

$\eta_c(1S)$

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

 $\eta_c(1S)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
2983.9 ± 0.5 OUR AVERAGE		Error includes scale factor of 1.3. See the ideogram below.		
2984.6 ± 0.7 ± 2.2	2673	XU	18 BELL	$e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$
2986.7 ± 0.5 ± 0.9	11K	¹ AAIJ	17AD LHCb	$pp \rightarrow B^+X \rightarrow p\bar{p}K^+X$
2982.8 ± 1.0 ± 0.5	6.4k	² AAIJ	17BB LHCb	$pp \rightarrow b\bar{b}X \rightarrow 2(K^+K^-)X$
2982.2 ± 1.5 ± 0.1	2.0k	³ AAIJ	15BI LHCb	$pp \rightarrow \eta_c(1S)X$
2983.5 ± 1.4 ⁺ ₋ $\frac{1.6}{3.6}$		⁴ ANASHIN	14 KEDR	$J/\psi \rightarrow \gamma\eta_c$
2979.8 ± 0.8 ± 3.5	4.5k	^{5,6} LEES	14E BABR	$\gamma\gamma \rightarrow K^+K^-\pi^0$
2984.1 ± 1.1 ± 2.1	900	^{5,6,7} LEES	14E BABR	$\gamma\gamma \rightarrow K^+K^-\eta$
2984.3 ± 0.6 ± 0.6		^{8,9} ABLIKIM	12F BES3	$\psi(2S) \rightarrow \gamma\eta_c$
2984.49 ± 1.16 ± 0.52	832	⁵ ABLIKIM	12N BES3	$\psi(2S) \rightarrow \pi^0\gamma$ hadrons
2982.7 ± 1.8 ± 2.2	486	ZHANG	12A BELL	$e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$
2984.5 ± 0.8 ± 3.1	11k	DEL-AMO-SA..11M	BABR	$\gamma\gamma \rightarrow K^+K^-\pi^+\pi^-\pi^0$
2985.4 ± 1.5 ⁺ ₋ $\frac{0.5}{2.0}$	920	⁹ VINOKUROVA	11 BELL	$B^\pm \rightarrow K^\pm(K_S^0 K^\pm \pi^\mp)$
2982.2 ± 0.4 ± 1.6	14k	¹⁰ LEES	10 BABR	$10.6 e^+e^- \rightarrow e^+e^-K_S^0 K^\pm \pi^\mp$
2985.8 ± 1.5 ± 3.1	0.9k	AUBERT	08AB BABR	$B \rightarrow \eta_c(1S)K^{(*)} \rightarrow K\bar{K}\pi K^{(*)}$
2986.1 ± 1.0 ± 2.5	7.5k	UEHARA	08 BELL	$\gamma\gamma \rightarrow \eta_c \rightarrow$ hadrons
2970 ± 5 ± 6	501	¹¹ ABE	07 BELL	$e^+e^- \rightarrow J/\psi(c\bar{c})$
2971 ± 3 ⁺ ₋ $\frac{2}{1}$	195	WU	06 BELL	$B^+ \rightarrow p\bar{p}K^+$
2974 ± 7 ⁺ ₋ $\frac{2}{1}$	20	WU	06 BELL	$B^+ \rightarrow \Lambda\bar{\Lambda}K^+$
2981.8 ± 1.3 ± 1.5	592	ASNER	04 CLEO	$\gamma\gamma \rightarrow \eta_c \rightarrow K_S^0 K^\pm \pi^\mp$
2984.1 ± 2.1 ± 1.0	190	¹² AMBROGIANI	03 E835	$\bar{p}p \rightarrow \eta_c \rightarrow \gamma\gamma$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
2982.5 ± 0.4 ± 1.4	12k	¹³ DEL-AMO-SA..11M	BABR	$\gamma\gamma \rightarrow K_S^0 K^\pm \pi^\mp$
2982.2 ± 0.6		¹⁴ MITCHELL	09 CLEO	$e^+e^- \rightarrow \gamma X$
2982 ± 5	270	¹⁵ AUBERT	06E BABR	$B^\pm \rightarrow K^\pm X_{c\bar{c}}$
2982.5 ± 1.1 ± 0.9	2.5k	¹⁶ AUBERT	04D BABR	$\gamma\gamma \rightarrow \eta_c(1S) \rightarrow K\bar{K}\pi$
2977.5 ± 1.0 ± 1.2		^{14,17} BAI	03 BES	$J/\psi \rightarrow \gamma\eta_c$
2979.6 ± 2.3 ± 1.6	180	¹⁸ FANG	03 BELL	$B \rightarrow \eta_c K$
2976.3 ± 2.3 ± 1.2		^{14,19} BAI	00F BES	$J/\psi, \psi(2S) \rightarrow \gamma\eta_c$
2976.6 ± 2.9 ± 1.3	140	^{14,20} BAI	00F BES	$J/\psi \rightarrow \gamma\eta_c$

$2980.4 \pm 2.3 \pm 0.6$	²¹	BRANDENB...	00B	CLE2	$\gamma\gamma \rightarrow \eta_c \rightarrow$ $K^\pm K_S^0 \pi^\mp$
$2975.8 \pm 3.9 \pm 1.2$	²⁰	BAI	99B	BES	Sup. by BAI 00F
2999 ± 8	²⁵	ABREU	98O	DLPH	$e^+ e^- \rightarrow e^+ e^-$ +hadrons
$2988.3 \begin{smallmatrix} + 3.3 \\ - 3.1 \end{smallmatrix}$		ARMSTRONG	95F	E760	$\bar{p}p \rightarrow \gamma\gamma$
2974.4 ± 1.9	^{14,22}	BISELLO	91	DM2	$J/\psi \rightarrow \eta_c \gamma$
$2969 \pm 4 \pm 4$	⁸⁰	¹⁴ BAI	90B	MRK3	$J/\psi \rightarrow$ $\gamma K^+ K^- K^+ K^-$
$2956 \pm 12 \pm 12$	¹⁴	BAI	90B	MRK3	$J/\psi \rightarrow$ $\gamma K^+ K^- K_S^0 K_L^0$
$2982.6 \begin{smallmatrix} + 2.7 \\ - 2.3 \end{smallmatrix}$	¹²	BAGLIN	87B	SPEC	$\bar{p}p \rightarrow \gamma\gamma$
2980.2 ± 1.6	^{14,22}	BALTRUSAIT..	86	MRK3	$J/\psi \rightarrow \eta_c \gamma$
$2984 \pm 2.3 \pm 4.0$	¹⁴	GAISER	86	CBAL	$J/\psi \rightarrow \gamma X, \psi(2S) \rightarrow$ γX
2976 ± 8	^{14,23}	BALTRUSAIT..	84	MRK3	$J/\psi \rightarrow 2\phi\gamma$
2982 ± 8	¹⁸	²⁴ HIMEL	80B	MRK2	$e^+ e^-$
2980 ± 9	²⁴	PARTRIDGE	80B	CBAL	$e^+ e^-$

¹ AAIJ 17AD report $m_{J/\psi} - m_{\eta_c(1S)} = 110.2 \pm 0.5 \pm 0.9$ MeV. We use the current value $m_{J/\psi} = 3096.900 \pm 0.006$ MeV to obtain the quoted mass.

² From a fit of the $\phi\phi$ invariant mass with the mass and width of $\eta_c(1S)$ as free parameters.

³ AAIJ 15BI reports $m_{J/\psi} - m_{\eta_c(1S)} = 114.7 \pm 1.5 \pm 0.1$ MeV from a sample of $\eta_c(1S)$ and J/ψ produced in b -hadron decays. We have used current value of $m_{J/\psi} = 3096.900 \pm 0.006$ MeV to arrive at the quoted $m_{\eta_c(1S)}$ result.

⁴ Taking into account an asymmetric photon lineshape.

⁵ With floating width.

⁶ Ignoring possible interference with the non-resonant 0^- amplitude.

⁷ Using both, $\eta \rightarrow \gamma\gamma$ and $\eta \rightarrow \pi^+ \pi^- \pi^0$ decays.

⁸ From a simultaneous fit to six decay modes of the η_c .

⁹ Accounts for interference with non-resonant continuum.

¹⁰ Taking into account interference with the non-resonant $J^P = 0^-$ amplitude.

¹¹ From a fit of the J/ψ recoil mass spectrum. Supersedes ABE,K 02 and ABE 04G.

¹² Using mass of $\psi(2S) = 3686.00$ MeV.

¹³ Not independent from the measurements reported by LEES 10.

¹⁴ MITCHELL 09 observes a significant asymmetry in the lineshapes of $\psi(2S) \rightarrow \gamma\eta_c$ and $J/\psi \rightarrow \gamma\eta_c$ 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.

¹⁵ From the fit of the kaon momentum spectrum. Systematic errors not evaluated.

¹⁶ Superseded by LEES 10.

¹⁷ From a simultaneous fit of five decay modes of the η_c .

¹⁸ Superseded by VINOKUROVA 11.

¹⁹ Weighted average of the $\psi(2S)$ and $J/\psi(1S)$ samples. Using an η_c width of 13.2 MeV.

²⁰ Average of several decay modes. Using an η_c width of 13.2 MeV.

