$\eta_c(2S)$

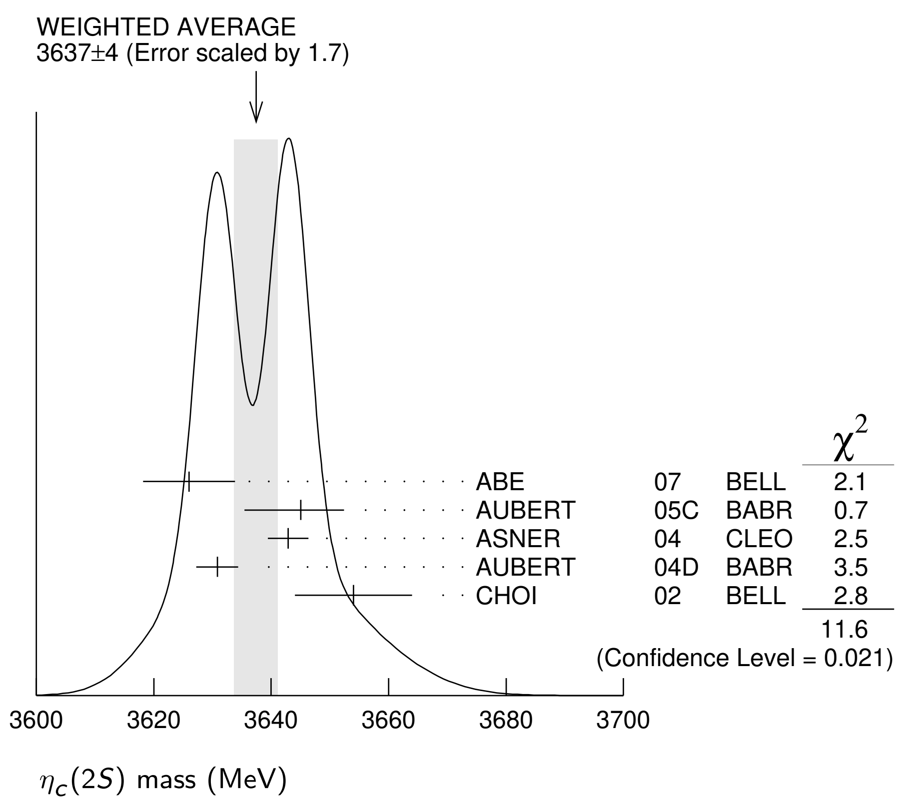
$I^G(J^{PC}) = 0^+(0^{-+})$

Quantum numbers are quark model predictions.

$\eta_c(2S)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
3637 ±4 OUR AVERAGE		Error includes scale factor of 1.7. See the ideogram below.			
3626 ±5 ±6	311	[1] ABE	07	BELL	$e^+e^- \to J/\psi(c\overline{c})$
$3645.0 \pm 5.5 ^{+4.9}_{-7.8}$	121 ± 27	AUBERT	05C	BABR	$e^+e^- \to J/\psi c\overline{c}$
3642.9±3.1±1.5	61	ASNER	04	CLEO	$\gamma\gamma \to \eta_c \to K^0_S K^\pm \pi^\mp$
3630.8±3.4±1.0	112 ± 24	AUBERT	04D	BABR	$\gamma\gamma \to \eta_c(2S) \to K\overline{K}\pi$
3654 ±6 ±8	39 ± 11	CHOI	02	BELL	$B \to K K_S K^- \pi^+$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
3639 ±7	98 ± 52	[2] AUBERT	06E	BABR	$B^\pm \to K^\pm X_{c\overline{c}}$
3594 ±5		[3] EDWARDS	82C	CBAL	$e^+e^- \to \gamma X$

[1] From a fit of the J/ψ recoil mass spectrum. Supersedes ABE,K 02 and ABE 04G.
[2] From the fit of the kaon momentum spectrum. Systematic errors not evaluated.
[3] Assuming mass of $\psi(2S) = 3686$ MeV.



