

X(1835)

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

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 $\pi^+\pi^-\eta'$. For the former ABLIKIM 12D determine $J^{PC} = 0(-^+)$.

X(1835) MASS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
1835.7^{+5.0}_{-3.2} OUR AVERAGE				
1836.5 $\pm$ 3.0 ^{+5.6} _{-2.1}	4265	¹ ABLIKIM	11C BES3	$J/\psi \rightarrow \gamma\pi^+\pi^-\eta'$
1833.7 $\pm$ 6.1 $\pm$ 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 $\pm$ 26		² ABLIKIM	12D BES3	$J/\psi \rightarrow \gamma p\bar{p}$
1877.3 $\pm$ 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 $\pm$ 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
99 $\pm$ 50 OUR AVERAGE					Error includes scale factor of 2.8.
190 $\pm$ 9 ⁺³⁸ ₋₃₆		4265	⁷ ABLIKIM	11C BES3	$J/\psi \rightarrow \gamma\pi^+\pi^-\eta'$
67.7 $\pm$ 20.3 $\pm$ 7.7		264	ABLIKIM	05R BES2	$J/\psi \rightarrow \gamma\pi^+\pi^-\eta'$

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

< 76	90	⁸ ABLIKIM	12D	BES3	$J/\psi \rightarrow \gamma p \bar{p}$
57 ± 12 $^{+19}_{-4}$		⁹ ABLIKIM	11J	BES3	$J/\psi \rightarrow \omega(\eta \pi^+ \pi^-)$
0 $^{+44}_{-0}$	231	^{10,11} ALEXANDER	10	CLEO	$J/\psi \rightarrow \gamma p \bar{p}$
< 153	90	^{11,12} ABLIKIM	05R	BES2	$J/\psi \rightarrow \gamma p \bar{p}$
< 30		¹¹ BAI	03F	BES2	$J/\psi \rightarrow \gamma p \bar{p}$

⁷ 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 $J/\psi \rightarrow \pi^0 \pi^+ \pi^- \eta'$.

⁸ From the fit including final state interaction effects in isospin 0 S -wave according to SIBIRTSEV 05A. Supersedes ABLIKIM 10G.

⁹ 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 $\eta_2(1870)$.

¹⁰ 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.

¹¹ 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 $\Upsilon(1S) \rightarrow p \bar{p} \gamma$.

¹² 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 $p \bar{p}$	seen
Γ_2 $\eta' \pi^+ \pi^-$	seen
Γ_3 $\gamma \gamma$	

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	

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

<35.6	90	¹³ ZHANG	12A	BELL	$e^+ e^- \rightarrow e^+ e^- \eta' \pi^+ \pi^-$
<83	90	¹⁴ ZHANG	12A	BELL	$e^+ e^- \rightarrow e^+ e^- \eta' \pi^+ \pi^-$

¹³ From a two-resonance fit and constructive interference of the $\eta(1760)$ and $X(1835)$, a significance of 2.8σ .

¹⁴ From a two-resonance fit and destructive interference of the $\eta(1760)$ and $X(1835)$, a significance of 2.8σ .

X(1835) BRANCHING RATIOS

$\Gamma(p\bar{p})/\Gamma(\eta'\pi^+\pi^-)$				Γ_1/Γ_2
VALUE	DOCUMENT ID	TECN	COMMENT	

• • • 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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X(1835) REFERENCES

ABLIKIM	12D	PRL 108 112003	M. Ablikim <i>et al.</i>	(BES III Collab.)
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.)
