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A Compilation of Recalibrated α-Particle Energy and Intensity Values

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Introductory remarks

Alpha particle energy values have been compiled many times and by various authors. In most cases, however, such lists suffered from one or several of the following shortcomings:

- Not enough unambiguous results available,
- Adjusted values superseded by new results, soon after publication,
- Adjustments made not stated by the compiler,
- No intensities nor errors given,
- Compilation is part of a large data collection; therefore, α-energy data not easily enough accessible.

In 1966, the Bureau International des Poids et Mesures (BIPM) started a programme for measuring absolute α-energies with the aim of determining accurate values of as many α-emitters as possible. To date 22 α-emitters (35 energy values) have been measured. During this work an increasing need of an up-to-date compilation of energy and intensity values was felt. We therefore started collecting data and consulting the original papers as far as possible.

The choice of the α-decaying nuclides is somewhat arbitrary. In general, energy values with uncertainties greater than 5 keV have not been considered except in cases where a special interest seemed to justify it. Thus, nuclides with very long partial α-half-lives were rejected. Although half-life and branching ratio seemed to be of some importance, they are given, as a rule, only with two significant figures and without reference. Intensity values are always given in percent of the corresponding α-decay. Separate references for intensity measurements are indicated where necessary. In some cases the arithmetic mean between two or more results was taken. Only such α-groups were included in the table which have a relative intensity of at least 5% or which correspond to ground state transitions. A dotted line between intensity values indicates the existence of intermediate lines weaker than 5%.

Much effort was put into the evaluation of what we consider as the most reliable particle energy. Under the column heading "E_α (keV)" we give the value found in the corresponding reference quoted, to which an amount indicated under "corr. (keV)" has been added. This correction is the difference between our value for the "standard used" and the one found in the reference (or guesses from similar measurements by the same author or laboratory). The letters m, s, i behind the reference indicate the method used, magnetic spectrometer, solid state detector, ion chamber, respectively.

Uncertainties indicated under "ΔE_α" and "ΔI" are as stated by the authors or, between brackets, otherwise guessed. No attempt has been made to find out the precise meaning of the errors, however. Therefore, the figures quoted may be standard errors, probable errors, some multiple of these, a sum of a statistical andanestimated systematic error, etc., or mere guesses.

Most of the references prior to 1967 have been found in LedeC67; the same quotation system has been adopted. For more recent papers Nuclear Data Sheets NDS were consulted, where available.

Since the energies of most of the α-emitters used as standards are now known from absolute measurements, there remain only 15 α-emitters where no direct calibration based on an absolute value could yet be made.

