$\chi_{c1}(3872)$

$I^G(J^{PC}) = 0^+(1^{++})$

also known as $X(3872)$

This state shows properties different from a conventional $q\overline{q}$ state. A candidate for an exotic structure. See the review on non-$q\overline{q}$ states.

First observed by CHOI 03 in $B \to K\pi^+\pi^- J/\psi(1S)$ decays as a narrow peak in the invariant mass distribution of the $\pi^+\pi^- J/\psi(1S)$ final state. Isovector hypothesis excluded by AUBERT 05B and CHOI 11.

AAIJ 13Q perform a full five-dimensional amplitude analysis of the angular correlations between the decay products in $B^+ \to \chi_{c1}(3872) K^+$ decays, where $\chi_{c1}(3872) \to J/\psi\pi^+\pi^-$ and $J/\psi \to \mu^+\mu^-$, which unambiguously gives the $J^{PC} = 1^{++}$ assignment under the assumption that the $\pi^+\pi^-$ and J/ψ are in an S-wave. AAIJ 15AO extend this analysis with more data to limit D-wave contributions to $< 4\%$ at 95% CL.

See the review on "Spectroscopy of Mesons Containing Two Heavy Quarks."

$\chi_{c1}(3872)$ MASS FROM $J/\psi X$ MODE

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
3871.65 ± 0.06 OUR AVERAGE					
3871.64 ± 0.06 ± 0.01	19.8k	[1] AAIJ	20S	LHCB	$B^+ \to J/\psi\pi^+\pi^- K^+$
3871.9 ± 0.7 ± 0.2	20	ABLIKIM	14	BES3	$e^+e^- \to J/\psi\pi^+\pi^-\gamma$
3871.95 ± 0.48 ± 0.12	0.6k	AAIJ	12H	LHCB	$pp \to J/\psi\pi^+\pi^- X$
3871.85 ± 0.27 ± 0.19	170	[2] CHOI	11	BELL	$B \to K\pi^+\pi^- J/\psi$
3873 $^{+1.8}_{-1.6}$ ± 1.3	27	[3] DEL-AMO-SA...	10B	BABR	$B \to \omega J/\psi K$
3871.61 ± 0.16 ± 0.19	6k	[3,4] AALTONEN	09AU	CDF2	$p\overline{p} \to J/\psi\pi^+\pi^- X$
3871.4 ± 0.6 ± 0.1	93.4	AUBERT	08Y	BABR	$B^+ \to K^+ J/\psi\pi^+\pi^-$
3868.7 ± 1.5 ± 0.4	9.4	AUBERT	08Y	BABR	$B^0 \to K^0_S J/\psi\pi^+\pi^-$
3871.8 ± 3.1 ± 3.0	522	[3,5] ABAZOV	04F	D0	$p\overline{p} \to J/\psi\pi^+\pi^- X$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
3871.695 ± 0.067 ± 0.068	15.6k	[6] AAIJ	20AD	LHCB	$pp \to J/\psi\pi^+\pi^- X$
3871.59 ± 0.06 ± 0.03	4.2k	[7] AAIJ	20S	LHCB	$B^+ \to J/\psi\pi^+\pi^- K^+$
3873.3 ± 1.1 ± 1.0	45	[8] ABLIKIM	19V	BES	$e^+e^- \to \gamma\omega J/\psi$
3860.0 ± 10.4	13.6	[3,9] AGHASYAN	18A	COMP	$\gamma^* N \to X\pi^\pm N'$
3868.6 ± 1.2 ± 0.2	8	[10] AUBERT	06	BABR	$B^0 \to K^0_S J/\psi\pi^+\pi^-$

3871.3	$\pm$ 0.6 $\pm$0.1	61	[10] AUBERT	06	BABR	$B^- \to K^- J/\psi \pi^+ \pi^-$
3873.4	$\pm$ 1.4	25	[11] AUBERT	05R	BABR	$B^+ \to K^+ J/\psi \pi^+ \pi^-$
3871.3	$\pm$ 0.7 $\pm$0.4	730	[3,12] ACOSTA	04	CDF2	$p\overline{p} \to J/\psi \pi^+ \pi^- X$
3872.0	$\pm$ 0.6 $\pm$0.5	36	[13] CHOI	03	BELL	$B \to K \pi^+ \pi^- J/\psi$
3836	$\pm$13	58	[3,14] ANTONIAZZI	94	E705	300 $\pi^\pm$ Li $\to J/\psi \pi^+ \pi^- X$

[1] Calculated from $m_{\chi_{c1}(3872)} - m_{\psi(2S)}$ = 185.54 $\pm$ 0.06 MeV obtained by combining the data with $\chi_{c1}(3872)$ produced in B^+ decays from AAIJ 20S and inclusive b-hadron decays from AAIJ 20AD and using $m_{\psi(2S)}$ = 3686.097 MeV. Breit-Wigner parametrization.

