^{210}Po - Comments on evaluation of decay data
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An updated evaluation has been produced in March 2014, including literature to this date, based on the original evaluation completed in 2008.

1 Decay Scheme

^{210}Po disintegrates by alpha emission to the 803-keV excited level and ground state level of ^{206}Pb. Spins and parities are from the ENSDF mass-chain evaluation of F.G. Kondev (2008Ko21). The level energy has been re-evaluated here.

2 Nuclear Data

The Q value (5407.45 (7) keV) is from the atomic mass evaluation of Wang *et al.* (2012Wa38).

Experimental ^{210}Po half-life values (in days) are given in **Table 1**:

Table 1: Experimental values of ^{210}Po half-life.

Reference	Experimental value (d)	Comments
E.V. Schweidler (1912Sc**)	136.5	Not used: no uncertainty.
M. Curie (1920Cu**)	140	Not used: no uncertainty.
M.A. da Silva (1927Da**)	140.2	Not used: no uncertainty.
M. Curie (1931Cu01)	140	Not used: no uncertainty – same as 1920Cu**
A. Dorabialska (1931Do**)	137.6 (6)	Calorimetry – rejected due to Chauvenet.
A.S. Sanielevici (1936Sa**)	139.6 (14)	Calorimetry – rejected due to Chauvenet.
W.H. Beamer (1949Be54)	138.30 (14)	Calorimetry.
D.C. Ginnings (1953Gi10)	138.39 (14)	Calorimetry.
M.L. Curtis (1953Cu46)	138.374 (32)	α counting.
J.F. Eichelberger (1954Ei20)	138.400 (6)	Calorimetry. Not used. Superseded by 1964EiZZ.
J.F. Eichelberger (1964EiZZ)	138.3763 (17)	Calorimetry
Recommended value	**138.3763 (17)**	χ^2 = 0.10

The weighted mean has been calculated using the LWEIGHT computer program (version 3).

The evaluators have chosen to use the six experimental values with uncertainties as found in the literature and given in **Table 1**. The values of A. Dorabialska (1931Do**) and A.S. Sanielevici (1936Sa**) have been rejected by the LWEIGHT program, as they are statistical outliers based on the Chauvenet criterion. With this data set, by far the largest contribution (99%) to the weighted mean comes from the value of J.F. Eichelberger (1964EiZZ). However, there is no reason to doubt this value and the published uncertainty.

The recommended value of ^{210}Po half-life is thus the weighted mean of **138.3763 d** with an internal uncertainty of **0.0017 d**. The reduced-χ^2 value is 0.10.

2.1 α Transitions and Emissions

The recommended value of $\alpha_{0,0}$ emission energy is given by A. Rytz (1991Ry01), based on an adjusted value from a measurement by D. J. Gorman (1973Go39). The experimental and recommended values of $\alpha_{0,0}$ emission energy are shown in **Table 2**.

Table 2: Experimental and recommended (calculated) values of $\alpha_{0,0}$ emission energy.

Reference	$\alpha_{0,0}$ emission energy (keV)	Comments
S. Rosenblum (1933Ro03)	5298 (6)	
W.B. Lewis (1934Le01)	5298 (21)	
E.R. Collins (1953Co64)	5304.3 (29)	
G.H. Briggs (1954Br07)	5300.6 (26)	Evaluated value reported by author.
I.I. Agapkin (1957Ag15)	5297.8 (15)	
F.A. White (1958Wh09)	5305.4 (10)	
C.P. Browne (1960Br20)	5308.6 (30)	
E.H. Beckner (1961Be13)	5302.5 (15)	
A. Rytz (1961Ry05)	5304.9 (6)	
D.J. Gorman (1973Go39)	5304.51 (7)	
A.M. Mandal (1989Ma05)	5304 (2)	Main area of study was ^{209}Po
A. Rytz (1991Ry01)	5304.33 (7)	Publication of recommended values
Recommended value	**5304.33 (7)**	Taken from A. Rytz (1991Ry01)

For $\alpha_{0,1}$, the emission energy has been obtained from Q_α(2012Wa38) = 5407.45 (7) keV and the level energy (see **Table 3**) evaluated from the weighted mean of the measured the γ-ray energies (see section **4.2 γ Emissions**).

Table 3: ^{206}Pb excited level populated in the decay of ^{210}Po.

Level Number	Level energy (keV)	Spin and parity
1	803.052 (24)	2^+

The emission intensities of the α-particles have been deduced from the P(γ + ce) decay scheme balance at each level and are shown in **Table 4**.

Table 4: Emission intensities of the α-particles.

α emission energy (keV)	Emission Intensities (%)
4516.70 (9)	0.00124 (4)
5304.33 (7)	99.99876 (4)

The ratio Iα(4517)/Iα(5304), with the recommended values (**Table 4**), is 1.24 (4) 10^{-5}, which can be compared with the measured values of 1.07 (2) 10^{-5} (1958Ba45) and 0.88 (5) 10^{-5} (1999Oh02).