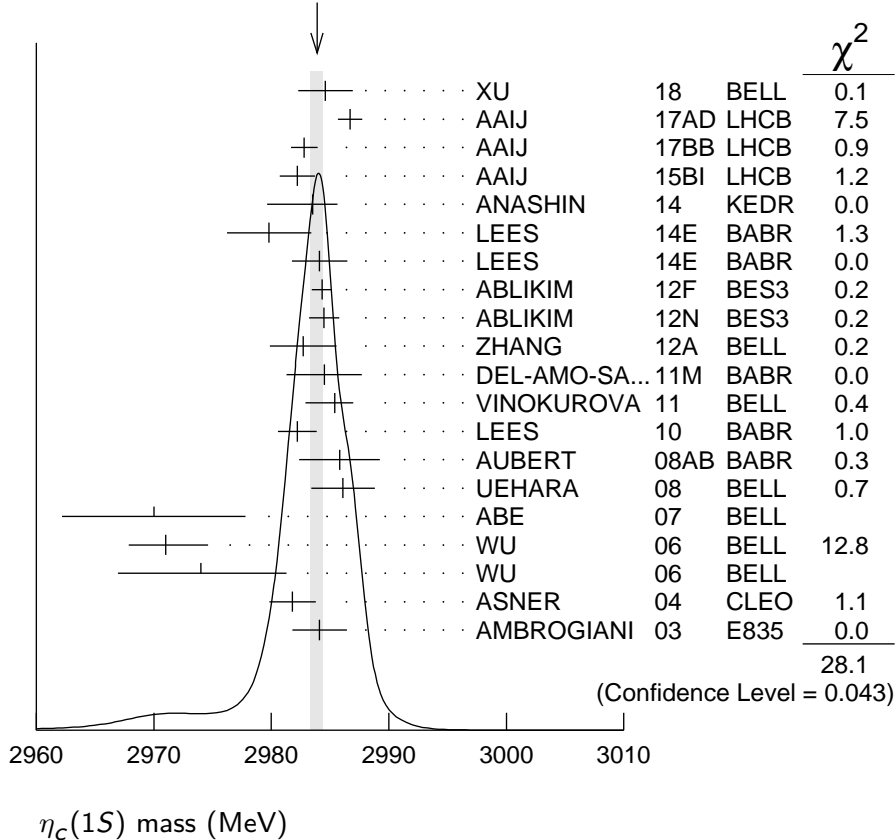
²¹ Superseded by ASNER 04.

²² Average of several decay modes.

²³ $\eta_c \rightarrow \phi\phi$.

²⁴ Mass adjusted by us to correspond to $J/\psi(1S)$ mass = 3097 MeV.

WEIGHTED AVERAGE
 2983.9 ± 0.5 (Error scaled by 1.3)



$\eta_c(1S)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
31.9 ± 0.7 OUR FIT				
32.1 ± 0.8 OUR AVERAGE				Error includes scale factor of 1.1.
$30.8^{+2.3}_{-2.2} \pm 2.9$	2673	XU	18 BELL	$e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$
$34.0 \pm 1.9 \pm 1.3$	11K	AAIJ	17AD LHCb	$pp \rightarrow B^+X \rightarrow p\bar{p}K^+X$
$31.4 \pm 3.5 \pm 2.0$	6.4k	¹ AAIJ	17BB LHCb	$pp \rightarrow b\bar{b}X \rightarrow 2(K^+K^-)X$
$27.2 \pm 3.1^{+5.4}_{-2.6}$		² ANASHIN	14 KEDR	$J/\psi \rightarrow \gamma\eta_c$
$25.2 \pm 2.6 \pm 2.4$	4.5k	^{3,4} LEES	14E BABR	$\gamma\gamma \rightarrow K^+K^-\pi^0$
$34.8 \pm 3.1 \pm 4.0$	900	^{3,4,5} LEES	14E BABR	$\gamma\gamma \rightarrow K^+K^-\eta$
$32.0 \pm 1.2 \pm 1.0$		^{6,7} 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	⁷ VINOKUROVA	11 BELL	$B^\pm \rightarrow K^\pm(K_S^0 K^\pm \pi^\mp)$
$31.7 \pm 1.2 \pm 0.8$	14k	⁸ LEES	10 BABR	$10.6 e^+e^- \rightarrow e^+e^-K_S^0 K^\pm \pi^\mp$

$36.3^{+3.7}_{-3.6} \pm 4.4$	0.9k	AUBERT	08AB BABR	$B \rightarrow \eta_c(1S) K^{(*)} \rightarrow K\bar{K}\pi K^{(*)}$
$28.1 \pm 3.2 \pm 2.2$	7.5k	UEHARA	08 BELL	$\gamma\gamma \rightarrow \eta_c \rightarrow \text{hadrons}$
$48^{+8}_{-7} \pm 5$	195	WU	06 BELL	$B^+ \rightarrow p\bar{p}K^+$
$40 \pm 19 \pm 5$	20	WU	06 BELL	$B^+ \rightarrow \Lambda\bar{\Lambda}K^+$
$24.8 \pm 3.4 \pm 3.5$	592	ASNER	04 CLEO	$\gamma\gamma \rightarrow \eta_c \rightarrow K_S^0 K^\pm \pi^\mp$
$20.4^{+7.7}_{-6.7} \pm 2.0$	190	AMBROGIANI	03 E835	$\bar{p}p \rightarrow \eta_c \rightarrow \gamma\gamma$
$23.9^{+12.6}_{-7.1}$		ARMSTRONG	95F E760	$\bar{p}p \rightarrow \gamma\gamma$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$32.1 \pm 1.1 \pm 1.3$	12k	⁹ DEL-AMO-SA..11M	BABR	$\gamma\gamma \rightarrow K_S^0 K^\pm \pi^\mp$
$34.3 \pm 2.3 \pm 0.9$	2.5k	¹⁰ AUBERT	04D BABR	$\gamma\gamma \rightarrow \eta_c(1S) \rightarrow K\bar{K}\pi$
$17.0 \pm 3.7 \pm 7.4$		¹¹ BAI	03 BES	$J/\psi \rightarrow \gamma\eta_c$
$29 \pm 8 \pm 6$	180	¹² FANG	03 BELL	$B \rightarrow \eta_c K$
$11.0 \pm 8.1 \pm 4.1$		¹³ BAI	00F BES	$J/\psi \rightarrow \gamma\eta_c$ and $\psi(2S) \rightarrow \gamma\eta_c$
$27.0 \pm 5.8 \pm 1.4$		¹⁴ BRANDENB...	00B CLE2	$\gamma\gamma \rightarrow \eta_c \rightarrow K^\pm K_S^0 \pi^\mp$
$7.0^{+7.5}_{-7.0}$	12	BAGLIN	87B SPEC	$\bar{p}p \rightarrow \gamma\gamma$
$10.1^{+33.0}_{-8.2}$	23	¹⁵ BALTRUSAIT..86	MRK3	$J/\psi \rightarrow \gamma p\bar{p}$
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 fit of the $\phi\phi$ invariant mass with the mass and width of $\eta_c(1S)$ as free parameters.

² Taking into account an asymmetric photon lineshape.

³ With floating mass.

⁴ Ignoring possible interference with the non-resonant 0^- amplitude.

⁵ Using both, $\eta \rightarrow \gamma\gamma$ and $\eta \rightarrow \pi^+\pi^-\pi^0$ decays.

⁶ From a simultaneous fit to six decay modes of the η_c .

⁷ Accounts for interference with non-resonant continuum.

⁸ Taking into account interference with the non-resonant $J^P = 0^-$ amplitude.

⁹ Not independent from the measurements reported by LEES 10.

¹⁰ Superseded by LEES 10.

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

¹² Superseded by VINOKUROVA 11.

¹³ From a fit to the 4-prong invariant mass in $\psi(2S) \rightarrow \gamma\eta_c$ and $J/\psi(1S) \rightarrow \gamma\eta_c$ decays.

¹⁴ Superseded by ASNER 04.

¹⁵ Positive and negative errors correspond to 90% confidence level.

$\eta_c(1S)$ DECAY MODES

Mode	Fraction (Γ_j/Γ)	Confidence level
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Decays involving hadronic resonances

Γ_1	$\eta'(958)\pi\pi$	(4.1 \pm 1.7) %	
Γ_2	$\rho\rho$	(1.8 \pm 0.5) %	
Γ_3	$K^*(892)^0 K^- \pi^+ + \text{c.c.}$	(2.0 \pm 0.7) %	
Γ_4	$K^*(892)\bar{K}^*(892)$	(7.1 \pm 1.3) $\times 10^{-3}$	
Γ_5	$K^*(892)^0 \bar{K}^*(892)^0 \pi^+ \pi^-$	(1.1 \pm 0.5) %	
Γ_6	$\phi K^+ K^-$	(2.9 \pm 1.4) $\times 10^{-3}$	
Γ_7	$\phi\phi$	(1.79 \pm 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}	$K^*(892)\bar{K} + \text{c.c.}$	< 1.28 %	90%
Γ_{12}	$f_2(1270)\eta$	< 1.1 %	90%
Γ_{13}	$\omega\omega$	< 3.1 $\times 10^{-3}$	90%
Γ_{14}	$\omega\phi$	< 2.5 $\times 10^{-4}$	90%
Γ_{15}	$f_2(1270)f_2(1270)$	(9.8 \pm 2.5) $\times 10^{-3}$	
Γ_{16}	$f_2(1270)f_2'(1525)$	(9.8 \pm 3.2) $\times 10^{-3}$	
Γ_{17}	$f_0(980)\eta$	seen	
Γ_{18}	$f_0(1500)\eta$	seen	
Γ_{19}	$f_0(2200)\eta$	seen	
Γ_{20}	$a_0(980)\pi$	seen	
Γ_{21}	$a_0(1320)\pi$	seen	
Γ_{22}	$a_0(1450)\pi$	seen	
Γ_{23}	$a_0(1950)\pi$	seen	
Γ_{24}	$K_0^*(1430)\bar{K}$	seen	
Γ_{25}	$K_2^*(1430)\bar{K}$	seen	
Γ_{26}	$K_0^*(1950)\bar{K}$	seen	

