$\eta_c(1S)$

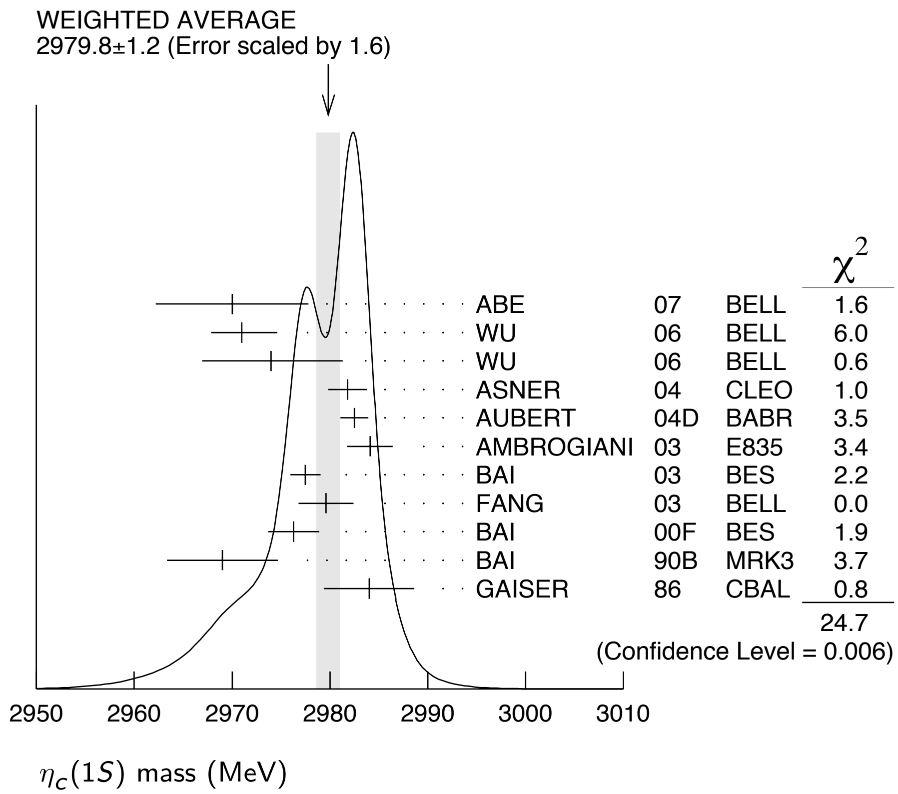
$I^G(J^{PC}) = 0^+(0^{-+})$

$\eta_c(1S)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
2979.8± 1.2 OUR AVERAGE	Error includes scale factor of 1.6. See the ideogram below.			
2970 ± 5 ± 6	501	[1] 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	$\gamma\gamma \to \eta_c \to K^0_S K^\pm \pi^\mp$
2982.5± 1.1± 0.9	2547 ± 90	AUBERT 04D	BABR	$\gamma\gamma \to \eta_c(1S) \to K\overline{K}\pi$
2984.1± 2.1± 1.0	190	[2] AMBROGIANI 03	E835	$\overline{p}p \to \eta_c \to \gamma\gamma$
2977.5± 1.0± 1.2		[3] BAI 03	BES	$J/\psi \to \gamma\eta_c$
2979.6± 2.3± 1.6	182 ± 25	FANG 03	BELL	$B \to \eta_c K$
2976.3± 2.3± 1.2		[4,5,6] BAI 00F	BES	$J/\psi \to \gamma\eta_c$ and $\psi(2S) \to \gamma\eta_c$
2969 ± 4 ± 4	80	BAI 90B	MRK3	$J/\psi \to \gamma K^+K^-K^+K^-$
2984 ± 2.3± 4.0		GAISER 86	CBAL	$J/\psi \to \gamma X$, $\psi(2S) \to \gamma X$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2982 ± 5	273 ± 43	[7] AUBERT 06E	BABR	$B^\pm \to K^\pm X_{c\overline{c}}$
2976.6± 2.9± 1.3	140	[4,5] BAI 00F	BES	$J/\psi \to \gamma\eta_c$
2980.4± 2.3± 0.6		[8] BRANDENB... 00B	CLE2	$\gamma\gamma \to \eta_c \to K^\pm K^0_S \pi^\mp$
2975.8± 3.9± 1.2		[4,5] 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		[4] BISELLO 91	DM2	$J/\psi \to \eta_c\gamma$
2956 ±12 ±12		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± 1.6		[4] BALTRUSAIT...86	MRK3	$J/\psi \to \eta_c\gamma$
2976 ± 8		[9] BALTRUSAIT...84	MRK3	$J/\psi \to 2\phi\gamma$
2982 ± 8	18	[10] HIMEL 80B	MRK2	e^+e^-
2980 ± 9		[10] PARTRIDGE 80B	CBAL	e^+e^-

[1] From a fit of the J/ψ recoil mass spectrum. Supersedes ABE,K 02 and ABE 04G.
[2] Using mass of $\psi(2S) = 3686.00$ MeV.
[3] From a simultaneous fit of five decay modes of the η_c.
[4] Average of several decay modes.
[5] Using an η_c width of 13.2 MeV.
[6] Weighted average of the $\psi(2S)$ and $J/\psi(1S)$ samples.

