$\Upsilon(2S)$

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

$\Upsilon(2S)$ MASS

VALUE (GeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
10.02326±0.00031 OUR AVERAGE				
10.0235 ±0.0005	[1] ARTAMONOV	00	MD1	$e^+e^- \to$ hadrons
10.0231 ±0.0004	BARBER	84	REDE	$e^+e^- \to$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •				
10.0236 ±0.0005	[2,3] BARU	86B	REDE	$e^+e^- \to$ hadrons

[1] Reanalysis of BARU 86B using new electron mass (COHEN 87).
[2] Reanalysis of ARTAMONOV 84.
[3] Superseded by ARTAMONOV 00.

$\Upsilon(2S)$ WIDTH

VALUE (keV)	*DOCUMENT ID*
31.98±2.63 OUR EVALUATION	See the Note on "Width Determinations of the Υ States"

$\Upsilon(2S)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Γ_1	$\Upsilon(1S)\pi^+\pi^-$	(18.1 ± 0.4) %	
Γ_2	$\Upsilon(1S)\pi^0\pi^0$	(8.6 ± 0.4) %	
Γ_3	$\tau^+\tau^-$	(2.00± 0.21) %	
Γ_4	$\mu^+\mu^-$	(1.93± 0.17) %	S=2.2
Γ_5	e^+e^-	(1.91± 0.16) %	
Γ_6	$\Upsilon(1S)\pi^0$	$< 1.8 \times 10^{-4}$	CL=90%
Γ_7	$\Upsilon(1S)\eta$	$(2.1 \,^{+\,0.8}_{-\,0.7}) \times 10^{-4}$	
Γ_8	$J/\psi(1S)$ anything	$< 6 \times 10^{-3}$	CL=90%
Γ_9	$\overline{d}$ anything	$(3.4 \pm 0.6) \times 10^{-5}$	
Γ_{10}	hadrons	(94 ±11) %	
Γ_{11}	ggg	(58.8 ± 1.2) %	
Γ_{12}	γgg	(1.87± 0.28) %	
	Radiative decays		
Γ_{13}	$\gamma\chi_{b1}(1P)$	(6.9 ± 0.4) %	
Γ_{14}	$\gamma\chi_{b2}(1P)$	(7.15± 0.35) %	
Γ_{15}	$\gamma\chi_{b0}(1P)$	(3.8 ± 0.4) %	
Γ_{16}	$\gamma f_0(1710)$	$< 5.9 \times 10^{-4}$	CL=90%

Γ_{17}	$\gamma f_2'(1525)$		$<$ 5.3	$\times 10^{-4}$	CL=90%
Γ_{18}	$\gamma f_2(1270)$		$<$ 2.41	$\times 10^{-4}$	CL=90%
Γ_{19}	$\gamma f_J(2220)$				
Γ_{20}	$\gamma \eta_b(1S)$		(3.9 $\pm$ 1.5)	$\times 10^{-4}$	
Γ_{21}	$\gamma X \rightarrow \gamma +$ ≥ 4 prongs	[a]	$<$ 1.95	$\times 10^{-4}$	CL=95%

Lepton Family number (*LF*) violating modes

Γ_{22}	$e^{\pm}\tau^{\mp}$	*LF*	$<$ 3.2	$\times 10^{-6}$	CL=90%
Γ_{23}	$\mu^{\pm}\tau^{\mp}$	*LF*	$<$ 3.3	$\times 10^{-6}$	CL=90%

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

$\Upsilon(2S)$ Γ(i)$\Gamma(e^+e^-)/\Gamma$(total)

$\Gamma(\mu^+\mu^-) \times \Gamma(e^+e^-)/\Gamma_{total}$ $\Gamma_4\Gamma_5/\Gamma$

VALUE (eV)	*DOCUMENT ID*		*TECN*	*COMMENT*
6.5±1.5±1.0	KOBEL	92	CBAL	$e^+e^- \rightarrow \mu^+\mu^-$

$\Gamma(\Upsilon(1S)\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{total}$ $\Gamma_1\Gamma_5/\Gamma$

VALUE (eV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
105.4±1.0±4.2	11.8K	[4] AUBERT	08BP	BABR	10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\ell^+\ell^-$

[4] Using B($\Upsilon(1S) \rightarrow e^+e^-$) = (2.38 $\pm$ 0.11)% and B($\Upsilon(1S) \rightarrow \mu^+\mu^-$) = (2.48 $\pm$ 0.05)%.

