^{139}Eu ε decay (17.9 s) 1986Re11,1986De35

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	P. K. Joshi, B. Singh, S. Singh, A. K. Jain	NDS 138, 1 (2016)	15-Oct-2016

Parent: ^{139}Eu: E=0.0; $J^\pi=(11/2)^-$; $T_{1/2}$=17.9 s *6*; Q(ε)=6982 *17*; %ε+%$β^+$ decay=100.0

^{139}Eu-Q(ε): From 2012Wa38.

1986De35: ^{139}Eu produced in ^{144}Sm(p,6n),E=50-90 MeV. Identification by means of $T_{1/2}$≈22 s, production threshold energy, and constancy of Iγ as a function of bombarding energies. Measured Eγ, Iγ and x rays, γγ, isomer half-life, ce. The isomer half-life measured over a period of ≈200 s; two groups, one with $T_{1/2}$ of 17.9 s *6* and one with a feeding $T_{1/2}$ of 17.9 s *6* and α decay $T_{1/2}$ of 10.7 s *6*.

1986Re11: ^{139}Eu produced in ^{112}Sn(^{32}S,3p2n),E=170 MeV and ^{106}Cd(^{35}Cl,2p),E=191 MeV reactions. Identification by means of γ rays observed in ^{139}Sm IT decay. Measured half-life; He jet.

1975Va14: measured β spectra, βγ-coin, γ spectra, ce; deduced shape implications for unhindered $11/2^-$ to $11/2^-$ β transition.

All data are from 1986De35, except as noted.

^{139}Sm Levels

E(level)†	J^π‡	$T_{1/2}$‡	Comments
0.0	$1/2^+$	2.57 min *10*	%ε+%$β^+$=100 $T_{1/2}$ and decay modes from Adopted Levels.
111.92 *14*	$3/2^+$		
223.50 *13*	$(3/2)^+$		
267.29 *13*	$5/2^+$		
457.37 *23*	$11/2^-$	10.7 s *6*	%ε+%$β^+$=6.3 *5*; %IT=93.7 *5* $T_{1/2}$ and decay modes from Adopted Levels.
(531.4 *4*)	$5/2^+$		E(level): from Adopted Levels.
589.6 *3*	$(9/2)^-$		
686.7 *4*			
720.75 *20*	$(7/2^+)$		
786.8 *5*			
920.1 *8*			
1020.2 *6*			
1158.5 *4*			
1176.4 *5*			
1380.3 *4*			

† ΔEγ=0.5 keV assumed in least-squares analysis when not given.

‡ From the Adopted Levels.

ε,$β^+$ radiations

The β feedings and log *ft* values are considered as apparent as the decay scheme seems poorly known.

E(decay)	E(level)	I$β^+$ †	Iε†	Log *ft*	I(ε+$β^+$)†	Comments
(5602 *17*)	1380.3	11 *3*	2.0 *6*	5.3	13 *4*	av Eβ=2096.8 *95*; εK=0.1324 *15*; εL=0.01890 *21*; εM+=0.00543 *6*
(5806 *17*)	1176.4	16 *3*	2.7 *4*	5.2	19 *3*	av Eβ=2193.1 *95*; εK=0.1189 *13*; εL=0.01696 *18*; εM+=0.00487 *6*
(5824 *17*)	1158.5	13 *3*	2.1 *6*	5.3	15 *4*	av Eβ=2201.6 *95*; εK=0.1178 *13*; εL=0.01680 *18*; εM+=0.00483 *5*
(5962 *17*)	1020.2	3.2 *16*	0.48 *23*	6.0	3.7 *18*	av Eβ=2267.1 *95*; εK=0.1097 *12*; εL=0.01564 *17*; εM+=0.00449 *5*
(6062 *17*)	920.1	11 *4*	1.5 *6*	5.5	12 *5*	av Eβ=2314.6 *95*; εK=0.1042 *11*; εL=0.01486 *16*;

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^{139}Eu ε decay (17.9 s) 1986Re11,1986De35 (continued)

ε,β+ radiations (continued)