[2] The mass difference for the $\chi_{c1}(3872)$ produced in B^+ and B^0 decays is ($-0.71 \pm 0.96 \pm 0.19$) MeV.

[3] Width consistent with detector resolution.

[4] A possible equal mixture of two states with a mass difference greater than 3.6 MeV/c^2 is excluded at 95% CL.

[5] Calculated from the corresponding $m_{\chi_{c1}(3872)} - m_{J/\psi}$ using $m_{J/\psi}$=3096.916 MeV.

[6] Using $\chi_{c1}(3872)$ produced in inclusive b-hadron decays and $m_{\psi(2S)} = 3686.097 \pm 0.010$ MeV. Breit-Wigner parametrization. Superseded by the combined value in AAIJ 20S.

[7] Using Breit-Wigner parametrization. Superseded by the combined value in AAIJ 20S.

[8] Fit with fixed width and including two resonances, $X(3915)$ and $X(3960)$.

[9] Could be a different state.

[10] Calculated from the corresponding $m_{\chi_{c1}(3872)} - m_{\psi(2S)}$ using $m_{\psi(2S)}$ = 3686.093 MeV. Superseded by AUBERT 08Y.

[11] Calculated from the corresponding $m_{\chi_{c1}(3872)} - m_{\psi(2S)}$ using $m_{\psi(2S)}$ = 3685.96MeV. Superseded by AUBERT 06.

[12] Superseded by AALTONEN 09AU.

[13] Superseded by CHOI 11.

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

$\chi_{c1}(3872)$ MASS FROM $\overline{D}^{*0} D^0$ MODE

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$3872.9^{+0.6}_{-0.4}{}^{+0.4}_{-0.5}$	50	[1,2] AUSHEV	10	BELL	$B \to \overline{D}^{*0} D^0 K$
$3875.1^{+0.7}_{-0.5} \pm 0.5$	33 $\pm$ 6	[2] AUBERT	08B	BABR	$B \to \overline{D}^{*0} D^0 K$
$3875.2 \pm 0.7^{+0.9}_{-1.8}$	24 $\pm$ 6	[2,3] GOKHROO	06	BELL	$B \to D^0 \overline{D}^0 \pi^0 K$

[1] Calculated from the measured $m_{\chi_{c1}(3872)} - m_{D^{*0}} - m_{\overline{D}^0} = 1.1^{+0.6}_{-0.4}{}^{+0.1}_{-0.3}$ MeV.

[2] Experiments report $D^{*0} \overline{D}^0$ invariant mass above $D^{*0} \overline{D}^0$ threshold because D^{*0} decay products are kinematically constrained to the D^{*0} mass, even though the D^{*0} may decay off-shell.

[3] Superseded by AUSHEV 10.

$m_{\chi_{c1}(3872)} - m_{J/\psi}$

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

$m_{\chi_{c1}(3872)} - m_{\psi(2S)}$

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
185.598±0.067±0.068	15.6k	[1] AAIJ	20AD	LHCB	$p p \to J/\psi \pi^+ \pi^- X$
185.54 ±0.06	19.8k	[2] AAIJ	20S	LHCB	$p p \to J/\psi \pi^+ \pi^- X$
187.4 ±1.4	25	[3] AUBERT	05R	BABR	$B^+ \to K^+ J/\psi \pi^+ \pi^-$

[1] Using $\chi_{c1}(3872)$ produced in inclusive b-hadron decays. Breit-Wigner parametrization. Superseded by the combined value in AAIJ 20S.

[2] Combining $m_{\chi_{c1}}(3872) - m_{\psi(2S)}$ = 185.49 ± 0.06 ± 0.03 MeV from AAIJ 20S and the measured mass difference from AAIJ 20AD. Breit-Wigner parametrization.

[3] Superseded by AUBERT 06.

$\chi_{c1}(3872)$ WIDTH

VALUE (MeV)	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
1.19±0.21 OUR AVERAGE	Error includes scale factor of 1.1.					
1.39±0.24±0.10		15.6k	[1] AAIJ	20AD	LHCB	$p p \to J/\psi \pi^+ \pi^- X$
$0.96^{+0.19}_{-0.18}\pm0.21$		4.2k	[2] AAIJ	20S	LHCB	$B^+ \to J/\psi \pi^+ \pi^- K^+$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<2.4	90		ABLIKIM	14	BES3	$e^+ e^- \to J/\psi \pi^+ \pi^- \gamma$
<1.2	90		CHOI	11	BELL	$B \to K \pi^+ \pi^- J/\psi$
<3.3	90		AUBERT	08Y	BABR	$B^+ \to K^+ J/\psi \pi^+ \pi^-$
<4.1	90	69	AUBERT	06	BABR	$B \to K \pi^+ \pi^- J/\psi$
<2.3	90	36	[3] CHOI	03	BELL	$B \to K \pi^+ \pi^- J/\psi$

[1] Using $\chi_{c1}(3872)$ produced in inclusive b-hadron decays. Breit-Wigner parametrization.

