

$\chi_{c0}(3915)$

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

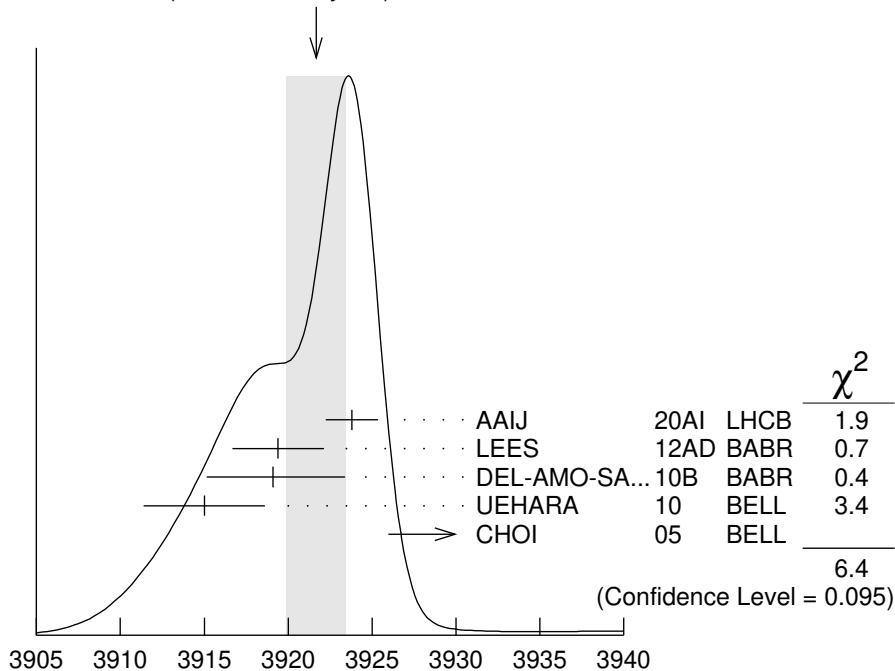
was $X(3915)$

The $\chi_{c0}(3915)$ was originally seen by BELLE in its $\omega J/\psi$ decay mode and was produced in both B decays in CHOI 05 and $\gamma\gamma$ collisions in UEHARA 10. The J^{PC} was determined to be 0^{++} by BABAR in LEES 12AD but this assignment was questioned by ZHOU 15C. In AAIJ 20AI LHCb found the $D^+ D^-$ decay mode of the $\chi_{c0}(3915)$ using B decays and determined its J^{PC} to be 0^{++} . Based on their compatible mass, width, and J^{PC} , we assume the state decaying to $\omega J/\psi$ and the state decaying to $D^+ D^-$ are both the $\chi_{c0}(3915)$. See also the $\chi_{c2}(3930)$.

$\chi_{c0}(3915)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
3921.7 ± 1.8	OUR AVERAGE	Error includes scale factor of 1.5. See the ideogram below.		
3923.8 ± 1.5 ± 0.4	1.2k	¹ AAIJ	20AI LHCb	$B^+ \rightarrow D^+ D^- K^+$
3919.4 ± 2.2 ± 1.6	59 ± 10	LEES	12AD BABR	$e^+ e^- \rightarrow e^+ e^- \omega J/\psi$
3919.1 ⁺ ₋ 3.8 ± 3.4 ± 2.0		DEL-AMO-SA...10B	BABR	$B \rightarrow \omega J/\psi K$
3915 ± 3 ± 2	49 ± 15	UEHARA	10 BELL	10.6 $e^+ e^- \rightarrow e^+ e^- \omega J/\psi$
3943 ± 11 ± 13	58 ± 11	² CHOI	05 BELL	$B \rightarrow \omega J/\psi K$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
3926.4 ± 2.2 ± 1.2		³ ABLIKIM	19V BES	$e^+ e^- \rightarrow \gamma \omega J/\psi$
3914.6 ⁺ ₋ 3.8 ± 3.4 ± 2.0		² AUBERT	08W BABR	Superseded by DEL-AMO-SANCHEZ 10B

WEIGHTED AVERAGE
3921.7 ± 1.8 (Error scaled by 1.5)



¹ Obtained from the full amplitude analysis. Parameterized with the relativistic Breit-Wigner line shape.

² $\omega J/\psi$ threshold enhancement fitted as an S-wave Breit-Wigner resonance.

