$\Upsilon(1S)$

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

$\Upsilon(1S)$ 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	$e^+e^- \rightarrow$ 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	[2,3]	BARU	92B	REDE	$e^+e^- \rightarrow$ hadrons
9460.59±0.12		BARU	86	REDE	$e^+e^- \rightarrow$ hadrons
9460.6 ±0.4	[3,4]	ARTAMONOV	84	REDE	$e^+e^- \rightarrow$ 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[3] Superseded by ARTAMONOV 00.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)	Scale factor/ 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	ggg	(81.7 ±0.7) %	
Γ_5	γgg	(2.2 ±0.6) %	
Γ_6	$\eta'(958)$ anything	(2.94 ±0.24) %	
Γ_7	$J/\psi(1S)$ anything	(5.4 ±0.4) $\times 10^{-4}$	S=1.4
Γ_8	$J/\psi(1S)\eta_c$	$<$ 2.2 $\times 10^{-6}$	CL=90%
Γ_9	$J/\psi(1S)\chi_{c0}$	$<$ 3.4 $\times 10^{-6}$	CL=90%
Γ_{10}	$J/\psi(1S)\chi_{c1}$	(3.9 ±1.2) $\times 10^{-6}$	
Γ_{11}	$J/\psi(1S)\chi_{c2}$	$<$ 1.4 $\times 10^{-6}$	CL=90%
Γ_{12}	$J/\psi(1S)\eta_c(2S)$	$<$ 2.2 $\times 10^{-6}$	CL=90%
Γ_{13}	$J/\psi(1S)X(3940)$	$<$ 5.4 $\times 10^{-6}$	CL=90%
Γ_{14}	$J/\psi(1S)X(4160)$	$<$ 5.4 $\times 10^{-6}$	CL=90%
Γ_{15}	$X(4350)$ anything, $X \rightarrow J/\psi(1S)\phi$	$<$ 8.1 $\times 10^{-6}$	CL=90%

Γ_{16}	$Z_c(3900)^{\pm}$ anything, $Z_c \to J/\psi(1S)\pi^{\pm}$	$<$ 1.3	$\times 10^{-5}$	CL=90%
Γ_{17}	$Z_c(4200)^{\pm}$ anything, $Z_c \to J/\psi(1S)\pi^{\pm}$	$<$ 6.0	$\times 10^{-5}$	CL=90%
Γ_{18}	$Z_c(4430)^{\pm}$ anything, $Z_c \to J/\psi(1S)\pi^{\pm}$	$<$ 4.9	$\times 10^{-5}$	CL=90%
Γ_{19}	$X^{\pm}_{cs}$ anything, $X \to J/\psi K^{\pm}$	$<$ 5.7	$\times 10^{-6}$	CL=90%
Γ_{20}	$\chi_{c1}(3872)$ anything, $\chi_{c1} \to J/\psi(1S)\pi^+\pi^-$	$<$ 9.5	$\times 10^{-6}$	CL=90%
Γ_{21}	$\psi(4260)$ anything, $\psi \to J/\psi(1S)\pi^+\pi^-$	$<$ 3.8	$\times 10^{-5}$	CL=90%
Γ_{22}	$\psi(4260)$ anything, $\psi \to J/\psi(1S)K^+K^-$	$<$ 7.5	$\times 10^{-6}$	CL=90%
Γ_{23}	$\chi_{c1}(4140)$ anything, $\chi_{c1} \to J/\psi(1S)\phi$	$<$ 5.2	$\times 10^{-6}$	CL=90%
Γ_{24}	χ_{c0} anything	$<$ 4	$\times 10^{-3}$	CL=90%
Γ_{25}	χ_{c1} anything	(1.90 $\pm$0.35)	$\times 10^{-4}$	
Γ_{26}	$\chi_{c1}(1P)X_{tetra}$	$<$ 3.78	$\times 10^{-5}$	CL=90%
Γ_{27}	χ_{c2} anything	(2.8 $\pm$0.8)	$\times 10^{-4}$	
Γ_{28}	$\psi(2S)$ anything	(1.23 $\pm$0.20)	$\times 10^{-4}$	
Γ_{29}	$\psi(2S)\eta_c$	$<$ 3.6	$\times 10^{-6}$	CL=90%
Γ_{30}	$\psi(2S)\chi_{c0}$	$<$ 6.5	$\times 10^{-6}$	CL=90%
Γ_{31}	$\psi(2S)\chi_{c1}$	$<$ 4.5	$\times 10^{-6}$	CL=90%
Γ_{32}	$\psi(2S)\chi_{c2}$	$<$ 2.1	$\times 10^{-6}$	CL=90%
Γ_{33}	$\psi(2S)\eta_c(2S)$	$<$ 3.2	$\times 10^{-6}$	CL=90%
Γ_{34}	$\psi(2S)X(3940)$	$<$ 2.9	$\times 10^{-6}$	CL=90%
Γ_{35}	$\psi(2S)X(4160)$	$<$ 2.9	$\times 10^{-6}$	CL=90%
Γ_{36}	$\psi(4260)$ anything, $\psi \to \psi(2S)\pi^+\pi^-$	$<$ 7.9	$\times 10^{-5}$	CL=90%
Γ_{37}	$\psi(4360)$ anything, $\psi \to \psi(2S)\pi^+\pi^-$	$<$ 5.2	$\times 10^{-5}$	CL=90%
Γ_{38}	$\psi(4660)$ anything, $\psi \to \psi(2S)\pi^+\pi^-$	$<$ 2.2	$\times 10^{-5}$	CL=90%
Γ_{39}	$X(4050)^{\pm}$ anything, $X \to \psi(2S)\pi^{\pm}$	$<$ 8.8	$\times 10^{-5}$	CL=90%
Γ_{40}	$Z_c(4430)^{\pm}$ anything, $Z_c \to \psi(2S)\pi^{\pm}$	$<$ 6.7	$\times 10^{-5}$	CL=90%
Γ_{41}	$\rho\pi$	$<$ 3.68	$\times 10^{-6}$	CL=90%
Γ_{42}	$\omega\pi^0$	$<$ 3.90	$\times 10^{-6}$	CL=90%
Γ_{43}	$\pi^+\pi^-$	$<$ 5	$\times 10^{-4}$	CL=90%
Γ_{44}	K^+K^-	$<$ 5	$\times 10^{-4}$	CL=90%
Γ_{45}	$p\overline{p}$	$<$ 5	$\times 10^{-4}$	CL=90%
Γ_{46}	$\pi^+\pi^-\pi^0$	(2.1 $\pm$0.8)	$\times 10^{-6}$	
Γ_{47}	ϕK^+K^-	(2.4 $\pm$0.5)	$\times 10^{-6}$	

