^{222}Rn - Comments on evaluation of decay data
by V. Chisté and M. M. Bé

1 Decay Scheme

^{222}Rn disintegrates by alpha emission mainly to the ground state level of ^{218}Po. Spin and parity are from the mass-chain evaluation of Y. A. Akovali (1987El12, 1995El08 for A = 218 and 1996El01 for A = 222) and A. K. Jain (2006Ja03 for A = 218).
The calculated Q value of 5590.2 (6) keV deduced from the decay scheme data is in good agreement with the adopted value from Audi *et al.*

2 Nuclear Data

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

The experimental ^{222}Rn half-life values (in days) are given in Table 1:

Table 1: Experimental values of ^{222}Rn half-life.

Reference	Experimental value (d)	Comments
W. Bothe (1923Bo**)	3.824 (4)	Ionization-chamber. Revised uncertainty by N.E. Holden (1990Ho28).
I. Curie (1924Cu**)	3.823 (2)	Ionization-chamber. Revised uncertainty by N.E. Holden (1990Ho28).
J. Tobailem (1951To25)	3.825 (5)	Ionization-chamber. Revised uncertainty by N.E. Holden (1990Ho28).
J. Robert (1956Ro31)	3.825 (4)	Calorimetry. Revised uncertainty by N.E. Holden (1990Ho28).
P. C. Marin (1956Ma64)	3.8229 (17)	Revised uncertainty by N.E. Holden (1990Ho28).
N. S. Shimanskaya (1958Sh69)	3.83 (3)	Calorimetry. Outlier
D. K. Butt (1972Bu33)	3.8235 (17)	Revised uncertainty by N.E. Holden 1990Ho28.
R. Collé (1995Co**)	3.8224 (18)	Liquid scintillator.
H. Schrader (2004Sc04)	3.8195 (30)	Ionization-chamber. Outlier
Recommended value	**3.8232 (8)**	χ^2 = 0.11

For the half-life values in references from W. Bothe (1923Bo*) to D. K. Butt (1972Bu33), the retained values take into account the uncertainty recommendations given by N. E. Holden (1990Ho28). With this data set, a weighted average was calculated using LWEIGHT computer program (version 3). Based on the Chauvenet's criterion, the Shimanskaya (1958Sh69) and Schrader's (2004Sc04) values have been shown outlier and then omitted in the final calculation.

The recommended value of ^{222}Rn half-life is the weighted average of **3.8232 days** with an internal uncertainty of **0.0008 day**. The reduced-χ^2 value is 0.11 and the critical χ^2 value is 2.8.

2.1 a Transitions and Emissions

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

The energy of the $\alpha_{0,0}$ emission given in section 4 is from A. Rytz (1991Ry01). For the $\alpha_{0,1}$ and $\alpha_{0,2}$, the emission energies are given by R. J. Walen (1958Wa16).

The α-particle emission probabilities are recommended by A. Rytz (1991Ry01). For the $\alpha_{0,1}$ emission probability, the adopted value is the measured value of R. J. Walen (1958Wa16) (0.078). Existence of the $\alpha_{0,2}$ branch is questionable.

2.2 g Transitions

The $\gamma_{(1,0)}$ transition probability was deduced from the decay-scheme balance using recommended experimental α-particle intensity value of 0.078 given by R. J. Walen (1958Wa16). (see **2.1** a **Transitions and Emissions**). The multipolarity of the 510-keV γ-ray transition is from 2006Ja03.

510-keV γ-ray : [E2]

The internal conversion coefficients (ICC's) for this γ-ray transition have been calculated using the BrIcc computer program, which interpolates from 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 a Emissions

See **2.1** a **Transitions and Emissions**.

5 Photon emissions

5.1 g-ray Emissions

The energy of the 510 keV γ-ray given in Section 5.1 was measured by L. Madansky (1956Ma28).
The intensity of 0,076 deduced from alpha intensity measurements is in agreement with the measured value of 0,07 obtained by L. Madansky (1956Ma28).

6 References

1923Bo** W. Bothe, Z. Phys. 16(1923)266 [Half-life].
1924Cu** I. Curie, C. Chamié, J. Phys. Radium 5(1924)238 [Half-life].
1951To25 J. Tobailem, Compt. Rend. (Paris) 233(1951)1360 [Half-life].
1956Ma28 L. Madansky, F. Rasetti, Phys. Rev. 102(1956)464 [E_γ].
1956Ro31 J. Robert, J. Phys. Radium 17(1956)605 [Half-life].
1956Ma64 P. C. Marin, Brit. J. Appl. Phys. 7(1956)188 [Half-life].
1958Sh69 N. S. Shimanskaya, Instr. Experiments Techniques 2(1958)283 [Half-life].
1958Wa16 R. J. Walen, G. Bastin, Comp. Rend. Int. Conf. Nucl. Phys., Paris, (1959)910 [E_α, I_α].
1971Gr17 B. Grennberg, A. Rytz, Metrologia 7(1971)65 [E_α].
1972Bu33 D. K. Butt, A. R. Wilson, J. Phys. (London) A5(1972)1248 [Half-life].
1979Ry03 A. Rytz, At. Data and Nucl. Data Tables 23(1979)205 [E_α, I_α].
1987El12 Y. A. Ellis-Akovali, Nucl. Data Sheets 52(1987)789 [Spin, parity and multipolarity].
1990Ho28 N. E. Holden, Pure Appl. Chem. 62(1990)941 [Half-life].
1991Ry01 A. Rytz, At. Data and Nucl. Data Tables 47(1991)205 [E_α, I_α].
1995Co** R. Collé, Radioact. Radiochem. 6(1995)16 [Half-life].
1995El08 Y. A. Akovali, Nucl. Data Sheets 76(1995)457 [Spin, parity and multipolarity].
1996El01 Y. A. Akovali, Nucl. Data Sheets 77(1996)271 [Spin, parity and multipolarity].
1996Sc06 E. Schönfeld, H. Janβen, Nucl. Instrum. Meth. Phys. Res. A369(1996)527 [Atomic data].
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].
2004Sc04 H. Schrader, Appl. Radiat. Isot. 60(2004)317 [Half-life].
2006Ja03 A. K. Jain, B. Singh, Nucl. Data Sheets 107(2006)1027 [Spin, parity and multipolarity].