\( \chi_{b_0}(1P) \)

\[ J^G(J^{PC}) = 0^+ (0^+ +) \]

Observed in radiative decay of the \( \Upsilon(2S) \), therefore \( C = + \). Branching ratio requires E1 transition, M1 is strongly disfavored, therefore \( P = + \).

**\( \chi_{b_0}(1P) \) MASS**

<table>
<thead>
<tr>
<th>VALUE (MeV)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>9859.44±0.42±0.31 OUR EVALUATION</td>
<td>From average ( \gamma ) energy below, using ( \Upsilon(2S) ) mass = 10023.26 ± 0.31 MeV</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**\( m_{\chi_{b_1}(1P)} - m_{\chi_{b_0}(1P)} \)**

<table>
<thead>
<tr>
<th>VALUE (MeV)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>32.49±0.93</td>
<td>LEES 14M BABR</td>
<td>( \Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^- )</td>
<td></td>
</tr>
</tbody>
</table>

**\( \gamma \) ENERGY IN \( \Upsilon(2S) \) DECAY**

<table>
<thead>
<tr>
<th>VALUE (MeV)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>162.5 ± 0.4 OUR AVERAGE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>162.56±0.19±0.42</td>
<td>ARTUSO 05 CLEO</td>
<td>( \Upsilon(2S) \rightarrow \gamma X )</td>
<td></td>
</tr>
<tr>
<td>162.0 ± 0.8 ± 1.2</td>
<td>EDWARDS 99 CLEO2</td>
<td>( \Upsilon(2S) \rightarrow \gamma \chi(1P) )</td>
<td></td>
</tr>
<tr>
<td>162.1 ± 0.5 ± 1.4</td>
<td>ALBRECHT 85e ARG</td>
<td>( \Upsilon(2S) \rightarrow \text{conv.}\gamma X )</td>
<td></td>
</tr>
<tr>
<td>163.8 ± 1.6 ± 2.7</td>
<td>NERNST 85 CBAL</td>
<td>( \Upsilon(2S) \rightarrow \gamma X )</td>
<td></td>
</tr>
<tr>
<td>158.0 ± 7 ± 1</td>
<td>HAAS 84 CLEO</td>
<td>( \Upsilon(2S) \rightarrow \text{conv.}\gamma X )</td>
<td></td>
</tr>
<tr>
<td>• • •</td>
<td></td>
<td></td>
<td>We do not use the following data for averages, fits, limits, etc. • • •</td>
</tr>
<tr>
<td>149.4 ± 0.7 ± 5.0</td>
<td>KLOPFEN... 83 CUSB</td>
<td>( \Upsilon(2S) \rightarrow \gamma X )</td>
<td></td>
</tr>
</tbody>
</table>

