

1 Decay Scheme

U-235 disintegrates by alpha emission to levels in Th-231. The spontaneous fission branching ratio is 7,0 (2) E-9 %.

L'uranium 235 se désintègre par émission alpha vers des niveaux du thorium 231. Le pourcentage de fission spontanée est de 7,0 (2) E-9 %.

2 Nuclear Data

$T_{1/2}(^{235}\text{U})$:	704	(1)	10^6	a
$T_{1/2}(^{231}\text{Th})$:	25,522	(10)	h	
$Q^\alpha(^{235}\text{U})$:	4678,3	(7)	keV	

2.1 α Transitions

	Energy keV	Probability $\times 100$	F
$\alpha_{0,22}$	4045 (5)	$\approx 0,0011$	79
$\alpha_{0,21}$	4082,7 (8)	0,0396 (10)	4,86
$\alpha_{0,20}$	4148,1 (7)	0,016 (12)	46
$\alpha_{0,19}$	4224 (5)	0,294 (13)	11,6
$\alpha_{0,18}$	4287,7 (19)	5,95 (12)	2
$\alpha_{0,17}$	4292,6 (7)	0,01732 (12)	714
$\alpha_{0,16}$	4300,8 (7)	0,122 (6)	119
$\alpha_{0,15}$	4322 (5)	0,069 (10)	343
$\alpha_{0,14}$	4340 (5)	0,22 (3)	150
$\alpha_{0,13}$	4353,4 (7)	0,0329 (5)	1185
$\alpha_{0,12}$	4361,1 (7)	0,065 (13)	690
$\alpha_{0,11}$	4376,6 (7)	0,00959 (13)	6260
$\alpha_{0,10}$	4397 (4)	3,33 (6)	28,1
$\alpha_{0,9}$	4402,8 (7)	0,405 (13)	241
$\alpha_{0,8}$	4437,4 (7)	0,206 (21)	890
$\alpha_{0,7}$	4441,7 (20)	18,80 (13)	10,47

	Energy keV	Probability × 100	F
$\alpha_{0,6}$	4457,0 (7)	0,106 (16)	2460
$\alpha_{0,5}$	4474,0 (13)	57,19 (20)	6,08
$\alpha_{0,4}$	4491,3 (5)	3,01 (16)	164
$\alpha_{0,3}$	4514,7 (40)	0,236 (25)	3170
$\alpha_{0,2}$	4580,4 (7)	1,28 (5)	1856
$\alpha_{0,1}$	4635,0 (4)	3,79 (6)	1586
$\alpha_{0,0}$	4676,0 (13)	4,74 (6)	2571

