^{239}Np β^- decay 1959Ew90,1965Da04,1996Wo05

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	E. Browne, J. K. Tuli	NDS 122, 293 (2014)	30-Jun-2013

Parent: ^{239}Np: E=0; J$^\pi$=5/2$^+$; T$_{1/2}$=2.356 d *3*; Q(β^-)=722.5 *10*; %β^- decay=100.0
Additional information 1.

^{239}Pu Levels

E(level)	J$^\pi$	T$_{1/2}$	Comments
0.0	1/2$^+$	24110 y *30*	
7.861	3/2$^+$		
57.276 *2*	5/2$^+$		
75.706?	7/2$^+$		
163.76	9/2$^+$		
285.460	5/2$^+$	1.12† ns *5*	g=−0.49 *11* (1974Pa03) g-factor: assuming paramagnetic correction β=2.16.
330.125	7/2$^+$		
387.41	9/2$^+$		
391.586	7/2$^-$	193† ns *4*	
469.8	(1/2$^-$)		
492.2	3/2$^-$		
505.2	5/2$^-$		
511.81 *6*	7/2$^+$		
556.2	(7/2$^-$)		

† Average of values from 1974Pa03, 1955En07, 1951Gr34.

β^- radiations

E(decay)†	E(level)	Iβ^-‡#@	Log *ft*	Comments
(166.3 *10*)	556.2	≈0.003	≈9.7	av Eβ=44.2 *3*
(210.7 *10*)	511.81	1.70 *6*	7.3	av Eβ=56.8 *3*
(217.3 *10*)	505.2	0.0074 *2*	9.7	av Eβ=58.7 *3*
(230.3 *10*)	492.2	0.020 *1*	9.3	av Eβ=62.5 *4*
(252.7& *10*)	469.8	≥0.0027	≤9.9^{1u}	av Eβ=74.7 *3*
341 *3*	391.586	44 *2*	6.5	av Eβ=92.5 *3*
393 *3*	330.125	7 *2*	7.5	av Eβ=111.5 *4*
438 *3*	285.460	45 *3*	6.8	av Eβ=125.6 *4*
(646.8& *10*)	75.706?			
(665.2& *10*)	57.276			
713 *3*	7.861	2 *1*	8.9	av Eβ=218.1 *4* Iβ^-: 1952Fr25, 1956Ba95, 1959Co63.

† From 1959Co63.
‡ I(β^-) to 7.85, 57 and 75 levels deduced from I(β^- to 7.85)/ I(β^- to 57+75)=1.6 (1959Co63) and from Σ(Iβ) to higher levels)=100.
# I(β^- to 57+75 level)<2.
@ Absolute intensity per 100 decays.
& Existence of this branch is questionable.

$\gamma(^{239}$Pu)

Iγ normalization: all γ-ray intensities were measured on an absolute scale (per 100 disintegrations of ^{239}Np).
Others: 1975Pa04, 2008Gr11.

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         x-rays(Pu):

  Eγ          Iγ(%α)                  Iγ(%α)          Calculated
(1982Ah04)  (1982Ah04)             (1972Ah02)      (RADLST)
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 99.53       12.8 4       Kα2       x ray   14.5 6            13.1 5
103.74       20.4 6       Kα1       x ray   22.2 8            20.8 7
117.6         7.3 3       Kβ1'      x ray                 10.3 4    (Kβ   x ray)
120.6         2.6 1       Kβ2'      x ray    2.8 1
          The agreement between measured and calculated K  x ray supports
the experimental γ-ray  intensities and assigned multipolarities.
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E_γ	I_γ[‡e]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	δ[c]	α[†]	$I_{(\gamma+ce)}$[e]	Comments
(4.2 *CA*)		391.586	7/2⁻	387.41	9/2⁺	[E1]			2.6 *CA*	$I_{(\gamma+ce)}$: from transition intensity balance at 387-keV level, where no significant β^- feeding is expected (5/2⁺ to 9/2⁺).
7.85[@]		7.861	3/2⁺	0.0	1/2⁺	M1+E2	0.055 *3*	5.7×10³ *4*		ce(M)/(γ+ce)=0.74 *4*; ce(N+)/(γ+ce)=0.261 *20* ce(N)/(γ+ce)=0.203 *17*; ce(O)/(γ+ce)=0.049 *5*; ce(P)/(γ+ce)=0.0083 *7*; ce(Q)/(γ+ce)=0.000285 *19* δ: from ^{239}Am ε decay.
(18.4)		75.706?	7/2⁺	57.276	5/2⁺	[M1+E2]				
44.66[b] *2*	0.13 *1*	330.125	7/2⁺	285.460	5/2⁺	M1+E2	0.20 *3*	86 *8*		α(L)=64 *6*; α(M)=16.2 *17*; α(N+..)=5.7 *6* α(N)=4.4 *5*; α(O)=1.08 *11*; α(P)=0.193 *17*; α(Q)=0.00903 *15* I_γ: from 1982Ah04. δ: from ^{239}Am ε decay.
49.41[b] *2*	0.12 *2*	57.276	5/2⁺	7.861	3/2⁺	M1+E2	0.50 *3*	126 *8*		α(L)=92 *6*; α(M)=24.8 *17*; α(N+..)=8.7 *6* α(N)=6.8 *5*; α(O)=1.62 *11*; α(P)=0.269 *17*; α(Q)=0.00592 *13* δ: from ^{239}Am ε. I_γ: weighted average of 0.11% *1* (1982Ah04) and 0.18% *3* (1974HeYW). Iγ; =0.11 from ce(L) of 1959Ew90 and α(L)=95.
57.28[fb]	≈0.036[f]	57.276	5/2⁺	0.0	1/2⁺	E2		222		α(L)=161.0 *23*; α(M)=45.0 *7*; α(N+..)=15.72 *22* α(N)=12.36 *18*; α(O)=2.91 *4*; α(P)=0.457 *7*; α(Q)=0.001108 *16* I_γ: from Iγ(57γ, 57 level)/Iγ(49γ)≈0.3 in ^{243}Cm α decay and Iγ(49γ)=0.12% *2* in ^{239}Np β^- Decay.

