$\eta_c(2S)$

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

Quantum numbers are quark model predictions.

$\eta_c(2S)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
3639.2±1.2 OUR AVERAGE					
3637.0±5.7±3.4	178	[1,2] LEES	14E	BABR	$\gamma\gamma \to K^+ K^- \pi^0$
3635.1±5.8±2.1	47	[1,3] 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	[4] ABLIKIM	12G	BES3	$\psi(2S) \to \gamma K^0 K \pi$, $K K \pi^0$
3638.5±1.5±0.8	624	[1] DEL-AMO-SA...	11M	BABR	$\gamma\gamma \to K^0_S K^\pm \pi^\mp$
3640.5±3.2±2.5	1201	[1] 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	[5] VINOKUROVA	11	BELL	$B^\pm \to K^\pm (K^0_S K^\pm \pi^\mp)$
3626 ±5 ±6	311	[6] 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	[7] AUBERT	06E	BABR	$B^\pm \to K^\pm X_{c\overline{c}}$
3630.8±3.4±1.0	112 ± 24	[8] AUBERT	04D	BABR	$\gamma\gamma \to \eta_c(2S) \to K\overline{K}\pi$
3654 ±6 ±8	39 ± 11	[9] CHOI	02	BELL	$B \to K K_S K^- \pi^+$
3594 ±5		[10] EDWARDS	82C	CBAL	$e^+ e^- \to \gamma X$

[1] Ignoring possible interference with continuum.
[2] With a width fixed to 11.3 MeV.
[3] With a width fixed to 11.3 MeV. Using both $\eta \to \gamma\gamma$ and $\eta \to \pi^+ \pi^- \pi^0$ decays.
[4] From a simultaneous fit to $K^0_S K^\pm \pi^\mp$ and $K^+ K^- \pi^0$ decay modes.
[5] Accounts for interference with non-resonant continuum.
[6] From a fit of the J/ψ recoil mass spectrum. Supersedes ABE,K 02 and ABE 04G.
[7] From the fit of the kaon momentum spectrum. Systematic errors not evaluated.
[8] Superseded by DEL-AMO-SANCHEZ 11M.
[9] Superseded by VINOKUROVA 11.
[10] 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± 4.8±2.9		57 ± 17	ABLIKIM	13K	BES3	$\psi(2S) \to \gamma K^0_S K^\pm \pi^\mp \pi^+ \pi^-$
16.9± 6.4±4.8		127 ± 18	[11] ABLIKIM	12G	BES3	$\psi(2S) \to \gamma K^0 K \pi$, $K K \pi^0$
13.4± 4.6±3.2		624	[12] 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	[13] VINOKUROVA	11	BELL	$B^{\pm} \rightarrow K^{\pm}(K^0_S K^{\pm} \pi^{\mp})$
$6.3 \pm 12.4 \pm 4.0$		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. • • •

< 23	90	98 ± 52	[14] AUBERT	06E	BABR	$B^{\pm} \rightarrow K^{\pm} X_{c\overline{c}}$
22 ± 14		121 ± 27	AUBERT	05C	BABR	$e^+ e^- \rightarrow J/\psi c\overline{c}$
$17.0 \pm 8.3 \pm 2.5$		112 ± 24	[15] AUBERT	04D	BABR	$\gamma\gamma \rightarrow \eta_c(2S) \rightarrow K\overline{K}\pi$
<55	90	39 ± 11	[16] CHOI	02	BELL	$B \rightarrow K K_S K^- \pi^+$
<8.0	95		[17] EDWARDS	82C	CBAL	$e^+ e^- \rightarrow \gamma X$

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

[12] Ignoring possible interference with continuum.

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

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

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

[16] For a mass value of 3654 ± 6 MeV. Superseded by VINOKUROVA 11.

[17] 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}	$p\overline{p}$	$< 2.0 \times 10^{-3}$	90%
Γ_{15}	$\gamma\gamma$	$(1.9 \pm 1.3) \times 10^{-4}$	
Γ_{16}	$\pi^+ \pi^- \eta$	not seen	
Γ_{17}	$\pi^+ \pi^- \eta'$	not seen	
Γ_{18}	$\pi^+ \pi^- \eta_c(1S)$	< 25 %	90%

$\eta_c(2S)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$ Γ_{15}

VALUE (keV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.3 ± 0.6	[18] ASNER	04	CLEO	$\gamma\gamma \to \eta_c \to K^0_S K^\pm \pi^\mp$

[18] 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.