**\( \chi_{b_0}(1P) \) DECAY MODES**

<table>
<thead>
<tr>
<th>Mode</th>
<th>Fraction (( \Gamma_i/\Gamma ))</th>
<th>Confidence level</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Gamma_1 )</td>
<td>( \gamma \Upsilon(1S) )</td>
<td>(1.94±0.27) %</td>
</tr>
<tr>
<td>( \Gamma_2 )</td>
<td>( D^0 X )</td>
<td>&lt; 10.4 % 90%</td>
</tr>
<tr>
<td>( \Gamma_3 )</td>
<td>( \pi^+ \pi^- K^+ K^- \pi^0 )</td>
<td>&lt; 1.6 ( \times 10^{-4} ) 90%</td>
</tr>
<tr>
<td>( \Gamma_4 )</td>
<td>( 2\pi^+ \pi^- K^- K_S^0 )</td>
<td>&lt; 5 ( \times 10^{-5} ) 90%</td>
</tr>
<tr>
<td>( \Gamma_5 )</td>
<td>( 2\pi^+ \pi^- K^- K_S^0 2\pi^0 )</td>
<td>&lt; 5 ( \times 10^{-4} ) 90%</td>
</tr>
<tr>
<td>( \Gamma_6 )</td>
<td>( 2\pi^+ 2\pi^- 2\pi^0 )</td>
<td>&lt; 2.1 ( \times 10^{-4} ) 90%</td>
</tr>
<tr>
<td>( \Gamma_7 )</td>
<td>( 2\pi^+ 2\pi^- K^+ K^- )</td>
<td>(1.1 ± 0.6) ( \times 10^{-4} ) 90%</td>
</tr>
<tr>
<td>( \Gamma_8 )</td>
<td>( 2\pi^+ 2\pi^- K^+ K^- \pi^0 )</td>
<td>&lt; 2.7 ( \times 10^{-4} ) 90%</td>
</tr>
<tr>
<td>( \Gamma_9 )</td>
<td>( 2\pi^+ 2\pi^- K^+ K^- 2\pi^0 )</td>
<td>&lt; 5 ( \times 10^{-4} ) 90%</td>
</tr>
<tr>
<td>( \Gamma_{10} )</td>
<td>( 3\pi^+ 2\pi^- K^- K_S^0 \pi^0 )</td>
<td>&lt; 1.6 ( \times 10^{-4} ) 90%</td>
</tr>
<tr>
<td>( \Gamma_{11} )</td>
<td>( 3\pi^+ 3\pi^- )</td>
<td>&lt; 8 ( \times 10^{-5} ) 90%</td>
</tr>
<tr>
<td>( \Gamma_{12} )</td>
<td>( 3\pi^+ 3\pi^- 2\pi^0 )</td>
<td>&lt; 6 ( \times 10^{-4} ) 90%</td>
</tr>
</tbody>
</table>
\( \chi_{b0}(1P) \) BRANCHING RATIOS

<table>
<thead>
<tr>
<th>( \Gamma(\gamma \psi(1S))/\Gamma_{\text{total}} )</th>
<th>( \Gamma_1/\Gamma )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VALUE (%)</strong></td>
<td>**CL% **</td>
</tr>
<tr>
<td>1.94(\pm0.27) OUR AVERAGE</td>
<td>1.2 LEES 14M BABR</td>
</tr>
<tr>
<td>2.07(\pm0.24)</td>
<td>2.07 (\pm0.24) LEES 14M BABR</td>
</tr>
<tr>
<td>1.76(\pm0.18)</td>
<td>1.76 (\pm0.18) LEES 14M BABR</td>
</tr>
</tbody>
</table>

1. LEES 14M quotes \( \Gamma(\chi_{b0}(1P) \rightarrow \gamma \gamma(1S))/\Gamma_{\text{total}} \times \Gamma(\gamma \psi(1S) \rightarrow \gamma \chi_{b0}(1P))/\Gamma_{\text{total}} \)
\((7.75 \pm 0.91) \times 10^{-4}\) combining the results from samples of \( \gamma \psi(1S) \rightarrow \gamma \gamma \mu^+ \mu^- \) with and without converted photons. Assumes \( B(\gamma(1S) \rightarrow \mu^+ \mu^-) = (2.48 \pm 0.05)\% \).

2. LEES 14M reports \([ \Gamma(\chi_{b0}(1P) \rightarrow \gamma \gamma(1S))/\Gamma_{\text{total}}] \times [B(\gamma \psi(1S) \rightarrow \gamma \chi_{b0}(1P))] = (7.75 \pm 0.91) \times 10^{-4}\)
which we divide by our best value \( B(\gamma \psi(1S) \rightarrow \gamma \chi_{b0}(1P)) = (3.8 \pm 0.4) \times 10^{-2}\). Our first error is their experiment’s error and our second error is the systematic error from using our best value.

3. Assuming \( B(\gamma(1S) \rightarrow \ell^+ \ell^-) = (2.48 \pm 0.05)\% \).

4. KRONICER 11 reports \([ \Gamma(\chi_{b0}(1P) \rightarrow \gamma \gamma(1S))/\Gamma_{\text{total}}] \times [B(\gamma \psi(1S) \rightarrow \gamma \chi_{b0}(1P))] = (6.59 \pm 0.96 \pm 0.60) \times 10^{-4}\)
which we divide by our best value \( B(\gamma \psi(1S) \rightarrow \gamma \chi_{b0}(1P)) = (3.8 \pm 0.4) \times 10^{-2}\). Our first error is their experiment’s error and our second error is the systematic error from using our best value.

