^{180}Tl ε decay (1.09 s) 2011El07

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	E. A. Mccutchan	NDS 126, 151 (2015)	1-Feb-2015

Parent: ^{180}Tl: E=0.0; J$^\pi$=(5$^-$); $T_{1/2}$=1.09 s *1*; Q(ε)=10990 *60*; %ε+%β^+ decay=94 *4*

2011El07: ^{180}Tl activity produced from spallation of UC_x with E(p)=1.4 GeV and separated with resonant laser ionization technique and the High Resolution Separator. Measured Eγ, Iγ, $\gamma\gamma$, E(ce), I(ce) using a Miniball cluster detector (consisting of three HPGe crystals) and two Si detectors.

Other: 2013El08, deduced asymmetric fission of excited levels populated in ^{180}Tl decay.

The decay scheme is most likely incomplete, as the highest observed level is at only ≈2.5 MeV compared with the large Q value for the decay (10.99 MeV). A total energy release of 9.6 MeV *3* is calculated for this decay scheme using the RADLST code, compared with the effective Q value of 10.3 keV *4*.

α: Additional information 1.

^{180}Hg Levels

E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡
0.0	0$^+$	1031.82 *24*	6$^+$	1468.62 *18*	(3$^-$,4$^+$)	2021.90 *20*	
419.7 *4*	0$^+$	1091.4 *4*	(2$^+$,1)	1504.1 *3*	(6$^+$)	2348.56 *19*	(4,5$^-$)
434.13 *15*	2$^+$	1203.87 *23*		1663.0 *5*		2487.5 *3*	
601.47 *15*	2$^+$	1223.60 *19*	(3$^-$,4$^+$)	1797.26 *19*	5$^{(-)}$		
706.01 *18*	4$^+$	1399.20 *19*	(3$^-$)	1840.2 *5*			

† From a least-squares fit to Eγ by evaluator.
‡ From the Adopted Levels.

ε,β^+ radiations

E(decay)	E(level)	Iβ^+ ‡	Iε‡	Log *ft*	I($\varepsilon+\beta^+$)†‡	Comments
(8.50×10^3 *6*)	2487.5	1.3 *3*	0.27 *5*	6.0	1.6 *3*	av Eβ=3427 *29*; εK=0.135 *3*; εL=0.0233 *5*; εM+=0.00747 *15*
(8.64×10^3 *6*)	2348.56	16.5 *13*	3.12 *25*	4.9	19.6 *15*	av Eβ=3493 *29*; εK=0.1297 *25*; εL=0.0223 *5*; εM+=0.00715 *14*
(8.97×10^3 *6*)	2021.90	6.5 *9*	1.1 *1*	5.4	7.6 *10*	av Eβ=3648 *29*; εK=0.1174 *22*; εL=0.0202 *4*; εM+=0.00647 *12*
(9.15×10^3 *6*)	1840.2	0.69 *8*	0.11 *1*	6.4	0.80 *9*	av Eβ=3734 *29*; εK=0.1112 *20*; εL=0.0191 *4*; εM+=0.00613 *11*
(9.19×10^3 *6*)	1797.26	5.2 *11*	0.81 *18*	5.5	6.0 *13*	av Eβ=3755 *29*; εK=0.1098 *20*; εL=0.0189 *4*; εM+=0.00605 *11*
(9.33×10^3 *6*)	1663.0	0.50 *13*	0.075 *19*	6.6	0.58 *15*	av Eβ=3818 *29*; εK=0.1056 *19*; εL=0.0182 *4*; εM+=0.00582 *11*
(9.49×10^3 *6*)	1504.1	4.0 *12*	0.57 *17*	5.7	4.6 *14*	av Eβ=3894 *29*; εK=0.1008 *18*; εL=0.0173 *3*; εM+=0.00555 *10*
(9.77×10^3 *6*)	1223.60	7.6 *14*	0.98 *18*	5.5	8.6 *16*	av Eβ=4028 *29*; εK=0.0931 *16*; εL=0.0160 *3*; εM+=0.00512 *9*
(9.79×10^3 *6*)	1203.87	4.1 *4*	0.52 *5*	5.8	4.6 *4*	av Eβ=4037 *29*; εK=0.0925 *16*; εL=0.0159 *3*; εM+=0.00509 *9*
(9.96×10^3 *6*)	1031.82	8.7 *10*	1.1 *1*	5.5	9.8 *11*	av Eβ=4120 *29*; εK=0.0882 *15*; εL=0.0152 *3*; εM+=0.00485 *9*
(1.028×10^4 *6*)	706.01	21 *4*	2.3 *4*	5.2	23 *4*	av Eβ=4276 *29*; εK=0.0806 *14*; εL=0.01386 *23*; εM+=0.00444 *8*

† From an intensity balance at each level. Feedings are considered to be upper limits given the large Q value of the decay (10.99

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^{180}Tl ε decay (1.09 s) 2011El07 (continued)

ε,β^+ radiations (continued)

MeV) and the highest observed level at only ≈2.5 MeV.
‡ Absolute intensity per 100 decays.