Γ_{48}	$\omega\pi^+\pi^-$		$(4.5 \pm 1.0) \times 10^{-6}$	
Γ_{49}	$K^*(892)^0 K^-\pi^+ +$ c.c.		$(4.4 \pm 0.8) \times 10^{-6}$	
Γ_{50}	$\phi f_2'(1525)$		$< 1.63 \times 10^{-6}$	CL=90%
Γ_{51}	$\omega f_2(1270)$		$< 1.79 \times 10^{-6}$	CL=90%
Γ_{52}	$\rho(770) a_2(1320)$		$< 2.24 \times 10^{-6}$	CL=90%
Γ_{53}	$K^*(892)^0 \overline{K}_2^*(1430)^0 +$ c.c.		$(3.0 \pm 0.8) \times 10^{-6}$	
Γ_{54}	$K_1(1270)^\pm K^\mp$		$< 2.41 \times 10^{-6}$	CL=90%
Γ_{55}	$K_1(1400)^\pm K^\mp$		$(1.0 \pm 0.4) \times 10^{-6}$	
Γ_{56}	$b_1(1235)^\pm \pi^\mp$		$< 1.25 \times 10^{-6}$	CL=90%
Γ_{57}	$\pi^+\pi^-\pi^0\pi^0$		$(1.28 \pm 0.30) \times 10^{-5}$	
Γ_{58}	$K_S^0 K^+\pi^- +$ c.c.		$(1.6 \pm 0.4) \times 10^{-6}$	
Γ_{59}	$K^*(892)^0 \overline{K}^0 +$ c.c.		$(2.9 \pm 0.9) \times 10^{-6}$	
Γ_{60}	$K^*(892)^- K^+ +$ c.c.		$< 1.11 \times 10^{-6}$	CL=90%
Γ_{61}	$f_1(1285)$ anything		$(4.6 \pm 3.1) \times 10^{-3}$	
Γ_{62}	$D^*(2010)^\pm$ anything		(2.52 ± 0.20) %	
Γ_{63}	$f_1(1285) X_{tetra}$		$< 6.24 \times 10^{-5}$	CL=90%
Γ_{64}	$\overline{^2H}$ anything		$(2.85 \pm 0.25) \times 10^{-5}$	
Γ_{65}	Sum of 100 exclusive modes		(1.200 ± 0.017) %	

Radiative decays

Γ_{66}	$\gamma\pi^+\pi^-$		$(6.3 \pm 1.8) \times 10^{-5}$	
Γ_{67}	$\gamma\pi^0\pi^0$		$(1.7 \pm 0.7) \times 10^{-5}$	
Γ_{68}	$\gamma\pi^0\eta$		$< 2.4 \times 10^{-6}$	CL=90%
Γ_{69}	$\gamma K^+ K^-$	[a]	$(1.14 \pm 0.13) \times 10^{-5}$	
Γ_{70}	$\gamma p\overline{p}$	[b]	$< 6 \times 10^{-6}$	CL=90%
Γ_{71}	$\gamma 2h^+ 2h^-$		$(7.0 \pm 1.5) \times 10^{-4}$	
Γ_{72}	$\gamma 3h^+ 3h^-$		$(5.4 \pm 2.0) \times 10^{-4}$	
Γ_{73}	$\gamma 4h^+ 4h^-$		$(7.4 \pm 3.5) \times 10^{-4}$	
Γ_{74}	$\gamma\pi^+\pi^- K^+ K^-$		$(2.9 \pm 0.9) \times 10^{-4}$	
Γ_{75}	$\gamma 2\pi^+ 2\pi^-$		$(2.5 \pm 0.9) \times 10^{-4}$	
Γ_{76}	$\gamma 3\pi^+ 3\pi^-$		$(2.5 \pm 1.2) \times 10^{-4}$	
Γ_{77}	$\gamma 2\pi^+ 2\pi^- K^+ K^-$		$(2.4 \pm 1.2) \times 10^{-4}$	
Γ_{78}	$\gamma\pi^+\pi^- p\overline{p}$		$(1.5 \pm 0.6) \times 10^{-4}$	
Γ_{79}	$\gamma 2\pi^+ 2\pi^- p\overline{p}$		$(4 \pm 6) \times 10^{-5}$	
Γ_{80}	$\gamma 2K^+ 2K^-$		$(2.0 \pm 2.0) \times 10^{-5}$	
Γ_{81}	$\gamma\eta'(958)$		$< 1.9 \times 10^{-6}$	CL=90%
Γ_{82}	$\gamma\eta$		$< 1.0 \times 10^{-6}$	CL=90%
Γ_{83}	$\gamma f_0(980)$		$< 3 \times 10^{-5}$	CL=90%
Γ_{84}	$\gamma f_2'(1525)$		$(3.8 \pm 0.9) \times 10^{-5}$	
Γ_{85}	$\gamma f_2(1270)$		$(1.01 \pm 0.09) \times 10^{-4}$	
Γ_{86}	$\gamma\eta(1405)$		$< 8.2 \times 10^{-5}$	CL=90%
Γ_{87}	$\gamma f_0(1500)$		$< 1.5 \times 10^{-5}$	CL=90%
Γ_{88}	$\gamma f_0(1710)$		$< 2.6 \times 10^{-4}$	CL=90%
Γ_{89}	$\gamma f_0(1710) \to \gamma K^+ K^-$		$< 7 \times 10^{-6}$	CL=90%