E(decay)	E(level)	Iβ+ †	Iε†	Log *ft*	I(ε+β+)†	Comments
						εM+=0.00427 *5*
(6195 *17*)	786.8	6 *3*	0.8 *3*	5.8	7 *3*	av Eβ=2377.8 *95*; εK=0.0975 *10*; εL=0.01390 *14*; εM+=0.00399 *4*
(6261 *17*)	720.75	18 *5*	5.2 *16*	7.2[1u]	23 *7*	av Eβ=2374.1 *93*; εK=0.1895 *18*; εL=0.0274 *3*; εM+=0.00788 *8*
(6295‡ *17*)	686.7	<4.1	<1.2	>7.8[1u]	<5.3	av Eβ=2389.8 *93*; εK=0.1866 *18*; εL=0.0269 *3*; εM+=0.00775 *8* Iβ+,Iε,I(ε+β+): upper limit with 90% confidence level has been estimated by evaluators for I(ε+β+)=−1 *4* (from gamma-ray transition intensity balance).
(6392‡ *17*)	589.6	<14	<1.7	≥5.5	<16	av Eβ=2471.6 *96*; εK=0.0885 *9*; εL=0.01261 *13*; εM+=0.00362 *4* Iβ+,Iε,I(ε+β+): upper limit with 90% confidence level has been estimated by evaluators for I(ε+β+)=−15 *4* (from gamma-ray transition intensity balance).
(6525 *17*)	457.37					av Eβ=2534.6 *96*; εK=0.0831 *8*; εL=0.01184 *12*; εM+=0.00340 *4* Measured Eβ=5622 *50*. I(ε+β+): not known since it is time-dependent.

† Absolute intensity per 100 decays.
‡ Existence of this branch is questionable.

γ(^{139}Sm)

Iγ normalization: From summed transition intensity balances=100 for levels above the 457-keV isomer. The normalization factor is treated as approximate as the decay scheme seems incomplete.

Eγ	Iγ[e]	Ei(level)	J_i^π	Ef	J_f^π	Mult.†	δ†	α[d]	Comments
43.8‡# *1*	*c*	267.29	5/2+	223.50	(3/2)+	(E2)		57.7 *11*	ce(L)/(γ+ce)=0.762 *9*; ce(M)/(γ+ce)=0.178 *4*; ce(N)/(γ+ce)=0.0387 *10*; ce(O)/(γ+ce)=0.00473 *12*; ce(P)/(γ+ce)=4.96×10^{-6} *12* Particle normalization/$T_{1/2}$=0.0434 *11* $I_{(\gamma+ce)}$: 10.2 *15* (1986De35).
111.6‡ *2*	*c*@	223.50	(3/2)+	111.92	3/2+	[M1,E2]		1.41 *18*	α(K)=0.96 *9*; α(L)=0.35 *20*; α(M)=0.08 *5*; α(N)=0.017 *11*; α(O)=0.0023 *13*; α(P)=5.2×10^{-5} *15* I_γ: 12 *3* (1986De35).
111.9‡ *2*	*c*@	111.92	3/2+	0.0	1/2+	M1(+E2)	<0.50	1.26 *4*	α(K)=1.022 *23*; α(L)=0.19 *4*; α(M)=0.041 *10*; α(N)=0.0092 *21*; α(O)=0.00131 *24* α(P)=6.3×10^{-5} *3* I_γ: 142 *16* (1986De35).
132.2 *2*	90 *20*	589.6	(9/2)−	457.37	11/2−	(M1)		0.764	α(K)=0.648 *10*; α(L)=0.0915 *14*; α(M)=0.0197 *3*; α(N)=0.00446 *7*; α(O)=0.000668 *10* α(P)=4.13×10^{-5} *6*

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^{139}Eu ε decay (17.9 s) 1986Re11,1986De35 (continued)

γ(^{139}Sm) (continued)

