$\eta_c(2S)$

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

Quantum numbers are quark model predictions.

$\eta_c(2S)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
3637.7 ±0.9 OUR AVERAGE		Error includes scale factor of 1.2.			
3637.90±0.54±1.40	3.7k	AAIJ	23AH	LHCB	$B^+ \to K^+ (K^0_S K \pi)$
3643.4 ±2.3 ±4.4	569	ABLIKIM	22Q	BES3	$\psi(2S) \to \gamma 3(\pi^+ \pi^-)$
3635.1 ±3.7 ±2.9	106	XU	18	BELL	$e^+ e^- \to e^+ e^- \eta' \pi^+ \pi^-$
3633.6 ±1.7 ±0.6	106	[1] AAIJ	17AD	LHCB	$p p \to B^+ X \to p \overline{p} K^+ X$
3636.4 ±4.1 ±0.7	365	[2] AAIJ	17BB	LHCB	$p p \to b \overline{b} X \to 2(K^+ K^-) X$
3637.0 ±5.7 ±3.4	178	[3,4] LEES	14E	BABR	$\gamma\gamma \to K^+ K^- \pi^0$
3635.1 ±5.8 ±2.1	47	[3,5] LEES	14E	BABR	$\gamma\gamma \to K^+ K^- \eta$
3646.9 ±1.6 ±3.6	57	ABLIKIM	13K	BES3	$\psi(2S) \to \gamma K^0_S K^\pm \pi^\mp \pi^+ \pi^-$
3637.6 ±2.9 ±1.6	127	[6] ABLIKIM	12G	BES3	$\psi(2S) \to \gamma K^0 K \pi$, $K K \pi^0$
3638.5 ±1.5 ±0.8	624	[3] DEL-AMO-SA...	11M	BABR	$\gamma\gamma \to K^0_S K^\pm \pi^\mp$
3640.5 ±3.2 ±2.5	1201	[3] DEL-AMO-SA...	11M	BABR	$\gamma\gamma \to K^+ K^- \pi^+ \pi^- \pi^0$
3636.1 $^{+3.9}_{-4.2}$ $^{+0.7}_{-2.0}$	128	[7] VINOKUROVA	11	BELL	$B^\pm \to K^\pm (K^0_S K^\pm \pi^\mp)$
3626 ±5 ±6	311	[8] ABE	07	BELL	$e^+ e^- \to J/\psi (c \overline{c})$
3645.0 ±5.5 $^{+4.9}_{-7.8}$	121	AUBERT	05C	BABR	$e^+ e^- \to J/\psi c \overline{c}$
3642.9 ±3.1 ±1.5	61	ASNER	04	CLEO	$\gamma\gamma \to \eta'_c \to K^0_S K^\pm \pi^\mp$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
3639 ±7	98	[9] AUBERT	06E	BABR	$B^\pm \to K^\pm X_{c \overline{c}}$
3630.8 ±3.4 ±1.0	112	[10] AUBERT	04D	BABR	$\gamma\gamma \to \eta_c(2S) \to K \overline{K} \pi$
3654 ±6 ±8	39	[11] CHOI	02	BELL	$B \to K K_S K^- \pi^+$
3594 ±5		[12] EDWARDS	82C	CBAL	$e^+ e^- \to \gamma X$

[1] AAIJ 17AD report $m_{\psi(2S)} - m_{\eta_c(2S)} = 52.5 \pm 1.7 \pm 0.6$ MeV. We use the current value $m_{\psi(2S)} = 3686.097 \pm 0.025$ MeV to obtain the quoted mass.

[2] From a fit of the $\phi\phi$ invariant mass with the width of $\eta_c(2S)$ fixed to the PDG 16 value.

[3] Ignoring possible interference with continuum.

[4] With a width fixed to 11.3 MeV.

[5] With a width fixed to 11.3 MeV. Using both $\eta \to \gamma\gamma$ and $\eta \to \pi^+ \pi^- \pi^0$ decays.

[6] From a simultaneous fit to $K^0_S K^\pm \pi^\mp$ and $K^+ K^- \pi^0$ decay modes.

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

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

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

[10] Superseded by DEL-AMO-SANCHEZ 11M.

[11] Superseded by VINOKUROVA 11.

[12] Assuming mass of $\psi(2S)$ = 3686 MeV.

