>-5</sub> AALTONEN 14I CDF  $p\bar{p}$  at 1.96 TeV  
 • • • We do not use the following data for averages, fits, limits, etc. • • •  
 22.7<sup>+3.8+3.2</sup><sub>-3.2-10.2</sub> AALTONEN 09D CDF Repl. by AALTONEN 14I

 **$B_2^*(5747)^0$  DECAY MODES**

NODE=M184215;NODE=M184

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------|--------------------------------|
| $\Gamma_1$ $B^+\pi^-$    | dominant                       |
| $\Gamma_2$ $B^{*+}\pi^-$ | dominant                       |

DESIG=1

DESIG=2

**$B_2^*(5747)^0$  BRANCHING RATIOS**

NODE=M184220

| $\Gamma(B^+\pi^-)/\Gamma_{\text{total}}$ |      |             |           |                        | $\Gamma_1/\Gamma$ |
|------------------------------------------|------|-------------|-----------|------------------------|-------------------|
| VALUE                                    | EVTs | DOCUMENT ID | TECN      | COMMENT                |                   |
| seen                                     | 17K  | AAIJ        | 15AB LHCB | $pp$ at 7, 8 TeV       |                   |
| dominant                                 |      | AALTONEN    | 09D CDF   | $p\bar{p}$ at 1.96 TeV |                   |
| dominant                                 |      | ABAZOV      | 07T D0    | $p\bar{p}$ at 1.96 TeV |                   |

NODE=M184R01  
NODE=M184R01

| $\Gamma(B^{*+}\pi^-)/\Gamma_{\text{total}}$ |      |             |           |                        | $\Gamma_2/\Gamma$ |
|---------------------------------------------|------|-------------|-----------|------------------------|-------------------|
| VALUE                                       | EVTs | DOCUMENT ID | TECN      | COMMENT                |                   |
| seen                                        | 17K  | AAIJ        | 15AB LHCB | $pp$ at 7, 8 TeV       |                   |
| dominant                                    |      | AALTONEN    | 09D CDF   | $p\bar{p}$ at 1.96 TeV |                   |
| dominant                                    |      | ABAZOV      | 07T D0    | $p\bar{p}$ at 1.96 TeV |                   |

NODE=M184R02  
NODE=M184R02

| $\Gamma(B^{*+}\pi^-)/\Gamma(B^+\pi^-)$ |      |                     |           |                        | $\Gamma_2/\Gamma_1$ |
|----------------------------------------|------|---------------------|-----------|------------------------|---------------------|
| VALUE                                  | EVTs | DOCUMENT ID         | TECN      | COMMENT                |                     |
| <b>0.82±0.28 OUR AVERAGE</b>           |      |                     |           |                        |                     |
| 0.71±0.14±0.30                         | 17K  | AAIJ                | 15AB LHCB | $pp$ at 7, 8 TeV       |                     |
| 1.10±0.42±0.31                         |      | <sup>1</sup> ABAZOV | 07T D0    | $p\bar{p}$ at 1.96 TeV |                     |

NODE=M184R03  
NODE=M184R03

<sup>1</sup> Converted from measured ratio of  $R = B(B_2^{*0} \rightarrow B^{*+}\pi^-) / B(B_2^{*0} \rightarrow B^{(*)+}\pi^-)$   
 $= 0.475 \pm 0.095 \pm 0.069$ .

NODE=M184R03;LINKAGE=AB

 **$B_2^*(5747)^0$  REFERENCES**

NODE=M184

|          |      |                |                           |                |
|----------|------|----------------|---------------------------|----------------|
| 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.)   |

REFID=56628  
REFID=56029  
REFID=52700  
REFID=52014

NODE=M224

 **$B_J(5840)^+$** 
 $I(J^P) = \frac{1}{2}(?^?)$   
 $I, J, P$  need confirmation.

OMITTED FROM SUMMARY TABLE

Quantum numbers shown are quark-model predictions.

NODE=M224

 **$B_J(5840)^+$  MASS**

NODE=M224M

OUR FIT uses  $m_{B^0}$  and  $m_{B_J(5840)^+} - m_{B^0}$  to determine  $m_{B_J(5840)^+}$ .

NODE=M224M

| VALUE (MeV)            | DOCUMENT ID |
|------------------------|-------------|
| <b>5851±19 OUR FIT</b> |             |

NODE=M224M

 **$m_{B_J(5840)^+} - m_{B^0}$** 

NODE=M224DM

| VALUE (MeV)           | EVTs | DOCUMENT ID | TECN | COMMENT |
|-----------------------|------|-------------|------|---------|
| <b>571±19 OUR FIT</b> |      |             |      |         |

NODE=M224DM

**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

OCCUR=2

<sup>1</sup> AAIJ 15AB reports  $[m_{B_J^+} - m_{B^0}] - m_{\pi^+} = 431 \pm 13 \pm 14$  MeV which we adjust by

the  $\pi^+$  mass. The masses inside the square brackets were measured for each candidate event. The result assumes  $P = (-1)^J$  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 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=M224DM;LINKAGE=A

NODE=M224DM;LINKAGE=B

 **$m_{B_J(5840)^+} - m_{B^0}$** 

NODE=M224DM2

| VALUE (MeV) | EVTs | DOCUMENT ID       | TECN      | COMMENT          |
|-------------|------|-------------------|-----------|------------------|
| 565±15±14   | 7k   | <sup>1</sup> AAIJ | 15AB LHCB | $pp$ at 7, 8 TeV |

NODE=M224DM2

<sup>1</sup> AAIJ 15AB reports  $[m_{B^+} - m_{B^0}] - (m_{B^{*+}} - m_{B^+}) - m_{\pi^+} = 425 \pm 15 \pm 14$  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.

NODE=M224DM2;LINKAGE=A

 **$B_J(5840)^+$  WIDTH**

NODE=M224W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID       | TECN      | COMMENT          |
|-------------------------------------------------------------------------------|------|-------------------|-----------|------------------|
| <b><math>224 \pm 24 \pm 80</math></b>                                         | 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 |

NODE=M224W

OCCUR=2

OCCUR=3

<sup>1</sup> Assuming  $P = (-1)^J$  and using two relativistic Breit-Wigner functions in the fit for mass difference.

NODE=M224W;LINKAGE=A

<sup>2</sup> Assuming  $P = (-1)^J$  and using three relativistic Breit-Wigner functions in the fit for mass difference.

NODE=M224W;LINKAGE=B

<sup>3</sup> Assuming  $P = -(-1)^J$  and using three relativistic Breit-Wigner functions in the fit for mass difference.

NODE=M224W;LINKAGE=C

 **$B_J(5840)^+$  DECAY MODES**

NODE=M224215;NODE=M224

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------|--------------------------------|
| $\Gamma_1 \quad B^{*0} \pi^+$ | seen                           |
| $\Gamma_2 \quad B^0 \pi^+$    | possibly seen                  |

DESIG=1

DESIG=2

 **$B_J(5840)^+$  BRANCHING RATIOS**

NODE=M224220

| $\Gamma(B^{*0} \pi^+)/\Gamma_{\text{total}}$ |      |             |           |                  | $\Gamma_1/\Gamma$ |
|----------------------------------------------|------|-------------|-----------|------------------|-------------------|
| VALUE                                        | EVTS | DOCUMENT ID | TECN      | COMMENT          |                   |
| <b>seen</b>                                  | 7k   | AAIJ        | 15AB LHCB | $pp$ at 7, 8 TeV |                   |

NODE=M224R01  
NODE=M224R01

| $\Gamma(B^0 \pi^+)/\Gamma_{\text{total}}$ |      |                   |           |                  | $\Gamma_2/\Gamma$ |
|-------------------------------------------|------|-------------------|-----------|------------------|-------------------|
| VALUE                                     | EVTS | DOCUMENT ID       | TECN      | COMMENT          |                   |
| <b>possibly seen</b>                      | 7k   | <sup>1</sup> AAIJ | 15AB LHCB | $pp$ at 7, 8 TeV |                   |

NODE=M224R02  
NODE=M224R02

<sup>1</sup> A  $B \pi$  decay is forbidden from a  $P = -(-1)^J$  parent, whereas  $B^* \pi$  is allowed.

NODE=M224R02;LINKAGE=A

 **$B_J(5840)^+$  REFERENCES**

NODE=M224

AAIJ      15AB JHEP 1504 024      R. Aaij *et al.*      (LHCb Collab.)

REFID=56628

**$B_J(5840)^0$** 

$$I(J^P) = \frac{1}{2}(?)$$

$I, J, P$  need confirmation.

OMITTED FROM SUMMARY TABLE

Quantum numbers shown are quark-model predictions.

 **$B_J(5840)^0$  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 by the  $\pi^-$  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 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.

 **$m_{B_J(5840)^0} - m_{B^{*+}}$** 

VALUE (MeV)

EVTS

DOCUMENT ID

TECN

COMMENT

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

584±5±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.

 **$B_J(5840)^0$  WIDTH**

VALUE (MeV)

EVTS

DOCUMENT ID

TECN

COMMENT

**127±17±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±20±34

12k

<sup>2</sup> AAIJ

15AB LHCB

 $pp$  at 7, 8 TeV

119±17±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.

 **$B_J(5840)^0$  DECAY MODES**

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $B^{*+} \pi^-$ | seen                           |
| $\Gamma_2$ $B^+ \pi^-$    | possibly seen                  |

NODE=M225

NODE=M225

NODE=M225M

NODE=M225M

NODE=M225M

NODE=M225DM

NODE=M225DM

OCCUR=2

NODE=M225DM;LINKAGE=A

NODE=M225DM;LINKAGE=B

NODE=M225DM2

NODE=M225DM2

NODE=M225DM2;LINKAGE=A

NODE=M225W

NODE=M225W

OCCUR=2

OCCUR=3

NODE=M225W;LINKAGE=A

NODE=M225W;LINKAGE=B

NODE=M225W;LINKAGE=C

NODE=M225215;NODE=M225

DESIG=1

DESIG=2

**$B_J(5840)^0$  BRANCHING RATIOS**

| $\Gamma(B^{*+}\pi^-)/\Gamma_{\text{total}}$ |      |             |           |                  | $\Gamma_1/\Gamma$ |
|---------------------------------------------|------|-------------|-----------|------------------|-------------------|
| VALUE                                       | EVTS | DOCUMENT ID | TECN      | COMMENT          |                   |
| seen                                        | 12k  | AAIJ        | 15AB LHCB | $pp$ at 7, 8 TeV |                   |

NODE=M225220

NODE=M225R01  
NODE=M225R01

| $\Gamma(B^+\pi^-)/\Gamma_{\text{total}}$ |                   |           |                  |  | $\Gamma_2/\Gamma$ |
|------------------------------------------|-------------------|-----------|------------------|--|-------------------|
| VALUE                                    | DOCUMENT ID       | TECN      | COMMENT          |  |                   |
| possibly seen                            | <sup>1</sup> AAIJ | 15AB LHCB | $pp$ at 7, 8 TeV |  |                   |

NODE=M225R02  
NODE=M225R02<sup>1</sup> A  $B\pi$  decay is forbidden from a  $P = -(-1)^J$  parent, whereas  $B^*\pi$  is allowed.

NODE=M225R02;LINKAGE=A

 **$B_J(5840)^0$  REFERENCES**AAIJ 15AB JHEP 1504 024 R. Aaij *et al.* (LHCb Collab.)

NODE=M225

REFID=56628

NODE=M220

 **$B_J(5970)^+$**  $I(J^P) = \frac{1}{2}(?)$   
 $I, J, P$  need confirmation.

Quantum numbers shown are quark-model predictions.

NODE=M220

 **$B_J(5970)^+$  MASS**OUR FIT uses  $m_{B^0}$  and  $m_{B_J(5970)^+} - m_{B^0}$  to determine  $m_{B_J(5970)^+}$ .

NODE=M220M

NODE=M220M

NODE=M220M

| VALUE (MeV)             | DOCUMENT ID |
|-------------------------|-------------|
| <b>5964 ± 5 OUR FIT</b> |             |

 **$m_{B_J(5970)^+} - m_{B^0}$** 

NODE=M220DM

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID           | TECN      | COMMENT                |
|-------------------------------------------------------------------------------|------|-----------------------|-----------|------------------------|
| <b>685 ± 5 OUR FIT</b>                                                        |      |                       |           |                        |
| <b>685 ± 5 OUR AVERAGE</b>                                                    |      |                       |           |                        |
| 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       |

NODE=M220DM

<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 by the  $\pi^+$  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.

OCCUR=2

NODE=M220DM;LINKAGE=B

<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.

NODE=M220DM;LINKAGE=A

<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.

NODE=M220DM;LINKAGE=C

 **$m_{B_J(5970)^+} - m_{B^{*0}}$** 

NODE=M220DM2

NODE=M220DM2

| VALUE (MeV)                                                                                                                                                                                                                                                                                                                                                                                                                                 | EVTS | 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 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. |      |                   |           |                  |

NODE=M220DM2;LINKAGE=A

 **$B_J(5970)^+$  WIDTH**

NODE=M220W

| VALUE (MeV)                                                                                                             | EVTS | DOCUMENT ID       | TECN      | COMMENT                |
|-------------------------------------------------------------------------------------------------------------------------|------|-------------------|-----------|------------------------|
| <b>62±20 OUR AVERAGE</b>                                                                                                |      |                   |           |                        |
| 63±15±17                                                                                                                | 2K   | <sup>1</sup> AAIJ | 15AB LHCB | $p\bar{p}$ at 7, 8 TeV |
| 60 <sup>+30</sup> <sub>-20</sub> ±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±14±17                                                                                                                | 2K   | <sup>2</sup> AAIJ | 15AB LHCB | $p\bar{p}$ at 7, 8 TeV |
| 61±15±17                                                                                                                | 2K   | <sup>3</sup> AAIJ | 15AB LHCB | $p\bar{p}$ 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=M220W

OCCUR=2

OCCUR=3

NODE=M220W;LINKAGE=A

NODE=M220W;LINKAGE=B

NODE=M220W;LINKAGE=C

 **$B_J(5970)^+$  DECAY MODES**

NODE=M220215;NODE=M220

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------|--------------------------------|
| $\Gamma_1$ $B^0\pi^+$    | possibly seen                  |
| $\Gamma_2$ $B^{*0}\pi^+$ | seen                           |

DESIG=1

DESIG=2

 **$B_J(5970)^+$  BRANCHING RATIOS**

NODE=M220220

| $\Gamma(B^0\pi^+)/\Gamma_{\text{total}}$                                                           | VALUE | EVTS | DOCUMENT ID       | TECN      | COMMENT                | $\Gamma_1/\Gamma$ |
|----------------------------------------------------------------------------------------------------|-------|------|-------------------|-----------|------------------------|-------------------|
| possibly seen                                                                                      |       | 2K   | <sup>1</sup> AAIJ | 15AB LHCB | $p\bar{p}$ at 7, 8 TeV |                   |
| possibly seen                                                                                      |       | 1.4k | AALTONEN          | 14l CDF   | $p\bar{p}$ at 1.96 TeV |                   |
| <sup>1</sup> A $B\pi$ decay is forbidden from a $P = -(-1)^J$ parent, whereas $B^*\pi$ is allowed. |       |      |                   |           |                        |                   |
| $\Gamma(B^{*0}\pi^+)/\Gamma_{\text{total}}$                                                        | VALUE | EVTS | DOCUMENT ID       | TECN      | COMMENT                | $\Gamma_2/\Gamma$ |
| seen                                                                                               |       | 2k   | AAIJ              | 15AB LHCB | $p\bar{p}$ at 7, 8 TeV |                   |
| seen                                                                                               |       | 1.4k | AALTONEN          | 14l CDF   | $p\bar{p}$ at 1.96 TeV |                   |

NODE=M220R01

NODE=M220R01

NODE=M220R01;LINKAGE=A

NODE=M220R02

NODE=M220R02

 **$B_J(5970)^+$  REFERENCES**

NODE=M220

|          |                    |                           |                |
|----------|--------------------|---------------------------|----------------|
| 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

NODE=M221

$$B_J(5970)^0$$

$$I(J^P) = \frac{1}{2}(??)$$

$I, J, P$  need confirmation.

Quantum numbers shown are quark-model predictions.

NODE=M221

 **$B_J(5970)^0$  MASS**

NODE=M221M

OUR FIT uses  $m_{B^+}$  and  $m_{B_J(5970)^0} - m_{B^+}$  to determine  $m_{B_J(5970)^0}$ .

NODE=M221M

NODE=M221M

| VALUE (MeV)           | DOCUMENT ID |
|-----------------------|-------------|
| <b>5971±5 OUR FIT</b> |             |

$$m_{B_J(5970)^0} - m_{B^+}$$

NODE=M221DM

NODE=M221DM

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID           | TECN      | COMMENT                |
|-------------------------------------------------------------------------------|------|-----------------------|-----------|------------------------|
| <b>691 ±5 OUR FIT</b>                                                         |      |                       |           |                        |
| <b>691 ±5 OUR AVERAGE</b>                                                     |      |                       |           |                        |
| 689.9±2.9± 5.1                                                                | 10K  | <sup>1</sup> AAIJ     | 15AB LHCB | $p\bar{p}$ 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 | $p\bar{p}$ at 7, 8 TeV |

OCCUR=2



<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 by the  $\pi^-$  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 14I 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.

$$m_{B_J(5970)^0} - m_{B^{*+}}$$

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

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

|                   |     |                   |           |                  |
|-------------------|-----|-------------------|-----------|------------------|
| 691.6 ± 3.7 ± 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.

### $B_J(5970)^0$ WIDTH

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

**81 ± 12 OUR AVERAGE**

|            |     |                   |           |                  |
|------------|-----|-------------------|-----------|------------------|
| 82 ± 8 ± 9 | 10K | <sup>1</sup> AAIJ | 15AB LHCB | $pp$ at 7, 8 TeV |
|------------|-----|-------------------|-----------|------------------|

|                                       |      |          |         |                        |
|---------------------------------------|------|----------|---------|------------------------|
| 70 <sup>+30</sup> <sub>-20</sub> ± 30 | 2.6k | AALTONEN | 14I CDF | $p\bar{p}$ at 1.96 TeV |
|---------------------------------------|------|----------|---------|------------------------|

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

|            |     |                   |           |                  |
|------------|-----|-------------------|-----------|------------------|
| 56 ± 7 ± 9 | 10K | <sup>2</sup> AAIJ | 15AB LHCB | $pp$ at 7, 8 TeV |
|------------|-----|-------------------|-----------|------------------|

|             |     |                   |           |                  |
|-------------|-----|-------------------|-----------|------------------|
| 82 ± 10 ± 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.

### $B_J(5970)^0$ DECAY MODES

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------|--------------------------------|
| $\Gamma_1 \quad B^+ \pi^-$    | possibly seen                  |
| $\Gamma_2 \quad B^{*+} \pi^-$ | seen                           |

### $B_J(5970)^0$ BRANCHING RATIOS

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

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

|               |     |                   |           |                  |
|---------------|-----|-------------------|-----------|------------------|
| possibly seen | 10K | <sup>1</sup> AAIJ | 15AB LHCB | $pp$ at 7, 8 TeV |
|---------------|-----|-------------------|-----------|------------------|

|                      |      |          |         |                        |
|----------------------|------|----------|---------|------------------------|
| <b>possibly seen</b> | 2.6k | AALTONEN | 14I CDF | $p\bar{p}$ at 1.96 TeV |
|----------------------|------|----------|---------|------------------------|

<sup>1</sup> A  $B\pi$  decay is forbidden from a  $P = -(-1)^J$  parent, whereas  $B^*\pi$  is allowed.

$\Gamma(B^{*+} \pi^-)/\Gamma_{\text{total}}$   $\Gamma_2/\Gamma$

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

|      |     |      |           |                  |
|------|-----|------|-----------|------------------|
| seen | 10K | AAIJ | 15AB LHCB | $pp$ at 7, 8 TeV |
|------|-----|------|-----------|------------------|

|             |      |          |         |                        |
|-------------|------|----------|---------|------------------------|
| <b>seen</b> | 2.6k | AALTONEN | 14I CDF | $p\bar{p}$ at 1.96 TeV |
|-------------|------|----------|---------|------------------------|

### $B_J(5970)^0$ 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.)  |

NODE=M221DM;LINKAGE=B

NODE=M221DM;LINKAGE=A

NODE=M221DM;LINKAGE=C

NODE=M221DM2

NODE=M221DM2

NODE=M221DM2;LINKAGE=A

NODE=M221W

NODE=M221W

OCCUR=2

OCCUR=3

NODE=M221W;LINKAGE=A

NODE=M221W;LINKAGE=B

NODE=M221W;LINKAGE=C

NODE=M221215;NODE=M221

DESIG=1

DESIG=2

NODE=M221220

NODE=M221R01

NODE=M221R01

OCCUR=2

NODE=M221R01;LINKAGE=A

NODE=M221R02

NODE=M221R02

OCCUR=2

NODE=M221

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>\pm</math>3.3 OUR AVERAGE</b>                                                                                                                     |      | [5567.8 $^{+3.0}_{-3.5}$ MeV OUR 2018 AVERAGE] |        |                                       |
| <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>19 <math>^{+9}_{-7}</math> OUR AVERAGE</b>                                                                              |      | [22 $^{+8}_{-7}$ MeV OUR 2018 AVERAGE] |        |                                     |
| <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                           |

### X(5568) $^\pm$ BRANCHING RATIOS

| $\Gamma(B_s\pi^\pm)/\Gamma_{\text{total}}$                                    |      |                       |           |                                       | $\Gamma_1/\Gamma$ |
|-------------------------------------------------------------------------------|------|-----------------------|-----------|---------------------------------------|-------------------|
| 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 | $pp \rightarrow B_s^0\pi^\pm X$       |                   |

NODE=MXXX046

NODE=MXXX046

NODE=M232

NODE=M232

NODE=M232M

NODE=M232M

NEW

NODE=M232M;LINKAGE=B

NODE=M232M;LINKAGE=A

NODE=M232W

NODE=M232W

NEW

NODE=M232W;LINKAGE=B

NODE=M232215;NODE=M232

DESIG=1

NODE=M232220

NODE=M232R01  
NODE=M232R01

OCCUR=2

- <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.
- <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  $p_T(B_s) > 10$  GeV/c and less than 1.6% at  $p_T(B_s) > 15$  GeV/c at 95% CL.
- <sup>4</sup> Not seen in  $9.6 \text{ fb}^{-1}$  of  $p\bar{p}$  collision data at  $\sqrt{s} = 1.96$  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  $\sqrt{s} = 8$  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  $p_T(B_s) > 10$  GeV/c and less than 1.0% at  $p_T(B_s) > 15$  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  $p_T(B_s) > 10$  GeV/c at 90% CL.

NODE=M232R01;LINKAGE=F  
NODE=M232R01;LINKAGE=A

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

NODE=M187

$B_{s1}(5830)^0$

$I(J^P) = 0(1^+)$   
 $I, J, P$  need confirmation.

Quantum numbers shown are quark-model predictions.

NODE=M187

### $B_{s1}(5830)^0$ MASS

| VALUE (MeV)                                                                                                                                                                                                               | DOCUMENT ID           | TECN     | COMMENT               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------|-----------------------|
| <b>5828.70<math>\pm</math>0.20 OUR FIT</b>                                                                                                                                                                                |                       |          |                       |
| [5828.63 $\pm$ 0.27 MeV OUR 2018 FIT]                                                                                                                                                                                     |                       |          |                       |
| <b>5828.65<math>\pm</math>0.24 OUR AVERAGE</b>                                                                                                                                                                            |                       |          |                       |
| [5828.4 $\pm$ 0.4 MeV OUR 2018 AVERAGE]                                                                                                                                                                                   |                       |          |                       |
| 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     | 13O 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

NODE=M187M  
NEW

NEW

NODE=M187M;LINKAGE=AI  
NODE=M187M;LINKAGE=AA

### $m_{B_{s1}^0} - m_{B^{*+}}$

| VALUE (MeV)                                                                                                                                                                                                               | DOCUMENT ID           | TECN    | COMMENT                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------|------------------------|
| <b>504.00<math>\pm</math>0.17 OUR FIT</b>                                                                                                                                                                                 |                       |         |                        |
| [503.98 $\pm$ 0.18 MeV OUR 2018 FIT]                                                                                                                                                                                      |                       |         |                        |
| <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 $m_{B_{s1}(5830)^0} - m_{B^{*+}} - m_{K^-} = 10.35 \pm 0.12 \pm 0.15$ 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

NODE=M187DM  
NEW

NODE=M187DM;LINKAGE=AL

NODE=M187DM;LINKAGE=AA

### $B_{s1}(5830)^0$ WIDTH

| 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 |

NODE=M187W

NODE=M187W

**$B_{s1}(5830)^0$  DECAY MODES**

NODE=M187215;NODE=M187

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $B^{*+} K^-$   | dominant                       |
| $\Gamma_2$ $B^{*0} K_S^0$ |                                |

DESIG=1

DESIG=2

 **$B_{s1}(5830)^0$  BRANCHING RATIOS**

NODE=M187220

| $\Gamma(B^{*+} K^-)/\Gamma_{\text{total}}$                                                                                                                                              | $\Gamma_1/\Gamma$     |             |                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-------------|------------------------|
| <u>VALUE</u>                                                                                                                                                                            | <u>DOCUMENT ID</u>    | <u>TECN</u> | <u>COMMENT</u>         |
| <b>dominant</b>                                                                                                                                                                         | AALTONEN              | 08K CDF     | $p\bar{p}$ at 1.96 TeV |
| $\Gamma(B^{*0} K_S^0)/\Gamma(B^{*+} K^-)$                                                                                                                                               | $\Gamma_2/\Gamma_1$   |             |                        |
| <u>VALUE</u>                                                                                                                                                                            | <u>DOCUMENT ID</u>    | <u>TECN</u> | <u>COMMENT</u>         |
| <b><math>0.49 \pm 0.12 \pm 0.07</math></b>                                                                                                                                              | <sup>1</sup> SIRUNYAN | 18DF CMS    | pp at 8 TeV            |
| <sup>1</sup> With the branching fraction $(1.026 \pm 0.031) \times 10^{-3}$ for $B^+ \rightarrow J/\psi K^+$ and $(1.28 \pm 0.05) \times 10^{-3}$ for $B^0 \rightarrow J/\psi K^{*0}$ . |                       |             |                        |

NODE=M187R01

NODE=M187R01

NODE=M187R00

NODE=M187R00

NODE=M187R00;LINKAGE=A

 **$B_{s1}(5830)^0$  REFERENCES**

NODE=M187

|          |      |                |                             |                |
|----------|------|----------------|-----------------------------|----------------|
| SIRUNYAN | 18DF | EPJ C78 939    | A.M. Sirunyan <i>et al.</i> | (CMS)          |
| 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><math>5839.85 \pm 0.12</math> OUR FIT</b>                                                                                                                                                                              |                       |      |                           |
| [5839.85 $\pm$ 0.17 MeV OUR 2018 FIT Scale factor = 1.1]                                                                                                                                                                  |                       |      |                           |
| <b><math>5839.92 \pm 0.14</math> OUR AVERAGE</b>                                                                                                                                                                          |                       |      |                           |
| [5839.98 $\pm$ 0.20 MeV OUR 2018 AVERAGE]                                                                                                                                                                                 |                       |      |                           |
| 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 $p\bar{p}$ 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

NEW

NEW

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 $B^+ \rightarrow \bar{D}^0 \pi^+$ , $\bar{D}^0 \rightarrow K^+ \pi^-$ . |                       |      |                           |
| $m_{B_{s2}^{*0}} - m_{B^+}$                                                                                                                                                                                               |                       |      |                           |

NODE=M186DM

NODE=M186DM;LINKAGE=AA

NODE=M186DM2

| VALUE (MeV)                                             | DOCUMENT ID           | TECN | COMMENT                    |
|---------------------------------------------------------|-----------------------|------|----------------------------|
| <b><math>560.53 \pm 0.14</math> OUR FIT</b>             |                       |      |                            |
| [560.53 $\pm$ 0.17 MeV OUR 2018 FIT Scale factor = 1.1] |                       |      |                            |
| <b><math>560.41 \pm 0.13 \pm 0.14</math></b>            | <sup>1</sup> AALTONEN | 14I  | CDF $p\bar{p}$ at 1.96 TeV |

NODE=M186DM2

NEW

<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>                                        |                   |          |                        |
| [1.47 ± 0.33 MeV OUR 2018 AVERAGE]                                  |                   |          |                        |
| 1.52±0.34±0.30                                                      | SIRUNYAN          | 18DF CMS | pp 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 | $pp$ at 7 TeV          |
| <sup>1</sup> Uses $B_{s2}^*(5840)^0 \rightarrow B^{*+} K^-$ decays. |                   |          |                        |

NODE=M186W  
NEW

NODE=M186W;LINKAGE=AI

### $B_{s2}^*(5840)^0$ DECAY MODES

NODE=M186215;NODE=M186

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $B^+ K^-$      | dominant                       |
| $\Gamma_2$ $B^{*+} K^-$   |                                |
| $\Gamma_3$ $B^0 K_S^0$    |                                |
| $\Gamma_4$ $B^{*0} K_S^0$ |                                |

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>dominant</b>                                                                                               |                   |
| <b>dominant</b>                                                                                               |                   |
|                                                                                                               |                   |
|                                                                                                               |                   |
| <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>             |                     |
|                                      |                     |
|                                      |                     |

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>                 |                     |
|                                          |                     |
|                                          |                     |

NODE=M186R00  
NODE=M186R00

<sup>1</sup>With the branching fraction  $(1.28 \pm 0.05) \times 10^{-3}$  for  $B^0 \rightarrow J/\psi K^{*0}$ .

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>            |                     |
|                                     |                     |
|                                     |                     |

NODE=M186R03  
NODE=M186R03

<sup>1</sup>With the branching fraction  $(1.026 \pm 0.031) \times 10^{-3}$  for  $B^+ \rightarrow J/\psi K^+$  and  $(1.28 \pm 0.05) \times 10^{-3}$  for  $B^0 \rightarrow J/\psi K^{*0}$ .

NODE=M186R03;LINKAGE=A

| $\Gamma(B^{*+} K^-)/\Gamma(B^+ K^-)$ | $\Gamma_2/\Gamma_1$ |
|--------------------------------------|---------------------|
| VALUE                                |                     |
| <b>0.081±0.021±0.015</b>             |                     |
|                                      |                     |
|                                      |                     |

NODE=M186R04  
NODE=M186R04

<sup>1</sup>With the branching fraction  $(1.026 \pm 0.031) \times 10^{-3}$  for  $B^+ \rightarrow J/\psi K^+$ .

NODE=M186R04;LINKAGE=A

### $B_{s2}^*(5840)^0$ REFERENCES

NODE=M186

|          |      |                |                             |                |
|----------|------|----------------|-----------------------------|----------------|
| SIRUNYAN | 18DF | EPJ C78 939    | A.M. Sirunyan <i>et al.</i> | (CMS)          |
| 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

NODE=M217

 $B_c(2S)^\pm$  $I(J^P) = 0(0^-)$ 

OMITTED FROM SUMMARY TABLE

Quantum numbers neither measured nor confirmed.

NODE=M217

 $B_c(2S)^\pm$  MASS

| VALUE (MeV)                                                                   | EVTs                            | DOCUMENT ID           | TECN       | COMMENT          |
|-------------------------------------------------------------------------------|---------------------------------|-----------------------|------------|------------------|
| <b>6871.0 ± 1.6 OUR AVERAGE</b>                                               | [6842 ± 6 MeV OUR 2018 AVERAGE] |                       |            |                  |
| <b>6871.0 ± 1.2 ± 0.8 ± 0.8</b>                                               | 51                              | <sup>1</sup> SIRUNYAN | 19M CMS    | $pp$ at 13 TeV   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                 |                       |            |                  |
| not seen                                                                      |                                 | <sup>2</sup> AAIJ     | 18AL LHCb  | $pp$ at 8 TeV    |
| 6842 ± 4 ± 5                                                                  | 57                              | <sup>3,4</sup> AAD    | 14AQ ATLAS | $pp$ at 7, 8 TeV |

NODE=M217M

NODE=M217M

NEW

<sup>1</sup> The second systematic uncertainty reflects the PDG uncertainty on the  $B_c^+$  mass. Observed 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>2</sup> AAIJ 18AL reports an upper limit on the ratio of production cross sections for  $[\sigma(B_c(2S)^+)/\sigma(B_c^+)] \cdot \mathcal{B}(B_c(2S)^+ \rightarrow B_c^+ \pi^+ \pi^-) < 0.04-0.09$  at 95% CL for the mass value reported by AAD 14AQ.

<sup>3</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>4</sup> Might be the  $B_c^*(2S)$ .

NODE=M217M;LINKAGE=B

NODE=M217M;LINKAGE=A

NODE=M217M;LINKAGE=AA

NODE=M217M;LINKAGE=C

 $B_c(2S)^\pm$  DECAY MODES

| Mode                               | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------------------------------|--------------------------------|
| $\Gamma_1 \quad B_c^+ \pi^+ \pi^-$ | seen                           |

NODE=M217215;NODE=M217

DESIG=1

**$B_c(2S)^\pm$  BRANCHING RATIOS**

| $\Gamma(B_c^+ \pi^+ \pi^-)/\Gamma_{\text{total}}$                                                                                                                                                                                                       |      |                   |           |                  | $\Gamma_1/\Gamma$ |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------|-----------|------------------|-------------------|
| VALUE                                                                                                                                                                                                                                                   | EVTS | DOCUMENT ID       | TECN      | COMMENT          |                   |
| <b>seen</b>                                                                                                                                                                                                                                             | 57   | <sup>1</sup> AAD  | 14AQ ATLS | $pp$ at 7, 8 TeV |                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                           |      |                   |           |                  |                   |
| <b>not seen</b>                                                                                                                                                                                                                                         |      | <sup>2</sup> AAIJ | 18AL LHCb | $pp$ at 8 TeV    |                   |
| <sup>1</sup> Observed with 5.2 standard deviations significance.                                                                                                                                                                                        |      |                   |           |                  |                   |
| <sup>2</sup> AAIJ 18AL reports an upper limit on the ratio of production cross sections for $[\sigma(B_c(2S)^+)/\sigma(B_c^+)] \cdot B(B_c(2S)^+ \rightarrow B_c^+ \pi^+ \pi^-) < 0.04\text{--}0.09$ at 95% CL for the mass value reported by AAD 14AQ. |      |                   |           |                  |                   |

NODE=M217225

NODE=M217R01  
NODE=M217R01NODE=M217R01;LINKAGE=AA  
NODE=M217R01;LINKAGE=A **$B_c(2S)^\pm$  REFERENCES**

|          |      |                |                             |                 |
|----------|------|----------------|-----------------------------|-----------------|
| SIRUNYAN | 19M  | PRL 122 132001 | A.M. Sirunyan <i>et al.</i> | (CMS Collab.)   |
| AAIJ     | 18AL | JHEP 1801 138  | R. Aaij <i>et al.</i>       | (LHCb Collab.)  |
| AAD      | 14AQ | PRL 113 212004 | G. Aad <i>et al.</i>        | (ATLAS Collab.) |

NODE=M217

REFID=59639  
REFID=59246  
REFID=56117

See the related review(s):

[Spectroscopy of Mesons Containing Two Heavy Quarks](#)

## $c\bar{c}$ MESONS

### (including possibly non- $q\bar{q}$ states)

NODE=MXXX025

See the related review(s):

[Charmonium System](#) $\eta_c(1S)$ 

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

NODE=M026

 **$\eta_c(1S)$  MASS**

| VALUE (MeV)                                    | EVTS | DOCUMENT ID                                                                                                            | TECN      | COMMENT                                                     |
|------------------------------------------------|------|------------------------------------------------------------------------------------------------------------------------|-----------|-------------------------------------------------------------|
| <b>2983.9 <math>\pm</math> 0.5 OUR AVERAGE</b> |      | Error includes scale factor of 1.3. See the ideogram below. [2983.9 $\pm$ 0.5 MeV OUR 2018 AVERAGE Scale factor = 1.3] |           |                                                             |
| 2984.6 $\pm$ 0.7 $\pm$ 2.2                     | 2673 | XU                                                                                                                     | 18 BELL   | $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$                  |
| 2986.7 $\pm$ 0.5 $\pm$ 0.9                     | 11K  | <sup>1</sup> AAIJ                                                                                                      | 17AD LHCb | $pp \rightarrow B^+X \rightarrow p\bar{p}K^+X$              |
| 2982.8 $\pm$ 1.0 $\pm$ 0.5                     | 6.4k | <sup>2</sup> AAIJ                                                                                                      | 17BB LHCb | $pp \rightarrow b\bar{b}X \rightarrow 2(K^+K^-)X$           |
| 2982.2 $\pm$ 1.5 $\pm$ 0.1                     | 2.0k | <sup>3</sup> AAIJ                                                                                                      | 15BI LHCb | $pp \rightarrow \eta_c(1S)X$                                |
| 2983.5 $\pm$ 1.4 $^{+1.6}_{-3.6}$              |      | <sup>4</sup> ANASHIN                                                                                                   | 14 KEDR   | $J/\psi \rightarrow \gamma\eta_c$                           |
| 2979.8 $\pm$ 0.8 $\pm$ 3.5                     | 4.5k | <sup>5,6</sup> LEES                                                                                                    | 14E BABR  | $\gamma\gamma \rightarrow K^+K^-\pi^0$                      |
| 2984.1 $\pm$ 1.1 $\pm$ 2.1                     | 900  | <sup>5,6,7</sup> LEES                                                                                                  | 14E BABR  | $\gamma\gamma \rightarrow K^+K^-\eta$                       |
| 2984.3 $\pm$ 0.6 $\pm$ 0.6                     |      | <sup>8,9</sup> ABLIKIM                                                                                                 | 12F BES3  | $\psi(2S) \rightarrow \gamma\eta_c$                         |
| 2984.49 $\pm$ 1.16 $\pm$ 0.52                  | 832  | <sup>5</sup> ABLIKIM                                                                                                   | 12N BES3  | $\psi(2S) \rightarrow \pi^0\gamma$ hadrons                  |
| 2982.7 $\pm$ 1.8 $\pm$ 2.2                     | 486  | ZHANG                                                                                                                  | 12A BELL  | $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$                  |
| 2984.5 $\pm$ 0.8 $\pm$ 3.1                     | 11k  | DEL-AMO-SA..11M                                                                                                        | BABR      | $\gamma\gamma \rightarrow K^+K^-\pi^+\pi^-\pi^0$            |
| 2985.4 $\pm$ 1.5 $^{+0.5}_{-2.0}$              | 920  | <sup>9</sup> VINOKUROVA                                                                                                | 11 BELL   | $B^\pm \rightarrow K^\pm(K_S^0 K^\pm \pi^\mp)$              |
| 2982.2 $\pm$ 0.4 $\pm$ 1.6                     | 14k  | <sup>10</sup> LEES                                                                                                     | 10 BABR   | $10.6 e^+e^- \rightarrow e^+e^-K_S^0 K^\pm \pi^\mp$         |
| 2985.8 $\pm$ 1.5 $\pm$ 3.1                     | 0.9k | AUBERT                                                                                                                 | 08AB BABR | $B \rightarrow \eta_c(1S)K(*) \rightarrow K\bar{K}\pi K(*)$ |
| 2986.1 $\pm$ 1.0 $\pm$ 2.5                     | 7.5k | UEHARA                                                                                                                 | 08 BELL   | $\gamma\gamma \rightarrow \eta_c \rightarrow$ hadrons       |
| 2970 $\pm$ 5 $\pm$ 6                           | 501  | <sup>11</sup> ABE                                                                                                      | 07 BELL   | $e^+e^- \rightarrow J/\psi(c\bar{c})$                       |
| 2971 $\pm$ 3 $^{+2}_{-1}$                      | 195  | WU                                                                                                                     | 06 BELL   | $B^+ \rightarrow p\bar{p}K^+$                               |

NODE=M026M

NODE=M026M  
NEW

OCCUR=2

|                                                                               |                       |                   |      |                                 |      |                                                |                                                                   |         |
|-------------------------------------------------------------------------------|-----------------------|-------------------|------|---------------------------------|------|------------------------------------------------|-------------------------------------------------------------------|---------|
| 2974                                                                          | $\pm 7$               | $\pm \frac{2}{1}$ | 20   | WU                              | 06   | BELL                                           | $B^+ \rightarrow \Lambda \bar{\Lambda} K^+$                       | OCCUR=2 |
| 2981.8                                                                        | $\pm 1.3$             | $\pm 1.5$         | 592  | ASNER                           | 04   | CLEO                                           | $\gamma\gamma \rightarrow \eta_c \rightarrow K_S^0 K^\pm \pi^\mp$ |         |
| 2984.1                                                                        | $\pm 2.1$             | $\pm 1.0$         | 190  | <sup>12</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                                                                        | $\pm 0.4$             | $\pm 1.4$         | 12k  | <sup>13</sup> DEL-AMO-SA..11M   | BABR | $\gamma\gamma \rightarrow K_S^0 K^\pm \pi^\mp$ | OCCUR=2                                                           |         |
| 2982.2                                                                        | $\pm 0.6$             |                   |      | <sup>14</sup> MITCHELL          | 09   | CLEO                                           | $e^+e^- \rightarrow \gamma X$                                     |         |
| 2982                                                                          | $\pm 5$               |                   | 270  | <sup>15</sup> AUBERT            | 06E  | BABR                                           | $B^\pm \rightarrow K^\pm X_{c\bar{c}}$                            |         |
| 2982.5                                                                        | $\pm 1.1$             | $\pm 0.9$         | 2.5k | <sup>16</sup> AUBERT            | 04D  | BABR                                           | $\gamma\gamma \rightarrow \eta_c(1S) \rightarrow K \bar{K} \pi$   |         |
| 2977.5                                                                        | $\pm 1.0$             | $\pm 1.2$         |      | <sup>14,17</sup> BAI            | 03   | BES                                            | $J/\psi \rightarrow \gamma \eta_c$                                |         |
| 2979.6                                                                        | $\pm 2.3$             | $\pm 1.6$         | 180  | <sup>18</sup> FANG              | 03   | BELL                                           | $B \rightarrow \eta_c K$                                          |         |
| 2976.3                                                                        | $\pm 2.3$             | $\pm 1.2$         |      | <sup>14,19</sup> BAI            | 00F  | BES                                            | $J/\psi, \psi(2S) \rightarrow \gamma \eta_c$                      |         |
| 2976.6                                                                        | $\pm 2.9$             | $\pm 1.3$         | 140  | <sup>14,20</sup> BAI            | 00F  | BES                                            | $J/\psi \rightarrow \gamma \eta_c$                                | OCCUR=2 |
| 2980.4                                                                        | $\pm 2.3$             | $\pm 0.6$         |      | <sup>21</sup> BRANDENB...       | 00B  | CLE2                                           | $\gamma\gamma \rightarrow \eta_c \rightarrow K^\pm K_S^0 \pi^\mp$ |         |
| 2975.8                                                                        | $\pm 3.9$             | $\pm 1.2$         |      | <sup>20</sup> BAI               | 99B  | BES                                            | Sup. by BAI 00F                                                   |         |
| 2999                                                                          | $\pm 8$               |                   | 25   | ABREU                           | 98O  | DLPH                                           | $e^+e^- \rightarrow e^+e^- + \text{hadrons}$                      |         |
| 2988.3                                                                        | $\pm \frac{3.3}{3.1}$ |                   |      | ARMSTRONG                       | 95F  | E760                                           | $\bar{p}p \rightarrow \gamma\gamma$                               |         |
| 2974.4                                                                        | $\pm 1.9$             |                   |      | <sup>14,22</sup> BISELLO        | 91   | DM2                                            | $J/\psi \rightarrow \eta_c \gamma$                                |         |
| 2969                                                                          | $\pm 4$               | $\pm 4$           | 80   | <sup>14</sup> BAI               | 90B  | MRK3                                           | $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$                       |         |
| 2956                                                                          | $\pm 12$              | $\pm 12$          |      | <sup>14</sup> BAI               | 90B  | MRK3                                           | $J/\psi \rightarrow \gamma K^+ K^- K_S^0 K_L^0$                   | OCCUR=3 |
| 2982.6                                                                        | $\pm \frac{2.7}{2.3}$ |                   | 12   | BAGLIN                          | 87B  | SPEC                                           | $\bar{p}p \rightarrow \gamma\gamma$                               |         |
| 2980.2                                                                        | $\pm 1.6$             |                   |      | <sup>14,22</sup> BALTRUSAIT..86 | MRK3 | $J/\psi \rightarrow \eta_c \gamma$             |                                                                   |         |
| 2984                                                                          | $\pm 2.3$             | $\pm 4.0$         |      | <sup>14</sup> GAISER            | 86   | CBAL                                           | $J/\psi \rightarrow \gamma X, \psi(2S) \rightarrow \gamma X$      |         |
| 2976                                                                          | $\pm 8$               |                   |      | <sup>14,23</sup> BALTRUSAIT..84 | MRK3 | $J/\psi \rightarrow 2\phi \gamma$              |                                                                   |         |
| 2982                                                                          | $\pm 8$               |                   | 18   | <sup>24</sup> HIMEL             | 80B  | MRK2                                           | $e^+e^-$                                                          |         |
| 2980                                                                          | $\pm 9$               |                   |      | <sup>24</sup> PARTRIDGE         | 80B  | CBAL                                           | $e^+e^-$                                                          |         |

<sup>1</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.

<sup>2</sup> From a fit of the  $\phi\phi$  invariant mass with the mass and width of  $\eta_c(1S)$  as free parameters.

<sup>3</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.

<sup>4</sup> Taking into account an asymmetric photon lineshape.

<sup>5</sup> With floating width.

<sup>6</sup> Ignoring possible interference with the non-resonant  $0^-$  amplitude.

<sup>7</sup> Using both,  $\eta \rightarrow \gamma\gamma$  and  $\eta \rightarrow \pi^+\pi^-\pi^0$  decays.

<sup>8</sup> From a simultaneous fit to six decay modes of the  $\eta_c$ .

<sup>9</sup> Accounts for interference with non-resonant continuum.

<sup>10</sup> Taking into account interference with the non-resonant  $J^P = 0^-$  amplitude.

<sup>11</sup> From a fit of the  $J/\psi$  recoil mass spectrum. Supersedes ABE,K 02 and ABE 04G.

<sup>12</sup> Using mass of  $\psi(2S) = 3686.00$  MeV.

<sup>13</sup> Not independent from the measurements reported by LEES 10.

<sup>14</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.

<sup>15</sup> From the fit of the kaon momentum spectrum. Systematic errors not evaluated.

<sup>16</sup> Superseded by LEES 10.

<sup>17</sup> From a simultaneous fit of five decay modes of the  $\eta_c$ .

<sup>18</sup> Superseded by VINOKUROVA 11.

<sup>19</sup> Weighted average of the  $\psi(2S)$  and  $J/\psi(1S)$  samples. Using an  $\eta_c$  width of 13.2 MeV.

<sup>20</sup> Average of several decay modes. Using an  $\eta_c$  width of 13.2 MeV.

<sup>21</sup> Superseded by ASNER 04.

<sup>22</sup> Average of several decay modes.

<sup>23</sup>  $\eta_c \rightarrow \phi\phi$ .

<sup>24</sup> Mass adjusted by us to correspond to  $J/\psi(1S)$  mass = 3097 MeV.

NODE=M026M;LINKAGE=F

NODE=M026M;LINKAGE=G

NODE=M026M;LINKAGE=D

NODE=M026M;LINKAGE=E

NODE=M026M;LINKAGE=AL

NODE=M026M;LINKAGE=LS

NODE=M026M;LINKAGE=EL

NODE=M026M;LINKAGE=BL

NODE=M026M;LINKAGE=VA

NODE=M026M;LINKAGE=LE

NODE=M026M;LINKAGE=EB

NODE=M026M;LINKAGE=BG

NODE=M026M;LINKAGE=DE

NODE=M026M;LINKAGE=MI

NODE=M026M;LINKAGE=AU

NODE=M026M;LINKAGE=UB

NODE=M026M;LINKAGE=AK

NODE=M026M;LINKAGE=FA

NODE=M026M;LINKAGE=KZ

NODE=M026M;LINKAGE=C1

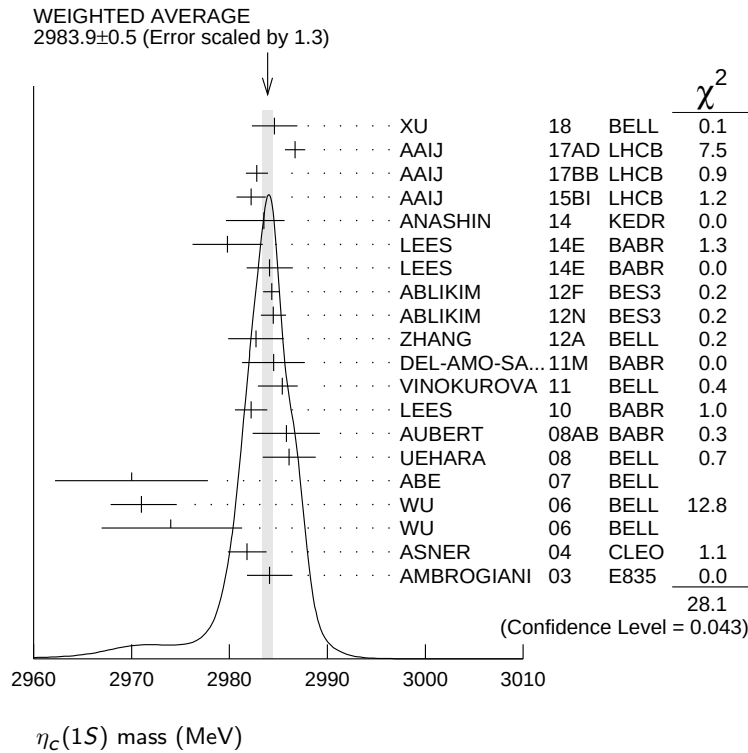
NODE=M026M;LINKAGE=NN

NODE=M026M;LINKAGE=A

NODE=M026M;LINKAGE=B

NODE=M026M;LINKAGE=M





### $\eta_c(1S)$ WIDTH

NODE=M026W

| VALUE (MeV)                                                                              | EVTS | DOCUMENT ID     | TECN      | COMMENT                                                         |
|------------------------------------------------------------------------------------------|------|-----------------|-----------|-----------------------------------------------------------------|
| <b>31.9± 0.7 OUR FIT</b>                                                                 |      |                 |           |                                                                 |
| [32.0 ± 0.8 MeV OUR 2018 FIT]                                                            |      |                 |           |                                                                 |
| <b>32.1± 0.8 OUR AVERAGE</b>                                                             |      |                 |           |                                                                 |
| Error includes scale factor of 1.1. [32.1 ± 0.9 MeV OUR 2018 AVERAGE Scale factor = 1.1] |      |                 |           |                                                                 |
| 30.8 <sup>+2.3</sup> <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 | 1 AAIJ          | 17BB LHCB | $pp \rightarrow b\bar{b}X \rightarrow 2(K^+K^-)X$               |
| 27.2 ± 3.1 <sup>+5.4</sup> <sub>-2.6</sub>                                               |      | 2 ANASHIN       | 14 KEDR   | $J/\psi \rightarrow \gamma\eta_c$                               |
| 25.2 ± 2.6 ± 2.4                                                                         | 4.5k | 3,4 LEES        | 14E BABR  | $\gamma\gamma \rightarrow K^+K^-\pi^0$                          |
| 34.8 ± 3.1 ± 4.0                                                                         | 900  | 3,4,5 LEES      | 14E BABR  | $\gamma\gamma \rightarrow K^+K^-\eta$                           |
| 32.0 ± 1.2 ± 1.0                                                                         |      | 6,7 ABLIKIM     | 12F BES3  | $\psi(2S) \rightarrow \gamma\eta_c$                             |
| 36.4 ± 3.2 ± 1.7                                                                         | 832  | 3 ABLIKIM       | 12N BES3  | $\psi(2S) \rightarrow \pi^0\gamma \text{ hadrons}$              |
| 37.8 <sup>+5.8</sup> <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>+1.0</sup> <sub>-1.6</sub>                                               | 920  | 7 VINOKUROVA    | 11 BELL   | $B^\pm \rightarrow K^\pm(K_S^0K^\pm\pi^\mp)$                    |
| 31.7 ± 1.2 ± 0.8                                                                         | 14k  | 8 LEES          | 10 BABR   | $10.6 e^+e^- \rightarrow e^+e^-K_S^0K^\pm\pi^\mp$               |
| 36.3 <sup>+3.7</sup> <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>+8</sup> <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   | $\gamma\gamma \rightarrow \eta_c \rightarrow K_S^0K^\pm\pi^\mp$ |
| 20.4 <sup>+7.7</sup> <sub>-6.7</sub> ± 2.0                                               | 190  | AMBROGIANI      | 03 E835   | $\bar{p}p \rightarrow \eta_c \rightarrow \gamma\gamma$          |
| 23.9 <sup>+12.6</sup> <sub>-7.1</sub>                                                    |      | ARMSTRONG       | 95F E760  | $\bar{p}p \rightarrow \gamma\gamma$                             |

NODE=M026W

NEW

NEW

OCCUR=2

OCCUR=2

• • • 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  | $J/\psi \rightarrow \gamma\eta_c$ 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>7.0</sub>  | 12   | BAGLIN                       | 87B SPEC | $\bar{p}p \rightarrow \gamma\gamma$                                       |
| 10.1 <sup>+</sup> <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 | $e^+e^-$                                                                  |

OCCUR=2

<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;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 |
|----------------------------------------------------------|------------------------------------|------------------|
| <b>Decays involving hadronic resonances</b>              |                                    |                  |
| $\Gamma_1 \quad \eta'(958)\pi\pi$                        | ( 4.1 ± 1.7 ) %                    |                  |
| $\Gamma_2 \quad \rho\rho$                                | ( 1.8 ± 0.5 ) %                    |                  |
| $\Gamma_3 \quad K^*(892)^0 K^- \pi^+ + \text{c.c.}$      | ( 2.0 ± 0.7 ) %                    |                  |
| $\Gamma_4 \quad K^*(892)\bar{K}^*(892)$                  | ( 7.1 ± 1.3 ) × 10 <sup>-3</sup>   |                  |
| $\Gamma_5 \quad K^*(892)^0 \bar{K}^*(892)^0 \pi^+ \pi^-$ | ( 1.1 ± 0.5 ) %                    |                  |
| $\Gamma_6 \quad \phi K^+ K^-$                            | ( 2.9 ± 1.4 ) × 10 <sup>-3</sup>   |                  |
| $\Gamma_7 \quad \phi\phi$                                | ( 1.79 ± 0.20 ) × 10 <sup>-3</sup> |                  |
| $\Gamma_8 \quad \phi 2(\pi^+ \pi^-)$                     | < 4 × 10 <sup>-3</sup>             | 90%              |
| $\Gamma_9 \quad a_0(980)\pi$                             | < 2 %                              | 90%              |
| $\Gamma_{10} \quad a_2(1320)\pi$                         | < 2 %                              | 90%              |
| $\Gamma_{11} \quad K^*(892)\bar{K} + \text{c.c.}$        | < 1.28 %                           | 90%              |
| $\Gamma_{12} \quad f_2(1270)\eta$                        | < 1.1 %                            | 90%              |
| $\Gamma_{13} \quad \omega\omega$                         | < 3.1 × 10 <sup>-3</sup>           | 90%              |
| $\Gamma_{14} \quad \omega\phi$                           | < 2.5 × 10 <sup>-4</sup>           | 90%              |
| $\Gamma_{15} \quad f_2(1270)f_2(1270)$                   | ( 9.8 ± 2.5 ) × 10 <sup>-3</sup>   |                  |
| $\Gamma_{16} \quad f_2(1270)f_2'(1525)$                  | ( 9.8 ± 3.2 ) × 10 <sup>-3</sup>   |                  |
| $\Gamma_{17} \quad f_0(980)\eta$                         | seen                               |                  |
| $\Gamma_{18} \quad f_0(1500)\eta$                        | seen                               |                  |
| $\Gamma_{19} \quad f_0(2200)\eta$                        | seen                               |                  |
| $\Gamma_{20} \quad a_0(980)\pi$                          | seen                               |                  |
| $\Gamma_{21} \quad a_0(1320)\pi$                         | seen                               |                  |
| $\Gamma_{22} \quad a_0(1450)\pi$                         | seen                               |                  |
| $\Gamma_{23} \quad a_0(1950)\pi$                         | seen                               |                  |
| $\Gamma_{24} \quad K_0^*(1430)\bar{K}$                   | seen                               |                  |
| $\Gamma_{25} \quad K_2^*(1430)\bar{K}$                   | seen                               |                  |
| $\Gamma_{26} \quad K_0^*(1950)\bar{K}$                   | seen                               |                  |

NODE=M026;CLUMP=A

DESIG=24

DESIG=19

DESIG=26

DESIG=18

DESIG=57

DESIG=28

DESIG=17

DESIG=58

DESIG=21

DESIG=22

DESIG=40

DESIG=23

DESIG=20

DESIG=47

DESIG=46

DESIG=59

DESIG=70

DESIG=71

DESIG=72

DESIG=73

DESIG=74

DESIG=75

DESIG=79

DESIG=76

DESIG=77

DESIG=78

**Decays into stable hadrons**

|               |                                            |                                  |     |                               |
|---------------|--------------------------------------------|----------------------------------|-----|-------------------------------|
| $\Gamma_{27}$ | $K\bar{K}\pi$                              | $(7.3 \pm 0.5) \%$               |     | NODE=M026;CLUMP=B<br>DESIG=14 |
| $\Gamma_{28}$ | $K\bar{K}\eta$                             | $(1.36 \pm 0.16) \%$             |     | DESIG=25                      |
| $\Gamma_{29}$ | $\eta\pi^+\pi^-$                           | $(1.7 \pm 0.5) \%$               |     | DESIG=16                      |
| $\Gamma_{30}$ | $\eta 2(\pi^+\pi^-)$                       | $(4.4 \pm 1.3) \%$               |     | DESIG=61                      |
| $\Gamma_{31}$ | $K^+K^-\pi^+\pi^-$                         | $(6.9 \pm 1.1) \times 10^{-3}$   |     | DESIG=15                      |
| $\Gamma_{32}$ | $K^+K^-\pi^+\pi^-\pi^0$                    | $(3.5 \pm 0.6) \%$               |     | DESIG=60                      |
| $\Gamma_{33}$ | $K^0K^-\pi^+\pi^-\pi^+ + \text{c.c.}$      | $(5.6 \pm 1.5) \%$               |     | DESIG=62                      |
| $\Gamma_{34}$ | $K^+K^-2(\pi^+\pi^-)$                      | $(7.5 \pm 2.4) \times 10^{-3}$   |     | DESIG=55                      |
| $\Gamma_{35}$ | $2(K^+K^-)$                                | $(1.47 \pm 0.31) \times 10^{-3}$ |     | DESIG=27                      |
| $\Gamma_{36}$ | $\pi^+\pi^-\pi^0$                          | $< 5 \times 10^{-4}$             | 90% | DESIG=81                      |
| $\Gamma_{37}$ | $\pi^+\pi^-\pi^0\pi^0$                     | $(4.7 \pm 1.0) \%$               |     | DESIG=63                      |
| $\Gamma_{38}$ | $2(\pi^+\pi^-)$                            | $(9.7 \pm 1.2) \times 10^{-3}$   |     | DESIG=11                      |
| $\Gamma_{39}$ | $2(\pi^+\pi^-\pi^0)$                       | $(17.4 \pm 3.3) \%$              |     | DESIG=64                      |
| $\Gamma_{40}$ | $3(\pi^+\pi^-)$                            | $(1.8 \pm 0.4) \%$               |     | DESIG=56                      |
| $\Gamma_{41}$ | $p\bar{p}$                                 | $(1.51 \pm 0.16) \times 10^{-3}$ |     | DESIG=12                      |
| $\Gamma_{42}$ | $p\bar{p}\pi^0$                            | $(3.6 \pm 1.3) \times 10^{-3}$   |     | DESIG=65                      |
| $\Gamma_{43}$ | $\Lambda\bar{\Lambda}$                     | $(1.09 \pm 0.24) \times 10^{-3}$ |     | 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                      |
| $\Gamma_{48}$ | $\pi^+\pi^-p\bar{p}$                       | $(5.3 \pm 1.8) \times 10^{-3}$   |     | DESIG=13                      |

**Radiative decays**

|               |                |                                  |  |                               |
|---------------|----------------|----------------------------------|--|-------------------------------|
| $\Gamma_{49}$ | $\gamma\gamma$ | $(1.57 \pm 0.12) \times 10^{-4}$ |  | NODE=M026;CLUMP=C<br>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<br>DESIG=51 |
| $\Gamma_{51}$ | $\pi^0\pi^0$ | $P, CP < 4 \times 10^{-5}$   | 90% | DESIG=52                      |
| $\Gamma_{52}$ | $K^+K^-$     | $P, CP < 6 \times 10^{-4}$   | 90% | DESIG=53                      |
| $\Gamma_{53}$ | $K_S^0K_S^0$ | $P, CP < 3.1 \times 10^{-4}$ | 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 89 measurements and one constraint to determine 13 parameters. The overall fit has a  $\chi^2 = 120.0$  for 77 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.

|          |       |       |          |          |          |          |          |          |          |          |
|----------|-------|-------|----------|----------|----------|----------|----------|----------|----------|----------|
| $x_7$    | 17    |       |          |          |          |          |          |          |          |          |
| $x_{15}$ | 3     | 6     |          |          |          |          |          |          |          |          |
| $x_{27}$ | 21    | 41    | 7        |          |          |          |          |          |          |          |
| $x_{28}$ | 11    | 22    | 4        | 54       |          |          |          |          |          |          |
| $x_{31}$ | 11    | 20    | 4        | 24       | 13       |          |          |          |          |          |
| $x_{35}$ | 9     | 16    | 3        | 25       | 13       | 10       |          |          |          |          |
| $x_{38}$ | 13    | 25    | 5        | 30       | 16       | 15       | 12       |          |          |          |
| $x_{41}$ | 14    | 25    | 5        | 35       | 19       | 16       | 13       | 19       |          |          |
| $x_{43}$ | 3     | 6     | 1        | 9        | 5        | 4        | 3        | 5        | 25       |          |
| $x_{49}$ | -29   | -54   | -10      | -66      | -35      | -34      | -26      | -41      | -45      | -11      |
| $\Gamma$ | -1    | -3    | 0        | -3       | -2       | -2       | -1       | -2       | 6        | 2        |
|          | $x_4$ | $x_7$ | $x_{15}$ | $x_{27}$ | $x_{28}$ | $x_{31}$ | $x_{35}$ | $x_{38}$ | $x_{41}$ | $x_{43}$ |

$$\Gamma \begin{array}{|l} -26 \\ \times 49 \end{array}$$

| Mode                                 | Rate (MeV)          |
|--------------------------------------|---------------------|
| $\Gamma_4$ $K^*(892)\bar{K}^*(892)$  | 0.23 $\pm$ 0.04     |
| $\Gamma_7$ $\phi\phi$                | 0.057 $\pm$ 0.006   |
| $\Gamma_{15}$ $f_2(1270)f_2(1270)$   | 0.31 $\pm$ 0.08     |
| $\Gamma_{27}$ $K\bar{K}\pi$          | 2.34 $\pm$ 0.16     |
| $\Gamma_{28}$ $K\bar{K}\eta$         | 0.43 $\pm$ 0.05     |
| $\Gamma_{31}$ $K^+K^-\pi^+\pi^-$     | 0.222 $\pm$ 0.034   |
| $\Gamma_{35}$ $2(K^+K^-)$            | 0.047 $\pm$ 0.010   |
| $\Gamma_{38}$ $2(\pi^+\pi^-)$        | 0.31 $\pm$ 0.04     |
| $\Gamma_{41}$ $\rho\bar{\rho}$       | 0.048 $\pm$ 0.005   |
| $\Gamma_{43}$ $\Lambda\bar{\Lambda}$ | 0.035 $\pm$ 0.008   |
| $\Gamma_{49}$ $\gamma\gamma$         | 0.0050 $\pm$ 0.0004 |

DESIG=18  
DESIG=17  
DESIG=46  
DESIG=14  
DESIG=25  
DESIG=15  
DESIG=27  
DESIG=11  
DESIG=12  
DESIG=45  
DESIG=31

### $\eta_c(1S)$ PARTIAL WIDTHS

NODE=M026217

$\Gamma(\gamma\gamma)$

$\Gamma_{49}$

| VALUE (keV)                             | EVTS | DOCUMENT ID | TECN | COMMENT |
|-----------------------------------------|------|-------------|------|---------|
| <b>5.0 <math>\pm</math> 0.4 OUR FIT</b> |      |             |      |         |

NODE=M026W1  
NODE=M026W1

• • • 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      | 157 $\pm$ 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 $^{+1.1}_{-1.0} \pm 1.9$ | 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 $e^+e^-$                                                       |
| 6.7 $^{+2.4}_{-1.7} \pm 2.3$ |              | <sup>4</sup> ARMSTRONG     | 95F E760 | $\bar{p}p \rightarrow \gamma\gamma$                               |
| 11.3 $\pm$ 4.2               |              | <sup>10</sup> ALBRECHT     | 94H ARG  | $e^+e^- \rightarrow e^+e^-\eta_c$                                 |
| 8.0 $\pm$ 2.3 $\pm$ 2.4      | 17           | <sup>11</sup> ADRIANI      | 93N L3   | $e^+e^- \rightarrow e^+e^-\eta_c$                                 |
| 5.9 $^{+2.1}_{-1.8} \pm 1.9$ |              | <sup>7</sup> CHEN          | 90B CLEO | $e^+e^- \rightarrow e^+e^-\eta_c$                                 |
| 6.4 $^{+5.0}_{-3.4}$         |              | <sup>12</sup> AIHARA       | 88D TPC  | $e^+e^- \rightarrow e^+e^-X$                                      |
| 4.3 $^{+3.4}_{-3.7} \pm 2.4$ |              | <sup>4</sup> BAGLIN        | 87B SPEC | $\bar{p}p \rightarrow \gamma\gamma$                               |
| 28 $\pm 15$                  |              | <sup>5,13</sup> 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

 $\Gamma(\eta'(958)\pi\pi) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}} \quad \Gamma_1 \Gamma_{49} / \Gamma$ 

| VALUE (eV)        | EVTS                           | DOCUMENT ID | TECN | COMMENT                                         |
|-------------------|--------------------------------|-------------|------|-------------------------------------------------|
| 98 + OUR AVERAGE  | [76 ± 10 keV OUR 2018 AVERAGE] |             |      |                                                 |
| 98.1 ± 3.9 ± 11.7 | 2673                           | XU          | 18   | BELL $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$ |

NODE=M026G10  
 NODE=M026G10  
 NEW

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

|                                            |     |                    |     |                                                 |
|--------------------------------------------|-----|--------------------|-----|-------------------------------------------------|
| 75.8 <sup>+6.3</sup> <sub>-6.2</sub> ± 8.4 | 486 | <sup>1</sup> ZHANG | 12A | BELL $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$ |
|--------------------------------------------|-----|--------------------|-----|-------------------------------------------------|

<sup>1</sup> Superseded by XU 2018

NODE=M026G10;LINKAGE=A

 $\Gamma(\rho\rho) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}} \quad \Gamma_2 \Gamma_{49} / \Gamma$ 

| VALUE (eV) | CL% | EVTS   | DOCUMENT ID | TECN | COMMENT                                       |
|------------|-----|--------|-------------|------|-----------------------------------------------|
| <39        | 90  | < 1556 | UEHARA      | 08   | BELL $\gamma\gamma \rightarrow 2(\pi^+\pi^-)$ |

NODE=M026G09  
 NODE=M026G09

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

 $\Gamma(K^*(892)\bar{K}^*(892)) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}} \quad \Gamma_4 \Gamma_{49} / \Gamma$ 

| VALUE (eV)       | EVTS      | DOCUMENT ID | TECN | COMMENT                                          |
|------------------|-----------|-------------|------|--------------------------------------------------|
| 35 ± 6 OUR FIT   |           |             |      |                                                  |
| 32.4 ± 4.2 ± 5.8 | 882 ± 115 | UEHARA      | 08   | BELL $\gamma\gamma \rightarrow \pi^+\pi^-K^+K^-$ |

NODE=M026G08  
 NODE=M026G08

 $\Gamma(\phi\phi) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}} \quad \Gamma_7 \Gamma_{49} / \Gamma$ 

| VALUE (eV)         | EVTS     | DOCUMENT ID      | TECN | COMMENT                                   |
|--------------------|----------|------------------|------|-------------------------------------------|
| 9.0 ± 0.8 OUR FIT  |          |                  |      |                                           |
| 7.75 ± 0.66 ± 0.62 | 386 ± 31 | <sup>1</sup> LIU | 12B  | BELL $\gamma\gamma \rightarrow 2(K^+K^-)$ |

NODE=M026G07  
 NODE=M026G07

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

|                 |          |        |    |                                           |
|-----------------|----------|--------|----|-------------------------------------------|
| 6.8 ± 1.2 ± 1.3 | 132 ± 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;LINKAGE=LI

 $\Gamma(\omega\omega) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}} \quad \Gamma_{13} \Gamma_{49} / \Gamma$ 

| VALUE (eV)         | EVTS    | DOCUMENT ID      | TECN | COMMENT                                            |
|--------------------|---------|------------------|------|----------------------------------------------------|
| 8.67 ± 2.86 ± 0.96 | 85 ± 29 | <sup>1</sup> LIU | 12B  | BELL $\gamma\gamma \rightarrow 2(\pi^+\pi^-\pi^0)$ |

NODE=M026G03  
 NODE=M026G03

<sup>1</sup> Using  $B(\omega \rightarrow \pi^+\pi^-\pi^0) = (89.2 \pm 0.7)\%$ .

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                                               |
|------------|-----|------------------|------|-------------------------------------------------------|
| <0.49      | 90  | <sup>1</sup> LIU | 12B  | BELL $\gamma\gamma \rightarrow K^+K^-\pi^+\pi^-\pi^0$ |

NODE=M026G04  
 NODE=M026G04

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

<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;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                                       |
|-----------------|------------|-------------|------|-----------------------------------------------|
| 49 ± 13 OUR FIT |            |             |      |                                               |
| 69 ± 17 ± 12    | 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                                          |
|-------------|------------|-------------|------|--------------------------------------------------|
| 49 ± 9 ± 13 | 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                             |
|---------------------------|-----|------|-------------|------|-------------------------------------|
| 0.367 ± 0.021 OUR FIT     |     |      |             |      |                                     |
| 0.407 ± 0.027 OUR AVERAGE |     |      |             |      | Error includes scale factor of 1.2. |

NODE=M026G14  
 NODE=M026G14

|                       |     |                   |    |                                                        |
|-----------------------|-----|-------------------|----|--------------------------------------------------------|
| 0.374 ± 0.009 ± 0.031 | 14k | <sup>1</sup> LEES | 10 | BABR $10.6 e^+e^- \rightarrow e^+e^-K_S^0K^\pm\pi^\mp$ |
|-----------------------|-----|-------------------|----|--------------------------------------------------------|

|                       |  |                      |    |                                                                      |
|-----------------------|--|----------------------|----|----------------------------------------------------------------------|
| 0.407 ± 0.022 ± 0.028 |  | <sup>2,3</sup> ASNER | 04 | CLEO $\gamma\gamma \rightarrow \eta_c \rightarrow K_S^0K^\pm\pi^\mp$ |
|-----------------------|--|----------------------|----|----------------------------------------------------------------------|

|                    |    |                         |     |                                                   |
|--------------------|----|-------------------------|-----|---------------------------------------------------|
| 0.60 ± 0.12 ± 0.09 | 41 | <sup>3,4</sup> ABDALLAH | 03J | DLPH $\gamma\gamma \rightarrow K_S^0K^\pm\pi^\mp$ |
|--------------------|----|-------------------------|-----|---------------------------------------------------|

|                    |  |                     |    |                                                                      |
|--------------------|--|---------------------|----|----------------------------------------------------------------------|
| 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

$\Gamma(K^+ K^- \pi^+ \pi^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$   $\Gamma_{31}\Gamma_{49}/\Gamma$

| VALUE (eV)                | EVTS       |  | DOCUMENT ID | TECN     | COMMENT                                        |
|---------------------------|------------|--|-------------|----------|------------------------------------------------|
| <b>35 ± 5 OUR FIT</b>     |            |  |             |          |                                                |
| <b>27 ± 6 OUR AVERAGE</b> |            |  |             |          |                                                |
| 25.7 ± 3.2 ± 4.9          | 2019 ± 248 |  | 1 UEHARA    | 08 BELL  | $\gamma\gamma \rightarrow \pi^+ \pi^- K^+ K^-$ |
| 280 ± 100 ± 60            | 42         |  | 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

NODE=M026G;LINKAGE=CC

$\Gamma(K^+ K^- \pi^+ \pi^- \pi^0) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$   $\Gamma_{32}\Gamma_{49}/\Gamma$

| 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

$\Gamma(2(K^+ K^-)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$   $\Gamma_{35}\Gamma_{49}/\Gamma$

| <u>VALUE (eV)</u>           | <u>EVTS</u> | <u>DOCUMENT ID</u>    | <u>TECN</u> | <u>COMMENT</u>                        |
|-----------------------------|-------------|-----------------------|-------------|---------------------------------------|
| <b>7.4± 1.5 OUR FIT</b>     |             |                       |             |                                       |
| <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

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>49 ± 6 OUR FIT</b>     |            |             |         |                                           |
| <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

$\Gamma(p\bar{p}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$   $\Gamma_{41}\Gamma_{49}/\Gamma$

| VALUE (eV)                                       | EVTS     | DOCUMENT ID      | TECN    | COMMENT                             |
|--------------------------------------------------|----------|------------------|---------|-------------------------------------|
| <b>7.6 ±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

| $\Gamma(\rho\rho)/\Gamma_{\text{total}}$                                                                                                                                                                                   |     |                             |             |                                    | $\Gamma_2/\Gamma$                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----------------------------|-------------|------------------------------------|-----------------------------------------------------|
| VALUE (units $10^{-3}$ )                                                                                                                                                                                                   | CL% | EVTS                        | DOCUMENT ID | TECN                               | COMMENT                                             |
| <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                            |                                                  |
| <b>71±13 OUR FIT</b>                                                                                                                                                                                                       |      |                             |      |                                    |                                                  |
| <b>91±26 OUR AVERAGE</b>                                                                                                                                                                                                   |      |                             |      |                                    |                                                  |
| 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

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 |                                                             |
| <b>113±47±24</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 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                                   |                   |
| <b>2.9<sup>+0.9</sup><sub>-0.8</sub>±1.1</b>                                                                                                                                                | 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

**17.9 ± 2.0 OUR FIT****28 ± 4 OUR AVERAGE**

|                        |                   |         |      |                      |     |      |                                                 |
|------------------------|-------------------|---------|------|----------------------|-----|------|-------------------------------------------------|
| 26                     | $\pm \frac{4}{8}$ | $\pm 5$ | 1.2k | <sup>1</sup> ABLIKIM | 17P | BES3 | $J/\psi \rightarrow K^+ K^- K^+ K^- \gamma$     |
| 25.3 ± 26              | 5.1 ± 9           | 9.1     | 72   | <sup>2</sup> ABLIKIM | 05L | BES2 | $J/\psi \rightarrow K^+ K^- K^+ K^- \gamma$     |
| $\pm 9$                |                   |         | 357  | <sup>2</sup> BAI     | 04  | BES  | $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$     |
| 31 ± 7                 | $\pm 10$          |         | 19   | <sup>2</sup> BISELLO | 91  | DM2  | $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$     |
| 30 $\pm \frac{18}{12}$ | $\pm 10$          |         | 5    | <sup>2</sup> BISELLO | 91  | DM2  | $J/\psi \rightarrow \gamma K^+ K^- K_S^0 K_L^0$ |
| 74 ± 18                | $\pm 24$          |         | 80   | <sup>2</sup> BAI     | 90B | MRK3 | $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$     |
| 67 ± 21                | $\pm 24$          |         |      | <sup>2</sup> BAI     | 90B | MRK3 | $J/\psi \rightarrow \gamma K^+ K^- K_S^0 K_L^0$ |

OCCUR=2

OCCUR=3

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

|    |                   |         |   |                    |    |      |                                  |
|----|-------------------|---------|---|--------------------|----|------|----------------------------------|
| 18 | $\pm \frac{8}{6}$ | $\pm 7$ | 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;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

**0.0245 ± 0.0025 OUR FIT****0.044  $\pm \frac{0.012}{0.010}$  OUR AVERAGE**0.055 ± 0.014 ± 0.005 AUBERT,B 04B BABR  $B^\pm \rightarrow K^\pm \eta_c$ 0.032  $\pm \frac{0.014}{0.010}$  ± 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

NODE=M026R39;LINKAGE=BB

 $\Gamma(\phi\phi)/\Gamma(p\bar{p})$  $\Gamma_7/\Gamma_{41}$ 

VALUE EVTS DOCUMENT ID TECN COMMENT

**1.79 ± 0.14 ± 0.32** 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**<40** 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

**<0.02** 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=M026R11NODE=M026R11;LINKAGE=E  
NODE=M026R11;LINKAGE=F $\Gamma(a_2(1320)\pi)/\Gamma_{\text{total}}$  $\Gamma_{10}/\Gamma$ 

VALUE CL% DOCUMENT ID TECN COMMENT

**<0.02** 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

**<0.0128** 90 BISELLO 91 DM2  $J/\psi \rightarrow \gamma K_S^0 K^\pm \pi^\mp$ <0.0132 90 <sup>1</sup> BISELLO 91 DM2  $J/\psi \rightarrow \gamma K^\mp K^\mp \pi^0$ 

<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



$\Gamma(f_2(1270)\eta)/\Gamma_{\text{total}}$ 

| VALUE  | CL% | DOCUMENT ID                 | TECN | COMMENT                            |
|--------|-----|-----------------------------|------|------------------------------------|
| <0.011 | 90  | <sup>1</sup> BALTRUSAIT..86 | MRK3 | $J/\psi \rightarrow \eta_c \gamma$ |

<sup>1</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = 0.0127 \pm 0.0036$ .

 $\Gamma_{12}/\Gamma$ 

NODE=M026R13  
NODE=M026R13

NODE=M026R13;LINKAGE=E

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

| VALUE   | CL% | DOCUMENT ID                 | TECN | COMMENT                            |
|---------|-----|-----------------------------|------|------------------------------------|
| <0.0031 | 90  | <sup>1</sup> BALTRUSAIT..86 | MRK3 | $J/\psi \rightarrow \eta_c \gamma$ |

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

|         |    |                      |          |                                                                 |
|---------|----|----------------------|----------|-----------------------------------------------------------------|
| <0.0063 | 90 | <sup>1</sup> ABLIKIM | 05L BES2 | $J/\psi \rightarrow \pi^+ \pi^- \pi^0 \pi^+ \pi^- \pi^0 \gamma$ |
| <0.0063 |    | <sup>1</sup> BISELLO | 91 DM2   | $J/\psi \rightarrow \gamma \omega \omega$                       |

<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.

 $\Gamma_{13}/\Gamma$ 

NODE=M026R10  
NODE=M026R10

NODE=M026R10;LINKAGE=E

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

| VALUE                  | CL% | DOCUMENT ID          | TECN     | COMMENT                                               |
|------------------------|-----|----------------------|----------|-------------------------------------------------------|
| < $2.5 \times 10^{-4}$ | 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 $\times 10^{-4}$ | 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  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = 0.0127 \pm 0.0036$ .

 $\Gamma_{14}/\Gamma$ 

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 |
|----------------------------|------|-------------|------|---------|
| <b>0.98 ± 0.25 OUR FIT</b> |      |             |      |         |

|                                                    |             |                      |         |                                           |
|----------------------------------------------------|-------------|----------------------|---------|-------------------------------------------|
| <b>0.77<sup>+0.25</sup><sub>-0.30</sub> ± 0.17</b> | 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.

 $\Gamma_{15}/\Gamma$ 

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 $\eta_c \rightarrow K^+ K^- \eta$ |

 $\Gamma_{17}/\Gamma$ 

NODE=M026R41  
NODE=M026R41

 $\Gamma(f_0(1500)\eta)/\Gamma_{\text{total}}$ 

| VALUE | DOCUMENT ID | TECN     | COMMENT                                           |
|-------|-------------|----------|---------------------------------------------------|
| seen  | LEES        | 14E BABR | Dalitz anal. of $\eta_c \rightarrow K^+ K^- \eta$ |

 $\Gamma_{18}/\Gamma$ 

NODE=M026R42  
NODE=M026R42

 $\Gamma(f_0(2200)\eta)/\Gamma_{\text{total}}$ 

| VALUE | DOCUMENT ID | TECN     | COMMENT                                           |
|-------|-------------|----------|---------------------------------------------------|
| seen  | LEES        | 14E BABR | Dalitz anal. of $\eta_c \rightarrow K^+ K^- \eta$ |

 $\Gamma_{19}/\Gamma$ 

NODE=M026R43  
NODE=M026R43

 $\Gamma(a_0(980)\pi)/\Gamma_{\text{total}}$ 

| VALUE | DOCUMENT ID | TECN     | COMMENT                                            |
|-------|-------------|----------|----------------------------------------------------|
| seen  | LEES        | 14E BABR | Dalitz anal. of $\eta_c \rightarrow K^+ K^- \pi^0$ |

 $\Gamma_{20}/\Gamma$ 

NODE=M026R44  
NODE=M026R44

 $\Gamma(a_0(1320)\pi)/\Gamma_{\text{total}}$ 

| VALUE | DOCUMENT ID | TECN     | COMMENT                                            |
|-------|-------------|----------|----------------------------------------------------|
| seen  | LEES        | 14E BABR | Dalitz anal. of $\eta_c \rightarrow K^+ K^- \pi^0$ |

 $\Gamma_{21}/\Gamma$ 

NODE=M026R45  
NODE=M026R45

 $\Gamma(a_0(1450)\pi)/\Gamma_{\text{total}}$ 

| VALUE | DOCUMENT ID | TECN     | COMMENT                                            |
|-------|-------------|----------|----------------------------------------------------|
| seen  | LEES        | 14E BABR | Dalitz anal. of $\eta_c \rightarrow K^+ K^- \pi^0$ |

 $\Gamma_{22}/\Gamma$ 

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 | $\gamma \gamma \rightarrow \eta_c(1S) \rightarrow K \bar{K} \pi$ |

 $\Gamma_{23}/\Gamma$ 

NODE=M026R00  
NODE=M026R00

<sup>1</sup> From a model-independant partial wave analysis.

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 $\eta_c \rightarrow K^+ K^- \eta/\pi^0$       |

 $\Gamma_{24}/\Gamma$ 

NODE=M026R47  
 NODE=M026R47

<sup>1</sup> From a model-independant partial wave analysis.

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 $\eta_c \rightarrow K^+ K^- \pi^0$ |

 $\Gamma_{25}/\Gamma$ 

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 $\eta_c \rightarrow K^+ K^- \eta/\pi^0$       |

 $\Gamma_{26}/\Gamma$ 

NODE=M026R49  
 NODE=M026R49

<sup>1</sup> From a Dalitz plot analysis using an isobar model.

NODE=M026R49;LINKAGE=A

 $\Gamma(K\bar{K}\pi)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-2}$ )             | EVTs | DOCUMENT ID                   | TECN     | COMMENT                                                 |
|--------------------------------------|------|-------------------------------|----------|---------------------------------------------------------|
| <b>7.3 ± 0.5 OUR FIT</b>             |      |                               |          |                                                         |
| <b>6.5 ± 0.6 OUR AVERAGE</b>         |      |                               |          |                                                         |
| 6.3 ± 1.3 ± 0.6                      | 55   | <sup>1,2</sup> ABLIKIM        | 12N BES3 | $\psi(2S) \rightarrow \pi^0 \gamma K^+ K^- \pi^0$       |
| 7.9 ± 1.4 ± 0.7                      | 107  | <sup>3,4</sup> ABLIKIM        | 12N BES3 | $\psi(2S) \rightarrow \pi^0 \gamma K_S^0 K^\mp \pi^\pm$ |
| 8.5 ± 1.8                            |      | <sup>5</sup> AUBERT           | 06E BABR | $B^\pm \rightarrow K^\pm X_{c\bar{c}}$                  |
| 5.1 ± 2.1                            | 0.6k | <sup>6</sup> BAI              | 04 BES   | $J/\psi \rightarrow \gamma K^\pm \pi^\mp K_S^0$         |
| 6.90 ± 1.42 ± 1.32                   | 33   | <sup>6</sup> BISELLO          | 91 DM2   | $J/\psi \rightarrow \gamma K^+ K^- \pi^0$               |
| 5.43 ± 0.94 ± 0.94                   | 68   | <sup>6</sup> BISELLO          | 91 DM2   | $J/\psi \rightarrow \gamma K^\pm \pi^\mp K_S^0$         |
| 4.8 ± 1.7                            | 95   | <sup>6,7</sup> BALTRUSAIT..86 | MRK3     | $J/\psi \rightarrow \eta_c \gamma$                      |
| 16.1 <sup>+9.2</sup> <sub>-7.3</sub> |      | <sup>8,9</sup> HIMEL          | 80B MRK2 | $\psi(2S) \rightarrow \eta_c \gamma$                    |

 $\Gamma_{27}/\Gamma$ 

NODE=M026R4  
 NODE=M026R4

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

< 10.7 90% CL <sup>6,10</sup> PARTRIDGE 80B CBAL  $J/\psi \rightarrow \eta_c \gamma$ <sup>1</sup> ABLIKIM 12N quotes  $B(\psi(2S) \rightarrow \pi^0 h_c) \cdot B(h_c \rightarrow \gamma \eta_c) \cdot B(\eta_c \rightarrow K^+ K^- \pi^0) = (4.54 \pm 0.76 \pm 0.48) \times 10^{-6}$  which we multiply by 6 to account for isospin symmetry.

NODE=M026R4;LINKAGE=BK

<sup>2</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow K\bar{K}\pi)/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (27.24 \pm 4.56 \pm 2.88) \times 10^{-6}$  which we divide by our best value  $\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R4;LINKAGE=CK

<sup>3</sup> ABLIKIM 12N quotes  $B(\psi(2S) \rightarrow \pi^0 h_c) \cdot B(h_c \rightarrow \gamma \eta_c) \cdot B(\eta_c \rightarrow K_S^0 K^\pm \pi^\mp) = (11.35 \pm 1.25 \pm 1.50) \times 10^{-6}$  which we multiply by 3 to account for isospin symmetry.

NODE=M026R4;LINKAGE=BL

<sup>4</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow K\bar{K}\pi)/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (34.05 \pm 3.75 \pm 4.50) \times 10^{-6}$  which we divide by our best value  $\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R4;LINKAGE=CL

<sup>5</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.

NODE=M026R4;LINKAGE=AB

<sup>6</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=M026R4;LINKAGE=E

<sup>7</sup> Average from  $K^+ K^- \pi^0$  and  $K^\pm K_S^0 \pi^\mp$  decay channels.

NODE=M026R4;LINKAGE=D

<sup>8</sup>  $K^\pm K_S^0 \pi^\mp$  corrected to  $K\bar{K}\pi$  by factor 3. KS, MR.

NODE=M026R4;LINKAGE=01

<sup>9</sup> Estimated using  $B(\psi(2S) \rightarrow \gamma \eta_c(1S)) = 0.0028 \pm 0.0006$ .

NODE=M026R4;LINKAGE=A

<sup>10</sup>  $K^+ K^- \pi^0$  corrected to  $K\bar{K}\pi$  by factor 6. KS, MR

NODE=M026R4;LINKAGE=02

 $\Gamma(\phi K^+ K^-)/\Gamma(K\bar{K}\pi)$ 

| 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 | $B^\pm \rightarrow K^\pm \phi \phi$ |

 $\Gamma_6/\Gamma_{27}$ 

NODE=M026R02  
 NODE=M026R02

<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;LINKAGE=BB

$\Gamma(K\bar{K}\eta)/\Gamma_{\text{total}}$ 

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

**1.36±0.16 OUR FIT****1.0 ±0.5 ±0.2**

• • • 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  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ ,  $B(h_c(1P) \rightarrow \gamma \eta_c(1S)) = (51 \pm 6) \times 10^{-2}$ . 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  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = 0.0127 \pm 0.0036$ .

 $\Gamma_{28}/\Gamma$ 

NODE=M026R15  
NODE=M026R15

OCCUR=2

NODE=M026R15;LINKAGE=AK

NODE=M026R15;LINKAGE=AM

NODE=M026R15;LINKAGE=E

 $\Gamma(K\bar{K}\eta)/\Gamma(K\bar{K}\pi)$ 

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

**0.186±0.018 OUR FIT****0.190±0.008±0.017**

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.

 $\Gamma_{28}/\Gamma_{27}$ 

NODE=M026R40  
NODE=M026R40

NODE=M026R40;LINKAGE=LE

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

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

**1.7±0.4±0.1**

• • • 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  $[\Gamma(\eta_c(1S) \rightarrow \eta\pi^+\pi^-)/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (7.22 \pm 1.47 \pm 1.11) \times 10^{-6}$  which we divide by our best value  $\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> 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.

 $\Gamma_{29}/\Gamma$ 

NODE=M026R6  
NODE=M026R6

NODE=M026R6;LINKAGE=AB

NODE=M026R6;LINKAGE=E

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

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

**4.4±1.2±0.4**

39 <sup>1</sup> ABLIKIM 12N BES3  $\psi(2S) \rightarrow \pi^0 \gamma \eta 2(\pi^+\pi^-)$

<sup>1</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow \eta 2(\pi^+\pi^-))/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (19.17 \pm 3.77 \pm 3.72) \times 10^{-6}$  which we divide by our best value  $\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

 $\Gamma_{30}/\Gamma$ 

NODE=M026R05  
NODE=M026R05

NODE=M026R05;LINKAGE=AB

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

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

**6.9± 1.1 OUR FIT****11.2± 1.9 OUR AVERAGE**

9.7± 2.2±0.9 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 <sup>+22</sup><sub>-9</sub> <sup>3</sup> HIMEL 80B MRK2  $\psi(2S) \rightarrow \eta_c \gamma$

<sup>1</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow K^+ K^- \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (4.16 \pm 0.76 \pm 0.59) \times 10^{-6}$  which we divide by our best value  $\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> 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  $B(\psi(2S) \rightarrow \gamma \eta_c(1S)) = 0.0028 \pm 0.0006$ .

 $\Gamma_{31}/\Gamma$ 

NODE=M026R5  
NODE=M026R5

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 | $\gamma\gamma \rightarrow K^+K^-\pi^+\pi^-\pi^0$ |

NODE=M026R01  
 NODE=M026R01

<sup>1</sup> We have multiplied the value of  $\Gamma(K^+K^-\pi^+\pi^-\pi^0)/\Gamma(K_S^0K^\pm\pi^\mp)$  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;LINKAGE=DE

 $\Gamma(K^0K^-\pi^+\pi^-\pi^++c.c.)/\Gamma_{\text{total}}$  $\Gamma_{33}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID            | TECN     | COMMENT                                                       |
|--------------------------|------|------------------------|----------|---------------------------------------------------------------|
| <b>5.6±1.4±0.5</b>       | 43   | <sup>1,2</sup> ABLIKIM | 12N BES3 | $\psi(2S) \rightarrow \pi^0\gamma K_S^0K^\mp\pi^\mp 2\pi^\pm$ |

NODE=M026R06  
 NODE=M026R06

<sup>1</sup> ABLIKIM 12N quotes  $B(\psi(2S) \rightarrow \pi^0 h_c) \cdot B(h_c \rightarrow \gamma\eta_c) \cdot B(\eta_c \rightarrow K_S^0K^\mp\pi^\mp 2\pi^\pm) = (12.01 \pm 2.22 \pm 2.04) \times 10^{-6}$  which we multiply by 2 to take c.c. into account.

NODE=M026R06;LINKAGE=AA

<sup>2</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow K^0K^-\pi^+\pi^-\pi^++c.c.)/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (24.02 \pm 4.44 \pm 4.08) \times 10^{-6}$  which we divide by our best value  $\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R06;LINKAGE=AB

 $\Gamma(K^+K^-2(\pi^+\pi^-))/\Gamma_{\text{total}}$  $\Gamma_{34}/\Gamma$ 

| VALUE (units $10^{-3}$ )   | EVTS | DOCUMENT ID | TECN | COMMENT |
|----------------------------|------|-------------|------|---------|
| <b>7.5±2.4 OUR AVERAGE</b> |      |             |      |         |

NODE=M026R23  
 NODE=M026R23

|             |     |                      |          |                                                        |
|-------------|-----|----------------------|----------|--------------------------------------------------------|
| 8 ±4 ±1     | 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  $[\Gamma(\eta_c(1S) \rightarrow K^+K^-2(\pi^+\pi^-))/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (3.60 \pm 1.71 \pm 0.64) \times 10^{-6}$  which we divide by our best value  $\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R23;LINKAGE=AL

<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;LINKAGE=AB

 $\Gamma(2(K^+K^-))/\Gamma_{\text{total}}$  $\Gamma_{35}/\Gamma$ 

| VALUE (units $10^{-3}$ )  | EVTS | DOCUMENT ID | TECN | COMMENT |
|---------------------------|------|-------------|------|---------|
| <b>1.47± 0.31 OUR FIT</b> |      |             |      |         |

NODE=M026R20  
 NODE=M026R20

|                        |   |                      |          |                                              |
|------------------------|---|----------------------|----------|----------------------------------------------|
| <b>2.2 ± 0.9 ± 0.2</b> | 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 $\pm$ 0.5 $\pm$ 0.6 | 14.5 $^{+4.6}_{-3.0}$ | <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  $[\Gamma(\eta_c(1S) \rightarrow 2(K^+K^-))/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (0.94 \pm 0.37 \pm 0.14) \times 10^{-6}$  which we divide by our best value  $\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R20;LINKAGE=AB

<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  $B(\eta_c \rightarrow K\bar{K}\pi) = (5.5 \pm 1.7) \times 10^{-2}$ .

NODE=M026R20;LINKAGE=BB

<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;LINKAGE=AL

 $\Gamma(2(K^+K^-))/\Gamma(K\bar{K}\pi)$  $\Gamma_{35}/\Gamma_{27}$ 

| VALUE                      | EVTS | DOCUMENT ID | TECN | COMMENT |
|----------------------------|------|-------------|------|---------|
| <b>0.020±0.004 OUR FIT</b> |      |             |      |         |

NODE=M026R38  
 NODE=M026R38

**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 $^{+0.009}_{-0.007}$ ±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;LINKAGE=BB

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{36}/\Gamma$ 

| VALUE               | CL% | DOCUMENT ID          | TECN      | COMMENT                                      |
|---------------------|-----|----------------------|-----------|----------------------------------------------|
| $<5 \times 10^{-4}$ | 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=A

 $\Gamma(\pi^+\pi^-\pi^0\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{37}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                           |
|--------------------------|------|----------------------|----------|---------------------------------------------------|
| $4.7 \pm 0.9 \pm 0.4$    | 118  | <sup>1</sup> ABLIKIM | 12N BES3 | $\psi(2S) \rightarrow \pi^0\gamma\pi^+\pi^-\pi^0$ |

<sup>1</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow \pi^+\pi^-\pi^0\pi^0)/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (20.31 \pm 2.20 \pm 3.33) \times 10^{-6}$  which we divide by our best value  $\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R07  
 NODE=M026R07

NODE=M026R07;LINKAGE=AB

 $\Gamma(2(\pi^+\pi^-))/\Gamma_{\text{total}}$  $\Gamma_{38}/\Gamma$ 

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

**0.97±0.12 OUR FIT****1.35±0.21 OUR AVERAGE**

|                          |              |                             |          |                                                  |
|--------------------------|--------------|-----------------------------|----------|--------------------------------------------------|
| $1.74 \pm 0.32 \pm 0.15$ | 100          | <sup>1</sup> ABLIKIM        | 12N BES3 | $\psi(2S) \rightarrow \pi^0\gamma 2(\pi^+\pi^-)$ |
| $1.0 \pm 0.5$            | $542 \pm 75$ | <sup>2</sup> BAI            | 04 BES   | $J/\psi \rightarrow \gamma 2(\pi^+\pi^-)$        |
| $1.05 \pm 0.17 \pm 0.34$ | 137          | <sup>2</sup> BISELLO        | 91 DM2   | $J/\psi \rightarrow \gamma 2\pi^+ 2\pi^-$        |
| $1.3 \pm 0.6$            | 25           | <sup>2</sup> BALTRUSAIT..86 | MRK3     | $J/\psi \rightarrow \eta_c\gamma$                |
| $2.0^{+1.5}_{-1.0}$      |              | <sup>3</sup> HIMEL          | 80B MRK2 | $\psi(2S) \rightarrow \eta_c\gamma$              |

<sup>1</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow 2(\pi^+\pi^-))/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (7.51 \pm 0.85 \pm 1.11) \times 10^{-6}$  which we divide by our best value  $\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> 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

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                                               |
|--------------------------|------|----------------------|----------|-------------------------------------------------------|
| $17.4 \pm 2.9 \pm 1.5$   | 175  | <sup>1</sup> ABLIKIM | 12N BES3 | $\psi(2S) \rightarrow \pi^0\gamma 2(\pi^+\pi^-\pi^0)$ |

<sup>1</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow 2(\pi^+\pi^-\pi^0))/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (75.13 \pm 7.42 \pm 9.99) \times 10^{-6}$  which we divide by our best value  $\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R08  
 NODE=M026R08

NODE=M026R08;LINKAGE=AB

 $\Gamma(3(\pi^+\pi^-))/\Gamma_{\text{total}}$  $\Gamma_{40}/\Gamma$ 

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

**18 ±4 OUR AVERAGE**

|                        |     |                      |          |                                                  |
|------------------------|-----|----------------------|----------|--------------------------------------------------|
| $20 \pm 5 \pm 2$       | 51  | <sup>1</sup> ABLIKIM | 12N BES3 | $\psi(2S) \rightarrow \pi^0\gamma 3(\pi^+\pi^-)$ |
| $15.4 \pm 3.4 \pm 3.3$ | 479 | <sup>2</sup> ABLIKIM | 06A BES2 | $J/\psi \rightarrow 3(\pi^+\pi^-)\gamma$         |

<sup>1</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow 3(\pi^+\pi^-))/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (8.82 \pm 1.57 \pm 1.59) \times 10^{-6}$  which we divide by our best value  $\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> 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

NODE=M026R24;LINKAGE=AL

NODE=M026R24;LINKAGE=AB

$\Gamma(p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{41}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**15.1 ± 1.6 OUR FIT**[(15.2 ± 1.6) × 10<sup>-4</sup> OUR 2018 FIT]**13.2 ± 2.7 OUR AVERAGE**

|               |          |                  |          |                                               |
|---------------|----------|------------------|----------|-----------------------------------------------|
| 15 ± 5 ± 1    | 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+1.0<br>- 2.1-1.1 | 195 | 4 WU | 06 BELL | $B^+ \rightarrow p \bar{p} K^+$ |
|-----------------------------|-----|------|---------|---------------------------------|

<sup>1</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow p \bar{p})/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (0.65 \pm 0.19 \pm 0.10) \times 10^{-6}$  which we divide by our best value  $\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> 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  $B(B^+ \rightarrow \eta_c K^+) = (1.09 \pm 0.09) \times 10^{-3}$ . 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

NODE=M026R2;LINKAGE=AB

NODE=M026R2;LINKAGE=E

NODE=M026R2;LINKAGE=A

NODE=M026R2;LINKAGE=WU

 $\Gamma(p\bar{p})/\Gamma(K\bar{K}\pi)$  $\Gamma_{41}/\Gamma_{27}$ 

VALUE EVTS

DOCUMENT ID

TECN

COMMENT

**0.0207 ± 0.0021 OUR FIT**

|                                |     |      |         |                                     |
|--------------------------------|-----|------|---------|-------------------------------------|
| 0.021 ± 0.002 +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

NODE=M026R03;LINKAGE=BB

 $\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\phi\phi)/\Gamma_{\text{total}}$  $\Gamma_{41}/\Gamma \times \Gamma_7/\Gamma$ VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

**0.27 ± 0.05 OUR FIT**

|                  |  |        |         |                                         |
|------------------|--|--------|---------|-----------------------------------------|
| 4.0 +3.5<br>-3.2 |  | BAGLIN | 89 SPEC | $\bar{p} p \rightarrow K^+ K^- K^+ K^-$ |
|------------------|--|--------|---------|-----------------------------------------|

NODE=M026R33

NODE=M026R33

 $\Gamma(p\bar{p}\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{42}/\Gamma$ VALUE (units  $10^{-2}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**0.36 ± 0.13 ± 0.03**

|    |           |          |                                                     |
|----|-----------|----------|-----------------------------------------------------|
| 14 | 1 ABLIKIM | 12N BES3 | $\psi(2S) \rightarrow \pi^0 \gamma p \bar{p} \pi^0$ |
|----|-----------|----------|-----------------------------------------------------|

<sup>1</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow p \bar{p} \pi^0)/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (1.53 \pm 0.49 \pm 0.23) \times 10^{-6}$  which we divide by our best value  $\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R09

NODE=M026R09

NODE=M026R09;LINKAGE=AB

 $\Gamma(\Lambda\bar{\Lambda})/\Gamma_{\text{total}}$  $\Gamma_{43}/\Gamma$ VALUE (units  $10^{-4}$ )

CL% EVTS

DOCUMENT ID

TECN

COMMENT

**10.9 ± 2.4 OUR FIT****11.8 ± 3.4 OUR AVERAGE** [(11.7 ± 3.4) × 10<sup>-4</sup> OUR 2018 AVERAGE]**11.8 ± 2.3 ± 2.5**

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

|                        |    |           |         |                                                    |
|------------------------|----|-----------|---------|----------------------------------------------------|
| 8.8 +2.4<br>-2.3 ± 0.7 | 20 | 2 WU      | 06 BELL | $B^+ \rightarrow \Lambda \bar{\Lambda} K^+$        |
| <20                    | 90 | 3 BISELLO | 91 DM2  | $e^+ e^- \rightarrow \gamma \Lambda \bar{\Lambda}$ |

<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.

<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  $B(B^+ \rightarrow \eta_c K^+) = (1.09 \pm 0.09) \times 10^{-3}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>3</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = 0.0127 \pm 0.0036$ .

NODE=M026R18

NODE=M026R18

NEW

NODE=M026R18;LINKAGE=AB

NODE=M026R18;LINKAGE=WU

NODE=M026R18;LINKAGE=E

$\Gamma(\Lambda\bar{\Lambda})/\Gamma(p\bar{p})$  $\Gamma_{43}/\Gamma_{41}$ 

| VALUE                                            | DOCUMENT ID        | TECN | COMMENT                                                |
|--------------------------------------------------|--------------------|------|--------------------------------------------------------|
| <b>0.72±0.16 OUR FIT</b>                         |                    |      |                                                        |
| <b>0.67<sup>+0.19</sup><sub>-0.16</sub>±0.12</b> | <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  
NODE=M026R27

NODE=M026R27;LINKAGE=WU

 $\Gamma(K^+\bar{p}\Lambda + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{44}/\Gamma$ 

| VALUE                                                        | EVTS               | DOCUMENT ID | TECN | COMMENT                                  |
|--------------------------------------------------------------|--------------------|-------------|------|------------------------------------------|
| <b>0.00250<sup>+0.00034</sup><sub>-0.00032</sub>±0.00020</b> | <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  $B(B^+ \rightarrow \eta_c K^+) = (1.09 \pm 0.09) \times 10^{-3}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R53  
NODE=M026R53

NODE=M026R53;LINKAGE=A

 $\Gamma(\bar{\Lambda}(1520)\Lambda + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{45}/\Gamma$ 

| VALUE                       | EVTS | DOCUMENT ID        | TECN | COMMENT                                  |
|-----------------------------|------|--------------------|------|------------------------------------------|
| <b>0.0031±0.0013±0.0002</b> | 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  $B(B^+ \rightarrow \eta_c K^+) = (1.09 \pm 0.09) \times 10^{-3}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R54  
NODE=M026R54

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 | $J/\psi \rightarrow \gamma p\bar{p}\pi^0\pi^0$ |

<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  
NODE=M026R28

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 | $J/\psi \rightarrow \gamma \Lambda\bar{\Lambda}\pi^+\pi^-$ |

<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  
NODE=M026R29

NODE=M026R29;LINKAGE=AB

 $\Gamma(\pi^+\pi^-\rho\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{48}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | EVTS | DOCUMENT ID              | TECN | COMMENT                                               |
|--------------------------|-----|------|--------------------------|------|-------------------------------------------------------|
| <b>5.3±1.7±0.5</b>       |     | 19   | <sup>1</sup> ABLIKIM 12N | BES3 | $\psi(2S) \rightarrow \pi^0\gamma p\bar{p}\pi^+\pi^-$ |

• • • 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  $[\Gamma(\eta_c(1S) \rightarrow \pi^+\pi^-\rho\bar{p})/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (2.30 \pm 0.65 \pm 0.36) \times 10^{-6}$  which we divide by our best value  $\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R3  
NODE=M026R3

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 |
|--------------------------|-----|------|-------------|------|---------|
| <b>1.57±0.12 OUR FIT</b> |     |      |             |      |         |

**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 | $\psi(2S) \rightarrow \pi^+\pi^- J/\psi$ |  |

NODE=M026R31  
NODE=M026R31

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

|                                              |    |             |     |      |                                           |
|----------------------------------------------|----|-------------|-----|------|-------------------------------------------|
| 2.0 <sup>+0.9</sup> <sub>-0.7</sub> ± 0.2    | 13 | 3 WICHT     | 08  | BELL | $B^\pm \rightarrow K^\pm \gamma \gamma$   |
| 2.80 <sup>+0.67</sup> <sub>-0.58</sub> ± 1.0 |    | 4 ARMSTRONG | 95F | E760 | $\bar{p}p \rightarrow \gamma \gamma$      |
| < 9                                          | 90 | 5 BISELLO   | 91  | DM2  | $J/\psi \rightarrow \gamma \gamma \gamma$ |
| 6 <sup>+4</sup> <sub>-3</sub> ± 4            |    | 4 BAGLIN    | 87B | SPEC | $\bar{p}p \rightarrow \gamma \gamma$      |
| < 18                                         | 90 | 6 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.

<sup>2</sup> ADAMS 08 reports  $[\Gamma(\eta_c(1S) \rightarrow \gamma \gamma)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma \eta_c(1S))] = (2.4^{+1.1}_{-0.8} \pm 0.3) \times 10^{-6}$  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.

<sup>3</sup> WICHT 08 reports  $[\Gamma(\eta_c(1S) \rightarrow \gamma \gamma)/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \eta_c K^+)] = (2.2^{+0.9+0.4}_{-0.7-0.2}) \times 10^{-7}$  which we divide by our best value  $B(B^+ \rightarrow \eta_c K^+) = (1.09 \pm 0.09) \times 10^{-3}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>4</sup> Not independent from the values of the total and two-photon width quoted by the same experiment.

<sup>5</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = 0.0127 \pm 0.0036$ .

<sup>6</sup> Using  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = 0.0127 \pm 0.0036$ .

NODE=M026R31;LINKAGE=AL

NODE=M026R31;LINKAGE=AD

NODE=M026R31;LINKAGE=WI

NODE=M026R31;LINKAGE=AB

NODE=M026R31;LINKAGE=E

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                                      |
|---------------------------------------------------------------------|------|-------------|------|----------------------------------------------|
| <b>2.15 ± 0.28 OUR FIT</b>                                          |      |             |      |                                              |
| 3.2 <sup>+1.3</sup> <sub>-1.0</sub> <sup>+0.8</sup> <sub>-0.6</sub> | 13   | 1 WICHT     | 08   | BELL $B^\pm \rightarrow K^\pm \gamma \gamma$ |

<sup>1</sup> Using  $B(B^+ \rightarrow \eta_c K^+) = (1.25 \pm 0.12^{+0.10}_{-0.12}) \times 10^{-3}$  from FANG 03 and  $B(\eta_c \rightarrow K \bar{K} \pi) = (5.5 \pm 1.7) \times 10^{-2}$ .

NODE=M026R04  
NODE=M026R04

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                                                 |
|---------------------------------------------------|------|---------------|------|---------------------------------------------------------|
| <b>0.238 ± 0.023 OUR FIT</b>                      |      |               |      |                                                         |
| <b>0.26 ± 0.05 OUR AVERAGE</b>                    |      |               |      | 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

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

NODE=M026320

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

$\Gamma_{50}/\Gamma$

| VALUE (units $10^{-5}$ )                                                      | CL% | DOCUMENT ID | TECN | COMMENT                                      |
|-------------------------------------------------------------------------------|-----|-------------|------|----------------------------------------------|
| <b>&lt; 11</b>                                                                | 90  | 1 ABLIKIM   | 11G  | BES3 $J/\psi \rightarrow \gamma \pi^+ \pi^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                              |
| < 70                                                                          | 90  | 2 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=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  | 1 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  | 2 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



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

| 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 $[\Gamma(\eta_c(1S) \rightarrow K^+K^-)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))]$<br>< $0.96 \times 10^{-5}$ which we divide by our best value $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 1.7 \times 10^{-2}$ . |     |                      |          |                                   |

 $\Gamma_{52}/\Gamma$ 

NODE=M026R36  
NODE=M026R36

NODE=M026R36;LINKAGE=AB

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

| 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 $[\Gamma(\eta_c(1S) \rightarrow K_S^0 K_S^0)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))]$<br>< $0.53 \times 10^{-5}$ 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.                                                                                                                                                                                                                      |     |                      |          |                                         |

 $\Gamma_{53}/\Gamma$ 

NODE=M026R37  
NODE=M026R37

OCCUR=2

NODE=M026R37;LINKAGE=AB

NODE=M026R37;LINKAGE=U1  
NODE=M026R37;LINKAGE=U2

 $\eta_c(1S)$  REFERENCES

|               |      |                  |                                      |                        |
|---------------|------|------------------|--------------------------------------|------------------------|
| LU            | 19   | PR D99 032003    | P.-C. Lu <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       | 17AJ | PR D96 112008    | M. Ablikim <i>et al.</i>             | (BES III Collab.)      |
| ABLIKIM       | 17P  | PR D95 092004    | M. Ablikim <i>et al.</i>             | (BES III Collab.)      |
| LEES          | 16A  | PR D93 012005    | J.P. Lees <i>et al.</i>              | (BABAR Collab.)        |
| PDG           | 16   | CP C40 100001    | C. Patrignani <i>et al.</i>          | (PDG Collab.)          |
| AAIJ          | 15AS | JHEP 1510 053    | R. Aaij <i>et al.</i>                | (LHCb Collab.)         |
| AAIJ          | 15BI | EPJ C75 311      | R. Aaij <i>et al.</i>                | (LHCb Collab.)         |
| ANASHIN       | 14   | PL B738 391      | V.V. Anashin <i>et al.</i>           | (KEDR Collab.)         |
| LEES          | 14E  | PR D89 112004    | J.P. Lees <i>et al.</i>              | (BABAR Collab.)        |
| ABLIKIM       | 13C  | PR D87 012003    | M. Ablikim <i>et al.</i>             | (BES III Collab.)      |
| ABLIKIM       | 13I  | PR D87 032003    | M. Ablikim <i>et al.</i>             | (BES III Collab.)      |
| UEHARA        | 13   | PTEP 2013 123C01 | S. Uehara <i>et al.</i>              | (BELLE Collab.)        |
| ABLIKIM       | 12B  | PR D86 032008    | M. Ablikim <i>et al.</i>             | (BES III Collab.)      |
| ABLIKIM       | 12F  | PRL 108 222002   | M. Ablikim <i>et al.</i>             | (BES III Collab.)      |
| ABLIKIM       | 12N  | PR D86 092009    | M. Ablikim <i>et al.</i>             | (BES III Collab.)      |
| LIU           | 12B  | PRL 108 232001   | Z.Q. Liu <i>et al.</i>               | (BELLE Collab.)        |
| ZHANG         | 12A  | PR D86 052002    | C.C. Zhang <i>et al.</i>             | (BELLE Collab.)        |
| ABLIKIM       | 11G  | PR D84 032006    | M. Ablikim <i>et al.</i>             | (BES III 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.)        |
| LEES          | 10   | PR D81 052010    | J.P. Lees <i>et al.</i>              | (BABAR Collab.)        |
| MITCHELL      | 09   | PRL 102 011801   | R.E. Mitchell <i>et al.</i>          | (CLEO Collab.)         |
| ADAMS         | 08   | PRL 101 101801   | G.S. Adams <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.)        |
| ABLIKIM       | 06A  | PL B633 19       | M. Ablikim <i>et al.</i>             | (BES Collab.)          |
| ABLIKIM       | 06B  | EPJ C45 337      | M. Ablikim <i>et al.</i>             | (BES Collab.)          |
| AUBERT        | 06E  | PRL 96 052002    | B. Aubert <i>et al.</i>              | (BABAR Collab.)        |
| PDG           | 06   | JP G33 1         | W.-M. Yao <i>et al.</i>              | (PDG Collab.)          |
| WU            | 06   | PRL 97 162003    | C.-H. Wu <i>et al.</i>               | (BELLE Collab.)        |
| ABLIKIM       | 05L  | PR D72 072005    | M. Ablikim <i>et al.</i>             | (BES Collab.)          |
| KUO           | 05   | PL B621 41       | C.C. Kuo <i>et al.</i>               | (BELLE Collab.)        |
| ABE           | 04G  | PR D70 071102    | K. Abe <i>et al.</i>                 | (BELLE Collab.)        |
| ABLIKIM       | 04M  | PR D70 112008    | M. Ablikim <i>et al.</i>             | (BES 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.)        |
| AUBERT,B      | 04B  | PR D70 011101    | B. Aubert <i>et al.</i>              | (BABAR Collab.)        |
| BAI           | 04   | PL B578 16       | J.Z. Bai <i>et al.</i>               | (BES Collab.)          |
| ABDALLAH      | 03J  | EPJ C31 481      | J. Abdallah <i>et al.</i>            | (DELPHI Collab.)       |
| AMBROGIANI    | 03   | PL B566 45       | M. Ambrogiani <i>et al.</i>          | (FNAL E835 Collab.)    |
| BAI           | 03   | PL B555 174      | J.Z. Bai <i>et al.</i>               | (BES Collab.)          |
| FANG          | 03   | PRL 90 071801    | F. Fang <i>et al.</i>                | (BELLE Collab.)        |
| HUANG         | 03   | PRL 91 241802    | H.-C. Huang <i>et al.</i>            | (BELLE Collab.)        |
| ABE,K         | 02   | PRL 89 142001    | K. Abe <i>et al.</i>                 | (BELLE Collab.)        |
| BAI           | 00F  | PR D62 072001    | J.Z. Bai <i>et al.</i>               | (BES Collab.)          |
| BRANDENB...   | 00B  | PRL 85 3095      | G. Brandenburg <i>et al.</i>         | (CLEO Collab.)         |
| ACCIARRI      | 99T  | PL B461 155      | M. Acciarri <i>et al.</i>            | (L3 Collab.)           |
| BAI           | 99B  | PR D60 072001    | J.Z. Bai <i>et al.</i>               | (BES Collab.)          |
| ABREU         | 98O  | PL B441 479      | P. Abreu <i>et al.</i>               | (DELPHI Collab.)       |
| SHIRAI        | 98   | PL B424 405      | M. Shirai <i>et al.</i>              | (AMY Collab.)          |
| ARMSTRONG     | 95F  | PR D52 4839      | T.A. Armstrong <i>et al.</i>         | (FNAL, FERR, GENO+)    |
| ALBRECHT      | 94H  | PL B338 390      | H. Albrecht <i>et al.</i>            | (ARGUS Collab.)        |
| ADRIANI       | 93N  | PL B318 575      | O. Adriani <i>et al.</i>             | (L3 Collab.)           |
| BISELLO       | 91   | NP B350 1        | D. Bisello <i>et al.</i>             | (DM2 Collab.)          |
| BAI           | 90B  | PRL 65 1309      | Z. Bai <i>et al.</i>                 | (Mark III Collab.)     |
| CHEN          | 90B  | PL B243 169      | W.Y. Chen <i>et al.</i>              | (CLEO Collab.)         |
| BAGLIN        | 89   | PL B231 557      | C. Baglin, S. Baird, G. Bassompierre | (R704 Collab.)         |
| BEHREND       | 89   | ZPHY C42 367     | H.J. Behrend <i>et al.</i>           | (CELLO Collab.)        |
| BRAUNSCH...   | 89   | ZPHY C41 533     | W. Braunschweig <i>et al.</i>        | (TASSO Collab.)        |
| AIHARA        | 88D  | PRL 60 2355      | H. Aihara <i>et al.</i>              | (TPC Collab.)          |
| BAGLIN        | 87B  | PL B187 191      | C. Baglin <i>et al.</i>              | (R704 Collab.)         |
| BALTRUSAIT... | 86   | PR D33 629       | R.M. Baltrusaitis <i>et al.</i>      | (Mark III Collab.)     |
| BERGER        | 86   | PL 167B 120      | C. Berger <i>et al.</i>              | (PLUTO Collab.)        |
| GAISER        | 86   | PR D34 711       | J. Gaiser <i>et al.</i>              | (Crystal Ball Collab.) |
| ALTHOFF       | 85B  | ZPHY C29 189     | M. Althoff <i>et al.</i>             | (TASSO Collab.)        |
| BALTRUSAIT... | 84   | PRL 52 2126      | R.M. Baltrusaitis <i>et al.</i>      | (CIT, UCSC+)           |
| BLOOM         | 83   | ARNS 33 143      | E.D. Bloom, C. Peck                  | (SLAC, CIT)            |
| HIMEL         | 80B  | PRL 45 1146      | T.M. Himel <i>et al.</i>             | (SLAC, LBL, UCB)       |
| PARTRIDGE     | 80B  | PRL 45 1150      | R. Partridge <i>et al.</i>           | (CIT, HARV, PRIN+)     |

NODE=M026

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REFID=22003  
REFID=22004

$J/\psi(1S)$ 

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

NODE=M070

 $J/\psi(1S)$  MASS

NODE=M070M

NODE=M070M

| 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.<br><sup>2</sup> Reanalysis of ZHOLENTZ 80 using new electron mass (COHEN 87) and radiative corrections (KURAEV 85).<br><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.<br><sup>4</sup> From a sample of $\eta_c(1S)$ and $J/\psi$ produced in $b$ -hadron decays. Systematic uncertainties not estimated.<br><sup>5</sup> Superseded by ARTAMONOV 00.<br><sup>6</sup> From a simultaneous fit to $e^+e^-$ , $\mu^+\mu^-$ and hadronic channels assuming $\Gamma(e^+e^-) = \Gamma(\mu^+\mu^-)$ . |      |                            |      |                                                        |

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

NODE=M070W

| VALUE (keV)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | EVTS | DOCUMENT ID                | TECN | COMMENT                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------------|------|-----------------------------------------------|
| <b>92.9 ± 2.8 OUR AVERAGE</b> Error includes scale factor of 1.1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |      |                            |      |                                               |
| 96.1 ± 3.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 13k  | <sup>1</sup> ADAMS 06A     | CLEO | $e^+e^- \rightarrow \mu^+\mu^-\gamma$         |
| 84.4 ± 8.9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      | BAI 95B                    | BES  | $e^+e^-$                                      |
| 91 ±11 ±6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      | <sup>2</sup> ARMSTRONG 93B | E760 | $\bar{p}p \rightarrow e^+e^-$                 |
| 85.5 $^{+6.1}_{-5.8}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |      | <sup>3</sup> HSUEH 92      | RVUE | See $\Upsilon$ mini-review                    |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      |                            |      |                                               |
| 92.94 ± 1.83                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      | <sup>4</sup> ANASHIN 18A   | KEDR | $e^+e^-$                                      |
| 94.1 ± 2.7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      | <sup>5</sup> ANASHIN 10    | KEDR | $3.097 e^+e^- \rightarrow e^+e^-, \mu^+\mu^-$ |
| 93.7 ± 3.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 7.8k | <sup>1</sup> AUBERT 04     | BABR | $e^+e^- \rightarrow \mu^+\mu^-\gamma$         |
| <sup>1</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 $B(\mu^+\mu^-) = (5.93 \pm 0.06)\%$ .<br><sup>2</sup> The initial-state radiation correction reevaluated by ANDREOTTI 07 in its Ref. [4].<br><sup>3</sup> Using data from COFFMAN 92, BALDINI-CELIO 75, BOYARSKI 75, ESPOSITO 75B, BRANDELIK 79C.<br><sup>4</sup> Using $\Gamma(e^+e^-)$ from ANASHIN 18A and $B(J/\psi(1S) \rightarrow e^+e^-) = (5.971 \pm 0.032)\%$ from PDG 16.<br><sup>5</sup> Assuming $\Gamma(e^+e^-) = \Gamma(\mu^+\mu^-)$ and using $\Gamma(e^+e^-)/\Gamma_{\text{total}} = (5.94 \pm 0.06)\%$ . |      |                            |      |                                               |

NODE=M070W;LINKAGE=AA

NODE=M070W;LINKAGE=AN  
NODE=M070W;LINKAGE=A

NODE=M070W;LINKAGE=B

NODE=M070W;LINKAGE=AS

 $J/\psi(1S)$  DECAY MODES

NODE=M070215;NODE=M070

| Mode                                                   | Fraction ( $\Gamma_i/\Gamma$ )     | Scale factor/<br>Confidence level |
|--------------------------------------------------------|------------------------------------|-----------------------------------|
| $\Gamma_1$ hadrons                                     | (87.7 ± 0.5 ) %                    | DESIG=3                           |
| $\Gamma_2$ virtual $\gamma \rightarrow \text{hadrons}$ | (13.50 ± 0.30 ) %                  | DESIG=4                           |
| $\Gamma_3$ $ggg$                                       | (64.1 ± 1.0 ) %                    | DESIG=249                         |
| $\Gamma_4$ $\gamma gg$                                 | ( 8.8 ± 1.1 ) %                    | DESIG=250                         |
| $\Gamma_5$ $e^+e^-$                                    | ( 5.971 ± 0.032 ) %                | DESIG=1                           |
| $\Gamma_6$ $e^+e^-\gamma$                              | [a] ( 8.8 ± 1.4 ) $\times 10^{-3}$ | DESIG=5                           |
| $\Gamma_7$ $\mu^+\mu^-$                                | ( 5.961 ± 0.033 ) %                | DESIG=2                           |

## Decays involving hadronic resonances

|                 |                                                                                           |                                    |       |                   |
|-----------------|-------------------------------------------------------------------------------------------|------------------------------------|-------|-------------------|
| Г <sub>8</sub>  | $\rho\pi$                                                                                 | ( 1.69 ± 0.15 ) %                  | S=2.4 | NODE=M070;CLUMP=A |
| Г <sub>9</sub>  | $\rho^0\pi^0$                                                                             | ( 5.6 ± 0.7 ) × 10 <sup>-3</sup>   |       | DESIG=20          |
| Г <sub>10</sub> | $\rho(770)^\mp K^\pm K_S^0$                                                               | ( 1.9 ± 0.4 ) × 10 <sup>-3</sup>   |       | DESIG=21          |
| Г <sub>11</sub> | $\rho(1450)\pi$                                                                           |                                    |       | DESIG=342         |
| Г <sub>12</sub> | $\rho(1450)\pi \rightarrow \pi^+\pi^-\pi^0$                                               | ( 2.3 ± 0.7 ) × 10 <sup>-3</sup>   |       | DESIG=310         |
| Г <sub>13</sub> | $\rho(1450)^\pm\pi^\mp \rightarrow K_S^0 K^\pm\pi^\mp$                                    | ( 3.5 ± 0.6 ) × 10 <sup>-4</sup>   |       | DESIG=328         |
| Г <sub>14</sub> | $\rho(1450)^0\pi^0 \rightarrow K^+K^-\pi^0$                                               | ( 2.0 ± 0.5 ) × 10 <sup>-4</sup>   |       | DESIG=329         |
| Г <sub>15</sub> | $\rho(1450)\eta'(958) \rightarrow \pi^+\pi^-\eta'(958)$                                   | ( 3.3 ± 0.7 ) × 10 <sup>-6</sup>   |       | DESIG=312         |
| Г <sub>16</sub> | $\rho(1700)\pi$                                                                           |                                    |       | DESIG=345         |
| Г <sub>17</sub> | $\rho(1700)\pi \rightarrow \pi^+\pi^-\pi^0$                                               | ( 1.7 ± 1.1 ) × 10 <sup>-4</sup>   |       | DESIG=325         |
| Г <sub>18</sub> | $\rho(2150)\pi$                                                                           |                                    |       | DESIG=313         |
| Г <sub>19</sub> | $\rho(2150)\pi \rightarrow \pi^+\pi^-\pi^0$                                               | ( 8 ± 40 ) × 10 <sup>-6</sup>      |       | DESIG=326         |
| Г <sub>20</sub> | $\rho_3(1690)\pi \rightarrow \pi^+\pi^-\pi^0$                                             |                                    |       | DESIG=314         |
| Г <sub>21</sub> | $a_2(1320)\rho$                                                                           | ( 1.09 ± 0.22 ) %                  |       | DESIG=316         |
| Г <sub>22</sub> | $\omega\pi^+\pi^+\pi^-\pi^-$                                                              | ( 8.5 ± 3.4 ) × 10 <sup>-3</sup>   |       | DESIG=43          |
| Г <sub>23</sub> | $\omega\pi^+\pi^-\pi^0$                                                                   | ( 4.0 ± 0.7 ) × 10 <sup>-3</sup>   |       | DESIG=26          |
| Г <sub>24</sub> | $\omega\pi^+\pi^-$                                                                        | ( 7.2 ± 1.0 ) × 10 <sup>-3</sup>   |       | DESIG=211         |
| Г <sub>25</sub> | $\omega f_2(1270)$                                                                        | ( 4.3 ± 0.6 ) × 10 <sup>-3</sup>   |       | DESIG=24          |
| Г <sub>26</sub> | $K^*(892)^0\bar{K}^*(892)^0$                                                              | ( 2.3 ± 0.6 ) × 10 <sup>-4</sup>   |       | DESIG=28          |
| Г <sub>27</sub> | $K^*(892)^\pm K^*(892)^\mp$                                                               | ( 1.00 ± 0.22 ) × 10 <sup>-3</sup> |       | DESIG=46          |
| Г <sub>28</sub> | $K^*(892)^\pm K^*(700)^\mp$                                                               | ( 1.1 ± 1.0 ) × 10 <sup>-3</sup>   |       | DESIG=256         |
| Г <sub>29</sub> | $K_S^0\pi^- K^*(892)^+ + \text{c.c.}$                                                     | ( 2.0 ± 0.5 ) × 10 <sup>-3</sup>   |       | DESIG=257         |
| Г <sub>30</sub> | $K_S^0\pi^- K^*(892)^+ + \text{c.c.} \rightarrow K_S^0 K_S^0\pi^+\pi^-$                   | ( 6.7 ± 2.2 ) × 10 <sup>-4</sup>   |       | DESIG=299         |
| Г <sub>31</sub> | $K_S^0 K^*(892)^0 \rightarrow \gamma K_S^0 K_S^0$                                         | ( 6.3 ± 0.6 ) × 10 <sup>-6</sup>   |       | DESIG=300         |
| Г <sub>32</sub> | $\eta K^*(892)^0\bar{K}^*(892)^0$                                                         | ( 1.15 ± 0.26 ) × 10 <sup>-3</sup> |       | DESIG=376         |
| Г <sub>33</sub> | $\eta' K^{*\pm} K^\mp$                                                                    | ( 1.48 ± 0.13 ) × 10 <sup>-3</sup> |       | DESIG=252         |
| Г <sub>34</sub> | $\eta' K^{*0}\bar{K}^0 + \text{c.c.}$                                                     | ( 1.66 ± 0.21 ) × 10 <sup>-3</sup> |       | DESIG=355         |
| Г <sub>35</sub> | $\eta' h_1(1415) \rightarrow \eta' K^*\bar{K} + \text{c.c.}$                              | ( 2.16 ± 0.31 ) × 10 <sup>-4</sup> |       | DESIG=357         |
| Г <sub>36</sub> | $\eta' h_1(1415) \rightarrow \eta' K^{*\pm} K^\mp$                                        | ( 1.51 ± 0.23 ) × 10 <sup>-4</sup> |       | DESIG=353         |
| Г <sub>37</sub> | $K^*(1410)\bar{K} + \text{c.c.}$                                                          |                                    |       | DESIG=354         |
| Г <sub>38</sub> | $K^*(1410)\bar{K} + \text{c.c.} \rightarrow K^\pm K^\mp\pi^0$                             | ( 4.9 ± 2.8 ) × 10 <sup>-5</sup>   |       | DESIG=317         |
| Г <sub>39</sub> | $K^*(1410)\bar{K} + \text{c.c.} \rightarrow K_S^0 K^\pm\pi^\mp$                           | ( 8 ± 6 ) × 10 <sup>-5</sup>       |       | DESIG=330         |
| Г <sub>40</sub> | $K_2^*(1430)\bar{K} + \text{c.c.}$                                                        |                                    |       | DESIG=318         |
| Г <sub>41</sub> | $K_2^*(1430)\bar{K} + \text{c.c.} \rightarrow K^\pm K^\mp\pi^0$                           | ( 7.5 ± 3.5 ) × 10 <sup>-5</sup>   |       | DESIG=319         |
| Г <sub>42</sub> | $K_2^*(1430)\bar{K} + \text{c.c.} \rightarrow K_S^0 K^\pm\pi^\mp$                         | ( 4.0 ± 1.0 ) × 10 <sup>-4</sup>   |       | DESIG=321         |
| Г <sub>43</sub> | $K^*(892)^0\bar{K}_2^*(1430)^0 + \text{c.c.}$                                             | ( 4.66 ± 0.31 ) × 10 <sup>-3</sup> |       | DESIG=320         |
| Г <sub>44</sub> | $K^*(892)^+ K_2^*(1430)^- + \text{c.c.}$                                                  | ( 3.4 ± 2.9 ) × 10 <sup>-3</sup>   |       | DESIG=48          |
| Г <sub>45</sub> | $K^*(892)^+ K_2^*(1430)^- + \text{c.c.} \rightarrow K^*(892)^+ K_S^0\pi^- + \text{c.c.}$  | ( 4 ± 4 ) × 10 <sup>-4</sup>       |       | DESIG=303         |
| Г <sub>46</sub> | $K^*(892)^0\bar{K}_2(1770)^0 + \text{c.c.} \rightarrow K^*(892)^0 K^-\pi^+ + \text{c.c.}$ | ( 6.9 ± 0.9 ) × 10 <sup>-4</sup>   |       | DESIG=304         |
| Г <sub>47</sub> | $\omega K^*(892)\bar{K} + \text{c.c.}$                                                    | ( 6.1 ± 0.9 ) × 10 <sup>-3</sup>   |       | DESIG=235         |
| Г <sub>48</sub> | $\bar{K} K^*(892) + \text{c.c.}$                                                          |                                    |       | DESIG=102         |
| Г <sub>49</sub> | $\bar{K} K^*(892) + \text{c.c.} \rightarrow K_S^0 K^\pm\pi^\mp$                           | ( 5.0 ± 0.5 ) × 10 <sup>-3</sup>   |       | DESIG=331         |
| Г <sub>50</sub> | $K^+ K^*(892)^- + \text{c.c.}$                                                            | ( 5.0 ± 0.4 ) × 10 <sup>-3</sup>   |       | DESIG=332         |
| Г <sub>51</sub> | $K^+ K^*(892)^- + \text{c.c.} \rightarrow K^+ K^-\pi^0$                                   | ( 1.98 ± 0.21 ) × 10 <sup>-3</sup> |       | DESIG=121         |
| Г <sub>52</sub> | $K^+ K^*(892)^- + \text{c.c.} \rightarrow K^0 K^\pm\pi^\mp + \text{c.c.}$                 | ( 3.0 ± 0.4 ) × 10 <sup>-3</sup>   |       | DESIG=231         |
| Г <sub>53</sub> | $K^0\bar{K}^*(892)^0 + \text{c.c.}$                                                       | ( 4.2 ± 0.4 ) × 10 <sup>-3</sup>   |       | DESIG=232         |
|                 |                                                                                           |                                    |       | DESIG=122         |

|                  |                                                                                     |                                        |                |
|------------------|-------------------------------------------------------------------------------------|----------------------------------------|----------------|
| Г <sub>54</sub>  | $K^0 \bar{K}^*(892)^0 + \text{c.c.} \rightarrow K^0 K^\pm \pi^\mp + \text{c.c.}$    | ( 3.2 ± 0.4 ) × 10 <sup>-3</sup>       | DESIG=233      |
| Г <sub>55</sub>  | $K_1(1400)^\pm K^\mp$                                                               | ( 3.8 ± 1.4 ) × 10 <sup>-3</sup>       | DESIG=132      |
| Г <sub>56</sub>  | $\bar{K}^*(892)^0 K^+ \pi^- + \text{c.c.}$                                          | ( 7.7 ± 1.6 ) × 10 <sup>-3</sup>       | DESIG=214      |
| Г <sub>57</sub>  | $K^*(892)^\pm K^\mp \pi^0$                                                          | ( 4.1 ± 1.3 ) × 10 <sup>-3</sup>       | DESIG=343      |
| Г <sub>58</sub>  | $K^*(892)^0 K_S^0 \pi^0$                                                            | ( 6 ± 4 ) × 10 <sup>-4</sup>           | DESIG=344      |
| Г <sub>59</sub>  | $\omega \pi^0 \pi^0$                                                                | ( 3.4 ± 0.8 ) × 10 <sup>-3</sup>       | DESIG=140      |
| Г <sub>60</sub>  | $\omega \pi^0 \eta$                                                                 | ( 3.4 ± 1.7 ) × 10 <sup>-4</sup>       | DESIG=360      |
| Г <sub>61</sub>  | $b_1(1235)^\pm \pi^\mp$                                                             | [b] ( 3.0 ± 0.5 ) × 10 <sup>-3</sup>   | DESIG=49       |
| Г <sub>62</sub>  | $\omega K^\pm K_S^0 \pi^\mp$                                                        | [b] ( 3.4 ± 0.5 ) × 10 <sup>-3</sup>   | DESIG=101      |
| Г <sub>63</sub>  | $b_1(1235)^0 \pi^0$                                                                 | ( 2.3 ± 0.6 ) × 10 <sup>-3</sup>       | DESIG=160      |
| Г <sub>64</sub>  | $\eta K^\pm K_S^0 \pi^\mp$                                                          | [b] ( 2.2 ± 0.4 ) × 10 <sup>-3</sup>   | DESIG=230      |
| Г <sub>65</sub>  | $\phi K^*(892) \bar{K} + \text{c.c.}$                                               | ( 2.18 ± 0.23 ) × 10 <sup>-3</sup>     | DESIG=104      |
| Г <sub>66</sub>  | $\omega K \bar{K}$                                                                  | ( 1.9 ± 0.4 ) × 10 <sup>-3</sup>       | DESIG=27       |
| Г <sub>67</sub>  | $\omega f_0(1710) \rightarrow \omega K \bar{K}$                                     | ( 4.8 ± 1.1 ) × 10 <sup>-4</sup>       | DESIG=130      |
| Г <sub>68</sub>  | $\phi 2(\pi^+ \pi^-)$                                                               | ( 1.60 ± 0.32 ) × 10 <sup>-3</sup>     | DESIG=35       |
| Г <sub>69</sub>  | $\Delta(1232)^{++} \bar{p} \pi^-$                                                   | ( 1.6 ± 0.5 ) × 10 <sup>-3</sup>       | DESIG=70       |
| Г <sub>70</sub>  | $\omega \eta$                                                                       | ( 1.74 ± 0.20 ) × 10 <sup>-3</sup>     | S=1.6 DESIG=30 |
| Г <sub>71</sub>  | $\phi K \bar{K}$                                                                    | ( 1.77 ± 0.16 ) × 10 <sup>-3</sup>     | S=1.3 DESIG=36 |
| Г <sub>72</sub>  | $\phi K_S^0 K_S^0$                                                                  | ( 5.9 ± 1.5 ) × 10 <sup>-4</sup>       | DESIG=305      |
| Г <sub>73</sub>  | $\phi f_0(1710) \rightarrow \phi K \bar{K}$                                         | ( 3.6 ± 0.6 ) × 10 <sup>-4</sup>       | DESIG=129      |
| Г <sub>74</sub>  | $\phi K^+ K^-$                                                                      | ( 8.3 ± 1.2 ) × 10 <sup>-4</sup>       | DESIG=295      |
| Г <sub>75</sub>  | $\phi f_2(1270)$                                                                    | ( 3.2 ± 0.6 ) × 10 <sup>-4</sup>       | DESIG=39       |
| Г <sub>76</sub>  | $\Delta(1232)^{++} \bar{\Delta}(1232)^{--}$                                         | ( 1.10 ± 0.29 ) × 10 <sup>-3</sup>     | DESIG=66       |
| Г <sub>77</sub>  | $\Sigma(1385)^- \bar{\Sigma}(1385)^+ (\text{or c.c.})$                              | [b] ( 1.16 ± 0.05 ) × 10 <sup>-3</sup> | DESIG=67       |
| Г <sub>78</sub>  | $\Sigma(1385)^0 \bar{\Sigma}(1385)^0$                                               | ( 1.07 ± 0.08 ) × 10 <sup>-3</sup>     | DESIG=309      |
| Г <sub>79</sub>  | $K^+ K^- f_2'(1525)$                                                                | ( 1.04 ± 0.35 ) × 10 <sup>-3</sup>     | DESIG=308      |
| Г <sub>80</sub>  | $\phi f_2'(1525)$                                                                   | ( 8 ± 4 ) × 10 <sup>-4</sup>           | S=2.7 DESIG=40 |
| Г <sub>81</sub>  | $\phi \pi^+ \pi^-$                                                                  | ( 9.4 ± 1.5 ) × 10 <sup>-4</sup>       | S=1.7 DESIG=34 |
| Г <sub>82</sub>  | $\phi \pi^0 \pi^0$                                                                  | ( 5.0 ± 1.0 ) × 10 <sup>-4</sup>       | DESIG=76       |
| Г <sub>83</sub>  | $\phi K^\pm K_S^0 \pi^\mp$                                                          | [b] ( 7.2 ± 0.8 ) × 10 <sup>-4</sup>   | DESIG=103      |
| Г <sub>84</sub>  | $\omega f_1(1420)$                                                                  | ( 6.8 ± 2.4 ) × 10 <sup>-4</sup>       | DESIG=105      |
| Г <sub>85</sub>  | $\phi \eta$                                                                         | ( 7.4 ± 0.8 ) × 10 <sup>-4</sup>       | S=1.5 DESIG=37 |
| Г <sub>86</sub>  | $\Xi^0 \Xi^0$                                                                       | ( 1.17 ± 0.04 ) × 10 <sup>-3</sup>     | DESIG=248      |
| Г <sub>87</sub>  | $\Xi(1530)^- \Xi^+$                                                                 | ( 5.9 ± 1.5 ) × 10 <sup>-4</sup>       | DESIG=107      |
| Г <sub>88</sub>  | $p K^- \bar{\Sigma}(1385)^0$                                                        | ( 5.1 ± 3.2 ) × 10 <sup>-4</sup>       | DESIG=74       |
| Г <sub>89</sub>  | $\omega \pi^0$                                                                      | ( 4.5 ± 0.5 ) × 10 <sup>-4</sup>       | S=1.4 DESIG=32 |
| Г <sub>90</sub>  | $\omega \pi^0 \rightarrow \pi^+ \pi^- \pi^0$                                        | ( 1.7 ± 0.8 ) × 10 <sup>-5</sup>       | DESIG=327      |
| Г <sub>91</sub>  | $\phi \eta'(958)$                                                                   | ( 4.6 ± 0.5 ) × 10 <sup>-4</sup>       | S=2.2 DESIG=38 |
| Г <sub>92</sub>  | $\phi f_0(980)$                                                                     | ( 3.2 ± 0.9 ) × 10 <sup>-4</sup>       | S=1.9 DESIG=41 |
| Г <sub>93</sub>  | $\phi f_0(980) \rightarrow \phi \pi^+ \pi^-$                                        | ( 2.59 ± 0.34 ) × 10 <sup>-4</sup>     | DESIG=236      |
| Г <sub>94</sub>  | $\phi f_0(980) \rightarrow \phi \pi^0 \pi^0$                                        | ( 1.8 ± 0.5 ) × 10 <sup>-4</sup>       | DESIG=237      |
| Г <sub>95</sub>  | $\phi \pi^0 f_0(980) \rightarrow \phi \pi^0 \pi^+ \pi^-$                            | ( 4.5 ± 1.0 ) × 10 <sup>-6</sup>       | DESIG=278      |
| Г <sub>96</sub>  | $\phi \pi^0 f_0(980) \rightarrow \phi \pi^0 p^0 \pi^0$                              | ( 1.7 ± 0.6 ) × 10 <sup>-6</sup>       | DESIG=279      |
| Г <sub>97</sub>  | $\eta \phi f_0(980) \rightarrow \eta \phi \pi^+ \pi^-$                              | ( 3.2 ± 1.0 ) × 10 <sup>-4</sup>       | DESIG=229      |
| Г <sub>98</sub>  | $\phi a_0(980)^0 \rightarrow \phi \eta \pi^0$                                       | ( 4.4 ± 1.4 ) × 10 <sup>-6</sup>       | DESIG=258      |
| Г <sub>99</sub>  | $\Xi(1530)^0 \Xi^0$                                                                 | ( 3.2 ± 1.4 ) × 10 <sup>-4</sup>       | DESIG=108      |
| Г <sub>100</sub> | $\Sigma(1385)^- \bar{\Sigma}^+ (\text{or c.c.})$                                    | [b] ( 3.1 ± 0.5 ) × 10 <sup>-4</sup>   | DESIG=68       |
| Г <sub>101</sub> | $\phi f_1(1285)$                                                                    | ( 2.6 ± 0.5 ) × 10 <sup>-4</sup>       | DESIG=106      |
| Г <sub>102</sub> | $\phi f_1(1285) \rightarrow \phi \pi^0 f_0(980) \rightarrow \phi \pi^0 \pi^+ \pi^-$ | ( 9.4 ± 2.8 ) × 10 <sup>-7</sup>       | DESIG=280      |
| Г <sub>103</sub> | $\phi f_1(1285) \rightarrow \phi \pi^0 f_0(980) \rightarrow \phi \pi^0 \pi^0 \pi^0$ | ( 2.1 ± 2.2 ) × 10 <sup>-7</sup>       | DESIG=281      |
| Г <sub>104</sub> | $\eta \pi^+ \pi^-$                                                                  | ( 4.2 ± 0.8 ) × 10 <sup>-4</sup>       | DESIG=239      |
| Г <sub>105</sub> | $\eta \rho$                                                                         | ( 1.93 ± 0.23 ) × 10 <sup>-4</sup>     | DESIG=22       |
| Г <sub>106</sub> | $\omega \eta'(958)$                                                                 | ( 1.89 ± 0.18 ) × 10 <sup>-4</sup>     | DESIG=31       |
| Г <sub>107</sub> | $\omega f_0(980)$                                                                   | ( 1.4 ± 0.5 ) × 10 <sup>-4</sup>       | DESIG=150      |

|                  |                                                                                   |                                                 |        |                                 |
|------------------|-----------------------------------------------------------------------------------|-------------------------------------------------|--------|---------------------------------|
| Γ <sub>108</sub> | $\rho\eta'(958)$                                                                  | $(8.1 \pm 0.8) \times 10^{-5}$                  | S=1.6  | DESIG=23                        |
| Γ <sub>109</sub> | $a_2(1320)^\pm \pi^\mp$                                                           | $[b] < 4.3 \times 10^{-3}$                      | CL=90% | DESIG=42                        |
| Γ <sub>110</sub> | $K\bar{K}_2^*(1430) + \text{c.c.}$                                                | $< 4.0 \times 10^{-3}$                          | CL=90% | DESIG=45                        |
| Γ <sub>111</sub> | $K_1(1270)^\pm K^\mp$                                                             | $< 3.0 \times 10^{-3}$                          | CL=90% | DESIG=131                       |
| Γ <sub>112</sub> | $K_1(1270)K_S^0 \rightarrow \gamma K_S^0 K_S^0$                                   | $(8.5 \pm 2.5) \times 10^{-7}$                  |        | DESIG=377                       |
| Γ <sub>113</sub> | $K_S^0 \pi^- K_2^*(1430)^+ + \text{c.c.}$                                         | $(3.6 \pm 1.8) \times 10^{-3}$                  |        | DESIG=301                       |
| Γ <sub>114</sub> | $K_2^*(1430)^0 \bar{K}_2^*(1430)^0$                                               | $< 2.9 \times 10^{-3}$                          | CL=90% | DESIG=47                        |
| Γ <sub>115</sub> | $\phi\pi^0$                                                                       | $3 \times 10^{-6} \text{ or } 1 \times 10^{-7}$ |        | DESIG=33;OUR EVAL;→ UNCHECKED ← |
| Γ <sub>116</sub> | $\phi\eta(1405) \rightarrow \phi\eta\pi^+\pi^-$                                   | $(2.0 \pm 1.0) \times 10^{-5}$                  |        | DESIG=128                       |
| Γ <sub>117</sub> | $\omega f_2'(1525)$                                                               | $< 2.2 \times 10^{-4}$                          | CL=90% | DESIG=29                        |
| Γ <sub>118</sub> | $\omega X(1835) \rightarrow \omega p\bar{p}$                                      | $< 3.9 \times 10^{-6}$                          | CL=95% | DESIG=263                       |
| Γ <sub>119</sub> | $\phi X(1835) \rightarrow \phi p\bar{p}$                                          | $< 2.1 \times 10^{-7}$                          | CL=90% | DESIG=291                       |
| Γ <sub>120</sub> | $\phi X(1835) \rightarrow \phi\eta\pi^+\pi^-$                                     | $< 2.8 \times 10^{-4}$                          | CL=90% | DESIG=288                       |
| Γ <sub>121</sub> | $\phi X(1870) \rightarrow \phi\eta\pi^+\pi^-$                                     | $< 6.13 \times 10^{-5}$                         | CL=90% | DESIG=289                       |
| Γ <sub>122</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>123</sub> | $\eta\phi(2170) \rightarrow \eta K^*(892)^0 \bar{K}^*(892)^0$                     | $< 2.52 \times 10^{-4}$                         | CL=90% | DESIG=253                       |
| Γ <sub>124</sub> | $\Sigma(1385)^0 \bar{\Lambda} + \text{c.c.}$                                      | $< 8.2 \times 10^{-6}$                          | CL=90% | DESIG=111                       |
| Γ <sub>125</sub> | $\Delta(1232)^+ \bar{p}$                                                          | $< 1 \times 10^{-4}$                            | CL=90% | DESIG=112                       |
| Γ <sub>126</sub> | $\Lambda(1520)\bar{\Lambda} + \text{c.c.} \rightarrow \gamma\Lambda\bar{\Lambda}$ | $< 4.1 \times 10^{-6}$                          | CL=90% | DESIG=260                       |
| Γ <sub>127</sub> | $\bar{\Lambda}(1520)\Lambda + \text{c.c.}$                                        | $2 \times 10^{-3}$                              | CL=90% | DESIG=364                       |
| Γ <sub>128</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>129</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>130</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>131</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>132</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                       |
| Γ <sub>133</sub> | $\Sigma^0 \bar{\Lambda}$                                                          | $< 9 \times 10^{-5}$                            | CL=90% | DESIG=110                       |

## Decays into stable hadrons

NODE=M070;CLUMP=B

|                  |                                                                       |                                  |       |           |
|------------------|-----------------------------------------------------------------------|----------------------------------|-------|-----------|
| Γ <sub>134</sub> | $2(\pi^+\pi^-\pi^0)$                                                  | $(3.37 \pm 0.26) \%$             |       | DESIG=9   |
| Γ <sub>135</sub> | $3(\pi^+\pi^-\pi^0)$                                                  | $(2.9 \pm 0.6) \%$               |       | DESIG=11  |
| Γ <sub>136</sub> | $\pi^+\pi^-\pi^0$                                                     | $(2.10 \pm 0.08) \%$             | S=1.6 | DESIG=7   |
| Γ <sub>137</sub> | $\pi^+\pi^-\pi^0\pi^0\pi^0$                                           | $(2.71 \pm 0.29) \%$             |       | DESIG=358 |
| Γ <sub>138</sub> | $\rho^\pm\pi^\mp\pi^0\pi^0$                                           | $(1.41 \pm 0.22) \%$             |       | DESIG=362 |
| Γ <sub>139</sub> | $\rho^+\rho^-\pi^0$                                                   | $(6.0 \pm 1.1) \times 10^{-3}$   |       | DESIG=363 |
| Γ <sub>140</sub> | $\pi^+\pi^-\pi^0 K^+ K^-$                                             | $(1.20 \pm 0.30) \%$             |       | DESIG=18  |
| Γ <sub>141</sub> | $4(\pi^+\pi^-\pi^0)$                                                  | $(9.0 \pm 3.0) \times 10^{-3}$   |       | DESIG=12  |
| Γ <sub>142</sub> | $\pi^+\pi^- K^+ K^-$                                                  | $(6.84 \pm 0.32) \times 10^{-3}$ |       | DESIG=16  |
| Γ <sub>143</sub> | $\pi^+\pi^- K_S^0 K_L^0$                                              | $(3.8 \pm 0.6) \times 10^{-3}$   |       | DESIG=296 |
| Γ <sub>144</sub> | $\pi^+\pi^- K_S^0 K_S^0$                                              | $(1.68 \pm 0.19) \times 10^{-3}$ |       | DESIG=297 |
| Γ <sub>145</sub> | $\pi^\pm\pi^0 K^\mp K_S^0$                                            | $(5.7 \pm 0.5) \times 10^{-3}$   |       | DESIG=341 |
| Γ <sub>146</sub> | $K^+ K^- K_S^0 K_S^0$                                                 | $(4.1 \pm 0.8) \times 10^{-4}$   |       | DESIG=298 |
| Γ <sub>147</sub> | $\pi^+\pi^- K^+ K^- \eta$                                             | $(4.7 \pm 0.7) \times 10^{-3}$   |       | DESIG=238 |
| Γ <sub>148</sub> | $\pi^0\pi^0 K^+ K^-$                                                  | $(2.12 \pm 0.23) \times 10^{-3}$ |       | DESIG=234 |
| Γ <sub>149</sub> | $\pi^0\pi^0 K_S^0 K_L^0$                                              | $(1.9 \pm 0.4) \times 10^{-3}$   |       | DESIG=337 |
| Γ <sub>150</sub> | $K\bar{K}\pi$                                                         | $(6.1 \pm 1.0) \times 10^{-3}$   |       | DESIG=15  |
| Γ <sub>151</sub> | $K^+ K^- \pi^0$                                                       | $(2.14 \pm 0.24) \times 10^{-3}$ |       | DESIG=334 |
| Γ <sub>152</sub> | $K_S^0 K^\pm \pi^\mp$                                                 | $(5.6 \pm 0.5) \times 10^{-3}$   |       | DESIG=335 |
| Γ <sub>153</sub> | $K_S^0 K_L^0 \pi^0$                                                   | $(2.06 \pm 0.27) \times 10^{-3}$ |       | DESIG=336 |
| Γ <sub>154</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>155</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>156</sub> | $K_S^0 K_L^0 \eta$                                                    | $(1.44 \pm 0.34) \times 10^{-3}$ |       | DESIG=340 |
| Γ <sub>157</sub> | $2(\pi^+\pi^-)$                                                       | $(3.57 \pm 0.30) \times 10^{-3}$ |       | DESIG=8   |
| Γ <sub>158</sub> | $3(\pi^+\pi^-)$                                                       | $(4.3 \pm 0.4) \times 10^{-3}$   |       | DESIG=10  |
| Γ <sub>159</sub> | $2(\pi^+\pi^-\pi^0)$                                                  | $(1.61 \pm 0.21) \%$             |       | DESIG=210 |

|                  |                                                  |                                    |        |                                 |
|------------------|--------------------------------------------------|------------------------------------|--------|---------------------------------|
| ┌ <sub>160</sub> | $2(\pi^+\pi^-)\eta$                              | $(2.26 \pm 0.28) \times 10^{-3}$   |        | DESIG=201                       |
| ┌ <sub>161</sub> | $3(\pi^+\pi^-)\eta$                              | $(7.2 \pm 1.5) \times 10^{-4}$     |        | DESIG=202                       |
| ┌ <sub>162</sub> | $\pi^+\pi^-\pi^0\pi^0\eta$                       | $(2.3 \pm 0.5) \times 10^{-3}$     |        | DESIG=359                       |
| ┌ <sub>163</sub> | $\rho^\pm\pi^\mp\pi^0\eta$                       | $(1.9 \pm 0.8) \times 10^{-3}$     |        | DESIG=361                       |
| ┌ <sub>164</sub> | $p\bar{p}$                                       | $(2.123 \pm 0.029) \times 10^{-3}$ |        | DESIG=50                        |
| ┌ <sub>165</sub> | $p\bar{p}\pi^0$                                  | $(1.19 \pm 0.08) \times 10^{-3}$   | S=1.1  | DESIG=52                        |
| ┌ <sub>166</sub> | $p\bar{p}\pi^+\pi^-$                             | $(6.0 \pm 0.5) \times 10^{-3}$     | S=1.3  | DESIG=54                        |
| ┌ <sub>167</sub> | $p\bar{p}\pi^+\pi^-\pi^0$                        | [c] $(2.3 \pm 0.9) \times 10^{-3}$ | S=1.9  | DESIG=55                        |
| ┌ <sub>168</sub> | $p\bar{p}\eta$                                   | $(2.00 \pm 0.12) \times 10^{-3}$   |        | DESIG=56                        |
| ┌ <sub>169</sub> | $p\bar{p}\rho$                                   | < 3.1 $\times 10^{-4}$             | CL=90% | DESIG=57                        |
| ┌ <sub>170</sub> | $p\bar{p}\omega$                                 | $(9.8 \pm 1.0) \times 10^{-4}$     | S=1.3  | DESIG=58                        |
| ┌ <sub>171</sub> | $p\bar{p}\eta'(958)$                             | $(1.29 \pm 0.14) \times 10^{-4}$   | S=2.0  | DESIG=59                        |
| ┌ <sub>172</sub> | $p\bar{p}a_0(980) \rightarrow p\bar{p}\pi^0\eta$ | $(6.8 \pm 1.8) \times 10^{-5}$     |        | DESIG=276                       |
| ┌ <sub>173</sub> | $p\bar{p}\phi$                                   | $(5.19 \pm 0.33) \times 10^{-5}$   |        | DESIG=127                       |
| ┌ <sub>174</sub> | $n\bar{n}$                                       | $(2.09 \pm 0.16) \times 10^{-3}$   |        | DESIG=64                        |
| ┌ <sub>175</sub> | $n\bar{n}\pi^+\pi^-$                             | $(4 \pm 4) \times 10^{-3}$         |        | DESIG=65                        |
| ┌ <sub>176</sub> | $\Sigma^+\bar{\Sigma}^-$                         | $(1.50 \pm 0.24) \times 10^{-3}$   |        | DESIG=247                       |
| ┌ <sub>177</sub> | $\Sigma^0\bar{\Sigma}^0$                         | $(1.172 \pm 0.032) \times 10^{-3}$ | S=1.4  | DESIG=63                        |
| ┌ <sub>178</sub> | $2(\pi^+\pi^-)K^+K^-$                            | $(3.1 \pm 1.3) \times 10^{-3}$     |        | DESIG=17                        |
| ┌ <sub>179</sub> | $p\bar{n}\pi^-$                                  | $(2.12 \pm 0.09) \times 10^{-3}$   |        | DESIG=53                        |
| ┌ <sub>180</sub> | $nN(1440)$                                       | seen                               |        | DESIG=215;OUR EST;→ UNCHECKED ← |
| ┌ <sub>181</sub> | $nN(1520)$                                       | seen                               |        | DESIG=216;OUR EST;→ UNCHECKED ← |
| ┌ <sub>182</sub> | $nN(1535)$                                       | seen                               |        | DESIG=217;OUR EST;→ UNCHECKED ← |
| ┌ <sub>183</sub> | $\Xi^-\bar{\Xi}^+$                               | $(9.7 \pm 0.8) \times 10^{-4}$     | S=1.4  | DESIG=62                        |
| ┌ <sub>184</sub> | $\Lambda\bar{\Lambda}$                           | $(1.89 \pm 0.09) \times 10^{-3}$   | S=2.8  | DESIG=60                        |
| ┌ <sub>185</sub> | $\Lambda\bar{\Sigma}^-\pi^+(\text{or c.c.})$     | [b] $(8.3 \pm 0.7) \times 10^{-4}$ | S=1.2  | DESIG=71                        |
| ┌ <sub>186</sub> | $pK^-\bar{\Lambda}+\text{c.c.}$                  | $(8.8 \pm 1.2) \times 10^{-4}$     |        | DESIG=72                        |
| ┌ <sub>187</sub> | $2(K^+K^-)$                                      | $(7.2 \pm 0.8) \times 10^{-4}$     |        | DESIG=19                        |
| ┌ <sub>188</sub> | $pK^-\bar{\Sigma}^0$                             | $(2.9 \pm 0.8) \times 10^{-4}$     |        | DESIG=73                        |
| ┌ <sub>189</sub> | $K^+K^-$                                         | $(2.86 \pm 0.21) \times 10^{-4}$   |        | DESIG=13                        |
| ┌ <sub>190</sub> | $K_S^0K_L^0$                                     | $(1.95 \pm 0.11) \times 10^{-4}$   | S=2.4  | DESIG=75                        |
| ┌ <sub>191</sub> | $\Lambda\bar{\Lambda}\pi^+\pi^-$                 | $(4.3 \pm 1.0) \times 10^{-3}$     |        | DESIG=261                       |
| ┌ <sub>192</sub> | $\Lambda\bar{\Lambda}\eta$                       | $(1.62 \pm 0.17) \times 10^{-4}$   |        | DESIG=228                       |
| ┌ <sub>193</sub> | $\Lambda\bar{\Lambda}\pi^0$                      | $(3.8 \pm 0.4) \times 10^{-5}$     |        | DESIG=109                       |
| ┌ <sub>194</sub> | $\bar{\Lambda}nK_S^0+\text{c.c.}$                | $(6.5 \pm 1.1) \times 10^{-4}$     |        | DESIG=225                       |
| ┌ <sub>195</sub> | $\pi^+\pi^-$                                     | $(1.47 \pm 0.14) \times 10^{-4}$   |        | DESIG=6                         |
| ┌ <sub>196</sub> | $\Lambda\bar{\Sigma}^+\text{c.c.}$               | $(2.83 \pm 0.23) \times 10^{-5}$   |        | DESIG=61                        |
| ┌ <sub>197</sub> | $K_S^0K_S^0$                                     | < 1.4 $\times 10^{-8}$             | CL=95% | DESIG=14                        |

## Radiative decays

|                  |                                                          |                                            |        |                               |
|------------------|----------------------------------------------------------|--------------------------------------------|--------|-------------------------------|
| ┌ <sub>198</sub> | $3\gamma$                                                | $(1.16 \pm 0.22) \times 10^{-5}$           |        | NODE=M070;CLUMP=C<br>DESIG=81 |
| ┌ <sub>199</sub> | $4\gamma$                                                | < 9 $\times 10^{-6}$                       | CL=90% | DESIG=244                     |
| ┌ <sub>200</sub> | $5\gamma$                                                | < 1.5 $\times 10^{-5}$                     | CL=90% | DESIG=245                     |
| ┌ <sub>201</sub> | $\gamma\pi^0\pi^0$                                       | $(1.15 \pm 0.05) \times 10^{-3}$           |        | DESIG=283                     |
| ┌ <sub>202</sub> | $\gamma\eta\pi^0$                                        | $(2.14 \pm 0.31) \times 10^{-5}$           |        | DESIG=292                     |
| ┌ <sub>203</sub> | $\gamma a_0(980)^0 \rightarrow \gamma\eta\pi^0$          | < 2.5 $\times 10^{-6}$                     | CL=95% | DESIG=293                     |
| ┌ <sub>204</sub> | $\gamma a_2(1320)^0 \rightarrow \gamma\eta\pi^0$         | < 6.6 $\times 10^{-6}$                     | CL=95% | DESIG=294                     |
| ┌ <sub>205</sub> | $\gamma K_S^0K_S^0$                                      | $(8.1 \pm 0.4) \times 10^{-4}$             |        | DESIG=378                     |
| ┌ <sub>206</sub> | $\gamma\eta_c(1S)$                                       | $(1.7 \pm 0.4) \%$                         | S=1.5  | DESIG=85                      |
| ┌ <sub>207</sub> | $\gamma\eta_c(1S) \rightarrow 3\gamma$                   | $(3.8 \pm \frac{1.3}{1.0}) \times 10^{-6}$ | S=1.1  | DESIG=246                     |
| ┌ <sub>208</sub> | $\gamma\pi^+\pi^-\pi^0$                                  | $(8.3 \pm 3.1) \times 10^{-3}$             |        | DESIG=99                      |
| ┌ <sub>209</sub> | $\gamma\eta\pi\pi$                                       | $(6.1 \pm 1.0) \times 10^{-3}$             |        | DESIG=96                      |
| ┌ <sub>210</sub> | $\gamma\eta_2(1870) \rightarrow \gamma\eta\pi^+\pi^-$    | $(6.2 \pm 2.4) \times 10^{-4}$             |        | DESIG=142                     |
| ┌ <sub>211</sub> | $\gamma\eta(1405/1475) \rightarrow \gamma K\bar{K}\pi$   | [d] $(2.8 \pm 0.6) \times 10^{-3}$         | S=1.6  | DESIG=89                      |
| ┌ <sub>212</sub> | $\gamma\eta(1405/1475) \rightarrow \gamma\gamma\rho^0$   | $(7.8 \pm 2.0) \times 10^{-5}$             | S=1.8  | DESIG=171                     |
| ┌ <sub>213</sub> | $\gamma\eta(1405/1475) \rightarrow \gamma\eta\pi^+\pi^-$ | $(3.0 \pm 0.5) \times 10^{-4}$             |        | DESIG=170                     |
| ┌ <sub>214</sub> | $\gamma\eta(1405/1475) \rightarrow \gamma\gamma\phi$     | < 8.2 $\times 10^{-5}$                     | CL=95% | DESIG=212                     |
| ┌ <sub>215</sub> | $\gamma\eta(1405) \rightarrow \gamma\gamma\gamma$        | < 2.63 $\times 10^{-6}$                    |        | DESIG=348                     |
| ┌ <sub>216</sub> | $\gamma\eta(1475) \rightarrow \gamma\gamma\gamma$        | < 1.86 $\times 10^{-6}$                    |        | DESIG=349                     |
| ┌ <sub>217</sub> | $\gamma\rho\rho$                                         | $(4.5 \pm 0.8) \times 10^{-3}$             |        | DESIG=94                      |

|      |                                                               |                                         |        |           |
|------|---------------------------------------------------------------|-----------------------------------------|--------|-----------|
| Г218 | $\gamma \rho \omega$                                          | $< 5.4 \times 10^{-4}$                  | CL=90% | DESIG=226 |
| Г219 | $\gamma \rho \phi$                                            | $< 8.8 \times 10^{-5}$                  | CL=90% | DESIG=227 |
| Г220 | $\gamma \eta'(958)$                                           | $(5.21 \pm 0.17) \times 10^{-3}$        | S=1.4  | DESIG=84  |
| Г221 | $\gamma 2\pi^+ 2\pi^-$                                        | $(2.8 \pm 0.5) \times 10^{-3}$          | S=1.9  | DESIG=95  |
| Г222 | $\gamma f_2(1270) f_2(1270)$                                  | $(9.5 \pm 1.7) \times 10^{-4}$          |        | DESIG=203 |
| Г223 | $\gamma f_2(1270) f_2(1270) (\text{non resonant})$            | $(8.2 \pm 1.9) \times 10^{-4}$          |        | DESIG=204 |
| Г224 | $\gamma K^+ K^- \pi^+ \pi^-$                                  | $(2.1 \pm 0.6) \times 10^{-3}$          |        | DESIG=143 |
| Г225 | $\gamma f_4(2050)$                                            | $(2.7 \pm 0.7) \times 10^{-3}$          |        | DESIG=100 |
| Г226 | $\gamma \omega \omega$                                        | $(1.61 \pm 0.33) \times 10^{-3}$        |        | DESIG=97  |
| Г227 | $\gamma \eta(1405/1475) \rightarrow \gamma \rho^0 \rho^0$     | $(1.7 \pm 0.4) \times 10^{-3}$          | S=1.3  | DESIG=124 |
| Г228 | $\gamma f_2(1270)$                                            | $(1.64 \pm 0.12) \times 10^{-3}$        | S=1.3  | DESIG=86  |
| Г229 | $\gamma f_2(1270) \rightarrow \gamma K_S^0 K_S^0$             | $(2.58 \pm 0.60 - 0.22) \times 10^{-5}$ |        | DESIG=373 |
| Г230 | $\gamma f_0(1370) \rightarrow \gamma K \bar{K}$               | $(4.2 \pm 1.5) \times 10^{-4}$          |        | DESIG=284 |
| Г231 | $\gamma f_0(1370) \rightarrow \gamma K_S^0 K_S^0$             | $(1.1 \pm 0.4) \times 10^{-5}$          |        | DESIG=368 |
| Г232 | $\gamma f_0(1500) \rightarrow \gamma K_S^0 K_S^0$             | $(1.59 \pm 0.24 - 0.60) \times 10^{-5}$ |        | DESIG=369 |
| Г233 | $\gamma f_0(1710) \rightarrow \gamma K \bar{K}$               | $(9.5 \pm 1.0 - 0.5) \times 10^{-4}$    | S=1.5  | DESIG=91  |
| Г234 | $\gamma f_0(1710) \rightarrow \gamma \pi \pi$                 | $(3.8 \pm 0.5) \times 10^{-4}$          |        | DESIG=135 |
| Г235 | $\gamma f_0(1710) \rightarrow \gamma \omega \omega$           | $(3.1 \pm 1.0) \times 10^{-4}$          |        | DESIG=221 |
| Г236 | $\gamma f_0(1710) \rightarrow \gamma \eta \eta$               | $(2.4 \pm 1.2 - 0.7) \times 10^{-4}$    |        | DESIG=266 |
| Г237 | $\gamma \eta$                                                 | $(1.108 \pm 0.027) \times 10^{-3}$      |        | DESIG=83  |
| Г238 | $\gamma f_1(1420) \rightarrow \gamma K \bar{K} \pi$           | $(7.9 \pm 1.3) \times 10^{-4}$          |        | DESIG=175 |
| Г239 | $\gamma f_1(1285)$                                            | $(6.1 \pm 0.8) \times 10^{-4}$          |        | DESIG=88  |
| Г240 | $\gamma f_1(1510) \rightarrow \gamma \eta \pi^+ \pi^-$        | $(4.5 \pm 1.2) \times 10^{-4}$          |        | DESIG=141 |
| Г241 | $\gamma f_2'(1525)$                                           | $(5.7 \pm 0.8 - 0.5) \times 10^{-4}$    | S=1.5  | DESIG=87  |
| Г242 | $\gamma f_2'(1525) \rightarrow \gamma K_S^0 K_S^0$            | $(8.0 \pm 0.7 - 0.5) \times 10^{-5}$    |        | DESIG=374 |
| Г243 | $\gamma f_2'(1525) \rightarrow \gamma \eta \eta$              | $(3.4 \pm 1.4) \times 10^{-5}$          |        | DESIG=268 |
| Г244 | $\gamma f_2(1640) \rightarrow \gamma \omega \omega$           | $(2.8 \pm 1.8) \times 10^{-4}$          |        | DESIG=222 |
| Г245 | $\gamma f_2(1910) \rightarrow \gamma \omega \omega$           | $(2.0 \pm 1.4) \times 10^{-4}$          |        | DESIG=223 |
| Г246 | $\gamma f_0(1750) \rightarrow \gamma K_S^0 K_S^0$             | $(1.11 \pm 0.20 - 0.33) \times 10^{-5}$ |        | DESIG=370 |
| Г247 | $\gamma f_0(1800) \rightarrow \gamma \omega \phi$             | $(2.5 \pm 0.6) \times 10^{-4}$          |        | DESIG=262 |
| Г248 | $\gamma f_2(1810) \rightarrow \gamma \eta \eta$               | $(5.4 \pm 3.5 - 2.4) \times 10^{-5}$    |        | DESIG=269 |
| Г249 | $\gamma f_2(1950) \rightarrow \gamma K^*(892) \bar{K}^*(892)$ | $(7.0 \pm 2.2) \times 10^{-4}$          |        | DESIG=144 |
| Г250 | $\gamma K^*(892) \bar{K}^*(892)$                              | $(4.0 \pm 1.3) \times 10^{-3}$          |        | DESIG=145 |
| Г251 | $\gamma \phi \phi$                                            | $(4.0 \pm 1.2) \times 10^{-4}$          | S=2.1  | DESIG=98  |
| Г252 | $\gamma p \bar{p}$                                            | $(3.8 \pm 1.0) \times 10^{-4}$          |        | DESIG=90  |
| Г253 | $\gamma \eta(2225)$                                           | $(3.14 \pm 0.50 - 0.19) \times 10^{-4}$ |        | DESIG=126 |
| Г254 | $\gamma \eta(1760) \rightarrow \gamma \rho^0 \rho^0$          | $(1.3 \pm 0.9) \times 10^{-4}$          |        | DESIG=125 |
| Г255 | $\gamma \eta(1760) \rightarrow \gamma \omega \omega$          | $(1.98 \pm 0.33) \times 10^{-3}$        |        | DESIG=224 |
| Г256 | $\gamma \eta(1760) \rightarrow \gamma \gamma \gamma$          | $< 4.80 \times 10^{-6}$                 |        | DESIG=347 |
| Г257 | $\gamma X(1835) \rightarrow \gamma \pi^+ \pi^- \eta'$         | $(2.77 \pm 0.34 - 0.40) \times 10^{-4}$ | S=1.1  | DESIG=213 |
| Г258 | $\gamma X(1835) \rightarrow \gamma p \bar{p}$                 | $(7.7 \pm 1.5 - 0.9) \times 10^{-5}$    |        | DESIG=254 |
| Г259 | $\gamma X(1835) \rightarrow \gamma K_S^0 K_S^0 \eta$          | $(3.3 \pm 2.0 - 1.3) \times 10^{-5}$    |        | DESIG=282 |
| Г260 | $\gamma X(1835) \rightarrow \gamma \gamma \phi(1020)$         |                                         |        | DESIG=346 |
| Г261 | $\gamma X(1835) \rightarrow \gamma \gamma \gamma$             | $< 3.56 \times 10^{-6}$                 |        | DESIG=350 |
| Г262 | $\gamma X(1840) \rightarrow \gamma 3(\pi^+ \pi^-)$            | $(2.4 \pm 0.7 - 0.8) \times 10^{-5}$    |        | DESIG=264 |
| Г263 | $\gamma (K \bar{K} \pi) [J^{PC} = 0^{-+}]$                    | $(7 \pm 4) \times 10^{-4}$              | S=2.1  | DESIG=176 |
| Г264 | $\gamma \pi^0$                                                | $(3.56 \pm 0.17) \times 10^{-5}$        |        | DESIG=82  |
| Г265 | $\gamma p \bar{p} \pi^+ \pi^-$                                | $< 7.9 \times 10^{-4}$                  | CL=90% | DESIG=93  |

|                |                                                   |                   |                  |        |           |
|----------------|---------------------------------------------------|-------------------|------------------|--------|-----------|
| $\Gamma_{266}$ | $\gamma \Lambda \bar{\Lambda}$                    | $< 1.3$           | $\times 10^{-4}$ | CL=90% | DESIG=200 |
| $\Gamma_{267}$ | $\gamma f_0(2100) \rightarrow \gamma \eta \eta$   | $(1.13 \pm 0.60)$ | $\times 10^{-4}$ |        | DESIG=267 |
| $\Gamma_{268}$ | $\gamma f_0(2100) \rightarrow \gamma \pi \pi$     | $(6.2 \pm 1.0)$   | $\times 10^{-4}$ |        | DESIG=286 |
| $\Gamma_{269}$ | $\gamma f_0(2200)$                                |                   |                  |        | DESIG=123 |
| $\Gamma_{270}$ | $\gamma f_0(2200) \rightarrow \gamma K \bar{K}$   | $(5.9 \pm 1.3)$   | $\times 10^{-4}$ |        | DESIG=285 |
| $\Gamma_{271}$ | $\gamma f_0(2200) \rightarrow \gamma K_S^0 K_S^0$ | $(2.72 \pm 0.19)$ | $\times 10^{-4}$ |        | DESIG=371 |
| $\Gamma_{272}$ | $\gamma f_J(2220)$                                |                   |                  |        | DESIG=92  |
| $\Gamma_{273}$ | $\gamma f_J(2220) \rightarrow \gamma \pi \pi$     | $< 3.9$           | $\times 10^{-5}$ | CL=90% | DESIG=136 |
| $\Gamma_{274}$ | $\gamma f_J(2220) \rightarrow \gamma K \bar{K}$   | $< 4.1$           | $\times 10^{-5}$ | CL=90% | DESIG=137 |
| $\Gamma_{275}$ | $\gamma f_J(2220) \rightarrow \gamma p \bar{p}$   | $(1.5 \pm 0.8)$   | $\times 10^{-5}$ |        | DESIG=138 |
| $\Gamma_{276}$ | $\gamma f_0(2330) \rightarrow \gamma K_S^0 K_S^0$ | $(4.9 \pm 0.7)$   | $\times 10^{-5}$ |        | DESIG=372 |
| $\Gamma_{277}$ | $\gamma f_2(2340) \rightarrow \gamma \eta \eta$   | $(5.6 \pm 2.4)$   | $\times 10^{-5}$ |        | DESIG=270 |
| $\Gamma_{278}$ | $\gamma f_2(2340) \rightarrow \gamma K_S^0 K_S^0$ | $(5.5 \pm 4.0)$   | $\times 10^{-5}$ |        | DESIG=375 |
| $\Gamma_{279}$ | $\gamma f_0(1500) \rightarrow \gamma \pi \pi$     | $(1.09 \pm 0.24)$ | $\times 10^{-4}$ |        | DESIG=172 |
| $\Gamma_{280}$ | $\gamma f_0(1500) \rightarrow \gamma \eta \eta$   | $(1.7 \pm 0.6)$   | $\times 10^{-5}$ |        | DESIG=265 |
| $\Gamma_{281}$ | $\gamma A \rightarrow \gamma \text{invisible}$    | $[e] < 6.3$       | $\times 10^{-6}$ | CL=90% | DESIG=251 |
| $\Gamma_{282}$ | $\gamma A^0 \rightarrow \gamma \mu^+ \mu^-$       | $[f] < 5$         | $\times 10^{-6}$ | CL=90% | DESIG=259 |

**Dalitz decays**

|                |                                               |                   |                  |        |           |
|----------------|-----------------------------------------------|-------------------|------------------|--------|-----------|
| $\Gamma_{283}$ | $\pi^0 e^+ e^-$                               | $(7.6 \pm 1.4)$   | $\times 10^{-7}$ |        | DESIG=271 |
| $\Gamma_{284}$ | $\eta e^+ e^-$                                | $(1.43 \pm 0.07)$ | $\times 10^{-5}$ |        | DESIG=272 |
| $\Gamma_{285}$ | $\eta'(958) e^+ e^-$                          | $(6.59 \pm 0.18)$ | $\times 10^{-5}$ |        | DESIG=273 |
| $\Gamma_{286}$ | $\eta U \rightarrow \eta e^+ e^-$             | $< 9.11$          | $\times 10^{-7}$ | CL=90% | DESIG=352 |
| $\Gamma_{287}$ | $\eta'(958) U \rightarrow \eta'(958) e^+ e^-$ | $< 2.0$           | $\times 10^{-7}$ | CL=90% | DESIG=366 |

**Weak decays**

|                |                                        |         |                  |        |           |
|----------------|----------------------------------------|---------|------------------|--------|-----------|
| $\Gamma_{288}$ | $D^- e^+ \nu_e + \text{c.c.}$          | $< 1.2$ | $\times 10^{-5}$ | CL=90% | DESIG=218 |
| $\Gamma_{289}$ | $\bar{D}^0 e^+ e^- + \text{c.c.}$      | $< 8.5$ | $\times 10^{-8}$ | CL=90% | DESIG=219 |
| $\Gamma_{290}$ | $D_s^- e^+ \nu_e + \text{c.c.}$        | $< 1.3$ | $\times 10^{-6}$ | CL=90% | DESIG=220 |
| $\Gamma_{291}$ | $D_s^{*-} e^+ \nu_e + \text{c.c.}$     | $< 1.8$ | $\times 10^{-6}$ | CL=90% | DESIG=290 |
| $\Gamma_{292}$ | $D^- \pi^+ + \text{c.c.}$              | $< 7.5$ | $\times 10^{-5}$ | CL=90% | DESIG=241 |
| $\Gamma_{293}$ | $\bar{D}^0 \bar{K}^0 + \text{c.c.}$    | $< 1.7$ | $\times 10^{-4}$ | CL=90% | DESIG=242 |
| $\Gamma_{294}$ | $\bar{D}^0 \bar{K}^{*0} + \text{c.c.}$ | $< 2.5$ | $\times 10^{-6}$ | CL=90% | DESIG=275 |
| $\Gamma_{295}$ | $D_s^- \pi^+ + \text{c.c.}$            | $< 1.3$ | $\times 10^{-4}$ | CL=90% | DESIG=243 |
| $\Gamma_{296}$ | $D_s^- \rho^+ + \text{c.c.}$           | $< 1.3$ | $\times 10^{-5}$ | CL=90% | DESIG=274 |

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

|                |                    |    |         |                  |        |           |
|----------------|--------------------|----|---------|------------------|--------|-----------|
| $\Gamma_{297}$ | $\gamma \gamma$    | C  | $< 2.7$ | $\times 10^{-7}$ | CL=90% | DESIG=80  |
| $\Gamma_{298}$ | $\gamma \phi$      | C  | $< 1.4$ | $\times 10^{-6}$ | CL=90% | DESIG=277 |
| $\Gamma_{299}$ | $e^\pm \mu^\mp$    | LF | $< 1.6$ | $\times 10^{-7}$ | CL=90% | DESIG=177 |
| $\Gamma_{300}$ | $e^\pm \tau^\mp$   | LF | $< 8.3$ | $\times 10^{-6}$ | CL=90% | DESIG=178 |
| $\Gamma_{301}$ | $\mu^\pm \tau^\mp$ | LF | $< 2.0$ | $\times 10^{-6}$ | CL=90% | DESIG=179 |

**Other decays**

|                |           |       |                  |        |           |
|----------------|-----------|-------|------------------|--------|-----------|
| $\Gamma_{302}$ | invisible | $< 7$ | $\times 10^{-4}$ | CL=90% | 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] See the "Note on the  $\eta(1405)$ " in the  $\eta(1405)$  Particle Listings.[e] For a narrow state  $A$  with mass less than 960 MeV.[f] For a narrow scalar or pseudoscalar  $A^0$  with mass 0.21–3.0 GeV.

