$^{148m}_{61}\mathrm{Pm}_{87}$

1 Decay Scheme

Pm-148m decays 94.4 (5) % via beta minus emission to four excited levels of Sm-148, and via an isomeric transition of 5.6 (5) %.

Le prométhéum 148m se désintègre 94,4 (5) % par émission bêta vers quatre niveaux excités du samarium 148 et 5,6 (5) % par transition isomerique.

2 Nuclear Data

$T_{1/2}(^{148m}\mathrm{Pm})$	:	41,29	(13)	d
$T_{1/2}(^{148}\mathrm{Pm})$	:	5,370	(15)	d
$Q^-(^{148m}\mathrm{Pm})$	:	2608	(6)	keV
$Q^{IT}(^{148m}\mathrm{Pm})$	:	137	(3)	keV

2.1 β^- Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta^-_{0,9}$	414 (6)	54,0 (9)	1st Forbidden	7,18
$\beta^-_{0,8}$	513 (6)	18,1 (9)	1st Forbidden	7,96
$\beta^-_{0,7}$	702 (6)	21,8 (7)	1st Forbidden	8,35
$\beta^-_{0,4}$	1014 (6)	0,93 (45)	Allowed	10,29

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	$P_{\gamma+ce}$ (%)	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{2,1}$(Pm)	61,30 (5)	5,6 (5)	E4	30 (5)	10000 (4000)	2900 (1200)	14000 (6000)
$\gamma_{1,0}$(Pm)	75,8 (1)	5,6 (5)	M1	2,9 (4)	0,41 (6)	0,088 (11)	3,4 (5)
$\gamma_{9,8}$(Sm)	98,48 (6)	8,1 (7)	M1+3%E2	1,488 (21)	0,236 (4)	0,0511 (8)	1,79 (3)
$\gamma_{8,7}$(Sm)	189,63 (6)	1,44 (8)	E2	0,1769 (25)	0,0565 (8)	0,01284 (18)	0,249 (4)

	Energy (keV)	$P_{\gamma+ce}$ (%)	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{9,7}$(Sm)	288,11 (6)	13,1 (4)	M1+0,8%E2	0,0763 (11)	0,01062 (15)	0,00228 (4)	0,0898 (13)
$\gamma_{9,6}$(Sm)	299,12 (13)	0,14 (4)	E2	0,0442 (7)	0,00982 (14)	0,00219 (3)	0,0567 (8)
$\gamma_{7,4}$(Sm)	311,63 (6)	3,82 (11)	E1	0,01141 (16)	0,001546 (22)	0,000330 (5)	0,01337 (19)
$\gamma_{8,5}$(Sm)	362,09 (6)	0,176 (13)	E2	0,0253 (4)	0,00504 (7)	0,001114 (16)	0,0318 (5)
$\gamma_{4,3}$(Sm)	414,07 (6)	18,47 (33)	E1+0,017%M2	0,00572 (9)	0,000766 (13)	0,000163 (3)	0,00670 (11)
$\gamma_{4,2}$(Sm)	432,78 (6)	5,29 (13)	E2	0,01544 (22)	0,00281 (4)	0,000617 (9)	0,0190 (3)
$\gamma_{9,5}$(Sm)	460,57 (6)	0,41 (1)	E2	0,01306 (19)	0,00231 (4)	0,000507 (7)	0,01601 (23)
$\gamma_{8,4}$(Sm)	501,26 (6)	6,62 (11)	E1+0,029%M2	0,00369 (7)	0,000489 (9)	0,0001042 (20)	0,00431 (8)
$\gamma_{1,0}$(Sm)	550,27 (3)	94,4 (5)	E2	0,00825 (12)	0,001360 (19)	0,000296 (5)	0,00998 (14)
$\gamma_{5,3}$(Sm)	553,24 (6)	0,35 (4)	M1+73%E2	0,0098 (4)	0,00150 (4)	0,000324 (8)	0,0117 (4)
$\gamma_{5,2}$(Sm)	571,95 (6)	0,212 (7)	E1	0,00274 (4)	0,000361 (5)	0,0000768 (11)	0,00320 (5)
$\gamma_{9,4}$(Sm)	599,74 (6)	12,39 (22)	E1+0,04%M2	0,00249 (4)	0,000327 (6)	0,0000696 (12)	0,00290 (5)
$\gamma_{2,1}$(Sm)	611,26 (5)	5,6 (2)	E1	0,00237 (4)	0,000312 (5)	0,0000663 (10)	0,00277 (4)
$\gamma_{3,1}$(Sm)	629,97 (5)	88,4 (19)	E2	0,00591 (9)	0,000932 (13)	0,000202 (3)	0,0071 (1)
$\gamma_{6,3}$(Sm)	714,69 (13)	0,045 (5)	M1+E2	0,0060 (16)	0,00084 (18)	0,00018 (4)	0,0070 (18)
$\gamma_{7,3}$(Sm)	725,70 (6)	32,5 (6)	E2	0,00424 (6)	0,000642 (9)	0,0001389 (20)	0,00506 (7)
$\gamma_{8,3}$(Sm)	915,33 (6)	18,0 (5)	E2	0,00254 (4)	0,000364 (6)	0,0000783 (11)	0,00300 (5)
$\gamma_{9,3}$(Sm)	1013,81 (6)	19,9 (4)	E2+0,06%M3	0,00206 (4)	0,000290 (5)	0,0000622 (10)	0,00243 (4)
$\gamma_{6,1}$(Sm)	1344,66 (12)	0,057 (5)	E2	0,001162 (17)	0,0001570 (22)	0,0000335 (5)	0,001392 (20)