[2] Using Breit-Wigner parametrization. Partially overlapping dataset with that of AAIJ 20AD.

[3] Superseded by CHOI 11.

$\chi_{c1}(3872)$ WIDTH FROM $\overline{D}^{*0} D^0$ MODE

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$3.9^{+2.8}_{-1.4}{}^{+0.2}_{-1.1}$	50	[1] AUSHEV	10	BELL	$B \to \overline{D}^{*0} D^0 K$
$3.0^{+1.9}_{-1.4}\pm0.9$	33 ± 6	AUBERT	08B	BABR	$B \to \overline{D}^{*0} D^0 K$

[1] With a measured value of B($B \to \chi_{c1}(3872) K$) × B($\chi_{c1}(3872) \to D^{*0} \overline{D}^0$) = $(0.80 \pm 0.20 \pm 0.10) \times 10^{-4}$, assumed to be equal for both charged and neutral modes.

$\chi_{c1}(3872)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	$e^+ e^-$	$< 2.8 \times 10^{-6}$	90%
Γ_2	$\pi^+ \pi^- J/\psi(1S)$	(3.8 ± 1.2) %	
Γ_3	$\pi^+ \pi^- \pi^0 J/\psi(1S)$	not seen	
Γ_4	$\omega \eta_c(1S)$	< 33 %	90%
Γ_5	$\omega J/\psi(1S)$	(4.3 ± 2.1) %	
Γ_6	$\phi \phi$	not seen	
Γ_7	$D^0 \overline{D}^0 \pi^0$	$(49 {}^{+18}_{-20})$ %	
Γ_8	$\overline{D}^{*0} D^0$	(37 ± 9) %	
Γ_9	$\gamma \gamma$	< 11 %	90%
Γ_{10}	$D^0 \overline{D}^0$	< 29 %	90%
Γ_{11}	$D^+ D^-$	< 19 %	90%
Γ_{12}	$\pi^0 \chi_{c2}$	< 4 %	90%
Γ_{13}	$\pi^0 \chi_{c1}$	(3.4 ± 1.6) %	
Γ_{14}	$\pi^0 \chi_{c0}$	< 70 %	90%
Γ_{15}	$\pi^+ \pi^- \eta_c(1S)$	< 14 %	90%
Γ_{16}	$\pi^+ \pi^- \chi_{c1}$	$< 7 \times 10^{-3}$	90%
Γ_{17}	$p \overline{p}$	$< 2.4 \times 10^{-5}$	95%
	Radiative decays		
Γ_{18}	$\gamma D^+ D^-$	< 4 %	90%
Γ_{19}	$\gamma \overline{D}^0 D^0$	< 6 %	90%
Γ_{20}	$\gamma J/\psi$	$(8 \pm 4) \times 10^{-3}$	
Γ_{21}	$\gamma \chi_{c1}$	$< 9 \times 10^{-3}$	90%
Γ_{22}	$\gamma \chi_{c2}$	< 3.2 %	90%
Γ_{23}	$\gamma \psi(2S)$	(4.5 ± 2.0) %	
	***C*-violating decays**		
Γ_{24}	$\eta J/\psi$	< 1.8 %	90%

$\chi_{c1}(3872)$ PARTIAL WIDTHS

$\Gamma(e^+ e^-)$ Γ_1

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
< 4.3	90	[1] ABLIKIM	15V	BES3	4.0–4.4 $e^+ e^- \to \pi^+ \pi^- J/\psi$
<280	90	[2] YUAN	04	RVUE	$e^+ e^- \to \pi^+ \pi^- J/\psi$

[1] ABLIKIM 15V reports this limit from the measurement of $\Gamma(\chi_{c1}(3872) \to \pi^+ \pi^- J/\psi(1S)) \times \Gamma(\chi_{c1}(3872) \to e^+ e^-)/\Gamma < 0.13$ eV using $\Gamma(\chi_{c1}(3872) \to \pi^+ \pi^- J/\psi(1S))/\Gamma = 3\%$.

[2] Using BAI 98E data on $e^+ e^- \to \pi^+ \pi^- \ell^+ \ell^-$. Assuming that $\Gamma(\pi^+ \pi^- J/\psi)$ of $\chi_{c1}(3872)$ is the same as that of $\psi(2S)$ (85.4 keV).

