$\psi(2S)$

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

See the Review on "$\psi(2S)$ and χ_c branching ratios" before the $\chi_{c0}(1P)$ Listings.

$\psi(2S)$ MASS

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
3685.96±0.09 OUR AVERAGE					
3685.95±0.10	413	[1] ARTAMONOV	00	OLYA	$e^+e^- \rightarrow$ hadrons
3686.02±0.09±0.27		ARMSTRONG	93B	E760	$\overline{p}p \rightarrow e^+e^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
3684 ±2		GRIBUSHIN	96	FMPS	515 π^- Be $\rightarrow 2\mu X$
3683 ±5	77	ANTONIAZZI	94	E705	300 $\pi^\pm$, pLi $\rightarrow J/\psi\pi^+\pi^-$X
3686.00±0.10	413	[2] ZHOLENTZ	80	OLYA	e^+e^-

[1] Reanalysis of ZHOLENTZ 80 using new electron mass (COHEN 87) and radiative corrections (KURAEV 85).
[2] Superseded by ARTAMONOV 00.

$m_{\psi(2S)} - m_{J/\psi(1S)}$

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
589.07±0.13 OUR AVERAGE				
589.7 ±1.2	LEMOIGNE	82	GOLI	190 π^- Be $\rightarrow 2\mu$
589.07±0.13	[3] ZHOLENTZ	80	OLYA	e^+e^-
588.7 ±0.8	LUTH	75	MRK1	
• • • We do not use the following data for averages, fits, limits, etc. • • •				
588 ±1	[4] BAI	98E	BES	e^+e^-

[3] Redundant with data in mass above.
[4] Systematic errors not evaluated.

$\psi(2S)$ WIDTH

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
300±25 OUR FIT				
306±36±16	ARMSTRONG	93B	E760	$\overline{p}p \rightarrow e^+e^-$

$\psi(2S)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	hadrons	(98.10±0.30) %	
Γ_2	virtual$\gamma \rightarrow$ hadrons	(2.9 ±0.4) %	
Γ_3	e^+e^-	(7.3 ±0.4) $\times 10^{-3}$	
Γ_4	$\mu^+\mu^-$	(7.0 ±0.9) $\times 10^{-3}$	
Γ_5	$\tau^+\tau^-$	(2.7 ±0.7) $\times 10^{-3}$	

Decays into $J/\psi(1S)$ and anything

Γ_6	$J/\psi(1S)$ anything	(55.7 ± 2.6) %	
Γ_7	$J/\psi(1S)$ neutrals	(23.9 ± 1.2) %	
Γ_8	$J/\psi(1S)\pi^+\pi^-$	(30.5 ± 1.6) %	
Γ_9	$J/\psi(1S)\pi^0\pi^0$	(18.2 ± 1.2) %	
Γ_{10}	$J/\psi(1S)\eta$	(3.13 ± 0.21) %	
Γ_{11}	$J/\psi(1S)\pi^0$	$(9.6 \pm 2.1) \times 10^{-4}$	

