$\Upsilon(1S)$

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

$\Upsilon(1S)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
9460.30±0.26 OUR AVERAGE	Error includes scale factor of 3.3.			
9460.51±0.09±0.05	[1] ARTAMONOV	00	MD1	$e^+e^- \to$ hadrons
9459.97±0.11±0.07	MACKAY	84	REDE	$e^+e^- \to$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •				
9460.60±0.09±0.05	[2,3] BARU	92B	REDE	$e^+e^- \to$ hadrons
9460.59±0.12	BARU	86	REDE	$e^+e^- \to$ hadrons
9460.6 ±0.4	[3,4] ARTAMONOV	84	REDE	$e^+e^- \to$ hadrons

[1] Reanalysis of BARU 92B and ARTAMONOV 84 using new electron mass (COHEN 87).
[2] Superseding BARU 86.
[3] Superseded by ARTAMONOV 00.
[4] Value includes data of ARTAMONOV 82.

$\Upsilon(1S)$ WIDTH

VALUE (keV)	*DOCUMENT ID*
54.02±1.25 OUR EVALUATION	See the Note on "Width Determinations of the Υ States"

$\Upsilon(1S)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	$\tau^+\tau^-$	(2.60±0.10) %	
Γ_2	e^+e^-	(2.38±0.11) %	
Γ_3	$\mu^+\mu^-$	(2.48±0.05) %	
	Hadronic decays		
Γ_4	$\eta'(958)$ anything	(2.94±0.24) %	
Γ_5	$J/\psi(1S)$ anything	$(6.5 \pm 0.7) \times 10^{-4}$	
Γ_6	χ_{c0} anything	$< 5 \times 10^{-3}$	90%
Γ_7	χ_{c1} anything	$(2.3 \pm 0.7) \times 10^{-4}$	
Γ_8	χ_{c2} anything	$(3.4 \pm 1.0) \times 10^{-4}$	
Γ_9	$\psi(2S)$ anything	$(2.7 \pm 0.9) \times 10^{-4}$	
Γ_{10}	$\rho\pi$	$< 2 \times 10^{-4}$	90%
Γ_{11}	$\pi^+\pi^-$	$< 5 \times 10^{-4}$	90%
Γ_{12}	K^+K^-	$< 5 \times 10^{-4}$	90%
Γ_{13}	$p\overline{p}$	$< 5 \times 10^{-4}$	90%
Γ_{14}	$\pi^0\pi^+\pi^-$	$< 1.84 \times 10^{-5}$	90%
Γ_{15}	$D^*(2010)^\pm$ anything		
Γ_{16}	$\overline{d}$ anything	$(2.86\pm0.28) \times 10^{-5}$	

