$\eta_c(2S)$

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

Quantum numbers are quark model predictions.

$\eta_c(2S)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
3637.5±1.1 OUR AVERAGE	Error includes scale factor of 1.2.			
3635.1±3.7±2.9	106	XU 18	BELL	$e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$
3633.6±1.7±0.6	106	[1] AAIJ 17AD	LHCB	$pp \rightarrow B^+X \rightarrow p\overline{p}K^+X$
3636.4±4.1±0.7	365	[2] AAIJ 17BB	LHCB	$pp \rightarrow b\overline{b}X \rightarrow 2(K^+K^-)X$
3637.0±5.7±3.4	178	[3,4] LEES 14E	BABR	$\gamma\gamma \rightarrow K^+K^-\pi^0$
3635.1±5.8±2.1	47	[3,5] LEES 14E	BABR	$\gamma\gamma \rightarrow K^+K^-\eta$
3646.9±1.6±3.6	57 ± 17	ABLIKIM 13K	BES3	$\psi(2S) \rightarrow \gamma K^0_S K^\pm\pi^\mp\pi^+\pi^-$
3637.6±2.9±1.6	127 ± 18	[6] ABLIKIM 12G	BES3	$\psi(2S) \rightarrow \gamma K^0 K\pi$, $KK\pi^0$
3638.5±1.5±0.8	624	[3] DEL-AMO-SA...11M	BABR	$\gamma\gamma \rightarrow K^0_S K^\pm\pi^\mp$
3640.5±3.2±2.5	1201	[3] DEL-AMO-SA...11M	BABR	$\gamma\gamma \rightarrow K^+K^-\pi^+\pi^-\pi^0$
$3636.1^{+3.9}_{-4.2}{}^{+0.7}_{-2.0}$	128	[7] VINOKUROVA 11	BELL	$B^\pm \rightarrow K^\pm(K^0_S K^\pm\pi^\mp)$
3626 ±5 ±6	311	[8] ABE 07	BELL	$e^+e^- \rightarrow J/\psi(c\overline{c})$
$3645.0\pm5.5^{+4.9}_{-7.8}$	121 ± 27	AUBERT 05C	BABR	$e^+e^- \rightarrow J/\psi c\overline{c}$
3642.9±3.1±1.5	61	ASNER 04	CLEO	$\gamma\gamma \rightarrow \eta_c \rightarrow K^0_S K^\pm\pi^\mp$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
3639 ±7	98 ± 52	[9] AUBERT 06E	BABR	$B^\pm \rightarrow K^\pm X_{c\overline{c}}$
3630.8±3.4±1.0	112 ± 24	[10] AUBERT 04D	BABR	$\gamma\gamma \rightarrow \eta_c(2S) \rightarrow K\overline{K}\pi$
3654 ±6 ±8	39 ± 11	[11] CHOI 02	BELL	$B \rightarrow KK_S K^-\pi^+$
3594 ±5		[12] EDWARDS 82C	CBAL	$e^+e^- \rightarrow \gamma X$

[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 $\eta \rightarrow \gamma\gamma$ and $\eta \rightarrow \pi^+\pi^-\pi^0$ 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
$11.3^{+3.2}_{-2.9}$ OUR AVERAGE						
$9.9 \pm 4.8 \pm 2.9$		57 ± 17	ABLIKIM	13K	BES3	$\psi(2S) \to \gamma K^0_S K^\pm \pi^\mp \pi^+ \pi^-$
$16.9 \pm 6.4 \pm 4.8$		127 ± 18	[13] ABLIKIM	12G	BES3	$\psi(2S) \to \gamma K^0 K \pi$, $K K \pi^0$
$13.4 \pm 4.6 \pm 3.2$		624	[14] DEL-AMO-SA...	11M	BABR	$\gamma\gamma \to K^0_S K^\pm \pi^\mp$
$6.6^{+8.4+2.6}_{-5.1-0.9}$		128	[15] VINOKUROVA	11	BELL	$B^\pm \to K^\pm (K^0_S K^\pm \pi^\mp)$
$6.3 \pm 12.4 \pm 4.0$		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. • • •						
< 23	90	98 ± 52	[16] AUBERT	06E	BABR	$B^\pm \to K^\pm X_{c\overline{c}}$
22 ± 14		121 ± 27	AUBERT	05C	BABR	$e^+ e^- \to J/\psi c \overline{c}$
$17.0 \pm 8.3 \pm 2.5$		112 ± 24	[17] AUBERT	04D	BABR	$\gamma\gamma \to \eta_c(2S) \to K \overline{K} \pi$
<55	90	39 ± 11	[18] CHOI	02	BELL	$B \to K K_S K^- \pi^+$
<8.0	95		[19] EDWARDS	82C	CBAL	$e^+ e^- \to \gamma X$

