$\Upsilon(1S)$

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

$\Upsilon(1S)$ 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[3] Superseded by ARTAMONOV 00.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)	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, $X \to J/\psi(1S)\phi$	< 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	± 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	± 0.8)	$\times 10^{-4}$	
Γ_{28}	$\psi(2S)$ anything	(	1.23	± 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}	$Z_c(4200)^+Z_c(4200)^-$	<	2.23		$\times 10^{-5}$	CL=90%
Γ_{42}	$Z_c(3900)^{\pm}Z_c(4200)^{\mp}$	<	8.1		$\times 10^{-6}$	CL=90%
Γ_{43}	$Z_c(3900)^+Z_c(3900)^-$	<	1.8		$\times 10^{-6}$	CL=90%
Γ_{44}	$X(4050)^+X(4050)^-$	<	1.58		$\times 10^{-5}$	CL=90%
Γ_{45}	$X(4250)^+X(4250)^-$	<	2.66		$\times 10^{-5}$	CL=90%
Γ_{46}	$X(4050)^{\pm}X(4250)^{\mp}$	<	4.42		$\times 10^{-5}$	CL=90%
Γ_{47}	$Z_c(4430)^+Z_c(4430)^-$	<	2.03		$\times 10^{-5}$	CL=90%

Γ_{48}	$X(4055)^{\pm} X(4055)^{\mp}$		$< 2.33 \times 10^{-5}$	CL=90%
Γ_{49}	$X(4055)^{\pm} Z_c(4430)^{\mp}$		$< 4.55 \times 10^{-5}$	CL=90%
Γ_{50}	$\rho\pi$		$< 3.68 \times 10^{-6}$	CL=90%
Γ_{51}	$\omega\pi^0$		$< 3.90 \times 10^{-6}$	CL=90%
Γ_{52}	$\pi^+\pi^-$		$< 5 \times 10^{-4}$	CL=90%
Γ_{53}	K^+K^-		$< 5 \times 10^{-4}$	CL=90%
Γ_{54}	$p\overline{p}$		$< 5 \times 10^{-4}$	CL=90%
Γ_{55}	$\pi^+\pi^-\pi^0$		$(2.1 \pm 0.8) \times 10^{-6}$	
Γ_{56}	ϕK^+K^-		$(2.4 \pm 0.5) \times 10^{-6}$	
Γ_{57}	$\omega\pi^+\pi^-$		$(4.5 \pm 1.0) \times 10^{-6}$	
Γ_{58}	$K^*(892)^0 K^-\pi^+$ + c.c.		$(4.4 \pm 0.8) \times 10^{-6}$	
Γ_{59}	$\phi f_2'(1525)$		$< 1.63 \times 10^{-6}$	CL=90%
Γ_{60}	$\omega f_2(1270)$		$< 1.79 \times 10^{-6}$	CL=90%
Γ_{61}	$\rho(770) a_2(1320)$		$< 2.24 \times 10^{-6}$	CL=90%
Γ_{62}	$K^*(892)^0 \overline{K}{}_2^*(1430)^0$ + c.c.		$(3.0 \pm 0.8) \times 10^{-6}$	
Γ_{63}	$K_1(1270)^{\pm} K^{\mp}$		$< 2.41 \times 10^{-6}$	CL=90%
Γ_{64}	$K_1(1400)^{\pm} K^{\mp}$		$(1.0 \pm 0.4) \times 10^{-6}$	
Γ_{65}	$b_1(1235)^{\pm}\pi^{\mp}$		$< 1.25 \times 10^{-6}$	CL=90%
Γ_{66}	$\pi^+\pi^-\pi^0\pi^0$		$(1.28 \pm 0.30) \times 10^{-5}$	
Γ_{67}	$K_S^0 K^+\pi^-$ + c.c.		$(1.6 \pm 0.4) \times 10^{-6}$	
Γ_{68}	$K^*(892)^0 \overline{K}^0$ + c.c.		$(2.9 \pm 0.9) \times 10^{-6}$	
Γ_{69}	$K^*(892)^- K^+$ + c.c.		$< 1.11 \times 10^{-6}$	CL=90%
Γ_{70}	$f_1(1285)$ anything		$(4.6 \pm 3.1) \times 10^{-3}$	
Γ_{71}	$D^*(2010)^{\pm}$ anything		(2.52 ± 0.20) %	
Γ_{72}	$\underline{f_1(}1285) X_{tetra}$		$< 6.24 \times 10^{-5}$	CL=90%
Γ_{73}	${}^2H$ anything		$(2.85 \pm 0.25) \times 10^{-5}$	
Γ_{74}	Sum of 100 exclusive modes		(1.200 ± 0.017) %	