LINKAGE=Egm

LINKAGE=SG

LINKAGE=MF

LINKAGE=MG

LINKAGE=NSA

LINKAGE=NAO



**$J/\psi(1S)$  PARTIAL WIDTHS**

NODE=M070220

 **$\Gamma(\text{hadrons})$**  **$\Gamma_1$** 

| VALUE (keV)                                                                   | DOCUMENT ID | TECN     | COMMENT  |
|-------------------------------------------------------------------------------|-------------|----------|----------|
| • • • 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 | $e^+e^-$ |

NODE=M070W3  
NODE=M070W3 **$\Gamma(e^+e^-)$**  **$\Gamma_5$** 

| VALUE (keV)                                                                   | EVTs | DOCUMENT ID              | TECN     | COMMENT                                     |
|-------------------------------------------------------------------------------|------|--------------------------|----------|---------------------------------------------|
| <b>5.53 ± 0.10 OUR AVERAGE</b>                                                |      |                          |          |                                             |
| [5.36 ± 0.29 keV OUR 1992 AVERAGE]                                            |      |                          |          |                                             |
| 5.550 ± 0.056 ± 0.089                                                         |      | <sup>1</sup> ANASHIN     | 18A KEDR | $e^+e^-$                                    |
| 5.36 $^{+0.29}_{-0.28}$                                                       |      | <sup>2</sup> HSUEH       | 92 RVUE  | See $\Upsilon$ mini-review                  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                          |          |                                             |
| 5.58 ± 0.05 ± 0.08                                                            |      | <sup>3</sup> ABLIKIM     | 16Q BES3 | $3.773 e^+e^- \rightarrow \mu^+\mu^-\gamma$ |
| 5.71 ± 0.16                                                                   | 13k  | <sup>4</sup> ADAMS       | 06A CLEO | $e^+e^- \rightarrow \mu^+\mu^-\gamma$       |
| 5.57 ± 0.19                                                                   | 7.8k | <sup>4</sup> AUBERT      | 04 BABR  | $e^+e^- \rightarrow \mu^+\mu^-\gamma$       |
| 5.14 ± 0.39                                                                   |      | BAI                      | 95B BES  | $e^+e^-$                                    |
| 4.72 ± 0.35                                                                   |      | ALEXANDER                | 89 RVUE  | See $\Upsilon$ mini-review                  |
| 4.4 ± 0.6                                                                     |      | <sup>2</sup> BRANDELIK   | 79C DASP | $e^+e^-$                                    |
| 4.6 ± 0.8                                                                     |      | <sup>5</sup> BALDINI-... | 75 FRAG  | $e^+e^-$                                    |
| 4.8 ± 0.6                                                                     |      | BOYARSKI                 | 75 MRK1  | $e^+e^-$                                    |
| 4.6 ± 1.0                                                                     |      | ESPOSITO                 | 75B FRAM | $e^+e^-$                                    |

NODE=M070W1  
NODE=M070W1  
NEW

OCCUR=4

<sup>1</sup> From the cross sections of  $e^+e^- \rightarrow e^+e^-$  and  $e^+e^- \rightarrow \text{hadrons}$  near the  $J/\psi(1S)$  peak.<sup>2</sup> From a simultaneous fit to  $e^+e^-$ ,  $\mu^+\mu^-$ , and hadronic channels assuming  $\Gamma(e^+e^-) = \Gamma(\mu^+\mu^-)$ .<sup>3</sup> Using  $B(J/\psi \rightarrow \mu^+\mu^-) = (5.973 \pm 0.007 \pm 0.037)\%$  from ABLIKIM 13R.<sup>4</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>5</sup> Assuming equal partial widths for  $e^+e^-$  and  $\mu^+\mu^-$ .

NODE=M070W1;LINKAGE=D

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 ± 0.52                                                                   | BAI         | 95B BES  | $e^+e^-$ |
| 4.8 ± 0.6                                                                     | BOYARSKI    | 75 MRK1  | $e^+e^-$ |
| 5 ± 1                                                                         | ESPOSITO    | 75B FRAM | $e^+e^-$ |

NODE=M070W2  
NODE=M070W2 **$\Gamma(\gamma\gamma)$**  **$\Gamma_{297}$** 

| VALUE (eV) | CL% | DOCUMENT ID | TECN     | COMMENT  |
|------------|-----|-------------|----------|----------|
| <5.4       | 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  |
|-------------------------------------------------------------------------------|--------------------------|----------|----------|
| <b>4.884 ± 0.048 ± 0.078</b>                                                  |                          |          |          |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                          |          |          |
|                                                                               | <sup>1</sup> ANASHIN     | 18A KEDR | $e^+e^-$ |
| 4 ± 0.8                                                                       | <sup>2</sup> BALDINI-... | 75 FRAG  | $e^+e^-$ |
| 3.9 ± 0.8                                                                     | <sup>2</sup> ESPOSITO    | 75B FRAM | $e^+e^-$ |

NODE=M070G3  
NODE=M070G3<sup>1</sup> From the cross sections of  $e^+e^- \rightarrow e^+e^-$  and  $e^+e^- \rightarrow \text{hadrons}$  near the  $J/\psi(1S)$  peak.<sup>2</sup> Data redundant with branching ratios or partial widths above.

NODE=M070G3;LINKAGE=A

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                           |
|-------------------------------------------------------------------------------|--|-------------------------------|----------|-----------------------------------|
| <b>333 ± 8 OUR AVERAGE</b>                                                    |  | [332 ± 8 eV OUR 2018 AVERAGE] |          |                                   |
| <b>333.1 ± 6.6 ± 4.0</b>                                                      |  | <sup>1</sup> ANASHIN          | 18A KEDR | $e^+e^-$                          |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |  |                               |          |                                   |
| 332.3 ± 6.4 ± 4.8                                                             |  | ANASHIN                       | 10 KEDR  | $3.097 e^+e^- \rightarrow e^+e^-$ |
| 350 ± 20                                                                      |  | BRANDELIK                     | 79C DASP | $e^+e^-$                          |
| 320 ± 70                                                                      |  | <sup>2</sup> BALDINI-...      | 75 FRAG  | $e^+e^-$                          |
| 340 ± 90                                                                      |  | <sup>2</sup> ESPOSITO         | 75B FRAM | $e^+e^-$                          |
| 360 ± 100                                                                     |  | <sup>2</sup> FORD             | 75 SPEC  | $e^+e^-$                          |

<sup>1</sup> From the cross sections of  $e^+e^- \rightarrow e^+e^-$  and  $e^+e^- \rightarrow \text{hadrons}$  near the  $J/\psi(1S)$  peak.

<sup>2</sup> Data redundant with branching ratios or partial widths above.

NODE=M070G1  
NODE=M070G1  
NEW  
OCCUR=2

NODE=M070G1;LINKAGE=A

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  $B(\omega(782) \rightarrow \pi^+\pi^-\pi^0) = (89.3 \pm 0.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070G24;LINKAGE=AU

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

$$\Gamma_{59}\Gamma_5/\Gamma$$

| VALUE (eV)              | EVTS | DOCUMENT ID       | TECN     | COMMENT                                              |
|-------------------------|------|-------------------|----------|------------------------------------------------------|
| <b>27.8 ± 3.5 ± 0.2</b> | 398  | <sup>1</sup> LEES | 18E BABR | $10.6 e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0\gamma$ |

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  $B(\omega(782) \rightarrow \pi^+\pi^-\pi^0) = (89.3 \pm 0.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

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 | $10.6 e^+e^- \rightarrow \pi^+\pi^-K^+K^-\gamma$ |

• • • 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  $B(K^{*0} \rightarrow K^+\pi^-) = 2/3 B(K^{*0} \rightarrow K\pi)$ .

<sup>2</sup> Superseded by LEES 12F.

NODE=M070G01  
NODE=M070G01

NODE=M070G01;LINKAGE=AE

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 | $e^+e^- \rightarrow \pi^+\pi^-K_S^0 K_S^0 \gamma$ |

<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  
NODE=M070GY8

NODE=M070GY8;LINKAGE=A

$$\Gamma(K_S^0 \pi^- K^*(892)^+ + \text{c.c.}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{29} \Gamma_5 / \Gamma$$

| VALUE (eV)                  | EVTS | DOCUMENT ID       | TECN     | COMMENT                                                |
|-----------------------------|------|-------------------|----------|--------------------------------------------------------|
| <b>11.0±2.8 OUR AVERAGE</b> |      |                   |          |                                                        |
| 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 | $e^+ e^- \rightarrow \pi^\pm \pi^- K_S^0 K_S^0 \gamma$ |

<sup>1</sup> Dividing by 1/2 to take into account  $B(K^*(892)^\pm \rightarrow K^\pm \pi^\mp) = 1/2$ .

<sup>2</sup> Dividing by 1/4 to take into account  $B(K^*(892) \rightarrow K_S^0 \pi) = 1/4$ .

NODE=M070GY4  
NODE=M070GY4

NODE=M070GY4;LINKAGE=B  
NODE=M070GY4;LINKAGE=A

$$\Gamma(K_S^0 \pi^- K^*(892)^+ + \text{c.c.} \rightarrow K_S^0 K_S^0 \pi^+ \pi^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{30} \Gamma_5 / \Gamma$$

| VALUE (eV)         | EVTS | DOCUMENT ID | TECN     | COMMENT                                                |
|--------------------|------|-------------|----------|--------------------------------------------------------|
| <b>3.7±1.2±0.3</b> | 53   | LEES        | 14H BABR | $e^+ e^- \rightarrow \pi^\pm \pi^- K_S^0 K_S^0 \gamma$ |

NODE=M070GY5  
NODE=M070GY5

$$\Gamma(K^*(892)^0 \bar{K}_2^*(1430)^0 + \text{c.c.}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{43} \Gamma_5 / \Gamma$$

| VALUE (eV)          | EVTS | DOCUMENT ID           | TECN     | COMMENT                                                 |
|---------------------|------|-----------------------|----------|---------------------------------------------------------|
| <b>25.8±1.4±0.6</b> | 710  | <sup>1,2,3</sup> LEES | 12F BABR | $10.6 e^+ e^- \rightarrow \pi^\pm \pi^- K^+ K^- \gamma$ |

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

|          |     |                       |           |                                                         |
|----------|-----|-----------------------|-----------|---------------------------------------------------------|
| 33 ±4 ±1 | 317 | <sup>2,4</sup> AUBERT | 07AK BABR | $10.6 e^+ e^- \rightarrow \pi^\pm \pi^- K^+ K^- \gamma$ |
|----------|-----|-----------------------|-----------|---------------------------------------------------------|

<sup>1</sup> LEES 12F reports  $[\Gamma(J/\psi(1S) \rightarrow K^*(892)^0 \bar{K}_2^*(1430)^0 + \text{c.c.}) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-) / \Gamma_{\text{total}}] \times [B(K_2^*(1430) \rightarrow K\pi)] = 12.89 \pm 0.54 \pm 0.41$  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  $[\Gamma(J/\psi(1S) \rightarrow K^*(892)^0 \bar{K}_2^*(1430)^0 + \text{c.c.}) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-) / \Gamma_{\text{total}}] \times [B(K_2^*(1430) \rightarrow K\pi)] = 16.4 \pm 1.1 \pm 1.4$  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

$$\Gamma(K^*(892)^+ K_2^*(1430)^- + \text{c.c.}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{44} \Gamma_5 / \Gamma$$

| VALUE (eV)           | EVTS  | DOCUMENT ID         | TECN     | COMMENT                                                |
|----------------------|-------|---------------------|----------|--------------------------------------------------------|
| <b>18.6±16.1±0.4</b> | 8 ± 8 | <sup>1,2</sup> LEES | 14H BABR | $e^+ e^- \rightarrow \pi^\pm \pi^- K_S^0 K_S^0 \gamma$ |

<sup>1</sup> Dividing by  $(1/4)^2$  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  $[\Gamma(J/\psi(1S) \rightarrow K^*(892)^+ K_2^*(1430)^- + \text{c.c.}) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-) / \Gamma_{\text{total}}] \times [B(K_2^*(1430) \rightarrow K\pi)] = 9.28 \pm 8.0 \pm 0.32$  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

$$\Gamma(K^*(892)^+ K_2^*(1430)^- + \text{c.c.} \rightarrow K^*(892)^+ K_S^0 \pi^- + \text{c.c.}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{45} \Gamma_5 / \Gamma$$

| VALUE (eV)            | EVTS  | DOCUMENT ID       | TECN     | COMMENT                                                |
|-----------------------|-------|-------------------|----------|--------------------------------------------------------|
| <b>2.32±2.00±0.08</b> | 8 ± 8 | <sup>1</sup> LEES | 14H BABR | $e^+ e^- \rightarrow \pi^\pm \pi^- K_S^0 K_S^0 \gamma$ |

<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

$$\Gamma(K^*(892)^0 \bar{K}_2^*(1770)^0 + \text{c.c.} \rightarrow K^*(892)^0 K^- \pi^+ + \text{c.c.}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{46} \Gamma_5 / \Gamma$$

| VALUE (eV)         | EVTS     | DOCUMENT ID         | TECN      | COMMENT                                                 |
|--------------------|----------|---------------------|-----------|---------------------------------------------------------|
| <b>3.8±0.4±0.3</b> | 110 ± 14 | <sup>1</sup> AUBERT | 07AK BABR | $10.6 e^+ e^- \rightarrow \pi^\pm \pi^- K^+ K^- \gamma$ |

<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

$$\Gamma(K^+ K^*(892)^- + \text{c.c.}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{50} \Gamma_5 / \Gamma$$

| VALUE (eV)          | DOCUMENT ID | TECN     | COMMENT                                          |
|---------------------|-------------|----------|--------------------------------------------------|
| <b>29.0±1.7±1.3</b> | AUBERT      | 08S BABR | $10.6 e^+ e^- \rightarrow K^+ K^*(892)^- \gamma$ |

NODE=M070G18  
NODE=M070G18

$$\Gamma(K^+ K^*(892)^- + \text{c.c.} \rightarrow K^+ K^- \pi^0) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{51} \Gamma_5 / \Gamma$$

| VALUE (eV)             | EVTS | DOCUMENT ID | TECN     | COMMENT                                         |
|------------------------|------|-------------|----------|-------------------------------------------------|
| <b>10.96±0.85±0.70</b> | 155  | AUBERT      | 08S BABR | $10.6 e^+ e^- \rightarrow K^+ K^- \pi^0 \gamma$ |

NODE=M070G20  
NODE=M070G20

$$\Gamma(K^+ K^*(892)^- + \text{c.c.} \rightarrow K^0 K^\pm \pi^\mp + \text{c.c.}) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{52} \Gamma_5 / \Gamma$$

| VALUE (eV)                 | EVTS | DOCUMENT ID | TECN | COMMENT                                                                                               |
|----------------------------|------|-------------|------|-------------------------------------------------------------------------------------------------------|
| <b>16.76 ± 1.70 ± 1.00</b> | 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

$$\Gamma(K^0 \bar{K}^*(892)^0 + \text{c.c.}) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{53} \Gamma_5 / \Gamma$$

| VALUE (eV)              | DOCUMENT ID | TECN | COMMENT                                                                       |
|-------------------------|-------------|------|-------------------------------------------------------------------------------|
| <b>26.6 ± 2.5 ± 1.5</b> | AUBERT      | 08S  | BABR 10.6 e <sup>+</sup> e <sup>-</sup> → K <sup>0</sup> $\bar{K}^*(892)^0$ γ |

NODE=M070G19  
NODE=M070G19

$$\Gamma(K^0 \bar{K}^*(892)^0 + \text{c.c.} \rightarrow K^0 K^\pm \pi^\mp + \text{c.c.}) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{54} \Gamma_5 / \Gamma$$

| VALUE (eV)                 | EVTS | DOCUMENT ID | TECN | COMMENT                                                                                               |
|----------------------------|------|-------------|------|-------------------------------------------------------------------------------------------------------|
| <b>17.70 ± 1.70 ± 1.00</b> | 94   | 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=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 <sup>-6</sup> )                       | DOCUMENT ID | TECN | COMMENT                                                              |
|-------------------------------------------------------|-------------|------|----------------------------------------------------------------------|
| <b>6.28<sup>+0.16+0.59</sup><sub>-0.17-0.52</sub></b> | ABLIKIM     | 18AA | BES3 J/ψ → γ K <sub>s</sub> <sup>0</sup> K <sub>s</sub> <sup>0</sup> |

NODE=M070P71  
NODE=M070P71

$$\Gamma(\bar{K}^*(892)^0 K^+ \pi^- + \text{c.c.}) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{56} \Gamma_5 / \Gamma$$

| VALUE (eV)              | EVTS | DOCUMENT ID       | TECN | COMMENT                                                                                                         |
|-------------------------|------|-------------------|------|-----------------------------------------------------------------------------------------------------------------|
| <b>42.6 ± 4.8 ± 7.2</b> | 99   | <sup>1</sup> LEES | 17D  | BABR e <sup>+</sup> e <sup>-</sup> → K <sub>S</sub> <sup>0</sup> K <sup>±</sup> π <sup>∓</sup> π <sup>0</sup> γ |

NODE=M070G39  
NODE=M070G39

<sup>1</sup> Dividing by 1/6 to account for B(K\*(892)<sup>0</sup> → K<sub>S</sub><sup>0</sup> π<sup>0</sup>) = 1/6.

NODE=M070G39;LINKAGE=A

$$\Gamma(K^*(892)^\pm K^\mp \pi^0) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{57} \Gamma_5 / \Gamma$$

| VALUE (eV)              | EVTS | DOCUMENT ID       | TECN | COMMENT                                                                                                         |
|-------------------------|------|-------------------|------|-----------------------------------------------------------------------------------------------------------------|
| <b>22.8 ± 2.8 ± 6.8</b> | 80   | <sup>1</sup> LEES | 17D  | BABR e <sup>+</sup> e <sup>-</sup> → K <sub>S</sub> <sup>0</sup> K <sup>±</sup> π <sup>∓</sup> π <sup>0</sup> γ |

NODE=M070G32  
NODE=M070G32

<sup>1</sup> Dividing by 1/4 to account for B(K\*(892)<sup>±</sup> → K<sub>S</sub><sup>0</sup> π<sup>±</sup>) = 1/4.

NODE=M070G32;LINKAGE=A

$$\Gamma(K^*(892)^0 K_S^0 \pi^0) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{58} \Gamma_5 / \Gamma$$

| VALUE (eV)                | EVTS | DOCUMENT ID       | TECN | COMMENT                                                                                                         |
|---------------------------|------|-------------------|------|-----------------------------------------------------------------------------------------------------------------|
| <b>3.60 ± 0.75 ± 2.25</b> | 34   | <sup>1</sup> LEES | 17D  | BABR e <sup>+</sup> e <sup>-</sup> → K <sub>S</sub> <sup>0</sup> K <sup>±</sup> π <sup>∓</sup> π <sup>0</sup> γ |

NODE=M070G33  
NODE=M070G33

<sup>1</sup> Dividing by 2/3 to account for B(K\*(892)<sup>0</sup> → K<sup>+</sup> π<sup>-</sup>) = 2/3.

NODE=M070G33;LINKAGE=A

$$\Gamma(\eta K^\pm K_S^0 \pi^\mp) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{64} \Gamma_5 / \Gamma$$

| VALUE (eV)             | EVTS | DOCUMENT ID | TECN | COMMENT                                                                                                         |
|------------------------|------|-------------|------|-----------------------------------------------------------------------------------------------------------------|
| <b>7.3 ± 1.4 ± 0.4</b> | 44   | LEES        | 17D  | BABR e <sup>+</sup> e <sup>-</sup> → K <sub>S</sub> <sup>0</sup> K <sup>±</sup> π <sup>∓</sup> π <sup>0</sup> γ |

NODE=M070G38  
NODE=M070G38

$$\Gamma(\omega K \bar{K}) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{66} \Gamma_5 / \Gamma$$

| VALUE (eV)                | EVTS | DOCUMENT ID         | TECN | COMMENT                                                                     |
|---------------------------|------|---------------------|------|-----------------------------------------------------------------------------|
| <b>3.70 ± 1.98 ± 0.03</b> | 24   | <sup>1</sup> AUBERT | 07AU | BABR 10.6 e <sup>+</sup> e <sup>-</sup> → ω K <sup>+</sup> K <sup>-</sup> γ |

NODE=M070G29  
NODE=M070G29

<sup>1</sup> AUBERT 07AU reports [Γ(J/ψ(1S) → ω K $\bar{K}$ ) × 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>)] = 3.3 ± 1.3 ± 1.2 eV which we divide by our best value B(ω(782) → π<sup>+</sup> π<sup>-</sup> π<sup>0</sup>) = (89.3 ± 0.6) × 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=M070G29;LINKAGE=AU

$$\Gamma(\phi 2(\pi^+ \pi^-)) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{68} \Gamma_5 / \Gamma$$

| VALUE (10 <sup>-2</sup> keV) | EVTS | DOCUMENT ID         | TECN | COMMENT                                                                         |
|------------------------------|------|---------------------|------|---------------------------------------------------------------------------------|
| <b>0.95 ± 0.19 ± 0.01</b>    | 35   | <sup>1</sup> AUBERT | 06D  | BABR 10.6 e <sup>+</sup> e <sup>-</sup> → φ 2(π <sup>+</sup> π <sup>-</sup> ) γ |

NODE=M070G10  
NODE=M070G10

<sup>1</sup> AUBERT 06D reports [Γ(J/ψ(1S) → φ 2(π<sup>+</sup> π<sup>-</sup>)) × Γ(J/ψ(1S) → e<sup>+</sup> e<sup>-</sup>)/Γ<sub>total</sub>] × [B(φ(1020) → K<sup>+</sup> K<sup>-</sup>)] = (0.47 ± 0.09 ± 0.03) × 10<sup>-2</sup> keV which we divide by our best value B(φ(1020) → K<sup>+</sup> K<sup>-</sup>) = (49.2 ± 0.5) × 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=M070G10;LINKAGE=AU

$$\Gamma(\phi K_S^0 K_S^0) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{72} \Gamma_5 / \Gamma$$

| VALUE (eV)                | EVTS | DOCUMENT ID       | TECN | COMMENT                                                                                                                      |
|---------------------------|------|-------------------|------|------------------------------------------------------------------------------------------------------------------------------|
| <b>3.25 ± 0.84 ± 0.03</b> | 29   | <sup>1</sup> LEES | 14H  | BABR e <sup>+</sup> e <sup>-</sup> → K <sub>S</sub> <sup>0</sup> K <sub>S</sub> <sup>0</sup> K <sup>+</sup> K <sup>-</sup> γ |

NODE=M070GZ1  
NODE=M070GZ1

<sup>1</sup> LEES 14H reports [Γ(J/ψ(1S) → φ K<sub>S</sub><sup>0</sup> K<sub>S</sub><sup>0</sup>) × Γ(J/ψ(1S) → e<sup>+</sup> e<sup>-</sup>)/Γ<sub>total</sub>] × [B(φ(1020) → K<sup>+</sup> K<sup>-</sup>)] = 1.6 ± 0.4 ± 0.1 eV which we divide by our best value B(φ(1020) → K<sup>+</sup> K<sup>-</sup>) = (49.2 ± 0.5) × 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=M070GZ1;LINKAGE=A

$\Gamma(\phi K^+ K^-) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$  $\Gamma_{74}\Gamma_5/\Gamma$ 

| 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

 $\Gamma(\phi f_2(1270)) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$  $\Gamma_{75}\Gamma_5/\Gamma$ 

| 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. • • •

|                                             |    |                       |           |                                                       |
|---------------------------------------------|----|-----------------------|-----------|-------------------------------------------------------|
| 4.08±0.73 <sup>+0.04</sup> <sub>-0.14</sub> | 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

 $\Gamma(K^+ K^- f'_2(1525)) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$  $\Gamma_{79}\Gamma_5/\Gamma$ 

| 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  $B(f'_2(1525) \rightarrow K\bar{K}) = (88.7 \pm 2.2) \times 10^{-2}$ . 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

 $\Gamma(\phi f'_2(1525)) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$  $\Gamma_{80}\Gamma_5/\Gamma$ 

| VALUE (eV)         | EVTS | DOCUMENT ID         | TECN     | COMMENT                                          |
|--------------------|------|---------------------|----------|--------------------------------------------------|
| <b>8.1±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  $B(f'_2(1525) \rightarrow K\bar{K}) = (88.7 \pm 2.2) \times 10^{-2}$ . 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

 $\Gamma(\phi \pi^+ \pi^-) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$  $\Gamma_{81}\Gamma_5/\Gamma$ 

| 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. • • •

|               |     |                            |      |                                                       |
|---------------|-----|----------------------------|------|-------------------------------------------------------|
| 5.3 ±0.7 ±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.

<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

NODE=M070G14  
NODE=M070G14

NODE=M070G14;LINKAGE=B

NODE=M070G14;LINKAGE=SH

$B(\phi(1020) \rightarrow K^+ K^-) = (49.2 \pm 0.6) \times 10^{-2}$ , 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.

<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

$\Gamma(\phi \pi^0 \pi^0) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$   $\Gamma_{82} \Gamma_5 / \Gamma$

| VALUE (eV)            | EVTS | DOCUMENT ID       | TECN     | COMMENT                                               |
|-----------------------|------|-------------------|----------|-------------------------------------------------------|
| <b>2.76±0.57±0.03</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±0.88±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

$\Gamma(\phi \eta) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$   $\Gamma_{85} \Gamma_5 / \Gamma$

| VALUE (eV)         | EVTS | DOCUMENT ID         | TECN      | COMMENT                                     |
|--------------------|------|---------------------|-----------|---------------------------------------------|
| <b>6.1±2.7±0.4</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

$\Gamma(\phi f_0(980) \rightarrow \phi \pi^+ \pi^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$   $\Gamma_{93} \Gamma_5 / \Gamma$

| VALUE (eV)                   | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------------------------|------|-------------|------|---------|
| <b>1.44±0.19 OUR AVERAGE</b> |      |             |      |         |

NODE=M070G05  
NODE=M070G05

1.40±0.25±0.02 57 ± 9 <sup>1</sup> LEES 12F BABR 10.6  $e^+ e^- \rightarrow \pi^+ \pi^- K^+ K^- \gamma$

1.48±0.27±0.09 60 ± 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±0.24±0.01 20 ± 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

$\Gamma(\phi f_0(980) \rightarrow \phi \pi^0 \pi^0) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$   $\Gamma_{94} \Gamma_5 / \Gamma$

| VALUE (eV)            | EVTS   | DOCUMENT ID       | TECN     | COMMENT                                               |
|-----------------------|--------|-------------------|----------|-------------------------------------------------------|
| <b>0.98±0.26±0.01</b> | 16 ± 4 | <sup>1</sup> LEES | 12F BABR | 10.6 $e^+ e^- \rightarrow \pi^0 \pi^0 K^+ K^- \gamma$ |

NODE=M070G06  
NODE=M070G06

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

0.95±0.40±0.01 7.0 ± 2.8 <sup>2</sup> AUBERT 07AK BABR 10.6  $e^+ e^- \rightarrow \pi^0 \pi^0 K^+ K^- \gamma$

<sup>1</sup> LEES 12F reports  $[\Gamma(J/\psi(1S) \rightarrow \phi f_0(980) \rightarrow \phi \pi^0 \pi^0) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-) / \Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow K^+ K^-)] = 0.48 \pm 0.12 \pm 0.05$  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  $[\Gamma(J/\psi(1S) \rightarrow \phi f_0(980) \rightarrow \phi \pi^0 \pi^0) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-) / \Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow K^+ K^-)] = 0.47 \pm 0.19 \pm 0.05$  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

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

$$\Gamma_{104}\Gamma_5/\Gamma$$

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

**2.3 ± 0.4 OUR AVERAGE**

[2.2 ± 1.0 eV OUR 2018 AVERAGE]

|                    |    |                     |           |                                                |
|--------------------|----|---------------------|-----------|------------------------------------------------|
| 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 $e^+e^- \rightarrow \eta\pi^+\pi^-\gamma$ |

<sup>1</sup> AUBERT 07AU reports  $[\Gamma(J/\psi(1S) \rightarrow \eta\pi^+\pi^-) \times \Gamma(J/\psi(1S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\eta \rightarrow \pi^+\pi^-\pi^0)] = 0.51 \pm 0.22 \pm 0.03$  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

NODE=M070G25

NEW

NODE=M070G25;LINKAGE=AU

$$\Gamma(K_S^0\pi^-K_2^*(1430)^+ + \text{c.c.}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$$

$$\Gamma_{113}\Gamma_5/\Gamma$$

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

**20.1 ± 9.8 ± 0.5** 35 <sup>1,2</sup> LEES 14H BABR  $e^+e^- \rightarrow \pi^+\pi^-K_S^0K_S^0\gamma$

<sup>1</sup> Dividing by 1/4 to take into account  $B(K^*(1430) \rightarrow K_S^0\pi) = 1/4 B(K^*(1430) \rightarrow K\pi)$ .

<sup>2</sup> LEES 14H reports  $[\Gamma(J/\psi(1S) \rightarrow K_S^0\pi^-K_2^*(1430)^+ + \text{c.c.}) \times \Gamma(J/\psi(1S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(K_2^*(1430) \rightarrow K\pi)] = 10.0 \pm 4.8 \pm 0.8$  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

NODE=M070GY6

NODE=M070GY6;LINKAGE=A

NODE=M070GY6;LINKAGE=B

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

$$\Gamma_{134}\Gamma_5/\Gamma$$

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

**303 ± 5 ± 18** 4990 AUBERT 07AU BABR  $10.6 e^+e^- \rightarrow 2(\pi^+\pi^-)\pi^0\gamma$

NODE=M070G23

NODE=M070G23

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

$$\Gamma_{136}\Gamma_5/\Gamma$$

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

**0.122 ± 0.005 ± 0.008** AUBERT,B 04N BABR  $10.6 e^+e^- \rightarrow \pi^+\pi^-\pi^0\gamma$

NODE=M070G5

NODE=M070G5

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

$$\Gamma_{137}\Gamma_5/\Gamma$$

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

**150.0 ± 4.0 ± 15.0** 2389 LEES 18E BABR  $10.6 e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0\pi^0\gamma$

NODE=M070P53

NODE=M070P53

$$\Gamma(\rho^\pm\pi^\mp\pi^0\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$$

$$\Gamma_{138}\Gamma_5/\Gamma$$

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

**78.0 ± 9.0 ± 8.0** 1241 LEES 18E BABR  $10.6 e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0\gamma$

NODE=M070P55

NODE=M070P55

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

$$\Gamma_{139}\Gamma_5/\Gamma$$

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

**33.0 ± 5.0 ± 3.3** 529 LEES 18E BABR  $10.6 e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0\gamma$

NODE=M070P56

NODE=M070P56

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

$$\Gamma_{140}\Gamma_5/\Gamma$$

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

**107.0 ± 4.3 ± 6.4** 768 AUBERT 07AU BABR  $10.6 e^+e^- \rightarrow K^+K^-\pi^+\pi^-\pi^0\gamma$

NODE=M070G27

NODE=M070G27

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

$$\Gamma_{142}\Gamma_5/\Gamma$$

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

**37.94 ± 0.81 ± 1.10** 3.1k 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. • • •

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.

<sup>2</sup> Superseded by AUBERT 07AK.

NODE=M070G12

NODE=M070G12

OCCUR=2

NODE=M070G12;LINKAGE=B

NODE=M070G12;LINKAGE=AU

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

$$\Gamma_{143}\Gamma_5/\Gamma$$

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

**20.8 ± 2.3 ± 2.1** 248 LEES 14H BABR  $e^+e^- \rightarrow \pi^+\pi^-K_S^0K_L^0\gamma$

NODE=M070GY1

NODE=M070GY1

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

$$\Gamma_{144}\Gamma_5/\Gamma$$

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

**9.3 ± 0.9 ± 0.5** 133 LEES 14H BABR  $e^+e^- \rightarrow \pi^+\pi^-K_S^0K_S^0\gamma$

NODE=M070GY2

NODE=M070GY2

$$\Gamma(\pi^{\pm}\pi^0 K^{\mp} K_S^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{145}\Gamma_5/\Gamma$$

| VALUE (eV)          | EVTS | DOCUMENT ID | TECN     | COMMENT                                                |
|---------------------|------|-------------|----------|--------------------------------------------------------|
| <b>31.7±1.9±1.8</b> | 393  | LEES        | 17D BABR | $e^+e^- \rightarrow K_S^0 K^{\pm}\pi^{\mp}\pi^0\gamma$ |

NODE=M070G34  
NODE=M070G34

$$\Gamma(K^+K^- K_S^0 K_S^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{146}\Gamma_5/\Gamma$$

| VALUE (eV)         | EVTS | DOCUMENT ID | TECN     | COMMENT                                       |
|--------------------|------|-------------|----------|-----------------------------------------------|
| <b>2.3±0.4±0.1</b> | 29   | LEES        | 14H BABR | $e^+e^- \rightarrow K_S^0 K_S^0 K^+K^-\gamma$ |

NODE=M070GY3  
NODE=M070GY3

$$\Gamma(\pi^+\pi^- K^+K^-\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{147}\Gamma_5/\Gamma$$

| 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

$$\Gamma(\pi^0\pi^0 K^+K^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{148}\Gamma_5/\Gamma$$

| VALUE (eV)             | EVTS | DOCUMENT ID | TECN     | COMMENT                                           |
|------------------------|------|-------------|----------|---------------------------------------------------|
| <b>11.75±0.81±0.90</b> | 388  | LEES        | 12F BABR | 10.6 $e^+e^- \rightarrow \pi^0\pi^0 K^+K^-\gamma$ |

• • • 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 $e^+e^- \rightarrow \pi^0\pi^0 K^+K^-\gamma$ |
|----------------|-----|--------------------------|------|---------------------------------------------------|

<sup>1</sup> Superseded by LEES 12F.

NODE=M070G04  
NODE=M070G04

NODE=M070G04;LINKAGE=A

$$\Gamma(\pi^0\pi^0 K_S^0 K_L^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{149}\Gamma_5/\Gamma$$

| VALUE (eV)          | EVTS | DOCUMENT ID | TECN     | COMMENT                                           |
|---------------------|------|-------------|----------|---------------------------------------------------|
| <b>10.3±2.3±0.5</b> | 47   | LEES        | 17A BABR | $e^+e^- \rightarrow K_S^0 K_L^0 \pi^0\pi^0\gamma$ |

NODE=M070G40  
NODE=M070G40

$$\Gamma(K_S^0 K_L^0 \pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{153}\Gamma_5/\Gamma$$

| VALUE (eV)          | EVTS | DOCUMENT ID | TECN     | COMMENT                                      |
|---------------------|------|-------------|----------|----------------------------------------------|
| <b>11.4±1.3±0.6</b> | 182  | LEES        | 17A BABR | $e^+e^- \rightarrow K_S^0 K_L^0 \pi^0\gamma$ |

NODE=M070G41  
NODE=M070G41

$$\Gamma(K^*(892)^0 \bar{K}^0 + \text{c.c.} \rightarrow K_S^0 K_L^0 \pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{154}\Gamma_5/\Gamma$$

| VALUE (eV)         | EVTS | DOCUMENT ID | TECN     | COMMENT                                      |
|--------------------|------|-------------|----------|----------------------------------------------|
| <b>6.7±0.9±0.4</b> | 106  | LEES        | 17A BABR | $e^+e^- \rightarrow K_S^0 K_L^0 \pi^0\gamma$ |

NODE=M070G42  
NODE=M070G42

$$\Gamma(K_2^*(1430)^0 \bar{K}^0 + \text{c.c.} \rightarrow K_S^0 K_L^0 \pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{155}\Gamma_5/\Gamma$$

| VALUE (eV)         | EVTS | DOCUMENT ID | TECN     | COMMENT                                      |
|--------------------|------|-------------|----------|----------------------------------------------|
| <b>2.4±0.7±0.1</b> | 37   | LEES        | 17A BABR | $e^+e^- \rightarrow K_S^0 K_L^0 \pi^0\gamma$ |

NODE=M070G43  
NODE=M070G43

$$\Gamma(K_S^0 K_L^0 \eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{156}\Gamma_5/\Gamma$$

| VALUE (eV)         | EVTS | DOCUMENT ID | TECN     | COMMENT                                     |
|--------------------|------|-------------|----------|---------------------------------------------|
| <b>8.0±1.8±0.4</b> | 45   | LEES        | 17A BABR | $e^+e^- \rightarrow K_S^0 K_L^0 \eta\gamma$ |

NODE=M070G35  
NODE=M070G35

$$\Gamma(2(\pi^+\pi^-)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{157}\Gamma_5/\Gamma$$

| VALUE (eV)          | EVTS | DOCUMENT ID | TECN     | COMMENT                                     |
|---------------------|------|-------------|----------|---------------------------------------------|
| <b>20.4±0.9±0.4</b> |      | LEES        | 12E BABR | 10.6 $e^+e^- \rightarrow 2\pi^+\pi^-\gamma$ |

• • • 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  
NODE=M070G11

NODE=M070G11;LINKAGE=AU

$$\Gamma(3(\pi^+\pi^-)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{158}\Gamma_5/\Gamma$$

| 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

$$\Gamma(2(\pi^+\pi^-\pi^0)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{159}\Gamma_5/\Gamma$$

| 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 $e^+e^- \rightarrow 2(\pi^+\pi^-\pi^0)\gamma$ |

NODE=M070G7  
NODE=M070G7



$$\Gamma(2(\pi^+\pi^-\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{160}\Gamma_5/\Gamma$$

| 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 |

<sup>1</sup> AUBERT 07AU reports  $[\Gamma(J/\psi(1S) \rightarrow 2(\pi^+\pi^-\eta) \times \Gamma(J/\psi(1S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\eta \rightarrow 2\gamma)] = 5.16 \pm 0.85 \pm 0.39$  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=M070G26  
NODE=M070G26

NODE=M070G26;LINKAGE=AU

$$\Gamma(\pi^+\pi^-\pi^0\pi^0\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{162}\Gamma_5/\Gamma$$

| 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

$$\Gamma(\omega\pi^0\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{60}\Gamma_5/\Gamma$$

| 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  $[\Gamma(J/\psi(1S) \rightarrow \omega\pi^0\eta) \times \Gamma(J/\psi(1S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\omega(782) \rightarrow \pi^+\pi^-\pi^0)] = 1.7 \pm 0.8 \pm 0.3$  eV which we divide by our best value  $B(\omega(782) \rightarrow \pi^+\pi^-\pi^0) = (89.3 \pm 0.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070P58;LINKAGE=A

$$\Gamma(\rho^\pm\pi^\mp\pi^0\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{163}\Gamma_5/\Gamma$$

| 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

$$\Gamma(\rho\rho) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{164}\Gamma_5/\Gamma$$

| 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      | 13O BABR | e <sup>+</sup> e <sup>-</sup> → ρρ̄γ |
| 12.9±0.4±0.4 | 918 | <sup>2</sup> LEES      | 13Y BABR | e <sup>+</sup> e <sup>-</sup> → ρρ̄γ |
| 9.7±1.7      |     | <sup>3</sup> ARMSTRONG | 93B E760 | ρ̄p → e <sup>+</sup> e <sup>-</sup>  |

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

|              |     |                     |          |                                      |
|--------------|-----|---------------------|----------|--------------------------------------|
| 12.0±0.6±0.5 | 438 | <sup>4</sup> AUBERT | 06B BABR | e <sup>+</sup> e <sup>-</sup> → ρρ̄γ |
|--------------|-----|---------------------|----------|--------------------------------------|

<sup>1</sup> ISR photon reconstructed in the detector

<sup>2</sup> ISR photon undetected

<sup>3</sup> Using  $\Gamma_{\text{total}} = 85.5^{+6.1}_{-5.8}$  MeV.

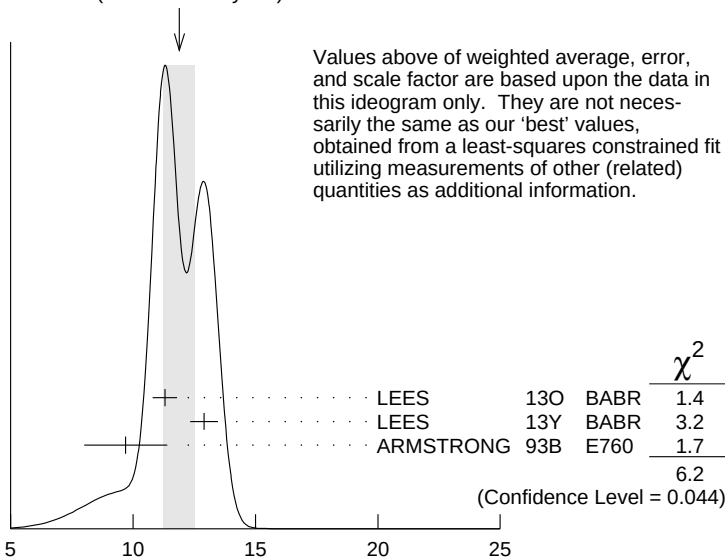
<sup>4</sup> Superseded by LEES 130

NODE=M070G4  
NODE=M070G4

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)



$$\Gamma(\Sigma^0\bar{\Sigma}^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{177}\Gamma_5/\Gamma$$

| VALUE (eV)         | DOCUMENT ID | TECN      | COMMENT                                                              |
|--------------------|-------------|-----------|----------------------------------------------------------------------|
| <b>6.4±1.2±0.6</b> | AUBERT      | 07BD BABR | 10.6 e <sup>+</sup> e <sup>-</sup> → Σ <sup>0</sup> Σ <sup>0</sup> γ |

NODE=M070G17  
NODE=M070G17

$$\Gamma(2(\pi^+\pi^-)K^+K^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{178}\Gamma_5/\Gamma$$

| 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 <sup>+</sup> e <sup>-</sup> → K <sup>+</sup> K <sup>-</sup> 2(π <sup>+</sup> π <sup>-</sup> )γ |

NODE=M070G9  
NODE=M070G9

$$\Gamma(\Lambda\bar{\Lambda}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{184}\Gamma_5/\Gamma$$

| VALUE (eV)          | DOCUMENT ID | TECN      | COMMENT                                   |
|---------------------|-------------|-----------|-------------------------------------------|
| <b>10.7±0.9±0.7</b> | AUBERT      | 07BD BABR | 10.6 e <sup>+</sup> e <sup>-</sup> → ΛΛ̄γ |

NODE=M070G16  
NODE=M070G16

$$\Gamma(2(K^+K^-)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{187}\Gamma_5/\Gamma$$

| VALUE (eV)                                                                    | EVTS     | DOCUMENT ID         | TECN      | COMMENT                                                                 |
|-------------------------------------------------------------------------------|----------|---------------------|-----------|-------------------------------------------------------------------------|
| <b>4.00±0.33±0.29</b>                                                         | 287 ± 24 | LEES                | 12F BABR  | 10.6 e <sup>+</sup> e <sup>-</sup> → 2(K <sup>+</sup> K <sup>-</sup> )γ |
| • • • 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 <sup>+</sup> e <sup>-</sup> → 2(K <sup>+</sup> K <sup>-</sup> )γ |
| 4.0 ±0.7 ±0.6                                                                 | 38       | <sup>2</sup> AUBERT | 05D BABR  | 10.6 e <sup>+</sup> e <sup>-</sup> → 2(K <sup>+</sup> K <sup>-</sup> )γ |

NODE=M070G13  
NODE=M070G13

<sup>1</sup> Superseded by LEES 12F.

<sup>2</sup> Superseded by AUBERT 07AK.

NODE=M070G13;LINKAGE=A  
NODE=M070G13;LINKAGE=AU

$$\Gamma(K^+K^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{189}\Gamma_5/\Gamma$$

| 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 <sup>+</sup> e <sup>-</sup> → K <sup>+</sup> K <sup>-</sup> γ |
| 1.94±0.11±0.05                                                                | 462  | <sup>2</sup> LEES | 15J BABR | e <sup>+</sup> e <sup>-</sup> → K <sup>+</sup> K <sup>-</sup> γ |
| 1.42±0.23±0.08                                                                | 51   | <sup>3</sup> LEES | 13Q BABR | e <sup>+</sup> e <sup>-</sup> → K <sup>+</sup> K <sup>-</sup> γ |

NODE=M070G08  
NODE=M070G08

<sup>1</sup> sin ϕ > 0.

<sup>2</sup> sin ϕ < 0.

<sup>3</sup> Interference with non-resonant K<sup>+</sup>K<sup>-</sup> production not taken into account.

OCCUR=2

NODE=M070G08;LINKAGE=A  
NODE=M070G08;LINKAGE=B  
NODE=M070G08;LINKAGE=BA

## J/ψ(1S) BRANCHING RATIOS

NODE=M070230

For the first four branching ratios, see also the partial widths, and (partial widths) × Γ(e<sup>+</sup>e<sup>-</sup>)/Γ<sub>total</sub> 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 <sup>+</sup> e <sup>-</sup> |
| 0.86 ±0.02                     | BOYARSKI    | 75 MRK1 | e <sup>+</sup> e <sup>-</sup> |

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 <sup>+</sup> e <sup>-</sup> |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                       |         |                               |
| 0.17 ±0.02                                                                    | <sup>1</sup> BOYARSKI | 75 MRK1 | e <sup>+</sup> e <sup>-</sup> |

NODE=M070R4  
NODE=M070R4

<sup>1</sup> Included in Γ(hadrons)/Γ<sub>total</sub>.

<sup>2</sup> Using B(J/ψ → ℓ<sup>+</sup>ℓ<sup>-</sup>) = (5.90 ± 0.09)% from RPP-2002 and R = 2.28 ± 0.04 determined by a fit to data from BAI 00 and BAI 02C.

NODE=M070R4;LINKAGE=C  
NODE=M070R4;LINKAGE=SE

$$\Gamma(ggg)/\Gamma_{\text{total}} \quad \Gamma_3/\Gamma$$

| 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 | ψ(2S) → π <sup>+</sup> π <sup>-</sup> + hadrons |

NODE=M070S65  
NODE=M070S65

<sup>1</sup> Calculated using the value Γ(γγg)/Γ(ggg) = 0.137 ± 0.001 ± 0.016 ± 0.004 from BESSON 08 and the PDG 08 values of B(ℓ<sup>+</sup>ℓ<sup>-</sup>), B(virtual γ → hadrons), and B(γ η<sub>C</sub>). The statistical error is negligible and the systematic error is partially correlated with that of Γ(γγg)/Γ<sub>total</sub> measurement of BESSON 08.

NODE=M070S65;LINKAGE=BE

$$\Gamma(\gamma gg)/\Gamma_{\text{total}} \quad \Gamma_4/\Gamma$$

| VALUE (units 10 <sup>-2</sup> ) | EVTS  | DOCUMENT ID         | TECN    | COMMENT                                           |
|---------------------------------|-------|---------------------|---------|---------------------------------------------------|
| <b>8.79±1.05</b>                | 200 k | <sup>1</sup> BESSON | 08 CLEO | ψ(2S) → π <sup>+</sup> π <sup>-</sup> γ + hadrons |

NODE=M070S66  
NODE=M070S66

<sup>1</sup> Calculated using the value Γ(γγg)/Γ(ggg) = 0.137 ± 0.001 ± 0.016 ± 0.004 from BESSON 08 and the value of Γ(ggg)/Γ<sub>total</sub>. The statistical error is negligible and the systematic error is partially correlated with that of Γ(ggg)/Γ<sub>total</sub> measurement of BESSON 08.

NODE=M070S66;LINKAGE=BE

$\Gamma(\gamma g g)/\Gamma(g g g)$ 

| VALUE (units $10^{-2}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT                                        |
|--------------------------|------|-------------|------|------------------------------------------------|
| <b>13.7±0.1±0.7</b>      | 6 M  | BESSON      | 08   | CLEO $\psi(2S) \rightarrow \pi^+ \pi^- J/\psi$ |

 $\Gamma_4/\Gamma_3$ 

NODE=M070S67  
 NODE=M070S67

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

| 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 $e^+ e^-$                                 |

 $\Gamma_5/\Gamma$ 

NODE=M070R1  
 NODE=M070R1

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

| VALUE (units $10^{-3}$ ) | DOCUMENT ID            | TECN | COMMENT                                     |
|--------------------------|------------------------|------|---------------------------------------------|
| <b>8.8±1.3±0.4</b>       | <sup>1</sup> ARMSTRONG | 96   | E760 $\bar{p} p \rightarrow e^+ e^- \gamma$ |

 $\Gamma_6/\Gamma$ 

NODE=M070S33  
 NODE=M070S33

<sup>1</sup> For  $E_\gamma > 100$  MeV.

NODE=M070S33;LINKAGE=A

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

| 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 $e^+ e^-$                                 |

 $\Gamma_7/\Gamma$ 

NODE=M070R2  
 NODE=M070R2

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

| 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 $e^+ e^-$                                        |

 $\Gamma_5/\Gamma_7$ 

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

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

| 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 $e^+ e^- \rightarrow J/\psi \rightarrow \pi^+ \pi^- \pi^0$ |
| 2.091±0.021±0.116             |      | <sup>2,4</sup> 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 $e^+ e^-$                                                 |

 $\Gamma_8/\Gamma$ 

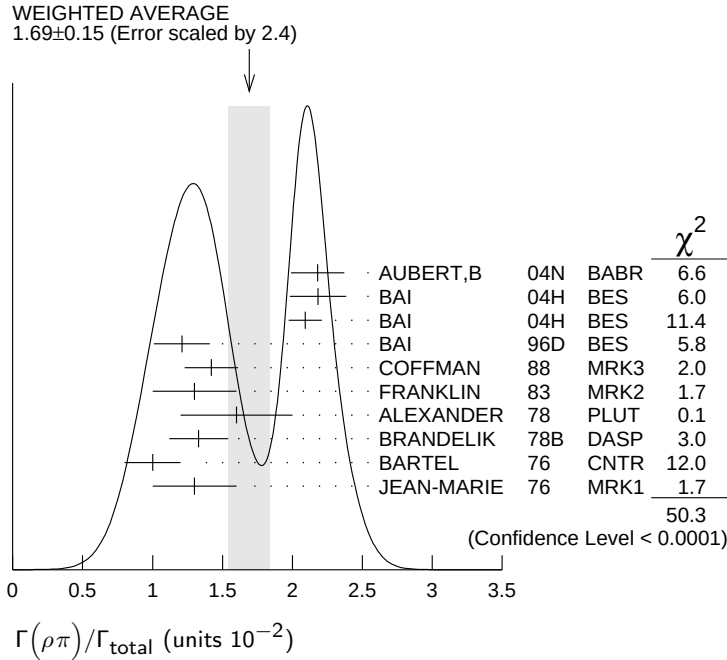
NODE=M070R20  
 NODE=M070R20

OCCUR=2

NODE=M070305

- <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  $B(J/\psi \rightarrow \mu^+\mu^-) = 5.88 \pm 0.10\%$ .

NODE=M070R20;LINKAGE=AU  
 NODE=M070R20;LINKAGE=BU  
 NODE=M070R20;LINKAGE=BA  
 NODE=M070R20;LINKAGE=BI



### $\Gamma(\rho\pi)/\Gamma(\pi^+\pi^-\pi^0)$ $\Gamma_8/\Gamma_{136}$

| VALUE                                                                         | EVTs | DOCUMENT ID       | TECN     | COMMENT                              |
|-------------------------------------------------------------------------------|------|-------------------|----------|--------------------------------------|
| <b><math>1.142 \pm 0.011 \pm 0.026</math></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. • • • |      |                   |          |                                      |
| $1.331 \pm 0.033$                                                             | 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><math>0.328 \pm 0.005 \pm 0.027</math></b>                                 | COFFMAN 88    | MRK3 | $e^+e^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |               |      |          |
| $0.35 \pm 0.08$                                                               | ALEXANDER 78  | PLUT | $e^+e^-$ |
| $0.32 \pm 0.08$                                                               | BRANDELIK 78B | DASP | $e^+e^-$ |
| $0.39 \pm 0.11$                                                               | BARTEL 76     | CNTR | $e^+e^-$ |
| $0.37 \pm 0.09$                                                               | JEAN-MARIE 76 | MRK1 | $e^+e^-$ |

NODE=M070R21  
 NODE=M070R21

### $\Gamma(\rho(1450)\pi \rightarrow \pi^+\pi^-\pi^0)/\Gamma(\pi^+\pi^-\pi^0)$ $\Gamma_{12}/\Gamma_{136}$

| VALUE (%)                                                                     | EVTs | DOCUMENT ID       | TECN     | COMMENT                              |
|-------------------------------------------------------------------------------|------|-------------------|----------|--------------------------------------|
| <b><math>10.9 \pm 1.7 \pm 2.7</math></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. • • • |      |                   |          |                                      |
| $0.80 \pm 0.27$                                                               | 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

### $\Gamma(\rho(1450)^\pm \pi^\mp \rightarrow K_S^0 K^\pm \pi^\mp)/\Gamma(K_S^0 K^\pm \pi^\mp)$ $\Gamma_{13}/\Gamma_{152}$

| VALUE (%)                                                    | EVTs | DOCUMENT ID       | TECN     | COMMENT                                  |
|--------------------------------------------------------------|------|-------------------|----------|------------------------------------------|
| <b><math>6.3 \pm 0.8 \pm 0.6</math></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

### $\Gamma(\rho(1450)^0 \pi^0 \rightarrow K^+ K^- \pi^0)/\Gamma(K^+ K^- \pi^0)$ $\Gamma_{14}/\Gamma_{151}$

| VALUE (%)                                                    | EVTs | DOCUMENT ID       | TECN     | COMMENT                            |
|--------------------------------------------------------------|------|-------------------|----------|------------------------------------|
| <b><math>9.3 \pm 2.0 \pm 0.6</math></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

$\Gamma(\rho(1450)\eta'(958) \rightarrow \pi^+\pi^-\eta'(958))/\Gamma_{\text{total}}$  $\Gamma_{15}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | 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

 $\Gamma(\rho(1700)\pi \rightarrow \pi^+\pi^-\pi^0)/\Gamma(\pi^+\pi^-\pi^0)$  $\Gamma_{17}/\Gamma_{136}$ 

| VALUE (units $10^{-3}$ ) | 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 $\Gamma(\rho(2150)\pi \rightarrow \pi^+\pi^-\pi^0)/\Gamma(\pi^+\pi^-\pi^0)$  $\Gamma_{19}/\Gamma_{136}$ 

| VALUE (units $10^{-4}$ ) | 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 $\Gamma(\rho_3(1690)\pi \rightarrow \pi^+\pi^-\pi^0)/\Gamma(\pi^+\pi^-\pi^0)$  $\Gamma_{20}/\Gamma_{136}$ 

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

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

|         |     |                   |          |                                      |
|---------|-----|-------------------|----------|--------------------------------------|
| 4.0±0.8 | 20K | <sup>1</sup> LEES | 17C BABR | $J/\psi \rightarrow \pi^+\pi^-\pi^0$ |
|---------|-----|-------------------|----------|--------------------------------------|

<sup>1</sup> From a Dalitz plot analysis in a Veneziano model.NODE=M070P24  
NODE=M070P24

NODE=M070P24;LINKAGE=A

 $\Gamma(a_2(1320)\rho)/\Gamma_{\text{total}}$  $\Gamma_{21}/\Gamma$ 

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

**10.9±2.2 OUR AVERAGE**

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

| VALUE (units $10^{-4}$ ) | 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 $\Gamma(\omega\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{24}/\Gamma$ 

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

**7.2±1.0 OUR AVERAGE**[(8.6 ± 0.7) × 10<sup>-3</sup> OUR 2018 AVERAGE Scale factor = 1.1]

|         |       |          |        |                                         |
|---------|-------|----------|--------|-----------------------------------------|
| 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

NEW

 $\Gamma(\omega f_2(1270))/\Gamma_{\text{total}}$  $\Gamma_{25}/\Gamma$ 

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

**4.3±0.6 OUR AVERAGE**

|             |      |          |        |          |
|-------------|------|----------|--------|----------|
| 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

$$\Gamma(K^*(892)^\pm K^*(700)^\mp)/\Gamma_{\text{total}} \quad \Gamma_{28}/\Gamma$$

| VALUE (units $10^{-3}$ )        | EVTs | DOCUMENT ID | TECN     | COMMENT                                        |
|---------------------------------|------|-------------|----------|------------------------------------------------|
| $1.09 \pm 0.18^{+0.94}_{-0.54}$ | 655  | ABLIKIM     | 10E BES2 | $J/\psi \rightarrow K^\pm K_S^0 \pi^\mp \pi^0$ |

NODE=M070S74  
NODE=M070S74

$$\Gamma(\eta K^*(892)^0 \bar{K}^*(892)^0)/\Gamma_{\text{total}} \quad \Gamma_{32}/\Gamma$$

| VALUE (units $10^{-3}$ ) | EVTs | DOCUMENT ID | TECN     | COMMENT                                       |
|--------------------------|------|-------------|----------|-----------------------------------------------|
| $1.15 \pm 0.13 \pm 0.22$ | 209  | ABLIKIM     | 10C BES2 | $J/\psi \rightarrow \eta K^+ \pi^- K^- \pi^+$ |

NODE=M070S69  
NODE=M070S69

$$\Gamma(K^*(1410) \bar{K} + c.c. \rightarrow K^\pm K^\mp \pi^0)/\Gamma(K^+ K^- \pi^0) \quad \Gamma_{38}/\Gamma_{151}$$

| VALUE (%)             | EVTs | DOCUMENT ID       | TECN     | COMMENT                            |
|-----------------------|------|-------------------|----------|------------------------------------|
| $2.3 \pm 1.1 \pm 0.7$ | 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

$$\Gamma(K^*(1410) \bar{K} + c.c. \rightarrow K_S^0 K^\pm \pi^\mp)/\Gamma(K_S^0 K^\pm \pi^\mp) \quad \Gamma_{39}/\Gamma_{152}$$

| VALUE (%)             | EVTs | DOCUMENT ID       | TECN     | COMMENT                                  |
|-----------------------|------|-------------------|----------|------------------------------------------|
| $1.5 \pm 0.5 \pm 0.9$ | 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

$$\Gamma(K_2^*(1430) \bar{K} + c.c. \rightarrow K^\pm K^\mp \pi^0)/\Gamma(K^+ K^- \pi^0) \quad \Gamma_{41}/\Gamma_{151}$$

| VALUE (%)             | EVTs | DOCUMENT ID       | TECN     | COMMENT                            |
|-----------------------|------|-------------------|----------|------------------------------------|
| $3.5 \pm 1.3 \pm 0.9$ | 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

$$\Gamma(K_2^*(1430) \bar{K} + c.c. \rightarrow K_S^0 K^\pm \pi^\mp)/\Gamma(K_S^0 K^\pm \pi^\mp) \quad \Gamma_{42}/\Gamma_{152}$$

| VALUE (%)             | EVTs | DOCUMENT ID       | TECN     | COMMENT                                  |
|-----------------------|------|-------------------|----------|------------------------------------------|
| $7.1 \pm 1.3 \pm 1.2$ | 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

$$\Gamma(K^*(892)^0 \bar{K}_2^*(1430)^0 + c.c.)/\Gamma_{\text{total}} \quad \Gamma_{43}/\Gamma$$

| VALUE (units $10^{-3}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT                                   |
|--------------------------|------|-------------|------|-------------------------------------------|
| 6.7 $\pm$ 2.6            | 40   | VANNUCCI 77 | MRK1 | $e^+ e^- \rightarrow \pi^+ \pi^- K^+ K^-$ |

NODE=M070R48  
NODE=M070R48

$$\Gamma(\omega K^*(892) \bar{K} + c.c.)/\Gamma_{\text{total}} \quad \Gamma_{47}/\Gamma$$

| VALUE (units $10^{-4}$ )                 | EVTs          | DOCUMENT ID | TECN     | COMMENT                                         |
|------------------------------------------|---------------|-------------|----------|-------------------------------------------------|
| <b>61 <math>\pm</math> 9 OUR AVERAGE</b> |               |             |          |                                                 |
| 62.0 $\pm$ 6.8 $\pm$ 10.6                | 899 $\pm$ 98  | ABLIKIM     | 08E BES2 | $J/\psi \rightarrow \omega K_S^0 K^\pm \pi^\mp$ |
| 65.3 $\pm$ 10.2 $\pm$ 13.5               | 176 $\pm$ 28  | ABLIKIM     | 08E BES2 | $J/\psi \rightarrow \omega K^+ K^- \pi^0$       |
| 53 $\pm$ 14 $\pm$ 14                     | 530 $\pm$ 140 | BECKER      | 87 MRK3  | $e^+ e^- \rightarrow \text{hadrons}$            |

NODE=M070S2  
NODE=M070S2

OCCUR=2

$$\Gamma(\bar{K} K^*(892) + c.c. \rightarrow K_S^0 K^\pm \pi^\mp)/\Gamma(K_S^0 K^\pm \pi^\mp) \quad \Gamma_{49}/\Gamma_{152}$$

| VALUE (%)              | EVTs | DOCUMENT ID       | TECN     | COMMENT                                  |
|------------------------|------|-------------------|----------|------------------------------------------|
| $90.5 \pm 0.9 \pm 3.8$ | 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

$$\Gamma(K^+ K^*(892)^- + c.c.)/\Gamma_{\text{total}} \quad \Gamma_{50}/\Gamma$$

| VALUE (units $10^{-3}$ )                              | EVTs | DOCUMENT ID | TECN    | COMMENT                                                 |
|-------------------------------------------------------|------|-------------|---------|---------------------------------------------------------|
| <b>5.0 <math>\pm</math> 0.4 OUR AVERAGE</b>           |      |             |         |                                                         |
| [(5.12 $\pm$ 0.30) $\times 10^{-3}$ OUR 2018 AVERAGE] |      |             |         |                                                         |
| 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 | $J/\psi \rightarrow K^\pm K_S^0 \pi^\mp, K^+ K^- \pi^0$ |

NODE=M070S15  
NODE=M070S15

NEW

• • • 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 | $J/\psi \rightarrow K^\pm X$             |

$$\Gamma(K^+ K^*(892)^- + c.c. \rightarrow K^+ K^- \pi^0)/\Gamma(K^+ K^- \pi^0) \quad \Gamma_{51}/\Gamma_{151}$$

| VALUE (%)              | EVTs | DOCUMENT ID       | TECN     | COMMENT                            |
|------------------------|------|-------------------|----------|------------------------------------|
| $92.4 \pm 1.5 \pm 3.4$ | 2K   | <sup>1</sup> LEES | 17C BABR | $J/\psi \rightarrow K^+ K^- \pi^0$ |

NODE=M070P26  
NODE=M070P26

<sup>1</sup> From a Dalitz plot analysis in an isobar model.

NODE=M070P26;LINKAGE=A

$\Gamma(K^0 \bar{K}^*(892)^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{53}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                      | EVTs | DOCUMENT ID | TECN    | COMMENT                                  |
|-------------------------------------------------------------------------------|------|-------------|---------|------------------------------------------|
| <b>4.2 <math>\pm</math> 0.4 OUR AVERAGE</b>                                   |      |             |         |                                          |
| [(4.39 $\pm$ 0.31) $\times 10^{-3}$ OUR 2018 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 | $J/\psi \rightarrow K^\pm K_S^0 \pi^\mp$ |

NODE=M070S16  
 NODE=M070S16  
 NEW

 $\Gamma(K_1(1400)^\pm K^\mp)/\Gamma_{\text{total}}$  $\Gamma_{55}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                 | DOCUMENT ID      | TECN    | COMMENT   |
|--------------------------------------------------------------------------|------------------|---------|-----------|
| <b>3.8 <math>\pm</math> 0.8 <math>\pm</math> 1.2</b>                     | <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=M070S35  
 NODE=M070S35

NODE=M070S35;LINKAGE=M3

 $\Gamma(\bar{K}^*(892)^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{56}/\Gamma$ 

| 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=M070S52  
 NODE=M070S52

NODE=M070S52;LINKAGE=AB

 $\Gamma(\omega \pi^0 \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{59}/\Gamma$ 

| VALUE (units $10^{-3}$ )                             | EVTs | DOCUMENT ID | TECN   | COMMENT                                 |
|------------------------------------------------------|------|-------------|--------|-----------------------------------------|
| <b>3.4 <math>\pm</math> 0.3 <math>\pm</math> 0.7</b> | 509  | AUGUSTIN    | 89 DM2 | $J/\psi \rightarrow \pi^+ \pi^- 3\pi^0$ |

NODE=M070S26  
 NODE=M070S26

 $\Gamma(b_1(1235)^\pm \pi^\mp)/\Gamma_{\text{total}}$  $\Gamma_{61}/\Gamma$ 

| VALUE (units $10^{-4}$ )                 | EVTs | DOCUMENT ID | TECN     | COMMENT                                   |
|------------------------------------------|------|-------------|----------|-------------------------------------------|
| <b>30 <math>\pm</math> 5 OUR AVERAGE</b> |      |             |          |                                           |
| 31 $\pm$ 6                               | 4600 | AUGUSTIN    | 89 DM2   | $J/\psi \rightarrow 2(\pi^+ \pi^-) \pi^0$ |
| 29 $\pm$ 7                               | 87   | BURMESTER   | 77D PLUT | $e^+ e^-$                                 |

NODE=M070R49  
 NODE=M070R49

 $\Gamma(\omega K^\pm K_S^0 \pi^\mp)/\Gamma_{\text{total}}$  $\Gamma_{62}/\Gamma$ 

| VALUE (units $10^{-4}$ )                 | EVTs          | DOCUMENT ID | TECN     | COMMENT                              |
|------------------------------------------|---------------|-------------|----------|--------------------------------------|
| <b>34 <math>\pm</math> 5 OUR AVERAGE</b> |               |             |          |                                      |
| 37.7 $\pm$ 0.8 $\pm$ 5.8                 | 1972 $\pm$ 41 | ABLIKIM     | 08E BES2 | $e^+ e^- \rightarrow J/\psi$         |
| 29.5 $\pm$ 1.4 $\pm$ 7.0                 | 879 $\pm$ 41  | BECKER      | 87 MRK3  | $e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M070S1  
 NODE=M070S1

 $\Gamma(b_1(1235)^0 \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{63}/\Gamma$ 

| VALUE (units $10^{-4}$ )                        | EVTs | DOCUMENT ID | TECN   | COMMENT   |
|-------------------------------------------------|------|-------------|--------|-----------|
| <b>23 <math>\pm</math> 3 <math>\pm</math> 5</b> | 229  | AUGUSTIN    | 89 DM2 | $e^+ e^-$ |

NODE=M070S28  
 NODE=M070S28

 $\Gamma(\eta K^\pm K_S^0 \pi^\mp)/\Gamma_{\text{total}}$  $\Gamma_{64}/\Gamma$ 

| VALUE (units $10^{-4}$ )                              | EVTs         | DOCUMENT ID | TECN     | COMMENT                      |
|-------------------------------------------------------|--------------|-------------|----------|------------------------------|
| <b>21.8 <math>\pm</math> 2.2 <math>\pm</math> 3.4</b> | 232 $\pm$ 23 | ABLIKIM     | 08E BES2 | $e^+ e^- \rightarrow J/\psi$ |

NODE=M070S57  
 NODE=M070S57

 $\Gamma(\eta' K^* \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{34}/\Gamma$ 

| VALUE                                                                                 | DOCUMENT ID          | TECN      | COMMENT                                |
|---------------------------------------------------------------------------------------|----------------------|-----------|----------------------------------------|
| <b>(1.66 <math>\pm</math> 0.03 <math>\pm</math> 0.21) <math>\times 10^{-3}</math></b> | <sup>1</sup> ABLIKIM | 18AB BES3 | $J/\psi \rightarrow \eta' K^* \bar{K}$ |
| <sup>1</sup> From $\eta' K_S^0 K^\pm \pi^\mp$                                         |                      |           |                                        |

NODE=M070P49  
 NODE=M070P49

NODE=M070P49;LINKAGE=A

 $\Gamma(\eta' K^* \pi^\pm K^\mp)/\Gamma_{\text{total}}$  $\Gamma_{33}/\Gamma$ 

| VALUE                                               | DOCUMENT ID          | TECN      | COMMENT                                |
|-----------------------------------------------------|----------------------|-----------|----------------------------------------|
| <b>0.00148 <math>\pm</math> 0.00013 OUR AVERAGE</b> |                      |           |                                        |
| (1.50 $\pm$ 0.02 $\pm$ 0.19) $\times 10^{-3}$       | <sup>1</sup> ABLIKIM | 18AB BES3 | $J/\psi \rightarrow \eta' K^* \bar{K}$ |
| (1.47 $\pm$ 0.03 $\pm$ 0.17) $\times 10^{-3}$       | <sup>2</sup> ABLIKIM | 18AB BES3 | $J/\psi \rightarrow \eta' K^* \bar{K}$ |
| <sup>1</sup> From $\eta' K^+ K^- \pi^0$             |                      |           |                                        |
| <sup>2</sup> From $\eta' K_S^0 K^\pm \pi^\mp$       |                      |           |                                        |

NODE=M070P48  
 NODE=M070P48

OCCUR=2

NODE=M070P48;LINKAGE=A  
 NODE=M070P48;LINKAGE=B

$$\Gamma(\eta' h_1(1415) \rightarrow \eta' K^{*\pm} K^\mp) / \Gamma_{\text{total}} \quad \Gamma_{36}/\Gamma$$

| VALUE                                      | EVTs | DOCUMENT ID          | TECN      | COMMENT                                                      |
|--------------------------------------------|------|----------------------|-----------|--------------------------------------------------------------|
| $(1.51 \pm 0.09 \pm 0.21) \times 10^{-04}$ |      | <sup>1</sup> ABLIKIM | 18AB BES3 | $J/\psi \rightarrow \eta' h_1 \rightarrow \eta' K^* \bar{K}$ |
| <sup>1</sup> From $\eta' K^+ K^- \pi^0$ .  |      |                      |           |                                                              |

NODE=M070P44  
NODE=M070P44

NODE=M070P44;LINKAGE=A

$$\Gamma(\eta' h_1(1415) \rightarrow \eta' K^* \bar{K} + \text{c.c.}) / \Gamma_{\text{total}} \quad \Gamma_{35}/\Gamma$$

| VALUE                                         | EVTs | DOCUMENT ID          | TECN      | COMMENT                                                      |
|-----------------------------------------------|------|----------------------|-----------|--------------------------------------------------------------|
| $(2.16 \pm 0.12 \pm 0.29) \times 10^{-04}$    |      | <sup>1</sup> ABLIKIM | 18AB BES3 | $J/\psi \rightarrow \eta' h_1 \rightarrow \eta' K^* \bar{K}$ |
| <sup>1</sup> From $\eta' K_S^0 K^\pm \pi^\mp$ |      |                      |           |                                                              |

NODE=M070P52  
NODE=M070P52

NODE=M070P52;LINKAGE=A

$$\Gamma(\phi K^*(892) \bar{K} + \text{c.c.}) / \Gamma_{\text{total}} \quad \Gamma_{65}/\Gamma$$

| VALUE (units $10^{-4}$ )      | EVTs     | DOCUMENT ID | TECN     | COMMENT                                       |
|-------------------------------|----------|-------------|----------|-----------------------------------------------|
| <b>21.8 ± 2.3 OUR AVERAGE</b> |          |             |          |                                               |
| 20.8 ± 2.7 ± 3.9              | 195 ± 25 | ABLIKIM     | 08E BES2 | $J/\psi \rightarrow \phi K_S^0 K^\pm \pi^\mp$ |
| 29.6 ± 3.7 ± 4.7              | 238 ± 30 | ABLIKIM     | 08E BES2 | $J/\psi \rightarrow \phi K^+ K^- \pi^0$       |
| 20.7 ± 2.4 ± 3.0              |          | FALVARD     | 88 DM2   | $J/\psi \rightarrow \text{hadrons}$           |
| 20 ± 3 ± 3                    | 155 ± 20 | BECKER      | 87 MRK3  | $e^+ e^- \rightarrow \text{hadrons}$          |

NODE=M070S4  
NODE=M070S4

OCCUR=2

$$\Gamma(\omega K \bar{K}) / \Gamma_{\text{total}} \quad \Gamma_{66}/\Gamma$$

| VALUE (units $10^{-4}$ )                           | EVTs | DOCUMENT ID          | TECN    | COMMENT                             |
|----------------------------------------------------|------|----------------------|---------|-------------------------------------|
| <b>19 ± 4 OUR AVERAGE</b>                          |      |                      |         |                                     |
| [(17.0 ± 3.2) × 10 <sup>-4</sup> OUR 2018 AVERAGE] |      |                      |         |                                     |
| 19.8 ± 2.1 ± 3.9                                   |      | <sup>1</sup> FALVARD | 88 DM2  | $J/\psi \rightarrow \text{hadrons}$ |
| 16 ± 10                                            | 22   | FELDMAN              | 77 MRK1 | $e^+ e^-$                           |

NODE=M070R27  
NODE=M070R27

NEW

<sup>1</sup> Addition of  $\omega K^+ K^-$  and  $\omega K^0 \bar{K}^0$  branching ratios.

NODE=M070R27;LINKAGE=B

$$\Gamma(\omega f_0(1710) \rightarrow \omega K \bar{K}) / \Gamma_{\text{total}} \quad \Gamma_{67}/\Gamma$$

| VALUE (units $10^{-4}$ ) | DOCUMENT ID            | TECN   | COMMENT                             |
|--------------------------|------------------------|--------|-------------------------------------|
| <b>4.8 ± 1.1 ± 0.3</b>   | <sup>1,2</sup> FALVARD | 88 DM2 | $J/\psi \rightarrow \text{hadrons}$ |

NODE=M070S25  
NODE=M070S25

<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;LINKAGE=F  
NODE=M070S25;LINKAGE=G

$$\Gamma(\phi 2(\pi^+ \pi^-)) / \Gamma_{\text{total}} \quad \Gamma_{68}/\Gamma$$

| VALUE (units $10^{-4}$ )      | DOCUMENT ID                                        | TECN   | COMMENT                             |
|-------------------------------|----------------------------------------------------|--------|-------------------------------------|
| <b>16.0 ± 3.2 OUR AVERAGE</b> | [(16.6 ± 2.3) × 10 <sup>-4</sup> OUR 2018 AVERAGE] |        |                                     |
| <b>16.0 ± 1.0 ± 3.0</b>       | FALVARD                                            | 88 DM2 | $J/\psi \rightarrow \text{hadrons}$ |

NODE=M070R35  
NODE=M070R35

NEW

$$\Gamma(\Delta(1232)^{++} \bar{p} \pi^-) / \Gamma_{\text{total}} \quad \Gamma_{69}/\Gamma$$

| VALUE (units $10^{-3}$ )  | EVTs | DOCUMENT ID | TECN    | COMMENT   |
|---------------------------|------|-------------|---------|-----------|
| <b>1.58 ± 0.23 ± 0.40</b> | 332  | EATON       | 84 MRK2 | $e^+ e^-$ |

NODE=M070R70  
NODE=M070R70

$$\Gamma(\omega \eta) / \Gamma_{\text{total}} \quad \Gamma_{70}/\Gamma$$

| VALUE (units $10^{-3}$ )       | EVTs                                                        | DOCUMENT ID          | TECN     | COMMENT                                       |
|--------------------------------|-------------------------------------------------------------|----------------------|----------|-----------------------------------------------|
| <b>1.74 ± 0.20 OUR AVERAGE</b> | 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  | $e^+ e^- \rightarrow 3\pi \eta$               |

NODE=M070R30  
NODE=M070R30

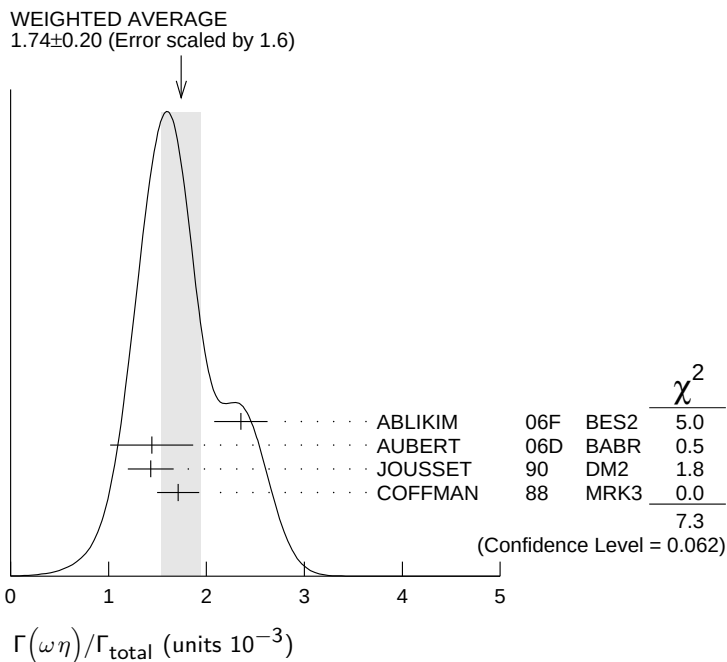
<sup>1</sup> Using  $B(\eta \rightarrow 2\gamma) = (39.43 \pm 0.26)\%$ ,  $B(\eta \rightarrow \pi^+ \pi^- \pi^0) = 22.6 \pm 0.4\%$ ,  $B(\eta \rightarrow \pi^+ \pi^- \gamma) = 4.68 \pm 0.11\%$ , and  $B(\omega \rightarrow \pi^+ \pi^- \pi^0) = (89.1 \pm 0.7)\%$ .

<sup>2</sup> Using  $\Gamma(J/\psi \rightarrow e^+ e^-) = 5.52 \pm 0.14 \pm 0.04$  keV.

NODE=M070R30;LINKAGE=BL

NODE=M070R30;LINKAGE=EE





$\Gamma(\phi K \bar{K})/\Gamma_{\text{total}}$

| VALUE (units $10^{-4}$ )     | EVTS                 | DOCUMENT ID                                                 | TECN     | COMMENT                                   |
|------------------------------|----------------------|-------------------------------------------------------------|----------|-------------------------------------------|
| <b>17.7± 1.6 OUR AVERAGE</b> |                      | 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 $^{+20}_{-16}$ ±6         | 9.0 $^{+3.7}_{-3.0}$ | 1,2 HUANG                                                   | 03 BELL  | $B^+ \rightarrow (\phi K^+K^-) K^+$       |
| 14.6± 0.8±2.1                |                      | 3 FALVARD                                                   | 88 DM2   | $J/\psi \rightarrow \text{hadrons}$       |
| 18 ± 8                       | 14                   | FELDMAN                                                     | 77 MRK1  | $e^+e^-$                                  |

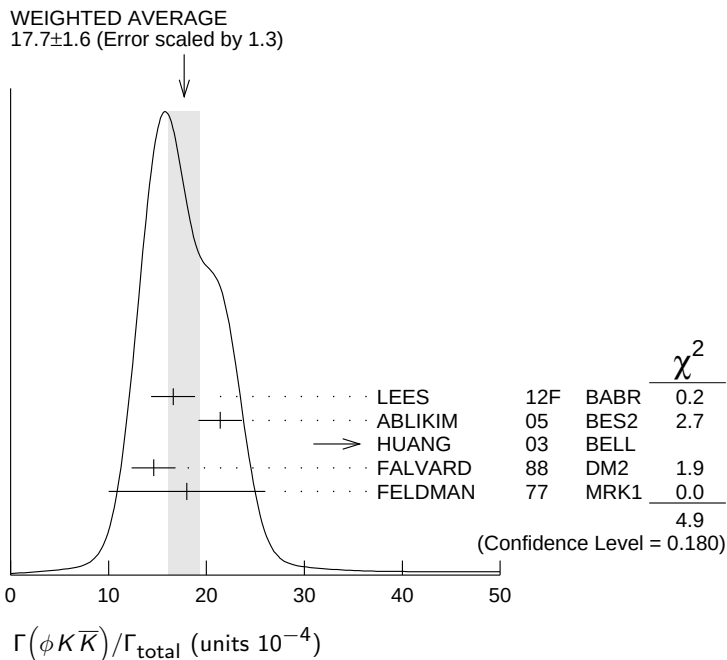
<sup>1</sup> We have multiplied  $K^+K^-$  measurement by 2 to obtain  $K\bar{K}$ .

<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=M070R36

NODE=M070R36;LINKAGE=AA  
NODE=M070R36;LINKAGE=CC  
NODE=M070R36;LINKAGE=A



$\Gamma(\phi f_0(1710) \rightarrow \phi K \bar{K})/\Gamma_{\text{total}}$

| VALUE (units $10^{-4}$ ) | DOCUMENT ID | TECN   | COMMENT                             |
|--------------------------|-------------|--------|-------------------------------------|
| <b>3.6±0.2±0.6</b>       | 1,2 FALVARD | 88 DM2 | $J/\psi \rightarrow \text{hadrons}$ |

<sup>1</sup> Including interference with  $f'_2(1525)$ .

<sup>2</sup> Includes unknown branching fraction  $f_0(1710) \rightarrow K\bar{K}$ .

NODE=M070S24  
NODE=M070S24

NODE=M070S24;LINKAGE=D  
NODE=M070S24;LINKAGE=E

$\Gamma(\phi f_2(1270))/\Gamma_{\text{total}}$  $\Gamma_{75}/\Gamma$ 

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

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

|        |    |          |    |      |                                       |
|--------|----|----------|----|------|---------------------------------------|
| < 0.45 | 90 | FALVARD  | 88 | DM2  | $J/\psi \rightarrow \text{hadrons}$   |
| < 0.37 | 90 | VANNUCCI | 77 | MRK1 | $e^+e^- \rightarrow \pi^+\pi^-K^+K^-$ |

NODE=M070R39  
NODE=M070R39

 $\Gamma(\Delta(1232)^{++}\bar{\Delta}(1232)^{--})/\Gamma_{\text{total}}$  $\Gamma_{76}/\Gamma$ 

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

|                       |     |       |    |      |          |
|-----------------------|-----|-------|----|------|----------|
| <b>1.10±0.09±0.28</b> | 233 | EATON | 84 | MRK2 | $e^+e^-$ |
|-----------------------|-----|-------|----|------|----------|

NODE=M070R66  
NODE=M070R66

 $\Gamma(\Sigma(1385)^-\bar{\Sigma}(1385)^+(\text{or c.c.}))/\Gamma_{\text{total}}$  $\Gamma_{77}/\Gamma$ 

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

**1.16 ±0.05 OUR AVERAGE**

|                   |      |         |     |      |                                                         |
|-------------------|------|---------|-----|------|---------------------------------------------------------|
| 1.096±0.012±0.071 | 43K  | ABLIKIM | 16L | BES3 | $J/\psi \rightarrow \Sigma(1385)^-\bar{\Sigma}(1385)^+$ |
| 1.258±0.014±0.078 | 53k  | ABLIKIM | 16L | BES3 | $J/\psi \rightarrow \Sigma(1385)^+\bar{\Sigma}(1385)^-$ |
| 1.23 ±0.07 ±0.30  | 0.8k | ABLIKIM | 12P | BES2 | $J/\psi \rightarrow \Sigma(1385)^-\bar{\Sigma}(1385)^+$ |
| 1.50 ±0.08 ±0.38  | 1k   | ABLIKIM | 12P | BES2 | $J/\psi \rightarrow \Sigma(1385)^+\bar{\Sigma}(1385)^-$ |
| 1.00 ±0.04 ±0.21  | 0.6k | HENRARD | 87  | DM2  | $e^+e^- \rightarrow \Sigma^{*-}$                        |
| 1.19 ±0.04 ±0.25  | 0.7k | HENRARD | 87  | DM2  | $e^+e^- \rightarrow \Sigma^{*+}$                        |
| 0.86 ±0.18 ±0.22  | 56   | EATON   | 84  | MRK2 | $e^+e^- \rightarrow \Sigma^{*-}$                        |
| 1.03 ±0.24 ±0.25  | 68   | EATON   | 84  | MRK2 | $e^+e^- \rightarrow \Sigma^{*+}$                        |

NODE=M070R67  
NODE=M070R67

OCCUR=2

OCCUR=2

OCCUR=2

OCCUR=2

 $\Gamma(\Sigma(1385)^0\bar{\Sigma}(1385)^0)/\Gamma_{\text{total}}$  $\Gamma_{78}/\Gamma$ 

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

|                          |      |         |     |      |                                                        |
|--------------------------|------|---------|-----|------|--------------------------------------------------------|
| <b>1.071±0.009±0.082</b> | 103k | ABLIKIM | 17E | BES3 | $e^+e^- \rightarrow J/\psi \rightarrow \text{hadrons}$ |
|--------------------------|------|---------|-----|------|--------------------------------------------------------|

NODE=M070P17  
NODE=M070P17

OCCUR=2

 $\Gamma(\phi f'_2(1525))/\Gamma_{\text{total}}$  $\Gamma_{80}/\Gamma$ 

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

**8 ±4 OUR AVERAGE** Error includes scale factor of 2.7.

|              |    |                        |    |      |                                     |
|--------------|----|------------------------|----|------|-------------------------------------|
| 12.3±0.6±2.0 |    | <sup>1,2</sup> FALVARD | 88 | DM2  | $J/\psi \rightarrow \text{hadrons}$ |
| 4.8±1.8      | 46 | <sup>1</sup> GIDAL     | 81 | MRK2 | $J/\psi \rightarrow K^+K^-K^+K^-$   |

<sup>1</sup> Re-evaluated using  $B(f'_2(1525) \rightarrow K\bar{K}) = 0.713$ .<sup>2</sup> Including interference with  $f_0(1710)$ .

NODE=M070R40  
NODE=M070R40

NODE=M070R40;LINKAGE=B  
NODE=M070R40;LINKAGE=C

 $\Gamma(\phi\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{81}/\Gamma$ 

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

**0.94±0.15 OUR AVERAGE** Error includes scale factor of 1.7.  $[(0.87 \pm 0.09) \times 10^{-3}]$   
OUR 2018 AVERAGE Scale factor = 1.4]

|                |    |         |    |      |                                     |
|----------------|----|---------|----|------|-------------------------------------|
| 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

NEW

 $\Gamma(\phi K^\pm K_S^0 \pi^\mp)/\Gamma_{\text{total}}$  $\Gamma_{83}/\Gamma$ 

| 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

 $\Gamma(\omega f_1(1420))/\Gamma_{\text{total}}$  $\Gamma_{84}/\Gamma$ 

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

|                                              |                                   |        |    |      |                                     |
|----------------------------------------------|-----------------------------------|--------|----|------|-------------------------------------|
| <b>6.8<sup>+1.9</sup><sub>-1.6</sub>±1.7</b> | 111 <sup>+31</sup> <sub>-26</sub> | BECKER | 87 | MRK3 | $e^+e^- \rightarrow \text{hadrons}$ |
|----------------------------------------------|-----------------------------------|--------|----|------|-------------------------------------|

NODE=M070S5  
NODE=M070S5

 $\Gamma(\phi\eta)/\Gamma_{\text{total}}$  $\Gamma_{85}/\Gamma$ 

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

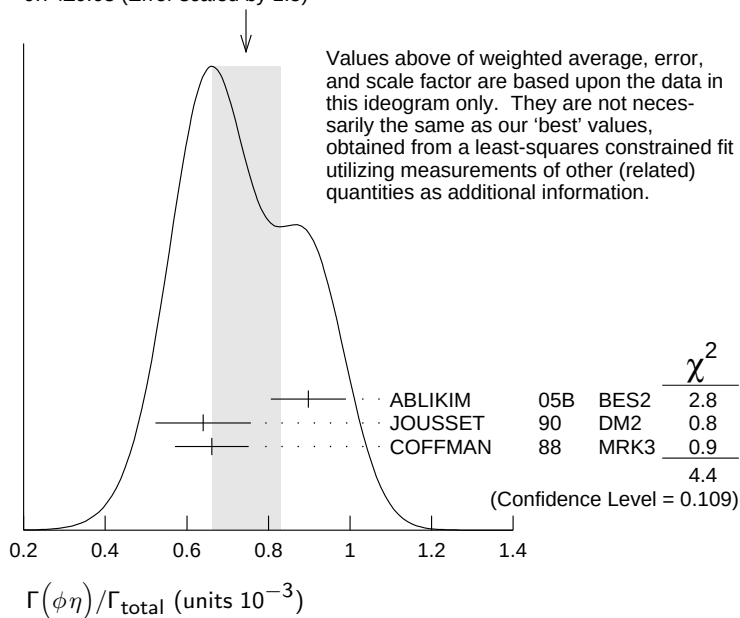
**0.74 ±0.08 OUR AVERAGE** Error includes scale factor of 1.5. See the ideogram below.  
[(0.75 ± 0.08) × 10<sup>-3</sup> OUR 2018 AVERAGE Scale factor = 1.5]

|                   |     |         |     |      |                                                     |
|-------------------|-----|---------|-----|------|-----------------------------------------------------|
| 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

NEW

WEIGHTED AVERAGE  
0.74±0.08 (Error scaled by 1.5)



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

VALUE (units  $10^{-3}$ ) EVTS

**1.17 ± 0.04 OUR AVERAGE**

1.165 ± 0.004 ± 0.043 135K

1.20 ± 0.12 ± 0.21 206

DOCUMENT ID

TECN

COMMENT

ABLIKIM

17E

BES3

$e^+e^- \rightarrow J/\psi \rightarrow$   
hadrons

ABLIKIM

080

BES2

$e^+e^- \rightarrow J/\psi$

$\Gamma_{86}/\Gamma$

NODE=M070S64  
NODE=M070S64

$\Gamma(\Xi(1530)^-\Xi^+)/\Gamma_{\text{total}}$

VALUE (units  $10^{-3}$ ) EVTS

**0.59 ± 0.09 ± 0.12** 75 ± 11

DOCUMENT ID

TECN

COMMENT

HENRARD

87

DM2

$e^+e^-$

$\Gamma_{87}/\Gamma$

NODE=M070S9  
NODE=M070S9

$\Gamma(pK^-\bar{\Sigma}(1385)^0)/\Gamma_{\text{total}}$

VALUE (units  $10^{-3}$ ) EVTS

**0.51 ± 0.26 ± 0.18** 89

DOCUMENT ID

TECN

COMMENT

EATON

84

MRK2

$e^+e^-$

$\Gamma_{88}/\Gamma$

NODE=M070R74  
NODE=M070R74

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

VALUE (units  $10^{-3}$ ) EVTS

**0.45 ± 0.05 OUR AVERAGE**

0.538 ± 0.012 ± 0.065 2090

0.360 ± 0.028 ± 0.054 222

0.482 ± 0.019 ± 0.064

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

<sup>1</sup>

ABLIKIM

06F

BES2

$J/\psi \rightarrow \omega\pi^0$

JOUSSET

90

DM2

$J/\psi \rightarrow$  hadrons

COFFMAN

88

MRK3

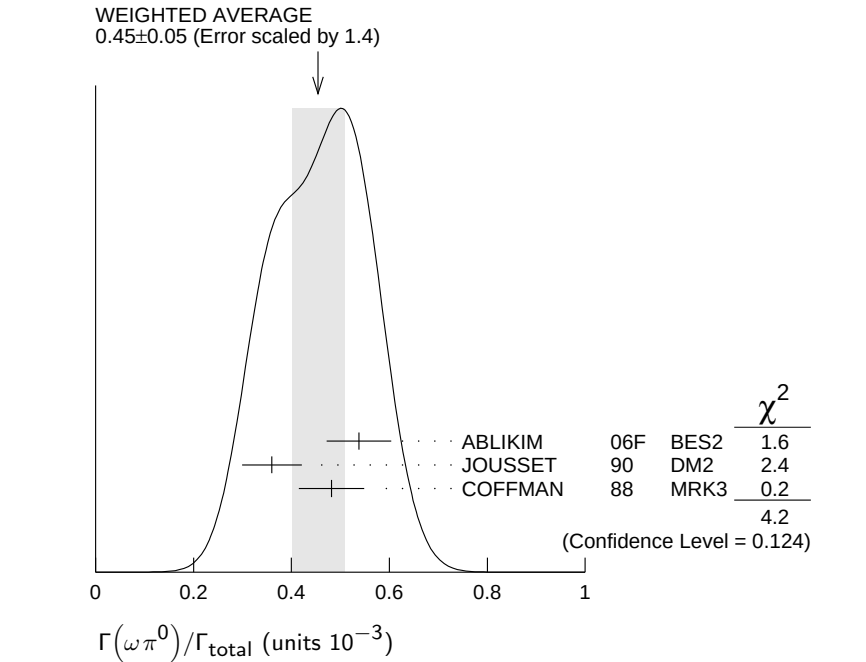
$e^+e^- \rightarrow \pi^0\pi^+\pi^-\pi^0$

$\Gamma_{89}/\Gamma$

NODE=M070R32  
NODE=M070R32

<sup>1</sup> Using  $B(\omega \rightarrow \pi^+\pi^-\pi^0) = (89.1 \pm 0.7)\%$ .

NODE=M070R32;LINKAGE=BL



|                          |      |                   |          |                                      | $\Gamma_{90}/\Gamma_{136}$ |
|--------------------------|------|-------------------|----------|--------------------------------------|----------------------------|
| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID       | TECN     | COMMENT                              |                            |
| $8 \pm 3 \pm 2$          | 20K  | <sup>1</sup> LEES | 17C BABR | $J/\psi \rightarrow \pi^+\pi^-\pi^0$ |                            |

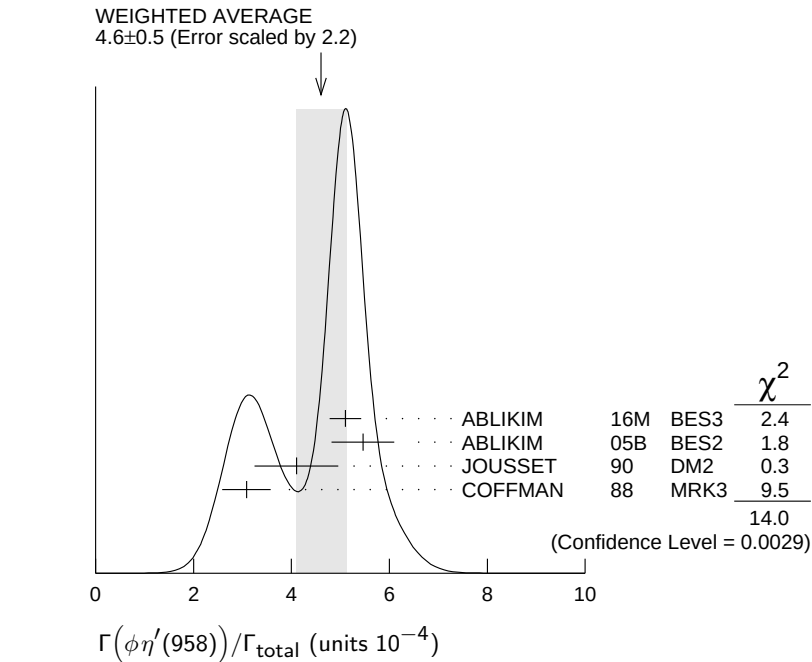
<sup>1</sup> From a Dalitz plot analysis in an isobar model and significance 4.9  $\sigma$ .

NODE=M070P23  
NODE=M070P23

NODE=M070P23;LINKAGE=A

|                                                                               |          |                                                             |          |                                                        | $\Gamma_{91}/\Gamma$ |
|-------------------------------------------------------------------------------|----------|-------------------------------------------------------------|----------|--------------------------------------------------------|----------------------|
| VALUE (units $10^{-4}$ )                                                      | CL% EVTS | DOCUMENT ID                                                 | TECN     | COMMENT                                                |                      |
| <b>4.6 ± 0.5 OUR AVERAGE</b>                                                  |          | Error includes scale factor of 2.2. See the ideogram below. |          |                                                        |                      |
| 5.10±0.03±0.32                                                                | 31k      | ABLIKIM                                                     | 16M BES3 | $e^+e^- \rightarrow J/\psi \rightarrow \text{hadrons}$ |                      |
| 5.46±0.31±0.56                                                                |          | ABLIKIM                                                     | 05B BES2 | $e^+e^- \rightarrow J/\psi \rightarrow \text{hadrons}$ |                      |
| 4.1 ± 0.3 ± 0.8                                                               | 167      | JOUSSET                                                     | 90 DM2   | $J/\psi \rightarrow \text{hadrons}$                    |                      |
| 3.08±0.34±0.36                                                                |          | COFFMAN                                                     | 88 MRK3  | $e^+e^- \rightarrow K^+K^-\eta'$                       |                      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |          |                                                             |          |                                                        |                      |
| < 13                                                                          | 90       | VANNUCCI                                                    | 77 MRK1  | $e^+e^-$                                               |                      |

NODE=M070R38  
NODE=M070R38



$\Gamma(\phi f_0(980))/\Gamma_{\text{total}}$  $\Gamma_{92}/\Gamma$ 

| 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

 $\Gamma(\phi\pi^0 f_0(980) \rightarrow \phi\pi^0\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{95}/\Gamma$ 

| 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 $\Gamma(\phi\pi^0 f_0(980) \rightarrow \phi\pi^0\rho^0\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{96}/\Gamma$ 

| 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 $\Gamma(\eta\phi f_0(980) \rightarrow \eta\phi\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{97}/\Gamma$ 

| 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 $\Gamma(\phi a_0(980)^0 \rightarrow \phi\eta\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{98}/\Gamma$ 

| VALUE (units $10^{-6}$ )    | DOCUMENT ID                                   | TECN | COMMENT |
|-----------------------------|-----------------------------------------------|------|---------|
| <b>4.4 ±1.4 OUR AVERAGE</b> | [(5 ± 4) × 10 <sup>-6</sup> OUR 2018 AVERAGE] |      |         |

**4.37±1.35** <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  $J/\psi \rightarrow \phi\eta\pi^0$ <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  
NODE=M070S75

NEW

NODE=M070S75;LINKAGE=A

NODE=M070S75;LINKAGE=AB

 $\Gamma(\Xi(1530)^0 \Xi^0)/\Gamma_{\text{total}}$  $\Gamma_{99}/\Gamma$ 

| 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 $\Gamma(\Sigma(1385)^- \Sigma^+ (\text{or c.c.}))/\Gamma_{\text{total}}$  $\Gamma_{100}/\Gamma$ 

| 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

 $\Gamma(\phi f_1(1285))/\Gamma_{\text{total}}$  $\Gamma_{101}/\Gamma$ 

| VALUE (units $10^{-4}$ )   | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                     |
|----------------------------|------|----------------------|----------|-------------------------------------------------------------|
| <b>2.6±0.5 OUR AVERAGE</b> |      |                      |          |                                                             |
| 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   | $J/\psi \rightarrow \phi\eta\pi^+\pi^-$                     |
| 0.6±0.2±0.1                | 16   | BECKER               | 87 MRK3  | $J/\psi \rightarrow \phi K \bar{K} \pi$                     |

NODE=M070S6  
NODE=M070S6

OCCUR=2

<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;LINKAGE=A

NODE=M070S6;LINKAGE=Q

 $\Gamma(\phi f_1(1285) \rightarrow \phi\pi^0 f_0(980) \rightarrow \phi\pi^0\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{102}/\Gamma$ 

| VALUE (units $10^{-7}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                           |
|--------------------------|------|-------------|----------|-----------------------------------|
| <b>9.36±2.31±1.54</b>    | 78   | ABLIKIM     | 15P BES3 | $J/\psi \rightarrow K^+ K^- 3\pi$ |

NODE=M070S99  
NODE=M070S99 $\Gamma(\phi f_1(1285) \rightarrow \phi\pi^0 f_0(980) \rightarrow \phi\pi^0\pi^0\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{103}/\Gamma$ 

| VALUE (units $10^{-7}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                           |
|--------------------------|------|-------------|----------|-----------------------------------|
| <b>2.08±1.63±1.47</b>    | 9    | ABLIKIM     | 15P BES3 | $J/\psi \rightarrow K^+ K^- 3\pi$ |

NODE=M070S00  
NODE=M070S00

$\Gamma(\eta\rho)/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ ) EVTS**0.193±0.023 OUR AVERAGE**

0.194±0.017±0.029 299

0.193±0.013±0.029

DOCUMENT ID

TECN

COMMENT

JOUSSET

90

DM2

 $J/\psi \rightarrow \text{hadrons}$ 

COFFMAN

88

MRK3

 $e^+e^- \rightarrow \pi^+\pi^-\eta$  $\Gamma_{105}/\Gamma$ 

NODE=M070R22

NODE=M070R22

 $\Gamma(\omega\eta'(958))/\Gamma_{\text{total}}$ VALUE (units  $10^{-4}$ ) EVTS**1.89±0.18 OUR AVERAGE**

2.08±0.30±0.14 137

2.26±0.43 218

1.8  $^{+1.0}_{-0.8}$  ±0.3 6

1.66±0.17±0.19

DOCUMENT ID

TECN

COMMENT

<sup>1</sup> ABLIKIM

17AK

BES3

 $J/\psi \rightarrow \pi^+\pi^-\eta'$ <sup>2</sup> ABLIKIM

06F

BES2

 $J/\psi \rightarrow \omega\eta'$ 

JOUSSET

90

DM2

 $J/\psi \rightarrow \text{hadrons}$ 

COFFMAN

88

MRK3

 $e^+e^- \rightarrow 3\pi\eta'$  $\Gamma_{106}/\Gamma$ 

NODE=M070R31

NODE=M070R31

<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;LINKAGE=A

NODE=M070R31;LINKAGE=BL

 $\Gamma(\omega f_0(980))/\Gamma_{\text{total}}$ VALUE (units  $10^{-4}$ )**1.41±0.27±0.47**

DOCUMENT ID

TECN

COMMENT

<sup>1</sup> AUGUSTIN

89

DM2

 $J/\psi \rightarrow 2(\pi^+\pi^-\pi^0)$ <sup>1</sup> Assuming  $B(f_0(980) \rightarrow \pi\pi) = 0.78$ . $\Gamma_{107}/\Gamma$ 

NODE=M070S27

NODE=M070S27

NODE=M070S27;LINKAGE=K

 $\Gamma(\rho\eta'(958))/\Gamma_{\text{total}}$ VALUE (units  $10^{-5}$ ) EVTS**8.1 ±0.8 OUR AVERAGE**

Error includes scale factor of 1.6.

7.90±0.19±0.49 3476

8.3 ±3.0 ±1.2 19

11.4 ±1.4 ±1.6

DOCUMENT ID

TECN

COMMENT

<sup>1</sup> ABLIKIM

17AK

BES3

 $J/\psi \rightarrow \pi^+\pi^-\eta'$ 

JOUSSET

90

DM2

 $J/\psi \rightarrow \text{hadrons}$ 

COFFMAN

88

MRK3

 $J/\psi \rightarrow \pi^+\pi^-\eta'$ <sup>1</sup> From a partial wave analysis of the decay  $J/\psi \rightarrow \pi^+\pi^-\eta'$ . $\Gamma_{108}/\Gamma$ 

NODE=M070R23

NODE=M070R23

NODE=M070R23;LINKAGE=A

 $\Gamma(a_2(1320)^\pm\pi^\mp)/\Gamma_{\text{total}}$ 

VALUE CL%

**<43 × 10<sup>-4</sup>**

90

DOCUMENT ID

TECN

COMMENT

BRAUNSCH... 76

DASP

 $e^+e^-$  $\Gamma_{109}/\Gamma$ 

NODE=M070R42

NODE=M070R42

 $\Gamma(K\bar{K}_2^*(1430) + \text{c.c.})/\Gamma_{\text{total}}$ 

VALUE CL%

**<40 × 10<sup>-4</sup>**

90

DOCUMENT ID

TECN

COMMENT

VANNUCCI 77

MRK1

 $e^+e^- \rightarrow K^0\bar{K}_2^{*0}$ 

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

<66 × 10<sup>-4</sup> 90

BRAUNSCH... 76

DASP

 $e^+e^- \rightarrow K^\pm\bar{K}_2^{*\mp}$  $\Gamma_{110}/\Gamma$ 

NODE=M070R45

NODE=M070R45

 $\Gamma(K_1(1270)^\pm K^\mp)/\Gamma_{\text{total}}$ 

VALUE CL%

**<3.0 × 10<sup>-3</sup>**

90

DOCUMENT ID

TECN

COMMENT

<sup>1</sup> BAI

99C

BES

 $e^+e^-$ <sup>1</sup> Assuming  $B(K_1(1270) \rightarrow K\rho) = 0.42 \pm 0.06$  $\Gamma_{111}/\Gamma$ 

NODE=M070S34

NODE=M070S34

NODE=M070S34;LINKAGE=M2

 $\Gamma(K_1(1270)K_S^0 \rightarrow \gamma K_S^0 K_S^0)/\Gamma_{\text{total}}$ VALUE (units  $10^{-7}$ )**8.54  $^{+1.07}_{-1.20}$   $^{+2.35}_{-2.13}$** 

DOCUMENT ID

TECN

COMMENT

ABLIKIM

18AA

BES3

 $J/\psi \rightarrow \gamma K_S^0 K_S^0$  $\Gamma_{112}/\Gamma$ 

NODE=M070P72

NODE=M070P72

 $\Gamma(K_2^*(1430)^0\bar{K}_2^*(1430)^0)/\Gamma_{\text{total}}$ 

VALUE CL%

**<29 × 10<sup>-4</sup>**

90

DOCUMENT ID

TECN

COMMENT

VANNUCCI 77

MRK1

 $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$  $\Gamma_{114}/\Gamma$ 

NODE=M070R47

NODE=M070R47

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

2.94 ±0.16 ±0.16 0.8k

DOCUMENT ID

TECN

COMMENT

<sup>1</sup> ABLIKIM

15K

BES3

 $e^+e^- \rightarrow J/\psi \rightarrow$  $K^+K^-\gamma\gamma$ 

0.124±0.033±0.030 35 ± 9

<sup>2</sup> ABLIKIM

15K

BES3

 $e^+e^- \rightarrow J/\psi \rightarrow$  $K^+K^-\gamma\gamma$  $\Gamma_{115}/\Gamma$ 

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

### $\Gamma(\phi\eta(1405) \rightarrow \phi\eta\pi^+\pi^-)/\Gamma_{\text{total}}$ $\Gamma_{116}/\Gamma$

| VALUE (units $10^{-5}$ )                   | CL% | DOCUMENT ID          | TECN | COMMENT                                                         |
|--------------------------------------------|-----|----------------------|------|-----------------------------------------------------------------|
| <b><math>2.01 \pm 0.58 \pm 0.82</math></b> | 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

### $\Gamma(\omega f'_2(1525))/\Gamma_{\text{total}}$ $\Gamma_{117}/\Gamma$

| VALUE                                       | CL% | DOCUMENT ID           | TECN | COMMENT                                          |
|---------------------------------------------|-----|-----------------------|------|--------------------------------------------------|
| <b><math>&lt; 2.2 \times 10^{-4}</math></b> | 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

### $\Gamma(\omega X(1835) \rightarrow \omega p\bar{p})/\Gamma_{\text{total}}$ $\Gamma_{118}/\Gamma$

| VALUE                                                  | CL% | DOCUMENT ID | TECN | COMMENT                                                  |
|--------------------------------------------------------|-----|-------------|------|----------------------------------------------------------|
| <b><math>&lt; 3.9 \times 10^{-6}</math> (CL = 95%)</b> |     |             |      | [ $< 3.9 \times 10^{-6}$ (CL = 95%) OUR 2018 BEST LIMIT] |
| <b><math>&lt; 3.9 \times 10^{-6}</math></b>            | 95  | ABLIKIM     | 13P  | BES3 $J/\psi \rightarrow \gamma\pi^0 p\bar{p}$           |

NODE=M070S81  
NODE=M070S81

### $\Gamma(\phi X(1835) \rightarrow \phi p\bar{p})/\Gamma_{\text{total}}$ $\Gamma_{119}/\Gamma$

| VALUE                                       | CL% | DOCUMENT ID          | TECN | COMMENT                                                       |
|---------------------------------------------|-----|----------------------|------|---------------------------------------------------------------|
| <b><math>&lt; 2.1 \times 10^{-7}</math></b> | 90  | <sup>1</sup> ABLIKIM | 16K  | BES3 $J/\psi \rightarrow p\bar{p}K_S^0 K_L^0, p\bar{p}K^+K^-$ |

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

### $\Gamma(\phi X(1835) \rightarrow \phi\eta\pi^+\pi^-)/\Gamma_{\text{total}}$ $\Gamma_{120}/\Gamma$

| VALUE                                       | CL% | DOCUMENT ID | TECN | COMMENT                                                         |
|---------------------------------------------|-----|-------------|------|-----------------------------------------------------------------|
| <b><math>&lt; 2.8 \times 10^{-4}</math></b> | 90  | ABLIKIM     | 15H  | BES3 $e^+e^- \rightarrow J/\psi \rightarrow \phi\eta\pi^+\pi^-$ |

NODE=M070B10  
NODE=M070B10

### $\Gamma(\phi X(1870) \rightarrow \phi\eta\pi^+\pi^-)/\Gamma_{\text{total}}$ $\Gamma_{121}/\Gamma$

| VALUE                                        | CL% | DOCUMENT ID | TECN | COMMENT                                                         |
|----------------------------------------------|-----|-------------|------|-----------------------------------------------------------------|
| <b><math>&lt; 6.13 \times 10^{-5}</math></b> | 90  | ABLIKIM     | 15H  | BES3 $e^+e^- \rightarrow J/\psi \rightarrow \phi\eta\pi^+\pi^-$ |

NODE=M070B11  
NODE=M070B11

### $\Gamma(\eta\phi(2170) \Rightarrow \eta\phi f_0(980) \Rightarrow \eta\phi\pi^+\pi^-)/\Gamma_{\text{total}}$ $\Gamma_{122}/\Gamma$

| VALUE (units $10^{-4}$ )                   | EVTS | DOCUMENT ID | TECN | COMMENT                                                         |
|--------------------------------------------|------|-------------|------|-----------------------------------------------------------------|
| <b><math>1.20 \pm 0.14 \pm 0.37</math></b> | 471  | ABLIKIM     | 15H  | BES3 $e^+e^- \rightarrow J/\psi \rightarrow \phi\eta\pi^+\pi^-$ |

NODE=M070B12  
NODE=M070B12

### $\Gamma(\eta\phi(2170) \Rightarrow \eta K^*(892)^0 \bar{K}^*(892)^0)/\Gamma_{\text{total}}$ $\Gamma_{123}/\Gamma$

| VALUE                                                   | CL% | DOCUMENT ID | TECN | COMMENT                                                   |
|---------------------------------------------------------|-----|-------------|------|-----------------------------------------------------------|
| <b><math>&lt; 2.52 \times 10^{-4}</math> (CL = 90%)</b> |     |             |      | [ $< 2.52 \times 10^{-4}$ (CL = 90%) OUR 2018 BEST LIMIT] |
| <b><math>&lt; 2.52 \times 10^{-4}</math></b>            | 90  | ABLIKIM     | 10C  | BES2 $J/\psi \rightarrow \eta K^+\pi^- K^-\pi^+$          |

NODE=M070S70  
NODE=M070S70

### $\Gamma(\Sigma(1385)^0 \bar{\Lambda} + \text{c.c.})/\Gamma_{\text{total}}$ $\Gamma_{124}/\Gamma$

| VALUE                                                  | CL% | DOCUMENT ID | TECN | COMMENT                                                   |
|--------------------------------------------------------|-----|-------------|------|-----------------------------------------------------------|
| <b><math>&lt; 8.2 \times 10^{-6}</math> (CL = 90%)</b> |     |             |      | [ $< 0.82 \times 10^{-5}$ (CL = 90%) OUR 2018 BEST LIMIT] |
| <b><math>&lt; 0.82 \times 10^{-5}</math></b>           | 90  | ABLIKIM     | 13F  | BES3 $J/\psi \rightarrow p\bar{p}\pi^+\pi^-\gamma\gamma$  |

NODE=M070S13  
NODE=M070S13

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

|                        |    |         |    |              |
|------------------------|----|---------|----|--------------|
| < $0.2 \times 10^{-3}$ | 90 | HENRARD | 87 | DM2 $e^+e^-$ |
|------------------------|----|---------|----|--------------|

### $\Gamma(\Delta(1232)^+ \bar{p})/\Gamma_{\text{total}}$ $\Gamma_{125}/\Gamma$

| VALUE                                                | CL% | DOCUMENT ID | TECN | COMMENT                                                  |
|------------------------------------------------------|-----|-------------|------|----------------------------------------------------------|
| <b><math>&lt; 1 \times 10^{-4}</math> (CL = 90%)</b> |     |             |      | [ $< 0.1 \times 10^{-3}$ (CL = 90%) OUR 2018 BEST LIMIT] |
| <b><math>&lt; 0.1 \times 10^{-3}</math></b>          | 90  | HENRARD     | 87   | DM2 $e^+e^-$                                             |

NODE=M070S14  
NODE=M070S14

$$\Gamma(\Lambda(1520)\bar{\Lambda} + \text{c.c.} \rightarrow \gamma\Lambda\bar{\Lambda})/\Gamma_{\text{total}} \quad \Gamma_{126}/\Gamma$$

| VALUE                            | CL% | DOCUMENT ID                                             | TECN     | COMMENT                                         |
|----------------------------------|-----|---------------------------------------------------------|----------|-------------------------------------------------|
| $<4.1 \times 10^{-6}$ (CL = 90%) |     | [ $<4.1 \times 10^{-6}$ (CL = 90%) OUR 2018 BEST LIMIT] |          |                                                 |
| $<4.1 \times 10^{-6}$            | 90  | ABLIKIM                                                 | 12B BES3 | $J/\psi \rightarrow \Lambda\bar{\Lambda}\gamma$ |

NODE=M070S77  
NODE=M070S77

$$\Gamma(\bar{\Lambda}(1520)\Lambda + \text{c.c.})/\Gamma_{\text{total}} \quad \Gamma_{127}/\Gamma$$

| 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

$$\Gamma(\Theta(1540)\bar{\Theta}(1540) \rightarrow K_S^0 p K^- \bar{n} + \text{c.c.})/\Gamma_{\text{total}} \quad \Gamma_{128}/\Gamma$$

| VALUE                            | CL% | DOCUMENT ID                                             | TECN     | COMMENT   |
|----------------------------------|-----|---------------------------------------------------------|----------|-----------|
| $<1.1 \times 10^{-5}$ (CL = 90%) |     | [ $<1.1 \times 10^{-5}$ (CL = 90%) OUR 2018 BEST LIMIT] |          |           |
| $<1.1 \times 10^{-5}$            | 90  | BAI                                                     | 04G BES2 | $e^+ e^-$ |

NODE=M070S47  
NODE=M070S47

$$\Gamma(\Theta(1540)K^- \bar{n} \rightarrow K_S^0 p K^- \bar{n})/\Gamma_{\text{total}} \quad \Gamma_{129}/\Gamma$$

| VALUE                            | CL% | DOCUMENT ID                                             | TECN     | COMMENT   |
|----------------------------------|-----|---------------------------------------------------------|----------|-----------|
| $<2.1 \times 10^{-5}$ (CL = 90%) |     | [ $<2.1 \times 10^{-5}$ (CL = 90%) OUR 2018 BEST LIMIT] |          |           |
| $<2.1 \times 10^{-5}$            | 90  | BAI                                                     | 04G BES2 | $e^+ e^-$ |

NODE=M070S48  
NODE=M070S48

$$\Gamma(\Theta(1540)K_S^0 \bar{p} \rightarrow K_S^0 \bar{p} K^+ n)/\Gamma_{\text{total}} \quad \Gamma_{130}/\Gamma$$

| VALUE                            | CL% | DOCUMENT ID                                             | TECN     | COMMENT   |
|----------------------------------|-----|---------------------------------------------------------|----------|-----------|
| $<1.6 \times 10^{-5}$ (CL = 90%) |     | [ $<1.6 \times 10^{-5}$ (CL = 90%) OUR 2018 BEST LIMIT] |          |           |
| $<1.6 \times 10^{-5}$            | 90  | BAI                                                     | 04G BES2 | $e^+ e^-$ |

NODE=M070S49  
NODE=M070S49

$$\Gamma(\bar{\Theta}(1540)K^+ n \rightarrow K_S^0 \bar{p} K^+ n)/\Gamma_{\text{total}} \quad \Gamma_{131}/\Gamma$$

| VALUE                            | CL% | DOCUMENT ID                                             | TECN     | COMMENT   |
|----------------------------------|-----|---------------------------------------------------------|----------|-----------|
| $<5.6 \times 10^{-5}$ (CL = 90%) |     | [ $<5.6 \times 10^{-5}$ (CL = 90%) OUR 2018 BEST LIMIT] |          |           |
| $<5.6 \times 10^{-5}$            | 90  | BAI                                                     | 04G BES2 | $e^+ e^-$ |

NODE=M070S50  
NODE=M070S50

$$\Gamma(\bar{\Theta}(1540)K_S^0 p \rightarrow K_S^0 p K^- \bar{n})/\Gamma_{\text{total}} \quad \Gamma_{132}/\Gamma$$

| VALUE                            | CL% | DOCUMENT ID                                             | TECN     | COMMENT   |
|----------------------------------|-----|---------------------------------------------------------|----------|-----------|
| $<1.1 \times 10^{-5}$ (CL = 90%) |     | [ $<1.1 \times 10^{-5}$ (CL = 90%) OUR 2018 BEST LIMIT] |          |           |
| $<1.1 \times 10^{-5}$            | 90  | BAI                                                     | 04G BES2 | $e^+ e^-$ |

NODE=M070S51  
NODE=M070S51

$$\Gamma(\Sigma^0 \bar{\Lambda})/\Gamma_{\text{total}} \quad \Gamma_{133}/\Gamma$$

| VALUE                          | CL% | DOCUMENT ID                                             | TECN   | COMMENT   |
|--------------------------------|-----|---------------------------------------------------------|--------|-----------|
| $<9 \times 10^{-5}$ (CL = 90%) |     | [ $<0.9 \times 10^{-4}$ (CL = 90%) OUR 2018 BEST LIMIT] |        |           |
| $<0.9 \times 10^{-4}$          | 90  | HENRARD                                                 | 87 DM2 | $e^+ e^-$ |

NODE=M070S12  
NODE=M070S12

### STABLE HADRONS

$$\Gamma(2(\pi^+ \pi^-)\pi^0)/\Gamma_{\text{total}} \quad \Gamma_{134}/\Gamma$$

| VALUE (units $10^{-2}$ )                                             | EVTS  | DOCUMENT ID | TECN     | COMMENT                                  |
|----------------------------------------------------------------------|-------|-------------|----------|------------------------------------------|
| <b>3.37±0.26 OUR AVERAGE</b>                                         |       |             |          |                                          |
| [(4.1 ± 0.5) × 10 <sup>-2</sup> OUR 2018 AVERAGE Scale factor = 2.4] |       |             |          |                                          |
| 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  | $e^+ e^-$                                |

NODE=M070307

NODE=M070R9  
NODE=M070R9  
NEW

$$\Gamma(3(\pi^+ \pi^-)\pi^0)/\Gamma_{\text{total}} \quad \Gamma_{135}/\Gamma$$

| 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

$$\Gamma(\pi^+ \pi^- \pi^0)/\Gamma_{\text{total}} \quad \Gamma_{136}/\Gamma$$

| 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.           |      |             |           |                                                      |
| [(21.1 ± 0.7) × 10 <sup>-3</sup> OUR 2018 AVERAGE Scale factor = 1.5] |      |             |           |                                                      |
| 21.37±0.04 <sup>+0.64</sup> <sub>-0.62</sub>                          | 1.8M | 1,2 ABLIKIM | 12H BES3  | $e^+ e^- \rightarrow J/\psi$                         |
| 23.0 ±2.0 ±0.4                                                        | 256  | 3 AUBERT    | 07AU BABR | 10.6 $e^+ e^- \rightarrow J/\psi \pi^+ \pi^- \gamma$ |
| 21.84±0.05±2.01                                                       | 220k | 1,4 BAI     | 04H BES   | $e^+ e^-$                                            |
| 20.91±0.21±1.16                                                       |      | 4,5 BAI     | 04H BES   | $e^+ e^-$                                            |
| 15 ±2                                                                 | 168  | FRANKLIN    | 83 MRK2   | $e^+ e^-$                                            |

NODE=M070R7  
NODE=M070R7

OCCUR=2

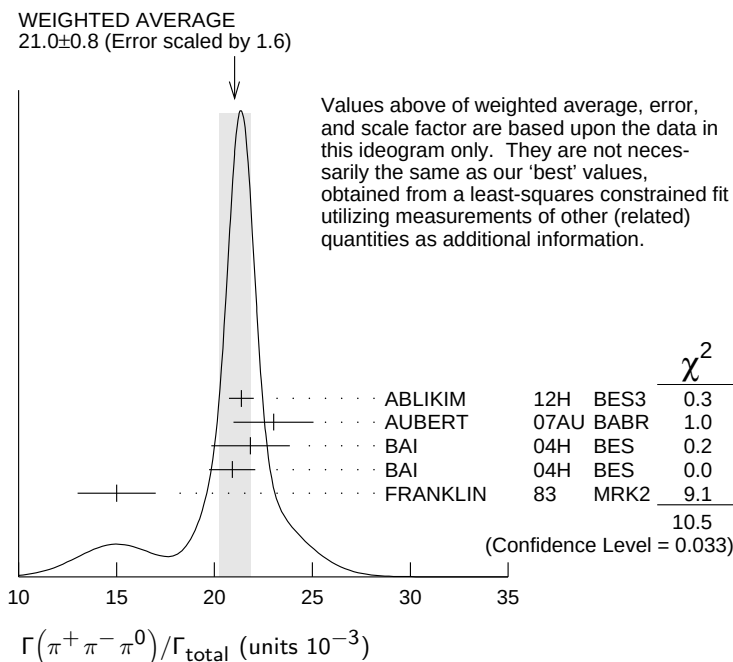


- <sup>1</sup> From  $J/\psi \rightarrow \pi^+ \pi^- \pi^0$  events directly.
- <sup>2</sup> The quoted systematic error includes a contribution of 1.23% (added in quadrature) from the uncertainty on the number of  $J/\psi$  events.
- <sup>3</sup> AUBERT 07AU reports  $[\Gamma(J/\psi(1S) \rightarrow \pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}] \times [\Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-) \times \Gamma(\psi(2S) \rightarrow e^+ e^-)/\Gamma_{\text{total}}] = (18.6 \pm 1.2 \pm 1.1) \times 10^{-3}$  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



### $\Gamma(\pi^+ \pi^- \pi^0 K^+ K^-)/\Gamma_{\text{total}}$ $\Gamma_{140}/\Gamma$

| VALUE (units $10^{-2}$ )   | EVTS                                                                   | DOCUMENT ID | TECN | COMMENT                            |
|----------------------------|------------------------------------------------------------------------|-------------|------|------------------------------------|
| <b>1.2±0.3 OUR AVERAGE</b> | [(1.79 ± 0.29) × 10 <sup>-2</sup> OUR 2018 AVERAGE Scale factor = 2.2] |             |      |                                    |
| <b>1.2±0.3</b>             | 309                                                                    | VANNUCCI    | 77   | MRK1 e <sup>+</sup> e <sup>-</sup> |

NODE=M070R18  
NODE=M070R18  
NEW

### $\Gamma(4(\pi^+ \pi^-) \pi^0)/\Gamma_{\text{total}}$ $\Gamma_{141}/\Gamma$

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                            |
|--------------------------|------|-------------|------|------------------------------------|
| <b>90±30</b>             | 13   | JEAN-MARIE  | 76   | MRK1 e <sup>+</sup> e <sup>-</sup> |

NODE=M070R12  
NODE=M070R12

### $\Gamma(\pi^+ \pi^- K^+ K^-)/\Gamma_{\text{total}}$ $\Gamma_{142}/\Gamma$

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                            |
|--------------------------|------|-------------|------|------------------------------------|
| 7.2±2.3                  | 205  | VANNUCCI    | 77   | MRK1 e <sup>+</sup> e <sup>-</sup> |

NODE=M070R16  
NODE=M070R16

### $\Gamma(K \bar{K} \pi)/\Gamma_{\text{total}}$ $\Gamma_{150}/\Gamma$

| VALUE (units $10^{-4}$ )  | EVTS | DOCUMENT ID | TECN | COMMENT                                                                                        |
|---------------------------|------|-------------|------|------------------------------------------------------------------------------------------------|
| <b>61 ±10 OUR AVERAGE</b> |      |             |      |                                                                                                |
| 55.2±12.0                 | 25   | FRANKLIN    | 83   | MRK2 e <sup>+</sup> e <sup>-</sup> → K <sup>+</sup> K <sup>-</sup> π <sup>0</sup>              |
| 78.0±21.0                 | 126  | VANNUCCI    | 77   | MRK1 e <sup>+</sup> e <sup>-</sup> → K <sub>S</sub> <sup>0</sup> K <sup>±</sup> π <sup>∓</sup> |

NODE=M070R15  
NODE=M070R15

### $\Gamma(K^+ K^- \pi^0)/\Gamma(\pi^+ \pi^- \pi^0)$ $\Gamma_{151}/\Gamma_{136}$

| VALUE (%)           | EVTS | DOCUMENT ID | TECN | COMMENT                                                 |
|---------------------|------|-------------|------|---------------------------------------------------------|
| <b>12.0±0.3±0.9</b> | 23K  | LEES        | 17C  | BABR J/ψ → h <sup>+</sup> h <sup>-</sup> π <sup>0</sup> |

NODE=M070P34  
NODE=M070P34

### $\Gamma(K_S^0 K^\pm \pi^\mp)/\Gamma(\pi^+ \pi^- \pi^0)$ $\Gamma_{152}/\Gamma_{136}$

| VALUE (%)           | EVTS | DOCUMENT ID | TECN | COMMENT                                                 |
|---------------------|------|-------------|------|---------------------------------------------------------|
| <b>26.5±0.5±2.1</b> | 24K  | LEES        | 17C  | BABR J/ψ → h <sup>0</sup> h <sup>+</sup> h <sup>-</sup> |

NODE=M070P35  
NODE=M070P35

$\Gamma(2(\pi^+\pi^-))/\Gamma_{\text{total}}$  $\Gamma_{157}/\Gamma$ VALUE (units  $10^{-3}$ ) EVTS

DOCUMENT ID TECN COMMENT

**3.57±0.30 OUR AVERAGE**

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  
NODE=M070R8

NODE=M070R8;LINKAGE=AB

 $\Gamma(3(\pi^+\pi^-))/\Gamma_{\text{total}}$  $\Gamma_{158}/\Gamma$ 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

 $\Gamma(2(\pi^+\pi^-)\eta)/\Gamma_{\text{total}}$  $\Gamma_{160}/\Gamma$ VALUE (units  $10^{-3}$ ) EVTS

DOCUMENT ID TECN COMMENT

**2.26±0.28 OUR AVERAGE** [(2.29 ± 0.24) × 10<sup>-3</sup> OUR 2018 AVERAGE]

**2.26±0.08±0.27** 4.8k ABLIKIM 05C BES2  $e^+e^- \rightarrow 2(\pi^+\pi^-)\eta$

NODE=M070S42  
NODE=M070S42

NEW

 $\Gamma(3(\pi^+\pi^-)\eta)/\Gamma_{\text{total}}$  $\Gamma_{161}/\Gamma$ 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

 $\Gamma(p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{164}/\Gamma$ VALUE (units  $10^{-3}$ ) EVTS

DOCUMENT ID TECN COMMENT

**2.123±0.029 OUR AVERAGE**

[(2.121 ± 0.029) × 10<sup>-3</sup> OUR 2018 AVERAGE]

2.112±0.004±0.031 314k ABLIKIM 12C BES3  $e^+e^-$

2.27 ±0.17 ±0.07 317 <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 [ $\Gamma(J/\psi(1S) \rightarrow p\bar{p})/\Gamma_{\text{total}}$ ] × [B( $B^+ \rightarrow J/\psi(1S)K^+$ )] = (2.21 ± 0.13 ± 0.10) × 10<sup>-6</sup> which we divide by our best value B( $B^+ \rightarrow J/\psi(1S)K^+$ ) = (9.71 ± 0.31) × 10<sup>-4</sup>. 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<sup>2</sup>θ).

NODE=M070R50  
NODE=M070R50

NEW

NODE=M070R50;LINKAGE=WU

NODE=M070R50;LINKAGE=A

 $\Gamma(p\bar{p}\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{165}/\Gamma$ 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

 $\Gamma(p\bar{p}\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{166}/\Gamma$ 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.

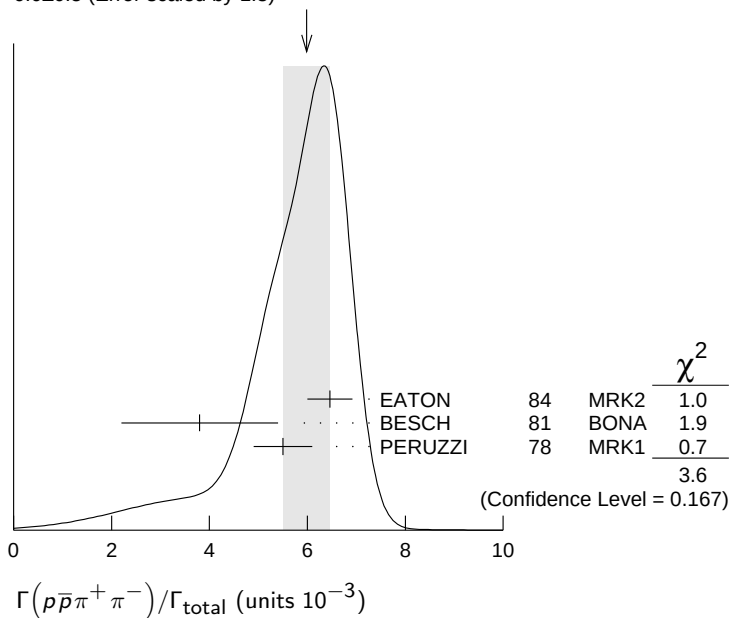
6.46±0.17±0.43 1435 EATON 84 MRK2  $e^+e^-$

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)



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

$\Gamma_{167}/\Gamma$

NODE=M070R55  
 NODE=M070R55  
 NODE=M070R55

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 $e^+e^-$                       |

### $\Gamma(p\bar{p}\eta)/\Gamma_{\text{total}}$

$\Gamma_{168}/\Gamma$

NODE=M070R56  
 NODE=M070R56

| 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 $e^+e^-$ |

<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

### $\Gamma(p\bar{p}\rho)/\Gamma_{\text{total}}$

$\Gamma_{169}/\Gamma$

NODE=M070R57  
 NODE=M070R57

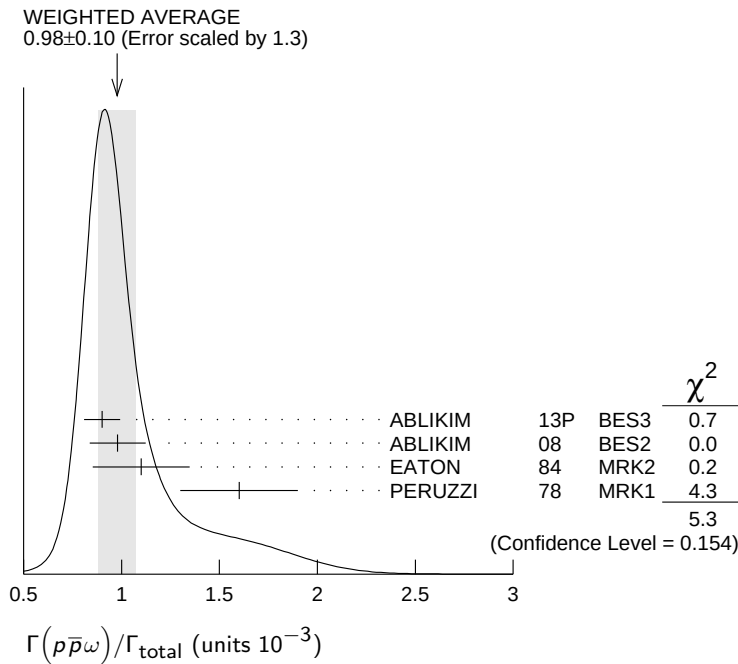
| VALUE                                                  | CL% | DOCUMENT ID | TECN | COMMENT                                                  |
|--------------------------------------------------------|-----|-------------|------|----------------------------------------------------------|
| <b><math>&lt; 3.1 \times 10^{-4}</math> (CL = 90%)</b> |     |             |      | $[< 0.31 \times 10^{-3}$ (CL = 90%) OUR 2018 BEST LIMIT] |
| <b><math>&lt; 0.31 \times 10^{-3}</math></b>           | 90  | EATON       | 84   | MRK2 $e^+e^- \rightarrow \text{hadrons}\gamma$           |

### $\Gamma(p\bar{p}\omega)/\Gamma_{\text{total}}$

$\Gamma_{170}/\Gamma$

NODE=M070R58  
 NODE=M070R58

| 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 $e^+e^-$                                               |



### $\Gamma(p\bar{\rho}\eta(958))/\Gamma_{\text{total}}$

$\Gamma_{171}/\Gamma$

| <u>VALUE (units <math>10^{-3}</math>)</u> | <u>EVTS</u> | <u>DOCUMENT ID</u>                                                     | <u>TECN</u> | <u>COMMENT</u> |
|-------------------------------------------|-------------|------------------------------------------------------------------------|-------------|----------------|
| <b>0.129±0.014 OUR AVERAGE</b>            |             | Error includes scale factor of 2.0. $[(0.21 \pm 0.04) \times 10^{-3}]$ |             |                |
| OUR 2018 AVERAGE]                         |             |                                                                        |             |                |
| 0.126±0.002±0.007                         | 16K         | <sup>1</sup> ABLIKIM                                                   | 19N BES3    | $e^+e^-$       |
| 0.200±0.023±0.028                         | 265 ± 31    | <sup>2</sup> ABLIKIM                                                   | 09 BES2     | $e^+e^-$       |
| 0.68 ±0.23 ±0.17                          | 19          | EATON                                                                  | 84 MRK2     | $e^+e^-$       |
| 1.8 ±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

NEW

### $\Gamma(p\bar{p}a_0(980) \rightarrow p\bar{p}\pi^0\eta)/\Gamma_{\text{total}}$

$\Gamma_{172}/\Gamma$

| VALUE (units $10^{-5}$ ) | DOCUMENT ID | TECN     | COMMENT                     |
|--------------------------|-------------|----------|-----------------------------|
| <b>6.8±1.2±1.3</b>       | ABLIKIM     | 14N BES3 | $e^+e^- \rightarrow J/\psi$ |

NODE=M070S94  
NODE=M070S94

### $\Gamma(p\bar{p}\phi)/\Gamma_{\text{total}}$

$\Gamma_{173}/\Gamma$

| VALUE (units $10^{-4}$ )       | EVTS | DOCUMENT ID | TECN     | COMMENT                                  |
|--------------------------------|------|-------------|----------|------------------------------------------|
| <b>0.519±0.033 OUR AVERAGE</b> |      |             |          |                                          |
| 0.523±0.006±0.033              | 14K  | ABLIKIM     | 16K BES3 | $J/\psi \rightarrow p\bar{p}K_S^0 K_L^0$ |
|                                |      |             |          | $p\bar{p}K^+K^-$                         |
| 0.45 ±0.13 ±0.07               |      | FALVARD     | 88 DM2   | $J/\psi \rightarrow \text{hadrons}$      |

NODE=M070S22  
NODE=M070S22

### $\Gamma(n\bar{n})/\Gamma_{\text{total}}$

$\Gamma_{174}/\Gamma$

| VALUE (units $10^{-3}$ )                                                      | EVTS | DOCUMENT ID | TECN     | COMMENT  |
|-------------------------------------------------------------------------------|------|-------------|----------|----------|
| <b>2.09±0.16 OUR AVERAGE</b>                                                  |      |             |          |          |
| 2.07±0.01±0.17                                                                | 36k  | ABLIKIM     | 12C BES3 | $e^+e^-$ |
| 2.31±0.49                                                                     | 79   | BALDINI     | 98 FENI  | $e^+e^-$ |
| 1.8 ±0.9                                                                      |      | BESCH       | 78 BONA  | $e^+e^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |          |          |
| 1.90±0.55                                                                     | 40   | ANTONELLI   | 93 SPEC  | $e^+e^-$ |

NODE=M070R64  
NODE=M070R64

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

$\Gamma_{175}/\Gamma$

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN    | COMMENT  |
|--------------------------|------|-------------|---------|----------|
| <b>3.8±3.6</b>           | 5    | BESCH       | 81 BONA | $e^+e^-$ |

NODE=M070R65  
NODE=M070R65

### $\Gamma(\Sigma^+\bar{\Sigma}^-)/\Gamma_{\text{total}}$

$\Gamma_{176}/\Gamma$

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                     |
|--------------------------|------|-------------|----------|-----------------------------|
| <b>1.50±0.10±0.22</b>    | 399  | ABLIKIM     | 080 BES2 | $e^+e^- \rightarrow J/\psi$ |

NODE=M070S09  
NODE=M070S09

$\Gamma(\Sigma^0 \bar{\Sigma}^0)/\Gamma_{\text{total}}$  $\Gamma_{177}/\Gamma$ VALUE (units  $10^{-3}$ ) EVTS DOCUMENT ID TECN COMMENT**1.172 $\pm$ 0.032 OUR AVERAGE** Error includes scale factor of 1.4.  $[(1.172 \pm 0.031) \times 10^{-3}]$   
OUR 2018 AVERAGE Scale factor = 1.4]

|                               |      |         |     |      |                                               |
|-------------------------------|------|---------|-----|------|-----------------------------------------------|
| 1.164 $\pm$ 0.004 $\pm$ 0.023 | 111k | ABLIKIM | 17L | BES3 | $J/\psi \rightarrow \Sigma^0 \bar{\Sigma}^0$  |
| 1.33 $\pm$ 0.04 $\pm$ 0.11    | 1.7k | ABLIKIM | 06  | BES2 | $J/\psi \rightarrow \Sigma^0 \bar{\Sigma}^0$  |
| 1.06 $\pm$ 0.04 $\pm$ 0.23    | 884  | PALLIN  | 87  | DM2  | $e^+ e^- \rightarrow \Sigma^0 \bar{\Sigma}^0$ |
| 1.58 $\pm$ 0.16 $\pm$ 0.25    | 90   | EATON   | 84  | MRK2 | $e^+ e^- \rightarrow \Sigma^0 \bar{\Sigma}^0$ |
| 1.3 $\pm$ 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 $\pm$ 2.6 | 3 | BESCH | 81 | BONA | $e^+ e^- \rightarrow \Sigma^+ \bar{\Sigma}^-$ |
|---------------|---|-------|----|------|-----------------------------------------------|

NODE=M070R63  
NODE=M070R63

NEW

 $\Gamma(2(\pi^+ \pi^-) K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{178}/\Gamma$ VALUE (units  $10^{-4}$ ) EVTS DOCUMENT ID TECN COMMENT**31 $\pm$ 13 OUR AVERAGE**  $[(47 \pm 7) \times 10^{-4}]$  OUR 2018 AVERAGE Scale factor = 1.3]**31 $\pm$ 13** 30 VANNUCCI 77 MRK1  $e^+ e^-$ NODE=M070R17  
NODE=M070R17

NEW

 $\Gamma(p \bar{n} \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{179}/\Gamma$ VALUE (units  $10^{-3}$ ) EVTS DOCUMENT ID TECN COMMENT**2.12 $\pm$ 0.09 OUR AVERAGE**

|                            |      |         |     |      |                                      |
|----------------------------|------|---------|-----|------|--------------------------------------|
| 2.36 $\pm$ 0.02 $\pm$ 0.21 | 59k  | ABLIKIM | 06K | BES2 | $J/\psi \rightarrow p \pi^- \bar{n}$ |
| 2.47 $\pm$ 0.02 $\pm$ 0.24 | 55k  | ABLIKIM | 06K | BES2 | $J/\psi \rightarrow \bar{p} \pi^+ n$ |
| 2.02 $\pm$ 0.07 $\pm$ 0.16 | 1288 | EATON   | 84  | MRK2 | $e^+ e^- \rightarrow p \pi^-$        |
| 1.93 $\pm$ 0.07 $\pm$ 0.16 | 1191 | EATON   | 84  | MRK2 | $e^+ e^- \rightarrow \bar{p} \pi^+$  |
| 1.7 $\pm$ 0.7              | 32   | BESCH   | 81  | BONA | $e^+ e^- \rightarrow p \pi^-$        |
| 1.6 $\pm$ 1.2              | 5    | BESCH   | 81  | BONA | $e^+ e^- \rightarrow \bar{p} \pi^+$  |
| 2.16 $\pm$ 0.29            | 194  | PERUZZI | 78  | MRK1 | $e^+ e^- \rightarrow p \pi^-$        |
| 2.04 $\pm$ 0.27            | 204  | PERUZZI | 78  | MRK1 | $e^+ e^- \rightarrow \bar{p} \pi^+$  |

NODE=M070R53  
NODE=M070R53

OCCUR=2

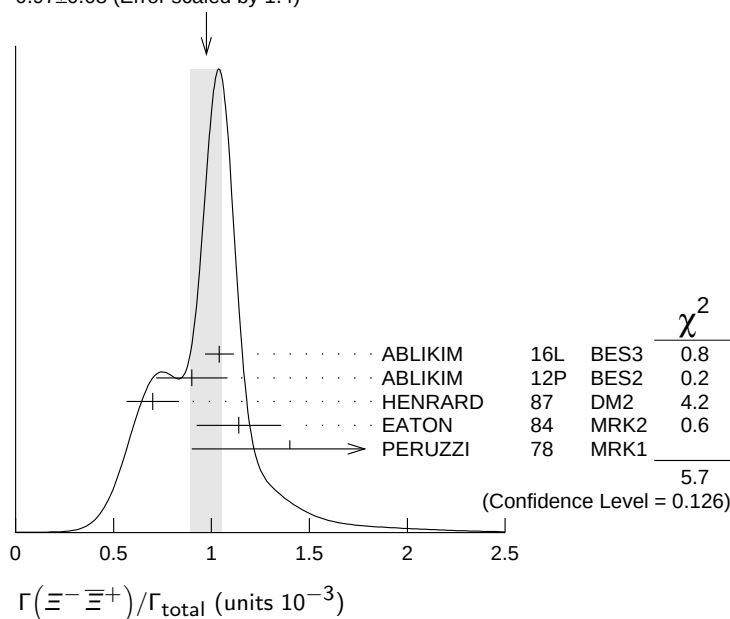
OCCUR=2

OCCUR=2

OCCUR=2

 $\Gamma(\Xi^- \bar{\Xi}^+)/\Gamma_{\text{total}}$  $\Gamma_{183}/\Gamma$ VALUE (units  $10^{-3}$ ) EVTS DOCUMENT ID TECN COMMENT**0.97  $\pm$ 0.08 OUR AVERAGE** Error includes scale factor of 1.4. See the ideogram below.

|                               |     |         |     |      |                                         |
|-------------------------------|-----|---------|-----|------|-----------------------------------------|
| 1.040 $\pm$ 0.006 $\pm$ 0.074 | 43k | ABLIKIM | 16L | BES3 | $J/\psi \rightarrow \Xi^- \bar{\Xi}^+$  |
| 0.90 $\pm$ 0.03 $\pm$ 0.18    | 961 | ABLIKIM | 12P | BES2 | $J/\psi \rightarrow \Xi^- \bar{\Xi}^+$  |
| 0.70 $\pm$ 0.06 $\pm$ 0.12    | 132 | HENRARD | 87  | DM2  | $e^+ e^- \rightarrow \Xi^- \bar{\Xi}^+$ |
| 1.14 $\pm$ 0.08 $\pm$ 0.20    | 194 | EATON   | 84  | MRK2 | $e^+ e^- \rightarrow \Xi^- \bar{\Xi}^+$ |
| 1.4 $\pm$ 0.5                 | 51  | PERUZZI | 78  | MRK1 | $e^+ e^- \rightarrow \Xi^- \bar{\Xi}^+$ |

NODE=M070R62  
NODE=M070R62WEIGHTED AVERAGE  
0.97 $\pm$ 0.08 (Error scaled by 1.4)

$\Gamma(\Lambda\bar{\Lambda})/\Gamma_{\text{total}}$  $\Gamma_{184}/\Gamma$ 

| 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. |          |                                           |
| [(1.89 $\pm$ 0.08) $\times 10^{-3}$ OUR 2018 AVERAGE Scale factor = 2.5] |      |                                                             |          |                                           |
| 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  | $J/\psi \rightarrow \Lambda\bar{\Lambda}$ |
| 2.1 $\pm$ 0.5 $\pm$ 0.1                                                  | 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  | $e^+e^-$                                  |

NODE=M070R60

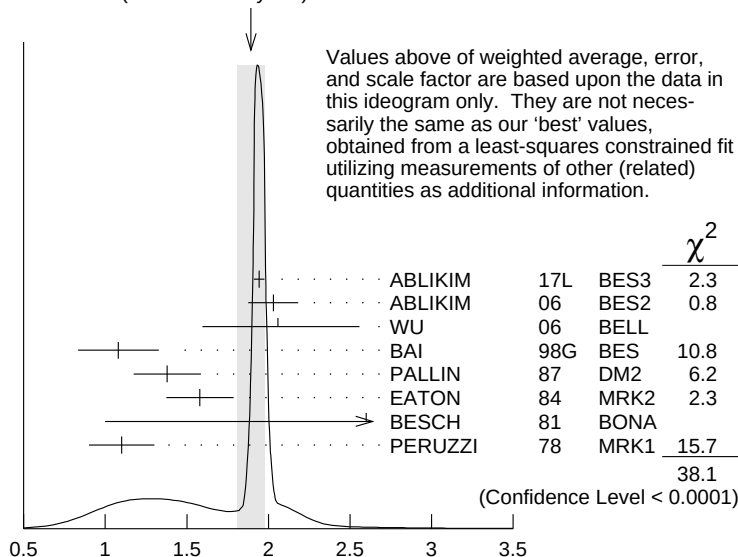
NODE=M070R60

NEW

<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  $B(B^+ \rightarrow J/\psi(1S)K^+) = (9.71 \pm 0.31) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070R60;LINKAGE=WU

WEIGHTED AVERAGE  
1.89 $\pm$ 0.09 (Error scaled by 2.8)

 $\Gamma(\Lambda\bar{\Sigma}^-\pi^+(\text{or c.c.}))/\Gamma_{\text{total}}$  $\Gamma_{185}/\Gamma$ 

| 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  | $e^+e^- \rightarrow \Lambda\bar{\Sigma}^-\pi^+$ |

NODE=M070R71

NODE=M070R71

OCCUR=2

OCCUR=2

OCCUR=2

<sup>1</sup> Using  $B(\Lambda \rightarrow \pi^- p) = 63.9\%$  and  $B(\Sigma^+ \rightarrow \pi^0 p) = 51.6\%$ .

NODE=M070R71;LINKAGE=AB

 $\Gamma(pK^-\bar{\Lambda}+\text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{186}/\Gamma$ 

| <u>VALUE (units <math>10^{-3}</math>)</u>             | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u>                            |
|-------------------------------------------------------|-------------|--------------------|-------------|-------------------------------------------|
| <b>0.88<math>\pm</math>0.12 OUR AVERAGE</b>           |             |                    |             |                                           |
| [(0.89 $\pm$ 0.16) $\times 10^{-3}$ OUR 2018 AVERAGE] |             |                    |             |                                           |
| 0.88 $^{+0.18}_{-0.16}$ $\pm$ 0.03                    | 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     | $e^+ e^-$                                 |

NODE=M070R72

NODE=M070R72

NEW

<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  $B(B^+ \rightarrow J/\psi(1S)K^+) = (9.71 \pm 0.31) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070R72;LINKAGE=A

$\Gamma(2(K^+ K^-))/\Gamma_{\text{total}}$  $\Gamma_{187}/\Gamma$ 

| 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

 $\Gamma(p K^- \bar{\Sigma}^0)/\Gamma_{\text{total}}$  $\Gamma_{188}/\Gamma$ 

| 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

 $\Gamma(K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{189}/\Gamma$ 

| 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

 $\Gamma(K_S^0 K_L^0)/\Gamma_{\text{total}}$  $\Gamma_{190}/\Gamma$ 

| 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 | $e^+ e^-$ |
|--------------------------|----|-----------------|------|-----------|

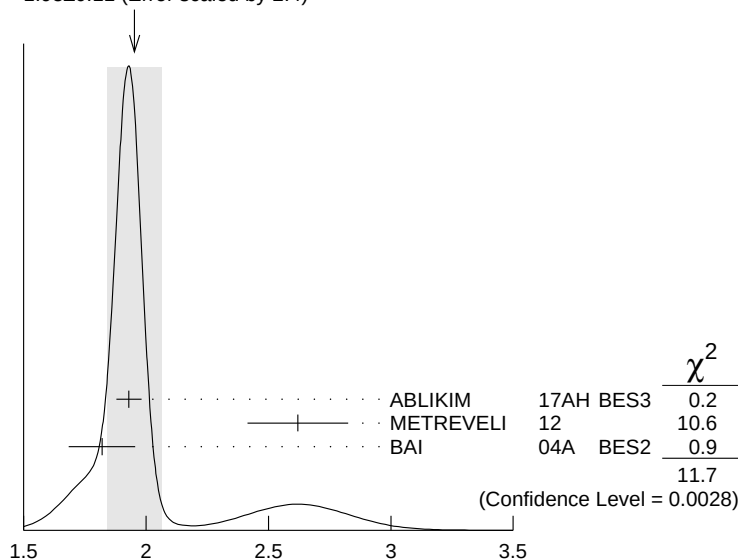
<sup>1</sup> Obtained by analyzing CLEO-c data but not authored by the CLEO Collaboration.

<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=M070R75;LINKAGE=HZ

WEIGHTED AVERAGE  
 $1.95 \pm 0.11$  (Error scaled by 2.4)



$\Gamma(K_S^0 K_L^0)/\Gamma_{\text{total}}$

 $\Gamma_{190}/\Gamma$  $\Gamma(\Lambda \bar{\Lambda} \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{191}/\Gamma$ 

| 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

$\Gamma(\Lambda\bar{\Lambda}\eta)/\Gamma_{\text{total}}$  $\Gamma_{192}/\Gamma$ 

| VALUE (units $10^{-5}$ )    | CL% | EVTS | DOCUMENT ID | TECN     | COMMENT                                             |
|-----------------------------|-----|------|-------------|----------|-----------------------------------------------------|
| <b>16.2±1.7 OUR AVERAGE</b> |     |      |             |          |                                                     |
| 15.7±0.80±1.54              | 454 | 1    | ABLIKIM     | 13F BES3 | $J/\psi \rightarrow p\bar{p}\pi^+\pi^-\gamma\gamma$ |
| 26.2±6.0 ±4.4               | 44  | 2    | 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=M070R07NODE=M070R07;LINKAGE=AL  
NODE=M070R07;LINKAGE=AB $\Gamma(\Lambda\bar{\Lambda}\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{193}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | EVTS | DOCUMENT ID | TECN     | COMMENT                                             |
|-------------------------------------------------------------------------------|-----|------|-------------|----------|-----------------------------------------------------|
| <b>3.78±0.27±0.30</b>                                                         |     | 323  | 1 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  | 2    | 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=M070S11NODE=M070S11;LINKAGE=AL  
NODE=M070S11;LINKAGE=AB $\Gamma(\bar{\Lambda}nK_S^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{194}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | EVTS | DOCUMENT ID | TECN     | COMMENT                     |
|--------------------------|-----|------|-------------|----------|-----------------------------|
| <b>6.46±0.20±1.07</b>    |     | 1058 | 1 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

 $\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{195}/\Gamma$ 

| VALUE (units $10^{-4}$ )     | CL% | EVTS | DOCUMENT ID     | TECN     | COMMENT                              |
|------------------------------|-----|------|-----------------|----------|--------------------------------------|
| <b>1.47±0.14 OUR AVERAGE</b> |     |      |                 |          |                                      |
| 1.47±0.13±0.13               | 140 | 1    | 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

 $\Gamma(\Lambda\bar{\Sigma} + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{196}/\Gamma$ 

| 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 | 1    | ABLIKIM     | 12B BES3 | $J/\psi \rightarrow \Lambda\bar{\Sigma}^0$ |
| 2.92±0.22±0.24               | 308 ± 24 | 2    | ABLIKIM     | 12B BES3 | $J/\psi \rightarrow \bar{\Lambda}\Sigma^0$ |

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

<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 quotes  $B(J/\psi \rightarrow \bar{\Lambda}\Sigma^0)$  which we multiply by 2.NODE=M070R61  
NODE=M070R61

OCCUR=2

NODE=M070R61;LINKAGE=AB  
NODE=M070R61;LINKAGE=AC $\Gamma(K_S^0 K_S^0)/\Gamma_{\text{total}}$  $\Gamma_{197}/\Gamma$ 

| VALUE                            | CL% | DOCUMENT ID | TECN      | COMMENT                                                           |
|----------------------------------|-----|-------------|-----------|-------------------------------------------------------------------|
| <b>&lt;1.4 × 10<sup>-8</sup></b> | 95  | 1 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 1 BAI 04D BES  $e^+e^-$ <5.2 × 10<sup>-6</sup> 90 1 BALTRUSAIT..85C MRK3  $e^+e^-$ <sup>1</sup> Forbidden by CP.NODE=M070R14  
NODE=M070R14

NODE=M070R14;LINKAGE=C

## ———— RADIATIVE DECAYS ————

NODE=M070310

 $\Gamma(3\gamma)/\Gamma_{\text{total}}$  $\Gamma_{198}/\Gamma$ 

| 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=M070R81  
NODE=M070R81



$\Gamma(4\gamma)/\Gamma_{\text{total}}$ 

| VALUE                          | CL% | DOCUMENT ID                                           | TECN | COMMENT                                        |
|--------------------------------|-----|-------------------------------------------------------|------|------------------------------------------------|
| $<9 \times 10^{-6}$ (CL = 90%) |     | [ $<9 \times 10^{-6}$ (CL = 90%) OUR 2018 BEST LIMIT] |      |                                                |
| $<9 \times 10^{-6}$            | 90  | ADAMS                                                 | 08   | CLEO $\psi(2S) \rightarrow \pi^+ \pi^- J/\psi$ |

 $\Gamma_{199}/\Gamma$ 

NODE=M070S06  
NODE=M070S06

 $\Gamma(5\gamma)/\Gamma_{\text{total}}$ 

| VALUE                            | CL% | DOCUMENT ID                                            | TECN | COMMENT                                        |
|----------------------------------|-----|--------------------------------------------------------|------|------------------------------------------------|
| $<1.5 \times 10^{-5}$ (CL = 90%) |     | [ $<15 \times 10^{-6}$ (CL = 90%) OUR 2018 BEST LIMIT] |      |                                                |
| $<15 \times 10^{-6}$             | 90  | ADAMS                                                  | 08   | CLEO $\psi(2S) \rightarrow \pi^+ \pi^- J/\psi$ |

 $\Gamma_{200}/\Gamma$ 

NODE=M070S07  
NODE=M070S07

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

| VALUE (units $10^{-3}$ ) | DOCUMENT ID          | TECN      | COMMENT                               |
|--------------------------|----------------------|-----------|---------------------------------------|
| $1.15 \pm 0.05$          | <sup>1</sup> ABLIKIM | 15AE BES3 | $J/\psi \rightarrow \gamma\pi^0\pi^0$ |

 $\Gamma_{201}/\Gamma$ 

NODE=M070B00  
NODE=M070B00

<sup>1</sup> The uncertainty is systematic as statistical is netligible.

NODE=M070B00;LINKAGE=A

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

| VALUE (units $10^{-6}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                           |
|--------------------------|------|-------------|------|-----------------------------------|
| $21.4 \pm 1.8 \pm 2.5$   | 596  | ABLIKIM     | 16P  | BES3 $J/\psi \rightarrow 5\gamma$ |

 $\Gamma_{202}/\Gamma$ 

NODE=M070P01  
NODE=M070P01

 $\Gamma(\gamma a_0(980)^0 \rightarrow \gamma\eta\pi^0)/\Gamma_{\text{total}}$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                           |
|-----------------------|-----|-------------|------|-----------------------------------|
| $<2.5 \times 10^{-6}$ | 95  | ABLIKIM     | 16P  | BES3 $J/\psi \rightarrow 5\gamma$ |

 $\Gamma_{203}/\Gamma$ 

NODE=M070P02  
NODE=M070P02

 $\Gamma(\gamma a_2(1320)^0 \rightarrow \gamma\eta\pi^0)/\Gamma_{\text{total}}$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                           |
|-----------------------|-----|-------------|------|-----------------------------------|
| $<6.6 \times 10^{-6}$ | 95  | ABLIKIM     | 16P  | BES3 $J/\psi \rightarrow 5\gamma$ |

 $\Gamma_{204}/\Gamma$ 

NODE=M070P03  
NODE=M070P03

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

| VALUE (units $10^{-4}$ ) | DOCUMENT ID | TECN      | COMMENT                                 |
|--------------------------|-------------|-----------|-----------------------------------------|
| $8.1 \pm 0.4$            | ABLIKIM     | 18AA BES3 | $J/\psi \rightarrow \gamma K_S^0 K_S^0$ |

 $\Gamma_{205}/\Gamma$ 

NODE=M070P73  
NODE=M070P73

 $\Gamma(\gamma\eta_c(1S))/\Gamma_{\text{total}}$ 

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

$1.7 \pm 0.4$  OUR AVERAGE Error includes scale factor of 1.5.

$2.00 \pm 0.31 \pm 0.02$

$1.27 \pm 0.36$

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

seen

$0.79 \pm 0.20$

seen

<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.

 $\Gamma_{206}/\Gamma$ 

NODE=M070R85  
NODE=M070R85

 $\Gamma(\gamma\eta_c(1S) \rightarrow 3\gamma)/\Gamma_{\text{total}}$ 

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

$3.8^{+1.3}_{-1.0}$  OUR AVERAGE Error includes scale factor of 1.1.