Γ_{90}	$\gamma f_0(1710) \to \gamma\pi^0\pi^0$		$<$	1.4	$\times 10^{-6}$	CL=90%
Γ_{91}	$\gamma f_0(1710) \to \gamma\eta\eta$		$<$	1.8	$\times 10^{-6}$	CL=90%
Γ_{92}	$\gamma f_4(2050)$		$<$	5.3	$\times 10^{-5}$	CL=90%
Γ_{93}	$\gamma f_0(2200) \to \gamma K^+K^-$		$<$	2	$\times 10^{-4}$	CL=90%
Γ_{94}	$\gamma f_J(2220) \to \gamma K^+K^-$		$<$	8	$\times 10^{-7}$	CL=90%
Γ_{95}	$\gamma f_J(2220) \to \gamma\pi^+\pi^-$		$<$	6	$\times 10^{-7}$	CL=90%
Γ_{96}	$\gamma f_J(2220) \to \gamma p\overline{p}$		$<$	1.1	$\times 10^{-6}$	CL=90%
Γ_{97}	$\gamma\eta(2225) \to \gamma\phi\phi$		$<$	3	$\times 10^{-3}$	CL=90%
Γ_{98}	$\gamma\eta_c(1S)$		$<$	5.7	$\times 10^{-5}$	CL=90%
Γ_{99}	$\gamma\chi_{c0}$		$<$	6.5	$\times 10^{-4}$	CL=90%
Γ_{100}	$\gamma\chi_{c1}$		$<$	2.3	$\times 10^{-5}$	CL=90%
Γ_{101}	$\gamma\chi_{c2}$		$<$	7.6	$\times 10^{-6}$	CL=90%
Γ_{102}	$\gamma\chi_{c1}(3872) \to \pi^+\pi^-J/\psi$		$<$	1.6	$\times 10^{-6}$	CL=90%
Γ_{103}	$\gamma\chi_{c1}(3872) \to \pi^+\pi^-\pi^0J/\psi$		$<$	2.8	$\times 10^{-6}$	CL=90%
Γ_{104}	$\gamma X(3915) \to \omega J/\psi$		$<$	3.0	$\times 10^{-6}$	CL=90%
Γ_{105}	$\gamma\chi_{c1}(4140) \to \phi J/\psi$		$<$	2.2	$\times 10^{-6}$	CL=90%
Γ_{106}	γX	[c]	$<$	4.5	$\times 10^{-6}$	CL=90%
Γ_{107}	$\gamma X\overline{X}(m_X < 3.1\text{ GeV})$	[d]	$<$	1	$\times 10^{-3}$	CL=90%
Γ_{108}	$\gamma X\overline{X}(m_X < 4.5\text{ GeV})$	[e]	$<$	2.4	$\times 10^{-4}$	CL=90%
Γ_{109}	$\gamma X \to \gamma + \geq 4$ prongs	[f]	$<$	1.78	$\times 10^{-4}$	CL=95%
Γ_{110}	$\gamma a_1^0 \to \gamma\mu^+\mu^-$	[g]	$<$	9	$\times 10^{-6}$	CL=90%
Γ_{111}	$\gamma a_1^0 \to \gamma\tau^+\tau^-$	[a]	$<$	1.30	$\times 10^{-4}$	CL=90%
Γ_{112}	$\gamma a_1^0 \to \gamma g g$	[h]	$<$	1	%	CL=90%
Γ_{113}	$\gamma a_1^0 \to \gamma s\overline{s}$	[h]	$<$	1	$\times 10^{-3}$	CL=90%

Lepton Family number (*LF*) violating modes

Γ_{114}	$\mu^\pm\tau^\mp$	*LF*	$<$	6.0	$\times 10^{-6}$	CL=95%

Other decays

Γ_{115}	invisible		$<$	3.0	$\times 10^{-4}$	CL=90%

[a] $2m_\tau < \text{M}(\tau^+\tau^-) < 9.2$ GeV

[b] 2 GeV $< m_{K^+K^-} <$ 3 GeV

[c] X = scalar with $m < 8.0$ GeV

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

[e] X and $\overline{X}$ = zero spin with $m < 4.5$ GeV

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

[g] 201 MeV $< \text{M}(\mu^+\mu^-) <$ 3565 MeV

[h] 0.5 GeV $< m_X <$ 9.0 GeV, where m_X is the invariant mass of the hadronic final state.

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

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

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

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

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

$\Gamma(\tau^+\tau^-)/\Gamma_{total}$ — 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 $[\Gamma(\Upsilon(1S) \to \tau^+\tau^-)/\Gamma_{total}]$ / $[B(\Upsilon(1S) \to \mu^+\mu^-)] = 1.02 \pm 0.02 \pm 0.05$ which we multiply by our best value $B(\Upsilon(1S) \to \mu^+\mu^-) = (2.48 \pm 0.05) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.
[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
1.008±0.023 OUR AVERAGE					
1.005±0.013±0.022	0.7M	[11] DEL-AMO-SA...	10C	BABR	$\Upsilon(3S) \to \pi^+\pi^-\Upsilon(1S)$
1.02 ±0.02 ±0.05	60k	BESSON	07	CLEO	$e^+e^- \to \Upsilon(1S)$

[11] Allows any number of extra photons with total energy < 500 MeV.

$\Gamma(ggg)/\Gamma_{total}$ — Γ_4/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
81.7±0.7	20M	[12] BESSON	06A	CLEO	$\Upsilon(1S) \to$ hadrons

[12] 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 $R_{hadrons} = 3.51$. The statistical error is negligible and the systematic error is partially correlated with that of $\Gamma(\gamma gg)/\Gamma_{total}$ measurement of BESSON 06A.