Radiative decays

Γ_{17}	$\gamma\pi^+\pi^-$		$(6.3 \pm 1.8) \times 10^{-5}$		
Γ_{18}	$\gamma\pi^0\pi^0$		$(1.7 \pm 0.7) \times 10^{-5}$		
Γ_{19}	$\gamma\pi^0\eta$		$< 2.4 \times 10^{-6}$		90%
Γ_{20}	K^+K^- with $2<m_{K^+K^-}<3$ GeV		$(1.14\pm0.13) \times 10^{-5}$		
Γ_{21}	$\gamma p\overline{p}$ with $2<m_{p\overline{p}}<3$ GeV		$< 6 \times 10^{-6}$		90%
Γ_{22}	$\gamma 2h^+2h^-$		$(7.0 \pm 1.5) \times 10^{-4}$		
Γ_{23}	$\gamma 3h^+3h^-$		$(5.4 \pm 2.0) \times 10^{-4}$		
Γ_{24}	$\gamma 4h^+4h^-$		$(7.4 \pm 3.5) \times 10^{-4}$		
Γ_{25}	$\gamma\pi^+\pi^-K^+K^-$		$(2.9 \pm 0.9) \times 10^{-4}$		
Γ_{26}	$\gamma 2\pi^+2\pi^-$		$(2.5 \pm 0.9) \times 10^{-4}$		
Γ_{27}	$\gamma 3\pi^+3\pi^-$		$(2.5 \pm 1.2) \times 10^{-4}$		
Γ_{28}	$\gamma 2\pi^+2\pi^-K^+K^-$		$(2.4 \pm 1.2) \times 10^{-4}$		
Γ_{29}	$\gamma\pi^+\pi^-p\overline{p}$		$(1.5 \pm 0.6) \times 10^{-4}$		
Γ_{30}	$\gamma 2\pi^+2\pi^-p\overline{p}$		$(4 \pm 6) \times 10^{-5}$		
Γ_{31}	$\gamma 2K^+2K^-$		$(2.0 \pm 2.0) \times 10^{-5}$		
Γ_{32}	$\gamma\eta'(958)$		$< 1.9 \times 10^{-6}$		90%
Γ_{33}	$\gamma\eta$		$< 1.0 \times 10^{-6}$		90%
Γ_{34}	$\gamma f_0(980)$		$< 3 \times 10^{-5}$		90%
Γ_{35}	$\gamma f_2'(1525)$		$(3.7\ ^{+1.2}_{-1.1}) \times 10^{-5}$		
Γ_{36}	$\gamma f_2(1270)$		$(1.01\pm0.09) \times 10^{-4}$		
Γ_{37}	$\gamma\eta(1405)$		$< 8.2 \times 10^{-5}$		90%
Γ_{38}	$\gamma f_0(1500)$		$< 1.5 \times 10^{-5}$		90%
Γ_{39}	$\gamma f_0(1710)$		$< 2.6 \times 10^{-4}$		90%
Γ_{40}	$\gamma f_0(1710) \to \gamma K^+K^-$		$< 7 \times 10^{-6}$		90%
Γ_{41}	$\gamma f_0(1710) \to \gamma\pi^0\pi^0$		$< 1.4 \times 10^{-6}$		90%
Γ_{42}	$\gamma f_0(1710) \to \gamma\eta\eta$		$< 1.8 \times 10^{-6}$		90%
Γ_{43}	$\gamma f_4(2050)$		$< 5.3 \times 10^{-5}$		90%
Γ_{44}	$\gamma f_0(2200) \to \gamma K^+K^-$		$< 2 \times 10^{-4}$		90%
Γ_{45}	$\gamma f_J(2220) \to \gamma K^+K^-$		$< 8 \times 10^{-7}$		90%
Γ_{46}	$\gamma f_J(2220) \to \gamma\pi^+\pi^-$		$< 6 \times 10^{-7}$		90%
Γ_{47}	$\gamma f_J(2220) \to \gamma p\overline{p}$		$< 1.1 \times 10^{-6}$		90%
Γ_{48}	$\gamma\eta(2225) \to \gamma\phi\phi$		$< 3 \times 10^{-3}$		90%
Γ_{49}	γX	[a]	$< 3 \times 10^{-5}$		90%
Γ_{50}	$\gamma X\overline{X}$	[b]	$< 1 \times 10^{-3}$		90%
Γ_{51}	$\gamma X \to \gamma + \geq 4$ prongs	[c]	$< 1.78 \times 10^{-4}$		95%

Other decays

Γ_{52}	invisible		$< 2.5 \times 10^{-3}$		90%

[a] X = pseudoscalar with $m < 7.2$ GeV

[b] $X\overline{X}$ = vectors with $m < 3.1$ GeV

[c] 1.5 GeV $< m_X <$ 5.0 GeV

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

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

VALUE (eV)	DOCUMENT ID		TECN	COMMENT
31.2±1.6±1.7	KOBEL	92	CBAL	$e^+e^- \to \mu^+\mu^-$

$\Gamma(\text{hadrons}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_0\Gamma_2/\Gamma$