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

$\eta_c(2S)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	hadrons	not seen	
Γ_2	$K \overline{K} \pi$	(1.9 ± 1.2) %	
Γ_3	$K \overline{K} \eta$	$(5 \pm 4) \times 10^{-3}$	
Γ_4	$2\pi^+ 2\pi^-$	not seen	
Γ_5	$\rho^0 \rho^0$	not seen	
Γ_6	$3\pi^+ 3\pi^-$	not seen	
Γ_7	$K^+ K^- \pi^+ \pi^-$	not seen	
Γ_8	$K^{*0} \overline{K}^{*0}$	not seen	
Γ_9	$K^+ K^- \pi^+ \pi^- \pi^0$	(1.4 ± 1.0) %	
Γ_{10}	$K^+ K^- 2\pi^+ 2\pi^-$	not seen	
Γ_{11}	$K^0_S K^- 2\pi^+ \pi^- +$ c.c.	seen	
Γ_{12}	$2K^+ 2K^-$	not seen	
Γ_{13}	$\phi\phi$	not seen	

Γ_{14}	$p\overline{p}$	seen		
Γ_{15}	$\gamma\gamma$	$(1.9\pm1.3)\times10^{-4}$		
Γ_{16}	$\gamma J/\psi(1S)$	<1.4	%	90%
Γ_{17}	$\pi^+\pi^-\eta$	not seen		
Γ_{18}	$\pi^+\pi^-\eta'$	not seen		
Γ_{19}	$\pi^+\pi^-\eta_c(1S)$	<25	%	90%

$\eta_c(2S)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$ — Γ_{15}

VALUE (keV)	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.44 ± 0.14	106	[20] XU	18	BELL	$e^+e^-\rightarrow e^+e^-\eta'\pi^+\pi^-$
$1.3\ \pm0.6$		[21] ASNER	04	CLEO	$\gamma\gamma\rightarrow\eta_c\rightarrow K^0_S K^\pm\pi^\mp$

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

[21] They measure $\Gamma(\eta_c(2S)\gamma\gamma)$ B$(\eta_c(2S)\rightarrow K\overline{K}\pi) = (0.18\pm0.05\pm0.02)$ $\Gamma(\eta_c(1S)\gamma\gamma)$ B$(\eta_c(1S)\rightarrow K\overline{K}\pi)$. The value for $\Gamma(\eta_c(2S)\rightarrow\gamma\gamma)$ 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 $\Gamma(\eta_c(1S)\rightarrow\gamma\gamma) = 7.4\pm0.4\pm2.3$ keV.

$\Gamma(\gamma\gamma)\times\Gamma(\pi^+\pi^-\eta')/\Gamma_{\rm total}$ — $\Gamma_{15}\Gamma_{18}/\Gamma$

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

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

$\Gamma(2\pi^+2\pi^-)\times\Gamma(\gamma\gamma)/\Gamma_{\rm total}$ — $\Gamma_4\Gamma_{15}/\Gamma$

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

$\Gamma(K\overline{K}\pi)\times\Gamma(\gamma\gamma)/\Gamma_{\rm total}$ — $\Gamma_2\Gamma_{15}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID	TECN	COMMENT
41±4±6	624	[22] DEL-AMO-SA..11M	BABR	$\gamma\gamma\rightarrow K^0_S K^\pm\pi^\mp$

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

$\Gamma(K^+K^-\pi^+\pi^-)\times\Gamma(\gamma\gamma)/\Gamma_{\rm total}$ — $\Gamma_7\Gamma_{15}/\Gamma$

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

$\Gamma(K^+K^-\pi^+\pi^-\pi^0)\times\Gamma(\gamma\gamma)/\Gamma_{\rm total}$ — $\Gamma_9\Gamma_{15}/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID	TECN	COMMENT
30±6±5	1201	[23] DEL-AMO-SA..11M	BABR	$\gamma\gamma\rightarrow K^+K^-\pi^+\pi^-\pi^0$

