$^{234}_{90}\mathrm{Th}_{144}$

1 Decay Scheme

Th-234 decays 100 % by beta minus particle emissions, mainly to Pa-234m, the 1,159 min half-life metastable state of Pa-234.
Le thorium 234 se désintègre 100 % par émissions bêta, principalement vers le niveau métastable du protactinium 234 de 1,159 min de période.

2 Nuclear Data

$T_{1/2}(^{234}\mathrm{Th})$	:	24,10	(3)	d
$T_{1/2}(^{234}\mathrm{Pa})$	:	6,70	(5)	h
$Q^{-}(^{234}\mathrm{Th})$	:	272	(10)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,7}$	85 (10)	1,6 (6)	Allowed	7
$\beta^-_{0,6}$	95 (10)	0,016 (5)	1st Forbidden	9,1
$\beta^-_{0,5}$	105 (10)	6,5 (7)	Allowed	6,7
$\beta^-_{0,4}$	106 (10)	14,1 (12)	1st Forbidden	6,3
$\beta^-_{0,2}$	198 (10)	77,8 (15)	1st Forbidden	6,4

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{7,5}$(Pa)	20,01 (2)	1,2 (6)	M1+E2		70 (40)	124 (21)	240 (70)
$\gamma_{3,2}$(Pa)	29,50 (2)	5,4 (6)	E2		3210 (50)	880 (13)	4390 (70)
$\gamma_{4,3}$(Pa)	62,88 (2)	0,43 (11)	M1+E2		19 (4)	4,8 (9)	25 (5)
$\gamma_{5,3}$(Pa)	63,30 (2)	5,27 (11)	E1		0,305 (5)	0,0749 (11)	0,405 (6)

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{1,0}$(Pa)	73,92 (2)	0,154 (17)	M1+E2		7,96 (25)	1,94 (7)	10,6 (4)
$\gamma_{7,3}$(Pa)	83,31 (5)	0,073 (6)	E1		0,1475 (21)	0,0361 (5)	0,196 (3)
$\gamma_{4,2}$(Pa)	92,38 (1)	13,7 (12)	M1		3,98 (6)	0,960 (14)	5,27 (8)
$\gamma_{5,2}$(Pa)	92,80 (2)	2,47 (22)	E1		0,1110 (16)	0,0271 (4)	0,1472 (21)
$\gamma_{6,2}$(Pa)	103,35 (10)	0,0154 (48)	M1		2,88 (5)	0,694 (10)	3,81 (6)
$\gamma_{7,2}$(Pa)	112,81 (5)	0,264 (40)	E1	0,21 (13)	0,0666 (10)	0,01620 (23)	0,23 (14)

3 Atomic Data

3.1 Pa

ω_K	:	0,970	(4)
$\bar{\omega}_L$	:	0,488	(18)
n_{KL}	:	0,795	(5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	92,288		62,14
	$K\alpha_1$	95,869		100
	$K\beta_3$	107,595	}	
	$K\beta_1$	108,422	}	
	$K\beta_5''$	109,072	}	35,84
	$K\beta_2$	111,405	}	
	$K\beta_4$	111,87	}	12,15
	$KO_{2,3}$	112,38	}	
X_L				
	$L\ell$	11,3676		
	$L\alpha$	13,1215 – 13,2887		
	$L\eta$	14,9488		
	$L\beta$	15,3584 – 17,6655		
	$L\gamma$	18,9396 – 20,1126		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	70,081 – 78,822	100
KLX	85,989 – 95,858	59,2
KXY	101,87 – 112,59	8,76
Auger L	5,9 – 21,6	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Pa)	5,9 - 21,6		7,7 (6)
e_{AK}	(Pa)			0,0014 (9)
	KLL	70,081 - 78,822	}	
	KLX	85,989 - 95,858	}	
	KXY	101,87 - 112,59	}	
$ec_{3,2\ L}$	(Pa)	8,4 - 12,8		3,95 (45)
$ec_{7,5\ M}$	(Pa)	14,65 - 16,57		0,63 (28)
$ec_{7,5\ N}$	(Pa)	18,63 - 19,65		0,17 (8)
$ec_{3,2\ M}$	(Pa)	24,1 - 26,1		1,08 (12)
$ec_{3,2\ N}$	(Pa)	28,1 - 29,1		0,292 (34)
$ec_{4,3\ L}$	(Pa)	41,78 - 46,15		0,31 (8)
$ec_{5,3\ L}$	(Pa)	42,2 - 46,6		1,144 (31)
$ec_{1,0\ L}$	(Pa)	52,82 - 57,19		0,106 (12)
$ec_{5,3\ M}$	(Pa)	57,9 - 59,9		0,281 (7)
$ec_{4,2\ L}$	(Pa)	71,27 - 75,65		8,7 (8)
$ec_{5,2\ L}$	(Pa)	71,7 - 76,1		0,239 (21)
$ec_{4,2\ M}$	(Pa)	87,02 - 88,94		2,09 (18)
$ec_{4,2\ N}$	(Pa)	91,00 - 92,02		0,56 (5)
$\beta^-_{0,7}$	max:	85	(10)	1,6 (6)
$\beta^-_{0,7}$	avg:	22	(3)	
$\beta^-_{0,6}$	max:	95	(10)	0,016 (5)
$\beta^-_{0,6}$	avg:	25	(3)	
$\beta^-_{0,5}$	max:	105	(10)	6,5 (7)
$\beta^-_{0,5}$	avg:	27	(3)	
$\beta^-_{0,4}$	max:	106	(10)	14,1 (12)
$\beta^-_{0,4}$	avg:	28	(3)	

