^{149}Pm β^- decay (53.08 h) 1982Me10

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 185, 2 (2022)	23-Aug-2022

Parent: ^{149}Pm: E=0.0; J$^\pi$=7/2$^+$; $T_{1/2}$=53.08 h *9*; Q(β^-)=1071.5 *19*; %β^- decay=100.0
^{149}Pm-J$^\pi$,$T_{1/2}$: From ^{149}Pm Adopted Levels.
^{149}Pm-Q(β^-): From 2021Wa16.
1982Me10: measured γ, $\gamma\gamma$ at LLNL. Mass separated source and Compton suppression spectrometer used for this study.
Others: 1976MiZJ, 1972Ho08, 1972De67, 1971Ba28, 1970Ch09, 1969Gr32, 1966Mc11, 1963Ho15, 1960Ch15, 1960Ar05, 1960Bu06, 1960Sc08.
$\gamma\gamma$-coin: 1976MiZJ, 1966Mc11, 1960Ar05, 1960Sc08.
$\gamma\gamma(\theta)$: 1976MiZJ (semi-scin system). Reanalysis by 1980Mi07.
$\gamma(\theta$,t): 1984Pr04, 1960Ch15.
$\gamma\gamma$(t): 1965Cu01, 1960Ma27.
ce: 1960Ar05, 1960Sc08, 1952Ru10.
References prior to 1960 dealing mainly with production and identification of ^{149}Pm: 1954Fi29, 1952Ki25, 1952Ru10, 1951Ko01, 1949Ma02, 1947Ma28, 1947In06, 1946Bo25, 1941La01.
Following γ rays [Eγ(Iγ)] seen by 1976MiZJ have been omitted by (evaluators) for lack of confirmation: 64.1(0.0033); 239.5(0.19); 278.6(0.0066); 487.0(0.33); 553.4(0.0165); 556.2(0.0033); 605.0(0.01); 920.0; 925.6. A level proposed at 836.8 from 278.6γ and 487.0γ has also been omitted. It may be pointed out that the source material used by 1976MiZJ contained several impurities.
β^- and $\gamma\beta^-$: 1978Re01, 1960Sc08, 1960Ar05, 1960Ch15.
$\beta\gamma(\theta)$: 1980Mi07, 1979Ra11, 1977Mi17.
β^- shape: 1978Re01.
$\beta\gamma$(t): 1968Ak02, 1960Ch15.
The statement "in-beam γ-ray" includes (α,nγ); and (α,3nγ), (^{3}He,4nγ) reactions.
Total decay energy deposit of 1065 keV *4* calculated by RADLIST code is in agreement with expected value of 1071.5 keV *19*, indicating the completeness of the decay scheme.

^{149}Sm Levels

E(level)‡	J$^\pi$†	$T_{1/2}$	Comments
0.0	7/2$^-$	stable	
22.5002 *8*	5/2$^-$		
277.093 *17*	5/2$^-$		
285.948 *10*	9/2$^-$	0.22 ns *4*	$T_{1/2}$: unweighted average of 0.182 ns *7* ($\gamma\gamma$(t),1965Cu01), 0.253 ns *27* ($\beta\gamma$(t),1968Ak02). Other: 1960Ma27.
350.08 *4*	3/2$^-$		
528.54 *9*	3/2$^-$		
558.352 *23*	5/2$^-$		
590.883 *10*	9/2$^-$	3.0 ps *7*	
636.54 *3*	7/2$^-$	<1.5 ps	
664.40 *10*	11/2$^-$		
785.23 *12*	5/2$^-$		
830.38 *4*	(5/2$^-$,7/2,9/2$^-$)		
833.23 *5*			
835.59 *7*	(5/2$^-$,7/2,9/2$^-$)		
881.97 *4*	(5/2,7/2$^-$)		
952.78 *9*	(5/2,7/2,9/2$^-$)		

† From the Adopted Levels.
‡ From least-squares fit to Eγ values. Energy uncertainties of six γ rays were doubled to obtain a fairly acceptable reduced χ^2=2.9 as compared to critical χ^2=1.8. Without this adjustment reduced χ^2 was 5.9.

