NUCLEAR WALLET CARDS

April 2005

Jagdish K. Tuli

National Nuclear Data Center
www.nndc.bnl.gov

Brookhaven National Laboratory
P.O. Box 5000
Upton, New York 11973–5000
U.S.A.

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NATIONAL NUCLEAR DATA CENTER
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for

The U.S. Nuclear Data Program

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U.S. Nuclear Data Program

(http://www.nndc.bnl.gov/usndp/)

Argonne National Laboratory
Technology Development Division
9700 South Cass Avenue
Argonne, IL 60439

Brookhaven National Laboratory
National Nuclear Data Center
Building 197D,
P.O. Box 5000,
Upton, NY 11973–5000

Lawrence Berkeley National Laboratory
Isotopes Project
Berkeley, CA 94720

Lawrence Livermore National Laboratory
Computational Nuclear Physics Group
P.O. Box 808, MS L–059
Livermore, CA 94550

Los Alamos National Laboratory
Group T–16, Nuclear Physics
MS B–283
Los Alamos, NM 87545

Los Alamos National Laboratory
Group LANSC–3, Neutron and
Nuclear Science, MS H–855
Los Alamos, NM 87545

McMaster University
Tandem Accelerator Laboratory
Hamilton, Ontario L8S 4K1
Canada

National Institute of Standards and Technology
Nucl. Data Verification &
Standardization Project
100 Bureau Dr Stop 8463
Gaithersburg, MD 20899–8463

Oak Ridge National Laboratory
Nuclear Data Project
Bldg. 6000, MS 6371
P.O. Box 2008
Oak Ridge, TN 37831–6371

Triangle Universities Nuclear Laboratory
Nuclear Data Evaluation
Project
Nuclear Reaction Phenomenology
P.O. Box 90308,
Durham, NC 27708–0308

INTRODUCTION

This is an updated edition of the 2000 booklet of the same name†.

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 For nuclides for which either there are no data in ENSDF or those data have since been superseded, the half–life and the decay modes are taken either from recent literature[4] or from other sources[*e.g.*, 5]. The ground–state mass excesses are from the mass adjustments by G. Audi, A. H. Wapstra, and C. Thibault[6]. The isotopic abundances are those of N.Holden[7].

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*, 7th edition (1978)[9]. The subsequent editions, the third in 1985, the fourth in 1990, the fifth in 1995, and the sixth edition in 2000 were produced by J.K. Tuli, NNDC.

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 are included 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. A nuclide is included 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$\geq 10^{-6}$, are *italicized* in the table. The information on fission products is taken from the ENDF/B–VI fission products file [8].

The names (El) for elements Z=104–111 are those adopted by the International Union of Pure and Applied Chemistry (2004).

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 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, T½, Γ or Abundance:

The half–life and the abundance (in **bold face**) 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, mostly from [5]. A '?' in this field indicates that T1/2 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 Sercices

The centerfold presents the NNDC home page on the web (*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. The content of this booklet, and its archival editions, are available on the web.

Acknowledgements

The appendix on Λ hypernuclides has been prepared by R. Chrien, BNL. The author is thankful to T. Burrows, M. Herman, B. Pritychenko, D. Rochman, A. Sonzogni, and D. Winchell for many useful sugges–tions. The help in library matters from J. Totans, proof–reading from M. Blennau, and in all computer matters from R. Arcilla is acknowledged. The author is grateful for encouragement and support from P. Oblozinsky and C. Dunford.

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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	10.15 m *1*	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		49.s	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		29.s	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+)	38.s	?	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%

Nuclear Wallet Cards

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 23%, 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***	
		14m	4–	11.353	13.2 Fs *21*	p 79%, IT 21%
		14m	5+	11.827	73 Fs *12*	p 81%, IT 19%
		14m	3+	11.992	9 Fs *4*	p 80%, IT 20%
		15	1/2–	0.101	**0.366%** ***20***	
		15m	9/2+	10.795	12 Fs *6*	IT, p
		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***	

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
8	**O**	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−
		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?

