

$\Upsilon(1S)$ 

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

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

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	$e^+ e^- \rightarrow$ 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 Superseded by ARTAMONOV 00.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

VALUE (keV)	DOCUMENT ID
<b>54.02 ± 1.25 OUR EVALUATION</b>	See the Note on "Width Determinations of the $\Upsilon$ States"

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

Mode	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level
$\Gamma_1$ $\tau^+ \tau^-$	( 2.60 ± 0.10 ) %	
$\Gamma_2$ $e^+ e^-$	( 2.38 ± 0.11 ) %	
$\Gamma_3$ $\mu^+ \mu^-$	( 2.48 ± 0.05 ) %	

#### Hadronic decays

$\Gamma_4$ $g g g$	( 81.7 ± 0.7 ) %	
$\Gamma_5$ $\gamma g g$	( 2.2 ± 0.6 ) %	
$\Gamma_6$ $\eta'(958)$ anything	( 2.94 ± 0.24 ) %	
$\Gamma_7$ $J/\psi(1S)$ anything	( 5.4 ± 0.4 ) × 10 <sup>-4</sup>	S=1.4
$\Gamma_8$ $J/\psi(1S)\eta_c$	< 2.2	× 10 <sup>-6</sup> CL=90%
$\Gamma_9$ $J/\psi(1S)\chi_{c0}$	< 3.4	× 10 <sup>-6</sup> CL=90%
$\Gamma_{10}$ $J/\psi(1S)\chi_{c1}$	( 3.9 ± 1.2 ) × 10 <sup>-6</sup>	
$\Gamma_{11}$ $J/\psi(1S)\chi_{c2}$	< 1.4	× 10 <sup>-6</sup> CL=90%
$\Gamma_{12}$ $J/\psi(1S)\eta_c(2S)$	< 2.2	× 10 <sup>-6</sup> CL=90%
$\Gamma_{13}$ $J/\psi(1S)X(3940)$	< 5.4	× 10 <sup>-6</sup> CL=90%
$\Gamma_{14}$ $J/\psi(1S)X(4160)$	< 5.4	× 10 <sup>-6</sup> CL=90%
$\Gamma_{15}$ $X(4350)$ anything, $X \rightarrow J/\psi(1S)\phi$	< 8.1	× 10 <sup>-6</sup> CL=90%

$\Gamma_{16}$	$Z_c(3900)^\pm$ anything, $Z_c \rightarrow J/\psi(1S)\pi^\pm$	$< 1.3$	$\times 10^{-5}$	CL=90%
$\Gamma_{17}$	$Z_c(4200)^\pm$ anything, $Z_c \rightarrow J/\psi(1S)\pi^\pm$	$< 6.0$	$\times 10^{-5}$	CL=90%
$\Gamma_{18}$	$Z_c(4430)^\pm$ anything, $Z_c \rightarrow J/\psi(1S)\pi^\pm$	$< 4.9$	$\times 10^{-5}$	CL=90%
$\Gamma_{19}$	$X_{cs}^\pm$ anything, $X \rightarrow J/\psi K^\pm$	$< 5.7$	$\times 10^{-6}$	CL=90%
$\Gamma_{20}$	$\psi(4230)$ anything, $\psi \rightarrow J/\psi(1S)\pi^+\pi^-$	$< 3.8$	$\times 10^{-5}$	CL=90%
$\Gamma_{21}$	$\psi(4230)$ anything, $\psi \rightarrow J/\psi(1S)K^+K^-$	$< 7.5$	$\times 10^{-6}$	CL=90%
$\Gamma_{22}$	$\chi_{c1}(4140)$ anything, $\chi_{c1} \rightarrow J/\psi(1S)\phi$	$< 5.2$	$\times 10^{-6}$	CL=90%
$\Gamma_{23}$	$\chi_{c0}$ anything	$< 4$	$\times 10^{-3}$	CL=90%
$\Gamma_{24}$	$\chi_{c1}$ anything	$(1.90 \pm 0.35) \times 10^{-4}$		
$\Gamma_{25}$	$\chi_{c1}(1P)X_{tetra}$	$< 3.78$	$\times 10^{-5}$	CL=90%
$\Gamma_{26}$	$\chi_{c2}$ anything	$(2.8 \pm 0.8) \times 10^{-4}$		
$\Gamma_{27}$	$\psi(2S)$ anything	$(1.23 \pm 0.20) \times 10^{-4}$		
$\Gamma_{28}$	$\psi(2S)\eta_c$	$< 3.6$	$\times 10^{-6}$	CL=90%
$\Gamma_{29}$	$\psi(2S)\chi_{c0}$	$< 6.5$	$\times 10^{-6}$	CL=90%
$\Gamma_{30}$	$\psi(2S)\chi_{c1}$	$< 4.5$	$\times 10^{-6}$	CL=90%
$\Gamma_{31}$	$\psi(2S)\chi_{c2}$	$< 2.1$	$\times 10^{-6}$	CL=90%
$\Gamma_{32}$	$\psi(2S)\eta_c(2S)$	$< 3.2$	$\times 10^{-6}$	CL=90%
$\Gamma_{33}$	$\psi(2S)X(3940)$	$< 2.9$	$\times 10^{-6}$	CL=90%
$\Gamma_{34}$	$\psi(2S)X(4160)$	$< 2.9$	$\times 10^{-6}$	CL=90%
$\Gamma_{35}$	$\psi(4230)$ anything, $\psi \rightarrow \psi(2S)\pi^+\pi^-$	$< 7.9$	$\times 10^{-5}$	CL=90%
$\Gamma_{36}$	$\psi(4360)$ anything, $\psi \rightarrow \psi(2S)\pi^+\pi^-$	$< 5.2$	$\times 10^{-5}$	CL=90%
$\Gamma_{37}$	$\psi(4660)$ anything, $\psi \rightarrow \psi(2S)\pi^+\pi^-$	$< 2.2$	$\times 10^{-5}$	CL=90%
$\Gamma_{38}$	$X(4050)^\pm$ anything, $X \rightarrow \psi(2S)\pi^\pm$	$< 8.8$	$\times 10^{-5}$	CL=90%
$\Gamma_{39}$	$Z_c(4430)^\pm$ anything, $Z_c \rightarrow \psi(2S)\pi^\pm$	$< 6.7$	$\times 10^{-5}$	CL=90%
$\Gamma_{40}$	$\chi_{c1}(3872)$ anything	$< 2.5$	$\times 10^{-4}$	CL=90%
$\Gamma_{41}$	$Z_c(4200)^+Z_c(4200)^-$	$< 2.23$	$\times 10^{-5}$	CL=90%
$\Gamma_{42}$	$Z_c(3900)^\pm Z_c(4200)^\mp$	$< 8.1$	$\times 10^{-6}$	CL=90%
$\Gamma_{43}$	$Z_c(3900)^+Z_c(3900)^-$	$< 1.8$	$\times 10^{-6}$	CL=90%
$\Gamma_{44}$	$X(4050)^+X(4050)^-$	$< 1.58$	$\times 10^{-5}$	CL=90%
$\Gamma_{45}$	$X(4250)^+X(4250)^-$	$< 2.66$	$\times 10^{-5}$	CL=90%
$\Gamma_{46}$	$X(4050)^\pm X(4250)^\mp$	$< 4.42$	$\times 10^{-5}$	CL=90%
$\Gamma_{47}$	$Z_c(4430)^+Z_c(4430)^-$	$< 2.03$	$\times 10^{-5}$	CL=90%
$\Gamma_{48}$	$X(4055)^\pm X(4055)^\mp$	$< 2.33$	$\times 10^{-5}$	CL=90%