^{149}Pm β^- decay (53.08 h) 1982Me10 (continued)

β^- radiations

E(decay)	E(level)	Iβ^- [†#]	Log *ft*	Comments
(118.7 *19*)	952.78	0.0015 *2*	8.7 *1*	av Eβ=31.31 *53*
(189.5 *19*)	881.97	0.136 *10*	7.41 *4*	av Eβ=51.52 *56* Measured Eβ=190 *40*, Iβ=0.6 (1960Sc08), Eβ=210 (1978Re01).
(235.9 *19*)	835.59	0.0016 *2*	9.6 *1*	av Eβ=65.34 *58*
(238.3 *19*)	833.23	0.035 *4*	8.31 *5*	av Eβ=66.05 *58*
(241.1 *19*)	830.38	0.052 *5*	8.16 *5*	av Eβ=66.92 *58*
(286.3 *19*)	785.23	0.00037 *7*	10.5 *1*	av Eβ=80.84 *61*
(407.1 *19*)	664.40	0.00077 *11*	10.7[1u] *1*	av Eβ=134.53 *65*
(435.0 *19*)	636.54	0.027 *2*	9.28 *4*	av Eβ=129.30 *65*
(480.6 *19*)	590.883	0.090 *7*	8.90 *4*	av Eβ=144.91 *66* Measured Eβ=470 *40* and Iβ=0.3 (1960Sc08); Eβ=470 (1978Re01).
(513.1 *19*)	558.352	0.035 *3*	9.40 *4*	av Eβ=156.23 *67*
(721.4 *19*)	350.08	0.0013 *3*	11.6[1u] *1*	av Eβ=245.32 *70*
(785.6 *19*)	285.948	3.4 *2*	8.06 *3*	av Eβ=256.28 *73* E(decay): measured Eβ=786 *7* from weighted average of 788 *9* (1960Ar05), 784 *10* (1960Sc08), 770 *50* (1960Ch15). Other: 776 (1978Re01). Iβ^-: from absolute intensity measurement of 286γ (1982Me10,1970Ch09,1966Mc11). Measured Iβ: 2.9 *4* (1960Ar05), 10 *3* (1960Sc08), 11 (1978Re01).
(794.4 *19*)	277.093	0.027 *2*	10.17 *4*	av Eβ=259.67 *73*
(1049.0 *19*)	22.5002	‡		Iβ^-: total β^- feeding to g.s. and 22 level is 95.6% *5*. From the measured endpoint energy it is estimated that feeding to g.s. is >50%, implying <46% β feeding for 22.5-keV level. See also comment with 1071.5β.
(1071.5 *19*)	0.0	95.6[‡] *5*	7.092 *4*	av Eβ=369.20 *78* E(decay): measured Eβ=1067 *5* from weighted average of 1062 *2* (1978Re01), 1072 *2* (1960Ar05), 1064 *8* (1960Sc08), 1050 *50* (1960Ch15). Iβ^-: total β^- feeding to g.s. and 22.5 level. Measured Iβ corresponding to endpoint energy of 1072: 97.1 *4* (1960Ar05), 89 *3* (1960Sc08), 88 (1978Re01), which indicates that a large fraction (probably>50%) of β^- feeding proceeds to the g.s. The shape of 1067β is neither statistical nor characteristic of a unique transition. Log *ft*: combined value for β feedings to 0 and 22 levels.

† From intensity balance at each level.

‡ Total β feeding is 95.6 *5* for 0+22.5 levels. Feeding for the g.s. is estimated as >50% implying <46% for 22.5 level.

Absolute intensity per 100 decays.

γ(^{149}Sm)

Iγ normalization: From absolute intensity (in $4\pi\beta\gamma$ measurement) %Iγ(286γ)=3.1 *2* (1966Mc11).

