

²⁰⁶Hg - Comments on evaluation of decay data by F. G. Kondev

This evaluation was completed in May 2011 with a literature cut off by the same date. The Saisinuc software (2008DuZX) and associated supporting programs were used in assembling the data following the established protocol within the DDEP collaboration.

1 Decay Scheme

The nuclide ²⁰⁶Hg disintegrates 100 % by β⁻ emissions. The strongest β⁻-decay branch of 62 (7) % populates the J^π = 0⁻ ground state of the daughter nuclide ²⁰⁶Tl. The level schemes of ²⁰⁶Hg and ²⁰⁶Tl are based on the ENSDF evaluations of Browne (1999Br39) and Kondev (2008Ko21).

2 Nuclear Data

Q(β⁻) value is taken from the evaluation of Audi et al (2003Au03).

The experimental half-life data for the ²⁰⁶Hg ground state are presented in Table 1. These data were evaluated using different techniques (see for example 1992Ra08, 1994Ka08 and 2004Mb11 and references therein) and the results are presented in Table 2. The LRSW value of T_{1/2} = 8.32 (7) min is recommended here with χ²_v = 3.22 (χ²_v = χ²/N-1) which is smaller than the critical value of χ²_{v,crit} = 4.61 (99 % confidence level). The lifetimes assigned to the excited states of the daughter nuclide ²⁰⁶Tl are taken from the ENSDF evaluation of Browne (1999Br39).

Table 1. Experimental data for the half-life of ²⁰⁶Hg.

Author	T _{1/2} (min)	Used in the evaluation
1961Nu01	7.5 (10)	No
1962Ka27	8.5 (1)	Yes
1964Wo05	8.1 (4)	Yes
1968Wo08	8.15 (10)	Yes

Table 2. Evaluated values for the half-life of ²⁰⁶Hg.

Method/Author ^{a)}	Evaluated T _{1/2} (min)	χ ² /N-1
UWM	8.25 (13)	3.70
WM	8.32 (7)	3.22
LRSW	8.32 (7)	3.22
NRM	8.27 (8)	2.30
RM	8.18 (9)	0.38
1999Br39	8.15 (10)	

^{a)} UWM – Unweighted Mean; WM – Weighted Mean; LRSW – Limitation of Relative Statistical Weight; NRM – Normalized Residual; RM – Rajeval.

2.1 β^- Transitions

Information of level and maximum β^- -decay energies, $E_{\beta \text{ max}}$, and β^- -decay transition probabilities, P_{β} , and $\log ft$ values is presented in Table 3. The $E_{\beta \text{ max}}$ values for the $\beta_{0,2}$ and $\beta_{0,3}$ transitions were determined from $Q(\beta^-)$ (2003Au03) and the excitation energies for the 1^- states, deduced from the corresponding γ -ray transition energies (see section 2.2 and Table 4 for details). The $P_{\beta_{0,2}}$ and $P_{\beta_{0,3}}$ values were deduced from the decay scheme and the corresponding absolute γ -ray transition probabilities, as detailed in section 2.2 and Table 4. It was assumed that no direct β^- -decay feeding takes places to the first excited state at 265.8 keV ($J^\pi = 2^-$), since such a transition is a second-fold forbidden non-unique, and hence, the $\beta_{0,0}$ transition probability was determined as:

$$P_{\beta_{0,0}} = 100 - P_{\beta_{0,2}} - P_{\beta_{0,3}} \quad (1)$$

The $\log ft$ values were calculated using the LOGFT program from the ENSDF evaluation package.

Table 3. Level energies, $E_{\beta \text{ max}}$, P_{β} and $\log ft$ values in decay of ²⁰⁶Hg.

