NUCLEAR WALLET CARDS

April 2005

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www.nndc.bnl.gov

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(Seventh edition)

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JAGDISH K. TULI

NATIONAL NUCLEAR DATA CENTER
(www.nndc.bnl.gov)

for

The U.S. Nuclear Data Program

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INTRODUCTION

This is an updated edition of the 2000 booklet of the same name†. The 2000 edition is being archived for the US, DOE nuclear material inventory control (see p. vii).

This booklet presents selected properties of all known nuclides and their known isomeric states. Properties of ionized atoms are not included.

The data given here are taken mostly from the adopted properties of the various nuclides as given in the *Evaluated Nuclear Structure Data File* (ENSDF)[1]. The data in ENSDF are based on experimental results and are published in *Nuclear Data Sheets*[2] for A>20 and in *Nuclear Physics*[3] for A≤20. For nuclides for which either there are no data in ENSDF or those data that have since been superseded, the half–life and the decay modes are taken either from recent literature[4] or from other sources, *e.g.*, [5].

For other references, experimental data, and information on the data measurements, please refer to the original evaluations [1–3]. The data were updated to **January 15, 2005**.

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†The first *Nuclear Wallet Cards* was produced by F. Ajzenberg–Selove and C. L. Busch in 1971. The Isotopes Project, Lawrence Berkeley National Laboratory, produced the next edition in 1979 based upon the *Table of Isotopes*, 7^{th} edition (1978)[9]. The subsequent editions, the third in 1985, the fourth in 1990, the fifth in 1995, and the sixth in 2000 were produced by J.K. Tuli, NNDC. In 2004, **Nuclear Wallet Cards for Radioactive Nuclides** aimed at Homeland Security personnel was produced by J.K. Tuli, NNDC (see p. vii).

Explanation of Table

Column 1, Nuclide (Z, El, A):

Nuclides are listed in order of increasing atomic number (Z), and are subordered by increasing mass number (A). All isotopic species, as well as all isomers with half–life ≥0.1 s, and some with half–life≥1 ms which decay by SF, α or p emissions, are included. A nuclide is given even if only its mass estimate or its production cross section is available. For the latter nuclides half–life limit or an approximate value is given as estimated from systematics [5].

Isomeric states are denoted by the symbol "m" after the mass number and are given in the order of increasing excitation energy.

The ^{235}U thermal fission products, with fractional cumulative yields≥10^{-6}, are *italicized* in the table. The information on fission products is taken from the ENDF/B–VI fission products file [8].

The names and symbols for elements are those adopted by the International Union of Pure and Applied Chemistry (2004). No names and symbols have as yet been adopted for Z>111.

Column 2, Jπ:

Spin and parity assignments, without and with parentheses, are based upon strong and weak arguments, respectively. See the introductory pages of any issue of *Nuclear Data Sheets*[2] for description of strong and weak arguments for Jπ assignments.

Explanation of Table (cont.)

Column 3, Mass Excess, Δ:

Mass excesses, M–A, are given in MeV (from [6]) with $\Delta(^{12}C)=0$, by definition. For isomers the values are obtained by adding the excitation energy to the Δ(g.s.) values. Wherever the excitation energy is not known, the mass excess for the next lower isomer (or the g.s.) is given. The values are given to the accuracy determined by uncertainty in Δ(g.s.) (maximum of three figures after the decimal). The uncertainty is ≤9 in the last significant figure. An appended "s" denotes that the value is obtained from systematics [6].

Column 4, $T_{½}$,Γ or Abundance:

The half–life and the abundance (in **bold face** from [7]) are shown followed by their units ("%" symbol in the case of abundance) which are followed by the uncertainty, in *italics*,in the last significant figures. For example, 8.1 s *10* means 8.1±1.0 s. For some very short–lived nuclei, level widths rather than half–lives are given. There also, the width is followed by units (*e.g.*, eV, keV, or MeV) which are followed by the uncertainty in *italics*, if known. As stated above when a limit or an approximate value is given it is based on systematics (*sy*), mostly from [5]. A '?' in this field indicates that $T_{½}$ is not known.

For $2\beta^-$ and 2ε decay only the lowest value of their several limits (*e.g.*, for 0ν or 2ν, etc.) is given.

If a new measurement of half–life, has since become available it is presented in place of the evaluated value in ENSDF.

Explanation of Table (cont.)

Column 5, Decay Mode:

Decay modes are given in decreasing strength from left to right, followed by the percentage branching, if known ("w" indicates a weak branch). The percentage branching is omitted where there is no competing mode of decay or no other mode has been observed. A "?" indicates an expected but not observed mode of decay[5]. The various modes of decay are given below:

β–	β^- decay
ε	ε (electron capture), or ε+β^+, or β^+ decay
IT	isomeric transition (through γ or conver–sion–electron decay)
n, p, α, ...	neutron, proton, alpha, ... decay
SF	spontaneous fission
2β–, 3α, ...	double β^- decay ($\beta^-\beta^-$), decay through emission of 3 α's, ...
β–n, β–p, β–α, ...	delayed n, p, α, ... (emission following β^- decay)
εp, εα, εSF, ...	delayed p, α, SF, ... (emission following ε or β^+ decay)

NNDC Web Services

The centerfold presents the NNDC home page on the web (*www.nndc.bnl.gov*). The greatly expanded NNDC web service offers a wealth of Nuclear Physics information which includes analysis programs, reference data, and custom–tailored retrievals from its many databases.

DOE Standard for Nuclear Material Inventory

The 2000 edition was adopted as the standard by the the Department of Energy for the purposes of their nuclear material inventory. The 2000 edition, as well as, the current version are available through the NNDC web site, *www.nndc.bnl.gov/wallet/*.

Homeland Security

Nuclear Wallet Cards for Radioactive Nuclides, a reference for homeland security personnel based on this booklet was published in March 2004. The booklet, although limited to radioactive nuclides, contains additional radiation information. It is available on the web as well as in printed form from NNDC.

Acknowledgements

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Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
0	**n**	1	1/2+	8.071	10.24 m *2*	β–
1	**H**	1	1/2+	7.289	**99.985%** ***1***	
		2	1+	13.136	**0.015%** ***1***	
		3	1/2+	14.950	12.32 y *2*	β–
		4	2–	25.9	4.6 MeV *9*	n
		5		32.9	5.7 MeV *21*	n
		6	(2–)	41.9	1.6 MeV *4*	n
		7		49s	29×10^{-23} y *7*	
2	**He**	3	1/2+	14.931	**0.000137%** ***3***	
		4	0+	2.425	**99.999863%** ***3***	
		5	3/2–	11.39	0.60 MeV *2*	α, n
		6	0+	17.595	806.7 ms *15*	β–
		7	(3/2)–	26.10	150 keV *20*	n
		8	0+	31.598	119.0 ms *15*	β–, β–n 16%
		9	(1/2–)	40.94	65 keV *37*	n
		10	0+	48.81	0.17 MeV *11*	2n?
3	**Li**	3		29s	unstable	p?
		4	2–	25.3	6.03 MeV	p
		5	3/2–	11.68	≈1.5 MeV	α, p
		6	1+	14.087	**7.59%** ***4***	
		7	3/2–	14.908	**92.41%** ***4***	
		8	2+	20.947	838 ms *6*	β–, β–α
		9	3/2–	24.954	178.3 ms *4*	β–, β–n 50.8%
		10	(1–,2–)	33.05	1.2 MeV *3*	n
		11	3/2–	40.80	8.59 ms *14*	β–, β–nα 0.027%, β–n
		12		50.1s	<10 ns	n?
4	**Be**	5	(1/2+)	38s	?	p
		6	0+	18.375	92 keV *6*	p, α
		7	3/2–	15.770	53.22 d *6*	ε
		8	0+	4.942	6.8 eV *17*	α
		9	3/2–	11.348	**100%**	
		10	0+	12.607	1.51×10^{6} y *6*	β–
		11	1/2+	20.174	13.81 s *8*	β–, β–α 3.1%
		12	0+	25.08	21.49 ms *3*	β–, β–n≤1%
		13	(1/2–)	33.25	2.7×10^{-21} s *18*	n
		14	0+	40.0	4.84 ms *10*	β–, β–n 94%, β–2n 6%
		15		49.8s	<200 ns	n?
		16	0+	57.7s	<200 ns	2n?
5	**B**	6		43.6s	unstable	2p?
		7	(3/2–)	27.87	1.4 MeV *2*	p, α
		8	2+	22.921	770 ms *3*	ε, εα
		9	3/2–	12.416	0.54 keV *21*	p,
		10	3+	12.051	**19.8%** ***3***	
		11	3/2–	8.668	**80.2%** ***3***	
		12	1+	13.369	20.20 ms *2*	β–, β–3α 1.58%
		13	3/2–	16.562	17.33 ms *17*	β–
		14	2–	23.66	12.5 ms *5*	β–, β–n 6.04%
		15		28.97	9.93 ms *7*	β–, β–n 93.6%, β–2n 0.4%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
5	**B**	16	0−	37.08	<190 ps	n
		17	(3/2−)	43.8	5.08 ms *5*	β−, β−n 63%, β−2n 11%, β−3n 3.5%, β−4n 0.4%
		18	(4−)	52.3s	<26 ns	n?
		19	(3/2−)	59.4s	2.92 ms *13*	β−, β−n 72%, β−2n 16%
6	**C**	8	0+	35.09	230 keV *50*	p, α
		9	(3/2−)	28.910	126.5 ms *9*	ε, εp 83%, εα 17%
		10	0+	15.699	19.26 s *5*	ε
		11	3/2−	10.650	20.334 m *24*	ε
		12	0+	0.000	**98.89%** ***1***	
		13	1/2−	3.125	**1.11%** ***1***	
		14	0+	3.020	5700 y *30*	β−
		15	1/2+	9.873	2.449 s *5*	β−
		16	0+	13.694	0.747 s *8*	β−, β−n 99%
		17		21.04	193 ms *13*	β−, β−n 32%
		18	0+	24.93	92 ms *2*	β−, β−n 31.5%
		19		32.42	49 ms *4*	β−n 61%, β−
		20	0+	37.6	14 ms +*6*−*5*	β−, β−n 72%
		21	(1/2+)	46.0s	<30 ns	n?
		22	0+	53.3s	6.1 ms +*14*−*12*	β−, β−n 61%, β−2n>0%
7	**N**	10	(1−)	38.8	20×10^{-23} y *14*	p?
		11m	1/2+	24.62	1.58 MeV +*75*−*52*	p
		12	1+	17.338	11.000 ms *16*	ε
		13	1/2−	5.345	9.965 m *4*	ε
		14	1+	2.863	**99.634%** ***20***	
		15	1/2−	0.101	**0.366%** ***20***	
		16	2−	5.684	7.13 s *2*	β−, β−α 1.2×10^{-3}%
		17	1/2−	7.87	4.173 s *4*	β−, β−n 95.1%
		18	1−	13.11	624 ms *12*	β−, β−n 14.3%, β−α 12.2%
		19		15.86	271 ms *8*	β−, β−n 54.6%
		20		21.77	130 ms *7*	β−, β−n 57%
		21	(1/2−)	25.25	85 ms *7*	β−, β−n 81%
		22		32.0	18 ms *4*	β−, β−n 36%, β−2n<13%
		23		38.4s	14.1 ms +*12*−*15*	β−, β−n 42%, β−2n 8%
		24		47.5s	<52 ns	n?
		25		56.5s	<260 ns	n?
8	**O**	12	0+	32.05	0.40 MeV *25*	p
		13	(3/2−)	23.112	8.58 ms *5*	ε, εp=100%
		14	0+	8.007	70.641 s *20*	ε
		15	1/2−	2.856	122.24 s *16*	ε
		16	0+	−4.737	**99.762%** ***16***	
		17	5/2+	−0.809	**0.038%** ***1***	
		18	0+	−0.781	**0.200%** ***14***	
		19	5/2+	3.335	26.88 s *5*	β−
		20	0+	3.797	13.51 s *5*	β−

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
8	**O**	21	(5/2+)	8.06	3.42 s *10*	β–
		22	0+	9.28	2.25 s *15*	β–, β–n<22%
		23		14.6	82 ms *37*	β–, β–n 31%
		24	0+	19.1	65 ms *5*	β–, β–n 18%
		25	(3/2+)	27.4s	<50 ns	n
		26	0+	35.7s	<40 ns	n
		27		45.0s	<260 ns	n?
		28	0+	53.8s	<100 ns	n?
9	**F**	14	(2–)	32.7s	?	p
		15	(1/2+)	16.8	1.0 MeV *2*	p
		16	0–	10.680	40 keV *20*	p
		17	5/2+	1.952	64.49 s *16*	ε
		18	1+	0.874	1.8291 h *4*	ε
		19	1/2+	–1.487	**100%**	
		20	2+	–0.017	11.07 s *6*	β–
		21	5/2+	–0.048	4.158 s *20*	β–
		22	(4+)	2.79	4.23 s *4*	β–, β–n<11%
		23	(3/2,5/2)+	3.33	2.23 s *14*	β–
		24	(1,2,3)+	7.56	400 ms *50*	β–, β–n<5.9%
		25	(5/2+)	11.27	50 ms *6*	β–, β–n 14%
		26	1+	18.3	9.6 ms *8*	β–, β–n 11%
		27	(5/2+)	24.9	5.0 ms *2*	β–, β–n 77%
		28		33.2s	<40 ns	n
		29	(5/2+)	40.3s	2.5 ms *4*	β–, β–n, β–
		30		48.9s	<260 ns	n?
		31		56.3s	>260 ns	β–?, β–n?
10	**Ne**	16	0+	24.00	122 keV *37*	p
		17	1/2–	16.46	109.2 ms *6*	ε , εp=100%, εα
		18	0+	5.317	1672 ms *8*	ε
		19	1/2+	1.751	17.22 s *2*	ε
		20	0+	–7.042	**90.48%** ***3***	
		21	3/2+	–5.732	**0.27%** ***1***	
		22	0+	–8.025	**9.25%** ***3***	
		23	5/2+	–5.154	37.24 s *12*	β–
		24	0+	–5.951	3.38 m *2*	β–
		25	(3/2)+	–2.11	602 ms *8*	β–
		26	0+	0.43	192 ms *6*	β–, β–n<0.2%
		27	(3/2+)	7.1	32 ms *2*	β–, β–n 2%
		28	0+	11.2	19 ms *3*	β–, β–n 16%
		29	(3/2+)	18.1	15.6 ms *5*	β–, β–n 17%, β–2n<2.9%
		30	0+	23.1	5.8 ms *2*	β–, β–n<26%
		31		30.8s	3.4 ms *8*	β–
		32	0+	37.3s	3.5 ms *9*	β–
		33		46.0s	<260 ns	n?
		34	0+	53.1s	>1.5 μs	β–?, β–n?
11	**Na**	18	(1–)	24.19	1.3×10^{-21} s *4*	p?, ε ?
		19	(5/2+)	12.93	<40 ns	p
		20	2+	6.848	447.9 ms *23*	ε , εα 20.05%
		21	3/2+	–2.184	22.49 s *4*	ε
		22	3+	–5.182	2.6027 y *10*	ε

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
11	**Na**	23	3/2+	−9.530	**100%**	
		24	4+	−8.418	14.951 h *3*	β−
		25	5/2+	−9.358	59.1 s *6*	β−
		26	3+	−6.862	1.077 s *5*	β−
		27	5/2+	−5.517	301 ms *6*	β−, β−n 0.13%
		28	1+	−0.99	30.5 ms *4*	β−, β−n 0.58%
		29	3/2+	2.66	44.9 ms *12*	β−, β−n 21.5%
		30	2+	8.36	48 ms *2*	β−, β−n 30%, β− 1.17%, β−α 5.5×10^{-5}%
		31	3/2+	12.7	17.0 ms *4*	β−, β−n 37%, β− 0.9%
		32		19.1	13.2 ms *4*	β−, β−n 24%, β− 8%
		33		24.9	8.1 ms *4*	β−, β−n 47%, β−2n 13%
		34		32.8s	5.5 ms *10*	β−, β−n≤100%, β−
		35		39.6s	1.5 ms *5*	β−, β−n
		36		48.0s	<260 ns	n?
		37		55.3s	>1.5 μs	β−?, β−n?
12	**Mg**	19		33.0	?	2p?
		20	0+	17.57	90.8 ms *24*	ε, εp=27%
		21	5/2+	10.91	122 ms *3*	ε, εp 32.6%, εα<0.5%
		22	0+	−0.397	3.8755 s *12*	ε
		23	3/2+	−5.474	11.317 s *11*	ε
		24	0+	−13.934	**78.99%** ***4***	
		25	5/2+	−13.193	**10.00%** ***1***	
		26	0+	−16.215	**11.01%** ***3***	
		27	1/2+	−14.587	9.458 m *12*	β−
		28	0+	−15.019	20.915 h *9*	β−
		29	3/2+	−10.62	1.30 s *12*	β−
		30	0+	−8.911	335 ms *17*	β−
		31		−3.22	230 ms *20*	β−, β−n 1.7%
		32	0+	−0.95	86 ms *5*	β−, β−n 5.5%
		33		4.89	90.5 ms *16*	β−, β−n 17%
		34	0+	8.8	20 ms *10*	β−, β−n
		35	(7/2−)	16.2s	70 ms *40*	β−, β−n 52%
		36	0+	21.4s	3.9 ms *13*	β−
		37	(7/2−)	29.2s	>260 ns	β−, β−n
		38	0+	35.0s	>260 ns	β−?
		39		43.6s	>260 ns	n?
		40	0+	50.2s	1 ms *sy*	β−?, β−n?
13	**Al**	21	(5/2+)	26.1s	<35 ns	p
		22	(3)+	18.18s	59 ms *3*	ε, εp=60%, ε 0.9%, εα 0.31%
		23	3/2+	6.77	0.47 s *3*	ε, εp=1.1%
		24	4+	−0.057	2.053 s *4*	ε, εα 0.04%, εp 1.6×10^{-3}%
		24m	1+	0.369	131.3 ms *25*	IT 82%, ε 18%, εα 0.03%
		25	5/2+	−8.916	7.183 s *12*	ε
		26	5+	−12.210	7.17×10^{5} y *24*	ε

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
13	**Al**	26m	0+	–11.982	6.3452 s *19*	ε
		27	5/2+	–17.197	**100%**	
		28	3+	–16.850	2.2414 m *12*	β–
		29	5/2+	–18.215	6.56 m *6*	β–
		30	3+	–15.87	3.60 s *6*	β–
		31	(3/2,5/2)+	–14.95	644 ms *25*	β–
		32	1+	–11.06	33 ms *4*	β–
		33	(5/2+)	–8.53	41.7 ms *2*	β–, β–n 8.5%
		34		–2.9	42 ms *6*	β–, β–n 27%
		35		–0.1	38.6 ms *4*	β–, β–n 41%
		36		5.8	90 ms *40*	β–, β–n<31%
		37		9.9	10.7 ms *13*	β–
		38		16.1	7.6 ms *6*	β–
		39	(3/2+)	21	7.6 ms *16*	β–
		40		29.3s	>260 ns	β–, β–n
		41		35.7s	>260 ns	β–
		42		43.7s	1 ms *sy*	β–?, β–n?
14	**Si**	22	0+	32.2s	29 ms *2*	ε , εp 32%
		23		23.8s	42.3 ms *4*	ε , εp=73%, ε2p<4%
		24	0+	10.75	140 ms *8*	ε , εp 38%
		25	5/2+	3.82	220 ms *3*	ε , εp
		26	0+	–7.145	2.234 s *13*	ε
		27	5/2+	–12.384	4.16 s *2*	ε
		28	0+	–21.493	**92.230%** ***19***	
		29	1/2+	–21.895	**4.683%** ***8***	
		30	0+	–24.433	**3.087%** ***5***	
		31	3/2+	–22.949	157.3 m *3*	β–
		32	0+	–24.081	132 y *13*	β–
		33	(3/2+)	–20.49	6.18 s *18*	β–
		34	0+	–19.96	2.77 s *20*	β–
		35		–14.36	0.78 s *12*	β–
		36	0+	–12.5	0.45 s *6*	β–, β–n<10%
		37	(7/2–)	–6.6	90 ms *60*	β–, β–n 17%
		38	0+	–4.1	>1 µs	β–, β–n
		39	(7/2–)	1.9	47.5 ms *20*	β–
		40	0+	5.5	33.0 ms *10*	β–, β–n
		41		14	20.0 ms *25*	
		42	0+	18.4s	13 ms *4*	β–
		43		26.7s	>260 ns	β–?, β–n?
		44	0+	32.8s	10 ms *sy*	β–?, β–n?
15	**P**	24	(1+)	32.0s	?	p?, ε ?
		25	(1/2+)	18.9s	<30 ns	p
		26	(3+)	11.0s	43.7 ms *6*	ε , εp
		27	1/2+	–0.72	260 ms *80*	ε , εp 0.07%
		28	3+	–7.159	270.3 ms *5*	ε , εp 1.3×10^{-3}%, εα 8.6×10^{-4}%
		29	1/2+	–16.953	4.142 s *15*	ε
		30	1+	–20.201	2.498 m *4*	ε
		31	1/2+	–24.441	**100%**	
		32	1+	–24.305	14.262 d *14*	β–
		33	1/2+	–26.337	25.34 d *12*	β–
		34	1+	–24.558	12.43 s *8*	β–

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
15	**P**	35	1/2+	−24.858	47.3 s *7*	β−
		36	4−	−20.25	5.6 s *3*	β−
		37		−18.99	2.31 s *13*	β−
		38		−14.8	0.64 s *14*	β−, β−n<10%
		39		−12.9	0.25 s *8*	β−, β−n 26%
		40	(2−,3−)	−8.1	125 ms *25*	β−, β−n 15.8%
		41		−5.3	100 ms *5*	β−, β−n 30%
		42		0.9	48.5 ms *15*	β−, β−n 50%
		43		5.8	36.5 ms *15*	β−, β−n
		44		12.1s	18.5 ms *25*	β−
		45		17.9s	>200 ns	β−?
		46		25.5s	>200 ns	β−
16	**S**	26	0+	26.0s	≈10 ms	2p?
		27	(5/2+)	17.5s	15.5 ms *15*	ε, εp 2.3%, εα2p 1.1%
		28	0+	4.1	125 ms *10*	ε, εp 21%
		29	5/2+	−3.16	187 ms *4*	ε, εp 47%
		30	0+	−14.063	1.178 s *5*	ε
		31	1/2+	−19.045	2.572 s *13*	ε
		32	0+	−26.016	**95.02%** ***9***	
		33	3/2+	−26.586	**0.75%** ***1***	
		34	0+	−29.932	**4.21%** ***8***	
		35	3/2+	−28.846	87.51 d *12*	β−
		36	0+	−30.664	**0.02%** ***1***	
		37	7/2−	−26.896	5.05 m *2*	β−
		38	0+	−26.861	170.3 m *7*	β−
		39	(3/2,5/2,7/2)−	−23.16	11.5 s *5*	β−
		40	0+	−22.9	8.8 s *22*	β−
		41	(7/2−)	−19.0	1.99 s *5*	β−, β−n
		42	0+	−17.7	1.013 s *15*	β−
		43		−12.0	0.28 s *3*	β−, β−n 40%
		44	0+	−9.1	100 ms *1*	β−, β−n 18%
		45		−3	68 ms *2*	β−, β−n 54%
		46	0+	0.7s	50 ms *8*	β−
		47		8.0s	>200 ns	β−?
		48	0+	13.2s	≥200 ns	β−
		49		22.0s	<200 ns	n
17	**Cl**	28	(1+)	26.6s	?	p?
		29	(3/2+)	13.1s	<20 ns	p
		30	(3+)	4.4s	<30 ns	p
		31		−7.07	150 ms *25*	ε, εp 0.7%
		32	1+	−13.330	298 ms *1*	ε, εα 0.05%, εp 0.03%
		33	3/2+	−21.003	2.511 s *3*	ε
		34	0+	−24.440	1.5264 s *14*	ε
		34m	3+	−24.293	32.00 m *4*	ε 55.4%, IT 44.6%
		35	3/2+	−29.014	**75.77%** ***4***	
		36	2+	−29.522	3.01×10^{5} y *2*	β− 98.1%, ε 1.9%
		37	3/2+	−31.761	**24.23%** ***4***	
		38	2−	−29.798	37.24 m *5*	β−
		38m	5−	−29.127	715 ms *3*	IT
		39	3/2+	−29.800	55.6 m *2*	β−

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
17	**Cl**	40	2−	−27.56	1.35 m *2*	β−
		41	(1/2+,3/2+)	−27.31	38.4 s *8*	β−
		42		−24.9	6.8 s *3*	β−
		43		−24.2	3.07 s *7*	β−
		44		−20.2	0.56 s *11*	β−, β−n<8%
		45		−18.4	400 ms *43*	β−, β−n 24%
		46		−14.7	232 ms *2*	β−, β−n 60%
		47		−10.5s	101 ms *6*	β−, β−n>0%
		48		−4.7s	≥200 ns	β−
		49		0.3s	≥170 ns	
		50		7.3s	20 ms *sy*	β−?
		51	(3/2+)	13.5s	>200 ns	β−
18	**Ar**	30	0+	20.1s	<20 ns	p?
		31	5/2+	11.3s	15.1 ms *13*	ε, εp 69%, ε 7.6%
		32	0+	−2.200	98 ms *2*	ε, εp 43%
		33	1/2+	−9.384	173.0 ms *20*	ε, εp 38.7%
		34	0+	−18.377	844.5 ms *34*	ε
		35	3/2+	−23.047	1.775 s *4*	ε
		36	0+	−30.232	**0.3365%** ***30***	
		37	3/2+	−30.948	34.95 d *4*	ε
		38	0+	−34.715	**0.0632%** ***5***	
		39	7/2−	−33.242	269 y *3*	β−
		40	0+	−35.040	**99.6003%** ***30***	
		41	7/2−	−33.068	109.61 m *4*	β−
		42	0+	−34.423	32.9 y *11*	β−
		43	(5/2−)	−32.010	5.37 m *6*	β−
		44	0+	−32.673	11.87 m *5*	β−
		45		−29.771	21.48 s *15*	β−
		46	0+	−29.72	8.4 s *6*	β−
		47	(3/2−)	−25.9	1.23 s *3*	β−, β−n<0.002%
		48	0+	−23.7s	0.48 s *40*	β−
		49		−18.1s	≥170 ns	
		50	0+	−14.5s	≥170 ns	
		51		−7.8s	>200 ns	β−?
		52	0+	−3.0s	10 ms	β−
		53	(5/2−)	4.6s	3 ms *sy*	β−, β−n
19	**K**	32		20.4s	?	p?
		33	(3/2+)	6.8s	<25 ns	p
		34	(1+)	−1.5s	<25 ns	p
		35	3/2+	−11.17	178 ms *8*	ε, εp 0.37%
		36	2+	−17.426	342 ms *2*	ε, εp 0.05%, εα 3.4×10^{-3}%
		37	3/2+	−24.800	1.226 s *7*	ε
		38	3+	−28.801	7.636 m *18*	ε
		38m	0+	−28.670	924.2 ms *3*	ε
		39	3/2+	−33.807	**93.2581%** ***44***	
		40	4−	−33.535	1.248×10^{9} y *3* **0.0117%** ***1***	β− 89.28%, ε 10.72%
		41	3/2+	−35.559	**6.7302%** ***44***	
		42	2−	−35.022	12.321 h *25*	β−
		43	3/2+	−36.593	22.3 h *1*	β−
		44	2−	−35.81	22.13 m *19*	β−

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
19	**K**	45	3/2+	–36.61	17.3 m *6*	β–
		46	(2–)	–35.42	105 s *10*	β–
		47	1/2+	–35.696	17.50 s *24*	β–
		48	(2–)	–32.12	6.8 s *2*	β–, β–n 1.14%
		49	(3/2+)	–30.32	1.26 s *5*	β–, β–n 86%
		50	(0–,1,2–)	–25.4	472 ms *4*	β–, β–n 29%
		51	(1/2+,3/2+)	–22.0s	365 ms *5*	β–, β–n 47%
		52	(2–)	–16.2s	105 ms *5*	β–, β–n=64%, β–
		53	(3/2+)	–12.0s	30 ms *5*	β–, β–n=67%, β–2n=17%
		54		–5.4s	10 ms *5*	β–, β–n>0%
		55		–0.3s	3 ms *sy*	β–?, β–n?
20	**Ca**	34	0+	13.2s	<35 ns	p
		35		4.6s	25.7 ms *2*	ε , εp 95.7%, εβp 4.2%
		36	0+	–6.44	102 ms *2*	ε , εp 57%
		37	3/2+	–13.16	181.1 ms *10*	ε , εp 82.1%
		38	0+	–22.059	440 ms *8*	ε
		39	3/2+	–27.274	859.6 ms *14*	ε
		40	0+	–34.846	$>3.0\times10^{21}$ y **96.94%** ***16***	2ε
		41	7/2–	–35.138	1.02×10^{5} y *7*	ε
		42	0+	–38.547	**0.647%** ***23***	
		43	7/2–	–38.409	**0.135%** ***10***	
		44	0+	–41.468	**2.09%** ***11***	
		45	7/2–	–40.812	162.61 d *9*	β–
		46	0+	–43.135	$>0.28\times10^{16}$ y **0.004%** ***3***	2β–
		47	7/2–	–42.340	4.536 d *3*	β–
		48	0+	–44.2142	2.3×10^{19} y *+12–6* **0.187%** ***21***	2β– 84%, β–<25%
		49	3/2–	–41.289	8.718 m *6*	β–
		50	0+	–39.571	13.9 s *6*	β–
		51	(3/2–)	–35.86	10.0 s *8*	β–, β–n
		52	0+	–32.5	4.6 s *3*	β–, β–n≤2%
		53	(3/2–,5/2–)	–27.9s	90 ms *15*	β–, β–n>30%
		54	0+	–23.9s	>300 ns	β–
		55		–18.1s	>300 ns	β–?
		56	0+	–13.4s	10 ms *sy*	β–?
		57		–7s	5 ms *sy*	β–?, β–n?
21	**Sc**	36		13.9s	?	p?
		37		2.8s	?	p?
		38	(2–)	–4.9s	<300 ns	p
		39	(7/2–)	–14.17	<300 ns	p
		40	4–	–20.523	182.3 ms *7*	ε , εp 0.44%, εα 0.02%
		41	7/2–	–28.642	596.3 ms *17*	ε
		42	0+	–32.121	681.3 ms *7*	ε
		42m	(7)+	–31.505	61.7 s *4*	ε
		43	7/2–	–36.188	3.891 h *12*	ε
		44	2+	–37.816	3.97 h *4*	ε
		44m	6+	–37.545	58.61 h *10*	IT 98.8%, ε 1.2%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
21	**Sc**	45	7/2−	−41.068	**100%**	
		45m	3/2+	−41.056	318 ms *7*	IT
		46	4+	−41.757	83.79 d *4*	β−
		46m	1−	−41.615	18.75 s *4*	IT
		47	7/2−	−44.332	3.3492 d *6*	β−
		48	6+	−44.496	43.67 h *9*	β−
		49	7/2−	−46.552	57.2 m *2*	β−
		50	5+	−44.54	102.5 s *5*	β−
		50m	(2,3)+	−44.28	0.35 s *4*	IT>97.5%, β−<2.5%
		51	(7/2)−	−43.22	12.4 s *1*	β−
		52	3(+)	−40.4	8.2 s *2*	β−
		53	(7/2−)	−37.6s	>3 s	β−, β−n
		54	(3,4+)	−34.2	0.36 s *6*	β−
		55	(7/2−)	−29.6	0.115 s *15*	β−, β−n
		56	(1+)	−25.3s	35 ms *5*	β−, β−n
		56	(6+,7+)	−25.3s	60 ms *7*	β−, β−n
		57		−20.7s	13 ms *4*	β−
		57	(7/2−)	−20.7s	13 ms *4*	β−n
		58	(3+)	−15.2s	12 ms *5*	β−
		59		−10.0s	10 ms *sy*	β−?, β−n?
		60		−4.0s	3 ms *sy*	β−
22	**Ti**	38	0+	9.1s	<120 ns	2p?
		39	(3/2+)	1.5s	31 ms *+6−4*	ε, εp 14%
		40	0+	−8.9	53.3 ms *15*	ε, εp
		41	3/2+	−15.7s	80.4 ms *9*	ε, εp=100%
		42	0+	−25.122	199 ms *6*	ε
		43	7/2−	−29.321	509 ms *5*	ε
		44	0+	−37.549	60.0 y *11*	ε
		45	7/2−	−39.006	184.8 m *5*	ε
		46	0+	−44.123	**8.25%** ***3***	
		47	5/2−	−44.932	**7.44%** ***2***	
		48	0+	−48.488	**73.72%** ***3***	
		49	7/2−	−48.559	**5.41%** ***2***	
		50	0+	−51.427	**5.18%** ***2***	
		51	3/2−	−49.728	5.76 m *1*	β−
		52	0+	−49.465	1.7 m *1*	β−
		53	(3/2)−	−46.8	32.7 s *9*	β−
		54	0+	−45.6	1.5 s *4*	β−
		55	(3/2−)	−41.7	1.3 s *1*	β−
		56	0+	−38.9	200 ms *5*	β−, β−n
		57		−33.5	60 ms *16*	β−, β−n
		58	0+	−30.8s	59 ms *9*	β−
		59	(5/2−)	−25.2s	30 ms *3*	β−
		60	0+	−21.6s	22 ms *2*	β−
		61		−15.6s	>300 ns	β−?
		62	0+	−11.7s	10 ms *sy*	β−?
		63		−5.2s	3 ms *sy*	β−?, β−n?
23	**V**	40		10.3s	?	p?
		41		−0.2s	?	p?
		42		−8.2s	<55 ns	p
		43		−18.0s	>800 ms	ε
		44	(2+)	−24.1	111 ms *7*	ε, εα

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
23	**V**	44m	(6+)	–24.1	150 ms *3*	ε
		45	7/2–	–31.88	547 ms *6*	ε
		46	0+	–37.073	422.50 ms *11*	ε
		47	3/2–	–42.002	32.6 m *3*	ε
		48	4+	–44.475	15.9735 d *25*	ε
		49	7/2–	–47.957	329 d *3*	ε
		50	6+	–49.222	1.4×10^{17} y *4*	ε 83%,
					0.250% *2*	β– 17%
		51	7/2–	–52.201	**99.750% *2***	
		52	3+	–51.441	3.743 m *5*	β–
		53	7/2–	–51.849	1.60 m *4*	β–
		54	3+	–49.89	49.8 s *5*	β–
		55	(7/2–)	–49.2	6.54 s *15*	β–
		56	(1+)	–46.1	216 ms *4*	β–
		56	1+	–46.1	216 ms *4*	β–n 0.06%
		57	(3/2–)	–44.2	0.35 s *1*	β–, β–n 0.04%
		58	(1+)	–40.2	185 ms *10*	β–
		59	(5/2–,3/2–)	–37.1	75 ms *7*	β–
		60		–32.6	68 ms *5*	β–
		60m		–32.6	122 ms *18*	β–, β–n
		61	(3/2–)	–29.4s	47 ms *1*	β–
		62		–24.4s	33.5 ms *2*	β–
		63	(7/2–)	–20.9s	17 ms *3*	β–
		64		–15.4s	>150 ns	β–
		65		–11.3s	10 ms *sy*	β–?, β–n?
24	**Cr**	42	0+	6.0s	13 ms *+4–2*	ε
		43	(3/2+)	–2.1s	21.6 ms *7*	ε , εp 23%, ε 6%
		44	0+	–13.46s	53 ms *+4–3*	ε , εp>7%
		45		–19.0	50 ms *6*	ε , εp>27%
		46	0+	–29.47	0.26 s *6*	ε
		47	3/2–	–34.56	500 ms *15*	ε
		48	0+	–42.819	21.56 h *3*	ε
		49	5/2–	–45.331	42.3 m *1*	ε
		50	0+	–50.259	$>1.3\times10^{18}$ y	2ε
					4.345% *13*	
		51	7/2–	–51.449	27.7025 d *24*	ε
		52	0+	–55.417	**83.789% *18***	
		53	3/2–	–55.285	**9.501% *17***	
		54	0+	–56.932	**2.365% *7***	
		55	3/2–	–55.107	3.497 m *3*	β–
		56	0+	–55.281	5.94 m *10*	β–
		57	3/2–,5/2–,7/2–	–52.524	21.1 s *10*	β–
		58	0+	–51.8	7.0 s *3*	β–
		59	(1/2–)	–47.9	0.46 s *5*	β–
		60	0+	–46.5	0.57 s *6*	β–
		61		–42.2	0.27 s *2*	β–
		62	0+	–40.4	209 ms *12*	β–, β–n
		63	(1/2–)	–35.5s	129 ms *2*	β–, β–n
		64	0+	–33.2s	43 ms *1*	β–
		65	(1/2–)	–27.8s	27 ms *3*	β–, β–n?
		66	0+	–24.8s	10 ms *6*	β–
		67		–19.0s	=50 ms	β–?