$4.5 \pm 1.2 \pm 0.6$  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  $\psi(2S) \rightarrow \pi^+ \pi^- J/\psi$

 $\Gamma_{207}/\Gamma$ 

NODE=M070S08  
NODE=M070S08

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

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

$8.3 \pm 0.2 \pm 3.1$  <sup>1</sup> BALTRUSAIT..86B MRK3  $J/\psi \rightarrow 4\pi\gamma$

 $\Gamma_{208}/\Gamma$ 

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 |      | $J/\psi \rightarrow \eta 2\pi^0$    |

 $\Gamma_{209}/\Gamma$ 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  |      | $J/\psi \rightarrow \gamma\eta\pi^+\pi^-$ |

 $\Gamma_{210}/\Gamma$ 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  $^{+0.21+0.26}_{-0.18-0.19}$ 

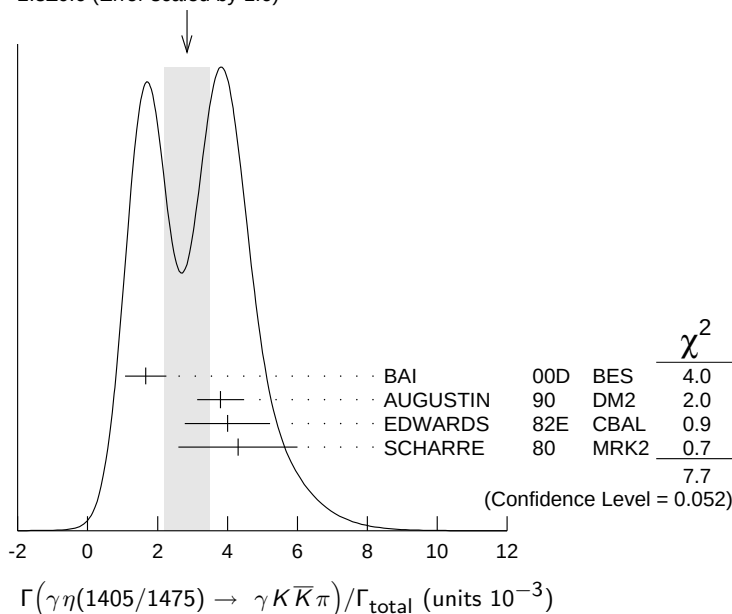
| DOCUMENT ID                      | TECN | COMMENT                                         |
|----------------------------------|------|-------------------------------------------------|
| <sup>1,2</sup> BAI 00D BES       |      | $J/\psi \rightarrow \gamma K^\pm K_S^0 \pi^\mp$ |
| <sup>3</sup> AUGUSTIN 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   |      | $J/\psi \rightarrow \gamma K_S^0 K^\pm \pi^\mp$ |

 $\Gamma_{211}/\Gamma$ NODE=M070R89  
NODE=M070R89

OCCUR=2

OCCUR=2

NODE=M070R89;LINKAGE=BD

<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.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=EWEIGHTED 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 |      | $J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$ |

 $\Gamma_{212}/\Gamma$ NODE=M070S30  
NODE=M070S30

NODE=M070S30;LINKAGE=C

$\Gamma(\gamma\eta(1405/1475) \rightarrow \gamma\eta\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{213}/\Gamma$ 

| 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

 $\Gamma(\gamma\eta(1405/1475) \rightarrow \gamma\gamma\phi)/\Gamma_{\text{total}}$   $\Gamma_{214}/\Gamma$ 

| VALUE (units $10^{-6}$ )                                                                       | CL% | EVTS | DOCUMENT ID | TECN | COMMENT                                       |
|------------------------------------------------------------------------------------------------|-----|------|-------------|------|-----------------------------------------------|
| <b>&lt;82 (CL = 95%) [<math>&lt;0.82 \times 10^{-4}</math> (CL = 95%) OUR 2018 BEST LIMIT]</b> |     |      |             |      |                                               |
| <82                                                                                            | 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  $\gamma\phi$  mass.

<sup>2</sup> Destructive interference between the  $X(1835)$  and  $\eta(1405)/\eta(1475)$  is assumed in a fit to the  $\gamma\phi$  mass.

NODE=M070R77  
NODE=M070R77

OCCUR=2

NODE=M070R77;LINKAGE=B

NODE=M070R77;LINKAGE=A

 $\Gamma(\gamma\eta(1405) \rightarrow \gamma\gamma\gamma)/\Gamma_{\text{total}}$   $\Gamma_{215}/\Gamma$ 

| VALUE                                       | DOCUMENT ID | TECN | COMMENT                                                  |
|---------------------------------------------|-------------|------|----------------------------------------------------------|
| <b>&lt;2.63 <math>\times 10^{-6}</math></b> | ABLIKIM     | 18O  | BES3 $\psi(2S) \rightarrow \pi^+\pi^-\gamma\gamma\gamma$ |

NODE=M070P38  
NODE=M070P38

 $\Gamma(\gamma\eta(1475) \rightarrow \gamma\gamma\gamma)/\Gamma_{\text{total}}$   $\Gamma_{216}/\Gamma$ 

| VALUE                                       | DOCUMENT ID | TECN | COMMENT                                                  |
|---------------------------------------------|-------------|------|----------------------------------------------------------|
| <b>&lt;1.86 <math>\times 10^{-6}</math></b> | ABLIKIM     | 18O  | BES3 $\psi(2S) \rightarrow \pi^+\pi^-\gamma\gamma\gamma$ |

NODE=M070P39  
NODE=M070P39

 $\Gamma(\gamma\rho\rho)/\Gamma_{\text{total}}$   $\Gamma_{217}/\Gamma$ 

| 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

 $\Gamma(\gamma\rho\omega)/\Gamma_{\text{total}}$   $\Gamma_{218}/\Gamma$ 

| VALUE                                                                                                                      | CL% | DOCUMENT ID | TECN | COMMENT                          |
|----------------------------------------------------------------------------------------------------------------------------|-----|-------------|------|----------------------------------|
| <b>&lt;5.4 <math>\times 10^{-4}</math> (CL = 90%) [<math>&lt;5.4 \times 10^{-4}</math> (CL = 90%) OUR 2018 BEST LIMIT]</b> |     |             |      |                                  |
| <5.4 $\times 10^{-4}$                                                                                                      | 90  | ABLIKIM     | 08A  | BES2 $e^+e^- \rightarrow J/\psi$ |

NODE=M070R05  
NODE=M070R05

 $\Gamma(\gamma\rho\phi)/\Gamma_{\text{total}}$   $\Gamma_{219}/\Gamma$ 

| VALUE                                                                                                                      | CL% | DOCUMENT ID | TECN | COMMENT                          |
|----------------------------------------------------------------------------------------------------------------------------|-----|-------------|------|----------------------------------|
| <b>&lt;8.8 <math>\times 10^{-5}</math> (CL = 90%) [<math>&lt;8.8 \times 10^{-5}</math> (CL = 90%) OUR 2018 BEST LIMIT]</b> |     |             |      |                                  |
| <8.8 $\times 10^{-5}$                                                                                                      | 90  | ABLIKIM     | 08A  | BES2 $e^+e^- \rightarrow J/\psi$ |

NODE=M070R06  
NODE=M070R06

 $\Gamma(\gamma\eta'(958))/\Gamma_{\text{total}}$   $\Gamma_{220}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                 | EVTS | DOCUMENT ID          | TECN | COMMENT                                                  |
|--------------------------------------------------------------------------|------|----------------------|------|----------------------------------------------------------|
| <b>5.21 <math>\pm</math> 0.17 OUR AVERAGE</b>                            |      |                      |      |                                                          |
| Error includes scale factor of 1.4. See the ideogram below.              |      |                      |      |                                                          |
| [(5.13 $\pm$ 0.17) $\times 10^{-3}$ OUR 2018 AVERAGE Scale factor = 1.3] |      |                      |      |                                                          |
| 5.64 $\pm$ 0.24 $\pm$ 0.20                                               | 5057 | <sup>1</sup> ABLIKIM | 18O  | BES3 $\psi(2S) \rightarrow \pi^+\pi^-\gamma\gamma\gamma$ |
| 4.78 $\pm$ 0.22 $\pm$ 0.08                                               |      | <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 $J/\psi \rightarrow \eta'\gamma$                    |

NODE=M070R84  
NODE=M070R84

NEW

• • • 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 | $e^+ e^- \rightarrow 2\gamma \rho$                                               |

OCCUR=2

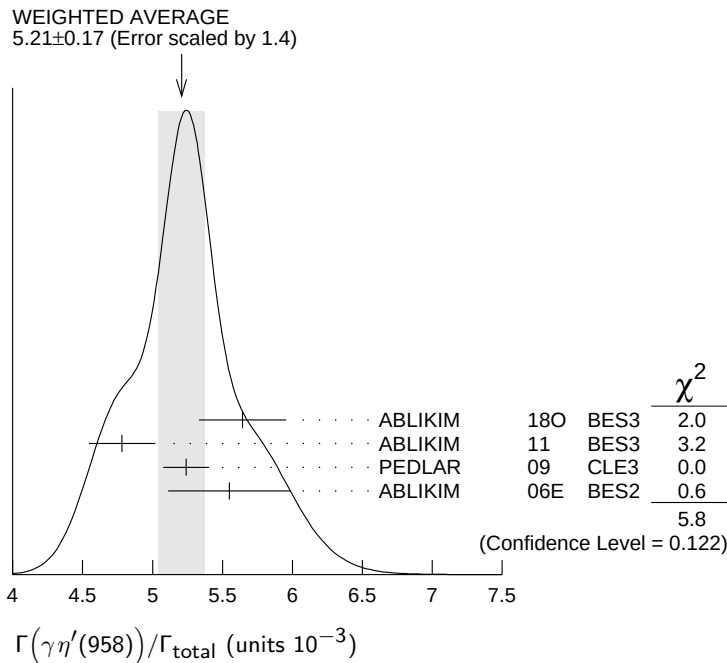
OCCUR=2

<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  $B(\eta'(958) \rightarrow \gamma \gamma) = (2.22 \pm 0.08) \times 10^{-2}$ ,  $B(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-) = (34.68 \pm 0.30) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best values.

NODE=M070R84;LINKAGE=A

<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  $B(\eta'(958) \rightarrow \pi^+ \pi^- \eta) = (42.6 \pm 0.7) \times 10^{-2}$ ,  $B(\eta \rightarrow 2\gamma) = (39.41 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best values.

NODE=M070R84;LINKAGE=AB



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

$\Gamma_{221}/\Gamma$

| 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. |      |                                       |
| $4.32 \pm 0.14 \pm 0.73$     | <sup>1</sup> BISELLO                                        | 89B  | DM2 $J/\psi \rightarrow 4\pi \gamma$  |
| $2.08 \pm 0.13 \pm 0.35$     | <sup>2</sup> BISELLO                                        | 89B  | DM2 $J/\psi \rightarrow 4\pi \gamma$  |
| $3.05 \pm 0.08 \pm 0.45$     | <sup>2</sup> BALTRUSAIT..                                   | 86B  | MRK3 $J/\psi \rightarrow 4\pi \gamma$ |
| $4.85 \pm 0.45 \pm 1.20$     | <sup>3</sup> BURKE                                          | 82   | MRK2 $e^+ e^-$                        |

<sup>1</sup>  $4\pi$  mass less than 3.0 GeV.

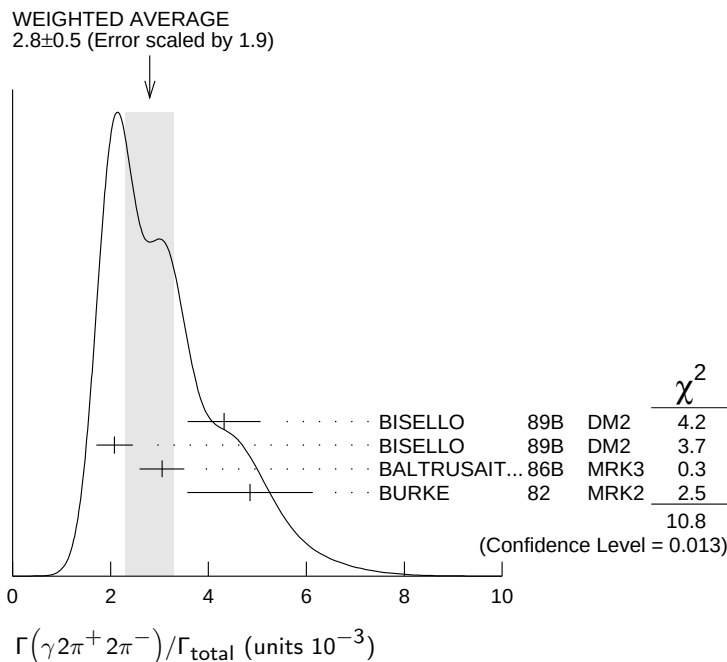
<sup>2</sup>  $4\pi$  mass less than 2.0 GeV.

<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



### $\Gamma(\gamma f_2(1270) f_2(1270))/\Gamma_{\text{total}}$

$\Gamma_{222}/\Gamma$

| 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

### $\Gamma(\gamma f_2(1270) f_2(1270) (\text{non resonant}))/\Gamma_{\text{total}}$

$\Gamma_{223}/\Gamma$

| 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

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

$\Gamma_{224}/\Gamma$

| 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

### $\Gamma(\gamma f_4(2050))/\Gamma_{\text{total}}$

$\Gamma_{225}/\Gamma$

| 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

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

$\Gamma_{226}/\Gamma$

| 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

### $\Gamma(\gamma \eta(1405/1475) \rightarrow \gamma \rho^0 \rho^0)/\Gamma_{\text{total}}$

$\Gamma_{227}/\Gamma$

| 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

### $\Gamma(\gamma f_2(1270))/\Gamma_{\text{total}}$

$\Gamma_{228}/\Gamma$

| 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.

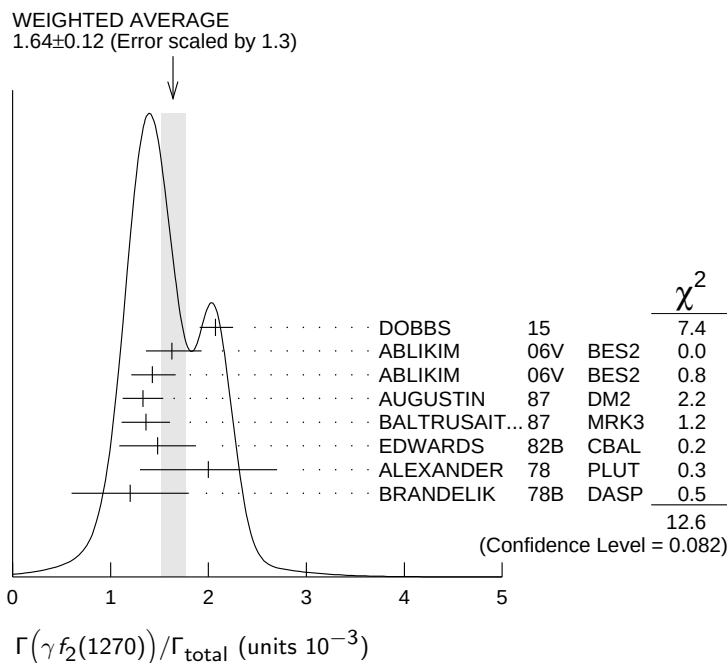
NODE=M070R86;LINKAGE=AL

<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



| $\Gamma(\gamma f_2(1270) \rightarrow \gamma K_S^0 K_S^0)/\Gamma_{\text{total}}$ |             |           |                                         | $\Gamma_{229}/\Gamma$ |
|---------------------------------------------------------------------------------|-------------|-----------|-----------------------------------------|-----------------------|
| 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

| $\Gamma(\gamma f_0(1370) \rightarrow \gamma K \bar{K})/\Gamma_{\text{total}}$ |      |                       |                                       | $\Gamma_{230}/\Gamma$ |
|-------------------------------------------------------------------------------|------|-----------------------|---------------------------------------|-----------------------|
| 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

| $\Gamma(\gamma f_0(1370) \rightarrow \gamma K_S^0 K_S^0)/\Gamma_{\text{total}}$ |             |           |                                         | $\Gamma_{231}/\Gamma$ |
|---------------------------------------------------------------------------------|-------------|-----------|-----------------------------------------|-----------------------|
| 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

$\Gamma(\gamma f_0(1500) \rightarrow \gamma K_S^0 K_S^0) / \Gamma_{\text{total}}$  $\Gamma_{232} / \Gamma$ 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 $\Gamma(\gamma f_0(1710) \rightarrow \gamma K \bar{K}) / \Gamma_{\text{total}}$  $\Gamma_{233} / \Gamma$ VALUE (units  $10^{-4}$ )

CL%

EVTS

DOCUMENT ID

TECN

COMMENT

 $9.5 \pm 1.0^{+1.1}_{-0.9}$ **OUR AVERAGE**

Error includes scale factor of 1.5. See the ideogram

NODE=M070R91  
NODE=M070R91

NEW

below.  $[(10.0^{+1.1}_{-0.9}) \times 10^{-4}]$  OUR 2018 AVERAGE Scale factor = 1.5]

|                                                                               |                                |                                |     |                |           |                                         |
|-------------------------------------------------------------------------------|--------------------------------|--------------------------------|-----|----------------|-----------|-----------------------------------------|
| 8.00 <sup>+</sup> <sub>-</sub>                                                | 0.12 <sup>+</sup> <sub>-</sub> | 1.24 <sup>+</sup> <sub>-</sub> | 1   | ABLIKIM        | 18AA BES3 | $J/\psi \rightarrow \gamma K_S^0 K_S^0$ |
| 11.76 $\pm$                                                                   | 0.54 $\pm$                     | 0.94                           | 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 $\pm$                      | $^{+1.8}_{-0.4}$               | 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      | $J/\psi \rightarrow \gamma K^+ K^-$     |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                                |                                |     |                |           |                                         |
| 1.6 $\pm$                                                                     | 0.2 $\pm$                      | $^{+0.6}_{-0.2}$               | 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

OCCUR=2

NODE=M070R91;LINKAGE=B

<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  $f_0(1710)$ .

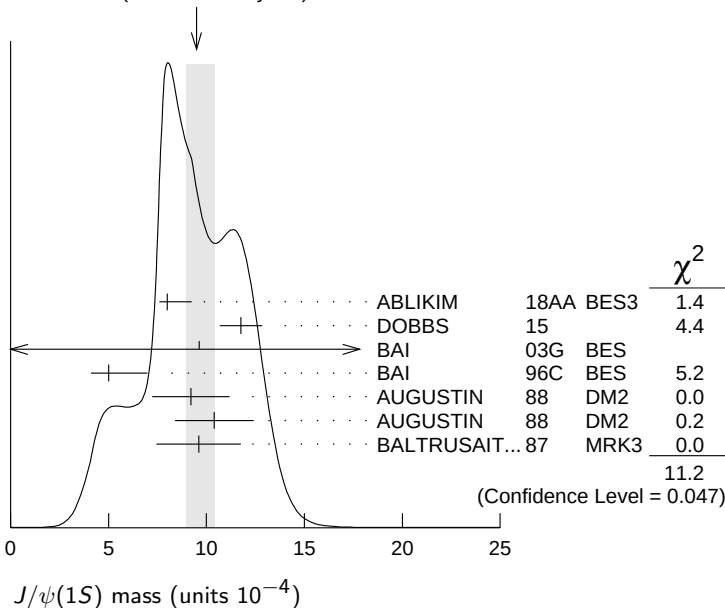
<sup>6</sup> Includes unknown branching fraction to  $\rho^0 \rho^0$ .

<sup>7</sup> Includes unknown branching fraction to  $\pi^+ \pi^-$ .

<sup>8</sup> Includes unknown branching fraction to  $\eta \eta$ .

NODE=M070R91;LINKAGE=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)

 $\Gamma(\gamma f_0(1710) \rightarrow \gamma \pi \pi) / \Gamma_{\text{total}}$  $\Gamma_{234} / \Gamma$ 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 | $e^+ e^- \rightarrow J/\psi \rightarrow \gamma \pi^0 \pi^0$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |            |      |     |   |         |          |                                                             |
| 2.5 $\pm$                                                                     | 1.6 $\pm$  | 0.8  |     |   | BAI     | 98H BES  | $J/\psi \rightarrow \gamma \pi^0 \pi^0$                     |

NODE=M070B01  
NODE=M070B01

OCCUR=2

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

<sup>2</sup> Including unknown branching fraction to  $\pi\pi$ .

| $\Gamma(\gamma f_0(1710) \rightarrow \gamma \omega \omega) / \Gamma_{\text{total}}$ |      |             |      |         | $\Gamma_{235} / \Gamma$                   |
|-------------------------------------------------------------------------------------|------|-------------|------|---------|-------------------------------------------|
| 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

| $\Gamma(\gamma f_0(1710) \rightarrow \gamma \eta \eta) / \Gamma_{\text{total}}$ |      |                      |      |         | $\Gamma_{236} / \Gamma$               |
|---------------------------------------------------------------------------------|------|----------------------|------|---------|---------------------------------------|
| 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

| $\Gamma(\gamma \eta) / \Gamma_{\text{total}}$                                 |       |                      |      |         | $\Gamma_{237} / \Gamma$                                 |
|-------------------------------------------------------------------------------|-------|----------------------|------|---------|---------------------------------------------------------|
| VALUE (units $10^{-3}$ )                                                      | EVTs  | DOCUMENT ID          | TECN | COMMENT |                                                         |
| <b><math>1.108 \pm 0.027</math> OUR AVERAGE</b>                               |       |                      |      |         |                                                         |
| [( $1.104 \pm 0.034$ ) $\times 10^{-3}$ OUR 2018 AVERAGE]                     |       |                      |      |         |                                                         |
| $1.12 \pm 0.05 \pm 0.01$                                                      | 18.6k | <sup>1</sup> ABLIKIM | 180  | 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  
NEW

<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

| $\Gamma(\gamma f_1(1420) \rightarrow \gamma K \bar{K} \pi) / \Gamma_{\text{total}}$ |                |             |      |         | $\Gamma_{238} / \Gamma$                         |
|-------------------------------------------------------------------------------------|----------------|-------------|------|---------|-------------------------------------------------|
| 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

| $\Gamma(\gamma f_1(1285)) / \Gamma_{\text{total}}$ |              |             |      |         | $\Gamma_{239} / \Gamma$                         |
|----------------------------------------------------|--------------|-------------|------|---------|-------------------------------------------------|
| 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

| $\Gamma(\gamma f_1(1510) \rightarrow \gamma \eta \pi^+ \pi^-) / \Gamma_{\text{total}}$ |  |             |      |         | $\Gamma_{240} / \Gamma$                      |
|----------------------------------------------------------------------------------------|--|-------------|------|---------|----------------------------------------------|
| 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



$\Gamma(\gamma f'_2(1525))/\Gamma_{\text{total}}$ 
 $\Gamma_{241}/\Gamma$ 

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.

below.

|                                                                               |     |     |                |           |     |                                               |
|-------------------------------------------------------------------------------|-----|-----|----------------|-----------|-----|-----------------------------------------------|
| 8.0 ± 0.9 ± 0.2                                                               | 750 | 1,2 | DOBBS          | 15        |     | $J/\psi \rightarrow \gamma K \bar{K}$         |
| 3.85 ± 0.17 <sup>+1.91</sup> <sub>-0.73</sub>                                 |     | 3   | BAI            | 03G       | BES | $J/\psi \rightarrow \gamma K \bar{K}$         |
| 3.6 ± 0.4 <sup>+1.4</sup> <sub>-0.4</sub>                                     |     | 3   | BAI            | 96C       | BES | $J/\psi \rightarrow \gamma K^+ K^-$           |
| 5.6 ± 1.4 ± 0.9                                                               |     | 3   | AUGUSTIN       | 88        | DM2 | $J/\psi \rightarrow \gamma K^+ K^-$           |
| 4.5 ± 0.4 ± 0.9                                                               |     | 3   | AUGUSTIN       | 88        | DM2 | $J/\psi \rightarrow \gamma K_S^0 K_S^0$       |
| 6.8 ± 1.6 ± 1.4                                                               |     | 3   | BALTRUSAIT..87 | MRK3      |     | $J/\psi \rightarrow \gamma K^+ K^-$           |
| • • • 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  $B(f'_2(1525) \rightarrow K \bar{K}) = (88.7 \pm 2.2) \times 10^{-2}$ . 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.

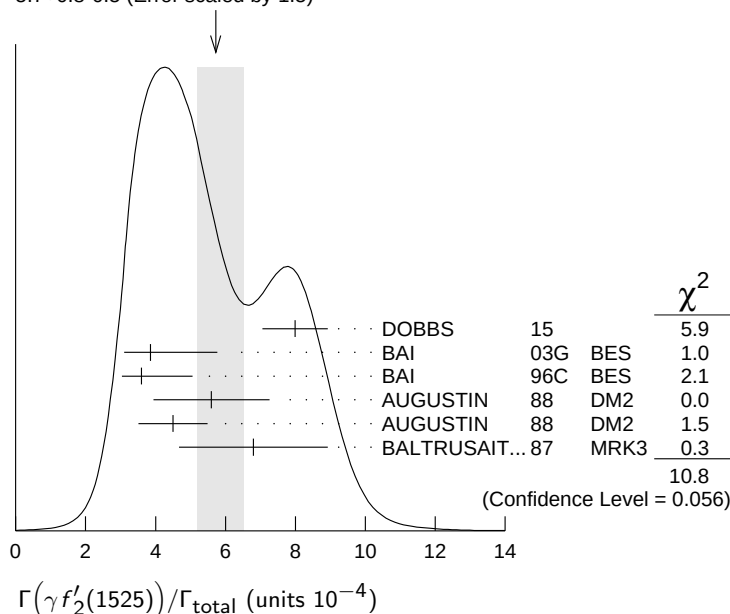
NODE=M070R87  
NODE=M070R87

OCCUR=3  
OCCUR=4  
OCCUR=2

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)


 $\Gamma(\gamma f'_2(1525) \rightarrow \gamma K_S^0 K_S^0)/\Gamma_{\text{total}}$ 
 $\Gamma_{242}/\Gamma$ 

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

 $\Gamma(\gamma f'_2(1525) \rightarrow \gamma \eta \eta)/\Gamma_{\text{total}}$ 
 $\Gamma_{243}/\Gamma$ 

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

 $\Gamma(\gamma f_2(1640) \rightarrow \gamma \omega \omega)/\Gamma_{\text{total}}$ 
 $\Gamma_{244}/\Gamma$ 

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

**0.28 ± 0.05 ± 0.17** 141 ABLIKIM 06H BES  $J/\psi \rightarrow \gamma \omega \omega$

NODE=M070R02  
NODE=M070R02

 $\Gamma(\gamma f_2(1910) \rightarrow \gamma \omega \omega)/\Gamma_{\text{total}}$ 
 $\Gamma_{245}/\Gamma$ 

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

**0.20 ± 0.04 ± 0.13** 151 ABLIKIM 06H BES  $J/\psi \rightarrow \gamma \omega \omega$

NODE=M070R03  
NODE=M070R03

$\Gamma(\gamma f_0(1750) \rightarrow \gamma K_S^0 K_S^0)/\Gamma_{\text{total}}$  $\Gamma_{246}/\Gamma$ VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

 $1.11 \pm 0.06^{+0.19}_{-0.32}$ 

ABLIKIM

18AA BES3

 $J/\psi \rightarrow \gamma K_S^0 K_S^0$ NODE=M070P65  
NODE=M070P65 $\Gamma(\gamma f_0(1800) \rightarrow \gamma \omega \phi)/\Gamma_{\text{total}}$  $\Gamma_{247}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $2.5 \pm 0.6$  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

 $J/\psi \rightarrow \gamma \omega \phi$ NODE=M070S79  
NODE=M070S79 $\Gamma(\gamma f_2(1810) \rightarrow \gamma \eta \eta)/\Gamma_{\text{total}}$  $\Gamma_{248}/\Gamma$ VALUE (units  $10^{-5}$ )

EVTS

DOCUMENT ID

COMMENT

 $5.40^{+0.60+3.42}_{-0.67-2.35}$ 

5.5k

<sup>1</sup>

ABLIKIM

13N

 $J/\psi \rightarrow \gamma \eta \eta$ NODE=M070S87  
NODE=M070S87<sup>1</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.

NODE=M070S87;LINKAGE=A

 $\Gamma(\gamma f_2(1950) \rightarrow \gamma K^*(892) \bar{K}^*(892))/\Gamma_{\text{total}}$  $\Gamma_{249}/\Gamma$ VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

 $0.7 \pm 0.1 \pm 0.2$ 

BAI

00B

BES

 $J/\psi \rightarrow \gamma K^+ K^0 \pi^+ \pi^-$ NODE=M070B06  
NODE=M070B06 $\Gamma(\gamma K^*(892) \bar{K}^*(892))/\Gamma_{\text{total}}$  $\Gamma_{250}/\Gamma$ VALUE (units  $10^{-3}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $4.0 \pm 0.3 \pm 1.3$ 

320

<sup>1</sup>

BAI

00B

BES

 $J/\psi \rightarrow \gamma K^+ K^0 \pi^+ \pi^-$ NODE=M070B07  
NODE=M070B07<sup>1</sup> Summed over all charges.

NODE=M070R;LINKAGE=B7

 $\Gamma(\gamma \phi \phi)/\Gamma_{\text{total}}$  $\Gamma_{251}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $4.0 \pm 1.2$  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>

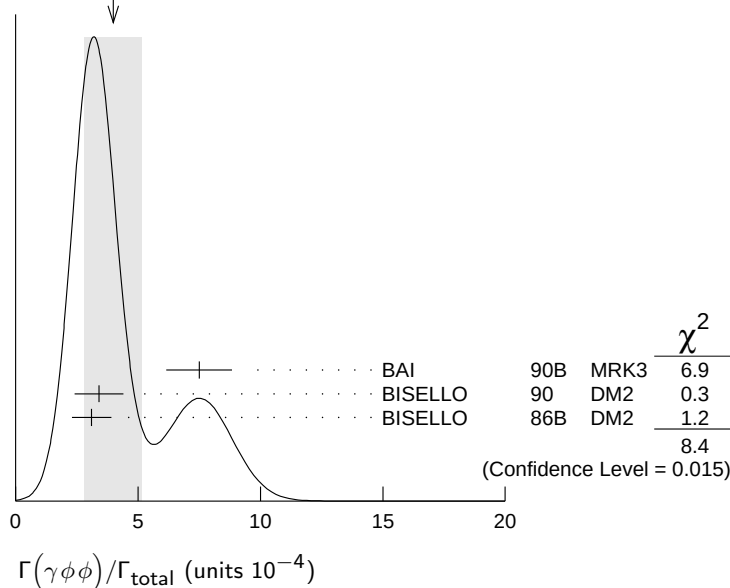
BISELLO

86B

DM2

 $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$ NODE=M070R98  
NODE=M070R98<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) $\Gamma(\gamma \rho \rho)/\Gamma_{\text{total}}$  $\Gamma_{252}/\Gamma$ VALUE (units  $10^{-3}$ )

CL%

EVTS

DOCUMENT ID

TECN

COMMENT

 $0.38 \pm 0.07 \pm 0.07$ 

49

EATON

84

MRK2

 $e^+ e^-$ NODE=M070R90  
NODE=M070R90

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

&lt;0.11

90

PERUZZI

78

MRK1

 $e^+ e^-$

$\Gamma(\gamma\eta(2225))/\Gamma_{\text{total}}$  $\Gamma_{253}/\Gamma$ 

| 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 | 1,2 ABLIKIM | 16N BES3 | $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$     |
| 4.4 ± 0.4 ± 0.8                               |     | 2 ABLIKIM   | 08I BES  | $J/\psi \rightarrow \gamma K^+ K^- K_S^0 K_L^0$ |
| 3.3 ± 0.8 ± 0.5                               |     | 2 BAI       | 90B MRK3 | $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$     |
| 2.7 ± 0.6 ± 0.6                               |     | 2 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>           |     | 3,4 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).

NODE=M070S21;LINKAGE=C

<sup>2</sup> Includes unknown branching fraction to  $\phi\phi$ .

NODE=M070S21;LINKAGE=U

<sup>3</sup> Estimated by us from various fits.

NODE=M070S21;LINKAGE=A

<sup>4</sup> Includes unknown branching fraction to  $\rho^0\rho^0$ .

NODE=M070S21;LINKAGE=B

 $\Gamma(\gamma\eta(1760) \rightarrow \gamma\rho^0\rho^0)/\Gamma_{\text{total}}$  $\Gamma_{254}/\Gamma$ 

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

|                    |             |         |                                 |
|--------------------|-------------|---------|---------------------------------|
| <b>0.13 ± 0.09</b> | 1,2 BISELLO | 89B DM2 | $J/\psi \rightarrow 4\pi\gamma$ |
|--------------------|-------------|---------|---------------------------------|

NODE=M070S20  
NODE=M070S20

<sup>1</sup> Estimated by us from various fits.

NODE=M070S20;LINKAGE=A

<sup>2</sup> Includes unknown branching fraction to  $\rho^0\rho^0$ .

NODE=M070S20;LINKAGE=B

 $\Gamma(\gamma\eta(1760) \rightarrow \gamma\omega\omega)/\Gamma_{\text{total}}$  $\Gamma_{255}/\Gamma$ 

| 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

 $\Gamma(\gamma\eta(1760) \rightarrow \gamma\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_{256}/\Gamma$ 

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

|                                    |         |          |                                                     |
|------------------------------------|---------|----------|-----------------------------------------------------|
| <b>&lt; 4.80 × 10<sup>-6</sup></b> | ABLIKIM | 180 BES3 | $\psi(2S) \rightarrow \pi^+\pi^-\gamma\gamma\gamma$ |
|------------------------------------|---------|----------|-----------------------------------------------------|

NODE=M070P40  
NODE=M070P40

 $\Gamma(\gamma X(1835) \rightarrow \gamma\pi^+\pi^-\eta')/\Gamma_{\text{total}}$  $\Gamma_{257}/\Gamma$ 

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

**2.77<sup>+0.34</sup><sub>-0.40</sub> OUR AVERAGE** Error includes scale factor of 1.1.

|                                               |      |           |          |                                            |
|-----------------------------------------------|------|-----------|----------|--------------------------------------------|
| 3.93 ± 0.38 <sup>+0.31</sup> <sub>-0.84</sub> |      | 1 ABLIKIM | 16J BES3 | $J/\psi \rightarrow \gamma\pi^+\pi^-\eta'$ |
| 2.87 ± 0.09 <sup>+0.49</sup> <sub>-0.52</sub> | 4265 | 2 ABLIKIM | 11C BES3 | $J/\psi \rightarrow \gamma\pi^+\pi^-\eta'$ |
| 2.2 ± 0.4 ± 0.4                               | 264  | ABLIKIM   | 05R BES2 | $J/\psi \rightarrow \gamma\pi^+\pi^-\eta'$ |

NODE=M070R78;LINKAGE=A

<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 Flatté 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 unconfirmed states  $\gamma X(2120)$ , and  $\gamma X(2370)$ , for  $M(p\bar{p}) < 2.8$  GeV, and accounting for backgrounds from non- $\eta'$  events and  $J/\psi \rightarrow \pi^0\pi^+\pi^-\eta'$ .

NODE=M070R78;LINKAGE=AI

 $\Gamma(\gamma X(1835) \rightarrow \gamma p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{258}/\Gamma$ 

| 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> |     | 1 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 | 2 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 | $J/\psi \rightarrow \gamma p\bar{p}$ |

NODE=M070S71  
NODE=M070S71

<sup>1</sup> From the fit including final state interaction effects in isospin 0  $S$ -wave according to SIBIRTSEV 05A.

NODE=M070S71;LINKAGE=AK

<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;LINKAGE=AL

$\Gamma(\gamma X(1835) \rightarrow \gamma K_S^0 K_S^0 \eta) / \Gamma_{\text{total}} \quad \Gamma_{259} / \Gamma$ 

| 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

 $\Gamma(\gamma X(1835) \rightarrow \gamma \gamma \phi(1020)) / \Gamma_{\text{total}} \quad \Gamma_{260} / \Gamma$ 

| 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 | $J/\psi \rightarrow \gamma \gamma \phi(1020)$ |
| $8.09 \pm 1.99 \pm 1.36$ | 1394 | <sup>2</sup> ABLIKIM | 18I BES3 | $J/\psi \rightarrow \gamma \gamma \phi(1020)$ |

NODE=M070P37  
NODE=M070P37

<sup>1</sup> From a fit to the  $\gamma \phi$  mass assuming constructive interference between the  $X(1835)$  and  $\eta(1405)/\eta(1475)$ .

<sup>2</sup> From a fit to the  $\gamma \phi$  mass assuming destructive interference between the  $X(1835)$  and  $\eta(1405)/\eta(1475)$ .

OCCUR=2

NODE=M070P37;LINKAGE=A

NODE=M070P37;LINKAGE=B

 $\Gamma(\gamma X(1835) \rightarrow \gamma \gamma \gamma) / \Gamma_{\text{total}} \quad \Gamma_{261} / \Gamma$ 

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

$<3.56 \times 10^{-6}$  ABLIKIM 180 BES3  $\psi(2S) \rightarrow \pi^+ \pi^- \gamma \gamma \gamma$

NODE=M070P41  
NODE=M070P41

 $\Gamma(\gamma X(1840) \rightarrow \gamma 3(\pi^+ \pi^-)) / \Gamma_{\text{total}} \quad \Gamma_{262} / \Gamma$ 

| 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

 $\Gamma(\gamma(K\bar{K}\pi) [J^{PC} = 0^{-+}]) / \Gamma_{\text{total}} \quad \Gamma_{263} / \Gamma$ 

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

**0.7 ± 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 | $J/\psi \rightarrow \gamma K_S^0 \pi^\mp$ |
| $2.1 \pm 0.1 \pm 0.7$    | <sup>2</sup> BAI | 00D BES | $J/\psi \rightarrow \gamma K_S^0 \pi^\mp$ |

NODE=M070S38  
NODE=M070S38

OCCUR=2

<sup>1</sup> For a broad structure around 1800 MeV.

<sup>2</sup> For a broad structure around 2040 MeV.

NODE=M070S38;LINKAGE=BD  
NODE=M070S38;LINKAGE=BE

 $\Gamma(\gamma \pi^0) / \Gamma_{\text{total}} \quad \Gamma_{264} / \Gamma$ 

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

**3.56 ± 0.17 OUR AVERAGE**  
 $[(3.49^{+0.33}_{-0.30}) \times 10^{-5} \text{ OUR 2018 AVERAGE}]$

|                          |      |                      |          |                                                         |
|--------------------------|------|----------------------|----------|---------------------------------------------------------|
| $3.59 \pm 0.20 \pm 0.03$ | 1635 | <sup>1</sup> ABLIKIM | 180 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 | $J/\psi \rightarrow \pi^0 \gamma$                       |

NODE=M070R82  
NODE=M070R82

NEW

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

|               |    |           |     |      |                               |
|---------------|----|-----------|-----|------|-------------------------------|
| 3.6 ±1.1 ±0.7 |    | BLOOM     | 83  | CBAL | e <sup>+</sup> e <sup>-</sup> |
| 7.3 ±4.7      | 10 | BRANDELIK | 79c | DASP | e <sup>+</sup> e <sup>-</sup> |

<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

 $\Gamma(\gamma \rho \bar{\rho} \pi^+ \pi^-) / \Gamma_{\text{total}} \quad \Gamma_{265} / \Gamma$ 

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

$<7.9 \times 10^{-4}$  (CL = 90%) [ $<0.79 \times 10^{-3}$  (CL = 90%) OUR 2018 BEST LIMIT]  
 $<0.79 \times 10^{-3}$  90 EATON 84 MRK2  $e^+ e^-$

NODE=M070R93  
NODE=M070R93

 $\Gamma(\gamma \Lambda \bar{\Lambda}) / \Gamma_{\text{total}} \quad \Gamma_{266} / \Gamma$ 

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

$<1.3 \times 10^{-4}$  (CL = 90%) [ $<0.13 \times 10^{-3}$  (CL = 90%) OUR 2018 BEST LIMIT]  
 $<0.13 \times 10^{-3}$  90 HENRARD 87 DM2  $e^+ e^-$

NODE=M070S8  
NODE=M070S8

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

|                        |    |     |         |           |
|------------------------|----|-----|---------|-----------|
| $<0.16 \times 10^{-3}$ | 90 | BAI | 98G BES | $e^+ e^-$ |
|------------------------|----|-----|---------|-----------|

$\Gamma(\gamma f_0(2100) \rightarrow \gamma \eta \eta) / \Gamma_{\text{total}}$  $\Gamma_{267} / \Gamma$ 

| 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 | $J/\psi \rightarrow \gamma \eta \eta$ |

<sup>1</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.

NODE=M070S85  
NODE=M070S85

NODE=M070S85;LINKAGE=A

 $\Gamma(\gamma f_0(2100) \rightarrow \gamma \pi \pi) / \Gamma_{\text{total}}$  $\Gamma_{268} / \Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTs | DOCUMENT ID        | TECN | COMMENT                             |
|--------------------------|------|--------------------|------|-------------------------------------|
| $6.24 \pm 0.48 \pm 0.87$ | 744  | <sup>1</sup> DOBBS | 15   | $J/\psi \rightarrow \gamma \pi \pi$ |

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

NODE=M070B08  
NODE=M070B08

NODE=M070B08;LINKAGE=A

 $\Gamma(\gamma f_0(2200)) / \Gamma_{\text{total}}$  $\Gamma_{269} / \Gamma$ 

| VALUE (units $10^{-4}$ )                                                      | DOCUMENT ID           | TECN   | COMMENT                                 |
|-------------------------------------------------------------------------------|-----------------------|--------|-----------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                       |        |                                         |
| 1.5                                                                           | <sup>1</sup> AUGUSTIN | 88 DM2 | $J/\psi \rightarrow \gamma K_S^0 K_S^0$ |

<sup>1</sup> Includes unknown branching fraction to  $K_S^0 K_S^0$ .

NODE=M070S18  
NODE=M070S18

NODE=M070S18;LINKAGE=A

 $\Gamma(\gamma f_0(2200) \rightarrow \gamma K \bar{K}) / \Gamma_{\text{total}}$  $\Gamma_{270} / \Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTs | DOCUMENT ID        | TECN | COMMENT                               |
|--------------------------|------|--------------------|------|---------------------------------------|
| $5.86 \pm 0.49 \pm 1.20$ | 490  | <sup>1</sup> DOBBS | 15   | $J/\psi \rightarrow \gamma K \bar{K}$ |

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

NODE=M070B09  
NODE=M070B09

NODE=M070B09;LINKAGE=A

 $\Gamma(\gamma f_0(2200) \rightarrow \gamma K_S^0 K_S^0) / \Gamma_{\text{total}}$  $\Gamma_{271} / \Gamma$ 

| 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

 $\Gamma(\gamma f_J(2220)) / \Gamma_{\text{total}}$  $\Gamma_{272} / \Gamma$ 

| 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    | $J/\psi \rightarrow \gamma K^+ K^-$               |

<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  
NODE=M070R92

OCCUR=2

OCCUR=2

NODE=M070R92;LINKAGE=A  
NODE=M070R92;LINKAGE=M  
NODE=M070R92;LINKAGE=W

 $\Gamma(\gamma f_J(2220) \rightarrow \gamma \pi \pi) / \Gamma_{\text{total}}$  $\Gamma_{273} / \Gamma$ 

| 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 | $e^+ e^- \rightarrow J/\psi \rightarrow \gamma \pi^+ \pi^-$ |

<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  
NODE=M070B02

NODE=M070B02;LINKAGE=A  
NODE=M070B02;LINKAGE=DO

 $\Gamma(\gamma f_J(2220) \rightarrow \gamma K \bar{K}) / \Gamma_{\text{total}}$  $\Gamma_{274} / \Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | DOCUMENT ID                  | TECN    | COMMENT                                                     |
|-------------------------------------------------------------------------------|-----|------------------------------|---------|-------------------------------------------------------------|
| < 4.1                                                                         | 90  | <sup>1,2</sup> 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

$\Gamma(\gamma f_J(2220) \rightarrow \gamma p \bar{p})/\Gamma_{\text{total}}$  $\Gamma_{275}/\Gamma$ VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

 $1.5 \pm 0.6 \pm 0.5$ 

BAI

96B

BES

 $e^+ e^- \rightarrow J/\psi \rightarrow \gamma p \bar{p}$ NODE=M070B04  
NODE=M070B04 $\Gamma(\gamma f_0(2330) \rightarrow \gamma K_S^0 K_S^0)/\Gamma_{\text{total}}$  $\Gamma_{276}/\Gamma$ VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

 $4.95 \pm 0.21^{+0.66}_{-0.72}$ 

ABLIKIM

18AA

BES3

 $J/\psi \rightarrow \gamma K_S^0 K_S^0$ NODE=M070P67  
NODE=M070P67 $\Gamma(\gamma f_2(2340) \rightarrow \gamma \eta \eta)/\Gamma_{\text{total}}$  $\Gamma_{277}/\Gamma$ VALUE (units  $10^{-5}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $5.60^{+0.62+2.37}_{-0.65-2.07}$ 

5.5k

<sup>1</sup> ABLIKIM

13N

BES3

 $J/\psi \rightarrow \gamma \eta \eta$ NODE=M070S88  
NODE=M070S88<sup>1</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.

NODE=M070S88;LINKAGE=A

 $\Gamma(\gamma f_2(2340) \rightarrow \gamma K_S^0 K_S^0)/\Gamma_{\text{total}}$  $\Gamma_{278}/\Gamma$ VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

 $5.54^{+0.34+3.82}_{-0.40-1.49}$ 

ABLIKIM

18AA

BES3

 $J/\psi \rightarrow \gamma K_S^0 K_S^0$ NODE=M070P70  
NODE=M070P70 $\Gamma(\gamma f_0(1500) \rightarrow \gamma \pi \pi)/\Gamma_{\text{total}}$  $\Gamma_{279}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**1.09 ± 0.24 OUR AVERAGE** $1.21 \pm 0.29 \pm 0.24$ 

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

 $J/\psi \rightarrow \gamma \pi^+ \pi^- \pi^+ \pi^-$ 

OCCUR=2

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.<sup>2</sup> Including unknown branching fraction to  $\pi \pi$ .<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;LINKAGE=C  
NODE=M070S32;LINKAGE=AB  
NODE=M070S32;LINKAGE=A  
NODE=M070S32;LINKAGE=B $\Gamma(\gamma f_0(1500) \rightarrow \gamma \eta \eta)/\Gamma_{\text{total}}$  $\Gamma_{280}/\Gamma$ VALUE (units  $10^{-5}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $1.65^{+0.26+0.51}_{-0.31-1.40}$ 

5.5k

<sup>1</sup> ABLIKIM

13N

BES3

 $J/\psi \rightarrow \gamma \eta \eta$ NODE=M070S83  
NODE=M070S83<sup>1</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.

NODE=M070S83;LINKAGE=A

 $\Gamma(\gamma A \rightarrow \gamma \text{invisible})/\Gamma_{\text{total}}$  $\Gamma_{281}/\Gamma$ (narrow state A with  $m_A < 960$  MeV)

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

 $< 6.3 \times 10^{-6}$  (CL = 90%) [ $< 6.3 \times 10^{-6}$  (CL = 90%) OUR 2018 BEST LIMIT] $< 6.3 \times 10^{-6}$ 

90

<sup>1</sup> INSLE

10

CLEO

 $e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$ NODE=M070S68  
NODE=M070S68<sup>1</sup> The limit varies with mass  $m_A$  of a narrow state A and is  $4.3 \times 10^{-6}$  for  $m_A = 0$  MeV, 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;LINKAGE=IN

 $\Gamma(\gamma A^0 \rightarrow \gamma \mu^+ \mu^-)/\Gamma_{\text{total}}$  $\Gamma_{282}/\Gamma$ (narrow state  $A^0$  with  $0.2 \text{ GeV} < m_{A^0} < 3 \text{ GeV}$ )

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

 $< 5 \times 10^{-6}$  (CL = 90%) [ $< 0.5 \times 10^{-5}$  (CL = 90%) OUR 2018 BEST LIMIT] $< 0.5 \times 10^{-5}$ 

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

 $J/\psi \rightarrow \gamma \mu^+ \mu^-$ NODE=M070S76  
NODE=M070S76<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  $(2.8\text{--}495.3) \times 10^{-8}$ .

NODE=M070S76;LINKAGE=A

<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;LINKAGE=AB

## DALITZ DECAYS

 $\Gamma(\pi^0 e^+ e^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{283}/\Gamma$ 

| VALUE (units $10^{-7}$ )                   | EVTS | DOCUMENT ID | TECN | COMMENT                                 |
|--------------------------------------------|------|-------------|------|-----------------------------------------|
| <b><math>7.56 \pm 1.32 \pm 0.50</math></b> | 39   | ABLIKIM     | 14I  | BES3 $J/\psi \rightarrow \pi^0 e^+ e^-$ |

NODE=M070330

 NODE=M070S89  
 NODE=M070S89

 $\Gamma(\eta e^+ e^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{284}/\Gamma$ 

| VALUE (units $10^{-5}$ )                      | EVTS                                                    | DOCUMENT ID | TECN | COMMENT |
|-----------------------------------------------|---------------------------------------------------------|-------------|------|---------|
| <b><math>1.43 \pm 0.07</math> OUR AVERAGE</b> | [( $1.16 \pm 0.09$ ) $\times 10^{-5}$ OUR 2018 AVERAGE] |             |      |         |

 NODE=M070S90  
 NODE=M070S90

NEW

|                                            |       |                        |     |                                        |
|--------------------------------------------|-------|------------------------|-----|----------------------------------------|
| <b><math>1.43 \pm 0.04 \pm 0.06</math></b> | 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;LINKAGE=A  
 NODE=M070S90;LINKAGE=C

 $\Gamma(\eta'(958) e^+ e^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{285}/\Gamma$ 

| VALUE (units $10^{-5}$ )                      | EVTS                                                    | DOCUMENT ID | TECN | COMMENT |
|-----------------------------------------------|---------------------------------------------------------|-------------|------|---------|
| <b><math>6.59 \pm 0.18</math> OUR AVERAGE</b> | [( $5.81 \pm 0.35$ ) $\times 10^{-5}$ OUR 2018 AVERAGE] |             |      |         |

 NODE=M070S91  
 NODE=M070S91

NEW

|                                            |      |                      |     |                                              |
|--------------------------------------------|------|----------------------|-----|----------------------------------------------|
| <b><math>6.59 \pm 0.07 \pm 0.17</math></b> | 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;LINKAGE=A  
 NODE=M070S91;LINKAGE=B

 $\Gamma(\eta U \rightarrow \eta e^+ e^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{286}/\Gamma$ 

| VALUE                                        | CL% | DOCUMENT ID          | TECN | COMMENT                                |
|----------------------------------------------|-----|----------------------|------|----------------------------------------|
| <b><math>&lt; 9.11 \times 10^{-7}</math></b> | 90  | <sup>1</sup> ABLIKIM | 19A  | BES3 $J/\psi \rightarrow \eta e^+ e^-$ |

 NODE=M070P42  
 NODE=M070P42

<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;LINKAGE=A

 $\Gamma(\eta'(958) U \rightarrow \eta'(958) e^+ e^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{287}/\Gamma$ 

| VALUE                                       | CL% | DOCUMENT ID          | TECN | COMMENT                                      |
|---------------------------------------------|-----|----------------------|------|----------------------------------------------|
| <b><math>&lt; 2.0 \times 10^{-7}</math></b> | 90  | <sup>1</sup> ABLIKIM | 19H  | BES3 $J/\psi \rightarrow \eta'(958) e^+ e^-$ |

 NODE=M070P61  
 NODE=M070P61

<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;LINKAGE=A

## WEAK DECAYS

 $\Gamma(D^- e^+ \nu_e + \text{c.c.})/\Gamma_{\text{total}}$ 
 $\Gamma_{288}/\Gamma$ 

| VALUE                                                  | CL%                                                      | DOCUMENT ID | TECN | COMMENT                           |
|--------------------------------------------------------|----------------------------------------------------------|-------------|------|-----------------------------------|
| <b><math>&lt; 1.2 \times 10^{-5}</math> (CL = 90%)</b> | [ $< 1.2 \times 10^{-5}$ (CL = 90%) OUR 2018 BEST LIMIT] |             |      |                                   |
| <b><math>&lt; 1.2 \times 10^{-5}</math></b>            | 90                                                       | ABLIKIM     | 06M  | BES2 $e^+ e^- \rightarrow J/\psi$ |

NODE=M070320

 NODE=M070S53  
 NODE=M070S53

 $\Gamma(\bar{D}^0 e^+ e^- + \text{c.c.})/\Gamma_{\text{total}}$ 
 $\Gamma_{289}/\Gamma$ 

| VALUE                                       | CL% | DOCUMENT ID          | TECN | COMMENT                           |
|---------------------------------------------|-----|----------------------|------|-----------------------------------|
| <b><math>&lt; 8.5 \times 10^{-8}</math></b> | 90  | <sup>1</sup> ABLIKIM | 17AF | BES3 $e^+ e^- \rightarrow J/\psi$ |

 NODE=M070S54  
 NODE=M070S54

• • • 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;LINKAGE=A

 $\Gamma(D_s^- e^+ \nu_e + \text{c.c.})/\Gamma_{\text{total}}$ 
 $\Gamma_{290}/\Gamma$ 

| VALUE                                                  | CL%                                                      | DOCUMENT ID | TECN | COMMENT |
|--------------------------------------------------------|----------------------------------------------------------|-------------|------|---------|
| <b><math>&lt; 1.3 \times 10^{-6}</math> (CL = 90%)</b> | [ $< 1.3 \times 10^{-6}$ (CL = 90%) OUR 2018 BEST LIMIT] |             |      |         |

 NODE=M070S55  
 NODE=M070S55

|                                             |    |         |     |                                   |
|---------------------------------------------|----|---------|-----|-----------------------------------|
| <b><math>&lt; 1.3 \times 10^{-6}</math></b> | 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;LINKAGE=AB

$\Gamma(D_s^{*-} e^+ \nu_e + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{291}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                           |
|-----------------------|-----|-------------|------|-----------------------------------|
| $<1.8 \times 10^{-6}$ | 90  | ABLIKIM     | 14R  | BES3 $e^+ e^- \rightarrow J/\psi$ |

NODE=M070B13  
NODE=M070B13

 $\Gamma(D^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{292}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                           |
|-----------------------|-----|-------------|------|-----------------------------------|
| $<7.5 \times 10^{-5}$ | 90  | ABLIKIM     | 08J  | BES2 $e^+ e^- \rightarrow J/\psi$ |

NODE=M070S61  
NODE=M070S61

 $\Gamma(\bar{D}^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{293}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                           |
|-----------------------|-----|-------------|------|-----------------------------------|
| $<1.7 \times 10^{-4}$ | 90  | ABLIKIM     | 08J  | BES2 $e^+ e^- \rightarrow J/\psi$ |

NODE=M070S62  
NODE=M070S62

 $\Gamma(\bar{D}^0 \bar{K}^{*0} + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{294}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                           |
|-----------------------|-----|-------------|------|-----------------------------------|
| $<2.5 \times 10^{-6}$ | 90  | ABLIKIM     | 14K  | BES3 $e^+ e^- \rightarrow J/\psi$ |

NODE=M070S93  
NODE=M070S93

 $\Gamma(D_s^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{295}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                           |
|-----------------------|-----|-------------|------|-----------------------------------|
| $<1.3 \times 10^{-4}$ | 90  | ABLIKIM     | 08J  | BES2 $e^+ e^- \rightarrow J/\psi$ |

NODE=M070S63  
NODE=M070S63

 $\Gamma(D_s^- \rho^+ + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{296}/\Gamma$ 

| 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

 $\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$   $\Gamma_{297}/\Gamma$ 

| VALUE                                                                                     | CL% | DOCUMENT ID        | TECN | COMMENT                                        |
|-------------------------------------------------------------------------------------------|-----|--------------------|------|------------------------------------------------|
| $< 2.7 \times 10^{-7}$ (CL = 90%) [ $<2.7 \times 10^{-7}$ (CL = 90%) OUR 2018 BEST LIMIT] |     |                    |      |                                                |
| $< 2.7 \times 10^{-7}$                                                                    | 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

<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  $B(B^+ \rightarrow J/\psi(1S) K^+) = 9.71 \times 10^{-4}$ .

NODE=M070R80;LINKAGE=WI

 $\Gamma(\gamma\phi)/\Gamma_{\text{total}}$   $\Gamma_{298}/\Gamma$ 

| 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

 $\Gamma(e^\pm \mu^\mp)/\Gamma_{\text{total}}$   $\Gamma_{299}/\Gamma$ 

| VALUE                                                                                    | CL% | DOCUMENT ID | TECN | COMMENT                           |
|------------------------------------------------------------------------------------------|-----|-------------|------|-----------------------------------|
| $<1.6 \times 10^{-7}$ (CL = 90%) [ $<1.6 \times 10^{-7}$ (CL = 90%) OUR 2018 BEST LIMIT] |     |             |      |                                   |
| $<1.6 \times 10^{-7}$                                                                    | 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

 $\Gamma(e^\pm \tau^\mp)/\Gamma_{\text{total}}$   $\Gamma_{300}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                          |
|-----------------------|-----|-------------|------|----------------------------------|
| $<8.3 \times 10^{-6}$ | 90  | ABLIKIM     | 04   | BES $e^+ e^- \rightarrow J/\psi$ |

NODE=M070S40  
NODE=M070S40

 $\Gamma(\mu^\pm \tau^\mp)/\Gamma_{\text{total}}$   $\Gamma_{301}/\Gamma$ 

| 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

 $\Gamma(\text{invisible})/\Gamma(e^+ e^-)$   $\Gamma_{302}/\Gamma_5$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                             |
|-----------------------|-----|-------------|------|-------------------------------------|
| $<6.6 \times 10^{-2}$ | 90  | LEES        | 13I  | BABR $B \rightarrow K^{(*)} J/\psi$ |

NODE=M070S80  
NODE=M070S80



$\Gamma(\text{invisible})/\Gamma(\mu^+\mu^-)$  $\Gamma_{302}/\Gamma_7$ 

| 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

 $J/\psi(1S)$  REFERENCES

NODE=M070

|               |      |                |                                  |                     |             |
|---------------|------|----------------|----------------------------------|---------------------|-------------|
| ABLIKIM       | 19A  | PR D99 012006  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=59517 |
| ABLIKIM       | 19H  | PR D99 012013  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=59604 |
| ABLIKIM       | 19N  | PR D99 032006  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=59615 |
| LU            | 19   | PR D99 032003  | P.-C. Lu <i>et al.</i>           | (BELLE Collab.)     | REFID=59614 |
| ABLIKIM       | 18AA | PR D98 072003  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=59455 |
| ABLIKIM       | 18AB | PR D98 072005  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=59456 |
| ABLIKIM       | 18D  | PRL 121 022001 | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=58849 |
| ABLIKIM       | 18I  | PR D97 051101  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=58893 |
| ABLIKIM       | 18O  | PR D97 072014  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=58925 |
| ANASHIN       | 18A  | JHEP 1805 119  | V.V. Anashin <i>et al.</i>       | (KEDR Collab.)      | REFID=59102 |
| LEES          | 18   | PR D97 052007  | J.P. Lees <i>et al.</i>          | (BABAR Collab.)     | REFID=58900 |
| 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>         | (BES III Collab.)   | REFID=58315 |
| ABLIKIM       | 17AH | PR D96 112001  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=58317 |
| ABLIKIM       | 17AK | PR D96 112012  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=58324 |
| ABLIKIM       | 17E  | PL B770 217    | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=57903 |
| ABLIKIM       | 17L  | PR D95 052003  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=57967 |
| LEES          | 17A  | PR D95 052001  | J.P. Lees <i>et al.</i>          | (BABAR Collab.)     | REFID=57966 |
| LEES          | 17C  | PR D95 072007  | J.P. Lees <i>et al.</i>          | (BABAR Collab.)     | REFID=57981 |
| LEES          | 17D  | PR D95 092005  | J.P. Lees <i>et al.</i>          | (BABAR Collab.)     | REFID=57990 |
| ABLIKIM       | 16E  | PR D93 052005  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=57265 |
| ABLIKIM       | 16J  | PRL 117 042002 | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=57454 |
| ABLIKIM       | 16K  | PR D93 052010  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=57509 |
| ABLIKIM       | 16L  | PR D93 072003  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=57510 |
| ABLIKIM       | 16M  | PR D93 072008  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=57511 |
| ABLIKIM       | 16N  | PR D93 112011  | M. Ablikim                       | (BES III Collab.)   | REFID=57512 |
| ABLIKIM       | 16P  | PR D94 072005  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=57522 |
| ABLIKIM       | 16Q  | PL B761 98     | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=57566 |
| PDG           | 16   | CP C40 100001  | C. Patrignani <i>et al.</i>      | (PDG Collab.)       | REFID=57140 |
| AAIJ          | 15BI | EPJ C75 311    | R. Aaij <i>et al.</i>            | (LHCb Collab.)      | REFID=57147 |
| ABLIKIM       | 15AE | PR D92 052003  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=56984 |
| ABLIKIM       | 15H  | PR D91 052017  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=56773 |
| ABLIKIM       | 15K  | PR D91 112001  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=56776 |
| ABLIKIM       | 15P  | PR D92 012007  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=56781 |
| ABLIKIM       | 15T  | PRL 115 091803 | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=56785 |
| 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       | 14I  | PR D89 092008  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=55900 |
| ABLIKIM       | 14K  | PR D89 071101  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=55902 |
| ABLIKIM       | 14N  | PR D90 052009  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=55905 |
| ABLIKIM       | 14Q  | PR D90 092002  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=56238 |
| ABLIKIM       | 14R  | PR D90 112014  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=56388 |
| ANASHIN       | 14   | PL B738 391    | V.V. Anashin <i>et al.</i>       | (KEDR Collab.)      | REFID=56130 |
| AULCHENKO     | 14   | PL B731 227    | V.M. Aulchenko <i>et al.</i>     | (KEDR Collab.)      | REFID=55655 |
| LEES          | 14H  | PR D89 092002  | J.P. Lees <i>et al.</i>          | (BABAR Collab.)     | REFID=55940 |
| ABLIKIM       | 13F  | PR D87 052007  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=54920 |
| ABLIKIM       | 13I  | PR D87 032003  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=54954 |
| ABLIKIM       | 13J  | PR D87 032008  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=54955 |
| ABLIKIM       | 13L  | PR D87 112007  | Ablikim M. <i>et al.</i>         | (BES III Collab.)   | REFID=55300 |
| ABLIKIM       | 13N  | PR D87 092009  | Ablikim M. <i>et al.</i>         | (BES III Collab.)   | REFID=55387 |
| ABLIKIM       | 13P  | PR D87 112004  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=55392 |
| ABLIKIM       | 13R  | PR D88 032007  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=55402 |
| ABLIKIM       | 13U  | PR D88 091502  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=55582 |
| 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 |
| ABLIKIM       | 12   | PR D85 092012  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=54265 |
| ABLIKIM       | 12B  | PR D86 032008  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=54267 |
| ABLIKIM       | 12C  | PR D86 032014  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=54268 |
| ABLIKIM       | 12D  | PRL 108 112003 | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=54269 |
| ABLIKIM       | 12H  | PL B710 594    | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=54273 |
| ABLIKIM       | 12P  | CP C36 1031    | M. Ablikim <i>et al.</i>         | (BES II Collab.)    | REFID=54863 |
| 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 |
| ABLIKIM       | 11   | PR D83 012003  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=53646 |
| ABLIKIM       | 11C  | PRL 106 072002 | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=53684 |
| ABLIKIM       | 11D  | PR D83 032003  | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=16715 |
| ABLIKIM       | 10C  | PL B685 27     | M. Ablikim <i>et al.</i>         | (BES II Collab.)    | REFID=53349 |
| ABLIKIM       | 10E  | PL B693 88     | M. Ablikim <i>et al.</i>         | (BES II Collab.)    | REFID=53361 |
| ALEXANDER     | 10   | PR D82 092002  | J.P. Alexander <i>et al.</i>     | (CLEO Collab.)      | REFID=53525 |
| ANASHIN       | 10   | PL B685 134    | V.V. Anashin <i>et al.</i>       | (KEDR Collab.)      | REFID=53220 |
| DEL-AMO-SA... | 100  | PRL 105 172001 | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.)     | REFID=53533 |
| INSLER        | 10   | PR D81 091101  | J. Insler <i>et al.</i>          | (CLEO Collab.)      | REFID=53359 |
| ABLIKIM       | 09   | PL B676 25     | M. Ablikim <i>et al.</i>         | (BES Collab.)       | REFID=52718 |
| ABLIKIM       | 09B  | PR D80 052004  | M. Ablikim <i>et al.</i>         | (BES II Collab.)    | REFID=53099 |
| 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 |
| SHEN          | 09   | PR D80 031101  | C.P. Shen <i>et al.</i>          | (BELLE Collab.)     | REFID=53000 |
| ABLIKIM       | 08   | EPJ C53 15     | M. Ablikim <i>et al.</i>         | (BES Collab.)       | REFID=52047 |
| ABLIKIM       | 08A  | PR D77 012001  | M. Ablikim <i>et al.</i>         | (BES Collab.)       | REFID=52128 |
| ABLIKIM       | 08C  | PL B659 789    | M. Ablikim <i>et al.</i>         | (BES Collab.)       | REFID=52130 |
| ABLIKIM       | 08E  | PR D77 032005  | M. Ablikim <i>et al.</i>         | (BES Collab.)       | REFID=52143 |
| ABLIKIM       | 08F  | PRL 100 102003 | M. Ablikim <i>et al.</i>         | (BES Collab.)       | REFID=52154 |
| ABLIKIM       | 08G  | PRL 100 192001 | M. Ablikim <i>et al.</i>         | (BES Collab.)       | REFID=52253 |
| ABLIKIM       | 08I  | PL B662 330    | M. Ablikim <i>et al.</i>         | (BES Collab.)       | REFID=52255 |
| ABLIKIM       | 08J  | PL B663 297    | M. Ablikim <i>et al.</i>         | (BES Collab.)       | REFID=52256 |
| ABLIKIM       | 08O  | PR D78 092005  | M. Ablikim <i>et al.</i>         | (BES Collab.)       | REFID=52571 |

|               |      |                       |                                 |                              |             |
|---------------|------|-----------------------|---------------------------------|------------------------------|-------------|
| ADAMS         | 08   | PRL 101 101801        | G.S. Adams <i>et al.</i>        | (CLEO Collab.)               | REFID=52261 |
| AUBERT        | 08S  | PR D77 092002         | B. Aubert <i>et al.</i>         | (BABAR Collab.)              | REFID=52242 |
| BESSION       | 08   | PR D78 032012         | D. Besson <i>et al.</i>         | (CLEO Collab.)               | REFID=52685 |
| PDG           | 08   | PL B667 1             | C. Amsler <i>et al.</i>         | (PDG Collab.)                | REFID=52166 |
| WICHT         | 08   | PL B662 323           | J. Wicht <i>et al.</i>          | (BELLE Collab.)              | REFID=52204 |
| ABLIKIM       | 07H  | PR D76 092003         | M. Ablikim <i>et al.</i>        | (BES Collab.)                | REFID=52046 |
| ABLIKIM       | 07J  | PR D76 117101         | M. Ablikim <i>et al.</i>        | (BES Collab.)                | REFID=52072 |
| 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 (err.) | 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 |
| ABLIKIM       | 06   | PL B632 181           | M. Ablikim <i>et al.</i>        | (BES Collab.)                | REFID=50986 |
| ABLIKIM       | 06C  | PL B633 681           | M. Ablikim <i>et al.</i>        | (BES Collab.)                | REFID=51037 |
| ABLIKIM       | 06E  | PR D73 052008         | M. Ablikim <i>et al.</i>        | (BES Collab.)                | REFID=51057 |
| ABLIKIM       | 06F  | PR D73 052007         | M. Ablikim <i>et al.</i>        | (BES Collab.)                | REFID=51058 |
| 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       | 06K  | PRL 97 062001         | M. Ablikim <i>et al.</i>        | (BES II Collab.)             | REFID=51128 |
| ABLIKIM       | 06M  | PL B639 418           | M. Ablikim <i>et al.</i>        | (BES Collab.)                | REFID=51130 |
| ABLIKIM       | 06V  | PL B642 441           | M. Ablikim <i>et al.</i>        | (BES Collab.)                | REFID=51507 |
| ADAMS         | 06A  | PR D73 051103         | G.S. Adams <i>et al.</i>        | (CLEO Collab.)               | REFID=51036 |
| 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        | 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 |
| ABLIKIM       | 05   | PL B607 243           | M. Ablikim <i>et al.</i>        | (BES Collab.)                | REFID=50450 |
| ABLIKIM       | 05B  | PR D71 032003         | M. Ablikim <i>et al.</i>        | (BES Collab.)                | REFID=50496 |
| ABLIKIM       | 05C  | PL B610 192           | M. Ablikim <i>et al.</i>        | (BES Collab.)                | REFID=50507 |
| 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 |
| SIBIRTSSEV    | 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 Collab., 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   | PRL 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=11616 |
| HENNRARD      | 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, MANZ)  | 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 |
| Translated from YAF 34 | 1471.        |                                 |                     |             |
| 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, MANZ)  | 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 |

See the related review(s):

Branching Ratios of  $\psi(2S)$  and  $\chi_{c,1,2}^0$

$\chi_{c0}(1P)$

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

NODE=M056

### $\chi_{c0}(1P)$ MASS

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 ± 0.2                                                            |      | <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                                                            |      | <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=NNW

NODE=M056M;LINKAGE=D

### $\chi_{c0}(1P)$ WIDTH

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 <sup>+1.5+0.9</sup> <sub>-1.6-1.1</sub>                                  |      | ABLIKIM               | 05G BES2 | $\psi(2S) \rightarrow \gamma\chi_{c0}$                          |
| 8.6 <sup>+1.7</sup> <sub>-1.3</sub> ±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 <sup>+5.2</sup> <sub>-3.7</sub> ±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

NODE=M056W;LINKAGE=AN

NODE=M056215;NODE=M056

### $\chi_{c0}(1P)$ DECAY MODES

| Mode                                                                                        | Fraction ( $\Gamma_i/\Gamma$ )                            | Scale factor/<br>Confidence level |
|---------------------------------------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------|
| <b>Hadronic decays</b>                                                                      |                                                           |                                   |
| $\Gamma_1$ $2(\pi^+\pi^-)$                                                                  | (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) %                                             |                                   |
| $\Gamma_9$ $K_0^*(1430)^0\bar{K}_0^*(1430)^0 \rightarrow \pi^+\pi^-K^+K^-$                  | (9.8 <sup>+4.0</sup> <sub>-2.8</sub> ) × 10 <sup>-4</sup> |                                   |
| $\Gamma_{10}$ $K_0^*(1430)^0\bar{K}_2^*(1430)^0 + \text{c.c.} \rightarrow \pi^+\pi^-K^+K^-$ | (8.0 <sup>+2.0</sup> <sub>-2.4</sub> ) × 10 <sup>-4</sup> |                                   |
| $\Gamma_{11}$ $K_1(1270)^+K^- + \text{c.c.} \rightarrow \pi^+\pi^-K^+K^-$                   | (6.3 ±1.9 ) × 10 <sup>-3</sup>                            |                                   |
| $\Gamma_{12}$ $K_1(1400)^+K^- + \text{c.c.} \rightarrow \pi^+\pi^-K^+K^-$                   | < 2.7 × 10 <sup>-3</sup>                                  | CL=90%                            |
| $\Gamma_{13}$ $f_0(980)f_0(980)$                                                            | (1.6 <sup>+1.0</sup> <sub>-0.9</sub> ) × 10 <sup>-4</sup> |                                   |
| $\Gamma_{14}$ $f_0(980)f_0(2200)$                                                           | (7.9 <sup>+2.0</sup> <sub>-2.5</sub> ) × 10 <sup>-4</sup> |                                   |
| $\Gamma_{15}$ $f_0(1370)f_0(1370)$                                                          | < 2.7 × 10 <sup>-4</sup>                                  | CL=90%                            |
| $\Gamma_{16}$ $f_0(1370)f_0(1500)$                                                          | < 1.7 × 10 <sup>-4</sup>                                  | CL=90%                            |
| $\Gamma_{17}$ $f_0(1370)f_0(1710)$                                                          | (6.7 <sup>+3.5</sup> <sub>-2.3</sub> ) × 10 <sup>-4</sup> |                                   |
| $\Gamma_{18}$ $f_0(1500)f_0(1370)$                                                          | < 1.3 × 10 <sup>-4</sup>                                  | CL=90%                            |
| $\Gamma_{19}$ $f_0(1500)f_0(1500)$                                                          | < 5 × 10 <sup>-5</sup>                                    | CL=90%                            |
| $\Gamma_{20}$ $f_0(1500)f_0(1710)$                                                          | < 7 × 10 <sup>-5</sup>                                    | CL=90%                            |
| $\Gamma_{21}$ $K^+K^-\pi^+\pi^-\pi^0$                                                       | (8.6 ±0.9 ) × 10 <sup>-3</sup>                            |                                   |
| $\Gamma_{22}$ $K_S^0 K^\pm\pi^\mp\pi^+\pi^-$                                                | (4.2 ±0.4 ) × 10 <sup>-3</sup>                            |                                   |
| $\Gamma_{23}$ $K^+K^-\pi^0\pi^0$                                                            | (5.6 ±0.9 ) × 10 <sup>-3</sup>                            |                                   |
| $\Gamma_{24}$ $K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.}$                                        | (2.49±0.33) %                                             |                                   |
| $\Gamma_{25}$ $\rho^+K^-K^0 + \text{c.c.}$                                                  | (1.21±0.21) %                                             |                                   |
| $\Gamma_{26}$ $K^*(892)^-K^+\pi^0 \rightarrow K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.}$         | (4.6 ±1.2 ) × 10 <sup>-3</sup>                            |                                   |
| $\Gamma_{27}$ $K_S^0 K_S^0\pi^+\pi^-$                                                       | (5.7 ±1.1 ) × 10 <sup>-3</sup>                            |                                   |
| $\Gamma_{28}$ $K^+K^-\eta\pi^0$                                                             | (3.0 ±0.7 ) × 10 <sup>-3</sup>                            |                                   |
| $\Gamma_{29}$ $3(\pi^+\pi^-)$                                                               | (1.20±0.18) %                                             |                                   |
| $\Gamma_{30}$ $K^+\bar{K}^*(892)^0\pi^- + \text{c.c.}$                                      | (7.5 ±1.6 ) × 10 <sup>-3</sup>                            |                                   |
| $\Gamma_{31}$ $K^*(892)^0\bar{K}^*(892)^0$                                                  | (1.7 ±0.6 ) × 10 <sup>-3</sup>                            |                                   |
| $\Gamma_{32}$ $\pi\pi$                                                                      | (8.51±0.33) × 10 <sup>-3</sup>                            |                                   |
| $\Gamma_{33}$ $\pi^0\eta$                                                                   | < 1.8 × 10 <sup>-4</sup>                                  |                                   |
| $\Gamma_{34}$ $\pi^0\eta'$                                                                  | < 1.1 × 10 <sup>-3</sup>                                  |                                   |

NODE=M056;CLUMP=A

DESIG=3

DESIG=9

DESIG=54

DESIG=20

DESIG=61

DESIG=62

DESIG=70

DESIG=5

DESIG=31

DESIG=32

DESIG=33

DESIG=34

DESIG=23

DESIG=24

DESIG=25

DESIG=26

DESIG=27

DESIG=28

DESIG=29

DESIG=30

DESIG=75

DESIG=87

DESIG=63

DESIG=65

DESIG=66

DESIG=67

DESIG=41

DESIG=68

DESIG=4

DESIG=10

DESIG=21

DESIG=18

DESIG=35

DESIG=36

|                 |                                                           |                                  |        |          |
|-----------------|-----------------------------------------------------------|----------------------------------|--------|----------|
| Γ <sub>35</sub> | $\pi^0 \eta_c$                                            | $< 1.6 \times 10^{-3}$           | CL=90% | DESIG=86 |
| Γ <sub>36</sub> | $\eta \eta$                                               | $(3.01 \pm 0.19) \times 10^{-3}$ |        | DESIG=13 |
| Γ <sub>37</sub> | $\eta \eta'$                                              | $(9.1 \pm 1.1) \times 10^{-5}$   |        | DESIG=37 |
| Γ <sub>38</sub> | $\eta' \eta'$                                             | $(2.17 \pm 0.12) \times 10^{-3}$ |        | DESIG=46 |
| Γ <sub>39</sub> | $\omega \omega$                                           | $(9.7 \pm 1.1) \times 10^{-4}$   |        | DESIG=22 |
| Γ <sub>40</sub> | $\omega \phi$                                             | $(1.41 \pm 0.13) \times 10^{-4}$ |        | DESIG=76 |
| Γ <sub>41</sub> | $\omega K^+ K^-$                                          | $(1.94 \pm 0.21) \times 10^{-3}$ |        | DESIG=88 |
| Γ <sub>42</sub> | $K^+ K^-$                                                 | $(6.05 \pm 0.31) \times 10^{-3}$ |        | DESIG=2  |
| Γ <sub>43</sub> | $K_S^0 K_S^0$                                             | $(3.16 \pm 0.17) \times 10^{-3}$ |        | DESIG=15 |
| Γ <sub>44</sub> | $\pi^+ \pi^- \eta$                                        | $< 2.0 \times 10^{-4}$           | CL=90% | DESIG=50 |
| Γ <sub>45</sub> | $\pi^+ \pi^- \eta'$                                       | $< 4 \times 10^{-4}$             | CL=90% | DESIG=53 |
| Γ <sub>46</sub> | $\bar{K}^0 K^+ \pi^- + \text{c.c.}$                       | $< 9 \times 10^{-5}$             | CL=90% | DESIG=17 |
| Γ <sub>47</sub> | $K^+ K^- \pi^0$                                           | $< 6 \times 10^{-5}$             | CL=90% | DESIG=47 |
| Γ <sub>48</sub> | $K^+ K^- \eta$                                            | $< 2.3 \times 10^{-4}$           | CL=90% | DESIG=51 |
| Γ <sub>49</sub> | $K^+ K^- K_S^0 K_S^0$                                     | $(1.4 \pm 0.5) \times 10^{-3}$   |        | DESIG=42 |
| Γ <sub>50</sub> | $K^+ K^- K^+ K^-$                                         | $(2.82 \pm 0.29) \times 10^{-3}$ |        | DESIG=14 |
| Γ <sub>51</sub> | $K^+ K^- \phi$                                            | $(9.7 \pm 2.5) \times 10^{-4}$   |        | DESIG=44 |
| Γ <sub>52</sub> | $\bar{K}^0 K^+ \pi^- \phi + \text{c.c.}$                  | $(3.7 \pm 0.6) \times 10^{-3}$   |        | DESIG=91 |
| Γ <sub>53</sub> | $K^+ K^- \pi^0 \phi$                                      | $(1.90 \pm 0.35) \times 10^{-3}$ |        | DESIG=92 |
| Γ <sub>54</sub> | $\phi \pi^+ \pi^- \pi^0$                                  | $(1.18 \pm 0.15) \times 10^{-3}$ |        | DESIG=89 |
| Γ <sub>55</sub> | $\phi \phi$                                               | $(8.0 \pm 0.7) \times 10^{-4}$   |        | DESIG=16 |
| Γ <sub>56</sub> | $p \bar{p}$                                               | $(2.21 \pm 0.08) \times 10^{-4}$ |        | DESIG=11 |
| Γ <sub>57</sub> | $p \bar{p} \pi^0$                                         | $(7.0 \pm 0.7) \times 10^{-4}$   | S=1.3  | DESIG=48 |
| Γ <sub>58</sub> | $p \bar{p} \eta$                                          | $(3.5 \pm 0.4) \times 10^{-4}$   |        | DESIG=52 |
| Γ <sub>59</sub> | $p \bar{p} \omega$                                        | $(5.2 \pm 0.6) \times 10^{-4}$   |        | DESIG=69 |
| Γ <sub>60</sub> | $p \bar{p} \phi$                                          | $(6.0 \pm 1.4) \times 10^{-5}$   |        | DESIG=74 |
| Γ <sub>61</sub> | $p \bar{p} \pi^+ \pi^-$                                   | $(2.1 \pm 0.7) \times 10^{-3}$   | S=1.4  | DESIG=8  |
| Γ <sub>62</sub> | $p \bar{p} \pi^0 \pi^0$                                   | $(1.04 \pm 0.28) \times 10^{-3}$ |        | DESIG=64 |
| Γ <sub>63</sub> | $p \bar{p} K^+ K^- (\text{non-resonant})$                 | $(1.22 \pm 0.26) \times 10^{-4}$ |        | DESIG=71 |
| Γ <sub>64</sub> | $p \bar{p} K_S^0 K_S^0$                                   | $< 8.8 \times 10^{-4}$           | CL=90% | DESIG=40 |
| Γ <sub>65</sub> | $p \bar{n} \pi^-$                                         | $(1.27 \pm 0.11) \times 10^{-3}$ |        | DESIG=43 |
| Γ <sub>66</sub> | $\bar{p} n \pi^+$                                         | $(1.37 \pm 0.12) \times 10^{-3}$ |        | DESIG=82 |
| Γ <sub>67</sub> | $p \bar{n} \pi^- \pi^0$                                   | $(2.34 \pm 0.21) \times 10^{-3}$ |        | DESIG=83 |
| Γ <sub>68</sub> | $\bar{p} n \pi^+ \pi^0$                                   | $(2.21 \pm 0.18) \times 10^{-3}$ |        | DESIG=84 |
| Γ <sub>69</sub> | $\Lambda \bar{\Lambda}$                                   | $(3.27 \pm 0.24) \times 10^{-4}$ |        | DESIG=19 |
| Γ <sub>70</sub> | $\Lambda \bar{\Lambda} \pi^+ \pi^-$                       | $(1.18 \pm 0.13) \times 10^{-3}$ |        | DESIG=38 |
| Γ <sub>71</sub> | $\Lambda \bar{\Lambda} \pi^+ \pi^- (\text{non-resonant})$ | $< 5 \times 10^{-4}$             | CL=90% | DESIG=77 |
| Γ <sub>72</sub> | $\Sigma(1385)^+ \bar{\Lambda} \pi^- + \text{c.c.}$        | $< 5 \times 10^{-4}$             | CL=90% | DESIG=78 |
| Γ <sub>73</sub> | $\Sigma(1385)^- \bar{\Lambda} \pi^+ + \text{c.c.}$        | $< 5 \times 10^{-4}$             | CL=90% | DESIG=79 |
| Γ <sub>74</sub> | $K^+ \bar{p} \Lambda + \text{c.c.}$                       | $(1.25 \pm 0.12) \times 10^{-3}$ | S=1.3  | DESIG=49 |
| Γ <sub>75</sub> | $K^+ \bar{p} \Lambda(1520) + \text{c.c.}$                 | $(2.9 \pm 0.7) \times 10^{-4}$   |        | DESIG=72 |
| Γ <sub>76</sub> | $\Lambda(1520) \bar{\Lambda}(1520)$                       | $(3.1 \pm 1.2) \times 10^{-4}$   |        | DESIG=73 |
| Γ <sub>77</sub> | $\Sigma^0 \bar{\Sigma}^0$                                 | $(4.68 \pm 0.32) \times 10^{-4}$ |        | DESIG=58 |
| Γ <sub>78</sub> | $\Sigma^+ \bar{\Sigma}^-$                                 | $(4.6 \pm 0.8) \times 10^{-4}$   | S=2.6  | DESIG=59 |
| Γ <sub>79</sub> | $\Sigma(1385)^+ \bar{\Sigma}(1385)^-$                     | $(1.6 \pm 0.6) \times 10^{-4}$   |        | DESIG=80 |
| Γ <sub>80</sub> | $\Sigma(1385)^- \bar{\Sigma}(1385)^+$                     | $(2.3 \pm 0.7) \times 10^{-4}$   |        | DESIG=81 |
| Γ <sub>81</sub> | $K^- \Lambda \Xi^+ + \text{c.c.}$                         | $(1.94 \pm 0.35) \times 10^{-4}$ |        | DESIG=85 |
| Γ <sub>82</sub> | $\Xi^0 \Xi^0$                                             | $(3.1 \pm 0.8) \times 10^{-4}$   |        | DESIG=60 |
| Γ <sub>83</sub> | $\Xi^- \Xi^+$                                             | $(4.8 \pm 0.7) \times 10^{-4}$   |        | DESIG=39 |
| Γ <sub>84</sub> | $\eta_c \pi^+ \pi^-$                                      | $< 7 \times 10^{-4}$             | CL=90% | DESIG=90 |

**Radiative decays**

|                 |                      |                                  |        |                              |
|-----------------|----------------------|----------------------------------|--------|------------------------------|
| Γ <sub>85</sub> | $\gamma J/\psi(1S)$  | $(1.40 \pm 0.05) \%$             |        | NODE=M056;CLUMP=B<br>DESIG=6 |
| Γ <sub>86</sub> | $\gamma \rho^0$      | $< 9 \times 10^{-6}$             | CL=90% | DESIG=55                     |
| Γ <sub>87</sub> | $\gamma \omega$      | $< 8 \times 10^{-6}$             | CL=90% | DESIG=56                     |
| Γ <sub>88</sub> | $\gamma \phi$        | $< 6 \times 10^{-6}$             | CL=90% | DESIG=57                     |
| Γ <sub>89</sub> | $\gamma \gamma$      | $(2.04 \pm 0.09) \times 10^{-4}$ |        | DESIG=7                      |
| Γ <sub>90</sub> | $e^+ e^- J/\psi(1S)$ | $(1.54 \pm 0.33) \times 10^{-4}$ |        | DESIG=93                     |

## 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       |          |          |          |
| $x_{50}$ | 5        | 1        | 5        | 2        | 9        | 5        | 7        | 7        |          |          |
| $x_{55}$ | 7        | 2        | 6        | 2        | 9        | 5        | 7        | 7        | 4        |          |
| $x_{56}$ | 3        | 1        | 4        | 1        | 3        | -1       | 7        | 7        | 3        | 3        |
| $x_{69}$ | 4        | 1        | 5        | 1        | 13       | 8        | 10       | 10       | 5        | 5        |
| $x_{85}$ | 5        | 1        | 6        | 2        | 17       | 11       | 13       | 12       | 6        | 6        |
| $x_{89}$ | -8       | -2       | -2       | -3       | 14       | 9        | 10       | 10       | 3        | 1        |
| $\Gamma$ | -26      | -6       | -19      | -10      | -15      | -7       | -14      | -12      | -10      | -13      |
|          | $x_1$    | $x_2$    | $x_8$    | $x_{30}$ | $x_{32}$ | $x_{36}$ | $x_{42}$ | $x_{43}$ | $x_{50}$ | $x_{55}$ |
| $x_{69}$ | 5        |          |          |          |          |          |          |          |          |          |
| $x_{85}$ | -19      | 9        |          |          |          |          |          |          |          |          |
| $x_{89}$ | 6        | 9        | 13       |          |          |          |          |          |          |          |
| $\Gamma$ | -4       | -7       | -9       | -38      |          |          |          |          |          |          |
|          | $x_{56}$ | $x_{69}$ | $x_{85}$ | $x_{89}$ |          |          |          |          |          |          |

### $\chi_{c0}(1P)$ PARTIAL WIDTHS

$$\chi_{c0}(1P) \Gamma(i) \Gamma(\gamma J/\psi(1S)) / \Gamma(\text{total})$$

NODE=M056217

NODE=M056223

$$\Gamma(p\bar{p}) \times \Gamma(\gamma J/\psi(1S)) / \Gamma_{\text{total}} \quad \Gamma_{56} \Gamma_{85} / \Gamma$$

| 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    1,2 BAGNASCO    02    E835     $\bar{p}p \rightarrow \chi_{c0} \rightarrow J/\psi \gamma$

48.7  $^{+11.3}_{-8.9} \pm 2.4$       1,2 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

$$\Gamma(2(\pi^+ \pi^-)) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}} \quad \Gamma_1 \Gamma_{89} / \Gamma$$

| 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

$$\Gamma(\rho^0 \rho^0) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}} \quad \Gamma_3 \Gamma_{89} / \Gamma$$

| 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

$$\Gamma(\pi^+\pi^-K^+K^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{89}/\Gamma$$

| 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

$$\Gamma(K^+K^-\pi^+\pi^-\pi^0) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{21}/\Gamma_{89}/\Gamma$$

| 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

$$\Gamma(K^+\bar{K}^*(892)^0\pi^- + \text{c.c.}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{30}/\Gamma_{89}/\Gamma$$

| 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

$$\Gamma(K^*(892)^0\bar{K}^*(892)^0) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{31}/\Gamma_{89}/\Gamma$$

| 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 $\gamma\gamma \rightarrow \chi_{c0} \rightarrow K^+K^-\pi^+\pi^-$ |
|----|----|------|--------|----|------------------------------------------------------------------------|

$$\Gamma(\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{32}/\Gamma_{89}/\Gamma$$

| VALUE (eV)                | EVTS | DOCUMENT ID | TECN | COMMENT |
|---------------------------|------|-------------|------|---------|
| <b>18.8± 1.3 OUR FIT</b>  |      |             |      |         |
| <b>23 ± 5 OUR AVERAGE</b> |      |             |      |         |

NODE=M056G3  
NODE=M056G3

|                                              |                                   |                       |    |      |                                            |
|----------------------------------------------|-----------------------------------|-----------------------|----|------|--------------------------------------------|
| 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;LINKAGE=UE

NODE=M056G;LINKAGE=NA

$$\Gamma(\eta\eta) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{36}/\Gamma_{89}/\Gamma$$

| VALUE (eV)         | EVTS | DOCUMENT ID         | TECN | COMMENT                                       |
|--------------------|------|---------------------|------|-----------------------------------------------|
| <b>9.4±2.3±1.2</b> | 22   | <sup>1</sup> UEHARA | 10A  | BELL 10.6 $e^+e^- \rightarrow e^+e^-\eta\eta$ |

NODE=M056G06  
NODE=M056G06

<sup>1</sup>Interference with the continuum not included.

NODE=M056G06;LINKAGE=UE

$$\Gamma(\omega\omega) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{39}/\Gamma_{89}/\Gamma$$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

NODE=M056G02  
NODE=M056G02

• • • 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;LINKAGE=LI

$$\Gamma(\omega\phi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{40}/\Gamma_{89}/\Gamma$$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

NODE=M056G03  
NODE=M056G03

• • • 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;LINKAGE=LI

$$\Gamma(K^+K^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{42}/\Gamma_{89}/\Gamma$$

| VALUE (eV)              | EVTS     | DOCUMENT ID | TECN | COMMENT                                     |
|-------------------------|----------|-------------|------|---------------------------------------------|
| <b>13.4±1.0 OUR FIT</b> |          |             |      |                                             |
| <b>14.3±1.6±2.3</b>     | 153 ± 17 | NAKAZAWA    | 05   | BELL 10.6 $e^+e^- \rightarrow e^+e^-K^+K^-$ |

NODE=M056G4  
NODE=M056G4

$$\Gamma(K_S^0\bar{K}_S^0) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{43}/\Gamma_{89}/\Gamma$$

| VALUE (eV)              | EVTS | DOCUMENT ID         | TECN | COMMENT                                          |
|-------------------------|------|---------------------|------|--------------------------------------------------|
| <b>7.0 ±0.5 OUR FIT</b> |      |                     |      |                                                  |
| <b>8.7 ±1.7 ±0.9</b>    | 266  | <sup>1</sup> UEHARA | 13   | BELL $\gamma\gamma \rightarrow K_S^0\bar{K}_S^0$ |

NODE=M056G5  
NODE=M056G5

• • • 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;LINKAGE=UE

$$\Gamma(K^+K^-K^+K^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{50}/\Gamma_{89}/\Gamma$$

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

NODE=M056G11  
NODE=M056G11

**6.2±0.7 OUR FIT**

|                    |          |        |    |                                                                 |
|--------------------|----------|--------|----|-----------------------------------------------------------------|
| <b>7.9±1.3±1.1</b> | 215 ± 36 | UEHARA | 08 | BELL $\gamma\gamma \rightarrow \chi_{c0} \rightarrow 2(K^+K^-)$ |
|--------------------|----------|--------|----|-----------------------------------------------------------------|

| $\Gamma(\phi\phi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$                       |            |                  |      |                                                                 |  | $\Gamma_{55}\Gamma_{89}/\Gamma$ |
|--------------------------------------------------------------------------------------------|------------|------------------|------|-----------------------------------------------------------------|--|---------------------------------|
| VALUE (eV)                                                                                 | EVTS       | DOCUMENT ID      | TECN | COMMENT                                                         |  |                                 |
| <b>1.76±0.18 OUR FIT</b>                                                                   |            |                  |      |                                                                 |  |                                 |
| <b>1.72±0.33±0.14</b>                                                                      | 56 ± 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. • • •              |            |                  |      |                                                                 |  |                                 |
| 2.3 ± 0.9 ± 0.4                                                                            | 23.6 ± 9.6 | UEHARA           | 08   | BELL $\gamma\gamma \rightarrow \chi_{c0} \rightarrow 2(K^+K^-)$ |  |                                 |
| <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>                     |  |             |      |                                             |  |                     |
|                                                  |  |             |      |                                             |  |                     |
| $\Gamma(\rho^0\pi^+\pi^-)/\Gamma(2(\pi^+\pi^-))$ |  |             |      |                                             |  | $\Gamma_2/\Gamma_1$ |
| VALUE                                            |  | DOCUMENT ID | TECN | COMMENT                                     |  |                     |
| <b>0.39±0.12 OUR FIT</b>                         |  |             |      |                                             |  |                     |
| <b>0.39±0.12</b>                                 |  | TANENBAUM   | 78   | MRK1 $\psi(2S) \rightarrow \gamma\chi_{c0}$ |  |                     |
| $\Gamma(\rho^0\pi^+\pi^-)/\Gamma_{\text{total}}$ |  |             |      |                                             |  | $\Gamma_2/\Gamma$   |
| 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   | DOCUMENT ID          | TECN | COMMENT                                         |  |                   |
| <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   | DOCUMENT ID     | TECN | COMMENT                                          |  |                   |
| <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   | DOCUMENT ID       | TECN | COMMENT                                          |  |                   |
| <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 | DOCUMENT ID          | TECN | COMMENT                                                        |  |                   |
| <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 | $e^+ e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M056R69  
NODE=M056R69

<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;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 | $\psi(2S) \rightarrow \gamma \chi_{c0}$ |

NODE=M056R4  
NODE=M056R4

→ UNCHECKED ←

<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=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.

NODE=M056R26;LINKAGE=A1

<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=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 OUR AVERAGE</b>                                                  |      |                        |          |                                               |
| <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

NEW

<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><br>[0.372 ± 0.023 OUR 2018 FIT] |             |      |         |

NODE=M056R53  
NODE=M056R53  
NEW

• • • 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;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

 $\Gamma(K^+ K^- K^+ K^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{50}/\Gamma$ 

| VALUE (units $10^{-3}$ )                  | DOCUMENT ID |
|-------------------------------------------|-------------|
| <b><math>2.82 \pm 0.29</math> OUR FIT</b> |             |

NODE=M056R14  
NODE=M056R14

 $\Gamma(K^+ K^- \phi)/\Gamma_{\text{total}}$ 
 $\Gamma_{51}/\Gamma$ 

| 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

 $\Gamma(\bar{K}^0 K^+ \pi^- \phi + \text{c.c.})/\Gamma_{\text{total}}$ 
 $\Gamma_{52}/\Gamma$ 

| VALUE (units $10^{-3}$ )                   | DOCUMENT ID | TECN     | COMMENT                                 |
|--------------------------------------------|-------------|----------|-----------------------------------------|
| <b><math>3.68 \pm 0.30 \pm 0.50</math></b> | ABLIKIM     | 15M BES3 | $\psi(2S) \rightarrow \gamma \chi_{c0}$ |

NODE=M056R90  
NODE=M056R90

 $\Gamma(K^+ K^- \pi^0 \phi)/\Gamma_{\text{total}}$ 
 $\Gamma_{53}/\Gamma$ 

| VALUE (units $10^{-3}$ )                   | DOCUMENT ID | TECN     | COMMENT                                 |
|--------------------------------------------|-------------|----------|-----------------------------------------|
| <b><math>1.90 \pm 0.14 \pm 0.32</math></b> | ABLIKIM     | 15M BES3 | $\psi(2S) \rightarrow \gamma \chi_{c0}$ |

NODE=M056R91  
NODE=M056R91

$\Gamma(\phi\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{54}/\Gamma$ VALUE (units  $10^{-3}$ ) EVTS

DOCUMENT ID TECN COMMENT

**1.18±0.07±0.13**

538

<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=M056R88  
NODE=M056R88

NODE=M056R88;LINKAGE=A

 $\Gamma(\phi\phi)/\Gamma_{\text{total}}$  $\Gamma_{55}/\Gamma$ VALUE (units  $10^{-3}$ )

DOCUMENT ID

**0.80±0.07 OUR FIT**NODE=M056R16  
NODE=M056R16 $\Gamma(p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{56}/\Gamma$ VALUE (units  $10^{-4}$ )

DOCUMENT ID

**2.21±0.08 OUR FIT**NODE=M056R11  
NODE=M056R11 $\Gamma(p\bar{p}\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{57}/\Gamma$ VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

**0.70±0.07 OUR AVERAGE** Error includes scale factor of 1.3.

0.73±0.06±0.01

<sup>1</sup> ONYISI

10

CLE3

 $\psi(2S) \rightarrow \gamma p\bar{p}X$ 

0.56±0.12±0.01

<sup>2</sup> ATHAR

07

CLEO

 $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ 

<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

 $\Gamma(p\bar{p}\eta)/\Gamma_{\text{total}}$  $\Gamma_{58}/\Gamma$ VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

**0.35±0.04 OUR AVERAGE**

0.35±0.04±0.01

<sup>1</sup> ONYISI

10

CLE3

 $\psi(2S) \rightarrow \gamma p\bar{p}X$ 

0.37±0.11±0.01

<sup>2</sup> ATHAR

07

CLEO

 $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ 

<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

 $\Gamma(p\bar{p}\omega)/\Gamma_{\text{total}}$  $\Gamma_{59}/\Gamma$ VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

**0.52±0.06±0.01**<sup>1</sup> ONYISI

10

CLE3

 $\psi(2S) \rightarrow \gamma p\bar{p}X$ 

<sup>1</sup> ONYISI 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  
NODE=M056R70

NODE=M056R70;LINKAGE=ON

 $\Gamma(p\bar{p}\phi)/\Gamma_{\text{total}}$  $\Gamma_{60}/\Gamma$ VALUE (units  $10^{-5}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**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  
NODE=M056R75

NODE=M056R75;LINKAGE=AB



$\Gamma(p\bar{p}\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{61}/\Gamma$ VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

**2.1  $\pm 0.7$  OUR EVALUATION** Error includes scale factor of 1.4. Treating systematic error as correlated.

NODE=M056R7  
NODE=M056R7

→ UNCHECKED ←

**2.1  $\pm 1.0$  OUR AVERAGE** Error includes scale factor of 2.0.

1.57  $\pm 0.21 \pm 0.53$ <sup>1</sup> BAI

99B

BES

 $\psi(2S) \rightarrow \gamma\chi_{c0}$ 4.20  $\pm 1.15 \pm 0.18$ <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

 $\Gamma(p\bar{p}\pi^0\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{62}/\Gamma$ 

VALUE (%)

EVTS

DOCUMENT ID

TECN

COMMENT

**0.104  $\pm 0.028 \pm 0.002$**  39.5 <sup>1</sup> HE 08B CLEO  $e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$

NODE=M056R65  
NODE=M056R65

<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

 $\Gamma(p\bar{p}K^+K^- \text{ (non-resonant)})/\Gamma_{\text{total}}$  $\Gamma_{63}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**1.22  $\pm 0.26 \pm 0.02$**  48  $\pm 8$  <sup>1</sup> ABLIKIM 11F BES3  $\psi(2S) \rightarrow \gamma p\bar{p}K^+K^-$

NODE=M056R72  
NODE=M056R72

<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

 $\Gamma(p\bar{p}K_S^0 K_S^0)/\Gamma_{\text{total}}$  $\Gamma_{64}/\Gamma$ VALUE (units  $10^{-4}$ )

CL%

DOCUMENT ID

TECN

COMMENT

**<8.8** 90 <sup>1</sup> ABLIKIM 06D BES2  $\psi(2S) \rightarrow \chi_{c0}\gamma$

NODE=M056R46  
NODE=M056R46

<sup>1</sup> Using  $B(\psi(2S) \rightarrow \chi_{c0}\gamma) = (9.2 \pm 0.5)\%$

NODE=M056R;LINKAGE=AB

 $\Gamma(p\bar{n}\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{65}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**12.7  $\pm 1.1$  OUR AVERAGE**12.9  $\pm 1.1 \pm 0.3$ 

5150

<sup>1</sup> ABLIKIM

12J

BES3

 $\psi(2S) \rightarrow \gamma p\bar{n}\pi^-$ 11.2  $\pm 3.1 \pm 0.2$ <sup>2</sup> ABLIKIM

06I

BES2

 $\psi(2S) \rightarrow \gamma p\pi^- X$ 

NODE=M056R49  
NODE=M056R49

<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

 $\Gamma(\bar{p}n\pi^+)/\Gamma_{\text{total}}$  $\Gamma_{66}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**13.7  $\pm 1.2 \pm 0.3$**  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

 $\Gamma(p\bar{n}\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{67}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**23.4  $\pm 2.0 \pm 0.5$**  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

$\Gamma(\bar{p}n\pi^+\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{68}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                | EVTs | DOCUMENT ID          | TECN     | COMMENT                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|--------------------------------------------------|
| <b>22.1±1.8±0.5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2757 | <sup>1</sup> ABLIKIM | 12J BES3 | $\psi(2S) \rightarrow \gamma \bar{p}n\pi^+\pi^0$ |
| <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  
 NODE=M056R84

NODE=M056R84;LINKAGE=AL

 $\Gamma(\Lambda\bar{\Lambda})/\Gamma_{\text{total}}$  $\Gamma_{69}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | DOCUMENT ID |
|--------------------------|-------------|
| <b>3.27±0.24 OUR FIT</b> |             |

NODE=M056R23  
 NODE=M056R23

 $\Gamma(\Lambda\bar{\Lambda}\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{70}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | CL% | EVTs | DOCUMENT ID          | TECN     | COMMENT                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|----------------------|----------|--------------------------------------------------------------|
| <b>118±12±2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     | 426  | <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. • • •                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |      |                      |          |                                                              |
| <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. |     |      |                      |          |                                                              |
| <sup>2</sup> Using $B(\psi(2S) \rightarrow \chi_{c0}\gamma) = (9.2 \pm 0.5)\%$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |      |                      |          |                                                              |

NODE=M056R44  
 NODE=M056R44

NODE=M056R44;LINKAGE=AL

NODE=M056R44;LINKAGE=AB

 $\Gamma(\Lambda\bar{\Lambda}\pi^+\pi^- (\text{non-resonant}))/\Gamma_{\text{total}}$  $\Gamma_{71}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                 | CL% | DOCUMENT ID          | TECN     | COMMENT                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------|----------|--------------------------------------------------------------|
| <b>&lt;50</b>                                                                                                                                                                                                                                                                                                                                                                                                                                            | 90  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Lambda\bar{\Lambda}\pi^+\pi^-$ |
| <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  
 NODE=M056R77

NODE=M056R77;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;50</b>                                                                                                                                                                                                                                                                                                                                                                                                                                      | 90  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Sigma(1385)^+\bar{\Lambda}\pi^-$ |
| <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  
 NODE=M056R78

NODE=M056R78;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;50</b>                                                                                                                                                                                                                                                                                                                                                                                                                                      | 90  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Sigma(1385)^-\bar{\Lambda}\pi^+$ |
| <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  
 NODE=M056R79

NODE=M056R79;LINKAGE=AL

 $\Gamma(K^+\bar{p}\Lambda + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{74}/\Gamma$ 

| 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 $[\Gamma(\chi_{c0}(1P) \rightarrow K^+\bar{p}\Lambda + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.68 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . 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 $[\Gamma(\chi_{c0}(1P) \rightarrow K^+\bar{p}\Lambda + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$ 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=M056R07  
 NODE=M056R07

NODE=M056R07;LINKAGE=AB

NODE=M056R07;LINKAGE=LB  
 NODE=M056R07;LINKAGE=AT

$\Gamma(K^+ \bar{p} \Lambda(1520) + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{75}/\Gamma$ 

| 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 $[\Gamma(\chi_{c0}(1P) \rightarrow K^+ \bar{p} \Lambda(1520) + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.62 \pm 0.31) \times 10^{-2}$ , 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

 $\Gamma(\Lambda(1520) \bar{\Lambda}(1520))/\Gamma_{\text{total}}$  $\Gamma_{76}/\Gamma$ 

| 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

 $\Gamma(\Sigma^0 \bar{\Sigma}^0)/\Gamma_{\text{total}}$  $\Gamma_{77}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | EVTS    | DOCUMENT ID            | TECN     | COMMENT                                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|------------------------|----------|-------------------------------------------------------|
| <b>4.68 ± 0.32 OUR AVERAGE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |                        |          |                                                       |
| [(4.5 ± 0.4) × 10 <sup>-4</sup> OUR 2018 AVERAGE]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |         |                        |          |                                                       |
| 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. • • •                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |         |                        |          |                                                       |
| 4.7 ± 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  
 NEW

NODE=M056R59;LINKAGE=A

NODE=M056R59;LINKAGE=NA

NODE=M056R59;LINKAGE=AB

NODE=M056R59;LINKAGE=B

 $\Gamma(\Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}$  $\Gamma_{78}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | EVTS   | DOCUMENT ID            | TECN     | COMMENT                                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------------|----------|-------------------------------------------------------|
| <b>4.6 ± 0.8 OUR AVERAGE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |        |                        |          |                                                       |
| Error includes scale factor of 2.6. [(4.0 ± 0.7) × 10 <sup>-4</sup> OUR 2018 AVERAGE Scale factor = 1.7]                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |                        |          |                                                       |
| 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  
 NODE=M056R60

NEW

NODE=M056R60;LINKAGE=A

NODE=M056R60;LINKAGE=NA

NODE=M056R60;LINKAGE=AB

NODE=M056R60;LINKAGE=B

$\Gamma(\Sigma(1385)^+ \bar{\Sigma}(1385)^-)/\Gamma_{\text{total}}$  $\Gamma_{79}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                         |
|--------------------------|------|----------------------|----------|-----------------------------------------------------------------|
| <b>16.2±5.8±0.3</b>      | 27   | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Lambda \bar{\Lambda} \pi^+ \pi^-$ |

NODE=M056R80  
 NODE=M056R80

<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;LINKAGE=AL

 $\Gamma(\Sigma(1385)^- \bar{\Sigma}(1385)^+)/\Gamma_{\text{total}}$  $\Gamma_{80}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                         |
|--------------------------|------|----------------------|----------|-----------------------------------------------------------------|
| <b>23.2±6.5±0.5</b>      | 33   | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Lambda \bar{\Lambda} \pi^+ \pi^-$ |

NODE=M056R81  
 NODE=M056R81

<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;LINKAGE=AL

 $\Gamma(K^- \Lambda \bar{\Xi}^+ + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{81}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                             |
|--------------------------|------|----------------------|----------|---------------------------------------------------------------------|
| <b>1.94±0.35±0.04</b>    | 57   | <sup>1</sup> ABLIKIM | 15I BES3 | $\psi(2S) \rightarrow \gamma K^- \Lambda \bar{\Xi}^+ + \text{c.c.}$ |

NODE=M056R92  
 NODE=M056R92

<sup>1</sup> ABLIKIM 15I reports  $[\Gamma(\chi_{c0}(1P) \rightarrow K^- \Lambda \bar{\Xi}^+ + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$   $= (1.90 \pm 0.30 \pm 0.16) \times 10^{-5}$  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;LINKAGE=A

 $\Gamma(\Xi^0 \Xi^0)/\Gamma_{\text{total}}$  $\Gamma_{82}/\Gamma$ 

| 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 | $\psi(2S) \rightarrow \gamma \Xi^0 \Xi^0$ |

NODE=M056R61  
 NODE=M056R61

<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;LINKAGE=NA

 $\Gamma(\Xi^- \Xi^+)/\Gamma_{\text{total}}$  $\Gamma_{83}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL%     | EVTS              | DOCUMENT ID | TECN | COMMENT                                   |
|--------------------------|---------|-------------------|-------------|------|-------------------------------------------|
| <b>4.8±0.7±0.1</b>       | 95 ± 11 | <sup>1</sup> NAIK | 08 CLEO     |      | $\psi(2S) \rightarrow \gamma \Xi^+ \Xi^-$ |

NODE=M056R45  
 NODE=M056R45

• • • 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.

NODE=M056R45;LINKAGE=NA

<sup>2</sup> Using  $B(\psi(2S) \rightarrow \chi_{c0} \gamma) = (9.2 \pm 0.5)\%$

NODE=M056R45;LINKAGE=AB

 $\Gamma(\eta_c \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{84}/\Gamma$ 

| VALUE                           | CL% | DOCUMENT ID            | TECN     | COMMENT                                                     |
|---------------------------------|-----|------------------------|----------|-------------------------------------------------------------|
| <b>&lt; 7 × 10<sup>-4</sup></b> | 90  | <sup>1,2</sup> ABLIKIM | 13B BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c0}$ |

NODE=M056R89  
 NODE=M056R89

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

|                        |    |                        |          |                                                             |
|------------------------|----|------------------------|----------|-------------------------------------------------------------|
| <41 × 10 <sup>-4</sup> | 90 | <sup>1,3</sup> ABLIKIM | 13B BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c0}$ |
|------------------------|----|------------------------|----------|-------------------------------------------------------------|

OCCUR=2

<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.

NODE=M056R89;LINKAGE=A

NODE=M056R89;LINKAGE=B

NODE=M056R89;LINKAGE=C

 $\Gamma(p \bar{p})/\Gamma_{\text{total}} \times \Gamma(\pi \pi)/\Gamma_{\text{total}}$  $\Gamma_{56}/\Gamma \times \Gamma_{32}/\Gamma$ 

| VALUE (units $10^{-7}$ ) | DOCUMENT ID            | TECN    | COMMENT                                                   |
|--------------------------|------------------------|---------|-----------------------------------------------------------|
| <b>18.8±1.0 OUR FIT</b>  |                        |         |                                                           |
| <b>15.3±2.4±0.8</b>      | <sup>1</sup> ANDREOTTI | 03 E835 | $\bar{p} p \rightarrow \chi_{c0} \rightarrow \pi^0 \pi^0$ |

NODE=M056R21  
 NODE=M056R21

<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=M056R;LINKAGE=AD

$$\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\pi^0\eta)/\Gamma_{\text{total}} \quad \Gamma_{56}/\Gamma \times \Gamma_{33}/\Gamma$$

| VALUE (units $10^{-7}$ ) | DOCUMENT ID   | TECN | COMMENT                          |
|--------------------------|---------------|------|----------------------------------|
| <0.4                     | ANDREOTTI 05C | E835 | $\bar{p}p \rightarrow \pi^0\eta$ |

NODE=M056R41  
NODE=M056R41

$$\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\pi^0\eta')/\Gamma_{\text{total}} \quad \Gamma_{56}/\Gamma \times \Gamma_{34}/\Gamma$$

| VALUE (units $10^{-7}$ ) | DOCUMENT ID   | TECN | COMMENT                          |
|--------------------------|---------------|------|----------------------------------|
| <2.5                     | ANDREOTTI 05C | E835 | $\bar{p}p \rightarrow \pi^0\eta$ |

NODE=M056R42  
NODE=M056R42

$$\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\eta\eta)/\Gamma_{\text{total}} \quad \Gamma_{56}/\Gamma \times \Gamma_{36}/\Gamma$$

| VALUE (units $10^{-7}$ )                     | DOCUMENT ID   | TECN | COMMENT                         |
|----------------------------------------------|---------------|------|---------------------------------|
| <b>6.7±0.5 OUR FIT</b>                       |               |      |                                 |
| <b>4.0±1.2<sup>+0.5</sup><sub>-0.3</sub></b> | ANDREOTTI 05C | E835 | $\bar{p}p \rightarrow \eta\eta$ |

NODE=M056R40  
NODE=M056R40

$$\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\eta\eta')/\Gamma_{\text{total}} \quad \Gamma_{56}/\Gamma \times \Gamma_{37}/\Gamma$$

| VALUE (units $10^{-6}$ )                                                      | DOCUMENT ID | TECN | COMMENT |
|-------------------------------------------------------------------------------|-------------|------|---------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |         |

NODE=M056R43  
NODE=M056R43

|                                     |               |      |                                  |
|-------------------------------------|---------------|------|----------------------------------|
| 2.1 <sup>+2.3</sup> <sub>-1.5</sub> | ANDREOTTI 05C | E835 | $\bar{p}p \rightarrow \pi^0\eta$ |
|-------------------------------------|---------------|------|----------------------------------|

### RADIATIVE DECAYS

$$\Gamma(\gamma J/\psi(1S))/\Gamma_{\text{total}} \quad \Gamma_{85}/\Gamma$$

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
| <b>1.40±0.05 OUR FIT</b> |      |             |      |         |

NODE=M056310

NODE=M056R8  
NODE=M056R8

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

|                |     |                      |          |                                                           |
|----------------|-----|----------------------|----------|-----------------------------------------------------------|
| 0.25±0.16±2.15 | 12k | <sup>1</sup> ABLIKIM | 17U BES3 | $e^+e^- \rightarrow \gamma X$                             |
| 2.0 ±0.2 ±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( $\psi(2S) \rightarrow \gamma\chi_{c0}(1P)$ ) × 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=M056R8;LINKAGE=A

NODE=M056R8;LINKAGE=AD

$$\Gamma(\gamma\rho^0)/\Gamma_{\text{total}} \quad \Gamma_{86}/\Gamma$$

| VALUE (units $10^{-6}$ ) | CL% | EVTS      | DOCUMENT ID          | TECN     | COMMENT                                   |
|--------------------------|-----|-----------|----------------------|----------|-------------------------------------------|
| < 9                      | 90  | 1.2 ± 4.5 | <sup>1</sup> BENNETT | 08A CLEO | $\psi(2S) \rightarrow \gamma\gamma\rho^0$ |

NODE=M056R56  
NODE=M056R56

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

|     |    |        |                      |          |                                           |
|-----|----|--------|----------------------|----------|-------------------------------------------|
| <10 | 90 | 6 ± 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( $\psi(2S) \rightarrow \gamma\chi_{c0}(1P)$ ) =  $9.79 \times 10^{-2}$ .

NODE=M056R56;LINKAGE=BE

<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;LINKAGE=AB

$$\Gamma(\gamma\omega)/\Gamma_{\text{total}} \quad \Gamma_{87}/\Gamma$$

| VALUE (units $10^{-6}$ ) | CL% | EVTS      | DOCUMENT ID          | TECN     | COMMENT                                   |
|--------------------------|-----|-----------|----------------------|----------|-------------------------------------------|
| < 8                      | 90  | 0.0 ± 2.8 | <sup>1</sup> BENNETT | 08A CLEO | $\psi(2S) \rightarrow \gamma\gamma\omega$ |

NODE=M056R57  
NODE=M056R57

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

|     |    |        |                      |          |                                           |
|-----|----|--------|----------------------|----------|-------------------------------------------|
| <13 | 90 | 5 ± 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( $\psi(2S) \rightarrow \gamma\chi_{c0}(1P)$ ) =  $9.79 \times 10^{-2}$ .

NODE=M056R57;LINKAGE=BE

<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;LINKAGE=AB

$$\Gamma(\gamma\phi)/\Gamma_{\text{total}} \quad \Gamma_{88}/\Gamma$$

| VALUE (units $10^{-6}$ ) | CL% | EVTS      | DOCUMENT ID          | TECN     | COMMENT                                 |
|--------------------------|-----|-----------|----------------------|----------|-----------------------------------------|
| < 6                      | 90  | 0.1 ± 1.6 | <sup>1</sup> BENNETT | 08A CLEO | $\psi(2S) \rightarrow \gamma\gamma\phi$ |

NODE=M056R58  
NODE=M056R58

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

|     |    |        |                      |          |                                         |
|-----|----|--------|----------------------|----------|-----------------------------------------|
| <16 | 90 | 15 ± 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;LINKAGE=BE

NODE=M056R58;LINKAGE=AB

| $\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ |     |             |      |         | $\Gamma_{89}/\Gamma$ |
|----------------------------------------------|-----|-------------|------|---------|----------------------|
| VALUE (units $10^{-4}$ )                     | CL% | DOCUMENT ID | TECN | COMMENT |                      |
| <b>2.04±0.09 OUR FIT</b>                     |     |             |      |         |                      |

NODE=M056R1  
NODE=M056R1

• • • 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  $B(B^+ \rightarrow \chi_{c0} K^+) = 1.49 \times 10^{-4}$ .

NODE=M056R1;LINKAGE=WI

| $\Gamma(e^+e^- J/\psi(1S))/\Gamma_{\text{total}}$ |      |                      |      |                                                   | $\Gamma_{90}/\Gamma$ |
|---------------------------------------------------|------|----------------------|------|---------------------------------------------------|----------------------|
| VALUE (units $10^{-4}$ )                          | EVTs | DOCUMENT ID          | TECN | COMMENT                                           |                      |
| <b>1.54±0.33±0.03</b>                             | 56   | <sup>1</sup> ABLIKIM | 17I  | BES3 $\psi(2S) \rightarrow \gamma e^+ e^- J/\psi$ |                      |

NODE=M056R93  
NODE=M056R93

- <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.

NODE=M056R93;LINKAGE=B

| $\Gamma(e^+e^- J/\psi(1S))/\Gamma(\gamma J/\psi(1S))$ |      |                      |      |                                                   | $\Gamma_{90}/\Gamma_{85}$ |
|-------------------------------------------------------|------|----------------------|------|---------------------------------------------------|---------------------------|
| VALUE (units $10^{-3}$ )                              | EVTs | DOCUMENT ID          | TECN | COMMENT                                           |                           |
| <b>9.5±1.9±0.7</b>                                    | 56   | <sup>1</sup> ABLIKIM | 17I  | BES3 $\psi(2S) \rightarrow e^+ e^- \gamma J/\psi$ |                           |

NODE=M056R94  
NODE=M056R94

- <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;LINKAGE=A

| $\Gamma(\gamma\gamma)/\Gamma(\gamma J/\psi(1S))$ |  |             |      |         | $\Gamma_{89}/\Gamma_{85}$ |
|--------------------------------------------------|--|-------------|------|---------|---------------------------|
| VALUE (units $10^{-2}$ )                         |  | DOCUMENT ID | TECN | COMMENT |                           |
| <b>1.45±0.08 OUR FIT</b>                         |  |             |      |         |                           |
| <b>2.0 ±0.4 OUR AVERAGE</b>                      |  |             |      |         |                           |

NODE=M056R18  
NODE=M056R18

2.2  $\pm 0.4$   $^{+0.1}_{-0.2}$                       <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       $\bar{p}p \rightarrow \chi_{c2} \rightarrow \gamma\gamma, \gamma J/\psi$

- <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.

NODE=M056R;LINKAGE=AN

- <sup>2</sup> Calculated by us using  $B(J/\psi(1S) \rightarrow e^+ e^-) = 0.0593 \pm 0.0010$ .

NODE=M056R;LINKAGE=7A

| $\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\gamma J/\psi(1S))/\Gamma_{\text{total}}$ |      |             |      |         | $\Gamma_{56}/\Gamma \times \Gamma_{85}/\Gamma$ |
|-------------------------------------------------------------------------------------------------|------|-------------|------|---------|------------------------------------------------|
| VALUE (units $10^{-7}$ )                                                                        | EVTs | DOCUMENT ID | TECN | COMMENT |                                                |
| <b>31.1±1.5 OUR FIT</b>                                                                         |      |             |      |         |                                                |
| <b>28.2±2.1 OUR AVERAGE</b>                                                                     |      |             |      |         |                                                |

NODE=M056R19  
NODE=M056R19

28.0±1.9±1.3                      392                      <sup>1,2,3</sup> BAGNASCO      02      E835       $\bar{p}p \rightarrow \chi_{c0} \rightarrow J/\psi\gamma$

29.3  $^{+5.7}_{-4.7}$  ±1.5                      89                      <sup>1,2</sup> AMBROGIANI 99B                       $\bar{p}p \rightarrow \chi_{c0} \rightarrow J/\psi\gamma$

- <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.

NODE=M056R;LINKAGE=KS

- <sup>2</sup> Calculated by us using  $B(J/\psi(1S) \rightarrow e^+ e^-) = 0.0593 \pm 0.0010$ .

NODE=M056R19;LINKAGE=7A  
NODE=M056R19;LINKAGE=AN

- <sup>3</sup> Recalculated by ANDREOTTI 05A.

| $\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ |  |             |      |         | $\Gamma_{56}/\Gamma \times \Gamma_{89}/\Gamma$ |
|--------------------------------------------------------------------------------------------|--|-------------|------|---------|------------------------------------------------|
| VALUE (units $10^{-8}$ )                                                                   |  | DOCUMENT ID | TECN | COMMENT |                                                |
| <b>4.52±0.27 OUR FIT</b>                                                                   |  |             |      |         |                                                |

NODE=M056R25  
NODE=M056R25

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

6.52±1.18  $^{+0.48}_{-0.72}$                       <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;LINKAGE=AN

$\chi_{c0}(1P)$  CROSS-PARTICLE BRANCHING RATIOS

NODE=M056230

$$\Gamma(\chi_{c0}(1P) \rightarrow p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))/\Gamma_{\text{total}}$$

$$\Gamma_{56}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma^{\psi(2S)}$$

NODE=M056B6  
NODE=M056B6

| VALUE (units $10^{-6}$ )                  | EVTS                               | DOCUMENT ID       | TECN     | COMMENT                                                               |
|-------------------------------------------|------------------------------------|-------------------|----------|-----------------------------------------------------------------------|
| <b>21.7±0.9 OUR FIT</b>                   |                                    |                   |          |                                                                       |
| <b>23.7±1.0 OUR AVERAGE</b>               |                                    |                   |          |                                                                       |
| 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  | $\psi(2S) \rightarrow \gamma\chi_{c0}(1P) \rightarrow \gamma\bar{p}p$ |

<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;LINKAGE=NA

$$\Gamma(\chi_{c0}(1P) \rightarrow p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)$$

$$\Gamma_{56}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$$

NODE=M056B1  
NODE=M056B1

| VALUE (units $10^{-5}$ ) | DOCUMENT ID      | TECN    | COMMENT                                                           |
|--------------------------|------------------|---------|-------------------------------------------------------------------|
| <b>6.25±0.26 OUR FIT</b> |                  |         |                                                                   |
| <b>4.6 ±1.9</b>          | <sup>1</sup> BAI | 98i BES | $\psi(2S) \rightarrow \gamma\chi_{c0} \rightarrow \gamma\bar{p}p$ |

<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=M056B;LINKAGE=B1

$$\Gamma(\chi_{c0}(1P) \rightarrow \Lambda\bar{\Lambda})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))/\Gamma_{\text{total}}$$

$$\Gamma_{69}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma^{\psi(2S)}$$

NODE=M056B20  
NODE=M056B20

| VALUE (units $10^{-6}$ )    | EVTS     | DOCUMENT ID          | TECN     | COMMENT                                           |
|-----------------------------|----------|----------------------|----------|---------------------------------------------------|
| <b>32.0±2.3 OUR FIT</b>     |          |                      |          |                                                   |
| <b>31.7±2.3 OUR AVERAGE</b> |          |                      |          |                                                   |
| 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  $B(\psi(2S) \rightarrow \gamma\chi_{c0}) = (9.62 \pm 0.31)\%$ .

NODE=M056B20;LINKAGE=AB

<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;LINKAGE=NA

$$\Gamma(\chi_{c0}(1P) \rightarrow \Lambda\bar{\Lambda})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)$$

$$\Gamma_{69}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$$

NODE=M056B21  
NODE=M056B21

| VALUE (units $10^{-5}$ )                      | EVTS                                 | DOCUMENT ID      | TECN    | COMMENT                                           |
|-----------------------------------------------|--------------------------------------|------------------|---------|---------------------------------------------------|
| <b>9.2±0.7 OUR FIT</b>                        |                                      |                  |         |                                                   |
| <b>13.0<sup>+3.6</sup><sub>-3.5</sub>±2.5</b> | 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;LINKAGE=BA

$$\Gamma(\chi_{c0}(1P) \rightarrow \gamma J/\psi(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))/\Gamma_{\text{total}}$$

$$\Gamma_{85}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma^{\psi(2S)}$$

NODE=M056B2  
NODE=M056B2

| VALUE (units $10^{-2}$ )                                                      | EVTS | DOCUMENT ID            | TECN     | COMMENT                                    |
|-------------------------------------------------------------------------------|------|------------------------|----------|--------------------------------------------|
| <b>0.138±0.005 OUR FIT</b>                                                    |      |                        |          |                                            |
| <b>0.147±0.029 OUR AVERAGE</b>                                                |      |                        |          |                                            |
| 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;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

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow \gamma J/\psi(1S))}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))}{\Gamma(\psi(2S) \rightarrow J/\psi(1S) \text{ anything})} = \frac{\Gamma_{85}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma_9^{\psi(2S)}}{\Gamma_{85}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma_9^{\psi(2S)} + \Gamma_{12}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)} + \Gamma_{13}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)} + 0.343\Gamma_{148}^{\psi(2S)} + 0.190\Gamma_{149}^{\psi(2S)}}$$

NODE=M056B7

NODE=M056B7

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. • • •

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID         | TECN | COMMENT                                      |
|--------------------------|------|---------------------|------|----------------------------------------------|
| 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;LINKAGE=ME

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow \gamma J/\psi(1S))}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))}{\Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)} = \frac{\Gamma_{85}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}{\Gamma_{85}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

NODE=M056B8

NODE=M056B8

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

**0.397±0.015 OUR FIT**

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                                      |
|--------------------------|------|-------------|------|----------------------------------------------|
| <b>0.358±0.020±0.037</b> | 560  | MENDEZ      | 08   | CLEO $\psi(2S) \rightarrow \gamma \chi_{c0}$ |

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

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID       | TECN | COMMENT                 |
|--------------------------|------|-------------------|------|-------------------------|
| 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=M056B;LINKAGE=AD

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow \gamma \gamma)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))}{\Gamma_{\text{total}}} = \frac{\Gamma_{89}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma^{\psi(2S)}}{\Gamma_{89}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma^{\psi(2S)}}$$

NODE=M056B3

NODE=M056B3

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

**2.00±0.08 OUR FIT**

**1.95±0.09 OUR AVERAGE**

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

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

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow \pi \pi)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))}{\Gamma_{\text{total}}} = \frac{\Gamma_{32}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma^{\psi(2S)}}{\Gamma_{32}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma^{\psi(2S)}}$$

NODE=M056B22

NODE=M056B22

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

**8.34±0.29 OUR FIT**

**8.80±0.34 OUR AVERAGE**

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

OCCUR=2

NODE=M056B22;LINKAGE=AB

NODE=M056B22;LINKAGE=AS

NODE=M056B22;LINKAGE=AN



$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow \pi\pi)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)}{\Gamma_{32}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

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

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow \eta\eta)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))/\Gamma_{\text{total}}}{\Gamma_{36}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

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 | $\psi(2S) \rightarrow \gamma\chi_{c0}$ |
|----------------|----|--------------------|----|------|----------------------------------------|

<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).

NODE=M056B11  
NODE=M056B11

NODE=M056B11;LINKAGE=AB

NODE=M056B11;LINKAGE=AS

NODE=M056B11;LINKAGE=AD

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow \eta\eta)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)}{\Gamma_{36}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

VALUE (units  $10^{-3}$ )

DOCUMENT ID TECN COMMENT

**0.85 ±0.05 OUR FIT**

**0.578±0.241±0.158**

BAI 03C BES  $\psi(2S) \rightarrow \gamma\eta\eta$

NODE=M056B10  
NODE=M056B10

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow K^+K^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))/\Gamma_{\text{total}}}{\Gamma_{42}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID TECN COMMENT

**5.92±0.28 OUR FIT**

**5.97±0.07±0.32**

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

NODE=M056B23;LINKAGE=AS

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow K^+K^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)}{\Gamma_{42}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

VALUE (units  $10^{-3}$ )

EVTS

DOCUMENT ID TECN COMMENT

**1.71±0.08 OUR FIT**

**1.63±0.10±0.15**

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

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow K_S^0 K_S^0)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))/\Gamma_{\text{total}}}{\Gamma_{43}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID TECN COMMENT

**3.10±0.16 OUR FIT**

**3.18±0.17 OUR AVERAGE**

|                |      |                    |     |      |                                           |
|----------------|------|--------------------|-----|------|-------------------------------------------|
| 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            | 05O | 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

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow K_S^0 K_S^0)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)}{\Gamma_{43}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

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

**8.9±0.5 OUR FIT**

**5.6±0.8±1.3**      <sup>1</sup> BAI      99B      BES       $\psi(2S) \rightarrow \gamma K_S^0 K_S^0$

NODE=M056B13  
NODE=M056B13

<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;LINKAGE=BA

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow 2(\pi^+\pi^-))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)}{\Gamma_1/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

VALUE (units 10<sup>-3</sup>)      DOCUMENT ID      TECN      COMMENT

**6.6±0.5 OUR FIT**

**6.9±2.4 OUR AVERAGE** 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       $\psi(2S) \rightarrow \gamma \chi_{c0}$

NODE=M056B4  
NODE=M056B4

<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].

NODE=M056B;LINKAGE=B2

<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=M056B;LINKAGE=J1

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow \pi^+\pi^- K^+ K^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))/\Gamma_{\text{total}}}{\Gamma_8/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

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

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow \pi^+\pi^- K^+ K^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)}{\Gamma_8/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

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

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow K^+ K^- K^+ K^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))/\Gamma_{\text{total}}}{\Gamma_{50}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

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

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow K^+ K^- K^+ K^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)}{\Gamma_{50}/\Gamma \times \Gamma_{147}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

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

$$\Gamma(\chi_{c0}(1P) \rightarrow \phi\phi) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) / \Gamma_{\text{total}}$$

$$\Gamma_{55} / \Gamma \times \Gamma_{147}^{\psi(2S)} / \Gamma_{11}^{\psi(2S)}$$

| VALUE (units $10^{-4}$ )     | EVTS | DOCUMENT ID          | TECN     | COMMENT                                 |
|------------------------------|------|----------------------|----------|-----------------------------------------|
| <b>0.78±0.07 OUR FIT</b>     |      |                      |          |                                         |
| <b>0.78±0.08 OUR AVERAGE</b> |      |                      |          |                                         |
| 0.77±0.03±0.08               | 612  | <sup>1</sup> ABLIKIM | 11K BES3 | $\psi(2S) \rightarrow \gamma$ hadrons   |
| 0.86±0.19±0.12               | 26   | <sup>2</sup> ABLIKIM | 06T BES2 | $\psi(2S) \rightarrow \gamma 2K^+ 2K^-$ |

<sup>1</sup> Calculated by us. The value of  $B(\chi_{c0} \rightarrow \phi\phi)$  reported by ABLIKIM 11K was derived using  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.62 \pm 0.31)\%$ .

<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  
NODE=M056B16

NODE=M056B16;LINKAGE=AL

NODE=M056B16;LINKAGE=AB

$$\Gamma(\chi_{c0}(1P) \rightarrow \phi\phi) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) / \Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)$$

$$\Gamma_{55} / \Gamma \times \Gamma_{147}^{\psi(2S)} / \Gamma_{11}^{\psi(2S)}$$

| VALUE (units $10^{-4}$ ) | DOCUMENT ID      | TECN    | COMMENT                                 |
|--------------------------|------------------|---------|-----------------------------------------|
| <b>2.25±0.21 OUR FIT</b> |                  |         |                                         |
| <b>2.6 ±1.0 ±1.1</b>     |                  |         |                                         |
|                          | <sup>1</sup> BAI | 99B BES | $\psi(2S) \rightarrow \gamma 2K^+ 2K^-$ |

<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  
NODE=M056B17

NODE=M056B17;LINKAGE=BA

### $\chi_{c0}(1P)$ REFERENCES

|               |      |                  |                                  |                     |             |
|---------------|------|------------------|----------------------------------|---------------------|-------------|
| ABLIKIM       | 19J  | PR D99 012015    | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=59606 |
| ABLIKIM       | 18V  | PR D97 052011    | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=58990 |
| AAIJ          | 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>         | (BES III Collab.)   | REFID=58310 |
| ABLIKIM       | 17AI | PR D96 112006    | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=58321 |
| ABLIKIM       | 17I  | PRL 118 221802   | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=57931 |
| ABLIKIM       | 17N  | PR D95 072004    | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=57978 |
| ABLIKIM       | 17U  | PR D96 032001    | M. Ablikim <i>et al.</i>         | (BES III 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>         | (BES III Collab.)   | REFID=56774 |
| ABLIKIM       | 15M  | PR D91 112008    | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=56778 |
| ABLIKIM       | 15N  | PR D91 112018    | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=56779 |
| ABLIKIM       | 13B  | PR D87 012002    | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=54877 |
| ABLIKIM       | 13D  | PR D87 012007    | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=54879 |
| ABLIKIM       | 13H  | PR D87 032007    | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=54953 |
| ABLIKIM       | 13V  | PR D88 112001    | M. Ablikim <i>et al.</i>         | (BES III 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>         | (BES III Collab.)   | REFID=54266 |
| ABLIKIM       | 12I  | PR D86 052004    | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=54736 |
| ABLIKIM       | 12J  | PR D86 052011    | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=54737 |
| ABLIKIM       | 12O  | PRL 109 172002   | M. Ablikim <i>et al.</i>         | (BES III 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>         | (BES III Collab.)   | REFID=53647 |
| ABLIKIM       | 11E  | PR D83 112005    | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=16717 |
| ABLIKIM       | 11F  | PR D83 112009    | M. Ablikim <i>et al.</i>         | (BES III Collab.)   | REFID=16719 |
| ABLIKIM       | 11K  | PRL 107 092001   | M. Ablikim <i>et al.</i>         | (BES III 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>         | (BES III 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 |

NODE=M056

|            |     |               |                               |                        |
|------------|-----|---------------|-------------------------------|------------------------|
| ABLIKIM    | 04G | PR D70 092002 | M. Ablikim <i>et al.</i>      | (BES Collab.)          |
| ABLIKIM    | 04H | PR D70 092003 | M. Ablikim <i>et al.</i>      | (BES Collab.)          |
| ANDREOTTI  | 04  | PL B584 16    | M. Andreotti <i>et al.</i>    | (E835 Collab.)         |
| ATHAR      | 04  | PR D70 112002 | S.B. Athar <i>et al.</i>      | (CLEO Collab.)         |
| BAI        | 04F | PR D69 092001 | J.Z. Bai <i>et al.</i>        | (BES Collab.)          |
| ANDREOTTI  | 03  | PRL 91 091801 | M. Andreotti <i>et al.</i>    | (FNAL E835 Collab.)    |
| AULCHENKO  | 03  | PL B573 63    | V.M. Aulchenko <i>et al.</i>  | (KEDR Collab.)         |
| BAI        | 03C | PR D67 032004 | J.Z. Bai <i>et al.</i>        | (BES Collab.)          |
| BAI        | 03E | PR D67 112001 | J.Z. Bai <i>et al.</i>        | (BES Collab.)          |
| ABE.K      | 02  | PRL 89 142001 | K. Abe <i>et al.</i>          | (BELLE Collab.)        |
| BAGNASCO   | 02  | PL B533 237   | S. Bagnasco <i>et al.</i>     | (FNAL E835 Collab.)    |
| EISENSTEIN | 01  | PRL 87 061801 | B.I. Eisenstein <i>et al.</i> | (CLEO Collab.)         |
| AMBROGIANI | 00B | PR D62 052002 | M. Ambrogiani <i>et al.</i>   | (FNAL E835 Collab.)    |
| AMBROGIANI | 99B | PRL 83 2902   | M. Ambrogiani <i>et al.</i>   | (FNAL E835 Collab.)    |
| BAI        | 99B | PR D60 072001 | J.Z. Bai <i>et al.</i>        | (BES Collab.)          |
| BAI        | 98D | PR D58 092006 | J.Z. Bai <i>et al.</i>        | (BES Collab.)          |
| BAI        | 98I | PRL 81 3091   | J.Z. Bai <i>et al.</i>        | (BES Collab.)          |
| GAISER     | 86  | PR D34 711    | J. Gaiser <i>et al.</i>       | (Crystal Ball Collab.) |
| LEE        | 85  | SLAC 282      | R.A. Lee                      | (SLAC)                 |
| OREGLIA    | 82  | PR D25 2259   | M.J. Oreglia <i>et al.</i>    | (SLAC, CIT, HARV+)     |
| BRANDELIK  | 79B | NP B160 426   | R. Brandelik <i>et al.</i>    | (DASP Collab.)         |
| BARTEL     | 78B | PL 79B 492    | W. Bartel <i>et al.</i>       | (DESY, HEIDP)          |
| TANENBAUM  | 78  | PR D17 1731   | W.M. Tanenbaum <i>et al.</i>  | (SLAC, LBL)            |
| Also       |     | Private Comm. | G. Trilling                   | (LBL, UCB)             |
| BIDDICK    | 77  | PRL 38 1324   | C.J. Biddick <i>et al.</i>    | (UCSD, UMD, PAVI+)     |

REFID=50187  
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NODE=M055

$\chi_{c1}(1P)$

$$I^G(J^{PC}) = 0^+(1^{++})$$

See the Review on " $\psi(2S)$  and  $\chi_c$  branching ratios" before the  $\chi_{c0}(1P)$  Listings.

NODE=M055

### $\chi_{c1}(1P)$ MASS

NODE=M055M

| 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   | $p\bar{p} \rightarrow e^+e^-\gamma$                     |
| 3511.3 ± 0.4 ± 0.4                                                            | 30   | BAGLIN                              | 86B SPEC  | $p\bar{p} \rightarrow e^+e^-X$                          |
| 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

NODE=M055W

| 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 +0.40 +0.26<br>-0.38 -0.77                                               |     |      | 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  | $p\bar{p} \rightarrow e^+e^-\gamma$    |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |     |      |                        |          |                                        |
| <1.3                                                                          | 95  |      | BAGLIN                 | 86B SPEC | $p\bar{p} \rightarrow e^+e^-X$         |
| <3.8                                                                          | 90  |      | GAISER                 | 86 CBAL  | $\psi(2S) \rightarrow \gamma X$        |

NODE=M055W

<sup>1</sup> Recalculated by ANDREOTTI 05A.

NODE=M055W;LINKAGE=AN

NODE=M055215;NODE=M055

 **$\chi_{c1}(1P)$  DECAY MODES**

| Mode                                                                                         | Fraction ( $\Gamma_i/\Gamma$ )         | Scale factor/<br>Confidence level |                   |
|----------------------------------------------------------------------------------------------|----------------------------------------|-----------------------------------|-------------------|
| <b>Hadronic decays</b>                                                                       |                                        |                                   |                   |
| $\Gamma_1$ $3(\pi^+\pi^-)$                                                                   | $(5.8 \pm 1.4) \times 10^{-3}$         | S=1.2                             | NODE=M055;CLUMP=A |
| $\Gamma_2$ $2(\pi^+\pi^-)$                                                                   | $(7.6 \pm 2.6) \times 10^{-3}$         |                                   | DESIG=6           |
| $\Gamma_3$ $\pi^+\pi^-\pi^0\pi^0$                                                            | $(1.19 \pm 0.15) \%$                   |                                   | DESIG=5           |
| $\Gamma_4$ $\rho^+\pi^-\pi^0 + \text{c.c.}$                                                  | $(1.45 \pm 0.24) \%$                   |                                   | DESIG=51          |
| $\Gamma_5$ $\rho^0\pi^+\pi^-$                                                                | $(3.9 \pm 3.5) \times 10^{-3}$         |                                   | DESIG=52          |
| $\Gamma_6$ $4\pi^0$                                                                          | $(5.4 \pm 0.8) \times 10^{-4}$         |                                   | DESIG=9           |
| $\Gamma_7$ $\pi^+\pi^-K^+K^-$                                                                | $(4.5 \pm 1.0) \times 10^{-3}$         |                                   | DESIG=60          |
| $\Gamma_8$ $K^+K^-\pi^0\pi^0$                                                                | $(1.12 \pm 0.27) \times 10^{-3}$       |                                   | DESIG=7           |
| $\Gamma_9$ $K^+K^-\pi^+\pi^-\pi^0$                                                           | $(1.15 \pm 0.13) \%$                   |                                   | DESIG=53          |
| $\Gamma_{10}$ $K_S^0 K^\pm \pi^\mp \pi^+\pi^-$                                               | $(7.5 \pm 0.8) \times 10^{-3}$         |                                   | DESIG=79          |
| $\Gamma_{11}$ $K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.}$                                         | $(8.6 \pm 1.4) \times 10^{-3}$         |                                   | DESIG=84          |
| $\Gamma_{12}$ $\rho^-K^+\bar{K}^0 + \text{c.c.}$                                             | $(5.0 \pm 1.2) \times 10^{-3}$         |                                   | DESIG=55          |
| $\Gamma_{13}$ $K^*(892)^0\bar{K}^0\pi^0 \rightarrow K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.}$    | $(2.3 \pm 0.6) \times 10^{-3}$         |                                   | DESIG=56          |
| $\Gamma_{14}$ $K^+K^-\eta\pi^0$                                                              | $(1.12 \pm 0.34) \times 10^{-3}$       |                                   | DESIG=57          |
| $\Gamma_{15}$ $\pi^+\pi^-K_S^0K_S^0$                                                         | $(6.9 \pm 2.9) \times 10^{-4}$         |                                   | DESIG=58          |
| $\Gamma_{16}$ $K^+K^-\eta$                                                                   | $(3.2 \pm 1.0) \times 10^{-4}$         |                                   | DESIG=28          |
| $\Gamma_{17}$ $\bar{K}^0K^+\pi^- + \text{c.c.}$                                              | $(7.0 \pm 0.6) \times 10^{-3}$         |                                   | DESIG=42          |
| $\Gamma_{18}$ $K^*(892)^0\bar{K}^0 + \text{c.c.}$                                            | $(10 \pm 4) \times 10^{-4}$            |                                   | DESIG=17          |
| $\Gamma_{19}$ $K^*(892)^+K^- + \text{c.c.}$                                                  | $(1.4 \pm 0.6) \times 10^{-3}$         |                                   | DESIG=32          |
| $\Gamma_{20}$ $K_J^*(1430)^0\bar{K}^0 + \text{c.c.} \rightarrow K_S^0K^+\pi^- + \text{c.c.}$ | $< 8 \times 10^{-4}$                   | CL=90%                            | DESIG=33          |
| $\Gamma_{21}$ $K_J^*(1430)^+K^- + \text{c.c.} \rightarrow K_S^0K^+\pi^- + \text{c.c.}$       | $< 2.1 \times 10^{-3}$                 | CL=90%                            | DESIG=34          |
| $\Gamma_{22}$ $K^+K^-\pi^0$                                                                  | $(1.81 \pm 0.24) \times 10^{-3}$       |                                   | DESIG=35          |
| $\Gamma_{23}$ $\eta\pi^+\pi^-$                                                               | $(4.62 \pm 0.23) \times 10^{-3}$       |                                   | DESIG=38          |
| $\Gamma_{24}$ $a_0(980)^+\pi^- + \text{c.c.} \rightarrow \eta\pi^+\pi^-$                     | $(3.2 \pm 0.4) \times 10^{-3}$         | S=2.2                             | DESIG=31          |
| $\Gamma_{25}$ $a_2(1320)^+\pi^- + \text{c.c.} \rightarrow \eta\pi^+\pi^-$                    | $(1.76 \pm 0.24) \times 10^{-4}$       |                                   | DESIG=36          |
| $\Gamma_{26}$ $a_2(1700)^+\pi^- + \text{c.c.} \rightarrow \eta\pi^+\pi^-$                    | $(4.6 \pm 0.7) \times 10^{-5}$         |                                   | DESIG=93          |
| $\Gamma_{27}$ $f_2(1270)\eta \rightarrow \eta\pi^+\pi^-$                                     | $(3.5 \pm 0.6) \times 10^{-4}$         |                                   | DESIG=96          |
| $\Gamma_{28}$ $f_4(2050)\eta \rightarrow \eta\pi^+\pi^-$                                     | $(2.5 \pm 0.9) \times 10^{-5}$         |                                   | DESIG=94          |
| $\Gamma_{29}$ $\pi_1(1400)^+\pi^- + \text{c.c.} \rightarrow \eta\pi^+\pi^-$                  | $< 5 \times 10^{-5}$                   | CL=90%                            | DESIG=95          |
| $\Gamma_{30}$ $\pi_1(1600)^+\pi^- + \text{c.c.} \rightarrow \eta\pi^+\pi^-$                  | $< 1.5 \times 10^{-5}$                 | CL=90%                            | DESIG=97          |
| $\Gamma_{31}$ $\pi_1(2015)^+\pi^- + \text{c.c.} \rightarrow \eta\pi^+\pi^-$                  | $< 8 \times 10^{-6}$                   | CL=90%                            | DESIG=98          |
| $\Gamma_{32}$ $f_2(1270)\eta$                                                                | $(6.7 \pm 1.1) \times 10^{-4}$         |                                   | DESIG=99          |
| $\Gamma_{33}$ $\pi^+\pi^-\eta'$                                                              | $(2.2 \pm 0.4) \times 10^{-3}$         |                                   | DESIG=37          |
| $\Gamma_{34}$ $K^+K^-\eta'(958)$                                                             | $(8.8 \pm 0.9) \times 10^{-4}$         |                                   | DESIG=44          |
| $\Gamma_{35}$ $K_0^*(1430)^+K^- + \text{c.c.}$                                               | $(6.4 \pm 2.2 \pm 2.8) \times 10^{-4}$ |                                   | DESIG=85          |
| $\Gamma_{36}$ $f_0(980)\eta'(958)$                                                           | $(1.6 \pm 1.4 \pm 0.7) \times 10^{-4}$ |                                   | DESIG=86          |
| $\Gamma_{37}$ $f_0(1710)\eta'(958)$                                                          | $(7 \pm 7 \pm 5) \times 10^{-5}$       |                                   | DESIG=87          |
| $\Gamma_{38}$ $f_2'(1525)\eta'(958)$                                                         | $(9 \pm 6) \times 10^{-5}$             |                                   | DESIG=88          |
| $\Gamma_{39}$ $\pi^0 f_0(980) \rightarrow \pi^0\pi^+\pi^-$                                   | $(3.5 \pm 0.9) \times 10^{-7}$         |                                   | DESIG=89          |
| $\Gamma_{40}$ $K^+\bar{K}^*(892)^0\pi^- + \text{c.c.}$                                       | $(3.2 \pm 2.1) \times 10^{-3}$         |                                   | DESIG=61          |
| $\Gamma_{41}$ $K^*(892)^0\bar{K}^*(892)^0$                                                   | $(1.4 \pm 0.4) \times 10^{-3}$         |                                   | DESIG=10          |
| $\Gamma_{42}$ $K^+K^-\bar{K}_S^0K_S^0$                                                       | $< 4 \times 10^{-4}$                   | CL=90%                            | DESIG=21          |
| $\Gamma_{43}$ $K^+K^-\bar{K}^+K^-$                                                           | $(5.4 \pm 1.1) \times 10^{-4}$         |                                   | DESIG=29          |
| $\Gamma_{44}$ $\bar{K}^0K^+\pi^-\phi + \text{c.c.}$                                          | $(4.1 \pm 1.5) \times 10^{-4}$         |                                   | DESIG=14          |
| $\Gamma_{45}$ $K^+K^-\pi^0\phi$                                                              | $(3.3 \pm 0.5) \times 10^{-3}$         |                                   | DESIG=30          |
| $\Gamma_{46}$ $K^+K^-\pi^0\phi$                                                              | $(1.62 \pm 0.30) \times 10^{-3}$       |                                   | DESIG=90          |

NODE=M055;CLUMP=A

DESIG=6

DESIG=5

DESIG=51

DESIG=52

DESIG=9

DESIG=60

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DESIG=61

DESIG=10

DESIG=21

DESIG=29

DESIG=14

DESIG=30

DESIG=90

DESIG=91

|                 |                                                   |                                  |        |          |
|-----------------|---------------------------------------------------|----------------------------------|--------|----------|
| Γ <sub>47</sub> | $\phi\pi^+\pi^-\pi^0$                             | $(7.5 \pm 1.0) \times 10^{-4}$   |        | DESIG=82 |
| Γ <sub>48</sub> | $\omega\omega$                                    | $(5.7 \pm 0.7) \times 10^{-4}$   |        | DESIG=66 |
| Γ <sub>49</sub> | $\omega K^+ K^-$                                  | $(7.8 \pm 0.9) \times 10^{-4}$   |        | DESIG=81 |
| Γ <sub>50</sub> | $\omega\phi$                                      | $(2.7 \pm 0.4) \times 10^{-5}$   |        | DESIG=67 |
| Γ <sub>51</sub> | $\phi\phi$                                        | $(4.2 \pm 0.5) \times 10^{-4}$   |        | DESIG=68 |
| Γ <sub>52</sub> | $p\bar{p}$                                        | $(7.60 \pm 0.34) \times 10^{-5}$ |        | DESIG=11 |
| Γ <sub>53</sub> | $p\bar{p}\pi^0$                                   | $(1.55 \pm 0.18) \times 10^{-4}$ |        | DESIG=39 |
| Γ <sub>54</sub> | $p\bar{p}\eta$                                    | $(1.45 \pm 0.25) \times 10^{-4}$ |        | DESIG=43 |
| Γ <sub>55</sub> | $p\bar{p}\omega$                                  | $(2.12 \pm 0.31) \times 10^{-4}$ |        | DESIG=59 |
| Γ <sub>56</sub> | $p\bar{p}\phi$                                    | $< 1.7 \times 10^{-5}$           | CL=90% | DESIG=65 |
| Γ <sub>57</sub> | $p\bar{p}\pi^+\pi^-$                              | $(5.0 \pm 1.9) \times 10^{-4}$   |        | DESIG=8  |
| Γ <sub>58</sub> | $p\bar{p}\pi^0\pi^0$                              | $< 5 \times 10^{-4}$             | CL=90% | DESIG=54 |
| Γ <sub>59</sub> | $p\bar{p}K^+K^-$ (non-resonant)                   | $(1.27 \pm 0.22) \times 10^{-4}$ |        | DESIG=62 |
| Γ <sub>60</sub> | $p\bar{p}K_S^0 K_S^0$                             | $< 4.5 \times 10^{-4}$           | CL=90% | DESIG=25 |
| Γ <sub>61</sub> | $p\bar{n}\pi^-$                                   | $(3.8 \pm 0.5) \times 10^{-4}$   |        | DESIG=74 |
| Γ <sub>62</sub> | $\bar{p}n\pi^+$                                   | $(3.9 \pm 0.5) \times 10^{-4}$   |        | DESIG=75 |
| Γ <sub>63</sub> | $p\bar{n}\pi^-\pi^0$                              | $(1.03 \pm 0.12) \times 10^{-3}$ |        | DESIG=76 |
| Γ <sub>64</sub> | $\bar{p}n\pi^+\pi^0$                              | $(1.01 \pm 0.12) \times 10^{-3}$ |        | DESIG=77 |
| Γ <sub>65</sub> | $\Lambda\bar{\Lambda}$                            | $(1.14 \pm 0.11) \times 10^{-4}$ |        | DESIG=19 |
| Γ <sub>66</sub> | $\Lambda\bar{\Lambda}\pi^+\pi^-$                  | $(2.9 \pm 0.5) \times 10^{-4}$   |        | DESIG=24 |
| Γ <sub>67</sub> | $\Lambda\bar{\Lambda}\pi^+\pi^-$ (non-resonant)   | $(2.5 \pm 0.6) \times 10^{-4}$   |        | DESIG=69 |
| Γ <sub>68</sub> | $\Sigma(1385)^+ \bar{\Lambda}\pi^- + \text{c.c.}$ | $< 1.3 \times 10^{-4}$           | CL=90% | DESIG=70 |
| Γ <sub>69</sub> | $\Sigma(1385)^- \bar{\Lambda}\pi^+ + \text{c.c.}$ | $< 1.3 \times 10^{-4}$           | CL=90% | DESIG=71 |
| Γ <sub>70</sub> | $K^+ \bar{p} \Lambda + \text{c.c.}$               | $(4.2 \pm 0.4) \times 10^{-4}$   | S=1.2  | DESIG=40 |
| Γ <sub>71</sub> | $K^+ \bar{p} \Lambda(1520) + \text{c.c.}$         | $(1.7 \pm 0.4) \times 10^{-4}$   |        | DESIG=63 |
| Γ <sub>72</sub> | $\Lambda(1520) \bar{\Lambda}(1520)$               | $< 9 \times 10^{-5}$             | CL=90% | DESIG=64 |
| Γ <sub>73</sub> | $\Sigma^0 \bar{\Sigma}^0$                         | $(4.2 \pm 0.6) \times 10^{-5}$   |        | DESIG=48 |
| Γ <sub>74</sub> | $\Sigma^+ \bar{\Sigma}^-$                         | $(3.6 \pm 0.7) \times 10^{-5}$   |        | DESIG=49 |
| Γ <sub>75</sub> | $\Sigma(1385)^+ \bar{\Sigma}(1385)^-$             | $< 9 \times 10^{-5}$             | CL=90% | DESIG=72 |
| Γ <sub>76</sub> | $\Sigma(1385)^- \bar{\Sigma}(1385)^+$             | $< 5 \times 10^{-5}$             | CL=90% | DESIG=73 |
| Γ <sub>77</sub> | $K^- \Lambda \bar{\Xi}^+ + \text{c.c.}$           | $(1.35 \pm 0.24) \times 10^{-4}$ |        | DESIG=92 |
| Γ <sub>78</sub> | $\Xi^0 \bar{\Xi}^0$                               | $< 6 \times 10^{-5}$             | CL=90% | DESIG=50 |
| Γ <sub>79</sub> | $\Xi^- \bar{\Xi}^+$                               | $(8.0 \pm 2.1) \times 10^{-5}$   |        | DESIG=26 |
| Γ <sub>80</sub> | $\pi^+\pi^-\pi^+K^-$                              | $< 2.1 \times 10^{-3}$           |        | DESIG=23 |
| Γ <sub>81</sub> | $K_S^0 K_S^0$                                     | $< 6 \times 10^{-5}$             | CL=90% | DESIG=27 |
| Γ <sub>82</sub> | $\eta_c \pi^+\pi^-$                               | $< 3.2 \times 10^{-3}$           | CL=90% | DESIG=83 |

### Radiative decays

|                 |                     |                                  |        |                              |
|-----------------|---------------------|----------------------------------|--------|------------------------------|
| Γ <sub>83</sub> | $\gamma J/\psi(1S)$ | $(34.3 \pm 1.0) \%$              |        | NODE=M055;CLUMP=B<br>DESIG=1 |
| Γ <sub>84</sub> | $\gamma\rho^0$      | $(2.16 \pm 0.17) \times 10^{-4}$ |        | DESIG=45                     |
| Γ <sub>85</sub> | $\gamma\omega$      | $(6.8 \pm 0.8) \times 10^{-5}$   |        | DESIG=46                     |
| Γ <sub>86</sub> | $\gamma\phi$        | $(2.4 \pm 0.5) \times 10^{-5}$   |        | DESIG=47                     |
| Γ <sub>87</sub> | $\gamma\gamma$      | $< 6.3 \times 10^{-6}$           | CL=90% | DESIG=4                      |
| Γ <sub>88</sub> | $e^+e^- J/\psi(1S)$ | $(3.65 \pm 0.25) \times 10^{-3}$ |        | DESIG=100                    |

### 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,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ .

|          |          |          |          |          |          |
|----------|----------|----------|----------|----------|----------|
| $x_{43}$ | 3        |          |          |          |          |
| $x_{52}$ | 4        | 2        |          |          |          |
| $x_{65}$ | 7        | 3        | 4        |          |          |
| $x_{83}$ | 23       | 9        | 2        | 20       |          |
| Γ        | -12      | -5       | -63      | -10      | -41      |
|          | $x_{17}$ | $x_{43}$ | $x_{52}$ | $x_{65}$ | $x_{83}$ |

$\chi_{c1}(1P)$  PARTIAL WIDTHS

$$\chi_{c1}(1P) \Gamma(i) \Gamma(\gamma J/\psi(1S)) / \Gamma(\text{total})$$

$$\Gamma(p\bar{p}) \times \Gamma(\gamma J/\psi(1S)) / \Gamma_{\text{total}}$$

$$\Gamma_{52} \Gamma_{83} / \Gamma$$

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

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

$$\Gamma_1 / \Gamma$$

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

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

$$\Gamma_2 / \Gamma$$

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

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

$$\Gamma_3 / \Gamma$$

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

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

$$\Gamma_4 / \Gamma$$

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

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

$$\Gamma_5 / \Gamma$$

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 (%)                | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                   |
|--------------------------|------|----------------------|----------|-----------------------------------------------------------|
| <b>0.054±0.008±0.001</b> | 608  | <sup>1</sup> ABLIKIM | 11A BES3 | $e^+e^- \rightarrow \psi(2S) \rightarrow \gamma\chi_{c1}$ |

NODE=M055R44  
 NODE=M055R44

<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;LINKAGE=AB

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

| VALUE (units $10^{-3}$ )      | DOCUMENT ID                              | TECN | COMMENT |
|-------------------------------|------------------------------------------|------|---------|
| <b>4.5±1.0 OUR EVALUATION</b> | Treating systematic error as correlated. |      |         |
| <b>4.5±0.9 OUR AVERAGE</b>    |                                          |      |         |

NODE=M055R5  
 NODE=M055R5

→ UNCHECKED ←

4.2±0.4±0.9

<sup>1</sup> BAI 99B BES  $\psi(2S) \rightarrow \gamma\chi_{c1}$

7.3±3.0±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;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>1.12±0.27±0.03</b>    | 45.1 | <sup>1</sup> HE | 08B CLEO | $e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M055R37  
 NODE=M055R37

<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;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>11.46±0.12±1.29</b>   | 12k  | <sup>1</sup> ABLIKIM | 13B BES3 | $e^+e^- \rightarrow \psi(2S) \rightarrow \gamma\chi_{c1}$ |

NODE=M055R00  
 NODE=M055R00

<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;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>7.52±0.11±0.79</b>    | 5.1k | <sup>1</sup> ABLIKIM | 13B BES3 | $e^+e^- \rightarrow \psi(2S) \rightarrow \gamma\chi_{c1}$ |

NODE=M055R60  
 NODE=M055R60

<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;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>0.86±0.13±0.02</b> | 141.3 | <sup>1</sup> HE | 08B CLEO | $e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M055R39  
 NODE=M055R39

<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;LINKAGE=HE

 $\Gamma(\rho^- K^+ \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{12}/\Gamma$ 

| VALUE (%)             | EVTS  | DOCUMENT ID     | TECN     | COMMENT                                     |
|-----------------------|-------|-----------------|----------|---------------------------------------------|
| <b>0.50±0.12±0.01</b> | 141.3 | <sup>1</sup> HE | 08B CLEO | $e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M055R40  
 NODE=M055R40

<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;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>0.23±0.06±0.01</b> | 141.3 | <sup>1</sup> HE | 08B CLEO | $e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M055R41  
 NODE=M055R41

<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;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

$\Gamma(K^+ K^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{22}/\Gamma$ VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

**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  
NODE=M055R20

NODE=M055R20;LINKAGE=AT

 $\Gamma(\eta \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{23}/\Gamma$ VALUE (units  $10^{-3}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**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.

<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.

<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  
NODE=M055R08

NODE=M055R08;LINKAGE=A  
NODE=M055R08;LINKAGE=B

NODE=M055R08;LINKAGE=AT

NODE=M055R08;LINKAGE=AB

 $\Gamma(a_0(980)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{24}/\Gamma$ VALUE (units  $10^{-3}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**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.

<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  
NODE=M055R15

NODE=M055R15;LINKAGE=A  
NODE=M055R15;LINKAGE=B

NODE=M055R15;LINKAGE=AB

 $\Gamma(a_2(1320)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{25}/\Gamma$ VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

**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  
NODE=M055R72

NODE=M055R72;LINKAGE=A  
NODE=M055R72;LINKAGE=B

 $\Gamma(a_2(1700)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{26}/\Gamma$ VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

**4.6±0.7±0.1**<sup>1,2</sup> ABLIKIM

17K

BES3

 $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$ 

NODE=M055R75  
NODE=M055R75

<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

### $\Gamma(f_2(1270)\eta \rightarrow \eta \pi^+ \pi^-) / \Gamma_{\text{total}}$

$\Gamma_{27}/\Gamma$

VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**$3.5 \pm 0.6 \pm 0.1$**

1,2 ABLIKIM 17K BES3  $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$

NODE=M055R73  
NODE=M055R73

OCCUR=2

<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;LINKAGE=A  
NODE=M055R73;LINKAGE=D

### $\Gamma(f_4(2050)\eta \rightarrow \eta \pi^+ \pi^-) / \Gamma_{\text{total}}$

$\Gamma_{28}/\Gamma$

VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

**$2.5 \pm 0.9 \pm 0.1$**

1,2 ABLIKIM 17K BES3  $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$

NODE=M055R74  
NODE=M055R74

<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;LINKAGE=A  
NODE=M055R74;LINKAGE=B

### $\Gamma(\pi_1(1400)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-) / \Gamma_{\text{total}}$

$\Gamma_{29}/\Gamma$

VALUE  
 **$< 5 \times 10^{-5}$**

CL%

DOCUMENT ID

TECN

COMMENT

1,2 ABLIKIM 17K BES3  $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$

NODE=M055R76  
NODE=M055R76

<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;LINKAGE=A  
NODE=M055R76;LINKAGE=B

### $\Gamma(\pi_1(1600)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-) / \Gamma_{\text{total}}$

$\Gamma_{30}/\Gamma$

VALUE  
 **$< 1.5 \times 10^{-5}$**

CL%

DOCUMENT ID

TECN

COMMENT

1,2 ABLIKIM 17K BES3  $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$

NODE=M055R77  
NODE=M055R77

<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;LINKAGE=A  
NODE=M055R77;LINKAGE=B

### $\Gamma(\pi_1(2015)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-) / \Gamma_{\text{total}}$

$\Gamma_{31}/\Gamma$

VALUE  
 **$< 8 \times 10^{-6}$**

CL%

DOCUMENT ID

TECN

COMMENT

1,2 ABLIKIM 17K BES3  $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$

NODE=M055R78  
NODE=M055R78

<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;LINKAGE=A  
NODE=M055R78;LINKAGE=B

### $\Gamma(f_2(1270)\eta) / \Gamma_{\text{total}}$

$\Gamma_{32}/\Gamma$

VALUE (units  $10^{-3}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**$0.67 \pm 0.11$  OUR AVERAGE**

$0.63 \pm 0.11 \pm 0.02$

1,2 ABLIKIM 17K BES3  $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$

$2.7 \pm 0.8 \pm 0.1$

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

 $\Gamma(K^+ K^- K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{43}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID |
|--------------------------|-------------|
| <b>0.54±0.11 OUR FIT</b> |             |

NODE=M055R14  
 NODE=M055R14

 $\Gamma(K^+ K^- \phi)/\Gamma_{\text{total}}$  $\Gamma_{44}/\Gamma$ 

| 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

 $\Gamma(\bar{K}^0 K^+ \pi^- \phi + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{45}/\Gamma$ 

| 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

 $\Gamma(K^+ K^- \pi^0 \phi)/\Gamma_{\text{total}}$  $\Gamma_{46}/\Gamma$ 

| 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

 $\Gamma(\phi \pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{47}/\Gamma$ 

| 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

 $\Gamma(\omega\omega)/\Gamma_{\text{total}}$  $\Gamma_{48}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                               |
|--------------------------|------|----------------------|----------|---------------------------------------|
| <b>5.7±0.7±0.1</b>       | 597  | <sup>1</sup> ABLIKIM | 11K BES3 | $\psi(2S) \rightarrow \gamma$ 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

 $\Gamma(\omega K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{49}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                     |
|--------------------------|------|----------------------|----------|-------------------------------------------------------------|
| <b>0.78±0.04±0.08</b>    | 628  | <sup>1</sup> ABLIKIM | 13B BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c1}$ |

NODE=M055R61  
 NODE=M055R61

<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;LINKAGE=A

 $\Gamma(\omega\phi)/\Gamma_{\text{total}}$  $\Gamma_{50}/\Gamma$ 

| VALUE (units $10^{-4}$ )     | EVTS | DOCUMENT ID          | TECN     | COMMENT                                              |
|------------------------------|------|----------------------|----------|------------------------------------------------------|
| <b>0.27±0.04 OUR AVERAGE</b> |      |                      |          | $[(0.21 \pm 0.06) \times 10^{-4}]$ OUR 2018 AVERAGE] |
| <b>0.27±0.04±0.01</b>        | 105  | <sup>1</sup> ABLIKIM | 19J BES3 | $\psi(2S) \rightarrow \gamma$ hadrons                |

NODE=M055R50  
 NODE=M055R50

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

NEW

|                |    |                        |          |                                       |
|----------------|----|------------------------|----------|---------------------------------------|
| 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;LINKAGE=A

NODE=M055R50;LINKAGE=AL

NODE=M055R50;LINKAGE=B

| $\Gamma(\phi\phi)/\Gamma_{\text{total}}$ |      |                      |          |                                       | $\Gamma_{51}/\Gamma$         |
|------------------------------------------|------|----------------------|----------|---------------------------------------|------------------------------|
| VALUE (units $10^{-4}$ )                 | EVTS | DOCUMENT ID          | TECN     | COMMENT                               |                              |
| <b><math>4.2 \pm 0.5 \pm 0.1</math></b>  | 366  | <sup>1</sup> ABLIKIM | 11K BES3 | $\psi(2S) \rightarrow \gamma$ hadrons | NODE=M055R51<br>NODE=M055R51 |

<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;LINKAGE=AL

| $\Gamma(p\bar{p})/\Gamma_{\text{total}}$    |  |             |  |  | $\Gamma_{52}/\Gamma$         |
|---------------------------------------------|--|-------------|--|--|------------------------------|
| VALUE (units $10^{-4}$ )                    |  | DOCUMENT ID |  |  |                              |
| <b><math>0.760 \pm 0.034</math> OUR FIT</b> |  |             |  |  | NODE=M055R11<br>NODE=M055R11 |

| $\Gamma(p\bar{p}\pi^0)/\Gamma_{\text{total}}$   |  |                     |         |                                           | $\Gamma_{53}/\Gamma$         |
|-------------------------------------------------|--|---------------------|---------|-------------------------------------------|------------------------------|
| VALUE (units $10^{-3}$ )                        |  | DOCUMENT ID         | TECN    | COMMENT                                   |                              |
| <b><math>0.155 \pm 0.018</math> OUR AVERAGE</b> |  |                     |         |                                           | NODE=M055R21<br>NODE=M055R21 |
| $0.163 \pm 0.019 \pm 0.004$                     |  | <sup>1</sup> ONYISI | 10 CLE3 | $\psi(2S) \rightarrow \gamma p\bar{p}X$   |                              |
| $0.112 \pm 0.047 \pm 0.003$                     |  | <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.