$^{239}_{94}$Pu$_{145}$-2

$\gamma(^{239}Pu)$ (continued)

E_γ	I_γ[‡e]	E_i(level)	J^π_i	E_f	J^π_f	Mult.	δ[c]	α[†]	Comments
(57.3[f])	≈0.09[f]	387.41	9/2+	330.125	7/2+	[M1]		28.6 4	α(L)=21.5 3; α(M)=5.2 8; α(N+..)=1.43 2 α(N)=7 6; α(O)=1.6 13; α(P)=0.26 20; α(Q)=0.0028 17 $I_{(\gamma+ce)}$: from Iγ(doublet)=0.135% 7 (1982Ah04) and Iγ(57γ, 57-keV level)≈0.036%.
61.460[#] 2	1.30 2	391.586	7/2−	330.125	7/2+	E1		0.473	α(L)=0.354 5; α(M)=0.0881 13; α(N+..)=0.0300 5 α(N)=0.0236 4; α(O)=0.00553 8; α(P)=0.000871 13; α(Q)=2.87×10^{-5} 4 I_γ: weighted average (Limited Relative Statistical Weight Method) of 1.40% 7 (1996Wo05), 1.29% 2 (1984Va41), and 1.29% 6 (1982Ah04).
67.86[@] 2	0.10 3	75.706?	7/2+	7.861	3/2+	E2		98.4	α(L)=71.4 10; α(M)=20.0 3; α(N+..)=6.98 10 α(N)=5.49 8; α(O)=1.291 19; α(P)=0.204 3; α(Q)=0.000543 8 I_γ: from 1974HeYW.
88.06[@] 3	0.006[&] 2	163.76	9/2+	75.706?	7/2+	M1+E2	0.50	12.26	α(L)=9.07 13; α(M)=2.36 4; α(N+..)=0.830 12 α(N)=0.645 9; α(O)=0.1563 22; α(P)=0.0274 4; α(Q)=0.001050 15
101.965 13	0.008 CA	387.41	9/2+	285.460	5/2+	E2		14.42	α(L)=10.46 15; α(M)=2.93 5; α(N+..)=1.025 15 α(N)=0.805 12; α(O)=0.190 3; α(P)=0.0302 5; α(Q)=0.0001088 16 I_γ,E_γ: from ^{239}Am ε decay.
106.123[#] 2	25.34 17	391.586	7/2−	285.460	5/2+	E1(+M2)	−0.007 7	0.26 3	α(L)exp=0.19 3; α(M)exp=0.050 8; α(N+...)exp=0.017 3 α(L)=0.088 8; α(M)=0.0216 21; α(N+..)=0.0074 8 α(N)=0.0058 6; α(O)=0.00139 15; α(P)=0.00023 3; α(Q)=9.4×10^{-6} 15 α: L1/L2=0.87 9/0.93 9 1959Ew90, conversion is anomalous. Other: 1957Ew30, 2008Go10. I_γ: Other value: 26.3% 10, weighted average (Limited Relative Statistical Weight Method) of 25.23% 28 (1996Wo05), 27.4% 4 (1984Va41), 26.4% 8 (1982Ah04), 26.6% 10 (1977St35), and 27.8% 9 (1972Ah02).
106.47[@] 4	0.049[&] 8	163.76	9/2+	57.276	5/2+	E2		11.80	α(L)=8.56 12; α(M)=2.40 4; α(N+..)=0.839 12 α(N)=0.659 10; α(O)=0.1553 22; α(P)=0.0248 4; α(Q)=9.29×10^{-5} 13
124.4	≈0.01	511.81	7/2+	387.41	9/2+	M1(+E2)	<0.26	13.8 4	α(K)=10.7 4; α(L)=2.32 7; α(M)=0.570 22; α(N+..)=0.202 8 α(N)=0.155 6; α(O)=0.0385 14; α(P)=0.00726 19; α(Q)=0.000452 15 Mult.,I_γ: from ^{239}Am ε decay.
166.39[@] 6	0.016[&] 7	330.125	7/2+	163.76	9/2+	M1		6.22	α(K)=4.91 7; α(L)=0.984 14; α(M)=0.239 4; α(N+..)=0.0846 12 α(N)=0.0651 10; α(O)=0.01621 23; α(P)=0.00308 5; α(Q)=0.000202 3
181.70 3	0.082 3	511.81	7/2+	330.125	7/2+	M1+E2	−0.150 7	4.77	α(K)exp=3.0 4; α(L)exp=0.62 8 α(K)=3.75 6; α(L)=0.767 11; α(M)=0.187 3; α(N+..)=0.0661 10