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	P _{$\gamma+ce$} × 100	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{5,4}(\text{Th})$	19,592 (6)	60 (60)	[M1+E2]		6000 (6000)	3000 (3000)	10000 (10000)
$\gamma_{7,5}(\text{Th})$	31,61 (5)	11,4 (40)	M1+E2		490 (8)	131,5 (21)	666 (11)
$\gamma_{10,7}(\text{Th})$	41,4 (3)	1,5 (6)	[M1]		37,7 (10)	9,08 (24)	49,9 (13)
$\gamma_{1,0}(\text{Th})$	42,01 (6)	24,7 (43)	M1+E2		325 (22)	88 (6)	440 (30)
$\gamma_{7,4}(\text{Th})$	51,21 (4)	9,4 (19)	[E2]		201 (3)	54,9 (8)	274 (4)
$\gamma_{9,6}(\text{Th})$	54,1 (1)	0,24	[E2]		154 (3)	42,1 (7)	210 (4)
$\gamma_{2,1}(\text{Th})$	54,25 (5)	2,1	[M1+E2]		52,7 (20)	14,0 (6)	71 (3)
$\gamma_{19,18}(\text{Th})$	64,45 (5)	0,26	[M1]		10,28 (15)	2,47 (4)	13,6 (2)
$\gamma_{10,5}(\text{Th})$	72,7 (2)	1,86 (47)	M1+E2		11,4 (19)	2,9 (6)	15 (3)
$\gamma_{7,3}(\text{Th})$	74,94 (3)	0,064 (8)	[E1]		0,190 (3)	0,0464 (7)	0,252 (4)
$\gamma_{12,6}(\text{Th})$	95,7						
$\gamma_{2,0}(\text{Th})$	96,13 (2)	1,33 (16)	[E2]		9,93 (14)	2,73 (4)	13,58 (19)
$\gamma_{14,7}(\text{Th})$	97 (4)	0,22 (7)	[E2]		9,5 (21)	2,6 (6)	13 (3)
$\gamma_{5,2}(\text{Th})$	109,19 (7)	1,81 (14)	[E1]		0,0704 (10)	0,01708 (24)	0,0932 (14)
$\gamma_{10,3}(\text{Th})$	115,48 (6)	0,040 (13)	[E1]	0,267 (4)	0,0609 (9)	0,01475 (21)	0,348 (5)
$\gamma_{3,1}(\text{Th})$	120,35 (5)	0,31	[M1]	8,73 (13)	1,678 (24)	0,404 (6)	10,95 (16)
$\gamma_{16,8}(\text{Th})$	136,62 (5)	0,103	[M1]	6,11 (9)	1,168 (17)	0,281 (4)	7,66 (11)
$\gamma_{7,2}(\text{Th})$	140,77 (2)	0,244 (12)	[E1]	0,1696 (24)	0,0364 (5)	0,00879 (13)	0,218 (3)
$\gamma_{20,18}(\text{Th})$	142,40 (5)	0,018	[E2]	0,253 (4)	1,627 (23)	0,446 (7)	2,48 (4)
$\gamma_{4,1}(\text{Th})$	143,768 (3)	13,20 (8)	E1	0,1615 (23)	0,0344 (5)	0,00833 (12)	0,207 (3)
$\gamma_{18,8}(\text{Th})$	147						
$\gamma_{18,7}(\text{Th})$	150,936 (15)	0,61 (20)	[M1]	4,60 (7)	0,877 (13)	0,211 (3)	5,76 (8)
$\gamma_{5,1}(\text{Th})$	163,358 (3)	5,855 (36)	[E1]	0,1197 (17)	0,0248 (4)	0,00599 (9)	0,1526 (22)
$\gamma_{16,5}(\text{Th})$	173 (1)	0,007 (6)	[E1]	0,1047 (21)	0,0215 (5)	0,00518 (11)	0,133 (3)
$\gamma_{10,2}(\text{Th})$	181,87						
$\gamma_{18,5}(\text{Th})$	182,63 (5)	1,70 (22)	[M1]	2,69 (4)	0,510 (8)	0,1226 (18)	3,36 (5)
$\gamma_{4,0}(\text{Th})$	185,722 (4)	63,41 (35)	E1	0,0887 (13)	0,0179 (3)	0,00433 (6)	0,1124 (16)
$\gamma_{7,1}(\text{Th})$	194,947 (8)	0,693 (11)	[E1]	0,0792 (11)	0,01589 (23)	0,00383 (6)	0,1002 (14)
$\gamma_{8,1}(\text{Th})$	198,902 (15)	0,131 (7)	M1	2,11 (3)	0,401 (6)	0,0963 (14)	2,64 (4)
$\gamma_{18,4}(\text{Th})$	202,12 (1)	3,81 (8)	[M1]	2,02 (3)	0,383 (6)	0,0920 (13)	2,53 (4)
$\gamma_{5,0}(\text{Th})$	205,316 (4)	5,465 (33)	(E1)	0,0703 (10)	0,01397 (20)	0,00336 (5)	0,0887 (13)
$\gamma_{19,7}(\text{Th})$	215,28 (4)	0,090 (9)	[M1]	1,693 (24)	0,321 (5)	0,0770 (11)	2,12 (3)
$\gamma_{6,0}(\text{Th})$	221,386 (14)	0,349 (15)	M1	1,566 (22)	0,296 (5)	0,0712 (10)	1,96 (3)
$\gamma_{13,2}(\text{Th})$	228,76 (5)	0,021	M1	1,429 (20)	0,270 (4)	0,0649 (9)	1,79 (3)
$\gamma_{9,1}(\text{Th})$	233,504 (20)	0,102 (11)	M1	1,350 (19)	0,255 (4)	0,0613 (9)	1,687 (24)
$\gamma_{8,0}(\text{Th})$	240,88 (4)	0,181 (19)	M1(+E2)	1,14 (21)	0,228 (13)	0,0553 (21)	1,45 (22)
$\gamma_{19,5}(\text{Th})$	246,865 (20)	0,134 (7)	[M1]	1,157 (17)	0,218 (3)	0,0525 (8)	1,445 (21)
$\gamma_{15,2}(\text{Th})$	255,395 (20)	0,017	M1	1,052 (15)	0,199 (3)	0,0477 (7)	1,315 (19)
$\gamma_{19,4}(\text{Th})$	266,47 (4)	0,0097 (7)	[E2]	0,0921 (13)	0,1121 (16)	0,0303 (5)	0,245 (4)
$\gamma_{12,1}(\text{Th})$	275,35 (15)	0,094 (11)	M1+E2	0,65 (5)	0,144 (5)	0,0355 (10)	0,84 (6)
$\gamma_{9,0}(\text{Th})$	275,49 (6)	0,065	M1(+E2)	0,81 (11)	0,157 (9)	0,0379 (18)	1,02 (12)