$\Gamma_{49}$	$X(4055)^\pm Z_c(4430)^\mp$	$< 4.55$	$\times 10^{-5}$	CL=90%
$\Gamma_{50}$	$\rho\pi$	$< 3.68$	$\times 10^{-6}$	CL=90%
$\Gamma_{51}$	$\omega\pi^0$	$< 3.90$	$\times 10^{-6}$	CL=90%
$\Gamma_{52}$	$\pi^+\pi^-$	$< 5$	$\times 10^{-4}$	CL=90%
$\Gamma_{53}$	$K^+K^-$	$< 5$	$\times 10^{-4}$	CL=90%
$\Gamma_{54}$	$p\bar{p}$	$< 5$	$\times 10^{-4}$	CL=90%
$\Gamma_{55}$	$\pi^+\pi^-\pi^0$	$(2.1 \pm 0.8)$	$\times 10^{-6}$	
$\Gamma_{56}$	$\phi K^+K^-$	$(2.4 \pm 0.5)$	$\times 10^{-6}$	
$\Gamma_{57}$	$\omega\pi^+\pi^-$	$(4.5 \pm 1.0)$	$\times 10^{-6}$	
$\Gamma_{58}$	$K^*(892)^0 K^- \pi^+ + \text{c.c.}$	$(4.4 \pm 0.8)$	$\times 10^{-6}$	
$\Gamma_{59}$	$\phi f_2'(1525)$	$< 1.63$	$\times 10^{-6}$	CL=90%
$\Gamma_{60}$	$\omega f_2(1270)$	$< 1.79$	$\times 10^{-6}$	CL=90%
$\Gamma_{61}$	$\rho(770) a_2(1320)$	$< 2.24$	$\times 10^{-6}$	CL=90%
$\Gamma_{62}$	$K^*(892)^0 \bar{K}_2^*(1430)^0 + \text{c.c.}$	$(3.0 \pm 0.8)$	$\times 10^{-6}$	
$\Gamma_{63}$	$K_1(1270)^\pm K^\mp$	$< 2.41$	$\times 10^{-6}$	CL=90%
$\Gamma_{64}$	$K_1(1400)^\pm K^\mp$	$(1.0 \pm 0.4)$	$\times 10^{-6}$	
$\Gamma_{65}$	$b_1(1235)^\pm \pi^\mp$	$< 1.25$	$\times 10^{-6}$	CL=90%
$\Gamma_{66}$	$\pi^+\pi^-\pi^0\pi^0$	$(1.28 \pm 0.30)$	$\times 10^{-5}$	
$\Gamma_{67}$	$K_S^0 K^+ \pi^- + \text{c.c.}$	$(1.6 \pm 0.4)$	$\times 10^{-6}$	
$\Gamma_{68}$	$K^*(892)^0 \bar{K}^0 + \text{c.c.}$	$(2.9 \pm 0.9)$	$\times 10^{-6}$	
$\Gamma_{69}$	$K^*(892)^- K^+ + \text{c.c.}$	$< 1.11$	$\times 10^{-6}$	CL=90%
$\Gamma_{70}$	$f_1(1285)$ anything	$(4.6 \pm 3.1)$	$\times 10^{-3}$	
$\Gamma_{71}$	$D^*(2010)^\pm$ anything	$(2.52 \pm 0.20)$	%	
$\Gamma_{72}$	$\frac{f_1(1285)}{X_{tetra}}$	$< 6.24$	$\times 10^{-5}$	CL=90%
$\Gamma_{73}$	$^2H$ anything	$(2.85 \pm 0.25)$	$\times 10^{-5}$	
$\Gamma_{74}$	Sum of 100 exclusive modes	$(1.200 \pm 0.017)$	%	

### Radiative decays

$\Gamma_{75}$	$\gamma\pi^+\pi^-$	$(6.3 \pm 1.8)$	$\times 10^{-5}$	
$\Gamma_{76}$	$\gamma\pi^0\pi^0$	$(1.7 \pm 0.7)$	$\times 10^{-5}$	
$\Gamma_{77}$	$\gamma\pi\pi$ (S-wave)	$(4.6 \pm 0.7)$	$\times 10^{-5}$	
$\Gamma_{78}$	$\gamma\pi^0\eta$	$< 2.4$	$\times 10^{-6}$	CL=90%
$\Gamma_{79}$	$\gamma K^+K^-$	[a] $(1.14 \pm 0.13)$	$\times 10^{-5}$	
$\Gamma_{80}$	$\gamma p\bar{p}$	[b] $< 6$	$\times 10^{-6}$	CL=90%
$\Gamma_{81}$	$\gamma 2h^+ 2h^-$	$(7.0 \pm 1.5)$	$\times 10^{-4}$	
$\Gamma_{82}$	$\gamma 3h^+ 3h^-$	$(5.4 \pm 2.0)$	$\times 10^{-4}$	
$\Gamma_{83}$	$\gamma 4h^+ 4h^-$	$(7.4 \pm 3.5)$	$\times 10^{-4}$	
$\Gamma_{84}$	$\gamma\pi^+\pi^- K^+ K^-$	$(2.9 \pm 0.9)$	$\times 10^{-4}$	
$\Gamma_{85}$	$\gamma 2\pi^+ 2\pi^-$	$(2.5 \pm 0.9)$	$\times 10^{-4}$	
$\Gamma_{86}$	$\gamma 3\pi^+ 3\pi^-$	$(2.5 \pm 1.2)$	$\times 10^{-4}$	
$\Gamma_{87}$	$\gamma 2\pi^+ 2\pi^- K^+ K^-$	$(2.4 \pm 1.2)$	$\times 10^{-4}$	
$\Gamma_{88}$	$\gamma\pi^+\pi^- p\bar{p}$	$(1.5 \pm 0.6)$	$\times 10^{-4}$	
$\Gamma_{89}$	$\gamma 2\pi^+ 2\pi^- p\bar{p}$	$(4 \pm 6)$	$\times 10^{-5}$	
$\Gamma_{90}$	$\gamma 2K^+ 2K^-$	$(2.0 \pm 2.0)$	$\times 10^{-5}$	

$\Gamma_{91}$	$\gamma\eta'(958)$	$< 1.9$	$\times 10^{-6}$	CL=90%
$\Gamma_{92}$	$\gamma\eta$	$< 1.0$	$\times 10^{-6}$	CL=90%
$\Gamma_{93}$	$\gamma f_0(980)$	$< 3$	$\times 10^{-5}$	CL=90%
$\Gamma_{94}$	$\gamma f_2'(1525)$	$( 2.9 \pm 0.6 )$	$\times 10^{-5}$	
$\Gamma_{95}$	$\gamma f_2(1270)$	$( 1.01 \pm 0.06 )$	$\times 10^{-4}$	
$\Gamma_{96}$	$\gamma\eta(1405)$	$< 8.2$	$\times 10^{-5}$	CL=90%
$\Gamma_{97}$	$\gamma f_0(1500)$	$< 1.5$	$\times 10^{-5}$	CL=90%
$\Gamma_{98}$	$\gamma f_0(1500) \rightarrow \gamma K^+ K^-$	$( 1.0 \pm 0.4 )$	$\times 10^{-5}$	
$\Gamma_{99}$	$\gamma f_0(1710)$	$< 2.6$	$\times 10^{-4}$	CL=90%
$\Gamma_{100}$	$\gamma f_0(1710) \rightarrow \gamma K^+ K^-$	$( 1.01 \pm 0.32 )$	$\times 10^{-5}$	
$\Gamma_{101}$	$\gamma f_0(1710) \rightarrow \gamma\pi^+\pi^-$	$( 5.3 \pm 2.0 )$	$\times 10^{-6}$	
$\Gamma_{102}$	$\gamma f_0(1710) \rightarrow \gamma\pi^0\pi^0$	$< 1.4$	$\times 10^{-6}$	CL=90%
$\Gamma_{103}$	$\gamma f_0(1710) \rightarrow \gamma\eta\eta$	$< 1.8$	$\times 10^{-6}$	CL=90%
$\Gamma_{104}$	$\gamma f_4(2050)$	$< 5.3$	$\times 10^{-5}$	CL=90%
$\Gamma_{105}$	$\gamma f_0(2200) \rightarrow \gamma K^+ K^-$	$< 2$	$\times 10^{-4}$	CL=90%
$\Gamma_{106}$	$\gamma f_J(2220) \rightarrow \gamma K^+ K^-$	$< 8$	$\times 10^{-7}$	CL=90%
$\Gamma_{107}$	$\gamma f_J(2220) \rightarrow \gamma\pi^+\pi^-$	$< 6$	$\times 10^{-7}$	CL=90%
$\Gamma_{108}$	$\gamma f_J(2220) \rightarrow \gamma p\bar{p}$	$< 1.1$	$\times 10^{-6}$	CL=90%
$\Gamma_{109}$	$\gamma\eta(2225) \rightarrow \gamma\phi\phi$	$< 3$	$\times 10^{-3}$	CL=90%
$\Gamma_{110}$	$\gamma\eta_c(1S)$	$< 2.9$	$\times 10^{-5}$	CL=90%
$\Gamma_{111}$	$\gamma\eta_c(2S)$	$< 4$	$\times 10^{-4}$	CL=90%
$\Gamma_{112}$	$\gamma\chi_{c0}$	$< 6.6$	$\times 10^{-5}$	CL=90%
$\Gamma_{113}$	$\gamma\chi_{c1}$	$( 4.7 \begin{smallmatrix} +2.4 \\ -1.9 \end{smallmatrix} )$	$\times 10^{-5}$	
$\Gamma_{114}$	$\gamma\chi_{c2}$	$< 7.6$	$\times 10^{-6}$	CL=90%
$\Gamma_{115}$	$\gamma\chi_{c1}(3872)$	$< 4$	$\times 10^{-5}$	CL=90%
$\Gamma_{116}$	$\gamma\chi_{c1}(3872), \chi_{c1} \rightarrow \pi^+\pi^-\pi^0 J/\psi$	$< 2.8$	$\times 10^{-6}$	CL=90%
$\Gamma_{117}$	$\gamma\chi_{c0}(3915) \rightarrow \omega J/\psi$	$< 3.0$	$\times 10^{-6}$	CL=90%
$\Gamma_{118}$	$\gamma\chi_{c1}(4140) \rightarrow \phi J/\psi$	$< 2.2$	$\times 10^{-6}$	CL=90%
$\Gamma_{119}$	$\gamma X$	[c] $< 4.5$	$\times 10^{-6}$	CL=90%
$\Gamma_{120}$	$\gamma X\bar{X} (m_X < 3.1 \text{ GeV})$	[d] $< 1$	$\times 10^{-3}$	CL=90%
$\Gamma_{121}$	$\gamma X\bar{X} (m_X < 4.5 \text{ GeV})$	[e] $< 2.4$	$\times 10^{-4}$	CL=90%
$\Gamma_{122}$	$\gamma X \rightarrow \gamma + \geq 4 \text{ prongs}$	[f] $< 1.78$	$\times 10^{-4}$	CL=95%
$\Gamma_{123}$	$\gamma a_1^0 \rightarrow \gamma\mu^+\mu^-$	[g] $< 9$	$\times 10^{-6}$	CL=90%
$\Gamma_{124}$	$\gamma a_1^0 \rightarrow \gamma\tau^+\tau^-$	[a] $< 1.30$	$\times 10^{-4}$	CL=90%
$\Gamma_{125}$	$\gamma a_1^0 \rightarrow \gamma g g$	[h] $< 1$	%	CL=90%
$\Gamma_{126}$	$\gamma a_1^0 \rightarrow \gamma s\bar{s}$	[h] $< 1$	$\times 10^{-3}$	CL=90%