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
11	**Na**	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
		23	3/2+	−9.530	**100%**	
		24	4+	−8.418	14.951 h *3*	β−
		24m	1+	−7.946	20.20 ms *7*	IT 99.95%, β− 0.05%
		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−
		32	0+	−0.95	65 ms *5*	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%

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
13	**Al**	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
		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}%

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
15	**P**	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−
		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%, εβ2p 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%

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
17	**Cl**	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−
		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***	

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
19	**K**	40	4–	–33.535	1.248×10^{9} y *3*	β– 89.28%,
					0.0117% ***1***	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–
		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%, ε2p 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	2ε
					96.94% ***16***	
		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	2β–
					0.004% ***3***	
		47	7/2–	–42.340	4.536 d *3*	β–
		48	0+	–44.214	$>4.5\times10^{22}$ y	2β– 84%,
					0.187% ***21***	β–<15%
		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		–7.s	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%

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
21	**Sc**	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
		43m	3/2+	−36.036	438 μs *7*	IT
		44	2+	−37.816	3.97 h *4*	ε
		44m	6+	−37.545	58.61 h *10*	IT 98.8%, ε 1.2%
		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−?

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
22	**Ti**	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
		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
		46m	3+	−36.271	1.02 ms *7*	IT
		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	40 ms *15*	β−, β−n
		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−

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
24	**Cr**	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−?
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	(3+,4+)	−48.0	671 ms *5*	β−
		62	1+	−48.0	92 ms *13*	β−
		62	(3+,4+)	−48.0	671 ms *5*	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
		68m		−28.6s	28 ms *4*	β−>0%, β−n>0%
		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

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
26	**Fe**	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–
		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%

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
27	**Co**	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
		49		9.0s	>350 ns	p
		50	0+	–3.8s	12 ms *3*	ε , εp 70%
		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
		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–
		68m	5–	–60.615	0.86 ms *5*	IT
		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+	–34.s	>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–

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
29	**Cu**	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%
		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?
		55m		−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−
		73m	(5/2+)	−65.21	13.0 ms *2*	IT
		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%

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
30	**Zn**	*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
		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−
		72m	(0+)	−68.470	39.68 ms *13*	IT
		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

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
32	**Ge**	69m	1/2–	–67.014	5.1 μs *2*	IT
		69m	9/2+	–66.703	2.81 μs *5*	IT
		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%
		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–
		79m	(9/2)+	–72.864	0.87 μs *6*	IT
		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–

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
33	**As**	*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
		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*	2β–
					8.73% ***22***	
		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

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
35	**Br**	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***	
		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%
		88m	(4−,5−)	−70.46	5.3 μs *4*	IT
		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 **0.35% *1***	2ε
		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

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
36	**Kr**	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%
		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%
		84	2–	–79.750	32.1 d *1*	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–

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
37	**Rb**	*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%
		98m	(3,4)	–53.95	96 ms *3*	β–
		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
		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

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
39	**Y**	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%
		80m	(2+)	−60.9	4.7 μs *3*	IT
		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
		88m	(8)+	−83.625	13.97 ms *18*	IT
		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}%
		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%
		99m	(17/2+)	−68.06	8.6 μs *8*	IT
		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

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
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***	
		91m	(21/2+)	–84.723	4.35 μs *14*	IT
		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	2β–
					2.80% 9	
		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		–47.s	≈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

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
41	**Nb**	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−
		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***	

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
42	**Mo**	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*	2β−
					9.63% *23*	
		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
		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%
		93m	(17/2)−	−81.417	10.2 μs *3*	IT
		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−

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
43	**Tc**	*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%
		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−
		103m	11/2−	−87.021	1.69 ms *7*	IT
		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−

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
44	**Ru**	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	(GE 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
		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	(GE4)	−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−

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
45	**Rh**	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–
		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	(9/2–)	–83.61	0.3 s *1*	IT
		113m		–83.69	≥100 s	
		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–
		117m	(11/2–)	–76.33	19.1 ms *7*	IT
		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?