Radiative decays

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

Γ_{90}	$\gamma 2K^+ 2K^-$			(2.0 ±2.0)	$\times 10^{-5}$	
Γ_{91}	$\gamma \eta'(958)$		<	1.9	$\times 10^{-6}$	CL=90%
Γ_{92}	$\gamma \eta$		<	1.0	$\times 10^{-6}$	CL=90%
Γ_{93}	$\gamma f_0(980)$		<	3	$\times 10^{-5}$	CL=90%
Γ_{94}	$\gamma f'_2(1525)$			(2.9 ±0.6)	$\times 10^{-5}$	
Γ_{95}	$\gamma f_2(1270)$			(1.01 ±0.06)	$\times 10^{-4}$	
Γ_{96}	$\gamma \eta(1405)$		<	8.2	$\times 10^{-5}$	CL=90%
Γ_{97}	$\gamma f_0(1500)$		<	1.5	$\times 10^{-5}$	CL=90%
Γ_{98}	$\gamma f_0(1500) \to \gamma K^+ K^-$			(1.0 ±0.4)	$\times 10^{-5}$	
Γ_{99}	$\gamma f_0(1710)$		<	2.6	$\times 10^{-4}$	CL=90%
Γ_{100}	$\gamma f_0(1710) \to \gamma K^+ K^-$			(1.01 ±0.32)	$\times 10^{-5}$	
Γ_{101}	$\gamma f_0(1710) \to \gamma \pi^+ \pi^-$			(5.3 ±2.0)	$\times 10^{-6}$	
Γ_{102}	$\gamma f_0(1710) \to \gamma \pi^0 \pi^0$		<	1.4	$\times 10^{-6}$	CL=90%
Γ_{103}	$\gamma f_0(1710) \to \gamma \eta \eta$		<	1.8	$\times 10^{-6}$	CL=90%
Γ_{104}	$\gamma f_4(2050)$		<	5.3	$\times 10^{-5}$	CL=90%
Γ_{105}	$\gamma f_0(2200) \to \gamma K^+ K^-$		<	2	$\times 10^{-4}$	CL=90%
Γ_{106}	$\gamma f_J(2220) \to \gamma K^+ K^-$		<	8	$\times 10^{-7}$	CL=90%
Γ_{107}	$\gamma f_J(2220) \to \gamma \pi^+ \pi^-$		<	6	$\times 10^{-7}$	CL=90%
Γ_{108}	$\gamma f_J(2220) \to \gamma p \overline{p}$		<	1.1	$\times 10^{-6}$	CL=90%
Γ_{109}	$\gamma \eta(2225) \to \gamma \phi \phi$		<	3	$\times 10^{-3}$	CL=90%
Γ_{110}	$\gamma \eta_c(1S)$		<	5.7	$\times 10^{-5}$	CL=90%
Γ_{111}	$\gamma \chi_{c0}$		<	6.5	$\times 10^{-4}$	CL=90%
Γ_{112}	$\gamma \chi_{c1}$		<	2.3	$\times 10^{-5}$	CL=90%
Γ_{113}	$\gamma \chi_{c2}$		<	7.6	$\times 10^{-6}$	CL=90%
Γ_{114}	$\gamma \chi_{c1}(3872) \to \pi^+ \pi^- J/\psi$		<	1.6	$\times 10^{-6}$	CL=90%
Γ_{115}	$\gamma \chi_{c1}(3872) \to \pi^+ \pi^- \pi^0 J/\psi$		<	2.8	$\times 10^{-6}$	CL=90%
Γ_{116}	$\gamma X(3915) \to \omega J/\psi$		<	3.0	$\times 10^{-6}$	CL=90%
Γ_{117}	$\gamma \chi_{c1}(4140) \to \phi J/\psi$		<	2.2	$\times 10^{-6}$	CL=90%
Γ_{118}	γX	[c]	<	4.5	$\times 10^{-6}$	CL=90%
Γ_{119}	$\gamma X \overline{X} (m_X < 3.1$ GeV)	[d]	<	1	$\times 10^{-3}$	CL=90%
Γ_{120}	$\gamma X \overline{X} (m_X < 4.5$ GeV)	[e]	<	2.4	$\times 10^{-4}$	CL=90%
Γ_{121}	$\gamma X \to \gamma + \geq 4$ prongs	[f]	<	1.78	$\times 10^{-4}$	CL=95%
Γ_{122}	$\gamma a_1^0 \to \gamma \mu^+ \mu^-$	[g]	<	9	$\times 10^{-6}$	CL=90%
Γ_{123}	$\gamma a_1^0 \to \gamma \tau^+ \tau^-$	[a]	<	1.30	$\times 10^{-4}$	CL=90%
Γ_{124}	$\gamma a_1^0 \to \gamma g g$	[h]	<	1	%	CL=90%
Γ_{125}	$\gamma a_1^0 \to \gamma s \overline{s}$	[h]	<	1	$\times 10^{-3}$	CL=90%

Lepton Family number (*LF*) violating modes

Γ_{126}	$\mu^\pm \tau^\mp$	*LF*	<	6.0	$\times 10^{-6}$	CL=95%

Other decays

Γ_{127}	invisible		<	3.0	$\times 10^{-4}$	CL=90%

[a] $2m_\tau$ < 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 < 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.

