$\eta_c(2S)$

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

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	$e^+e^- \to e^+e^-\eta'\pi^+\pi^-$
3633.6±1.7±0.6	106	[1] AAIJ 17AD	LHCB	$pp \to B^+X \to p\overline{p}K^+X$
3636.4±4.1±0.7	365	[2] AAIJ 17BB	LHCB	$pp \to b\overline{b}X \to 2(K^+K^-)X$
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 ± 17	ABLIKIM 13K	BES3	$\psi(2S) \to \gamma K^0_S K^\pm\pi^\mp\pi^+\pi^-$
3637.6±2.9±1.6	127 ± 18	[6] ABLIKIM 12G	BES3	$\psi(2S) \to \gamma K^0 K\pi$, $KK\pi^0$
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	$e^+e^- \to J/\psi(c\overline{c})$
$3645.0\pm5.5^{+4.9}_{-7.8}$	121 ± 27	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 ± 52	[9] AUBERT 06E	BABR	$B^\pm \to K^\pm X_{c\overline{c}}$
3630.8±3.4±1.0	112 ± 24	[10] AUBERT 04D	BABR	$\gamma\gamma \to \eta_c(2S) \to K\overline{K}\pi$
3654 ±6 ±8	39 ± 11	[11] CHOI 02	BELL	$B \to KK_S K^-\pi^+$
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[10] Superseded by DEL-AMO-SANCHEZ 11M.
[11] Superseded by VINOKUROVA 11.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
$11.3^{+3.2}_{-2.9}$ OUR AVERAGE					
$9.9\pm 4.8\pm2.9$		57 ± 17	ABLIKIM 13K	BES3	$\psi(2S)\to\gamma K^0_S K^\pm\pi^\mp\pi^+\pi^-$
$16.9\pm 6.4\pm4.8$		127 ± 18	[13] ABLIKIM 12G	BES3	$\psi(2S)\to\gamma K^0 K\pi$, $KK\pi^0$
$13.4\pm 4.6\pm3.2$		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	$B^\pm\to K^\pm(K^0_S K^\pm\pi^\mp)$
$6.3\pm12.4\pm4.0$		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	$B^\pm\to K^\pm X_{c\overline{c}}$
$22\ \pm14$		121 ± 27	AUBERT 05C	BABR	$e^+e^-\to J/\psi c\overline{c}$
$17.0\pm 8.3\pm2.5$		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	$B\to KK_S K^-\pi^+$
<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	$K\overline{K}\pi$	$(1.9\pm1.2)\ \%$	
Γ_3	$K\overline{K}\eta$	$(5\ \pm4\ )\times10^{-3}$	
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	$K^+K^-\pi^+\pi^-\pi^0$	$(1.4\pm1.0)\ \%$	
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}	$p\overline{p}\pi^+\pi^-$	seen	

Γ_{16}	$\gamma\gamma$	$(1.9\pm1.3)\times10^{-4}$		
Γ_{17}	$\gamma J/\psi(1S)$	<1.4	%	90%
Γ_{18}	$\pi^+\pi^-\eta$	not seen		
Γ_{19}	$\pi^+\pi^-\eta'$	not seen		
Γ_{20}	$\pi^+\pi^-\eta_c(1S)$	<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	[20] XU	18	BELL	$e^+e^-\to e^+e^-\eta'\pi^+\pi^-$
$1.3\ \pm0.6$		[21] ASNER	04	CLEO	$\gamma\gamma\to\eta_c\to K^0_S K^\pm\pi^\mp$

[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$(\eta_c(2S)\to K\overline{K}\pi) = (0.18\pm0.05\pm0.02)$ $\Gamma(\eta_c(1S)\gamma\gamma)$ 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 $\Gamma(\eta_c(1S)\to\gamma\gamma) = 7.4\pm0.4\pm2.3$ keV.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$\Gamma(\pi^+\pi^-\eta_c(1S)) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{20}\Gamma_{16}/\Gamma$

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

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

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

VALUE (units 10^{-8})	CL%	DOCUMENT ID		TECN	COMMENT
< 5.6	90	[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 $B(B^+ \to \eta_c(2S)K^+ \to p\overline{p}K^+)/B(B^+ \to J/\psi K^+ \to p\overline{p}K^+) = (1.58 \pm 0.33 \pm 0.09) \times 10^{-2}$.