5. LEES 11j quotes a central value of \( \Gamma(\chi_{b0}(1P) \rightarrow \gamma \gamma(1S))/\Gamma_{\text{total}} \times \Gamma(\gamma \psi(1S) \rightarrow \gamma \chi_{b0}(1P))/\Gamma_{\text{total}} = (8.3 \pm 5.6^{+3.7}_{-2.6}) \times 10^{-4}\).

\( \Gamma(D^0 X)/\Gamma_{\text{total}} \)

<table>
<thead>
<tr>
<th><strong>VALUE</strong></th>
<th><strong>CL%</strong></th>
<th><strong>DOCUMENT ID</strong></th>
<th><strong>TECN</strong></th>
<th><strong>COMMENT</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10.4(\times10^{-2})</td>
<td>90</td>
<td>6.7 BRIERE</td>
<td>CLEO</td>
<td>( T(2S) \rightarrow \gamma D^0 X )</td>
</tr>
</tbody>
</table>

6. For \( p_{D^0} > 2.5 \text{ GeV/c} \).

7. The authors also present their result as \((5.6 \pm 3.6 \pm 0.5) \times 10^{-2}\).

\( \Gamma(\pi^+ \pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}} \)

<table>
<thead>
<tr>
<th><strong>VALUE</strong> (units (10^{-4}))</th>
<th><strong>CL%</strong></th>
<th><strong>DOCUMENT ID</strong></th>
<th><strong>TECN</strong></th>
<th><strong>COMMENT</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1.6</td>
<td>90</td>
<td>8 ASNER 08A</td>
<td>CLEO</td>
<td>( T(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^- \pi^0 )</td>
</tr>
</tbody>
</table>

8. ASNER 08A reports \( \Gamma(\chi_{b0}(1P) \rightarrow \pi^+ \pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}} \times [B(\gamma \psi(1S) \rightarrow \gamma \chi_{b0}(1P))] < 6 \times 10^{-6}\)
which we divide by our best value \( B(\gamma \psi(1S) \rightarrow \gamma \chi_{b0}(1P)) = 3.8 \times 10^{-2}\).
\( \Gamma(2\pi^+ - K^- K^0_S) / \Gamma_{\text{total}} \)

<table>
<thead>
<tr>
<th>VALUE (units 10^{-6})</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.5</td>
<td>90</td>
<td>9 ASNER 08A CLEO</td>
<td>( \gamma(2S) \rightarrow \gamma2\pi^+ - K^- K^0_S )</td>
<td></td>
</tr>
</tbody>
</table>

9 ASNER 08A reports \[ \Gamma(\chi_{b0}(1P) \rightarrow 2\pi^+ - K^- K^0_S) / \Gamma_{\text{total}} \] \times [B(\gamma(2S) \rightarrow \gamma\chi_{b0}(1P))]

\( < 2 \times 10^{-6} \) which we divide by our best value \( B(\gamma(2S) \rightarrow \gamma\chi_{b0}(1P)) = 3.8 \times 10^{-2} \).

\( \Gamma(2\pi^+ - K^- K^0_S 2\pi^0) / \Gamma_{\text{total}} \)

<table>
<thead>
<tr>
<th>VALUE (units 10^{-6})</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5</td>
<td>90</td>
<td>10 ASNER 08A CLEO</td>
<td>( \gamma(2S) \rightarrow \gamma2\pi^+ - K^- 2\pi^0 )</td>
<td></td>
</tr>
</tbody>
</table>

10 ASNER 08A reports \[ \Gamma(\chi_{b0}(1P) \rightarrow 2\pi^+ - K^- K^0_S 2\pi^0) / \Gamma_{\text{total}} \] \times [B(\gamma(2S) \rightarrow \gamma\chi_{b0}(1P))]

\( < 18 \times 10^{-6} \) which we divide by our best value \( B(\gamma(2S) \rightarrow \gamma\chi_{b0}(1P)) = 3.8 \times 10^{-2} \).