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

$\Gamma(2K^+2K^-) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{12}\Gamma_{15}/\Gamma$

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

$\Gamma(\pi^+\pi^-\eta_c(1S)) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{19}\Gamma_{15}/\Gamma$

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

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

$\Gamma(p\overline{p})/\Gamma_{total} \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{14}/\Gamma \times \Gamma_{15}/\Gamma$

VALUE (units 10^{-8})	CL%	DOCUMENT ID		TECN	COMMENT
< 5.6	90	[24,25,26] AMBROGIANI	01	E835	$\overline{p}p \to \gamma\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
< 8.0	90	[24,25,27] AMBROGIANI	01	E835	$\overline{p}p \to \gamma\gamma$
<12.0	90	[25,27] AMBROGIANI	01	E835	$\overline{p}p \to \gamma\gamma$

[24] Including the measurements of of ARMSTRONG 95F in the AMBROGIANI 01 analysis.
[25] For a total width Γ=5 MeV.
[26] For the resonance mass region 3589–3599 MeV/c^2.
[27] 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	[28] EDWARDS	82C	CBAL	$e^+e^- \to \gamma X$

[28] 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	[29] 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	13K	BES3	$\psi(2S) \to \gamma K\overline{K}\pi$
seen	39 ± 11	[30] CHOI	02	BELL	$B \to KK_S K^-\pi^+$

[29] Derived from a measurement of $[B(B^+ \to \eta_c(2S)K^+) \times B(\eta_c(2S) \to K\overline{K}\pi)]$ / $[B(B^+ \to \eta_c K^+) \times B(\eta_c \to K\overline{K}\pi)] = (9.6^{+2.0}_{-1.9} \pm 2.5)\%$ and using $B(B^+ \to \eta_c(2S)K^+) = (3.4 \pm 1.8) \times 10^{-4}$, and $[B(B^+ \to \eta_c K^+) \times B(\eta_c \to K\overline{K}\pi)] = (6.88 \pm 0.77^{+0.55}_{-0.66}) \times 10^{-5}$.
[30] 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	[31] LEES	14E	BABR	$\gamma\gamma \to K^+K^-\gamma\gamma$

[31] 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
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
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
not seen	UEHARA	08	BELL	$\gamma\gamma \to \eta_c(2S)$

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.73±0.17±0.17	1201	[32] DEL-AMO-SA..11M		BABR	$\gamma\gamma \to K^+K^-\pi^+\pi^-\pi^0$

[32] 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.

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

VALUE	DOCUMENT ID		TECN	COMMENT
not seen	ABLIKIM	11H	BES3	$\psi(2S) \to \gamma K^+K^-\pi^+\pi^-$

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
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
not seen	UEHARA	08	BELL	$\gamma\gamma \to \eta_c(2S)$

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

VALUE	DOCUMENT ID		TECN	COMMENT
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
seen	106	[33] AAIJ	17AD	LHCB	$pp \to B^+X \to p\overline{p}K^+X$

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

$\Gamma(\gamma\gamma)/\Gamma_{total}$ Γ_{15}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<4 \times 10^{-4}$	90	[34] 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

[34] WICHT 08 reports $[\Gamma(\eta_c(2S) \to \gamma\gamma)/\Gamma_{total}] \times [B(B^+ \to \eta_c(2S)K^+)] < 0.18\times10^{-6}$ 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_{19}/Γ_2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<3.33	90	[35] LEES	12AE	BABR	$e^+e^- \to e^+e^-\pi^+\pi^-\eta_c$

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

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

$\Gamma(\eta_c(2S)\to K\overline{K}\eta)/\Gamma_{\text{total}} \times \Gamma(\psi(2S)\to\gamma\eta_c(2S))/\Gamma_{\text{total}}$ — $\Gamma_3/\Gamma \times \Gamma^{\psi(2S)}_{151}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<11.8\times10^{-6}$	90	[36] CRONIN-HEN..10		CLEO	$\psi(2S) \to \gamma K^+K^-\eta$

[36] CRONIN-HENNESSY 10 reports a limit of $< 5.9\times10^{-6}$ 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.