3 Atomic Data

3.1 Sm

ω_K : 0,926 (4)
$\bar{\omega}_L$: 0,158 (6)
n_{KL} : 0,857 (4)

3.1.1 X Radiations

		Energy (keV)	Relative probability
X_K			
	$K\alpha_2$	39,5229	55,25
	$K\alpha_1$	40,1186	100
	$K\beta_3$	45,289	31,26
	$K\beta_1$	45,413	
	$K\beta''_5$	45,731	
	$K\beta_2$	46,575	8,07
	$K\beta_4$	46,705	
	$KO_{2,3}$	46,813	
X_L			
	$L\ell$	4,9909	
	$L\alpha$	5,6088 - 5,6376	
	$L\eta$	5,586	
	$L\beta$	6,1928 - 6,6557	
	$L\gamma$	6,9644 - 7,4871	

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	31,190 - 33,218	100
KLX	37,302 - 40,097	50,7
KXY	43,39 - 46,79	6,42
Auger L	3,27 - 7,69	

3.2 Pm

ω_K : 0,922 (4)
$\bar{\omega}_L$: 0,148 (6)
n_{KL} : 0,861 (4)

3.2.1 X Radiations

		Energy (keV)	Relative probability
X_K			
	$K\alpha_2$	38,1716	55,08
	$K\alpha_1$	38,7251	100
	$K\beta_3$	43,713	31
	$K\beta_1$	43,826	
	$K\beta_5''$	44,145	
	$K\beta_2$	44,937	7,97
	$K\beta_4$	45,064	
	$KO_{2,3}$	45,162	
X_L			
	$L\ell$	4,81	
	$L\alpha$	5,4061 - 5,4325	
	$L\eta$	5,363	
	$L\beta$	5,9552 - 6,3985	
	$L\gamma$	6,6814 - 7,1893	

3.2.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	30,162 - 32,086	100
KLX	36,035 - 38,703	50,3
KXY	41,88 - 45,14	6,32
Auger L	3,16 - 7,38	