**Lepton Family number (LF) violating modes**

$\Gamma_{127}$	$\mu^\pm\tau^\mp$	LF	$< 6.0$	$\times 10^{-6}$	CL=95%
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**Other decays**

$\Gamma_{128}$	invisible	$< 3.0$	$\times 10^{-4}$	CL=90%
$\Gamma_{129}$	hadrons	$(97 \pm 5)$	%	

- [a]  $2m_\tau < M(\tau^+\tau^-) < 9.2 \text{ GeV}$
- [b]  $2 \text{ GeV} < m_{K^+K^-} < 3 \text{ GeV}$
- [c]  $X = \text{scalar with } m < 8.0 \text{ GeV}$
- [d]  $X\bar{X} = \text{vectors with } m < 3.1 \text{ GeV}$
- [e]  $X \text{ and } \bar{X} = \text{zero spin with } m < 4.5 \text{ GeV}$
- [f]  $1.5 \text{ GeV} < m_\chi < 5.0 \text{ GeV}$
- [g]  $201 \text{ MeV} < M(\mu^+\mu^-) < 3565 \text{ MeV}$
- [h]  $0.5 \text{ GeV} < m_\chi < 9.0 \text{ GeV}$ , where  $m_\chi$  is the invariant mass of the hadronic final state.

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

$\Gamma(\mu^+\mu^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$					$\Gamma_3\Gamma_2/\Gamma$
<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	$e^+e^- \rightarrow \mu^+\mu^-$	

$\Gamma(\text{hadrons}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$					$\Gamma_{129}\Gamma_2/\Gamma$
<u>VALUE (keV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>		
<b>1.240±0.016 OUR AVERAGE</b>					
1.252±0.004±0.019	<sup>1</sup> ROSNER	06	CLEO	$9.5 e^+e^- \rightarrow \text{hadrons}$	
1.187±0.023±0.031	<sup>1</sup> BARU	92B	MD1	$e^+e^- \rightarrow \text{hadrons}$	
1.23 ±0.02 ±0.05	<sup>1</sup> JAKUBOWSKI	88	CBAL	$e^+e^- \rightarrow \text{hadrons}$	
1.37 ±0.06 ±0.09	<sup>2</sup> GILES	84B	CLEO	$e^+e^- \rightarrow \text{hadrons}$	
1.23 ±0.08 ±0.04	<sup>2</sup> ALBRECHT	82	DASP	$e^+e^- \rightarrow \text{hadrons}$	
1.13 ±0.07 ±0.11	<sup>2</sup> NICZYPORUK	82	LENA	$e^+e^- \rightarrow \text{hadrons}$	
1.09 ±0.25	<sup>2</sup> BOCK	80	CNTR	$e^+e^- \rightarrow \text{hadrons}$	
1.35 ±0.14	<sup>3</sup> BERGER	79	PLUT	$e^+e^- \rightarrow \text{hadrons}$	

<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  $B(\mu\mu) = 0.026$ .

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

$\Gamma(e^+e^-)$					$\Gamma_2$
<u>VALUE (keV)</u>	<u>DOCUMENT ID</u>				
<b>1.340±0.018 OUR EVALUATION</b>					

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

$\Gamma(\tau^+\tau^-)/\Gamma_{\text{total}}$					$\Gamma_1/\Gamma$
<u>VALUE (units <math>10^{-2}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>2.60±0.10 OUR AVERAGE</b>					
2.53±0.13±0.05	60k	<sup>1</sup> BESSON	07	CLEO	$e^+e^- \rightarrow \Upsilon(1S) \rightarrow \tau^+\tau^-$
2.61±0.12 <sup>+0.09</sup> <sub>-0.13</sub>	25k	CINABRO	94B	CLE2	$e^+e^- \rightarrow \tau^+\tau^-$
2.7 ±0.4 ±0.2		<sup>2</sup> ALBRECHT	85C	ARG	$\Upsilon(2S) \rightarrow \pi^+\pi^-\tau^+\tau^-$

3.4 ± 0.4 ± 0.4 GILES 83 CLEO  $e^+e^- \rightarrow \tau^+\tau^-$ 

<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.

<sup>2</sup> Using  $B(\Upsilon(1S) \rightarrow ee) = B(\Upsilon(1S) \rightarrow \mu\mu) = 0.0256$ ; not used for width evaluations.

### $\Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_2/\Gamma$

VALUE (units $10^{-2}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>2.38 ± 0.11 OUR AVERAGE</b>				
2.29 ± 0.08 ± 0.11		ALEXANDER 98	CLE2	$\Upsilon(2S) \rightarrow \pi^+\pi^-e^+e^-$
2.42 ± 0.14 ± 0.14	307	ALBRECHT 87	ARG	$\Upsilon(2S) \rightarrow \pi^+\pi^-e^+e^-$
2.8 ± 0.3 ± 0.2	826	BESSON 84	CLEO	$\Upsilon(2S) \rightarrow \pi^+\pi^-e^+e^-$
5.1 ± 3.0		BERGER 80c	PLUT	$e^+e^- \rightarrow e^+e^-$

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

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 -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.

### $\Gamma(\tau^+\tau^-)/\Gamma(\mu^+\mu^-)$ $\Gamma_1/\Gamma_3$

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.

### $\Gamma(ggg)/\Gamma_{\text{total}}$ $\Gamma_4/\Gamma$

VALUE (units $10^{-2}$ )	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.

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

VALUE (units $10^{-2}$ )	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  $\Gamma(\gamma g g)/\Gamma(g g g) = (2.70 \pm 0.01 \pm 0.13 \pm 0.24)\%$  and  $\Gamma(g g g)/\Gamma_{\text{total}}$ . The statistical error is negligible and the systematic error is partially correlated with that of  $\Gamma(g g g)/\Gamma_{\text{total}}$  measurement of BESSON 06A.

 $\Gamma(\gamma g g)/\Gamma(g g g)$   $\Gamma_5/\Gamma_4$ 

VALUE (units $10^{-2}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>2.70 ± 0.01 ± 0.27</b>	20M	BESSON	06A CLEO	$\Upsilon(1S) \rightarrow (\gamma +) \text{hadrons}$

 $\Gamma(\eta'(958) \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_6/\Gamma$ 

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	$\Upsilon(1S) \rightarrow \eta' \text{ anything}$

 $\Gamma(J/\psi(1S) \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_7/\Gamma$ 

VALUE (units $10^{-4}$ )	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  $B((J/\psi) \rightarrow \mu^+ \mu^-) = (6.9 \pm 0.9)\%$ .

