$X(4660)$

$I^G(J^{PC}) = ?^?(1^{--})$

Seen in radiative return from e^+e^- collisions at $\sqrt{s} = 9.54$–10.58 GeV by WANG 07D. Also obtained in a combined fit of WANG 07D, AUBERT 07S, and LEES 14F. See also the review under the $X(3872)$ particle listings. (See the index for the page number.)

$X(4660)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
4643± 9 OUR AVERAGE		Error includes scale factor of 1.2.			
$4652 \pm 10 \pm 11$	279	[1] WANG	15A	BELL	$10.58\ e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$
$4669 \pm 21 \pm 3$	37	[2] LEES	14F	BABR	$10.58\ e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$
$4634^{+8}_{-7}{}^{+5}_{-8}$	142	[3] PAKHLOVA	08B	BELL	$e^+e^- \rightarrow \Lambda_c^+\Lambda_c^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$4661^{+9}_{-8} \pm 6$	44	[4] LIU	08H	RVUE	$10.58\ e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$
$4664 \pm 11 \pm 5$	44	WANG	07D	BELL	$10.58\ e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$

[1] From a two-resonance fit. Supersedes WANG 07D.
[2] From a two-resonance fit.
[3] The $\pi^+\pi^-\psi(2S)$ and $\Lambda_c^+\Lambda_c^-$ states are not necessarily the same.
[4] From a combined fit of AUBERT 07S and WANG 07D data with two resonances.

$X(4660)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
72±11 OUR AVERAGE					
$68 \pm 11 \pm 5$	279	[1] WANG	15A	BELL	$10.58\ e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$
$104 \pm 48 \pm 10$	37	[2] LEES	14F	BABR	$10.58\ e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$
$92^{+40}_{-24}{}^{+10}_{-21}$	142	[3] PAKHLOVA	08B	BELL	$e^+e^- \rightarrow \Lambda_c^+\Lambda_c^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$42^{+17}_{-12} \pm 6$	44	[4] LIU	08H	RVUE	$10.58\ e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$
$48 \pm 15 \pm 3$	44	WANG	07D	BELL	$10.58\ e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$

[1] From a two-resonance fit. Supersedes WANG 07D.
[2] From a two-resonance fit.
[3] The $\pi^+\pi^-\psi(2S)$ and $\Lambda_c^+\Lambda_c^-$ states are not necessarily the same.
[4] From a combined fit of AUBERT 07S and WANG 07D data with two resonances.

$X(4660)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	e^+e^-	
Γ_2	$\psi(2S)\pi^+\pi^-$	seen
Γ_3	$J/\psi\eta$	
Γ_4	$D^0 D^{*-}\pi^+$	
Γ_5	$\chi_{c1}\gamma$	
Γ_6	$\chi_{c2}\gamma$	
Γ_7	$\Lambda_c^+\Lambda_c^-$	

$X(4660)$ $\Gamma(i)\times\Gamma(e^+e^-)/\Gamma(\text{total})$

$\Gamma(\psi(2S)\pi^+\pi^-)\times\Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_2\Gamma_1/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$2.0\pm0.3\pm0.2$	279	[1] WANG	15A	BELL	$10.58\ e^+e^-\to\gamma\pi^+\pi^-\psi(2S)$
$8.1\pm1.1\pm1.0$	279	[2] WANG	15A	BELL	$10.58\ e^+e^-\to\gamma\pi^+\pi^-\psi(2S)$
$2.7\pm1.3\pm0.5$	37	[3] LEES	14F	BABR	$10.58\ e^+e^-\to\gamma\pi^+\pi^-\psi(2S)$
$7.5\pm1.7\pm0.7$	37	[4] LEES	14F	BABR	$10.58\ e^+e^-\to\gamma\pi^+\pi^-\psi(2S)$
$2.2^{+0.7}_{-0.6}$	44	[5] LIU	08H	RVUE	$10.58\ e^+e^-\to\gamma\pi^+\pi^-\psi(2S)$
5.9 ± 1.6	44	[6] LIU	08H	RVUE	$10.58\ e^+e^-\to\gamma\pi^+\pi^-\psi(2S)$
$3.0\pm0.9\pm0.3$	44	[3] WANG	07D	BELL	$10.58\ e^+e^-\to\gamma\pi^+\pi^-\psi(2S)$
$7.6\pm1.8\pm0.8$	44	[4] WANG	07D	BELL	$10.58\ e^+e^-\to\gamma\pi^+\pi^-\psi(2S)$

