$\chi_{c0}(3915)$

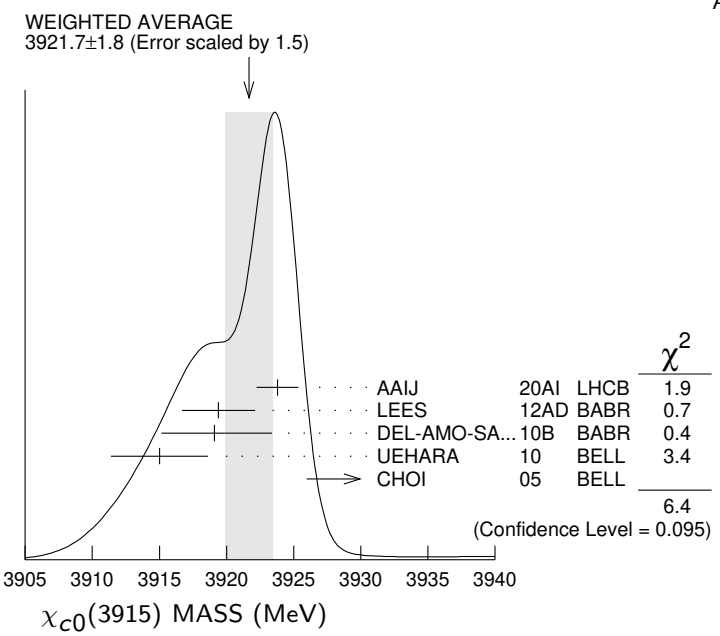
$I^G(J^{PC}) = 0^+(0^{++})$

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	$B^+ \to D^+D^-K^+$
3919.4± 2.2± 1.6	59 ± 10	LEES	12AD	BABR	$e^+e^- \to e^+e^-\omega J/\psi$
$3919.1^{+\ 3.8}_{-\ 3.4}$ ± 2.0		DEL-AMO-SA..	10B	BABR	$B \to \omega J/\psi K$
3915 ± 3 ± 2	49 ± 15	UEHARA	10	BELL	10.6 $e^+e^- \to e^+e^-\omega J/\psi$
3943 ±11 ±13	58 ± 11	[2] CHOI	05	BELL	$B \to \omega J/\psi K$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
3922.4± 6.5± 2.0		[3] WANG	22A	BELL	$\gamma\gamma \to \gamma\psi(2S)$
3926.4± 2.2± 1.2		[4] ABLIKIM	19V	BES	$e^+e^- \to \gamma\omega J/\psi$
$3914.6^{+\ 3.8}_{-\ 3.4}$ ± 2.0		[2] AUBERT	08W	BABR	Superseded by DEL-AMO-SANCHEZ 10B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] Not distinguished from the $\chi_{c2}(3930)$.
[4] Could also be $X(3940)$. Significance 3.1σ. Fit with additional resonance at 3963.7 ± 5.7 MeV, significance 3.4σ.

$\chi_{c0}(3915)$ WIDTH

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
18.8± 3.5 OUR AVERAGE					
$17.4 \pm 5.1 \pm 0.8$	1.2k	[1] AAIJ	20AI	LHCB	$B^+ \to D^+ D^- K^+$
$13 \pm 6 \pm 3$	59	LEES	12AD	BABR	$e^+ e^- \to e^+ e^- \omega J/\psi$
$31 \ ^{+10}_{-8} \pm 5$		DEL-AMO-SA..	10B	BABR	$B \to \omega J/\psi K$
$17 \pm 10 \pm 3$	49	UEHARA	10	BELL	10.6 $e^+ e^- \to e^+ e^- \omega J/\psi$
$87 \pm 22 \pm 26$	58	[2] CHOI	05	BELL	$B \to \omega J/\psi K$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$22 \pm 17 \pm 4$		[3] WANG	22A	BELL	$\gamma\gamma \to \gamma\psi(2S)$
$3.8 \pm 7.5 \pm 2.6$		[4] ABLIKIM	19V	BES	$e^+ e^- \to \gamma\omega J/\psi$
$34 \ ^{+12}_{-8} \pm 5$		[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] Not distinguished from the $\chi_{c2}(3930)$.
[4] 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	$\gamma\psi(2S)$	
Γ_{10}	$\pi^0 \chi_{c1}$	not seen

