^{135}Pm ε decay (45 s) 1989Vi04,1989Ko07

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh, Alexander A. Rodionov And Yuri L. Khazov	NDS 109, 517 (2008)	22-Jan-2008

Parent: ^{135}Pm: E=68.7+y; J^π=(11/2$^-$); $T_{1/2}$=45 s *4*; Q(ε)=6240 *60*; %ε+%$β^+$ decay=100.0

^{135}Pm-E: systematics (see figure 3 in 1993BrZU) suggest 11/2$^-$ as g.s. of ^{135}Pm. However, experimental evidence is lacking, as to which of the two activities (45 s or 49 s) corresponds to the ground state. See also comment for the 49-s isomer labeled 0.0+x. If 0+x is the ground state, then (11/2$^-$) state may be at an absolute energy of 68.7 keV. 2003Au03 give 50 *100* from systematics.

1989Vi04: ^{135}Pm produced by ^{92}Mo(^{46}Ti,3p) E=192 MeV followed by on-line mass separation and from decay of ^{135}Sm. Measured $T_{1/2}$, Eγ, Iγ, γγ, Xγ coin, β+γ coin.

1989Ko07: ^{135}Pm produced by ^{92}Mo(^{46}Ti,3p) E=250, 240 MeV and ^{112}Sn(^{28}Si,3p2n) E=190 MeV followed by on-line mass separation. Measured $T_{1/2}$, γ rays, ce, γγ, γce.

1995Ve08: measured $β^+$ end-point energies, deduced Q value.

Others: 1982AlZO, 1977Bo02, 1975Va14. 1977Bo02 reported five γ rays from ^{135}Pm decay and 1982AlZO reported 33 γ rays.

The ε+$β^+$ feedings and associated log *ft* values are given by 1989Vi04 as limits based on their proposed level scheme, but in the absence of clear separation between the level schemes for the two activities (45 s and 49 s), the evaluators consider the available data to be insufficient to determine such values reliably.

E($β^+$ endpoint)=4920 *150* (to g.s. and 198.8 level) (1995Ve08).

The separation of the decay schemes from the two activities is not considered as well established by the evaluators due to the two half-lives being close in value. In the work of 1989Vi04 this separation was based mainly on the decay pattern to high- and low-spin states in the daughter nucleus from the parent activities with spins (11/2$^-$) and (3/2$^+$,5/2$^+$). 1989Vi04 state that low-spin isomer in their work is mainly populated from the decay of ^{135}Sm whereas the high-spin isomer is populated in heavy-ion reaction. The growth and decay properties of certain γ rays for example that of 128.8γ clearly show the presence of two activities.

Total decay energy of 2589 keV *125* calculated (by RADLIST code) from level scheme is much lower than the expected value of 6240 keV *60*.

The decay scheme has not been normalized for Iγ/100 decays of the parent since the populated levels are known only up to about 1360; whereas, the Q value is 6240. Also no data exist for transition multipolarities and for ε+$β^+$ feeding to g.s. The decay scheme as given by 1989Vi04 implies Iγ normalization=0.3, based on I(ε+$β^+$)(to g.s.)<12%.

^{135}Nd Levels

E(level)[†]	J^π[‡]	Comments
0.0	9/2$^{(-)}$	
64.97 *24*	(1/2$^+$)	
193.6 *3*	(3/2$^+$)	
198.77 *14*	(11/2$^-$)	
273.05 *25*	(3/2,5/2)	
328.1 *3*	(1/2$^+$)	
371.13 *22*	(5/2$^+$)	
463.65 *25*	(5/2$^+$)	
493.17 *18*	(7/2,9/2,11/2)	
560.92 *20*	(13/2$^-$)	
564.19 *25*		
713.00 *15*	(7/2$^+$)	
717.1? *5*		Level proposed by 1989Ko07 only.
826.3? *10*		Level proposed by 1989Ko07 only.
1176.77 *16*		
1214.97 *25*		
1357.8 *5*		Level from 1989Ko07.

[†] From least-squares fit to Eγ's.

[‡] From 'Adopted Levels'.

^{135}Pm ε decay (45 s) 1989Vi04,1989Ko07 (continued)

γ(^{135}Nd)

The following γ rays reported by 1982AlZO were not confirmed by 1989Ko07 and 1989Vi04: 108.3 *2* (≈6), 140.2 *3* (4 *1*), 150.5 *3* (≈3), 688.0 *4* (5 *1*), 802.4 *3* (11 *2*), 813.7 *2* (26 *2*), 952.2 *14* (≈2), 962.0 *10* (≈5), 988.2 *5* (9 *2*), 1214.7 *5* (≈6), 1364.1 *5* (≈8).
Measurements of Eγ and Iγ are from a composite source of two isomers.