$\eta_c(2S)$ WIDTH

VALUE (MeV)	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
14 ± 7 OUR AVERAGE						
$6.3 \pm 12.4 \pm 4.0$		61	ASNER	04	CLEO	$\gamma\gamma \to \eta_c \to K^0_S K^\pm \pi^\mp$
$17.0 \pm 8.3 \pm 2.5$		112 ± 24	AUBERT	04D	BABR	$\gamma\gamma \to \eta_c(2S) \to K\overline{K}\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<23	90	98 ± 52	[4] AUBERT	06E	BABR	$B^\pm \to K^\pm X_{c\overline{c}}$
22 ± 14		121 ± 27	AUBERT	05C	BABR	$e^+e^- \to J/\psi c\overline{c}$
<55	90	39 ± 11	[5] CHOI	02	BELL	$B \to K K_S K^- \pi^+$
<8.0	95		[6] EDWARDS	82C	CBAL	$e^+e^- \to \gamma X$

[4] From the fit of the kaon momentum spectrum. Systematic errors not evaluated.
[5] For a mass value of 3654 ± 6 MeV
[6] For a mass value of 3594 ± 5 MeV

$\eta_c(2S)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	hadrons	
Γ_2	$K\overline{K}\pi$	seen
Γ_3	$p\overline{p}$	
Γ_4	$\gamma\gamma$	seen

$\eta_c(2S)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$ — Γ_4

VALUE (keV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.3 ± 0.6	[7] ASNER	04	CLEO	$\gamma\gamma \to \eta_c \to K^0_S K^\pm \pi^\mp$

[7] 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.

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

$\Gamma(p\overline{p}) \times \Gamma(\gamma\gamma)/\Gamma^2_{\text{total}}$ — $\Gamma_3\Gamma_4/\Gamma^2$

VALUE (units 10^{-8})	CL%	DOCUMENT ID		TECN	COMMENT
< 5.6	90	[8,9,10] AMBROGIANI	01	E835	$\overline{p}p \to \gamma\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
< 8.0	90	[8,9,11] AMBROGIANI	01	E835	$\overline{p}p \to \gamma\gamma$
<12.0	90	[9,11] AMBROGIANI	01	E835	$\overline{p}p \to \gamma\gamma$

[8] Including the measurements of of ARMSTRONG 95F in the AMBROGIANI 01 analysis.
[9] For a total width Γ=5 MeV.
[10] For the resonance mass region 3589–3599 MeV/c^2.
[11] 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
• • • We do not use the following data for averages, fits, limits, etc. • • •				
not seen	ABREU	98O	DLPH	$e^+e^- \to e^+e^-$ +hadrons
seen	[12] EDWARDS	82C	CBAL	$e^+e^- \to \gamma X$

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
seen	39 ± 11	[13] CHOI	02	BELL	$B \to K K_S K^- \pi^+$

$\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — Γ_4/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.01	90	LEE	85	CBAL	$\psi' \to$ photons

[12] For a mass value of 3594 ± 5 MeV
[13] For a mass value of 3654 ± 6 MeV

$\eta_c(2S)$ REFERENCES

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 031101R	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+)

OTHER RELATED PAPERS

SWANSON	06	PRPL 429 243	E.S. Swanson	(PITT)
BADALIAN	03	PR D67 071901	A.M. Badalian, B.L.G. Bakker	
EICHTEN	02	PRL 89 162002	E.J. Eichten, K. Lane, C. Quigg	
ACCIARRI	99T	PL B461 155	M. Acciarri et al.	(L3 Collab.)
OREGLIA	82	PR D25 2259	M.J. Oreglia et al.	(SLAC, CIT, HARV+)
PORTER	81	SLAC Summer Inst. 355	F.C. Porter et al.	(CIT, HARV, PRIN+)
BARTEL	78B	PL 79B 492	W. Bartel et al.	(DESY, HEIDP)