$\eta_c(2S)$ WIDTH

VALUE (MeV)	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
11.8 ± 1.6 OUR AVERAGE						
10.77 ± 1.62 ± 1.08		3.7k	AAIJ	23AH	LHCB	$B^+ \to K^+ (K^0_S K \pi)$
19.8 ± 3.9 ± 3.1		569	ABLIKIM	22Q	BES3	$\psi(2S) \to \gamma 3(\pi^+ \pi^-)$
9.9 ± 4.8 ± 2.9		57	ABLIKIM	13K	BES3	$\psi(2S) \to \gamma K^0_S K^\pm \pi^\mp \pi^+ \pi^-$
16.9 ± 6.4 ± 4.8		127	[1] ABLIKIM	12G	BES3	$\psi(2S) \to \gamma K^0 K \pi$, $K K \pi^0$
13.4 ± 4.6 ± 3.2		624	[2] DEL-AMO-SA...	11M	BABR	$\gamma\gamma \to K^0_S K^\pm \pi^\mp$
$6.6^{+8.4}_{-5.1}{}^{+2.6}_{-0.9}$		128	[3] VINOKUROVA	11	BELL	$B^\pm \to K^\pm (K^0_S K^\pm \pi^\mp)$
6.3 ± 12.4 ± 4.0		61	ASNER	04	CLEO	$\gamma\gamma \to \eta'_c \to K^0_S K^\pm \pi^\mp$

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

VALUE (MeV)	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
< 23	90	98	[4] AUBERT	06E	BABR	$B^\pm \to K^\pm X_{c\overline{c}}$
22 ± 14		121	AUBERT	05C	BABR	$e^+ e^- \to J/\psi c \overline{c}$
17.0 ± 8.3 ± 2.5		112	[5] AUBERT	04D	BABR	$\gamma\gamma \to \eta_c(2S) \to K \overline{K} \pi$
<55	90	39	[6] CHOI	02	BELL	$B \to K K_S K^- \pi^+$
<8.0	95		[7] EDWARDS	82C	CBAL	$e^+ e^- \to \gamma X$

[1] From a simultaneous fit to $K^0_S K^\pm \pi^\mp$ and $K^+ K^- \pi^0$ decay modes.
[2] Ignoring possible interference with continuum.
[3] Accounts for interference with non-resonant continuum.
[4] From the fit of the kaon momentum spectrum. Systematic errors not evaluated.
[5] Superseded by DEL-AMO-SANCHEZ 11M.
[6] For a mass value of 3654 ± 6 MeV. Superseded by VINOKUROVA 11.
[7] For a mass value of 3594 ± 5 MeV

$\eta_c(2S)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	hadrons	seen	
Γ_2	$K \overline{K} \pi$	(1.9±1.2) %	
Γ_3	$K \overline{K} \eta$	(5 ±4) × 10^{-3}	
Γ_4	$2\pi^+ 2\pi^-$	< 2.1 %	90%
Γ_5	$\rho^0 \rho^0$	< 1.9 × 10^{-3}	90%
Γ_6	$3\pi^+ 3\pi^-$	(1.3±0.9) %	
Γ_7	$K^+ K^- \pi^+ \pi^-$	< 1.4 %	90%
Γ_8	$K^{*0} \overline{K}^{*0}$	< 2.9 × 10^{-3}	90%
Γ_9	$K^+ K^- \pi^+ \pi^- \pi^0$	(1.4±1.0) %	
Γ_{10}	$K^+ K^- 2\pi^+ 2\pi^-$	< 1.4 %	90%
Γ_{11}	$K^0_S K^- 2\pi^+ \pi^-$ + c.c.	(1.0±0.8) %	
Γ_{12}	$2K^+ 2K^-$	< 1.3 × 10^{-3}	90%