	Energy keV	P _{γ+ce} × 100	Multipolarity	α _K	α _L	α _M	α _T
γ _{16,2} (Th)	281,42 (5)	0,013	M1	0,804 (12)	0,1515 (22)	0,0364 (5)	1,005 (14)
γ _{13,1} (Th)	282,94 (5)	0,013	[M1]	0,792 (12)	0,1493 (21)	0,0359 (5)	0,990 (14)
γ _{17,2} (Th)	289,56 (4)	0,0142	[M1]	0,743 (11)	0,140 (2)	0,0336 (5)	0,929 (13)
γ _{19,3} (Th)	291,2						
γ _{18,2} (Th)	291,71 (3)	0,042 (6)	[E1]	0,0317 (5)	0,00598 (9)	0,001433 (20)	0,0396 (6)
γ _{11,0} (Th)	301,7 (1)	0,01	M1	0,664 (10)	0,1249 (18)	0,0300 (5)	0,829 (12)
γ _{15,1} (Th)	310,69 (6)	0,011	(E2)	0,068 (1)	0,0616 (9)	0,01650 (24)	0,1517 (22)
γ _{12,0} (Th)	317,15 (8)	0,0019	M1	0,579 (9)	0,1088 (16)	0,0261 (4)	0,723 (11)
γ _{17,1} (Th)	343,6 (2)	0,0032					
γ _{18,1} (Th)	345,93 (3)	0,041 (6)	[E1]	0,0219 (3)	0,00403 (6)	0,000964 (14)	0,0272 (4)
γ _{15,0} (Th)	350 (5)	0,009	M1	0,442 (19)	0,083 (4)	0,0199 (9)	0,552 (24)
γ _{19,2} (Th)	356,05 (5)	0,0054	[E1]	0,0206 (3)	0,00377 (6)	0,000903 (13)	0,0255 (4)
γ _{18,0} (Th)	387,84 (3)	0,041 (6)	[E1]	0,01717 (24)	0,00312 (5)	0,000745 (11)	0,0213 (3)
γ _{21,5} (Th)	390,27 (20)	0,040 (1)					
γ _{19,1} (Th)	410,29 (4)	0,0033	[E1]	0,01527 (22)	0,00275 (4)	0,000657 (10)	0,0189 (3)
γ _{22,4} (Th)	448,40 (6)	0,0011					

3 Atomic Data

3.1 Th

ω _K	:	0,969	(4)
ω̄ _L	:	0,476	(18)
n _{KL}	:	0,797	(5)

3.1.1 X Radiations

	Energy keV	Relative probability
X _K	Kα ₂	89,954
	Kα ₁	93,351
	Kβ ₃	104,819
	Kβ ₁	105,604
	Kβ ₅ ''	106,239
	Kβ ₂	108,509
	Kβ ₄	108,955
	KO _{2,3}	109,442
X _L	Lℓ	11,1177
	Lα	12,8085 – 12,967
	Lη	14,509
	Lβ	14,972 – 17,1383
	Lγ	18,3633 – 19,5043