VALUE (keV)	DOCUMENT ID		TECN	COMMENT
1.240±0.016 OUR AVERAGE				
1.252±0.004±0.019	[5] ROSNER	06	CLEO	9.5 $e^+e^- \to$ hadrons
1.187±0.023±0.031	[5] BARU	92B	MD1	$e^+e^- \to$ hadrons
1.23 ±0.02 ±0.05	[5] JAKUBOWSKI	88	CBAL	$e^+e^- \to$ hadrons
1.37 ±0.06 ±0.09	[6] GILES	84B	CLEO	$e^+e^- \to$ hadrons
1.23 ±0.08 ±0.04	[6] ALBRECHT	82	DASP	$e^+e^- \to$ hadrons
1.13 ±0.07 ±0.11	[6] NICZYPORUK	82	LENA	$e^+e^- \to$ hadrons
1.09 ±0.25	[6] BOCK	80	CNTR	$e^+e^- \to$ hadrons
1.35 ±0.14	[7] BERGER	79	PLUT	$e^+e^- \to$ hadrons

[5] Radiative corrections evaluated following KURAEV 85.
[6] Radiative corrections reevaluated by BUCHMUELLER 88 following KURAEV 85.
[7] Radiative corrections reevaluated by ALEXANDER 89 using B($\mu\mu$) = 0.026.

$\Upsilon(1S)$ PARTIAL WIDTHS

$\Gamma(e^+e^-)$ Γ_2

VALUE (keV)	DOCUMENT ID
1.340±0.018 OUR EVALUATION	

$\Upsilon(1S)$ BRANCHING RATIOS

$\Gamma(\tau^+\tau^-)/\Gamma_{\text{total}}$ Γ_1/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
2.60±0.10 OUR AVERAGE					
2.53±0.13±0.05	60k	[8] BESSON	07	CLEO	$e^+e^- \to \Upsilon(1S) \to \tau^+\tau^-$
$2.61\pm0.12^{+0.09}_{-0.13}$	25k	CINABRO	94B	CLE2	$e^+e^- \to \tau^+\tau^-$
2.7 ±0.4 ±0.2		[9] ALBRECHT	85C	ARG	$\Upsilon(2S) \to \pi^+\pi^-\tau^+\tau^-$
3.4 ±0.4 ±0.4		GILES	83	CLEO	$e^+e^- \to \tau^+\tau^-$

[8] BESSON 07 reports [B($\Upsilon(1S) \to \tau^+\tau^-$)] / [B($\Upsilon(1S) \to \mu^+\mu^-$)] = 1.02 ± 0.02 ± 0.05. We multiply by our best value B($\Upsilon(1S) \to \mu^+\mu^-$) = (2.48 ± 0.05) × 10^{-2}. Our first error is their experiment's error and our second error is the systematic error from using our best value.
[9] Using B($\Upsilon(1S) \to ee$) = B($\Upsilon(1S) \to \mu\mu$) = 0.0256; not used for width evaluations.

$\Gamma(e^+e^-)/\Gamma_{total}$ Γ_2/Γ

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

$\Gamma(\mu^+\mu^-)/\Gamma_{total}$ Γ_3/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.0248±0.0005 OUR AVERAGE					
0.0249±0.0002±0.0007	345k	ADAMS	05	CLEO	$e^+e^- \to \mu^+\mu^-$
0.0249±0.0008±0.0013		ALEXANDER	98	CLE2	$\Upsilon(2S) \to \pi^+\pi^-\mu^+\mu^-$
0.0212±0.0020±0.0010		[10] BARU	92	MD1	$e^+e^- \to \mu^+\mu^-$
0.0231±0.0012±0.0010		[10] KOBEL	92	CBAL	$e^+e^- \to \mu^+\mu^-$
0.0252±0.0007±0.0007		CHEN	89B	CLEO	$e^+e^- \to \mu^+\mu^-$
0.0261±0.0009±0.0011		KAARSBERG	89	CSB2	$e^+e^- \to \mu^+\mu^-$
0.0230±0.0025±0.0013	86	ALBRECHT	87	ARG	$\Upsilon(2S) \to \pi^+\pi^-\mu^+\mu^-$
0.029 ±0.003 ±0.002	864	BESSON	84	CLEO	$\Upsilon(2S) \to \pi^+\pi^-\mu^+\mu^-$
0.027 ±0.003 ±0.003		ANDREWS	83	CLEO	$e^+e^- \to \mu^+\mu^-$
0.032 ±0.013 ±0.003		ALBRECHT	82	DASP	$e^+e^- \to \mu^+\mu^-$
0.038 ±0.015 ±0.002		NICZYPORUK	82	LENA	$e^+e^- \to \mu^+\mu^-$
$0.014\ {}^{+0.034}_{-0.014}$		BOCK	80	CNTR	$e^+e^- \to \mu^+\mu^-$
0.022 ±0.020		BERGER	79	PLUT	$e^+e^- \to \mu^+\mu^-$

[10] Taking into account interference between the resonance and continuum.