Γ_{13}	$\phi\phi$	$< 1.1 \times 10^{-3}$	90%
Γ_{14}	$p\overline{p}$	$< 2.0 \times 10^{-3}$	90%
Γ_{15}	$p\overline{p}\pi^+\pi^-$	seen	
Γ_{16}	$\gamma\gamma$	$(1.8\pm1.2) \times 10^{-4}$	
Γ_{17}	$\gamma J/\psi(1S)$	< 1.4 %	90%
Γ_{18}	$\pi^+\pi^-\eta$	$(4.3\pm3.2) \times 10^{-3}$	
Γ_{19}	$\pi^+\pi^-\eta'$	$(2.6\pm1.9) \times 10^{-3}$	
Γ_{20}	$K_2^*(1430)\overline{K}$ + c.c.	seen	
Γ_{21}	$K_0^*(1950)\overline{K}$ + c.c.	seen	
Γ_{22}	$a_0(1710)\pi$	seen	
Γ_{23}	$a_0(1450)\pi$	seen	
Γ_{24}	$a_2(1700)\pi$	seen	
Γ_{25}	$K_0^*(2600)\overline{K}$ + c.c.	seen	
Γ_{26}	$\pi^+\pi^-\eta_c(1S)$	< 25 %	90%

$\eta_c(2S)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$ — Γ_{16}

VALUE (keV)	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.44 ± 0.14	106	[1] XU	18	BELL	$e^+e^- \to e^+e^-\eta'\pi^+\pi^-$
$1.3\ \pm0.6$		[2] ASNER	04	CLEO	$\gamma\gamma \to \eta'_c \to K_S^0 K^\pm \pi^\mp$

[1] Assuming that the branching fraction into $\eta'\pi^+\pi^-$ is the same as for $\eta_c(1S)$.

[2] They measure $\Gamma(\eta_c(2S)\gamma\gamma)$ B$(\eta_c(2S) \to K\overline{K}\pi) = (0.18 \pm 0.05 \pm 0.02)$ $\Gamma(\eta_c(1S)\gamma\gamma)$ B$(\eta_c(1S) \to K\overline{K}\pi)$. The value for $\Gamma(\eta_c(2S) \to \gamma\gamma)$ is derived assuming that the branching fractions for $\eta_c(2S)$ and $\eta_c(1S)$ decays to $K_S K\pi$ are equal and using $\Gamma(\eta_c(1S) \to \gamma\gamma) = 7.4 \pm 0.4 \pm 2.3$ keV.

$\Gamma(\gamma\gamma) \times \Gamma(\pi^+\pi^-\eta')/\Gamma_{total}$ — $\Gamma_{16}\Gamma_{19}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{5.6^{+1.2}_{-1.1}\pm1.1}$	106	XU	18	BELL	$e^+e^- \to e^+e^-\eta'\pi^+\pi^-$

$\eta_c(2S)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(total)$

$\Gamma(K\overline{K}\pi) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_2\Gamma_{16}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID	TECN	COMMENT
41±4±6	624	[1] DEL-AMO-SA..11M	BABR	$\gamma\gamma \to K_S^0 K^\pm \pi^\mp$

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

$\Gamma(2\pi^+2\pi^-) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_4\Gamma_{16}/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
<6.5	90	UEHARA	08	BELL	$\gamma\gamma \to \eta_c(2S) \to 2(\pi^+\pi^-)$

$\Gamma(K^+K^-\pi^+\pi^-) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_7\Gamma_{16}/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
<5.0	90	UEHARA	08	BELL	$\gamma\gamma \to \eta_c(2S) \to K^+K^-\pi^+\pi^-$

$\Gamma(K^+K^-\pi^+\pi^-\pi^0) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_9\Gamma_{16}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID	TECN	COMMENT
30±6±5	1201	[1] DEL-AMO-SA..11M	BABR	$\gamma\gamma \to K^+K^-\pi^+\pi^-\pi^0$

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

$\Gamma(2K^+2K^-) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{12}\Gamma_{16}/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
<2.9	90	UEHARA 08	BELL	$\gamma\gamma \to \eta_c(2S) \to 2(K^+K^-)$

$\Gamma(\pi^+\pi^-\eta_c(1S)) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{26}\Gamma_{16}/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
<133	90	LEES 12AE	BABR	$e^+e^- \to e^+e^-\pi^+\pi^-\eta_c$

$\eta_c(2S)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma^2$(total)

$\Gamma(p\overline{p})/\Gamma_{total} \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{14}/\Gamma \times \Gamma_{16}/\Gamma$

VALUE (units 10^{-8})	CL%	DOCUMENT ID	TECN	COMMENT
< 5.6	90	[1,2,3] AMBROGIANI 01	E835	$\overline{p}p \to \gamma\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
< 8.0	90	[1,2,4] AMBROGIANI 01	E835	$\overline{p}p \to \gamma\gamma$
<12.0	90	[2,4] AMBROGIANI 01	E835	$\overline{p}p \to \gamma\gamma$

[1] Including the measurements of of ARMSTRONG 95F in the AMBROGIANI 01 analysis.
[2] For a total width Γ=5 MeV.
[3] For the resonance mass region 3589–3599 MeV/c^2.
[4] For the resonance mass region 3575–3660 MeV/c^2.