$^{239}_{94}Pu_{145}$-3

γ(^{239}Pu) (continued)

E_γ	I_γ[‡e]	E_i(level)	J^π_i	E_f	J^π_f	Mult.	δ[c]	α[†]	Comments
									α(N)=0.0509 *8*; α(O)=0.01265 *18*; α(P)=0.00240 *4*; α(Q)=0.0001538 *22* I_γ: Other value: 0.0831% 24, weighted average (Limited Relative Statistical Weight Method) of 0.085% *5* (1996Wo05), 0.07% *1* (1984Va41), 0.083% *4* (1982Ah04), and 0.075% *8* (1972Ah02).
209.753[#] *2*	3.363 *20*	285.460	5/2$^+$	75.706?	7/2$^+$	M1(+E2)	0.37[d] *8*	2.93 *13*	α(K)=2.27 *12*; α(L)=0.499 *9*; α(M)=0.1231 *18*; α(N+..)=0.0435 *7* α(N)=0.0335 *5*; α(O)=0.00830 *13*; α(P)=0.00156 *3*; α(Q)=9.3×10^{-5} *5* I_γ: Other value: 3.42% 3, weighted average (Limited Relative Statistical Weight Method) of 3.43% *7* (1996Wo05), 3.46% *5* (1984Va41), 3.30% *10* (1982Ah04), 3.36% *14* (1977St35,1991Po17), and 3.42% *10* (1972Ah02).
226.38 *2*	0.259 *16*	511.81	7/2$^+$	285.460	5/2$^+$	M1+E2	+0.133 *6*	2.58	α(K)=2.03 *3*; α(L)=0.410 *6*; α(M)=0.0998 *14*; α(N+..)=0.0353 *5* α(N)=0.0272 *4*; α(O)=0.00675 *10*; α(P)=0.001282 *18*; α(Q)=8.28×10^{-5} *12* I_γ: weighted average (Limited Relative Statistical Weight Method) of 0.230% *14* (1996Wo05), 0.28% *2* (1984Va41), and 0.24% *3* (1977St35,1991Po17). E_γ: from 1982Ah04.
227.83[f] *CA*	0.51[f] *CA*	391.586	7/2$^-$	163.76	9/2$^+$	[E1]		0.080	α(K)=0.06; α(L)=0.01
228.183[#] *1*	10.730 *87*	285.460	5/2$^+$	57.276	5/2$^+$	M1(+E2)	0.28[d] *7*	2.41 *9*	α(K)=1.88 *8*; α(L)=0.395 *7*; α(M)=0.0967 *15*; α(N+..)=0.0342 *6* α(N)=0.0263 *4*; α(O)=0.00653 *11*; α(P)=0.001233 *23*; α(Q)=7.7×10^{-5} *3* I_γ: After subtracting Iγ=0.51% for the 227.83-keV γ-ray component that deexcites the 391.5-keV level, and Iγ=0.259% 16 for the 226.38-keV γ-ray component from the 511-keV level. I_γ: Other value: 11.14% *11*, weighted average (Limited Relative Statistical Weight Method) of 10.91% *16* (1996Wo05), 11.21% *18* (1984Va41), 11.20% *30* (1982Ah04), 11.78% *44* (1977St35,1991Po17), 11.40% *3* (1972Ah02), after subtracting Iγ=0.51% for the 227.83-keV γ-ray component that deexcites the 391.5-keV level.
254.40[b] *3*	0.1092 *22*	330.125	7/2$^+$	75.706?	7/2$^+$	M1+E2	−0.159 *6*	1.85	α(K)=1.457 *21*; α(L)=0.294 *5*; α(M)=0.0716 *10*; α(N+..)=0.0253 *4* α(N)=0.0195 *3*; α(O)=0.00485 *7*; α(P)=0.000920 *13*; α(Q)=5.93×10^{-5} *9*

