This evaluation was completed in 2007. Literature available by January 2007 was included.

1 Decay Scheme

\(^{218}\text{At}\) disintegrates by alpha emission (99.9 (1) \%) to \(^{214}\text{Bi}\) mainly. The \(\gamma\) transitions between the \(^{214}\text{Bi}\) levels have not been observed. However, a Q value of 6811 (12) keV is calculated in the disintegration of \(^{218}\text{At}\) to \(^{214}\text{Bi}\) from the decay scheme data compared to a value of 6867 (3) keV from the Audi’s tables. This deficiency in the calculated Q value suggests the possible existence of a weak gamma transition from the 62-keV to the ground state levels.

A weak beta minus emission (0.1 (1) \%) to Rn-218 has been pointed out (1948Wa20). Spins and parities are from the mass-chain evaluation of Y. A. Akovali (1987El12, 1995El08 for \(A = 218\) and 1995El07 for \(A = 214\)) and A. K. Jain (2006Ja03 for \(A = 218\)).

2 Nuclear Data

The Q values (\(\alpha\) and \(\beta^-\)) are from the atomic mass evaluation of Audi et al. (2003Au03).

Experimental \(^{218}\text{At}\) half-life values (in seconds) are given in Table 1:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Experimental value (s)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>R. J. Walen (1949Wa05)</td>
<td>1.3 (2)</td>
<td>Uncertainty increased to take into account systematic uncertainty.</td>
</tr>
<tr>
<td>D. G. Burke (1989Bu09)</td>
<td>1.5 (3)</td>
<td></td>
</tr>
<tr>
<td>Recommended value</td>
<td>1.4 (2)</td>
<td>(\chi^2 = 0.31)</td>
</tr>
</tbody>
</table>

The original uncertainty value given by R. J. Walen (1949Wa05) was multiplied by 2, in order to take into account the systematic uncertainties which were not considered by 1949Wa05. A weighted average has been calculated using Lweight computer program (version 3).

The recommended value of \(^{218}\text{At}\) half-life is the weighted average of 1.4 second with an internal uncertainty of 0.2 second. The reduced-\(\chi^2\) value is 0.31.

2.1 \(\alpha\) Transitions and Emissions

The energies of the \(\alpha\)-particle transitions given in Section 2.1 were calculated from \(Q_\alpha\) (2003Au03) and level energies.

The energy of \(\alpha_{0,0}\), \(\alpha_{0,1}\) and \(\alpha_{0,2}\) emissions given in section 3 were measured by R.J. Walen (1963Wa29 (see 1964Hy02) and 1958Wa16), the adopted values are those recommended by A. Rytz (1991Ry01) where the original energy was decreased by 1 keV, due to a change in calibration energy (1995El07).

The \(\alpha_{0,0}\), \(\alpha_{0,1}\) and \(\alpha_{0,2}\) emission probabilities are the measured values of R. J. Walen (1958Wa16), 3.6, 90.0 and 6.4 respectively, without uncertainties. From R. J. Walen, the total \(\alpha\) decay is 99.9 (1) \%. Since, there is no precision in the Walen’s paper, the uncertainty of 0.1 \% from propagation of the \(\beta^-\) transition probability (1948Wa20) has been assigned to each \(\alpha\) line.
2.2 $\beta^-$ Transitions and Emissions

The maximum energy of the $\beta^-$ transition in the decay of $^{218}\text{At} \rightarrow ^{218}\text{Rn}$ is given by Audi (2003Au03) and, without any other information available, is affected to a ground state to ground state transition.

The adopted $\beta^-$ transition probability was measured by R. J. Walen (1948Wa20) to be 0.1 (1) %

3 References

1963Wa29 R. J. Walen, G. Bastin-Scoffier, Priv. Comm. quoted by 1964Hy02 (1963) [I$_{\alpha}$].
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1987El12 Y. A. Ellis-Akovali, Nucl. Data Sheets 52(1987)789 [I$_{\alpha}$, E$_{\alpha}$, spin and parity].
1995El07 Y. A. Akovali, Nucl. Data Sheets 76(1995)127 [I$_{\alpha}$, E$_{\alpha}$, spin and parity].
1995El08 Y. A. Akovali, Nucl. Data Sheets 76(1995)457 [I$_{\alpha}$, E$_{\alpha}$, spin and parity].