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,2}$	max:	198	(10)	77,8 (15)
$\beta^-_{0,2}$	avg:	53	(3)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Pa)	11,3676 — 20,1126		7,1 (3)	
$XK\alpha_2$	(Pa)	92,288		0,013 (9)	} $K\alpha$
$XK\alpha_1$	(Pa)	95,869		0,021 (13)	}
$XK\beta_3$	(Pa)	107,595	}		
$XK\beta_1$	(Pa)	108,422	}	0,007 (5)	$K'\beta_1$
$XK\beta''_5$	(Pa)	109,072	}		
$XK\beta_2$	(Pa)	111,405	}		
$XK\beta_4$	(Pa)	111,87	}	0,0025 (16)	$K'\beta_2$
$XKO_{2,3}$	(Pa)	112,38	}		

5.2 Gamma Emissions

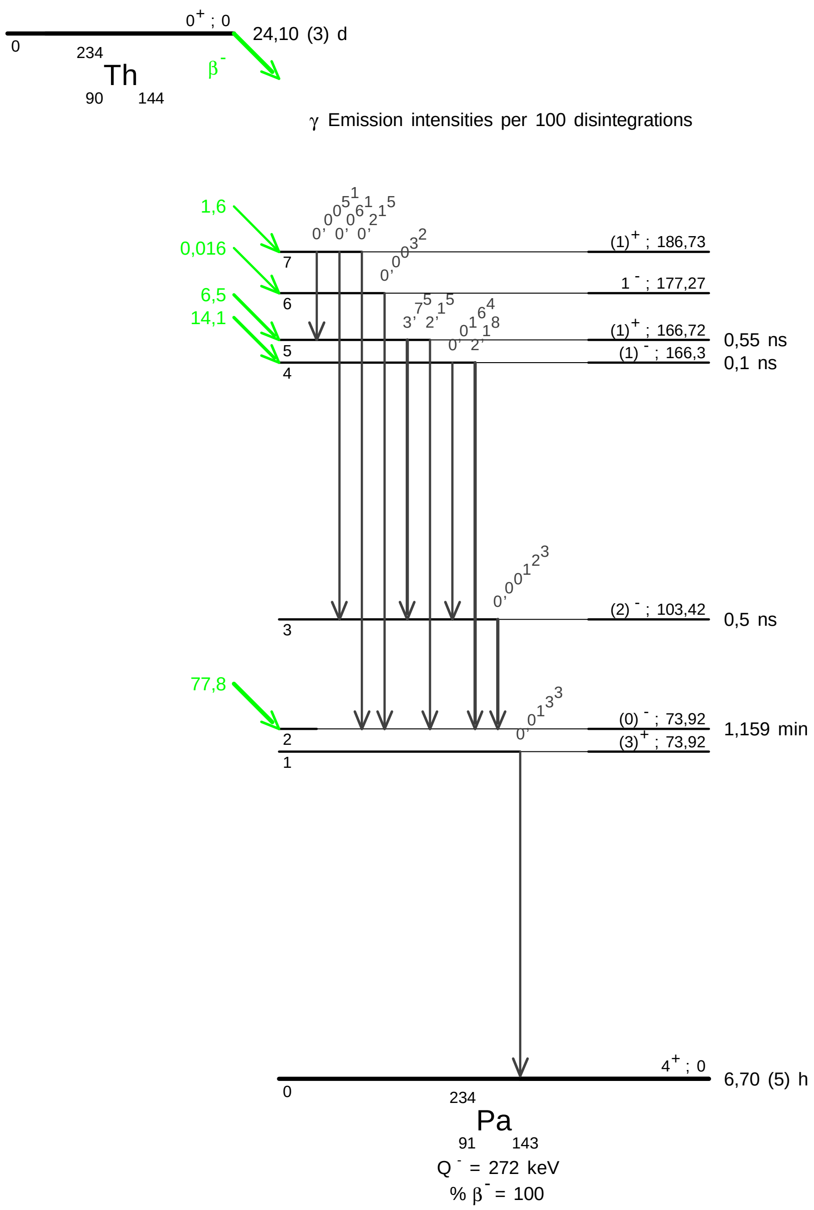
	Energy keV	Photons per 100 disint.
$\gamma_{7,5}$(Pa)	20,01 (2)	0,0051 (21)
$\gamma_{3,2}$(Pa)	29,50 (2)	0,00123 (14)
$\gamma_{4,3}$(Pa)	62,88 (2)	0,0164 (28)
$\gamma_{5,3}$(Pa)	63,30 (2)	3,75 (8)
$\gamma_{1,0}$(Pa)	73,92 (2)	0,0133 (14)
$\gamma_{7,3}$(Pa)	83,31 (5)	0,061 (5)
$\gamma_{4,2}$(Pa)	92,38 (1)	2,18 (19)
$\gamma_{5,2}$(Pa)	92,80 (2)	2,15 (19)
$\gamma_{6,2}$(Pa)	103,35 (10)	0,0032 (10)
$\gamma_{7,2}$(Pa)	112,81 (5)	0,215 (22)