\( \Gamma(2\pi^+ - 2\pi^0) / \Gamma_{\text{total}} \)

<table>
<thead>
<tr>
<th>VALUE (units 10^{-6})</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2.1</td>
<td>90</td>
<td>11 ASNER 08A CLEO</td>
<td>( \gamma(2S) \rightarrow \gamma2\pi^+ - 2\pi^0 )</td>
<td></td>
</tr>
</tbody>
</table>

11 ASNER 08A reports \[ \Gamma(\chi_{b0}(1P) \rightarrow 2\pi^+ - 2\pi^0) / \Gamma_{\text{total}} \] \times [B(\gamma(2S) \rightarrow \gamma\chi_{b0}(1P))]

\( < 8 \times 10^{-6} \) which we divide by our best value \( B(\gamma(2S) \rightarrow \gamma\chi_{b0}(1P)) = 3.8 \times 10^{-2} \).

\( \Gamma(2\pi^+ - 2\pi^0 K^+ K^-) / \Gamma_{\text{total}} \)

<table>
<thead>
<tr>
<th>VALUE (units 10^{-4})</th>
<th>EVTS</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 \pm 0.6 \pm 0.1</td>
<td>7</td>
<td>12 ASNER 08A CLEO</td>
<td>( \gamma(2S) \rightarrow \gamma2\pi^+ - 2\pi^0 K^+ K^- )</td>
<td></td>
</tr>
</tbody>
</table>

12 ASNER 08A reports \[ \Gamma(\chi_{b0}(1P) \rightarrow 2\pi^+ - 2\pi^0 K^+ K^-) / \Gamma_{\text{total}} \] \times [B(\gamma(2S) \rightarrow \gamma\chi_{b0}(1P))]

\( (4 \pm 2 \pm 1) \times 10^{-6} \) which we divide by our best value \( B(\gamma(2S) \rightarrow \gamma\chi_{b0}(1P)) = (3.8 \pm 0.4) \times 10^{-2} \). Our first error is their experiment’s error and our second error is the systematic error from using our best value.

\( \Gamma(2\pi^+ - 2\pi^0 K^+ K^- \pi^0) / \Gamma_{\text{total}} \)

<table>
<thead>
<tr>
<th>VALUE (units 10^{-6})</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2.7</td>
<td>90</td>
<td>13 ASNER 08A CLEO</td>
<td>( \gamma(2S) \rightarrow \gamma2\pi^+ - 2\pi^0 K^+ K^- \pi^0 )</td>
<td></td>
</tr>
</tbody>
</table>

13 ASNER 08A reports \[ \Gamma(\chi_{b0}(1P) \rightarrow 2\pi^+ - 2\pi^0 K^+ K^- \pi^0) / \Gamma_{\text{total}} \] \times [B(\gamma(2S) \rightarrow \gamma\chi_{b0}(1P))]

\( < 10 \times 10^{-6} \) which we divide by our best value \( B(\gamma(2S) \rightarrow \gamma\chi_{b0}(1P)) = 3.8 \times 10^{-2} \).

\( \Gamma(2\pi^+ - 2\pi^0 K^+ K^- 2\pi^0) / \Gamma_{\text{total}} \)

<table>
<thead>
<tr>
<th>VALUE (units 10^{-6})</th>
<th>CL%</th>
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<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5</td>
<td>90</td>
<td>14 ASNER 08A CLEO</td>
<td>( \gamma(2S) \rightarrow \gamma2\pi^+ - 2\pi^0 K^+ K^- 2\pi^0 )</td>
<td></td>
</tr>
</tbody>
</table>

