

# $\phi(1020)$

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

## $\phi(1020)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
<b>1019.455 ± 0.020 OUR AVERAGE</b>				
Error includes scale factor of 1.1.				
1019.30 ± 0.02 ± 0.10	105k	AKHMETSHIN 06	CMD2	0.98–1.06 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$
1019.52 ± 0.05 ± 0.05	17.4k	AKHMETSHIN 05	CMD2	0.60–1.38 $e^+e^- \rightarrow \eta\gamma$
1019.483 ± 0.011 ± 0.025	272k	<sup>1</sup> AKHMETSHIN 04	CMD2	$e^+e^- \rightarrow K_L^0 K_S^0$
1019.42 ± 0.05	1900k	<sup>2</sup> ACHASOV 01E	SND	$e^+e^- \rightarrow K^+K^-$ , $K_S K_L$ , $\pi^+\pi^-\pi^0$
1019.40 ± 0.04 ± 0.05	23k	AKHMETSHIN 01B	CMD2	$e^+e^- \rightarrow \eta\gamma$
1019.36 ± 0.12		<sup>3</sup> ACHASOV 00B	SND	$e^+e^- \rightarrow \eta\gamma$
1019.38 ± 0.07 ± 0.08	2200	<sup>4</sup> AKHMETSHIN 99F	CMD2	$e^+e^- \rightarrow \pi^+\pi^- \geq 2\gamma$
1019.51 ± 0.07 ± 0.10	11169	AKHMETSHIN 98	CMD2	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$
1019.5 ± 0.4		BARBERIS 98	OMEG	450 $pp \rightarrow pp2K^+2K^-$
1019.42 ± 0.06	55600	AKHMETSHIN 95	CMD2	$e^+e^- \rightarrow$ hadrons
1019.7 ± 0.3	2012	DAVENPORT 86	MPSF	400 $pA \rightarrow 4KX$
1019.7 ± 0.1 ± 0.1	5079	ALBRECHT 85D	ARG	10 $e^+e^- \rightarrow K^+K^-X$
1019.3 ± 0.1	1500	ARENTON 82	AEMS	11.8 polar. $pp \rightarrow KK$
1019.67 ± 0.17	25080	<sup>5</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. ● ● ●				
1019.441 ± 0.008 ± 0.080	542k	<sup>6</sup> AKHMETSHIN 08	CMD2	1.02 $e^+e^- \rightarrow K^+K^-$
1019.63 ± 0.07	12540	<sup>7</sup> AUBERT,B 05J	BABR	$D^0 \rightarrow \bar{K}^0 K^+ K^-$
1019.8 ± 0.7		ARMSTRONG 86	OMEG	85 $\pi^+ / pp \rightarrow \pi^+ / p4Kp$
1020.1 ± 0.11	5526	<sup>7</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>8</sup> DIJKSTRA 86	SPEC	100–200 $\pi^\pm, \bar{p}, p, K^\pm$ , on Be
1020.9 ± 0.2		<sup>7</sup> FRAME 86	OMEG	13 $K^+ p \rightarrow \phi K^+ p$
1021.0 ± 0.2		<sup>7</sup> ARMSTRONG 83B	OMEG	18.5 $K^- p \rightarrow K^- K^+ \Lambda$
1020.0 ± 0.5		<sup>7</sup> ARMSTRONG 83B	OMEG	18.5 $K^- p \rightarrow K^- K^+ \Lambda$
1019.7 ± 0.3		<sup>7</sup> BARATE 83	GOLI	190 $\pi^- Be \rightarrow 2\mu X$
1019.8 ± 0.2 ± 0.5	766	IVANOV 81	OLYA	1–1.4 $e^+e^- \rightarrow K^+K^-$
1019.4 ± 0.5	337	COOPER 78B	HBC	0.7–0.8 $\bar{p}p \rightarrow K_S^0 K_L^0 \pi^+ \pi^-$
1020 ± 1	383	<sup>7</sup> BALDI 77	CNTR	10 $\pi^- p \rightarrow \pi^- \phi p$

1018.9 ±0.6	800	COHEN	77	ASPK	$6 \pi^\pm N \rightarrow K^+ K^- N$
1019.7 ±0.5	454	KALBFLEISCH	76	HBC	$2.18 K^- p \rightarrow \Lambda K \bar{K}$
1019.4 ±0.8	984	BESCH	74	CNTR	$2 \gamma p \rightarrow p K^+ K^-$
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>9</sup> AGUILAR-...	72B	HBC	$3.9, 4.6 K^- p \rightarrow \Lambda K^+ K^-$
1019.9 ±0.5	100	<sup>9</sup> AGUILAR-...	72B	HBC	$3.9, 4.6 K^- p \rightarrow K^- p K^+ K^-$
1020.4 ±0.5	131	COLLEY	72	HBC	$10 K^+ p \rightarrow K^+ p \phi$
1019.9 ±0.3	410	STOTTLE...	71	HBC	$2.9 K^- p \rightarrow \Sigma / \Lambda K \bar{K}$

<sup>1</sup> Update of AKHMETSHIN 99D

<sup>2</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>3</sup> Using a total width of  $4.43 \pm 0.05$  MeV. Systematic uncertainty included.

<sup>4</sup> Using a total width of  $4.43 \pm 0.05$  MeV.

<sup>5</sup> PELLINEN 82 review includes AKERLOF 77, DAUM 81, BALDI 77, AYRES 74, DE-GROOT 74.

<sup>6</sup> Strongly correlated with AKHMETSHIN 04.

<sup>7</sup> Systematic errors not evaluated.

<sup>8</sup> Weighted and scaled average of 12 measurements of DIJKSTRA 86.

<sup>9</sup> Mass errors enlarged by us to  $\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.

### $\phi(1020)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
<b>4.26 ±0.04 OUR AVERAGE</b>		Error includes scale factor of 1.4. See the ideogram below.		
4.30 ±0.06 ±0.17	105k	AKHMETSHIN 06	CMD2	$0.98-1.06 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$
4.280 ±0.033 ±0.025	272k	<sup>10</sup> AKHMETSHIN 04	CMD2	$e^+ e^- \rightarrow K_L^0 K_S^0$
4.21 ±0.04	1900k	<sup>11</sup> ACHASOV 01E	SND	$e^+ e^- \rightarrow K^+ K^-, K_S K_L, \pi^+ \pi^- \pi^0$
4.44 ±0.09	55600	AKHMETSHIN 95	CMD2	$e^+ e^- \rightarrow$ hadrons
4.5 ±0.7	1500	ARENTON 82	AEMS	11.8 polar. $pp \rightarrow KK$
4.2 ±0.6	766	<sup>12</sup> IVANOV 81	OLYA	$1-1.4 e^+ e^- \rightarrow K^+ K^-$
4.3 ±0.6		<sup>12</sup> CORDIER 80	DM1	$e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$
4.36 ±0.29	3681	<sup>12</sup> BUKIN 78C	OLYA	$e^+ e^- \rightarrow$ hadrons
4.4 ±0.6	984	<sup>12</sup> BESCH 74	CNTR	$2 \gamma p \rightarrow p K^+ K^-$
4.67 ±0.72	681	<sup>12</sup> BALAKIN 71	OSPK	$e^+ e^- \rightarrow$ hadrons
4.09 ±0.29		BIZOT 70	OSPK	$e^+ e^- \rightarrow$ hadrons
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
4.24 ±0.02 ±0.03	542k	<sup>13</sup> AKHMETSHIN 08	CMD2	$1.02 e^+ e^- \rightarrow K^+ K^-$
4.28 ±0.13	12540	<sup>14</sup> AUBERT,B 05J	BABR	$D^0 \rightarrow \bar{K}^0 K^+ K^-$
4.45 ±0.06	271k	DIJKSTRA 86	SPEC	100 $\pi^-$ Be
3.6 ±0.8	337	<sup>12</sup> COOPER 78B	HBC	$0.7-0.8 \bar{p} p \rightarrow K_S^0 K_L^0 \pi^+ \pi^-$

4.5 ±0.50	1300	<sup>12,14</sup> AKERLOF	77	SPEC	400 pA → K <sup>+</sup> K <sup>-</sup> X
4.5 ±0.8	500	<sup>12,14</sup> AYRES	74	ASPK	3-6 π <sup>-</sup> p → K <sup>+</sup> K <sup>-</sup> n, K <sup>-</sup> p → K <sup>+</sup> K <sup>-</sup> Λ/Σ <sup>0</sup>
3.81 ±0.37		COSME	74B	OSPK	e <sup>+</sup> e <sup>-</sup> → K <sub>L</sub> <sup>0</sup> K <sub>S</sub> <sup>0</sup>
3.8 ±0.7	454	<sup>12</sup> BORENSTEIN	72	HBC	2.18 K <sup>-</sup> p → K K̄ n