Hadronic decays

Γ_{12}	$3(\pi^+\pi^-)\pi^0$	$(3.5 \pm 1.6) \times 10^{-3}$	
Γ_{13}	$2(\pi^+\pi^-)\pi^0$	$(3.0 \pm 0.8) \times 10^{-3}$	
Γ_{14}	$\omega f_2(1270)$	$< 1.7 \times 10^{-4}$	90%
Γ_{15}	$\rho a_2(1320)$	$< 2.3 \times 10^{-4}$	90%
Γ_{16}	$\pi^+\pi^- K^+ K^-$	$(1.6 \pm 0.4) \times 10^{-3}$	
Γ_{17}	$K^*(892)\overline{K}_2^*(1430)^0$	$< 1.2 \times 10^{-4}$	90%
Γ_{18}	$K_1(1270)^\pm K^\mp$	$(1.00 \pm 0.28) \times 10^{-3}$	
Γ_{19}	$\pi^+\pi^- p\overline{p}$	$(8.0 \pm 2.0) \times 10^{-4}$	
Γ_{20}	$K^+\overline{K}^*(892)^0\pi^- +$ c.c.	$(6.7 \pm 2.5) \times 10^{-4}$	
Γ_{21}	$b_1^\pm\pi^\mp$	$(5.2 \pm 1.3) \times 10^{-4}$	
Γ_{22}	$2(\pi^+\pi^-)$	$(4.5 \pm 1.0) \times 10^{-4}$	
Γ_{23}	$\rho^0\pi^+\pi^-$	$(4.2 \pm 1.5) \times 10^{-4}$	
Γ_{24}	$\overline{p}p$	$(2.07 \pm 0.31) \times 10^{-4}$	
Γ_{25}	$\Lambda\overline{\Lambda}$	$(1.81 \pm 0.34) \times 10^{-4}$	
Γ_{26}	$3(\pi^+\pi^-)$	$(1.5 \pm 1.0) \times 10^{-4}$	
Γ_{27}	$\overline{p}p\pi^0$	$(1.4 \pm 0.5) \times 10^{-4}$	
Γ_{28}	$\Delta^{++}\overline{\Delta}^{--}$	$(1.28 \pm 0.35) \times 10^{-4}$	
Γ_{29}	$\Sigma^0\overline{\Sigma}^0$	$(1.2 \pm 0.6) \times 10^{-4}$	
Γ_{30}	$\Sigma^{*+}\overline{\Sigma}^{*-}$	$(1.1 \pm 0.4) \times 10^{-4}$	
Γ_{31}	K^+K^-	$(1.0 \pm 0.7) \times 10^{-4}$	
Γ_{32}	$\pi^+\pi^-\pi^0$	$(8 \pm 5) \times 10^{-5}$	
Γ_{33}	$\rho\pi$	$< 8 \times 10^{-5}$	90%
Γ_{34}	$\pi^+\pi^-$	$(8 \pm 5) \times 10^{-5}$	
Γ_{35}	$\Xi^-\overline{\Xi}^+$	$(9.4 \pm 3.1) \times 10^{-5}$	
Γ_{36}	$K_1(1400)^\pm K^\mp$	$< 3.1 \times 10^{-4}$	90%
Γ_{37}	$\Xi^{*0}\overline{\Xi}^{*0}$	$< 8 \times 10^{-5}$	90%
Γ_{38}	$\Omega^-\overline{\Omega}^+$	$< 7 \times 10^{-5}$	90%
Γ_{39}	$K^+K^-\pi^0$	$< 3.0 \times 10^{-5}$	90%
Γ_{40}	$K^+\overline{K}^*(892)^- +$ c.c.	$< 5 \times 10^{-5}$	90%
Γ_{41}	$\phi f_2'(1525)$	$< 4 \times 10^{-5}$	90%

Radiative decays

Γ_{42}	$\gamma\chi_{c0}(1P)$	(8.7 ± 0.8) %	
Γ_{43}	$\gamma\chi_{c1}(1P)$	(8.4 ± 0.7) %	
Γ_{44}	$\gamma\chi_{c2}(1P)$	(6.8 ± 0.6) %	
Γ_{45}	$\gamma\eta_c(1S)$	$(2.8 \pm 0.6) \times 10^{-3}$	

Γ_{46}	$\gamma \eta_c(2S)$		
Γ_{47}	$\gamma \pi^0$		
Γ_{48}	$\gamma \eta'(958)$	$(1.5 \pm 0.4) \times 10^{-4}$	
Γ_{49}	$\gamma\gamma$	$< 1.4 \times 10^{-4}$	90%
Γ_{50}	$\gamma\eta$	$< 9 \times 10^{-5}$	90%
Γ_{51}	$\gamma\eta(1440) \to \gamma K \overline{K} \pi$	$< 1.2 \times 10^{-4}$	90%

$\psi(2S)$ PARTIAL WIDTHS

$\Gamma(\text{hadrons})$ — Γ_1

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
224 ± 56	LUTH	75	MRK1	$e^+ e^-$

$\Gamma(e^+ e^-)$ — Γ_3

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
2.19±0.15 OUR FIT				
2.14±0.21	ALEXANDER	89	RVUE	See Υ mini-review
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.0 ± 0.3	BRANDELIK	79C	DASP	$e^+ e^-$
2.1 ± 0.3	[5] LUTH	75	MRK1	$e^+ e^-$

[5] From a simultaneous fit to $e^+ e^-$, $\mu^+ \mu^-$, and hadronic channels assuming $\Gamma(e^+ e^-) = \Gamma(\mu^+ \mu^-)$.