NODE=M055R21;LINKAGE=ON

<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;LINKAGE=AT

| $\Gamma(p\bar{p}\eta)/\Gamma_{\text{total}}$  |     |                     |         |                                         | $\Gamma_{54}/\Gamma$         |
|-----------------------------------------------|-----|---------------------|---------|-----------------------------------------|------------------------------|
| VALUE (units $10^{-3}$ )                      | CL% | DOCUMENT ID         | TECN    | COMMENT                                 |                              |
| <b><math>0.145 \pm 0.024 \pm 0.004</math></b> |     | <sup>1</sup> ONYISI | 10 CLE3 | $\psi(2S) \rightarrow \gamma p\bar{p}X$ | NODE=M055R27<br>NODE=M055R27 |

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

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |    |                    |         |                                           |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|--------------------|---------|-------------------------------------------|--|
| $< 0.15$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 90 | <sup>2</sup> ATHAR | 07 CLEO | $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ |  |
| <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. |    |                    |         |                                           |  |

NODE=M055R27;LINKAGE=ON

<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=AT

| $\Gamma(p\bar{p}\omega)/\Gamma_{\text{total}}$ |  |                     |         |                                         | $\Gamma_{55}/\Gamma$         |
|------------------------------------------------|--|---------------------|---------|-----------------------------------------|------------------------------|
| VALUE (units $10^{-3}$ )                       |  | DOCUMENT ID         | TECN    | COMMENT                                 |                              |
| <b><math>0.212 \pm 0.030 \pm 0.005</math></b>  |  | <sup>1</sup> ONYISI | 10 CLE3 | $\psi(2S) \rightarrow \gamma p\bar{p}X$ | NODE=M055R43<br>NODE=M055R43 |

<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;LINKAGE=ON

$\Gamma(p\bar{p}\phi)/\Gamma_{\text{total}}$  $\Gamma_{56}/\Gamma$ 

| VALUE                                                                                                                                                                                                                                                                                                                                                                                                        | CL% | DOCUMENT ID          | TECN     | COMMENT                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------|----------|----------------------------------------------|
| $<1.7 \times 10^{-5}$                                                                                                                                                                                                                                                                                                                                                                                        | 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

 $\Gamma(p\bar{p}\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{57}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                                                                                                              | DOCUMENT ID                              | TECN    | COMMENT                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---------|----------------------------------------|
| <b>0.50±0.19 OUR EVALUATION</b>                                                                                                                                       | Treating systematic error as correlated. |         |                                        |
| <b>0.50±0.19 OUR AVERAGE</b>                                                                                                                                          |                                          |         |                                        |
| 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

 $\Gamma(p\bar{p}\pi^0\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{58}/\Gamma$ 

| VALUE                                                                                                                                                                                                                                                                                                                                                                                                                    | CL% | DOCUMENT ID     | TECN     | COMMENT                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----------------|----------|------------------------------------------|
| $<5 \times 10^{-4}$                                                                                                                                                                                                                                                                                                                                                                                                      | 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

 $\Gamma(p\bar{p}K^+K^- \text{ (non-resonant)})/\Gamma_{\text{total}}$  $\Gamma_{59}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | EVTS   | DOCUMENT ID          | TECN     | COMMENT                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|----------------------|----------|----------------------------------------------|
| <b>1.27±0.22±0.03</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 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

 $\Gamma(p\bar{p}K_S^0K_S^0)/\Gamma_{\text{total}}$  $\Gamma_{60}/\Gamma$ 

| 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

 $\Gamma(p\bar{n}\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{61}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                           | EVTS | DOCUMENT ID          | TECN     | COMMENT                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|---------------------------------------------|
| <b>3.8±0.5±0.1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                 | 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

 $\Gamma(p\bar{n}\pi^+)/\Gamma_{\text{total}}$  $\Gamma_{62}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                           | EVTS | DOCUMENT ID          | TECN     | COMMENT                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|---------------------------------------------|
| <b>3.9±0.5±0.1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1625 | <sup>1</sup> ABLIKIM | 12J BES3 | $\psi(2S) \rightarrow \gamma p\bar{n}\pi^+$ |
| <sup>1</sup> ABLIKIM 12J reports $[\Gamma(\chi_{c1}(1P) \rightarrow p\bar{n}\pi^+)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$ = $(0.38 \pm 0.02 \pm 0.04) \times 10^{-4}$ 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

 $\Gamma(p\bar{n}\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{63}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                | EVTS | DOCUMENT ID          | TECN     | COMMENT                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|--------------------------------------------------|
| <b>10.3±1.1±0.2</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

$\Gamma(\bar{p}n\pi^+\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{64}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTs | DOCUMENT ID          | TECN     | COMMENT                                          |
|--------------------------|------|----------------------|----------|--------------------------------------------------|
| <b>10.1±1.1±0.2</b>      | 1261 | <sup>1</sup> ABLIKIM | 12J BES3 | $\psi(2S) \rightarrow \gamma \bar{p}n\pi^+\pi^0$ |

NODE=M055R59  
 NODE=M055R59

<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;LINKAGE=AL

 $\Gamma(\Lambda\bar{\Lambda})/\Gamma_{\text{total}}$  $\Gamma_{65}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | DOCUMENT ID |
|--------------------------|-------------|
| <b>1.14±0.11 OUR FIT</b> |             |

NODE=M055R23  
 NODE=M055R23

 $\Gamma(\Lambda\bar{\Lambda}\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{66}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | EVTs | DOCUMENT ID          | TECN     | COMMENT                                                      |
|--------------------------|-----|------|----------------------|----------|--------------------------------------------------------------|
| <b>29±5±1</b>            |     | 105  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Lambda\bar{\Lambda}\pi^+\pi^-$ |

NODE=M055R01  
 NODE=M055R01

• • • 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.

NODE=M055R01;LINKAGE=AL

<sup>2</sup> Using  $B(\psi(2S) \rightarrow \chi_{c1}\gamma) (9.1 \pm 0.6)\%$ .

NODE=M055R01;LINKAGE=AB

 $\Gamma(\Lambda\bar{\Lambda}\pi^+\pi^- (\text{non-resonant}))/\Gamma_{\text{total}}$  $\Gamma_{67}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTs | DOCUMENT ID          | TECN     | COMMENT                                                      |
|--------------------------|------|----------------------|----------|--------------------------------------------------------------|
| <b>25±6±1</b>            | 13   | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Lambda\bar{\Lambda}\pi^+\pi^-$ |

NODE=M055R19  
 NODE=M055R19

<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;LINKAGE=AL

 $\Gamma(\Sigma(1385)^+\bar{\Lambda}\pi^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{68}/\Gamma$ 

| VALUE                            | CL% | DOCUMENT ID          | TECN     | COMMENT                                                        |
|----------------------------------|-----|----------------------|----------|----------------------------------------------------------------|
| <b>&lt;1.3 × 10<sup>-4</sup></b> | 90  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Sigma(1385)^+\bar{\Lambda}\pi^-$ |

NODE=M055R52  
 NODE=M055R52

<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;LINKAGE=AL

 $\Gamma(\Sigma(1385)^-\bar{\Lambda}\pi^+ + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{69}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                                                        |
|--------------------------|-----|----------------------|----------|----------------------------------------------------------------|
| <b>&lt;13</b>            | 90  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Sigma(1385)^-\bar{\Lambda}\pi^+$ |

NODE=M055R53  
 NODE=M055R53

<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;LINKAGE=AL

 $\Gamma(K^+\bar{p}\Lambda + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{70}/\Gamma$ 

| VALUE (units $10^{-4}$ )   | EVTs | DOCUMENT ID | TECN | COMMENT                                                                                                   |
|----------------------------|------|-------------|------|-----------------------------------------------------------------------------------------------------------|
| <b>4.2±0.4 OUR AVERAGE</b> |      |             |      | Error includes scale factor of 1.2. $[(4.1 \pm 0.4) \times 10^{-4}]$ OUR 2018 AVERAGE Scale factor = 1.2] |

NODE=M055R22  
 NODE=M055R22

NEW

|                             |    |                        |          |                                                   |
|-----------------------------|----|------------------------|----------|---------------------------------------------------|
| $9.1^{+2.7}_{-2.3} \pm 0.4$ | 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  $B(B^+ \rightarrow \chi_{c1}(1P) K^+) = (4.84 \pm 0.23) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R22;LINKAGE=A

<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.

NODE=M055R22;LINKAGE=AB

<sup>3</sup> Using  $B(\Lambda \rightarrow p \pi^-) = 63.9\%$ .

NODE=M055R22;LINKAGE=LB

<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;LINKAGE=AT

### $\Gamma(K^+ \bar{p} \Lambda(1520) + \text{c.c.})/\Gamma_{\text{total}}$

 $\Gamma_{71}/\Gamma$ 

| 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 | $\psi(2S) \rightarrow \gamma p \bar{p} K^+ K^-$ |

NODE=M055R46  
NODE=M055R46

<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;LINKAGE=AB

### $\Gamma(\Lambda(1520) \bar{\Lambda}(1520))/\Gamma_{\text{total}}$

 $\Gamma_{72}/\Gamma$ 

| VALUE                                     | CL% | DOCUMENT ID          | TECN     | COMMENT                                         |
|-------------------------------------------|-----|----------------------|----------|-------------------------------------------------|
| <b><math>&lt; 9 \times 10^{-5}</math></b> | 90  | <sup>1</sup> ABLIKIM | 11F BES3 | $\psi(2S) \rightarrow \gamma p \bar{p} K^+ K^-$ |

NODE=M055R47  
NODE=M055R47

<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;LINKAGE=AB

### $\Gamma(\Sigma^0 \bar{\Sigma}^0)/\Gamma_{\text{total}}$

 $\Gamma_{73}/\Gamma$ 

| 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 | $\psi(2S) \rightarrow \gamma \Sigma^0 \bar{\Sigma}^0$ |

NODE=M055R32  
NODE=M055R32

• • • 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 | <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.

NODE=M055R32;LINKAGE=B

<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  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R32;LINKAGE=AB

<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;LINKAGE=NA

### $\Gamma(\Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}$

 $\Gamma_{74}/\Gamma$ 

| 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 | <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

### $\Gamma(\Sigma(1385)^+ \bar{\Sigma}(1385)^-)/\Gamma_{\text{total}} \quad \Gamma_{75}/\Gamma$

| VALUE                | CL% | DOCUMENT ID              | TECN | COMMENT                                                         |
|----------------------|-----|--------------------------|------|-----------------------------------------------------------------|
| $< 9 \times 10^{-5}$ | 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

### $\Gamma(\Sigma(1385)^- \bar{\Sigma}(1385)^+)/\Gamma_{\text{total}} \quad \Gamma_{76}/\Gamma$

| VALUE                | CL% | DOCUMENT ID              | TECN | COMMENT                                                         |
|----------------------|-----|--------------------------|------|-----------------------------------------------------------------|
| $< 5 \times 10^{-5}$ | 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

### $\Gamma(K^- \Lambda \bar{\Xi}^+ + \text{c.c.})/\Gamma_{\text{total}} \quad \Gamma_{77}/\Gamma$

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID              | TECN | COMMENT                                                             |
|--------------------------|------|--------------------------|------|---------------------------------------------------------------------|
| $1.35 \pm 0.24 \pm 0.03$ | 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

### $\Gamma(\Xi^0 \bar{\Xi}^0)/\Gamma_{\text{total}} \quad \Gamma_{78}/\Gamma$

| VALUE                | CL% | EVTS          | DOCUMENT ID          | TECN | COMMENT                                         |
|----------------------|-----|---------------|----------------------|------|-------------------------------------------------|
| $< 6 \times 10^{-5}$ | 90  | $1.7 \pm 2.4$ | <sup>1</sup> NAIK 08 | CLEO | $\psi(2S) \rightarrow \gamma \Xi^0 \bar{\Xi}^0$ |

NODE=M055R34  
NODE=M055R34

<sup>1</sup> NAIK 08 reports  $< 0.60 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \Xi^0 \bar{\Xi}^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  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

### $\Gamma(\Xi^- \bar{\Xi}^+)/\Gamma_{\text{total}} \quad \Gamma_{79}/\Gamma$

| VALUE (units $10^{-4}$ ) | CL%  | EVTS      | DOCUMENT ID          | TECN | COMMENT                                         |
|--------------------------|------|-----------|----------------------|------|-------------------------------------------------|
| $0.80 \pm 0.21 \pm 0.02$ | 16.4 | $4 \pm 3$ | <sup>1</sup> NAIK 08 | CLEO | $\psi(2S) \rightarrow \gamma \Xi^- \bar{\Xi}^+$ |

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  $[\Gamma(\chi_{c1}(1P) \rightarrow \Xi^- \bar{\Xi}^+)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  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.

NODE=M055R03;LINKAGE=NA

<sup>2</sup> Using  $B(\psi(2S) \rightarrow \chi_{c1} \gamma) = (9.1 \pm 0.6)\%$ .

NODE=M055R03;LINKAGE=AB

### $[\Gamma(\pi^+ \pi^-) + \Gamma(K^+ K^-)]/\Gamma_{\text{total}} \quad \Gamma_{80}/\Gamma$

| VALUE                 | CL% | DOCUMENT ID             | TECN | COMMENT                                 |
|-----------------------|-----|-------------------------|------|-----------------------------------------|
| $< 21 \times 10^{-4}$ |     | <sup>1</sup> FELDMAN 77 | MRK1 | $\psi(2S) \rightarrow \gamma \chi_{c1}$ |

NODE=M055R2  
NODE=M055R2

• • • 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=M055R2;LINKAGE=T

### $\Gamma(K_S^0 K_S^0)/\Gamma_{\text{total}} \quad \Gamma_{81}/\Gamma$

| VALUE                | CL% | DOCUMENT ID              | TECN | COMMENT                                 |
|----------------------|-----|--------------------------|------|-----------------------------------------|
| $< 6 \times 10^{-5}$ | 90  | <sup>1</sup> ABLIKIM 050 | BES2 | $\psi(2S) \rightarrow \chi_{c1} \gamma$ |

NODE=M055R04  
NODE=M055R04

<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;LINKAGE=AB

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

| VALUE                                                                                                           | CL% | DOCUMENT ID | TECN     | COMMENT                                                     |
|-----------------------------------------------------------------------------------------------------------------|-----|-------------|----------|-------------------------------------------------------------|
| $<3.2 \times 10^{-3}$                                                                                           | 90  | 1,2 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  | 1,3 ABLIKIM | 13B BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c1}$ |
| 1 Using $1.06 \times 10^8$ $\psi(2S)$ mesons and $B(\psi(2S) \rightarrow \chi_{c1} \gamma) = (9.2 \pm 0.4)\%$ . |     |             |          |                                                             |
| 2 Using the $\eta_c \rightarrow K_S^0 K^\pm \pi^\mp$ decays.                                                    |     |             |          |                                                             |
| 3 Using the $\eta_c \rightarrow K^+ K^- \pi^0$ decays.                                                          |     |             |          |                                                             |

 $\Gamma_{82}/\Gamma$ 

NODE=M055R63  
 NODE=M055R63

OCCUR=2

NODE=M055R63;LINKAGE=A  
 NODE=M055R63;LINKAGE=B  
 NODE=M055R63;LINKAGE=C

NODE=M055310

## RADIATIVE DECAYS

 $\Gamma(\gamma J/\psi(1S))/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-2}$ )                                                                                                                                                                                                 | EVTS | DOCUMENT ID | TECN     | COMMENT                                                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|-------------------------------------------------------------|
| <b>34.3 <math>\pm</math> 1.0 OUR FIT</b>                                                                                                                                                                                 |      |             |          |                                                             |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                            |      |             |          |                                                             |
| 34.75 $\pm$ 0.11 $\pm$ 1.70                                                                                                                                                                                              | 1.9M | 1 ABLIKIM   | 17U BES3 | $e^+ e^- \rightarrow \gamma X$                              |
| 37.9 $\pm$ 0.8 $\pm$ 2.1                                                                                                                                                                                                 |      | 2 ADAM      | 05A CLEO | $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c1}$ |
| 1 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. |      |             |          |                                                             |
| 2 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.                                                           |      |             |          |                                                             |

 $\Gamma_{83}/\Gamma$ 

NODE=M055R1  
 NODE=M055R1

NODE=M055R1;LINKAGE=A

NODE=M055R1;LINKAGE=AD

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

| VALUE (units $10^{-6}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | EVTS         | DOCUMENT ID | TECN     | COMMENT                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|----------|---------------------------------------------|
| <b>216 <math>\pm</math> 17 OUR AVERAGE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |             |          |                                             |
| 215 $\pm$ 22 $\pm$ 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 432 $\pm$ 25 | 1 ABLIKIM   | 11E BES3 | $\psi(2S) \rightarrow \gamma \gamma \rho^0$ |
| 217 $\pm$ 24 $\pm$ 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 186 $\pm$ 15 | 2 BENNETT   | 08A CLEO | $\psi(2S) \rightarrow \gamma \gamma \rho^0$ |
| 1 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. |              |             |          |                                             |
| 2 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. |              |             |          |                                             |

 $\Gamma_{84}/\Gamma$ 

NODE=M055R29  
 NODE=M055R29

NODE=M055R29;LINKAGE=AB

NODE=M055R29;LINKAGE=BE

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

| VALUE (units $10^{-6}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | EVTS         | DOCUMENT ID | TECN     | COMMENT                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|----------|---------------------------------------------|
| <b>68 <math>\pm</math> 8 OUR AVERAGE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              |             |          |                                             |
| 66 $\pm$ 9 $\pm$ 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 136 $\pm$ 14 | 1 ABLIKIM   | 11E BES3 | $\psi(2S) \rightarrow \gamma \gamma \omega$ |
| 74 $\pm$ 17 $\pm$ 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 39 $\pm$ 7   | 2 BENNETT   | 08A CLEO | $\psi(2S) \rightarrow \gamma \gamma \omega$ |
| 1 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. |              |             |          |                                             |
| 2 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.     |              |             |          |                                             |

 $\Gamma_{85}/\Gamma$ 

NODE=M055R30  
 NODE=M055R30

NODE=M055R30;LINKAGE=AB

NODE=M055R30;LINKAGE=BE

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

| VALUE (units $10^{-6}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | CL% | EVTS          | DOCUMENT ID | TECN     | COMMENT                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---------------|-------------|----------|-------------------------------------------|
| <b>24 <math>\pm</math> 5 <math>\pm</math> 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     | 43 $\pm$ 9    | 1 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 $\pm$ 3.1 | 2 BENNETT   | 08A CLEO | $\psi(2S) \rightarrow \gamma \gamma \phi$ |
| 1 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. |     |               |             |          |                                           |
| 2 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 $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .                                                                                                                                                  |     |               |             |          |                                           |

 $\Gamma_{86}/\Gamma$ 

NODE=M055R31  
 NODE=M055R31

NODE=M055R31;LINKAGE=AB

NODE=M055R31;LINKAGE=BE

$\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_{87}/\Gamma$ 

| VALUE                                                                         | CL% | DOCUMENT ID         | TECN      | COMMENT                                                    |
|-------------------------------------------------------------------------------|-----|---------------------|-----------|------------------------------------------------------------|
| $< 6.3 \times 10^{-6}$                                                        | 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. • • • |     |                     |           |                                                            |
| $< 3.5 \times 10^{-5}$                                                        | 90  | ECKLUND             | 08A CLEO  | $\psi(2S) \rightarrow \gamma\chi_{c1} \rightarrow 3\gamma$ |
| $< 150 \times 10^{-5}$                                                        | 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

 $\Gamma(e^+e^- J/\psi(1S))/\Gamma_{\text{total}}$  $\Gamma_{88}/\Gamma$ 

| VALUE (units $10^{-3}$ )                   | EVTs | DOCUMENT ID          | TECN     | COMMENT                                     |
|--------------------------------------------|------|----------------------|----------|---------------------------------------------|
| <b><math>3.65 \pm 0.23 \pm 0.09</math></b> | 1.9k | <sup>1</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.

NODE=M055R79  
NODE=M055R79

NODE=M055R79;LINKAGE=B

 $\Gamma(e^+e^- J/\psi(1S))/\Gamma(\gamma J/\psi(1S))$  $\Gamma_{88}/\Gamma_{83}$ 

| VALUE (units $10^{-3}$ )                 | EVTs | DOCUMENT ID          | TECN     | COMMENT                                     |
|------------------------------------------|------|----------------------|----------|---------------------------------------------|
| <b><math>10.1 \pm 0.3 \pm 0.5</math></b> | 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

### $\chi_{c1}(1P)$ CROSS-PARTICLE BRANCHING RATIOS

NODE=M055230

$\Gamma(\chi_{c1}(1P) \rightarrow p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)$   
 $\Gamma_{52}/\Gamma \times \Gamma_{148}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$

| VALUE (units $10^{-5}$ )                  | DOCUMENT ID      | TECN    | COMMENT                                                            |
|-------------------------------------------|------------------|---------|--------------------------------------------------------------------|
| <b><math>2.14 \pm 0.10</math> OUR FIT</b> |                  |         |                                                                    |
| <b><math>1.1 \pm 1.0</math></b>           | <sup>1</sup> BAI | 98I BES | $\psi(2S) \rightarrow \gamma\chi_{c1} \rightarrow \gamma p\bar{p}$ |

<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=M055B1  
NODE=M055B1

NODE=M055B;LINKAGE=J2

$\Gamma(\chi_{c1}(1P) \rightarrow \Lambda\bar{\Lambda})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))/\Gamma_{\text{total}}$

 $\Gamma_{65}/\Gamma \times \Gamma_{148}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$ 

| VALUE (units $10^{-6}$ )                     | EVTs | DOCUMENT ID | TECN | COMMENT |
|----------------------------------------------|------|-------------|------|---------|
| <b><math>11.1 \pm 1.1</math> OUR FIT</b>     |      |             |      |         |
| <b><math>10.9 \pm 1.1</math> OUR AVERAGE</b> |      |             |      |         |

|                        |            |                      |          |                                                   |
|------------------------|------------|----------------------|----------|---------------------------------------------------|
| $11.2 \pm 1.0 \pm 0.9$ | 136        | <sup>1</sup> ABLIKIM | 13H BES3 | $\psi(2S) \rightarrow \gamma\Lambda\bar{\Lambda}$ |
| $10.5 \pm 1.6 \pm 0.6$ | $46 \pm 7$ | <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  $B(\psi(2S) \rightarrow \gamma\chi_{c1}) = (9.2 \pm 0.4)\%$ .

<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  
NODE=M055B10

NODE=M055B10;LINKAGE=AB

NODE=M055B10;LINKAGE=NA

$\Gamma(\chi_{c1}(1P) \rightarrow \Lambda\bar{\Lambda})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)$   
 $\Gamma_{65}/\Gamma \times \Gamma_{148}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$

| VALUE (units $10^{-5}$ )                  | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------------------------------------|------|-------------|------|---------|
| <b><math>3.20 \pm 0.30</math> OUR FIT</b> |      |             |      |         |

|                                               |                     |                  |         |                                                   |
|-----------------------------------------------|---------------------|------------------|---------|---------------------------------------------------|
| <b><math>7.1^{+2.8}_{-2.4} \pm 1.3</math></b> | $9.0^{+3.5}_{-3.1}$ | <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  
NODE=M055B11

NODE=M055B11;LINKAGE=BA

$$\frac{\Gamma(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S))}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))}{\Gamma_{\text{total}}} \times \frac{\Gamma_{83}/\Gamma \times \Gamma_{148}^{\psi(2S)}}{\Gamma_{148}^{\psi(2S)}/\Gamma_{\psi(2S)}}$$

| VALUE (units $10^{-2}$ )                                                      | EVTS  | DOCUMENT ID            | TECN     | COMMENT                                                     |
|-------------------------------------------------------------------------------|-------|------------------------|----------|-------------------------------------------------------------|
| <b>3.34 ±0.06 OUR FIT</b>                                                     |       |                        |          |                                                             |
| <b>3.24 ±0.16 OUR AVERAGE</b>                                                 |       |                        |          | 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  $B(J/\psi \rightarrow \mu^+ \mu^-) = (5.961 \pm 0.033)\%$ .

<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.

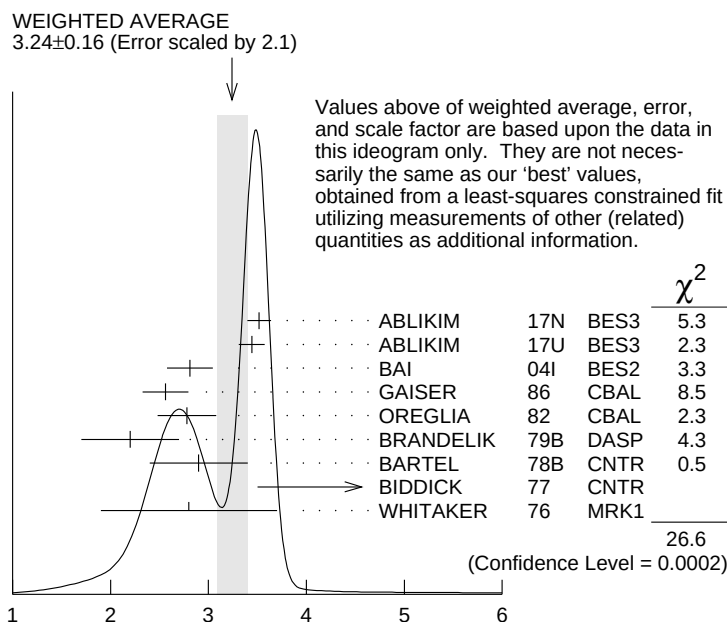
<sup>6</sup> Not independent from other measurements of MENDEZ 08.

<sup>7</sup> Not independent from other values reported by ADAM 05A.

NODE=M055B2  
NODE=M055B2

NODE=M055B2;LINKAGE=A

NODE=M055B;LINKAGE=3Q  
NODE=M055B;LINKAGE=2Q  
NODE=M055B;LINKAGE=EA  
NODE=M055B2;LINKAGE=B  
NODE=M055B2;LINKAGE=ME  
NODE=M055B;LINKAGE=AD



$$\frac{\Gamma(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S))}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))}{\Gamma_{\text{total}}} \text{ (units } 10^{-2})$$

$$\frac{\Gamma(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S))}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))}{\Gamma(\psi(2S) \rightarrow J/\psi(1S) \text{ anything})} \times \frac{\Gamma_{83}/\Gamma \times \Gamma_{148}^{\psi(2S)}}{\Gamma_{148}^{\psi(2S)}/\Gamma_{\psi(2S)}}$$

$$\frac{\Gamma_{83}/\Gamma \times \Gamma_{148}^{\psi(2S)}}{\Gamma_{148}^{\psi(2S)}/\Gamma_{\psi(2S)}} = \frac{\Gamma_{83}/\Gamma \times \Gamma_{148}^{\psi(2S)}}{(\Gamma_{11}^{\psi(2S)} + \Gamma_{12}^{\psi(2S)} + \Gamma_{13}^{\psi(2S)} + 0.343\Gamma_{148}^{\psi(2S)} + 0.190\Gamma_{149}^{\psi(2S)})}$$

| VALUE (units $10^{-2}$ )                        | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------------------------------------------|------|-------------|------|---------|
| <b>5.43±0.10 OUR FIT</b>                        |      |             |      |         |
| [(5.44 ± 0.10) × 10 <sup>-2</sup> OUR 2018 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  
NODE=M055B7

NODE=M055B7  
NEW

NODE=M055B7;LINKAGE=ME

$$\frac{\Gamma(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S))}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))}{\Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)} \quad \frac{\Gamma_{83}/\Gamma \times \Gamma_{148}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

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

12.6 ±0.3 ±3.8 3k

8.5 ±2.1

MENDEZ

08

CLEO

$\psi(2S) \rightarrow \gamma \chi_{c1}$

<sup>1</sup> ABLIKIM

04B

BES

$\psi(2S) \rightarrow J/\psi X$

<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=M055B3  
NODE=M055B3

NODE=M055B;LINKAGE=AB  
NODE=M055B;LINKAGE=J3

NODE=M055B3;LINKAGE=AD

$$\frac{\Gamma(\chi_{c1}(1P) \rightarrow \bar{K}^0 K^+ \pi^- + \text{c.c.})}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))}{\Gamma_{\text{total}}} \quad \frac{\Gamma_{17}/\Gamma \times \Gamma_{148}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

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  $B(\chi_{c1} \rightarrow K_S^0 K^+ \pi^- + \text{c.c.})$  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

$$\frac{\Gamma(\chi_{c1}(1P) \rightarrow \bar{K}^0 K^+ \pi^- + \text{c.c.})}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))}{\Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)} \quad \frac{\Gamma_{17}/\Gamma \times \Gamma_{148}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

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

$$\frac{\Gamma(\chi_{c1}(1P) \rightarrow K^+ K^- K^+ K^-)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))}{\Gamma_{\text{total}}} \quad \frac{\Gamma_{43}/\Gamma \times \Gamma_{148}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

VALUE (units  $10^{-4}$ )

EVTS

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

$$\frac{\Gamma(\chi_{c1}(1P) \rightarrow K^+ K^- K^+ K^-)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))}{\Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)} \quad \frac{\Gamma_{43}/\Gamma \times \Gamma_{148}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

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

$$\frac{\Gamma(\chi_{c1}(1P) \rightarrow p \bar{p})}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))}{\Gamma_{\text{total}}} \quad \frac{\Gamma_{52}/\Gamma \times \Gamma_{148}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

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  $\begin{smallmatrix} +1.4 \\ -1.3 \end{smallmatrix}$  ±0.6 18.2  $\begin{smallmatrix} +5.5 \\ -4.9 \end{smallmatrix}$

BAI

04F

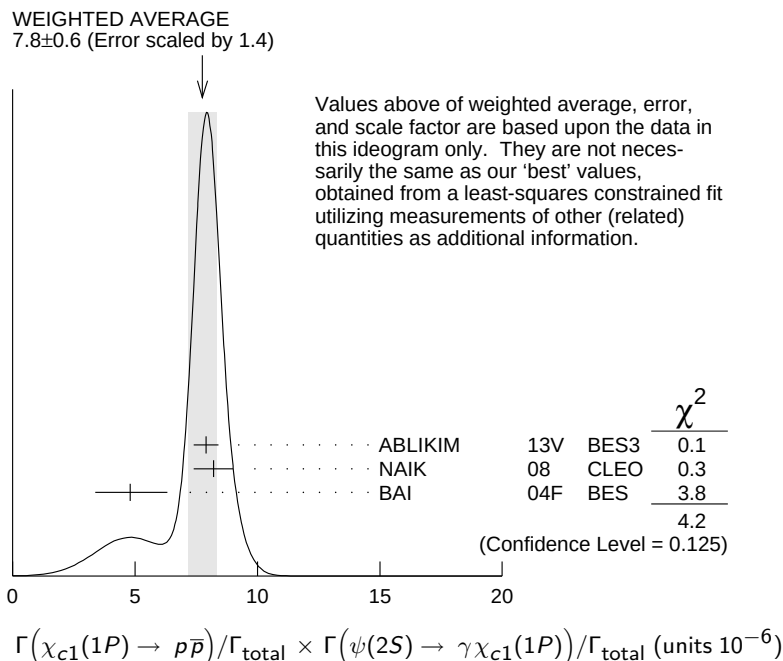
BES

$\psi(2S) \rightarrow \gamma \chi_{c1}(1P) \rightarrow \gamma p \bar{p}$

NODE=M055B6  
NODE=M055B6

<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;LINKAGE=NA



### MULTIPOLE AMPLITUDES IN $\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S)$

NODE=M055240

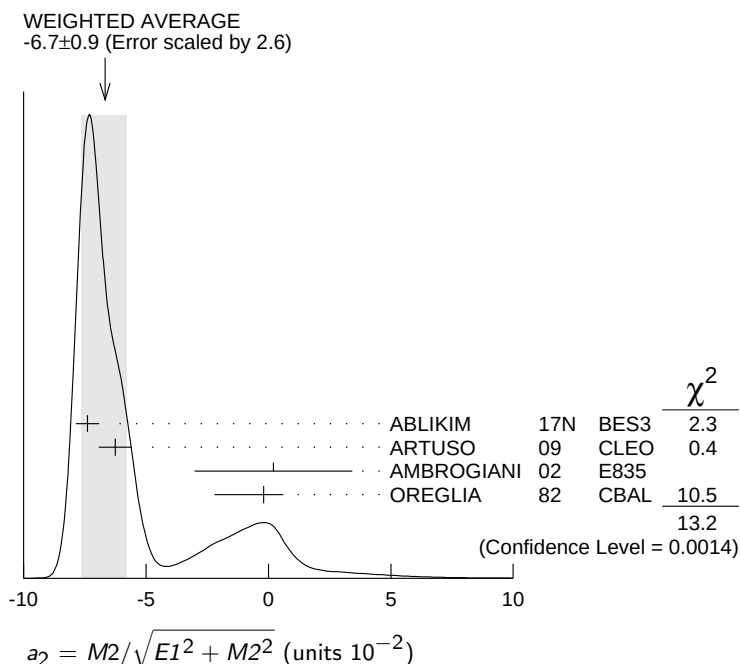
$a_2 = M_2 / \sqrt{E_1^2 + M_2^2}$  Magnetic quadrupole fractional transition amplitude

NODE=M055A1  
NODE=M055A1

| 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  | $p\bar{p} \rightarrow \chi_{c1} \rightarrow J/\psi\gamma$             |
| -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=M055A1;LINKAGE=A



# 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 <math>\pm</math> 0.4 OUR AVERAGE</b> |      |                      |          |                                                 |
| 2.29 $\pm$ 0.39 $\pm$ 0.27                  | 164k | <sup>1</sup> ABLIKIM | 17N BES3 | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$ |
| 2.76 $\pm$ 0.73 $\pm$ 0.23                  | 39k  | ARTUSO               | 09 CLEO  | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$ |
| 7.7 $^{+5.0}_{-4.5}$                        | 921  | OREGLIA              | 82 CBAL  | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$ |

<sup>1</sup> Correlated with  $a_2$  with correlation coefficient  $\rho_{a_2 b_2} = 0.133$ .

## MULTIPOLE AMPLITUDE RATIOS IN RADIATIVE DECAYS

$\psi(2S) \rightarrow \gamma\chi_{c1}(1S)$  and  $\chi_{c1} \rightarrow \gamma J/\psi(1S)$

$a_2/b_2$  Magnetic quadrupole transition amplitude ratio

| VALUE                                      | EVTS | DOCUMENT ID         | TECN    | COMMENT                                         |
|--------------------------------------------|------|---------------------|---------|-------------------------------------------------|
| <b>-2.27 <math>^{+0.57}_{-0.99}</math></b> | 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.

## $\chi_{c1}(1P)$ REFERENCES

|            |      |                  |                              |                        |             |
|------------|------|------------------|------------------------------|------------------------|-------------|
| ABLIKIM    | 19J  | PR D99 012015    | M. Ablikim <i>et al.</i>     | (BES III Collab.)      | REFID=59606 |
| 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>     | (BES III Collab.)      | REFID=58849 |
| ABLIKIM    | 18V  | PR D97 052011    | M. Ablikim <i>et al.</i>     | (BES III Collab.)      | REFID=58990 |
| 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>     | (BES III Collab.)      | REFID=58310 |
| ABLIKIM    | 17I  | PRL 118 221802   | M. Ablikim <i>et al.</i>     | (BES III Collab.)      | REFID=57931 |
| ABLIKIM    | 17K  | PR D95 032002    | M. Ablikim <i>et al.</i>     | (BES III Collab.)      | REFID=57953 |
| ABLIKIM    | 17N  | PR D95 072004    | M. Ablikim <i>et al.</i>     | (BES III Collab.)      | REFID=57978 |
| ABLIKIM    | 17U  | PR D96 032001    | M. Ablikim <i>et al.</i>     | (BES III 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>     | (BES III Collab.)      | REFID=56774 |
| ABLIKIM    | 15M  | PR D91 112008    | M. Ablikim <i>et al.</i>     | (BES III Collab.)      | REFID=56778 |
| ABLIKIM    | 14J  | PR D89 074030    | M. Ablikim <i>et al.</i>     | (BES III Collab.)      | REFID=55901 |
| ABLIKIM    | 13B  | PR D87 012002    | M. Ablikim <i>et al.</i>     | (BES III Collab.)      | REFID=54877 |
| ABLIKIM    | 13D  | PR D87 012007    | M. Ablikim <i>et al.</i>     | (BES III Collab.)      | REFID=54879 |
| ABLIKIM    | 13H  | PR D87 032007    | M. Ablikim <i>et al.</i>     | (BES III Collab.)      | REFID=54953 |
| ABLIKIM    | 13V  | PR D88 112001    | M. Ablikim <i>et al.</i>     | (BES III Collab.)      | REFID=55583 |
| ABLIKIM    | 12I  | PR D86 052004    | M. Ablikim <i>et al.</i>     | (BES III Collab.)      | REFID=54736 |
| ABLIKIM    | 12J  | PR D86 052011    | M. Ablikim <i>et al.</i>     | (BES III Collab.)      | REFID=54737 |
| ABLIKIM    | 12O  | PRL 109 172002   | M. Ablikim <i>et al.</i>     | (BES III Collab.)      | REFID=54742 |
| ABLIKIM    | 11A  | PR D83 012006    | M. Ablikim <i>et al.</i>     | (BES III Collab.)      | REFID=53647 |
| ABLIKIM    | 11D  | PR D83 032003    | M. Ablikim <i>et al.</i>     | (BES III Collab.)      | REFID=16715 |
| ABLIKIM    | 11E  | PR D83 112005    | M. Ablikim <i>et al.</i>     | (BES III Collab.)      | REFID=16717 |
| ABLIKIM    | 11F  | PR D83 112009    | M. Ablikim <i>et al.</i>     | (BES III Collab.)      | REFID=16719 |
| ABLIKIM    | 11K  | PRL 107 092001   | M. Ablikim <i>et al.</i>     | (BES III 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 |

NODE=M055250

NODE=M055QB2  
NODE=M055QB2

NODE=M055QB2;LINKAGE=A

NODE=M055260

NODE=M055QAR  
NODE=M055QAR

NODE=M055QAR;LINKAGE=AR

NODE=M055



$h_c(1P)$

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

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

| 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%              |
| $\Gamma_5$ $\pi^+\pi^-\pi^0$      | < 2.2 $\times 10^{-3}$                    |                  |
| $\Gamma_6$ $2\pi^+2\pi^-\pi^0$    | ( 2.2 <sup>+0.8</sup> <sub>-0.7</sub> ) % |                  |
| $\Gamma_7$ $3\pi^+3\pi^-\pi^0$    | < 2.9 %                                   |                  |

DESIG=1

DESIG=2;OUR EST;→ UNCHECKED ←

DESIG=10

DESIG=3

DESIG=5

DESIG=6

DESIG=7

#### Radiative decays

|                                  |                              |
|----------------------------------|------------------------------|
| $\Gamma_8$ $\gamma\eta$          | ( 4.7±2.1 ) $\times 10^{-4}$ |
| $\Gamma_9$ $\gamma\eta'(958)$    | ( 1.5±0.4 ) $\times 10^{-3}$ |
| $\Gamma_{10}$ $\gamma\eta_c(1S)$ | ( 51 ± 6 ) %                 |

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

 $\Gamma(\gamma h_c(1S)) \times \Gamma(p\bar{p}) / \Gamma_{\text{total}} \quad \Gamma_{10} \Gamma_4 / \Gamma$ 

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

NODE=M144G1  
NODE=M144G1

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

|          |    |                                 |                                      |
|----------|----|---------------------------------|--------------------------------------|
| 12.0±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

 $\Gamma(J/\psi(1S)\pi\pi) / \Gamma(J/\psi(1S)\pi^0) \quad \Gamma_2 / \Gamma_1$ 

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

NODE=M144R1  
NODE=M144R1

|                 |    |                    |                                     |
|-----------------|----|--------------------|-------------------------------------|
| <b>&lt;0.18</b> | 90 | ARMSTRONG 92D E760 | $\bar{p}p \rightarrow J/\psi \pi^0$ |
|-----------------|----|--------------------|-------------------------------------|

 $\Gamma(J/\psi(1S)\pi^+\pi^-) / \Gamma_{\text{total}} \quad \Gamma_3 / \Gamma$ 

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

NODE=M144R07  
NODE=M144R07

|                                  |    |                               |                                                 |
|----------------------------------|----|-------------------------------|-------------------------------------------------|
| <b>&lt;2.3 × 10<sup>-3</sup></b> | 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

 $\Gamma(\pi^+\pi^-\pi^0) / \Gamma_{\text{total}} \quad \Gamma_5 / \Gamma$ 

| VALUE (units 10 <sup>-3</sup> ) | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-------------|------|---------|
|---------------------------------|-------------|------|---------|

NODE=M144R01  
NODE=M144R01

|                |                            |                                            |
|----------------|----------------------------|--------------------------------------------|
| <b>&lt;2.2</b> | <sup>1</sup> ADAMS 09 CLEO | $\psi(2S) \rightarrow \pi^0 \gamma \eta_c$ |
|----------------|----------------------------|--------------------------------------------|

<sup>1</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

 $\Gamma(2\pi^+2\pi^-\pi^0) / \Gamma_{\text{total}} \quad \Gamma_6 / \Gamma$ 

| VALUE (units 10 <sup>-2</sup> ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|------|-------------|------|---------|
|---------------------------------|------|-------------|------|---------|

NODE=M144R02  
NODE=M144R02

|                                                |    |                            |                                            |
|------------------------------------------------|----|----------------------------|--------------------------------------------|
| <b>2.2<sup>+0.8</sup><sub>-0.6</sub> ± 0.3</b> | 92 | <sup>1</sup> ADAMS 09 CLEO | $\psi(2S) \rightarrow \pi^0 \gamma \eta_c$ |
|------------------------------------------------|----|----------------------------|--------------------------------------------|

<sup>1</sup> ADAMS 09 reports  $[\Gamma(h_c(1P) \rightarrow 2\pi^+2\pi^-\pi^0) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))] = (1.88^{+0.48+0.47}_{-0.45-0.30}) \times 10^{-5}$  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

 $\Gamma(3\pi^+3\pi^-\pi^0) / \Gamma_{\text{total}} \quad \Gamma_7 / \Gamma$ 

| VALUE (units 10 <sup>-2</sup> ) | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-------------|------|---------|
|---------------------------------|-------------|------|---------|

NODE=M144R03  
NODE=M144R03

|                |                            |                                            |
|----------------|----------------------------|--------------------------------------------|
| <b>&lt;2.9</b> | <sup>1</sup> ADAMS 09 CLEO | $\psi(2S) \rightarrow \pi^0 \gamma \eta_c$ |
|----------------|----------------------------|--------------------------------------------|

<sup>1</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

## RADIATIVE DECAYS

NODE=M144230

 $\Gamma(\gamma\eta) / \Gamma_{\text{total}} \quad \Gamma_8 / \Gamma$ 

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

NODE=M144R06  
NODE=M144R06

|                        |    |                  |                                          |
|------------------------|----|------------------|------------------------------------------|
| <b>4.7 ± 1.5 ± 1.4</b> | 18 | ABLIKIM 16I BES3 | $\psi(2S) \rightarrow \pi^0 \gamma \eta$ |
|------------------------|----|------------------|------------------------------------------|

 $\Gamma(\gamma\eta'(958)) / \Gamma_{\text{total}} \quad \Gamma_9 / \Gamma$ 

| VALUE (units 10 <sup>-3</sup> ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|------|-------------|------|---------|
|---------------------------------|------|-------------|------|---------|

NODE=M144R00  
NODE=M144R00

|                           |    |                  |                                                |
|---------------------------|----|------------------|------------------------------------------------|
| <b>1.52 ± 0.27 ± 0.29</b> | 44 | ABLIKIM 16I BES3 | $\psi(2S) \rightarrow \pi^0 \gamma \eta'(958)$ |
|---------------------------|----|------------------|------------------------------------------------|

 $\Gamma(\gamma\eta_c(1S)) / \Gamma_{\text{total}} \quad \Gamma_{10} / \Gamma$ 

| VALUE (units 10 <sup>-2</sup> ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|------|-------------|------|---------|
|---------------------------------|------|-------------|------|---------|

NODE=M144R2  
NODE=M144R2

**51 ± 6 OUR AVERAGE**

|                  |      |                  |                                            |
|------------------|------|------------------|--------------------------------------------|
| 54.3 ± 6.7 ± 5.2 | 3679 | ABLIKIM 10B BES3 | $\psi(2S) \rightarrow \pi^0 \gamma \eta_c$ |
|------------------|------|------------------|--------------------------------------------|

|            |  |                             |                                            |
|------------|--|-----------------------------|--------------------------------------------|
| 48 ± 6 ± 7 |  | <sup>1</sup> DOBBS 08A CLEO | $\psi(2S) \rightarrow \pi^0 \eta_c \gamma$ |
|------------|--|-----------------------------|--------------------------------------------|

OCCUR=2

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

|            |      |                             |                                            |
|------------|------|-----------------------------|--------------------------------------------|
| 48 ± 6 ± 7 | 1282 | <sup>2</sup> DOBBS 08A CLEO | $\psi(2S) \rightarrow \pi^0 \eta_c \gamma$ |
|------------|------|-----------------------------|--------------------------------------------|

|             |     |                             |                                            |
|-------------|-----|-----------------------------|--------------------------------------------|
| 46 ± 12 ± 7 | 168 | <sup>3</sup> ROSNER 05 CLEO | $\psi(2S) \rightarrow \pi^0 \eta_c \gamma$ |
|-------------|-----|-----------------------------|--------------------------------------------|

- <sup>1</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.
- <sup>2</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  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.
- <sup>3</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=DB

NODE=M144R2;LINKAGE=DO

NODE=M144R2;LINKAGE=RO

### CROSS-PARTICLE BRANCHING RATIOS

NODE=M144235

$$\frac{\Gamma(h_c(1P) \rightarrow p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}}{\Gamma_4/\Gamma \times \Gamma_{15}^{\psi(2S)}/\Gamma_{\psi(2S)}}$$

| VALUE                 | CL% | DOCUMENT ID | TECN     | COMMENT                                |
|-----------------------|-----|-------------|----------|----------------------------------------|
| $<1.3 \times 10^{-7}$ | 90  | ABLIKIM     | 13V BES3 | $\psi(2S) \rightarrow \gamma p\bar{p}$ |

NODE=M144R05  
NODE=M144R05

$$\frac{\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}}{\Gamma_{10}/\Gamma \times \Gamma_{15}^{\psi(2S)}/\Gamma_{\psi(2S)}}$$

| VALUE (units $10^{-4}$ )                    | EVTS | DOCUMENT ID          | TECN     | COMMENT                                    |
|---------------------------------------------|------|----------------------|----------|--------------------------------------------|
| <b>4.3 <math>\pm</math> 0.4 OUR AVERAGE</b> |      |                      |          |                                            |
| $4.58 \pm 0.40 \pm 0.50$                    | 3679 | <sup>1</sup> ABLIKIM | 10B BES3 | $\psi(2S) \rightarrow \pi^0 \gamma X$      |
| $4.16 \pm 0.30 \pm 0.37$                    | 1430 | <sup>2</sup> DOBBS   | 08A CLEO | $\psi(2S) \rightarrow \pi^0 \gamma \eta_c$ |

NODE=M144R04  
NODE=M144R04

- <sup>1</sup> Not independent of other branching fractions in ABLIKIM 10B.
- <sup>2</sup> Not independent of other branching fractions in DOBBS 08A.

NODE=M144R04;LINKAGE=AB  
NODE=M144R04;LINKAGE=DO

### $h_c(1P)$ REFERENCES

NODE=M144

|            |     |                |                              |                           |
|------------|-----|----------------|------------------------------|---------------------------|
| ABLIKIM    | 18M | PR D97 052008  | M. Ablikim <i>et al.</i>     | (BES III Collab.)         |
| ABLIKIM    | 16I | PRL 116 251802 | M. Ablikim <i>et al.</i>     | (BES III Collab.)         |
| ABLIKIM    | 13V | PR D88 112001  | M. Ablikim <i>et al.</i>     | (BES III Collab.)         |
| ABLIKIM    | 12N | PR D86 092009  | M. Ablikim <i>et al.</i>     | (BES III Collab.)         |
| ABLIKIM    | 10B | PRL 104 132002 | M. Ablikim <i>et al.</i>     | (BES III 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+) |

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

$\chi_{c2}(1P)$

$$I^G(J^{PC}) = 0^+(2^{++})$$

See the Review on " $\psi(2S)$  and  $\chi_c$  branching ratios" before the  $\chi_{c0}(1P)$  Listings.

NODE=M057

NODE=M057

NODE=M057M

NODE=M057M

### $\chi_{c2}(1P)$ MASS

| VALUE (MeV)                       | EVTS | DOCUMENT ID              | TECN      | COMMENT                                                 |
|-----------------------------------|------|--------------------------|-----------|---------------------------------------------------------|
| <b>3556.17 ± 0.07 OUR AVERAGE</b> |      |                          |           |                                                         |
| 3557.3 ± 1.7 ± 0.7                | 611  | <sup>1</sup> AAIJ        | 17BB LHCb | $p\bar{p} \rightarrow b\bar{b}X \rightarrow 2(K^+K^-)X$ |
| 3556.10 ± 0.06 ± 0.11             | 4.0k | <sup>2</sup> AAIJ        | 17BI LHCb | $\chi_{c2} \rightarrow J/\psi\mu^+\mu^-$                |
| 3555.3 ± 0.6 ± 2.2                | 2.5k | UEHARA                   | 08 BELL   | $\gamma\gamma \rightarrow \text{hadrons}$               |
| 3555.70 ± 0.59 ± 0.39             |      | ABLIKIM                  | 05G BES2  | $\psi(2S) \rightarrow \gamma\chi_{c2}$                  |
| 3556.173 ± 0.123 ± 0.020          |      | ANDREOTTI                | 05A E835  | $p\bar{p} \rightarrow e^+e^-\gamma$                     |
| 3559.9 ± 2.9                      |      | EISENSTEIN               | 01 CLE2   | $e^+e^- \rightarrow e^+e^-\chi_{c2}$                    |
| 3556.4 ± 0.7                      |      | BAI                      | 99B BES   | $\psi(2S) \rightarrow \gamma X$                         |
| 3556.22 ± 0.131 ± 0.020           | 585  | <sup>3</sup> ARMSTRONG   | 92 E760   | $\bar{p}p \rightarrow e^+e^-\gamma$                     |
| 3556.9 ± 0.4 ± 0.5                | 50   | BAGLIN                   | 86B SPEC  | $\bar{p}p \rightarrow e^+e^-X$                          |
| 3557.8 ± 0.2 ± 4                  |      | <sup>4</sup> GAISER      | 86 CBAL   | $\psi(2S) \rightarrow \gamma X$                         |
| 3553.4 ± 2.2                      | 66   | <sup>5</sup> LEMOIGNE    | 82 GOLI   | $185\pi^-\text{Be} \rightarrow \gamma\mu^+\mu^-A$       |
| 3555.9 ± 0.7                      |      | <sup>6</sup> OREGLIA     | 82 CBAL   | $e^+e^- \rightarrow J/\psi 2\gamma$                     |
| 3557 ± 1.5                        | 69   | <sup>7</sup> HIMEL       | 80 MRK2   | $e^+e^- \rightarrow J/\psi 2\gamma$                     |
| 3551 ± 11                         | 15   | BRANDELIK                | 79B DASP  | $e^+e^- \rightarrow J/\psi 2\gamma$                     |
| 3553 ± 4                          |      | <sup>7</sup> BARTEL      | 78B CNTR  | $e^+e^- \rightarrow J/\psi 2\gamma$                     |
| 3553 ± 4 ± 4                      |      | <sup>7,8</sup> TANENBAUM | 78 MRK1   | $e^+e^-$                                                |
| 3563 ± 7                          | 360  | <sup>7</sup> BIDDICK     | 77 CNTR   | $e^+e^- \rightarrow \gamma X$                           |
| 3555.4 ± 1.3                      | 53   | UEHARA                   | 13 BELL   | $\gamma\gamma \rightarrow K_S^0 K_S^0$                  |
| 3543 ± 10                         | 4    | WHITAKER                 | 76 MRK1   | $e^+e^- \rightarrow J/\psi 2\gamma$                     |

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

- <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;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

| 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   | $\bar{p}p \rightarrow e^+e^-\gamma$      |
| 2.6 <sup>+1.4</sup> <sub>-1.0</sub> | 50   | BAGLIN                 | 86B SPEC  | $\bar{p}p \rightarrow e^+e^-X$           |
| 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

NODE=M057W;LINKAGE=AN

NODE=M057W;LINKAGE=E

### $\chi_{c2}(1P)$ DECAY MODES

NODE=M057215;NODE=M057

| Mode | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|------|--------------------------------|------------------|
|------|--------------------------------|------------------|

## Hadronic decays

NODE=M057;CLUMP=A

|                 |                                                                                  |                                 |     |          |
|-----------------|----------------------------------------------------------------------------------|---------------------------------|-----|----------|
| Г <sub>1</sub>  | $2(\pi^+\pi^-)$                                                                  | ( 1.02±0.09) %                  |     | DESIG=3  |
| Г <sub>2</sub>  | $\rho\rho$                                                                       |                                 |     | DESIG=43 |
| Г <sub>3</sub>  | $\pi^+\pi^-\pi^0\pi^0$                                                           | ( 1.83±0.23) %                  |     | DESIG=50 |
| Г <sub>4</sub>  | $\rho^+\pi^-\pi^0 + \text{c.c.}$                                                 | ( 2.19±0.34) %                  |     | DESIG=51 |
| Г <sub>5</sub>  | $4\pi^0$                                                                         | ( 1.11±0.15) × 10 <sup>-3</sup> |     | DESIG=62 |
| Г <sub>6</sub>  | $K^+K^-\pi^0\pi^0$                                                               | ( 2.1 ±0.4 ) × 10 <sup>-3</sup> |     | DESIG=52 |
| Г <sub>7</sub>  | $K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.}$                                           | ( 1.38±0.20) %                  |     | DESIG=54 |
| Г <sub>8</sub>  | $\rho^-K^+\bar{K}^0 + \text{c.c.}$                                               | ( 4.1 ±1.2 ) × 10 <sup>-3</sup> |     | DESIG=55 |
| Г <sub>9</sub>  | $K^*(892)^0K^-\pi^+ \rightarrow$<br>$K^-\pi^+K^0\pi^0 + \text{c.c.}$             | ( 2.9 ±0.8 ) × 10 <sup>-3</sup> |     | DESIG=60 |
| Г <sub>10</sub> | $K^*(892)^0\bar{K}^0\pi^0 \rightarrow$<br>$K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.}$ | ( 3.8 ±0.9 ) × 10 <sup>-3</sup> |     | DESIG=56 |
| Г <sub>11</sub> | $K^*(892)^-K^+\pi^0 \rightarrow$<br>$K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.}$       | ( 3.7 ±0.8 ) × 10 <sup>-3</sup> |     | DESIG=57 |
| Г <sub>12</sub> | $K^*(892)^+\bar{K}^0\pi^- \rightarrow$<br>$K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.}$ | ( 2.9 ±0.8 ) × 10 <sup>-3</sup> |     | DESIG=58 |
| Г <sub>13</sub> | $K^+K^-\eta\pi^0$                                                                | ( 1.3 ±0.4 ) × 10 <sup>-3</sup> |     | DESIG=59 |
| Г <sub>14</sub> | $K^+K^-\pi^+\pi^-$                                                               | ( 8.4 ±0.9 ) × 10 <sup>-3</sup> |     | DESIG=5  |
| Г <sub>15</sub> | $K^+K^-\pi^+\pi^-\pi^0$                                                          | ( 1.17±0.13) %                  |     | DESIG=67 |
| Г <sub>16</sub> | $K_S^0K^\pm\pi^\mp\pi^+\pi^-$                                                    | ( 7.3 ±0.8 ) × 10 <sup>-3</sup> |     | DESIG=78 |
| Г <sub>17</sub> | $K^+\bar{K}^*(892)^0\pi^- + \text{c.c.}$                                         | ( 2.1 ±1.1 ) × 10 <sup>-3</sup> |     | DESIG=10 |
| Г <sub>18</sub> | $K^*(892)^0\bar{K}^*(892)^0$                                                     | ( 2.3 ±0.4 ) × 10 <sup>-3</sup> |     | DESIG=21 |
| Г <sub>19</sub> | $3(\pi^+\pi^-)$                                                                  | ( 8.6 ±1.8 ) × 10 <sup>-3</sup> |     | DESIG=4  |
| Г <sub>20</sub> | $\phi\phi$                                                                       | ( 1.06±0.09) × 10 <sup>-3</sup> |     | DESIG=16 |
| Г <sub>21</sub> | $\omega\omega$                                                                   | ( 8.4 ±1.0 ) × 10 <sup>-4</sup> |     | DESIG=25 |
| Г <sub>22</sub> | $\omega K^+K^-$                                                                  | ( 7.3 ±0.9 ) × 10 <sup>-4</sup> |     | DESIG=79 |
| Г <sub>23</sub> | $\omega\phi$                                                                     | ( 9.6 ±2.7 ) × 10 <sup>-6</sup> |     | DESIG=68 |
| Г <sub>24</sub> | $\pi\pi$                                                                         | ( 2.23±0.09) × 10 <sup>-3</sup> |     | DESIG=22 |
| Г <sub>25</sub> | $\rho^0\pi^+\pi^-$                                                               | ( 3.7 ±1.6 ) × 10 <sup>-3</sup> |     | DESIG=9  |
| Г <sub>26</sub> | $\pi^+\pi^-\pi^0 (\text{non-resonant})$                                          | ( 2.0 ±0.4 ) × 10 <sup>-5</sup> |     | DESIG=95 |
| Г <sub>27</sub> | $\rho(770)^\pm\pi^\mp$                                                           | ( 6 ±4 ) × 10 <sup>-6</sup>     |     | DESIG=96 |
| Г <sub>28</sub> | $\pi^+\pi^-\eta$                                                                 | ( 4.8 ±1.3 ) × 10 <sup>-4</sup> |     | DESIG=39 |
| Г <sub>29</sub> | $\pi^+\pi^-\eta'$                                                                | ( 5.0 ±1.8 ) × 10 <sup>-4</sup> |     | DESIG=42 |
| Г <sub>30</sub> | $\eta\eta$                                                                       | ( 5.4 ±0.4 ) × 10 <sup>-4</sup> |     | DESIG=14 |
| Г <sub>31</sub> | $K^+K^-$                                                                         | ( 1.01±0.06) × 10 <sup>-3</sup> |     | DESIG=2  |
| Г <sub>32</sub> | $K_S^0K_S^0$                                                                     | ( 5.2 ±0.4 ) × 10 <sup>-4</sup> |     | DESIG=15 |
| Г <sub>33</sub> | $K^*(892)^\pm K^\mp$                                                             | ( 1.44±0.21) × 10 <sup>-4</sup> |     | DESIG=87 |
| Г <sub>34</sub> | $K^*(892)^0\bar{K}^0 + \text{c.c.}$                                              | ( 1.24±0.27) × 10 <sup>-4</sup> |     | DESIG=88 |
| Г <sub>35</sub> | $K_2^*(1430)^\pm K^\mp$                                                          | ( 1.48±0.12) × 10 <sup>-3</sup> |     | DESIG=89 |
| Г <sub>36</sub> | $K_2^*(1430)^0\bar{K}^0 + \text{c.c.}$                                           | ( 1.24±0.17) × 10 <sup>-3</sup> |     | DESIG=90 |
| Г <sub>37</sub> | $K_3^*(1780)^\pm K^\mp$                                                          | ( 5.2 ±0.8 ) × 10 <sup>-4</sup> |     | DESIG=91 |
| Г <sub>38</sub> | $K_3^*(1780)^0\bar{K}^0 + \text{c.c.}$                                           | ( 5.6 ±2.1 ) × 10 <sup>-4</sup> |     | DESIG=92 |
| Г <sub>39</sub> | $a_2(1320)^0\pi^0$                                                               | ( 1.29±0.34) × 10 <sup>-3</sup> |     | DESIG=93 |
| Г <sub>40</sub> | $a_2(1320)^\pm\pi^\mp$                                                           | ( 1.8 ±0.6 ) × 10 <sup>-3</sup> |     | DESIG=94 |
| Г <sub>41</sub> | $\bar{K}^0K^+\pi^- + \text{c.c.}$                                                | ( 1.28±0.18) × 10 <sup>-3</sup> |     | DESIG=17 |
| Г <sub>42</sub> | $K^+K^-\pi^0$                                                                    | ( 3.0 ±0.8 ) × 10 <sup>-4</sup> |     | DESIG=36 |
| Г <sub>43</sub> | $K^+K^-\eta$                                                                     | < 3.2 × 10 <sup>-4</sup>        | 90% | DESIG=40 |
| Г <sub>44</sub> | $K^+K^-\eta'(958)$                                                               | ( 1.94±0.34) × 10 <sup>-4</sup> |     | DESIG=82 |
| Г <sub>45</sub> | $\eta\eta'$                                                                      | ( 2.2 ±0.5 ) × 10 <sup>-5</sup> |     | DESIG=34 |
| Г <sub>46</sub> | $\eta'\eta'$                                                                     | ( 4.6 ±0.6 ) × 10 <sup>-5</sup> |     | DESIG=35 |
| Г <sub>47</sub> | $\pi^+\pi^-K_S^0K_S^0$                                                           | ( 2.2 ±0.5 ) × 10 <sup>-3</sup> |     | DESIG=29 |
| Г <sub>48</sub> | $K^+K^-K_S^0K_S^0$                                                               | < 4 × 10 <sup>-4</sup>          | 90% | DESIG=30 |
| Г <sub>49</sub> | $K^+K^-K^+K^-$                                                                   | ( 1.65±0.20) × 10 <sup>-3</sup> |     | DESIG=24 |
| Г <sub>50</sub> | $K^+K^-\phi$                                                                     | ( 1.42±0.29) × 10 <sup>-3</sup> |     | DESIG=32 |
| Г <sub>51</sub> | $\bar{K}^0K^+\pi^-\phi + \text{c.c.}$                                            | ( 4.8 ±0.7 ) × 10 <sup>-3</sup> |     | DESIG=83 |
| Г <sub>52</sub> | $K^+K^-\pi^0\phi$                                                                | ( 2.7 ±0.5 ) × 10 <sup>-3</sup> |     | DESIG=84 |
| Г <sub>53</sub> | $\phi\pi^+\pi^-\pi^0$                                                            | ( 9.3 ±1.2 ) × 10 <sup>-4</sup> |     | DESIG=80 |
| Г <sub>54</sub> | $p\bar{p}$                                                                       | ( 7.33±0.33) × 10 <sup>-5</sup> |     | DESIG=11 |

|                 |                                                  |                                  |     |          |
|-----------------|--------------------------------------------------|----------------------------------|-----|----------|
| Γ <sub>55</sub> | $p\bar{p}\pi^0$                                  | $(4.7 \pm 0.4) \times 10^{-4}$   |     | DESIG=37 |
| Γ <sub>56</sub> | $p\bar{p}\eta$                                   | $(1.74 \pm 0.25) \times 10^{-4}$ |     | DESIG=41 |
| Γ <sub>57</sub> | $p\bar{p}\omega$                                 | $(3.6 \pm 0.4) \times 10^{-4}$   |     | DESIG=61 |
| Γ <sub>58</sub> | $p\bar{p}\phi$                                   | $(2.8 \pm 0.9) \times 10^{-5}$   |     | DESIG=66 |
| Γ <sub>59</sub> | $p\bar{p}\pi^+\pi^-$                             | $(1.32 \pm 0.34) \times 10^{-3}$ |     | DESIG=8  |
| Γ <sub>60</sub> | $p\bar{p}\pi^0\pi^0$                             | $(7.8 \pm 2.3) \times 10^{-4}$   |     | DESIG=53 |
| Γ <sub>61</sub> | $p\bar{p}K^+K^-$ (non-resonant)                  | $(1.91 \pm 0.32) \times 10^{-4}$ |     | DESIG=63 |
| Γ <sub>62</sub> | $p\bar{p}K_S^0 K_S^0$                            | $< 7.9 \times 10^{-4}$           | 90% | DESIG=28 |
| Γ <sub>63</sub> | $p\bar{n}\pi^-$                                  | $(8.5 \pm 0.9) \times 10^{-4}$   |     | DESIG=31 |
| Γ <sub>64</sub> | $\bar{p}n\pi^+$                                  | $(8.9 \pm 0.8) \times 10^{-4}$   |     | DESIG=75 |
| Γ <sub>65</sub> | $p\bar{n}\pi^-\pi^0$                             | $(2.17 \pm 0.18) \times 10^{-3}$ |     | DESIG=76 |
| Γ <sub>66</sub> | $\bar{p}n\pi^+\pi^0$                             | $(2.11 \pm 0.18) \times 10^{-3}$ |     | DESIG=77 |
| Γ <sub>67</sub> | $\Lambda\bar{\Lambda}$                           | $(1.84 \pm 0.15) \times 10^{-4}$ |     | DESIG=19 |
| Γ <sub>68</sub> | $\Lambda\bar{\Lambda}\pi^+\pi^-$                 | $(1.25 \pm 0.15) \times 10^{-3}$ |     | DESIG=27 |
| Γ <sub>69</sub> | $\Lambda\bar{\Lambda}\pi^+\pi^-$ (non-resonant)  | $(6.6 \pm 1.5) \times 10^{-4}$   |     | DESIG=70 |
| Γ <sub>70</sub> | $\Sigma(1385)^+\bar{\Lambda}\pi^- + \text{c.c.}$ | $< 4 \times 10^{-4}$             | 90% | DESIG=71 |
| Γ <sub>71</sub> | $\Sigma(1385)^-\bar{\Lambda}\pi^+ + \text{c.c.}$ | $< 6 \times 10^{-4}$             | 90% | DESIG=72 |
| Γ <sub>72</sub> | $K^+\bar{p}\Lambda + \text{c.c.}$                | $(7.8 \pm 0.5) \times 10^{-4}$   |     | DESIG=38 |
| Γ <sub>73</sub> | $K^+\bar{p}\Lambda(1520) + \text{c.c.}$          | $(2.8 \pm 0.7) \times 10^{-4}$   |     | DESIG=64 |
| Γ <sub>74</sub> | $\Lambda(1520)\bar{\Lambda}(1520)$               | $(4.6 \pm 1.5) \times 10^{-4}$   |     | DESIG=65 |
| Γ <sub>75</sub> | $\Sigma^0\bar{\Sigma}^0$                         | $(3.7 \pm 0.6) \times 10^{-5}$   |     | DESIG=47 |
| Γ <sub>76</sub> | $\Sigma^+\bar{\Sigma}^-$                         | $(3.4 \pm 0.7) \times 10^{-5}$   |     | DESIG=48 |
| Γ <sub>77</sub> | $\Sigma(1385)^+\bar{\Sigma}(1385)^-$             | $< 1.6 \times 10^{-4}$           | 90% | DESIG=73 |
| Γ <sub>78</sub> | $\Sigma(1385)^-\bar{\Sigma}(1385)^+$             | $< 8 \times 10^{-5}$             | 90% | DESIG=74 |
| Γ <sub>79</sub> | $K^-\Lambda\Xi^+ + \text{c.c.}$                  | $(1.76 \pm 0.32) \times 10^{-4}$ |     | DESIG=85 |
| Γ <sub>80</sub> | $\Xi^0\Xi^0$                                     | $< 1.0 \times 10^{-4}$           | 90% | DESIG=49 |
| Γ <sub>81</sub> | $\Xi^-\Xi^+$                                     | $(1.42 \pm 0.32) \times 10^{-4}$ |     | DESIG=26 |
| Γ <sub>82</sub> | $J/\psi(1S)\pi^+\pi^-\pi^0$                      | $< 1.5 \%$                       | 90% | DESIG=12 |
| Γ <sub>83</sub> | $\pi^0\eta_c$                                    | $< 3.2 \times 10^{-3}$           | 90% | DESIG=81 |
| Γ <sub>84</sub> | $\eta_c(1S)\pi^+\pi^-$                           | $< 5.4 \times 10^{-3}$           | 90% | DESIG=69 |

**Radiative decays**

|                 |                     |                                  |     |                              |
|-----------------|---------------------|----------------------------------|-----|------------------------------|
| Γ <sub>85</sub> | $\gamma J/\psi(1S)$ | $(19.0 \pm 0.5) \%$              |     | NODE=M057;CLUMP=B<br>DESIG=6 |
| Γ <sub>86</sub> | $\gamma\rho^0$      | $< 1.9 \times 10^{-5}$           | 90% | DESIG=44                     |
| Γ <sub>87</sub> | $\gamma\omega$      | $< 6 \times 10^{-6}$             | 90% | DESIG=45                     |
| Γ <sub>88</sub> | $\gamma\phi$        | $< 7 \times 10^{-6}$             | 90% | DESIG=46                     |
| Γ <sub>89</sub> | $\gamma\gamma$      | $(2.85 \pm 0.10) \times 10^{-4}$ |     | DESIG=7                      |
| Γ <sub>90</sub> | $e^+e^- J/\psi(1S)$ | $(2.37 \pm 0.16) \times 10^{-3}$ |     | DESIG=86                     |

**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  $\langle \delta p_i \delta p_j \rangle / (\delta p_i \cdot \delta p_j)$ , in percent, from the fit to parameters  $p_i$ , including the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ .

|          |       |          |          |          |          |          |          |          |          |          |
|----------|-------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| $x_{14}$ | 7     |          |          |          |          |          |          |          |          |          |
| $x_{17}$ | 2     | 21       |          |          |          |          |          |          |          |          |
| $x_{18}$ | 4     | 3        | 1        |          |          |          |          |          |          |          |
| $x_{20}$ | 7     | 5        | 1        | 3        |          |          |          |          |          |          |
| $x_{24}$ | 7     | 6        | 1        | 4        | 10       |          |          |          |          |          |
| $x_{25}$ | 18    | 2        | 0        | 1        | 1        | 1        |          |          |          |          |
| $x_{30}$ | 3     | 3        | 1        | 2        | 5        | 12       | 1        |          |          |          |
| $x_{31}$ | 5     | 4        | 1        | 3        | 7        | 15       | 1        | 8        |          |          |
| $x_{32}$ | 5     | 4        | 1        | 2        | 6        | 13       | 1        | 7        | 8        |          |
| $x_{41}$ | 2     | 2        | 0        | 1        | 3        | 7        | 0        | 3        | 4        | 4        |
| $x_{49}$ | 4     | 3        | 1        | 2        | 4        | 7        | 1        | 4        | 5        | 4        |
| $x_{54}$ | 10    | 9        | 2        | 5        | 9        | 11       | 2        | 5        | 8        | 7        |
| $x_{67}$ | 3     | 3        | 1        | 2        | 5        | 13       | 1        | 7        | 8        | 7        |
| $x_{85}$ | 12    | 10       | 2        | 6        | 15       | 34       | 2        | 18       | 22       | 18       |
| $x_{89}$ | -6    | -4       | -1       | -2       | 2        | 20       | -2       | 12       | 12       | 10       |
| $\Gamma$ | -23   | -19      | -4       | -11      | -19      | -25      | -5       | -12      | -18      | -15      |
|          | $x_1$ | $x_{14}$ | $x_{17}$ | $x_{18}$ | $x_{20}$ | $x_{24}$ | $x_{25}$ | $x_{30}$ | $x_{31}$ | $x_{32}$ |

|          |          |          |          |          |          |          |  |  |  |  |
|----------|----------|----------|----------|----------|----------|----------|--|--|--|--|
| $x_{49}$ | 2        |          |          |          |          |          |  |  |  |  |
| $x_{54}$ | 4        | 5        |          |          |          |          |  |  |  |  |
| $x_{67}$ | 4        | 4        | 6        |          |          |          |  |  |  |  |
| $x_{85}$ | 10       | 11       | 4        | 18       |          |          |  |  |  |  |
| $x_{89}$ | 5        | 4        | 18       | 12       | 34       |          |  |  |  |  |
| $\Gamma$ | -8       | -11      | -45      | -12      | -46      | -43      |  |  |  |  |
|          | $x_{41}$ | $x_{49}$ | $x_{54}$ | $x_{67}$ | $x_{85}$ | $x_{89}$ |  |  |  |  |

### $\chi_{c2}(1P)$ PARTIAL WIDTHS

$$\chi_{c2}(1P) \Gamma(i) \Gamma(\gamma J/\psi(1S)) / \Gamma(\text{total})$$

$$\Gamma(p\bar{p}) \times \Gamma(\gamma J/\psi(1S)) / \Gamma_{\text{total}} \quad \Gamma_{54} \Gamma_{85} / \Gamma$$

| VALUE (eV)                    | DOCUMENT ID                 | TECN | COMMENT                               |
|-------------------------------|-----------------------------|------|---------------------------------------|
| <b>27.5 ± 1.2 OUR FIT</b>     |                             |      |                                       |
| <b>27.5 ± 1.5 OUR AVERAGE</b> |                             |      |                                       |
| 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 | $\bar{p}p \rightarrow e^+ e^- \gamma$ |
| 36 ± 8                        | <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=M057220

NODE=M057223

NODE=M057G1  
NODE=M057G1

NODE=M057G;LINKAGE=7A  
NODE=M057G;LINKAGE=AN

$$\Gamma(\gamma\gamma) \times \Gamma(\gamma J/\psi(1S)) / \Gamma_{\text{total}} \quad \Gamma_{89} \Gamma_{85} / \Gamma$$

| VALUE (eV)                  | EVS        | DOCUMENT ID                   | TECN | COMMENT                                      |
|-----------------------------|------------|-------------------------------|------|----------------------------------------------|
| <b>107 ± 5 OUR FIT</b>      |            |                               |      |                                              |
| <b>117 ± 10 OUR AVERAGE</b> |            |                               |      |                                              |
| 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   | $e^+ e^- \rightarrow e^+ e^- \chi_{c2}$      |
| 242 ± 65 ± 51               |            | <sup>1,4</sup> ACKER.,K... 98 | OPAL | $e^+ e^- \rightarrow e^+ e^- \chi_{c2}$      |
| 150 ± 42 ± 36               |            | <sup>1,5</sup> DOMINICK 94    | CLE2 | $e^+ e^- \rightarrow e^+ e^- \chi_{c2}$      |
| 470 ± 240 ± 120             |            | <sup>1,6</sup> BAUER 93       | TPC  | $e^+ e^- \rightarrow e^+ e^- \chi_{c2}$      |

NODE=M057G2  
NODE=M057G2

<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  $B(J/\psi(1S) \rightarrow \mu^+ \mu^-) = 0.0597 \pm 0.0025$ .

### $\chi_{c2}(1P) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$

NODE=M057G;LINKAGE=LL

NODE=M057G;LINKAGE=GT

NODE=M057G;LINKAGE=J4

NODE=M057G;LINKAGE=J5

NODE=M057G;LINKAGE=J6

NODE=M057G;LINKAGE=J7

NODE=M057224

### $\Gamma(2(\pi^+ \pi^-)) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}} \quad \Gamma_1 \Gamma_{89} / \Gamma$

| 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

### $\Gamma(\rho\rho) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}} \quad \Gamma_2 \Gamma_{89} / \Gamma$

| 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

### $\Gamma(K^+ K^- \pi^+ \pi^-) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}} \quad \Gamma_{14} \Gamma_{89} / \Gamma$

| 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

### $\Gamma(K^+ K^- \pi^+ \pi^- \pi^0) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}} \quad \Gamma_{15} \Gamma_{89} / \Gamma$

| 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

### $\Gamma(K^*(892)^0 \bar{K}^*(892)^0) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}} \quad \Gamma_{18} \Gamma_{89} / \Gamma$

| 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

### $\Gamma(\phi\phi) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}} \quad \Gamma_{20} \Gamma_{89} / \Gamma$

| 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;LINKAGE=LI

### $\Gamma(\omega\omega) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}} \quad \Gamma_{21} \Gamma_{89} / \Gamma$

| 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

### $\Gamma(\omega\phi) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}} \quad \Gamma_{23} \Gamma_{89} / \Gamma$

| 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



$$\Gamma(\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{24}\Gamma_{89}/\Gamma$$

| 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

$$\Gamma(\rho^0\pi^+\pi^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{25}\Gamma_{89}/\Gamma$$

| 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

$$\Gamma(\eta\eta) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{30}\Gamma_{89}/\Gamma$$

| 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

$$\Gamma(K^+K^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{31}\Gamma_{89}/\Gamma$$

| 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

$$\Gamma(K_S^0 K_S^0) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{32}\Gamma_{89}/\Gamma$$

| 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

$$\Gamma(\bar{K}^0 K^+ \pi^- + \text{c.c.}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{41}\Gamma_{89}/\Gamma$$

| 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

$$\Gamma(K^+K^-K^+K^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{49}\Gamma_{89}/\Gamma$$

| 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

$$\Gamma(\eta_c(1S)\pi^+\pi^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{84}\Gamma_{89}/\Gamma$$

| 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

$$\Gamma(\rho^0\pi^+\pi^-)/\Gamma(2(\pi^+\pi^-)) \quad \Gamma_{25}/\Gamma_1$$

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

 $\Gamma_{21}/\Gamma$ 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  $B(\psi(2S) \rightarrow \chi_{c2}\gamma) = (8.72 \pm 0.34)\%$ .

 $\Gamma_{22}/\Gamma$ NODE=M057R74  
NODE=M057R74

NODE=M057R74;LINKAGE=A

 $\Gamma(\omega\phi)/\Gamma_{\text{total}}$ VALUE (units  $10^{-5}$ )

CL%

EVTS

DOCUMENT ID

TECN

COMMENT

**0.96±0.27±0.02**

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;1.8

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.

 $\Gamma_{23}/\Gamma$ 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** $\Gamma_{24}/\Gamma$ NODE=M057R27  
NODE=M057R27 $\Gamma(\rho^0\pi^+\pi^-)/\Gamma_{\text{total}}$ VALUE (units  $10^{-4}$ )

DOCUMENT ID

**37±16 OUR FIT** $\Gamma_{25}/\Gamma$ NODE=M057R8  
NODE=M057R8 $\Gamma(\pi^+\pi^-\pi^0(\text{non-resonant}))/\Gamma_{\text{total}}$ VALUE (units  $10^{-5}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**2.01±0.42±0.04**

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.

 $\Gamma_{26}/\Gamma$ NODE=M057R84  
NODE=M057R84

OCCUR=2

NODE=M057R84;LINKAGE=B

$\Gamma(\rho(770)^\pm \pi^\mp)/\Gamma_{\text{total}}$  $\Gamma_{27}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTs | DOCUMENT ID          | TECN      | COMMENT                                         |
|--------------------------|------|----------------------|-----------|-------------------------------------------------|
| <b>0.61±0.38±0.01</b>    | 15   | <sup>1</sup> ABLIKIM | 17AG BES3 | $\psi(2S) \rightarrow \gamma \pi^+ \pi^- \pi^0$ |

NODE=M057R85  
 NODE=M057R85

<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;LINKAGE=A

 $\Gamma(\pi^+ \pi^- \eta)/\Gamma_{\text{total}}$  $\Gamma_{28}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID        | TECN    | COMMENT                                   |
|--------------------------|-----|--------------------|---------|-------------------------------------------|
| <b>0.48±0.13±0.01</b>    |     | <sup>1</sup> ATHAR | 07 CLEO | $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ |

NODE=M057R08  
 NODE=M057R08

• • • 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.

NODE=M057R08;LINKAGE=AT

<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;LINKAGE=AB

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

| VALUE (units $10^{-3}$ ) | DOCUMENT ID        | TECN    | COMMENT                                   |
|--------------------------|--------------------|---------|-------------------------------------------|
| <b>0.50±0.18±0.01</b>    | <sup>1</sup> ATHAR | 07 CLEO | $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ |

NODE=M057R35  
 NODE=M057R35

<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;LINKAGE=AT

 $\Gamma(\eta\eta)/\Gamma_{\text{total}}$  $\Gamma_{30}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | DOCUMENT ID |
|--------------------------|-------------|
| <b>5.4±0.4 OUR FIT</b>   |             |

NODE=M057R16  
 NODE=M057R16

 $\Gamma(K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{31}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID |
|--------------------------|-------------|
| <b>1.01±0.06 OUR FIT</b> |             |

NODE=M057R11  
 NODE=M057R11

 $\Gamma(K_S^0 K_S^0)/\Gamma_{\text{total}}$  $\Gamma_{32}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID |
|--------------------------|-------------|
| <b>0.52±0.04 OUR FIT</b> |             |

NODE=M057R19  
 NODE=M057R19

 $\Gamma(K_S^0 K_S^0)/\Gamma(\pi\pi)$  $\Gamma_{32}/\Gamma_{24}$ 

| 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  $\pi\pi$ .

NODE=M057R36;LINKAGE=CH

<sup>2</sup> Not independent from other measurements.

NODE=M057R36;LINKAGE=NI

 $\Gamma(K_S^0 K_S^0)/\Gamma(K^+ K^-)$  $\Gamma_{32}/\Gamma_{31}$ 

| VALUE                    | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
| <b>0.52±0.05 OUR FIT</b> |             |      |         |

NODE=M057R37  
 NODE=M057R37

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

0.70±0.21±0.12 <sup>1,2</sup> 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.

NODE=M057R37;LINKAGE=CH

<sup>2</sup> Not independent from other measurements.

NODE=M057R37;LINKAGE=NI

$\Gamma(K^*(892)^\pm K^\mp)/\Gamma_{\text{total}}$  $\Gamma_{33}/\Gamma$ VALUE (units  $10^{-4}$ )

DOCUMENT ID TECN COMMENT

**1.44 $\pm$ 0.21 $\pm$ 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. • • •

1.72 $\pm$ 0.26 $\pm$ 0.04<sup>2</sup> ABLIKIM 17AG BES3  $\psi(2S) \rightarrow \gamma K^+ K^- \pi^0$ 1.34 $\pm$ 0.27 $\pm$ 0.03<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

 $\Gamma(K^*(892)^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{34}/\Gamma$ VALUE (units  $10^{-4}$ )

DOCUMENT ID TECN COMMENT

**1.24 $\pm$ 0.27 $\pm$ 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

 $\Gamma(K_2^*(1430)^\pm K^\mp)/\Gamma_{\text{total}}$  $\Gamma_{35}/\Gamma$ VALUE (units  $10^{-4}$ )

DOCUMENT ID TECN COMMENT

**14.8 $\pm$ 1.2 $\pm$ 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. • • •

17.4 $\pm$ 1.6 $\pm$ 0.4<sup>2</sup> ABLIKIM 17AG BES3  $\psi(2S) \rightarrow \gamma K^+ K^- \pi^0$ 13.0 $\pm$ 1.5 $\pm$ 0.3<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

 $\Gamma(K_2^*(1430)^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{36}/\Gamma$ VALUE (units  $10^{-4}$ )

DOCUMENT ID TECN COMMENT

**12.4 $\pm$ 1.7 $\pm$ 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

$\Gamma(K_3^*(1780)^\pm K^\mp)/\Gamma_{\text{total}}$  $\Gamma_{37}/\Gamma$ 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

 $\Gamma(K_3^*(1780)^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{38}/\Gamma$ 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

 $\Gamma(a_2(1320)^0 \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{39}/\Gamma$ 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

 $\Gamma(a_2(1320)^\pm \pi^\mp)/\Gamma_{\text{total}}$  $\Gamma_{40}/\Gamma$ 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

 $\Gamma(K^+ K^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{42}/\Gamma$ 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

$\Gamma(K^+ K^- \eta)/\Gamma_{\text{total}}$  $\Gamma_{43}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID        | TECN    | COMMENT                                   |
|--------------------------|-----|--------------------|---------|-------------------------------------------|
| <b>&lt;0.32</b>          | 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

 $\Gamma(K^+ K^- \eta'(958))/\Gamma_{\text{total}}$  $\Gamma_{44}/\Gamma$ 

| VALUE (units $10^{-4}$ )          | EVTS | DOCUMENT ID          | TECN     | COMMENT                                          |
|-----------------------------------|------|----------------------|----------|--------------------------------------------------|
| <b><math>1.94 \pm 0.34</math></b> | 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

 $\Gamma(\eta \eta')/\Gamma_{\text{total}}$  $\Gamma_{45}/\Gamma$ 

| VALUE (units $10^{-5}$ )                   | CL% | EVTS | DOCUMENT ID          | TECN      | COMMENT                                  |
|--------------------------------------------|-----|------|----------------------|-----------|------------------------------------------|
| <b><math>2.17 \pm 0.47 \pm 0.05</math></b> |     | 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. • • •

|      |    |               |                    |         |                                          |
|------|----|---------------|--------------------|---------|------------------------------------------|
| < 6  | 90 | 3.3 $\pm$ 8.0 | <sup>2</sup> ASNER | 09 CLEO | $\psi(2S) \rightarrow \gamma \eta \eta'$ |
| < 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.

<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  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

<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  
NODE=M057R03

NODE=M057R03;LINKAGE=A

NODE=M057R03;LINKAGE=AS

NODE=M057R03;LINKAGE=AD

 $\Gamma(\eta' \eta')/\Gamma_{\text{total}}$  $\Gamma_{46}/\Gamma$ 

| VALUE (units $10^{-5}$ )                | CL% | EVTS | DOCUMENT ID          | TECN      | COMMENT                                   |
|-----------------------------------------|-----|------|----------------------|-----------|-------------------------------------------|
| <b><math>4.6 \pm 0.6 \pm 0.1</math></b> |     | 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. • • •

|      |    |            |                    |         |                                           |
|------|----|------------|--------------------|---------|-------------------------------------------|
| < 10 | 90 | 12 $\pm$ 7 | <sup>2</sup> ASNER | 09 CLEO | $\psi(2S) \rightarrow \gamma \eta' \eta'$ |
| < 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.

<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  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

<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  
NODE=M057R04

NODE=M057R04;LINKAGE=A

NODE=M057R04;LINKAGE=AS

NODE=M057R04;LINKAGE=AD

 $\Gamma(\pi^+ \pi^- K_S^0 K_S^0)/\Gamma_{\text{total}}$  $\Gamma_{47}/\Gamma$ 

| VALUE (units $10^{-3}$ )                   | EVTS        | DOCUMENT ID          | TECN     | COMMENT                                 |
|--------------------------------------------|-------------|----------------------|----------|-----------------------------------------|
| <b><math>2.17 \pm 0.54 \pm 0.05</math></b> | 57 $\pm$ 11 | <sup>1</sup> ABLIKIM | 050 BES2 | $\psi(2S) \rightarrow \gamma \chi_{c2}$ |

<sup>1</sup> ABLIKIM 050 reports  $[\Gamma(\chi_{c2}(1P) \rightarrow \pi^+ \pi^- K_S^0 K_S^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$   $= (0.207 \pm 0.039 \pm 0.033) \times 10^{-3}$  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  
NODE=M057R31

NODE=M057R31;LINKAGE=AB



$\Gamma(K^+ K^- K_S^0 K_S^0)/\Gamma_{\text{total}}$   $\Gamma_{48}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                             | CL% | EVTS          | DOCUMENT ID          | TECN     | COMMENT                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---------------|----------------------|----------|----------------------------------------|
| <b>&lt;4</b>                                                                                                                                                                                                                                                                                         | 90  | $2.3 \pm 2.2$ | <sup>1</sup> ABLIKIM | 050 BES2 | $e^+ e^- \rightarrow \chi_{c2} \gamma$ |
| <sup>1</sup> ABLIKIM 050 reports $[\Gamma(\chi_{c2}(1P) \rightarrow K^+ K^- K_S^0 K_S^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))] < 3.5 \times 10^{-5}$ which we divide by our best value $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ . |     |               |                      |          |                                        |

NODE=M057R32  
NODE=M057R32

NODE=M057R32;LINKAGE=AB

 $\Gamma(K^+ K^- K^+ K^-)/\Gamma_{\text{total}}$   $\Gamma_{49}/\Gamma$ 

| VALUE (units $10^{-3}$ )                  | DOCUMENT ID |
|-------------------------------------------|-------------|
| <b><math>1.65 \pm 0.20</math> OUR FIT</b> |             |

NODE=M057R18  
NODE=M057R18

 $\Gamma(K^+ K^- \phi)/\Gamma_{\text{total}}$   $\Gamma_{50}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | EVTS | DOCUMENT ID          | TECN     | COMMENT                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|-----------------------------------------|
| <b><math>1.42 \pm 0.29 \pm 0.03</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 52   | <sup>1</sup> ABLIKIM | 06T BES2 | $\psi(2S) \rightarrow \gamma 2K^+ 2K^-$ |
| <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  
NODE=M057R01

NODE=M057R01;LINKAGE=AB

 $\Gamma(\bar{K}^0 K^+ \pi^- \phi + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{51}/\Gamma$ 

| VALUE (units $10^{-3}$ )                   | DOCUMENT ID | TECN     | COMMENT                                 |
|--------------------------------------------|-------------|----------|-----------------------------------------|
| <b><math>4.83 \pm 0.32 \pm 0.66</math></b> | ABLIKIM     | 15M BES3 | $\psi(2S) \rightarrow \gamma \chi_{c2}$ |

NODE=M057R79  
NODE=M057R79

 $\Gamma(K^+ K^- \pi^0 \phi)/\Gamma_{\text{total}}$   $\Gamma_{52}/\Gamma$ 

| VALUE (units $10^{-3}$ )                   | DOCUMENT ID | TECN     | COMMENT                                 |
|--------------------------------------------|-------------|----------|-----------------------------------------|
| <b><math>2.74 \pm 0.16 \pm 0.44</math></b> | ABLIKIM     | 15M BES3 | $\psi(2S) \rightarrow \gamma \chi_{c2}$ |

NODE=M057R80  
NODE=M057R80

 $\Gamma(\phi \pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}$   $\Gamma_{53}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                                                                     | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                     |
|------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|-------------------------------------------------------------|
| <b><math>0.93 \pm 0.06 \pm 0.10</math></b>                                                                                   | 408  | <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 $B(\psi(2S) \rightarrow \chi_{c2} \gamma) = (8.72 \pm 0.34)\%$ . |      |                      |          |                                                             |

NODE=M057R75  
NODE=M057R75

NODE=M057R75;LINKAGE=A

 $\Gamma(p\bar{p})/\Gamma_{\text{total}}$   $\Gamma_{54}/\Gamma$ 

| VALUE (units $10^{-4}$ )                    | DOCUMENT ID |
|---------------------------------------------|-------------|
| <b><math>0.733 \pm 0.033</math> OUR FIT</b> |             |

NODE=M057R12  
NODE=M057R12

 $\Gamma(p\bar{p}\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{55}/\Gamma$ 

| VALUE (units $10^{-3}$ )                   | DOCUMENT ID         | TECN    | COMMENT                                   |
|--------------------------------------------|---------------------|---------|-------------------------------------------|
| <b><math>0.47 \pm 0.04 \pm 0.01</math></b> | <sup>1</sup> ONYISI | 10 CLE3 | $\psi(2S) \rightarrow \gamma p\bar{p}X$   |
| <b><math>0.43 \pm 0.09 \pm 0.01</math></b> | <sup>2</sup> ATHAR  | 07 CLEO | $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ |

NODE=M057R06  
NODE=M057R06

NODE=M057R06;LINKAGE=ON

<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.

<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

 $\Gamma(p\bar{p}\eta)/\Gamma_{\text{total}}$   $\Gamma_{56}/\Gamma$ 

| VALUE (units $10^{-3}$ )                        | DOCUMENT ID         | TECN    | COMMENT                                   |
|-------------------------------------------------|---------------------|---------|-------------------------------------------|
| <b><math>0.174 \pm 0.025</math> OUR AVERAGE</b> |                     |         |                                           |
| $0.172 \pm 0.026 \pm 0.004$                     | <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 | $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ |

NODE=M057R34  
NODE=M057R34

<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

 **$\Gamma(p\bar{p}\omega)/\Gamma_{\text{total}}$**  **$\Gamma_{57}/\Gamma$** 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID            | TECN | COMMENT                                 |
|--------------------------|------------------------|------|-----------------------------------------|
| <b>0.36±0.04±0.01</b>    | <sup>1</sup> ONYISI 10 | CLE3 | $\psi(2S) \rightarrow \gamma p\bar{p}X$ |

NODE=M057R56  
NODE=M057R56

<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;LINKAGE=ON

 **$\Gamma(p\bar{p}\phi)/\Gamma_{\text{total}}$**  **$\Gamma_{58}/\Gamma$** 

| VALUE (units $10^{-5}$ ) | EVTS   | DOCUMENT ID              | TECN | COMMENT                                      |
|--------------------------|--------|--------------------------|------|----------------------------------------------|
| <b>2.8±0.9±0.1</b>       | 24 ± 7 | <sup>1</sup> ABLIKIM 11F | BES3 | $\psi(2S) \rightarrow \gamma p\bar{p}K^+K^-$ |

NODE=M057R62  
NODE=M057R62

<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;LINKAGE=AB

 **$\Gamma(p\bar{p}\pi^+\pi^-)/\Gamma_{\text{total}}$**  **$\Gamma_{59}/\Gamma$** 

| VALUE (units $10^{-3}$ )        | DOCUMENT ID                              | TECN | COMMENT                                |
|---------------------------------|------------------------------------------|------|----------------------------------------|
| <b>1.32±0.34 OUR EVALUATION</b> | Treating systematic error as correlated. |      |                                        |
| <b>1.3 ±0.4 OUR AVERAGE</b>     | Error includes scale factor of 1.3.      |      |                                        |
| 1.17±0.19±0.30                  | <sup>1</sup> BAI 99B                     | BES  | $\psi(2S) \rightarrow \gamma\chi_{c2}$ |
| 2.64±1.03±0.14                  | <sup>1</sup> TANENBAUM 78                | MRK1 | $\psi(2S) \rightarrow \gamma\chi_{c2}$ |

NODE=M057R6  
NODE=M057R6

→ UNCHECKED ←

<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;LINKAGE=X3

 **$\Gamma(p\bar{p}\pi^0\pi^0)/\Gamma_{\text{total}}$**  **$\Gamma_{60}/\Gamma$** 

| VALUE (%)                | EVTS | DOCUMENT ID         | TECN | COMMENT                                 |
|--------------------------|------|---------------------|------|-----------------------------------------|
| <b>0.078±0.023±0.002</b> | 29.2 | <sup>1</sup> HE 08B | CLEO | $e^+e^- \rightarrow \gamma h^+ h^- h^0$ |

NODE=M057R49  
NODE=M057R49

<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;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                                      |
|--------------------------|----------|--------------------------|------|----------------------------------------------|
| <b>1.91±0.32±0.04</b>    | 131 ± 12 | <sup>1</sup> ABLIKIM 11F | BES3 | $\psi(2S) \rightarrow \gamma p\bar{p}K^+K^-$ |

NODE=M057R59  
NODE=M057R59

<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;LINKAGE=AB

 **$\Gamma(p\bar{p}K_S^0 K_S^0)/\Gamma_{\text{total}}$**  **$\Gamma_{62}/\Gamma$** 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID              | TECN | COMMENT                                |
|--------------------------|-----|--------------------------|------|----------------------------------------|
| <b>&lt;7.9</b>           | 90  | <sup>1</sup> ABLIKIM 06D | BES2 | $\psi(2S) \rightarrow \chi_{c2}\gamma$ |

NODE=M057R30  
NODE=M057R30

<sup>1</sup> Using  $B(\psi(2S) \rightarrow \chi_{c2}\gamma) = (9.3 \pm 0.6)\%$ .

NODE=M057R;LINKAGE=AB

$\Gamma(p\bar{n}\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{63}/\Gamma$ 

| 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 | $\psi(2S) \rightarrow \gamma p\pi^- X$      |

NODE=M057R33  
 NODE=M057R33

<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.

NODE=M057R33;LINKAGE=AL

<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;LINKAGE=AB

 $\Gamma(\bar{p}n\pi^+)/\Gamma_{\text{total}}$  $\Gamma_{64}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                     |
|--------------------------|------|----------------------|----------|---------------------------------------------|
| <b>8.9±0.8±0.2</b>       | 3732 | <sup>1</sup> ABLIKIM | 12J BES3 | $\psi(2S) \rightarrow \gamma \bar{p}n\pi^+$ |

NODE=M057R70  
 NODE=M057R70

<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;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>21.7±1.7±0.5</b>      | 2128 | <sup>1</sup> ABLIKIM | 12J BES3 | $\psi(2S) \rightarrow \gamma p\bar{n}\pi^-\pi^0$ |

NODE=M057R71  
 NODE=M057R71

<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;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>21.1±1.8±0.4</b>      | 2352 | <sup>1</sup> ABLIKIM | 12J BES3 | $\psi(2S) \rightarrow \gamma \bar{p}n\pi^+\pi^0$ |

NODE=M057R72  
 NODE=M057R72

<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;LINKAGE=AL

 $\Gamma(\Lambda\bar{\Lambda})/\Gamma_{\text{total}}$  $\Gamma_{67}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | DOCUMENT ID |
|--------------------------|-------------|
| <b>1.84±0.15 OUR FIT</b> |             |

NODE=M057R25  
 NODE=M057R25

 $\Gamma(\Lambda\bar{\Lambda}\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{68}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                      |
|--------------------------|-----|------|----------------------|----------|--------------------------------------------------------------|
| <b>125±15±3</b>          |     | 371  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Lambda\bar{\Lambda}\pi^+\pi^-$ |

NODE=M057R29  
 NODE=M057R29

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

|      |    |                      |          |                                        |
|------|----|----------------------|----------|----------------------------------------|
| <350 | 90 | <sup>2</sup> ABLIKIM | 06D BES2 | $\psi(2S) \rightarrow \chi_{c2}\gamma$ |
|------|----|----------------------|----------|----------------------------------------|

<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.

NODE=M057R29;LINKAGE=AL

<sup>2</sup> Using  $B(\psi(2S) \rightarrow \chi_{c2}\gamma) = (9.3 \pm 0.6)\%$ .

NODE=M057R29;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>66±15±1</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

$\Gamma(\Sigma(1385)^+ \bar{\Lambda} \pi^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{70}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                                                                                                                                                                                             | CL% | DOCUMENT ID              | TECN | COMMENT                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|------------------------------------------------------------------|
| <b>&lt;40</b>                                                                                                                                                                                                                                                                                                                                                                                                                                        | 90  | <sup>1</sup> ABLIKIM 12i | BES3 | $\psi(2S) \rightarrow \gamma \Sigma(1385)^+ \bar{\Lambda} \pi^-$ |
| <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  
 NODE=M057R66

NODE=M057R66;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;60</b>                                                                                                                                                                                                                                                                                                                                                                                                                                        | 90  | <sup>1</sup> ABLIKIM 12i | BES3 | $\psi(2S) \rightarrow \gamma \Sigma(1385)^- \bar{\Lambda} \pi^+$ |
| <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  
 NODE=M057R67

NODE=M057R67;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>7.8±0.5 OUR AVERAGE</b> |      |                            |      |                                                   |
| 7.7±0.5±0.2                | 5k   | <sup>1,2</sup> ABLIKIM 13D | BES3 | $\psi(2S) \rightarrow \gamma \Lambda \bar{p} K^+$ |
| 8.3±1.6±0.2                |      | <sup>3</sup> ATHAR 07      | CLEO | $\psi(2S) \rightarrow \gamma h^+ h^- h^0$         |

NODE=M057R07  
 NODE=M057R07

NODE=M057R07;LINKAGE=AB

<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.

<sup>2</sup> Using  $B(\Lambda \rightarrow p \pi^-) = 63.9\%$ .

<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.

NODE=M057R07;LINKAGE=LB  
 NODE=M057R07;LINKAGE=AT

 $\Gamma(K^+ \bar{p} \Lambda(1520) + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{73}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | EVTS    | DOCUMENT ID              | TECN | COMMENT                                         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|--------------------------|------|-------------------------------------------------|
| <b>2.8±0.7±0.1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 79 ± 13 | <sup>1</sup> ABLIKIM 11F | BES3 | $\psi(2S) \rightarrow \gamma p \bar{p} K^+ K^-$ |
| <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  
 NODE=M057R60

NODE=M057R60;LINKAGE=AB

 $\Gamma(\Lambda(1520) \bar{\Lambda}(1520))/\Gamma_{\text{total}}$  $\Gamma_{74}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | EVTS   | DOCUMENT ID              | TECN | COMMENT                                         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------------------------|------|-------------------------------------------------|
| <b>4.6±1.4±0.1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 29 ± 7 | <sup>1</sup> ABLIKIM 11F | BES3 | $\psi(2S) \rightarrow \gamma p \bar{p} K^+ K^-$ |
| <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  
 NODE=M057R61

NODE=M057R61;LINKAGE=AB

 $\Gamma(\Sigma^0 \bar{\Sigma}^0)/\Gamma_{\text{total}}$  $\Gamma_{75}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | EVTS      | DOCUMENT ID              | TECN | COMMENT                                               |
|-------------------------------------------------------------------------------|-----|-----------|--------------------------|------|-------------------------------------------------------|
| <b>3.7±0.6±0.1</b>                                                            |     | 91        | <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 | $\psi(2S) \rightarrow \gamma \Sigma^0 \bar{\Sigma}^0$ |
| <7                                                                            | 90  | 7.5 ± 3.4 | <sup>3</sup> NAIK 08     | CLEO | $\psi(2S) \rightarrow \gamma \Sigma^0 \bar{\Sigma}^0$ |

NODE=M057R43  
 NODE=M057R43

- <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.
- <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  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .
- <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=A

NODE=M057R43;LINKAGE=AB

NODE=M057R43;LINKAGE=NA

 $\Gamma(\Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}$  $\Gamma_{76}/\Gamma$ 

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

**$3.4 \pm 0.7 \pm 0.1$**  55 <sup>1</sup> ABLIKIM 18V BES3  $\psi(2S) \rightarrow \gamma \Sigma^+ \bar{\Sigma}^-$

• • • 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

 $\Gamma(\Sigma(1385)^+ \bar{\Sigma}(1385)^-)/\Gamma_{\text{total}}$  $\Gamma_{77}/\Gamma$ 

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

**$< 16$**  90 <sup>1</sup> ABLIKIM 12I BES3  $\psi(2S) \rightarrow \gamma \Sigma(1385)^+ \bar{\Sigma}(1385)^-$

- <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  
NODE=M057R68

NODE=M057R68;LINKAGE=AL

 $\Gamma(\Sigma(1385)^- \bar{\Sigma}(1385)^+)/\Gamma_{\text{total}}$  $\Gamma_{78}/\Gamma$ 

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

**$< 8$**  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

 $\Gamma(K^- \Lambda \bar{\Xi}^+ + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{79}/\Gamma$ 

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

**$1.76 \pm 0.32 \pm 0.04$**  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

 $\Gamma(\Xi^0 \bar{\Xi}^0)/\Gamma_{\text{total}}$  $\Gamma_{80}/\Gamma$ 

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

**$< 1.0$**  90 2.9  $\pm$  1.7 <sup>1</sup> NAIK 08 CLEO  $\psi(2S) \rightarrow \gamma \Xi^0 \bar{\Xi}^0$

- <sup>1</sup> NAIK 08 reports  $< 1.06 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \Xi^0 \bar{\Xi}^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  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

$\Gamma(\Xi^- \Xi^+)/\Gamma_{\text{total}}$  $\Gamma_{81}/\Gamma$ 

| VALUE (units $10^{-4}$ )                   | CL%    | EVTS | DOCUMENT ID | TECN    | COMMENT                                   |
|--------------------------------------------|--------|------|-------------|---------|-------------------------------------------|
| <b><math>1.42 \pm 0.31 \pm 0.03</math></b> | 29 ± 5 | 1    | NAIK        | 08 CLEO | $\psi(2S) \rightarrow \gamma \Xi^+ \Xi^-$ |

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

< 3.7 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  $[\Gamma(\chi_{c2}(1P) \rightarrow \Xi^- \Xi^+)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  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

 $\Gamma(J/\psi(1S)\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{82}/\Gamma$ 

| 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

 $\Gamma(\pi^0 \eta_c)/\Gamma_{\text{total}}$  $\Gamma_{83}/\Gamma$ 

| 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

 $\Gamma(\eta_c(1S)\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{84}/\Gamma$ 

| 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. • • •

<  $1.2 \times 10^{-2}$  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

 $\Gamma(\eta_c(1S)\pi^+\pi^-)/\Gamma(\bar{K}^0 K^+ \pi^- + \text{c.c.})$  $\Gamma_{84}/\Gamma_{41}$ 

| 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

NODE=M057310

## RADIATIVE DECAYS

 $\Gamma(\gamma J/\psi(1S))/\Gamma_{\text{total}}$  $\Gamma_{85}/\Gamma$ 

| VALUE (units $10^{-2}$ )         | EVTS    | DOCUMENT ID | TECN | COMMENT |
|----------------------------------|---------|-------------|------|---------|
| <b><math>19.0 \pm 0.5</math></b> | 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=M057R7  
 NODE=M057R7

NODE=M057R7;LINKAGE=A

NODE=M057R7;LINKAGE=AD

 $\Gamma(\gamma \rho^0)/\Gamma_{\text{total}}$  $\Gamma_{86}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | EVTS    | DOCUMENT ID          | TECN     | COMMENT                                     |
|--------------------------|-----|---------|----------------------|----------|---------------------------------------------|
| <b>&lt;19</b>            | 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

$\Gamma(\gamma\omega)/\Gamma_{\text{total}}$ 
 $\Gamma_{87}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | EVTS      | DOCUMENT ID          | TECN     | COMMENT                                   |
|--------------------------|-----|-----------|----------------------|----------|-------------------------------------------|
| <6                       | 90  | $1 \pm 6$ | <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 | $0.0 \pm 1.8$ | <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

 $\Gamma(\gamma\phi)/\Gamma_{\text{total}}$ 
 $\Gamma_{88}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | EVTS      | DOCUMENT ID          | TECN     | COMMENT                                 |
|--------------------------|-----|-----------|----------------------|----------|-----------------------------------------|
| < 7                      | 90  | $5 \pm 5$ | <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 | $1.3 \pm 2.5$ | <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

 $\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ 
 $\Gamma_{89}/\Gamma$ 

| VALUE (units $10^{-4}$ )                  | DOCUMENT ID |
|-------------------------------------------|-------------|
| <b><math>2.85 \pm 0.10</math> OUR FIT</b> |             |

NODE=M057R1  
NODE=M057R1

 $\Gamma(e^+e^-J/\psi(1S))/\Gamma_{\text{total}}$ 
 $\Gamma_{90}/\Gamma$ 

| VALUE (units $10^{-3}$ )                   | EVTS | DOCUMENT ID          | TECN     | COMMENT                                    |
|--------------------------------------------|------|----------------------|----------|--------------------------------------------|
| <b><math>2.37 \pm 0.15 \pm 0.05</math></b> | 1.3k | <sup>1</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.

NODE=M057R82  
NODE=M057R82

NODE=M057R82;LINKAGE=B

 $\Gamma(e^+e^-J/\psi(1S))/\Gamma(\gamma J/\psi(1S))$ 
 $\Gamma_{90}/\Gamma_{85}$ 

| VALUE (units $10^{-3}$ )                 | EVTS | DOCUMENT ID          | TECN     | COMMENT                                    |
|------------------------------------------|------|----------------------|----------|--------------------------------------------|
| <b><math>11.3 \pm 0.4 \pm 0.5</math></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

 $\Gamma(\gamma\gamma)/\Gamma(\gamma J/\psi(1S))$ 
 $\Gamma_{89}/\Gamma_{85}$ 

| VALUE (units $10^{-3}$ )                  | DOCUMENT ID                 | TECN | COMMENT                                                                  |
|-------------------------------------------|-----------------------------|------|--------------------------------------------------------------------------|
| <b><math>1.50 \pm 0.05</math> OUR FIT</b> |                             |      |                                                                          |
| <b><math>0.99 \pm 0.18</math></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

 $\Gamma(\gamma\gamma)/\Gamma_{\text{total}} \times \Gamma(p\bar{p})/\Gamma_{\text{total}}$ 
 $\Gamma_{89}/\Gamma \times \Gamma_{54}/\Gamma$ 

| VALUE (units $10^{-8}$ )                  | DOCUMENT ID | TECN | COMMENT |
|-------------------------------------------|-------------|------|---------|
| <b><math>2.09 \pm 0.13</math> OUR FIT</b> |             |      |         |

**$1.7 \pm 0.4$  OUR AVERAGE**

|                 |              |      |                                       |
|-----------------|--------------|------|---------------------------------------|
| $1.60 \pm 0.42$ | ARMSTRONG 93 | E760 | $\bar{p}p \rightarrow \gamma\gamma X$ |
| $9.9 \pm 4.5$   | BAGLIN 87B   | SPEC | $\bar{p}p \rightarrow \gamma\gamma X$ |

NODE=M057R24  
NODE=M057R24

$\chi_{c2}(1P)$  CROSS-PARTICLE BRANCHING RATIOS

NODE=M057230

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow K^+ K^- \pi^+ \pi^-)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))}{\Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)} \times \frac{\Gamma_{14}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}{\Gamma_{18}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

NODE=M057B18  
NODE=M057B18VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

**2.31±0.26 OUR FIT****2.5 ±0.9 OUR AVERAGE** 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;LINKAGE=TA

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow K^*(892)^0 \bar{K}^*(892)^0)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))}{\Gamma_{\text{total}}} \times \frac{\Gamma_{18}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}{\Gamma_{18}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

NODE=M057B19  
NODE=M057B19VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**2.1 ±0.4 OUR FIT****3.11±0.36±0.48**

ABLIKIM

04H

BES2

 $\psi(2S) \rightarrow \gamma \chi_{c2}$ 

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow p \bar{p})}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))}{\Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)} \times \frac{\Gamma_{54}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}{\Gamma_{54}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

NODE=M057B1  
NODE=M057B1VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

**2.01±0.09 OUR FIT****1.4 ±1.1**<sup>1</sup> BAI

98i

BES

 $\psi(2S) \rightarrow \gamma \chi_{c2} \rightarrow \gamma p \bar{p}$ 

<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=M057B;LINKAGE=J8

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow p \bar{p})}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))}{\Gamma_{\text{total}}} \times \frac{\Gamma_{54}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}{\Gamma_{54}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

NODE=M057B6  
NODE=M057B6VALUE (units  $10^{-6}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**6.98±0.32 OUR FIT****7.1 ±0.5 OUR AVERAGE** 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  $\begin{smallmatrix} +1.6 \\ -1.4 \end{smallmatrix}$  ±0.614.3  $\begin{smallmatrix} +5.2 \\ -4.7 \end{smallmatrix}$ 

BAI

04F

BES

 $\psi(2S) \rightarrow \gamma \chi_{c2}(1P) \rightarrow \gamma p \bar{p}$ 

<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;LINKAGE=NA

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow \Lambda \bar{\Lambda})}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))}{\Gamma_{\text{total}}} \times \frac{\Gamma_{67}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}{\Gamma_{67}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

NODE=M057B10  
NODE=M057B10VALUE (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  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) = (8.74 \pm 0.35)\%$ .

NODE=M057B10;LINKAGE=AB

<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;LINKAGE=NA

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow \Lambda \bar{\Lambda})}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))}{\Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)} \times \frac{\Gamma_{67}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}{\Gamma_{67}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

NODE=M057B11  
NODE=M057B11VALUE (units  $10^{-5}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**5.1±0.4 OUR FIT****7.1  $\begin{smallmatrix} +3.1 \\ -2.9 \end{smallmatrix}$  ±1.3**8.3  $\begin{smallmatrix} +3.7 \\ -3.4 \end{smallmatrix}$ <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  $\begin{smallmatrix} +0.59 \\ -0.55 \end{smallmatrix}$  ± 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;LINKAGE=BA



$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow \pi\pi)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))/\Gamma_{\text{total}}}{\Gamma_{24}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma\psi(2S)}$$

| VALUE (units $10^{-4}$ )     | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                   |
|------------------------------|------|----------------------|----------|-----------------------------------------------------------|
| <b>2.12±0.08 OUR FIT</b>     |      |                      |          |                                                           |
| <b>2.17±0.09 OUR AVERAGE</b> |      |                      |          |                                                           |
| 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  | $\psi(2S) \rightarrow \gamma\pi^0\pi^0$                   |

NODE=M057B02  
NODE=M057B02

OCCUR=2

NODE=M057B02;LINKAGE=AB

NODE=M057B02;LINKAGE=AS

NODE=M057B02;LINKAGE=AN

- <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  $\pi\pi$ .

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow \pi\pi)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)}{\Gamma_{24}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

| VALUE (units $10^{-3}$ )      | EVTS     | DOCUMENT ID      | TECN    | COMMENT                                 |
|-------------------------------|----------|------------------|---------|-----------------------------------------|
| <b>0.612±0.023 OUR FIT</b>    |          |                  |         |                                         |
| <b>0.54 ±0.06 OUR AVERAGE</b> |          |                  |         |                                         |
| 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 | $\psi(2S) \rightarrow \gamma\pi^+\pi^-$ |

NODE=M057B9  
NODE=M057B9

NODE=M057B;LINKAGE=BM

NODE=M057B;LINKAGE=BA

- <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  $\pi\pi$ .

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow \eta\eta)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))/\Gamma_{\text{total}}}{\Gamma_{30}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma\psi(2S)}$$

| VALUE (units $10^{-4}$ )                                                      | CL% | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                   |
|-------------------------------------------------------------------------------|-----|------|----------------------|----------|-----------------------------------------------------------|
| <b>0.52±0.04 OUR FIT</b>                                                      |     |      |                      |          |                                                           |
| <b>0.52±0.04 OUR AVERAGE</b>                                                  |     |      |                      |          |                                                           |
| 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  | $\psi(2S) \rightarrow \gamma\eta\eta$                     |
| • • • 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±0.31±0.19                                                                |     |      | LEE                  | 85 CBAL  | $\psi(2S) \rightarrow \text{photons}$                     |

NODE=M057B04  
NODE=M057B04

NODE=M057B04;LINKAGE=AB

NODE=M057B04;LINKAGE=AD

- <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.

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow K^+K^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))/\Gamma_{\text{total}}}{\Gamma_{31}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma\psi(2S)}$$

| 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 | $\psi(2S) \rightarrow \gamma K^+K^-$ |

NODE=M057B03  
NODE=M057B03

NODE=M057B03;LINKAGE=AS

- <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  $B(\psi(2S) \rightarrow \gamma\chi_{c2}) = (9.33 \pm 0.14 \pm 0.61)\%$ .

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow K^+K^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)}{\Gamma_{31}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

| 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 | $\psi(2S) \rightarrow \gamma K^+K^-$ |

NODE=M057B8  
NODE=M057B8

NODE=M057B;LINKAGE=BI

- <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].

$$\Gamma(\chi_{c2}(1P) \rightarrow K_S^0 K_S^0) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma_{\text{total}}$$

$$\Gamma_{32} / \Gamma \times \Gamma_{149}^{\psi(2S)} / \Gamma^{\psi(2S)}$$

| 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 ± 0.3 ± 0.3              | 373 ± 20 | <sup>1</sup> ASNER | 09 CLEO  | $\psi(2S) \rightarrow \gamma K_S^0 K_S^0$ |
| 5.72 ± 0.76 ± 0.63           | 65       | ABLIKIM            | 050 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

$$\Gamma(\chi_{c2}(1P) \rightarrow K_S^0 K_S^0) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)$$

$$\Gamma_{32} / \Gamma \times \Gamma_{149}^{\psi(2S)} / \Gamma_{11}^{\psi(2S)}$$

| 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

$$\Gamma(\chi_{c2}(1P) \rightarrow \bar{K}^0 K^+ \pi^- + \text{c.c.}) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma_{\text{total}}$$

$$\Gamma_{41} / \Gamma \times \Gamma_{149}^{\psi(2S)} / \Gamma^{\psi(2S)}$$

| 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 ± 0.19 ± 0.09 | 37 | <sup>1</sup> ATHAR   | 07 CLEO  | $\psi(2S) \rightarrow \gamma K_S^0 K^\pm \pi^\mp$ |
| 0.97 ± 0.32 ± 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

$$\Gamma(\chi_{c2}(1P) \rightarrow 2(\pi^+ \pi^-)) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)$$

$$\Gamma_1 / \Gamma \times \Gamma_{149}^{\psi(2S)} / \Gamma_{11}^{\psi(2S)}$$

| VALUE (units $10^{-3}$ )     | DOCUMENT ID | TECN | COMMENT |
|------------------------------|-------------|------|---------|
| <b>2.79 ± 0.26 OUR FIT</b>   |             |      |         |
| <b>3.1 ± 1.0 OUR AVERAGE</b> |             |      |         |

|                 |                        |         |                                         |
|-----------------|------------------------|---------|-----------------------------------------|
| 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  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) \times B(\chi_{c2} \rightarrow 2\pi^+ 2\pi^-)$  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

$$\Gamma(\chi_{c2}(1P) \rightarrow K^+ K^- K^+ K^-) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma_{\text{total}}$$

$$\Gamma_{49} / \Gamma \times \Gamma_{149}^{\psi(2S)} / \Gamma^{\psi(2S)}$$

| VALUE (units $10^{-4}$ )   | EVTS | DOCUMENT ID          | TECN     | COMMENT                                 |
|----------------------------|------|----------------------|----------|-----------------------------------------|
| <b>1.57 ± 0.19 OUR FIT</b> |      |                      |          |                                         |
| <b>1.76 ± 0.16 ± 0.24</b>  | 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

$$\Gamma(\chi_{c2}(1P) \rightarrow K^+ K^- K^+ K^-) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)$$

$$\Gamma_{49} / \Gamma \times \Gamma_{149}^{\psi(2S)} / \Gamma_{11}^{\psi(2S)}$$

| VALUE (units $10^{-4}$ ) | DOCUMENT ID      | TECN    | COMMENT                                 |
|--------------------------|------------------|---------|-----------------------------------------|
| <b>4.5 ± 0.5 OUR FIT</b> |                  |         |                                         |
| <b>3.6 ± 0.6 ± 0.6</b>   | <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

$$\Gamma(\chi_{c2}(1P) \rightarrow \phi\phi)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))/\Gamma_{\text{total}}$$

$$\Gamma_{20}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma_{\psi(2S)}$$

| VALUE (units $10^{-4}$ )     | EVTS | DOCUMENT ID          | TECN     | COMMENT                                 |
|------------------------------|------|----------------------|----------|-----------------------------------------|
| <b>1.01±0.08 OUR FIT</b>     |      |                      |          |                                         |
| <b>0.98±0.13 OUR AVERAGE</b> |      |                      |          | Error includes scale factor of 1.3.     |
| 0.94±0.03±0.10               | 849  | <sup>1</sup> ABLIKIM | 11K BES3 | $\psi(2S) \rightarrow \gamma$ hadrons   |
| 1.38±0.24±0.23               | 41   | <sup>2</sup> ABLIKIM | 06T BES2 | $\psi(2S) \rightarrow \gamma 2K^+ 2K^-$ |

NODE=M057B16  
NODE=M057B16

<sup>1</sup> Calculated by us. The value of  $B(\chi_{c2} \rightarrow \phi\phi)$  reported by ABLIKIM 11K was derived using  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (8.74 \pm 0.35)\%$ .

NODE=M057B16;LINKAGE=AL

<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;LINKAGE=AB

$$\Gamma(\chi_{c2}(1P) \rightarrow \phi\phi)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)$$

$$\Gamma_{20}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$$

| VALUE (units $10^{-4}$ ) | DOCUMENT ID      | TECN    | COMMENT                                 |
|--------------------------|------------------|---------|-----------------------------------------|
| <b>2.92±0.24 OUR FIT</b> |                  |         |                                         |
| <b>4.8 ±1.3 ±1.3</b>     | <sup>1</sup> BAI | 99B BES | $\psi(2S) \rightarrow \gamma 2K^+ 2K^-$ |

NODE=M057B17  
NODE=M057B17

<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;LINKAGE=BA

$$\Gamma(\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))/\Gamma_{\text{total}}$$

$$\Gamma_{85}/\Gamma \times \Gamma_{149}^{\psi(2S)}/\Gamma_{\psi(2S)}$$

| VALUE (units $10^{-2}$ )      | EVTS | DOCUMENT ID            | TECN     | COMMENT                                                     |
|-------------------------------|------|------------------------|----------|-------------------------------------------------------------|
| <b>1.81 ±0.04 OUR FIT</b>     |      |                        |          |                                                             |
| <b>1.69 ±0.16 OUR AVERAGE</b> |      |                        |          | Error includes scale factor of 3.4. See the ideogram below. |
| 1.996±0.008±0.070             | 81k  | <sup>1</sup> ABLIKIM   | 17N BES3 | $\psi(2S) \rightarrow \gamma\gamma J/\psi$                  |
| 1.793±0.008±0.163             | 1.0M | ABLIKIM                | 17U BES3 | $e^+e^- \rightarrow \gamma X$                               |
| 1.62 ±0.04 ±0.12              | 5.8k | BAI                    | 04I BES2 | $\psi(2S) \rightarrow J/\psi\gamma\gamma$                   |
| 0.99 ±0.10 ±0.08              |      | GAISER                 | 86 CBAL  | $\psi(2S) \rightarrow \gamma X$                             |
| 1.47 ±0.17                    |      | <sup>2</sup> OREGLIA   | 82 CBAL  | $\psi(2S) \rightarrow \gamma\chi_{c2}$                      |
| 1.8 ±0.5                      |      | <sup>3</sup> BRANDELIK | 79B DASP | $\psi(2S) \rightarrow \gamma\chi_{c2}$                      |
| 1.2 ±0.2                      |      | <sup>3</sup> BARTEL    | 78B CNTR | $\psi(2S) \rightarrow \gamma\chi_{c2}$                      |
| 2.2 ±1.2                      |      | <sup>4</sup> BIDDICK   | 77 CNTR  | $e^+e^- \rightarrow \gamma X$                               |
| 1.2 ±0.7                      |      | <sup>2</sup> WHITAKER  | 76 MRK1  | $e^+e^-$                                                    |

NODE=M057B2  
NODE=M057B2

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

|                   |       |                      |          |                                        |
|-------------------|-------|----------------------|----------|----------------------------------------|
| 1.874±0.007±0.102 | 76k   | <sup>5</sup> ABLIKIM | 12O BES3 | $\psi(2S) \rightarrow \gamma\chi_{c2}$ |
| 1.95 ±0.02 ±0.07  | 12.4k | <sup>6</sup> MENDEZ  | 08 CLEO  | $\psi(2S) \rightarrow \gamma\chi_{c2}$ |
| 1.85 ±0.04 ±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  $B(J/\psi \rightarrow \mu^+\mu^-) = (5.961 \pm 0.033)\%$ .

NODE=M057B2;LINKAGE=A

<sup>2</sup> Recalculated by us using  $B(J/\psi(1S) \rightarrow \ell^+\ell^-) = 0.1181 \pm 0.0020$ .

NODE=M057B;LINKAGE=3Q

<sup>3</sup> Recalculated by us using  $B(J/\psi(1S) \rightarrow \mu^+\mu^-) = 0.0588 \pm 0.0010$ .

NODE=M057B;LINKAGE=2Q

<sup>4</sup> Assumes isotropic gamma distribution.

NODE=M057B;LINKAGE=EA

<sup>5</sup> Superseded by ABLIKIM 17N.

NODE=M057B2;LINKAGE=B

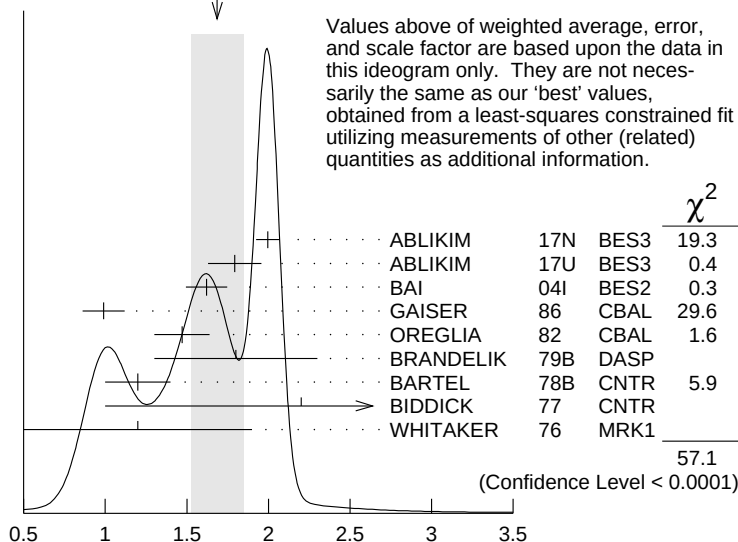
<sup>6</sup> Not independent from other measurements of MENDEZ 08.

NODE=M057B2;LINKAGE=ME

<sup>7</sup> Not independent from other values reported by ADAM 05A.

NODE=M057B;LINKAGE=AD

WEIGHTED AVERAGE  
1.69±0.16 (Error scaled by 3.4)



$$\Gamma(\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S)) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma_{\text{total}} \text{ (units } 10^{-2})$$

$$\Gamma(\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S)) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma(\psi(2S) \rightarrow J/\psi(1S) \text{ anything})$$

$$\Gamma_{85}/\Gamma \times \Gamma_{149}^{\psi(2S)} / \Gamma_9^{\psi(2S)} = \Gamma_{85}/\Gamma \times \Gamma_{149}^{\psi(2S)} / (\Gamma_{11}^{\psi(2S)} + \Gamma_{12}^{\psi(2S)} + \Gamma_{13}^{\psi(2S)} + 0.343\Gamma_{148}^{\psi(2S)} + 0.190\Gamma_{149}^{\psi(2S)})$$

NODE=M057B7

NODE=M057B7

NODE=M057B7

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

**2.95±0.06 OUR FIT**

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

|                |       |                     |     |      |                                         |
|----------------|-------|---------------------|-----|------|-----------------------------------------|
| 3.12±0.03±0.09 | 12.4k | <sup>1</sup> MENDEZ | 08  | CLEO | $\psi(2S) \rightarrow \gamma \chi_{c2}$ |
| 3.11±0.07±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

$$\Gamma(\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S)) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)$$

$$\Gamma_{85}/\Gamma \times \Gamma_{149}^{\psi(2S)} / \Gamma_{11}^{\psi(2S)}$$

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

**5.22±0.11 OUR FIT**

**5.53±0.17 OUR AVERAGE**

|                |       |                      |     |      |                                         |
|----------------|-------|----------------------|-----|------|-----------------------------------------|
| 5.56±0.05±0.16 | 12.4k | MENDEZ               | 08  | CLEO | $\psi(2S) \rightarrow \gamma \chi_{c2}$ |
| 6.0 ±2.8       | 1.3k  | <sup>1</sup> ABLIKIM | 04B | BES  | $\psi(2S) \rightarrow J/\psi X$         |
| 3.9 ±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=AB

NODE=M057B;LINKAGE=H8

NODE=M057B3;LINKAGE=AD

$$\Gamma(\chi_{c2}(1P) \rightarrow \gamma \gamma) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma_{\text{total}}$$

$$\Gamma_{89}/\Gamma \times \Gamma_{149}^{\psi(2S)} / \Gamma^{\psi(2S)}$$

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

**2.71±0.08 OUR FIT**

**2.82±0.10 OUR AVERAGE**

|                |      |                      |      |      |                                                             |
|----------------|------|----------------------|------|------|-------------------------------------------------------------|
| 2.83±0.08±0.06 | 5k   | <sup>1</sup> ABLIKIM | 17AE | BES3 | $\psi(2S) \rightarrow \gamma \chi_{c2} \rightarrow 3\gamma$ |
| 2.68±0.28±0.15 | 0.3k | ECKLUND              | 08A  | CLEO | $\psi(2S) \rightarrow \gamma \chi_{c2} \rightarrow 3\gamma$ |
| 7.0 ±2.1 ±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±0.17±0.15 | 1.1k | <sup>2</sup> ABLIKIM | 12A | BES3 | $\psi(2S) \rightarrow \gamma \chi_{c2} \rightarrow 3\gamma$ |
|----------------|------|----------------------|-----|------|-------------------------------------------------------------|

NODE=M057B4

NODE=M057B4

- <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  $f_{0/2} = \Gamma_{\gamma\gamma}^{\lambda=0} / \Gamma_{\gamma\gamma}^{\lambda=2} = 0.000 \pm 0.006 \pm 0.012$ .
- <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=A

NODE=M057B4;LINKAGE=AB

### $\Gamma(\chi_{c2}(1P) \rightarrow \gamma\gamma) / \Gamma(\chi_{c0}(1P) \rightarrow \gamma\gamma)$ $\Gamma_{89} / \Gamma_{89}^{\chi_{c0}(1P)}$

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

**0.292±0.028 OUR AVERAGE**

|                   |      |                      |           |                                                            |
|-------------------|------|----------------------|-----------|------------------------------------------------------------|
| 0.295±0.014±0.028 | 8k   | <sup>1</sup> ABLIKIM | 17AE BES3 | $\psi(2S) \rightarrow \gamma\chi_{cJ} \rightarrow 3\gamma$ |
| 0.278±0.050±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±0.029±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  
NODE=M057B06NODE=M057B06;LINKAGE=AB  
NODE=M057B06;LINKAGE=A**MULTIPOLE AMPLITUDES IN  $\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S)$  RADIATIVE DECAY**

NODE=M057240

 **$a_2 = M_2 / \sqrt{E_1^2 + M_2^2 + E_3^2}$  Magnetic quadrupole fractional transition amplitude**

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

**-11.0± 1.0 OUR AVERAGE**

|                                            |       |                         |          |                                                                       |
|--------------------------------------------|-------|-------------------------|----------|-----------------------------------------------------------------------|
| -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> 3.9±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  $M_2$  amplitudes  $a_2$  and  $b_2$ , and fixed  $E_3$  amplitudes  $a_3=b_3=0$ .<sup>3</sup> Assuming  $a_3=0$ .<sup>4</sup> From a fit with floating  $M_2$  and  $E_3$  amplitudes  $a_2$ ,  $b_2$ , and  $a_3$ , and  $b_3$ .NODE=M057A1  
NODE=M057A1

OCCUR=2

NODE=M057A1;LINKAGE=B

NODE=M057A1;LINKAGE=AR  
NODE=M057A1;LINKAGE=A  
NODE=M057A1;LINKAGE=AT **$a_3 = E_3 / \sqrt{E_1^2 + M_2^2 + E_3^2}$  Electric octupole fractional transition amplitude**

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

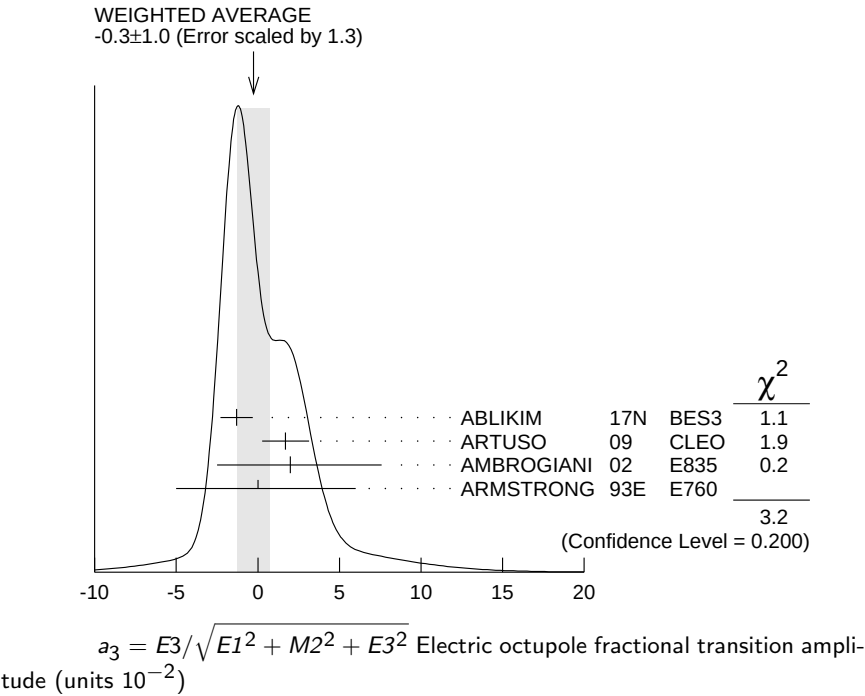
**-0.3±1.0 OUR AVERAGE** Error includes scale factor of 1.3. See the ideogram below.

|                                          |       |                      |          |                                                           |
|------------------------------------------|-------|----------------------|----------|-----------------------------------------------------------|
| -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> 5.5±0.9 | 5908  | AMBROGIANI           | 02 E835  | $p\bar{p} \rightarrow \chi_{c2} \rightarrow J/\psi\gamma$ |
| 0 <sup>+</sup> <sub>-5</sub> 6           | 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  $M_2$  and  $E_3$  amplitudes  $a_2$ ,  $b_2$ , and  $a_3$ , and  $b_3$ .NODE=M057A2  
NODE=M057A2

NODE=M057A2;LINKAGE=A

NODE=M057A2;LINKAGE=AR



MULTIPOLE AMPLITUDES IN  $\psi(2S) \rightarrow \gamma\chi_{c2}(1P)$  RADIATIVE DECAY

NODE=M057250

$b_2 = M2/\sqrt{E1^2 + M2^2 + E3^2}$  Magnetic quadrupole fractional transition amplitude

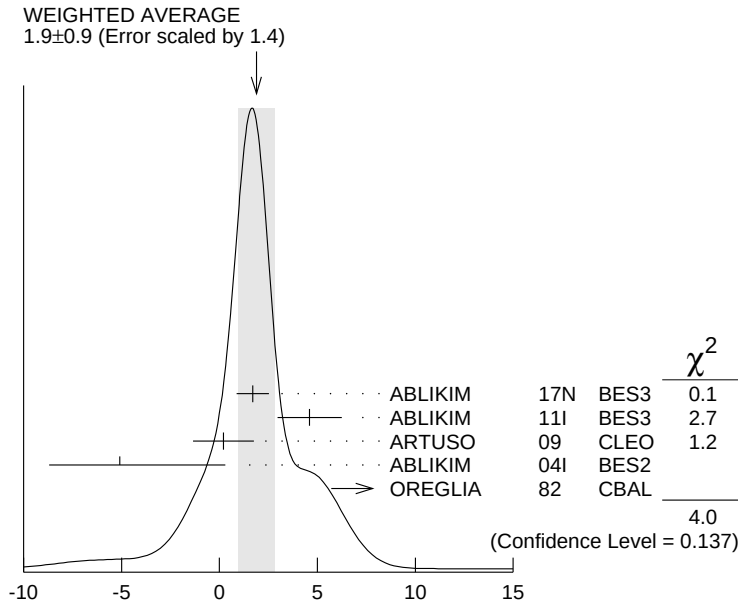
NODE=M057QB2  
NODE=M057QB2

| VALUE (units $10^{-2}$ )                                                                                                                                         | EVTS  | DOCUMENT ID                                                 | TECN     | COMMENT                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------------------------------------------------------|----------|--------------------------------------------------------|
| <b>1.9±0.9 OUR AVERAGE</b>                                                                                                                                       |       | Error includes scale factor of 1.4. See the ideogram below. |          |                                                        |
| 1.7±0.8±0.2                                                                                                                                                      | 89k   | 1 ABLIKIM                                                   | 17N BES3 | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$        |
| 4.6±1.0±1.3                                                                                                                                                      | 13.8k | 2 ABLIKIM                                                   | 11I BES3 | $\psi(2S) \rightarrow \gamma\pi^+\pi^-, \gamma K^+K^-$ |
| 0.2±1.5±0.4                                                                                                                                                      | 19.8k | 3 ARTUSO                                                    | 09 CLEO  | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$        |
| - 5.1 <sup>+5.4</sup> <sub>-3.6</sub>                                                                                                                            | 721   | 2 ABLIKIM                                                   | 04I BES2 | $\psi(2S) \rightarrow \gamma\pi^+\pi^-, \gamma K^+K^-$ |
| 13.2 <sup>+9.8</sup> <sub>-7.5</sub>                                                                                                                             | 441   | 4 OREGLIA                                                   | 82 CBAL  | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                    |       |                                                             |          |                                                        |
| 1.0±1.3±0.3                                                                                                                                                      | 19.8k | 4 ARTUSO                                                    | 09 CLEO  | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$        |
| 1 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 $\rho_{b_2 b_3} = 0.384$ . |       |                                                             |          |                                                        |
| 2 From a fit with floating $M2$ and $E3$ amplitudes $b_2$ and $b_3$ .                                                                                            |       |                                                             |          |                                                        |
| 3 From a fit with floating $M2$ and $E3$ amplitudes $a_2$ , $b_2$ , and $a_3$ , and $b_3$ .                                                                      |       |                                                             |          |                                                        |
| 4 From a fit with floating $M2$ amplitudes $a_2$ and $b_2$ , and fixed $E3$ amplitudes $a_3=b_3=0$ .                                                             |       |                                                             |          |                                                        |

OCCUR=2

NODE=M057QB2;LINKAGE=A

NODE=M057QB2;LINKAGE=AB  
NODE=M057QB2;LINKAGE=AT  
NODE=M057QB2;LINKAGE=AR



$b_2 = M_2/\sqrt{E_1^2 + M_2^2 + E_3^2}$  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

| VALUE (units $10^{-2}$ )             | EVTS  | DOCUMENT ID          | TECN     | COMMENT                                                |
|--------------------------------------|-------|----------------------|----------|--------------------------------------------------------|
| <b>-1.0±0.6 OUR AVERAGE</b>          |       |                      |          |                                                        |
| -1.4±0.7±0.4                         | 89k   | <sup>1</sup> ABLIKIM | 17N BES3 | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$        |
| 1.5±0.8±1.8                          | 13.8k | <sup>2</sup> ABLIKIM | 11I BES3 | $\psi(2S) \rightarrow \gamma\pi^+\pi^-, \gamma K^+K^-$ |
| -0.8±1.2±0.2                         | 19.8k | ARTUSO               | 09 CLEO  | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$        |
| -2.7 <sup>+4.3</sup> <sub>-2.9</sub> | 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  
NODE=M057QB3

NODE=M057QB3;LINKAGE=A

NODE=M057QB3;LINKAGE=AB

NODE=M057260

## MULTIPOLE AMPLITUDE RATIOS IN RADIATIVE DECAYS

$\psi(2S) \rightarrow \gamma\chi_{c2}(1P)$  and  $\chi_{c2} \rightarrow \gamma J/\psi(1S)$

$b_2/a_2$  Magnetic quadrupole transition amplitude ratio

| VALUE (units $10^{-2}$ )               | EVTS  | DOCUMENT ID         | TECN    | COMMENT                                         |
|----------------------------------------|-------|---------------------|---------|-------------------------------------------------|
| <b>-11<sup>+14</sup><sub>-15</sub></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  $M_2$  amplitudes  $a_2$  and  $b_2$ , and fixed  $E_3$  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  
NODE=M057QAR

NODE=M057QAR;LINKAGE=AR

## $\chi_{c2}(1P)$ REFERENCES

|         |      |                  |                             |                   |             |
|---------|------|------------------|-----------------------------|-------------------|-------------|
| ABLIKIM | 19J  | PR D99 012015    | M. Ablikim <i>et al.</i>    | (BES III Collab.) | REFID=59606 |
| ABLIKIM | 18V  | PR D97 052011    | M. Ablikim <i>et al.</i>    | (BES III Collab.) | REFID=58990 |
| 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>    | (BES III Collab.) | REFID=58310 |
| ABLIKIM | 17AG | PR D96 111102    | M. Ablikim <i>et al.</i>    | (BES III Collab.) | REFID=58316 |
| ABLIKIM | 17AI | PR D96 112006    | M. Ablikim <i>et al.</i>    | (BES III Collab.) | REFID=58321 |
| ABLIKIM | 17I  | PRL 118 221802   | M. Ablikim <i>et al.</i>    | (BES III Collab.) | REFID=57931 |
| ABLIKIM | 17N  | PR D95 072004    | M. Ablikim <i>et al.</i>    | (BES III Collab.) | REFID=57978 |
| ABLIKIM | 17U  | PR D96 032001    | M. Ablikim <i>et al.</i>    | (BES III 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>    | (BES III Collab.) | REFID=56774 |
| ABLIKIM | 15M  | PR D91 112008    | M. Ablikim <i>et al.</i>    | (BES III Collab.) | REFID=56778 |
| ABLIKIM | 15N  | PR D91 112018    | M. Ablikim <i>et al.</i>    | (BES III Collab.) | REFID=56779 |
| ABLIKIM | 14J  | PR D89 074030    | M. Ablikim <i>et al.</i>    | (BES III Collab.) | REFID=55901 |
| ABLIKIM | 13B  | PR D87 012002    | M. Ablikim <i>et al.</i>    | (BES III Collab.) | REFID=54877 |
| ABLIKIM | 13D  | PR D87 012007    | M. Ablikim <i>et al.</i>    | (BES III Collab.) | REFID=54879 |
| ABLIKIM | 13H  | PR D87 032007    | M. Ablikim <i>et al.</i>    | (BES III Collab.) | REFID=54953 |
| ABLIKIM | 13V  | PR D88 112001    | M. Ablikim <i>et al.</i>    | (BES III 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>    | (BES III Collab.) | REFID=54266 |
| ABLIKIM | 12I  | PR D86 052004    | M. Ablikim <i>et al.</i>    | (BES III Collab.) | REFID=54736 |
| ABLIKIM | 12J  | PR D86 052011    | M. Ablikim <i>et al.</i>    | (BES III Collab.) | REFID=54737 |

NODE=M057

|               |      |                |                                  |                                 |             |
|---------------|------|----------------|----------------------------------|---------------------------------|-------------|
| ABLIKIM       | 12O  | PRL 109 172002 | M. Ablikim <i>et al.</i>         | (BES III Collab.)               | REFID=54742 |
| LEES          | 12AE | PR D86 092005  | J.P. Lees <i>et al.</i>          | (BABAR Collab.)                 | REFID=54752 |
| 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>         | (BES III Collab.)               | REFID=53647 |
| ABLIKIM       | 11E  | PR D83 112005  | M. Ablikim <i>et al.</i>         | (BES III Collab.)               | REFID=16717 |
| ABLIKIM       | 11F  | PR D83 112009  | M. Ablikim <i>et al.</i>         | (BES III Collab.)               | REFID=16719 |
| ABLIKIM       | 11I  | PR D84 092006  | M. Ablikim <i>et al.</i>         | (BES III Collab.)               | REFID=53930 |
| ABLIKIM       | 11K  | PRL 107 092001 | M. Ablikim <i>et al.</i>         | (BES III 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>         | (BES III 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 |
| ARTUSO        | 09   | PR D80 112003  | M. Artuso <i>et al.</i>          | (CLEO Collab.)                  | REFID=53206 |
| 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 |
| 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 |
| DOBBS         | 06   | PR D73 071101  | S. Dobbs <i>et al.</i>           | (CLEO Collab.)                  | REFID=51062 |
| 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 |
| 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 |
| NAKAZAWA      | 05   | PL B615 39     | H. Nakazawa <i>et al.</i>        | (BELLE Collab.)                 | REFID=50807 |
| 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 |
| ABLIKIM       | 04I  | PR D70 092004  | M. Ablikim <i>et al.</i>         | (BES Collab.)                   | REFID=50189 |
| 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           | 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           | 02T  | PL B540 33     | K. Abe <i>et al.</i>             | (BELLE Collab.)                 | REFID=48813 |
| AMBROGIANI    | 02   | PR D65 052002  | M. Ambrogiani <i>et al.</i>      | (FNAL E835 Collab.)             | REFID=48552 |
| 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 |
| ACCARI        | 99E  | PL B453 73     | M. Acciarri <i>et al.</i>        | (L3 Collab.)                    | REFID=46943 |
| BAI           | 99B  | PR D60 072001  | J.Z. Bai <i>et al.</i>           | (BES Collab.)                   | REFID=47385 |
| ACKER...K...  | 98   | PL B439 197    | K. Ackerstaff <i>et al.</i>      | (OPAL Collab.)                  | REFID=46324 |
| 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 |
| DOMINICK      | 94   | PR D50 4265    | J. Dominick <i>et al.</i>        | (CLEO Collab.)                  | REFID=44077 |
| ARMSTRONG     | 93   | PRL 70 2988    | T.A. Armstrong <i>et al.</i>     | (FNAL E760 Collab.)             | REFID=43306 |
| ARMSTRONG     | 93E  | PR D48 3037    | T.A. Armstrong <i>et al.</i>     | (FNAL-E760 Collab.)             | REFID=48616 |
| BAUER         | 93   | PL B302 345    | D.A. Bauer <i>et al.</i>         | (TPC Collab.)                   | REFID=43315 |
| 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        | 87B  | PL B187 191    | C. Baglin <i>et al.</i>          | (R704 Collab.)                  | REFID=40018 |
| 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 |
| LEE           | 85   | SLAC 282       | R.A. Lee                         | (SLAC)                          | REFID=40589 |
| 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 |
| BARATE        | 81   | PR D24 2994    | R. Barate <i>et al.</i>          | (SACL, LOIC, SHMP, CERN+)       | REFID=22164 |
| 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 |
| WHITAKER      | 76   | PRL 37 1596    | J.S. Whitaker <i>et al.</i>      | (SLAC, LBL)                     | REFID=22151 |



$$\eta_c(2S)$$

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

Quantum numbers are quark model predictions.

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NODE=M059

NODE=M059M

NODE=M059M

NEW

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OCCUR=2

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 NODE=M059M;LINKAGE=A

NODE=M059W

NODE=M059W

### $\eta_c(2S)$ 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. [3637.6 $\pm$ 1.2 MeV OUR 2018 AVERAGE Scale factor = 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            | 17AD LHCb | $pp \rightarrow B^+X \rightarrow p\bar{p}K^+X$                    |
| 3636.4 $\pm$ 4.1 $\pm$ 0.7                                                                                                                  | 365          | <sup>2</sup> AAIJ            | 17BB LHCb | $pp \rightarrow b\bar{b}X \rightarrow 2(K^+K^-)X$                 |
| 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 | $e^+e^- \rightarrow \gamma X$                                 |

<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.

### $\eta_c(2S)$ 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 ± 52  | <sup>16</sup> AUBERT  | 06E BABR | $B^\pm \rightarrow K^\pm X_{c\bar{c}}$                        |
| 22 ± 14          |    | 121 ± 27 | AUBERT                | 05C BABR | $e^+ e^- \rightarrow J/\psi c\bar{c}$                         |
| 17.0 ± 8.3 ± 2.5 |    | 112 ± 24 | <sup>17</sup> AUBERT  | 04D BABR | $\gamma\gamma \rightarrow \eta_c(2S) \rightarrow K\bar{K}\pi$ |
| < 55             | 90 | 39 ± 11  | <sup>18</sup> CHOI    | 02 BELL  | $B \rightarrow K K_S K^- \pi^+$                               |
| < 8.0            | 95 |          | <sup>19</sup> EDWARDS | 82C CBAL | $e^+ e^- \rightarrow \gamma X$                                |

<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

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 NODE=M059W;LINKAGE=AU  
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 NODE=M059W;LINKAGE=W2  
 NODE=M059W;LINKAGE=W

## $\eta_c(2S)$ DECAY MODES

| Mode                                                 | Fraction ( $\Gamma_i/\Gamma$ )   | Confidence level |
|------------------------------------------------------|----------------------------------|------------------|
| $\Gamma_1$ hadrons                                   | not seen                         |                  |
| $\Gamma_2$ $K\bar{K}\pi$                             | ( 1.9 ± 1.2 ) %                  |                  |
| $\Gamma_3$ $K\bar{K}\eta$                            | ( 5 ± 4 ) × 10 <sup>-3</sup>     |                  |
| $\Gamma_4$ $2\pi^+ 2\pi^-$                           | 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 ± 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                             |                  |
| $\Gamma_{15}$ $\gamma\gamma$                         | ( 1.9 ± 1.3 ) × 10 <sup>-4</sup> |                  |
| $\Gamma_{16}$ $\gamma J/\psi(1S)$                    | < 1.4 %                          | 90%              |
| $\Gamma_{17}$ $\pi^+ \pi^- \eta$                     | not seen                         |                  |
| $\Gamma_{18}$ $\pi^+ \pi^- \eta'$                    | not seen                         |                  |
| $\Gamma_{19}$ $\pi^+ \pi^- \eta_c(1S)$               | < 25 %                           | 90%              |

NODE=M059215;NODE=M059

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 DESIG=4  
 DESIG=20  
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 DESIG=13;OUR EVAL;→ UNCHECKED ←  
 DESIG=15

## $\eta_c(2S)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$

| 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=M059216

NODE=M059W1  
 NODE=M059W1

NODE=M059W1;LINKAGE=A  
 NODE=M059W1;LINKAGE=AS

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

| 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

## $\eta_c(2S) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

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

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

|       |    |        |         |                                                                  |
|-------|----|--------|---------|------------------------------------------------------------------|
| < 6.5 | 90 | UEHARA | 08 BELL | $\gamma\gamma \rightarrow \eta_c(2S) \rightarrow 2(\pi^+ \pi^-)$ |
|-------|----|--------|---------|------------------------------------------------------------------|

NODE=M059218

NODE=M059G01  
 NODE=M059G01

$$\Gamma(K\bar{K}\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_2\Gamma_{15}/\Gamma$$

| VALUE (eV)    | EVTs | DOCUMENT ID                   | TECN | COMMENT                                        |
|---------------|------|-------------------------------|------|------------------------------------------------|
| <b>41±4±6</b> | 624  | <sup>22</sup> DEL-AMO-SA..11M | BABR | $\gamma\gamma \rightarrow K_S^0 K^\pm \pi^\mp$ |

<sup>22</sup> Not independent from other measurements reported in DEL-AMO-SANCHEZ 11M.

NODE=M059G04  
NODE=M059G04

NODE=M059G04;LINKAGE=DE

$$\Gamma(K^+ K^- \pi^+ \pi^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_7\Gamma_{15}/\Gamma$$

| 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

$$\Gamma(K^+ K^- \pi^+ \pi^- \pi^0) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_9\Gamma_{15}/\Gamma$$

| VALUE (eV)    | EVTs | DOCUMENT ID                   | TECN | COMMENT                                              |
|---------------|------|-------------------------------|------|------------------------------------------------------|
| <b>30±6±5</b> | 1201 | <sup>23</sup> DEL-AMO-SA..11M | BABR | $\gamma\gamma \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$ |

<sup>23</sup> Not independent from other measurements reported in DEL-AMO-SANCHEZ 11M.

NODE=M059G05  
NODE=M059G05

NODE=M059G05;LINKAGE=DE

$$\Gamma(2K^+ 2K^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{12}\Gamma_{15}/\Gamma$$

| 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

$$\Gamma(\pi^+ \pi^- \eta_c(1S)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{19}\Gamma_{15}/\Gamma$$

| 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

$$\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{14}/\Gamma \times \Gamma_{15}/\Gamma$$

| 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 $\bar{p}p \rightarrow \gamma\gamma$ |

• • • 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 $\bar{p}p \rightarrow \gamma\gamma$ |

<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  
NODE=M059G1

OCCUR=2

OCCUR=3

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 |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

**not seen** ABREU 98O DLPH  $e^+ e^- \rightarrow e^+ e^- + \text{hadrons}$

• • • 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=M059R1  
NODE=M059R1

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 |
|---------------------------------|------|-------------|------|---------|
|---------------------------------|------|-------------|------|---------|

**1.9±0.4±1.1** 59 ± 12 <sup>29</sup> AUBERT 08AB BABR  $B \rightarrow \eta_c(2S) K \rightarrow K\bar{K}\pi K$

• • • 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  $[B(B^+ \rightarrow \eta_c(2S) K^+) \times B(\eta_c(2S) \rightarrow K\bar{K}\pi)] / [B(B^+ \rightarrow \eta_c K^+) \times B(\eta_c \rightarrow K\bar{K}\pi)] = (9.6_{-1.9}^{+2.0} \pm 2.5)\%$  and using  $B(B^+ \rightarrow \eta_c(2S) K^+) = (3.4 \pm 1.8) \times 10^{-4}$ , and  $[B(B^+ \rightarrow \eta_c K^+) \times B(\eta_c \rightarrow K\bar{K}\pi)] = (6.88 \pm 0.77_{-0.66}^{+0.55}) \times 10^{-5}$ .

<sup>30</sup> For a mass value of 3654 ± 6 MeV

NODE=M059R3  
NODE=M059R3

NODE=M059R3;LINKAGE=AU

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 |
|---------------------------------|------|-------------|------|---------|
|---------------------------------|------|-------------|------|---------|

**27.3±7.0±9.0** 225 <sup>31</sup> LEES 14E BABR  $\gamma\gamma \rightarrow K^+ K^- \gamma\gamma$

<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  
NODE=M059R26

NODE=M059R26;LINKAGE=LE

$\Gamma(2\pi^+2\pi^-)/\Gamma_{\text{total}}$  $\Gamma_4/\Gamma$ 

| VALUE    | DOCUMENT ID | TECN | COMMENT                                    |
|----------|-------------|------|--------------------------------------------|
| not seen | 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

 $\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_{15}/\Gamma$ 

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

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

$<4 \times 10^{-4}$  90 <sup>34</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>34</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  
 NODE=M059R2

NODE=M059R2;LINKAGE=WI

 $\Gamma(\pi^+\pi^-\eta_c(1S))/\Gamma(K\bar{K}\pi)$  $\Gamma_{19}/\Gamma_2$ 

| VALUE   | CL% | DOCUMENT ID        | TECN      | COMMENT                                     |
|---------|-----|--------------------|-----------|---------------------------------------------|
| $<3.33$ | 90  | <sup>35</sup> LEES | 12AE BABR | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-\eta_c$ |

NODE=M059R23  
 NODE=M059R23

<sup>35</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

 $\Gamma(\eta_c(2S) \rightarrow K\bar{K}\eta)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\eta_c(2S))/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma_{\psi(2S)}$ 

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

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

$<11.8 \times 10^{-6}$  90 <sup>36</sup> CRONIN-HEN..10 CLEO  $\psi(2S) \rightarrow \gamma K^+K^-\eta$

<sup>36</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  
 NODE=M059R25

NODE=M059R25;LINKAGE=CR

$$\Gamma(\eta_c(2S) \rightarrow 2\pi^+ 2\pi^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_4/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma\psi(2S)$$

| VALUE                                                                                                           | CL% | DOCUMENT ID       | TECN | COMMENT                                     |
|-----------------------------------------------------------------------------------------------------------------|-----|-------------------|------|---------------------------------------------|
| $<14.6 \times 10^{-6}$                                                                                          | 90  | 37 CRONIN-HEN..10 | CLEO | $\psi(2S) \rightarrow \gamma 2\pi^+ 2\pi^-$ |
| 37 Assuming $\Gamma(\eta_c(2S)) = 14$ MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width. |     |                   |      |                                             |

NODE=M059R05  
NODE=M059R05

NODE=M059R05;LINKAGE=CR

$$\Gamma(\eta_c(2S) \rightarrow \rho^0 \rho^0)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_5/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma\psi(2S)$$

| 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

$$\Gamma(\eta_c(2S) \rightarrow 3\pi^+ 3\pi^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_6/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma\psi(2S)$$

| VALUE                                                                                                           | CL% | DOCUMENT ID       | TECN | COMMENT                                     |
|-----------------------------------------------------------------------------------------------------------------|-----|-------------------|------|---------------------------------------------|
| $<13.2 \times 10^{-6}$                                                                                          | 90  | 38 CRONIN-HEN..10 | CLEO | $\psi(2S) \rightarrow \gamma 3\pi^+ 3\pi^-$ |
| 38 Assuming $\Gamma(\eta_c(2S)) = 14$ MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width. |     |                   |      |                                             |

NODE=M059R06  
NODE=M059R06

NODE=M059R06;LINKAGE=CR

$$\Gamma(\eta_c(2S) \rightarrow K^+ K^- \pi^+ \pi^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_7/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma\psi(2S)$$

| VALUE                                                                                                           | CL% | DOCUMENT ID       | TECN | COMMENT                                           |
|-----------------------------------------------------------------------------------------------------------------|-----|-------------------|------|---------------------------------------------------|
| $<9.6 \times 10^{-6}$                                                                                           | 90  | 39 CRONIN-HEN..10 | CLEO | $\psi(2S) \rightarrow \gamma K^+ K^- \pi^+ \pi^-$ |
| 39 Assuming $\Gamma(\eta_c(2S)) = 14$ MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width. |     |                   |      |                                                   |

NODE=M059R07  
NODE=M059R07

NODE=M059R07;LINKAGE=CR

$$\Gamma(\eta_c(2S) \rightarrow K^{*0} \bar{K}^{*0})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_8/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma\psi(2S)$$

| 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

$$\Gamma(\eta_c(2S) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_9/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma\psi(2S)$$

| VALUE                  | CL% | DOCUMENT ID       | TECN | COMMENT                                                 |
|------------------------|-----|-------------------|------|---------------------------------------------------------|
| $<43.0 \times 10^{-6}$ | 90  | 40 CRONIN-HEN..10 | CLEO | $\psi(2S) \rightarrow \gamma K^+ K^- \pi^+ \pi^- \pi^0$ |

NODE=M059R08  
NODE=M059R08

NODE=M059R08;LINKAGE=CR

$$\Gamma(\eta_c(2S) \rightarrow K^+ K^- 2\pi^+ 2\pi^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_{10}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma\psi(2S)$$

| VALUE                                                                                                           | CL% | DOCUMENT ID       | TECN | COMMENT                                             |
|-----------------------------------------------------------------------------------------------------------------|-----|-------------------|------|-----------------------------------------------------|
| $<9.7 \times 10^{-6}$                                                                                           | 90  | 41 CRONIN-HEN..10 | CLEO | $\psi(2S) \rightarrow \gamma K^+ K^- 2\pi^+ 2\pi^-$ |
| 41 Assuming $\Gamma(\eta_c(2S)) = 14$ MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width. |     |                   |      |                                                     |

NODE=M059R09  
NODE=M059R09

NODE=M059R09;LINKAGE=CR

$$\Gamma(\eta_c(2S) \rightarrow K_S^0 K^- 2\pi^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_{11}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma\psi(2S)$$

| VALUE (units $10^{-6}$ ) | CL% EVTS | 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 | 42 CRONIN-HEN..10 | CLEO | $\psi(2S) \rightarrow \gamma K_S^0 K^- 2\pi^+ \pi^- + \text{c.c.}$ |
|----------|----|-------------------|------|--------------------------------------------------------------------|

42 Assuming  $\Gamma(\eta_c(2S)) = 14$  MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

NODE=M059R10;LINKAGE=CR

$$\Gamma(\eta_c(2S) \rightarrow \phi\phi)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_{13}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma\psi(2S)$$

| 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

$$\Gamma(\eta_c(2S) \rightarrow p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_{14}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma\psi(2S)$$

| 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

$$\Gamma(\eta_c(2S) \rightarrow \gamma J/\psi(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_{16}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma\psi(2S)$$

| VALUE                 | CL% | EVTS | DOCUMENT ID | TECN | COMMENT                                         |
|-----------------------|-----|------|-------------|------|-------------------------------------------------|
| $<9.7 \times 10^{-6}$ | 90  | 33   | 43 ABLIKIM  | 17N  | BES3 $\psi(2S) \rightarrow \gamma\gamma J/\psi$ |

<sup>43</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  
NODE=M059R27

NODE=M059R27;LINKAGE=A

$$\Gamma(\eta_c(2S) \rightarrow \pi^+\pi^-\eta)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_{17}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma\psi(2S)$$

| VALUE                 | CL% | DOCUMENT ID       | TECN | COMMENT                                     |
|-----------------------|-----|-------------------|------|---------------------------------------------|
| $<4.3 \times 10^{-6}$ | 90  | 44 CRONIN-HEN..10 | CLEO | $\psi(2S) \rightarrow \gamma\pi^+\pi^-\eta$ |

<sup>44</sup> Assuming  $\Gamma(\eta_c(2S)) = 14$  MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

NODE=M059R11  
NODE=M059R11

NODE=M059R11;LINKAGE=CR

$$\Gamma(\eta_c(2S) \rightarrow \pi^+\pi^-\eta')/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_{18}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma\psi(2S)$$

| VALUE                  | CL% | DOCUMENT ID       | TECN | COMMENT                                      |
|------------------------|-----|-------------------|------|----------------------------------------------|
| $<14.2 \times 10^{-6}$ | 90  | 45 CRONIN-HEN..10 | CLEO | $\psi(2S) \rightarrow \gamma\pi^+\pi^-\eta'$ |

<sup>45</sup> Assuming  $\Gamma(\eta_c(2S)) = 14$  MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

NODE=M059R12  
NODE=M059R12

NODE=M059R12;LINKAGE=CR

$$\Gamma(\eta_c(2S) \rightarrow \pi^+\pi^-\eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_{19}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma\psi(2S)$$

| VALUE                 | CL% | DOCUMENT ID       | TECN | COMMENT                                           |
|-----------------------|-----|-------------------|------|---------------------------------------------------|
| $<1.7 \times 10^{-4}$ | 90  | 46 CRONIN-HEN..10 | CLEO | $\psi(2S) \rightarrow \gamma\pi^+\pi^-\eta_c(1S)$ |

<sup>46</sup> Assuming  $\Gamma(\eta_c(2S)) = 14$  MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

NODE=M059R14  
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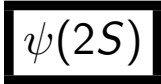
NODE=M059R14;LINKAGE=CR

## $\eta_c(2S)$ REFERENCES

|               |      |                |                                   |                     |
|---------------|------|----------------|-----------------------------------|---------------------|
| 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>          | (BES III 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>          | (BES III Collab.)   |
| ABLIKIM       | 13V  | PR D88 112001  | M. Ablikim <i>et al.</i>          | (BES III Collab.)   |
| ABLIKIM       | 12G  | PRL 109 042003 | M. Ablikim <i>et al.</i>          | (BES III 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>          | (BES III 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+)  |

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REFID=22173



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

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>3686.097±0.025 OUR FIT</b> Error includes scale factor of 2.6.             |      |                            |      |                                             |
| <b>3686.097±0.010 OUR AVERAGE</b>                                             |      |                            |      |                                             |
| 3686.099±0.004±0.009                                                          |      | <sup>1</sup> ANASHIN 15    | KEDR | $e^+e^- \rightarrow \text{hadrons}$         |
| 3686.12 ±0.06 ±0.10                                                           | 4k   | AAIJ 12H                   | LHCB | $p\bar{p} \rightarrow J/\psi \pi^+ \pi^- X$ |
| 3685.95 ±0.10                                                                 | 413  | <sup>2</sup> ARTAMONOV 00  | OLYA | $e^+e^- \rightarrow \text{hadrons}$         |
| 3685.98 ±0.09 ±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±0.007 <sup>+0.011</sup> <sub>-0.016</sub>                            |      | <sup>4</sup> ANASHIN 12    | KEDR | $e^+e^- \rightarrow \text{hadrons}$         |
| 3686.111±0.025±0.009                                                          |      | AULCHENKO 03               | KEDR | $e^+e^- \rightarrow \text{hadrons}$         |
| 3686.00 ±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±0.028 OUR AVERAGE</b>                                              |                           |      |                                                        |
| 589.194±0.027±0.011                                                           | <sup>1</sup> AULCHENKO 03 | KEDR | $e^+e^- \rightarrow \text{hadrons}$                    |
| 589.7 ±1.2                                                                    | LEMOIGNE 82               | GOLI | $185 \pi^- \text{Be} \rightarrow \gamma \mu^+ \mu^- A$ |
| 589.07 ±0.13                                                                  | <sup>1</sup> ZHOLENTZ 80  | OLYA | $e^+e^-$                                               |
| 588.7 ±0.8                                                                    | LUTH 75                   | MRK1 |                                                        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                           |      |                                                        |
| 588 ±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± 8 OUR FIT</b>     |      |                            |      |                                         |
| <b>286±16 OUR AVERAGE</b> |      |                            |      |                                         |
| 358±88± 4                 |      | ABLIKIM 08B                | BES2 | $e^+e^- \rightarrow \text{hadrons}$     |
| 290±25± 4                 | 2.7k | ANDREOTTI 07               | E835 | $p\bar{p} \rightarrow e^+e^-, J/\psi X$ |
| 331±58± 2                 |      | ABLIKIM 06L                | BES2 | $e^+e^- \rightarrow \text{hadrons}$     |
| 264±27                    |      | <sup>1</sup> BAI 02B       | BES2 | $e^+e^-$                                |
| 287±37±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].