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
seen	110	[34] CHILIKIN	19	BELL	$e^+e^- \to \Upsilon(4S)$

[34] 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	[35] 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

[35] 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_{20}/Γ_2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<3.33	90	[36] LEES	12AE	BABR	$e^+e^- \to e^+e^-\pi^+\pi^-\eta_c$

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

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

$\Gamma(\eta_c(2S) \to K\overline{K}\eta)/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ — $\Gamma_3/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$<11.8 \times 10^{-6}$	90	[37] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma K^+K^-\eta$

[37] 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.

$\Gamma(\eta_c(2S) \to 2\pi^+2\pi^-)/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ — $\Gamma_4/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$\mathbf{<14.6 \times 10^{-6}}$	90	[38] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma 2\pi^+2\pi^-$

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

$\Gamma(\eta_c(2S) \to \rho^0\rho^0)/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ — $\Gamma_5/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma^{\psi(2S)}$

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

$\Gamma(\eta_c(2S) \to 3\pi^+3\pi^-)/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ — $\Gamma_6/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$\mathbf{<13.2 \times 10^{-6}}$	90	[39] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma 3\pi^+3\pi^-$

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

$\Gamma(\eta_c(2S) \to K^+K^-\pi^+\pi^-)/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ — $\Gamma_7/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$\mathbf{<9.6 \times 10^{-6}}$	90	[40] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma K^+K^-\pi^+\pi^-$

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

$\Gamma(\eta_c(2S) \to K^{*0}\overline{K}^{*0})/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ $\quad\Gamma_8/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma^{\psi(2S)}$

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

$\Gamma(\eta_c(2S) \to K^+ K^- \pi^+ \pi^- \pi^0)/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ $\quad\Gamma_9/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<43.0 × 10^{-6}	90	[41] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma K^+ K^- \pi^+ \pi^- \pi^0$

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

$\Gamma(\eta_c(2S) \to K^+ K^- 2\pi^+ 2\pi^-)/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ $\quad\Gamma_{10}/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<9.7 × 10^{-6}	90	[42] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma K^+ K^- 2\pi^+ 2\pi^-$

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

$\Gamma(\eta_c(2S) \to K^0_S K^- 2\pi^+ \pi^- + \text{c.c.})/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ $\quad\Gamma_{11}/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma^{\psi(2S)}$

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

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

$\Gamma(\eta_c(2S) \to \phi\phi)/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ $\quad\Gamma_{13}/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma^{\psi(2S)}$

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

$\Gamma(\eta_c(2S) \to p\overline{p})/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ $\quad\Gamma_{14}/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma^{\psi(2S)}$

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

$\Gamma(\eta_c(2S) \to \gamma J/\psi(1S))/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ $\quad\Gamma_{17}/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<9.7 × 10^{-6}	90	33	[44] ABLIKIM	17N	BES3	$\psi(2S) \to \gamma\gamma J/\psi$

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

$\Gamma(\eta_c(2S) \to \pi^+\pi^-\eta)/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ $\Gamma_{18}/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<4.3 × 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.

$\Gamma(\eta_c(2S) \to \pi^+\pi^-\eta')/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ $\Gamma_{19}/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<14.2 × 10^{-6}	90	[46] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma\pi^+\pi^-\eta'$

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

$\Gamma(\eta_c(2S) \to \pi^+\pi^-\eta_c(1S))/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ $\Gamma_{20}/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<1.7 × 10^{-4}	90	[47] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma\pi^+\pi^-\eta_c(1S)$

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

$\eta_c(2S)$ REFERENCES

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.)
AAIJ	17BB	EPJ C77 609	R. Aaij et al.	(LHCb Collab.)
ABLIKIM	17N	PR D95 072004	M. Ablikim et al.	(BESIII 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.	(BESIII Collab.)
ABLIKIM	13V	PR D88 112001	M. Ablikim et al.	(BESIII Collab.)
ABLIKIM	12G	PRL 109 042003	M. Ablikim et al.	(BESIII Collab.)
LEES	12AE	PR D86 092005	J.P. Lees et al.	(BABAR Collab.)
ABLIKIM	11H	PR D84 091102	M. Ablikim et al.	(BESIII 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+)