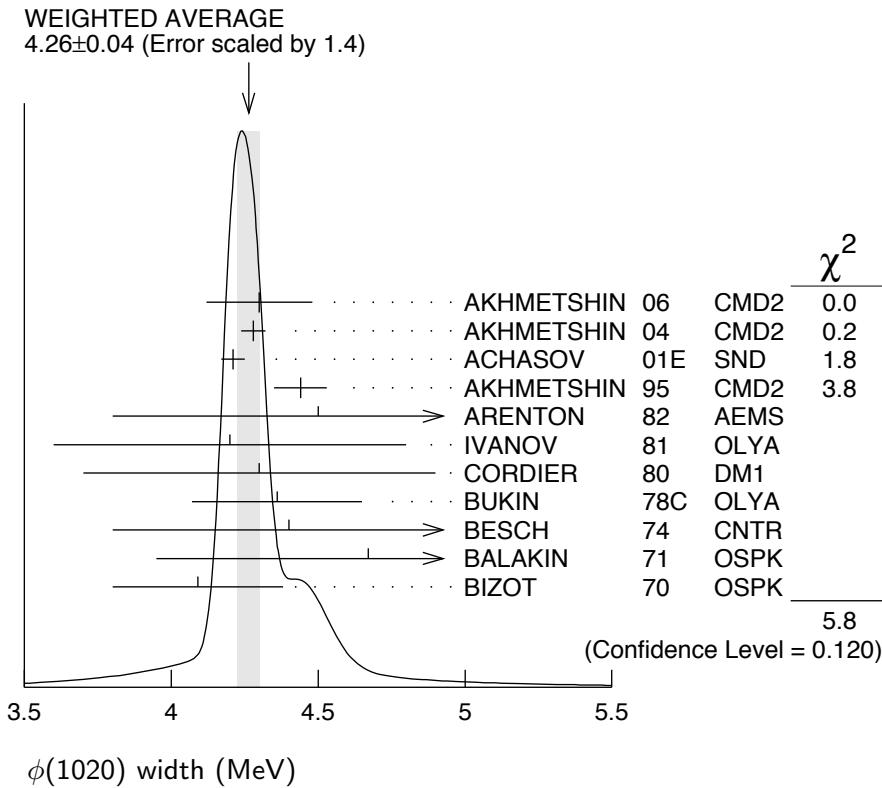
<sup>10</sup> Update of AKHMETSHIN 99D

<sup>11</sup> From the combined fit assuming that the total φ(1020) production cross section is saturated by those of K<sup>+</sup> K<sup>-</sup>, K<sub>S</sub> K<sub>L</sub>, π<sup>+</sup> π<sup>-</sup> π<sup>0</sup>, and ηγ decays modes and using ACHASOV 00B for the ηγ decay mode.

<sup>12</sup> Width errors enlarged by us to 4Γ/√N; see the note with the K\*(892) mass.

<sup>13</sup> Strongly correlated with AKHMETSHIN 04.

<sup>14</sup> Systematic errors not evaluated.



### φ(1020) DECAY MODES

Mode	Fraction (Γ <sub>i</sub> /Γ)	Scale factor/ Confidence level
Γ <sub>1</sub> K <sup>+</sup> K <sup>-</sup>	(48.9 ±0.5 ) %	S=1.1
Γ <sub>2</sub> K <sub>L</sub> <sup>0</sup> K <sub>S</sub> <sup>0</sup>	(34.2 ±0.4 ) %	S=1.1
Γ <sub>3</sub> ρπ + π <sup>+</sup> π <sup>-</sup> π <sup>0</sup>	(15.32 ±0.32 ) %	S=1.1
Γ <sub>4</sub> ρπ		
Γ <sub>5</sub> π <sup>+</sup> π <sup>-</sup> π <sup>0</sup>		
Γ <sub>6</sub> ηγ	( 1.309±0.024 ) %	S=1.2
Γ <sub>7</sub> π <sup>0</sup> γ	( 1.27 ±0.06 ) × 10 <sup>-3</sup>	

$\Gamma_8$	$\ell^+ \ell^-$	—	
$\Gamma_9$	$e^+ e^-$	$( 2.954 \pm 0.030 ) \times 10^{-4}$	S=1.1
$\Gamma_{10}$	$\mu^+ \mu^-$	$( 2.87 \pm 0.19 ) \times 10^{-4}$	
$\Gamma_{11}$	$\eta e^+ e^-$	$( 1.15 \pm 0.10 ) \times 10^{-4}$	
$\Gamma_{12}$	$\pi^+ \pi^-$	$( 7.4 \pm 1.3 ) \times 10^{-5}$	
$\Gamma_{13}$	$\omega \pi^0$	$( 4.7 \pm 0.5 ) \times 10^{-5}$	
$\Gamma_{14}$	$\omega \gamma$	$< 5$	% CL=84%
$\Gamma_{15}$	$\rho \gamma$	$< 1.2$	$\times 10^{-5}$ CL=90%
$\Gamma_{16}$	$\pi^+ \pi^- \gamma$	$( 4.1 \pm 1.3 ) \times 10^{-5}$	
$\Gamma_{17}$	$f_0(980) \gamma$	$( 3.22 \pm 0.19 ) \times 10^{-4}$	S=1.1
$\Gamma_{18}$	$\pi^0 \pi^0 \gamma$	$( 1.13 \pm 0.06 ) \times 10^{-4}$	
$\Gamma_{19}$	$\pi^+ \pi^- \pi^+ \pi^-$	$( 4.0 \begin{smallmatrix} +2.8 \\ -2.2 \end{smallmatrix} ) \times 10^{-6}$	
$\Gamma_{20}$	$\pi^+ \pi^+ \pi^- \pi^- \pi^0$	$< 4.6$	$\times 10^{-6}$ CL=90%
$\Gamma_{21}$	$\pi^0 e^+ e^-$	$( 1.12 \pm 0.28 ) \times 10^{-5}$	
$\Gamma_{22}$	$\pi^0 \eta \gamma$	$( 7.27 \pm 0.30 ) \times 10^{-5}$	S=1.5
$\Gamma_{23}$	$a_0(980) \gamma$	$( 7.6 \pm 0.6 ) \times 10^{-5}$	
$\Gamma_{24}$	$K^0 \bar{K}^0 \gamma$	$< 1.9$	$\times 10^{-8}$ CL=90%
$\Gamma_{25}$	$\eta'(958) \gamma$	$( 6.25 \pm 0.21 ) \times 10^{-5}$	
$\Gamma_{26}$	$\eta \pi^0 \pi^0 \gamma$	$< 2$	$\times 10^{-5}$ CL=90%
$\Gamma_{27}$	$\mu^+ \mu^- \gamma$	$( 1.4 \pm 0.5 ) \times 10^{-5}$	
$\Gamma_{28}$	$\rho \gamma \gamma$	$< 1.2$	$\times 10^{-4}$ CL=90%
$\Gamma_{29}$	$\eta \pi^+ \pi^-$	$< 1.8$	$\times 10^{-5}$ CL=90%
$\Gamma_{30}$	$\eta \mu^+ \mu^-$	$< 9.4$	$\times 10^{-6}$ CL=90%

## CONSTRAINED FIT INFORMATION

An overall fit to 30 branching ratios uses 79 measurements and one constraint to determine 14 parameters. The overall fit has a  $\chi^2 = 57.4$  for 66 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.

$x_2$	-72										
$x_3$	-53	-21									
$x_6$	-13	7	2								
$x_7$	-5	3	1	5							
$x_9$	30	-25	-10	-32	-15						
$x_{10}$	-4	3	1	3	2	-11					
$x_{12}$	-2	1	0	2	1	-5	1				
$x_{13}$	-2	2	1	2	1	-7	1	0			
$x_{17}$	0	0	0	0	0	0	0	0	0		
$x_{18}$	-6	4	2	17	3	-17	2	1	1	0	
$x_{19}$	0	0	0	0	0	-1	0	0	0	0	0
$x_{23}$	0	0	0	0	0	0	0	0	0	0	0
$x_{25}$	-4	2	1	32	2	-10	1	1	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									
$x_{25}$	5	0	0								
	$x_{18}$	$x_{19}$	$x_{23}$								

## $\phi(1020)$ PARTIAL WIDTHS

### $\Gamma(\eta\gamma)$ $\Gamma_6$

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

### $\Gamma(\pi^0\gamma)$ $\Gamma_7$

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

$\Gamma(\ell^+ \ell^-)$   $\Gamma_8$

VALUE (keV)	DOCUMENT ID	TECN	COMMENT
$1.320 \pm 0.017 \pm 0.015$	<sup>15</sup> AMBROSINO 05	KLOE	$1.02 e^+ e^- \rightarrow \mu^+ \mu^-$

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

VALUE (keV)	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>1.27 \pm 0.04</math> OUR EVALUATION</b>				
<b><math>1.32 \pm 0.05 \pm 0.03</math></b>		<sup>16</sup> AMBROSINO 05	KLOE	$1.02 e^+ e^- \rightarrow e^+ e^-$
$1.27 \pm 0.03$	272k	<sup>17</sup> AKHMETSHIN 04	CMD2	$e^+ e^- \rightarrow K_L^0 K_S^0$

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

VALUE (keV)	DOCUMENT ID	TECN	COMMENT
<b><math>1.320 \pm 0.018 \pm 0.017</math></b>	AMBROSINO 05	KLOE	$1.02 e^+ e^- \rightarrow \mu^+ \mu^-$
<sup>15</sup> Weighted average of $\Gamma_{ee}$ and $\sqrt{\Gamma_{ee} \Gamma_{\mu\mu}}$ from AMBROSINO 05 assuming lepton universality.			
<sup>16</sup> From forward-backward asymmetry and using $\Gamma_{\text{total}} = 4.26 \pm 0.05$ MeV from the 2004 edition of this Review.			
<sup>17</sup> Using $B(\phi \rightarrow K_L^0 K_S^0) = 0.337 \pm 0.005$ and $\Gamma_{\text{total}} = 4.26 \pm 0.05$ MeV. Update of AKHMETSHIN 99D.			