$\Gamma(\eta_c(2S)\to 2\pi^+2\pi^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S)\to\gamma\eta_c(2S))/\Gamma_{\text{total}}$ — $\Gamma_4/\Gamma \times \Gamma^{\psi(2S)}_{151}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<14.6\times10^{-6}$	90	[37] CRONIN-HEN..10		CLEO	$\psi(2S) \to \gamma 2\pi^+2\pi^-$

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

$\Gamma(\eta_c(2S)\to \rho^0\rho^0)/\Gamma_{\text{total}} \times \Gamma(\psi(2S)\to\gamma\eta_c(2S))/\Gamma_{\text{total}}$ — $\Gamma_5/\Gamma \times \Gamma^{\psi(2S)}_{151}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<12.7\times10^{-7}$	90	ABLIKIM	11H	BES3	$\psi(2S) \to \gamma 2\pi^+2\pi^-$

$\Gamma(\eta_c(2S)\to 3\pi^+3\pi^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S)\to\gamma\eta_c(2S))/\Gamma_{\text{total}}$ — $\Gamma_6/\Gamma \times \Gamma^{\psi(2S)}_{151}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<13.2\times10^{-6}$	90	[38] CRONIN-HEN..10		CLEO	$\psi(2S) \to \gamma 3\pi^+3\pi^-$

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

$\Gamma(\eta_c(2S)\to K^+K^-\pi^+\pi^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S)\to\gamma\eta_c(2S))/\Gamma_{\text{total}}$ — $\Gamma_7/\Gamma \times \Gamma^{\psi(2S)}_{151}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<9.6\times10^{-6}$	90	[39] CRONIN-HEN..10		CLEO	$\psi(2S) \to \gamma K^+K^-\pi^+\pi^-$

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

$\Gamma(\eta_c(2S)\to K^{*0}\overline{K}^{*0})/\Gamma_{\text{total}} \times \Gamma(\psi(2S)\to\gamma\eta_c(2S))/\Gamma_{\text{total}}$ — $\Gamma_8/\Gamma \times \Gamma^{\psi(2S)}_{151}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<19.6\times10^{-7}$	90	ABLIKIM	11H	BES3	$\psi(2S) \to \gamma K^+K^-\pi^+\pi^-$

$\Gamma(\eta_c(2S) \to K^+ K^- \pi^+ \pi^- \pi^0)/\Gamma_{\rm total} \times \Gamma(\psi(2S) \to \gamma \eta_c(2S))/\Gamma_{\rm total}$ $\quad \Gamma_9/\Gamma \times \Gamma^{\psi(2S)}_{151}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<43.0 × 10^{-6}	90	[40] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma K^+ K^- \pi^+ \pi^- \pi^0$

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

$\Gamma(\eta_c(2S) \to K^+ K^- 2\pi^+ 2\pi^-)/\Gamma_{\rm total} \times \Gamma(\psi(2S) \to \gamma \eta_c(2S))/\Gamma_{\rm total}$ $\quad \Gamma_{10}/\Gamma \times \Gamma^{\psi(2S)}_{151}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<9.7 × 10^{-6}	90	[41] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma K^+ K^- 2\pi^+ 2\pi^-$

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

$\Gamma(\eta_c(2S) \to K^0_S K^- 2\pi^+ \pi^- + \text{c.c.})/\Gamma_{\rm total} \times \Gamma(\psi(2S) \to \gamma \eta_c(2S))/\Gamma_{\rm total}$ $\quad \Gamma_{11}/\Gamma \times \Gamma^{\psi(2S)}_{151}/\Gamma^{\psi(2S)}$

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		[42] CRONIN-HEN..10		CLEO	$\psi(2S) \to \gamma K^0_S K^- 2\pi^+ \pi^-$ +c.c.

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

$\Gamma(\eta_c(2S) \to \phi\phi)/\Gamma_{\rm total} \times \Gamma(\psi(2S) \to \gamma \eta_c(2S))/\Gamma_{\rm total}$ $\quad \Gamma_{13}/\Gamma \times \Gamma^{\psi(2S)}_{151}/\Gamma^{\psi(2S)}$

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

$\Gamma(\eta_c(2S) \to p\overline{p})/\Gamma_{\rm total} \times \Gamma(\psi(2S) \to \gamma \eta_c(2S))/\Gamma_{\rm total}$ $\quad \Gamma_{14}/\Gamma \times \Gamma^{\psi(2S)}_{151}/\Gamma^{\psi(2S)}$

