$\eta_c(2S)$

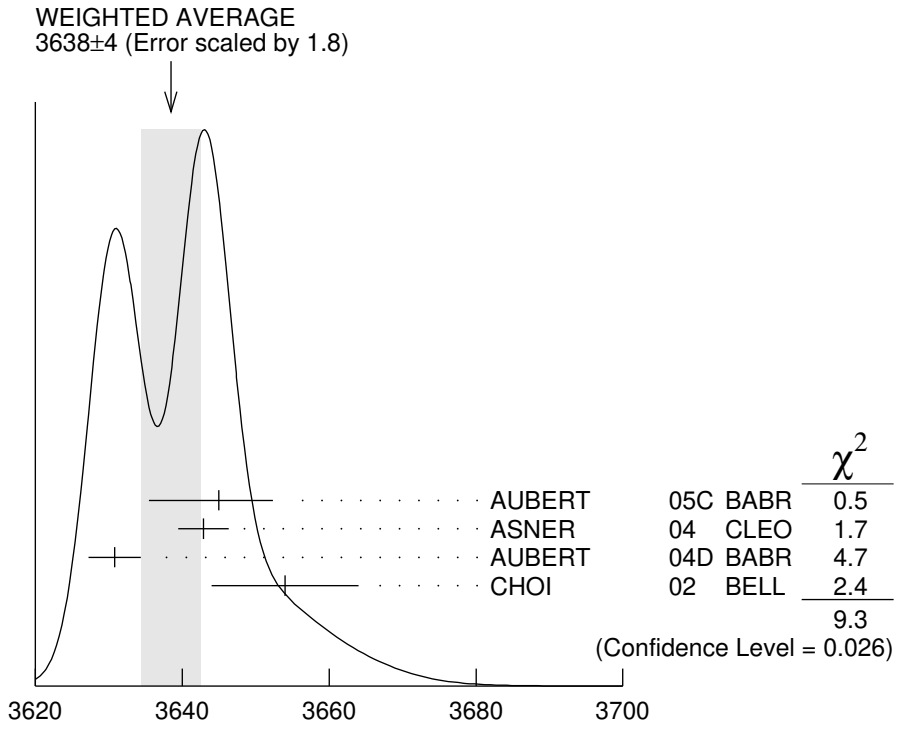
$I^G(J^{PC}) = 0^+(0^{-+})$

Quantum numbers are quark model predictions.

$\eta_c(2S)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
3638 ± 4 OUR AVERAGE		Error includes scale factor of 1.8. See the ideogram below.			
$3645.0 \pm 5.5^{+4.9}_{-7.8}$	121 ± 27	AUBERT	05C	BABR	$e^+e^- \to J/\psi c\overline{c}$
$3642.9 \pm 3.1 \pm 1.5$	61	ASNER	04	CLEO	$\gamma\gamma \to \eta_c \to K^0_S K^\pm \pi^\mp$
$3630.8 \pm 3.4 \pm 1.0$	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	[1] AUBERT	06E	BABR	$B^\pm \to K^\pm X_{c\overline{c}}$
3630 ± 8	164	[2] ABE	04G	BELL	10.6 $e^+e^- \to J/\psi(c\overline{c})$
3622 ± 12	42	[2] ABE,K	02	BELL	10.6 $e^+e^- \to J/\psi + X$
3594 ± 5		[3] EDWARDS	82C	CBAL	$e^+e^- \to \gamma X$

[1] From the fit of the kaon momentum spectrum. Systematic errors not evaluated.
[2] From a fit of the J/ψ recoil mass spectrum. Systematic errors not estimated.
[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±12.4±4.0		61	ASNER	04	CLEO	$\gamma\gamma \to \eta_c \to K^0_S K^\pm \pi^\mp$
17.0± 8.3±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.

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

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

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)