[7] From the fit of the kaon momentum spectrum. Systematic errors not evaluated.
[8] Superseded by ASNER 04.
[9] $\eta_c \to \phi\phi$.
[10] Mass adjusted by us to correspond to $J/\psi(1S)$ mass = 3097 MeV.



$\eta_c(1S)$ WIDTH

VALUE (MeV)	*CL%*	*EVTS*	*DOCUMENT ID*	*TECN*	*COMMENT*
26.5± 3.5 OUR AVERAGE			Error includes scale factor of 2.1. See the ideogram below.		
$48\ ^{+8}_{-7}\ \pm 5$		195	WU 06	BELL	$B^+ \to p\overline{p}K^+$
$40\ \pm 19\ \pm 5$		20	WU 06	BELL	$B^+ \to \Lambda\overline{\Lambda}K^+$
$24.8\pm 3.4\pm 3.5$		592	ASNER 04	CLEO	$\gamma\gamma \to \eta_c \to K^0_S K^\pm \pi^\mp$
$34.3\pm 2.3\pm 0.9$		2547 ± 90	AUBERT 04D	BABR	$\gamma\gamma \to \eta_c(1S) \to K\overline{K}\pi$
$20.4^{+7.7}_{-6.7}\pm 2.0$		190	AMBROGIANI 03	E835	$\overline{p}p \to \eta_c \to \gamma\gamma$
$17.0\pm 3.7\pm 7.4$			[11] BAI 03	BES	$J/\psi \to \gamma\eta_c$
$29\ \pm 8\ \pm 6$		182 ± 25	FANG 03	BELL	$B \to \eta_c K$
$11.0\pm 8.1\pm 4.1$			[12] BAI 00F	BES	$J/\psi \to \gamma\eta_c$ and $\psi(2S) \to \gamma\eta_c$
$23.9^{+12.6}_{-7.1}$			ARMSTRONG 95F	E760	$\overline{p}p \to \gamma\gamma$

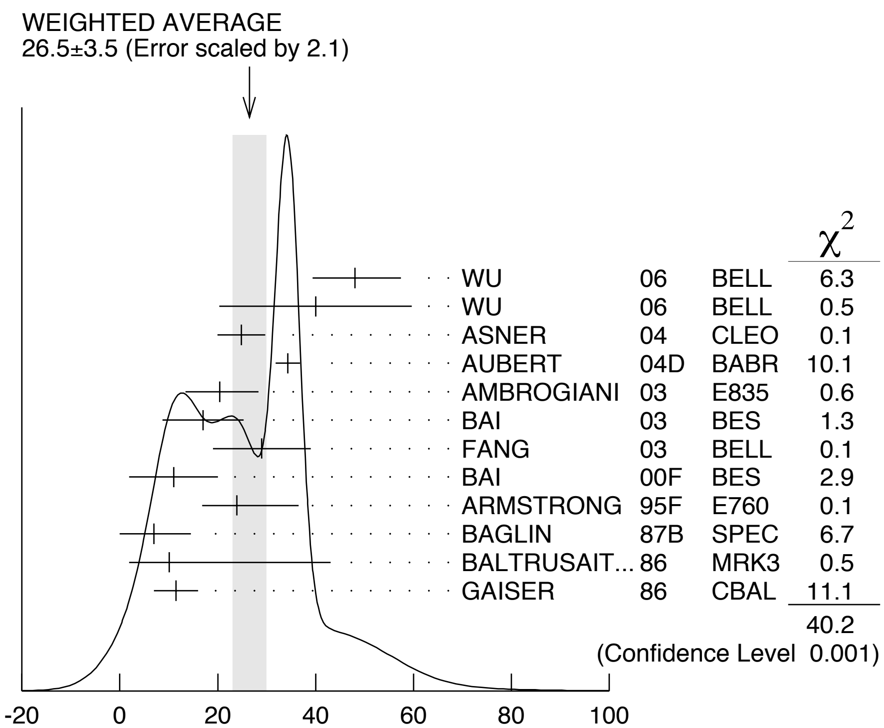
$7.0^{+7.5}_{-7.0}$		12	BAGLIN 87B	SPEC	$\overline{p}p \to \gamma\gamma$
$10.1^{+33.0}_{-8.2}$		23	[13] BALTRUSAIT...86	MRK3	$J/\psi \to \gamma p\overline{p}$
11.5 ± 4.5			GAISER 86	CBAL	$J/\psi \to \gamma X$, $\psi(2S) \to \gamma X$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$27.0\pm 5.8\pm 1.4$			[14] BRANDENB... 00B	CLE2	$\gamma\gamma \to \eta_c \to K^{\pm}K^0_S\pi^{\mp}$
<40	90	18	HIMEL 80B	MRK2	e^+e^-
<20	90		PARTRIDGE 80B	CBAL	e^+e^-

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

[12] 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.