[1] Solution I of two equivalent solutions from a fit using two interfering resonances. Supersedes WANG 07D.
[2] Solution II of two equivalent solutions from a fit using two interfering resonances. Supersedes WANG 07D.
[3] Solution I of two equivalent solutions in a fit using two interfering resonances.
[4] Solution II of two equivalent solutions in a fit using two interfering resonances.
[5] Solution I in a combined fit of AUBERT 07S and WANG 07D data with two resonances.
[6] Solution II in a combined fit of AUBERT 07S and WANG 07D data with two resonances.

$\Gamma(J/\psi\eta)\times\Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_3\Gamma_1/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.94	90	WANG	13B	BELL	$e^+e^-\to J/\psi\eta\gamma$

$\Gamma(\chi_{c1}\gamma)\times\Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_5\Gamma_1/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
<0.45	90	[1] HAN	15	BELL	$10.58\ e^+e^-\to\chi_{c1}\gamma$

[1] Using $B(\eta\to\gamma\gamma) = (39.41\pm0.21)\%$.

$\Gamma(\chi_{c2}\gamma) \times \Gamma(e^+e^-)/\Gamma_{\rm total}$ — $\Gamma_6\Gamma_1/\Gamma$

VALUE (eV)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
<2.1	90	[1] HAN	15	BELL	10.58 $e^+e^- \rightarrow \chi_{c2}\gamma$

[1] Using B($\eta \rightarrow \gamma\gamma$) = (39.41 ± 0.21)%.

X(4660) BRANCHING RATIOS

$\Gamma(D^0 D^{*-}\pi^+)/\Gamma(\psi(2S)\pi^+\pi^-)$ — Γ_4/Γ_2

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
<10	90	PAKHLOVA	09	BELL	$e^+e^- \rightarrow D^0 D^{*-}\pi^+$

$\Gamma(D^0 D^{*-}\pi^+)/\Gamma_{\rm total} \times \Gamma(e^+e^-)/\Gamma_{\rm total}$ — $\Gamma_4/\Gamma \times \Gamma_1/\Gamma$

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
$<0.37 \times 10^{-6}$	90	[1] PAKHLOVA	09	BELL	$e^+e^- \rightarrow D^0 D^{*-}\pi^+$

[1] Using 4664 ± 11 ± 5 MeV for the mass of *X*(4660).

$\Gamma(\Lambda_c^+\Lambda_c^-)/\Gamma_{\rm total} \times \Gamma(e^+e^-)/\Gamma_{\rm total}$ — $\Gamma_7/\Gamma \times \Gamma_1/\Gamma$

VALUE (units 10^{-6})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
$0.68^{+0.16}_{-0.15}{}^{+0.29}_{-0.30}$	142	[1] PAKHLOVA	08B	BELL	$e^+e^- \rightarrow \Lambda_c^+\Lambda_c^-$

[1] The $\pi^+\pi^-\psi(2S)$ and $\Lambda_c^+\Lambda_c^-$ states are not necessarily the same.

X(4660) REFERENCES

HAN	15	PR D92 012011	Y.L. Han *et al.*	(BELLE Collab.)
WANG	15A	PR D91 112007	X.L. Wang *et al.*	(BELLE Collab.)
LEES	14F	PR D89 111103	J.P. Lees *et al.*	(BABAR Collab.)
WANG	13B	PR D87 051101	X.L. Wang *et al.*	(BELLE Collab.)
PAKHLOVA	09	PR D80 091101	G. Pakhlova *et al.*	(BELLE Collab.)
LIU	08H	PR D78 014032	Z.Q. Liu, X.S. Qin, C.Z. Yuan	
PAKHLOVA	08B	PRL 101 172001	C. Pakhlova *et al.*	(BELLE Collab.)
AUBERT	07S	PRL 98 212001	B. Aubert *et al.*	(BABAR Collab.)
WANG	07D	PRL 99 142002	X.L. Wang *et al.*	(BELLE Collab.)