A	El	Z	$T_{1/2}$	Branch. ratio	Reference for intensity	I_α (%)	ΔI_α (%)	E_α (keV)	ΔE_α (keV)	Reference for energy		Standards used	corr. (keV)
148	Gd	64	84 a					3 185	10	GoloN67	m	^{241}Am, ^{234}U...	-
										SiiA62	i		
202	At	85	3.0 min	α/tot=0.12		36	2	6 230	3	HoffR63	m	^{203}At, ^{242}Cm	+ 3
						64	2	6 136	2				+ 3
203	At	85	7.4 min	α/tot=0.14		100		6 087	2	HoffR63	m	^{242}Cm	+ 3
										TreyW67	s	^{212}Bi	-
204	At	85	9.3 min	α/tot=0.045		100		5 950	3	HoffR63	m	^{203}At, ^{242}Cm	+ 3
										TreyW67	s	^{212}Bi	+ 1
205	At	85	26 min	α/tot=0.18		100		5 899	4	HoffR63	m	^{242}Cm	+ 3
208	Po	84	2.9 a	EC/tot=1.8×10^{-5}		100		5 118	5	TielE67	s	^{239}Pu, ^{210}Po	-
	Rn	86	23 min	α/tot=0.2		100		6 148	4	MomF55	i	^{211}At, ^{210}Po	+ 7
209	Po	84	102 a	EC/tot=0.0026	AsaF51;HageG66 s	99.3		4 884	5	AsaF51	m	^{210}Po	+ 7
	At	85	5.4 h	α/tot=0.05		(100)		5 648	5	HumJ56, StonA56	m	^{210}Po	+ 6
	Rn	86	30 min	α/tot=0.17		100		6 044	10	MomF55	i	^{211}At, ^{210}Po	+ 7
210	Bi	83	5 d	$\alpha/\beta=1.3\times10^{-6}$		40		4 686	(3)	WaleR59	m	^{210}Po	-
						60		4 649	(3)				-
	Bi^m	83	2.6×10^{6} a			58	1	4 959	5	KorG62	i	^{234}U	+ 6
						36	1	4 922	5				+ 6
						6	0.5	4 574	5				+ 6
	Po	84	138 d			100		5 304.6	0.6	RytA61	m	abs	-
	At	85	8.3 h	α/tot=0.0017		32		5 526	(5)	HoffR53	m	^{210}Po	+ 7
						31		5 444	(5)				+ 7
						37		5 362	(5)				+ 7
	Rn	86	2.4 h	α/tot=0.96		100		6 044	3	MomF	m	^{211}At	+ 7
211	Bi	83	2.2 min	β/tot=0.0027	GiaM62, WaleR62a	84.1	0.1	6 623.1	0.6	GrennB71	m	abs	-
						15.9	0.1	6 278.4	0.7	RytA61	m	(abs) α_0	+1.2
	Po	84	0.56 s		WaleR62a	99	(2)	7 450.6	0.7	WaleR62a	m	^{215}Po ...	+2.3
										VallK70	s	^{215}Po	+2.6
	Po^m	84	25 s			7.04	0.14	8 875	10	PerlmI62	s	^{212}Po	+ 5
						91		7 275	15				+ 5
	At	85	7.2 h	α/tot=0.4		100	(3)	5 869	3	HoffR53	m	^{241}Am, ^{218}Po, ^{210}Po	+ 7
	Rn	86	15 h	α/tot=0.26		33.5		5 854	3	MomF55	m	^{211}At	+ 7
						64.5		5 786	3				+ 7

A	El	Z	$T_{1/2}$	Branch. ratio	Reference for intensity	I_α (%)	ΔI_α (%)	E_α (keV)	ΔE_α (keV)	Reference for energy	Standards used	corr. (keV)
212	Bi	83	61 min	α/tot=0.38	RytA51	27.2	(0.1)	6 090.06	0.08	GrennB69	abs	-
						69.9	(0.1)	6 050.77	0.07	GrennB71 m		-
212	Po	84	0.3 μs			100		8 784.30	0.07	GrennB71, RytA72 m	abs	-
				long range	LeanC65 m	0.016		10 554	2	GrennB70 m	abs	-
					LeanC65	0.001		10 436	4	LeanC65 m	l.r. I	+ 4
					LeanC65	0.0034		9 503	4	LeanC65	l.r. I	+ 4
	Po^m	84	45 s			97		11 660	20	Perlm162 s	l.r. I	+ 10
	Rn	86	23 min			100		6 271	5	MomF55 m	^{211}At	+ 7
	Fr	87	19 min	α/tot=0.44		21	2	6 407	3	ValliK65 s	^{211}Bi, ^{212}Bi	-
						23	2	6 383	3			-
						12	1	6 338	3			-
						40	4	6 261	3			-
213	Bi	83	47 min	α/tot=0.022		93	5	5 869	10	ValliK64 s	^{210}Po, ^{212}Bi	-
						7	1.5	5 549	10			-
	Po	84	4.2 μs			100		8 376	5	ValliK64 s	^{212}Po	- 1
214	Bi	83	20 min	α/tot=2.1×10^{-4}		39.2	0.3	5 518	(3)	WaleR60 m	^{210}Po, ^{212}Bi, ^{218}Po	+ 6
						53.9	0.3	5 454	(3)			+6
						5.8	0.1	5 274	(3)			+6
	Po	84	0.16 ms			100		7 687.09	0.06	GrennB71 m	abs	-
				long range		$\leq 2\times10^{-5}$		14 lines	6 to 10	LeanC65 m	^{214}Po α_o	
215	Po	84	1.8 ms			100		7 386.4	0.8	GrennB71 m	abs	-
216	Po	84	0.15 s			100		6 778.5	0.5	GrennB71 m	abs	-
217	At	85	32 ms	β/tot < 10^{-3}		$\approx$100		7 068	5	ValliK64 } s	^{212}Bi, ^{212}Po	-
										LeanC69 } m	^{219}Rn	+ 1.3
	Rn	86	0.54 ms			100		7 742	4	RuiC61 m	^{214}Po	+ 7
218	Po	84	3.0 min	β/α =1.9×10^{-4}		100		6 002.55	0.09	GrennB71 m	abs	-
	At	85	2 s			94		6 698	3	WaleR59a m	^{218}Po	+ 0.5
						6		6 653	5			+ 0.5
	Rn	86	30 ms			100		7 132	5	AsaF56 m	^{224}Ra, ^{218}Po	+ 5
219	Rn	86	4 s		WaleR62 a	81	1	6 819.29	0.27	GrennB71 m	abs	-
						11.5	0.5	6 552.6	1.0	RytA61 m	(abs) α_o	+ 2.0
						7.5	0.5	6 425.6	1.0	RytA61 m		+ 2.0
220	Rn	86	55 s			100		6 288.29	0.10	GrennB71 m	abs	-