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
25	**Mn**	44	(2−)	6.4s	<105 ns	ε , p
		45	(7/2−)	−5.1s	<70 ns	p
		46	[4+]	−12.4s	34 ms *+5−4*	ε , εp 22%
		47		−22.3s	100 ms *50*	ε , εp>3.4%
		48	4+	−29.3	158.1 ms *22*	ε , εp 0.28%, εα<6.0×10^{-4}%
		49	5/2−	−37.62	382 ms *7*	ε
		50	0+	−42.627	283.29 ms *8*	ε
		50m	5+	−42.398	1.75 m *3*	ε
		51	5/2−	−48.241	46.2 m *1*	ε
		52	6+	−50.705	5.591 d *3*	ε
		52m	2+	−50.328	21.1 m *2*	ε 98.25%, IT 1.75%
		53	7/2−	−54.688	3.74×10^{6} y *4*	ε
		54	3+	−55.555	312.12 d *6*	ε , β−<2.9×10^{-4}%
		55	5/2−	−57.711	**100%**	
		56	3+	−56.910	2.5789 h *1*	β−
		57	5/2−	−57.487	85.4 s *18*	β−
		58	1+	−55.91	3.0 s *1*	β−
		58m	(4)+	−55.83	65.2 s *5*	β−=80%, IT=20%
		59	(5/2)−	−55.48	4.59 s *5*	β−
		60	0+	−53.18	51 s *6*	β−
		60m	3+	−52.91	1.77 s *2*	β− 88.5%, IT 11.5%
		61	(5/2)−	−51.6	0.67 s *4*	β−
		62	1+	−48.0	92 ms *13*	β−
		62	(3+,4+)	−48.0	671 ms *5*	β−, β−n
		63	(5/2−)	−46.4	0.29 s *2*	β−
		64		−42.6	89 ms *4*	β−, β−n 1.42%
		65		−40.7	92 ms *1*	β−, β−n 6.92%
		66		−36.3s	64 ms *2*	β−, β−n 10.88%
		67	(5/2−)	−33.4s	47 ms *4*	β−, β−n
		69	5/2−	−25.3s	14 ms *4*	β−
26	**Fe**	45	(3/2+)	13.6s	3.8 ms *+20−8*	2p
		46	0+	0.8s	12 ms *+4−3*	
		47		−6.6s	21.8 ms *7*	ε , εp
		48	0+	−18.16s	44 ms *7*	ε , εp>3.6%
		49	(7/2−)	−24.6s	70 ms *3*	ε , εp≥52%
		50	0+	−34.48	155 ms *11*	ε , εp=0%
		51	5/2−	−40.22	305 ms *5*	ε
		52	0+	−48.332	8.275 h *8*	ε
		52m	(12+)	−41.512	45.9 s *6*	ε
		53	7/2−	−50.945	8.51 m *2*	ε
		53m	19/2−	−47.905	2.526 m *24*	IT
		54	0+	−56.252	***5.845% 35***	
		55	3/2−	−57.479	2.737 y *11*	ε
		56	0+	−60.605	***91.754% 36***	
		57	1/2−	−60.180	***2.119% 10***	
		58	0+	−62.153	***0.282% 4***	
		59	3/2−	−60.663	44.495 d *9*	β−
		60	0+	−61.412	1.5×10^{6} y *3*	β−
		61	3/2−,5/2−	−58.92	5.98 m *6*	β−
		62	0+	−58.90	68 s *2*	β−
		63	(5/2)−	−55.5	6.1 s *6*	β−

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
26	**Fe**	64	0+	−54.8	2.0 s *2*	β−
		65		−50.9	1.3 s *3*	β−
		66	0+	−49.6	0.44 s *6*	β−
		67		−45.7	0.47 s *5*	β−, β−n 1.13%
		68	0+	−43.1	187 ms *6*	β−
		69	1/2−	−38.4s	109 ms *9*	β−
		70	0+	−35.9s	94 ms *17*	β−
		71	(7/2+)	−31.0s	>150 ns	β−
		72	0+	−28.3s	>150 ns	β−
27	**Co**	47		10.7s	?	p?
		49		−9.6s	<35 ns	ε, p
		50	(6+)	−17.2s	44 ms *4*	ε, εp>54%
		51	(7/2−)	−27.3s	>200 ns	ε
		52	(6+)	−33.92s	115 ms *23*	ε
		53	(7/2−)	−42.64	240 ms *9*	ε
		53m	(19/2−)	−39.45	247 ms *12*	ε=98.5%, p=1.5%
		54	0+	−48.009	193.28 ms *7*	ε
		54m	(7)+	−47.812	1.48 m *2*	ε
		55	7/2−	−54.028	17.53 h *3*	ε
		56	4+	−56.039	77.233 d *27*	ε
		57	7/2−	−59.344	271.74 d *6*	ε
		58	2+	−59.846	70.86 d *6*	ε
		58m	5+	−59.821	9.04 h *11*	IT
		59	7/2−	−62.228	**100%**	
		60	5+	−61.649	1925.28 d *14*	β−
		60m	2+	−61.590	10.467 m *6*	IT 99.76%, β− 0.24%
		61	7/2−	−62.898	1.650 h *5*	β−
		62	2+	−61.43	1.50 m *4*	β−
		62m	5+	−61.41	13.91 m *5*	β−>99%, IT<1%
		63	7/2−	−61.84	27.4 s *5*	β−
		64	1+	−59.79	0.30 s *3*	β−
		65	(7/2)−	−59.17	1.20 s *6*	β−
		66	(3+)	−56.1	0.18 s *1*	β−
		67	(7/2−)	−55.1	0.425 s *20*	β−
		68	(7−)	−51.4	0.199 s *21*	β−
		68m	(3+)	−51.4	1.6 s *3*	β−
		69	7/2−	−50.0	0.22 s *2*	β−
		70	(6−)	−45.6	119 ms *6*	β−
		70m	(3+)	−45.6	0.50 s *18*	β−
		71		−43.9	79 ms *5*	β−, β−n 2.61%
		72	(6−,7−)	−39.3s	62 ms *3*	β−, β−n 4.8%
		73		−37.0s	41 ms *4*	β−
		74	0+	−32.2s	>150 ns	β−
		75	(7/2−)	−29.5s	>150 ns	β−
28	**Ni**	48	0+	18.4s	>0.5 μs	ε
		49		9.0s	12 ms *+5−3*	ε, εp?
		50	0+	−3.8s	12 ms *3*	εp 70%, ε
		51	(7/2−)	−11.4s	>200 ns	ε
		52	0+	−22.65s	38 ms *5*	ε, εp 17%
		53	(7/2−)	−29.4s	45 ms *15*	ε, εp=45%
		54	0+	−39.21	104 ms *7*	ε
		55	7/2−	−45.34	202 ms *3*	ε

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
28	**Ni**	56	0+	–53.90	6.075 d *10*	ε
		57	3/2–	–56.082	35.60 h *6*	ε
		58	0+	–60.228	**68.077%** ***9***	
		59	3/2–	–61.156	7.6×10^{4} y *5*	ε
		60	0+	–64.472	**26.223%** ***8***	
		61	3/2–	–64.221	**1.140%** ***1***	
		62	0+	–66.746	**3.634%** ***2***	
		63	1/2–	–65.513	100.1 y *20*	β–
		64	0+	–67.099	**0.926%** ***1***	
		65	5/2–	–65.126	2.5172 h *3*	β–
		66	0+	–66.006	54.6 h *3*	β–
		67	(1/2)–	–63.743	21 s *1*	β–
		68	0+	–63.464	29 s *2*	β–
		69	9/2+	–59.979	11.4 s *3*	β–
		69m	1/2–	–59.658	3.5 s *5*	β–
		70	0+	–59.1	6.0 s *3*	β–
		71		–55.2	2.56 s *3*	β–
		72	0+	–53.9	1.57 s *5*	β–, β–n
		73	(9/2+)	–49.9s	0.84 s *3*	β–
		74	0+	–48.4s	0.68 s *18*	β–, β–n
		75	(7/2+)	–43.9s	0.6 s *2*	β–, β–n 8.43%
		76	0+	–41.6s	0.24 s *+55–24*	β–, β–n
		77		–36.7s	>150 ns	β–?
		78	0+	–34s	>150 ns	β–
29	**Cu**	52	(3+)	–2.6s	?	p
		53	(3/2–)	–13.5s	<300 ns	ε , p
		54	(3+)	–21.7s	<75 ns	p
		55	3/2–	–31.6s	>200 ns	ε
		56	4+	–38.6s	94 ms *3*	ε
		57	3/2–	–47.31	196.3 ms *7*	ε
		58	1+	–51.662	3.204 s *7*	ε
		59	3/2–	–56.357	81.5 s *5*	ε
		60	2+	–58.344	23.7 m *4*	ε
		61	3/2–	–61.984	3.333 h *5*	ε
		62	1+	–62.798	9.67 m *3*	ε
		63	3/2–	–65.579	**69.17%** ***3***	
		64	1+	–65.424	12.700 h *2*	ε 61%, β– 39%
		65	3/2–	–67.264	**30.83%** ***3***	
		66	1+	–66.258	5.120 m *14*	β–
		67	3/2–	–67.319	61.83 h *12*	β–
		68	1+	–65.567	31.1 s *15*	β–
		68m	(6–)	–64.845	3.75 m *5*	IT 84%, β– 16%
		69	3/2–	–65.736	2.85 m *15*	β–
		70	(6–)	–62.976	44.5 s *2*	β–
		70m	(3–)	–62.875	33 s *2*	β– 52%, IT 48%
		70m	1+	–62.734	6.6 s *2*	β– 93.2%, IT 6.8%
		71	(3/2–)	–62.711	19.5 s *16*	β–
		72	(1+)	–59.783	6.6 s *1*	β–
		73	(3/2–)	–58.987	4.2 s *3*	β–
		74	(1+,3+)	–56.006	1.594 s *10*	β–
		75	(3/2–)	–54.1	1.224 s *3*	β–, β–n 3.5%
		76m		–50.976	0.641 s *6*	β–, β–n 3%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
29	**Cu**	76m		–50.976	1.27 s *30*	β–
		77		–48.6s	0.469 s *8*	β–
		78		–44.7s	342 ms *11*	β–
		79		–42.3s	188 ms *25*	β–, β–n 55%
		80		–36.4s	>300 ns	β–
30	**Zn**	54	0+	–6.6s	?	2p ?
		55		–14.9s	>0.5 μs	ε , p
		56	0+	–25.7s	>0.5 μs	ε , p
		57	(7/2–)	–32.8s	38 ms *4*	ε , εp≥65%
		58	0+	–42.30	84 ms *9*	ε
		59	3/2–	–47.26	182.0 ms *18*	ε , εp 0.1%
		60	0+	–54.19	2.38 m *5*	ε
		61	3/2–	–56.35	89.1 s *2*	ε
		61m	1/2–	–56.26	<430 ms	IT
		61m	3/2–	–55.93	0.14 s *7*	IT
		61m	5/2–	–55.59	<0.13 s	IT
		62	0+	–61.17	9.186 h *13*	ε
		63	3/2–	–62.213	38.47 m *5*	ε
		64	0+	–66.004	$>2.8\times10^{16}$ y	2ε
					48.63% *60*	
		65	5/2–	–65.912	243.66 d *9*	ε
		66	0+	–68.899	**27.90% *27***	
		67	5/2–	–67.880	**4.10% *13***	
		68	0+	–70.007	**18.75% *51***	
		69	1/2–	–68.418	56.4 m *9*	β–
		69m	9/2+	–67.979	13.76 h *2*	IT 99.97%, β– 0.03%
		70	0+	–69.565	$>1.3\times10^{16}$ y	2β–
					0.62% *3*	
		71	1/2–	–67.33	2.45 m *10*	β–
		71m	9/2+	–67.17	3.96 h *5*	β–, IT≤0.05%
		72	0+	–68.131	46.5 h *1*	β–
		73	(1/2)–	–65.41	23.5 s *10*	β–
		73m		–65.41	5.8 s *8*	IT, β–
		74	0+	–65.71	95.6 s *12*	β–
		75	(7/2+)	–62.47	10.2 s *2*	β–
		76	0+	–62.14	5.7 s *3*	β–
		77	(7/2+)	–58.7	2.08 s *5*	β–
		77m	(1/2–)	–57.9	1.05 s *10*	IT>50%, β–<50%
		78	0+	–57.34	1.47 s *15*	β–
		79	(9/2+)	–53.4s	0.995 s *19*	β–, β–n 1.3%
		80	0+	–51.8	0.54 s *2*	β–, β–n 1%
		81		–46.1s	0.29 s *5*	β–, β–n 7.5%
		82	0+	–42.5s	>150 ns	β–
		83	(5/2+)	–36.3s	>150 ns	β–
31	**Ga**	56		–4.7s	?	p ?
		57		–15.9s	?	p ?
		58		–24.0s	?	p ?
		59		–34.1s	?	p ?
		60	(2+)	–40.0s	70 ms *13*	ε 98.4%, εp 1.6%, εα<0.02%
		61	3/2–	–47.09	168 ms *3*	ε
		62	0+	–52.00	116.18 ms *4*	ε

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
31	**Ga**	63	(3/2−)	−56.547	32.4 s *5*	ε
		64	0+	−58.834	2.627 m *12*	ε
		65	3/2−	−62.657	15.2 m *2*	ε
		66	0+	−63.724	9.49 h *7*	ε
		67	3/2−	−66.880	3.2623 d *15*	ε
		68	1+	−67.086	67.71 m *9*	ε
		69	3/2−	−69.328	**60.108%** ***9***	
		70	1+	−68.910	21.14 m *3*	β− 99.59%, ε 0.41%
		71	3/2−	−70.140	**39.892%** ***9***	
		72	3−	−68.589	14.095 h *3*	β−
		73	3/2−	−69.699	4.86 h *3*	β−
		74	(3−)	−68.050	8.12 m *12*	β−
		74m	(0)	−67.990	9.5 s *10*	IT 75%, β−<50%
		75	(3/2)−	−68.465	126 s *2*	β−
		76	(2+,3+)	−66.297	32.6 s *6*	β−
		77	(3/2−)	−65.992	13.2 s *2*	β−
		78	(3+)	−63.707	5.09 s *5*	β−
		79	(3/2−)	−62.51	2.847 s *3*	β−, β−n 0.09%
		80	(3)	−59.1	1.676 s *14*	β−, β−n 0.86%
		81	(5/2−)	−58.0	1.217 s *5*	β−, β−n 11.9%
		82	(1,2,3)	−53.1s	0.599 s *2*	β−, β−n 19.8%
		83		−49.4s	0.308 s *1*	β−, β−n 37%
		84		−44.1s	0.085 s *10*	β−, β−n 70%
		85	(3/2−)	−40.1s	>150 ns	β−
		86		−34.4s	>150 ns	β−
32	**Ge**	58	0+	−8.4s	?	2p?
		59		−17.0s	?	2p?
		60	0+	−27.8s	=30 ms	ε?, 2p?
		61	(3/2−)	−33.7s	39 ms *12*	ε, εp=80%
		62	0+	−42.2s	129 ns *35*	ε
		63	(3/2−)	−46.9s	142 ms *8*	ε
		64	0+	−54.35	63.7 s *25*	ε
		65	(3/2)−	−56.4	30.9 s *5*	ε
		66	0+	−61.62	2.26 h *5*	ε
		67	1/2−	−62.658	18.9 m *3*	ε
		68	0+	−66.980	270.95 d *16*	ε
		69	5/2−	−67.101	39.05 h *10*	ε
		70	0+	−70.563	**20.37%** ***18***	
		71	1/2−	−69.908	11.43 d *3*	ε
		72	0+	−72.586	**27.31%** ***26***	
		73	9/2+	−71.298	**7.76%** ***8***	
		73m	1/2−	−71.231	0.499 s *11*	IT
		74	0+	−73.422	**36.73%** ***15***	
		75	1/2−	−71.856	82.78 m *4*	β−
		75m	7/2+	−71.717	47.7 s *5*	IT 99.97%, β− 0.03%
		76	0+	−73.213	1.2×10^{25} y *14*	2β−
					7.83% ***7***	
		77	7/2+	−71.214	11.30 h *1*	β−
		77m	1/2−	−71.054	52.9 s *6*	β− 81%, IT 19%
		78	0+	−71.862	88.0 m *10*	β−
		79	(1/2)−	−69.49	18.98 s *3*	β−
		*79*m	(7/2+)	−69.30	39.0 s *10*	β− 96%, IT 4%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
32	**Ge**	*80*	0+	−69.52	29.5 s *4*	β−
		81	(9/2+)	−66.3	7.6 s *6*	β−
		81m	(1/2+)	−65.6	7.6 s *6*	β−
		82	0+	−65.6	4.55 s *5*	β−
		83	(5/2+)	−60.9s	1.85 s *6*	β−
		84	0+	−58.2s	0.947 s *11*	β−, β−n 10.8%
		85		−53.1s	535 ms *47*	β−, β−n 14%
		86	0+	−49.8s	>150 ns	β−
		87	(5/2+)	−44.2s	=0.14 s	β−, β−n
		88	0+	−40.1s	≥300 ns	β−?
		89		−33.7s	>150 ns	β−
33	**As**	60		−6.4s	?	p?
		61		−18.1s	?	p?
		62		−25.0s	?	p
		63	(3/2−)	−33.8s	?	p
		64		−39.5s	18 ms *+43−7*	ε?
		65		−47.0s	128 ms *16*	ε
		66		−51.5	95.79 ms *22*	ε
		67	(5/2−)	−56.6	42.5 s *12*	ε
		68	3+	−58.90	151.6 s *8*	ε
		69	5/2−	−63.09	15.2 m *2*	ε
		70	4+	−64.34	52.6 m *3*	ε
		71	5/2−	−67.894	65.28 h *15*	ε
		72	2−	−68.230	26.0 h *1*	ε
		73	3/2−	−70.957	80.30 d *6*	ε
		74	2−	−70.860	17.77 d *2*	ε 66%, β− 34%
		75	3/2−	−73.032	**100%**	
		76	2−	−72.289	1.0942 d *7*	β−
		77	3/2−	−73.917	38.83 h *5*	β−
		78	2−	−72.817	90.7 m *2*	β−
		79	3/2−	−73.636	9.01 m *15*	β−
		80	1+	−72.16	15.2 s *2*	β−
		81	3/2−	−72.533	33.3 s *8*	β−
		82	(1+)	−70.3	19.1 s *5*	β−
		*82*m	(5−)	−70.3	13.6 s *4*	β−
		83	(5/2−,3/2−)	−69.9	13.4 s *3*	β−
		84	(3−)	−66.1s	3.24 s *26*	β−, β−n 0.28%
		85	(3/2−)	−63.3s	2.021 s *10*	β−, β−n 59.4%
		86		−59.2s	0.945 s *8*	β−, β−n 33%
		87	(3/2−)	−56.0s	0.56 s *8*	β−, β−n 15.4%
		88		−51.3s	≥300 ns	β−?, β−n?
		89		−47.1s	≥300 ns	β−?
		90		−41.5s	>150 ns	β−?
		91		−36.9s	>150 ns	β−
		92		−30.9s	>300 ns	β−
34	**Se**	65		−32.9s	<50 ms	ε
		66	0+	−41.7s	33 ms *12*	ε
		67		−46.5s	133 ms *11*	ε, εp 0.5%
		68	0+	−54.21	35.5 s *7*	ε
		69	(1/2−,3/2−)	−56.30	27.4 s *2*	ε, εp 0.05%
		70	0+	−62.05	41.1 m *3*	ε
		71	5/2−	−63.12	4.74 m *5*	ε

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
34	**Se**	72	0+	−67.89	8.40 d *8*	ε
		73	9/2+	−68.22	7.15 h *8*	ε
		73m	3/2−	−68.19	39.8 m *13*	IT 72.6%, ε 27.4%
		74	0+	−72.213	**0.89%** ***4***	
		75	5/2+	−72.169	119.779 d *4*	ε
		76	0+	−75.252	**9.37%** ***29***	
		77	1/2−	−74.600	**7.63%** ***16***	
		77m	7/2+	−74.438	17.36 s *5*	IT
		78	0+	−77.026	**23.77%** ***28***	
		79	7/2+	−75.918	2.95×10^{5} y *38*	β−
		79m	1/2−	−75.822	3.92 m *1*	IT 99.94%, β− 0.06%
		80	0+	−77.760	**49.61%** ***41***	
		81	1/2−	−76.390	18.45 m *12*	β−
		*81*m	7/2+	−76.286	57.28 m *2*	IT 99.95%, β− 0.05%
		82	0+	−77.594	9.1×10^{19} y *9* **8.73%** ***22***	2β−
		83	9/2+	−75.341	22.3 m *3*	β−
		*83*m	1/2−	−75.112	70.1 s *4*	β−
		84	0+	−75.95	3.10 m *10*	β−
		85	(5/2+)	−72.43	31.7 s *9*	β−
		86	0+	−70.54	15.3 s *9*	β−
		87	(5/2+)	−66.58	5.50 s *12*	β−, β−n 0.2%
		88	0+	−63.88	1.53 s *6*	β−, β−n 0.99%
		89	(5/2+)	−59.2s	0.41 s *4*	β−, β−n 7.8%
		90	0+	−55.9s	>150 ns	β−?
		91		−50.3s	0.27 s *5*	β−, β−n 21%
		92	0+	−46.6s	>300 ns	β−
		93	(1/2+)	−40.7s	>150 ns	β−
		94	0+	−36.8s	>150 ns	β−
35	**Br**	67		−32.8s	?	p?
		68		−38.6s	<1.2 μs	p?
		69		−46.5s	<24 ns	p
		70	0+	−51.4s	79.1 ms *8*	ε
		70m	9+	−49.1s	2.2 s *2*	ε
		71	(5/2)−	−57.1	21.4 s *6*	ε
		72	1+	−59.02	78.6 s *24*	ε
		72m	1−	−58.91	10.6 s *3*	IT=100%, ε
		73	1/2−	−63.63	3.4 m *2*	ε
		74	(0−)	−65.31	25.4 m *3*	ε
		74m	4(+)	−65.29	46 m *2*	ε
		75	3/2−	−69.14	96.7 m *13*	ε
		76	1−	−70.289	16.2 h *2*	ε
		76m	(4)+	−70.186	1.31 s *2*	IT>99.4%, ε<0.6%
		77	3/2−	−73.235	57.036 h *6*	ε
		77m	9/2+	−73.129	4.28 m *10*	IT
		78	1+	−73.452	6.46 m *4*	ε≥99.99%, β−≤0.01%
		79	3/2−	−76.068	**50.69%** ***7***	
		79m	9/2+	−75.861	4.86 s *4*	IT
		80	1+	−75.890	17.68 m *2*	β− 91.7%, ε 8.3%
		80m	5−	−75.804	4.4205 h *8*	IT
		81	3/2−	−77.975	**49.31%** ***7***	

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
35	**Br**	82	5−	−77.496	35.282 h *7*	β−
		82m	2−	−77.451	6.13 m *5*	IT 97.6%, β− 2.4%
		83	3/2−	−79.009	2.40 h *2*	β−
		84	2−	−77.80	31.80 m *8*	β−
		*84*m	6−	−77.48	6.0 m *2*	β−
		85	3/2−	−78.61	2.90 m *6*	β−
		86	(2−)	−75.64	55.1 s *4*	β−
		87	3/2−	−73.86	55.65 s *13*	β−, β−n 2.6%
		88	(2−)	−70.73	16.29 s *6*	β−, β−n 6.58%
		89	(3/2−,5/2−)	−68.57	4.40 s *3*	β−, β−n 13.8%
		90		−64.62	1.91 s *1*	β−, β−n 25.2%
		91		−61.51	0.541 s *5*	β−, β−n 20%
		92	(2−)	−56.58	0.343 s *15*	β−, β−n 33.1%
		93	(5/2−)	−53.0s	102 ms *10*	β−, β−n 68%
		94		−47.8s	70 ms *20*	β−, β−n 70%
		95	(3/2−)	−43.9s	>150 ns	β−
		96		−38.6s	>150 ns	β−
		97	(3/2−)	−34.7s	>150 ns	β−
36	**Kr**	69		−32.4s	32 ms *10*	ε
		70	0+	−41.7s	52 ms *17*	ε, εp≤1.3%
		71	(5/2)−	−46.9	100 ms *3*	ε, εp 5.2%
		72	0+	−53.941	17.1 s *2*	ε
		73	3/2−	−56.552	27.3 s *10*	ε, εp 0.25%
		74	0+	−62.332	11.50 m *11*	ε
		75	5/2+	−64.324	4.29 m *17*	ε
		76	0+	−69.014	14.8 h *1*	ε
		77	5/2+	−70.169	74.4 m *6*	ε
		78	0+	−74.180	$\geq 2.3\times10^{20}$ y	2ε
					0.35% ***1***	
		79	1/2−	−74.443	35.04 h *10*	ε
		79m	7/2+	−74.313	50 s *3*	IT
		80	0+	−77.893	**2.28%** ***6***	
		81	7/2+	−77.694	2.29×10^{5} y *11*	ε
		81m	1/2−	−77.503	13.10 s *3*	IT, ε 2.5×10^{-3}%
		82	0+	−80.590	**11.58%** ***14***	
		83	9/2+	−79.982	**11.49%** ***6***	
		83m	1/2−	−79.940	1.83 h *2*	IT
		84	0+	−82.431	**57.00%** ***4***	
		85	9/2+	−81.480	3916.8 d *25*	β−
		*85*m	1/2−	−81.175	4.480 h *8*	β− 78.6%, IT 21.4%
		86	0+	−83.266	**17.30%** ***22***	
		87	5/2+	−80.709	76.3 m *5*	β−
		88	0+	−79.69	2.84 h *3*	β−
		89	3/2(+)	−76.73	3.15 m *4*	β−
		90	0+	−74.97	32.32 s *9*	β−
		91	5/2(+)	−71.31	8.57 s *4*	β−
		92	0+	−68.79	1.840 s *8*	β−, β−n 0.03%
		93	1/2+	−64.0	1.286 s *10*	β−, β−n 1.95%
		94	0+	−61.1s	212 ms *5*	β−, β−n 1.26%
		95	1/2	−56.0s	114 ms *3*	β−, β−n 2.87%
		96	0+	−53.0s	80 ms *8*	β−, β−n 3.8%
		97		−47.9s	63 ms *4*	β−, β−n 8.2%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
36	**Kr**	*98*	0+	–44.8s	46 ms *8*	β–, β–n 7%
		99	(3/2+)	–39.5s	40 ms *11*	β–, β–n 11%
		100	0+	–36.2s	>150 ns	β–
37	**Rb**	71		–32.3s	?	p?
		72	(3+)	–38.1s	<1.2 µs	p
		73		–46.1s	>30 ns	ε , p>0%
		74	(0+)	–51.917	64.9 ms *5*	ε
		75	(3/2–)	–57.222	19.0 s *12*	ε
		76	1(–)	–60.480	36.5 s *6*	ε , εα 3.8×10^{-7}%
		77	3/2–	–64.825	3.77 m *4*	ε
		78	0(+)	–66.936	17.66 m *8*	ε
		78m	4(–)	–66.833	5.74 m *5*	ε 90%, IT 10%
		79	5/2+	–70.803	22.9 m *5*	ε
		80	1+	–72.173	33.4 s *7*	ε
		81	3/2–	–75.455	4.570 h *4*	ε
		81m	9/2+	–75.368	30.5 m *3*	IT 97.6%, ε 2.4%
		82	1+	–76.188	1.273 m *2*	ε
		82m	5–	–76.119	6.472 h *5*	ε , IT<0.33%
		83	5/2–	–79.075	86.2 d *1*	ε
		84	2–	–79.750	33.1 d *1*	ε 96.2%, β– 3.8%
		84m	6–	–79.286	20.26 m *4*	IT
		85	5/2–	–82.167	**72.17% *2***	
		86	2–	–82.747	18.642 d *18*	β– 99.99%, ε 5.2×10^{-3}%
		86m	6–	–82.191	1.017 m *3*	IT, β–<0.3%
		87	3/2–	–84.598	4.97×10^{10} y *3*	β–
					27.83% *2*	
		88	2–	–82.609	17.773 m *11*	β–
		89	3/2–	–81.713	15.15 m *12*	β–
		90	0–	–79.362	158 s *5*	β–
		*90*m	3–	–79.255	258 s *4*	β– 97.4%, IT 2.6%
		91	3/2(–)	–77.745	58.4 s *4*	β–
		92	0–	–74.772	4.492 s *20*	β–, β–n 0.01%
		93	5/2–	–72.618	5.84 s *2*	β–, β–n 1.39%
		94	3(–)	–68.553	2.702 s *5*	β–, β–n 10.01%
		95	5/2–	–65.85	377.5 ms *8*	β–, β–n 8.73%
		96	2+	–61.22	202.8 ms *33*	β–, β–n 14%
		97	3/2+	–58.36	169.9 ms *7*	β–, β–n 25.1%
		98	(0,1)	–54.22	114 ms *5*	β–, β–n 13.8%, β– 0.05%
		99	(5/2+)	–50.9	50.3 ms *7*	β–, β–n 15.9%
		100		–46.7s	51 ms *8*	β–, β–n 6%, β–2n 0.16%
		101	(3/2+)	–43.6	32 ms *5*	β–, β–n 28%
38	**Sr**	73		–31.7s	>25 ms	ε , εp>0%
		74	0+	–40.7s	>1.2 µs	ε
		75	(3/2–)	–46.6	88 ms *3*	ε , εp 5.2%
		76	0+	–54.24	7.89 s *7*	ε , εp 0.34%
		77	5/2+	–57.804	9.0 s *2*	ε , εp<0.25%
		78	0+	–63.174	2.5 m *3*	ε
		79	3/2(–)	–65.477	2.25 m *10*	ε
		80	0+	–70.308	106.3 m *15*	ε

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38	**Sr**	81	1/2−	−71.528	22.3 m *4*	ε
		82	0+	−76.008	25.55 d *15*	ε
		83	7/2+	−76.80	32.41 h *3*	ε
		83m	1/2−	−76.54	4.95 s *12*	IT
		84	0+	−80.644	**0.56%** ***1***	
		85	9/2+	−81.103	64.84 d *2*	ε
		85m	1/2−	−80.864	67.63 m *4*	IT 86.6%, ε 13.4%
		86	0+	−84.524	**9.86%** ***1***	
		87	9/2+	−84.880	**7.00%** ***1***	
		87m	1/2−	−84.492	2.815 h *12*	IT 99.7%, ε 0.3%
		88	0+	−87.922	**82.58%** ***1***	
		89	5/2+	−86.209	50.57 d *3*	β−
		90	0+	−85.942	28.90 y *3*	β−
		91	5/2+	−83.645	9.63 h *5*	β−
		92	0+	−82.868	2.66 h *4*	β−
		93	5/2+	−80.085	7.423 m *24*	β−
		94	0+	−78.840	75.3 s *2*	β−
		95	1/2+	−75.117	23.90 s *14*	β−
		96	0+	−72.94	1.07 s *1*	β−
		97	1/2+	−68.79	429 ms *5*	β−, β−n≤0.05%
		98	0+	−66.65	0.653 s *2*	β−, β−n 0.25%
		99	3/2+	−62.19	0.269 s *1*	β−, β−n 0.1%
		100	0+	−60.2	202 ms *3*	β−, β−n 0.78%
		101	(5/2−)	−55.4	118 ms *3*	β−, β−n 2.37%
		102	0+	−53.1	69 ms *6*	β−, β−n 4.8%
		103		−47.6s	>150 ns	β−
		104	0+	−44.4s	>300 ns	
		105		−38.6s	>150 ns	β−
39	**Y**	76		−38.7s	>200 ns	ε ?, p ?
		77		−46.90s	=0.06 s	ε , εp
		78	(0+)	−52.5s	50 ms *8*	ε
		78m	(5+)	−52.5s	5.7 s *7*	ε
		79	(5/2+)	−58.4	14.8 s *6*	ε , εp
		80	(4−)	−61.2	30.1 s *5*	ε , εp
		80m	(1−)	−61.0	4.8 s *3*	IT 81%, ε 19%
		81	(5/2+)	−66.02	70.4 s *10*	ε
		82	1+	−68.2	8.30 s *20*	ε
		83	9/2+	−72.33	7.08 m *6*	ε
		83m	3/2−	−72.26	2.85 m *2*	ε 60%, IT 40%
		84	1+	−74.16	4.6 s *2*	ε
		84m	(5−)	−74.16	39.5 m *8*	ε
		85	(1/2)−	−77.84	2.68 h *5*	ε
		85m	9/2+	−77.82	4.86 h *13*	ε , IT<2.0×10^{-3}%
		86	4−	−79.28	14.74 h *2*	ε
		86m	(8+)	−79.07	48 m *1*	IT 99.31%, ε 0.69%
		87	1/2−	−83.019	79.8 h *3*	ε
		87m	9/2+	−82.638	13.37 h *3*	IT 98.43%, ε 1.57%
		88	4−	−84.299	106.616 d *13*	ε
		89	1/2−	−87.702	**100%**	
		89m	9/2+	−86.793	15.28 s *17*	IT
		90	2−	−86.488	64.053 h *20*	β−
		90m	7+	−85.806	3.19 h *6*	IT, β− 1.8×10^{-3}%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
39	**Y**	*91*	1/2−	−86.345	58.51 d *6*	β−
		*91*m	9/2+	−85.789	49.71 m *4*	IT, β−<1.5%
		92	2−	−84.813	3.54 h *1*	β−
		93	1/2−	−84.22	10.18 h *8*	β−
		*93*m	7/2+	−83.46	0.82 s *4*	IT
		94	2−	−82.349	18.7 m *1*	β−
		95	1/2−	−81.207	10.3 m *1*	β−
		96	0−	−78.35	5.34 s *5*	β−
		*96*m	(8)+	−78.35	9.6 s *2*	β−
		97	(1/2−)	−76.26	3.75 s *3*	β−, β−n 0.058%
		*97*m	(9/2)+	−75.59	1.17 s *3*	β−>99.3%, IT<0.7%, β−n<0.08%
		*97*m	(27/2−)	−72.73	142 ms *8*	IT>80%, β−<20%
		98	(0)−	−72.47	0.548 s *2*	β−, β−n 0.33%
		*98*m	(4,5)	−72.06	2.0 s *2*	β−>80%, IT<20%, β−n 3.4%
		99	(5/2+)	−70.20	1.470 s *7*	β−, β−n 1.9%
		100	1−,2−	−67.29	735 ms *7*	β−, β−n 0.92%
		100m	(3,4,5)	−67.29	0.94 s *3*	β−
		101	(5/2+)	−64.91	0.45 s *2*	β−, β−n 1.5%
		102m		−61.89	0.30 s *1*	β−, β−n 4%
		102m		−61.89	0.36 s *4*	β−, β−n 4%
		103	(5/2+)	−58.9s	0.23 s *2*	β−, β−n 8%
		104		−54.9s	180 ms *60*	β−, β−n?
		105		−51.4s	>300 ns	β−?
		106		−46.8s	>150 ns	β−
		107	(5/2+)	−42.7s	=30 ms	β−
		108		−37.7s	20 ms *sy*	β−, β−n
40	**Zr**	78	0+	−41.7s	>200 ns	ε?, εp?
		79		−47.4s	56 ms *30*	ε, εp
		80	0+	−56	4.6 s *6*	ε, εp
		81	(3/2−)	−58.5	5.5 s *4*	ε, εp 0.12%
		82	0+	−64.2s	32 s *5*	ε
		83	(1/2−)	−66.46	41.6 s *24*	ε, εp
		84	0+	−71.5s	25.9 m 7	ε
		85	7/2+	−73.1	7.86 m *4*	ε
		85m	(1/2−)	−72.9	10.9 s *3*	IT≤92%, ε>8%
		86	0+	−77.80	16.5 h *1*	ε
		87	(9/2)+	−79.348	1.68 h *1*	ε
		87m	(1/2)−	−79.012	14.0 s *2*	IT
		88	0+	−83.62	83.4 d *3*	ε
		89	9/2+	−84.869	78.41 h *12*	ε
		89m	1/2−	−84.281	4.161 m *17*	IT 93.77%, ε 6.23%
		90	0+	−88.767	**51.45%** ***40***	
		90m	5−	−86.448	809.2 ms *20*	IT
		91	5/2+	−87.890	**11.22%** ***5***	
		92	0+	−88.454	**17.15%** ***8***	
		93	5/2+	−87.117	1.53×10^{6} y *10*	β−
		94	0+	−87.267	**17.38%** ***28***	
		95	5/2+	−85.658	64.032 d *6*	β−
		96	0+	−85.443	$>3.9\times10^{20}$ y **2.80%** ***9***	2β−

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
40	**Zr**	*97*	1/2+	−82.947	16.744 h *11*	β−
		98	0+	−81.29	30.7 s *4*	β−
		99	(1/2+)	−77.77	2.1 s *1*	β−
		100	0+	−76.60	7.1 s *4*	β−
		101	(3/2+)	−73.46	2.3 s *1*	β−
		102	0+	−71.74	2.9 s *2*	β−
		103	(5/2−)	−68.4	1.3 s *1*	β−
		104	0+	−66.3s	1.2 s *3*	β−
		105		−62.4s	0.6 s *1*	β−
		106	0+	−59.7s	>150 ns	β−?
		107		−55.2s	≈150 ms	β−
		108	0+	−52.2s	80 ms *sy*	β−, β−n
		109		−47.3s	>150 ns	β−, β−n
		110	0+	−43.9s	>150 ns	β−
41	**Nb**	81		−47s	≈0.8 s	ε?, εp?, p?
		82	0+	−53.0s	50 ms *5*	ε
		83	(5/2+)	−59.0	4.1 s *3*	ε
		84	3+	−61.9s	9.5 s *10*	ε, εp
		85	(9/2+)	−67.1	20.9 s *7*	ε
		86?		−69.83	56 s *8*	ε
		86m	(6+)	−69.83	88 s *1*	ε
		87	(1/2−)	−74.18	3.75 m *9*	ε
		87m	(9/2+)	−74.18	2.6 m *1*	ε
		88	(8+)	−76.1	14.55 m *6*	ε
		88m	(4−)	−76.1	7.78 m *5*	ε
		89	(9/2+)	−80.65	2.03 h *7*	ε
		89m	(1/2)−	−80.62	66 m *2*	ε
		90	8+	−82.656	14.60 h *5*	ε
		90m	4−	−82.532	18.81 s *6*	IT
		91	9/2+	−86.632	6.8×10^{2} y *13*	ε
		91m	1/2−	−86.528	60.86 d *22*	IT 96.6%, ε 3.4%
		92	(7)+	−86.448	3.47×10^{7} y *24*	ε, β−<0.05%
		92m	(2)+	−86.313	10.15 d *2*	ε
		93	9/2+	−87.208	**100%**	
		93m	1/2−	−87.177	16.13 y *14*	IT
		94	(6)+	−86.365	2.03×10^{4} y *16*	β−
		94m	3+	−86.324	6.263 m *4*	IT 99.5%, β− 0.5%
		95	9/2+	−86.782	34.991 d *6*	β−
		95m	1/2−	−86.546	3.61 d *3*	IT 94.4%, β− 5.6%
		96	6+	−85.604	23.35 h *5*	β−
		97	9/2+	−85.606	72.1 m *7*	β−
		*97*m	1/2−	−84.863	58.7 s *18*	IT
		98	1+	−83.529	2.86 s *6*	β−
		*98*m	(5+)	−83.445	51.3 m *4*	β− 99.9%, IT<0.2%
		99	9/2+	−82.33	15.0 s *2*	β−
		*99*m	1/2−	−81.96	2.6 m *2*	β−>96.2%, IT<3.8%
		100	1+	−79.94	1.5 s *2*	β−
		*100*m	(4+,5+)	−79.44	2.99 s *11*	β−
		101	(5/2+)	−78.94	7.1 s *3*	β−
		*102*m	1+	−76.35	1.3 s *2*	β−
		*102*m		−76.35	4.3 s *4*	β−
		103	(5/2+)	−75.32	1.5 s *2*	β−

