

**$\Upsilon(1S)$** 

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

 **$\Upsilon(1S)$  MASS**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<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	$e^+ e^- \rightarrow$ hadrons
9459.97 ± 0.11 ± 0.07	MACKAY	84 REDE	$e^+ e^- \rightarrow$ 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	$e^+ e^- \rightarrow$ hadrons
9460.59 ± 0.12	BARU	86 REDE	$e^+ e^- \rightarrow$ hadrons
9460.6 ± 0.4	<sup>3,4</sup> ARTAMONOV 84	REDE	$e^+ e^- \rightarrow$ 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 Superseded by ARTAMONOV 00.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.			

 **$\Upsilon(1S)$  WIDTH**

<u>VALUE (keV)</u>	<u>DOCUMENT ID</u>
<b>53.0 ± 1.5 OUR EVALUATION</b>	See the Note on Width Determinations of the $\Upsilon$ states

 **$\Upsilon(1S)$  DECAY MODES**

Mode	Fraction ( $\Gamma_i/\Gamma$ )	Confidence level
$\Gamma_1 \quad \tau^+ \tau^-$	$(2.67^{+0.14}_{-0.16}) \%$	
$\Gamma_2 \quad e^+ e^-$	$(2.38 \pm 0.11) \%$	
$\Gamma_3 \quad \mu^+ \mu^-$	$(2.48 \pm 0.06) \%$	

**Hadronic decays**

$\Gamma_4 \quad \eta'(958)$ anything	$(2.8 \pm 0.4) \%$	
$\Gamma_5 \quad J/\psi(1S)$ anything	$(1.1 \pm 0.4) \times 10^{-3}$	
$\Gamma_6 \quad \rho\pi$	$< 2$	$\times 10^{-4}$ 90%
$\Gamma_7 \quad \pi^+ \pi^-$	$< 5$	$\times 10^{-4}$ 90%
$\Gamma_8 \quad K^+ K^-$	$< 5$	$\times 10^{-4}$ 90%
$\Gamma_9 \quad \rho\bar{p}$	$< 5$	$\times 10^{-4}$ 90%
$\Gamma_{10} \quad \pi^0 \pi^+ \pi^-$	$< 1.84$	$\times 10^{-5}$ 90%
$\Gamma_{11} \quad D^*(2010)^\pm$ anything		

### Radiative decays

$\Gamma_{12}$	$\gamma \pi^+ \pi^-$	$(6.3 \pm 1.8) \times 10^{-5}$	
$\Gamma_{13}$	$\gamma \pi^0 \pi^0$	$(1.7 \pm 0.7) \times 10^{-5}$	
$\Gamma_{14}$	$\gamma 2h^+ 2h^-$	$(7.0 \pm 1.5) \times 10^{-4}$	
$\Gamma_{15}$	$\gamma 3h^+ 3h^-$	$(5.4 \pm 2.0) \times 10^{-4}$	
$\Gamma_{16}$	$\gamma 4h^+ 4h^-$	$(7.4 \pm 3.5) \times 10^{-4}$	
$\Gamma_{17}$	$\gamma \pi^+ \pi^- K^+ K^-$	$(2.9 \pm 0.9) \times 10^{-4}$	
$\Gamma_{18}$	$\gamma 2\pi^+ 2\pi^-$	$(2.5 \pm 0.9) \times 10^{-4}$	
$\Gamma_{19}$	$\gamma 3\pi^+ 3\pi^-$	$(2.5 \pm 1.2) \times 10^{-4}$	
$\Gamma_{20}$	$\gamma 2\pi^+ 2\pi^- K^+ K^-$	$(2.4 \pm 1.2) \times 10^{-4}$	
$\Gamma_{21}$	$\gamma \pi^+ \pi^- p \bar{p}$	$(1.5 \pm 0.6) \times 10^{-4}$	
$\Gamma_{22}$	$\gamma 2\pi^+ 2\pi^- p \bar{p}$	$(4 \pm 6) \times 10^{-5}$	
$\Gamma_{23}$	$\gamma 2K^+ 2K^-$	$(2.0 \pm 2.0) \times 10^{-5}$	
$\Gamma_{24}$	$\gamma \eta'(958)$	$< 1.6$	$\times 10^{-5}$ 90%
$\Gamma_{25}$	$\gamma \eta$	$< 2.1$	$\times 10^{-5}$ 90%
$\Gamma_{26}$	$\gamma f'_2(1525)$	$< 1.4$	$\times 10^{-4}$ 90%
$\Gamma_{27}$	$\gamma f_2(1270)$	$(8 \pm 4)$	$\times 10^{-5}$
$\Gamma_{28}$	$\gamma \eta(1405)$	$< 8.2$	$\times 10^{-5}$ 90%
$\Gamma_{29}$	$\gamma f_0(1710) \rightarrow \gamma K \bar{K}$	$< 2.6$	$\times 10^{-4}$ 90%
$\Gamma_{30}$	$\gamma f_0(2200) \rightarrow \gamma K^+ K^-$	$< 2$	$\times 10^{-4}$ 90%
$\Gamma_{31}$	$\gamma f_J(2220) \rightarrow \gamma K^+ K^-$	$< 1.5$	$\times 10^{-5}$ 90%
$\Gamma_{32}$	$\gamma f_J(2220) \rightarrow \gamma \pi^+ \pi^-$	$< 1.2$	$\times 10^{-5}$ 90%
$\Gamma_{33}$	$\gamma f_J(2220) \rightarrow \gamma p \bar{p}$	$< 1.6$	$\times 10^{-5}$ 90%
$\Gamma_{34}$	$\gamma \eta(2225) \rightarrow \gamma \phi \phi$	$< 3$	$\times 10^{-3}$ 90%
$\Gamma_{35}$	$\gamma X$ ( $X =$ pseudoscalar with $m < 7.2$ GeV)	$< 3$	$\times 10^{-5}$ 90%
$\Gamma_{36}$	$\gamma X \bar{X}$ ( $X \bar{X} =$ vectors with $m < 3.1$ GeV)	$< 1$	$\times 10^{-3}$ 90%