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NODE=M071M

NODE=M071M

NODE=M071M

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NODE=M071W

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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 ) %                        |                                   | DESIG=3                        |
| $\Gamma_2$ virtual $\gamma \rightarrow$ hadrons                                           | ( 1.73 $\pm$ 0.14 ) %                        | S=1.5                             | DESIG=4                        |
| $\Gamma_3$ $g g g$                                                                        | (10.6 $\pm$ 1.6 ) %                          |                                   | DESIG=255                      |
| $\Gamma_4$ $\gamma g g$                                                                   | ( 1.03 $\pm$ 0.29 ) %                        |                                   | DESIG=256                      |
| $\Gamma_5$ light hadrons                                                                  | (15.4 $\pm$ 1.5 ) %                          |                                   | DESIG=226                      |
| $\Gamma_6$ $e^+ e^-$                                                                      | ( 7.93 $\pm$ 0.17 ) $\times 10^{-3}$         |                                   | DESIG=1                        |
| $\Gamma_7$ $\mu^+ \mu^-$                                                                  | ( 8.0 $\pm$ 0.6 ) $\times 10^{-3}$           |                                   | DESIG=2                        |
| $\Gamma_8$ $\tau^+ \tau^-$                                                                | ( 3.1 $\pm$ 0.4 ) $\times 10^{-3}$           |                                   | DESIG=68                       |
| <b>Decays into <math>J/\psi(1S)</math> and anything</b>                                   |                                              |                                   |                                |
| $\Gamma_9$ $J/\psi(1S)$ anything                                                          | (61.4 $\pm$ 0.6 ) %                          |                                   | NODE=M071;CLUMP=A<br>DESIG=11  |
| $\Gamma_{10}$ $J/\psi(1S)$ neutrals                                                       | (25.38 $\pm$ 0.32 ) %                        |                                   | DESIG=12                       |
| $\Gamma_{11}$ $J/\psi(1S) \pi^+ \pi^-$                                                    | (34.68 $\pm$ 0.30 ) %                        |                                   | DESIG=13                       |
| $\Gamma_{12}$ $J/\psi(1S) \pi^0 \pi^0$                                                    | (18.24 $\pm$ 0.31 ) %                        |                                   | DESIG=14                       |
| $\Gamma_{13}$ $J/\psi(1S) \eta$                                                           | ( 3.37 $\pm$ 0.05 ) %                        |                                   | DESIG=15                       |
| $\Gamma_{14}$ $J/\psi(1S) \pi^0$                                                          | ( 1.268 $\pm$ 0.032 ) $\times 10^{-3}$       |                                   | DESIG=18                       |
| <b>Hadronic decays</b>                                                                    |                                              |                                   |                                |
| $\Gamma_{15}$ $\pi^0 h_c(1P)$                                                             | ( 8.6 $\pm$ 1.3 ) $\times 10^{-4}$           |                                   | NODE=M071;CLUMP=B<br>DESIG=254 |
| $\Gamma_{16}$ $3(\pi^+ \pi^-) \pi^0$                                                      | ( 3.5 $\pm$ 1.6 ) $\times 10^{-3}$           |                                   | DESIG=37                       |
| $\Gamma_{17}$ $2(\pi^+ \pi^-) \pi^0$                                                      | ( 2.9 $\pm$ 1.0 ) $\times 10^{-3}$           | S=4.7                             | DESIG=25                       |
| $\Gamma_{18}$ $\rho a_2(1320)$                                                            | ( 2.6 $\pm$ 0.9 ) $\times 10^{-4}$           |                                   | DESIG=65                       |
| $\Gamma_{19}$ $\pi^+ \pi^- \pi^0 \pi^0 \pi^0$                                             | ( 5.3 $\pm$ 0.9 ) $\times 10^{-3}$           |                                   | DESIG=312                      |
| $\Gamma_{20}$ $\rho^\pm \pi^\mp \pi^0 \pi^0$                                              | ( 2.66 $\pm$ 0.09 ) $\times 10^{-3}$         | CL=90%                            | DESIG=315                      |
| $\Gamma_{21}$ $p \bar{p}$                                                                 | ( 2.94 $\pm$ 0.08 ) $\times 10^{-4}$         |                                   | DESIG=27                       |
| $\Gamma_{22}$ $n \bar{n}$                                                                 | ( 3.06 $\pm$ 0.15 ) $\times 10^{-4}$         |                                   | DESIG=309                      |
| $\Gamma_{23}$ $\Delta^{++} \bar{\Delta}^{--}$                                             | ( 1.28 $\pm$ 0.35 ) $\times 10^{-4}$         |                                   | DESIG=70                       |
| $\Gamma_{24}$ $\Lambda \bar{\Lambda} \pi^0$                                               | < 2.9 $\times 10^{-6}$                       | CL=90%                            | DESIG=238                      |
| $\Gamma_{25}$ $\Lambda \bar{\Lambda} \eta$                                                | ( 2.5 $\pm$ 0.4 ) $\times 10^{-5}$           |                                   | DESIG=239                      |
| $\Gamma_{26}$ $\Lambda \bar{p} K^+$                                                       | ( 1.00 $\pm$ 0.14 ) $\times 10^{-4}$         |                                   | DESIG=214                      |
| $\Gamma_{27}$ $\Lambda \bar{p} K^+ \pi^+ \pi^-$                                           | ( 1.8 $\pm$ 0.4 ) $\times 10^{-4}$           |                                   | DESIG=215                      |
| $\Gamma_{28}$ $\Lambda \bar{\Lambda} \pi^+ \pi^-$                                         | ( 2.8 $\pm$ 0.6 ) $\times 10^{-4}$           |                                   | DESIG=213                      |
| $\Gamma_{29}$ $\Lambda \bar{\Lambda}$                                                     | ( 3.81 $\pm$ 0.13 ) $\times 10^{-4}$         | S=1.4                             | DESIG=28                       |
| $\Gamma_{30}$ $\Lambda \bar{\Sigma}^+ \pi^- + \text{c.c.}$                                | ( 1.40 $\pm$ 0.13 ) $\times 10^{-4}$         |                                   | DESIG=280                      |
| $\Gamma_{31}$ $\Lambda \bar{\Sigma}^- \pi^+ + \text{c.c.}$                                | ( 1.54 $\pm$ 0.14 ) $\times 10^{-4}$         |                                   | DESIG=281                      |
| $\Gamma_{32}$ $\Lambda \bar{\Sigma}^0$                                                    | ( 1.23 $\pm$ 0.24 ) $\times 10^{-5}$         |                                   | DESIG=307                      |
| $\Gamma_{33}$ $\Sigma^0 \bar{p} K^+ + \text{c.c.}$                                        | ( 1.67 $\pm$ 0.18 ) $\times 10^{-5}$         |                                   | DESIG=274                      |
| $\Gamma_{34}$ $\Sigma^+ \bar{\Sigma}^-$                                                   | ( 2.32 $\pm$ 0.12 ) $\times 10^{-4}$         |                                   | DESIG=223                      |
| $\Gamma_{35}$ $\Sigma^0 \bar{\Sigma}^0$                                                   | ( 2.35 $\pm$ 0.09 ) $\times 10^{-4}$         | S=1.1                             | DESIG=71                       |
| $\Gamma_{36}$ $\Sigma(1385)^+ \bar{\Sigma}(1385)^-$                                       | ( 8.5 $\pm$ 0.7 ) $\times 10^{-5}$           |                                   | DESIG=72                       |
| $\Gamma_{37}$ $\Sigma(1385)^- \bar{\Sigma}(1385)^+$                                       | ( 8.5 $\pm$ 0.8 ) $\times 10^{-5}$           |                                   | DESIG=297                      |
| $\Gamma_{38}$ $\Sigma(1385)^0 \bar{\Sigma}(1385)^0$                                       | ( 6.9 $\pm$ 0.7 ) $\times 10^{-5}$           |                                   | DESIG=299                      |
| $\Gamma_{39}$ $\Xi^- \bar{\Xi}^+$                                                         | ( 2.87 $\pm$ 0.11 ) $\times 10^{-4}$         | S=1.1                             | DESIG=29                       |
| $\Gamma_{40}$ $\Xi^0 \bar{\Xi}^0$                                                         | ( 2.3 $\pm$ 0.4 ) $\times 10^{-4}$           | S=4.2                             | DESIG=224                      |
| $\Gamma_{41}$ $\Xi(1530)^0 \bar{\Xi}(1530)^0$                                             | ( 5.2 $\pm$ 3.2 $\pm$ 1.2 ) $\times 10^{-5}$ |                                   | DESIG=73                       |
| $\Gamma_{42}$ $K^- \Lambda \bar{\Xi}^+ + \text{c.c.}$                                     | ( 3.9 $\pm$ 0.4 ) $\times 10^{-5}$           |                                   | DESIG=293                      |
| $\Gamma_{43}$ $\Xi(1690)^- \bar{\Xi}^+ \rightarrow K^- \Lambda \bar{\Xi}^+ + \text{c.c.}$ | ( 5.2 $\pm$ 1.6 ) $\times 10^{-6}$           |                                   | DESIG=294                      |
| $\Gamma_{44}$ $\Xi(1820)^- \bar{\Xi}^+ \rightarrow K^- \Lambda \bar{\Xi}^+ + \text{c.c.}$ | ( 1.20 $\pm$ 0.32 ) $\times 10^{-5}$         |                                   | DESIG=295                      |
| $\Gamma_{45}$ $K^- \Sigma^0 \bar{\Xi}^+ + \text{c.c.}$                                    | ( 3.7 $\pm$ 0.4 ) $\times 10^{-5}$           |                                   | DESIG=296                      |
| $\Gamma_{46}$ $\Omega^- \bar{\Omega}^+$                                                   | ( 5.2 $\pm$ 0.4 ) $\times 10^{-5}$           |                                   | DESIG=74                       |
| $\Gamma_{47}$ $\pi^0 p \bar{p}$                                                           | ( 1.53 $\pm$ 0.07 ) $\times 10^{-4}$         |                                   | DESIG=35                       |
| $\Gamma_{48}$ $N(940) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$                  | ( 6.4 $\pm$ 1.8 $\pm$ 1.3 ) $\times 10^{-5}$ |                                   | DESIG=267                      |
| $\Gamma_{49}$ $N(1440) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$                 | ( 7.3 $\pm$ 1.7 $\pm$ 1.5 ) $\times 10^{-5}$ | S=2.5                             | DESIG=261                      |
| $\Gamma_{50}$ $N(1520) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$                 | ( 6.4 $\pm$ 2.3 $\pm$ 1.8 ) $\times 10^{-6}$ |                                   | DESIG=268                      |
| $\Gamma_{51}$ $N(1535) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$                 | ( 2.5 $\pm$ 1.0 ) $\times 10^{-5}$           |                                   | DESIG=269                      |



|                |                                                                     |                                             |        |           |
|----------------|---------------------------------------------------------------------|---------------------------------------------|--------|-----------|
| $\Gamma_{52}$  | $N(1650)\bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$          | $(3.8 \pm_{-1.7}^{+1.4}) \times 10^{-5}$    |        | DESIG=270 |
| $\Gamma_{53}$  | $N(1720)\bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$          | $(1.79 \pm_{-0.70}^{+0.26}) \times 10^{-5}$ |        | DESIG=271 |
| $\Gamma_{54}$  | $N(2300)\bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$          | $(2.6 \pm_{-0.7}^{+1.2}) \times 10^{-5}$    |        | DESIG=272 |
| $\Gamma_{55}$  | $N(2570)\bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$          | $(2.13 \pm_{-0.31}^{+0.40}) \times 10^{-5}$ |        | DESIG=273 |
| $\Gamma_{56}$  | $\pi^0 f_0(2100) \rightarrow \pi^0 p \bar{p}$                       | $(1.1 \pm 0.4) \times 10^{-5}$              |        | DESIG=262 |
| $\Gamma_{57}$  | $\eta p \bar{p}$                                                    | $(6.0 \pm 0.4) \times 10^{-5}$              |        | DESIG=200 |
| $\Gamma_{58}$  | $\eta f_0(2100) \rightarrow \eta p \bar{p}$                         | $(1.2 \pm 0.4) \times 10^{-5}$              |        | DESIG=263 |
| $\Gamma_{59}$  | $N(1535)\bar{p} \rightarrow \eta p \bar{p}$                         | $(4.4 \pm 0.7) \times 10^{-5}$              |        | DESIG=264 |
| $\Gamma_{60}$  | $\omega p \bar{p}$                                                  | $(6.9 \pm 2.1) \times 10^{-5}$              |        | DESIG=77  |
| $\Gamma_{61}$  | $\eta' p \bar{p}$                                                   | $(1.10 \pm 0.13) \times 10^{-5}$            |        | DESIG=317 |
| $\Gamma_{62}$  | $\phi p \bar{p}$                                                    | $< 2.4 \times 10^{-5}$                      | CL=90% | DESIG=80  |
| $\Gamma_{63}$  | $\pi^+ \pi^- p \bar{p}$                                             | $(6.0 \pm 0.4) \times 10^{-4}$              |        | DESIG=31  |
| $\Gamma_{64}$  | $p \bar{n} \pi^- \text{ or c.c.}$                                   | $(2.48 \pm 0.17) \times 10^{-4}$            |        | DESIG=227 |
| $\Gamma_{65}$  | $p \bar{n} \pi^- \pi^0$                                             | $(3.2 \pm 0.7) \times 10^{-4}$              |        | DESIG=228 |
| $\Gamma_{66}$  | $2(\pi^+ \pi^- \pi^0)$                                              | $(4.8 \pm 1.5) \times 10^{-3}$              |        | DESIG=221 |
| $\Gamma_{67}$  | $\eta \pi^+ \pi^-$                                                  | $< 1.6 \times 10^{-4}$                      | CL=90% | DESIG=202 |
| $\Gamma_{68}$  | $\eta \pi^+ \pi^- \pi^0$                                            | $(9.5 \pm 1.7) \times 10^{-4}$              |        | DESIG=203 |
| $\Gamma_{69}$  | $2(\pi^+ \pi^-) \eta$                                               | $(1.2 \pm 0.6) \times 10^{-3}$              |        | DESIG=251 |
| $\Gamma_{70}$  | $\pi^+ \pi^- \pi^0 \pi^0 \eta$                                      | $(3.65 \pm 0.12) \times 10^{-4}$            | CL=90% | DESIG=313 |
| $\Gamma_{71}$  | $\eta' \pi^+ \pi^- \pi^0$                                           | $(4.5 \pm 2.1) \times 10^{-4}$              |        | DESIG=204 |
| $\Gamma_{72}$  | $\omega \pi^+ \pi^-$                                                | $(7.3 \pm 1.2) \times 10^{-4}$              | S=2.1  | DESIG=75  |
| $\Gamma_{73}$  | $b_1^\pm \pi^\mp$                                                   | $(4.0 \pm 0.6) \times 10^{-4}$              | S=1.1  | DESIG=40  |
| $\Gamma_{74}$  | $b_1^0 \pi^0$                                                       | $(2.4 \pm 0.6) \times 10^{-4}$              |        | DESIG=193 |
| $\Gamma_{75}$  | $\omega f_2(1270)$                                                  | $(2.2 \pm 0.4) \times 10^{-4}$              |        | DESIG=64  |
| $\Gamma_{76}$  | $\omega \pi^0 \pi^0$                                                | $(1.11 \pm 0.35) \times 10^{-3}$            |        | DESIG=314 |
| $\Gamma_{77}$  | $\pi^0 \pi^0 K^+ K^-$                                               | $(2.6 \pm 1.3) \times 10^{-4}$              |        | DESIG=298 |
| $\Gamma_{78}$  | $\pi^+ \pi^- K^+ K^-$                                               | $(7.3 \pm 0.5) \times 10^{-4}$              |        | DESIG=26  |
| $\Gamma_{79}$  | $\pi^0 \pi^0 K_S^0 K_L^0$                                           | $(1.3 \pm 0.6) \times 10^{-3}$              |        | DESIG=304 |
| $\Gamma_{80}$  | $\rho^0 K^+ K^-$                                                    | $(2.2 \pm 0.4) \times 10^{-4}$              |        | DESIG=205 |
| $\Gamma_{81}$  | $K^*(892)^0 \bar{K}_2^*(1430)^0$                                    | $(1.9 \pm 0.5) \times 10^{-4}$              |        | DESIG=66  |
| $\Gamma_{82}$  | $K^+ K^- \pi^+ \pi^- \eta$                                          | $(1.3 \pm 0.7) \times 10^{-3}$              |        | DESIG=252 |
| $\Gamma_{83}$  | $K^+ K^- 2(\pi^+ \pi^-) \pi^0$                                      | $(1.00 \pm 0.31) \times 10^{-3}$            |        | DESIG=240 |
| $\Gamma_{84}$  | $K^+ K^- 2(\pi^+ \pi^-)$                                            | $(1.9 \pm 0.9) \times 10^{-3}$              |        | DESIG=222 |
| $\Gamma_{85}$  | $K_1(1270)^\pm K^\mp$                                               | $(1.00 \pm 0.28) \times 10^{-3}$            |        | DESIG=41  |
| $\Gamma_{86}$  | $K_S^0 K_S^0 \pi^+ \pi^-$                                           | $(2.2 \pm 0.4) \times 10^{-4}$              |        | DESIG=225 |
| $\Gamma_{87}$  | $\rho^0 p \bar{p}$                                                  | $(5.0 \pm 2.2) \times 10^{-5}$              |        | DESIG=210 |
| $\Gamma_{88}$  | $K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.}$                          | $(6.7 \pm 2.5) \times 10^{-4}$              |        | DESIG=34  |
| $\Gamma_{89}$  | $2(\pi^+ \pi^-)$                                                    | $(2.4 \pm 0.6) \times 10^{-4}$              | S=2.2  | DESIG=24  |
| $\Gamma_{90}$  | $\rho^0 \pi^+ \pi^-$                                                | $(2.2 \pm 0.6) \times 10^{-4}$              | S=1.4  | DESIG=33  |
| $\Gamma_{91}$  | $K^+ K^- \pi^+ \pi^- \pi^0$                                         | $(1.26 \pm 0.09) \times 10^{-3}$            |        | DESIG=206 |
| $\Gamma_{92}$  | $\omega f_0(1710) \rightarrow \omega K^+ K^-$                       | $(5.9 \pm 2.2) \times 10^{-5}$              |        | DESIG=216 |
| $\Gamma_{93}$  | $K^*(892)^0 K^- \pi^+ \pi^0 + \text{c.c.}$                          | $(8.6 \pm 2.2) \times 10^{-4}$              |        | DESIG=217 |
| $\Gamma_{94}$  | $K^*(892)^+ K^- \pi^+ \pi^- + \text{c.c.}$                          | $(9.6 \pm 2.8) \times 10^{-4}$              |        | DESIG=218 |
| $\Gamma_{95}$  | $K^*(892)^+ K^- \rho^0 + \text{c.c.}$                               | $(7.3 \pm 2.6) \times 10^{-4}$              |        | DESIG=219 |
| $\Gamma_{96}$  | $K^*(892)^0 K^- \rho^+ + \text{c.c.}$                               | $(6.1 \pm 1.8) \times 10^{-4}$              |        | DESIG=220 |
| $\Gamma_{97}$  | $\eta K^+ K^-$ , no $\eta \phi$                                     | $(3.1 \pm 0.4) \times 10^{-5}$              |        | DESIG=207 |
| $\Gamma_{98}$  | $\omega K^+ K^-$                                                    | $(1.62 \pm 0.11) \times 10^{-4}$            | S=1.1  | DESIG=76  |
| $\Gamma_{99}$  | $\omega K^*(892)^+ K^- + \text{c.c.}$                               | $(2.07 \pm 0.26) \times 10^{-4}$            |        | DESIG=276 |
| $\Gamma_{100}$ | $\omega K_2^*(1430)^+ K^- + \text{c.c.}$                            | $(6.1 \pm 1.2) \times 10^{-5}$              |        | DESIG=277 |
| $\Gamma_{101}$ | $\omega \bar{K}^*(892)^0 K^0$                                       | $(1.68 \pm 0.30) \times 10^{-4}$            |        | DESIG=278 |
| $\Gamma_{102}$ | $\omega \bar{K}_2^*(1430)^0 K^0$                                    | $(5.8 \pm 2.2) \times 10^{-5}$              |        | DESIG=279 |
| $\Gamma_{103}$ | $\omega X(1440) \rightarrow \omega K_S^0 K^- \pi^+ + \text{c.c.}$   | $(1.6 \pm 0.4) \times 10^{-5}$              |        | DESIG=282 |
| $\Gamma_{104}$ | $\omega X(1440) \rightarrow \omega K^+ K^- \pi^0$                   | $(1.09 \pm 0.26) \times 10^{-5}$            |        | DESIG=283 |
| $\Gamma_{105}$ | $\omega f_1(1285) \rightarrow \omega K_S^0 K^- \pi^+ + \text{c.c.}$ | $(3.0 \pm 1.0) \times 10^{-6}$              |        | DESIG=284 |
| $\Gamma_{106}$ | $\omega f_1(1285) \rightarrow \omega K^+ K^- \pi^0$                 | $(1.2 \pm 0.7) \times 10^{-6}$              |        | DESIG=285 |

|                  |                                                                                    |                                        |        |           |
|------------------|------------------------------------------------------------------------------------|----------------------------------------|--------|-----------|
| Γ <sub>107</sub> | $3(\pi^+\pi^-)$                                                                    | $(3.5 \pm 2.0) \times 10^{-4}$         | S=2.8  | DESIG=32  |
| Γ <sub>108</sub> | $p\bar{p}\pi^+\pi^-\pi^0$                                                          | $(7.3 \pm 0.7) \times 10^{-4}$         |        | DESIG=211 |
| Γ <sub>109</sub> | $K^+K^-$                                                                           | $(7.5 \pm 0.5) \times 10^{-5}$         |        | DESIG=23  |
| Γ <sub>110</sub> | $K_S^0 K_L^0$                                                                      | $(5.34 \pm 0.33) \times 10^{-5}$       |        | DESIG=85  |
| Γ <sub>111</sub> | $\pi^+\pi^-\pi^0$                                                                  | $(2.01 \pm 0.17) \times 10^{-4}$       | S=1.7  | DESIG=36  |
| Γ <sub>112</sub> | $\rho(2150)\pi \rightarrow \pi^+\pi^-\pi^0$                                        | $(1.9 \pm 1.2 \pm 0.4) \times 10^{-4}$ |        | DESIG=201 |
| Γ <sub>113</sub> | $\rho(770)\pi \rightarrow \pi^+\pi^-\pi^0$                                         | $(3.2 \pm 1.2) \times 10^{-5}$         | S=1.8  | DESIG=22  |
| Γ <sub>114</sub> | $\pi^+\pi^-$                                                                       | $(7.8 \pm 2.6) \times 10^{-6}$         |        | DESIG=21  |
| Γ <sub>115</sub> | $K_1(1400)^\pm K^\mp$                                                              | $< 3.1 \times 10^{-4}$                 | CL=90% | DESIG=42  |
| Γ <sub>116</sub> | $K_2^*(1430)^\pm K^\mp$                                                            | $(7.1 \pm 1.3 \pm 0.9) \times 10^{-5}$ |        | DESIG=265 |
| Γ <sub>117</sub> | $K^+K^-\pi^0$                                                                      | $(4.07 \pm 0.31) \times 10^{-5}$       |        | DESIG=38  |
| Γ <sub>118</sub> | $K_S^0 K_L^0 \pi^0$                                                                | $< 3.0 \times 10^{-4}$                 | CL=90% | DESIG=303 |
| Γ <sub>119</sub> | $K_S^0 K_L^0 \eta$                                                                 | $(1.3 \pm 0.5) \times 10^{-3}$         |        | DESIG=305 |
| Γ <sub>120</sub> | $K^+K^*(892)^- + \text{c.c.}$                                                      | $(2.9 \pm 0.4) \times 10^{-5}$         | S=1.2  | DESIG=39  |
| Γ <sub>121</sub> | $K^*(892)^0 \bar{K}^0 + \text{c.c.}$                                               | $(1.09 \pm 0.20) \times 10^{-4}$       |        | DESIG=194 |
| Γ <sub>122</sub> | $\phi\pi^+\pi^-$                                                                   | $(1.18 \pm 0.26) \times 10^{-4}$       | S=1.5  | DESIG=78  |
| Γ <sub>123</sub> | $\phi f_0(980) \rightarrow \pi^+\pi^-$                                             | $(7.5 \pm 3.3) \times 10^{-5}$         | S=1.6  | DESIG=81  |
| Γ <sub>124</sub> | $2(K^+K^-)$                                                                        | $(6.3 \pm 1.3) \times 10^{-5}$         |        | DESIG=208 |
| Γ <sub>125</sub> | $\phi K^+K^-$                                                                      | $(7.0 \pm 1.6) \times 10^{-5}$         |        | DESIG=79  |
| Γ <sub>126</sub> | $2(K^+K^-)\pi^0$                                                                   | $(1.10 \pm 0.28) \times 10^{-4}$       |        | DESIG=209 |
| Γ <sub>127</sub> | $\phi\eta$                                                                         | $(3.10 \pm 0.31) \times 10^{-5}$       |        | DESIG=89  |
| Γ <sub>128</sub> | $\eta\phi(2170), \phi(2170) \rightarrow \phi f_0(980), f_0 \rightarrow \pi^+\pi^-$ | $< 2.2 \times 10^{-6}$                 | CL=90% | DESIG=316 |
| Γ <sub>129</sub> | $\phi\eta'$                                                                        | $(3.1 \pm 1.6) \times 10^{-5}$         |        | DESIG=90  |
| Γ <sub>130</sub> | $\omega\eta'$                                                                      | $(3.2 \pm 2.5 \pm 2.1) \times 10^{-5}$ |        | DESIG=91  |
| Γ <sub>131</sub> | $\omega\pi^0$                                                                      | $(2.1 \pm 0.6) \times 10^{-5}$         |        | DESIG=92  |
| Γ <sub>132</sub> | $\rho\eta'$                                                                        | $(1.9 \pm 1.7 \pm 1.2) \times 10^{-5}$ |        | DESIG=93  |
| Γ <sub>133</sub> | $\rho\eta$                                                                         | $(2.2 \pm 0.6) \times 10^{-5}$         | S=1.1  | DESIG=94  |
| Γ <sub>134</sub> | $\omega\eta$                                                                       | $< 1.1 \times 10^{-5}$                 | CL=90% | DESIG=95  |
| Γ <sub>135</sub> | $\phi\pi^0$                                                                        | $< 4 \times 10^{-7}$                   | CL=90% | DESIG=96  |
| Γ <sub>136</sub> | $\eta_c\pi^+\pi^-\pi^0$                                                            | $< 1.0 \times 10^{-3}$                 | CL=90% | DESIG=229 |
| Γ <sub>137</sub> | $p\bar{p}K^+K^-$                                                                   | $(2.7 \pm 0.7) \times 10^{-5}$         |        | DESIG=212 |
| Γ <sub>138</sub> | $\bar{\Lambda}nK_S^0 + \text{c.c.}$                                                | $(8.1 \pm 1.8) \times 10^{-5}$         |        | DESIG=237 |
| Γ <sub>139</sub> | $\phi f_2'(1525)$                                                                  | $(4.4 \pm 1.6) \times 10^{-5}$         |        | DESIG=67  |
| Γ <sub>140</sub> | $\Theta(1540)\bar{\Theta}(1540) \rightarrow K_S^0 p K^- \bar{n} + \text{c.c.}$     | $< 8.8 \times 10^{-6}$                 | CL=90% | DESIG=195 |
| Γ <sub>141</sub> | $\Theta(1540)K^-\bar{n} \rightarrow K_S^0 p K^- \bar{n}$                           | $< 1.0 \times 10^{-5}$                 | CL=90% | DESIG=196 |
| Γ <sub>142</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 |
| Γ <sub>143</sub> | $\bar{\Theta}(1540)K^+n \rightarrow K_S^0 \bar{p} K^+ n$                           | $< 2.6 \times 10^{-5}$                 | CL=90% | DESIG=198 |
| Γ <sub>144</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 |
| Γ <sub>145</sub> | $K_S^0 K_S^0$                                                                      | $< 4.6 \times 10^{-6}$                 |        | DESIG=86  |
| Γ <sub>146</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>147</sub> | $\gamma\chi_{c0}(1P)$                           | $(9.79 \pm 0.20) \%$                      |       | DESIG=56  |
| Γ <sub>148</sub> | $\gamma\chi_{c1}(1P)$                           | $(9.75 \pm 0.24) \%$                      |       | DESIG=58  |
| Γ <sub>149</sub> | $\gamma\chi_{c2}(1P)$                           | $(9.52 \pm 0.20) \%$                      |       | DESIG=59  |
| Γ <sub>150</sub> | $\gamma\eta_c(1S)$                              | $(3.4 \pm 0.5) \times 10^{-3}$            | S=1.3 | DESIG=61  |
| Γ <sub>151</sub> | $\gamma\eta_c(2S)$                              | $(7 \pm 5) \times 10^{-4}$                |       | DESIG=63  |
| Γ <sub>152</sub> | $\gamma\pi^0$                                   | $(1.04 \pm 0.22) \times 10^{-6}$          | S=1.4 | DESIG=52  |
| Γ <sub>153</sub> | $\gamma\eta'(958)$                              | $(1.24 \pm 0.04) \times 10^{-4}$          |       | DESIG=54  |
| Γ <sub>154</sub> | $\gamma f_2(1270)$                              | $(2.73 \pm 0.29 \pm 0.25) \times 10^{-4}$ | S=1.8 | DESIG=82  |
| Γ <sub>155</sub> | $\gamma f_0(1370) \rightarrow \gamma K \bar{K}$ | $(3.1 \pm 1.7) \times 10^{-5}$            |       | DESIG=286 |
| Γ <sub>156</sub> | $\gamma f_0(1500)$                              | $(9.2 \pm 1.9) \times 10^{-5}$            |       | DESIG=287 |
| Γ <sub>157</sub> | $\gamma f_2'(1525)$                             | $(3.3 \pm 0.8) \times 10^{-5}$            |       | DESIG=288 |
| Γ <sub>158</sub> | $\gamma f_0(1710)$                              |                                           |       | DESIG=236 |
| Γ <sub>159</sub> | $\gamma f_0(1710) \rightarrow \gamma\pi\pi$     | $(3.5 \pm 0.6) \times 10^{-5}$            |       | DESIG=83  |

|                     |                                                                                            |                                                            |        |                                |
|---------------------|--------------------------------------------------------------------------------------------|------------------------------------------------------------|--------|--------------------------------|
| Γ <sub>160</sub>    | $\gamma f_0(1710) \rightarrow \gamma K \bar{K}$                                            | ( 6.6 ± 0.7 ) × 10 <sup>-5</sup>                           |        | DESIG=84                       |
| Γ <sub>161</sub>    | $\gamma f_0(2100) \rightarrow \gamma \pi \pi$                                              | ( 4.8 ± 1.0 ) × 10 <sup>-6</sup>                           |        | DESIG=289                      |
| Γ <sub>162</sub>    | $\gamma f_0(2200) \rightarrow \gamma K \bar{K}$                                            | ( 3.2 ± 1.0 ) × 10 <sup>-6</sup>                           |        | DESIG=290                      |
| Γ <sub>163</sub>    | $\gamma f_J(2220) \rightarrow \gamma \pi \pi$                                              | < 5.8 × 10 <sup>-6</sup>                                   | CL=90% | DESIG=291                      |
| Γ <sub>164</sub>    | $\gamma f_J(2220) \rightarrow \gamma K \bar{K}$                                            | < 9.5 × 10 <sup>-6</sup>                                   | CL=90% | DESIG=292                      |
| Γ <sub>165</sub>    | $\gamma \gamma$                                                                            | < 1.5 × 10 <sup>-4</sup>                                   | CL=90% | DESIG=51                       |
| Γ <sub>166</sub>    | $\gamma \eta$                                                                              | ( 9.2 ± 1.8 ) × 10 <sup>-7</sup>                           |        | DESIG=53                       |
| Γ <sub>167</sub>    | $\gamma \eta \pi^+ \pi^-$                                                                  | ( 8.7 ± 2.1 ) × 10 <sup>-4</sup>                           |        | DESIG=230                      |
| Γ <sub>168</sub>    | $\gamma \eta(1405)$                                                                        |                                                            |        | DESIG=231                      |
| Γ <sub>169</sub>    | $\gamma \eta(1405) \rightarrow \gamma K \bar{K} \pi$                                       | < 9 × 10 <sup>-5</sup>                                     | CL=90% | DESIG=62                       |
| Γ <sub>170</sub>    | $\gamma \eta(1405) \rightarrow \eta \pi^+ \pi^-$                                           | ( 3.6 ± 2.5 ) × 10 <sup>-5</sup>                           |        | DESIG=232                      |
| Γ <sub>171</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>172</sub>    | $\gamma \eta(1475)$                                                                        |                                                            |        | DESIG=233                      |
| Γ <sub>173</sub>    | $\gamma \eta(1475) \rightarrow K \bar{K} \pi$                                              | < 1.4 × 10 <sup>-4</sup>                                   | CL=90% | DESIG=234                      |
| Γ <sub>174</sub>    | $\gamma \eta(1475) \rightarrow \eta \pi^+ \pi^-$                                           | < 8.8 × 10 <sup>-5</sup>                                   | CL=90% | DESIG=235                      |
| Γ <sub>175</sub>    | $\gamma 2(\pi^+ \pi^-)$                                                                    | ( 4.0 ± 0.6 ) × 10 <sup>-4</sup>                           |        | DESIG=241                      |
| Γ <sub>176</sub>    | $\gamma K^{*0} K^+ \pi^- + \text{c.c.}$                                                    | ( 3.7 ± 0.9 ) × 10 <sup>-4</sup>                           |        | DESIG=242                      |
| Γ <sub>177</sub>    | $\gamma K^{*0} \bar{K}^{*0}$                                                               | ( 2.4 ± 0.7 ) × 10 <sup>-4</sup>                           |        | DESIG=243                      |
| Γ <sub>178</sub>    | $\gamma K_S^0 K^+ \pi^- + \text{c.c.}$                                                     | ( 2.6 ± 0.5 ) × 10 <sup>-4</sup>                           |        | DESIG=244                      |
| Γ <sub>179</sub>    | $\gamma K^+ K^- \pi^+ \pi^-$                                                               | ( 1.9 ± 0.5 ) × 10 <sup>-4</sup>                           |        | DESIG=245                      |
| Γ <sub>180</sub>    | $\gamma p \bar{p}$                                                                         | ( 3.9 ± 0.5 ) × 10 <sup>-5</sup>                           | S=2.0  | DESIG=246                      |
| Γ <sub>181</sub>    | $\gamma f_2(1950) \rightarrow \gamma p \bar{p}$                                            | ( 1.20 ± 0.22 ) × 10 <sup>-5</sup>                         |        | DESIG=257                      |
| Γ <sub>182</sub>    | $\gamma f_2(2150) \rightarrow \gamma p \bar{p}$                                            | ( 7.2 ± 1.8 ) × 10 <sup>-6</sup>                           |        | DESIG=258                      |
| Γ <sub>183</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>184</sub>    | $\gamma X \rightarrow \gamma p \bar{p}$                                                    | [a] < 2 × 10 <sup>-6</sup>                                 | CL=90% | DESIG=260                      |
| Γ <sub>185</sub>    | $\gamma \pi^+ \pi^- p \bar{p}$                                                             | ( 2.8 ± 1.4 ) × 10 <sup>-5</sup>                           |        | DESIG=247                      |
| Γ <sub>186</sub>    | $\gamma 2(\pi^+ \pi^-) K^+ K^-$                                                            | < 2.2 × 10 <sup>-4</sup>                                   | CL=90% | DESIG=248                      |
| Γ <sub>187</sub>    | $\gamma 3(\pi^+ \pi^-)$                                                                    | < 1.7 × 10 <sup>-4</sup>                                   | CL=90% | DESIG=249                      |
| Γ <sub>188</sub>    | $\gamma K^+ K^- K^+ K^-$                                                                   | < 4 × 10 <sup>-5</sup>                                     | CL=90% | DESIG=250                      |
| Γ <sub>189</sub>    | $\gamma \gamma J/\psi$                                                                     | ( 3.1 <sup>+1.0</sup> <sub>-1.2</sub> ) × 10 <sup>-4</sup> |        | DESIG=266                      |
| Γ <sub>190</sub>    | $e^+ e^- \eta'$                                                                            | ( 1.90 ± 0.26 ) × 10 <sup>-6</sup>                         |        | DESIG=311                      |
| Γ <sub>191</sub>    | $e^+ e^- \chi_{c0}(1P)$                                                                    | ( 1.06 ± 0.24 ) × 10 <sup>-3</sup>                         |        | DESIG=300                      |
| Γ <sub>192</sub>    | $e^+ e^- \chi_{c1}(1P)$                                                                    | ( 8.5 ± 0.6 ) × 10 <sup>-4</sup>                           |        | DESIG=301                      |
| Γ <sub>193</sub>    | $e^+ e^- \chi_{c2}(1P)$                                                                    | ( 7.0 ± 0.8 ) × 10 <sup>-4</sup>                           |        | DESIG=302                      |
| <b>Weak decays</b>  |                                                                                            |                                                            |        |                                |
| Γ <sub>194</sub>    | $D^0 e^+ e^- + \text{c.c.}$                                                                | < 1.4 × 10 <sup>-7</sup>                                   | CL=90% | NODE=M071;CLUMP=E<br>DESIG=306 |
| <b>Other decays</b> |                                                                                            |                                                            |        |                                |
| Γ <sub>195</sub>    | invisible                                                                                  | < 1.6 %                                                    | CL=90% | NODE=M071;CLUMP=D<br>DESIG=275 |

[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        |          |           |           |           |
| $x_{147}$ | 1     | 0     | 0     | 2        | 1        | 1        | 0        |           |           |           |
| $x_{148}$ | 1     | 0     | 0     | 2        | 1        | 1        | 0        | 0         |           |           |
| $x_{149}$ | 1     | 0     | 0     | 3        | 1        | 1        | 0        | 0         | 0         |           |
| $\Gamma$  | -81   | -4    | -1    | -38      | -34      | -16      | -7       | -1        | -1        | -1        |
|           | $x_6$ | $x_7$ | $x_8$ | $x_{11}$ | $x_{12}$ | $x_{13}$ | $x_{21}$ | $x_{147}$ | $x_{148}$ | $x_{149}$ |

### $\psi(2S)$ 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 $\mathcal{T}$ mini-review                          |
| $2.279 \pm 0.015 \pm 0.042$ | <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 | $e^+e^-$                                               |

<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.

<sup>2</sup> From a simultaneous fit to  $e^+e^-$ ,  $\mu^+\mu^-$ , and hadronic channel, assuming  $\Gamma_e = \Gamma_\mu = \Gamma_\tau/0.38847$ .

<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.

<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.

<sup>5</sup> From a simultaneous fit to  $e^+e^-$ ,  $\mu^+\mu^-$ , and hadronic channels assuming  $\Gamma(e^+e^-) = \Gamma(\mu^+\mu^-)$ .

OCCUR=2

NODE=M071W1;LINKAGE=A

NODE=M071W;LINKAGE=BB

NODE=M071W1;LINKAGE=B

NODE=M071W1;LINKAGE=C

NODE=M071W1;LINKAGE=F

#### $\Gamma(\gamma\gamma)$

$\Gamma_{165}$

VALUE (eV) CL% DOCUMENT ID TECN COMMENT

|               |    |           |     |      |          |
|---------------|----|-----------|-----|------|----------|
| <b>&lt;43</b> | 90 | BRANDELIK | 79C | DASP | $e^+e^-$ |
|---------------|----|-----------|-----|------|----------|

NODE=M071W51  
NODE=M071W51

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

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

NODE=M071230

 $\Gamma(\text{hadrons}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_1 \Gamma_6 / \Gamma$ 

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

|                          |                      |    |                                           |
|--------------------------|----------------------|----|-------------------------------------------|
| <b>2.233±0.015±0.042</b> | <sup>1</sup> ANASHIN | 12 | KEDR $e^+ e^- \rightarrow \text{hadrons}$ |
|--------------------------|----------------------|----|-------------------------------------------|

• • • 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  
NODE=M071G3

NODE=M071G3;LINKAGE=AN

 $\Gamma(e^+ e^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_6 \Gamma_6 / \Gamma$ 

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

|                     |                      |    |                |
|---------------------|----------------------|----|----------------|
| <b>21.2±0.7±1.2</b> | <sup>1</sup> ANASHIN | 18 | KEDR $e^+ e^-$ |
|---------------------|----------------------|----|----------------|

<sup>1</sup> From the average of nine scans of the  $\psi(2S)$ .

NODE=M071P14  
NODE=M071P14

NODE=M071P14;LINKAGE=A

 $\Gamma(\mu^+ \mu^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_7 \Gamma_6 / \Gamma$ 

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

|                     |                      |    |                                         |
|---------------------|----------------------|----|-----------------------------------------|
| <b>19.3±0.3±0.5</b> | <sup>1</sup> ANASHIN | 18 | KEDR $\psi(2S) \rightarrow \mu^+ \mu^-$ |
|---------------------|----------------------|----|-----------------------------------------|

<sup>1</sup> From the average of nine scans of the  $\psi(2S)$ .

NODE=M071P13  
NODE=M071P13

NODE=M071P13;LINKAGE=A

 $\Gamma(\tau^+ \tau^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_8 \Gamma_6 / \Gamma$ 

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

• • • 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  
NODE=M071G9

NODE=M071G9;LINKAGE=AN

 $\Gamma(J/\psi(1S) \pi^+ \pi^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{11} \Gamma_6 / \Gamma$ 

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

**0.808±0.013 OUR FIT**

[0.809 ± 0.013 keV OUR 2018 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.

<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  $B(J/\psi(1S) \rightarrow \ell^+ \ell^-) = 0.1181 \pm 0.0020$ .

<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.

<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.

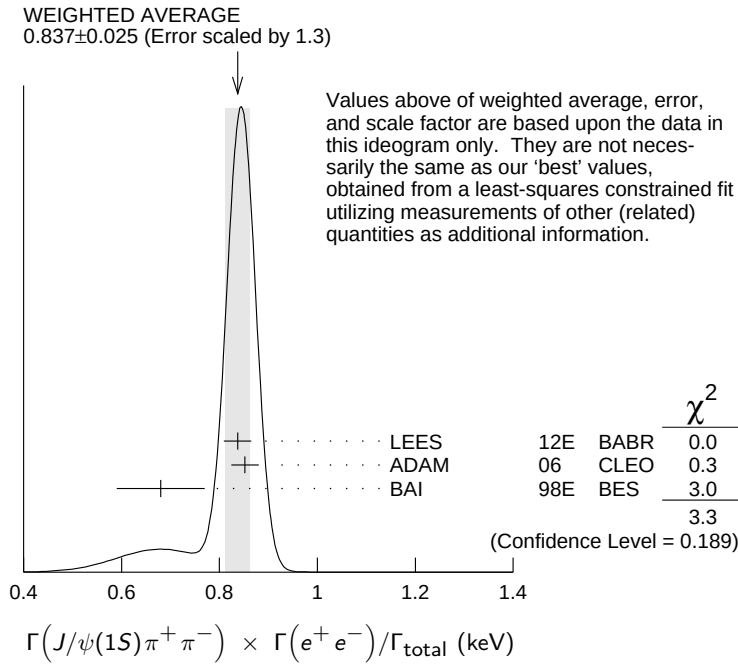
NODE=M071G1  
NODE=M071G1  
NEW

NODE=M071G1;LINKAGE=LE

NODE=M071G1;LINKAGE=A

NODE=M071G1;LINKAGE=UB

NODE=M071G1;LINKAGE=AU



### $\Gamma(J/\psi(1S)\pi^0\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_{12}\Gamma_6/\Gamma$

| 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±96 | 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>     |      |             |      |         |
| [78.7 ± 1.6 eV OUR 2018 FIT] |      |             |      |         |

**87 ± 9 OUR AVERAGE**

|             |          |                     |      |                                                            |
|-------------|----------|---------------------|------|------------------------------------------------------------|
| 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  
NEW

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>      |      |             |      |         |
| [0.672 ± 0.023 eV OUR 2018 FIT] |      |             |      |         |

**0.63 ± 0.05 OUR AVERAGE** 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  
NEW

NODE=M071G2;LINKAGE=C  
NODE=M071G2;LINKAGE=B  
NODE=M071G2;LINKAGE=A

$$\Gamma(\Lambda\bar{\Lambda}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{29}\Gamma_6/\Gamma$$

| VALUE (eV)         | DOCUMENT ID | TECN | COMMENT                                        |
|--------------------|-------------|------|------------------------------------------------|
| <b>1.5±0.4±0.1</b> | AUBERT      | 07BD | BABR 10.6 e <sup>+</sup> e <sup>-</sup> → ΛΛ̄γ |

NODE=M071G11  
NODE=M071G11

$$\Gamma(2(\pi^+\pi^-\pi^0)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{66}\Gamma_6/\Gamma$$

| VALUE (eV)          | EVTS | DOCUMENT ID | TECN | COMMENT                                                                                     |
|---------------------|------|-------------|------|---------------------------------------------------------------------------------------------|
| <b>11.2±3.3±1.3</b> | 43   | AUBERT      | 06D  | BABR 10.6 e <sup>+</sup> e <sup>-</sup> → 2(π <sup>+</sup> π <sup>-</sup> π <sup>0</sup> )γ |

NODE=M071G4  
NODE=M071G4

$$\Gamma(\pi^0\pi^0K^+K^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{77}\Gamma_6/\Gamma$$

| VALUE (eV)            | EVTS | DOCUMENT ID | TECN | COMMENT                                                                                                 |
|-----------------------|------|-------------|------|---------------------------------------------------------------------------------------------------------|
| <b>0.60±0.31±0.03</b> | 17   | LEES        | 12F  | BABR 10.6 e <sup>+</sup> e <sup>-</sup> → π <sup>0</sup> π <sup>0</sup> K <sup>+</sup> K <sup>-</sup> γ |

NODE=M071G08  
NODE=M071G08

$$\Gamma(K^+K^-2(\pi^+\pi^-)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{84}\Gamma_6/\Gamma$$

| VALUE (eV)         | EVTS | DOCUMENT ID | TECN | COMMENT                                                                                                    |
|--------------------|------|-------------|------|------------------------------------------------------------------------------------------------------------|
| <b>4.4±2.1±0.3</b> | 26   | AUBERT      | 06D  | BABR 10.6 e <sup>+</sup> e <sup>-</sup> → K <sup>+</sup> K <sup>-</sup> 2(π <sup>+</sup> π <sup>-</sup> )γ |

NODE=M071G5  
NODE=M071G5

$$\Gamma(\pi^+\pi^-K^+K^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{78}\Gamma_6/\Gamma$$

| VALUE (eV)            | EVTS | DOCUMENT ID | TECN | COMMENT                                                                                                 |
|-----------------------|------|-------------|------|---------------------------------------------------------------------------------------------------------|
| <b>1.92±0.30±0.06</b> | 133  | LEES        | 12F  | BABR 10.6 e <sup>+</sup> e <sup>-</sup> → π <sup>+</sup> π <sup>-</sup> K <sup>+</sup> K <sup>-</sup> γ |

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 <sup>+</sup> e <sup>-</sup> → π <sup>+</sup> π <sup>-</sup> K <sup>+</sup> K <sup>-</sup> γ |
| <sup>1</sup> Superseded by LEES 12F. |    |                     |      |                                                                                                         |

NODE=M071G12;LINKAGE=A

$$\Gamma(\pi^0\pi^0K_S^0K_L^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{79}\Gamma_6/\Gamma$$

| VALUE (eV)            | EVTS | DOCUMENT ID | TECN | COMMENT                                                                                                                      |
|-----------------------|------|-------------|------|------------------------------------------------------------------------------------------------------------------------------|
| <b>2.92±1.27±0.15</b> | 14   | LEES        | 17A  | BABR e <sup>+</sup> e <sup>-</sup> → K <sub>S</sub> <sup>0</sup> K <sub>L</sub> <sup>0</sup> π <sup>0</sup> π <sup>0</sup> γ |

NODE=M071G14  
NODE=M071G14

$$\Gamma(K_S^0K_L^0\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{118}\Gamma_6/\Gamma$$

| VALUE (eV)     | CL% | EVTS | DOCUMENT ID | TECN | COMMENT                                                                                                       |
|----------------|-----|------|-------------|------|---------------------------------------------------------------------------------------------------------------|
| <b>&lt;0.7</b> | 90  | 8    | LEES        | 17A  | BABR e <sup>+</sup> e <sup>-</sup> → K <sub>S</sub> <sup>0</sup> K <sub>L</sub> <sup>0</sup> π <sup>0</sup> γ |

NODE=M071G15  
NODE=M071G15

$$\Gamma(K_S^0K_L^0\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{119}\Gamma_6/\Gamma$$

| VALUE (eV)            | EVTS | DOCUMENT ID | TECN | COMMENT                                                                                         |
|-----------------------|------|-------------|------|-------------------------------------------------------------------------------------------------|
| <b>3.14±1.08±0.16</b> | 16   | LEES        | 17A  | BABR e <sup>+</sup> e <sup>-</sup> → K <sub>S</sub> <sup>0</sup> K <sub>L</sub> <sup>0</sup> ηγ |

NODE=M071G16  
NODE=M071G16

$$\Gamma(\phi f_0(980) \rightarrow \pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{123}\Gamma_6/\Gamma$$

| 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 <sup>+</sup> e <sup>-</sup> → π <sup>+</sup> π <sup>-</sup> K <sup>+</sup> K <sup>-</sup> γ |

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 <sup>+</sup> e <sup>-</sup> → π <sup>+</sup> π <sup>-</sup> K <sup>+</sup> K <sup>-</sup> γ |
|-------------------|-------|---------------------|------|---------------------------------------------------------------------------------------------------------|

<sup>1</sup> LEES 12F reports [Γ(ψ(2S) → φf<sub>0</sub>(980) → π<sup>+</sup>π<sup>-</sup>) × Γ(ψ(2S) → e<sup>+</sup>e<sup>-</sup>)/Γ<sub>total</sub>] × [B(φ(1020) → K<sup>+</sup>K<sup>-</sup>)] = 0.17 ± 0.06 ± 0.02 eV which we divide by our best value B(φ(1020) → K<sup>+</sup>K<sup>-</sup>) = (49.2 ± 0.5) × 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=M071G13;LINKAGE=A

<sup>2</sup> Superseded by LEES 12F. AUBERT 07AK reports [Γ(ψ(2S) → φf<sub>0</sub>(980) → π<sup>+</sup>π<sup>-</sup>) × Γ(ψ(2S) → e<sup>+</sup>e<sup>-</sup>)/Γ<sub>total</sub>] × [B(φ(1020) → K<sup>+</sup>K<sup>-</sup>)] = 0.17 ± 0.08 ± 0.02 eV which we divide by our best value B(φ(1020) → K<sup>+</sup>K<sup>-</sup>) = (49.2 ± 0.5) × 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=M071G13;LINKAGE=AU

$$\Gamma(2(K^+K^-)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{124}\Gamma_6/\Gamma$$

| VALUE (eV)            | EVTS | DOCUMENT ID | TECN | COMMENT                                                                                                 |
|-----------------------|------|-------------|------|---------------------------------------------------------------------------------------------------------|
| <b>0.22±0.10±0.02</b> | 13   | LEES        | 12F  | BABR 10.6 e <sup>+</sup> e <sup>-</sup> → K <sup>+</sup> K <sup>-</sup> K <sup>+</sup> K <sup>-</sup> γ |

NODE=M071G07  
NODE=M071G07

$$\Gamma(\phi\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{122}\Gamma_6/\Gamma$$

| 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 <sup>+</sup> e <sup>-</sup> → K <sup>+</sup> K <sup>-</sup> π <sup>+</sup> π <sup>-</sup> γ |

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 <sup>+</sup> e <sup>-</sup> → K <sup>+</sup> K <sup>-</sup> π <sup>+</sup> π <sup>-</sup> γ |
|----------------|----|------------------------|-----|---------------------------------------------------------------------------------------------------------|

<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

| $\Gamma(2(\pi^+\pi^-)\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ |      |             |           |                                                    | $\Gamma_{17}\Gamma_6/\Gamma$ |
|--------------------------------------------------------------------------|------|-------------|-----------|----------------------------------------------------|------------------------------|
| 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

| $\Gamma(\pi^+\pi^-\pi^0\pi^0\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ |      |             |          |                                                           | $\Gamma_{19}\Gamma_6/\Gamma$ |
|---------------------------------------------------------------------------------|------|-------------|----------|-----------------------------------------------------------|------------------------------|
| VALUE (eV)                                                                      | EVTS | DOCUMENT ID | TECN     | COMMENT                                                   |                              |
| <b>12.4±1.8±1.2</b>                                                             | 177  | LEES        | 18E BABR | 10.6 $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0\pi^0\gamma$ |                              |

NODE=M071P16  
NODE=M071P16

| $\Gamma(\rho^\pm\pi^\mp\pi^0\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ |     |             |          |                                                      | $\Gamma_{20}\Gamma_6/\Gamma$ |
|---------------------------------------------------------------------------------|-----|-------------|----------|------------------------------------------------------|------------------------------|
| VALUE (eV)                                                                      | CL% | DOCUMENT ID | TECN     | COMMENT                                              |                              |
| <b>6.2</b>                                                                      | 90  | LEES        | 18E BABR | 10.6 $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0\gamma$ |                              |

NODE=M071P18  
NODE=M071P18

| $\Gamma(\omega\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ |      |                     |           |                                                  | $\Gamma_{72}\Gamma_6/\Gamma$ |
|------------------------------------------------------------------------|------|---------------------|-----------|--------------------------------------------------|------------------------------|
| 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  $B(\omega(782) \rightarrow \pi^+\pi^-\pi^0) = (89.3 \pm 0.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M071G02;LINKAGE=UB

| $\Gamma(\omega\pi^0\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ |      |                   |          |                                                      | $\Gamma_{76}\Gamma_6/\Gamma$ |
|------------------------------------------------------------------------|------|-------------------|----------|------------------------------------------------------|------------------------------|
| VALUE (eV)                                                             | EVTS | DOCUMENT ID       | TECN     | COMMENT                                              |                              |
| <b>2.58±0.82±0.02</b>                                                  | 33   | <sup>1</sup> LEES | 18E BABR | 10.6 $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0\gamma$ |                              |

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  $B(\omega(782) \rightarrow \pi^+\pi^-\pi^0) = (89.3 \pm 0.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M071P17;LINKAGE=A

| $\Gamma(2(\pi^+\pi^-)\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ |      |                     |           |                                                   | $\Gamma_{69}\Gamma_6/\Gamma$ |
|-------------------------------------------------------------------------|------|---------------------|-----------|---------------------------------------------------|------------------------------|
| 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

| $\Gamma(\pi^+\pi^-\pi^0\pi^0\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ |     |             |          |                                                          | $\Gamma_{70}\Gamma_6/\Gamma$ |
|--------------------------------------------------------------------------------|-----|-------------|----------|----------------------------------------------------------|------------------------------|
| VALUE (eV)                                                                     | CL% | DOCUMENT ID | TECN     | COMMENT                                                  |                              |
| <b>0.85</b>                                                                    | 90  | LEES        | 18E BABR | 10.6 $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0\eta\gamma$ |                              |

NODE=M071P15  
NODE=M071P15

| $\Gamma(K^+K^-\pi^+\pi^-\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ |      |             |           |                                                       | $\Gamma_{91}\Gamma_6/\Gamma$ |
|-----------------------------------------------------------------------------|------|-------------|-----------|-------------------------------------------------------|------------------------------|
| 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

| $\Gamma(K^+K^-\pi^+\pi^-\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ |      |                     |           |                                                      | $\Gamma_{82}\Gamma_6/\Gamma$ |
|----------------------------------------------------------------------------|------|---------------------|-----------|------------------------------------------------------|------------------------------|
| 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



$\Gamma(K^+K^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_{109}\Gamma_6/\Gamma$ 

| VALUE (eV)                                                                              | EVTs | DOCUMENT ID       | TECN     | COMMENT                           |
|-----------------------------------------------------------------------------------------|------|-------------------|----------|-----------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •           |      |                   |          |                                   |
| $0.147 \pm 0.035 \pm 0.005$                                                             | 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 | $e^+e^- \rightarrow K^+K^-\gamma$ |
| <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><math>0.9785 \pm 0.0013</math> 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><math>0.0173 \pm 0.0014</math> 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 | $e^+e^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                            |                     |          |          |
| $0.029 \pm 0.004$                                                                                                                                                        | <sup>1</sup> LUTH   | 75 MRK1  | $e^+e^-$ |
| <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><math>10.58 \pm 1.62</math></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><math>1.025 \pm 0.288</math></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><math>9.7 \pm 2.6 \pm 1.6</math></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><math>0.154 \pm 0.015</math></b>                                                                                                                               |                   |          |                               |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                     |                   |          |                               |
| $0.169 \pm 0.026$                                                                                                                                                 | <sup>2</sup> ADAM | 05A CLEO | $e^+e^- \rightarrow \psi(2S)$ |
| <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

 $\Gamma(e^+e^-)/\Gamma(J/\psi(1S)\text{anything})$  $\Gamma_6/\Gamma_9 = \Gamma_6/(\Gamma_{11} + \Gamma_{12} + \Gamma_{13} + 0.343\Gamma_{148} + 0.190\Gamma_{149})$ VALUE (units  $10^{-2}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**1.291 ± 0.026 OUR FIT**[(1.292 ± 0.026) × 10<sup>-2</sup> OUR 2018 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  $\bar{p}p \rightarrow \psi(2S)$ 

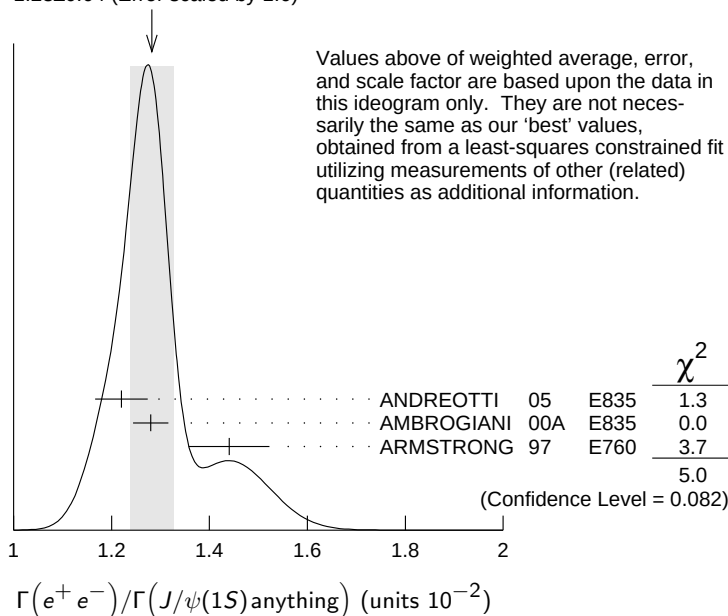
<sup>1</sup> Using  $B(J/\psi(1S) \rightarrow e^+e^-) = 0.0593 \pm 0.0010$ .

NODE=M071R72  
NODE=M071R72

NEW

NODE=M071R;LINKAGE=7A

WEIGHTED AVERAGE  
1.28±0.04 (Error scaled by 1.6)



$\Gamma(\mu^+\mu^-)/\Gamma(J/\psi(1S)\text{anything})$

$$\Gamma_7/\Gamma_9 = \Gamma_7/(\Gamma_{11} + \Gamma_{12} + \Gamma_{13} + 0.343\Gamma_{148} + 0.190\Gamma_{149})$$

| 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>   |             |
| [0.2537 ± 0.0032 OUR 2018 FIT] |             |

$\Gamma_{10}/\Gamma$

NODE=M071R18  
NODE=M071R18  
NEW

$\Gamma(J/\psi(1S)\pi^+\pi^-)/\Gamma_{\text{total}}$

| VALUE                          | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------------|------|-------------|------|---------|
| <b>0.3468±0.0030 OUR FIT</b>   |      |             |      |         |
| [0.3467 ± 0.0030 OUR 2018 FIT] |      |             |      |         |

$\Gamma_{11}/\Gamma$

NODE=M071R12  
NODE=M071R12  
NEW

**0.348 ±0.005 OUR AVERAGE** Error includes scale factor of 1.3. See the ideogram below.

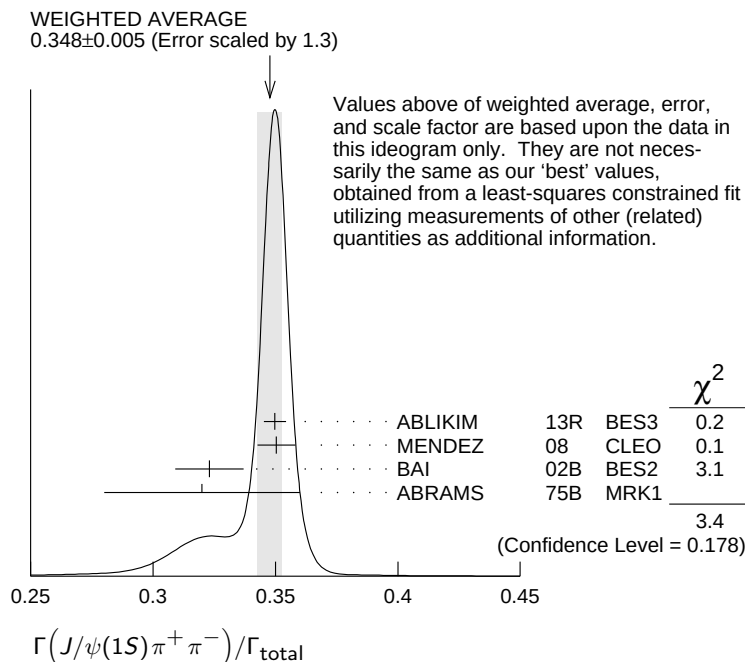
|                      |      |         |     |      |                                                  |
|----------------------|------|---------|-----|------|--------------------------------------------------|
| 0.3498±0.0002±0.0045 | 20M  | ABLIKIM | 13R | BES3 | $\psi(2S) \rightarrow J/\psi \pi^+ \pi^-$        |
| 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 $e^+e^-$ |

NODE=M071R73  
NODE=M071R73

<sup>1</sup> Using  $B(J/\psi(1S) \rightarrow e^+e^-) = 0.0593 \pm 0.0010$ .

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 $\pi^- \text{Be} \rightarrow 2\mu X$ |

NODE=M071R63  
NODE=M071R63

<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;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                                     |

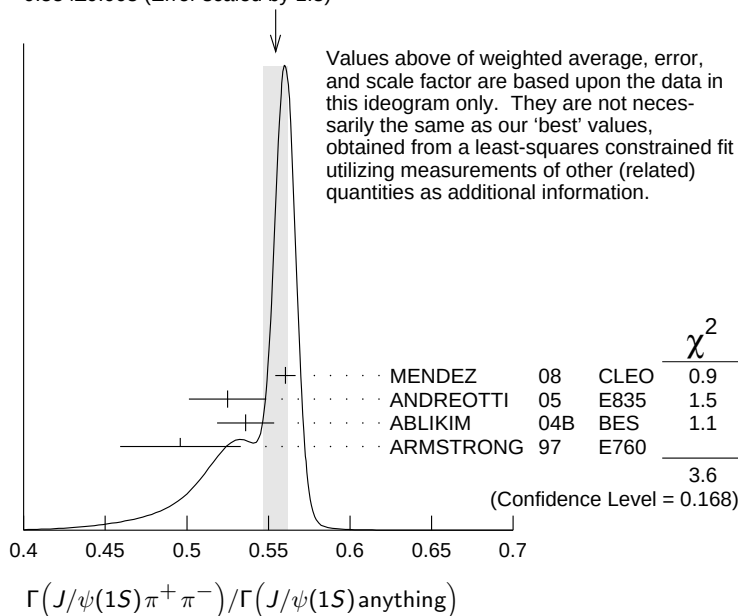
NODE=M071R70  
NODE=M071R70

<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=M071R;LINKAGE=AB  
NODE=M071R;LINKAGE=AL

WEIGHTED AVERAGE  
0.554±0.008 (Error scaled by 1.3)



$\Gamma(J/\psi(1S)\text{neutrals})/\Gamma(J/\psi(1S)\pi^+\pi^-)$

$$\Gamma_{10}/\Gamma_{11} = (0.9761\Gamma_{12} + 0.719\Gamma_{13} + 0.343\Gamma_{148} + 0.190\Gamma_{149})/\Gamma_{11}$$

| 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 | $\Gamma_{12}/\Gamma$ |
|--------------------------------|------|-------------|------|---------|----------------------|
| <b>0.1824±0.0031 OUR FIT</b>   |      |             |      |         |                      |
| [0.1823 ± 0.0031 OUR 2018 FIT] |      |             |      |         |                      |

NODE=M071R17  
NODE=M071R17  
NEW

• • • 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 | $\Gamma_{12}/\Gamma_9$ |
|---------------------------------|------|-------------|------|---------|------------------------|
| <b>0.2968±0.0031 OUR FIT</b>    |      |             |      |         |                        |
| <b>0.320 ±0.012 OUR AVERAGE</b> |      |             |      |         |                        |

|                     |           |            |     |      |                                 |
|---------------------|-----------|------------|-----|------|---------------------------------|
| 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 | $\bar{p}p \rightarrow \psi(2S)$ |

• • • 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 | $\Gamma_{12}/\Gamma_{11}$ |
|---------------------------------|------|-------------|------|---------|---------------------------|
| <b>0.526 ±0.008 OUR FIT</b>     |      |             |      |         |                           |
| <b>0.513 ±0.022 OUR AVERAGE</b> |      |             |      |         |                           |

|                      |     |                        |     |      |                                           |
|----------------------|-----|------------------------|-----|------|-------------------------------------------|
| 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  | $\psi(2S) \rightarrow J/\psi X$           |
| 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  
NODE=M071R14

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  $\pm$  0.5 OUR FIT****32.9  $\pm$  1.7 OUR AVERAGE**

Error includes scale factor of 2.1. See the ideogram below.

33.75  $\pm$  0.17  $\pm$  0.86 68.2k ABLIKIM 12M BES3  $e^+e^- \rightarrow \ell^+\ell^-2\gamma$ 29.8  $\pm$  0.9  $\pm$  2.3 5.7k BAI 04I BES2  $\psi(2S) \rightarrow J/\psi\gamma\gamma$ 25.5  $\pm$  2.9 386 <sup>1</sup>OREGLIA 80 CBAL  $e^+e^- \rightarrow J/\psi2\gamma$ 45  $\pm$  12 17 <sup>2</sup>BRANDELIK 79B DASP  $e^+e^- \rightarrow J/\psi2\gamma$ 42  $\pm$  6 164 <sup>2</sup>BARTEL 78B CNTR  $e^+e^-$ 

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

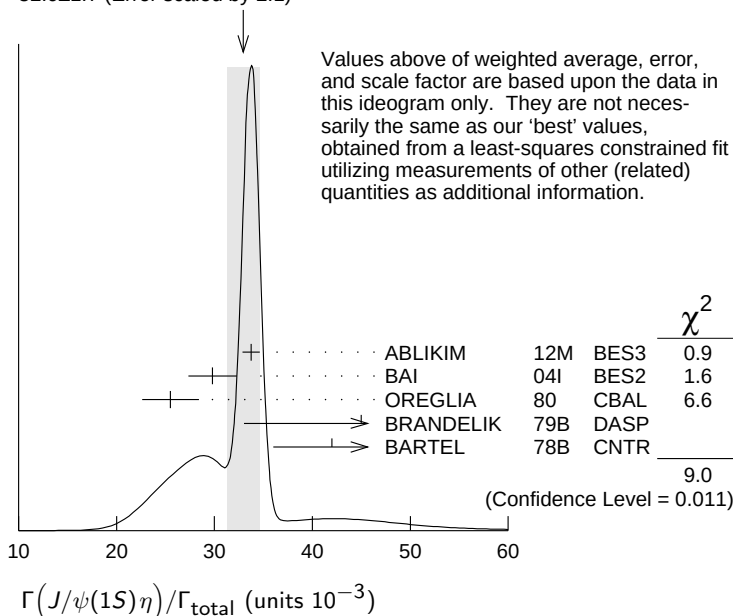
34.3  $\pm$  0.4  $\pm$  0.9 18.4k <sup>3</sup>MENDEZ 08 CLEO  $\psi(2S) \rightarrow \ell^+\ell^-\eta$ 32.5  $\pm$  0.6  $\pm$  1.1 2.8k <sup>4</sup>ADAM 05A CLEO Repl. by MENDEZ 0843  $\pm$  8 44 TANENBAUM 76 MRK1  $e^+e^-$ <sup>1</sup> Recalculated by us using  $B(J/\psi(1S) \rightarrow \ell^+\ell^-) = 0.1181 \pm 0.0020$ .<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 $\pm$ 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  $\pm$  0.0008 OUR FIT****0.058  $\pm$  0.007 OUR AVERAGE**

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

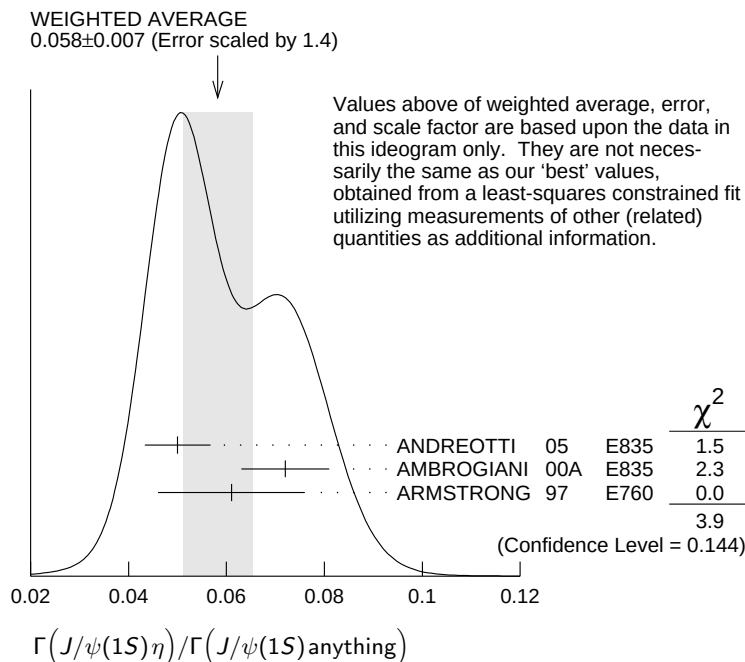
0.050  $\pm$  0.006  $\pm$  0.003 298  $\pm$  20 ANDREOTTI 05 E835  $\psi(2S) \rightarrow J/\psi X$ 0.072  $\pm$  0.009 AMBROGIANI 00A E835  $p\bar{p} \rightarrow \psi(2S)$ 0.061  $\pm$  0.015 ARMSTRONG 97 E760  $\bar{p}p \rightarrow \psi(2S)$ 

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

0.0549  $\pm$  0.0006  $\pm$  0.0009 18.4k <sup>1</sup>MENDEZ 08 CLEO  $\psi(2S) \rightarrow \ell^+\ell^-\eta$ 0.0546  $\pm$  0.0010  $\pm$  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;LINKAGE=3Q

### $\Gamma(J/\psi(1S)\pi^0)/\Gamma(J/\psi(1S)\text{anything})$

$$\Gamma_{14}/\Gamma_9 = \Gamma_{14}/(\Gamma_{11} + \Gamma_{12} + \Gamma_{13} + 0.343\Gamma_{148} + 0.190\Gamma_{149})$$

| 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  $B = (7.6 + 1.4 \times \Gamma(h_c(1P)/\Gamma_0) \times 10^{-4}$ , 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  $e^+e^- \rightarrow \text{hadrons}$

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.

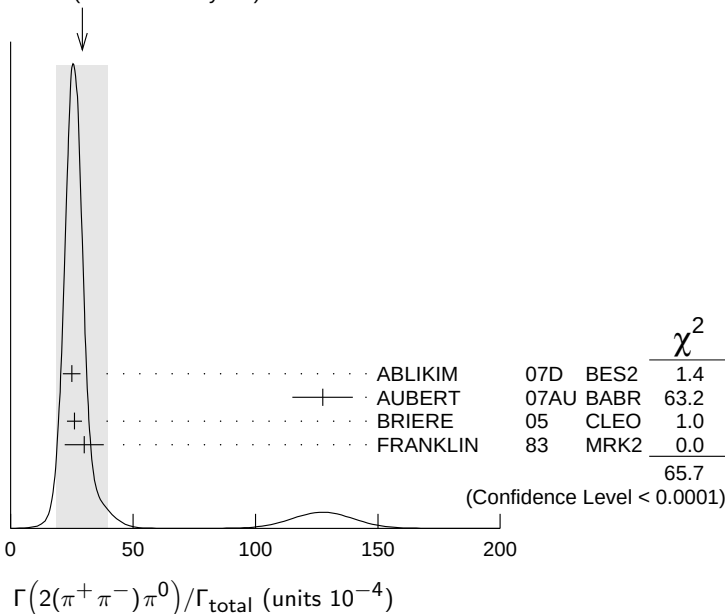
|                        |      |                     |      |                                                                   |
|------------------------|------|---------------------|------|-------------------------------------------------------------------|
| $24.9 \pm 0.7 \pm 3.6$ | 2173 | ABLIKIM             | 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)





$\Gamma(p\bar{a}_2(1320))/\Gamma_{\text{total}}$  $\Gamma_{18}/\Gamma$ 

| 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

 $\Gamma(p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{21}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                               | EVTS | DOCUMENT ID | TECN     | COMMENT                                            |
|------------------------------------------------------------------------|------|-------------|----------|----------------------------------------------------|
| <b>2.94±0.08 OUR FIT</b>                                               |      |             |          |                                                    |
| [(2.88 ± 0.10) × 10 <sup>-4</sup> OUR 2018 FIT]                        |      |             |          |                                                    |
| <b>3.02±0.08 OUR AVERAGE</b>                                           |      |             |          |                                                    |
| [(3.00 ± 0.13) × 10 <sup>-4</sup> OUR 2018 AVERAGE Scale factor = 1.1] |      |             |          |                                                    |
| 3.05±0.02±0.12                                                         | 19k  | ABLIKIM     | 18T BES3 | $e^+e^- \rightarrow \psi(2S) \rightarrow p\bar{p}$ |
| 3.08±0.05±0.18                                                         | 4.5k | 1 DOBBS     | 14       | $e^+e^- \rightarrow \psi(2S) \rightarrow p\bar{p}$ |
| 3.36±0.09±0.25                                                         | 1.6k | ABLIKIM     | 07C BES  | $e^+e^- \rightarrow \psi(2S) \rightarrow p\bar{p}$ |
| 2.87±0.12±0.15                                                         | 557  | PEDLAR      | 05 CLEO  | $e^+e^- \rightarrow \psi(2S) \rightarrow p\bar{p}$ |
| 1.4 ±0.8                                                               | 4    | BRANDELIK   | 79C DASP | $e^+e^- \rightarrow \psi(2S) \rightarrow p\bar{p}$ |
| 2.3 ±0.7                                                               |      | FELDMAN     | 77 MRK1  | $e^+e^- \rightarrow \psi(2S) \rightarrow p\bar{p}$ |

NODE=M071R25  
 NODE=M071R25

NEW

NEW

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

NODE=M071R25;LINKAGE=A

 $\Gamma(p\bar{p})/\Gamma(J/\psi(1S)\pi^+\pi^-)$  $\Gamma_{21}/\Gamma_{11}$ 

| VALUE (units $10^{-4}$ )                        | DOCUMENT ID | TECN   | COMMENT                                            |
|-------------------------------------------------|-------------|--------|----------------------------------------------------|
| <b>8.49±0.23 OUR FIT</b>                        |             |        |                                                    |
| [(8.31 ± 0.28) × 10 <sup>-4</sup> OUR 2018 FIT] |             |        |                                                    |
| <b>6.98±0.49±0.97</b>                           | BAI         | 01 BES | $e^+e^- \rightarrow \psi(2S) \rightarrow p\bar{p}$ |

NODE=M071S40  
 NODE=M071S40

NEW

 $\Gamma(n\bar{n})/\Gamma_{\text{total}}$  $\Gamma_{22}/\Gamma$ 

| 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 | $\psi(2S) \rightarrow p\bar{p}\pi^+\pi^-\gamma\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                      |          |                                                       |
| <12                                                                           | 90  | <sup>2</sup> ABLIKIM | 07H BES2 | $e^+e^- \rightarrow \psi(2S)$                         |

<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  
 NODE=M071R6

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    |      | $\psi(2S) \rightarrow p\bar{p}\pi^+\pi^-\gamma\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                      |             |      |                                                       |
| <4.9                                                                          | 90  | <sup>2</sup> ABLIKIM | 07H BES2    |      | $e^+e^- \rightarrow \psi(2S)$                         |

<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  
 NODE=M071R7

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>$p\bar{p}K^+\pi^-$ |

NODE=M071S18  
 NODE=M071S18

 $\Gamma(\Lambda\bar{p}K^+\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{27}/\Gamma$ 

| 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>$p\bar{p}K^+\pi^+\pi^-\pi^-$ |

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 | $e^+e^- \rightarrow \psi(2S) \rightarrow \rho\bar{\rho}2(\pi^+\pi^-)$ |

 $\Gamma_{28}/\Gamma$ 

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   | $e^+e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |

 $\Gamma_{29}/\Gamma$ 

NODE=M071R28  
 NODE=M071R28

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

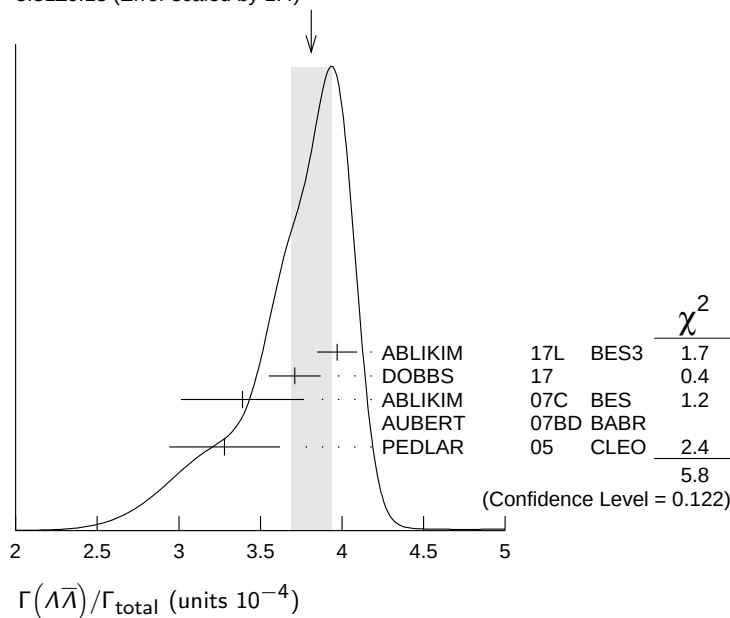
<sup>2</sup> AUBERT 07BD reports  $[\Gamma(\psi(2S) \rightarrow \Lambda\bar{\Lambda})/\Gamma_{\text{total}}] \times [\Gamma(\psi(2S) \rightarrow e^+e^-)] = (15 \pm 4 \pm 1) \times 10^{-4}$  keV which we divide by our best value  $\Gamma(\psi(2S) \rightarrow e^+e^-) = 2.33 \pm 0.04$  keV. Our first error 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 | $\psi(2S) \rightarrow \text{hadrons}$ |

 $\Gamma_{30}/\Gamma$ 

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 | $\psi(2S) \rightarrow \text{hadrons}$ |

 $\Gamma_{31}/\Gamma$ 

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 | $e^+e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |

 $\Gamma_{32}/\Gamma$ 

NODE=M071P08  
 NODE=M071P08

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

NODE=M071P08;LINKAGE=A

$\Gamma(\Sigma^0 \bar{p} K^+ + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{33}/\Gamma$ 

| 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

 $\Gamma(\Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}$  $\Gamma_{34}/\Gamma$ 

| 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 $\Gamma(\Sigma^0 \bar{\Sigma}^0)/\Gamma_{\text{total}}$  $\Gamma_{35}/\Gamma$ 

| 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 $\Gamma(\Sigma(1385)^+ \bar{\Sigma}(1385)^-)/\Gamma_{\text{total}}$  $\Gamma_{36}/\Gamma$ 

| 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

 $\Gamma(\Sigma(1385)^- \bar{\Sigma}(1385)^+)/\Gamma_{\text{total}}$  $\Gamma_{37}/\Gamma$ 

| 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 $\Gamma(\Sigma(1385)^0 \bar{\Sigma}(1385)^0)/\Gamma_{\text{total}}$  $\Gamma_{38}/\Gamma$ 

| 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 $\Gamma(\Xi^- \bar{\Xi}^+)/\Gamma_{\text{total}}$  $\Gamma_{39}/\Gamma$ 

| 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 <math>\pm</math> 0.4 OUR AVERAGE</b>                                   |      | Error includes scale factor of 4.2. |          |                                                          |
| 2.73 $\pm$ 0.03 $\pm$ 0.13                                                    | 11k  | ABLIKIM                             | 17E BES3 | $e^+e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| 1.97 $\pm$ 0.06 $\pm$ 0.11                                                    | 1.2k | <sup>1</sup> DOBBS                  | 17       | $e^+e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| 2.75 $\pm$ 0.64 $\pm$ 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 $\pm$ 0.19 $\pm$ 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.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 <math>\pm</math> 0.3 <math>^{+3.2}_{-1.2}</math></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  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = 0.310 \pm 0.028$ .NODE=M071R53  
NODE=M071R53NODE=M071R53;LINKAGE=A  
NODE=M071R53;LINKAGE=PP $\Gamma(K^- \Lambda \Xi^+ + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ )                                | EVTS | DOCUMENT ID | TECN     | COMMENT                                                                   |
|---------------------------------------------------------|------|-------------|----------|---------------------------------------------------------------------------|
| <b>3.86 <math>\pm</math> 0.27 <math>\pm</math> 0.32</b> | 236  | ABLIKIM     | 15I BES3 | $e^+e^- \rightarrow \psi(2S) \rightarrow K^- \Lambda \Xi^+ + \text{c.c.}$ |

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 <math>\pm</math> 1.48 <math>\pm</math> 0.57</b> | 74   | ABLIKIM     | 15I BES3 | $e^+e^- \rightarrow \psi(2S) \rightarrow K^- \Lambda \Xi^+ + \text{c.c.}$ |

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 <math>\pm</math> 2.94 <math>\pm</math> 1.22</b> | 136  | ABLIKIM     | 15I BES3 | $e^+e^- \rightarrow \psi(2S) \rightarrow K^- \Lambda \Xi^+ + \text{c.c.}$ |

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 <math>\pm</math> 0.33 <math>\pm</math> 0.28</b> | 142  | ABLIKIM     | 15I BES3 | $e^+e^- \rightarrow \psi(2S) \rightarrow K^- \Sigma^0 \Xi^+ + \text{c.c.}$ |

NODE=M071S85  
NODE=M071S85 $\Gamma(\Omega^- \bar{\Omega}^+)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )                                                      | CL% | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                  |
|-------------------------------------------------------------------------------|-----|------|----------------------|----------|----------------------------------------------------------|
| <b>0.52 <math>\pm</math> 0.03 <math>\pm</math> 0.03</b>                       |     | 326  | <sup>1</sup> DOBBS   | 17       | $e^+e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |      |                      |          |                                                          |
| 0.47 $\pm$ 0.09 $\pm$ 0.05                                                    |     | 27   | <sup>1,2</sup> DOBBS | 14       | $e^+e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| < 1.5                                                                         | 90  |      | ABLIKIM              | 12Q BES2 | $e^+e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| < 1.6                                                                         | 90  |      | PEDLAR               | 05 CLEO  | $e^+e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| < 0.73                                                                        | 90  |      | <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=M071R54  
NODE=M071R54NODE=M071R54;LINKAGE=A  
NODE=M071R54;LINKAGE=B  
NODE=M071R54;LINKAGE=PP $\Gamma(\pi^0 p \bar{p})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )                      | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                           |
|-----------------------------------------------|------|----------------------|----------|-------------------------------------------------------------------|
| <b>1.53 <math>\pm</math> 0.07 OUR AVERAGE</b> |      |                      |          |                                                                   |
| 1.65 $\pm$ 0.03 $\pm$ 0.15                    | 4.5k | ABLIKIM              | 13A BES3 | $\psi(2S) \rightarrow p \bar{p} \pi^0$                            |
| 1.54 $\pm$ 0.06 $\pm$ 0.06                    | 948  | ALEXANDER            | 10 CLEO  | $\psi(2S) \rightarrow \pi^0 p \bar{p}$                            |
| 1.32 $\pm$ 0.10 $\pm$ 0.15                    | 256  | <sup>1</sup> ABLIKIM | 05E BES2 | $e^+e^- \rightarrow \psi(2S) \rightarrow p \bar{p} \gamma \gamma$ |
| 1.4 $\pm$ 0.5                                 | 9    | FRANKLIN             | 83 MRK2  | $e^+e^-$                                                          |

<sup>1</sup> Computed using  $B(\pi^0 \rightarrow \gamma \gamma) = (98.80 \pm 0.03)\%$ .NODE=M071R35  
NODE=M071R35

NODE=M071R35;LINKAGE=AB

$$\Gamma(N(940)\bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}) / \Gamma_{\text{total}} \quad \Gamma_{48}/\Gamma$$

| VALUE (units $10^{-5}$ )        | EVTs | DOCUMENT ID          | TECN     | COMMENT                                |
|---------------------------------|------|----------------------|----------|----------------------------------------|
| $6.42 \pm 0.20^{+1.78}_{-1.28}$ | 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.

NODE=M071S56  
NODE=M071S56

NODE=M071S56;LINKAGE=AB

$$\Gamma(N(1440)\bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}) / \Gamma_{\text{total}} \quad \Gamma_{49}/\Gamma$$

| VALUE (units $10^{-5}$ )                                          | EVTs | DOCUMENT ID | TECN | COMMENT                             |
|-------------------------------------------------------------------|------|-------------|------|-------------------------------------|
| <b>7.3 <math>\pm 1.7</math><br/><math>-1.5</math></b> OUR AVERAGE |      |             |      | Error includes scale factor of 2.5. |

$3.58 \pm 0.25^{+1.59}_{-0.84}$  1.1k <sup>1</sup> ABLIKIM 13A BES3  $\psi(2S) \rightarrow p \bar{p} \pi^0$

$8.1 \pm 0.7 \pm 0.3$  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  $N(1440)\bar{p}$ ,  $\pi^0 f_0(2100)$ , and two other broad, unestablished resonances.

NODE=M071S50  
NODE=M071S50

NODE=M071S50;LINKAGE=AB

NODE=M071S50;LINKAGE=AL

$$\Gamma(N(1520)\bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}) / \Gamma_{\text{total}} \quad \Gamma_{50}/\Gamma$$

| VALUE (units $10^{-5}$ )        | EVTs | DOCUMENT ID          | TECN     | COMMENT                                |
|---------------------------------|------|----------------------|----------|----------------------------------------|
| $0.64 \pm 0.05^{+0.22}_{-0.17}$ | 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.

NODE=M071S57  
NODE=M071S57

NODE=M071S57;LINKAGE=AB

$$\Gamma(N(1535)\bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}) / \Gamma_{\text{total}} \quad \Gamma_{51}/\Gamma$$

| VALUE (units $10^{-5}$ )        | EVTs | DOCUMENT ID          | TECN     | COMMENT                                |
|---------------------------------|------|----------------------|----------|----------------------------------------|
| $2.47 \pm 0.28^{+0.99}_{-0.97}$ | 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.

NODE=M071S58  
NODE=M071S58

NODE=M071S58;LINKAGE=AB

$$\Gamma(N(1650)\bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}) / \Gamma_{\text{total}} \quad \Gamma_{52}/\Gamma$$

| VALUE (units $10^{-5}$ )        | EVTs | DOCUMENT ID          | TECN     | COMMENT                                |
|---------------------------------|------|----------------------|----------|----------------------------------------|
| $3.76 \pm 0.28^{+1.37}_{-1.66}$ | 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.

NODE=M071S59  
NODE=M071S59

NODE=M071S59;LINKAGE=AB

$$\Gamma(N(1720)\bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}) / \Gamma_{\text{total}} \quad \Gamma_{53}/\Gamma$$

| VALUE (units $10^{-5}$ )        | EVTs | DOCUMENT ID          | TECN     | COMMENT                                |
|---------------------------------|------|----------------------|----------|----------------------------------------|
| $1.79 \pm 0.10^{+0.24}_{-0.71}$ | 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.

NODE=M071S60  
NODE=M071S60

NODE=M071S60;LINKAGE=AB

$$\Gamma(N(2300)\bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}) / \Gamma_{\text{total}} \quad \Gamma_{54}/\Gamma$$

| VALUE (units $10^{-5}$ )        | EVTs | DOCUMENT ID          | TECN     | COMMENT                                |
|---------------------------------|------|----------------------|----------|----------------------------------------|
| $2.62 \pm 0.28^{+1.12}_{-0.64}$ | 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.

NODE=M071S61  
NODE=M071S61

NODE=M071S61;LINKAGE=AB

$$\Gamma(N(2570)\bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}) / \Gamma_{\text{total}} \quad \Gamma_{55}/\Gamma$$

| VALUE (units $10^{-5}$ )        | EVTs | DOCUMENT ID          | TECN     | COMMENT                                |
|---------------------------------|------|----------------------|----------|----------------------------------------|
| $2.13 \pm 0.08^{+0.40}_{-0.30}$ | 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=M071S62  
NODE=M071S62

NODE=M071S62;LINKAGE=AB

$$\Gamma(\pi^0 f_0(2100) \rightarrow \pi^0 p \bar{p}) / \Gamma_{\text{total}} \quad \Gamma_{56}/\Gamma$$

| VALUE (units $10^{-5}$ ) | EVTs | DOCUMENT ID            | TECN    | COMMENT                                |
|--------------------------|------|------------------------|---------|----------------------------------------|
| $1.1 \pm 0.4 \pm 0.1$    | 76   | <sup>1</sup> ALEXANDER | 10 CLEO | $\psi(2S) \rightarrow \pi^0 p \bar{p}$ |

<sup>1</sup> From a fit of the  $p \bar{p}$  and  $p \pi^0$  mass distributions to a combination of  $N_1^*(1440)\bar{p}$ ,  $\pi^0 f_0(2100)$ , and two other broad, unestablished resonances.

NODE=M071S51  
NODE=M071S51

NODE=M071S51;LINKAGE=AL

### $\Gamma(\eta p \bar{p})/\Gamma_{\text{total}}$ $\Gamma_{57}/\Gamma$

| 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

### $\Gamma(\eta f_0(2100) \rightarrow \eta p \bar{p})/\Gamma_{\text{total}}$ $\Gamma_{58}/\Gamma$

| VALUE (units $10^{-5}$ )                | EVTS | DOCUMENT ID            | TECN    | COMMENT                               |
|-----------------------------------------|------|------------------------|---------|---------------------------------------|
| <b><math>1.2 \pm 0.4 \pm 0.1</math></b> | 31   | <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  $\eta f_0(2100)$ .

NODE=M071S52  
NODE=M071S52

NODE=M071S52;LINKAGE=AL

### $\Gamma(N(1535)\bar{p} \rightarrow \eta p \bar{p})/\Gamma_{\text{total}}$ $\Gamma_{59}/\Gamma$

| 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  $\eta f_0(2100)$ .

NODE=M071S53  
NODE=M071S53

NODE=M071S53;LINKAGE=AL

### $\Gamma(\omega p \bar{p})/\Gamma_{\text{total}}$ $\Gamma_{60}/\Gamma$

| 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

### $\Gamma(\eta' p \bar{p})/\Gamma_{\text{total}}$ $\Gamma_{61}/\Gamma$

| 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

### $\Gamma(\phi p \bar{p})/\Gamma_{\text{total}}$ $\Gamma_{62}/\Gamma$

| VALUE (units $10^{-4}$ )     | CL% | DOCUMENT ID | TECN    | COMMENT                                                           |
|------------------------------|-----|-------------|---------|-------------------------------------------------------------------|
| <b><math>&lt;0.24</math></b> | 90  | BRIERE      | 05 CLEO | $e^+ e^- \rightarrow \psi(2S) \rightarrow$<br>$p \bar{p} K^+ K^-$ |

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

|         |    |                  |         |                                          |
|---------|----|------------------|---------|------------------------------------------|
| $<0.26$ | 90 | <sup>1</sup> BAI | 03B BES | $\psi(2S) \rightarrow K^+ K^- p \bar{p}$ |
|---------|----|------------------|---------|------------------------------------------|

<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

### $\Gamma(\pi^+ \pi^- p \bar{p})/\Gamma_{\text{total}}$ $\Gamma_{63}/\Gamma$

| 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

### $\Gamma(p \bar{n} \pi^- \text{ or c.c.})/\Gamma_{\text{total}}$ $\Gamma_{64}/\Gamma$

| 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

### $\Gamma(p \bar{n} \pi^- \pi^0)/\Gamma_{\text{total}}$ $\Gamma_{65}/\Gamma$

| 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 | $e^+e^- \rightarrow \psi(2S) \rightarrow 2(\pi^+\pi^-)\pi^0$ |

 $\Gamma_{67}/\Gamma$ 

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 | $e^+e^- \rightarrow \psi(2S) \rightarrow \eta 3\pi(\eta \rightarrow 3\pi)$         |

 $\Gamma_{68}/\Gamma$ 

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  $\Gamma_{ee}^{\psi(2S)} \cdot B(\psi(2S) \rightarrow 2(\pi^+\pi^-)\eta) \cdot B(\eta \rightarrow \gamma\gamma) = 1.2 \pm 0.7 \pm 0.1 \text{ eV}$ .

 $\Gamma_{69}/\Gamma$ 

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 | $e^+e^- \rightarrow \psi(2S) \rightarrow \text{hadr}$ |

 $\Gamma_{71}/\Gamma$ 

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  $B(\psi(2S) \rightarrow J/\psi\pi^+\pi^-) = 0.305 \pm 0.016$ .

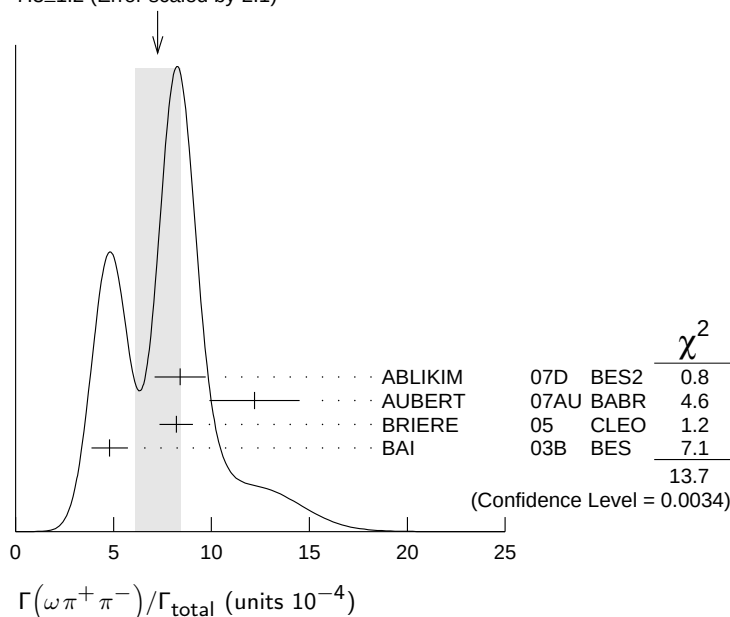
 $\Gamma_{72}/\Gamma$ 

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  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = 0.305 \pm 0.016$ . $\Gamma_{73}/\Gamma$ NODE=M071R40  
NODE=M071R40 $\Gamma(b_1^0 \pi^0)/\Gamma_{\text{total}}$ 

| 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 | $e^+ e^- \rightarrow \psi(2S)$ |

 $\Gamma_{74}/\Gamma$ 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  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = 0.305 \pm 0.016$ . $\Gamma_{75}/\Gamma$ NODE=M071R64  
NODE=M071R64 $\Gamma(\pi^+ \pi^- K^+ K^-)/\Gamma_{\text{total}}$ 

| 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. $\Gamma_{78}/\Gamma$ NODE=M071R24  
NODE=M071R24 $\Gamma(\rho^0 K^+ K^-)/\Gamma_{\text{total}}$ 

| 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 | $e^+ e^- \rightarrow \psi(2S) \rightarrow K^+ K^- \pi^+ \pi^-$ |

 $\Gamma_{80}/\Gamma$ 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 | $e^+ e^-$                                  |

 $\Gamma_{81}/\Gamma$ 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. |      |                     |           |                                                            |

 $\Gamma_{82}/\Gamma$ NODE=M071S39  
NODE=M071S39 $\Gamma(K^+ K^- 2(\pi^+ \pi^-) \pi^0)/\Gamma_{\text{total}}$ 

| 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 | $e^+ e^- \rightarrow \psi(2S)$ |

 $\Gamma_{83}/\Gamma$ NODE=M071R09  
NODE=M071R09



$\Gamma(K_1(1270)^\pm K^\mp)/\Gamma_{\text{total}}$  $\Gamma_{85}/\Gamma$ VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

 $10.0 \pm 1.8 \pm 2.1$ <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

 $\Gamma(K_S^0 K_S^0 \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{86}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $2.20 \pm 0.25 \pm 0.37$  $83 \pm 9$ 

ABLIKIM

050

BES2

 $e^+ e^- \rightarrow \psi(2S)$ NODE=M071R49  
NODE=M071R49 $\Gamma(\rho^0 p \bar{p})/\Gamma_{\text{total}}$  $\Gamma_{87}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $0.5 \pm 0.1 \pm 0.2$ 

61.1

BRIERE

05

CLEO

 $e^+ e^- \rightarrow \psi(2S) \rightarrow$   
 $p \bar{p} \pi^+ \pi^-$ NODE=M071S14  
NODE=M071S14 $\Gamma(K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{88}/\Gamma$ VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

 $6.7 \pm 2.5$ 

TANENBAUM

78

MRK1

 $e^+ e^-$ NODE=M071R34  
NODE=M071R34 $\Gamma(2(\pi^+ \pi^-))/\Gamma_{\text{total}}$  $\Gamma_{89}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $2.4 \pm 0.6$  OUR AVERAGE

Error includes scale factor of 2.2.

 $2.2 \pm 0.2 \pm 0.2$ 

308

BRIERE

05

CLEO

 $e^+ e^- \rightarrow \psi(2S) \rightarrow$   
 $2(\pi^+ \pi^-)$  $4.5 \pm 1.0$ 

TANENBAUM

78

MRK1

 $e^+ e^-$ NODE=M071R27  
NODE=M071R27 $\Gamma(\rho^0 \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{90}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $2.2 \pm 0.6$  OUR AVERAGE

Error includes scale factor of 1.4.

 $2.0 \pm 0.2 \pm 0.4$ 

285.5

BRIERE

05

CLEO

 $e^+ e^- \rightarrow \psi(2S) \rightarrow$   
 $2(\pi^+ \pi^-)$  $4.2 \pm 1.5$ 

TANENBAUM

78

MRK1

 $e^+ e^-$ NODE=M071R33  
NODE=M071R33 $\Gamma(K^+ K^- \pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{91}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $12.6 \pm 0.9$  OUR AVERAGE $18.9 \pm 5.7 \pm 0.3$ 

32

<sup>1</sup> AUBERT

07AU BABR

 $10.6 e^+ e^- \rightarrow$   
 $K^+ K^- \pi^+ \pi^- \pi^0 \gamma$  $11.7 \pm 1.0 \pm 1.5$ 

597

ABLIKIM

06G

BES2

 $\psi(2S) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$  $12.7 \pm 0.5 \pm 1.0$ 

711.6

BRIERE

05

CLEO

 $e^+ e^- \rightarrow \psi(2S) \rightarrow$   
 $K^+ K^- \pi^+ \pi^- \pi^0$ <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  
NODE=M071S10

NODE=M071S10;LINKAGE=UB

 $\Gamma(\omega f_0(1710) \rightarrow \omega K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{92}/\Gamma$ VALUE (units  $10^{-5}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $5.9 \pm 2.0 \pm 0.9$ 

19

ABLIKIM

06G

BES2

 $\psi(2S) \rightarrow$   
 $K^+ K^- \pi^+ \pi^- \pi^0$ NODE=M071S20  
NODE=M071S20 $\Gamma(K^*(892)^0 K^- \pi^+ \pi^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{93}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $8.6 \pm 1.3 \pm 1.8$ 

238

ABLIKIM

06G

BES2

 $\psi(2S) \rightarrow$   
 $K^+ K^- \pi^+ \pi^- \pi^0$ NODE=M071S21  
NODE=M071S21 $\Gamma(K^*(892)^+ K^- \pi^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{94}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $9.6 \pm 2.2 \pm 1.7$ 

133

ABLIKIM

06G

BES2

 $\psi(2S) \rightarrow$   
 $K^+ K^- \pi^+ \pi^- \pi^0$ NODE=M071S22  
NODE=M071S22 $\Gamma(K^*(892)^+ K^- \rho^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{95}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $7.3 \pm 2.2 \pm 1.4$ 

78

ABLIKIM

06G

BES2

 $\psi(2S) \rightarrow$   
 $K^+ K^- \pi^+ \pi^- \pi^0$ NODE=M071S23  
NODE=M071S23

$\Gamma(K^*(892)^0 K^- \rho^+ + \text{c.c.})/\Gamma_{\text{total}}$ 
 $\Gamma_{96}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                                          |
|--------------------------|------|-------------|----------|--------------------------------------------------|
| <b>6.1±1.3±1.2</b>       | 125  | ABLIKIM     | 06G BES2 | $\psi(2S) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$ |

NODE=M071S24  
NODE=M071S24

 $\Gamma(\eta K^+ K^-, \text{no } \eta\phi)/\Gamma_{\text{total}}$ 
 $\Gamma_{97}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL%  | EVTS | DOCUMENT ID | TECN     | COMMENT                                     |
|--------------------------|------|------|-------------|----------|---------------------------------------------|
| <b>3.08±0.29±0.25</b>    | 0.3k | 1    | ABLIKIM     | 12L BES3 | $\psi(2S) \rightarrow K^+ K^- \gamma\gamma$ |

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

|     |    |        |         |                                                                      |
|-----|----|--------|---------|----------------------------------------------------------------------|
| <13 | 90 | BRIERE | 05 CLEO | $e^+ e^- \rightarrow \psi(2S) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$ |
|-----|----|--------|---------|----------------------------------------------------------------------|

<sup>1</sup> Excluding  $\eta\phi$ .

NODE=M071S11  
NODE=M071S11

NODE=M071S11;LINKAGE=AB

 $\Gamma(\omega K^+ K^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{98}/\Gamma$ 

| VALUE (units $10^{-4}$ )     | EVTS | DOCUMENT ID                         | TECN     | COMMENT                                                              |
|------------------------------|------|-------------------------------------|----------|----------------------------------------------------------------------|
| <b>1.62±0.11 OUR AVERAGE</b> |      | 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  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = 0.305 \pm 0.016$ .

NODE=M071R78  
NODE=M071R78

NODE=M071R78;LINKAGE=B3

 $\Gamma(\omega K^*(892)^+ K^- + \text{c.c.})/\Gamma_{\text{total}}$ 
 $\Gamma_{99}/\Gamma$ 

| VALUE (units $10^{-5}$ )    | EVTS | DOCUMENT ID | TECN     | COMMENT                                       |
|-----------------------------|------|-------------|----------|-----------------------------------------------|
| <b>20.7±2.6 OUR AVERAGE</b> |      |             |          |                                               |
| 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 | $\psi(2S) \rightarrow \omega K^+ K^- \pi^0$   |

NODE=M071S67  
NODE=M071S67

OCCUR=2

 $\Gamma(\omega K_2^*(1430)^+ K^- + \text{c.c.})/\Gamma_{\text{total}}$ 
 $\Gamma_{100}/\Gamma$ 

| VALUE (units $10^{-5}$ )    | EVTS | DOCUMENT ID | TECN     | COMMENT                                       |
|-----------------------------|------|-------------|----------|-----------------------------------------------|
| <b>6.1 ±1.2 OUR AVERAGE</b> |      |             |          |                                               |
| 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 | $\psi(2S) \rightarrow \omega K^+ K^- \pi^0$   |

NODE=M071S68  
NODE=M071S68

OCCUR=2

 $\Gamma(\omega \bar{K}^*(892)^0 K^0)/\Gamma_{\text{total}}$ 
 $\Gamma_{101}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                                       |
|--------------------------|------|-------------|----------|-----------------------------------------------|
| <b>16.8±2.5±1.6</b>      | 356  | ABLIKIM     | 13M BES3 | $\psi(2S) \rightarrow \omega K_S^0 K^- \pi^+$ |

NODE=M071S69  
NODE=M071S69

 $\Gamma(\omega \bar{K}_2^*(1430)^0 K^0)/\Gamma_{\text{total}}$ 
 $\Gamma_{102}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                                       |
|--------------------------|------|-------------|----------|-----------------------------------------------|
| <b>5.82±2.08±0.72</b>    | 116  | ABLIKIM     | 13M BES3 | $\psi(2S) \rightarrow \omega K_S^0 K^- \pi^+$ |

NODE=M071S70  
NODE=M071S70

 $\Gamma(\omega X(1440) \rightarrow \omega K_S^0 K^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}}$ 
 $\Gamma_{103}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                       |
|--------------------------|------|----------------------|----------|-----------------------------------------------|
| <b>1.60±0.27±0.24</b>    | 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.

NODE=M071S71  
NODE=M071S71

NODE=M071S71;LINKAGE=AB

 $\Gamma(\omega X(1440) \rightarrow \omega K^+ K^- \pi^0)/\Gamma_{\text{total}}$ 
 $\Gamma_{104}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                     |
|--------------------------|------|----------------------|----------|---------------------------------------------|
| <b>1.09±0.20±0.16</b>    | 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.

NODE=M071S72  
NODE=M071S72

NODE=M071S72;LINKAGE=AB

 $\Gamma(\omega f_1(1285) \rightarrow \omega K_S^0 K^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}}$ 
 $\Gamma_{105}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                       |
|--------------------------|------|----------------------|----------|-----------------------------------------------|
| <b>0.302±0.098±0.027</b> | 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.

NODE=M071S73  
NODE=M071S73

NODE=M071S73;LINKAGE=AB

 $\Gamma(\omega f_1(1285) \rightarrow \omega K^+ K^- \pi^0)/\Gamma_{\text{total}}$ 
 $\Gamma_{106}/\Gamma$ 

| 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

$\Gamma(3(\pi^+\pi^-))/\Gamma_{\text{total}}$  $\Gamma_{107}/\Gamma$ 

| VALUE (units $10^{-4}$ )                    | EVTS | DOCUMENT ID                         | TECN     | COMMENT                                                 |
|---------------------------------------------|------|-------------------------------------|----------|---------------------------------------------------------|
| <b>3.5 <math>\pm</math> 2.0 OUR AVERAGE</b> |      | Error includes scale factor of 2.8. |          |                                                         |
| 5.45 $\pm$ 0.42 $\pm$ 0.87                  | 671  | ABLIKIM                             | 05H BES2 | $e^+e^- \rightarrow \psi(2S) \rightarrow 3(\pi^+\pi^-)$ |
| 1.5 $\pm$ 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

 $\Gamma(p\bar{p}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{108}/\Gamma$ 

| VALUE (units $10^{-4}$ )                             | EVTS  | DOCUMENT ID | TECN    | COMMENT                                                           |
|------------------------------------------------------|-------|-------------|---------|-------------------------------------------------------------------|
| <b>7.3 <math>\pm</math> 0.4 <math>\pm</math> 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 $\Gamma(K^+K^-)/\Gamma_{\text{total}}$  $\Gamma_{109}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | EVTS                   | DOCUMENT ID            | TECN                              | COMMENT                       |
|-------------------------------------------------------------------------------|-----|------------------------|------------------------|-----------------------------------|-------------------------------|
| <b>7.48 <math>\pm</math> 0.23 <math>\pm</math> 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 $\pm$ 1.5 $\pm$ 0.2                                                       | 66  | <sup>2,3</sup> LEES    | 15J BABR               | $e^+e^- \rightarrow K^+K^-\gamma$ | OCCUR=2                       |
| 8.3 $\pm$ 1.5 $\pm$ 0.2                                                       | 66  | <sup>3,4</sup> LEES    | 15J BABR               | $e^+e^- \rightarrow K^+K^-\gamma$ |                               |
| 6.3 $\pm$ 0.6 $\pm$ 0.3                                                       |     | <sup>5</sup> DOBBS     | 06A CLEO               | $e^+e^-$                          |                               |
| 10 $\pm$ 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;LINKAGE=ME  
NODE=M071R23;LINKAGE=A  
NODE=M071R23;LINKAGE=B  
NODE=M071R23;LINKAGE=C  
NODE=M071R23;LINKAGE=BA $\Gamma(K_S^0 K_L^0)/\Gamma_{\text{total}}$  $\Gamma_{110}/\Gamma$ 

| VALUE (units $10^{-5}$ )                      | EVTS         | DOCUMENT ID            | TECN     | COMMENT                                                    |
|-----------------------------------------------|--------------|------------------------|----------|------------------------------------------------------------|
| <b>5.34 <math>\pm</math> 0.33 OUR AVERAGE</b> |              |                        |          |                                                            |
| 5.28 $\pm$ 0.25 $\pm$ 0.34                    | 478 $\pm$ 23 | <sup>1</sup> METREVELI | 12       | $\psi(2S) \rightarrow K_S^0 K_L^0$                         |
| 5.8 $\pm$ 0.8 $\pm$ 0.4                       |              | DOBBS                  | 06A CLEO | $e^+e^-$                                                   |
| 5.24 $\pm$ 0.47 $\pm$ 0.48                    | 156 $\pm$ 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=M071R87NODE=M071R87;LINKAGE=ME  
NODE=M071R;LINKAGE=KZ $\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{111}/\Gamma$ 

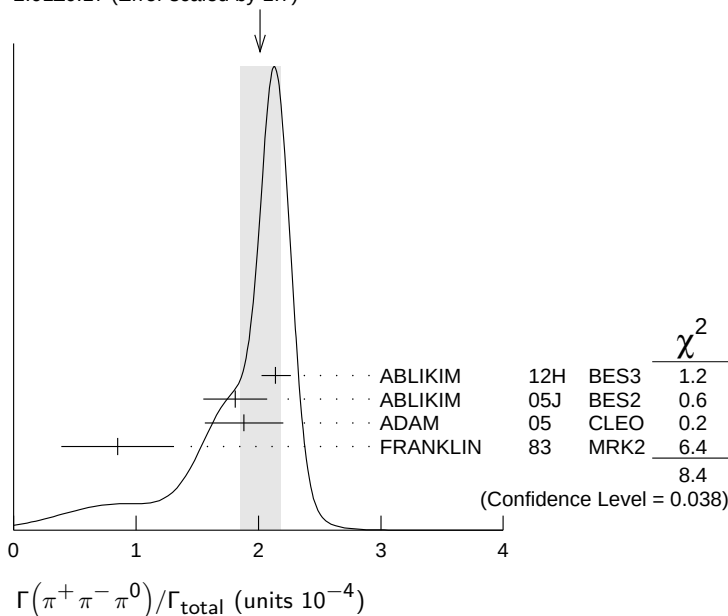
| VALUE (units $10^{-4}$ )                      | EVTS         | DOCUMENT ID                                                 | TECN     | COMMENT                             |
|-----------------------------------------------|--------------|-------------------------------------------------------------|----------|-------------------------------------|
| <b>2.01 <math>\pm</math> 0.17 OUR AVERAGE</b> |              | Error includes scale factor of 1.7. See the ideogram below. |          |                                     |
| 2.14 $\pm$ 0.03 $^{+0.12}_{-0.11}$            | 7k           | <sup>1</sup> ABLIKIM                                        | 12H BES3 | $e^+e^- \rightarrow \psi(2S)$       |
| 1.81 $\pm$ 0.18 $\pm$ 0.19                    | 260 $\pm$ 19 | <sup>2</sup> ABLIKIM                                        | 05J BES2 | $e^+e^- \rightarrow \psi(2S)$       |
| 1.88 $^{+0.16}_{-0.15} \pm 0.28$              | 194          | ADAM                                                        | 05 CLEO  | $e^+e^- \rightarrow \psi(2S)$       |
| 0.85 $\pm$ 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)



### $\Gamma(\rho(2150)\pi \rightarrow \pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ $\Gamma_{112}/\Gamma$

| 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

### $\Gamma(\rho(770)\pi \rightarrow \pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ $\Gamma_{113}/\Gamma$

| 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

### $\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$ $\Gamma_{114}/\Gamma$

| 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 ± 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

### $\Gamma(K_1(1400)^\pm K^\mp)/\Gamma_{\text{total}}$ $\Gamma_{115}/\Gamma$

| 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

### $\Gamma(K_2^*(1430)^\pm K^\mp)/\Gamma_{\text{total}}$ $\Gamma_{116}/\Gamma$

| 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

$\Gamma(K^+ K^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{117}/\Gamma$ 

| 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

 $\Gamma(K^+ K^*(892)^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{120}/\Gamma$ 

| 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

 $\Gamma(K^*(892)^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{121}/\Gamma$ 

| VALUE (units $10^{-5}$ )                     | CL% | 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

 $\Gamma(K^+ K^*(892)^- + \text{c.c.})/\Gamma(K^*(892)^0 \bar{K}^0 + \text{c.c.})$  $\Gamma_{120}/\Gamma_{121}$ 

| VALUE                                         | CL% | EVTS | 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

 $\Gamma(\phi \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{122}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                      | CL% | 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

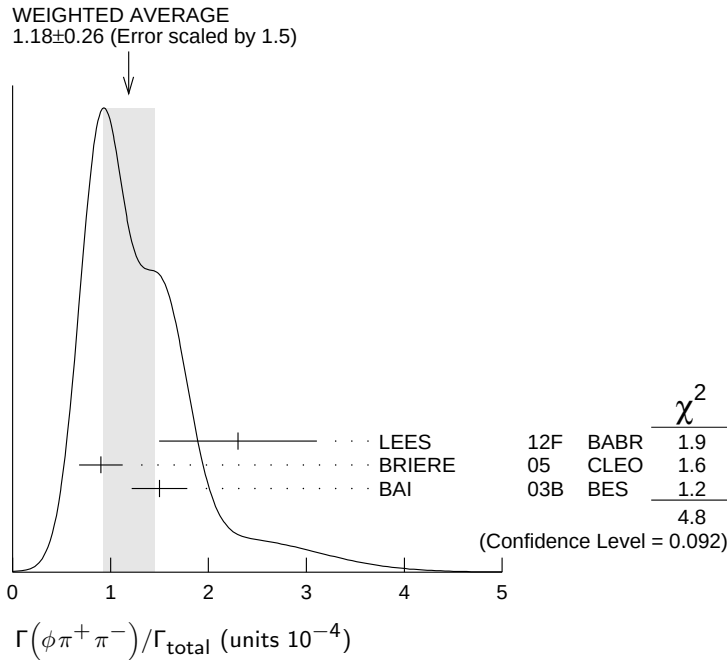
<sup>1</sup> Normalized to  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = 0.305 \pm 0.016$ .

<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



### $\Gamma(\phi f_0(980) \rightarrow \pi^+\pi^-)/\Gamma_{\text{total}}$

$\Gamma_{123}/\Gamma$

| 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

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

$\Gamma_{124}/\Gamma$

| 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

### $\Gamma(\phi K^+K^-)/\Gamma_{\text{total}}$

$\Gamma_{125}/\Gamma$

| 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

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

$\Gamma_{126}/\Gamma$

| 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

### $\Gamma(\phi\eta)/\Gamma_{\text{total}}$

$\Gamma_{127}/\Gamma$

| 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

$\Gamma(\eta\phi(2170), \phi(2170) \rightarrow \phi f_0(980), f_0 \rightarrow \pi^+\pi^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{128}/\Gamma$ 

| 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

 $\Gamma(\phi\eta')/\Gamma_{\text{total}}$ 
 $\Gamma_{129}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID              | TECN | COMMENT                       |
|--------------------------|------|--------------------------|------|-------------------------------|
| $3.1 \pm 1.4 \pm 0.7$    | 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

 $\Gamma(\omega\eta')/\Gamma_{\text{total}}$ 
 $\Gamma_{130}/\Gamma$ 

| VALUE (units $10^{-5}$ )    | EVTS | DOCUMENT ID              | TECN | COMMENT                       |
|-----------------------------|------|--------------------------|------|-------------------------------|
| $3.2^{+2.4}_{-2.0} \pm 0.7$ | 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

 $\Gamma(\omega\pi^0)/\Gamma_{\text{total}}$ 
 $\Gamma_{131}/\Gamma$ 

| VALUE (units $10^{-5}$ )                    | EVTS | DOCUMENT ID | TECN | COMMENT                       |
|---------------------------------------------|------|-------------|------|-------------------------------|
| <b>2.1 <math>\pm 0.6</math> 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

 $\Gamma(\rho\eta')/\Gamma_{\text{total}}$ 
 $\Gamma_{132}/\Gamma$ 

| VALUE (units $10^{-5}$ )                           | EVTS | DOCUMENT ID | TECN | COMMENT                       |
|----------------------------------------------------|------|-------------|------|-------------------------------|
| <b>1.87 <math>^{+1.64}_{-1.11} \pm 0.33</math></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

 $\Gamma(\rho\eta)/\Gamma_{\text{total}}$ 
 $\Gamma_{133}/\Gamma$ 

| VALUE (units $10^{-5}$ )                    | EVTS | DOCUMENT ID | TECN | COMMENT                             |
|---------------------------------------------|------|-------------|------|-------------------------------------|
| <b>2.2 <math>\pm 0.6</math> 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

 $\Gamma(\omega\eta)/\Gamma_{\text{total}}$ 
 $\Gamma_{134}/\Gamma$ 

| 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

 $\Gamma(\phi\pi^0)/\Gamma_{\text{total}}$ 
 $\Gamma_{135}/\Gamma$ 

| 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

 $\Gamma(\eta_c\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ 
 $\Gamma_{136}/\Gamma$ 

| 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

 $\Gamma(p\bar{p}K^+K^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{137}/\Gamma$ 

| VALUE (units $10^{-5}$ )                | EVTS | DOCUMENT ID | TECN | COMMENT                                                  |
|-----------------------------------------|------|-------------|------|----------------------------------------------------------|
| <b>2.7 <math>\pm 0.6 \pm 0.4</math></b> | 30.1 | BRIERE 05   | CLEO | $e^+e^- \rightarrow \psi(2S) \rightarrow p\bar{p}K^+K^-$ |

NODE=M071S16  
NODE=M071S16

$\Gamma(\bar{\Lambda} n K_S^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{138}/\Gamma$ 

| 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

 $\Gamma(\phi f_2'(1525))/\Gamma_{\text{total}}$  $\Gamma_{139}/\Gamma$ 

| 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

 $\Gamma(\Theta(1540) \bar{\Theta}(1540) \rightarrow K_S^0 p K^- \bar{n} + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{140}/\Gamma$ 

| 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

 $\Gamma(\Theta(1540) K^- \bar{n} \rightarrow K_S^0 p K^- \bar{n})/\Gamma_{\text{total}}$  $\Gamma_{141}/\Gamma$ 

| 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

 $\Gamma(\Theta(1540) K_S^0 \bar{p} \rightarrow K_S^0 \bar{p} K^+ n)/\Gamma_{\text{total}}$  $\Gamma_{142}/\Gamma$ 

| 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

 $\Gamma(\bar{\Theta}(1540) K^+ n \rightarrow K_S^0 \bar{p} K^+ n)/\Gamma_{\text{total}}$  $\Gamma_{143}/\Gamma$ 

| 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

 $\Gamma(\bar{\Theta}(1540) K_S^0 p \rightarrow K_S^0 p K^- \bar{n})/\Gamma_{\text{total}}$  $\Gamma_{144}/\Gamma$ 

| 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

 $\Gamma(K_S^0 K_S^0)/\Gamma_{\text{total}}$  $\Gamma_{145}/\Gamma$ 

| 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

 $\Gamma(\Lambda_c^+ \bar{p} e^+ e^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{146}/\Gamma$ 

| 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

 $\Gamma(\gamma \chi_{c0}(1P))/\Gamma_{\text{total}}$  $\Gamma_{147}/\Gamma$ 

| VALUE (units $10^{-2}$ )                      | EVTS | DOCUMENT ID           | TECN     | COMMENT                        |
|-----------------------------------------------|------|-----------------------|----------|--------------------------------|
| <b><math>9.79 \pm 0.20</math> OUR FIT</b>     |      |                       |          |                                |
| <b><math>9.33 \pm 0.26</math> OUR AVERAGE</b> |      |                       |          |                                |
| $9.389 \pm 0.014 \pm 0.332$                   | 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

 $\Gamma(\gamma \chi_{c1}(1P))/\Gamma_{\text{total}}$  $\Gamma_{148}/\Gamma$ 

| VALUE (units $10^{-2}$ )                      | EVTS | DOCUMENT ID          | TECN     | COMMENT                        |
|-----------------------------------------------|------|----------------------|----------|--------------------------------|
| <b><math>9.75 \pm 0.24</math> OUR FIT</b>     |      |                      |          |                                |
| <b><math>9.54 \pm 0.29</math> OUR AVERAGE</b> |      |                      |          |                                |
| $9.905 \pm 0.011 \pm 0.353$                   | 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=M071R58  
NODE=M071R58

NODE=M071R;LINKAGE=G  
NODE=M071R;LINKAGE=B



$$\Gamma(\gamma\chi_{c2}(1P))/\Gamma_{\text{total}}$$

$$\Gamma_{149}/\Gamma$$

VALUE (units  $10^{-2}$ ) EVTS

DOCUMENT ID

TECN

COMMENT

**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  $e^+e^- \rightarrow \gamma X$

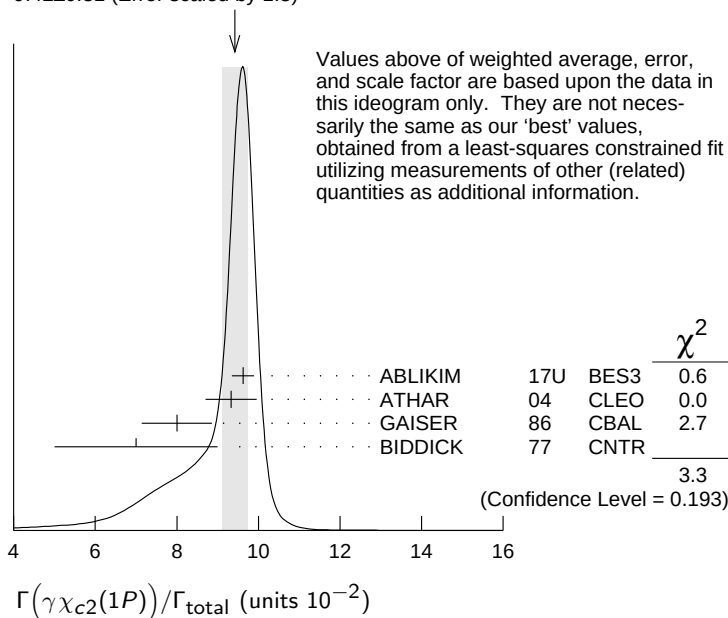
<sup>1</sup> Angular distribution  $(1 - 0.052 \cos^2\theta)$  assumed.

<sup>2</sup> Valid for isotropic distribution of the photon.

NODE=M071R59  
NODE=M071R59

NODE=M071R;LINKAGE=F  
NODE=M071R59;LINKAGE=B

WEIGHTED AVERAGE  
9.42 $\pm 0.31$  (Error scaled by 1.3)



$$[\Gamma(\gamma\chi_{c0}(1P)) + \Gamma(\gamma\chi_{c1}(1P)) + \Gamma(\gamma\chi_{c2}(1P))]/\Gamma_{\text{total}} (\Gamma_{147} + \Gamma_{148} + \Gamma_{149})/\Gamma$$

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

$$\Gamma(\gamma\chi_{c0}(1P))/\Gamma(\gamma\chi_{c1}(1P))$$

$$\Gamma_{147}/\Gamma_{148}$$

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  $B(\gamma\chi_{cJ})$ .

NODE=M071R97  
NODE=M071R97

NODE=M071R97;LINKAGE=AH

$$\Gamma(\gamma\chi_{c2}(1P))/\Gamma(\gamma\chi_{c1}(1P))$$

$$\Gamma_{149}/\Gamma_{148}$$

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  $B(\gamma\chi_{cJ})$ .

NODE=M071R98  
NODE=M071R98

NODE=M071R98;LINKAGE=AH

$$\Gamma(\gamma\chi_{c0}(1P))/\Gamma(\gamma\chi_{c2}(1P))$$

$$\Gamma_{147}/\Gamma_{149}$$

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

$\Gamma(\gamma\eta_c(1S))/\Gamma_{\text{total}}$  $\Gamma_{150}/\Gamma$ 

| VALUE (units $10^{-2}$ )                      | EVTS | DOCUMENT ID                                                 | TECN    | COMMENT                       |
|-----------------------------------------------|------|-------------------------------------------------------------|---------|-------------------------------|
| <b>0.34 <math>\pm</math> 0.05 OUR AVERAGE</b> |      | 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                    | 2.5k | <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.

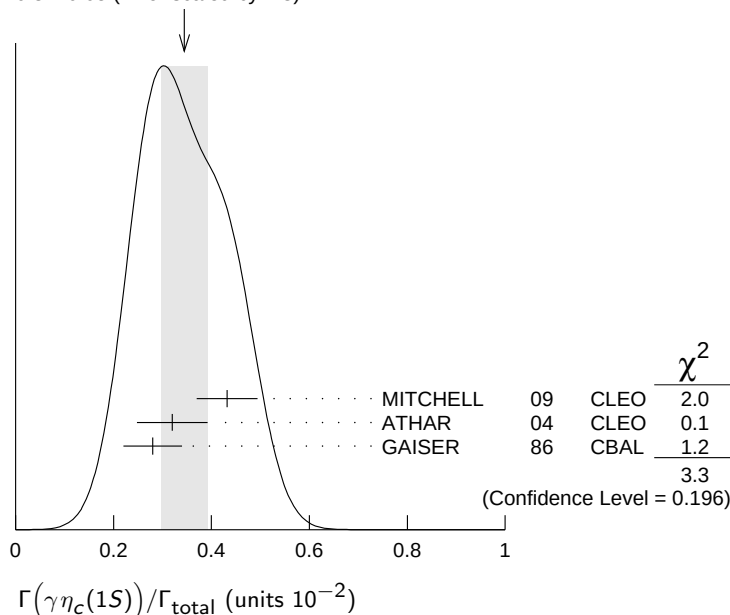
<sup>2</sup> GAISER 86 used  $\Gamma_{\eta_c(1S)} = 11.5 \pm 4.5$  MeV to obtain this result.

NODE=M071R60  
NODE=M071R60

NODE=M071R60;LINKAGE=AT

NODE=M071R60;LINKAGE=GA

WEIGHTED AVERAGE  
0.34 $\pm$ 0.05 (Error scaled by 1.3)

 $\Gamma(\gamma\eta_c(2S))/\Gamma_{\text{total}}$  $\Gamma_{151}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                      | CL% | DOCUMENT ID                 | TECN     | COMMENT                                            |
|-------------------------------------------------------------------------------|-----|-----------------------------|----------|----------------------------------------------------|
| <b>7 <math>\pm</math> 2 <math>\pm</math> 4</b>                                |     | <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

 $\Gamma(\gamma\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{152}/\Gamma$ 

| VALUE (units $10^{-6}$ )                      | CL% | EVTS | DOCUMENT ID                         | TECN     | COMMENT                            |
|-----------------------------------------------|-----|------|-------------------------------------|----------|------------------------------------|
| <b>1.04 <math>\pm</math> 0.22 OUR AVERAGE</b> |     |      | 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 | WIIK                  | 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

$\Gamma(\gamma\eta'(958))/\Gamma_{\text{total}}$  $\Gamma_{153}/\Gamma$ VALUE (units  $10^{-4}$ ) CL% EVTS

DOCUMENT ID

TECN

COMMENT

**1.24 ± 0.04 OUR AVERAGE**1.251 ± 0.022 ± 0.062 56K ABLIKIM 17X BES3  $\psi(2S) \rightarrow \gamma\pi^+\pi^-\eta$ , $\gamma\pi^0\pi^0\eta$ 1.26 ± 0.03 ± 0.08 2226 <sup>1</sup> ABLIKIM 10F BES3  $\psi(2S) \rightarrow 3\gamma\pi^+\pi^-$ , $2\gamma\pi^+\pi^-$ 1.19 ± 0.08 ± 0.03 PEDLAR 09 CLE3  $\psi(2S) \rightarrow \gamma X$ 1.24 ± 0.27 ± 0.15 23 ABLIKIM 06R BES2  $e^+e^- \rightarrow \psi(2S)$ 1.54 ± 0.31 ± 0.20 ~ 43 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. • • •

< 60 90 <sup>2</sup> BRAUNSCH... 77 DASP  $e^+e^-$ < 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 $\Gamma(\gamma f_2(1270))/\Gamma_{\text{total}}$  $\Gamma_{154}/\Gamma$ VALUE (units  $10^{-4}$ ) EVTS

DOCUMENT ID

TECN

COMMENT

**2.73<sup>+0.29</sup><sub>-0.25</sub> OUR AVERAGE** Error includes scale factor of 1.8.2.84 ± 0.15<sup>+0.03</sup><sub>-0.10</sub> 1.9k <sup>1,2</sup> DOBBS 15  $\psi(2S) \rightarrow \gamma\pi\pi$ 2.12 ± 0.19 ± 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 ± 0.19 ± 0.33 200.6 ± 18.8 <sup>3</sup> BAI 03C BES  $\psi(2S) \rightarrow \gamma\pi^+\pi^-$ 2.90 ± 1.08 ± 1.07 29.9 ± 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 $\Gamma(\gamma f_0(1370) \rightarrow \gamma K\bar{K})/\Gamma_{\text{total}}$  $\Gamma_{155}/\Gamma$ VALUE (units  $10^{-5}$ )

EVTS

DOCUMENT ID

COMMENT

**3.1 ± 1.0 ± 1.4** 175 <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=M071S75  
NODE=M071S75

NODE=M071S75;LINKAGE=A

 $\Gamma(\gamma f_0(1500))/\Gamma_{\text{total}}$  $\Gamma_{156}/\Gamma$ VALUE (units  $10^{-5}$ )

EVTS

DOCUMENT ID

COMMENT

**9.3 ± 1.8 ± 0.6** 274 <sup>1,2</sup> DOBBS 15  $\psi(2S) \rightarrow \gamma\pi\pi$ <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

 $\Gamma(\gamma f'_2(1525))/\Gamma_{\text{total}}$  $\Gamma_{157}/\Gamma$ VALUE (units  $10^{-5}$ )

EVTS

DOCUMENT ID

COMMENT

**3.3 ± 0.8 ± 0.1** 136 <sup>1,2</sup> DOBBS 15  $\psi(2S) \rightarrow \gamma K\bar{K}$ <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  $B(f'_2(1525) \rightarrow K\bar{K}) = (88.7 \pm 2.2) \times 10^{-2}$ . 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

 $\Gamma(\gamma f_0(1710) \rightarrow \gamma\pi\pi)/\Gamma_{\text{total}}$  $\Gamma_{159}/\Gamma$ VALUE (units  $10^{-5}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**3.5 ± 0.6 OUR AVERAGE**3.6 ± 0.4 ± 0.5 290 <sup>1</sup> DOBBS 15  $\psi(2S) \rightarrow \gamma\pi\pi$ 3.01 ± 0.41 ± 1.24 35.6 ± 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

$\Gamma(\gamma f_0(1710) \rightarrow \gamma K \bar{K})/\Gamma_{\text{total}}$  $\Gamma_{160}/\Gamma$ 

| 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 |     | <sup>2,3</sup> 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 | <sup>2,3</sup> 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

 $\Gamma(\gamma f_0(2100) \rightarrow \gamma \pi \pi)/\Gamma_{\text{total}}$  $\Gamma_{161}/\Gamma$ 

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

**4.8  $\pm$  0.5  $\pm$  0.9** 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

 $\Gamma(\gamma f_0(2200) \rightarrow \gamma K \bar{K})/\Gamma_{\text{total}}$  $\Gamma_{162}/\Gamma$ 

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

**3.2  $\pm$  0.6  $\pm$  0.8** 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

 $\Gamma(\gamma f_J(2220) \rightarrow \gamma \pi \pi)/\Gamma_{\text{total}}$  $\Gamma_{163}/\Gamma$ 

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

< **5.8  $\times 10^{-6}$**  90 <sup>1,2</sup> 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 $\Gamma(\gamma f_J(2220) \rightarrow \gamma K \bar{K})/\Gamma_{\text{total}}$  $\Gamma_{164}/\Gamma$ 

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

< **9.5  $\times 10^{-6}$**  90 <sup>1,2</sup> 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 $\Gamma(\gamma \eta)/\Gamma_{\text{total}}$  $\Gamma_{166}/\Gamma$ 

| 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

 $\Gamma(\gamma \eta \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{167}/\Gamma$ 

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

**8.71  $\pm$  1.25  $\pm$  1.64** 418 ABLIKIM 06R BES2  $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$ NODE=M071R04  
NODE=M071R04 $\Gamma(\gamma \eta(1405) \rightarrow \gamma K \bar{K} \pi)/\Gamma_{\text{total}}$  $\Gamma_{169}/\Gamma$ 

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

< **0.9** 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

$\Gamma(\gamma\eta(1405) \rightarrow \eta\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{170}/\Gamma$ 

| 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

 $\Gamma(\gamma\eta(1405) \rightarrow \gamma f_0(980)\pi^0 \rightarrow \gamma\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{171}/\Gamma$ 

| 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

 $\Gamma(\gamma\eta(1475) \rightarrow K\bar{K}\pi)/\Gamma_{\text{total}}$  $\Gamma_{173}/\Gamma$ 

| 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

 $\Gamma(\gamma\eta(1475) \rightarrow \eta\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{174}/\Gamma$ 

| 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

 $\Gamma(\gamma 2(\pi^+\pi^-))/\Gamma_{\text{total}}$  $\Gamma_{175}/\Gamma$ 

| 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

 $\Gamma(\gamma K^{*0} K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{176}/\Gamma$ 

| 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

 $\Gamma(\gamma K^{*0} \bar{K}^{*0})/\Gamma_{\text{total}}$  $\Gamma_{177}/\Gamma$ 

| 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

 $\Gamma(\gamma K_S^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{178}/\Gamma$ 

| 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

 $\Gamma(\gamma K^+ K^- \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{179}/\Gamma$ 

| 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

 $\Gamma(\gamma p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{180}/\Gamma$ 

| 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

 $\Gamma(\gamma f_2(1950) \rightarrow \gamma p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{181}/\Gamma$ 

| 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

 $\Gamma(\gamma f_2(2150) \rightarrow \gamma p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{182}/\Gamma$ 

| 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

$\Gamma(\gamma X(1835) \rightarrow \gamma p \bar{p})/\Gamma_{\text{total}}$  $\Gamma_{183}/\Gamma$ 

| 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

 $\Gamma(\gamma X \rightarrow \gamma p \bar{p})/\Gamma_{\text{total}}$  $\Gamma_{184}/\Gamma$ 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

 $\Gamma(\gamma \pi^+ \pi^- p \bar{p})/\Gamma_{\text{total}}$  $\Gamma_{185}/\Gamma$ 

| 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

 $\Gamma(\gamma 2(\pi^+ \pi^-) K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{186}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                        |
|--------------------------|-----|-------------|----------|--------------------------------|
| <22                      | 90  | ABLIKIM     | 07D BES2 | $e^+ e^- \rightarrow \psi(2S)$ |

NODE=M071S35  
 NODE=M071S35

 $\Gamma(\gamma 3(\pi^+ \pi^-))/\Gamma_{\text{total}}$  $\Gamma_{187}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                        |
|--------------------------|-----|-------------|----------|--------------------------------|
| <17                      | 90  | ABLIKIM     | 07D BES2 | $e^+ e^- \rightarrow \psi(2S)$ |

NODE=M071S36  
 NODE=M071S36

 $\Gamma(\gamma K^+ K^- K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{188}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                        |
|--------------------------|-----|-------------|----------|--------------------------------|
| <4                       | 90  | ABLIKIM     | 07D BES2 | $e^+ e^- \rightarrow \psi(2S)$ |

NODE=M071S37  
 NODE=M071S37

 $\Gamma(\gamma \gamma J/\psi)/\Gamma_{\text{total}}$  $\Gamma_{189}/\Gamma$ 

| VALUE (units $10^{-4}$ )    | EVTS | DOCUMENT ID | TECN     | COMMENT                        |
|-----------------------------|------|-------------|----------|--------------------------------|
| $3.1 \pm 0.6^{+0.8}_{-1.0}$ | 1.1k | ABLIKIM     | 12O 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

 $\Gamma(e^+ e^- \eta')/\Gamma_{\text{total}}$  $\Gamma_{190}/\Gamma$ 

| 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

 $\Gamma(e^+ e^- \chi_{c0}(1P))/\Gamma_{\text{total}}$  $\Gamma_{191}/\Gamma$ 

| 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

 $\Gamma(e^+ e^- \chi_{c1}(1P))/\Gamma_{\text{total}}$  $\Gamma_{192}/\Gamma$ 

| 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

$\Gamma(e^+e^- \chi_{c2}(1P))/\Gamma_{\text{total}}$ 
 $\Gamma_{193}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | EVTs | DOCUMENT ID          | TECN     | COMMENT                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|---------------------------------------------|
| <b>7.0±0.7±0.2</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

 $\Gamma(e^+e^- \chi_{c0}(1P))/\Gamma(\gamma \chi_{c0}(1P))$ 
 $\Gamma_{191}/\Gamma_{147}$ 

| VALUE (units $10^{-3}$ )                                                                                                                                                                                                   | EVTs | DOCUMENT ID          | TECN     | COMMENT                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|---------------------------------------------|
| <b>9.4±1.9±0.6</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

 $\Gamma(e^+e^- \chi_{c1}(1P))/\Gamma(\gamma \chi_{c1}(1P))$ 
 $\Gamma_{192}/\Gamma_{148}$ 

| VALUE (units $10^{-3}$ )                                                                                                                                                                                                     | EVTs | DOCUMENT ID          | TECN     | COMMENT                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|---------------------------------------------|
| <b>8.3±0.3±0.4</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

 $\Gamma(e^+e^- \chi_{c2}(1P))/\Gamma(\gamma \chi_{c2}(1P))$ 
 $\Gamma_{193}/\Gamma_{149}$ 

| VALUE (units $10^{-3}$ )                                                                                                                                                                                                    | EVTs | DOCUMENT ID          | TECN     | COMMENT                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|---------------------------------------------|
| <b>6.6±0.5±0.4</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

 $\Gamma(D^0 e^+ e^- + \text{c.c.})/\Gamma_{\text{total}}$ 
 $\Gamma_{194}/\Gamma$ 

| VALUE                                                                                              | CL% | DOCUMENT ID          | TECN      | COMMENT                       |
|----------------------------------------------------------------------------------------------------|-----|----------------------|-----------|-------------------------------|
| <b>&lt;1.4 × 10<sup>-7</sup></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

 $\Gamma(\text{invisible})/\Gamma(e^+e^-)$ 
 $\Gamma_{195}/\Gamma_6$ 

| VALUE          | CL% | DOCUMENT ID | TECN     | COMMENT                          |
|----------------|-----|-------------|----------|----------------------------------|
| <b>&lt;2.0</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>63 ± 7 OUR AVERAGE</b> |      |                      |          |                                                    |
| 61.7± 8.3                 | 253k | <sup>1</sup> ABLIKIM | 17N BES3 | $\psi(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |
| 67 +19<br>-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

|               |      |                |                                   |                     |             |
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| ABLIKIM       | 19N  | PR D99 032006  | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=59615 |
| ABLIKIM       | 18Q  | PR D97 091102  | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=58933 |
| ABLIKIM       | 18T  | PR D98 032006  | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=58975 |
| ABLIKIM       | 18Z  | PL B783 452    | M. Ablikim <i>et al.</i>          | (BES III 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>          | (BES III Collab.)   | REFID=58315 |
| ABLIKIM       | 17AJ | PR D96 112008  | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=58322 |
| ABLIKIM       | 17AK | PR D96 112012  | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=58324 |
| ABLIKIM       | 17E  | PL B770 217    | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=57903 |
| ABLIKIM       | 17I  | PRL 118 221802 | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=57931 |
| ABLIKIM       | 17L  | PR D95 052003  | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=57967 |
| ABLIKIM       | 17N  | PR D95 072004  | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=57978 |
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| ABLIKIM       | 17X  | PR D96 052003  | M. Ablikim <i>et al.</i>          | (BES III 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 |
| AAJ           | 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>          | (BES III Collab.)   | REFID=57510 |
| ABLIKIM       | 15I  | PR D91 092006  | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=56774 |
| ABLIKIM       | 15V  | PL B749 414    | M. Ablikim <i>et al.</i>          | (BES III 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>          | (BES III 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>          | (BES III Collab.)   | REFID=54834 |
| ABLIKIM       | 13D  | PR D87 012007  | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=54879 |
| ABLIKIM       | 13F  | PR D87 052007  | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=54920 |
| ABLIKIM       | 13M  | PR D87 092006  | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=55386 |
| ABLIKIM       | 13R  | PR D88 032007  | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=55402 |
| ABLIKIM       | 13S  | PR D88 032010  | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=55403 |
| ABLIKIM       | 13W  | PR D88 112007  | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=55634 |
| LEES          | 13I  | PR D87 112005  | J.P. Lees <i>et al.</i>           | (BABAR Collab.)     | REFID=55161 |
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| ABLIKIM       | 12D  | PRL 108 112003 | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=54269 |
| ABLIKIM       | 12G  | PRL 109 042003 | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=54272 |
| ABLIKIM       | 12H  | PL B710 594    | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=54273 |
| ABLIKIM       | 12L  | PR D86 072011  | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=54739 |
| ABLIKIM       | 12M  | PR D86 092008  | M. Ablikim <i>et al.</i>          | (BES III Collab.)   | REFID=54740 |
| ABLIKIM       | 12O  | PRL 109 172002 | M. Ablikim <i>et al.</i>          | (BES III 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>          | (BES III Collab.)   | REFID=53348 |
| ABLIKIM       | 10F  | PRL 105 261801 | M. Ablikim <i>et al.</i>          | (BES III 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.



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| 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=10 |
| 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           |
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| 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           |
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| 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           |
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| 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 Collab., 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  | M.E.B. Franklin <i>et al.</i> | (LBL, SLAC)                  | REFID=22216           |
| EDWARDS     | 82C  | PRL 48 70                   | C. Edwards <i>et al.</i>      | (CIT, HARV, PRIN+)           | REFID=22173           |
| LEMOIGNE    | 82   | PL 113B 509                 | Y. Lemoigne <i>et al.</i>     | (SACL, LOIC, SHMP+)          | REFID=22084           |
| HIMEL       | 80   | PRL 44 920                  | T. Himel <i>et al.</i>        | (LBL, SLAC)                  | REFID=22119           |
| OREGLIA     | 80   | PRL 45 959                  | M.J. Oreglia <i>et al.</i>    | (SLAC, CIT, HARV+)           | REFID=22207           |
| 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   | 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           |

$\psi(3770)$ 

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

 **$\psi(3770)$  MASS (MeV)**

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>3773.13 ± 0.35 OUR FIT</b>                                                 | Error includes scale factor of 1.1. |             |           |                                         |
| <b>3778.1 ± 1.2 OUR AVERAGE</b>                                               |                                     |             |           |                                         |
| 3779.2 +1.8 +0.6<br>-1.7 -0.8                                                 | 1                                   | 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                                                                  | 2                                   | SHAMOV      | 17 RVUE   | $e^+e^- \rightarrow D\bar{D}$ , hadrons |
| 3772.0 ± 1.9                                                                  | 3,4                                 | ABLIKIM     | 08D BES2  | $e^+e^- \rightarrow$ hadrons            |
| 3778.4 ± 3.0 ± 1.3                                                            | 34                                  | CHISTOV     | 04 BELL   | Sup. by BRODZICKA 08                    |

<sup>1</sup> Taking into account interference between the resonant and non-resonant  $D\bar{D}$  production.

<sup>2</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>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.

 **$m_{\psi(3770)} - m_{\psi(2S)}$** 

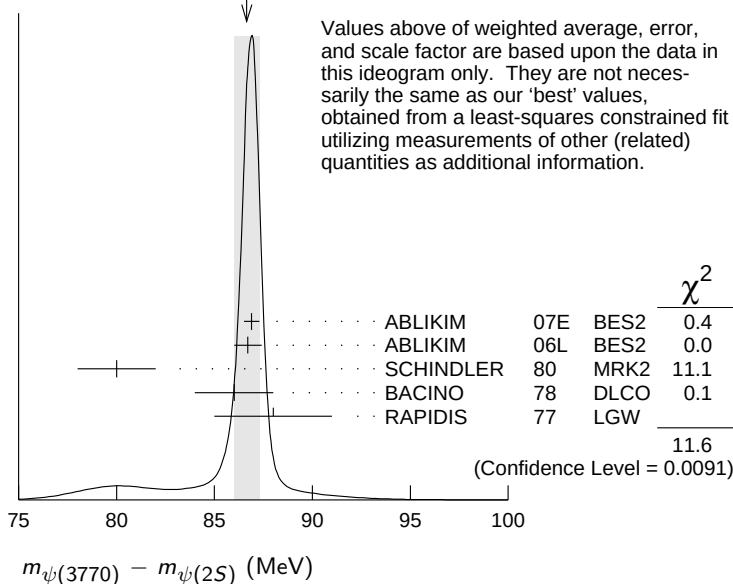
OUR FIT includes measurements of  $m_{\psi(2S)}$ ,  $m_{\psi(3770)}$ , and  $m_{\psi(3770)} - m_{\psi(2S)}$ .

| VALUE (MeV)                   | DOCUMENT ID                                                 | TECN      | COMMENT                               |
|-------------------------------|-------------------------------------------------------------|-----------|---------------------------------------|
| <b>87.04 ± 0.35 OUR FIT</b>   | Error includes scale factor of 1.1.                         |           |                                       |
| <b>86.6 ± 0.7 OUR AVERAGE</b> | Error includes scale factor of 2.0. See the ideogram below. |           |                                       |
| 86.9 ± 0.4                    | 1                                                           | ABLIKIM   | 07E BES2 $e^+e^- \rightarrow$ hadrons |
| 86.7 ± 0.7                    |                                                             | ABLIKIM   | 06L BES2 $e^+e^- \rightarrow$ hadrons |
| 80 ± 2                        |                                                             | SCHINDLER | 80 MRK2 $e^+e^-$                      |
| 86 ± 2                        | 2                                                           | 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).

WEIGHTED AVERAGE  
86.6 ± 0.7 (Error scaled by 2.0)



NODE=M053

NODE=M053M

NODE=M053M

NODE=M053M

NODE=M053M;LINKAGE=AN

NODE=M053M;LINKAGE=A

NODE=M053M;LINKAGE=AB

NODE=M053M;LINKAGE=NI

NODE=M053DM

NODE=M053DM

NODE=M053DM

NODE=M053DM;LINKAGE=AK

NODE=M053DM;LINKAGE=S

**$\psi(3770)$  WIDTH**

NODE=M053W

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   | $e^+e^- \rightarrow D\bar{D}, \text{hadrons}$ |
| <sup>1</sup> Taking into account interference between the resonant and non-resonant $D\bar{D}$ production.<br><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 $\delta = 0^\circ$ .<br><sup>3</sup> Interference between the resonant and non-resonant $D\bar{D}$ production not taken into account.<br><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

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).

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) | Scale factor/<br>Confidence level |
|-------------------------------|--------------------------------|-----------------------------------|
| $\Gamma_1$ $D\bar{D}$         | (93 $\pm$ 8 $\pm$ 9) %         | S=2.0                             |
| $\Gamma_2$ $D^0\bar{D}^0$     | (52 $\pm$ 4 $\pm$ 5) %         | S=2.0                             |
| $\Gamma_3$ $D^+D^-$           | (41 $\pm$ 4) %                 | S=2.0                             |
| $\Gamma_4$ $J/\psi\pi^+\pi^-$ | ( 1.93±0.28) $\times 10^{-3}$  |                                   |
| $\Gamma_5$ $J/\psi\pi^0\pi^0$ | ( 8.0 ±3.0) $\times 10^{-4}$   |                                   |
| $\Gamma_6$ $J/\psi\eta$       | ( 9 ±4) $\times 10^{-4}$       |                                   |
| $\Gamma_7$ $J/\psi\pi^0$      | < 2.8 $\times 10^{-4}$         | CL=90%                            |
| $\Gamma_8$ $e^+e^-$           | ( 9.6 ±0.7) $\times 10^{-6}$   | S=1.3                             |

DESIG=2

DESIG=5

DESIG=6

DESIG=4

DESIG=46

DESIG=47

DESIG=48

DESIG=1

**Decays to light hadrons**

NODE=M053;CLUMP=H

|                                                   |                              |        |
|---------------------------------------------------|------------------------------|--------|
| $\Gamma_9$ $b_1(1235)\pi$                         | < 1.4 $\times 10^{-5}$       | CL=90% |
| $\Gamma_{10}$ $\phi\eta'$                         | < 7 $\times 10^{-4}$         | CL=90% |
| $\Gamma_{11}$ $\omega\eta'$                       | < 4 $\times 10^{-4}$         | CL=90% |
| $\Gamma_{12}$ $\rho^0\eta'$                       | < 6 $\times 10^{-4}$         | CL=90% |
| $\Gamma_{13}$ $\phi\eta$                          | ( 3.1 ±0.7) $\times 10^{-4}$ |        |
| $\Gamma_{14}$ $\omega\eta$                        | < 1.4 $\times 10^{-5}$       | CL=90% |
| $\Gamma_{15}$ $\rho^0\eta$                        | < 5 $\times 10^{-4}$         | CL=90% |
| $\Gamma_{16}$ $\phi\pi^0$                         | < 3 $\times 10^{-5}$         | CL=90% |
| $\Gamma_{17}$ $\omega\pi^0$                       | < 6 $\times 10^{-4}$         | CL=90% |
| $\Gamma_{18}$ $\pi^+\pi^-\pi^0$                   | < 5 $\times 10^{-6}$         | CL=90% |
| $\Gamma_{19}$ $\rho\pi$                           | < 5 $\times 10^{-6}$         | CL=90% |
| $\Gamma_{20}$ $K^+K^-$                            |                              |        |
| $\Gamma_{21}$ $K^*(892)^+K^- + \text{c.c.}$       | < 1.4 $\times 10^{-5}$       | CL=90% |
| $\Gamma_{22}$ $K^*(892)^0\bar{K}^0 + \text{c.c.}$ | < 1.2 $\times 10^{-3}$       | CL=90% |
| $\Gamma_{23}$ $K_S^0 K_L^0$                       | < 1.2 $\times 10^{-5}$       | CL=90% |
| $\Gamma_{24}$ $2(\pi^+\pi^-)$                     | < 1.12 $\times 10^{-3}$      | CL=90% |
| $\Gamma_{25}$ $2(\pi^+\pi^-)\pi^0$                | < 1.06 $\times 10^{-3}$      | CL=90% |
| $\Gamma_{26}$ $2(\pi^+\pi^-\pi^0)$                | < 5.85 %                     | CL=90% |
| $\Gamma_{27}$ $\omega\pi^+\pi^-$                  | < 6.0 $\times 10^{-4}$       | CL=90% |

DESIG=20

DESIG=17

DESIG=16

DESIG=15

DESIG=8

DESIG=14

DESIG=13

DESIG=12

DESIG=11

DESIG=9

DESIG=10

DESIG=234

DESIG=19

DESIG=18

DESIG=3

DESIG=21

DESIG=22

DESIG=208

DESIG=24

|     |                                     |         |                  |        |           |
|-----|-------------------------------------|---------|------------------|--------|-----------|
| 「28 | $3(\pi^+\pi^-)$                     | < 9.1   | $\times 10^{-3}$ | CL=90% | DESIG=52  |
| 「29 | $3(\pi^+\pi^-)\pi^0$                | < 1.37  | %                | CL=90% | DESIG=55  |
| 「30 | $3(\pi^+\pi^-)2\pi^0$               | < 11.74 | %                | CL=90% | DESIG=210 |
| 「31 | $\eta\pi^+\pi^-$                    | < 1.24  | $\times 10^{-3}$ | CL=90% | DESIG=23  |
| 「32 | $\pi^+\pi^-2\pi^0$                  | < 8.9   | $\times 10^{-3}$ | CL=90% | DESIG=206 |
| 「33 | $\rho^0\pi^+\pi^-$                  | < 6.9   | $\times 10^{-3}$ | CL=90% | DESIG=64  |
| 「34 | $\eta3\pi$                          | < 1.34  | $\times 10^{-3}$ | CL=90% | DESIG=25  |
| 「35 | $\eta2(\pi^+\pi^-)$                 | < 2.43  | %                | CL=90% | DESIG=53  |
| 「36 | $\eta\rho^0\pi^+\pi^-$              | < 1.45  | %                | CL=90% | DESIG=221 |
| 「37 | $\eta'3\pi$                         | < 2.44  | $\times 10^{-3}$ | CL=90% | DESIG=26  |
| 「38 | $K^+K^-\pi^+\pi^-$                  | < 9.0   | $\times 10^{-4}$ | CL=90% | DESIG=27  |
| 「39 | $\phi\pi^+\pi^-$                    | < 4.1   | $\times 10^{-4}$ | CL=90% | DESIG=28  |
| 「40 | $K^+K^-2\pi^0$                      | < 4.2   | $\times 10^{-3}$ | CL=90% | DESIG=207 |
| 「41 | $4(\pi^+\pi^-)$                     | < 1.67  | %                | CL=90% | DESIG=62  |
| 「42 | $4(\pi^+\pi^-)\pi^0$                | < 3.06  | %                | CL=90% | DESIG=63  |
| 「43 | $\phi f_0(980)$                     | < 4.5   | $\times 10^{-4}$ | CL=90% | DESIG=29  |
| 「44 | $K^+K^-\pi^+\pi^-\pi^0$             | < 2.36  | $\times 10^{-3}$ | CL=90% | DESIG=30  |
| 「45 | $K^+K^-\rho^0\pi^0$                 | < 8     | $\times 10^{-4}$ | CL=90% | DESIG=67  |
| 「46 | $K^+K^-\rho^+\pi^-$                 | < 1.46  | %                | CL=90% | DESIG=68  |
| 「47 | $\omega K^+K^-$                     | < 3.4   | $\times 10^{-4}$ | CL=90% | DESIG=32  |
| 「48 | $\phi\pi^+\pi^-\pi^0$               | < 3.8   | $\times 10^{-3}$ | CL=90% | DESIG=69  |
| 「49 | $K^{*0}K^-\pi^+\pi^0 + \text{c.c.}$ | < 1.62  | %                | CL=90% | DESIG=70  |
| 「50 | $K^{*+}K^-\pi^+\pi^- + \text{c.c.}$ | < 3.23  | %                | CL=90% | DESIG=71  |
| 「51 | $K^+K^-\pi^+\pi^-2\pi^0$            | < 2.67  | %                | CL=90% | DESIG=209 |
| 「52 | $K^+K^-2(\pi^+\pi^-)$               | < 1.03  | %                | CL=90% | DESIG=57  |
| 「53 | $K^+K^-2(\pi^+\pi^-)\pi^0$          | < 3.60  | %                | CL=90% | DESIG=58  |
| 「54 | $\eta K^+K^-$                       | < 4.1   | $\times 10^{-4}$ | CL=90% | DESIG=31  |
| 「55 | $\eta K^+K^-\pi^+\pi^-$             | < 1.24  | %                | CL=90% | DESIG=222 |
| 「56 | $\rho^0 K^+K^-$                     | < 5.0   | $\times 10^{-3}$ | CL=90% | DESIG=65  |
| 「57 | $2(K^+K^-)$                         | < 6.0   | $\times 10^{-4}$ | CL=90% | DESIG=33  |
| 「58 | $\phi K^+K^-$                       | < 7.5   | $\times 10^{-4}$ | CL=90% | DESIG=34  |
| 「59 | $2(K^+K^-)\pi^0$                    | < 2.9   | $\times 10^{-4}$ | CL=90% | DESIG=35  |
| 「60 | $2(K^+K^-)\pi^+\pi^-$               | < 3.2   | $\times 10^{-3}$ | CL=90% | DESIG=59  |
| 「61 | $K_S^0 K^-\pi^+$                    | < 3.2   | $\times 10^{-3}$ | CL=90% | DESIG=200 |
| 「62 | $K_S^0 K^-\pi^+\pi^0$               | < 1.33  | %                | CL=90% | DESIG=201 |
| 「63 | $K_S^0 K^-\rho^+$                   | < 6.6   | $\times 10^{-3}$ | CL=90% | DESIG=214 |
| 「64 | $K_S^0 K^-\pi^+\pi^-$               | < 8.7   | $\times 10^{-3}$ | CL=90% | DESIG=202 |
| 「65 | $K_S^0 K^-\pi^+\rho^0$              | < 1.6   | %                | CL=90% | DESIG=215 |
| 「66 | $K_S^0 K^-\pi^+\eta$                | < 1.3   | %                | CL=90% | DESIG=216 |
| 「67 | $K_S^0 K^-\pi^+\pi^-\pi^0$          | < 4.18  | %                | CL=90% | DESIG=203 |
| 「68 | $K_S^0 K^-\pi^+\pi^-\eta$           | < 4.8   | %                | CL=90% | DESIG=217 |
| 「69 | $K_S^0 K^-\pi^+2(\pi^+\pi^-)$       | < 1.22  | %                | CL=90% | DESIG=204 |
| 「70 | $K_S^0 K^-\pi^+2\pi^0$              | < 2.65  | %                | CL=90% | DESIG=205 |
| 「71 | $K_S^0 K^-K^+K^-\pi^+$              | < 4.9   | $\times 10^{-3}$ | CL=90% | DESIG=218 |
| 「72 | $K_S^0 K^-K^+K^-\pi^+\pi^0$         | < 3.0   | %                | CL=90% | DESIG=219 |
| 「73 | $K_S^0 K^-K^+K^-\pi^+\eta$          | < 2.2   | %                | CL=90% | DESIG=220 |
| 「74 | $K^{*0}K^-\pi^+ + \text{c.c.}$      | < 9.7   | $\times 10^{-3}$ | CL=90% | DESIG=60  |
| 「75 | $p\bar{p}$                          |         |                  |        | DESIG=233 |
| 「76 | $p\bar{p}\pi^0$                     | < 4     | $\times 10^{-5}$ | CL=90% | DESIG=54  |
| 「77 | $p\bar{p}\pi^+\pi^-$                | < 5.8   | $\times 10^{-4}$ | CL=90% | DESIG=36  |
| 「78 | $\Lambda\bar{\Lambda}$              | < 1.2   | $\times 10^{-4}$ | CL=90% | DESIG=42  |
| 「79 | $p\bar{p}\pi^+\pi^-\pi^0$           | < 1.85  | $\times 10^{-3}$ | CL=90% | DESIG=37  |
| 「80 | $\omega p\bar{p}$                   | < 2.9   | $\times 10^{-4}$ | CL=90% | DESIG=39  |
| 「81 | $\Lambda\bar{\Lambda}\pi^0$         | < 7     | $\times 10^{-5}$ | CL=90% | DESIG=72  |
| 「82 | $p\bar{p}2(\pi^+\pi^-)$             | < 2.6   | $\times 10^{-3}$ | CL=90% | DESIG=61  |
| 「83 | $\eta p\bar{p}$                     | < 5.4   | $\times 10^{-4}$ | CL=90% | DESIG=38  |
| 「84 | $\eta p\bar{p}\pi^+\pi^-$           | < 3.3   | $\times 10^{-3}$ | CL=90% | DESIG=223 |

|               |                                     |         |                  |        |           |
|---------------|-------------------------------------|---------|------------------|--------|-----------|
| $\Gamma_{85}$ | $\rho^0 p \bar{p}$                  | $< 1.7$ | $\times 10^{-3}$ | CL=90% | DESIG=66  |
| $\Gamma_{86}$ | $p \bar{p} K^+ K^-$                 | $< 3.2$ | $\times 10^{-4}$ | CL=90% | DESIG=40  |
| $\Gamma_{87}$ | $\eta p \bar{p} K^+ K^-$            | $< 6.9$ | $\times 10^{-3}$ | CL=90% | DESIG=224 |
| $\Gamma_{88}$ | $\pi^0 p \bar{p} K^+ K^-$           | $< 1.2$ | $\times 10^{-3}$ | CL=90% | DESIG=225 |
| $\Gamma_{89}$ | $\phi p \bar{p}$                    | $< 1.3$ | $\times 10^{-4}$ | CL=90% | DESIG=41  |
| $\Gamma_{90}$ | $\Lambda \bar{\Lambda} \pi^+ \pi^-$ | $< 2.5$ | $\times 10^{-4}$ | CL=90% | DESIG=43  |
| $\Gamma_{91}$ | $\Lambda \bar{p} K^+$               | $< 2.8$ | $\times 10^{-4}$ | CL=90% | DESIG=44  |
| $\Gamma_{92}$ | $\Lambda \bar{p} K^+ \pi^+ \pi^-$   | $< 6.3$ | $\times 10^{-4}$ | CL=90% | DESIG=45  |
| $\Gamma_{93}$ | $\Lambda \bar{\Lambda} \eta$        | $< 1.9$ | $\times 10^{-4}$ | CL=90% | DESIG=226 |
| $\Gamma_{94}$ | $\Sigma^+ \bar{\Sigma}^-$           | $< 1.0$ | $\times 10^{-4}$ | CL=90% | DESIG=227 |
| $\Gamma_{95}$ | $\Sigma^0 \bar{\Sigma}^0$           | $< 4$   | $\times 10^{-5}$ | CL=90% | DESIG=228 |
| $\Gamma_{96}$ | $\Xi^+ \bar{\Xi}^-$                 | $< 1.5$ | $\times 10^{-4}$ | CL=90% | DESIG=229 |
| $\Gamma_{97}$ | $\Xi^0 \bar{\Xi}^0$                 | $< 1.4$ | $\times 10^{-4}$ | CL=90% | DESIG=230 |

### Radiative decays

|                |                     |                                  |                  |        |                               |
|----------------|---------------------|----------------------------------|------------------|--------|-------------------------------|
| $\Gamma_{98}$  | $\gamma \chi_{c2}$  | $< 6.4$                          | $\times 10^{-4}$ | CL=90% | NODE=M053;CLUMP=R<br>DESIG=51 |
| $\Gamma_{99}$  | $\gamma \chi_{c1}$  | $(2.49 \pm 0.23) \times 10^{-3}$ |                  |        | DESIG=50                      |
| $\Gamma_{100}$ | $\gamma \chi_{c0}$  | $(6.9 \pm 0.6) \times 10^{-3}$   |                  |        | DESIG=49                      |
| $\Gamma_{101}$ | $\gamma \eta_c$     | $< 7$                            | $\times 10^{-4}$ | CL=90% | DESIG=231                     |
| $\Gamma_{102}$ | $\gamma \eta_c(2S)$ | $< 9$                            | $\times 10^{-4}$ | CL=90% | DESIG=232                     |
| $\Gamma_{103}$ | $\gamma \eta'$      | $< 1.8$                          | $\times 10^{-4}$ | CL=90% | DESIG=213                     |
| $\Gamma_{104}$ | $\gamma \eta$       | $< 1.5$                          | $\times 10^{-4}$ | CL=90% | DESIG=212                     |
| $\Gamma_{105}$ | $\gamma \pi^0$      | $< 2$                            | $\times 10^{-4}$ | 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 |
|------------|-----------------|----------------------------------|--------------|
| $\Gamma_2$ | $D^0 \bar{D}^0$ | $14.0 \pm 1.4$                   | 1.8          |
| $\Gamma_3$ | $D^+ D^-$       | $11.2 \pm 1.1$                   | 1.7          |
| $\Gamma_8$ | $e^+ e^-$       | $(2.62 \pm 0.18) \times 10^{-4}$ | 1.4          |

### $\psi(3770)$ PARTIAL WIDTHS

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

| VALUE (keV)                                                                   | EVTS                                | DOCUMENT ID | TECN   | COMMENT                                       |
|-------------------------------------------------------------------------------|-------------------------------------|-------------|--------|-----------------------------------------------|
| <b><math>0.262 \pm 0.018</math> OUR FIT</b>                                   | Error includes scale factor of 1.4. |             |        |                                               |
| <b><math>0.256 \pm 0.016</math> OUR AVERAGE</b>                               | Error includes scale factor of 1.2. |             |        |                                               |
| $0.154^{+0.079+0.021}_{-0.058-0.027}$                                         | 1,2                                 | ANASHIN     | 12A    | KEDR $e^+ e^- \rightarrow D \bar{D}$          |
| $0.22 \pm 0.05$                                                               | 3,4                                 | ABLIKIM     | 08D    | BES2 $e^+ e^- \rightarrow$ hadrons            |
| $0.277 \pm 0.011 \pm 0.013$                                                   | 4                                   | ABLIKIM     | 07E    | BES2 $e^+ e^- \rightarrow$ hadrons            |
| $0.203 \pm 0.003^{+0.041}_{-0.027}$                                           | 1.4M                                | 4,5         | BESSON | 06 CLEO $e^+ e^- \rightarrow$ hadrons         |
| $0.276 \pm 0.050$                                                             | 4                                   | SCHINDLER   | 80     | MRK2 $e^+ e^-$                                |
| $0.18 \pm 0.06$                                                               | 4                                   | BACINO      | 78     | DLCO $e^+ e^-$                                |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                     |             |        |                                               |
| $0.196 \pm 0.018$                                                             | 6                                   | SHAMOV      | 17     | RVUE $e^+ e^- \rightarrow D \bar{D},$ hadrons |
| $0.414^{+0.072+0.093}_{-0.080-0.028}$                                         | 2,7                                 | ANASHIN     | 12A    | KEDR $e^+ e^- \rightarrow D \bar{D}$          |
| $0.37 \pm 0.09$                                                               | 8                                   | RAPIDIS     | 77     | LGW $e^+ e^-$                                 |

$\Gamma_8$

NODE=M053225

NODE=M053W1  
NODE=M053W1

OCCUR=2  
OCCUR=2

- <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;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

$\Gamma(D\bar{D})/\Gamma_{\text{total}}$   $\Gamma_1/\Gamma = (\Gamma_2 + \Gamma_3)/\Gamma$

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

**0.93  $^{+0.08}_{-0.09}$  OUR FIT** Error includes scale factor of 2.0.

**0.93  $^{+0.08}_{-0.09}$  OUR AVERAGE** Error includes scale factor of 2.1.

|                                     |                            |     |      |                                          |
|-------------------------------------|----------------------------|-----|------|------------------------------------------|
| $0.849 \pm 0.056 \pm 0.018$         | <sup>1</sup> ABLIKIM       | 08B | BES2 | $e^+e^- \rightarrow \text{non-}D\bar{D}$ |
| $1.033 \pm 0.014^{+0.048}_{-0.066}$ | 1.427M <sup>2</sup> BESSON | 06  | CLEO | $e^+e^- \rightarrow \text{hadrons}$      |

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

|                             |                        |     |      |                                               |
|-----------------------------|------------------------|-----|------|-----------------------------------------------|
| $0.836 \pm 0.049$           | <sup>3</sup> SHAMOV    | 17  | RVUE | $e^+e^- \rightarrow D\bar{D}, \text{hadrons}$ |
| $0.866 \pm 0.050 \pm 0.036$ | <sup>4,5</sup> ABLIKIM | 07K | BES2 | $e^+e^- \rightarrow \text{non-}D\bar{D}$      |
| $0.836 \pm 0.073 \pm 0.042$ | <sup>5</sup> ABLIKIM   | 06L | BES2 | $e^+e^- \rightarrow D\bar{D}$                 |
| $0.855 \pm 0.017 \pm 0.058$ | <sup>5,6</sup> 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  $\sigma^{\text{obs}} = 7.07 \pm 0.58$  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=M053230

NODE=M053R1  
 NODE=M053R1

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  $^{+0.04}_{-0.05}$  OUR FIT** Error includes scale factor of 2.0.

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

|                             |                      |     |      |                                   |
|-----------------------------|----------------------|-----|------|-----------------------------------|
| $0.467 \pm 0.047 \pm 0.023$ | ABLIKIM              | 06L | BES2 | $e^+e^- \rightarrow D^0\bar{D}^0$ |
| $0.499 \pm 0.013 \pm 0.038$ | <sup>1</sup> 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  $\pm 0.04$  OUR FIT** Error includes scale factor of 2.0.

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

|                             |                      |     |      |                             |
|-----------------------------|----------------------|-----|------|-----------------------------|
| $0.369 \pm 0.037 \pm 0.028$ | ABLIKIM              | 06L | BES2 | $e^+e^- \rightarrow D^+D^-$ |
| $0.357 \pm 0.011 \pm 0.034$ | <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

$\Gamma(D^0\bar{D}^0)/\Gamma(D^+D^-)$ 

| 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=M053R5 $\Gamma(J/\psi\pi^+\pi^-)/\Gamma_{\text{total}}$ 

| VALUE (units 10 <sup>-3</sup> ) | 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 $\Gamma(J/\psi\pi^0\pi^0)/\Gamma_{\text{total}}$ 

| VALUE (units 10 <sup>-2</sup> ) | 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 $\Gamma(J/\psi\eta)/\Gamma_{\text{total}}$ 

| VALUE (units 10 <sup>-5</sup> ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|------|-------------|------|---------|
|---------------------------------|------|-------------|------|---------|

**87±33±22** 22 ± 10 ADAM 06 CLEO  $e^+e^- \rightarrow \psi(3770)$ NODE=M053R8  
NODE=M053R8 $\Gamma(J/\psi\pi^0)/\Gamma_{\text{total}}$ 

| VALUE (units 10 <sup>-5</sup> ) | CL% | EVTs | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-----|------|-------------|------|---------|
|---------------------------------|-----|------|-------------|------|---------|

**<28** 90 <10 ADAM 06 CLEO  $e^+e^- \rightarrow \psi(3770)$ NODE=M053R9  
NODE=M053R9 $\Gamma(e^+e^-)/\Gamma_{\text{total}}$ 

| VALUE (units 10 <sup>-5</sup> ) | 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

 $\Gamma(b_1(1235)\pi)/\Gamma_{\text{total}}$ 

| VALUE (units 10 <sup>-5</sup> ) | 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

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

| VALUE (units 10 <sup>-4</sup> ) | 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

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

| VALUE (units 10 <sup>-4</sup> ) | 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 <sup>-4</sup> ) | 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                                             |
|-----------------------------------------|-----|--------------------|---------|-----------------------------------------------------|
| <b><math>3.1 \pm 0.6 \pm 0.3</math></b> |     | <sup>1</sup> ADAMS | 06 CLEO | $3.773 \text{ e}^+ \text{e}^- \rightarrow \phi\eta$ |

• • • 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  $\sqrt{s} = 3.773 \text{ GeV}$  and  $\sqrt{s} = 3.671 \text{ GeV}$ , neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D\bar{D}) = 6.39 \pm 0.20 \text{ nb}$ .

<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38 \text{ nb}$ .

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                         |
|--------------------------|-----|--------------------|---------|---------------------------------|
| <b>&lt;1.4</b>           | 90  | <sup>1</sup> ADAMS | 06 CLEO | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Comparing cross sections at  $\sqrt{s} = 3.773 \text{ GeV}$  and  $\sqrt{s} = 3.671 \text{ GeV}$ , neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D\bar{D}) = 6.39 \pm 0.20 \text{ nb}$ .

NODE=M053R86  
NODE=M053R86

NODE=M053R86;LINKAGE=AD

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

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID        | TECN    | COMMENT                         |
|--------------------------|-----|--------------------|---------|---------------------------------|
| <b>&lt;5</b>             | 90  | <sup>1</sup> ADAMS | 06 CLEO | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Comparing cross sections at  $\sqrt{s} = 3.773 \text{ GeV}$  and  $\sqrt{s} = 3.671 \text{ GeV}$ , neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D\bar{D}) = 6.39 \pm 0.20 \text{ nb}$ .

NODE=M053R87  
NODE=M053R87

NODE=M053R87;LINKAGE=AD

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

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID        | TECN    | COMMENT                         |
|--------------------------|-----|--------------------|---------|---------------------------------|
| <b>&lt; 3</b>            | 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  $\sqrt{s} = 3.773 \text{ GeV}$  and  $\sqrt{s} = 3.671 \text{ GeV}$ , neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D\bar{D}) = 6.39 \pm 0.20 \text{ nb}$ .

<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38 \text{ nb}$ .

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                         |
|--------------------------|-----|--------------------|---------|---------------------------------|
| <b>&lt;6</b>             | 90  | <sup>1</sup> ADAMS | 06 CLEO | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Comparing cross sections at  $\sqrt{s} = 3.773 \text{ GeV}$  and  $\sqrt{s} = 3.671 \text{ GeV}$ , neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D\bar{D}) = 6.39 \pm 0.20 \text{ nb}$ .