2.2 γ Transitions

The transition probability was calculated using the experimental 803-keV γ-ray emission intensity and the relevant internal conversion coefficients (see section **4.2 γ Emissions**).

The multipolarity of the 803-keV γ-ray transition (E2) is given by S. de Benedetti (1952De08).

The internal conversion coefficients (ICCs) for the 803-keV γ-ray transition have been interpolated from theoretical values of I.M. Band et al. (2002Ba85) using the BrIcc computer program of T. Kibédi (2008Ki07), with the frozen orbital approximation.

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-rays

The X-ray absolute intensities have been calculated from γ-ray data and the ICCs using the EMISSION computer program.

4.2 γ Emissions

The energy of the γ-ray emission (and thus the energy of the first excited level) is the weighted mean of the five measurements of the γ-ray energy following ^{206}Bi ε decay (1954Al31, 1972Ka30, 1972Ma63), ^{204}Hg(α,2nγ) reaction (1977Dr08) and ^{205}Pb(n,γ) studies (1996Ra16) as shown in **Table 5**. No accurate measurements of the γ-ray energy were made in conjunction with the emission intensity.

Table 5: The experimental data set of the γ-ray emission energy.

Reference	Experimental values (10^{-3} %)	Comments
D.E. Alburger (1954Al31)	803.3 (4)	^{206}Bi ε decay
M. Kanbe (1972Ka30)	803.00 (8)	^{206}Bi ε decay
J.C. Manthuruthil (1972Ma63)	803.10 (5)	^{206}Bi ε decay
J.E. Draper (1977Dr08)	803.4 (5)	^{204}Hg(α, 2nγ)
S. Raman (1996Ra16)	803.04 (3)	^{205}Pb(n,γ)
Recommended value	**803.052 (24)**	χ^2 = 0.62

For the 803-keV γ-ray, the experimental data set of γ-ray emission intensity is given in **Table 6**.

Table 6: The experimental data set of the γ-ray emission intensity.

Reference	Experimental values (10^{-3} %)	Comments
M.A. Grace (1951Gr15)	1.80 (14)	Rejected, Chauvenet
M. Riou (1952Ri04)	1.6 (2)	
W.C. Barber (1952Ba20)	1.5 (4)	
O. Rojo (1955Ro30)	1.20 (12)	
R.W. Hayward (1955Ha09)	1.21 (6)	
A. Ascoli (1956As46)	1.21 (8)	
N.S. Shimanskaia (1956Sh24)	1.2 (2)	
V.V. Ovechkin (1957Ov09)	1.22 (9)	
Recommended value	**1.23 (4)**	χ^2 = 0.69

The weighted mean has been calculated using the LWEIGHT computer program (version 3).

The evaluators have used the eight experimental values given with uncertainties in the literature and shown in **Table 6**. The value of M.A. Grace (1951Gr15) was rejected by the LWEIGHT program, as being a statistical outlier, based on the Chauvenet criterion. In the data set of seven values, the largest contribution (41%) to the weighted mean comes from the value of R.W. Hayward (1955Ha09).

The recommended value of the relative γ-ray emission intensity is the weighted mean of **1.23 10^{-3} %** with the internal uncertainty of **0.04 10^{-3} %**, and a reduced-χ^2 value of 0.69.

5 References

1912Sc** E.V. Schweidler, Verh. Deutsch Phys. Ges. 14 (1912) 539 [Half-life]
1920Cu** M. Curie, J. Phys. Radium 1 (1920) 12 [Half-life]
1927Da** M.A. da Silva, Compt. Rend. Acad. Sci. (Paris) 184 (1927) 197 [Half-life]
1931Cu01 M. Curie, A. Debierne, A.S. Eve, H. Geiger, O. Hahn, S.C. Lind, S. Meyer, E. Rutherford, E.

