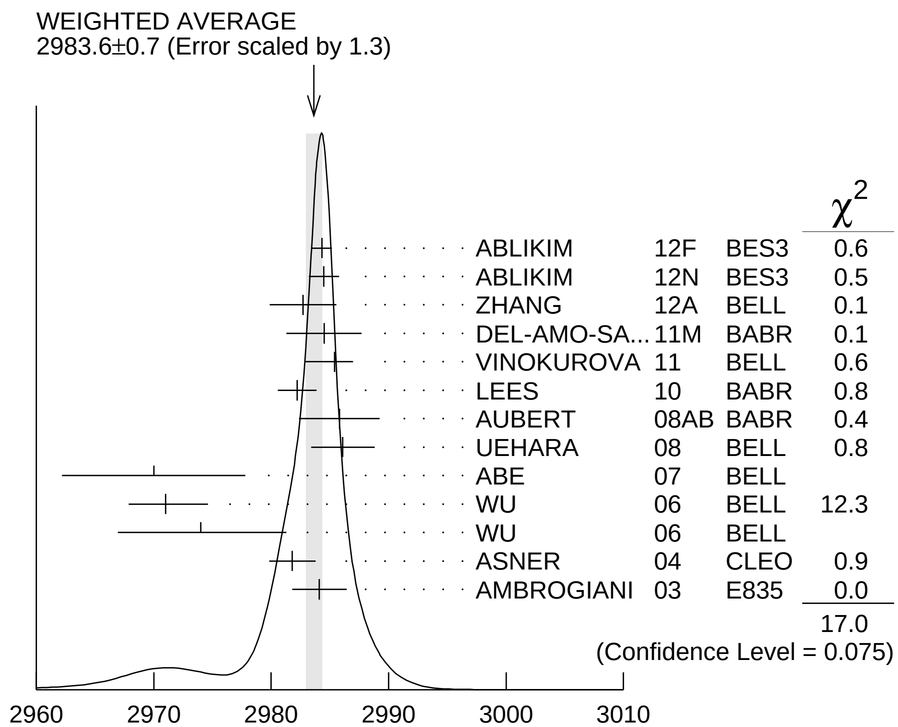
$\eta_c(1S)$

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

$\eta_c(1S)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
2983.6 ± 0.7 OUR AVERAGE		Error includes scale factor of 1.3. See the ideogram below.		
2984.3 ± 0.6 ± 0.6		[1,2] ABLIKIM 12F	BES3	$\psi(2S) \to \gamma\eta_c$
2984.49 ± 1.16 ± 0.52	832	[3] ABLIKIM 12N	BES3	$\psi(2S) \to \pi^0\gamma$ hadrons
2982.7 ± 1.8 ± 2.2	486	ZHANG 12A	BELL	$e^+e^- \to e^+e^-\eta'\pi^+\pi^-$
2984.5 ± 0.8 ± 3.1	11k	DEL-AMO-SA..11M	BABR	$\gamma\gamma \to K^+K^-\pi^+\pi^-\pi^0$
2985.4 ± 1.5 $^{+0.5}_{-2.0}$	920	[2] VINOKUROVA 11	BELL	$B^\pm \to K^\pm(K^0_S K^\pm\pi^\mp)$
2982.2 ± 0.4 ± 1.6	14k	[4] LEES 10	BABR	10.6 $e^+e^- \to e^+e^-K^0_S K^\pm\pi^\mp$
2985.8 ± 1.5 ± 3.1	0.9k	AUBERT 08AB	BABR	$B \to \eta_c(1S)K^{(*)} \to K\overline{K}\pi K^{(*)}$
2986.1 ± 1.0 ± 2.5	7.5k	UEHARA 08	BELL	$\gamma\gamma \to \eta_c \to$ hadrons
2970 ± 5 ± 6	501	[5] ABE 07	BELL	$e^+e^- \to J/\psi(c\overline{c})$
2971 ± 3 $^{+2}_{-1}$	195	WU 06	BELL	$B^+ \to p\overline{p}K^+$
2974 ± 7 $^{+2}_{-1}$	20	WU 06	BELL	$B^+ \to \Lambda\overline{\Lambda}K^+$
2981.8 ± 1.3 ± 1.5	592	ASNER 04	CLEO	$\gamma\gamma \to \eta_c \to K^0_S K^\pm\pi^\mp$
2984.1 ± 2.1 ± 1.0	190	[6] AMBROGIANI 03	E835	$\overline{p}p \to \eta_c \to \gamma\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2982.5 ± 0.4 ± 1.4	12k	[7] DEL-AMO-SA..11M	BABR	$\gamma\gamma \to K^0_S K^\pm\pi^\mp$
2982.2 ± 0.6		[8] MITCHELL 09	CLEO	$e^+e^- \to \gamma X$
2982 ± 5	270	[9] AUBERT 06E	BABR	$B^\pm \to K^\pm X_{c\overline{c}}$
2982.5 ± 1.1 ± 0.9	2.5k	[10] AUBERT 04D	BABR	$\gamma\gamma \to \eta_c(1S) \to K\overline{K}\pi$
2977.5 ± 1.0 ± 1.2		[8,11] BAI 03	BES	$J/\psi \to \gamma\eta_c$
2979.6 ± 2.3 ± 1.6	180	[12] FANG 03	BELL	$B \to \eta_c K$
2976.3 ± 2.3 ± 1.2		[8,13] BAI 00F	BES	$J/\psi,\ \psi(2S) \to \gamma\eta_c$
2976.6 ± 2.9 ± 1.3	140	[8,14] BAI 00F	BES	$J/\psi \to \gamma\eta_c$
2980.4 ± 2.3 ± 0.6		[15] BRANDENB... 00B	CLE2	$\gamma\gamma \to \eta_c \to K^\pm K^0_S\pi^\mp$
2975.8 ± 3.9 ± 1.2		[14] BAI 99B	BES	Sup. by BAI 00F
2999 ± 8	25	ABREU 98O	DLPH	$e^+e^- \to e^+e^-$ +hadrons
2988.3 $^{+3.3}_{-3.1}$		ARMSTRONG 95F	E760	$\overline{p}p \to \gamma\gamma$
2974.4 ± 1.9		[8,16] BISELLO 91	DM2	$J/\psi \to \eta_c\gamma$
2969 ± 4 ± 4	80	[8] BAI 90B	MRK3	$J/\psi \to \gamma K^+K^-K^+K^-$

2956	± 12 ± 12		[8] BAI	90B	MRK3	$J/\psi \to \gamma K^+ K^- K^0_S K^0_L$
2982.6	$^{+2.7}_{-2.3}$	12	BAGLIN	87B	SPEC	$\overline{p}p \to \gamma\gamma$
2980.2	$\pm$ 1.6		[8,16] BALTRUSAIT...	86	MRK3	$J/\psi \to \eta_c \gamma$
2984	$\pm$ 2.3 $\pm$ 4.0		[8] GAISER	86	CBAL	$J/\psi \to \gamma X$, $\psi(2S) \to \gamma X$
2976	$\pm$ 8		[8,17] BALTRUSAIT...	84	MRK3	$J/\psi \to 2\phi\gamma$
2982	$\pm$ 8	18	[18] HIMEL	80B	MRK2	$e^+ e^-$
2980	$\pm$ 9		[18] PARTRIDGE	80B	CBAL	$e^+ e^-$



$\eta_c(1S)$ mass (MeV)

[1] From a simultaneous fit to six decay modes of the η_c.

[2] Accounts for interference with non-resonant continuum.

[3] With floating width.

[4] Taking into account interference with the non-resonant $J^P = 0^-$ amplitude.

[5] From a fit of the J/ψ recoil mass spectrum. Supersedes ABE,K 02 and ABE 04G.

[6] Using mass of $\psi(2S) = 3686.00$ MeV.

[7] Not independent from the measurements reported by LEES 10.

[8] MITCHELL 09 observes a significant asymmetry in the lineshapes of $\psi(2S) \to \gamma\eta_c$ and $J/\psi \to \gamma\eta_c$ transitions. If ignored, this asymmetry could lead to significant bias whenever the mass and width are measured in $\psi(2S)$ or J/ψ radiative decays.

[9] From the fit of the kaon momentum spectrum. Systematic errors not evaluated.

[10] Superseded by LEES 10.

[11] From a simultaneous fit of five decay modes of the η_c.

[12] Superseded by VINOKUROVA 11.

[13] Weighted average of the $\psi(2S)$ and $J/\psi(1S)$ samples. Using an η_c width of 13.2 MeV.

[14] Average of several decay modes. Using an η_c width of 13.2 MeV.

[15] Superseded by ASNER 04.
[16] Average of several decay modes.
[17] $\eta_c \rightarrow \phi\phi$.
[18] Mass adjusted by us to correspond to $J/\psi(1S)$ mass = 3097 MeV.