$\eta_c(2S)$ BRANCHING RATIOS

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

VALUE	DOCUMENT ID	TECN	COMMENT
not seen	ABREU 98O	DLPH	$e^+e^- \to e^+e^-$ + hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •			
seen	[1] EDWARDS 82C	CBAL	$e^+e^- \to \gamma X$

[1] For a mass value of 3594 ± 5 MeV

$\Gamma(K\overline{K}\pi)/\Gamma_{total}$ — Γ_2/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
1.9±0.4±1.1	59 ± 12	[1] AUBERT 08AB	BABR	$B \to \eta_c(2S)K \to K\overline{K}\pi K$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
seen	127 ± 18	ABLIKIM 12G	BES3	$\psi(2S) \to \gamma K\overline{K}\pi$
seen	39 ± 11	[2] CHOI 02	BELL	$B \to KK_SK^-\pi^+$

[1] Derived from a measurement of [B($B^+ \to \eta_c(2S)K^+$) × B($\eta_c(2S) \to K\overline{K}\pi$)] / [B($B^+ \to \eta_cK^+$) × B($\eta_c \to K\overline{K}\pi$)] = $(9.6^{+2.0}_{-1.9} \pm 2.5)$% and using B($B^+ \to \eta_c(2S)K^+$) = (3.4 ± 1.8) × 10^{-4}, and [B($B^+ \to \eta_cK^+$) × B($\eta_c \to K\overline{K}\pi$)] = $(6.88 \pm 0.77^{+0.55}_{-0.66}) \times 10^{-5}$.
[2] For a mass value of 3654 ± 6 MeV

$\Gamma(K\overline{K}\eta)/\Gamma(K\overline{K}\pi)$ — Γ_3/Γ_2

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
27.3±7.0±9.0	225	[1] LEES	14E	BABR	$\gamma\gamma \to K^+ K^- \gamma\gamma$

[1] LEES 14E reports $B(\eta_c(2S) \to K^+ K^- \eta)/B(\eta_c(2S) \to K^+ K^- \pi^0) = 0.82 \pm 0.21 \pm 0.27$, which we divide by 3 to account for isospin symmetry.

$\Gamma(2\pi^+ 2\pi^-)/\Gamma_{total}$ — Γ_4/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
not seen	UEHARA	08	BELL	$\gamma\gamma \to \eta_c(2S)$

$\Gamma(\rho^0\rho^0)/\Gamma_{total}$ — Γ_5/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
not seen	ABLIKIM	11H	BES3	$\psi(2S) \to \gamma 2\pi^+ 2\pi^-$

$\Gamma(K^+ K^- \pi^+ \pi^-)/\Gamma_{total}$ — Γ_7/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
not seen	UEHARA	08	BELL	$\gamma\gamma \to \eta_c(2S)$

$\Gamma(K^{*0}\overline{K}^{*0})/\Gamma_{total}$ — Γ_8/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
not seen	ABLIKIM	11H	BES3	$\psi(2S) \to \gamma K^+ K^- \pi^+ \pi^-$

$\Gamma(K^+ K^- \pi^+ \pi^- \pi^0)/\Gamma(K\overline{K}\pi)$ — Γ_9/Γ_2

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.73±0.17±0.17	1201	[1] DEL-AMO-SA..11M		BABR	$\gamma\gamma \to K^+ K^- \pi^+ \pi^- \pi^0$

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

$\Gamma(K^0_S K^- 2\pi^+ \pi^- + c.c.)/\Gamma_{total}$ — Γ_{11}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
seen	57±17	ABLIKIM	13K	BES3	$\psi(2S) \to \gamma K^0_S K^\pm \pi^\mp \pi^+ \pi^-$

$\Gamma(2K^+ 2K^-)/\Gamma_{total}$ — Γ_{12}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
not seen	UEHARA	08	BELL	$\gamma\gamma \to \eta_c(2S)$