$\chi_{c0}(3915)$ Γ(i)$\Gamma(\gamma\gamma)/\Gamma$(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					
$52 \pm 10 \pm 3$	59 ± 10	[1] LEES	12AD	BABR	$e^+ e^- \to e^+ e^- \omega J/\psi$
$61 \pm 17 \pm 8$	49 ± 15	[1] UEHARA	10	BELL	10.6 $e^+ e^- \to e^+ e^- \omega J/\psi$

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

$18 \pm 5 \pm 2$	49 ± 15	[2] UEHARA	10	BELL	10.6	$e^+e^- \to e^+e^-\omega J/\psi$

[1] For $J^P = 0^+$.
[2] For $J^P = 2^+$, helicity-2.

$\Gamma(\gamma\psi(2S)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_9\Gamma_8/\Gamma$

VALUE (eV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$9.8 \pm 3.6 \pm 1.3$	[1] WANG	22A	BELL	$\gamma\gamma \to \gamma\psi(2S)$

[1] Not distinguished from the $\chi_{c2}(3930)$.

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

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

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

VALUE (eV)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
<1.96	90	UEHARA	13	BELL	$\gamma\gamma \to K^0_S K^0_S$

$\chi_{c0}(3915)$ BRANCHING RATIOS

$\Gamma(\omega J/\psi)/\Gamma_{\text{total}}$ Γ_1/Γ

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

[1] DEL-AMO-SANCHEZ 10B reports $B(B^\pm \to \chi_{c0}(3915)K^\pm) \times B(\chi_{c0}(3915) \to J/\psi\omega) = (3.0^{+0.7+0.5}_{-0.6-0.3}) \times 10^{-5}$ and $B(B^0 \to \chi_{c0}(3915)K^0) \times B(\chi_{c0}(3915) \to J/\psi\omega) = (2.1 \pm 0.9 \pm 0.3) \times 10^{-5}$.
[2] CHOI 05 reports $B(B \to \chi_{c0}(3915)K) \times B(\chi_{c0}(3915) \to J/\psi\omega) = (7.1 \pm 1.3 \pm 3.1) \times 10^{-5}$.

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

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

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

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

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

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

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

[1] VINOKUROVA 15 reports $B(B^+ \to K^+\chi_{c0}(3915)) \times B(\chi_{c0}(3915) \to \eta_c\eta) < 4.7 \times 10^{-5}$ 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	$B^+ \to K^+\eta_c\pi^0$

[1] VINOKUROVA 15 reports $B(B^+ \to K^+\chi_{c0}(3915)^0) \times B(\chi_{c0}(3915) \to \eta_c\pi^0) < 1.7\times10^{-5}$ at 90% CL.

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

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

$\Gamma(\pi^0\chi_{c1})/\Gamma_{\text{total}}$ Γ_{10}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
not seen	42 ± 14	[1] BHARDWAJ	19	BELL	$B^\pm \to \chi_{c1}\pi^0 K^\pm$

[1] BHARDWAJ 19 reports $B(B^+ \to K^+\chi_{c0}(3915)) \times B(\chi_{c0}(3915) \to \chi_{c1}\pi^0) < 3.8\times10^{-5}$ at 90% CL. A signal significance 2.3 standard deviations.

$\chi_{c0}(3915)$ REFERENCES

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Also		JHEP 1702 088 (errat.)	A. Vinokurava *et al.*	(BELLE Collab.)
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UEHARA	13	PTEP 2013 123C01	S. Uehara *et al.*	(BELLE Collab.)
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