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                         |
|--------------------------|-----|----------------------|---------|---------------------------------|
| <b>&lt;5</b>             | 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  $\sqrt{s} = 3.773 \text{ GeV}$  and  $\sqrt{s} = 3.671 \text{ GeV}$ , neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D\bar{D}) = 6.39 \pm 0.20 \text{ nb}$ .

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                         |
|--------------------------|-----|----------------------|---------|---------------------------------|
| <b>&lt;5</b>             | 90  | <sup>1,2</sup> ADAMS | 06 CLEO | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Comparing cross sections at  $\sqrt{s} = 3.773 \text{ GeV}$  and  $\sqrt{s} = 3.671 \text{ GeV}$ , neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D\bar{D}) = 6.39 \pm 0.20 \text{ nb}$ .

<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                          |
|--------------------------|-----|--------------------|---------|----------------------------------|
| <b>&lt;1.4</b>           | 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                          |
|--------------------------|-----|--------------------|---------|----------------------------------|
| <b>&lt;1.2</b>           | 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                          |
|--------------------------|-----|-----------------------------|------|----------------------------------|
| <b>&lt; 1.2</b>          | 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                          |
|--------------------------|-----|--------------------|----------|----------------------------------|
| <b>&lt;11.2</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. • • •

|     |    |                      |          |                                  |
|-----|----|----------------------|----------|----------------------------------|
| <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                          |
|--------------------------|-----|--------------------|----------|----------------------------------|
| <b>&lt;10.6</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. • • •

|     |    |                      |          |                                  |
|-----|----|----------------------|----------|----------------------------------|
| <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                          |
|--------------------------|-----|------|-------------|----------|----------------------------------|
| <b>&lt;58.5</b>          | 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                          |
|--------------------------|-----|--------------------|----------|----------------------------------|
| <b>&lt; 6.0</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. • • •

|     |    |                      |          |                |
|-----|----|----------------------|----------|----------------|
| <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                          |
|--------------------------|-----|----------------------|----------|----------------------------------|
| <b>&lt;91</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  $\sigma^{\text{obs}}(e^+ e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  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                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|---------------------------------|
| <18.5                                                                                                                                                                               | 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                         |
|------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|---------------------------------|
| < 2.9                                                                                                      | 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                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|---------------------------------|
| < 0.7                                                                                                                                                                               | 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                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|---------------------------------|
| <2.6                                                                                                                                                                                | 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=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                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|---------------------------------|
| < 5.4                                                                                                                                                                               | 90  | <sup>1</sup> HUANG 06A   | CLEO | $e^+e^- \rightarrow \psi(3770)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                       |     |                          |      |                                 |
| <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                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|---------------------------------|
| <3.3                                                                                                                                                                                | 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                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|---------------------------------|
| <1.7                                                                                                                                                                                | 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=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                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|---------------------------------|
| < 3.2                                                                                                                                                                               | 90  | <sup>1</sup> HUANG 06A   | CLEO | $e^+e^- \rightarrow \psi(3770)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                       |     |                          |      |                                 |
| <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



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

| 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.

 $\Gamma_{97}/\Gamma$ 

NODE=M053R97  
NODE=M053R97

NODE=M053R97;LINKAGE=A

NODE=M053240

### RADIATIVE DECAYS

 $\Gamma(\gamma\chi_{c2})/\Gamma_{\text{total}}$ 

| 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  $\sigma(e^+ e^- \rightarrow \psi(3770))$ .

 $\Gamma_{98}/\Gamma$ 

NODE=M053R03  
NODE=M053R03

NODE=M053R03;LINKAGE=A  
NODE=M053R03;LINKAGE=BR

NODE=M053R03;LINKAGE=CO

 $\Gamma(\gamma\chi_{c1})/\Gamma_{\text{total}}$ 

| 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  $\sigma(e^+ e^- \rightarrow \psi(3770))$ .

 $\Gamma_{99}/\Gamma$ 

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

 $\Gamma(\gamma\chi_{c1})/\Gamma(J/\psi\pi^+\pi^-)$ 

| 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.

 $\Gamma_{99}/\Gamma_4$ 

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                                                             |
|----------------------------|------|------|-------------|----------|---------------------------------------------------------------------|
| <b>6.9±0.6 OUR AVERAGE</b> |      |      |             |          |                                                                     |
| 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     |
|--------------------------------|-----|-------------|----------|
| <b>&lt;7 × 10<sup>-4</sup></b> | 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  $B(\eta_c(1S) \rightarrow K_S^0 K^\pm \pi^\mp) = 2.44 \times 10^{-2}$ . 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     |
|--------------------------------|-----|-------------|----------|
| <b>&lt;9 × 10<sup>-4</sup></b> | 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                         |
|--------------------------|-----|-------------|---------|---------------------------------|
| <b>&lt;1.8</b>           | 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                         |
|--------------------------|-----|-------------|---------|---------------------------------|
| <b>&lt;1.5</b>           | 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                         |
|--------------------------|-----|-------------|---------|---------------------------------|
| <b>&lt;2</b>             | 90  | PEDLAR      | 09 CLE3 | $\psi(2S) \rightarrow \gamma X$ |

NODE=M053R12  
NODE=M053R12

$\psi(3770)$  REFERENCES

NODE=M053

|               |      |                         |                                  |                    |             |
|---------------|------|-------------------------|----------------------------------|--------------------|-------------|
| 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>         | (BES III Collab.)  | REFID=57126 |
| ABLIKIM       | 15J  | PR D91 092009           | M. Ablikim <i>et al.</i>         | (BES III 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>         | (BES III Collab.)  | REFID=55899 |
| ABLIKIM       | 14L  | PL B735 101             | M. Ablikim <i>et al.</i>         | (BES III Collab.)  | REFID=55903 |
| ABLIKIM       | 14O  | PR D90 032007           | M. Ablikim <i>et al.</i>         | (BES III 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>         | (BES III 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 B670 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>3822.2<math>\pm</math>1.2 OUR AVERAGE</b> |             |                       |          |                                                    |
| 3821.7 $\pm$ 1.3 $\pm$ 0.7                   | 19 $\pm$ 5  | <sup>1</sup> ABLIKIM  | 15S BES3 | $e^+ e^- \rightarrow \pi^+ \pi^- \chi_{c1} \gamma$ |
| 3823.1 $\pm$ 1.8 $\pm$ 0.7                   | 33 $\pm$ 10 | <sup>2</sup> BHARDWAJ | 13 BELL  | $B \rightarrow \chi_{c1} \gamma K$                 |

NODE=M212M

<sup>1</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>2</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

 **$\psi_2(3823)$  WIDTH**

NODE=M212W

| VALUE (MeV)                                                                   | CL% | DOCUMENT ID           | TECN     | COMMENT                                            |
|-------------------------------------------------------------------------------|-----|-----------------------|----------|----------------------------------------------------|
| <b>&lt;16</b>                                                                 | 90  | <sup>1</sup> ABLIKIM  | 15S BES3 | $e^+ e^- \rightarrow \pi^+ \pi^- \chi_{c1} \gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                       |          |                                                    |
| <24                                                                           | 90  | <sup>2</sup> BHARDWAJ | 13 BELL  | $B \rightarrow \chi_{c1} \gamma K$                 |

NODE=M212W

<sup>1</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>2</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 ( $\Gamma_i/\Gamma$ ) |
|-------------------------------|--------------------------------|
| $\Gamma_1$ $\chi_{c1} \gamma$ | seen                           |
| $\Gamma_2$ $\chi_{c2} \gamma$ | not seen                       |

DESIG=1

DESIG=2

 **$\psi_2(3823)$  BRANCHING RATIOS**

NODE=M212225

| $\Gamma(\chi_{c1} \gamma)/\Gamma_{\text{total}}$ |             |                       |         | $\Gamma_1/\Gamma$                      |
|--------------------------------------------------|-------------|-----------------------|---------|----------------------------------------|
| VALUE                                            | EVTS        | DOCUMENT ID           | TECN    | COMMENT                                |
| seen                                             | $33 \pm 10$ | <sup>1</sup> BHARDWAJ | 13 BELL | $B^+ \rightarrow \chi_{c1} \gamma K^+$ |

NODE=M212R01  
NODE=M212R01

<sup>1</sup> Reported  $B(B^\pm \rightarrow \psi_2(3823) K^\pm) \times B(\psi_2(3823) \rightarrow \gamma \chi_{c1}) = (9.7 \pm 2.8 \pm 1.1) \times 10^{-6}$  with statistical significance  $3.8\sigma$ .

NODE=M212R01;LINKAGE=A

| $\Gamma(\chi_{c2}\gamma)/\Gamma_{\text{total}}$ | $\Gamma_2/\Gamma$     |      |         |                                                |
|-------------------------------------------------|-----------------------|------|---------|------------------------------------------------|
| VALUE                                           | DOCUMENT ID           | TECN | COMMENT |                                                |
| not seen                                        | <sup>1</sup> ABLIKIM  | 15S  | BES3    | $e^+e^- \rightarrow \pi^+\pi^-\chi_{c2}\gamma$ |
| <b>not seen</b>                                 | <sup>2</sup> BHARDWAJ | 13   | BELL    | $B^+ \rightarrow \chi_{c2}\gamma K^+$          |

NODE=M212R02  
NODE=M212R02

<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.

NODE=M212R02;LINKAGE=B

<sup>2</sup> Reported  $B(B^\pm \rightarrow \psi_2(3823) K^\pm) \times B(\psi_2(3823) \rightarrow \gamma \chi_{c2}) < 3.6 \times 10^{-6}$  at 90% CL.

NODE=M212R02;LINKAGE=A

$\Gamma(\chi_{c2}\gamma)/\Gamma(\chi_{c1}\gamma)$  $\Gamma_2/\Gamma_1$ 

| VALUE           | CL% | DOCUMENT ID | TECN | COMMENT                                   |
|-----------------|-----|-------------|------|-------------------------------------------|
| <b>&lt;0.41</b> | 90  | BHARDWAJ 13 | BELL | $B^+ \rightarrow \chi_{c1/c2} \gamma K^+$ |

NODE=M212R03  
 NODE=M212R03

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

<0.42      90      <sup>1</sup> ABLIKIM      15S    BES3     $e^+e^- \rightarrow \pi^+\pi^-\chi_{c1}\gamma$

<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.

NODE=M212R03;LINKAGE=A

### $\psi_2(3823)$ REFERENCES

|                                                                                    |
|------------------------------------------------------------------------------------|
| ABLIKIM      15S    PRL 115 011803      M. Ablikim <i>et al.</i> (BES III Collab.) |
| BHARDWAJ    13    PRL 111 032001      V. Bhardwaj <i>et al.</i> (BELLE Collab.)    |

NODE=M212

REFID=56784  
 REFID=55412

NODE=M237

$\chi_{c0}(3860)$

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

OMITTED FROM SUMMARY TABLE

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

| VALUE (MeV)                                | DOCUMENT ID      | TECN | COMMENT                              |
|--------------------------------------------|------------------|------|--------------------------------------|
| <b><math>3862^{+26+40}_{-32-13}</math></b> | CHILIKIN      17 | BELL | $e^+e^- \rightarrow J/\psi D\bar{D}$ |

NODE=M237M

NODE=M237M

### $\chi_{c0}(3860)$ WIDTH

| VALUE (MeV)                                | DOCUMENT ID      | TECN | COMMENT                              |
|--------------------------------------------|------------------|------|--------------------------------------|
| <b><math>201^{+154+88}_{-67-82}</math></b> | CHILIKIN      17 | BELL | $e^+e^- \rightarrow J/\psi D\bar{D}$ |

NODE=M237W

NODE=M237W

### $\chi_{c0}(3860)$ DECAY MODES

NODE=M237215;NODE=M237

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $D^0\bar{D}^0$ | seen                           |
| $\Gamma_2$ $D^+D^-$       | 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                                  |
|-------------|------------------|------|------------------------------------------|
| <b>seen</b> | 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                            |
|-------------|------------------|------|------------------------------------|
| <b>seen</b> | CHILIKIN      17 | BELL | $e^+e^- \rightarrow J/\psi D^+D^-$ |

NODE=M237R01  
 NODE=M237R01

### $\chi_{c0}(3860)$ REFERENCES

NODE=M237

|                                                                                      |
|--------------------------------------------------------------------------------------|
| CHILIKIN      17    PR D95 112003      K. Chilikin <i>et al.</i> (BELLE Collab.) JPC |
|--------------------------------------------------------------------------------------|

REFID=57995

$\chi_{c1}(3872)$

$$J^G(J^{PC}) = 0^+(1^{++})$$

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 our note on "Developments in Heavy Quarkonium Spectroscopy".

NODE=M176

NODE=M176

### $\chi_{c1}(3872)$ MASS FROM $J/\psi X$ MODE

NODE=M176M

NODE=M176M

| VALUE (MeV)                                                                   | EVTS   | DOCUMENT ID                 | TECN      | COMMENT                                        |
|-------------------------------------------------------------------------------|--------|-----------------------------|-----------|------------------------------------------------|
| <b>3871.69 ± 0.17 OUR AVERAGE</b>                                             |        |                             |           |                                                |
| 3871.9 ± 0.7 ± 0.2                                                            | 20 ± 5 | ABLIKIM                     | 14 BES3   | $e^+e^- \rightarrow J/\psi\pi^+\pi^-\gamma$    |
| 3871.95 ± 0.48 ± 0.12                                                         | 0.6k   | AAIJ                        | 12H LHCB  | $p\bar{p} \rightarrow J/\psi\pi^+\pi^- X$      |
| 3871.85 ± 0.27 ± 0.19                                                         | ~ 170  | <sup>1</sup> CHOI           | 11 BELL   | $B \rightarrow K\pi^+\pi^- J/\psi$             |
| 3873 +1.8 -1.6 ± 1.3                                                          | 27 ± 8 | <sup>2</sup> DEL-AMO-SA.10B | BABR      | $B \rightarrow \omega J/\psi K$                |
| 3871.61 ± 0.16 ± 0.19                                                         | 6k     | <sup>2,3</sup> AALTONEN     | 09AU CDF2 | $p\bar{p} \rightarrow J/\psi\pi^+\pi^- X$      |
| 3871.4 ± 0.6 ± 0.1                                                            | 93.4   | AUBERT                      | 08Y BABR  | $B^+ \rightarrow K^+ J/\psi\pi^+\pi^-$         |
| 3868.7 ± 1.5 ± 0.4                                                            | 9.4    | AUBERT                      | 08Y BABR  | $B^0 \rightarrow K_S^0 J/\psi\pi^+\pi^-$       |
| 3871.8 ± 3.1 ± 3.0                                                            | 522    | <sup>2,4</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. • • • |        |                             |           |                                                |
| 3860.0 ± 10.4                                                                 | 13.6   | <sup>2,5</sup> AGHASYAN     | 18A COMP  | $\gamma^* N \rightarrow X\pi^\pm N'$           |
| 3868.6 ± 1.2 ± 0.2                                                            | 8      | <sup>6</sup> AUBERT         | 06 BABR   | $B^0 \rightarrow K_S^0 J/\psi\pi^+\pi^-$       |
| 3871.3 ± 0.6 ± 0.1                                                            | 61     | <sup>6</sup> AUBERT         | 06 BABR   | $B^- \rightarrow K^- J/\psi\pi^+\pi^-$         |
| 3873.4 ± 1.4                                                                  | 25     | <sup>7</sup> AUBERT         | 05R BABR  | $B^+ \rightarrow K^+ J/\psi\pi^+\pi^-$         |
| 3871.3 ± 0.7 ± 0.4                                                            | 730    | <sup>2,8</sup> ACOSTA       | 04 CDF2   | $p\bar{p} \rightarrow J/\psi\pi^+\pi^- X$      |
| 3872.0 ± 0.6 ± 0.5                                                            | 36     | <sup>9</sup> CHOI           | 03 BELL   | $B \rightarrow K\pi^+\pi^- J/\psi$             |
| 3836 ± 13                                                                     | 58     | <sup>2,10</sup> ANTONIAZZI  | 94 E705   | $300\pi^\pm Li \rightarrow J/\psi\pi^+\pi^- X$ |

OCCUR=2

OCCUR=2

<sup>1</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>2</sup> Width consistent with detector resolution.

<sup>3</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>4</sup> Calculated from the corresponding  $m_{\chi_{c1}(3872)} - m_{J/\psi}$  using  $m_{J/\psi} = 3096.916$  MeV.

<sup>5</sup> Could be a different state.

<sup>6</sup> Calculated from the corresponding  $m_{\chi_{c1}(3872)} - m_{\psi(2S)}$  using  $m_{\psi(2S)} = 3686.093$  MeV. Superseded by AUBERT 08Y.

<sup>7</sup> Calculated from the corresponding  $m_{\chi_{c1}(3872)} - m_{\psi(2S)}$  using  $m_{\psi(2S)} = 3685.96$  MeV. Superseded by AUBERT 06.

<sup>8</sup> Superseded by AALTONEN 09AU.

<sup>9</sup> Superseded by CHOI 11.

<sup>10</sup> A lower mass value can be due to an incorrect momentum scale for soft pions.

NODE=M176M;LINKAGE=CO

NODE=M176M;LINKAGE=AC

NODE=M176M;LINKAGE=AA

NODE=M176M;LINKAGE=AB

NODE=M176M;LINKAGE=A

NODE=M176M;LINKAGE=AE

NODE=M176M;LINKAGE=AU

NODE=M176M;LINKAGE=AT

NODE=M176M;LINKAGE=CH

NODE=M176M;LINKAGE=AN

**$\chi_{c1}(3872)$  MASS FROM  $\bar{D}^{*0} D^0$  MODE**

NODE=M176MD0

| 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.<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.<sup>3</sup> Superseded by AUSHEV 10.

NODE=M176MD0;LINKAGE=AS

NODE=M176MD0;LINKAGE=AU

NODE=M176MD0;LINKAGE=GO

 **$m_{\chi_{c1}(3872)} - m_{J/\psi}$** 

NODE=M176207

| VALUE (MeV)                               | EVTS | DOCUMENT ID | TECN   | COMMENT                                     |
|-------------------------------------------|------|-------------|--------|---------------------------------------------|
| <b><math>774.9 \pm 3.1 \pm 3.0</math></b> | 522  | ABAZOV      | 04F D0 | $p\bar{p} \rightarrow J/\psi \pi^+ \pi^- X$ |

NODE=M176DM

 **$m_{\chi_{c1}(3872)} - m_{\psi(2S)}$** 

NODE=M176DM2

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID         | TECN | COMMENT                                       |
|-------------------------------------------------------------------------------|------|---------------------|------|-----------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                     |      |                                               |
| $187.4 \pm 1.4$                                                               | 25   | <sup>1</sup> AUBERT | 05R  | BABR $B^+ \rightarrow K^+ J/\psi \pi^+ \pi^-$ |

<sup>1</sup> Superseded by AUBERT 06.

NODE=M176DM2

NODE=M176DM2;LINKAGE=AU

 **$\chi_{c1}(3872)$  WIDTH**

NODE=M176W

| VALUE (MeV)                                                                   | CL% | EVTS | DOCUMENT ID       | TECN | COMMENT                                              |
|-------------------------------------------------------------------------------|-----|------|-------------------|------|------------------------------------------------------|
| <b><math>&lt;1.2</math></b>                                                   | 90  |      | CHOI              | 11   | BELL $B \rightarrow K \pi^+ \pi^- J/\psi$            |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |      |                   |      |                                                      |
| $<2.4$                                                                        | 90  |      | ABLIKIM           | 14   | BES3 $e^+ e^- \rightarrow J/\psi \pi^+ \pi^- \gamma$ |
| $<3.3$                                                                        | 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>1</sup> CHOI | 03   | BELL $B \rightarrow K \pi^+ \pi^- J/\psi$            |

<sup>1</sup> Superseded by CHOI 11.

NODE=M176W

NODE=M176W;LINKAGE=CH

 **$\chi_{c1}(3872)$  WIDTH FROM  $\bar{D}^{*0} D^0$  MODE**

NODE=M176WD0

NODE=M176WD0

| 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;LINKAGE=AU

 **$\chi_{c1}(3872)$  DECAY MODES**

NODE=M176215;NODE=M176

| Mode                                | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------------|--------------------------------|
| $\Gamma_1$ $e^+ e^-$                |                                |
| $\Gamma_2$ $\pi^+ \pi^- J/\psi(1S)$ | $> 3.2 \%$                     |
| $\Gamma_3$ $\rho^0 J/\psi(1S)$      |                                |
| $\Gamma_4$ $\omega J/\psi(1S)$      | $> 2.3 \%$                     |
| $\Gamma_5$ $D^0 \bar{D}^0 \pi^0$    | $> 40 \%$                      |
| $\Gamma_6$ $\bar{D}^{*0} D^0$       | $> 30 \%$                      |
| $\Gamma_7$ $\gamma\gamma$           |                                |
| $\Gamma_8$ $D^0 \bar{D}^0$          |                                |

DESIG=1

DESIG=2

DESIG=10

DESIG=13

DESIG=8

DESIG=12

DESIG=5

DESIG=6

|               |                          |                      |
|---------------|--------------------------|----------------------|
| $\Gamma_9$    | $D^+ D^-$                |                      |
| $\Gamma_{10}$ | $\gamma \chi_{c1}$       |                      |
| $\Gamma_{11}$ | $\gamma \chi_{c2}$       |                      |
| $\Gamma_{12}$ | $\gamma J/\psi$          | $> 7 \times 10^{-3}$ |
| $\Gamma_{13}$ | $\gamma \psi(2S)$        | $> 4 \%$             |
| $\Gamma_{14}$ | $\pi^+ \pi^- \eta_c(1S)$ | not seen             |
| $\Gamma_{15}$ | $\pi^+ \pi^- \chi_{c1}$  | not seen             |
| $\Gamma_{16}$ | $p \bar{p}$              | not seen             |

DESIG=7  
DESIG=3  
DESIG=15  
DESIG=9  
DESIG=11  
DESIG=14;OUR EVAL;→ UNCHECKED ←  
DESIG=17  
DESIG=16

### C-violating decays

$\Gamma_{17} \quad \eta J/\psi$

NODE=M176;CLUMP=A  
DESIG=4

### $\chi_{c1}(3872)$ PARTIAL WIDTHS

$\Gamma(e^+ e^-)$   $\Gamma_1$

| 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 | $4.0-4.4 \text{ e}^+ \text{e}^- \rightarrow \pi^+ \pi^- J/\psi$ |
| $< 280$ | 90 | <sup>2</sup> YUAN    | 04  | RVUE | $\text{e}^+ \text{e}^- \rightarrow \pi^+ \pi^- J/\psi$          |

<sup>1</sup> ABLIKIM 15V reports this limit from the measurement of  $\Gamma(\chi_{c1}(3872) \rightarrow \pi^+ \pi^- J/\psi(1S)) \times \Gamma(\chi_{c1}(3872) \rightarrow e^+ e^-) / \Gamma < 0.13 \text{ eV}$  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=M176220

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

$\Gamma(\pi^+ \pi^- J/\psi(1S)) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$   $\Gamma_2 \Gamma_1 / \Gamma$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

|          |    |         |     |      |                                                                 |
|----------|----|---------|-----|------|-----------------------------------------------------------------|
| $< 0.13$ | 90 | ABLIKIM | 15V | BES3 | $4.0-4.4 \text{ e}^+ \text{e}^- \rightarrow \pi^+ \pi^- J/\psi$ |
|----------|----|---------|-----|------|-----------------------------------------------------------------|

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

|         |    |                       |     |      |                                                                      |
|---------|----|-----------------------|-----|------|----------------------------------------------------------------------|
| $< 6.2$ | 90 | <sup>1,2</sup> AUBERT | 05D | BABR | $10.6 \text{ e}^+ \text{e}^- \rightarrow K^+ K^- \pi^+ \pi^- \gamma$ |
| $< 8.3$ | 90 | <sup>2</sup> DOBBS    | 05  | CLE3 | $\text{e}^+ \text{e}^- \rightarrow \pi^+ \pi^- J/\psi$               |
| $< 10$  | 90 | <sup>3</sup> YUAN     | 04  | RVUE | $\text{e}^+ \text{e}^- \rightarrow \pi^+ \pi^- J/\psi$               |

<sup>1</sup> Using  $B(\chi_{c1}(3872) \rightarrow J/\psi \pi^+ \pi^-) \cdot B(J/\psi \rightarrow \mu^+ \mu^-) \cdot \Gamma(\chi_{c1}(3872) \rightarrow e^+ e^-) < 0.37 \text{ eV}$  from AUBERT 05D and  $B(J/\psi \rightarrow \mu^+ \mu^-) = 0.0588 \pm 0.0010$  from the PDG 04.

<sup>2</sup> Assuming  $\chi_{c1}(3872)$  has  $J^{PC} = 1^{--}$ .

<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=AU

NODE=M176G1;LINKAGE=DO  
NODE=M176G1;LINKAGE=A

### $\chi_{c1}(3872) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$

NODE=M176232

$\Gamma(\pi^+ \pi^- J/\psi(1S)) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$   $\Gamma_2 \Gamma_7 / \Gamma$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

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

|          |    |                    |    |      |                                                               |
|----------|----|--------------------|----|------|---------------------------------------------------------------|
| $< 12.9$ | 90 | <sup>1</sup> DOBBS | 05 | CLE3 | $\text{e}^+ \text{e}^- \rightarrow \pi^+ \pi^- J/\psi \gamma$ |
|----------|----|--------------------|----|------|---------------------------------------------------------------|

<sup>1</sup> Assuming  $\chi_{c1}(3872)$  has positive C parity and spin 0.

NODE=M176H1;LINKAGE=DO

$\Gamma(\omega J/\psi(1S)) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$   $\Gamma_4 \Gamma_7 / \Gamma$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

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

|         |    |                   |      |      |                                                                         |
|---------|----|-------------------|------|------|-------------------------------------------------------------------------|
| $< 1.7$ | 90 | <sup>1</sup> LEES | 12AD | BABR | $\text{e}^+ \text{e}^- \rightarrow \text{e}^+ \text{e}^- \omega J/\psi$ |
|---------|----|-------------------|------|------|-------------------------------------------------------------------------|

<sup>1</sup> Assuming  $\chi_{c1}(3872)$  has spin 2.

NODE=M176G01;LINKAGE=LE

$\Gamma(\pi^+ \pi^- \eta_c(1S)) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$   $\Gamma_{14} \Gamma_7 / \Gamma$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

|          |    |      |      |      |                                                                              |
|----------|----|------|------|------|------------------------------------------------------------------------------|
| $< 11.1$ | 90 | LEES | 12AE | BABR | $\text{e}^+ \text{e}^- \rightarrow \text{e}^+ \text{e}^- \pi^+ \pi^- \eta_c$ |
|----------|----|------|------|------|------------------------------------------------------------------------------|

NODE=M176G02  
NODE=M176G02



$\chi_{c1}(3872)$  BRANCHING RATIOS $\Gamma(\pi^+\pi^-J/\psi(1S))/\Gamma_{\text{total}}$  $\Gamma_2/\Gamma$ 

| VALUE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | EVTS        | DOCUMENT ID         | TECN     | COMMENT                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------------------|----------|---------------------------------------|
| <b>&gt;0.032</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 93 $\pm$ 17 | <sup>1</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>2</sup> BALA   | 15 BELL  | $B \rightarrow \chi_{c1}(3872)K\pi$   |
| >0.05                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 30          | <sup>3</sup> AUBERT | 05R BABR | $B^+ \rightarrow K^+\pi^+\pi^-J/\psi$ |
| >0.06                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 36 $\pm$ 7  | <sup>4</sup> CHOI   | 03 BELL  | $B^+ \rightarrow K^+\pi^+\pi^-J/\psi$ |
| <sup>1</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 $B(B^+ \rightarrow \chi_{c1}(3872)K^+) < 2.6 \times 10^{-4}$ .                                                                                                                                                                                                                                           |             |                     |          |                                       |
| <sup>2</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 $B(\chi_{c1}(3872) \rightarrow \pi^+\pi^-J/\psi) \times B(B^+ \rightarrow \chi_{c1}(3872)K^0\pi^+) = (10.6 \pm 3.0 \pm 0.9) \times 10^{-6}$ .                                                                                                                                                                                                                           |             |                     |          |                                       |
| <sup>3</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 $B(B^+ \rightarrow \chi_{c1}(3872)K^+) < 2.6 \times 10^{-4}$ .                                                                                                                                                                                                                       |             |                     |          |                                       |
| <sup>4</sup> CHOI 03 reports $[\Gamma(\chi_{c1}(3872) \rightarrow \pi^+\pi^-J/\psi(1S))/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+)] / [B(B^+ \rightarrow \psi(2S)K^+)] / [B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)] = 0.063 \pm 0.012 \pm 0.007$ which we multiply or divide by our best values $B(B^+ \rightarrow \chi_{c1}(3872)K^+) < 2.6 \times 10^{-4}$ , $B(B^+ \rightarrow \psi(2S)K^+) = (7.00 \pm 0.30) \times 10^{-4}$ , $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (34.68 \pm 0.30) \times 10^{-2}$ . |             |                     |          |                                       |

NODE=M176235

NODE=M176R6  
NODE=M176R6

NODE=M176R6;LINKAGE=AB

NODE=M176R6;LINKAGE=A

NODE=M176R6;LINKAGE=AE

NODE=M176R6;LINKAGE=CH

 $\Gamma(\omega J/\psi(1S))/\Gamma_{\text{total}}$  $\Gamma_4/\Gamma$ 

| VALUE                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | EVTS       | DOCUMENT ID                  | TECN | COMMENT                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------------------|------|-------------------------------------|
| <b>&gt;0.023</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 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 $B(B^+ \rightarrow \chi_{c1}(3872)K^+) < 2.6 \times 10^{-4}$ . 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

 $\Gamma(\omega J/\psi(1S))/\Gamma(\pi^+\pi^-J/\psi(1S))$  $\Gamma_4/\Gamma_2$ 

| VALUE                                                                                                                                                                                                                                                 | DOCUMENT ID                  | TECN | COMMENT                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|------|---------------------------------|
| <b>0.8<math>\pm</math>0.3</b>                                                                                                                                                                                                                         | <sup>1</sup> DEL-AMO-SA..10B | BABR | $B \rightarrow \omega J/\psi K$ |
| <sup>1</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=DE

 $\Gamma(D^0\bar{D}^0\pi^0)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

| VALUE                                                                                                                                                                                                                                                                                                            | EVTS       | DOCUMENT ID          | TECN    | COMMENT                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------------------|---------|----------------------------------------|
| <b>&gt;0.4</b>                                                                                                                                                                                                                                                                                                   | 17 $\pm$ 5 | <sup>1</sup> GOKHROO | 06 BELL | $B^+ \rightarrow D^0\bar{D}^0\pi^0K^+$ |
| <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 $B(B^+ \rightarrow \chi_{c1}(3872)K^+) < 2.6 \times 10^{-4}$ . |            |                      |         |                                        |

NODE=M176R12  
NODE=M176R12

NODE=M176R12;LINKAGE=GO

 $\Gamma(D^0\bar{D}^0\pi^0)/\Gamma(\pi^+\pi^-J/\psi(1S))$  $\Gamma_5/\Gamma_2$ 

| VALUE                                                                                                                      | DOCUMENT ID          | TECN    | COMMENT                            |
|----------------------------------------------------------------------------------------------------------------------------|----------------------|---------|------------------------------------|
| seen                                                                                                                       | <sup>1</sup> GOKHROO | 06 BELL | $B \rightarrow D^0\bar{D}^0\pi^0K$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                              |                      |         |                                    |
| seen                                                                                                                       | AUSHEV               | 10 BELL | $B \rightarrow D^0\bar{D}^0\pi^0K$ |
| <sup>1</sup> May not necessarily be the same state as that observed in the $J/\psi\pi^+\pi^-$ mode. Supersedes CHISTOV 04. |                      |         |                                    |

NODE=M176R5  
NODE=M176R5

NODE=M176R5;LINKAGE=GO

 $\Gamma(\bar{D}^{*0}D^0)/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

| VALUE                                                                                                                                                                                                                                                                                                   | EVTS                           | DOCUMENT ID         | TECN     | COMMENT                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------|----------|--------------------------------------|
| <b>&gt;0.30</b>                                                                                                                                                                                                                                                                                         | 41 <sup>+9</sup> <sub>-8</sub> | <sup>1</sup> AUSHEV | 10 BELL  | $B^+ \rightarrow \bar{D}^{*0}D^0K^+$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                           |                                |                     |          |                                      |
| >0.6                                                                                                                                                                                                                                                                                                    | 27 $\pm$ 6                     | <sup>2</sup> AUBERT | 08B BABR | $B^+ \rightarrow \bar{D}^{*0}D^0K^+$ |
| <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 $B(B^+ \rightarrow \chi_{c1}(3872)K^+) < 2.6 \times 10^{-4}$ .  |                                |                     |          |                                      |
| <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 $B(B^+ \rightarrow \chi_{c1}(3872)K^+) < 2.6 \times 10^{-4}$ . |                                |                     |          |                                      |

NODE=M176R13  
NODE=M176R13

NODE=M176R13;LINKAGE=AS

NODE=M176R13;LINKAGE=AU

$\Gamma(D^0\bar{D}^0)/\Gamma(\pi^+\pi^-J/\psi(1S))$  $\Gamma_8/\Gamma_2$ 

| VALUE    | DOCUMENT ID | TECN | COMMENT                         |
|----------|-------------|------|---------------------------------|
| not seen | CHISTOV 04  | BELL | $B \rightarrow K D^0 \bar{D}^0$ |

NODE=M176R3  
 NODE=M176R3

 $\Gamma(D^+D^-)/\Gamma(\pi^+\pi^-J/\psi(1S))$  $\Gamma_9/\Gamma_2$ 

| VALUE    | DOCUMENT ID | TECN | COMMENT                   |
|----------|-------------|------|---------------------------|
| not seen | CHISTOV 04  | BELL | $B \rightarrow K D^+ D^-$ |

NODE=M176R4  
 NODE=M176R4

 $\Gamma(\gamma\chi_{c1})/\Gamma(\pi^+\pi^-J/\psi(1S))$  $\Gamma_{10}/\Gamma_2$ 

| VALUE           | CL% | DOCUMENT ID              | TECN | COMMENT                                |
|-----------------|-----|--------------------------|------|----------------------------------------|
| not seen        |     | <sup>1</sup> BHARDWAJ 13 | BELL | $B^+ \rightarrow \chi_{c1} \gamma K^+$ |
| <b>&lt;0.89</b> | 90  | CHOI 03                  | BELL | $B \rightarrow K \pi^+ \pi^- J/\psi$   |

NODE=M176R1  
 NODE=M176R1

<sup>1</sup> Reported  $B(B^\pm \rightarrow \chi_{c1}(3872) K^\pm) \times B(\chi_{c1}(3872) \rightarrow \gamma \chi_{c1}) < 1.9 \times 10^{-6}$  at 90% CL.

NODE=M176R1;LINKAGE=A

 $\Gamma(\gamma\chi_{c2})/\Gamma(\pi^+\pi^-J/\psi(1S))$  $\Gamma_{11}/\Gamma_2$ 

| VALUE    | DOCUMENT ID              | TECN | COMMENT                                  |
|----------|--------------------------|------|------------------------------------------|
| not seen | <sup>1</sup> BHARDWAJ 13 | BELL | $B^\pm \rightarrow \chi_{c2} \gamma K^+$ |

NODE=M176R01  
 NODE=M176R01

<sup>1</sup> Reported  $B(B^\pm \rightarrow \chi_{c1}(3872) K^\pm) \times B(\chi_{c1}(3872) \rightarrow \gamma \chi_{c2}) < 6.7 \times 10^{-6}$  at 90% CL.

NODE=M176R01;LINKAGE=A

 $\Gamma(\gamma J/\psi)/\Gamma_{\text{total}}$  $\Gamma_{12}/\Gamma$ 

| VALUE                                    | EVTs | DOCUMENT ID                | TECN | COMMENT                                 |
|------------------------------------------|------|----------------------------|------|-----------------------------------------|
| <b>&gt;7 <math>\times 10^{-3}</math></b> |      | <sup>1</sup> BHARDWAJ 11   | BELL | $B^\pm \rightarrow \gamma J/\psi K^\pm$ |
| >0.011                                   | 20   | <sup>2</sup> AUBERT 09B    | BABR | $B^+ \rightarrow \gamma J/\psi K^+$     |
| >0.013                                   | 19   | <sup>3</sup> AUBERT,BE 06M | BABR | $B^+ \rightarrow \gamma J/\psi K^+$     |

NODE=M176R7  
 NODE=M176R7

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

<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  $B(B^+ \rightarrow \chi_{c1}(3872) K^+) < 2.6 \times 10^{-4}$ .

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  $B(B^+ \rightarrow \chi_{c1}(3872) K^+) < 2.6 \times 10^{-4}$ .

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  $B(B^+ \rightarrow \chi_{c1}(3872) K^+) < 2.6 \times 10^{-4}$ .

NODE=M176R7;LINKAGE=AU

 $\Gamma(\gamma\psi(2S))/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ 

| VALUE           | EVTs       | DOCUMENT ID             | TECN | COMMENT                              |
|-----------------|------------|-------------------------|------|--------------------------------------|
| seen            | 36 $\pm$ 9 | <sup>1</sup> AAIJ 14AH  | LHCB | $B^+ \rightarrow \gamma\psi(2S) K^+$ |
| <b>&gt;0.04</b> | 25 $\pm$ 7 | <sup>2</sup> AUBERT 09B | BABR | $B^+ \rightarrow \gamma\psi(2S) K^+$ |

NODE=M176R10  
 NODE=M176R10

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

not seen <sup>3</sup> 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 $\sigma$ .

NODE=M176R10;LINKAGE=A

<sup>2</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  $B(B^+ \rightarrow \chi_{c1}(3872) K^+) < 2.6 \times 10^{-4}$ .

NODE=M176R10;LINKAGE=AU

<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.

NODE=M176R10;LINKAGE=BH

 $\Gamma(\gamma\psi(2S))/\Gamma(\gamma J/\psi)$  $\Gamma_{13}/\Gamma_{12}$ 

| VALUE                                       | CL% | EVTs       | DOCUMENT ID            | TECN | COMMENT                               |
|---------------------------------------------|-----|------------|------------------------|------|---------------------------------------|
| <b>2.6 <math>\pm</math> 0.6 OUR AVERAGE</b> |     |            |                        |      |                                       |
| 2.46 $\pm$ 0.64 $\pm$ 0.29                  |     | 36 $\pm$ 9 | <sup>1</sup> AAIJ 14AH | LHCB | $B^+ \rightarrow \gamma\psi(2S) K^+$  |
| 3.4 $\pm$ 1.4                               |     |            | AUBERT 09B             | BABR | $B^+ \rightarrow \gamma c \bar{c} K'$ |

NODE=M176R11  
 NODE=M176R11

• • • 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 $\sigma$ .

NODE=M176R11;LINKAGE=A

$\Gamma(\pi^+\pi^-\chi_{c1})/\Gamma_{\text{total}}$ 

| VALUE                                                                                                                                                            | DOCUMENT ID              | TECN | COMMENT                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|------|------------------------------------------|
| not seen                                                                                                                                                         | <sup>1</sup> BHARDWAJ 16 | BELL | $B^+ \rightarrow \pi^+\pi^-\chi_{c1}K^+$ |
| <sup>1</sup> BHARDWAJ 16 quotes $B(B^+ \rightarrow \chi_{c1}(3872)K^+) \cdot B(\chi_{c1}(3872) \rightarrow \pi^+\pi^-\chi_{c1}) < 1.5 \times 10^{-6}$ at 90% CL. |                          |      |                                          |

 $\Gamma_{15}/\Gamma$ NODE=M176R00  
NODE=M176R00

NODE=M176R00;LINKAGE=A

 $\Gamma(p\bar{p})/\Gamma_{\text{total}}$ 

| VALUE                                                                                                                                                                                            | DOCUMENT ID            | TECN | COMMENT                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|------|------------------------------------------------|
| not seen                                                                                                                                                                                         | <sup>1</sup> AAIJ 17AD | LHCB | $pp \rightarrow B^+X \rightarrow p\bar{p}K^+X$ |
| <sup>1</sup> AAIJ 17AD reports $B(B^+ \rightarrow \chi_{c1}(3872)K^+ \rightarrow p\bar{p}K^+)/B(B^+ \rightarrow J/\psi K^+ \rightarrow p\bar{p}K^+) < 2.0 (2.5) \times 10^{-3}$ at 90% (95%) CL. |                        |      |                                                |

 $\Gamma_{16}/\Gamma$ NODE=M176R03  
NODE=M176R03

NODE=M176R03;LINKAGE=A

 $\Gamma(p\bar{p})/\Gamma(\pi^+\pi^-J/\psi(1S))$ 

| VALUE                                                                                                                                                                                                                                                                                                                                                                                        | CL% | DOCUMENT ID           | TECN | COMMENT                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----------------------|------|-------------------------------|
| $< 2.0 \times 10^{-3}$                                                                                                                                                                                                                                                                                                                                                                       | 95  | <sup>1</sup> AAIJ 13S | LHCB | $B^+ \rightarrow p\bar{p}K^+$ |
| <sup>1</sup> AAIJ 13S reports $[\Gamma(\chi_{c1}(3872) \rightarrow p\bar{p})/\Gamma(\chi_{c1}(3872) \rightarrow \pi^+\pi^-J/\psi(1S))] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+, \chi_{c1} \rightarrow J/\psi\pi^+\pi^-)] < 1.7 \times 10^{-8}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872)K^+, \chi_{c1} \rightarrow J/\psi\pi^+\pi^-) = 8.6 \times 10^{-6}$ . |     |                       |      |                               |

 $\Gamma_{16}/\Gamma_2$ NODE=M176R02  
NODE=M176R02

NODE=M176R02;LINKAGE=A

## C-violating decays

NODE=M176405

 $\Gamma(\eta J/\psi)/\Gamma(\pi^+\pi^-J/\psi(1S))$ 

| VALUE                                                                                                                                                                                                                                                                                                                                                                                              | CL% | DOCUMENT ID                | TECN | COMMENT                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------------|------|------------------------------|
| $< 0.4$                                                                                                                                                                                                                                                                                                                                                                                            | 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. • • •                                                                                                                                                                                                                                                                                                                      |     |                            |      |                              |
| $< 0.6$                                                                                                                                                                                                                                                                                                                                                                                            | 90  | AUBERT 04Y                 | BABR | $B \rightarrow K\eta J/\psi$ |
| <sup>1</sup> IWASHITA 14 reports $[\Gamma(\chi_{c1}(3872) \rightarrow \eta J/\psi)/\Gamma(\chi_{c1}(3872) \rightarrow \pi^+\pi^-J/\psi(1S))] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+, \chi_{c1} \rightarrow J/\psi\pi^+\pi^-)] < 3.8 \times 10^{-6}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872)K^+, \chi_{c1} \rightarrow J/\psi\pi^+\pi^-) = 8.6 \times 10^{-6}$ . |     |                            |      |                              |
| <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.                                                                                                                                                                          |     |                            |      |                              |

 $\Gamma_{17}/\Gamma_2$ NODE=M176R2  
NODE=M176R2

NODE=M176R2;LINKAGE=A

NODE=M176R2;LINKAGE=C

 $\chi_{c1}(3872)$  REFERENCES

NODE=M176

|                   |                  |                                  |                   |             |
|-------------------|------------------|----------------------------------|-------------------|-------------|
| 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 |
| 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>         | (BES III Collab.) | REFID=56787 |
| BALA 15           | PR D91 051101    | A. Bala <i>et al.</i>            | (BELLE Collab.)   | REFID=56408 |
| 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>         | (BES III 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 |
| 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 |
| 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 |
| 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.

NODE=M210

NODE=M210

 **$Z_c(3900)$  MASS**

NODE=M210M

VALUE (MeV) EVTS DOCUMENT ID TECN CHG COMMENT  
**3887.2±2.3 OUR AVERAGE** Error includes scale factor of 1.6. See the ideogram below.  
 [3886.6 ± 2.4 MeV OUR 2018 AVERAGE Scale factor = 1.6]

NODE=M210M

NEW

|                                              |      |     |         |      |      |                                                    |
|----------------------------------------------|------|-----|---------|------|------|----------------------------------------------------|
| 3895.0±5.2 <sup>+4.0</sup> <sub>-2.7</sub>   | 502  | 1   | ABAZOV  | 18B  | D0   | 1.96 TeV $p\bar{p} \rightarrow J/\psi\pi^+\pi^- X$ |
| 3885.7 <sup>+4.3</sup> <sub>-5.7</sub> ± 8.4 |      | 2   | ABLIKIM | 15AB | BES3 | 0 $e^+e^- \rightarrow \pi^0(D\bar{D}^*)^0$         |
| 3881.7±1.6±1.6                               | 1.2k | 2   | ABLIKIM | 15AC | BES3 | ± $e^+e^- \rightarrow \pi^\pm(D\bar{D}^*)^\mp$     |
| 3894.8±2.3±3.2                               | 356  | 2   | ABLIKIM | 15U  | BES3 | 0 $e^+e^- \rightarrow \pi^0\pi^0 J/\psi$           |
| 3883.9±1.5±4.2                               | 1.2k | 2   | ABLIKIM | 14A  | BES3 | ± $e^+e^- \rightarrow \pi^\pm(D\bar{D}^*)^\mp$     |
| 3899.0±3.6±4.9                               | 307  | 2   | ABLIKIM | 13T  | BES3 | ± $e^+e^- \rightarrow \pi^+\pi^- J/\psi$           |
| 3894.5±6.6±4.5                               | 159  | 2   | LIU     | 13B  | BELL | ± $e^+e^- \rightarrow \gamma\pi^+\pi^- J/\psi$     |
| 3886 ±4 ±2                                   | 81   | 2,3 | XIAO    | 13A  |      | ± 4.17 $e^+e^- \rightarrow \pi^+\pi^- J/\psi$      |
| 3904 ±9 ±5                                   | 25   | 2,3 | XIAO    | 13A  | 0    | 4.17 $e^+e^- \rightarrow \pi^0\pi^0 J/\psi$        |

OCCUR=2

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

3881.2±4.2±52.7 6k 4 ABLIKIM 17J BES3 ±  $e^+e^- \rightarrow \pi^+\pi^- J/\psi$

NODE=M210M;LINKAGE=F

<sup>1</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.

<sup>2</sup> Neglecting interference between the  $Z_c(3900)$  and non-resonant continuum.

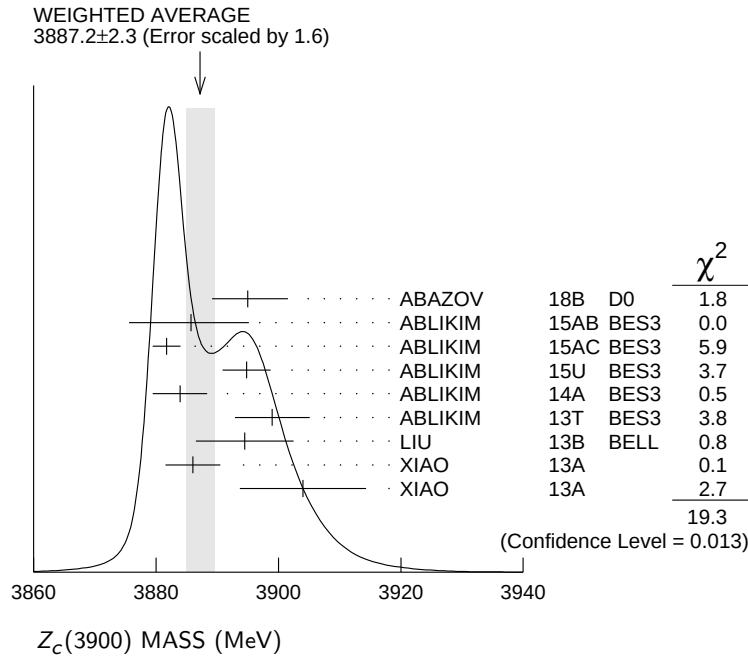
<sup>3</sup> For  $M^2(\pi^+\pi^-) < 0.65 \text{ GeV}^2$ . Obtained by analyzing CLEO-c data but not authored by the CLEO Collaboration.

<sup>4</sup> Pole mass obtained from a fit to a Flatte-like formula.

NODE=M210M;LINKAGE=A

NODE=M210M;LINKAGE=B

NODE=M210M;LINKAGE=E



### $Z_c(3900)$ WIDTH

| VALUE (MeV)                          | EVTS | DOCUMENT ID          | TECN | CHG  | COMMENT                                        |
|--------------------------------------|------|----------------------|------|------|------------------------------------------------|
| <b>28.2± 2.6 OUR AVERAGE</b>         |      |                      |      |      |                                                |
| 51.8± 4.6±36.0                       | 6 k  | <sup>1</sup> ABLIKIM | 17J  | BES3 | ± $e^+e^- \rightarrow \pi^+\pi^- J/\psi$       |
| 35 <sup>+11</sup> <sub>-12</sub> ±15 |      | <sup>2</sup> ABLIKIM | 15AB | BES3 | 0 $e^+e^- \rightarrow \pi^0(D\bar{D}^*)^0$     |
| 26.6± 2.0± 2.1                       | 1248 | <sup>2</sup> ABLIKIM | 15AC | BES3 | ± $e^+e^- \rightarrow \pi^\pm(D\bar{D}^*)^\mp$ |
| 29.6± 8.2± 8.2                       | 356  | <sup>2</sup> ABLIKIM | 15U  | BES3 | 0 $e^+e^- \rightarrow \pi^0\pi^0 J/\psi$       |
| 24.8± 3.3±11.0                       | 1212 | <sup>2</sup> ABLIKIM | 14A  | BES3 | ± $e^+e^- \rightarrow \pi^\pm(D\bar{D}^*)^\mp$ |
| 46 ±10 ±20                           | 307  | <sup>2</sup> ABLIKIM | 13T  | BES3 | ± $e^+e^- \rightarrow \pi^+\pi^- J/\psi$       |
| 63 ±24 ±26                           | 159  | <sup>2</sup> LIU     | 13B  | BELL | ± $e^+e^- \rightarrow \gamma\pi^+\pi^- J/\psi$ |
| 37 ± 4 ± 8                           | 81   | <sup>2,3</sup> XIAO  | 13A  |      | ± $4.17 e^+e^- \rightarrow \pi^+\pi^- J/\psi$  |

<sup>1</sup> Pole width obtained from a fit to a Flatte-like formula.

<sup>2</sup> Neglecting interference between the  $Z_c(3900)$  and non-resonant continuum.

<sup>3</sup> For  $M^2(\pi^+\pi^-) < 0.65 \text{ GeV}^2$ . Obtained by analyzing CLEO-c data but not authored by the CLEO Collaboration.

NODE=M210W

NODE=M210W

NODE=M210W;LINKAGE=E

NODE=M210W;LINKAGE=A

NODE=M210W;LINKAGE=B

### $Z_c(3900)$ 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                       |
| $\Gamma_4$ $(D\bar{D}^*)^\pm$                  | seen                           |
| $\Gamma_5$ $D^0 D^{*-} + \text{c.c.}$          | seen                           |
| $\Gamma_6$ $D^- D^{*0} + \text{c.c.}$          | seen                           |
| $\Gamma_7$ $\omega\pi^\pm$                     | not seen                       |
| $\Gamma_8$ $J/\psi\eta$                        | not seen                       |
| $\Gamma_9$ $D^+ D^{*-} + \text{c.c.}$          | seen                           |
| $\Gamma_{10}$ $D^0 \bar{D}^{*0} + \text{c.c.}$ | seen                           |

NODE=M210215;NODE=M210

DESIG=1

DESIG=2

DESIG=10

DESIG=3;OUR EVAL;→ UNCHECKED ←

DESIG=8

DESIG=9

DESIG=4

DESIG=5

DESIG=6

DESIG=7

### $Z_c(3900)$ BRANCHING RATIOS

| $\Gamma(J/\psi\pi)/\Gamma_{\text{total}}$ | CL% | EVTS | DOCUMENT ID       | TECN | CHG  | COMMENT                                     |
|-------------------------------------------|-----|------|-------------------|------|------|---------------------------------------------|
| seen                                      |     | 356  | ABLIKIM           | 15U  | BES3 | 0 $e^+e^- \rightarrow \pi^0\pi^0 J/\psi$    |
| <b>seen</b>                               |     | 307  | ABLIKIM           | 13T  | BES3 | ± $e^+e^- \rightarrow \pi^+\pi^- J/\psi$    |
| seen                                      |     | 25   | <sup>1</sup> XIAO | 13A  | 0    | $4.17 e^+e^- \rightarrow \pi^0\pi^0 J/\psi$ |

NODE=M210225

NODE=M210R01

NODE=M210R01

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

not seen 90 <sup>2</sup> ADOLPH 15D COMP ±  $\gamma N \rightarrow J/\psi\pi^\pm N$

<sup>1</sup> Obtained by analyzing CLEO-c data but not authored by the CLEO Collaboration.

<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.

NODE=M210R01;LINKAGE=XI

NODE=M210R01;LINKAGE=A

| $\Gamma(h_c \pi^\pm) / \Gamma_{\text{total}}$ | DOCUMENT ID | TECN | CHG  | COMMENT                                     | $\Gamma_2 / \Gamma$ |
|-----------------------------------------------|-------------|------|------|---------------------------------------------|---------------------|
| VALUE                                         |             |      |      |                                             |                     |
| not seen                                      | ABLIKIM     | 13X  | BES3 | $\pm$ $e^+ e^- \rightarrow h_c \pi^+ \pi^-$ |                     |

NODE=M210R02  
NODE=M210R02

| $\Gamma(\eta_c \pi^+ \pi^-) / \Gamma_{\text{total}}$ | DOCUMENT ID                | TECN | CHG | COMMENT                                  | $\Gamma_3 / \Gamma$ |
|------------------------------------------------------|----------------------------|------|-----|------------------------------------------|---------------------|
| VALUE                                                |                            |      |     |                                          |                     |
| 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

| $\Gamma((D\bar{D}^*)^\pm) / \Gamma(J/\psi \pi)$ | DOCUMENT ID          | TECN | CHG  | COMMENT                                              | $\Gamma_4 / \Gamma_1$ |
|-------------------------------------------------|----------------------|------|------|------------------------------------------------------|-----------------------|
| VALUE                                           |                      |      |      |                                                      |                       |
| $6.2 \pm 1.1 \pm 2.7$                           | <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

| $\Gamma(D^0 D^{*-} + \text{c.c.}) / \Gamma_{\text{total}}$ | DOCUMENT ID | TECN | CHG  | COMMENT                                                    | $\Gamma_5 / \Gamma$ |
|------------------------------------------------------------|-------------|------|------|------------------------------------------------------------|---------------------|
| VALUE                                                      |             |      |      |                                                            |                     |
| 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

| $\Gamma(D^- D^{*0} + \text{c.c.}) / \Gamma_{\text{total}}$ | DOCUMENT ID | TECN | CHG  | COMMENT                                                    | $\Gamma_6 / \Gamma$ |
|------------------------------------------------------------|-------------|------|------|------------------------------------------------------------|---------------------|
| VALUE                                                      |             |      |      |                                                            |                     |
| 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

| $\Gamma(\omega \pi^\pm) / \Gamma_{\text{total}}$ | DOCUMENT ID | TECN | CHG  | COMMENT                                        | $\Gamma_7 / \Gamma$ |
|--------------------------------------------------|-------------|------|------|------------------------------------------------|---------------------|
| VALUE                                            |             |      |      |                                                |                     |
| not seen                                         | ABLIKIM     | 15R  | BES3 | $\pm$ $e^+ e^- \rightarrow \omega \pi^+ \pi^-$ |                     |

NODE=M210R00  
NODE=M210R00

| $\Gamma(J/\psi \eta) / \Gamma_{\text{total}}$ | DOCUMENT ID | TECN | CHG  | COMMENT                                                     | $\Gamma_8 / \Gamma$ |
|-----------------------------------------------|-------------|------|------|-------------------------------------------------------------|---------------------|
| VALUE                                         |             |      |      |                                                             |                     |
| not seen                                      | ABLIKIM     | 15Q  | BES3 | 0 $4.0\text{--}4.6$ $e^+ e^- \rightarrow J/\psi \eta \pi^0$ |                     |

NODE=M210R04  
NODE=M210R04

| $\Gamma(J/\psi \eta) / \Gamma(J/\psi \pi)$                                    | DOCUMENT ID | TECN    | CHG | COMMENT                                                | $\Gamma_8 / \Gamma_1$ |
|-------------------------------------------------------------------------------|-------------|---------|-----|--------------------------------------------------------|-----------------------|
| VALUE                                                                         |             |         |     |                                                        |                       |
| CL%                                                                           |             |         |     |                                                        |                       |
| <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

| $\Gamma(D^+ D^{*-} + \text{c.c.}) / \Gamma_{\text{total}}$ | DOCUMENT ID | TECN | CHG  | COMMENT                                      | $\Gamma_9 / \Gamma$ |
|------------------------------------------------------------|-------------|------|------|----------------------------------------------|---------------------|
| VALUE                                                      |             |      |      |                                              |                     |
| seen                                                       | ABLIKIM     | 15AB | BES3 | 0 $e^+ e^- \rightarrow \pi^0 (D\bar{D}^*)^0$ |                     |

NODE=M210R06  
NODE=M210R06

| $\Gamma(D^0 \bar{D}^{*0} + \text{c.c.}) / \Gamma_{\text{total}}$ | DOCUMENT ID | TECN | CHG  | COMMENT                                      | $\Gamma_{10} / \Gamma$ |
|------------------------------------------------------------------|-------------|------|------|----------------------------------------------|------------------------|
| VALUE                                                            |             |      |      |                                              |                        |
| seen                                                             | ABLIKIM     | 15AB | BES3 | 0 $e^+ e^- \rightarrow \pi^0 (D\bar{D}^*)^0$ |                        |

NODE=M210R07  
NODE=M210R07

| $\Gamma(D^+ D^{*-} + \text{c.c.}) / \Gamma(D^0 \bar{D}^{*0} + \text{c.c.})$ | DOCUMENT ID | TECN | CHG  | COMMENT                                      | $\Gamma_9 / \Gamma_{10}$ |
|-----------------------------------------------------------------------------|-------------|------|------|----------------------------------------------|--------------------------|
| VALUE                                                                       |             |      |      |                                              |                          |
| $0.96 \pm 0.18 \pm 0.12$                                                    | 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

|            |      |                        |                             |                      |             |
|------------|------|------------------------|-----------------------------|----------------------|-------------|
| ABAZOV     | 18B  | PR D98 052010          | V.M. Abazov <i>et al.</i>   | (D0 Collab.)         | REFID=59442 |
| ABLIKIM    | 17J  | PRL 119 072001         | M. Ablikim <i>et al.</i>    | (BES III Collab.)    | REFID=57950 |
| ABLIKIM    | 15AB | PRL 115 222002         | M. Ablikim <i>et al.</i>    | (BES III Collab.)    | REFID=56954 |
| ABLIKIM    | 15AC | PR D92 092006          | M. Ablikim <i>et al.</i>    | (BES III Collab.) JP | REFID=56967 |
| ABLIKIM    | 15Q  | PR D92 012008          | M. Ablikim <i>et al.</i>    | (BES III Collab.)    | REFID=56782 |
| ABLIKIM    | 15R  | PR D92 032009          | M. Ablikim <i>et al.</i>    | (BES III Collab.)    | REFID=56783 |
| ABLIKIM    | 15U  | PRL 115 112003         | M. Ablikim <i>et al.</i>    | (BES III Collab.)    | REFID=56786 |
| ADOLPH     | 15D  | PL B742 330            | C. Adolph <i>et al.</i>     | (COMPASS Collab.)    | REFID=56791 |
| 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    | 14A  | PRL 112 022001         | M. Ablikim <i>et al.</i>    | (BES III Collab.) JP | REFID=55648 |
| ABLIKIM    | 13T  | PRL 110 252001         | M. Ablikim <i>et al.</i>    | (BES III Collab.)    | REFID=55409 |
| ABLIKIM    | 13X  | PRL 111 242001         | M. Ablikim <i>et al.</i>    | (BES III Collab.)    | REFID=55635 |
| LIU        | 13B  | PRL 110 252002         | Z.Q. Liu <i>et al.</i>      | (BELLE Collab.)      | REFID=55410 |
| XIAO       | 13A  | PL B727 366            | T. Xiao <i>et al.</i>       | (NWES)               | REFID=55593 |

**X(3915)**

$$J^{PC} = 0^{++} \text{ (or } 2^{++})$$

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

NODE=M159M

| VALUE (MeV)                                                                                    | EVTS    | DOCUMENT ID         | TECN      | COMMENT                                       |
|------------------------------------------------------------------------------------------------|---------|---------------------|-----------|-----------------------------------------------|
| <b>3918.4 ± 1.9 OUR AVERAGE</b>                                                                |         |                     |           |                                               |
| 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 <sup>+</sup> <sub>3.4</sub> ± 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>1</sup> CHOI   | 05 BELL   | $B \rightarrow \omega J/\psi K$               |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                  |         |                     |           |                                               |
| 3914.6 <sup>+</sup> <sub>-</sub> 3.8 <sup>+</sup> <sub>3.4</sub> ± 2.0                         |         | <sup>1</sup> AUBERT | 08W BABR  | Superseded by DEL-AMO-SANCHEZ 10B             |
| <sup>1</sup> $\omega J/\psi$ threshold enhancement fitted as an S-wave Breit-Wigner resonance. |         |                     |           |                                               |

NODE=M159M;LINKAGE=CH

**X(3915) WIDTH**

NODE=M159W

NODE=M159W

| VALUE (MeV)                                                                                    | EVTS    | DOCUMENT ID                   | TECN      | COMMENT                                       |
|------------------------------------------------------------------------------------------------|---------|-------------------------------|-----------|-----------------------------------------------|
| <b>20 ± 5 OUR AVERAGE</b>                                                                      | Error   | includes scale factor of 1.1. |           |                                               |
| 13 ± 6 ± 3                                                                                     | 59 ± 10 | LEES                          | 12AD BABR | $e^+e^- \rightarrow e^+e^-\omega J/\psi$      |
| 31 <sup>+</sup> <sub>-</sub> 10 <sup>+</sup> <sub>8</sub> ± 5                                  |         | DEL-AMO-SA..10B               | BABR      | $B \rightarrow \omega J/\psi K$               |
| 17 ± 10 ± 3                                                                                    | 49 ± 15 | UEHARA                        | 10 BELL   | 10.6 $e^+e^- \rightarrow e^+e^-\omega J/\psi$ |
| 87 ± 22 ± 26                                                                                   | 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. • • •                  |         |                               |           |                                               |
| 34 <sup>+</sup> <sub>-</sub> 12 <sup>+</sup> <sub>8</sub> ± 5                                  |         | <sup>2</sup> AUBERT           | 08W BABR  | Superseded by DEL-AMO-SANCHEZ 10B             |
| <sup>2</sup> $\omega J/\psi$ threshold enhancement fitted as an S-wave Breit-Wigner resonance. |         |                               |           |                                               |

NODE=M159W;LINKAGE=CH

**X(3915) DECAY MODES**

NODE=M159215;NODE=M159

| Mode                                | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------------|--------------------------------|
| $\Gamma_1$ $\omega J/\psi$          | seen                           |
| $\Gamma_2$ $\bar{D}^{*0} D^0$       |                                |
| $\Gamma_3$ $\pi^+ \pi^- \eta_c(1S)$ | not seen                       |
| $\Gamma_4$ $\eta_c \eta$            | not seen                       |
| $\Gamma_5$ $\eta_c \pi^0$           | not seen                       |
| $\Gamma_6$ $K \bar{K}$              | not seen                       |
| $\Gamma_7$ $\gamma \gamma$          | seen                           |

DESIG=1;OUR EST;→ UNCHECKED ←  
 DESIG=3  
 DESIG=4;OUR EVAL;→ UNCHECKED ←  
 DESIG=6  
 DESIG=7  
 DESIG=5;OUR EVAL;→ UNCHECKED ←  
 DESIG=2

**X(3915)  $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$** 

NODE=M159220

| $\Gamma(\omega J/\psi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$          |         |                     |           |                                               | $\Gamma_1\Gamma_7/\Gamma$ |
|------------------------------------------------------------------------------------|---------|---------------------|-----------|-----------------------------------------------|---------------------------|
| VALUE (eV)                                                                         | EVTS    | DOCUMENT ID         | TECN      | COMMENT                                       |                           |
| <b>54 ± 9 OUR AVERAGE</b>                                                          |         |                     |           |                                               |                           |
| 52 ± 10 ± 3                                                                        | 59 ± 10 | <sup>3</sup> LEES   | 12AD BABR | $e^+e^- \rightarrow e^+e^-\omega J/\psi$      |                           |
| 61 ± 17 ± 8                                                                        | 49 ± 15 | <sup>3</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>4</sup> UEHARA | 10 BELL   | 10.6 $e^+e^- \rightarrow e^+e^-\omega J/\psi$ |                           |
| <sup>3</sup> For $J^P = 0^+$ .<br><sup>4</sup> For $J^P = 2^+$ , helicity-2.       |         |                     |           |                                               |                           |
| $\Gamma(\pi^+ \pi^- \eta_c(1S)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ |         |                     |           |                                               | $\Gamma_3\Gamma_7/\Gamma$ |
| 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=M159G01  
 NODE=M159G01

OCCUR=2

NODE=M159G01;LINKAGE=UH  
 NODE=M159G01;LINKAGE=UR

NODE=M159G02  
 NODE=M159G02

| $\Gamma(K\bar{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ |     |             |      |         | $\Gamma_6\Gamma_7/\Gamma$              |
|----------------------------------------------------------------------|-----|-------------|------|---------|----------------------------------------|
| VALUE (eV)                                                           | CL% | DOCUMENT ID | TECN | COMMENT |                                        |
| <1.96                                                                | 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                                         | CL% | DOCUMENT ID                   | TECN | COMMENT                         |                                 |
| seen                                          |     | <sup>5</sup> DEL-AMO-SA...10B | BABR | $B \rightarrow \omega J/\psi K$ |                                 |
| seen                                          |     | <sup>6</sup> CHOI             | 05   | BELL                            | $B \rightarrow \omega J/\psi K$ |

NODE=M159R03  
NODE=M159R03

<sup>5</sup> DEL-AMO-SANCHEZ 10B reports  $B(B^\pm \rightarrow X(3915)K^\pm) \times B(X(3915) \rightarrow J/\psi\omega) = (3.0_{-0.6}^{+0.7+0.5}) \times 10^{-5}$  and  $B(B^0 \rightarrow X(3915)K^0) \times B(X(3915) \rightarrow J/\psi\omega) = (2.1 \pm 0.9 \pm 0.3) \times 10^{-5}$ .

NODE=M159R03;LINKAGE=DE

<sup>6</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=CH

| $\Gamma(\omega J/\psi)/\Gamma(\bar{D}^{*0}D^0)$ |     |                     |      |         | $\Gamma_1/\Gamma_2$               |
|-------------------------------------------------|-----|---------------------|------|---------|-----------------------------------|
| VALUE                                           | CL% | DOCUMENT ID         | TECN | COMMENT |                                   |
| >0.71                                           | 90  | <sup>7</sup> AUSHEV | 10   | BELL    | $B \rightarrow \bar{D}^{*0}D^0 K$ |

NODE=M159R02  
NODE=M159R02

<sup>7</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                           |                   |
| not seen                                   |     | <sup>8</sup> VINOKUROVA 15 | BELL | $B^+ \rightarrow K^+ \eta_c \eta$ |                   |

NODE=M159R00  
NODE=M159R00

<sup>8</sup> VINOKUROVA 15 reports  $B(B^+ \rightarrow K^+ X(3915)^0) \times B(X \rightarrow \eta_c \eta) < 3.3 \times 10^{-5}$  at 90% CL.

NODE=M159R00;LINKAGE=VI

| $\Gamma(\eta_c\pi^0)/\Gamma_{\text{total}}$ |     |                            |      |                                    | $\Gamma_5/\Gamma$ |
|---------------------------------------------|-----|----------------------------|------|------------------------------------|-------------------|
| VALUE                                       | CL% | DOCUMENT ID                | TECN | COMMENT                            |                   |
| not seen                                    |     | <sup>9</sup> VINOKUROVA 15 | BELL | $B^+ \rightarrow K^+ \eta_c \pi^0$ |                   |

NODE=M159R04  
NODE=M159R04

<sup>9</sup> VINOKUROVA 15 reports  $B(B^+ \rightarrow K^+ X(3915)^0) \times B(X \rightarrow \eta_c \pi^0) < 1.8 \times 10^{-5}$  at 90% CL.

NODE=M159R04;LINKAGE=VI

| $\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ |         |             |      |         | $\Gamma_7/\Gamma$                             |
|----------------------------------------------|---------|-------------|------|---------|-----------------------------------------------|
| 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

### X(3915) REFERENCES

NODE=M159

|                  |                        |                                  |                 |
|------------------|------------------------|----------------------------------|-----------------|
| 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.) |
| ZHOU 15C         | PRL 115 022001         | Z.-Y. Zhou, Z. Xiao, H.-Q. Zhou  | (BEIJT, NANJ)   |
| UEHARA 13        | PTEP 2013 123C01       | S. Uehara <i>et al.</i>          | (BELLE Collab.) |
| LEES 12AD        | PR D86 072002          | J.P. Lees <i>et al.</i>          | (BABAR Collab.) |
| LEES 12AE        | PR D86 092005          | J.P. Lees <i>et al.</i>          | (BABAR Collab.) |
| AUSHEV 10        | PR D81 031103          | T. Aushev <i>et al.</i>          | (BELLE Collab.) |
| DEL-AMO-SA...10B | PR D82 011101          | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.) |
| UEHARA 10        | PRL 104 092001         | S. Uehara <i>et al.</i>          | (BELLE Collab.) |
| AUBERT 08W       | PRL 101 082001         | B. Aubert <i>et al.</i>          | (BABAR Collab.) |
| CHOI 05          | PRL 94 182002          | S.-K. Choi <i>et al.</i>         | (BELLE Collab.) |

REFID=56706  
REFID=57795  
REFID=56842  
REFID=55592  
REFID=54751  
REFID=54752  
REFID=53225  
REFID=53362  
REFID=53232  
REFID=52263  
REFID=50737



$\chi_{c2}(3930)$ 

$$J^G(J^{PC}) = 0^+(2^{++})$$

was  $\chi_{c2}(2P)$ 

NODE=M050

 $\chi_{c2}(3930)$  MASS

NODE=M050M

| VALUE (MeV)                   | EVTS    | DOCUMENT ID | TECN     | COMMENT                                   |
|-------------------------------|---------|-------------|----------|-------------------------------------------|
| <b>3927.2±2.6 OUR AVERAGE</b> |         |             |          |                                           |
| 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

 $\chi_{c2}(3930)$  WIDTH

NODE=M050W

| VALUE (MeV)               | EVTS    | DOCUMENT ID | TECN     | COMMENT                                   |
|---------------------------|---------|-------------|----------|-------------------------------------------|
| <b>24 ± 6 OUR AVERAGE</b> |         |             |          |                                           |
| 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

 $\chi_{c2}(3930)$  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>                                         |         |                     |      |         |                                           |
| 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  
 NODE=M050G1

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                                     |                           |
| <18                                                                              | 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

|               |      |                  |                                  |                 |
|---------------|------|------------------|----------------------------------|-----------------|
| 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.) |

NODE=M050

REFID=55592  
REFID=54752  
REFID=16751  
REFID=53357  
REFID=51039

NODE=M029

**X(3940)**

$$I^G(J^{PC}) = ?^?(??)$$

OMITTED FROM SUMMARY TABLE

Reported by ABE 07, observed in  $e^+e^- \rightarrow J/\psi X$ .

NODE=M029

**X(3940) MASS**

NODE=M029M

NODE=M029M

| VALUE (MeV)                                                                                  | EVTS | DOCUMENT ID      | TECN | COMMENT                                    |
|----------------------------------------------------------------------------------------------|------|------------------|------|--------------------------------------------|
| $3942^{+7}_{-6} \pm 6$                                                                       | 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. |      |                  |      |                                            |

OCCUR=2

NODE=M029M;LINKAGE=EB

NODE=M029M;LINKAGE=EM

**X(3940) WIDTH**

NODE=M029W

NODE=M029W

| VALUE (MeV)                                                                   | CL% | EVTS | DOCUMENT ID | TECN | COMMENT                            |
|-------------------------------------------------------------------------------|-----|------|-------------|------|------------------------------------|
| $37^{+26}_{-15} \pm 8$                                                        |     | 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**

NODE=M029215;NODE=M029

| 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                       |

DESIG=1;OUR EVAL;→ UNCHECKED ←

DESIG=2;OUR EVAL;→ UNCHECKED ←

DESIG=3;OUR EVAL;→ UNCHECKED ←

**X(3940) BRANCHING RATIOS**

NODE=M029225

 $\Gamma(D\bar{D}^* + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_1/\Gamma$ 

NODE=M029R01

NODE=M029R01

| 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. |     |      |                    |      |                                    |

NODE=M029R01;LINKAGE=AB

NODE=M029R01;LINKAGE=AE

 $\Gamma(D\bar{D})/\Gamma_{\text{total}}$   $\Gamma_2/\Gamma$ 

NODE=M029R02

NODE=M029R02

| 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. |     |                    |      |                                    |

NODE=M029R02;LINKAGE=AB

NODE=M029R02;LINKAGE=AE

 $\Gamma(J/\psi\omega)/\Gamma_{\text{total}}$   $\Gamma_3/\Gamma$ 

NODE=M029R03

NODE=M029R03

| 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. |     |                    |      |                                    |

NODE=M029R03;LINKAGE=AB

NODE=M029R03;LINKAGE=AE

**X(3940) REFERENCES**

NODE=M029

|         |    |                |                          |                 |
|---------|----|----------------|--------------------------|-----------------|
| 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.) |

REFID=52302

REFID=51627

NODE=M213

NODE=M213

X(4020)

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

Properties incompatible with a  $q\bar{q}$  structure (exotic state). See the review on non- $q\bar{q}$  states.

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) MASS

NODE=M213M

NODE=M213M

| VALUE (MeV)                                 | EVTS | DOCUMENT ID            | TECN | CHG    | COMMENT                                        |
|---------------------------------------------|------|------------------------|------|--------|------------------------------------------------|
| 4024.1±1.9 OUR AVERAGE                      |      |                        |      |        |                                                |
| 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 ± | $e^+e^- \rightarrow \pi^+\pi^-h_c$             |

<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) WIDTH

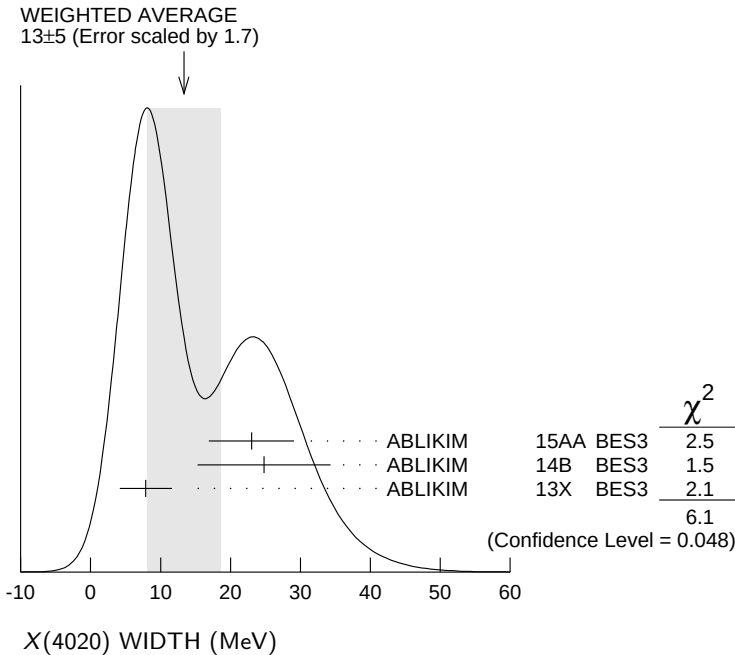
NODE=M213W

NODE=M213W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID          | TECN | CHG    | COMMENT                                        |
|-------------------------------------------------------------------------------|------|----------------------|------|--------|------------------------------------------------|
| 13 ±5 OUR AVERAGE 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 ± | $e^+e^- \rightarrow \pi^+\pi^-h_c$             |

<sup>1</sup> Neglecting interference between the X(4020) and non-resonant continuum.

NODE=M213W;LINKAGE=AB



**X(4020) 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                       |
| $\Gamma_5$ $J/\psi(1S)\pi^\pm$        | not seen                       |

DESIG=1

DESIG=2

DESIG=4

DESIG=3

DESIG=5

**X(4020) 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

| $\Gamma(J/\psi(1S)\pi^\pm)/\Gamma_{\text{total}}$ |                      |      |         |                                        |  | $\Gamma_5/\Gamma$ |
|---------------------------------------------------|----------------------|------|---------|----------------------------------------|--|-------------------|
| 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) REFERENCES**

NODE=M213

|            |      |                         |                             |                   |
|------------|------|-------------------------|-----------------------------|-------------------|
| ABLIKIM    | 17J  | PRL 119 072001          | M. Ablikim <i>et al.</i>    | (BES III Collab.) |
| ABLIKIM    | 15AA | PRL 115 182002          | M. Ablikim <i>et al.</i>    | (BES III Collab.) |
| ABLIKIM    | 15AC | PR D92 092006           | M. Ablikim <i>et al.</i>    | (BES III Collab.) |
| VINOKUROVA | 15   | JHEP 1506 132           | A. Vinokurova <i>et al.</i> | (BELLE Collab.)   |
| Also       |      | JHEP 1702 088 (errata.) | A. Vinokurava <i>et al.</i> | (BELLE Collab.)   |
| ABLIKIM    | 14B  | PRL 112 132001          | M. Ablikim <i>et al.</i>    | (BES III Collab.) |
| ABLIKIM    | 14P  | PRL 113 212002          | M. Ablikim <i>et al.</i>    | (BES III Collab.) |
| ABLIKIM    | 13X  | PRL 111 242001          | M. Ablikim <i>et al.</i>    | (BES III Collab.) |

REFID=57950

REFID=56951

REFID=56967

REFID=56706

REFID=57795

REFID=55654

REFID=56118

REFID=55635

$\psi(4040)$ 

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

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 | $e^+e^- \rightarrow$ hadrons |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                    |                      |          |                              |
| 4034 ± 6                                                                                                                                                                                                                                                                         | <sup>2</sup> MO      | 10 RVUE  | $e^+e^- \rightarrow$ hadrons |
| 4037 ± 2                                                                                                                                                                                                                                                                         | <sup>3</sup> SETH    | 05A RVUE | $e^+e^- \rightarrow$ hadrons |
| 4040 ± 1                                                                                                                                                                                                                                                                         | <sup>4</sup> SETH    | 05A RVUE | $e^+e^- \rightarrow$ 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 | $e^+e^- \rightarrow$ hadrons |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                    |                      |          |                              |
| 87 ± 11                                                                                                                                                                                                                                                                          | <sup>6</sup> MO      | 10 RVUE  | $e^+e^- \rightarrow$ hadrons |
| 85 ± 10                                                                                                                                                                                                                                                                          | <sup>7</sup> SETH    | 05A RVUE | $e^+e^- \rightarrow$ hadrons |
| 89 ± 6                                                                                                                                                                                                                                                                           | <sup>8</sup> SETH    | 05A RVUE | $e^+e^- \rightarrow$ 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 |
| $\Gamma_{35}$ | $\mu^+ \mu^-$                                                                     |                                |                  |     | 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

 **$\psi(4040) \Gamma(i) \times \Gamma(e^+ e^-) / \Gamma(\text{total})$** 

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>13</sup> HAN

15

BELL

 $10.58 e^+ e^- \rightarrow \chi_{c1} \gamma$ 

<sup>13</sup> Using  $B(\eta \rightarrow \gamma \gamma) = (39.41 \pm 0.21)\%$ .

NODE=M072G01;LINKAGE=A

 **$\Gamma(\chi_{c2} \gamma) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$**  **$\Gamma_{23} \Gamma_1 / \Gamma$** 

VALUE (eV)

CL%

DOCUMENT ID

TECN

COMMENT

 **$< 4.6$** 

90

<sup>14</sup> HAN

15

BELL

 $10.58 e^+ e^- \rightarrow \chi_{c2} \gamma$ 

<sup>14</sup> Using  $B(\eta \rightarrow \gamma \gamma) = (39.41 \pm 0.21)\%$ .

NODE=M072G02;LINKAGE=A

$\psi(4040) \Gamma(i) \times \Gamma(e^+ e^-) / \Gamma^2(\text{total})$ 

NODE=M072230

 $\Gamma(J/\psi\eta) / \Gamma_{\text{total}} \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_{19} / \Gamma \times \Gamma_1 / \Gamma$ NODE=M072R25  
NODE=M072R25VALUE (units  $10^{-8}$ )

DOCUMENT ID

TECN

COMMENT

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

 $5.1 \pm 1.4 \pm 1.5$ <sup>15</sup> WANG

13B

BELL

 $e^+ e^- \rightarrow J/\psi \eta \gamma$  $12.8 \pm 2.1 \pm 1.9$ <sup>16</sup> WANG

13B

BELL

 $e^+ e^- \rightarrow J/\psi \eta \gamma$ 

OCCUR=2

<sup>15</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.

NODE=M072R25;LINKAGE=A

<sup>16</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;LINKAGE=B

 $\psi(4040) \text{ BRANCHING RATIOS}$ 

NODE=M072225

 $\Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_1 / \Gamma$ NODE=M072R4  
NODE=M072R4VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

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

 $\sim 1.0$ 

FELDMAN

77

MRK1

 $e^+ e^-$  $\Gamma(D^0 \bar{D}^0) / \Gamma_{\text{total}}$  $\Gamma_3 / \Gamma$ NODE=M072R14  
NODE=M072R14

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

 $e^+ e^- \rightarrow D^0 \bar{D}^0 \gamma$  $\Gamma(D^+ D^-) / \Gamma_{\text{total}}$  $\Gamma_4 / \Gamma$ NODE=M072R15  
NODE=M072R15

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

 $e^+ e^- \rightarrow D^+ D^- \gamma$  $\Gamma(D \bar{D}) / \Gamma(D^* \bar{D} + \text{c.c.})$  $\Gamma_2 / \Gamma_5$ NODE=M072R12  
NODE=M072R12

VALUE

DOCUMENT ID

TECN

COMMENT

 $0.24 \pm 0.05 \pm 0.12$ 

AUBERT

09M

BABR

 $e^+ e^- \rightarrow \gamma D^{(*)} \bar{D}$  $\Gamma(D^0 \bar{D}^0) / \Gamma(D^*(2007)^0 \bar{D}^0 + \text{c.c.})$  $\Gamma_3 / \Gamma_6$ NODE=M072R1  
NODE=M072R1

VALUE

DOCUMENT ID

TECN

COMMENT

 $0.05 \pm 0.03$ <sup>17</sup> GOLDHABER

77

MRK1

 $e^+ e^-$ <sup>17</sup> Phase-space factor ( $p^3$ ) explicitly removed.

NODE=M072R;LINKAGE=P

 $\Gamma(D^*(2007)^0 \bar{D}^0 + \text{c.c.}) / \Gamma_{\text{total}}$  $\Gamma_6 / \Gamma$ NODE=M072R16  
NODE=M072R16

VALUE

DOCUMENT ID

TECN

COMMENT

seen

AUBERT

09M

BABR

 $e^+ e^- \rightarrow D^{*0} \bar{D}^0 \gamma$ 

seen

CRONIN-HEN..09

CLEO

 $e^+ e^- \rightarrow D^{*0} \bar{D}^0$  $\Gamma(D^*(2010)^+ D^- + \text{c.c.}) / \Gamma_{\text{total}}$  $\Gamma_7 / \Gamma$ NODE=M072R17  
NODE=M072R17

VALUE

DOCUMENT ID

TECN

COMMENT

seen

<sup>18</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>18</sup> Supersedes PAKHLOVA 07.

NODE=M072R17;LINKAGE=C

 $\Gamma(D^*(2010)^+ D^- + \text{c.c.}) / \Gamma(D^*(2007)^0 \bar{D}^0 + \text{c.c.})$  $\Gamma_7 / \Gamma_6$ NODE=M072R11  
NODE=M072R11

VALUE

DOCUMENT ID

TECN

COMMENT

 $0.95 \pm 0.09 \pm 0.10$ 

AUBERT

09M

BABR

 $e^+ e^- \rightarrow \gamma D^{*} \bar{D}$  $\Gamma(D^* \bar{D}^*) / \Gamma(D^* \bar{D} + \text{c.c.})$  $\Gamma_8 / \Gamma_5$ NODE=M072R13  
NODE=M072R13

VALUE

DOCUMENT ID

TECN

COMMENT

 $0.18 \pm 0.14 \pm 0.03$ 

AUBERT

09M

BABR

 $e^+ e^- \rightarrow \gamma D^{(*)} \bar{D}^{(*)}$

$$\Gamma(D^*(2007)^0 \bar{D}^*(2007)^0) / \Gamma_{\text{total}} \quad \Gamma_9 / \Gamma$$

| 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=M072R18  
NODE=M072R18

$$\Gamma(D^*(2007)^0 \bar{D}^*(2007)^0) / \Gamma(D^*(2007)^0 \bar{D}^0 + \text{c.c.}) \quad \Gamma_9 / \Gamma_6$$

| VALUE              | DOCUMENT ID                | TECN | COMMENT   |
|--------------------|----------------------------|------|-----------|
| <b>32.0 ± 12.0</b> | <sup>19</sup> GOLDHABER 77 | MRK1 | $e^+ e^-$ |

NODE=M072R2  
NODE=M072R2

<sup>19</sup> Phase-space factor ( $p^3$ ) explicitly removed.

NODE=M072R2;LINKAGE=P

$$\Gamma(D^*(2010)^+ D^*(2010)^-) / \Gamma_{\text{total}} \quad \Gamma_{10} / \Gamma$$

| VALUE | DOCUMENT ID              | TECN | COMMENT                                    |
|-------|--------------------------|------|--------------------------------------------|
| seen  | <sup>20</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=M072R19  
NODE=M072R19

OCCUR=2

• • • 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=M072R19;LINKAGE=B

$$\Gamma(D^0 D^- \pi^+ + \text{c.c. (excl. } D^*(2007)^0 \bar{D}^0 + \text{c.c., } D^*(2010)^+ D^- + \text{c.c.})) / \Gamma_{\text{total}} \quad \Gamma_{12} / \Gamma$$

| VALUE    | DOCUMENT ID  | TECN | COMMENT                                    |
|----------|--------------|------|--------------------------------------------|
| not seen | PAKHLOVA 08A | BELL | $e^+ e^- \rightarrow D^0 D^- \pi^+ \gamma$ |

NODE=M072R20  
NODE=M072R20

$$\Gamma(D \bar{D}^* \pi (\text{excl. } D^* \bar{D}^*)) / \Gamma_{\text{total}} \quad \Gamma_{13} / \Gamma$$

| VALUE    | DOCUMENT ID    | TECN | COMMENT                               |
|----------|----------------|------|---------------------------------------|
| not seen | CRONIN-HEN..09 | CLEO | $e^+ e^- \rightarrow D \bar{D}^* \pi$ |

NODE=M072R21  
NODE=M072R21

$$\Gamma(D^0 \bar{D}^{*-} \pi^+ + \text{c.c. (excl. } D^*(2010)^+ D^*(2010)^-) / \Gamma_{\text{total}} \quad \Gamma_{14} / \Gamma$$

| VALUE | DOCUMENT ID | TECN | COMMENT                                       |
|-------|-------------|------|-----------------------------------------------|
| seen  | PAKHLOVA 09 | BELL | $e^+ e^- \rightarrow D^0 D^{*-} \pi^+ \gamma$ |

NODE=M072R22  
NODE=M072R22

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

| 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=M072R23  
NODE=M072R23

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

| 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

$$\Gamma(J/\psi \pi^0 \pi^0) / \Gamma_{\text{total}} \quad \Gamma_{18} / \Gamma$$

| 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

$$\Gamma(J/\psi \eta) / \Gamma_{\text{total}} \quad \Gamma_{19} / \Gamma$$

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID               | TECN | COMMENT                                     |
|--------------------------|-----|---------------------------|------|---------------------------------------------|
| <b>5.2 ± 0.5 ± 0.5</b>   |     | <sup>21</sup> ABLIKIM 12K | BES3 | $e^+ e^- \rightarrow \ell^+ \ell^- 2\gamma$ |

NODE=M072R03  
NODE=M072R03

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

|    |    |         |      |                                                |
|----|----|---------|------|------------------------------------------------|
| <7 | 90 | COAN 06 | CLEO | $3.97-4.06 e^+ e^- \rightarrow \text{hadrons}$ |
|----|----|---------|------|------------------------------------------------|

<sup>21</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;LINKAGE=AB

$$\Gamma(J/\psi \pi^0) / \Gamma_{\text{total}} \quad \Gamma_{20} / \Gamma$$

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID               | TECN | COMMENT                                     |
|--------------------------|-----|---------------------------|------|---------------------------------------------|
| <b>&lt;0.28</b>          | 90  | <sup>22</sup> ABLIKIM 12K | BES3 | $e^+ e^- \rightarrow \ell^+ \ell^- 2\gamma$ |

NODE=M072R04  
NODE=M072R04

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

|    |    |         |      |                                                |
|----|----|---------|------|------------------------------------------------|
| <2 | 90 | COAN 06 | CLEO | $3.97-4.06 e^+ e^- \rightarrow \text{hadrons}$ |
|----|----|---------|------|------------------------------------------------|

<sup>22</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;LINKAGE=AB



$\Gamma(J/\psi\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{21}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                     |
|--------------------------|-----|-------------|------|---------------------------------------------|
| <2                       | 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                                     |
|-------------------------------------------------------------------------------|-----|-------------|------|---------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                             |
| <11                                                                           | 90  | COAN        | 06   | CLEO 3.97–4.06 $e^+e^- \rightarrow$ hadrons |

NODE=M072R06  
 NODE=M072R06

 $\Gamma(\chi_{c2}\gamma)/\Gamma_{\text{total}}$  $\Gamma_{23}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                      | CL% | DOCUMENT ID | TECN | COMMENT                                     |
|-------------------------------------------------------------------------------|-----|-------------|------|---------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                             |
| <17                                                                           | 90  | COAN        | 06   | CLEO 3.97–4.06 $e^+e^- \rightarrow$ hadrons |

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                                     |
|--------------------------|-----|-------------|------|---------------------------------------------|
| <11                      | 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                                     |
|--------------------------|-----|-------------|------|---------------------------------------------|
| <32                      | 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                                     |
|--------------------------|-----|-------------|------|---------------------------------------------|
| <3                       | 90  | 23 PEDLAR   | 11   | CLEO $e^+e^- \rightarrow h_c(1P)\pi^+\pi^-$ |

NODE=M072R24  
 NODE=M072R24

<sup>23</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;LINKAGE=PE

 $\Gamma(\phi\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{27}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                     |
|--------------------------|-----|-------------|------|---------------------------------------------|
| <3                       | 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                              |
|--------------------------|-----|-------------|------|--------------------------------------|
| <2.9                     | 90  | 24 ABLIKIM  | 13Q  | BES3 $e^+e^- \rightarrow \psi(4040)$ |

NODE=M072R26  
 NODE=M072R26

<sup>24</sup>Assuming that interference effects between resonance and continuum can be neglected.

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                              |
|--------------------------|-----|-------------|------|--------------------------------------|
| <0.9                     | 90  | 25 ABLIKIM  | 13Q  | BES3 $e^+e^- \rightarrow \psi(4040)$ |

NODE=M072R27  
 NODE=M072R27

<sup>25</sup>Assuming that interference effects between resonance and continuum can be neglected.

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  | 26 ABLIKIM  | 13Q  | BES3 $e^+e^- \rightarrow \psi(4040)$ |

NODE=M072R28  
 NODE=M072R28

<sup>26</sup>Assuming that interference effects between resonance and continuum can be neglected.

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  | 27 ABLIKIM  | 13Q  | BES3 $e^+e^- \rightarrow \psi(4040)$ |

NODE=M072R29  
 NODE=M072R29

<sup>27</sup>Assuming that interference effects between resonance and continuum can be neglected.

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  | 28 ABLIKIM  | 13Q  | BES3 $e^+e^- \rightarrow \psi(4040)$ |

NODE=M072R30  
 NODE=M072R30

<sup>28</sup>Assuming that interference effects between resonance and continuum can be neglected.

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  | 29 ABLIKIM  | 13Q  | BES3 $e^+e^- \rightarrow \psi(4040)$ |

NODE=M072R31  
 NODE=M072R31

<sup>29</sup>Assuming that interference effects between resonance and continuum can be neglected.

NODE=M072R31;LINKAGE=A

$\Gamma(\Xi^0 \Xi^0)/\Gamma_{\text{total}}$  $\Gamma_{34}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID           | TECN     | COMMENT                          |
|--------------------------|-----|-----------------------|----------|----------------------------------|
| <b>&lt;1.8</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=M072R32  
NODE=M072R32

NODE=M072R32;LINKAGE=A

### $\psi(4040)$ REFERENCES

|               |     |                |                                  |                             |
|---------------|-----|----------------|----------------------------------|-----------------------------|
| ZHUKOVA       | 18  | PR D97 012002  | V. Zhukova <i>et al.</i>         | (BELLE Collab.)             |
| HAN           | 15  | PR D92 012011  | Y.L. Han <i>et al.</i>           | (BELLE Collab.)             |
| ABLIKIM       | 13Q | PR D87 112011  | Ablikim M. <i>et al.</i>         | (BES III Collab.)           |
| WANG          | 13B | PR D87 051101  | X.L. Wang <i>et al.</i>          | (BELLE Collab.)             |
| ABLIKIM       | 12K | PR D86 071101  | M. Ablikim <i>et al.</i>         | (BES III Collab.)           |
| 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.)              |
| Also          |     | ZPHY C1 233    | R. Brandelik <i>et al.</i>       | (DASP Collab.)              |
| FELDMAN       | 77  | PRPL 33C 285   | G.J. Feldman, M.L. Perl          | (LBL, SLAC)                 |
| GOLDHABER     | 77  | PL 69B 503     | G. Goldhaber <i>et al.</i>       | (Mark I Collab.)            |

NODE=M072

REFID=58710  
REFID=56816  
REFID=55393  
REFID=55377  
REFID=54738  
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  
REFID=22114  
REFID=22062  
REFID=11434

**$X(4050)^\pm$**

$I^G(J^{PC}) = 1^-(?^{?+})$   
 $I, G, C$  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=M191

NODE=M191

### $X(4050)^\pm$ MASS

| VALUE (MeV)                                 | DOCUMENT ID        | TECN    | COMMENT                                         |
|---------------------------------------------|--------------------|---------|-------------------------------------------------|
| <b><math>4051 \pm 14^{+20}_{-41}</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=M191M

NODE=M191M

NODE=M191M;LINKAGE=MI

### $X(4050)^\pm$ WIDTH

| VALUE (MeV)                              | DOCUMENT ID        | TECN    | COMMENT                                         |
|------------------------------------------|--------------------|---------|-------------------------------------------------|
| <b><math>82^{+21+47}_{-17-22}</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=M191W

NODE=M191W

NODE=M191W;LINKAGE=MI

### $X(4050)^\pm$ DECAY MODES

| Mode                                 | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------------------|--------------------------------|
| $\Gamma_1 \quad \pi^+ \chi_{c1}(1P)$ | seen                           |

NODE=M191215;NODE=M191

DESIG=1

**$X(4050)^\pm$  BRANCHING RATIOS**

| $\Gamma(\pi^+ \chi_{c1}(1P))/\Gamma_{\text{total}}$                                                                                                                                                       | DOCUMENT ID        | TECN     | COMMENT                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------|-------------------------------------------------|
| 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. • • •                                                                                                                             |                    |          |                                                 |
| <b>not seen</b>                                                                                                                                                                                           | <sup>2</sup> LEES  | 12B BABR | $B \rightarrow K \pi \chi_{c1}(1P)$             |
| <sup>1</sup> With a product branching fraction measurement of $B(\bar{B}^0 \rightarrow K^- X(4050)^+) \times B(X(4050)^+ \rightarrow \pi^+ \chi_{c1}(1P)) = (3.0^{+1.5+3.7}_{-0.8-1.6}) \times 10^{-5}$ . |                    |          |                                                 |
| <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=M191225

NODE=M191R01  
NODE=M191R01

NODE=M191R01;LINKAGE=MI

NODE=M191R01;LINKAGE=LE

 **$X(4050)^\pm$  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=M191

REFID=54042  
REFID=52535

NODE=M223

 **$X(4055)^\pm$** 
 $I^G(J^{PC}) = 1^+(?^-)$   
 $I, G, C$  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.

NODE=M223

Needs confirmation. Seen by WANG 15A in the  $\psi(2S)\pi^+$  invariant mass distribution in  $\psi(4360) \rightarrow \psi(2S)\pi^+\pi^-$  decay.

 **$X(4055)^\pm$  MASS**

| VALUE (MeV)                                                                                                                                                                                                                                                                                                            | DOCUMENT ID          | TECN     | COMMENT                                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------|---------------------------------------------------------|
| <b>4054 <math>\pm 3</math> <math>\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</math> <math>\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 ( $\Gamma_i/\Gamma$ ) |
|---------------------------------|--------------------------------|
| $\Gamma_1 \quad \pi^+ \psi(2S)$ | seen                           |

NODE=M223215;NODE=M223

DESIG=1

**$X(4055)^\pm$  BRANCHING RATIOS** $\Gamma(\pi^+\psi(2S))/\Gamma_{\text{total}}$  $\Gamma_1/\Gamma$ 

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

 **$X(4055)^\pm$  REFERENCES**

|         |     |                        |                          |                   |
|---------|-----|------------------------|--------------------------|-------------------|
| ABLIKIM | 18K | PR D97 052001          | M. Ablikim <i>et al.</i> | (BES III Collab.) |
| ABLIKIM | 17V | PR D96 032004          | M. Ablikim <i>et al.</i> | (BES III Collab.) |
| Also    |     | PR D99 019903 (errat.) | M. Ablikim <i>et al.</i> | (BES III Collab.) |
| WANG    | 15A | PR D91 112007          | X.L. Wang <i>et al.</i>  | (BELLE Collab.)   |

NODE=M223

REFID=58896  
REFID=58029  
REFID=59611  
REFID=56839

NODE=M240

 **$X(4100)^\pm$** 

$$I^G(J^{PC}) = 1^-(??)$$

**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**

| VALUE (MeV)                                 | DOCUMENT ID | TECN      | COMMENT                              |
|---------------------------------------------|-------------|-----------|--------------------------------------|
| <b><math>4096 \pm 20^{+18}_{-22}</math></b> | AAIJ        | 18AN LHCB | $B^0 \rightarrow \eta_c(1S)K^+\pi^-$ |

NODE=M240M

NODE=M240M

 **$X(4100)^\pm$  WIDTH**

| VALUE (MeV)                                | DOCUMENT ID | TECN      | COMMENT                              |
|--------------------------------------------|-------------|-----------|--------------------------------------|
| <b><math>152 \pm 58^{+60}_{-35}</math></b> | AAIJ        | 18AN LHCB | $B^0 \rightarrow \eta_c(1S)K^+\pi^-$ |

NODE=M240W

NODE=M240W

 **$X(4100)^\pm$  DECAY MODES**

| Mode                             | Fraction ( $\Gamma_i/\Gamma$ ) |
|----------------------------------|--------------------------------|
| $\Gamma_1 \quad \eta_c(1S)\pi^-$ | seen                           |

NODE=M240215;NODE=M240

DESIG=1

 **$X(4100)^\pm$  BRANCHING RATIOS** $\Gamma(\eta_c(1S)\pi^-)/\Gamma_{\text{total}}$  $\Gamma_1/\Gamma$ 

| 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=M240225

NODE=M240R01  
NODE=M240R01

NODE=M240R01;LINKAGE=A

 **$X(4100)^\pm$  REFERENCES**

|      |                   |                       |                |
|------|-------------------|-----------------------|----------------|
| AAIJ | 18AN EPJ C78 1019 | R. Aaij <i>et al.</i> | (LHCb Collab.) |
|------|-------------------|-----------------------|----------------|

NODE=M240

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  $3.1 \sigma$ .

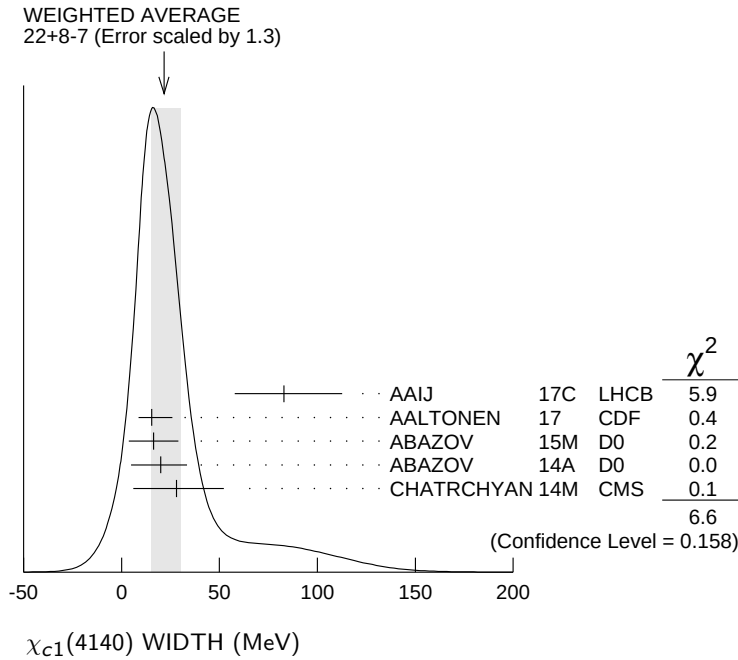
<sup>5</sup> From a fit assuming an  $S$ -wave relativistic Breit-Wigner shape above a three-body phase-space non-resonant component with statistical significance of more than  $5 \sigma$ .

<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



### $\chi_{c1}(4140)$ 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. • • • |     |                   |      |         |                                              |
| < 6                                                                           | 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

$\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_2/\Gamma$ 

| VALUE    | DOCUMENT ID | TECN | COMMENT                                          |
|----------|-------------|------|--------------------------------------------------|
| not seen | SHEN        | 10   | BELL 10.6 $e^+e^- \rightarrow e^+e^- J/\psi\phi$ |

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>    | (BES III 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)                                                                   | DOCUMENT ID          | TECN | COMMENT                                |
|-------------------------------------------------------------------------------|----------------------|------|----------------------------------------|
| <b>4191 <math>\pm</math> 5 OUR AVERAGE</b>                                    |                      |      |                                        |
| 4191 $\begin{smallmatrix} +9 \\ -8 \end{smallmatrix}$                         | AAIJ                 | 13BC | LHCB $B^+ \rightarrow K^+ \mu^+ \mu^-$ |
| 4191.7 $\pm$ 6.5                                                              | <sup>1</sup> ABLIKIM | 08D  | BES2 $e^+e^- \rightarrow$ hadrons      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                      |      |                                        |
| 4193 $\pm$ 7                                                                  | <sup>2</sup> MO      | 10   | RVUE $e^+e^- \rightarrow$ hadrons      |
| 4151 $\pm$ 4                                                                  | <sup>3</sup> SETH    | 05A  | RVUE $e^+e^- \rightarrow$ hadrons      |
| 4155 $\pm$ 5                                                                  | <sup>4</sup> SETH    | 05A  | RVUE $e^+e^- \rightarrow$ hadrons      |
| 4159 $\pm$ 20                                                                 | BRANDELIK            | 78C  | DASP $e^+e^-$                          |

NODE=M025M

NODE=M025M

<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.

OCCUR=2

NODE=M025M;LINKAGE=AB

NODE=M025M;LINKAGE=MO

NODE=M025M;LINKAGE=ST

NODE=M025M;LINKAGE=SE

 $\psi(4160)$  WIDTH

| VALUE (MeV)                                                                   | DOCUMENT ID          | TECN | COMMENT                                |
|-------------------------------------------------------------------------------|----------------------|------|----------------------------------------|
| <b>70 <math>\pm</math> 10 OUR AVERAGE</b>                                     |                      |      |                                        |
| 65 $\begin{smallmatrix} +22 \\ -16 \end{smallmatrix}$                         | AAIJ                 | 13BC | LHCB $B^+ \rightarrow K^+ \mu^+ \mu^-$ |
| 71.8 $\pm$ 12.3                                                               | <sup>1</sup> ABLIKIM | 08D  | BES2 $e^+e^- \rightarrow$ hadrons      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                      |      |                                        |
| 79 $\pm$ 14                                                                   | <sup>2</sup> MO      | 10   | RVUE $e^+e^- \rightarrow$ hadrons      |
| 107 $\pm$ 10                                                                  | <sup>3</sup> SETH    | 05A  | RVUE $e^+e^- \rightarrow$ hadrons      |
| 107 $\pm$ 16                                                                  | <sup>4</sup> SETH    | 05A  | RVUE $e^+e^- \rightarrow$ hadrons      |
| 78 $\pm$ 20                                                                   | BRANDELIK            | 78C  | DASP $e^+e^-$                          |

NODE=M025W

NODE=M025W

<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;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                        |
| $\Gamma_{34}$ $\gamma\chi_{c1}(3872) \rightarrow \gamma J/\psi\pi^+\pi^-$                                            | $< 6.8 \times 10^{-5}$         | 90%              | DESIG=34                        |
| $\Gamma_{35}$ $\gamma X(3915) \rightarrow \gamma J/\psi\pi^+\pi^-$                                                   | $< 1.36 \times 10^{-4}$        | 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                        |
| $\Gamma_{38}$ $\gamma\chi_{c1}(3872) \rightarrow \gamma\gamma J/\psi$                                                | $< 1.05 \times 10^{-4}$        | 90%              | DESIG=38                        |
| $\Gamma_{39}$ $\gamma X(3915) \rightarrow \gamma\gamma J/\psi$                                                       | $< 1.26 \times 10^{-4}$        | 90%              | DESIG=39                        |
| $\Gamma_{40}$ $\gamma X(3930) \rightarrow \gamma\gamma J/\psi$                                                       | $< 8.8 \times 10^{-5}$         | 90%              | DESIG=40                        |
| $\Gamma_{41}$ $\gamma X(3940) \rightarrow \gamma\gamma J/\psi$                                                       | $< 1.79 \times 10^{-4}$        | 90%              | DESIG=41                        |
| $\Gamma_{42}$ $K^+K^-$                                                                                               |                                |                  | DESIG=42                        |



$\psi(4160)$  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

 $\psi(4160) \Gamma(i) \times \Gamma(e^+e^-)/\Gamma(\text{total})$  $\Gamma(\chi_{c1}\gamma) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_{25}\Gamma_1/\Gamma$ 

| 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=M025235

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

 $\psi(4160) \Gamma(i) \times \Gamma(e^+e^-)/\Gamma^2(\text{total})$  $\Gamma(J/\psi\eta)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_{20}/\Gamma \times \Gamma_1/\Gamma$ 

| VALUE (units $10^{-8}$ ) | DOCUMENT ID       | TECN     | COMMENT                               |
|--------------------------|-------------------|----------|---------------------------------------|
| 2.8±0.9±0.9              | <sup>1</sup> WANG | 13B BELL | $e^+e^- \rightarrow J/\psi\eta\gamma$ |
| 12.8±1.7±2.0             | <sup>2</sup> WANG | 13B BELL | $e^+e^- \rightarrow J/\psi\eta\gamma$ |

<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.

<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=M025230

NODE=M025R32  
NODE=M025R32

OCCUR=2

NODE=M025R32;LINKAGE=A

NODE=M025R32;LINKAGE=B

 $\psi(4160)$  BRANCHING RATIOS $\Gamma(\mu^+\mu^-)/\Gamma_{\text{total}}$  $\Gamma_2/\Gamma$ 

| VALUE       | DOCUMENT ID       | TECN      | COMMENT                         |
|-------------|-------------------|-----------|---------------------------------|
| <b>seen</b> | <sup>1</sup> AAIJ | 13BC LHCb | $B^+ \rightarrow K^+\mu^+\mu^-$ |

<sup>1</sup> AAIJ 13BC report  $B(B^+ \rightarrow K^+\psi(4160)) B(\psi(4160) \rightarrow \mu^+\mu^-) = (3.5_{-0.8}^{+0.9}) \times 10^{-9}$ .

NODE=M025225

NODE=M025R31  
NODE=M025R31

NODE=M025R31;LINKAGE=A

 $\Gamma(D\bar{D})/\Gamma(D^*\bar{D}^*)$  $\Gamma_3/\Gamma_9$ 

| VALUE                 | DOCUMENT ID | TECN     | COMMENT                                          |
|-----------------------|-------------|----------|--------------------------------------------------|
| <b>0.02±0.03±0.02</b> | 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                                 |
|-------------------------------------------------------------------------------|----------------|----------|-----------------------------------------|
| <b>seen</b>                                                                   | CRONIN-HEN..09 | CLEO     | $e^+e^- \rightarrow D^0\bar{D}^0$       |
| <b>seen</b>                                                                   | PAKHOVA 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=M025R16  
NODE=M025R16

$\Gamma(D^+ D^-)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ NODE=M025R17  
NODE=M025R17

| VALUE                                                                         | DOCUMENT ID    | TECN | COMMENT                              |
|-------------------------------------------------------------------------------|----------------|------|--------------------------------------|
| seen                                                                          | CRONIN-HEN..09 | CLEO | $e^+ e^- \rightarrow D^+ D^-$        |
| seen                                                                          | PAKHLOVA 08    | BELL | $e^+ e^- \rightarrow D^+ D^- \gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                |      |                                      |
| not seen                                                                      | AUBERT 09M     | BABR | $e^+ e^- \rightarrow D^+ D^- \gamma$ |

 $\Gamma(D^*(2007)^0 \bar{D}^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ NODE=M025R18  
NODE=M025R18

| VALUE | DOCUMENT ID    | TECN | COMMENT                                       |
|-------|----------------|------|-----------------------------------------------|
| seen  | AUBERT 09M     | BABR | $e^+ e^- \rightarrow D^{*0} \bar{D}^0 \gamma$ |
| seen  | CRONIN-HEN..09 | CLEO | $e^+ e^- \rightarrow D^{*0} \bar{D}^0$        |

 $\Gamma(D^*(2010)^+ D^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_8/\Gamma$ NODE=M025R19  
NODE=M025R19

| 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=M025R19;LINKAGE=A

 $\Gamma(D^* \bar{D} + \text{c.c.})/\Gamma(D^* \bar{D}^*)$  $\Gamma_6/\Gamma_9$ NODE=M025R15  
NODE=M025R15

| VALUE                    | DOCUMENT ID | TECN | COMMENT                                            |
|--------------------------|-------------|------|----------------------------------------------------|
| $0.34 \pm 0.14 \pm 0.05$ | AUBERT 09M  | BABR | $e^+ e^- \rightarrow \gamma D^{(*)} \bar{D}^{(*)}$ |

 $\Gamma(D^*(2007)^0 \bar{D}^{*0}(2007)^0)/\Gamma_{\text{total}}$  $\Gamma_{10}/\Gamma$ NODE=M025R20  
NODE=M025R20

| VALUE | DOCUMENT ID    | TECN | COMMENT                                          |
|-------|----------------|------|--------------------------------------------------|
| seen  | AUBERT 09M     | BABR | $e^+ e^- \rightarrow D^{*0} \bar{D}^{*0} \gamma$ |
| seen  | CRONIN-HEN..09 | CLEO | $e^+ e^- \rightarrow D^{*0} \bar{D}^{*0}$        |

 $\Gamma(D^*(2010)^+ D^*(2010)^-)/\Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ NODE=M025R21  
NODE=M025R21

| 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;LINKAGE=A

 $\Gamma(D^0 D^- \pi^+ + \text{c.c. (excl. } D^*(2007)^0 \bar{D}^0 + \text{c.c., } D^*(2010)^+ D^- + \text{c.c.}))/$  $\Gamma_{\text{total}}$  $\Gamma_{12}/\Gamma$ NODE=M025R22  
NODE=M025R22

| VALUE    | DOCUMENT ID  | TECN | COMMENT                                    |
|----------|--------------|------|--------------------------------------------|
| not seen | PAKHLOVA 08A | BELL | $e^+ e^- \rightarrow D^0 D^- \pi^+ \gamma$ |

 $\Gamma(D \bar{D}^* \pi + \text{c.c. (excl. } D^* \bar{D}^*))/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ NODE=M025R23  
NODE=M025R23

| VALUE | DOCUMENT ID    | TECN | COMMENT                               |
|-------|----------------|------|---------------------------------------|
| seen  | CRONIN-HEN..09 | CLEO | $e^+ e^- \rightarrow D \bar{D}^* \pi$ |

 $\Gamma(D^0 D^{*-} \pi^+ + \text{c.c. (excl. } D^*(2010)^+ D^*(2010)^-))/\Gamma_{\text{total}}$  $\Gamma_{14}/\Gamma$ NODE=M025R24  
NODE=M025R24

| VALUE    | DOCUMENT ID | TECN | COMMENT                                       |
|----------|-------------|------|-----------------------------------------------|
| not seen | PAKHLOVA 09 | BELL | $e^+ e^- \rightarrow D^0 D^{*-} \pi^+ \gamma$ |

 $\Gamma(D_s^+ D_s^-)/\Gamma_{\text{total}}$  $\Gamma_{15}/\Gamma$ NODE=M025R25  
NODE=M025R25

| 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 | $e^+ e^- \rightarrow D_s^+ D_s^-$        |

 $\Gamma(D_s^{*+} D_s^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{16}/\Gamma$ NODE=M025R26  
NODE=M025R26

| 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 | $e^+ e^- \rightarrow D_s^{*+} D_s^-$        |

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

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                    |
|--------------------------|-----|-------------|------|--------------------------------------------|
| <3                       | 90  | COAN        | 06   | CLEO 4.12–4.2 $e^+e^- \rightarrow$ hadrons |

 $\Gamma_{17}/\Gamma$ 

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 |

 $\Gamma_{18}/\Gamma$ 

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 |

 $\Gamma_{19}/\Gamma$ 

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 |

 $\Gamma_{20}/\Gamma$ 

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 |

 $\Gamma_{21}/\Gamma$ 

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 |

 $\Gamma_{22}/\Gamma$ 

NODE=M025R06  
 NODE=M025R06

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

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                    |
|--------------------------|-----|-------------|------|--------------------------------------------|
| <1                       | 90  | COAN        | 06   | CLEO 4.12–4.2 $e^+e^- \rightarrow$ hadrons |

 $\Gamma_{23}/\Gamma$ 

NODE=M025R07  
 NODE=M025R07

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

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                    |
|--------------------------|-----|-------------|------|--------------------------------------------|
| <4                       | 90  | COAN        | 06   | CLEO 4.12–4.2 $e^+e^- \rightarrow$ hadrons |

 $\Gamma_{24}/\Gamma$ 

NODE=M025R08  
 NODE=M025R08

 $\Gamma(\chi_{c1}\gamma)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                    |
|--------------------------|-----|-------------|------|--------------------------------------------|
| <7                       | 90  | COAN        | 06   | CLEO 4.12–4.2 $e^+e^- \rightarrow$ hadrons |

 $\Gamma_{25}/\Gamma$ 

NODE=M025R09  
 NODE=M025R09

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

 $\Gamma(\chi_{c2}\gamma)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                    |
|--------------------------|-----|-------------|------|--------------------------------------------|
| <13                      | 90  | COAN        | 06   | CLEO 4.12–4.2 $e^+e^- \rightarrow$ hadrons |

 $\Gamma_{26}/\Gamma$ 

NODE=M025R10  
 NODE=M025R10

 $\Gamma(\chi_{c1}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                    |
|--------------------------|-----|-------------|------|--------------------------------------------|
| <2                       | 90  | COAN        | 06   | CLEO 4.12–4.2 $e^+e^- \rightarrow$ hadrons |

 $\Gamma_{27}/\Gamma$ 

NODE=M025R11  
 NODE=M025R11

 $\Gamma(\chi_{c2}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                    |
|--------------------------|-----|-------------|------|--------------------------------------------|
| <8                       | 90  | COAN        | 06   | CLEO 4.12–4.2 $e^+e^- \rightarrow$ hadrons |

 $\Gamma_{28}/\Gamma$ 

NODE=M025R12  
 NODE=M025R12

 $\Gamma(h_c(1P)\pi^+\pi^-)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID         | TECN | COMMENT                                     |
|--------------------------|-----|---------------------|------|---------------------------------------------|
| <5                       | 90  | <sup>1</sup> PEDLAR | 11   | CLEO $e^+e^- \rightarrow h_c(1P)\pi^+\pi^-$ |

 $\Gamma_{29}/\Gamma$ 

NODE=M025R27  
 NODE=M025R27

<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;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

 $\Gamma(\gamma\chi_{c1}(3872) \rightarrow \gamma J/\psi\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{34}/\Gamma$ 

| VALUE                  | CL% | DOCUMENT ID       | COMMENT                                             |
|------------------------|-----|-------------------|-----------------------------------------------------|
| <0.68 $\times 10^{-4}$ | 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=M025R34  
NODE=M025R34

NODE=M025R34;LINKAGE=A

 $\Gamma(\gamma X(3915) \rightarrow \gamma J/\psi\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{35}/\Gamma$ 

| 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

 $\Gamma(\gamma\chi_{c1}(3872) \rightarrow \gamma\gamma J/\psi)/\Gamma_{\text{total}}$  $\Gamma_{38}/\Gamma$ 

| VALUE                  | CL% | DOCUMENT ID       | COMMENT                                         |
|------------------------|-----|-------------------|-------------------------------------------------|
| <1.05 $\times 10^{-4}$ | 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=M025R38  
NODE=M025R38

NODE=M025R38;LINKAGE=A

 $\Gamma(\gamma X(3915) \rightarrow \gamma\gamma J/\psi)/\Gamma_{\text{total}}$  $\Gamma_{39}/\Gamma$ 

| 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

 $\Gamma(\gamma X(3930) \rightarrow \gamma\gamma J/\psi)/\Gamma_{\text{total}}$  $\Gamma_{40}/\Gamma$ 

| 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

$\Gamma(\gamma X(3940) \rightarrow \gamma\gamma J/\psi)/\Gamma_{\text{total}}$ 

| VALUE                  | CL% | DOCUMENT ID          | TECN | 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.

 $\Gamma_{41}/\Gamma$ 

NODE=M025R41  
NODE=M025R41

NODE=M025R41;LINKAGE=A

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

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

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

$<2 \times 10^{-5}$  90 <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  $e^+e^- \rightarrow K_S^0 K_L^0$ .

 $\Gamma_{42}/\Gamma$ 

NODE=M025R33  
NODE=M025R33

NODE=M025R33;LINKAGE=A

 $\psi(4160)$  REFERENCES

|                                 |                                                        |
|---------------------------------|--------------------------------------------------------|
| ZHUKOVA 18 PR D97 012002        | V. Zhukova <i>et al.</i> (BELLE Collab.)               |
| ABLIKIM 17R PR D96 012001       | M. Ablikim <i>et al.</i> (BES III Collab.)             |
| ABLIKIM 15L PR D91 112005       | M. Ablikim <i>et al.</i> (BES III Collab.)             |
| DRUZHININ 15 PR D92 054024      | V.P. Druzhinin (NOVO)                                  |
| HAN 15 PR D92 012011            | Y.L. Han <i>et al.</i> (BELLE Collab.)                 |
| AAIJ 13BC PRL 111 112003        | R. Aaij <i>et al.</i> (LHCb Collab.)                   |
| WANG 13B PR D87 051101          | X.L. Wang <i>et al.</i> (BELLE Collab.)                |
| XIAO 13 PR D87 057501           | T. Xiao <i>et al.</i> (NWES, WAYN)                     |
| 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.)              |

NODE=M025

REFID=58710  
REFID=58009  
REFID=56777  
REFID=56962  
REFID=56816  
REFID=55229  
REFID=55377  
REFID=55381  
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

 $X(4160)$ 

$$I^G(J^{PC}) = ?^?(??)$$

OMITTED FROM SUMMARY TABLE

Seen by PAKHLOV 08 in  $e^+e^- \rightarrow J/\psi X$ ,  $X \rightarrow D^* \bar{D}^*$

NODE=M190

NODE=M190

 $X(4160)$  MASS

| VALUE (MeV)               | EVTS | DOCUMENT ID | TECN | COMMENT                       |
|---------------------------|------|-------------|------|-------------------------------|
| $4156^{+25}_{-20} \pm 15$ | 24   | PAKHLOV 08  | BELL | $e^+e^- \rightarrow J/\psi X$ |

NODE=M190M

NODE=M190M

 $X(4160)$  WIDTH

| VALUE (MeV)               | EVTS | DOCUMENT ID | TECN | COMMENT                       |
|---------------------------|------|-------------|------|-------------------------------|
| $139^{+111}_{-61} \pm 21$ | 24   | PAKHLOV 08  | BELL | $e^+e^- \rightarrow J/\psi X$ |

NODE=M190W

NODE=M190W

 $X(4160)$  DECAY MODES

| Mode                                  | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------------|--------------------------------|
| $\Gamma_1$ $D\bar{D}$                 | not seen                       |
| $\Gamma_2$ $D^*\bar{D} + \text{c.c.}$ | not seen                       |
| $\Gamma_3$ $D^*\bar{D}^*$             | seen                           |

NODE=M190215;NODE=M190

DESIG=1;OUR EVAL;→ UNCHECKED ←

DESIG=2;OUR EVAL;→ UNCHECKED ←

DESIG=3;OUR EVAL;→ UNCHECKED ←

 $X(4160)$  BRANCHING RATIOS $\Gamma(D\bar{D})/\Gamma(D^*\bar{D}^*)$ 

| VALUE   | CL% | DOCUMENT ID | TECN | COMMENT                       |
|---------|-----|-------------|------|-------------------------------|
| $<0.09$ | 90  | PAKHLOV 08  | BELL | $e^+e^- \rightarrow J/\psi X$ |

 $\Gamma_1/\Gamma_3$ 

NODE=M190225

NODE=M190R01  
NODE=M190R01

$\Gamma(D^*\bar{D} + \text{c.c.})/\Gamma(D^*\bar{D}^*)$  $\Gamma_2/\Gamma_3$ 

| VALUE           | CL% | DOCUMENT ID | TECN | COMMENT                            |
|-----------------|-----|-------------|------|------------------------------------|
| <b>&lt;0.22</b> | 90  | PAKHLOV     | 08   | BELL $e^+e^- \rightarrow J/\psi X$ |

NODE=M190R02  
 NODE=M190R02

**X(4160) REFERENCES**

PAKHLOV 08 PRL 100 202001 P. Pakhlov *et al.* (BELLE Collab.)

NODE=M190

REFID=52302

NODE=M231

 **$Z_c(4200)$** 

$I^G(J^{PC}) = 1^+(1^{+-})$   
 $I, G, C$  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.

NODE=M231

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.

 **$Z_c(4200)$  MASS**

| VALUE (MeV)                                | DOCUMENT ID | TECN | COMMENT                                       |
|--------------------------------------------|-------------|------|-----------------------------------------------|
| <b><math>4196^{+31+17}_{-29-13}</math></b> | CHILIKIN    | 14   | BELL $\bar{B}^0 \rightarrow J/\psi K^- \pi^+$ |

NODE=M231M

NODE=M231M

 **$Z_c(4200)$  WIDTH**

| VALUE (MeV)                                 | DOCUMENT ID | TECN | COMMENT                                       |
|---------------------------------------------|-------------|------|-----------------------------------------------|
| <b><math>370 \pm 70^{+70}_{-132}</math></b> | CHILIKIN    | 14   | BELL $\bar{B}^0 \rightarrow J/\psi K^- \pi^+$ |

NODE=M231W

NODE=M231W

 **$Z_c(4200)$  DECAY MODES**

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------|--------------------------------|
| $\Gamma_1$ $J/\psi\pi^+$ | seen                           |

NODE=M231215;NODE=M231

DESIG=1

 **$Z_c(4200)$  BRANCHING RATIOS** $\Gamma(J/\psi\pi^+)/\Gamma_{\text{total}}$  $\Gamma_1/\Gamma$ 

| VALUE       | DOCUMENT ID | TECN | COMMENT                                       |
|-------------|-------------|------|-----------------------------------------------|
| <b>seen</b> | CHILIKIN    | 14   | BELL $\bar{B}^0 \rightarrow J/\psi K^- \pi^+$ |

NODE=M231220

NODE=M231R01  
 NODE=M231R01

 **$Z_c(4200)$  REFERENCES**

CHILIKIN 14 PR D90 112009 K. Chilikin *et al.* (BELLE Collab.)

NODE=M231

REFID=56344

**$\psi(4230)$** 

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

OMITTED FROM SUMMARY TABLE

was  $X(4230)$ 

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.

Enhancement reported by ABLIKIM 15C in  $e^{+}e^{-} \rightarrow \omega\chi_{c0}$  at  $\sqrt{s} = 4.23\text{--}4.26$  GeV at  $9\sigma$  significance. Lineshape found to be inconsistent with origination from  $\psi(4260)$ . Needs confirmation.

NODE=M222

NODE=M222

 **$\psi(4230)$  MASS**

NODE=M222M

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

NODE=M222M

**4218  $^{+5}_{-4}$  OUR AVERAGE** Error includes scale factor of 1.2.

|                               |     |                      |     |      |                                                 |
|-------------------------------|-----|----------------------|-----|------|-------------------------------------------------|
| 4218 $^{+5.5}_{-4.5} \pm 0.9$ |     | ABLIKIM              | 17G | BES3 | $e^{+}e^{-} \rightarrow \pi^{+}\pi^{-}h_c$      |
| 4209.5 $\pm 7.4 \pm 1.4$      |     | <sup>1</sup> ABLIKIM | 17V | BES3 | $e^{+}e^{-} \rightarrow \pi^{+}\pi^{-}\psi(2S)$ |
| 4230 $\pm 8 \pm 6$            | 180 | <sup>2</sup> ABLIKIM | 15C | BES3 | $e^{+}e^{-} \rightarrow \omega\chi_{c0}$        |

<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  $5.1\text{ fb}^{-1}$ .

<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=M222M;LINKAGE=B

NODE=M222M;LINKAGE=A

 **$\psi(4230)$  WIDTH**

NODE=M222W

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

NODE=M222W

**59  $^{+12}_{-10}$  OUR AVERAGE** Error includes scale factor of 1.5. See the ideogram below.

|                                |     |                      |     |      |                                                 |
|--------------------------------|-----|----------------------|-----|------|-------------------------------------------------|
| 66.0 $^{+12.3}_{-8.3} \pm 0.4$ |     | ABLIKIM              | 17G | BES3 | $e^{+}e^{-} \rightarrow \pi^{+}\pi^{-}h_c$      |
| 80.1 $\pm 24.6 \pm 2.9$        |     | <sup>1</sup> ABLIKIM | 17V | BES3 | $e^{+}e^{-} \rightarrow \pi^{+}\pi^{-}\psi(2S)$ |
| 38 $\pm 12 \pm 2$              | 180 | <sup>2</sup> ABLIKIM | 15C | BES3 | $e^{+}e^{-} \rightarrow \omega\chi_{c0}$        |

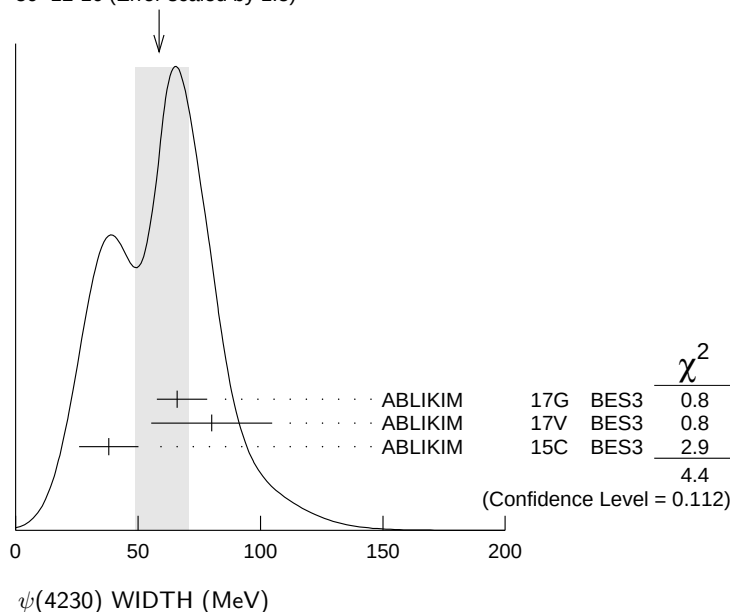
<sup>1</sup> From a fit to the cross section for  $e^{+}e^{-} \rightarrow \pi^{+}\pi^{-}\psi(2S) \rightarrow 2(\pi^{+}\pi^{-})\ell^{+}\ell^{-}$  obtained from 16 center-of-mass energies between 4.008 and 4.600 GeV and comprising  $5.1\text{ fb}^{-1}$ .

<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=M222W;LINKAGE=B

NODE=M222W;LINKAGE=A

WEIGHTED AVERAGE  
59 $^{+12}_{-10}$  (Error scaled by 1.5)



**$\psi(4230)$  DECAY MODES**

NODE=M222215;NODE=M222

| Mode                            | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------|--------------------------------|
| $\Gamma_1$ $e^+e^-$             |                                |
| $\Gamma_2$ $\omega\chi_{c0}$    | seen                           |
| $\Gamma_3$ $\pi^+\pi^-h_c$      | seen                           |
| $\Gamma_4$ $\pi^+\pi^-\psi(2S)$ | seen                           |

DESIG=1

DESIG=2

DESIG=3

DESIG=4

 **$\psi(4230) \Gamma(i)\Gamma(e^+e^-)/\Gamma(\text{total})$** 

NODE=M222220

 **$\Gamma(\omega\chi_{c0}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$**  **$\Gamma_2\Gamma_1/\Gamma$** 

| VALUE (eV)                              | EVTs | DOCUMENT ID          | TECN     | COMMENT                              |
|-----------------------------------------|------|----------------------|----------|--------------------------------------|
| <b><math>2.7 \pm 0.5 \pm 0.4</math></b> | 180  | <sup>1</sup> ABLIKIM | 15C BES3 | $e^+e^- \rightarrow \omega\chi_{c0}$ |

NODE=M222G01

NODE=M222G01

<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=M222G01;LINKAGE=A

 **$\Gamma(\pi^+\pi^-\psi(2S)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$**  **$\Gamma_4\Gamma_1/\Gamma$** 

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

NODE=M222R03

NODE=M222R03

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

|               |                      |          |                                         |
|---------------|----------------------|----------|-----------------------------------------|
| $1.6 \pm 1.3$ | <sup>1</sup> ABLIKIM | 19K BES3 | $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$ |
| $1.8 \pm 1.4$ | <sup>2</sup> ABLIKIM | 19K BES3 | $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$ |

OCCUR=2

<sup>1</sup> Solution I of two equivalent solutions in a fit using two interfering resonances.

NODE=M222R03;LINKAGE=A

<sup>2</sup> Solution II of two equivalent solutions in a fit using two interfering resonances.

NODE=M222R03;LINKAGE=B

 **$\psi(4230)$  BRANCHING RATIOS**

NODE=M222225

 **$\Gamma(\omega\chi_{c0})/\Gamma_{\text{total}}$**  **$\Gamma_2/\Gamma$** 

| VALUE       | EVTs | DOCUMENT ID          | TECN     | COMMENT                              |
|-------------|------|----------------------|----------|--------------------------------------|
| <b>seen</b> | 180  | <sup>1</sup> ABLIKIM | 15C BES3 | $e^+e^- \rightarrow \omega\chi_{c0}$ |

NODE=M222R01

NODE=M222R01

<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;LINKAGE=A

 **$\Gamma(\pi^+\pi^-h_c)/\Gamma_{\text{total}}$**  **$\Gamma_3/\Gamma$** 

| VALUE       | DOCUMENT ID | TECN     | COMMENT                            |
|-------------|-------------|----------|------------------------------------|
| <b>seen</b> | ABLIKIM     | 17G BES3 | $e^+e^- \rightarrow \pi^+\pi^-h_c$ |

NODE=M222R00

NODE=M222R00

 **$\Gamma(\pi^+\pi^-\psi(2S))/\Gamma_{\text{total}}$**  **$\Gamma_4/\Gamma$** 

| VALUE       | DOCUMENT ID          | TECN     | COMMENT                                 |
|-------------|----------------------|----------|-----------------------------------------|
| <b>seen</b> | <sup>1</sup> ABLIKIM | 17V BES3 | $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$ |

NODE=M222R02

NODE=M222R02

<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  $5.1 \text{ fb}^{-1}$ .

NODE=M222R02;LINKAGE=A

 **$\psi(4230)$  REFERENCES**

NODE=M222

|         |     |                        |                          |                   |
|---------|-----|------------------------|--------------------------|-------------------|
| ABLIKIM | 19K | PR D99 019903 (errat.) | M. Ablikim <i>et al.</i> | (BES III Collab.) |
| ABLIKIM | 17G | PRL 118 092002         | M. Ablikim <i>et al.</i> | (BES III Collab.) |
| ABLIKIM | 17V | PR D96 032004          | M. Ablikim <i>et al.</i> | (BES III Collab.) |
| Also    |     | PR D99 019903 (errat.) | M. Ablikim <i>et al.</i> | (BES III Collab.) |
| ABLIKIM | 15C | PRL 114 092003         | M. Ablikim <i>et al.</i> | (BES III Collab.) |

REFID=59611

REFID=57915

REFID=58029

REFID=59611

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)<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=M192

NODE=M192

X(4250)<sup>±</sup> MASS

NODE=M192M

| VALUE (MeV)                                                                | DOCUMENT ID        | TECN | COMMENT                                            |
|----------------------------------------------------------------------------|--------------------|------|----------------------------------------------------|
| 4248 <sup>+44+180</sup> <sub>-29-35</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=M192M

NODE=M192M;LINKAGE=MI

X(4250)<sup>±</sup> WIDTH

NODE=M192W

| VALUE (MeV)                                                                | DOCUMENT ID        | TECN | COMMENT                                            |
|----------------------------------------------------------------------------|--------------------|------|----------------------------------------------------|
| 177 <sup>+54+316</sup> <sub>-39-61</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=M192W

NODE=M192W;LINKAGE=MI

X(4250)<sup>±</sup> DECAY MODES

NODE=M192215;NODE=M192

| Mode                                | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------------|--------------------------------|
| $\Gamma_1 \quad \pi^+\chi_{c1}(1P)$ | seen                           |

DESIG=1

X(4250)<sup>±</sup> BRANCHING RATIOS

NODE=M192225

| $\Gamma(\pi^+ \chi_{c1}(1P))/\Gamma_{\text{total}}$                                                                                                                                                        | $\Gamma_1/\Gamma$  |      |         |                                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------|---------|-------------------------------------------------|
| 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 $B(\bar{B}^0 \rightarrow K^- X(4250)^+) \times B(X(4250)^+ \rightarrow \pi^+ \chi_{c1}(1P)) = (4.0^{+2.3+19.7}_{-0.9-0.5}) \times 10^{-5}$ . |                    |      |         |                                                 |
| <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=M192R01  
NODE=M192R01

NODE=M192R01;LINKAGE=MI

NODE=M192R01;LINKAGE=LE

X(4250)<sup>±</sup> REFERENCES

NODE=M192

|       |     |               |                         |                 |
|-------|-----|---------------|-------------------------|-----------------|
| 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=54042  
REFID=52535

NODE=M074

$\psi(4260)$

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

also known as  $Y(4260)$ ; was  $X(4260)$

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=M074

Seen in radiative return from  $e^+e^-$  collisions at  $\sqrt{s} = 9.54\text{--}10.58$  GeV by AUBERT,B 05I, HE 06B, and YUAN 07, and in  $e^+e^-$  collisions at  $\sqrt{s} \approx 4.26$  GeV by COAN 06. Possibly seen by AUBERT 06 in  $B^- \rightarrow K^- \pi^+ \pi^- J/\psi$ . See also the review on "Spectroscopy of mesons containing two heavy quarks."

$\psi(4260)$  MASS

NODE=M074M

| VALUE (MeV)                                                                   | EVTS               | DOCUMENT ID                                                 | TECN      | COMMENT                                               |
|-------------------------------------------------------------------------------|--------------------|-------------------------------------------------------------|-----------|-------------------------------------------------------|
| <b>4230 <math>\pm</math> 8</b>                                                | <b>OUR AVERAGE</b> | Error includes scale factor of 2.9. See the ideogram below. |           |                                                       |
| 4222.0 $\pm$ 3.1 $\pm$ 1.4                                                    | <sup>1</sup>       | ABLIKIM                                                     | 17B BES3  | $e^+e^- \rightarrow \pi^+\pi^- J/\psi$                |
| 4258.6 $\pm$ 8.3 $\pm$ 12.1                                                   | <sup>2</sup>       | LIU                                                         | 13B BELL  | $e^+e^- \rightarrow \gamma\pi^+\pi^- J/\psi$          |
| 4245 $\pm$ 5 $\pm$ 4                                                          | <sup>3</sup>       | LEES                                                        | 12AC BABR | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^- J/\psi$    |
| 4284 $^{+17}_{-16}$ $\pm$ 413.6                                               |                    | 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. • • • |                    |                                                             |           |                                                       |
| 4209.1 $\pm$ 6.8 $\pm$ 7.0                                                    | <sup>4</sup>       | ZHANG                                                       | 17B RVUE  | $e^+e^- \rightarrow \pi^+\pi^- \psi(2S)$              |
| 4223.3 $\pm$ 1.6 $\pm$ 2.5                                                    | <sup>5</sup>       | ZHANG                                                       | 17C RVUE  | $e^+e^- \rightarrow \pi^+\pi^- J/\psi$ or $\psi(2S)$  |
| 4247 $\pm$ 12 $^{+17}_{-32}$                                                  | <sup>2,6</sup>     | YUAN                                                        | 07 BELL   | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^- J/\psi$    |
| 4259 $\pm$ 8 $\pm$ $\frac{2}{6}$ 125                                          | <sup>7</sup>       | AUBERT,B                                                    | 05I BABR  | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^- J/\psi$    |

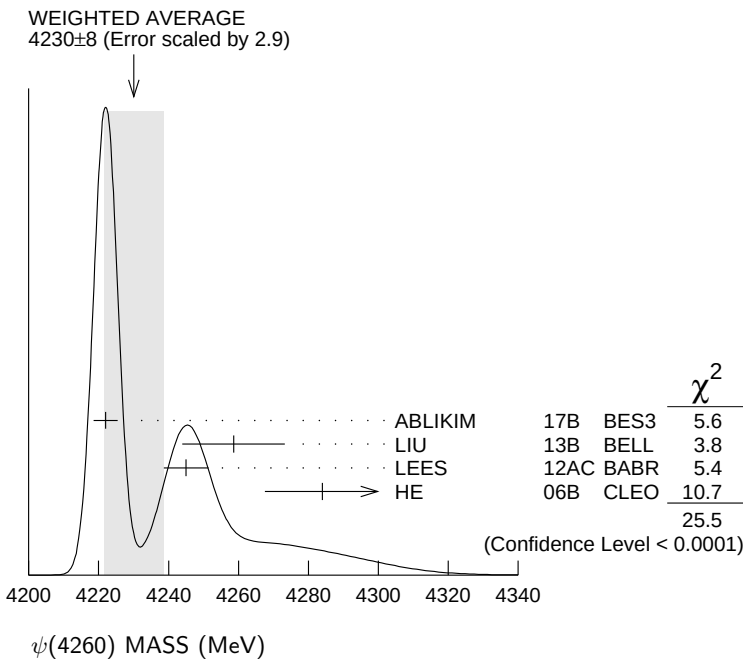
NODE=M074M

OCCUR=2

- <sup>1</sup> From a three-resonance fit.
- <sup>2</sup> From a two-resonance fit.
- <sup>3</sup> From a single-resonance fit. Supersedes AUBERT,B 05I.
- <sup>4</sup> From a three-resonance fit.
- <sup>5</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>6</sup> Superseded by LIU 13B.
- <sup>7</sup> From a single-resonance fit. Two interfering resonances are not excluded. Superseded by LEES 12AC.

NODE=M074M;LINKAGE=A  
NODE=M074M;LINKAGE=YU  
NODE=M074M;LINKAGE=LE  
NODE=M074M;LINKAGE=D  
NODE=M074M;LINKAGE=C

NODE=M074M;LINKAGE=YN  
NODE=M074M;LINKAGE=AU



$\psi(4260)$  WIDTH

NODE=M074W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                                                 | TECN      | COMMENT                                              |
|-------------------------------------------------------------------------------|------|-------------------------------------------------------------|-----------|------------------------------------------------------|
| <b>55 ±19 OUR AVERAGE</b>                                                     |      | Error includes scale factor of 4.4. See the ideogram below. |           |                                                      |
| 44.1± 4.3± 2.0                                                                | 1    | ABLIKIM                                                     | 17B BES3  | $e^+e^- \rightarrow \pi^+\pi^- J/\psi$               |
| 134.1±16.4± 5.5                                                               | 2    | LIU                                                         | 13B BELL  | $e^+e^- \rightarrow \gamma\pi^+\pi^- J/\psi$         |
| 114 $^{+16}_{-15}$ ± 7                                                        | 3    | LEES                                                        | 12AC BABR | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^- J/\psi$   |
| 73 $^{+39}_{-25}$ ± 5 13.6                                                    | 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. • • • |      |                                                             |           |                                                      |
| 76.6±14.2± 2.4                                                                | 4    | ZHANG                                                       | 17B RVUE  | $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$              |
| 54.2± 2.6± 1.0                                                                | 5    | ZHANG                                                       | 17C RVUE  | $e^+e^- \rightarrow \pi^+\pi^- J/\psi$ or $\psi(2S)$ |
| 108 ±19 ±10                                                                   | 2,6  | YUAN                                                        | 07 BELL   | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^- J/\psi$   |
| 88 ±23 $^{+6}_{-4}$ 125                                                       | 7    | AUBERT,B                                                    | 05I BABR  | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^- J/\psi$   |

<sup>1</sup> From a three-resonance fit.

<sup>2</sup> From a two-resonance fit.

<sup>3</sup> From a single-resonance fit. Supersedes AUBERT,B 05I.

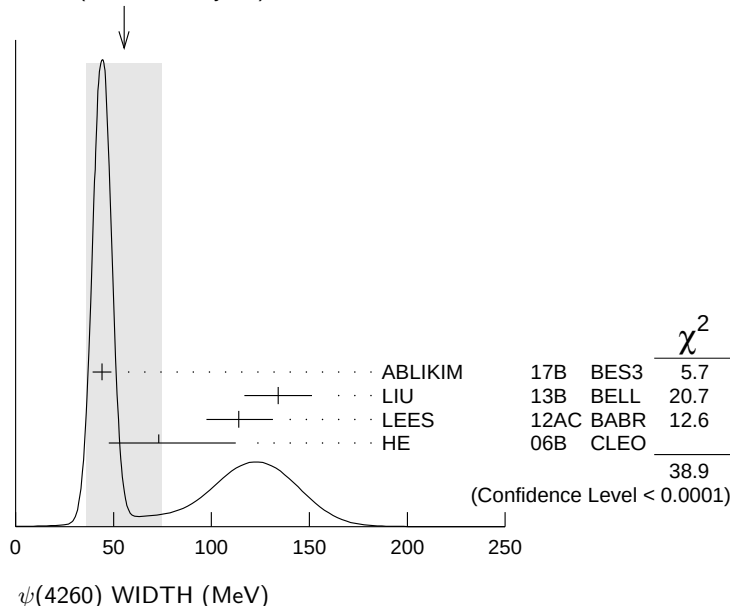
<sup>4</sup> From a three-resonance fit.

<sup>5</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>6</sup> Superseded by LIU 13B.

<sup>7</sup> From a single-resonance fit. Two interfering resonances are not excluded. Superseded by LEES 12AC.

WEIGHTED AVERAGE  
55±19 (Error scaled by 4.4)



### $\psi(4260)$ DECAY MODES

| Mode                                                                 | Fraction ( $\Gamma_i/\Gamma$ ) |
|----------------------------------------------------------------------|--------------------------------|
| $\Gamma_1$ $e^+e^-$                                                  |                                |
| $\Gamma_2$ $J/\psi\pi^+\pi^-$                                        | seen                           |
| $\Gamma_3$ $J/\psi f_0(980), f_0(980) \rightarrow \pi^+\pi^-$        | seen                           |
| $\Gamma_4$ $Z_c(3900)^\pm\pi^\mp, Z_c^\pm \rightarrow J/\psi\pi^\pm$ | seen                           |
| $\Gamma_5$ $J/\psi\pi^0\pi^0$                                        | seen                           |
| $\Gamma_6$ $J/\psi K^+K^-$                                           | seen                           |
| $\Gamma_7$ $J/\psi K_S^0 K_S^0$                                      | not seen                       |
| $\Gamma_8$ $J/\psi\eta$                                              | not seen                       |
| $\Gamma_9$ $J/\psi\pi^0$                                             | not seen                       |
| $\Gamma_{10}$ $J/\psi\eta'$                                          | not seen                       |
| $\Gamma_{11}$ $J/\psi\pi^+\pi^-\pi^0$                                | not seen                       |
| $\Gamma_{12}$ $J/\psi\eta\pi^0$                                      | not seen                       |
| $\Gamma_{13}$ $J/\psi\eta\eta$                                       | not seen                       |
| $\Gamma_{14}$ $\psi(2S)\pi^+\pi^-$                                   | not seen                       |
| $\Gamma_{15}$ $\psi(2S)\eta$                                         | not seen                       |

NODE=M074W

NODE=M074W;LINKAGE=A  
NODE=M074W;LINKAGE=YU  
NODE=M074W;LINKAGE=LE  
NODE=M074W;LINKAGE=C  
NODE=M074W;LINKAGE=B

NODE=M074W;LINKAGE=YN  
NODE=M074W;LINKAGE=AU

NODE=M074215;NODE=M074

DESIG=1

DESIG=2;OUR EVAL;→ UNCHECKED ←  
DESIG=41;OUR EVAL;→ UNCHECKED ←  
DESIG=43;OUR EVAL;→ UNCHECKED ←  
DESIG=4;OUR EVAL;→ UNCHECKED ←  
DESIG=5;OUR EVAL;→ UNCHECKED ←  
DESIG=44  
DESIG=6;OUR EVAL;→ UNCHECKED ←  
DESIG=7;OUR EVAL;→ UNCHECKED ←  
DESIG=8;OUR EVAL;→ UNCHECKED ←  
DESIG=9;OUR EVAL;→ UNCHECKED ←  
DESIG=45  
DESIG=10;OUR EVAL;→ UNCHECKED ←  
DESIG=11;OUR EVAL;→ UNCHECKED ←  
DESIG=12;OUR EVAL;→ UNCHECKED ←

|                         |                                                                                                           |               |                                 |
|-------------------------|-----------------------------------------------------------------------------------------------------------|---------------|---------------------------------|
| Γ <sub>16</sub>         | $\chi_{c0}\omega$                                                                                         | not seen      | DESIG=13;OUR EVAL;→ UNCHECKED ← |
| Γ <sub>17</sub>         | $\chi_{c1}\pi^+\pi^-\pi^0$                                                                                | not seen      | DESIG=16;OUR EVAL;→ UNCHECKED ← |
| Γ <sub>18</sub>         | $\chi_{c2}\pi^+\pi^-\pi^0$                                                                                | not seen      | DESIG=17;OUR EVAL;→ UNCHECKED ← |
| Γ <sub>19</sub>         | $h_c(1P)\pi^+\pi^-$                                                                                       | not seen      | DESIG=40;OUR EVAL;→ UNCHECKED ← |
| Γ <sub>20</sub>         | $\phi\pi^+\pi^-$                                                                                          | not seen      | DESIG=18;OUR EVAL;→ UNCHECKED ← |
| Γ <sub>21</sub>         | $\phi f_0(980) \rightarrow \phi\pi^+\pi^-$                                                                | not seen      | DESIG=22;OUR EVAL;→ UNCHECKED ← |
| Γ <sub>22</sub>         | $D\bar{D}$                                                                                                | not seen      | DESIG=19;OUR EVAL;→ UNCHECKED ← |
| Γ <sub>23</sub>         | $D^0\bar{D}^0$                                                                                            | not seen      | DESIG=31                        |
| Γ <sub>24</sub>         | $D^+D^-$                                                                                                  | not seen      | DESIG=32                        |
| Γ <sub>25</sub>         | $D^*\bar{D} + \text{c.c.}$                                                                                | not seen      | DESIG=23;OUR EVAL;→ UNCHECKED ← |
| Γ <sub>26</sub>         | $D^*(2007)^0\bar{D}^0 + \text{c.c.}$                                                                      | not seen      | DESIG=33                        |
| Γ <sub>27</sub>         | $D^*(2010)^+D^- + \text{c.c.}$                                                                            | not seen      | DESIG=34                        |
| Γ <sub>28</sub>         | $D^*\bar{D}^*$                                                                                            | not seen      | DESIG=24;OUR EVAL;→ UNCHECKED ← |
| Γ <sub>29</sub>         | $D^*(2007)^0\bar{D}^*(2007)^0$                                                                            | not seen      | DESIG=35                        |
| Γ <sub>30</sub>         | $D^*(2010)^+D^*(2010)^-$                                                                                  | not seen      | DESIG=36                        |
| Γ <sub>31</sub>         | $D\bar{D}\pi + \text{c.c.}$                                                                               |               | DESIG=37                        |
| Γ <sub>32</sub>         | $D^0D^-\pi^+ + \text{c.c. (excl. } D^*(2007)^0\bar{D}^{*0} + \text{c.c., } D^*(2010)^+D^- + \text{c.c.})$ | not seen      | DESIG=38                        |
| Γ <sub>33</sub>         | $D\bar{D}^*\pi + \text{c.c. (excl. } D^*\bar{D}^*)$                                                       | not seen      | DESIG=25                        |
| Γ <sub>34</sub>         | $D^0D^{*-}\pi^+ + \text{c.c. (excl. } D^*(2010)^+D^*(2010)^-)$                                            | not seen      | DESIG=39                        |
| Γ <sub>35</sub>         | $D^0D^*(2010)^-\pi^+ + \text{c.c.}$                                                                       | not seen      | DESIG=30;OUR EVAL;→ UNCHECKED ← |
| Γ <sub>36</sub>         | $D^*\bar{D}^*\pi$                                                                                         | not seen      | DESIG=26                        |
| Γ <sub>37</sub>         | $D_s^+D_s^-$                                                                                              | not seen      | DESIG=27                        |
| Γ <sub>38</sub>         | $D_s^{*+}D_s^- + \text{c.c.}$                                                                             | not seen      | DESIG=28                        |
| Γ <sub>39</sub>         | $D_s^{*+}D_s^{*-}$                                                                                        | not seen      | DESIG=29                        |
| Γ <sub>40</sub>         | $p\bar{p}$                                                                                                | not seen      | DESIG=3;OUR EVAL;→ UNCHECKED ←  |
| Γ <sub>41</sub>         | $p\bar{p}\pi^0$                                                                                           | not seen      | DESIG=46;OUR EVAL;→ UNCHECKED ← |
| Γ <sub>42</sub>         | $K_S^0K^\pm\pi^\mp$                                                                                       | not seen      | DESIG=20;OUR EVAL;→ UNCHECKED ← |
| Γ <sub>43</sub>         | $K_S^0K^\pm\pi^\mp\pi^0$                                                                                  |               | DESIG=48                        |
| Γ <sub>44</sub>         | $K_S^0K^\pm\pi^\mp\eta$                                                                                   |               | DESIG=49                        |
| Γ <sub>45</sub>         | $K^+K^-\pi^0$                                                                                             | not seen      | DESIG=21;OUR EVAL;→ UNCHECKED ← |
| <b>Radiative decays</b> |                                                                                                           |               |                                 |
| Γ <sub>46</sub>         | $\eta_c(1S)\gamma$                                                                                        | possibly seen | NODE=M074;CLUMP=C               |
| Γ <sub>47</sub>         | $\chi_{c1}\gamma$                                                                                         | not seen      | DESIG=47                        |
| Γ <sub>48</sub>         | $\chi_{c2}\gamma$                                                                                         | not seen      | DESIG=14;OUR EVAL;→ UNCHECKED ← |
| Γ <sub>49</sub>         | $\chi_{c1}(3872)\gamma$                                                                                   | seen          | DESIG=15;OUR EVAL;→ UNCHECKED ← |
|                         |                                                                                                           |               | DESIG=42                        |

### $\psi(4260) \Gamma(i) \times \Gamma(e^+e^-)/\Gamma(\text{total})$

| $\Gamma(J/\psi\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$        |      | $\Gamma_2\Gamma_1/\Gamma$ |                                                                |
|-------------------------------------------------------------------------------|------|---------------------------|----------------------------------------------------------------|
| VALUE (eV)                                                                    | EVTS | DOCUMENT ID               | TECN COMMENT                                                   |
| <b>9.2±1.0 OUR AVERAGE</b>                                                    |      |                           |                                                                |
| 9.2±0.8±0.7                                                                   | 1    | 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                                                                   | 2    | LIU                       | 13B BELL $e^+e^- \rightarrow \gamma\pi^+\pi^- J/\psi$          |
| 20.5±1.4±2.0                                                                  | 3    | 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  | 5 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=M074230

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

$$\Gamma(J/\psi K^+ K^-) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_6 \Gamma_1 / \Gamma$$

| VALUE (eV)     | CL% | DOCUMENT ID       | TECN    | COMMENT                                              |
|----------------|-----|-------------------|---------|------------------------------------------------------|
| <b>&lt;1.7</b> | 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.

<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

$$\Gamma(J/\psi K_S^0 K_S^0) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_7 \Gamma_1 / \Gamma$$

| VALUE (eV)      | CL% | DOCUMENT ID       | TECN    | COMMENT                                                  |
|-----------------|-----|-------------------|---------|----------------------------------------------------------|
| <b>&lt;0.85</b> | 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

$$\Gamma(J/\psi \eta) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_8 \Gamma_1 / \Gamma$$

| 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

$$\Gamma(\psi(2S) \pi^+ \pi^-) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{14} \Gamma_1 / \Gamma$$

| 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 $e^+ e^- \rightarrow \psi(2S) \pi^+ \pi^- \gamma$ |
| $7.4^{+2.1}_{-1.7}$ |    | <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 |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

|                |    |           |          |                                                       |
|----------------|----|-----------|----------|-------------------------------------------------------|
| <b>&lt;0.4</b> | 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 |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

|                 |    |                     |           |                                                       |
|-----------------|----|---------------------|-----------|-------------------------------------------------------|
| <b>&lt;0.28</b> | 90 | <sup>1</sup> AUBERT | 07AK BABR | 10.6 $e^+ e^- \rightarrow \pi^+ \pi^- K^+ K^- \gamma$ |
|-----------------|----|---------------------|-----------|-------------------------------------------------------|

<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  
NODE=M074G6

NODE=M074G6;LINKAGE=AU

$$\Gamma(K_S^0 K^\pm \pi^\mp) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{42} \Gamma_1 / \Gamma$$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

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

|      |    |        |          |                                                       |
|------|----|--------|----------|-------------------------------------------------------|
| <0.5 | 90 | AUBERT | 08S BABR | 10.6 $e^+ e^- \rightarrow K_S^0 K^\pm \pi^\mp \gamma$ |
|------|----|--------|----------|-------------------------------------------------------|

NODE=M074G4  
NODE=M074G4

$$\Gamma(K_S^0 K^\pm \pi^\mp \pi^0) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{43} \Gamma_1 / \Gamma$$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

|                 |    |         |         |                                                 |
|-----------------|----|---------|---------|-------------------------------------------------|
| <b>&lt;0.05</b> | 90 | ABLIKIM | 19 BES3 | $e^+ e^- \rightarrow K_S^0 K^\pm \pi^\mp \pi^0$ |
|-----------------|----|---------|---------|-------------------------------------------------|

NODE=M074R31  
NODE=M074R31

$$\Gamma(K_S^0 K^\pm \pi^\mp \eta) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{44} \Gamma_1 / \Gamma$$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

|                 |    |         |         |                                                |
|-----------------|----|---------|---------|------------------------------------------------|
| <b>&lt;0.19</b> | 90 | ABLIKIM | 19 BES3 | $e^+ e^- \rightarrow K_S^0 K^\pm \pi^\mp \eta$ |
|-----------------|----|---------|---------|------------------------------------------------|

NODE=M074R32  
NODE=M074R32

$$\Gamma(K^+ K^- \pi^0) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{45} \Gamma_1 / \Gamma$$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

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

|      |    |        |          |                                                 |
|------|----|--------|----------|-------------------------------------------------|
| <0.6 | 90 | AUBERT | 08S BABR | 10.6 $e^+ e^- \rightarrow K^+ K^- \pi^0 \gamma$ |
|------|----|--------|----------|-------------------------------------------------|

NODE=M074G5  
NODE=M074G5

$$\Gamma(\chi_{c1}\gamma) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{47}\Gamma_1/\Gamma$$

| VALUE (eV)                                                                   | CL% | DOCUMENT ID      | TECN | COMMENT                                         |
|------------------------------------------------------------------------------|-----|------------------|------|-------------------------------------------------|
| <b>&lt;1.4</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=M074G03  
NODE=M074G03

NODE=M074G03;LINKAGE=A

$$\Gamma(\chi_{c2}\gamma) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{48}\Gamma_1/\Gamma$$

| VALUE (eV)                                                                   | CL% | DOCUMENT ID      | TECN | COMMENT                                         |
|------------------------------------------------------------------------------|-----|------------------|------|-------------------------------------------------|
| <b>&lt;4.0</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=M074G04  
NODE=M074G04

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                                                  |
|------------------------------------------------------|-------------------|------|----------------------------------------------------------|
| 0.17 ± 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  
NODE=M074R02

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 $e^+e^- \rightarrow \pi^+\pi^- J/\psi$        |
| <sup>1</sup> We do not use the following data for averages, fits, limits, etc. • • • |                      |      |                                                    |
| 0.29 ± 0.08                                                                          | <sup>2</sup> LIU     | 13B  | BELL $e^+e^- \rightarrow \gamma \pi^+\pi^- J/\psi$ |

NODE=M074R01  
NODE=M074R01

<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;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                                                   |
|----------------------------------------------|--------------------|------|-----------------------------------------------------------|
| (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 $\psi(2S)$ |

NODE=M074R30  
NODE=M074R30

<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;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 $e^+e^- \rightarrow h_c(1P) \pi^+\pi^-$ |

NODE=M074R25  
NODE=M074R25

<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;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 $e^+e^- \rightarrow D\bar{D}\gamma$ |

NODE=M074R2  
NODE=M074R2

• • • 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;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 | $e^+e^- \rightarrow D^0 \bar{D}^0$ |

NODE=M074R12  
NODE=M074R12

• • • 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  $e^+e^- \rightarrow D^0 \bar{D}^0 \gamma$

$\Gamma(D^+ D^-)/\Gamma_{\text{total}}$  $\Gamma_{24}/\Gamma$ NODE=M074R13  
NODE=M074R13

| 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  | $e^+ e^- \rightarrow D^+ D^- \gamma$ |

 $\Gamma(D^* \bar{D} + \text{c.c.})/\Gamma(J/\psi \pi^+ \pi^-)$  $\Gamma_{25}/\Gamma_2$ NODE=M074R03  
NODE=M074R03

| 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     | $e^+ e^-$                                |

 $\Gamma(D^*(2007)^0 \bar{D}^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{26}/\Gamma$ NODE=M074R14  
NODE=M074R14

| 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 | $e^+ e^- \rightarrow D^{*0} \bar{D}^0 \gamma$ |

 $\Gamma(D^*(2010)^+ D^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{27}/\Gamma$ NODE=M074R15  
NODE=M074R15

| VALUE                                                                         | DOCUMENT ID    | TECN     | COMMENT                                 |
|-------------------------------------------------------------------------------|----------------|----------|-----------------------------------------|
| <b>not seen</b>                                                               | CRONIN-HEN..09 | CLEO     | $e^+ e^- \rightarrow D^{*+} D^-$        |
| <b>not seen</b>                                                               | 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 | $e^+ e^- \rightarrow D^{*+} D^- \gamma$ |

 $\Gamma(D^* \bar{D}^*)/\Gamma(J/\psi \pi^+ \pi^-)$  $\Gamma_{28}/\Gamma_2$ NODE=M074R04  
NODE=M074R04

| VALUE                                                                         | CL% | DOCUMENT ID    | TECN     | COMMENT                                    |
|-------------------------------------------------------------------------------|-----|----------------|----------|--------------------------------------------|
| <b>&lt;11</b>                                                                 | 90  | CRONIN-HEN..09 | CLEO     | $e^+ e^-$                                  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                |          |                                            |
| <40                                                                           | 90  | AUBERT         | 09M BABR | $e^+ e^- \rightarrow \gamma D^* \bar{D}^*$ |

 $\Gamma(D^*(2007)^0 \bar{D}^*(2007)^0)/\Gamma_{\text{total}}$  $\Gamma_{29}/\Gamma$ NODE=M074R17  
NODE=M074R17

| 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 | $e^+ e^- \rightarrow D^{*0} \bar{D}^{*0} \gamma$ |

 $\Gamma(D^*(2010)^+ D^*(2010)^-)/\Gamma_{\text{total}}$  $\Gamma_{30}/\Gamma$ NODE=M074R18  
NODE=M074R18

| VALUE                                                                         | DOCUMENT ID    | TECN     | COMMENT                                    |
|-------------------------------------------------------------------------------|----------------|----------|--------------------------------------------|
| <b>not seen</b>                                                               | CRONIN-HEN..09 | CLEO     | $e^+ e^- \rightarrow D^{*+} D^{*-}$        |
| <b>not seen</b>                                                               | 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 | $e^+ e^- \rightarrow D^{*+} D^{*-} \gamma$ |

 $\Gamma(D^0 D^- \pi^+ + \text{c.c. (excl. } D^*(2007)^0 \bar{D}^{*0} + \text{c.c., } D^*(2010)^+ D^- + \text{c.c.}))/\Gamma_{\text{total}}$  $\Gamma_{32}/\Gamma$ NODE=M074R16  
NODE=M074R16

| VALUE           | DOCUMENT ID | TECN     | COMMENT                                                                      |
|-----------------|-------------|----------|------------------------------------------------------------------------------|
| <b>not seen</b> | PAKHLOVA    | 08A BELL | $10.6 \frac{e^+ e^- \rightarrow D^0 D^- \pi^+ \gamma}{D^0 D^- \pi^+ \gamma}$ |

 $\Gamma(D \bar{D}^* \pi + \text{c.c. (excl. } D^* \bar{D}^*))/\Gamma_{\text{total}}$  $\Gamma_{33}/\Gamma$ NODE=M074R22  
NODE=M074R22

| VALUE           | DOCUMENT ID    | TECN | COMMENT                               |
|-----------------|----------------|------|---------------------------------------|
| <b>not seen</b> | CRONIN-HEN..09 | CLEO | $e^+ e^- \rightarrow D^* \bar{D} \pi$ |

 $\Gamma(D \bar{D}^* \pi + \text{c.c. (excl. } D^* \bar{D}^*))/\Gamma(J/\psi \pi^+ \pi^-)$  $\Gamma_{33}/\Gamma_2$ NODE=M074R05  
NODE=M074R05

| VALUE         | CL% | DOCUMENT ID    | TECN | COMMENT   |
|---------------|-----|----------------|------|-----------|
| <b>&lt;15</b> | 90  | CRONIN-HEN..09 | CLEO | $e^+ e^-$ |

 $\Gamma(D^0 D^{*-} \pi^+ + \text{c.c. (excl. } D^*(2010)^+ D^*(2010)^-))/\Gamma_{\text{total}}$  $\Gamma_{34}/\Gamma$ NODE=M074R23  
NODE=M074R23

| VALUE           | DOCUMENT ID | TECN    | COMMENT                                       |
|-----------------|-------------|---------|-----------------------------------------------|
| <b>not seen</b> | PAKHLOVA    | 09 BELL | $e^+ e^- \rightarrow D^0 D^{*-} \pi^+ \gamma$ |



$$\Gamma(D^0 D^{*+}(2010)^- \pi^+ + \text{c.c.}) / \Gamma(J/\psi \pi^+ \pi^-)$$

$$\Gamma_{35}/\Gamma_2$$

| 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 × 10 <sup>-6</sup> | 90  | <sup>1</sup> PAKHLOVA 09 | BELL | $e^+ e^- \rightarrow D^0 D^{*-} \pi^+$ |

NODE=M074R11  
NODE=M074R11

<sup>1</sup> Using 4263<sup>+8</sup><sub>-9</sub> MeV for the mass of  $\psi(4260)$ .

NODE=M074R11;LINKAGE=PA

$$\Gamma(D^* \bar{D}^* \pi) / \Gamma_{\text{total}}$$

$$\Gamma_{36}/\Gamma$$

| VALUE    | DOCUMENT ID    | TECN | COMMENT                                 |
|----------|----------------|------|-----------------------------------------|
| not seen | CRONIN-HEN..09 | CLEO | $e^+ e^- \rightarrow D^* \bar{D}^* \pi$ |

NODE=M074R24  
NODE=M074R24

$$\Gamma(D^* \bar{D}^* \pi) / \Gamma(J/\psi \pi^+ \pi^-)$$

$$\Gamma_{36}/\Gamma_2$$

| VALUE | CL% | DOCUMENT ID    | TECN | COMMENT   |
|-------|-----|----------------|------|-----------|
| <8.2  | 90  | CRONIN-HEN..09 | CLEO | $e^+ e^-$ |

NODE=M074R06  
NODE=M074R06

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

$$\Gamma_{37}/\Gamma$$

| 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 | $e^+ e^- \rightarrow D_s^+ D_s^-$        |

NODE=M074R19  
NODE=M074R19

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

|          |             |      |                                          |
|----------|-------------|------|------------------------------------------|
| not seen | PAKHLOVA 11 | BELL | $e^+ e^- \rightarrow D_s^+ D_s^- \gamma$ |
|----------|-------------|------|------------------------------------------|

$$\Gamma(D_s^+ D_s^-) / \Gamma(J/\psi \pi^+ \pi^-)$$

$$\Gamma_{37}/\Gamma_2$$

| VALUE | CL% | DOCUMENT ID     | TECN | COMMENT        |
|-------|-----|-----------------|------|----------------|
| <0.7  | 95  | DEL-AMO-SA..10N | BABR | 10.6 $e^+ e^-$ |

NODE=M074R07  
NODE=M074R07

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

|      |    |                |      |           |
|------|----|----------------|------|-----------|
| <1.3 | 90 | CRONIN-HEN..09 | CLEO | $e^+ e^-$ |
|------|----|----------------|------|-----------|

$$\Gamma(D_s^{*+} D_s^- + \text{c.c.}) / \Gamma_{\text{total}}$$

$$\Gamma_{38}/\Gamma$$

| 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 | $e^+ e^- \rightarrow D_s^{*+} D_s^-$        |

NODE=M074R20  
NODE=M074R20

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

|          |             |      |                                             |
|----------|-------------|------|---------------------------------------------|
| not seen | PAKHLOVA 11 | BELL | $e^+ e^- \rightarrow D_s^{*+} D_s^- \gamma$ |
|----------|-------------|------|---------------------------------------------|

$$\Gamma(D_s^{*+} D_s^- + \text{c.c.}) / \Gamma(J/\psi \pi^+ \pi^-)$$

$$\Gamma_{38}/\Gamma_2$$

| VALUE | CL% | DOCUMENT ID    | TECN | COMMENT   |
|-------|-----|----------------|------|-----------|
| < 0.8 | 90  | CRONIN-HEN..09 | CLEO | $e^+ e^-$ |

NODE=M074R08  
NODE=M074R08

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

|     |    |                 |      |                |
|-----|----|-----------------|------|----------------|
| <44 | 95 | DEL-AMO-SA..10N | BABR | 10.6 $e^+ e^-$ |
|-----|----|-----------------|------|----------------|

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

$$\Gamma_{39}/\Gamma$$

| VALUE    | DOCUMENT ID    | TECN | COMMENT                                 |
|----------|----------------|------|-----------------------------------------|
| not seen | CRONIN-HEN..09 | CLEO | $e^+ e^- \rightarrow D_s^{*+} D_s^{*-}$ |

NODE=M074R21  
NODE=M074R21

• • • 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 | $e^+ e^- \rightarrow D_s^{*+} D_s^{*-} \gamma$ |
|----------|-----------------|------|------------------------------------------------|

$$\Gamma(D_s^{*+} D_s^{*-}) / \Gamma(J/\psi \pi^+ \pi^-)$$

$$\Gamma_{39}/\Gamma_2$$

| VALUE | CL% | DOCUMENT ID    | TECN | COMMENT   |
|-------|-----|----------------|------|-----------|
| < 9.5 | 90  | CRONIN-HEN..09 | CLEO | $e^+ e^-$ |

NODE=M074R09  
NODE=M074R09

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

|     |    |                 |      |                |
|-----|----|-----------------|------|----------------|
| <30 | 95 | DEL-AMO-SA..10N | BABR | 10.6 $e^+ e^-$ |
|-----|----|-----------------|------|----------------|

$$\Gamma(p\bar{p}) / \Gamma(J/\psi \pi^+ \pi^-)$$

$$\Gamma_{40}/\Gamma_2$$

| VALUE | CL% | DOCUMENT ID             | TECN | COMMENT                               |
|-------|-----|-------------------------|------|---------------------------------------|
| <0.13 | 90  | <sup>1</sup> AUBERT 06B | BABR | $e^+ e^- \rightarrow p\bar{p} \gamma$ |

NODE=M074R1  
NODE=M074R1

<sup>1</sup> Using 4259 ± 10 MeV for the mass and 88 ± 24 MeV for the width of  $\psi(4260)$ .