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

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
not seen	ABLIKIM	11H	BES3	$\psi(2S) \to \gamma K^+ K^- K^+ K^-$

$\Gamma(p\overline{p})/\Gamma_{total}$ — Γ_{14}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
seen	106	[1] AAIJ	17AD	LHCB	$p p \to B^+ X \to p\overline{p} K^+ X$

[1] AAIJ 17AD report a 6.4 standard deviation signal, with $B(B^+ \to \eta_c(2S) K^+ \to p\overline{p} K^+)/B(B^+ \to J/\psi K^+ \to p\overline{p} K^+) = (1.58 \pm 0.33 \pm 0.09) \times 10^{-2}$.

$\Gamma(p\overline{p}\pi^+\pi^-)/\Gamma_{total}$ — Γ_{15}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
seen	110	[1] CHILIKIN	19	BELL	$e^+ e^- \to \Upsilon(4S)$

[1] CHILIKIN 19 reports signals in $B^+ \to \eta_c(2S) K^+$ and $B^0 \to \eta_c(2S) K^0_S$ with 12.3 and 5.9 standard deviations, respectively.

$\Gamma(\gamma\gamma)/\Gamma_{total}$ — Γ_{16}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<4 \times 10^{-4}$	90	[1] WICHT	08	BELL	$B^\pm \to K^\pm \gamma\gamma$
not seen		AMBROGIANI	01	E835	$\overline{p} p \to \gamma\gamma$
<0.01	90	LEE	85	CBAL	$\psi' \to$ photons

[1] WICHT 08 reports $[\Gamma(\eta_c(2S) \to \gamma\gamma)/\Gamma_{total}] \times [B(B^+ \to \eta_c(2S) K^+)] < 0.18 \times 10^{-6}$ which we divide by our best value $B(B^+ \to \eta_c(2S) K^+) = 4.4 \times 10^{-4}$.

$\Gamma(\pi^+\pi^-\eta_c(1S))/\Gamma(K\overline{K}\pi)$ — Γ_{26}/Γ_2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<3.33	90	[1] LEES	12AE	BABR	$e^+ e^- \to e^+ e^- \pi^+ \pi^- \eta_c$

[1] We divided the reported limit by 3 to take into account isospin relations.

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

$\Gamma(\eta_c(2S) \to K\overline{K}\eta)/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ — $\Gamma_3/\Gamma \times \Gamma^{\psi(2S)}_{183}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<11.8 \times 10^{-6}$	90	[1] CRONIN-HEN..10		CLEO	$\psi(2S) \to \gamma K^+ K^- \eta$

[1] CRONIN-HENNESSY 10 reports a limit of $< 5.9 \times 10^{-6}$ for the decay $\eta_c(2S) \to K^+ K^- \eta$ which we multiply by 2 account for isospin symmetry. It assumes $\Gamma(\eta_c(2S))$ = 14 MeV. It also gives the analytic dependence of limits on width.

$\Gamma(\eta_c(2S) \to 2\pi^+ 2\pi^-)/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ — $\Gamma_4/\Gamma \times \Gamma^{\psi(2S)}_{183}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$\mathbf{<14.6 \times 10^{-6}}$	90	[1] CRONIN-HEN..10		CLEO	$\psi(2S) \to \gamma 2\pi^+ 2\pi^-$

[1] Assuming $\Gamma(\eta_c(2S))$ = 14 MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

$\Gamma\big(\eta_c(2S) \to \rho^0\rho^0\big)/\Gamma_{total} \times \Gamma\big(\psi(2S) \to \gamma\eta_c(2S)\big)/\Gamma_{total}$ $\Gamma_5/\Gamma \times \Gamma^{\psi(2S)}_{183}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<12.7 × 10^{-7}	90	ABLIKIM	11H	BES3	$\psi(2S) \to \gamma 2\pi^+ 2\pi^-$

$\Gamma\big(\eta_c(2S) \to 3\pi^+3\pi^-\big)/\Gamma_{total} \times \Gamma\big(\psi(2S) \to \gamma\eta_c(2S)\big)/\Gamma_{total}$ $\Gamma_6/\Gamma \times \Gamma^{\psi(2S)}_{183}/\Gamma^{\psi(2S)}$