E_γ	I_γ[e]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[†]	α[d]	Comments
155.3[‡] 2	c@	267.29	5/2+	111.92	3/2+	M1	0.486	α(K)=0.412 6; α(L)=0.0581 9; α(M)=0.01247 18; α(N)=0.00283 4; α(O)=0.000424 7 α(P)=2.63×10^{-5} 4 I_γ: 204 22 (1986De35).
189.4[#] 4	97 22	720.75	(7/2+)	531.4?	5/2+	(M1)	0.280 5	α(K)=0.238 4; α(L)=0.0334 5; α(M)=0.00716 11; α(N)=0.001624 25; α(O)=0.000244 4 α(P)=1.513×10^{-5} 23 Placement from ^{110}Pd(^{34}S,5nγ) (evaluators). I_γ: from Iγ(190γ)/Iγ(454)=0.97 22 in ^{110}Pd(^{34}S,5nγ) and Iγ(453γ)=100 (evaluators).
190.1[‡] 2	c&	457.37	11/2−	267.29	5/2+	E3	1.516	α(K)=0.650 10; α(L)=0.668 10; α(M)=0.1588 24; α(N)=0.0350 6; α(O)=0.00442 7 α(P)=3.30×10^{-5} 5 $I_{(\gamma+ce)}$: 417 51 (from intensity balance).
197.2[#] 4	40 15	786.8		589.6	(9/2)−	[D,E2]	0.15 10	α(K)=0.13 9; α(L)=0.027 22; α(M)=0.006 5
223.5[‡] 2	c@	223.50	(3/2)+	0.0	1/2+	(M1+E2)	0.161 18	α(K)=0.129 23; α(L)=0.025 5; α(M)=0.0056 11; α(N)=0.00125 22; α(O)=0.000176 22 α(P)=7.5×10^{-6} 21 I_γ: 46 10 (1986De35).
(263.9[a])	19[b] 6	(531.4)	5/2+	267.29	5/2+	[M1,E2]	0.099 15	α(K)=0.080 17; α(L)=0.0145 11; α(M)=0.0032 3; α(N)=0.00071 6; α(O)=0.000102 4 α(P)=4.7×10^{-6} 14
267.3[‡] 2	c@	267.29	5/2+	0.0	1/2+	E2	0.0808	α(K)=0.0618 9; α(L)=0.01483 22; α(M)=0.00332 5; α(N)=0.000738 11; α(O)=0.0001005 15 α(P)=3.25×10^{-6} 5 I_γ: 204 24 (1986De35).
299.5[#] 5	25 12	1020.2		720.75	(7/2+)			
330.5[#] 7	80 30	920.1		589.6	(9/2)−			
419.5[#] 5	20 10	686.7		267.29	5/2+			
(420.3[a])	85[b] 19	(531.4)	5/2+	111.92	3/2+	(M1)	0.0335	α(K)=0.0286 4; α(L)=0.00391 6; α(M)=0.000838 12; α(N)=0.000190 3; α(O)=2.85×10^{-5} 4 α(P)=1.79×10^{-6} 3
437.7[#] 4	60 25	1158.5		720.75	(7/2+)			
453.4 2	100	720.75	(7/2+)	267.29	5/2+	(M1)	0.0276	α(K)=0.0235 4; α(L)=0.00321 5; α(M)=0.000688 10; α(N)=0.0001560 22; α(O)=2.35×10^{-5} 4 α(P)=1.476×10^{-6} 21
463.4[#] 5	15 7	686.7		223.50	(3/2)+			
[x]486.5[#] 4								
497.2 3	58 12	720.75	(7/2+)	223.50	(3/2)+	[E2]	0.01302	α(K)=0.01068 15; α(L)=0.00183 3; α(M)=0.000401 6; α(N)=8.98×10^{-5} 13; α(O)=1.286×10^{-5} 19

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^{139}Eu ε decay (17.9 s) 1986Re11,1986De35 (continued)

γ(^{139}Sm) (continued)

E_γ	I_γ[e]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[†]	α[d]	Comments
								α(P)=6.14×10^{-7} *9* Not observed in ^{110}Pd(^{34}S,5nγ).
(531.5[a])	21[b] *7*	(531.4)	5/2$^+$	0.0	1/2$^+$	E2	0.01092	α(K)=0.00900 *13*; α(L)=0.001504 *21*; α(M)=0.000328 *5*; α(N)=7.37×10^{-5} *11* α(O)=1.059×10^{-5} *15*; α(P)=5.21×10^{-7} *8*
659.5 *3*	46 *10*	1380.3		720.75	(7/2$^+$)			
693.8# *4*	40 *20*	1380.3		686.7				
701.2 *4*	42 *8*	1158.5		457.37	11/2$^-$			
719.0 *4*	130 *20*	1176.4		457.37	11/2$^-$			
[x]741.2# *3*								

† From Adopted Gammas.
‡ From ^{139}Sm IT decay.
# Observed clearly only in the coincidence spectrum.
@ From adopted branching ratios, α, and ΣI(γ+ce) feeding level. Strong direct feeding of (11/2)$^-$ level indicates levels below 457 are not directly fed (evaluators).
& From I(γ+ce) and α.
a From Adopted Gammas.
b From Iγ(1+α)(189γ) and adopted branching ratios and α′s.
c Value is not given due to their time-dependency arising from comparable half-lives of the ^{139}Eu parent (17.9 s) and 10.7-s isomer at 457 keV in ^{139}Sm populated in this decay. Apparent values from intensity balances are given under comments.
d Theoretical values from BrIcc code. When δ(E2/M1) is not given, listed value overlaps those for pure M1 and for pure E2.
e For absolute intensity per 100 decays, multiply by ≈0.15.
x γ ray not placed in level scheme.

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Legend

- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)
- Coincidence
- Coincidence (Uncertain)

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays