$\chi_{c1}(3872)$

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

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 our note on "Developments in Heavy Quarkonium Spectroscopy".

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

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
3871.69± 0.17 OUR AVERAGE					
3871.9 ± 0.7 ± 0.2	20 ± 5	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	[1] CHOI	11	BELL	$B \to K\pi^+\pi^- J/\psi$
3873 $^{+1.8}_{-1.6}$ ± 1.3	27 ± 8	[2] DEL-AMO-SA.	10B	BABR	$B \to \omega J/\psi K$
3871.61 ± 0.16 ± 0.19	6k	[2,3] 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	[2,4] ABAZOV	04F	D0	$p\overline{p} \to J/\psi\pi^+\pi^- X$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
3860.0 ± 10.4	13.6	[2,5] AGHASYAN	18A	COMP	$\gamma^* N \to X\pi^\pm N'$
3868.6 ± 1.2 ± 0.2	8	[6] AUBERT	06	BABR	$B^0 \to K^0_S J/\psi\pi^+\pi^-$
3871.3 ± 0.6 ± 0.1	61	[6] AUBERT	06	BABR	$B^- \to K^- J/\psi\pi^+\pi^-$
3873.4 ± 1.4	25	[7] AUBERT	05R	BABR	$B^+ \to K^+ J/\psi\pi^+\pi^-$
3871.3 ± 0.7 ± 0.4	730	[2,8] ACOSTA	04	CDF2	$p\overline{p} \to J/\psi\pi^+\pi^- X$
3872.0 ± 0.6 ± 0.5	36	[9] CHOI	03	BELL	$B \to K\pi^+\pi^- J/\psi$
3836 ± 13	58	[2,10] ANTONIAZZI	94	E705	$300\ \pi^\pm \mathrm{Li} \to J/\psi\pi^+\pi^- X$

[1] 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.
[2] Width consistent with detector resolution.
[3] A possible equal mixture of two states with a mass difference greater than 3.6 MeV/c^2 is excluded at 95% CL.
[4] Calculated from the corresponding $m_{\chi_{c1}(3872)} - m_{J/\psi}$ using $m_{J/\psi}$=3096.916 MeV.
[5] Could be a different state.
[6] Calculated from the corresponding $m_{\chi_{c1}(3872)} - m_{\psi(2S)}$ using $m_{\psi(2S)}$ = 3686.093 MeV. Superseded by AUBERT 08Y.
[7] Calculated from the corresponding $m_{\chi_{c1}(3872)} - m_{\psi(2S)}$ using $m_{\psi(2S)}$ = 3685.96MeV. Superseded by AUBERT 06.
[8] Superseded by AALTONEN 09AU.
[9] Superseded by CHOI 11.
[10] 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 ± 6	[2] AUBERT	08B	BABR	$B \to \overline{D}^{*0} D^0 K$
$3875.2 \pm 0.7^{+0.9}_{-1.8}$	24 ± 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±3.1±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. • • •					
187.4 ± 1.4	25	[1] AUBERT	05R	BABR	$B^+ \to K^+ J/\psi \pi^+ \pi^-$

[1] Superseded by AUBERT 06.

$\chi_{c1}(3872)$ WIDTH

VALUE (MeV)	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<1.2	90		CHOI	11	BELL	$B \to K \pi^+ \pi^- J/\psi$

• • • We do not use the following data for averages, fits, limits, etc. • • •

<2.4	90		ABLIKIM	14	BES3	$e^+ e^- \rightarrow J/\psi \pi^+ \pi^- \gamma$
<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	[1] CHOI	03	BELL	$B \rightarrow K \pi^+ \pi^- J/\psi$

[1] Superseded by CHOI 11.

χ_{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	$B \rightarrow \overline{D}^{*0} D^0 K$
$3.0^{+1.9}_{-1.4} \pm 0.9$	33 ± 6	AUBERT	08B	BABR	$B \rightarrow \overline{D}^{*0} D^0 K$

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

χ_{c1}(3872) DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	$e^+ e^-$	
Γ_2	$\pi^+ \pi^- J/\psi(1S)$	> 3.2 %
Γ_3	$\rho^0 J/\psi(1S)$	
Γ_4	$\omega J/\psi(1S)$	> 2.3 %
Γ_5	$D^0 \overline{D}^0 \pi^0$	>40 %
Γ_6	$\overline{D}^{*0} D^0$	>30 %
Γ_7	$\gamma\gamma$	
Γ_8	$D^0 \overline{D}^0$	
Γ_9	$D^+ D^-$	
Γ_{10}	$\gamma \chi_{c1}$	
Γ_{11}	$\gamma \chi_{c2}$	
Γ_{12}	$\gamma J/\psi$	> 7 $\times 10^{-3}$
Γ_{13}	$\gamma \psi(2S)$	> 4 %
Γ_{14}	$\pi^+ \pi^- \eta_c(1S)$	not seen
Γ_{15}	$\pi^+ \pi^- \chi_{c1}$	not seen
Γ_{16}	$p \overline{p}$	not seen
	C-violating decays	
Γ_{17}	$\eta J/\psi$	