$\phi(1020) \Gamma(i) \Gamma(e^+ e^-) / \Gamma^2(\text{total})$

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

VALUE (units $10^{-5}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>14.46 \pm 0.23</math> OUR FIT</b>	Error includes scale factor of 1.1.			
<b><math>14.24 \pm 0.30</math> OUR AVERAGE</b>				
$14.27 \pm 0.05 \pm 0.31$	542k	AKHMETSHIN 08	CMD2	$1.02 e^+ e^- \rightarrow K^+ K^-$
$13.93 \pm 0.14 \pm 0.99$	1000k	<sup>18</sup> ACHASOV 01E	SND	$e^+ e^- \rightarrow K^+ K^-, K_S^0 K_L^0, \pi^+ \pi^- \pi^0$

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

VALUE (units $10^{-5}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>10.10 \pm 0.13</math> OUR FIT</b>				
<b><math>10.06 \pm 0.16</math> OUR AVERAGE</b>				
$10.01 \pm 0.04 \pm 0.17$	272k	<sup>19</sup> AKHMETSHIN 04	CMD2	$e^+ e^- \rightarrow K_L^0 K_S^0$
$10.27 \pm 0.07 \pm 0.34$	500k	<sup>18</sup> ACHASOV 01E	SND	$e^+ e^- \rightarrow K^+ K^-, K_S^0 K_L^0, \pi^+ \pi^- \pi^0$

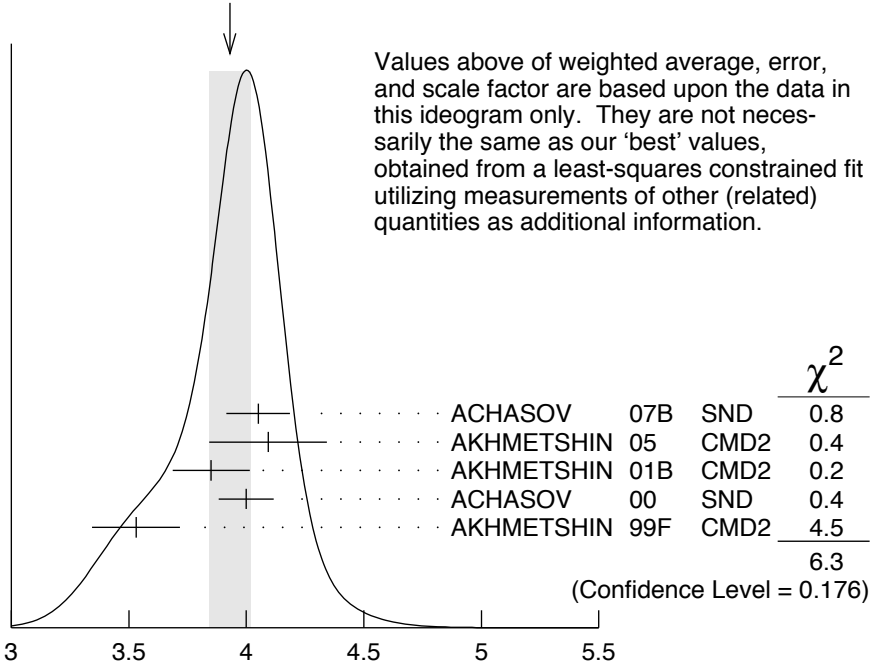
$[\Gamma(\rho\pi) + \Gamma(\pi^+ \pi^- \pi^0)] / \Gamma_{\text{total}} \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$   $\Gamma_3 / \Gamma \times \Gamma_9 / \Gamma$

VALUE (units $10^{-5}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>4.53 \pm 0.10</math> OUR FIT</b>	Error includes scale factor of 1.1.			
<b><math>4.46 \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>18</sup> ACHASOV 01E	SND	$e^+ e^- \rightarrow K^+ K^-, K_S^0 K_L^0, \pi^+ \pi^- \pi^0$
$4.35 \pm 0.27 \pm 0.08$	11169	<sup>20</sup> AKHMETSHIN 98	CMD2	$e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$

$\Gamma(\eta\gamma)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_6/\Gamma \times \Gamma_9/\Gamma$

VALUE (units $10^{-6}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>3.87 ± 0.07</b>				<b>OUR FIT</b> Error includes scale factor of 1.2.
<b>3.93 ± 0.09</b>				<b>OUR AVERAGE</b> Error includes scale factor of 1.3. See the ideogram below.
4.050 ± 0.067 ± 0.118	33k	<sup>21</sup> ACHASOV	07B SND	0.6–1.38 $e^+e^- \rightarrow \eta\gamma$
4.093 <sup>+0.040</sup> <sub>-0.043</sub> ± 0.247	17.4k	<sup>22</sup> AKHMETSHIN	05 CMD2	0.60–1.38 $e^+e^- \rightarrow \eta\gamma$
3.850 ± 0.041 ± 0.159	23k	<sup>23,24</sup> AKHMETSHIN	01B CMD2	$e^+e^- \rightarrow \eta\gamma$
4.00 ± 0.04 ± 0.11		<sup>25</sup> ACHASOV	00 SND	$e^+e^- \rightarrow \eta\gamma$
3.53 ± 0.08 ± 0.17	2200	<sup>26,27</sup> AKHMETSHIN	99F CMD2	$e^+e^- \rightarrow \eta\gamma$

WEIGHTED AVERAGE  
3.93±0.09 (Error scaled by 1.3)



Values above of weighted average, error, and scale factor are based upon the data in this ideogram only. They are not necessarily the same as our 'best' values, obtained from a least-squares constrained fit utilizing measurements of other (related) quantities as additional information.

$\Gamma(\eta\gamma)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_6/\Gamma \times \Gamma_9/\Gamma$

$\Gamma(\pi^0\gamma)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_7/\Gamma \times \Gamma_9/\Gamma$

VALUE (units $10^{-7}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>3.74 ± 0.18</b>				<b>OUR FIT</b>
<b>3.71 ± 0.21</b>				<b>OUR AVERAGE</b>
3.75 ± 0.11 ± 0.29	18680	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>		<sup>28</sup> ACHASOV	00 SND	$e^+e^- \rightarrow \pi^0\gamma$

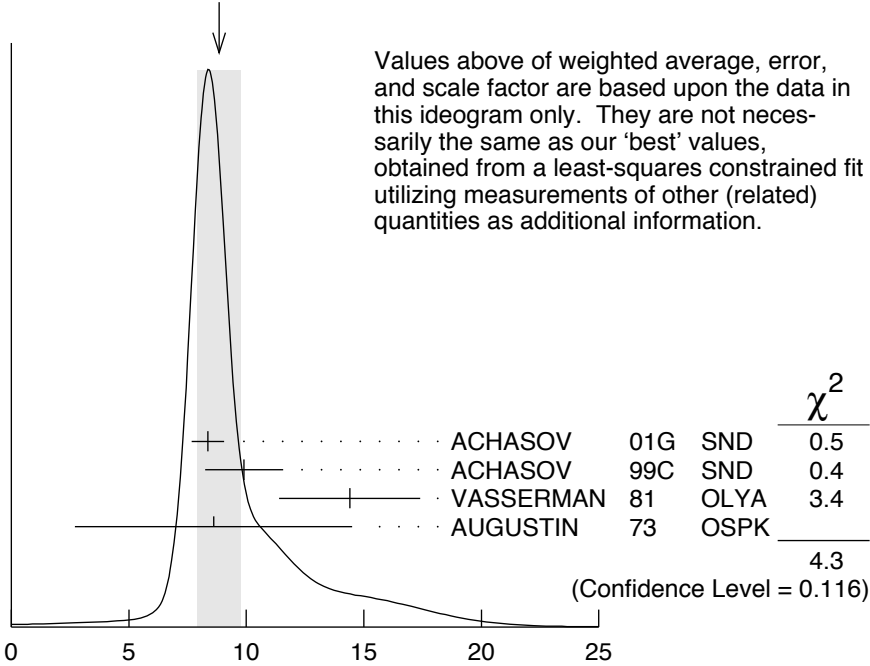
$\Gamma(\mu^+\mu^-)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_{10}/\Gamma \times \Gamma_9/\Gamma$