14 ASNER 08A reports \[ \Gamma(\chi_{b0}(1P) \rightarrow 2\pi^+ - 2\pi^0 K^+ K^- 2\pi^0) / \Gamma_{\text{total}} \] \times [B(\gamma(2S) \rightarrow \gamma\chi_{b0}(1P))]

\( < 20 \times 10^{-6} \) which we divide by our best value \( B(\gamma(2S) \rightarrow \gamma\chi_{b0}(1P)) = 3.8 \times 10^{-2} \).
\begin{align*}
\Gamma(3\pi^+ + 2\pi^- - K^- K_S^0 \pi^0)/\Gamma_{\text{total}} & \quad \Gamma_{10}/\Gamma \\
\text{VALUE (units } 10^{-4}) & \quad \text{CL\%} & \quad \text{DOCUMENT ID} & \quad \text{TECN} & \quad \text{COMMENT} \\
<1.6 & \quad 90 & \quad 15 & \text{ASNER} & \text{08A} & \text{CLEO} & \gamma(2S) \rightarrow \gamma 3\pi^+ + 2\pi^- - K^- K_S^0 \pi^0 \\
15 & \text{ASNER 08A reports } [\Gamma(\chi_{b0}(1P) \rightarrow 3\pi^+ + 2\pi^- - K^- K_S^0 \pi^0)/\Gamma_{\text{total}}] \times [B(\gamma(2S) \rightarrow \gamma \chi_{b0}(1P))] < 6 \times 10^{-6} \text{ which we divide by our best value } B(\gamma(2S) \rightarrow \gamma \chi_{b0}(1P)) = 3.8 \times 10^{-2}.
\end{align*}

\begin{align*}
\Gamma(3\pi^+ + 3\pi^-)/\Gamma_{\text{total}} & \quad \Gamma_{11}/\Gamma \\
\text{VALUE (units } 10^{-4}) & \quad \text{CL\%} & \quad \text{DOCUMENT ID} & \quad \text{TECN} & \quad \text{COMMENT} \\
<0.8 & \quad 90 & \quad 16 & \text{ASNER} & \text{08A} & \text{CLEO} & \gamma(2S) \rightarrow \gamma 3\pi^+ + 3\pi^- \\
16 & \text{ASNER 08A reports } [\Gamma(\chi_{b0}(1P) \rightarrow 3\pi^+ + 3\pi^-)/\Gamma_{\text{total}}] \times [B(\gamma(2S) \rightarrow \gamma \chi_{b0}(1P))] < 3 \times 10^{-6} \text{ which we divide by our best value } B(\gamma(2S) \rightarrow \gamma \chi_{b0}(1P)) = 3.8 \times 10^{-2}.
\end{align*}

\begin{align*}
\Gamma(3\pi^+ + 3\pi^- - 2\pi^0)/\Gamma_{\text{total}} & \quad \Gamma_{12}/\Gamma \\
\text{VALUE (units } 10^{-4}) & \quad \text{CL\%} & \quad \text{DOCUMENT ID} & \quad \text{TECN} & \quad \text{COMMENT} \\
<6 & \quad 90 & \quad 17 & \text{ASNER} & \text{08A} & \text{CLEO} & \gamma(2S) \rightarrow \gamma 3\pi^+ + 3\pi^- - 2\pi^0 \\
17 & \text{ASNER 08A reports } [\Gamma(\chi_{b0}(1P) \rightarrow 3\pi^+ + 3\pi^- - 2\pi^0)/\Gamma_{\text{total}}] \times [B(\gamma(2S) \rightarrow \gamma \chi_{b0}(1P))] < 22 \times 10^{-6} \text{ which we divide by our best value } B(\gamma(2S) \rightarrow \gamma \chi_{b0}(1P)) = 3.8 \times 10^{-2}.
\end{align*}