A	El	Z	$T_{1/2}$	Branch. ratio	Reference for intensity	Iα (%)	ΔIα (%)	Eα (keV)	ΔEα (keV)	Reference for energy		Standards used	corr. (keV)
221	Fr	87	4.8 min	β/tot < 10^{-3}	LeanC69	83.4	0.8	6 340.6	1.5	LeanC69, WaleR62	m	^{224}Ra; ^{216}Po	+ 1.6
						15.1	0.2	6 126	2	VorA60	i	^{216}Po, ^{224}Ra, ^{228}Th	+ 3.4
										ValliK64	s	^{212}Bi, ^{210}Po	-
	Ra	88	30 s			30	2	6 758	5	RuiC61	m	^{226}Th, ^{222}Ra	+ 4
						20	2	6 665	5				-
						34	2	6 610	5				-
						8	1	6 588	5				-
222	Rn	86	3.8 d			≈100		5 489.66	0.30	GrennB71	m	abs	-
	Ra	88	38 s			95		6 556	5	AsaF56	m	^{224}Ra, ^{218}Po	+ 5
223	Ra	88	11 d		WaleR62 a m	0.9		5 872	2	WaleR62 a	m	(^{211}Bi), α_{159}	+ 2.0
						9.1	0.2	5 747.2	0.4	GrennB71	m	abs	-
						53.7	1.1	5 716.42	0.29	GrennB71			-
						26.0	0.5	5 606.92	0.30	GrennB71			-
						9.1	0.2	5 539.8	(0.4)	GrennB71, WaleR62 a		α_{159}	+ 2.0
	Ac	89	2.2 min	α/tot=0.99		31.8	3.0	6 662	1	LeanC69	m	^{211}Bi	+ 1.2
						44.6	4.0	6 647	1				+ 1.2
						13.7	1.0	6 564	1				+ 1.2
224	Ra	88	3.6 d		WaleR62 m	94.0	(0.5)	5 685.56	0.15	GrennB71	m	abs	-
						5.5		5 448.8	0.5	BastG62	m	(^{223}Ra); α_o	+ 1.6
	Ac	89	2.9 h	α/tot=0.10		20.4		6 210.6	0.7	LeanC69	m	^{212}Bi; ^{224}Ra, ^{214}Po	+ 0.6
						11.9		6 203.8	0.7				+ 0.6
						25.6		6 138.5	0.7				+ 0.6
						21.9		6 056.6	0.7				+ 0.6
						6.7		6 000.4	1.4				+ 0.6
225	Ac	89	10 d		BastG67 m	50.6	(0.1)	5 830	2	BastG67	m	^{224}Ra	+ 1.6
						24.3	(0.1)	5 794	3	ValliK64	s	^{210}Po, ^{212}Bi	-
						10.1	(0.2)	5 732	2				
	Th	90	8.0 min	α/tot ≈ 0.9		9	1	6 798	5	RuiC61	m	^{222}Ra, ^{226}Th	+ 5
						7	1	6 744	5				+ 5
						14	1	6 501	3				+ 5
						43	2	6 478	3				+ 5
						15	1	6 441	3				+ 5
226	Ra	88	1.6×10^{3} a		WaleR59 a	94.6		4 784.50	0.25	GrennB71	m	abs	-
						5.4	0.1	4 601.9	0.5	WaleR59 a	m	(^{210}Po); α_o	+ 2.5
	Th	90	31 min			79	(1)	6 335	(5)	AsaF56	m	^{218}Po, ^{224}Ra	+ 5
						19		6 225					-