$^{239}_{94}$Pu$_{145}$-4

γ(^{239}Pu) (continued)

E_γ	I_γ [‡e]	E_i(level)	J^π_i	E_f	J^π_f	Mult.	δ [c]	α [†]	Comments
									I_γ: Other value: 0.109% 2, weighted average (Limited Relative Statistical Weight Method) of 0.1078% *27* (1996Wo05), 0.12% *1* (1984Va41), 0.110% *6* (1982Ah04), and 0.11% *1* (1972Ah02).
272.84[b] *3*	0.0766 *19*	330.125	7/2+	57.276	5/2+	M1+E2	+0.165 *9*	1.519	α(K)=1.198 *17*; α(L)=0.241 *4*; α(M)=0.0588 *9*; α(N+..)=0.0208 *3* α(N)=0.01599 *23*; α(O)=0.00398 *6*; α(P)=0.000755 *11*; α(Q)=4.86×10^{-5} *7* I_γ: Other value: 0.077% 2, weighted average (Limited Relative Statistical Weight Method) of 0.0762% *24* (1996Wo05), 0.08% *1* (1984Va41), 0.077% *4* (1982Ah04), and 0.08% *1* (1972Ah02).
277.599[#] *1*	14.505 *79*	285.460	5/2+	7.861	3/2+	M1+E2	0.23[d] *10*	1.42 *7*	α(K)=1.12 *6*; α(L)=0.228 *6*; α(M)=0.0555 *13*; α(N+..)=0.0196 *5* α(N)=0.0151 *4*; α(O)=0.00375 *9*; α(P)=0.000711 *19*; α(Q)=4.53×10^{-5} *22* I_γ: Other value: 14.44% 10, weighted average (Limited Relative Statistical Weight Method) of 14.53% *17* (1996Wo05), 14.38% *21* (1984Va41), 14.5% *4* (1982Ah04), 14.30% *24* (1979Mo25), 15.0% *5* (1977St35,1991Po17),14.1% *4* (1974Yu04), and 14.5% *4* (1972Ah02).
285.460[#] *2*	0.7939 *64*	285.460	5/2+	0.0	1/2+	E2		0.247	α(K)=0.0843 *12*; α(L)=0.1190 *17*; α(M)=0.0326 *5*; α(N+..)=0.01145 *16* α(N)=0.00896 *13*; α(O)=0.00213 *3*; α(P)=0.000356 *5*; α(Q)=4.99×10^{-6} *7* I_γ: Other value: 0.79% 1, weighted average (Limited Relative Statistical Weight Method) of 0.797% *10* (1996Wo05), 0.77% *2* (1984Va41), 0.790% *25* (1982Ah04), 0.93% *6* (1977St35,1991Po17), and 0.76% *2* (1972Ah02).
315.880[#] *3*	1.600 *12*	391.586	7/2−	75.706?	7/2+	E1(+M2)	+0.008 *8*	0.0372 *9*	α(K)=0.0294 *6*; α(L)=0.00583 *16*; α(M)=0.00141 *4*; α(N+..)=0.000493 *15* α(N)=0.000382 *12*; α(O)=9.3×10^{-5} *3*; α(P)=1.69×10^{-5} *6*; α(Q)=8.9×10^{-7} *3* I_γ: Other value: 1.60% 2, weighted average (Limited Relative Statistical Weight Method) of 1.604% *20* (1996Wo05), 1.60% *3* (1984Va41), 1.60% *5* (1982Ah04), 1.63% *7* (1977St35,1991Po17), and 1.52% *5* (1972Ah02).
(322.26 *CA*)	0.0052 *CA*	330.125	7/2+	7.861	3/2+	[E2]		0.174	α(K)=0.0691; α(L)=0.0760; α(M)=0.0207; α(N+..)=0.00791 I_γ: from Iγ branchings in ^{239}Am ε decay and ^{243}Cm α decay.