$\chi_{c1}(3872)$ $\Gamma(i)\Gamma(e^+e^-)/\Gamma(\text{total})$

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

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
< 0.13	90	ABLIKIM	15V	BES3	4.0–4.4 $e^+e^- \to \pi^+\pi^- J/\psi$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
< 6.2	90	[1,2] AUBERT	05D	BABR	10.6 $e^+e^- \to K^+K^-\pi^+\pi^-\gamma$
< 8.3	90	[2] DOBBS	05	CLE3	$e^+e^- \to \pi^+\pi^- J/\psi$
<10	90	[3] YUAN	04	RVUE	$e^+e^- \to \pi^+\pi^- J/\psi$

[1] Using B($\chi_{c1}(3872) \to J/\psi\pi^+\pi^-$) · B($J/\psi \to \mu^+\mu^-$) · Γ($\chi_{c1}(3872) \to e^+e^-$) < 0.37 eV from AUBERT 05D and B($J/\psi \to \mu^+\mu^-$) = 0.0588 ± 0.0010 from the PDG 04.

[2] Assuming $\chi_{c1}(3872)$ has $J^{PC} = 1^{--}$.

[3] Using BAI 98E data on $e^+e^- \to \pi^+\pi^-\ell^+\ell^-$. From theoretical calculation of the production cross section and using B($J/\psi \to \mu^+\mu^-$) = (5.88 ± 0.10)%.

$\chi_{c1}(3872)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(\pi^+\pi^- J/\psi(1S)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_2\Gamma_9/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<12.9	90	[1] DOBBS	05	CLE3	$e^+e^- \to \pi^+\pi^- J/\psi\gamma$

[1] Assuming $\chi_{c1}(3872)$ has positive C parity and spin 0.

$\Gamma(\omega J/\psi(1S)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_5\Gamma_9/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<1.7	90	[1] LEES	12AD	BABR	$e^+e^- \to e^+e^-\omega J/\psi$

[1] Assuming $\chi_{c1}(3872)$ has spin 2.

$\Gamma(\pi^+\pi^-\eta_c(1S)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ — $\Gamma_{15}\Gamma_9/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
<11.1	90	LEES	12AE	BABR	$e^+e^- \to e^+e^-\pi^+\pi^-\eta_c$

$\chi_{c1}(3872)$ BRANCHING RATIOS

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.038±0.012 OUR AVERAGE					
0.038±0.002±0.012		[1] AAIJ	20S	LHCB	$B^+ \to J/\psi\pi^+\pi^- K^+$
0.041±0.005±0.013		[2] CHOI	11	BELL	$B^+ \to \pi^+\pi^- J/\psi K^+$
0.040±0.008±0.013	93	[3,4] AUBERT	08Y	BABR	$B \to \chi_{c1}(3872)K$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
seen	151	[5] BALA	15	BELL	$B \to \chi_{c1}(3872)K\pi$
0.061±0.020±0.020	30	[6] AUBERT	05R	BABR	$B^+ \to K^+\pi^+\pi^- J/\psi$
0.065±0.014±0.021	36	[7] CHOI	03	BELL	$B^+ \to K^+\pi^+\pi^- J/\psi$

[1] AAIJ 20S reports $[\Gamma(\chi_{c1}(3872) \to \pi^+\pi^- J/\psi(1S))/\Gamma_{\rm total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] = (7.95 \pm 0.15 \pm 0.33) \times 10^{-6}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) = (2.1 \pm 0.7) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[2] CHOI 11 reports $[\Gamma(\chi_{c1}(3872) \to \pi^+\pi^- J/\psi(1S))/\Gamma_{\rm total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] = (8.63 \pm 0.82 \pm 0.52) \times 10^{-6}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) = (2.1 \pm 0.7) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[3] AUBERT 08Y reports $[\Gamma(\chi_{c1}(3872) \to \pi^+\pi^- J/\psi(1S))/\Gamma_{\rm total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] = (8.4 \pm 1.5 \pm 0.7) \times 10^{-6}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) = (2.1 \pm 0.7) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[4] superseded by LEES 20C

[5] BALA 15 reports $B(\chi_{c1}(3872) \to \pi^+\pi^- J/\psi) \times B(B^0 \to \chi_{c1}(3872) K^+\pi^-) = (7.9 \pm 1.3 \pm 0.4) \times 10^{-6}$ and $B(\chi_{c1}(3872) \to \pi^+\pi^- J/\psi) \times B(B^+ \to \chi_{c1}(3872) K^0\pi^+) = (10.6 \pm 3.0 \pm 0.9) \times 10^{-6}$.

