

X(1835)

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

OMITTED FROM SUMMARY TABLE

Could be a superposition of two states, one with small width appearing as threshold enhancement in $p\bar{p}$, the other one with a larger width, decaying into $\pi^+\pi^-\eta'$ and $K_S^0 K_S^0 \eta$. For the former ABLIKIM 12D determine $J^{PC} = 0^- +$.

X(1835) MASS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
1835.8^{+4.0}_{-3.2} OUR AVERAGE				
1844 ± 9 ⁺¹⁶ ₋₂₅		ABLIKIM	15T BES3	$J/\psi \rightarrow \gamma K_S^0 K_S^0 \eta$
1836.5 ± 3.0 ^{+5.6} _{-2.1}	4265	¹ ABLIKIM	11C BES3	$J/\psi \rightarrow \gamma \pi^+ \pi^- \eta'$
1833.7 ± 6.1 ± 2.7	264	ABLIKIM	05R BES2	$J/\psi \rightarrow \gamma \pi^+ \pi^- \eta'$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
1832 ⁺¹⁹ ₋₅ ± 26		² ABLIKIM	12D BES3	$J/\psi \rightarrow \gamma p\bar{p}$
1877.3 ± 6.3 ^{+3.4} _{-7.4}		³ ABLIKIM	11J BES3	$J/\psi \rightarrow \omega(\eta \pi^+ \pi^-)$
1837 ⁺¹⁰ ₋₁₂ ± 9 ₋₇	231	^{4,5} ALEXANDER	10 CLEO	$J/\psi \rightarrow \gamma p\bar{p}$
1831 ± 7		^{5,6} ABLIKIM	05R BES2	$J/\psi \rightarrow \gamma p\bar{p}$
1859 ⁺³ ₋₁₀ ± 5 ₋₂₅		⁵ BAI	03F BES2	$J/\psi \rightarrow \gamma p\bar{p}$

¹ From a fit of the $\pi^+\pi^-\eta'$ mass distribution to a combination of $\gamma f_1(1510)$, $\gamma X(1835)$, and two unconfirmed states $\gamma X(2120)$, and $\gamma X(2370)$, for $M(p\bar{p}) < 2.8$ GeV, and accounting for backgrounds from non- η' events and $J/\psi \rightarrow \pi^0 \pi^+ \pi^- \eta'$.

² From the fit including final state interaction effects in isospin 0 S-wave according to SIBIRTSEV 05A. Supersedes ABLIKIM 10G.

³ The selected process is $J/\psi \rightarrow \omega a_0(980)\pi$. This state may be due also to $\eta_2(1870)$ or to a combination of $X(1835)$ and $\eta_2(1870)$.

⁴ From a fit of the $p\bar{p}$ mass distribution to a combination of $\gamma X(1835)$, γR with $M(R) = 2100$ MeV and $\Gamma(R) = 160$ MeV, and $\gamma p\bar{p}$ phase space, for $M(p\bar{p}) < 2.85$ GeV.

⁵ Evidence for a threshold enhancement in the $p\bar{p}$ mass spectrum was also reported by ABE 02K, AUBERT,B 05L, and WANG 05A in $B^+ \rightarrow p\bar{p}K^+$, WANG 05A in $B^0 \rightarrow p\bar{p}K_S^0$, ABE 02W in $\bar{B}^0 \rightarrow p\bar{p}D^0$, DEL-AMO-SANCHEZ 12 in $B \rightarrow D(D^*)p\bar{p}(\pi)$, and WEI 08 in $B^+ \rightarrow p\bar{p}\pi^+$ decays. Not seen by ATHAR 06 in $\Upsilon(1S) \rightarrow p\bar{p}\gamma$.

⁶ From the fit including final state interaction effects in isospin 0 S-wave according to SIBIRTSEV 05A. Systematic errors not estimated.