$\gamma(^{180}Hg)$

Iγ normalization, I(γ+ce) normalization: From ΣI(γ+c.e.)(to g.s.)=94 *4*. Direct feeding of the ground state is not expected (ΔJ=5).

E_γ †	I_γ ‡@	E_i(level)	J^π_i	E_f	J^π_f	Mult.#	α	$I_{(\gamma+ce)}$ @	Comments
104.7 *5*	1.4 *4*	706.01	4$^+$	601.47	2$^+$	[E2]	4.57 *12*		α(K)=0.597 *9*; α(L)=2.97 *8*; α(M)=0.778 *21*; α(N)=0.193 *6*; α(O)=0.0320 *9* α(P)=0.0001041 *20* I_γ: calculated from Iγ(272γ), the relative branching ratio of the 272γ (89%) and 105γ (11%) determined from $\gamma\gamma$ coincidences, and α(E2)=4.575 for the 105γ.
167.0 *2*	3.3 *2*	601.47	2$^+$	434.13	2$^+$	E0(+M1+E2)	3.5 *4*	15 *1*	ce(K)/(γ+ce)=0.39 *17*; ce(L)/(γ+ce)=0.13 *4*; ce(M)/(γ+ce)=0.033 *11*; ce(N)/(γ+ce)=0.008 *3*; ce(O)/(γ+ce)=0.0015 *5* ce(P)/(γ+ce)=5.E−5 *5* α(K)=0.9 *7*; α(L)=0.31 *6*; α(M)=0.076 *18*; α(N)=0.019 *5*; α(O)=0.0034 *6*; α(P)=0.00012 *9* α: deduced from I(γ+ce). $I_{(\gamma+ce)}$: from $\gamma\gamma$ coincidence spectrum gated on 622γ which populates the 602 level.
181.8 *5*	0.16 *1*	601.47	2$^+$	419.7	0$^+$	[E2]	0.545 *10*		α(K)=0.213 *4*; α(L)=0.249 *5*; α(M)=0.0646 *12*; α(N)=0.0160 *3*; α(O)=0.00270 *5* α(P)=2.66×10^{-5} *5* I_γ: determined from γ spectrum gated on K electron of 421γ.
272.0 *2*	54 *3*	706.01	4$^+$	434.13	2$^+$	E2	0.1433		α(K)=0.0800 *12*; α(L)=0.0476 *7*; α(M)=0.01213 *18*; α(N)=0.00302 *5*; α(O)=0.000518 *8* α(P)=1.021×10^{-5} *15*
325.8 *2*	15.3 *10*	1031.82	6$^+$	706.01	4$^+$	E2	0.0836		α(K)=0.0517 *8*; α(L)=0.0240 *4*; α(M)=0.00607 *9*; α(N)=0.001511 *22*; α(O)=0.000262 *4* α(P)=6.71×10^{-6} *10*
326.8 *2*	5.6 *9*	2348.56	(4,5$^-$)	2021.90					
328.6 *2*	2.7 *17*	1797.26	5$^{(-)}$	1468.62	(3$^-$,4$^+$)				
398.2 *2*	2.9 *2*	1797.26	5$^{(-)}$	1399.20	(3$^-$)	E2	0.0480		α(K)=0.0324 *5*; α(L)=0.01182 *17*; α(M)=0.00295 *5*;

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^{180}Tl ε decay (1.09 s) 2011El07 (continued)

$\gamma(^{180}Hg)$ (continued)