$\Gamma(\gamma\gamma)$ — Γ_{49}

VALUE (eV)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
<43	90	BRANDELIK	79C	DASP	$e^+ e^-$

$\psi(2S)$ $\Gamma(i)\Gamma(e^+ e^-)/\Gamma(\text{total})$

This combination of a partial width with the partial width into $e^+ e^-$ and with the total width is obtained from the integrated cross section into channel_I in the $e^+ e^-$ annihilation. We list only data that have not been used to determine the partial width $\Gamma(\text{I})$ or the branching ratio $\Gamma(\text{I})$/total.

$\Gamma(\text{hadrons}) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$ — $\Gamma_1\Gamma_3/\Gamma$

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.2 ± 0.4	ABRAMS	75	MRK1	$e^+ e^-$

$\Gamma(e^+ e^-) \times \Gamma(J/\psi(1S)\pi^+\pi^-)/\Gamma_{\text{total}}$ — $\Gamma_3\Gamma_8/\Gamma$

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
0.67±0.06 OUR FIT				
0.68±0.09	[6] BAI	98E	BES	$e^+ e^-$

[6] The value of $\Gamma(e^+ e^-)$ quoted in BAI 98E is derived using $B(\psi(2S) \to J/\psi(1S)\pi^+\pi^-) = (32.4 \pm 2.6) \times 10^{-2}$ and $B(J/\psi(1S) \to \ell^+\ell^-) = 0.1203 \pm 0.0038$. Recalculated by us using $B(J/\psi(1S) \to \ell^+\ell^-) = 0.1181 \pm 0.0020$.

$\psi(2S)$ BRANCHING RATIOS

$\Gamma(\text{hadrons})/\Gamma_{\text{total}}$ — Γ_1/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.981 ±0.003	[7] LUTH	75	MRK1	e^+e^-

$\Gamma(\text{virtual}\gamma \rightarrow \text{hadrons})/\Gamma_{\text{total}}$ — Γ_2/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.029±0.004	[8] LUTH	75	MRK1	e^+e^-

$\Gamma(e^+e^-)/\Gamma_{\text{total}}$ — Γ_3/Γ

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
73± 4 OUR FIT				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
88±13	[9] FELDMAN	77	RVUE	e^+e^-

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

VALUE (units 10^{-4})	DOCUMENT ID
70±9 OUR FIT	

$\Gamma(\tau^+\tau^-)/\Gamma_{\text{total}}$ — Γ_5/Γ

VALUE (units 10^{-4})	DOCUMENT ID
27±7 OUR FIT	

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.97±0.14 OUR FIT				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.89±0.16	BOYARSKI	75C	MRK1	e^+e^-

[7] Includes cascade decay into $J/\psi(1S)$.
[8] Included in $\Gamma(\text{hadrons})/\Gamma_{\text{total}}$.
[9] From an overall fit assuming equal partial widths for e^+e^- and $\mu^+\mu^-$. For a measurement of the ratio see the entry $\Gamma(\mu^+\mu^-)/\Gamma(e^+e^-)$ below. Includes LUTH 75, HILGER 75, BURMESTER 77.

——— DECAYS INTO $J/\psi(1S)$ AND ANYTHING ———

$\Gamma(J/\psi(1S)\text{anything})/\Gamma_{\text{total}}$ — Γ_6/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.557±0.026 OUR FIT				
0.55 ±0.07 OUR AVERAGE				
0.51 ±0.12	BRANDELIK	79C	DASP	$e^+e^- \rightarrow \mu^+\mu^- X$
0.57 ±0.08	ABRAMS	75B	MRK1	$e^+e^- \rightarrow \mu^+\mu^- X$