$\Gamma(\gamma gg)/\Gamma_{total}$ — Γ_5/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
2.20±0.60	400k	[13] BESSON	06A	CLEO	$\Upsilon(1S) \to \gamma +$ hadrons

[13] Calculated using BESSON 06A values of $\Gamma(\gamma gg)/\Gamma(ggg) = (2.70 \pm 0.01 \pm 0.13 \pm 0.24)\%$ and $\Gamma(ggg)/\Gamma_{total}$. The statistical error is negligible and the systematic error is partially correlated with that of $\Gamma(ggg)/\Gamma_{total}$ measurement of BESSON 06A.

$\Gamma(\gamma gg)/\Gamma(ggg)$ — Γ_5/Γ_4

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

$\Gamma(\eta'(958)\text{ anything})/\Gamma_{total}$ — Γ_6/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_7/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
5.4 ±0.4 OUR FIT Error includes scale factor of 1.4.						
5.4 ±0.4 OUR AVERAGE Error includes scale factor of 1.5.						
5.25±0.13±0.25		3k	SHEN	16	BELL	$e^+e^- \to J/\psi X$
6.4 ±0.4 ±0.6		730	BRIERE	04	CLEO	$e^+e^- \to J/\psi X$
11 ±4 ±2			[14] FULTON	89	CLEO	$e^+e^- \to \mu^+\mu^- X$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<6.8	90		ALBRECHT	92J	ARG	$e^+e^- \to e^+e^- X$, $\mu^+\mu^- X$
<17	90		MASCHMANN	90	CBAL	$e^+e^- \to$ hadrons
<200	90		NICZYPORUK	83	LENA	

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

$\Gamma(J/\psi(1S)\eta_c)/\Gamma_{total}$ — Γ_8/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<2.2 × 10⁻⁶	90	YANG	14	BELL	$e^+e^- \to J/\psi X$

$\Gamma(J/\psi(1S)\chi_{c0})/\Gamma_{total}$ — Γ_9/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<3.4 \times 10^{-6}$	90	YANG	14	BELL	$e^+e^- \to J/\psi X$

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

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

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1.4 \times 10^{-6}$	90	YANG	14	BELL	$e^+e^- \to J/\psi X$

$\Gamma(J/\psi(1S)\eta_c(2S))/\Gamma_{total}$ — Γ_{12}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<2.2 \times 10^{-6}$	90	YANG	14	BELL	$e^+e^- \to J/\psi X$

$\Gamma(J/\psi(1S)X(3940))/\Gamma_{total}$ — Γ_{13}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<5.4 \times 10^{-6}$	90	YANG	14	BELL	$e^+e^- \to J/\psi X$

$\Gamma(J/\psi(1S)X(4160))/\Gamma_{total}$ — Γ_{14}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<5.4 \times 10^{-6}$	90	YANG	14	BELL	$e^+e^- \to J/\psi X$

$\Gamma(X(4350)$ anything, $X \to J/\psi(1S)\phi)/\Gamma_{total}$ — Γ_{15}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<8.1 \times 10^{-6}$	90	SHEN	16	BELL	$\Upsilon(1S) \to J/\psi K^+ K^- X$

$\Gamma(Z_c(3900)^\pm$ anything, $Z_c \to J/\psi(1S)\pi^\pm)/\Gamma_{total}$ — Γ_{16}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1.3 \times 10^{-5}$	90	SHEN	16	BELL	$\Upsilon(1S) \to J/\psi \pi^\pm X$

$\Gamma(Z_c(4200)^\pm$ anything, $Z_c \to J/\psi(1S)\pi^\pm)/\Gamma_{total}$ — Γ_{17}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<6.0 \times 10^{-5}$	90	SHEN	16	BELL	$\Upsilon(1S) \to J/\psi \pi^\pm X$

$\Gamma(Z_c(4430)^\pm$ anything, $Z_c \to J/\psi(1S)\pi^\pm)/\Gamma_{total}$ — Γ_{18}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<4.9 \times 10^{-5}$	90	SHEN	16	BELL	$\Upsilon(1S) \to J/\psi \pi^\pm X$

$\Gamma(X^\pm_{cs}$ anything, $X \to J/\psi K^\pm)/\Gamma_{total}$ — Γ_{19}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<5.7 \times 10^{-6}$	90	SHEN	16	BELL	$\Upsilon(1S) \to J/\psi K^- X$

$\Gamma(\chi_{c1}(3872)$ anything, $\chi_{c1} \to J/\psi(1S)\pi^+\pi^-)/\Gamma_{total}$ — Γ_{20}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<9.5 \times 10^{-6}$	90	SHEN	16	BELL	$\Upsilon(1S) \to J/\psi \pi^+\pi^- X$

$\Gamma(\psi(4260)$ anything, $\psi \to J/\psi(1S)\pi^+\pi^-)/\Gamma_{total}$ — Γ_{21}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<3.8 \times 10^{-5}$	90	SHEN	16	BELL	$\Upsilon(1S) \to J/\psi \pi^+\pi^- X$

$\Gamma(\psi(4260)$ anything, $\psi \to J/\psi(1S)K^+K^-)/\Gamma_{total}$ — Γ_{22}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<7.5 \times 10^{-6}$	90	SHEN	16	BELL	$\Upsilon(1S) \to J/\psi K^+ K^- X$

$\Gamma(\chi_{c1}(4140)$ anything, $\chi_{c1} \to J/\psi(1S)\phi)/\Gamma_{total}$ — Γ_{23}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<5.2 \times 10^{-6}$	90	SHEN	16	BELL	$\Upsilon(1S) \to J/\psi K^+ K^- X$

$\Gamma(\chi_{c0}$ anything$)/\Gamma(J/\psi(1S)$ anything$)$ — Γ_{24}/Γ_7

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

$\Gamma(\chi_{c1}$ anything$)/\Gamma_{total}$ — Γ_{25}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
1.90±0.35 OUR FIT					
1.90±0.43±0.14	215	JIA	17	BELL	$\Upsilon(1S) \to \gamma J/\psi(1S)$

$\Gamma(\chi_{c1}$ anything$)/\Gamma(J/\psi(1S)$ anything$)$ — Γ_{25}/Γ_7

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.35±0.07 OUR FIT					
0.35±0.08±0.06	52 ± 12	BRIERE	04	CLEO	$e^+e^- \to J/\psi X$

$\Gamma(\chi_{c1}(1P) X_{tetra})/\Gamma_{total}$ — Γ_{26}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<37.8 × 10^{-6}	90	[15] JIA	17A	BELL	$e^+ e^- \rightarrow$ hadrons

[15] 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 4.4×10^{-6} to 37.8×10^{-6}.