$\Gamma(\text{hadrons}) \times \Gamma(e^+e^-)/\Gamma_{total}$ $\Gamma_{10}\Gamma_5/\Gamma$

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
0.577±0.009 OUR AVERAGE				
0.581±0.004±0.009	[5] ROSNER	06	CLEO	10.0 $e^+e^- \rightarrow$ hadrons
0.552±0.031±0.017	[5] BARU	96	MD1	$e^+e^- \rightarrow$ hadrons
0.54 ±0.04 ±0.02	[5] JAKUBOWSKI	88	CBAL	$e^+e^- \rightarrow$ hadrons
0.58 ±0.03 ±0.04	[6] GILES	84B	CLEO	$e^+e^- \rightarrow$ hadrons
0.60 ±0.12 ±0.07	[6] ALBRECHT	82	DASP	$e^+e^- \rightarrow$ hadrons
0.54 ±0.07 $^{+0.09}_{-0.05}$	[6] NICZYPORUK	81C	LENA	$e^+e^- \rightarrow$ hadrons
0.41 ±0.18	[6] BOCK	80	CNTR	$e^+e^- \rightarrow$ hadrons

[5] Radiative corrections evaluated following KURAEV 85.
[6] Radiative corrections reevaluated by BUCHMUELLER 88 following KURAEV 85.

$\Upsilon(2S)$ PARTIAL WIDTHS

$\Gamma(e^+e^-)$ Γ_5

VALUE (keV)	*DOCUMENT ID*
0.612±0.011 OUR EVALUATION	

$\Upsilon(2S)$ BRANCHING RATIOS

$\Gamma(\Upsilon(1S)\pi^+\pi^-)/\Gamma_{total}$ Γ_1/Γ

Abbreviation MM in the *COMMENT* field below stands for missing mass.

VALUE (units 10^{-2})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
18.1 ±0.4 OUR AVERAGE					
18.02±0.02±0.61	851k	[7] BHARI	09	CLEO	$e^+e^- \to \pi^+\pi^-$ MM
17.22±0.17±0.75	11.8K	[8,9] AUBERT	08BP	BABR	$e^+e^- \to \gamma\pi^+\pi^-\ell^+\ell^-$
19.2 ±0.2 ±1.0	52.6k	[10] ALEXANDER	98	CLE2	$\pi^+\pi^-\ell^+\ell^-$, $\pi^+\pi^-$ MM
18.1 ±0.5 ±1.0	11.6k	ALBRECHT	87	ARG	$e^+e^- \to \pi^+\pi^-$ MM
16.9 ±4.0		GELPHMAN	85	CBAL	$e^+e^- \to e^+e^-\pi^+\pi^-$
19.1 ±1.2 ±0.6		BESSON	84	CLEO	$\pi^+\pi^-$ MM
18.9 ±2.6		FONSECA	84	CUSB	$e^+e^- \to \ell^+\ell^-\pi^+\pi^-$
21 ±7	7	NICZYPORUK	81B	LENA	$e^+e^- \to \ell^+\ell^-\pi^+\pi^-$

[7] A weighted average of the inclusive and exclusive results.

[8] Using B($\Upsilon(2S) \to e^+e^-$) = (1.91 ± 0.16)% and B($\Upsilon(2S) \to \mu^+\mu^-$) = (1.93 ± 0.17)%.

[9] Using $\Gamma_{ee}(\Upsilon(2S))$ = 0.612 ± 0.011 keV.

[10] Using B($\Upsilon(1S) \to e^+e^-$) = (2.52 ± 0.17)% and B($\Upsilon(1S) \to \mu^+\mu^-$) = (2.48 ± 0.07)%.