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	68,406 – 76,745	100
KLX	83,857 – 93,345	58,8
KXY	99,29 – 109,64	8,64
Auger L	5,8 – 20,3	

4 α Emissions

	Energy keV	Probability $\times 100$
$\alpha_{0,22}$	3976 (5)	$\approx 0,0011$
$\alpha_{0,21}$	4013,2 (8)	0,0396 (10)
$\alpha_{0,20}$	4077,5 (7)	0,016 (12)
$\alpha_{0,19}$	4152 (5)	0,294 (13)
$\alpha_{0,18}$	4214,7 (19)	5,95 (12)
$\alpha_{0,17}$	4219,5 (7)	0,01732 (12)
$\alpha_{0,16}$	4227,6 (7)	0,122 (6)
$\alpha_{0,15}$	4248 (5)	0,069 (10)
$\alpha_{0,14}$	4266 (5)	0,22 (3)
$\alpha_{0,13}$	4279,3 (7)	0,0329 (5)
$\alpha_{0,12}$	4286,9 (7)	0,065 (13)
$\alpha_{0,11}$	4302,1 (7)	0,00959 (13)
$\alpha_{0,10}$	4322 (4)	3,33 (6)
$\alpha_{0,9}$	4327,9 (7)	0,405 (13)
$\alpha_{0,8}$	4361,9 (7)	0,206 (21)
$\alpha_{0,7}$	4366,1 (20)	18,80 (13)
$\alpha_{0,6}$	4381,1 (7)	0,106 (16)
$\alpha_{0,5}$	4397,8 (13)	57,19 (20)
$\alpha_{0,4}$	4414,9 (5)	3,01 (16)
$\alpha_{0,3}$	4437,9 (40)	0,236 (25)
$\alpha_{0,2}$	4502,4 (7)	1,28 (5)
$\alpha_{0,1}$	4556,0 (4)	3,79 (6)
$\alpha_{0,0}$	4596,4 (13)	4,74 (6)

5 Electron Emissions

		Energy keV	Electrons per 100 disint.
e _{AL}	(Th)	5,8 - 20,3	47 (22)
e _{AK}	(Th)		0,39 (5)
	KLL	68,406 - 76,745	}
	KLX	83,857 - 93,345	}
	KXY	99,29 - 109,64	}
ec _{7,5} L	(Th)	11,117 - 15,300	8,3 (29)
ec _{5,4} M	(Th)	14,41 - 16,26	18 (18)
ec _{5,4} N	(Th)	18,260 - 19,257	5 (5)
ec _{10,7} L	(Th)	20,6 - 24,8	1,09 (42)
ec _{1,0} L	(Th)	21,484 - 25,700	18,2 (32)
ec _{7,5} M	(Th)	26,407 - 28,257	2,2 (8)
ec _{7,5} N	(Th)	30,260 - 31,254	0,60 (23)
ec _{7,4} L	(Th)	30,709 - 34,900	6,8 (14)
ec _{9,6} L	(Th)	33,602 - 37,800	0,1771 (34)
ec _{10,7} M	(Th)	35,9 - 37,8	0,26 (10)
ec _{1,0} M	(Th)	36,774 - 38,624	4,9 (9)
ec _{10,7} N	(Th)	39,8 - 40,8	0,070 (27)
ec _{1,0} N	(Th)	40,630 - 41,621	1,32 (23)
ec _{19,18} L	(Th)	43,87 - 48,00	0,1850 (27)
ec _{7,4} M	(Th)	45,999 - 47,849	1,87 (39)
ec _{9,6} M	(Th)	48,892 - 50,742	0,0484 (8)
ec _{7,4} N	(Th)	49,850 - 50,846	0,5 (1)
ec _{9,6} N	(Th)	52,740 - 53,739	0,01296 (22)
ec _{19,18} M	(Th)	59,16 - 61,01	0,0445 (7)
ec _{19,18} N	(Th)	63,01 - 64,01	0,01188 (18)
ec _{2,0} L	(Th)	75,66 - 79,80	0,90 (11)
ec _{4,0} K	(Th)	76,072 (4)	5,06 (8)
ec _{2,0} M	(Th)	90,95 - 92,80	0,248 (30)
ec _{2,0} N	(Th)	94,8 - 95,8	0,067 (8)
ec _{4,0} L	(Th)	165,25 - 169,40	1,020 (18)
ec _{4,0} M	(Th)	180,54 - 182,39	0,2468 (37)
ec _{4,0} N	(Th)	184,390 - 185,387	0,0651 (10)

