^{218}Rn - Comments on evaluation of decay data
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This evaluation was completed in 2007. Literature available by January 2007 was included.

1 Decay Scheme

^{218}Rn disintegrates by alpha emissions to the 609-keV level (0.127 (7) %) and to the ground state (99.873 (7) %) of ^{214}Po. Spins and parities are from the mass-chain evaluation of Y. A. Akovali (1987El12, 1995El08, 1998Ak04 and 2006Ja03 for A = 218 and 1995El07 for A = 214).
A good agreement was found between the recommended Q value from Audi and the effective Q value (7262.5 (20) keV) calculated from decay scheme data.

2 Nuclear Data

The Q value is from the atomic mass evaluation of Audi *et al.* (2003Au03).

Experimental ^{218}Rn half-life values (in ms) are given in Table 1:

Table 1: Experimental values of ^{218}Rn half-life, in ms.

Reference	Experimental value (ms)	Comments
M.H. Studier (1948St42)	19	
P. A. Tove (1958To25)	39 (4)	
C. P. Ruiz (1961Ru06)	30 (3)	
H. Diamond (1963Di05)	35 (2)	Original uncertainty × 2
A. Erlik (1971Er02)	39 (2)	
Recommended value	**36.0 (19)**	reduced χ^2 = 2.3, critical χ^2 = 3.8

The original uncertainty of Diamond includes statistical uncertainty only, it was multiply by 2 to try to take into account systematic components.
A weighted average has been calculated using Lweight computer program (version 3), then the recommended value of ^{218}Rn half-life is **36.0 ms** with an external uncertainty of **1.9 ms**.

2.1 a Transitions and Emissions

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

The energy of $\alpha_{0,0}$ emission given in section 4 is the weighted average of the two measured values of F. Asaro (1956As38) and J. D. Bowman (1982Bo04), with the recommendations given by A. Rytz (1991Ry01) where the original energy of 1956As38 was increased by 4 keV and the energy of 1982Bo04 was decreased by 4 keV, due to changes in calibration energies (1998Ak04). For the $\alpha_{0,1,}$ the emission energy was calculated from Q_α (2003Au03), the level energy and taking the nucleus recoil into account.

The α emission probabilities were deduced from the level decay-scheme balance (see **2.2 Gamma Transitions**).

2.2 g Transitions

The 609-keV γ-ray transition probability was calculated using the γ-ray emission intensity and the relevant internal conversion coefficient (see **4.2** g **Emissions**).
Multipolarity of this γ-ray transition (E2) is from 1995El04.

The internal conversion coefficient (ICC) for the 609-keV γ-ray transition has been calculated using the BrIcc computer program (calculation for 'hole'), based on the theoretical values of I. M. Band (2002Ba85).

3 Atomic Data

Atomic values, ω_K, ϖ_L and n_{KL} and the X-ray relative probabilities are from Schönfeld and Janβen (1996Sc06).

4 Photon Emissions

4.1 X-ray Emissions

The X-ray absolute intensities were calculated from γ-ray data and ICC using the EMISSION computer program.

4.2 g Emissions

The energy of the 609-keV γ-ray given in section 5.2 is from W. Kurcewicz (1976Ku08).

The emission intensity of the 609-keV γ-ray was calculated from the measured relative photon intensity of W. Kurcewicz (1976Ku08), who measured the U-230 decay chain, and from the absolute emission intensity of 2.77 (8) % for the 324.22-keV γ-ray of ^{222}Ra decay, as measured by A. Peghaire (1969Pe17). This 609-keV emission intensity was then deduced being 0.124 (7) %.
This result can be compared with the less precise measured absolute intensities of 0.20 (5) (1956As38) and 0.16 (5) (1963Le17).

5 References

1948St42 – M.H. Studier, E.K. Hyde. Phys. Rev. 74 (1948) 591 [Half-life].
1956As38 – F. Asaro, I. Perlman, Phys. Rev. 104(1956)91 [E_α].
1958To25 – P. A. Tove, Ark. Fys. 13(1958)549 [Half-life].
1961Ru06 – C. P. Ruiz, UCRL – 9511 (1961) [Half-life].
1963Di05 – H. Diamond, J. E. Gindler, J. Inorg. Nucl. Chem. 25(1963)143 [Half-life].
1963Le17 – C. M. Lederer, UCRL – 11028(1963) [I_γ].
1969Pe17 – A. Peghaire, Nucl. Instrum. Meth. 75(1969)66 [I_γ].
1971Er02 – A. Erlik, J. Felsteiner, H. Lindeman, M. Tatcher, Nucl. Instrum. Meth. 92(1971)45 [Half-life].
1976Ku08 – W. Kurcewicz, N. Kaffrell, N. Trautmann, A. Plochocki, J. Kylicz, K. Stryczniewicz, I. Yutlandov, Nucl. Phys. A270(1976)175 [I_γ, E_γ, I_α].
1979Ry03 – A. Rytz, At. Data and Nucl. Data Tables 23(1979)205 [E_α, I_α].
1982Bo04 – J. D. Bowman, R. E. Eppley, E. K. Hyde, Phys. Rev. C25(1982)941 [E_α].
1987El12 – Y. A. Ellis-Akovali, Nucl. Data Sheets 52(1987)789 [I_α, E_α, I_γ, E_γ, spin and parity].
1991Ry01 – A. Rytz, At. Data and Nucl. Data Tables 47(1991)205 [E_α, I_α].
1995El07 – Y. A. Akovali, Nucl. Data Sheets 76(1995)127 [I_α, E_α, I_γ, E_γ, spin and parity].
1996Sc06 – E. Schönfeld, H. Janβen, Nucl. Instrum. Meth. Phys. Res. A369(1996)527 [Atomic data].
1998Ak04 – Y. A. Akovali, Nucl. Data Sheets 84(1998)1 [I_α, E_α, I_γ, E_γ, spin and parity].
2002Ba85 – I. M. Band, M. B. Trzhaskovskaya, C. W. Nestor, Jr., P. O. Tikkanen, S. Raman, At. Data Nucl. Data Tables 81(2002)1 [Theoretical ICC].
2003Au03 – G. Audi, A. H. Wapstra, C. Thibault, Nucl. Phys. A729(2003)129 [Q].
2006Ja03 – A. K. Jain, B. Singh, Nucl. Data Sheets 107(2006)1027 [Spin, parity and multipolarity].