$\eta_c(1S)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
32.2± 0.9 OUR FIT					
32.3± 1.0 OUR AVERAGE		Error includes scale factor of 1.2.			
$32.0 \pm 1.2 \pm 1.0$		[1,2] ABLIKIM	12F	BES3	$\psi(2S) \rightarrow \gamma\eta_c$
$36.4 \pm 3.2 \pm 1.7$	832	[3] ABLIKIM	12N	BES3	$\psi(2S) \rightarrow \pi^0\gamma$ hadrons
$37.8^{+5.8}_{-5.3} \pm 3.1$	486	ZHANG	12A	BELL	$e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$
$36.2 \pm 2.8 \pm 3.0$	11k	DEL-AMO-SA...	11M	BABR	$\gamma\gamma \rightarrow K^+K^-\pi^+\pi^-\pi^0$
$35.1 \pm 3.1^{+1.0}_{-1.6}$	920	[2] VINOKUROVA	11	BELL	$B^\pm \rightarrow K^\pm(K^0_S K^\pm \pi^\mp)$
$31.7 \pm 1.2 \pm 0.8$	14k	[4] LEES	10	BABR	10.6 $e^+e^- \rightarrow e^+e^-K^0_S K^\pm\pi^\mp$
$36.3^{+3.7}_{-3.6} \pm 4.4$	0.9k	AUBERT	08AB	BABR	$B \rightarrow \eta_c(1S)K^{(*)} \rightarrow K\overline{K}\pi K^{(*)}$
$28.1 \pm 3.2 \pm 2.2$	7.5k	UEHARA	08	BELL	$\gamma\gamma \rightarrow \eta_c \rightarrow$ hadrons
$48\ ^{+8}_{-7} \pm 5$	195	WU	06	BELL	$B^+ \rightarrow p\overline{p}K^+$
$40 \pm 19 \pm 5$	20	WU	06	BELL	$B^+ \rightarrow \Lambda\overline{\Lambda}K^+$
$24.8 \pm 3.4 \pm 3.5$	592	ASNER	04	CLEO	$\gamma\gamma \rightarrow \eta_c \rightarrow K^0_S K^\pm\pi^\mp$
$20.4^{+7.7}_{-6.7} \pm 2.0$	190	AMBROGIANI	03	E835	$\overline{p}p \rightarrow \eta_c \rightarrow \gamma\gamma$
$23.9^{+12.6}_{-7.1}$		ARMSTRONG	95F	E760	$\overline{p}p \rightarrow \gamma\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$32.1 \pm 1.1 \pm 1.3$	12k	[5] DEL-AMO-SA...	11M	BABR	$\gamma\gamma \rightarrow K^0_S K^\pm\pi^\mp$
$34.3 \pm 2.3 \pm 0.9$	2.5k	[6] AUBERT	04D	BABR	$\gamma\gamma \rightarrow \eta_c(1S) \rightarrow K\overline{K}\pi$
$17.0 \pm 3.7 \pm 7.4$		[7] BAI	03	BES	$J/\psi \rightarrow \gamma\eta_c$
$29 \pm 8 \pm 6$	180	[8] FANG	03	BELL	$B \rightarrow \eta_c K$
$11.0 \pm 8.1 \pm 4.1$		[9] BAI	00F	BES	$J/\psi \rightarrow \gamma\eta_c$ and $\psi(2S) \rightarrow \gamma\eta_c$
$27.0 \pm 5.8 \pm 1.4$		[10] BRANDENB...	00B	CLE2	$\gamma\gamma \rightarrow \eta_c \rightarrow K^\pm K^0_S\pi^\mp$
$7.0^{+7.5}_{-7.0}$	12	BAGLIN	87B	SPEC	$\overline{p}p \rightarrow \gamma\gamma$
$10.1^{+33.0}_{-8.2}$	23	[11] BALTRUSAIT...	86	MRK3	$J/\psi \rightarrow \gamma p\overline{p}$
11.5 ± 4.5		GAISER	86	CBAL	$J/\psi \rightarrow \gamma X$, $\psi(2S) \rightarrow \gamma X$
<40 90% CL	18	HIMEL	80B	MRK2	e^+e^-
<20 90% CL		PARTRIDGE	80B	CBAL	e^+e^-

[1] From a simultaneous fit to six decay modes of the η_c.
[2] Accounts for interference with non-resonant continuum.
[3] With floating mass.
[4] Taking into account interference with the non-resonant $J^P = 0^-$ amplitude.
[5] Not independent from the measurements reported by LEES 10.
[6] Superseded by LEES 10.

[7] From a simultaneous fit of five decay modes of the η_c.
[8] Superseded by VINOKUROVA 11.
[9] From a fit to the 4-prong invariant mass in $\psi(2S) \to \gamma\eta_c$ and $J/\psi(1S) \to \gamma\eta_c$ decays.
[10] Superseded by ASNER 04.
[11] Positive and negative errors correspond to 90% confidence level.

$\eta_c(1S)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
	Decays involving hadronic resonances		
Γ_1	$\eta'(958)\pi\pi$	(4.1 ±1.7) %	
Γ_2	$\rho\rho$	(1.8 ±0.5) %	
Γ_3	$K^*(892)^0 K^-\pi^+$ + c.c.	(2.0 ±0.7) %	
Γ_4	$K^*(892)\overline{K}^*(892)$	(7.0 ±1.3) $\times 10^{-3}$	
Γ_5	$K^{*0}\overline{K}^{*0}\pi^+\pi^-$	(1.1 ±0.5) %	
Γ_6	ϕK^+K^-	(2.9 ±1.4) $\times 10^{-3}$	
Γ_7	$\phi\phi$	(1.76±0.20) $\times 10^{-3}$	
Γ_8	$\phi 2(\pi^+\pi^-)$	$<$ 4 $\times 10^{-3}$	90%
Γ_9	$a_0(980)\pi$	$<$ 2 %	90%
Γ_{10}	$a_2(1320)\pi$	$<$ 2 %	90%
Γ_{11}	$K^*(892)\overline{K}$ + c.c.	$<$ 1.28 %	90%
Γ_{12}	$f_2(1270)\eta$	$<$ 1.1 %	90%
Γ_{13}	$\omega\omega$	$<$ 3.1 $\times 10^{-3}$	90%
Γ_{14}	$\omega\phi$	$<$ 1.7 $\times 10^{-3}$	90%
Γ_{15}	$f_2(1270) f_2(1270)$	(9.8 ±2.5) $\times 10^{-3}$	
Γ_{16}	$f_2(1270) f'_2(1525)$	(9.7 ±3.2) $\times 10^{-3}$	
	Decays into stable hadrons		
Γ_{17}	$K\overline{K}\pi$	(7.3 ±0.5) %	
Γ_{18}	$\eta\pi^+\pi^-$	(1.7 ±0.5) %	
Γ_{19}	$\eta 2(\pi^+\pi^-)$	(4.4 ±1.3) %	
Γ_{20}	$K^+K^-\pi^+\pi^-$	(6.9 ±1.1) $\times 10^{-3}$	
Γ_{21}	$K^+K^-\pi^+\pi^-\pi^0$	(3.5 ±0.6) %	
Γ_{22}	$K^0K^-\pi^+\pi^-\pi^+$+c.c.	(5.6 ±1.5) %	
Γ_{23}	$K^+K^- 2(\pi^+\pi^-)$	(7.5 ±2.4) $\times 10^{-3}$	
Γ_{24}	$2(K^+K^-)$	(1.47±0.31) $\times 10^{-3}$	
Γ_{25}	$\pi^+\pi^-\pi^0\pi^0$	(4.7 ±1.0) %	
Γ_{26}	$2(\pi^+\pi^-)$	(9.7 ±1.2) $\times 10^{-3}$	
Γ_{27}	$2(\pi^+\pi^-\pi^0)$	(17.4 ±3.3) %	
Γ_{28}	$3(\pi^+\pi^-)$	(1.8 ±0.4) %	
Γ_{29}	$p\overline{p}$	(1.52±0.16) $\times 10^{-3}$	
Γ_{30}	$p\overline{p}\pi^0$	(3.6 ±1.3) $\times 10^{-3}$	
Γ_{31}	$\Lambda\overline{\Lambda}$	(1.09±0.24) $\times 10^{-3}$	

Γ_{32}	$\Sigma^+\overline{\Sigma}^-$		$(2.1 \pm 0.6) \times 10^{-3}$		
Γ_{33}	$\Xi^-\overline{\Xi}^+$		$(8.9 \pm 2.7) \times 10^{-4}$		
Γ_{34}	$K\overline{K}\eta$		$(10 \pm 5) \times 10^{-3}$		
Γ_{35}	$\pi^+\pi^- p\overline{p}$		$(5.3 \pm 1.8) \times 10^{-3}$		

Radiative decays

Γ_{36}	$\gamma\gamma$		$(1.57 \pm 0.12) \times 10^{-4}$		

Charge conjugation (*C*), Parity (*P*), Lepton family number (*LF*) violating modes

Γ_{37}	$\pi^+\pi^-$	P,CP	< 1.1	$\times 10^{-4}$	90%
Γ_{38}	$\pi^0\pi^0$	P,CP	< 3.5	$\times 10^{-5}$	90%
Γ_{39}	K^+K^-	P,CP	< 6	$\times 10^{-4}$	90%
Γ_{40}	$K^0_S K^0_S$	P,CP	< 3.1	$\times 10^{-4}$	90%

CONSTRAINED FIT INFORMATION

An overall fit to the total width, 8 combinations of partial widths obtained from integrated cross section, and 17 branching ratios uses 80 measurements and one constraint to determine 12 parameters. The overall fit has a $\chi^2 = 113.0$ for 69 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\left\langle \delta p_i \delta p_j \right\rangle / (\delta p_i \cdot \delta p_j)$, in percent, from the fit to parameters p_i, including the branching fractions, $x_i \equiv \Gamma_i/\Gamma_{\text{total}}$. The fit constrains the x_i whose labels appear in this array to sum to one.