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV	Photons per 100 disint.	
XL	(Th)	11,1177 — 19,5043	40 (22)	
XK α_2	(Th)	89,954	3,56 (7)	} K α
XK α_1	(Th)	93,351	5,75 (11)	}
XK β_3	(Th)	104,819	}	
XK β_1	(Th)	105,604	}	
XK β_5''	(Th)	106,239	}	K' β_1
XK β_2	(Th)	108,509	}	
XK β_4	(Th)	108,955	}	
XK $O_{2,3}$	(Th)	109,442	}	K' β_2

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{7,5}(\text{Th})$	31,60 (5)	0,017 (6)
$\gamma_{10,7}(\text{Th})$	41,4 (3)	0,029 (11)
$\gamma_{1,0}(\text{Th})$	42,01 (6)	0,056 (9)
$\gamma_{7,4}(\text{Th})$	51,21 (4)	0,034 (7)
$\gamma_{9,6}(\text{Th})$	54,1 (1)	0,00115
$\gamma_{2,1}(\text{Th})$	54,25 (5)	0,0285
$\gamma_{19,18}(\text{Th})$	64,45 (5)	0,018
$\gamma_{10,5}(\text{Th})$	72,7 (2)	0,116
$\gamma_{7,3}(\text{Th})$	74,94 (3)	0,051 (6)
$\gamma_{2,0}(\text{Th})$	96,09 (2)	0,091 (11)
$\gamma_{14,7}(\text{Th})$	97 (4)	0,016 (4)
$\gamma_{5,2}(\text{Th})$	109,19 (7)	1,66 (13)
$\gamma_{10,3}(\text{Th})$	115,45 (5)	0,03 (1)
$\gamma_{3,1}(\text{Th})$	120,35 (5)	0,026
$\gamma_{16,8}(\text{Th})$	136,55 (5)	0,012
$\gamma_{7,2}(\text{Th})$	140,76 (2)	0,20 (1)
$\gamma_{20,18}(\text{Th})$	142,40 (5)	0,0051
$\gamma_{4,1}(\text{Th})$	143,767 (3)	10,94 (6)
$\gamma_{18,7}(\text{Th})$	150,936 (15)	0,09 (3)
$\gamma_{5,1}(\text{Th})$	163,356 (3)	5,08 (3)
$\gamma_{16,5}(\text{Th})$	173 (1)	0,006 (5)
$\gamma_{18,5}(\text{Th})$	182,62 (5)	0,39 (5)
$\gamma_{4,0}(\text{Th})$	185,720 (4)	57,0 (3)
$\gamma_{7,1}(\text{Th})$	194,940 (6)	0,63 (1)