### $\mathcal{R}(1S) \Gamma(i) \Gamma(e^+ e^-) / \Gamma(\text{total})$

$\Gamma(e^+ e^-) \times \Gamma(\mu^+ \mu^-) / \Gamma_{\text{total}}$				$\Gamma_2 \Gamma_3 / \Gamma$
<u>VALUE (eV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>31.2 ± 1.6 ± 1.7</b>	KOBEL	92	CBAL	$e^+ e^- \rightarrow \mu^+ \mu^-$

$\Gamma(\text{hadrons}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$				$\Gamma_0 \Gamma_2 / \Gamma$
<u>VALUE (keV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>1.216 ± 0.027 OUR AVERAGE</b>				
1.187 ± 0.023 ± 0.031	<sup>5</sup> BARU	92B	MD1	$e^+ e^- \rightarrow$ hadrons
1.23 ± 0.02 ± 0.05	<sup>5</sup> JAKUBOWSKI	88	CBAL	$e^+ e^- \rightarrow$ hadrons
1.37 ± 0.06 ± 0.09	<sup>6</sup> GILES	84B	CLEO	$e^+ e^- \rightarrow$ hadrons
1.23 ± 0.08 ± 0.04	<sup>6</sup> ALBRECHT	82	DASP	$e^+ e^- \rightarrow$ hadrons
1.13 ± 0.07 ± 0.11	<sup>6</sup> NICZYPORUK	82	LENA	$e^+ e^- \rightarrow$ hadrons
1.09 ± 0.25	<sup>6</sup> BOCK	80	CNTR	$e^+ e^- \rightarrow$ hadrons
1.35 ± 0.14	<sup>7</sup> BERGER	79	PLUT	$e^+ e^- \rightarrow$ hadrons

<sup>5</sup> Radiative corrections evaluated following KURAEV 85.

<sup>6</sup> Radiative corrections reevaluated by BUCHMUELLER 88 following KURAEV 85.

<sup>7</sup> Radiative corrections reevaluated by ALEXANDER 89 using  $B(\mu\mu) = 0.026$ .

