NUCLEAR WALLET CARDS

October 2011

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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(Eighth edition)

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

for

The U.S. Nuclear Data Program

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U.S. Nuclear Data Program

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

Argonne National Laboratory
Nuclear Data Program
Nuclear Engineering 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
One Cyclotron Road
Berkeley, CA 94720–8101

Lawrence Livermore National Laboratory
Computational Nuclear Physics Group
P.O. Box 808, MS L–059
Livermore, CA 94551–0808

Los Alamos National Laboratory
Group T–2, Nuclear Physics
MS B283
Los Alamos, NM 87545

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

McMaster University
Dept. of Physics and Astronomy
Hamilton, Ontario L8S 4M1
Canada

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

Oak Ridge National Laboratory
Nuclear Data Project
Physics Division
MS 6354
P.O. Box 2008
Oak Ridge, TN 37831–6354

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

INTRODUCTION

This is an updated edition of the 2005 booklet of the same name†.

This booklet presents selected properties of all known nuclides and some of their isomeric states. Properties of ionized atoms are presented as an appendix.

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 For nuclides for which either there are no data in ENSDF or those data that have since been superseded, the half–life and the decay modes are taken from Experimental Unevaluated Nuclear Data List (XUNDL)[4] covering recent literature[5].

For other references, experimental data, and information on the data measurements, please refer to the original evaluations [1–4]. The data were updated to **September 1, 2011**.

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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: in years 1985, 1990, 1995, 2000, and the last in 2005, were produced by Jagdish K. Tuli, NNDC.
In 2004, *Nuclear Wallet Cards for Radioactive Nuclides* aimed at Homeland Security personnel was also produced by Jagdish K. Tuli.

Explanation of Table

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

Nuclides are listed in the order of increasing atomic number (Z), and are subordered by increasing mass number (A). All isotopic species, as well as all isomers with half–life ≥0.1 s, and some with half–life≥1 ms which decay by SF, α or p emissions, are included. A nuclide is given even if only its mass estimate [6] is known.

Isomeric states are denoted by the symbol "m" after the mass number and are given in the order of increasing excitation energy. Where the ground state is not well established all given states carry symbol "m".

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 and symbols for elements are those adopted by the International Union of Pure and Applied Chemistry (2010). No names and symbols have as yet been adopted for Z>112.

Column 2, Jπ:

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

Explanation of Table (cont.)

Column 3, Mass Excess, Δ:

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

Column 4, $T_{1/2}$,Γ or Abundance:

The half–life and the abundance (in **bold face** from [7]) are shown followed by their units ("%" symbol in the case of abundance) which are followed by the uncertainty, in *italics*,in the last significant figures. For example, 8.1 s *10* means 8.1±1.0 s. For some very short–lived nuclei, level widths rather than half–lives are given. There also, the width is followed by units (*e.g.*, eV, keV, or MeV) which are followed by the uncertainty in *italics*, if known. This field is left blank when the half–life 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 or decay mode has since become available [4] then its value 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. The various modes of decay are given below:

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

NNDC Web Services

The centerfold presents the NNDC home page on the web (*www.nndc.bnl.gov*) and was prepared by Boris Pritychenko. The greatly expanded NNDC web services offer a wealth of Nuclear Physics information which includes analysis programs, reference data, and custom–tailored retrievals from its many databases. The ND2013 info is provided by Alejandro Sonzogni.

DOE Standard for Nuclear Material Inventory

The sixth edition (2000) of Nuclear Wallet Cards was adopted as the standard by the the US Department of Energy for the purposes of their nuclear material inventory. The sixth edition, as well as, the current edition are available through the NNDC web site.

Homeland Security

Nuclear Wallet Cards for Radioactive Nuclides, a reference for homeland security personnel based on this booklet was published in March 2004. The booklet, although limited to radioactive nuclides, contains additional radiation information. It is available only on the web and its printed form is no longer available.

Acknowledgements

The author is grateful for help from Eddie Browne, Tim Johnson, John Kelley, Filip Kondev, Elizabeth McCutchan, and Balraj Singh in checking parts of the table. Thanks to NNDC colleagues, especially, Michael Herman, Head, NNDC, for their support.

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1. *Evaluated Nuclear Structure Data File*– a computer file of evaluated experimental nuclear structure data maintained by the National Nuclear Data Center, Brookhaven National Laboratory (file as of August 15, 2011).

2. *Nuclear Data Sheets* – Elsevier, Amsterdam. Evaluations published by mass number for A = 21 to 294. See page ii of any issue for the index to A–chains.

3. *Nuclear Physics* – Elsevier, Amsterdam – Evaluations for A = 3 to 20.

4. XUNDL, An Experimental Unevaluated Nuclear Data List, mostly prepared under supervision of Dr. Balraj Singh, McMaster U., Canada, and maintained by the National Nuclear Data Center, Brookhaven National Laboratory.

5. *Nuclear Science Reference File*– a bibliographic computer file of nuclear science references continually updated and maintained by the National Nuclear Data Center, Brookhaven National Laboratory.

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References (cont.)

9. *Table of Isotopes* (1978), 7th edition, Editors: C.M. Lederer, V.S. Shirley, Authors: E. Browne, J.M. Dairiki, R.E. Doebler, A.A. Shihab–Eldin, J. Jardine, J.K. Tuli, and A.B. Buyrn, John Wiley, New York.

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
0	**n**	1	1/2+	8.071	10.183 m *17*	β–
1	**H**	1	1/2+	7.289	**99.9885% *70***	
		2	1+	13.136	**0.0115% *70***	
		3	1/2+	14.950	12.32 y *2*	β–
		4	2–	24.6		n
		5	(1/2+)	32.89	5.7 MeV *21*	2n
		6	(2–)	41.9	1.6 MeV *4*	n
		7	(1/2+)	47.9	29×10^{-23} y *7*	
2	**He**	3	1/2+	14.931	**0.000134% *3***	
		4	0+	2.425	**99.999866% *3***	
		5	3/2–	11.23	0.60 MeV *2*	α, n
		6	0+	17.592	801 ms *10*	β–
		7	(3/2)–	26.067	150 keV *20*	n
		8	0+	31.609	119.1 ms *12*	β–, β–n 16%
		9	1/2+	39.78		n
		10	0+	48.81	300 keV *200*	n
3	**Li**	3		29s	unbound	p?
		4	2–	25.3	6.03 MeV	p
		5	3/2–	11.68	≈1.5 MeV	p, α
		6	1+	14.087	**7.59% *4***	
		7	3/2–	14.907	**92.41% *4***	
		8	2+	20.945	839.9 ms *9*	β–, β–α
		9	3/2–	24.954	178.3 ms *4*	β–, β–n 50.8%
		10	(1–,2–)	33.05		n
		11	3/2–	40.728	8.75 ms *14*	β–, β–n 83%, β–2n 4.1%, β–nα 0.027%
		12		48.92	<10 ns	n?
		13		58.3		
4	**Be**	5	(1/2+)	37s		p
		6	0+	18.375	92 keV *6*	p, α
		7	3/2–	15.768	53.24 d *4*	ε
		8	0+	4.941	5.57 eV *25*	α
		9	3/2–	11.348	**100.%**	
		10	0+	12.607	1.387×10^{6} y *12*	β–
		11	1/2+	20.177	13.81 s *8*	β–, β–α 3.1%
		12	0+	25.076	21.49 ms *3*	β–, β–n ≤ 1%
		13	(1/2–)	33.21	2.7×10^{-21} s *18*	n
		14	0+	40.0	4.35 ms *17*	β–, β–n 81%, β–2n 5%
		15		49.8s	<200 ns	n?
		16	0+	57.7s	<200 ns	2n?
5	**B**	6		47s	unbound	2p?
		7	(3/2–)	27.87	1.4 MeV *2*	α, p
		8	2+	22.921	770 ms *3*	ε, εα
		9	3/2–	12.416	0.54 keV *21*	p, 2α
		10	3+	12.050	**19.9% *7***	
		11	3/2–	8.667	**80.1% *7***	
		12	1+	13.368	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–

Nuclear Wallet Cards

Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
5	**B**	15		28.96	9.93 ms *7*	β−, β−n 93.6%, β−2n 0.4%
		16	0−	37.12	<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−)	51.9s	<26 ns	n?
		19	(3/2−)	58.8s	2.92 ms *13*	β−, β−n 72%, β−2n 16%
		20		67.1s		
		21		75.7s		
6	**C**	8	0+	35.08	230 keV *50*	p, α
		9	(3/2−)	28.909	126.5 ms *9*	ε, εp 61.6%, εα 38.4%
		10	0+	15.698	19.308 s *4*	ε
		11	3/2−	10.650	20.334 m *24*	ε
		12	0+	0.000	**98.93% *8***	
		13	1/2−	3.125	**1.07% *8***	
		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	3/2+	21.03	193 ms *13*	β−, β−n 32%
		18	0+	24.92	92 ms *2*	β−, β−n 31.5%
		19	1/2+	32.41	49 ms *4*	β−, β−n 61%
		20	0+	37.6	14 ms +*6*−*5*	β−, β−n 72%
		21	(1/2+)	45.6s	<30 ns	n?
		22	0+	52.1s	6.1 ms +*14*−*12*	β−, β−n 61%, β−2n<37%
		23		62.7s		
7	**N**	10		38.8		p
		11	1/2+	24.30	0.83 MeV *3*	p
		12	1+	17.338	11.000 ms *16*	ε
		13	1/2−	5.345	9.965 m *4*	ε
		14	1+	2.863	**99.636% *20***	
		15	1/2−	0.101	**0.364% *20***	
		16	2−	5.683	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	620 ms *8*	β−, β−α 12.2%, β−n 7%
		19		15.86	336 ms *3*	β−, β−n 41.8%
		20	2−	21.76	136 ms *3*	β−, β−n 42.9%
		21	(1/2−)	25.25	83 ms *8*	β−, β−n 90.5%
		22	(0−,1−)	32.0	20 ms *2*	β−, β−n 33%, β−2n 12%
		23		38.4s	14.5 ms *14*	β−, β−n, β−2n
		24		47.5s	<52 ns	n?
		25		56.5s		
8	**O**	12	0+	32.05	0.40 MeV *25*	p
		13	(3/2−)	23.114	8.58 ms *5*	ε, εp
		14	0+	8.007	70.620 s *15*	ε
		15	1/2−	2.855	122.24 s *16*	ε

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
8	**O**	16	0+	–4.737	**99.757%** ***16***	
		17	5/2+	–0.809	**0.038%** ***1***	
		18	0+	–0.783	**0.205%** ***14***	
		19	5/2+	3.333	26.88 s *5*	β–
		20	0+	3.796	13.51 s *5*	β–
		21	(5/2+)	8.06	3.42 s *10*	β–
		22	0+	9.28	2.25 s *9*	β– , β–n < 22%
		23	1/2+	14.62	97 ms *8*	β– , β–n 7%
		24	0+	18.5	65 ms *5*	β– , β–n 58%
		25		27.3		
		26	0+	35.1s	<40 ns	n?
		27		44.1s	<260 ns	n?
		28	0+	52.9s	<100 ns	n?
9	**F**	14	(2–)	31.96		p
		15	(1/2+)	16.81	1.0 MeV *2*	p
		16	0–	10.680	40 keV *20*	p
		17	5/2+	1.951	64.49 s *16*	ε
		18	1+	0.873	109.77 m *5*	ε
		19	1/2+	–1.487	**100%**	
		20	2+	–0.017	11.07 s *6*	β–
		21	5/2+	–0.047	4.158 s *20*	β–
		22	(4+)	2.79	4.23 s *4*	β– , β–n < 11%
		23	5/2+	3.3	2.23 s *14*	β–
		24	(1,2,3)+	7.56	390 ms *70*	β– , β–n < 5.9%
		25	5/2+	11.36	80 ms *9*	β– , β–n 23.1%
		26	(1+)	18.67	9.7 ms *7*	β– , β–n 11%
		27	(5/2+)	24.6	5.0 ms *2*	β– , β–n 77%
		28		33.1s	<40 ns	
		29	(5/2+)	40.0s	2.5 ms *3*	β– , β–n
		30		48.4s		n
		31		55.9s	>250 ns	β–n , β–
10	**Ne**	16	0+	24.00	9×10^{-21} s	2p
		17	1/2–	16.500	109.2 ms *6*	ε , εp, εα
		18	0+	5.317	1.6670 s *17*	ε
		19	1/2+	1.752	17.22 s *2*	ε
		20	0+	–7.042	**90.48%** ***3***	
		21	3/2+	–5.731	**0.27%** ***1***	
		22	0+	–8.024	**9.25%** ***3***	
		23	5/2+	–5.154	37.24 s *12*	β–
		24	0+	–5.951	3.38 m *2*	β–
		25	1/2+	–2.06	602 ms *8*	β–
		26	0+	0.48	197 ms *1*	β– , β–n 0.13%
		27	(3/2+)	7.03	31.5 ms *13*	β– , β–n 2%
		28	0+	11.29	18.9 ms *4*	β– , β–n 12%, β– 3.6%
		29	(3/2+)	18.40	14.8 ms *3*	β– , β–n 28%, β–2n 4%
		30	0+	23.0	7.3 ms *3*	β– , β–n 13%, β– 8.9%
		31		31	3.4 ms *8*	β– , β–n
		32	0+	37.0s	3.5 ms *9*	β– , β–n
		33		46.0s	<180 ns	n

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	$T_{1/2}$, Γ, or Abundance	Decay Mode
10	**Ne**	34	0+	52.8s	>60 ns	β–n , β–
11	**Na**	18	1–	25.0	1.3×10^{-21} s *4*	p
		19	(5/2+)	12.93	<40 ns	p
		20	2+	6.850	447.9 ms *23*	ε , εα 20.05%
		21	3/2+	–2.184	22.49 s *4*	ε
		22	3+	–5.181	2.6027 y *10*	ε
		23	3/2+	–9.530	**100%**	
		24	4+	–8.417	14.997 h *12*	β–
		24m	1+	–7.945	20.18 ms *10*	IT 99.95% , β–≈0.05%
		25	5/2+	–9.357	59.1 s *6*	β–
		26	3+	–6.860	1.07128 s *25*	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+	2.67	44.9 ms *12*	β– , β–n 21.5%
		30	2+	8.37	48 ms *2*	β– , β–n 30%, β–2n 1.15% , β–α 5.5×10^{-5}%
		31	3/2(+)	12.5	17.0 ms *4*	β– , β–n 37%, β–2n 0.87% , β–3n<0.05%
		32	(3–,4–)	18.8	13.2 ms *4*	β– , β–n 24%, β–2n 8%
		33	(3/2+)	24.0s	8.0 ms *4*	β– , β–n 47%, β–2n 13%
		34		31.3s	5.5 ms *10*	β– , β–2n≈50%, β–n≈15%
		35		37.8s	1.5 ms *5*	β– , β–n
		36		45.9s	<180 ns	n
		37		53.1s	>60 ns	β–n , β–
12	**Mg**	19		31.83	4.0 ps *15*	2p
		20	0+	17.56	90.8 ms *24*	ε , εp≈27%
		21	5/2+	10.91	122 ms *3*	ε , εp 32.6%, εα<0.5%
		22	0+	–0.399	3.8755 s *12*	ε
		23	3/2+	–5.473	11.317 s *11*	ε
		24	0+	–13.933	**78.99% *4***	
		25	5/2+	–13.192	**10.00% *1***	
		26	0+	–16.214	**11.01% *3***	
		27	1/2+	–14.586	9.458 m *12*	β–
		28	0+	–15.018	20.915 h *9*	β–
		29	3/2+	–10.60	1.30 s *12*	β–
		30	0+	–8.89	335 ms *17*	β–
		31	1/2(+)	–3.19	232 ms *15*	β– , β–n 1.7%
		32	0+	–0.91	86 ms *5*	β– , β–n 5.5%
		33	3/2–	4.95	90.5 ms *16*	β– , β–n 14%
		34	0+	8.56	20 ms *10*	β– , β–n
		35	(7/2–)	15.6	70 ms *40*	β– , β–n 52%
		36	0+	20.4	3.9 ms *13*	β– , β–n
		37	(7/2–)	28.3s	>260 ns	β– , β–n
		38	0+	34.1s	>260 ns	β– , β–n
		39		42.3s	<180 ns	n

Nuclear Wallet Cards

Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
12	**Mg**	40	0+	48.6s	>170 ns	β−, β−n
13	**Al**	21	(5/2+)	27.1s	<35 ns	p
		22	4+	18.2s	91.1 ms *5*	ε, εp 54.5%, ε2p 1.1%, εα 0.04%
		23	5/2+	6.748	446 ms *6*	ε, εp 1.22%
		24	4+	−0.048	2.053 s *4*	ε, εp 1.6×10^{-3}%, εα 0.04%
		24m	1+	0.378	130 ms *3*	IT 82.5%, ε 17.5%, 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	6.3464 s *7*	ε
		27	5/2+	−17.196	**100%**	
		28	3+	−16.850	2.2414 m *12*	β−
		29	5/2+	−18.215	6.56 m *6*	β−
		30	3+	−15.87	3.62 s *6*	β−
		31	(3/2,5/2)+	−14.95	644 ms *25*	β−
		32	1+	−11.06	33.0 ms *2*	β−, β−n 0.7%
		33	(5/2)+	−8.44	41.7 ms *2*	β−, β−n 8.5%
		34		−3.05	42 ms *6*	β−, β−n 27%
		35		−0.22	37.2 ms *8*	β−, β−n 38%
		36		5.95	90 ms *40*	β−, β−n<31%
		37		9.8	10.7 ms *13*	β−
		38		16.2	7.6 ms *6*	β−, β−n
		39		21.0s	7.6 ms *16*	β−, β−n
		40		28.0s	>260 ns	β−, β−n
		41		33.9s	>260 ns	β−
		42		41.5s	>170 ns	β−, β−n
		43		48.4s	>170 ns	β−, β−n
14	**Si**	22	0+	33.0s	29 ms *2*	ε, εp 32%
		23	(5/2)+	23.1s	42.3 ms *4*	ε, εp 71%, ε2p 3.6%
		24	0+	10.75	140.5 ms *15*	ε, εp 45%
		25	5/2+	3.83	220 ms *3*	ε, εp 35%
		26	0+	−7.140	2.229 s *3*	ε
		27	5/2+	−12.384	4.15 s *4*	ε
		28	0+	−21.493	**92.223% *19***	
		29	1/2+	−21.895	**4.685% *8***	
		30	0+	−24.432	**3.092% *11***	
		31	3/2+	−22.949	157.3 m *3*	β−
		32	0+	−24.077	153 y *19*	β−
		33	3/2+	−20.514	6.11 s *21*	β−
		34	0+	−19.96	2.77 s *20*	β−
		35		−14.36	0.78 s *12*	β−, β−n<5%
		36	0+	−12.42	0.45 s *6*	β−, β−n<10%
		37	(7/2−)	−6.59	90 ms *60*	β−, β−n 17%
		38	0+	−4.17	>1 μs	β−, β−n
		39		2.32	47.5 ms *20*	β−, β−n
		40	0+	5.4	33.0 ms *10*	β−, β−n
		41		12.1	20.0 ms *25*	β−, β−n?
		42	0+	16.6s	12.5 ms *35*	β−, β−n
		43		23.1s	>60 ns	β−, β−n
		44	0+	28.5s	>360 ns	β−, β−n

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
14	**Si**	45		37.2s		
15	**P**	24	(1+)	32.8s		ε?, p?
		25	(1/2+)	19.7s	<30 ns	p
		26	(3+)	11.0s	43.7 ms *6*	ε, εp
		27	1/2+	−0.71	260 ms *80*	ε, εp 0.07%
		28	3+	−7.149	270.3 ms *5*	ε, εp $1.3{\times}10^{-3}$%, εα $8.6{\times}10^{-4}$%
		29	1/2+	−16.952	4.142 s *15*	ε
		30	1+	−20.200	2.498 m *4*	ε
		31	1/2+	−24.441	**100%**	
		32	1+	−24.304	14.262 d *14*	β−
		33	1/2+	−26.337	25.35 d *11*	β−
		34	1+	−24.548	12.43 s *8*	β−
		35	1/2+	−24.857	47.3 s *7*	β−
		36	4−	−20.25	5.6 s *3*	β−
		37		−19.00	2.31 s *13*	β−
		38	(0−:4−)	−14.64	0.64 s *14*	β−, β−n 12%
		39	(1/2+)	−12.80	0.28 s *4*	β−, β−n 26%
		40	(2−,3−)	−8.1	125 ms *25*	β−, β−n 15.8%
		41	(1/2+)	−4.98	100 ms *5*	β−, β−n 30%
		42		1.0	48.5 ms *15*	β−, β−n 50%
		43	(1/2+)	4.7	36.5 ms *15*	β−, β−n
		44		10.4s	18.5 ms *25*	β−, β−n
		45		15.3s	>200 ns	β−
		46		22.8s	>200 ns	β−
		47		29.2s		
16	**S**	26	0+	27.1s	<79 ns	2p?
		27	(5/2+)	17.0s	15.5 ms *15*	ε, εp 2.3%, ε2p 1.1%
		28	0+	4.1	125 ms *10*	ε, εp 20.7%
		29	5/2+	−3.16	187 ms *4*	ε, εp 47%
		30	0+	−14.062	1.178 s *5*	ε
		31	1/2+	−19.043	2.572 s *13*	ε
		32	0+	−26.015	**94.99% *26***	
		33	3/2+	−26.586	**0.75% *2***	
		34	0+	−29.931	**4.25% *24***	
		35	3/2+	−28.846	87.37 d *4*	β−
		36	0+	−30.664	**0.01% *1***	
		37	7/2−	−26.896	5.05 m *2*	β−
		38	0+	−26.861	170.3 m *7*	β−
		39	(7/2)−	−23.16	11.5 s *5*	β−
		40	0+	−22.9	8.8 s *22*	β−
		41	(7/2−)	−19.09	1.99 s *5*	β−, β−n
		42	0+	−17.7	1.03 s *3*	β−
		43		−12.07	0.28 s *3*	β−, β−n 40%
		44	0+	−9.1	100 ms *1*	β−, β−n 18%
		45		−4.0	68 ms *2*	β−, β−n 54%
		46	0+	0.0s	50 ms *8*	β−
		47		7.4s		
		48	0+	12.8s	≥200 ns	β−
		49		21.2s	<200 ns	n
17	**Cl**	28	(1+)	27.5s		p?

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
17	**Cl**	29	(3/2+)	13.8s	<20 ns	p
		30	(3+)	4.4s	<30 ns	p
		31		−7.07	150 ms *25*	ε, εp 0.7%
		32	1+	−13.335	298 ms *1*	ε, εα 0.05%, εp 0.03%
		33	3/2+	−21.003	2.511 s *4*	ε
		34	0+	−24.440	1.5264 s *14*	ε
		34m	3+	−24.294	32.00 m *4*	ε 55.4%, IT 44.6%
		35	3/2+	−29.013	**75.76% *10***	
		36	2+	−29.521	3.01×10^{5} y *2*	β− 98.1%, ε 1.9%
		37	3/2+	−31.761	**24.24% *10***	
		38	2−	−29.798	37.24 m *5*	β−
		38m	5−	−29.127	715 ms *3*	IT
		39	3/2+	−29.800	56.2 m *6*	β−
		40	2−	−27.56	1.35 m *2*	β−
		41	(1/2+)	−27.31	38.4 s *8*	β−
		42		−24.9	6.8 s *3*	β−
		43	(1/2+)	−24.4	3.13 s *9*	β−
		44	(2−)	−20.6	0.56 s *11*	β−, β−n<8%
		45	(1/2+)	−18.36	413 ms *25*	β−, β−n 24%
		46		−13.8	232 ms *2*	β−, β−n 60%
		47		−10.1s	101 ms *6*	β−, β−n>0%
		48		−4.1s	≥200 ns	β−
		49		1.1s	≥170 ns	β−
		50		8.4s	>620 ns	β−, β−n
		51	(3/2+)	14.5s	>200 ns	β−
18	**Ar**	30	0+	21.5s	<20 ns	p?
		31	5/2(+)	11.3s	14.4 ms *6*	ε, εp 62%, ε2p 8.5%
		32	0+	−2.200	100.5 ms *3*	ε, εp 35.6%
		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	1.7756 s *10*	ε
		36	0+	−30.231	**0.3336% *21***	
		37	3/2+	−30.947	35.04 d *4*	ε
		38	0+	−34.714	**0.0629% *7***	
		39	7/2−	−33.242	269 y *3*	β−
		40	0+	−35.040	**99.6035% *25***	
		41	7/2−	−33.067	109.61 m *4*	β−
		42	0+	−34.422	32.9 y *11*	β−
		43	(5/2−)	−32.009	5.37 m *6*	β−
		44	0+	−32.673	11.87 m *5*	β−
		45	5/2−,7/2−	−29.770	21.48 s *15*	β−
		46	0+	−29.73	8.4 s *6*	β−
		47	(3/2)−	−25.21	1.23 s *3*	β−, β−n<0.2%
		48	0+	−22.6s	475 ms *40*	β−
		49		−16.8s	170 ms *50*	β−, β−n 65%
		50	0+	−12.8s	85 ms *30*	β−, β−n 35%
		51		−5.9s	>200 ns	β−
		52	0+	−1.0s	>620 ns	β−?
		53		7.1s	>620 ns	β−?, β−n?, β−2n?
19	**K**	32		21.1s		p?
		33		7.0s	<25 ns	p

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
19	**K**	34	(1+)	–1.2s	<25 ns	p
		35	3/2+	–11.172	178 ms *8*	ε , εp 0.37%
		36	2+	–17.417	342 ms *2*	ε , εp 0.05%,
						εα 3.4×10^{-3}%
		37	3/2+	–24.800	1.226 s *7*	ε
		38	3+	–28.800	7.636 m *18*	ε
		38m	0+	–28.670	924.3 ms *3*	ε 99.97%, IT 0.03%
		39	3/2+	–33.807	**93.2581% *44***	
		40	4–	–33.535	1.248×10^{9} y *3*	β– 89.28%,
					0.0117% *1*	ε 10.72%
		41	3/2+	–35.560	**6.7302% *44***	
		42	2–	–35.022	12.321 h *25*	β–
		43	3/2+	–36.575	22.3 h *1*	β–
		44	2–	–35.781	22.13 m *19*	β–
		45	3/2+	–36.615	17.81 m *61*	β–
		46	(2–)	–35.413	105 s *10*	β–
		47	1/2+	–35.708	17.50 s *24*	β–
		48	(2–)	–32.285	6.8 s *2*	β– , β–n 1.14%
		49	(1/2+,3/2+)	–29.611	1.26 s *5*	β– , β–n 86%
		50	(0–,1–,2–)	–25.74	472 ms *4*	β– , β–n 29%
		51	(1/2+,3/2+)	–21.6s	365 ms *5*	β– , β–n 47%
		52	(2–)	–16.0s	118 ms *6*	β– , β–n ≈ 73%
		53	(3/2+)	–11.1s	30 ms *5*	β– , β–n ≈ 75%,
						β–2n < 1%
		54		–4.3s	10 ms *5*	β– , β–n > 0%
		55		2s	>360 ns	β– , β–n
		56		8.7s	>620 ns	β– , β–n ?, β–2n ?
20	**Ca**	34	0+	13.9s	<35 ns	p
		35		4.8s	25.7 ms *2*	ε , εp 95.9%,
						ε2p 4.1%
		36	0+	–6.45	102 ms *2*	ε , εp 54.3%
		37	3/2+	–13.135	181.1 ms *10*	ε , εp 82.1%
		38	0+	–22.058	440 ms *12*	ε
		39	3/2+	–27.282	859.6 ms *14*	ε
		40	0+	–34.846	$>3.0\times10^{21}$ y	2ε
					96.94% *16*	
		41	7/2–	–35.137	1.02×10^{5} y *7*	ε
		42	0+	–38.547	**0.647% *23***	
		43	7/2–	–38.408	**0.135% *10***	
		44	0+	–41.468	**2.09% *11***	
		45	7/2–	–40.812	162.61 d *9*	β–
		46	0+	–43.139	$>0.28\times10^{16}$ y	2β–
					0.004% *3*	
		47	7/2–	–42.345	4.536 d *3*	β–
		48	0+	–44.223	$>5.8\times10^{22}$ y	2β– 75%
					0.187% *21*	
		49	3/2–	–41.298	8.718 m *6*	β–
		50	0+	–39.588	13.9 s *6*	β–
		51	(3/2–)	–35.87	10.0 s *8*	β– , β–n
		52	0+	–32.5	4.6 s *3*	β– , β–n ≤ 2%
		53	(3/2–,5/2–)	–27.5s	90 ms *15*	β– , β–n > 30%
		54	0+	–23.0s	86 ms *7*	β–