$\Upsilon(1S)$ Γ(i)Γ(e^+e^-)/Γ(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	$e^+e^- \rightarrow \mu^+\mu^-$

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

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

[1] Radiative corrections evaluated following KURAEV 85.
[2] Radiative corrections reevaluated by BUCHMUELLER 88 following KURAEV 85.
[3] 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					
$2.53\pm0.13\pm0.05$	60k	[1] BESSON	07	CLEO	$e^+e^- \rightarrow \Upsilon(1S) \rightarrow \tau^+\tau^-$
$2.61\pm0.12^{+0.09}_{-0.13}$	25k	CINABRO	94B	CLE2	$e^+e^- \rightarrow \tau^+\tau^-$
$2.7\pm0.4\pm0.2$		[2] ALBRECHT	85C	ARG	$\Upsilon(2S) \rightarrow \pi^+\pi^-\tau^+\tau^-$
$3.4\pm0.4\pm0.4$		GILES	83	CLEO	$e^+e^- \rightarrow \tau^+\tau^-$

[1] BESSON 07 reports $[\Gamma(\Upsilon(1S) \rightarrow \tau^+\tau^-)/\Gamma_{total}] / [B(\Upsilon(1S) \rightarrow \mu^+\mu^-)] = 1.02 \pm 0.02 \pm 0.05$ 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.

[2] Using $B(\Upsilon(1S) \rightarrow ee) = B(\Upsilon(1S) \rightarrow \mu\mu) = 0.0256$; 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					
$2.29\pm0.08\pm0.11$		ALEXANDER	98	CLE2	$\Upsilon(2S) \rightarrow \pi^+\pi^-e^+e^-$
$2.42\pm0.14\pm0.14$	307	ALBRECHT	87	ARG	$\Upsilon(2S) \rightarrow \pi^+\pi^-e^+e^-$
$2.8\pm0.3\pm0.2$	826	BESSON	84	CLEO	$\Upsilon(2S) \rightarrow \pi^+\pi^-e^+e^-$
5.1 ± 3.0		BERGER	80C	PLUT	$e^+e^- \rightarrow e^+e^-$

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.0248±0.0005 OUR AVERAGE					
$0.0249\pm0.0002\pm0.0007$	345k	ADAMS	05	CLEO	$e^+e^- \rightarrow \mu^+\mu^-$
$0.0249\pm0.0008\pm0.0013$		ALEXANDER	98	CLE2	$\Upsilon(2S) \rightarrow \pi^+\pi^-\mu^+\mu^-$
$0.0212\pm0.0020\pm0.0010$		[1] BARU	92	MD1	$e^+e^- \rightarrow \mu^+\mu^-$
$0.0231\pm0.0012\pm0.0010$		[1] KOBEL	92	CBAL	$e^+e^- \rightarrow \mu^+\mu^-$
$0.0252\pm0.0007\pm0.0007$		CHEN	89B	CLEO	$e^+e^- \rightarrow \mu^+\mu^-$
$0.0261\pm0.0009\pm0.0011$		KAARSBERG	89	CSB2	$e^+e^- \rightarrow \mu^+\mu^-$
$0.0230\pm0.0025\pm0.0013$	86	ALBRECHT	87	ARG	$\Upsilon(2S) \rightarrow \pi^+\pi^-\mu^+\mu^-$
$0.029\pm0.003\pm0.002$	864	BESSON	84	CLEO	$\Upsilon(2S) \rightarrow \pi^+\pi^-\mu^+\mu^-$
$0.027\pm0.003\pm0.003$		ANDREWS	83	CLEO	$e^+e^- \rightarrow \mu^+\mu^-$
$0.032\pm0.013\pm0.003$		ALBRECHT	82	DASP	$e^+e^- \rightarrow \mu^+\mu^-$
$0.038\pm0.015\pm0.002$		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	$e^+e^- \rightarrow \mu^+\mu^-$

[1] 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	[1] DEL-AMO-SA...	10C	BABR	$\Upsilon(3S) \to \pi^+\pi^-\Upsilon(1S)$
1.02 ±0.02 ±0.05	60k	BESSON	07	CLEO	$e^+e^- \to \Upsilon(1S)$

[1] 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	[1] BESSON	06A	CLEO	$\Upsilon(1S) \to$ hadrons