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e_{AL}	(Sm)	3,27 - 7,69	6,23 (10)
e_{AK}	(Sm)		0,54 (5)
	KLL	31,190 - 33,218	
	KLX	37,302 - 40,097	
	KXY	43,39 - 46,79	
e_{AL}	(Pm)	3,16 - 7,38	6,59 (10)
e_{AK}	(Pm)		0,287 (23)
	KLL	30,162 - 32,086	
	KLX	36,035 - 38,703	
	KXY	41,88 - 45,14	
$ec_{2,1\ T}$	(Pm)	16,1 - 61,3	5,6 (34)
$ec_{2,1\ K}$	(Pm)	16,12 (5)	0,012 (5)
$ec_{1,0\ T}$	(Pm)	30,6 - 75,8	4,3 (9)
$ec_{1,0\ K}$	(Pm)	30,6 (1)	3,7 (8)
$ec_{9,8\ K}$	(Sm)	51,65 (6)	4,37 (39)
$ec_{9,8\ T}$	(Sm)	51,65 - 98,46	5,26 (47)
$ec_{2,1\ L}$	(Pm)	53,9 - 54,8	4,0 (23)
$ec_{2,1\ M}$	(Pm)	59,6 - 60,3	1,2 (7)
$ec_{2,1\ N}$	(Pm)	61,0 - 61,3	0,24 (16)
$ec_{1,0\ L}$	(Pm)	68,4 - 69,3	0,52 (11)
$ec_{1,0\ M}$	(Pm)	74,1 - 74,8	0,112 (22)
$ec_{1,0\ N}$	(Pm)	75,5 - 75,8	0,025 (5)
$ec_{9,8\ L}$	(Sm)	90,74 - 91,76	0,69 (6)
$ec_{9,8\ M}$	(Sm)	96,76 - 97,40	0,150 (13)
$ec_{9,8\ N}$	(Sm)	98,13 - 98,47	0,0339 (30)
$ec_{8,7\ K}$	(Sm)	142,80 (6)	0,205 (11)
$ec_{8,7\ L}$	(Sm)	181,89 - 182,91	0,0655 (35)
$ec_{8,7\ M}$	(Sm)	187,91 - 188,55	0,0149 (8)
$ec_{9,7\ K}$	(Sm)	241,28 (6)	0,925 (31)
$ec_{9,7\ T}$	(Sm)	241,28 - 288,09	1,088 (37)

		Energy (keV)	Electrons (per 100 disint.)
$ec_{7,4\ K}$	(Sm)	264,80 (6)	0,0432 (14)
$ec_{9,7\ L}$	(Sm)	280,37 - 281,39	0,1287 (43)
$ec_{9,7\ M}$	(Sm)	286,39 - 287,03	0,0276 (10)
$ec_{4,3\ K}$	(Sm)	367,24 (6)	0,1054 (22)
$ec_{4,2\ K}$	(Sm)	385,95 (6)	0,0806 (22)
$ec_{4,3\ L}$	(Sm)	406,33 - 407,35	0,01408 (29)
$ec_{4,2\ L}$	(Sm)	425,04 - 426,06	0,01467 (40)
$ec_{8,4\ K}$	(Sm)	454,43 (6)	0,0243 (5)
$ec_{1,0\ T}$	(Sm)	503,44 - 550,25	0,933 (19)
$ec_{1,0\ K}$	(Sm)	503,44 (3)	0,776 (16)
$ec_{1,0\ L}$	(Sm)	542,53 - 543,55	0,1280 (26)
$ec_{1,0\ M}$	(Sm)	548,55 - 549,19	0,0279 (6)
$ec_{9,4\ K}$	(Sm)	552,91 (6)	0,0310 (7)
$ec_{2,1\ K}$	(Sm)	564,43 (5)	0,0134 (5)
$ec_{3,1\ K}$	(Sm)	583,14 (5)	0,522 (10)
$ec_{3,1\ T}$	(Sm)	583,14 - 629,95	0,627 (12)
$ec_{3,1\ L}$	(Sm)	622,23 - 623,25	0,0823 (16)
$ec_{3,1\ M}$	(Sm)	628,25 - 628,89	0,01784 (35)
$ec_{7,3\ K}$	(Sm)	678,87 (6)	0,1378 (28)
$ec_{7,3\ L}$	(Sm)	718 - 719	0,02086 (42)
$ec_{8,3\ K}$	(Sm)	868,50 (6)	0,0457 (15)
$ec_{9,3\ K}$	(Sm)	966,98 (6)	0,0411 (10)
$\beta^-_{0,9}$	max: avg:	414 (6) 122,3 (26)	54,0 (9)
$\beta^-_{0,8}$	max: avg:	513 (6) 156,0 (27)	18,1 (9)
$\beta^-_{0,7}$	max: avg:	702 (6) 224,7 (29)	21,8 (7)
$\beta^-_{0,4}$	max: avg:	1014 (6) 345,9 (31)	0,93 (45)