A	El	Z	$T_{1/2}$	Branch. ratio	Reference for intensity	I_α (%)	ΔI_α (%)	E_α (keV)	ΔE_α (keV)	Reference for energy	Standard used	corr. (keV)
227	Ac	89	22 a	α/tot=0.014	NoviG59, BastG65	48	3	4 954	2	NoviG59 m	?	(+ 5)
						38	3	4 942	3			(+5)
						6	1	4 871	3			(+5)
						5	1	4 854	3			(+5)
	Th	90	18 d		BastG64	25	1	6 038.21	0.15	GrennB71 m	abs	-
						23	1	5 977.92	0.10			-
						20	1	5 757.06	0.15			-
						8.2	0.3	5 709.2	0.3	BastG64 m	α_{286}	+ 1.9
	Pa	91	38 min	α/tot ≈ 0.85		50.7		6 466	5	SubV63 m	^{211}Bi	+ 6.1
						11.8		6 424	5			+ 6.1
						15.2		6 416	5			+ 6.1
						9.6		6 402	5			+ 6.1
						8.0		6 357	5			+ 6.1
228	Th	90	1.9 a		AsaF53 m	71		5 423.33	0.22	GrennB71 m	abs	-
						28	1	5 340.54	0.15	GrennB71 m	abs	-
	Pa	91	22 h	α/tot ≈ 0.02		2.5		6 142	(3)	HillM58 m	^{230}U; ^{212}Bi, ^{224}Ra	+ 4
						10.5		6 118				+ 4
						12		6 105				+ 4
						20.7		6 078				+ 4
						9.0		6 028				+ 4
229	Th	90	7.3×10^3 a			0.01		5 077 (?)		NDS	mass difference	
					NDS	5.2		≈5 054	(3)	GoldiL59 m	(^{210}Po)	+ 6
					KocG59	6.4		4 967.6	1.2	BaranS71 m	^{240}Pu	+ 0.7
						10.8		4 901.1	1.2			+0.7
						56.2		4 845.4	1.2			+0.7
						8.4		4 814.7	1.2			+0.7
	Pa	91	1.5 d	α/tot ≈ 0.2	SubV63 m	0.5		5 734	(5)	HillM58 m	^{230}U, ^{224}Ra	+ 4
						18.5		5 669				+ 4
						9.7		5 629				+ 4
						13.3		5 614				+ 4
						36.5		5 579				+ 4
						8.8		5 535				+ 4
	U	92	58 min	α/tot ≈ 0.2		64		6 360	3	RuiC61 m	^{226}Th, ^{222}Ra	+ 5
						20		6 332				+ 5
						11		6 297				+ 5