$\Gamma(\Upsilon(1S)\pi^0\pi^0)/\Gamma_{total}$ Γ_2/Γ

VALUE (units 10^{-2})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
8.6 ±0.4 OUR AVERAGE					
8.43±0.16±0.42	38k	[11] BHARI	09	CLEO	$e^+e^- \to \pi^0\pi^0\ell^+\ell^-$
9.2 ±0.6 ±0.8	275	[12] ALEXANDER	98	CLE2	$e^+e^- \to \pi^0\pi^0\ell^+\ell^-$
9.5 ±1.9 ±1.9	25	ALBRECHT	87	ARG	$e^+e^- \to \pi^0\pi^0\ell^+\ell^-$
8.0 ±1.5		GELPHMAN	85	CBAL	$e^+e^- \to \pi^0\pi^0\ell^+\ell^-$
10.3 ±2.3		FONSECA	84	CUSB	$e^+e^- \to \pi^0\pi^0\ell^+\ell^-$

[11] Authors assume B($\Upsilon(1S) \to e^+e^-$) + B($\Upsilon(1S) \to \mu^+\mu^-$) = 4.96%.

[12] Using B($\Upsilon(1S) \to e^+e^-$) = (2.52 ± 0.17)% and B($\Upsilon(1S) \to \mu^+\mu^-$) = (2.48 ± 0.07)%.

$\Gamma(\Upsilon(1S)\pi^0\pi^0)/\Gamma(\Upsilon(1S)\pi^+\pi^-)$ Γ_2/Γ_1

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.462±0.037	[13] BHARI	09	CLEO	$e^+e^- \to \Upsilon(2S)$

[13] Not independent of other values reported by BHARI 09.

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

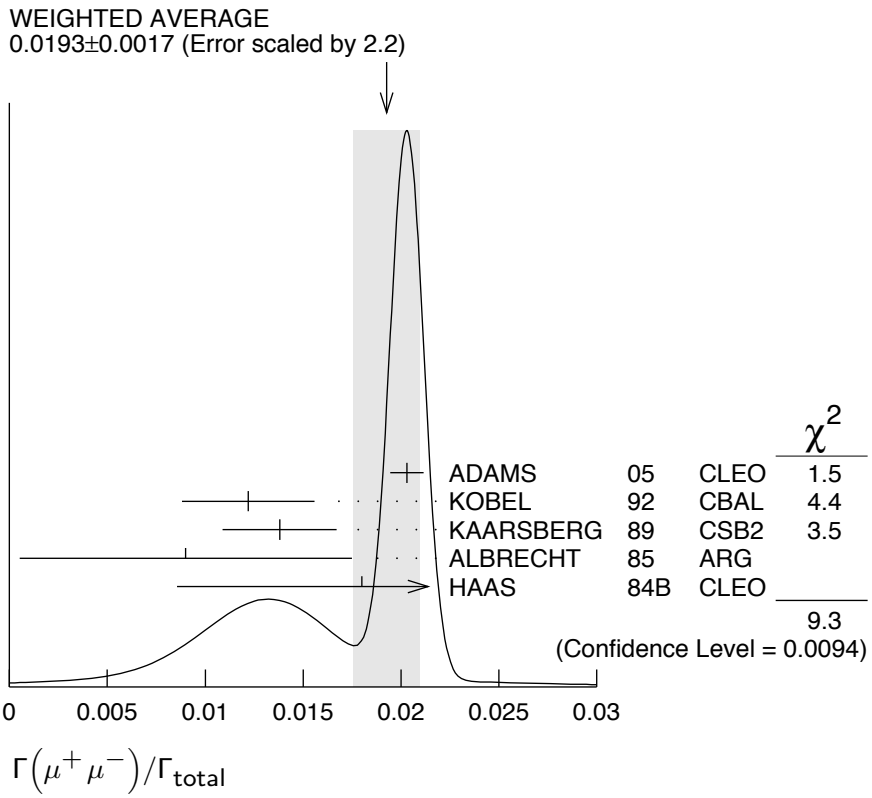
VALUE (units 10^{-2})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
2.00±0.21 OUR AVERAGE					
2.00±0.12±0.18	22k	[14] BESSON	07	CLEO	$e^+e^- \to \Upsilon(2S) \to \tau^+\tau^-$
1.7 ±1.5 ±0.6		HAAS	84B	CLEO	$e^+e^- \to \tau^+\tau^-$