NODE=M074R1;LINKAGE=AU

$$\Gamma(p\bar{p}\pi^0)/\Gamma(J/\psi\pi^+\pi^-)$$

| VALUE               | CL% | DOCUMENT ID | TECN     | COMMENT                                                | $\Gamma_{41}/\Gamma_2$ |
|---------------------|-----|-------------|----------|--------------------------------------------------------|------------------------|
| $<2 \times 10^{-4}$ | 90  | ABLIKIM     | 17F BES3 | $e^+e^- \rightarrow \psi(4260) \rightarrow$<br>hadrons |                        |

NODE=M074R00  
NODE=M074R00  
OCCUR=2

### Radiative decays

$$\Gamma(\eta_c(1S)\gamma)/\Gamma_{\text{total}}$$

| VALUE                | DOCUMENT ID          | COMMENT                                   | $\Gamma_{46}/\Gamma$ |
|----------------------|----------------------|-------------------------------------------|----------------------|
| <b>possibly seen</b> | <sup>1</sup> ABLIKIM | 17W $e^+e^- \rightarrow \gamma\eta_c(1S)$ |                      |

<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=M074310

NODE=M074R29  
NODE=M074R29

NODE=M074R29;LINKAGE=A

$$\Gamma(\chi_{c1}(3872)\gamma)/\Gamma_{\text{total}}$$

| VALUE       | EVTS       | DOCUMENT ID | TECN    | COMMENT                                     | $\Gamma_{49}/\Gamma$ |
|-------------|------------|-------------|---------|---------------------------------------------|----------------------|
| <b>seen</b> | 20 $\pm$ 5 | ABLIKIM     | 14 BES3 | $e^+e^- \rightarrow J/\psi\pi^+\pi^-\gamma$ |                      |

NODE=M074R26  
NODE=M074R26

### $\psi(4260)$ REFERENCES

|               |      |                |                                  |                   |             |
|---------------|------|----------------|----------------------------------|-------------------|-------------|
| ABLIKIM       | 19   | PR D99 012003  | M. Ablikim <i>et al.</i>         | (BES III Collab.) | REFID=59515 |
| ABLIKIM       | 17B  | PRL 118 092001 | M. Ablikim <i>et al.</i>         | (BES III Collab.) | REFID=57755 |
| ABLIKIM       | 17F  | PL B771 45     | M. Ablikim <i>et al.</i>         | (BES III Collab.) | REFID=57909 |
| ABLIKIM       | 17W  | PR D96 051101  | M. Ablikim <i>et al.</i>         | (BES III Collab.) | REFID=58212 |
| ZHANG         | 17B  | PR D96 054008  | J. Zhang, J. Zhang               |                   | REFID=58219 |
| ZHANG         | 17C  | EPJ C77 727    | J. Zhang, L. Yuan                |                   | REFID=58463 |
| ABLIKIM       | 15Q  | PR D92 012008  | M. Ablikim <i>et al.</i>         | (BES III 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>         | (BES III 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>         | (BES III 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        | 06   | PR D73 011101  | B. Aubert <i>et al.</i>          | (BABAR Collab.)   | REFID=51017 |
| 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 |
| COAN          | 06   | PRL 96 162003  | T.E. Coan <i>et al.</i>          | (CLEO Collab.)    | REFID=51075 |
| 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 |

$\chi_{c1}(4274)$ 

$$I^G(J^{PC}) = 0^+(1^{++})$$

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.

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  $6.0 \sigma$ .

NODE=M233

NODE=M233

 $\chi_{c1}(4274)$  MASS

NODE=M233M

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

NODE=M233M

**4274  $\pm 8$   
 $-6$  OUR AVERAGE**

|                                 |      |                   |          |                                   |
|---------------------------------|------|-------------------|----------|-----------------------------------|
| $4273.3 \pm 8.3^{+17.2}_{-3.6}$ | 4289 | <sup>1</sup> AAIJ | 17C LHCb | $B^+ \rightarrow J/\psi \phi K^+$ |
|---------------------------------|------|-------------------|----------|-----------------------------------|

|                                |    |                       |        |                                   |
|--------------------------------|----|-----------------------|--------|-----------------------------------|
| $4274.4^{+8.4}_{-6.7} \pm 1.9$ | 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  $6.0 \sigma$ .

NODE=M233M;LINKAGE=A

<sup>2</sup> From a fit to the invariant mass spectrum with a significance of  $3.1 \sigma$ .

NODE=M233M;LINKAGE=B

 $\chi_{c1}(4274)$  WIDTH

NODE=M233W

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

NODE=M233W

**49  $\pm 12$  OUR AVERAGE**

|                        |      |                   |          |                                   |
|------------------------|------|-------------------|----------|-----------------------------------|
| $56 \pm 11^{+8}_{-11}$ | 4289 | <sup>1</sup> AAIJ | 17C LHCb | $B^+ \rightarrow J/\psi \phi K^+$ |
|------------------------|------|-------------------|----------|-----------------------------------|

|                                |    |                       |        |                                   |
|--------------------------------|----|-----------------------|--------|-----------------------------------|
| $32.3^{+21.9}_{-15.3} \pm 7.6$ | 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  $6.0 \sigma$ .

NODE=M233W;LINKAGE=A

<sup>2</sup> From a fit to the invariant mass spectrum with a significance of  $3.1 \sigma$ .

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 |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

NODE=M233R01  
NODE=M233R01

|             |      |                   |          |                                   |
|-------------|------|-------------------|----------|-----------------------------------|
| <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  $6.0 \sigma$ .

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.

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

**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**

| $\Gamma(J/\psi\phi)/\Gamma_{\text{total}}$              | $\Gamma_1/\Gamma$ |      |         |                                             |
|---------------------------------------------------------|-------------------|------|---------|---------------------------------------------|
| VALUE                                                   | DOCUMENT ID       | TECN | COMMENT |                                             |
| seen                                                    | <sup>1</sup> SHEN | 10   | BELL    | 10.6 $e^+e^- \rightarrow e^+e^- J/\psi\phi$ |
| <sup>1</sup> Statistical significance of 3.2 $\sigma$ . |                   |      |         |                                             |
| $\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$            | $\Gamma_2/\Gamma$ |      |         |                                             |
| VALUE                                                   | DOCUMENT ID       | TECN | COMMENT |                                             |
| seen                                                    | <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.) |
|------|----|----------------|-------------------------|-----------------|

$\psi(4360)$

$I^G(J^{PC}) = 0^-(1^{--})$   
 $I$  needs confirmation.

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 <sup>+9</sup> <sub>-10</sub> ±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 $e^+e^- \rightarrow \gamma\pi^+\pi^- \psi(2S)$ |

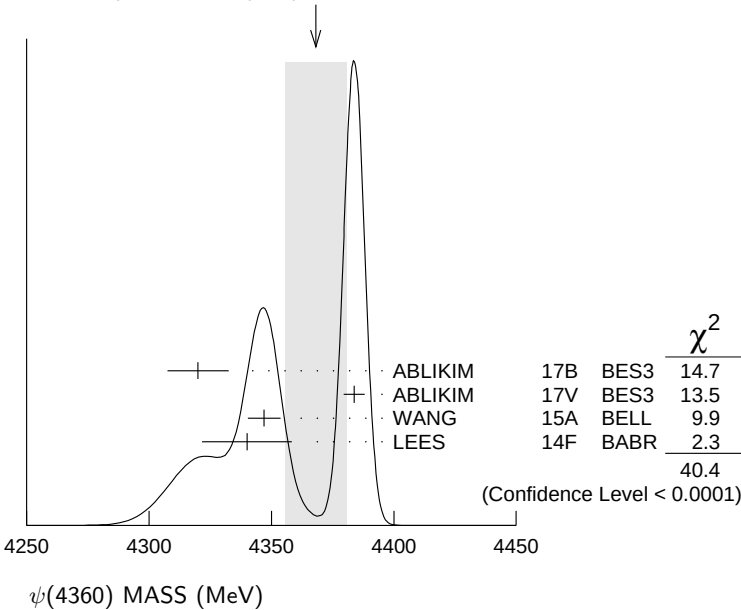
- <sup>1</sup> From a three-resonance fit.
- <sup>2</sup> From a fit to the cross section for  $e^+e^- \rightarrow \pi^+\pi^- \psi(2S) \rightarrow 2(\pi^+\pi^-)\ell^+\ell^-$  obtained from 16 center-of-mass energies between 4.008 and 4.600 GeV and comprising 5.1 fb<sup>-1</sup>.
- <sup>3</sup> From a 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 <sup>+25.3</sup> <sub>-19.7</sub> ±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                  |
| $\Gamma_5$ $J/\psi\eta$             |                                |
| $\Gamma_6$ $D^0D^{*-}\pi^+$         |                                |
| $\Gamma_7$ $\chi_{c1}\gamma$        |                                |
| $\Gamma_8$ $\chi_{c2}\gamma$        |                                |

DESIG=1  
 DESIG=8  
 DESIG=2;OUR EVAL;→ UNCHECKED ←  
 DESIG=5  
 DESIG=4  
 DESIG=3  
 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

$$\Gamma(\chi_{c1}\gamma) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_7\Gamma_1/\Gamma$$

| VALUE (eV)      | CL% | DOCUMENT ID      | TECN | COMMENT |
|-----------------|-----|------------------|------|---------|
| <b>&lt;0.57</b> | 90  | <sup>1</sup> HAN | 15   | BELL    |

<sup>1</sup> Using  $B(\eta \rightarrow \gamma\gamma) = (39.41 \pm 0.21)\%$ .

NODE=M181G02  
NODE=M181G02

NODE=M181G02;LINKAGE=A

$$\Gamma(\chi_{c2}\gamma) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_8\Gamma_1/\Gamma$$

| VALUE (eV)     | CL% | DOCUMENT ID      | TECN | COMMENT |
|----------------|-----|------------------|------|---------|
| <b>&lt;1.9</b> | 90  | <sup>1</sup> HAN | 15   | BELL    |

<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

$$\Gamma(D^0 D^{*-} \pi^+)/\Gamma(\psi(2S) \pi^+ \pi^-) \quad \Gamma_6/\Gamma_3$$

| 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

$$\Gamma(\psi(2S) \pi^+ \pi^-)/\Gamma_{\text{total}} \quad \Gamma_3/\Gamma$$

| 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

$$\Gamma(\psi(2S) \pi^+ \pi^-)/\Gamma(J/\psi \pi^+ \pi^-) \quad \Gamma_3/\Gamma_2$$

| 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

$$\Gamma(\psi_2(3823) \pi^+ \pi^-)/\Gamma_{\text{total}} \quad \Gamma_4/\Gamma$$

| 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

$$\Gamma(D^0 D^{*-} \pi^+)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_6/\Gamma \times \Gamma_1/\Gamma$$

| 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

### $\psi(4360)$ REFERENCES

NODE=M181

|         |     |                        |                               |                   |
|---------|-----|------------------------|-------------------------------|-------------------|
| ABLIKIM | 19K | PR D99 019903 (errat.) | M. Ablikim <i>et al.</i>      | (BES III Collab.) |
| ABLIKIM | 17B | PRL 118 092001         | M. Ablikim <i>et al.</i>      | (BES III Collab.) |
| ABLIKIM | 17V | PR D96 032004          | M. Ablikim <i>et al.</i>      | (BES III Collab.) |
| Also    |     | PR D99 019903 (errat.) | M. Ablikim <i>et al.</i>      | (BES III Collab.) |
| ZHANG   | 17B | PR D96 054008          | J. Zhang, J. Zhang            |                   |
| ZHANG   | 17C | EPJ C77 727            | J. Zhang, L. Yuan             |                   |
| ABLIKIM | 15S | PRL 115 011803         | M. Ablikim <i>et al.</i>      | (BES III Collab.) |
| 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 |                   |
| 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=59611  
REFID=57755  
REFID=58029  
REFID=59611  
REFID=58219  
REFID=58463  
REFID=56784  
REFID=56816  
REFID=56839  
REFID=55938  
REFID=55377  
REFID=53143  
REFID=52296  
REFID=51724  
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

NODE=M236M

| VALUE (MeV)                    | DOCUMENT ID | TECN     | COMMENT                            |
|--------------------------------|-------------|----------|------------------------------------|
| $4391.5^{+6.3}_{-6.8} \pm 1.0$ | ABLIKIM     | 17G BES3 | $e^+e^- \rightarrow \pi^+\pi^-h_c$ |

NODE=M236M

 $\psi(4390)$  WIDTH

NODE=M236W

| VALUE (MeV)                     | DOCUMENT ID | TECN     | COMMENT                            |
|---------------------------------|-------------|----------|------------------------------------|
| $139.5^{+16.2}_{-20.6} \pm 0.6$ | ABLIKIM     | 17G BES3 | $e^+e^- \rightarrow \pi^+\pi^-h_c$ |

NODE=M236W

 $\psi(4390)$  DECAY MODES

NODE=M236215;NODE=M236

| Mode                           | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------------|--------------------------------|
| $\Gamma_1 \quad \pi^+\pi^-h_c$ | seen                           |

DESIG=1

 $\psi(4390)$  BRANCHING RATIOS

NODE=M236220

| $\Gamma(\pi^+\pi^-h_c)/\Gamma_{\text{total}}$ | $\Gamma_1/\Gamma$  |             |                                    |
|-----------------------------------------------|--------------------|-------------|------------------------------------|
| <u>VALUE</u>                                  | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u>                     |
| <b>seen</b>                                   | ABLIKIM            | 17G BES3    | $e^+e^- \rightarrow \pi^+\pi^-h_c$ |

NODE=M236R01  
NODE=M236R01

 $\psi(4390)$  REFERENCES

ABLIKIM 17G PRL 118 092002 M. Ablikim *et al.* (BES III Collab.)

NODE=M236

REFID=57915

NODE=M073

 $\psi(4415)$ 

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

 $\psi(4415)$  MASS

NODE=M073M

| VALUE (MeV)                                 | DOCUMENT ID          | TECN     | COMMENT                             |
|---------------------------------------------|----------------------|----------|-------------------------------------|
| <b>4421 <math>\pm</math> 4 OUR ESTIMATE</b> |                      |          |                                     |
| <b>4415.1 <math>\pm</math> 7.9</b>          | <sup>1</sup> ABLIKIM | 08D BES2 | $e^+e^- \rightarrow \text{hadrons}$ |

NODE=M073M  
→ UNCHECKED ←

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

|               |                       |          |                                                |
|---------------|-----------------------|----------|------------------------------------------------|
| 4412 $\pm$ 15 | <sup>2</sup> MO       | 10 RVUE  | $e^+e^- \rightarrow \text{hadrons}$            |
| 4411 $\pm$ 7  | <sup>3</sup> PAKHLOVA | 08A BELL | $10.6 e^+e^- \rightarrow D^0 D^- \pi^+ \gamma$ |
| 4425 $\pm$ 6  | <sup>4</sup> SETH     | 05A RVUE | $e^+e^- \rightarrow \text{hadrons}$            |
| 4429 $\pm$ 9  | <sup>5</sup> SETH     | 05A RVUE | $e^+e^- \rightarrow \text{hadrons}$            |
| 4417 $\pm$ 10 | BRANDELIK             | 78C DASP | $e^+e^-$                                       |
| 4414 $\pm$ 7  | SIEGRIST              | 76 MRK1  | $e^+e^-$                                       |

OCCUR=2

<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  $\delta = (234 \pm 88)^\circ$ .

NODE=M073M;LINKAGE=AB

<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.

NODE=M073M;LINKAGE=MO

<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;LINKAGE=NS  
NODE=M073M;LINKAGE=ST  
NODE=M073M;LINKAGE=SE

 $\psi(4415)$  WIDTH

NODE=M073W

| VALUE (MeV)                                | DOCUMENT ID          | TECN     | COMMENT                             |
|--------------------------------------------|----------------------|----------|-------------------------------------|
| <b>62 <math>\pm</math> 20 OUR ESTIMATE</b> |                      |          |                                     |
| <b>71.5 <math>\pm</math> 19.0</b>          | <sup>6</sup> ABLIKIM | 08D BES2 | $e^+e^- \rightarrow \text{hadrons}$ |

NODE=M073W  
→ UNCHECKED ←



• • • 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 | $e^+e^-$                                       |

OCCUR=2

<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  $\delta = (234 \pm 88)^\circ$ .

NODE=M073W;LINKAGE=AB

<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.

NODE=M073W;LINKAGE=MO

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

NODE=M073W;LINKAGE=NS

<sup>9</sup> From a fit to Crystal Ball (OSTERHELD 86) data.

NODE=M073W;LINKAGE=ST

<sup>10</sup> From a fit to BES (BAI 02C) data.

NODE=M073W;LINKAGE=SE

## $\psi(4415)$ DECAY MODES

NODE=M073215;NODE=M073

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=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                           |                  |
| $\Gamma_{10} D^0D^-\pi^+ (\text{excl. } D^*(2007)^0\bar{D}^0 + \text{c.c., } D^*(2010)^+D^- + \text{c.c.})$ | < 2.3 %                        | 90%              |
| $\Gamma_{11} D\bar{D}_2^*(2460) \rightarrow D^0D^-\pi^+ + \text{c.c.}$                                      | (10 ±4) %                      |                  |
| $\Gamma_{12} D^0D^{*-}\pi^+ + \text{c.c.}$                                                                  | < 11 %                         | 90%              |
| $\Gamma_{13} D_s^+D_s^-$                                                                                    | not seen                       |                  |
| $\Gamma_{14} \omega\chi_{c2}$                                                                               | possibly seen                  |                  |
| $\Gamma_{15} D_s^{*+}D_s^- + \text{c.c.}$                                                                   | seen                           |                  |
| $\Gamma_{16} D_s^{*+}D_s^{*-}$                                                                              | not seen                       |                  |
| $\Gamma_{17} \psi_2(3823)\pi^+\pi^-$                                                                        | possibly seen                  |                  |
| $\Gamma_{18} J/\psi\eta$                                                                                    | < 6 × 10 <sup>-3</sup>         | 90%              |
| $\Gamma_{19} \chi_{c1}\gamma$                                                                               | < 8 × 10 <sup>-4</sup>         | 90%              |
| $\Gamma_{20} \chi_{c2}\gamma$                                                                               | < 4 × 10 <sup>-3</sup>         | 90%              |
| $\Gamma_{21} e^+e^-$                                                                                        | (9.4 ± 3.2) × 10 <sup>-6</sup> |                  |

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=16

DESIG=20

DESIG=17

DESIG=18

DESIG=21

DESIG=19

DESIG=22

DESIG=23

DESIG=1

## $\psi(4415)$ PARTIAL WIDTHS

NODE=M073220

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

$\Gamma_{21}$

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

**0.58 ± 0.07 OUR ESTIMATE**

**0.35 ± 0.12**

<sup>11</sup> ABLIKIM 08D BES2  $e^+e^- \rightarrow \text{hadrons}$

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

|             |                    |     |      |                                     |
|-------------|--------------------|-----|------|-------------------------------------|
| 0.4 to 0.8  | <sup>12</sup> MO   | 10  | RVUE | $e^+e^- \rightarrow \text{hadrons}$ |
| 0.72 ± 0.11 | <sup>13</sup> SETH | 05A | RVUE | $e^+e^- \rightarrow \text{hadrons}$ |
| 0.64 ± 0.23 | <sup>14</sup> SETH | 05A | RVUE | $e^+e^- \rightarrow \text{hadrons}$ |
| 0.49 ± 0.13 | BRANDELIK          | 78C | DASP | $e^+e^-$                            |
| 0.44 ± 0.14 | SIEGRIST           | 76  | MRK1 | $e^+e^-$                            |

OCCUR=2

NODE=M073W1

NODE=M073W1

→ UNCHECKED ←

- <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;LINKAGE=AB

NODE=M073W1;LINKAGE=MO

NODE=M073W1;LINKAGE=ST  
 NODE=M073W1;LINKAGE=SE

 **$\psi(4415) \Gamma(i) \times \Gamma(e^+e^-)/\Gamma(\text{total})$** 

| $\Gamma(J/\psi\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ |     | $\Gamma_{18}\Gamma_{21}/\Gamma$ |          |                                       |
|------------------------------------------------------------------|-----|---------------------------------|----------|---------------------------------------|
| VALUE (eV)                                                       | CL% | DOCUMENT ID                     | TECN     | COMMENT                               |
| <b>&lt;3.6</b>                                                   | 90  | WANG                            | 13B BELL | $e^+e^- \rightarrow J/\psi\eta\gamma$ |

NODE=M073230

NODE=M073G01  
 NODE=M073G01

| $\Gamma(\chi_{c1}\gamma) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ |     | $\Gamma_{19}\Gamma_{21}/\Gamma$ |         |                                            |
|-----------------------------------------------------------------------|-----|---------------------------------|---------|--------------------------------------------|
| VALUE (eV)                                                            | CL% | DOCUMENT ID                     | TECN    | COMMENT                                    |
| <b>&lt;0.47</b>                                                       | 90  | <sup>15</sup> HAN               | 15 BELL | $10.58 e^+e^- \rightarrow \chi_{c1}\gamma$ |

NODE=M073G02  
 NODE=M073G02

<sup>15</sup> Using  $B(\eta \rightarrow \gamma\gamma) = (39.41 \pm 0.21)\%$ .

NODE=M073G02;LINKAGE=A

| $\Gamma(\chi_{c2}\gamma) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ |     | $\Gamma_{20}\Gamma_{21}/\Gamma$ |         |                                            |
|-----------------------------------------------------------------------|-----|---------------------------------|---------|--------------------------------------------|
| VALUE (eV)                                                            | CL% | DOCUMENT ID                     | TECN    | COMMENT                                    |
| <b>&lt;2.3</b>                                                        | 90  | <sup>16</sup> HAN               | 15 BELL | $10.58 e^+e^- \rightarrow \chi_{c2}\gamma$ |

NODE=M073G03  
 NODE=M073G03

<sup>16</sup> Using  $B(\eta \rightarrow \gamma\gamma) = (39.41 \pm 0.21)\%$ .

NODE=M073G03;LINKAGE=A

 **$\psi(4415)$  BRANCHING RATIOS**

| $\Gamma(D^0\bar{D}^0)/\Gamma_{\text{total}}$                                  |  | $\Gamma_2/\Gamma$ |          |                                         |
|-------------------------------------------------------------------------------|--|-------------------|----------|-----------------------------------------|
| VALUE                                                                         |  | DOCUMENT ID       | TECN     | COMMENT                                 |
| <b>seen</b>                                                                   |  | PAKHOLOVA         | 08 BELL  | $e^+e^- \rightarrow D^0\bar{D}^0\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |  |                   |          |                                         |
| <b>not seen</b>                                                               |  | AUBERT            | 09M BABR | $e^+e^- \rightarrow D^0\bar{D}^0\gamma$ |

NODE=M073225

NODE=M073R04  
 NODE=M073R04

| $\Gamma(D^+D^-)/\Gamma_{\text{total}}$                                        |  | $\Gamma_3/\Gamma$ |          |                                   |
|-------------------------------------------------------------------------------|--|-------------------|----------|-----------------------------------|
| VALUE                                                                         |  | DOCUMENT ID       | TECN     | COMMENT                           |
| <b>seen</b>                                                                   |  | PAKHOLOVA         | 08 BELL  | $e^+e^- \rightarrow D^+D^-\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |  |                   |          |                                   |
| <b>not seen</b>                                                               |  | 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                                          |
| <b>0.14±0.12±0.03</b>                   |  | 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                                    |
| <b>seen</b>                                                        |  | 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                              |
| <b>seen</b>                                                                   | <sup>17</sup> | ZHUKOVA           | 18 BELL  | $e^+e^- \rightarrow D^{*+}D^-\gamma$ |
| <b>seen</b>                                                                   |               | AUBERT            | 09M BABR | $e^+e^- \rightarrow D^{*+}D^-\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |               |                   |          |                                      |
| <b>seen</b>                                                                   |               | PAKHOLOVA         | 07 BELL  | $e^+e^- \rightarrow D^{*+}D^-\gamma$ |

NODE=M073R07  
 NODE=M073R07

<sup>17</sup> Supersedes PAKHOLOVA 07.

NODE=M073R07;LINKAGE=A

| $\Gamma(D^*\bar{D} + \text{c.c.})/\Gamma(D^*\bar{D}^*)$ |  | $\Gamma_4/\Gamma_7$ |          |                                                  |
|---------------------------------------------------------|--|---------------------|----------|--------------------------------------------------|
| VALUE                                                   |  | DOCUMENT ID         | TECN     | COMMENT                                          |
| <b>0.17±0.25±0.03</b>                                   |  | 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                                       |
| <b>seen</b>                                                                |  | AUBERT            | 09M BABR | $e^+e^- \rightarrow D^{*0}\bar{D}^{*0}\gamma$ |

NODE=M073R08  
 NODE=M073R08

$$\Gamma(D^*(2010)^+ D^*(2010)^- + \text{c.c.})/\Gamma_{\text{total}} \quad \Gamma_9/\Gamma$$

| VALUE                                                                         | DOCUMENT ID | TECN     | COMMENT                                    |
|-------------------------------------------------------------------------------|-------------|----------|--------------------------------------------|
| <b>seen</b>                                                                   | 18 ZHUKOVA  | 18 BELL  | $e^+ e^- \rightarrow D^{*+} D^{*-} \gamma$ |
| <b>seen</b>                                                                   | AUBERT      | 09M BABR | $e^+ e^- \rightarrow D^{*+} D^{*-} \gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |          |                                            |
| <b>seen</b>                                                                   | PAKHLOVA    | 07 BELL  | $e^+ e^- \rightarrow D^{*+} D^{*-} \gamma$ |
| 18 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>10.5 ± 2.4 ± 3.8</b>                                                                    | 19 PAKHLOVA | 08A BELL | $10.6 e^+ e^- \rightarrow D^0 D^- \pi^+ \gamma$ |
| 19 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  | 20 PAKHLOVA | 08A BELL | $10.6 e^+ e^- \rightarrow D^0 D^- \pi^+ \gamma$ |
| 20 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

$$\Gamma(D^0 D^{*-} \pi^+ + \text{c.c.})/\Gamma_{\text{total}} \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{12}/\Gamma \times \Gamma_{21}/\Gamma$$

| VALUE                                                    | CL% | DOCUMENT ID | TECN    | COMMENT                                |
|----------------------------------------------------------|-----|-------------|---------|----------------------------------------|
| <b>&lt;0.99 × 10<sup>-6</sup></b>                        | 90  | 21 PAKHLOVA | 09 BELL | $e^+ e^- \rightarrow D^0 D^{*-} \pi^+$ |
| 21 Using $4421 \pm 4$ MeV for the mass of $\psi(4415)$ . |     |             |         |                                        |

NODE=M073R01  
NODE=M073R01

NODE=M073R01;LINKAGE=PA

$$\Gamma(D_s^+ D_s^-)/\Gamma_{\text{total}} \quad \Gamma_{13}/\Gamma$$

| 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

$$\Gamma(\omega \chi_{c2})/\Gamma_{\text{total}} \quad \Gamma_{14}/\Gamma$$

| 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

$$\Gamma(D_s^{*+} D_s^- + \text{c.c.})/\Gamma_{\text{total}} \quad \Gamma_{15}/\Gamma$$

| 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    | $e^+ e^- \rightarrow D_s^{*+} D_s^- \gamma$ |

NODE=M073R11  
NODE=M073R11

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

| 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

$$\Gamma(\psi_2(3823) \pi^+ \pi^-)/\Gamma_{\text{total}} \quad \Gamma_{17}/\Gamma$$

| VALUE                | EVTS | DOCUMENT ID | TECN     | COMMENT                                            |
|----------------------|------|-------------|----------|----------------------------------------------------|
| <b>possibly seen</b> | 19   | 22 ABLIKIM  | 15S BES3 | $e^+ e^- \rightarrow \pi^+ \pi^- \chi_{c1} \gamma$ |

NODE=M073R13  
NODE=M073R13

22 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;LINKAGE=A

### $\psi(4415)$ REFERENCES

NODE=M073

|                  |     |                |                                  |                             |
|------------------|-----|----------------|----------------------------------|-----------------------------|
| ZHUKOVA          | 18  | PR D97 012002  | V. Zhukova <i>et al.</i>         | (BELLE Collab.)             |
| ABLIKIM          | 16A | PR D93 011102  | M. Ablikim <i>et al.</i>         | (BES III Collab.)           |
| ABLIKIM          | 15S | PRL 115 011803 | M. Ablikim <i>et al.</i>         | (BES III Collab.)           |
| HAN              | 15  | PR D92 012011  | Y.L. Han <i>et al.</i>           | (BELLE Collab.)             |
| WANG             | 13B | PR D87 051101  | X.L. Wang <i>et al.</i>          | (BELLE Collab.)             |
| PAKHLOVA         | 11  | PR D83 011101  | G. Pakhlova <i>et al.</i>        | (BELLE 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.)             |
| 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                        | (BELLE Collab.)             |
| 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=58710  
REFID=57122  
REFID=56784  
REFID=56816  
REFID=55377  
REFID=53638  
REFID=53532  
REFID=53540  
REFID=52724  
REFID=53143  
REFID=52142  
REFID=52132  
REFID=52134  
REFID=51628  
REFID=50813  
REFID=50506  
REFID=50503  
REFID=51064  
REFID=22232  
REFID=22243

**$Z_c(4430)$** 

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

$I, G, C$  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.

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.

NODE=M195

NODE=M195

 **$Z_c(4430)$  MASS**

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

 **$4478^{+15}_{-18}$  OUR AVERAGE**

|                                                                               |                       |           |                                    |
|-------------------------------------------------------------------------------|-----------------------|-----------|------------------------------------|
| $4475 \pm 7^{+15}_{-25}$                                                      | <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

NODE=M195M;LINKAGE=A  
 NODE=M195M;LINKAGE=MI  
 NODE=M195M;LINKAGE=CH

 **$Z_c(4430)$  WIDTH**

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

 **$181 \pm 31$  OUR AVERAGE**

|                                                                               |                       |           |                                    |
|-------------------------------------------------------------------------------|-----------------------|-----------|------------------------------------|
| $172 \pm 13^{+37}_{-34}$                                                      | <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

NODE=M195W;LINKAGE=A  
 NODE=M195W;LINKAGE=MI  
 NODE=M195W;LINKAGE=CH

 **$Z_c(4430)$  DECAY MODES**

| Mode                           | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------------|--------------------------------|
| $\Gamma_1 \quad \pi^+\psi(2S)$ | seen                           |
| $\Gamma_2 \quad \pi^+J/\psi$   | seen                           |

NODE=M195215;NODE=M195

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                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|------|------------------------------------------|
| <b>seen</b>                                                                                                                                                                                                                                                                  | <sup>1</sup> CHILIKIN 14      | BELL | $\bar{B}^0 \rightarrow K^- \pi^+ J/\psi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                |                               |      |                                          |
| <b>not seen</b>                                                                                                                                                                                                                                                              | <sup>2</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> 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=AU

 **$Z_c(4430)$  REFERENCES**

|                           |                           |                    |
|---------------------------|---------------------------|--------------------|
| 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=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.

NODE=M234

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  $\sigma$ .

 **$\chi_{c0}(4500)$  MASS**

| VALUE (MeV)                                 | EVTS | DOCUMENT ID           | TECN | COMMENT                           |
|---------------------------------------------|------|-----------------------|------|-----------------------------------|
| <b><math>4506 \pm 11^{+12}_{-15}</math></b> | 4289 | <sup>1</sup> AAIJ 17C | LHCB | $B^+ \rightarrow J/\psi \phi K^+$ |

NODE=M234M

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**

| VALUE (MeV)                               | EVTS | DOCUMENT ID           | TECN | COMMENT                           |
|-------------------------------------------|------|-----------------------|------|-----------------------------------|
| <b><math>92 \pm 21^{+21}_{-20}</math></b> | 4289 | <sup>1</sup> AAIJ 17C | LHCB | $B^+ \rightarrow J/\psi \phi K^+$ |

NODE=M234W

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**

| Mode                         |
|------------------------------|
| $\Gamma_1 \quad J/\psi \phi$ |

NODE=M234215;NODE=M234

DESIG=1

 **$\chi_{c0}(4500)$  BRANCHING RATIOS** $\Gamma(J/\psi \phi)/\Gamma_{\text{total}}$  $\Gamma_1/\Gamma$ 

| VALUE       | EVTS | DOCUMENT ID           | TECN | COMMENT                           |
|-------------|------|-----------------------|------|-----------------------------------|
| <b>seen</b> | 4289 | <sup>1</sup> AAIJ 17C | LHCB | $B^+ \rightarrow J/\psi \phi K^+$ |

NODE=M234220

NODE=M234R01  
 NODE=M234R01

<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;LINKAGE=A

 **$\chi_{c0}(4500)$  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.)    |

NODE=M234

REFID=57657  
 REFID=57636

**$\psi(4660)$** 

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

$I$  needs confirmation.

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.

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."

NODE=M189

NODE=M189

 **$\psi(4660)$  MASS**

NODE=M189M

NODE=M189M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                         | TECN     | COMMENT                                             |
|-------------------------------------------------------------------------------|------|-------------------------------------|----------|-----------------------------------------------------|
| <b>4643 <math>\pm 9</math> OUR AVERAGE</b>                                    |      | Error includes scale factor of 1.2. |          |                                                     |
| 4652 $\pm 10$ $\pm 11$                                                        | 279  | <sup>1</sup> WANG                   | 15A BELL | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| 4669 $\pm 21$ $\pm 3$                                                         | 37   | <sup>2</sup> LEES                   | 14F BABR | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| 4634 $^{+8}_{-7}$ $^{+5}_{-8}$                                                | 142  | <sup>3</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>4</sup> DAI                    | 17 RVUE  | $e^+e^- \rightarrow \Lambda_c^+\Lambda_c^-$         |
| 4645.2 $\pm 9.5$ $\pm 6.0$                                                    |      | <sup>5</sup> ZHANG                  | 17B RVUE | $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$             |
| 4646.4 $\pm 9.7$ $\pm 4.8$                                                    |      | <sup>6</sup> ZHANG                  | 17C RVUE | $e^+e^- \rightarrow \pi^+\pi^-J/\psi$ or $\psi(2S)$ |
| 4661 $^{+9}_{-8}$ $\pm 6$                                                     | 44   | <sup>7</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> From a two-resonance fit. Supersedes WANG 07D.

<sup>2</sup> From a two-resonance fit.

<sup>3</sup> The  $\pi^+\pi^-\psi(2S)$  and  $\Lambda_c^+\Lambda_c^-$  states are not necessarily the same.

<sup>4</sup> The pole parameters are extracted from the speed plot.

<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.

NODE=M189M;LINKAGE=A  
NODE=M189M;LINKAGE=LE

NODE=M189M;LINKAGE=PA  
NODE=M189M;LINKAGE=C  
NODE=M189M;LINKAGE=D  
NODE=M189M;LINKAGE=B

NODE=M189M;LINKAGE=LI

 **$\psi(4660)$  WIDTH**

NODE=M189W

NODE=M189W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID           | TECN     | COMMENT                                             |
|-------------------------------------------------------------------------------|------|-----------------------|----------|-----------------------------------------------------|
| <b>72 <math>\pm 11</math> OUR AVERAGE</b>                                     |      |                       |          |                                                     |
| 68 $\pm 11$ $\pm 5$                                                           | 279  | <sup>1</sup> WANG     | 15A BELL | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| 104 $\pm 48$ $\pm 10$                                                         | 37   | <sup>2</sup> LEES     | 14F BABR | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| 92 $^{+40}_{-24}$ $^{+10}_{-21}$                                              | 142  | <sup>3</sup> PAKHLOVA | 08B BELL | $e^+e^- \rightarrow \Lambda_c^+\Lambda_c^-$         |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                       |          |                                                     |
| 62.6 $\pm 5.6$ $\pm 4.3$                                                      |      | <sup>4</sup> DAI      | 17 RVUE  | $e^+e^- \rightarrow \Lambda_c^+\Lambda_c^-$         |
| 113.8 $\pm 18.1$ $\pm 3.4$                                                    |      | <sup>5</sup> ZHANG    | 17B RVUE | $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$             |
| 103.5 $\pm 15.6$ $\pm 4.0$                                                    |      | <sup>6</sup> ZHANG    | 17C RVUE | $e^+e^- \rightarrow \pi^+\pi^-J/\psi$ or $\psi(2S)$ |
| 42 $^{+17}_{-12}$ $\pm 6$                                                     | 44   | <sup>7</sup> LIU      | 08H RVUE | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| 48 $\pm 15$ $\pm 3$                                                           | 44   | WANG                  | 07D BELL | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |

<sup>1</sup> From a two-resonance fit. Supersedes WANG 07D.

<sup>2</sup> From a two-resonance fit.

<sup>3</sup> The  $\pi^+\pi^-\psi(2S)$  and  $\Lambda_c^+\Lambda_c^-$  states are not necessarily the same.

<sup>4</sup> The pole parameters are extracted from the speed plot.

<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.

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

**$\psi(4660)$  DECAY MODES**

NODE=M189215;NODE=M189

| Mode                                | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------------|--------------------------------|
| $\Gamma_1$ $e^+e^-$                 |                                |
| $\Gamma_2$ $\psi(2S)\pi^+\pi^-$     | seen                           |
| $\Gamma_3$ $J/\psi\eta$             |                                |
| $\Gamma_4$ $D^0D^{*-}\pi^+$         |                                |
| $\Gamma_5$ $\chi_{c1}\gamma$        |                                |
| $\Gamma_6$ $\chi_{c2}\gamma$        |                                |
| $\Gamma_7$ $\Lambda_c^+\Lambda_c^-$ |                                |

DESIG=1

DESIG=2;OUR EVAL;→ UNCHECKED ←

DESIG=4

DESIG=3

DESIG=6

DESIG=7

DESIG=5

 **$\psi(4660) \Gamma(i) \times \Gamma(e^+e^-)/\Gamma(\text{total})$** 

NODE=M189230

 **$\Gamma(\psi(2S)\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$**  **$\Gamma_2\Gamma_1/\Gamma$** 

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

NODE=M189G1

NODE=M189G1

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

|                       |     |        |          |                                                     |
|-----------------------|-----|--------|----------|-----------------------------------------------------|
| $2.0 \pm 0.3 \pm 0.2$ | 279 | 1 WANG | 15A BELL | $10.58 e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| $8.1 \pm 1.1 \pm 1.0$ | 279 | 2 WANG | 15A BELL | $10.58 e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| $2.7 \pm 1.3 \pm 0.5$ | 37  | 3 LEES | 14F BABR | $10.58 e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| $7.5 \pm 1.7 \pm 0.7$ | 37  | 4 LEES | 14F BABR | $10.58 e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| $2.2^{+0.7}_{-0.6}$   | 44  | 5 LIU  | 08H RVUE | $10.58 e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| $5.9 \pm 1.6$         | 44  | 6 LIU  | 08H RVUE | $10.58 e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| $3.0 \pm 0.9 \pm 0.3$ | 44  | 3 WANG | 07D BELL | $10.58 e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| $7.6 \pm 1.8 \pm 0.8$ | 44  | 4 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.<sup>2</sup> Solution II of two equivalent solutions from a fit using two interfering resonances. Supersedes WANG 07D.<sup>3</sup> Solution I of two equivalent solutions in a fit using two interfering resonances.<sup>4</sup> Solution II of two equivalent solutions in a fit using two interfering resonances.<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=M189G1;LINKAGE=A

NODE=M189G1;LINKAGE=B

NODE=M189G1;LINKAGE=WA

NODE=M189G1;LINKAGE=WN

NODE=M189G1;LINKAGE=LI

NODE=M189G1;LINKAGE=LU

 **$\Gamma(J/\psi\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$**  **$\Gamma_3\Gamma_1/\Gamma$** 

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

NODE=M189G01

NODE=M189G01

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

|         |    |      |          |                                       |
|---------|----|------|----------|---------------------------------------|
| $<0.94$ | 90 | WANG | 13B BELL | $e^+e^- \rightarrow J/\psi\eta\gamma$ |
|---------|----|------|----------|---------------------------------------|

 **$\Gamma(\chi_{c1}\gamma) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$**  **$\Gamma_5\Gamma_1/\Gamma$** 

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

NODE=M189G02

NODE=M189G02

 **$<0.45$** <sup>1</sup> Using  $B(\eta \rightarrow \gamma\gamma) = (39.41 \pm 0.21)\%$ .

NODE=M189G02;LINKAGE=A

 **$\Gamma(\chi_{c2}\gamma) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$**  **$\Gamma_6\Gamma_1/\Gamma$** 

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

NODE=M189G03

NODE=M189G03

 **$<2.1$** <sup>1</sup> Using  $B(\eta \rightarrow \gamma\gamma) = (39.41 \pm 0.21)\%$ .

NODE=M189G03;LINKAGE=A

 **$\psi(4660)$  BRANCHING RATIOS**

NODE=M189225

 **$\Gamma(D^0D^{*-}\pi^+)/\Gamma(\psi(2S)\pi^+\pi^-)$**  **$\Gamma_4/\Gamma_2$** 

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

NODE=M189R01

NODE=M189R01

 **$<10$**  **$\Gamma(D^0D^{*-}\pi^+)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$**  **$\Gamma_4/\Gamma \times \Gamma_1/\Gamma$** 

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

NODE=M189R02

NODE=M189R02

 **$<0.37 \times 10^{-6}$** <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

|          |     |                |                                           |                 |
|----------|-----|----------------|-------------------------------------------|-----------------|
| 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.) |
| PAKHLOVA | 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             |                 |
| PAKHLOVA | 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=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

|                   |                             |
|-------------------|-----------------------------|
| $\chi_{c0}(4700)$ | $J^G(J^{PC}) = 0^+(0^{++})$ |
|-------------------|-----------------------------|

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

See the related review(s):

Bottomonium System

Width Determination of the  $\Upsilon$  States

$\eta_b(1S)$

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

NODE=M171

Quantum numbers shown are quark-model predictions. Observed in radiative decay of the  $\Upsilon(3S)$ , therefore  $C = +$ .

NODE=M171

$\eta_b(1S)$  MASS

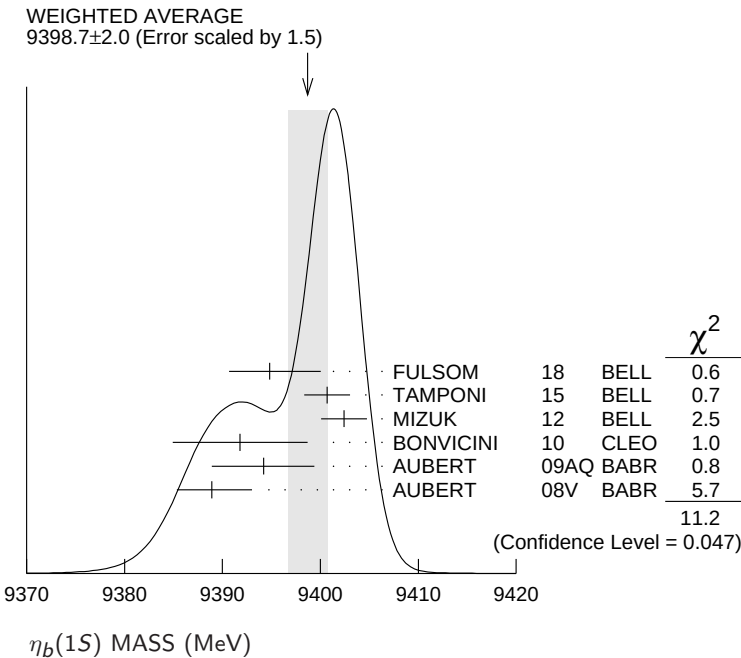
NODE=M171M

| VALUE (MeV)                                                                                                                                          | EVTS       | DOCUMENT ID | TECN                   | COMMENT                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------|------------------------|----------------------------------------------------------------|
| <b>9398.7± 2.0 OUR AVERAGE</b> Error includes scale factor of 1.5. See the ideogram below.<br>[9399.0 ± 2.3 MeV OUR 2018 AVERAGE Scale factor = 1.6] |            |             |                        |                                                                |
| 9394.8 <sup>+2.7</sup> <sub>-3.1</sub>                                                                                                               | 4.5<br>2.7 | 29K         | FULSOM                 | 18 BELL $\Upsilon(2S) \rightarrow \gamma X$                    |
| 9400.7± 1.7                                                                                                                                          | ± 1.6      | 33.1k       | TAMPONI                | 15 BELL $e^+e^- \rightarrow \gamma\eta + \text{hadrons}$       |
| 9402.4± 1.5                                                                                                                                          | ± 1.8      | 34k         | <sup>1</sup> MIZUK     | 12 BELL $e^+e^- \rightarrow \gamma\pi^+\pi^- + \text{hadrons}$ |
| 9391.8± 6.6                                                                                                                                          | ± 2.0      | 2.3k        | <sup>2</sup> BONVICINI | 10 CLEO $\Upsilon(3S) \rightarrow \gamma X$                    |
| 9394.2 <sup>+4.8</sup> <sub>-4.9</sub>                                                                                                               | ± 2.0      | 13k         | <sup>2</sup> AUBERT    | 09AQ BABR $\Upsilon(2S) \rightarrow \gamma X$                  |
| 9388.9 <sup>+3.1</sup> <sub>-2.3</sub>                                                                                                               | ± 2.7      | 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± 3.4                                                                                                                                          | ± 2.3      | 10          | <sup>2,3</sup> DOBBS   | 12 $\Upsilon(2S) \rightarrow \gamma \text{hadrons}$            |
| 9300 ± 20                                                                                                                                            | ± 20       |             | HEISTER                | 02D ALEP 181–209 $e^+e^-$                                      |

NODE=M171M  
NEW

<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.

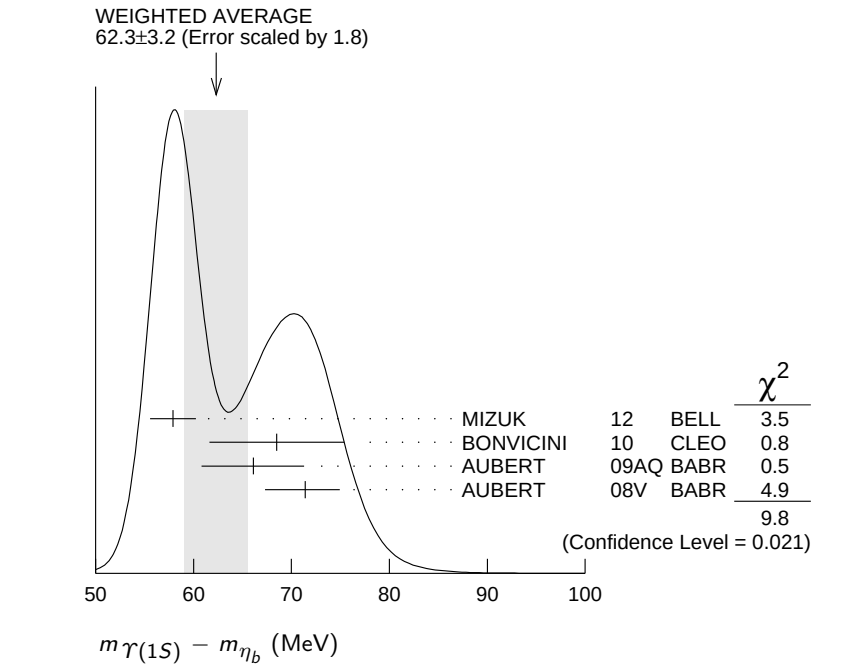
NODE=M171M;LINKAGE=MI  
NODE=M171M;LINKAGE=AU  
NODE=M171M;LINKAGE=DO



$m_{\Upsilon(1S)} - m_{\eta_b}$

| VALUE (MeV)                                                                             | EVTS                           | DOCUMENT ID            | TECN      | COMMENT                                            |
|-----------------------------------------------------------------------------------------|--------------------------------|------------------------|-----------|----------------------------------------------------|
| <b>62.3±3.2 OUR AVERAGE</b> Error includes scale factor of 1.8. See the ideogram below. |                                |                        |           |                                                    |
| 57.9±1.5±1.8                                                                            | 34k                            | <sup>4</sup> MIZUK     | 12 BELL   | $e^+e^- \rightarrow \gamma\pi^+\pi^-$<br>+ hadrons |
| 68.5±6.6±2.0                                                                            | 2.3±0.5k                       | <sup>5</sup> BONVICINI | 10 CLEO   | $\Upsilon(3S) \rightarrow \gamma X$                |
| 66.1 <sup>+4.8</sup> <sub>-4.9</sub> ±2.0                                               | 13±5k                          | <sup>5</sup> AUBERT    | 09AQ BABR | $\Upsilon(2S) \rightarrow \gamma X$                |
| 71.4 <sup>+2.3</sup> <sub>-3.1</sub> ±2.7                                               | 19±3k                          | <sup>5</sup> AUBERT    | 08v BABR  | $\Upsilon(3S) \rightarrow \gamma X$                |
| • • • We do not use the following data for averages, fits, limits, etc. • • •           |                                |                        |           |                                                    |
| 67.1±3.4±2.3                                                                            | 10 <sup>+5</sup> <sub>-4</sub> | <sup>5,6</sup> DOBBS   | 12        | $\Upsilon(2S) \rightarrow \gamma$ hadrons          |

<sup>4</sup> With floating width. Not independent of the corresponding mass measurement.  
<sup>5</sup> Assuming  $\Gamma_{\eta_b(1S)} = 10$  MeV. Not independent of the corresponding  $\gamma$  energy or mass measurements.  
<sup>6</sup> Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.



NODE=M171M2

NODE=M171M2

NODE=M171M2;LINKAGE=MI

NODE=M171M2;LINKAGE=AU

NODE=M171M2;LINKAGE=DO

$\gamma$  ENERGY IN  $\Upsilon(3S)$  DECAY

| 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>7</sup> BONVICINI | 10 CLEO  | $\Upsilon(3S) \rightarrow \gamma X$ |
| 921.2 <sup>+2.1</sup> <sub>-2.8</sub> ±2.4                                                                                       | 19±3k    | <sup>7</sup> AUBERT    | 08v BABR | $\Upsilon(3S) \rightarrow \gamma X$ |
| <sup>7</sup> Assuming $\Gamma_{\eta_b(1S)} = 10$ MeV. Not independent of the corresponding mass or mass difference measurements. |          |                        |          |                                     |

NODE=M171DM

NODE=M171DM

NODE=M171DM;LINKAGE=BO

$\gamma$  ENERGY IN  $\Upsilon(2S)$  DECAY

| VALUE (MeV)                                                                                                                      | EVTS  | DOCUMENT ID         | TECN      | COMMENT                             |
|----------------------------------------------------------------------------------------------------------------------------------|-------|---------------------|-----------|-------------------------------------|
| <b>609.3<sup>+4.6</sup><sub>-4.5</sub>±1.9</b>                                                                                   | 13±5k | <sup>8</sup> AUBERT | 09AQ BABR | $\Upsilon(2S) \rightarrow \gamma X$ |
| <sup>8</sup> Assuming $\Gamma_{\eta_b(1S)} = 10$ MeV. Not independent of the corresponding mass or mass difference measurements. |       |                     |           |                                     |

NODE=M171U2S

NODE=M171U2S

NODE=M171U2S;LINKAGE=AU

$\eta_b(1S)$  WIDTH

NODE=M171W

| VALUE (MeV)                                   | EVTS  | DOCUMENT ID          | TECN | COMMENT                                                     |
|-----------------------------------------------|-------|----------------------|------|-------------------------------------------------------------|
| <b>10 <math>^{+5}_{-4}</math> OUR AVERAGE</b> |       |                      |      |                                                             |
| 8 $^{+6}_{-5} \pm 5$                          | 33.1k | <sup>9</sup> TAMPONI | 15   | BELL $e^+e^- \rightarrow \gamma\eta + \text{hadrons}$       |
| 10.8 $^{+4.0+4.5}_{-3.7-2.0}$                 | 34k   | <sup>9</sup> MIZUK   | 12   | BELL $e^+e^- \rightarrow \gamma\pi^+\pi^- + \text{hadrons}$ |
| <sup>9</sup> With floating mass.              |       |                      |      |                                                             |

NODE=M171W

NODE=M171W;LINKAGE=MI

NODE=M171225;NODE=M171

 **$\eta_b(1S)$  DECAY MODES**

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|---------------------------|--------------------------------|------------------|
| $\Gamma_1$ hadrons        | seen                           |                  |
| $\Gamma_2$ $3h^+3h^-$     | not seen                       |                  |
| $\Gamma_3$ $2h^+2h^-$     | not seen                       |                  |
| $\Gamma_4$ $4h^+4h^-$     |                                |                  |
| $\Gamma_5$ $\gamma\gamma$ | 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

DESIG=3;OUR EST;→ UNCHECKED ←

DESIG=5

DESIG=6

 **$\eta_b(1S)$   $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$**  **$\Gamma(3h^+3h^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$   $\Gamma_2\Gamma_5/\Gamma$** 

| VALUE (eV)                                                                    | CL% | DOCUMENT ID | TECN | COMMENT               |
|-------------------------------------------------------------------------------|-----|-------------|------|-----------------------|
| • • • 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 $181-209 e^+e^-$ |

NODE=M171230

NODE=M171G1

NODE=M171G1

 **$\Gamma(2h^+2h^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$   $\Gamma_3\Gamma_5/\Gamma$** 

| VALUE (eV)                                                                    | CL% | DOCUMENT ID | TECN | COMMENT               |
|-------------------------------------------------------------------------------|-----|-------------|------|-----------------------|
| • • • 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 $181-209 e^+e^-$ |

NODE=M171G2

NODE=M171G2

 **$\Gamma(4h^+4h^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$   $\Gamma_4\Gamma_5/\Gamma$** 

| VALUE (eV)                                                                    | CL% | DOCUMENT ID | TECN | COMMENT               |
|-------------------------------------------------------------------------------|-----|-------------|------|-----------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                       |
| $<660$                                                                        | 95  | ABDALLAH    | 06   | DLPH $161-209 e^+e^-$ |

NODE=M171G3

NODE=M171G3

 **$\eta_b(1S)$  BRANCHING RATIOS** **$\Gamma(\text{hadrons})/\Gamma_{\text{total}}$   $\Gamma_1/\Gamma$** 

| VALUE       | EVTS | DOCUMENT ID | TECN | COMMENT                                                     |
|-------------|------|-------------|------|-------------------------------------------------------------|
| <b>seen</b> | 34k  | MIZUK       | 12   | BELL $e^+e^- \rightarrow \gamma\pi^+\pi^- + \text{hadrons}$ |

NODE=M171235

NODE=M171R03

NODE=M171R03

 **$\Gamma(\mu^+\mu^-)/\Gamma_{\text{total}}$   $\Gamma_6/\Gamma$** 

| VALUE                                    | CL% | DOCUMENT ID          | TECN | COMMENT                                                             |
|------------------------------------------|-----|----------------------|------|---------------------------------------------------------------------|
| <b><math>&lt;9 \times 10^{-3}</math></b> | 90  | <sup>10</sup> AUBERT | 09Z  | BABR $e^+e^- \rightarrow \Upsilon(2S, 3S) \rightarrow \gamma\eta_b$ |

NODE=M171R01

NODE=M171R01

<sup>10</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                                      |
|------------------------------------------|-----|-------------|------|----------------------------------------------|
| <b><math>&lt;8 \times 10^{-2}</math></b> | 90  | AUBERT      | 09P  | BABR $e^+e^- \rightarrow \gamma\tau^+\tau^-$ |

NODE=M171R02

NODE=M171R02

 **$\eta_b(1S)$  REFERENCES**

|           |      |                |                             |                  |
|-----------|------|----------------|-----------------------------|------------------|
| FULSOM    | 18   | PRL 121 232001 | B.G.Fulsom                  | (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.)  |

NODE=M171

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 ) %               |                                   |

DESIG=3

DESIG=2

DESIG=1

**Hadronic decays**

NODE=M049;CLUMP=A

|                                                                                                     |                                 |                    |        |
|-----------------------------------------------------------------------------------------------------|---------------------------------|--------------------|--------|
| $\Gamma_4 \quad g g g$                                                                              | (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% |
| $\Gamma_{20} \quad \chi_{c1}(3872) \text{ anything, } \chi_{c1} \rightarrow J/\psi(1S) \pi^+ \pi^-$ | < 9.5                           | × 10 <sup>-6</sup> | CL=90% |
| $\Gamma_{21} \quad \psi(4260) \text{ anything, } \psi \rightarrow J/\psi(1S) \pi^+ \pi^-$           | < 3.8                           | × 10 <sup>-5</sup> | CL=90% |
| $\Gamma_{22} \quad \psi(4260) \text{ anything, } \psi \rightarrow J/\psi(1S) K^+ K^-$               | < 7.5                           | × 10 <sup>-6</sup> | CL=90% |
| $\Gamma_{23} \quad \chi_{c1}(4140) \text{ anything, } \chi_{c1} \rightarrow J/\psi(1S) \phi$        | < 5.2                           | × 10 <sup>-6</sup> | CL=90% |
| $\Gamma_{24} \quad \chi_{c0} \text{ anything}$                                                      | < 4                             | × 10 <sup>-3</sup> | CL=90% |

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=160

DESIG=161

DESIG=165

DESIG=166

DESIG=5

|                 |                                                              |                                  |        |           |
|-----------------|--------------------------------------------------------------|----------------------------------|--------|-----------|
| Г <sub>25</sub> | $\chi_{c1}$ anything                                         | $(1.90 \pm 0.35) \times 10^{-4}$ |        | DESIG=6   |
| Г <sub>26</sub> | $\chi_{c1}(1P)X_{tetra}$                                     | $< 3.78 \times 10^{-5}$          | CL=90% | DESIG=175 |
| Г <sub>27</sub> | $\chi_{c2}$ anything                                         | $(2.8 \pm 0.8) \times 10^{-4}$   |        | DESIG=7   |
| Г <sub>28</sub> | $\psi(2S)$ anything                                          | $(1.23 \pm 0.20) \times 10^{-4}$ |        | DESIG=8   |
| Г <sub>29</sub> | $\psi(2S)\eta_c$                                             | $< 3.6 \times 10^{-6}$           | CL=90% | DESIG=153 |
| Г <sub>30</sub> | $\psi(2S)\chi_{c0}$                                          | $< 6.5 \times 10^{-6}$           | CL=90% | DESIG=154 |
| Г <sub>31</sub> | $\psi(2S)\chi_{c1}$                                          | $< 4.5 \times 10^{-6}$           | CL=90% | DESIG=155 |
| Г <sub>32</sub> | $\psi(2S)\chi_{c2}$                                          | $< 2.1 \times 10^{-6}$           | CL=90% | DESIG=156 |
| Г <sub>33</sub> | $\psi(2S)\eta_c(2S)$                                         | $< 3.2 \times 10^{-6}$           | CL=90% | DESIG=157 |
| Г <sub>34</sub> | $\psi(2S)X(3940)$                                            | $< 2.9 \times 10^{-6}$           | CL=90% | DESIG=158 |
| Г <sub>35</sub> | $\psi(2S)X(4160)$                                            | $< 2.9 \times 10^{-6}$           | CL=90% | DESIG=159 |
| Г <sub>36</sub> | $\psi(4260)$ anything, $\psi \rightarrow \psi(2S)\pi^+\pi^-$ | $< 7.9 \times 10^{-5}$           | CL=90% | DESIG=162 |
| Г <sub>37</sub> | $\psi(4360)$ anything, $\psi \rightarrow \psi(2S)\pi^+\pi^-$ | $< 5.2 \times 10^{-5}$           | CL=90% | DESIG=163 |
| Г <sub>38</sub> | $\psi(4660)$ anything, $\psi \rightarrow \psi(2S)\pi^+\pi^-$ | $< 2.2 \times 10^{-5}$           | CL=90% | DESIG=164 |
| Г <sub>39</sub> | $X(4050)^\pm$ anything, $X \rightarrow \psi(2S)\pi^\pm$      | $< 8.8 \times 10^{-5}$           | CL=90% | DESIG=171 |
| Г <sub>40</sub> | $Z_c(4430)^\pm$ anything, $Z_c \rightarrow \psi(2S)\pi^\pm$  | $< 6.7 \times 10^{-5}$           | CL=90% | DESIG=172 |
| 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

|      |                                                            |                    |                  |        |           |
|------|------------------------------------------------------------|--------------------|------------------|--------|-----------|
| Г75  | $\gamma\pi^+\pi^-$                                         | ( 6.3 ±1.8 )       | $\times 10^{-5}$ |        | DESIG=70  |
| Г76  | $\gamma\pi^0\pi^0$                                         | ( 1.7 ±0.7 )       | $\times 10^{-5}$ |        | DESIG=71  |
| Г77  | $\gamma\pi\pi$ (S-wave)                                    | ( 4.6 ±0.7 )       | $\times 10^{-5}$ |        | DESIG=190 |
| Г78  | $\gamma\pi^0\eta$                                          | < 2.4              | $\times 10^{-6}$ | CL=90% | DESIG=111 |
| Г79  | $\gamma K^+ K^-$                                           | [a] ( 1.14 ±0.13 ) | $\times 10^{-5}$ |        | DESIG=102 |
| Г80  | $\gamma p\bar{p}$                                          | [b] < 6            | $\times 10^{-6}$ | CL=90% | DESIG=103 |
| Г81  | $\gamma 2h^+ 2h^-$                                         | ( 7.0 ±1.5 )       | $\times 10^{-4}$ |        | DESIG=20  |
| Г82  | $\gamma 3h^+ 3h^-$                                         | ( 5.4 ±2.0 )       | $\times 10^{-4}$ |        | DESIG=21  |
| Г83  | $\gamma 4h^+ 4h^-$                                         | ( 7.4 ±3.5 )       | $\times 10^{-4}$ |        | DESIG=22  |
| Г84  | $\gamma\pi^+\pi^- K^+ K^-$                                 | ( 2.9 ±0.9 )       | $\times 10^{-4}$ |        | DESIG=14  |
| Г85  | $\gamma 2\pi^+ 2\pi^-$                                     | ( 2.5 ±0.9 )       | $\times 10^{-4}$ |        | DESIG=13  |
| Г86  | $\gamma 3\pi^+ 3\pi^-$                                     | ( 2.5 ±1.2 )       | $\times 10^{-4}$ |        | DESIG=17  |
| Г87  | $\gamma 2\pi^+ 2\pi^- K^+ K^-$                             | ( 2.4 ±1.2 )       | $\times 10^{-4}$ |        | DESIG=18  |
| Г88  | $\gamma\pi^+\pi^- p\bar{p}$                                | ( 1.5 ±0.6 )       | $\times 10^{-4}$ |        | DESIG=15  |
| Г89  | $\gamma 2\pi^+ 2\pi^- p\bar{p}$                            | ( 4 ±6 )           | $\times 10^{-5}$ |        | DESIG=19  |
| Г90  | $\gamma 2K^+ 2K^-$                                         | ( 2.0 ±2.0 )       | $\times 10^{-5}$ |        | DESIG=16  |
| Г91  | $\gamma\eta'(958)$                                         | < 1.9              | $\times 10^{-6}$ | CL=90% | DESIG=55  |
| Г92  | $\gamma\eta$                                               | < 1.0              | $\times 10^{-6}$ | CL=90% | DESIG=54  |
| Г93  | $\gamma f_0(980)$                                          | < 3                | $\times 10^{-5}$ | CL=90% | DESIG=105 |
| Г94  | $\gamma f_2'(1525)$                                        | ( 2.9 ±0.6 )       | $\times 10^{-5}$ |        | DESIG=52  |
| Г95  | $\gamma f_2(1270)$                                         | ( 1.01 ±0.06 )     | $\times 10^{-4}$ |        | DESIG=51  |
| Г96  | $\gamma\eta(1405)$                                         | < 8.2              | $\times 10^{-5}$ | CL=90% | DESIG=65  |
| Г97  | $\gamma f_0(1500)$                                         | < 1.5              | $\times 10^{-5}$ | CL=90% | DESIG=108 |
| Г98  | $\gamma f_0(1500) \rightarrow \gamma K^+ K^-$              | ( 1.0 ±0.4 )       | $\times 10^{-5}$ |        | DESIG=192 |
| Г99  | $\gamma f_0(1710)$                                         | < 2.6              | $\times 10^{-4}$ | CL=90% | DESIG=53  |
| Г100 | $\gamma f_0(1710) \rightarrow \gamma K^+ K^-$              | ( 1.01 ±0.32 )     | $\times 10^{-5}$ |        | DESIG=112 |
| Г101 | $\gamma f_0(1710) \rightarrow \gamma\pi^+\pi^-$            | ( 5.3 ±2.0 )       | $\times 10^{-6}$ |        | DESIG=191 |
| Г102 | $\gamma f_0(1710) \rightarrow \gamma\pi^0\pi^0$            | < 1.4              | $\times 10^{-6}$ | CL=90% | DESIG=109 |
| Г103 | $\gamma f_0(1710) \rightarrow \gamma\eta\eta$              | < 1.8              | $\times 10^{-6}$ | CL=90% | DESIG=110 |
| Г104 | $\gamma f_4(2050)$                                         | < 5.3              | $\times 10^{-5}$ | CL=90% | DESIG=104 |
| Г105 | $\gamma f_0(2200) \rightarrow \gamma K^+ K^-$              | < 2                | $\times 10^{-4}$ | CL=90% | DESIG=69  |
| Г106 | $\gamma f_J(2220) \rightarrow \gamma K^+ K^-$              | < 8                | $\times 10^{-7}$ | CL=90% | DESIG=60  |
| Г107 | $\gamma f_J(2220) \rightarrow \gamma\pi^+\pi^-$            | < 6                | $\times 10^{-7}$ | CL=90% | DESIG=61  |
| Г108 | $\gamma f_J(2220) \rightarrow \gamma p\bar{p}$             | < 1.1              | $\times 10^{-6}$ | CL=90% | DESIG=62  |
| Г109 | $\gamma\eta(2225) \rightarrow \gamma\phi\phi$              | < 3                | $\times 10^{-3}$ | CL=90% | DESIG=68  |
| Г110 | $\gamma\eta_c(1S)$                                         | < 5.7              | $\times 10^{-5}$ | CL=90% | DESIG=119 |
| Г111 | $\gamma\chi_{c0}$                                          | < 6.5              | $\times 10^{-4}$ | CL=90% | DESIG=120 |
| Г112 | $\gamma\chi_{c1}$                                          | < 2.3              | $\times 10^{-5}$ | CL=90% | DESIG=121 |
| Г113 | $\gamma\chi_{c2}$                                          | < 7.6              | $\times 10^{-6}$ | CL=90% | DESIG=122 |
| Г114 | $\gamma\chi_{c1}(3872) \rightarrow \pi^+\pi^- J/\psi$      | < 1.6              | $\times 10^{-6}$ | CL=90% | DESIG=123 |
| Г115 | $\gamma\chi_{c1}(3872) \rightarrow \pi^+\pi^-\pi^0 J/\psi$ | < 2.8              | $\times 10^{-6}$ | CL=90% | DESIG=124 |
| Г116 | $\gamma X(3915) \rightarrow \omega J/\psi$                 | < 3.0              | $\times 10^{-6}$ | CL=90% | DESIG=125 |
| Г117 | $\gamma\chi_{c1}(4140) \rightarrow \phi J/\psi$            | < 2.2              | $\times 10^{-6}$ | CL=90% | DESIG=126 |
| Г118 | $\gamma X$                                                 | [c] < 4.5          | $\times 10^{-6}$ | CL=90% | DESIG=66  |
| Г119 | $\gamma X\bar{X} (m_X < 3.1 \text{ GeV})$                  | [d] < 1            | $\times 10^{-3}$ | CL=90% | DESIG=67  |
| Г120 | $\gamma X\bar{X} (m_X < 4.5 \text{ GeV})$                  | [e] < 2.4          | $\times 10^{-4}$ | CL=90% | DESIG=127 |
| Г121 | $\gamma X \rightarrow \gamma + \geq 4 \text{ prongs}$      | [f] < 1.78         | $\times 10^{-4}$ | CL=95% | DESIG=113 |
| Г122 | $\gamma a_1^0 \rightarrow \gamma\mu^+\mu^-$                | [g] < 9            | $\times 10^{-6}$ | CL=90% | DESIG=114 |
| Г123 | $\gamma a_1^0 \rightarrow \gamma\tau^+\tau^-$              | [a] < 1.30         | $\times 10^{-4}$ | CL=90% | DESIG=115 |
| Г124 | $\gamma a_1^0 \rightarrow \gamma g g$                      | [h] < 1            | %                | CL=90% | DESIG=129 |
| Г125 | $\gamma a_1^0 \rightarrow \gamma s\bar{s}$                 | [h] < 1            | $\times 10^{-3}$ | CL=90% | DESIG=130 |

**Lepton Family number (LF) violating modes**

NODE=M049;CLUMP=C

|      |                    |    |       |                  |        |
|------|--------------------|----|-------|------------------|--------|
| Г126 | $\mu^\pm \tau^\mp$ | LF | < 6.0 | $\times 10^{-6}$ | CL=95% |
|------|--------------------|----|-------|------------------|--------|

DESIG=116

**Other decays**
 $\Gamma_{127}$  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><math>31.2 \pm 1.6 \pm 1.7</math></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><math>1.240 \pm 0.016</math> OUR AVERAGE</b> |                         |      |                                              |
| $1.252 \pm 0.004 \pm 0.019$                     | <sup>1</sup> ROSNER     | 06   | CLEO $9.5 e^+e^- \rightarrow \text{hadrons}$ |
| $1.187 \pm 0.023 \pm 0.031$                     | <sup>1</sup> BARU       | 92B  | MD1 $e^+e^- \rightarrow \text{hadrons}$      |
| $1.23 \pm 0.02 \pm 0.05$                        | <sup>1</sup> JAKUBOWSKI | 88   | CBAL $e^+e^- \rightarrow \text{hadrons}$     |
| $1.37 \pm 0.06 \pm 0.09$                        | <sup>2</sup> GILES      | 84B  | CLEO $e^+e^- \rightarrow \text{hadrons}$     |
| $1.23 \pm 0.08 \pm 0.04$                        | <sup>2</sup> ALBRECHT   | 82   | DASP $e^+e^- \rightarrow \text{hadrons}$     |
| $1.13 \pm 0.07 \pm 0.11$                        | <sup>2</sup> NICZYPORUK | 82   | LENA $e^+e^- \rightarrow \text{hadrons}$     |
| $1.09 \pm 0.25$                                 | <sup>2</sup> BOCK       | 80   | CNTR $e^+e^- \rightarrow \text{hadrons}$     |
| $1.35 \pm 0.14$                                 | <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><math>1.340 \pm 0.018</math> 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><math>2.60 \pm 0.10</math> OUR AVERAGE</b> |      |                       |      |                                                                 |
| $2.53 \pm 0.13 \pm 0.05$                      | 60k  | <sup>1</sup> BESSON   | 07   | CLEO $e^+e^- \rightarrow \Upsilon(1S) \rightarrow \tau^+\tau^-$ |
| $2.61 \pm 0.12^{+0.09}_{-0.13}$               | 25k  | CINABRO               | 94B  | CLE2 $e^+e^- \rightarrow \tau^+\tau^-$                          |
| $2.7 \pm 0.4 \pm 0.2$                         |      | <sup>2</sup> ALBRECHT | 85C  | ARG $\Upsilon(2S) \rightarrow \pi^+\pi^-\tau^+\tau^-$           |
| $3.4 \pm 0.4 \pm 0.4$                         |      | 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><math>2.38 \pm 0.11</math> OUR AVERAGE</b> |      |             |      |                                                  |
| $2.29 \pm 0.08 \pm 0.11$                      |      | ALEXANDER   | 98   | CLE2 $\Upsilon(2S) \rightarrow \pi^+\pi^-e^+e^-$ |
| $2.42 \pm 0.14 \pm 0.14$                      | 307  | ALBRECHT    | 87   | ARG $\Upsilon(2S) \rightarrow \pi^+\pi^-e^+e^-$  |
| $2.8 \pm 0.3 \pm 0.2$                         | 826  | BESSON      | 84   | CLEO $\Upsilon(2S) \rightarrow \pi^+\pi^-e^+e^-$ |
| $5.1 \pm 3.0$                                 |      | 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 +0.034<br>-0.014           |      | 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=M049R43  
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    | $\Upsilon(1S) \rightarrow J/\psi K^- X$         |                              |
| $\Gamma(\chi_{c1}(3872) \text{ anything}, \chi_{c1} \rightarrow J/\psi(1S)\pi^+\pi^-)/\Gamma_{\text{total}}$ |      |             |      |         | $\Gamma_{20}/\Gamma$                            | NODE=M049R00<br>NODE=M049R00 |
| VALUE                                                                                                        | CL%  | DOCUMENT ID | TECN | COMMENT |                                                 |                              |
| $<9.5 \times 10^{-6}$                                                                                        | 90   | SHEN        | 16   | BELL    | $\Upsilon(1S) \rightarrow J/\psi \pi^+ \pi^- X$ |                              |
| $\Gamma(\psi(4260) \text{ anything}, \psi \rightarrow J/\psi(1S)\pi^+\pi^-)/\Gamma_{\text{total}}$           |      |             |      |         | $\Gamma_{21}/\Gamma$                            | NODE=M049R99<br>NODE=M049R99 |
| VALUE                                                                                                        | CL%  | DOCUMENT ID | TECN | COMMENT |                                                 |                              |
| $<3.8 \times 10^{-5}$                                                                                        | 90   | SHEN        | 16   | BELL    | $\Upsilon(1S) \rightarrow J/\psi \pi^+ \pi^- X$ |                              |
| $\Gamma(\psi(4260) \text{ anything}, \psi \rightarrow J/\psi(1S)K^+K^-)/\Gamma_{\text{total}}$               |      |             |      |         | $\Gamma_{22}/\Gamma$                            | NODE=M049P03<br>NODE=M049P03 |
| VALUE                                                                                                        | CL%  | DOCUMENT ID | TECN | COMMENT |                                                 |                              |
| $<7.5 \times 10^{-6}$                                                                                        | 90   | SHEN        | 16   | BELL    | $\Upsilon(1S) \rightarrow J/\psi K^+ K^- X$     |                              |
| $\Gamma(\chi_{c1}(4140) \text{ anything}, \chi_{c1} \rightarrow J/\psi(1S)\phi)/\Gamma_{\text{total}}$       |      |             |      |         | $\Gamma_{23}/\Gamma$                            | NODE=M049P04<br>NODE=M049P04 |
| VALUE                                                                                                        | CL%  | DOCUMENT ID | TECN | COMMENT |                                                 |                              |
| $<5.2 \times 10^{-6}$                                                                                        | 90   | SHEN        | 16   | BELL    | $\Upsilon(1S) \rightarrow J/\psi K^+ K^- X$     |                              |

$\Gamma(\chi_{c0} \text{ anything})/\Gamma(J/\psi(1S) \text{ anything})$  $\Gamma_{24}/\Gamma_7$ 

| VALUE          | CL% | DOCUMENT ID | TECN | COMMENT                            |
|----------------|-----|-------------|------|------------------------------------|
| <b>&lt;7.4</b> | 90  | BRIERE      | 04   | CLEO $e^+e^- \rightarrow J/\psi X$ |

NODE=M049R25  
 NODE=M049R25

 $\Gamma(\chi_{c1} \text{ anything})/\Gamma_{\text{total}}$  $\Gamma_{25}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                                           |
|--------------------------|------|-------------|------|---------------------------------------------------|
| <b>1.90±0.35 OUR FIT</b> |      |             |      |                                                   |
| <b>1.90±0.43±0.14</b>    | 215  | JIA         | 17   | BELL $\Upsilon(1S) \rightarrow \gamma J/\psi(1S)$ |

NODE=M049P13  
 NODE=M049P13

 $\Gamma(\chi_{c1} \text{ anything})/\Gamma(J/\psi(1S) \text{ anything})$  $\Gamma_{25}/\Gamma_7$ 

| VALUE                    | EVTS    | DOCUMENT ID | TECN | COMMENT                            |
|--------------------------|---------|-------------|------|------------------------------------|
| <b>0.35±0.07 OUR FIT</b> |         |             |      |                                    |
| <b>0.35±0.08±0.06</b>    | 52 ± 12 | BRIERE      | 04   | CLEO $e^+e^- \rightarrow J/\psi X$ |

NODE=M049R26  
 NODE=M049R26

 $\Gamma(\chi_{c1}(1P)X_{tetra})/\Gamma_{\text{total}}$  $\Gamma_{26}/\Gamma$ 

| VALUE                             | CL% | DOCUMENT ID      | TECN | COMMENT                                  |
|-----------------------------------|-----|------------------|------|------------------------------------------|
| <b>&lt;37.8 × 10<sup>-6</sup></b> | 90  | <sup>1</sup> JIA | 17A  | BELL $e^+e^- \rightarrow \text{hadrons}$ |

NODE=M049P15  
 NODE=M049P15

<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  $37.8 \times 10^{-6}$ .

NODE=M049P15;LINKAGE=A

 $\Gamma(\chi_{c2} \text{ anything})/\Gamma(J/\psi(1S) \text{ anything})$  $\Gamma_{27}/\Gamma_7$ 

| VALUE                 | EVTS    | DOCUMENT ID | TECN | COMMENT                            |
|-----------------------|---------|-------------|------|------------------------------------|
| <b>0.52±0.12±0.09</b> | 47 ± 11 | BRIERE      | 04   | CLEO $e^+e^- \rightarrow J/\psi X$ |

NODE=M049R27  
 NODE=M049R27

 $\Gamma(\psi(2S) \text{ anything})/\Gamma_{\text{total}}$  $\Gamma_{28}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                              |
|--------------------------|------|-------------|------|--------------------------------------|
| <b>1.23±0.17±0.11</b>    | 215  | SHEN        | 16   | BELL $e^+e^- \rightarrow \psi(2S) X$ |

NODE=M049P12  
 NODE=M049P12

 $\Gamma(\psi(2S) \text{ anything})/\Gamma(J/\psi(1S) \text{ anything})$  $\Gamma_{28}/\Gamma_7$ 

| VALUE                 | EVTS    | DOCUMENT ID | TECN | COMMENT                                        |
|-----------------------|---------|-------------|------|------------------------------------------------|
| <b>0.41±0.11±0.08</b> | 42 ± 11 | BRIERE      | 04   | CLEO $e^+e^- \rightarrow J/\psi \pi^+ \pi^- X$ |

NODE=M049R28  
 NODE=M049R28

 $\Gamma(\psi(2S)\eta_c)/\Gamma_{\text{total}}$  $\Gamma_{29}/\Gamma$ 

| VALUE                            | CL% | DOCUMENT ID | TECN | COMMENT                              |
|----------------------------------|-----|-------------|------|--------------------------------------|
| <b>&lt;3.6 × 10<sup>-6</sup></b> | 90  | YANG        | 14   | BELL $e^+e^- \rightarrow \psi(2S) X$ |

NODE=M049R92  
 NODE=M049R92

 $\Gamma(\psi(2S)\chi_{c0})/\Gamma_{\text{total}}$  $\Gamma_{30}/\Gamma$ 

| VALUE                            | CL% | DOCUMENT ID | TECN | COMMENT                              |
|----------------------------------|-----|-------------|------|--------------------------------------|
| <b>&lt;6.5 × 10<sup>-6</sup></b> | 90  | YANG        | 14   | BELL $e^+e^- \rightarrow \psi(2S) X$ |

NODE=M049R93  
 NODE=M049R93

 $\Gamma(\psi(2S)\chi_{c1})/\Gamma_{\text{total}}$  $\Gamma_{31}/\Gamma$ 

| VALUE                            | CL% | DOCUMENT ID | TECN | COMMENT                              |
|----------------------------------|-----|-------------|------|--------------------------------------|
| <b>&lt;4.5 × 10<sup>-6</sup></b> | 90  | YANG        | 14   | BELL $e^+e^- \rightarrow \psi(2S) X$ |

NODE=M049R94  
 NODE=M049R94

 $\Gamma(\psi(2S)\chi_{c2})/\Gamma_{\text{total}}$  $\Gamma_{32}/\Gamma$ 

| VALUE                            | CL% | DOCUMENT ID | TECN | COMMENT                              |
|----------------------------------|-----|-------------|------|--------------------------------------|
| <b>&lt;2.1 × 10<sup>-6</sup></b> | 90  | YANG        | 14   | BELL $e^+e^- \rightarrow \psi(2S) X$ |

NODE=M049R95  
 NODE=M049R95

 $\Gamma(\psi(2S)\eta_c(2S))/\Gamma_{\text{total}}$  $\Gamma_{33}/\Gamma$ 

| VALUE                            | CL% | DOCUMENT ID | TECN | COMMENT                              |
|----------------------------------|-----|-------------|------|--------------------------------------|
| <b>&lt;3.2 × 10<sup>-6</sup></b> | 90  | YANG        | 14   | BELL $e^+e^- \rightarrow \psi(2S) X$ |

NODE=M049R96  
 NODE=M049R96

 $\Gamma(\psi(2S)X(3940))/\Gamma_{\text{total}}$  $\Gamma_{34}/\Gamma$ 

| VALUE                            | CL% | DOCUMENT ID | TECN | COMMENT                              |
|----------------------------------|-----|-------------|------|--------------------------------------|
| <b>&lt;2.9 × 10<sup>-6</sup></b> | 90  | YANG        | 14   | BELL $e^+e^- \rightarrow \psi(2S) X$ |

NODE=M049R97  
 NODE=M049R97

 $\Gamma(\psi(2S)X(4160))/\Gamma_{\text{total}}$  $\Gamma_{35}/\Gamma$ 

| VALUE                            | CL% | DOCUMENT ID | TECN | COMMENT                              |
|----------------------------------|-----|-------------|------|--------------------------------------|
| <b>&lt;2.9 × 10<sup>-6</sup></b> | 90  | YANG        | 14   | BELL $e^+e^- \rightarrow \psi(2S) X$ |

NODE=M049R98  
 NODE=M049R98

 $\Gamma(\psi(4260) \text{ anything}, \psi \rightarrow \psi(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{36}/\Gamma$ 

| VALUE                            | CL% | DOCUMENT ID | TECN | COMMENT                                              |
|----------------------------------|-----|-------------|------|------------------------------------------------------|
| <b>&lt;7.9 × 10<sup>-5</sup></b> | 90  | SHEN        | 16   | BELL $\Upsilon(1S) \rightarrow \psi(2S)\pi^+\pi^- X$ |

NODE=M049P00  
 NODE=M049P00

$\Gamma(\psi(4360) \text{ anything}, \psi \rightarrow \psi(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{37}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                                              |
|-----------------------|-----|-------------|------|------------------------------------------------------|
| $<5.2 \times 10^{-5}$ | 90  | SHEN        | 16   | BELL $\Upsilon(1S) \rightarrow \psi(2S)\pi^+\pi^- X$ |

NODE=M049P01  
NODE=M049P01

 $\Gamma(\psi(4660) \text{ anything}, \psi \rightarrow \psi(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{38}/\Gamma$ 

| 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

 $\Gamma(X(4050)^\pm \text{ anything}, X \rightarrow \psi(2S)\pi^\pm)/\Gamma_{\text{total}}$   $\Gamma_{39}/\Gamma$ 

| 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

 $\Gamma(Z_c(4430)^\pm \text{ anything}, Z_c \rightarrow \psi(2S)\pi^\pm)/\Gamma_{\text{total}}$   $\Gamma_{40}/\Gamma$ 

| 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

 $\Gamma(Z_c(4200)^+ Z_c(4200)^-)/\Gamma_{\text{total}}$   $\Gamma_{41}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID      | TECN | COMMENT                                         |
|--------------------------|-----|------------------|------|-------------------------------------------------|
| $<22.3$                  | 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=M049P17  
NODE=M049P17

NODE=M049P17;LINKAGE=A

 $\Gamma(Z_c(3900)^\pm Z_c(4200)^\mp)/\Gamma_{\text{total}}$   $\Gamma_{42}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID      | TECN | COMMENT                                         |
|--------------------------|-----|------------------|------|-------------------------------------------------|
| $<8.1$                   | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(1S) \rightarrow J/\psi\pi^\pm X$ |

<sup>1</sup> Assuming  $B(Z_c(4200)^\pm \rightarrow J/\psi\pi^\pm) = 1 = B(Z_c(3900)^\pm \rightarrow J/\psi\pi^\pm)$ .

NODE=M049P18  
NODE=M049P18

NODE=M049P18;LINKAGE=A

 $\Gamma(Z_c(3900)^+ Z_c(3900)^-)/\Gamma_{\text{total}}$   $\Gamma_{43}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID      | TECN | COMMENT                                         |
|--------------------------|-----|------------------|------|-------------------------------------------------|
| $<1.8$                   | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(1S) \rightarrow J/\psi\pi^\pm X$ |

<sup>1</sup> Assuming  $B(Z_c(3900)^\pm \rightarrow J/\psi\pi^\pm) = 1$

NODE=M049P19  
NODE=M049P19

NODE=M049P19;LINKAGE=A

 $\Gamma(X(4050)^+ X(4050)^-)/\Gamma_{\text{total}}$   $\Gamma_{44}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID      | TECN | COMMENT                                                |
|--------------------------|-----|------------------|------|--------------------------------------------------------|
| $<15.8$                  | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(1S) \rightarrow \chi_{c1}(1P)\pi^\pm X$ |

<sup>1</sup> Assuming  $B(X(4050)^\pm \rightarrow \chi_{c1}(1P)\pi^\pm) = 1$

NODE=M049P20  
NODE=M049P20

NODE=M049P20;LINKAGE=A

 $\Gamma(X(4250)^+ X(4250)^-)/\Gamma_{\text{total}}$   $\Gamma_{45}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID      | TECN | COMMENT                                                |
|--------------------------|-----|------------------|------|--------------------------------------------------------|
| $<26.6$                  | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(1S) \rightarrow \chi_{c1}(1P)\pi^\pm X$ |

<sup>1</sup> Assuming  $B(X(4250)^\pm \rightarrow \chi_{c1}(1P)\pi^\pm) = 1$

NODE=M049P21  
NODE=M049P21

NODE=M049P21;LINKAGE=A

 $\Gamma(X(4050)^\pm X(4250)^\mp)/\Gamma_{\text{total}}$   $\Gamma_{46}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID      | TECN | COMMENT                                                |
|--------------------------|-----|------------------|------|--------------------------------------------------------|
| $<44.2$                  | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(1S) \rightarrow \chi_{c1}(1P)\pi^\pm X$ |

<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=M049P22  
NODE=M049P22

NODE=M049P22;LINKAGE=A

 $\Gamma(Z_c(4430)^+ Z_c(4430)^-)/\Gamma_{\text{total}}$   $\Gamma_{47}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID      | TECN | COMMENT                                           |
|--------------------------|-----|------------------|------|---------------------------------------------------|
| $<20.3$                  | 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=M049P23  
NODE=M049P23

NODE=M049P23;LINKAGE=A

 $\Gamma(X(4055)^\pm X(4055)^\mp)/\Gamma_{\text{total}}$   $\Gamma_{48}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID      | TECN | COMMENT                                           |
|--------------------------|-----|------------------|------|---------------------------------------------------|
| $<23.3$                  | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(1S) \rightarrow \psi(2S)\pi^\pm X$ |

<sup>1</sup> Assuming  $B(X(4055)^\pm \rightarrow \psi(2S)\pi^\pm) = 1$

NODE=M049P25  
NODE=M049P25

NODE=M049P25;LINKAGE=A

$\Gamma(X(4055)^\pm Z_c(4430)^\mp)/\Gamma_{\text{total}}$  $\Gamma_{49}/\Gamma$ 

| VALUE (units $10^{-6}$ )                                                                                              | CL% | DOCUMENT ID      | TECN    | COMMENT                                      |
|-----------------------------------------------------------------------------------------------------------------------|-----|------------------|---------|----------------------------------------------|
| <b>&lt;45.5</b>                                                                                                       | 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                                    |
|-------------------------------------------------------------------------------|-----|-------------|---------|--------------------------------------------|
| <b>&lt;3.68</b>                                                               | 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                                         |
|--------------------------|-----|-------------|---------|-------------------------------------------------|
| <b>&lt;3.90</b>          | 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                               |
|--------------------------|-----|-------------|--------|---------------------------------------|
| <b>&lt;5</b>             | 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                           |
|--------------------------|-----|-------------|--------|-----------------------------------|
| <b>&lt;5</b>             | 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                             |
|--------------------------|-----|-------------------|--------|-------------------------------------|
| <b>&lt;5</b>             | 90  | <sup>1</sup> BARU | 96 MD1 | $\Upsilon(1S) \rightarrow p\bar{p}$ |

<sup>1</sup> Supersedes BARU 92 in this node.

NODE=M049R59  
 NODE=M049R59

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                                    |
|-------------------------------------------------------------------------------|-----|------------|---------------|---------|--------------------------------------------|
| <b><math>2.14 \pm 0.72 \pm 0.34</math></b>                                    |     | $26 \pm 9$ | 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                              |
|--------------------------------------------|------|-------------|----------|--------------------------------------|
| <b><math>2.36 \pm 0.37 \pm 0.29</math></b> | 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                                       |
|--------------------------------------------|------|-------------|----------|-----------------------------------------------|
| <b><math>4.46 \pm 0.67 \pm 0.72</math></b> | 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                                     |
|--------------------------------------------|------|-------------|----------|---------------------------------------------|
| <b><math>4.42 \pm 0.50 \pm 0.58</math></b> | 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                              |
|--------------------------|-----|-------------|----------|--------------------------------------|
| <b>&lt;1.63</b>          | 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                                       |
|--------------------------|-----|-------------|----------|-----------------------------------------------|
| <b>&lt;1.79</b>          | 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                                       |
|--------------------------|-----|-------------|----------|-----------------------------------------------|
| <b>&lt;2.24</b>          | 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

 $\Gamma(D^*(2010)^\pm \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{71}/\Gamma$ 

| <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><math>25.2 \pm 1.3 \pm 1.5</math></b>  | $\approx 2k$ | <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

COMMENT

**1.200±0.017**

1,2

DOBBS

12A

 $\Upsilon(1S) \rightarrow \text{hadrons}$ 

<sup>1</sup> DOBBS 12A presents individual exclusive branching fractions or upper limits for 100 modes of four to ten pions, kaons, or protons.

<sup>2</sup> Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

NODE=M049R02  
NODE=M049R02

NODE=M049R02;LINKAGE=DO

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

**3.36±0.23±0.25**

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

**6.3±1.2±1.3**

1

ANASTASSOV 99

CLE2

 $e^+ e^- \rightarrow \text{hadrons}$ 

<sup>1</sup> For  $m_{\pi\pi} > 1 \text{ GeV}$ .

NODE=M049R70  
NODE=M049R70

NODE=M049R70;LINKAGE=A

 $\Gamma(\gamma \pi^0 \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{76}/\Gamma$ VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

**1.7±0.6±0.3**

1

ANASTASSOV 99

CLE2

 $e^+ e^- \rightarrow \text{hadrons}$ 

<sup>1</sup> For  $m_{\pi\pi} > 1 \text{ GeV}$ .

NODE=M049R71  
NODE=M049R71

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

**4.63±0.56±0.48**

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

**<2.4**

90

1

BESSON

07A

CLEO

 $e^+ e^- \rightarrow \Upsilon(1S)$ 

<sup>1</sup> BESSON 07A obtained this limit for  $0.7 < m_{\pi^0 \eta} < 3 \text{ GeV}$ .

NODE=M049R47  
NODE=M049R47

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

**1.14±0.08±0.10**

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

**<0.6**

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

**7.0±1.1±1.0**

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

**5.4±1.5±1.3**

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

**7.4±2.5±2.5**

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

**2.9±0.7±0.6**

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

**2.5±0.7±0.5**

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

 $\Gamma(\gamma f'_2(1525))/\Gamma_{\text{total}}$  $\Gamma_{94}/\Gamma$ 

| <u>VALUE (units 10<sup>-5</sup>)</u>              | <u>CL%</u>         | <u>EVTs</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---------------------------------------------------|--------------------|-------------|--------------------|-------------|----------------|
| <b>2.9 ±0.6</b>                                   | <b>OUR AVERAGE</b> |             |                    |             |                |
| [(3.8 ± 0.9) × 10 <sup>-5</sup> OUR 2018 AVERAGE] |                    |             |                    |             |                |

|                             |    |                     |          |                                           |  |
|-----------------------------|----|---------------------|----------|-------------------------------------------|--|
| $2.13 \pm 0.28 \pm 0.72$    |    | <sup>1</sup> LEES   | 18A BABR | $\Upsilon(1S) \rightarrow \gamma K^+ K^-$ |  |
| $4.0 \pm 1.4 \pm 0.1$       | 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  $B(f'_2(1525) \rightarrow K \bar{K}) = (88.7 \pm 2.2) \times 10^{-2}$ . 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  $B(f'_2(1525) \rightarrow K \bar{K}) = 4 B(f'_2(1525) \rightarrow K_S^0 \bar{K}_S^0)$ .

<sup>3</sup> Assuming  $B(f'_2(1525) \rightarrow K \bar{K}) = 0.71$ .

NODE=M049R52;LINKAGE=A  
 NODE=M049R52;LINKAGE=BE

NODE=M049R52;LINKAGE=D

$\Gamma(\gamma f_2(1270))/\Gamma_{\text{total}}$  $\Gamma_{95}/\Gamma$ 

| VALUE (units $10^{-5}$ )                           | CL% | DOCUMENT ID             | TECN     | COMMENT                                       |
|----------------------------------------------------|-----|-------------------------|----------|-----------------------------------------------|
| <b>10.1 ± 0.6 OUR AVERAGE</b>                      |     |                         |          |                                               |
| [(10.1 ± 0.9) × 10 <sup>-5</sup> OUR 2018 AVERAGE] |     |                         |          |                                               |
| 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  
 NEW

NODE=M049R51;LINKAGE=A

NODE=M049R51;LINKAGE=BE

NODE=M049R51;LINKAGE=C

 $\Gamma(\gamma \eta(1405))/\Gamma_{\text{total}}$  $\Gamma_{96}/\Gamma$ 

| 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

 $\Gamma(\gamma f_0(1500))/\Gamma_{\text{total}}$  $\Gamma_{97}/\Gamma$ 

| 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

 $\Gamma(\gamma f_0(1500) \rightarrow \gamma K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{98}/\Gamma$ 

| 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

 $\Gamma(\gamma f_0(1710))/\Gamma_{\text{total}}$  $\Gamma_{99}/\Gamma$ 

| 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

 $\Gamma(\gamma f_0(1710) \rightarrow \gamma K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{100}/\Gamma$ 

| 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                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|------|----------------------------------------------------|
| <b><math>0.53 \pm 0.17 \pm 0.11</math></b>                                                                                                                                                    | <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                                                                |
|------------------------------|-----|-------------|------|------------------------------------------------------------------------|
| <b><math>&lt; 1.4</math></b> | 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                                                              |
|------------------------------|-----|-------------|------|----------------------------------------------------------------------|
| <b><math>&lt; 1.8</math></b> | 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                                            |
|-------------------------------------------------------------------|-----|--------------------|------|----------------------------------------------------|
| <b>&lt;5.3</b>                                                    | 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                                       |
|---------------------------------|-----|-------------|------|-----------------------------------------------|
| <b><math>&lt; 0.0002</math></b> | 90  | BARU        | 89   | MD1 $\Upsilon(1S) \rightarrow \gamma K^+ K^-$ |

NODE=M049R63  
 NODE=M049R63

 $\Gamma(\gamma f_J(2220) \rightarrow \gamma K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{106}/\Gamma$ 

| <u>VALUE (units <math>10^{-7}</math>)</u>                                     | <u>CL%</u> | <u>DOCUMENT ID</u> |     | <u>TECN</u> | <u>COMMENT</u>                            |
|-------------------------------------------------------------------------------|------------|--------------------|-----|-------------|-------------------------------------------|
| <b>&lt; 8</b>                                                                 | 90         | ATHAR              | 06  | CLE3        | $\Upsilon(1S) \rightarrow \gamma K^+ K^-$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |            |                    |     |             |                                           |
| < 160                                                                         | 90         | MASEK              | 02  | CLEO        | $\Upsilon(1S) \rightarrow \gamma K^+ K^-$ |
| < 150                                                                         | 90         | FULTON             | 90B | CLEO        | $\Upsilon(1S) \rightarrow \gamma K^+ K^-$ |
| < 290                                                                         | 90         | ALBRECHT           | 89  | ARG         | $\Upsilon(1S) \rightarrow \gamma K^+ K^-$ |
| <2000                                                                         | 90         | BARU               | 89  | MD1         | $\Upsilon(1S) \rightarrow \gamma K^+ K^-$ |

NODE=M049R56  
 NODE=M049R56

 $\Gamma(\gamma f_J(2220) \rightarrow \gamma \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{107}/\Gamma$ 

| <u>VALUE (units <math>10^{-7}</math>)</u>                                     | <u>CL%</u> | <u>DOCUMENT ID</u> |    | <u>TECN</u> | <u>COMMENT</u>                                |
|-------------------------------------------------------------------------------|------------|--------------------|----|-------------|-----------------------------------------------|
| <b>&lt; 6</b>                                                                 | 90         | ATHAR              | 06 | CLE3        | $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |            |                    |    |             |                                               |
| <120                                                                          | 90         | MASEK              | 02 | CLEO        | $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$ |

NODE=M049R41  
 NODE=M049R41

 $\Gamma(\gamma f_J(2220) \rightarrow \gamma p \bar{p})/\Gamma_{\text{total}}$  $\Gamma_{108}/\Gamma$ 

| <u>VALUE (units <math>10^{-7}</math>)</u>                                     | <u>CL%</u> | <u>DOCUMENT ID</u> |    | <u>TECN</u> | <u>COMMENT</u>                              |
|-------------------------------------------------------------------------------|------------|--------------------|----|-------------|---------------------------------------------|
| <b>&lt; 11</b>                                                                | 90         | ATHAR              | 06 | CLE3        | $\Upsilon(1S) \rightarrow \gamma p \bar{p}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |            |                    |    |             |                                             |
| <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                                               |
|--------------------------------|-----|-------------|------|-------------------------------------------------------|
| <b><math>&lt; 0.003</math></b> | 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 (units $10^{-5}$ )     | CL% | DOCUMENT ID | TECN | COMMENT                                  |
|------------------------------|-----|-------------|------|------------------------------------------|
| <b><math>&lt; 5.7</math></b> | 90  | SHEN        | 10A  | BELL $\Upsilon(1S) \rightarrow \gamma X$ |

NODE=M049R38  
 NODE=M049R38

 $\Gamma(\gamma \chi_{c0})/\Gamma_{\text{total}}$  $\Gamma_{111}/\Gamma$ 

| VALUE (units $10^{-4}$ )     | CL% | DOCUMENT ID | TECN | COMMENT                                  |
|------------------------------|-----|-------------|------|------------------------------------------|
| <b><math>&lt; 6.5</math></b> | 90  | SHEN        | 10A  | BELL $\Upsilon(1S) \rightarrow \gamma X$ |

NODE=M049R39  
 NODE=M049R39

 $\Gamma(\gamma \chi_{c1})/\Gamma_{\text{total}}$  $\Gamma_{112}/\Gamma$ 

| VALUE (units $10^{-5}$ )     | CL% | DOCUMENT ID | TECN | COMMENT                                  |
|------------------------------|-----|-------------|------|------------------------------------------|
| <b><math>&lt; 2.3</math></b> | 90  | SHEN        | 10A  | BELL $\Upsilon(1S) \rightarrow \gamma X$ |

NODE=M049R40  
 NODE=M049R40

 $\Gamma(\gamma \chi_{c2})/\Gamma_{\text{total}}$  $\Gamma_{113}/\Gamma$ 

| VALUE (units $10^{-6}$ )     | CL% | DOCUMENT ID | TECN | COMMENT                                  |
|------------------------------|-----|-------------|------|------------------------------------------|
| <b><math>&lt; 7.6</math></b> | 90  | SHEN        | 10A  | BELL $\Upsilon(1S) \rightarrow \gamma X$ |

NODE=M049R48  
 NODE=M049R48

$\Gamma(\gamma\chi_{c1}(3872) \rightarrow \pi^+\pi^- J/\psi)/\Gamma_{\text{total}}$   $\Gamma_{114}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                  |
|--------------------------|-----|-------------|------|------------------------------------------|
| <1.6                     | 90  | SHEN        | 10A  | BELL $\Upsilon(1S) \rightarrow \gamma X$ |

NODE=M049R49  
NODE=M049R49

 $\Gamma(\gamma\chi_{c1}(3872) \rightarrow \pi^+\pi^-\pi^0 J/\psi)/\Gamma_{\text{total}}$   $\Gamma_{115}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                  |
|--------------------------|-----|-------------|------|------------------------------------------|
| <2.8                     | 90  | SHEN        | 10A  | BELL $\Upsilon(1S) \rightarrow \gamma X$ |

NODE=M049R68  
NODE=M049R68

 $\Gamma(\gamma X(3915) \rightarrow \omega J/\psi)/\Gamma_{\text{total}}$   $\Gamma_{116}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                  |
|--------------------------|-----|-------------|------|------------------------------------------|
| <3.0                     | 90  | SHEN        | 10A  | BELL $\Upsilon(1S) \rightarrow \gamma X$ |

NODE=M049R69  
NODE=M049R69

 $\Gamma(\gamma\chi_{c1}(4140) \rightarrow \phi J/\psi)/\Gamma_{\text{total}}$   $\Gamma_{117}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                  |
|--------------------------|-----|-------------|------|------------------------------------------|
| <2.2                     | 90  | SHEN        | 10A  | BELL $\Upsilon(1S) \rightarrow \gamma X$ |

NODE=M049R74  
NODE=M049R74

 $\Gamma(\gamma X)/\Gamma_{\text{total}}$   $\Gamma_{118}/\Gamma$ 

( $X$  = 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

 $\Gamma(\gamma X\bar{X}(m_X < 3.1 \text{ GeV}))/\Gamma_{\text{total}}$   $\Gamma_{119}/\Gamma$ 

( $X\bar{X}$  = 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

 $\Gamma(\gamma X\bar{X}(m_X < 4.5 \text{ GeV}))/\Gamma_{\text{total}}$   $\Gamma_{120}/\Gamma$ 

$X$  and  $\bar{X}$  = zero spin with  $m < 4.5$  GeV

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID                   | TECN | COMMENT                                |
|--------------------------|-----|-------------------------------|------|----------------------------------------|
| <24                      | 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  $m < 4.5$  GeV.

NODE=M049R01  
NODE=M049R01  
NODE=M049R01

NODE=M049R01;LINKAGE=DA

 $\Gamma(\gamma X \rightarrow \gamma + \geq 4 \text{ prongs})/\Gamma_{\text{total}}$   $\Gamma_{121}/\Gamma$ 

( $1.5 \text{ GeV} < m_X < 5.0 \text{ GeV}$ )

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                            |
|--------------------------|-----|-------------|------|------------------------------------|
| <1.78                    | 95  | ROSNER      | 07A  | CLEO $e^+e^- \rightarrow \gamma X$ |

NODE=M049R64  
NODE=M049R64  
NODE=M049R64

 $\Gamma(\gamma a_1^0 \rightarrow \gamma \mu^+ \mu^-)/\Gamma_{\text{total}}$   $\Gamma_{122}/\Gamma$ 

( $201 < M(\mu^+ \mu^-) < 3565 \text{ MeV}$ )

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID       | TECN | COMMENT                                                               |
|--------------------------|-----|-------------------|------|-----------------------------------------------------------------------|
| <9                       | 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  $212-9200 \text{ MeV}$ , 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

 $\Gamma(\gamma a_1^0 \rightarrow \gamma \tau^+ \tau^-)/\Gamma_{\text{total}}$   $\Gamma_{123}/\Gamma$ 

( $2m_\tau < M(\tau^+ \tau^-) < 9.2 \text{ GeV}$ )

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID       | TECN | COMMENT                                                          |
|--------------------------|-----|-------------------|------|------------------------------------------------------------------|
| <130                     | 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 $e^+e^- \rightarrow \gamma a_1^0 \rightarrow \gamma \tau^+ \tau^-$ |
|------|----|-------------------|----|-------------------------------------------------------------------------|

NODE=M049R66  
NODE=M049R66  
NODE=M049R66

<sup>1</sup> For a narrow scalar  $a_1^0$  with  $2m_\tau < M(a_1^0) < 9.2$  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  $M(a_1^0) = 7.5$  GeV, and  $13 \times 10^{-5}$  at  $M(a_1^0) = 9.2$  GeV.

<sup>2</sup> For a narrow scalar or pseudoscalar  $a_1^0$  with  $2m_\tau < M(a_1^0) < 7.5$  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  $M(a_1^0) = 7.5$  GeV.

$\Gamma(\gamma a_1^0 \rightarrow \gamma g g) / \Gamma_{\text{total}}$   $\Gamma_{124} / \Gamma$   
(0.5 GeV <  $m$  < 9.0 GeV)

| VALUE                | CL% | DOCUMENT ID       | TECN     | COMMENT                             |
|----------------------|-----|-------------------|----------|-------------------------------------|
| $< 1 \times 10^{-2}$ | 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  $0.5 \text{ GeV} < m_X < 9.0$  GeV. Measured 90% CL limit as a function of  $m_X$  range from  $10^{-6}$  to  $10^{-2}$ .

$\Gamma(\gamma a_1^0 \rightarrow \gamma s \bar{s}) / \Gamma_{\text{total}}$   $\Gamma_{125} / \Gamma$   
(0.5 GeV <  $m$  < 9.0 GeV)

| VALUE                | CL% | DOCUMENT ID       | TECN     | COMMENT                             |
|----------------------|-----|-------------------|----------|-------------------------------------|
| $< 1 \times 10^{-3}$ | 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  $1.5 \text{ GeV} < m_X < 9.0$  GeV. Measured 90% CL limit as a function of  $m_X$  range from  $10^{-5}$  to  $10^{-3}$ .

### LEPTON FAMILY NUMBER ( $LF$ ) VIOLATING MODES

$\Gamma(\mu^\pm \tau^\mp) / \Gamma_{\text{total}}$   $\Gamma_{126} / \Gamma$   
(units  $10^{-6}$ )

| VALUE   | CL% | DOCUMENT ID | TECN     | COMMENT                                |
|---------|-----|-------------|----------|----------------------------------------|
| $< 6.0$ | 95  | LOVE        | 08A CLEO | $e^+ e^- \rightarrow \mu^\pm \tau^\mp$ |

### OTHER DECAYS

$\Gamma(\text{invisible}) / \Gamma_{\text{total}}$   $\Gamma_{127} / \Gamma$   
(units  $10^{-4}$ )

| VALUE   | CL% | DOCUMENT ID | TECN      | COMMENT                                             |
|---------|-----|-------------|-----------|-----------------------------------------------------|
| $< 3.0$ | 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 | $\Upsilon(3S) \rightarrow \pi^+ \pi^- \Upsilon(1S)$ |

### $\Upsilon(1S)$ REFERENCES

|               |      |                |                                  |                 |             |
|---------------|------|----------------|----------------------------------|-----------------|-------------|
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| LEES          | 18A  | PR D97 112006  | J.P. Lees <i>et al.</i>          | (BABAR Collab.) | REFID=58950 |
| 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 |
| SHEN          | 16   | PR D93 112013  | C.P. Shen <i>et al.</i>          | (BELLE Collab.) | REFID=57515 |
| 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 |
| LEES          | 13C  | PR D87 031102  | J.P. Lees <i>et al.</i>          | (BABAR Collab.) | REFID=54949 |
| LEES          | 13L  | PR D88 031701  | J.P. Lees <i>et al.</i>          | (BABAR Collab.) | REFID=55167 |
| LEES          | 13R  | PR D88 071102  | J.P. Lees <i>et al.</i>          | (BABAR Collab.) | REFID=55451 |
| SHEN          | 13   | PR D88 011102  | C.P. Shen <i>et al.</i>          | (BELLE Collab.) | REFID=55395 |
| 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 |
| BESSION       | 11   | PR D83 037101  | D. Besson <i>et al.</i>          | (CLEO Collab.)  | REFID=16737 |
| DEL-AMO-SA... | 11J  | PRL 107 021804 | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.) | REFID=16495 |
| AUBERT        | 10C  | PR D81 011102  | B. Aubert <i>et al.</i>          | (BABAR Collab.) | REFID=53211 |
| DEL-AMO-SA... | 10C  | PRL 104 191801 | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.) | REFID=53354 |
| SHEN          | 10A  | PR D82 051504  | C.P. Shen <i>et al.</i>          | (BELLE Collab.) | REFID=53545 |
| AUBERT        | 09AX | PRL 103 251801 | B. Aubert <i>et al.</i>          | (BABAR Collab.) | REFID=53201 |
| LOVE          | 08   | PRL 101 151802 | W. Love <i>et al.</i>            | (CLEO Collab.)  | REFID=52565 |
| 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 |
| ATHAR         | 07A  | PR D76 072003  | S.B. Athar <i>et al.</i>         | (CLEO Collab.)  | REFID=51945 |
| BESSION       | 07   | PRL 98 052002  | D. Besson <i>et al.</i>          | (CLEO Collab.)  | REFID=51620 |
| BESSION       | 07A  | PR D75 072001  | D. Besson <i>et al.</i>          | (CLEO Collab.)  | REFID=51638 |
| ROSNER        | 07A  | PR D76 117102  | J.L. Rosner <i>et al.</i>        | (CLEO Collab.)  | REFID=52079 |
| RUBIN         | 07   | PR D75 031104  | P. Rubin <i>et al.</i>           | (CLEO Collab.)  | REFID=51629 |
| TAJIMA        | 07   | PRL 98 132001  | O. Tajima <i>et al.</i>          | (BELLE Collab.) | REFID=51645 |
| AQUINES       | 06A  | PR D74 092006  | O. Aquines <i>et al.</i>         | (CLEO Collab.)  | REFID=51510 |
| ATHAR         | 06   | PR D73 032001  | S.B. Athar <i>et al.</i>         | (CLEO Collab.)  | REFID=50993 |
| 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 |
| BRIERE        | 04   | PR D70 072001  | R.A. Briere <i>et al.</i>        | (CLEO Collab.)  | REFID=50183 |
| ARTUSO        | 03   | PR D67 052003  | M. Artuso <i>et al.</i>          | (CLEO Collab.)  | REFID=49395 |
| MASEK         | 02   | PR D65 072002  | G. Masek <i>et al.</i>           | (CLEO Collab.)  | REFID=48846 |
| RICHICHI      | 01B  | PRL 87 141801  | S.J. Richichi <i>et al.</i>      | (CLEO Collab.)  | REFID=48345 |
| ARTAMONOV     | 00   | PL B474 427    | A.S. Artamonov <i>et al.</i>     |                 | REFID=47424 |

NODE=M049R66;LINKAGE=A

NODE=M049R66;LINKAGE=LO

NODE=M049R03

NODE=M049R03

NODE=M049R03

NODE=M049R03;LINKAGE=A

NODE=M049R04

NODE=M049R04

NODE=M049R04

NODE=M049R04;LINKAGE=A

NODE=M049230

NODE=M049R67

NODE=M049R67

NODE=M049235

NODE=M049R10

NODE=M049R10

NODE=M049

|                                                             |     |                         |                              |                           |             |
|-------------------------------------------------------------|-----|-------------------------|------------------------------|---------------------------|-------------|
| ANASTASSOV                                                  | 99  | PRL 82 286              | A. Anastassov <i>et al.</i>  | (CLEO Collab.)            | REFID=46609 |
| 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 |
| BALEST                                                      | 95  | PR D51 2053             | R. Balest <i>et al.</i>      | (CLEO Collab.)            | REFID=44146 |
| CINABRO                                                     | 94B | PL B340 129             | D. Cinabro <i>et al.</i>     | (CLEO Collab.)            | REFID=44102 |
| ALBRECHT                                                    | 92J | ZPHY C55 25             | H. Albrecht <i>et al.</i>    | (ARGUS Collab.)           | REFID=42167 |
| BARU                                                        | 92  | ZPHY C54 229            | S.E. Baru <i>et al.</i>      | (NOVO)                    | REFID=41860 |
| BARU                                                        | 92B | ZPHY C56 547            | S.E. Baru <i>et al.</i>      | (NOVO)                    | REFID=42168 |
| KOBEL                                                       | 92  | ZPHY C53 193            | M. Kobel <i>et al.</i>       | (Crystal Ball Collab.)    | REFID=41861 |
| BLINOV                                                      | 90  | PL B245 311             | A.E. Blinov <i>et al.</i>    | (NOVO)                    | REFID=41361 |
| FULTON                                                      | 90B | PR D41 1401             | R. Fulton <i>et al.</i>      | (CLEO Collab.)            | REFID=41012 |
| 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 |
| ALEXANDER                                                   | 89  | NP B320 45              | J.P. Alexander <i>et al.</i> | (LBL, MICH, SLAC)         | REFID=40345 |
| BARU                                                        | 89  | ZPHY C42 505            | S.E. Baru <i>et al.</i>      | (NOVO)                    | REFID=40917 |
| CHEN                                                        | 89B | PR D39 3528             | W.Y. Chen <i>et al.</i>      | (CLEO Collab.)            | REFID=40919 |
| FULTON                                                      | 89  | PL B224 445             | R. Fulton <i>et al.</i>      | (CLEO Collab.)            | REFID=40918 |
| KAARSBERG                                                   | 89  | PRL 62 2077             | T.M. Kaarsberg <i>et al.</i> | (CUSB Collab.)            | REFID=40733 |
| BUCHMUELLER                                                 | 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 |
| SCHMITT                                                     | 88  | ZPHY C40 199            | P. Schmitt <i>et al.</i>     | (Crystal Ball Collab.)    | REFID=40582 |
| 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 |
| BARU                                                        | 86  | ZPHY C30 551            | S.E. Baru <i>et al.</i>      | (NOVO)                    | REFID=22284 |
| ALBRECHT                                                    | 85C | PL 154B 452             | H. Albrecht <i>et al.</i>    | (ARGUS Collab.)           | REFID=22282 |
| KURAEV                                                      | 85  | SJNP 41 466             | E.A. Kuraev, V.S. Fadin      | (NOVO)                    | REFID=40033 |
| Translated from YAF 41 733.                                 |     |                         |                              |                           |             |
| ARTAMONOV                                                   | 84  | PL 137B 272             | A.S. Artamonov <i>et al.</i> | (NOVO)                    | REFID=22278 |
| BESSION                                                     | 84  | PR D30 1433             | D. Besson <i>et al.</i>      | (CLEO Collab.)            | REFID=22279 |
| GILES                                                       | 84B | PR D29 1285             | R. Giles <i>et al.</i>       | (CLEO Collab.)            | REFID=22280 |
| MACKAY                                                      | 84  | PR D29 2483             | W.W. MacKay <i>et al.</i>    | (CUSB Collab.)            | REFID=22281 |
| ANDREWS                                                     | 83  | PRL 50 807              | D.E. Andrews <i>et al.</i>   | (CLEO Collab.)            | REFID=22273 |
| GILES                                                       | 83  | PRL 50 877              | R. Giles <i>et al.</i>       | (HARV, OSU, ROCH, RUTG+)  | REFID=22274 |
| NICZYPORUK                                                  | 83  | ZPHY C17 197            | B. Niczyporuk <i>et al.</i>  | (LENA Collab.)            | REFID=12488 |
| ALBRECHT                                                    | 82  | PL 116B 383             | H. Albrecht <i>et al.</i>    | (DESY, DORT, HEIDH+)      | REFID=22270 |
| ARTAMONOV                                                   | 82  | PL 118B 225             | A.S. Artamonov <i>et al.</i> | (NOVO)                    | REFID=22271 |
| NICZYPORUK                                                  | 82  | ZPHY C15 299            | B. Niczyporuk <i>et al.</i>  | (LENA Collab.)            | REFID=22272 |
| BERGER                                                      | 80C | PL 93B 497              | C. Berger <i>et al.</i>      | (PLUTO Collab.)           | REFID=22263 |
| BOCK                                                        | 80  | ZPHY C6 125             | P. Bock <i>et al.</i>        | (HEIDP, MPIM, DESY, HAMB) | REFID=22264 |
| BERGER                                                      | 79  | ZPHY C1 343             | C. Berger <i>et al.</i>      | (PLUTO Collab.)           | 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

NODE=M076M

| VALUE (MeV)                                 | DOCUMENT ID                                                                         |
|---------------------------------------------|-------------------------------------------------------------------------------------|
| <b>9859.44 ± 0.42 ± 0.31 OUR EVALUATION</b> | From average $\gamma$ energy below, using $\Upsilon(2S)$ mass = 10023.26 ± 0.31 MeV |

NODE=M076M  
→ UNCHECKED ←

### $m_{\chi_{b1}(1P)} - m_{\chi_{b0}(1P)}$

| VALUE (MeV)         | DOCUMENT ID | TECN     | COMMENT                                              |
|---------------------|-------------|----------|------------------------------------------------------|
| <b>32.49 ± 0.93</b> | LEES        | 14M BABR | $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$ |

NODE=M076M2  
NODE=M076M2

### $\gamma$ ENERGY IN $\Upsilon(2S)$ DECAY

NODE=M076DM

| VALUE (MeV)                                                                   | DOCUMENT ID | TECN    | COMMENT                                          |
|-------------------------------------------------------------------------------|-------------|---------|--------------------------------------------------|
| <b>162.5 ± 0.4 OUR AVERAGE</b>                                                |             |         |                                                  |
| 162.56 ± 0.19 ± 0.42                                                          | ARTUSO      | 05 CLEO | $\Upsilon(2S) \rightarrow \gamma X$              |
| 162.0 ± 0.8 ± 1.2                                                             | EDWARDS     | 99 CLE2 | $\Upsilon(2S) \rightarrow \gamma \chi(1P)$       |
| 162.1 ± 0.5 ± 1.4                                                             | ALBRECHT    | 85E ARG | $\Upsilon(2S) \rightarrow \text{conv.} \gamma X$ |
| 163.8 ± 1.6 ± 2.7                                                             | NERNST      | 85 CBAL | $\Upsilon(2S) \rightarrow \gamma X$              |
| 158.0 ± 7 ± 1                                                                 | HAAS        | 84 CLEO | $\Upsilon(2S) \rightarrow \text{conv.} \gamma X$ |
| • • • 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

$\chi_{b0}(1P)$  DECAY MODES

NODE=M076215;NODE=M076

| Mode                                              | Fraction ( $\Gamma_i/\Gamma$ )     | Confidence level |
|---------------------------------------------------|------------------------------------|------------------|
| $\Gamma_1 \quad \gamma \Upsilon(1S)$              | ( $1.94 \pm 0.27$ ) %              |                  |
| $\Gamma_2 \quad D^0 X$                            | < 10.4 %                           | 90%              |
| $\Gamma_3 \quad \pi^+ \pi^- K^+ K^- \pi^0$        | < 1.6 $\times 10^{-4}$             | 90%              |
| $\Gamma_4 \quad 2\pi^+ \pi^- K^- K_S^0$           | < 5 $\times 10^{-5}$               | 90%              |
| $\Gamma_5 \quad 2\pi^+ \pi^- K^- K_S^0 2\pi^0$    | < 5 $\times 10^{-4}$               | 90%              |
| $\Gamma_6 \quad 2\pi^+ 2\pi^- 2\pi^0$             | < 2.1 $\times 10^{-4}$             | 90%              |
| $\Gamma_7 \quad 2\pi^+ 2\pi^- K^+ K^-$            | ( $1.1 \pm 0.6$ ) $\times 10^{-4}$ |                  |
| $\Gamma_8 \quad 2\pi^+ 2\pi^- K^+ K^- \pi^0$      | < 2.7 $\times 10^{-4}$             | 90%              |
| $\Gamma_9 \quad 2\pi^+ 2\pi^- K^+ K^- 2\pi^0$     | < 5 $\times 10^{-4}$               | 90%              |
| $\Gamma_{10} \quad 3\pi^+ 2\pi^- K^- K_S^0 \pi^0$ | < 1.6 $\times 10^{-4}$             | 90%              |
| $\Gamma_{11} \quad 3\pi^+ 3\pi^-$                 | < 8 $\times 10^{-5}$               | 90%              |
| $\Gamma_{12} \quad 3\pi^+ 3\pi^- 2\pi^0$          | < 6 $\times 10^{-4}$               | 90%              |
| $\Gamma_{13} \quad 3\pi^+ 3\pi^- K^+ K^-$         | ( $2.4 \pm 1.2$ ) $\times 10^{-4}$ |                  |
| $\Gamma_{14} \quad 3\pi^+ 3\pi^- K^+ K^- \pi^0$   | < 1.0 $\times 10^{-3}$             | 90%              |
| $\Gamma_{15} \quad 4\pi^+ 4\pi^-$                 | < 8 $\times 10^{-5}$               | 90%              |
| $\Gamma_{16} \quad 4\pi^+ 4\pi^- 2\pi^0$          | < 2.1 $\times 10^{-3}$             | 90%              |
| $\Gamma_{17} \quad J/\psi J/\psi$                 | < 7 $\times 10^{-5}$               | 90%              |
| $\Gamma_{18} \quad J/\psi \psi(2S)$               | < 1.2 $\times 10^{-4}$             | 90%              |
| $\Gamma_{19} \quad \psi(2S) \psi(2S)$             | < 3.1 $\times 10^{-5}$             | 90%              |
| $\Gamma_{20} \quad J/\psi(1S) \text{anything}$    | < 2.3 $\times 10^{-3}$             | 90%              |

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

NODE=M076220

| $\Gamma(\gamma \Upsilon(1S))/\Gamma_{\text{total}}$ | $\Gamma_1/\Gamma$ |
|-----------------------------------------------------|-------------------|
| VALUE (%)                                           | CL% EVTS          |

**1.94 ± 0.27 OUR AVERAGE**

|                    |                 |          |                                                      |
|--------------------|-----------------|----------|------------------------------------------------------|
| 2.07 ± 0.24 ± 0.21 | 1,2 LEES        | 14M BABR | $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$ |
| 1.76 ± 0.30 ± 0.18 | 87 3,4 KORNICER | 11 CLEO  | $e^+ e^- \rightarrow \gamma \gamma \ell^+ \ell^-$    |

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

|       |    |        |          |                                                        |
|-------|----|--------|----------|--------------------------------------------------------|
| < 4.6 | 90 | 5 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

| $\Gamma(D^0 X)/\Gamma_{\text{total}}$ | $\Gamma_2/\Gamma$ |
|---------------------------------------|-------------------|
| VALUE                                 | CL%               |

|                         |    |            |         |                                         |
|-------------------------|----|------------|---------|-----------------------------------------|
| < 10.4 $\times 10^{-2}$ | 90 | 6,7 BRIERE | 08 CLEO | $\Upsilon(2S) \rightarrow \gamma D^0 X$ |
|-------------------------|----|------------|---------|-----------------------------------------|

<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 $10^{-4}$ )                                  | CL%               |

|       |    |         |          |                                                             |
|-------|----|---------|----------|-------------------------------------------------------------|
| < 1.6 | 90 | 8 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

$$\Gamma(2\pi^+\pi^-K^-K_S^0)/\Gamma_{\text{total}} \quad \Gamma_4/\Gamma$$

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                              | 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

$$\Gamma(2\pi^+\pi^-K^-K_S^02\pi^0)/\Gamma_{\text{total}} \quad \Gamma_5/\Gamma$$

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                      | 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 $[\Gamma(\chi_{b0}(1P) \rightarrow 2\pi^+\pi^-K^-K_S^02\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b0}(1P))] < 18 \times 10^{-6}$ 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

$$\Gamma(2\pi^+2\pi^-2\pi^0)/\Gamma_{\text{total}} \quad \Gamma_6/\Gamma$$

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                              | 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

$$\Gamma(2\pi^+2\pi^-K^+K^-)/\Gamma_{\text{total}} \quad \Gamma_7/\Gamma$$

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                          | CL% | DOCUMENT ID         | TECN     | COMMENT                                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---------------------|----------|------------------------------------------------------|
| <b>1.1<math>\pm</math>0.6<math>\pm</math>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

$$\Gamma(2\pi^+2\pi^-K^+K^-\pi^0)/\Gamma_{\text{total}} \quad \Gamma_8/\Gamma$$

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                    | CL% | DOCUMENT ID         | TECN     | COMMENT                                                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---------------------|----------|-----------------------------------------------------------|
| <b>&lt;2.7</b>                                                                                                                                                                                                                                                                                              | 90  | <sup>13</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-\pi^0$ |
| <sup>13</sup> 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

$$\Gamma(2\pi^+2\pi^-K^+K^-2\pi^0)/\Gamma_{\text{total}} \quad \Gamma_9/\Gamma$$

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                     | CL% | DOCUMENT ID         | TECN     | COMMENT                                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---------------------|----------|------------------------------------------------------------|
| <b>&lt;5</b>                                                                                                                                                                                                                                                                                                 | 90  | <sup>14</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-2\pi^0$ |
| <sup>14</sup> 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

$$\Gamma(3\pi^+2\pi^-K^-K_S^0\pi^0)/\Gamma_{\text{total}} \quad \Gamma_{10}/\Gamma$$

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                     | CL% | DOCUMENT ID         | TECN     | COMMENT                                                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---------------------|----------|-------------------------------------------------------------|
| <b>&lt;1.6</b>                                                                                                                                                                                                                                                                                               | 90  | <sup>15</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+2\pi^-K^-K_S^0\pi^0$ |
| <sup>15</sup> 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

$$\Gamma(3\pi^+3\pi^-)/\Gamma_{\text{total}} \quad \Gamma_{11}/\Gamma$$

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                        | CL% | DOCUMENT ID         | TECN     | COMMENT                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---------------------|----------|------------------------------------------------|
| <b>&lt;0.8</b>                                                                                                                                                                                                                                                                                  | 90  | <sup>16</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+3\pi^-$ |
| <sup>16</sup> 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

$$\Gamma(3\pi^+3\pi^-2\pi^0)/\Gamma_{\text{total}} \quad \Gamma_{12}/\Gamma$$

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                               | CL% | DOCUMENT ID         | TECN     | COMMENT                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---------------------|----------|------------------------------------------------------|
| <b>&lt;6</b>                                                                                                                                                                                                                                                                                           | 90  | <sup>17</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+3\pi^-2\pi^0$ |
| <sup>17</sup> 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 $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                      | EVTs | DOCUMENT ID | TECN     | COMMENT                                                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|---------------------------------------------------------|
| <b><math>2.4 \pm 1.2 \pm 0.2</math></b>                                                                                                                                                                                                                                                                                                                                                                                                       | 9    | 18 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+ 3\pi^- K^+ K^-$ |
| 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 | $\Upsilon(2S) \rightarrow \gamma 3\pi^+ 3\pi^- K^+ K^- \pi^0$ |
| 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 | $\Upsilon(2S) \rightarrow \gamma 4\pi^+ 4\pi^-$ |
| 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 | $\Upsilon(2S) \rightarrow \gamma 4\pi^+ 4\pi^- 2\pi^0$ |
| 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

$$B(\chi_{b0}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P)) \times B(\Upsilon(1S) \rightarrow \ell^+ \ell^-)$$

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

**1.67±0.28 OUR AVERAGE**

|                                       |    |      |          |                                                      |
|---------------------------------------|----|------|----------|------------------------------------------------------|
| 2.9 $^{+1.7}_{-1.4}$ $^{+0.1}_{-0.8}$ | 26 | LEES | 14M BABR | $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$ |
|---------------------------------------|----|------|----------|------------------------------------------------------|

|                |    |          |         |                                                   |
|----------------|----|----------|---------|---------------------------------------------------|
| 1.63±0.24±0.15 | 87 | KORNICER | 11 CLEO | $e^+ e^- \rightarrow \gamma \gamma \ell^+ \ell^-$ |
|----------------|----|----------|---------|---------------------------------------------------|

<sup>26</sup> From a sample of  $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$  with one converted photon.

$$[B(\chi_{b0}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P))] / [B(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))]$$

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

**3.28±0.37**

|    |      |          |                                                      |
|----|------|----------|------------------------------------------------------|
| 27 | LEES | 14M BABR | $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$ |
|----|------|----------|------------------------------------------------------|

<sup>27</sup> From a sample of  $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$  without converted photons.

### $\chi_{b0}(1P)$ REFERENCES

|            |     |               |                               |                          |             |
|------------|-----|---------------|-------------------------------|--------------------------|-------------|
| JIA        | 17A | PR D96 112002 | S. Jia <i>et al.</i>          | (BELLE Collab.)          | REFID=58318 |
| LEES       | 14M | PR D90 112010 | J.P. Lees <i>et al.</i>       | (BABAR Collab.)          | REFID=56343 |
| SHEN       | 12  | PR D85 071102 | C.P. Shen <i>et al.</i>       | (BELLE Collab.)          | REFID=54313 |
| KORNICER   | 11  | PR D83 054003 | M. Kornicer <i>et al.</i>     | (CLEO Collab.)           | REFID=16769 |
| LEES       | 11J | PR D84 072002 | J.P. Lees <i>et al.</i>       | (BABAR Collab.)          | REFID=53936 |
| ASNER      | 08A | PR D78 091103 | D.M. Asner <i>et al.</i>      | (CLEO Collab.)           | REFID=52574 |
| BRIERE     | 08  | PR D78 092007 | R.A. Briere <i>et al.</i>     | (CLEO Collab.)           | REFID=52577 |
| ARTUSO     | 05  | PRL 94 032001 | M. Artuso <i>et al.</i>       | (CLEO Collab.)           | REFID=50454 |
| EDWARDS    | 99  | PR D59 032003 | K.W. Edwards <i>et al.</i>    | (CLEO Collab.)           | REFID=46612 |
| WALK       | 86  | PR D34 2611   | W.S. Walk <i>et al.</i>       | (Crystal Ball Collab.)   | REFID=22290 |
| ALBRECHT   | 85E | PL 160B 331   | H. Albrecht <i>et al.</i>     | (ARGUS Collab.)          | REFID=22288 |
| NERNST     | 85  | PRL 54 2195   | R. Nernst <i>et al.</i>       | (Crystal Ball Collab.)   | REFID=22289 |
| HAAS       | 84  | PRL 52 799    | J. Haas <i>et al.</i>         | (CLEO Collab.)           | REFID=22287 |
| KLOPFEN... | 83  | PRL 51 160    | C. Klopfenstein <i>et al.</i> | (CUSB Collab.)           | REFID=22285 |
| PAUSS      | 83  | PL 130B 439   | F. Pauss <i>et al.</i>        | (MPIM, COLU, CORN, LSU+) | REFID=22286 |

NODE=M076

$$\chi_{b1}(1P)$$

$$I^G(J^{PC}) = 0^+(1^{++})$$

$J$  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

| VALUE (MeV)                             | DOCUMENT ID                                              |
|-----------------------------------------|----------------------------------------------------------|
| <b>9892.78±0.26±0.31 OUR EVALUATION</b> | From average $\gamma$ energy below, using $\Upsilon(2S)$ |
| mass = 10023.26 ± 0.31 MeV              |                                                          |

NODE=M077M

NODE=M077M  
→ UNCHECKED ←

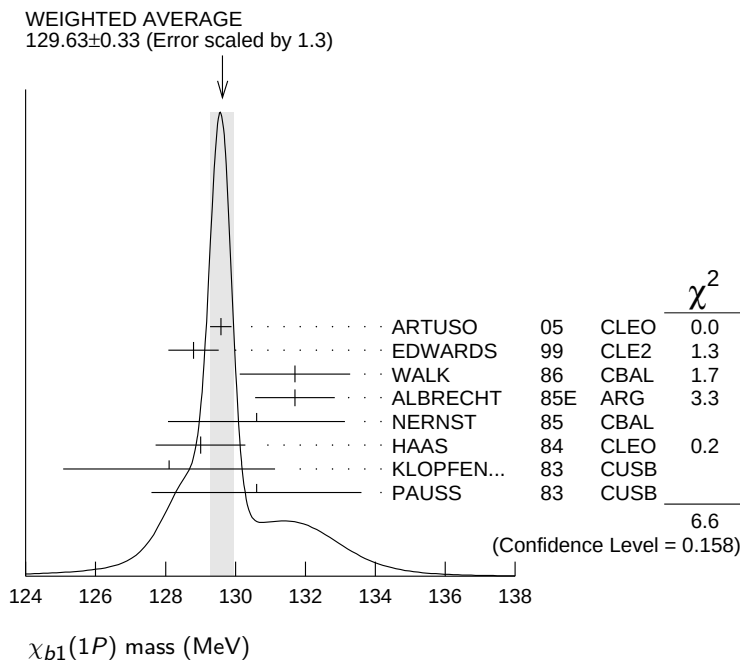
### $\gamma$ ENERGY IN $\Upsilon(2S)$ DECAY

| VALUE (MeV)                    | DOCUMENT ID                                                 | TECN    | COMMENT                                                |
|--------------------------------|-------------------------------------------------------------|---------|--------------------------------------------------------|
| <b>129.63±0.33 OUR AVERAGE</b> | 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 | $\Upsilon(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |

NODE=M077DM

NODE=M077DM





### $\chi_{b1}(1P)$ DECAY MODES

NODE=M077215;NODE=M077

| Mode                                          | Fraction ( $\Gamma_i/\Gamma$ )  | Confidence level |          |
|-----------------------------------------------|---------------------------------|------------------|----------|
| $\Gamma_1$ $\gamma \Upsilon(1S)$              | (35.2 ± 2.0) %                  |                  | DESIG=1  |
| $\Gamma_2$ $D^0 X$                            | (12.6 ± 2.2) %                  |                  | DESIG=2  |
| $\Gamma_3$ $\pi^+ \pi^- K^+ K^- \pi^0$        | ( 2.0 ± 0.6) × 10 <sup>-4</sup> |                  | DESIG=3  |
| $\Gamma_4$ $2\pi^+ \pi^- K^- K_S^0$           | ( 1.3 ± 0.5) × 10 <sup>-4</sup> |                  | DESIG=4  |
| $\Gamma_5$ $2\pi^+ \pi^- K^- K_S^0 2\pi^0$    | < 6 × 10 <sup>-4</sup>          | 90%              | DESIG=5  |
| $\Gamma_6$ $2\pi^+ 2\pi^- 2\pi^0$             | ( 8.0 ± 2.5) × 10 <sup>-4</sup> |                  | DESIG=6  |
| $\Gamma_7$ $2\pi^+ 2\pi^- K^+ K^-$            | ( 1.5 ± 0.5) × 10 <sup>-4</sup> |                  | DESIG=7  |
| $\Gamma_8$ $2\pi^+ 2\pi^- K^+ K^- \pi^0$      | ( 3.5 ± 1.2) × 10 <sup>-4</sup> |                  | DESIG=8  |
| $\Gamma_9$ $2\pi^+ 2\pi^- K^+ K^- 2\pi^0$     | ( 8.6 ± 3.2) × 10 <sup>-4</sup> |                  | DESIG=9  |
| $\Gamma_{10}$ $3\pi^+ 2\pi^- K^- K_S^0 \pi^0$ | ( 9.3 ± 3.3) × 10 <sup>-4</sup> |                  | DESIG=10 |
| $\Gamma_{11}$ $3\pi^+ 3\pi^-$                 | ( 1.9 ± 0.6) × 10 <sup>-4</sup> |                  | DESIG=11 |
| $\Gamma_{12}$ $3\pi^+ 3\pi^- 2\pi^0$          | ( 1.7 ± 0.5) × 10 <sup>-3</sup> |                  | DESIG=12 |
| $\Gamma_{13}$ $3\pi^+ 3\pi^- K^+ K^-$         | ( 2.6 ± 0.8) × 10 <sup>-4</sup> |                  | DESIG=13 |
| $\Gamma_{14}$ $3\pi^+ 3\pi^- K^+ K^- \pi^0$   | ( 7.5 ± 2.6) × 10 <sup>-4</sup> |                  | DESIG=14 |
| $\Gamma_{15}$ $4\pi^+ 4\pi^-$                 | ( 2.6 ± 0.9) × 10 <sup>-4</sup> |                  | DESIG=15 |
| $\Gamma_{16}$ $4\pi^+ 4\pi^- 2\pi^0$          | ( 1.4 ± 0.6) × 10 <sup>-3</sup> |                  | DESIG=16 |
| $\Gamma_{17}$ $\omega$ anything               | ( 4.9 ± 1.4) %                  |                  | DESIG=21 |
| $\Gamma_{18}$ $\omega X_{tetra}$              | < 4.44 × 10 <sup>-4</sup>       | 90%              | DESIG=22 |
| $\Gamma_{19}$ $J/\psi J/\psi$                 | < 2.7 × 10 <sup>-5</sup>        | 90%              | DESIG=17 |
| $\Gamma_{20}$ $J/\psi \psi(2S)$               | < 1.7 × 10 <sup>-5</sup>        | 90%              | DESIG=18 |
| $\Gamma_{21}$ $\psi(2S) \psi(2S)$             | < 6 × 10 <sup>-5</sup>          | 90%              | DESIG=19 |
| $\Gamma_{22}$ $J/\psi(1S)$ anything           | < 1.1 × 10 <sup>-3</sup>        | 90%              | DESIG=20 |
| $\Gamma_{23}$ $J/\psi(1S) X_{tetra}$          | < 2.27 × 10 <sup>-4</sup>       | 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>                    |      |                         |      |         |                                                        |  |                   |
| [0.350 ± 0.021 OUR 2018 AVERAGE]                  |      |                         |      |         |                                                        |  |                   |
| 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  
NEW

OCCUR=4

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| <sup>1</sup> FULSOM 18 reports $[\Gamma(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))] = (2.45 \pm 0.02^{+0.11}_{-0.15}) \times 10^{-2}$ 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 $\Gamma(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))/\Gamma_{\text{total}} = (2.51 \pm 0.12) \%$ combining the results from samples of $\Upsilon(2S) \rightarrow \gamma \mu^+ \mu^-$ with and without converted photons.                                                                                                                          | NODE=M077R1;LINKAGE=B  |
| <sup>3</sup> LEES 14M reports $[\Gamma(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))] = (2.51 \pm 0.12) \times 10^{-2}$ 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 $B(\Upsilon(1S) \rightarrow \mu^+ \mu^-) = (2.48 \pm 0.05)\%$ .                                                                                                                                                                                                                                                                                                                                                                               | NODE=M077R1;LINKAGE=KA |
| <sup>5</sup> KORNICER 11 reports $[\Gamma(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))] = (22.8 \pm 0.4 \pm 1.2) \times 10^{-3}$ 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=KR |
| <sup>6</sup> LEES 11J reports $[\Gamma(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))] = (24.1 \pm 0.6 \pm 1.5) \times 10^{-3}$ 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 $[\Gamma(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))] = (23.4 \pm 3.63 \pm 2.82) \times 10^{-3}$ 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  |

### $\Gamma(D^0 X)/\Gamma_{\text{total}} \quad \Gamma_2/\Gamma$

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID         | TECN | COMMENT                                      |
|--------------------------|------|---------------------|------|----------------------------------------------|
| <b>12.6±1.9±1.1</b>      | 2310 | <sup>9</sup> BRIERE | 08   | CLEO $\Upsilon(2S) \rightarrow \gamma D^0 X$ |

<sup>9</sup> For  $p_{D^0} > 2.5$  GeV/c.

NODE=M077R01  
NODE=M077R01

NODE=M077R01;LINKAGE=BR

### $\Gamma(\pi^+ \pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}} \quad \Gamma_3/\Gamma$

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID         | TECN | COMMENT                                                          |
|--------------------------|------|---------------------|------|------------------------------------------------------------------|
| <b>2.0±0.6±0.1</b>       | 18   | <sup>10</sup> ASNER | 08A  | CLEO $\Upsilon(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^- \pi^0$ |

<sup>10</sup> ASNER 08A reports  $[\Gamma(\chi_{b1}(1P) \rightarrow \pi^+ \pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))] = (14 \pm 3 \pm 3) \times 10^{-6}$  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

### $\Gamma(2\pi^+ \pi^- K^- K_S^0)/\Gamma_{\text{total}} \quad \Gamma_4/\Gamma$

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID         | TECN | COMMENT                                                       |
|--------------------------|------|---------------------|------|---------------------------------------------------------------|
| <b>1.3±0.5±0.1</b>       | 11   | <sup>11</sup> ASNER | 08A  | CLEO $\Upsilon(2S) \rightarrow \gamma 2\pi^+ \pi^- K^- K_S^0$ |

<sup>11</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  
NODE=M077R03

NODE=M077R03;LINKAGE=AS

### $\Gamma(2\pi^+ \pi^- K^- K_S^0 2\pi^0)/\Gamma_{\text{total}} \quad \Gamma_5/\Gamma$

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID         | TECN | COMMENT                                                        |
|--------------------------|-----|---------------------|------|----------------------------------------------------------------|
| <b>&lt;6</b>             | 90  | <sup>12</sup> ASNER | 08A  | CLEO $\Upsilon(2S) \rightarrow \gamma 2\pi^+ \pi^- K^- 2\pi^0$ |

<sup>12</sup> ASNER 08A reports  $[\Gamma(\chi_{b1}(1P) \rightarrow 2\pi^+ \pi^- K^- K_S^0 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))] < 42 \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) = 6.9 \times 10^{-2}$ .

NODE=M077R04  
NODE=M077R04

NODE=M077R04;LINKAGE=AS

### $\Gamma(2\pi^+ 2\pi^- 2\pi^0)/\Gamma_{\text{total}} \quad \Gamma_6/\Gamma$

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID         | TECN | COMMENT                                                     |
|--------------------------|------|---------------------|------|-------------------------------------------------------------|
| <b>8.0±2.4±0.4</b>       | 46   | <sup>13</sup> ASNER | 08A  | CLEO $\Upsilon(2S) \rightarrow \gamma 2\pi^+ 2\pi^- 2\pi^0$ |

<sup>13</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  
NODE=M077R05

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   | 14 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+ 2\pi^- K^+ K^-$ |
| 14 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  
 NODE=M077R06

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   | 15 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+ 2\pi^- K^+ K^- \pi^0$ |
| 15 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  
 NODE=M077R07

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   | 16 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+ 2\pi^- K^+ K^- 2\pi^0$ |
| 16 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  
 NODE=M077R08

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   | 17 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+ 2\pi^- K^- K_S^0 \pi^0$ |
| 17 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  
 NODE=M077R09

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   | 18 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+ 3\pi^-$ |
| 18 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  
 NODE=M077R10

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>17±5±1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    | 56   | 19 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+ 3\pi^- 2\pi^0$ |
| 19 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>2.6±0.8±0.1</b>                                                                                                                                                                                                                                                                                                                                                                                                                             | 21   | 20 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+ 3\pi^- K^+ K^-$ |
| 20 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>7.5±2.6±0.4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     | 28   | 21 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+ 3\pi^- K^+ K^- \pi^0$ |
| 21 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   | 22 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 4\pi^+ 4\pi^-$ |
| 22 ASNER 08A reports $[\Gamma(\chi_{b1}(1P) \rightarrow 4\pi^+ 4\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))]$<br>$= (18 \pm 4 \pm 5) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) =$<br>$(6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is<br>the systematic error from using our best value. |      |             |          |                                                 |

NODE=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   | 23 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 4\pi^+ 4\pi^- 2\pi^0$ |
| 23 ASNER 08A reports $[\Gamma(\chi_{b1}(1P) \rightarrow 4\pi^+ 4\pi^- 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))]$<br>$= (96 \pm 24 \pm 29) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) =$<br>$(6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is<br>the systematic error from using our best value. |      |             |          |                                                        |

NODE=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  | 24 JIA      | 17A BELL | $e^+ e^- \rightarrow \text{hadrons}$ |
| 24 For a tetraquark state $X_{\text{tetra}}$ , with mass in the range 1.16–2.46 GeV and width in the<br>range 0–0.3 GeV. Measured 90% CL limits as a function of $X_{\text{tetra}}$ mass and width range<br>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  | 25 SHEN     | 12 BELL | $\Upsilon(2S) \rightarrow \gamma \psi X$ |
| 25 SHEN 12 reports $< 2.7 \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{b1}(1P) \rightarrow J/\psi J/\psi)/\Gamma_{\text{total}}]$<br>$\times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))]$ 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  | 26 SHEN     | 12 BELL | $\Upsilon(2S) \rightarrow \gamma \psi X$ |
| 26 SHEN 12 reports $< 1.7 \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{b1}(1P) \rightarrow J/\psi \psi(2S))/\Gamma_{\text{total}}]$<br>$\times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))]$ assuming $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times$<br>$10^{-2}$ . |     |             |         |                                          |

NODE=M077R17  
 NODE=M077R17

NODE=M077R17;LINKAGE=SH

 $\Gamma(\psi(2S) \psi(2S))/\Gamma_{\text{total}}$  $\Gamma_{21}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                                                       | CL% | DOCUMENT ID | TECN    | COMMENT                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------------|---------|------------------------------------------|
| <b><math>&lt; 6</math></b>                                                                                                                                                                                                                                                                                     | 90  | 27 SHEN     | 12 BELL | $\Upsilon(2S) \rightarrow \gamma \psi X$ |
| 27 SHEN 12 reports $< 6.2 \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{b1}(1P) \rightarrow \psi(2S) \psi(2S))/\Gamma_{\text{total}}]$<br>$\times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))]$ assuming $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times$<br>$10^{-2}$ . |     |             |         |                                          |

NODE=M077R18  
 NODE=M077R18

NODE=M077R18;LINKAGE=SH

 $\Gamma(J/\psi(1S) \text{ anything})/\Gamma_{\text{total}}$  $\Gamma_{22}/\Gamma$ 

| VALUE                                       | CL% | DOCUMENT ID | TECN     | COMMENT                              |
|---------------------------------------------|-----|-------------|----------|--------------------------------------|
| <b><math>&lt; 1.1 \times 10^{-3}</math></b> | 90  | JIA         | 17A BELL | $e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M077R00  
 NODE=M077R00

 $\Gamma(J/\psi(1S) X_{\text{tetra}})/\Gamma_{\text{total}}$  $\Gamma_{23}/\Gamma$ 

| VALUE                                                                                                                                                                                                                                                            | CL% | DOCUMENT ID | TECN     | COMMENT                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------------|----------|--------------------------------------|
| <b><math>&lt; 22.7 \times 10^{-5}</math></b>                                                                                                                                                                                                                     | 90  | 28 JIA      | 17A BELL | $e^+ e^- \rightarrow \text{hadrons}$ |
| 28 For a tetraquark state $X_{\text{tetra}}$ , with mass in the range 1.16–2.46 GeV and width in the<br>range 0–0.3 GeV. Measured 90% CL limits as a function of $X_{\text{tetra}}$ mass and width range<br>from $1.8 \times 10^{-5}$ to $22.7 \times 10^{-5}$ . |     |             |          |                                      |

NODE=M077R22  
 NODE=M077R22

NODE=M077R22;LINKAGE=A

 $\chi_{b1}(1P)$  Cross-Particle Branching Ratios

NODE=M077230

$$\Gamma(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))/\Gamma_{\text{total}}$$

$$\Gamma_1/\Gamma \times \Gamma_{59}^{\Upsilon(2S)}/\Gamma \Upsilon(2S)$$

| VALUE (units $10^{-3}$ )                 | EVTS | DOCUMENT ID | TECN     | COMMENT                             |
|------------------------------------------|------|-------------|----------|-------------------------------------|
| <b><math>24.1 \pm 0.6 \pm 1.5</math></b> | 13k  | LEES        | 11J BABR | $\Upsilon(2S) \rightarrow X \gamma$ |

NODE=M077B03  
 NODE=M077B03

$$B(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) \times B(\Upsilon(1S) \rightarrow \ell^+ \ell^-)$$

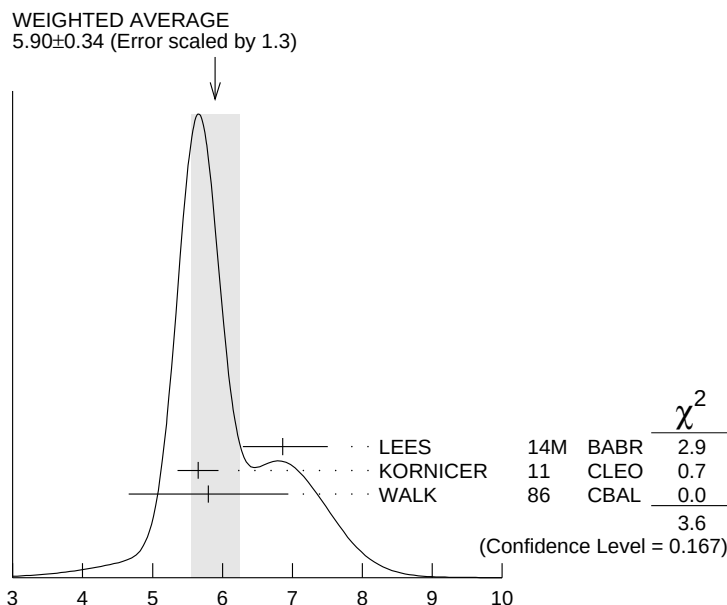
VALUE (units  $10^{-4}$ ) EVTS DOCUMENT ID TECN COMMENT  
**5.90±0.34 OUR AVERAGE** Error includes scale factor of 1.3. See the ideogram below.

|                                                  |      |          |     |      |                                                        |
|--------------------------------------------------|------|----------|-----|------|--------------------------------------------------------|
| 6.86 <sup>+0.47+0.44</sup> <sub>-0.45-0.35</sub> | 29   | LEES     | 14M | BABR | $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$   |
| 5.65±0.11±0.27                                   | 3222 | KORNICER | 11  | CLEO | $e^+ e^- \rightarrow \gamma \gamma \ell^+ \ell^-$      |
| 5.8 ±0.9 ±0.7                                    | 53   | WALK     | 86  | CBAL | $\Upsilon(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |

<sup>29</sup> From a sample of  $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$  with one converted photon.

NODE=M077B01  
 NODE=M077B01

NODE=M077B01;LINKAGE=A



$$B(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) \times B(\Upsilon(1S) \rightarrow \ell^+ \ell^-)$$

(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  
**1.30±0.34 OUR AVERAGE**

|                                                  |    |          |     |      |                                                      |
|--------------------------------------------------|----|----------|-----|------|------------------------------------------------------|
| 1.16 <sup>+0.78+0.14</sup> <sub>-0.67-0.16</sub> | 30 | LEES     | 14M | BABR | $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$ |
| 1.33±0.30±0.23                                   | 50 | KORNICER | 11  | CLEO | $e^+ e^- \rightarrow \gamma \gamma \ell^+ \ell^-$    |

<sup>30</sup> From a sample of  $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$  with converted photons.

NODE=M077B02  
 NODE=M077B02

NODE=M077B02;LINKAGE=A

$$B(\chi_{b2}(1P) \rightarrow \rho X + \bar{\rho} X) / B(\chi_{b1}(1P) \rightarrow \rho X + \bar{\rho} X)$$

VALUE DOCUMENT ID TECN COMMENT  
**1.068±0.010±0.040** BRIERE 07 CLEO  $\Upsilon(2S) \rightarrow \gamma \chi_{bJ}(1P)$

NODE=M077R20  
 NODE=M077R20

$$B(\chi_{b0}(1P) \rightarrow \rho X + \bar{\rho} X) / B(\chi_{b1}(1P) \rightarrow \rho X + \bar{\rho} X)$$

VALUE DOCUMENT ID TECN COMMENT  
**1.11±0.15±0.20** 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                    | (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.) J |
| 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+) |

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

$$h_b(1P)$$

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

Quantum numbers are quark model predictions,  $C = -$  established by  $\eta_b \gamma$  decay.

NODE=M204

NODE=M204

NODE=M204M

NODE=M204M

NODE=M204M;LINKAGE=AD

NODE=M204215;NODE=M204

DESIG=1

NODE=M204225

NODE=M204R01  
NODE=M204R01

NODE=M204R01;LINKAGE=A

NODE=M204

REFID=56996  
REFID=53962  
REFID=54718  
REFID=53937

| $h_b(1P)$ MASS                                                                |       |                     |      |         |                                                  |
|-------------------------------------------------------------------------------|-------|---------------------|------|---------|--------------------------------------------------|
| VALUE (MeV)                                                                   | EVTs  | DOCUMENT ID         | TECN | COMMENT |                                                  |
| <b>9899.3±0.8 OUR AVERAGE</b>                                                 |       |                     |      |         |                                                  |
| 9899.3±0.4±1.0                                                                | 112k  | TAMPONI             | 15   | BELL    | $e^+e^- \rightarrow \gamma\eta + \text{hadrons}$ |
| 9899.1±0.4±1.0                                                                | 70k   | MIZUK               | 12   | BELL    | $e^+e^- \rightarrow \pi^+\pi^- \text{ hadrons}$  |
| 9902 ±4 ±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 <sup>+1.1+1.0</sup> <sub>-1.0-1.1</sub>                                | 50.0k | <sup>1</sup> ADACHI | 12   | BELL    | 10.86 $e^+e^- \rightarrow \pi^+\pi^-$ MM         |
| <sup>1</sup> Superseded by MIZUK 12.                                          |       |                     |      |         |                                                  |

| h <sub>b</sub> (1P) DECAY MODES   |                                     |
|-----------------------------------|-------------------------------------|
| Mode                              | Fraction ( $\Gamma_i/\Gamma$ )      |
| $\Gamma_1 \quad \eta_b(1S)\gamma$ | (52 <sup>+6</sup> <sub>-5</sub> ) % |

| $h_b(1P)$ BRANCHING RATIOS                                                    |       |                      |             |      |                                                         |  |
|-------------------------------------------------------------------------------|-------|----------------------|-------------|------|---------------------------------------------------------|--|
| $\Gamma(\eta_b(1S)\gamma)/\Gamma_{\text{total}}$                              |       |                      |             |      | $\Gamma_1/\Gamma$                                       |  |
| VALUE (units $10^{-2}$ )                                                      |       | EVTs                 | DOCUMENT ID | TECN | COMMENT                                                 |  |
| 52 $\pm 6_{-5}$ OUR AVERAGE                                                   |       |                      |             |      |                                                         |  |
| 56 $\pm 8 \pm 4$                                                              | 33.1k | <sup>1</sup> TAMPONI | 15          | BELL | $e^+e^- \rightarrow \gamma\eta + \text{hadrons}$        |  |
| 49.2 $\pm 5.7^{+5.6}_{-3.3}$                                                  | 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 $B(\eta \rightarrow 2\gamma) = (39.41 \pm 0.20)\%$ .       |       |                      |             |      |                                                         |  |

| h <sub>b</sub> (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.) |  |

$\chi_{b2}(1P)$ 

$$I^G(J^{PC}) = 0^+(2^{++})$$

$J$  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**

VALUE (MeV)

DOCUMENT ID

**9912.21 ± 0.26 ± 0.31 OUR EVALUATION** From average  $\gamma$  energy below, using  $\Upsilon(2S)$  mass = 10023.26 ± 0.31 MeV

NODE=M078M

NODE=M078M

→ UNCHECKED ←

 **$m_{\chi_{b2}(1P)} - m_{\chi_{b1}(1P)}$** 

VALUE (MeV)

DOCUMENT ID

TECN

COMMENT

**19.10 ± 0.25 OUR AVERAGE** Error includes scale factor of 1.1.

19.81 ± 0.65 ± 0.20

<sup>1</sup> AAIJ

14BG LHCb

 $pp \rightarrow \gamma \mu^+ \mu^- X$ 

19.01 ± 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

NODE=M078DM2;LINKAGE=A

 **$\gamma$  ENERGY IN  $\Upsilon(2S)$  DECAY**

VALUE (MeV)

DOCUMENT ID

TECN

COMMENT

**110.44 ± 0.29 OUR AVERAGE** Error includes scale factor of 1.1.

110.58 ± 0.08 ± 0.30

ARTUSO

05

CLEO

 $\Upsilon(2S) \rightarrow \gamma X$ 

110.8 ± 0.3 ± 0.6

EDWARDS

99

CLE2

 $\Upsilon(2S) \rightarrow \gamma \chi(1P)$ 

107.0 ± 1.1 ± 1.3

WALK

86

CBAL

 $\Upsilon(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ 

110.6 ± 0.3 ± 0.9

ALBRECHT

85E

ARG

 $\Upsilon(2S) \rightarrow \text{conv.} \gamma X$ 

110.4 ± 0.8 ± 2.2

NERNST

85

CBAL

 $\Upsilon(2S) \rightarrow \gamma X$ 

109.5 ± 0.7 ± 1.0

HAAS

84

CLEO

 $\Upsilon(2S) \rightarrow \text{conv.} \gamma X$ 

108.2 ± 0.3 ± 2.0

KLOPFEN...

83

CUSB

 $\Upsilon(2S) \rightarrow \gamma X$ 

108.8 ± 4.0

PAUSS

83

CUSB

 $\Upsilon(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ 

NODE=M078DM

NODE=M078DM

 **$\chi_{b2}(1P)$  DECAY MODES**

NODE=M078215;NODE=M078

| Mode                                              | Fraction ( $\Gamma_i/\Gamma$ )   | Confidence level |
|---------------------------------------------------|----------------------------------|------------------|
| $\Gamma_1 \quad \gamma \Upsilon(1S)$              | (18.0 ± 1.0) %                   |                  |
| $\Gamma_2 \quad D^0 X$                            | < 7.9 %                          | 90%              |
| $\Gamma_3 \quad \pi^+ \pi^- K^+ K^- \pi^0$        | ( 8 ± 5 ) × 10 <sup>-5</sup>     |                  |
| $\Gamma_4 \quad 2\pi^+ \pi^- K^- K_S^0$           | < 1.0 × 10 <sup>-4</sup>         | 90%              |
| $\Gamma_5 \quad 2\pi^+ \pi^- K^- K_S^0 2\pi^0$    | ( 5.3 ± 2.4 ) × 10 <sup>-4</sup> |                  |
| $\Gamma_6 \quad 2\pi^+ 2\pi^- 2\pi^0$             | ( 3.5 ± 1.4 ) × 10 <sup>-4</sup> |                  |
| $\Gamma_7 \quad 2\pi^+ 2\pi^- K^+ K^-$            | ( 1.1 ± 0.4 ) × 10 <sup>-4</sup> |                  |
| $\Gamma_8 \quad 2\pi^+ 2\pi^- K^+ K^- \pi^0$      | ( 2.1 ± 0.9 ) × 10 <sup>-4</sup> |                  |
| $\Gamma_9 \quad 2\pi^+ 2\pi^- K^+ K^- 2\pi^0$     | ( 3.9 ± 1.8 ) × 10 <sup>-4</sup> |                  |
| $\Gamma_{10} \quad 3\pi^+ 2\pi^- K^- K_S^0 \pi^0$ | < 5 × 10 <sup>-4</sup>           | 90%              |
| $\Gamma_{11} \quad 3\pi^+ 3\pi^-$                 | ( 7.0 ± 3.1 ) × 10 <sup>-5</sup> |                  |
| $\Gamma_{12} \quad 3\pi^+ 3\pi^- 2\pi^0$          | ( 1.0 ± 0.4 ) × 10 <sup>-3</sup> |                  |
| $\Gamma_{13} \quad 3\pi^+ 3\pi^- K^+ K^-$         | < 8 × 10 <sup>-5</sup>           | 90%              |
| $\Gamma_{14} \quad 3\pi^+ 3\pi^- K^+ K^- \pi^0$   | ( 3.6 ± 1.5 ) × 10 <sup>-4</sup> |                  |
| $\Gamma_{15} \quad 4\pi^+ 4\pi^-$                 | ( 8 ± 4 ) × 10 <sup>-5</sup>     |                  |
| $\Gamma_{16} \quad 4\pi^+ 4\pi^- 2\pi^0$          | ( 1.8 ± 0.7 ) × 10 <sup>-3</sup> |                  |
| $\Gamma_{17} \quad J/\psi J/\psi$                 | < 4 × 10 <sup>-5</sup>           | 90%              |
| $\Gamma_{18} \quad J/\psi \psi(2S)$               | < 5 × 10 <sup>-5</sup>           | 90%              |
| $\Gamma_{19} \quad \psi(2S) \psi(2S)$             | < 1.6 × 10 <sup>-5</sup>         | 90%              |
| $\Gamma_{20} \quad J/\psi(1S) \text{anything}$    | ( 1.5 ± 0.4 ) × 10 <sup>-3</sup> |                  |

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

 $\Gamma(\gamma \Upsilon(1S))/\Gamma_{\text{total}}$  $\Gamma_1/\Gamma$ 

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

NODE=M078R1  
 NODE=M078R1  
 NEW

**0.180±0.010 OUR AVERAGE**

[0.188 ± 0.011 OUR 2018 AVERAGE]

|                                                   |      |              |     |      |                                                        |
|---------------------------------------------------|------|--------------|-----|------|--------------------------------------------------------|
| 0.164 <sup>+0.009</sup> <sub>-0.010</sub> ± 0.008 | 503k | 2 FULSOM     | 18  | BELL | $\Upsilon(2S) \rightarrow \gamma X$                    |
| 0.185 ± 0.008 ± 0.009                             |      | 3,4,5 LEES   | 14M | BABR | $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$   |
| 0.186 ± 0.011 ± 0.009                             | 1770 | 5,6 KORNICER | 11  | CLEO | $e^+ e^- \rightarrow \gamma \gamma \ell^+ \ell^-$      |
| 0.194 <sup>+0.014</sup> <sub>-0.017</sub> ± 0.009 | 8k   | 7 LEES       | 11J | BABR | $\Upsilon(2S) \rightarrow X \gamma$                    |
| 0.25 ± 0.06 ± 0.01                                | 35   | 5,8,9 WALK   | 86  | CBAL | $\Upsilon(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |
| 0.20 ± 0.05                                       |      | KLOPFEN...   | 83  | CUSB | $\Upsilon(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |

OCCUR=2

<sup>2</sup> FULSOM 18 reports  $[\Gamma(\chi_{b2}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))] = (1.17 \pm 0.01 \pm 0.06 \pm 0.07) \times 10^{-2}$  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=H

<sup>3</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>4</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>5</sup> Assuming  $B(\Upsilon(1S) \rightarrow \mu^+ \mu^-) = (2.48 \pm 0.05)\%$ .

NODE=M078R1;LINKAGE=KA

<sup>6</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>7</sup> LEES 11J reports  $[\Gamma(\chi_{b2}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))] = (13.9 \pm 0.5 \pm 0.9 \pm 1.1) \times 10^{-3}$  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>8</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>9</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

 $\Gamma(D^0 X)/\Gamma_{\text{total}}$  $\Gamma_2/\Gamma$ 

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

NODE=M078R01  
 NODE=M078R01

**<7.9 × 10<sup>-2</sup>**<sup>10</sup> For  $p_{D^0} > 2.5$  GeV/c.<sup>11</sup> The authors also present their result as  $(5.4 \pm 1.9 \pm 0.5) \times 10^{-2}$ .

NODE=M078R01;LINKAGE=BR  
 NODE=M078R01;LINKAGE=RI

 $\Gamma(\pi^+ \pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma$ 

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

NODE=M078R02  
 NODE=M078R02

**0.84±0.50±0.04**

<sup>12</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

 $\Gamma(2\pi^+ \pi^- K^- K_S^0)/\Gamma_{\text{total}}$  $\Gamma_4/\Gamma$ 

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

NODE=M078R03  
 NODE=M078R03

**<1.0**

<sup>13</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   | 14 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+\pi^-K^-2\pi^0$ |
| <sup>14</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  
 NODE=M078R04

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   | 15 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+2\pi^-2\pi^0$ |
| <sup>15</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  
 NODE=M078R05

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   | 16 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-$ |
| <sup>16</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  
 NODE=M078R06

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   | 17 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-\pi^0$ |
| <sup>17</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  
 NODE=M078R07

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   | 18 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-2\pi^0$ |
| <sup>18</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  
 NODE=M078R08

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  | 19 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+2\pi^-K^-K_S^0\pi^0$ |
| <sup>19</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  
 NODE=M078R09

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    | 20 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+3\pi^-$ |
| <sup>20</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  
 NODE=M078R10

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   | 21 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+3\pi^-2\pi^0$ |
| <sup>21</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  
 NODE=M078R11

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  | 22 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+ 3\pi^- K^+ K^-$ |
| 22 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   | 23 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+ 3\pi^- K^+ K^- \pi^0$ |
| 23 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    | 24 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 4\pi^+ 4\pi^-$ |
| 24 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   | 25 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 4\pi^+ 4\pi^- 2\pi^0$ |
| 25 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  | 26 SHEN     | 12 BELL | $\Upsilon(2S) \rightarrow \gamma \psi X$ |
| 26 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  | 27 SHEN     | 12 BELL | $\Upsilon(2S) \rightarrow \gamma \psi X$ |
| 27 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  | 28 SHEN     | 12 BELL | $\Upsilon(2S) \rightarrow \gamma \psi X$ |
| 28 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 $^{+0.36+0.18}_{-0.34-0.19}$ |      | 29 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>29</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 |
|-----------|-------------|------|---------|
|-----------|-------------|------|---------|

**55.6 $\pm$ 1.6**

|         |          |                                                      |
|---------|----------|------------------------------------------------------|
| 30 LEES | 14M BABR | $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$ |
|---------|----------|------------------------------------------------------|

<sup>30</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 $^{+0.99}_{-0.92} \pm 0.37$ |     | 31 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>31</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                    | (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+) |

$$\eta_b(2S)$$

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

OMITTED FROM SUMMARY TABLE

Quantum numbers shown are quark-model predictions.

### $\eta_b(2S)$ MASS

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

**9999.0 $\pm$ 3.5 $^{+2.8}_{-1.9}$** 

|     |         |         |                                                       |
|-----|---------|---------|-------------------------------------------------------|
| 26k | 1 MIZUK | 12 BELL | $e^+ e^- \rightarrow \gamma \pi^+ \pi^- +$<br>hadrons |
|-----|---------|---------|-------------------------------------------------------|

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

|                          |            |           |                                              |
|--------------------------|------------|-----------|----------------------------------------------|
| 9974.6 $\pm 2.3 \pm 2.1$ | 11 $\pm 4$ | 2,3 DOBBS | 12 $\Upsilon(2S) \rightarrow \gamma$ hadrons |
|--------------------------|------------|-----------|----------------------------------------------|

<sup>1</sup> Assuming  $\Gamma_{\eta_b(2S)} = 4.9$  MeV. Not independent of the corresponding mass difference measurement.

<sup>2</sup> Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

<sup>3</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 | 4 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 $\pm 4$ | 5,6 DOBBS | 12 $\Upsilon(2S) \rightarrow \gamma$ hadrons |
|------------------------|------------|-----------|----------------------------------------------|

<sup>4</sup> Assuming  $\Gamma_{\eta_b(2S)} = 4.9$  MeV. Not independent of the corresponding mass measurement.

