

**X(1835)**

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

## 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
<b>1835.7<sup>+5.0</sup><sub>-3.2</sub></b>				<b>OUR AVERAGE</b>
1836.5 ± 3.0 <sup>+5.6</sup> <sub>-2.1</sub>	4265	<sup>1</sup> 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 <sup>+19</sup> <sub>-5</sub> ± 26		<sup>2</sup> ABLIKIM	12D BES3	$J/\psi \rightarrow \gamma p\bar{p}$
1877.3 ± 6.3 <sup>+3.4</sup> <sub>-7.4</sub>		<sup>3</sup> ABLIKIM	11J BES3	$J/\psi \rightarrow \omega(\eta\pi^+\pi^-)$
1837 <sup>+10</sup> <sub>-12</sub> <sup>+9</sup> <sub>-7</sub>	231	<sup>4,5</sup> ALEXANDER	10 CLEO	$J/\psi \rightarrow \gamma p\bar{p}$
1831 ± 7		<sup>5,6</sup> ABLIKIM	05R BES2	$J/\psi \rightarrow \gamma p\bar{p}$
1859 <sup>+3</sup> <sub>-10</sub> <sup>+5</sup> <sub>-25</sub>		<sup>5</sup> BAI	03F BES2	$J/\psi \rightarrow \gamma p\bar{p}$

<sup>1</sup> 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- $\eta'$  events and  $J/\psi \rightarrow \pi^0\pi^+\pi^-\eta'$ .

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

<sup>3</sup> 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  $\eta_2(1870)$ .

<sup>4</sup> From a fit of the  $p\bar{p}$  mass distribution to a combination of  $\gamma X(1835)$ ,  $\gamma R$  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.

<sup>5</sup> 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  $\Upsilon(1S) \rightarrow p\bar{p}\gamma$ .

<sup>6</sup> 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
<b>99 ± 50</b>					<b>OUR AVERAGE</b> Error includes scale factor of 2.8.
190 ± 9 <sup>+38</sup> <sub>-36</sub>		4265	<sup>7</sup> ABLIKIM	11C BES3	$J/\psi \rightarrow \gamma\pi^+\pi^-\eta'$
67.7 ± 20.3 ± 7.7		264	ABLIKIM	05R BES2	$J/\psi \rightarrow \gamma\pi^+\pi^-\eta'$

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

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

<sup>7</sup> 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- $\eta'$  events and  $J/\psi \rightarrow \pi^0\pi^+\pi^-\eta'$ .

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

<sup>9</sup> 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  $\eta_2(1870)$ .

<sup>10</sup> From a fit of the  $p\bar{p}$  mass distribution to a combination of  $\gamma X(1835)$ ,  $\gamma R$  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.

<sup>11</sup> 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  $\Upsilon(1S) \rightarrow p\bar{p}\gamma$ .

<sup>12</sup> 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 ( $\Gamma_i/\Gamma$ )
$\Gamma_1$ $p\bar{p}$	seen
$\Gamma_2$ $\eta'\pi^+\pi^-$	seen
$\Gamma_3$ $\gamma\gamma$	

### 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

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

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

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

### X(1835) BRANCHING RATIOS

$\Gamma(p\bar{p})/\Gamma(\eta'\pi^+\pi^-)$	$\Gamma_1/\Gamma_2$		
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	CP C34 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.)

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