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
41	**Nb**	*104*	(1+)	−72.2	4.9 s *3*	β−, β−n 0.06%
		*104*m		−72.0	0.94 s *4*	β−, β−n 0.05%
		105	(5/2+)	−70.85	2.95 s *6*	β−, β−n 1.7%
		106		−67.1s	1.02 s *5*	β−, β−n 4.5%
		107		−64.9s	330 ms *50*	β−
		108	(2+)	−60.7s	0.193 s *17*	β−, β−n 6.2%
		109	(5/2)	−58.1s	0.19 s *3*	β−, β−n 31%
		110		−53.6s	0.17 s *2*	β−, β−n 40%
		111	(5/2+)	−50.6s	80. ms *sy*	β−
		112	(2+)	−45.8s	>150 ns	β−
		113		−42.2s	30 ms *sy*	β−
42	**Mo**	83		−47.7s	6 ms *+30−3*	ε
		84	0+	−55.8s	3.7 s *+10−8*	ε
		85	(1/2−)	−59.1s	3.2 s *2*	εp 0.14%, ε
		86	0+	−64.6	19.6 s *11*	ε
		87	7/2+	−67.7	14.02 s *26*	ε , εp 15%
		88	0+	−72.70	8.0 m *2*	ε
		89	(9/2+)	−75.00	2.11 m *10*	ε
		89m	(1/2−)	−74.62	190 ms *15*	IT
		90	0+	−80.167	5.56 h *9*	ε
		91	9/2+	−82.20	15.49 m *1*	ε
		91m	1/2−	−81.55	64.6 s *6*	ε 50%, IT 50%
		92	0+	−86.805	**14.84% *35***	
		93	5/2+	−86.803	4.0×10^{3} y *8*	ε
		93m	21/2+	−84.379	6.85 h *7*	IT 99.88%, ε 0.12%
		94	0+	−88.410	**9.25% *12***	
		95	5/2+	−87.707	**15.92% *13***	
		96	0+	−88.790	**16.68% *2***	
		97	5/2+	−87.540	**9.55% *8***	
		98	0+	−88.112	**24.13% *31***	
		99	1/2+	−85.966	2.7489 d *6*	β−
		100	0+	−86.184	0.78×10^{19} y *8* **9.63% *23***	2β−
		101	1/2+	−83.511	14.61 m *3*	β−
		102	0+	−83.56	11.3 m *2*	β−
		103	(3/2+)	−80.85	67.5 s *15*	β−
		104	0+	−80.33	60 s *2*	β−
		105	(5/2−)	−77.34	35.6 s *16*	β−
		106	0+	−76.26	8.4 s *5*	β−
		107	(7/2−)	−72.9	3.5 s *5*	β−
		108	0+	−71.3s	1.09 s *2*	β−
		109	(7/2−)	−67.2s	0.53 s *6*	β−
		110	0+	−65.5s	0.27 s *1*	β−
		111		−61.1s	200. ms *sy*	β−
		112	0+	−58.8s	>150 ns	β−?
		113		−54.1s	100 ms *sy*	β−
		114	0+	−51.3s	80 ms *sy*	β−
		115		−46.3s	60 ms *sy*	β−, β−n
43	**Tc**	85		−47.7s	=0.5 s	ε?
		86	(0+)	−53.2s	54 ms *7*	ε
		87	(9/2+)	−59.1s	2.2 s *2*	ε
		88	(3+)	−62.7s	5.8 s *2*	ε

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
43	**Tc**	88m	(6+)	–62.7s	6.4 s *8*	ε
		89	(9/2+)	–67.8s	12.8 s *9*	ε
		89m	(1/2–)	–67.8s	12.9 s *8*	ε , IT<0.01%
		90m	1+	–71.2	8.7 s *2*	ε
		90m	(6+)	–70.7	49.2 s *4*	ε
		91	(9/2)+	–76.0	3.14 m *2*	ε
		91m	(1/2)–	–75.8	3.3 m *1*	ε , IT<1%
		92	(8)+	–78.93	4.25 m *15*	ε
		93	9/2+	–83.603	2.75 h *5*	ε
		93m	1/2–	–83.211	43.5 m *10*	IT 76.6%, ε 23.4%
		94	7+	–84.154	293 m *1*	ε
		94m	(2)+	–84.079	52.0 m *10*	ε , IT<0.1%
		95	9/2+	–86.017	20.0 h *1*	ε
		95m	1/2–	–85.978	61 d *2*	ε 96.12%, IT 3.88%
		96	7+	–85.817	4.28 d *7*	ε
		96m	4+	–85.783	51.5 m *10*	IT 98%, ε 2%
		97	9/2+	–87.220	4.21×10^{6} y *16*	ε
		97m	1/2–	–87.123	91.4 d *8*	IT, ε 3.94%
		98	(6)+	–86.428	4.2×10^{6} y *3*	β–
		99	9/2+	–87.323	2.111×10^{5} y *12*	β–
		99m	1/2–	–87.180	6.0058 h *12*	IT, β– 3.7×10^{-3}%
		100	1+	–86.016	15.8 s *1*	β–, ε 1.8×10^{-3}%
		101	9/2+	–86.34	14.22 m *1*	β–
		102	1+	–84.566	5.28 s *15*	β–
		*102*m	(4,5)	–84.566	4.35 m *7*	β– 98%, IT 2%
		103	5/2+	–84.60	54.2 s *8*	β–
		104	(3+)	–82.49	18.3 m *3*	β–
		105	(3/2–)	–82.29	7.6 m *1*	β–
		106	(1,2)	–79.78	35.6 s *6*	β–
		107	(3/2–)	–79.1	21.2 s *2*	β–
		108	(2)+	–76.0	5.17 s *7*	β–
		109	(5/2+)	–74.54	0.86 s *4*	β–, β–n 0.08%
		110	(2+)	–70.96	0.92 s *3*	β– 99.96%, β–n 0.04%
		111	(7/2+,9/2+)	–69.2	290 ms *20*	β–, β–n 0.85%
		112		–66.0	0.29 s *2*	β–, β–n 1.5%
		113		–63.7s	170 ms *20*	β–, β–n 2.1%
		114		–59.7s	150 ms *30*	β–, β–n
		115		–57.1s	100 ms *sy*	β–, β–n
		116		–52.8s	90 ms *sy*	β–
		117		–49.9s	40 ms *sy*	β–
		118		–45.2s	>150 ns	β–
44	**Ru**	87		–47.3s	>1.5 µs	ε ?
		88	0+	–55.6s	1.2 s *+3–2*	ε , εp
		89		–59.5s	1.5 s *2*	ε , εp<0.15%
		90	0+	–65.3s	11.7 s *9*	ε
		91	(9/2+)	–68.7s	7.9 s *4*	ε
		91m	(1/2–)	–68.7s	7.6 s *8*	ε>0%, εp>0%, IT
		92	0+	–74.4s	3.65 m *5*	ε
		93	(9/2)+	–77.27	59.7 s *6*	ε
		93m	(1/2)–	–76.53	10.8 s *3*	ε 78%, IT 22%, εp 0.03%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
44	**Ru**	94	0+	−82.57	51.8 m *6*	ε
		95	5/2+	−83.45	1.643 h *14*	ε
		96	0+	−86.072	**5.54%** ***14***	
		97	5/2+	−86.112	2.791 d *4*	ε
		98	0+	−88.225	**1.87%** ***3***	
		99	5/2+	−87.617	**12.76%** ***14***	
		100	0+	−89.219	**12.60%** ***7***	
		101	5/2+	−87.950	**17.06%** ***2***	
		102	0+	−89.098	**31.55%** ***14***	
		103	3/2+	−87.259	39.26 d *2*	β−
		104	0+	−88.089	**18.62%** ***27***	
		105	3/2+	−85.928	4.44 h *2*	β−
		106	0+	−86.322	373.59 d *15*	β−
		107	(5/2)+	−83.9	3.75 m *5*	β−
		108	0+	−83.7	4.55 m *5*	β−
		109	(5/2+)	−80.85	34.5 s *10*	β−
		110	0+	−79.98	11.6 s *6*	β−
		111	(5/2+)	−76.67	2.12 s *7*	β−
		112	0+	−75.48	1.75 s *7*	β−
		113	(5/2+)	−72.20	0.80 s *5*	β−
		113m	(11/2−)	−72.07	510 ms *30*	β− 92%, IT 8%
		114	0+	−70.5s	0.53 s *6*	β−
		115		−66.4	740 ms *80*	β−, β−n
		116	0+	−64.4s	400 ms *sy*	β−?
		117		−60.0s	300 ms *sy*	β−
		118	0+	−57.9s	>150 ns	β−?
		119		−53.2s	>150 ns	β−
		120	0+	−50.9s	>150 ns	β−
45	**Rh**	89		−47.7s	>1.5 µs	ε
		90		−53.2s	12 ms *+9−4*	ε?
		90m		−53.2s	1.0 s *+3−2*	ε?
		91	(9/2+)	−59.1s	1.47 s *22*	ε
		91m	(1/2−)	−59.1s	1.46 s *11*	ε
		92	(2+)	−63.4s	0.5 s *4*	ε
		92	(≥ 6+)	−63.4s	4.66 s *25*	ε
		93	(9/2+)	−69.2s	11.9 s *7*	ε
		94m	(8+)	−72.9s	25.8 s *2*	ε
		94m	(3+)	−72.9s	70.6 s *6*	ε
		95	(9/2)+	−78.3	5.02 m *10*	ε
		95m	(1/2)−	−77.8	1.96 m *4*	IT 88%, ε 12%
		96	(6+)	−79.68	9.90 m *10*	ε
		96m	(3+)	−79.63	1.51 m *2*	IT 60%, ε 40%
		97	9/2+	−82.59	30.7 m *6*	ε
		97m	1/2−	−82.33	46.2 m *16*	ε 94.4%, IT 5.6%
		98	(2)+	−83.17	8.72 m *12*	ε
		98m	(5+)	−83.17	3.6 m *2*	IT 89%, ε 11%
		99	1/2−	−85.574	16.1 d *2*	ε
		99m	9/2+	−85.510	4.7 h *1*	ε>99.84%, IT<0.16%
		100	1−	−85.58	20.8 h *1*	ε
		100m	(5+)	−85.58	4.6 m *2*	IT=98.3%, ε=1.7%
		101	1/2−	−87.41	3.3 y *3*	ε

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
45	**Rh**	101m	9/2+	–87.25	4.34 d *1*	ε 92.8%, IT 7.2%
		102	(1–,2–)	–86.775	207 d *3*	ε 78%, β– 22%
		102m	6(+)	–86.634	=2.9 y	ε 99.77%, IT 0.23%
		103	1/2–	–88.022	**100%**	
		103m	7/2+	–87.982	56.114 m *9*	IT
		104	1+	–86.950	42.3 s *4*	β– 99.55%, ε 0.45%
		104m	5+	–86.821	4.34 m *3*	IT 99.87%, β– 0.13%
		105	7/2+	–87.846	35.36 h *6*	β–
		105m	1/2–	–87.716	42.9 s *3*	IT
		106	1+	–86.362	29.80 s *8*	β–
		106m	(6)+	–86.225	131 m *2*	β–
		107	7/2+	–86.86	21.7 m *4*	β–
		108	1+	–85.0	16.8 s *5*	β–
		108m	(5+)	–85.0	6.0 m *3*	β–
		109	7/2+	–85.01	80 s *2*	β–
		110m	1+	–82.78	3.2 s *2*	β–
		110m	(≥4)	–82.78	28.5 s *15*	β–
		111	(7/2+)	–82.36	11 s *1*	β–
		112m	1+	–79.74	3.45 s *37*	β–
		112m	(4,5,6)	–79.74	6.73 s *15*	β–
		113	(7/2+)	–78.68	2.80 s *12*	β–
		114	1+	–75.6	1.85 s *5*	β–
		114m	(4,5)	–75.6	1.85 s *5*	β–
		115	(7/2+)	–74.21	0.99 s *5*	β–
		116	1+	–70.7	0.68 s *6*	β–
		116m	(6–)	–70.6	0.57 s *5*	β–
		117	(7/2+)	–68.9s	0.44 s *4*	β–
		118	0+	–65.1s	0.30 s *6*	β–
		119		–63.2s	>150 ns	β–
		120		–59.2s	>150 ns	β–?
		121		–57.1s	>150 ns	β–?
		122		–52.9s	=50 ms	β–?
46	**Pd**	91		–47.4s	>1 μs	ε ?
		92	0+	–55.5s	0.7 s *+4–2*	ε
		93	(7/2+,9/2+)	–59.7s	1.3 s *2*	ε , εp 1.5%
		93m		–59.7s	9.3 s *+25–17*	ε , IT
		94	0+	–66.3s	9.0 s *5*	ε
		95		–70.2s	10 s *sy*	ε
		95m	(21/2+)	–68.2s	13.3 s *3*	ε≥91.3%, IT≤9.7%, εp 0.9%
		96	0+	–76.2	122 s *2*	ε
		97	5/2+	–77.8	3.10 m *9*	ε
		98	0+	–81.30	17.7 m *3*	ε
		99	(5/2)+	–82.19	21.4 m *2*	ε
		100	0+	–85.23	3.63 d *9*	ε
		101	5/2+	–85.43	8.47 h *6*	ε
		102	0+	–87.925	**1.02%** ***1***	
		103	5/2+	–87.479	16.991 d *19*	ε
		104	0+	–89.390	**11.14%** ***8***	
		105	5/2+	–88.413	**22.33%** ***8***	
		106	0+	–89.902	**27.33%** ***3***	
		107	5/2+	–88.368	6.5×10^{6} y *3*	β–

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
46	**Pd**	107m	11/2−	−88.153	21.3 s *5*	IT
		108	0+	−89.524	**26.46% *9***	
		109	5/2+	−87.607	13.7012 h *24*	β−
		109m	11/2−	−87.418	4.696 m *3*	IT
		110	0+	−88.35	**11.72% *9***	
		111	5/2+	−86.00	23.4 m *2*	β−
		111m	11/2−	−85.83	5.5 h *1*	IT 73%, β− 27%
		112	0+	−86.34	21.03 h *5*	β−
		113	(5/2+)	−83.69	93 s *5*	β−
		113m		−83.69	≥100 s	
		113m	(9/2−)	−83.61	0.3 s *1*	IT
		114	0+	−83.50	2.42 m *6*	β−
		115	(5/2+)	−80.40	25 s *2*	β−
		115m	(11/2−)	−80.31	50 s *3*	β− 92%, IT 8%
		116	0+	−79.96	11.8 s *4*	β−
		117	(5/2+)	−76.53	4.3 s *3*	β−
		118	0+	−75.5	1.9 s *1*	β−
		119		−71.6s	0.92 s *13*	β−
		120	0+	−70.1	0.5 s *1*	β−
		121		−66.3s	>150 ns	β−?
		122	0+	−64.7s	>150 ns	β−, β−n
		123		−60.6s	>150 ns	β−
		124	0+	−58.8s	≈0.2 s	β−?
47	**Ag**	93		−46.8s	>1.5 μs	ε?, p?
		94	(0+)	−53.3s	26 ms *+26−9*	ε, εp
		94m	(21+)	−53.3s	0.47 s *8*	ε, εp
		94m	(7+)	−53.3s	0.59 s *2*	ε, εp>0%
		95		−60.1s	2.0 s *1*	ε, εp
		96	(8+)	−64.6s	4.40 s *6*	ε, εp 8.15%
		96	(2+)	−64.6s	6.9 s *6*	ε, εp 18%
		97	9/2+	−70.8	25.9 s *4*	ε
		98	(6+)	−73.06	47.5 s *3*	ε, εp 1.1×10^{-3}%
		99	(9/2)+	−76.8	124 s *3*	ε
		99m	(1/2−)	−76.3	10.5 s *5*	IT
		100	(5)+	−78.15	2.01 m *9*	ε
		100m	(2)+	−78.13	2.24 m *13*	ε, IT
		101	9/2+	−81.2	11.1 m *3*	ε
		101m	(1/2)−	−81.0	3.10 s *10*	IT
		102	5+	−82.26	12.9 m *3*	ε
		102m	2+	−82.26	7.7 m *5*	ε 51%, IT 49%
		103	7/2+	−84.79	65.7 m *7*	ε
		103m	1/2−	−84.66	5.7 s *3*	IT
		104	5+	−85.111	69.2 m *10*	ε
		104m	2+	−85.104	33.5 m *20*	ε 99.93%, IT<0.07%
		105	1/2−	−87.07	41.29 d *7*	ε
		105m	7/2+	−87.04	7.23 m *16*	IT 99.66%
		106	1+	−86.937	23.96 m *4*	ε 99.5%, β−<1%
		106m	6+	−86.847	8.28 d *2*	ε
		107	1/2−	−88.402	**51.839% *8***	
		107m	7/2+	−88.309	44.5 s *8*	IT
		108	1+	−87.602	2.37 m *1*	β− 97.15%, ε 2.85%
		108m	6+	−87.492	438 y *9*	ε 91.3%, IT 8.7%

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
47	**Ag**	109	1/2−	−88.723	**48.161% *8***	
		109m	7/2+	−88.635	38.0 s *12*	IT
		110	1+	−87.461	24.6 s *2*	β− 99.7%, ε 0.3%
		110m	6+	−87.343	249.76 d *4*	β− 98.64%, IT 1.36%
		111	1/2−	−88.221	7.45 d *1*	β−
		111m	7/2+	−88.161	64.8 s *8*	IT 99.3%, β− 0.7%
		112	2(−)	−86.62	3.130 h *9*	β−
		113	1/2−	−87.03	5.37 h *5*	β−
		113m	7/2+	−86.99	68.7 s *16*	IT 64%, β− 36%
		114	1+	−84.95	4.6 s *1*	β−
		115	1/2−	−84.99	20.0 m *5*	β−
		*115*m	7/2+	−84.95	18.0 s *7*	β− 79%, IT 21%
		116	(2)−	−82.57	2.68 m *10*	β−
		*116*m	(5+)	−82.49	8.6 s *3*	β− 94%, IT 6%
		117	(1/2−)	−82.27	72.8 s *+20−7*	β−=100%
		*117*m	(7/2+)	−82.24	5.34 s *5*	β− 94%, IT 6%
		118	1(−)	−79.57	3.76 s *15*	β−
		*118*m	4(+)	−79.44	2.0 s *2*	β− 59%, IT 41%
		119m	(7/2+)	−78.56	2.1 s *1*	β−
		119m	(1/2−)	−78.56	6.0 s *5*	β−
		120	3(+)	−75.65	1.23 s *4*	β−, β–n<3.0×10^{-3}%
		*120*m	6(−)	−75.45	0.40 s *3*	β−=63%, IT=37%
		121	(7/2+)	−74.7	0.79 s *2*	β−, β–n 0.08%
		122	(3+)	−71.2s	0.529 s *13*	β−, β–n 0.19%
		*122*m	(8−)	−71.2s	1.5 s *5*	β−, β–n
		123	(7/2+)	−70.0s	0.300 s *5*	β−, β–n 0.55%
		124		−66.5s	0.172 s *5*	β−, β–n>0.1%
		125	(7/2+)	−64.8s	166 ms *7*	β−, β–n
		126		−61.0s	107 ms *12*	β−, β–n
		127	(1/2−)	−58.9s	79 ms *3*	β−
		128		−54.8s	58 ms *5*	β−, β–n
		129	(9/2+)	−52.5s	46 ms *+5−9*	β−, β–n
		129m	(1/2−)	−52.5s	≈160 ms	β−, β–n
		130		−46.2s	≈50 ms	β−
48	**Cd**	95		−46.7s	5 ms *sy*	ε ?, εp ?
		96	0+	−56.1s	≈1 s	ε ?
		97		−60.6s	2.8 s *6*	ε, εp
		98	0+	−67.63	9.2 s *3*	ε, εp<0.03%
		99	(5/2+)	−69.9s	16 s *3*	ε, εp 0.17%, εα<1.0×10^{-4}%
		100	0+	−74.25	49.1 s *5*	ε
		101	(5/2+)	−75.7	1.36 m *5*	ε
		102	0+	−79.68	5.5 m *5*	ε
		103	5/2+	−80.65	7.3 m *1*	ε
		104	0+	−83.975	57.7 m *10*	ε
		105	5/2+	−84.33	55.5 m *4*	ε
		106	0+	−87.132	≥2.6×10^{17} y	2ε
					1.25% *6*	
		107	5/2+	−86.985	6.50 h *2*	ε
		108	0+	−89.252	>1.0×10^{18} y	2ε
					0.89% *3*	
		109	5/2+	−88.508	461.4 d *12*	ε

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
48	**Cd**	110	0+	−90.353	**12.49%** ***18***	
		111	1/2+	−89.257	**12.80%** ***12***	
		111m	11/2−	−88.861	48.50 m *9*	IT
		112	0+	−90.580	**24.13%** ***21***	
		113	1/2+	−89.049	7.7×10^{15} y *3*	β−
					12.22% ***12***	
		113m	11/2−	−88.786	14.1 y *5*	β− 99.86%, IT 0.14%
		114	0+	−90.021	$>6.4\times10^{18}$ y	2β−
					28.73% ***42***	
		115	1/2+	−88.090	53.46 h *5*	β−
		115m	(11/2)−	−87.910	44.56 d *24*	β−
		116	0+	−88.719	3.1×10^{19} y *4*	2β−
					7.49% ***18***	
		117	1/2+	−86.425	2.49 h *4*	β−
		*117*m	(11/2)−	−86.289	3.36 h *5*	β−
		118	0+	−86.71	50.3 m *2*	β−
		119	3/2+	−83.91	2.69 m *2*	β−
		*119*m	(11/2−)	−83.76	2.20 m *2*	β−
		120	0+	−83.97	50.80 s *21*	β−
		121	(3/2+)	−81.06	13.5 s *3*	β−
		*121*m	(11/2−)	−80.85	8.3 s *8*	β−
		122	0+	−80.73	5.24 s *3*	β−
		123	(3/2+)	−77.31	2.10 s *2*	β−
		123m	(11/2−)	−76.99	1.82 s *3*	β−≤100%, IT
		124	0+	−76.71	1.25 s *2*	β−
		125	(3/2+)	−73.36	0.65 s *2*	β−
		125m	(11/2−)	−73.31	0.48 s *3*	β−
		126	0+	−72.33	0.515 s *17*	β−
		127	(3/2+)	−68.52	0.37 s *7*	β−
		128	0+	−67.3	0.28 s *4*	β−
		129	(3/2+)	−63.2s	0.27 s *4*	β−
		130	0+	−61.6	162 ms *7*	β−, β−n=3.5%
		131		−55.3s	68 ms *3*	β−, β−n 3.5%
		132	0+	−50.7s	97 ms *10*	β−, β−n 60%
49	**In**	97		−47.0s	5 ms *sy*	p?, ε?
		98		−53.9s	32 ms *+32−11*	ε
		98m		−53.9s	1.2 s *+12−4*	ε
		99	(9/2+)	−61.3s	3.0 s *+8−7*	ε
		100	(6,7)+	−64.2	5.9 s *2*	ε, εp 1.6%
		101		−68.6s	15.1 s *3*	ε=100%, εp
		102	(6+)	−70.7	23.3 s *1*	ε, εp 9.3×10^{-3}%
		103	(9/2+)	−74.60	65 s *7*	ε
		103m	(1/2−)	−73.97	34 s *2*	ε 67%, IT 33%
		104	5,6(+)	−76.11	1.80 m *3*	ε
		104m	(3+)	−76.01	15.7 s *5*	IT 80%, ε 20%
		105	9/2+	−79.48	5.07 m *7*	ε
		105m	(1/2−)	−78.81	48 s *6*	IT
		106	7+	−80.61	6.2 m *1*	ε
		106m	(3+)	−80.58	5.2 m *1*	ε
		107	9/2+	−83.56	32.4 m *3*	ε
		107m	1/2−	−82.88	50.4 s *6*	IT
		108	7+	−84.116	58.0 m *12*	ε

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
49	**In**	108m	2+	–84.086	39.6 m *7*	ε
		109	9/2+	–86.489	4.2 h *1*	ε
		109m	1/2–	–85.839	1.34 m *7*	IT
		109m	(19/2+)	–84.387	0.209 s *6*	IT
		110	7+	–86.47	4.9 h *1*	ε
		110m	2+	–86.41	69.1 m *5*	ε
		111	9/2+	–88.396	2.8047 d *5*	ε
		111m	1/2–	–87.859	7.7 m *2*	IT
		112	1+	–87.996	14.97 m *10*	ε 56%, β– 44%
		112m	4+	–87.840	20.56 m *6*	IT
		113	9/2+	–89.370	**4.29%** ***5***	
		113m	1/2–	–88.978	99.476 m *23*	IT
		114	1+	–88.572	71.9 s *1*	β– 99.5%, ε 0.5%
		114m	5+	–88.382	49.51 d *1*	IT 96.75%, ε 3.25%
		115	9/2+	–89.537	4.41×10^{14} y *25*	β–
					95.71% ***5***	
		115m	1/2–	–89.200	4.486 h *4*	IT 95%, β– 5%
		116	1+	–88.250	14.10 s *3*	β– 99.98%, ε 0.02%
		116m	5+	–88.123	54.29 m *17*	β–
		116m	8–	–87.960	2.18 s *4*	IT
		117	9/2+	–88.945	43.2 m *3*	β–
		117m	1/2–	–88.630	116.2 m *3*	β– 52.9%, IT 47.1%
		118	1+	–87.230	5.0 s *5*	β–
		118m	5+	–87.170	4.45 m *5*	β–
		118m	8–	–87.030	8.5 s *3*	IT 98.6%, β– 1.4%
		119	9/2+	–87.704	2.4 m *1*	β–
		119m	1/2–	–87.393	18.0 m *3*	β– 94.4%, IT 5.6%
		120	1+	–85.74	3.08 s *8*	β–
		*120*m	(8–)	–85.74	47.3 s *5*	β–
		*120*m	(5)+	–85.67	46.2 s *8*	β–
		121	9/2+	–85.84	23.1 s *6*	β–
		*121*m	1/2–	–85.53	3.88 m *10*	β– 98.8%, IT 1.2%
		122	1+	–83.58	1.5 s *3*	β–
		*122*m	5+	–83.54	10.3 s *6*	β–
		*122*m	8–	–83.29	10.8 s *4*	β–
		123	(9/2)+	–83.43	6.17 s *5*	β–
		*123*m	(1/2)–	–83.10	47.4 s *4*	β–
		124	3+	–80.88	3.11 s *10*	β–
		*124*m	(8–)	–80.83	3.7 s *2*	β–
		125	9/2+	–80.48	2.36 s *4*	β–
		*125*m	1/2(–)	–80.12	12.2 s *2*	β–
		126	3(+)	–77.81	1.53 s *1*	β–
		*126*m	(8–)	–77.71	1.64 s *5*	β–
		127	(9/2+)	–76.99	1.09 s *1*	β–, β–n≤0.03%
		*127*m	(1/2–)	–76.52	3.67 s *4*	β–, β–n 0.69%
		128	(3)+	–74.36	0.84 s *6*	β–, β–n<0.05%
		*128*m	(8–)	–74.02	0.72 s *10*	β–, β–n<0.05%
		129	(9/2+)	–72.94	0.61 s *1*	β–, β–n 0.25%
		*129*m	(1/2–)	–72.56	1.23 s *3*	β–>99.7%, β–n 2.5%, IT<0.3%
		130	1(–)	–69.89	0.29 s *2*	β–, β–n 0.93%
		*130*m	(10–)	–69.84	0.54 s *1*	β–, β–n 1.65%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
49	**In**	*130*m	(5+)	−69.49	0.54 s *1*	β−, β−n 1.65%
		131	(9/2+)	−68.14	0.28 s *3*	β−, β−n≤2%
		*131*m	(1/2−)	−67.77	0.35 s *5*	β−≥99.98%, β−n≤2%, IT≤0.02%
		*131*m		−63.87	0.32 s *6*	β−>99%, IT<1%, β−n 0.03%
		132	(7−)	−62.42	0.207 s *6*	β−, β−n 6.3%
		133	(9/2+)	−57.9s	165 ms *3*	β−, β−n 85%
		134	(4− to 7−)	−52.0s	140 ms *4*	β−, β−n 65%
		135		−47.2s	92 ms *10*	β−, β−n>0%
50	**Sn**	99		−47.2s	5 ms *sy*	ε ?, εp ?
		100	0+	−56.8	0.94 s *+54−27*	ε, εp<17%
		101		−59.6s	3 s *1*	ε, εp
		102	0+	−64.9	4.5 s *7*	ε
		103		−67.0s	7.0 s *6*	ε, εp
		104	0+	−71.6	20.8 s *5*	ε
		105	(5/2+)	−73.26	34 s *1*	ε, εp
		106	0+	−77.43	115 s *5*	ε
		107	(5/2+)	−78.58	2.90 m *5*	ε
		108	0+	−82.04	10.30 m *8*	ε
		109	5/2(+)	−82.64	18.0 m *2*	ε
		110	0+	−85.84	4.11 h *10*	ε
		111	7/2+	−85.945	35.3 m *6*	ε
		112	0+	−88.661	**0.97%** ***1***	
		113	1/2+	−88.333	115.09 d *3*	ε
		113m	7/2+	−88.256	21.4 m *4*	IT 91.1%, ε 8.9%
		114	0+	−90.561	**0.66%** ***1***	
		115	1/2+	−90.036	**0.34%** ***1***	
		116	0+	−91.528	**14.54%** ***9***	
		117	1/2+	−90.400	**7.68%** ***7***	
		117m	11/2−	−90.085	13.76 d *4*	IT
		118	0+	−91.656	**24.22%** ***9***	
		119	1/2+	−90.068	**8.59%** ***4***	
		119m	11/2−	−89.979	293.1 d *7*	IT
		120	0+	−91.105	**32.58%** ***9***	
		121	3/2+	−89.204	27.03 h *4*	β−
		121m	11/2−	−89.198	43.9 y *5*	IT 77.6%, β− 22.4%
		122	0+	−89.946	**4.63%** ***3***	
		123	11/2−	−87.821	129.2 d *4*	β−
		*123*m	3/2+	−87.796	40.06 m *1*	β−
		124	0+	−88.237	**5.79%** ***5***	
		125	11/2−	−85.898	9.64 d *3*	β−
		*125*m	3/2+	−85.871	9.52 m *5*	β−
		126	0+	−86.02	2.30×10^{5} y *14*	β−
		127	(11/2−)	−83.50	2.10 h *4*	β−
		*127*m	(3/2+)	−83.49	4.13 m *3*	β−
		128	0+	−83.33	59.07 m *14*	β−
		*128*m	(7−)	−81.24	6.5 s *5*	IT
		129	(3/2+)	−80.59	2.23 m *4*	β−
		*129*m	(11/2−)	−80.56	6.9 m *1*	β−, IT<2.0×10^{-3}%
		130	0+	−80.14	3.72 m *7*	β−
		*130*m	(7−)	−78.19	1.7 m *1*	β−

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
50	**Sn**	*131*	(3/2+)	−77.31	56.0 s *5*	β−
		*131*m	(11/2−)	−77.07	58.4 s *5*	β−, IT≤4.0×10^{-4}%
		132	0+	−76.55	39.7 s *8*	β−
		133	(7/2−)	−70.95	1.45 s *3*	β−, β−n 0.08%
		134	0+	−66.80	1.050 s *11*	β−, β−n 17%
		135	(7/2−)	−60.8s	530 ms *20*	β−, β−n 21%
		136	0+	−56.5s	0.25 s *3*	β−, β−n 30%
		137		−50.3s	190 ms *60*	β−, β−n 58%
51	**Sb**	103		−56.2s	>1.5 μs	ε ?
		104		−59.2s	0.44 s *+15−11*	ε, εp<7%, p<1%
		105	(5/2+)	−63.8	1.12 s *16*	ε 99%, p 1%
		106	(4+)	−66.3s	0.6 s *2*	ε
		107	(5/2+)	−70.7s	4.0 s *2*	ε
		108	(4+)	−72.5s	7.4 s *3*	ε
		109	(5/2+)	−76.26	17.3 s *5*	ε
		110	(3+,4+)	−77.5s	23.0 s *4*	ε
		111	(5/2+)	−80.89	75 s *1*	ε
		112	3+	−81.60	51.4 s *10*	ε
		113	5/2+	−84.42	6.67 m *7*	ε
		114	3+	−84.52	3.49 m *3*	ε
		115	5/2+	−87.00	32.1 m *3*	ε
		116	3+	−86.821	15.8 m *8*	ε
		116m	8−	−86.438	60.3 m *6*	ε
		117	5/2+	−88.645	2.80 h *1*	ε, ε 1.7%
		118	1+	−87.999	3.6 m *1*	ε
		118m	8−	−87.749	5.00 h *2*	ε
		119	5/2+	−89.477	38.19 h *22*	ε
		119m	(27/2+)	−86.636	0.85 s *9*	IT
		120	1+	−88.424	15.89 m *4*	ε
		120m	8−	−88.424	5.76 d *2*	ε
		121	5/2+	−89.595	**57.21% *5***	
		122	2−	−88.330	2.7238 d *2*	β− 97.59%, ε 2.41%
		122m	(8)−	−88.167	4.191 m *3*	IT
		123	7/2+	−89.224	**42.79% *5***	
		124	3−	−87.620	60.11 d *7*	β−
		124m	5+	−87.609	93 s *5*	IT 75%, β− 25%
		124m	(8)−	−87.584	20.2 m *2*	IT
		125	7/2+	−88.256	2.7586 y *3*	β−
		126	(8−)	−86.40	12.35 d *6*	β−
		*126*m	(5+)	−86.38	19.15 m *8*	β− 86%, IT 14%
		*126*m	(3−)	−86.36	=11 s	IT
		127	7/2+	−86.700	3.85 d *5*	β−
		128	8−	−84.61	9.01 h *4*	β−
		*128*m	5+	−84.61	10.4 m *2*	β− 96.4%, IT 3.6%
		129	7/2+	−84.63	4.40 h *1*	β−
		129m	(19/2−)	−82.78	17.7 m *1*	β− 85%, IT 15%
		130	(8−)	−82.29	39.5 m *8*	β−
		*130*m	(4,5)+	−82.29	6.3 m *2*	β−
		131	(7/2+)	−81.99	23.03 m *4*	β−
		132	(4)+	−79.67	2.79 m *7*	β−
		*132*m	(8−)	−79.67	4.10 m *5*	β−
		133	(7/2+)	−78.94	2.5 m *1*	β−