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
47	**Ag**	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%
		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−
		114m	(LE6+)	−84.75	1.50 ms *5*	IT
		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%

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
47	**Ag**	*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 **1.25%** ***6***	2ε
		107	5/2+	−86.985	6.50 h *2*	ε
		108	0+	−89.252	>1.0×10^{18} y **0.89%** ***3***	2ε
		109	5/2+	−88.508	461.4 d *12*	ε
		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* **12.22%** ***12***	β−
		113m	11/2−	−88.786	14.1 y *5*	β− 99.86%, IT 0.14%
		114	0+	−90.021	>6.4×10^{18} y **28.73%** ***42***	2β−
		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* **7.49%** ***18***	2β−
		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−

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
48	**Cd**	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
		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%
		114m	8–	–88.070	43.1 ms *6*	IT
		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%

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
49	**In**	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%
		*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−TO7−)	−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

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
50	**Sn**	111	7/2+	−85.945	35.3 m *6*	ε
		111m	1/2+	−85.690	12.5 μs *10*	IT
		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***	
		115m	7/2+	−89.423	3.26 μs *8*	IT
		115m	11/2−	−89.322	159 μs *1*	IT
		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−
		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−
		132m	(8+)	−71.71	2.03 μs *4*	IT
		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

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
51	**Sb**	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
		115m	11/2−	−85.70	6.2 ns *3*	IT
		115m	(19/2)−	−84.21	159 ns *3*	IT
		115m	(25/2)+	−83.34	4.1 ns *2*	IT
		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%
		117m	(25/2)+	−85.514	355 µs *17*	IT
		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	5+	−88.193	0.53 ms *3*	IT
		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−
		134	(0−)	−74.17	0.78 s *6*	β−
		*134*m	(7−)	−74.17	10.07 s *5*	β− , β−n 0.09%
		*134*m	(1+)	−70.39	<1 ns	n
		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%
		136m	(6−)	−64.9s	0.57 µs *5*	IT
		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%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
52	**Te**	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
		115m	11/2−	−81.78	7.5 μs *2*	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	2ε
					0.09% ***1***	
		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	ε
					0.89% ***3***	
		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*	2β−
					31.74% ***8***	
		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	2β−
					34.08% ***62***	
		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%
		132	0+	−85.182	3.204 d *13*	β−
		132m	(7)−	−83.257	28.1 μs *15*	IT
		132m	(10+)	−82.459	3.70 μs *9*	IT
		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−
		134m	6+	−80.87	164.1 ns *9*	IT
		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%

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
52	**Te**	*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%
		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

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
54	**Xe**	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	≥1.1×10^{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***	
		132m	(10+)	−86.528	8.39 ms *11*	IT
		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	>5.8×10^{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	>2.4×10^{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%
		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	100 ms +*100−50*	β−, β−n<8%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
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−
		*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%

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
55	**Cs**	144m	(GE4)	−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 **0.106%** ***1***	2ε
		130m	8−	−84.786	9.54 ms *14*	IT
		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 **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***	
		134m	(10+)	−85.993	2.63 μs *14*	IT
		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***	
		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−

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
56	**Ba**	*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
		134m		−84.88	29 μs *4*	IT
		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%
					0.090% ***1***	
		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−
		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−

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
57	**La**	*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
		132m	(8–)	–80.13	9.4 ms *3*	IT
		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***	
		138m	7–	–85.44	8.65 ms *20*	IT
		138m	10+	–84.03	81 ns *2*	IT
		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	GE4	−60.3s	3.14 s *22*	ε , 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%
		130m	(2+)	−71.18	40 s *4*	ε
		130m	(4,5)+	−71.18	40 s *4*	ε
		130m	(7,8)	−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− ?

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
59	**Pr**	157		−49.0s	≈0.3 s	β−?
		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
		134m	(8)−	−73.35	410 μs *30*	IT
		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
		140m	7−	−82.03	0.60 ms *5*	IT
		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?