<sup>5</sup> Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

<sup>6</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                           |

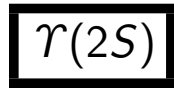
### $\eta_b(2S)$ BRANCHING RATIOS

| $\Gamma(\text{hadrons})/\Gamma_{\text{total}}$                                |             |                    |             |                | $\Gamma_1/\Gamma$                             |
|-------------------------------------------------------------------------------|-------------|--------------------|-------------|----------------|-----------------------------------------------|
| <i>VALUE</i>                                                                  | <i>EVTS</i> | <i>DOCUMENT ID</i> | <i>TECN</i> | <i>COMMENT</i> |                                               |
| <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>7</sup> DOBBS | 12          |                | $\Upsilon(2S) \rightarrow \gamma$ hadrons     |

<sup>7</sup> Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

### $\eta_b(2S)$ REFERENCES

|       |    |                |                        |                 |
|-------|----|----------------|------------------------|-----------------|
| DOBBS | 12 | PRL 109 082001 | S. Dobbs <i>et al.</i> |                 |
| MIZUK | 12 | PRL 109 232002 | R. Mizuk <i>et al.</i> | (BELLE Collab.) |



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

### $\Upsilon(2S)$ MASS

| VALUE (MeV)                                                                   | DOCUMENT ID               | TECN | COMMENT                           |
|-------------------------------------------------------------------------------|---------------------------|------|-----------------------------------|
| <b>10023.26 ± 0.31 OUR AVERAGE</b>                                            |                           |      |                                   |
| 10023.5 ± 0.5                                                                 | <sup>1</sup> ARTAMONOV 00 | MD1  | $e^+e^- \rightarrow$ hadrons      |
| 10023.1 ± 0.4                                                                 | BARBER 84                 | REDE | $e^+e^- \rightarrow$ hadrons      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                           |      |                                   |
| 10023.6 ± 0.5                                                                 | <sup>2,3</sup> BARU       | 86B  | REDE $e^+e^- \rightarrow$ 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.

### $m_{\Upsilon(3S)} - m_{\Upsilon(2S)}$

| VALUE (MeV)                 | DOCUMENT ID | TECN | COMMENT                               |
|-----------------------------|-------------|------|---------------------------------------|
| <b>331.50 ± 0.02 ± 0.13</b> | LEES        | 11C  | BABR $e^+e^- \rightarrow \pi^+\pi^-X$ |

### $\Upsilon(2S)$ WIDTH

| VALUE (keV)                        | DOCUMENT ID                                                     |
|------------------------------------|-----------------------------------------------------------------|
| <b>31.98 ± 2.63 OUR EVALUATION</b> | See the Note on "Width Determinations of the $\Upsilon$ States" |

NODE=M200DM;LINKAGE=MI

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=DO

NODE=M200

REFID=54288  
REFID=54718

NODE=M052

NODE=M052M

NODE=M052M

NODE=M052M;LINKAGE=AR  
NODE=M052M;LINKAGE=C  
NODE=M052M;LINKAGE=RZ

NODE=M052DM3

NODE=M052DM3

NODE=M052W

NODE=M052W  
→ UNCHECKED ←

**$\Upsilon(2S)$  DECAY MODES**

NODE=M052215;NODE=M052

| Mode                                         | Fraction ( $\Gamma_i/\Gamma$ )          | Scale factor/<br>Confidence level |           |
|----------------------------------------------|-----------------------------------------|-----------------------------------|-----------|
| $\Upsilon(1S)\pi^+\pi^-$                     | $(17.85 \pm 0.26) \%$                   |                                   | DESIG=4   |
| $\Upsilon(1S)\pi^0\pi^0$                     | $(8.6 \pm 0.4) \%$                      |                                   | DESIG=5   |
| $\tau^+\tau^-$                               | $(2.00 \pm 0.21) \%$                    |                                   | DESIG=3   |
| $\mu^+\mu^-$                                 | $(1.93 \pm 0.17) \%$                    | S=2.2                             | DESIG=1   |
| $e^+e^-$                                     | $(1.91 \pm 0.16) \%$                    |                                   | DESIG=2   |
| $\Upsilon(1S)\pi^0$                          | $< 4 \times 10^{-5}$                    | CL=90%                            | DESIG=10  |
| $\Upsilon(1S)\eta$                           | $(2.9 \pm 0.4) \times 10^{-4}$          | S=2.0                             | DESIG=6   |
| $J/\psi(1S)$ anything                        | $< 6 \times 10^{-3}$                    | CL=90%                            | DESIG=20  |
| $J/\psi(1S)\eta_c$                           | $< 5.4 \times 10^{-6}$                  | CL=90%                            | DESIG=143 |
| $J/\psi(1S)\chi_{c0}$                        | $< 3.4 \times 10^{-6}$                  | CL=90%                            | DESIG=144 |
| $J/\psi(1S)\chi_{c1}$                        | $< 1.2 \times 10^{-6}$                  | CL=90%                            | DESIG=145 |
| $J/\psi(1S)\chi_{c2}$                        | $< 2.0 \times 10^{-6}$                  | CL=90%                            | DESIG=146 |
| $J/\psi(1S)\eta_c(2S)$                       | $< 2.5 \times 10^{-6}$                  | CL=90%                            | DESIG=147 |
| $J/\psi(1S)X(3940)$                          | $< 2.0 \times 10^{-6}$                  | CL=90%                            | DESIG=148 |
| $J/\psi(1S)X(4160)$                          | $< 2.0 \times 10^{-6}$                  | CL=90%                            | DESIG=149 |
| $\chi_{c1}$ anything                         | $(2.2 \pm 0.5) \times 10^{-4}$          |                                   | DESIG=157 |
| $\chi_{c1}(1P)^0 X_{tetra}$                  | $< 3.67 \times 10^{-5}$                 | CL=90%                            | DESIG=160 |
| $\chi_{c2}$ anything                         | $(2.3 \pm 0.8) \times 10^{-4}$          |                                   | DESIG=158 |
| $\psi(2S)\eta_c$                             | $< 5.1 \times 10^{-6}$                  | CL=90%                            | DESIG=150 |
| $\psi(2S)\chi_{c0}$                          | $< 4.7 \times 10^{-6}$                  | CL=90%                            | DESIG=151 |
| $\psi(2S)\chi_{c1}$                          | $< 2.5 \times 10^{-6}$                  | CL=90%                            | DESIG=152 |
| $\psi(2S)\chi_{c2}$                          | $< 1.9 \times 10^{-6}$                  | CL=90%                            | DESIG=153 |
| $\psi(2S)\eta_c(2S)$                         | $< 3.3 \times 10^{-6}$                  | CL=90%                            | DESIG=154 |
| $\psi(2S)X(3940)$                            | $< 3.9 \times 10^{-6}$                  | CL=90%                            | DESIG=155 |
| $\psi(2S)X(4160)$                            | $< 3.9 \times 10^{-6}$                  | CL=90%                            | DESIG=156 |
| $Z_c(3900)^+ Z_c(3900)^-$                    | $< 1.0 \times 10^{-6}$                  | CL=90%                            | DESIG=162 |
| $Z_c(4200)^+ Z_c(4200)^-$                    | $< 1.67 \times 10^{-5}$                 | CL=90%                            | DESIG=163 |
| $Z_c(3900)^\pm Z_c(4200)^\mp$                | $< 7.3 \times 10^{-6}$                  | CL=90%                            | DESIG=164 |
| $X(4050)^+ X(4050)^-$                        | $< 1.35 \times 10^{-5}$                 | CL=90%                            | DESIG=165 |
| $X(4250)^+ X(4250)^-$                        | $< 2.67 \times 10^{-5}$                 | CL=90%                            | DESIG=166 |
| $X(4050)^\pm X(4250)^\mp$                    | $< 2.72 \times 10^{-5}$                 | CL=90%                            | DESIG=167 |
| $Z_c(4430)^+ Z_c(4430)^-$                    | $< 2.03 \times 10^{-5}$                 | CL=90%                            | DESIG=168 |
| $X(4055)^\pm X(4055)^\mp$                    | $< 1.11 \times 10^{-5}$                 | CL=90%                            | DESIG=170 |
| $X(4055)^\pm Z_c(4430)^\mp$                  | $< 2.11 \times 10^{-5}$                 | CL=90%                            | DESIG=171 |
| $\overline{2H}$ anything                     | $(2.78^{+0.30}_{-0.26}) \times 10^{-5}$ | S=1.2                             | DESIG=16  |
| hadrons                                      | $(94 \pm 11) \%$                        |                                   | DESIG=101 |
| $ggg$                                        | $(58.8 \pm 1.2) \%$                     |                                   | DESIG=105 |
| $\gamma g g$                                 | $(1.87 \pm 0.28) \%$                    |                                   | DESIG=106 |
| $\phi K^+ K^-$                               | $(1.6 \pm 0.4) \times 10^{-6}$          |                                   | DESIG=133 |
| $\omega \pi^+ \pi^-$                         | $< 2.58 \times 10^{-6}$                 | CL=90%                            | DESIG=134 |
| $K^*(892)^0 K^- \pi^+ + c.c.$                | $(2.3 \pm 0.7) \times 10^{-6}$          |                                   | DESIG=135 |
| $\phi f'_2(1525)$                            | $< 1.33 \times 10^{-6}$                 | CL=90%                            | DESIG=136 |
| $\omega f_2(1270)$                           | $< 5.7 \times 10^{-7}$                  | CL=90%                            | DESIG=137 |
| $\rho(770) a_2(1320)$                        | $< 8.8 \times 10^{-7}$                  | CL=90%                            | DESIG=138 |
| $K^*(892)^0 \overline{K}_2^*(1430)^0 + c.c.$ | $(1.5 \pm 0.6) \times 10^{-6}$          |                                   | DESIG=139 |
| $K_1(1270)^\pm K^\mp$                        | $< 3.22 \times 10^{-6}$                 | CL=90%                            | DESIG=140 |
| $K_1(1400)^\pm K^\mp$                        | $< 8.3 \times 10^{-7}$                  | CL=90%                            | DESIG=141 |
| $b_1(1235)^\pm \pi^\mp$                      | $< 4.0 \times 10^{-7}$                  | CL=90%                            | DESIG=142 |
| $\rho \pi$                                   | $< 1.16 \times 10^{-6}$                 | CL=90%                            | DESIG=126 |
| $\pi^+ \pi^- \pi^0$                          | $< 8.0 \times 10^{-7}$                  | CL=90%                            | DESIG=127 |
| $\omega \pi^0$                               | $< 1.63 \times 10^{-6}$                 | CL=90%                            | DESIG=128 |
| $\pi^+ \pi^- \pi^0 \pi^0$                    | $(1.30 \pm 0.28) \times 10^{-5}$        |                                   | DESIG=129 |
| $K_S^0 K^+ \pi^- + c.c.$                     | $(1.14 \pm 0.33) \times 10^{-6}$        |                                   | DESIG=130 |
| $K^*(892)^0 \overline{K}^0 + c.c.$           | $< 4.22 \times 10^{-6}$                 | CL=90%                            | DESIG=131 |
| $K^*(892)^- K^+ + c.c.$                      | $< 1.45 \times 10^{-6}$                 | CL=90%                            | DESIG=132 |
| $f_1(1285)$ anything                         | $(2.2 \pm 1.6) \times 10^{-3}$          |                                   | DESIG=159 |
| $f_1(1285) X_{tetra}$                        | $< 6.47 \times 10^{-5}$                 | CL=90%                            | DESIG=161 |
| Sum of 100 exclusive modes                   | $(2.90 \pm 0.30) \times 10^{-3}$        |                                   | DESIG=121 |

**Radiative decays**

|               |                                                                    |                                              |                  |        |                   |
|---------------|--------------------------------------------------------------------|----------------------------------------------|------------------|--------|-------------------|
| $\Gamma_{59}$ | $\gamma\chi_{b1}(1P)$                                              | ( 6.9 $\pm$ 0.4 ) %                          |                  |        | NODE=M052;CLUMP=A |
| $\Gamma_{60}$ | $\gamma\chi_{b2}(1P)$                                              | ( 7.15 $\pm$ 0.35 ) %                        |                  |        | DESIG=8           |
| $\Gamma_{61}$ | $\gamma\chi_{b0}(1P)$                                              | ( 3.8 $\pm$ 0.4 ) %                          |                  |        | DESIG=7           |
| $\Gamma_{62}$ | $\gamma f_0(1710)$                                                 | < 5.9                                        | $\times 10^{-4}$ | CL=90% | DESIG=9           |
| $\Gamma_{63}$ | $\gamma f'_2(1525)$                                                | < 5.3                                        | $\times 10^{-4}$ | CL=90% | DESIG=13          |
| $\Gamma_{64}$ | $\gamma f_2(1270)$                                                 | < 2.41                                       | $\times 10^{-4}$ | CL=90% | DESIG=12          |
| $\Gamma_{65}$ | $\gamma f_J(2220)$                                                 |                                              |                  |        | DESIG=11          |
| $\Gamma_{66}$ | $\gamma\eta_c(1S)$                                                 | < 2.7                                        | $\times 10^{-5}$ | CL=90% | DESIG=14          |
| $\Gamma_{67}$ | $\gamma\chi_{c0}$                                                  | < 1.0                                        | $\times 10^{-4}$ | CL=90% | DESIG=111         |
| $\Gamma_{68}$ | $\gamma\chi_{c1}$                                                  | < 3.6                                        | $\times 10^{-6}$ | CL=90% | DESIG=112         |
| $\Gamma_{69}$ | $\gamma\chi_{c2}$                                                  | < 1.5                                        | $\times 10^{-5}$ | CL=90% | DESIG=113         |
| $\Gamma_{70}$ | $\gamma\chi_{c1}(3872) \rightarrow \pi^+\pi^- J/\psi$              | < 8                                          | $\times 10^{-7}$ | CL=90% | DESIG=114         |
| $\Gamma_{71}$ | $\gamma\chi_{c1}(3872) \rightarrow \pi^+\pi^-\pi^0 J/\psi$         | < 2.4                                        | $\times 10^{-6}$ | CL=90% | DESIG=115         |
| $\Gamma_{72}$ | $\gamma X(3915) \rightarrow \omega J/\psi$                         | < 2.8                                        | $\times 10^{-6}$ | CL=90% | DESIG=116         |
| $\Gamma_{73}$ | $\gamma\chi_{c1}(4140) \rightarrow \phi J/\psi$                    | < 1.2                                        | $\times 10^{-6}$ | CL=90% | DESIG=117         |
| $\Gamma_{74}$ | $\gamma X(4350) \rightarrow \phi J/\psi$                           | < 1.3                                        | $\times 10^{-6}$ | CL=90% | DESIG=118         |
| $\Gamma_{75}$ | $\gamma\eta_b(1S)$                                                 | ( 5.5 $\pm$ 1.1 $\pm$ 0.9 ) $\times 10^{-4}$ |                  | S=1.2  | DESIG=119         |
| $\Gamma_{76}$ | $\gamma\eta_b(1S) \rightarrow \gamma$ Sum of 26 exclusive modes    | < 3.7                                        | $\times 10^{-6}$ | CL=90% | DESIG=102         |
| $\Gamma_{77}$ | $\gamma X_{b\bar{b}} \rightarrow \gamma$ Sum of 26 exclusive modes | < 4.9                                        | $\times 10^{-6}$ | CL=90% | DESIG=124         |
| $\Gamma_{78}$ | $\gamma X \rightarrow \gamma + \geq 4$ prongs                      | [a] < 1.95                                   | $\times 10^{-4}$ | CL=95% | DESIG=125         |
| $\Gamma_{79}$ | $\gamma A^0 \rightarrow \gamma$ hadrons                            | < 8                                          | $\times 10^{-5}$ | CL=90% | DESIG=103         |
| $\Gamma_{80}$ | $\gamma a_1^0 \rightarrow \gamma\mu^+\mu^-$                        | < 8.3                                        | $\times 10^{-6}$ | CL=90% | DESIG=107         |
|               |                                                                    |                                              |                  |        | DESIG=108         |
|               |                                                                    |                                              |                  |        | DESIG=123         |

**Lepton Family number (LF) violating modes**

|               |                    |    |       |                  |        |                   |
|---------------|--------------------|----|-------|------------------|--------|-------------------|
| $\Gamma_{81}$ | $e^\pm \tau^\mp$   | LF | < 3.2 | $\times 10^{-6}$ | CL=90% | NODE=M052;CLUMP=B |
| $\Gamma_{82}$ | $\mu^\pm \tau^\mp$ | LF | < 3.3 | $\times 10^{-6}$ | CL=90% | DESIG=107         |

[a] 1.5 GeV <  $m_X$  < 5.0 GeV

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  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \delta x_j)$ , 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.

$$x_7 \quad \begin{array}{|c} \hline 2 \\ \hline \end{array} \\ x_1$$

 **$\mathcal{T}(2S) \Gamma(i) \Gamma(e^+ e^-) / \Gamma(\text{total})$** 

NODE=M052218

 **$\Gamma(\mu^+ \mu^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$**  **$\Gamma_4 \Gamma_5 / \Gamma$** 

| VALUE (eV)                                           | DOCUMENT ID | TECN | COMMENT                                |
|------------------------------------------------------|-------------|------|----------------------------------------|
| <b>6.5 <math>\pm</math> 1.5 <math>\pm</math> 1.0</b> | KOBEL       | 92   | CBAL $e^+ e^- \rightarrow \mu^+ \mu^-$ |

NODE=M052G1  
NODE=M052G1 **$\Gamma(\mathcal{T}(1S) \pi^+ \pi^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$**  **$\Gamma_1 \Gamma_5 / \Gamma$** 

| VALUE (eV)                                             | EVTS  | DOCUMENT ID         | TECN      | COMMENT                                                      |
|--------------------------------------------------------|-------|---------------------|-----------|--------------------------------------------------------------|
| <b>105.4 <math>\pm</math> 1.0 <math>\pm</math> 4.2</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  $B(\mathcal{T}(1S) \rightarrow e^+ e^-) = (2.38 \pm 0.11)\%$  and  $B(\mathcal{T}(1S) \rightarrow \mu^+ \mu^-) = (2.48 \pm 0.05)\%$ .

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

**0.577±0.009 OUR AVERAGE**

|                                      |                         |     |      |                                          |
|--------------------------------------|-------------------------|-----|------|------------------------------------------|
| 0.581±0.004±0.009                    | <sup>1</sup> ROSNER     | 06  | CLEO | 10.0 $e^+e^- \rightarrow \text{hadrons}$ |
| 0.552±0.031±0.017                    | <sup>1</sup> BARU       | 96  | MD1  | $e^+e^- \rightarrow \text{hadrons}$      |
| 0.54 ±0.04 ±0.02                     | <sup>1</sup> JAKUBOWSKI | 88  | CBAL | $e^+e^- \rightarrow \text{hadrons}$      |
| 0.58 ±0.03 ±0.04                     | <sup>2</sup> GILES      | 84B | CLEO | $e^+e^- \rightarrow \text{hadrons}$      |
| 0.60 ±0.12 ±0.07                     | <sup>2</sup> ALBRECHT   | 82  | DASP | $e^+e^- \rightarrow \text{hadrons}$      |
| 0.54 ±0.07 <sup>+0.09</sup><br>-0.05 | <sup>2</sup> NICZYPORUK | 81C | LENA | $e^+e^- \rightarrow \text{hadrons}$      |
| 0.41 ±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  
NODE=M052G2NODE=M052G2;LINKAGE=P  
NODE=M052G2;LINKAGE=R $\Upsilon(2S)$  PARTIAL WIDTHS

NODE=M052220

 $\Gamma(e^+e^-)$  $\Gamma_5$ 

VALUE (keV)

DOCUMENT ID

**0.612±0.011 OUR EVALUATION**NODE=M052W2  
NODE=M052W2  
→ UNCHECKED ← $\Upsilon(2S)$  BRANCHING RATIOS

NODE=M052225

 $\Gamma(\Upsilon(1S)\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_1/\Gamma$ 

Abbreviation MM in the COMMENT field below stands for missing mass.

VALUE (units  $10^{-2}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**17.85±0.26 OUR FIT****17.92±0.26 OUR AVERAGE**

|                 |       |                        |      |      |                                                   |
|-----------------|-------|------------------------|------|------|---------------------------------------------------|
| 16.8 ±1.1 ±1.3  | 906k  | <sup>1</sup> LEES      | 11C  | BABR | $e^+e^- \rightarrow \pi^+\pi^-\text{X}$           |
| 17.80±0.05±0.37 | 170k  | <sup>2</sup> LEES      | 11L  | BABR | $\Upsilon(2S) \rightarrow \pi^+\pi^-\mu^+\mu^-$   |
| 18.02±0.02±0.61 | 851k  | <sup>3</sup> BHARI     | 09   | CLEO | $e^+e^- \rightarrow \pi^+\pi^-\text{MM}$          |
| 17.22±0.17±0.75 | 11.8K | <sup>4</sup> AUBERT    | 08BP | BABR | $e^+e^- \rightarrow \gamma\pi^+\pi^-\ell^+\ell^-$ |
| 19.2 ±0.2 ±1.0  | 52.6k | <sup>5</sup> ALEXANDER | 98   | CLE2 | $\pi^+\pi^-\ell^+\ell^-, \pi^+\pi^-\text{MM}$     |
| 18.1 ±0.5 ±1.0  | 11.6k | ALBRECHT               | 87   | ARG  | $e^+e^- \rightarrow \pi^+\pi^-\text{MM}$          |
| 16.9 ±4.0       |       | GELPHMAN               | 85   | CBAL | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-$             |
| 19.1 ±1.2 ±0.6  |       | BESSON                 | 84   | CLEO | $\pi^+\pi^-\text{MM}$                             |
| 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

NODE=M052R4  
NODE=M052R4

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

**8.6 ±0.4 OUR AVERAGE**

|                |     |                        |    |      |                                             |
|----------------|-----|------------------------|----|------|---------------------------------------------|
| 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=M052R5NODE=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 |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**2.00±0.21 OUR AVERAGE**

|                |     |                     |     |                                                                 |
|----------------|-----|---------------------|-----|-----------------------------------------------------------------|
| 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 |
|-------|-----|------|-------------|------|---------|
|-------|-----|------|-------------|------|---------|

**0.0193±0.0017 OUR AVERAGE** 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 $e^+e^- \rightarrow \mu^+\mu^-$ |
|--------|----|------------|-----|--------------------------------------|

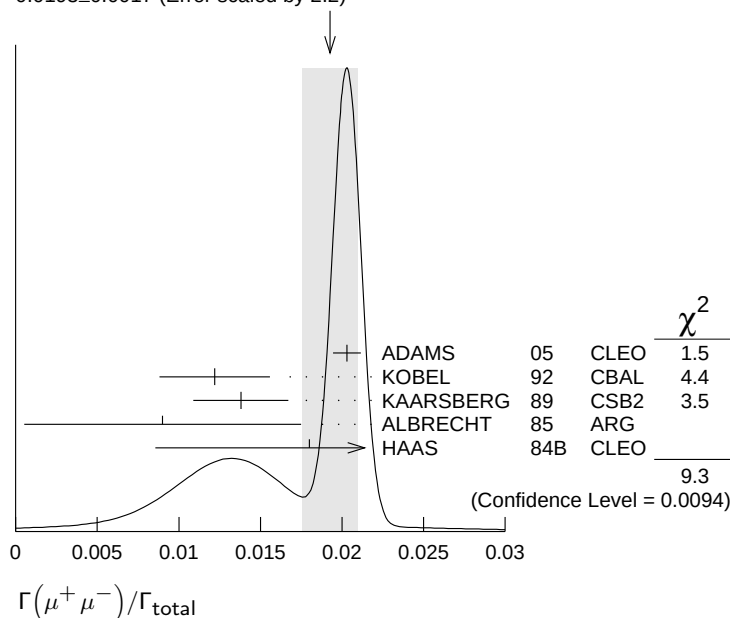
<sup>1</sup> Taking into account interference between the resonance and continuum.

<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

WEIGHTED AVERAGE  
0.0193±0.0017 (Error scaled by 2.2)

 $\Gamma(\tau^+\tau^-)/\Gamma(\mu^+\mu^-)$  $\Gamma_3/\Gamma_4$ 

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

**1.04±0.04±0.05** 22k BESSON 07 CLEO  $e^+e^- \rightarrow \Upsilon(2S)$ 

NODE=M052R17  
NODE=M052R17

 $\Gamma(\Upsilon(1S)\pi^0)/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

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

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

|      |    |                      |     |                                                    |
|------|----|----------------------|-----|----------------------------------------------------|
| < 4  | 90 | <sup>1</sup> TAMPONI | 13  | BELL $e^+e^- \rightarrow \Upsilon(1S)\pi^0$        |
| < 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  $[\Gamma(\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^0)/\Gamma_{\text{total}}] / [B(\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^+\pi^-)] < 2.3 \times 10^{-4}$  which we multiply by our best value  $B(\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^+\pi^-) = 17.85 \times 10^{-2}$ .

<sup>2</sup> Authors assume  $B(\Upsilon(1S) \rightarrow e^+e^-) + B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = 4.96\%$ .

NODE=M052R10  
NODE=M052R10

NODE=M052R10;LINKAGE=TA

NODE=M052R10;LINKAGE=HE



$\Gamma(\Upsilon(1S)\pi^0)/\Gamma(\Upsilon(1S)\pi^+\pi^-)$  $\Gamma_6/\Gamma_1$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                     |
|--------------------------|-----|-------------|------|---------------------------------------------|
| <b>&lt;2.3</b>           | 90  | TAMPONI     | 13   | BELL $e^+e^- \rightarrow \Upsilon(1S)\pi^0$ |

NODE=M052R09  
 NODE=M052R09

 $\Gamma(\Upsilon(1S)\eta)/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ 

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

**2.9  $\pm$  0.4 OUR FIT** Error includes scale factor of 2.0.

**2.9  $\pm$  0.4 OUR AVERAGE** Error includes scale factor of 1.9. See the ideogram below.

2.39  $\pm$  0.31  $\pm$  0.14 112 <sup>1</sup> LEES 11L BABR  $\Upsilon(2S) \rightarrow \ell^+\ell^-\eta$

2.1  $^{+0.7}_{-0.6}$   $\pm$  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  $\pm$  0.32  $\pm$  0.05 241 <sup>3</sup> TAMPONI 13 BELL  $e^+e^- \rightarrow \Upsilon(1S)\eta$

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 ALEXANDER98 CLE2  $e^+e^- \rightarrow \ell^+\ell^-\eta$

< 50 90 ALBRECHT 87 ARG  $e^+e^- \rightarrow \pi^+\pi^-\ell^+\ell^-$  MM

< 70 90 LURZ 87 CBAL  $e^+e^- \rightarrow \ell^+\ell^-(\gamma\gamma, 3\pi^0)$

< 100 90 BESSON 84 CLEO  $e^+e^- \rightarrow \pi^+\pi^-\ell^+\ell^-$  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.

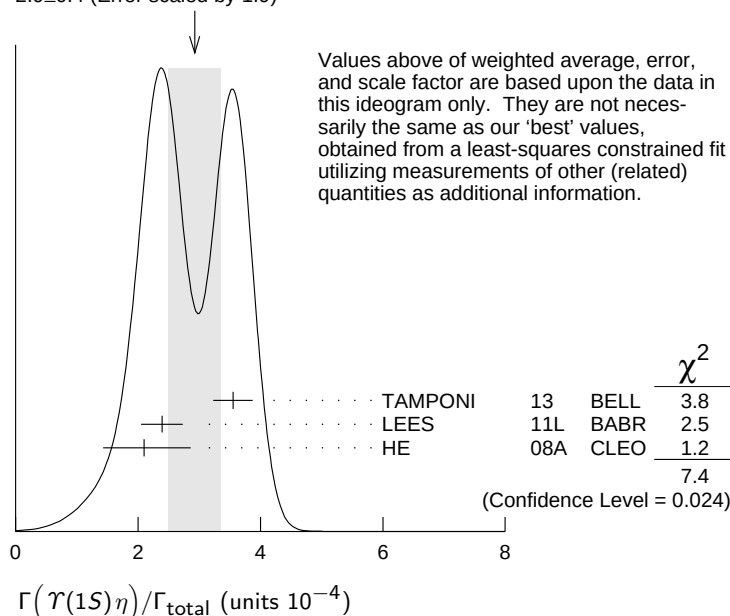
NODE=M052R6;LINKAGE=AU

NODE=M052R6;LINKAGE=HE

NODE=M052R6;LINKAGE=TA

NODE=M052R6;LINKAGE=UB

WEIGHTED AVERAGE  
 2.9 $\pm$ 0.4 (Error scaled by 1.9)

 $\Gamma(\Upsilon(1S)\eta)/\Gamma(\Upsilon(1S)\pi^+\pi^-)$  $\Gamma_7/\Gamma_1$ 

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

**1.64  $\pm$  0.25 OUR FIT** Error includes scale factor of 2.0.

**1.99  $\pm$  0.14  $\pm$  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  $\pm$  0.17  $\pm$  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 |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

NODE=M052R23  
NODE=M052R23

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

|       |    |         |    |      |                                        |
|-------|----|---------|----|------|----------------------------------------|
| <0.13 | 90 | TAMPONI | 13 | BELL | $e^+e^- \rightarrow \Upsilon(1S)\pi^0$ |
|-------|----|---------|----|------|----------------------------------------|

 $\Gamma(J/\psi(1S) \text{ anything})/\Gamma_{\text{total}}$  $\Gamma_8/\Gamma$ 

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

NODE=M052R16  
NODE=M052R16

|        |    |           |    |      |                                     |
|--------|----|-----------|----|------|-------------------------------------|
| <0.006 | 90 | MASCHMANN | 90 | CBAL | $e^+e^- \rightarrow \text{hadrons}$ |
|--------|----|-----------|----|------|-------------------------------------|

 $\Gamma(J/\psi(1S)\eta_c)/\Gamma_{\text{total}}$  $\Gamma_9/\Gamma$ 

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

NODE=M052R53  
NODE=M052R53

|                         |    |      |    |      |                               |
|-------------------------|----|------|----|------|-------------------------------|
| <5.4 × 10 <sup>-6</sup> | 90 | YANG | 14 | BELL | $e^+e^- \rightarrow J/\psi X$ |
|-------------------------|----|------|----|------|-------------------------------|

 $\Gamma(J/\psi(1S)\chi_{c0})/\Gamma_{\text{total}}$  $\Gamma_{10}/\Gamma$ 

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

NODE=M052R54  
NODE=M052R54

|                         |    |      |    |      |                               |
|-------------------------|----|------|----|------|-------------------------------|
| <3.4 × 10 <sup>-6</sup> | 90 | YANG | 14 | BELL | $e^+e^- \rightarrow J/\psi X$ |
|-------------------------|----|------|----|------|-------------------------------|

 $\Gamma(J/\psi(1S)\chi_{c1})/\Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ 

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

NODE=M052R55  
NODE=M052R55

|                         |    |      |    |      |                               |
|-------------------------|----|------|----|------|-------------------------------|
| <1.2 × 10 <sup>-6</sup> | 90 | YANG | 14 | BELL | $e^+e^- \rightarrow J/\psi X$ |
|-------------------------|----|------|----|------|-------------------------------|

 $\Gamma(J/\psi(1S)\chi_{c2})/\Gamma_{\text{total}}$  $\Gamma_{12}/\Gamma$ 

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

NODE=M052R56  
NODE=M052R56

|                         |    |      |    |      |                               |
|-------------------------|----|------|----|------|-------------------------------|
| <2.0 × 10 <sup>-6</sup> | 90 | YANG | 14 | BELL | $e^+e^- \rightarrow J/\psi X$ |
|-------------------------|----|------|----|------|-------------------------------|

 $\Gamma(J/\psi(1S)\eta_c(2S))/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ 

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

NODE=M052R57  
NODE=M052R57

|                         |    |      |    |      |                               |
|-------------------------|----|------|----|------|-------------------------------|
| <2.5 × 10 <sup>-6</sup> | 90 | YANG | 14 | BELL | $e^+e^- \rightarrow J/\psi X$ |
|-------------------------|----|------|----|------|-------------------------------|

 $\Gamma(J/\psi(1S)X(3940))/\Gamma_{\text{total}}$  $\Gamma_{14}/\Gamma$ 

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

NODE=M052R58  
NODE=M052R58

|                         |    |      |    |      |                               |
|-------------------------|----|------|----|------|-------------------------------|
| <2.0 × 10 <sup>-6</sup> | 90 | YANG | 14 | BELL | $e^+e^- \rightarrow J/\psi X$ |
|-------------------------|----|------|----|------|-------------------------------|

 $\Gamma(J/\psi(1S)X(4160))/\Gamma_{\text{total}}$  $\Gamma_{15}/\Gamma$ 

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

NODE=M052R59  
NODE=M052R59

|                         |    |      |    |      |                               |
|-------------------------|----|------|----|------|-------------------------------|
| <2.0 × 10 <sup>-6</sup> | 90 | YANG | 14 | BELL | $e^+e^- \rightarrow J/\psi X$ |
|-------------------------|----|------|----|------|-------------------------------|

 $\Gamma(\chi_{c1} \text{ anything})/\Gamma_{\text{total}}$  $\Gamma_{16}/\Gamma$ 

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

NODE=M052R00  
NODE=M052R00

|                    |     |     |    |      |                                              |
|--------------------|-----|-----|----|------|----------------------------------------------|
| 2.24 ± 0.44 ± 0.20 | 376 | JIA | 17 | BELL | $\Upsilon(2S) \rightarrow \gamma J/\psi(1S)$ |
|--------------------|-----|-----|----|------|----------------------------------------------|

 $\Gamma(\chi_{c1}(1P)^0 X_{tetra})/\Gamma_{\text{total}}$  $\Gamma_{17}/\Gamma$ 

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

NODE=M052R69  
NODE=M052R69

|                          |    |                  |     |      |                                     |
|--------------------------|----|------------------|-----|------|-------------------------------------|
| <36.7 × 10 <sup>-6</sup> | 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

 $\Gamma(\chi_{c2} \text{ anything})/\Gamma_{\text{total}}$  $\Gamma_{18}/\Gamma$ 

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

NODE=M052R67  
NODE=M052R67

|                    |     |    |      |                                              |
|--------------------|-----|----|------|----------------------------------------------|
| 2.28 ± 0.73 ± 0.34 | JIA | 17 | BELL | $\Upsilon(2S) \rightarrow \gamma J/\psi(1S)$ |
|--------------------|-----|----|------|----------------------------------------------|

 $\Gamma(\psi(2S)\eta_c)/\Gamma_{\text{total}}$  $\Gamma_{19}/\Gamma$ 

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

NODE=M052R60  
NODE=M052R60

|                         |    |      |    |      |                                |
|-------------------------|----|------|----|------|--------------------------------|
| <5.1 × 10 <sup>-6</sup> | 90 | YANG | 14 | BELL | $e^+e^- \rightarrow \psi(2S)X$ |
|-------------------------|----|------|----|------|--------------------------------|

 $\Gamma(\psi(2S)\chi_{c0})/\Gamma_{\text{total}}$  $\Gamma_{20}/\Gamma$ 

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

NODE=M052R61  
NODE=M052R61

|                         |    |      |    |      |                                |
|-------------------------|----|------|----|------|--------------------------------|
| <4.7 × 10 <sup>-6</sup> | 90 | YANG | 14 | BELL | $e^+e^- \rightarrow \psi(2S)X$ |
|-------------------------|----|------|----|------|--------------------------------|

 $\Gamma(\psi(2S)\chi_{c1})/\Gamma_{\text{total}}$  $\Gamma_{21}/\Gamma$ 

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

NODE=M052R62  
NODE=M052R62

|                         |    |      |    |      |                                |
|-------------------------|----|------|----|------|--------------------------------|
| <2.5 × 10 <sup>-6</sup> | 90 | YANG | 14 | BELL | $e^+e^- \rightarrow \psi(2S)X$ |
|-------------------------|----|------|----|------|--------------------------------|

$\Gamma(\psi(2S)\chi_{c2})/\Gamma_{\text{total}}$ 
 $\Gamma_{22}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                        |
|-----------------------|-----|-------------|------|--------------------------------|
| $<1.9 \times 10^{-6}$ | 90  | YANG 14     | BELL | $e^+e^- \rightarrow \psi(2S)X$ |

NODE=M052R63  
NODE=M052R63

 $\Gamma(\psi(2S)\eta_c(2S))/\Gamma_{\text{total}}$ 
 $\Gamma_{23}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                        |
|-----------------------|-----|-------------|------|--------------------------------|
| $<3.3 \times 10^{-6}$ | 90  | YANG 14     | BELL | $e^+e^- \rightarrow \psi(2S)X$ |

NODE=M052R64  
NODE=M052R64

 $\Gamma(\psi(2S)X(3940))/\Gamma_{\text{total}}$ 
 $\Gamma_{24}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                        |
|-----------------------|-----|-------------|------|--------------------------------|
| $<3.9 \times 10^{-6}$ | 90  | YANG 14     | BELL | $e^+e^- \rightarrow \psi(2S)X$ |

NODE=M052R65  
NODE=M052R65

 $\Gamma(\psi(2S)X(4160))/\Gamma_{\text{total}}$ 
 $\Gamma_{25}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                        |
|-----------------------|-----|-------------|------|--------------------------------|
| $<3.9 \times 10^{-6}$ | 90  | YANG 14     | BELL | $e^+e^- \rightarrow \psi(2S)X$ |

NODE=M052R66  
NODE=M052R66

 $\Gamma(Z_c(3900)^+Z_c(3900)^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{26}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID         | TECN | COMMENT                                    |
|--------------------------|-----|---------------------|------|--------------------------------------------|
| $<1.0$                   | 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  
NODE=M052R71

NODE=M052R71;LINKAGE=A

 $\Gamma(Z_c(4200)^+Z_c(4200)^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{27}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID         | TECN | COMMENT                                    |
|--------------------------|-----|---------------------|------|--------------------------------------------|
| $<16.7$                  | 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 (units $10^{-6}$ ) | CL% | DOCUMENT ID         | TECN | COMMENT                                    |
|--------------------------|-----|---------------------|------|--------------------------------------------|
| $<7.3$                   | 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 (units $10^{-6}$ ) | CL% | DOCUMENT ID         | TECN | COMMENT                                           |
|--------------------------|-----|---------------------|------|---------------------------------------------------|
| $<13.5$                  | 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 (units $10^{-6}$ ) | CL% | DOCUMENT ID         | TECN | COMMENT                                           |
|--------------------------|-----|---------------------|------|---------------------------------------------------|
| $<26.7$                  | 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 (units $10^{-6}$ ) | CL% | DOCUMENT ID         | TECN | COMMENT                                           |
|--------------------------|-----|---------------------|------|---------------------------------------------------|
| $<27.2$                  | 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 (units $10^{-6}$ ) | CL% | DOCUMENT ID         | TECN | COMMENT                                      |
|--------------------------|-----|---------------------|------|----------------------------------------------|
| $<20.3$                  | 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 (units $10^{-6}$ ) | CL% | DOCUMENT ID         | TECN | COMMENT                                      |
|--------------------------|-----|---------------------|------|----------------------------------------------|
| $<11.1$                  | 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 (units $10^{-6}$ )                                                                                              | CL% | DOCUMENT ID      | TECN    | COMMENT                                      |
|-----------------------------------------------------------------------------------------------------------------------|-----|------------------|---------|----------------------------------------------|
| <b>&lt;21.1</b>                                                                                                       | 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<sup>+0.30</sup><sub>-0.26</sub>** OUR AVERAGE Error includes scale factor of 1.2.

|                                               |    |       |          |                                      |
|-----------------------------------------------|----|-------|----------|--------------------------------------|
| 2.64 ± 0.11 <sup>+0.26</sup> <sub>-0.21</sub> |    | LEES  | 14G BABR | $e^+e^- \rightarrow \overline{2H} X$ |
| 3.37 ± 0.50 ± 0.25                            | 58 | ASNER | 07 CLEO  | $e^+e^- \rightarrow \overline{2H} X$ |

NODE=M052R18  
 NODE=M052R18

 $\Gamma(ggg)/\Gamma_{\text{total}}$  $\Gamma_{37}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID         | TECN     | COMMENT                                   |
|--------------------------|------|---------------------|----------|-------------------------------------------|
| <b>58.8 ± 1.2</b>        | 6M   | <sup>1</sup> BESSON | 06A CLEO | $\Upsilon(2S) \rightarrow \text{hadrons}$ |

<sup>1</sup> Calculated using the value  $\Gamma(\gamma gg)/\Gamma(ggg) = (3.18 \pm 0.04 \pm 0.22 \pm 0.41)\%$  from BESSON 06A and PDG 08 values of  $B(\pi^+\pi^-\Upsilon(1S)) = (18.1 \pm 0.4)\%$ ,  $B(\pi^0\pi^0\Upsilon(1S)) = (8.6 \pm 0.4)\%$ ,  $B(\mu^+\mu^-\Upsilon(1S)) = (1.93 \pm 0.17)\%$ , and  $R_{\text{hadrons}} = 3.51$ . The statistical error is negligible and the systematic error is partially correlated with that of  $\Gamma(\gamma gg)/\Gamma_{\text{total}}$  measurement of BESSON 06A.

NODE=M052R01  
 NODE=M052R01

NODE=M052R01;LINKAGE=BE

 $\Gamma(\gamma gg)/\Gamma(ggg)$  $\Gamma_{38}/\Gamma_{37}$ 

| VALUE (units $10^{-2}$ )  | EVTS | DOCUMENT ID | TECN     | COMMENT                                               |
|---------------------------|------|-------------|----------|-------------------------------------------------------|
| <b>3.18 ± 0.04 ± 0.47</b> | 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>1.58 ± 0.33 ± 0.18</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>&lt;2.58</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>2.32 ± 0.40 ± 0.54</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>&lt;1.33</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>&lt;0.57</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>&lt;0.88</b>          | 90  | SHEN        | 12A BELL | $\Upsilon(1S) \rightarrow 2(\pi^+ \pi^-)\pi^0$ |

NODE=M052R48  
 NODE=M052R48

 $\Gamma(K^*(892)^0 \overline{K}_2^*(1430)^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{45}/\Gamma$ 

| VALUE (units $10^{-6}$ )  | EVTS | DOCUMENT ID | TECN     | COMMENT                                        |
|---------------------------|------|-------------|----------|------------------------------------------------|
| <b>1.53 ± 0.52 ± 0.19</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>&lt;3.22</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>&lt;0.83</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>&lt;0.40</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>&lt;1.16</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>&lt;0.80</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>&lt;1.63</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 $\Upsilon(2S) \rightarrow K_S^0 K^- \pi^+$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |                    |             |      |                                                 |
| <b>&lt;3.2</b>                                                                | 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  
 NODE=M052R40

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                                         |
|--------------------------|-----|-------------|------|-------------------------------------------------|
| <b>&lt;4.22</b>          | 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                                         |
|--------------------------|-----|-------------|------|-------------------------------------------------|
| <b>&lt;1.45</b>          | 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                                   |
|--------------------------------------------|------|-------------|------|-------------------------------------------|
| <b><math>2.20 \pm 1.50 \pm 0.63</math></b> | 2.9k | JIA         | 17A  | BELL $e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M052R68  
 NODE=M052R68

 $\Gamma(f_1(1285) X_{tetra})/\Gamma_{\text{total}}$  $\Gamma_{57}/\Gamma$ 

| VALUE                                       | CL% | DOCUMENT ID      | TECN | COMMENT                                   |
|---------------------------------------------|-----|------------------|------|-------------------------------------------|
| <b><math>&lt;64.7 \times 10^{-6}</math></b> | 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  $7.8 \times 10^{-6}$  to  $64.7 \times 10^{-6}$ .

NODE=M052R70  
 NODE=M052R70

NODE=M052R70;LINKAGE=A

 $\Gamma(\text{Sum of 100 exclusive modes})/\Gamma_{\text{total}}$  $\Gamma_{58}/\Gamma$ 

| VALUE (units $10^{-2}$ )          | DOCUMENT ID          | COMMENT                                       |
|-----------------------------------|----------------------|-----------------------------------------------|
| <b><math>0.29 \pm 0.03</math></b> | <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><math>0.069 \pm 0.004</math> 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

$\Gamma(\gamma\chi_{b2}(1P))/\Gamma_{\text{total}}$ 

VALUE EVTS  
**0.0715 ± 0.0035 OUR AVERAGE**

| VALUE                    | EVTS | DOCUMENT ID | TECN    | COMMENT                                    |
|--------------------------|------|-------------|---------|--------------------------------------------|
| 0.0724 ± 0.0011 ± 0.0040 | 410k | ARTUSO      | 05 CLEO | $e^+e^- \rightarrow \gamma X$              |
| 0.074 ± 0.005 ± 0.008    |      | EDWARDS     | 99 CLE2 | $\Upsilon(2S) \rightarrow \gamma\chi(1P)$  |
| 0.098 ± 0.021 ± 0.024    |      | ALBRECHT    | 85E ARG | $e^+e^- \rightarrow \gamma\text{conv. } X$ |
| 0.058 ± 0.007 ± 0.010    |      | NERNST      | 85 CBAL | $e^+e^- \rightarrow \gamma X$              |
| 0.102 ± 0.018 ± 0.021    |      | HAAS        | 84 CLEO | $e^+e^- \rightarrow \gamma\text{conv. } X$ |
| 0.061 ± 0.014            |      | KLOPFEN...  | 83 CUSB | $e^+e^- \rightarrow \gamma X$              |

 $\Gamma_{60}/\Gamma$ 

NODE=M052R7  
 NODE=M052R7

 $\Gamma(\gamma\chi_{b0}(1P))/\Gamma_{\text{total}}$ 

VALUE EVTS  
**0.038 ± 0.004 OUR AVERAGE**

| VALUE                    | EVTS | DOCUMENT ID | TECN    | COMMENT                                    |
|--------------------------|------|-------------|---------|--------------------------------------------|
| 0.0375 ± 0.0012 ± 0.0047 | 198k | ARTUSO      | 05 CLEO | $e^+e^- \rightarrow \gamma X$              |
| 0.034 ± 0.005 ± 0.006    |      | EDWARDS     | 99 CLE2 | $\Upsilon(2S) \rightarrow \gamma\chi(1P)$  |
| 0.064 ± 0.014 ± 0.016    |      | ALBRECHT    | 85E ARG | $e^+e^- \rightarrow \gamma\text{conv. } X$ |
| 0.036 ± 0.008 ± 0.009    |      | NERNST      | 85 CBAL | $e^+e^- \rightarrow \gamma X$              |
| 0.044 ± 0.023 ± 0.009    |      | HAAS        | 84 CLEO | $e^+e^- \rightarrow \gamma\text{conv. } X$ |
| 0.035 ± 0.014            |      | KLOPFEN...  | 83 CUSB | $e^+e^- \rightarrow \gamma X$              |

 $\Gamma_{61}/\Gamma$ 

NODE=M052R9  
 NODE=M052R9

 $\Gamma(\gamma f_0(1710))/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID           | TECN   | COMMENT                                   |
|--------------------------|-----|-----------------------|--------|-------------------------------------------|
| <b>&lt;59</b>            | 90  | <sup>1</sup> ALBRECHT | 89 ARG | $\Upsilon(2S) \rightarrow \gamma K^+ K^-$ |

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

|       |    |                       |        |                                               |
|-------|----|-----------------------|--------|-----------------------------------------------|
| < 5.9 | 90 | <sup>2</sup> ALBRECHT | 89 ARG | $\Upsilon(2S) \rightarrow \gamma \pi^+ \pi^-$ |
|-------|----|-----------------------|--------|-----------------------------------------------|

<sup>1</sup> Re-evaluated assuming  $B(f_0(1710) \rightarrow K^+ K^-) = 0.19$ .

<sup>2</sup> Includes unknown branching ratio of  $f_0(1710) \rightarrow \pi^+ \pi^-$ .

 $\Gamma_{62}/\Gamma$ 

NODE=M052R13  
 NODE=M052R13

OCCUR=2

NODE=M052R13;LINKAGE=M  
 NODE=M052R13;LINKAGE=N

 $\Gamma(\gamma f'_2(1525))/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID           | TECN   | COMMENT                                   |
|--------------------------|-----|-----------------------|--------|-------------------------------------------|
| <b>&lt;53</b>            | 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                                       |
|--------------------------|-----|-----------------------|--------|-----------------------------------------------|
| <b>&lt;24.1</b>          | 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                                   |
|--------------------------|-----|-----------------------|--------|-------------------------------------------|
| <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                             |
|----------------------------------|-----|-------------|----------|-------------------------------------|
| <b>&lt;2.7 × 10<sup>-5</sup></b> | 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                             |
|----------------------------------|-----|-------------|----------|-------------------------------------|
| <b>&lt;1.0 × 10<sup>-4</sup></b> | 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                             |
|----------------------------------|-----|-------------|----------|-------------------------------------|
| <b>&lt;3.6 × 10<sup>-6</sup></b> | 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                             |
|----------------------------------|-----|-------------|----------|-------------------------------------|
| <b>&lt;1.5 × 10<sup>-5</sup></b> | 90  | WANG        | 11B BELL | $\Upsilon(2S) \rightarrow \gamma X$ |

 $\Gamma_{69}/\Gamma$ 

NODE=M052R34  
 NODE=M052R34

 $\Gamma(\gamma\chi_{c1}(3872) \rightarrow \pi^+ \pi^- J/\psi)/\Gamma_{\text{total}}$ 

| VALUE                            | CL% | DOCUMENT ID | TECN     | COMMENT                             |
|----------------------------------|-----|-------------|----------|-------------------------------------|
| <b>&lt;0.8 × 10<sup>-6</sup></b> | 90  | WANG        | 11B BELL | $\Upsilon(2S) \rightarrow \gamma X$ |

 $\Gamma_{70}/\Gamma$ 

NODE=M052R35  
 NODE=M052R35

$\Gamma(\gamma\chi_{c1}(3872) \rightarrow \pi^+\pi^-\pi^0 J/\psi)/\Gamma_{\text{total}}$   $\Gamma_{71}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN     | COMMENT                             |
|-----------------------|-----|-------------|----------|-------------------------------------|
| $<2.4 \times 10^{-6}$ | 90  | WANG        | 11B BELL | $\Upsilon(2S) \rightarrow \gamma X$ |

NODE=M052R36  
NODE=M052R36

 $\Gamma(\gamma X(3915) \rightarrow \omega J/\psi)/\Gamma_{\text{total}}$   $\Gamma_{72}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN     | COMMENT                             |
|-----------------------|-----|-------------|----------|-------------------------------------|
| $<2.8 \times 10^{-6}$ | 90  | WANG        | 11B BELL | $\Upsilon(2S) \rightarrow \gamma X$ |

NODE=M052R37  
NODE=M052R37

 $\Gamma(\gamma\chi_{c1}(4140) \rightarrow \phi J/\psi)/\Gamma_{\text{total}}$   $\Gamma_{73}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN     | COMMENT                             |
|-----------------------|-----|-------------|----------|-------------------------------------|
| $<1.2 \times 10^{-6}$ | 90  | WANG        | 11B BELL | $\Upsilon(2S) \rightarrow \gamma X$ |

NODE=M052R38  
NODE=M052R38

 $\Gamma(\gamma X(4350) \rightarrow \phi J/\psi)/\Gamma_{\text{total}}$   $\Gamma_{74}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN     | COMMENT                             |
|-----------------------|-----|-------------|----------|-------------------------------------|
| $<1.3 \times 10^{-6}$ | 90  | WANG        | 11B BELL | $\Upsilon(2S) \rightarrow \gamma X$ |

NODE=M052R39  
NODE=M052R39

 $\Gamma(\gamma\eta_b(1S))/\Gamma_{\text{total}}$   $\Gamma_{75}/\Gamma$ 

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

$5.5^{+1.1}_{-0.9}$  OUR AVERAGE Error includes scale factor of 1.2.  $[(3.9 \pm 1.5) \times 10^{-4}$   
OUR 2018 AVERAGE]

NODE=M052R15  
NODE=M052R15

NEW

|                             |             |                     |      |      |                                     |
|-----------------------------|-------------|---------------------|------|------|-------------------------------------|
| $6.1^{+0.6+0.9}_{-0.7-0.6}$ | 29k         | FULSOM              | 18   | BELL | $\Upsilon(2S) \rightarrow \gamma X$ |
| $3.9 \pm 1.1^{+1.1}_{-0.9}$ | $13 \pm 5k$ | <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                                           |
|-----------------------|-----|-------------|---------|---------------------------------------------------|
| $<3.7 \times 10^{-6}$ | 90  | SANDILYA    | 13 BELL | $\Upsilon(2S) \rightarrow \gamma \text{ hadrons}$ |

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 $10^{-6}$ ) | CL% | EVTS | DOCUMENT ID | TECN    | COMMENT                                           |
|--------------------------|-----|------|-------------|---------|---------------------------------------------------|
| $< 4.9$                  | 90  |      | SANDILYA    | 13 BELL | $\Upsilon(2S) \rightarrow \gamma \text{ hadrons}$ |

NODE=M052R26  
NODE=M052R26

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

|                                 |    |                    |    |  |                                                   |
|---------------------------------|----|--------------------|----|--|---------------------------------------------------|
| $46.2^{+29.7}_{-14.2} \pm 10.6$ | 10 | <sup>1</sup> DOBBS | 12 |  | $\Upsilon(2S) \rightarrow \gamma \text{ hadrons}$ |
|---------------------------------|----|--------------------|----|--|---------------------------------------------------|

<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 $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                       |
|--------------------------|-----|-------------|----------|-------------------------------|
| $<1.95$                  | 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                                           |
|---------------------|-----|-------------------|----------|---------------------------------------------------|
| $<8 \times 10^{-5}$ | 90  | <sup>1</sup> LEES | 11H BABR | $\Upsilon(2S) \rightarrow \gamma \text{ hadrons}$ |

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 $10^{-6}$ ) | CL% | DOCUMENT ID         | TECN     | COMMENT                                                          |
|--------------------------|-----|---------------------|----------|------------------------------------------------------------------|
| $<8.3$                   | 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  $0.26\text{--}8.3 \times 10^{-6}$ .

NODE=M052R24;LINKAGE=AU

LEPTON FAMILY NUMBER ( $LF$ ) VIOLATING MODES

| $\Gamma(e^{\pm}\tau^{\mp})/\Gamma_{\text{total}}$                             |     |             |          |                                          | $\Gamma_{81}/\Gamma$ |
|-------------------------------------------------------------------------------|-----|-------------|----------|------------------------------------------|----------------------|
| VALUE (units $10^{-6}$ )                                                      | CL% | DOCUMENT ID | TECN     | COMMENT                                  |                      |
| <b>&lt;3.2</b>                                                                | 90  | LEES        | 10B BABR | $e^+e^- \rightarrow e^{\pm}\tau^{\mp}$   |                      |
| $\Gamma(\mu^{\pm}\tau^{\mp})/\Gamma_{\text{total}}$                           |     |             |          |                                          | $\Gamma_{82}/\Gamma$ |
| VALUE (units $10^{-6}$ )                                                      | CL% | DOCUMENT ID | TECN     | COMMENT                                  |                      |
| <b>&lt; 3.3</b>                                                               | 90  | LEES        | 10B BABR | $e^+e^- \rightarrow \mu^{\pm}\tau^{\mp}$ |                      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |          |                                          |                      |
| <b>&lt;14.4</b>                                                               | 95  | LOVE        | 08A CLEO | $e^+e^- \rightarrow \mu^{\pm}\tau^{\mp}$ |                      |

 $\mathcal{T}(2S)$  Cross-Particle Branching Ratios

| $B(\mathcal{T}(2S) \rightarrow \pi^+\pi^-) \times B(\mathcal{T}(3S) \rightarrow \mathcal{T}(2S)X)$ |      |             |          |                                  |  |
|----------------------------------------------------------------------------------------------------|------|-------------|----------|----------------------------------|--|
| VALUE (units $10^{-2}$ )                                                                           | EVTS | DOCUMENT ID | TECN     | COMMENT                          |  |
| <b><math>1.78 \pm 0.02 \pm 0.11</math></b>                                                         | 906k | LEES        | 11C BABR | $e^+e^- \rightarrow \pi^+\pi^-X$ |  |

 $\mathcal{T}(2S)$  REFERENCES

|                                                             |      |                         |                               |                           |
|-------------------------------------------------------------|------|-------------------------|-------------------------------|---------------------------|
| FULSOM                                                      | 18   | PRL 121 232001          | B.G.Fulsom                    | (BELLE Collab.)           |
| JIA                                                         | 18   | PR D97 112004           | S. Jia <i>et al.</i>          | (BELLE 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.)           |
| 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.)           |
| SANDILYA                                                    | 13   | PRL 111 112001          | S. Sandilya <i>et al.</i>     | (BELLE Collab.)           |
| SHEN                                                        | 13   | PR D88 011102           | C.P. Shen <i>et al.</i>       | (BELLE Collab.)           |
| TAMPONI                                                     | 13   | PR D87 011104           | U. Tamponi <i>et al.</i>      | (BELLE Collab.)           |
| DOBBS                                                       | 12   | PRL 109 082001          | S. Dobbs <i>et al.</i>        |                           |
| 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.)           |
| LEES                                                        | 11C  | PR D84 011104           | J.P. Lees <i>et al.</i>       | (BABAR Collab.)           |
| LEES                                                        | 11H  | PRL 107 221803          | J.P. Lees <i>et al.</i>       | (BABAR Collab.)           |
| LEES                                                        | 11J  | PR D84 072002           | J.P. Lees <i>et al.</i>       | (BABAR Collab.)           |
| LEES                                                        | 11L  | PR D84 092003           | J.P. Lees <i>et al.</i>       | (BABAR Collab.)           |
| WANG                                                        | 11B  | PR D84 071107           | X.L. Wang <i>et al.</i>       | (BELLE Collab.)           |
| BONVICINI                                                   | 10   | PR D81 031104           | G. Bonvicini <i>et al.</i>    | (CLEO Collab.)            |
| LEES                                                        | 10B  | PRL 104 151802          | J.P. Lees <i>et al.</i>       | (BABAR Collab.)           |
| AUBERT                                                      | 09AQ | PRL 103 161801          | B. Aubert <i>et al.</i>       | (BABAR Collab.)           |
| AUBERT                                                      | 09Z  | PRL 103 081803          | B. Aubert <i>et al.</i>       | (BABAR Collab.)           |
| BHARI                                                       | 09   | PR D79 011103           | S.R. Bhari <i>et al.</i>      | (CLEO Collab.)            |
| AUBERT                                                      | 08BP | PR D78 112002           | B. Aubert <i>et al.</i>       | (BABAR Collab.)           |
| HE                                                          | 08A  | PRL 101 192001          | Q. He <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.)            |
| BESSION                                                     | 07   | PRL 98 052002           | D. Besson <i>et al.</i>       | (CLEO Collab.)            |
| ROSNER                                                      | 07A  | PR D76 117102           | J.L. Rosner <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.)            |
| ARTUSO                                                      | 05   | PRL 94 032001           | M. Artuso <i>et al.</i>       | (CLEO Collab.)            |
| ARTAMONOV                                                   | 00   | PL B474 427             | A.S. Artamonov <i>et al.</i>  |                           |
| EDWARDS                                                     | 99   | PR D59 032003           | K.W. Edwards <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)                    |
| KOBEL                                                       | 92   | ZPHY C53 193            | M. Kobel <i>et al.</i>        | (Crystal Ball 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.)           |
| 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.)    |
| 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)               |
| LURZ                                                        | 87   | ZPHY C36 383            | B. Lurz <i>et al.</i>         | (Crystal Ball Collab.)    |
| BARU                                                        | 86B  | ZPHY C32 622 (erratum)  | S.E. Baru <i>et al.</i>       | (NOVO)                    |
| ALBRECHT                                                    | 85   | ZPHY C28 45             | H. Albrecht <i>et al.</i>     | (ARGUS Collab.)           |
| ALBRECHT                                                    | 85E  | PL 160B 331             | H. Albrecht <i>et al.</i>     | (ARGUS Collab.)           |
| GELPHMAN                                                    | 85   | PR D32 2893             | D. Gelphman <i>et al.</i>     | (Crystal Ball Collab.)    |
| KURAEV                                                      | 85   | SJNP 41 466             | E.A. Kuraev, V.S. Fadin       | (NOVO)                    |
| Translated from YAF 41 733.                                 |      |                         |                               |                           |
| NERNST                                                      | 85   | PRL 54 2195             | R. Nernst <i>et al.</i>       | (Crystal Ball Collab.)    |
| ARTAMONOV                                                   | 84   | PL 137B 272             | A.S. Artamonov <i>et al.</i>  | (NOVO)                    |
| BARBER                                                      | 84   | PL 135B 498             | D.P. Barber <i>et al.</i>     | (DESY, ARGUS Collab.+)    |
| BESSION                                                     | 84   | PR D30 1433             | D. Besson <i>et al.</i>       | (CLEO Collab.)            |
| FONSECA                                                     | 84   | NP B242 31              | V. Fonseca <i>et al.</i>      | (CUSB Collab.)            |
| GILES                                                       | 84B  | PR D29 1285             | R. Giles <i>et al.</i>        | (CLEO Collab.)            |
| HAAS                                                        | 84   | PRL 52 799              | J. Haas <i>et al.</i>         | (CLEO Collab.)            |
| HAAS                                                        | 84B  | PR D30 1996             | J. Haas <i>et al.</i>         | (CLEO Collab.)            |
| KLOPFEN...                                                  | 83   | PRL 51 160              | C. Klopfenstein <i>et al.</i> | (CUSB Collab.)            |
| ALBRECHT                                                    | 82   | PL 116B 383             | H. Albrecht <i>et al.</i>     | (DESY, DORT, HEIDH+)      |
| NICZYPORUK                                                  | 81B  | PL 100B 95              | B. Niczyporuk <i>et al.</i>   | (LENA Collab.)            |
| NICZYPORUK                                                  | 81C  | PL 99B 169              | B. Niczyporuk <i>et al.</i>   | (LENA Collab.)            |
| BOCK                                                        | 80   | ZPHY C6 125             | P. Bock <i>et al.</i>         | (HEIDP, MPIM, DESY, HAMB) |

NODE=M052230

NODE=M052R04  
NODE=M052R04NODE=M052R20  
NODE=M052R20

NODE=M052240

NODE=M052R05  
NODE=M052R05

NODE=M052

REFID=59535  
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REFID=22319  
REFID=22318  
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.

NODE=M177

NODE=M177

### $\Upsilon_2(1D)$ MASS

NODE=M177M

NODE=M177M

| 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

NODE=M177215;NODE=M177

| 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                       |
| $\Gamma_4 \quad \pi^+\pi^- \Upsilon(1S)$   | $(6.6 \pm 1.6) \times 10^{-3}$ |

DESIG=1;OUR EVAL;→ UNCHECKED ←  
 DESIG=2;OUR EVAL;→ UNCHECKED ←  
 DESIG=3;OUR EVAL;→ UNCHECKED ←  
 DESIG=4

### $\Upsilon_2(1D)$ BRANCHING RATIOS

NODE=M177225

| $\Gamma(\eta \Upsilon(1S))/\Gamma(\gamma\gamma \Upsilon(1S))$ |     |              |      |                                                | $\Gamma_3/\Gamma_1$ |
|---------------------------------------------------------------|-----|--------------|------|------------------------------------------------|---------------------|
| VALUE                                                         | CL% | DOCUMENT ID  | TECN | COMMENT                                        |                     |
| <b>&lt;0.25</b>                                               | 90  | BONVICINI 04 | CLE3 | $\Upsilon(3S) \rightarrow 4\gamma\ell^+\ell^-$ |                     |

NODE=M177R01  
 NODE=M177R01

| $\Gamma(\pi^+\pi^- \Upsilon(1S))/\Gamma_{\text{total}}$ |  |                              |      |                                                               | $\Gamma_4/\Gamma$ |
|---------------------------------------------------------|--|------------------------------|------|---------------------------------------------------------------|-------------------|
| VALUE (units $10^{-2}$ )                                |  | DOCUMENT ID                  | TECN | COMMENT                                                       |                   |
| <b>0.66<sup>+0.15</sup><sub>-0.14</sub>±0.06</b>        |  | <sup>1</sup> DEL-AMO-SA..10R | BABR | $\Upsilon(3S) \rightarrow \gamma\gamma\pi^+\pi^-\ell^+\ell^-$ |                   |

NODE=M177R03  
 NODE=M177R03

<sup>1</sup> Using theoretical predictions for  $B(\chi_{bJ}(2P) \rightarrow \gamma \Upsilon_2(1D))$ .

NODE=M177R03;LINKAGE=DE

| $\Gamma(\pi^+\pi^- \Upsilon(1S))/\Gamma(\gamma\gamma \Upsilon(1S))$ |     |                           |      |                                                | $\Gamma_4/\Gamma_1$ |
|---------------------------------------------------------------------|-----|---------------------------|------|------------------------------------------------|---------------------|
| VALUE                                                               | CL% | DOCUMENT ID               | TECN | COMMENT                                        |                     |
| <b>&lt;1.2</b>                                                      | 90  | <sup>2</sup> BONVICINI 04 | CLE3 | $\Upsilon(3S) \rightarrow 4\gamma\ell^+\ell^-$ |                     |

NODE=M177R02  
 NODE=M177R02

<sup>2</sup> Assuming  $J = 2$ .

NODE=M177R02;LINKAGE=BO

### $\Upsilon_2(1D)$ REFERENCES

NODE=M177

|                   |               |                                  |                 |
|-------------------|---------------|----------------------------------|-----------------|
| 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.)  |

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  $e^+e^- \rightarrow \gamma X$   
<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.

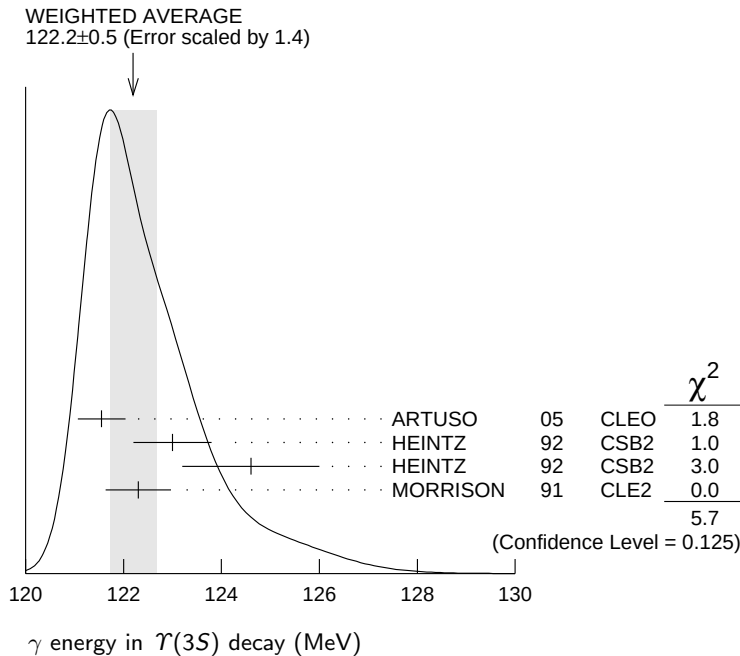
NODE=M079DM

NODE=M079DM  
 → UNCHECKED ←

OCCUR=2

NODE=M079DM;LINKAGE=A

NODE=M079DM;LINKAGE=B



### $\chi_{b0}(2P)$ DECAY MODES

| Mode                                      | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|-------------------------------------------|--------------------------------|------------------|
| $\Gamma_1$ $\gamma \Upsilon(2S)$          | (1.38 ± 0.30) %                |                  |
| $\Gamma_2$ $\gamma \Upsilon(1S)$          | (3.8 ± 1.7) × 10 <sup>-3</sup> |                  |
| $\Gamma_3$ $D^0 X$                        | < 8.2 %                        | 90%              |
| $\Gamma_4$ $\pi^+\pi^- K^+ K^- \pi^0$     | < 3.4 × 10 <sup>-5</sup>       | 90%              |
| $\Gamma_5$ $2\pi^+\pi^- K^- K_S^0$        | < 5 × 10 <sup>-5</sup>         | 90%              |
| $\Gamma_6$ $2\pi^+\pi^- K^- K_S^0 2\pi^0$ | < 2.2 × 10 <sup>-4</sup>       | 90%              |
| $\Gamma_7$ $2\pi^+ 2\pi^- 2\pi^0$         | < 2.4 × 10 <sup>-4</sup>       | 90%              |
| $\Gamma_8$ $2\pi^+ 2\pi^- K^+ K^-$        | < 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                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------|-----|-------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;0.34</b>          | 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                                                                                                                                                                                                                                                                                                                                              |
|--------------------------|-----|-------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;0.5</b>           | 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

$$\Gamma(2\pi^+\pi^-K^-K_S^02\pi^0)/\Gamma_{\text{total}}$$

 $\Gamma_6/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                                      |
|--------------------------|-----|-------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;2.2</b>           | 90  | 18 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+\pi^-K^-2\pi^0$<br>18 ASNER 08A reports $[\Gamma(\chi_{b0}(2P) \rightarrow 2\pi^+\pi^-K^-K_S^02\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b0}(2P))] < 13 \times 10^{-6}$ 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                                                                                                                                                                                                                                                                                                                                             |
|--------------------------|-----|-------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;2.4</b>           | 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                                                                                                                                                                                                                                                                                                                                            |
|--------------------------|-----|-------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;1.5</b>           | 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                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------|-----|-------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;2.2</b>           | 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                                                                                                                                                                                                                                                                                                                                                         |
|--------------------------|-----|-------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;11</b>            | 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                                                                                                                                                                                                                                                                                                                                                           |
|--------------------------|-----|-------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;7</b>             | 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                                                                                                                                                                                                                                                                                                                                |
|--------------------------|-----|-------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;0.7</b>           | 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  $B(\Upsilon(2S) \rightarrow \mu^+ \mu^-) = (1.44 \pm 0.10)\%$ .NODE=M079A03  
NODE=M079A03NODE=M079A03;LINKAGE=A  
NODE=M079A03;LINKAGE=B
$$[B(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(2S)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P))] / [B(\chi_{b1}(2P) \rightarrow \gamma \Upsilon(2S)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P))]$$

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.NODE=M079A01  
NODE=M079A01

NODE=M079A01;LINKAGE=A

 **$\chi_{b0}(2P)$  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.)    |

NODE=M079

REFID=56343  
REFID=53936  
REFID=52574  
REFID=52577  
REFID=50454  
REFID=43177  
REFID=43604  
REFID=41580  
REFID=41634  
REFID=41586

NODE=M080

 $\chi_{b1}(2P)$ 

$$J^G(J^{PC}) = 0^+(1^{++})$$

$J$  needs confirmation.

Observed in radiative decay of the  $\Upsilon(3S)$ , therefore  $C = +$ . Branching ratio requires E1 transition, M1 is strongly disfavored, therefore  $P = +$ .

NODE=M080

 **$\chi_{b1}(2P)$  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

NODE=M080M

NODE=M080M  
→ UNCHECKED ← **$m_{\chi_{b1}(2P)} - m_{\chi_{b0}(2P)}$** 

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.

NODE=M080M2

NODE=M080M2

NODE=M080M2;LINKAGE=A

 **$\gamma$  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=M080DM

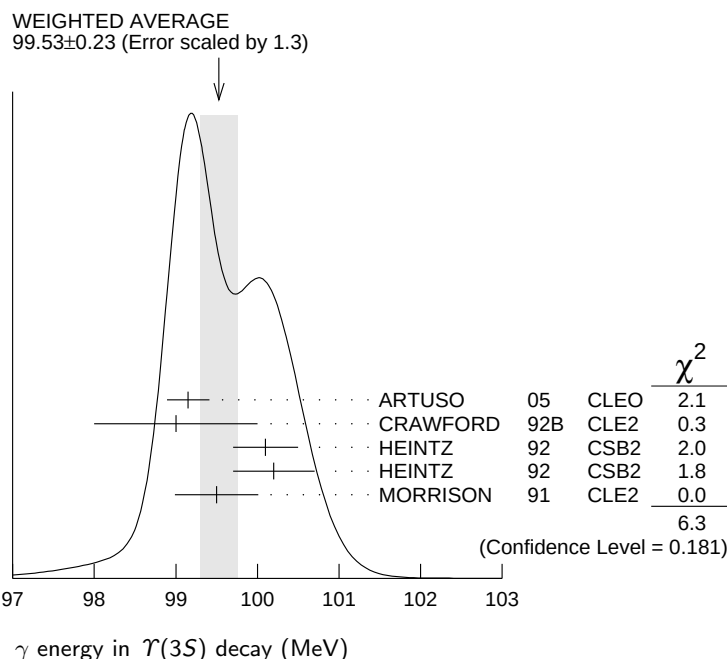
NODE=M080DM  
→ UNCHECKED ←

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 ( $\Gamma_i/\Gamma$ ) |          |
|-----------------------------------------------|--------------------------------|----------|
| $\Gamma_1 \quad \omega \chi(1S)$              | $(1.63^{+0.40}_{-0.34}) \%$    | DESIG=3  |
| $\Gamma_2 \quad \gamma \chi(2S)$              | $(18.1 \pm 1.9) \%$            | DESIG=2  |
| $\Gamma_3 \quad \gamma \chi(1S)$              | $(9.9 \pm 1.0) \%$             | 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  |
| $\Gamma_8 \quad 2\pi^+\pi^-K^-K_S^0 2\pi^0$   | $(7.7 \pm 3.2) \times 10^{-4}$ | 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

| $\Gamma(\omega \chi(1S))/\Gamma_{\text{total}}$    |                      |                             |      |                                             | $\Gamma_1/\Gamma$ |
|----------------------------------------------------|----------------------|-----------------------------|------|---------------------------------------------|-------------------|
| 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 | $\chi(3S) \rightarrow \gamma\omega\chi(1S)$ |                   |

NODE=M080R3  
NODE=M080R3

<sup>4</sup>Using  $B(\chi(3S) \rightarrow \gamma\chi_{b1}(2P)) = (11.3 \pm 0.6)\%$  and  $B(\chi(1S) \rightarrow \ell^+\ell^-) = 2$   
 $B(\chi(1S) \rightarrow \mu^+\mu^-) = 2 (2.48 \pm 0.06)\%$ .

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  
NODE=M080R2

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  
NODE=M080R1

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   | <sup>20</sup> ASNER | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma\pi^+\pi^-K^+K^-\pi^0$ |
| <sup>20</sup> 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   | <sup>21</sup> ASNER | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+\pi^-K^-K_S^0$ |
| <sup>21</sup> 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   | <sup>22</sup> ASNER | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+\pi^-K^-2\pi^0$ |
| <sup>22</sup> 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   | <sup>23</sup> ASNER | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+2\pi^-2\pi^0$ |
| <sup>23</sup> 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   | <sup>24</sup> ASNER | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-$ |
| <sup>24</sup> 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   | <sup>25</sup> ASNER | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-\pi^0$ |
| <sup>25</sup> 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   | <sup>26</sup> ASNER | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-2\pi^0$ |
| <sup>26</sup> 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   | <sup>27</sup> ASNER | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 3\pi^+2\pi^-K^-K_S^0\pi^0$ |
| <sup>27</sup> 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±0.4±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±4±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±0.7±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±2.1±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±0.6±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±7±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±0.3±0.6</b>      | 15k  | LEES        | 11J BABR | $\Upsilon(3S) \rightarrow X\gamma$ |

NODE=M080B01  
 NODE=M080B01

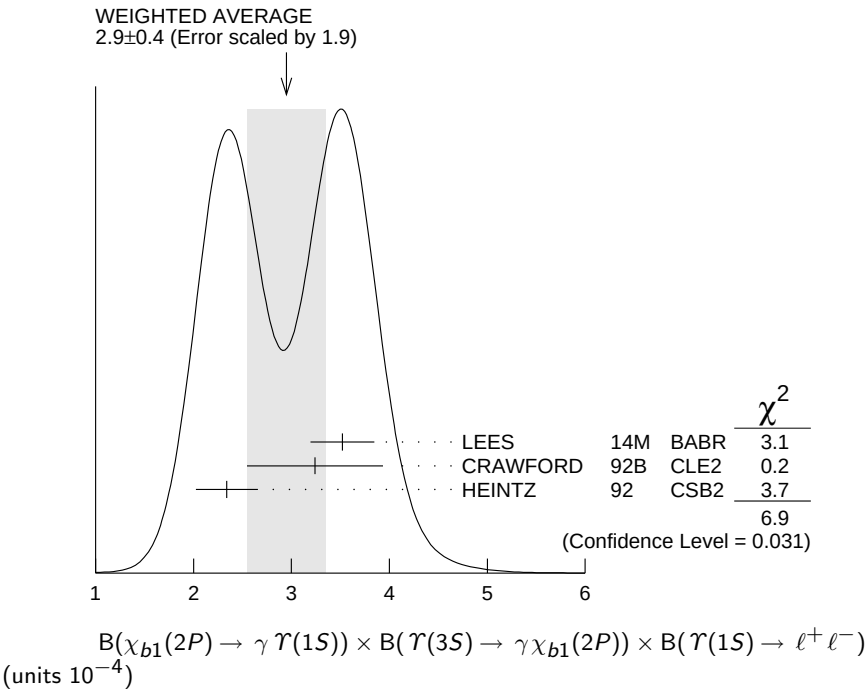
 $B(\chi_{b1}(2P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P)) \times B(\Upsilon(1S) \rightarrow \ell^+ \ell^-)$ 

NODE=M080A00  
 NODE=M080A00

| VALUE (units $10^{-4}$ )                         | EVTS                                                        | DOCUMENT ID | TECN     | COMMENT                                                |
|--------------------------------------------------|-------------------------------------------------------------|-------------|----------|--------------------------------------------------------|
| <b>2.9 ±0.4 OUR AVERAGE</b>                      | Error includes scale factor of 1.9. See the ideogram below. |             |          |                                                        |
| 3.52 <sup>+0.28+0.17</sup> <sub>-0.27-0.18</sub> |                                                             | 34 LEES     | 14M BABR | $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$   |
| 3.24±0.56±0.41                                   | 58                                                          | 35 CRAWFORD | 92B CLE2 | $\Upsilon(3S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |
| 2.34±0.28±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



$\Gamma(\chi_{b1}(2P) \rightarrow \gamma\Upsilon(2S)) / \Gamma_{\text{total}} \times \Gamma(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) / \Gamma_{\text{total}}$   
 $\Gamma_2 / \Gamma \times \Gamma_{21}^{\Upsilon(3S)} / \Gamma^{\Upsilon(3S)}$

NODE=M080B02  
NODE=M080B02

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                            |
|--------------------------|------|-------------|----------|------------------------------------|
| 2.4±0.1±0.2              | 4.3k | LEES        | 11J BABR | $\Upsilon(3S) \rightarrow X\gamma$ |

$B(\chi_{b1}(2P) \rightarrow \gamma\Upsilon(2S)) \times B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) \times B(\Upsilon(2S) \rightarrow \ell^+\ell^-)$

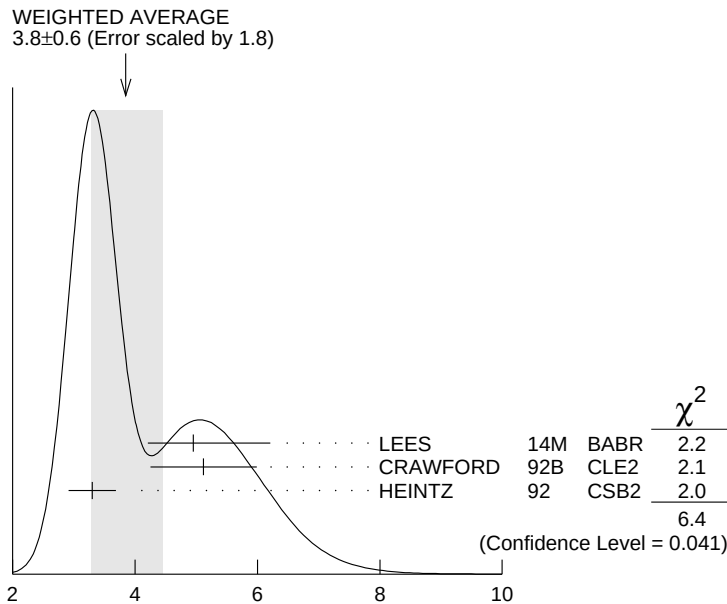
| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                                                     |
|--------------------------|------|-------------|------|-------------------------------------------------------------|
| 3.8 ±0.6                 |      | OUR AVERAGE |      | Error includes scale factor of 1.8. See the ideogram below. |

NODE=M080A01  
NODE=M080A01

|                                                    |     |    |          |     |      |                                                     |
|----------------------------------------------------|-----|----|----------|-----|------|-----------------------------------------------------|
| 4.95 <sup>+0.75</sup> <sub>-0.70</sub> ±1.01 ±0.24 |     | 37 | LEES     | 14M | BABR | $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$   |
| 5.12 ±0.60 ±0.63                                   | 111 | 38 | CRAWFORD | 92B | CLE2 | $\Upsilon(3S) \rightarrow \gamma\gamma\ell^+\ell^-$ |
| 3.30 ±0.33 ±0.20                                   |     | 39 | HEINTZ   | 92  | CSB2 | $\Upsilon(3S) \rightarrow \gamma\gamma\ell^+\ell^-$ |

- 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

NODE=M080

|               |     |               |                                  |                   |             |
|---------------|-----|---------------|----------------------------------|-------------------|-------------|
| LEES          | 14M | PR D90 112010 | J.P. Lees <i>et al.</i>          | (BABAR Collab.)   | REFID=56343 |
| LEES          | 11C | PR D84 011104 | J.P. Lees <i>et al.</i>          | (BABAR Collab.)   | REFID=16775 |
| LEES          | 11J | PR D84 072002 | J.P. Lees <i>et al.</i>          | (BABAR Collab.)   | REFID=53936 |
| ASNER         | 08A | PR D78 091103 | D.M. Asner <i>et al.</i>         | (CLEO Collab.)    | REFID=52574 |
| BRIERE        | 08  | PR D78 092007 | R.A. Briere <i>et al.</i>        | (CLEO Collab.)    | REFID=52577 |
| BRIERE        | 07  | PR D76 012005 | R.A. Briere <i>et al.</i>        | (CLEO Collab.)    | REFID=51887 |
| CAWLFIELD     | 06  | PR D73 012003 | C. Cawfield <i>et al.</i>        | (CLEO Collab.)    | REFID=50997 |
| ARTUSO        | 05  | PRL 94 032001 | M. Artuso <i>et al.</i>          | (CLEO Collab.)    | REFID=50454 |
| CRONIN-HEN... | 04  | PRL 92 222002 | D. Cronin-Hennessy <i>et al.</i> | (CLEO Collab.)    | REFID=49766 |
| CRAWFORD      | 92B | PL B294 139   | G. Crawford <i>et al.</i>        | (CLEO Collab.)    | REFID=43177 |
| HEINTZ        | 92  | PR D46 1928   | U. Heintz <i>et al.</i>          | (CUSB II Collab.) | REFID=43604 |
| HEINTZ        | 91  | PRL 66 1563   | U. Heintz <i>et al.</i>          | (CUSB Collab.)    | REFID=41580 |
| MORRISON      | 91  | PRL 67 1696   | R.J. Morrison <i>et al.</i>      | (CLEO Collab.)    | REFID=41634 |
| NARAIN        | 91  | PRL 66 3113   | M. Narain <i>et al.</i>          | (CUSB Collab.)    | REFID=41586 |

$$h_b(2P)$$

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

OMITTED FROM SUMMARY TABLE  
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 $\pm$ 0.22 $\pm$ 0.50 OUR EVALUATION** From  $\gamma$  energy below, using  $\Upsilon(3S)$  mass = 10355.2  $\pm$  0.5 MeV

NODE=M081M

NODE=M081M

→ UNCHECKED ←

 $m_{\chi_{b2}(2P)} - m_{\chi_{b1}(2P)}$ 

VALUE (MeV)

DOCUMENT ID

TECN

COMMENT

**13.10 $\pm$ 0.24 OUR AVERAGE**12.3  $\pm$ 2.6  $\pm$ 0.6<sup>1</sup> AAIJ

14BG LHCb

 $pp \rightarrow \gamma \mu^+ \mu^- X$ 13.04 $\pm$ 0.26

LEES

14M BABR

 $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$ 13.5  $\pm$ 0.4  $\pm$ 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 $\pm$ 0.22 OUR EVALUATION**

Treating systematic errors as correlated

**86.40 $\pm$ 0.18 OUR AVERAGE**86.04 $\pm$ 0.06 $\pm$ 0.27

ARTUSO

05

CLEO

 $\Upsilon(3S) \rightarrow \gamma X$ 86  $\pm$ 1

101

CRAWFORD

92B

CLE2

 $e^+ e^- \rightarrow \ell^+ \ell^- \gamma \gamma$ 86.7  $\pm$ 0.4

10319

<sup>3</sup> HEINTZ

92

CSB2

 $e^+ e^- \rightarrow \gamma X$ 86.9  $\pm$ 0.4

157

<sup>4</sup> HEINTZ

92

CSB2

 $e^+ e^- \rightarrow \ell^+ \ell^- \gamma \gamma$ 86.4  $\pm$ 0.1  $\pm$ 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 |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

|                                  |                      |                             |      |                                                       |
|----------------------------------|----------------------|-----------------------------|------|-------------------------------------------------------|
| $1.10^{+0.32+0.11}_{-0.28-0.10}$ | $20.1^{+5.8}_{-5.1}$ | <sup>5</sup> CRONIN-HEN..04 | CLE3 | $\Upsilon(3S) \rightarrow \gamma \omega \Upsilon(1S)$ |
|----------------------------------|----------------------|-----------------------------|------|-------------------------------------------------------|

<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  
NODE=M081R3

NODE=M081R3;LINKAGE=CR

 $\Gamma(\gamma \Upsilon(2S))/\Gamma_{\text{total}}$  $\Gamma_2/\Gamma$ 

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

**0.089±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 $e^+ e^- \rightarrow \ell^+ \ell^- \gamma \gamma$    |

<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.

<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.

<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.

<sup>10</sup> CRAWFORD 92B quotes  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P)) \times B(\chi_{b2}(2P) \rightarrow \gamma \Upsilon(2S)) \times 2$   
 $B(\Upsilon(2S) \rightarrow \ell^+ \ell^-) = (4.98 \pm 0.94 \pm 0.62) 10^{-4}$ .

<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  
NODE=M081R2

NODE=M081R2;LINKAGE=D

NODE=M081R2;LINKAGE=E  
NODE=M081R2;LINKAGE=F

NODE=M081R2;LINKAGE=LE

NODE=M081R2;LINKAGE=B

NODE=M081R2;LINKAGE=C

 $\Gamma(\gamma \Upsilon(1S))/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma$ 

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

**0.066±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 $e^+ e^- \rightarrow \ell^+ \ell^- \gamma \gamma$    |

<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.

<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.

<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.

<sup>16</sup> CRAWFORD 92B quotes  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) \times B(\chi_{b2}(2P) \rightarrow \gamma \Upsilon(1S)) \times 2$   
 $B(\Upsilon(1S) \rightarrow \ell^+ \ell^-) = (5.03 \pm 0.94 \pm 0.63) 10^{-4}$ .

<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  
NODE=M081R1

NODE=M081R1;LINKAGE=D

NODE=M081R1;LINKAGE=E  
NODE=M081R1;LINKAGE=F

NODE=M081R1;LINKAGE=LE

NODE=M081R1;LINKAGE=B

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±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  | $\Upsilon(3S) \rightarrow \gamma\gamma\ell^+\ell^-$ |

<sup>36</sup> From a sample of  $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$  with converted photons.

<sup>37</sup> CRAWFORD 92B quotes  $2 \times B(\Upsilon(3S) \rightarrow \gamma\chi_{bJ}(2P)) B(\chi_{bJ}(2P) \rightarrow \gamma\Upsilon(nS))$   
 $B(\Upsilon(nS) \rightarrow \ell^+\ell^-)$ .

<sup>38</sup> 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 | $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$ |

<sup>39</sup> 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  | $\Upsilon(3S) \rightarrow \gamma\gamma\ell^+\ell^-$ |

<sup>40</sup> From a sample of  $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$  with converted photons.

<sup>41</sup> CRAWFORD 92B quotes  $2 \times B(\Upsilon(3S) \rightarrow \gamma\chi_{bJ}(2P)) B(\chi_{bJ}(2P) \rightarrow \gamma\Upsilon(nS))$   
 $B(\Upsilon(nS) \rightarrow \ell^+\ell^-)$ .

<sup>42</sup> 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 | $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$ |

<sup>43</sup> 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.)    |
| 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-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

**$\Upsilon(3S)$** 

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

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 ) %                  |                                   |
| $\Gamma_{18}$ $\gamma gg$                                      | ( 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=5

DESIG=6

DESIG=7

DESIG=103

DESIG=104

DESIG=13

DESIG=14

DESIG=15

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 | $e^+e^- \rightarrow \gamma\pi^+\pi^-\ell^+\ell^-$ |

<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  
NODE=M048G01

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.

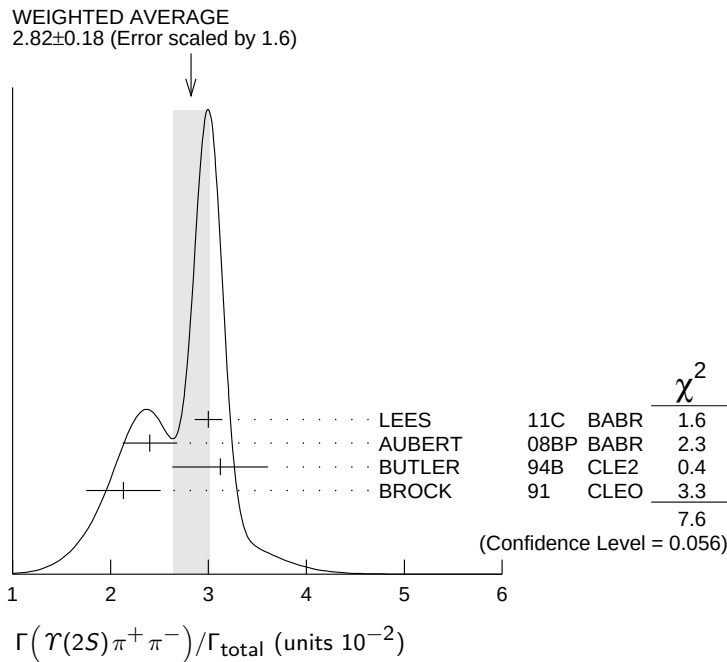
NODE=M048R;LINKAGE=M

<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



### $\Gamma(\Upsilon(2S)\pi^0\pi^0)/\Gamma_{\text{total}}$

| VALUE (units 10 <sup>-2</sup> )                                                                                                    | EVTS | DOCUMENT ID             | TECN     | COMMENT                                     | $\Gamma_3/\Gamma$ |
|------------------------------------------------------------------------------------------------------------------------------------|------|-------------------------|----------|---------------------------------------------|-------------------|
| <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

### $\Gamma(\Upsilon(2S)\gamma\gamma)/\Gamma_{\text{total}}$

| VALUE                                  | DOCUMENT ID          | TECN     | COMMENT                                  | $\Gamma_4/\Gamma$ |
|----------------------------------------|----------------------|----------|------------------------------------------|-------------------|
| <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

### $\Gamma(\Upsilon(2S)\pi^0)/\Gamma_{\text{total}}$

| VALUE (units 10 <sup>-3</sup> )                                                                                       | CL% | DOCUMENT ID      | TECN     | COMMENT                                       | $\Gamma_5/\Gamma$ |
|-----------------------------------------------------------------------------------------------------------------------|-----|------------------|----------|-----------------------------------------------|-------------------|
| <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

### $\Gamma(\Upsilon(1S)\pi^+\pi^-)/\Gamma_{\text{total}}$

Abbreviation MM in the COMMENT field below stands for missing mass.

| VALUE (units 10 <sup>-2</sup> ) | EVTS  | DOCUMENT ID          | TECN      | COMMENT                                                       | $\Gamma_6/\Gamma$ |
|---------------------------------|-------|----------------------|-----------|---------------------------------------------------------------|-------------------|
| <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

 $\Gamma(\tau^+\tau^-)/\Gamma(\mu^+\mu^-)$ 

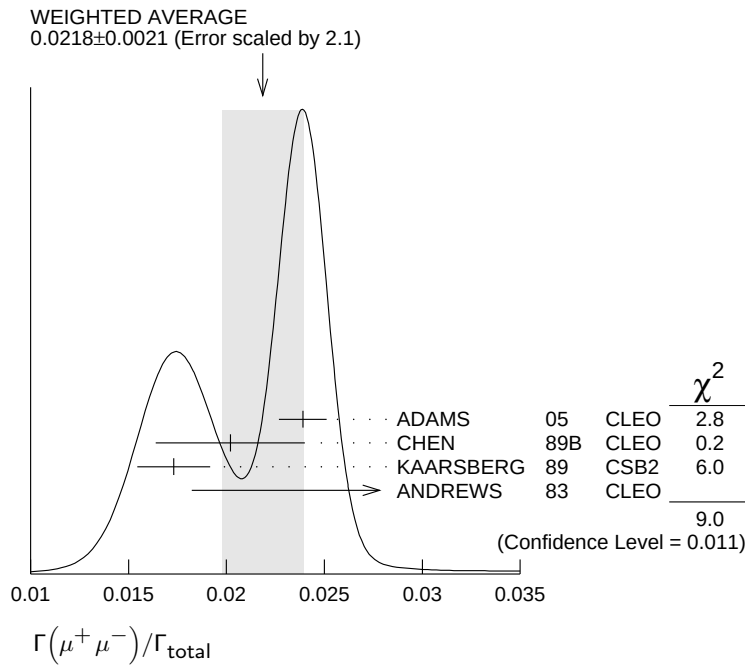
| VALUE                 | EVTS | DOCUMENT ID | TECN    | COMMENT                           |
|-----------------------|------|-------------|---------|-----------------------------------|
| <b>1.05±0.08±0.05</b> | 15k  | BESSON      | 07 CLEO | $e^+e^- \rightarrow \Upsilon(3S)$ |

NODE=M048R19  
 NODE=M048R19

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

| 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

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

| 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  $B(\Upsilon(2S) \rightarrow \text{anything}) = (10.6 \pm 0.8)\%$ ,  $B(\pi^+\pi^-\Upsilon(1S)) = (4.40 \pm 0.10)\%$ ,  $B(\pi^0\pi^0\Upsilon(1S)) = (2.20 \pm 0.13)\%$ ,  $B(\gamma\chi_{b2}(2P)) = (13.1 \pm 1.6)\%$ ,  $B(\gamma\chi_{b1}(2P)) = (12.6 \pm 1.2)\%$ ,  $B(\gamma\chi_{b0}(2P)) = (5.9 \pm 0.6)\%$ ,  $B(\gamma\chi_{b0}(1P)) = (0.30 \pm 0.11)\%$ ,  $B(\mu^+\mu^-) = (2.18 \pm 0.21)\%$ , 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><math>0.97 \pm 0.18</math></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><math>2.72 \pm 0.06 \pm 0.49</math></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><math>2.33 \pm 0.15^{+0.31}_{-0.28}</math></b> | LEES        | 14G BABR | $e^+e^- \rightarrow \overline{2H} X$ |

 $\Gamma_{19}/\Gamma$ 

NODE=M048R00  
NODE=M048R00

 $\Gamma(\gamma \chi_{b2}(2P))/\Gamma_{\text{total}}$ 

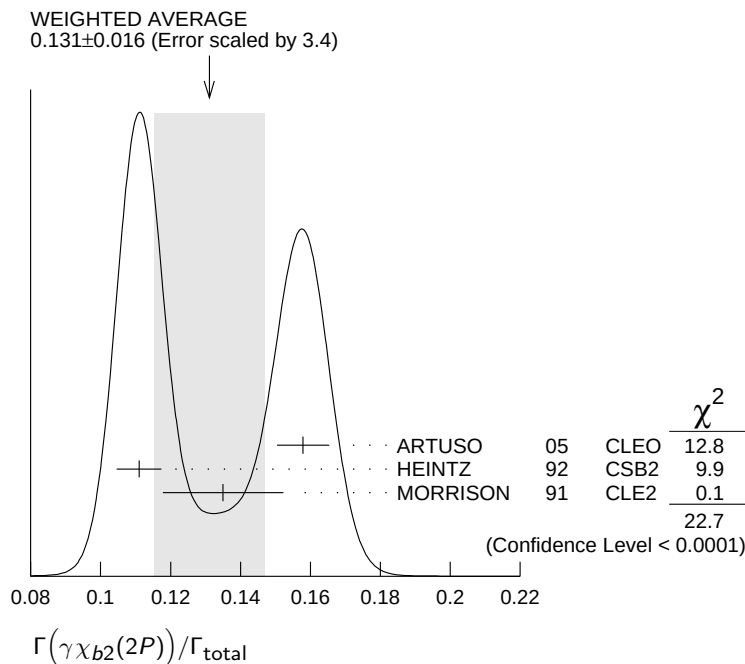
| VALUE                                           | EVTS  | DOCUMENT ID                                                 | TECN    | COMMENT                       |
|-------------------------------------------------|-------|-------------------------------------------------------------|---------|-------------------------------|
| <b><math>0.131 \pm 0.016</math> OUR AVERAGE</b> |       | Error includes scale factor of 3.4. See the ideogram below. |         |                               |
| $0.1579 \pm 0.0017 \pm 0.0073$                  | 568k  | ARTUSO                                                      | 05 CLEO | $e^+e^- \rightarrow \gamma X$ |
| $0.111 \pm 0.005 \pm 0.004$                     | 10319 | <sup>40</sup> HEINTZ                                        | 92 CSB2 | $e^+e^- \rightarrow \gamma X$ |
| $0.135 \pm 0.003 \pm 0.017$                     | 30741 | MORRISON                                                    | 91 CLE2 | $e^+e^- \rightarrow \gamma X$ |

<sup>40</sup> Supersedes NARAIN 91.

 $\Gamma_{20}/\Gamma$ 

NODE=M048R5  
NODE=M048R5

NODE=M048R;LINKAGE=H

 $\Gamma(\gamma \chi_{b1}(2P))/\Gamma_{\text{total}}$ 

| VALUE                                           | EVTS  | DOCUMENT ID                                                 | TECN    | COMMENT                       |
|-------------------------------------------------|-------|-------------------------------------------------------------|---------|-------------------------------|
| <b><math>0.126 \pm 0.012</math> OUR AVERAGE</b> |       | Error includes scale factor of 2.4. See the ideogram below. |         |                               |
| $0.1454 \pm 0.0018 \pm 0.0073$                  | 537k  | ARTUSO                                                      | 05 CLEO | $e^+e^- \rightarrow \gamma X$ |
| $0.115 \pm 0.005 \pm 0.005$                     | 11147 | <sup>41</sup> HEINTZ                                        | 92 CSB2 | $e^+e^- \rightarrow \gamma X$ |
| $0.105^{+0.003}_{-0.002} \pm 0.013$             | 25759 | MORRISON                                                    | 91 CLE2 | $e^+e^- \rightarrow \gamma X$ |

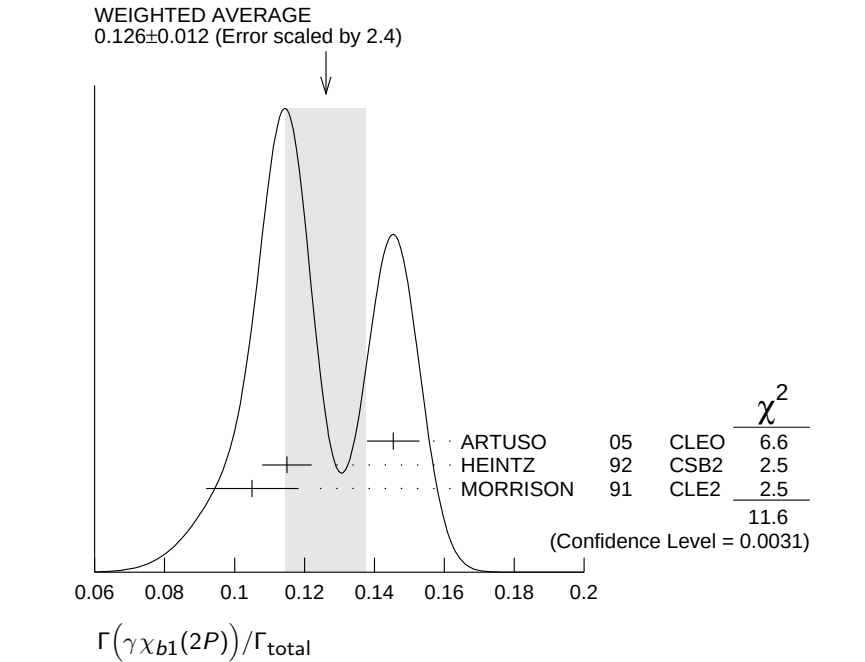
<sup>41</sup> Supersedes NARAIN 91.

 $\Gamma_{21}/\Gamma$ 

NODE=M048R6  
NODE=M048R6

NODE=M048R6;LINKAGE=H



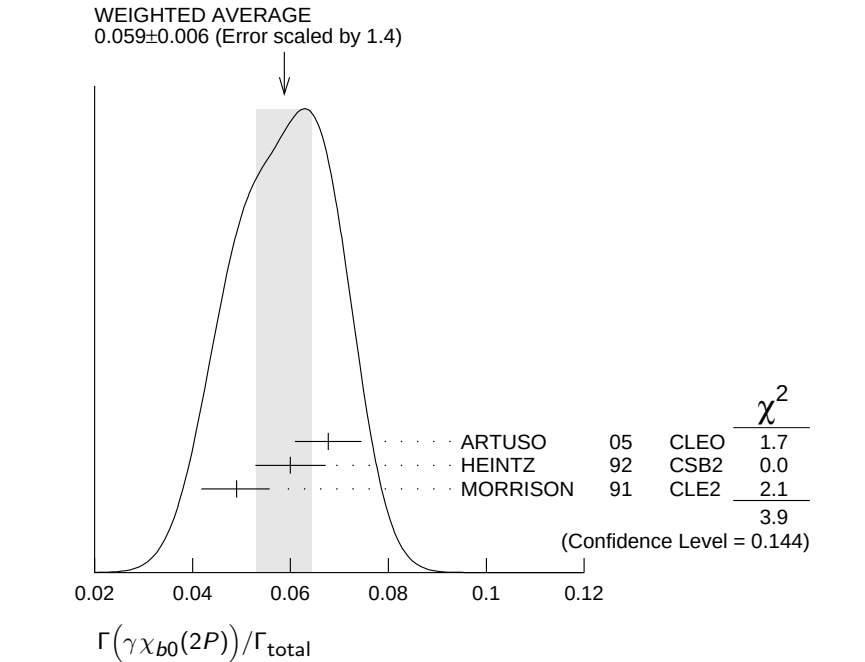


| $\Gamma(\gamma\chi_{b0}(2P))/\Gamma_{\text{total}}$ |      |             |      |         | $\Gamma_{22}/\Gamma$                                        |  |
|-----------------------------------------------------|------|-------------|------|---------|-------------------------------------------------------------|--|
| 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 | 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. |      | $[(9.9 \pm 1.2) \times 10^{-3}]$ |                                                    |
| OUR 2018 AVERAGE Scale factor = 1.9]                                          |      |                  |                                     |      |                                  |                                                    |
| 8.0±1.3±0.4                                                                   | 126  | <sup>43,44</sup> | KORNICER                            | 11   | CLEO                             | $e^+e^- \rightarrow \gamma\gamma\ell^+\ell^-$      |
| 10.5±0.3 <sup>+0.7</sup> <sub>-0.6</sub>                                      | 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

NEW

<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.

<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  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) = 6.9 \times 10^{-2}$ .

<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=KA

NODE=M048R22;LINKAGE=KR

NODE=M048R22;LINKAGE=AS

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% | EVTs | 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) $\Gamma_{28}/\Gamma$ 

| 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

 NODE=M048R02  
 NODE=M048R02

NODE=M048R02;LINKAGE=LE

 $\Gamma(\gamma X \rightarrow \gamma + \geq 4 \text{ prongs})/\Gamma_{\text{total}}$ (1.5 GeV <  $m_X$  < 5.0 GeV) $\Gamma_{29}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                       |
|--------------------------|-----|-------------|----------|-------------------------------|
| $< 2.2$                  | 95  | ROSNER      | 07A CLEO | $e^+e^- \rightarrow \gamma X$ |

NODE=M048R20

 NODE=M048R20  
 NODE=M048R20
 $\Gamma(\gamma a_1^0 \rightarrow \gamma \mu^+ \mu^-)/\Gamma_{\text{total}}$  $\Gamma_{30}/\Gamma$ 

| 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  
 NODE=M048R04

NODE=M048R04;LINKAGE=AU

 $\Gamma(\gamma a_1^0 \rightarrow \gamma \tau^+ \tau^-)/\Gamma_{\text{total}}$  $\Gamma_{31}/\Gamma$ 

| 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  
 NODE=M048R29

NODE=M048R29;LINKAGE=AU

## LEPTON FAMILY NUMBER (LF) VIOLATING MODES

 $\Gamma(e^\pm \tau^\mp)/\Gamma_{\text{total}}$  $\Gamma_{32}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                             |
|--------------------------|-----|-------------|----------|-------------------------------------|
| $< 4.2$                  | 90  | LEES        | 10B BABR | $e^+e^- \rightarrow e^\pm \tau^\mp$ |

NODE=M048230

 NODE=M048R01  
 NODE=M048R01
 $\Gamma(\mu^\pm \tau^\mp)/\Gamma_{\text{total}}$  $\Gamma_{33}/\Gamma$ 

| 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 | $e^+e^- \rightarrow \mu^\pm \tau^\mp$ |
|----------|----|------|----------|---------------------------------------|

 NODE=M048R23  
 NODE=M048R23
 $\Upsilon(3S)$  REFERENCES

NODE=M048

|           |      |                |                              |                 |
|-----------|------|----------------|------------------------------|-----------------|
| LEES      | 14G  | PR D89 111102  | J.P. Lees <i>et al.</i>      | (BABAR Collab.) |
| GE        | 11   | PR D84 032008  | J.Y. Ge <i>et al.</i>        | (CLEO Collab.)  |
| KORNICER  | 11   | PR D83 054003  | M. Kornicer <i>et al.</i>    | (CLEO Collab.)  |
| LEES      | 11C  | PR D84 011104  | J.P. Lees <i>et al.</i>      | (BABAR Collab.) |
| LEES      | 11H  | PRL 107 221803 | J.P. Lees <i>et al.</i>      | (BABAR Collab.) |
| LEES      | 11J  | PR D84 072002  | J.P. Lees <i>et al.</i>      | (BABAR Collab.) |
| LEES      | 11K  | PR D84 091101  | J.P. Lees <i>et al.</i>      | (BABAR Collab.) |
| LEES      | 11L  | PR D84 092003  | J.P. Lees <i>et al.</i>      | (BABAR Collab.) |
| BONVICINI | 10   | PR D81 031104  | G. Bonvicini <i>et al.</i>   | (CLEO Collab.)  |
| LEES      | 10B  | PRL 104 151802 | J.P. Lees <i>et al.</i>      | (BABAR 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.) |
| BHARI     | 09   | PR D79 011103  | S.R. Bhari <i>et al.</i>     | (CLEO Collab.)  |
| ASNER     | 08A  | PR D78 091103  | D.M. Asner <i>et al.</i>     | (CLEO Collab.)  |
| AUBERT    | 08BP | PR D78 112002  | B. Aubert <i>et al.</i>      | (BABAR Collab.) |
| AUBERT    | 08V  | PRL 101 071801 | B. Aubert <i>et al.</i>      | (BABAR Collab.) |
| HE        | 08A  | PRL 101 192001 | Q. He <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.)   |
| BESSON    | 07   | PRL 98 052002  | D. Besson <i>et al.</i>      | (CLEO Collab.)  |
| ROSNER    | 07A  | PR D76 117102  | J.L. Rosner <i>et al.</i>    | (CLEO Collab.)  |
| BESSON    | 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.)  |
| ARTUSO    | 05   | PRL 94 032001  | M. Artuso <i>et al.</i>      | (CLEO Collab.)  |
| ARTAMONOV | 00   | PL B474 427    | A.S. Artamonov <i>et al.</i> |                 |

 REFID=55939  
 REFID=53960  
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|                                                             |     |                         |                              |                    |
|-------------------------------------------------------------|-----|-------------------------|------------------------------|--------------------|
| 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.)     |
| BUCHMUEL...                                                 | 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=43799  
REFID=43313  
REFID=43604  
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REFID=41580  
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REFID=11616  
REFID=22338  
REFID=40033

REFID=22278  
REFID=22280  
REFID=22273  
REFID=22321  
REFID=22359

NODE=M206

$\chi_{b1}(3P)$

$$I^G(J^{PC}) = 0^+(1^{++})$$

Observed in the radiative decay to  $\Upsilon(1S, 2S, 3S)$ , therefore  $C = +$ .  
 $J$  needs confirmation.

NODE=M206

### $\chi_{b1}(3P)$ MASS

NODE=M206M

| VALUE (MeV)                                                                                                       | EVTS | DOCUMENT ID                          | TECN      | COMMENT                                     |
|-------------------------------------------------------------------------------------------------------------------|------|--------------------------------------|-----------|---------------------------------------------|
| <b>10513.4 ± 0.7 OUR AVERAGE</b>                                                                                  |      | [10512.1 ± 2.3 MeV OUR 2018 AVERAGE] |           |                                             |
| <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 $\begin{smallmatrix} +2.2 \\ -3.9 \end{smallmatrix}$ $\begin{smallmatrix} +1.5 \\ -2.1 \end{smallmatrix}$ | 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

NEW

OCCUR=2

<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.

NODE=M206M;LINKAGE=D

<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  $\chi_{b1}(3P)$ .

NODE=M206M;LINKAGE=A

<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.

NODE=M206M;LINKAGE=B

<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.

NODE=M206M;LINKAGE=C

<sup>5</sup> The mass barycenter of the merged lineshapes from the  $J = 1$  and 2 states.

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

| $\Gamma(\Upsilon(1S)\gamma)/\Gamma_{\text{total}}$                            | 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

$\Gamma(\Upsilon(2S)\gamma)/\Gamma_{\text{total}}$ 

| VALUE | EVTS | DOCUMENT ID       | TECN      | COMMENT                               |
|-------|------|-------------------|-----------|---------------------------------------|
| seen  | 169  | <sup>1</sup> AAIJ | 14BG LHCb | $pp \rightarrow \gamma \mu^+ \mu^- X$ |
| 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

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

| 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

$$\chi_{b2}(3P)$$

$$J^{PC} = 0^+(2^{++})$$

Observed in the radiative decay to  $\Upsilon(3S)$ , therefore  $C = +$ .  $J$  needs confirmation.

NODE=M238

NODE=M238

 $\chi_{b2}(3P)$  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 | $pp \rightarrow \gamma \mu^+ \mu^- X$ |

<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.

NODE=M238M

NODE=M238M

NODE=M238M;LINKAGE=A

 $\chi_{b2}(3P)$  DECAY MODES

| Mode                                | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------------|--------------------------------|
| $\Gamma_1 \quad \Upsilon(3S)\gamma$ | seen                           |

NODE=M238215;NODE=M238

DESIG=1

 $\chi_{b2}(3P)$  BRANCHING RATIOS

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

| 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.) |
|----------|-----|----------------|-----------------------------|---------------|

NODE=M238

REFID=58873

$\Upsilon(4S)$ 

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

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 | $e^+e^- \rightarrow$ hadrons |
| 10580.0±3.5                                                                   | <sup>1</sup> BEBEK    | 87 CLEO  | $e^+e^- \rightarrow$ hadrons |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                       |          |                              |
| 10577.4±1.0                                                                   | <sup>2</sup> LOVELOCK | 85 CUSB  | $e^+e^- \rightarrow$ 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 | $e^+e^- \rightarrow$ hadrons |
| 20 ±2 ±4                                                                      | BESSON      | 85 CLEO  | $e^+e^- \rightarrow$ hadrons |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |          |                              |
| 25 ±2.5                                                                       | LOVELOCK    | 85 CUSB  | $e^+e^- \rightarrow$ 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) %                   |                  |
| $\Gamma_3$ $D^+_S$ anything + 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%              |
| $\Gamma_{10}$ $J/\psi(1S)$ anything                | < 1.9 × 10 <sup>-4</sup>        | 95%              |
| $\Gamma_{11}$ $D^{*+}$ anything + c.c.             | < 7.4 %                         | 90%              |
| $\Gamma_{12}$ $\phi$ 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%              |
| $\Gamma_{17}$ $\Upsilon(1S)$ 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> |                  |
| $\Gamma_{24}$ $^2H$ 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=14

**Double Radiative Decays**

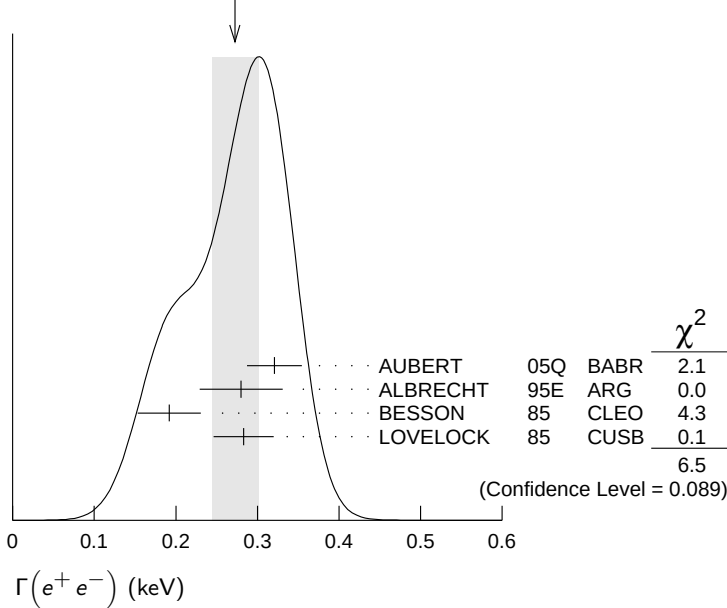
|                                                                                  |                          |     |
|----------------------------------------------------------------------------------|--------------------------|-----|
| $\Gamma_{25}$ $\gamma\gamma\Upsilon(D) \rightarrow \gamma\gamma\eta\Upsilon(1S)$ | < 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<math>\pm</math>0.029 OUR AVERAGE</b> | Error includes scale factor of 1.5. See the ideogram below. |          |                                     |
| 0.321 $\pm$ 0.017 $\pm$ 0.029                 | AUBERT                                                      | 05Q BABR | $e^+e^- \rightarrow \text{hadrons}$ |
| 0.28 $\pm$ 0.05 $\pm$ 0.01                    | <sup>1</sup> ALBRECHT                                       | 95E ARG  | $e^+e^- \rightarrow \text{hadrons}$ |
| 0.192 $\pm$ 0.007 $\pm$ 0.038                 | BESSON                                                      | 85 CLEO  | $e^+e^- \rightarrow \text{hadrons}$ |
| 0.283 $\pm$ 0.037                             | LOVELOCK                                                    | 85 CUSB  | $e^+e^- \rightarrow \text{hadrons}$ |

<sup>1</sup> Using LEYAOUANC 77 parametrization of  $\Gamma(s)$ .WEIGHTED AVERAGE  
0.272 $\pm$ 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 <http://www.slac.stanford.edu/xorg/hflav/>. 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<math>\pm</math>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<math>\pm</math>0.021<math>\pm</math>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 intermediate 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 intermediate 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 intermediate 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   | $e^+e^-$                                          |

NODE=M047R7  
NODE=M047R7

NODE=M047R7;LINKAGE=SK

<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  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.05)\%$ .

NODE=M047R7;LINKAGE=UB

<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.

NODE=M047R7;LINKAGE=SO

<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;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  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.05)\%$ .

NODE=M047R18;LINKAGE=UB

<sup>2</sup> Using  $B(\eta \rightarrow 2\gamma) = (39.41 \pm 0.20)\%$ .

NODE=M047R18;LINKAGE=A

### $\Gamma(\Upsilon(1S)\eta')/\Gamma_{\text{total}}$ $\Gamma_{20}/\Gamma$

| VALUE (units $10^{-5}$ )  | 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±0.40±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 <sup>-5</sup> ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-----|------|-------------|------|---------|
|---------------------------------|-----|------|-------------|------|---------|

**8.2±0.8 OUR AVERAGE**7.9±1.0±0.4 181 GUIDO 17 BELL  $\Upsilon(4S) \rightarrow \pi^+\pi^-\mu^+\mu^-$ 8.6±1.1±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±1.7±0.8 97 ± 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±0.16±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 <sup>-3</sup> ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|------|-------------|------|---------|
|---------------------------------|------|-------------|------|---------|

**2.18±0.11±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

 $\Gamma(\overline{2H} \text{ anything})/\Gamma_{\text{total}}$  $\Gamma_{24}/\Gamma$ 

| VALUE (units 10 <sup>-5</sup> ) | CL% | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-----|-------------|------|---------|
|---------------------------------|-----|-------------|------|---------|

<1.3 90 ASNER 07 CLEO  $e^+e^- \rightarrow \bar{d}X$ 

## Double Radiative Decays

NODE=M047240

 $\Gamma(\gamma\gamma\Upsilon(D) \rightarrow \gamma\gamma\eta\Upsilon(1S))/\Gamma_{\text{total}}$  $\Gamma_{25}/\Gamma$ 

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

<2.3 × 10<sup>-5</sup> 90 GUIDO 17 BELL  $\Upsilon(4S) \rightarrow \gamma\gamma\pi^+\pi^-\pi^0\mu^+\mu^-$ NODE=M047R24  
NODE=M047R24 $\Upsilon(4S)$  REFERENCES

NODE=M047

|           |      |                |                          |                 |             |
|-----------|------|----------------|--------------------------|-----------------|-------------|
| GUIDO     | 18   | PRL 121 062001 | E. Guido <i>et al.</i>   | (BELLE Collab.) | REFID=58860 |
| GUIDO     | 17   | PR D96 052005  | E. Guido <i>et al.</i>   | (BELLE Collab.) | REFID=58218 |
| TAMPONI   | 15   | PRL 115 142001 | U. Tamponi <i>et al.</i> | (BELLE Collab.) | REFID=56996 |
| SHEN      | 13A  | PR D88 052019  | C.P. Shen <i>et al.</i>  | (BELLE Collab.) | REFID=55591 |
| ADACHI    | 12   | PRL 108 032001 | I. Adachi <i>et al.</i>  | (BELLE Collab.) | REFID=53962 |
| BELOUS    | 09   | PL B681 400    | K. Belous <i>et al.</i>  | (BELLE Collab.) | REFID=53107 |
| SOKOLOV   | 09   | PR D79 051103  | A. Sokolov <i>et al.</i> | (BELLE Collab.) | REFID=52760 |
| AUBERT    | 08BO | PR D78 071103  | B. Aubert <i>et al.</i>  | (BABAR Collab.) | REFID=52659 |
| AUBERT    | 08BP | PR D78 112002  | B. Aubert <i>et al.</i>  | (BABAR Collab.) | REFID=52660 |
| 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 |
| HUANG     | 07   | PR D75 012002  | G.S. Huang <i>et al.</i> | (CLEO Collab.)  | REFID=51624 |
| SOKOLOV   | 07   | PR D75 071103  | A. Sokolov <i>et al.</i> | (BELLE Collab.) | REFID=51715 |
| TAJIMA    | 07A  | PRL 99 211601  | O. Tajima <i>et al.</i>  | (BELLE Collab.) | REFID=52066 |
| AUBERT    | 06R  | PRL 96 232001  | B. Aubert <i>et al.</i>  | (BABAR Collab.) | REFID=51143 |
| AUBERT,BE | 06F  | PR D74 111103  | B. Aubert <i>et al.</i>  | (BABAR Collab.) | REFID=51563 |
| ARTUSO    | 05B  | PRL 95 261801  | M. Artuso <i>et al.</i>  | (CLEO Collab.)  | REFID=50992 |
| AUBERT    | 05Q  | PR D72 032005  | B. Aubert <i>et al.</i>  | (BABAR Collab.) | REFID=50774 |

|           |     |               |                               |                 |
|-----------|-----|---------------|-------------------------------|-----------------|
| 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.)  |
| 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> | (CUSB Collab.)  |
| LEYAOUANC | 77  | PL B71 397    | A. Le Yaouanc <i>et al.</i>   | (ORSAY)         |

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

NODE=M207

**$Z_b(10610)$**

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

was  $X(10610)$

Properties incompatible with a  $q\bar{q}$  structure (exotic state). See the review on non- $q\bar{q}$  states.

NODE=M207

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. Isospin = 1 is favored due to observation by KROKOVNY 13 of a corresponding neutral state produced in  $\Upsilon(10860) \rightarrow \Upsilon(2S)/\Upsilon(3S)\pi^0\pi^0$  decays at a consistent mass.

### $Z_b(10610)^\pm$ MASS

NODE=M207M

| VALUE (MeV)                                                                   | DOCUMENT ID          | TECN | COMMENT                                          |
|-------------------------------------------------------------------------------|----------------------|------|--------------------------------------------------|
| <b>10607.2<math>\pm</math>2.0</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 $\pm 2 \pm 3$                                                           | <sup>3</sup> BONDAR  | 12   | BELL $e^+e^- \rightarrow h_b(1P)\pi^+\pi^-$      |
| 10599 $^{+6}_{-3} \pm 4$                                                      | <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.

### $Z_b(10610)^0$ MASS

NODE=M207M;LINKAGE=BO  
NODE=M207M;LINKAGE=A  
NODE=M207M;LINKAGE=BN  
NODE=M207M0

| VALUE (MeV)                                    | DOCUMENT ID           | TECN | COMMENT                                                       |
|------------------------------------------------|-----------------------|------|---------------------------------------------------------------|
| <b>10609<math>\pm</math>4<math>\pm</math>4</b> | <sup>1</sup> KROKOVNY | 13   | BELL $e^+e^- \rightarrow \Upsilon(2S)/\Upsilon(3S)\pi^0\pi^0$ |

NODE=M207M0

<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;LINKAGE=A

### $Z_b(10610)^\pm$ WIDTH

NODE=M207W

| VALUE (MeV)                     | DOCUMENT ID         | TECN | COMMENT                                  |
|---------------------------------|---------------------|------|------------------------------------------|
| <b>18.4<math>\pm</math> 2.4</b> | <sup>1</sup> BONDAR | 12   | BELL $e^+e^- \rightarrow \text{hadrons}$ |

NODE=M207W

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

|                              |              |    |      |                                             |         |
|------------------------------|--------------|----|------|---------------------------------------------|---------|
| $18.5 \pm 5.3^{+6.1}_{-2.3}$ | $^2$ GARMASH | 15 | BELL | $e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$ |         |
| $20.8 \pm 2.5^{+0.3}_{-2.1}$ | $^2$ GARMASH | 15 | BELL | $e^+e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$ | OCCUR=2 |
| $18.7 \pm 3.4^{+2.5}_{-1.3}$ | $^2$ GARMASH | 15 | BELL | $e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$ | OCCUR=3 |
| $22.3 \pm 7.7^{+3.0}_{-4.0}$ | $^3$ BONDAR  | 12 | BELL | $e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$ | OCCUR=2 |
| $24.2 \pm 3.1^{+2.0}_{-3.0}$ | $^3$ BONDAR  | 12 | BELL | $e^+e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$ | OCCUR=3 |
| $17.6 \pm 3.0 \pm 3.0$       | $^3$ BONDAR  | 12 | BELL | $e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$ | OCCUR=4 |
| $11.4^{+4.5+2.1}_{-3.9-1.2}$ | $^3$ BONDAR  | 12 | BELL | $e^+e^- \rightarrow h_b(1P)\pi^+\pi^-$      | OCCUR=5 |
| $13^{+10+9}_{-8-7}$          | $^3$ BONDAR  | 12 | BELL | $e^+e^- \rightarrow h_b(2P)\pi^+\pi^-$      | 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

NODE=M207215;NODE=M207

| Mode                                                  | Fraction ( $\Gamma_i/\Gamma$ )       |          |
|-------------------------------------------------------|--------------------------------------|----------|
| $\Gamma_1 \quad \Upsilon(1S)\pi^+$                    | $(5.4^{+1.9}_{-1.5}) \times 10^{-3}$ | DESIG=1  |
| $\Gamma_2 \quad \Upsilon(1S)\pi^0$                    | not seen                             | DESIG=9  |
| $\Gamma_3 \quad \Upsilon(2S)\pi^+$                    | $(3.6^{+1.1}_{-0.8}) \%$             | DESIG=2  |
| $\Gamma_4 \quad \Upsilon(2S)\pi^0$                    | seen                                 | DESIG=10 |
| $\Gamma_5 \quad \Upsilon(3S)\pi^+$                    | $(2.1^{+0.8}_{-0.6}) \%$             | DESIG=3  |
| $\Gamma_6 \quad \Upsilon(3S)\pi^0$                    | seen                                 | DESIG=11 |
| $\Gamma_7 \quad h_b(1P)\pi^+$                         | $(3.5^{+1.2}_{-0.9}) \%$             | DESIG=4  |
| $\Gamma_8 \quad h_b(2P)\pi^+$                         | $(4.7^{+1.7}_{-1.3}) \%$             | DESIG=5  |
| $\Gamma_9 \quad B^+\bar{B}^0$                         | not seen                             | DESIG=8  |
| $\Gamma_{10} \quad B^+\bar{B}^{*0} + B^{*+}\bar{B}^0$ | $(85.6^{+2.1}_{-2.9}) \%$            | DESIG=6  |
| $\Gamma_{11} \quad B^{*+}\bar{B}^{*0}$                | not seen                             | DESIG=7  |

### $Z_b(10610)$ BRANCHING RATIOS

NODE=M207225

$\Gamma(\Upsilon(1S)\pi^+)/\Gamma_{\text{total}}$

$\Gamma_1/\Gamma$

| 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 | $e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$ |

<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;LINKAGE=A

$\Gamma(\Upsilon(2S)\pi^0)/\Gamma_{\text{total}}$  $\Gamma_4/\Gamma$ 

| VALUE       | DOCUMENT ID              | TECN | COMMENT                                     |
|-------------|--------------------------|------|---------------------------------------------|
| <b>seen</b> | <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                                                             |
|-------------------------------------------------------|-------------------------|------|---------------------------------------------------------------------|
| <b>2.15<sup>+0.55+0.60</sup><sub>-0.42-0.43</sub></b> | <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. • • •

|             |            |      |                                             |
|-------------|------------|------|---------------------------------------------|
| <b>seen</b> | GARMASH 15 | BELL | $e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$ |
| <b>seen</b> | 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                                     |
|-------------|--------------------------|------|---------------------------------------------|
| <b>seen</b> | <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                                                             |
|-------------------------------------------------------|-------------------------|------|---------------------------------------------------------------------|
| <b>3.45<sup>+0.87+0.86</sup><sub>-0.71-0.63</sub></b> | <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. • • •

|                      |                        |      |                                        |
|----------------------|------------------------|------|----------------------------------------|
| <b>possibly seen</b> | <sup>2</sup> MIZUK 16  | BELL | $e^+e^- \rightarrow h_b(1P)\pi^+\pi^-$ |
| <b>seen</b>          | <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                                                             |
|-------------------------------------------------------|-------------------------|------|---------------------------------------------------------------------|
| <b>4.67<sup>+1.24+1.18</sup><sub>-1.00-0.89</sub></b> | <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. • • •

|                      |                        |      |                                        |
|----------------------|------------------------|------|----------------------------------------|
| <b>possibly seen</b> | <sup>2</sup> MIZUK 16  | BELL | $e^+e^- \rightarrow h_b(2P)\pi^+\pi^-$ |
| <b>seen</b>          | <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                                  |
|-----------------|-------------|------|------------------------------------------|
| <b>not seen</b> | GARMASH 16  | BELL | $e^+e^- \rightarrow \pi^- B^+ \bar{B}^0$ |

NODE=M207R08  
NODE=M207R08

 $[\Gamma(B^+ \bar{B}^{*0}) + \Gamma(B^{*+} \bar{B}^0)]/\Gamma_{\text{total}}$  $\Gamma_{10}/\Gamma$ 

| VALUE (units $10^{-2}$ )                          | EVTS | DOCUMENT ID             | TECN | COMMENT                                                             |
|---------------------------------------------------|------|-------------------------|------|---------------------------------------------------------------------|
| <b>85.6<sup>+1.5+1.5</sup><sub>-2.0-2.1</sub></b> | 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

 $\Gamma(B^{*+} \bar{B}^0)/\Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ 

| VALUE           | DOCUMENT ID | TECN | COMMENT                                     |
|-----------------|-------------|------|---------------------------------------------|
| <b>not seen</b> | GARMASH 16  | BELL | $e^+e^- \rightarrow \pi^- B^{*+} \bar{B}^0$ |

NODE=M207R06  
NODE=M207R06

$$\frac{[\Gamma(B^+\bar{B}^{*0}) + \Gamma(B^{*+}\bar{B}^0)]}{[\Gamma(\Upsilon(1S)\pi^+) + \Gamma(\Upsilon(2S)\pi^+) + \Gamma(\Upsilon(3S)\pi^+) + \Gamma(h_b(1P)\pi^+) + \Gamma(h_b(2P)\pi^+)]} \Gamma_{10}/(\Gamma_1 + \Gamma_3 + \Gamma_5 + \Gamma_7 + \Gamma_9)$$

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

NODE=M208

$Z_b(10650)$

$I^G(J^{PC}) = 1^+(1^{+-})$   
 $I, G, C$  need confirmation.

OMITTED FROM SUMMARY TABLE

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

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>10652.2<math>\pm</math>1.5</b>                                             | <sup>1</sup> BONDAR  | 12   | BELL $e^+e^- \rightarrow$ 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>11.5<math>\pm</math> 2.2</b>                                               | <sup>4</sup> BONDAR  | 12   | BELL $e^+e^- \rightarrow$ hadrons                |
| • • • 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 $e^+e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$ |
| 9.3 $\pm$ 2.2 $^{+0.3}_{-0.5}$                                                | <sup>5</sup> GARMASH | 15   | BELL $e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$ |
| 16.3 $\pm$ 9.8 $^{+6.0}_{-2.0}$                                               | <sup>6</sup> BONDAR  | 12   | BELL $e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$ |
| 13.3 $\pm$ 3.3 $^{+4.0}_{-3.0}$                                               | <sup>6</sup> BONDAR  | 12   | BELL $e^+e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$ |
| 8.4 $\pm$ 2.0 $\pm$ 2.0                                                       | <sup>6</sup> BONDAR  | 12   | BELL $e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$ |
| 20.9 $^{+5.4+2.1}_{-4.7-5.7}$                                                 | <sup>6</sup> BONDAR  | 12   | BELL $e^+e^- \rightarrow h_b(1P)\pi^+\pi^-$      |
| 19 $\pm$ 7 $^{+11}_{-7}$                                                      | <sup>6</sup> BONDAR  | 12   | BELL $e^+e^- \rightarrow h_b(2P)\pi^+\pi^-$      |

NODE=M208W

NODE=M208W

OCCUR=2

OCCUR=3

OCCUR=2

OCCUR=3

OCCUR=4

OCCUR=5

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 ( $\Gamma_i/\Gamma$ )       |
|----------------------------------------------------|--------------------------------------|
| $\Gamma_1 \quad \Upsilon(1S)\pi^+$                 | $(1.7^{+0.8}_{-0.6}) \times 10^{-3}$ |
| $\Gamma_2 \quad \Upsilon(2S)\pi^+$                 | $(1.4^{+0.6}_{-0.4}) \%$             |
| $\Gamma_3 \quad \Upsilon(3S)\pi^+$                 | $(1.6^{+0.7}_{-0.5}) \%$             |
| $\Gamma_4 \quad h_b(1P)\pi^+$                      | $(8.4^{+2.9}_{-2.4}) \%$             |
| $\Gamma_5 \quad h_b(2P)\pi^+$                      | $(15 \pm 4) \%$                      |
| $\Gamma_6 \quad B^+\bar{B}^0$                      | not seen                             |
| $\Gamma_7 \quad B^+\bar{B}^{*0} + B^{*+}\bar{B}^0$ | not seen                             |
| $\Gamma_8 \quad B^{*+}\bar{B}^{*0}$                | $(74^{+4}_{-6}) \%$                  |

DESIG=1

DESIG=2

DESIG=3

DESIG=4

DESIG=5

DESIG=8

DESIG=6

DESIG=7

## $Z_b(10650)$ BRANCHING RATIOS

NODE=M208225

$\Gamma(\Upsilon(1S)\pi^+)/\Gamma_{\text{total}} \quad \Gamma_1/\Gamma$

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

$1.7^{+0.7+0.3}_{-0.6-0.2}$  <sup>7</sup> GARMASH 16 BELL  $e^+e^- \rightarrow \pi^- B^{*+}\bar{B}^{*0}$

• • • 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

NODE=M208R01

NODE=M208R01;LINKAGE=A

$\Gamma(\Upsilon(2S)\pi^+)/\Gamma_{\text{total}} \quad \Gamma_2/\Gamma$

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

$1.39^{+0.48+0.34}_{-0.38-0.23}$  <sup>8</sup> GARMASH 16  $e^+e^- \rightarrow \pi^- B^{*+}\bar{B}^{*0}$

• • • 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

NODE=M208R02

NODE=M208R02;LINKAGE=A

$\Gamma(\Upsilon(3S)\pi^+)/\Gamma_{\text{total}} \quad \Gamma_3/\Gamma$

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

$\Gamma(h_b(1P)\pi^+)/\Gamma_{\text{total}} \quad \Gamma_4/\Gamma$

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<sup>+3.2+2.8</sup><sub>-2.8-2.3</sub>**

<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<sup>+3.4+2.7</sup><sub>-4.4-3.5</sub>**

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

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

**2.80<sup>+0.69+0.54</sup><sub>-0.40-0.36</sub>**

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



**$\Upsilon(10860)$** 

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

NODE=M092

 **$\Upsilon(10860)$  MASS**

NODE=M092M

NODE=M092M

| VALUE (MeV)                                                                   | DOCUMENT ID | TECN     | COMMENT                                                   |
|-------------------------------------------------------------------------------|-------------|----------|-----------------------------------------------------------|
| <b><math>10889.9^{+3.2}_{-2.6}</math> OUR AVERAGE</b>                         |             |          |                                                           |
| $10884.7^{+3.6+8.9}_{-3.4-1.0}$                                               | 1 MIZUK     | 16 BELL  | $e^{+}e^{-} \rightarrow h_b(1P,2P)\pi^{+}\pi^{-}$         |
| $10891.1 \pm 3.2^{+1.2}_{-2.0}$                                               | 2 SANTEL    | 16 BELL  | $e^{+}e^{-} \rightarrow \Upsilon(1S,2S,3S)\pi^{+}\pi^{-}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |          |                                                           |
| $10881.8^{+1.0}_{-1.1} \pm 1.2$                                               | 3,4 SANTEL  | 16 BELL  | $e^{+}e^{-} \rightarrow \text{hadrons}$                   |
| $10879 \pm 3$                                                                 | 5,6 CHEN    | 10 BELL  | $e^{+}e^{-} \rightarrow \text{hadrons}$                   |
| $10888.4^{+2.7}_{-2.6} \pm 1.2$                                               | 7 CHEN      | 10 BELL  | $e^{+}e^{-} \rightarrow \Upsilon(1S,2S,3S)\pi^{+}\pi^{-}$ |
| $10876 \pm 2$                                                                 | 5 AUBERT    | 09E BABR | $e^{+}e^{-} \rightarrow \text{hadrons}$                   |
| $10869 \pm 2$                                                                 | 8 AUBERT    | 09E BABR | $e^{+}e^{-} \rightarrow \text{hadrons}$                   |
| $10868 \pm 6 \pm 5$                                                           | 9 BESSON    | 85 CLEO  | $e^{+}e^{-} \rightarrow \text{hadrons}$                   |
| $10845 \pm 20$                                                                | 10 LOVELOCK | 85 CUSB  | $e^{+}e^{-} \rightarrow \text{hadrons}$                   |

OCCUR=2

OCCUR=2

OCCUR=2

<sup>1</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=M092M;LINKAGE=D

<sup>2</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=M092M;LINKAGE=C

<sup>3</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=M092M;LINKAGE=A

<sup>4</sup> Not including uncertain and potentially large systematic errors due to assumed continuum amplitude  $1/\sqrt{s}$  dependence and related interference contributions.

NODE=M092M;LINKAGE=B

<sup>5</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=M092M;LINKAGE=AU

<sup>6</sup> The parameters of the  $\Upsilon(11020)$  are fixed to those in AUBERT 09E.

NODE=M092M;LINKAGE=CH

<sup>7</sup> In a model where a flat nonresonant  $\Upsilon(1S,2S,3S)\pi^{+}\pi^{-}$  continuum interferes with a single Breit-Wigner resonance.

NODE=M092M;LINKAGE=CE

<sup>8</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=M092M;LINKAGE=UB

<sup>9</sup> Assuming four Gaussians with radiative tails and a single step in  $R$ .

NODE=M092M;LINKAGE=BE

<sup>10</sup> In a coupled-channel model with three resonances and a smooth step in  $R$ .

NODE=M092M;LINKAGE=LO

 **$\Upsilon(10860)$  WIDTH**

NODE=M092W

NODE=M092W

| VALUE (MeV)                                                                   | DOCUMENT ID | TECN     | COMMENT                                                   |
|-------------------------------------------------------------------------------|-------------|----------|-----------------------------------------------------------|
| <b><math>51^{+6}_{-7}</math> OUR AVERAGE</b>                                  |             |          |                                                           |
| $40.6^{+12.7+1.1}_{-8.0-19.1}$                                                | 1 MIZUK     | 16 BELL  | $e^{+}e^{-} \rightarrow h_b(1P,2P)\pi^{+}\pi^{-}$         |
| $53.7^{+7.1+1.3}_{-5.6-5.4}$                                                  | 2 SANTEL    | 16 BELL  | $e^{+}e^{-} \rightarrow \Upsilon(1S,2S,3S)\pi^{+}\pi^{-}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |          |                                                           |
| $48.5^{+1.9+2.0}_{-1.8-2.8}$                                                  | 3,4 SANTEL  | 16 BELL  | $e^{+}e^{-} \rightarrow \text{hadrons}$                   |
| $46^{+9}_{-7}$                                                                | 5,6 CHEN    | 10 BELL  | $e^{+}e^{-} \rightarrow \text{hadrons}$                   |
| $30.7^{+8.3}_{-7.0} \pm 3.1$                                                  | 7 CHEN      | 10 BELL  | $e^{+}e^{-} \rightarrow \Upsilon(1S,2S,3S)\pi^{+}\pi^{-}$ |
| $43 \pm 4$                                                                    | 5 AUBERT    | 09E BABR | $e^{+}e^{-} \rightarrow \text{hadrons}$                   |
| $74 \pm 4$                                                                    | 8 AUBERT    | 09E BABR | $e^{+}e^{-} \rightarrow \text{hadrons}$                   |
| $112 \pm 17 \pm 23$                                                           | 9 BESSON    | 85 CLEO  | $e^{+}e^{-} \rightarrow \text{hadrons}$                   |
| $110 \pm 15$                                                                  | 10 LOVELOCK | 85 CUSB  | $e^{+}e^{-} \rightarrow \text{hadrons}$                   |

OCCUR=2

OCCUR=2

OCCUR=2

- <sup>1</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>2</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>3</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>4</sup> Not including uncertain and potentially large systematic errors due to assumed continuum amplitude  $1/\sqrt{s}$  dependence and related interference contributions.
- <sup>5</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>6</sup> The parameters of the  $\Upsilon(11020)$  are fixed to those in AUBERT 09E.
- <sup>7</sup> In a model where a flat nonresonant  $\Upsilon(1S, 2S, 3S)\pi^+\pi^-$  continuum interferes with a single Breit-Wigner resonance.
- <sup>8</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>9</sup> Assuming four Gaussians with radiative tails and a single step in  $R$ .
- <sup>10</sup> In a coupled-channel model with three resonances and a smooth step in  $R$ .

NODE=M092W;LINKAGE=D

NODE=M092W;LINKAGE=C

NODE=M092W;LINKAGE=A

NODE=M092W;LINKAGE=B

NODE=M092W;LINKAGE=AU

NODE=M092W;LINKAGE=CH

NODE=M092W;LINKAGE=CE

NODE=M092W;LINKAGE=UB

NODE=M092W;LINKAGE=BE

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 $^{+2.7}_{-4.0}$ ) %               |                  |
| $\Gamma_2$ $B\bar{B}$                        | ( 5.5 $\pm 1.0$ ) %                       |                  |
| $\Gamma_3$ $B\bar{B}^* + \text{c.c.}$        | ( 13.7 $\pm 1.6$ ) %                      |                  |
| $\Gamma_4$ $B^*\bar{B}^*$                    | ( 38.1 $\pm 3.4$ ) %                      |                  |
| $\Gamma_5$ $B\bar{B}^{(*)}\pi$               | < 19.7 %                                  | 90%              |
| $\Gamma_6$ $B\bar{B}\pi$                     | ( 0.0 $\pm 1.2$ ) %                       |                  |
| $\Gamma_7$ $B^*\bar{B}\pi + B\bar{B}^*\pi$   | ( 7.3 $\pm 2.3$ ) %                       |                  |
| $\Gamma_8$ $B^*\bar{B}^*\pi$                 | ( 1.0 $\pm 1.4$ ) %                       |                  |
| $\Gamma_9$ $B\bar{B}\pi\pi$                  | < 8.9 %                                   | 90%              |
| $\Gamma_{10}$ $B_s^{(*)}\bar{B}_s^{(*)}$     | ( 20.1 $\pm 3.1$ ) %                      |                  |
| $\Gamma_{11}$ $B_s\bar{B}_s$                 | ( 5 $\pm 5$ ) $\times 10^{-3}$            |                  |
| $\Gamma_{12}$ $B_s\bar{B}_s^* + \text{c.c.}$ | ( 1.35 $\pm 0.32$ ) %                     |                  |
| $\Gamma_{13}$ $B_s^*\bar{B}_s^*$             | ( 17.6 $\pm 2.7$ ) %                      |                  |
| $\Gamma_{14}$ no open-bottom                 | ( 3.8 $^{+5.0}_{-0.5}$ ) %                |                  |
| $\Gamma_{15}$ $e^+e^-$                       | ( 6.1 $\pm 1.6$ ) $\times 10^{-6}$        |                  |
| $\Gamma_{16}$ $K^*(892)^0\bar{K}^0$          | < 1.0 $\times 10^{-5}$                    | 90%              |
| $\Gamma_{17}$ $\Upsilon(1S)\pi^+\pi^-$       | ( 5.3 $\pm 0.6$ ) $\times 10^{-3}$        |                  |
| $\Gamma_{18}$ $\Upsilon(2S)\pi^+\pi^-$       | ( 7.8 $\pm 1.3$ ) $\times 10^{-3}$        |                  |
| $\Gamma_{19}$ $\Upsilon(3S)\pi^+\pi^-$       | ( 4.8 $^{+1.9}_{-1.7}$ ) $\times 10^{-3}$ |                  |
| $\Gamma_{20}$ $\Upsilon(1S)K^+K^-$           | ( 6.1 $\pm 1.8$ ) $\times 10^{-4}$        |                  |
| $\Gamma_{21}$ $\eta\Upsilon_J(1D)$           | ( 4.8 $\pm 1.1$ ) $\times 10^{-3}$        |                  |
| $\Gamma_{22}$ $h_b(1P)\pi^+\pi^-$            | ( 3.5 $^{+1.0}_{-1.3}$ ) $\times 10^{-3}$ |                  |
| $\Gamma_{23}$ $h_b(2P)\pi^+\pi^-$            | ( 5.7 $^{+1.7}_{-2.1}$ ) $\times 10^{-3}$ |                  |
| $\Gamma_{24}$ $\chi_{bJ}(1P)\pi^+\pi^-\pi^0$ |                                           |                  |
| $\Gamma_{25}$ $\chi_{b0}(1P)\pi^+\pi^-\pi^0$ | < 6.3 $\times 10^{-3}$                    | 90%              |
| $\Gamma_{26}$ $\chi_{b0}(1P)\omega$          | < 3.9 $\times 10^{-3}$                    | 90%              |

DESIG=9

DESIG=2

DESIG=3

DESIG=4

DESIG=10

DESIG=23

DESIG=24

DESIG=25

DESIG=11

DESIG=16

DESIG=5

DESIG=7

DESIG=8

DESIG=28

DESIG=1

DESIG=29

DESIG=17

DESIG=18

DESIG=19

DESIG=20

DESIG=40

DESIG=26

DESIG=27

DESIG=41

DESIG=30

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 |

### Inclusive Decays.

These decay modes are submodes of one or more of the decay modes above.

|               |                       |                          |          |
|---------------|-----------------------|--------------------------|----------|
| $\Gamma_{35}$ | $\phi$ anything       | $(13.8^{+2.4}_{-1.7})\%$ | DESIG=12 |
| $\Gamma_{36}$ | $D^0$ anything + c.c. | $(108 \pm 8)\%$          | DESIG=13 |
| $\Gamma_{37}$ | $D_s$ anything + c.c. | $(46 \pm 6)\%$           | DESIG=6  |
| $\Gamma_{38}$ | $J/\psi$ anything     | $(2.06 \pm 0.21)\%$      | DESIG=14 |
| $\Gamma_{39}$ | $B^0$ anything + c.c. | $(77 \pm 8)\%$           | DESIG=21 |
| $\Gamma_{40}$ | $B^+$ anything + c.c. | $(72 \pm 6)\%$           | DESIG=22 |

### $\Upsilon(10860)$ PARTIAL WIDTHS

| $\Gamma(e^+e^-)$                              |                                     |      |                                          | $\Gamma_{15}$ |
|-----------------------------------------------|-------------------------------------|------|------------------------------------------|---------------|
| VALUE (keV)                                   | DOCUMENT ID                         | TECN | COMMENT                                  |               |
| <b><math>0.31 \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 $e^+e^- \rightarrow \text{hadrons}$ | NODE=M092W1   |
| $0.365 \pm 0.070$                             | LOVELOCK                            | 85   | CUSB $e^+e^- \rightarrow \text{hadrons}$ | NODE=M092W1   |

### $\Upsilon(10860)$ 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 <http://www.slac.stanford.edu/xorg/hflav/>.

| $\Gamma(B\bar{B}X)/\Gamma_{\text{total}}$                                                                      |      |                       |      | $\Gamma_1/\Gamma$                              |
|----------------------------------------------------------------------------------------------------------------|------|-----------------------|------|------------------------------------------------|
| VALUE                                                                                                          | EVTS | DOCUMENT ID           | TECN | COMMENT                                        |
| <b><math>0.762^{+0.027}_{-0.043}</math> OUR EVALUATION</b>                                                     |      |                       |      |                                                |
| <b><math>0.71 \pm 0.06</math> OUR AVERAGE</b>                                                                  |      |                       |      |                                                |
| $0.737 \pm 0.032 \pm 0.051$                                                                                    | 1063 | <sup>1</sup> DRUTSKOY | 10   | BELL $\Upsilon(5S) \rightarrow B^+X, B^0X$     |
| $0.589 \pm 0.100 \pm 0.092$                                                                                    |      | <sup>2</sup> HUANG    | 07   | CLEO $\Upsilon(5S) \rightarrow \text{hadrons}$ |
| <sup>1</sup> Not independent of DRUTSKOY 10 values for $\Upsilon(5S) \rightarrow B^{\pm,0} \text{ anything}$ . |      |                       |      |                                                |
| <sup>2</sup> Using measurements or limits from AQUINES 06.                                                     |      |                       |      |                                                |

| $\Gamma(B\bar{B})/\Gamma_{\text{total}}$                                      |     |                       |      | $\Gamma_2/\Gamma$                              |
|-------------------------------------------------------------------------------|-----|-----------------------|------|------------------------------------------------|
| VALUE (units $10^{-2}$ )                                                      | CL% | DOCUMENT ID           | TECN | COMMENT                                        |
| <b><math>5.5^{+1.0}_{-0.9} \pm 0.4</math></b>                                 |     | <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.                    |     |                       |      |                                                |

| $\Gamma(B\bar{B})/\Gamma(B\bar{B}X)$ |     |             |      | $\Gamma_2/\Gamma_1$                            |
|--------------------------------------|-----|-------------|------|------------------------------------------------|
| VALUE                                | CL% | DOCUMENT ID | TECN | COMMENT                                        |
| <b><math>&lt; 0.22</math></b>        | 90  | AQUINES     | 06   | CLE3 $\Upsilon(5S) \rightarrow \text{hadrons}$ |

| $\Gamma(B\bar{B}^* + \text{c.c.})/\Gamma_{\text{total}}$   |  |                       |      | $\Gamma_3/\Gamma$                              |
|------------------------------------------------------------|--|-----------------------|------|------------------------------------------------|
| VALUE                                                      |  | DOCUMENT ID           | TECN | COMMENT                                        |
| <b><math>0.137 \pm 0.016</math> OUR AVERAGE</b>            |  |                       |      |                                                |
| $0.137 \pm 0.013 \pm 0.011$                                |  | <sup>1</sup> DRUTSKOY | 10   | BELL $\Upsilon(5S) \rightarrow B^+X, B^0X$     |
| $0.143 \pm 0.053 \pm 0.027$                                |  | <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. |  |                       |      |                                                |

$$\Gamma(B\bar{B}^* + \text{c.c.})/\Gamma(B\bar{B}X)$$

| VALUE                 | EVTs | DOCUMENT ID | TECN | COMMENT                                        |
|-----------------------|------|-------------|------|------------------------------------------------|
| <b>0.24±0.09±0.03</b> | 10   | AQUINES     | 06   | CLE3 $\Upsilon(5S) \rightarrow \text{hadrons}$ |

$$\Gamma_3/\Gamma_1$$

NODE=M092R06  
NODE=M092R06

$$\Gamma(B^*\bar{B}^*)/\Gamma_{\text{total}}$$

| VALUE                                             | DOCUMENT ID           | TECN | COMMENT                                        |
|---------------------------------------------------|-----------------------|------|------------------------------------------------|
| <b>0.381±0.034 OUR AVERAGE</b>                    |                       |      |                                                |
| 0.375 <sup>+0.021</sup> <sub>-0.019</sub> ± 0.030 | <sup>1</sup> DRUTSKOY | 10   | BELL $\Upsilon(5S) \rightarrow B^+ X, B^0 X$   |
| 0.436 ± 0.083 ± 0.072                             | <sup>2</sup> HUANG    | 07   | CLEO $\Upsilon(5S) \rightarrow \text{hadrons}$ |

$$\Gamma_4/\Gamma$$

NODE=M092R14  
NODE=M092R14

<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                                        |
|-----------------------|------|-------------|------|------------------------------------------------|
| <b>0.74±0.15±0.08</b> | 31   | AQUINES     | 06   | CLE3 $\Upsilon(5S) \rightarrow \text{hadrons}$ |

$$\Gamma_4/\Gamma_1$$

NODE=M092R07  
NODE=M092R07

$$\Gamma(B\bar{B}^{(*)}\pi)/\Gamma_{\text{total}}$$

| VALUE            | CL% | DOCUMENT ID        | TECN | COMMENT                                        |
|------------------|-----|--------------------|------|------------------------------------------------|
| <b>&lt;0.197</b> | 90  | <sup>1</sup> HUANG | 07   | CLEO $\Upsilon(5S) \rightarrow \text{hadrons}$ |

$$\Gamma_5/\Gamma$$

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                                        |
|-----------------|-----|-------------|------|------------------------------------------------|
| <b>&lt;0.32</b> | 90  | AQUINES     | 06   | CLE3 $\Upsilon(5S) \rightarrow \text{hadrons}$ |

$$\Gamma_5/\Gamma_1$$

NODE=M092R08  
NODE=M092R08

$$\Gamma(B\bar{B}\pi)/\Gamma_{\text{total}}$$

| VALUE (units 10 <sup>-2</sup> ) | EVTs | DOCUMENT ID           | TECN | COMMENT                                       |
|---------------------------------|------|-----------------------|------|-----------------------------------------------|
| <b>0.0±1.2±0.3</b>              | 0    | <sup>1</sup> DRUTSKOY | 10   | BELL $\Upsilon(5S) \rightarrow B^+, 0\pi^- X$ |

$$\Gamma_6/\Gamma$$

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                                       |
|------------------------------------------------|------|-----------------------|------|-----------------------------------------------|
| <b>7.3<sup>+2.3</sup><sub>-2.1</sub> ± 0.8</b> | 38   | <sup>1</sup> DRUTSKOY | 10   | BELL $\Upsilon(5S) \rightarrow B^+, 0\pi^- X$ |

$$\Gamma_7/\Gamma$$

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                                       |
|------------------------------------------------|------|-----------------------|------|-----------------------------------------------|
| <b>1.0<sup>+1.4</sup><sub>-1.3</sub> ± 0.4</b> | 5    | <sup>1</sup> DRUTSKOY | 10   | BELL $\Upsilon(5S) \rightarrow B^+, 0\pi^- X$ |

$$\Gamma_8/\Gamma$$

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                                        |
|------------------|-----|--------------------|------|------------------------------------------------|
| <b>&lt;0.089</b> | 90  | <sup>1</sup> HUANG | 07   | CLEO $\Upsilon(5S) \rightarrow \text{hadrons}$ |

$$\Gamma_9/\Gamma$$

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                                        |
|-----------------|-----|-------------|------|------------------------------------------------|
| <b>&lt;0.14</b> | 90  | AQUINES     | 06   | CLE3 $\Upsilon(5S) \rightarrow \text{hadrons}$ |

$$\Gamma_9/\Gamma_1$$

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

$$\mathbf{0.201^{+0.030}_{-0.031} \text{ OUR EVALUATION}}$$

→ UNCHECKED ←

$$\mathbf{0.189^{+0.027}_{-0.021} \text{ OUR AVERAGE}}$$

|                                        |                    |    |      |                                         |
|----------------------------------------|--------------------|----|------|-----------------------------------------|
| 0.172 ± 0.030                          | <sup>1</sup> ESEN  | 13 | BELL | $\Upsilon(5S) \rightarrow D^0 X, D_s X$ |
| 0.21 <sup>+0.06</sup> <sub>-0.03</sub> | <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 ± 0.013 ± 0.032 | <sup>3</sup> DRUTSKOY | 07  | BELL | $\Upsilon(5S) \rightarrow D^0 X, D_s X$ |
| 0.160 ± 0.026 ± 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

 $4.82 \pm 0.92 \pm 0.67$ <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

 $4.8^{+1.8}_{-1.5} \pm 0.7$ 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

 $6.1^{+1.6}_{-1.4} \pm 1.0$ 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

 $0.45 \pm 0.08^{+0.07}_{-0.12}$ 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

 $0.77 \pm 0.08^{+0.22}_{-0.17}$ 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

DOCUMENT ID

TECN

COMMENT

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

 $(2.5 \pm 0.6 \pm 2.2) \times 10^{-3}$ 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

 $\Gamma(\gamma X_b \rightarrow \gamma \Upsilon(1S)\omega)/\Gamma_{\text{total}}$  $\Gamma_{34}/\Gamma$ 

| VALUE                                       | CL% | DOCUMENT ID     | TECN | COMMENT                                                           |
|---------------------------------------------|-----|-----------------|------|-------------------------------------------------------------------|
| <b><math>&lt; 3.8 \times 10^{-5}</math></b> | 90  | <sup>1</sup> HE | 14   | BELL $\Upsilon(5S) \rightarrow \pi^+\pi^-\pi^0\gamma\Upsilon(1S)$ |

NODE=M092R47  
 NODE=M092R47

<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;LINKAGE=A

 $\Gamma(\phi \text{ anything})/\Gamma_{\text{total}}$  $\Gamma_{35}/\Gamma$ 

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

NODE=M092R12  
 NODE=M092R12

**$0.138 \pm 0.007 +0.023$   
 $=0.015$**

HUANG 07 CLEO  $\Upsilon(5S) \rightarrow \phi X$

$\Gamma(D^0 \text{ anything} + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE                                                  | DOCUMENT ID | TECN | COMMENT                          | $\Gamma_{36}/\Gamma$ |
|--------------------------------------------------------|-------------|------|----------------------------------|----------------------|
| <b>1.076<math>\pm</math>0.040<math>\pm</math>0.068</b> | DRUTSKOY 07 | BELL | $\Upsilon(5S) \rightarrow D^0 X$ |                      |

NODE=M092R10  
NODE=M092R10

 $\Gamma(D_s \text{ anything} + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE                                        | DOCUMENT ID              | TECN | COMMENT                          | $\Gamma_{37}/\Gamma$ |
|----------------------------------------------|--------------------------|------|----------------------------------|----------------------|
| <b>0.46 <math>\pm</math>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

 $\Gamma(J/\psi \text{ anything})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-2}$ )                               | DOCUMENT ID | TECN | COMMENT                             | $\Gamma_{38}/\Gamma$ |
|--------------------------------------------------------|-------------|------|-------------------------------------|----------------------|
| <b>2.060<math>\pm</math>0.160<math>\pm</math>0.134</b> | DRUTSKOY 07 | BELL | $\Upsilon(5S) \rightarrow J/\psi X$ |                      |

NODE=M092R11  
NODE=M092R11

 $\Gamma(B^0 \text{ anything} + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE                                                            | EVTs | DOCUMENT ID | TECN | COMMENT                          | $\Gamma_{39}/\Gamma$ |
|------------------------------------------------------------------|------|-------------|------|----------------------------------|----------------------|
| <b>0.770<math>^{+0.058}_{-0.056}</math><math>\pm</math>0.061</b> | 352  | DRUTSKOY 10 | BELL | $\Upsilon(5S) \rightarrow B^0 X$ |                      |

NODE=M092R26  
NODE=M092R26

 $\Gamma(B^+ \text{ anything} + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE                                                            | EVTs | DOCUMENT ID | TECN | COMMENT                          | $\Gamma_{40}/\Gamma$ |
|------------------------------------------------------------------|------|-------------|------|----------------------------------|----------------------|
| <b>0.721<math>^{+0.039}_{-0.038}</math><math>\pm</math>0.050</b> | 711  | DRUTSKOY 10 | BELL | $\Upsilon(5S) \rightarrow B^+ X$ |                      |

NODE=M092R27  
NODE=M092R27

 $\Upsilon(10860)$  REFERENCES

NODE=M092

|           |     |                |                               |                 |             |
|-----------|-----|----------------|-------------------------------|-----------------|-------------|
| TAMPONI   | 18  | EPJ C78 633    | U. Tamponi <i>et al.</i>      | (BELLE Collab.) | REFID=59195 |
| YIN       | 18  | PR D98 091102  | J.H. Yin <i>et al.</i>        | (BELLE Collab.) | REFID=59468 |
| MIZUK     | 16  | PRL 117 142001 | R. Mizuk <i>et al.</i>        | (BELLE Collab.) | REFID=57465 |
| SANTEL    | 16  | PR D93 011101  | D. Santel <i>et al.</i>       | (BELLE Collab.) | REFID=57121 |
| HE        | 14  | PRL 113 142001 | X.H. He <i>et al.</i>         | (BELLE Collab.) | REFID=55927 |
| ESEN      | 13  | PR D87 031101  | S. Esen <i>et al.</i>         | (BELLE Collab.) | REFID=54894 |
| SHEN      | 13A | PR D88 052019  | C.P. Shen <i>et al.</i>       | (BELLE Collab.) | REFID=55591 |
| ADACHI    | 12  | PRL 108 032001 | I. Adachi <i>et al.</i>       | (BELLE Collab.) | REFID=53962 |
| LI        | 12  | PRL 108 181808 | J. Li <i>et al.</i>           | (BELLE Collab.) | REFID=54116 |
| CHEN      | 10  | PR D82 091106  | K.-F. Chen <i>et al.</i>      | (BELLE Collab.) | REFID=53531 |
| DRUTSKOY  | 10  | PR D81 112003  | A. Drutskoy <i>et al.</i>     | (BELLE Collab.) | REFID=53358 |
| AUBERT    | 09E | PRL 102 012001 | B. Aubert <i>et al.</i>       | (BABAR Collab.) | REFID=52661 |
| LOUVOT    | 09  | PRL 102 021801 | R. Louvot <i>et al.</i>       | (BELLE Collab.) | REFID=52646 |
| CHEN      | 08  | PRL 100 112001 | K.-F. Chen <i>et al.</i>      | (BELLE Collab.) | REFID=52153 |
| DRUTSKOY  | 07  | PRL 98 052001  | A. Drutskoy <i>et al.</i>     | (BELLE Collab.) | REFID=51621 |
| DRUTSKOY  | 07A | PR D76 012002  | A. Drutskoy <i>et al.</i>     | (BELLE Collab.) | REFID=51852 |
| HUANG     | 07  | PR D75 012002  | G.S. Huang <i>et al.</i>      | (CLEO Collab.)  | REFID=51624 |
| AQUINES   | 06  | PRL 96 152001  | O. Aquines <i>et al.</i>      | (CLEO Collab.)  | REFID=51106 |
| BONVICINI | 06  | PRL 96 022002  | G. Bonvicini <i>et al.</i>    | (CLEO Collab.)  | REFID=50995 |
| PDG       | 06  | JP G33 1       | W.-M. Yao <i>et al.</i>       | (PDG Collab.)   | REFID=51004 |
| ARTUSO    | 05B | PRL 95 261801  | M. Artuso <i>et al.</i>       | (CLEO Collab.)  | REFID=50992 |
| BESSION   | 85  | PRL 54 381     | D. Besson <i>et al.</i>       | (CLEO Collab.)  | REFID=22368 |
| LOVELOCK  | 85  | PRL 54 377     | D.M.J. Lovelock <i>et al.</i> | (CUSB Collab.)  | REFID=22369 |



$\Upsilon(11020)$ 

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

NODE=M093

 **$\Upsilon(11020)$  MASS**

NODE=M093M

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

NODE=M093M

**10992.9<sup>+10.0</sup><sub>-3.1</sub> OUR AVERAGE**

|                                                  |          |    |                                                        |
|--------------------------------------------------|----------|----|--------------------------------------------------------|
| 10999.0 <sup>+7.3+16.9</sup> <sub>-7.8-1.0</sub> | 1 MIZUK  | 16 | BELL $e^+e^- \rightarrow h_b(1P,2P)\pi^+\pi^-$         |
| 10987.5 <sup>+6.4+9.1</sup> <sub>-2.5-2.3</sub>  | 2 SANTEL | 16 | BELL $e^+e^- \rightarrow \Upsilon(1S,2S,3S)\pi^+\pi^-$ |

OCCUR=2

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

|                                             |            |     |                                   |
|---------------------------------------------|------------|-----|-----------------------------------|
| 11003.0 <sup>+1.1+0.9</sup> <sub>-1.0</sub> | 3,4 SANTEL | 16  | BELL $e^+e^- \rightarrow$ hadrons |
| 10996 $\pm$ 2                               | 5 AUBERT   | 09E | BABR $e^+e^- \rightarrow$ hadrons |
| 11019 $\pm$ 5 $\pm$ 7                       | BESSON     | 85  | CLEO $e^+e^- \rightarrow$ hadrons |
| 11020 $\pm$ 30                              | LOVELOCK   | 85  | CUSB $e^+e^- \rightarrow$ hadrons |

<sup>1</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>2</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>3</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>4</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>5</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

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

NODE=M093W

**49<sup>+9</sup><sub>-15</sub> OUR AVERAGE**

|                                       |          |    |                                                        |
|---------------------------------------|----------|----|--------------------------------------------------------|
| 27 <sup>+27+5</sup> <sub>-11-12</sub> | 6 MIZUK  | 16 | BELL $e^+e^- \rightarrow h_b(1P,2P)\pi^+\pi^-$         |
| 61 <sup>+9+2</sup> <sub>-19-20</sub>  | 7 SANTEL | 16 | BELL $e^+e^- \rightarrow \Upsilon(1S,2S,3S)\pi^+\pi^-$ |

OCCUR=2

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

|                                              |            |     |                                   |
|----------------------------------------------|------------|-----|-----------------------------------|
| 39.3 <sup>+1.7+1.3</sup> <sub>-1.6-2.4</sub> | 8,9 SANTEL | 16  | BELL $e^+e^- \rightarrow$ hadrons |
| 37 $\pm$ 3                                   | 10 AUBERT  | 09E | BABR $e^+e^- \rightarrow$ hadrons |
| 61 $\pm$ 13 $\pm$ 22                         | BESSON     | 85  | CLEO $e^+e^- \rightarrow$ hadrons |
| 90 $\pm$ 20                                  | LOVELOCK   | 85  | CUSB $e^+e^- \rightarrow$ hadrons |

<sup>6</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=M093W;LINKAGE=D

<sup>7</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=M093W;LINKAGE=C

<sup>8</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>9</sup> Not including uncertain and potentially large systematic errors due to assumed continuum amplitude  $1/\sqrt{s}$  dependence and related interference contributions.

<sup>10</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=A

NODE=M093W;LINKAGE=B

NODE=M093W;LINKAGE=AU

### $\Upsilon(11020)$ DECAY MODES

NODE=M093215;NODE=M093

| Mode                                      | Fraction ( $\Gamma_i/\Gamma$ )       |
|-------------------------------------------|--------------------------------------|
| $\Gamma_1$ $e^+ e^-$                      | $(2.7^{+1.0}_{-0.8}) \times 10^{-6}$ |
| $\Gamma_2$ $\chi_{bJ}(1P)\pi^+\pi^-\pi^0$ |                                      |
| $\Gamma_3$ $\chi_{b1}(1P)\pi^+\pi^-\pi^0$ |                                      |
| $\Gamma_4$ $\chi_{b2}(1P)\pi^+\pi^-\pi^0$ |                                      |

DESIG=1

DESIG=2

DESIG=3

DESIG=4

### $\Upsilon(11020)$ PARTIAL WIDTHS

NODE=M093220

| $\Gamma(e^+e^-)$                                |             |      |         |                                     | $\Gamma_1$ |
|-------------------------------------------------|-------------|------|---------|-------------------------------------|------------|
| VALUE (keV)                                     | DOCUMENT ID | TECN | COMMENT |                                     |            |
| <b><math>0.130 \pm 0.030</math> OUR AVERAGE</b> |             |      |         |                                     |            |
| $0.095 \pm 0.03$ $\pm 0.035$                    | BESSION     | 85   | CLEO    | $e^+e^- \rightarrow \text{hadrons}$ |            |
| $0.156 \pm 0.040$                               | LOVELOCK    | 85   | CUSB    | $e^+e^- \rightarrow \text{hadrons}$ |            |

NODE=M093W1  
NODE=M093W1

| $\Gamma(\chi_{bJ}(1P)\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ |             |      |         |                                     | $\Gamma_2/\Gamma$ |
|--------------------------------------------------------------|-------------|------|---------|-------------------------------------|-------------------|
| VALUE                                                        | DOCUMENT ID | TECN | COMMENT |                                     |                   |
| $(8.7 \pm 4.3^{+7.6}_{-6.6}) \times 10^{-3}$                 | YIN         | 18   | BELL    | $e^+e^- \rightarrow \text{hadrons}$ |                   |

NODE=M093R00  
NODE=M093R00

| $\Gamma(\chi_{b1}(1P)\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$                  |             |      |         |                                     | $\Gamma_3/\Gamma$ |
|-------------------------------------------------------------------------------|-------------|------|---------|-------------------------------------|-------------------|
| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT |                                     |                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |         |                                     |                   |
| seen                                                                          | YIN         | 18   | BELL    | $e^+e^- \rightarrow \text{hadrons}$ |                   |

NODE=M093R01  
NODE=M093R01

| $\Gamma(\chi_{b2}(1P)\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$                  |             |      |         |                                     | $\Gamma_4/\Gamma$ |
|-------------------------------------------------------------------------------|-------------|------|---------|-------------------------------------|-------------------|
| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT |                                     |                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |         |                                     |                   |
| seen                                                                          | YIN         | 18   | BELL    | $e^+e^- \rightarrow \text{hadrons}$ |                   |

NODE=M093R02  
NODE=M093R02

| $\Gamma(\chi_{b2}(1P)\pi^+\pi^-\pi^0)/\Gamma(\chi_{b1}(1P)\pi^+\pi^-\pi^0)$ |             |      |         |                                     | $\Gamma_4/\Gamma_3$ |
|-----------------------------------------------------------------------------|-------------|------|---------|-------------------------------------|---------------------|
| VALUE                                                                       | DOCUMENT ID | TECN | COMMENT |                                     |                     |
| $0.4 \pm 0.2$                                                               | YIN         | 18   | BELL    | $e^+e^- \rightarrow \text{hadrons}$ |                     |

NODE=M093R03  
NODE=M093R03

### $\Upsilon(11020)$ REFERENCES

NODE=M093

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