E_γ †	I_γ ‡@	E_i(level)	J_i^π	E_f	J_f^π	Mult.#	α	$I_{(\gamma+ce)}$ @	Comments
									α(N)=0.000735 *11*; α(O)=0.0001290 *19* α(P)=4.25×10^{-6} *6*
421 *20*		419.7	0$^+$	0.0	0$^+$	E0		1.04 *5*	ce(K)/ce(tot)=0.85 *18*. $I_{(\gamma+ce)}$: from ΣI(γ+c.e.) feeding the 420 level. Direct feeding of J^π=0$^+$ is not expected. E_γ: from Si spectrum gated on 272γ and 671γ.
434.0 *2*	100 *3*	434.13	2$^+$	0.0	0$^+$	E2	0.0383		α(K)=0.0266 *4*; α(L)=0.00887 *13*; α(M)=0.00220 *3*; α(N)=0.000548 *8*; α(O)=9.68×10^{-5} *14* α(P)=3.51×10^{-6} *5*
472.5 *5*	1.1 *2*	1504.1	(6$^+$)	1031.82	6$^+$				
498.1 *5*	1.3 *2*	1203.87		706.01	4$^+$				
517.4 *2*	3.4 *4*	1223.60	(3$^-$,4$^+$)	706.01	4$^+$				
551.1 *2*	3.0 *4*	2348.56	(4,5$^-$)	1797.26	5$^{(-)}$				
553.0 *2*	2.9 *4*	2021.90		1468.62	(3$^-$,4$^+$)				
573.4 *2*	1.6 *2*	1797.26	5$^{(-)}$	1223.60	(3$^-$,4$^+$)				
601.6 *2*	24.3 *12*	601.47	2$^+$	0.0	0$^+$	E2	0.01748		α(K)=0.01317 *19*; α(L)=0.00328 *5*; α(M)=0.000796 *12*; α(N)=0.000199 *3*; α(O)=3.58×10^{-5} *5* α(P)=1.748×10^{-6} *25*
602.4 *5*	1.5 *2*	1203.87		601.47	2$^+$				
622.0 *2*	18.5 *9*	1223.60	(3$^-$,4$^+$)	601.47	2$^+$				
657.3 *5*	1.0 *2*	1091.4	(2$^+$,1)	434.13	2$^+$				
671.6 *5*	0.79 *4*	1091.4	(2$^+$,1)	419.7	0$^+$				I_γ: determined from conversion electron spectrum.
692.9 *2*	2.4 *2*	1399.20	(3$^-$)	706.01	4$^+$	[E1]	0.00459		α(K)=0.00383 *6*; α(L)=0.000587 *9*; α(M)=0.0001349 *19*; α(N)=3.37×10^{-5} *5*; α(O)=6.30×10^{-6} *9* α(P)=4.58×10^{-7} *7*
765.4 *5*	1.5 *1*	1797.26	5$^{(-)}$	1031.82	6$^+$	[E1]	0.00379		α(K)=0.00316 *5*; α(L)=0.000481 *7*; α(M)=0.0001106 *16*; α(N)=2.76×10^{-5} *4*; α(O)=5.17×10^{-6} *8* α(P)=3.80×10^{-7} *6*
769.7 *2*	3.5 *2*	1203.87		434.13	2$^+$				
789.4	10.4 *12*	1223.60	(3$^-$,4$^+$)	434.13	2$^+$				
797.7 *2*	4.5 *17*	1399.20	(3$^-$)	601.47	2$^+$	[E1]	0.00350		α(K)=0.00292 *4*; α(L)=0.000444 *7*; α(M)=0.0001019 *15*; α(N)=2.54×10^{-5} *4*; α(O)=4.77×10^{-6} *7* α(P)=3.52×10^{-7} *5*
798.0 *2*	5.1 *18*	1504.1	(6$^+$)	706.01	4$^+$	(E2)	0.00950		α(K)=0.00747 *11*; α(L)=0.001551 *22*; α(M)=0.000370 *6*; α(N)=9.25×10^{-5} *13* α(O)=1.695×10^{-5} *24*; α(P)=9.87×10^{-7} *14*
798.1 *2*	9.2 *6*	2021.90		1223.60	(3$^-$,4$^+$)				
867.1 *2*	1.9 *2*	1468.62	(3$^-$,4$^+$)	601.47	2$^+$				
880.3 *2*	5.0 *4*	2348.56	(4,5$^-$)	1468.62	(3$^-$,4$^+$)				

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^{180}Tl ε decay (1.09 s) 2011El07 (continued)

$\gamma(^{180}Hg)$ (continued)

E_γ [†]	I_γ [‡@]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	α	Comments
948.9 *2*	3.5 *11*	2348.56	(4,5$^-$)	1399.20	(3$^-$)			
1034.6 *2*	7.5 *8*	1468.62	(3$^-$,4$^+$)	434.13	2$^+$			
1091.2 *2*	2.3 *1*	1797.26	5$^{(-)}$	706.01	4$^+$	[E1]	0.00197	α(K)=0.001650 *24*; α(L)=0.000246 *4*; α(M)=5.63×10^{-5} *8*; α(N)=1.405×10^{-5} *20*; α(O)=2.65×10^{-6} *4* α(P)=2.00×10^{-7} *3*
1125.1 *2*	9.7 *5*	2348.56	(4,5$^-$)	1223.60	(3$^-$,4$^+$)			
1134.2 *5*	1.1 *1*	1840.2		706.01	4$^+$			
1228.9 *5*	0.8 *2*	1663.0		434.13	2$^+$			
1316.5 *2*	3.9 *2*	2021.90		706.01	4$^+$			
1455.4 *5*	0.6 *1*	2487.5		1031.82	6$^+$			
1781.5 *2*	1.6 *3*	2487.5		706.01	4$^+$			

† Uncertainties taken as 0.2 keV for Iγ>1.5% and 0.5 keV for I$\gamma\leq$1.5% from a general statement by 2011El07.
‡ Intensities relative to Iγ(434γ)=100; values do not include a correction for summing.
# From the Adopted Gammas.
@ For absolute intensity per 100 decays, multiply by 0.73 *4*.

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Decay Scheme

Intensities: I_γ per 100 parent decays