[6] Superseded by AUBERT 08Y. AUBERT 05R reports $[\Gamma(\chi_{c1}(3872) \to \pi^+\pi^- J/\psi(1S))/\Gamma_{\rm total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] = (1.28 \pm 0.41) \times 10^{-5}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) = (2.1 \pm 0.7) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[7] CHOI 03 reports $[\Gamma(\chi_{c1}(3872) \to \pi^+\pi^- J/\psi(1S))/\Gamma_{\rm total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] / [B(B^+ \to \psi(2S) K^+)] / [B(\psi(2S) \to J/\psi(1S)\pi^+\pi^-)] = 0.063 \pm 0.012 \pm 0.007$ which we multiply or divide by our best values $B(B^+ \to \chi_{c1}(3872) K^+) = (2.1 \pm 0.7) \times 10^{-4}$, $B(B^+ \to \psi(2S) K^+) = (6.24 \pm 0.20) \times 10^{-4}$, $B(\psi(2S) \to J/\psi(1S)\pi^+\pi^-) = (34.68 \pm 0.30) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best values.

$\Gamma(\pi^+\pi^-\pi^0 J/\psi(1S))/\Gamma_{\rm total}$ Γ_3/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
not seen	[1] WANG	11B	BELL	$\Upsilon(2S) \to \gamma X$
not seen	[2] SHEN	10A	BELL	$\Upsilon(1S) \to \gamma X$

[1] WANG 11B reports $B(\Upsilon(2S) \to \gamma\chi_{c1}(3872)) \times B(\chi_{c1} \to \pi^+\pi^-\pi^0 J/\psi) < 2.4 \times 10^{-6}$ at 95% CL.

[2] SHEN 10A reports $B(\Upsilon(1S) \to \gamma\chi_{c1}(3872)) \times B(\chi_{c1} \to \pi^+\pi^-\pi^0 J/\psi) < 2.8 \times 10^{-6}$ at 95% CL.

$\Gamma(\omega\eta_c(1S))/\Gamma_{\rm total}$ Γ_4/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.33	90	[1] VINOKUROVA 15	BELL	$B^+ \to \omega\eta_c K^+$

[1] VINOKUROVA 15 reports $[\Gamma(\chi_{c1}(3872) \to \omega\eta_c(1S))/\Gamma_{\rm total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] < 6.9 \times 10^{-5}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) = 2.1 \times 10^{-4}$.

$\Gamma(\omega J/\psi(1S))/\Gamma_{\rm total}$ Γ_5/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.029 \pm 0.011 \pm 0.009$	21 ± 7	[1] DEL-AMO-SA..10B	BABR	$B^+ \to \omega J/\psi K^+$

[1] DEL-AMO-SANCHEZ 10B reports $[\Gamma(\chi_{c1}(3872) \to \omega J/\psi(1S))/\Gamma_{\text{total}}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] = (6 \pm 2 \pm 1) \times 10^{-6}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) = (2.1 \pm 0.7) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value. DEL-AMO-SANCHEZ 10B also reports $B(B^0 \to \chi_{c1}(3872) K^0) \times B(\chi_{c1}(3872) \to J/\psi\omega) = (6 \pm 3 \pm 1) \times 10^{-6}$.

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

VALUE	DOCUMENT ID		TECN	COMMENT
1.1±0.4 OUR AVERAGE Error includes scale factor of 1.7.				
$1.6^{+0.4}_{-0.3} \pm 0.2$	[1] ABLIKIM	19V	BES	$e^+e^- \to \gamma\omega J/\psi$
0.8 ± 0.3	[2] DEL-AMO-SA..10B		BABR	$B \to \omega J/\psi K$

[1] Fit with fixed width and including two resonances, $X(3915)$ and $X(3960)$.

[2] Statistical and systematic errors added in quadrature. Uses the values of $B(B \to \chi_{c1}(3872) K) \times B(\chi_{c1}(3872) \to J/\psi\pi^+\pi^-)$ reported in AUBERT 08Y, taking into account the common systematics.

$\Gamma(\phi\phi)/\Gamma_{\text{total}}$ — Γ_6/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
not seen	[1] AAIJ	17BB	LHCB	pp at 7, 8 TeV

[1] AAIJ 17BB reports $B(b \to \chi_{c1}(3872)\,\text{anything}) \times B(\chi_{c1}(3872) \to \phi\phi) < 4.5 \times 10^{-7}$ at 95% CL.