[1] 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	[1] BESSON	06A	CLEO	$\Upsilon(1S) \to \gamma +$ hadrons

[1] 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			[1] 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	

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

$\Gamma(J/\psi(1S)\eta_c)/\Gamma_{total}$ — 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
$3.90 \pm 1.21 \pm 0.23$	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 × 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 × 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 × 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	[1] JIA	17A	BELL	$e^+e^- \to$ hadrons

[1] 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	$e^+e^- \to J/\psi X$

$\Gamma(\psi(2S)$ 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	$e^+e^- \to \psi(2S)X$

$\Gamma(\psi(2S)$ 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	$e^+e^- \to J/\psi\pi^+\pi^- X$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<7.9 \times 10^{-5}$	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
$<5.2 \times 10^{-5}$	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
$<2.2 \times 10^{-5}$	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
$<8.8 \times 10^{-5}$	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
$<6.7 \times 10^{-5}$	90	SHEN	16	BELL	$\Upsilon(1S) \to \psi(2S)\pi^{\pm}X$

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

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

[1] Assuming B($Z_c(4200)^{\pm} \to J/\psi\pi^{\pm}$) = 1.

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

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

[1] Assuming $B(Z_c(4200)^{\pm} \to J/\psi \pi^{\pm}) = 1 = B(Z_c(3900)^{\pm} \to J/\psi \pi^{\pm})$.

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

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

[1] Assuming $B(Z_c(3900)^{\pm} \to J/\psi \pi^{\pm}) = 1$

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

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

[1] Assuming $B(X(4050)^{\pm} \to \chi_{c1}(1P) \pi^{\pm}) = 1$

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

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

[1] Assuming $B(X(4250)^{\pm} \to \chi_{c1}(1P) \pi^{\pm}) = 1$

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

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

[1] Assuming $B(X(4050)^{\pm} \to \chi_{c1}(1P) \pi^{\pm}) = 1 = B(X(4250)^{\pm} \to \chi_{c1}(1P) \pi^{\pm})$

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

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

[1] Assuming $B(Z_c(4430)^{\pm} \to \psi(2S) \pi^{\pm}) = 1$

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

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

[1] Assuming $B(X(4055)^{\pm} \to \psi(2S) \pi^{\pm}) = 1$

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

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

[1] Assuming $B(X(4055)^{\pm} \to \psi(2S) \pi^{\pm}) = 1 = B(Z_c(4430)^{\pm} \to \psi(2S) \pi^{\pm})$

$\Gamma(\rho\pi)/\Gamma_{total}$ — Γ_{50}/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_{51}/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_{52}/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_{53}/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_{54}/Γ

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

[1] Supersedes BARU 92 in this node.

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{total}$ — Γ_{55}/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_{56}/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_{57}/Γ

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

$\Gamma(K^*(892)^0K^-\pi^+ + c.c.)/\Gamma_{total}$ — Γ_{58}/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_{59}/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_{60}/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_{61}/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_{62}/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_{63}/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_{64}/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_{65}/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_{66}/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_{67}/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		[1] DOBBS	12A		$\Upsilon(1S) \to K^0_S K^-\pi^+$

[1] 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_{68}/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_{69}/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_{70}/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

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

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

[1] For $x_p > 0.1$.

[2] For $x_p > 0.2$.

$\Gamma(f_1(1285)X_{tetra})/\Gamma_{total}$ — Γ_{72}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<62.4 × 10^{-6}	90	[1] JIA	17A	BELL	$e^+e^- \to$ hadrons

[1] 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}.

$\Gamma(\overline{^2H}$ anything$)/\Gamma_{total}$ — Γ_{73}/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	$e^+e^- \to \overline{^2H}\,X$

Γ(Sum of 100 exclusive modes)$/\Gamma_{total}$ — Γ_{74}/Γ

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

[1] DOBBS 12A presents individual exclusive branching fractions or upper limits for 100 modes of four to ten pions, kaons, or protons.

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

$\Gamma(ggg, \gamma gg \to \overline{d}$ anything$)/\Gamma(ggg, \gamma gg \to$ 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_{75}/Γ

VALUE (units 10^{-5})	DOCUMENT ID		TECN	COMMENT
6.3±1.2±1.3	[1] ANASTASSOV	99	CLE2	$e^+e^- \to$ hadrons

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

$\Gamma(\gamma\pi^0\pi^0)/\Gamma_{total}$ — Γ_{76}/Γ

VALUE (units 10^{-5})	DOCUMENT ID		TECN	COMMENT
1.7±0.6±0.3	[1] ANASTASSOV	99	CLE2	$e^+e^- \to$ hadrons