x_7	18									
x_{15}	3	6								
x_{17}	22	42	7							
x_{20}	11	21	4	25						
x_{24}	9	16	3	25	10					
x_{26}	14	25	5	31	16	12				
x_{29}	14	26	5	36	16	13	20			
x_{31}	3	6	1	9	4	3	5	25		
x_{36}	−29	−54	−10	−66	−34	−27	−41	−45	−11	
Γ	−2	−3	−1	−4	−2	−2	−2	7	2	−29
	x_4	x_7	x_{15}	x_{17}	x_{20}	x_{24}	x_{26}	x_{29}	x_{31}	x_{36}

	Mode	Rate (MeV)
Γ_4	$K^*(892)\overline{K}^*(892)$	0.23 ± 0.04
Γ_7	$\phi\phi$	0.057 ± 0.007

Γ_{15}	$f_2(1270) f_2(1270)$	0.32 $\pm$0.08
Γ_{17}	$K \overline{K} \pi$	2.36 $\pm$0.17
Γ_{20}	$K^+ K^- \pi^+ \pi^-$	0.223 $\pm$0.035
Γ_{24}	$2(K^+ K^-)$	0.047 $\pm$0.010
Γ_{26}	$2(\pi^+ \pi^-)$	0.31 $\pm$0.04
Γ_{29}	$p \overline{p}$	0.049 $\pm$0.005
Γ_{31}	$\Lambda \overline{\Lambda}$	0.035 $\pm$0.008
Γ_{36}	$\gamma \gamma$	0.0050$\pm$0.0004

$\eta_c(1S)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$ Γ_{36}

VALUE (keV)	EVTS	DOCUMENT ID	TECN	COMMENT
5.0$\pm$ 0.4 OUR FIT				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
5.8$\pm$ 1.1	486	[1] ZHANG	12A BELL	$e^+ e^- \to e^+ e^- \eta' \pi^+ \pi^-$
5.2$\pm$ 1.2	273 $\pm$ 43	[2,3] AUBERT	06E BABR	$B^\pm \to K^\pm X_{c\overline{c}}$
5.5$\pm$ 1.2$\pm$ 1.8	157 $\pm$ 33	[4] KUO	05 BELL	$\gamma\gamma \to p\overline{p}$
7.4$\pm$ 0.4$\pm$ 2.3		[5] ASNER	04 CLEO	$\gamma\gamma \to \eta_c \to K^0_S K^\pm \pi^\mp$
13.9$\pm$ 2.0$\pm$ 3.0	41	[6] ABDALLAH	03J DLPH	$\gamma\gamma \to \eta_c$
$3.8^{+1.1+1.9}_{-1.0-1.0}$	190	[7] AMBROGIANI	03 E835	$\overline{p} p \to \eta_c \to \gamma\gamma$
7.6$\pm$ 0.8$\pm$ 2.3		[5,8] BRANDENB...	00B CLE2	$\gamma\gamma \to \eta_c \to K^\pm K^0_S \pi^\mp$
6.9$\pm$ 1.7$\pm$ 2.1	76	[9] ACCIARRI	99T L3	$e^+ e^- \to e^+ e^- \eta_c$
27 $\pm$16 $\pm$10	5	[5] SHIRAI	98 AMY	58 $e^+ e^-$
$6.7^{+2.4}_{-1.7}\pm$ 2.3		[4] ARMSTRONG	95F E760	$\overline{p} p \to \gamma\gamma$
11.3$\pm$ 4.2		[10] ALBRECHT	94H ARG	$e^+ e^- \to e^+ e^- \eta_c$
8.0$\pm$ 2.3$\pm$ 2.4	17	[11] ADRIANI	93N L3	$e^+ e^- \to e^+ e^- \eta_c$
$5.9^{+2.1}_{-1.8}\pm$ 1.9		[7] CHEN	90B CLEO	$e^+ e^- \to e^+ e^- \eta_c$
$6.4^{+5.0}_{-3.4}$		[12] AIHARA	88D TPC	$e^+ e^- \to e^+ e^- X$
$4.3^{+3.4}_{-3.7}\pm$ 2.4		[4] BAGLIN	87B SPEC	$\overline{p} p \to \gamma\gamma$
28 $\pm$15		[5,13] BERGER	86 PLUT	$\gamma\gamma \to K\overline{K}\pi$

[1] Assuming there is no interference with the non-resonant background.

[2] Calculated by us using $\Gamma(\eta_c \to K\overline{K}\pi) \times \Gamma(\eta_c \to \gamma\gamma) / \Gamma = 0.44 \pm 0.05$ keV from PDG 06 and $B(\eta_c \to K\overline{K}\pi) = (8.5 \pm 1.8)\%$ from AUBERT 06E.

[3] Systematic errors not evaluated.

[4] Normalized to $B(\eta_c \to p\overline{p}) = (1.3 \pm 0.4) \times 10^{-3}$.

[5] Normalized to $B(\eta_c \to K^\pm K^0_S \pi^\mp)$.

[6] Average of $K^0_S K^\pm \pi^\mp$, $\pi^+\pi^- K^+ K^-$, and $2(K^+ K^-)$ decay modes.

[7] Normalized to the sum of $B(\eta_c \to K^\pm K^0_S \pi^\mp)$, $B(\eta_c \to K^+ K^- \pi^+ \pi^-)$, and $B(\eta_c \to 2\pi^+ 2\pi^-)$.

[8] Superseded by ASNER 04.

[9] Normalized to the sum of 9 branching ratios.

[10] Normalized to the sum of B($\eta_c \to K^\pm K^0_S \pi^\mp$), B($\eta_c \to \phi\phi$), B($\eta_c \to K^+ K^- \pi^+ \pi^-$), and B($\eta_c \to 2\pi^+ 2\pi^-$).
[11] Superseded by ACCIARRI 99T.
[12] Normalized to the sum of B($\eta_c \to K^\pm K^0_S \pi^\mp$), B($\eta_c \to 2K^+ 2K^-$), B($\eta_c \to K^+ K^- \pi^+ \pi^-$), and B($\eta_c \to 2\pi^+ 2\pi^-$).
[13] Re-evaluated by AIHARA 88D.

$\eta_c(1S)$ Γ(i)Γ(γγ)/Γ(total)

$\Gamma(\eta'(958)\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_1\Gamma_{36}/\Gamma$

VALUE (keV)	EVTS	DOCUMENT ID		TECN	COMMENT
$75.8^{+6.3}_{-6.2}\pm8.4$	486	[1] ZHANG	12A	BELL	$e^+e^- \to e^+e^-\eta'\pi^+\pi^-$

[1] Assuming there is no interference with the non-resonant background.

$\Gamma(\rho\rho) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_2\Gamma_{36}/\Gamma$

VALUE (eV)	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<39	90	< 1556	UEHARA	08	BELL	$\gamma\gamma \to 2(\pi^+\pi^-)$

$\Gamma(K^*(892)\overline{K}^*(892)) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_4\Gamma_{36}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID		TECN	COMMENT
35 ±6 OUR FIT					
32.4±4.2±5.8	882 ± 115	UEHARA	08	BELL	$\gamma\gamma \to \pi^+\pi^- K^+ K^-$

$\Gamma(\phi\phi) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_7\Gamma_{36}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID		TECN	COMMENT
8.9 ±0.8 OUR FIT					
7.75±0.66±0.62	386 ± 31	[1] LIU	12B	BELL	$\gamma\gamma \to 2(K^+K^-)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
6.8 ±1.2 ±1.3	132 ± 23	UEHARA	08	BELL	$\gamma\gamma \to 2(K^+K^-)$

[1] Supersedes UEHARA 08. Using B($\phi \to K^+K^-$) = (48.9 ± 0.5)%.

$\Gamma(\omega\omega) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{13}\Gamma_{36}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID		TECN	COMMENT
8.67±2.86±0.96	85 ± 29	[1] LIU	12B	BELL	$\gamma\gamma \to 2(\pi^+\pi^-\pi^0)$

[1] Using B($\omega \to \pi^+\pi^-\pi^0$) = (89.2 ± 0.7)%.

$\Gamma(\omega\phi) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{14}\Gamma_{36}/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.49	90	[1] LIU	12B	BELL	$\gamma\gamma \to K^+K^-\pi^+\pi^-\pi^0$

[1] Using B($\phi \to K^+K^-$) = (48.9 ± 0.5)% and B($\omega \to \pi^+\pi^-\pi^0$) = (89.2 ± 0.7)%.