$\Gamma(J/\psi(1S)\text{neutrals})/\Gamma_{\text{total}}$ — Γ_7/Γ

VALUE	DOCUMENT ID
0.239±0.012 OUR FIT	

$\Gamma(J/\psi(1S)\pi^+\pi^-)/\Gamma_{total}$ — Γ_8/Γ

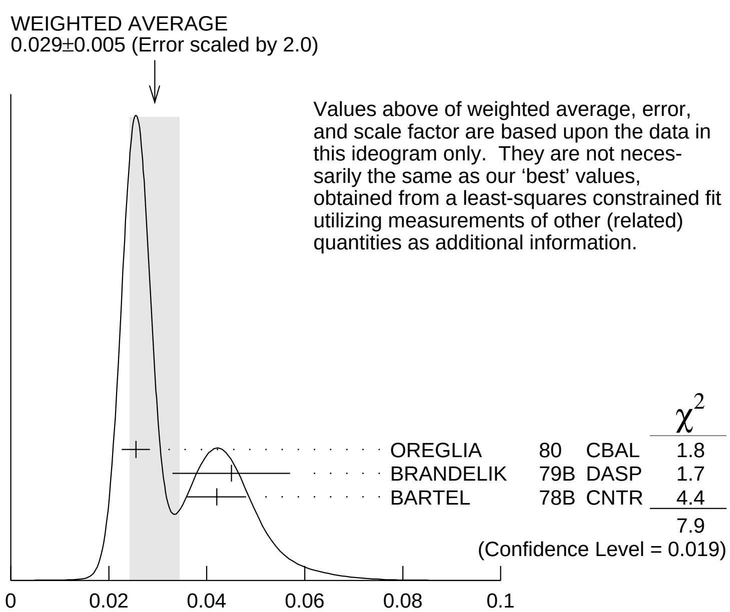
VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.305±0.016 OUR FIT				
0.32 ±0.04	ABRAMS	75B	MRK1	$e^+e^- \to J/\psi\pi^+\pi^-$

$\Gamma(J/\psi(1S)\pi^0\pi^0)/\Gamma_{total}$ — Γ_9/Γ

VALUE	*DOCUMENT ID*
0.182±0.012 OUR FIT	

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

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
0.0313±0.0021 OUR FIT					
0.029 ±0.005 OUR AVERAGE Error includes scale factor of 2.0. See the ideogram below.					
0.0255±0.0029	386	[10] OREGLIA	80	CBAL	$e^+e^- \to J/\psi 2\gamma$
0.045 ±0.012	17	[11] BRANDELIK	79B	DASP	$e^+e^- \to J/\psi 2\gamma$
0.042 ±0.006	164	[11] BARTEL	78B	CNTR	e^+e^-
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.043 ±0.008	44	TANENBAUM	76	MRK1	e^+e^-



$\Gamma(J/\psi(1S)\eta)/\Gamma_{total}$

$\Gamma(J/\psi(1S)\pi^0)/\Gamma_{total}$ — Γ_{11}/Γ

VALUE (units 10^{-4})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
9.6±2.1 OUR AVERAGE					
14 ±6	7	HIMEL	80	MRK2	e^+e^-
9 ±2 ±1	23	[10] OREGLIA	80	CBAL	$\psi(2S) \to J/\psi 2\gamma$

$\Gamma(J/\psi(1S)\text{neutrals})/\Gamma(J/\psi(1S)\pi^+\pi^-)$ — Γ_7/Γ_8

VALUE	DOCUMENT ID		TECN	COMMENT
0.784±0.035 OUR FIT				
0.73 ±0.09	TANENBAUM	76	MRK1	e^+e^-

$\Gamma(J/\psi(1S)\pi^+\pi^-)/\Gamma(J/\psi(1S)\text{anything})$ — Γ_8/Γ_6

VALUE	DOCUMENT ID		TECN	COMMENT
0.547±0.011 OUR FIT				
0.496±0.037	ARMSTRONG	97	E760	$\overline{p}p \to \psi(2S)$