$\Gamma(\chi_{c2}$ anything$)/\Gamma(J/\psi(1S)$ anything$)$ — Γ_{27}/Γ_7

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$)/\Gamma_{total}$ — Γ_{28}/Γ

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

$\Gamma(\psi(2S)$ anything$)/\Gamma(J/\psi(1S)$ anything$)$ — Γ_{28}/Γ_7

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

$\Gamma(\psi(2S)\eta_c)/\Gamma_{total}$ — Γ_{29}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<3.6 × 10^{-6}	90	YANG	14	BELL	$e^+ e^- \rightarrow \psi(2S) X$

$\Gamma(\psi(2S)\chi_{c0})/\Gamma_{total}$ — Γ_{30}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<6.5 × 10^{-6}	90	YANG	14	BELL	$e^+ e^- \rightarrow \psi(2S) X$

$\Gamma(\psi(2S)\chi_{c1})/\Gamma_{total}$ — Γ_{31}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<4.5 × 10^{-6}	90	YANG	14	BELL	$e^+ e^- \rightarrow \psi(2S) X$

$\Gamma(\psi(2S)\chi_{c2})/\Gamma_{total}$ — Γ_{32}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<2.1 × 10^{-6}	90	YANG	14	BELL	$e^+ e^- \rightarrow \psi(2S) X$

$\Gamma(\psi(2S)\eta_c(2S))/\Gamma_{total}$ — Γ_{33}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<3.2 × 10^{-6}	90	YANG	14	BELL	$e^+ e^- \rightarrow \psi(2S) X$

$\Gamma(\psi(2S) X(3940))/\Gamma_{total}$ — Γ_{34}/Γ

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

$\Gamma(\psi(2S) X(4160))/\Gamma_{total}$ — Γ_{35}/Γ

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

$\Gamma(\psi(4260)$ anything, $\psi \to \psi(2S)\pi^+\pi^-)/\Gamma_{total}$ — Γ_{36}/Γ

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

$\Gamma(\psi(4360)$ anything, $\psi \to \psi(2S)\pi^+\pi^-)/\Gamma_{total}$ — Γ_{37}/Γ

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

$\Gamma(\psi(4660)$ anything, $\psi \to \psi(2S)\pi^+\pi^-)/\Gamma_{total}$ — Γ_{38}/Γ

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

$\Gamma(X(4050)^\pm$ anything, $X \to \psi(2S)\pi^\pm)/\Gamma_{total}$ — Γ_{39}/Γ

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

$\Gamma(Z_c(4430)^\pm$ anything, $Z_c \to \psi(2S)\pi^\pm)/\Gamma_{total}$ — Γ_{40}/Γ

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

$\Gamma(\rho\pi)/\Gamma_{total}$ — Γ_{41}/Γ

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<3.68	90	SHEN	13	BELL	$\Upsilon(1S) \to \pi^+\pi^-\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<1 \times 10^3$	90	BLINOV	90	MD1	$\Upsilon(1S) \to \rho^0\pi^0$
$<2 \times 10^2$	90	FULTON	90B		$\Upsilon(1S) \to \rho^0\pi^0$
$<2.1 \times 10^3$	90	NICZYPORUK	83	LENA	$\Upsilon(1S) \to \rho^0\pi^0$

$\Gamma(\omega\pi^0)/\Gamma_{total}$ — Γ_{42}/Γ

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<3.90	90	SHEN	13	BELL	$\Upsilon(1S) \to \pi^+\pi^-\pi^0\pi^0$

$\Gamma(\pi^+\pi^-)/\Gamma_{total}$ — Γ_{43}/Γ

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

$\Gamma(K^+K^-)/\Gamma_{total}$ — Γ_{44}/Γ

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

$\Gamma(p\overline{p})/\Gamma_{total}$ — Γ_{45}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<5	90	[16] BARU	96	MD1	$\Upsilon(1S) \to p\overline{p}$

[16] Supersedes BARU 92 in this node.

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{total}$ Γ_{46}/Γ

VALUE (units 10^{-6})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
2.14±0.72±0.34		26 ± 9	SHEN	13	BELL	$\Upsilon(1S) \to \pi^+\pi^-\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<18.4	90		ANASTASSOV	99	CLE2	$e^+e^- \to$ hadrons

$\Gamma(\phi K^+K^-)/\Gamma_{total}$ Γ_{47}/Γ

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
2.36±0.37±0.29	56	SHEN	12A	BELL	$\Upsilon(1S) \to 2(K^+K^-)$

$\Gamma(\omega\pi^+\pi^-)/\Gamma_{total}$ Γ_{48}/Γ

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
4.46±0.67±0.72	64	SHEN	12A	BELL	$\Upsilon(1S) \to 2(\pi^+\pi^-)\pi^0$

$\Gamma(K^*(892)^0 K^-\pi^+ + \text{c.c.})/\Gamma_{total}$ Γ_{49}/Γ

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
4.42±0.50±0.58	173	SHEN	12A	BELL	$\Upsilon(1S) \to K^+K^-\pi^+\pi^-$

$\Gamma(\phi f_2'(1525))/\Gamma_{total}$ Γ_{50}/Γ

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<1.63	90	SHEN	12A	BELL	$\Upsilon(1S) \to 2(K^+K^-)$