$\Gamma(\tau^+\tau^-)/\Gamma(\mu^+\mu^-)$ Γ_1/Γ_3

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
1.02±0.02±0.05	60k	BESSON	07	CLEO	$e^+e^- \to \Upsilon(1S)$

$\Gamma(\eta'(958)\ \text{anything})/\Gamma_{total}$ Γ_4/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.0294±0.0024 OUR AVERAGE				
0.030 ±0.002 ±0.002	AQUINES	06A	CLE3	$\Upsilon(1S) \to \eta'$ anything
0.028 ±0.004 ±0.002	ARTUSO	03	CLE2	$\Upsilon(1S) \to \eta'$ anything

$\Gamma(J/\psi(1S)\ \text{anything})/\Gamma_{total}$ Γ_5/Γ

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
0.65±0.07 OUR AVERAGE						
0.64±0.04±0.06		730 ± 40	BRIERE	04	CLEO	$e^+e^- \to J/\psi X$
1.1 ±0.4 ±0.2			[11] FULTON	89	CLEO	$e^+e^- \to \mu^+\mu^- X$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.68	90		ALBRECHT	92J	ARG	$e^+e^- \to e^+e^- X$, $\mu^+\mu^- X$
<1.7	90		MASCHMANN	90	CBAL	$e^+e^- \to$ hadrons
<20	90		NICZYPORUK	83	LENA	

[11] Using B($(J/\psi) \rightarrow \mu^+\mu^-$) = (6.9 ± 0.9)%.

$\Gamma(\chi_{c0}$ anything$)/\Gamma(J/\psi(1S)$ anything$)$ Γ_6/Γ_5

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<7.4	90	BRIERE	04	CLEO	$e^+e^- \rightarrow J/\psi X$

$\Gamma(\chi_{c1}$ anything$)/\Gamma(J/\psi(1S)$ anything$)$ Γ_7/Γ_5

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.35±0.08±0.06	52 ± 12	BRIERE	04	CLEO	$e^+e^- \rightarrow J/\psi X$

$\Gamma(\chi_{c2}$ anything$)/\Gamma(J/\psi(1S)$ anything$)$ Γ_8/Γ_5

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

$\Gamma(\psi(2S)$ anything$)/\Gamma(J/\psi(1S)$ anything$)$ Γ_9/Γ_5

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

$\Gamma(\rho\pi)/\Gamma_{\text{total}}$ Γ_{10}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
< 2	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	$\Upsilon(1S) \rightarrow \rho^0\pi^0$

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

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<5	90	BARU	92	MD1	$\Upsilon(1S) \rightarrow \pi^+\pi^-$

$\Gamma(K^+K^-)/\Gamma_{\text{total}}$ Γ_{12}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<5	90	BARU	92	MD1	$\Upsilon(1S) \rightarrow K^+K^-$

$\Gamma(p\overline{p})/\Gamma_{\text{total}}$ Γ_{13}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<5	90	[12] BARU	96	MD1	$\Upsilon(1S) \rightarrow p\overline{p}$

[12] Supersedes BARU 92 in this node.

$\Gamma(\pi^0\pi^+\pi^-)/\Gamma_{\text{total}}$ Γ_{14}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<1.84	90	ANASTASSOV	99	CLE2	$e^+e^- \rightarrow$ hadrons

$\Gamma(D^*(2010)^{\pm}$ anything$)/\Gamma_{\text{total}}$ Γ_{15}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<19	90	[13] ALBRECHT	92J	ARG	$e^+e^- \rightarrow D^0\pi^{\pm}$X

[13] For $x_p > 0.2$.