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
20	**Ca**	55	(5/2–)	–17.0s	22 ms *2*	β–, β–n
		56	0+	–12.4s	11 ms *2*	β–, β–n?
		57		–5s	>620 ns	β–, β–n, β–2n
		58	0+	–0.3s	>620 ns	β–, β–n
21	**Sc**	36		15.5s		p?
		37		3.6s		p?
		38		–4.4s		p
		39	(7/2–)	–14.17	<300 ns	p
		40	4–	–20.523	182.3 ms *7*	ε, εp 0.44%, εα 0.02%
		41	7/2–	–28.642	596.3 ms *17*	ε
		42	0+	–32.121	681.3 ms *7*	ε
		42m	(7)+	–31.505	61.7 s *4*	ε
		43	7/2–	–36.188	3.891 h *12*	ε
		44	2+	–37.816	3.97 h *4*	ε
		44m	6+	–37.545	58.61 h *10*	IT 98.8%, ε 1.2%
		45	7/2–	–41.070	**100%**	
		45m	3/2+	–41.058	318 ms *7*	IT
		46	4+	–41.759	83.79 d *4*	β–
		46m	1–	–41.617	18.75 s *4*	IT
		47	7/2–	–44.336	3.3492 d *6*	β–
		48	6+	–44.502	43.67 h *9*	β–
		49	7/2–	–46.560	57.18 m *13*	β–
		50	5+	–44.55	102.5 s *5*	β–
		50m	2+,3+	–44.29	0.35 s *4*	IT>97.5%, β–<2.5%
		51	(7/2)–	–43.23	12.4 s *1*	β–
		52	3(+)	–40.4	8.2 s *2*	β–
		53	(7/2–)	–37.5s	2.4 s *6*	β–, β–n?
		54	(3)+	–33.7s	526 ms *15*	β–
		55	(7/2)–	–29.6	96 ms *2*	β–, β–n 17%
		56	(1+)	–24.5s	26 ms *6*	β–, β–n?
		56m	(5,6)+	–24.5s	75 ms *6*	β–, β–n>14%
		57	(7/2–)	–20.1s	22 ms *2*	β–, β–n
		58		–14.4s	12 ms *5*	β–, β–n
		59		–9.6s	>360 ns	β–, β–n
		60		–3.4s	>360 ns	β–, β–n
		61		1.6s	>360 ns	β–, β–n
22	**Ti**	38	0+	10.6s		
		39	(3/2+)	2.2s	31 ms +*6*–*4*	ε, εp
		40	0+	–8.9	52.4 ms *3*	ε, εp 97.5%
		41	3/2+	–15.1	80.4 ms *9*	ε, εp
		42	0+	–25.104	199 ms *6*	ε
		43	7/2–	–29.321	509 ms *5*	ε
		44	0+	–37.548	60.0 y *11*	ε
		45	7/2–	–39.008	184.8 m *5*	ε
		46	0+	–44.127	**8.25% *3***	
		47	5/2–	–44.936	**7.44% *2***	
		48	0+	–48.491	**73.72% *3***	
		49	7/2–	–48.562	**5.41% *2***	
		50	0+	–51.430	**5.18% *2***	
		51	3/2–	–49.731	5.76 m *1*	β–
		52	0+	–49.468	1.7 m *1*	β–

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
22	**Ti**	53	(3/2)–	–46.8	32.7 s *9*	β–
		54	0+	–45.6	1.5 s *4*	β–
		55	(1/2)–	–41.7	1.3 s *1*	β–
		56	0+	–38.9	0.200 s *5*	β–, β–n
		57	(5/2–)	–33.5	98 ms *5*	β–, β–n
		58	0+	–30.7s	57 ms *10*	β–, β–n
		59	(5/2–)	–25.0s	27.5 ms *25*	β–
		60	0+	–21.5s	22.4 ms *25*	β–
		61	(1/2–)	–15.5s	15 ms *4*	β–, β–n
		62	0+	–11.8s	>620 ns	β–, β–n
		63		–5.2s	>360 ns	β–, β–n
23	**V**	40		11.6s		p?
		41		0.0s		p?
		42		–7.6s	<55 ns	p
		43		–18.0s	79.3 ms *24*	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+	–37.074	422.50 ms *11*	ε
		46m	3+	–36.272	1.02 ms *7*	IT
		47	3/2–	–42.005	32.6 m *3*	ε
		48	4+	–44.476	15.9735 d *25*	ε
		49	7/2–	–47.960	330 d *15*	ε
		50	6+	–49.224	$>2.1\times10^{17}$ y **0.250% *2***	ε>92.9%, β–<7.1%
		51	7/2–	–52.203	**99.750% *2***	
		52	3+	–51.443	3.743 m *5*	β–
		53	7/2–	–51.849	1.543 m *14*	β–
		54	3+	–49.89	49.8 s *5*	β–
		55	(7/2–)	–49.2	6.54 s *15*	β–
		56	1+	–46.1	0.216 s *4*	β–, β–n
		57	(7/2–)	–44.2	0.32 s *3*	β–, β–n
		58	(1+)	–40.2	191 ms *10*	β–, β–n
		59	(5/2–)	–37.1	97 ms *2*	β–, β–n<3%
		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–)	–29.5s	52.6 ms *42*	β–, β–n≥6%
		62		–24.6s	33.5 ms *20*	β–, β–n
		63	7/2–	–21.1s	19.2 ms *24*	β–, β–n≈35%
		64		–15.6s	19 ms *8*	β–
		65		–11.3s	>360 ns	β–, β–n
		66		–5.3s	>360 ns	β–, β–n
24	**Cr**	42	0+	6.5s	13.3 ms *10*	ε, εp 94.4%
		43	(3/2+)	–1.9s	20.6 ms *9*	ε, εp 81%, ε2p 7.1%, ε3p 0.08%
		44	0+	–13.1s	42.8 ms *6*	ε, εp 14%
		45	(7/2–)	–19.4s	60.9 ms *4*	ε, εp 34.4%
		46	0+	–29.47	0.26 s *6*	ε
		47	3/2–	–34.56	500 ms *15*	ε
		48	0+	–42.821	21.56 h *3*	ε
		49	5/2–	–45.332	42.3 m *1*	ε

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Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
24 Cr	50	0+	–50.261	>1.3×10^{18} y	2ε
				4.345% *13*	
	51	7/2–	–51.451	27.7025 d *24*	ε
	52	0+	–55.418	**83.789% *18***	
	53	3/2–	–55.285	**9.501% *17***	
	54	0+	–56.933	**2.365% *7***	
	55	3/2–	–55.108	3.497 m *3*	β–
	56	0+	–55.281	5.94 m *10*	β–
	57	(3/2)–	–52.524	21.1 s *10*	β–
	58	0+	–51.8	7.0 s *3*	β–
	59	(1/2–)	–47.9	1.05 s *9*	β–
	60	0+	–46.5	0.49 s *1*	β–
	61	(5/2–)	–42.2	243 ms *11*	β–, β–n
	62	0+	–40.4	206 ms *12*	β–, β–n
	63	1/2–	–35.6s	129 ms *2*	β–, β–n
	64	0+	–33.3s	42 ms *2*	β–
	65	(1/2–)	–27.8s	28 ms *3*	β–
	66	0+	–24.3s	23 ms *4*	β–
	67		–18.5s		β–?
	68	0+	–14.9s	>360 ns	β–, β–n
25 Mn	44	(2–)	6.7s	<105 ns	ε, p
	45		–5.1s		
	46	(4+)	–12.0s	36.2 ms *4*	ε, εp 57%
	47	(5/2–)	–22.3s	88.0 ms *13*	ε, εp<1.7%
	48	4+	–29.3	158.1 ms *22*	ε, εp 0.28%, εα<6.0×10^{-4}%
	49	5/2–	–37.61	382 ms *7*	ε
	50	0+	–42.627	283.19 ms *10*	ε
	50m	5+	–42.402	1.75 m *3*	ε
	51	5/2–	–48.243	46.2 m *1*	ε
	52	6+	–50.706	5.591 d *3*	ε
	52m	2+	–50.328	21.1 m *2*	ε 98.25%, IT 1.75%
	53	7/2–	–54.689	3.74×10^{6} y *4*	ε
	54	3+	–55.556	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–	–57.486	85.4 s *18*	β–
	58	1+	–55.827	3.0 s *1*	β–
	58m	4+	–55.755	65.4 s *5*	β–≈90%, IT≈10%
	59	(5/2)–	–55.525	4.59 s *5*	β–
	60	1+	–52.967	0.28 s *2*	β–
	60m	4+	–52.695	1.77 s *2*	β– 88.5%, IT 11.5%
	61	(5/2)–	–51.742	0.67 s *4*	β–
	62m	(3+)	–48.180	671 ms *5*	β–, β–n
	62m	(1+)	–48.180	92 ms *13*	β–, β–n
	63	5/2–	–46.886	0.275 s *4*	β–, β–n
	64	(1+)	–42.989	90 ms *4*	β–, β–n 33%
	64m	(4+)	–42.814	0.50 ms *5*	IT
	65	(5/2–)	–40.967	84 ms *8*	β–
	66		–36.75	65 ms *2*	β–
	67	(5/2+)	–32.8s	51 ms *4*	β–, β–n>10%
	68	(>3)	–28.0s	28 ms *3*	β–, β–n

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
25 Mn	69	5/2–	–24.4s	18 ms *4*	β–
	70		–19.2s	>360 ns	β–, β–n
	71			>637 ns	β–, β–n, β–2n
26 Fe	45	(3/2+)	13.8s	1.89 ms *+49–21*	2p 70%, ε≤30%, εp 19%, ε2p 7.8%, ε3p 3.3%
	46	0+	0.8s	13.0 ms *20*	ε, εp 78.7%
	47	(7/2–)	–6.6s	21.9 ms *2*	ε, εp 88.4%, ε2p
	48	0+	–18.16s	45.3 ms *6*	ε, εp 15.9%
	49	(7/2–)	–24.8s	64.7 ms *3*	ε, εp 56.7%
	50	0+	–34.49	155 ms *11*	ε, εp?
	51	5/2–	–40.22	305 ms *5*	ε
	52	0+	–48.332	8.275 h *8*	ε
	52m	12+	–41.374	45.9 s *6*	ε, IT<4.0×10^{-3}%
	53	7/2–	–50.946	8.51 m *2*	ε
	53m	19/2–	–47.906	2.54 m *2*	IT
	54	0+	–56.253	**5.845% *35***	
	55	3/2–	–57.480	2.744 y *9*	ε
	56	0+	–60.606	**91.754% *36***	
	57	1/2–	–60.181	**2.119% *10***	
	58	0+	–62.154	**0.282% *4***	
	59	3/2–	–60.664	44.495 d *9*	β–
	60	0+	–61.412	2.62×10^{6} y *4*	β–
	61	3/2–,5/2–	–58.920	5.98 m *6*	β–
	62	0+	–58.877	68 s *2*	β–
	63	(5/2–)	–55.635	6.1 s *6*	β–
	64	0+	–54.969	2.0 s *2*	β–
	65	(1/2–)	–51.221	0.81 s *5*	β–
	65m	(9/2+)	–50.819	1.12 s *15*	β–
	66	0+	–50.067	440 ms *60*	β–
	67	(1/2–)	–45.7	0.40 s *4*	β–
	68	0+	–43.1	180 ms *19*	β–
	69	1/2–	–38.4s	110 ms *6*	β–
	70	0+	–36.3s	71 ms *10*	β–
	71		–31.0s	28 ms *5*	β–, β–n
	72	0+	–28.3s	≥150 ns	β–, β–n 27.6%
	73			>633 ns	β–, β–n, β–2n
	74	0+		>638 ns	β–, β–n, β–2n
27 Co	47		10.3s		
	48		1.9s		
	49		–9.6s		
	50	(6+)	–17.2s	38.8 ms *2*	ε, εp 70.5%, ε2p
	51	(7/2–)	–27.3s	>200 ns	ε
	52	(6+)	–33.92s	115 ms *23*	ε
	53	(7/2–)	–42.658	240 ms *9*	ε
	53m	(19/2–)	–39.461	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–	–54.029	17.53 h *3*	ε
	56	4+	–56.039	77.236 d *26*	ε
	57	7/2–	–59.344	271.74 d *6*	ε
	58	2+	–59.846	70.86 d *6*	ε

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
27 Co	58m	5+	−59.821	9.10 h *9*	IT
	59	7/2−	−62.229	**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−	−62.897	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)−	−59.185	1.16 s *3*	β−
	66	(3+)	−56.41	0.20 s *2*	β−
	67	(7/2−)	−55.321	0.425 s *20*	β−
	68	(7−)	−51.9	0.199 s *21*	β−
	68m	(3+)	−51.9	1.6 s *3*	β−
	69	7/2−	−50.0	229 ms *24*	β−
	70	(6−)	−45.6	108 ms *7*	β−
	70m	(3+)	−45.6	0.50 s *18*	β−
	71	(7/2−)	−43.9	80 ms *3*	β−, β−n ≤ 6%
	72	(6−,7−)	−39.7s	59.9 ms *17*	β−, β−n ≥ 6%
	73		−37.2s	41 ms *4*	β−
	74	0+	−32.7s	25 ms *5*	β−, β−n ≈ 18%
	75	(7/2−)	−29.4s	>150 ns	β−
	76			>634 ns	β−, β−2n, β−n
28 Ni	48	0+	18.0s	2.1 ms *+14−6*	2p ≈ 70%, ε
	49		8.7s	7.5 ms *10*	ε, εp 83%
	50	0+	−3.6s	18.5 ms *12*	ε, εp 86.7%, ε2p
	51	(7/2−)	−11.5s	23.8 ms *2*	ε, εp 87.2%
	52	0+	−22.9s	40.8 ms *2*	ε, εp 31.4%
	53	(7/2−)	−29.7s	55.2 ms *7*	ε, εp 23.4%
	54	0+	−39.22	104 ms *7*	ε
	55	7/2−	−45.335	204.7 ms *37*	ε
	56	0+	−53.906	6.075 d *10*	ε
	57	3/2−	−56.083	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	**1.1399% *13***	
	62	0+	−66.745	**3.6346% *40***	
	63	1/2−	−65.512	101.2 y *15*	β−
	64	0+	−67.098	**0.9255% *19***	
	65	5/2−	−65.125	2.5175 h *5*	β−
	66	0+	−66.006	54.6 h *3*	β−
	67	(1/2)−	−63.742	21 s *1*	β−
	68	0+	−63.463	29 s *2*	β−
	68m	5−	−60.614	0.86 ms *5*	IT
	69	9/2+	−59.978	11.2 s *9*	β−
	69m	1/2−	−59.657	3.5 s *9*	β−
	70	0+	−59.213	6.0 s *3*	β−
	71	(9/2+)	−55.405	2.56 s *3*	β−
	71m	(1/2−)	−54.906	2.3 s *3*	β−
	72	0+	−54.225	1.57 s *5*	β−
	73	(9/2+)	−50.107	0.84 s *3*	β−

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
28	**Ni**	74	0+	–48.7s	0.68 s *18*	β– , β–n
		75	(7/2+)	–44.1s	344 ms *25*	β– , β–n 10%
		76	0+	–41.6s	0.238 s *+15–18*	β– , β–n
		77		–36.7s	128 ms *+36–32*	β– , β–n 30%
		78	0+	–34.1s	0.11 s *+10–6*	β– , β–n
		79			>635 ns	β– , β–n, β–2n
29	**Cu**	52	(3+)	–1.9s		p
		53	(3/2–)	–13.5s	<300 ns	ε , p
		54	(3+)	–21.4s	<75 ns	p
		55	(3/2–)	–31.6s	27 ms *8*	ε , εp 15%
		56	(4+)	–38.2s	93 ms *3*	ε , εp 0.4%
		57	3/2–	–47.308	196.3 ms *7*	ε
		58	1+	–51.667	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–	–61.983	3.333 h *5*	ε
		62	1+	–62.786	9.673 m *8*	ε
		63	3/2–	–65.579	**69.15% *15***	
		64	1+	–65.424	12.701 h *2*	ε 61.5%, β– 38.5%
		65	3/2–	–67.263	**30.85% *15***	
		66	1+	–66.257	5.120 m *14*	β–
		67	3/2–	–67.318	61.83 h *12*	β–
		68	1+	–65.567	30.9 s *6*	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+	–62.733	6.6 s *2*	β– 93.2%, IT 6.8%
		71	3/2(–)	–62.711	19.4 s *16*	β–
		72	(2)	–59.782	6.63 s *3*	β–
		73	(3/2–)	–58.987	4.2 s *3*	β–
		74	(1+,3+)	–56.006	1.594 s *10*	β–
		75	(5/2–)	–54.471	1.222 s *8*	β– , β–n 3.5%
		76	(3,4)	–50.975	637 ms *7*	β– , β–n 7.2%
		76m		–50.975	1.27 s *30*	β–
		77	(5/2–)	–48.3	468.1 ms *20*	β– , β–n 30.3%
		78	(4–,5–,6–)	–44.5	335 ms *11*	β– , β–n>65%
		79		–41.9s	188 ms *25*	β– , β–n 55%
		80		–36.4s	0.17 s *+11–5*	β–
		81			>632 ns	β– , β–2n, β–n
		82			>636 ns	β– , β–n, β–2n
30	**Zn**	54	0+	–6.0s	1.59 ms *+60–35*	2p 92%
		55	(5/2–)	–14.4s	19.8 ms *13*	ε , εp 91%
		56	0+	–25.2s	30.0 ms *17*	ε , εp 86%
		57	(7/2–)	–32.5s	38 ms *4*	ε , εp≥65%
		58	0+	–42.30	86 ms *8*	ε , εp<3%
		59	3/2–	–47.214	182.0 ms *18*	ε , εp 0.1%
		60	0+	–54.173	2.38 m *5*	ε
		61	3/2–	–56.34	89.1 s *2*	ε
		61m	1/2–	–56.25	<430 ms	IT
		61m	3/2–	–55.92	0.14 s *7*	IT
		61m	5/2–	–55.59	<0.13 s	IT

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
30 Zn	62	0+	–61.167	9.186 h *13*	ε
	63	3/2–	–62.213	38.47 m *5*	ε
	64	0+	–66.003	$\geq 7.0\times10^{20}$ y **49.17% *75***	2ε
	65	5/2–	–65.911	243.93 d *9*	ε
	66	0+	–68.899	**27.73% *98***	
	67	5/2–	–67.880	**4.04% *16***	
	68	0+	–70.006	**18.45% *63***	
	69	1/2–	–68.417	56.4 m *9*	β–
	69m	9/2+	–67.978	13.76 h *2*	IT 99.97%, β– 0.03%
	70	0+	–69.564	$\geq 2.3\times10^{17}$ y **0.61% *10***	2β–
	71	1/2–	–67.328	2.45 m *10*	β–
	71m	9/2+	–67.170	3.96 h *5*	β–, IT≤0.05%
	72	0+	–68.145	46.5 h *1*	β–
	73	(1/2)–	–65.593	23.5 s *10*	β–
	73m		–65.593	5.8 s *8*	β–, IT
	73m	(5/2+)	–65.397	13.0 ms *2*	IT
	74	0+	–65.756	95.6 s *12*	β–
	75	(7/2+)	–62.558	10.2 s *2*	β–
	76	0+	–62.303	5.7 s *3*	β–
	77	(7/2+)	–58.789	2.08 s *5*	β–
	77m	(1/2–)	–58.017	1.05 s *10*	IT>50%, β–<50%
	78	0+	–57.483	1.47 s *15*	β–
	79	(9/2+)	–53.432	0.995 s *19*	β–, β–n 1.3%
	80	0+	–51.648	0.54 s *2*	β–, β–n 1%
	81	(5/2+)	–46.199	304 ms *13*	β–, β–n 7.5%
	82	0+	–42.6s	>150 ns	β–
	83		–36.7s	>300 ns	β–, β–n
	84	0+		>633 ns	β–, β–2n, β–n
	85			>637 ns	β–?, β–n?, β–2n?
31 Ga	56		–4.2s		p?
	57		–15.6s		p?
	58		–23.8s		p?
	59		–34.0s		p?
	60	(2+)	–39.8s	70 ms *13*	ε 98.4%, εp 1.6%, εα<0.02%
	61	3/2–	–47.09	167 ms *3*	ε, εp<0.25%
	62	0+	–51.986	116.121 ms *21*	ε, εp
	63	3/2–	–56.547	32.4 s *5*	ε
	64	0+	–58.833	2.627 m *12*	ε
	65	3/2–	–62.657	15.2 m *2*	ε
	66	0+	–63.724	9.49 h *3*	ε
	67	3/2–	–66.878	3.2617 d *5*	ε
	68	1+	–67.085	67.71 m *9*	ε
	69	3/2–	–69.327	**60.108% *9***	
	70	1+	–68.910	21.14 m *3*	β– 99.59%, ε 0.41%
	71	3/2–	–70.139	**39.892% *9***	
	72	3–	–68.588	14.10 h *2*	β–
	73	3/2–	–69.699	4.86 h *3*	β–
	74	(3–)	–68.049	8.12 m *12*	β–
	74m	(0)	–67.989	9.5 s *10*	IT 75%, β–<50%

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
31 Ga	*75*	3/2–	–68.464	126 s *2*	β–
	76	2+	–66.296	32.6 s *6*	β–
	77	3/2–	–65.992	13.2 s *2*	β–
	78	2+	–63.705	5.09 s *5*	β–
	79	3/2–	–62.547	2.847 s *3*	β– , β–n 0.09%
	80	3	–59.223	1.676 s *14*	β– , β–n 0.86%
	81	5/2–	–57.627	1.217 s *5*	β– , β–n 11.9%
	82	(1,2,3)	–52.930	0.599 s *2*	β– , β–n 19.8%
	83		–49.257	308.1 ms *10*	β– , β–n 62.8%
	84	(0–)	–44.3s	0.085 s *10*	β– , β–n 74%
	84m	(3–,4–)	–44.3s	<0.085 s	β– , β–n ?
	85	(1/2–,3/2–)	–40.2s	<100 ms	β– , β–n >35%
	86		–34.5s	>150 ns	β– , β–n
	87			>634 ns	β– , β–n, β–2n
32 Ge	58	0+	–7.7s		2p ?
	59		–16.5s		2p ?
	60	0+	–27.6s	>110 ns	εp , ε
	61	(3/2–)	–33.7s	44 ms *6*	ε , εp >58%
	62	0+	–42.2s	129 ms *35*	ε , εp
	63	3/2–	–46.92	150 ms *9*	ε
	64	0+	–54.315	63.7 s *25*	ε
	65	3/2–	–56.480	30.9 s *5*	ε , εp 0.01%
	66	0+	–61.606	2.26 h *5*	ε
	67	1/2–	–62.657	18.9 m *3*	ε
	68	0+	–66.978	270.95 d *16*	ε
	69	5/2–	–67.100	39.05 h *10*	ε
	70	0+	–70.561	**20.57% *27***	
	71	1/2–	–69.906	11.43 d *3*	ε
	71m	9/2+	–69.708	20.41 ms *18*	IT
	72	0+	–72.585	**27.45% *32***	
	73	9/2+	–71.297	**7.75% *12***	
	73m	1/2–	–71.230	0.499 s *11*	IT
	74	0+	–73.422	**36.50% *20***	
	75	1/2–	–71.856	82.78 m *4*	β–
	75m	7/2+	–71.716	47.7 s *5*	IT 99.97%, β– 0.03%
	76	0+	–73.212	**7.73% *12***	
	77	7/2+	–71.213	11.30 h *1*	β–
	77m	1/2–	–71.053	52.9 s *6*	β– 81%, IT 19%
	78	0+	–71.862	88.0 m *10*	β–
	79	(1/2)–	–69.53	18.98 s *3*	β–
	79m	(7/2+)	–69.34	39.0 s *10*	β– 96%, IT 4%
	80	0+	–69.535	29.5 s *4*	β–
	81	(9/2+)	–66.291	7.6 s *6*	β–
	81m	(1/2+)	–65.612	7.6 s *6*	β–
	82	0+	–65.415	4.56 s *26*	β–
	83	(5/2)+	–60.976	1.85 s *6*	β–
	84	0+	–58.148	0.954 s *14*	β– , β–n 10.2%
	85	(1/2+,5/2+)	–53.123	0.56 s *5*	β– , β–n 14%
	86	0+	–49.8s	>150 ns	β– , β–n
	87	(5/2+)	–44.2s	≈0.14 s	β– , β–n
	88	0+	–40.2s	≥300 ns	β–
	89		–33.8s	≥300 ns	β– ?