X(1835) WIDTH

VALUE (MeV)	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
112 ± 40 OUR AVERAGE					Error includes scale factor of 2.4. See the ideogram below.
192 ⁺²⁰ ₋₁₇ ± 62 ₋₄₃			ABLIKIM	15T BES3	$J/\psi \rightarrow \gamma K_S^0 K_S^0 \eta$
190 ± 9 ⁺³⁸ ₋₃₆		4265	¹ ABLIKIM	11C BES3	$J/\psi \rightarrow \gamma \pi^+ \pi^- \eta'$
67.7 ± 20.3 ± 7.7		264	ABLIKIM	05R BES2	$J/\psi \rightarrow \gamma \pi^+ \pi^- \eta'$

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< 76	90	² ABLIKIM	12D	BES3	$J/\psi \rightarrow \gamma p\bar{p}$
57 ±12 +19 - 4		³ ABLIKIM	11J	BES3	$J/\psi \rightarrow \omega(\eta\pi^+\pi^-)$
0 +44 - 0	231	^{4,5} ALEXANDER	10	CLEO	$J/\psi \rightarrow \gamma p\bar{p}$
< 153	90	^{5,6} ABLIKIM	05R	BES2	$J/\psi \rightarrow \gamma p\bar{p}$
< 30		⁵ BAI	03F	BES2	$J/\psi \rightarrow \gamma p\bar{p}$

¹ From a fit of the $\pi^+\pi^-\eta'$ mass distribution to a combination of $\gamma f_1(1510)$, $\gamma X(1835)$, and two unconfirmed states $\gamma X(2120)$, and $\gamma X(2370)$, for $M(p\bar{p}) < 2.8$ GeV, and accounting for backgrounds from non- η' events and $J/\psi \rightarrow \pi^0\pi^+\pi^-\eta'$.

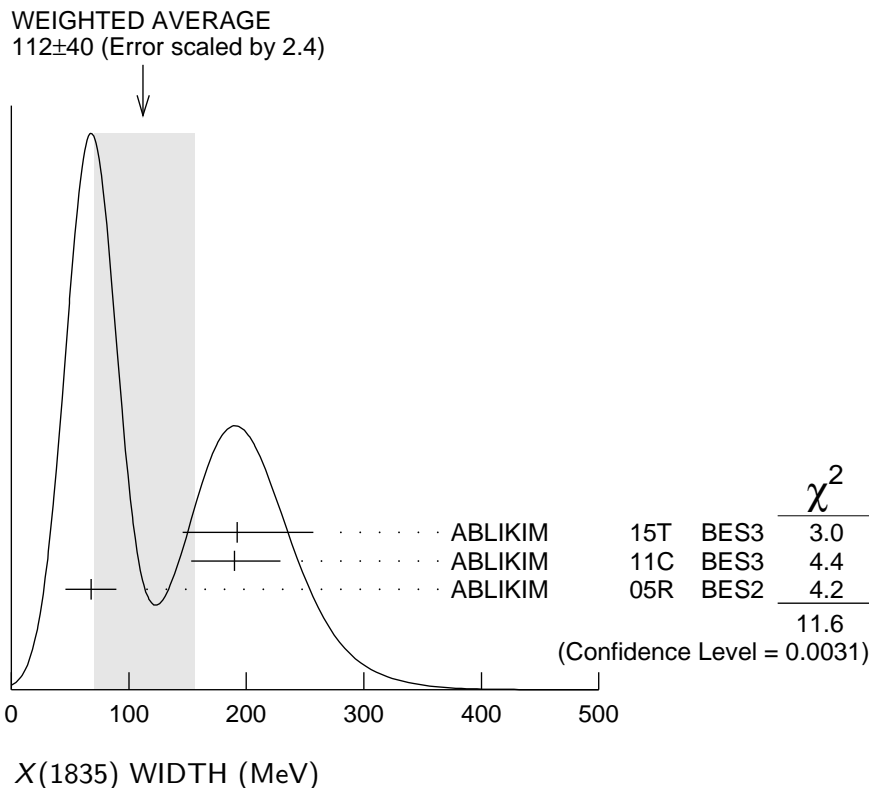
² From the fit including final state interaction effects in isospin 0 S-wave according to SIBIRTSEV 05A. Supersedes ABLIKIM 10G.

³ The selected process is $J/\psi \rightarrow \omega a_0(980)\pi$. This state may be due also to $\eta_2(1870)$ or to a combination of $X(1835)$ and $\eta_2(1870)$.

⁴ From a fit of the $p\bar{p}$ mass distribution to a combination of $\gamma X(1835)$, γR with $M(R) = 2100$ MeV and $\Gamma(R) = 160$ MeV, and $\gamma p\bar{p}$ phase space, for $M(p\bar{p}) < 2.85$ GeV.