E_γ [†]	I_γ [‡]	E_i(level)	J_i^π	E_f	J_f^π	Comments
98.1 *2*	≈2 [@]	371.13	(5/2$^+$)	273.05	(3/2,5/2)	
128.8 *2*	≈4 [@]	193.6	(3/2$^+$)	64.97	(1/2$^+$)	
135.5 *5*	≈0.01 [@]	328.1	(1/2$^+$)	193.6	(3/2$^+$)	
135.5 *5*	≈0.2 [@]	463.65	(5/2$^+$)	328.1	(1/2$^+$)	
177.4 *3*	≈2 [@]	371.13	(5/2$^+$)	193.6	(3/2$^+$)	
190.6 *5*	≈0.2 [@]	463.65	(5/2$^+$)	273.05	(3/2,5/2)	
198.8 *2*	100 *10*	198.77	(11/2$^-$)	0.0	9/2$^{(-)}$	
208.1 *2*	≈11 [@]	273.05	(3/2,5/2)	64.97	(1/2$^+$)	
219.9 *3*	6 *3*	713.00	(7/2$^+$)	493.17	(7/2,9/2,11/2)	
[x]245.0 [#] *4*	9 *3*					Coincidences with 342γ and 493γ suggest this γ is from the decay of 45-s activity of ^{135}Pm.
249.3 *3*	11 *3*	713.00	(7/2$^+$)	463.65	(5/2$^+$)	
262.9 *2*	≈0.2 [@]	328.1	(1/2$^+$)	64.97	(1/2$^+$)	
270.0 *2*	≈5 [@]	463.65	(5/2$^+$)	193.6	(3/2$^+$)	
306.2 *2*	≈10 [@]	371.13	(5/2$^+$)	64.97	(1/2$^+$)	
341.9 *2*	20 *5*	713.00	(7/2$^+$)	371.13	(5/2$^+$)	
[x]357.0 [#] *4*	6 *2*					
362.2 *2*	17 *3*	560.92	(13/2$^-$)	198.77	(11/2$^-$)	E_γ: 362.8 (1989Ko07). I_γ: 6 *1* for Eγ=361.8 (1982AlZO).
365.4 *4*	6 *3*	564.19		198.77	(11/2$^-$)	E_γ: 366.8 (1989Ko07).
398.7 *2*	≈5 [@]	463.65	(5/2$^+$)	64.97	(1/2$^+$)	
439.9 *4*	7 *3*	713.00	(7/2$^+$)	273.05	(3/2,5/2)	This γ was shown (by 1989Ko07) to deexcite a separate level at 712.4.
463.8 *2*	64 *5*	1176.77		713.00	(7/2$^+$)	
493.2 *2*	30 *5*	493.17	(7/2,9/2,11/2)	0.0	9/2$^{(-)}$	
514.0		713.00	(7/2$^+$)	198.77	(11/2$^-$)	Reported by 1989Ko07 only.
518.3 *4*	8 *3*	717.1?		198.77	(11/2$^-$)	E_γ: from 1989Vi04. Placement from 1989Ko07. Coincidence with 129γ (1989Vi04) does not support this placement. Unplaced in 1989Vi04.
560.8 *3*	12 *3*	560.92	(13/2$^-$)	0.0	9/2$^{(-)}$	E_γ: 561.5 (1989Ko07).
564.2 *3*	22 *5*	564.19		0.0	9/2$^{(-)}$	γ reported by 1989Vi04 only, considered uncertain by the evaluators.
[x]582.8 [#] *3*	11 *3*					
627.5		826.3?		198.77	(11/2$^-$)	E_γ: from 1989Ko07. Eγ=628.9 *4*, Iγ≈7 (1982AlZO). γ not reported by 1989Vi04.
644.8		1357.8		713.00	(7/2$^+$)	
713.0 *2*	30 *5*	713.00	(7/2$^+$)	0.0	9/2$^{(-)}$	
978.0 *2*	40 *5*	1176.77		198.77	(11/2$^-$)	
1016.2 *2*	11 *3*	1214.97		198.77	(11/2$^-$)	
[x]1078.0 [#] *5*	10 *5*					
1159.0 *5*	6 *2*	1357.8		198.77	(11/2$^-$)	E_γ: from 1989Vi04. Placement from 1989Ko07. Unplaced in 1989Vi04.
1176.7 *3*	33 *5*	1176.77		0.0	9/2$^{(-)}$	I_γ: 19 *2* for Eγ=1177.0 (1982AlZO).