$\Gamma(f_2(1270) f_2(1270)) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{15}\Gamma_{36}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID		TECN	COMMENT
49±13 OUR FIT					
69±17±12	3182±766	UEHARA	08	BELL	$\gamma\gamma \to 2(\pi^+\pi^-)$

$\Gamma(f_2(1270) f'_2(1525)) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{16}\Gamma_{36}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID		TECN	COMMENT
49±9±13	1128±206	UEHARA	08	BELL	$\gamma\gamma \to \pi^+\pi^- K^+ K^-$

$\Gamma(K\overline{K}\pi) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{17}\Gamma_{36}/\Gamma$

VALUE (keV)	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
0.369±0.021 OUR FIT						
0.407±0.027 OUR AVERAGE Error includes scale factor of 1.2.						
0.374±0.009±0.031		14k	[1] LEES	10	BABR	10.6 $e^+e^- \to e^+e^- K^0_S K^\pm \pi^\mp$
0.407±0.022±0.028			[2,3] ASNER	04	CLEO	$\gamma\gamma \to \eta_c \to K^0_S K^\pm \pi^\mp$
0.60 ±0.12 ±0.09		41	[3,4] ABDALLAH	03J	DLPH	$\gamma\gamma \to K^0_S K^\pm \pi^\mp$
1.47 ±0.87 ±0.27			[3] SHIRAI	98	AMY	$\gamma\gamma \to \eta_c \to K^\pm K^0_S \pi^\mp$
0.84 ±0.21			[3] ALBRECHT	94H	ARG	$\gamma\gamma \to K^\pm K^0_S \pi^\mp$
0.60 $^{+0.23}_{-0.20}$			[3] CHEN	90B	CLEO	$\gamma\gamma \to \eta_c K^\pm K^0_S \pi^\mp$
1.06 ±0.41 ±0.27		11	[3] BRAUNSCH...	89	TASS	$\gamma\gamma \to K\overline{K}\pi$
1.5 $^{+0.60}_{-0.45}$ ±0.3		7	[3] BERGER	86	PLUT	$\gamma\gamma \to K\overline{K}\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.386±0.008±0.021		12k	[5] DEL-AMO-SA...	11M	BABR	$\gamma\gamma \to K^0_S K^\pm \pi^\mp$
0.418±0.044±0.022			[3,6] BRANDENB...	00B	CLE2	$\gamma\gamma \to \eta_c \to K^\pm K^0_S \pi^\mp$
<0.63	95		[3] BEHREND	89	CELL	$\gamma\gamma \to K^0_S K^\pm \pi^\mp$
<4.4	95		ALTHOFF	85B	TASS	$\gamma\gamma \to K\overline{K}\pi$

[1] From the corrected and unfolded mass spectrum.
[2] Calculated by us from the value reported in ASNER 04 that assumes B($\eta_c \to K\overline{K}\pi$) = 5.5 ± 1.7%
[3] We have multiplied $K^\pm K^0_S \pi^\mp$ measurement by 3 to obtain $K\overline{K}\pi$.
[4] Calculated by us from the value reported in ABDALLAH 03J, which uses B($\eta_c \to K^0_S K^\pm \pi^\mp$) = (1.5 ± 0.4)%.
[5] Not independent from the measurements reported by LEES 10.
[6] Superseded by ASNER 04.

$\Gamma(K^+K^-\pi^+\pi^-) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{20}\Gamma_{36}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID		TECN	COMMENT
35 ± 5 OUR FIT					
27 ± 6 OUR AVERAGE					
25.7± 3.2± 4.9	2019±248	UEHARA	08	BELL	$\gamma\gamma \to \pi^+\pi^- K^+ K^-$
280 ±100 ±60	42	[1] ABDALLAH	03J	DLPH	$\gamma\gamma \to \pi^+\pi^- K^+ K^-$
170 ± 80 ±20	13.9 ± 6.6	ALBRECHT	94H	ARG	$\gamma\gamma \to \pi^+\pi^- K^+ K^-$

[1] Calculated by us from the value reported in ABDALLAH 03J, which uses B($\eta_c \to \pi^+\pi^- K^+ K^-$) = (2.0 ± 0.7)%.

$\Gamma(K^+K^-\pi^+\pi^-\pi^0) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{21}\Gamma_{36}/\Gamma$

VALUE (keV)	EVTS	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.190±0.006±0.028	11k	[1] DEL-AMO-SA..11M	BABR	$\gamma\gamma \to K^+K^-\pi^+\pi^-\pi^0$

[1] Not independent from other measurements reported in DEL-AMO-SANCHEZ 11M.

$\Gamma(2(K^+K^-)) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{24}\Gamma_{36}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID	TECN	COMMENT
7.4± 1.5 OUR FIT				
5.8± 1.9 OUR AVERAGE				
5.6± 1.1± 1.6	216 ± 42	UEHARA 08	BELL	$\gamma\gamma \to 2(K^+K^-)$
350 ±90 ±60	46	[1] ABDALLAH 03J	DLPH	$\gamma\gamma \to 2(K^+K^-)$
231 ±90 ±23	9.1 ± 3.3	[2] ALBRECHT 94H	ARG	$\gamma\gamma \to 2(K^+K^-)$

[1] Calculated by us from the value reported in ABDALLAH 03J, which uses B($\eta_c \to$) $2(K^+K^-) = (2.1 \pm 1.2)\%$.
[2] Includes all topological modes except $\eta_c \to \phi\phi$.

$\Gamma(2(\pi^+\pi^-)) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{26}\Gamma_{36}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID	TECN	COMMENT
49 ± 6 OUR FIT				
42 ± 6 OUR AVERAGE				
40.7± 3.7± 5.3	5381±492	UEHARA 08	BELL	$\gamma\gamma \to 2(\pi^+\pi^-)$
180 ±70 ±20	21.4 ± 8.6	ALBRECHT 94H	ARG	$\gamma\gamma \to 2(\pi^+\pi^-)$

$\Gamma(p\overline{p}) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{29}\Gamma_{36}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID	TECN	COMMENT
7.6 ±0.8 OUR FIT				
$7.20\pm1.53^{+0.67}_{-0.75}$	157 ± 33	[1] KUO 05	BELL	$\gamma\gamma \to p\overline{p}$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$4.6\ ^{+1.3}_{-1.1}\ \pm0.4$	190	[1] AMBROGIANI 03	E835	$\overline{p}p \to \gamma\gamma$
$8.1\ ^{+2.9}_{-2.0}$		[1] ARMSTRONG 95F	E760	$\overline{p}p \to \gamma\gamma$

[1] Not independent from the $\Gamma_{\gamma\gamma}$ reported by the same experiment.

$\Gamma(K^0_S K^0_S) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{40}\Gamma_{36}/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
<1.6	90	[1] UEHARA 13	BELL	$\gamma\gamma \to K^0_S K^0_S$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.29	90	[2] UEHARA 13	BELL	$\gamma\gamma \to K^0_S K^0_S$

[1] Taking into account interference with the non-resonant continuum.
[2] Neglecting interference with the non-resonant continuum.

$\eta_c(1S)$ BRANCHING RATIOS

HADRONIC DECAYS

$\Gamma(\eta'(958)\pi\pi)/\Gamma_{total}$ — Γ_1/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.041±0.017	14	[1] BALTRUSAIT...86	MRK3	$J/\psi \to \eta_c \gamma$

[1] The quoted branching ratios use B($J/\psi(1S) \to \gamma\eta_c(1S)$) = 0.0127 ± 0.0036.

$\Gamma(\rho\rho)/\Gamma_{total}$ — Γ_2/Γ

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
18 ± 5 OUR AVERAGE						
12.6± 3.8±5.1		72	[1] ABLIKIM	05L	BES2	$J/\psi \to \pi^+\pi^-\pi^+\pi^-\gamma$
26.0± 2.4±8.8		113	[1] BISELLO	91	DM2	$J/\psi \to \gamma\rho^0\rho^0$
23.6±10.6±8.2		32	[1] BISELLO	91	DM2	$J/\psi \to \gamma\rho^+\rho^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<14	90		[1] BALTRUSAIT...86		MRK3	$J/\psi \to \eta_c\gamma$

[1] The quoted branching ratios use B($J/\psi(1S) \to \gamma\eta_c(1S)$) = 0.0127 ± 0.0036. Where relevant, the error in this branching ratio is treated as a common systematic in computing averages.

$\Gamma(K^*(892)^0 K^-\pi^+ + \text{c.c.})/\Gamma_{total}$ — Γ_3/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.02±0.007	63	[1,2] BALTRUSAIT...86	MRK3	$J/\psi \to \eta_c\gamma$

[1] BALTRUSAITIS 86 has an error according to Partridge.
[2] The quoted branching ratios use B($J/\psi(1S) \to \gamma\eta_c(1S)$) = 0.0127 ± 0.0036.

$\Gamma(K^*(892)\overline{K}^*(892))/\Gamma_{total}$ — Γ_4/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
70±13 OUR FIT					
91±26 OUR AVERAGE					
108±25±44	60	[1] ABLIKIM	05L	BES2	$J/\psi \to K^+K^-\pi^+\pi^-\gamma$
82±28±27	14	[1] BISELLO	91	DM2	$e^+e^- \to \gamma K^+K^-\pi^+\pi^-$
90±50	9	[1] BALTRUSAIT...86		MRK3	$J/\psi \to \eta_c\gamma$

[1] The quoted branching ratios use B($J/\psi(1S) \to \gamma\eta_c(1S)$) = 0.0127 ± 0.0036. Where relevant, the error in this branching ratio is treated as a common systematic in computing averages.

$\Gamma(K^{*0}\overline{K}^{*0}\pi^+\pi^-)/\Gamma_{total}$ — Γ_5/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
113±47±25	45	[1] ABLIKIM	06A	BES2	$J/\psi \to K^{*0}\overline{K}^{*0}\pi^+\pi^-\gamma$

[1] ABLIKIM 06A reports $[\Gamma(\eta_c(1S) \to K^{*0}\overline{K}^{*0}\pi^+\pi^-)/\Gamma_{total}] \times [B(J/\psi(1S) \to \gamma\eta_c(1S))] = (1.91\pm0.64\pm0.48)\times10^{-4}$ which we divide by our best value $B(J/\psi(1S) \to \gamma\eta_c(1S)) = (1.7\pm0.4)\times10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\phi K^+ K^-)/\Gamma_{total}$ Γ_6/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
$2.9^{+0.9}_{-0.8}\pm1.1$	$14.1^{+4.4}_{-3.7}$	[1] HUANG	03	BELL	$B^+ \to (\phi K^+ K^-) K^+$

[1] Using $B(B^+ \to \eta_c K^+) = (1.25 \pm 0.12^{+0.10}_{-0.12}) \times 10^{-3}$ from FANG 03 and $B(\eta_c \to K\overline{K}\pi) = (5.5 \pm 1.7) \times 10^{-2}$.