VALUE (units $10^{-8}$ )	DOCUMENT ID	TECN	COMMENT
<b>8.5<sup>+0.5</sup><sub>-0.6</sub></b>			<b>OUR FIT</b>
<b>8.8 ± 0.9</b>			<b>OUR AVERAGE</b> 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	<sup>26</sup> ACHASOV	99C SND	$e^+e^- \rightarrow \mu^+\mu^-$

14.4 ± 3.0  
8.6 ± 5.9

20 VASSERMAN 81 OLYA  $e^+e^- \rightarrow \mu^+\mu^-$   
20 AUGUSTIN 73 OSPK  $e^+e^- \rightarrow \mu^+\mu^-$

WEIGHTED AVERAGE  
8.8±0.9 (Error scaled by 1.5)



$$\Gamma(\mu^+\mu^-)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \qquad \Gamma_{10}/\Gamma \times \Gamma_9/\Gamma$$

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

VALUE (units $10^{-8}$ )	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	26 ACHASOV	00C	SND $e^+e^- \rightarrow \pi^+\pi^-$
1.95 <sup>+1.15</sup> <sub>-0.87</sub>	20 GOLUBEV	86	ND $e^+e^- \rightarrow \pi^+\pi^-$
6.01 <sup>+3.19</sup> <sub>-2.51</sub>	20 VASSERMAN	81	OLYA $e^+e^- \rightarrow \pi^+\pi^-$

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

VALUE (units $10^{-8}$ )	DOCUMENT ID	TECN	COMMENT
<b>1.40 ± 0.15 OUR FIT</b>			
<b>1.37 ± 0.17 ± 0.01</b>	29,30 AMBROSINO	08G	KLOE $e^+e^- \rightarrow \pi^+\pi^-2\pi^0, 2\pi^0\gamma$

$$\Gamma(\pi^0\pi^0\gamma)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \qquad \Gamma_{18}/\Gamma \times \Gamma_9/\Gamma$$

VALUE (units $10^{-8}$ )	DOCUMENT ID	TECN	COMMENT
<b>3.34 ± 0.17 OUR FIT</b>			
<b>3.33<sup>+0.04+0.19</sup><sub>-0.09-0.20</sub></b>	31 AMBROSINO	07	KLOE $e^+e^- \rightarrow \pi^0\pi^0\gamma$



$\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$					$\Gamma_{19}/\Gamma \times \Gamma_9/\Gamma$
VALUE (units $10^{-9}$ )	EVTS	DOCUMENT ID	TECN	COMMENT	

**1.2  $^{+0.8}_{-0.7}$  OUR FIT**

**1.17 ± 0.52 ± 0.64**    3285    <sup>26</sup> AKHMETSHIN 00E    CMD2     $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$

<sup>18</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>19</sup> Update of AKHMETSHIN 99D

<sup>20</sup> Recalculated by us from the cross section in the peak.

<sup>21</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>22</sup> From the  $\eta \rightarrow 2\gamma$  decay and using  $B(\eta \rightarrow \gamma\gamma) = 39.43 \pm 0.26\%$ .

<sup>23</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>24</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>25</sup> From the  $\eta \rightarrow 2\gamma$  decay and using  $B(\eta \rightarrow 2\gamma) = (39.21 \pm 0.34) \times 10^{-2}$ .

<sup>26</sup> Recalculated by the authors from the cross section in the peak.

<sup>27</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>28</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>29</sup> Recalculated by the authors from the cross section at the peak.

<sup>30</sup> AMBROSINO 08G reports  $[\Gamma(\phi(1020) \rightarrow \omega\pi^0)/\Gamma_{\text{total}} \times \Gamma(\phi(1020) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\omega(782) \rightarrow \pi^+\pi^-\pi^0)] = (1.22 \pm 0.13 \pm 0.08) \times 10^{-8}$  which we divide by our best value  $B(\omega(782) \rightarrow \pi^+\pi^-\pi^0) = (89.2 \pm 0.7) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>31</sup> Calculated by the authors from the cross section at the peak.

**$\phi(1020)$  BRANCHING RATIOS**

$\Gamma(K^+K^-)/\Gamma_{\text{total}}$					$\Gamma_1/\Gamma$
VALUE	EVTS	DOCUMENT ID	TECN	COMMENT	

**0.489 ± 0.005 OUR FIT**    Error includes scale factor of 1.1.

**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. • • •

0.476 ± 0.017	1000k	<sup>32</sup> ACHASOV 01E	SND	$e^+e^- \rightarrow K^+K^-, K_S K_L, \pi^+\pi^-\pi^0$	
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$\Gamma(K_L^0 K_S^0)/\Gamma_{\text{total}}$   $\Gamma_2/\Gamma$

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.342±0.004 OUR FIT</b>				Error includes scale factor of 1.1.
<b>0.331±0.009 OUR AVERAGE</b>				
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. ● ● ●				
0.351±0.013	500k	<sup>32</sup> ACHASOV 01E	SND	$e^+ e^- \rightarrow K^+ K^-, K_S K_L, \pi^+ \pi^- \pi^0$
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	BALAKIN 71	OSPK	$e^+ e^- \rightarrow K_L^0 K_S^0$
0.40 ±0.04	167	LINDSEY 66	HBC	$2.1-2.7 K^- p \rightarrow \Lambda K_L^0 K_S^0$

$\Gamma(K_L^0 K_S^0)/\Gamma(K^+ K^-)$   $\Gamma_2/\Gamma_1$

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.698±0.014 OUR FIT</b>				Error includes scale factor of 1.1.
<b>0.740±0.031 OUR AVERAGE</b>				
0.70 ±0.06	2732	BUKIN 78C	OLYA	$e^+ e^- \rightarrow K_L^0 K_S^0$
0.82 ±0.08		LOSTY 78	HBC	$4.2 K^- p \rightarrow \phi \text{hyperon}$
0.71 ±0.05		LAVEN 77	HBC	$10 K^- p \rightarrow K^+ K^- \Lambda$
0.71 ±0.08		LYONS 77	HBC	$3-4 K^- p \rightarrow \Lambda \phi$
0.89 ±0.10	144	AGUILAR-...	72B HBC	$3.9, 4.6 K^- p$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.68 ±0.03		<sup>33</sup> AKHMETSHIN 95	CMD2	$e^+ e^- \rightarrow K_L^0 K_S^0, K^+ K^-$

$\Gamma(K_L^0 K_S^0)/\Gamma(K\bar{K})$   $\Gamma_2/(\Gamma_1+\Gamma_2)$

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.411±0.005 OUR FIT</b>				Error includes scale factor of 1.1.
<b>0.45 ±0.04 OUR AVERAGE</b>				
0.44 ±0.07		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	$1.95 K^- p \rightarrow \Lambda K\bar{K}$

$[\Gamma(\rho\pi) + \Gamma(\pi^+ \pi^- \pi^0)]/\Gamma_{\text{total}}$   $\Gamma_3/\Gamma$

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.1532±0.0032 OUR FIT</b>				Error includes scale factor of 1.1.
<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. ● ● ●				
0.159 ±0.008	400k	<sup>32</sup> ACHASOV 01E	SND	$e^+ e^- \rightarrow K^+ K^-, K_S K_L, \pi^+ \pi^- \pi^0$
0.145 ±0.009 ±0.003	11169	<sup>34</sup> AKHMETSHIN 98	CMD2	$e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$
0.139 ±0.007		<sup>35</sup> PARROUR 76B	OSPK	$e^+ e^-$

$[\Gamma(\rho\pi) + \Gamma(\pi^+\pi^-\pi^0)]/\Gamma(K^+K^-)$   $\Gamma_3/\Gamma_1$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
<b>0.313±0.009 OUR FIT</b>				Error includes scale factor of 1.1.
<b>0.28 ±0.09</b>	34	AGUILAR-...	72B HBC	3.9,4.6 $K^-p$

$[\Gamma(\rho\pi) + \Gamma(\pi^+\pi^-\pi^0)]/\Gamma(K\bar{K})$   $\Gamma_3/(\Gamma_1+\Gamma_2)$