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

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

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

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

VALUE (eV)	EVTS	DOCUMENT ID	TECN	COMMENT
41±4±6	624	[19] DEL-AMO-SA..11M	BABR	$\gamma\gamma \to K^0_S K^\pm \pi^\mp$

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

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

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

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

VALUE (eV)	EVTS	DOCUMENT ID	TECN	COMMENT
30±6±5	1201	[20] DEL-AMO-SA..11M	BABR	$\gamma\gamma \to K^+K^-\pi^+\pi^-\pi^0$

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

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

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

$\Gamma(\pi^+\pi^-\eta_c(1S)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_{18}\Gamma_{15}/\Gamma$

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

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

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

VALUE (units 10^{-8})	CL%	DOCUMENT ID		TECN	COMMENT
< 5.6	90	[21,22,23] AMBROGIANI	01	E835	$\overline{p}p \to \gamma\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
< 8.0	90	[21,22,24] AMBROGIANI	01	E835	$\overline{p}p \to \gamma\gamma$
<12.0	90	[22,24] AMBROGIANI	01	E835	$\overline{p}p \to \gamma\gamma$

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

$\eta_c(2S)$ BRANCHING RATIOS

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

VALUE	DOCUMENT ID		TECN	COMMENT
not seen	ABREU	98O	DLPH	$e^+e^- \rightarrow e^+e^- +$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •				
seen	[25] EDWARDS	82C	CBAL	$e^+e^- \rightarrow \gamma X$

[25] For a mass value of 3594 $\pm$ 5 MeV

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

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
1.9±0.4±1.1	59 $\pm$ 12	[26] AUBERT	08AB	BABR	$B \rightarrow \eta_c(2S)K \rightarrow K\overline{K}\pi K$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
seen	127 $\pm$ 18	ABLIKIM	13K	BES3	$\psi(2S) \rightarrow \gamma K\overline{K}\pi$
seen	39 $\pm$ 11	[27] CHOI	02	BELL	$B \rightarrow K K_S K^- \pi^+$

[26] Derived from a measurement of $[B(B^+ \rightarrow \eta_c(2S)K^+) \times B(\eta_c(2S) \rightarrow K\overline{K}\pi)] / [B(B^+ \rightarrow \eta_c K^+) \times B(\eta_c \rightarrow K\overline{K}\pi)] = (9.6^{+2.0}_{-1.9} \pm 2.5)\%$ and using $B(B^+ \rightarrow \eta_c(2S)K^+) = (3.4 \pm 1.8) \times 10^{-4}$, and $[B(B^+ \rightarrow \eta_c K^+) \times B(\eta_c \rightarrow K\overline{K}\pi)] = (6.88 \pm 0.77^{+0.55}_{-0.66}) \times 10^{-5}$.
[27] For a mass value of 3654 $\pm$ 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	[28] LEES	14E	BABR	$\gamma\gamma \rightarrow K^+K^-\gamma\gamma$

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

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

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

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

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

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

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

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

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.73±0.17±0.17	1201	[29] DEL-AMO-SA..11M	BABR	$\gamma\gamma \rightarrow K^+K^-\pi^+\pi^-\pi^0$

[29] 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	$\psi(2S) \rightarrow \gamma K^+K^-\pi^+\pi^-$

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

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
seen	57 ± 17	ABLIKIM 13K	BES3	$\psi(2S) \rightarrow \gamma K^0_S K^\pm\pi^\mp\pi^+\pi^-$

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

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

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

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

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

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$<5 \times 10^{-4}$	90	[30] WICHT 08	BELL	$B^\pm \rightarrow K^\pm\gamma\gamma$
not seen		AMBROGIANI 01	E835	$\overline{p}p \rightarrow \gamma\gamma$
<0.01	90	LEE 85	CBAL	$\psi' \rightarrow$ photons

[30] WICHT 08 reports $[\Gamma(\eta_c(2S) \rightarrow \gamma\gamma)/\Gamma_{total}] \times [B(B^+ \rightarrow \eta_c(2S)K^+)] < 0.18\times10^{-6}$ which we divide by our best value $B(B^+ \rightarrow \eta_c(2S)K^+) = 3.4 \times 10^{-4}$.