$\Gamma(\phi\phi)/\Gamma_{total}$ Γ_7/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
17.6± 2.0 OUR FIT					
30 ± 5 OUR AVERAGE					
25.3± 5.1± 9.1	72	[1] ABLIKIM	05L	BES2	$J/\psi \to K^+K^-K^+K^-\gamma$
26 ± 9	357 ± 64	[1] BAI	04	BES	$J/\psi \to \gamma K^+K^-K^+K^-$
31 ± 7 ±10	19	[1] BISELLO	91	DM2	$J/\psi \to \gamma K^+K^-K^+K^-$
30 $^{+18}_{-12}$ ±10	5	[1] BISELLO	91	DM2	$J/\psi \to \gamma K^+K^-K^0_S K^0_L$
74 ±18 ±24	80	[1] BAI	90B	MRK3	$J/\psi \to \gamma K^+K^-K^+K^-$
67 ±21 ±24		[1] BAI	90B	MRK3	$J/\psi \to \gamma K^+K^-K^0_S K^0_L$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
18 $^{+8}_{-6}$ ± 7	$7.0^{+3.0}_{-2.3}$	[2] HUANG	03	BELL	$B^+ \to (\phi\phi) K^+$

[1] The quoted branching ratios use $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$. Where relevant, the error in this branching ratio is treated as a common systematic in computing averages.

[2] Using $B(B^+ \to \eta_c K^+) = (1.25 \pm 0.12^{+0.10}_{-0.12}) \times 10^{-3}$ from FANG 03 and $B(\eta_c \to K\overline{K}\pi) = (5.5 \pm 1.7) \times 10^{-2}$.

$\Gamma(\phi\phi)/\Gamma(K\overline{K}\pi)$ Γ_7/Γ_{17}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.0240±0.0026 OUR FIT					
0.044 $^{+0.012}_{-0.010}$ OUR AVERAGE					
0.055 ±0.014 ±0.005		AUBERT,B	04B	BABR	$B^\pm \to K^\pm \eta_c$
0.032 $^{+0.014}_{-0.010}$ ±0.009	7	[1] HUANG	03	BELL	$B^\pm \to K^\pm \phi\phi$

[1] Using $B(B^+ \to \eta_c K^+) = (1.25 \pm 0.12^{+0.10}_{-0.12}) \times 10^{-3}$ from FANG 03 and $B(\eta_c \to K\overline{K}\pi) = (5.5 \pm 1.7) \times 10^{-2}$.

$\Gamma(\phi 2(\pi^+\pi^-))/\Gamma_{total}$ Γ_8/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<40	90	[1] ABLIKIM	06A	BES2	$J/\psi \to \phi 2(\pi^+\pi^-)\gamma$

[1] ABLIKIM 06A reports $[\Gamma(\eta_c(1S) \to \phi 2(\pi^+\pi^-))/\Gamma_{total}] \times [B(J/\psi(1S) \to \gamma\eta_c(1S))] < 0.603 \times 10^{-4}$ which we divide by our best value $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 1.7 \times 10^{-2}$.

$\Gamma(a_0(980)\pi)/\Gamma_{total}$ — Γ_9/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.02	90	[1,2] BALTRUSAIT...86	MRK3	$J/\psi \to \eta_c \gamma$

[1] The quoted branching ratios use $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$.

[2] We are assuming $B(a_0(980) \to \eta\pi) > 0.5$.

$\Gamma(a_2(1320)\pi)/\Gamma_{total}$ — Γ_{10}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.02	90	[1] BALTRUSAIT...86	MRK3	$J/\psi \to \eta_c \gamma$

[1] The quoted branching ratios use $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$.

$\Gamma(K^*(892)\overline{K}+\text{c.c.})/\Gamma_{total}$ — Γ_{11}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.0128	90	BISELLO 91	DM2	$J/\psi \to \gamma K^0_S K^\pm \pi^\mp$
<0.0132	90	[1] BISELLO 91	DM2	$J/\psi \to \gamma K^+ K^- \pi^0$

[1] The quoted branching ratios use $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$.

$\Gamma(f_2(1270)\eta)/\Gamma_{total}$ — Γ_{12}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.011	90	[1] BALTRUSAIT...86	MRK3	$J/\psi \to \eta_c \gamma$

[1] The quoted branching ratios use $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$.

$\Gamma(\omega\omega)/\Gamma_{total}$ — Γ_{13}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.0031	90	[1] BALTRUSAIT...86	MRK3	$J/\psi \to \eta_c \gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.0063	90	[1] ABLIKIM 05L	BES2	$J/\psi \to \pi^+\pi^-\pi^0\pi^+\pi^-\pi^0\gamma$
<0.0063		[1] BISELLO 91	DM2	$J/\psi \to \gamma\omega\omega$

[1] The quoted branching ratios use $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$. Where relevant, the error in this branching ratio is treated as a common systematic in computing averages.

$\Gamma(\omega\phi)/\Gamma_{total}$ — Γ_{14}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.0017	90	[1] ABLIKIM 05L	BES2	$J/\psi \to \pi^+\pi^-\pi^0 K^+ K^- \gamma$

[1] The quoted branching ratios use $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$.

$\Gamma(f_2(1270) f_2(1270))/\Gamma_{total}$ — Γ_{15}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
0.98±0.25 OUR FIT				
$0.77^{+0.25}_{-0.30} \pm 0.17$	91.2 ± 19.8	[1] ABLIKIM 04M	BES	$J/\psi \to \gamma 2\pi^+ 2\pi^-$

[1] ABLIKIM 04M reports $[\Gamma(\eta_c(1S) \to f_2(1270) f_2(1270))/\Gamma_{total}] \times [B(J/\psi(1S) \to \gamma\eta_c(1S))] = (1.3 \pm 0.3^{+0.3}_{-0.4}) \times 10^{-4}$ which we divide by our best value $B(J/\psi(1S) \to \gamma\eta_c(1S)) = (1.7 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(K\overline{K}\pi)/\Gamma_{total}$ Γ_{17}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
7.3 ±0.5 OUR FIT				
6.5 ±0.6 OUR AVERAGE				
6.3 ±1.3 ±0.6	55	[1,2] ABLIKIM 12N	BES3	$\psi(2S) \to \pi^0 \gamma K^+ K^- \pi^0$
7.9 ±1.4 ±0.7	107	[3,4] ABLIKIM 12N	BES3	$\psi(2S) \to \pi^0 \gamma K^0_S K^\mp \pi^\pm$
8.5 ±1.8		[5] AUBERT 06E	BABR	$B^\pm \to K^\pm X_{c\overline{c}}$
5.1 ±2.1	0.6k	[6] BAI 04	BES	$J/\psi \to \gamma K^\pm \pi^\mp K^0_S$
6.90±1.42±1.32	33	[6] BISELLO 91	DM2	$J/\psi \to \gamma K^+ K^- \pi^0$
5.43±0.94±0.94	68	[6] BISELLO 91	DM2	$J/\psi \to \gamma K^\pm \pi^\mp K^0_S$
4.8 ±1.7	95	[6,7] BALTRUSAIT...86	MRK3	$J/\psi \to \eta_c \gamma$
16.1 $^{+9.2}_{-7.3}$		[8,9] HIMEL 80B	MRK2	$\psi(2S) \to \eta_c \gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$<$ 10.7 90% CL		[6,10] PARTRIDGE 80B	CBAL	$J/\psi \to \eta_c \gamma$

[1] ABLIKIM 12N quotes B($\psi(2S) \to \pi^0 h_c$) · B($h_c \to \gamma\eta_c$) · B($\eta_c \to K^+ K^- \pi^0$) = (4.54 ± 0.76 ± 0.48) × 10^{-6} which we multiply by 6 to account for isospin symmetry.

[2] ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \to K\overline{K}\pi)/\Gamma_{total}] \times [\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total}]$ = (27.24 ± 4.56 ± 2.88) × 10^{-6} which we divide by our best value $\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total}$ = (4.3 ± 0.4) × 10^{-4}. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[3] ABLIKIM 12N quotes B($\psi(2S) \to \pi^0 h_c$) · B($h_c \to \gamma\eta_c$) · B($\eta_c \to K^0_S K^\pm \pi^\mp$) = (11.35 ± 1.25 ± 1.50) × 10^{-6} which we multiply by 3 to account for isospin symmetry.

[4] ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \to K\overline{K}\pi)/\Gamma_{total}] \times [\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total}]$ = (34.05 ± 3.75 ± 4.50) × 10^{-6} which we divide by our best value $\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total}$ = (4.3 ± 0.4) × 10^{-4}. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[5] Determined from the ratio of B($B^\pm \to K^\pm \eta_c$) B($\eta_c \to K\overline{K}\pi$) = (7.4 ± 0.5 ± 0.7) × 10^{-5} reported in AUBERT,B 04B and B($B^\pm \to K^\pm \eta_c$) = (8.7 ± 1.5) × 10^{-3} reported in AUBERT 06E.

[6] The quoted branching ratios use B($J/\psi(1S) \to \gamma\eta_c(1S)$) = 0.0127 ± 0.0036. Where relevant, the error in this branching ratio is treated as a common systematic in computing averages.

[7] Average from $K^+ K^- \pi^0$ and $K^\pm K^0_S \pi^\mp$ decay channels.