$\Gamma(D^0\overline{D}^0\pi^0)/\Gamma_{\text{total}}$ — Γ_7/Γ

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.49^{+0.18}_{-0.20} \pm 0.16}$		17	[1] GOKHROO	06	BELL	$B^+ \to D^0\overline{D}^0\pi^0 K^+$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.29	90		[2] CHISTOV	04	BELL	Sup. by GOKHROO 06

[1] GOKHROO 06 reports $[\Gamma(\chi_{c1}(3872) \to D^0\overline{D}^0\pi^0)/\Gamma_{\text{total}}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] = (1.02 \pm 0.31^{+0.21}_{-0.29}) \times 10^{-4}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) = (2.1 \pm 0.7) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[2] CHISTOV 04 reports $[\Gamma(\chi_{c1}(3872) \to D^0\overline{D}^0\pi^0)/\Gamma_{\text{total}}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] < 0.6 \times 10^{-4}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) = 2.1 \times 10^{-4}$.

$\Gamma(D^0\overline{D}^0\pi^0)/\Gamma(\pi^+\pi^- J/\psi(1S))$ — Γ_7/Γ_2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<1.16	90	ABLIKIM	20W	BES3	$e^+e^- \to \gamma\chi_{c1}(3872)$

$\Gamma(\overline{D}^{*0} D^0)/\Gamma_{\text{total}}$ — Γ_8/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.37±0.09±0.12	41^{+9}_{-8}	[1] AUSHEV	10	BELL	$B^+ \to D^{*0}\overline{D}^0 K^+$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.80 \pm 0.28 \pm 0.26$	27 ± 6	[2] AUBERT	08B	BABR	$B^+ \to \overline{D}^{*0} D^0 K^+$

[1] AUSHEV 10 reports $[\Gamma(\chi_{c1}(3872) \to \overline{D}^{*0} D^0)/\Gamma_{total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] = (0.77 \pm 0.16 \pm 0.10) \times 10^{-4}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) = (2.1 \pm 0.7) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[2] AUBERT 08B reports $[\Gamma(\chi_{c1}(3872) \to \overline{D}^{*0} D^0)/\Gamma_{total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] = (1.67 \pm 0.36 \pm 0.47) \times 10^{-4}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) = (2.1 \pm 0.7) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\overline{D}^{*0} D^0)/\Gamma(\pi^+\pi^- J/\psi(1S))$ — Γ_8/Γ_2

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
11.77±3.09	50	ABLIKIM	20W	BES3	$e^+e^- \to \gamma\chi_{c1}(3872)$

$\Gamma(\gamma\gamma)/\Gamma_{total}$ — Γ_9/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.11	90	[1] WICHT	08	BELL	$e^+e^- \to \Upsilon(4S)$

[1] WICHT 08 reports $[\Gamma(\chi_{c1}(3872) \to \gamma\gamma)/\Gamma_{total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] < 2.4 \times 10^{-5}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) = 2.1 \times 10^{-4}$.

$\Gamma(D^0 \overline{D}^0)/\Gamma_{total}$ — Γ_{10}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.29	90	[1] CHISTOV	04	BELL	$B \to K D^0 \overline{D}^0$

[1] CHISTOV 04 reports $[\Gamma(\chi_{c1}(3872) \to D^0 \overline{D}^0)/\Gamma_{total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] < 6 \times 10^{-5}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) = 2.1 \times 10^{-4}$.

$\Gamma(D^+ D^-)/\Gamma_{total}$ — Γ_{11}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.19	90	[1] CHISTOV	04	BELL	$B \to K D^+ D^-$

[1] CHISTOV 04 reports $[\Gamma(\chi_{c1}(3872) \to D^+ D^-)/\Gamma_{total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] < 4 \times 10^{-5}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) = 2.1 \times 10^{-4}$.

$\Gamma(\pi^0 \chi_{c2})/\Gamma(\pi^+\pi^- J/\psi(1S))$ — Γ_{12}/Γ_2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.1	90	ABLIKIM	19U	BES3	$e^+e^- \to \gamma\chi_{c1}(3872)$

$\Gamma(\pi^0 \chi_{c1})/\Gamma_{total}$ — Γ_{13}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.04	90	[1] BHARDWAJ	19	BELL	$B^\pm \to \pi^0 \chi_{c1} K^\pm$

[1] BHARDWAJ 19 reports $[\Gamma(\chi_{c1}(3872) \to \pi^0\chi_{c1})/\Gamma_{total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] < 8.1 \times 10^{-6}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) = 2.1 \times 10^{-4}$.