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

$\Gamma(\gamma\pi\pi$(S-wave)$)/\Gamma_{total}$ — Γ_{77}/Γ

VALUE (units 10^{-5})	DOCUMENT ID		TECN	COMMENT
4.63±0.56±0.48	LEES	18A	BABR	$\Upsilon(1S) \to \gamma\pi^+\pi^-$

$\Gamma(\gamma\pi^0\eta)/\Gamma_{total}$ Γ_{78}/Γ

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

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

$\Gamma(\gamma K^+K^-)/\Gamma_{total}$ Γ_{79}/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_{80}/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_{81}/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_{82}/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_{83}/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_{84}/Γ

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

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

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

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

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

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

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

$\Gamma(\gamma\pi^+\pi^-p\overline{p})/\Gamma_{total}$ Γ_{88}/Γ

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

$\Gamma(\gamma 2\pi^+ 2\pi^- p\overline{p})/\Gamma_{total}$ — Γ_{89}/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_{90}/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_{91}/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_{92}/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_{93}/Γ

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

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

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

VALUE (units 10^{-5})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
2.9 ±0.6 OUR AVERAGE						
2.13±0.28±0.72			[1] LEES	18A	BABR	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$
4.1 ±1.4 ±0.1		17	[2] BESSON	11	CLEO	$\Upsilon(1S) \rightarrow K^0_S K^0_S$
$3.7\ ^{+0.9}_{-0.7}\ \pm 0.8$			ATHAR	06	CLE3	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<14	90		[3] FULTON	90B	CLEO	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$
<19.4	90		[3] ALBRECHT	89	ARG	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$

[1] Using $B(f'_2(1525) \rightarrow K\overline{K}) = 0.887 \pm 0.022$ and $B(K^0\overline{K}^0) = 1/2\ B(K\overline{K})$.

[2] BESSON 11 reports $(4.0 \pm 1.3 \pm 0.6) \times 10^{-5}$ from a measurement of $[\Gamma(\Upsilon(1S) \rightarrow \gamma f'_2(1525))/\Gamma_{total}] \times [B(f'_2(1525) \rightarrow K\overline{K})]$ assuming $B(f'_2(1525) \rightarrow K\overline{K}) = (88.8 \pm 3.1) \times 10^{-2}$, which we rescale to our best value $B(f'_2(1525) \rightarrow K\overline{K}) = (87.6 \pm 2.2) \times 10^{-2}$. 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 $B(K^0_S \rightarrow \pi^+\pi^-) = (69.20 \pm 0.05)\%$ and $B(f'_2(1525) \rightarrow K\overline{K}) = 4\ B(f'_2(1525) \rightarrow K^0_S K^0_S)$.

[3] Assuming $B(f'_2(1525) \rightarrow K\overline{K}) = 0.71$.

$\Gamma(\gamma f_2(1270))/\Gamma_{total}$ — Γ_{95}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
10.1 ±0.6 OUR AVERAGE					
$10.15\pm0.59^{+0.54}_{-0.43}$		[1] LEES	18A	BABR	$\Upsilon(1S) \to \gamma\pi^+\pi^-$
$10.5\pm1.6^{+1.9}_{-1.8}$		[2] BESSON	07A	CLE3	$\Upsilon(1S) \to \gamma\pi^0\pi^0$
$10.2\pm0.8\pm0.7$		ATHAR	06	CLE3	$\Upsilon(1S) \to \gamma\pi^+\pi^-$
$8.1\pm2.3^{+2.9}_{-2.7}$		[3] ANASTASSOV	99	CLE2	$e^+e^- \to$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<21	90	[3] FULTON	90B	CLEO	$\Upsilon(1S) \to \gamma\pi^+\pi^-$
<13	90	[3] ALBRECHT	89	ARG	$\Upsilon(1S) \to \gamma\pi^+\pi^-$
<81	90	SCHMITT	88	CBAL	$\Upsilon(1S) \to \gamma X$

[1] Using $B(f_2(1270) \to \pi^0\pi^0) = 1/3\ B(f_2(1270) \to \pi\pi)$ and $B(f_2(1270) \to \pi\pi) = (84.2^{+2.9}_{-0.9})\%$.

[2] Using $B(f_2(1270) \to \pi^0\pi^0) = B(f_2(1270) \to \pi\pi)/3$ and $B(f_2(1270) \to \pi\pi) = (84.7^{+2.5}_{-1.2})\%$.