 $\Gamma(J/\psi(1S)\eta_c)/\Gamma_{\text{total}}$   $\Gamma_8/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;2.2 × 10<sup>-6</sup></b>	90	YANG	14 BELL	$e^+ e^- \rightarrow J/\psi X$

 $\Gamma(J/\psi(1S)\chi_{c0})/\Gamma_{\text{total}}$   $\Gamma_9/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;3.4 × 10<sup>-6</sup></b>	90	YANG	14 BELL	$e^+ e^- \rightarrow J/\psi X$

 $\Gamma(J/\psi(1S)\chi_{c1})/\Gamma_{\text{total}}$   $\Gamma_{10}/\Gamma$ 

VALUE (units $10^{-6}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>3.90 ± 1.21 ± 0.23</b>	20	YANG	14 BELL	$e^+ e^- \rightarrow J/\psi X$

 $\Gamma(J/\psi(1S)\chi_{c2})/\Gamma_{\text{total}}$   $\Gamma_{11}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;1.4 × 10<sup>-6</sup></b>	90	YANG	14 BELL	$e^+ e^- \rightarrow J/\psi X$

$\Gamma(J/\psi(1S)\eta_c(2S))/\Gamma_{\text{total}}$					$\Gamma_{12}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$<2.2 \times 10^{-6}$	90	YANG 14	BELL	$e^+e^- \rightarrow J/\psi X$	
$\Gamma(J/\psi(1S)X(3940))/\Gamma_{\text{total}}$					$\Gamma_{13}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$<5.4 \times 10^{-6}$	90	YANG 14	BELL	$e^+e^- \rightarrow J/\psi X$	
$\Gamma(J/\psi(1S)X(4160))/\Gamma_{\text{total}}$					$\Gamma_{14}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$<5.4 \times 10^{-6}$	90	YANG 14	BELL	$e^+e^- \rightarrow J/\psi X$	
$\Gamma(X(4350) \text{ anything}, X \rightarrow J/\psi(1S)\phi)/\Gamma_{\text{total}}$					$\Gamma_{15}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$<8.1 \times 10^{-6}$	90	SHEN 16	BELL	$\Upsilon(1S) \rightarrow J/\psi K^+ K^- X$	
$\Gamma(Z_c(3900)^\pm \text{ anything}, Z_c \rightarrow J/\psi(1S)\pi^\pm)/\Gamma_{\text{total}}$					$\Gamma_{16}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$<1.3 \times 10^{-5}$	90	SHEN 16	BELL	$\Upsilon(1S) \rightarrow J/\psi \pi^\pm X$	
$\Gamma(Z_c(4200)^\pm \text{ anything}, Z_c \rightarrow J/\psi(1S)\pi^\pm)/\Gamma_{\text{total}}$					$\Gamma_{17}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$<6.0 \times 10^{-5}$	90	SHEN 16	BELL	$\Upsilon(1S) \rightarrow J/\psi \pi^\pm X$	
$\Gamma(Z_c(4430)^\pm \text{ anything}, Z_c \rightarrow J/\psi(1S)\pi^\pm)/\Gamma_{\text{total}}$					$\Gamma_{18}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$<4.9 \times 10^{-5}$	90	SHEN 16	BELL	$\Upsilon(1S) \rightarrow J/\psi \pi^\pm X$	
$\Gamma(X_{cs}^\pm \text{ anything}, X \rightarrow J/\psi K^\pm)/\Gamma_{\text{total}}$					$\Gamma_{19}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$<5.7 \times 10^{-6}$	90	SHEN 16	BELL	$\Upsilon(1S) \rightarrow J/\psi K^- X$	
$\Gamma(\psi(4230) \text{ anything}, \psi \rightarrow J/\psi(1S)\pi^+\pi^-)/\Gamma_{\text{total}}$					$\Gamma_{20}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$<3.8 \times 10^{-5}$	90	SHEN 16	BELL	$\Upsilon(1S) \rightarrow J/\psi \pi^+ \pi^- X$	
$\Gamma(\psi(4230) \text{ anything}, \psi \rightarrow J/\psi(1S)K^+K^-)/\Gamma_{\text{total}}$					$\Gamma_{21}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$<7.5 \times 10^{-6}$	90	SHEN 16	BELL	$\Upsilon(1S) \rightarrow J/\psi K^+ K^- X$	
$\Gamma(\chi_{c1}(4140) \text{ anything}, \chi_{c1} \rightarrow J/\psi(1S)\phi)/\Gamma_{\text{total}}$					$\Gamma_{22}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$<5.2 \times 10^{-6}$	90	SHEN 16	BELL	$\Upsilon(1S) \rightarrow J/\psi K^+ K^- X$	
$\Gamma(\chi_{c0} \text{ anything})/\Gamma(J/\psi(1S) \text{ anything})$					$\Gamma_{23}/\Gamma_7$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$<7.4$	90	BRIERE 04	CLEO	$e^+e^- \rightarrow J/\psi X$	



$\Gamma(\chi_{c1} \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{24}/\Gamma$ 

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 $\Upsilon(1S) \rightarrow \gamma J/\psi(1S)$

 $\Gamma(\chi_{c1} \text{ anything})/\Gamma(J/\psi(1S) \text{ anything})$   $\Gamma_{24}/\Gamma_7$ 

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 $e^+e^- \rightarrow J/\psi X$

 $\Gamma(\chi_{c1}(1P)X_{tetra})/\Gamma_{\text{total}}$   $\Gamma_{25}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;37.8 × 10<sup>-6</sup></b>	90	<sup>1</sup> JIA	17A	BELL $e^+e^- \rightarrow \text{hadrons}$

<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  $37.8 \times 10^{-6}$ .

 $\Gamma(\chi_{c2} \text{ anything})/\Gamma(J/\psi(1S) \text{ anything})$   $\Gamma_{26}/\Gamma_7$ 

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
<b>0.52±0.12±0.09</b>	47 ± 11	BRIERE	04	CLEO $e^+e^- \rightarrow J/\psi X$

 $\Gamma(\psi(2S) \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{27}/\Gamma$ 

VALUE (units $10^{-4}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>1.23±0.17±0.11</b>	215	SHEN	16	BELL $e^+e^- \rightarrow \psi(2S)X$

 $\Gamma(\psi(2S) \text{ anything})/\Gamma(J/\psi(1S) \text{ anything})$   $\Gamma_{27}/\Gamma_7$ 

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
<b>0.41±0.11±0.08</b>	42 ± 11	BRIERE	04	CLEO $e^+e^- \rightarrow J/\psi \pi^+ \pi^- X$

 $\Gamma(\psi(2S)\eta_c)/\Gamma_{\text{total}}$   $\Gamma_{28}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;3.6 × 10<sup>-6</sup></b>	90	YANG	14	BELL $e^+e^- \rightarrow \psi(2S)X$

 $\Gamma(\psi(2S)\chi_{c0})/\Gamma_{\text{total}}$   $\Gamma_{29}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;6.5 × 10<sup>-6</sup></b>	90	YANG	14	BELL $e^+e^- \rightarrow \psi(2S)X$

 $\Gamma(\psi(2S)\chi_{c1})/\Gamma_{\text{total}}$   $\Gamma_{30}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;4.5 × 10<sup>-6</sup></b>	90	YANG	14	BELL $e^+e^- \rightarrow \psi(2S)X$

 $\Gamma(\psi(2S)\chi_{c2})/\Gamma_{\text{total}}$   $\Gamma_{31}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;2.1 × 10<sup>-6</sup></b>	90	YANG	14	BELL $e^+e^- \rightarrow \psi(2S)X$

 $\Gamma(\psi(2S)\eta_c(2S))/\Gamma_{\text{total}}$   $\Gamma_{32}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;3.2 × 10<sup>-6</sup></b>	90	YANG	14	BELL $e^+e^- \rightarrow \psi(2S)X$

$\Gamma(\psi(2S)X(3940))/\Gamma_{\text{total}}$   $\Gamma_{33}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<2.9 \times 10^{-6}$	90	YANG 14	BELL	$e^+e^- \rightarrow \psi(2S)X$

 $\Gamma(\psi(2S)X(4160))/\Gamma_{\text{total}}$   $\Gamma_{34}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<2.9 \times 10^{-6}$	90	YANG 14	BELL	$e^+e^- \rightarrow \psi(2S)X$

 $\Gamma(\psi(4230) \text{ anything, } \psi \rightarrow \psi(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{35}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<7.9 \times 10^{-5}$	90	SHEN 16	BELL	$\Upsilon(1S) \rightarrow \psi(2S)\pi^+\pi^-X$

 $\Gamma(\psi(4360) \text{ anything, } \psi \rightarrow \psi(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{36}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<5.2 \times 10^{-5}$	90	SHEN 16	BELL	$\Upsilon(1S) \rightarrow \psi(2S)\pi^+\pi^-X$

 $\Gamma(\psi(4660) \text{ anything, } \psi \rightarrow \psi(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{37}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<2.2 \times 10^{-5}$	90	SHEN 16	BELL	$\Upsilon(1S) \rightarrow \psi(2S)\pi^+\pi^-X$

 $\Gamma(X(4050)^\pm \text{ anything, } X \rightarrow \psi(2S)\pi^\pm)/\Gamma_{\text{total}}$   $\Gamma_{38}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<8.8 \times 10^{-5}$	90	SHEN 16	BELL	$\Upsilon(1S) \rightarrow \psi(2S)\pi^\pm X$

 $\Gamma(Z_c(4430)^\pm \text{ anything, } Z_c \rightarrow \psi(2S)\pi^\pm)/\Gamma_{\text{total}}$   $\Gamma_{39}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<6.7 \times 10^{-5}$	90	SHEN 16	BELL	$\Upsilon(1S) \rightarrow \psi(2S)\pi^\pm X$

 $\Gamma(\chi_{c1}(3872) \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{40}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<2.5 \times 10^{-4}$	90	<sup>1</sup> SHEN 16	BELL	$\Upsilon(1S) \rightarrow J/\psi\pi^+\pi^-X$

<sup>1</sup> SHEN 16 reports  $[\Gamma(\Upsilon(1S) \rightarrow \chi_{c1}(3872) \text{ anything})/\Gamma_{\text{total}}] \times [B(\chi_{c1}(3872) \rightarrow \pi^+\pi^-J/\psi(1S))] < 9.5 \times 10^{-6}$  which we divide by our best value  $B(\chi_{c1}(3872) \rightarrow \pi^+\pi^-J/\psi(1S)) = 3.8 \times 10^{-2}$ .