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
51	**Sb**	*134*	(0−)	−74.17	0.78 s *6*	β−
		*134*m	(7−)	−74.17	10.07 s *5*	β−, β−n 0.09%
		135	(7/2+)	−69.7	1.68 s *2*	β−, β−n 22%
		136	1−	−64.9s	0.923 s *14*	β−, β−n 16.3%
		137		−60.3s	>150 ns	β−?, β−n?
		138		−55.2s	>300 ns	β−?, β−n?
		139		−50.3s	>150 ns	β−?
52	**Te**	105		−52.5s	1 μs *sy*	α?, ε?
		106	0+	−58.2	70 μs *+20−10*	α
		107		−60.5s	3.1 ms *1*	α 70%, ε 30%
		108	0+	−65.7	2.1 s *1*	ε 51%, α 49%, εp 2.4%
		109	(5/2+)	−67.61	4.6 s *3*	ε 96.1%, εp 9.4%, α 3.9%, εα<5.0×10^{-3}%
		110	0+	−72.28	18.6 s *8*	ε=100%, α=3.0×10^{-3}%
		111	(5/2)+	−73.48	19.3 s *4*	ε, εp
		112	0+	−77.3	2.0 m *2*	ε
		113	(7/2+)	−78.35	1.7 m *2*	ε
		114	0+	−81.89	15.2 m *7*	ε
		115	7/2+	−82.06	5.8 m *2*	ε
		115m	(1/2)+	−82.04	6.7 m *4*	ε≤100%, IT
		116	0+	−85.27	2.49 h *4*	ε
		117	1/2+	−85.10	62 m *2*	ε, ε 25%
		117m	(11/2−)	−84.80	103 ms *3*	IT
		118	0+	−87.72	6.00 d *2*	ε
		119	1/2+	−87.184	16.05 h *5*	ε, ε 2.06%
		119m	11/2−	−86.923	4.70 d *4*	ε, ε 0.41%, IT<8.0×10^{-3}%
		120	0+	−89.405	>2.2×10^{16} y **0.09%** ***1***	2ε
		121	1/2+	−88.55	19.16 d *5*	ε
		121m	11/2−	−88.26	154 d *7*	IT 88.6%, ε 11.4%
		122	0+	−90.314	**2.55%** ***12***	
		123	1/2+	−89.172	>9.2×10^{16} y **0.89%** ***3***	ε
		123m	11/2−	−88.924	119.2 d *1*	IT
		124	0+	−90.524	**4.74%** ***14***	
		125	1/2+	−89.022	**7.07%** ***15***	
		125m	11/2−	−88.877	57.40 d *15*	IT
		126	0+	−90.065	**18.84%** ***25***	
		127	3/2+	−88.281	9.35 h *7*	β−
		127m	11/2−	−88.193	109 d *2*	IT 97.6%, β− 2.4%
		128	0+	−88.992	8.8×10^{18} y *4* **31.74%** ***8***	2β−
		129	3/2+	−87.003	69.6 m *3*	β−
		129m	11/2−	−86.898	33.6 d *1*	IT 63%, β− 37%
		130	0+	−87.351	>5×10^{23} y **34.08%** ***62***	2β−
		131	3/2+	−85.210	25.0 m *1*	β−
		*131*m	11/2−	−85.027	30 h *2*	β− 77.8%, IT 22.2%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
52	**Te**	*132*	0+	−85.182	3.204 d *13*	β−
		133	(3/2+)	−82.94	12.5 m *3*	β−
		*133*m	(11/2−)	−82.61	55.4 m *4*	β− 82.5%, IT 17.5%
		134	0+	−82.56	41.8 m *8*	β−
		135	(7/2−)	−77.83	19.0 s *2*	β−
		136	0+	−74.43	17.63 s *8*	β−, β−n 1.31%
		137	(7/2−)	−69.6	2.49 s *5*	β−, β−n 2.69%
		138	0+	−65.9s	1.4 s *4*	β−, β−n 6.3%
		139	(7/2−)	−60.8s	>150 ns	β−, β−n
		140	0+	−57.0s	>150 ns	β−?, β−n?
		141		−51.6s	>150 ns	β−?, β−n?
		142	0+	−47.4s	>150 ns	β−?
53	**I**	108	(1)	−52.7s	36 ms *6*	α 91%, ε 9%, p<1%
		109	1/2+	−57.6	103 μs *5*	p
		110		−60.3s	0.65 s *2*	ε 83%, α 17%, εp 11%, εα 1.1%
		111	(5/2+)	−64.9s	2.5 s *2*	ε 99.9%, α=0.1%
		112		−67.1s	3.42 s *11*	ε, α=1.2×10^{-3}%
		113	5/2+	−71.13	6.6 s *2*	ε, α 3.3×10^{-7}%
		114	1+	−72.8s	2.1 s *2*	ε, εp
		114m	(7)	−72.5s	6.2 s *5*	ε 91%, IT 9%
		115	(5/2+)	−76.34	1.3 m *2*	ε
		116	1+	−77.49	2.91 s *15*	ε
		117	(5/2)+	−80.43	2.22 m *4*	ε
		118	2−	−80.97	13.7 m *5*	ε
		118m	(7−)	−80.87	8.5 m *5*	ε<100%, IT>0%
		119	5/2+	−83.77	19.1 m *4*	ε
		120	2−	−83.79	81.6 m *2*	ε
		120m	(7−)	−83.47	53 m *4*	ε
		121	5/2+	−86.29	2.12 h *1*	ε
		122	1+	−86.080	3.63 m *6*	ε
		123	5/2+	−87.943	13.232 h *6*	ε
		124	2−	−87.365	4.1760 d *3*	ε
		125	5/2+	−88.836	59.400 d *10*	ε
		126	2−	−87.910	12.93 d *5*	ε 52.7%, β− 47.3%
		127	5/2+	−88.983	**100%**	
		128	1+	−87.738	24.99 m *2*	β− 93.1%, ε 6.9%
		129	7/2+	−88.503	1.57×10^{7} y *4*	β−
		130	5+	−86.932	12.36 h *1*	β−
		130m	2+	−86.892	8.84 m *6*	IT 84%, β− 16%
		131	7/2+	−87.444	8.02070 d *11*	β−
		132	4+	−85.700	2.295 h *13*	β−
		*132*m	(8−)	−85.580	1.387 h *15*	IT 86%, β− 14%
		133	7/2+	−85.887	20.8 h *1*	β−
		*133*m	(19/2−)	−84.252	9 s *2*	IT
		134	(4)+	−84.073	52.5 m *2*	β−
		*134*m	(8)−	−83.756	3.52 m *4*	IT 97.7%, β− 2.3%
		135	7/2+	−83.790	6.57 h *2*	β−
		136	(1−)	−79.50	83.4 s *10*	β−
		*136*m	(6−)	−78.86	46.9 s *10*	β−
		137	(7/2+)	−76.50	24.5 s *2*	β−, β−n 6.97%
		138	(2−)	−72.33	6.23 s *3*	β−, β−n 5.56%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
53	**I**	*139*	(7/2+)	−68.84	2.280 s *11*	β−, β−n 10%
		140	(3)	−64.3s	0.86 s *4*	β−, β−n 9.3%
		141		−60.5s	0.43 s *2*	β−, β−n 21.2%
		142		−55.7s	=0.2 s	β−
		143		−51.6s	>150 ns	β−?
		144		−46.6s	>300 ns	β−?
54	**Xe**	110	0+	−51.9	105 ms *+35−25*	α=64%
		110	0+	−51.9	=0.2 s	ε
		111		−54.4s	0.74 s *20*	α 8%, ε
		112	0+	−60.0	2.7 s *8*	ε 99.16%, α 0.84%
		113	(5/2+)	−62.09	2.74 s *8*	ε=100%, εp 7%, α=0.01%, εα=7.0×10^{-3}%
		114	0+	−67.09	10.0 s *4*	ε
		115	(5/2+)	−68.66	18 s *4*	ε, εp 0.34%, α 3.0×10^{-4}%
		116	0+	−73.05	59 s *2*	ε
		117	5/2(+)	−74.19	61 s *2*	ε, εp 2.9×10^{-3}%
		118	0+	−78.08	3.8 m *9*	ε
		119	(5/2+)	−78.79	5.8 m *3*	ε
		120	0+	−82.17	40 m *1*	ε
		121	(5/2+)	−82.47	40.1 m *20*	ε
		122	0+	−85.36	20.1 h *1*	ε
		123	(1/2)+	−85.249	2.08 h *2*	ε
		124	0+	−87.660	$\geq1.1\times10^{17}$ y	2ε
					0.095% ***3***	
		125	1/2(+)	−87.192	16.9 h *2*	ε
		125m	9/2(−)	−86.939	56.9 s *9*	IT
		126	0+	−89.169	**0.089%** ***1***	
		127	1/2+	−88.321	36.4 d *1*	ε
		127m	9/2−	−88.024	69.2 s *9*	IT
		128	0+	−89.860	**1.910%** ***22***	
		129	1/2+	−88.697	**26.40%** ***18***	
		129m	11/2−	−88.461	8.88 d *2*	IT
		130	0+	−89.882	**4.071%** ***53***	
		131	3/2+	−88.415	**21.232%** ***62***	
		131m	11/2−	−88.251	11.934 d *21*	IT
		132	0+	−89.281	**26.909%** ***68***	
		133	3/2+	−87.644	5.243 d *1*	β−
		*133*m	11/2−	−87.410	2.19 d *1*	IT
		134	0+	−88.124	$>5.8\times10^{22}$ y	2β−≥0%
					10.436% ***29***	
		*134*m	7−	−86.159	290 ms *17*	IT
		135	3/2+	−86.417	9.14 h *2*	β−
		*135*m	11/2−	−85.890	15.29 m *5*	IT>99.4%, β−<0.6%
		136	0+	−86.425	$>2.4\times10^{21}$ y	2β−
					8.857% ***33***	
		137	7/2−	−82.379	3.818 m *13*	β−
		138	0+	−80.15	14.08 m *8*	β−
		139	3/2−	−75.64	39.68 s *14*	β−
		140	0+	−72.99	13.60 s *10*	β−
		141	5/2(−)	−68.33	1.73 s *1*	β−, β−n 0.04%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
54	**Xe**	*142*	0+	−65.5	1.250 s *25*	β−, β−n 0.21%
		143	5/2−	−60.4s	0.511 s *6*	β−, β−n 1%
		144	0+	−57.3s	0.388 s *7*	β−, β−n 3%
		145	(3/2−)	−52.1s	188 ms *4*	β−
		145		−52.1s	188 ms *4*	β−n 5%
		146	0+	−48.7s	146 ms *6*	β−, β−n 6.9%
		147		−43.3s	0.10 s *+10−5*	β−n<8%
55	**Cs**	112	(0+,3+)	−46.3s	0.5 ms *1*	p
		113	(3/2+)	−51.7	16.7 μs *7*	p, α
		114	(1+)	−54.5s	0.57 s *2*	ε=100%, εp 8.7%, εα 0.19%, α 0.02%
		115		−59.7s	1.4 s *8*	ε, εp=0.07%
		116	(1+)	−62.1s	0.70 s *4*	ε, εp>0%, εα>0%
		116m	4+,5,6	−62.0s	3.85 s *13*	ε, εp>0%, εα>0%
		117	(9/2+)	−66.44	8.4 s *6*	ε
		117m	(3/2+)	−66.29	6.5 s *4*	ε
		118	2	−68.41	14 s *2*	ε, εp<0.04%, εα<2.4×10−3%
		118m	6,7,8	−68.41	17 s *3*	ε, εp<0.04%, εα<2.4×10−3%
		119	9/2+	−72.31	43.0 s *2*	ε
		119m	3/2(+)	−72.31	30.4 s *1*	ε
		120	2(+)	−73.89	61.3 s *11*	ε, εα 2.0×10−5%, εp 7.0×10−6%
		120m	(7−)	−73.89	57 s *6*	ε
		121	3/2(+)	−77.10	155 s *4*	ε
		121m	9/2(+)	−77.03	122 s *3*	ε 83%, IT 17%
		122	1+	−78.14	21.18 s *19*	ε
		122m	8−	−78.02	3.70 m *11*	ε
		122m	(5)−	−78.01	0.36 s *2*	IT
		123	1/2+	−81.04	5.88 m *3*	ε
		123m	(11/2)−	−80.89	1.64 s *12*	IT
		124	1+	−81.731	30.8 s *5*	ε
		124m	(7)+	−81.269	6.3 s *2*	IT
		125	1/2(+)	−84.088	46.7 m *1*	ε
		126	1+	−84.34	1.64 m *2*	ε
		127	1/2+	−86.240	6.25 h *10*	ε
		128	1+	−85.931	3.66 m *2*	ε
		129	1/2+	−87.500	32.06 h *6*	ε
		130	1+	−86.900	29.21 m *4*	ε 98.4%, β− 1.6%
		130m	5−	−86.737	3.46 m *6*	IT 99.84%, ε 0.16%
		131	5/2+	−88.060	9.689 d *16*	ε
		132	2+	−87.156	6.480 d *6*	ε 98.13%, β− 1.87%
		133	7/2+	−88.071	**100%**	
		134	4+	−86.891	2.0652 y *4*	β−, ε 3.0×10−4%
		134m	8−	−86.753	2.912 h *2*	IT
		135	7/2+	−87.582	2.3×10^{6} y *3*	β−
		*135*m	19/2−	−85.949	53 m *2*	IT
		136	5+	−86.339	13.04 d *3*	β−
		*136*m	8−	−86.339	19 s *2*	IT>0%, β−
		137	7/2+	−86.546	30.03 y *5*	β−
		138	3−	−82.887	33.41 m *18*	β−

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
55	**Cs**	*138*m	6−	−82.808	2.91 m *8*	IT 81%, β− 19%
		139	7/2+	−80.701	9.27 m *5*	β−
		140	1−	−77.051	63.7 s *3*	β−
		141	7/2+	−74.48	24.84 s *16*	β−, β−n 0.04%
		142	0−	−70.52	1.684 s *14*	β−, β−n 0.09%
		143	3/2+	−67.67	1.791 s *7*	β−, β−n 1.64%
		144	1	−63.27	0.994 s *4*	β−, β−n 3.2%
		144m	(≥4)	−63.27	<1 s	β−
		145	3/2+	−60.06	0.594 s *13*	β−, β−n 14.3%
		146	1−	−55.62	0.321 s *2*	β−, β−n 14.2%
		147	(3/2+)	−52.02	0.235 s *3*	β−, β−n 43%
		148		−47.3	146 ms *6*	β−, β−n 25.1%
		149		−43.8s	>50 ms	β−, β−n
		150		−39.0s	>50 ms	β−, β−n
		151		−35.2s	>50 ms	β−?, β−n?
56	**Ba**	114	0+	−45.9	0.43 s *+30−15*	ε=100%, εp 20%, α 9.0×10^{-5}%, 12=3.0×10^{-5}%
		115	(5/2+)	−49.0s	0.45 s *5*	ε, εp>15%
		116	0+	−54.6s	1.3 s *2*	ε, εp 3%
		117	(3/2)	−57.3s	1.75 s *7*	ε, εp>0%, εα>0%
		118	0+	−62.4s	5.2 s *2*	ε
		119	(5/2+)	−64.6	5.4 s *3*	ε, εp<25%
		120	0+	−68.9	24 s *2*	ε
		121	5/2(+)	−70.7	29.7 s *15*	ε
		122	0+	−74.61	1.95 m *15*	ε
		123	5/2(+)	−75.65	2.7 m *4*	ε
		124	0+	−79.09	11.0 m *5*	ε
		125	1/2(+)	−79.67	3.5 m *4*	ε
		126	0+	−82.67	100 m *2*	ε
		127	1/2+	−82.82	12.7 m *4*	ε
		127m	7/2−	−82.74	1.9 s *2*	IT
		128	0+	−85.40	2.43 d *5*	ε
		129	1/2+	−85.06	2.23 h *11*	ε
		129m	7/2+	−85.06	2.16 h *2*	ε≤100%, IT
		130	0+	−87.262	≥3.5×10^{14} y	2ε
					0.106% ***1***	
		131	1/2+	−86.684	11.50 d *6*	ε
		131m	9/2−	−86.497	14.6 m *2*	IT
		132	0+	−88.435	>3.0×10^{21} y	2ε
					0.101% ***1***	
		133	1/2+	−87.553	3841 d *7*	ε
		133m	11/2−	−87.265	38.9 h *1*	IT 99.99%, ε 9.6×10^{-3}%
		134	0+	−88.950	**2.417%** ***18***	
		135	3/2+	−87.851	**6.592%** ***12***	
		135m	11/2−	−87.582	28.7 h *2*	IT
		136	0+	−88.887	**7.854%** ***24***	
		136m	7−	−86.856	0.3084 s *19*	IT
		137	3/2+	−87.721	**11.232%** ***24***	
		*137*m	11/2−	−87.060	2.552 m *1*	IT
		138	0+	−88.262	**71.698%** ***42***	

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
56	**Ba**	*139*	7/2−	−84.914	83.06 m *28*	β−
		140	0+	−83.271	12.752 d *3*	β−
		141	3/2−	−79.726	18.27 m *7*	β−
		142	0+	−77.823	10.6 m *2*	β−, β−n 0.09%
		143	5/2−	−73.94	14.5 s *3*	β−
		144	0+	−71.77	11.5 s *2*	β−, β−n 3.6%
		145	5/2−	−67.42	4.31 s *16*	β−
		146	0+	−65.00	2.22 s *7*	β−
		147	(3/2+)	−60.6s	0.893 s *1*	β−, β−n 0.06%
		148	0+	−58.01	0.612 s *17*	β−, β−n 0.4%
		149		−53.5s	0.344 s *7*	β−, β−n 0.43%
		150	0+	−50.6s	0.3 s	β−
		151		−45.8s	>150 ms	β−?
		152	0+	−42.6s	≈0.1 s	β−?
		153		−37.6s	≈0.08 s	β−?
57	**La**	117	(3/2+,3/2−)	−46.5s	23.5 ms *26*	p 93.9%, ε 6.1%
		117m	(9/2+)	−46.4s	10 ms *5*	p 97.4%, ε 2.6%
		118		−49.6s	≈1 s	ε?
		119		−55.0s	≈2 s	ε?
		120m		−57.7s	2.8 s *2*	ε, εp>0%
		121		−62.4s	5.3 s *2*	ε
		122		−64.5s	8.6 s *5*	ε, εp
		123		−68.7s	17 s *3*	ε
		124m	low	−70.26	<1 s	ε
		124m	(7,8−)	−70.26	29 s *1*	ε
		125		−73.76	64.8 s *12*	ε
		125m		−73.65	0.4 s *2*	IT
		126m	(0−,1,2−)	−74.97	<50 s	ε, IT
		126m	(5+)	−74.97	54 s *2*	ε>0%
		127	(11/2−)	−77.90	5.1 m *1*	ε
		127m	(3/2+)	−77.88	3.7 m *4*	ε, IT
		128	(5+)	−78.63	5.18 m *14*	ε
		128m	(1+,2−)	−78.63	<1.4 m	ε
		129	3/2+	−81.33	11.6 m *2*	ε
		129m	11/2−	−81.15	0.56 s *5*	IT
		130	3(+)	−81.63	8.7 m *1*	ε
		131	3/2+	−83.77	59 m *2*	ε
		132	2−	−83.74	4.8 h *2*	ε
		132m	6−	−83.55	24.3 m *5*	IT 76%, ε 24%
		133	5/2+	−85.49	3.912 h *8*	ε
		134	1+	−85.22	6.45 m *16*	ε
		135	5/2+	−86.65	19.5 h *2*	ε
		136	1+	−86.04	9.87 m *3*	ε
		136m	(8+)	−85.81	114 ms *3*	IT
		137	7/2+	−87.10	6×10^{4} y *2*	ε
		138	5+	−86.525	1.02×10^{11} y *1*	ε 65.6%,
					0.090% ***1***	β− 34.4%
		139	7/2+	−87.231	**99.910%** ***1***	
		140	3−	−84.321	1.6781 d *3*	β−
		141	(7/2+)	−82.938	3.92 h *3*	β−
		142	2−	−80.035	91.1 m *5*	β−
		143	(7/2)+	−78.19	14.2 m *1*	β−

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
57	**La**	*144*	(3−)	−74.89	40.8 s *4*	β−
		145	(5/2+)	−72.99	24.8 s *20*	β−
		146	2−	−69.12	6.27 s *10*	β−
		*146*m	(6−)	−69.12	10.0 s *1*	β−
		147	(5/2+)	−66.85	4.015 s *8*	β−, β−n 0.04%
		148	(2−)	−63.13	1.26 s *8*	β−, β−n 0.15%
		149	(3/2,5/2)	−60.8s	1.05 s *3*	β−, β−n 1.43%
		150	(3−)	−57.0s	0.51 s *3*	β−, β−n 2.7%
		151		−54.3s	>150 ns	β−?
		152		−50.1s	>150 ns	β−?
		153		−46.9s	>100 ns	
		154		−42.4s	=0.1 s	β−?
		155		−38.8s	=0.06 s	β−?
58	**Ce**	119		−44.0s	=0.2 s	ε?
		120	0+	−49.7s	=0.25 s	ε?
		121		−52.7s	1.1 s *1*	ε, εp=1%
		122	0+	−57.8s	=2 s	ε?, εp?
		123	(5/2)	−60.2s	3.8 s *2*	ε, εp>0%
		124	0+	−64.8s	6 s *2*	ε
		125	(5/2+)	−66.7s	10.2 s *4*	ε, εp
		126	0+	−70.82	51.0 s *3*	ε
		127	(5/2+)	−71.98	31 s *2*	ε
		128	0+	−75.53	3.93 m *2*	ε
		129	5/2+	−76.29	3.5 m *5*	ε>0%
		130	0+	−79.42	22.9 m *5*	ε
		131	(7/2+)	−79.72	10.2 m *3*	ε
		131m	(1/2+)	−79.72	5.0 m *10*	ε
		132	0+	−82.47	3.51 h *11*	ε
		133	1/2+	−82.42	97 m *4*	ε
		133m	9/2−	−82.39	4.9 h *4*	ε
		134	0+	−84.84	3.16 d *4*	ε
		135	1/2(+)	−84.62	17.7 h *3*	ε
		135m	(11/2−)	−84.18	20 s *1*	IT
		136	0+	−86.47	$>0.7\times10^{14}$ y	2ε
					0.185% ***2***	
		137	3/2+	−85.88	9.0 h *3*	ε
		137m	11/2−	−85.62	34.4 h *3*	IT 99.22%, ε 0.78%
		138	0+	−87.57	$\geq0.9\times10^{14}$ y	2ε
					0.251% ***2***	
		139	3/2+	−86.952	137.641 d *20*	ε
		139m	11/2−	−86.198	54.8 s *10*	IT
		140	0+	−88.083	**88.450%** ***18***	
		141	7/2−	−85.440	32.508 d *13*	β−
		142	0+	−84.538	$>2.6\times10^{17}$ y	2β−
					11.114% ***17***	
		143	3/2−	−81.612	33.039 h *6*	β−
		144	0+	−80.437	284.91 d *5*	β−
		145	(3/2−)	−77.10	3.01 m *6*	β−
		146	0+	−75.68	13.52 m *13*	β−
		147	(5/2−)	−72.03	56.4 s *10*	β−
		148	0+	−70.39	56 s *1*	β−
		149	(3/2−)	−66.70	5.3 s *2*	β−

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
58	**Ce**	*150*	0+	−64.82	4.0 s *6*	β−
		151		−61.5	1.02 s *6*	β−
		152	0+	−59.1s	1.4 s *2*	β−
		153		−55.3s	>100 ns	β−?
		154	0+	−52.7s	>150 ns	β−?
		155		−48.4s	>300 ns	β−?
		156	0+	−45.4s	=0.15 s	β−?
		157		−40.7s	=0.05 s	β−?
59	**Pr**	121	(3/2−)	−41.6s	1.4 s *8*	p
		122		−44.9s	=0.5 s	ε?
		123		−50.3s	=0.8 s	ε?
		124		−53.1s	1.2 s *2*	ε , εp
		125		−57.9s	3.3 s *7*	ε , εp
		126	≥4	−60.3s	3.14 s *22*	ε
		126	≥4	−60.3s	3.14 s *22*	εp
		127		−64.4s	4.2 s *3*	ε
		128	4,5,6	−66.33	2.84 s *9*	ε
		129	(11/2−)	−69.77	32 s *3*	ε>0%
		130?	(4,5)+	−71.18	40 s *4*	ε
		131	(3/2+)	−74.28	94 s *4*	ε
		131m	(11/2−)	−74.13	5.7 s *2*	IT 96.4%, ε 3.6%
		132	(2)+	−75.21	1.6 m *3*	ε
		133	(3/2+)	−77.94	6.5 m *3*	ε
		134m	(6−)	−78.51	=11 m	ε
		134m	2−	−78.51	17 m *2*	ε
		135	3/2(+)	−80.94	24 m *2*	ε
		136	2+	−81.33	13.1 m *1*	ε
		137	5/2+	−83.18	1.28 h *3*	ε
		138	1+	−83.13	1.45 m *5*	ε
		138m	7−	−82.77	2.12 h *4*	ε
		139	5/2+	−84.823	4.41 h *4*	ε
		140	1+	−84.695	3.39 m *1*	ε
		141	5/2+	−86.021	**100%**	
		142	2−	−83.793	19.12 h *4*	β− 99.98%, ε 0.02%
		142m	5−	−83.789	14.6 m *5*	IT
		143	7/2+	−83.074	13.57 d *2*	β−
		144	0−	−80.756	17.28 m *5*	β−
		144m	3−	−80.697	7.2 m *3*	IT 99.93%, β− 0.07%
		145	7/2+	−79.632	5.984 h *10*	β−
		146	(2)−	−76.71	24.15 m *18*	β−
		147	(3/2+)	−75.45	13.4 m *4*	β−
		148	1−	−72.53	2.29 m *2*	β−
		*148*m	(4)	−72.44	2.01 m *7*	β−
		149	(5/2+)	−71.06	2.26 m *7*	β−
		150	(1)−	−68.30	6.19 s *16*	β−
		151	(3/2−)	−66.77	18.90 s *7*	β−
		152	(4−)	−63.8	3.63 s *12*	β−
		153		−61.6	4.28 s *11*	β−
		154	(3+,2+)	−58.2	2.3 s *1*	β−
		155		−55.8s	>300 ns	β−?
		156		−51.9s	>300 ns	β−?
		157		−49.0s	=0.3 s	β−?

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
59	**Pr**	158		−44.7s	=0.2 s	β−?
		159		−41.5s	=0.1 s	β−?
60	**Nd**	124	0+	−44.5s	0.5 s *sy*	ε?
		125	(5/2)	−47.6s	0.60 s *15*	ε, εp>0%
		126	0+	−52.9s	>200 ns	ε, εp
		127		−55.4s	1.8 s *4*	ε, εp
		128	0+	−60.2s	5 s	ε, εp
		129	(5/2+)	−62.2s	7 s *1*	ε, εp
		130	0+	−66.60	21 s *3*	ε
		131	(5/2)	−67.77	33 s *3*	ε, εp
		132	0+	−71.43	94 s *8*	ε
		133	(7/2+)	−72.33	70 s *10*	ε
		133m	(1/2)+	−72.20	=70 s	ε, IT
		134	0+	−75.65	8.5 m *15*	ε
		135	9/2(−)	−76.21	12.4 m *6*	ε
		135m	(1/2+)	−76.15	5.5 m *5*	ε>99.97%, IT<0.03%
		136	0+	−79.20	50.65 m *33*	ε
		137	1/2+	−79.58	38.5 m *15*	ε
		137m	11/2−	−79.06	1.60 s *15*	IT
		138	0+	−82.02	5.04 h *9*	ε
		139	3/2+	−81.99	29.7 m *5*	ε
		139m	11/2−	−81.76	5.50 h *20*	ε 88.2%, IT 11.8%
		140	0+	−84.25	3.37 d *2*	ε
		141	3/2+	−84.198	2.49 h *3*	ε
		141m	11/2−	−83.441	62.0 s *8*	IT, ε<0.05%
		142	0+	−85.955	**27.2%** ***5***	
		143	7/2−	−84.007	**12.2%** ***2***	
		144	0+	−83.753	2.29×10^{15} y *16*	α
					23.8% ***3***	
		145	7/2−	−81.437	**8.3%** ***1***	
		146	0+	−80.931	**17.2%** ***3***	
		147	5/2−	−78.152	10.98 d *1*	β−
		148	0+	−77.413	**5.7%** ***1***	
		149	5/2−	−74.381	1.728 h *1*	β−
		150	0+	−73.690	0.79×10^{19} y *7*	2β−
					5.6% ***2***	
		151	3/2+	−70.953	12.44 m *7*	β−
		152	0+	−70.16	11.4 m *2*	β−
		153	(3/2)−	−67.35	31.6 s *10*	β−
		154	0+	−65.7	25.9 s *2*	β−
		155		−62.5s	8.9 s *2*	β−
		156	0+	−60.5	5.49 s *7*	β−
		157		−56.8s	>100 ns	β−?
		158	0+	−54.4s	>50 ns	β−
		159		−50.2s	=0.7 s	β−?
		160	0+	−47.4s	=0.3 s	β−?
		161		−43.0s	=0.2 s	β−?
61	**Pm**	126		−39.6s	0.5 s *sy*	ε?
		127		−45.1s	1 s *sy*	ε?, p?
		128		−48.0s	1.0 s *3*	ε, α, εp
		129	5/2−)	−52.9s	2.4 s *9*	ε

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
61	**Pm**	130	(4,5,6)	–55.5s	2.6 s *2*	ε , εp
		131	(11/2)	–59.7s	6.3 s *8*	ε
		132	(3+)	–61.7s	6.2 s *6*	ε , εp=5.0×10^{-5}%
		133	(11/2–)	–65.41	15 s *3*	ε
		134	(2+)	–66.74	=5 s	ε
		134m	(5+)	–66.74	22 s *1*	ε
		135m	(11/2–)	–69.98	45 s *4*	ε
		135m	3/2+,5/2+)	–69.98	49 s *3*	ε
		136m	(2+)	–71.20	47 s *2*	ε
		136m	(5–)	–71.20	107 s *6*	ε
		137	11/2–	–74.07	2.4 m *1*	ε
		138		–74.94	10 s *2*	ε
		138m		–74.92	3.24 m *5*	ε
		139	(5/2)+	–77.50	4.15 m *5*	ε
		139m	(11/2)–	–77.31	180 ms *20*	IT 99.94%, ε 0.06%
		140	1+	–78.21	9.2 s *2*	ε
		140m	8–	–78.21	5.95 m *5*	ε
		141	5/2+	–80.52	20.90 m *5*	ε
		142	1+	–81.16	40.5 s *5*	ε
		143	5/2+	–82.966	265 d *7*	ε , ε<5.7×10^{-6}%
		144	5–	–81.421	363 d *14*	ε
		145	5/2+	–81.274	17.7 y *4*	ε , α 3×10^{-7}%
		146	3–	–79.460	5.53 y *5*	ε 66%, β– 34%
		147	7/2+	–79.048	2.6234 y *2*	β–
		148	1–	–76.872	5.368 d *2*	β–
		148m	5–,6–	–76.734	41.29 d *11*	β– 95.8%, IT 4.2%
		149	7/2+	–76.071	53.08 h *5*	β–
		150	(1–)	–73.60	2.68 h *2*	β–
		151	5/2+	–73.395	28.40 h *4*	β–
		152	1+	–71.26	4.12 m *8*	β–
		*152*m	4–	–71.11	7.52 m *8*	β–
		*152*m	(8)	–71.11	13.8 m *2*	β–≤100%, IT≥0%
		153	5/2–	–70.68	5.25 m *2*	β–
		154	(3,4)	–68.50	2.68 m *7*	β–
		*154*m	(0,1)	–68.50	1.73 m *10*	β–
		155	5/2–	–66.97	41.5 s *2*	β–
		156m	4–	–64.22	26.70 s *10*	β–
		157	(5/2–)	–62.4	10.56 s *10*	β–
		158		–59.1	4.8 s *5*	β–
		159		–56.8s	1.47 s *15*	β–
		160		–53.1s	=2 s	β–?
		161		–50.4s	=0.7 s	β–?
		162		–46.3s	=0.5 s	β–?
		163		–43.1s	=0.2 s	β–?
62	**Sm**	128	0+	–39.0s	0.5 s *sy*	ε?, p?
		129	(1/2+)	–42.3s	0.55 10	ε , εp
		130	0+	–47.6s	1 s *sy*	ε
		131		–50.2s	1.2 s *2*	ε , εp>0%
		132	0+	–55.2s	4.0 s *3*	ε , εp
		133	(5/2+)	–57.1s	3.7 s *7*	ε , εp>0%
		134	0+	–61.5s	9.5 s *8*	ε
		135	(3/2+,5/2+)	–62.9	10.3 s *5*	ε , εp 0.02%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
62	**Sm**	136	0+	−66.81	47 s *2*	ε
		137	(9/2−)	−68.03	45 s *1*	ε
		138	0+	−71.50	3.1 m *2*	ε
		139	1/2+	−72.38	2.57 m *10*	ε
		139m	11/2−	−71.92	10.7 s *6*	IT 93.7%, ε 6.3%
		140	0+	−75.46	14.82 m *12*	ε
		141	1/2+	−75.939	10.2 m *2*	ε
		141m	11/2−	−75.763	22.6 m *2*	ε 99.69%, IT 0.31%
		142	0+	−78.993	72.49 m *5*	ε
		143	3/2+	−79.523	8.75 m *8*	ε
		143m	11/2−	−78.769	66 s *2*	IT 99.76%, ε 0.24%
		144	0+	−81.972	**3.07% *7***	
		145	7/2−	−80.658	340 d *3*	ε
		146	0+	−81.002	10.3×10^{7} y *5*	α
		147	7/2−	−79.272	1.06×10^{11} y *2*	α
					14.99% *18*	
		148	0+	−79.342	7×10^{15} y *3*	α
					11.24% *10*	
		149	7/2−	−77.142	**13.82% *7***	
		150	0+	−77.057	**7.38% *1***	
		151	5/2−	−74.582	90 y *8*	β−
		152	0+	−74.769	**26.75% *16***	
		153	3/2+	−72.566	46.284 h *4*	β−
		154	0+	−72.462	**22.75% *29***	
		155	3/2−	−70.197	22.3 m *2*	β−
		156	0+	−69.370	9.4 h *2*	β−
		157	(3/2−)	−66.73	8.03 m *7*	β−
		158	0+	−65.21	5.30 m *3*	β−
		159	5/2−	−62.2	11.37 s *15*	β−
		160	0+	−60.4s	9.6 s *3*	β−
		161		−57.0s	4.8 s *8*	β−
		162	0+	−54.8s	=2 s	β−?
		163		−50.9s	=1 s	β−?
		164	0+	−48.2s	=0.5 s	β−?
		165		−43.8s	=0.2 s	β−
63	**Eu**	130	(1+)	−33.9s	0.9 ms *+5−3*	p
		131	3/2+	−39.4s	17.8 ms *19*	p 87.9%, ε 12.1%
		132		−42.5s	200 ms *sy*	ε
		133		−47.3s	=1 s	ε?
		134		−49.8s	0.5 s *2*	ε, εp>0%
		135		−54.2s	1.5 s *2*	ε, εp
		136m	(7+)	−56.3s	3.3 s *3*	ε, εp 0.09%
		136m	(3+)	−56.3s	3.8 s *3*	ε, εp 0.09%
		137	(11/2−)	−60.0s	11 s *2*	ε
		138	(6−)	−61.75	12.1 s *6*	ε
		139	(11/2)−	−65.40	17.9 s *6*	ε
		140	1+	−66.99	1.51 s *2*	ε
		140m	(5−)	−66.80	125 ms *2*	IT, ε<1%
		141	5/2+	−69.93	40.7 s *7*	ε
		141m	11/2−	−69.83	2.7 s *3*	IT 87%, ε 13%
		142	1+	−71.32	2.34 s *12*	ε
		142m	8−	−71.32	1.223 m *8*	ε

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
63	**Eu**	143	5/2+	−74.24	2.59 m *2*	ε
		144	1+	−75.62	10.2 s *1*	ε
		145	5/2+	−77.998	5.93 d *4*	ε
		146	4−	−77.122	4.61 d *3*	ε
		147	5/2+	−77.550	24.1 d *6*	ε , α 2.2×10^{-3}%
		148	5−	−76.30	54.5 d *5*	ε , α 9.4×10^{-7}%
		149	5/2+	−76.447	93.1 d *4*	ε
		150	5(−)	−74.797	36.9 y *9*	ε
		150m	0−	−74.755	12.8 h *1*	β− 89%, ε 11%, IT≤5.0×10^{-8}%
		151	5/2+	−74.659	**47.81%** ***3***	
		152	3−	−72.895	13.506 y *6*	ε 72.1%, β− 27.9%
		152m	0−	−72.849	9.3116 h *13*	β− 72%, ε 28%
		152m	8−	−72.747	96 m *1*	IT
		153	5/2+	−73.373	**52.19%** ***3***	
		154	3−	−71.744	8.590 y *3*	β− 99.98%, ε 0.02%
		154m	(8−)	−71.599	46.3 m *4*	IT
		155	5/2+	−71.825	4.753 y *14*	β−
		156	0+	−70.093	15.19 d *8*	β−
		157	5/2+	−69.467	15.18 h *3*	β−
		158	(1−)	−67.21	45.9 m *2*	β−
		159	5/2+	−66.053	18.1 m *1*	β−
		160	1	−63.4s	38 s *4*	β−
		161		−61.8s	26 s *3*	β−
		162		−58.6s	10.6 s *10*	β−
		163		−56.6s	6 s *sy*	β−?
		164		−53.1s	=2 s	β−?
		165		−50.6s	=1 s	β−?
		166		−46.6s	=0.4 s	β−
		167		−43.6s	=0.2 s	β−?
64	**Gd**	134	0+	−41.6s	0.4 s *sy*	ε?
		135		−44.2s	1.1 s *2*	ε , εp=2%
		136	0+	−49.1s	≥200 ns	
		137	(7/2)	−51.2s	2.2 s *2*	ε , εp
		138	0+	−55.8s	4.7 s *9*	ε
		139	(9/2−)	−57.5s	5.8 s *9*	ε>0%, εp>0%
		139m		−57.5s	4.8 s *9*	ε>0%, εp>0%
		140	0+	−61.78	15.8 s *4*	ε
		141	1/2+	−63.22	14 s *4*	ε , εp 0.03%
		141m	11/2−	−62.85	24.5 s *5*	ε 89%, IT 11%
		142	0+	−66.96	70.2 s *6*	ε
		143	(1/2)+	−68.2	39 s *2*	ε
		143m	(11/2−)	−68.1	110.0 s *14*	ε
		144	0+	−71.76	4.47 m *6*	ε
		145	1/2+	−72.93	23.0 m *4*	ε
		145m	11/2−	−72.18	85 s *3*	IT 94.3%, ε 5.7%
		146	0+	−76.093	48.27 d *10*	ε
		147	7/2−	−75.363	38.06 h *12*	ε
		148	0+	−76.276	70.9 y *10*	α
		149	7/2−	−75.133	9.28 d *10*	ε , α 4.3×10^{-4}%
		150	0+	−75.769	1.79×10^{6} y *8*	α
		151	7/2−	−74.195	124 d *1*	ε , α=8.0×10^{-7}%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
64	**Gd**	152	0+	−74.714	1.08×10^{14} y *8*	α
					0.20% ***1***	
		153	3/2−	−72.890	240.4 d *10*	ε
		154	0+	−73.713	**2.18%** ***3***	
		155	3/2−	−72.077	**14.80%** ***12***	
		156	0+	−72.542	**20.47%** ***9***	
		157	3/2−	−70.831	**15.65%** ***2***	
		158	0+	−70.697	**24.84%** ***7***	
		159	3/2−	−68.568	18.479 h *4*	β−
		160	0+	−67.949	$>3.1\times10^{19}$ y	2β−
					21.86% ***19***	
		161	5/2−	−65.513	3.66 m *5*	β−
		162	0+	−64.287	8.4 m *2*	β−
		163	(5/2−,7/2+)	−61.5s	68 s *3*	β−
		164	0+	−59.7s	45 s *3*	β−
		165		−56.5s	10.3 s *16*	β−
		166	0+	−54.4s	=7 s	β−
		167		−50.7s	=3 s	β−?
		168	0+	−48.1s	=0.3 s	β−?
		169		−43.9s	=1 s	β−?
65	**Tb**	135	(7/2−)		0.94 ms *+33−22*	p
		136		−36.0s	0.2 s *sy*	ε?
		137		−41.0s	0.6 s *sy*	p?, ε?
		138?		−43.6s	≥200 ns	ε, p
		139		−48.2s	1.6 s *2*	ε, εp?
		140	(7+)	−50.5	2.1 s *4*	ε, εp 0.26%
		141	(5/2−)	−54.5	3.5 s *2*	ε
		141m		−54.5	7.9 s *6*	ε
		142	1+	−57.1s	597 ms *17*	ε, εp 2.2×10^{-3}%
		142m	(5−)	−56.8s	303 ms *17*	IT
		143	(11/2−)	−60.43	12 s *1*	ε
		143m		−60.43	<21 s	ε
		144	1+	−62.37	=1 s	ε
		144m	(6−)	−61.97	4.25 s *15*	IT 66%, ε 34%
		145	(3/2+)	−65.88	=20 m	ε?
		145m	(11/2−)	−65.88	30.9 s *7*	ε
		146	1+	−67.77	8 s *4*	ε
		146m	5−	−67.77	23 s *2*	ε
		147	(1/2+)	−70.75	1.7 h *1*	ε
		147m	(11/2)−	−70.70	1.83 m *6*	ε
		148	2−	−70.54	60 m *1*	ε
		148m	(9)+	−70.45	2.20 m *5*	ε
		149	1/2+	−71.496	4.118 h *25*	ε 83.3%, α 16.7%
		149m	11/2−	−71.460	4.16 m *4*	ε 99.98%, α 0.02%
		150	(2−)	−71.110	3.48 h *16*	ε, α<0.05%
		150m	9+	−70.637	5.8 m *2*	ε
		151	1/2(+)	−71.630	17.609 h *1*	ε, α 9.5×10^{-3}%
		151m	(11/2−)	−71.530	25 s *3*	IT 93.8%, ε 6.2%
		152	2−	−70.72	17.5 h *1*	ε, α$<7.0\times10^{-7}$%
		152m	8+	−70.22	4.2 m *1*	IT 78.8%, ε 21.2%
		153	5/2+	−71.320	2.34 d *1*	ε
		154	0	−70.16	21.5 h *4*	ε, β−<0.1%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
65	**Tb**	154m	3−	−70.16	9.4 h *4*	ε 78.2%, IT 21.8%, β−<0.1%
		154m	7−	−70.16	22.7 h *5*	ε 98.2%, IT 1.8%
		155	3/2+	−71.25	5.32 d *6*	ε
		156	3−	−70.098	5.35 d *10*	ε
		156m	(7−)	−70.048	24.4 h *10*	IT
		156m	(0+)	−70.009	5.3 h *2*	IT<100%, ε>0%
		157	3/2+	−70.771	71 y *7*	ε
		158	3−	−69.477	180 y *11*	ε 83.4%, β− 16.6%
		158m	0−	−69.367	10.70 s *17*	IT, β−<0.6%, ε<0.01%
		159	3/2+	−69.539	**100%**	
		160	3−	−67.843	72.3 d *2*	β−
		161	3/2+	−67.468	6.906 d *19*	β−
		162	1−	−65.68	7.60 m *15*	β−
		163	3/2+	−64.601	19.5 m *3*	β−
		164	(5+)	−62.1	3.0 m *1*	β−
		165	(3/2+)	−60.7s	2.11 m *10*	β−
		166		−57.8	21 s *6*	β−
		167	(3/2+)	−55.8s	19.4 s *27*	β−
		168	(4−)	−52.5s	8.2 s *13*	β−
		169		−50.1s	≈2 s	β−?
		170		−46.3s	≈3 s	β−?
		171		−43.5s	≈0.5 s	β−
66	**Dy**	138	0+	−34.9s	200 ms *sy*	ε?
		139	(7/2+)	−37.7s	0.6 s *2*	ε, εp
		141	(9/2−)	−45.3s	0.9 s *2*	ε, εp
		142	0+	−50.0s	2.3 s *3*	ε, εp 0.06%
		143	(1/2+)	−52.3s	5.6 s *10*	ε, εp
		143m	(11/2−)	−52.3s	3.0 s *3*	ε, εp
		144	0+	−56.58	9.1 s *4*	ε, εp
		145	(1/2+)	−58.29	10.5 s *15*	ε
		145m	(11/2−)	−58.29	13.6 s *10*	ε
		146	0+	−62.55	29 s *3*	ε
		146m	(10+)	−59.62	150 ms *20*	IT
		147	1/2+	−64.19	40 s *10*	ε, εp>0%
		147m	11/2−	−63.44	55.7 s *7*	ε 65%, IT 35%
		148	0+	−67.86	3.3 m *2*	ε
		149	(7/2−)	−67.715	4.20 m *14*	ε
		149m	(27/2−)	−65.054	0.490 s *15*	IT 99.3%, ε 0.7%
		150	0+	−69.317	7.17 m *5*	ε 64%, α 36%
		151	7/2(−)	−68.759	17.9 m *3*	ε 94.4%, α 5.6%
		152	0+	−70.124	2.38 h *2*	ε 99.9%, α 0.1%
		153	7/2(−)	−69.150	6.4 h *1*	ε 99.99%, α 9.4×10^{-3}%
		154	0+	−70.398	3.0×10^{6} y *15*	α
		155	3/2−	−69.16	9.9 h *2*	ε
		156	0+	−70.530	***0.06% 1***	
		157	3/2−	−69.428	8.14 h *4*	ε
		158	0+	−70.412	***0.10% 1***	
		159	3/2−	−69.174	144.4 d *2*	ε
		160	0+	−69.678	***2.34% 8***	

