Table 11.4 from (1990AJ01): Electromagnetic transitions in $^{11}$B

<table>
<thead>
<tr>
<th>Initial state</th>
<th>$J^\pi$</th>
<th>$\Gamma_\gamma$ (total) (eV)</th>
<th>Branching ratios (%) to final state</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>g.s.</td>
</tr>
<tr>
<td>2.12</td>
<td>$\frac{1}{2}^-$</td>
<td>0.120 ± 0.009</td>
<td>100</td>
</tr>
<tr>
<td>4.44</td>
<td>$\frac{1}{2}^-$</td>
<td>0.56 ± 0.02</td>
<td></td>
</tr>
<tr>
<td>5.02</td>
<td>$\frac{3}{2}^-$</td>
<td>1.963 ± 0.067</td>
<td>85.6 ± 0.6 $^e$</td>
</tr>
<tr>
<td>6.74</td>
<td>$\frac{3}{2}^-$</td>
<td>0.030 ± 0.007</td>
<td>70 ± 2 $^g$</td>
</tr>
<tr>
<td>6.79</td>
<td>$\frac{1}{2}^+$</td>
<td>0.385 ± 0.044</td>
<td>67.5 ± 1.1</td>
</tr>
<tr>
<td>7.29</td>
<td>$\frac{3}{2}^+$</td>
<td>1.149 ± 0.080</td>
<td>87.0 ± 2.0</td>
</tr>
<tr>
<td>7.98</td>
<td>$\frac{3}{2}^+$</td>
<td>1.15 ± 0.15</td>
<td>46.2 ± 1.1</td>
</tr>
<tr>
<td>8.56</td>
<td>($\frac{3}{2}^-$)$^i$</td>
<td>0.946 ± 0.090</td>
<td>56 ± 2</td>
</tr>
<tr>
<td>8.92</td>
<td>$\frac{5}{2}^-$</td>
<td>4.368 ± 0.021</td>
<td>95 ± 1 $^h$</td>
</tr>
<tr>
<td>9.19</td>
<td>$\frac{7}{2}^+$</td>
<td>0.17$^{+0.06}_{-0.03}$</td>
<td>0.9 ± 0.3</td>
</tr>
<tr>
<td>9.27</td>
<td>$\frac{7}{2}^+$</td>
<td>1.15 ± 0.16</td>
<td>18.4 ± 0.9</td>
</tr>
</tbody>
</table>

$^a$ See discussion in (1982MI08). See also Table 11.4 in (1980AJ01) and Tables 11.5 and 11.13 here.  
$^b$ See also (1965OL03).  
$^c$ Weighted mean of branching ratios and $\Gamma_\gamma$ (1984HA13). Earlier work is also included: see (1984HA13).  
$^d$ $\delta = -0.19 ± 0.03$.  
$^e$ $\delta = 0.03 ± 0.05$.  
$^f$ $\delta = -0.05 ± 0.02$.  
$^g$ $\delta = -0.45 ± 0.18$. This value leads to too large a value of $\Gamma_\gamma$ for an M3 transition (P.M. Endt, private communication).  
$^h$ $\delta = -0.11 ± 0.04$.  
$^i$ This is probably the $^{11}$B analog of $^{11}$C*$^*(8.10)$. If so $J^\pi = \frac{3}{2}^-$.  

Comments [mainly from (1965OL03, 1962GR07)]  
(1) 4.44 MeV. 9.28 $\to$ 4.44 $\to$ 0 angular distribution fixes $J = \frac{3}{2}^-$. Odd parity determined from direct interaction assignments.  
(2) 5.02 MeV. Internal pair correlation permit M1, E2 for the g.s. transition: $J^\pi \leq \frac{3}{2}^-$ (parity from $l$-assignments). $\tau_m$ excludes $\frac{7}{2}^-$, branch to 2.12, $\frac{5}{2}^-$. Angular correlation fixes $\frac{3}{2}^-$.  
(3) 6.74 MeV. Internal pairs indicate practically pure E2 g.s. radiation. Angular distributions and branching ratios (and $l$-assignments) all lead to $\frac{3}{2}^-$.  

(4) 6.79 MeV. The allowed β-decay from $^{11}$Be [$J^\pi = \frac{1}{2}^+$] requires $J^\pi \leq \frac{3}{2}^+$. The relatively strong γ-branch to $^{11}$B*(2.12) favors $\frac{1}{2}^+, \frac{3}{2}^+$. All γ’s from this level are isotropic, suggesting $J^\pi = \frac{1}{2}^+$, but not excluding $\frac{3}{2}^+$.

(5) 7.29 MeV. The g.s. transition is mainly E1, so $J^\pi \leq \frac{5}{2}^+$. The assignment $\frac{1}{2}^+$ is excluded by the strength of (7.29→4.44). $J^\pi = \frac{5}{2}^+$ is consistent with log $ft > 8.04$ in the $^{11}$Be β-decay.

(6) 7.98 MeV. Transitions to $^{11}$B(0, 2.12) are predominantly E1; thus $^{11}$B*(7.98) has even parity, and the odd parity of $^{11}$B*(2.12) is confirmed. The transition to $^{11}$B*(2.12) is not isotropic, so $J^\pi = \frac{3}{2}^+$.

(7) 8.56 MeV. Correlation of internal pairs indicate that the g.s. transition is M1 + E2 or E1 + M2. $J^\pi = \leq \frac{5}{2}^+$ or $\leq \frac{7}{2}^+$; the lifetime to $^{11}$B*(2.12) excludes $\frac{7}{2}^-$. If the level has even parity, the required M2 admixture is excessive. $J^\pi \leq \frac{5}{2}^-$ is favored. See also footnote i in Table 11.4.

(8) 8.92 MeV. From $^7$Li($\alpha$, $\gamma$)$^{11}$B, $J^\pi = \frac{3}{2}^+, \frac{5}{2}^+, \frac{5}{2}^-$. The internal pair correlation confirms $\frac{5}{2}^-$. For higher states see comments under individual reactions and (1968AJ02).