³ Could also be X(3940). Significance 3.1σ . Fit with additional resonance at 3963.7 ± 5.7 MeV, significance 3.4σ . $\chi_{c0}(3915)$ MASS (MeV)

$\chi_{c0}(3915)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
18.8 ± 3.5 OUR AVERAGE				
17.4 ± 5.1 ± 0.8	1.2k	¹ AAIJ	20AI LHCb	$B^+ \rightarrow D^+ D^- K^+$
13 ± 6 ± 3	59	LEES	12AD BABR	$e^+ e^- \rightarrow e^+ e^- \omega J/\psi$
31 $^{+10}_{-8}$ ± 5		DEL-AMO-SA..10B	BABR	$B \rightarrow \omega J/\psi K$
17 ± 10 ± 3	49	UEHARA	10 BELL	10.6 $e^+ e^- \rightarrow e^+ e^- \omega J/\psi$
87 ± 22 ± 26	58	² CHOI	05 BELL	$B \rightarrow \omega J/\psi K$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
3.8 ± 7.5 ± 2.6		³ ABLIKIM	19V BES	$e^+ e^- \rightarrow \gamma \omega J/\psi$
34 $^{+12}_{-8}$ ± 5		² AUBERT	08W BABR	Superseded by DEL-AMO-SANCHEZ 10B

¹ Obtained from the full amplitude analysis. Parameterized with the relativistic Breit-Wigner line shape.

² $\omega J/\psi$ threshold enhancement fitted as an S-wave Breit-Wigner resonance.

³ Could also be X(3940). Significance 3.1σ . Fit with additional resonance at 3963.7 ± 5.7 MeV, significance 3.4σ .

$\chi_{c0}(3915)$ DECAY MODES

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

$\chi_{c0}(3915)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(\omega J/\psi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$				$\Gamma_1 \Gamma_8/\Gamma$
VALUE (eV)	EVTS	DOCUMENT ID	TECN	COMMENT
54 ± 9 OUR AVERAGE				
52 ± 10 ± 3	59 ± 10	¹ LEES	12AD BABR	$e^+ e^- \rightarrow e^+ e^- \omega J/\psi$
61 ± 17 ± 8	49 ± 15	¹ UEHARA	10 BELL	10.6 $e^+ e^- \rightarrow e^+ e^- \omega J/\psi$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
18 ± 5 ± 2	49 ± 15	² UEHARA	10 BELL	10.6 $e^+ e^- \rightarrow e^+ e^- \omega J/\psi$

¹ For $J^P = 0^+$.

² For $J^P = 2^+$, helicity-2.

$\Gamma(\pi^+\pi^-\eta_c(1S)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_4\Gamma_8/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
<16	90	LEES	12AE BABR	$e^+e^- \rightarrow e^+e^-\pi^+\pi^-\eta_c$

 $\Gamma(K\bar{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_7\Gamma_8/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
<1.96	90	UEHARA	13 BELL	$\gamma\gamma \rightarrow K_S^0 K_S^0$

 $\chi_{c0}(3915)$ BRANCHING RATIOS $\Gamma(\omega J/\psi)/\Gamma_{\text{total}}$ Γ_1/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	¹ DEL-AMO-SA..10B	BABR	$B \rightarrow \omega J/\psi K$
seen	² CHOI	05 BELL	$B \rightarrow \omega J/\psi K$

¹ DEL-AMO-SANCHEZ 10B reports $B(B^\pm \rightarrow \chi_{c0}(3915) K^\pm) \times B(\chi_{c0}(3915) \rightarrow J/\psi\omega)$
 $= (3.0^{+0.7+0.5}_{-0.6-0.3}) \times 10^{-5}$ and $B(B^0 \rightarrow \chi_{c0}(3915) K^0) \times B(\chi_{c0}(3915) \rightarrow J/\psi\omega)$
 $= (2.1 \pm 0.9 \pm 0.3) \times 10^{-5}$.

² CHOI 05 reports $B(B \rightarrow \chi_{c0}(3915) K) \times B(\chi_{c0}(3915) \rightarrow J/\psi\omega) = (7.1 \pm 1.3 \pm 3.1) \times 10^{-5}$.