A	El	Z	$T_{1/2}$	Branch. ratio	Reference for intensity		I_α (%)	ΔI_α (%)	E_α (keV)	ΔE_α (keV)	Reference for energy		Standards used	corr. (keV)
230	Th	90	7.7×10^4 a		RosS48	m	76		4 686.5	1.5	BastG66	s	^{226}Ra	+ 2.5
					RosS54	m	24		4 620.0	1.5				+ 2.5
	Pa	91	17 d	α/tot=3.2×10^{-5}			23	5	5 344.4	0.7	BastG66	s	^{222}Rn, ^{224}Ra	+ 1.3
							15	5	5 339.4	1.0				+ 1.3
							18	3	5 325.9	0.7				+ 1.3
							13	3	5 311.7	0.7				+ 1.3
							17	3	5 300.2	0.7				+ 1.3
	U	92	21 d				67.5	0.5	5 888.0	0.7	BastG66	s	^{222}Rn, ^{224}Ra	+ 1.1
							31.9	0.2	5 817.2	0.7				+ 1.1
231	Pa	91	3.2×10^4 a		BaranS61	m	11.0		5 058.2	1.0	BaranS68	m	^{240}Pu	+ 0.7
							22.5		{5 031.5 / 5 029.0					+ 0.7
							25.4		5 013.4					+ 0.7
							22.8		4 951.0					+ 0.7
							8.4		4 737.0					+ 0.7
232	U	92	72 a		AsaF55	m	68		5 320.36	0.09	GorD72	m	abs	-
							32		5 263.56	0.13			abs	-
233	U	92	1.6×10^5 a		BaranS66	m	84.4		4 824.7	1.0	BaranS66	m	^{240}Pu	+ 0.7
							13.2		4 784.0	1.0	BaranS68	m	^{240}Pu	+ 0.7
234	U	92	2.5×10^5 a		BaranS60	m	72.5	3	4 774	1	GoldiL55 }	m	^{210}Po	+ 6.2
							27.5	1.5	4 722	1	HarvB57 }	i	^{226}Ra	+ 5.5
	Pu	94	9 h	α/tot=0.06			68		6 202		HoffR60	m	^{220}Rn	+ 6.3
							32		6 151					+ 6.3
235	U	92	7.1×10^8 a				4.6		4 598	2	VorA60 }	i	^{234,236}U	+ 7
							57		4 402		BaranS60 }	m	^{234}U	+ 6
							18		4 372					+ 6
	Np	93	410 d	α/tot=1.6×10^{-5}			1.5	0.2	5 097	3	BrowE69	s	^{237}Np (?)	-
							53	10	5 014	2				-
							24 }	8	4 996	4				-
							6 }		4 986	4				-
							11.5	0.5	4 915	2				-

A	El	Z	$T_{1/2}$	Branch. ratio	Reference for intensity		I_α (%)	ΔI_α (%)	E_α (keV)	ΔE_α (keV)	Reference for energy		Standards used	corr. (keV)
236	U	92	2.4×10^{7} a				74		4 494	3	KomA60	i	^{234}U	+ 6
							26		4 449					+ 6
	Pu	94	2.8 a				72.0	0.5	5 768		HumJ56	m	^{220}Rn, ^{224}Ra	+ 5
							28.0	0.5	5 722		BaranS67	m	^{242}Cm	+ 1
237	Np	93	2.1×10^{6} a		BrowE67	s	2.6	0.2	4 872	3	BaranS61a,	m	α_{87}	+ 1
							48	9	4 788	2	BaranS68,	m	^{240}Pu	+ 0.7
							31	9	4 771	5	BrowE67	s	α_{87}	+ 7
							6.5	0.1	4 640	2	BrowE67	s	α_{87}	+ 7
238	U	92	4.5×10^{9} a		KocG59 a	i	77		4 197	5	VorA60	i	^{224}Ra, ^{228}Th	+ 2
							23	4	4 150	(10)	HarvB57	i	BrigG54	+ 5
	Pu	94	86 a		KondL57	m	71.1	1.2	5 499.21	0.20	GrennB71	m	abs	-
							28.7	1.2	5 456.5	0.4			abs	-
239	Pu	94	2.4×10^{4} a		GoldiL55, DzhB61,		72.6	0.5	5 156.3	0.5	LeanC62	m	^{212}Bi	+ 0.6
					BaranS68		16.3	0.5	5 143.8	0.6	BaranS68	m	^{240}Pu	+ 0.7
							11.1	0.5	5 105.9	0.6				
	Am	95	12 h	α/tot=5×10^{-5}			0.33	0.02	5 825	4	GorD71	m	^{241}Am	- 0.3
							83.7	0.4	5 776	2				- 0.3
							13.75	0.07	5 734	2				- 0.3
240	Pu	94	6.5×10^{3} a		GoldiL55, AsaF52	m	75.5	0.5	5 168.38	0.09	GorD72	m	abs	-
					KondL56	m	24.5	0.5	5 123.45	0.20			abs	-
	Cm	96	27 d	EC/tot $\leq$0.005	BaranS66 a	m	71.1	(1)	6 290.8	0.6	BaranS71	m	^{240}Pu	+ 0.7
							28.9	(1)	6 248.0	0.6				+ 0.7
241	Pu	94	15 a	α/tot=2.3×10^{-5}	AhmI68	s	1.5	0.1	5 056	5	AhmI68	s	α_{162}	+ 1
									5 043	3				
							83.2	0.5	4 896.8	1.2	BaranS68,	m	^{240}Pu	+ 0.7
							12.1	0.2	4 853.8	1.2	AhmI68	s	^{240}Pu	+ 0.9
	Am	95	433 a		MicW65	s	0.36	0.05	5 545	1	BaranS64, GoldiL55	m	α_{61}	
					AsaF53, GoldiL55,	m	85.2	0.5	5 485.74	0.12	GrennB71	m	abs	-
					RosS57, BaranS64	m	12.8	0.5	5 442.98	0.13	GrennB71	m	abs	-
	Cm	96	36 d	α/tot=0.01	BaranS66a	m	0.6		6 081	(1)	BaranS66a	m	^{242}Cm	+ 0.8
							71.5		5 939.3	0.6	BaranS71	m	^{240}Pu	+ 0.7
							16.3		5 927	(1)	BaranS66a	m	^{242}Cm	+ 0.8
							11.5		5 885.0	0.6	BaranS71	m	^{240}Pu	+ 0.7