From ENSDF

γ(^{239}Pu) (continued)

E_γ	I_γ [‡e]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	δ [c]	α [†]	Comments
334.310 *2*	2.056 *13*	391.586	7/2⁻	57.276	5/2⁺	E1(+M2)	+0.006 *6*	0.0329 *6*	α(K)=0.0261 *5*; α(L)=0.00511 *10*; α(M)=0.001238 *24*; α(N+..)=0.000432 *9* α(N)=0.000334 *7*; α(O)=8.18×10^{-5} *16*; α(P)=1.48×10^{-5} *3*; α(Q)=7.91×10^{-7} *17* I_γ: Other value: 2.06% 2, weighted average (Limited Relative Statistical Weight Method) of 2.050% *25* (1996Wo05), 2.08% *3* (1984Va41), 2.06% *6* (1982Ah04), 2.10% *10* (1977St35,1991Po17), and 1.95% *7* (1972Ah02). E_γ: from 1974HeYW, 1959Ew90.
392.4[a] *5*	0.0016[a]	556.2	(7/2⁻)	163.76	9/2⁺				
429.5[a] *5*	0.0039[a]	505.2	5/2⁻	75.706?	7/2⁺				
434.7[a] *5*	0.013[a]	492.2	3/2⁻	57.276	5/2⁺	E1(+M2)	−0.002 *2*	0.0190	α(K)=0.01522 *22*; α(L)=0.00287 *4*; α(M)=0.000692 *10*; α(N+..)=0.000242 *4* α(N)=0.000187 *3*; α(O)=4.59×10^{-5} *7*; α(P)=8.41×10^{-6} *12*; α(Q)=4.72×10^{-7} *7*
447.6[a] *5*	0.00026[a]	505.2	5/2⁻	57.276	5/2⁺				
454.2[a] *5*	0.00082[a]	511.81	7/2⁺	57.276	5/2⁺	[M1]		0.383	α(K)=0.304 *5*; α(L)=0.0598 *9*; α(M)=0.01451 *21*; α(N+..)=0.00513 *8* α(N)=0.00395 *6*; α(O)=0.000982 *14*; α(P)=0.000187 *3*; α(Q)=1.217×10^{-5} *18*
461.9[a] *5*	0.0016[a]	469.8	(1/2⁻)	7.861	3/2⁺				
469.8[a] *5*	0.0011[a]	469.8	(1/2⁻)	0.0	1/2⁺				
484.3[a] *5*	0.0010[a]	492.2	3/2⁻	7.861	3/2⁺				
492.3[a] *5*	0.0060[a]	492.2	3/2⁻	0.0	1/2⁺				
497.8[a] *5*	0.0032[a]	505.2	5/2⁻	7.861	3/2⁺				
≈498.7[a]	≈0.001[a]	556.2	(7/2⁻)	57.276	5/2⁺				
504.2[a] *5*	0.00078[a]	511.81	7/2⁺	7.861	3/2⁺	[E2]		0.0516	α(K)=0.0304 *5*; α(L)=0.01559 *23*; α(M)=0.00412 *6*; α(N+..)=0.001449 *21* α(N)=0.001128 *17*; α(O)=0.000272 *4*; α(P)=4.75×10^{-5} *7*; α(Q)=1.386×10^{-6} *20*

† Additional information 2.

‡ Unless otherwise specified, absolute γ-ray intensities are values deduced from thermal neutron activations analysis [^{238}U(n,γ)] combined with absolute intensities measured by several authors, and included as fitted parameters in a least-squares fit (2005Tr08).

\# From 1976BoYH corrected for change in calibration line of Kα_1 x ray of U from 98.440 to 98.4346 eV (cryst). See also 1979Bo30.

@ From 1959Ew90, magnetic spectrometer ce.

& From ce data of 1959Ew90 and theoretical conversion coefficient α.

a From 1965Da04; Ge(Li), $\Delta I\gamma$ estimated by evaluator at 15-30%.

$\gamma(^{239}Pu)$ (continued)

[b] From 1982Ah04.
[c] From 1972Kr07, 1959Ew90, 1990Si12, unless otherwise specified. Other: 1974Pa03.
[d] Deduced by evaluator from conversion electron data of 1991Sh06 in ^{243}Cm α decay.
[e] Absolute intensity per 100 decays.
[f] Multiply placed with intensity suitably divided.

$^{239}_{94}Pu_{145}$-7

^{239}Np β^- decay 1959Ew90,1965Da04,1996Wo05

Decay Scheme

Intensities: I_γ per 100 parent decays
@ Multiply placed: intensity suitably divided