[8] $K^\pm K^0_S \pi^\mp$ corrected to $K\overline{K}\pi$ by factor 3. KS, MR.

[9] Estimated using B($\psi(2S) \to \gamma\eta_c(1S)$) = 0.0028 ± 0.0006.

[10] $K^+ K^- \pi^0$ corrected to $K\overline{K}\pi$ by factor 6. KS, MR

$\Gamma(\phi K^+ K^-)/\Gamma(K\overline{K}\pi)$ Γ_6/Γ_{17}

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
$\mathbf{0.052^{+0.016}_{-0.014}\pm0.014}$	7	[1] HUANG 03	BELL	$B^\pm \to K^\pm \phi\phi$

[1] Using B($B^+ \to \eta_c K^+$) = (1.25 ± 0.12$^{+0.10}_{-0.12}$) × 10^{-3} from FANG 03 and B($\eta_c \to K\overline{K}\pi$) = (5.5 ± 1.7) × 10^{-2}.

$\Gamma(\eta\pi^+\pi^-)/\Gamma_{total}$ — Γ_{18}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
1.7±0.4±0.1	33	[1] ABLIKIM	12N	BES3	$\psi(2S) \to \pi^0\gamma\eta\pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
5.4±2.0	75	[2] BALTRUSAIT...86		MRK3	$J/\psi \to \eta_c\gamma$
3.7±1.3±2.0	18	[2] PARTRIDGE	80B	CBAL	$J/\psi \to \eta\pi^+\pi^-\gamma$

[1] ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \to \eta\pi^+\pi^-)/\Gamma_{total}] \times [\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total}] = (7.22 \pm 1.47 \pm 1.11) \times 10^{-6}$ which we divide by our best value $\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total} = (4.3 \pm 0.4) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[2] The quoted branching ratios use $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$. Where relevant, the error in this branching ratio is treated as a common systematic in computing averages.

$\Gamma(\eta 2(\pi^+\pi^-))/\Gamma_{total}$ — Γ_{19}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
4.4±1.2±0.4	39	[1] ABLIKIM	12N	BES3	$\psi(2S) \to \pi^0\gamma\eta 2(\pi^+\pi^-)$

[1] ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \to \eta 2(\pi^+\pi^-))/\Gamma_{total}] \times [\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total}] = (19.17 \pm 3.77 \pm 3.72) \times 10^{-6}$ which we divide by our best value $\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total} = (4.3 \pm 0.4) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(K^+K^-\pi^+\pi^-)/\Gamma_{total}$ — Γ_{20}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
6.9± 1.1 OUR FIT					
11.2± 1.9 OUR AVERAGE					
9.7± 2.2±0.9	38	[1] ABLIKIM	12N	BES3	$\psi(2S) \to \pi^0\gamma K^+K^-\pi^+\pi^-$
12 ± 4	0.4k	[2] BAI	04	BES	$J/\psi \to \gamma K^+K^-\pi^+\pi^-$
21 ± 7	110	[2] BALTRUSAIT...86		MRK3	$J/\psi \to \eta_c\gamma$
14 $^{+22}_{-9}$		[3] HIMEL	80B	MRK2	$\psi(2S) \to \eta_c\gamma$

[1] ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \to K^+K^-\pi^+\pi^-)/\Gamma_{total}] \times [\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total}] = (4.16 \pm 0.76 \pm 0.59) \times 10^{-6}$ which we divide by our best value $\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total} = (4.3 \pm 0.4) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[2] The quoted branching ratios use $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$. Where relevant, the error in this branching ratio is treated as a common systematic in computing averages.

[3] Estimated using $B(\psi(2S) \to \gamma\eta_c(1S)) = 0.0028 \pm 0.0006$.

$\Gamma(K^+K^-\pi^+\pi^-\pi^0)/\Gamma(K\overline{K}\pi)$ — Γ_{21}/Γ_{17}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.477±0.017±0.070	11k	[1] DEL-AMO-SA...11M		BABR	$\gamma\gamma \to K^+K^-\pi^+\pi^-\pi^0$

[1] We have multiplied the value of $\Gamma(K^+K^-\pi^+\pi^-\pi^0)/\Gamma(K^0_S K^\pm\pi^\mp)$ reported in DEL-AMO-SANCHEZ 11M by a factor 1/3 to obtain $\Gamma(K^+K^-\pi^+\pi^-\pi^0)/\Gamma(K\overline{K}\pi)$. Not independent from other measurements reported in DEL-AMO-SANCHEZ 11M.

$\Gamma(K^0 K^- \pi^+ \pi^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}}$ — Γ_{22}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
5.6±1.4±0.5	43	[1,2] ABLIKIM	12N	BES3	$\psi(2S) \rightarrow \pi^0 \gamma K^0_S K^\mp \pi^\mp 2\pi^\pm$

[1] ABLIKIM 12N quotes $B(\psi(2S) \rightarrow \pi^0 h_c) \cdot B(h_c \rightarrow \gamma \eta_c) \cdot B(\eta_c \rightarrow K^0_S K^- \pi^- 2\pi^+) = (12.01 \pm 2.22 \pm 2.04) \times 10^{-6}$ which we multiply by 2 to take c.c. into account.

[2] ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \rightarrow K^0 K^- \pi^+ \pi^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \eta_c(1S)\gamma)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (24.02 \pm 4.44 \pm 4.08) \times 10^{-6}$ which we divide by our best value $\Gamma(h_c(1P) \rightarrow \eta_c(1S)\gamma)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(K^+ K^- 2(\pi^+ \pi^-))/\Gamma_{\text{total}}$ — Γ_{23}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
7.5±2.4 OUR AVERAGE					
8 ±4 ±1	10	[1] ABLIKIM	12N	BES3	$\psi(2S) \rightarrow \pi^0 \gamma K^+ K^- 2(\pi^+ \pi^-)$
7.2±2.4±1.6	100	[2] ABLIKIM	06A	BES2	$J/\psi \rightarrow K^+ K^- 2(\pi^+ \pi^-)\gamma$

[1] ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \rightarrow K^+ K^- 2(\pi^+ \pi^-))/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \eta_c(1S)\gamma)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (3.60 \pm 1.71 \pm 0.64) \times 10^{-6}$ which we divide by our best value $\Gamma(h_c(1P) \rightarrow \eta_c(1S)\gamma)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[2] ABLIKIM 06A reports $[\Gamma(\eta_c(1S) \rightarrow K^+ K^- 2(\pi^+ \pi^-))/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma \eta_c(1S))] = (1.21 \pm 0.32 \pm 0.24) \times 10^{-4}$ which we divide by our best value $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = (1.7 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(2(K^+ K^-))/\Gamma_{\text{total}}$ — Γ_{24}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
1.47± 0.31 OUR FIT					
2.2 ± 0.9 ±0.2	7	[1] ABLIKIM	12N	BES3	$\psi(2S) \rightarrow \pi^0 \gamma 2(K^+ K^-)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$1.4 {}^{+0.5}_{-0.4} \pm 0.6$	$14.5^{+4.6}_{-3.0}$	[2] HUANG	03	BELL	$B^+ \rightarrow 2(K^+ K^-) K^+$
21 ±10 ±6		[3] ALBRECHT	94H	ARG	$\gamma\gamma \rightarrow K^+ K^- K^+ K^-$

[1] ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \rightarrow 2(K^+ K^-))/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \eta_c(1S)\gamma)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (0.94 \pm 0.37 \pm 0.14) \times 10^{-6}$ which we divide by our best value $\Gamma(h_c(1P) \rightarrow \eta_c(1S)\gamma)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[2] Using $B(B^+ \rightarrow \eta_c K^+) = (1.25 \pm 0.12^{+0.10}_{-0.12}) \times 10^{-3}$ from FANG 03 and $B(\eta_c \rightarrow K\overline{K}\pi) = (5.5 \pm 1.7) \times 10^{-2}$.

[3] Normalized to the sum of $B(\eta_c \rightarrow K^\pm K^0_S \pi^\mp)$, $B(\eta_c \rightarrow \phi\phi)$, $B(\eta_c \rightarrow K^+ K^- \pi^+ \pi^-)$, and $B(\eta_c \rightarrow 2\pi^+ 2\pi^-)$.

$\Gamma(2(K^+K^-))/\Gamma(K\overline{K}\pi)$ — Γ_{24}/Γ_{17}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.020±0.004 OUR FIT					
0.024±0.007 OUR AVERAGE					
0.023±0.007±0.006		AUBERT,B	04B	BABR	$B^\pm \to K^\pm \eta_c$
$0.026^{+0.009}_{-0.007}\pm0.007$	15	[1] HUANG	03	BELL	$B^\pm \to K^\pm (2K^+ 2K^-)$

[1] Using $B(B^+ \to \eta_c K^+) = (1.25 \pm 0.12^{+0.10}_{-0.12}) \times 10^{-3}$ from FANG 03 and $B(\eta_c \to K\overline{K}\pi) = (5.5 \pm 1.7) \times 10^{-2}$.