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
61	**Pm**	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
		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
		142m	(8)−	−80.27	2.0 ms *2*	IT
		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%

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
62	**Sm**	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%
		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%
		143m	23/2(−)	−76.729	30 ms *3*	IT
		144	0+	−81.972	**3.07%** ***7***	
		145	7/2−	−80.658	340 d *3*	ε
		145m	(49/2+)	−71.871	0.96 μs +*19*−*15*	IT
		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−
		153m	11/2−	−72.467	10.6 ms *3*	IT
		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

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
63	**Eu**	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
		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

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
64	**Gd**	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}%
		152	0+	–74.714	1.08×10^{14} y *8*	α
					0.20% ***1***	
		153	3/2–	–72.890	240.4 d *10*	ε
		153m	9/2+	–72.795	3.5 μs *4*	IT
		153m	(11/2–)	–72.719	76.0 μs *14*	IT
		154	0+	–73.713	**2.18%** ***3***	
		155	3/2–	–72.077	**14.80%** ***12***	
		155m	11/2–	–71.956	31.97 ms *27*	IT
		156	0+	–72.542	**20.47%** ***9***	
		157	3/2–	–70.831	**15.65%** ***2***	
		157m	11/2–	–70.404	18.5 μs *23*	IT
		158	0+	–70.697	**24.84%** ***7***	
		159	3/2–	–68.568	18.479 h *4*	β–
		159m	5/2+	–68.501	26.2 ns *8*	IT
		160	0+	–67.949	>3.1×10^{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?
		138m		–43.6s	≥200 ns	ε, p
		139		–48.2s	1.6 s *2*	
		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
		142m		–56.4s	15 μs *4*	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

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
65	**Tb**	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
		153m	11/2−	−71.157	186 μs *4*	IT
		154	0	−70.16	21.5 h *4*	ε, β−<0.1%
		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%
		158m	7−	−69.089	0.40 ms *4*	IT
		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%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
66	**Dy**	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
		155m	11/2−	−68.93	6 μs *1*	IT
		156	0+	−70.530	**0.06%** ***1***	
		157	3/2−	−69.428	8.14 h *4*	ε
		157m	11/2−	−69.229	21.6 ms *16*	IT
		158	0+	−70.412	**0.10%** ***1***	
		159	3/2−	−69.174	144.4 d *2*	ε
		159m	11/2−	−68.821	122 μs *3*	IT
		160	0+	−69.678	**2.34%** ***8***	
		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
		141m	1/2+	−34.3s	6.6 μs *8*	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%
		148m	(10+)	−57.3	2.35 ms *4*	IT
		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%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
67	**Ho**	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
		155m	11/2−	−65.90	0.88 ms *8*	IT
		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
		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

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
68	**Er**	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%
		154m	11–	–59.587	39 ns *4*	IT≈100%, α≈0%
		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%
		157m	(9/2+)	–63.26	76 ms *6*	IT
		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
		161m	11/2–	–64.813	7.5 μs *7*	IT
		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***	
		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%
		147m	3/2+	–36.3s	0.36 ms *4*	p
		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%

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
69	**Tm**	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%
		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, α≈2.1×10^{-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***	

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
70	**Yb**	171	1/2−	−59.312	**14.28% *57***	
		171m	7/2+	−59.217	5.25 ms *24*	IT
		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−
		175m	1/2−	−54.186	68.2 ms *3*	IT
		176	0+	−53.494	$\geq 1.6\times10^{17}$ y **12.76% *41***	2β−
		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%
		150m	(1−,2−)	−24.9s	39 μs *7*	p
		151	11/2−	−30.2s	80.6 ms *19*	p 63.4%, ε 36.6%
		151m	3/2+	−30.1s	16 μs *1*	p
		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%
		155m	(25/2−)	−40.77	2.69 ms *3*	α≈100%
		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%
		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, $\alpha\leq1.0\times10^{-4}$%
		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