$\Gamma(\pi^0 \chi_{c1})/\Gamma(\pi^+\pi^- J/\psi(1S))$ — Γ_{13}/Γ_2

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
$88^{+33}_{-27}\pm10$	10.8	ABLIKIM	19U	BES3	$e^+e^- \to \gamma\chi_{c1}(3872)$

$\Gamma(\pi^0 \chi_{c0})/\Gamma(\pi^+\pi^- J/\psi(1S))$ — Γ_{14}/Γ_2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<19	90	ABLIKIM	19U	BES3	$e^+e^- \to \gamma\chi_{c1}(3872)$

$\Gamma(\pi^+\pi^- \eta_c(1S))/\Gamma_{total}$ — Γ_{15}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.14	90	[1] VINOKUROVA	15	BELL	$B^+ \to \pi^+\pi^-\eta_c K^+$

[1] VINOKUROVA 15 reports $[\Gamma(\chi_{c1}(3872) \to \pi^+\pi^-\eta_c(1S))/\Gamma_{total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] < 3.0 \times 10^{-5}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) = 2.1 \times 10^{-4}$.

$\Gamma(\pi^+\pi^- \chi_{c1})/\Gamma_{total}$ — Γ_{16}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<7 \times 10^{-3}$	90	[1] BHARDWAJ	16	BELL	$B^+ \to \pi^+\pi^-\chi_{c1} K^+$

[1] BHARDWAJ 16 reports $[\Gamma(\chi_{c1}(3872) \to \pi^+\pi^-\chi_{c1})/\Gamma_{total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] < 1.5 \times 10^{-6}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) = 2.1 \times 10^{-4}$.

$\Gamma(p\overline{p})/\Gamma_{total}$ — Γ_{17}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<2.4 \times 10^{-5}$	95	[1] AAIJ	17AD	LHCB	$B^+ \to p\overline{p}K^+$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<8 \times 10^{-5}$	95	[2] AAIJ	13S	LHCB	$B^+ \to p\overline{p}K^+$

[1] AAIJ 17AD reports $[\Gamma(\chi_{c1}(3872) \to p\overline{p})/\Gamma_{total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] < 0.5 \times 10^{-8}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) = 2.1 \times 10^{-4}$.

[2] AAIJ 13S reports $[\Gamma(\chi_{c1}(3872) \to p\overline{p})/\Gamma_{total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] < 1.7 \times 10^{-8}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) = 2.1 \times 10^{-4}$.

Radiative decays

$\Gamma(\gamma D^+ D^-)/\Gamma(\pi^+\pi^- J/\psi(1S))$ — Γ_{18}/Γ_2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.99	90	ABLIKIM	20W	BES3	$e^+e^- \to \gamma\chi_{c1}(3872)$

$\Gamma(\gamma \overline{D}^0 D^0)/\Gamma(\pi^+\pi^- J/\psi(1S))$ — Γ_{19}/Γ_2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.58	90	ABLIKIM	20W	BES3	$e^+e^- \to \gamma\chi_{c1}(3872)$

$\Gamma(\gamma J/\psi)/\Gamma_{total}$ — Γ_{20}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$0.0085^{+0.0024}_{-0.0022} \pm 0.0027$		[1] BHARDWAJ	11	BELL	$B^\pm \to \gamma J/\psi K^\pm$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.013 \pm 0.004 \pm 0.004$	20	[2] AUBERT	09B	BABR	$B^+ \to \gamma J/\psi K^+$
$0.016 \pm 0.005 \pm 0.005$	19	[3] AUBERT,BE	06M	BABR	$B^+ \to \gamma J/\psi K^+$

[1] BHARDWAJ 11 reports $[\Gamma(\chi_{c1}(3872) \to \gamma J/\psi)/\Gamma_{total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] = (1.78^{+0.48}_{-0.44} \pm 0.12) \times 10^{-6}$ which we divide by our best value $B(B^+ \to$

$\chi_{c1}(3872) K^+) = (2.1 \pm 0.7) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[2] AUBERT 09B reports $[\Gamma(\chi_{c1}(3872) \rightarrow \gamma J/\psi)/\Gamma_{total}] \times [B(B^+ \rightarrow \chi_{c1}(3872) K^+)] = (2.8 \pm 0.8 \pm 0.1) \times 10^{-6}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872) K^+) = (2.1 \pm 0.7) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[3] Superseded by AUBERT 09B. AUBERT,BE 06M reports $[\Gamma(\chi_{c1}(3872) \rightarrow \gamma J/\psi)/\Gamma_{total}] \times [B(B^+ \rightarrow \chi_{c1}(3872) K^+)] = (3.3 \pm 1.0 \pm 0.3) \times 10^{-6}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872) K^+) = (2.1 \pm 0.7) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\gamma J/\psi)/\Gamma(\pi^+\pi^- J/\psi(1S))$ — Γ_{20}/Γ_2

VALUE	DOCUMENT ID		TECN	COMMENT
0.79±0.28	ABLIKIM	20W	BES3	$e^+e^- \rightarrow \gamma\chi_{c1}(3872)$

$\Gamma(\gamma\chi_{c1})/\Gamma_{total}$ — Γ_{21}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<9 \times 10^{-3}$	90	[1] BHARDWAJ	13	BELL	$B^\pm \rightarrow \chi_{c1}\gamma K^\pm$

[1] BHARDWAJ 13 reports $[\Gamma(\chi_{c1}(3872) \rightarrow \gamma\chi_{c1})/\Gamma_{total}] \times [B(B^+ \rightarrow \chi_{c1}(3872) K^+)] < 1.9 \times 10^{-6}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872) K^+) = 2.1 \times 10^{-4}$.