VALUE	DOCUMENT ID	TECN	COMMENT
<b>0.184±0.005 OUR FIT</b>			Error includes scale factor of 1.1.
<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 $K^-p \rightarrow \Lambda \pi^+\pi^-\pi^0$

$[\Gamma(\rho\pi) + \Gamma(\pi^+\pi^-\pi^0)]/\Gamma(K_L^0 K_S^0)$   $\Gamma_3/\Gamma_2$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
<b>0.448±0.012 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	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{total}$   $\Gamma_5/\Gamma$

VALUE	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
≈ 0.0087		1.98M <sup>36,37</sup>	ALOISIO 03	KLOE	1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$
<0.0006	90		<sup>38</sup> ACHASOV 02	SND	1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$
<0.23	90		<sup>38</sup> CORDIER 80	DM1	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$
<0.20	90		<sup>38</sup> PARROUR 76B	OSPK	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$

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

VALUE (units 10 <sup>-2</sup> )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>1.309±0.024 OUR FIT</b>				Error includes scale factor of 1.2.
<b>1.26 ±0.04 OUR AVERAGE</b>				
1.246±0.025±0.057	10k	<sup>39</sup> ACHASOV 98F	SND	$e^+e^- \rightarrow 7\gamma$
1.18 ±0.11	279	<sup>40</sup> AKHMETSHIN 95	CMD2	$e^+e^- \rightarrow \pi^+\pi^-3\gamma$
1.30 ±0.06		<sup>41</sup> DRUZHININ 84	ND	$e^+e^- \rightarrow 3\gamma$
1.4 ±0.2		<sup>42</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>41</sup> COSME 76	OSPK	$e^+e^-$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
1.37 ±0.05 ±0.01	33k	<sup>43</sup> ACHASOV 07B	SND	0.6–1.38 $e^+e^- \rightarrow \eta\gamma$
1.373±0.014±0.085	17.4k	<sup>44,45</sup> AKHMETSHIN 05	CMD2	0.60-1.38 $e^+e^- \rightarrow \eta\gamma$
1.287±0.013±0.063		<sup>46,47</sup> AKHMETSHIN 01B	CMD2	$e^+e^- \rightarrow \eta\gamma$
1.338±0.012±0.052		<sup>48</sup> ACHASOV 00	SND	$e^+e^- \rightarrow \eta\gamma$
1.18 ±0.03 ±0.06	2200	<sup>49</sup> AKHMETSHIN 99F	CMD2	$e^+e^- \rightarrow \eta\gamma$
1.21 ±0.07		<sup>50</sup> BENAYOUN 96	RVUE	0.54-1.04 $e^+e^- \rightarrow \eta\gamma$

$\Gamma(\pi^0\gamma)/\Gamma_{\text{total}}$   $\Gamma_7/\Gamma$

VALUE (units $10^{-3}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>1.27 ± 0.06</b>				<b>OUR FIT</b>
<b>1.31 ± 0.13</b>				<b>OUR AVERAGE</b>
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. ● ● ●				
1.258 ± 0.037 ± 0.077	18680	<sup>51,52</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>53</sup> ACHASOV 00	SND	$e^+e^- \rightarrow \pi^0\gamma$
1.26 ± 0.17		<sup>50</sup> BENAYOUN 96	RVUE	0.54-1.04 $e^+e^- \rightarrow \pi^0\gamma$

$\Gamma(\eta\gamma)/\Gamma(\pi^0\gamma)$   $\Gamma_6/\Gamma_7$

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	$e^+e^- \rightarrow \eta\gamma, \pi^0\gamma$

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

VALUE (units $10^{-4}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>2.954 ± 0.030</b>				<b>OUR FIT</b> Error includes scale factor of 1.1.
<b>2.98 ± 0.07</b>				<b>OUR AVERAGE</b> Error includes scale factor of 1.1.
2.93 ± 0.14	1900k	<sup>54</sup> ACHASOV 01E	SND	$e^+e^- \rightarrow K^+K^-, K_S^0K_L^0, \pi^+\pi^-\pi^0$
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>55</sup> PARROUR 76	OSPK	$e^+e^-$
3.3 ± 0.3		COSME 74	OSPK	$e^+e^- \rightarrow \text{hadrons}$
2.81 ± 0.25	681	BALAKIN 71	OSPK	$e^+e^- \rightarrow \text{hadrons}$
3.50 ± 0.27		CHATELUS 71	OSPK	$e^+e^-$

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

VALUE (units $10^{-4}$ )	DOCUMENT ID	TECN	COMMENT
<b>2.87 ± 0.19</b>			<b>OUR FIT</b>
<b>2.5 ± 0.4</b>			<b>OUR AVERAGE</b>
2.69 ± 0.46	<sup>56</sup> HAYES 71	CNTR	8.3, 9.8 $\gamma C \rightarrow \mu^+\mu^- X$
2.17 ± 0.60	<sup>56</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>57</sup> ACHASOV 01G	SND	$e^+e^- \rightarrow \mu^+\mu^-$
3.30 ± 0.45 ± 0.32	<sup>34</sup> ACHASOV 99C	SND	$e^+e^- \rightarrow \mu^+\mu^-$
4.83 ± 1.02	<sup>58</sup> VASSERMAN 81	OLYA	$e^+e^- \rightarrow \mu^+\mu^-$
2.87 ± 1.98	<sup>58</sup> AUGUSTIN 73	OSPK	$e^+e^- \rightarrow \mu^+\mu^-$

$\Gamma(\eta e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_{11}/\Gamma$

VALUE (units $10^{-4}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>1.15 ± 0.10</b>				<b>OUR AVERAGE</b>
1.19 ± 0.19 ± 0.12	213	<sup>59</sup> ACHASOV 01B	SND	$e^+e^- \rightarrow \gamma\gamma e^+e^-$
1.14 ± 0.10 ± 0.06	355	<sup>60</sup> AKHMETSHIN 01	CMD2	$e^+e^- \rightarrow \eta e^+e^-$
1.3 <sup>+0.8</sup> / <sub>-0.6</sub>	7	GOLUBEV 85	ND	$e^+e^- \rightarrow \gamma\gamma e^+e^-$

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

1.13±0.14±0.07	183	61	AKHMETSHIN 01	CMD2	$e^+e^- \rightarrow \eta e^+e^-$
1.21±0.14±0.09	130	62	AKHMETSHIN 01	CMD2	$e^+e^- \rightarrow \eta e^+e^-$
1.04±0.20±0.08	42	63	AKHMETSHIN 01	CMD2	$e^+e^- \rightarrow \eta e^+e^-$

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

$\Gamma_{12}/\Gamma$

VALUE (units $10^{-4}$ )	CL%	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.71±0.11±0.09		34	ACHASOV 00C	SND $e^+e^- \rightarrow \pi^+\pi^-$
0.65 <sup>+0.38</sup> <sub>-0.29</sub>		34	GOLUBEV 86	ND $e^+e^- \rightarrow \pi^+\pi^-$
2.01 <sup>+1.07</sup> <sub>-0.84</sub>		34	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 $\gamma C \rightarrow C\pi^+\pi^-$

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

$\Gamma_{13}/\Gamma$

VALUE (units $10^{-5}$ )	DOCUMENT ID	TECN	COMMENT
<b>4.7±0.5 OUR FIT</b>			
5.2 <sup>+1.3</sup> <sub>-1.1</sub>	64,65	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±0.6	66	AMBROSINO 08G	KLOE $e^+e^- \rightarrow \pi^+\pi^-\pi^0, 2\pi^0\gamma$
~ 5.4	67	ACHASOV 00E	SND $e^+e^- \rightarrow \pi^0\pi^0\gamma$
5.5 <sup>+1.6</sup> <sub>-1.4</sub> ±0.3	65,68	AULCHENKO 00A	SND $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0$
4.8 <sup>+1.9</sup> <sub>-1.7</sub> ±0.8	67	ACHASOV 99	SND $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0$

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

$\Gamma_{14}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.05	84	LINDSEY 66	HBC	2.1–2.7 $K^-p \rightarrow \Lambda\pi^+\pi^-$ neutrals

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

$\Gamma_{15}/\Gamma$

VALUE (units $10^{-4}$ )	CL%	DOCUMENT ID	TECN	COMMENT
< 0.12	90	69	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

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

$\Gamma_{16}/\Gamma$

VALUE (units $10^{-4}$ )	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<b>0.41±0.12±0.04</b>		30175	70	AKHMETSHIN 99B	CMD2 $e^+e^- \rightarrow \pi^+\pi^-\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
< 0.3	90		71	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

$\Gamma(f_0(980)\gamma)/\Gamma_{\text{total}}$   $\Gamma_{17}/\Gamma$

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 <sup>+0.03</sup> <sub>-0.09</sub> ±0.18		72	AMBROSINO 07	KLOE	$e^+e^- \rightarrow \pi^0\pi^0\gamma$
2.90±0.21±1.54		73	AKHMETSHIN 99C	CMD2	$e^+e^- \rightarrow \pi^+\pi^-\gamma, \pi^0\pi^0\gamma$