Decays into stable hadrons

Γ_{27}	$K\bar{K}\pi$	(7.3 \pm 0.5) %	
Γ_{28}	$K\bar{K}\eta$	(1.36 \pm 0.16) %	
Γ_{29}	$\eta\pi^+\pi^-$	(1.7 \pm 0.5) %	
Γ_{30}	$\eta 2(\pi^+ \pi^-)$	(4.4 \pm 1.3) %	
Γ_{31}	$K^+ K^- \pi^+ \pi^-$	(6.9 \pm 1.1) $\times 10^{-3}$	
Γ_{32}	$K^+ K^- \pi^+ \pi^- \pi^0$	(3.5 \pm 0.6) %	
Γ_{33}	$K^0 K^- \pi^+ \pi^- \pi^+ + \text{c.c.}$	(5.6 \pm 1.5) %	
Γ_{34}	$K^+ K^- 2(\pi^+ \pi^-)$	(7.5 \pm 2.4) $\times 10^{-3}$	
Γ_{35}	$2(K^+ K^-)$	(1.47 \pm 0.31) $\times 10^{-3}$	
Γ_{36}	$\pi^+ \pi^- \pi^0$	< 5 $\times 10^{-4}$	90%
Γ_{37}	$\pi^+ \pi^- \pi^0 \pi^0$	(4.7 \pm 1.0) %	
Γ_{38}	$2(\pi^+ \pi^-)$	(9.7 \pm 1.2) $\times 10^{-3}$	
Γ_{39}	$2(\pi^+ \pi^- \pi^0)$	(17.4 \pm 3.3) %	
Γ_{40}	$3(\pi^+ \pi^-)$	(1.8 \pm 0.4) %	

Γ_{41}	$p\bar{p}$	$(1.51 \pm 0.16) \times 10^{-3}$
Γ_{42}	$p\bar{p}\pi^0$	$(3.6 \pm 1.3) \times 10^{-3}$
Γ_{43}	$\Lambda\bar{\Lambda}$	$(1.09 \pm 0.24) \times 10^{-3}$
Γ_{44}	$K^+\bar{p}\Lambda + \text{c.c.}$	$(2.5 \pm 0.4) \times 10^{-3}$
Γ_{45}	$\bar{\Lambda}(1520)\Lambda + \text{c.c.}$	$(3.1 \pm 1.3) \times 10^{-3}$
Γ_{46}	$\Sigma^+\bar{\Sigma}^-$	$(2.1 \pm 0.6) \times 10^{-3}$
Γ_{47}	$\Xi^-\bar{\Xi}^+$	$(9.0 \pm 2.6) \times 10^{-4}$
Γ_{48}	$\pi^+\pi^-p\bar{p}$	$(5.3 \pm 1.8) \times 10^{-3}$

Radiative decays

Γ_{49}	$\gamma\gamma$	$(1.57 \pm 0.12) \times 10^{-4}$
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**Charge conjugation (C), Parity (P),
Lepton family number (LF) violating modes**

Γ_{50}	$\pi^+\pi^-$	$P, CP < 1.1$	$\times 10^{-4}$	90%
Γ_{51}	$\pi^0\pi^0$	$P, CP < 4$	$\times 10^{-5}$	90%
Γ_{52}	K^+K^-	$P, CP < 6$	$\times 10^{-4}$	90%
Γ_{53}	$K_S^0K_S^0$	$P, CP < 3.1$	$\times 10^{-4}$	90%

CONSTRAINED FIT INFORMATION

An overall fit to the total width, 8 combinations of partial widths obtained from integrated cross section, and 19 branching ratios uses 89 measurements and one constraint to determine 13 parameters. The overall fit has a $\chi^2 = 120.0$ for 77 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\langle \delta p_i \delta p_j \rangle / (\delta p_i \cdot \delta p_j)$, 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	17									
x_{15}	3	6								
x_{27}	21	41	7							
x_{28}	11	22	4	54						
x_{31}	11	20	4	24	13					
x_{35}	9	16	3	25	13	10				
x_{38}	13	25	5	30	16	15	12			
x_{41}	14	25	5	35	19	16	13	19		
x_{43}	3	6	1	9	5	4	3	5	25	
x_{49}	-29	-54	-10	-66	-35	-34	-26	-41	-45	-11
Γ	-1	-3	0	-3	-2	-2	-1	-2	6	2
	x_4	x_7	x_{15}	x_{27}	x_{28}	x_{31}	x_{35}	x_{38}	x_{41}	x_{43}

$$\Gamma \left| \begin{array}{l} -26 \\ \times 49 \end{array} \right.$$

	Mode	Rate (MeV)
Γ_4	$K^*(892)\bar{K}^*(892)$	0.23 ± 0.04
Γ_7	$\phi\phi$	0.057 ± 0.006
Γ_{15}	$f_2(1270)f_2(1270)$	0.31 ± 0.08
Γ_{27}	$K\bar{K}\pi$	2.34 ± 0.16
Γ_{28}	$K\bar{K}\eta$	0.43 ± 0.05
Γ_{31}	$K^+K^-\pi^+\pi^-$	0.222 ± 0.034
Γ_{35}	$2(K^+K^-)$	0.047 ± 0.010
Γ_{38}	$2(\pi^+\pi^-)$	0.31 ± 0.04
Γ_{41}	$p\bar{p}$	0.048 ± 0.005
Γ_{43}	$\Lambda\bar{\Lambda}$	0.035 ± 0.008
Γ_{49}	$\gamma\gamma$	0.0050 ± 0.0004

$\eta_c(1S)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$ Γ_{49}

VALUE (keV)	EVTS	DOCUMENT ID	TECN	COMMENT
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5.0 ± 0.4 OUR FIT

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

5.8 ± 1.1	486	¹ ZHANG	12A BELL	$e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$
5.2 ± 1.2	273 ± 43	^{2,3} AUBERT	06E BABR	$B^\pm \rightarrow K^\pm X_c \bar{c}$
$5.5 \pm 1.2 \pm 1.8$	157 ± 33	⁴ KUO	05 BELL	$\gamma\gamma \rightarrow p\bar{p}$
$7.4 \pm 0.4 \pm 2.3$		⁵ ASNER	04 CLEO	$\gamma\gamma \rightarrow \eta_c \rightarrow K_S^0 K^\pm \pi^\mp$
$13.9 \pm 2.0 \pm 3.0$	41	⁶ ABDALLAH	03J DLPH	$\gamma\gamma \rightarrow \eta_c$
$3.8^+_{-1.0} \ 1.1^+_{-1.0}$	190	⁷ AMBROGIANI	03 E835	$\bar{p}p \rightarrow \eta_c \rightarrow \gamma\gamma$
$7.6 \pm 0.8 \pm 2.3$		^{5,8} BRANDENB...	00B CLE2	$\gamma\gamma \rightarrow \eta_c \rightarrow K^\pm K_S^0 \pi^\mp$
$6.9 \pm 1.7 \pm 2.1$	76	⁹ ACCIARRI	99T L3	$e^+e^- \rightarrow e^+e^-\eta_c$
$27 \pm 16 \pm 10$	5	⁵ SHIRAI	98 AMY	58 e^+e^-
$6.7^+_{-1.7} \ 2.4 \pm 2.3$		⁴ ARMSTRONG	95F E760	$\bar{p}p \rightarrow \gamma\gamma$
11.3 ± 4.2		¹⁰ ALBRECHT	94H ARG	$e^+e^- \rightarrow e^+e^-\eta_c$
$8.0 \pm 2.3 \pm 2.4$	17	¹¹ ADRIANI	93N L3	$e^+e^- \rightarrow e^+e^-\eta_c$
$5.9^+_{-1.8} \ 2.1 \pm 1.9$		⁷ CHEN	90B CLEO	$e^+e^- \rightarrow e^+e^-\eta_c$
$6.4^+_{-3.4} \ 5.0$		¹² AIHARA	88D TPC	$e^+e^- \rightarrow e^+e^-X$
$4.3^+_{-3.7} \ 3.4 \pm 2.4$		⁴ BAGLIN	87B SPEC	$\bar{p}p \rightarrow \gamma\gamma$
28 ± 15		^{5,13} BERGER	86 PLUT	$\gamma\gamma \rightarrow K\bar{K}\pi$

- ¹ Assuming there is no interference with the non-resonant background.
- ² Calculated by us using $\Gamma(\eta_c \rightarrow K\bar{K}\pi) \times \Gamma(\eta_c \rightarrow \gamma\gamma) / \Gamma = 0.44 \pm 0.05$ keV from PDG 06 and $B(\eta_c \rightarrow K\bar{K}\pi) = (8.5 \pm 1.8)\%$ from AUBERT 06E.
- ³ Systematic errors not evaluated.
- ⁴ Normalized to $B(\eta_c \rightarrow p\bar{p}) = (1.3 \pm 0.4) \times 10^{-3}$.
- ⁵ Normalized to $B(\eta_c \rightarrow K^\pm K_S^0 \pi^\mp)$.
- ⁶ Average of $K_S^0 K^\pm \pi^\mp$, $\pi^+ \pi^- K^+ K^-$, and $2(K^+ K^-)$ decay modes.
- ⁷ Normalized to the sum of $B(\eta_c \rightarrow K^\pm K_S^0 \pi^\mp)$, $B(\eta_c \rightarrow K^+ K^- \pi^+ \pi^-)$, and $B(\eta_c \rightarrow 2\pi^+ 2\pi^-)$.
- ⁸ Superseded by ASNER 04.
- ⁹ Normalized to the sum of 9 branching ratios.
- ¹⁰ Normalized to the sum of $B(\eta_c \rightarrow K^\pm K_S^0 \pi^\mp)$, $B(\eta_c \rightarrow \phi\phi)$, $B(\eta_c \rightarrow K^+ K^- \pi^+ \pi^-)$, and $B(\eta_c \rightarrow 2\pi^+ 2\pi^-)$.
- ¹¹ Superseded by ACCIARRI 99T.
- ¹² Normalized to the sum of $B(\eta_c \rightarrow K^\pm K_S^0 \pi^\mp)$, $B(\eta_c \rightarrow 2K^+ 2K^-)$, $B(\eta_c \rightarrow K^+ K^- \pi^+ \pi^-)$, and $B(\eta_c \rightarrow 2\pi^+ 2\pi^-)$.
- ¹³ Re-evaluated by AIHARA 88D.