6 Main Production Modes

$U - 238(\alpha,)Th - 234$

7 References

- G. Kirsch. Mitt.Ra.Inst.127,Wien.Ber.Iia 129 (1920) 309
  (Half-life)
- M. Curie, A. Debierne, A.S. Eve, H. Geiger, O. Hahn, S.C. Lind, St. Meyer, E. Rutherford, E. Schweidler. Rev. Mod. Phys. 3 (1931) 427-445
  (Half-life)
- B.W. Sargent. Can. J. Research A17 (1939) 103
  (Half-life)
- G.B. Knight, R.L. Macklin. Phys. Rev. 74 (1948) 1540-1541
  (Half-life)
- J.S. Geiger, R.L. Graham, T.A. Eastwood. AECL-1472 PR-P-52 (1961) 26-27
  (L ICC (for 29 keV and 63 keV), Gamma ray energies)
- J.-P. Briand. Comp. Rend. Acad. Sci. (Paris) 254 (1962) 84-86
  (L ICC (for 29 keV))
- S. Bjornholm, O.B. Nielsen. Nucl. Phys. 42 (1963) 642-659
  (Conv. Elec. emission energies, Conv. Elec. emission probabilities, Beta emission energies)
- H. Abou-Leila. Comp. Rend. Acad. Sci. (Paris) 258 (1964) 5632-5635
  (Half-life)
- R. Foucher. Bull. Acad. Sci. USSR Phys.Ser. 29 (1966) 99-100
  (Multipolarities)
- Harry W. Taylor. Int. J. Appl. Radiat. Isotop. 24 (1973) 593-597
  (Gamma ray energies, Gamma-ray relative intensities)
- J. Godart, A.. Gizon. Nucl. Phys. A217 (1973) 159-176
  (Beta and Conv. Elec. emission energies and probabilities, Gamma ray energies and transitions probabilities, Multipolarities)
- T.E.Sampson. Nucl. Instrum. Methods 111 (1973) 209-211
  (Gamma ray energies, Gamma-ray relative intensities)
- Y.Y.Chu, G. Scharff-Goldhaber. Phys. Rev. C 17 (1978) 1507-1509
  (Gamma-ray relative intensities)
- Michael H. Momeni. Nucl. Instrum. Methods 193 (1982) 185-190
  (Gamma ray energies, Gamma-ray emission probabilities)
- H.L. Scott, K.W. Marlow. Nucl. Instrum. Methods A 286 (1990) 549-555
  (Gamma-ray emission probabilities)
- N. Coursol, F. Lagoutine, B. Duchemin. Nucl. Instrum. Methods A 286 (1990) 589-594
  (Half-life, Beta emission probabilities, Gamma-ray emission probabilities, X-ray emission probabilities)
- G.A. Sutton, S.T. Napier, M. John, A. Taylor. The Science of the Total Environment 130/131 (1993) 393-401
  (Gamma-ray emission probabilities)
- I. Adsley, J.S. Backhouse, A.L. Nichols, J. Toole. Appl. Rad. Isotopes 49 (1998) 1337-1344
  (Gamma-ray emission probabilities)
- G. Audi, A.H. Wapstra, C. Thibault. Nucl. Phys. A729 (2003) 337-676
  (Q)
- S. Abousahl, P. van Belle, B. Lynch, H. Ottmar. Nucl. Instrum. Methods A 517 (2004) 211-218
  (Gamma-ray emission probabilities)
- F.S. Al-Saleh, Al-J.H. Al-Mukren, M.A. Farouk. Nucl. Instrum. Methods A 568 (2006) 734-738
  (Gamma-ray emission probabilities)
- E. Browne, J.K. Tuli. Nucl. Data Sheets 108 (2007) 681-772
  (Multipolarities, Mixing ratio, Spin and Parity, Gamma-ray emission probabilities, Gamma ray energies, Beta emission energies)


0+ ; 0
24,10 (3) d
0
234
Th
90 144
β-
γ Emission intensities per 100 disintegrations
1,6
0,016
6,5
14,1
77,8
(1)+ ; 186,73
1 - ; 177,27
(1)+ ; 166,72
(1) - ; 166,3
0,55 ns
0,1 ns
(2) - ; 103,42
0,5 ns
(0) - ; 73,92
(3)+ ; 73,92
1,159 min
4+ ; 0
6,70 (5) h
234
Pa
91 143
Q - = 272 keV
% β- = 100