	Schweidler, Revs. Modern Phys. 3 (1931) 427	[Half-life]
1931Do**	A. Dorabialska, Roczniki Chem. (Poland) 11 (1931) 475	[Half-life]
1933Ro03	S. Rosenblum, G. Dupouy, J. Phys. Radium 4 (1933) 262	[E_α]
1934Le01	W.B. Lewis, B. V. Bowden, Proc. Roy. Soc. (London) A145 (1934) 235	[E_α]
1936Sa**	A.S. Sanielevici, J. Chim. Phys. 33 (1936) 759	[Half-life]
1949Be54	W.H. Beamer, C.R. Maxwell, J. Chem. Phys. 17 (1949) 1293	[Half-life]
1951Gr15	M.A. Grace, R.A. Allen, D. West, H. Halban, Proc. Roy. Soc. (London) A64 (1951) 493	[I_γ]
1952Ba20	W.C. Barber, R.H. Helm, Phys. Rev. 86 (1952) 275	[I_γ]
1952Ri14	M. Riou, J. Phys. Radium 13 (1952) 244	[I_γ]
1952De08	S. de Benedetti, G. H. Minton, Phys. Rev. 85 (1952) 944	[Multipolarity]
1953Gi10	D.C. Ginnings, A.F. Ball, D.T. Vier, J. Res. NBS 50 (1953) 75	[Half-life]
1953Cu46	M.L. Curtis, Phys. Rev. 92 (1953) 1489	[Half-life]
1953Co64	E.R. Collins, C.D. McKenzie, C.A. Ramm, Proc. Roy. Soc. (London) 216A (1953) 219	[E_α]
1954Al31	D.E. Alburger, M.H.L. Pryce, Phys. Rev. 95 (1954) 1482	[E_γ]
1954Br07	G.H. Briggs, Rev. Mod. Phys. 26 (1954) 1	[E_α]
1954Ei20	J.F. Eichelberger, K.C. Jordan, S.R. Orr, J.R. Parks, Phys. Rev. 96 (1954) 719	[Half-life]
1955Ha09	R.W. Hayward, D.D. Hoppes, W.B. Mann, J. Res. Nat. Bur. Stand. 54 (1955) 47	[I_γ]
1955Ro30	O. Rojo, M.A. Hakeem, M. Goodrich, Phys. Rev. 99 (1955) 1629	[I_γ]
1956As46	A. Ascoli, M. Asdente, E. Germagnoli, Nuovo Cim. 4 (1956) 946	[I_γ]
1956Sh24	N.S. Shimanskaia, Soviet Phys. JETP 4 (1957) 165	[I_γ]
1957Ag15	I.I. Agapkin, L.L. Gol'din, Bull. Acad. Sci. USSR 21 (1958) 911	[E_α]
1957Ov09	V.V. Ovechkin, Bull. Acad. Sci. USSR 21 (1958) 1627	[I_γ]
1958Ba45	G. Bastin-Scoffier, R.J. Walen, Compt. Rend. Acad. Sci. (Paris) 247 (1958) 2333	[Iα(4516)/Iα(5304)]
1958Wh09	F.A. White, F.M. Rourke, J.C. Shefield, R.P. Schuman, J.R. Huizenga, Phys. Rev. 109 (1958) 437	[E_α]
1960Br20	C.P. Browne, J.A. Galey, J.R. Erskine, K.L. Warsh, Phys. Rev. 120 (1960) 905	[E_α]
1961Ry05	A. Rytz, H.H. Staub, H. Winkler, Helv. Phys. Acta 34 (1961) 960	[E_α]
1961Be13	E.H. Beckner, R.L. Bramblett, G.C. Phillips, T.A. Eastwood, Phys. Rev. 123 (1961) 2100	[E_α]
1962Br22	C.P. Browne, Phys. Rev. 126 (1962) 1139	[E_α]
1964EiZZ	J.F. Eichelberger, G.R. Grove, L.V. Jones, MLM – 1209 (1964) 11	[Half-life]
1972Ka30	M. Kanbe, M. Fujioka, K. Hisatake, Nucl. Phys. A192 (1972) 151	[E_γ]
1972Ma63	J.C. Manthuruthil, D.C. Camp, A.V. Ramayya, J.H. Hamilton, J.J. Pinajian, J.W. Doornebos, Phys. Rev. C6 (1972) 1870	[E_γ]
1973Go39	D.J. Gorman, A. Rytz, Compt. Rend. Acad. Sci. (Paris), Ser. B277 (1973) 29	[E_α]
1977Dr08	J.E. Draper, R.J. McDonald, N.S.P. King, Phys. Rev. C16 (1977) 1594	[E_γ]
1989Ma05	A.M. Mandal, S.K. Saha, S.M. Sahakundu, A.P. Patro, J. Phys. (London) G15 (1989) 173	[E_α]
1991Ry01	A. Rytz, At. Data Nucl. Data Tables 47 (1991) 205	[E_α]
1996Ra16	S. Raman, J.B. McGrory, E.T. Jurney, J.W. Starner, Phys. Rev. C53 (1996) 2732; Erratum Phys. Rev. C54 (1996) 2786	[E_γ]
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, Atomic Data Nucl. Data Tables 81 (2002) 1	[Theoretical ICC]
2008Ki07	T. Kibédi, T.W. Burrows, M.B. Trzhaskovskaya, P.M. Davidson, C.W. Nestor, Jr., Nucl. Instrum. Methods Phys. Res. A589 (2008) 202	[Theoretical ICC]
2008Ko21	F.G. Kondev, Nucl. Data Sheets 109 (2008) 1527	[Spin, parity]
2012Wa38	M. Wang, G. Audi, A.H. Wapstra, F.G. Kondev, M. MacCormick, X. Xu, B. Pfeiffer, Chin. Phys. C36 (2012) 1603	[Q]