$\Gamma(J/\psi(1S)\pi^0\pi^0)/\Gamma(J/\psi(1S)\text{anything})$ — Γ_9/Γ_6

VALUE	DOCUMENT ID		TECN	COMMENT
0.326±0.012 OUR FIT				
0.327±0.014 OUR AVERAGE				
0.328±0.013±0.008	AMBROGIANI	00A	E835	$p\overline{p} \to \psi(2S)$
0.323±0.033	ARMSTRONG	97	E760	$\overline{p}p \to \psi(2S)$

$\Gamma(J/\psi(1S)\pi^0\pi^0)/\Gamma(J/\psi(1S)\pi^+\pi^-)$ — Γ_9/Γ_8

VALUE	DOCUMENT ID		TECN	COMMENT
0.60±0.06 OUR FIT				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.53±0.06	TANENBAUM	76	MRK1	e^+e^-
0.64±0.15	[12] HILGER	75	SPEC	e^+e^-

$\Gamma(J/\psi(1S)\eta)/\Gamma(J/\psi(1S)\text{anything})$ — Γ_{10}/Γ_6

VALUE	DOCUMENT ID		TECN	COMMENT
0.056±0.004 OUR FIT				
0.069±0.008 OUR AVERAGE				
0.072±0.009	AMBROGIANI	00A	E835	$p\overline{p} \to \psi(2S)$
0.061±0.015	ARMSTRONG	97	E760	$\overline{p}p \to \psi(2S)$

$\Gamma(J/\psi(1S)\eta)/\Gamma(J/\psi(1S)\pi^+\pi^-)$ — Γ_{10}/Γ_8

VALUE	DOCUMENT ID		TECN	COMMENT
0.103±0.010 OUR FIT				
0.091±0.021	[13] HIMEL	80	MRK2	$e^+e^- \to \psi(2S)X$

$\Gamma(e^+e^-)/\Gamma(J/\psi(1S)\text{anything})$ — Γ_3/Γ_6

VALUE	DOCUMENT ID		TECN	COMMENT
0.01308±0.00032 OUR FIT				
0.0131 ±0.0006 OUR AVERAGE	Error includes scale factor of 1.8.			
0.0128 ±0.0003 ±0.0002	[14] AMBROGIANI	00A	E835	$p\overline{p} \to \psi(2S)$
0.0144 ±0.0008 ±0.0002	[14] ARMSTRONG	97	E760	$\overline{p}p \to \psi(2S)$

$\Gamma(e^+e^-)/\Gamma(J/\psi(1S)\pi^+\pi^-)$ — Γ_3/Γ_8

VALUE	DOCUMENT ID		TECN	COMMENT
0.0239±0.0024 OUR FIT				
0.0252±0.0028±0.0011	[14] AUBERT	02B	BABR	e^+e^-

$\Gamma(\mu^+\mu^-)/\Gamma(J/\psi(1S)\text{anything})$ — Γ_4/Γ_6

VALUE	DOCUMENT ID		TECN	COMMENT
0.0126±0.0014 OUR FIT				
0.014 ±0.003	HILGER	75	SPEC	e^+e^-

$\Gamma(\mu^+\mu^-)/\Gamma(J/\psi(1S)\pi^+\pi^-)$ — Γ_4/Γ_8

VALUE	DOCUMENT ID		TECN	COMMENT
0.0231±0.0035 OUR FIT				
0.0224±0.0029 OUR AVERAGE				
0.0216±0.0026±0.0014	[15] AUBERT	02B	BABR	e^+e^-
0.0327±0.0077±0.0072	[15] GRIBUSHIN	96	FMPS	515 π^- Be → $2\mu X$

$\Gamma(\tau^+\tau^-)/\Gamma(J/\psi(1S)\pi^+\pi^-)$ — Γ_5/Γ_8

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
8.7 ±2.3 OUR FIT				
8.73±1.39±1.57	BAI	02	BES	e^+e^-

[10] Recalculated by us using B($J/\psi(1S) \to \ell^+\ell^-$) = 0.1181 ± 0.0020.
[11] Recalculated by us using B($J/\psi(1S) \to \mu^+\mu^-$) = 0.0588 ± 0.0010.
[12] Ignoring the $J/\psi(1S)\eta$ and $J/\psi(1S)\gamma\gamma$ decays.
[13] The value for B($\psi(2S) \to J/\psi(1s)\eta$) reported in HIMEL 80 is derived using B(ψ(2S)) → $J/\psi(1S)\pi^+\pi^-$) = (33 ± 3))% and B($J/\psi(1S) \to \ell^+\ell^-$) = 0.138 ± 0.018. Calculated by us using B($J/\psi(1S) \to \ell^+\ell^-$) = (0.1181 ± 0.0020).
[14] Using B($J/\psi(1S) \to e^+e^-$) = 0.0593 ± 0.0010.
[15] Using B($J/\psi(1S) \to \mu^+\mu^-$) = 0.0588 ± 0.0010.