[14] BESSON 07 reports [$\Gamma(\Upsilon(2S) \to \tau^+\tau^-)/\Gamma_{total}$] / [B($\Upsilon(2S) \to \mu^+\mu^-$)] = 1.04 ± 0.04 ± 0.05 which we multiply by our best value B($\Upsilon(2S) \to \mu^+\mu^-$) = (1.93 ± 0.17) × 10^{-2}. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\mu^+\mu^-)/\Gamma_{\text{total}}$ Γ_4/Γ

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
0.0193±0.0017 OUR AVERAGE Error includes scale factor of 2.2. See the ideogram below.						
0.0203±0.0003±0.0008		120k	ADAMS	05	CLEO	$e^+e^- \to \mu^+\mu^-$
0.0122±0.0028±0.0019			[15] KOBEL	92	CBAL	$e^+e^- \to \mu^+\mu^-$
0.0138±0.0025±0.0015			KAARSBERG	89	CSB2	$e^+e^- \to \mu^+\mu^-$
0.009 ±0.006 ±0.006			[16] ALBRECHT	85	ARG	$e^+e^- \to \mu^+\mu^-$
0.018 ±0.008 ±0.005			HAAS	84B	CLEO	$e^+e^- \to \mu^+\mu^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.038	90		NICZYPORUK	81C	LENA	$e^+e^- \to \mu^+\mu^-$

[15] Taking into account interference between the resonance and continuum.
[16] Re-evaluated using B($\Upsilon(1S) \to \mu^+\mu^-$) = 0.026.



$\Gamma(\tau^+\tau^-)/\Gamma(\mu^+\mu^-)$ Γ_3/Γ_4

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
1.04±0.04±0.05	22k	BESSON	07	CLEO	$e^+e^- \to \Upsilon(2S)$

$\Gamma(\Upsilon(1S)\pi^0)/\Gamma_{\text{total}}$ Γ_6/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<0.18	90	[17] HE	08A	CLEO	$e^+e^- \to \ell^+\ell^-\gamma\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<1.1	90	ALEXANDER	98	CLE2	$e^+e^- \to \ell^+\ell^-\gamma\gamma$
<8	90	LURZ	87	CBAL	$e^+e^- \to \ell^+\ell^-\gamma\gamma$

[17] Authors assume B($\Upsilon(1S) \to e^+e^-$) + B($\Upsilon(1S) \to \mu^+\mu^-$) = 4.96%.

$\Gamma(\Upsilon(1S)\eta)/\Gamma_{\text{total}}$ Γ_7/Γ

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.21^{+0.07}_{-0.06}\pm0.03}$		14	[18] HE	08A	CLEO	$e^+e^- \to \ell^+\ell^-\eta$

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

< 0.9	90	[19,20]	AUBERT	08BP	BABR	$e^+e^- \to \gamma\pi^+\pi^-\pi^0\ell^+\ell^-$
< 2.8	90		ALEXANDER	98	CLE2	$e^+e^- \to \ell^+\ell^-\eta$
< 5	90		ALBRECHT	87	ARG	$e^+e^- \to \pi^+\pi^-\ell^+\ell^-$ MM
< 7	90		LURZ	87	CBAL	$e^+e^- \to \ell^+\ell^-(\gamma\gamma,\ 3\pi^0)$
< 10	90		BESSON	84	CLEO	$e^+e^- \to \pi^+\pi^-\ell^+\ell^-$ MM
< 2	90		FONSECA	84	CUSB	$e^+e^- \to \ell^+\ell^-(\gamma\gamma,\pi^+\pi^-\pi^0)$

[18] Authors assume $B(\Upsilon(1S) \to e^+e^-) + B(\Upsilon(1S) \to \mu^+\mu^-) = 4.96\%$.