χ_{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 $e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$
<280	90	[2] YUAN	04	RVUE	$e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$

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

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

χ_{c1}(3872) Γ(i)Γ(e^+e^-)/Γ(total)

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

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

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

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

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

χ_{c1}(3872) Γ(i)Γ($\gamma\gamma$)/Γ(total)

$\Gamma(\pi^+\pi^- J/\psi(1S)) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_2\Gamma_7/\Gamma$

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	$e^+e^- \rightarrow \pi^+\pi^- J/\psi\gamma$

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

$\Gamma(\omega J/\psi(1S)) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_4\Gamma_7/\Gamma$

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	$e^+e^- \rightarrow e^+e^-\omega J/\psi$

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

$\Gamma(\pi^+\pi^-\eta_c(1S)) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_{14}\Gamma_7/\Gamma$

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

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

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
>0.032	93 ± 17	[1] AUBERT	08Y	BABR	$B \to \chi_{c1}(3872) K$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
seen	151	[2] BALA	15	BELL	$B \to \chi_{c1}(3872) K \pi$
>0.05	30	[3] AUBERT	05R	BABR	$B^+ \to K^+ \pi^+ \pi^- J/\psi$
>0.05	36 ± 7	[4] CHOI	03	BELL	$B^+ \to K^+ \pi^+ \pi^- J/\psi$

[1] AUBERT 08Y reports $[\Gamma(\chi_{c1}(3872) \to \pi^+\pi^- J/\psi(1S))/\Gamma_{total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] = (8.4 \pm 1.5 \pm 0.7) \times 10^{-6}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) < 2.6 \times 10^{-4}$.

[2] 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 $B(\chi_{c1}(3872) \to \pi^+\pi^- J/\psi) \times B(B^+ \to \chi_{c1}(3872) K^0 \pi^+) = (10.6 \pm 3.0 \pm 0.9) \times 10^{-6}$.

[3] Superseded by AUBERT 08Y. AUBERT 05R reports $[\Gamma(\chi_{c1}(3872) \to \pi^+\pi^- J/\psi(1S))/\Gamma_{total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] = (1.28 \pm 0.41) \times 10^{-5}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) < 2.6 \times 10^{-4}$.

[4] CHOI 03 reports $[\Gamma(\chi_{c1}(3872) \to \pi^+\pi^- J/\psi(1S))/\Gamma_{total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] / [B(B^+ \to \psi(2S) K^+)] / [B(\psi(2S) \to J/\psi(1S) \pi^+\pi^-)] = 0.063 \pm 0.012 \pm 0.007$ which we multiply or divide by our best values $B(B^+ \to \chi_{c1}(3872) K^+) < 2.6 \times 10^{-4}$, $B(B^+ \to \psi(2S) K^+) = (6.21 \pm 0.22) \times 10^{-4}$, $B(\psi(2S) \to J/\psi(1S) \pi^+\pi^-) = (34.68 \pm 0.30) \times 10^{-2}$.

$\Gamma(\omega J/\psi(1S))/\Gamma_{total}$ — Γ_4/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
>0.023	21 ± 7	[1] DEL-AMO-SA..10B	BABR	$B^+ \to \omega J/\psi K^+$

[1] DEL-AMO-SANCHEZ 10B reports $[\Gamma(\chi_{c1}(3872) \to \omega J/\psi(1S))/\Gamma_{total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] = (6 \pm 2 \pm 1) \times 10^{-6}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) < 2.6 \times 10^{-4}$. 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_4/Γ_2

VALUE	DOCUMENT ID	TECN	COMMENT
0.8±0.3	[1] DEL-AMO-SA..10B	BABR	$B \to \omega J/\psi K$

[1] 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.

$\Gamma(D^0 \overline{D}{}^0 \pi^0)/\Gamma_{total}$ — Γ_5/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
>0.4	17 ± 5	[1] GOKHROO	06	BELL	$B^+ \to D^0 \overline{D}{}^0 \pi^0 K^+$

[1] GOKHROO 06 reports $[\Gamma(\chi_{c1}(3872) \to D^0 \overline{D}{}^0 \pi^0)/\Gamma_{total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] = (1.02 \pm 0.31^{+0.21}_{-0.29}) \times 10^{-4}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) < 2.6 \times 10^{-4}$.