[13] Positive and negative errors correspond to 90% confidence level.

[14] Superseded by ASNER 04.



$\eta_c(1S)$ WIDTH

$\eta_c(1S)$ 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	$\rho\rho$			(2.0 ± 0.7) %	
Γ_3	$K^*(892)^0 K^- \pi^+ +$ c.c.			(2.0 ± 0.7) %	
Γ_4	$K^*(892)\overline{K}^*(892)$			$(9.2 \pm 3.4) \times 10^{-3}$	
Γ_5	$K^{*0}\overline{K}^{*0}\pi^+\pi^-$			(1.5 ± 0.8) %	
Γ_6	$\phi K^+ K^-$			$(2.9 \pm 1.4) \times 10^{-3}$	
Γ_7	$\phi\phi$			$(2.7 \pm 0.9) \times 10^{-3}$	
Γ_8	$\phi 2(\pi^+\pi^-)$		$<$	4.7×10^{-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}	$\omega\omega$		$<$	3.1×10^{-3}	90%
Γ_{14}	$\omega\phi$		$<$	1.7×10^{-3}	90%
Γ_{15}	$f_2(1270) f_2(1270)$			$(1.0 \,^{+0.4}_{-0.5})$ %	

Decays into stable hadrons

Γ_{16}	$K\overline{K}\pi$			(7.0 ± 1.2) %	
Γ_{17}	$\eta\pi\pi$			(4.9 ± 1.8) %	
Γ_{18}	$\pi^+\pi^- K^+ K^-$			(1.5 ± 0.6) %	
Γ_{19}	$K^+ K^- 2(\pi^+\pi^-)$			$(10 \pm 4) \times 10^{-3}$	
Γ_{20}	$2(K^+ K^-)$			$(1.5 \pm 0.7) \times 10^{-3}$	
Γ_{21}	$2(\pi^+\pi^-)$			(1.20 ± 0.30) %	
Γ_{22}	$3(\pi^+\pi^-)$			(2.0 ± 0.7) %	
Γ_{23}	$p\overline{p}$			$(1.3 \pm 0.4) \times 10^{-3}$	
Γ_{24}	$\Lambda\overline{\Lambda}$			$(1.04 \pm 0.31) \times 10^{-3}$	
Γ_{25}	$K\overline{K}\eta$		$<$	3.1 %	90%
Γ_{26}	$\pi^+\pi^- p\overline{p}$		$<$	1.2 %	90%

Radiative decays

Γ_{27}	$\gamma\gamma$			$(2.7 \pm 0.9) \times 10^{-4}$	

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

Γ_{28}	$\pi^+\pi^-$	*P*,*CP*	$<$	8.7×10^{-4}	90%
Γ_{29}	$\pi^0\pi^0$	*P*,*CP*	$<$	5.6×10^{-4}	90%
Γ_{30}	$K^+ K^-$	*P*,*CP*	$<$	7.6×10^{-4}	90%
Γ_{31}	$K^0_S K^0_S$	*P*,*CP*	$<$	4.2×10^{-4}	90%

