^{243}Pu β^- decay 1969Fr01,1969Ho10

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	C. D. Nesaraja, E. A. Mccutchan	NDS 121, 695 (2014)	30-Sep-2013

Parent: ^{243}Pu: E=0.0; $J^\pi=7/2^+$; $T_{1/2}$=4.956 h *3*; Q(β^-)=579 *3*; %β^- decay=100.0

1977Dr07: ^{242}Pu targets were irradiated with neutrons at a fast pulsed reactor followed by radiochemical separation. β decay of ^{243}Pu detected with a β scintillation counter. Measured $T_{1/2}$ and β energy.

1969Fr01: ^{242}Pu targets were irradiated with neutrons at the Argonne CP-5 reactor at two separate irradiations out of which one was followed by chemically and mass separation to identify the weak and high energy γ-rays. γ- singles and $\gamma\gamma$ coincidence were measured using 2 cm^3 Ge(Li) and NaI(Tl) detectors. Conversion electrons were measured with a Si(Li) detector with FWHM=2.8 keV for the 155.8 keV ^{243}Cm electron line.

1969Ho10: ^{242}Pu targets were irradiated with neutrons at the Los Alamos Omega West Reactor. Measured conversion electrons, X-ray, γ's, β's, $\gamma\beta$ coincidence with Si(Li) and Ge(Li) detector, and Kr- and Xe filled Reuter-Stokes proportional counters. Determined $T_{1/2}$(^{243}Pu).

1953En08: Enriched ^{242}Pu irradiated at the Argonne Heavy Water Reactor followed by chemical separation. Gamma and beta spectrums and $\beta\gamma$ coincidence measured with scintillation spectrometers.

α: Additional information 1.

^{243}Am Levels

E(level)	J^π[†]	$T_{1/2}$	Comments
0.0	$5/2^-$	7364 y *22*	$T_{1/2}$: From Adopted Levels.
42.21 *22*	$7/2^-$		
84.00 *15*	$5/2^+$	2.34 ns *7*	$T_{1/2}$: From delayed β^- −84 keV γ coincidence measurement (1969Fr01).
96.4 *4*	$9/2^-$		
109.21 *16*	$7/2^+$		
143.39 *24*	$(9/2^+)$		
189.2? *11*	$(11/2^+)$		
407.2 *5*			
465.64 *18*	$7/2^+$		
532.4 *3*	$(9/2^+)$		

[†] From Adopted Levels.

β^- radiations

E(decay)	E(level)	Iβ^-[†‡]	Log *ft*	Comments
(47 *3*)	532.4	≈0.028	≈6.0	av Eβ=11.83 *78*
(113 *3*)	465.64	≈1.26	≈5.5	av Eβ=29.53 *82*
(172 *3*)	407.2	≈0.002	≈8.9	av Eβ=45.69 *86*
(436 *3*)	143.39	≈3.4	≈6.9	av Eβ=125.00 *96*
(470 *3*)	109.21	≈5	≈6.9	av Eβ=135.91 *97* Iβ^-: From I(β^- to 84-keV level)+I(β^- to 109-keV level)≈26, with I(β^- to 84-keV level)≈21 deduced from level scheme.
(483 *3*)	96.4	≈1.3	≈7.5	av Eβ=140.06 *98*
490 *10*	84.00	≈21	≈6.3	av Eβ=144.08 *98* Iβ^-: I(β^- to 84-keV level)+I(β^- to 109-keV level)≈26, deduced from level scheme. Alaga rule has been used by the evaluator to estimate β intensities to each of these levels. Measured energies and intensities: E(β)=468, Iβ=40% (scin,1953En08), E(β)=485 *10*, Iβ≈40% (semi,1969Ho10); the observed β was assigned to a group of β's feeding the levels between 84 keV and 143 keV.
(537 *3*)	42.21	≈8.9	≈6.8	av Eβ=157.73 *99*
580 *10*	0.0	≈60	≈6.1	av Eβ=171.7 *10* E(decay): Measured energies: E(β)=566 (1953En08), E(β)=578 *10* (1969Ho10),

Continued on next page (footnotes at end of table)

^{243}Pu β^- decay 1969Fr01,1969Ho10 (continued)

β^- radiations (continued)

E(decay)	E(level)	Comments
		E(β)=580 *10* (1977Dr07). Iβ^-: Iβ^-≈60% was measured by 1969Ho10 and 1953En08 for their 578 *10* and 566 β groups. Non-observation of coincidences between the 566-keV β's and L x-rays led to 1953En08 to conclude that the decay was entirely to the ground state. 1969Ho10 postulate that their 578 *10* β group involves the ground state and 42-keV level and divide their β intensities into 49% and 9%, respectively. As 1969Ho10 provide no details on this separation, the evaluators adopt the measurement of 1953En08.

