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

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**

<table>
<thead>
<tr>
<th>VALUE (MeV)</th>
<th>EVTS</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1835.7^+ 5.0^- 3.2$ OUR AVERAGE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1836.5± 3.0± 5.6</td>
<td>4265</td>
<td>ABLIKIM</td>
<td>11c BES3</td>
<td>$J/\psi \rightarrow \gamma \pi^+\pi^-\eta'$</td>
</tr>
<tr>
<td>1833.7± 6.1± 2.7</td>
<td>264</td>
<td>ABLIKIM</td>
<td>05r BES2</td>
<td>$J/\psi \rightarrow \gamma \pi^+\pi^-\eta'$</td>
</tr>
<tr>
<td>• • • We do not use the following data for averages, fits, limits, etc. • • •</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1832 ±19 5 ±26</td>
<td>2 ABLIKIM</td>
<td>12d BES3</td>
<td>$J/\psi \rightarrow \gamma p\bar{p}$</td>
<td></td>
</tr>
<tr>
<td>1877.3± 6.3± 3.4</td>
<td>3 ABLIKIM</td>
<td>11l BES3</td>
<td>$J/\psi \rightarrow \omega(\eta\pi^+\pi^-)$</td>
<td></td>
</tr>
<tr>
<td>1837 ±10 +9 -12</td>
<td>231</td>
<td>ALEXANDER</td>
<td>10 CLEO</td>
<td>$J/\psi \rightarrow \gamma p\bar{p}$</td>
</tr>
<tr>
<td>1831 ± 7</td>
<td>5,6 ABLIKIM</td>
<td>05r BES2</td>
<td>$J/\psi \rightarrow \gamma p\bar{p}$</td>
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<tr>
<td>1859 ± 3 +5 -10 -25</td>
<td>5 BAI</td>
<td>03r BES2</td>
<td>$J/\psi \rightarrow \gamma p\bar{p}$</td>
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</tr>
</tbody>
</table>

1. From a fit of the $\pi^+\pi^-\eta'$ mass distribution to a combination of $\gamma f_2 (1510)$, $\gamma X(1835)$, 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 $J/\psi \rightarrow \pi^0\pi^+\pi^-\eta'$.  
2. From the fit including final state interaction effects in isospin 0 $S$-wave according to SIBIRTESEV 05A. Supersedes ABLIKIM 10c.  
3. The selected process is $J/\psi \rightarrow \omega \eta(980)\pi$. 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 $\gamma X(1835)$, $\gamma R$ 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.  
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 $B^0 \rightarrow p\bar{p}K^0$, ABE 02w in $\pi^0 \rightarrow p\bar{p}D^0$, DEL-AMO-SANCHEZ 12 in $B \rightarrow D(D^*)p\pi(\pi)$, and WEI 08 in $B^+ \rightarrow p\bar{p}\pi^+$ decays. Not seen by ATHAR 06 in $T(1S) \rightarrow p\bar{p}\gamma$.  
6. From the fit including final state interaction effects in isospin 0 $S$-wave according to SIBIRTESEV 05A. Systematic errors not estimated.