E_γ	I_γ [†@]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [‡]	δ [‡]	α [&]	Comments
22.5002 *8*	<54	22.5002	5/2$^-$	0.0	7/2$^-$	M1+E2	0.0784 *9*	30.0 *5*	%Iγ≤0.0496 α(L)=23.5 *4*; α(M)=5.17 *8* α(N)=1.155 *18*; α(O)=0.1620 *25*; α(P)=0.00718 *10* E_γ: from ^{149}Eu ε decay (2011In01), γ not observed in ^{149}Pm β^-. I_γ: from Iβ(22.5 level)<46% (see comment for Iβ to 22.5 level). For Iβ(22 level)=0%, Iγ(22γ)≈0.2. Mult.,δ: from ^{149}Eu ε decay; δ(E2/M1) from ce measurements by 2011In01.
72.98 *7*	0.0010 *8*	350.08	3/2$^-$	277.093	5/2$^-$	M1+E2	0.27 *6*	4.42 *12*	%Iγ=3.1×10^{-5} *25* α(K)=3.48 *6*; α(L)=0.73 *10*; α(M)=0.162 *24* α(N)=0.036 *5*; α(O)=0.0051 *6*; α(P)=0.000219 *5*
208.28 *11*	0.047 *3*	558.352	5/2$^-$	350.08	3/2$^-$	M1+E2	−0.45 *15*	0.210 *4*	%Iγ=0.00146 *13* α(K)=0.175 *5*; α(L)=0.0279 *13*; α(M)=0.00606 *33* α(N)=0.00137 *7*; α(O)=0.000199 *7*; α(P)=1.08×10^{-5} *5* δ: from $\gamma(\theta)$ in in-beam γ-ray.
^{x}238.38 *12*	0.007 *1*								%Iγ=0.000217 *34*
242.10 *14*	0.006 *1*	833.23		590.883	9/2$^-$				%Iγ=0.000186 *33*
254.57 *8*	0.17 *1*	277.093	5/2$^-$	22.5002	5/2$^-$	M1+E2	+0.20 *+8−6*	0.1242 *20*	%Iγ=0.0053 *5* α(K)=0.1052 *19*; α(L)=0.01494 *23*; α(M)=0.00321 *5* α(N)=0.000727 *12*; α(O)=0.0001087 *16*; α(P)=6.63×10^{-6} *14* δ: from $\gamma(\theta)$ in in-beam γ-ray.
^{x}257.77 *11*	0.011 *1*								%Iγ=0.00034 *4*
263.23[#] *4*	0.31 *1*	285.948	9/2$^-$	22.5002	5/2$^-$	[E2]		0.0849	%Iγ=0.0096 *7* α(K)=0.0647 *9*; α(L)=0.01571 *22*; α(M)=0.00352 *5* α(N)=0.000782 *11*; α(O)=0.0001063 *15*; α(P)=3.40×10^{-6} *5*
277.09 *2*	0.93 *4*	277.093	5/2$^-$	0.0	7/2$^-$	M1+E2	−0.08 *+1−2*	0.0997 *14*	%Iγ=0.0288 *22* α(K)=0.0847 *12*; α(L)=0.01179 *17*; α(M)=0.002530 *35* α(N)=0.000574 *8*; α(O)=8.61×10^{-5} *12*; α(P)=5.36×10^{-6} *8* δ: from $\gamma(\theta)$ in in-beam γ-ray.
281.24 *3*	0.24 *1*	558.352	5/2$^-$	277.093	5/2$^-$	M1+E2	+0.14 *9*	0.0955 *16*	%Iγ=0.0074 *6* α(K)=0.0811 *14*; α(L)=0.01134 *16*; α(M)=0.002435 *35* α(N)=0.000552 *8*; α(O)=8.27×10^{-5} *12*; α(P)=5.12×10^{-6} *10* Mult.,δ: from ^{149}Eu ε decay. (281γ)(277γ)(θ): A_2=−0.08 *5* (1976MiZJ). Consistent with δ=0.14 from ^{149}Eu ε decay.
285.95 *1*	100	285.948	9/2$^-$	0.0	7/2$^-$	M1(+E2)	+0.06 *6*	0.0917 *13*	%Iγ=3.10 *20* α(K)=0.0780 *11*; α(L)=0.01083 *15*; α(M)=0.002323 *33*