† Iβ's have been deduced from intensity balance at each level, except where noted otherwise.
‡ Absolute intensity per 100 decays.

^{243}Pu β^- decay 1969Fr01,1969Ho10 (continued)

$\gamma(^{243}Am)$

Iγ normalization: From Σ(Iγ+c.e.)(to ^{243}Am g.s.)≈ 40. Iβ to ground state is estimated as ≈ 60, from subtraction of coincidence spectrum (β-85γ coin.) and total β spectrum in the Kurie plots of ^{243}Pu β spectra (1953En08).

γγ coincidences:
(84γ)(K x ray,322.2,356.4,381.7,388.9,423.2 γ's) (1969Fr01),
(84γ)(ce 356.5,381.6 γ's) (1969Ho10).

x-rays:
I(K x ray) relative to I(84γ)=100

E(x ray)	1969Fr01	1969Ho10	
102.0 2	0.65 6	0.64 6	Kα$_2$ x ray+101.3γ
106.4 2	0.90 9	0.82 8	Kα$_1$ x ray
119.8 3	0.38 5	0.30 3	Kβ$_1'$ x ray
123.9 3	0.12 2	0.11 2	Kβ$_2'$ x ray

E_γ [†]	I_γ [a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[&]	δ	α	$I_{(\gamma+ce)}$ [b]	Comments
(25.2 *3*)		109.21	7/2$^+$	84.00	5/2$^+$				≈8	γ not observed. Eγ is from level scheme. $I_{(\gamma+ce)}$: The 25 γ is required by an intensity balance at the 109 level. With Iβ$^-$ ≈ 5 and with I(γ+ce)(34 γ) taken ≈ 4, an intensity balance gives I(γ+ce)(25γ) ≈ 8.
≈34		143.39	(9/2$^+$)	109.21	7/2$^+$				>3.5	E_γ: From 1969Ho01. $I_{(\gamma+ce)}$: The authors (1969Ho01) report Ice(L3) only. Ice(L3) value given in Table 2 (1969Ho10) is a typo and should be 0.05 *2*. The expected multipolarity is M1+E2. Ice/Ice(L3)=3 for a pure M1 and 267 for pure E2. The authors adopt a value of approximately 3 which makes the I(γ+ce) value a lower limit assuming the M1 multipolarity.
41.8[‡] *2*	3.3[‡] *3*	84.00	5/2$^+$	42.21	7/2$^-$	[E1]		1.33 *3*	≈1.77	α(L)=0.991 *19*; α(M)=0.252 *5*; α(N)=0.0675 *13*; α(O)=0.0157 *3*; α(P)=0.00231 *5* α(Q)=6.32×10^{-5} *11*
42.2 *5*	≈0.35	42.21	7/2$^-$	0.0	5/2$^-$	M1+E2	≈0.28	≈149	≈12	α(L)≈110; α(M)≈28.9; α(N)≈7.9; α(O)≈1.94; α(P)≈0.336; α(Q)≈0.0116 α(L12)/α(L3)=3.3 (1969Ho10); α(L12)exp>9 from Ice(L12)/Iγ(42.2γ+41.9γ). I_γ: from Ice(L)≈39 (1969Ho10) and α(L) from BrICC (2008Ki07)=110 for M1+8% E2.
(45.8)		189.2?	(11/2$^+$)	143.39	(9/2$^+$)				≈0.0028	Transition was not observed; Eγ from level scheme. I(γ+ce)

^{243}Pu β^- decay 1969Fr01,1969Ho10 (continued)

$\gamma(^{243}Am)$ (continued)