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

4.47±0.21	2438	74	ALOISIO 02D	KLOE	$e^+e^- \rightarrow \pi^0\pi^0\gamma$
3.5 ±0.3 <sup>+1.3</sup> <sub>-0.5</sub>	419	75,76	ACHASOV 00H	SND	$e^+e^- \rightarrow \pi^0\pi^0\gamma$
1.93±0.46±0.50	27188	77	AKHMETSHIN 99B	CMD2	$e^+e^- \rightarrow \pi^+\pi^-\gamma$
3.05±0.25±0.72	268	78	AKHMETSHIN 99C	CMD2	$e^+e^- \rightarrow \pi^0\pi^0\gamma$
1.5 ±0.5	268	79	AKHMETSHIN 99C	CMD2	$e^+e^- \rightarrow \pi^0\pi^0\gamma$
3.42±0.30±0.36	164	75	ACHASOV 98I	SND	$e^+e^- \rightarrow 5\gamma$
< 1	90	80	AKHMETSHIN 97C	CMD2	$e^+e^- \rightarrow \pi^+\pi^-\gamma$
< 7	90	81	AKHMETSHIN 97C	CMD2	$e^+e^- \rightarrow \pi^+\pi^-\gamma$
< 20	90		DRUZHININ 87	ND	$e^+e^- \rightarrow \pi^0\pi^0\gamma$

$\Gamma(f_0(980)\gamma)/\Gamma(\eta\gamma)$   $\Gamma_{17}/\Gamma_6$

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

**2.46±0.15 OUR FIT** Error includes scale factor of 1.1.

<b>2.6 ±0.2<sup>+0.8</sup></b> <b>-0.3</b>	419	75	ACHASOV 00H	SND	$e^+e^- \rightarrow \pi^0\pi^0\gamma$
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$\Gamma(\pi^0\pi^0\gamma)/\Gamma_{\text{total}}$   $\Gamma_{18}/\Gamma$

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>		82	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	76,83	ACHASOV 00H	SND	$e^+e^- \rightarrow \pi^0\pi^0\gamma$
<10	90		DRUZHININ 87	ND	$e^+e^- \rightarrow 5\gamma$

$\Gamma(\pi^0\pi^0\gamma)/\Gamma(\eta\gamma)$   $\Gamma_{18}/\Gamma_6$

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

**0.86 ±0.04 OUR FIT**

<b>0.865±0.070±0.017</b>	419	83	ACHASOV 00H	SND	$e^+e^- \rightarrow \pi^0\pi^0\gamma$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.90 ±0.08 ±0.07	164		ACHASOV 98I	SND	$e^+e^- \rightarrow 5\gamma$
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$\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{19}/\Gamma$

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

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

3.93±1.74±2.14	3285		AKHMETSHIN 00E	CMD2	$e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$
< 870	90		CORDIER 79	WIRE	$e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$

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

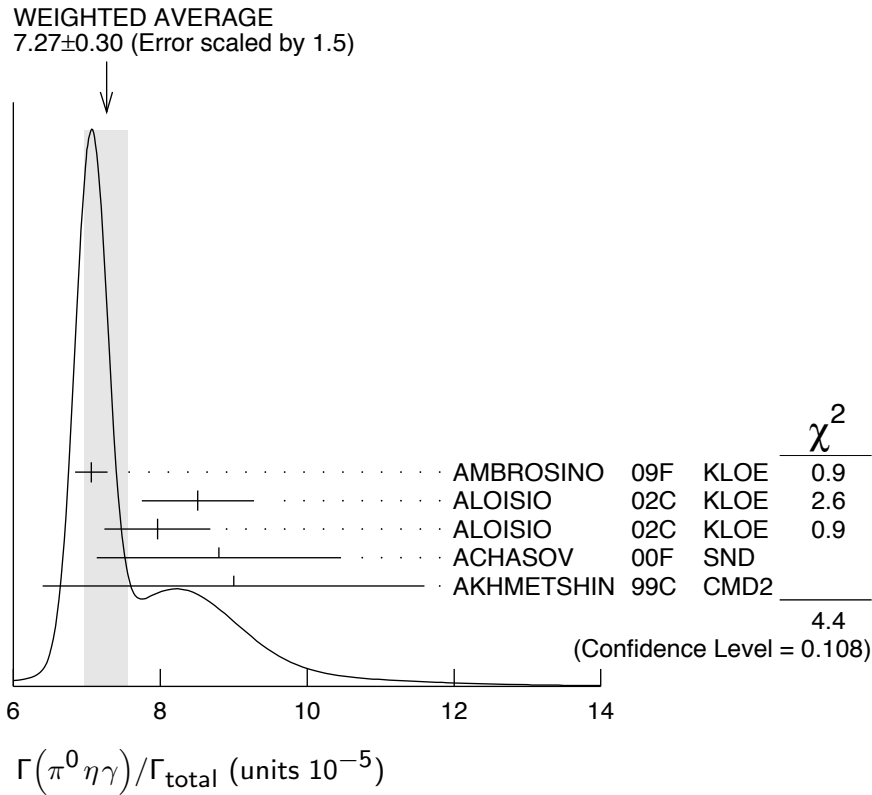
<u>VALUE (units <math>10^{-6}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt; 4.6</b>	90	AKHMETSHIN 00E	CMD2	$e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-\pi^0$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
<150	95	BARKOV	88	CMD $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-\pi^0$

$\Gamma(\pi^0 e^+ e^-)/\Gamma_{\text{total}}$   $\Gamma_{21}/\Gamma$

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>1.12±0.28 OUR AVERAGE</b>					
1.01±0.28±0.29		52	<sup>84</sup> ACHASOV	02D	SND $e^+e^- \rightarrow \pi^0 e^+ e^-$
1.22±0.34±0.21		46	<sup>85</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 $e^+e^- \rightarrow \pi^0 e^+ e^-$

$\Gamma(\pi^0 \eta \gamma)/\Gamma_{\text{total}}$   $\Gamma_{22}/\Gamma$

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>7.27±0.30 OUR AVERAGE</b> Error includes scale factor of 1.5. See the ideogram below.					
7.06±0.22		16.9k	<sup>86</sup> AMBROSINO	09F	KLOE $1.02 e^+e^- \rightarrow \eta\pi^0\gamma$
8.51±0.51±0.57		607	<sup>87</sup> ALOISIO	02C	KLOE $e^+e^- \rightarrow \eta\pi^0\gamma$
7.96±0.60±0.40		197	<sup>88</sup> ALOISIO	02C	KLOE $e^+e^- \rightarrow \eta\pi^0\gamma$
8.8 ±1.4 ±0.9		36	<sup>89</sup> ACHASOV	00F	SND $e^+e^- \rightarrow \eta\pi^0\gamma$
9.0 ±2.4 ±1.0		80	AKHMETSHIN	99C	CMD2 $e^+e^- \rightarrow \eta\pi^0\gamma$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
7.01±0.10±0.20		13.3k	<sup>87,90</sup> AMBROSINO	09F	KLOE $1.02 e^+e^- \rightarrow \eta\pi^0\gamma$
7.12±0.13±0.22		3.6k	<sup>88,91</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 $e^+e^- \rightarrow \pi^0\eta\gamma$



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

**$\Gamma_{23}/\Gamma$**

VALUE (units $10^{-5}$ )	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<b>7.6±0.6 OUR FIT</b>					
<b>7.6±0.6 OUR AVERAGE</b>					
7.4±0.7			92 ALOISIO	02C	KLOE $e^+e^- \rightarrow \eta\pi^0\gamma$
8.8±1.7	36		93 ACHASOV	00F	SND $e^+e^- \rightarrow \eta\pi^0\gamma$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
11 ±2			94 GOKALP	02	RVUE $e^+e^- \rightarrow \eta\pi^0\gamma$
<500	90		DOLINSKY	91	ND $e^+e^- \rightarrow \pi^0\eta\gamma$

**$\Gamma(f_0(980)\gamma)/\Gamma(a_0(980)\gamma)$**

**$\Gamma_{17}/\Gamma_{23}$**

VALUE	DOCUMENT ID	TECN	COMMENT
<b>6.1±0.6</b>	95 ALOISIO	02C	KLOE $e^+e^- \rightarrow \eta\pi^0\gamma$

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

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

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

**$\Gamma(\eta'(958)\gamma)/\Gamma_{total}$**

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

VALUE (units $10^{-5}$ )	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<b>6.25±0.21 OUR FIT</b>					
<b>6.25±0.30 OUR AVERAGE</b>					
6.25±0.28±0.11	3407		96 AMBROSINO	07A	KLOE $1.02 e^+e^- \rightarrow \pi^+\pi^-\gamma$
6.7 <sup>+2.8</sup> <sub>-2.4</sub> ±0.8	12		97 AULCHENKO	03B	SND $e^+e^- \rightarrow \eta'\gamma$