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242	Pu	94	3.9×10^{5} a		HumJ56, KondL56 m	76		4 900.7	1.2	BaranS68 m	^{240}Pu	+ 0.7
						24		4 856.4	1.2			+ 0.7
	Cm	96	163 d		AsaF53a; KondL58 m	73.9	0.3	6 112.92	0.08	GrennB71 m	abs	-
					DzhB63, BaranS66b m	26.1	0.3	6 069.63	0.12	GrennB71 m	abs	-
243	Am	95	7.4×10^{3} a		BaranS64 m	0.16		5 349		StepF55, HumJ56 m	^{241}Am	+ 9.7
						87.9	0.3	5 276	1	BaranS68 m	^{240}Pu	+ 0.7
						10.6	0.3	5 234	1	BaranS64 m	^{241}Am	- 0.3
	Cm	96	30 a	α/tot=0.997	BaranS66b m	1.5		6 068	(2)	BaranS66b m	α_{286}	+ 0.8
						5.6		5 994	(2)			
						73.5	(0.5)	5 785.2	1.0	BaranS71 m	^{240}Pu	+ 0.7
						10.6		5 742.3	1.0			
	Bk	97	4.6 h	α/tot=1.5×10^{-3}	AhmI66 s	15.4		6 758		AhmI66 s	^{226}Th, ^{244}Cm	-
						12.5		6 718				-
						25.6		6 574				-
						19.4		6 542				-
						6.9		6 502				-
						13.6		6 210				-
244	Cm	96	18 a		HumJ56, DzhB63 m	76.4	(0.2)	5 804.96	0.05	GrennB71 m	abs	-
					BaranS66b m	23.6	(0.2)	5 762.835	0.030	GrennB71 m	abs	-
245	Cm	96	8.7×10^{3} a			≤0.5		5 533		BaranS66b m	?	-
						87.6		5 359				-
	Bk	97	5 d	α/tot=1.1×10^{-4}	AhmI66 s	16.5	0.5	6 358		AhmI66 s	^{244}Cm, ^{226}Th	-
						15.0	0.5	6 317				-
						19.0	0.5	6 153				-
						14.8	0.5	6 124				-
						5.6	0.3	6 087				-
						21.9	0.5	5 889				-
246	Cm	96	5×10^{3} a			79		5 386	(2)	BeloL63, BaranS66b m	^{238}Pu; ^{240}Pu, ^{244}Cm	-
						21		5 343		AsaF60a m	^{243}Am α_{75}	+ 4
	Cf	98	36 h		HumJ56, FrieA63 s	78	(0.5)	6 758	(5)	HumJ56 m	^{218}Rn	+ 5
						22	(0.5)	6 717	(5)	FrieA63 s	α_0	
247	Cm	96	1.6×10^{7} a			13.8	0.7	5 266	4	FieP71 s	^{242}Pu	+ 1
						5.7	0.5	5 211	4			+ 1
						71.0	1.0	4 868	4			+ 1