 $\Gamma(Z_c(4200)^+Z_c(4200)^-)/\Gamma_{\text{total}}$   $\Gamma_{41}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<22.3 \times 10^{-6}$	90	<sup>1</sup> JIA 18	BELL	$\Upsilon(1S) \rightarrow J/\psi\pi^\pm X$

<sup>1</sup> Assuming  $B(Z_c(4200)^\pm \rightarrow J/\psi\pi^\pm) = 1$ .

 $\Gamma(Z_c(3900)^\pm Z_c(4200)^\mp)/\Gamma_{\text{total}}$   $\Gamma_{42}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<8.1 \times 10^{-6}$	90	<sup>1</sup> JIA 18	BELL	$\Upsilon(1S) \rightarrow J/\psi\pi^\pm X$

<sup>1</sup> Assuming  $B(Z_c(4200)^\pm \rightarrow J/\psi\pi^\pm) = 1 = B(Z_c(3900)^\pm \rightarrow J/\psi\pi^\pm)$ .

$\Gamma(Z_c(3900)^+ Z_c(3900)^-)/\Gamma_{\text{total}}$   $\Gamma_{43}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<1.8 \times 10^{-6}$	90	<sup>1</sup> JIA	18	BELL $\Upsilon(1S) \rightarrow J/\psi \pi^\pm X$

<sup>1</sup> Assuming  $B(Z_c(3900)^\pm \rightarrow J/\psi \pi^\pm) = 1$

 $\Gamma(X(4050)^+ X(4050)^-)/\Gamma_{\text{total}}$   $\Gamma_{44}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<15.8 \times 10^{-6}$	90	<sup>1</sup> JIA	18	BELL $\Upsilon(1S) \rightarrow \chi_{c1}(1P) \pi^\pm X$

<sup>1</sup> Assuming  $B(X(4050)^\pm \rightarrow \chi_{c1}(1P) \pi^\pm) = 1$

 $\Gamma(X(4250)^+ X(4250)^-)/\Gamma_{\text{total}}$   $\Gamma_{45}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<26.6 \times 10^{-6}$	90	<sup>1</sup> JIA	18	BELL $\Upsilon(1S) \rightarrow \chi_{c1}(1P) \pi^\pm X$

<sup>1</sup> Assuming  $B(X(4250)^\pm \rightarrow \chi_{c1}(1P) \pi^\pm) = 1$

 $\Gamma(X(4050)^\pm X(4250)^\mp)/\Gamma_{\text{total}}$   $\Gamma_{46}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<44.2 \times 10^{-6}$	90	<sup>1</sup> JIA	18	BELL $\Upsilon(1S) \rightarrow \chi_{c1}(1P) \pi^\pm X$

<sup>1</sup> Assuming  $B(X(4050)^\pm \rightarrow \chi_{c1}(1P) \pi^\pm) = 1 = B(X(4250)^\pm \rightarrow \chi_{c1}(1P) \pi^\pm)$

 $\Gamma(Z_c(4430)^+ Z_c(4430)^-)/\Gamma_{\text{total}}$   $\Gamma_{47}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<20.3 \times 10^{-6}$	90	<sup>1</sup> JIA	18	BELL $\Upsilon(2S) \rightarrow \psi(2S) \pi^\pm X$

<sup>1</sup> Assuming  $B(Z_c(4430)^\pm \rightarrow \psi(2S) \pi^\pm) = 1$

 $\Gamma(X(4055)^\pm X(4055)^\mp)/\Gamma_{\text{total}}$   $\Gamma_{48}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<23.3 \times 10^{-6}$	90	<sup>1</sup> JIA	18	BELL $\Upsilon(1S) \rightarrow \psi(2S) \pi^\pm X$

<sup>1</sup> Assuming  $B(X(4055)^\pm \rightarrow \psi(2S) \pi^\pm) = 1$

 $\Gamma(X(4055)^\pm Z_c(4430)^\mp)/\Gamma_{\text{total}}$   $\Gamma_{49}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<45.5 \times 10^{-6}$	90	<sup>1</sup> JIA	18	BELL $\Upsilon(1S) \rightarrow \psi(2S) \pi^\pm X$

<sup>1</sup> Assuming  $B(X(4055)^\pm \rightarrow \psi(2S) \pi^\pm) = 1 = B(Z_c(4430)^\pm \rightarrow \psi(2S) \pi^\pm)$

 $\Gamma(\rho\pi)/\Gamma_{\text{total}}$   $\Gamma_{50}/\Gamma$ 

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;3.68</b>	90	SHEN	13	BELL $\Upsilon(1S) \rightarrow \pi^+ \pi^- \pi^0$
$<1 \times 10^3$	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 $\Upsilon(1S) \rightarrow \rho^0 \pi^0$

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

 $\Gamma(\omega\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{51}/\Gamma$ 

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;3.90</b>	90	SHEN	13	BELL $\Upsilon(1S) \rightarrow \pi^+ \pi^- \pi^0 \pi^0$

$\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{52}/\Gamma$

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

$\Gamma(K^+K^-)/\Gamma_{\text{total}}$   $\Gamma_{53}/\Gamma$

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

$\Gamma(\rho\bar{\rho})/\Gamma_{\text{total}}$   $\Gamma_{54}/\Gamma$

<u>VALUE (units <math>10^{-4}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt;5</b>	90	<sup>1</sup> BARU	96 MD1	$\Upsilon(1S) \rightarrow \rho\bar{\rho}$

<sup>1</sup>Supersedes BARU 92 in this node.

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{55}/\Gamma$

<u>VALUE (units <math>10^{-6}</math>)</u>	<u>CL%</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<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	$e^+e^- \rightarrow \text{hadrons}$
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$\Gamma(\phi K^+K^-)/\Gamma_{\text{total}}$   $\Gamma_{56}/\Gamma$

<u>VALUE (units <math>10^{-6}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>2.36 \pm 0.37 \pm 0.29</math></b>	56	SHEN	12A BELL	$\Upsilon(1S) \rightarrow 2(K^+K^-)$

$\Gamma(\omega\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{57}/\Gamma$

<u>VALUE (units <math>10^{-6}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>4.46 \pm 0.67 \pm 0.72</math></b>	64	SHEN	12A BELL	$\Upsilon(1S) \rightarrow 2(\pi^+\pi^-)\pi^0$

$\Gamma(K^*(892)^0 K^-\pi^+ + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{58}/\Gamma$

<u>VALUE (units <math>10^{-6}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>4.42 \pm 0.50 \pm 0.58</math></b>	173	SHEN	12A BELL	$\Upsilon(1S) \rightarrow K^+K^-\pi^+\pi^-$

$\Gamma(\phi f'_2(1525))/\Gamma_{\text{total}}$   $\Gamma_{59}/\Gamma$

<u>VALUE (units <math>10^{-6}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt;1.63</b>	90	SHEN	12A BELL	$\Upsilon(1S) \rightarrow 2(K^+K^-)$

$\Gamma(\omega f_2(1270))/\Gamma_{\text{total}}$   $\Gamma_{60}/\Gamma$

<u>VALUE (units <math>10^{-6}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt;1.79</b>	90	SHEN	12A BELL	$\Upsilon(1S) \rightarrow 2(\pi^+\pi^-)\pi^0$

$\Gamma(\rho(770) a_2(1320))/\Gamma_{\text{total}}$   $\Gamma_{61}/\Gamma$

<u>VALUE (units <math>10^{-6}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt;2.24</b>	90	SHEN	12A BELL	$\Upsilon(1S) \rightarrow 2(\pi^+\pi^-)\pi^0$

$\Gamma(K^*(892)^0 \bar{K}_2^*(1430)^0 + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{62}/\Gamma$

<u>VALUE (units <math>10^{-6}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>3.02 \pm 0.68 \pm 0.34</math></b>	42	SHEN	12A BELL	$\Upsilon(1S) \rightarrow K^+K^-\pi^+\pi^-$

$\Gamma(K_1(1270)^\pm K^\mp)/\Gamma_{\text{total}}$   $\Gamma_{63}/\Gamma$

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;2.41</b>	90	SHEN	12A	BELL $\Upsilon(1S) \rightarrow K^+ K^- \pi^+ \pi^-$