$\Gamma(\gamma\chi_{c1})/\Gamma(\pi^+\pi^- J/\psi(1S))$ — Γ_{21}/Γ_2

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

$\Gamma(\gamma\chi_{c2})/\Gamma_{total}$ — Γ_{22}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.032	90	[1] BHARDWAJ	13	BELL	$B^\pm \rightarrow \chi_{c2}\gamma K^\pm$

[1] BHARDWAJ 13 reports $[\Gamma(\chi_{c1}(3872) \rightarrow \gamma\chi_{c2})/\Gamma_{total}] \times [B(B^+ \rightarrow \chi_{c1}(3872) K^+)] < 6.7 \times 10^{-6}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872) K^+) = 2.1 \times 10^{-4}$.

$\Gamma(\gamma\psi(2S))/\Gamma_{total}$ — Γ_{23}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.045±0.013±0.015	25 ± 7	[1] AUBERT	09B	BABR	$B^+ \rightarrow \gamma\psi(2S) K^+$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
seen	36 ± 9	[2] AAIJ	14AH	LHCB	$B^+ \rightarrow \gamma\psi(2S) K^+$
not seen		[3] BHARDWAJ	11	BELL	$B^+ \rightarrow \gamma\psi(2S) K^+$

[1] AUBERT 09B reports $[\Gamma(\chi_{c1}(3872) \rightarrow \gamma\psi(2S))/\Gamma_{total}] \times [B(B^+ \rightarrow \chi_{c1}(3872) K^+)] = (9.5 \pm 2.7 \pm 0.6) \times 10^{-6}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872) K^+) = (2.1 \pm 0.7) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[2] From 36.4 ± 9.0 events of $\chi_{c1}(3872) \rightarrow J/\psi\gamma$ decays with a statistical significance of 4.4σ.

[3] BHARDWAJ 11 reports $B(B^+ \rightarrow K^+\chi_{c1}(3872)) \times B(\chi_{c1} \rightarrow \gamma\psi(2S)) < 3.45 \times 10^{-6}$ at 90% CL.

$\Gamma(\gamma\psi(2S))/\Gamma(\pi^+\pi^- J/\psi(1S))$ — Γ_{23}/Γ_2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.42	90	ABLIKIM	20W	BES3	$e^+e^- \rightarrow \gamma\chi_{c1}(3872)$

$\Gamma(\gamma\psi(2S))/\Gamma(\gamma J/\psi)$ — Γ_{23}/Γ_{20}

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
2.6 ±0.6 OUR AVERAGE						
2.46±0.64±0.29		36 ± 9	[1] AAIJ	14AH	LHCB	$B^+ \to \gamma\psi(2S)K^+$
3.4 ±1.4			AUBERT	09B	BABR	$B^+ \to \gamma c\overline{c}K'$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<2.1	90		BHARDWAJ	11	BELL	$B^+ \to \gamma\psi(2S)K^+$

[1] From 36.4 ± 9.0 events of $\chi_{c1}(3872) \to J/\psi\gamma$ decays with a statistical significance of 4.4σ.

C-violating decays

$\Gamma(\eta J/\psi)/\Gamma_{\text{total}}$ — Γ_{24}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.018	90	[1,2] IWASHITA	14	BELL	$B \to K\eta J/\psi$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.04	90	[3] AUBERT	04Y	BABR	$B \to K\eta J/\psi$

[1] IWASHITA 14 reports $[\Gamma(\chi_{c1}(3872) \to \eta J/\psi)/\Gamma_{\text{total}}] \times [B(B^+ \to \chi_{c1}(3872)K^+)] < 3.8\times10^{-6}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872)K^+) = 2.1\times10^{-4}$.

[2] IWASHITA 14 also scans the $\eta J/\psi$ mass range 3.8–4.75 GeV and sets upper limits for $B(B^\pm \to \chi_{c1}(3872)K^\pm)\times B(\chi_{c1}(3872) \to \eta J/\psi)$ in 5 MeV intervals.

[3] AUBERT 04Y reports $[\Gamma(\chi_{c1}(3872) \to \eta J/\psi)/\Gamma_{\text{total}}] \times [B(B^+ \to \chi_{c1}(3872)K^+)] < 7.7\times10^{-6}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872)K^+) = 2.1\times10^{-4}$.

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