^{207}Tl - Comments on evaluation of decay data by F. G. Kondev

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1 Decay Scheme

The nuclide ^{207}Tl ($J^{\pi} = 1/2^{+}$) disintegrates 100 % by β^{-} emission. The strongest β^{-}-decay branch of 99.729 (10) % populates the $J^{\pi} = 1/2^{-}$ ground state of the daughter nuclide ^{207}Pb. The level schemes of ^{207}Tl and ^{207}Pb, including level energies and J^{π} values, are based on the ENSDF evaluation of Kondev and Lalkovski (2011Ko04).

2 Nuclear Data

Adopted $Q(\beta^{-})$ value of 1418 (5) keV is taken from the evaluation of Audi *et al.* (2003Au03).

The experimental half-life data for the ^{207}Tl ground state are listed in Table 1. The LRSW value of $T_{1/2}$ = 4.774 (12) min was adopted ($\chi^2_{\nu} = 0.38$, which is smaller than the critical value of $\chi^2_{\nu\,crit} = 3.78$ (99 % confidence level)).

Table 1. Experimental data for the half-life of ^{207}Tl.

Author	$T_{1/2}$ (min)	Used in evaluation
1931Cu01	4.76 (2)	Yes
1940Fa04	4.77 (5)	Yes
1953Sa11	4.79 (2)	Yes
1967Tr01	4.77 (3)	Yes

2.1 β- Transitions

The values for the maximum β^{-}-decay energies, $E_{\beta^-,max}$, presented in Table 2, were deduced from $Q(\beta^{-})$ = 1418 (5) keV (2003Au03) and the adopted level energies of ENSDF (2011Ko04). The β^{-}-decay transition probabilities (P_{β}) were deduced from the decay scheme and the corresponding absolute γ transition probabilities. Comparisons with other measured values are given in Table 3. The log *ft* values were calculated using the LOGFT program from the ENSDF evaluation package, based on the work of Gove and Martin (1971Go40).

Table 2. Level energies, quantum numbers, $E_{\beta 0,t\,max}$, P_{β} and log *ft* values in decay of ^{207}Tl.

	Level energy (keV)	J^{π}	$E_{\beta^-\,max}$ (keV)	P_{β} (%)	Nature	log *ft*
$\beta_{0,2}$	897.698 (17)	3/2-	520 (5)	0.271 (10)	First forbidden non-unique	6.15
$\beta_{0,1}$	569.6982 (20)	5/2-	848 (5)	$< 8\times10^{-5}$	First forbidden unique	$> 10.8^{1U}$
$\beta_{0,0}$	0.0	1/2-	1418 (5)	99.729 (10)	First forbidden non-unique	5.11

Table 3. Beta-decay transition probabilities (P_β) in decay of ^{207}Tl.

	Present work (%)	**1967Da10 (%)**	**1963Ch09 (%)**	**1988Hi14 (%)**
$\beta_{0,2}$	0.271 (10)	0.24	0.155 (20)	
$\beta_{0,1}$	$< 8\times10^{-5}$	$< 1\times10^{-2}$		$< 8\times10^{-5}$
$\beta_{0,0}$	99.729 (10)	99.76	99.845 (20)	

2.2 γ Transitions

The γ–ray energies, multipolarities, absolute transition probabilities and electron internal conversion coefficients are listed in Table 4. γ transition multipolarities are taken from the ENSDF evaluation of Kondev and Lalkovski (2011Ko04), while the electron conversion coefficients were calculated using the BrIcc code (2008Ki07).

The P_γ(897.77 γ) value of 0.263 (9) % was deduced from the intensity ratio of $I_\gamma(898\gamma)/I_\gamma(351\gamma)$ = 0.0202 (7) (1988Hi14) and $P_\gamma(351\gamma$ in ^{211}Bi α decay) = 13.02 (12) %. A $P_\gamma(328.10\gamma)$ value of 0.00142 (14) % was deduced from the intensity ratio of $I_\gamma(328.10\gamma)/I_\gamma(898\gamma)$ = 0.0054 (5) (1988Hi14) and $P_\gamma(897.77\gamma)$ = 0.263 (9) %, as described above. The absolute emission probability for the 569.698 γ of 0.00185 (19) % was deduced from the intensity balance at the 569-keV level and by neglecting the small β^- decay feeding contribution of $< 8\times10^{-5}$ reported in 1988Hi14. The mixing ratio of + 0.091 (9) for the 569.698-keV transition was deduced as a weighted average of + 0.096 (11) (1970Kl03), + 0.075 (25) (1972Ha59), + 0.075 (25) (1976Av01), and + 0.11 (6) (1973Ba38).

Table 4. Energies, multipolarities, mixing ratios, absolute emission probabilities and electron internal conversion coefficients for γ transitions following the β^-–decay of ^{207}Tl.

	Energy (keV)	Multi-polarity	δ	P_γ (%)	α_K $\times10^{-2}$	α_L $\times10^{-3}$	α_M $\times10^{-4}$	α_{N+} $\times10^{-4}$	α_T
$\gamma_{2,0}$	897.77 (12)	M1+E2	+0.091 (9)	0.263 (9)	1.92 (3)	3.18 (5)	7.41 (11)	2.30 (4)	0.0233 (4)
$\gamma_{2,1}$	328.10 (12)	[M1]		0.00142 (14)	27.3 (4)	46.6 (7)	109.0 (16)	33.8 (5)	0.334 (5)
$\gamma_{1,0}$	569.698 (2)	E2		0.00185 (19)	1.584 (23)	4.39 (7)	10.81 (16)	3.30 (5)	0.0216 (3)

3 Atomic Data

The atomic data (fluorescence yields, X-ray energies and relative probabilities, and Auger electrons energies and relative probabilities) were provided by the SAISINUC software (2008DuZX). Details regarding the origin of these data can be found in 1996Sc06, 1998ScZM, 1999ScZX, 2000Sc47 and 2003De44.

4 Emissions

4.1 K x-rays

The X-ray data have been calculated using the evaluated gamma-ray data, and the atomic data from 1996Sc06, 1998ScZM and 1999ScZX. Both the X-ray and Auger-electron emission probabilities were determined by means of the EMISSION computer program. This program incorporates atomic data from 1996Sc06 and the evaluated gamma-ray data.

5 Electron emissions

Electron energies were determined from electron binding energies tabulated by Larkins (1977La19) and the evaluated gamma-ray energies. Absolute electron emission probabilities were calculated from the evaluated absolute gamma-ray emission probabilities and associated internal conversion coefficients.

6 References

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