Nuclear Wallet Cards

Nuclide				**Δ**	**$T_{1/2}$, Γ, or**	
Z	**El**	**A**	**$J\pi$**	**(MeV)**	**Abundance**	**Decay Mode**
32	**Ge**	90	0+		>635 ns	β–, β–n, β–2n
33	**As**	60		–6.1s		p?
		61		–17.8s		p?
		62		–24.8s		p?
		63	3/2–	–33.5s	<43 ns	p
		64		–39.4s	18 ms *+43–7*	ε
		65		–46.94	128 ms *16*	ε
		66	(0+)	–52.03	95.77 ms *23*	ε
		67	(5/2–)	–56.585	42.5 s *12*	ε
		68	3+	–58.894	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–	–67.893	65.30 h *7*	ε
		72	2–	–68.229	26.0 h *1*	ε
		73	3/2–	–70.952	80.30 d *6*	ε
		74	2–	–70.859	17.77 d *2*	ε 66%, β– 34%
		75	3/2–	–73.033	**100%**	
		75m	9/2+	–72.729	17.62 ms *23*	IT
		76	2–	–72.290	1.0942 d *7*	β–
		77	3/2–	–73.916	38.83 h *5*	β–
		78	2–	–72.817	90.7 m *2*	β–
		79	3/2–	–73.636	9.01 m *15*	β–
		80	1+	–72.17	15.2 s *2*	β–
		81	3/2–	–72.533	33.3 s *8*	β–
		82	(2–)	–70.103	19.1 s *5*	β–
		82m	(5–)	–69.956	13.6 s *4*	β–
		83	(5/2–,3/2–)	–69.669	13.4 s *3*	β–
		84	(3–)	–65.853	4.2 s *5*	β–, β–n 0.18%
		85	(3/2–)	–63.189	2.021 s *10*	β–, β–n 59.4%
		86		–58.962	0.945 s *8*	β–, β–n 26%
		87	(3/2–)	–55.617	0.56 s *8*	β–, β–n 15.4%
		88		–50.9s	>300 ns	β–
		89		–46.9s	>300 ns	β–?, β–n?
		90		–41.3s	>300 ns	β–, β–n
		91		–36.9s	>150 ns	β–
		92		–31.0s		β–
34	**Se**	64	0+	–26.9s	>180 ns	ε
		65	(3/2–)	–32.9s	33 ms *4*	ε, εp
		66	0+	–41.7s		
		67		–46.58	136 ms *12*	ε, εp 0.5%
		68	0+	–54.189	35.5 s *7*	ε
		69	(1/2–,3/2–)	–56.30	27.4 s *2*	ε, εp 0.05%
		70	0+	–61.929	41.1 m *3*	ε
		71	(5/2–)	–63.146	4.74 m *5*	ε
		72	0+	–67.868	8.40 d *8*	ε
		73	9/2+	–68.227	7.15 h *8*	ε
		73m	3/2–	–68.201	39.8 m *13*	IT 72.6%, ε 27.4%
		74	0+	–72.212	**0.89% *4***	
		75	5/2+	–72.169	119.79 d *4*	ε
		76	0+	–75.251	**9.37% *29***	
		77	1/2–	–74.599	**7.63% *16***	
		77m	7/2+	–74.437	17.4 s *8*	IT

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
34	**Se**	78	0+	−77.025	**23.77%** ***28***	
		79	7/2+	−75.917	2.95×10^5 y *38*	β−
		79m	1/2−	−75.821	3.92 m *1*	IT 99.94%, β− 0.06%
		80	0+	−77.759	**49.61%** ***41***	
		81	1/2−	−76.389	18.45 m *12*	β−
		81m	7/2+	−76.286	57.28 m *2*	IT 99.95%, β− 0.05%
		82	0+	−77.594	**8.73%** ***22***	
		83	9/2+	−75.340	22.3 m *3*	β−
		83m	1/2−	−75.112	70.1 s *4*	β−
		84	0+	−75.947	3.26 m *10*	β−
		85	(5/2+)	−72.413	32.9 s *3*	β−
		86	0+	−70.503	14.3 s *3*	β−
		87	(5/2+)	−66.426	5.50 s *12*	β−, β−n 0.2%
		88	0+	−63.884	1.53 s *6*	β−, β−n 0.67%
		89	(5/2+)	−58.992	0.41 s *4*	β−, β−n 7.8%
		90	0+	−55.9s	>300 ns	β−, β−n
		91		−50.3s	0.27 s *5*	β−, β−n 21%
		92	0+	−46.7s		β−
		93	(1/2+)	−40.7s		β−
		94	0+	−36.8s	>150 ns	β−
		95			>300 ns	β−?, β−n?, β−2n?
35	**Br**	67		−32.8s		p?
		68		−38.7s	<1.2 μs	p?
		69		−46.5s	<24 ns	p?
		70	0+	−51.42	79.1 ms *8*	ε
		70m	9+	−49.13	2.2 s *2*	ε
		71	(5/2)−	−56.502	21.4 s *6*	ε
		72	1+	−59.067	78.6 s *24*	ε
		72m	(3−)	−58.966	10.6 s *3*	IT, ε
		73	1/2−	−63.647	3.4 m *2*	ε
		74	(0−)	−65.285	25.4 m *3*	ε
		74m	4(+)	−65.271	46 m *2*	ε
		75	3/2−	−69.107	96.7 m *13*	ε
		76	1−	−70.288	16.2 h *2*	ε
		76m	(4)+	−70.185	1.31 s *2*	IT>99.4%, ε<0.6%
		77	3/2−	−73.234	57.036 h *6*	ε
		77m	9/2+	−73.128	4.28 m *10*	IT
		78	1+	−73.452	6.45 m *4*	ε≥99.99%, β−≤0.01%
		79	3/2−	−76.068	**50.69%** ***7***	
		79m	9/2+	−75.860	5.1 s *4*	IT
		80	1+	−75.889	17.68 m *2*	β− 91.7%, ε 8.3%
		80m	5−	−75.803	4.4205 h *8*	IT
		81	3/2−	−77.975	**49.31%** ***7***	
		82	5−	−77.497	35.282 h *7*	β−
		82m	2−	−77.451	6.13 m *5*	IT 97.6%, β− 2.4%
		83	3/2−	−79.006	2.40 h *2*	β−
		84	2−	−77.79	31.76 m *8*	β−
		84m	(6)−	−77.47	6.0 m *2*	β−
		85	3/2−	−78.575	2.90 m *6*	β−
		86	(1−)	−75.632	55.1 s *4*	β−
		87	3/2−	−73.891	55.65 s *13*	β−, β−n 2.6%

Nuclear Wallet Cards

Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
35	**Br**	*88*	(2−)	−70.715	16.29 s *6*	β−, β−n 6.58%
		89	(3/2−,5/2−)	−68.274	4.40 s *3*	β−, β−n 13.8%
		90		−64.000	1.91 s *1*	β−, β−n 25.2%
		91		−61.107	0.541 s *5*	β−, β−n 20%
		92	(2−)	−56.232	0.343 s *15*	β−, β−n 33.1%
		93	(5/2−)	−52.9s	102 ms *10*	β−, β−n 68%
		94		−47.6s	70 ms *20*	β−, β−n 68%
		95		−43.9s	≥150 ns	β−, β−n 34%
		96		−38.3s	≥150 ns	β−, β−n 27.6%
		97		−34.5s	>300 ns	β−
		98			>634 ns	β−, β−n, β−2n
36	**Kr**	69		−32.4s	32 ms *10*	ε
		70	0+	−41.6s	52 ms *17*	ε, εp≤1.3%
		71	(5/2−)	−46.3	100 ms *3*	ε, εp 2.1%
		72	0+	−53.940	17.1 s *2*	ε, εp<1.0×10^{-6}%
		73	3/2−	−56.551	27.3 s *10*	ε, εp 0.25%
		74	0+	−62.331	11.50 m *11*	ε
		75	5/2+	−64.323	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+	−74.179	≥1.5×10^{21} y **0.355% *3***	2ε
		79	1/2−	−74.442	35.04 h *10*	ε
		79m	7/2+	−74.312	50 s *3*	IT
		80	0+	−77.892	**2.286% *10***	
		81	7/2+	−77.694	2.29×10^{5} y *11*	ε
		81m	1/2−	−77.503	13.10 s *3*	IT, ε 2.5×10^{-3}%
		82	0+	−80.590	**11.593% *31***	
		83	9/2+	−79.990	**11.500% *19***	
		83m	1/2−	−79.948	1.85 h *3*	IT
		84	0+	−82.439	**56.987% *15***	
		85	9/2+	−81.480	10.752 y *25*	β−
		85m	1/2−	−81.175	4.480 h *8*	β− 78.6%, IT 21.4%
		86	0+	−83.266	**17.279% *41***	
		87	5/2+	−80.709	76.3 m *5*	β−
		88	0+	−79.691	2.84 h *3*	β−
		89	3/2(+)	−76.535	3.15 m *4*	β−
		90	0+	−74.959	32.32 s *9*	β−
		91	5/2(+)	−70.973	8.57 s *4*	β−
		92	0+	−68.769	1.840 s *8*	β−, β−n 0.03%
		93	1/2+	−64.135	1.286 s *10*	β−, β−n 1.95%
		94	0+	−61.35	212 ms *5*	β−, β−n 1.11%
		95	1/2(+)	−56.16	0.114 s *3*	β−, β−n 2.87%
		96	0+	−53.08	80 ms *6*	β−, β−n 3.7%
		97	(3/2+)	−47.4	63 ms *4*	β−, β−n 6.7%
		98	0+	−44.5s	46 ms *8*	β−, β−n 7%
		99		−38.8s	13 ms *+34−6*	β−, β−n 11%
		100	0+	−35.2s	7 ms *+11−3*	β−, β−n
		101			>635 ns	β−, β−n, β−2n
37	**Rb**	71		−32.3s		p?
		72	(3+)	−38.1s	<1.2 µs	p?
		73		−46.1s	<30 ns	ε?, p>0%

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
37 Rb	74	(0+)	−51.916	64.9 ms *5*	ε
	75	(3/2−)	−57.218	19.0 s *12*	ε
	76	1(−)	−60.478	36.5 s *6*	ε, εα 3.8×10^{-7}%
	77	3/2−	−64.830	3.77 m *4*	ε
	78	0(+)	−66.936	17.66 m *3*	ε
	78m	4(−)	−66.825	5.74 m *3*	ε 91%, IT 9%
	79	5/2+	−70.802	22.9 m *5*	ε
	80	1+	−72.175	33.4 s *7*	ε
	81	3/2−	−75.456	4.572 h *4*	ε
	81m	9/2+	−75.370	30.5 m *3*	IT 97.6%, ε 2.4%
	82	1+	−76.187	1.2575 m *2*	ε
	82m	5−	−76.118	6.472 h *6*	ε, IT<0.33%
	83	5/2−	−79.070	86.2 d *1*	ε
	84	2−	−79.756	32.82 d *7*	ε 96.1%, β− 3.9%
	84m	6−	−79.292	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−	−84.597	4.81×10^{10} y *9* **27.83% *2***	β−
	88	2−	−82.608	17.773 m *11*	β−
	89	3/2−	−81.712	15.15 m *12*	β−
	90	0−	−79.364	158 s *5*	β−
	90m	3−	−79.257	258 s *4*	β− 97.4%, IT 2.6%
	91	3/2(−)	−77.746	58.4 s *4*	β−
	92	0−	−74.772	4.492 s *20*	β−, β−n 0.01%
	93	5/2−	−72.620	5.84 s *2*	β−, β−n 1.39%
	94	3(−)	−68.561	2.702 s *5*	β−, β−n 10.5%
	95	5/2−	−65.89	377.7 ms *8*	β−, β−n 8.7%
	96	2(−)	−61.354	203 ms *3*	β−, β−n 13.3%
	97	3/2+	−58.518	169.1 ms *6*	β−, β−n 25.5%
	98	(0,1)	−54.03	102 ms *4*	β−, β−n 13.8%, β−2n 0.05%
	98m	(3,4)	−53.76	96 ms *3*	β−
	99	(5/2+)	−51.2	54 ms *4*	β−, β−n 15.8%
	100	(3+,4−)	−46.5s	51 ms *8*	β−, β−n 6%, β−2n 0.16%
	101	(3/2+)	−43.0s	32 ms *5*	β−, β−n 28%
	102		−37.9s	37 ms *3*	β−, β−n 18%
	103			>633 ns	β−, β−n
38 Sr	73		−32.0s	>25 ms	ε, εp>0%
	74	0+	−40.8s	>1.2 μs	ε
	75	(3/2−)	−46.6	88 ms *3*	ε, εp 5.2%
	76	0+	−54.25	7.89 s *7*	ε, εp 3.4×10^{-5}%
	77	5/2+	−57.803	9.0 s *2*	ε, εp<0.25%
	78	0+	−63.173	160 s *8*	ε
	79	3/2(−)	−65.476	2.25 m *10*	ε
	80	0+	−70.311	106.3 m *15*	ε
	81	1/2−	−71.528	22.3 m *4*	ε
	82	0+	−76.009	25.34 d *2*	ε
	83	7/2+	−76.797	32.41 h *3*	ε

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
38	**Sr**	83m	1/2–	–76.538	4.95 s *12*	IT
		84	0+	–80.649	**0.56% *1***	
		85	9/2+	–81.103	64.850 d *7*	ε
		85m	1/2–	–80.864	67.63 m *4*	IT 86.6%, ε 13.4%
		86	0+	–84.523	**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+	–87.921	**82.58% *1***	
		89	5/2+	–86.208	50.53 d *7*	β–
		90	0+	–85.949	28.90 y *3*	β–
		91	5/2+	–83.652	9.63 h *5*	β–
		92	0+	–82.867	2.66 h *4*	β–
		93	5/2+	–80.086	7.43 m *3*	β–
		94	0+	–78.843	75.3 s *2*	β–
		95	1/2+	–75.123	23.90 s *14*	β–
		96	0+	–72.932	1.07 s *1*	β–
		97	1/2+	–68.591	429 ms *5*	β–, β–n ≤ 0.05%
		98	0+	–66.436	0.653 s *2*	β–, β–n 0.25%
		99	3/2+	–62.529	0.269 s *1*	β–, β–n 0.1%
		100	0+	–59.833	202 ms *3*	β–, β–n 0.78%
		101	(5/2–)	–55.56	118 ms *3*	β–, β–n 2.37%
		102	0+	–52.4s	69 ms *6*	β–, β–n 5.5%
		103		–47.5s	68 ms +*48*–*20*	β–
		104	0+	–43.9s	43 ms +*9*–*7*	β–
		105		–38.6s	40 ms +*36*–*13*	β–
		106	0+		>392 ns	β–, β–n, β–2n
		107			>395 ns	β–, β–n, β–2n
39	**Y**	76		–38.6s	>200 ns	ε, p
		77	(5/2+)	–46.78s	57 ms +*22*–*12*	ε, εp, p
		78	(0+)	–52.5s	53 ms *8*	ε, εp
		78m	(5+)	–52.5s	5.8 s *6*	ε, εp
		79	(5/2+)	–58.4	14.8 s *6*	ε, εp
		80	(4–)	–61.148	30.1 s *5*	ε, εp
		80m	(1–)	–60.919	4.8 s *3*	IT 81%, ε 19%
		81	(5/2+)	–65.713	70.4 s *10*	ε
		82	1+	–68.064	8.30 s *20*	ε
		83	9/2+	–72.21	7.08 m *6*	ε
		83m	3/2–	–72.14	2.85 m *2*	ε 60%, IT 40%
		84	(6+)	–73.894	39.5 m *8*	ε
		84m	1+	–73.827	4.6 s *2*	ε
		85	(1/2)–	–77.84	2.68 h *5*	ε
		85m	9/2+	–77.82	4.86 h *20*	ε, IT < 2.0×10^{-3}%
		86	4–	–79.28	14.74 h *2*	ε
		86m	(8+)	–79.06	48 m *1*	IT 99.31%, ε 0.69%
		87	1/2–	–83.018	79.8 h *3*	ε
		87m	9/2+	–82.637	13.37 h *3*	IT 98.43%, ε 1.57%
		88	4–	–84.298	106.626 d *21*	ε
		89	1/2–	–87.709	**100%**	
		89m	9/2+	–86.800	15.663 s *5*	IT
		90	2–	–86.495	64.053 h *20*	β–
		90m	7+	–85.813	3.19 h *6*	IT, β– 1.8×10^{-3}%
		91	1/2–	–86.352	58.51 d *6*	β–

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
39	**Y**	91m	9/2+	–85.796	49.71 m *4*	IT, β–<1.5%
		92	2–	–84.817	3.54 h *1*	β–
		93	1/2–	–84.23	10.18 h *8*	β–
		93m	(9/2)+	–83.47	0.82 s *4*	IT
		94	2–	–82.352	18.7 m *1*	β–
		95	1/2–	–81.213	10.3 m *1*	β–
		96	0–	–78.344	5.34 s *5*	β–
		96m	8+	–77.204	9.6 s *2*	β–
		97	(1/2–)	–76.130	3.75 s *3*	β–, β–n 0.06%
		97m	(9/2)+	–75.463	1.17 s *3*	β–>99.3%, IT<0.7%, β–n<0.08%
		97m	(27/2–)	–72.607	142 ms *8*	IT 98.4%, β– 1.6%
		98	(0)–	–72.303	0.548 s *2*	β–, β–n 0.33%
		98m	(4,5)	–71.893	2.0 s *2*	β–>80%, IT<20%, β–n 3.4%
		99	(5/2+)	–70.658	1.484 s *7*	β–, β–n 1.7%
		100	1–,2–	–67.34	735 ms *7*	β–, β–n 0.92%
		100m	(3,4,5)	–67.19	0.94 s *3*	β–
		101	(5/2+)	–65.070	0.45 s *2*	β–, β–n 1.94%
		102m	HighJ	–61.2s	0.36 s *4*	β–, β–n 4.9%
		102m	LowJ	–61.2s	0.298 s *9*	β–, β–n 4.9%
		103	(5/2+)	–58.50	0.23 s *2*	β–, β–n 8%
		104		–54.1s	197 ms *4*	β–, β–n
		105		–50.8s	85 ms +*5*–*4*	β–, β–n<82%
		106		–46.1s	62 ms +*25*–*14*	β–
		107	(5/2+)	–42.4s	41 ms +*15*–*9*	β–
		108		–37.3s	25 ms +*66*–*10*	β–, β–n
		109			>393 ns	β–, β–n, β–2n
40	**Zr**	78	0+	–41.3s	>170 ns	ε
		79		–47.1s	56 ms *30*	ε, εp
		80	0+	–56	4.6 s *6*	ε, εp
		81	(3/2–)	–58.4	5.5 s *4*	ε, εp 0.12%
		82	0+	–63.9s	32 s *5*	ε
		83	(1/2–)	–65.911	41.6 s *24*	ε, εp
		84	0+	–71.421	25.8 m *5*	ε
		85	(7/2+)	–73.175	7.86 m *4*	ε
		85m	(1/2–)	–72.883	10.9 s *3*	IT≤92%, ε>8%
		86	0+	–77.969	16.5 h *1*	ε
		87	(9/2)+	–79.347	1.68 h *1*	ε
		87m	(1/2)–	–79.011	14.0 s *2*	IT
		88	0+	–83.629	83.4 d *3*	ε
		89	9/2+	–84.876	78.41 h *12*	ε
		89m	1/2–	–84.288	4.161 m *17*	IT 93.77%, ε 6.23%
		90	0+	–88.774	**51.45% *40***	
		90m	5–	–86.455	809.2 ms *20*	IT
		91	5/2+	–87.897	**11.22% *5***	
		92	0+	–88.460	**17.15% *8***	
		93	5/2+	–87.123	1.61×10^{6} y *5*	β–
		94	0+	–87.272	**17.38% *28***	
		95	5/2+	–85.663	64.032 d *6*	β–
		96	0+	–85.447	2.35×10^{19} y *21* **2.80% *9***	2β–

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
40	**Zr**	*97*	1/2+	–82.951	16.749 h *8*	β–
		98	0+	–81.295	30.7 s *4*	β–
		99	(1/2+)	–77.63	2.1 s *1*	β–
		100	0+	–76.384	7.1 s *4*	β–
		101	(3/2+)	–73.173	2.3 s *1*	β–
		102	0+	–71.595	2.9 s *2*	β–
		103	(5/2–)	–67.824	1.32 s *11*	β– , β–n ≤ 1%
		104	0+	–65.733	0.87 s *6*	β– , β–n ≤ 1%
		105		–61.47	0.66 s *7*	β– , β–n ≤ 2%
		106	0+	–59.0s	191 ms *19*	β– , β–n ≤ 7%
		107		–54.3s	138 ms *4*	β– , β–n ≤ 23%
		108	0+	–51.4s	73 ms *4*	β– , β–n
		109		–46.2s	63 ms *+38–17*	β– , β–n
		110	0+	–42.9s	37 ms *+17–9*	β–
		111			>392 ns	β– , β–n, β–2n
		112	0+		>394 ns	β– , β–n, β–2n
41	**Nb**	81		–47.2s	<200 ns	ε
		82	(0+)	–52.2s	50 ms *5*	ε , εp
		83	(5/2+)	–58.4	3.8 s *2*	ε
		84	(1+,2+,3+)	–61.0s	9.8 s *9*	ε , εp
		85	(9/2+)	–66.279	20.5 s *12*	ε
		85m		–66.279	12 s *5*	ε , IT
		85m	(1/2–,3/2–)	–66.279	3.3 s *9*	ε , IT
		86	(6+)	–69.134	88 s *1*	ε
		87	(1/2–)	–73.874	3.75 m *9*	ε
		87m	(9/2+)	–73.870	2.6 m *1*	ε
		88	(8+)	–76.18	14.55 m *6*	ε
		88m	(4–)	–76.18	7.78 m *5*	ε
		89	(9/2+)	–80.65	2.03 h *7*	ε
		89m	(1/2)–	–80.61	66 m *2*	ε
		90	8+	–82.663	14.60 h *5*	ε
		90m	4–	–82.538	18.81 s *6*	IT
		91	9/2+	–86.639	6.8×10^{2} y *13*	ε
		91m	1/2–	–86.534	60.86 d *22*	IT 96.6%, ε 3.4%
		92	(7)+	–86.454	3.47×10^{7} y *24*	ε , β– < 0.05%
		92m	(2)+	–86.318	10.15 d *2*	ε
		93	9/2+	–87.214	**100%**	
		93m	1/2–	–87.183	16.12 y *12*	IT
		94	6+	–86.370	2.03×10^{4} y *16*	β–
		94m	3+	–86.329	6.263 m *4*	IT 99.5%, β– 0.5%
		95	9/2+	–86.786	34.991 d *6*	β–
		95m	1/2–	–86.550	3.61 d *3*	IT 94.4%, β– 5.6%
		96	6+	–85.608	23.35 h *5*	β–
		97	9/2+	–85.610	72.1 m *7*	β–
		97m	1/2–	–84.867	58.7 s *18*	IT
		98	1+	–83.533	2.86 s *6*	β–
		98m	(5+)	–83.449	51.3 m *4*	β– 99.9%, IT < 0.2%
		99	9/2+	–82.33	15.0 s *2*	β–
		99m	1/2–	–81.96	2.5 m *2*	β– > 96.2%, IT < 3.8%
		100	1+	–79.806	1.5 s *2*	β–
		100m	(5+)	–79.492	2.99 s *11*	β–
		101	(5/2+)	–78.886	7.1 s *3*	β–

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
41 Nb	*102*	(4+)	–76.313	4.3 s *4*	β–
	102m	1+	–76.313	1.3 s *2*	β–
	103	(5/2+)	–75.023	1.5 s *2*	β–
	104	(1+)	–71.828	4.9 s *3*	β– , β–n 0.06%
	104m		–71.613	0.94 s *4*	β– , β–n 0.05%
	105	(5/2+)	–69.910	2.95 s *6*	β– , β–n 1.7%
	106		–66.197	0.93 s *4*	β– , β–n 4.5%
	107		–63.718	300 ms *9*	β– , β–n 8%
	108	(2+)	–59.6	220 ms *18*	β– , β–n 8%
	109	(5/2)	–56.8s	106 ms *9*	β– , β–n < 15%
	110		–52.3s	86 ms *6*	β– , β–n 40%
	111	(5/2+)	–49.0s	51 ms +*6–5*	β–
	112	(2+)	–44.4s	33 ms +*9–6*	β–
	113		–40.6s	>300 ns	β–
	114			>392 ns	β– , β–n, β–2n
	115			>394 ns	β– , β–n, β–2n
42 Mo	83		–46.7s	6 ms +*30–3*	ε
	84	0+	–54.5s	2.3 s *3*	ε , εp
	85	(1/2–)	–57.51	3.2 s *2*	ε , εp ≈ 0.14%
	86	0+	–64.110	19.1 s *3*	ε
	87	7/2+	–66.882	14.02 s *26*	ε , εp 15%
	88	0+	–72.686	8.0 m *2*	ε
	89	(9/2+)	–75.014	2.11 m *10*	ε
	89m	(1/2–)	–74.627	190 ms *15*	IT
	90	0+	–80.174	5.56 h *9*	ε
	91	9/2+	–82.21	15.49 m *1*	ε
	91m	1/2–	–81.56	64.6 s *6*	ε 50%, IT 50%
	92	0+	–86.809	**14.53% *30***	
	93	5/2+	–86.807	4.0×10^{3} y *8*	ε
	93m	21/2+	–84.382	6.85 h *7*	IT 99.88%, ε 0.12%
	94	0+	–88.414	**9.15% *9***	
	95	5/2+	–87.711	**15.84% *11***	
	96	0+	–88.794	**16.67% *15***	
	97	5/2+	–87.544	**9.60% *14***	
	98	0+	–88.116	**24.39% *37***	
	99	1/2+	–85.970	65.976 h *24*	β–
	100	0+	–86.187	7.3×10^{18} y *4*	2β–
				9.82% *31*	
	101	1/2+	–83.514	14.61 m *3*	β–
	102	0+	–83.572	11.3 m *2*	β–
	103	(3/2+)	–80.970	67.5 s *15*	β–
	104	0+	–80.359	60 s *2*	β–
	105	(5/2–)	–77.346	35.6 s *16*	β–
	106	0+	–76.144	8.73 s *12*	β–
	107	(5/2+)	–72.561	3.5 s *5*	β–
	108	0+	–70.765	1.09 s *2*	β– , β–n < 0.5%
	109	(7/2–)	–66.68	660 ms *45*	β– , β–n 1.3%
	110	0+	–64.55	0.27 s *1*	β– , β–n 2%
	111		–60.1s	220 ms +*41–36*	β– , β–n ≤ 12%
	112	0+	–57.6s	120 ms +*13–11*	β–
	113		–52.9s	78 ms +*6–5*	β–
	114	0+	–50.0s	60 ms +*13–9*	β–

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
42 Mo	115		–44.7s	51 ms +*79–19*	β–, β–n
	116	0+		>391 ns	β–, β–n
	117			>393 ns	β–?, β–n?, β–2n?
43 Tc	85		–46.0s	≈0.5 s	p?
	86	(0+)	–51.3s	54 ms *7*	ε, εp
	87	(9/2+)	–57.690	2.2 s *2*	ε
	88m	(3+)	–61.679	5.8 s *2*	ε
	88m	(6+)	–61.679	6.4 s *8*	ε
	89	(9/2+)	–67.394	12.8 s *9*	ε
	89m	(1/2–)	–67.331	12.9 s *8*	ε, IT<0.01%
	90m	1+	–70.723	8.7 s *2*	ε
	90m	(6+)	–70.223	49.2 s *4*	ε
	91	(9/2)+	–75.987	3.14 m *2*	ε
	91m	(1/2)–	–75.848	3.3 m *1*	ε, IT<1%
	92	(8)+	–78.924	4.25 m *15*	ε
	93	9/2+	–83.606	2.75 h *5*	ε
	93m	1/2–	–83.214	43.5 m *10*	IT 77.4%, ε 22.6%
	94	7+	–84.158	293 m *1*	ε
	94m	(2)+	–84.082	52.0 m *10*	ε, IT<0.1%
	95	9/2+	–86.021	20.0 h *1*	ε
	95m	1/2–	–85.982	61 d *2*	ε 96.12%, IT 3.88%
	96	7+	–85.821	4.28 d *7*	ε
	96m	4+	–85.787	51.5 m *10*	IT 98%, ε 2%
	97	9/2+	–87.224	4.21×10^{6} y *16*	ε
	97m	1/2–	–87.127	91.0 d *6*	IT 96.06%, ε 3.94%
	98	(6)+	–86.431	4.2×10^{6} y *3*	β–
	99	9/2+	–87.327	2.111×10^{5} y *12*	β–
	99m	1/2–	–87.184	6.0067 h *5*	IT, β– 3.7×10^{-3}%
	100	1+	–86.020	15.46 s *19*	β–, ε 2.6×10^{-3}%
	101	9/2+	–86.34	14.02 m *1*	β–
	102	1+	–84.569	5.28 s *15*	β–
	102m	(4,5)	–84.569	4.35 m *7*	β– 98%, IT 2%
	103	5/2+	–84.600	54.2 s *8*	β–
	104	(3+)	–82.51	18.3 m *3*	β–
	105	(3/2–)	–82.29	7.6 m *1*	β–
	106	(2+)	–79.77	35.6 s *6*	β–
	107	(3/2–)	–78.746	21.2 s *2*	β–
	108	(2)+	–75.919	5.17 s *7*	β–
	109	(5/2+)	–74.279	0.86 s *4*	β–, β–n 0.08%
	110	(2+)	–71.030	0.92 s *3*	β–, β–n 0.04%
	111	(5/2+)	–69.02	350 ms *21*	β–, β–n 0.85%
	112		–65.253	0.29 s *2*	β–, β–n 4%
	113	>5/2	–62.88	160 ms +*50–40*	β–, β–n 2.1%
	114m	>3	–58.9s	100 ms *20*	β–, β–n?
	114m	(1+)	–58.9s	90 ms *20*	β–, β–n?
	115		–56.1s	83 ms +*20–13*	β–, β–n
	116		–51.5s	56 ms +*15–10*	β–
	117	(5/2+)	–48.4s	85 ms +*95–30*	β–
	118		–43.8s		β–
	119			>392 ns	β–, β–n?, β–2n?
	120			>394 ns	β–, β–n?, β–2n?
44 Ru	87		–45.9s	>1.5 μs	ε?