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

6.7 $\begin{smallmatrix} +5.0 \\ -4.2 \end{smallmatrix} \pm 1.5$	7	AULCHENKO 03B	SND	$e^+e^- \rightarrow 7\gamma$
6.10 $\pm 0.61 \pm 0.43$	120	<sup>98</sup> ALOISIO	02E	KLOE 1.02 $e^+e^- \rightarrow \pi^+\pi^-3\gamma$
8.2 $\begin{smallmatrix} +2.1 \\ -1.9 \end{smallmatrix} \pm 1.1$	21	<sup>99</sup> AKHMETSHIN 00B	CMD2	$e^+e^- \rightarrow \pi^+\pi^-3\gamma$
4.9 $\begin{smallmatrix} +2.2 \\ -1.8 \end{smallmatrix} \pm 0.6$	9	<sup>100</sup> AKHMETSHIN 00F	CMD2	$e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^- \geq 2\gamma$
6.4 $\pm 1.6$	30	<sup>101</sup> AKHMETSHIN 00F	CMD2	$e^+e^- \rightarrow \eta'(958)\gamma$
6.7 $\begin{smallmatrix} +3.4 \\ -2.9 \end{smallmatrix} \pm 1.0$	5	<sup>102</sup> AULCHENKO 99	SND	$e^+e^- \rightarrow \pi^+\pi^-3\gamma$
<11	90	AULCHENKO 98	SND	$e^+e^- \rightarrow 7\gamma$
12 $\begin{smallmatrix} +7 \\ -5 \end{smallmatrix} \pm 2$	6	<sup>99</sup> AKHMETSHIN 97B	CMD2	$e^+e^- \rightarrow \pi^+\pi^-3\gamma$
<41	90	DRUZHININ 87	ND	$e^+e^- \rightarrow \gamma\eta\pi^+\pi^-$

### $\Gamma(\eta'(958)\gamma)/\Gamma(K_L^0 K_S^0)$

$\Gamma_{25}/\Gamma_2$

<u>VALUE (units <math>10^{-4}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>1.83 <math>\pm 0.06</math> OUR FIT</b>				
1.46 $\begin{smallmatrix} +0.64 \\ -0.54 \end{smallmatrix} \pm 0.18$	9	<sup>103</sup> AKHMETSHIN 00F	CMD2	$e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^- \geq 2\gamma$

### $\Gamma(\eta'(958)\gamma)/\Gamma(\eta\gamma)$

$\Gamma_{25}/\Gamma_6$

<u>VALUE (units <math>10^{-3}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>4.77 <math>\pm 0.15</math> OUR FIT</b>				
<b>4.78 <math>\pm 0.20</math> OUR AVERAGE</b>				
4.77 $\pm 0.09 \pm 0.19$	3407	AMBROSINO 07A	KLOE	1.02 $e^+e^- \rightarrow \pi^+\pi^-7\gamma$
4.70 $\pm 0.47 \pm 0.31$	120	<sup>104</sup> ALOISIO 02E	KLOE	1.02 $e^+e^- \rightarrow \pi^+\pi^-3\gamma$
6.5 $\begin{smallmatrix} +1.7 \\ -1.5 \end{smallmatrix} \pm 0.8$	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 $\begin{smallmatrix} +5.2 \\ -4.0 \end{smallmatrix} \pm 1.4$	6	<sup>105</sup> AKHMETSHIN 97B	CMD2	$e^+e^- \rightarrow \pi^+\pi^-3\gamma$
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### $\Gamma(\eta\pi^0\pi^0\gamma)/\Gamma_{\text{total}}$

$\Gamma_{26}/\Gamma$

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt;2</b>	90	AULCHENKO 98	SND	$e^+e^- \rightarrow 7\gamma$

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

$\Gamma_{27}/\Gamma$

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>1.43 <math>\pm 0.45 \pm 0.14</math></b>	27188	<sup>77</sup> AKHMETSHIN 99B	CMD2	$e^+e^- \rightarrow \mu^+\mu^-\gamma$
2.3 $\pm 1.0$	824 $\pm 33$	<sup>106</sup> AKHMETSHIN 97C	CMD2	$e^+e^- \rightarrow \mu^+\mu^-\gamma$

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

$\Gamma_{28}/\Gamma$

<u>VALUE (units <math>10^{-4}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt;1.2</b>	90	AULCHENKO 08	CMD2	$\phi \rightarrow \pi^+\pi^-\gamma\gamma$
<5	90	AKHMETSHIN 98	CMD2	$e^+e^- \rightarrow \pi^+\pi^-\gamma\gamma$

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

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

VALUE (units $10^{-5}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt; 1.8</b>	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	$e^+e^- \rightarrow \pi^+\pi^-\gamma\gamma$

$\Gamma(\eta\mu^+\mu^-)/\Gamma_{\text{total}}$   $\Gamma_{30}/\Gamma$

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt; 9.4</b>	90	AKHMETSHIN 01	CMD2	$e^+e^- \rightarrow \eta e^+e^-$

- <sup>32</sup> Using  $B(\phi \rightarrow e^+e^-) = (2.93 \pm 0.14) \times 10^{-4}$ .
- <sup>33</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 DUBYNSKIY 07.
- <sup>34</sup> Using  $B(\phi \rightarrow e^+e^-) = (2.99 \pm 0.08) \times 10^{-4}$ .
- <sup>35</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.
- <sup>36</sup> From a fit without limitations on charged and neutral  $\rho$  masses and widths.
- <sup>37</sup> Adding the direct and  $\omega\pi$  contributions and considering the interference between the  $\rho\pi$  and  $\pi^+\pi^-\pi^0$ .
- <sup>38</sup> Neglecting the interference between the  $\rho\pi$  and  $\pi^+\pi^-\pi^0$ .
- <sup>39</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>40</sup> From  $\pi^+\pi^-\pi^0$  decay mode of  $\eta$ .
- <sup>41</sup> From  $2\gamma$  decay mode of  $\eta$ .
- <sup>42</sup> From  $3\pi^0$  decay mode of  $\eta$ .
- <sup>43</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  $B(\phi(1020) \rightarrow e^+e^-) = (2.954 \pm 0.030) \times 10^{-4}$ . 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>44</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>45</sup> Not independent of the corresponding  $\Gamma(e^+e^-) \times \Gamma(\eta\gamma)/\Gamma_{\text{total}}^2$ .
- <sup>46</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>47</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>48</sup> From the  $\eta \rightarrow 2\gamma$  decay and using  $B(\phi \rightarrow e^+e^-) = (2.99 \pm 0.08) \times 10^{-4}$ .
- <sup>49</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>50</sup> Reanalysis of DRUZHININ 84, DOLINSKY 89, and DOLINSKY 91 taking into account a triangle anomaly contribution.
- <sup>51</sup> Using  $B(\phi \rightarrow e^+e^-) = (2.98 \pm 0.04) \times 10^{-4}$ .
- <sup>52</sup> Not independent of the corresponding  $\Gamma(e^+e^-) \times \Gamma(\pi^0\gamma)/\Gamma_{\text{total}}^2$ .
- <sup>53</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>54</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>55</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.
- <sup>56</sup> Neglecting interference between resonance and continuum.