E_γ[†]	I_γ[a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[&]	α	$I_{(\gamma+ce)}$[b]	Comments
									intensity of≈0.0028 from intensity balance at the 189-keV level.
54[#] *1*	≤0.1[#]	96.4	9/2$^-$	42.21	7/2$^-$	[M1+E2]	≈87	≤2	ce(L)/(γ+ce)=0.72 *20*; ce(M)/(γ+ce)=0.20 *17*; ce(N)/(γ+ce)=0.08 *8* α(L)≈64; α(M)≈17.1; α(N)≈4.7; α(O)≈1.14; α(P)≈0.193; α(Q)≈0.0051 α: for an analogous 9/2$^-$ to 7/2$^-$ transition of 5/2[523] band in ^{237}Np, δ=0.46 *4* was determined. Eγ=54.2 *5* from level scheme.
67[#] *1*	1.0[#] *5*	109.21	7/2$^+$	42.21	7/2$^-$	[E1]	0.386 *17*	≈0.32	α(L)=0.290 *13*; α(M)=0.072 *3*; α(N)=0.0194 *9*; α(O)=0.00463 *20*; α(P)=0.00074 *3* α(Q)=2.41×10^{-5} *9*
84.0 *2*	100	84.00	5/2$^+$	0.0	5/2$^-$	E1	0.214 *4*	≈28	α(L)=0.1605 *25*; α(M)=0.0397 *6*; α(N)=0.01072 *17*; α(O)=0.00257 *4*; α(P)=0.000422 *7* α(Q)=1.494×10^{-5} *23* Absolute photon intensity of 84γ was determined by 1969Ho10 and 1971Fi01: Iγ(84γ)=27.6% (1969Ho10), 23% 2 (1971Fi01). α(L12)exp=0.12 *2*; L12/L3=3 (1969Ho10). See 1970Gr36 and 1971Vo13 for calculations of penetration matrix elements.
96.4[‡] *4*	0.06[‡] *1*	96.4	9/2$^-$	0.0	5/2$^-$	(E2)	20.4 *5*	≈0.30	α(L)=14.8 *4*; α(M)=4.15 *10*; α(N)=1.15 *3*; α(O)=0.274 *7*; α(P)=0.0438 *11*; α(Q)=0.000152 *4* α(L12)exp≤17 from Ice(L12)/Iγ(96.4) (1969Ho10).
101.3[d]	0.17 *8*	143.39	(9/2$^+$)	42.21	7/2$^-$	[E1]	0.1315	≈0.04	α(L)=0.0987 *14*; α(M)=0.0244 *4*; α(N)=0.00658 *10*; α(O)=0.001589 *23*; α(P)=0.000266 *4* α(Q)=1.002×10^{-5} *14* γ was obscured by Kα$_2$ x ray; energy is from level scheme. I_γ: Relative to Iγ(84γ). Obtained from the observed I(Kα$_2$ x ray)/I(Kα$_1$ x ray) =0.78 *10*. This observed value was in excess of the reported value of 0.57 in 1959Wa11. Authors (1969Ho10) report the excess of 0.21 relative to I(Kα$_1$ x ray) was from the gamma intensity.
109.2[@] *2*	0.70[@] *7*	109.21	7/2$^+$	0.0	5/2$^-$	[E1]	0.1083	≈0.18	α(L)=0.0813 *12*; α(M)=0.0200 *3*; α(N)=0.00541 *8*; α(O)=0.001310 *20*; α(P)=0.000221 *4* α(Q)=8.52×10^{-6} *13*
322.3[@] *2*	0.12[@] *1*	465.64	7/2$^+$	143.39	(9/2$^+$)	[M1]	1.071	≈0.057	α(K)=0.845 *12*; α(L)=0.1699 *24*; α(M)=0.0414 *6*; α(N)=0.01131 *16*; α(O)=0.00285 *4* α(P)=0.000544 *8*; α(Q)=3.45×10^{-5} *5*
343.0[#d] *5*	≈0.0065[#]	532.4	(9/2$^+$)	189.2?	(11/2$^+$)	[M1]	0.903	≈0.0028	α(K)=0.712 *11*; α(L)=0.1430 *21*; α(M)=0.0348 *5*; α(N)=0.00951 *14*; α(O)=0.00239 *4* α(P)=0.000458 *7*; α(Q)=2.90×10^{-5} *5*