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)	
XL	(Sm)	4,9909 - 7,4871	1,20 (4)	
XKα_2	(Sm)	39,5229	1,92 (11)	Kα
XKα_1	(Sm)	40,1186	3,47 (19)	
XKβ_3	(Sm)	45,289		
XKβ_1	(Sm)	45,413	1,09 (6)	K$'\beta_1$
XKβ''_5	(Sm)	45,731		
XKβ_2	(Sm)	46,575		
XKβ_4	(Sm)	46,705	0,280 (17)	K$'\beta_2$
XKO$_{2,3}$	(Sm)	46,813		
XL	(Pm)	4,81 - 7,1893	1,20 (4)	
XKα_2	(Pm)	38,1716	0,96 (6)	Kα
XKα_1	(Pm)	38,7251	1,75 (11)	
XKβ_3	(Pm)	43,713		
XKβ_1	(Pm)	43,826	0,54 (4)	K$'\beta_1$
XKβ''_5	(Pm)	44,145		
XKβ_2	(Pm)	44,937		
XKβ_4	(Pm)	45,064	0,139 (9)	K$'\beta_2$
XKO$_{2,3}$	(Pm)	45,162		

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{2,1}$(Pm)	61,30 (5)	0,00040 (17)
$\gamma_{1,0}$(Pm)	75,8 (1)	1,27 (20)
$\gamma_{9,8}$(Sm)	98,48 (3)	2,92 (26)
$\gamma_{8,7}$(Sm)	189,63 (3)	1,15 (6)
$\gamma_{9,7}$(Sm)	288,11 (3)	12,0 (4)
$\gamma_{9,6}$(Sm)	299,1 (2)	0,13 (4)
$\gamma_{7,4}$(Sm)	311,63 (3)	3,77 (11)
$\gamma_{8,5}$(Sm)	362,09 (3)	0,171 (13)
$\gamma_{4,3}$(Sm)	414,07 (3)	18,35 (33)
$\gamma_{4,2}$(Sm)	432,78 (3)	5,19 (13)
$\gamma_{9,5}$(Sm)	460,57 (3)	0,40 (1)
$\gamma_{8,4}$(Sm)	501,26 (3)	6,59 (11)
$\gamma_{1,0}$(Sm)	550,27 (3)	93,5 (14)

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{5,3}$(Sm)	553,24 (3)	0,35 (4)
$\gamma_{5,2}$(Sm)	571,95 (3)	0,211 (7)
$\gamma_{9,4}$(Sm)	599,74 (3)	12,35 (22)
$\gamma_{2,1}$(Sm)	611,26 (3)	5,6 (2)
$\gamma_{3,1}$(Sm)	629,97 (3)	87,8 (14)
$\gamma_{6,3}$(Sm)	714,7 (2)	0,045 (5)
$\gamma_{7,3}$(Sm)	725,70 (3)	32,3 (6)
$\gamma_{8,3}$(Sm)	915,33 (3)	17,9 (5)
$\gamma_{9,3}$(Sm)	1013,81 (3)	19,8 (4)
$\gamma_{6,1}$(Sm)	1344,6 (2)	0,057 (5)

6 Main Production Modes

$\left\{ \begin{array}{l} ^{148}\mathrm{Nd(p,n)}^{148m}\mathrm{Pm} \\ \text{Possible impurities :} \ ^{148}\mathrm{Pm} \end{array} \right.$

$\left\{ \begin{array}{l} ^{148}\mathrm{Nd(d,2n)}^{148m}\mathrm{Pm} \\ \text{Possible impurities :} \ ^{148}\mathrm{Pm} \end{array} \right.$

$\left\{ \begin{array}{ll} ^{147}\mathrm{Pm(n,\gamma)}^{148m}\mathrm{Pm} & \sigma : 70 \ \text{barns} \\ \text{Possible impurities :} \ ^{148}\mathrm{Pm} \ (80 \ \text{barns}); & ^{149,150}\mathrm{Pm \ from} \ ^{148,149}\mathrm{Pm(n,\gamma)} \end{array} \right.$

$\left\{ \begin{array}{l} ^{238}\mathrm{U(p,f)}^{148m}\mathrm{Pm} \\ \text{Possible impurities :} \ ^{148}\mathrm{Pm} \end{array} \right.$