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
44 Ru	88	0+	–54.4s	1.2 s *+3–2*	ε
	89	(9/2+)	–58.1s	1.5 s *2*	ε , εp<0.15%
	90	0+	–64.883	11.7 s *9*	ε
	91	(9/2+)	–68.238	7.9 s *4*	ε
	91m	(1/2–)	–68.238	7.6 s *8*	IT , ε>0%, εp>0%
	92	0+	–74.301	3.65 m *5*	ε
	93	(9/2)+	–77.213	59.7 s *6*	ε
	93m	(1/2)–	–76.479	10.8 s *3*	ε 78%, IT 22%, εp 0.03%
	94	0+	–82.579	51.8 m *6*	ε
	95	5/2+	–83.457	1.643 h *13*	ε
	96	0+	–86.080	**5.54%** ***14***	
	97	5/2+	–86.120	2.83 d *23*	ε
	98	0+	–88.224	**1.87%** ***3***	
	99	5/2+	–87.620	**12.76%** ***14***	
	100	0+	–89.222	**12.60%** ***7***	
	101	5/2+	–87.952	**17.06%** ***2***	
	102	0+	–89.101	**31.55%** ***14***	
	103	3/2+	–87.262	39.247 d *13*	β–
	104	0+	–88.092	**18.62%** ***27***	
	105	3/2+	–85.931	4.44 h *2*	β–
	106	0+	–86.320	371.8 d *18*	β–
	107	(5/2)+	–83.859	3.75 m *5*	β–
	108	0+	–83.657	4.55 m *5*	β–
	109	(5/2+)	–80.734	34.5 s *10*	β–
	110	0+	–80.069	11.6 s *6*	β–
	111	5/2+	–76.781	2.12 s *7*	β–
	112	0+	–75.627	1.75 s *7*	β–
	113	(1/2+)	–71.87	0.80 s *5*	β–
	113m	(7/2–)	–71.87	510 ms *30*	β–
	114	0+	–70.21	0.52 s *5*	β–
	115	(3/2+)	–66.19	318 ms *19*	β–
	115m		–66.19	740 ms *80*	β– , β–n
	115m		–66.19	270 ms *38*	β– , β–n
	115m		–66.19	76 ms *6*	β– , β–n
	116	0+	–64.2s	204 ms *+32–29*	β–
	117		–59.6s	142 ms *+18–17*	β–
	118	0+	–57.3s	123 ms *+48–35*	β– , β–n
	119		–52.6s	>300 ns	β–
	120	0+	–50.0s	>150 ns	β–
	121			>390 ns	β– , β–n
	122	0+		>392 ns	β– , β–n
	123			>394 ns	β– , β–n , β–2n
	124	0+		>396 ns	β– , β–n
45 Rh	89		–46.0s	>1.5 µs	ε ?, p ?
	90		–52.0s	12 ms *+9–4*	ε ?
	90m		–52.0s	1.0 s *+3–2*	ε ?
	91	(9/2+)	–58.8s	1.47 s *22*	ε
	91m	(1/2–)	–58.8s	1.46 s *11*	ε
	92?	(6+)	–62.999	4.66 s *25*	ε
	92m	(2+)	–62.999	0.53 s *37*	ε
	93	(9/2+)	–69.017	12.2 s *7*	ε

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
45 Rh	94	(4+)	−72.907	66 s *6*	ε , εp 1.8%
	94m	(8+)	−72.607	25.8 s *2*	ε
	95	9/2+	−78.342	5.02 m *10*	ε
	95m	(1/2)−	−77.799	1.96 m *4*	IT 88%, ε 12%
	96	≥ 6+	−79.69	9.90 m *10*	ε
	96m	3+	−79.64	1.51 m *2*	IT 60%, ε 40%
	97	9/2+	−82.60	30.7 m *6*	ε
	97m	1/2−	−82.34	46.2 m *16*	ε 94.4%, IT 5.6%
	98	(2)+	−83.18	8.72 m *12*	ε
	98m	(5+)	−83.18	3.6 m *2*	IT 89%, ε 11%
	99	1/2−	−85.576	16.1 d *2*	ε
	99m	9/2+	−85.511	4.7 h *1*	ε >99.84%, IT<0.16%
	100	1−	−85.59	20.8 h *1*	ε
	100m	(5+)	−85.48	4.6 m *2*	IT≈98.3%, ε ≈1.7%
	101	1/2−	−87.411	3.3 y *3*	ε
	101m	9/2+	−87.254	4.34 d *1*	ε 92.8%, IT 7.2%
	102	(1−,2−)	−86.778	207.3 d *17*	ε 78%, β− 22%
	102m	6(+)	−86.637	3.742 y *10*	ε 99.77%, IT 0.23%
	103	1/2−	−88.025	**100%**	
	103m	7/2+	−87.985	56.114 m *9*	IT
	104	1+	−86.953	42.3 s *4*	β− 99.55%, ε 0.45%
	104m	5+	−86.824	4.34 m *3*	IT 99.87%, β− 0.13%
	105	7/2+	−87.848	35.36 h *6*	β−
	105m	1/2−	−87.718	42.9 s *3*	IT
	106	1+	−86.360	30.07 s *35*	β−
	106m	(6)+	−86.223	131 m *2*	β−
	107	7/2+	−86.86	21.7 m *4*	β−
	108	1+	−85.03	16.8 s *5*	β−
	108m	(5+)	−85.03	6.0 m *3*	β− , IT
	109	7/2+	−85.010	80 s *2*	β−
	110m	(≥4)	−82.84	28.5 s *15*	β−
	110m	1+	−82.84	3.2 s *2*	β−
	111	(7/2+)	−82.304	11 s *1*	β−
	112m	1+	−79.73	3.45 s *37*	β−
	112m	(4,5,6)	−79.73	6.73 s *15*	β−
	113	(7/2+)	−78.767	2.80 s *12*	β−
	114	1+	−75.71	1.85 s *5*	β−
	114m	(7−)	−75.51	1.86 s *6*	β−
	115	(7/2+)	−74.229	0.99 s *5*	β−
	116	1+	−70.74	0.68 s *6*	β−
	116m	(6−)	−70.59	0.57 s *5*	β−
	117	(7/2+)	−68.897	0.44 s *4*	β−
	118		−64.89	266 ms *+22−21*	β− , β−n 3.1%
	119	(7/2+)	−62.8s	171 ms *18*	β− , β−n 6.4%
	120		−58.8s	136 ms *+14−13*	β− , β−n<5.4%
	121		−56.4s	151 ms *+67−58*	β− , β−n
	122		−52.4s	>300 ns	β− , β−n
	123			>403 ns	β− , β−n
	124			>391 ns	β− , β−n, β−2n
	125			>393 ns	β− , β−n
	126			>395 ns	β− , β−2n, β−n

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Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
46 Pd	91		–46.3s	>1 μs	ε ?
	92	0+	–55.1s	0.7 s +*4–2*	ε
	93	(9/2+)	–59.1s	1.00 s *9*	ε , εp
	94	0+	–66.102	9.6 s *2*	ε
	95	(9/2+)	–69.966	5 s *3*	ε
	95m	(21/2+)	–68.091	13.3 s *3*	ε 89%, IT 11%, εp 0.93%
	96	0+	–76.183	122 s *2*	ε
	97	(5/2+)	–77.805	3.10 m *9*	ε
	98	0+	–81.320	17.7 m *3*	ε
	99	(5/2)+	–82.184	21.4 m *2*	ε
	100	0+	–85.23	3.63 d *9*	ε
	101	5/2+	–85.431	8.47 h *6*	ε
	102	0+	–87.928	**1.02% *1***	
	103	5/2+	–87.482	16.991 d *19*	ε
	104	0+	–89.393	**11.14% *8***	
	105	5/2+	–88.416	**22.33% *8***	
	106	0+	–89.905	**27.33% *3***	
	107	5/2+	–88.370	6.5×10^{6} y *3*	β–
	107m	11/2–	–88.155	21.3 s *5*	IT
	108	0+	–89.521	**26.46% *9***	
	109	5/2+	–87.603	13.7012 h *24*	β–
	109m	11/2–	–87.414	4.696 m *3*	IT
	110	0+	–88.348	**11.72% *9***	
	111	5/2+	–86.003	23.4 m *2*	β–
	111m	11/2–	–85.831	5.5 h *1*	IT 73%, β– 27%
	112	0+	–86.323	21.03 h *5*	β–
	113	(5/2+)	–83.590	93 s *5*	β–
	113m	(9/2–)	–83.509	0.3 s *1*	IT
	114	0+	–83.490	2.42 m *6*	β–
	115	(5/2+)	–80.43	25 s *2*	β–
	115m	(11/2–)	–80.34	50 s *3*	β– 92%, IT 8%
	116	0+	–79.831	11.8 s *4*	β–
	117	(5/2+)	–76.424	4.3 s *3*	β–
	118	0+	–75.391	1.9 s *1*	β–
	119		–71.407	0.92 s *1*	β–
	120	0+	–70.309	0.5 s *1*	β–
	121	(3/2+)	–66.3s	285 ms *24*	β– , β–n ≤ 0.8%
	122	0+	–64.7s	175 ms *16*	β– ≥ 97.5%, β–n ≤ 2.5%
	123		–60.6s	174 ms +*38–34*	β–
	124	0+	–58.8s	38 ms +*38–19*	β–
	125			>230 ns	β– , β–n
	126	0+		>230 ns	β– , β–n
	128	0+		>394 ns	β– , β–n
47 Ag	93		–46.3s		p , ε, εp
	94	(0+)	–52.4s	26 ms +*26–9*	ε , εp
	94m	(7+)	–52.4s	0.60 s *2*	ε , εp 20%
	94m	(21+)	–45.7s	0.40 s *4*	ε 95.4%, εp 27%, p 4.1%, 2p 0.5%
	95	(9/2+)	–59.6s	1.75 s *12*	ε , εp
	95m	(1/2–)	–59.3s	<500 ms	IT

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
47 Ag	96m	(8)+	–64.62	4.40 s *6*	ε , εp 8.5%
	96m	(2+)	–64.62	6.9 s *6*	ε , εp 18%
	97	(9/2+)	–70.8	25.5 s *3*	ε
	98	(6+)	–73.05	47.5 s *3*	ε , εp 1.1×10^{-3}%
	99	(9/2)+	–76.712	124 s *3*	ε
	99m	(1/2–)	–76.206	10.5 s *5*	IT
	100	(5)+	–78.137	2.01 m *9*	ε
	100m	(2)+	–78.121	2.24 m *13*	ε , IT
	101	9/2+	–81.334	11.1 m *3*	ε
	101m	(1/2)–	–81.060	3.10 s *10*	IT
	102	5(+)	–82.246	12.9 m *3*	ε
	102m	2+	–82.237	7.7 m *5*	ε 51%, IT 49%
	103	7/2+	–84.800	65.7 m *7*	ε
	103m	1/2–	–84.665	5.7 s *3*	IT
	104	5+	–85.114	69.2 m *10*	ε
	104m	2+	–85.107	33.5 m *20*	ε 99.93%, IT<0.07%
	105	1/2–	–87.070	41.29 d *7*	ε
	105m	7/2+	–87.045	7.23 m *16*	IT 99.66%, ε 0.34%
	106	1+	–86.940	23.96 m *4*	ε 99.5%, β– <1%
	106m	6+	–86.850	8.28 d *2*	ε
	107	1/2–	–88.405	**51.839% *8***	
	107m	7/2+	–88.312	44.3 s *2*	IT
	108	1+	–87.605	2.382 m *11*	β– 97.15%, ε 2.85%
	108m	6+	–87.495	438 y *9*	ε 91.3%, IT 8.7%
	109	1/2–	–88.719	**48.161% *8***	
	109m	7/2+	–88.631	39.6 s *2*	IT
	110	1+	–87.457	24.6 s *2*	β– 99.7%, ε 0.3%
	110m	6+	–87.339	249.76 d *4*	β– 98.64%, IT 1.36%
	111	1/2–	–88.217	7.45 d *1*	β–
	111m	7/2+	–88.157	64.8 s *8*	IT 99.3%, β– 0.7%
	112	2(–)	–86.583	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+	–84.930	4.6 s *1*	β–
	115	1/2–	–84.98	20.0 m *5*	β–
	115m	7/2+	–84.94	18.0 s *7*	β– 79%, IT 21%
	116	(0–)	–82.542	237 s *5*	β–
	116m	(3+)	–82.494	20 s *1*	β– 93%, IT 7%
	116m	(6–)	–82.412	9.3 s *3*	β– 92%, IT 8%
	117	(1/2–)	–82.18	72.8 s *+20–7*	β–
	117m	(7/2+)	–82.15	5.34 s *5*	β– 94%, IT 6%
	118	1(–)	–79.553	3.76 s *15*	β–
	118m	4(+)	–79.425	2.0 s *2*	β– 59%, IT 41%
	119m	(1/2–)	–78.64	6.0 s *5*	β–
	119m	(7/2+)	–78.64	2.1 s *1*	β–
	120	3(+)	–75.651	1.23 s *4*	β– , β–n <3.0×10^{-3}%
	120m	6(–)	–75.448	0.40 s *3*	β– ≈63%, IT ≈37%
	121	(7/2+)	–74.40	0.78 s *2*	β– , β–n 0.08%
	122	(3+)	–71.11	0.529 s *13*	β– 99.8%, β–n 0.2%
	122m	(1–)	–71.11	0.55 s *5*	β– , IT, β–n
	122m	(9–)	–71.03	0.20 s *5*	β– , β–n
	123	(7/2+)	–69.55	0.300 s *5*	β– , β–n 0.55%

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
47 Ag	*124*	≥2	−66.2	0.172 s *5*	β−, β−n 1.3%
	125	(9/2+)	−64.4s	166 ms *7*	β−, β−n
	126		−60.9s	107 ms *12*	β−, β−n
	127		−58.8s	109 ms *25*	β−
	128		−54.9s	58 ms *5*	β−, β−n
	129	(9/2+)	−52.6s	46 ms +*5*−*9*	β−, β−n
	129m	(1/2−)	−52.6s	≈160 ms	β−, β−n
	130		−46.3s	≈50 ms	β−, β−n
48 Cd	95		−46.6s		εp?, ε?
	96	0+	−55.6s	1.03 s +*24*−*21*	ε
	97	(9/2+)	−60.5s	1.10 s *7*	ε, εp 12%
	97m	(25/2+)	−60.5s	3.70 s *8*	ε, εp 25%
	98	0+	−67.62	9.2 s *3*	ε, εp<0.03%
	99	(5/2+)	−69.931	16 s *3*	ε, εα<1.0×10^{-4}%, εp 0.17%
	100	0+	−74.194	49.1 s *5*	ε
	101	(5/2+)	−75.836	1.36 m *5*	ε
	102	0+	−79.659	5.5 m *5*	ε
	103	(5/2)+	−80.652	7.3 m *1*	ε
	104	0+	−83.968	57.7 m *10*	ε
	105	5/2+	−84.333	55.5 m *4*	ε
	106	0+	−87.130	>3.6×10^{20} y **1.25% *6***	2ε
	107	5/2+	−86.990	6.50 h *2*	ε
	108	0+	−89.252	>1.9×10^{18} y **0.89% *3***	2ε
	109	5/2+	−88.504	461.4 d *12*	ε
	110	0+	−90.350	**12.49% *18***	
	111	1/2+	−89.254	**12.80% *12***	
	111m	11/2−	−88.858	48.50 m *9*	IT
	112	0+	−90.577	**24.13% *21***	
	113	1/2+	−89.046	8.00×10^{15} y *26* **12.22% *12***	β−
	113m	11/2−	−88.783	14.1 y *5*	β− 99.86%, IT 0.14%
	114	0+	−90.018	>2.1×10^{18} y **28.73% *42***	2β−
	115	1/2+	−88.087	53.46 h *5*	β−
	115m	(11/2)−	−87.906	44.56 d *24*	β−
	116	0+	−88.716	3.3×10^{19} y *4* **7.49% *18***	2β−
	117	1/2+	−86.422	2.49 h *4*	β−
	117m	(11/2)−	−86.286	3.36 h *5*	β−
	118	0+	−86.71	50.3 m *2*	β−
	119	3/2+	−83.98	2.69 m *2*	β−
	119m	(11/2−)	−83.83	2.20 m *2*	β−
	120	0+	−83.957	50.80 s *21*	β−
	121	(3/2+)	−81.06	13.5 s *3*	β−
	121m	(11/2−)	−80.84	8.3 s *8*	β−
	122	0+	−80.616	5.24 s *3*	β−
	123	(3/2+)	−77.32	2.10 s *2*	β−
	123m	(11/2−)	−77.00	1.82 s *3*	β−≤100%, IT
	124	0+	−76.697	1.25 s *2*	β−

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
48 Cd	*125*	(3/2+)	–73.35	0.68 s *4*	β–
	125m	(11/2–)	–73.35	0.48 s *3*	β–
	126	0+	–72.256	0.515 s *17*	β–
	127	(3/2+)	–68.43	0.37 s *7*	β–
	128	0+	–67.25	0.28 s *4*	β–
	129	(3/2+)	–63.3s	0.27 s *4*	
	130	0+	–61.5	162 ms *7*	β–, β–n 3.5%
	131	(7/2–)	–55.4s	68 ms *3*	β–, β–n 3.5%
	132	0+	–50.9s	97 ms *10*	β–, β–n 60%
	133	(7/2–)		57 ms *10*	β–, β–n, β–2n
49 In	97		–47.2s		ε?, p?
	98		–53.9s	32 ms +*32*–*11*	ε
	98m		–53.9s	1.2 s +*12*–*4*	ε
	99		–61.4s	3.0 s *8*	ε
	100	(6+,7+)	–64.3	5.9 s *2*	ε, εp 1.6%
	101	(9/2+)	–68.6s	15.1 s *3*	ε, εp
	102	(6+)	–70.694	23.3 s *1*	ε, εp 9.3×10^{-3}%
	103	(9/2)+	–74.629	65 s *7*	ε
	103m	(1/2–)	–73.997	34 s *2*	ε 67%, IT 33%
	104	(6+)	–76.182	1.80 m *3*	ε
	104m	(3+)	–76.089	15.7 s *5*	IT 80%, ε 20%
	105	9/2+	–79.64	5.07 m *7*	ε
	105m	(1/2–)	–78.97	48 s *6*	IT
	106	7+	–80.60	6.2 m *1*	ε
	106m	(2)+	–80.57	5.2 m *1*	ε
	107	9/2+	–83.56	32.4 m *3*	ε
	107m	1/2–	–82.89	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+	–86.488	4.167 h *18*	ε
	109m	1/2–	–85.838	1.34 m *7*	IT
	109m	(19/2+)	–84.386	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+	–88.393	2.8047 d *4*	ε
	111m	1/2–	–87.856	7.7 m *2*	IT
	112	1+	–87.992	14.97 m *10*	ε 56%, β– 44%
	112m	4+	–87.835	20.56 m *6*	IT
	113	9/2+	–89.368	**4.29% *5***	
	113m	1/2–	–88.976	99.476 m *23*	IT
	114	1+	–88.570	71.9 s *1*	β– 99.5%, ε 0.5%
	114m	5+	–88.380	49.51 d *1*	IT 96.75%, ε 3.25%
	115	9/2+	–89.536	4.41×10^{14} y *25* **95.71% *5***	β–
	115m	1/2–	–89.200	4.486 h *4*	IT 95%, β– 5%
	116	1+	–88.249	14.10 s *3*	β– 99.98%, ε 0.02%
	116m	5+	–88.122	54.29 m *17*	β–
	116m	8–	–87.959	2.18 s *4*	IT
	117	9/2+	–88.943	43.2 m *3*	β–
	117m	1/2–	–88.628	116.2 m *3*	β– 52.9%, IT 47.1%
	118	1+	–87.228	5.0 s *5*	β–
	118m	5+	–87.168	4.45 m *5*	β–

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
49	**In**	118m	8−	−87.028	8.5 s *3*	IT 98.6%, β− 1.4%
		119	9/2+	−87.699	2.4 m *1*	β−
		119m	1/2−	−87.388	18.0 m *3*	β− 95.6%, IT 4.4%
		120	1+	−85.73	3.08 s *8*	β−
		120m	(8−)	−85.73	47.3 s *5*	β−
		120m	(5)+	−85.66	46.2 s *8*	β−
		121	9/2+	−85.84	23.1 s *6*	β−
		121m	1/2−	−85.52	3.88 m *10*	β− 98.8%, IT 1.2%
		122	1+	−83.57	1.5 s *3*	β−
		122m	5+	−83.53	10.3 s *6*	β−
		122m	(8−)	−83.28	10.8 s *4*	β−
		123	(9/2)+	−83.43	6.17 s *5*	β−
		123m	(1/2)−	−83.10	47.4 s *4*	β−
		124	(1)+	−80.87	3.12 s *9*	β−
		124m	(8−)	−80.82	3.7 s *2*	β−
		125	9/2+	−80.48	2.36 s *4*	β−
		125m	1/2(−)	−80.12	12.2 s *2*	β−
		126	3(+)	−77.81	1.53 s *1*	β−
		126m	(8−)	−77.71	1.64 s *5*	β−
		127	(9/2+)	−76.89	1.09 s *1*	β−, β−n ≤ 0.03%
		127m	(1/2−)	−76.43	3.67 s *4*	β−, β−n 0.69%
		127m	(21/2−)	−75.03	1.04 s *10*	β−
		128	(3)+	−74.36	0.84 s *6*	β−, β−n < 0.05%
		128m	(8−)	−74.02	0.72 s *10*	β−, β−n < 0.05%
		129	(9/2+)	−72.81	0.61 s *1*	β−, β−n 0.25%
		129m	(1/2−)	−72.44	1.23 s *3*	β− > 99.7%, β−n 2.5%, IT < 0.3%
		129m	(23/2−)	−71.18	0.67 s *10*	β−
		130	1(−)	−69.89	0.29 s *2*	β−, β−n 0.93%
		130m	(10−)	−69.84	0.54 s *1*	β−, β−n 1.65%
		130m	(5+)	−69.49	0.54 s *1*	β−, β−n 1.65%
		131	(9/2+)	−68.05	0.28 s *3*	β−, β−n ≤ 2%
		131m	(1/2−)	−67.75	0.35 s *5*	β− ≥ 99.98%, β−n ≤ 2%, IT ≤ 0.02%
		131m	(21/2+)	−64.29	0.32 s *6*	β− > 99%, IT < 1%, β−n ≈ 0.03%
		132	(7−)	−62.41	0.207 s *6*	β−, β−n 6.3%
		133	(9/2+)	−57.8s	165 ms *3*	β−, β−n 85%
		133m	(1/2−)	−57.4s	180 ms *15*	β−, IT, β−n
		134	(4− to 7−)	−52.0s	140 ms *4*	β−, β−n 65%
		135		−47.2s	92 ms *10*	β−, β−n
50	**Sn**	99		−47.7s		ε?, εp?
		100	0+	−56.9	0.86 s +*37*−*20*	ε, εp < 17%
		101	(5/2+)	−59.9s	1.7 s *3*	ε, εp 26%
		102	0+	−64.9	3.8 s *2*	ε
		103	(5/2+)	−66.97	7.0 s *2*	ε, εp 1.2%
		104	0+	−71.624	20.8 s *5*	ε
		105	(5/2+)	−73.337	32.7 s *5*	ε, εp 0.01%
		106	0+	−77.353	115 s *5*	ε
		107	(5/2+)	−78.512	2.90 m *5*	ε
		108	0+	−82.071	10.30 m *8*	ε
		109	5/2+	−82.632	18.0 m *2*	ε

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
50	**Sn**	110	0+	–85.84	4.11 h *10*	ε
		111	7/2+	–85.941	35.3 m *6*	ε
		112	0+	–88.657	$<1.3\times10^{21}$ y	2ε
					0.97% *1*	
		113	1/2+	–88.330	115.09 d *3*	ε
		113m	7/2+	–88.253	21.4 m *4*	IT 91.1%, ε 8.9%
		114	0+	–90.559	**0.66% *1***	
		115	1/2+	–90.033	**0.34% *1***	
		116	0+	–91.525	**14.54% *9***	
		117	1/2+	–90.397	**7.68% *7***	
		117m	11/2–	–90.082	13.76 d *4*	IT
		118	0+	–91.652	**24.22% *9***	
		119	1/2+	–90.065	**8.59% *4***	
		119m	11/2–	–89.976	293.1 d *7*	IT
		120	0+	–91.098	**32.58% *9***	
		121	3/2+	–89.197	27.03 h *4*	β–
		121m	11/2–	–89.191	43.9 y *5*	IT 77.6%, β– 22.4%
		122	0+	–89.942	**4.63% *3***	
		123	11/2–	–87.817	129.2 d *4*	β–
		123m	3/2+	–87.792	40.06 m *1*	β–
		124	0+	–88.237	$>1.2\times10^{21}$ y	2β–
					5.79% *5*	
		125	11/2–	–85.898	9.64 d *3*	β–
		125m	3/2+	–85.870	9.52 m *5*	β–
		126	0+	–86.02	2.30×10^{5} y *14*	β–
		127	(11/2–)	–83.47	2.10 h *4*	β–
		127m	(3/2+)	–83.46	4.13 m *3*	β–
		128	0+	–83.34	59.07 m *14*	β–
		128m	(7–)	–81.24	6.5 s *5*	IT
		129	(3/2+)	–80.59	2.23 m *4*	β–
		129m	(11/2–)	–80.56	6.9 m *1*	β–, IT$<2.0\times10^{-3}$%
		130	0+	–80.137	3.72 m *7*	β–
		130m	(7–)	–78.190	1.7 m *1*	β–
		131	(3/2+)	–77.271	56.0 s *5*	β–
		131m	(11/2–)	–77.271	58.4 s *5*	β–, IT
		132	0+	–76.548	39.7 s *8*	β–
		133	7/2–	–70.85	1.46 s *3*	β–, β–n 0.03%
		134	0+	–66.3	1.050 s *11*	β–, β–n 17%
		135	(7/2–)	–60.6s	530 ms *20*	β–, β–n 21%
		136	0+	–56.3s	0.25 s *3*	β–, β–n 30%
		137		–50.3s	190 ms *60*	β–, β–n 58%
		138	0+		>408 ns	β–, β–n
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+)	–63.85	1.22 s *11*	ε 99%, p 1%
		106	(2+)	–66.473	0.6 s *2*	ε
		107	(5/2+)	–70.653	4.0 s *2*	ε
		108	(4+)	–72.445	7.4 s *3*	ε
		109	(5/2+)	–76.251	17.0 s *7*	ε
		110	(3+,4+)	–77.449	23.0 s *4*	ε
		111	(5/2+)	–80.836	75 s *1*	ε
		112	3+	–81.60	51.4 s *10*	ε