Continued on next page (footnotes at end of table)

^{135}Pm ε decay (45 s) 1989Vi04,1989Ko07 (continued)

γ(^{135}Nd) (continued)

† From 1989Vi04, unless otherwise stated.
‡ From 1989Vi04. No Iγ's were given by 1989Ko07. Other: 1982AlZO.
# From 1989Vi04 only. The γ ray belongs to the decay of either of the two isomers.
@ Estimated (by the evaluators) intensity (from intensity balance). For low energy transitions mult=M1,E2 was assumed. No ε+β^+ feeding is expected from (11/2$^-$) parent state to the low-spin levels involved.
x γ ray not placed in level scheme.

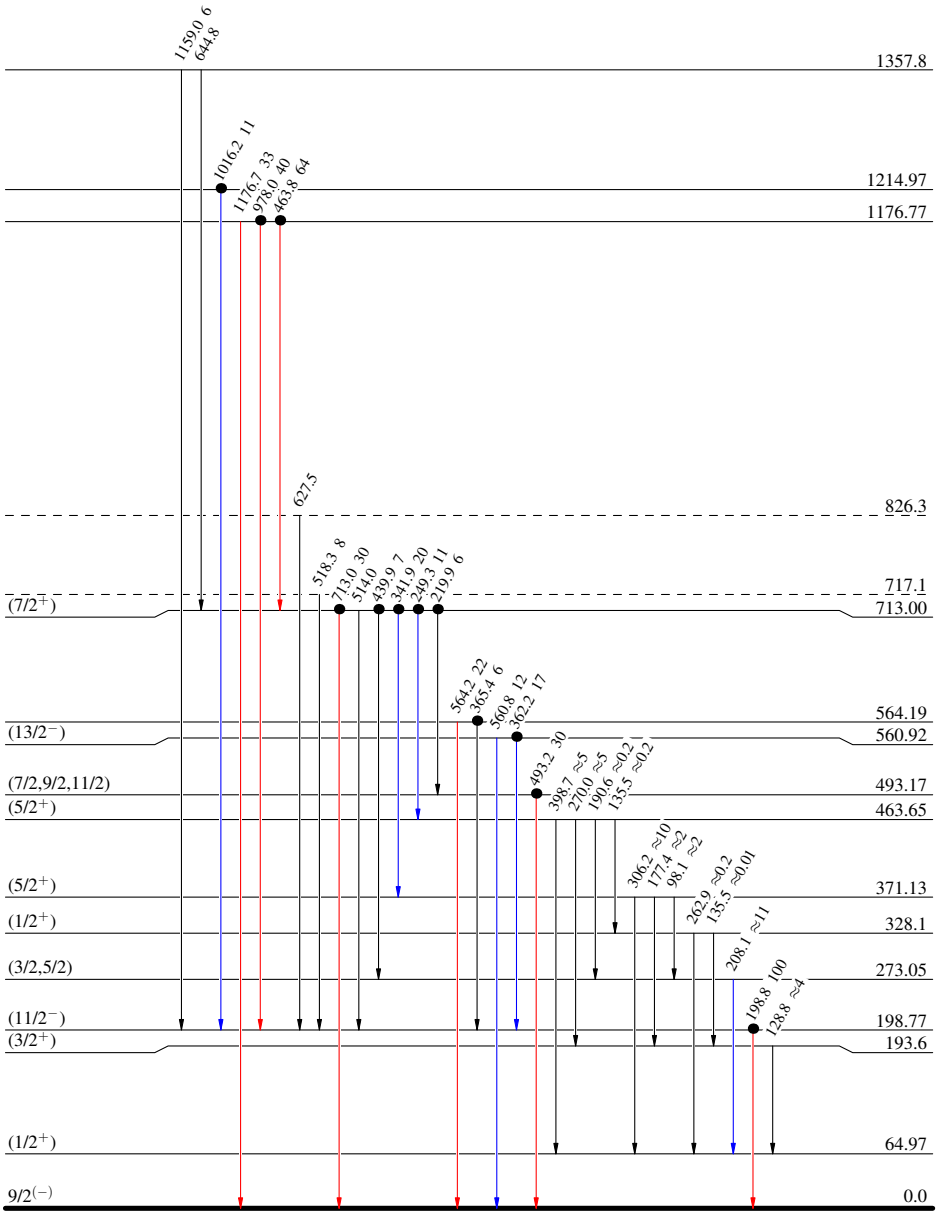
^{135}Pm ε decay (45 s) 1989Vi04,1989Ko07

Decay Scheme

Intensities: Relative I_γ

Legend
- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- Coincidence

$^{135}_{61}Pm_{74}$ (11/2⁻) 68.7+y 45 s 4
%ε+%β⁺=100 Qε=6240 60



$^{135}_{60}Nd_{75}$