⁵ Evidence for a threshold enhancement in the $p\bar{p}$ mass spectrum was also reported by ABE 02K, AUBERT,B 05L, and WANG 05A in $B^+ \rightarrow p\bar{p}K^+$, WANG 05A in $B^0 \rightarrow p\bar{p}K_S^0$, ABE 02W in $\bar{B}^0 \rightarrow p\bar{p}D^0$, DEL-AMO-SANCHEZ 12 in $B \rightarrow D(D^*)p\bar{p}(\pi)$, and WEI 08 in $B^+ \rightarrow p\bar{p}\pi^+$ decays. Not seen by ATHAR 06 in $\Upsilon(1S) \rightarrow p\bar{p}\gamma$.

⁶ From the fit including final state interaction effects in isospin 0 S-wave according to SIBIRTSEV 05A. Systematic errors not estimated.



X(1835) DECAY MODES

Mode	Fraction (Γ_i/Γ)
Γ_1 $\rho\bar{\rho}$	seen
Γ_2 $\eta'\pi^+\pi^-$	seen
Γ_3 $\gamma\gamma$	
Γ_4 $K_S^0 K_S^0 \eta$	seen

X(1835) $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(\eta'\pi^+\pi^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_2\Gamma_3/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
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<35.6	90	¹ ZHANG	12A BELL	$e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$
<83	90	² ZHANG	12A BELL	$e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$

¹ From a two-resonance fit and constructive interference of the $\eta(1760)$ and $X(1835)$, a significance of 2.8σ .

² From a two-resonance fit and destructive interference of the $\eta(1760)$ and $X(1835)$, a significance of 2.8σ .

X(1835) BRANCHING RATIOS

$\Gamma(\rho\bar{\rho})/\Gamma(\eta'\pi^+\pi^-)$ Γ_1/Γ_2

VALUE	DOCUMENT ID	TECN	COMMENT
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••• We do not use the following data for averages, fits, limits, etc. •••

0.333	ABLIKIM	05R BES2	$J/\psi \rightarrow \gamma\pi^+\pi^-\eta'$
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$\Gamma(\eta'\pi^+\pi^-)/\Gamma(K_S^0 K_S^0 \eta)$ Γ_2/Γ_4

VALUE	DOCUMENT ID	TECN	COMMENT
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••• We do not use the following data for averages, fits, limits, etc. •••

6.7 ± 1.8	¹ ABLIKIM	15T BES3	$J/\psi \rightarrow \gamma K_S^0 K_S^0 \eta$
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¹ Using results from ABLIKIM 05R.

X(1835) REFERENCES

ABLIKIM	15T	PRL 115 091803	M. Ablikim <i>et al.</i>	(BES III Collab.)
ABLIKIM	12D	PRL 108 112003	M. Ablikim <i>et al.</i>	(BES III Collab.) JPC
DEL-AMO-SA...	12	PR D85 092017	P. del Amo Sanchez <i>et al.</i>	(BABAR Collab.)
ZHANG	12A	PR D86 052002	C.C. Zhang <i>et al.</i>	(BELLE Collab.)
ABLIKIM	11C	PRL 106 072002	M. Ablikim <i>et al.</i>	(BES III Collab.)
ABLIKIM	11J	PRL 107 182001	M. Ablikim <i>et al.</i>	(BES III Collab.)
ABLIKIM	10G	CPC 34 421	M. Ablikim <i>et al.</i>	(BES III Collab.)
ALEXANDER	10	PR D82 092002	J.P. Alexander <i>et al.</i>	(CLEO Collab.)
WEI	08	PL B659 80	J.-T. Wei <i>et al.</i>	(BELLE Collab.)
ATHAR	06	PR D73 032001	S.B. Athar <i>et al.</i>	(CLEO Collab.)
ABLIKIM	05R	PRL 95 262001	M. Ablikim <i>et al.</i>	(BES Collab.)
AUBERT,B	05L	PR D72 051101	B. Aubert <i>et al.</i>	(BABAR Collab.)
SIBIRTSEV	05A	PR D71 054010	A. Sibirtsev, J. Haidenbauer	
WANG	05A	PL B617 141	M.-Z. Wang <i>et al.</i>	(BELLE Collab.)
BAI	03F	PRL 91 022001	J.Z. Bai <i>et al.</i>	(BES II Collab.)
ABE	02K	PRL 88 181803	K. Abe <i>et al.</i>	(BELLE Collab.)
ABE	02W	PRL 89 151802	K. Abe <i>et al.</i>	(BELLE Collab.)