Nuclear Wallet Cards

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+	−84.50	3.49 m *3*	ε
		115	5/2+	−87.00	32.1 m *3*	ε
		116	3+	−86.822	15.8 m *8*	ε
		116m	8−	−86.439	60.3 m *6*	ε
		117	5/2+	−88.642	2.80 h *1*	ε
		118	1+	−87.996	3.6 m *1*	ε
		118m	8−	−87.746	5.00 h *2*	ε
		119	5/2+	−89.474	38.19 h *22*	ε
		119m	(27/2+)	−86.632	0.85 s *9*	IT
		120	1+	−88.417	15.89 m *4*	ε
		120m	8−	−88.417	5.76 d *2*	ε
		121	5/2+	−89.599	**57.21% *5***	
		122	2−	−88.334	2.7238 d *2*	β− 97.59%, ε 2.41%
		122m	(8)−	−88.170	4.191 m *3*	IT
		123	7/2+	−89.226	**42.79% *5***	
		124	3−	−87.622	60.20 d *3*	β−
		124m	5+	−87.611	93 s *5*	IT 75%, β− 25%
		124m	(8)−	−87.585	20.2 m *2*	IT
		125	7/2+	−88.257	2.75856 y *25*	β−
		126	(8−)	−86.40	12.35 d *6*	β−
		126m	(5+)	−86.38	19.15 m *8*	β− 86%, IT 14%
		126m	(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−
		128m	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−
		130m	(4,5)+	−82.29	6.3 m *2*	β−
		131	(7/2+)	−81.98	23.03 m *4*	β−
		132	(4)+	−79.67	2.79 m *7*	β−
		132m	(8−)	−79.67	4.10 m *5*	β−
		133	(7/2+)	−78.94	2.34 m *5*	β−
		134	(0−)	−74.17	0.78 s *6*	β−
		134m	(7−)	−73.89	10.07 s *5*	β−, β−n 0.09%
		135	(7/2+)	−69.79	1.679 s *15*	β−, β−n 22%
		136	1−	−64.5s	0.923 s *14*	β−, β−n 16.3%
		137	(7/2+)	−60.4s	492 ms *25*	β−, β−n 49%
		138		−54.8s	350 ms *15*	β−, β−n 72%
		139		−50.3s	93 ms *+14−3*	β−, β−n 90%
		140			>407 ns	β−, β−n, β−2n
52	**Te**	105	(5/2+)	−52.6s	0.62 μs *7*	α
		106	0+	−58.2	70 μs *17*	α
		107		−60.54	3.1 ms *1*	α 70%, ε 30%
		108	0+	−65.783	2.1 s *1*	ε 51%, α 49%, εp 2.4%
		109	(5/2+)	−67.715	4.6 s *3*	ε 96.1%, εp 9.4%, α 3.9%, εα<5.0×10^{-3}%
		110	0+	−72.229	18.6 s *8*	ε, α≈3.0×10^{-3}%
		111	(5/2)+	−73.587	19.3 s *4*	ε, εp

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
52	**Te**	112	0+	−77.567	2.0 m *2*	ε
		113	(7/2+)	−78.35	1.7 m *2*	ε
		114	0+	−81.89	15.2 m *7*	ε
		115	7/2+	−82.06	5.8 m *2*	ε
		115m	(1/2)+	−82.04	6.7 m *4*	ε ≤ 100%, IT
		116	0+	−85.27	2.49 h *4*	ε
		117	1/2+	−85.10	62 m *2*	ε
		117m	(11/2−)	−84.80	103 ms *3*	IT
		118	0+	−87.68	6.00 d *2*	ε
		119	1/2+	−87.181	16.05 h *5*	ε
		119m	11/2−	−86.920	4.70 d *4*	ε, IT $<8.0\times10^{-3}$%
		120	0+	−89.369	***0.09% 1***	
		121	1/2+	−88.54	19.17 d *4*	ε
		121m	11/2−	−88.25	164.2 d *8*	IT 88.6%, ε 11.4%
		122	0+	−90.315	***2.55% 12***	
		123	1/2+	−89.173	$>9.2\times10^{16}$ y ***0.89% 3***	ε
		123m	11/2−	−88.925	119.2 d *1*	IT
		124	0+	−90.526	***4.74% 14***	
		125	1/2+	−89.024	***7.07% 15***	
		125m	11/2−	−88.879	57.40 d *15*	IT
		126	0+	−90.066	***18.84% 25***	
		127	3/2+	−88.283	9.35 h *7*	β−
		127m	11/2−	−88.195	106.1 d *7*	IT 97.6%, β− 2.4%
		128	0+	−88.993	2.41×10^{24} y *39* ***31.74% 8***	2β−
		129	3/2+	−87.004	69.6 m *3*	β−
		129m	11/2−	−86.898	33.6 d *1*	IT 63%, β− 37%
		130	0+	−87.352	$\geq3.0\times10^{24}$ y ***34.08% 62***	2β−
		131	3/2+	−85.211	25.0 m *1*	β−
		131m	11/2−	−85.029	33.25 h *25*	β− 74.1%, IT 25.9%
		131m	(23/2+)	−83.271	93 ms *12*	IT
		132	0+	−85.180	3.204 d *13*	β−
		133	(3/2+)	−82.94	12.5 m *3*	β−
		133m	(11/2−)	−82.61	55.4 m *4*	β− 83.5%, IT 16.5%
		134	0+	−82.56	41.8 m *8*	β−
		135	(7/2−)	−77.90	19.0 s *2*	β−
		136	0+	−74.48	17.63 s *8*	β−, β−n 1.31%
		137	(7/2−)	−69.3	2.49 s *5*	β−, β−n 2.99%
		138	0+	−65.8	1.4 s *4*	β−, β−n 6.3%
		139	(7/2−)	−60.4s	>150 ns	β−, β−n
		140	0+	−56.6s	>300 ns	β−, β−n
		141		−51.0s	>150 ns	β−?, β−n?
		142	0+	−46.9s		
		143			>408 ns	β−, β−n, β−2n
53	**I**	107		−49.6s		
		108	(1)	−52.6s	36 ms *6*	α 91%, ε 9%, p < 1%
		109	1/2+	−57.675	93.5 µs *3*	p 99.99%, α 0.01%
		110		−60.46	0.65 s *2*	ε 83%, α 17%, εp 11%, εα 1.1%
		111	(5/2+)	−64.953	2.5 s *2*	ε 99.9%, α ≈ 0.1%

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
53	**I**	112		−67.06	3.42 s *11*	ε , α ≈ 1.2×10^{-3}%
		113	5/2+	−71.119	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
		119	5/2+	−83.76	19.1 m *4*	ε
		120	2−	−83.75	81.6 m *2*	ε
		120m	(7−)	−83.43	53 m *4*	ε
		121	5/2+	−86.253	2.12 h *1*	ε
		122	1+	−86.081	3.63 m *6*	ε
		123	5/2+	−87.945	13.2235 h *19*	ε
		124	2−	−87.367	4.1760 d *3*	ε
		125	5/2+	−88.838	59.407 d *10*	ε
		126	2−	−87.912	12.93 d *5*	ε 52.7%, β− 47.3%
		127	5/2+	−88.984	**100%**	
		128	1+	−87.739	24.99 m *2*	β− 93.1%, ε 6.9%
		129	7/2+	−88.507	1.57×10^{7} y *4*	β−
		130	5+	−86.936	12.36 h *1*	β−
		130m	2+	−86.896	8.84 m *6*	IT 84%, β− 16%
		131	7/2+	−87.442	8.0252 d *6*	β−
		132	4+	−85.698	2.295 h *13*	β−
		132m	(8−)	−85.578	1.387 h *15*	IT 86%, β− 14%
		133	7/2+	−85.886	20.83 h *8*	β−
		133m	(19/2−)	−84.252	9 s *2*	IT
		134	(4)+	−84.072	52.5 m *2*	β−
		134m	(8)−	−83.756	3.52 m *4*	IT 97.7%, β− 2.3%
		135	7/2+	−83.791	6.58 h *3*	β−
		136	(1−)	−79.57	83.4 s *10*	β−
		136m	(6−)	−78.93	46.9 s *10*	β−
		137	(7/2+)	−76.51	24.5 s *2*	β− , β−n 7.14%
		138	(2−)	−71.9s	6.23 s *3*	β− , β−n 5.56%
		139	(7/2+)	−68.5	2.280 s *11*	β− , β−n 10%
		140	(4−)	−63.6	0.86 s *4*	β− , β−n 9.3%
		141		−60.3	0.43 s *2*	β− , β−n 21.2%
		142		−55.0s	222 ms *12*	β− , β−n ?
		143		−51.1s	130 ms *45*	β− ?
		144		−45.8s	>300 ns	β− ?
		145			>407 ns	β− , β−n
54	**Xe**	108	0+	−42.7s		
		109	(7/2+)	−45.9s	13 ms *2*	α
		110	0+	−51.9	93 ms *3*	α 64%, ε , εp
		111	(7/2+)	−54.39	0.81 s *20*	ε 90%, α 10%
		112	0+	−60.028	2.7 s *8*	ε 99.16%, α 0.84%
		113	(5/2+)	−62.203	2.74 s *8*	ε , εp 7%, α ≈ 0.01%, εα ≈ 7.0×10^{-3}%
		114	0+	−67.08	10.0 s *4*	ε
		115	(5/2+)	−68.66	18 s *4*	ε , εp 0.34%, α 3.0×10^{-4}%

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
54	**Xe**	116	0+	−73.05	59 s *2*	ε
		117	5/2(+)	−74.18	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+	−85.35	20.1 h *1*	ε
		123	(1/2)+	−85.249	2.08 h *2*	ε
		124	0+	−87.661	≥1.6×10^{14} y	2ε
					0.0952% *3*	
		125	1/2(+)	−87.193	16.9 h *2*	ε
		125m	9/2(−)	−86.940	57 s *1*	IT
		126	0+	−89.146	**0.0890% *2***	
		127	1/2+	−88.322	36.346 d *3*	ε
		127m	9/2−	−88.025	69.2 s *9*	IT
		128	0+	−89.860	**1.9102% *8***	
		129	1/2+	−88.696	**26.4006% *82***	
		129m	11/2−	−88.460	8.88 d *2*	IT
		130	0+	−89.880	**4.0710% *13***	
		131	3/2+	−88.413	**21.232% *30***	
		131m	11/2−	−88.249	11.84 d *4*	IT
		132	0+	−89.279	**26.9086% *33***	
		132m	(10+)	−86.527	8.39 ms *11*	IT
		133	3/2+	−87.643	5.2475 d *5*	β−
		133m	11/2−	−87.410	2.198 d *13*	IT
		134	0+	−88.124	>5.8×10^{22} y	2β−
					10.4357% *21*	
		134m	7−	−86.159	290 ms *17*	IT
		135	3/2+	−86.417	9.14 h *2*	β−
		135m	11/2−	−85.890	15.29 m *5*	IT>99.4%, β−<0.6%
		136	0+	−86.429	>2.4×10^{21} y	2β−
					8.8573% *44*	
		137	7/2−	−82.383	3.818 m *13*	β−
		138	0+	−79.975	14.08 m *8*	β−
		139	3/2−	−75.644	39.68 s *14*	β−
		140	0+	−72.986	13.60 s *10*	β−
		141	5/2(−)	−68.197	1.73 s *1*	β− , β−n 0.04%
		142	0+	−65.229	1.23 s *2*	β− , β−n 0.21%
		143	5/2−	−60.202	0.511 s *6*	β− , β−n 1%
		144	0+	−56.872	0.388 s *7*	β− , β−n 3%
		145		−51.49	188 ms *4*	β− , β−n 5%
		146	0+	−47.95	146 ms *6*	β− , β−n 6.9%
		147	(3/2−)	−42.5s	0.10 s *+10−5*	β− , β−n<8%
		148	0+		>408 ns	β− , β−n
55	**Cs**	112	(0+,3+)	−46.29	0.5 ms *1*	p
		113	(3/2+)	−51.765	16.7 μs *7*	p , α
		114	(1+)	−54.68	0.57 s *2*	ε 99.98%, 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 2.8%, εα 0.05%
		116m	4+,5,6	−62.0s	3.85 s *13*	ε , εp 0.51%, εα 8.0×10^{-3}%

Nuclear Wallet Cards

Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
55	**Cs**	117m	(9/2+)	–66.49	8.4 s *6*	ε
		117m	(3/2+)	–66.49	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(+)	–73.888	61.3 s *11*	ε, εα 2.0×10^{-5}%, εp 7.0×10^{-6}%
		120m	(7–)	–73.888	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	(5)–	–78.01	0.36 s *2*	IT
		122m	8(–)	–78.00	3.70 m *11*	ε
		123	1/2+	–81.04	5.88 m *3*	ε
		123m	(11/2)–	–80.89	1.64 s *12*	IT
		124	1+	–81.731	30.9 s *4*	ε
		124m	(7)+	–81.268	6.3 s *2*	IT
		125	1/2(+)	–84.087	46.7 m *1*	ε
		125m	(11/2–)	–83.821	0.90 ms *3*	IT
		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+	–87.499	32.06 h *6*	ε
		130	1+	–86.899	29.21 m *4*	ε 98.4%, β– 1.6%
		130m	5–	–86.736	3.46 m *6*	IT 99.84%, ε 0.16%
		131	5/2+	–88.058	9.689 d *16*	ε
		132	2+	–87.155	6.480 d *6*	ε 98.13%, β– 1.87%
		133	7/2+	–88.070	**100%**	
		134	4+	–86.891	2.0652 y *4*	β–, ε 3.0×10^{-4}%
		134m	8–	–86.752	2.912 h *2*	IT
		135	7/2+	–87.581	2.3×10^{6} y *3*	β–
		135m	19/2–	–85.948	53 m *2*	IT
		136	5+	–86.339	13.04 d *3*	β–
		136m	8–	–85.821	17.5 s *2*	β–, IT>0%
		137	7/2+	–86.545	30.08 y *9*	β–
		138	3–	–82.887	33.41 m *18*	β–
		138m	6–	–82.807	2.91 m *8*	IT 81%, β– 19%
		139	7/2+	–80.701	9.27 m *5*	β–
		140	1–	–77.050	63.7 s *3*	β–
		141	7/2+	–74.48	24.84 s *16*	β–, β–n 0.04%
		142	0–	–70.53	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 *6*	β–, β–n 3.03%
		144m	(≥4)	–63.27	<1 s	β–
		145	3/2+	–60.06	0.587 s *5*	β–, β–n 14.7%
		146	1–	–55.57	0.321 s *2*	β–, β–n 14.2%
		147	(3/2+)	–52.02	0.230 s *1*	β–, β–n 28.5%
		148		–47.3	146 ms *6*	β–, β–n 25.1%
		149		–43.8s	>50 ms	β–, β–n

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Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
55 Cs	150		−39.0s	>50 ms	β−, β−n
	151		−35.1s	>50 ms	β−, β−n
56 Ba	112	0+	−36.1s		
	113		−39.8s		
	114	0+	−46.0	0.43 s *+30−15*	ε 99.1%, εp 20%, α 0.9%, ^{12}C<0.0034%
	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)	−57.5	1.75 s *7*	ε, εα>0%, εp>0%
	118	0+	−62.4s	5.5 s *2*	ε, εp
	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	3.3 m *3*	ε
	126	0+	−82.67	100 m *2*	ε
	127	1/2+	−82.82	12.7 m *4*	ε
	127m	7/2−	−82.73	1.9 s *2*	IT
	128	0+	−85.379	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+	−87.261	**0.106% *1***	
	130m	8−	−84.786	9.4 ms *4*	IT
	131	1/2+	−86.684	11.50 d *6*	ε
	131m	9/2−	−86.496	14.6 m *2*	IT
	132	0+	−88.434	>3.0×10^{21} y **0.101% *1***	2ε
	133	1/2+	−87.553	10.551 y *11*	ε
	133m	11/2−	−87.265	38.93 h *10*	IT 99.99%, ε 0.01%
	134	0+	−88.950	**2.417% *18***	
	135	3/2+	−87.850	**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***	
	137m	11/2−	−87.059	2.552 m *1*	IT
	138	0+	−88.261	**71.698% *42***	
	139	7/2−	−84.914	83.06 m *28*	β−
	140	0+	−83.270	12.7527 d *23*	β−
	141	3/2−	−79.733	18.27 m *7*	β−
	142	0+	−77.845	10.6 m *2*	β−
	143	5/2−	−73.937	14.5 s *3*	β−
	144	0+	−71.767	11.5 s *2*	β−, β−n 3.6%
	145	5/2−	−67.516	4.31 s *16*	β−
	146	0+	−64.94	2.22 s *7*	β−
	147	(3/2−)	−60.26	0.894 s *10*	β−, β−n 0.06%
	148	0+	−57.59	0.612 s *17*	β−, β−n 0.4%
	149		−53.2s	0.344 s *7*	β−, β−n 0.43%
	150	0+	−50.3s	0.3 s	β−, β−n

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
56 Ba	151		–45.6s	>300 ns	β–, β–n
	152	0+	–42.4s	>406 ns	β–, β–n
	153		–37.2s		β–?
57 La	117	(3/2+,3/2–)	–46.5s	23.5 ms *26*	p 93.9%, ε 6.1%
	117m	(9/2+)	–46.3s	10 ms *5*	p 97.4%, ε 2.6%
	118		–49.6s		ε?
	119		–55.0s		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	(8–)	–70.26	29.21 s *17*	ε
	124m		–70.26	21 s *4*	ε
	125	(3/2+)	–73.76	64.8 s *12*	ε
	125m		–73.65	0.39 s *4*	
	126m	(5+)	–74.97	54 s *2*	ε>0%
	126m	(0–,1,2–)	–74.97	<50 s	ε, IT
	127	(11/2–)	–77.89	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–	–83.72	4.8 h *2*	ε
	132m	6–	–83.53	24.3 m *5*	IT 76%, ε 24%
	133	5/2+	–85.49	3.912 h *8*	ε
	134	1+	–85.22	6.45 m *16*	ε
	135	5/2+	–86.65	19.5 h *2*	ε
	136	1+	–86.04	9.87 m *3*	ε
	136m	(8+)	–85.81	114 ms *3*	IT
	137	7/2+	–87.11	6×10^4 y *2*	ε
	138	5+	–86.521	1.02×10^{11} y *1*	ε 65.6%,
				0.08881% *71*	β– 34.4%
	139	7/2+	–87.228	**99.9119% *71***	
	140	3–	–84.317	1.67855 d *12*	β–
	141	(7/2+)	–82.934	3.92 h *3*	β–
	142	2–	–80.022	91.1 m *5*	β–
	143	(7/2)+	–78.171	14.2 m *1*	β–
	144	(3–)	–74.83	40.8 s *4*	β–
	145	(5/2+)	–72.83	24.8 s *20*	β–
	146	2–	–69.05	6.27 s *10*	β–
	146m	(6–)	–69.05	10.0 s *1*	β–
	147	(3/2+)	–66.68	4.06 s *4*	β–, β–n 0.04%
	148	(2–)	–62.71	1.26 s *8*	β–, β–n 0.15%
	149	(3/2–)	–60.2	1.05 s *3*	β–, β–n 1.43%
	150	(3+)	–56.6s	0.86 s *5*	β–, β–n 2.7%
	151		–53.9s	>300 ns	β–, β–n
	152		–49.7s	>150 ns	β–
	153		–46.6s	>100 ns	β–?
	154		–42.0s		β–?

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
57	**La**	155		−38.5s		β− ?
58	**Ce**	119		−43.9s		ε ?
		120	0+	−49.5s		ε ?
		121	(5/2)	−52.5s	1.1 s *1*	ε , εp ≈ 1%
		122	0+	−57.7s		ε , εp
		123	(5/2)	−60.1s	3.8 s *2*	ε , εp > 0%
		124	0+	−64.6s	6 s *2*	ε
		125	(7/2−)	−66.7s	9.7 s *3*	ε , εp
		126	0+	−70.82	51.0 s *3*	ε
		127	(1/2+)	−71.97	34 s *2*	ε
		127m	(5/2+)	−71.97	28.6 s *7*	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+	−79.71	10.3 m *3*	ε
		131m	(1/2+)	−79.64	5.4 m *4*	ε , IT
		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	5.1 h *3*	ε , IT
		134	0+	−84.83	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	>0.7×10^{14} y	2ε
					0.185% *2*	
		137	3/2+	−85.88	9.0 h *3*	ε
		137m	11/2−	−85.63	34.4 h *3*	IT 99.21%, ε 0.79%
		138	0+	−87.56	≥0.9×10^{14} y	2ε
					0.251% *2*	
		138m	7−	−85.43	8.65 ms *20*	IT
		139	3/2+	−86.949	137.641 d *20*	ε
		139m	11/2−	−86.195	54.8 s *10*	IT
		140	0+	−88.078	**88.450% *51***	
		141	7/2−	−85.435	32.508 d *13*	β−
		142	0+	−84.532	>5×10^{16} y	2β−
					11.114% *51*	
		143	3/2−	−81.605	33.039 h *6*	β−
		144	0+	−80.431	284.91 d *5*	β−
		145	(5/2−)	−77.09	3.01 m *6*	β−
		146	0+	−75.64	13.52 m *13*	β−
		147	(5/2−)	−72.013	56.4 s *10*	β−
		148	0+	−70.40	56 s *1*	β−
		149	(3/2−)	−66.67	5.3 s *2*	β−
		150	0+	−64.85	4.0 s *6*	β−
		151	(5/2+)	−61.22	1.76 s *6*	β−
		151m		−61.22	1.02 s *6*	β−
		152	0+	−59.3s	1.4 s *2*	β−
		153		−55.2s	>100 ns	β− ?
		154	0+	−52.7s	>100 ns	β−
		155		−48.3s	>300 ns	β− ?
		156	0+	−45.3s		β− ?
		157		−40.4s		β− ?

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
59 Pr	121	(3/2)	−41.4s	10 ms +*6*−*3*	p
	122		−44.7s	≈0.5 s	ε ?
	123		−50.1s	≈0.8 s	ε ?
	124		−53.0s	1.2 s *2*	ε , εp>0%
	125		−57.7s	3.3 s *7*	ε , εp
	126	>3	−60.1s	3.14 s *22*	ε , εp
	127		−64.3s	4.2 s *3*	ε
	128	4,5,6	−66.33	2.84 s *9*	ε
	129	(11/2−)	−69.77	30 s *4*	ε>0%
	130?	(7,8)	−71.18	40 s *4*	ε
	130?	(4+,5+)	−71.18	40 s *4*	ε
	130?	(2+)	−71.18	40 s *4*	ε
	131	(3/2+)	−74.30	1.51 m *2*	ε
	131m	(11/2−)	−74.15	5.73 s *20*	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
	133m	(11/2−)	−77.74	1.1 s *2*	IT
	134m	(6−)	−78.51	≈11 m	ε
	134m	2−	−78.51	17 m *2*	ε
	135	3/2(+)	−80.93	24 m *1*	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−	−82.76	2.12 h *4*	ε
	139	5/2+	−84.820	4.41 h *4*	ε
	140	1+	−84.690	3.39 m *1*	ε
	141	5/2+	−86.015	**100%**	
	142	2−	−83.787	19.12 h *4*	β− 99.98%, ε 0.02%
	142m	5−	−83.783	14.6 m *5*	IT
	143	7/2+	−83.067	13.57 d *2*	β−
	144	0−	−80.749	17.28 m *5*	β−
	144m	3−	−80.690	7.2 m *3*	IT 99.93%, β− 0.07%
	145	7/2+	−79.626	5.984 h *10*	β−
	146	(2)−	−76.68	24.15 m *18*	β−
	147	(5/2+)	−75.44	13.4 m *3*	β−
	148	1−	−72.54	2.29 m *2*	β−
	148m	(4)	−72.44	2.01 m *7*	β−
	149	(5/2+)	−71.039	2.26 m *7*	β−
	150	(1)−	−68.299	6.19 s *16*	β−
	151	(3/2−)	−66.78	18.90 s *7*	β−
	152	(4+)	−63.76	3.57 s *18*	β−
	153		−61.58	4.28 s *11*	β−
	154	(3+)	−58.2	2.3 s *1*	β−
	155		−55.8s	>300 ns	β− ?
	156		−51.9s	>300 ns	β− ?
	157		−49.0s		β− ?
	158		−44.7s		β− ?
	159		−41.5s		β− ?
60 Nd	124	0+	−44.3s		ε ?
	125	(5/2)	−47.4s	0.65 s *15*	ε , εp>0%
	126	0+	−52.6s	>200 ns	ε , εp
	127		−55.3s	1.8 s *4*	ε , εp

Nuclear Wallet Cards

Nuclide Z El A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
60 Nd 128	0+	–60.1s	5 s	ε , εp
129	(5/2+)	–62.2s	4.9 s *2*	ε > 0%, εp > 0%
130	0+	–66.60	21 s *3*	ε
131	(5/2+)	–67.77	25.4 s *9*	ε , εp > 0%
132	0+	–71.43	94 s *8*	ε
133	(7/2+)	–72.33	70 s *10*	ε
133m	(1/2+)	–72.20	≈70 s	ε , IT
134	0+	–75.65	8.5 m *15*	ε
135	9/2(–)	–76.21	12.4 m *6*	ε
135m	(1/2+)	–76.15	5.5 m *5*	ε > 99.97%, IT < 0.03%
136	0+	–79.20	50.65 m *33*	ε
137	1/2+	–79.58	38.5 m *15*	ε
137m	11/2–	–79.06	1.60 s *15*	IT
138	0+	–82.02	5.04 h *9*	ε
139	3/2+	–82.01	29.7 m *5*	ε
139m	11/2–	–81.78	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+	–84.192	2.49 h *3*	ε
141m	11/2–	–83.436	62.0 s *8*	IT , ε < 0.05%
142	0+	–85.949	**27.152% *40***	
143	7/2–	–84.001	**12.174% *26***	
144	0+	–83.747	2.29×10^{15} y *16* **23.798% *19***	α
145	7/2–	–81.431	**8.293% *12***	
146	0+	–80.925	**17.189% *32***	
147	5/2–	–78.146	10.98 d *1*	β–
148	0+	–77.406	**5.756% *21***	
149	5/2–	–74.374	1.728 h *1*	β–
150	0+	–73.683	0.79×10^{19} y *7* **5.638% *28***	
151	3/2+	–70.946	12.44 m *7*	β–
152	0+	–70.15	11.4 m *2*	β–
153	(3/2)–	–67.34	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	5.06 s *13*	β–
157		–56.8s	>100 ns	β– ?
158	0+	–54.4s	>50 ns	β–
159		–50.2s		β– ?
160	0+	–47.4s		β– ?
161		–43.0s		β– ?
61 Pm 126		–38.8s		ε ?
127		–44.4s		p ?, ε ?
128		–47.6s	1.0 s *3*	ε , α, εp
129	(5/2–)	–52.5s	2.4 s *9*	ε
130	(4,5,6)	–55.2s	2.6 s *2*	ε , εp
131	(11/2–)	–59.6s	6.3 s *8*	ε
132	(3+)	–61.6s	6.2 s *6*	ε , εp ≈ 5.0×10^{-5}%
133	(3/2+)	–65.41	13.5 s *21*	ε
133m	(11/2–)	–65.28	<8.8 s	IT , ε