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

$\Gamma(\eta_c(2S) \to \gamma J/\psi(1S))/\Gamma_{\rm total} \times \Gamma(\psi(2S) \to \gamma \eta_c(2S))/\Gamma_{\rm total}$ $\quad \Gamma_{16}/\Gamma \times \Gamma^{\psi(2S)}_{151}/\Gamma^{\psi(2S)}$

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<9.7 × 10^{-6}	90	33	[43] ABLIKIM	17N	BES3	$\psi(2S) \to \gamma\gamma J/\psi$

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

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

$\Gamma_{17}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<4.3 \times 10^{-6}$	90	[44] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma\pi^+\pi^-\eta$

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

$\Gamma\big(\eta_c(2S) \to \pi^+\pi^-\eta'\big)/\Gamma_{\text{total}} \times \Gamma\big(\psi(2S) \to \gamma\eta_c(2S)\big)/\Gamma_{\text{total}}$

$\Gamma_{18}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<14.2 \times 10^{-6}$	90	[45] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma\pi^+\pi^-\eta'$

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

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

$\Gamma_{19}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<1.7 \times 10^{-4}$	90	[46] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma\pi^+\pi^-\eta_c(1S)$

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

$\eta_c(2S)$ REFERENCES

XU	18	PR D98 072001	Q.N. Xu *et al.*	(BELLE Collab.)
AAIJ	17AD	PL B769 305	R. Aaij *et al.*	(LHCb Collab.)
AAIJ	17BB	EPJ C77 609	R. Aaij *et al.*	(LHCb Collab.)
ABLIKIM	17N	PR D95 072004	M. Ablikim *et al.*	(BES III Collab.)
PDG	16	CP C40 100001	C. Patrignani *et al.*	(PDG Collab.)
LEES	14E	PR D89 112004	J.P. Lees *et al.*	(BABAR Collab.)
ABLIKIM	13K	PR D87 052005	M. Ablikim *et al.*	(BES III Collab.)
ABLIKIM	13V	PR D88 112001	M. Ablikim *et al.*	(BES III Collab.)
ABLIKIM	12G	PRL 109 042003	M. Ablikim *et al.*	(BES III Collab.)
LEES	12AE	PR D86 092005	J.P. Lees *et al.*	(BABAR Collab.)
ABLIKIM	11H	PR D84 091102	M. Ablikim *et al.*	(BES III Collab.)
DEL-AMO-SA...	11M	PR D84 012004	P. del Amo Sanchez *et al.*	(BABAR Collab.)
VINOKUROVA	11	PL B706 139	A. Vinokurova *et al.*	(BELLE Collab.)
CRONIN-HEN...	10	PR D81 052002	D. Cronin-Hennessey *et al.*	(CLEO Collab.)
AUBERT	08AB	PR D78 012006	B. Aubert *et al.*	(BABAR Collab.)
UEHARA	08	EPJ C53 1	S. Uehara *et al.*	(BELLE Collab.)
WICHT	08	PL B662 323	J. Wicht *et al.*	(BELLE Collab.)
ABE	07	PRL 98 082001	K. Abe *et al.*	(BELLE Collab.)
AUBERT	06E	PRL 96 052002	B. Aubert *et al.*	(BABAR Collab.)
AUBERT	05C	PR D72 031101	B. Aubert *et al.*	(BABAR Collab.)
ABE	04G	PR D70 071102	K. Abe *et al.*	(BELLE Collab.)
ASNER	04	PRL 92 142001	D.M. Asner *et al.*	(CLEO Collab.)
AUBERT	04D	PRL 92 142002	B. Aubert *et al.*	(BABAR Collab.)
ABE,K	02	PRL 89 142001	K. Abe *et al.*	(BELLE Collab.)
CHOI	02	PRL 89 102001	S.-K. Choi *et al.*	(BELLE Collab.)
AMBROGIANI	01	PR D64 052003	M. Ambrogiani *et al.*	(FNAL E835 Collab.)
ABREU	98O	PL B441 479	P. Abreu *et al.*	(DELPHI Collab.)
ARMSTRONG	95F	PR D52 4839	T.A. Armstrong *et al.*	(FNAL, FERR, GENO+)
LEE	85	SLAC 282	R.A. Lee	(SLAC)
EDWARDS	82C	PRL 48 70	C. Edwards *et al.*	(CIT, HARV, PRIN+)