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
71	**Lu**	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	4.08×10^{10} 3 *8*	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−
		179m	1/2(+)	−48.472	3.1 ms *9*	IT
		180	5+	−46.69	5.7 m *1*	β−
		180m	(9−)	−46.06	≥1 ms	IT
		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%
		154m	(10+)	−30.1s	9 μs *4*	IT
		155		−34.1s	0.89 s *12*	ε
		156	0+	−37.9	23 ms *1*	α
		156m	8+	−35.9	0.52 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%
		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$<1.0\times10^{-4}$%
		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

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
72	**Hf**	174	0+	−55.847	2.0×10^{15} y *4*	α
					0.16% ***1***	
		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−
		181m	(25/2−)	−45.670	1.5 ms *5*	IT
		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−	−41.50	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%
		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

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
73	**Ta**	175	7/2+	–52.41	10.5 h *2*	ε
		176	(1)–	–51.37	8.09 h *5*	ε
		176m	(+)	–51.26	1.1 ms *1*	IT
		176m	(20–)	–48.59	0.97 ms *7*	IT
		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
		179m	(25/2+)	–49.049	9.0 ms *2*	IT
		179m	(37/2+)	–47.727	54.1 ms *17*	IT
		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–
		185m	(21/2)	–40.14	>1 ms	IT
		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
		158m	(8+)	–21.8s	0.143 ms *19*	α, IT
		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
		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%

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
74	**W**	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***	
		186m	(16+)	−38.967	>3 ms	IT
		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−
		190m	(10−)	−31.9	≤3.1 ms	IT
		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%, α≈5.0×10^{-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
		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

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
75	**Re**	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*	β−,
					62.60% ***2***	$\alpha<1.0\times10^{-4}$%
		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	α
					0.02% ***1***	
		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

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
76	**Os**	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
		164m		−7.3s	58 μs +*46*−*18*	p
		165	(1/2+)	−11.6s	<1 μs	p?, α?
		165m	11/2−	−11.4s	0.30 ms *6*	p 87%, α 13%
		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*	α 5.2%, ε 94.8%
		170m		−23.3s	0.44 s *6*	α 36%, ε≤64%, IT≤64%
		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%
		187	3/2+	−39.716	10.5 h *3*	ε
		188	1−	−38.328	41.5 h *5*	ε
		188m		−37.405	4.2 ms *2*	IT, ε?
		189	3/2+	−38.45	13.2 d *1*	ε
		189m	11/2−	−38.08	13.3 ms *3*	IT

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
77	**Ir**	189m	(25/2)+	–36.12	3.7 ms *2*	IT
		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	4+	–32.382	31.85 ms *24*	IT
		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
		190	0+	–37.323	6.5×10^{11} y *3* **0.014% *1***	α

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
78	**Pt**	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?, ε?
		170	(2−)	−3.6s	286 µs +*50−40*	p 89%, α 11%
		170m	(9+)	−3.6s	617 µs +*50−40*	p 58%, α 42%
		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
		192	1−	−32.78	4.94 h *9*	ε

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
79	**Au**	192m	(5)+	–32.64	29 ms	IT
		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, $\alpha<3.4\times10^{-7}$%

Nuclear Wallet Cards

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−
		205m	13/2+	−20.731	1.09 ms *4*	IT
		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%
		177m	(11/2−)	−2.52	230 μs *+70−40*	p 55%
		177m	(11/2−)	−2.52	160 μs *+70−40*	α 45%
		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
		188m	(9−)	−22.08	41 ms *4*	IT≈100%, ε
		189	(1/2+)	−24.60	2.3 m *2*	ε

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
81	**Tl**	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
		190m	(8–)	–24.17	0.75 ms *4*	IT
		191	(1/2+)	–26.281	?	ε ?
		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%
		198m	(10–)	–26.75	32.1 ms *10*	IT
		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%