## $\Upsilon(1S)$ PARTIAL WIDTHS

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

$\Gamma_2$

VALUE (keV)

DOCUMENT ID

**1.314 ± 0.029 OUR EVALUATION**

## $\Upsilon(1S)$ BRANCHING RATIOS

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

$\Gamma_1/\Gamma$

VALUE

EVTS

DOCUMENT ID

TECN

COMMENT

**0.0267<sup>+0.0014</sup><sub>-0.0016</sub> OUR AVERAGE**

0.0261 ± 0.0012<sup>+0.0009</sup><sub>-0.0013</sub>    25k    CINABRO    94B CLE2     $e^+e^- \rightarrow \tau^+\tau^-$

0.027 ± 0.004 ± 0.002    <sup>8</sup> ALBRECHT    85C ARG     $\Upsilon(2S) \rightarrow$

0.034 ± 0.004 ± 0.004    GILES    83 CLEO     $e^+e^- \rightarrow \tau^+\tau^-$   
 $\pi^+\pi^-\tau^+\tau^-$

<sup>8</sup> Using  $B(\Upsilon(1S) \rightarrow ee) = B(\Upsilon(1S) \rightarrow \mu\mu) = 0.0256$ ; not used for width evaluations.

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

$\Gamma_3/\Gamma$

VALUE

EVTS

DOCUMENT ID

TECN

COMMENT

**0.0248 ± 0.0006 OUR AVERAGE**

0.0249 ± 0.0008 ± 0.0013

ALEXANDER 98 CLE2  $\Upsilon(2S) \rightarrow$

$\pi^+\pi^-\mu^+\mu^-$

0.0212 ± 0.0020 ± 0.0010

<sup>9</sup> BARU 92 MD1  $e^+e^- \rightarrow$

$\mu^+\mu^-$

0.0231 ± 0.0012 ± 0.0010

<sup>9</sup> KOBEL 92 CBAL  $e^+e^- \rightarrow$

$\mu^+\mu^-$

0.0252 ± 0.0007 ± 0.0007

CHEN 89B CLEO  $e^+e^- \rightarrow$

$\mu^+\mu^-$

0.0261 ± 0.0009 ± 0.0011

KAARSBERG 89 CSB2  $e^+e^- \rightarrow$

$\mu^+\mu^-$

0.0230 ± 0.0025 ± 0.0013

86

ALBRECHT 87 ARG  $\Upsilon(2S) \rightarrow$

$\pi^+\pi^-\mu^+\mu^-$

0.029 ± 0.003 ± 0.002

864

BESSON 84 CLEO  $\Upsilon(2S) \rightarrow$

$\pi^+\pi^-\mu^+\mu^-$

0.027 ± 0.003 ± 0.003

ANDREWS 83 CLEO  $e^+e^- \rightarrow$

$\mu^+\mu^-$

0.032 ± 0.013 ± 0.003

ALBRECHT 82 DASP  $e^+e^- \rightarrow$

$\mu^+\mu^-$

0.038 ± 0.015 ± 0.002

NICZYPORUK 82 LENA  $e^+e^- \rightarrow$

$\mu^+\mu^-$

0.014<sup>+0.034</sup><sub>-0.014</sub>

BOCK 80 CNTR  $e^+e^- \rightarrow$

$\mu^+\mu^-$

0.022 ± 0.020

BERGER 79 PLUT  $e^+e^- \rightarrow$

$\mu^+\mu^-$

<sup>9</sup> Taking into account interference between the resonance and continuum.

$\Gamma(e^+e^-)/\Gamma_{\text{total}}$				$\Gamma_2/\Gamma$
<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.0238 ± 0.0011 OUR AVERAGE</b>				
0.0229 ± 0.0008 ± 0.0011		ALEXANDER	98 CLE2	$\Upsilon(2S) \rightarrow \pi^+\pi^-e^+e^-$
0.0242 ± 0.0014 ± 0.0014	307	ALBRECHT	87 ARG	$\Upsilon(2S) \rightarrow \pi^+\pi^-e^+e^-$
0.028 ± 0.003 ± 0.002	826	BESSION	84 CLEO	$\Upsilon(2S) \rightarrow \pi^+\pi^-e^+e^-$
0.051 ± 0.030		BERGER	80c PLUT	$e^+e^- \rightarrow e^+e^-$

$\Gamma(\eta'(958)\text{anything})/\Gamma_{\text{total}}$				$\Gamma_4/\Gamma$
<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>0.028 ± 0.004 ± 0.002</b>				
	ARTUSO	03 CLE2	$\Upsilon(1S) \rightarrow \eta'\text{anything}$	

