

X(3872)

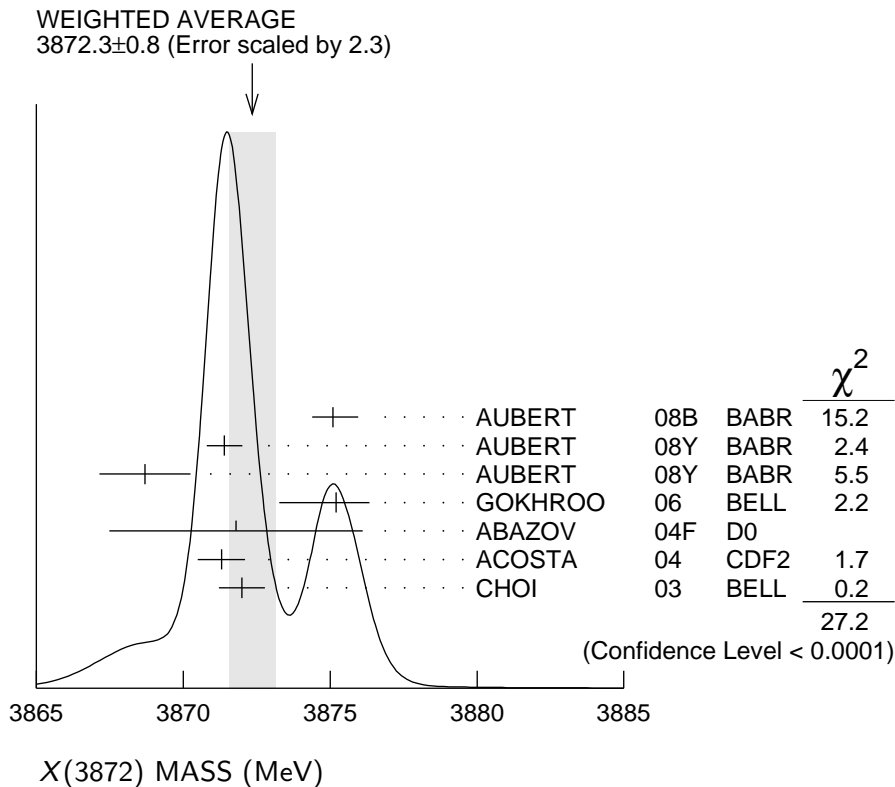
$$I^G(J^{PC}) = 0^{?}(?^{?}+)$$

Seen by CHOI 03 in $B \rightarrow K \pi^+ \pi^- J/\psi(1S)$ decays as a narrow peak in the invariant mass distribution of the $\pi^+ \pi^- J/\psi(1S)$ final state, but not seen in the $\gamma \chi_{c1}$ final state of these decays. Possibly absent in the invariant mass spectrum of the final state $\pi^+ \pi^- J/\psi(1S)$ in $e^+ e^-$ collisions. Interpretation as a 1^{--} charmonium state not favored. Isovector hypothesis excluded by AUBERT 05B. A helicity amplitude analysis of the $X(3872) \rightarrow J/\psi \pi^+ \pi^-$ decay gives two possible J^{PC} assignments: $J^{PC} = 1^{++}$ and 2^{-+} (ABULENCIA 07E).

X(3872) MASS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
3872.3 ± 0.8 OUR AVERAGE		Error includes scale factor of 2.3. See the ideogram below.		
3875.1 ⁺ _{-0.5} ± 0.7 ± 0.5	33 ± 6	¹ AUBERT	08B BABR	$B \rightarrow \bar{D}^{*0} D^0 K$
3871.4 ± 0.6 ± 0.1	93.4	AUBERT	08Y BABR	$B^+ \rightarrow K^+ J/\psi \pi^+ \pi^-$
3868.7 ± 1.5 ± 0.4	9.4	AUBERT	08Y BABR	$B^0 \rightarrow K_S^0 J/\psi \pi^+ \pi^-$
3875.2 ± 0.7 ⁺ _{-1.8} ± 0.9	24 ± 6	¹ GOKHROO	06 BELL	$B \rightarrow D^0 \bar{D}^0 \pi^0 K$
3871.8 ± 3.1 ± 3.0	522	^{2,3} ABAZOV	04F D0	$p\bar{p} \rightarrow J/\psi \pi^+ \pi^- X$
3871.3 ± 0.7 ± 0.4	730	³ ACOSTA	04 CDF2	$p\bar{p} \rightarrow J/\psi \pi^+ \pi^- X$
3872.0 ± 0.6 ± 0.5	36	CHOI	03 BELL	$B \rightarrow K \pi^+ \pi^- J/\psi$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
3868.6 ± 1.2 ± 0.2	8	⁴ AUBERT	06 BABR	$B^0 \rightarrow K_S^0 J/\psi \pi^+ \pi^-$
3871.3 ± 0.6 ± 0.1	61	⁴ AUBERT	06 BABR	$B^- \rightarrow K^- J/\psi \pi^+ \pi^-$
3873.4 ± 1.4	25	⁵ AUBERT	05R BABR	$B^+ \rightarrow K^+ J/\psi \pi^+ \pi^-$
3836 ± 13	58	^{3,6} ANTONIAZZI	94 E705	$300 \pi^\pm \text{Li} \rightarrow J/\psi \pi^+ \pi^- X$