$\Gamma(\pi^+\pi^-\pi^0\pi^0)/\Gamma_{\rm total}$ — Γ_{25}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
4.7±0.9±0.4	118	[1] ABLIKIM	12N	BES3	$\psi(2S) \to \pi^0 \gamma \pi^+\pi^- 2\pi^0$

[1] ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \to \pi^+\pi^-\pi^0\pi^0)/\Gamma_{\rm total}] \times [\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{\rm total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{\rm total}] = (20.31 \pm 2.20 \pm 3.33) \times 10^{-6}$ which we divide by our best value $\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{\rm total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{\rm total} = (4.3 \pm 0.4) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

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

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
0.97±0.12 OUR FIT					
1.35±0.21 OUR AVERAGE					
1.74±0.32±0.15	100	[1] ABLIKIM	12N	BES3	$\psi(2S) \to \pi^0 \gamma 2(\pi^+\pi^-)$
1.0 ±0.5	542 ± 75	[2] BAI	04	BES	$J/\psi \to \gamma\, 2(\pi^+\pi^-)$
1.05±0.17±0.34	137	[2] BISELLO	91	DM2	$J/\psi \to \gamma 2\pi^+ 2\pi^-$
1.3 ±0.6	25	[2] BALTRUSAIT...	86	MRK3	$J/\psi \to \eta_c \gamma$
$2.0\ ^{+1.5}_{-1.0}$		[3] HIMEL	80B	MRK2	$\psi(2S) \to \eta_c \gamma$

[1] ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \to 2(\pi^+\pi^-))/\Gamma_{\rm total}] \times [\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{\rm total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{\rm total}] = (7.51 \pm 0.85 \pm 1.11) \times 10^{-6}$ which we divide by our best value $\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{\rm total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{\rm total} = (4.3 \pm 0.4) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[2] The quoted branching ratios use $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$. Where relevant, the error in this branching ratio is treated as a common systematic in computing averages.

[3] Estimated using $B(\psi(2S) \to \gamma\eta_c(1S)) = 0.0028 \pm 0.0006$.

$\Gamma(2(\pi^+\pi^-\pi^0))/\Gamma_{\rm total}$ — Γ_{27}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
17.4±2.9±1.5	175	[1] ABLIKIM	12N	BES3	$\psi(2S) \to \pi^0 \gamma 2(\pi^+\pi^- 2\pi^0)$

[1] ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \to 2(\pi^+\pi^-\pi^0))/\Gamma_{\rm total}] \times [\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{\rm total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{\rm total}] = (75.13 \pm 7.42 \pm 9.99) \times 10^{-6}$ which we divide by our best value $\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{\rm total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{\rm total} = (4.3 \pm 0.4) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(3(\pi^+\pi^-))/\Gamma_{total}$ — Γ_{28}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
18 ±4 OUR AVERAGE					
20 ±5 ±2	51	[1] ABLIKIM	12N	BES3	$\psi(2S) \to \pi^0\gamma 3(\pi^+\pi^-)$
15.3±3.4±3.3	479	[2] ABLIKIM	06A	BES2	$J/\psi \to 3(\pi^+\pi^-)\gamma$

[1] ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \to 3(\pi^+\pi^-))/\Gamma_{total}] \times [\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total}] = (8.82 \pm 1.57 \pm 1.59) \times 10^{-6}$ which we divide by our best value $\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total} = (4.3 \pm 0.4) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[2] ABLIKIM 06A reports $[\Gamma(\eta_c(1S) \to 3(\pi^+\pi^-))/\Gamma_{total}] \times [B(J/\psi(1S) \to \gamma\eta_c(1S))] = (2.59 \pm 0.32 \pm 0.47) \times 10^{-4}$ which we divide by our best value $B(J/\psi(1S) \to \gamma\eta_c(1S)) = (1.7 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(p\overline{p})/\Gamma_{total}$ — Γ_{29}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
15.2± 1.6 OUR FIT					
13.2± 2.7 OUR AVERAGE					
15 ± 5 ±1	15	[1] ABLIKIM	12N	BES3	$\psi(2S) \to \pi^0\gamma p\overline{p}$
15 ± 6	213 ± 33	[2] BAI	04	BES	$J/\psi \to \gamma p\overline{p}$
10 ± 3 ±4	18	[2] BISELLO	91	DM2	$J/\psi \to \gamma p\overline{p}$
11 ± 6	23	[2] BALTRUSAIT...	86	MRK3	$J/\psi \to \eta_c\gamma$
$29\ ^{+29}_{-15}$		[3] HIMEL	80B	MRK2	$\psi(2S) \to \eta_c\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$14.8\ ^{+2.0}_{-2.4}\ ^{+1.7}_{-1.8}$	195	[4] WU	06	BELL	$B^+ \to p\overline{p}K^+$

[1] ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \to p\overline{p})/\Gamma_{total}] \times [\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total}] = (0.65 \pm 0.19 \pm 0.10) \times 10^{-6}$ which we divide by our best value $\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total} = (4.3 \pm 0.4) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[2] The quoted branching ratios use $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$. Where relevant, the error in this branching ratio is treated as a common systematic in computing averages.

[3] Estimated using $B(\psi(2S) \to \gamma\eta_c(1S)) = 0.0028 \pm 0.0006$.

[4] WU 06 reports $[\Gamma(\eta_c(1S) \to p\overline{p})/\Gamma_{total}] \times [B(B^+ \to \eta_c K^+)] = (1.42 \pm 0.11\ ^{+0.16}_{-0.20}) \times 10^{-6}$ which we divide by our best value $B(B^+ \to \eta_c K^+) = (9.6 \pm 1.1) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(p\overline{p})/\Gamma(K\overline{K}\pi)$ — Γ_{29}/Γ_{17}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.0207±0.0021 OUR FIT					
0.021 ±0.002 $^{+0.004}_{-0.006}$	195	[1] WU	06	BELL	$B^\pm \to K^\pm p\overline{p}$

[1] Using $B(B^+ \to \eta_c K^+) = (1.25 \pm 0.12\ ^{+0.10}_{-0.12}) \times 10^{-3}$ from FANG 03 and $B(\eta_c \to K\overline{K}\pi) = (5.5 \pm 1.7) \times 10^{-2}$.

$\Gamma(p\overline{p})/\Gamma_{total} \times \Gamma(\phi\phi)/\Gamma_{total}$ — $\Gamma_{29}/\Gamma \times \Gamma_7/\Gamma$

VALUE (units 10^{-5})	DOCUMENT ID		TECN	COMMENT
0.27±0.05 OUR FIT				
4.0 $^{+3.5}_{-3.2}$	BAGLIN	89	SPEC	$\overline{p}p \to K^+K^-K^+K^-$

$\Gamma(p\overline{p}\pi^0)/\Gamma_{total}$ — Γ_{30}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
0.36±0.13±0.03	14	[1] ABLIKIM	12N	BES3	$\psi(2S) \to \pi^0\gamma p\overline{p}\pi^0$

[1] ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \to p\overline{p}\pi^0)/\Gamma_{total}] \times [\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total}] = (1.53 \pm 0.49 \pm 0.23) \times 10^{-6}$ which we divide by our best value $\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total} = (4.3 \pm 0.4) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\Lambda\overline{\Lambda})/\Gamma_{total}$ — Γ_{31}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
10.9±2.4 OUR FIT						
11.7±2.3±2.6			[1] ABLIKIM	12B	BES3	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$9.9^{+2.7}_{-2.6}\pm1.2$		20	[2] WU	06	BELL	$B^+ \to \Lambda\overline{\Lambda}K^+$
<20	90		[3] BISELLO	91	DM2	$e^+e^- \to \gamma\Lambda\overline{\Lambda}$

[1] ABLIKIM 12B reports $[\Gamma(\eta_c(1S) \to \Lambda\overline{\Lambda})/\Gamma_{total}] \times [B(J/\psi(1S) \to \gamma\eta_c(1S))] = (0.198 \pm 0.021 \pm 0.032) \times 10^{-4}$ which we divide by our best value $B(J/\psi(1S) \to \gamma\eta_c(1S)) = (1.7 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[2] WU 06 reports $[\Gamma(\eta_c(1S) \to \Lambda\overline{\Lambda})/\Gamma_{total}] \times [B(B^+ \to \eta_c K^+)] = (0.95^{+0.25}_{-0.22}{}^{+0.08}_{-0.11}) \times 10^{-6}$ which we divide by our best value $B(B^+ \to \eta_c K^+) = (9.6 \pm 1.1) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[3] The quoted branching ratios use $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$.

$\Gamma(\Lambda\overline{\Lambda})/\Gamma(p\overline{p})$ — Γ_{31}/Γ_{29}

VALUE	DOCUMENT ID		TECN	COMMENT
0.72±0.16 OUR FIT				
$0.67^{+0.19}_{-0.16}\pm0.12$	[1] WU	06	BELL	$B^+ \to p\overline{p}K^+$, $\Lambda\overline{\Lambda}K^+$

[1] Not independent from other $\eta_c \to \Lambda\overline{\Lambda}$, $p\overline{p}$ branching ratios reported by WU 06.