$\Gamma(J/\psi(1S)\text{anything})/\Gamma_{\text{total}}$				$\Gamma_5/\Gamma$
<u>VALUE (units 10<sup>-3</sup>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt; 0.68</b>	90	ALBRECHT	92J ARG	$e^+e^- \rightarrow e^+e^-X, e^+e^- \rightarrow \mu^+\mu^-X$
<b>1.1 ± 0.4 ± 0.2</b>	10	FULTON	89 CLEO	$e^+e^- \rightarrow \mu^+\mu^-X$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
< 1.7	90	MASCHMANN	90 CBAL	$e^+e^- \rightarrow \text{hadrons}$
< 20	90	NICZYPORUK	83 LENA	

<sup>10</sup> Using  $B((J/\psi) \rightarrow \mu^+\mu^-) = (6.9 \pm 0.9)\%$ .

$\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$				$\Gamma_7/\Gamma$
<u>VALUE (units 10<sup>-4</sup>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt; 5</b>	90	BARU	92 MD1	$\Upsilon(1S) \rightarrow \pi^+\pi^-$

$\Gamma(K^+K^-)/\Gamma_{\text{total}}$				$\Gamma_8/\Gamma$
<u>VALUE (units 10<sup>-4</sup>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt; 5</b>	90	BARU	92 MD1	$\Upsilon(1S) \rightarrow K^+K^-$

$\Gamma(p\bar{p})/\Gamma_{\text{total}}$				$\Gamma_9/\Gamma$
<u>VALUE (units 10<sup>-4</sup>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt; 5</b>	90	<sup>11</sup> BARU	96 MD1	$\Upsilon(1S) \rightarrow p\bar{p}$

<sup>11</sup> Supersedes BARU 92 in this node.

$\Gamma(\pi^0\pi^+\pi^-)/\Gamma_{\text{total}}$				$\Gamma_{10}/\Gamma$
<u>VALUE (units 10<sup>-5</sup>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt; 1.84</b>	90	ANASTASSOV	99 CLE2	$e^+e^- \rightarrow \text{hadrons}$

$\Gamma(\gamma X)/\Gamma_{\text{total}}$				$\Gamma_{35}/\Gamma$
(X = pseudoscalar with $m < 7.2$ GeV)				
<u>VALUE (units 10<sup>-5</sup>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt; 3</b>	90	<sup>12</sup> BALEST	95 CLEO	$e^+e^- \rightarrow \gamma + X$

<sup>12</sup> For a noninteracting pseudoscalar X with mass < 7.2 GeV.

$\Gamma(\gamma X \bar{X})/\Gamma_{\text{total}}$   $\Gamma_{36}/\Gamma$   
 ( $X \bar{X}$  = vectors with  $m < 3.1$  GeV)

VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;1</b>	90	<sup>13</sup> BALEST	95	CLEO $e^+ e^- \rightarrow \gamma + X \bar{X}$

<sup>13</sup> For a noninteracting vector  $X$  with mass  $< 3.1$  GeV.

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

VALUE (units $10^{-5}$ )	DOCUMENT ID	TECN	COMMENT
<b><math>6.3 \pm 1.2 \pm 1.3</math></b>	<sup>14</sup> ANASTASSOV 99	CLE2	$e^+ e^- \rightarrow$ hadrons

<sup>14</sup> For  $m_{\pi\pi} > 1$  GeV.

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

VALUE (units $10^{-5}$ )	DOCUMENT ID	TECN	COMMENT
<b><math>1.7 \pm 0.6 \pm 0.3</math></b>	<sup>15</sup> ANASTASSOV 99	CLE2	$e^+ e^- \rightarrow$ hadrons

<sup>15</sup> For  $m_{\pi\pi} > 1$  GeV.