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

VALUE	DOCUMENT ID		TECN	COMMENT
seen	[1] GOKHROO	06	BELL	$B \rightarrow D^0\overline{D}^0\pi^0 K$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
seen	AUSHEV	10	BELL	$B \rightarrow D^0\overline{D}^0\pi^0 K$

[1] May not necessarily be the same state as that observed in the $J/\psi\pi^+\pi^-$ mode. Supersedes CHISTOV 04.

$\Gamma(\overline{D}^{*0}D^0)/\Gamma_{total}$ Γ_6/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
>0.30	41^{+9}_{-8}	[1] AUSHEV	10	BELL	$B^+ \rightarrow D^{*0}\overline{D}^0 K^+$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
>0.6	27 ± 6	[2] AUBERT	08B	BABR	$B^+ \rightarrow \overline{D}^{*0}D^0 K^+$

[1] AUSHEV 10 reports $[\Gamma(\chi_{c1}(3872) \rightarrow \overline{D}^{*0}D^0)/\Gamma_{total}] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+)] = (0.77 \pm 0.16 \pm 0.10) \times 10^{-4}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872)K^+) < 2.6 \times 10^{-4}$.

[2] AUBERT 08B reports $[\Gamma(\chi_{c1}(3872) \rightarrow \overline{D}^{*0}D^0)/\Gamma_{total}] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+)] = (1.67 \pm 0.36 \pm 0.47) \times 10^{-4}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872)K^+) < 2.6 \times 10^{-4}$.

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

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

$\Gamma(D^+D^-)/\Gamma(\pi^+\pi^- J/\psi(1S))$ Γ_9/Γ_2

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

$\Gamma(\gamma\chi_{c1})/\Gamma(\pi^+\pi^- J/\psi(1S))$ Γ_{10}/Γ_2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
not seen		[1] BHARDWAJ	13	BELL	$B^+ \rightarrow \chi_{c1}\gamma K^+$
<0.89	90	CHOI	03	BELL	$B \rightarrow K\pi^+\pi^- J/\psi$

[1] Reported $B(B^\pm \rightarrow \chi_{c1}(3872)K^\pm) \times B(\chi_{c1}(3872) \rightarrow \gamma\chi_{c1}) < 1.9 \times 10^{-6}$ at 90% CL.

$\Gamma(\gamma\chi_{c2})/\Gamma(\pi^+\pi^- J/\psi(1S))$ Γ_{11}/Γ_2

VALUE	DOCUMENT ID		TECN	COMMENT
not seen	[1] BHARDWAJ	13	BELL	$B^\pm \rightarrow \chi_{c2}\gamma K^+$

[1] Reported $B(B^\pm \rightarrow \chi_{c1}(3872)K^\pm) \times B(\chi_{c1}(3872) \rightarrow \gamma\chi_{c2}) < 6.7 \times 10^{-6}$ at 90% CL.

$\Gamma(\gamma J/\psi)/\Gamma_{total}$ — Γ_{12}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
>7 $\times 10^{-3}$		[1] BHARDWAJ	11	BELL	$B^\pm \to \gamma J/\psi K^\pm$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
>0.011	20	[2] AUBERT	09B	BABR	$B^+ \to \gamma J/\psi K^+$
>0.013	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 $B(B^+ \to \chi_{c1}(3872) K^+) < 2.6 \times 10^{-4}$.

[2] AUBERT 09B reports $[\Gamma(\chi_{c1}(3872) \to \gamma J/\psi)/\Gamma_{total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] = (2.8 \pm 0.8 \pm 0.1) \times 10^{-6}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) < 2.6 \times 10^{-4}$.

[3] Superseded by AUBERT 09B. AUBERT,BE 06M reports $[\Gamma(\chi_{c1}(3872) \to \gamma J/\psi)/\Gamma_{total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] = (3.3 \pm 1.0 \pm 0.3) \times 10^{-6}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) < 2.6 \times 10^{-4}$.

$\Gamma(\gamma\psi(2S))/\Gamma_{total}$ — Γ_{13}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
seen	36 ± 9	[1] AAIJ	14AH	LHCB	$B^+ \to \gamma\psi(2S) K^+$
>0.04	25 ± 7	[2] AUBERT	09B	BABR	$B^+ \to \gamma\psi(2S) K^+$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
not seen		[3] 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.