\begin{align*}
\Gamma(3\pi^+ + 3\pi^- - K^+ K^-)/\Gamma_{\text{total}} & \quad \Gamma_{13}/\Gamma \\
\text{VALUE (units } 10^{-4}) & \quad \text{CL\%} & \quad \text{DOCUMENT ID} & \quad \text{TECN} & \quad \text{COMMENT} \\
2.4 \pm 1.2 \pm 0.2 & \quad 9 & \quad 18 & \text{ASNER} & \text{08A} & \text{CLEO} & \gamma(2S) \rightarrow \gamma 3\pi^+ + 3\pi^- - K^+ K^- \\
18 & \text{ASNER 08A reports } [\Gamma(\chi_{b0}(1P) \rightarrow 3\pi^+ + 3\pi^- - K^+ K^-)/\Gamma_{\text{total}}] \times [B(\gamma(2S) \rightarrow \gamma \chi_{b0}(1P))] \sim (9 \pm 4 \pm 2) \times 10^{-6} \text{ which we divide by our best value } B(\gamma(2S) \rightarrow \gamma \chi_{b0}(1P)) = (3.8 \pm 0.4) \times 10^{-2}. \text{ Our first error is their experiment’s error and our second error is the systematic error from using our best value.}
\end{align*}

\begin{align*}
\Gamma(3\pi^+ + 3\pi^- - K^+ K^- - \pi^0)/\Gamma_{\text{total}} & \quad \Gamma_{14}/\Gamma \\
\text{VALUE (units } 10^{-4}) & \quad \text{CL\%} & \quad \text{DOCUMENT ID} & \quad \text{TECN} & \quad \text{COMMENT} \\
<10 & \quad 90 & \quad 19 & \text{ASNER} & \text{08A} & \text{CLEO} & \gamma(2S) \rightarrow \gamma 3\pi^+ + 3\pi^- - K^+ K^- - \pi^0 \\
19 & \text{ASNER 08A reports } [\Gamma(\chi_{b0}(1P) \rightarrow 3\pi^+ + 3\pi^- - K^+ K^- - \pi^0)/\Gamma_{\text{total}}] \times [B(\gamma(2S) \rightarrow \gamma \chi_{b0}(1P))] \sim 37 \times 10^{-6} \text{ which we divide by our best value } B(\gamma(2S) \rightarrow \gamma \chi_{b0}(1P)) = 3.8 \times 10^{-2}.
\end{align*}

\begin{align*}
\Gamma(4\pi^+ + 4\pi^-)/\Gamma_{\text{total}} & \quad \Gamma_{15}/\Gamma \\
\text{VALUE (units } 10^{-4}) & \quad \text{CL\%} & \quad \text{DOCUMENT ID} & \quad \text{TECN} & \quad \text{COMMENT} \\
<0.8 & \quad 90 & \quad 20 & \text{ASNER} & \text{08A} & \text{CLEO} & \gamma(2S) \rightarrow \gamma 4\pi^+ + 4\pi^- \\
20 & \text{ASNER 08A reports } [\Gamma(\chi_{b0}(1P) \rightarrow 4\pi^+ + 4\pi^-)/\Gamma_{\text{total}}] \times [B(\gamma(2S) \rightarrow \gamma \chi_{b0}(1P))] < 3 \times 10^{-6} \text{ which we divide by our best value } B(\gamma(2S) \rightarrow \gamma \chi_{b0}(1P)) = 3.8 \times 10^{-2}.
\end{align*}

\begin{align*}
\Gamma(4\pi^+ + 4\pi^- - 2\pi^0)/\Gamma_{\text{total}} & \quad \Gamma_{16}/\Gamma \\
\text{VALUE (units } 10^{-4}) & \quad \text{CL\%} & \quad \text{DOCUMENT ID} & \quad \text{TECN} & \quad \text{COMMENT} \\
<21 & \quad 90 & \quad 21 & \text{ASNER} & \text{08A} & \text{CLEO} & \gamma(2S) \rightarrow \gamma 4\pi^+ + 4\pi^- - 2\pi^0 \\
21 & \text{ASNER 08A reports } [\Gamma(\chi_{b0}(1P) \rightarrow 4\pi^+ + 4\pi^- - 2\pi^0)/\Gamma_{\text{total}}] \times [B(\gamma(2S) \rightarrow \gamma \chi_{b0}(1P))] < 77 \times 10^{-6} \text{ which we divide by our best value } B(\gamma(2S) \rightarrow \gamma \chi_{b0}(1P)) = 3.8 \times 10^{-2}.
\end{align*}
\( \Gamma(J/\psi J/\psi) / \Gamma_{\text{total}} \)