$\Gamma(\overline{d}\text{ anything})/\Gamma_{\text{total}}$ Γ_{16}/Γ

VALUE (units 10^{-5})	EVTS	DOCUMENT ID		TECN	COMMENT
2.86±0.19±0.21	455	ASNER	07	CLEO	$e^+e^- \to \overline{d}X$

$\Gamma(ggg,\ gg\gamma \to \overline{d}\text{ anything})/\Gamma(ggg,\ gg\gamma \to \text{anything})$

VALUE (units 10^{-5})	EVTS	DOCUMENT ID		TECN	COMMENT
3.36±0.23±0.25	455	ASNER	07	CLEO	$e^+e^- \to \overline{d}X$

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

VALUE (units 10^{-5})	DOCUMENT ID		TECN	COMMENT
6.3±1.2±1.3	[14] ANASTASSOV	99	CLE2	$e^+e^- \to$ hadrons

[14] For $m_{\pi\pi} > 1$ GeV.

$\Gamma(\gamma\pi^0\pi^0)/\Gamma_{\text{total}}$ Γ_{18}/Γ

VALUE (units 10^{-5})	DOCUMENT ID		TECN	COMMENT
1.7±0.6±0.3	[15] ANASTASSOV	99	CLE2	$e^+e^- \to$ hadrons

[15] For $m_{\pi\pi} > 1$ GeV.

$\Gamma(\gamma\pi^0\eta)/\Gamma_{\text{total}}$ Γ_{19}/Γ

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<2.4	90	[16] BESSON	07A	CLEO	$e^+e^- \to \Upsilon(1S)$

[16] BESSON 07A obtained this limit for $0.7 < m_{\pi^0\eta} < 3$ GeV.

$\Gamma(K^+K^-\text{ with } 2<m_{K^+K^-}<3\text{ GeV})/\Gamma_{\text{total}}$ Γ_{20}/Γ

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

$\Gamma(\gamma p\overline{p}\ \text{ with } 2<m_{p\overline{p}}<3\text{ GeV})/\Gamma_{\text{total}}$ Γ_{21}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<0.6	90	ATHAR	06	CLE3	$\Upsilon(1S) \to \gamma p\overline{p}$

$\Gamma(\gamma 2h^+2h^-)/\Gamma_{\text{total}}$ Γ_{22}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
7.0±1.1±1.0	80 ± 12	FULTON	90B	CLEO	$e^+e^- \to$ hadrons

$\Gamma(\gamma 3h^+3h^-)/\Gamma_{\text{total}}$ Γ_{23}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
5.4±1.5±1.3	39 ± 11	FULTON	90B	CLEO	$e^+e^- \to$ hadrons

$\Gamma(\gamma 4h^+4h^-)/\Gamma_{\text{total}}$ Γ_{24}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
7.4±2.5±2.5	36 ± 12	FULTON	90B	CLEO	$e^+e^- \to$ hadrons

$\Gamma(\gamma\pi^+\pi^-K^+K^-)/\Gamma_{total}$ Γ_{25}/Γ

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

$\Gamma(\gamma 2\pi^+2\pi^-)/\Gamma_{total}$ Γ_{26}/Γ

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

$\Gamma(\gamma 3\pi^+3\pi^-)/\Gamma_{total}$ Γ_{27}/Γ

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

$\Gamma(\gamma 2\pi^+2\pi^-K^+K^-)/\Gamma_{total}$ Γ_{28}/Γ

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

$\Gamma(\gamma\pi^+\pi^-p\overline{p})/\Gamma_{total}$ Γ_{29}/Γ

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

$\Gamma(\gamma 2\pi^+2\pi^-p\overline{p})/\Gamma_{total}$ Γ_{30}/Γ

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

$\Gamma(\gamma 2K^+2K^-)/\Gamma_{total}$ Γ_{31}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
0.2±0.2	2 ± 2	FULTON	90B	CLEO	$e^+e^- \rightarrow$ hadrons

$\Gamma(\gamma\eta'(958))/\Gamma_{total}$ Γ_{32}/Γ

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

$\Gamma(\gamma\eta)/\Gamma_{total}$ Γ_{33}/Γ

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

$\Gamma(\gamma f_0(980))/\Gamma_{total}$ Γ_{34}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<3	90	[17] ATHAR	06	CLE3	$\Upsilon(1S) \rightarrow \gamma\pi^+\pi^-$

[17] Assuming B($f_0(980) \rightarrow \pi\pi$) = 1.