¹ May not necessarily be the same state as that observed in the $J/\psi \pi^+ \pi^-$ mode.
² Calculated from the corresponding $m_{X(3872)} - m_{J/\psi}$ using $m_{J/\psi} = 3096.916$ MeV.
³ Width consistent with detector resolution.
⁴ Calculated from the corresponding $m_{X(3872)} - m_{\psi(2S)}$ using $m_{\psi(2S)} = 3686.093$ MeV. Superseded by AUBERT 08Y.
⁵ Calculated from the corresponding $m_{X(3872)} - m_{\psi(2S)}$ using $m_{\psi(2S)} = 3685.96$ MeV. Superseded by AUBERT 06.
⁶ A lower mass value can be due to an incorrect momentum scale for soft pions.



$m_{X(3872)} - m_{J/\psi}$

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
774.9±3.1±3.0	522	ABAZOV 04F	D0	$p\bar{p} \rightarrow J/\psi \pi^+ \pi^- X$

$m_{X(3872)} - m_{\psi(2S)}$

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
••• We do not use the following data for averages, fits, limits, etc. •••				
187.4±1.4	25	⁷ AUBERT 05R	BABR	$B^+ \rightarrow K^+ J/\psi \pi^+ \pi^-$
⁷ Superseded by AUBERT 06.				

X(3872) WIDTH

VALUE (MeV)	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
$3.0^{+1.9}_{-1.4} \pm 0.9$		33 ± 6	⁸ AUBERT 08B	BABR	$B \rightarrow \bar{D}^{*0} D^0 K$
••• We do not use the following data for averages, fits, limits, etc. •••					
<3.3	90		AUBERT 08Y	BABR	$B^+ \rightarrow K^+ J/\psi \pi^+ \pi^-$
<4.1	90	69	AUBERT 06	BABR	$B \rightarrow K \pi^+ \pi^- J/\psi$
<2.3	90	36	CHOI 03	BELL	$B \rightarrow K \pi^+ \pi^- J/\psi$
⁸ May not necessarily be the same state as that observed in the $J/\psi \pi^+ \pi^-$ mode.					

X(3872) DECAY MODES

Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1 $e^+ e^-$	$< 8 \times 10^{-5}$	90%
Γ_2 $\pi^+ \pi^- J/\psi(1S)$	$> 2.6 \%$	90%
Γ_3 $\rho^0 J/\psi(1S)$	seen	
Γ_4 $\gamma\gamma$		
Γ_5 $D^0 \bar{D}^0$	not seen	
Γ_6 $D^+ D^-$	not seen	
Γ_7 $D^0 \bar{D}^0 \pi^0$	seen	
Γ_8 $\gamma \chi_{c1}$		
Γ_9 $\eta J/\psi$		
Γ_{10} $\gamma J/\psi$		

X(3872) PARTIAL WIDTHS

$\Gamma(e^+ e^-)$ Γ_1

VALUE (keV)	CL%	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
< 0.28	90	⁹ YUAN	04	RVUE $e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$
⁹ Using BAI 98E data on $e^+ e^- \rightarrow \pi^+ \pi^- \ell^+ \ell^-$. Assuming that $\Gamma(\pi^+ \pi^- J/\psi)$ of X(3872) is the same as that of $\psi(2S)$ (85.4 keV).				