$\eta_c(1S) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(\eta'(958)\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_1\Gamma_{49}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID	TECN	COMMENT
98.1±3.9±11.7	2673	XU	18	BELL $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
75.8 ^{+6.3} _{-6.2} ± 8.4	486	¹ ZHANG	12A	BELL $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$

¹ Superseded by XU 18.

$\Gamma(\rho\rho) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_2\Gamma_{49}/\Gamma$

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 $\gamma\gamma \rightarrow 2(\pi^+\pi^-)$

$\Gamma(K^*(892)\bar{K}^*(892)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_4\Gamma_{49}/\Gamma$

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

$\Gamma(\phi\phi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_7\Gamma_{49}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID	TECN	COMMENT
9.0 ± 0.8 OUR FIT				
7.75±0.66±0.62	386 ± 31	¹ LIU	12B	BELL $\gamma\gamma \rightarrow 2(K^+K^-)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
6.8 ± 1.2 ± 1.3	132 ± 23	UEHARA	08	BELL $\gamma\gamma \rightarrow 2(K^+K^-)$

¹ Supersedes UEHARA 08. Using $B(\phi \rightarrow K^+K^-) = (48.9 \pm 0.5)\%$.

$\Gamma(\omega\omega) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_{13}\Gamma_{49}/\Gamma$

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

¹ Using $B(\omega \rightarrow \pi^+\pi^-\pi^0) = (89.2 \pm 0.7)\%$.

$\Gamma(\omega\phi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_{14}\Gamma_{49}/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.49	90	¹ LIU	12B BELL	$\gamma\gamma \rightarrow K^+K^-\pi^+\pi^-\pi^0$
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¹ Using $B(\phi \rightarrow K^+K^-) = (48.9 \pm 0.5)\%$ and $B(\omega \rightarrow \pi^+\pi^-\pi^0) = (89.2 \pm 0.7)\%$.

$\Gamma(f_2(1270)f_2(1270)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_{15}\Gamma_{49}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID	TECN	COMMENT
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49±13 OUR FIT

69±17±12	3182 ± 766	UEHARA	08 BELL	$\gamma\gamma \rightarrow 2(\pi^+\pi^-)$
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$\Gamma(f_2(1270)f'_2(1525)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_{16}\Gamma_{49}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID	TECN	COMMENT
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49±9±13	1128 ± 206	UEHARA	08 BELL	$\gamma\gamma \rightarrow \pi^+\pi^-K^+K^-$
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$\Gamma(K\bar{K}\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_{27}\Gamma_{49}/\Gamma$

VALUE (keV)	CL% EVTS	DOCUMENT ID	TECN	COMMENT
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0.367±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	$10.6 e^+e^- \rightarrow e^+e^-K_S^0K^\pm\pi^\mp$
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0.407±0.022±0.028		^{2,3} ASNER	04 CLEO	$\gamma\gamma \rightarrow \eta_c \rightarrow K_S^0K^\pm\pi^\mp$
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0.60 ±0.12 ±0.09	41	^{3,4} ABDALLAH	03J DLPH	$\gamma\gamma \rightarrow K_S^0K^\pm\pi^\mp$
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1.47 ±0.87 ±0.27		³ SHIRAI	98 AMY	$\gamma\gamma \rightarrow \eta_c \rightarrow K^\pm K_S^0\pi^\mp$
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0.84 ±0.21		³ ALBRECHT	94H ARG	$\gamma\gamma \rightarrow K^\pm K_S^0\pi^\mp$
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0.60 ^{+0.23} _{-0.20}		³ CHEN	90B CLEO	$\gamma\gamma \rightarrow \eta_c K^\pm K_S^0\pi^\mp$
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1.06 ±0.41 ±0.27	11	³ BRAUNSCH...	89 TASS	$\gamma\gamma \rightarrow K\bar{K}\pi$
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1.5 ^{+0.60} _{-0.45} ±0.3	7	³ BERGER	86 PLUT	$\gamma\gamma \rightarrow K\bar{K}\pi$
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• • • 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	$\gamma\gamma \rightarrow K_S^0K^\pm\pi^\mp$
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0.418±0.044±0.022		^{3,6} BRANDENB...	00B CLE2	$\gamma\gamma \rightarrow \eta_c \rightarrow K^\pm K_S^0\pi^\mp$
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<0.63	95	³ BEHREND	89 CELL	$\gamma\gamma \rightarrow K_S^0K^\pm\pi^\mp$
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<4.4	95	ALTHOFF	85B TASS	$\gamma\gamma \rightarrow K\bar{K}\pi$
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¹ From the corrected and unfolded mass spectrum.

² Calculated by us from the value reported in ASNER 04 that assumes $B(\eta_c \rightarrow K\bar{K}\pi) = 5.5 \pm 1.7\%$

³ We have multiplied $K^\pm K_S^0 \pi^\mp$ measurement by 3 to obtain $K\bar{K}\pi$.

⁴ Calculated by us from the value reported in ABDALLAH 03J, which uses $B(\eta_c \rightarrow K_S^0 K^\pm \pi^\mp) = (1.5 \pm 0.4)\%$.

⁵ Not independent from the measurements reported by LEES 10.

⁶ Superseded by ASNER 04.

$\Gamma(K^+ K^- \pi^+ \pi^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_{31}\Gamma_{49}/\Gamma$

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	$\gamma\gamma \rightarrow \pi^+ \pi^- K^+ K^-$
280 ± 100 ± 60	42	¹ ABDALLAH	03J DLPH	$\gamma\gamma \rightarrow \pi^+ \pi^- K^+ K^-$
170 ± 80 ± 20	13.9 ± 6.6	ALBRECHT	94H ARG	$\gamma\gamma \rightarrow \pi^+ \pi^- K^+ K^-$

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

$\Gamma(K^+ K^- \pi^+ \pi^- \pi^0) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_{32}\Gamma_{49}/\Gamma$

VALUE (keV)	EVTS	DOCUMENT ID	TECN	COMMENT
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• • • 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 $\gamma\gamma \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$

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

$\Gamma(2(K^+ K^-)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_{35}\Gamma_{49}/\Gamma$

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	$\gamma\gamma \rightarrow 2(K^+ K^-)$
350 ± 90 ± 60	46	¹ ABDALLAH	03J DLPH	$\gamma\gamma \rightarrow 2(K^+ K^-)$
231 ± 90 ± 23	9.1 ± 3.3	² ALBRECHT	94H ARG	$\gamma\gamma \rightarrow 2(K^+ K^-)$

¹ Calculated by us from the value reported in ABDALLAH 03J, which uses $B(\eta_c \rightarrow 2(K^+ K^-)) = (2.1 \pm 1.2)\%$.

² Includes all topological modes except $\eta_c \rightarrow \phi\phi$.

$\Gamma(2(\pi^+ \pi^-)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_{38}\Gamma_{49}/\Gamma$

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	$\gamma\gamma \rightarrow 2(\pi^+ \pi^-)$
180 ± 70 ± 20	21.4 ± 8.6	ALBRECHT	94H ARG	$\gamma\gamma \rightarrow 2(\pi^+ \pi^-)$

$\Gamma(p\bar{p}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_{41}\Gamma_{49}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID	TECN	COMMENT
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7.6 ± 0.7 OUR FIT

7.20 ± 1.53^{+0.67}_{-0.75}	157 ± 33	¹ KUO	05 BELL	$\gamma\gamma \rightarrow p\bar{p}$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

4.6 ^{+1.3} _{-1.1} ± 0.4	190	¹ AMBROGIANI	03 E835	$\bar{p}p \rightarrow \gamma\gamma$
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8.1 ^{+2.9} _{-2.0}		¹ ARMSTRONG	95F E760	$\bar{p}p \rightarrow \gamma\gamma$
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¹ Not independent from the $\Gamma_{\gamma\gamma}$ reported by the same experiment.

$\Gamma(K_S^0 K_S^0) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_{53}\Gamma_{49}/\Gamma$

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

<0.29	90	² UEHARA	13 BELL	$\gamma\gamma \rightarrow K_S^0 K_S^0$
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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

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

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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0.041 ± 0.017	14	¹ BALTRUSAIT..86	MRK3	$J/\psi \rightarrow \eta_c \gamma$
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¹ The quoted branching ratios use $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$.

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

VALUE (units 10 ⁻³)	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
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18 ± 5 OUR AVERAGE

12.6 ± 3.8 ± 5.1	72	¹ ABLIKIM	05L BES2	$J/\psi \rightarrow \pi^+ \pi^- \pi^+ \pi^- \gamma$
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26.0 ± 2.4 ± 8.8	113	¹ BISELLO	91 DM2	$J/\psi \rightarrow \gamma \rho^0 \rho^0$
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23.6 ± 10.6 ± 8.2	32	¹ BISELLO	91 DM2	$J/\psi \rightarrow \gamma \rho^+ \rho^-$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

<14	90	¹ BALTRUSAIT..86	MRK3	$J/\psi \rightarrow \eta_c \gamma$
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¹ The quoted branching ratios use $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$. Where relevant, the error in this branching ratio is treated as a common systematic in computing averages.

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

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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0.02 ± 0.007	63	^{1,2} BALTRUSAIT..86	MRK3	$J/\psi \rightarrow \eta_c \gamma$
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¹ BALTRUSAITIS 86 has an error according to Partridge.

² The quoted branching ratios use $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$.