γ(^{149}Sm) (continued)

E_γ	I_γ [†@]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [‡]	δ [‡]	α [&]	Comments
									α(N)=0.000527 *7*; α(O)=7.91×10^{-5} *11*; α(P)=4.93×10^{-6} *7* I_γ: Iγ/100 decays=3.1 *2* (1966Mc11). Others: 1970Ch09, 1960Bu06. δ: from $\gamma(\theta$,t) (1984Pr04). α(K)exp=0.075 *8*, K/L=6.5 *7*, L/M=4 *1* (1960Ar05). Others: α(K)exp=0.16 *5*, K/L=9.0 *15* (1960Sc08), K/L=8.0 *25* (1952Ru10). A_2=+0.097 to +0.30 in $\gamma(\theta$,t) (1984Pr04).
305.22[#] *8*	0.083 *5*	590.883	9/2$^-$	285.948	9/2$^-$	M1(+E2)	+0.15 *15*	0.0767 *18*	%Iγ=0.00257 *23* α(K)=0.0652 *17*; α(L)=0.00909 *13*; α(M)=0.001951 *28* α(N)=0.000442 *6*; α(O)=6.63×10^{-5} *10*; α(P)=4.11×10^{-6} *13* δ: from (305γ)(286γ)(θ): A_2=−0.104 *12*, A_4=−0.004 *15* (1976MiZJ, 1980Mi07).
^{x}314.85 *15*	0.009 *1*								%Iγ=0.00028 *4*
323.95[#] *9*	0.049 *5*	881.97	(5/2,7/2$^-$)	558.352	5/2$^-$				%Iγ=0.00152 *18*
327.53 *7*	0.120 *6*	350.08	3/2$^-$	22.5002	5/2$^-$	M1+E2	+0.14 *3*	0.0637 *9*	%Iγ=0.00372 *30* α(N)=0.000366 *5*; α(O)=5.49×10^{-5} *8*; α(P)=3.41×10^{-6} *5* α(K)=0.0542 *8*; α(L)=0.00753 *11*; α(M)=0.001614 *23* δ: from $\gamma(\theta$,t) in ^{149}Eu decay (1981KrZS).
350.0 *1*	0.0111	350.08	3/2$^-$	0.0	7/2$^-$	E2		0.0352 *5*	%Iγ=0.000344 α(N)=0.000280 *4*; α(O)=3.90×10^{-5} *5*; α(P)=1.539×10^{-6} *22* α(K)=0.0279 *4*; α(L)=0.00566 *8*; α(M)=0.001253 *18* γ not resolved from 350.71γ.
350.71 *7*	0.048 *3*	636.54	7/2$^-$	285.948	9/2$^-$	M1+E2	−0.30 *10*	0.0521 *13*	%Iγ=0.00149 *13* α(K)=0.0441 *12*; α(L)=0.00623 *9*; α(M)=0.001339 *20* α(N)=0.000303 *5*; α(O)=4.53×10^{-5} *7*; α(P)=2.76×10^{-6} *8* δ: from (351γ)(286γ)(θ): A_2=−0.074 *14*, A_4=−0.023 *19* (1976MiZJ,1980Mi07).
353.46 *11*	0.010 *1*	881.97	(5/2,7/2$^-$)	528.54	3/2$^-$				%Iγ=0.00031 *4*
359.57 *7*	0.048 *4*	636.54	7/2$^-$	277.093	5/2$^-$	M1+E2	+0.9 *5*	0.042 *6*	%Iγ=0.00149 *16* α(K)=0.035 *5*; α(L)=0.00556 *24*; α(M)=0.00121 *4* α(N)=0.000272 *10*; α(O)=3.97×10^{-5} *23*; α(P)=2.1×10^{-6} *4* δ: from (360γ)(277γ)(θ): A_2=−0.08 *2* (1976MiZJ).
506.1 *2*	0.004 *1*	528.54	3/2$^-$	22.5002	5/2$^-$	E2+M1	+4.9 *+31−15*	0.0128 *4*	%Iγ=0.000124 *32* α(K)=0.01051 *34*; α(L)=0.00176 *4*; α(M)=0.000385 *8* α(N)=8.65×10^{-5} *18*; α(O)=1.242×10^{-5} *28*; α(P)=6.09×10^{-7} *23* Mult.,δ: from $\gamma(\theta$,t) in ^{149}Eu decay (1981KrZS).
528.6 *2*	0.004 *1*	528.54	3/2$^-$	0.0	7/2$^-$	E2		0.01108 *16*	%Iγ=0.000124 *32*