HADRONIC DECAYS

$\Gamma(3(\pi^+\pi^-)\pi^0)/\Gamma_{total}$ — Γ_{12}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
35±16	6	FRANKLIN	83	MRK2	$e^+e^- \to$ hadrons

$\Gamma(2(\pi^+\pi^-)\pi^0)/\Gamma_{total}$ — Γ_{13}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
30±8	42	FRANKLIN	83	MRK2	e^+e^-

$\Gamma(\pi^+\pi^-K^+K^-)/\Gamma_{total}$ — Γ_{16}/Γ

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
16±4	[16] TANENBAUM	78	MRK1	e^+e^-

$\Gamma(K_1(1270)^\pm K^\mp)/\Gamma_{total}$ — Γ_{18}/Γ

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
10.0±1.8±2.1	[17] BAI	99C	BES	e^+e^-

$\Gamma(\pi^+\pi^-p\overline{p})/\Gamma_{total}$ — Γ_{19}/Γ

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
8 ±2	[16] TANENBAUM	78	MRK1	e^+e^-

$\Gamma(K^+\overline{K}^*(892)^0\pi^- + \text{c.c.})/\Gamma_{total}$ — Γ_{20}/Γ

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
6.7±2.5	TANENBAUM	78	MRK1	e^+e^-

$\Gamma(b_1^{\pm}\pi^{\mp})/\Gamma_{total}$ Γ_{21}/Γ

VALUE (units 10^{-4})		DOCUMENT ID		TECN	COMMENT
5.2±0.8±1.0	[18]	BAI	99C	BES	e^+e^-

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

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
4.5±1.0	TANENBAUM	78	MRK1	e^+e^-

$\Gamma(\omega f_2(1270))/\Gamma_{total}$ Γ_{14}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<1.7	90	BAI	98J	BES	e^+e^-

$\Gamma(\rho^0\pi^+\pi^-)/\Gamma_{total}$ Γ_{23}/Γ

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
4.2±1.5	TANENBAUM	78	MRK1	e^+e^-

$\Gamma(\rho a_2(1320))/\Gamma_{total}$ Γ_{15}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<2.3	90	BAI	98J	BES	e^+e^-

$\Gamma(\overline{p}p)/\Gamma_{total}$ Γ_{24}/Γ

VALUE (units 10^{-4})	EVTS		DOCUMENT ID		TECN	COMMENT
2.07±0.31 OUR AVERAGE						
2.16±0.15±0.36	201	[19]	BAI	01	BES	$e^+e^- \to \psi(2S)$
1.4 ±0.8	4		BRANDELIK	79C	DASP	e^+e^-
2.3 ±0.7			FELDMAN	77	MRK1	e^+e^-

$\Gamma(\Lambda\overline{\Lambda})/\Gamma_{total}$ Γ_{25}/Γ

VALUE (units 10^{-4})	CL%	EVTS		DOCUMENT ID		TECN	COMMENT
1.81±0.20±0.27		80	[19]	BAI	01	BES	$e^+e^- \to \psi(2S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •							
<4	90			FELDMAN	77	MRK1	e^+e^-

$\Gamma(3(\pi^+\pi^-))/\Gamma_{total}$ Γ_{26}/Γ

VALUE (units 10^{-4})		DOCUMENT ID		TECN	COMMENT
1.5±1.0	[16]	TANENBAUM	78	MRK1	e^+e^-

$\Gamma(\overline{p}p\pi^0)/\Gamma_{total}$ Γ_{27}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
1.4±0.5	9	FRANKLIN	83	MRK2	e^+e^-