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
82	**Pb**	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
		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
		205m	13/2+	−22.756	5.55 ms *2*	IT
		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
		187m	(1/2+)	−6.26	0.29 ms +*9*−*5*	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%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
83	**Bi**	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%
		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 $<1.0\times10^{-4}$%
		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 $<1.0\times10^{-5}$%
		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
		207m	21/2+	−17.953	182 μs *6*	IT
		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%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
83	**Bi**	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
		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%
		205m	13/2+	−16.63	0.645 ms *20*	IT
		205m	19/2−	−16.05	57.4 ms *9*	IT
		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%
		212	0+	−10.369	0.299 μs *2*	α
		212m	6+	−9.014	0.76 ns *21*	α≈71%
		212m	8+	−8.893	17.1 ns *2*	α≈42%
		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}%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
84	**Po**	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
		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%

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
85	**At**	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%
		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%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
87	**Fr**	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%
		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%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
88	**Ra**	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−
		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%
		217m	21/2−	10.24	<10 ns	IT≥99.6%, α≤0.48%
		217m	(29/2)+	10.72	740 ns *40*	IT 95.7%, α 4.3%
		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}%

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
89	**Ac**	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%
		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
		217m	(15/2−)	12.89	141 ns *50*	IT
		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 < $4.\times10^{-11}$%
		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−
		233m		40.583	50 ns *+50−49*	IT ≈ 100%
		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

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91	**Pa**	219m	9/2–	18.52	53 ns *10*	α
		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–
		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*** **0.7204% *6*** **0.7204% *6*** **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

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92	**U**	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*	α,
					99.2742% ***10***	SF 5.5×10^{-5}%
					99.2742% ***10***	
		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
		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}%
		235m		45.18	25 ns *5*	SF≤100%
		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 $3.\times10^{-10}$%
		239m	(5/2+)	51.690	7.5 μs *10*	SF≤100%
		239m	(9/2–)	51.893	2.6 ns *+40–12*	SF≤100%
		240	0+	50.127	6561 y *7*	α, SF 5.7×10^{-6}%
		240m	(0+)	50.127	3.6 ns *2*	SF>0%

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94	**Pu**	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}%
		242m		56.718	3.5 ns *6*	SF≤100%
		242m		56.718	28 ns	SF≤100%
		243	7/2+	57.756	4.956 h *3*	β−
		243m		59.456	45 ns *15*	SF
		244	0+	59.806	8.00×10^{7} y *9*	α 99.88%, SF 0.12%
		244m		62.206	380 ps *80*	SF≤100%
		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
		236m		46.2s	≥30 d	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%
		239m	(7/2+)	51.892	163 ns *12*	SF≤100%
		240	(3−)	51.51	50.8 h *3*	ε, α 1.9×10^{-4}%
		240m		54.51	0.94 ms *4*	SF≤100%
		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%
		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}%
		243m		59.476	5.5 μs *5*	SF≤100%
		244	(6−)	59.881	10.1 h *1*	β−
		244m		59.881	≈6.5 μs	SF≤100%
		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%
		246m		66.99	73 μs *10*	SF≤100%
		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?

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
96	**Cm**	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}%
		240m		53.725	10 ps *3*	SF ≤ 100%
		240m		54.725	55 ns *12*	SF ≈ 100%
		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 $1.\times10^{-14}$%
		242m	0+	54.805	40 ps *15*	SF ≤ 100%
		242m		57.605	180 ns *70*	SF, IT
		243	5/2+	57.184	29.1 y *1*	α 99.71%, ε 0.29%, SF 5.3×10^{-9}%
		243m		59.084	42 ns *6*	SF ≤ 100%
		244	0+	58.454	18.1 y *1*	α, SF 1.4×10^{-4}%
		244m	0+	58.454	>500 ns	SF ≤ 100%
		244m	6+	59.494	34 ms *2*	IT
		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	$\approx8.3\times10^{3}$ 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?
		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%
		242m		57.7s	9.5 ns *20*	SF ≤ 100%
		242m		57.7s	600 ns *100*	SF ≤ 100%
		243	(3/2−)	58.691	4.5 h *2*	ε ≈ 99.85%, α ≈ 0.15%
		243m		60.891	5 ns	SF ≤ 100%
		244	(4−)	60.72	4.35 h *15*	ε 99.99%, α 6.0×10^{-3}%
		244m		60.72	820 ns *60*	SF ≤ 100%
		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%
		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−?