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
66	**Dy**	161	5/2+	−68.061	**18.91%** ***24***	
		162	0+	−68.187	**25.51%** ***26***	
		163	5/2−	−66.386	**24.90%** ***16***	
		164	0+	−65.973	**28.18%** ***37***	
		165	7/2+	−63.618	2.334 h *1*	β−
		165m	1/2−	−63.510	1.257 m *6*	IT 97.76%, β− 2.24%
		166	0+	−62.590	81.6 h *1*	β−
		167	(1/2−)	−59.94	6.20 m *8*	β−
		168	0+	−58.6	8.7 m *3*	β−
		169	(5/2−)	−55.6	39 s *8*	β−
		170	0+	−53.7s	=30 s	β−?
		171		−50.1s	=6 s	β−
		172	0+	−47.7s	=3 s	β−
		173		−43.8s	=2 s	β−?
67	**Ho**	140	(6−,0−,8+)	−29.3s	6 ms *3*	p
		141	7/2−	−34.4s	4.1 ms *3*	p
		142		−37.5s	=0.3 s	ε , εp
		143		−42.3s	>200 ns	ε?, εp?
		144		−45.2s	0.7 s *1*	ε , εp
		145		−49.2s	2.4 s *1*	ε
		146	(10+)	−51.6s	3.6 s *3*	ε
		147	(11/2−)	−55.84	5.8 s *4*	ε
		148	(1+)	−58.0	2.2 s *11*	ε
		148m	(6)−	−58.0	9.59 s *15*	ε , εp 0.08%
		149	(11/2−)	−61.69	21.1 s *2*	ε
		149m	(1/2+)	−61.64	56 s *3*	ε
		150	2−	−61.95	72 s *4*	ε
		150m	(9)+	−61.15	23.3 s *3*	ε
		151	(11/2−)	−63.63	35.2 s *1*	ε 78%, α 22%
		151m	(1/2+)	−63.59	47.2 s *10*	α 80%, ε 20%
		152	2−	−63.61	161.8 s *3*	ε 88%, α 12%
		152m	9+	−63.45	50.0 s *4*	ε 89.2%, α 10.8%
		153	11/2−	−65.019	2.01 m *3*	ε 99.95%, α 0.05%
		153m	1/2+	−64.951	9.3 m *5*	ε 99.82%, α 0.18%
		154	2−	−64.644	11.76 m *19*	ε 99.98%, α 0.02%
		154m	8+	−64.644	3.10 m *14*	ε , α<1.0×10^{-3}%, IT?
		155	5/2+	−66.04	48 m *1*	ε
		156	4−	−65.35	56 m *1*	ε
		156m	1−	−65.30	9.5 s *15*	IT
		156m	9+	−65.30	7.8 m *3*	ε 75%, IT 25%
		157	7/2−	−66.83	12.6 m *2*	ε
		158	5+	−66.19	11.3 m *4*	ε
		158m	2−	−66.12	28 m *2*	IT>81%, ε<19%
		158m	(9+)	−66.01	21.3 m *23*	ε≥93%, IT≤7%
		159	7/2−	−67.336	33.05 m *11*	ε
		159m	1/2+	−67.130	8.30 s *8*	IT
		160	5+	−66.39	25.6 m *3*	ε
		160m	2−	−66.33	5.02 h *5*	IT 73%, ε 27%
		160m	(9+)	−66.22	3 s	IT
		161	7/2−	−67.203	2.48 h *5*	ε
		161m	1/2+	−66.992	6.76 s *7*	IT

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
67	**Ho**	162	1+	−66.047	15.0 m *10*	ε
		162m	6−	−65.941	67.0 m *7*	IT 62%, ε 38%
		163	7/2−	−66.384	4570 y *25*	ε
		163m	1/2+	−66.086	1.09 s *3*	IT
		164	1+	−64.987	29 m *1*	ε 60%, β− 40%
		164m	6−	−64.847	37.5 m +*15*−*5*	IT
		165	7/2−	−64.905	**100%**	
		166	0−	−63.077	26.83 h *2*	β−
		166m	(7)−	−63.071	1.20×10^{3} y *18*	β−
		167	7/2−	−62.287	3.003 h *18*	β−
		168	3+	−60.07	2.99 m *7*	β−
		168m	(6+)	−60.01	132 s *4*	IT ≥ 99.5%, β− ≤ 0.5%
		169	7/2−	−58.80	4.72 m *10*	β−
		170	(6+)	−56.24	2.76 m *5*	β−
		170m	(1+)	−56.12	43 s *2*	β−
		171	(7/2−)	−54.5	53 s *2*	β−
		172		−51.4s	25 s *3*	β−
		173		−49.1s	≈10 s	β−?
		174		−45.5s	≈8 s	β−?
		175		−42.8s	≈5 s	β−?
68	**Er**	143		−31.4s	0.2 s *sy*	ε?
		144	0+	−36.9s	≥200 ns	ε
		145	(11/2−)	−39.7s	0.9 s *3*	ε, εp
		146	0+	−44.7s	1.7 s *6*	ε, εp
		147	(11/2−)	−47.0s	2.5 s *2*	ε, εp>0%
		147m	(1/2+)	−47.0s	≈2.5 s	ε, εp>0%
		148	0+	−51.7s	4.6 s *2*	ε
		149	(1/2+)	−53.74	4 s *2*	ε, εp 7%
		149m	(11/2−)	−53.00	8.9 s *2*	ε 96.5%, IT 3.5%, εp 0.18%
		150	0+	−57.83	18.5 s *7*	ε
		151	(7/2−)	−58.27	23.5 s *13*	ε
		151m	(27/2−)	−55.68	0.58 s *2*	IT 95.3%, ε 4.7%
		152	0+	−60.50	10.3 s *1*	α 90%, ε 10%
		153	(7/2−)	−60.488	37.1 s *2*	α 53%, ε 47%
		154	0+	−62.612	3.73 m *9*	ε 99.53%, α 0.47%
		155	7/2−	−62.215	5.3 m *3*	ε 99.98%, α 0.02%
		156	0+	−64.21	19.5 m *10*	ε=100%, α 1.7×10^{-5}%
		157	3/2−	−63.42	18.65 m *10*	ε=100%
		158	0+	−65.30	2.29 h *6*	ε
		159	3/2−	−64.567	36 m *1*	ε
		160	0+	−66.06	28.58 h *9*	ε
		161	3/2−	−65.209	3.21 h *3*	ε
		162	0+	−66.343	**0.139%** ***5***	
		163	5/2−	−65.174	75.0 m *4*	ε
		164	0+	−65.950	**1.601%** ***3***	
		165	5/2−	−64.528	10.36 h *4*	ε
		166	0+	−64.932	**33.503%** ***36***	
		167	7/2+	−63.297	**22.869%** ***9***	
		167m	1/2−	−63.089	2.269 s *6*	IT
		168	0+	−62.997	**26.978%** ***18***	

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
68	**Er**	169	1/2−	−60.929	9.392 d *18*	β−
		170	0+	−60.115	**14.910%** ***36***	
		171	5/2−	−57.725	7.516 h *2*	β−
		172	0+	−56.489	49.3 h *3*	β−
		173	(7/2−)	−53.7s	1.4 m *1*	β−
		174	0+	−51.9s	3.2 m *2*	β−
		175	(9/2+)	−48.7s	1.2 m *3*	β−
		176	0+	−46.5s	=20 s	β−?
		177		−42.8s	=3 s	β−?
69	**Tm**	145	(11/2−)	−27.9s	3.1 μs *3*	p
		146	(5−)	−31.3s	80 ms *10*	p, ε
		146m	(8+)	−31.1s	200 ms *10*	p, ε
		147	11/2−	−36.4s	0.58 s *3*	ε 85%, p 15%
		148m	(10+)	−39.3s	0.7 s *2*	ε
		149	(11/2−)	−44.0s	0.9 s *2*	ε, εp 0.2%
		150	(6−)	−46.6s	2.2 s *2*	ε
		151	(11/2−)	−50.78	4.17 s *10*	ε
		151m	(1/2+)	−50.78	6.6 s *14*	ε
		152	(2)−	−51.77	8.0 s *10*	ε
		152m	(9)+	−51.77	5.2 s *6*	ε
		153	(11/2−)	−54.02	1.48 s *1*	α 91%, ε 9%
		153m	(1/2+)	−53.97	2.5 s *2*	α 92%, ε 8%
		154	(2−)	−54.43	8.1 s *3*	α 54%, ε 46%
		154m	(9+)	−54.43	3.30 s *7*	α 58%, ε 42%, IT
		155	11/2−	−56.64	21.6 s *2*	ε 99.11%, α 0.89%
		155m	1/2+	−56.59	45 s *3*	ε>98%, α<2%
		156	2−	−56.84	83.8 s *18*	ε 99.94%, α 0.06%
		157	1/2+	−58.71	3.63 m *9*	ε
		158	2−	−58.70	3.98 m *6*	ε
		158m	(5+)	−58.70	=20 s	IT?
		159	5/2+	−60.57	9.13 m *16*	ε
		160	1−	−60.30	9.4 m *3*	ε
		160m	5	−60.23	74.5 s *15*	IT 85%, ε 15%
		161	7/2+	−61.90	30.2 m *8*	ε
		162	1−	−61.48	21.70 m *19*	ε
		162m	5+	−61.48	24.3 s *17*	IT 82%, ε 18%
		163	1/2+	−62.735	1.810 h *5*	ε
		164	1+	−61.89	2.0 m *1*	ε, ε 39%
		164m	6−	−61.89	5.1 m *1*	IT=80%, ε=20%
		165	1/2+	−62.936	30.06 h *3*	ε
		166	2+	−61.89	7.70 h *3*	ε
		167	1/2+	−62.548	9.25 d *2*	ε
		168	3+	−61.318	93.1 d *2*	ε 99.99%, β− 0.01%
		169	1/2+	−61.280	**100%**	
		170	1−	−59.801	128.6 d *3*	β− 99.87%, ε 0.13%
		171	1/2+	−59.216	1.92 y *1*	β−
		172	2−	−57.380	63.6 h *2*	β−
		173	(1/2+)	−56.259	8.24 h *8*	β−
		174	(4)−	−53.87	5.4 m *1*	β−
		175	(1/2+)	−52.32	15.2 m *5*	β−
		176	(4+)	−49.4	1.9 m *1*	β−
		177m	(7/2−)	−47.5s	90 s *6*	β−≤100%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
69	**Tm**	178		−44.1s	=30 s	β−?
		179		−41.6s	=20 s	β−?
70	**Yb**	148	0+	−30.3s	=0.25 s	ε?
		149	(1/2+,3/2+)	−33.5s	0.7 s *2*	ε, εp=100%
		150	0+	−38.7s	>200 ns	ε?
		151	(1/2+)	−41.5	1.6 s *1*	ε, εp
		151m	(11/2−)	−41.5	1.6 s *1*	ε=100%, εp, IT?
		152	0+	−46.3	3.04 s *6*	ε, εp
		153	7/2−	−47.1s	4.2 s *2*	α 60%, ε 40%
		154	0+	−49.93	0.409 s *2*	α 92.6%, ε 7.4%
		155	(7/2−)	−50.50	1.793 s *19*	α 89%, ε 11%
		156	0+	−53.26	26.1 s *7*	ε 90%, α 10%
		157	7/2−	−53.44	38.6 s *10*	ε 99.5%, α 0.5%
		158	0+	−56.015	1.49 m *13*	ε, $\alpha=2.1\times10^{-3}$%
		159	5/2(−)	−55.84	1.67 m *9*	ε
		160	0+	−58.17	4.8 m *2*	ε
		161	3/2−	−57.84	4.2 m *2*	ε
		162	0+	−59.83	18.87 m *19*	ε
		163	3/2−	−59.30	11.05 m *35*	ε
		164	0+	−61.02	75.8 m *17*	ε
		165	5/2−	−60.29	9.9 m *3*	ε
		166	0+	−61.589	56.7 h *1*	ε
		167	5/2−	−60.594	17.5 m *2*	ε
		168	0+	−61.575	**0.13%** ***1***	
		169	7/2+	−60.370	32.018 d *5*	ε
		169m	1/2−	−60.346	46 s *2*	IT
		170	0+	−60.769	**3.04%** ***15***	
		171	1/2−	−59.312	**14.28%** ***57***	
		172	0+	−59.260	**21.83%** ***67***	
		173	5/2−	−57.556	**16.13%** ***27***	
		174	0+	−56.950	**31.83%** ***92***	
		175	(7/2−)	−54.701	4.185 d *1*	β−
		176	0+	−53.494	$\geq1.6\times10^{17}$ y	2β−
					12.76% ***41***	
		176m	(8)−	−52.444	11.4 s *3*	IT≥90%, β−≤10%
		177	(9/2+)	−50.989	1.911 h *3*	β−
		177m	(1/2−)	−50.658	6.41 s *2*	IT
		178	0+	−49.70	74 m *3*	β−
		179	(1/2−)	−46.4s	8.0 m *4*	β−
		180	0+	−44.4s	2.4 m *5*	β−
		181		−40.8s	1 m *sy*	β−?
71	**Lu**	150	(2+)	−24.9s	43 ms *5*	p 68%, ε 32%
		151	11/2−	−30.2s	80.6 ms *19*	p 63.4%, ε 36.6%
		152	(5−,6−)	−33.4s	0.7 s *1*	ε, εp 15%
		153	11/2−	−38.4	0.9 s *2*	α=70%, ε=30%
		154	(2−)	−39.6s	=2 s	ε?
		154m	(9+)	−39.6s	1.12 s *8*	ε=100%
		155	11/2−	−42.55	68 ms *1*	α 90%, ε 10%
		155m	1/2+	−42.53	138 ms *8*	α 76%, ε 24%
		156	(2)−	−43.75	494 ms *12*	α=95%, ε=5%
		156m	9+	−43.75	198 ms *2*	α
		157	(1/2+,3/2+)	−46.48	6.8 s *18*	α>0%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
71	**Lu**	157m	(11/2−)	−46.46	4.79 s *12*	ε 94%, α 6%
		158		−47.21	10.6 s *3*	ε 99.09%, α 0.91%
		159		−49.72	12.1 s *10*	ε , α 0.1%
		160		−50.27	36.1 s *3*	ε , α≤1.0×10^{-4}%
		160m		−50.27	40 s *1*	ε≤100%, α
		161	1/2+	−52.56	77 s *2*	ε
		161m	(9/2−)	−52.43	7.3 ms *4*	IT
		162	(1−)	−52.84	1.37 m *2*	ε≤100%
		162m	(4−)	−52.84	1.5 m	ε≤100%
		162m		−52.84	1.9 m	ε≤100%
		163	1/2(+)	−54.79	3.97 m *13*	ε
		164	1	−54.64	3.14 m *3*	ε
		165	1/2+	−56.44	10.74 m *10*	ε
		166	(6−)	−56.02	2.65 m *10*	ε
		166m	(3−)	−55.99	1.41 m *10*	ε 58%, IT 42%
		166m	(0−)	−55.98	2.12 m *10*	ε>80%, IT<20%
		167	7/2+	−57.50	51.5 m *10*	ε
		167m	1/2+	−57.50	≥1 m	ε , IT
		168	(6−)	−57.06	5.5 m *1*	ε
		168m	3+	−56.84	6.7 m *4*	ε>95%, IT<5%
		169	7/2+	−58.077	34.06 h *5*	ε
		169m	1/2−	−58.048	160 s *10*	IT
		170	0+	−57.31	2.012 d *20*	ε
		170m	(4)−	−57.22	0.67 s *10*	IT
		171	7/2+	−57.833	8.24 d *3*	ε
		171m	1/2−	−57.762	79 s *2*	IT
		172	4−	−56.741	6.70 d *3*	ε
		172m	1−	−56.699	3.7 m *5*	IT
		173	7/2+	−56.886	1.37 y *1*	ε
		174	(1)−	−55.575	3.31 y *5*	ε
		174m	(6)−	−55.404	142 d *2*	IT 99.38%, ε 0.62%
		175	7/2+	−55.171	**97.41% *2***	
		176	7−	−53.387	3.76×10^{10} y *7*	β−
					2.59% *2*	
		176m	1−	−53.264	3.664 h *19*	β− 99.91%, ε 0.1%
		177	7/2+	−52.389	6.6475 d *20*	β−
		177m	23/2−	−51.419	160.44 d *6*	β− 78.6%, IT 21.4%
		177m	(39/2−)	−49.689	6 m *+3−2*	β−≤100%, IT
		178	1(+)	−50.343	28.4 m *2*	β−
		178m	(9−)	−50.223	23.1 m *3*	β−
		179	7/2(+)	−49.064	4.59 h *6*	β−
		180	5+	−46.69	5.7 m *1*	β−
		181	(7/2+)	−44.7s	3.5 m *3*	β−
		182	(0,1,2)	−41.9s	2.0 m *2*	β−
		183	(7/2+)	−39.5s	58 s *4*	β−
		184	(3+)	−36.4s	20 s *3*	β−
72	**Hf**	153		−27.3s	>60 ns	ε ?
		154	0+	−32.7s	2 s *1*	ε=100%, α=0%
		155		−34.1s	0.89 s *12*	ε
		156	0+	−37.9	23 ms *1*	α
		157	7/2−	−38.8s	110 ms *6*	α 86%, ε 14%
		158	0+	−42.10	2.85 s *7*	ε 55.7%, α 44.3%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
72	**Hf**	159	7/2−	−42.85	5.6 s *4*	ε 65%, α 35%
		160	0+	−45.94	13.6 s *2*	ε 99.3%, α 0.7%
		161		−46.32	18.2 s *5*	ε>99.87%, α<0.13%
		162	0+	−49.173	39.4 s *9*	ε 99.99%, α 8.0×10^{-3}%
		163		−49.29	40.0 s *6*	ε , α<1.0×10^{-4}%
		164	0+	−51.82	111 s *8*	ε
		165	(5/2−)	−51.64	76 s *4*	ε
		166	0+	−53.86	6.77 m *30*	ε
		167	(5/2)−	−53.47	2.05 m *5*	ε
		168	0+	−55.36	25.95 m *20*	ε
		169	(5/2)−	−54.72	3.24 m *4*	ε
		170	0+	−56.25	16.01 h *13*	ε
		171	7/2(+)	−55.43	12.1 h *4*	ε
		171m	1/2(−)	−55.41	29.5 s *9*	IT≤100%, ε
		172	0+	−56.40	1.87 y *3*	ε
		173	1/2−	−55.41	23.6 h *1*	ε
		174	0+	−55.847	2.0×10^{15} y *4* **0.16%** ***1***	α
		175	5/2(−)	−54.484	70 d *2*	ε
		176	0+	−54.577	**5.26%** ***7***	
		177	7/2−	−52.890	**18.60%** ***9***	
		177m	23/2+	−51.574	1.09 s *5*	IT
		177m	37/2−	−50.150	51.4 m *5*	IT
		178	0+	−52.444	**27.28%** ***7***	
		178m	8−	−51.297	4.0 s *2*	IT
		178m	16+	−49.998	31 y *1*	IT
		179	9/2+	−50.472	**13.62%** ***2***	
		179m	1/2−	−50.097	18.67 s *4*	IT
		179m	25/2−	−49.366	25.05 d *25*	IT
		180	0+	−49.788	**35.08%** ***16***	
		180m	8−	−48.647	5.47 h *4*	IT 99.7%, β− 0.3%
		181	1/2−	−47.412	42.39 d *6*	β−
		182	0+	−46.059	8.90×10^{6} y *9*	β−
		182m	8−	−44.886	61.5 m *15*	β− 58%, IT 42%
		183	(3/2−)	−43.29	1.067 h *17*	β−
		184	0+	−41.50	4.12 h *5*	β−
		184m	8−	−40.23	48 s *10*	β−
		185		−38.4s	3.5 m *6*	β−
		186	0+	−36.4s	2.6 m *12*	β−
		187		−33.0s	30 s *sy*	β−?
		188	0+	−30.9s	20 s *sy*	β−
73	**Ta**	155m	11/2−	−23.7s	12 μs *+4−3*	p
		156	(2−)	−25.8s	144 ms *24*	p=100%, ε
		156m	9+	−25.7s	0.36 s *4*	ε 95.8%, p 4.2%
		157	1/2+	−29.6	10.1 ms *4*	α 96.6%, p 3.4%
		157m	11/2−	−29.6	4.3 ms *1*	α
		157m	(25/2−)	−28.0	1.7 ms *1*	α
		158	(2−)	−31.0s	55 ms *15*	α=91%, ε=9%
		158m	(9+)	−30.9s	36.7 ms *15*	α 95%, ε 5%
		159	(1/2−)	−34.45	0.83 s *18*	ε 66%, α 34%
		159m	(11/2−)	−34.38	515 ms *20*	α 55%, ε 45%

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73	**Ta**	160		–35.88	1.55 s *4*	ε 66%, α 34%
		160m		–35.88	1.7 s *2*	α?
		161		–38.73s	2.89 s *12*	ε 95%, α?
		162		–39.78	3.57 s *12*	ε 99.93%, α 0.07%
		163		–42.54	10.6 s *18*	ε=99.8%, α=0.2%
		164	(3+)	–43.28	14.2 s *3*	ε
		165		–45.86	31.0 s *15*	ε
		166	(2)+	–46.10	34.4 s *5*	ε
		167	(3/2+)	–48.35	80 s *4*	ε
		168	(2–,3+)	–48.39	2.0 m *1*	ε
		169	(5/2+)	–50.29	4.9 m *4*	ε
		170	(3+)	–50.14	6.76 m *6*	ε
		171	(5/2–)	–51.72	23.3 m *3*	ε
		172	(3+)	–51.33	36.8 m *3*	ε
		173	5/2–	–52.40	3.14 h *13*	ε
		174	3+	–51.74	1.14 h *8*	ε
		175	7/2+	–52.41	10.5 h *2*	ε
		176	(1)–	–51.37	8.09 h *5*	ε
		177	7/2+	–51.724	56.56 h *6*	ε
		178	1+	–50.51	9.31 m *3*	ε
		178	(7)–	–50.51	2.36 h *8*	ε
		179	7/2+	–50.366	1.82 y *3*	ε
		180	1+	–48.936	8.154 h *6*	ε 86%, β– 14%
		180m	9–	–48.859	$>1.2\times10^{15}$ y	2ε ?
		181	7/2+	–48.442	**99.988% *2***	
		182	3–	–46.433	114.43 d *3*	β–
		182m	5+	–46.417	283 ms *3*	IT
		182m	10–	–45.913	15.84 m *10*	IT
		183	7/2+	–45.296	5.1 d *1*	β–
		184	(5–)	–42.84	8.7 h *1*	β–
		185	(7/2+)	–41.40	49.4 m *15*	β–
		186	(2–,3–)	–38.61	10.5 m *3*	β–
		186m		–38.61	1.54 m *5*	β–
		187		–36.8s	≈2 m	β–?
		188		–33.8s	≈20 s	β–
		189	(7/2+)	–31.8s	3 s *sy*	β–?
		190		–28.7s	0.3 s *sy*	β–?
74	**W**	158	0+	–23.7s	1.25 ms *21*	α
		159		–25.2s	7.3 ms *27*	α=99.9%, ε=0.1%
		160	0+	–29.4	91 ms *5*	α 87%
		161		–30.4s	409 ms *18*	α 73%
		162	0+	–34.00	1.36 s *7*	ε 54.8%, α 45.2%
		163		–34.91	2.8 s *2*	ε 87%, α 13%
		164	0+	–38.23	6.3 s *2*	ε 96.2%, α 3.8%
		165	(5/2–)	–38.86	5.1 s *5*	ε , α<0.2%
		166	0+	–41.89	19.2 s *6*	ε 99.97%, α 0.04%
		167	(+)	–42.09	19.9 s *5*	ε 99.96%, α 0.04%
		168	0+	–44.89	53 s *2*	ε=100%, α 3.2×10^{-3}%
		169	(5/2–)	–44.92	74 s *6*	ε
		170	0+	–47.29	2.42 m *4*	ε
		171	(5/2–)	–47.09	2.38 m *4*	ε

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74	**W**	172	0+	–49.10	6.6 m *9*	ε
		173	5/2–	–48.73	7.6 m *2*	ε
		174	0+	–50.23	33.2 m *21*	ε
		175	(1/2–)	–49.63	35.2 m *6*	ε
		176	0+	–50.64	2.5 h *1*	ε
		177	1/2–	–49.70	132 m *2*	ε
		178	0+	–50.42	21.6 d *3*	ε
		179	(7/2)–	–49.30	37.05 m *16*	ε
		179m	(1/2)–	–49.08	6.40 m *7*	IT 99.72%, ε 0.28%
		180	0+	–49.645	1.8×10^{18} y *2*	α
					0.12% ***1***	
		181	9/2+	–48.254	121.2 d *2*	ε
		182	0+	–48.248	$>8.3\times10^{18}$ y	α
					26.50% ***16***	
		183	1/2–	–46.367	$>1.3\times10^{19}$ y	α
					14.31% ***4***	
		183m	11/2+	–46.057	5.2 s *3*	IT
		184	0+	–45.707	$>2.9\times10^{19}$ y	α
					30.64% ***2***	
		185	3/2–	–43.390	75.1 d *3*	β–
		185m	11/2+	–43.192	1.67 m *3*	IT
		186	0+	–42.509	$>2.7\times10^{19}$ y	α
					28.43% ***19***	
		187	3/2–	–39.905	23.72 h *6*	β–
		188	0+	–38.667	69.78 d *5*	β–
		189	(3/2–)	–35.5	10.7 m *5*	β–
		190	0+	–34.3	30.0 m *15*	β–
		191		–31.1s	>300 ns	β–?
		192	0+	–29.6s	>300 ns	β–?
75	**Re**	160	(2–)	–16.7s	0.82 ms *+15–9*	p 91%, α 9%
		161	1/2+	–20.9	0.37 ms *4*	p
		161m	11/2–	–20.8	15.6 ms *9*	α 95.2%, p 4.8%
		162	(2–)	–22.4s	107 ms *13*	α 94%, ε 6%
		162m	(9+)	–22.2s	77 ms *9*	α 91%, ε 9%
		163	(1/2+)	–26.01	390 ms *72*	ε 68%, α 32%
		163m	(11/2–)	–25.89	214 ms *5*	α 66%, ε 34%
		164		–27.6s	0.53 s *23*	α=58%, ε=42%
		165	(1/2+)	–30.66	=1 s	ε , α
		165m	(11/2–)	–30.61	2.1 s *3*	ε 87%, α 13%
		166		–31.85s	2.8 s *3*	α≥8%
		167	(9/2–)	–34.84s	5.9 s *3*	ε=99%, α=1%
		167m		–34.84s	3.4 s *4*	α=100%
		168	(5+,6+,7+)	–35.79	4.4 s *1*	ε=100%, $\alpha=5.0\times10^{-3}$%
		169	(9/2–)	–38.39	8.1 s *5*	ε , α<0.01%
		169m		–38.39	15.1 s *15*	α=0.2%
		170	(5+)	–38.92	9.2 s *2*	ε
		171	(9/2–)	–41.25	15.2 s *4*	ε
		172m	(5)	–41.52	15 s *3*	ε
		172m	(2)	–41.52	55 s *5*	ε
		173	(5/2–)	–43.55	1.98 m *26*	ε
		174		–43.67	2.40 m *4*	ε

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75	**Re**	175	(5/2−)	−45.29	5.89 m *5*	ε
		176	3+	−45.06	5.3 m *3*	ε
		177	5/2−	−46.27	14 m *1*	ε
		178	(3+)	−45.65	13.2 m *2*	ε
		179	(5/2)+	−46.59	19.5 m *1*	ε
		180	(1)−	−45.84	2.44 m *6*	ε
		181	5/2+	−46.51	19.9 h *7*	ε
		182	7+	−45.4	64.0 h *5*	ε
		182m	2+	−45.4	12.7 h *2*	ε
		183	5/2+	−45.811	70.0 d *14*	ε
		184	3(−)	−44.227	38.0 d *5*	ε
		184m	8(+)	−44.039	169 d *8*	IT 75.4%, ε 24.6%
		185	5/2+	−43.822	**37.40% *2***	
		186	1−	−41.930	3.7186 d *5*	β− 92.53%, ε 7.47%
		186m	(8+)	−41.781	2.0×10^{5} y	IT
		187	5/2+	−41.216	4.12×10^{10} y *11* **62.60% *2***	β−, α<1.0×10^{-4}%
		188	1−	−39.016	17.003 h *3*	β−
		188m	(6)−	−38.844	18.59 m *4*	IT
		189	5/2+	−37.978	24.3 h *4*	β−
		190	(2)−	−35.6	3.1 m *3*	β−
		190m	(6−)	−35.4	3.2 h *2*	β− 54.4%, IT 45.6%
		191	(3/2+,1/2+)	−34.35	9.8 m *5*	β−
		192		−31.7s	16 s *1*	β−
		193		−30.3s	30 s *sy*	β−?
		194		−27.6s	>300 ns	β−
76	**Os**	162	0+	−14.5s	1.9 ms *2*	α
		163		−16.1s	5.5 ms *6*	α=100%, ε
		164	0+	−20.5	21 ms *1*	α 98%, ε 2%
		165	(7/2−)	−21.6s	71 ms *3*	α>60%, ε<40%
		166	0+	−25.44	181 ms *38*	α 72%, ε 18%
		167		−26.50	0.81 s *6*	α 57%, ε 43%
		168	0+	−29.99	2.1 s *1*	α 40%, ε
		169		−30.72	3.40 s *9*	ε 88.8%, α 11.2%
		170	0+	−33.93	7.46 s *23*	ε 91.4%, α 8.6%
		171	(5/2−)	−34.29	8.3 s *2*	ε 98.2%, α 1.8%
		172	0+	−37.24	19.2 s *5*	α 1.1%, ε
		173	(5/2−)	−37.44	22.4 s *9*	α 0.4%, ε
		174	0+	−40.00	44 s *4*	ε 99.98%, α 0.02%
		175	(5/2−)	−40.10	1.4 m *1*	ε
		176	0+	−42.10	3.6 m *5*	ε
		177	1/2−	−41.95	3.0 m *2*	ε
		178	0+	−43.55	5.0 m *4*	ε
		179	(1/2−)	−43.02	6.5 m *3*	ε
		180	0+	−44.36	21.5 m *4*	ε
		181	1/2−	−43.55	105 m *3*	ε
		181m	7/2−	−43.50	2.7 m *1*	ε=100%, IT≤3%
		182	0+	−44.61	22.10 h *25*	ε
		183	9/2+	−43.66	13.0 h *5*	ε
		183m	1/2−	−43.49	9.9 h *3*	ε 85%, IT 15%
		184	0+	−44.256	$>5.6\times10^{13}$ y **0.02% *1***	α

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76	**Os**	185	1/2−	−42.809	93.6 d *5*	ε
		186	0+	−43.000	2.0×10^{15} y *11*	α
					1.59% *3*	
		187	1/2−	−41.218	**1.6% *3***	
		188	0+	−41.136	**13.29% *8***	
		189	3/2−	−38.985	**16.21% *5***	
		189m	9/2−	−38.955	5.81 h *6*	IT
		190	0+	−38.706	**26.36% *2***	
		190m	(10)−	−37.001	9.9 m *1*	IT
		191	9/2−	−36.394	15.4 d *1*	β−
		191m	3/2−	−36.320	13.10 h *5*	IT
		192	0+	−35.881	**40.93% *19***	
		192m	(10−)	−33.865	5.9 s *1*	IT>87%, β−<13%
		193	3/2−	−33.393	30.11 h *1*	β−
		194	0+	−32.433	6.0 y *2*	β−
		195		−29.7	≈9 m	β−?
		196	0+	−28.28	34.9 m *2*	β−
		197			2.8 m *6*	β−
77	**Ir**	164	(9+)	−7.3s	0.11 ms *+6−3*	p
		165	(1/2+)	−11.6s	<1 μs	p?, α?
		166	(2−)	−13.2s	10.5 ms *22*	α 93.1%, p 6.9%
		166m	(9+)	−13.0s	15.1 ms *9*	α 98.2%, p 1.8%
		167	1/2+	−17.08	35.2 ms *20*	α 48%, p 32%, ε 20%
		167m	11/2−	−16.90	25.7 ms *8*	α 80%, ε 20%, p 0.4%
		168		−18.7s	0.161 ms *21*	α 82%
		169	(1/2+)	−22.08	0.64 s *+46−24*	α 50%, ε, p
		169m	(11/2−)	−21.93	0.308 s *22*	α 81%
		170		−23.3s	0.87 s *+18−12*	ε 94.8%, α 5.2%
		170m		−23.3s	0.44 s *6*	ε≤64%, IT≤64%, α 36%
		171	(1/2+)	−26.43	3.2 s *+13−7*	ε, α>0%, p
		171m	(11/2−)	−26.43	1.40 s *10*	α 58%, ε≤42%, p≤42%
		172	(3+)	−27.5s	4.4 s *3*	ε 98%, α=2%
		172m	(7+)	−27.4s	2.0 s *1*	ε 77%, α 23%
		173m	(11/2−)	−30.27	2.4 s *9*	α 7%, ε
		173m	3/2+,5/2+	−30.27	9.0 s *8*	ε>93%, α<7%
		174	(3+)	−30.87	7.9 s *6*	ε 99.5%, α 0.5%
		174m	(7+)	−30.68	4.9 s *3*	ε 97.5%, α 2.5%
		175	(5/2−)	−33.43	9 s *2*	ε 99.15%, α 0.85%
		176		−33.86	8.3 s *6*	ε 96.9%, α 3.1%
		177	5/2−	−36.05	30 s *2*	ε 99.94%, α 0.06%
		178		−36.25	12 s *2*	ε
		179	(5/2)−	−38.08	79 s *1*	ε
		180	(4,5)	−37.98	1.5 m *1*	ε
		181	5/2−	−39.47	4.90 m *15*	ε
		182	(5+)	−39.05	15 m *1*	ε
		183	5/2−	−40.20	57 m *4*	ε
		184	5−	−39.61	3.09 h *3*	ε
		185	5/2−	−40.34	14.4 h *1*	ε
		186	5+	−39.17	16.64 h *3*	ε
		186m	2−	−39.17	1.90 h *5*	ε=75%, IT=25%

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77	**Ir**	187	3/2+	–39.716	10.5 h *3*	ε
		188	1–	–38.328	41.5 h *5*	ε
		189	3/2+	–38.45	13.2 d *1*	ε
		190	4–	–36.751	11.78 d *10*	ε , ε<2.0×10^{-3}%
		190m	(1–)	–36.725	1.120 h *3*	IT
		190m	(11)–	–36.375	3.087 h *12*	ε 91.4%, IT 8.6%
		191	3/2+	–36.706	**37.3%** ***2***	
		191m	11/2–	–36.535	4.94 s *3*	IT
		191m		–34.659	5.5 s *7*	IT
		192	4+	–34.833	73.827 d *13*	β– 95.13%, ε 4.87%
		192m	1–	–34.777	1.45 m *5*	IT 99.98%, β– 0.02%
		192m	(11–)	–34.665	241 y *9*	IT
		193	3/2+	–34.534	**62.7%** ***2***	
		193m	11/2–	–34.454	10.53 d *4*	IT
		194	1–	–32.529	19.28 h *13*	β–
		194m	(10,11)	–32.339	171 d *11*	β–
		195	3/2+	–31.690	2.5 h *2*	β–
		195m	11/2–	–31.590	3.8 h *2*	β– 95%, IT 5%
		196	(0–)	–29.44	52 s *1*	β–
		196m	(10,11–)	–29.03	1.40 h *2*	β– = 100%, IT<0.3%
		197	3/2+	–28.27	5.8 m *5*	β–
		197m	11/2–	–28.15	8.9 m *3*	β– 99.75%, IT 0.25%
		198		–25.8s	8 s *1*	β–
		199		–24.40	20 s *sy*	β–
78	**Pt**	166	0+	–4.8s	300 μs *100*	α
		167		–6.5s	0.9 ms *3*	α
		168	0+	–11.0	2.1 ms *2*	α≤100%
		169		–12.4s	7.0 ms *2*	α=100%
		170	0+	–16.31	14.0 ms *2*	α
		171		–17.47	51 ms *2*	α=98%, ε 2%
		172	0+	–21.10	104 ms *7*	α 94%, ε 6%
		173		–21.94	370 ms *13*	α 83%, ε
		174	0+	–25.32	0.889 s *17*	α 76%, ε 24%
		175	(7/2–)	–25.69	2.53 s *6*	α 64%, ε 36%
		176	0+	–28.93	6.33 s *15*	ε 62%, α 38%
		177	5/2–	–29.37	10.6 s *4*	ε 94.3%, α 5.7%
		178	0+	–32.00	21.1 s *6*	ε 92.3%, α 7.7%
		179	1/2–	–32.264	21.2 s *4*	ε 99.76%, α 0.24%
		180	0+	–34.44	56 s *2*	ε , α=0.3%
		181	1/2–	–34.37	52.0 s *22*	ε , α=0.08%
		182	0+	–36.17	3.0 m *2*	ε 99.96%, α 0.04%
		183	1/2–	–35.77	6.5 m *10*	ε , α=1.3×10^{-3}%
		183m	(7/2)–	–35.74	43 s *5*	ε=100%, α<4.0×10^{-4}% , IT
		184	0+	–37.33	17.3 m *2*	ε , α=0.001%
		185	9/2+	–36.68	70.9 m *24*	ε
		185m	1/2–	–36.58	33.0 m *8*	ε 99%, IT<2%
		186	0+	–37.86	2.08 h *5*	ε , α=1.4×10^{-4}%
		187	3/2–	–36.71	2.35 h *3*	ε
		188	0+	–37.823	10.2 d *3*	ε , α 2.6×10^{-5}%
		189	3/2–	–36.48	10.87 h *12*	ε