	Level energy (keV)	$E_{\beta \text{ max}}$ (keV)	P_{β} (%)	Nature	$\log ft$
$\beta_{0,0}$	0.0	1308 (20)	62 (7)	First forbidden non-unique	5.67 (10)
$\beta_{0,2}$	304.896 (6)	1003 (20)	35 (7)	First forbidden non-unique	5.24 (10)
$\beta_{0,3}$	649.42 (5)	659 (20)	3.0 (4)	First forbidden non-unique	5.41 (6)

2.2 γ Transitions

The γ -ray transition energies, multiplicities, absolute transition probabilities and electron internal conversion coefficients are presented in Table 4.

Table 4. Energies, multiplicities, absolute transition probabilities and electron internal conversion coefficients for γ -ray transitions following β^- -decay of ²⁰⁶Hg.

	Energy (keV)	$P_{\gamma+ce}$ (%)	Multi- polarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$	265.832 (5)	0.014 (7)	E2	0.0855 (12)	0.0561 (8)	0.01440 (21)	0.1603 (23)
$\gamma_{2,0}$	304.896 (6)	36 (7)	M1	0.308 (5)	0.0519 (8)	0.01211 (17)	0.375 (6)
$\gamma_{3,0}$	649.42 (5)	2.3 (3)	M1	0.0412 (6)	0.00681 (10)	0.001585 (23)	0.0501 (7)
$\gamma_{3,2}$	344.52 (17)	0.70 (14)	M1	0.221 (4)	0.0371 (6)	0.00866 (13)	0.269 (4)
$\gamma_{3,1}$	383.59 (6)	0.014 (7)	M1(+E2)	0.10 (7)	0.021 (7)	0.0050 (15)	0.13 (8)

The γ -ray transition energies and multiplicities are taken from the ENSDF evaluation of Browne (1999Br39). The $\gamma(3,1)$ energy is deduced from the adopted level energies difference. The electron internal conversion coefficients were calculated using a program supplied by the Saisinuc software (2008DuZX) which uses interpolated values of Band et al (2002Ba85) with the hole being taken into account. These are consistent with values given by the BrIcc program (2008Ki07). The $P_{\beta_{0,2}}$ value was deduced from the reported in 1968Wo08 absolute γ -ray transition probabilities for the 304.9 keV transition of $P_{\gamma_{2,0+ce}}(304.9\gamma) = 36 (7) \%$ and by taking into account a small feeding from the 1^- level at 649.4 keV via the 344.5 keV γ -ray transition. The $P_{\gamma+ce}$ values for the $\gamma(1,0)$ and $\gamma(2,1)$ transitions were determined from the absolute γ -ray emission

probabilities, P_γ , shown in Table 5, and the total electron internal conversion coefficients as:

Table 5

E level (keV)	Relative Intensity				Abs. Total Int. (%)
	E_γ (keV)	1970As05	1969La18	1976TuZY	1968Wo08
265.832	265.832 (5)				
304.896	304.896 (6)	100 (1)			36 (7)
649.42	344.52 (17)	2.4 (1)	1.4	1.4	
	383.59 (6)			0.011	
	649.42 (5)	8.4 (17)	5.6	7.7	5 (2)

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 Photon emissions

The number of γ rays per 100 disintegrations was evaluated from the available experimental data, as described in section 2.2 (see also Table 5).

5 Electron emissions

The energies of the conversion electrons were calculated from the γ -ray transition energies presented in Table 4 and the corresponding electron shell binding energies (1977La19). The number of conversion electrons of type $x=T,K$ and L where T stands for total, K and L for K - and L -shell electrons, per 100 disintegrations was calculated from the recommended in the present evaluation (see Table 5) numbers of photons per 100 disintegrations, $P_{\gamma 1,0}$, and the corresponding electron internal conversion coefficients (see Table 4), $\alpha_{x1,0}$: $ec_{1,0x} = P_{\gamma 1,0} \times \alpha_{x1,0}$.

The number of K and L Auger electrons per 100 disintegrations, $P(e_{AK(L)})$ was calculated from the number of vacancies in the K and L shells and the corresponding $P_{XK(L)}$ yield: $P(e_{AK}) = N_K - P_{XK}$ and $P(e_{AL}) = N_L - P_{XL}$.

6 References

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