	Energy keV	Photons per 100 disint.
$\gamma_{8,1}(\text{Th})$	198,894 (14)	0,036 (2)
$\gamma_{18,4}(\text{Th})$	202,12 (1)	1,08 (2)
$\gamma_{5,0}(\text{Th})$	205,316 (4)	5,02 (3)
$\gamma_{19,7}(\text{Th})$	215,28 (4)	0,029 (3)
$\gamma_{6,0}(\text{Th})$	221,386 (14)	0,118 (5)
$\gamma_{13,2}(\text{Th})$	228,76 (5)	0,0074
$\gamma_{9,1}(\text{Th})$	233,50 (2)	0,038 (4)
$\gamma_{8,0}(\text{Th})$	240,88 (4)	0,074 (4)
$\gamma_{19,5}(\text{Th})$	246,83 (2)	0,055 (3)
$\gamma_{15,2}(\text{Th})$	255,365 (10)	0,0074
$\gamma_{19,4}(\text{Th})$	266,47 (4)	0,0078 (6)
$\gamma_{12,1}(\text{Th})$	275,35 (15)	0,051 (6)
$\gamma_{9,0}(\text{Th})$	275,49 (6)	0,032
$\gamma_{16,2}(\text{Th})$	281,42 (5)	0,0063
$\gamma_{13,1}(\text{Th})$	282,94 (5)	0,0063
$\gamma_{17,2}(\text{Th})$	289,56 (4)	0,0074
$\gamma_{18,2}(\text{Th})$	291,65 (3)	0,040 (6)
$\gamma_{11,0}(\text{Th})$	301,7 (1)	0,0053
$\gamma_{15,1}(\text{Th})$	310,69 (6)	0,0094
$\gamma_{12,0}(\text{Th})$	317,10 (8)	0,0011
$\gamma_{17,1}(\text{Th})$	343,5 (2)	0,0032
$\gamma_{18,1}(\text{Th})$	345,92 (3)	0,040 (6)
$\gamma_{15,0}(\text{Th})$	350 (5)	0,006
$\gamma_{19,2}(\text{Th})$	356,03 (5)	0,0053
$\gamma_{18,0}(\text{Th})$	387,84 (3)	0,040 (6)
$\gamma_{21,5}(\text{Th})$	390,27 (20)	0,040 (1)
$\gamma_{19,1}(\text{Th})$	410,29 (4)	0,0032
$\gamma_{22,4}(\text{Th})$	448,40 (6)	0,0011

7 Main Production Modes

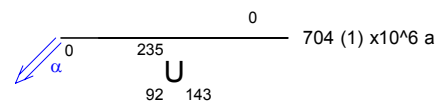
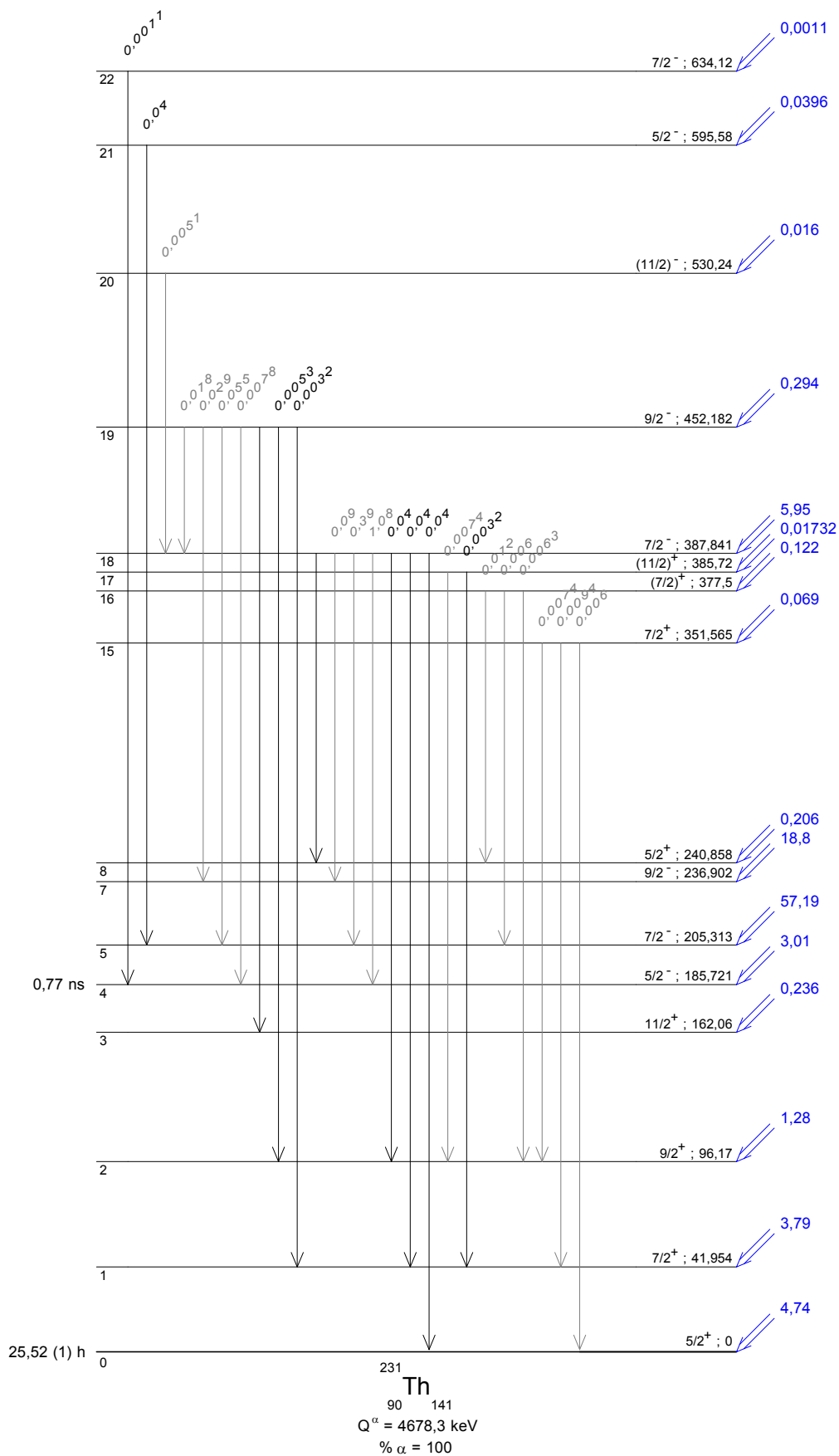
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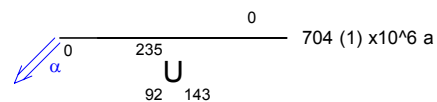
8 References

