

# X(1835)

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

Seen by BAI 03F and ABLIKIM 05R in radiative decays of the  $J/\psi$ . 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  $\bar{B}^0 \rightarrow p\bar{p}D^0$ , and WEI 08 in  $B^+ \rightarrow p\bar{p}\pi^+$  decays. Not seen by ATHAR 06 in  $\Upsilon(1S) \rightarrow p\bar{p}\gamma$ . Confirmed by ALEXANDER 10.

## X(1835) MASS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
<b>1835.7<sup>+4.0</sup><sub>-3.1</sub> OUR AVERAGE</b>				
1836.5 ± 3.0 <sup>+5.6</sup> <sub>-2.1</sub>	4265	<sup>1</sup> ABLIKIM	11C BES3	$J/\psi \rightarrow \gamma\pi^+\pi^-\eta'$
1837 <sup>+10</sup> <sub>-12</sub> <sup>+9</sup> <sub>-7</sub>	231	<sup>2</sup> ALEXANDER	10 CLEO	$J/\psi \rightarrow \gamma p\bar{p}$
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. ● ● ●				
1812 <sup>+19</sup> <sub>-26</sub> ± 18	95	<sup>3</sup> ABLIKIM	06J BES2	$J/\psi \rightarrow \gamma\omega\phi$
1831 ± 7		<sup>4</sup> ABLIKIM	05R 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 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>3</sup> Favors  $J^{PC} = 0^{++}$  quantum numbers assignment.

<sup>4</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 OUR AVERAGE</b> Error includes scale factor of 2.8.					
190 ± 9 <sup>+38</sup> <sub>-36</sub>		4265	<sup>5</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. ● ● ●					
0 <sup>+44</sup> <sub>-0</sub>		231	<sup>6</sup> ALEXANDER	10 CLEO	$J/\psi \rightarrow \gamma p\bar{p}$
105 ± 20 ± 28		95	<sup>7</sup> ABLIKIM	06J BES2	$J/\psi \rightarrow \gamma\omega\phi$
< 153	90		<sup>8</sup> ABLIKIM	05R BES2	$J/\psi \rightarrow \gamma p\bar{p}$

- <sup>5</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>6</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>7</sup> Favors  $J^{PC} = 0^{++}$  quantum numbers assignment.
- <sup>8</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
$\Gamma_2$ $\pi^+\pi^-\eta'$	seen
$\Gamma_3$ $\omega\phi$	seen

### X(1835) BRANCHING RATIOS

$\Gamma(p\bar{p})/\Gamma(\pi^+\pi^-\eta')$	$\Gamma_1/\Gamma_2$		
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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$\Gamma(\omega\phi)/\Gamma_{\text{total}}$	$\Gamma_3/\Gamma$		
VALUE	DOCUMENT ID	TECN	COMMENT

seen	ABLIKIM	06J	BES2	$J/\psi \rightarrow \gamma\omega\phi$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

not seen	<sup>9</sup> LIU	09	BELL	$B^\pm \rightarrow K^\pm\omega\phi$
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<sup>9</sup> Reported  $B(B^\pm \rightarrow K^\pm X(1812)) \times B(X \rightarrow \omega\phi) < 3.2 \times 10^{-7}$  at 90% CL.

### X(1835) REFERENCES

ABLIKIM	11C	PRL 106 072002	M. Ablikim <i>et al.</i>	(BES III Collab.)
ALEXANDER	10	PR D82 092002	J.P. Alexander <i>et al.</i>	(CLEO Collab.)
LIU	09	PR D79 071102R	C. Liu <i>et al.</i>	(BELLE Collab.)
WEI	08	PL B659 80	J.-T. Wei <i>et al.</i>	(BELLE Collab.)
ABLIKIM	06J	PRL 96 162002	M. Ablikim <i>et al.</i>	(BES 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 051101R	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.)