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
61 Pm	134	(2+)	−66.74	≈5 s	ε
	134m	(5+)	−66.74	22 s *1*	ε
	135m	(3/2+,5/2+)	−69.98	49 s *3*	ε
	135m	(11/2−)	−69.91	45 s *4*	ε
	136m	(5−)	−71.20	107 s *6*	ε
	136m	(2+)	−71.20	47 s *2*	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+	−82.960	265 d *7*	ε
	144	5−	−81.415	363 d *14*	ε
	145	5/2+	−81.267	17.7 y *4*	ε, α 2.8×10^{-7}%
	146	3−	−79.453	5.53 y *5*	ε 66%, β− 34%
	147	7/2+	−79.041	2.6234 y *2*	β−
	148	1−	−76.865	5.368 d *2*	β−
	148m	5−,6−	−76.727	41.29 d *11*	β− 95.8%, IT 4.2%
	149	7/2+	−76.063	53.08 h *5*	β−
	150	(1−)	−73.60	2.68 h *2*	β−
	151	5/2+	−73.388	28.40 h *4*	β−
	152	1+	−71.25	4.12 m *8*	β−
	152m	(8)	−71.11	13.8 m *2*	β−, IT≥0%
	152m	4−	−71.11	7.52 m *8*	β−
	153	5/2−	−70.68	5.25 m *2*	β−
	154	(3,4)	−68.49	2.68 m *7*	β−
	154m	(0−,1−)	−68.49	1.73 m *10*	β−
	155	5/2−	−66.97	41.5 s *2*	β−
	156m	4−	−64.21	26.70 s *10*	β−
	157	(5/2−)	−62.4	10.56 s *10*	β−
	158		−59.1	4.8 s *5*	β−
	159		−56.8	1.5 s *2*	β−
	160		−53.1s		β−?
	161		−50.4s		β−?
	162		−46.3s		β−?
	163		−43.1s		β−?
62 Sm	128	0+	−38.0s		ε?, p?
	129	(1/2+,3/2+)	−41.3s	0.55 s *10*	ε, εp>0%
	130	0+	−46.9s		ε
	131		−49.6s	1.2 s *2*	ε, εp>0%
	132	0+	−54.7s	4.0 s *3*	ε, εp
	133	(5/2+)	−56.8s	2.89 s *16*	ε, εp>0%
	133m	(1/2−)	−56.8s	3.5 s *4*	ε, IT, εp
	134	0+	−61.2s	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

Nuclear Wallet Cards

Nuclide Z El A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
62 Sm 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+	–75.934	10.2 m *2*	ε
141m	11/2–	–75.758	22.6 m *2*	ε 99.69%, IT 0.31%
142	0+	–78.987	72.49 m *5*	ε
143	3/2+	–79.516	8.75 m *6*	ε
143m	11/2–	–78.762	66 s *2*	IT 99.76%, ε 0.24%
143m	23/2(–)	–76.722	30 ms *3*	IT
144	0+	–81.965	**3.07% *7***	
145	7/2–	–80.651	340 d *3*	α
146	0+	–80.995	10.3×10^{7} y *5*	α
147	7/2–	–79.265	1.060×10^{11} y *11*	α
			14.99% *18*	
148	0+	–79.335	7×10^{15} y *3*	α
			11.24% *10*	
149	7/2–	–77.135	**13.82% *7***	
150	0+	–77.050	**7.38% *1***	
151	5/2–	–74.575	90 y *8*	β–
152	0+	–74.762	**26.75% *16***	
153	3/2+	–72.559	46.284 h *4*	β–
153m	11/2–	–72.461	10.6 ms *3*	IT
154	0+	–72.454	**22.75% *29***	
155	3/2–	–70.190	22.3 m *2*	β–
156	0+	–69.362	9.4 h *2*	β–
157	(3/2–)	–66.72	8.03 m *7*	β–
158	0+	–65.21	5.30 m *3*	β–
159	5/2–	–62.24	11.37 s *15*	β–
160	0+	–60.4s	9.6 s *3*	β–
161		–56.8	4.8 s *4*	β–
162	0+	–54.8s	2.4 s *5*	β–
163		–50.9s		β–?
164	0+	–48.2s		β–?
165		–43.8s		β–?
63 Eu 130	(1+)	–33.0s	0.90 ms *+49–29*	p
131	3/2+	–38.7s	17.8 ms *19*	p 89%, ε 11%
132		–41.9s		p, ε
133		–47.1s		ε?
134		–49.7s	0.5 s *2*	ε, εp>0%
135		–54.1s	1.5 s *2*	ε, εp
136m	(7+)	–56.1s	3.3 s *3*	ε, εp 0.09%
136m	(3+)	–56.1s	3.8 s *3*	ε, εp 0.09%
137	(11/2–)	–60.0s	11 s *2*	ε
138	(6–)	–61.75	12.1 s *6*	ε
139	(11/2)–	–65.40	17.9 s *6*	ε
140	1+	–66.99	1.51 s *2*	ε
140m	(5–)	–66.99	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+	–71.31	2.34 s *12*	ε
142m	8–	–71.31	1.223 m *8*	ε

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
63 Eu	143	5/2+	−74.24	2.59 m *2*	ε
	144	1+	−75.62	10.2 s *1*	ε
	145	5/2+	−77.991	5.93 d *4*	ε
	146	4−	−77.117	4.61 d *3*	ε
	147	5/2+	−77.544	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+	−76.440	93.1 d *4*	ε
	150	5−	−74.791	36.9 y *9*	ε
	150m	0−	−74.749	12.8 h *1*	β− 89%, ε 11%, IT≤5.0×10^{-8}%
	151	5/2+	−74.651	≥1.7×10^{18} y **47.81% *3***	α
	152	3−	−72.887	13.528 y *14*	ε 72.1%, β− 27.9%
	152m	0−	−72.841	9.3116 h *13*	β− 72%, ε 28%
	152m	8−	−72.739	96 m *1*	IT
	153	5/2+	−73.366	**52.19% *6***	
	154	3−	−71.736	8.601 y *10*	β− 99.98%, ε 0.02%
	154m	8−	−71.591	46.3 m *4*	IT
	155	5/2+	−71.816	4.753 y *14*	β−
	156	0+	−70.085	15.19 d *8*	β−
	157	5/2+	−69.459	15.18 h *3*	β−
	158	(1−)	−67.20	45.9 m *2*	β−
	159	5/2+	−66.045	18.1 m *1*	β−
	160	1	−63.24	38 s *4*	β−
	161		−61.80	26 s *3*	β−
	162		−58.69	10.6 s *10*	β−
	163		−56.80	7.7 s *4*	β−
	164		−53.4s	4.2 s *2*	β−
	165		−50.8s	2.3 s *2*	β−
	166		−46.8s		β−?
	167		−43.8s		β−?
64 Gd	133		−35.6s		
	134	0+	−41.1s		ε?
	135	(5/2+)	−44.0s	1.1 s *2*	ε , εp 18%
	136	0+	−48.9s	≥200 ns	
	137	(7/2)	−51.2s	2.2 s *2*	ε , εp
	138	0+	−55.7s	4.7 s *9*	ε
	139	(9/2−)	−57.6s	5.8 s *9*	εp>0%, ε>0%
	139m		−57.6s	4.8 s *9*	εp>0%, ε>0%
	140	0+	−61.78	15.8 s *4*	ε
	141	1/2+	−63.22	14 s *4*	ε , εp 0.03%
	141m	11/2−	−62.85	24.5 s *5*	ε 89%, IT 11%
	142	0+	−66.96	70.2 s *6*	ε
	143	(1/2)+	−68.2	39 s *2*	ε
	143m	(11/2−)	−68.1	110.0 s *14*	ε
	144	0+	−71.76	4.47 m *6*	ε
	145	1/2+	−72.93	23.0 m *4*	ε
	145m	11/2−	−72.18	85 s *3*	IT 94.3%, ε 5.7%
	146	0+	−76.087	48.27 d *10*	ε
	147	7/2−	−75.356	38.06 h *12*	ε
	148	0+	−76.269	70.9 y *10*	α
	149	7/2−	−75.126	9.28 d *10*	ε , α 4.3×10^{-4}%

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
64 Gd	150	0+	−75.763	1.79×10^{6} y *8*	α
	151	7/2−	−74.187	123.9 d *10*	ε, α≈8.0×10^{-7}%
	152	0+	−74.706	1.08×10^{14} y *8*	α
				0.20% *1*	
	153	3/2−	−72.882	240.4 d *10*	ε
	154	0+	−73.705	**2.18% *3***	
	155	3/2−	−72.069	**14.80% *12***	
	155m	11/2−	−71.948	31.97 ms *27*	IT
	156	0+	−72.534	**20.47% *9***	
	157	3/2−	−70.823	**15.65% *2***	
	158	0+	−70.689	**24.84% *7***	
	159	3/2−	−68.560	18.479 h *4*	β−
	160	0+	−67.940	>3.1×10^{19} y	2β−
				21.86% *19*	
	161	5/2−	−65.505	3.66 m *5*	β−
	162	0+	−64.279	8.4 m *2*	β−
	163	(5/2−,7/2+)	−61.47	68 s *3*	β−
	164	0+	−59.9s	45 s *3*	β−
	165		−56.6s	10.3 s *16*	β−
	166	0+	−54.5s	4.8 s *10*	β−
	167		−50.8s		β−?
	168	0+	−48.3s		β−?
	169		−44.2s		β−?
65 Tb	135	(7/2−)	−32.6s	0.94 ms *+33−22*	p
	136		−35.9s		ε?
	137		−40.7s		p?, ε?
	138m		−43.5s	≥200 ns	ε, p
	139		−48.0s	1.6 s *2*	ε, εp?
	140	(7+)	−50.5	2.0 s *5*	ε, εp 0.26%
	141	(5/2−)	−54.5	3.5 s *2*	ε
	141m		−54.5	7.9 s *6*	ε
	142	1+	−56.6	597 ms *17*	ε, εp 2.2×10^{-3}%
	142m	5−	−56.3	303 ms *17*	IT
	143	(11/2−)	−60.42	12 s *1*	ε
	143m		−60.42	<21 s	ε
	144	1+	−62.37	≈1 s	ε
	144m	(6−)	−61.97	4.25 s *15*	IT 66%, ε 34%
	145		−65.88		ε?
	145m	(11/2−)	−65.88	30.9 s *6*	ε
	146	1+	−67.76	8 s *4*	ε
	146m	5−	−67.76	23 s *2*	ε
	146m	(10+)	−66.98	1.18 ms *2*	IT
	147	(1/2+)	−70.742	1.64 h *3*	ε
	147m	(11/2−)	−70.691	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+	−71.489	4.118 h *25*	ε 83.3%, α 16.7%
	149m	11/2−	−71.453	4.16 m *4*	ε 99.98%, α 0.02%
	150	(2−)	−71.105	3.48 h *16*	ε, α<0.05%
	150m	9+	−70.631	5.8 m *2*	ε
	151	1/2(+)	−71.622	17.609 h *14*	ε 99.99%,
					α 9.5×10^{-3}%

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
65 Tb	151m	(11/2−)	−71.522	25 s *3*	IT 93.4%, ε 6.6%
	152	2−	−70.72	17.5 h *1*	ε, α<7.0×10^{-7}%
	152m	8+	−70.21	4.2 m *1*	IT 78.8%, ε 21.2%
	153	5/2+	−71.313	2.34 d *1*	ε
	154	0	−70.15	21.5 h *4*	ε, β−<0.1%
	154m	7−	−70.15	22.7 h *5*	ε 98.2%, IT 1.8%
	154m	3−	−70.15	9.4 h *4*	ε 78.2%, IT 21.8%, β−<0.1%
	155	3/2+	−71.25	5.32 d *6*	ε
	156	3−	−70.090	5.35 d *10*	ε
	156m	(7−)	−70.040	24.4 h *10*	IT
	156m	(0+)	−70.002	5.3 h *2*	IT<100%, ε>0%
	157	3/2+	−70.762	71 y *7*	ε
	158	3−	−69.469	180 y *11*	ε 83.4%, β− 16.6%
	158m	0−	−69.359	10.70 s *17*	IT, β−<0.6%, ε<0.01%
	158m	7−	−69.081	0.40 ms *4*	IT
	159	3/2+	−69.531	**100%**	
	160	3−	−67.835	72.3 d *2*	β−
	161	3/2+	−67.460	6.89 d *2*	β−
	162	1−	−65.67	7.60 m *15*	β−
	163	3/2+	−64.594	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	(2−)	−57.88	25.1 s *21*	β−
	167	(3/2+)	−55.9s	19.4 s *27*	β−
	168	(4−)	−52.6s	8.2 s *13*	β−
	169		−50.2s		β−?
	170		−46.5s		β−?
	171		−43.8s		β−?
66 Dy	138	0+	−34.8s		ε?
	139	(7/2+)	−37.6s	0.6 s *2*	ε, εp
	140	0+	−42.7s		ε
	141	(9/2−)	−45.2s	0.9 s *2*	ε, εp
	142	0+	−49.9s	2.3 s *3*	ε, εp 0.06%
	143	(1/2+)	−52.17	5.6 s *10*	ε, εp
	143m	(11/2−)	−51.86	3.0 s *3*	ε, εp
	144	0+	−56.570	9.1 s *4*	ε, εp
	145	(1/2+)	−58.242	6 s *2*	ε, εp≈50%
	145m	(11/2−)	−58.124	14.1 s *7*	ε, εp≈50%
	146	0+	−62.554	29 s *3*	ε
	146m	(10+)	−59.618	150 ms *20*	IT
	147	(1/2+)	−64.194	67 s *7*	ε, εp 0.05%
	147m	(11/2−)	−63.444	55.2 s *5*	ε 68.9%, IT 31.1%
	148	0+	−67.859	3.3 m *2*	ε
	149	(7/2−)	−67.702	4.20 m *14*	ε
	149m	(27/2−)	−65.041	0.490 s *15*	IT 99.3%, ε 0.7%
	150	0+	−69.310	7.17 m *5*	ε 64%, α 36%
	151	7/2(−)	−68.752	17.9 m *3*	ε 94.4%, α 5.6%
	152	0+	−70.118	2.38 h *2*	ε 99.9%, α 0.1%
	153	7/2(−)	−69.142	6.4 h *1*	ε 99.99%, α 9.4×10^{-3}%

Nuclear Wallet Cards

Nuclide Z El A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
66 Dy 154	0+	−70.392	3.0×10^{6} y *15*	α
155	3/2−	−69.15	9.9 h *2*	ε
156	0+	−70.522	**0.056% *3***	
157	3/2−	−69.420	8.14 h *4*	ε
157m	11/2−	−69.221	21.6 ms *16*	IT
158	0+	−70.404	**0.095% *3***	
159	3/2−	−69.166	144.4 d *2*	ε
160	0+	−69.671	**2.329% *18***	
161	5/2+	−68.054	**18.889% *42***	
162	0+	−68.179	**25.475% *36***	
163	5/2−	−66.379	**24.896% *42***	
164	0+	−65.966	**28.260% *54***	
165	7/2+	−63.610	2.334 h *1*	β−
165m	1/2−	−63.502	1.257 m *6*	IT 97.76%, β− 2.24%
166	0+	−62.583	81.6 h *1*	β−
167	(1/2−)	−59.93	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		β−
171		−50.1s		β−?
172	0+	−47.8s		β−?
173		−43.7s		β−?
67 Ho 140	(6−,0−,8+)	−29.2s	6 ms *3*	p
141	7/2−	−34.3s	4.1 ms *3*	p
142	(7−,8+)	−37.2s	0.4 s *1*	ε, εp>0%
143	(11/2−)	−42.0s		ε?, εp?
144	(5−)	−44.609	0.7 s *1*	ε, εp
145	(11/2−)	−49.120	2.4 s *1*	ε
146	(10+)	−51.238	3.6 s *3*	ε
147	(11/2−)	−55.757	5.8 s *4*	ε
148	(1+)	−57.99	2.2 s *11*	ε
148m	(6)−	−57.99	9.59 s *15*	ε, εp 0.08%
148m	(10+)	−57.30	2.35 ms *4*	IT
149	(11/2−)	−61.66	21.1 s *2*	ε
149m	(1/2+)	−61.62	56 s *3*	ε
150	2−	−61.95	72 s *4*	ε
150m	(9)+	−61.45	24.1 s *5*	ε,
151	(11/2−)	−63.622	35.2 s *1*	ε 78%, α 22%
151m	(1/2+)	−63.581	47.2 s *13*	α 80%, ε 20%
152	2−	−63.61	161.8 s *3*	ε 88%, α 12%
152m	9+	−63.45	50.0 s *4*	ε 89.2%, α 10.8%
153	11/2−	−65.012	2.01 m *3*	ε 99.95%, α 0.05%
153m	1/2+	−64.943	9.3 m *5*	ε 99.82%, α 0.18%
154	2−	−64.639	11.76 m *19*	ε 99.98%, α 0.02%
154m	8+	−64.639	3.10 m *14*	ε, α<1.0×10^{-3}%
155	5/2+	−66.04	48 m *1*	ε
155m	11/2−	−65.90	0.88 ms *8*	IT
156	4−	−65.47	56 m *1*	ε
156m	1−	−65.42	9.5 s *15*	IT
156m	9+	−65.42	7.8 m *3*	ε 75%, IT 25%
157	7/2−	−66.83	12.6 m *2*	ε
158	5+	−66.18	11.3 m *4*	ε

Nuclear Wallet Cards

Nuclide Z El A		Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
67 Ho	158m	2–	–66.12	28 m *2*	IT>81%, ε<19%
	158m	(9+)	–66.00	21.3 m *23*	ε≥93%, IT≤7%
	159	7/2–	–67.328	33.05 m *11*	ε
	159m	1/2+	–67.122	8.30 s *8*	IT
	160	5+	–66.38	25.6 m *3*	ε
	160m	2–	–66.32	5.02 h *5*	IT 73%, ε 27%
	160m	(9+)	–66.21	3 s	IT
	161	7/2–	–67.195	2.48 h *5*	ε
	161m	1/2+	–66.984	6.76 s *7*	IT
	162	1+	–66.040	15.0 m *10*	ε
	162m	6–	–65.934	67.0 m *7*	IT 62%, ε 38%
	163	7/2–	–66.376	4570 y *25*	ε
	163m	1/2+	–66.078	1.09 s *3*	IT
	164	1+	–64.980	29 m *1*	ε 60%, β– 40%
	164m	6–	–64.840	37.5 m *+15–5*	IT
	165	7/2–	–64.897	**100%**	
	166	0–	–63.070	26.824 h *12*	β–
	166m	7–	–63.064	1.20×10^{3} y *18*	β–
	167	7/2–	–62.279	3.003 h *18*	β–
	168	3+	–60.06	2.99 m *7*	β–
	168m	(6+)	–60.00	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		–51.5s	25 s *3*	β–
	173		–49.2s		β–?
	174		–45.7s		β–?
	175		–43.1s		β–?
68 Er	142	0+	–28.1s		
	143		–31.2s		ε?
	144	0+	–36.7s	≥200 ns	ε
	145	(1/2+)	–39.4s		ε?
	145m	(11/2–)	–39.2s	1.0 s *3*	ε, εp
	146	0+	–44.322	1.7 s *6*	ε, εp
	147	(1/2+)	–46.61	2.5 s *2*	ε, εp>0%
	147m	(11/2–)	–46.61	1.6 s *2*	ε, εp>0%
	148	0+	–51.48	4.6 s *2*	ε
	149	(1/2+)	–53.74	4 s *2*	ε, εp 7%
	149m	(11/2–)	–53.00	8.9 s *2*	ε 96.5%, IT 3.5%, εp 0.18%
	150	0+	–57.83	18.5 s *7*	ε
	151	(7/2–)	–58.26	23.5 s *20*	ε
	151m	(27/2–)	–55.68	0.58 s *2*	IT 95.3%, ε 4.7%
	152	0+	–60.500	10.3 s *1*	α 90%, ε 10%
	153	(7/2–)	–60.475	37.1 s *2*	α 53%, ε 47%
	154	0+	–62.606	3.73 m *9*	ε 99.53%, α 0.47%
	155	7/2–	–62.209	5.3 m *3*	ε 99.98%, α 0.02%
	156	0+	–64.21	19.5 m *10*	ε, α 1.7×10^{-5}%
	157	3/2–	–63.41	18.65 m *10*	ε
	157m	(9/2+)	–63.26	76 ms *6*	IT
	158	0+	–65.30	2.29 h *6*	ε

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
68 Er	159	3/2−	−64.560	36 m *1*	ε
	160	0+	−66.06	28.58 h *9*	ε
	161	3/2−	−65.199	3.21 h *3*	ε
	162	0+	−66.332	**0.139% *5***	
	163	5/2−	−65.166	75.0 m *4*	ε
	164	0+	−65.941	**1.601% *3***	
	165	5/2−	−64.520	10.36 h *4*	ε
	166	0+	−64.924	**33.503% *36***	
	167	7/2+	−63.289	**22.869% *9***	
	167m	1/2−	−63.081	2.269 s *6*	IT
	168	0+	−62.989	**26.978% *18***	
	169	1/2−	−60.921	9.392 d *18*	β−
	170	0+	−60.108	**14.910% *36***	
	171	5/2−	−57.718	7.516 h *2*	β−
	172	0+	−56.482	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+	−46.6s		β−?
	177		−42.9s		β−?
69 Tm	144	(10+)	−22.2s	1.9 μs *+12−5*	p>0%
	145	(11/2−)	−27.7s	3.17 μs *20*	p
	146	(5−)	−31.2s	80 ms *10*	p, ε
	146m	(8+)	−31.1s	200 ms *10*	p, ε
	147	11/2−	−35.974	0.58 s *3*	ε 85%, p 15%
	147m	3/2+	−35.906	0.36 ms *4*	p
	148m	(10+)	−38.76	0.7 s *2*	ε
	149	(11/2−)	−43.9s	0.9 s *2*	ε, εp 0.2%
	150	(6−)	−46.5s	2.20 s *6*	ε
	150m	(10+)	−45.8s	5.2 ms *3*	IT
	151	(11/2−)	−50.78	4.17 s *11*	ε
	151m	(1/2+)	−50.78	6.6 s *20*	ε
	152	(2)−	−51.77	8.0 s *10*	ε
	152m	(9)+	−51.77	5.2 s *6*	ε
	153	(11/2−)	−53.99	1.48 s *1*	α 91%, ε 9%
	153m	(1/2+)	−53.95	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−	−56.626	21.6 s *2*	ε 99.11%, α 0.89%
	155m	1/2+	−56.585	45 s *3*	ε>98%, α<2%
	156	2−	−56.84	83.8 s *18*	ε 99.94%, α 0.06%
	157	1/2+	−58.71	3.63 m *9*	ε
	158	2−	−58.70	3.98 m *6*	ε
	158m	(5+)	−58.70	≈20 s	ε?
	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−	−61.47	21.70 m *19*	ε
	162m	5+	−61.47	24.3 s *17*	IT 81%, ε 19%
	163	1/2+	−62.727	1.810 h *5*	ε
	164	1+	−61.90	2.0 m *1*	ε

Nuclear Wallet Cards

Nuclide Z El A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
69 Tm 164m	6−	−61.90	5.1 m *1*	IT≈80%, ε≈20%
165	1/2+	−62.928	30.06 h *3*	ε
166	2+	−61.89	7.70 h *3*	ε
166m	(6−)	−61.78	340 ms *25*	IT
167	1/2+	−62.542	9.25 d *2*	ε
168	3+	−61.312	93.1 d *2*	ε 99.99%, β− 0.01%
169	1/2+	−61.274	**100%**	
170	1−	−59.795	128.6 d *3*	β− 99.87%, ε 0.13%
171	1/2+	−59.210	1.92 y *1*	β−
172	2−	−57.373	63.6 h *2*	β−
173	(1/2+)	−56.253	8.24 h *8*	β−
174	(4)−	−53.86	5.4 m *1*	β−
174m	0+	−53.61	2.29 s *1*	IT 99%, β−<1%
175	(1/2+)	−52.31	15.2 m *5*	β−
176	(4+)	−49.4	1.9 m *1*	β−
177m	(7/2−)	−47.5s	90 s *6*	β−
178		−44.1s	>300 ns	β−
179		−41.6s		β−?
70 Yb 148	0+	−30.2s		ε?
149	(1/2+,3/2+)	−33.2s	0.7 s *2*	ε, εp
150	0+	−38.6s	≥200 ns	ε?
151	(1/2+)	−41.5	1.6 s *1*	ε, εp>0%
151m	(11/2−)	−41.5	1.6 s *1*	ε, IT≈0.4%, εp
152	0+	−46.3	3.03 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+	−53.265	26.1 s *7*	ε 90%, α 10%
157	7/2−	−53.43	38.6 s *10*	ε 99.5%, α 0.5%
158	0+	−56.008	1.49 m *13*	α≈2.1×10^{-3}%, ε
159	5/2(−)	−55.84	1.67 m *9*	ε
160	0+	−58.16	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+	−61.594	56.7 h *1*	ε
167	5/2−	−60.588	17.5 m *2*	ε
168	0+	−61.580	**0.123% *3***	
169	7/2+	−60.376	32.018 d *5*	ε
169m	1/2−	−60.352	46 s *2*	IT
170	0+	−60.763	**2.982% *39***	
171	1/2−	−59.306	**14.09% *14***	
171m	7/2+	−59.211	5.25 ms *24*	IT
172	0+	−59.255	**21.68% *13***	
173	5/2−	−57.551	**16.103% *63***	
174	0+	−56.944	**32.026% *80***	
175	(7/2−)	−54.695	4.185 d *1*	β−
175m	1/2−	−54.180	68.2 ms *3*	IT
176	0+	−53.488	**12.996% *83***	
176m	8−	−52.438	11.4 s *3*	IT

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
70 Yb	177	(9/2+)	–50.983	1.911 h *3*	β–
	177m	(1/2–)	–50.652	6.41 s *2*	IT
	178	0+	–49.69	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		β– ?
71 Lu	150	(2+)	–24.6s	45 ms *3*	p 70.9%, ε 29.1%
	151	11/2–	–30.1s	80.6 ms *20*	p 63.4%, ε 36.6%
	152	(4–,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		
	154m	(9+)	–39.6s	1.12 s *8*	ε
	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
	156	(2)–	–43.75	494 ms *12*	α ≈ 95%, ε ≈ 5%
	156m	9+	–43.75	198 ms *2*	α
	157	(1/2+,3/2+)	–46.46	6.8 s *18*	α > 0%
	157m	(11/2–)	–46.43	4.79 s *12*	ε 94%, α 6%
	158		–47.21	10.6 s *3*	ε 99.09%, α 0.91%
	159		–49.71	12.1 s *10*	ε, α 0.1%
	160		–50.27	36.1 s *3*	ε, α ≤ 1.0×10^{-4}%
	160m		–50.27	40 s *1*	ε ≤ 100%, α
	161	1/2+	–52.56	77 s *2*	ε
	161m	(9/2–)	–52.40	7.3 ms *4*	IT
	162	1–	–52.84	1.37 m *2*	ε ≤ 100%
	162m		–52.84	1.9 m	ε ≤ 100%
	162m	(4–)	–52.84	1.5 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(–)	–57.07	5.5 m *1*	ε
	168m	3+	–56.87	6.7 m *4*	ε > 99.6%, IT < 0.8%
	169	7/2+	–58.083	34.06 h *5*	ε
	169m	1/2–	–58.054	160 s *10*	IT
	170	0+	–57.30	2.012 d *20*	ε
	170m	(4)–	–57.21	0.67 s *10*	IT
	171	7/2+	–57.828	8.24 d *3*	ε
	171m	1/2–	–57.757	79 s *2*	IT
	172	4–	–56.736	6.70 d *3*	ε
	172m	1–	–56.694	3.7 m *5*	IT
	173	7/2+	–56.881	1.37 y *1*	ε
	174	(1)–	–55.570	3.31 y *5*	ε
	174m	(6)–	–55.399	142 d *2*	IT 99.38%, ε 0.62%
	175	7/2+	–55.166	**97.401% *13***	
	176	7–	–53.382	3.76×10^{10} y 7 **2.599% *13***	β–