X(3872) $\Gamma(i)\Gamma(e^+ e^-)/\Gamma(\text{total})$

$\Gamma(\pi^+ \pi^- J/\psi(1S)) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$ $\Gamma_2 \Gamma_1/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
< 6.2	90	^{10,11} AUBERT	05D	BABR $10.6 e^+ e^- \rightarrow K^+ K^- \pi^+ \pi^- \gamma$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
< 8.3	90	¹¹ DOBBS	05	CLE3 $e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$
< 10	90	¹² YUAN	04	RVUE $e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$
¹⁰ Using $B(X(3872) \rightarrow J/\psi \pi^+ \pi^-) \cdot B(J/\psi \rightarrow \mu^+ \mu^-) \cdot \Gamma(X(3872) \rightarrow e^+ e^-) < 0.37$ eV from AUBERT 05D and $B(J/\psi \rightarrow \mu^+ \mu^-) = 0.0588 \pm 0.0010$ from the PDG 04.				
¹¹ Assuming X(3872) has $J^{PC} = 1^{--}$.				
¹² Using BAI 98E data on $e^+ e^- \rightarrow \pi^+ \pi^- \ell^+ \ell^-$. From theoretical calculation of the production cross section and using $B(J/\psi \rightarrow \mu^+ \mu^-) = (5.88 \pm 0.10)\%$.				

X(3872) $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(\gamma\gamma) \times \Gamma(\pi^+ \pi^- J/\psi(1S))/\Gamma_{\text{total}}$ $\Gamma_4 \Gamma_2/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
< 12.9	90	¹³ DOBBS	05	CLE3 $e^+ e^- \rightarrow \pi^+ \pi^- J/\psi \gamma$
¹³ Assuming X(3872) has positive C parity and spin 0.				

X(3872) BRANCHING RATIOS

$\Gamma(\pi^+\pi^- J/\psi(1S))/\Gamma_{\text{total}}$ Γ_2/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
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>0.026	90	¹⁴ AUBERT	08Y	BABR $B \rightarrow X(3872)K$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

>0.042	90	^{15,16} AUBERT	06E	BABR $B^\pm \rightarrow K^\pm X_{c\bar{c}}$
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¹⁴ AUBERT 08Y reports $[\Gamma(X(3872) \rightarrow \pi^+\pi^- J/\psi(1S))/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow X(3872)K^+)] = (8.4 \pm 1.5 \pm 0.7) \times 10^{-6}$. We divide by our best value $B(B^+ \rightarrow X(3872)K^+) < 3.2 \times 10^{-4}$.

¹⁵ Superseded by AUBERT 08Y. Calculated by us using $B(B^\pm \rightarrow K^\pm X(3872)) < 3.2 \times 10^{-4}$ from AUBERT 06E and $B(B^\pm \rightarrow K^\pm X(3872)) \times B(X(3872) \rightarrow J/\psi\pi^+\pi^-) = (11.4 \pm 2.0) \times 10^{-6}$ from the 2006 Edition of this Review (PDG 06).

¹⁶ Decay proceeds via the $\rho^0 J/\psi$ (ABULENCIA 06B).

$\Gamma(D^0\bar{D}^0)/\Gamma(\pi^+\pi^- J/\psi(1S))$ Γ_5/Γ_2

VALUE	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

not seen	CHISTOV	04	BELL $B \rightarrow K D^0\bar{D}^0$
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$\Gamma(D^+D^-)/\Gamma(\pi^+\pi^- J/\psi(1S))$ Γ_6/Γ_2

VALUE	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

not seen	CHISTOV	04	BELL $B \rightarrow K D^+D^-$
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$\Gamma(D^0\bar{D}^0\pi^0)/\Gamma(\pi^+\pi^- J/\psi(1S))$ Γ_7/Γ_2

VALUE	DOCUMENT ID	TECN	COMMENT
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seen	¹⁷ GOKHROO	06	BELL $B \rightarrow D^0\bar{D}^0\pi^0 K$
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¹⁷ May not necessarily be the same state as that observed in the $J/\psi\pi^+\pi^-$ mode. Supersedes CHISTOV 04.

$\Gamma(\gamma\chi_{c1})/\Gamma(\pi^+\pi^- J/\psi(1S))$ Γ_8/Γ_2

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
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<0.89	90	CHOI	03	BELL $B \rightarrow K\pi^+\pi^- J/\psi$
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$\Gamma(\eta J/\psi)/\Gamma(\pi^+\pi^- J/\psi(1S))$ Γ_9/Γ_2

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.6	90	AUBERT	04Y	BABR $B \rightarrow K\eta J/\psi$
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$\Gamma(\gamma J/\psi)/\Gamma_{\text{total}}$ Γ_{10}/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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>0.010	19	¹⁸ AUBERT,BE	06M	BABR $B^+ \rightarrow K^+ J/\psi\gamma$
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¹⁸ AUBERT,BE 06M reports $[\Gamma(X(3872) \rightarrow \gamma J/\psi)/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow X(3872)K^+)] = (3.3 \pm 1.0 \pm 0.3) \times 10^{-6}$. We divide by our best value $B(B^+ \rightarrow X(3872)K^+) < 3.2 \times 10^{-4}$.

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