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

VALUE (units 10^{-4})	EVTS	DOCUMENT ID	TECN	COMMENT
71±13 OUR FIT				
91±26 OUR AVERAGE				
108±25±44	60	¹ ABLIKIM	05L BES2	$J/\psi \rightarrow K^+ K^- \pi^+ \pi^- \gamma$
82±28±27	14	¹ BISELLO	91 DM2	$e^+ e^- \rightarrow \gamma K^+ K^- \pi^+ \pi^-$
90±50	9	¹ BALTRUSAIT..86	MRK3	$J/\psi \rightarrow \eta_c \gamma$

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

$\Gamma(K^*(892)^0 \bar{K}^*(892)^0 \pi^+ \pi^-)/\Gamma_{\text{total}}$ Γ_5/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID	TECN	COMMENT
113±47±24	45	¹ ABLIKIM	06A BES2	$J/\psi \rightarrow K^{*0} \bar{K}^{*0} \pi^+ \pi^- \gamma$

¹ ABLIKIM 06A reports $[\Gamma(\eta_c(1S) \rightarrow K^*(892)^0 \bar{K}^*(892)^0 \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma \eta_c(1S))] = (1.91 \pm 0.64 \pm 0.48) \times 10^{-4}$ 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.

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

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
2.9^{+0.9}_{-0.8}±1.1	14.1 ^{+4.4} _{-3.7}	¹ HUANG	03 BELL	$B^+ \rightarrow (\phi K^+ K^-) K^+$

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

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

VALUE (units 10^{-4})	EVTS	DOCUMENT ID	TECN	COMMENT
17.9± 2.0 OUR FIT				
28 ± 4 OUR AVERAGE				

26 ⁺⁴ ₋₈ ± 5	1.2k	¹ ABLIKIM	17P BES3	$J/\psi \rightarrow K^+ K^- K^+ K^- \gamma$
25.3± 5.1± 9.1	72	² ABLIKIM	05L BES2	$J/\psi \rightarrow K^+ K^- K^+ K^- \gamma$
26 ± 9	357	² BAI	04 BES	$J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$
31 ± 7 ± 10	19	² BISELLO	91 DM2	$J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$
30 ⁺¹⁸ ₋₁₂ ± 10	5	² BISELLO	91 DM2	$J/\psi \rightarrow \gamma K^+ K^- K_S^0 K_L^0$
74 ± 18 ± 24	80	² BAI	90B MRK3	$J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$
67 ± 21 ± 24		² BAI	90B MRK3	$J/\psi \rightarrow \gamma K^+ K^- K_S^0 K_L^0$

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

18 ⁺⁸ ₋₆ ± 7	7	³ HUANG	03 BELL	$B^+ \rightarrow (\phi\phi) K^+$
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¹ ABLIKIM 17P reports $[\Gamma(\eta_c(1S) \rightarrow \phi\phi)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma \eta_c(1S))] = (4.3 \pm 0.5^{+0.5}_{-1.2}) \times 10^{-5}$ 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.

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

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

$\Gamma(\phi\phi)/\Gamma(K\bar{K}\pi)$

Γ_7/Γ_{27}

VALUE	EVTs	DOCUMENT ID	TECN	COMMENT
0.0245 ± 0.0025 OUR FIT				

0.044 $\begin{smallmatrix} +0.012 \\ -0.010 \end{smallmatrix}$ OUR AVERAGE

0.055 ± 0.014 ± 0.005		AUBERT,B	04B	BABR	$B^\pm \rightarrow K^\pm \eta_c$
0.032 $\begin{smallmatrix} +0.014 \\ -0.010 \end{smallmatrix}$ ± 0.009	7	¹ HUANG	03	BELL	$B^\pm \rightarrow K^\pm \phi\phi$

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

$\Gamma(\phi\phi)/\Gamma(p\bar{p})$

Γ_7/Γ_{41}

VALUE	EVTs	DOCUMENT ID	TECN	COMMENT	
1.79 ± 0.14 ± 0.32	6.4k	¹ AAIJ	17BB	LHCB	$pp \rightarrow b\bar{b}X \rightarrow 2(K^+ K^-)X$

¹ Using inputs from AAIJ 15AS and AAIJ 15BI and $\Gamma(b \rightarrow J/\psi(1S) \text{ anything})/\Gamma_{\text{total}} = (1.16 \pm 0.10)\%$ and $\Gamma(J/\psi(1S) \rightarrow p\bar{p})/\Gamma_{\text{total}} = (2.120 \pm 0.029) \times 10^{-3}$ from PDG 16.

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

Γ_8/Γ

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

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

$\Gamma(a_0(980)\pi)/\Gamma_{\text{total}}$

Γ_9/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.02	90	^{1,2} BALTRUSAIT..86	MRK3	$J/\psi \rightarrow \eta_c \gamma$

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

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

$\Gamma(a_2(1320)\pi)/\Gamma_{\text{total}}$

Γ_{10}/Γ

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

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

$\Gamma(K^*(892)\bar{K} + \text{c.c.})/\Gamma_{\text{total}}$

Γ_{11}/Γ

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

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

$\Gamma(f_2(1270)\eta)/\Gamma_{\text{total}}$

Γ_{12}/Γ

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

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

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

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.0031	90	¹ BALTRUSAIT..86	MRK3	$J/\psi \rightarrow \eta_c \gamma$
<0.0063	90	¹ ABLIKIM	05L BES2	$J/\psi \rightarrow \pi^+ \pi^- \pi^0 \pi^+ \pi^- \pi^0 \gamma$
<0.0063		¹ BISELLO	91 DM2	$J/\psi \rightarrow \gamma \omega \omega$

• • • We do not use the following data for averages, fits, limits, etc. • • •
¹ The quoted branching ratios use $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = 0.0127 \pm 0.0036$. Where relevant, the error in this branching ratio is treated as a common systematic in computing averages.

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

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
< 2.5 × 10⁻⁴	90	¹ ABLIKIM	17P BES3	$J/\psi \rightarrow \pi^+ \pi^- \pi^0 K^+ K^- \gamma$
<17 × 10 ⁻⁴	90	² ABLIKIM	05L BES2	$J/\psi \rightarrow \pi^+ \pi^- \pi^0 K^+ K^- \gamma$

• • • We do not use the following data for averages, fits, limits, etc. • • •
¹ Using $B(J/\psi \rightarrow \gamma \eta_c) = 0.017 \pm 0.004$.
² The quoted branching ratios use $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = 0.0127 \pm 0.0036$.

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

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

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

$\Gamma(f_0(980)\eta)/\Gamma_{\text{total}}$ Γ_{17}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	LEES	14E BABR	Dalitz anal. of $\eta_c \rightarrow K^+ K^- \eta$

$\Gamma(f_0(1500)\eta)/\Gamma_{\text{total}}$ Γ_{18}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	LEES	14E BABR	Dalitz anal. of $\eta_c \rightarrow K^+ K^- \eta$

$\Gamma(f_0(2200)\eta)/\Gamma_{\text{total}}$ Γ_{19}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	LEES	14E BABR	Dalitz anal. of $\eta_c \rightarrow K^+ K^- \eta$

$\Gamma(a_0(980)\pi)/\Gamma_{\text{total}}$ Γ_{20}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	LEES	14E BABR	Dalitz anal. of $\eta_c \rightarrow K^+ K^- \pi^0$

$\Gamma(a_0(1320)\pi)/\Gamma_{\text{total}}$ Γ_{21}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	LEES	14E BABR	Dalitz anal. of $\eta_c \rightarrow K^+ K^- \pi^0$

$\Gamma(a_0(1450)\pi)/\Gamma_{\text{total}}$ Γ_{22}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	LEES	14E	BABR Dalitz anal. of $\eta_c \rightarrow K^+ K^- \pi^0$

$\Gamma(a_0(1950)\pi)/\Gamma_{\text{total}}$ Γ_{23}/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
seen	12k	¹ LEES	16A	BABR $\gamma\gamma \rightarrow \eta_c(1S) \rightarrow K\bar{K}\pi$

¹ From a model-independent partial wave analysis.

$\Gamma(K_0^*(1430)\bar{K})/\Gamma_{\text{total}}$ Γ_{24}/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
seen	12k	¹ LEES	16A	BABR $\gamma\gamma \rightarrow \eta_c(1S) \rightarrow K\bar{K}\pi$
seen		LEES	14E	BABR Dalitz anal. of $\eta_c \rightarrow K^+ K^- \eta/\pi^0$

¹ From a model-independent partial wave analysis.

$\Gamma(K_2^*(1430)\bar{K})/\Gamma_{\text{total}}$ Γ_{25}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	LEES	14E	BABR Dalitz anal. of $\eta_c \rightarrow K^+ K^- \pi^0$

$\Gamma(K_0^*(1950)\bar{K})/\Gamma_{\text{total}}$ Γ_{26}/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
seen	12K	¹ LEES	16A	BABR $\gamma\gamma \rightarrow \eta_c(1S) \rightarrow K\bar{K}\pi$
seen		LEES	14E	BABR Dalitz anal. of $\eta_c \rightarrow K^+ K^- \eta/\pi^0$

¹ From a Dalitz plot analysis using an isobar model.

$\Gamma(K\bar{K}\pi)/\Gamma_{\text{total}}$ Γ_{27}/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 $\psi(2S) \rightarrow \pi^0 \gamma K^+ K^- \pi^0$
7.9 ± 1.4 ± 0.7	107	^{3,4} ABLIKIM	12N	BES3 $\psi(2S) \rightarrow \pi^0 \gamma K_S^0 K^\mp \pi^\pm$
8.5 ± 1.8		⁵ AUBERT	06E	BABR $B^\pm \rightarrow K^\pm X_{c\bar{c}}$
5.1 ± 2.1	0.6k	⁶ BAI	04	BES $J/\psi \rightarrow \gamma K^\pm \pi^\mp K_S^0$
6.90 ± 1.42 ± 1.32	33	⁶ BISELLO	91	DM2 $J/\psi \rightarrow \gamma K^+ K^- \pi^0$
5.43 ± 0.94 ± 0.94	68	⁶ BISELLO	91	DM2 $J/\psi \rightarrow \gamma K^\pm \pi^\mp K_S^0$
4.8 ± 1.7	95	^{6,7} BALTRUSAIT..86	MRK3	$J/\psi \rightarrow \eta_c \gamma$
16.1 ^{+9.2} / _{-7.3}		^{8,9} HIMEL	80B	MRK2 $\psi(2S) \rightarrow \eta_c \gamma$

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

< 10.7 90% CL ^{6,10} PARTRIDGE 80B CBAL $J/\psi \rightarrow \eta_c \gamma$

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

² ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \rightarrow K\bar{K}\pi)/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (27.24 \pm 4.56 \pm 2.88) \times 10^{-6}$ which we divide by our best value $\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}$

$\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

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

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

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

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

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

⁸ $K^\pm K_S^0 \pi^\mp$ corrected to $K\bar{K}\pi$ by factor 3. KS, MR.