[19] Using $B(\Upsilon(1S) \to e^+e^-) = (2.38 \pm 0.11)\%$ and $B(\Upsilon(1S) \to \mu^+\mu^-) = (2.48 \pm 0.05)\%$.

[20] Using $\Gamma_{ee}(\Upsilon(2S)) = 0.612 \pm 0.011$ keV.

$\Gamma(\Upsilon(1S)\eta)/\Gamma(\Upsilon(1S)\pi^+\pi^-)$ Γ_7/Γ_1

VALUE (units 10^{-2})	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.52	90	[21] AUBERT	08BP	BABR	$e^+e^- \to \gamma\pi^+\pi^-(\pi^0)\ell^+\ell^-$

[21] Not independent of other values reported by AUBERT 08BP.

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.006	90	MASCHMANN	90	CBAL	$e^+e^- \to$ hadrons

$\Gamma(\overline{d}\text{ anything})/\Gamma_{\text{total}}$ Γ_9/Γ

VALUE (units 10^{-5})	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{3.37\pm0.50\pm0.25}$	58	ASNER	07	CLEO	$e^+e^- \to \overline{d}X$

$\Gamma(ggg)/\Gamma_{\text{total}}$ Γ_{11}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{58.8\pm1.2}$	6M	[22] BESSON	06A	CLEO	$\Upsilon(2S) \to$ hadrons

[22] Calculated using the value $\Gamma(\gamma gg)/\Gamma(ggg) = (3.18 \pm 0.04 \pm 0.22 \pm 0.41)\%$ from BESSON 06A and PDG 08 values of $B(\pi^+\pi^-\Upsilon(1S)) = (18.1\pm0.4)\%$, $B(\pi^0\pi^0\Upsilon(1S)) = (8.6\pm0.4)\%$, $B(\mu^+\mu^-) = (1.93\pm0.17)\%$, and $R_{\text{hadrons}} = 3.51$. The statistical error is negligible and the systematic error is partially correlated with that of $\Gamma(\gamma gg)/\Gamma_{\text{total}}$ measurement of BESSON 06A.

$\Gamma(\gamma gg)/\Gamma_{\text{total}}$ Γ_{12}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{8.79\pm1.05}$	100k	[23] BESSON	06A	CLEO	$\Upsilon(2S) \to \gamma +$ hadrons

[23] Calculated using BESSON 06A values of $\Gamma(\gamma gg)/\Gamma(ggg) = (3.18\pm0.04\pm0.22\pm0.41)\%$ and $\Gamma(ggg)/\Gamma_{\text{total}}$. The statistical error is negligible and the systematic error is partially correlated with that of $\Gamma(ggg)/\Gamma_{\text{total}}$ measurement of BESSON 06A.

$\Gamma(\gamma gg)/\Gamma(ggg)$ Γ_{12}/Γ_{11}

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
3.18±0.04±0.47	6M	BESSON	06A	CLEO	$\Upsilon(2S) \to (\gamma\ +)$ hadrons

$\Gamma(\gamma\chi_{b1}(1P))/\Gamma_{\text{total}}$ Γ_{13}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.069 ±0.004 OUR AVERAGE					
0.0693±0.0012±0.0041	407k	ARTUSO	05	CLEO	$e^+e^- \to \gamma X$
0.069 ±0.005 ±0.009		EDWARDS	99	CLE2	$\Upsilon(2S) \to \gamma\chi(1P)$
0.091 ±0.018 ±0.022		ALBRECHT	85E	ARG	$e^+e^- \to \gamma$conv. X
0.065 ±0.007 ±0.012		NERNST	85	CBAL	$e^+e^- \to \gamma X$
0.080 ±0.017 ±0.016		HAAS	84	CLEO	$e^+e^- \to \gamma$conv. X
0.059 ±0.014		KLOPFEN...	83	CUSB	$e^+e^- \to \gamma X$