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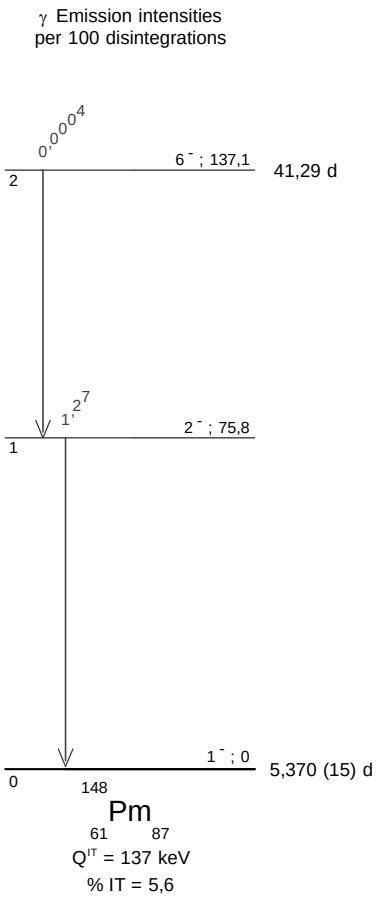
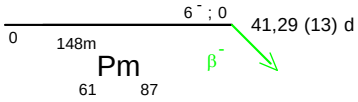
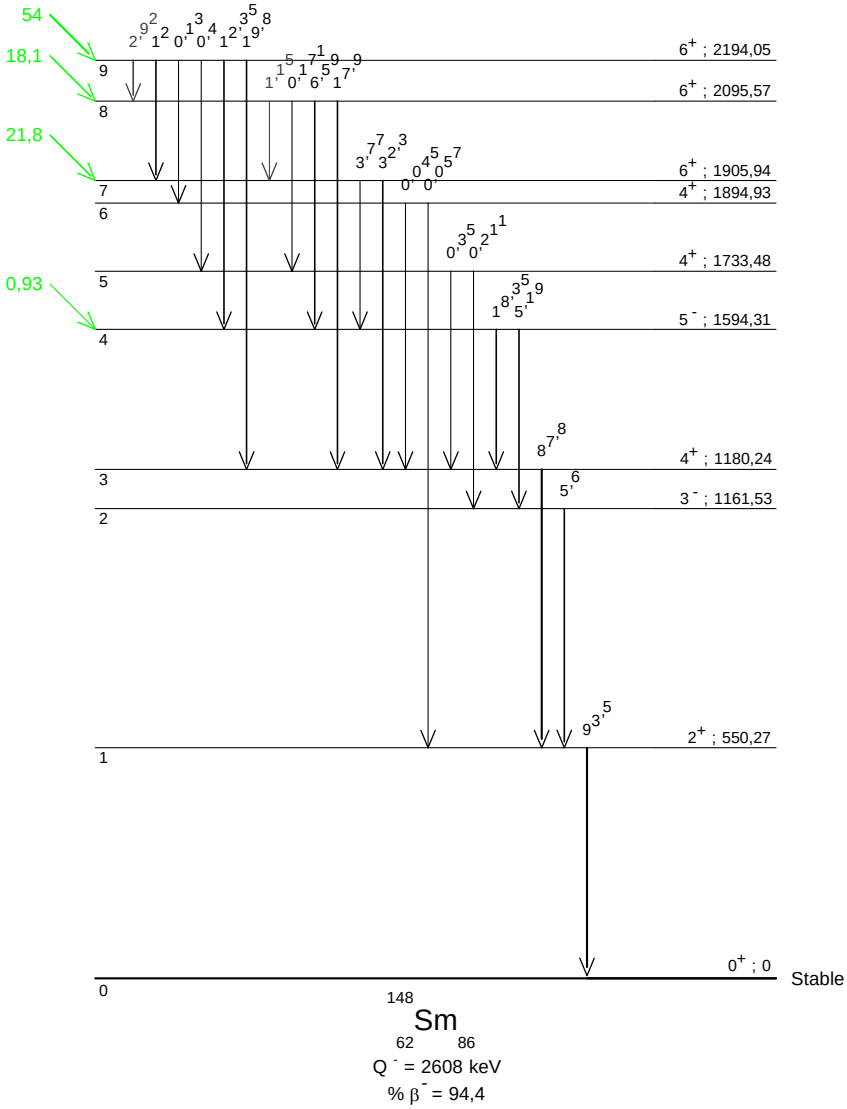
(Q)


γ Emission intensities
per 100 disintegrations
0,0,0,0,4
6 - ; 137,1
41,29 d
2
2,7
1
2 - ; 75,8
1
1 - ; 0
5,370 (15) d
0
148
Pm
61 87
Q^IT = 137 keV
% IT = 5,6



γ Emission intensities per 100 disintegrations



148
Sm
62 86

Q - = 2608 keV

% β - = 94,4