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

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
1.0±0.7		BRANDELIK	79C	DASP	e^+e^-
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.5	90	FELDMAN	77	MRK1	e^+e^-

$\Gamma(\pi^+\pi^-)/\Gamma_{total}$ — Γ_{34}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
0.8±0.5		BRANDELIK	79C	DASP	e^+e^-
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.5	90	FELDMAN	77	MRK1	e^+e^-

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{total}$ — Γ_{32}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
0.85±0.46	4	FRANKLIN	83	MRK2	$e^+e^- \rightarrow$ hadrons

$\Gamma(\Delta^{++}\overline{\Delta}^{--})/\Gamma_{total}$ — Γ_{28}/Γ

VALUE (units 10^{-5})	EVTS	DOCUMENT ID		TECN	COMMENT
12.8±1.0±3.4	157	[19] BAI	01	BES	$e^+e^- \rightarrow \psi(2S)$

$\Gamma(\Sigma^0\overline{\Sigma}^0)/\Gamma_{total}$ — Γ_{29}/Γ

VALUE (units 10^{-5})	EVTS	DOCUMENT ID		TECN	COMMENT
12±4±4	8	[19] BAI	01	BES	$e^+e^- \rightarrow \psi(2S)$

$\Gamma(\Sigma^{*+}\overline{\Sigma}^{*-})/\Gamma_{total}$ — Γ_{30}/Γ

VALUE (units 10^{-5})	EVTS	DOCUMENT ID		TECN	COMMENT
11±3±3	14	[19] BAI	01	BES	$e^+e^- \rightarrow \psi(2S)$

$\Gamma(K_1(1400)^\pm K^\mp)/\Gamma_{total}$ — Γ_{36}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<3.1	90	[20] BAI	99C	BES	e^+e^-

$\Gamma(\Xi^-\overline{\Xi}^+)/\Gamma_{total}$ — Γ_{35}/Γ

VALUE (units 10^{-5})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
9.4±2.7±1.5		12	[19] BAI	01	BES	$e^+e^- \rightarrow \psi(2S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<20	90		FELDMAN	77	MRK1	e^+e^-

$\Gamma(\Xi^{*0}\overline{\Xi}^{*0})/\Gamma_{total}$ — Γ_{37}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<8.1	90	[19] BAI	01	BES	$e^+e^- \rightarrow \psi(2S)$

$\Gamma(\Omega^-\overline{\Omega}^+)/\Gamma_{total}$ — Γ_{38}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<7.3	90	[19] BAI	01	BES	$e^+e^- \rightarrow \psi(2S)$

$\Gamma(\rho\pi)/\Gamma_{total}$ — Γ_{33}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
< 0.83	90	1	FRANKLIN	83	MRK2	e^+e^-
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<10	90		BARTEL	76	CNTR	e^+e^-
<10	90		[21] ABRAMS	75	MRK1	e^+e^-

$\Gamma(K^+ K^- \pi^0)/\Gamma_{total}$ — Γ_{39}/Γ

VALUE (units 10^{-5})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<2.96	90	1	FRANKLIN	83	MRK2	$e^+ e^- \to$ hadrons

$\Gamma(K^+ \overline{K}^*(892)^- + \text{c.c.})/\Gamma_{total}$ — Γ_{40}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<5.4	90	FRANKLIN	83	MRK2	$e^+ e^- \to$ hadrons

$\Gamma(K^*(892)\overline{K}^*_2(1430)^0)/\Gamma_{total}$ — Γ_{17}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<1.2	90	BAI	98J	BES	$e^+ e^-$

$\Gamma(\phi f'_2(1525))/\Gamma_{total}$ — Γ_{41}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<0.45	90	BAI	98J	BES	$e^+ e^- \to 2(K^+ K^-)$

[16] Assuming entirely strong decay.
[17] Assuming B($K_1(1270) \to K\rho$)=0.42 ± 0.06
[18] Assuming B($b_1 \to \omega\pi$)=1.
[19] Estimated using B($\psi(2S) \to J/\psi \pi^+ \pi^-$)= 0.310 ± 0.028.
[20] Assuming B($K_1(1400) \to K^* \pi$)=0.94 ± 0.06
[21] Final state $\rho^0 \pi^0$.