VALUE (units 10^{-6})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
9.2±1.0±1.2		569	ABLIKIM	22Q	BES3	$\psi(2S) \to \gamma 3(\pi^+\pi^-)$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<13.2	90		[1] CRONIN-HEN..10		CLEO	$\psi(2S) \to \gamma 3\pi^+ 3\pi^-$

[1] Assuming $\Gamma(\eta_c(2S))$ = 14 MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

$\Gamma\big(\eta_c(2S) \to K^+K^-\pi^+\pi^-\big)/\Gamma_{total} \times \Gamma\big(\psi(2S) \to \gamma\eta_c(2S)\big)/\Gamma_{total}$ $\Gamma_7/\Gamma \times \Gamma^{\psi(2S)}_{183}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<9.6 × 10^{-6}	90	[1] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma K^+K^-\pi^+\pi^-$

[1] Assuming $\Gamma(\eta_c(2S))$ = 14 MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

$\Gamma\big(\eta_c(2S) \to K^{*0}\overline{K}^{*0}\big)/\Gamma_{total} \times \Gamma\big(\psi(2S) \to \gamma\eta_c(2S)\big)/\Gamma_{total}$ $\Gamma_8/\Gamma \times \Gamma^{\psi(2S)}_{183}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<19.6 × 10^{-7}	90	ABLIKIM	11H	BES3	$\psi(2S) \to \gamma K^+K^-\pi^+\pi^-$

$\Gamma\big(\eta_c(2S) \to K^+K^-\pi^+\pi^-\pi^0\big)/\Gamma_{total} \times \Gamma\big(\psi(2S) \to \gamma\eta_c(2S)\big)/\Gamma_{total}$ $\Gamma_9/\Gamma \times \Gamma^{\psi(2S)}_{183}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<43.0 × 10^{-6}	90	[1] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma K^+K^-\pi^+\pi^-\pi^0$

[1] Assuming $\Gamma(\eta_c(2S))$ = 14 MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

$\Gamma\big(\eta_c(2S) \to K^+K^-2\pi^+2\pi^-\big)/\Gamma_{total} \times \Gamma\big(\psi(2S) \to \gamma\eta_c(2S)\big)/\Gamma_{total}$ $\Gamma_{10}/\Gamma \times \Gamma^{\psi(2S)}_{183}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<9.7 × 10^{-6}	90	[1] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma K^+K^-2\pi^+2\pi^-$

[1] Assuming $\Gamma(\eta_c(2S))$ = 14 MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

$\Gamma(\eta_c(2S) \to K^0_S K^- 2\pi^+\pi^- + \text{c.c.})/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ — $\Gamma_{11}/\Gamma \times \Gamma^{\psi(2S)}_{183}/\Gamma^{\psi(2S)}$

VALUE (units 10^{-6})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
7.03±2.10±0.7		60	ABLIKIM	13K	BES3	$\psi(2S) \to \gamma K^0_S K^- 2\pi^+\pi^-$ +c.c.
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$<$ 15.2	90		[1] CRONIN-HEN..10		CLEO	$\psi(2S) \to \gamma K^0_S K^- 2\pi^+\pi^-$ +c.c.

[1] Assuming $\Gamma(\eta_c(2S))$ = 14 MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

$\Gamma(\eta_c(2S) \to \phi\phi)/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ — $\Gamma_{13}/\Gamma \times \Gamma^{\psi(2S)}_{183}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<7.8 \times 10^{-7}$	90	ABLIKIM	11H	BES3	$\psi(2S) \to \gamma K^+ K^- K^+ K^-$

$\Gamma(\eta_c(2S) \to p\overline{p})/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ — $\Gamma_{14}/\Gamma \times \Gamma^{\psi(2S)}_{183}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1.4 \times 10^{-6}$	90	ABLIKIM	13V	BES3	$\psi(2S) \to \gamma p\overline{p}$

$\Gamma(\eta_c(2S) \to \gamma J/\psi(1S))/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ — $\Gamma_{17}/\Gamma \times \Gamma^{\psi(2S)}_{183}/\Gamma^{\psi(2S)}$

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$<9.7 \times 10^{-6}$	90	33	[1] ABLIKIM	17N	BES3	$\psi(2S) \to \gamma\gamma J/\psi$

[1] Uses B($J/\psi \to e^+e^-$) = (5.971 ± 0.032)% and B($J/\psi \to \mu^+\mu^-$) = (5.961 ± 0.033)%.