⁹ Estimated using $B(\psi(2S) \rightarrow \gamma \eta_c(1S)) = 0.0028 \pm 0.0006$.

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

$\Gamma(\phi K^+ K^-)/\Gamma(K\bar{K}\pi)$ Γ_6/Γ_{27}

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
$0.052^{+0.016}_{-0.014} \pm 0.014$	7	¹ HUANG	03	BELL $B^\pm \rightarrow K^\pm \phi \phi$

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

$\Gamma(K\bar{K}\eta)/\Gamma_{\text{total}}$ Γ_{28}/Γ

VALUE (units 10^{-2})	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
1.36 ± 0.16 OUR FIT					
$1.0 \pm 0.5 \pm 0.2$		7	^{1,2} ABLIKIM	12N BES3	$\psi(2S) \rightarrow \pi^0 \gamma \eta K^+ K^-$

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

<3.1 90 ³ BALTRUSAIT..86 MRK3 $J/\psi \rightarrow \eta_c \gamma$

¹ ABLIKIM 12N quotes $B(\psi(2S) \rightarrow \pi^0 h_c) \cdot B(h_c \rightarrow \gamma \eta_c) \cdot B(\eta_c \rightarrow K^+ K^- \eta) = (2.11 \pm 1.01 \pm 0.32) \times 10^{-6}$ which we multiply by 2 to account for isospin symmetry.

² ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \rightarrow K\bar{K}\eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))] \times [B(h_c(1P) \rightarrow \gamma \eta_c(1S))] = (4.22 \pm 2.02 \pm 0.64) \times 10^{-6}$ which we divide by our best values $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$, $B(h_c(1P) \rightarrow \gamma \eta_c(1S)) = (51 \pm 6) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best values.

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

$\Gamma(K\bar{K}\eta)/\Gamma(K\bar{K}\pi)$ Γ_{28}/Γ_{27}

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.186 ± 0.018 OUR FIT				
$0.190 \pm 0.008 \pm 0.017$	5.4k	¹ LEES	14E BABR	$\gamma \gamma \rightarrow K^+ K^- \eta/\pi^0$

¹ LEES 14E reports $B(\eta_c(1S) \rightarrow K^+ K^- \eta)/B(\eta_c(1S) \rightarrow K^+ K^- \pi^0) = 0.571 \pm 0.025 \pm 0.051$, which we divide by 3 to account for isospin symmetry. It uses both $\eta \rightarrow \gamma \gamma$ and $\eta \rightarrow \pi^+ \pi^- \pi^0$ decays.

$\Gamma(\eta\pi^+\pi^-)/\Gamma_{\text{total}}$ Γ_{29}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
1.7±0.4±0.1	33	¹ ABLIKIM	12N BES3	$\psi(2S) \rightarrow \pi^0 \gamma \eta \pi^+ \pi^-$
5.4±2.0	75	² BALTRUSAIT..86	MRK3	$J/\psi \rightarrow \eta_c \gamma$
3.7±1.3±2.0	18	² PARTRIDGE	80B CBAL	$J/\psi \rightarrow \eta \pi^+ \pi^- \gamma$

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

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

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

 $\Gamma(\eta 2(\pi^+ \pi^-))/\Gamma_{\text{total}}$ Γ_{30}/Γ

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

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

 $\Gamma(K^+ K^- \pi^+ \pi^-)/\Gamma_{\text{total}}$ Γ_{31}/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	$\psi(2S) \rightarrow \pi^0 \gamma K^+ K^- \pi^+ \pi^-$
12 ± 4	0.4k	² BAI	04 BES	$J/\psi \rightarrow \gamma K^+ K^- \pi^+ \pi^-$
21 ± 7	110	² BALTRUSAIT..86	MRK3	$J/\psi \rightarrow \eta_c \gamma$
14 + ²² / ₉		³ HIMEL	80B MRK2	$\psi(2S) \rightarrow \eta_c \gamma$

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

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

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

 $\Gamma(K^+ K^- \pi^+ \pi^- \pi^0)/\Gamma(K \bar{K} \pi)$ Γ_{32}/Γ_{27}

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

¹ We have multiplied the value of $\Gamma(K^+ K^- \pi^+ \pi^- \pi^0)/\Gamma(K_S^0 K^\pm \pi^\mp)$ reported in DEL-AMO-SANCHEZ 11M by a factor 1/3 to obtain $\Gamma(K^+ K^- \pi^+ \pi^- \pi^0)/\Gamma(K \bar{K} \pi)$. 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_{33}/Γ

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

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

² ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \rightarrow K^0 K^- \pi^+ \pi^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (24.02 \pm 4.44 \pm 4.08) \times 10^{-6}$
 which we divide by our best value $\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$. 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_{34}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
7.5 ± 2.4 OUR AVERAGE				

$8 \pm 4 \pm 1$	10	¹ ABLIKIM	12N BES3	$\psi(2S) \rightarrow \pi^0 \gamma K^+ K^- 2(\pi^+ \pi^-)$
$7.2 \pm 2.4 \pm 1.5$	100	² ABLIKIM	06A BES2	$J/\psi \rightarrow K^+ K^- 2(\pi^+ \pi^-) \gamma$

¹ ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \rightarrow K^+ K^- 2(\pi^+ \pi^-))/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (3.60 \pm 1.71 \pm 0.64) \times 10^{-6}$
 which we divide by our best value $\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$. 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_{35}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
1.47 ± 0.31 OUR FIT				

$2.2 \pm 0.9 \pm 0.2$	7	¹ ABLIKIM	12N BES3	$\psi(2S) \rightarrow \pi^0 \gamma 2(K^+ K^-)$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

$1.4 \begin{smallmatrix} +0.5 \\ -0.4 \end{smallmatrix} \pm 0.6$	$14.5 \begin{smallmatrix} +4.6 \\ -3.0 \end{smallmatrix}$	² HUANG	03 BELL	$B^+ \rightarrow 2(K^+ K^-) K^+$
$21 \pm 10 \pm 6$		³ ALBRECHT	94H ARG	$\gamma \gamma \rightarrow K^+ K^- K^+ K^-$

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

² Using $B(B^+ \rightarrow \eta_c K^+) = (1.25 \pm 0.12 \begin{smallmatrix} +0.10 \\ -0.12 \end{smallmatrix}) \times 10^{-3}$ from FANG 03 and $B(\eta_c \rightarrow K \bar{K} \pi) = (5.5 \pm 1.7) \times 10^{-2}$.

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

$\Gamma(2(K^+K^-))/\Gamma(K\bar{K}\pi)$

Γ_{35}/Γ_{27}

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	$B^\pm \rightarrow K^\pm \eta_c$
0.026 ^{+0.009} _{-0.007} ±0.007	15	¹ HUANG	03 BELL	$B^\pm \rightarrow K^\pm(2K^+2K^-)$

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

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$

Γ_{36}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<5 × 10⁻⁴	90	¹ ABLIKIM	17AJ BES3	$\psi(2S) \rightarrow \gamma\pi^+\pi^-\pi^0$

¹ ABLIKIM 17AJ reports $[\Gamma(\eta_c(1S) \rightarrow \pi^+\pi^-\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\eta_c(1S))]$ < 1.6×10^{-6} which we divide by our best value $B(\psi(2S) \rightarrow \gamma\eta_c(1S)) = 3.4 \times 10^{-3}$.

$\Gamma(\pi^+\pi^-\pi^0\pi^0)/\Gamma_{\text{total}}$

Γ_{37}/Γ

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

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

$\Gamma(2(\pi^+\pi^-))/\Gamma_{\text{total}}$

Γ_{38}/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	$\psi(2S) \rightarrow \pi^0\gamma 2(\pi^+\pi^-)$
1.0 ±0.5	542 ± 75	² BAI	04 BES	$J/\psi \rightarrow \gamma 2(\pi^+\pi^-)$
1.05±0.17±0.34	137	² BISELLO	91 DM2	$J/\psi \rightarrow \gamma 2\pi^+ 2\pi^-$
1.3 ±0.6	25	² BALTRUSAIT..86	MRK3	$J/\psi \rightarrow \eta_c\gamma$
2.0 ^{+1.5} _{-1.0}		³ HIMEL	80B MRK2	$\psi(2S) \rightarrow \eta_c\gamma$

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

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

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

$\Gamma(2(\pi^+\pi^-\pi^0))/\Gamma_{\text{total}}$ **Γ_{39}/Γ**

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
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17.4 ± 2.9 ± 1.5	175	¹ ABLIKIM	12N BES3	$\psi(2S) \rightarrow \pi^0 \gamma 2(\pi^+ \pi^- 2\pi^0)$
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¹ ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \rightarrow 2(\pi^+ \pi^- \pi^0))/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (75.13 \pm 7.42 \pm 9.99) \times 10^{-6}$ which we divide by our best value $\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(3(\pi^+\pi^-))/\Gamma_{\text{total}}$ **Γ_{40}/Γ**