$\Gamma(K_1(1400)^\pm K^\mp)/\Gamma_{\text{total}}$   $\Gamma_{64}/\Gamma$

VALUE (units $10^{-6}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>1.02 ± 0.35 ± 0.22</b>	24	SHEN	12A	BELL $\Upsilon(1S) \rightarrow K^+ K^- \pi^+ \pi^-$

$\Gamma(b_1(1235)^\pm \pi^\mp)/\Gamma_{\text{total}}$   $\Gamma_{65}/\Gamma$

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;1.25</b>	90	SHEN	12A	BELL $\Upsilon(1S) \rightarrow 2(\pi^+ \pi^-) \pi^0$

$\Gamma(\pi^+ \pi^- \pi^0 \pi^0)/\Gamma_{\text{total}}$   $\Gamma_{66}/\Gamma$

VALUE (units $10^{-6}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>12.8 ± 2.0 ± 2.3</b>	143 ± 22	SHEN	13	BELL $\Upsilon(1S) \rightarrow \pi^+ \pi^- \pi^0 \pi^0$

$\Gamma(K_S^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{67}/\Gamma$

VALUE (units $10^{-6}$ )	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<b>1.59 ± 0.33 ± 0.18</b>	37 ± 8	SHEN	13	BELL	$\Upsilon(1S) \rightarrow K_S^0 K^- \pi^+$

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

<3.4	90	<sup>1</sup> DOBBS	12A	$\Upsilon(1S) \rightarrow K_S^0 K^- \pi^+$
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<sup>1</sup> Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

$\Gamma(K^*(892)^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{68}/\Gamma$

VALUE (units $10^{-6}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>2.92 ± 0.85 ± 0.37</b>	16 ± 5	SHEN	13	BELL $\Upsilon(1S) \rightarrow K_S^0 K^- \pi^+$

$\Gamma(K^*(892)^- K^+ + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{69}/\Gamma$

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;1.11</b>	90	SHEN	13	BELL $\Upsilon(1S) \rightarrow K_S^0 K^- \pi^+$

$\Gamma(f_1(1285) \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{70}/\Gamma$

VALUE (units $10^{-3}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>4.6 ± 2.8 ± 1.3</b>	3.1k	JIA	17A	BELL $e^+ e^- \rightarrow \text{hadrons}$

$\Gamma(D^*(2010)^\pm \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{71}/\Gamma$

VALUE (units $10^{-3}$ )	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<b>25.2 ± 1.3 ± 1.5</b>	≈ 2k	<sup>1</sup> AUBERT	10c	BABR	$\Upsilon(2S) \rightarrow \pi^+ \pi^- \Upsilon(1S)$

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

<19	90	<sup>2</sup> ALBRECHT	92J	ARG	$e^+ e^- \rightarrow D^0 \pi^\pm X$
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<sup>1</sup> For  $x_p > 0.1$ .

<sup>2</sup> For  $x_p > 0.2$ .

$\Gamma(f_1(1285)X_{tetra})/\Gamma_{total}$					$\Gamma_{72}/\Gamma$
VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
<b>&lt;62.4 × 10<sup>-6</sup></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  $4.6 \times 10^{-6}$  to  $62.4 \times 10^{-6}$ .

$\Gamma(\overline{2H} \text{ anything})/\Gamma_{total}$					$\Gamma_{73}/\Gamma$
VALUE (units 10 <sup>-5</sup> )	EVTS	DOCUMENT ID	TECN	COMMENT	
<b>2.85 ± 0.25 OUR AVERAGE</b>					

2.81 ± 0.49 <sup>+0.20</sup> <sub>-0.24</sub>		LEES	14G	BABR	$e^+e^- \rightarrow \overline{2H} X$
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2.86 ± 0.19 ± 0.21	455	ASNER	07	CLEO	$e^+e^- \rightarrow \overline{2H} X$
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$\Gamma(\text{Sum of 100 exclusive modes})/\Gamma_{total}$					$\Gamma_{74}/\Gamma$
VALUE (units 10 <sup>-2</sup> )		DOCUMENT ID		COMMENT	
<b>1.200 ± 0.017</b>		<sup>1,2</sup> 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.

$\Gamma(ggg, \gamma gg \rightarrow \overline{d} \text{ anything})/\Gamma(ggg, \gamma gg \rightarrow \text{anything})$				
VALUE (units 10 <sup>-5</sup> )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>3.36 ± 0.23 ± 0.25</b>	455	ASNER	07	CLEO $e^+e^- \rightarrow \overline{d} X$

$\Gamma(\gamma\pi^+\pi^-)/\Gamma_{total}$					$\Gamma_{75}/\Gamma$
VALUE (units 10 <sup>-5</sup> )		DOCUMENT ID	TECN	COMMENT	
<b>6.3 ± 1.2 ± 1.3</b>		<sup>1</sup> ANASTASSOV 99	CLE2	$e^+e^- \rightarrow \text{hadrons}$	

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

$\Gamma(\gamma\pi^0\pi^0)/\Gamma_{total}$					$\Gamma_{76}/\Gamma$
VALUE (units 10 <sup>-5</sup> )		DOCUMENT ID	TECN	COMMENT	
<b>1.7 ± 0.6 ± 0.3</b>		<sup>1</sup> ANASTASSOV 99	CLE2	$e^+e^- \rightarrow \text{hadrons}$	

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

$\Gamma(\gamma\pi\pi(\text{S-wave}))/\Gamma_{total}$					$\Gamma_{77}/\Gamma$
VALUE (units 10 <sup>-5</sup> )		DOCUMENT ID	TECN	COMMENT	
<b>4.63 ± 0.56 ± 0.48</b>		LEES	18A	BABR $\Upsilon(1S) \rightarrow \gamma\pi^+\pi^-$	

$\Gamma(\gamma\pi^0\eta)/\Gamma_{total}$					$\Gamma_{78}/\Gamma$
VALUE (units 10 <sup>-6</sup> )	CL%	DOCUMENT ID	TECN	COMMENT	
<b>&lt;2.4</b>	90	<sup>1</sup> BESSON	07A	CLEO $e^+e^- \rightarrow \Upsilon(1S)$	

<sup>1</sup> BESSON 07A obtained this limit for  $0.7 < m_{\pi^0\eta} < 3$  GeV.

$$\Gamma(\gamma K^+ K^-)/\Gamma_{\text{total}} \quad \Gamma_{79}/\Gamma$$

$(2 < m_{K^+ K^-} < 3 \text{ GeV})$

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>1.14±0.08±0.10</b>	90	ATHAR	06 CLE3	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$

$$\Gamma(\gamma p \bar{p})/\Gamma_{\text{total}} \quad \Gamma_{80}/\Gamma$$

$(2 < m_{p \bar{p}} < 3 \text{ GeV})$

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt;0.6</b>	90	ATHAR	06 CLE3	$\Upsilon(1S) \rightarrow \gamma p \bar{p}$

$$\Gamma(\gamma 2h^+ 2h^-)/\Gamma_{\text{total}} \quad \Gamma_{81}/\Gamma$$

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

$$\Gamma(\gamma 3h^+ 3h^-)/\Gamma_{\text{total}} \quad \Gamma_{82}/\Gamma$$

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

$$\Gamma(\gamma 4h^+ 4h^-)/\Gamma_{\text{total}} \quad \Gamma_{83}/\Gamma$$

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

$$\Gamma(\gamma \pi^+ \pi^- K^+ K^-)/\Gamma_{\text{total}} \quad \Gamma_{84}/\Gamma$$

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

$$\Gamma(\gamma 2\pi^+ 2\pi^-)/\Gamma_{\text{total}} \quad \Gamma_{85}/\Gamma$$

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

$$\Gamma(\gamma 3\pi^+ 3\pi^-)/\Gamma_{\text{total}} \quad \Gamma_{86}/\Gamma$$

<u>VALUE (units <math>10^{-4}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>2.5±0.9±0.8</b>	17 ± 5	FULTON	90B CLEO	$e^+ e^- \rightarrow \text{hadrons}$

$$\Gamma(\gamma 2\pi^+ 2\pi^- K^+ K^-)/\Gamma_{\text{total}} \quad \Gamma_{87}/\Gamma$$

<u>VALUE (units <math>10^{-4}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>2.4±0.9±0.8</b>	18 ± 7	FULTON	90B CLEO	$e^+ e^- \rightarrow \text{hadrons}$

$$\Gamma(\gamma \pi^+ \pi^- p \bar{p})/\Gamma_{\text{total}} \quad \Gamma_{88}/\Gamma$$

<u>VALUE (units <math>10^{-4}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>1.5±0.5±0.3</b>	22 ± 6	FULTON	90B CLEO	$e^+ e^- \rightarrow \text{hadrons}$

$$\Gamma(\gamma 2\pi^+ 2\pi^- p \bar{p})/\Gamma_{\text{total}} \quad \Gamma_{89}/\Gamma$$

<u>VALUE (units <math>10^{-4}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.4±0.4±0.4</b>	7 ± 6	FULTON	90B CLEO	$e^+ e^- \rightarrow \text{hadrons}$

$\Gamma(\gamma 2K^+ 2K^-)/\Gamma_{\text{total}}$   $\Gamma_{90}/\Gamma$ 

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

 $\Gamma(\gamma \eta'(958))/\Gamma_{\text{total}}$   $\Gamma_{91}/\Gamma$ 

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt; 1.9</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 $\Upsilon(1S) \rightarrow \gamma \eta' \rightarrow \gamma \eta \pi^+ \pi^-$

 $\Gamma(\gamma \eta)/\Gamma_{\text{total}}$   $\Gamma_{92}/\Gamma$ 

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt; 1.0</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 $\Upsilon(1S) \rightarrow \gamma \eta$

 $\Gamma(\gamma f_0(980))/\Gamma_{\text{total}}$   $\Gamma_{93}/\Gamma$ 

VALUE (units $10^{-5}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt; 3</b>	90	<sup>1</sup> ATHAR	06	CLE3 $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$
<sup>1</sup> Assuming $B(f_0(980) \rightarrow \pi\pi) = 1$ .				