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

VALUE (units $10^{-4}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>2.5 \pm 0.7 \pm 0.5</math></b>	$26 \pm 7$	FULTON	90B	CLEO $e^+ e^- \rightarrow$ hadrons

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

VALUE (units $10^{-4}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>2.9 \pm 0.7 \pm 0.6</math></b>	$29 \pm 8$	FULTON	90B	CLEO $e^+ e^- \rightarrow$ hadrons

$\Gamma(\gamma \pi^+ \pi^- \rho \bar{\rho})/\Gamma_{\text{total}}$   $\Gamma_{21}/\Gamma$

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 $e^+ e^- \rightarrow$ hadrons

$\Gamma(\gamma 2K^+ 2K^-)/\Gamma_{\text{total}}$   $\Gamma_{23}/\Gamma$

VALUE (units $10^{-4}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>0.2 \pm 0.2</math></b>	$2 \pm 2$	FULTON	90B	CLEO $e^+ e^- \rightarrow$ hadrons

$\Gamma(\gamma 3\pi^+ 3\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{19}/\Gamma$

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 $e^+ e^- \rightarrow$ hadrons

$\Gamma(\gamma 2\pi^+ 2\pi^- K^+ K^-)/\Gamma_{\text{total}}$   $\Gamma_{20}/\Gamma$

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 $e^+ e^- \rightarrow$ hadrons

$\Gamma(\gamma 2\pi^+ 2\pi^- \rho \bar{\rho})/\Gamma_{\text{total}}$   $\Gamma_{22}/\Gamma$

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 $e^+ e^- \rightarrow$ hadrons

$\Gamma(\gamma 2h^+ 2h^-)/\Gamma_{\text{total}}$   $\Gamma_{14}/\Gamma$

VALUE (units $10^{-4}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>7.0 \pm 1.1 \pm 1.0</math></b>	$80 \pm 12$	FULTON	90B CLEO	$e^+ e^- \rightarrow \text{hadrons}$

$\Gamma(\gamma 3h^+ 3h^-)/\Gamma_{\text{total}}$   $\Gamma_{15}/\Gamma$

VALUE (units $10^{-4}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>5.4 \pm 1.5 \pm 1.3</math></b>	$39 \pm 11$	FULTON	90B CLEO	$e^+ e^- \rightarrow \text{hadrons}$

$\Gamma(\gamma 4h^+ 4h^-)/\Gamma_{\text{total}}$   $\Gamma_{16}/\Gamma$

VALUE (units $10^{-4}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>7.4 \pm 2.5 \pm 2.5</math></b>	$36 \pm 12$	FULTON	90B CLEO	$e^+ e^- \rightarrow \text{hadrons}$

$\Gamma(\rho\pi)/\Gamma_{\text{total}}$   $\Gamma_6/\Gamma$

VALUE (units $10^{-4}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>&lt; 2</math></b>	90	FULTON	90B	$\Upsilon(1S) \rightarrow \rho^0 \pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$< 10$	90	BLINOV	90 MD1	$\Upsilon(1S) \rightarrow \rho^0 \pi^0$
$< 21$	90	NICZYPORUK	83 LENA	$\Upsilon(1S) \rightarrow \rho^0 \pi^0$

$\Gamma(D^*(2010)^\pm \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{11}/\Gamma$

VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT
$< 19$	90	<sup>16</sup> ALBRECHT	92J ARG	$e^+ e^- \rightarrow D^0 \pi^\pm X$
<sup>16</sup> For $x_p > 0.2$ .				

$\Gamma(\gamma\eta(1405))/\Gamma_{\text{total}}$   $\Gamma_{28}/\Gamma$

VALUE (units $10^{-5}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>&lt; 8.2</math></b>	90	<sup>17</sup> FULTON	90B CLEO	$\Upsilon(1S) \rightarrow \gamma K^\pm \pi^\mp K_S^0$
<sup>17</sup> Includes unknown branching ratio of $\eta(1405) \rightarrow K^\pm \pi^\mp K_S^0$ .				

$\Gamma(\gamma\eta'(958))/\Gamma_{\text{total}}$   $\Gamma_{24}/\Gamma$

VALUE (units $10^{-5}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>&lt; 1.6</math></b>	90	RICHICHI	01B CLE2	$\Upsilon(1S) \rightarrow \gamma\eta' \rightarrow \gamma\eta\pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$< 130$	90	SCHMITT	88 CBAL	$\Upsilon(1S) \rightarrow \gamma X$

$\Gamma(\gamma\eta)/\Gamma_{\text{total}}$   $\Gamma_{25}/\Gamma$

VALUE (units $10^{-5}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>&lt; 2.1</math></b>	90	MASEK	02 CLEO	$\Upsilon(1S) \rightarrow \gamma\eta$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$< 28.2$	90	MASEK	02 CLEO	$\eta \rightarrow \gamma\gamma$
$< 6.7$	90	MASEK	02 CLEO	$\eta \rightarrow \pi^0 \pi^0 \pi^0$
$< 2.6$	90	MASEK	02 CLEO	$\eta \rightarrow \pi^+ \pi^- \pi^0$
$< 35$	90	SCHMITT	88 CBAL	$\Upsilon(1S) \rightarrow \gamma X$