$\eta_c(1S)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$ — Γ_{27}

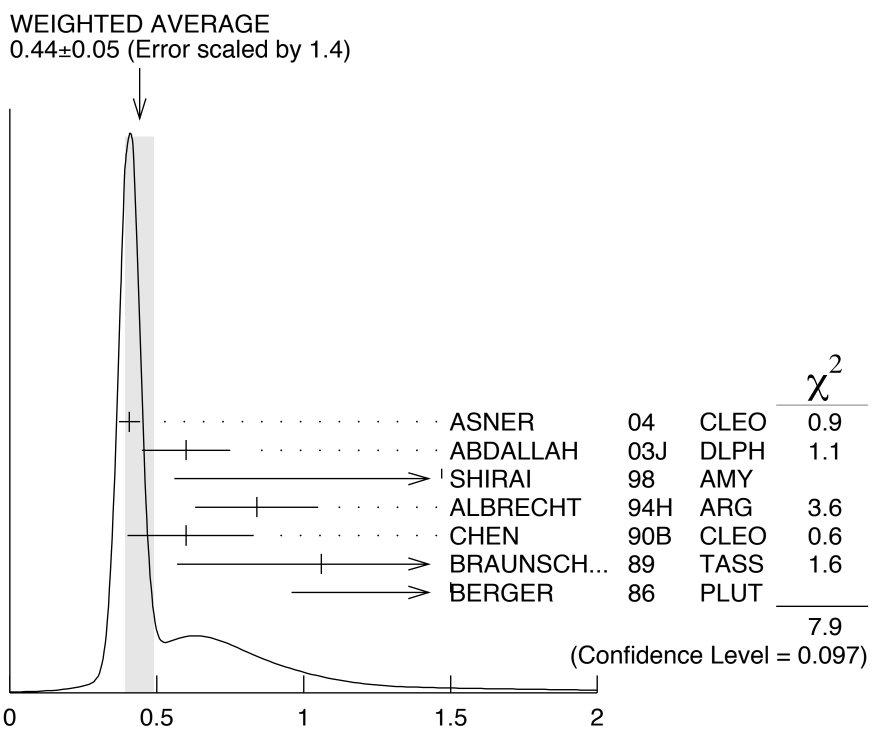
VALUE (keV)	EVTS	DOCUMENT ID	TECN	COMMENT
7.2± 0.7± 2.0 OUR EVALUATION Error includes scale factor of 1.3. Treating systematic errors as correlated.				
$6.7^{+0.9}_{-0.8}$ OUR AVERAGE				
5.5± 1.2± 1.8	157 ± 33	[15] KUO 05	BELL	$\gamma\gamma \to p\overline{p}$
7.4± 0.4± 2.3		[16] ASNER 04	CLEO	$\gamma\gamma \to \eta_c \to K^0_S K^\pm \pi^\mp$
13.9± 2.0± 3.0	41	[17] ABDALLAH 03J	DLPH	$\gamma\gamma \to \eta_c$
$3.8^{+1.1}_{-1.0}{}^{+1.9}_{-1.0}$	190	[18] AMBROGIANI 03	E835	$\overline{p}p \to \eta_c \to \gamma\gamma$
6.9± 1.7± 2.1	76	[19] ACCIARRI 99T	L3	$e^+e^- \to e^+e^-\eta_c$
27 ±16 ±10	5	[16] SHIRAI 98	AMY	58 e^+e^-
$6.7^{+2.4}_{-1.7}$± 2.3		[15] ARMSTRONG 95F	E760	$\overline{p}p \to \gamma\gamma$
11.3± 4.2		[20] ALBRECHT 94H	ARG	$e^+e^- \to e^+e^-\eta_c$
$5.9^{+2.1}_{-1.8}$± 1.9		[18] CHEN 90B	CLEO	$e^+e^- \to e^+e^-\eta_c$
$6.4^{+5.0}_{-3.4}$		[21] AIHARA 88D	TPC	$e^+e^- \to e^+e^-X$
$4.3^{+3.4}_{-3.7}$± 2.4		[15] BAGLIN 87B	SPEC	$\overline{p}p \to \gamma\gamma$
28 ±15		[16,22] BERGER 86	PLUT	$\gamma\gamma \to K\overline{K}\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
5.2± 1.2	273 ± 43	[23,24] AUBERT 06E	BABR	$B^\pm \to K^\pm X_{c\overline{c}}$
7.6± 0.8± 2.3		[16,25] BRANDENB... 00B	CLE2	$\gamma\gamma \to \eta_c \to K^\pm K^0_S \pi^\mp$
8.0± 2.3± 2.4	17	[26] ADRIANI 93N	L3	$e^+e^- \to e^+e^-\eta_c$

[15] Normalized to B($\eta_c \to p\overline{p}$)= $(1.3 \pm 0.4) \times 10^{-3}$.
[16] Normalized to B($\eta_c \to K^\pm K^0_S \pi^\mp$).
[17] Average of $K^0_S K^\pm \pi^\mp$, $\pi^+\pi^- K^+ K^-$, and $2(K^+K^-)$ decay modes.
[18] 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($\eta_c \to 2\pi^+ 2\pi^-$).
[19] Normalized to the sum of 9 branching ratios.
[20] 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($\eta_c \to 2\pi^+ 2\pi^-$).
[21] 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($\eta_c \to 2\pi^+ 2\pi^-$).
[22] Re-evaluated by AIHARA 88D.
[23] 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 ± 1.8)% from AUBERT 06E.
[24] Systematic errors not evaluated.
[25] Superseded by ASNER 04.
[26] Superseded by ACCIARRI 99T.

$\eta_c(1S)$ Γ(i)Γ(γγ)/Γ(total)

$\Gamma(K\overline{K}\pi) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{16}\Gamma_{27}/\Gamma$

VALUE (keV)	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
0.44 ±0.05 OUR AVERAGE			Error includes scale factor of 1.4. See the ideogram below.			
0.407±0.022±0.028			[27,28] ASNER	04	CLEO	$\gamma\gamma \to \eta_c \to K^0_S K^\pm \pi^\mp$
0.60 ±0.12 ±0.09		41	[28,29] ABDALLAH	03J	DLPH	$\gamma\gamma \to K^0_S K^\pm \pi^\mp$
1.47 ±0.87 ±0.27			[28] SHIRAI	98	AMY	$\gamma\gamma \to \eta_c \to K^\pm K^0_S \pi^\mp$
0.84 ±0.21			[28] ALBRECHT	94H	ARG	$\gamma\gamma \to K^\pm K^0_S \pi^\mp$
0.60 $^{+0.23}_{-0.20}$			[28] CHEN	90B	CLEO	$\gamma\gamma \to \eta_c K^\pm K^0_S \pi^\mp$
1.06 ±0.41 ±0.27		11	[28] BRAUNSCH...	89	TASS	$\gamma\gamma \to K\overline{K}\pi$
1.5 $^{+0.60}_{-0.45}$ ±0.3		7	[28] BERGER	86	PLUT	$\gamma\gamma \to K\overline{K}\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.418±0.044±0.022			[28,30] BRANDENB...	00B	CLE2	$\gamma\gamma \to \eta_c \to K^\pm K^0_S \pi^\mp$
<0.63	95		[28] BEHREND	89	CELL	$\gamma\gamma \to K^0_S K^\pm \pi^\mp$
<4.4	95		ALTHOFF	85B	TASS	$\gamma\gamma \to K\overline{K}\pi$