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
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18 ± 4 OUR AVERAGE				
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20 ± 5 ± 2	51	¹ ABLIKIM	12N BES3	$\psi(2S) \rightarrow \pi^0 \gamma 3(\pi^+ \pi^-)$
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15.4 ± 3.4 ± 3.3	479	² ABLIKIM	06A BES2	$J/\psi \rightarrow 3(\pi^+ \pi^-) \gamma$
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¹ ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \rightarrow 3(\pi^+ \pi^-))/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (8.82 \pm 1.57 \pm 1.59) \times 10^{-6}$ which we divide by our best value $\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$. 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 $[\Gamma(\eta_c(1S) \rightarrow 3(\pi^+ \pi^-))/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma \eta_c(1S))] = (2.59 \pm 0.32 \pm 0.47) \times 10^{-4}$ which we divide by our best value $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = (1.7 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(p\bar{p})/\Gamma_{\text{total}}$ **Γ_{41}/Γ**

VALUE (units 10^{-4})	EVTS	DOCUMENT ID	TECN	COMMENT
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15.1 ± 1.6 OUR FIT				
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13.2 ± 2.7 OUR AVERAGE				
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15 ± 5 ± 1	15	¹ ABLIKIM	12N BES3	$\psi(2S) \rightarrow \pi^0 \gamma p\bar{p}$
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15 ± 6	213 ± 33	² BAI	04 BES	$J/\psi \rightarrow \gamma p\bar{p}$
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10 ± 3 ± 4	18	² BISELLO	91 DM2	$J/\psi \rightarrow \gamma p\bar{p}$
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11 ± 6	23	² BALTRUSAIT..86	MRK3	$J/\psi \rightarrow \eta_c \gamma$
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29 +29 -15		³ HIMEL	80B MRK2	$\psi(2S) \rightarrow \eta_c \gamma$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

13.1 + 1.8 + 1.0 - 2.1 - 1.1	195	⁴ WU	06 BELL	$B^+ \rightarrow p\bar{p}K^+$
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¹ ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \rightarrow p\bar{p})/\Gamma_{\text{total}}] \times [\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}}] = (0.65 \pm 0.19 \pm 0.10) \times 10^{-6}$ which we divide by our best value $\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \pi^0 h_c(1P))/\Gamma_{\text{total}} = (4.3 \pm 0.4) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

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

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

⁴ WU 06 reports $[\Gamma(\eta_c(1S) \rightarrow p\bar{p})/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \eta_c K^+)] = (1.42 \pm 0.11 +0.16/-0.20) \times 10^{-6}$ which we divide by our best value $B(B^+ \rightarrow \eta_c K^+) = (1.09 \pm 0.09) \times 10^{-3}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$$\Gamma(p\bar{p})/\Gamma(K\bar{K}\pi) \qquad \Gamma_{41}/\Gamma_{27}$$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.0207 ± 0.0021 OUR FIT				
0.021 ± 0.002 $\begin{smallmatrix} +0.004 \\ -0.006 \end{smallmatrix}$	195	¹ WU	06	BELL $B^\pm \rightarrow K^\pm p\bar{p}$

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

$$\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\phi\phi)/\Gamma_{\text{total}} \qquad \Gamma_{41}/\Gamma \times \Gamma_7/\Gamma$$

VALUE (units 10^{-5})	DOCUMENT ID	TECN	COMMENT
0.27 ± 0.05 OUR FIT			
4.0 $\begin{smallmatrix} +3.5 \\ -3.2 \end{smallmatrix}$	BAGLIN	89	SPEC $\bar{p}p \rightarrow K^+ K^- K^+ K^-$

$$\Gamma(p\bar{p}\pi^0)/\Gamma_{\text{total}} \qquad \Gamma_{42}/\Gamma$$

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

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

$$\Gamma(\Lambda\bar{\Lambda})/\Gamma_{\text{total}} \qquad \Gamma_{43}/\Gamma$$

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
10.9 ± 2.4 OUR FIT					
11.8 ± 2.3 ± 2.5			¹ ABLIKIM	12B	BES3

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

$8.8^{+2.4}_{-2.3} \pm 0.7$	20	² WU	06	BELL $B^+ \rightarrow \Lambda\bar{\Lambda}K^+$
<20	90	³ BISELLO	91	DM2 $e^+e^- \rightarrow \gamma\Lambda\bar{\Lambda}$

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

² WU 06 reports $[\Gamma(\eta_c(1S) \rightarrow \Lambda\bar{\Lambda})/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \eta_c K^+)] = (0.95^{+0.25+0.08}_{-0.22-0.11}) \times 10^{-6}$ which we divide by our best value $B(B^+ \rightarrow \eta_c K^+) = (1.09 \pm 0.09) \times 10^{-3}$. 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 $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$.

$$\Gamma(\Lambda\bar{\Lambda})/\Gamma(p\bar{p}) \qquad \Gamma_{43}/\Gamma_{41}$$

VALUE	DOCUMENT ID	TECN	COMMENT
0.72 ± 0.16 OUR FIT			
0.67 $\begin{smallmatrix} +0.19 \\ -0.16 \end{smallmatrix} \pm 0.12$	¹ WU	06	BELL $B^+ \rightarrow p\bar{p}K^+, \Lambda\bar{\Lambda}K^+$

¹ Not independent from other $\eta_c \rightarrow \Lambda\bar{\Lambda}, p\bar{p}$ branching ratios reported by WU 06.

$\Gamma(K^+ \bar{p} \Lambda + \text{c.c.})/\Gamma_{\text{total}}$ Γ_{44}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
$2.50^{+0.34}_{-0.32} \pm 0.20$	157	¹ LU	19	BELL $B^+ \rightarrow \bar{p} \Lambda K^+ K^+$

¹ LU 19 reports $(2.83^{+0.36}_{-0.34} \pm 0.35) \times 10^{-3}$ from a measurement of $[\Gamma(\eta_c(1S) \rightarrow K^+ \bar{p} \Lambda + \text{c.c.})/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \eta_c K^+)]$ assuming $B(B^+ \rightarrow \eta_c K^+) = (9.6 \pm 1.1) \times 10^{-4}$, which we rescale to our best value $B(B^+ \rightarrow \eta_c K^+) = (1.09 \pm 0.09) \times 10^{-3}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\bar{\Lambda}(1520) \Lambda + \text{c.c.})/\Gamma_{\text{total}}$ Γ_{45}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
$3.1 \pm 1.3 \pm 0.2$	43	¹ LU	19	BELL $B^+ \rightarrow \bar{p} \Lambda K^+ K^+$

¹ LU 19 reports $(3.48 \pm 1.48 \pm 0.46) \times 10^{-3}$ from a measurement of $[\Gamma(\eta_c(1S) \rightarrow \bar{\Lambda}(1520) \Lambda + \text{c.c.})/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \eta_c K^+)]$ assuming $B(B^+ \rightarrow \eta_c K^+) = (9.6 \pm 1.1) \times 10^{-4}$, which we rescale to our best value $B(B^+ \rightarrow \eta_c K^+) = (1.09 \pm 0.09) \times 10^{-3}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}$ Γ_{46}/Γ

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

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

$\Gamma(\Xi^- \bar{\Xi}^+)/\Gamma_{\text{total}}$ Γ_{47}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
$0.90 \pm 0.18 \pm 0.19$	78	¹ ABLIKIM	13C	BES3 $J/\psi \rightarrow \gamma \Lambda \bar{\Lambda} \pi^+ \pi^-$

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

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

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
$5.3 \pm 1.7 \pm 0.5$		19	¹ ABLIKIM	12N	BES3 $\psi(2S) \rightarrow \pi^0 \gamma p \bar{p} \pi^+ \pi^-$

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

<12 90 HIMEL 80B MRK2 $\psi(2S) \rightarrow \eta_c \gamma$

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

RADIATIVE DECAYS

$\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$						Γ_{49}/Γ
<u>VALUE (units 10^{-4})</u>	<u>CL%</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	

1.57±0.12 OUR FIT

1.9 $^{+0.7}_{-0.6}$ OUR AVERAGE

2.7	±0.8	±0.6	1	ABLIKIM	13I	BES3	
1.4	$^{+0.7}_{-0.5}$	±0.3	2	ADAMS	08	CLEO	$\psi(2S) \rightarrow \pi^+\pi^- J/\psi$

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

2.0	±0.9	±0.2	13	3	WICHT	08	BELL	B $^\pm \rightarrow K^\pm \gamma\gamma$
2.80	$^{+0.67}_{-0.58}$	±1.0		4	ARMSTRONG	95F	E760	$\bar{p}p \rightarrow \gamma\gamma$
< 9			90	5	BISELLO	91	DM2	$J/\psi \rightarrow \gamma\gamma\gamma$
6	$^{+4}_{-3}$	±4		4	BAGLIN	87B	SPEC	$\bar{p}p \rightarrow \gamma\gamma$
< 18			90	6	BLOOM	83	CBAL	$J/\psi \rightarrow \eta_c \gamma$

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

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

³ WICHT 08 reports $[\Gamma(\eta_c(1S) \rightarrow \gamma\gamma)/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \eta_c K^+)] = (2.2^{+0.9+0.4}_{-0.7-0.2}) \times 10^{-7}$ which we divide by our best value $B(B^+ \rightarrow \eta_c K^+) = (1.09 \pm 0.09) \times 10^{-3}$. 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 $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$.