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
78	**Pt**	190	0+	–37.323	6.5×10^{11} y *3*	α
					0.014% ***1***	
		191	3/2–	–35.698	2.862 d *7*	ε
		192	0+	–36.293	**0.782%** ***7***	
		193	1/2–	–34.477	50 y *6*	ε
		193m	13/2+	–34.327	4.33 d *3*	IT
		194	0+	–34.763	**32.967%** ***99***	
		195	1/2–	–32.797	**33.832%** ***10***	
		195m	13/2+	–32.537	4.010 d *5*	IT
		196	0+	–32.647	**25.242%** ***41***	
		197	1/2–	–30.422	19.8915 h *19*	β–
		197m	13/2+	–30.023	95.41 m *18*	IT 96.7%, β– 3.3%
		198	0+	–29.908	**7.163%** ***55***	
		199	5/2–	–27.392	30.80 m *21*	β–
		199m	(13/2)+	–26.968	13.6 s *4*	IT
		200	0+	–26.60	12.5 h *3*	β–
		201	(5/2–)	–23.74	2.5 m *1*	β–
		202	0+	–22.6s	44 h *15*	β–
79	**Au**	169		–1.8s	150 μs *sy*	α?, p?
		170	(2–)	–3.6s	286 μs *+50–40*	p 89%, α 11%
		171	(1/2+)	–7.56	22 μs *+3–2*	p=100%
		171m	(11/2–)	–7.31	1.09 ms *3*	α 66%, p 36%
		172		–9.3s	6.3 ms *15*	α≤100%, p<2%
		173	(1/2+)	–12.82	25 ms *1*	α 94%, ε, p
		173m	(11/2–)	–12.61	14.0 ms *9*	α 92%, ε, p
		174		–14.2s	139 ms *3*	α>0%
		175	(1/2+)	–17.44	0.1 s *sy*	α?, ε?
		175m	(11/2–)	–17.44	156 ms *5*	α 94%, ε 6%
		176		–18.5s	0.84 s *+17–14*	α, ε
		177	(1/2+,3/2+)	–21.55	1462 ms *32*	α≤100%, ε
		177m	11/2–	–21.39	1180 ms *12*	α≤100%, ε
		178		–22.33	2.6 s *5*	ε≤60%, α≥40%
		179		–24.95	3.3 s *13*	ε 78%, α 22%
		180		–25.60	8.1 s *3*	ε≤98.2%, α≥1.8%
		181	(3/2–)	–27.87	13.7 s *14*	ε 97.3%, α 2.7%
		182		–28.30	15.6 s *4*	ε 99.87%, α 0.13%
		183	(5/2)–	–30.19	42.8 s *10*	ε 99.45%, α 0.55%
		184	5+	–30.32	20.6 s *9*	α≤0.02%, ε
		184m	2+	–30.25	47.6 s *14*	ε 70%, IT 30%, α≤0.02%
		185	5/2–	–31.87	4.25 m *6*	ε 99.74%, α 0.26%
		185m		–31.87	6.8 m *3*	ε<100%, IT
		186	3–	–31.71	10.7 m *5*	ε, α 8.0×10^{-4}%
		187	1/2+	–33.01	8.4 m *3*	ε, α 3.0×10^{-3}%
		187m	9/2–	–32.88	2.3 s *1*	IT
		188	1(–)	–32.30	8.84 m *6*	ε
		189	1/2+	–33.58	28.7 m *3*	ε, α<3.0×10^{-5}%
		189m	11/2–	–33.33	4.59 m *11*	ε
		190	1–	–32.88	42.8 m *10*	ε, α<1.0×10^{-6}%
		190m	(11–)	–32.88	125 ms *20*	IT=100%
		191	3/2+	–33.81	3.18 h *8*	ε
		191m	(11/2–)	–33.54	0.92 s *11*	IT

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
79	**Au**	192	1−	−32.78	4.94 h *9*	ε
		192m	(11−)	−32.34	160 ms *20*	IT
		193	3/2+	−33.39	17.65 h *15*	ε
		193m	11/2−	−33.10	3.9 s *3*	IT 99.97%, ε=0.03%
		194	1−	−32.26	38.02 h *10*	ε
		194m	(5+)	−32.15	600 ms *8*	IT
		194m	(11−)	−31.79	420 ms *10*	IT
		195	3/2+	−32.570	186.098 d *47*	ε
		195m	11/2−	−32.251	30.5 s *2*	IT
		196	2−	−31.140	6.1669 d *6*	ε 92.8%, β− 7.2%
		196m	5+	−31.055	8.1 s *2*	IT
		196m	12−	−30.544	9.6 h *1*	IT
		197	3/2+	−31.141	**100%**	
		197m	11/2−	−30.732	7.73 s *6*	IT
		198	2−	−29.582	2.6956 d *3*	β−
		198m	(12−)	−28.770	2.27 d *2*	IT
		199	3/2+	−29.095	3.139 d *7*	β−
		200	1(−)	−27.27	48.4 m *3*	β−
		200m	12−	−26.31	18.7 h *5*	β− 82%, IT 18%
		201	3/2+	−26.401	26 m *1*	β−
		202	(1−)	−24.4	28.8 s *19*	β−
		203	(3/2+)	−23.143	60 s *6*	β−
		204	(2−)	−20.8s	39.8 s *9*	β−
		205	(3/2+)	−18.8s	31 s *2*	β−
80	**Hg**	171		3.5s	59 μs *+36−16*	α=100%
		172	0+	−1.1	0.25 ms *+35−9*	α
		173		−2.6s	0.6 ms *+5−2*	α=100%
		174	0+	−6.65	2.1 ms *+18−7*	α 99.6%
		175	(7/2−,9/2−)	−8.0	10.8 ms *4*	α
		176	0+	−11.78	20 ms *2*	α=100%
		177	(13/2+)	−12.78	127.3 ms *18*	α 85%, ε 15%
		178	0+	−16.32	0.269 s *3*	α=70%, ε=30%
		179		−16.92	1.08 s *9*	α=53%, ε=47%, εp=0.15%
		180	0+	−20.24	2.58 s *1*	ε 52%, α 48%
		181	1/2−	−20.66	3.6 s *1*	ε 73%, α 27%, εp 0.01%, εα 9.0×10^{-6}%
		182	0+	−23.576	10.83 s *6*	ε 84.8%, α 15.2%
		183	1/2−	−23.800	9.4 s *7*	ε 88.3%, α 11.7%, εp 2.6×10^{-4}%
		184	0+	−26.35	30.9 s *3*	ε 98.89%, α 1.11%
		185	1/2−	−26.18	49.1 s *10*	ε 94%, α 6%
		185m	13/2+	−26.08	21.6 s *15*	IT 54%, ε 46%, α=0.03%
		186	0+	−28.54	1.38 m *6*	ε 99.98%, α 0.02%
		187	13/2+	−28.12	2.4 m *3*	ε , $\alpha>1.2\times10^{-4}$%
		187m	3/2−	−28.12	1.9 m *3*	ε , $\alpha>2.5\times10^{-4}$%
		188	0+	−30.20	3.25 m *15*	ε , $\alpha\ 3.7\times10^{-5}$%
		189	3/2−	−29.63	7.6 m *1*	ε , $\alpha<3.0\times10^{-5}$%
		189m	13/2+	−29.63	8.6 m *1*	ε , $\alpha<3.0\times10^{-5}$%
		190	0+	−31.37	20.0 m *5*	ε , $\alpha<3.4\times10^{-7}$%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
80	**Hg**	191	(3/2−)	−30.59	49 m *10*	ε
		191m	13/2+	−30.59	50.8 m *15*	ε
		192	0+	−32.01	4.85 h *20*	ε
		193	3/2−	−31.05	3.80 h *15*	ε
		193m	13/2+	−30.91	11.8 h *2*	ε 92.8%, IT 7.2%
		194	0+	−32.19	444 y *77*	ε
		195	1/2−	−31.00	10.53 h *3*	ε
		195m	13/2+	−30.82	41.6 h *8*	IT 54.2%, ε 45.8%
		196	0+	−31.827	**0.15%** ***1***	
		197	1/2−	−30.541	64.14 h *5*	ε
		197m	13/2+	−30.242	23.8 h *1*	IT 91.4%, ε 8.6%
		198	0+	−30.954	**9.97%** ***20***	
		199	1/2−	−29.547	**16.87%** ***22***	
		199m	13/2+	−29.015	42.67 m *9*	IT
		200	0+	−29.504	**23.10%** ***19***	
		201	3/2−	−27.663	**13.18%** ***9***	
		202	0+	−27.346	**29.86%** ***26***	
		203	5/2−	−25.269	46.595 d *6*	β−
		204	0+	−24.690	**6.87%** ***15***	
		205	1/2−	−22.288	5.14 m *9*	β−
		206	0+	−20.95	8.15 m *10*	β−
		207	(9/2+)	−16.2	2.9 m *2*	β−
		208	0+	−13.1s	41 m *+5−4*	β−
		209		−8.3s	37 s *8*	β−
		210	0+	−5.1s	>300 ns	β−?
81	**Tl**	176	(3−,4−,5−)	1.4s	5.2 ms *+30−14*	p=100%
		177	(1/2+)	−3.33	18 ms *5*	α 73%, p 27%
		178		−4.8s	=60 ms	α?, ε?
		179	(1/2+)	−8.30	0.42 s *6*	α<100%, ε
		179m	(11/2−)	−8.30	1.7 ms *2*	α≤100%, IT, ε
		180		−9.4s	1.5 s *2*	α 7%, εSF=1.0×10^{-4}%, ε
		181	1/2+	−12.801	1.4 ms *5*	ε, α≤10%
		181m	9/2−	−11.951	3.2 s *3*	α
		182	(7+)	−13.35	3.1 s *10*	ε>96%, α<4%
		183	(1/2+)	−16.587	6.9 s *7*	ε>0%, α
		183m	(9/2−)	−15.957	53.3 ms *3*	α 2%, ε, IT
		184	(2+)	−16.89	11 s *1*	ε 97.9%, α 2.1%
		185	(1/2+)	−19.76	19.5 s *5*	ε
		185m	(9/2−)	−19.30	1.93 s *8*	IT, α
		186m	(7+)	−20.2	27.5 s *10*	ε, α=6.0×10^{-3}%
		186m	(10−)	−19.8	2.9 s *2*	IT
		187	(1/2+)	−22.444	=51 s	ε<100%, α>0%
		187m	(9/2−)	−22.108	15.60 s *12*	ε<99.9%, IT<99.9%, α 0.15%
		188m	(2−)	−22.35	71 s *2*	ε
		188m	(7+)	−22.35	71 s *1*	ε
		189	(1/2+)	−24.60	2.3 m *2*	ε
		189m	(9/2−)	−24.34	1.4 m *1*	ε<100%, IT<4%
		190m	2(−)	−24.33	2.6 m *3*	ε
		190m	7(+)	−24.33	3.7 m *3*	ε
		191	(1/2+)	−26.281	?	ε?

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
81	**Tl**	191m	9/2(−)	−25.982	5.22 m *16*	ε
		192	(2−)	−25.87	9.6 m *4*	ε
		192m	(7+)	−25.72	10.8 m *2*	ε
		193	1/2+	−27.3	21.6 m *8*	ε
		193m	9/2−	−27.0	2.11 m *15*	IT≤75%, ε≤25%
		194	2−	−26.8	33.0 m *5*	ε , α<1.0×10^{-7}%
		194m	(7+)	−26.8	32.8 m *2*	ε
		195	1/2+	−28.16	1.16 h *5*	ε
		195m	9/2−	−27.67	3.6 s *4*	IT
		196	2−	−27.50	1.84 h *3*	ε
		196m	(7+)	−27.10	1.41 h *2*	ε 95.5%, IT 4.5%
		197	1/2+	−28.34	2.84 h *4*	ε
		197m	9/2−	−27.73	0.54 s *1*	IT
		198	2−	−27.49	5.3 h *5*	ε
		198m	7+	−26.95	1.87 h *3*	ε 54%, IT 46%
		199	1/2+	−28.06	7.42 h *8*	ε
		200	2−	−27.048	26.1 h *1*	ε
		201	1/2+	−27.18	72.912 h *17*	ε
		202	2−	−25.98	12.23 d *2*	ε
		203	1/2+	−25.761	**29.524%** ***14***	
		204	2−	−24.346	3.78 y *2*	β− 97.1%, ε 2.9%
		205	1/2+	−23.821	**70.476%** ***14***	
		206	0−	−22.253	4.200 m *17*	β−
		206m	(12−)	−19.610	3.74 m *3*	IT
		207	1/2+	−21.034	4.77 m *2*	β−
		207m	11/2−	−19.686	1.33 s *11*	IT
		208	5(+)	−16.750	3.053 m *4*	β−
		209	(1/2+)	−13.638	2.161 m *7*	β−
		210	(5+)	−9.25	1.30 m *3*	β−, β−n 7.0×10^{-3}%
		211		−6.1s	>300 ns	β−?
		212		−1.7s	>300 ns	β−?
82	**Pb**	178	0+	3.57	0.23 ms *15*	α, ε?
		179		2.0s	3 ms *sy*	α?
		180	0+	−1.94	4.5 ms *11*	α≤100%
		181m	(13/2+)	−3.14	45 ms *20*	α<100%
		182	0+	−6.83	55 ms *+40−35*	α≤100%
		183	(3/2−)	−7.57	535 ms *30*	α=90%
		183m	(13/2+)	−7.47	415 ms *20*	α=100%
		184	0+	−11.05	490 ms *25*	ε 77%, α 23%
		185m	13/2+	−11.54	4.24 s *17*	α=50%, ε?
		185m	3/2−	−11.54	6.3 s *4*	α=50%, ε?
		186	0+	−14.68	4.82 s *3*	ε 60%, α 40%
		187	(3/2−)	−14.980	15.2 s *3*	ε 93%, α 7%
		187m	(13/2+)	−14.899	18.3 s *3*	ε 88%, α 12%
		188	0+	−17.82	25.1 s *1*	ε 90.7%, α 9.3%
		189	(3/2−)	−17.88	51 s *3*	ε>99%, α=0.4%
		190	0+	−20.42	71 s *1*	ε 99.6%, α 0.4%
		191	(3/2−)	−20.25	1.33 m *8*	ε 99.99%, α 0.01%
		191m	(13/2+)	−20.11	2.18 m *8*	ε , α=0.02%
		192	0+	−22.56	3.5 m *1*	ε 99.99%, α 5.9×10^{-3}%
		193	(3/2−)	−22.19	5 m *sy*	ε

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
82	**Pb**	193m	(13/2+)	–22.19	5.8 m *2*	ε
		194	0+	–24.21	10.7 m *6*	ε , α 7.3×10^{-6}%
		195	3/2–	–23.71	=15 m	ε
		195m	13/2+	–23.51	15.0 m *12*	ε
		196	0+	–25.36	37 m *3*	ε=100%, α≤3.0×10^{-5}%
		197	3/2–	–24.749	8.1 m *17*	ε
		197m	13/2+	–24.429	42.9 m *9*	ε 81%, IT 19%
		198	0+	–26.05	2.4 h *1*	ε
		199	3/2–	–25.23	90 m *10*	ε
		199m	(13/2+)	–24.80	12.2 m *3*	IT<100%, ε>0%
		200	0+	–26.24	21.5 h *4*	ε
		201	5/2–	–25.26	9.33 h *3*	ε
		201m	13/2+	–24.63	61 s *2*	IT>99%, ε<1%
		202	0+	–25.934	52.5×10^{3} y *28*	ε , α<1%
		202m	9–	–23.764	3.53 h *1*	IT 90.5%, ε 9.5%
		203	5/2–	–24.787	51.92 h *3*	ε
		203m	13/2+	–23.961	6.21 s *8*	IT
		203m	29/2–	–21.837	480 ms *7*	IT
		204	0+	–25.110	≥1.4×10^{17} y **1.4%** ***1***	α?
		204m	9–	–22.924	1.14 h *4*	IT
		205	5/2–	–23.770	1.73×10^{7} y *7*	ε
		206	0+	–23.785	**24.1%** ***1***	
		207	1/2–	–22.452	**22.1%** ***1***	
		207m	13/2+	–20.819	0.806 s *6*	IT
		208	0+	–21.749	**52.4%** ***1***	
		209	9/2+	–17.614	3.253 h *14*	β–
		210	0+	–14.728	22.20 y *22*	β–, α 1.9×10^{-6}%
		211	9/2+	–10.491	36.1 m *2*	β–
		212	0+	–7.547	10.64 h *1*	β–
		213	(9/2+)	–3.184	10.2 m *3*	β–
		214	0+	–0.181	26.8 m *9*	β–
		215		4.5s	36 s *1*	β–
83	**Bi**	184m		1.0s	6.6 ms *15*	α=100%
		184m		1.0s	13 ms *2*	α=100%
		185	1/2+	–2.21s	63 μs *3*	p 90%, α 10%
		186	(3+)	–3.17	15.0 ms *17*	α=100%
		186m	(10–)	–3.17	9.8 ms *13*	α=100%
		187	(9/2–)	–6.37	32 ms *3*	α
		188m	(3+)	–7.20	60 ms *3*	α, ε ?
		188m	(10–)	–7.20	265 ms *15*	α, ε ?
		189	(9/2–)	–10.06	674 ms *11*	α>50%, ε<50%
		189m	(1/2+)	–9.88	5.0 ms *1*	α>50%, ε<50%
		190m	(10–)	–10.9	6.2 s *1*	α 70%, ε 30%
		190m	(3+)	–10.9	6.3 s *1*	α 90%, ε 10%
		191	(9/2–)	–13.240	12.4 s *4*	α 51%, ε 49%
		191m	(1/2+)	–13.000	121 ms *8*	α 68%, ε 32%
		192	(3+)	–13.55	34.6 s *9*	ε 88%, α 12%
		192m	(10–)	–13.55	39.6 s *4*	ε 90%, α 10%
		193	(9/2–)	–15.873	63 s *3*	ε 96.2%, α 3.8%
		193m	(1/2+)	–15.566	3.2 s *6*	α 84%, ε 16%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
83	**Bi**	194	(3+)	−15.99	95 s *3*	ε 99.54%, α 0.46%
		194m	(10−)	−15.99	115 s *4*	ε 99.8%, α 0.2%
		194m	(6+,7+)	−15.99	125 s *2*	ε
		195	(9/2−)	−18.024	183 s *4*	ε 99.97%, α 0.03%
		195m	(1/2+)	−17.623	87 s *1*	ε 67%, α 33%
		196	(3+)	−18.01	308 s *12*	ε=100%, α 1.2×10^{-3}%
		196m	(7+)	−17.84	0.6 s *5*	IT, ε
		196m	(10−)	−17.74	240 s *3*	ε 74.2%, IT 25.8%, α 3.8×10^{-4}%
		197	(9/2−)	−19.688	9.33 m *50*	ε, α 1.0×10^{-4}%
		197m	(1/2+)	−19.188	5.04 m *16*	α 55%, ε 45%, IT<0.3%
		198	(2+,3+)	−19.37	10.3 m *3*	ε
		198m	(7+)	−19.37	11.6 m *3*	ε
		198m	10−	−19.12	7.7 s *5*	IT
		199	9/2−	−20.80	27 m *1*	ε
		199m	(1/2+)	−20.12	24.70 m *15*	ε≥98%, IT≤2%, α=0.01%
		200	7+	−20.37	36.4 m *5*	ε
		200m	(2+)	−20.37	31 m *2*	ε>90%, IT<10%
		200m	(10−)	−19.94	0.40 s *5*	IT
		201	9/2−	−21.42	108 m *3*	ε, α<1.0×10^{-4}%
		201m	1/2+	−20.57	59.1 m *6*	ε>93%, IT≤6.8%, α=0.3%
		202	5+	−20.73	1.72 h *5*	ε, α<1.0×10^{-5}%
		203	9/2−	−21.54	11.76 h *5*	ε
		203m	1/2+	−20.44	305 ms *5*	IT
		204	6+	−20.67	11.22 h *10*	ε
		205	9/2−	−21.062	15.31 d *4*	ε
		206	6(+)	−20.028	6.243 d *3*	ε
		207	9/2−	−20.054	32.9 y *14*	ε
		208	(5)+	−18.870	3.68×10^{5} y *4*	ε
		209	9/2−	−18.258	1.9×10^{19} y *2* **100%**	α
		210	1−	−14.792	5.012 d *5*	β−, α 1.3×10^{-4}%
		210m	9−	−14.521	3.04×10^{6} y *6*	α
		211	9/2−	−11.858	2.14 m *2*	α 99.72%, β− 0.28%
		212	1(−)	−8.117	60.55 m *6*	β− 64.06%, α 35.94%
		212m	(8−,9−)	−7.867	25.0 m *2*	α 67%, β− 33%, β−α 30%
		212m	≥16	−6.207	7.0 m *3*	β−=100%
		213	9/2−	−5.231	45.59 m *6*	β− 97.91%, α 2.09%
		214	1−	−1.20	19.9 m *4*	β− 99.98%, α 0.02%
		215	(9/2−)	1.65	7.6 m *2*	β−
		215m	(25/2−)	3.00	36.4 s	IT, β−
		216	(1−)	5.87	2.17 m *5*	β−≤100%
		217		8.8s	98.5 s *8*	β−
		218		13.3s	33 s *1*	β−
84	**Po**	188	0+	−0.54	0.40 ms +*20*−*15*	ε<100%, α>0%
		189		−1.42	5 ms *1*	α
		190	0+	−4.56	2.46 ms *5*	α

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84	**Po**	191	(3/2−)	−5.05	22 ms *1*	α
		191m	(13/2+)	−4.92	93 ms *3*	α
		192	0+	−8.07	33.2 ms *14*	α=99.5%, ε=0.5%
		193m	(13/2+)	−8.36	243 ms *+11−10*	α≤100%
		193m	(3/2−)	−8.36	370 ms *+46−40*	α≤100%
		194	0+	−11.01	0.392 s *4*	α=100%, ε
		195	(3/2−)	−11.07	4.64 s *9*	α 75%, ε 25%
		195m	(13/2+)	−10.84	1.92 s *2*	α=90%, ε=10%, IT<0.01%
		196	0+	−13.47	5.8 s *2*	α=98%, ε=2%
		197	(3/2−)	−13.36	84 s *16*	ε 56%, α 44%
		197m	(13/2+)	−13.15	32 s *2*	α 84%, ε 16%, IT 0.01%
		198	0+	−15.47	1.77 m *3*	α 57%, ε 43%
		199	(3/2−)	−15.22	4.58 m *52*	ε 92.5%, α 7.5%
		199m	13/2+	−14.90	4.13 m *43*	ε 73.5%, α 24%, IT 2.5%
		200	0+	−16.95	10.9 m *11*	ε 88.9%, α 11.1%
		201	3/2−	−16.525	15.3 m *2*	ε 98.4%, α 1.6%
		201m	13/2+	−16.101	8.9 m *2*	IT 56%, ε 41%, α=2.9%
		202	0+	−17.92	44.7 m *5*	ε 98.08%, α 1.92%
		203	5/2−	−17.31	36.7 m *5*	ε 99.89%, α 0.11%
		203m	13/2+	−16.67	45 s *2*	IT
		204	0+	−18.33	3.53 h *2*	ε 99.34%, α 0.66%
		205	5/2−	−17.51	1.74 h *8*	ε 99.96%, α 0.04%
		206	0+	−18.182	8.8 d *1*	ε 94.55%, α 5.45%
		207	5/2−	−17.146	5.80 h *2*	ε 99.98%, α 0.02%
		207m	19/2−	−15.763	2.79 s *8*	IT
		208	0+	−17.469	2.898 y *2*	α, ε
		209	1/2−	−16.366	102 y *5*	α 99.52%, ε 0.48%
		210	0+	−15.953	138.376 d *2*	α
		211	9/2+	−12.432	0.516 s *3*	α
		211m	(25/2+)	−10.970	25.2 s *6*	α 99.98%, IT 0.02%
		212m	(18+)	−7.447	45.1 s *6*	α 99.93%
		213	9/2+	−6.653	3.65 μs *4*	α
		214	0+	−4.470	164.3 μs *20*	α
		215	9/2+	−0.540	1.781 ms *4*	α, β− 2.3×10^{-4}%
		216	0+	1.784	0.145 s *2*	α
		217	(9/2+)	5.901	1.53 s *5*	α
		218	0+	8.358	3.10 m *2*	α 99.98%, β− 0.02%
		219		12.8s	=2 m	α?, β−?
		220	0+	15.5s	>300 ns	β−?
85	**At**	191	(1/2+)		1.7 ms *+11−5*	α
		191m	(7/2−)		2.1 ms *+4−3*	α
		193	(1/2+)	−0.15	28 ms *+5−4*	α=100%
		193m	(7/2−)	−0.14	21 ms *5*	α=100%
		193m	(13/2+)	−0.11	27 ms *+4−5*	α 24%
		194m		−1.2	=40 ms	α, ε
		194m		−1.2	=250 ms	α, ε, IT
		195	(1/2+)	−3.476	328 ms *+20*	α
		195m	(7/2−)	−3.439	147 ms *+5*	α

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85	**At**	196		−3.92	0.39 s *5*	α 94%, ε
		197	(9/2−)	−6.34	0.390 s *16*	α 96.1%, ε 3.9%
		197m	(1/2+)	−6.29	2.0 s *2*	α≤100%, IT≤4.0×10^{-3}%, ε
		198	(3+)	−6.67	4.2 s *3*	α 90%, ε 10%
		198m	(10−)	−6.57	1.0 s *2*	α 84%, ε 16%
		199	(9/2−)	−8.82	6.92 s *13*	α 90%, ε 10%
		200	(3+)	−8.99	43 s *1*	α 57%, ε 43%
		200m	(7+)	−8.88	47 s *1*	ε≤57%, α 43%
		200m	(10−)	−8.65	3.5 s *2*	IT=84%, α=10.5%, ε=4.5%
		201	(9/2−)	−10.790	89 s *3*	α 71%, ε 29%
		202	(2,3)+	−10.59	184 s *1*	ε 82%, α 18%
		202m	(7+)	−10.59	182 s *2*	ε 91.3%, α 8.7%
		202m	(10−)	−10.20	0.46 s *5*	IT 99.7%, ε 0.25%, α 0.1%
		203	9/2−	−12.16	7.37 m *13*	ε 69%, α 31%
		204	7+	−11.88	9.2 m *2*	ε 96.2%, α 3.8%
		204m	(10−)	−11.29	108 ms *10*	IT
		205	9/2−	−12.97	26.9 m *8*	ε 90%, α 10%
		206	(5)+	−12.42	30.6 m *13*	ε 99.11%, α 0.89%
		207	9/2−	−13.24	1.80 h *4*	ε 91.4%, α 8.6%
		208	6+	−12.49	1.63 h *3*	ε 99.45%, α 0.55%
		209	9/2−	−12.880	5.41 h *5*	ε 95.9%, α 4.1%
		210	(5)+	−11.972	8.1 h *4*	ε 99.82%, α 0.18%
		211	9/2−	−11.647	7.214 h *7*	ε 58.2%, α 41.8%
		212	(1−)	−8.621	0.314 s *2*	α, ε<0.03%, β−<2.0×10^{-6}%
		212m	(9−)	−8.398	0.119 s *3*	α>99%, IT<1%
		213	9/2−	−6.580	125 ns *6*	α
		214	1−	−3.380	558 ns *10*	α
		215	9/2−	−1.255	0.10 ms *2*	α
		216	1−	2.257	0.30 ms *3*	α, β−<6.0×10^{-3}%, ε<3.0×10^{-7}%
		217	9/2−	4.396	32.3 ms *4*	α 99.99%, β− 7.0×10^{-3}%
		218		8.10	1.5 s *3*	α 99.9%, β− 0.1%
		219		10.397	56 s *3*	α=97%, β−=3%
		220	3	14.35	3.71 m *4*	β− 92%, α 8%
		221		16.8s	2.3 m *2*	β−
		222		20.8s	54 s *10*	β−
		223		23.5s	50 s *7*	β−
86	**Rn**	195		5.07	6 ms *+3−2*	α
		195m		5.12	5 ms *+3−2*	α
		196	0+	1.97	4.4 ms *+13−9*	α
		197	(3/2−)	1.48	65 ms *+25−14*	α=100%
		197m	(13/2+)	1.48	19 ms *+8−4*	α=100%
		198	0+	−1.23	65 ms *3*	α, ε
		199	(3/2−)	−1.52	0.62 s *3*	α 94%, ε 6%
		199m	(13/2+)	−1.52	0.32 s *2*	α 97%, ε 3%
		200	0+	−4.01	0.96 s *3*	α=98%, ε=2%
		201	(3/2−)	−4.07	7.1 s *8*	α=80%, ε=20%

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86	**Rn**	201m	(13/2+)	−3.79	3.8 s *1*	α=90%, ε=10%, IT=0%
		202	0+	−6.28	10.0 s *3*	α 86%, ε 14%
		203	(3/2−)	−6.16	44.2 s *16*	α 66%, ε 34%
		203m	(13/2+)	−5.80	26.9 s *5*	α 75%, ε 25%
		204	0+	−7.98	1.17 m *18*	α 73%, ε 27%
		205	5/2−	−7.71	170 s *4*	ε 75.4%, α 24.6%
		206	0+	−9.12	5.67 m *17*	α 62%, ε 38%
		207	5/2−	−8.63	9.25 m *17*	ε 79%, α 21%
		208	0+	−9.65	24.35 m *14*	α 62%, ε 38%
		209	5/2−	−8.93	28.5 m *10*	ε 83%, α 17%
		210	0+	−9.598	2.4 h *1*	α 96%, ε 4%
		211	1/2−	−8.756	14.6 h 2	ε 72.6%, α 27.4%
		212	0+	−8.660	23.9 m *12*	α
		213	(9/2+)	−5.698	19.4 ms *1*	α
		214	0+	−4.320	0.27 μs *2*	α
		215	9/2+	−1.169	2.30 μs *10*	α
		216	0+	0.256	45 μs *5*	α
		217	9/2+	3.659	0.54 ms *5*	α
		218	0+	5.218	35 ms *5*	α
		219	5/2+	8.831	3.96 s *1*	α
		220	0+	10.613	55.6 s *1*	α
		221	7/2(+)	14.472	25.7 m *5*	β− 78%, α 22%
		222	0+	16.374	3.8235 d *4*	α
		223	7/2	20.3s	24.3 m *4*	β−
		224	0+	22.4s	107 m *3*	β−
		225	7/2−	26.5s	4.66 m *4*	β−
		226	0+	28.8s	7.4 m *1*	β−
		227		33.0s	20.8 s *7*	β−
		228	0+	35.4s	65 s *2*	β−
87	**Fr**	199		6.76	12 ms *+10−4*	α>0%, ε
		200	(3+)	6.12	49 ms *4*	α
		200m	(10−)	6.32	0.57 s *+27−14*	α
		201	(9/2−)	3.60	67 ms *3*	α, ε<1%
		201m		3.60	19 ms *+19−6*	α
		202	(3+)	3.14	0.23 s *+8−4*	α=97%, ε=3%
		202m	(10−)	3.24	0.23 s *+14−5*	α=97%, ε=3%
		203	(9/2−)	0.86	0.55 s *2*	α≤100%
		204	(3+)	0.61	1.7 s *3*	α=80%, ε=20%
		204m	(7+)	0.65	2.6 s *3*	α≤100%
		204m	(10−)	0.92	=1 s	α≤100%, IT
		205	(9/2−)	−1.310	3.80 s *3*	α≤100%
		206	(2+,3+)	−1.24	=16 s	α=84%, ε=16%
		206m	(7+)	−1.24	15.9 s *1*	α 84%, ε 16%
		206m	(10−)	−0.71	0.7 s *1*	α=12%, IT
		207	9/2−	−2.84	14.8 s *1*	α 95%, ε 5%
		208	7+	−2.67	59.1 s *3*	α 90%, ε 10%
		209	9/2−	−3.77	50.0 s *3*	α 89%, ε 11%
		210	6+	−3.35	3.18 m *6*	α 60%, ε 40%
		211	9/2−	−4.16	3.10 m *2*	α>80%, ε<20%
		212	5+	−3.54	20.0 m *6*	ε 57%, α 43%
		213	9/2−	−3.550	34.6 s *3*	α 99.45%, ε 0.55%

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87	**Fr**	214	(1−)	−0.958	5.0 ms *2*	α
		214m	(8−)	−0.836	3.35 ms *5*	α
		215	9/2−	0.318	86 ns *5*	α
		216	(1−)	2.98	0.70 μs *2*	α, ε<2.0×10^{-7}%
		217	9/2−	4.315	19 μs *3*	α
		218	1−	7.059	1.0 ms *6*	α
		218m		7.145	22.0 ms *5*	α≤100%, IT
		219	9/2−	8.618	20 ms *2*	α
		220	1+	11.483	27.4 s *3*	α 99.65%, β− 0.35%
		221	5/2−	13.278	4.9 m *2*	α, β−<0.1%, ^{14}C 9×10^{-13}%
		222	2−	16.35	14.2 m *3*	β−
		223	3/2(−)	18.384	22.00 m *7*	β− 99.99%, α 6.0×10^{-3}%
		224	1−	21.66	3.33 m *10*	β−
		225	3/2−	23.81	4.0 m *2*	β−
		226	1−	27.4	49 s *1*	β−
		227	1/2+	29.7	2.47 m *3*	β−
		228	2−	33.3s	38 s *1*	β−≤100%
		229	(1/2+)	35.82	50.2 s *4*	β−
		230		39.6s	19.1 s *5*	β−
		231	(1/2+)	42.3s	17.6 s *6*	β−
		232		46.4s	5 s *1*	β−
88	**Ra**	202	0+	9.21	0.7 ms *+33−3*	α
		203	(3/2−)	8.64	1.0 ms *+50−5*	α=100%
		203m	(13/2+)	8.64	33 ms *+22−10*	α=100%
		204	0+	6.05	59 ms *+12−9*	α
		205	(3/2−)	5.84	210 ms *+60−40*	α≤100%, ε
		205m	(13/2+)	5.84	170 ms *+60−40*	α≤100%, ε
		206	0+	3.57	0.24 s *2*	α
		207	(5/2−,3/2−)	3.54	1.3 s *2*	α=90%, ε=10%
		207m	(13/2+)	4.01	55 ms *10*	IT 85%, α 15%, ε=0.35%
		208	0+	1.71	1.3 s *2*	α 95%, ε 5%
		209	5/2−	1.86	4.6 s *2*	α=90%, ε=10%
		210	0+	0.46	3.7 s *2*	α=96%, ε=4%
		211	5/2(−)	0.84	13 s *2*	α>93%, ε<7%
		212	0+	−0.19	13.0 s *2*	α=85%, ε=15%
		213	1/2−	0.36	2.74 m *6*	α 80%, ε 20%
		213m		2.13	2.1 ms *1*	IT=99%, α=1%
		214	0+	0.101	2.46 s *3*	α 99.94%, ε 0.06%
		215	(9/2+)	2.533	1.55 ms *7*	α
		216	0+	3.291	182 ns *10*	α, ε<1.0×10^{-8}%
		217	(9/2+)	5.887	1.6 μs *2*	α=100%
		218	0+	6.65	25.2 μs *3*	α
		219	(7/2)+	9.394	10 ms *3*	α
		220	0+	10.273	18 ms *2*	α
		221	5/2+	12.964	28 s *2*	α, ^{14}C 1×10^{-12}%
		222	0+	14.321	38.0 s *5*	α, ^{14}C 3.0×10^{-8}%
		223	3/2+	17.235	11.43 d *5*	α, ^{14}C 8.9×10^{-8}%
		224	0+	18.827	3.6319 d *23*	α, ^{14}C 4.0×10^{-9}%
		225	1/2+	21.994	14.9 d *2*	β−

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88	**Ra**	226	0+	23.669	1600 y *7*	α, ^{14}C 3.2×10^{-9}%
		227	3/2+	27.179	42.2 m *5*	β–
		228	0+	28.942	5.75 y *3*	β–
		229	5/2(+)	32.56	4.0 m *2*	β–
		230	0+	34.52	93 m *2*	β–
		231	(5/2+)	38.4s	103 s *3*	β–
		232	0+	40.6s	250 s *50*	β–
		233		44.8s	30 s *5*	β–
		234	0+	47.2s	30 s *10*	β–
89	**Ac**	206m		13.51	11 ms +*9*–*3*	α
		206m	(3+)	13.51	22 ms +*9*–*5*	α
		206m	(10–)	13.51	33 ms +*22*–*9*	α
		207	(9/2–)	11.13	27 ms +*11*–*6*	α
		208	(3+)	10.76	95 ms +*24*–*16*	ε 1%, α
		208m	(10–)	11.27	25 ms +*9*–*5*	IT<10%, ε 1%, α
		209	(9/2–)	8.84	0.10 s *5*	α=99%, ε=1%
		210		8.79	0.35 s *5*	α 91%, ε=9%
		211		7.20	0.21 s *3*	α=100%
		212		7.28	0.93 s *5*	α=57%, ε=43%
		213		6.16	0.731 s *17*	α≤100%
		214		6.43	8.2 s *2*	α≥89%, ε≤11%
		215	9/2–	6.01	0.17 s *1*	α 99.91%, ε 0.09%
		216	(1–)	8.12	0.440 ms *16*	α
		217	9/2–	8.71	69 ns *4*	α=100%, ε≤2%
		218	(1–)	10.84	1.08 µs *9*	α
		219	9/2–	11.57	11.8 µs *15*	α
		220	(3–)	13.75	26.4 ms *2*	α, ε 5.0×10^{-4}%
		221		14.52	52 ms *2*	α
		222	1–	16.621	5.0 s *5*	α 99%, ε 1%
		222m		16.621	63 s *3*	α≥88%, IT≤10%, ε≥0.7%
		223	(5/2–)	17.826	2.10 m *5*	α 99%, ε 1%
		224	0–	20.235	2.78 h *17*	ε 90.9%, α 9.1%, β–<1.6%
		225	(3/2–)	21.638	10.0 d *1*	α, ^{14}C 5×10^{-10}%
		226	(1)	24.310	29.37 h *12*	β– 83%, ε 17%, α 6.0×10^{-3}%
		227	3/2–	25.851	21.772 y *3*	β– 98.62%, α 1.38%
		228	3+	28.896	6.15 h *2*	β–
		229	(3/2+)	30.75	62.7 m *5*	β–
		230	(1+)	33.8	122 s *3*	β–
		231	(1/2+)	35.9	7.5 m *1*	β–
		232	(1+)	39.1	119 s *5*	β–
		233	(1/2+)	41.5s	145 s *10*	β–
		234		45.1s	44 s *7*	β–
		235		47.7s	≈40 s	β–?
		236		51.5s	≈2 m	β–?
90	**Th**	209	(5/2–)	16.50	3.8 ms +*69*–*15*	α
		210	0+	14.04	9 ms +*17*–*4*	α 99%, ε=1%
		211		13.91	0.04 s +*3*–*1*	α
		212	0+	12.09	30 ms +*20*–*10*	α, ε=0.3%
		213		12.12	140 ms *25*	α≤100%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
90	**Th**	214	0+	10.71	100 ms *25*	α
		215	(1/2−)	10.93	1.2 s *2*	α
		216	0+	10.30	0.028 s *2*	α, ε=0.01%
		217	(9/2+)	12.22	0.241 ms *5*	α
		218	0+	12.37	109 ns *13*	α
		219		14.47	1.05 μs *3*	α
		220	0+	14.67	9.7 μs *6*	α, ε 2.0×10^{-7}%
		221	(7/2+)	16.938	1.73 ms *3*	α
		222	0+	17.20	2.237 ms *13*	α
		223	(5/2)+	19.386	0.60 s *2*	α
		224	0+	20.00	0.81 s *10*	α
		225	(3/2)+	22.310	8.72 m *4*	α=90%, ε=10%
		226	0+	23.197	30.57 m *10*	α
		227	1/2+	25.806	18.68 d *9*	α
		228	0+	26.772	1.9116 y *16*	α, ^{20}O 1×10^{-11}%
		229	5/2+	29.587	7340 y *160*	α
		229m		29.590	13.9 h *30*	α
		230	0+	30.864	7.538×10^{4} y *30*	α, SF<4.×10^{-11}%
		231	5/2+	33.817	25.52 h *1*	β−, α=4×10^{-11}%
		232	0+	35.448	1.405×10^{10} y *6* **100%**	α, SF 1.2×10^{-8}%, Ne
		233	1/2+	38.733	21.83 m *4*	β−
		234	0+	40.614	24.10 d *3*	β−
		235	(1/2+)	44.26	7.2 m *1*	β−
		236	0+	46.5s	37.5 m *2*	β−
		237	(5/2+)	50.2s	4.7 m *6*	β−
		238	0+	52.6s	9.4 m *20*	β−
91	**Pa**	212		21.61	5.1 ms *+61−19*	α=100%
		213	(9/2−)	19.66	5.3 ms *+40−16*	α
		214		19.49	17 ms *3*	α
		215		17.87	14 ms *2*	α
		216		17.80	105 ms *12*	α=98%, ε=2%
		217		17.07	3.6 ms *8*	α
		217m		18.92	1.2 ms *2*	α 73%, IT 27%
		218		18.67	0.113 ms *1*	α
		219m	9/2−	18.52	53 ns *10*	α
		220?		20.38	0.78 μs *16*	α, ε 3.0×10^{-7}%
		221	9/2−	20.38	4.9 μs *8*	α
		222		22.12s	3.3 ms *3*	α
		223		22.32	5.1 ms *6*	α
		224		23.87	0.85 s *2*	α
		225		24.34	1.7 s *2*	α
		226		26.03	1.8 m *2*	α 74%, ε 26%
		227	(5/2−)	26.832	38.3 m *3*	α 85%, ε 15%
		228	3+	28.924	22 h *1*	ε 98%, α 2%
		229	(5/2+)	29.898	1.50 d *5*	ε 99.52%, α 0.48%
		230	(2−)	32.174	17.4 d *5*	ε 91.6%, β− 8.4%, α 3.2×10^{-3}%
		231	3/2−	33.426	3.276×10^{4} y *11*	α, SF≤3×10^{-10}%
		232	(2−)	35.948	1.31 d *2*	β−, ε 3.0×10^{-3}%
		233	3/2−	37.490	26.975 d *13*	β−
		234	4+	40.341	6.70 h *5*	β−

