

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 fit to the dipion mass spectrum is compatible with both S- and P-wave $J/\psi \rho$ decays implying positive C-parity (ABULENCIA 06B).

Quantum numbers are not established.

X(3872) MASS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
3871.4 ± 0.6 OUR AVERAGE		Error includes scale factor of 1.6. See the ideogram below.		
3868.6 ± 1.2 ± 0.2	8	¹ AUBERT	06 BABR	$B^0 \rightarrow K_S^0 J/\psi \pi^+ \pi^-$
3871.3 ± 0.6 ± 0.1	61	¹ AUBERT	06 BABR	$B^- \rightarrow K^- J/\psi \pi^+ \pi^-$
3875.2 ± 0.7 ^{+0.9} _{-1.8}	24 ± 6	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	$\rho \bar{\rho} \rightarrow J/\psi \pi^+ \pi^- X$
3871.3 ± 0.7 ± 0.4	730	³ ACOSTA	04 CDF2	$\rho \bar{\rho} \rightarrow J/\psi \pi^+ \pi^- X$
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. ● ● ●				
3873.4 ± 1.4	25	⁴ AUBERT	05R BABR	$B^+ \rightarrow K^+ J/\psi \pi^+ \pi^-$
3836 ± 13	58	^{3,5} ANTONIAZZI	94 E705	$300 \pi^\pm \text{Li} \rightarrow J/\psi \pi^+ \pi^- X$

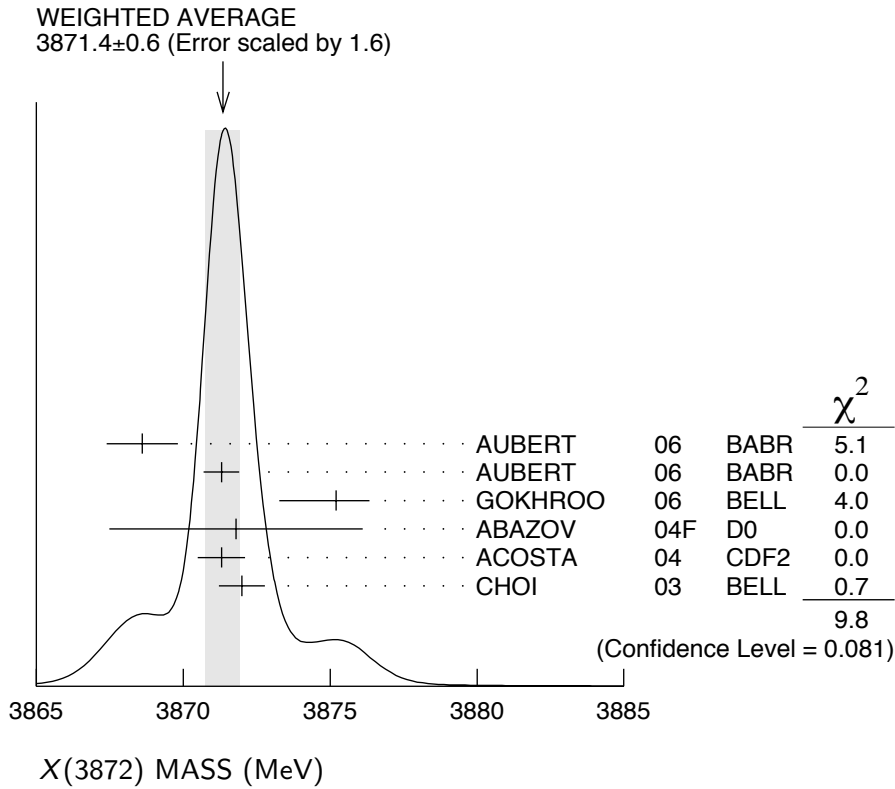
¹ Calculated from the corresponding $m_{X(3872)} - m_{\psi(2S)}$ using $m_{\psi(2S)} = 3686.093$ MeV.

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 $m_{X(3872)^\pm} - m_{\psi(2S)}$ using $m_{\psi(2S)} = 3685.96$ MeV. Superseded by AUBERT 06.

⁵ A lower mass value can be due to an incorrect momentum scale for soft pions.



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

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

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

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
187.4±1.4	25	⁶ AUBERT 05R	BABR	$B^+ \rightarrow K^+ J/\psi \pi^+ \pi^-$
⁶ Superseded by AUBERT 06.				