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

$\Gamma(\gamma\eta(1405))/\Gamma_{total}$ — Γ_{96}/Γ

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

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

$\Gamma(\gamma f_0(1500))/\Gamma_{total}$ — Γ_{97}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<1.5	90	[1] 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	[2] BESSON	07A	CLEO	$e^+e^- \to \Upsilon(1S) \to \gamma\eta\eta$

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

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

$\Gamma(\gamma f_0(1500) \to \gamma K^+K^-)/\Gamma_{total}$ — Γ_{98}/Γ

VALUE (units 10^{-5})	DOCUMENT ID		TECN	COMMENT
1.04±0.14±0.33	[1] LEES	18A	BABR	$e^+e^- \to \Upsilon(1S) \to \gamma K^+K^-$

[1] LEES 18A quotes $B(\Upsilon(1S) \to \gamma f_0(1500) \to \gamma K\overline{K}) = (2.08 \pm 0.27 \pm 0.65) \times 10^{-5}$ assuming $B(K^0\overline{K}^0) = 1/2\ B(K\overline{K})$.

$\Gamma(\gamma f_0(1710))/\Gamma_{total}$ — Γ_{99}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
< 2.6	90	[1] ALBRECHT	89	ARG	$\Upsilon(1S) \to \gamma K^+K^-$

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

< 6.3	90	[1] FULTON	90B	CLEO	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$
<19	90	[1] FULTON	90B	CLEO	$\Upsilon(1S) \rightarrow \gamma K^0_S K^0_S$
< 8	90	[2] ALBRECHT	89	ARG	$\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$
<24	90	[3] SCHMITT	88	CBAL	$\Upsilon(1S) \rightarrow \gamma X$

[1] Assuming B($f_0(1710) \rightarrow K\overline{K}$) = 0.38.
[2] Assuming B($f_0(1710) \rightarrow \pi\pi$) = 0.04.
[3] Assuming B($f_0(1710) \rightarrow \eta\eta$) = 0.18.

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

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
1.01±0.26±0.18		[1] 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	$e^+ e^- \rightarrow \Upsilon(1S) \rightarrow \gamma K^+ K^-$

[1] LEES 18A quotes B($\Upsilon(1S) \rightarrow \gamma f_0(1710) \rightarrow \gamma K\overline{K}$) = $(2.02 \pm 0.51 \pm 0.35) \times 10^{-5}$ assuming B($K^0\overline{K}^0$) = 1/2 B($K\overline{K}$).

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

VALUE (units 10^{-5})	DOCUMENT ID		TECN	COMMENT
0.53±0.17±0.11	[1] LEES	18A	BABR	$\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$

[1] 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($\pi\pi$).

$\Gamma(\gamma f_0(1710) \rightarrow \gamma \pi^0 \pi^0)/\Gamma_{total}$ Γ_{102}/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_{103}/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_{104}/Γ

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

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

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

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

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

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	$\Upsilon(1S) \to \gamma K^+ K^-$
$<$ 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	$\Upsilon(1S) \to \gamma K^+ K^-$

$\Gamma(\gamma f_J(2220) \to \gamma \pi^+ \pi^-)/\Gamma_{\text{total}}$ Γ_{107}/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	$\Upsilon(1S) \to \gamma \pi^+ \pi^-$

$\Gamma(\gamma f_J(2220) \to \gamma p \overline{p})/\Gamma_{\text{total}}$ Γ_{108}/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_{109}/Γ

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

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

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

$\Gamma(\gamma \chi_{c0})/\Gamma_{\text{total}}$ Γ_{111}/Γ

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

$\Gamma(\gamma \chi_{c1})/\Gamma_{\text{total}}$ Γ_{112}/Γ

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

$\Gamma(\gamma \chi_{c2})/\Gamma_{\text{total}}$ Γ_{113}/Γ

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

$\Gamma(\gamma \chi_{c1}(3872) \to \pi^+ \pi^- J/\psi)/\Gamma_{\text{total}}$ Γ_{114}/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_{115}/Γ

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

$\Gamma(\gamma X(3915) \to \omega J/\psi)/\Gamma_{total}$ — Γ_{116}/Γ

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

$\Gamma(\gamma \chi_{c1}(4140) \to \phi J/\psi)/\Gamma_{total}$ — Γ_{117}/Γ

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

$\Gamma(\gamma X)/\Gamma_{total}$ — Γ_{118}/Γ

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

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
< 4.5	90	[1] DEL-AMO-SA..11J		BABR	$e^+e^- \to \gamma + X$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<30	90	[2] BALEST	95	CLEO	$e^+e^- \to \gamma + X$

[1] For a noninteracting scalar X with mass $m <$ 8.0 GeV.