<table>
<thead>
<tr>
<th>VALUE (units 10^{-5})</th>
<th>CL( % )</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;7</td>
<td>90</td>
<td>22 SHEN 12</td>
<td>BELL</td>
<td>( \gamma \psi X )</td>
</tr>
</tbody>
</table>

22 SHEN 12 reports \(< 7.1 \times 10^{-5} \) from a measurement of \[ \Gamma(\chi_{b0}(1P) \rightarrow J/\psi J/\psi) / \Gamma_{\text{total}} \] \times \text{[B(\( \Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P) \)] assuming \text{B(\( \Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P) \]) = (3.8 \pm 0.4) \times 10^{-2}.} \]

\( \Gamma(J/\psi \psi(2S)) / \Gamma_{\text{total}} \)

<table>
<thead>
<tr>
<th>VALUE (units 10^{-5})</th>
<th>CL( % )</th>
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<tr>
<td>&lt;12</td>
<td>90</td>
<td>23 SHEN 12</td>
<td>BELL</td>
<td>( \gamma \psi X )</td>
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23 SHEN 12 reports \(< 12 \times 10^{-5} \) from a measurement of \[ \Gamma(\chi_{b0}(1P) \rightarrow J/\psi \psi(2S)) / \Gamma_{\text{total}} \] \times \text{[B(\( \Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P) \)] assuming \text{B(\( \Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P) \]) = (3.8 \pm 0.4) \times 10^{-2}.} \]

\( \Gamma(\psi(2S) \psi(2S)) / \Gamma_{\text{total}} \)

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<th>VALUE (units 10^{-5})</th>
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<td>&lt;3.1</td>
<td>90</td>
<td>24 SHEN 12</td>
<td>BELL</td>
<td>( \gamma \psi X )</td>
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24 SHEN 12 reports \(< 3.1 \times 10^{-5} \) from a measurement of \[ \Gamma(\chi_{b0}(1P) \rightarrow \psi(2S) \psi(2S)) / \Gamma_{\text{total}} \] \times \text{[B(\( \Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P) \)] assuming \text{B(\( \Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P) \]) = (3.8 \pm 0.4) \times 10^{-2}.} \]

\( \chi_{b0}(1P) \) CROSS-PARTICLE BRANCHING RATIOS

\( \Gamma(\chi_{b0}(1P) \rightarrow \gamma \Upsilon(1S)) / \Gamma_{\text{total}} \times \Gamma(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P)) / \Gamma_{\text{total}} \)

\( \Gamma_{17}/\Gamma \)

\( \Gamma_{18}/\Gamma \)

\( \Gamma_{19}/\Gamma \)

\( \chi_{b0}(1P) \) CROSS-PARTICLE BRANCHING RATIOS

\( B(\chi_{b0}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P)) \times B(\Upsilon(1S) \rightarrow \ell^+ \ell^-) \)

<table>
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<td>1.67 \pm 0.28 OUR AVERAGE</td>
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<td>26 LEES 14M BABR</td>
<td>( \Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^- )</td>
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From a sample of \( \Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^- \) with one converted photon.

\( [B(\chi_{b0}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P))] / [B(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))] \)

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<td>3.28 \pm 0.37</td>
<td>27 LEES 14M BABR</td>
<td>( \Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^- )</td>
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From a sample of \( \Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^- \) without converted photons.

Citation: C. Patrignani et al. (Particle Data Group), Chin. Phys. C, 40, 100001 (2016) and 2017 update
$\chi_{b0}(1P)$ REFERENCES

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<tr>
<th>Reference</th>
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