- A.O.NIER. Phys.Rev. 55 (1939) 150
(Half-life)
- G.B.KNIGHT. Report ORNL K-663 (1950)
(Half-life)
- G.J.SAYAG. Comp. Rend. Acad. Sci. (Paris) 232 (1951) 2091
(Half-life)
- E.H.FLEMING, JR., A.GHIORSO, B.B.CUNNINGHAM. Phys. Rev. 88 (1952) 642
(Half-life)
- E.SEGRE. Phys. Rev. 86 (1952) 21
(Half-life)
- F.L.CLARK, H.J.SPENCER-PALMER, R.N.WOODWARD. J.S.African Chem. Inst. 10 (1957) 62
(Half-life)

- E.WURGER, K.P.MEYER, P.HUBER. *Helv. Phys. Acta* 30 (1957) 157
(Half-life)
- S.A.BARANOV, A.G.ZELENKOV, V.M.KULAKOV. *Izvest.Akad.Nauk SSSR, Ser.Fiz.* 24 (1960) 1035
(Alpha energies and intensities)
- R.C.PILGER, F.S.STEPHENS, F.ASARO, I.PERLMAN. *Priv.Comm.*, quoted by unpublished (1962)
(Alpha energies and intensities)
- A.J.DERUYTTER, I.G.SCHRODER, J.A.MOORE. *Nucl.Sci.Eng.* 21 (1965) 325
(Half-life)
- P.H.WHITE, G.J.WALL, F.R.PONTET. *J.Nucl.Energy A/B19* (1965) 33
(Half-life)
- B.M.ALEKSANDROV, A.S.KRIVOKHATSKII, L.Z.MALKIN, K.A.PETRZHAK. *At.Energ.* 20 (1966) 315
(Half-life)
- R.GAETA, M.A.VIGON. *Nucl.Phys.* 76 (1966) 353
([Alpha energies and intensities, gamma-ray energie])
- J.E.CLIN. *IN-1448 Rev.* (1971)
(gamma-ray energies and intensities)
- A.H.JAFFEY, K.F.FLYNN, L.E.GLENDENIN, W.C.BENTLEY, A.M.ESSLING. *Phys.Rev. C4* (1971) 1889
(Half-life)
- L.A.KROGER, C.W.REICH, J.E.CLIN. *ANCR-1016* (1971) p.75
(gamma-ray energies and intensities)
- A.J.DERUYTTER, G.WEGENER-PENNING. *Phys. Rev. C10* (1974) 383
(Half-life)
- A.GRUTTER, H.R.VON GUNTEN, V.HERRNBERGER, B.HAHN, U. MOSER, H.W. REIST, G. SLETTEN. *Int. At. En. Agency, Vienna* (1974) p.305
(Half-life)
- W.TEOH, R.D.CONNOR, R.H.BETTS. *Nucl. Phys. A228* (1974) 432
(gamma-ray energies and intensities)
- E.VANO, R.GAETA, L.GONZALEZ, C.F.LIANG. *Nucl. Phys. A251* (1975) 225
(gamma-ray energies and intensities)
- S.A.BARANOV, V.M.SHATINSKII, A.G.ZELENKOV, V.A.PCHELIN. *Sov.J.Nucl.Phys.* 26 (1977) 486
(gamma-ray energies and intensities)
- H.R.VON GUNTEN, A.GRUTTER, H.W.REIST, M.BAGGENSTOS. *Phys. Rev. C23* (1981) 1110
(Half-life)
- R.VANINBROUKX, B.DENECKE. *Nucl. Instrum. Methods* 193 (1982) 191