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

$\Gamma(\gamma\gamma)/\Gamma(K\bar{K}\pi)$						Γ_{49}/Γ_{27}
<u>VALUE (units 10^{-3})</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>		

2.15±0.28 OUR FIT

3.2 $^{+1.3}_{-1.0}$ $^{+0.8}_{-0.6}$ 13 1 WICHT 08 BELL B $^\pm \rightarrow K^\pm \gamma\gamma$

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

$\Gamma(\bar{p}\bar{p})/\Gamma_{\text{total}} \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$		$\Gamma_{41}/\Gamma \times \Gamma_{49}/\Gamma$		
VALUE (units 10^{-6})	EVTS	DOCUMENT ID	TECN	COMMENT
0.238 ± 0.023 OUR FIT				
0.26 ± 0.05 OUR AVERAGE Error includes scale factor of 1.4.				
$0.224^{+0.038}_{-0.037} \pm 0.020$	190	AMBROGIANI 03	E835	$\bar{p}p \rightarrow \eta_c \rightarrow \gamma\gamma$
$0.336^{+0.080}_{-0.070}$		ARMSTRONG 95F	E760	$\bar{p}p \rightarrow \gamma\gamma$
$0.68^{+0.42}_{-0.31}$	12	BAGLIN	87B SPEC	$\bar{p}p \rightarrow \gamma\gamma$

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

$\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$		Γ_{50}/Γ		
VALUE (units 10^{-5})	CL%	DOCUMENT ID	TECN	COMMENT
<11	90	¹ ABLIKIM 11G	BES3	$J/\psi \rightarrow \gamma\pi^+\pi^-$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
<70	90	² ABLIKIM 06B	BES2	$J/\psi \rightarrow \pi^+\pi^-\gamma$
¹ ABLIKIM 11G reports $[\Gamma(\eta_c(1S) \rightarrow \pi^+\pi^-)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))] < 1.82 \times 10^{-6}$ which we divide by our best value $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 1.7 \times 10^{-2}$.				
² ABLIKIM 06B reports $[\Gamma(\eta_c(1S) \rightarrow \pi^+\pi^-)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))] < 1.1 \times 10^{-5}$ which we divide by our best value $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 1.7 \times 10^{-2}$.				

$\Gamma(\pi^0\pi^0)/\Gamma_{\text{total}}$		Γ_{51}/Γ		
VALUE (units 10^{-5})	CL%	DOCUMENT ID	TECN	COMMENT
<4	90	¹ ABLIKIM 11G	BES3	$J/\psi \rightarrow \gamma\pi^0\pi^0$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
<40	90	² ABLIKIM 06B	BES2	$J/\psi \rightarrow \pi^0\pi^0\gamma$
¹ ABLIKIM 11G reports $[\Gamma(\eta_c(1S) \rightarrow \pi^0\pi^0)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))] < 6.0 \times 10^{-7}$ which we divide by our best value $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 1.7 \times 10^{-2}$.				
² ABLIKIM 06B reports $[\Gamma(\eta_c(1S) \rightarrow \pi^0\pi^0)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))] < 0.71 \times 10^{-5}$ which we divide by our best value $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 1.7 \times 10^{-2}$.				

$\Gamma(K^+K^-)/\Gamma_{\text{total}}$		Γ_{52}/Γ		
VALUE (units 10^{-5})	CL%	DOCUMENT ID	TECN	COMMENT
<60	90	¹ ABLIKIM 06B	BES2	$J/\psi \rightarrow K^+K^-\gamma$
¹ ABLIKIM 06B reports $[\Gamma(\eta_c(1S) \rightarrow K^+K^-)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))] < 0.96 \times 10^{-5}$ which we divide by our best value $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 1.7 \times 10^{-2}$.				

$\Gamma(K_S^0 K_S^0)/\Gamma_{\text{total}}$		Γ_{53}/Γ		
VALUE (units 10^{-5})	CL%	DOCUMENT ID	TECN	COMMENT
<31	90	¹ ABLIKIM 06B	BES2	$J/\psi \rightarrow K_S^0 K_S^0 \gamma$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
<32	90	² UEHARA 13	BELL	$\gamma\gamma \rightarrow K_S^0 K_S^0$
<5.6	90	³ UEHARA 13	BELL	$\gamma\gamma \rightarrow K_S^0 K_S^0$

¹ ABLIKIM 06B reports $[\Gamma(\eta_c(1S) \rightarrow K_S^0 K_S^0)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))] < 0.53 \times 10^{-5}$ which we divide by our best value $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 1.7 \times 10^{-2}$.

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

³ Neglecting interference with the non-resonant continuum.

$\eta_c(1S)$ REFERENCES

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DEL-AMO-SA...	11M	PR D84 012004	P. del Amo Sanchez <i>et al.</i>	(BABAR Collab.)
VINOKUROVA	11	PL B706 139	A. Vinokurova <i>et al.</i>	(BELLE Collab.)
LEES	10	PR D81 052010	J.P. Lees <i>et al.</i>	(BABAR Collab.)
MITCHELL	09	PRL 102 011801	R.E. Mitchell <i>et al.</i>	(CLEO Collab.)
ADAMS	08	PRL 101 101801	G.S. Adams <i>et al.</i>	(CLEO Collab.)
AUBERT	08AB	PR D78 012006	B. Aubert <i>et al.</i>	(BABAR Collab.)
UEHARA	08	EPJ C53 1	S. Uehara <i>et al.</i>	(BELLE Collab.)
WICHT	08	PL B662 323	J. Wicht <i>et al.</i>	(BELLE Collab.)
ABE	07	PRL 98 082001	K. Abe <i>et al.</i>	(BELLE Collab.)
ABLIKIM	06A	PL B633 19	M. Ablikim <i>et al.</i>	(BES Collab.)
ABLIKIM	06B	EPJ C45 337	M. Ablikim <i>et al.</i>	(BES Collab.)
AUBERT	06E	PRL 96 052002	B. Aubert <i>et al.</i>	(BABAR Collab.)
PDG	06	JP G33 1	W.-M. Yao <i>et al.</i>	(PDG Collab.)
WU	06	PRL 97 162003	C.-H. Wu <i>et al.</i>	(BELLE Collab.)
ABLIKIM	05L	PR D72 072005	M. Ablikim <i>et al.</i>	(BES Collab.)
KUO	05	PL B621 41	C.C. Kuo <i>et al.</i>	(BELLE Collab.)
ABE	04G	PR D70 071102	K. Abe <i>et al.</i>	(BELLE Collab.)
ABLIKIM	04M	PR D70 112008	M. Ablikim <i>et al.</i>	(BES Collab.)
ASNER	04	PRL 92 142001	D.M. Asner <i>et al.</i>	(CLEO Collab.)
AUBERT	04D	PRL 92 142002	B. Aubert <i>et al.</i>	(BABAR Collab.)
AUBERT,B	04B	PR D70 011101	B. Aubert <i>et al.</i>	(BABAR Collab.)
BAI	04	PL B578 16	J.Z. Bai <i>et al.</i>	(BES Collab.)
ABDALLAH	03J	EPJ C31 481	J. Abdallah <i>et al.</i>	(DELPHI Collab.)
AMBROGIANI	03	PL B566 45	M. Ambrogiani <i>et al.</i>	(FNAL E835 Collab.)
BAI	03	PL B555 174	J.Z. Bai <i>et al.</i>	(BES Collab.)
FANG	03	PRL 90 071801	F. Fang <i>et al.</i>	(BELLE Collab.)
HUANG	03	PRL 91 241802	H.-C. Huang <i>et al.</i>	(BELLE Collab.)
ABE,K	02	PRL 89 142001	K. Abe <i>et al.</i>	(BELLE Collab.)
BAI	00F	PR D62 072001	J.Z. Bai <i>et al.</i>	(BES Collab.)
BRANDENB...	00B	PRL 85 3095	G. Brandenburg <i>et al.</i>	(CLEO Collab.)
ACCIARRI	99T	PL B461 155	M. Acciarri <i>et al.</i>	(L3 Collab.)
BAI	99B	PR D60 072001	J.Z. Bai <i>et al.</i>	(BES Collab.)
ABREU	98O	PL B441 479	P. Abreu <i>et al.</i>	(DELPHI Collab.)
SHIRAI	98	PL B424 405	M. Shirai <i>et al.</i>	(AMY Collab.)
ARMSTRONG	95F	PR D52 4839	T.A. Armstrong <i>et al.</i>	(FNAL, FERR, GENO+)
ALBRECHT	94H	PL B338 390	H. Albrecht <i>et al.</i>	(ARGUS Collab.)
ADRIANI	93N	PL B318 575	O. Adriani <i>et al.</i>	(L3 Collab.)
BISELLO	91	NP B350 1	D. Bisello <i>et al.</i>	(DM2 Collab.)
BAI	90B	PRL 65 1309	Z. Bai <i>et al.</i>	(Mark III Collab.)

CHEN	90B	PL B243 169	W.Y. Chen <i>et al.</i>	(CLEO Collab.)
BAGLIN	89	PL B231 557	C. Baglin, S. Baird, G. Bassompierre	(R704 Collab.)
BEHREND	89	ZPHY C42 367	H.J. Behrend <i>et al.</i>	(CELLO Collab.)
BRAUNSCH...	89	ZPHY C41 533	W. Braunschweig <i>et al.</i>	(TASSO Collab.)
AIHARA	88D	PRL 60 2355	H. Aihara <i>et al.</i>	(TPC Collab.)
BAGLIN	87B	PL B187 191	C. Baglin <i>et al.</i>	(R704 Collab.)
BALTRUSAIT...	86	PR D33 629	R.M. Baltrusaitis <i>et al.</i>	(Mark III Collab.)
BERGER	86	PL 167B 120	C. Berger <i>et al.</i>	(PLUTO Collab.)
GAISER	86	PR D34 711	J. Gaiser <i>et al.</i>	(Crystal Ball Collab.)
ALTHOFF	85B	ZPHY C29 189	M. Althoff <i>et al.</i>	(TASSO Collab.)
BALTRUSAIT...	84	PRL 52 2126	R.M. Baltrusaitis <i>et al.</i>	(CIT, UCSC+) JP
BLOOM	83	ARNS 33 143	E.D. Bloom, C. Peck	(SLAC, CIT)
HIMEL	80B	PRL 45 1146	T.M. Himel <i>et al.</i>	(SLAC, LBL, UCB)
PARTRIDGE	80B	PRL 45 1150	R. Partridge <i>et al.</i>	(CIT, HARV, PRIN+)