 $\Gamma(\gamma f'_2(1525))/\Gamma_{\text{total}}$   $\Gamma_{94}/\Gamma$ 

VALUE (units $10^{-5}$ )	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>2.9 \pm 0.6</math> OUR AVERAGE</b>					
$2.13 \pm 0.28 \pm 0.72$			<sup>1</sup> LEES	18A	BABR $\Upsilon(1S) \rightarrow \gamma K^+ K^-$
$4.1 \pm 1.4 \pm 0.1$		17	<sup>2</sup> BESSION	11	CLEO $\Upsilon(1S) \rightarrow K_S^0 K_S^0$
$3.7 \begin{smallmatrix} +0.9 \\ -0.7 \end{smallmatrix} \pm 0.8$			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> BESSION 11 reports  $(4.0 \pm 1.3 \pm 0.6) \times 10^{-5}$  from a measurement of  $[\Gamma(\Upsilon(1S) \rightarrow \gamma f'_2(1525))/\Gamma_{\text{total}}] \times [B(f'_2(1525) \rightarrow K\bar{K})]$  assuming  $B(f'_2(1525) \rightarrow K\bar{K}) = (88.8 \pm 3.1) \times 10^{-2}$ , which we rescale to our best value  $B(f'_2(1525) \rightarrow K\bar{K}) = (87.6 \pm 2.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. The result also assumes  $B(K_S^0 \rightarrow \pi^+ \pi^-) = (69.20 \pm 0.05)\%$  and  $B(f'_2(1525) \rightarrow K\bar{K}) = 4 B(f'_2(1525) \rightarrow K_S^0 K_S^0)$ .<sup>3</sup> Assuming  $B(f'_2(1525) \rightarrow K\bar{K}) = 0.71$ . $\Gamma(\gamma f_2(1270))/\Gamma_{\text{total}}$   $\Gamma_{95}/\Gamma$ 

VALUE (units $10^{-5}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>10.1 \pm 0.6</math> OUR AVERAGE</b>				
$10.15 \pm 0.59 \begin{smallmatrix} +0.54 \\ -0.43 \end{smallmatrix}$		<sup>1</sup> LEES	18A	BABR $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$



10.5 ± 1.6 <sup>+1.9</sup> / <sub>-1.8</sub>	2	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>	3	ANASTASSOV 99		CLE2	$e^+ e^- \rightarrow \text{hadrons}$

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

<21	90	3 FULTON	90B	CLEO	$\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$
<13	90	3 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  $B(f_2(1270) \rightarrow \pi \pi) = 0.84$ .

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

$\Gamma_{96}/\Gamma$

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  $\eta(1405) \rightarrow K^\pm \pi^\mp K_S^0$ .

### $\Gamma(\gamma f_0(1500))/\Gamma_{\text{total}}$

$\Gamma_{97}/\Gamma$

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	2 BESSON	07A	CLEO	$e^+ e^- \rightarrow \Upsilon(1S) \rightarrow \gamma \eta \eta$
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<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  $B(f_0(1500) \rightarrow \eta \eta) = (5.1 \pm 0.9)\%$ .

### $\Gamma(\gamma f_0(1500) \rightarrow \gamma K^+ K^-)/\Gamma_{\text{total}}$

$\Gamma_{98}/\Gamma$

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  $B(K^0 \bar{K}^0) = 1/2 B(K \bar{K})$ .

### $\Gamma(\gamma f_0(1710))/\Gamma_{\text{total}}$

$\Gamma_{99}/\Gamma$

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  $B(f_0(1710) \rightarrow \eta \eta) = 0.18$ .

$\Gamma(\gamma f_0(1710) \rightarrow \gamma K^+ K^-) / \Gamma_{\text{total}}$   $\Gamma_{100} / \Gamma$ 

VALUE (units $10^{-5}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>1.01 \pm 0.26 \pm 0.18</math></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 $B(K^0 \bar{K}^0) = 1/2 B(K \bar{K})$ .				

 $\Gamma(\gamma f_0(1710) \rightarrow \gamma \pi^+ \pi^-) / \Gamma_{\text{total}}$   $\Gamma_{101} / \Gamma$ 

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 $B(\pi^0 \pi^0) = 1/3 B(\pi \pi)$ .			

 $\Gamma(\gamma f_0(1710) \rightarrow \gamma \pi^0 \pi^0) / \Gamma_{\text{total}}$   $\Gamma_{102} / \Gamma$ 

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<1.4	90	BESSON	07A	CLEO $e^+ e^- \rightarrow \Upsilon(1S) \rightarrow \gamma \pi^0 \pi^0$

 $\Gamma(\gamma f_0(1710) \rightarrow \gamma \eta \eta) / \Gamma_{\text{total}}$   $\Gamma_{103} / \Gamma$ 

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<1.8	90	BESSON	07A	CLEO $e^+ e^- \rightarrow \Upsilon(1S) \rightarrow \gamma \eta \eta$

 $\Gamma(\gamma f_4(2050)) / \Gamma_{\text{total}}$   $\Gamma_{104} / \Gamma$ 

VALUE (units $10^{-5}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<5.3	90	<sup>1</sup> ATHAR	06	CLE3 $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$
<sup>1</sup> Assuming $B(f_4(2050) \rightarrow \pi \pi) = 0.17$ .				

 $\Gamma(\gamma f_0(2200) \rightarrow \gamma K^+ K^-) / \Gamma_{\text{total}}$   $\Gamma_{105} / \Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.0002	90	BARU	89	MD1 $\Upsilon(1S) \rightarrow \gamma K^+ K^-$

 $\Gamma(\gamma f_J(2220) \rightarrow \gamma K^+ K^-) / \Gamma_{\text{total}}$   $\Gamma_{106} / \Gamma$ 

VALUE (units $10^{-7}$ )	CL%	DOCUMENT ID	TECN	COMMENT
< 8	90	ATHAR	06	CLE3 $\Upsilon(1S) \rightarrow \gamma K^+ K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
< 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 $\Upsilon(1S) \rightarrow \gamma K^+ K^-$

 $\Gamma(\gamma f_J(2220) \rightarrow \gamma \pi^+ \pi^-) / \Gamma_{\text{total}}$   $\Gamma_{107} / \Gamma$ 

VALUE (units $10^{-7}$ )	CL%	DOCUMENT ID	TECN	COMMENT
< 6	90	ATHAR	06	CLE3 $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<120	90	MASEK	02	CLEO $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$

$\Gamma(\gamma f_J(2220) \rightarrow \gamma p \bar{p})/\Gamma_{\text{total}}$   $\Gamma_{108}/\Gamma$ 

VALUE (units $10^{-7}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<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 $\Upsilon(1S) \rightarrow \gamma p \bar{p}$

 $\Gamma(\gamma \eta(2225) \rightarrow \gamma \phi \phi)/\Gamma_{\text{total}}$   $\Gamma_{109}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;0.003</b>	90	BARU	89	MD1 $\Upsilon(1S) \rightarrow \gamma K^+ K^- K^+ K^-$

 $\Gamma(\gamma \eta_c(1S))/\Gamma_{\text{total}}$   $\Gamma_{110}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;2.9 <math>\times 10^{-5}</math></b>	90	<sup>1</sup> KATRENKO	20	BELL $e^+ e^- \rightarrow \gamma + \text{hadrons}$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<5.7 $\times 10^{-5}$	90	SHEN	10A	BELL $\Upsilon(1S) \rightarrow \gamma X$
<sup>1</sup> Using $\Upsilon(2S) \rightarrow \Upsilon(1S) \pi^+ \pi^-$ decays.				

 $\Gamma(\gamma \eta_c(2S))/\Gamma_{\text{total}}$   $\Gamma_{111}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;4 <math>\times 10^{-4}</math></b>	90	<sup>1</sup> KATRENKO	20	BELL $e^+ e^- \rightarrow \gamma + \text{hadrons}$
<sup>1</sup> Using $\Upsilon(2S) \rightarrow \Upsilon(1S) \pi^+ \pi^-$ decays.				