From ENSDF

γ(^{149}Sm) (continued)

E_γ	I_γ †@	E_i(level)	J_i^π	E_f	J_f^π	Mult.‡	δ‡	α&	Comments
									α(K)=0.00913 *13*; α(L)=0.001528 *21*; α(M)=0.000333 *5* α(N)=7.49×10^{-5} *11*; α(O)=1.076×10^{-5} *15*; α(P)=5.28×10^{-7} *7*
531.61# *6*	0.048 *4*	881.97	(5/2,7/2$^-$)	350.08	3/2$^-$				%Iγ=0.00149 *16*
535.90 *5*	0.37 *2*	558.352	5/2$^-$	22.5002	5/2$^-$	E2+M1	−0.65 *+23−43*	0.0159 *18*	%Iγ=0.0115 *10* α(K)=0.0135 *16*; α(L)=0.00191 *15*; α(M)=0.000410 *31* α(N)=9.3×10^{-5} *7*; α(O)=1.38×10^{-5} *12*; α(P)=8.3×10^{-7} *11* Mult.,δ: from $\gamma(\theta$,t) in ^{149}Eu decay (1981KrZS).
544.27 *6*	0.080 *4*	830.38	(5/2$^-$,7/2,9/2$^-$)	285.948	9/2$^-$				%Iγ=0.00248 *20*
547.17 *7*	0.052 *4*	833.23		285.948	9/2$^-$				%Iγ=0.00161 *16*
550.01 *15*	0.006 *1*	835.59	(5/2$^-$,7/2,9/2$^-$)	285.948	9/2$^-$				%Iγ=0.000186 *33*
552.92# *9*	0.019 *1*	830.38	(5/2$^-$,7/2,9/2$^-$)	277.093	5/2$^-$				%Iγ=0.00059 *5*
558.37 *4*	0.49 *3*	558.352	5/2$^-$	0.0	7/2$^-$	M1+E2	+1.5 *5*	0.0117 *13*	%Iγ=0.0152 *14* α(K)=0.0098 *12*; α(L)=0.00148 *11*; α(M)=0.000321 *23* α(N)=7.2×10^{-5} *5*; α(O)=1.06×10^{-5} *9*; α(P)=5.9×10^{-7} *8*
568.36 *7*	0.60 *4*	590.883	9/2$^-$	22.5002	5/2$^-$	E2		0.00919 *13*	%Iγ=0.0186 *17* α(K)=0.00761 *11*; α(L)=0.001240 *17*; α(M)=0.000270 *4* α(N)=6.07×10^{-5} *8*; α(O)=8.76×10^{-6} *12*; α(P)=4.42×10^{-7} *6*
^{x}571.08 *9*	0.078 *7*								%Iγ=0.00242 *27*
590.88 *1*	2.23 *9*	590.883	9/2$^-$	0.0	7/2$^-$	E2+M1	−1.5 *+9−4*	0.0101 *25*	%Iγ=0.069 *5* α(K)=0.0085 *22*; α(L)=0.00127 *22*; α(M)=0.00027 *5* α(N)=6.2×10^{-5} *11*; α(O)=9.1×10^{-6} *17*; α(P)=5.1×10^{-7} *15*
^{x}598.42 *15*	0.007 *1*								%Iγ=0.000217 *34*
613.92 *6*	0.48 *3*	636.54	7/2$^-$	22.5002	5/2$^-$				%Iγ=0.0149 *13*
636.50 *5*	0.30 *2*	636.54	7/2$^-$	0.0	7/2$^-$	M1+E2	−0.30 *+16−18*	0.0114 *5*	%Iγ=0.0093 *9* α(K)=0.0097 *5*; α(L)=0.00132 *5*; α(M)=0.000282 *11* α(N)=6.40×10^{-5} *24*; α(O)=9.6×10^{-6} *4*; α(P)=6.02×10^{-7} *31*
664.4 *1*	0.025 *3*	664.40	11/2$^-$	0.0	7/2$^-$	E2		0.00624 *9*	%Iγ=0.00078 *11* α(K)=0.00521 *7*; α(L)=0.000808 *11*; α(M)=0.0001752 *25* α(N)=3.94×10^{-5} *6*; α(O)=5.74×10^{-6} *8*; α(P)=3.06×10^{-7} *4*
785.23 *12*	0.012 *2*	785.23	5/2$^-$	0.0	7/2$^-$				%Iγ=0.00037 *7*