**$\Gamma(\gamma f'_2(1525))/\Gamma_{\text{total}}$**   **$\Gamma_{26}/\Gamma$**

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt;14</b>	90	18 FULTON	90B CLEO	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<19.4	90	18 ALBRECHT	89 ARG	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$
18 Assuming $B(f'_2(1525) \rightarrow K\bar{K}) = 0.71$ .				

**$\Gamma(\gamma f_0(1710) \rightarrow \gamma K\bar{K})/\Gamma_{\text{total}}$**   **$\Gamma_{29}/\Gamma$**

<u>VALUE (units <math>10^{-4}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt; 2.6</b>	90	19 ALBRECHT	89 ARG	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
< 6.3	90	19 FULTON	90B CLEO	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$
<19	90	19 FULTON	90B CLEO	$\Upsilon(1S) \rightarrow \gamma K_S^0 K_S^0$
< 8	90	20 ALBRECHT	89 ARG	$\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$
<24	90	21 SCHMITT	88 CBAL	$\Upsilon(1S) \rightarrow \gamma X$
19 Assuming $B(f_0(1710) \rightarrow K\bar{K}) = 0.38$ .				
20 Assuming $B(f_0(1710) \rightarrow \pi\pi) = 0.04$ .				
21 Assuming $B(f_0(1710) \rightarrow \eta\eta) = 0.18$ .				

**$\Gamma(\gamma f_2(1270))/\Gamma_{\text{total}}$**   **$\Gamma_{27}/\Gamma$**

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>8.1 \pm 2.3^{+2.9}_{-2.7}</math></b>		22 ANASTASSOV	99 CLE2	$e^+ e^- \rightarrow \text{hadrons}$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<21	90	22 FULTON	90B CLEO	$\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$
<13	90	22 ALBRECHT	89 ARG	$\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$
<81	90	SCHMITT	88 CBAL	$\Upsilon(1S) \rightarrow \gamma X$
22 Using $B(f_2(1270) \rightarrow \pi\pi) = 0.84$ .				

**$\Gamma(\gamma f_J(2220) \rightarrow \gamma K^+ K^-)/\Gamma_{\text{total}}$**   **$\Gamma_{31}/\Gamma$**

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
< 1.6	90	MASEK	02 CLEO	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$
<b>&lt; 1.5</b>	90	23 FULTON	90B CLEO	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
< 2.9	90	23 ALBRECHT	89 ARG	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$
<20	90	23 BARU	89 MD1	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$
23 Including unknown branching ratio of $f_J(2220) \rightarrow K^+ K^-$ .				

**$\Gamma(\gamma f_J(2220) \rightarrow \gamma \pi^+ \pi^-)/\Gamma_{\text{total}}$**   **$\Gamma_{32}/\Gamma$**

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt;1.2</b>	90	MASEK	02 CLEO	$\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$

**$\Gamma(\gamma f_J(2220) \rightarrow \gamma p\bar{p})/\Gamma_{\text{total}}$**   **$\Gamma_{33}/\Gamma$**

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt;1.6</b>	90	MASEK	02 CLEO	$\Upsilon(1S) \rightarrow \gamma p\bar{p}$

$\Gamma(\gamma\eta(2225) \rightarrow \gamma\phi\phi)/\Gamma_{\text{total}}$					$\Gamma_{34}/\Gamma$
VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
<0.003	90	<sup>24</sup> BARU	89 MD1	$\Upsilon(1S) \rightarrow$ $\gamma K^+ K^- K^+ K^-$	

<sup>24</sup> Assuming that the  $\eta(2225)$  decays only into  $\phi\phi$ .

$\Gamma(\gamma f_0(2200) \rightarrow \gamma K^+ K^-)/\Gamma_{\text{total}}$					$\Gamma_{30}/\Gamma$
VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
<0.0002	90	<sup>25</sup> BARU	89 MD1	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$	

<sup>25</sup> Assuming that the  $f_0(2200)$  decays only into  $K^+ K^-$ .

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