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
91	**Pa**	234m	(0−)	40.415	1.17 m *3*	β− 99.84%, IT 0.16%
		235	(3/2−)	42.33	24.44 m *11*	β−
		236	1(−)	45.3	9.1 m *1*	β−
		237	(1/2+)	47.6	8.7 m *2*	β−
		238	(3−)	50.77	2.27 m *9*	β−, SF<2.6×10^{-6}%
		239	(3/2)	53.3s	1.8 h *5*	β−
		240		56.8s	=2 m	β−?
92	**U**	217		22.70	16 ms *+21−6*	α≤100%
		218	0+	21.92	1.5 ms *+73−7*	α
		219		23.21	42 μs *+34−13*	α
		220	0+	23.0s	=60 ns	α?, ε?
		221		24.6s	=0.7 μs	α?, ε?
		222	0+	24.3s	1.0 μs *+10−4*	α
		223		25.84	18 μs *+10−5*	α, ε 0.2%
		224	0+	25.71	0.9 ms *3*	α
		225		27.38	84 ms *4*	α
		226	0+	27.33	0.26 s *2*	α
		227	(3/2+)	29.02	1.1 m *1*	α
		228	0+	29.22	9.1 m *2*	α>95%, ε<5%
		229	(3/2+)	31.211	58 m *3*	ε=80%, α=20%
		230	0+	31.615	20.8 d	α, SF<1×10^{-10}%
		231	(5/2−)	33.807	4.2 d *1*	ε, α=4.0×10^{-3}%
		232	0+	34.611	68.9 y *4*	α, Ne 9×10^{-10}%, Mg<5×10^{-12}%, SF 3×10^{-12}%
		233	5/2+	36.920	1.592×10^{5} y *2*	α, SF<6.0×10^{-9}%
		234	0+	38.147	2.455×10^{5} y *6* **0.0054% *5***	α, SF 1.6×10^{-9}%, Mg 1×10^{-11}%, Ne 9×10^{-12}%
		235	7/2−	40.921	7.04×10^{8} y *1* **0.7204% *6***	α, SF 7.0×10^{-9}%, Ne=8.×10^{-10}%, 28 8.×10^{-10}%
		235m	1/2+	40.921	=26 m	IT
		236	0+	42.446	2.342×10^{7} y *3*	α, SF 9.4×10^{-8}%, ^{30}Mg
		237	1/2+	45.392	6.75 d *1*	β−
		238	0+	47.309	4.468×10^{9} y *3* **99.2742% *10***	α, SF 5.5×10^{-5}%
		239	5/2+	50.574	23.45 m *2*	β−
		240	0+	52.715	14.1 h *1*	β−
		241		56.2s	=5 m	β−?
		242	0+	58.6s	16.8 m *5*	β−
93	**Np**	225	(9/2−)	31.59	>2 μs	α
		226		32.74s	35 ms *10*	α
		227		32.56	0.51 s *6*	α
		228		33.7s	61.4 s *14*	ε 60%, α 40%
		229		33.78	4.0 m *4*	α 68%, ε 32%
		230		35.24	4.6 m *3*	ε≤97%, α≥3%
		231	(5/2)	35.63	48.8 m *2*	ε 98%, α 2%
		232	(4+)	37.4s	14.7 m *3*	ε

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
93	**Np**	233	(5/2+)	37.95	36.2 m *1*	ε , α≤1.0×10^{-3}%
		234	(0+)	39.957	4.4 d *1*	ε
		235	5/2+	41.045	396.1 d *12*	ε , α 2.6×10^{-3}%
		236	(6–)	43.38	154×10^{3} y *6*	ε 87.3%, β– 12.5%, α 0.16%
		236m	1	43.44	22.5 h *4*	ε 52%, β– 48%
		237	5/2+	44.873	2.144×10^{6} y *7*	α, SF≤2×10^{-10}%
		238	2+	47.456	2.117 d *2*	β–
		239	5/2+	49.312	2.356 d *3*	β–
		240	(5+)	52.31	61.9 m *2*	β–
		240m	(1+)	52.31	7.22 m *2*	β– 99.88%, IT 0.12%
		241	(5/2+)	54.26	13.9 m *2*	β–
		242	(1+)	57.4	2.2 m *2*	β–
		242m	(6+)	57.4	5.5 m *1*	β–
		243	(5/2–)	59.88s	1.85 m *15*	β–
		244	(7–)	63.2s	2.29 m *16*	β–
94	**Pu**	228	0+	36.09	1.1 s +*20*–*5*	α
		229	(3/2+)	37.40	>2 μs	α
		230	0+	36.93	1.70 m *17*	α 84%, ε 16%
		231	(3/2+)	38.29	8.6 m *5*	ε≤99.8%, α>0.2%
		232	0+	38.37	33.1 m *8*	ε 80%, α 20%
		233		40.05	20.9 m *4*	ε 99.88%, α 0.12%
		234	0+	40.350	8.8 h *1*	ε=94%, α=6%
		235	(5/2+)	42.18	25.3 m *5*	ε , α 2.8×10^{-3}%
		236	0+	42.903	2.858 y *8*	α, SF 1.9×10^{-7}%
		237	7/2–	45.093	45.2 d *1*	ε , α 4.2×10^{-3}%
		237m	1/2+	45.239	0.18 s *2*	IT
		238	0+	46.165	87.7 y *1*	α, SF 1.9×10^{-7}%
		239	1/2+	48.590	24110 y *30*	α, SF 3.×10^{-10}%
		240	0+	50.127	6561 y *7*	α, SF 5.7×10^{-6}%
		241	5/2+	52.957	14.290 y *6*	β– , α 2.5×10^{-3}% , SF>2.×10^{-14}%
		242	0+	54.718	3.75×10^{5} y *2*	α, SF 5.5×10^{-4}%
		243	7/2+	57.756	4.956 h *3*	β–
		244	0+	59.806	8.00×10^{7} y *9*	α 99.88%, SF 0.12%
		245	(9/2–)	63.11	10.5 h *1*	β–
		246	0+	65.40	10.84 d *2*	β–
		247		69.0s	2.27 d *23*	β–
95	**Am**	231		42.4s	=10 s	ε ?, α ?
		232		43.4s	79 s *2*	ε=98%, α=2%
		233		43.2s	3.2 m *8*	α>3%, ε
		234		44.5s	2.32 m *8*	ε>99.96%, α<0.04%
		235m		44.7s	10.3 m *6*	ε 99.6%, α 0.4%
		236?		46.2s	3.6 m *1*	α 0.004%, ε
		236m		46.2s	0.6 y *2*	ε
		237	5/2(–)	46.57s	73.0 m *10*	ε 99.98%, α 0.03%
		238	1+	48.42	98 m *2*	ε , α 1.0×10^{-4}%
		238m		48.42	3.8 y	α
		239	(5/2)–	49.392	11.9 h *1*	ε 99.99%, α 0.01%
		240	(3–)	51.51	50.8 h *3*	ε , α 1.9×10^{-4}%
		241	5/2–	52.936	432.2 y *7*	α, SF 4×10^{-10}%
		242	1–	55.470	16.02 h *2*	β– 82.7%, ε 17.3%

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95	**Am**	242m	5−	55.518	141 y *2*	IT 99.55%, α 0.45%, SF<4.7×10^{-9}%
		242m	(2+,3−)	57.670	14.0 ms *10*	SF=100%, α<5.0×10^{-3}% , IT
		243	5/2−	57.176	7370 y *40*	α, SF 3.7×10^{-9}%
		244	(6−)	59.881	10.1 h *1*	β−
		244m		59.881	0.90 ms *15*	SF≤100%
		244m	1+	59.967	26 m *1*	β− 99.96%, ε 0.04%
		245	(5/2)+	61.900	2.05 h *1*	β−
		246	(7−)	64.99	39 m *3*	β−
		246m	2(−)	64.99	25.0 m *2*	β−, IT<0.02%
		247	(5/2)	67.2s	23.0 m *13*	β−
		248		70.6s	≈10 m	β−
		249		73.1s	≈2 m	β−?
96	**Cm**	232	0+		1 m *?*	SF<30.3%
		233		47.29		α, ε
		234	0+	46.72	≈2 m	ε?, α?
		235		47.9s	5 m *sy*	ε?, α?
		236	0+	47.9s	≈10 m	ε, α
		237		49.3s	≈20 m	ε?, α?
		238	0+	49.40	2.4 h *1*	ε≥90%, α≤10%
		239	(7/2−)	51.2s	≈2.9 h	ε, α<0.1%
		240	0+	51.725	27 d *1*	α>99.5%, ε<0.5%, SF 3.9×10^{-6}%
		241	1/2+	53.703	32.8 d *2*	ε 99%, α 1%
		242	0+	54.805	162.8 d *2*	α, SF 6.2×10^{-6}% , 34 1.×10^{-14}%
		243	5/2+	57.184	29.1 y *1*	α 99.71%, ε 0.29%, SF 5.3×10^{-9}%
		244	0+	58.454	18.1 y *1*	α, SF 1.4×10^{-4}%
		245	7/2+	61.005	8500 y *100*	α, SF 6.1×10^{-7}%
		246	0+	62.618	4760 y *40*	α 99.97%, SF 0.03%
		247	9/2−	65.534	1.56×10^{7} y *5*	α
		248	0+	67.392	3.48×10^{5} y *6*	α 91.61%, SF 8.39%
		249	1/2(+)	70.750	64.15 m *3*	β−
		250	0+	72.99	≈8.3×10^{3} y	SF=74%, α=18%, β−=8%
		251	(1/2+)	76.65	16.8 m *2*	β−
		252	0+	79.1s	<2 d	β−
97	**Bk**	235		52.7s	≈20 s	ε?, α?
		236		53.4s	≈42 s	α?, ε?
		236m		46.2s	≥30 d	ε
		237		53.1s	≈1 m	ε?, α?
		238		54.3s	144 s *5*	ε, εSF 0.048%
		240		55.7s	4.8 m *8*	εSF 2.0×10^{-3}% , ε
		241	(7/2+)	56.1s	≈3 m	α?, ε?
		242		57.7s	7.0 m *13*	ε≤100%
		243	(3/2−)	58.691	4.5 h *2*	ε=99.85%, α=0.15%
		244	(4−)	60.72	4.35 h *15*	ε 99.99%, α 6.0×10^{-3}%
		245	3/2−	61.815	4.94 d *3*	ε 99.88%, α 0.12%
		246m	2(−)	63.97	1.80 d *2*	ε, α<0.2%

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97	**Bk**	247	(3/2−)	65.491	1380 y *250*	α≤100%
		248		68.08s	>9 y	α
		248m	1(−)	68.08s	23.7 h *2*	β− 70%, ε 30%
		249	7/2+	69.850	330 d *4*	β−, α 1.4×10^{-3}%, SF 4.7×10^{-8}%
		250	2−	72.951	3.212 h *5*	β−
		251	(3/2−)	75.23	55.6 m *11*	β−
		252		78.5s	≈2 m	β−?, α?
		253		80.9s	≈10 m	β−?
		254		84.4s	≈2 m	β−?
98	**Cf**	237		57.8s	2.1 s *3*	SF=10%, α?
		238	0+	57.2s	21 ms *2*	SF=100%
		239		58.1s	39 s *+37−12*	ε, α
		240	0+	58.0s	0.96 m *15*	α=98%, SF=2%, ε
		241		59.4s	3.78 m *70*	ε=75%, α=25%
		242	0+	59.34	3.7 m *5*	α 80%, ε 20%, SF≤0.01%
		243	(1/2+)	60.9s	10.7 m *5*	ε=86%, α=14%
		244	0+	61.479	19.4 m *6*	α≤100%
		245	(1/2+,5/2+)	63.387	45.0 m *15*	ε 64%, α 36%
		246	0+	64.092	35.7 h *5*	α, ε<4.0×10^{-3}%, SF 2.5×10^{-4}%
		247	(7/2+)	66.137	3.11 h *3*	ε 99.97%, α 0.04%
		248	0+	67.240	333.5 d *28*	α, SF 2.9×10^{-3}%
		249	9/2−	69.726	351 y *2*	α, SF 5.0×10^{-7}%
		250	0+	71.172	13.08 y *9*	α 99.92%, SF 0.08%
		251	1/2+	74.135	898 y *44*	α, SF
		252	0+	76.034	2.645 y *8*	α 96.91%, SF 3.09%
		253	(7/2+)	79.301	17.81 d *8*	β− 99.69%, α 0.31%
		254	0+	81.34	60.5 d *2*	SF 99.69%, α 0.31%
		255	(7/2+)	84.8s	85 m *18*	β−
		256	0+	87.0s	12.3 m *12*	SF, β−<1%, α=1.0×10^{-6}%
99	**Es**	240		64.2s	1 s *sy*	α?, ε?
		241	(3/2−)	63.8s	8 s *+6−5*	α
		242		65.0s	13.5 s *25*	α>0%, ε>0%
		243		64.8s	21 s *2*	ε≤70%, α≥30%
		244		66.0s	37 s *4*	ε 96%, α 4%
		245	(3/2−)	66.4s	1.1 m *1*	ε 60%, α 40%
		246m		67.9s	7.7 m *5*	ε 90.1%, α 9.9%, ε 3.0×10^{-3}%
		247	(7/2+)	68.61s	4.55 m *26*	ε=93%, α=7%
		247m		68.61s	625 d *84*	α
		248	(2−,0+)	70.30s	27 m *5*	ε 99.7%, α=0.25%
		249	7/2+	71.18s	102.2 m *6*	ε 99.43%, α 0.57%
		250	(6+)	73.2s	8.6 h *1*	ε>97%, α<3%
		250m	1(−)	73.2s	2.22 h *5*	ε≤100%
		251	(3/2−)	74.512	33 h *1*	ε 99.5%, α 0.5%
		252	(5−)	77.29	471.7 d *19*	α 78%, ε 22%, β−=0.01%
		253	7/2+	79.014	20.47 d *3*	α, SF 8.7×10^{-6}%
		254	(7+)	81.992	275.7 d *5*	α=100%, β− 1.7×10^{-4}%, SF<3.0×10^{-6}%, ε

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99	**Es**	254m	2+	82.072	39.3 h *2*	β− 98%, IT<3%, α 0.32%, ε 0.08%, SF<0.05%
		255	(7/2+)	84.09	39.8 d *12*	β− 92%, α 8%, SF 4.1×10^{-3}%
		256	(1+,0−)	87.2s	25.4 m *24*	β−
		256m	(8+)	87.2s	7.6 h	β−
		257		89.4s	7.7 d *2*	β−, SF
		258		92.7s	3 m *sy*	ε?, α?
100	**Fm**	242	0+	68.4s	0.8 ms *2*	SF≤100%
		243	(7/2+)	69.3s	0.18 s *+8−4*	α≤100%
		244	0+	69.0s	3.3 ms *5*	SF≤100%
		245		70.2s	4.2 s *13*	α≤100%, SF≤0.1%
		246	0+	70.14	1.1 s *2*	α 92%, SF 8%, ε≤1%
		247	(7/2+)	71.6s	29 s *1*	α≥50%, ε≤50%
		247m	(1/2+)	71.6s	4.3 s *4*	α≤100%
		248	0+	71.91	36 s *2*	α 93%, ε 7%, SF 0.1%
		249	(7/2+)	73.6s	2.6 m *7*	ε 67%, α 33%
		250	0+	74.07	30 m *3*	α>90%, ε<10%, SF 6.9×10^{-3}%
		250m	0+	74.07	1.8 s *1*	IT≥80%, α<20%, SF≤8.2×10^{-5}%, ε
		251	(9/2−)	75.987	5.30 h *8*	ε 98.2%, α 1.8%
		252	0+	76.817	25.39 h *4*	α, SF 2.3×10^{-3}%
		253	(1/2)+	79.350	3.00 d *12*	ε 88%, α 12%
		254	0+	80.904	3.240 h *2*	α 99.94%, SF 0.06%
		255	7/2+	83.799	20.07 h *7*	α, SF 2.4×10^{-5}%
		256	0+	85.486	157.6 m *13*	SF 91.9%, α 8.1%
		257	(9/2+)	88.590	100.5 d *2*	α 99.79%, SF 0.21%
		258	0+	90.4s	370 μs *43*	SF≤100%
		259		93.7s	1.5 s *3*	SF
		260	0+	95.6s	≈4 ms	SF
101	**Md**	245	(1/2−)	75.3s	0.90 ms *25*	α, SF
		245m		75.6s	0.35 s *+23−16*	α, ε
		246m		76.3s	1.0 s *4*	SF, α>0%, ε>0%
		247		76.0s	1.12 s *22*	α≤100%
		248		77.1s	7 s *3*	ε 80%, α 20%, SF≤0.05%
		249		77.3s	24 s *4*	α>60%, ε≤40%
		250		78.6s	52 s *6*	ε 93%, α 7%
		251		79.0s	4.0 m *5*	ε≥90%, α≤10%
		252		80.6s	2.3 m *8*	ε≤100%
		253	(1/2−)	81.3s	6 m *+12−3*	ε≤100%, α
		254m		83.5s	10 m *3*	ε≤100%
		254m		83.5s	28 m *8*	ε≤100%
		255	(7/2−)	84.843	27 m *2*	ε 92%, α 8%, SF<0.15%
		256	(1−)	87.62	77 m *2*	ε 90.8%, α 9.2%, SF<3%
		257	(7/2−)	88.996	5.52 h *5*	ε 85%, α 15%, SF<1%
		258		91.688	51.5 d *3*	α, SF
		258m		91.688	57.0 m *9*	ε≥70%, SF

Nuclide Z El A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
101 Md 259		93.6s	96 m *3*	SF=100%, α<1.3%
260		96.6s	31.8 d *5*	SF≥42%, α≤25%, ε≤23%, β−≤10%
261		98.5s	40 m *sy*	α?
262		101.4s	3 m *sy*	SF?, α?
102 No 248	0+	80.7s	<2 μs	SF?
249		81.8s	54 μs *+15−10*	SF
250	0+	81.5s	6 μs *1*	SF≤100%, α 0.1%, ε 1.0×10^{-3}%
251	(7/2+)	82.9s	0.78 s *2*	α≤100%, SF≤8%, ε
251m	(1/2+)	83.0s	0.93 s *6*	α≤100%
252	0+	82.88	2.27 s *14*	α 58%, ε 23%, SF 19%
252m		82.88	26 d *7*	α
253	(9/2−)	84.5s	1.62 m *15*	α≤100%, ε
254	0+	84.72	51 s *10*	α 90%, ε 10%, SF 0.17%
254m	0+	84.72	0.28 s *4*	IT>80%
255	(1/2+)	86.85	3.1 m *2*	α 61%, ε 39%
256	0+	87.824	2.91 s *5*	α 99.47%, SF 0.53%
257	(7/2+)	90.24	25 s *3*	α≤100%, SF≤1.5%
258	0+	91.5s	1.2 ms *2*	SF≤100%
259		94.1s	58 m *5*	α 75%, ε 25%, SF<10%
260	0+	95.6s	106 ms *8*	SF
261		98.5s		β−, α
262	0+	100.0s	=5 ms	SF
263		103.0s	20 m *sy*	α?, SF?
264	0+	104.6s	1 m *sy*	α?
103 Lr 251		87.9s		ε?, α?
252		88.8s	0.36 s *+11−7*	α=90%, ε=10%, SF<1%
253		88.7s	0.57 s *+7−6*	α, SF<2%
253m		88.7s	1.5 s *+3−2*	α 90%, SF<2%
254		89.8s	13 s *3*	α 76%, ε 24%
255		90.1s	22 s *4*	α 85%, ε<30%, SF≤0.1%
256		91.9s	27 s *3*	α 85%, ε 15%, SF<0.03%
257		92.7s	0.646 s *25*	α≤100%, SF≤0.03%
258		94.8s	4.1 s *3*	α>95%, SF<5%
259		95.85s	6.2 s *3*	α 78%, SF 22%
260		98.3s	180 s *30*	α 80%, ε<40%, SF<10%
261		99.6s	39 m *12*	SF
262		102.1s	=4 h	SF<10%, ε, α
263		103.7s	5 h *sy*	α?
264		106.2s	10 h *sy*	α?, SF?
265		107.9s	10 h *sy*	α?, SF?
266		111.1s	1 h *sy*	α?, SF?
104 Rf 253m		93.8s	48 μs *+17−10*	SF≤100%, α
253m		93.8s	=1.8 s	SF=50%, α=50%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
104	**Rf**	254	0+	93.3s	23 μs *3*	SF≤100%
		255	(9/2−)	94.4s	1.64 s *11*	SF 52%, α 48%
		255m		94.4s	0.8 s *+5−2*	α≤100%
		256	0+	94.24	6.4 ms *2*	SF 99.68%, α 0.32%
		257	(1/2+)	95.9s	4.7 s *3*	α<100%, SF≤1.4%, ε>0%
		257m		95.9s	3.9 s *4*	α<100%, SF≤1.4%, ε>0%
		258	0+	96.4s	12 ms *2*	SF 87%, α 13%
		259		98.40s	3.2 s *6*	α 92%, SF 8%
		260	0+	99.1s	21 ms *1*	SF≤100%, α?
		261		101.32	65 s *10*	α>80%, ε<15%, SF<10%
		262	0+	102.4s	2.3 s *4*	SF≤100%, α<3%
		263		104.8s	10 m *2*	SF=100%, α
		264	0+	106.2s	1 h *sy*	α?
		265		108.7s	=13 h	α?
		266	0+	109.9s	10 h *sy*	α?, SF?
		267?		113.2s	2.3 h *+980−17*	SF
		268	0+	115.2s	6 h *sy*	α?, SF?
105	**Db**	255		100.0s	1.6 s *+6−4*	α=80%, SF=20%
		256		100.7s	1.6 s *+5−3*	α=64%, ε=36%, SF=0.02%
		257		100.3s	1.50 s *+19−15*	α>94%, SF<6%
		257m		100.3s	0.76 s *+15−11*	α≥87%, SF≤13%
		258		101.7s	4.0 s *10*	α 67%, ε 33%, SF<1%
		258m		101.7s	20 s *10*	ε=100%
		259		102.1s	0.51 s *16*	α
		260		103.7s	1.52 s *13*	α≥90.4%, SF≤9.6%, ε<2.5%
		261		104.4s	1.8 s *4*	α≥82%, SF≤18%
		262		106.3s	35 s *5*	α=67%, SF
		263		107.1s	27 s *+10−7*	SF 55%, α 41%, ε 3%
		264		109.4s	3 m *sy*	α?
		265		110.5s	15 m *sy*	α?
		266		112.7s	20 m *sy*	α?, SF?
		267?		114.0s	73 m *+350−33*	SF>0%
		268?		116.9s	32 h *+11−7*	SF
		269		118.7s	3 h *sy*	α?, SF?
106	**Sg**	258	0+	105.4s	2.9 ms *+13−7*	SF≤100%, α?
		259	(1/2+)	106.7s	0.48 s *+28−13*	α 90%, SF<20%
		260	0+	106.58	3.6 ms *9*	α 50%, SF 50%
		261		108.2s	0.23 s *6*	α=100%, SF<1%
		262	0+	108.4s	6.9 ms *+38−18*	SF≥78%, α≤22%
		263		110.2s	1.0 s *2*	α>70%, SF<30%
		263m		110.2s	0.12 s	α, IT
		264	0+	110.8s	0.4 s *sy*	α?
		265	(9/2+)	112.82	8 s *3*	SF≤57%, α≥43%
		266	0+	113.7s	21 s *+20−12*	SF≥50%, α≤50%
		268	0+	117.0s	30 s *sy*	α?, SF?
		270	0+	121.4s	10 m *sy*	α?, SF?
		271?		124.3s	2.4 m *+43−10*	α 50%, SF 50%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
106	**Sg**	272	0+	125.9s	1 h *sy*	α?, SF?
		273		128.8s	1 m *sy*	SF?
107	**Bh**	260		113.6s	0.3 ms *sy*	α≤100%
		261		113.3s	12 ms *+5–3*	α 95%, SF<10%
		262m		114.5s	8.0 ms *21*	α≤100%
		262m		114.5s	102 ms *26*	α≤100%
		263		114.6s	0.2 ms *sy*	α?
		264		116.1s	0.44 s *+60–16*	α≤100%
		265		116.6s	0.9 s *+7–3*	α
		266?		118.2s	1.7 ms *+82–8*	α
		267?		118.9s	17 s *+14–6*	α
		271?		125.9s	40 s *sy*	α?
		272?		128.6s	10 s *+12–4*	α
		273		130.1s	90 m *sy*	α?, SF?
		274		132.7s	90 m *sy*	α?, SF?
		275		134.4s	40 m *sy*	SF?
108	**Hs**	263		119.8s		α≤100%
		264	0+	119.60	=0.8 ms	α=50%, SF=50%
		265		121.2s	2.0 ms *+3–2*	α=100%, SF≤1%
		266	0+	121.2s	2.3 ms *+13–6*	α=100%, SF<1.4%
		267		122.8s	52 ms *+13–8*	α≥80%, SF<20%
		267m		122.8s	0.80 s *+380–37*	α>0%
		269?		124.9s	9.7 s *+97–33*	α
		270?	0+	125.4s	3.6 s *+8–14*	α
		271		128.2s	40 s *sy*	α?, SF?
		272	0+	129.5s	40 s *sy*	α?, SF?
		273	(3/2+)	132.3s	50 s *sy*	α?
		274	0+	133.3s	1 m *sy*	α?, SF?
		275?		136.0s	0.15 s *+27–6*	α
		276	0+	137.1s	1 h *sy*	α?, SF?
109	**Mt**	265		126.8s	2 m *sy*	α?
		266?		127.9s	1.7 ms *+18–16*	α≤100%
		267		127.9s	10 ms *sy*	α?
		268?		129.2s	21 ms *+8–5*	α
		270?		131.0s	4.96 ms	α
		271		131.5s	5 s *sy*	α?
		272		133.9s	10 s *sy*	α?, SF?
		273		135.0s	20 s *sy*	α?, SF?
		274		137.4s	20 s *sy*	α?, SF?
		275?		138.5s	9.7 ms *+460–44*	α
		276?		140.8s	0.72 s *+87–25*	α
		279		145.5s	6 m *sy*	α?, SF?
110	**Ds**	267?		134.5s	3 μs *+6–2*	α
		268	0+	133.9s	100 μs *sy*	
		269?		135.2s	179 μs *+245–66*	α
		270	0+	134.8s	0.10 ms *+14–4*	α, SF<0.2%
		270m		135.9s	6.0 ms *+82–22*	α>70%, IT≤30%
		271		136.1s	1.63 ms *+44–29*	α
		271m		136.1s	69 ms *+56–21*	α>0%, IT?
		272	0+	136.3s	1 s *sy*	SF
		273		138.7s	0.17 ms *+17–6*	α

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
110	**Ds**	274	0+	139.3s	2 s *sy*	α?, SF?
		275		141.8s	2 s *sy*	α?
		276	0+	142.6s	5 s *sy*	α?, SF?
		277		145.0s	5 s *sy*	α?
		278	0+	145.8s	10 s *sy*	α?, SF?
		279?		148.0s	0.18 s *+5–3*	SF 90%, α 10%
		281?		151.0s	11.1 s *+50–27*	SF
111	**Rg**	272?		143.1s	3.8 ms *+14–8*	α
		273		143.2s	5 ms *sy*	α?
		274?		145.1s	6.4 ms *+307–29*	α
		275		145.4s	10 ms *sy*	α?
		276		147.6s	100 ms *sy*	α?, SF?
		277		148.6s	1 s *sy*	α?, SF?
		278		150.5s	1 s *sy*	α?, SF?
		279?		151.3s	0.17 s *+81–8*	α
		280?		153.2s	3.6 s *+43–13*	α
		281		154.0s	1 m *sy*	α?, SF?
		282		156.0s	4 m *sy*	α?, SF?
		283		156.9s	10 m *sy*	α?, SF?
112		277		152.7s	0.69 ms *+69–24*	α
		278	0+	153.1s	10 ms *sy*	α?, SF?
		279		155.1s	0.1 s *sy*	α?, SF?
		280	0+	155.6s	1 s *sy*	α?, SF?
		282?		158.1s	0.50 ms *+33–14*	SF
		283?		160.0s	4.0 s *+13–7*	α≥99%, SF≤1%
		284?		160.6s	97 ms *+31–19*	SF
		285?		162.2s	29 s *+13–7*	α
113		278?			0.24 ms *+114–11*	α
		283?		164.4s	100 ms *+490–45*	α
		284?		165.9s	0.48 s *+58–17*	α
		285		166.5s	2 m *sy*	α?, SF?
		286		168.1s	5 m *sy*	α?, SF?
		287		168.6s	20 m *sy*	α?, SF?
114		286?		171.3s	0.16 ms *+7–3*	SF 60%, α 40%
		287?		172.9s	0.51 s *+18–10*	α
		288?		173.0s	0.8 s *+27–16*	α
		289?		174.4s	2.6 s *+12–7*	α
115		287?		178.1s	32 ms *+155–14*	α
		288?		179.3s	87 ms *+105–30*	α
		289		180s	10 s *sy*	α?, SF?
		290		180.8s	10 s *sy*	α?, SF?
		291		181.1s	1 m *sy*	α?, SF?
116		290	0+	185.0s	15 ms *+26–6*	α
		291		186.3s	6.3 ms *+116–25*	α
		292?	0+	186.1s	18.0 ms *+16–6*	α
		293?			61 ms *+57–20*	α
117		291		192.4s	10 ms *sy*	α?, SF?
		292		193.3s	50 ms *sy*	α?, SF?
118		294?	0+		1.8 ms *+84–8*	α>0%, SF?

Appendix–I Table of Elemental Properties

Z	El	Atomic Weight[a]	Density (g/cc)[b]	Melting Pt. (°C)[b]	Boiling Pt. (°C)[b]	Valence[b]
1	H	1.00794 *7*	8.988×10^{-5}[d]	–259.34	–252.87	1
2	He	4.002602 *2*	1.785×10^{-4}[f]	<–272.2 (26 atm)	–268.93	0
3	Li	6.941 *2*	0.534[c]	180.5	1342	1
4	Be	9.012182 *3*	1.848[c]	1287	2471 (5 mm)	2
5	B	10.811 *7*	2.34[h]	2075	4000 (subl.)	3
6	C	12.0107 *8*	1.8 to 2.1[i]	=3550	4827	2,3,4
7	N	14.0067 *2*	0.0012506[j]	–210.00	–198.79	3,5
8	O	15.9994 *3*	0.001308[k]	–218.79	–182.953	2
9	F	18.9984032 *5*	0.001696	–219.62[g]	–188.12[g]	1
10	Ne	20.1797 *6*	8.9990×10^{-4}	–248.59	–246.08[g]	0
11	Na	22.989770 *2*	0.971[c]	97.80	883	1
12	Mg	24.3050 *6*	1.738[c]	650	1090	2
13	Al	26.981538 *2*	2.6989[c]	660.32	2519	3
14	Si	28.0855 *3*	2.33[e]	1414	3265	4
15	P	30.973761 *2*	1.82[l]	44.15[l]	280.5[l]	3,5
16	S	32.065 *5*	2.07[cm]	115.21[m]	444.60	2,4,6
17	Cl	35.453 *2*	0.003214	–101.5	–34.04	1,3,5,7
18	Ar	39.948	0.0017837	–189.35	–185.85	0
19	K	39.0983	0.862[c]	63.38	759	1
20	Ca	40.078 *4*	1.55[c]	842	1484	2
21	Sc	44.955910 *8*	2.989[e]	1541	2836	3
22	Ti	47.867	4.54	1668	3287	2 to 4
23	V	50.9415	6.11 (18.7°C)	1910	3407	2 to 5
24	Cr	51.9961 *6*	7.18 to 7.20[c]	1907	2671	2,3,6
25	Mn	54.938049 *9*	7.21 to 7.44[n]	1246	2061	1 to 4,6,7
26	Fe	55.845 *2*	7.874[c]	1538	2861	2,3,4,6
27	Co	58.933200 *9*	8.9[c]	1495	2927	2,3
28	Ni	58.6934 *2*	8.902[e]	1455	2913	0 to 3
29	Cu	63.546 *3*	8.96[c]	1084.62	2562	1,2
30	Zn	65.39 *2*	7.133[e]	419.53	907	2
31	Ga	69.723	5.904 (29.6°C)	29.76	2204	2,3
32	Ge	72.64	5.323[e]	938.25	2833	2,4
33	As	74.92160 *2*	5.73[o]	817[o] (28 atm)	614[o] (subl.)	0,±3,5
34	Se	78.96 *3*	4.79[p]	221[p]	685[p]	–2,4,6
35	Br	79.904	3.12[u]	–7.2	58.8	1,3,5,7
36	Kr	83.80	0.003733	–157.36	–153.22	0
37	Rb	85.4678 *3*	1.532[c]	39.31	688	1
38	Sr	87.62	2.54	777	1382	2
39	Y	88.90585 *2*	4.469[e]	1522	3345	3
40	Zr	91.224 *2*	6.506[c]	1855	4409	2 to 4
41	Nb	92.90638 *2*	8.57[c]	2477	4744	2,3,4?,5
42	Mo	95.94	10.22[c]	2623	4639	2 to 6
43	Tc	(98)	11.50[t]	2157	4265	0,2,4 to 7
44	Ru	101.07 *2*	12.41[c]	2334	4150	0 to 8
45	Rh	102.90550 *2*	12.41[c]	1964	3695	3

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Z	El	Atomic Weight[a]	Density (g/cc)[b]	Melting Pt. (°C)[b]	Boiling Pt. (°C)[b]	Valence[b]
46	Pd	106.42	12.02[c]	1554.9	2963	2 to 4
47	Ag	107.8682 *2*	10.50[c]	961.78	2162	1
48	Cd	112.411 *8*	8.65[c]	321.07	767	2
49	In	114.818 *3*	7.31[c]	156.60	2072	1 to 3
50	Sn	118.710 *7*	5.75[q]	231.93	2602	2,4
51	Sb	121.760	6.691[c]	630.63	1587	0,±3,5
52	Te	127.60 *3*	6.24[c]	449.51	988	2,4,6
53	I	126.90447 *3*	4.93[v]	113.7	184.4	1,3,5,7
54	Xe	131.293 *6*	0.005887	–111.79	–108.12	0
55	Cs	132.90545 *2*	1.873[c]	28.44	671	1
56	Ba	137.327 *7*	3.5[c]	727	1897	2
57	La	138.9055 *2*	6.145[e]	918	3464	3
58	Ce	140.116	6.770[e]	798	3424	3,4
59	Pr	140.90765 *2*	6.773[r] 6.64[s]	931	3520	3
60	Nd	144.24 *3*	7.008	1021	3074	3
61	Pm	(145)	7.264[e]	1042	3000	3
62	Sm	150.36 *3*	7.520[r] 7.40[s]	1072	1790	2,3
63	Eu	151.964	5.244[e]	822	1596	2,3
64	Gd	157.25 *3*	7.901[e]	1313	3273	3
65	Tb	158.92534 *2*	8.230	1356	3230	3,4
66	Dy	162.50 *3*	8.551[e]	1412	2567	3
67	Ho	164.93032 *2*	8.795[e]	1474	2700	3
68	Er	167.259 *3*	9.066[e]	1529	2868	3
69	Tm	168.93421 *2*	9.321[e]	1545	1950	3
70	Yb	173.04 *3*	6.903[r] 6.966[s]	819	1196	2,3
71	Lu	174.967	9.841[e]	1663	3402	3
72	Hf	178.49 *2*	13.31[c]	2233	4603	4
73	Ta	180.9479	16.654	3017	5458	2?,3,4?,5
74	W	183.84	19.3[c]	3422	5555	2 to 6
75	Re	186.207	21.02[c]	3186	5596 (est.)	4,6,7
76	Os	190.23 *3*	22.57	3033	5012	0 to 8
77	Ir	192.217 *3*	22.42 (17°C)	2446	4428	3,4
78	Pt	195.078 *2*	21.45[c]	1768.4	3825	1?,2,3
79	Au	196.96655 *2*	=19.3[c]	1064.18	2856	1,3
80	Hg	200.59 *2*	13.546[c]	–38.83	356.73	1,2
81	Tl	204.3833 *2*	11.85[c]	304	1473	1,3
82	Pb	207.2	11.35[c]	327.46	1749	2,4
83	Bi	208.98038 *2*	9.747[c]	271.40	1564	3,5
84	Po	(209)	9.32[r]	254	962	0,±2,3?,4,6
85	At	(210)		300[t]		1,3,5,7
86	Rn	(222)	0.00973	–71	–61.7	0
87	Fr	(223)		27		1
88	Ra	(226)	5	700		2
89	Ac	(227)	10.07[t]	1051	3198	3
90	Th	232.03801	11.72	1750	4788	2?,3?,4
91	Pa	(231)	15.37[t]	1572		4,5

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Z	El	Atomic Weight[a]	Density (g/cc)[b]	Melting Pt. (°C)[b]	Boiling Pt. (°C)[b]	Valence[b]
92	U	238.02891 *3*	=18.95	1135	4131	2 to 6
93	Np	(237)	20.25[c]	644		3 to 6
94	Pu	(244)	19.84[e]	640	3228	3,to 6
95	Am	(243)	13.67[c]	1176	2011	2 to 6
96	Cm	(247)	13.51[t]	1345		3,4
97	Bk	(247)	14[t]	1050		3,4
98	Cf	(251)		900		3
99	Es	(252)		860[t]		3
100	Fm	(257)		1527		3
101	Md	(258)		827		2,3
102	No	(259)		827		2,3

Footnotes and References

a) Atomic weights of many elements are not invariant and depend on the origin and treatment of the material. The values given here apply to elements as they exist naturally on earth and are from N. E. Holden, *Handbook of Chemistry and Physics* (2002). Uncertainty is 1 in last significant figure, unless expressly given.