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

$\Gamma(\gamma X \overline{X}(m_X < 3.1\text{ GeV}))/\Gamma_{total}$ — Γ_{119}/Γ

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

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

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

$\Gamma(\gamma X \overline{X}(m_X < 4.5\text{ GeV}))/\Gamma_{total}$ — Γ_{120}/Γ

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

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<24	90	[1] DEL-AMO-SA..11J		BABR	$e^+e^- \to \gamma + X\overline{X}$

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

$\Gamma(\gamma X \to \gamma + \geq 4\text{ prongs})/\Gamma_{total}$ — Γ_{121}/Γ

(1.5 GeV $< m_X <$ 5.0 GeV)

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

$\Gamma(\gamma a_1^0 \to \gamma \mu^+\mu^-)/\Gamma_{total}$ — Γ_{122}/Γ

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

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<9	90	[1] 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	[2] LEES	13C	BABR	$e^+e^- \to \gamma a_1^0 \to \gamma \mu^+\mu^-$

[1] 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 $\times 10^{-6}$.

[2] 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_{123}/Γ

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

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<130	90	[1] 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	[2] LOVE	08	CLEO	$e^+e^- \to \gamma a_1^0 \to \gamma\tau^+\tau^-$

[1] 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.

[2] 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_{124}/Γ

(0.5 GeV < m < 9.0 GeV)

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

[1] 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}.

$\Gamma(\gamma a_1^0 \to \gamma s \overline{s})/\Gamma_{total}$ — Γ_{125}/Γ

(0.5 GeV < m < 9.0 GeV)

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

[1] 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_{126}/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

$\Gamma(\text{invisible})/\Gamma_{total}$ — Γ_{127}/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	$\Upsilon(3S) \to \pi^+\pi^-\Upsilon(1S)$

$\Upsilon(1S)$ REFERENCES

JIA	18	PR D97 112004	S. Jia *et al.*	(BELLE Collab.)
LEES	18A	PR D97 112006	J.P. Lees *et al.*	(BABAR Collab.)
JIA	17	PR D95 012001	S. Jia *et al.*	(BELLE Collab.)
JIA	17A	PR D96 112002	S. Jia *et al.*	(BELLE Collab.)
SHEN	16	PR D93 112013	C.P. Shen *et al.*	(BELLE Collab.)
LEES	14G	PR D89 111102	J.P. Lees *et al.*	(BABAR Collab.)
YANG	14	PR D90 112008	S.D. Yang *et al.*	(BELLE Collab.)
LEES	13C	PR D87 031102	J.P. Lees *et al.*	(BABAR Collab.)
LEES	13L	PR D88 031701	J.P. Lees *et al.*	(BABAR Collab.)
LEES	13R	PR D88 071102	J.P. Lees *et al.*	(BABAR Collab.)
SHEN	13	PR D88 011102	C.P. Shen *et al.*	(BELLE Collab.)
DOBBS	12A	PR D86 052003	S. Dobbs *et al.*	
SHEN	12A	PR D86 031102	C.P. Shen *et al.*	(BELLE Collab.)
BESSON	11	PR D83 037101	D. Besson *et al.*	(CLEO Collab.)
DEL-AMO-SA...	11J	PRL 107 021804	P. del Amo Sanchez *et al.*	(BABAR Collab.)
AUBERT	10C	PR D81 011102	B. Aubert *et al.*	(BABAR Collab.)
DEL-AMO-SA...	10C	PRL 104 191801	P. del Amo Sanchez *et al.*	(BABAR Collab.)
SHEN	10A	PR D82 051504	C.P. Shen *et al.*	(BELLE Collab.)
AUBERT	09AX	PRL 103 251801	B. Aubert *et al.*	(BABAR Collab.)
LOVE	08	PRL 101 151802	W. Love *et al.*	(CLEO Collab.)
LOVE	08A	PRL 101 201601	W. Love *et al.*	(CLEO Collab.)
PDG	08	PL B667 1	C. Amsler *et al.*	(PDG Collab.)
ASNER	07	PR D75 012009	D.M. Asner *et al.*	(CLEO Collab.)
ATHAR	07A	PR D76 072003	S.B. Athar *et al.*	(CLEO Collab.)
BESSON	07	PRL 98 052002	D. Besson *et al.*	(CLEO Collab.)
BESSON	07A	PR D75 072001	D. Besson *et al.*	(CLEO Collab.)
ROSNER	07A	PR D76 117102	J.L. Rosner *et al.*	(CLEO Collab.)
RUBIN	07	PR D75 031104	P. Rubin *et al.*	(CLEO Collab.)
TAJIMA	07	PRL 98 132001	O. Tajima *et al.*	(BELLE Collab.)
AQUINES	06A	PR D74 092006	O. Aquines *et al.*	(CLEO Collab.)
ATHAR	06	PR D73 032001	S.B. Athar *et al.*	(CLEO Collab.)
BESSON	06A	PR D74 012003	D. Besson *et al.*	(CLEO Collab.)
ROSNER	06	PRL 96 092003	J.L. Rosner *et al.*	(CLEO Collab.)
ADAMS	05	PRL 94 012001	G.S. Adams *et al.*	(CLEO Collab.)
BRIERE	04	PR D70 072001	R.A. Briere *et al.*	(CLEO Collab.)
ARTUSO	03	PR D67 052003	M. Artuso *et al.*	(CLEO Collab.)
MASEK	02	PR D65 072002	G. Masek *et al.*	(CLEO Collab.)
RICHICHI	01B	PRL 87 141801	S.J. Richichi *et al.*	(CLEO Collab.)
ARTAMONOV	00	PL B474 427	A.S. Artamonov *et al.*	
ANASTASSOV	99	PRL 82 286	A. Anastassov *et al.*	(CLEO Collab.)
ALEXANDER	98	PR D58 052004	J.P. Alexander *et al.*	(CLEO Collab.)
BARU	96	PRPL 267 71	S.E. Baru *et al.*	(NOVO)
BALEST	95	PR D51 2053	R. Balest *et al.*	(CLEO Collab.)
CINABRO	94B	PL B340 129	D. Cinabro *et al.*	(CLEO Collab.)
ALBRECHT	92J	ZPHY C55 25	H. Albrecht *et al.*	(ARGUS Collab.)
BARU	92	ZPHY C54 229	S.E. Baru *et al.*	(NOVO)
BARU	92B	ZPHY C56 547	S.E. Baru *et al.*	(NOVO)
KOBEL	92	ZPHY C53 193	M. Kobel *et al.*	(Crystal Ball Collab.)
BLINOV	90	PL B245 311	A.E. Blinov *et al.*	(NOVO)
FULTON	90B	PR D41 1401	R. Fulton *et al.*	(CLEO Collab.)
MASCHMANN	90	ZPHY C46 555	W.S. Maschmann *et al.*	(Crystal Ball Collab.)
ALBRECHT	89	ZPHY C42 349	H. Albrecht *et al.*	(ARGUS Collab.)
ALEXANDER	89	NP B320 45	J.P. Alexander *et al.*	(LBL, MICH, SLAC)
BARU	89	ZPHY C42 505	S.E. Baru *et al.*	(NOVO)
CHEN	89B	PR D39 3528	W.Y. Chen *et al.*	(CLEO Collab.)
FULTON	89	PL B224 445	R. Fulton *et al.*	(CLEO Collab.)
KAARSBERG	89	PRL 62 2077	T.M. Kaarsberg *et al.*	(CUSB Collab.)
BUCHMUEL...	88	HE e^+e^- Physics 412	W. Buchmueller, S. Cooper	(HANN, DESY, MIT)
Editors: A. Ali and P. Soeding, World Scientific, Singapore				
JAKUBOWSKI	88	ZPHY C40 49	Z. Jakubowski *et al.*	(Crystal Ball Collab.) IGJPC
SCHMITT	88	ZPHY C40 199	P. Schmitt *et al.*	(Crystal Ball Collab.)
ALBRECHT	87	ZPHY C35 283	H. Albrecht *et al.*	(ARGUS Collab.)
COHEN	87	RMP 59 1121	E.R. Cohen, B.N. Taylor	(RISC, NBS)
BARU	86	ZPHY C30 551	S.E. Baru *et al.*	(NOVO)
ALBRECHT	85C	PL 154B 452	H. Albrecht *et al.*	(ARGUS Collab.)
KURAEV	85	SJNP 41 466	E.A. Kuraev, V.S. Fadin	(NOVO)
		Translated from YAF 41 733.		