$^{243}_{95}Am_{148}$-4

^{243}Pu β^- decay 1969Fr01,1969Ho10 (continued)

$\gamma(^{243}Am)$ (continued)

E_γ [†]	I_γ [a]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [&]	α	$I_{(\gamma+ce)}$ [b]	Comments
356.4 [@] 2	0.58 [@] 3	465.64	7/2$^+$	109.21	7/2$^+$	M1	0.812	≈0.242	α(K)=0.641 9; α(L)=0.1286 19; α(M)=0.0313 5; α(N)=0.00856 12; α(O)=0.00215 3 α(P)=0.000412 6; α(Q)=2.61×10^{-5} 4 α(K)exp=0.6 1 from Ice(K)/Iγ(356.4) (1969Ho10).
381.6 [#] 2	2.50 [#] 10	465.64	7/2$^+$	84.00	5/2$^+$	M1	0.674	≈0.96	α(K)=0.532 8; α(L)=0.1066 15; α(M)=0.0259 4; α(N)=0.00709 10; α(O)=0.00178 3 α(P)=0.000341 5; α(Q)=2.16×10^{-5} 3 α(K)exp=0.6 1, α(L)exp≤0.15 from Ice(K)/Iγ(381.7) (1969Ho10).
388.9 [@] 3	0.021 [@] 3	532.4	(9/2$^+$)	143.39	(9/2$^+$)	[M1]	0.640	≈0.0079	α(K)=0.505 8; α(L)=0.1011 15; α(M)=0.0246 4; α(N)=0.00673 10; α(O)=0.001693 24 α(P)=0.000324 5; α(Q)=2.05×10^{-5} 3
407.2 [#] 5	0.005 [#] 2	407.2		0.0	5/2$^-$			≈0.002	1969Fr01 suspected this γ as an impurity, however, a higher purity sample and an additional cycle of plutonium chemistry by 1969Ho10 verified that the 407.1 γ is associated with the decay of ^{243}Pu. $I_{(\gamma+ce)}$: From 1969Ho10; authors assume a M1 transition with α=0.564 from BrICC (2008KI07).
423.2 [cd] 2		465.64	7/2$^+$	42.21	7/2$^-$				
423.2 [c] 3	0.057 6	532.4	(9/2$^+$)	109.21	7/2$^+$	[M1]	0.508	≈0.0198	α(K)=0.401 6; α(L)=0.0802 12; α(M)=0.0195 3; α(N)=0.00533 8; α(O)=0.001342 19 α(P)=0.000257 4; α(Q)=1.627×10^{-5} 23
448.7 [‡] 5	≈0.001 [‡]	532.4	(9/2$^+$)	84.00	5/2$^+$	[E2]	0.0725	≈0.00025	α(K)=0.0387 6; α(L)=0.0248 4; α(M)=0.00665 10; α(N)=0.00183 3; α(O)=0.000446 7 α(P)=7.73×10^{-5} 12; α(Q)=1.90×10^{-6} 3
465.7 [#] 5	≤0.001 [#]	465.64	7/2$^+$	0.0	5/2$^-$	[E1]	0.01710	≤0.00023	α(K)=0.01367 20; α(L)=0.00259 4; α(M)=0.000625 9; α(N)=0.0001697 24; α(O)=4.22×10^{-5} 6 α(P)=7.78×10^{-6} 11; α(Q)=4.28×10^{-7} 6

† From 1969Fr01 and 1969Ho10. Other measurements: 1953En08, 1956St48.
‡ From 1969Fr01.
# From 1969Ho10.
@ Weighted average from 1969Fr01 and 1969Ho10.
& Deduced from ce measurements of 1969Ho10. Multipolarities in square brackets are from the level scheme; they were not determined experimentally.
a For absolute intensity per 100 decays, multiply by ≈0.23.
b Absolute intensity per 100 decays.
c Multiply placed.
d Placement of transition in the level scheme is uncertain.

$^{243}_{95}Am_{148}$-5

^{243}Pu β^- decay 1969Fr01,1969Ho10

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 decays through this branch