(gamma-ray energies and emission probabilities)
- C.BAKTASH, E.DER MATEOSIAN, O.C.KISTNER, A.W.SUNYAR, D.HORN, C.J.LISTER. *Bull. Am. Phys. Soc.* 28, No.1 (1983) 41
(gamma-ray emission probabilities)
- D.G.OLSON. *Nucl. Instrum. Methods* 206 (1983) 313
(gamma-ray emission probabilities)
- R.G.HELMEYER, C.W.REICH. *Int. J. Appl. Radiat. Isotop.* 35 (1984) 783
(gamma-ray energies and emission probabilities)
- A.LORENZ. *IAEA Tech.Rept.Ser. No.261* (1986)
(evaluated gamma-ray energies and emission probabilities)
- A.RYTZ. *At. Data Nucl. Data Tables* 47 (1991) 205
(Evaluated alpha intensities)
- W.-J.LIN, G.HARBOTTLE. *J. Radioanal. Nucl. Chem.* 157 (1992) 367
(gamma-ray emission probabilities)
- C.C.BUENO, M.D.S.SANTOS. *Appl. Rad. Isotopes* 44 (1993) 567
(Half-life)
- H.RUELLAN, M.C.LÉPY, M.ETCHEVERRY, J.PLAGNARD, J.MOREL. *Nucl. Instrum. Methods Phys. Res. A369* (1996) 651
(gamma-ray and X-ray intensities)
- E.SCHÖNFELD, H.JANSSEN. *Nucl. Instrum. Methods Phys. Res. A369* (1996) 527
(Atomic data)
- N.E.HOLDEN, D.C.HOFFMAN. *Pure Applied Chim.* 72 (2000) 1525
(evaluated Half-life)
- I.M.BAND, M.B.TRZHASKOVSKAYA, C.W.NESTOR, JR., P.O.TIKKANEN, S.RAMAN. *At. Data Nucl. Data Tables* 81 (2002) 1
(calculated ICC)

- G.AUDI, A.H.WAPSTRA, C.THIBAUT. Nucl. Phys. A729 (2003) 129
(Q)
- E.BROWNE. Nucl. Data Sheets 98 (2003) 665
(NDS)
- F.DAYRAS, N.CHAUVIN. Nucl. Instrum. Methods Phys. Res. A530 (2004) 391
(Alpha energies and intensities)
- R.SCHÖN, G.WINKLER, W.KUTSCHERA. Appl. Rad. Isotopes 60 (2004) 263
(evaluated Half-life)
- E.GARCIA-TORANO, M.T.CRESPO, M. ROTETA, G. SIBBENS, S. POMMÉ, A.M. SANCHEZ, M.P.R. MONTERO, S. WOODS, A. PEARCE. Nucl. Instrum. Methods Phys. Res. A550 (2005) 581
(Alpha energies and intensities)
- F.S.AL-SALEH, AL-J.H.AL-MUKREN, M.A.FAROUK. Nucl. Instrum. Methods Phys. Res. A568 (2006) 734
(gamma-ray emission probabilities)
- T. KIBÉDI, T.W. BURROWS, M.B. TRZHASOVSKAYA, P.M. DAVIDSON, C.W. NESTOR JR.. Nucl. Instrum. Methods Phys. Res. A589 (2008) 202
(Theoretical ICC)

 γ Emission intensities per 100 disintegrations

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