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

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
2.1±0.3±0.5	112	[1] ABLIKIM	13C	BES3	$J/\psi \to \gamma p\overline{p}\pi^0\pi^0$

[1] ABLIKIM 13C reports $[\Gamma(\eta_c(1S) \to \Sigma^+\overline{\Sigma}^-)/\Gamma_{total}] \times [B(J/\psi(1S) \to \gamma\eta_c(1S))] = (3.60 \pm 0.48 \pm 0.31) \times 10^{-5}$ which we divide by our best value $B(J/\psi(1S) \to \gamma\eta_c(1S)) = (1.7 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\Xi^-\overline{\Xi}^+)/\Gamma_{total}$ — Γ_{33}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
0.89±0.18±0.19	78	[1] ABLIKIM	13C	BES3	$J/\psi \to \gamma \Lambda \overline{\Lambda} \pi^+ \pi^-$

[1] ABLIKIM 13C reports $[\Gamma(\eta_c(1S) \to \Xi^-\overline{\Xi}^+)/\Gamma_{total}] \times [B(J/\psi(1S) \to \gamma\eta_c(1S))] = (1.51 \pm 0.27 \pm 0.14) \times 10^{-5}$ which we divide by our best value $B(J/\psi(1S) \to \gamma\eta_c(1S)) = (1.7 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(K\overline{K}\eta)/\Gamma_{total}$ — Γ_{34}/Γ

VALUE (units 10^{-2})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
1.0±0.5±0.1		7	[1,2] ABLIKIM	12N	BES3	$\psi(2S) \to \pi^0\gamma\eta K^+K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<3.1	90		[3] BALTRUSAIT...	86	MRK3	$J/\psi \to \eta_c\gamma$

[1] ABLIKIM 12N quotes $B(\psi(2S) \to \pi^0 h_c) \cdot B(h_c \to \gamma\eta_c) \cdot B(\eta_c \to K^+K^-\eta) = (12.01 \pm 2.22 \pm 2.04) \times 10^{-6}$ which we multiply by 2 to account for isospin symmetry.

[2] ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \to K\overline{K}\eta)/\Gamma_{total}] \times [\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total}] = (4.22 \pm 2.02 \pm 0.64) \times 10^{-6}$ which we divide by our best value $\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total} = (4.3 \pm 0.4) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[3] The quoted branching ratios use $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$.

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

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
5.3±1.7±0.5		19	[1] ABLIKIM	12N	BES3	$\psi(2S) \to \pi^0\gamma p\overline{p}\pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<12	90		HIMEL	80B	MRK2	$\psi(2S) \to \eta_c\gamma$

[1] ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \to \pi^+\pi^- p\overline{p})/\Gamma_{total}] \times [\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total}] = (2.30 \pm 0.65 \pm 0.36) \times 10^{-6}$ which we divide by our best value $\Gamma(h_c(1P) \to \eta_c(1S)\gamma)/\Gamma_{total} \times \Gamma(\psi(2S) \to \pi^0 h_c(1P))/\Gamma_{total} = (4.3 \pm 0.4) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

RADIATIVE DECAYS

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

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
1.57±0.12 OUR FIT						
$1.9^{+0.7}_{-0.6}$ OUR AVERAGE						
$2.7 \pm 0.8 \pm 0.6$			[1] ABLIKIM	13I	BES3	
$1.4^{+0.7}_{-0.5} \pm 0.3$		$1.2^{+2.8}_{-1.1}$	[2] ADAMS	08	CLEO	$\psi(2S) \to \pi^+\pi^- J/\psi$

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

$2.3\ ^{+1.0}_{-0.8}\ \pm0.3$		13	[3] WICHT	08	BELL	$B^{\pm} \to K^{\pm}\gamma\gamma$
$2.80^{+0.67}_{-0.58}\pm1.0$			[4] ARMSTRONG	95F	E760	$\overline{p}p \to \gamma\gamma$
<9	90		[5] BISELLO	91	DM2	$J/\psi \to \gamma\gamma\gamma$
$6\ ^{+4}_{-3}\ \pm4$			[4] BAGLIN	87B	SPEC	$\overline{p}p \to \gamma\gamma$
<18	90		[6] BLOOM	83	CBAL	$J/\psi \to \eta_c\gamma$

[1] ABLIKIM 13I reports $[\Gamma(\eta_c(1S) \to \gamma\gamma)/\Gamma_{total}] \times [B(J/\psi(1S) \to \gamma\eta_c(1S))] = (4.5 \pm 1.2 \pm 0.6) \times 10^{-6}$ which we divide by our best value $B(J/\psi(1S) \to \gamma\eta_c(1S)) = (1.7 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[2] ADAMS 08 reports $[\Gamma(\eta_c(1S) \to \gamma\gamma)/\Gamma_{total}] \times [B(J/\psi(1S) \to \gamma\eta_c(1S))] = (2.4^{+1.1}_{-0.8} \pm 0.3) \times 10^{-6}$ which we divide by our best value $B(J/\psi(1S) \to \gamma\eta_c(1S)) = (1.7 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[3] WICHT 08 reports $[\Gamma(\eta_c(1S) \to \gamma\gamma)/\Gamma_{total}] \times [B(B^+ \to \eta_c K^+)] = (2.2^{+0.9}_{-0.7}{}^{+0.4}_{-0.2}) \times 10^{-7}$ which we divide by our best value $B(B^+ \to \eta_c K^+) = (9.6 \pm 1.1) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[4] Not independent from the values of the total and two-photon width quoted by the same experiment.

[5] The quoted branching ratios use $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$.

[6] Using $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$.

$\Gamma(\gamma\gamma)/\Gamma(K\overline{K}\pi)$ — Γ_{36}/Γ_{17}

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
2.13±0.29 OUR FIT					
$\mathbf{3.2\ ^{+1.3}_{-1.0}\ ^{+0.8}_{-0.6}}$	13	[1] WICHT	08	BELL	$B^{\pm} \to K^{\pm}\gamma\gamma$

[1] Using $B(B^+ \to \eta_c K^+) = (1.25 \pm 0.12^{+0.10}_{-0.12}) \times 10^{-3}$ from FANG 03 and $B(\eta_c \to K\overline{K}\pi) = (5.5 \pm 1.7) \times 10^{-2}$.

$\Gamma(p\overline{p})/\Gamma_{total} \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{29}/\Gamma \times \Gamma_{36}/\Gamma$

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
0.237±0.024 OUR FIT					
0.26 ±0.05 OUR AVERAGE Error includes scale factor of 1.4.					
$0.224^{+0.038}_{-0.037}\pm0.020$	190	AMBROGIANI	03	E835	$\overline{p}p \to \eta_c \to \gamma\gamma$
$0.336^{+0.080}_{-0.070}$		ARMSTRONG	95F	E760	$\overline{p}p \to \gamma\gamma$
$0.68\ ^{+0.42}_{-0.31}$	12	BAGLIN	87B	SPEC	$\overline{p}p \to \gamma\gamma$

Charge conjugation (C), Parity (P), Lepton family number (LF) violating modes

$\Gamma(\pi^+\pi^-)/\Gamma_{total}$ — Γ_{37}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<11	90	[1] ABLIKIM	11G	BES3	$J/\psi \to \gamma\pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<70	90	[2] ABLIKIM	06B	BES2	$J/\psi \to \pi^+\pi^-\gamma$

[1] ABLIKIM 11G reports $[\Gamma(\eta_c(1S) \to \pi^+\pi^-)/\Gamma_{total}] \times [B(J/\psi(1S) \to \gamma\eta_c(1S))] < 1.82\times10^{-6}$ which we divide by our best value $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 1.7\times10^{-2}$.

[2] ABLIKIM 06B reports $[\Gamma(\eta_c(1S) \to \pi^+\pi^-)/\Gamma_{total}] \times [B(J/\psi(1S) \to \gamma\eta_c(1S))] < 1.1\times10^{-5}$ which we divide by our best value $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 1.7\times10^{-2}$.

$\Gamma(\pi^0\pi^0)/\Gamma_{total}$ — Γ_{38}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
< 3.5	90	[1] ABLIKIM	11G	BES3	$J/\psi \to \gamma\pi^0\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<40	90	[2] ABLIKIM	06B	BES2	$J/\psi \to \pi^0\pi^0\gamma$

[1] ABLIKIM 11G reports $[\Gamma(\eta_c(1S) \to \pi^0\pi^0)/\Gamma_{total}] \times [B(J/\psi(1S) \to \gamma\eta_c(1S))] < 6.0\times10^{-7}$ which we divide by our best value $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 1.7\times10^{-2}$.

[2] ABLIKIM 06B reports $[\Gamma(\eta_c(1S) \to \pi^0\pi^0)/\Gamma_{total}] \times [B(J/\psi(1S) \to \gamma\eta_c(1S))] < 0.71\times10^{-5}$ which we divide by our best value $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 1.7\times10^{-2}$.

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

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<60	90	[1] ABLIKIM	06B	BES2	$J/\psi \to K^+K^-\gamma$

[1] ABLIKIM 06B reports $[\Gamma(\eta_c(1S) \to K^+K^-)/\Gamma_{total}] \times [B(J/\psi(1S) \to \gamma\eta_c(1S))] < 0.96\times10^{-5}$ which we divide by our best value $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 1.7\times10^{-2}$.

$\Gamma(K^0_S K^0_S)/\Gamma_{total}$ — Γ_{40}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<31	90	[1] ABLIKIM	06B	BES2	$J/\psi \to K^0_S K^0_S\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<32	90	[2] UEHARA	13	BELL	$\gamma\gamma \to K^0_S K^0_S$
< 5.6	90	[3] UEHARA	13	BELL	$\gamma\gamma \to K^0_S K^0_S$

[1] ABLIKIM 06B reports $[\Gamma(\eta_c(1S) \to K^0_S K^0_S)/\Gamma_{total}] \times [B(J/\psi(1S) \to \gamma\eta_c(1S))] < 0.53\times10^{-5}$ which we divide by our best value $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 1.7\times10^{-2}$.

[2] Taking into account interference with the non-resonant continuum.

[3] Neglecting interference with the non-resonant continuum.

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ZHANG	12A	PR D86 052002	C.C. Zhang *et al.*	(BELLE Collab.)
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BISELLO	91	NP B350 1	D. Bisello *et al.*	(DM2 Collab.)
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