X(3872) WIDTH

VALUE (MeV)	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<2.3	90	36	CHOI 03	BELL	$B \rightarrow K \pi^+ \pi^- J/\psi$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<4.1	90	69	AUBERT 06	BABR	$B \rightarrow K \pi^+ \pi^- J/\psi$

X(3872) DECAY MODES

Mode	Fraction (Γ_i/Γ)
Γ_1 $e^+ e^-$	
Γ_2 $\pi^+ \pi^- J/\psi(1S)$	seen
Γ_3 $\gamma\gamma$	
Γ_4 $D^0 \bar{D}^0$	not seen
Γ_5 $D^+ D^-$	not seen
Γ_6 $D^0 \bar{D}^0 \pi^0$	seen
Γ_7 $\gamma\chi_{c1}$	
Γ_8 $\eta J/\psi$	
Γ_9 $\gamma J/\psi$	

X(3872) PARTIAL WIDTHS

$\Gamma(e^+ e^-)$	Γ_1			
<u>VALUE (keV)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<ul style="list-style-type: none"> • • • We do not use the following data for averages, fits, limits, etc. • • • 				
<0.28	90	⁷ YUAN	04	RVUE $e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$
<p>⁷ 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).</p>				

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

$\Gamma(\pi^+ \pi^- J/\psi(1S)) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$	$\Gamma_2 \Gamma_1/\Gamma$			
<u>VALUE (eV)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
< 6.2	90	^{8,9} AUBERT	05D BABR	10.6 $e^+ e^- \rightarrow K^+ K^- \pi^+ \pi^- \gamma$
<ul style="list-style-type: none"> • • • We do not use the following data for averages, fits, limits, etc. • • • 				
< 8.3	90	⁹ DOBBS	05 CLE3	$e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$
<10	90	¹⁰ YUAN	04 RVUE	$e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$
<p>⁸ 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.</p> <p>⁹ Assuming X(3872) has $J^{PC} = 1^{--}$.</p> <p>¹⁰ Using BAI 98E data on $e^+ e^- \rightarrow \pi^+ \pi^- \ell^+ \ell^-$. From theoretical calculation of the production cross section and using $B(J/\psi \rightarrow \mu^+ \mu^-) = (5.88 \pm 0.10)\%$.</p>				

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

$\Gamma(\gamma\gamma) \times \Gamma(\pi^+ \pi^- J/\psi(1S))/\Gamma_{\text{total}}$	$\Gamma_3 \Gamma_2/\Gamma$			
<u>VALUE (eV)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<ul style="list-style-type: none"> • • • We do not use the following data for averages, fits, limits, etc. • • • 				
<12.9	90	¹¹ DOBBS	05 CLE3	$e^+ e^- \rightarrow \pi^+ \pi^- J/\psi \gamma$
<p>¹¹ Assuming X(3872) has positive C parity and spin 0.</p>				

X(3872) BRANCHING RATIOS

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

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
>0.042	90	¹² AUBERT	06E	BABR $B^\pm \rightarrow K^\pm X_{c\bar{c}}$

¹² 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).

$\Gamma(D^0\bar{D}^0)/\Gamma(\pi^+\pi^- J/\psi(1S))$ Γ_4/Γ_2

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
••• We do not use the following data for averages, fits, limits, etc. ••• not seen	CHISTOV	04	BELL $B \rightarrow K D^0 \bar{D}^0$

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

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
••• We do not use the following data for averages, fits, limits, etc. ••• not seen	CHISTOV	04	BELL $B \rightarrow K D^+ D^-$

$\Gamma(D^0\bar{D}^0\pi^0)/\Gamma(\pi^+\pi^- J/\psi(1S))$ Γ_6/Γ_2

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
seen	¹³ GOKHROO	06	BELL $B \rightarrow D^0 \bar{D}^0 \pi^0 K$

¹³ Supersedes CHISTOV 04.

$\Gamma(\gamma\chi_{c1})/\Gamma(\pi^+\pi^- J/\psi(1S))$ Γ_7/Γ_2

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<0.89	90	CHOI	03	BELL $B \rightarrow K \pi^+ \pi^- J/\psi$

$\Gamma(\eta J/\psi)/\Gamma(\pi^+\pi^- J/\psi(1S))$ Γ_8/Γ_2

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
••• We do not use the following data for averages, fits, limits, etc. ••• <0.6	90	AUBERT	04Y	BABR $B \rightarrow K \eta J/\psi$

$\Gamma(\gamma J/\psi)/\Gamma_{\text{total}}$ Γ_9/Γ

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
>0.010	19	¹⁴ AUBERT,BE	06M	BABR $B^+ \rightarrow K^+ J/\psi \gamma$

¹⁴ AUBERT,BE 06M reports $[B(X(3872) \rightarrow \gamma J/\psi) \times B(B^+ \rightarrow X(3872) K^+)] = (3.3 \pm 1.0 \pm 0.3) \times 10^{-6}$. We divide by our best value $B(B^+ \rightarrow X(3872) K^+) < 3.2 \times 10^{-4}$.

X(3872) REFERENCES

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GOKHROO	06	PRL 97 162002	G. Gokhroo <i>et al.</i>	(BELLE Collab.)
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AUBERT	05R	PR D71 071103R	B. Aubert <i>et al.</i>	(BABAR Collab.)

DOBBS	05	PRL 94 032004	S. Dobbs <i>et al.</i>	(CLEO Collab.)
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