$\Gamma(K\overline{K}\pi) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{16}\Gamma_{27}/\Gamma$

$\Gamma(\pi^+\pi^- K^+ K^-) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{18}\Gamma_{27}/\Gamma$

VALUE (keV)	EVTS	DOCUMENT ID		TECN	COMMENT
0.21±0.07 OUR AVERAGE					
0.28±0.10±0.06	42	[31] ABDALLAH	03J	DLPH	$\gamma\gamma \to \pi^+\pi^- K^+ K^-$
0.17±0.08±0.02	13.9±6.6	ALBRECHT	94H	ARG	$\gamma\gamma \to \pi^+\pi^- K^+ K^-$

$\Gamma(2(K^+ K^-)) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{20}\Gamma_{27}/\Gamma$

VALUE (keV)	EVTS	DOCUMENT ID		TECN	COMMENT
0.28 ±0.07 OUR AVERAGE					
0.35 ±0.09 ±0.06	46	[32] ABDALLAH	03J	DLPH	$\gamma\gamma \to 2(K^+ K^-)$
0.231±0.090±0.023	9.1 ± 3.3	[33] ALBRECHT	94H	ARG	$\gamma\gamma \to 2(K^+ K^-)$

$\Gamma(2(\pi^+\pi^-)) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{21}\Gamma_{27}/\Gamma$

VALUE (keV)	EVTS	DOCUMENT ID		TECN	COMMENT
0.18±0.07±0.02	21.4±8.6	ALBRECHT	94H	ARG	$\gamma\gamma \to 2(\pi^+\pi^-)$

$\Gamma(p\overline{p}) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{23}\Gamma_{27}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID		TECN	COMMENT
$6.2^{+1.1}_{-1.0}$ OUR AVERAGE Error includes scale factor of 1.1.					
$7.20\pm1.53^{+0.67}_{-0.75}$	157 ± 33	[34] KUO	05	BELL	$\gamma\gamma \to p\overline{p}$
$4.6^{+1.3}_{-1.1}\pm0.4$	190	[34] AMBROGIANI	03	E835	$\overline{p}p \to \gamma\gamma$
$8.1^{+2.9}_{-2.0}$		[34] ARMSTRONG	95F	E760	$\overline{p}p \to \gamma\gamma$

[27] Calculated by us from the value reported in ASNER 04 that assumes B($\eta_c \to K\overline{K}\pi$) = 5.5 ± 1.7%

[28] We have multiplied $K^\pm K^0_S \pi^\mp$ measurement by 3 to obtain $K\overline{K}\pi$.

[29] 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)%.

[30] Superseded by ASNER 04.

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

[32] Calculated by us from the value reported in ABDALLAH 03J, which uses B($\eta_c \to$) $2(K^+ K^-)$ = (2.1 ± 1.2)%.

[33] Incudes all topological modes except $\eta_c \to \phi\phi$.

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

$\eta_c(1S)$ 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	[35] BALTRUSAIT...86		MRK3	$J/\psi \to \eta_c\gamma$

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

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
20 ± 7 OUR EVALUATION			(Treating systematicerrors as correlated.)			
18 ± 5 OUR AVERAGE						
12.6± 3.8±5.1		72	[35] ABLIKIM	05L	BES2	$J/\psi \to \pi^+\pi^-\pi^+\pi^-\gamma$
26.0± 2.4±8.8		113	[35] BISELLO	91	DM2	$J/\psi \to \gamma\rho^0\rho^0$
23.6±10.6±8.2		32	[35] BISELLO	91	DM2	$J/\psi \to \gamma\rho^+\rho^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<14	90		[35] BALTRUSAIT...86		MRK3	$J/\psi \to \eta_c\gamma$

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.02±0.007	63	[35] BALTRUSAIT...86		MRK3	$J/\psi \to \eta_c\gamma$

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

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
92±34 OUR EVALUATION		(Treating systematicerrors as correlated.)			
91±26 OUR AVERAGE					
108±25±44	60	[35] ABLIKIM	05L	BES2	$J/\psi \to K^+K^-\pi^+\pi^-\gamma$
82±28±27	14	[35] BISELLO	91	DM2	$e^+e^- \to \gamma K^+K^-\pi^+\pi^-$
90±50	9	[35] BALTRUSAIT...86		MRK3	$J/\psi \to \eta_c\gamma$