$\Gamma(\gamma\chi_{b2}(1P))/\Gamma_{\text{total}}$ Γ_{14}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.0715±0.0035 OUR AVERAGE					
0.0724±0.0011±0.0040	410k	ARTUSO	05	CLEO	$e^+e^- \to \gamma X$
0.074 ±0.005 ±0.008		EDWARDS	99	CLE2	$\Upsilon(2S) \to \gamma\chi(1P)$
0.098 ±0.021 ±0.024		ALBRECHT	85E	ARG	$e^+e^- \to \gamma$conv. X
0.058 ±0.007 ±0.010		NERNST	85	CBAL	$e^+e^- \to \gamma X$
0.102 ±0.018 ±0.021		HAAS	84	CLEO	$e^+e^- \to \gamma$conv. X
0.061 ±0.014		KLOPFEN...	83	CUSB	$e^+e^- \to \gamma X$

$\Gamma(\gamma\chi_{b0}(1P))/\Gamma_{\text{total}}$ Γ_{15}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.038 ±0.004 OUR AVERAGE					
0.0375±0.0012±0.0047	198k	ARTUSO	05	CLEO	$e^+e^- \to \gamma X$
0.034 ±0.005 ±0.006		EDWARDS	99	CLE2	$\Upsilon(2S) \to \gamma\chi(1P)$
0.064 ±0.014 ±0.016		ALBRECHT	85E	ARG	$e^+e^- \to \gamma$conv. X
0.036 ±0.008 ±0.009		NERNST	85	CBAL	$e^+e^- \to \gamma X$
0.044 ±0.023 ±0.009		HAAS	84	CLEO	$e^+e^- \to \gamma$conv. X
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.035 ±0.014		KLOPFEN...	83	CUSB	$e^+e^- \to \gamma X$

$\Gamma(\gamma f_0(1710))/\Gamma_{\text{total}}$ Γ_{16}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<59	90	[24] ALBRECHT	89	ARG	$\Upsilon(2S) \to \gamma K^+K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
< 5.9	90	[25] ALBRECHT	89	ARG	$\Upsilon(2S) \to \gamma\pi^+\pi^-$

[24] Re-evaluated assuming B($f_0(1710) \to K^+K^-$) = 0.19.

[25] Includes unknown branching ratio of $f_0(1710) \to \pi^+\pi^-$.

$\Gamma(\gamma f_2'(1525))/\Gamma_{\text{total}}$ Γ_{17}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<53	90	[26] ALBRECHT	89	ARG	$\Upsilon(2S) \to \gamma K^+K^-$

[26] Re-evaluated assuming B($f_2'(1525) \to K\overline{K}$) = 0.71.

$\Gamma(\gamma f_2(1270))/\Gamma_{total}$ Γ_{18}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<24.1	90	[27] ALBRECHT	89	ARG	$\Upsilon(2S) \to \gamma\pi^+\pi^-$

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

$\Gamma(\gamma f_J(2220))/\Gamma_{total}$ Γ_{19}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<6.8	90	[28] ALBRECHT	89	ARG	$\Upsilon(2S) \to \gamma K^+ K^-$

[28] Includes unknown branching ratio of $f_J(2220) \to K^+ K^-$.

$\Gamma(\gamma\eta_b(1S))/\Gamma_{total}$ Γ_{20}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$3.9 \pm 1.1^{+1.1}_{-0.9}$		13 ± 5k	[29] AUBERT	09AQ	BABR	$\Upsilon(2S) \to \gamma X$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<8.4	90		[29] BONVICINI	10	CLEO	$\Upsilon(2S) \to \gamma X$
<5.1	90		[30] ARTUSO	05	CLEO	$e^+e^- \to \gamma X$

[29] Assuming $\Gamma_{\eta_b(1S)}$ = 10 MeV.

[30] Superseded by BONVICINI 10.