$\Gamma(\eta_c(2S) \to \pi^+\pi^-\eta)/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ — $\Gamma_{18}/\Gamma \times \Gamma^{\psi(2S)}_{183}/\Gamma^{\psi(2S)}$

VALUE (units 10^{-6})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
2.97±0.81±0.26		106	ABLIKIM	23Q	BES3	$\psi(2S) \to \gamma\pi^+\pi^-\eta$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$<$4.3	90		[1] CRONIN-HEN..10		CLEO	$\psi(2S) \to \gamma\pi^+\pi^-\eta$

[1] Assuming $\Gamma(\eta_c(2S))$ = 14 MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

$\Gamma(\eta_c(2S) \to \pi^+\pi^-\eta')/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ — $\Gamma_{19}/\Gamma \times \Gamma^{\psi(2S)}_{183}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$<14.2 \times 10^{-6}$	90	[1] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma\pi^+\pi^-\eta'$

[1] Assuming $\Gamma(\eta_c(2S))$ = 14 MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

$\Gamma(K_2^*(1430)\overline{K}+\text{c.c.})/\Gamma_{\text{total}}$ Γ_{20}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	[1] AAIJ 23AH	LHCB	$B^+ \to K^+(K_S^0 K\pi)$

[1] From a Dalitz plot analysis of $\eta_c(2S) \to K_S^0 K^+ \pi^- +$ c.c..

$\Gamma(a_0(1710)\pi)/\Gamma_{\text{total}}$ Γ_{22}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	[1] AAIJ 23AH	LHCB	$B^+ \to K^+(K_S^0 K\pi)$

[1] From a Dalitz plot analysis of $\eta_c(2S) \to K_S^0 K^+ \pi^- +$ c.c..

$\Gamma(a_0(1450)\pi)/\Gamma_{\text{total}}$ Γ_{23}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	[1] AAIJ 23AH	LHCB	$B^+ \to K^+(K_S^0 K\pi)$

[1] From a Dalitz plot analysis of $\eta_c(2S) \to K_S^0 K^+ \pi^- +$ c.c..

$\Gamma(a_2(1700)\pi)/\Gamma_{\text{total}}$ Γ_{24}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	[1] AAIJ 23AH	LHCB	$B^+ \to K^+(K_S^0 K\pi)$

[1] From a Dalitz plot analysis of $\eta_c(2S) \to K_S^0 K^+ \pi^- +$ c.c..

$\Gamma(K_0^*(2600)\overline{K}+\text{c.c.})/\Gamma_{\text{total}}$ Γ_{25}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	[1] AAIJ 23AH	LHCB	$B^+ \to K^+(K_S^0 K\pi)$

[1] From a Dalitz plot analysis of $\eta_c(2S) \to K_S^0 K^+ \pi^- +$ c.c..

$\Gamma(K_0^*(1950)\overline{K}+\text{c.c.})/\Gamma_{\text{total}}$ Γ_{21}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	[1] AAIJ 23AH	LHCB	$B^+ \to K^+(K_S^0 K\pi)$

[1] From a Dalitz plot analysis of $\eta_c(2S) \to K_S^0 K^+ \pi^- +$ c.c..

$\Gamma(\eta_c(2S) \to \pi^+\pi^-\eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{\text{total}}$ $\Gamma_{26}/\Gamma \times \Gamma_{183}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<1.7 \times 10^{-4}$	90	[1] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma\pi^+\pi^-\eta_c(1S)$

[1] Assuming $\Gamma(\eta_c(2S)) = 14$ MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

$\eta_c(2S)$ REFERENCES

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ABLIKIM	23Q	PR D107 052007	M. Ablikim *et al.*	(BESIII Collab.)
ABLIKIM	22Q	PR D106 032014	M. Ablikim *et al.*	(BESIII Collab.)
CHILIKIN	19	PR D100 012001	K. Chilikin *et al.*	(BELLE Collab.)
XU	18	PR D98 072001	Q.N. Xu *et al.*	(BELLE Collab.)
AAIJ	17AD	PL B769 305	R. Aaij *et al.*	(LHCb Collab.)
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