**X(1835) WIDTH**

<table>
<thead>
<tr>
<th>VALUE (MeV)</th>
<th>CL%</th>
<th>EVTS</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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<tr>
<td>$99 \pm 50$ OUR AVERAGE</td>
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<tr>
<td>190 ± 9 +38 -36</td>
<td>4265</td>
<td>7 ABLIKIM</td>
<td>11c BES3</td>
<td>$J/\psi \rightarrow \gamma \pi^+\pi^-\eta'$</td>
<td></td>
</tr>
<tr>
<td>67.7± 20.3± 7.7</td>
<td>264</td>
<td>ABLIKIM</td>
<td>05r BES2</td>
<td>$J/\psi \rightarrow \gamma \pi^+\pi^-\eta'$</td>
<td></td>
</tr>
<tr>
<td>• • • We do not use the following data for averages, fits, limits, etc. • • •</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 76</td>
<td>90</td>
<td>8 ABLIKIM</td>
<td>12d BES3</td>
<td>$J/\psi \rightarrow \gamma p\bar{p}$</td>
<td></td>
</tr>
<tr>
<td>57 ± 12 +19 -4</td>
<td>9 ABLIKIM</td>
<td>11l BES3</td>
<td>$J/\psi \rightarrow \omega(\eta\pi^+\pi^-)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 ± 44 -12</td>
<td>231</td>
<td>10,11 ALEXANDER</td>
<td>10 CLEO</td>
<td>$J/\psi \rightarrow \gamma p\bar{p}$</td>
<td></td>
</tr>
<tr>
<td>&lt; 153</td>
<td>90</td>
<td>11,12 ABLIKIM</td>
<td>05r BES2</td>
<td>$J/\psi \rightarrow \gamma p\bar{p}$</td>
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<tr>
<td>&lt; 30</td>
<td>11 BAI</td>
<td>03r BES2</td>
<td>$J/\psi \rightarrow \gamma p\bar{p}$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7. From a fit of the $\pi^+\pi^-\eta'$ mass distribution to a combination of $\gamma f_2 (1510)$, $\gamma X(1835)$, 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 $J/\psi \rightarrow \pi^0\pi^+\pi^-\eta'$.  
8. From the fit including final state interaction effects in isospin 0 $S$-wave according to SIBIRTESEV 05A. Supersedes ABLIKIM 10c.  
9. The selected process is $J/\psi \rightarrow \omega \eta(980)\pi$. This state may be due also to $\eta_2(1870)$ or to a combination of $X(1835)$ and $\eta_2(1870)$.  
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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 $B^0 \rightarrow p\bar{p}K^0$, ABE 02w in $\pi^0 \rightarrow p\bar{p}D^0$, DEL-AMO-SANCHEZ 12 in $B \rightarrow D(D^*)p\pi(\pi)$, and WEI 08 in $B^+ \rightarrow p\bar{p}\pi^+$ decays. Not seen by ATHAR 06 in $T(1S) \rightarrow p\bar{p}\gamma$.  
12. Systematic errors not estimated.
\[ p\bar{p}K_S^0, \text{ ABE 02W in } p\bar{p}D^0, \text{ DEL-AMO-SANCHEZ 12 in } B \to D(D^+)p\bar{p}(\pi), \]
and WEI 08 in \( B^+ \to p\bar{p}\pi^+ \) decays. Not seen by ATHAR 06 in \( \Upsilon(1S) \to p\bar{p}\gamma \).

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**

<table>
<thead>
<tr>
<th>Mode</th>
<th>Fraction ((\Gamma_i/\Gamma))</th>
</tr>
</thead>
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<tr>
<td>(\Gamma_1)</td>
<td>(p\bar{p}) seen</td>
</tr>
<tr>
<td>(\Gamma_2)</td>
<td>(\eta'\pi^+\pi^-) seen</td>
</tr>
<tr>
<td>(\Gamma_3)</td>
<td>(\gamma\gamma)</td>
</tr>
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</table>

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

<table>
<thead>
<tr>
<th>(\Gamma(\eta'\pi^+\pi^-)\times\Gamma(\gamma\gamma)/\Gamma(\text{total}))</th>
<th>(\Gamma_2\Gamma_3/\Gamma)</th>
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<tr>
<td>(\text{VALUE (eV)})</td>
<td>(\text{CL%})</td>
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<tr>
<td>(&lt;35.6)</td>
<td>(90)</td>
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<tr>
<td>(&lt;83)</td>
<td>(90)</td>
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</table>

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

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

### **X(1835) BRANCHING RATIOS**

<table>
<thead>
<tr>
<th>(\Gamma(p\bar{p})/\Gamma(\eta'\pi^+\pi^-))</th>
<th>(\Gamma_1/\Gamma_2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\text{VALUE (eV)})</td>
<td>(\text{DOCUMENT ID})</td>
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<td>(0.333)</td>
<td>(ABLIKIM)</td>
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### **X(1835) REFERENCES**

<table>
<thead>
<tr>
<th><strong>AUTH</strong></th>
<th><strong>JOURNAL</strong></th>
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<td>ABLIKIM</td>
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**NODE=M085**

**DESIGN=1; OUR EVAL; → UNCHECKED → **

**DESIGN=2; OUR EVAL; → UNCHECKED → **

**DESIGN=4**

**NODE=M085G01**

**NODE=M085G01**

**NODE=M085G01**