Masses are scaled to 12 for ^{12}C.

Parenthetical whole numbers represent the mass numbers (A) of the longest lived isotopes for radioactive elements.

Isotopic masses (and more precise atomic weights for some mono–isotopic elements) may be calculated as A+(Δ/931.494), where A is the mass number and Δ is the mass excess as given in the *Nuclear Wallet Cards*.

b) C.R. Hammond, in *CRC Handbook of Chemistry and Physics, 85th edition, 2004*, 4–1, 4–121. Where specified, exact temperature and pressure conditions are given; the conditions for all gases have been inferred to be 0°C and 1 atm. The densities for the following gaseous elements are for diatomic molecules: H, N, O, F, Cl. In general, densities for gases (in g/cc) may be approximated by the formula: density=MP/82.05T, where M is the molecular weight in g, P the pressure in atm, and T the temperature in °K. The reported oxidation states do not include some uncommon states, or those states predicted by periodicity, but not confirmed chemically.

c) At 20°C.

d) For gas; density (liquid)=0.0708 g/cc at b.p.; density (solid)=0.0706 g/cc at –262°C.

f) For gas; density (liquid)=0.1221 g/cc at b.p.

e) At 25°C.

f) For gas; density (liquid)=1.221 g/cc at b.p.

g) At 1 atm.

h) For crystal form; density (amorphous)=2.37 g/cc.

i) For amorphous carbon; density (graphite)=1.9 to 2.3 g/cc; density (gem diamond)=3.513 g/cc at 25°C; density (other diamond)=3.15 to 3.53 g/cc.

j) For gas; density (liquid)=0.808 g/cc at b.p.; density (solid)=1.026 g/cc at –252°C.

k) For gas; density (liquid)=1.14 g/cc at b.p.

l) For white phosphorus; density (red)=2.20 g/cc; density (black)=2.25 to 2.69 g/cc.

m) For rhombic sulfur; melting point (monoclinic)=119.0°C; density (monoclinic)=1.957 g/cc at 20°C.

n) Depending on allotropic form.

o) For gray arsenic; density (yellow)=1.97 g/cc.

p) For gray selenium; density (vitreous)=4.28 g/cc.

q) For gray tin; density (white)=7.13 g/cc.

r) For α modification.

s) For β modification.

t) Calculated.

u) For liquid at 20°C; 0.00759 g/cc for gas.

v) For solid at 20°C; 0.01127 g/cc for gas.

Appendix–II Frequently–Used Constants

The frequently used constants are given below in familiar units. Only approximate values are given, see App–III for values to current known precision.

Symbol	Constant	Value
$1/\alpha=\hbar c/e^2$	Fine structure constant	137.0
c	Speed of light in vacuum	2.998×10^{10} cm/s
h $\hbar=h/2\pi$ $\hbar c$	Planck constant	6.626×10^{-27} erg s 6.582×10^{-22} MeV s 197.3 MeV fm
$k=R/N_A$	Boltzmann constant	8.617×10^{-11} MeV/K
$r_e=e^2/m_ec^2$	Classical e^- radius	2.818 fm
$\lambda\!\!\!^{-}_{C,e}=\hbar/m_ec$	Compton wavelength of e^-	386.2 fm
$\lambda\!\!\!^{-}_{C,p}=\hbar/m_pc$	Compton wavelength of p	0.210 fm
$\lambda\!\!\!^{-}_{C,\pi}=\hbar/m_\pi c$	Compton wavelength of π	1.414 fm
u	Atomic mass unit	931.5 MeV/c^2
m_e	Electron mass	0.511 MeV/c^2
m_n	Neutron mass	939.6 MeV/c^2
m_p	Proton mass	938.3 MeV/c^2
m_d	Deuteron mass	1875.6 MeV/c^2
$m_{\pi^\pm}$	$\pi^\pm$ mass	139.6 MeV/c^2
m_{π°	π^0 mass	135.0 MeV/c^2
m_W	$W^\pm$ boson mass	80.2 GeV/c^2
m_Z	Z^0 boson mass	91.2 GeV/c^2
$\mu_N=\hbar e/2m_pc$	Nuclear magneton	3.152×10^{-18} MeV/Gauss
μ_p	Proton magnetic moment	2.793 μ_N
μ_n	Neutron magnetic moment	–1.913 μ_N

1 fm=10^{-13} cm	1 Å=10^{-8} cm	π=3.1416
1 barn=10^{-24} cm^2	1 eV/c^2=1.783×10^{-33} g	
1 joule=10^7 erg	1 coulomb=2.998×10^9 esu	
1 newton=10^5 dyne	1 tesla=10^4 gauss	

Appendix–IIa Fundamental Constants

Unless otherwise noted, the information presented in this table is from *CODATA Values of Fundamental Physical Constants: 1998*.[a] The constants are arranged alphabetically according to the symbols by which they are denoted. The numbers in *italics* are the one–standard–deviation uncertainty in the last digits of the values given. The unified atomic mass scale ($^{12}C \equiv 12$) has been used throughout. Values are given for both SI and cgs units. In cgs units "permittivity of vacuum" μ_0 and "permeability of vacuum" ε_0 are dimensionless unit quantities; in SI units they have the values[f]

$\mu_0 = 4\pi \times 10^{-7}\ \mathrm{m \cdot kg \cdot s^{-2} \cdot A^{-2}} = 4\pi \times 10^{-7}\ \mathrm{N \cdot A^{-2}} = 4\pi \times 10^{-7}\ \mathrm{T \cdot A^{-1}}$
$\varepsilon_0 = 1/\mu_0 c^2$

The factor in square brackets given in the definition of a quantity is to be omitted to obtain the expression in cgs units[f].

The following abbreviations are used:

A = ampere

C = coulomb

cm = centimeter

emu = electromagnetic unit

esu = electrostatic unit

G = gauss

g = gram

Hz = hertz = cycles/sec

J = joule

K = degree Kelvin

kg = kilogram

m = meter

mol = mole

N = newton

s = second

T = tesla

u = atomic mass unit (unified scale)

V = volt

W = watt

Wb = Weber

Appendix–IIa Fundamental Constants

Symbol	Constant	Value	Units (SI)[b]	Units (cgs)[b]
$a_0=r_e/\alpha^2$	Bohr radius	5.291772083 *19*	10^{-11} m	10^{-9} cm
$\alpha=e^2/\hbar c[4\pi\varepsilon_0]$ $1/\alpha$	Fine structure constant	0.007297352533 *27* 137.035999976 *50*		
c	Speed of light in vacuum	2.99792458[(e)]	10^8 m s^{-1}	10^{10} cm s^{-1}
$c_1=2\pi hc^2$	First radiation constant	3.74177107 *29*	10^{-16} W m^2	10^{-5} erg cm^2 s^{-1}
$c_2=hc/k$	Second radiation constant	1.4387752 *25*	10^{-2} m K	cm K
e	Elementary charge	4.80320420 *19* 1.602176462 *63*	10^{-10} esu 10^{-19} C	10^{-20} emu
2e/h	Josephson frequency–voltage ratio	4.83597898 *19*	10^{14} Hz V^{-1}	
$-e/m_e$	Electron specific charge	–1.758820174 *71*	10^{11} C kg^{-1}	10^7 emu g^{-1}
$F=N_Ae$	Faraday constant	9.64853415 *39*	10^4 C mol^{-1}	10^3 emu mol^{-1}
γ_p	Gyromagnetic ratio of proton	2.67522212 *11*	10^8 s^{-1} T^{-1}	10^4 s^{-1} G^{-1}
γ_p'	Gyromagnetic ratio of proton (uncorrected for diamagnetism of H_2O)	2.67515341 *11*	10^8 s^{-1} T^{-1}	10^4 s^{-1} G^{-1}
G	Gravitational constant	6.673 *10*	10^{-11} m^3 kg^{-1} s^{-2}	10^{-8} cm^{-3} g^{-1} s^{-2}

Appendix–IIa Fundamental Constants

Symbol	Constant	Value	Units (SI)[b]	Units (cgs)[b]
h	Planck constant	6.62606876 *52*	10^{-34} J s	10^{-27} erg s
$\hbar=h/2\pi$		1.054571596 *82*	10^{-34} J s	10^{-27} erg s
$h/2e$	Quantum of magnetic flux	2.067833636 *81*	10^{-15} Wb	10^{-7} G cm^2
$k=R/N_A$	Boltzmann constant	1.3806503 *24*	10^{-23} J K^{-1}	10^{-16} erg K^{-1}
$\lambda_{C,e}=h/m_e c$	Compton wavelength of electron	2.426310215 *18*	10^{-12} m	10^{-10} cm
$\lambda_{C,p}=h/m_p c$	Compton wavelength of proton	1.321409847 *10*	10^{-15} m	10^{-13} cm
$\lambda_{C,n}=h/m_n c$	Compton wavelength of neutron	1.319590898 *10*	10^{-15} m	10^{-13} cm
m_e	Electron mass	5.485799110 *12*	10^{-4} u	10^{-4} u
m_H	Mass of hydrogen atom	1.007825032 *1*[(c)]	u	u
m_μ	Muon mass	0.1134289168 *34*	u	u
m_n	Neutron mass	1.00866491578 *55*	u	u
m_p	Proton mass	1.00727646688 *13*	u	u
$m_{\pi\pm}$	$\pi^\pm$ mass	0.1498348 *4*[(d)]	u	u

Appendix–IIa Fundamental Constants

Symbol	Constant	Value	Units (SI)[b]	Units (cgs)[b]
$m_{\pi 0}$	π^0 mass	0.1449034 *6*[(d)]	u	u
$\mu_B=[c]e\hbar/2m_ec$	Bohr magneton	9.27400899 *37*	10^{-24} J T^{-1}	10^{-21} erg G^{-1}
μ_e/μ_B	Magnetic moment of electron in units of μ_B	−1.0011596521869 *41*		
μ_μ	Muon magnetic moment	−4.49044813 *22*	10^{-26} J T^{-1}	10^{-23} erg Gs^{-1}
$\mu_N=[c]e\hbar/2m_pc$	Nuclear magneton	5.05078317 *20*	10^{-27} J T^{-1}	10^{-24} erg G^{-1}
N_A	Avogadro constant	6.02214199 *47*	10^{23} mol^{-1}	10^{23} mol^{-1}
R	Molar gas constant	8.314472 *15*	J mol^{-1} K^{-1}	10^7 erg mol^{-1} K^{-1}
$R_\infty=m_ec\alpha^2/2h$	Rydberg constant for infinite mass	1.0973731568549 *83*	10^7 m^{-1}	10^5 cm^{-1}
$r_e=\hbar\alpha/m_ec$	Classical e^- radius	2.817940285 *31*	10^{-15} m	10^{-13} cm
$\sigma=(\pi^2/60)k^4/\hbar^3c^2$	Stefan–Boltzmann constant	5.670400 *40*	10^{-8} W m^{-2} K^{-4} erg cm^{-2} s^{-1} K^{-4}	10^{-5}
$u = 1/N_A$	Atomic mass unit	1.66053873 *13* 931.494013 *37*	10^{-27} kg MeV	10^{-24} g

1 year (sidereal) = 365.25636 days = 3.1558150×10^7 s, 1 year (tropical) = 365.242 days = 3.15569×10^7 s

Appendix–IIa Fundamental Constants

a) P.J. Mohr and B.N. Taylor, *Jl. of Phys. and Chem. Ref. Data* 28, 1713 (1999); *Rev. Mod. Phys.* 72, 351 (2000). Data taken from *Physics Today* 56, BG6 (2003); http://physics.nist.gov/constants

b) Quantities are given in the International System of Units (SI) except for the atomic mass unit; this unit is not part of the SI.

c) The AME2003 atomic mass evaluation, G. Audi, A.H. Wapstra, and C. Thibault, *Nuclear Physics* A729, 337 (2003)

d) Review of Particle Physics, S. Eidelman, *et al.*, *Physics Letters* B592, 1 (2004); http://pdg.lbl.gov/

e) Speed of light in vacuum is an exact constant as a result of redefinition of meter [P. Giacomo, *Metrologia* 20, 25 (1984)].

f) General Section by H.L. Anderson and E.R. Cohen in *A Physicist's Desk Reference*, H.L. Anderson, Editor–in–Chief, AIP, New York (1989)

Appendix–III Energy–Equivalent Factors†

units	erg	eV	s^{-1}	cm^{-1}
erg	1.0	1.602176462 *63*$\times10^{-12}$	6.6260876 *52*$\times10^{-27}$	1.98644544 *16*$\times10^{-16}$
eV	6.24150974 *24*$\times10^{11}$	1.0	4.13566727 *16*$\times10^{-15}$	1.239841857 *49*$\times10^{-4}$
s^{-1}	1.50919050 *12*$\times10^{26}$	2.417989491 *95*$\times10^{14}$	1.0	2.99792458 $\times10^{10}$
cm^{-1}	5.03411762 *39*$\times10^{15}$	8.06554477 *32*$\times10^{3}$	3.335640952$\times10^{-11}$	1.0
K	7.242964 *13*$\times10^{15}$	1.1604506 *20*$\times10^{4}$	4.7992374 *84*$\times10^{-11}$	1.4387752 *25*
g	1.112650056$\times10^{-21}$	1.782661731 *70*$\times10^{-33}$	7.37249578 *58*$\times10^{-48}$	2.21021863 *17*$\times10^{-37}$
u	6.70053662 *53*$\times10^{2}$	1.073544206 *43*$\times10^{-9}$	4.439821637 *34*$\times10^{-24}$	1.331025042 *10*$\times10^{-13}$

(1 cal = 4.1840 J, 1 J = 10^7 erg)

Note: In the above table all entries in the same column are equivalent. The various units of energy are connected as follows:

1 erg = $1/c^2$ g = $1/(mc^2)$ u = 1/(hc) cm^{-1} = 1/h s^{-1} = 1/k ^{0}K = 1/e eV

Examples:1 eV = 1.602..$\times10^{-12}$ erg = 1.073..$\times10^{-9}$ u= 3.829..$\times10^{-20}$ cal

e/h = 2.417..$\times10^{14}$ s^{-1}, e/(hc) = 8.0654..$\times10^{3}$ cm^{-1}

e/c^2 = 1.782..$\times10^{-33}$ g, e/mc^2 = 1.073..$\times10^{-9}$ u

e/k = 1.160..$\times10^{4}$ K

Appendix–III Energy–Equivalent Factors†

units	deg K	g	u
erg	$1.3806503\ 24\times10^{-16}$	8.987551787×10^{20}	$1.49241778\ 12\times10^{-3}$
eV	$8.617342\ 15\times10^{-5}$	$5.60958921\ 22\times10^{32}$	$9.31494013\ 37\times10^{8}$
s^{-1}	$2.0836644\ 36\times10^{10}$	$1.35639277\ 11\times10^{47}$	$2.252342733\ 17\times10^{23}$
cm^{-1}	$6.950356\ 12\times10^{-1}$	$4.52443929\ 35\times10^{36}$	$7.513006658\ 57\times10^{12}$
K	1.0	$6.509651\ 11\times10^{36}$	$1.0809528\ 19\times10^{13}$
g	$1.5361807\ 27\times10^{-37}$	1.0	$1.66053873\ 13\times10^{-24}$
u	$9.251098\ 16\times10^{-14}$	$6.02214199\ 47\times10^{23}$	1.0

Note: In the above table all entries in the same column are equivalent.

Example: 1u ≡ 1.492..$\times10^{-3}$ erg = 9.314..$\times10^{8}$ eV = 3.567..$\times10^{-11}$ cal, etc.

† From CODATA Values of Fundamental Physical Constants:1998, P.J. Mohr and B.N. Taylor, *Jour. of Phys. and Chem. Ref. Data* 28, 1713 (1999), *Rev. Mod. Phys.* 72, 351 (2000), *Physics Today* 56, BG6 (2003); http://physics.nist.gov/constants.

Appendix–IV Observed Λ Hypernuclides†

El	A	J(g.s.)	B_Λ(g.s.)*	Excited (bound) states (MeV)
H	3	1/2	0.13 *5*	
	4	0	2.04 *4*	E=1.05 *4*
He	4	0	2.39 *3*	E=1.15 *4*
	5	1/2	3.12 *2*	
	6	(1)	4.18 *10*	
	8		7.16 *70*	
Li	6		4.50	E=8.3,18.3
	7	1/2+	5.58 *3*	E=0.692 *4* 3/2+[a],2.050 *2* 5/2+[a], 2.521 7/2+[a],3.877 1/2+[a]
	8	1	6.80 *3*	E=0.442?[b],1.22 4
	9		8.50 *12*	
Be	7	1/2	5.16 *8*	
	8		6.84 *5*	
	9	1/2	6.71 *4*	E[b]=3.079 *4*[#],5.98 84,10.59 72, 16.55 69,22.93 71,27.90 72
	10		9.11 *22*	
B	9		8.29 *18*	
	10		8.89 *12*	E[c]=2.5 *2*,6.2 2,9.5 *3*
	11	5/2	10.24 *5*	
	12	1	11.37 *6*[d]	
C	12	1	10.80 *18*[d]	E[e]=2.71 *13* 1−,6.05 *18* 1−,8.10 *38*, 10.97 *5* 2+,12.0 *3*[b],16.2 *2*[b]
	13	1/2+	11.69 *12*	E[e]=4.9 *1* 3/2+,9.6 *3* 3/2−,11.6 *2* 1/2+, 15.4 *1*[#]
	14		12.17 *33*	
N	14		12.17	E=10.5,19,22
	15		13.59 *15*	
O	16	1−[e]	12.5	E[e]=6.3 *1* 1−,10.6 *1* 2+,0−,16.7 *1* 2+,0+, 20.0 *4*[b],23.3 5[b]
	18			E=13,20,24,30
Al	27			E=7,18[b]
Si	28		16.6[c]	E[c]=4.7 *4*,9.6 *3*,12.3 *3*,17.6 *8*,23.2 *5*[b]
S	32		17.5 *5*	E=11.5,22.5
Ca	40		20.0 *5*	E[b]=2.9 *13*,6.1 *13*,8.3 *11*,13.9 *11*, 16.7 *11*,19.8 *11*,22.9 *13*
V	51		19.5[f]	E[b]=3.5 *16*,5.7 *10*,8.4 *10*,12.1 *11*, 15.0 *10*,18.3 *11*,21.8 *10*,26.0 *10*
Fe	56		21	
Y	89		23 *2*	E[b,c]=6.9 *16*,13.4 *16*,19.8 *16*,27.2 *16*
La	139		23.8 *10*[c]	E[c]=3.8 *11*
Pb	208		26.5 *5*[c]	E[c]=5.2 *9*
Bi	209			E=32,40

Appendix–IV Observed Λ Hypernuclides†

Footnotes and References

† This table has been prepared by R. Chrien (BNL). The data are mostly from D. Davis and J. Pniewski, *Contemp. Phys.* 27, 91 (1986), and H. Bando, T. Motoba, and J. Zofka, *Int. J. Mod. Phys.* A5, 4021 (1990), except where indicated otherwise.

Almost all recent data have come from (π^+,K^+) reactions using magnetic spectrometers and Ge detectors at BNL and KEK. The early work is emulsion data while the later work is derived from magnetic spectrometers using $(K^\pm,\pi^\pm)$ data.

The only confirmed example of a bound Σ hypernuclide is the T=1/2 isospin state in ^{4}He reported by Nagae *et al.*, *Phys. Rev. Lett.* 80, 1605 (1998).

In addition to these single Λ hypernuclides, several instances of double Λ species have been reported. These are an observation of ${}_{\Lambda\Lambda}{}^{6}$He by H. Takahashi, *et al.*, *Phys. Rev. Lett.* 87, 212502 (2001), and of ${}_{\Lambda\Lambda}{}^{4}$He by J.K. Ahn, *et al.*, *Phys. Rev. Lett.* 87, 132504 (2001),

* Λ binding energy.

\# Possibly complex.

a K. Tanida, Proc. of APCTP workshop (1999), World Scientific Pub., Pvt. Ltd., Singapore; H. Tamura, *et al.*, *Phys. Rev. Lett.* 84, 5963 (2000); M. Ukai, "Cascade γ Decay in the ${}^{7}_{\Lambda}$Li Hypernucleus", submitted for publication, April 2005.

b P.H. Pile, *et al.*, *Phys. Rev. Lett.* 66, 2585 (1991) and R.E. Chrien, priv. comm. (2000).

c T. Hasegawa *et al.*, *Phys. Rev* C53, 1210 (1996).

d P. Dluzewski *et al.*, *Nucl. Phys.* A484 520 (1988).

e O. Hashimoto, *et al.*, *Nucl. Phys.* A639, 93c (1998)

f Calculated.

Radioactive Decay Chains in Nature

The following three radioactive decay chains occur in nature:

The Thorium Series:

$^{232}Th(\alpha)^{228}Ra(\beta^-)^{228}Ac(\beta^-)^{228}Th(\alpha)$
$^{224}Ra(\alpha)^{220}Rn(\alpha)^{216}Po(\alpha)^{212}Pb(\beta^-)$
$^{212}Bi(\beta^-)^{212}Po(\alpha)^{208}Pb$,
$^{212}Bi(\alpha)^{208}Tl(\beta^-)^{208}Pb$

The Uranium Series:

$^{238}U(\alpha)^{234}Th(\beta^-)^{234}Pa(\beta^-)^{234}U(\alpha)$
$^{230}Th(\alpha)^{226}Ra(\alpha)^{222}Rn(\alpha)^{218}Po(\beta^-)$
$^{218}At(\alpha)^{214}Bi(\beta^-)^{214}Po(\alpha)^{210}Pb(\beta^-)$,
$^{218}Po(\alpha)^{214}Pb(\beta^-)^{214}Bi(\alpha)^{210}Tl(\beta^-)$
$^{210}Pb(\beta^-)^{210}Bi(\alpha)^{206}Tl(\beta^-)^{206}Pb$,
$^{210}Pb(\alpha)^{206}Hg(\beta^-)^{206}Tl(\beta^-)^{206}Pb$,
$^{210}Bi(\beta^-)^{210}Po(\alpha)^{206}Pb$

The Actinium Series

$^{235}U(\alpha)^{231}Th(\beta^-)^{231}Pa(\alpha)^{227}Ac(\beta^-)$
$^{227}Th(\alpha)^{223}Ra(\alpha)$,$^{227}Ac(\alpha)^{223}Fr(\beta^-)$
$^{223}Ra(\alpha)^{219}Rn(\alpha)$,$^{223}Fr(\alpha)^{219}At(\beta^-)$
$^{219}Rn(\alpha)^{215}Po(\alpha)$,$^{219}At(\alpha)^{215}Bi(\beta^-)$
$^{215}Po(\beta^-)^{215}At(\alpha)^{211}Bi(\beta^-)^{211}Po(\alpha)$
^{207}Pb,$^{215}Po(\alpha)^{211}Pb(\beta^-)^{211}Bi(\alpha)$
$^{207}Tl(\beta^-)^{207}Pb$

Radioactive Nuclides in Nature

Nuclide			Half–life	Decay Modes	Major γ–rays (keV) Iγ>2%
1	**H**	**3**	12.32 y	β–	
4	**Be**	**7**	53.22 d	ε	
6	**C**	**14**	5700 y	β–	
19	**K**	**40**	1.248×10^{9} y	β–, γ	1461
23	**V**	**50**	1.4×10^{17} y	ε	1554, 783
37	**Rb**	**87**	4.97×10^{10} y	β–	
48	**Cd**	**113**	7.7×10^{15} y	β–	
49	**In**	**115**	4.41×10^{14} y	β–	
52	**Te**	**123**	$>9.2\times10^{16}$ y	ε	
57	**La**	**138**	1.02×10^{11} y	ε	1436, 789
60	**Nd**	**144**	2.29×10^{15} y	α	
62	**Sm**	**147**	1.06×10^{11} y	α	
		148	7×10^{15} y	α	
64	**Gd**	**152**	1.08×10^{14} y	α	
71	**Lu**	**176**	4.08×10^{10} 3	β–	
72	**Hf**	**174**	2.0×10^{15} y	α	
73	**Ta**	**180m**	$>1.2\times10^{15}$ y	2ε	
75	**Re**	**187**	4.12×10^{10} y	β–	
76	**Os**	**186**	2.0×10^{15} y	α	
78	**Pt**	**190**	6.5×10^{11} y	α	
80	**Hg**	206	8.15 m	β–	
81	**Tl**	206	4.2 m	β–	
		207	4.77 m	β–	
		208	3.053 m	β–, γ	2615, 583, 511
		210	1.3 m	β–, γ	800, 296, 1316
82	**Pb**	210	22.2 y	β–	
		211	36.1 m	β–, γ	405, 832
		212	10.64 h	β–, γ	239, 77, 75
		214	26.8 m	β–, γ	352, 295, 77
83	**Bi**	210	5.012 d	β–	
		211	2.14 m	α, γ	351
		212	1.009 h	β–, γ	727
		214	19.9 m	β–, γ	609, 1764, 1120
		215	7.6 m	β–	
84	**Po**	210	138.4 d	α	
		211	0.516 s	α	
		212	0.299 μs	α	
		214	164.3 μs	α	
		215	1.781 ms	α	
		216	0.145 s	α	
		218	3.1 m	α	
85	**At**	215	0.1 ms	α	
		218	1.5 s	α	
		219	56 s	α	
86	**Rn**	219	3.96 s	α, γ	271, 402

Radioactive Nuclides in Nature

Nuclide		Half–life	Decay Modes	Major γ–rays (keV) Iγ>2%
86 Rn	220	55.6 s	α	
	222	3.823 d	α	
87 Fr	223	22 m	β−, γ	50, 80, 235
88 Ra	223	11.43 d	α, γ	84, 81, 269
	224	3.632 d	α, γ	241
	226	1600 y	α, γ	186
	228	5.75 y	β−	
89 Ac	227	21.77 y	β−	
	228	6.15 h	β−, γ	911, 969, 338
90 Th	227	18.68 d	α, γ	236, 50, 256
	228	1.912 y	α	
	230	7.538×10^{4} y	α	
	231	1.063 d	β−, γ	84
	232	1.405×10^{10} y	α	
	234	24.1 d	β−, γ	63, 92, 93
91 Pa	231	3.276×10^{4} y	α, γ	300, 303
	234	6.7 h	β−, γ	98, 131, 946
	234m	1.17 m	β−	
92 U	234	2.455×10^{5} y	α	
	235	7.04×10^{8} y	α, γ	186, 144, 93
	238	4.468×10^{9} y	α	

Appendix–VIa Periodic Table of Elements

IA	IIA	IIIB	IVB	VB	VIB	VIIB	---	VIII	---	IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
H 1																	He 2
Li 3	Be 4											B 5	C 6	N 7	O 8	F 9	Ne 10
Na 11	Mg 12											Al 13	Si 14	P 15	S 16	Cl 17	Ar 18
K 19	Ca 20	Sc 21	Ti 22	V 23	Cr 24	Mn 25	Fe 26	Co 27	Ni 28	Cu 29	Zn 30	Ga 31	Ge 32	As 33	Se 34	Br 35	Kr 36
Rb 37	Sr 38	Y 39	Zr 40	Nb 41	Mo 42	Tc 43	Ru 44	Rh 45	Pd 46	Ag 47	Cd 48	In 49	Sn 50	Sb 51	Te 52	I 53	Xe 54
Cs 55	Ba 56	* 57–	Hf 72	Ta 73	W 74	Re 75	Os 76	Ir 77	Pt 78	Au 79	Hg 80	Tl 81	Pb 82	Bi 83	Po 84	At 85	Rn 86
Fr 87	Ra 88	** 89–	Rf 104	Db 105	Sg 106	Bh 107	Hs 108	Mt 109	Ds 110	Rg 111	112	113	114	115	116	117	118
*	La 57	Ce 58	Pr 59	Nd 60	Pm 61	Sm 62	Eu 63	Gd 64	Tb 65	Dy 66	Ho 67	Er 68	Tm 69	Yb 70	Lu 71	Lanthanides	
**	Ac 89	Th 90	Pa 91	U 92	Np 93	Pu 94	Am 95	Cm 96	Bk 97	Cf 98	Es 99	Fm 100	Md 101	No 102	Lr 103	Actinides	

Appendix–VIb List of Elements – Alphabetical

Name	Symbol	Z	Name	Symbol	Z
Actinium	Ac	89	Mendelevium	Md	101
Aluminum	Al	13	Mercury	Hg	80
Americium	Am	95	Molybdenum	Mo	42
Antimony	Sb	51	Neodymium	Nd	60
Argon	Ar	18	Neon	Ne	10
Arsenic	As	33	Neptunium	Np	93
Astatine	At	85	Nickel	Ni	28
Barium	Ba	56	Niobium	Nb	41
Berkelium	Bk	97	Nitrogen	N	7
Beryllium	Be	4	Nobelium	No	102
Bismuth	Bi	83	Osmium	Os	76
Bohrium	Bh	107	Oxygen	O	8
Boron	B	5	Palladium	Pd	46
Bromine	Br	35	Phosphorus	P	15
Cadmium	Cd	48	Platinum	Pt	78
Calcium	Ca	20	Plutonium	Pu	94
Californium	Cf	98	Polonium	Po	84
Carbon	C	6	Potassium	K	19
Cerium	Ce	58	Praseodymium	Pr	59
Cesium	Cs	55	Promethium	Pm	61
Chlorine	Cl	17	Protactinium	Pa	91
Chromium	Cr	24	Radium	Ra	88
Cobalt	Co	27	Radon	Rn	86
Copper	Cu	29	Roentgenium	Rg	111
Curium	Cm	96	Rhenium	Re	75
Darmstadtium	Ds	110	Rhodium	Rh	45
Dubnium	Db	105	Rubidium	Rb	37
Dysprosium	Dy	66	Ruthenium	Ru	44
Einsteinium	Es	99	Rutherfordium	Rf	104
Erbium	Er	68	Samarium	Sm	62
Europium	Eu	63	Scandium	Sc	21
Fermium	Fm	100	Selenium	Se	34
Fluorine	F	9	Seaborgium	Sg	106
Francium	Fr	87	Silicon	Si	14
Gadolinium	Gd	64	Silver	Ag	47
Gallium	Ga	31	Sodium	Na	11
Germanium	Ge	32	Strontium	Sr	38
Gold	Au	79	Sulfur	S	16
Hafnium	Hf	72	Tantalum	Ta	73
Hassium	Hs	108	Technetium	Tc	43
Helium	He	2	Tellurium	Te	52
Holmium	Ho	67	Terbium	Tb	65
Hydrogen	H	1	Thallium	Tl	81
Indium	In	49	Thorium	Th	90
Iodine	I	53	Thulium	Tm	69
Iridium	Ir	77	Tin	Sn	50
Iron	Fe	26	Titanium	Ti	22
Krypton	Kr	36	Tungsten	W	74
Lanthanum	La	57	Uranium	U	92
Lawrencium	Lr	103	Vanadium	V	23
Lead	Pb	82	Xenon	Xe	54
Lithium	Li	3	Ytterbium	Yb	70
Lutetium	Lu	71	Yttrium	Y	39
Magnesium	Mg	12	Zinc	Zn	30
Manganese	Mn	25	Zirconium	Zr	40
Meitnerium	Mt	109			

Appendix–VIc List of Elements – by Z

Z	Symbol	Name
1	H	Hydrogen
2	He	Helium
3	Li	Lithium
4	Be	Beryllium
5	B	Boron
6	C	Carbon
7	N	Nitrogen
8	O	Oxygen
9	F	Fluorine
10	Ne	Neon
11	Na	Sodium
12	Mg	Magnesium
13	Al	Aluminum
14	Si	Silicon
15	P	Phosphorus
16	S	Sulfur
17	Cl	Chlorine
18	Ar	Argon
19	K	Potassium
20	Ca	Calcium
21	Sc	Scandium
22	Ti	Titanium
23	V	Vanadium
24	Cr	Chromium
25	Mn	Manganese
26	Fe	Iron
27	Co	Cobalt
28	Ni	Nickel
29	Cu	Copper
30	Zn	Zinc
31	Ga	Gallium
32	Ge	Germanium
33	As	Arsenic
34	Se	Selenium
35	Br	Bromine
36	Kr	Krypton
37	Rb	Rubidium
38	Sr	Strontium
39	Y	Yttrium
40	Zr	Zirconium
41	Nb	Niobium
42	Mo	Molybdenum
43	Tc	Technetium
44	Ru	Ruthenium
45	Rh	Rhodium
46	Pd	Palladium
47	Ag	Silver
48	Cd	Cadmium
49	In	Indium
50	Sn	Tin
51	Sb	Antimony
52	Te	Tellurium
53	I	Iodine
54	Xe	Xenon
55	Cs	Cesium
56	Ba	Barium
57	La	Lanthanum
58	Ce	Cerium
59	Pr	Praseodymium
60	Nd	Neodymium
61	Pm	Promethium
62	Sm	Samarium
63	Eu	Europium
64	Gd	Gadolinium
65	Tb	Terbium
66	Dy	Dysprosium
67	Ho	Holmium
68	Er	Erbium
69	Tm	Thulium
70	Yb	Ytterbium
71	Lu	Lutetium
72	Hf	Hafnium
73	Ta	Tantalum
74	W	Tungsten
75	Re	Rhenium
76	Os	Osmium
77	Ir	Iridium
78	Pt	Platinum
79	Au	Gold
80	Hg	Mercury
81	Tl	Thallium
82	Pb	Lead
83	Bi	Bismuth
84	Po	Polonium
85	At	Astatine
86	Rn	Radon
87	Fr	Francium
88	Ra	Radium
89	Ac	Actinium
90	Th	Thorium
91	Pa	Protactinium
92	U	Uranium
93	Np	Neptunium
94	Pu	Plutonium
95	Am	Americium
96	Cm	Curium
97	Bk	Berkelium
98	Cf	Californium
99	Es	Einsteinium
100	Fm	Fermium
101	Md	Mendelevium
102	No	Nobelium
103	Lr	Lawrencium
104	Rf	Rutherfordium
105	Db	Dubnium
106	Sg	Seaborgium
107	Bh	Bohrium
108	Hs	Hassium
109	Mt	Meitnerium
110	Ds	Darmstadtium
111	Rg	Roentgenium

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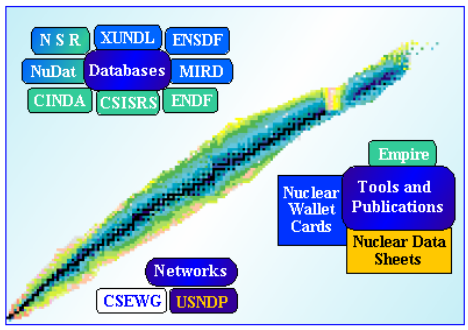

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CapGam Thermal Neutron Capture Gamma-rays

CINDA Computer Index of Nuclear (reaction) Data

CSEWG Cross Section Evaluation Working Group

CSISRS alias EXFOR Nuclear reaction experimental data

Empire Nuclear reaction model code

ENDF Evaluated Nuclear (reaction) Data File

ENSDF Evaluated Nuclear Structure Data File

For NMMSS and DoE NMIRDC Standards for decay data

IRDF International Reactor Dosimetry File [IRDF-2002]

MIRD Medical Internal Radiation Dose

NSR Nuclear Science References

Nuclear Data Sheets Nuclear structure and decay data journal

Nuclear Wallet Cards Ground and isomeric states properties

Nuclear Wallet Cards for Homeland Security

NuDat Nuclear structure and decay data

RIPL Reference Input Parameter Library

USNDP U.S. Nuclear Data Program

XUNDL Experimental Unevaluated Nuclear Data List

Coming Early 2006: **Atlas of Neutron Resonances**

Coming March 2005: **Empire 2.19**

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Nuclear Reaction Services

ENDF (*E*valuated *N*uclear *D*ata *F*ile): Core nuclear reaction database containing evaluated data for all relevant nuclides (328 in total) for n energies up to 20 MeV, and in some cases up to 150 MeV.

CSISRS (*C*ross *S*ection *I*nformation *S*torage and *R*etrieval *S*ystem) alias EXFOR (*Ex*change *For*mat): Experimental nuclear reaction data for incident n, charged particles, and photons. It contains >14000 experiments, spanning almost all n-induced reaction experiments

Empire: Nuclear reaction model code using various reaction mechanisms. Offers friendly graphic user interface and provides ENDF-6 formatted files.

Libraries: Includes the 2003 Atomic Mass Evaluation and the International Reactor Dosimetry File (2002)

CINDA (*C*omputer *I*ndex of *N*uclear reaction *Da*ta)—Bibliographic references to nuclear reaction data.

Nuclear Structure Services

ENSDF (*E*valuated *N*uclear *S*tructure *D*ata *F*ile): Evaluated data on adopted levels and their properties, decay schemes, and nuclear structure from reactions for all known nuclides.

NSR (*N*uclear *S*cience *R*eferences): Bibliographic information on nuclear structure, nuclear reactions, and radioactive decays. Some papers on atomic physics are included that are relevant to the physics of nuclear structure.

NuDat (*Nu*clear *Da*ta)—Evaluated nuclear data for all known nuclides, including nuclear levels and γ's and their properties, thermal cross sections and resonance integrals in user-friendly format. User-defined retrieval, plot and tabular output options are available.

XUNDL (Experimental *U*nevaluated *N*uclear *D*ata *L*ist): Experimental nuclear structure and decay data compiled in ENSDF format.

MIRD—Information on radionuclide decay in the format of the **M**edical **I**nternal **R**adiation **D**ose Committee