$\Gamma(\pi^+\pi^-\eta_c(1S))/\Gamma(K\overline{K}\pi)$ — Γ_{18}/Γ_2

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<3.33	90	[31] LEES 12AE	BABR	$e^+e^- \rightarrow e^+e^-\pi^+\pi^-\eta_c$

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

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

$\Gamma(\eta_c(2S) \rightarrow 2\pi^+2\pi^-)/\Gamma_{total} \times \Gamma(\psi(2S) \rightarrow \gamma\eta_c(2S))/\Gamma_{total}$ — $\Gamma_4/\Gamma \times \Gamma^{\psi(2S)}_{138}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<14.6 \times 10^{-6}$	90	[32] CRONIN-HEN..10	CLEO	$\psi(2S) \rightarrow \gamma 2\pi^+2\pi^-$

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

$\Gamma(\eta_c(2S) \to \rho^0\rho^0)/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ $\Gamma_5/\Gamma \times \Gamma^{\psi(2S)}_{138}/\Gamma^{\psi(2S)}$

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

$\Gamma(\eta_c(2S) \to 3\pi^+3\pi^-)/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ $\Gamma_6/\Gamma \times \Gamma^{\psi(2S)}_{138}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<13.2 × 10^−6	90	[33] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma 3\pi^+ 3\pi^-$

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

$\Gamma(\eta_c(2S) \to K^+K^-\pi^+\pi^-)/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ $\Gamma_7/\Gamma \times \Gamma^{\psi(2S)}_{138}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<9.6 × 10^−6	90	[34] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma K^+K^-\pi^+\pi^-$

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

$\Gamma(\eta_c(2S) \to K^{*0}\overline{K}^{*0})/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ $\Gamma_8/\Gamma \times \Gamma^{\psi(2S)}_{138}/\Gamma^{\psi(2S)}$

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

$\Gamma(\eta_c(2S) \to K^+K^-\pi^+\pi^-\pi^0)/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ $\Gamma_9/\Gamma \times \Gamma^{\psi(2S)}_{138}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<43.0 × 10^−6	90	[35] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma K^+K^-\pi^+\pi^-\pi^0$

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

$\Gamma(\eta_c(2S) \to K^+K^-2\pi^+2\pi^-)/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ $\Gamma_{10}/\Gamma \times \Gamma^{\psi(2S)}_{138}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<9.7 × 10^−6	90	[36] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma K^+K^-2\pi^+2\pi^-$

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

$\Gamma(\eta_c(2S) \to K^0_S K^- 2\pi^+\pi^- + \text{c.c.})/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\eta_c(2S))/\Gamma_{total}$ $\Gamma_{11}/\Gamma \times \Gamma^{\psi(2S)}_{138}/\Gamma^{\psi(2S)}$

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

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

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

$\Gamma_{13}/\Gamma \times \Gamma_{138}^{\psi(2S)}/\Gamma^{\psi(2S)}$

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

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

$\Gamma_{16}/\Gamma \times \Gamma_{138}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<4.3 × 10^{-6}	90	[38] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma\pi^+\pi^-\eta$

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

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

$\Gamma_{17}/\Gamma \times \Gamma_{138}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<14.2 × 10^{-6}	90	[39] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma\pi^+\pi^-\eta'$

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

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

$\Gamma_{3}/\Gamma \times \Gamma_{138}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<11.8 × 10^{-6}	90	[40] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma K^+ K^- \eta$

[40] 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.

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

$\Gamma_{18}/\Gamma \times \Gamma_{138}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<1.7 × 10^{-4}	90	[41] CRONIN-HEN..10	CLEO	$\psi(2S) \to \gamma\pi^+\pi^-\eta_c(1S)$

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

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

$\Gamma_{14}/\Gamma \times \Gamma_{138}^{\psi(2S)}/\Gamma^{\psi(2S)}$

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

$\eta_c(2S)$ REFERENCES

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+)