$\Gamma(\omega f_2(1270))/\Gamma_{total}$ Γ_{51}/Γ

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<1.79	90	SHEN	12A	BELL	$\Upsilon(1S) \to 2(\pi^+\pi^-)\pi^0$

$\Gamma(\rho(770) a_2(1320))/\Gamma_{total}$ Γ_{52}/Γ

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<2.24	90	SHEN	12A	BELL	$\Upsilon(1S) \to 2(\pi^+\pi^-)\pi^0$

$\Gamma(K^*(892)^0 \overline{K}{}_2^*(1430)^0 + \text{c.c.})/\Gamma_{total}$ Γ_{53}/Γ

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
3.02±0.68±0.34	42	SHEN	12A	BELL	$\Upsilon(1S) \to K^+K^-\pi^+\pi^-$

$\Gamma(K_1(1270)^\pm K^\mp)/\Gamma_{total}$ Γ_{54}/Γ

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<2.41	90	SHEN	12A	BELL	$\Upsilon(1S) \to K^+K^-\pi^+\pi^-$

$\Gamma(K_1(1400)^\pm K^\mp)/\Gamma_{total}$ Γ_{55}/Γ

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

$\Gamma(b_1(1235)^\pm \pi^\mp)/\Gamma_{total}$ Γ_{56}/Γ

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

$\Gamma(\pi^+\pi^-\pi^0\pi^0)/\Gamma_{total}$ — Γ_{57}/Γ

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

$\Gamma(K^0_S K^+\pi^- + \text{c.c.})/\Gamma_{total}$ — Γ_{58}/Γ

VALUE (units 10^{-6})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
1.59±0.33±0.18		37 ± 8	SHEN	13	BELL	$\Upsilon(1S) \to K^0_S K^-\pi^+$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<3.4	90		[17] DOBBS	12A		$\Upsilon(1S) \to K^0_S K^-\pi^+$

[17] Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

$\Gamma(K^*(892)^0\overline{K}^0 + \text{c.c.})/\Gamma_{total}$ — Γ_{59}/Γ

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

$\Gamma(K^*(892)^- K^+ + \text{c.c.})/\Gamma_{total}$ — Γ_{60}/Γ

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<1.11	90	SHEN	13	BELL	$\Upsilon(1S) \to K^0_S K^-\pi^+$

$\Gamma(f_1(1285)\text{ anything})/\Gamma_{total}$ — Γ_{61}/Γ

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

$\Gamma(D^*(2010)^\pm\text{ anything})/\Gamma_{total}$ — Γ_{62}/Γ

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
25.2±1.3±1.5		≈ 2k	[18] AUBERT	10C	BABR	$\Upsilon(2S) \to \pi^+\pi^-\Upsilon(1S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<19	90		[19] ALBRECHT	92J	ARG	$e^+e^- \to D^0\pi^\pm X$

[18] For $x_p > 0.1$.

[19] For $x_p > 0.2$.

$\Gamma(f_1(1285)X_{tetra})/\Gamma_{total}$ — Γ_{63}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<62.4 × 10^{-6}	90	[20] JIA	17A	BELL	$e^+e^- \to$ hadrons

[20] 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 4.6×10^{-6} to 62.4×10^{-6}.

$\Gamma(\overline{^2H}\text{ anything})/\Gamma_{total}$ — Γ_{64}/Γ

VALUE (units 10^{-5})	EVTS	DOCUMENT ID		TECN	COMMENT
2.85±0.25 OUR AVERAGE					
$2.81 \pm 0.49^{+0.20}_{-0.24}$		LEES	14G	BABR	$e^+e^- \to \overline{^2H}\,X$
2.86±0.19±0.21	455	ASNER	07	CLEO	$e^+e^- \to \overline{^2H}\,X$

$\Gamma(\text{Sum of 100 exclusive modes})/\Gamma_{total}$ Γ_{65}/Γ

VALUE (units 10^{-2})	DOCUMENT ID		COMMENT
1.200±0.017	[21,22] DOBBS	12A	$\Upsilon(1S) \to$ hadrons

[21] DOBBS 12A presents individual exclusive branching fractions or upper limits for 100 modes of four to ten pions, kaons, or protons.
[22] Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

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

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

$\Gamma(\gamma\pi^+\pi^-)/\Gamma_{total}$ Γ_{66}/Γ

VALUE (units 10^{-5})	DOCUMENT ID		TECN	COMMENT
6.3±1.2±1.3	[23] ANASTASSOV	99	CLE2	$e^+e^- \to$ hadrons

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

$\Gamma(\gamma\pi^0\pi^0)/\Gamma_{total}$ Γ_{67}/Γ

VALUE (units 10^{-5})	DOCUMENT ID		TECN	COMMENT
1.7±0.6±0.3	[24] ANASTASSOV	99	CLE2	$e^+e^- \to$ hadrons

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

$\Gamma(\gamma\pi^0\eta)/\Gamma_{total}$ Γ_{68}/Γ

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<2.4	90	[25] BESSON	07A	CLEO	$e^+e^- \to \Upsilon(1S)$

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

$\Gamma(\gamma K^+K^-)/\Gamma_{total}$ Γ_{69}/Γ

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

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

$\Gamma(\gamma p\overline{p})/\Gamma_{total}$ Γ_{70}/Γ

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

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

$\Gamma(\gamma 2h^+2h^-)/\Gamma_{total}$ Γ_{71}/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

$\Gamma(\gamma 3h^+3h^-)/\Gamma_{total}$ Γ_{72}/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

$\Gamma(\gamma 4h^+ 4h^-)/\Gamma_{total}$ — Γ_{73}/Γ

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

$\Gamma(\gamma \pi^+ \pi^- K^+ K^-)/\Gamma_{total}$ — Γ_{74}/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_{75}/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_{76}/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_{77}/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_{78}/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_{79}/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_{80}/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_{81}/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_{82}/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_{83}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<3	90	[26] ATHAR	06	CLE3	$\Upsilon(1S) \to \gamma\pi^+\pi^-$

[26] Assuming B($f_0(980) \to \pi\pi$) = 1.