γ(^{149}Sm) (continued)

E_γ	I_γ[†@]	E_i(level)	J^π_i	E_f	J^π_f	Comments
808.11[#]	0.53 *4*	830.38	(5/2$^-$,7/2,9/2$^-$)	22.5002	5/2$^-$	%Iγ=0.0164 *16*
812.92	0.010 *1*	835.59	(5/2$^-$,7/2,9/2$^-$)	22.5002	5/2$^-$	%Iγ=0.00031 *4*
^{x}824.3 *2*	0.004 *1*					%Iγ=0.000124 *32*
830.53 *7*	1.05 *8*	830.38	(5/2$^-$,7/2,9/2$^-$)	0.0	7/2$^-$	%Iγ=0.0325 *32*
833.40 *7*	1.07 *8*	833.23		0.0	7/2$^-$	%Iγ=0.0332 *33*
835.55 *11*	0.035 *3*	835.59	(5/2$^-$,7/2,9/2$^-$)	0.0	7/2$^-$	%Iγ=0.00108 *12*
859.46 *6*	3.5 *1*	881.97	(5/2,7/2$^-$)	22.5002	5/2$^-$	%Iγ=0.108 *8*
881.98 *5*	0.77 *3*	881.97	(5/2,7/2$^-$)	0.0	7/2$^-$	%Iγ=0.0239 *18*
^{x}915.5 *3*	0.0003 *1*					%Iγ=9.3×10^{-6} *32*
930.2 *2*	0.019 *3*	952.78	(5/2,7/2,9/2$^-$)	22.5002	5/2$^-$	%Iγ=0.00059 *10*
^{x}950.6 *2*	0.007 *2*					%Iγ=0.00022 *6*
952.8 *1*	0.028 *3*	952.78	(5/2,7/2,9/2$^-$)	0.0	7/2$^-$	%Iγ=0.00087 *11*
^{x}964.4 *5*	0.00010 *3*					%Iγ=3.1×10^{-6} *10*
^{x}969.6 *5*	0.00010 *3*					%Iγ=3.1×10^{-6} *10*

† 3% uncertainty added (evaluators) in quadrature to uncertainties given by 1982Me10.
‡ From the Adopted Gammas, where the assignments are from ce data in ^{149}Eu decay and $\gamma(\theta)$, γ(lin pol) data in in-beam γ-ray.
# Uncertainty doubled for fitting purpose, as the Eγ fits poorly.
@ For absolute intensity per 100 decays, multiply by 0.031 *2*.
& Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.
^{x} γ ray not placed in level scheme.

^{149}Pm β^- decay (53.08 h) 1982Me10

Decay Scheme

Intensities: I_γ per 100 parent decays