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
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}%
		246m		66.592	45 ns *10*	SF ≤ 100%
		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
		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–

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
99	**Es**	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
		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?

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
102	**No**	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%
		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%

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
104	**Rf**	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
		268		116.9s	16 h *+19–6*	SF, α?, ε?
		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>18%
		269m		119.9s	22 s *+32–11*	α<100%, SF
		271		124.3s	2.4 s *+43–10*	SF 50%, α 50%
		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%

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107	**Bh**	265		116.6s	0.9 s *+7–3*	α
		266		118.2s	<10 s	α≤100%
		267		118.9s	17 s *+14–6*	α
		271		125.9s	40 s *SY*	α
		272		128.6s	9.8 s *+117–35*	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%
		267m		122.8s	26 ms *+20–10*	α
		269m		124.9s	9 s *4*	α≈100%
		273m		132.3s	1.2 s *+17–6*	α, SF
		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?
		277m		139.6s	12 m *+54–6*	SF, α
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?
		268m		129.2s	0.07 s *+10–3*	α
		274		137.4s	20 s *SY*	α?, SF?
		275		138.5s	9.7 ms *+46–44*	α
		276		140.8s	0.72 s *+87–27*	α
		279		145.5s	6 m *SY*	α?, SF?
110	**Ds**	267m		134.5s	3 μs *+6–2*	α
		268	0+	133.9s	100 μs *SY*	
		269m		135.2s	0.17 ms *+17–6*	α
		271m		136.1s	0.06 s *+27–3*	α
		271m		136.1s	1.1 ms *+6–3*	α
		272	0+	136.3s	≈8.6 ms	SF
		273m		138.7s	0.18 ms *+40–12*	α
		273m		138.9s	≈120 ms	α
		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?
		277m		145.0s	3.0 ms *+47–15*	α, SF
		279		148.0s	0.28 s *+5–3*	SF 90%, α 10%
		280	0+	148.8s	11 s *6*	SF
		281		151.0s	9.6 s *+50–25*	SF
		281m		151.0s	1.1 m *+50–6*	α
111	**Rg**	272m		143.1s	1.5 ms *+20–5*	α
		273		143.2s	5 ms *SY*	α?
		274		145.1s	5 ms *SY*	α?, SF?
		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

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
111	**Rg**	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	1.1 ms *7*	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?
		281		157.7s	10 s *SY*	α?
		282	0+	158.1s	0.50 ms *+33–14*	SF
		283		160.0s	4.0 s *+13–7*	SF≤10%
		283	RG	160.0s	4.0 s *+13–7*	α
		284	0+	160.6s	101 ms *+41–22*	SF
		285		162.2s	34 s *+17–9*	α
113		283		164.4s	0.10 s *+49–5*	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		285		171.s	5 s *SY*	α?
		286	0+	171.3s	0.16 s *+7–3*	SF 60%, α 40%
		287		172.9s	0.51 s *+18–10*	α
		288	0+	173.0s	0.80 s *+32–18*	α
		289		174.4s	2.7 s *+14–7*	α
115		287		178.1s	32 ms *+155–14*	α
		288		179.3s	87 ms *+105–30*	α
		289		180.s	10 s *SY*	α?, SF?
		290		180.8s	10 s *SY*	α?, SF?
		291		181.1s	1 m *SY*	α?, SF?
116		289		185.s	10 ms *SY*	α?
		290	0+	185.0s	15 ms *+26–6*	α
		291		186.3s	6.3 ms *+116–25*	α
		292	0+	186.1s	18 ms *+16–6*	α
		293			53 ms *+62–19*	α
117		291		192.4s	10 ms *SY*	α?, SF?
		292		193.3s	50 ms *SY*	α?, SF?
118		293		200.	5 ms *SY*	α?
		294	0+		1.8 ms *+750–13*	α

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

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]
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

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]
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 $A+(\Delta/931.494)$, 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	Planck constant	6.626×10^{-27} erg s
$\hbar=h/2\pi$		6.582×10^{-22} MeV s
$\hbar c$		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* 137.03599976 *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–IIIa 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–IIIa Energy–Equivalent Factors†

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

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

Example: $1u \equiv 1.492..\times10^{-3}$ 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],8.3,20.2
	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 KFK. 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).