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

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
150.±63.±43.	45	[36] ABLIKIM	06A	BES2	$J/\psi \to K^{*0}\overline{K}^{*0}\pi^+\pi^-\gamma$

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

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{2.9^{+0.9}_{-0.8}\pm1.1}$	$14.1^{+4.4}_{-3.7}$	[37] HUANG	03	BELL	$B^+ \to (\phi K^+K^-)\,K^+$

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

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
27 ± 9 OUR EVALUATION		(Treating systematic errors as correlated.)			
27 ± 5 OUR AVERAGE					
25.3± 5.1± 9.1	72	[35] ABLIKIM	05L	BES2	$J/\psi \to K^+K^-K^+K^-\gamma$
26 ± 9	357 ± 64	[35] BAI	04	BES	$J/\psi \to \gamma K^+K^-K^+K^-$
$18\ {}^{+\ 8}_{-\ 6}\ \pm\ 7$	$7.0^{+3.0}_{-2.3}$	[37] HUANG	03	BELL	$B^+ \to (\phi\phi)\,K^+$
31 ± 7 ±10	19	[35] BISELLO	91	DM2	$J/\psi \to \gamma K^+K^-K^+K^-$
$30\ {}^{+18}_{-12}\ \pm10$	5	[35] BISELLO	91	DM2	$J/\psi \to \gamma K^+K^-K^0_S K^0_L$
74 ±18 ±24	80	[35] BAI	90B	MRK3	$J/\psi \to \gamma K^+K^-K^+K^-$
67 ±21 ±24		[35] BAI	90B	MRK3	$J/\psi \to \gamma K^+K^-K^0_S K^0_L$

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

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<50	90	[38] ABLIKIM	06A	BES2	$J/\psi \to \phi 2(\pi^+\pi^-)\gamma$

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.02	90	[35,39] BALTRUSAIT...	86	MRK3	$J/\psi \to \eta_c\gamma$

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.02	90	[35] BALTRUSAIT...	86	MRK3	$J/\psi \to \eta_c\gamma$

$\Gamma(K^*(892)\overline{K}+\text{c.c.})/\Gamma_{total}$ — 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	[35] BISELLO	91	DM2	$J/\psi \to \gamma K^+ K^- \pi^0$

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.011	90	[35] BALTRUSAIT...	86	MRK3	$J/\psi \to \eta_c\gamma$

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.0031	90	[35] BALTRUSAIT...	86	MRK3	$J/\psi \to \eta_c\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.0063	90	[35] ABLIKIM	05L	BES2	$J/\psi \to \pi^+\pi^-\pi^0\pi^+\pi^-\pi^0\gamma$
<0.0063		[35] BISELLO	91	DM2	$J/\psi \to \gamma\omega\omega$

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.0017	90	[35] ABLIKIM	05L	BES2	$J/\psi \to \pi^+\pi^-\pi^0 K^+ K^-\gamma$

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

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{1.02^{+0.33}_{-0.39}\pm0.29}$	91.2 ± 19.8	[40] ABLIKIM	04M	BES	$J/\psi \to \gamma 2\pi^+ 2\pi^-$

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

VALUE (units 10^{-2})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
7.0 ±1.2 OUR EVALUATION (Treating systematic errors as correlated.)						
6.1 ±0.8 OUR AVERAGE						
8.5 ±1.8			[41] AUBERT	06E	BABR	$B^\pm \to K^\pm X_{c\overline{c}}$
5.1 ±2.1		609 ± 71	[35] BAI	04	BES	$J/\psi \to \gamma K^\pm \pi^\mp K^0_S$
6.90±1.42±1.32		33	[35] BISELLO	91	DM2	$J/\psi \to \gamma K^+ K^- \pi^0$

5.43±0.94±0.94	68		[35] BISELLO	91	DM2	$J/\psi \to \gamma K^{\pm}\pi^{\mp}K^0_S$
4.8 ±1.7	95		[35,42] BALTRUSAIT...86		MRK3	$J/\psi \to \eta_c\gamma$
16.1 $^{+9.2}_{-7.3}$			[43] HIMEL	80B	MRK2	$\psi(2S) \to \eta_c\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
< 10.7		90	[35] PARTRIDGE	80B	CBAL	$J/\psi \to \eta_c\gamma$

$\Gamma(\phi\phi)/\Gamma(K\overline{K}\pi)$ — Γ_7/Γ_{16}

VALUE	DOCUMENT ID		TECN	COMMENT
0.055±0.014±0.005	AUBERT,B	04B	BABR	$B^{\pm} \to K^{\pm}\eta_c$

$\Gamma(\eta\pi\pi)/\Gamma_{total}$ — Γ_{17}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.049±0.018 OUR EVALUATION					
0.047±0.015 OUR AVERAGE					
0.054±0.020	75	[35] BALTRUSAIT...86		MRK3	$J/\psi \to \eta_c\gamma$
0.037±0.013±0.020	18	[35] PARTRIDGE	80B	CBAL	$J/\psi \to \eta\pi^+\pi^-\gamma$