- 57 Using  $B(\phi \rightarrow e^+ e^-) = (2.91 \pm 0.07) \times 10^{-4}$ .
- 58 Recalculated by us using  $B(\phi \rightarrow e^+ e^-) = (2.99 \pm 0.08) \times 10^{-4}$ .
- 59 Using  $B(\eta \rightarrow \gamma\gamma) = (39.25 \pm 0.32)\%$ ,  $B(\phi \rightarrow \eta\gamma) = (1.26 \pm 0.06)\%$ , and  $B(\phi \rightarrow e^+ e^-) = (3.00 \pm 0.06) \times 10^{-4}$ .
- 60 The average of the branching ratios separately obtained from the  $\eta \rightarrow \gamma\gamma$ ,  $3\pi^0$ ,  $\pi^+ \pi^- \pi^0$  decays.
- 61 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  $B(\phi \rightarrow \eta\gamma) = (1.297 \pm 0.033) \times 10^{-2}$ .
- 62 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  $B(\phi \rightarrow \eta\gamma) = (1.297 \pm 0.033) \times 10^{-2}$ .
- 63 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  $B(\phi \rightarrow \eta\gamma) = (1.297 \pm 0.033) \times 10^{-2}$ .
- 64 Using the 1996 and 1998 data.
- 65  $(2.3 \pm 0.3)\%$  correction for other decay modes of the  $\omega(782)$  applied.
- 66 Not independent of the corresponding  $\Gamma(\omega\pi^0) \times \Gamma(e^+ e^-) / \Gamma^2(\text{total})$ .
- 67 Using the 1996 data.
- 68 Using the 1998 data.
- 69 Supersedes AKHMETSHIN 97C.
- 70 For  $E_\gamma > 20$  MeV and assuming that  $B(\phi(1020) \rightarrow f_0(980)\gamma)$  is negligible. Supersedes AKHMETSHIN 97C.
- 71 For  $E_\gamma > 20$  MeV and assuming that  $B(\phi(1020) \rightarrow f_0(980)\gamma)$  is negligible.
- 72 Obtained by the authors taking into account the  $\pi^+ \pi^-$  decay mode. Includes a component due to  $\pi\pi$  production via the  $f_0(600)$  meson. Supersedes ALOISIO 02D.
- 73 From the combined fit of the photon spectra in the reactions  $e^+ e^- \rightarrow \pi^+ \pi^- \gamma$ ,  $\pi^0 \pi^0 \gamma$ .
- 74 From the negative interference with the  $f_0(600)$  meson of AITALA 01B using the ACHASOV 89 parameterization for the  $f_0(980)$ , a Breit-Wigner for the  $f_0(600)$ , and ACHASOV 01F for the  $\rho\pi$  contribution. Superseded by AMBROSINO 07.
- 75 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  $B(f_0 \rightarrow \pi^+ \pi^-) = 2B(f_0 \rightarrow \pi^0 \pi^0)$ .
- 76 Using the value  $B(\phi \rightarrow \eta\gamma) = (1.338 \pm 0.053) \times 10^{-2}$ .
- 77 For  $E_\gamma > 20$  MeV. Supersedes AKHMETSHIN 97C.
- 78 Neglecting other intermediate mechanisms ( $\rho\pi$ ,  $\sigma\gamma$ ).
- 79 A narrow pole fit taking into account  $f_0(980)$  and  $f_0(1200)$  intermediate mechanisms.
- 80 For destructive interference with the Bremsstrahlung process
- 81 For constructive interference with the Bremsstrahlung process
- 82 Supersedes ALOISIO 02D.
- 83 Supersedes ACHASOV 98I. Excluding  $\omega\pi^0$ .
- 84 Using various branching ratios from the 2000 Edition of this Review (PDG 00).
- 85 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  $B(\eta \rightarrow \pi^+ \pi^- \gamma) = (4.75 \pm 0.11) \times 10^{-2}$ .
- 86 Combined results of  $\eta \rightarrow \gamma\gamma$  and  $\eta \rightarrow \pi^+ \pi^- \pi^0$  decay modes measurements.
- 87 From the decay mode  $\eta \rightarrow \gamma\gamma$ .
- 88 From the decay mode  $\eta \rightarrow \pi^+ \pi^- \pi^0$ .
- 89 Supersedes ACHASOV 98B.
- 90 Using  $B(\phi \rightarrow \eta\gamma) = (1.304 \pm 0.025)\%$ ,  $B(\eta \rightarrow 3\pi^0) = (32.56 \pm 0.23)\%$ , and  $B(\eta \rightarrow \gamma\gamma) = (39.31 \pm 0.20)\%$ .

- 91 Using  $B(\phi \rightarrow \eta\gamma) = (1.304 \pm 0.025)\%$ ,  $B(\eta \rightarrow 3\pi^0) = (32.56 \pm 0.23)\%$ , and  $B(\eta \rightarrow \pi^+\pi^-\pi^0) = (22.73 \pm 0.28)\%$ .
- 92 Using  $M_{a_0(980)} = 984.8$  MeV and assuming  $a_0(980)\gamma$  dominance.
- 93 Assuming  $a_0(980)\gamma$  dominance in the  $\eta\pi^0\gamma$  final state.
- 94 Using data of ACHASOV 00F.
- 95 Using results of ALOISIO 02D and assuming that  $f_0(980)$  decays into  $\pi\pi$  only and  $a_0(980)$  into  $\eta\pi$  only.
- 96 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  $B(\phi(1020) \rightarrow \eta\gamma) = (1.309 \pm 0.024) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.
- 97 Averaging AULCHENKO 03B with AULCHENKO 99.
- 98 Using  $B(\phi \rightarrow \eta\gamma) = (1.297 \pm 0.033)\%$ .
- 99 Using the value  $B(\phi \rightarrow \eta\gamma) = (1.26 \pm 0.06) \times 10^{-2}$ .
- 100 Using  $B(\phi \rightarrow K_L^0 K_S^0) = (33.8 \pm 0.6)\%$ .
- 101 Averaging AKHMETSHIN 00B with AKHMETSHIN 00F.
- 102 Using the value  $B(\eta' \rightarrow \eta\pi^+\pi^-) = (43.7 \pm 1.5) \times 10^{-2}$  and  $B(\eta \rightarrow \gamma\gamma) = (39.25 \pm 0.31) \times 10^{-2}$ .
- 103 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.
- 104 From the decay mode  $\eta' \rightarrow \eta\pi^+\pi^-$ ,  $\eta \rightarrow \gamma\gamma$ .
- 105 Superseded by AKHMETSHIN 00B.
- 106 For  $E_\gamma > 20$  MeV.

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### $\pi^+\pi^-\pi^0 / \rho\pi$ AMPLITUDE RATIO $a_1$ IN DECAY OF $\phi \rightarrow \pi^+\pi^-\pi^0$

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	107	AKHMETSHIN 06	CMD2	$1.017-1.021 e^+e^- \rightarrow \pi^+\pi^-\pi^0$
9.0±1.1±0.6	1.98M	108,109	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	109	ACHASOV	02	SND $e^+e^- \rightarrow \pi^+\pi^-\pi^0$
$-16 < a_1 < 11$	90	9.8k	107,110	AKHMETSHIN 98	CMD2 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$
107 Dalitz plot analysis taking into account interference between the contact and $\rho\pi$ amplitudes.					
108 From a fit without limitations on charged and neutral $\rho$ masses and widths.					
109 Recalculated by us to match the notations of AKHMETSHIN 98.					
110 Assuming zero phase for the contact term.					

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AMBROSINO	08G	PL B669 223	F. Ambrosino <i>et al.</i>	(KLOE Collab.)
AULCHENKO	08	JETPL 88 85	V. Aulchenko <i>et al.</i>	(CMD-2 Collab.)
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ACHASOV	07B	PR D76 077101	M.N. Achasov <i>et al.</i>	(SND Collab.)
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ALOISIO	03	PL B561 55	A. Aloisio <i>et al.</i>	(KLOE Collab.)
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		Translated from ZETFP 75 539.		
ALOISIO	02C	PL B536 209	A. Aloisio <i>et al.</i>	(KLOE Collab.)
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ACHASOV	01E	PR D63 072002	M.N. Achasov <i>et al.</i>	(Novosibirsk SND Collab.)
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BENAYOUN	01	EPJ C22 503	M. Benayoun, H.B. O'Connell	
ACHASOV	00	EPJ C12 25	M.N. Achasov <i>et al.</i>	(Novosibirsk SND Collab.)
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ACHASOV	00C	PL B474 188	M.N. Achasov <i>et al.</i>	(Novosibirsk SND Collab.)
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DOLINSKY	91	PRPL 202 99	S.I. Dolinsky <i>et al.</i>	(NOVO)
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ARMSTRONG	86	PL 166B 245	T.A. Armstrong <i>et al.</i>	(ATHU, BARI, BIRM+)
ATKINSON	86	ZPHY C30 521	M. Atkinson <i>et al.</i>	(BONN, CERN, GLAS+)
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GOLUBEV	85	SJNP 41 756	V.B. Golubev <i>et al.</i>	(NOVO)
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ARMSTRONG	83B	NP B224 193	T.A. Armstrong <i>et al.</i>	(BARI, BIRM, CERN+)
BARATE	83	PL 121B 449	R. Barate <i>et al.</i>	(SACL, LOIC, SHMP, IND)
KURDADZE	83C	JETPL 38 366	L.M. Kurdadze <i>et al.</i>	(NOVO)
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ARENTON	82	PR D25 2241	M.W. Arenton <i>et al.</i>	(ANL, ILL)
PELLINEN	82	PS 25 599	A. Pellinen, M. Roos	(HELS)
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BUKIN	78B	SJNP 27 521	A.D. Bukin <i>et al.</i>	(NOVO)
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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+)
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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. Parroure <i>et al.</i>	(ORSAY)
PARROUR	76B	PL 63B 362	G. Parroure <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)
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COLLEY	72	NP B50 1	D.C. Colley <i>et al.</i>	(BIRM, GLAS)
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BADIER	65B	PL 17 337	J. Badier <i>et al.</i>	(EPOL, SACL, AMST)
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