$\Gamma(\gamma f_2'(1525))/\Gamma_{total}$ Γ_{35}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
$3.7^{+0.9}_{-0.7}\pm0.8$		ATHAR	06	CLE3	$\Upsilon(1S) \to \gamma K^+ K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<14	90	[18] FULTON	90B	CLEO	$\Upsilon(1S) \to \gamma K^+ K^-$
<19.4	90	[18] ALBRECHT	89	ARG	$\Upsilon(1S) \to \gamma K^+ K^-$

[18] Assuming $B(f_2'(1525) \to K\overline{K}) = 0.71$.

$\Gamma(\gamma f_2(1270))/\Gamma_{total}$ Γ_{36}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
10.1±0.9 OUR AVERAGE					
$10.5\pm1.6^{+1.9}_{-1.8}$		[19] BESSON	07A	CLE3	$\Upsilon(1S) \to \gamma\pi^0\pi^0$
$10.2\pm0.8\pm0.7$		ATHAR	06	CLE3	$\Upsilon(1S) \to \gamma\pi^+\pi^-$
$8.1\pm2.3^{+2.9}_{-2.7}$		[20] ANASTASSOV	99	CLE2	$e^+e^- \to$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<21	90	[20] FULTON	90B	CLEO	$\Upsilon(1S) \to \gamma\pi^+\pi^-$
<13	90	[20] ALBRECHT	89	ARG	$\Upsilon(1S) \to \gamma\pi^+\pi^-$
<81	90	SCHMITT	88	CBAL	$\Upsilon(1S) \to \gamma X$

[19] Using $B(f_2(1270) \to \pi^0\pi^0) = B(f_2(1270) \to \pi\pi)/3$ and $B(f_2(1270) \to \pi\pi) = (0.845^{+0.025}_{-0.012})\%$.

[20] Using $B(f_2(1270) \to \pi\pi) = 0.84$.

$\Gamma(\gamma\eta(1405))/\Gamma_{total}$ Γ_{37}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<8.2	90	[21] FULTON	90B	CLEO	$\Upsilon(1S) \to \gamma K^\pm\pi^\mp K^0_S$

[21] Includes unknown branching ratio of $\eta(1405) \to K^\pm\pi^\mp K^0_S$.

$\Gamma(\gamma f_0(1500))/\Gamma_{total}$ Γ_{38}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<1.5	90	[22] BESSON	07A	CLEO	$e^+e^- \to \Upsilon(1S) \to \gamma\pi^0\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<6.1	90	[23] BESSON	07A	CLEO	$e^+e^- \to \Upsilon(1S) \to \gamma\eta\eta$

[22] Using $B(f_0(1500) \to \pi^0\pi^0) = B(f_0(1500) \to \pi\pi)/3$ and $B(f_0(1500) \to \pi\pi) = (0.349 \pm 0.023)\%$.

[23] Calculated by us using $B(f_0(1500) \to \eta\eta) = (5.1 \pm 0.9)\%$.

$\Gamma(\gamma f_0(1710))/\Gamma_{total}$ Γ_{39}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
< 2.6	90	[24] ALBRECHT	89	ARG	$\Upsilon(1S) \to \gamma K^+ K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
< 6.3	90	[24] FULTON	90B	CLEO	$\Upsilon(1S) \to \gamma K^+ K^-$
<19	90	[24] FULTON	90B	CLEO	$\Upsilon(1S) \to \gamma K^0_S K^0_S$
< 8	90	[25] ALBRECHT	89	ARG	$\Upsilon(1S) \to \gamma\pi^+\pi^-$
<24	90	[26] SCHMITT	88	CBAL	$\Upsilon(1S) \to \gamma X$

[24] Assuming B($f_0(1710) \to K\overline{K}$) = 0.38.
[25] Assuming B($f_0(1710) \to \pi\pi$) = 0.04.
[26] Assuming B($f_0(1710) \to \eta\eta$) = 0.18.