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.015 ±0.006 OUR EVALUATION					
0.0142±0.0033 OUR AVERAGE					
0.012 ±0.004	413 ± 54	[35] BAI	04	BES	$J/\psi \to \gamma K^+K^-\pi^+\pi^-$
0.021 ±0.007	110	[35] BALTRUSAIT...86		MRK3	$J/\psi \to \eta_c\gamma$
0.014 $^{+0.022}_{-0.009}$		[43] HIMEL	80B	MRK2	$\psi(2S) \to \eta_c\gamma$

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

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
95.±31.±27.	100	[44] ABLIKIM	06A	BES2	$J/\psi \to K^+K^-2(\pi^+\pi^-)\gamma$

$\Gamma(2(K^+K^-))/\Gamma_{total}$ — Γ_{20}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.0015±0.0007 OUR AVERAGE					
0.0014$^{+0.0005}_{-0.0004}$±0.0006	14.5$^{+4.6}_{-3.0}$	[37] HUANG	03	BELL	$B^+ \to 2(K^+K^-)K^+$
0.021 ±0.010 ±0.006		[45] ALBRECHT	94H	ARG	$\gamma\gamma \to K^+K^-K^+K^-$

$\Gamma(2(K^+K^-))/\Gamma(K\overline{K}\pi)$ — Γ_{20}/Γ_{16}

VALUE	DOCUMENT ID		TECN	COMMENT
0.023±0.007±0.006	AUBERT,B	04B	BABR	$B^{\pm} \to K^{\pm}\eta_c$

$\Gamma(2(\pi^+\pi^-))/\Gamma_{total}$ — Γ_{21}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
1.2 ±0.3 OUR EVALUATION					
1.15±0.26 OUR AVERAGE					
1.0 ±0.5	542 ± 75	[35] BAI	04	BES	$J/\psi \to \gamma\, 2(\pi^+\pi^-)$
1.05±0.17±0.34	137	[35] BISELLO	91	DM2	$J/\psi \to \gamma 2\pi^+ 2\pi^-$
1.3 ±0.6	25	[35] BALTRUSAIT...	86	MRK3	$J/\psi \to \eta_c \gamma$
2.0 $^{+1.5}_{-1.0}$		[43] HIMEL	80B	MRK2	$\psi(2S) \to \eta_c \gamma$

$\Gamma(3(\pi^+\pi^-))/\Gamma_{total}$ — Γ_{22}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
204.±45.±58.	479	[46] ABLIKIM	06A	BES2	$J/\psi \to 3(\pi^+\pi^-)\gamma$

$\Gamma(p\overline{p})/\Gamma_{total}$ — Γ_{23}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
13 ± 4 OUR EVALUATION		(Treating systematic errors as correlated.)			
14.0± 2.2 OUR AVERAGE					
15.5 $^{+2.1}_{-2.5}$ ±2.1	195	[47] WU	06	BELL	$B^+ \to p\overline{p}K^+$
15 ± 6	213 ± 33	[35] BAI	04	BES	$J/\psi \to \gamma p\overline{p}$
10 ± 3 ±4	18	[35] BISELLO	91	DM2	$J/\psi \to \gamma p\overline{p}$
11 ± 6	23	[35] BALTRUSAIT...	86	MRK3	$J/\psi \to \eta_c \gamma$
29 $^{+29}_{-15}$		[43] HIMEL	80B	MRK2	$\psi(2S) \to \eta_c \gamma$

$\Gamma(p\overline{p}) \times \Gamma(\phi\phi)/\Gamma^2_{total}$ — $\Gamma_{23}\Gamma_7/\Gamma^2$

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

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

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$10.4^{+2.9}_{-2.7}$±1.4		20	[48] WU	06	BELL	$B^+ \to \Lambda\overline{\Lambda}K^+$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<20	90		[35] BISELLO	91	DM2	$e^+e^- \to \gamma\Lambda\overline{\Lambda}$

$\Gamma(\Lambda\overline{\Lambda})/\Gamma(p\overline{p})$ — Γ_{24}/Γ_{23}

VALUE	DOCUMENT ID		TECN	COMMENT
$0.67^{+0.19}_{-0.16}$±0.12	[49] WU	06	BELL	$B^+ \to p\overline{p}K^+$, $\Lambda\overline{\Lambda}K^+$

$\Gamma(K\overline{K}\eta)/\Gamma_{total}$ — Γ_{25}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.031	90	[35] BALTRUSAIT...	86	MRK3	$J/\psi \to \eta_c \gamma$

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.012	90	HIMEL	80B	MRK2	$\psi(2S) \to \eta_c\gamma$

[35] 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.