 $\Gamma(\gamma \chi_{c0})/\Gamma_{\text{total}}$   $\Gamma_{112}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;6.6 <math>\times 10^{-5}</math></b>	90	<sup>1</sup> KATRENKO	20	BELL $\Upsilon(1S) \rightarrow \gamma + \text{hadrons}$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<6.5 $\times 10^{-4}$	90	SHEN	10A	BELL $\Upsilon(1S) \rightarrow \gamma X$
<sup>1</sup> Using $\Upsilon(2S) \rightarrow \Upsilon(1S) \pi^+ \pi^-$ decays.				

 $\Gamma(\gamma \chi_{c1})/\Gamma_{\text{total}}$   $\Gamma_{113}/\Gamma$ 

VALUE (units $10^{-5}$ )	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>4.7^{+2.4+0.4}_{-1.8-0.5}</math></b>		5	<sup>1</sup> KATRENKO	20	BELL $\Upsilon(1S) \rightarrow \gamma + \text{hadrons}$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<2.3	90		SHEN	10A	BELL $\Upsilon(1S) \rightarrow \gamma X$
<sup>1</sup> Using $\Upsilon(2S) \rightarrow \Upsilon(1S) \pi^+ \pi^-$ decays.					

 $\Gamma(\gamma \chi_{c2})/\Gamma_{\text{total}}$   $\Gamma_{114}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;7.6 <math>\times 10^{-6}</math></b>	90	SHEN	10A	BELL $\Upsilon(1S) \rightarrow \gamma X$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<3.3 $\times 10^{-5}$	90	<sup>1</sup> KATRENKO	20	BELL $\Upsilon(1S) \rightarrow \gamma + \text{hadrons}$
<sup>1</sup> Using $\Upsilon(2S) \rightarrow \Upsilon(1S) \pi^+ \pi^-$ decays.				

$\Gamma(\gamma\chi_{c1}(3872))/\Gamma_{\text{total}}$   $\Gamma_{115}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<4 \times 10^{-5}$	90	<sup>1</sup> SHEN 10A	BELL	$\Upsilon(1S) \rightarrow \gamma X$

<sup>1</sup> SHEN 10A reports  $[\Gamma(\Upsilon(1S) \rightarrow \gamma\chi_{c1}(3872))/\Gamma_{\text{total}}] \times [B(\chi_{c1}(3872) \rightarrow \pi^+\pi^- J/\psi(1S))] < 1.6 \times 10^{-6}$  which we divide by our best value  $B(\chi_{c1}(3872) \rightarrow \pi^+\pi^- J/\psi(1S)) = 3.8 \times 10^{-2}$ .

 $\Gamma(\gamma\chi_{c1}(3872), \chi_{c1} \rightarrow \pi^+\pi^-\pi^0 J/\psi)/\Gamma_{\text{total}}$   $\Gamma_{116}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<2.8 \times 10^{-6}$	90	SHEN 10A	BELL	$\Upsilon(1S) \rightarrow \gamma X$

 $\Gamma(\gamma\chi_{c0}(3915) \rightarrow \omega J/\psi)/\Gamma_{\text{total}}$   $\Gamma_{117}/\Gamma$ 

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
$<3.0$	90	SHEN 10A	BELL	$\Upsilon(1S) \rightarrow \gamma X$

 $\Gamma(\gamma\chi_{c1}(4140) \rightarrow \phi J/\psi)/\Gamma_{\text{total}}$   $\Gamma_{118}/\Gamma$ 

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
$<2.2$	90	SHEN 10A	BELL	$\Upsilon(1S) \rightarrow \gamma X$

 $\Gamma(\gamma X)/\Gamma_{\text{total}}$   $\Gamma_{119}/\Gamma$ (X = scalar with  $m < 8.0$  GeV)

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
$<4.5$	90	<sup>1</sup> DEL-AMO-SA..11J	BABR	$e^+e^- \rightarrow \gamma + X$

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

$<30$	90	<sup>2</sup> BALEST 95	CLEO	$e^+e^- \rightarrow \gamma + X$
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<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. $\Gamma(\gamma X \bar{X} (m_X < 3.1 \text{ GeV}))/\Gamma_{\text{total}}$   $\Gamma_{120}/\Gamma$ (X  $\bar{X}$  = vectors with  $m < 3.1$  GeV)

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

<sup>1</sup> For a noninteracting vector X with mass  $< 3.1$  GeV. $\Gamma(\gamma X \bar{X} (m_X < 4.5 \text{ GeV}))/\Gamma_{\text{total}}$   $\Gamma_{121}/\Gamma$ 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. $\Gamma(\gamma X \rightarrow \gamma + \geq 4 \text{ prongs})/\Gamma_{\text{total}}$   $\Gamma_{122}/\Gamma$ (1.5 GeV  $< m_X < 5.0$  GeV)

VALUE (units $10^{-4}$ )	CL%	DOCUMENT ID	TECN	COMMENT
$<1.78$	95	ROSNER 07A	CLEO	$e^+e^- \rightarrow \gamma X$

$\Gamma(\gamma a_1^0 \rightarrow \gamma \mu^+ \mu^-)/\Gamma_{\text{total}}$   $\Gamma_{123}/\Gamma$   
 (201 < M( $\mu^+ \mu^-$ ) < 3565 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 $e^+ e^- \rightarrow \gamma a_1^0 \rightarrow \gamma \mu^+ \mu^-$
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<sup>1</sup> For a narrow scalar or pseudoscalar  $a_1^0$  with 201 < M( $\mu^+ \mu^-$ ) < 3565 MeV, excluding  $J/\psi$ . Measured 90% CL limits as a function of M( $\mu^+ \mu^-$ ) range from 1–9 × 10<sup>-6</sup>.

<sup>2</sup> For a narrow scalar or pseudoscalar  $a_1^0$  with mass in the range 212–9200 MeV, excluding  $J/\psi$  and  $\psi(2S)$ . Measured 90% CL limits as a function of  $m_{a_1^0}$  range from 0.28–9.7 × 10<sup>-6</sup>.

$\Gamma(\gamma a_1^0 \rightarrow \gamma \tau^+ \tau^-)/\Gamma_{\text{total}}$   $\Gamma_{124}/\Gamma$   
 (2 $m_\tau$  < M( $\tau^+ \tau^-$ ) < 9.2 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 $e^+ e^- \rightarrow \gamma a_1^0 \rightarrow \gamma \tau^+ \tau^-$
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<sup>1</sup> For a narrow scalar  $a_1^0$  with 2 $m_\tau$  < M( $a_1^0$ ) < 9.2 GeV, which result in a 90% CL upper limits of 0.9 × 10<sup>-5</sup> at M( $a_1^0$ ) = 2 $m_\tau$ , ≈ 1.5 × 10<sup>-5</sup> at M( $a_1^0$ ) = 7.5 GeV, and 13 × 10<sup>-5</sup> at M( $a_1^0$ ) = 9.2 GeV.

<sup>2</sup> For a narrow scalar or pseudoscalar  $a_1^0$  with 2 $m_\tau$  < M( $a_1^0$ ) < 7.5 GeV, which result in a 90% CL limits ranging from 1 × 10<sup>-5</sup> at M( $a_1^0$ )=2 $m_\tau$  to 5 × 10<sup>-5</sup> at M( $a_1^0$ )=7.5 GeV.

$\Gamma(\gamma a_1^0 \rightarrow \gamma g g)/\Gamma_{\text{total}}$   $\Gamma_{125}/\Gamma$   
 (0.5 GeV < m < 9.0 GeV)

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<1 × 10 <sup>-2</sup>	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 GeV <  $m_X$  < 9.0 GeV. Measured 90% CL limit as a function of  $m_X$  range from 10<sup>-6</sup> to 10<sup>-2</sup>.

$\Gamma(\gamma a_1^0 \rightarrow \gamma s \bar{s})/\Gamma_{\text{total}}$   $\Gamma_{126}/\Gamma$   
 (0.5 GeV < m < 9.0 GeV)

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<1 × 10 <sup>-3</sup>	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 GeV <  $m_X$  < 9.0 GeV. Measured 90% CL limit as a function of  $m_X$  range from 10<sup>-5</sup> to 10<sup>-3</sup>.

———— LEPTON FAMILY NUMBER (LF) VIOLATING MODES ————

$\Gamma(\mu^\pm \tau^\mp)/\Gamma_{\text{total}}$   $\Gamma_{127}/\Gamma$

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<6.0	95	LOVE	08A	CLEO $e^+ e^- \rightarrow \mu^\pm \tau^\mp$

## OTHER DECAYS

$\Gamma(\text{invisible})/\Gamma_{\text{total}}$					$\Gamma_{128}/\Gamma$
VALUE (units $10^{-4}$ )	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	$\Upsilon(3S) \rightarrow \pi^+ \pi^- \Upsilon(1S)$	

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