* Λ binding energy.

\# Possibly complex.

a K. Tanida et al. Proc. of APCTP workshop (1999), to be published.

b R. Chrien, BNL, priv. comm. and results of BNL–AGS 798.

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

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

e O. Hashimoto, Proc. of APCTP workshop (1999), to be published.

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	Major Radiations	Major γ-rays (keV) Iγ>2%
1 H 3	12.32 y	β–	
6 C 14	5700 y	β–	
19 K 40	1.265×10^{9} y	β–, γ	1461
23 V 50	1.4×10^{17} y	γ	1554, 783
37 Rb 87	4.81×10^{10} y	β–	
48 Cd 113	7.7×10^{15} y	β–	
49 In 115	4.41×10^{14} y	β–	
57 La 138	1.02×10^{11} y	γ	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	4.00×10^{10} y	β–, γ	307, 202, 56
72 Hf 174	2.0×10^{15} y	α	
73 Ta 180m	$>1.2\times10^{15}$ y	β–	
75 Re 187	4.35×10^{10} y	β–	
76 Os 186	2.0×10^{15} y	α	
78 Pt 190	6.5×10^{11} y	α	
90 Th 232	1.405×10^{10} y	α	
92 U 235	7.04×10^{8} y	α, γ	186, 144, 93
238	4.468×10^{9} y	α	

Some Well–known Radionuclides

Nuclide		Half–life	Major Radiations	Major γ–rays (keV) Iγ>2%
11 Na	22	2.602 y	γ	511, 1275
24 Cr	51	27.7 d	γ	320
25 Mn	56	2.579 h	β–, γ	847, 1811, 2113
26 Fe	59	44.5 d	β–, γ	1099, 1292
27 Co	57	271.7 d	γ	122, 136
	60	5.271 y	β–, γ	1332, 1173
29 Cu	64	12.7 h	γ	511
31 Ga	66	9.49 h	γ	511, 1039, 2752
	67	3.261 d	γ	93, 185, 300
	68	1.127 h	γ	511, 1077
34 Se	75	119.8 d	γ	265, 136, 280
38 Sr	85	64.84 d	γ	514
	85m	1.127 h	γ	232, 151
	90	28.79 y	β–	
43 Tc	99m	6.015 h	γ	141
44 Ru	103	39.26 d	β–, γ	497, 610
	106	1.023 y	β–	
45 Rh	106m	2.183 h	β–, γ	512, 1047, 717
47 Ag	110m	249.8 d	β–, γ	658, 885, 937
49 In	111	2.805 d	γ	245, 171
53 I	123	13.27 h	γ	159
	131	8.021 d	β–, γ	364, 637, 284
55 Cs	137	30.07 y	β–, γ	662
56 Ba	133	10.54 y	γ	356, 81, 303
	133m	1.621 d	γ	276
58 Ce	144	284.9 d	β–, γ	134
62 Sm	153	1.929 d	β–, γ	103, 70
67 Ho	166	1.118 d	β–, γ	81, 56
	166m	1.20×10^{3} y	β–, γ	184, 810, 712
70 Yb	169	32.03 d	γ	51, 63, 57
77 Ir	192	73.83 d	β–, γ	317, 468, 308
	192m	1.45 m	γ	
	192m	241 y	γ	
81 Tl	201	3.038 d	γ	71, 69, 80
83 Bi	207	32.9 y	γ	570, 1064, 75
95 Am	241	432.2 y	α, γ	60

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