[36] ABLIKIM 06A reports $[B(\eta_c(1S) \to K^{*0}\overline{K}^{*0}\pi^+\pi^-) \times B(J/\psi(1S) \to \gamma\eta_c(1S))] = (1.91 \pm 0.64 \pm 0.48) \times 10^{-4}$. We divide by our best value $B(J/\psi(1S) \to \gamma\eta_c(1S)) = (1.3 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

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

[38] ABLIKIM 06A reports $[B(\eta_c(1S) \to \phi 2(\pi^+\pi^-)) \times B(J/\psi(1S) \to \gamma\eta_c(1S))] = < 0.603 \times 10^{-4}$. We divide by our best value $B(J/\psi(1S) \to \gamma\eta_c(1S)) = 0.013$.

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

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

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

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

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

[44] ABLIKIM 06A reports $[B(\eta_c(1S) \to K^+K^- 2(\pi^+\pi^-)) \times B(J/\psi(1S) \to \gamma\eta_c(1S))] = (1.21 \pm 0.32 \pm 0.24) \times 10^{-4}$. We divide by our best value $B(J/\psi(1S) \to \gamma\eta_c(1S)) = (1.3 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[45] 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 $B(\eta_c \to 2\pi^+2\pi^-)$.

[46] ABLIKIM 06A reports $[B(\eta_c(1S) \to 3(\pi^+\pi^-)) \times B(J/\psi(1S) \to \gamma\eta_c(1S))] = (2.59 \pm 0.32 \pm 0.47) \times 10^{-4}$. We divide by our best value $B(J/\psi(1S) \to \gamma\eta_c(1S)) = (1.3 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[47] WU 06 reports $[B(\eta_c(1S) \to p\overline{p}) \times B(B^+ \to \eta_c K^+)] = (1.42 \pm 0.11^{+0.16}_{-0.20}) \times 10^{-6}$. We divide by our best value $B(B^+ \to \eta_c K^+) = (9.1 \pm 1.3) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[48] WU 06 reports $[B(\eta_c(1S) \to \Lambda\overline{\Lambda}) \times B(B^+ \to \eta_c K^+)] = (0.95^{+0.25}_{-0.22}{}^{+0.08}_{-0.11}) \times 10^{-6}$. We divide by our best value $B(B^+ \to \eta_c K^+) = (9.1 \pm 1.3) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

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

RADIATIVE DECAYS

$\Gamma(\gamma\gamma)/\Gamma_{total}$ — Γ_{27}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$2.80^{+0.67}_{-0.58}\pm1.0$		[50] ARMSTRONG	95F	E760	$\overline{p}p \rightarrow \gamma\gamma$
<9	90	[51] BISELLO	91	DM2	$J/\psi \rightarrow \gamma\gamma\gamma$
$6\ ^{+4}_{-3}\ \pm4$		[50] BAGLIN	87B	SPEC	$\overline{p}p \rightarrow \gamma\gamma$
<18	90	[52] BLOOM	83	CBAL	$J/\psi \rightarrow \eta_c\gamma$

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

[51] 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.

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

$\Gamma(p\overline{p}) \times \Gamma(\gamma\gamma)/\Gamma^2_{total}$ — $\Gamma_{23}\Gamma_{27}/\Gamma^2$

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
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	$\overline{p}p \rightarrow \eta_c \rightarrow \gamma\gamma$
$0.336^{+0.080}_{-0.070}$		ARMSTRONG	95F	E760	$\overline{p}p \rightarrow \gamma\gamma$
$0.68\ ^{+0.42}_{-0.31}$	12	BAGLIN	87B	SPEC	$\overline{p}p \rightarrow \gamma\gamma$

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

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

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<90	90	[53] ABLIKIM	06B	BES2	$J/\psi \rightarrow \pi^+\pi^-\gamma$

[53] ABLIKIM 06B reports $[B(\eta_c(1S) \rightarrow \pi^+\pi^-) \times B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))] = < 1.1 \times 10^{-5}$. We divide by our best value $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 0.013$.

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

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<60	90	[54] ABLIKIM	06B	BES2	$J/\psi \rightarrow \pi^0\pi^0\gamma$

[54] ABLIKIM 06B reports $[B(\eta_c(1S) \rightarrow \pi^0\pi^0) \times B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))] = < 0.71 \times 10^{-5}$. We divide by our best value $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 0.013$.

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

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<80	90	[55] ABLIKIM	06B	BES2	$J/\psi \rightarrow K^+K^-\gamma$

[55] ABLIKIM 06B reports $[B(\eta_c(1S) \rightarrow K^+K^-) \times B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))] = < 0.96 \times 10^{-5}$. We divide by our best value $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 0.013$.

$\Gamma(K^0_S K^0_S)/\Gamma_{total}$ Γ_{31}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<40	90	[56] ABLIKIM	06B	BES2	$J/\psi \to K^0_S K^0_S \gamma$

[56] ABLIKIM 06B reports $[B(\eta_c(1S) \to K^0_S K^0_S) \times B(J/\psi(1S) \to \gamma \eta_c(1S))] = < 0.53 \times 10^{-5}$. We divide by our best value $B(J/\psi(1S) \to \gamma \eta_c(1S)) = 0.013$.

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