Nuclear Wallet Cards

Nuclide Z El A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
71 Lu 176m	1−	−53.259	3.664 h *19*	β− 99.9%, ε 0.09%
177	7/2+	−52.384	6.647 d *4*	β−
177m	23/2−	−51.414	160.44 d *6*	β− 78.6%, IT 21.4%
177m	(39/2−)	−49.644	6 m +*3*−*2*	β−, IT?
178	1(+)	−50.338	28.4 m *2*	β−
178m	(9−)	−50.214	23.1 m *3*	β−
179	7/2+	−49.059	4.59 h *6*	β−
179m	1/2+	−48.467	3.1 ms *9*	IT
180	5+	−46.68	5.7 m *1*	β−
181	(7/2+)	−44.7s	3.5 m *3*	β−
182		−41.9s	2.0 m *2*	β−
183	(7/2+)	−39.5s	58 s *4*	β−
184	(3+)	−36.4s	19 s *2*	β−
72 Hf 153		−27.3s	>60 ns	ε?
154	0+	−32.7s	2 s *1*	ε, α?
155		−34.1s	0.84 s *3*	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+	−45.938	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+	−49.166	39.4 s *9*	ε 99.99%, α 8.0×10^{-3}%
163		−49.29	40.0 s *6*	ε, α<1.0×10^{-4}%
164	0+	−51.83	111 s *8*	ε
165	(5/2−)	−51.63	76 s *4*	ε
166	0+	−53.86	6.77 m *30*	ε
167	(5/2)−	−53.47	2.05 m *5*	ε
168	0+	−55.36	25.95 m *20*	ε
169	5/2−	−54.72	3.24 m *4*	ε
170	0+	−56.25	16.01 h *13*	ε
171	7/2+	−55.43	12.1 h *4*	ε
171m	1/2−	−55.41	29.5 s *9*	IT≤100%, ε
172	0+	−56.40	1.87 y *3*	ε
173	1/2−	−55.41	23.6 h *1*	ε
174	0+	−55.845	2.0×10^{15} y *4* **0.16% *1***	α
175	5/2(−)	−54.482	70 d *2*	ε
176	0+	−54.576	**5.26% *7***	
177	7/2−	−52.885	**18.60% *9***	
177m	23/2+	−51.569	1.09 s *5*	IT
177m	37/2−	−50.145	51.4 m *5*	IT
178	0+	−52.439	**27.28% *7***	
178m	8−	−51.292	4.0 s *2*	IT
178m	16+	−49.993	31 y *1*	IT
179	9/2+	−50.467	**13.62% *2***	
179m	1/2−	−50.092	18.67 s *4*	IT
179m	25/2−	−49.361	25.05 d *25*	IT
180	0+	−49.783	**35.08% *16***	
180m	8−	−48.641	5.47 h *4*	IT 99.7%, β− 0.3%

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
72	**Hf**	181	1/2–	–47.407	42.39 d *6*	β–
		181m	(25/2–)	–45.665	1.5 ms *5*	IT
		182	0+	–46.053	8.90×10^{6} y *9*	β–
		182m	(8–)	–44.880	61.5 m *15*	β– 54%, IT 46%
		183	(3/2–)	–43.29	1.018 h *2*	β–
		184	0+	–41.50	4.12 h *5*	β–
		184m	(8–)	–40.23	48 s *10*	IT
		185		–38.4s	3.5 m *6*	β–
		186	0+	–36.4s	2.6 m *12*	β–
		187m		–32.8s	0.27 μs *8*	β–
		188	0+	–30.9s		β–
		189				
73	**Ta**	155m	11/2–	–24.0s	2.9 ms +*15*–*11*	p
		156	(2–)	–25.8s	144 ms *24*	p, 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+	–34.44	0.83 s *18*	ε 66%, α 34%
		159m	11/2–	–34.38	0.56 s *6*	α 55%, ε 45%
		160		–35.87	1.55 s *4*	ε 66%, α 34%
		160m		–35.87	1.7 s *2*	
		161	(1/2+)	–38.71		ε, α
		161m	(11/2–)	–38.71	3.08 s *11*	ε, 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		–45.85	31.0 s *15*	ε
		166	(2)+	–46.10	34.4 s *5*	ε
		167	(3/2+)	–48.35	80 s *4*	ε
		168	(2–,3+)	–48.39	2.0 m *1*	ε
		169	(5/2+)	–50.29	4.9 m *4*	ε
		170	(3+)	–50.14	6.76 m *6*	ε
		171	(5/2–)	–51.72	23.3 m *3*	ε
		172	(3+)	–51.33	36.8 m *3*	ε
		173	5/2–	–52.40	3.14 h *13*	ε
		174	3+	–51.74	1.14 h *8*	ε
		175	7/2+	–52.41	10.5 h *2*	ε
		176	(1)–	–51.37	8.09 h *5*	ε
		177	7/2+	–51.719	56.56 h *6*	ε
		178m	(1+)	–50.50	9.31 m *3*	ε
		178m	7–	–50.50	2.36 h *8*	ε
		178m	15–	–49.03	58 ms *4*	IT
		178m	(21–)	–47.60	290 ms *12*	IT
		179	7/2+	–50.361	1.82 y *3*	ε
		179m	(25/2+)	–49.044	9.0 ms *2*	IT
		179m	(37/2+)	–47.722	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 **0.01201% *32***	ε ?

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
73	**Ta**	180m	9−	−48.859	>1.2×10^{15} y	β−?
					0.01201% *32*	
		181	7/2+	−48.441	**99.98799% *32***	
		182	3−	−46.433	114.74 d *12*	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	
		186	(2−,3−)	−38.61	10.5 m *3*	β−
		186m		−38.61	1.54 m *5*	β−
		187	(7/2+)	−36.8s	2.3 m *6*	β−
		187m	(27/2−)	−35.0s	22 s *9*	β−?, IT?
		187m	(41/2+)	−33.8s	>5 m	β−?, IT?
		188		−33.7s	19.6 s *20*	β−
		189?		−31.8s	1.6 μs *2*	β−?
		190		−28.7s	5.3 s *7*	β−
		191		−26.5s	>300 ns	β−?
		192	(1,2)	−23.1s	2.2 s *7*	β−
74	**W**	157	(7/2−)	−19.3s	275 ms *40*	ε
		158	0+	−23.7s	1.25 ms *21*	α
		158m	(8+)	−21.8s	0.143 ms *19*	IT, α
		159		−25.2s	7.3 ms *27*	α≈99.9%, ε≈0.1%
		160	0+	−29.4	91 ms *5*	α 87%
		161		−30.4s	409 ms *18*	α 73%, ε 27%
		162	0+	−34.00	1.36 s *7*	ε 54.8%, α 45.2%
		163	7/2−	−34.91	2.67 s *10*	ε 86%, α 14%
		164	0+	−38.235	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+	−41.88	19.2 s *6*	ε 99.96%, α 0.04%
		167	(+)	−42.09	19.9 s *5*	ε 99.96%, α 0.04%
		168	0+	−44.90	50.9 s *19*	ε, 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+	−50.41	21.6 d *3*	ε
		179	7/2−	−49.29	37.05 m *16*	ε
		179m	1/2−	−49.07	6.40 m *7*	IT 99.71%, ε 0.29%
		180	0+	−49.636	≥6.6×10^{17} y	2ε
					0.12% *1*	
		181	9/2+	−48.253	121.2 d *2*	ε
		182	0+	−48.247	**26.50% *16***	
		183	1/2−	−46.367	>1.3×10^{19} y	α
					14.31% *4*	
		183m	11/2+	−46.057	5.2 s *3*	IT

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
74 W	184	0+	–45.707	***30.64% 2***	
	185	3/2–	–43.389	75.1 d *3*	β–
	185m	11/2+	–43.192	1.67 m *3*	IT
	186	0+	–42.510	$>2.3\times10^{19}$ y	2β–
				28.43% 19	
	186m	(16+)	–38.967	>3 ms	IT
	187	3/2–	–39.906	24.000 h *4*	β–
	188	0+	–38.669	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		β– ?
	193		–26.2s	>300 ns	β– ?
	194	0+	–24.4s	>300 ns	β– ?
75 Re	159	(1/2+)	–14.8s		
	160	(2–)	–16.7s	0.82 ms *+15–9*	p 91%, α 9%
	161	1/2+	–20.9	0.44 ms *1*	p, α≤1.4%
	161m	11/2–	–20.8	14.7 ms *3*	α 93%, p 7%
	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		–27.52	0.85 s *+14–11*	α≈58%, ε≈42%
	164m		–27.45	0.86 s *+15–11*	IT, α≈3%
	165	(1/2+)	–30.65	≈1 s	α, ε
	165m	(11/2–)	–30.60	2.1 s *3*	ε 87%, α 13%
	166		–31.89	2.25 s *21*	ε>76%, α<24%
	167	(9/2–)	–34.84s	5.9 s *3*	ε≈99%, α≈1%
	167m		–34.84s	3.4 s *4*	α
	168	(7+)	–35.79	4.4 s *1*	ε, $\alpha\approx5.0\times10^{-3}$%
	169	(9/2–)	–38.41	8.1 s *5*	ε, α<0.01%
	169m	(5/2+,3/2+)	–38.41	15.1 s *15*	ε, IT, α≈0.2%
	170	(5+)	–38.92	9.2 s *2*	ε
	171	(9/2–)	–41.25	15.2 s *4*	ε
	172m	(2)	–41.52	55 s *5*	ε
	172m	(5)	–41.52	15 s *3*	ε
	173	(5/2–)	–43.55	1.98 m *26*	ε
	174	(≤ 4)	–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+	–46.58	19.5 m *1*	ε
	179m	47/2,49/2+	–41.18	0.466 ms *15*	IT
	180	(1)–	–45.84	2.44 m *6*	ε
	181	5/2+	–46.52	19.9 h *7*	ε
	182	7+	–45.4	64.0 h *5*	ε
	182m	2+	–45.4	12.7 h *2*	ε
	183	5/2+	–45.811	70.0 d *14*	ε
	183m	(25/2)+	–43.903	1.04 ms *4*	IT
	184	3(–)	–44.224	35.4 d *7*	ε

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
75 Re	184m	8(+)	–44.036	169 d *8*	IT 74.5%, ε 25.5%
	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+	–41.218	4.33×10^{10} y *7* **62.60% *2***	β–, α<1.0×10^{-4}%
	188	1–	–39.018	17.003 h *3*	β–
	188m	(6)–	–38.846	18.59 m *4*	IT
	189	5/2+	–37.980	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		–31.8s	16 s *1*	β–
	193?		–30.2s		
	194m		–27.4s	5 s *1*	β–
	194m		–27.4s	25 s *8*	β–
	194m		–27.4s	100 s *10*	β–
	195		–25.6s	6 s *1*	β–
	196		–22.5s	3 s +*1*–*2*	β–
	198				
76 Os	161	(7/2–)	–9.9s	0.64 ms *6*	α
	162	0+	–14.5s	2.1 ms *1*	α≈99%
	163	(7/2–)	–16.1s	5.5 ms *6*	α, 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	199 ms *3*	α 72%, ε 18%
	167	(7/2–)	–26.50	0.81 s *6*	α 57%, ε 43%
	168	0+	–29.992	2.1 s *1*	ε 57%, α 43%
	169	(5/2–)	–30.72	3.43 s *14*	ε 86.3%, α 13.7%
	170	0+	–33.92	7.37 s *18*	ε 90.5%, α 9.5%
	171	(5/2–)	–34.29	8.3 s *2*	ε 98.2%, α 1.8%
	172	0+	–37.24	19.2 s *9*	ε 99.8%, α 0.2%
	173	(5/2–)	–37.44	22.4 s *9*	ε, α 0.4%
	174	0+	–40.00	44 s *4*	ε 99.98%, α 0.02%
	175	(5/2–)	–40.11	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, α
	179	1/2–	–43.02	6.5 m *3*	ε
	180	0+	–44.35	21.5 m *4*	ε
	181	1/2–	–43.55	105 m *3*	ε
	181m	7/2–	–43.50	2.7 m *1*	ε, IT≤3%
	182	0+	–44.61	21.84 h *20*	ε
	182m	(8)–	–42.78	0.78 ms *7*	IT
	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	>5.6×10^{13} y **0.02% *1***	α
	185	1/2–	–42.809	93.6 d *5*	ε
	186	0+	–43.002	2.0×10^{15} y *11* **1.59% *3***	α
	187	1/2–	–41.220	**1.96% *2***	

Nuclear Wallet Cards

Nuclide Z El A		Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
76 Os	188	0+	–41.139	**13.24%** ***8***	
	189	3/2–	–38.988	**16.15%** ***5***	
	189m	9/2–	–38.957	5.81 h *6*	IT
	190	0+	–38.709	**26.26%** ***2***	
	190m	(10)–	–37.004	9.9 m *1*	IT
	191	9/2–	–36.396	15.4 d *1*	β–
	191m	3/2–	–36.322	13.10 h *5*	IT
	192	0+	–35.883	**40.78%** ***19***	
	192m	(10–)	–33.868	5.9 s *1*	IT>87%, β–<13%
	193	3/2–	–33.395	30.11 h *1*	β–
	194	0+	–32.437	6.0 y *2*	β–
	195		–29.7	≈9 m	β–
	196	0+	–28.28	34.9 m *2*	β–
	197		–25.3s	2.8 m *6*	β–
	198	0+	–23.8s		β–
	199		–20.5s	5 s +*4–2*	β–
	200	0+	–18.9s	6 s +*4–3*	β–
	201			>300 ns	β–?
	202	0+		>300 ns	β–?
77 Ir	164m	(9+)	–7.3s	94 μs *27*	p>0%, α, ε
	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%, p 7%
	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		–18.72	222 ms +*60–40*	α≤100%, ε, p
	168m		–18.72	159 ms +*16–13*	α 77%, ε≤23%, p
	169	(1/2+)	–22.08	0.353 s *4*	α 45%, ε, p
	169m	(11/2–)	–21.93	0.281 s *4*	α 72%, ε, p
	170	(3–)	–23.36s	0.87 s +*18–12*	ε 94.8%, α 5.2%
	170m	(8+)	–23.36s	811 ms *18*	IT≤62%, ε≤62%, α 38%
	171	(1/2+)	–26.43	3.2 s +*13–7*	α>0%, p, ε
	171m	(11/2–)	–26.43	1.40 s *10*	α 58%, p≤42%, ε≤42%
	172	(3+)	–27.38	4.4 s *3*	ε 98%, α≈2%
	172m	(7+)	–27.24	2.0 s *1*	ε 77%, α 23%
	173	(3/2+,5/2+)	–30.27	9.0 s *8*	ε>93%, α<7%
	173m	(11/2–)	–30.04	2.4 s *9*	ε, α 7%
	174	(3+)	–30.87	7.9 s *6*	ε 99.5%, α 0.5%
	174m	(7+)	–30.67	4.9 s *3*	ε 97.5%, α 2.5%
	175	(5/2–)	–33.39	9 s *2*	ε 99.15%, α 0.85%
	176		–33.86	8.7 s *5*	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	3+	–39.05	15 m *1*	ε
	183	5/2–	–40.20	57 m *4*	ε
	184	5–	–39.61	3.09 h *3*	ε

Nuclear Wallet Cards

Nuclide Z El A		Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
77 Ir	185	5/2–	–40.33	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+	–39.532	10.5 h *3*	ε
	187m	9/2–	–39.346	30.3 ms *6*	IT
	188	1–	–38.351	41.5 h *5*	ε
	188m		–37.428	4.2 ms *2*	ε ?, IT
	189	3/2+	–38.46	13.2 d *1*	ε
	189m	11/2–	–38.08	13.3 ms *3*	IT
	189m	(25/2)+	–36.12	3.7 ms *2*	IT
	190	4–	–36.755	11.78 d *10*	ε
	190m	(1–)	–36.729	1.120 h *3*	IT
	190m	(11)–	–36.379	3.087 h *12*	ε 91.4%, IT 8.6%
	191	3/2+	–36.710	**37.3% *2***	
	191m	11/2–	–36.539	4.899 s *23*	IT
	191m		–34.663	5.5 s *7*	IT
	192	4+	–34.837	73.829 d *11*	β– 95.24%, ε 4.76%
	192m	1–	–34.780	1.45 m *5*	IT 99.98%, β– 0.02%
	192m	(11–)	–34.669	241 y *9*	IT
	193	3/2+	–34.538	**62.7% *2***	
	193m	11/2–	–34.458	10.53 d *4*	IT
	194	1–	–32.533	19.28 h *13*	β–
	194m	4+	–32.386	31.85 ms *24*	IT
	194m	(10,11)	–32.343	171 d *11*	β–
	195	3/2+	–31.694	2.5 h *2*	β–
	195m	11/2–	–31.594	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–, IT<0.3%
	197	3/2+	–28.26	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	6 s *+5–4*	β–
	200		–21.6s	>300 ns	β–
	201		–19.9s	>300 ns	β–
	202	(1–,2–)	–17.0s	11 s *3*	β–
	203			>300 ns	β– ?
	204				
78 Pt	166	0+	–4.8s	300 μs *100*	α
	167		–6.5s	0.9 ms *3*	α
	168	0+	–11.0	2.02 ms *10*	α
	169	(7/2–)	–12.4s	7.0 ms *2*	α
	170	0+	–16.30	13.8 ms *5*	α 98%, ε
	171	(7/2–)	–17.47	45.5 ms *25*	α 90%, ε 10%
	172	0+	–21.10	97.6 ms *13*	α 94%, ε 6%
	173	(5/2–)	–21.94	382 ms *2*	α, ε ?
	174	0+	–25.31	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 60%, α 40%
	177	5/2–	–29.37	10.6 s *4*	ε 94.3%, α 5.7%
	178	0+	–32.00	20.7 s *7*	ε 92.3%, α 7.7%
	179	1/2–	–32.270	21.2 s *4*	ε 99.76%, α 0.24%
	180	0+	–34.44	56 s *2*	ε, α ≈ 0.3%

Nuclear Wallet Cards

Nuclide Z El A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
78 Pt 181	1/2–	–34.37	52.0 s *22*	ε, α≈0.08%
182	0+	–36.17	2.67 m *12*	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, α<4.0×10^{-4}%, IT
184	0+	–37.33	17.3 m *2*	ε, α≈1.0×10^{-3}%
184m	8–	–35.49	1.01 ms *5*	IT
185	9/2+	–36.68	70.9 m *24*	ε<100%
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+	–37.828	10.2 d *3*	ε, α 2.6×10^{-5}%
189	3/2–	–36.49	10.87 h *12*	ε
190	0+	–37.325	6.5×10^{11} y *3*	α
			0.012% *2*	
191	3/2–	–35.701	2.83 d *2*	ε
192	0+	–36.292	**0.782% *24***	
193	1/2–	–34.481	50 y *6*	ε
193m	13/2+	–34.331	4.33 d *3*	IT
194	0+	–34.762	**32.86% *40***	
195	1/2–	–32.796	**33.78% *24***	
195m	13/2+	–32.537	4.010 d *5*	IT
196	0+	–32.646	**25.21% *34***	
197	1/2–	–30.421	19.8915 h *19*	β–
197m	13/2+	–30.021	95.41 m *18*	IT 96.7%, β– 3.3%
198	0+	–29.905	**7.36% *13***	
199	5/2–	–27.390	30.80 m *21*	β–
199m	(13/2)+	–26.966	13.6 s *4*	IT
200	0+	–26.60	12.6 h *3*	β–
201	(5/2–)	–23.74	2.5 m *1*	β–
202	0+	–22.6s	44 h *15*	β–
202m	(7–)	–20.8s	0.28 ms *+42–19*	IT
203	(1/2–)	–19.7s	10 s *3*	β–
204	0+	–18.1s	10.3 s *14*	β–
205		–12.8s	>300 ns	β–
79 Au 169		–1.8s		p?, α?
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+)	–7.57	17 µs *+9–5*	p, α
171m	(11/2–)	–7.32	1.02 ms *10*	α 54%, p 46%
172		–9.37	22 ms *+6–4*	α, ε, p
172m		–9.37	7.7 ms *14*	α, p<0.02%, ε
173	(1/2+)	–12.82	25 ms *1*	α 94%, ε, p
173m	(11/2–)	–12.61	14.0 ms *9*	α 92%, p, ε
174		–14.24s	139 ms *3*	α>0%
175	(1/2+)	–17.44		ε?, α?
175m	(11/2–)	–17.44	156 ms *5*	α 94%, ε 6%
176		–18.40		
176m	(3–)	–18.40	1.05 s *1*	ε, α
176m	(9+)	–18.40	1.36 s *2*	
177	(1/2+,3/2+)	–21.55	1.53 s *7*	α 40%, ε
177m	11/2–	–21.39	1.00 s *20*	α 66%, ε
178		–22.33	2.6 s *5*	ε≤60%, α≥40%

Nuclear Wallet Cards

Nuclide Z El A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
79 Au 179	(1/2+,3/2+)	–24.98	7.1 s *3*	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	(2+)	–28.30	15.5 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*	ε, α ≤ 0.02%
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	8.3 m *2*	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
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
192m	(5)+	–32.64	29 ms	IT
192m	(11–)	–32.34	160 ms *20*	IT
193	3/2+	–33.405	17.65 h *15*	ε
193m	11/2–	–33.115	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+	–32.569	186.098 d *47*	ε
195m	11/2–	–32.250	30.5 s *2*	IT
196	2–	–31.139	6.1669 d *6*	ε 93%, β– 7%
196m	5+	–31.054	8.1 s *2*	IT
196m	12–	–30.543	9.6 h *1*	IT
197	3/2+	–31.140	**100%**	
197m	11/2–	–30.731	7.73 s *6*	IT
198	2–	–29.581	2.6948 d *12*	β–
198m	(12–)	–28.769	2.272 d *16*	IT
199	3/2+	–29.094	3.139 d *7*	β–
199m	(11/2)–	–28.545	0.44 ms *3*	IT
200	(1–)	–27.27	48.4 m *3*	β–
200m	12–	–26.31	18.7 h *5*	β– 84%, IT 16%
201	3/2+	–26.401	26.0 m *8*	β–
202	(1–)	–24.4	28.4 s *12*	β–
203	3/2+	–23.143	60 s *6*	β–
204	(2–)	–20.8s	39.8 s *9*	β–
205	(3/2+)	–18.9s	32.5 s *14*	β–
205m	(11/2–)	–18.0s	6 s *2*	β–, IT
206		–14.3s	>300 ns	β–
207		–10.8s	>300 ns	β–, β–n
208		–6.1s	>300 ns	β–, β–n
209		–2.5s	>300 ns	β–, β–n
210		2.3s	>300 ns	β–, β–n

Nuclear Wallet Cards

Nuclide Z El A		Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
80 Hg	171		3.5s	59 μs *+36–16*	α
	172	0+	–1.1	231 μs *9*	α
	173		–2.6s	0.6 ms *+5–2*	α
	174	0+	–6.65	2.1 ms *+18–7*	α 99.6%
	175	(7/2–)	–7.97	10.6 ms *4*	α
	176	0+	–11.78	20.3 ms *14*	α 94%
	177	(7/2–)	–12.78	118 ms *8*	α
	178	0+	–16.31	266.5 ms *24*	α≈70%, ε≈30%
	179	(7/2–)	–16.92	1.05 s *3*	α 55%, ε 45%, εp≈0.15%
	180	0+	–20.25	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–	–23.806	9.4 s *7*	ε 88.3%, α 11.7%, εp 2.6×10^{-4}%
	184	0+	–26.35	30.87 s *26*	ε 98.89%, α 1.11%
	185	1/2–	–26.17	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	3/2(–)	–28.12	2.4 m *3*	ε, α<3.7×10^{-4}%
	187m	13/2(+)	–28.12	1.9 m *3*	ε, α<3.7×10^{-4}%
	188	0+	–30.20	3.25 m *15*	ε, α 3.7×10^{-5}%
	189	3/2–	–29.63	7.6 m *1*	ε, α<3.0×10^{-5}%
	189m	13/2+	–29.63	8.6 m *1*	ε, α<3.0×10^{-5}%
	190	0+	–31.37	20.0 m *5*	ε, α<3.4×10^{-7}%
	191	3/2(–)	–30.59	49 m *10*	ε, α 5.0×10^{-6}%
	191m	13/2(+)	–30.59	50.8 m *15*	ε
	192	0+	–32.01	4.85 h *20*	ε
	193	3/2(–)	–31.06	3.80 h *15*	ε
	193m	13/2(+)	–30.92	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+	–31.826	**0.15% *1***	
	197	1/2–	–30.540	64.14 h *5*	ε
	197m	13/2+	–30.241	23.8 h *1*	IT 91.4%, ε 8.6%
	198	0+	–30.954	**9.97% *20***	
	199	1/2–	–29.546	**16.87% *22***	
	199m	13/2+	–29.014	42.67 m *9*	IT
	200	0+	–29.503	**23.10% *19***	
	201	3/2–	–27.662	**13.18% *9***	
	202	0+	–27.345	**29.86% *26***	
	203	5/2–	–25.269	46.594 d *12*	β–
	204	0+	–24.690	**6.87% *15***	
	205	1/2–	–22.287	5.14 m *9*	β–
	205m	13/2+	–20.731	1.09 ms *4*	IT
	206	0+	–20.95	8.32 m *7*	β–
	207	(9/2+)	–16.2	2.9 m *2*	β–
	208	0+	–13.27	41 m *+5–4*	β–

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
80	**Hg**	209		–8.5s	35 s +*9–6*	β–
		210	0+	–5.4s	>300 ns	β–?
		211		–0.5s	>300 ns	β–, β–n
		212	0+	2.8s	>300 ns	β–, β–n
		213		7.8s	>300 ns	β–, β–n
		214	0+	11.2s	>300 ns	β–, β–n
		215		16.3s	>300 ns	β–, β–n
		216	0+	19.9s	>300 ns	β–, β–n
81	**Tl**	176	(3–,4–,5–)	0.58	5.2 ms +*30–14*	p
		177	(1/2+)	–3.33	18 ms *5*	α 73%, p 27%
		178		–4.8s	254 ms +*11–9*	α≈53%, ε≈47%
		179	(1/2+)	–8.30	0.23 s *4*	α<100%, ε, p
		179m	(11/2–)	–8.30	1.5 ms *3*	α≤100%, p, ε, IT
		180	(4–,5–)	–9.26	1.09 s *1*	ε 94%, α 6%, εSF≈1.0×10^{-4}%
		181	(1/2+)	–12.799	3.2 s *3*	ε, α≤10%
		181m	(9/2–)	–11.963	1.40 ms *3*	IT 99.6%, α 0.4%
		182	(7+)	–13.35	3.1 s *10*	ε 97.5%, α<5%
		183	(1/2+)	–16.589	6.9 s *7*	α, ε>0%
		183m	(9/2–)	–15.959	53.3 ms *3*	IT, ε, α 2%
		184		–16.89	10.1 s *5*	ε 97.9%, α 2.1%
		185	(1/2+)	–19.75	19.5 s *5*	ε
		185m	(9/2–)	–19.30	1.93 s *8*	α, IT
		186m	(7+)	–19.87	27.5 s *10*	ε, α≈6.0×10^{-3}%
		186m	(10–)	–19.50	2.9 s *2*	IT
		187	(1/2+)	–22.443	≈51 s	ε, α≈0.03%
		187m	(9/2–)	–22.109	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, ε
		189	(1/2+)	–24.60	2.3 m *2*	ε
		189m	(9/2–)	–24.34	1.4 m *1*	ε<100%, IT<4%
		190m	2(–)	–24.31	2.6 m *3*	ε
		190m	7(+)	–24.31	3.7 m *3*	ε
		190m	(8–)	–24.15	0.75 ms *4*	IT
		191	(1/2+)	–26.282		
		191m	9/2(–)	–26.282	5.22 m *16*	
		192	(2–)	–25.87	9.6 m *4*	ε
		192m	(7+)	–25.72	10.8 m *2*	ε
		193	1/2(+)	–27.30	21.6 m *8*	ε
		193m	(9/2–)	–26.93	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 96.2%, IT 3.8%
		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 55.9%, IT 44.1%