$\Gamma(\gamma f_2'(1525))/\Gamma_{total}$ — Γ_{84}/Γ

VALUE (units 10^{-5})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
3.8±0.9 OUR AVERAGE						
4.0±1.4±0.1		17 ± 5	[27] BESSON	11	CLEO	$\Upsilon(1S) \to K^0_S K^0_S$
$3.7^{+0.9}_{-0.7}\pm0.8$			ATHAR	06	CLE3	$\Upsilon(1S) \to \gamma K^+ K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<14	90		[28] FULTON	90B	CLEO	$\Upsilon(1S) \to \gamma K^+ K^-$
<19.4	90		[28] ALBRECHT	89	ARG	$\Upsilon(1S) \to \gamma K^+ K^-$

[27] BESSON 11 reports (4.0 ± 1.3 ± 0.6) × 10^{-5} from a measurement of [$\Gamma(\Upsilon(1S) \to \gamma f_2'(1525))/\Gamma_{total}$] × [B($f_2'(1525) \to K\overline{K}$)] assuming B($f_2'(1525) \to K\overline{K}$) = (88.8 ± 3.1) × 10^{-2}, which we rescale to our best value B($f_2'(1525) \to K\overline{K}$) = (88.7 ± 2.2) × 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($K^0_S \to \pi^+\pi^-$) = (69.20 ± 0.05)% and B($f_2'(1525) \to K\overline{K}$) = 4 B($f_2'(1525) \to K^0_S K^0_S$).

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

$\Gamma(\gamma f_2(1270))/\Gamma_{total}$ — Γ_{85}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
10.1±0.9 OUR AVERAGE					
$10.5\pm1.6^{+1.9}_{-1.8}$		[29] BESSON	07A	CLE3	$\Upsilon(1S) \to \gamma\pi^0\pi^0$
10.2±0.8±0.7		ATHAR	06	CLE3	$\Upsilon(1S) \to \gamma\pi^+\pi^-$
$8.1\pm2.3^{+2.9}_{-2.7}$		[30] ANASTASSOV	99	CLE2	$e^+e^- \to$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<21	90	[30] FULTON	90B	CLEO	$\Upsilon(1S) \to \gamma\pi^+\pi^-$
<13	90	[30] ALBRECHT	89	ARG	$\Upsilon(1S) \to \gamma\pi^+\pi^-$
<81	90	SCHMITT	88	CBAL	$\Upsilon(1S) \to \gamma X$

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

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

$\Gamma(\gamma\eta(1405))/\Gamma_{total}$ — Γ_{86}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<8.2	90	[31] FULTON	90B	CLEO	$\Upsilon(1S) \to \gamma K^\pm\pi^\mp K^0_S$

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

$\Gamma(\gamma f_0(1500))/\Gamma_{total}$ — Γ_{87}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<1.5	90	[32] 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	[33] BESSON	07A	CLEO	$e^+e^- \rightarrow \Upsilon(1S) \rightarrow \gamma\eta\eta$

[32] 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 ± 0.023)%.

[33] Calculated by us using B($f_0(1500) \rightarrow \eta\eta$) = (5.1 ± 0.9)%.

$\Gamma(\gamma f_0(1710))/\Gamma_{total}$ — Γ_{88}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
< 2.6	90	[34] ALBRECHT	89	ARG	$\Upsilon(1S) \rightarrow \gamma K^+K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
< 6.3	90	[34] FULTON	90B	CLEO	$\Upsilon(1S) \rightarrow \gamma K^+K^-$
<19	90	[34] FULTON	90B	CLEO	$\Upsilon(1S) \rightarrow \gamma K^0_S K^0_S$
< 8	90	[35] ALBRECHT	89	ARG	$\Upsilon(1S) \rightarrow \gamma\pi^+\pi^-$
<24	90	[36] SCHMITT	88	CBAL	$\Upsilon(1S) \rightarrow \gamma X$

[34] Assuming B($f_0(1710) \rightarrow K\overline{K}$) = 0.38.

[35] Assuming B($f_0(1710) \rightarrow \pi\pi$) = 0.04.

[36] Assuming B($f_0(1710) \rightarrow \eta\eta$) = 0.18.

$\Gamma(\gamma f_0(1710) \rightarrow \gamma K^+K^-)/\Gamma_{total}$ — Γ_{89}/Γ

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

$\Gamma(\gamma f_0(1710) \rightarrow \gamma\pi^0\pi^0)/\Gamma_{total}$ — Γ_{90}/Γ

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

$\Gamma(\gamma f_0(1710) \rightarrow \gamma\eta\eta)/\Gamma_{total}$ — Γ_{91}/Γ

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

$\Gamma(\gamma f_4(2050))/\Gamma_{total}$ — Γ_{92}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<5.3	90	[37] ATHAR	06	CLE3	$\Upsilon(1S) \rightarrow \gamma\pi^+\pi^-$

[37] Assuming B($f_4(2050) \rightarrow \pi\pi$) = 0.17.