$\Gamma(\gamma X \to \gamma + \geq 4 \text{ prongs})/\Gamma_{total}$ Γ_{21}/Γ

(1.5 GeV < m_X < 5.0 GeV)

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<1.95	95	ROSNER	07A	CLEO	$e^+e^- \to \gamma X$

LEPTON FAMILY NUMBER (*LF*) VIOLATING MODES

$\Gamma(e^\pm\tau^\mp)/\Gamma_{total}$ Γ_{22}/Γ

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<3.2	90	LEES	10B	BABR	$e^+e^- \to e^\pm\tau^\mp$

$\Gamma(\mu^\pm\tau^\mp)/\Gamma_{total}$ Γ_{23}/Γ

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
< 3.3	90	LEES	10B	BABR	$e^+e^- \to \mu^\pm\tau^\mp$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<14.4	95	LOVE	08A	CLEO	$e^+e^- \to \mu^\pm\tau^\mp$

$\Upsilon(2S)$ REFERENCES

BONVICINI	10	PR D81 031104R	G. Bonvicini *et al.*	(CLEO Collab.)
LEES	10B	PRL 104 151802	J.P. Lees *et al.*	(BABAR Collab.)
AUBERT	09AQ	PRL 103 161801	B. Aubert *et al.*	(BABAR Collab.)
BHARI	09	PR D79 011103	S.R. Bhari *et al.*	(CLEO Collab.)
AUBERT	08BP	PR D78 112002	B. Aubert *et al.*	(BABAR Collab.)
HE	08A	PRL 101 192001	Q. He *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.)
BESSON	07	PRL 98 052002	D. Besson *et al.*	(CLEO Collab.)
ROSNER	07A	PR D76 117102	J.L. Rosner *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.)
ARTUSO	05	PRL 94 032001	M. Artuso *et al.*	(CLEO Collab.)
ARTAMONOV	00	PL B474 427	A.S. Artamonov *et al.*	
EDWARDS	99	PR D59 032003	K.W. Edwards *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)
KOBEL	92	ZPHY C53 193	M. Kobel *et al.*	(Crystal Ball 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.)
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
ALBRECHT	87	ZPHY C35 283	H. Albrecht *et al.*	(ARGUS Collab.)
COHEN	87	RMP 59 1121	E.R. Cohen, B.N. Taylor	(RISC, NBS)
LURZ	87	ZPHY C36 383	B. Lurz *et al.*	(Crystal Ball Collab.)
BARU	86B	ZPHY C32 622 (erratum)	S.E. Baru *et al.*	(NOVO)
ALBRECHT	85	ZPHY C28 45	H. Albrecht *et al.*	(ARGUS Collab.)
ALBRECHT	85E	PL 160B 331	H. Albrecht *et al.*	(ARGUS Collab.)
GELPHMAN	85	PR D32 2893	D. Gelphman *et al.*	(Crystal Ball Collab.)
KURAEV	85	SJNP 41 466	E.A. Kuraev, V.S. Fadin	(NOVO)
		Translated from YAF 41 733.		
NERNST	85	PRL 54 2195	R. Nernst *et al.*	(Crystal Ball Collab.)
ARTAMONOV	84	PL 137B 272	A.S. Artamonov *et al.*	(NOVO)
BARBER	84	PL 135B 498	D.P. Barber *et al.*	(DESY, ARGUS Collab.+)
BESSON	84	PR D30 1433	D. Besson *et al.*	(CLEO Collab.)
FONSECA	84	NP B242 31	V. Fonseca *et al.*	(CUSB Collab.)
GILES	84B	PR D29 1285	R. Giles *et al.*	(CLEO Collab.)
HAAS	84	PRL 52 799	J. Haas *et al.*	(CLEO Collab.)
HAAS	84B	PR D30 1996	J. Haas *et al.*	(CLEO Collab.)
KLOPFEN...	83	PRL 51 160	C. Klopfenstein *et al.*	(CUSB Collab.)
ALBRECHT	82	PL 116B 383	H. Albrecht *et al.*	(DESY, DORT, HEIDH+)
NICZYPORUK	81B	PL 100B 95	B. Niczyporuk *et al.*	(LENA Collab.)
NICZYPORUK	81C	PL 99B 169	B. Niczyporuk *et al.*	(LENA Collab.)
BOCK	80	ZPHY C6 125	P. Bock *et al.*	(HEIDP, MPIM, DESY, HAMB)