$\Gamma(\gamma f_0(1710) \to \gamma K^+ K^-)/\Gamma_{total}$ Γ_{40}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<0.7	90	ATHAR	06	CLEO	$e^+e^- \to \Upsilon(1S) \to \gamma K^+ K^-$

$\Gamma(\gamma f_0(1710) \to \gamma \pi^0 \pi^0)/\Gamma_{total}$ Γ_{41}/Γ

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

$\Gamma(\gamma f_0(1710) \to \gamma\eta\eta)/\Gamma_{total}$ Γ_{42}/Γ

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

$\Gamma(\gamma f_4(2050))/\Gamma_{total}$ Γ_{43}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<5.3	90	[27] ATHAR	06	CLE3	$\Upsilon(1S) \to \gamma\pi^+\pi^-$

[27] Assuming B($f_4(2050) \to \pi\pi$) = 0.17.

$\Gamma(\gamma f_0(2200) \to \gamma K^+ K^-)/\Gamma_{total}$ Γ_{44}/Γ

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

$\Gamma(\gamma f_J(2220) \to \gamma K^+ K^-)/\Gamma_{total}$ Γ_{45}/Γ

VALUE (units 10^{-7})	CL%	DOCUMENT ID		TECN	COMMENT
< 8	90	ATHAR	06	CLE3	$\Upsilon(1S) \to \gamma K^+ K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
< 160	90	MASEK	02	CLEO	$\Upsilon(1S) \to \gamma K^+ K^-$
< 150	90	FULTON	90B	CLEO	$\Upsilon(1S) \to \gamma K^+ K^-$
< 290	90	ALBRECHT	89	ARG	$\Upsilon(1S) \to \gamma K^+ K^-$
<2000	90	BARU	89	MD1	$\Upsilon(1S) \to \gamma K^+ K^-$

$\Gamma(\gamma f_J(2220) \to \gamma \pi^+ \pi^-)/\Gamma_{total}$ Γ_{46}/Γ

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

$\Gamma(\gamma f_J(2220) \to \gamma p\overline{p})/\Gamma_{total}$ Γ_{47}/Γ

VALUE (units 10^{-7})	CL%	DOCUMENT ID		TECN	COMMENT
< 11	90	ATHAR	06	CLE3	$\Upsilon(1S) \to \gamma p\overline{p}$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<160	90	MASEK	02	CLEO	$\Upsilon(1S) \to \gamma p\overline{p}$

$\Gamma(\gamma\eta(2225) \to \gamma\phi\phi)/\Gamma_{\text{total}}$ Γ_{48}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.003	90	BARU	89	MD1	$\Upsilon(1S) \to \gamma K^+ K^- K^+ K^-$

$\Gamma(\gamma X)/\Gamma_{\text{total}}$ Γ_{49}/Γ

(X = pseudoscalar with $m<$ 7.2 GeV)

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<3	90	[28] BALEST	95	CLEO	$e^+ e^- \to \gamma +$ X

[28] For a noninteracting pseudoscalar X with mass < 7.2 GeV.

$\Gamma(\gamma X \overline{X})/\Gamma_{\text{total}}$ Γ_{50}/Γ

($X\overline{X}$ = vectors with $m<$ 3.1 GeV)

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<1	90	[29] BALEST	95	CLEO	$e^+ e^- \to \gamma +$ $X\overline{X}$

[29] For a noninteracting vector X with mass < 3.1 GeV.

$\Gamma(\gamma X \to \gamma + \geq \text{4 prongs})/\Gamma_{\text{total}}$ Γ_{51}/Γ

(1.5 GeV $< m_X <$ 5.0 GeV)

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

$\Gamma(\text{invisible})/\Gamma_{\text{total}}$ Γ_{52}/Γ

VALUE (units 10^{-2})	CL%	DOCUMENT ID		TECN	COMMENT
<0.25	90	TAJIMA	07	BELL	$\Upsilon(3S) \to \pi^+ \pi^- \Upsilon(1S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.39	90	RUBIN	07	CLEO	$\Upsilon(2S) \to \pi^+ \pi^- \Upsilon(1S)$

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