 $\Gamma(\omega J/\psi)/\Gamma(\bar{D}^{*0} D^0)$ Γ_1/Γ_2

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
>0.71	90	¹ AUSHEV	10 BELL	$B \rightarrow \bar{D}^{*0} D^0 K$

¹ By combining the upper limit $B(B \rightarrow \chi_{c0}(3915) K) \times B(\chi_{c0}(3915) \rightarrow D^{*0} \bar{D}^0)$
 $< 0.67 \times 10^{-4}$ from AUSHEV 10 with the average of CHOI 05 and AUBERT 08w
measurements $B(B \rightarrow \chi_{c0}(3915) K) \times B(\chi_{c0}(3915) \rightarrow \omega J/\psi) = (0.51 \pm 0.11) \times 10^{-4}$.

 $\Gamma(D^+ D^-)/\Gamma_{\text{total}}$ Γ_3/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	AAIJ	20AI LHCB	$B^+ \rightarrow D^+ D^- K^+$

 $\Gamma(\eta_c \eta)/\Gamma_{\text{total}}$ Γ_5/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
not seen	90	¹ VINOKUROVA 15	BELL	$B^+ \rightarrow K^+ \eta_c \eta$

¹ VINOKUROVA 15 reports $B(B^+ \rightarrow K^+ \chi_{c0}(3915)) \times B(\chi_{c0}(3915) \rightarrow \eta_c \eta) < 4.7 \times 10^{-5}$ at 90% CL.

 $\Gamma(\eta_c \pi^0)/\Gamma_{\text{total}}$ Γ_6/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
not seen	90	¹ VINOKUROVA 15	BELL	$B^+ \rightarrow K^+ \eta_c \pi^0$

¹ VINOKUROVA 15 reports $B(B^+ \rightarrow K^+ \chi_{c0}(3915)^0) \times B(\chi_{c0}(3915) \rightarrow \eta_c \pi^0) < 1.7 \times 10^{-5}$ at 90% CL.

 $\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ Γ_8/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
seen	59 ± 10	LEES	12AD BABR	$e^+e^- \rightarrow e^+e^-\omega J/\psi$
seen		UEHARA	10 BELL	10.6 $e^+e^- \rightarrow e^+e^-\omega J/\psi$

$\Gamma(\pi^0 \chi_{c1})/\Gamma_{\text{total}}$					Γ_g/Γ
<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
not seen	42 ± 14	¹ BHARDWAJ	19	BELL	$B^\pm \rightarrow \chi_{c1} \pi^0 K^\pm$
¹ BHARDWAJ 19 reports $B(B^+ \rightarrow K^+ \chi_{c0}(3915)) \times B(\chi_{c0}(3915) \rightarrow \chi_{c1} \pi^0) < 3.8 \times 10^{-5}$ at 90% CL. A signal significance 2.3 standard deviations.					

$\chi_{c0}(3915)$ REFERENCES

AAIJ	20AI	PR D102 112003	R. Aaij <i>et al.</i>	(LHCb Collab.) JPC
ABLIKIM	19V	PRL 122 232002	M. Ablikim <i>et al.</i>	(BESIII Collab.)
BHARDWAJ	19	PR D99 111101	V. Bhardwaj <i>et al.</i>	(BELLE Collab.)
VINOKUROVA	15	JHEP 1506 132	A. Vinokurova <i>et al.</i>	(BELLE Collab.)
Also		JHEP 1702 088 (errat.)	A. Vinokurava <i>et al.</i>	(BELLE Collab.)
ZHOU	15C	PRL 115 022001	Z.-Y. Zhou, Z. Xiao, H.-Q. Zhou	(BEIJT, NANJ)
UEHARA	13	PTEP 2013 123C01	S. Uehara <i>et al.</i>	(BELLE Collab.)
LEES	12AD	PR D86 072002	J.P. Lees <i>et al.</i>	(BABAR Collab.)
LEES	12AE	PR D86 092005	J.P. Lees <i>et al.</i>	(BABAR Collab.)
AUSHEV	10	PR D81 031103	T. Aushev <i>et al.</i>	(BELLE Collab.)
DEL-AMO-SA...	10B	PR D82 011101	P. del Amo Sanchez <i>et al.</i>	(BABAR Collab.)
UEHARA	10	PRL 104 092001	S. Uehara <i>et al.</i>	(BELLE Collab.)
AUBERT	08W	PRL 101 082001	B. Aubert <i>et al.</i>	(BABAR Collab.)
CHOI	05	PRL 94 182002	S.-K. Choi <i>et al.</i>	(BELLE Collab.)