ARTAMONOV	84	PL 137B 272	A.S. Artamonov *et al.*	(NOVO)
BESSON	84	PR D30 1433	D. Besson *et al.*	(CLEO Collab.)
GILES	84B	PR D29 1285	R. Giles *et al.*	(CLEO Collab.)
MACKAY	84	PR D29 2483	W.W. MacKay *et al.*	(CUSB Collab.)
ANDREWS	83	PRL 50 807	D.E. Andrews *et al.*	(CLEO Collab.)
GILES	83	PRL 50 877	R. Giles *et al.*	(HARV, OSU, ROCH, RUTG+)
NICZYPORUK	83	ZPHY C17 197	B. Niczyporuk *et al.*	(LENA Collab.)
ALBRECHT	82	PL 116B 383	H. Albrecht *et al.*	(DESY, DORT, HEIDH+)
ARTAMONOV	82	PL 118B 225	A.S. Artamonov *et al.*	(NOVO)
NICZYPORUK	82	ZPHY C15 299	B. Niczyporuk *et al.*	(LENA Collab.)
BERGER	80C	PL 93B 497	C. Berger *et al.*	(PLUTO Collab.)
BOCK	80	ZPHY C6 125	P. Bock *et al.*	(HEIDP, MPIM, DESY, HAMB)
BERGER	79	ZPHY C1 343	C. Berger *et al.*	(PLUTO Collab.)