$\Gamma(\gamma f_0(2200) \rightarrow \gamma K^+K^-)/\Gamma_{total}$ — Γ_{93}/Γ

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

$\Gamma(\gamma f_J(2220) \to \gamma K^+ K^-)/\Gamma_{total}$ — Γ_{94}/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_{95}/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_{96}/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	$\Upsilon(1S) \to \gamma p \overline{p}$

$\Gamma(\gamma \eta(2225) \to \gamma \phi \phi)/\Gamma_{total}$ — Γ_{97}/Γ

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

$\Gamma(\gamma \eta_c(1S))/\Gamma_{total}$ — Γ_{98}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<5.7	90	SHEN	10A	BELL	$\Upsilon(1S) \to \gamma X$

$\Gamma(\gamma \chi_{c0})/\Gamma_{total}$ — Γ_{99}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<6.5	90	SHEN	10A	BELL	$\Upsilon(1S) \to \gamma X$

$\Gamma(\gamma \chi_{c1})/\Gamma_{total}$ — Γ_{100}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<2.3	90	SHEN	10A	BELL	$\Upsilon(1S) \to \gamma X$

$\Gamma(\gamma \chi_{c2})/\Gamma_{total}$ — Γ_{101}/Γ

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<7.6	90	SHEN	10A	BELL	$\Upsilon(1S) \to \gamma X$

$\Gamma(\gamma \chi_{c1}(3872) \to \pi^+ \pi^- J/\psi)/\Gamma_{total}$ — Γ_{102}/Γ

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<1.6	90	SHEN	10A	BELL	$\Upsilon(1S) \to \gamma X$

$\Gamma(\gamma\chi_{c1}(3872) \to \pi^+\pi^-\pi^0 J/\psi)/\Gamma_{\text{total}}$ — Γ_{103}/Γ

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

$\Gamma(\gamma X(3915) \to \omega J/\psi)/\Gamma_{\text{total}}$ — Γ_{104}/Γ

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

$\Gamma(\gamma\chi_{c1}(4140) \to \phi J/\psi)/\Gamma_{\text{total}}$ — Γ_{105}/Γ

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

$\Gamma(\gamma X)/\Gamma_{\text{total}}$ — Γ_{106}/Γ

(X = scalar with $m <$ 8.0 GeV)

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
< 4.5	90	[38] DEL-AMO-SA..	11J	BABR	$e^+e^- \to \gamma + X$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<30	90	[39] BALEST	95	CLEO	$e^+e^- \to \gamma + X$

[38] For a noninteracting scalar X with mass $m <$ 8.0 GeV.
[39] For a noninteracting pseudoscalar X with mass < 7.2 GeV.

$\Gamma(\gamma X\overline{X}(m_X < 3.1\text{ GeV}))/\Gamma_{\text{total}}$ — Γ_{107}/Γ

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

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<1	90	[40] BALEST	95	CLEO	$e^+e^- \to \gamma + X\overline{X}$

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

$\Gamma(\gamma X\overline{X}(m_X < 4.5\text{ GeV}))/\Gamma_{\text{total}}$ — Γ_{108}/Γ

X and $\overline{X}$ = zero spin with $m <$ 4.5 GeV

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<24	90	[41] DEL-AMO-SA..	11J	BABR	$e^+e^- \to \gamma + X\overline{X}$

[41] For a noninteracting scalar X with mass $m <$ 4.5 GeV.

$\Gamma(\gamma X \to \gamma + \geq 4\text{ prongs})/\Gamma_{\text{total}}$ — Γ_{109}/Γ

(1.5 GeV $< m_X <$ 5.0 GeV)

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

$\Gamma(\gamma a_1^0 \to \gamma\mu^+\mu^-)/\Gamma_{\text{total}}$ — Γ_{110}/Γ

(201 < M($\mu^+\mu^-$) < 3565 MeV)

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<9	90	[42] LOVE	08	CLEO	$e^+e^- \to \gamma a_1^0 \to \gamma\mu^+\mu^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<9.7	90	[43] LEES	13C	BABR	$e^+e^- \to \gamma a_1^0 \to \gamma\mu^+\mu^-$

[42] For a narrow scalar or pseudoscalar a_1^0 with 201 < M($\mu^+\mu^-$) < 3565 MeV, excluding J/ψ. Measured 90% CL limits as a function of M($\mu^+\mu^-$) range from 1–9 $\times 10^{-6}$.

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

$\Gamma(\gamma a_1^0 \to \gamma\tau^+\tau^-)/\Gamma_{total}$ — Γ_{111}/Γ

($2m_\tau$ < M($\tau^+\tau^-$) < 9.2 GeV)

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<130	90	[44] LEES	13R	BABR	$\Upsilon(2S) \to \gamma\tau^+\tau^-\pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
< 50	90	[45] LOVE	08	CLEO	$e^+e^- \to \gamma a_1^0 \to \gamma\tau^+\tau^-$

[44] For a narrow scalar a_1^0 with $2m_\tau$ < M(a_1^0) < 9.2 GeV, which result in a 90% CL upper limits of 0.9×10^{-5} at M(a_1^0) = $2m_\tau$, $\approx 1.5\times10^{-5}$ at M(a_1^0) = 7.5 GeV, and 13×10^{-5} at M(a_1^0) = 9.2 GeV.

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

$\Gamma(\gamma a_1^0 \to \gamma g g)/\Gamma_{total}$ — Γ_{112}/Γ

(0.5 GeV < m < 9.0 GeV)

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1 × 10⁻²	90	[46] LEES	13L	BABR	$\Upsilon(1S) \to \gamma X$

[46] 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^{-6} to 10^{-2}.

$\Gamma(\gamma a_1^0 \to \gamma s\bar{s})/\Gamma_{total}$ — Γ_{113}/Γ

(0.5 GeV < m < 9.0 GeV)

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1 \times 10^{-3}$	90	[47] LEES	13L	BABR	$\Upsilon(1S) \to \gamma X$

[47] 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^{-5} to 10^{-3}.

LEPTON FAMILY NUMBER (*LF*) VIOLATING MODES

$\Gamma(\mu^\pm\tau^\mp)/\Gamma_{total}$ — Γ_{114}/Γ

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

OTHER DECAYS

Γ(invisible)/Γ_{total} — Γ_{115}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
< 3.0	90	AUBERT	09AX	BABR	$\Upsilon(3S) \to \pi^+\pi^- \Upsilon(1S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<39	90	RUBIN	07	CLEO	$\Upsilon(2S) \to \pi^+\pi^- \Upsilon(1S)$
<25	90	TAJIMA	07	BELL	$\Upsilon(3S) \to \pi^+\pi^- \Upsilon(1S)$

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