[2] AUBERT 09B reports $[\Gamma(\chi_{c1}(3872) \to \gamma\psi(2S))/\Gamma_{total}] \times [B(B^+ \to \chi_{c1}(3872) K^+)] = (9.5 \pm 2.7 \pm 0.6) \times 10^{-6}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+) < 2.6 \times 10^{-4}$.

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

$\Gamma(\gamma\psi(2S))/\Gamma(\gamma J/\psi)$ — Γ_{13}/Γ_{12}

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.

$\Gamma(\pi^+\pi^-\chi_{c1})/\Gamma_{total}$ — Γ_{15}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
not seen	[1] BHARDWAJ	16	BELL	$B^+ \to \pi^+\pi^-\chi_{c1} K^+$

[1] BHARDWAJ 16 quotes $B(B^+ \to \chi_{c1}(3872) K^+) \cdot B(\chi_{c1}(3872) \to \pi^+\pi^-\chi_{c1}) < 1.5 \times 10^{-6}$ at 90% CL.

$\Gamma(p\overline{p})/\Gamma_{total}$ — Γ_{16}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
not seen	[1] AAIJ	17AD	LHCB	$pp \to B^+ X \to p\overline{p} K^+ X$

[1] AAIJ 17AD reports $B(B^+ \to \chi_{c1}(3872) K^+ \to p\overline{p} K^+)/B(B^+ \to J/\psi K^+ \to p\overline{p} K^+) < 2.0\ (2.5) \times 10^{-3}$ at 90% (95%) CL.

$\Gamma(p\overline{p})/\Gamma(\pi^+\pi^- J/\psi(1S))$ — Γ_{16}/Γ_2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<2.0 \times 10^{-3}$	95	[1] AAIJ	13S	LHCB	$B^+ \to p\overline{p} K^+$

[1] AAIJ 13S reports $[\Gamma(\chi_{c1}(3872) \to p\overline{p})/\Gamma(\chi_{c1}(3872) \to \pi^+\pi^- J/\psi(1S))] \times [B(B^+ \to \chi_{c1}(3872) K^+,\ \chi_{c1} \to J/\psi \pi^+\pi^-)] < 1.7 \times 10^{-8}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+,\ \chi_{c1} \to J/\psi \pi^+\pi^-) = 8.6 \times 10^{-6}$.

C-violating decays

$\Gamma(\eta J/\psi)/\Gamma(\pi^+\pi^- J/\psi(1S))$ — Γ_{17}/Γ_2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.4	90	[1,2] IWASHITA	14	BELL	$B \to K \eta J/\psi$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.6	90	AUBERT	04Y	BABR	$B \to K \eta J/\psi$

[1] IWASHITA 14 reports $[\Gamma(\chi_{c1}(3872) \to \eta J/\psi)/\Gamma(\chi_{c1}(3872) \to \pi^+\pi^- J/\psi(1S))] \times [B(B^+ \to \chi_{c1}(3872) K^+,\ \chi_{c1} \to J/\psi \pi^+\pi^-)] < 3.8 \times 10^{-6}$ which we divide by our best value $B(B^+ \to \chi_{c1}(3872) K^+,\ \chi_{c1} \to J/\psi \pi^+\pi^-) = 8.6 \times 10^{-6}$.

[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.

$\chi_{c1}(3872)$ REFERENCES

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BHARDWAJ	16	PR D93 052016	V. Bhardwaj *et al.*	(BELLE Collab.)
AAIJ	15AO	PR D92 011102	R. Aaij *et al.*	(LHCb Collab.)
ABLIKIM	15V	PL B749 414	M. Ablikim *et al.*	(BES III Collab.)
BALA	15	PR D91 051101	A. Bala *et al.*	(BELLE Collab.)
AAIJ	14AH	NP B886 665	R. Aaij *et al.*	(LHCb Collab.)
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IWASHITA	14	PTEP 2014 043C01	T. Iwashita *et al.*	(BELLE Collab.)
AAIJ	13Q	PRL 110 222001	R. Aaij *et al.*	(LHCb Collab.) JP
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BHARDWAJ	13	PRL 111 032001	V. Bhardwaj *et al.*	(BELLE Collab.)
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ABAZOV	04F	PRL 93 162002	V.M. Abazov *et al.*	(D0 Collab.)
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PDG	04	PL B592 1	S. Eidelman *et al.*	(PDG Collab.)
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BAI	98E	PR D57 3854	J.Z. Bai *et al.*	(BES Collab.)
ANTONIAZZI	94	PR D50 4258	L. Antoniazzi *et al.*	(E705 Collab.)