RADIATIVE DECAYS

$\Gamma(\gamma \chi_{c0}(1P))/\Gamma_{total}$ — Γ_{42}/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
8.7±0.8 OUR FIT				
9.3±0.8 OUR AVERAGE				
9.9±0.5±0.8	[22] GAISER	86	CBAL	$e^+ e^- \to \gamma X$
7.2±2.3	[22] BIDDICK	77	CNTR	$e^+ e^- \to \gamma X$
7.5±2.6	[22] WHITAKER	76	MRK1	$e^+ e^-$

$\Gamma(\gamma \chi_{c1}(1P))/\Gamma_{total}$ — Γ_{43}/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
8.4±0.7 OUR FIT				
8.7±0.8 OUR AVERAGE				
9.0±0.5±0.7	[23] GAISER	86	CBAL	$e^+ e^- \to \gamma X$
7.1±1.9	[24] BIDDICK	77	CNTR	$e^+ e^- \to \gamma X$

$\Gamma(\gamma \chi_{c2}(1P))/\Gamma_{total}$ — Γ_{44}/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
6.8±0.6 OUR FIT				
7.8±0.8 OUR AVERAGE				
8.0±0.5±0.7	[25] GAISER	86	CBAL	$e^+ e^- \to \gamma X$
7.0±2.0	[24] BIDDICK	77	CNTR	$e^+ e^- \to \gamma X$

$\Gamma(\gamma\eta_c(1S))/\Gamma_{total}$ — Γ_{45}/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
0.28±0.06	GAISER	86	CBAL	$e^+e^- \to \gamma X$

$\Gamma(\gamma\eta_c(2S))/\Gamma_{total}$ — Γ_{46}/Γ

VALUE (units 10^{-2})	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.2 to 1.3	95	EDWARDS	82C	CBAL	$e^+e^- \to \gamma X$

$\Gamma(\gamma\pi^0)/\Gamma_{total}$ — Γ_{47}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<$ 54	95	[26] LIBERMAN	75	SPEC	e^+e^-
$<$100	90	WIIK	75	DASP	e^+e^-

$\Gamma(\gamma\eta'(958))/\Gamma_{total}$ — Γ_{48}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
1.54±0.31±0.20		~ 43	BAI	98F	BES	$\psi(2S) \to \pi^+\pi^-2\gamma, \pi^+\pi^-3\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$<$60	90		[27] BRAUNSCH...	77	DASP	e^+e^-
$<$11	90		[28] BARTEL	76	CNTR	e^+e^-

$\Gamma(\gamma\eta)/\Gamma_{total}$ — Γ_{50}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
$<$0.9	90	BAI	98F	BES	$\psi(2S) \to \pi^+\pi^-3\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<$2	90	YAMADA	77	DASP	$e^+e^- \to 3\gamma$

$\Gamma(\gamma\eta(1440) \to \gamma K\overline{K}\pi)/\Gamma_{total}$ — Γ_{51}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
$<$0.12	90	[29] SCHARRE	80	MRK1	e^+e^-

[22] Angular distribution $(1+\cos^2\theta)$ assumed.
[23] Angular distribution $(1-0.189\cos^2\theta)$ assumed.
[24] Valid for isotropic distribution of the photon.
[25] Angular distribution $(1-0.052\cos^2\theta)$ assumed.
[26] Restated by us using $B(\psi(2S) \to \mu^+\mu^-) = 0.0077$.
[27] Restated by us using total decay width 228 keV.
[28] The value is normalized to the branching ratio for $\Gamma(J/\psi(1S)\eta)/\Gamma_{total}$.
[29] Includes unknown branching fraction $\eta(1440) \to K\overline{K}\pi$.

$\psi(2S)$ CROSS-PARTICLE BRANCHING RATIOS

For measurements involving $B(\psi(2S) \to \gamma\chi_{cJ}(1P))\times B(\chi_{cJ}(1P) \to X)$ see the corresponding entries in the $\chi_{cJ}(1P)$ sections.

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