A	El	Z	$T_{1/2}$	Branch. ratio	Reference for intensity		I_α (%)	ΔI_α (%)	E_α (keV)	ΔE_α (keV)	Reference for energy		Standards used	corr. (keV
248	Cm	96	3.7×10^{5} a	α/tot=0.89			82	(1)	5 078	(3)	HulE61	m	^{246}Cm	+ 4
							18		5 035		SchuR67	s	^{240}Pu	+ 8
249	Bk	97	314 d	α/tot=2.2×10^{-5}	Ahml66	m	6.7	0.3	5 437.3	1.0	BaranS71	m	^{242}Cm	-
							69.2	1.5	5 416.8	1.0				-
							18.4	0.5	5 389.9	1.0				-
	Cf	98	352 a		Ahml66	s	2.4	0.1	6 194.0	0.7	BaranS71	m	^{242}Cm	-
							82.6	0.3	5 813.5	1.0				-
250	Cf	98	13 a		AsaF55a	m	83		6 030.8	0.6	BaranS71	m	^{242}Cm	-
							17		5 989.1	0.6				-
251	Cf	98	898 a		ChetA68	s	2.7	0.3	6 074	3	ChetA68	s	^{252}Cf	+ 7
					BrowE69	s	12.0	0.5	6 014	3	BrowE69	s	^{240}Pu	+ 8
							27.4	1.0	5 848	3	GrouCR66	s	^{249}Cf	+ 7
							34.8	1.0	5 680.3	1.0	BaranS71	m	^{242}Cm	-
252	Cf	98	2.6 a	α/tot=0.97	AsaF55a	m	84.3		6 118.3	0.5	BaranS71	m	^{242}Cm	-
							15.5		6 075.7	0.5				-
	Es	99	≈140 d	β/tot < 0.02			84.7		6 639	5	MHarW65	s	^{253}Es, ^{254}Es	-
							13.0		6 576	10				-
253	Es	99	20 d		AsaF60	m	90		6 632.73	0.05	GrennB71	m	abs	-
							6.6		6 592	(1)	AsaF60	m		-
254	Es	99	2.8×10^{2} d	β/tot < 0.01	MHarW65	s	0.005		6 516	10	MHarW65	s	α_{86}	- 8
							93.0		6 428.8	1.5	BaranS71	m	^{242}Cm	-
	Fm	100	3.2 h		AsaF55b	m	85		7 192	5	AsaF64	m	^{253}Es	-
							15		7 150					-
255	Es	99	40 d	α/tot=0.085	FielP67	s	87.7		6 299.5	1.5	BaranS71	m	^{242}Cm	-
							9.8		6 261	(5)	FielP67	s	α_x	- 6
	Fm	100	20 h		Ahml71	s	0.08	0.01	7 119	4	AsaF64	m	^{253}Es	- 3
							93.3	0.3	7 015.8	1.8	BaranS71	m	^{253}Es	+ 1
							5.2	0.1	6 957	3	AsaF64	m	α_{107}	- 3
257	Fm	100	80 d				0.4	0.2	6 750	(10)	AsaF67	i,s	^{253}Es	-
							94	1	6 519	2				-
240	Am	95	51 h	α/tot=1.9×10^{-6}			86.8	1.0	5 378*	1	GorD70	s	^{241}Am, ^{240}Pu	-
							12.0	0.4	5 337	2				-

* probably not to groundstate

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