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
81	**Tl**	198m	(10−)	−26.75	32.1 ms *10*	IT
		199	1/2+	−28.06	7.42 h *8*	ε
		199m	9/2−	−27.31	28.4 ms *2*	IT
		200	2−	−27.047	26.1 h *1*	ε
		200m	7+	−26.293	34.0 ms *9*	IT
		201	1/2+	−27.18	3.0421 d *17*	ε
		201m	(9/2−)	−26.26	2.01 ms *7*	IT
		202	2−	−25.99	12.31 d *8*	ε
		203	1/2+	−25.762	**29.524% *1***	
		204	2−	−24.346	3.783 y *12*	β− 97.08%, ε 2.92%
		205	1/2+	−23.821	**70.48% *1***	
		206	0−	−22.254	4.202 m *11*	β−
		206m	(12−)	−19.611	3.74 m *3*	IT
		207	1/2+	−21.034	4.77 m *3*	β−
		207m	11/2−	−19.686	1.33 s *11*	IT
		208	5+	−16.752	3.053 m *4*	β−
		209	(1/2+)	−13.637	2.161 m *7*	β−
		210	(5+)	−9.25	1.30 m *3*	β−, β−n 7.0×10^{-3}%
		211		−5.9s	>300 ns	β−?
		212		−1.5s	>300 ns	β−?
		213		1.76	101 s *+486−46*	β−
		214		6.5s	>300 ns	β−, β−n
		215		10.1s	>300 ns	β−, β−n
		216		14.7s	>300 ns	β−, β−n
		217		18.4s	>300 ns	β−, β−n
82	**Pb**	178	0+	3.57	0.12 ms *+22−5*	α
		179	(9/2−)	2.05	3.5 ms *+14−8*	α
		180	0+	−1.93	4.2 ms *5*	α
		181	(9/2−)	−3.10	36 ms *2*	α
		181m	(13/2+)	−3.10	45 ms *20*	α<100%
		182	0+	−6.82	55 ms *5*	α≈98%, ε≈2%
		183	(3/2−)	−7.57	535 ms *30*	α≈90%
		183m	(13/2+)	−7.47	415 ms *20*	α
		184	0+	−11.05	490 ms *25*	α 80%, ε 20%
		185	3/2−	−11.54	6.3 s *4*	ε, α 34%
		185m	13/2+	−11.54	4.3 s *2*	α 50%, ε
		186	0+	−14.68	4.82 s *3*	ε 60%, α 40%
		187	(13/2+)	−14.990	18.3 s *3*	ε 88%, α 12%
		187m	(3/2−)	−14.957	15.2 s *3*	ε 90.5%, α 9.5%
		188	0+	−17.82	25.1 s *1*	ε 90.7%, α 9.3%
		189	(3/2−)	−17.88	39 s *8*	ε, α<1%
		189m	(13/2+)	−17.84	50 s *3*	ε, α<1%
		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+)	−20.25	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		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

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
82	**Pb**	196	0+	−25.36	37 m *3*	ε , α≤3.0×10^{-5}%
		197	3/2−	−24.748	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−	−25.231	90 m *10*	ε
		199m	(13/2+)	−24.806	12.2 m *3*	IT≈93%, ε≈7%
		200	0+	−26.25	21.5 h *4*	ε
		201	5/2−	−25.26	9.33 h *3*	ε
		201m	13/2+	−24.63	60.8 s *18*	IT
		202	0+	−25.937	52.5×10^{3} y *28*	ε
		202m	9−	−23.767	3.54 h *2*	IT 90.5%, ε 9.5%
		203	5/2−	−24.787	51.92 h *3*	ε
		203m	13/2+	−23.962	6.21 s *11*	IT
		203m	29/2−	−21.838	480 ms *7*	IT
		204	0+	−25.110	≥1.4×10^{17} y **1.4% *1***	α
		204m	9−	−22.924	66.93 m *10*	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+	−23.786	**24.1% *1***	
		207	1/2−	−22.452	**22.1% *1***	
		207m	13/2+	−20.819	0.806 s *5*	IT
		208	0+	−21.749	**52.4% *1***	
		209	9/2+	−17.615	3.253 h *14*	β−
		210	0+	−14.729	22.20 y *22*	β−, α 1.9×10^{-6}%
		211	9/2+	−10.491	36.1 m *2*	β−
		212	0+	−7.553	10.64 h *1*	β−
		213	(9/2+)	−3.200	10.2 m *3*	β−
		214	0+	−0.181	26.8 m *9*	β−
		215		4.5s	147 s *12*	β−
		216	0+	7.7s	>300 ns	β−
		217		12.4s	>300 ns	β−
		218	0+	15.6s	>300 ns	β−
		219		20.5s	>300 ns	β−
		220	0+	23.9s	>300 ns	β−
83	**Bi**	184m		1.19	13 ms *2*	α
		184m		1.19	6.6 ms *15*	α
		185	1/2+	−2.3s	58 µs *4*	p 90%, α 10%
		186	(3+)	−3.17	15.0 ms *17*	α
		186m	(10−)	−3.17	9.8 ms *13*	α
		187	(9/2−)	−6.39	37 ms *2*	α
		187m	(1/2+)	−6.27	0.370 ms *20*	α
		188m	(10−)	−7.20	265 ms *15*	α, ε?
		188m	(3+)	−7.20	60 ms *3*	α, ε?
		189	(9/2−)	−10.06	674 ms *11*	α>50%, ε<50%
		189m	(1/2+)	−9.88	5.0 ms *1*	α>50%, ε<50%
		190m	(3+)	−10.59	6.3 s *1*	α 90%, ε 10%
		190m	(10−)	−10.59	6.2 s *1*	α 70%, ε 30%
		191	(9/2−)	−13.240	12.4 s *3*	α 51%, ε 49%
		191m	(1/2+)	−12.999	125 ms *13*	α 68%, IT 32%, ε
		192	(3+)	−13.55	34.6 s *9*	ε 88%, α 12%
		192m	(10−)	−13.40	39.6 s *4*	ε 90%, α 10%

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
83	**Bi**	193	(9/2−)	−15.872	63.6 s *30*	ε 96.5%, α 3.5%
		193m	(1/2+)	−15.564	3.2 s *5*	α 84%, ε 16%
		194	(3+)	−15.97	95 s *3*	ε 99.54%, α 0.46%
		194m	(6+,7+)	−15.97	125 s *2*	ε
		194m	(10−)	−15.97	115 s *4*	ε 99.8%, α 0.2%
		195	(9/2−)	−18.025	183 s *4*	ε 99.97%, α 0.03%
		195m	(1/2+)	−17.624	87 s *1*	ε 67%, α 33%
		196	(3+)	−18.01	308 s *12*	ε, α $1.2{\times}10^{-3}$%
		196m	(7+)	−17.84	0.6 s *5*	ε, IT
		196m	(10−)	−17.74	240 s *3*	ε 74.2%, IT 25.8%, α $3.8{\times}10^{-4}$%
		197	(9/2−)	−19.686	9.33 m *50*	ε, α $1.0{\times}10^{-4}$%
		197m	(1/2+)	−19.186	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+)	−20.13	24.70 m *15*	ε 99%, IT≤2%, α≈0.01%
		200	7+	−20.37	36.4 m *5*	ε
		200m	(2+)	−20.37	31 m *2*	ε≤100%
		200m	(10−)	−19.94	0.40 s *5*	IT
		201	9/2−	−21.42	103 m *3*	ε
		201m	1/2+	−20.57	57.5 m *21*	ε>91.1%, IT≤8.6%, α≈0.3%
		202	5+	−20.74	1.71 h *4*	ε
		203	9/2−	−21.52	11.76 h *5*	ε
		203m	1/2+	−20.43	305 ms *5*	IT
		204	6+	−20.645	11.22 h *10*	ε
		204m	10−	−19.840	13.0 ms *1*	IT
		204m	17+	−17.812	1.07 ms *3*	IT
		205	9/2−	−21.064	15.31 d *4*	ε
		206	6+	−20.028	6.243 d *3*	ε
		206m	10−	−18.983	0.89 ms *1*	IT
		207	9/2−	−20.055	31.55 y *4*	ε
		208	5+	−18.870	$3.68{\times}10^{5}$ y *4*	ε
		208m	10−	−17.299	2.58 ms *4*	IT
		209	9/2−	−18.259	**100%**	
		210	1−	−14.792	5.012 d *5*	β−, α $1.3{\times}10^{-4}$%
		210m	9−	−14.521	$3.04{\times}10^{6}$ y *6*	α
		211	9/2−	−11.858	2.14 m *2*	α 99.72%, β− 0.28%
		212	1(−)	−8.120	60.55 m *6*	β− 64.06%, α 35.94%
		212m	(8−,9−)	−7.870	25.0 m *2*	α 67%, β− 33%, β−α 30%
		212m	≥16	−6.210	7.0 m *3*	β−
		213	9/2−	−5.230	45.59 m *6*	β− 97.8%, α 2.2%
		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	>23/2−	3.00	36.9 s *6*	IT 76.2%, β− 23.8%
		216	(6−,7−)	5.87	2.25 m *5*	β−≤100%
		216m	(3)	5.87	6.6 m *21*	β−≤100%

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
83	**Bi**	217	(9/2−)	8.9s	98.5 s *8*	β−
		218		13.2s	33 s *1*	β−
		219		16.3s	>300 ns	β−
		220		20.7s	>300 ns	β−
		221		24.0s	>300 ns	β− , β−n
		222		28.4s	>300 ns	β−
		223		31.9s	>300 ns	β− , β−n
		224		36.4s	>300 ns	β− , β−n
84	**Po**	186	0+	4.10		
		187	(1/2−,5/2−)	2.83	1.40 ms *25*	α
		188	0+	−0.54	0.275 ms *30*	ε , α
		189	(7/2−)	−1.42	3.5 ms *5*	α
		190	0+	−4.56	2.46 ms *5*	α
		191	(3/2−)	−5.05	22 ms *1*	α 99%
		191m	(13/2+)	−5.01	93 ms *3*	α 96%
		192	0+	−8.07	32.2 ms *3*	α≈99.5%, ε≈0.5%
		193m	(13/2+)	−8.36	245 ms *22*	α≤100%
		193m	(3/2−)	−8.36	370 ms *+46−40*	α≤100%
		194	0+	−11.01	0.392 s *4*	α , 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−)	−15.21	5.47 m *15*	ε 92.5%, α 7.5%
		199m	(13/2+)	−14.90	4.17 m *5*	ε 73.5%, α 24%, IT 2.5%
		200	0+	−16.95	11.51 m *8*	ε 88.9%, α 11.1%
		201	3/2−	−16.524	15.6 m *1*	ε 98.87%, α 1.13%
		201m	13/2+	−16.100	8.96 m *12*	IT 56.2%, ε 41.4%, α 2.4%
		202	0+	−17.92	44.6 m *4*	ε 98.08%, α 1.92%
		203	5/2−	−17.310	36.7 m *5*	ε 99.89%, α 0.11%
		203m	13/2+	−16.668	45 s *2*	IT , ε
		204	0+	−18.34	3.519 h *12*	ε 99.33%, α 0.67%
		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+	−18.185	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+	−17.470	2.898 y *2*	α , ε 4.0×10^{-3}%
		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+	−12.433	0.516 s *3*	α
		211m	(25/2+)	−10.971	25.2 s *6*	α 99.98%, IT 0.02%
		212	0+	−10.370	0.299 μs *2*	α
		212m	(18+)	−7.448	45.1 s *6*	α 99.93%, IT 0.07%
		213	9/2+	−6.654	3.72 μs *2*	α

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Nuclide Z El A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
84 Po 214	0+	−4.470	164.3 μs *20*	α
215	9/2+	−0.540	1.781 ms *4*	α, β− 2.3×10^{-4}%
216	0+	1.778	0.145 s *2*	α
217	(9/2+)	5.886	1.53 s *5*	α
218	0+	8.357	3.098 m *12*	α 99.98%, β− 0.02%
219		12.6s	>300 ns	β−
220	0+	15.3s	>300 ns	β−
221		19.78	112 s *+58−28*	β−?
222	0+	22.48	550 s *430*	β−?
223		26.8s	>300 ns	β−
224	0+	29.7s	>300 ns	β−
225		34.3s	>300 ns	β−
226	0+	37.3s	>300 ns	β−
227		42.0s	>300 ns	β−
85 At 191	(1/2+)	3.86	1.7 ms *+11−5*	α
191m	(7/2−)	3.92	2.1 ms *+4−3*	α
192m		2.92	11.5 ms *6*	α
192m	(9−,10−)	2.92	88 ms *6*	α
193	(1/2+)	−0.06	28 ms *+5−4*	α
193m	(7/2−)	−0.06	21 ms *5*	α
193m	(13/2+)	−0.03	27 ms *+4−3*	IT 76%, α 24%
194m	(9−10−)	−0.70	310 ms *8*	α
194m		−0.70	253 ms *10*	α
195	1/2+	−3.476	328 ms *20*	α
195m	7/2−	−3.476	147 ms *5*	α
196	(3+)	−3.92	0.388 s *7*	α≈95.1%, ε≈4.9%
197	(9/2−)	−6.34	0.388 s *6*	α 96.1%, ε 3.9%
197m	(1/2+)	−6.29	2.0 s *2*	α≤100%, ε, IT≤4.0×10^{-3}%
198	(3+)	−6.65	3.8 s *4*	α 90%, ε 10%
198m	(10−)	−6.55	1.04 s *15*	α 84%, ε 16%
199	(9/2−)	−8.822	7.03 s *15*	α 90%, ε 10%
200	(3+)	−8.99	43 s *1*	α 52%, ε 48%
200m	(7+)	−8.88	47 s *1*	ε≤57%, α 43%
200m	(10−)	−8.64	7.3 s *+26−15*	ε<89.5%, IT<89.5%, α≈10.5%
201	(9/2−)	−10.789	85.2 s *16*	α 71%, ε 29%
202	(2+,3+)	−10.59	184 s *1*	ε 63%, α 37%
202m	(7+)	−10.59	182 s *2*	ε 91.3%, α 8.7%
202m	(10−)	−10.20	0.46 s *5*	IT 99.9%, α 0.1%
203	9/2−	−12.16	7.4 m *2*	ε 69%, α 31%
204	7+	−11.88	9.12 m *11*	ε 96.09%, α 3.91%
204m	10−	−11.29	108 ms *10*	IT
205	9/2−	−12.97	26.9 m *8*	ε 90%, α 10%
206	(5)+	−12.43	30.6 m *8*	ε 99.1%, α 0.9%
207	9/2−	−13.23	1.81 h *3*	ε 91.4%, α 8.6%
208	6+	−12.469	1.63 h *3*	ε 99.45%, α 0.55%
209	9/2−	−12.882	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−	−11.648	7.214 h *7*	ε 58.2%, α 41.8%
212	(1−)	−8.628	0.314 s *2*	α, ε<0.03%, β−<2.0×10^{-6}%

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
85	**At**	212m	(9−)	−8.405	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−	2.254	0.30 ms *3*	α, β−<6.0×10^{-3}%, ε<3.0×10^{-7}%
		217	9/2−	4.395	32.3 ms *4*	α 99.99%, β− 7.0×10^{-3}%
		218		8.10	1.5 s *3*	α 99.9%, β− 0.1%
		219		10.397	56 s *3*	α≈97%, β−≈3%
		220	3	14.35	3.71 m *4*	β− 92%, α 8%
		221		16.8s	2.3 m *2*	β−
		222		20.6s	54 s *10*	β−
		223		23.4s	50 s *7*	β−
		224		27.71	76 s *+138−23*	β−?
		225		30.2s	>300 ns	β−
		226		34.2s	>300 ns	β−
		227		37.2s	>300 ns	β−
		228		41.4s	>300 ns	β−
		229		44.6s	>300 ns	β−, β−n
86	**Rn**	193	(3/2−)	9.05	1.15 ms *27*	α
		194	0+	5.72	0.78 ms *16*	α
		195	3/2−	5.06	6 ms *+3−2*	α
		195m	13/2+	5.12	5 ms *+3−2*	α
		196	0+	1.97	4.4 ms *+13−9*	α 99.9%, ε≈0.1%
		197	(3/2−)	1.48	53 ms *+7−5*	α
		197m	(13/2+)	1.48	25 ms *+3−2*	α
		198	0+	−1.23	65 ms *3*	α, ε
		199	(3/2−)	−1.51	0.59 s *3*	α 94%, ε 6%
		199m	(13/2+)	−1.33	0.31 s *2*	α 97%, ε 3%
		200	0+	−4.01	1.03 s *+20−11*	α 86%, ε 14%
		201	(3/2−)	−4.07	7.0 s *4*	α, ε
		201m	(13/2+)	−4.07	3.8 s *1*	ε, α
		202	0+	−6.28	9.7 s *1*	α 78%, ε 22%
		203	(3/2−)	−6.16	44 s *2*	α 66%, ε 34%
		203m	(13/2+)	−5.80	26.9 s *5*	α 75%, ε 25%
		204	0+	−7.98	74.5 s *14*	α 72.4%, ε 27.6%
		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−	−8.634	9.25 m *17*	ε 79%, α 21%
		208	0+	−9.66	24.35 m *14*	α 62%, ε 38%
		209	5/2−	−8.93	28.5 m *10*	ε 83%, α 17%
		210	0+	−9.601	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+)	−5.699	19.5 ms *1*	α
		214	0+	−4.320	0.27 μs *2*	α
		215	9/2+	−1.169	2.30 μs *10*	α
		216	0+	0.254	45 μs *5*	α
		217	9/2+	3.657	0.54 ms *5*	α
		218	0+	5.216	35 ms *5*	α
		219	5/2+	8.831	3.96 s *1*	α

Nuclear Wallet Cards

Nuclide Z El A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
86 Rn 220	0+	10.607	55.6 s *1*	α
221	7/2+	14.473	25 m *2*	β− 78%, α 22%
222	0+	16.373	3.8235 d *3*	α
223	7/2	20.40	24.3 m *4*	β−
224	0+	22.43	107 m *3*	β−
225	7/2−	26.56	4.66 m *4*	β−
226	0+	28.74	7.4 m *1*	β−
227		32.87	20.8 s *7*	β−
228	0+	35.25	65 s *2*	β−
229		39.36	12.0 s +*12*−*13*	β−
230	0+	42.1s	>300 ns	β−
231		46.5s	>300 ns	β−
87 Fr 199		6.76	12 ms +*10*−*4*	α>0%, ε
200	(3+)	6.12	49 ms *4*	α
201	(9/2−)	3.60	62 ms *5*	α
201m	(1/2+)	3.60	19 ms +*19*−*6*	α
202	(3+)	3.16	0.30 s *5*	α
202m	(10−)	3.16	0.29 s *5*	α
203	(9/2−)	0.877	0.55 s *1*	α≤100%
204	(3+)	0.61	1.8 s *3*	α 92%, ε 8%
204m	(7+)	0.65	1.6 s +*5*−*3*	α 90%, ε 10%
204m	(10−)	0.92	0.8 s *2*	α 74%, ε 26%
205	(9/2−)	−1.309	3.97 s *4*	α 98.5%, ε 1.5%
206	(2+,3+)	−1.24	≈16 s	α≈84%, ε≈16%
206m	(7+)	−1.24	≈16 s	α≈84%, ε≈16%
206m	(10−)	−0.71	0.7 s *1*	IT 95%, α 5%
207	9/2−	−2.84	14.8 s *1*	α 95%, ε 5%
208	7+	−2.67	59.1 s *3*	α 89%, ε 11%
209	9/2−	−3.77	50.5 s *7*	α 89%, ε 11%
210	6+	−3.33	3.18 m *6*	α 71%, ε 29%
211	9/2−	−4.14	3.10 m *2*	α 87%, ε 13%
212	5+	−3.515	20.0 m *6*	ε 57%, α 43%
213	9/2−	−3.553	34.82 s *14*	α 99.44%, ε 0.56%
214	(1−)	−0.959	5.0 ms *2*	α
214m	(8−)	−0.837	3.35 ms *5*	α
215	9/2−	0.317	86 ns *5*	α
216	(1−)	2.970	700 ns *20*	α
217	9/2−	4.313	19 μs *3*	α
218	1−	7.058	1.0 ms *6*	α
218m		7.144	22.0 ms *5*	α≤100%, IT
219	9/2−	8.617	20 ms *2*	α
220	1+	11.480	27.4 s *3*	α 99.65%, β− 0.35%
221	5/2−	13.278	286.1 s *10*	α, β−<0.1%
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−	21.65	3.33 m *10*	β−
225	3/2−	23.82	3.95 m *14*	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 *20*	β−

Nuclear Wallet Cards

Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
87	**Fr**	230		39.50	19.1 s *5*	β–
		231	(1/2+)	42.3s	17.6 s *6*	β–
		232	(5)	46.1s	5.5 s *6*	β–
		233		49.2s	>300 ns	β–
88	**Ra**	201m	(13/2+)	11.8s	1.6 ms +*77–7*	α, ε
		202	0+	9.09	16 ms +*30–7*	α
		203	(3/2–)	8.66	31 ms +*17–9*	α
		203m	(13/2+)	8.66	24 ms +*6–4*	α
		204	0+	6.06	57 ms +*11–5*	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+	3.56	0.24 s *2*	α
		207	(3/2–,5/2–)	3.54	1.35 s *–13+22*	α≈86%, ε≈14%
		207m	(13/2+)	4.09	59 ms *4*	IT≥85%, α≤15%
		208	0+	1.71	1.3 s *2*	α 95%, ε 5%
		209	5/2–	1.85	4.6 s *2*	α≈90%, ε≈10%
		210	0+	0.46	3.7 s *2*	α≈96%, ε≈4%
		211	5/2(–)	0.832	13 s *2*	α>93%, ε<7%
		212	0+	–0.20	13.0 s *2*	α≈85%, ε≈15%
		213	1/2–	0.36	2.73 m *5*	α 80%, ε 20%
		213m	(17/2–)	2.13	2.20 ms *5*	IT≈99.4%, α≈0.6%
		214	0+	0.095	2.46 s *3*	α 99.94%, ε 0.06%
		215	(9/2+)	2.532	1.55 ms *7*	α
		216	0+	3.290	182 ns *10*	α, ε<1.0×10^{-8}%
		217	(9/2+)	5.886	1.6 μs *2*	α
		218	0+	6.65	25.2 μs *3*	α
		219	(7/2)+	9.393	10 ms *3*	α
		220	0+	10.272	18 ms *2*	α
		221	5/2+	12.963	28 s *2*	α, ^{14}C 1×10^{-12}%
		222	0+	14.320	38.0 s *5*	α, ^{14}C 3.0×10^{-8}%
		223	3/2+	17.234	11.43 d *5*	α, ^{14}C 8.9×10^{-8}%
		224	0+	18.821	3.6319 d *23*	α, ^{14}C 4.0×10^{-9}%
		225	1/2+	21.995	14.9 d *2*	β–
		226	0+	23.668	1600 y *7*	α, ^{14}C 3.2×10^{-9}%
		227	3/2+	27.178	42.2 m *5*	β–
		228	0+	28.946	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+)	38.22	104.1 s *8*	β–
		232	0+	40.50	4.2 m *8*	β–
		233		44.6s	30 s *5*	β–
		234	0+	47.2s	30 s *10*	β–
		235		51.4s		
89	**Ac**	206	(3+)	13.53	22 ms +*9–5*	α
		206m	(10–)	13.53	33 ms +*22–9*	α
		207	(9/2–)	11.15	27 ms +*11–6*	α
		208	(3+)	10.76	95 ms +*24–16*	α≈99%, ε≈1%
		208m	(10–)	11.27	25 ms +*9–5*	α≈90%, ε≈10%
		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
		212		7.27	0.93 s *5*	α≈57%, ε≈43%

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
89	**Ac**	213		6.16	738 ms *16*	α≤100%
		214	(5+)	6.44	8.2 s *2*	α≥89%, ε≤11%
		215	9/2−	6.03	0.17 s *1*	α 99.91%, ε 0.09%
		216	(1−)	8.14	440 μs *16*	α
		216m	(9−)	8.19	441 μs *7*	α
		217	9/2−	8.70	69 ns *4*	α, ε≤2%
		218	(1−)	10.84	1.08 μs *9*	α
		219	9/2−	11.57	11.8 μs *15*	α
		220	(3−)	13.742	26.4 ms *2*	α, ε 5.0×10^{-4}%
		221	(3/2−)	14.52	52 ms *2*	α
		222	1−	16.620	5.0 s *5*	α 99%, ε 1%
		222m		16.620	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−	20.231	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 4×10^{-12}%
		226	(1)	24.309	29.37 h *12*	β− 83%, ε 17%, α 6.0×10^{-3}%
		227	3/2−	25.851	21.772 y *3*	β− 98.62%, α 1.38%
		228	3+	28.900	6.15 h *2*	β−
		229	(3/2+)	30.75	62.7 m *5*	β−
		230	(1+)	33.8	122 s *3*	β−, β−F 1.2×10^{-6}%
		231	(1/2+)	35.9	7.5 m *1*	β−
		232	(1+)	39.2	119 s *5*	β−
		233	(1/2+)	41.5s	145 s *10*	β−
		234		45.0s	44 s *7*	β−
		235		47.6s	60 s *4*	β−
		236		51.27		β−?
		237		54.3s		
90	**Th**	208	0+	16.68	1.7 ms +*17*−*6*	α
		209	(5/2−)	16.54	2.5 ms +*17*−*7*	α
		210	0+	14.06	16 ms *4*	α 99%, ε≈1%
		211		13.90	0.04 s +*3*−*1*	α
		212	0+	12.10	31.7 ms *13*	α, ε≈0.3%
		213		12.12	144 ms *21*	α≤100%
		214	0+	10.71	87 ms *10*	α
		215	(1/2−)	10.921	1.2 s *2*	α
		216	0+	10.29	26.0 ms *2*	α, ε≈0.01%
		216m	8+	12.33	134 μs *4*	α 2.8%, IT
		217	(9/2+)	12.22	0.241 ms *5*	α
		218	0+	12.37	117 ns *9*	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+)	16.937	1.68 ms *6*	α
		222	0+	17.20	2.8 ms *3*	α
		223	(5/2)+	19.384	0.60 s *2*	α
		224	0+	20.00	0.81 s *10*	α
		225	(3/2+)	22.309	8.75 m *4*	α≈90%, ε≈10%
		226	0+	23.196	30.57 m *10*	α
		227	1/2+	25.806	18.68 d *9*	α
		228	0+	26.766	1.9116 y *16*	α, ^{20}O 1×10^{-11}%

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Nuclide Z	El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
90	**Th**	229	5/2+	29.587	7932 y *28*	α
		229m	(3/2+)	29.587	2 m *1*	IT?
		230	0+	30.863	7.54×10^{4} y *3*	α, ^{24}Ne 6×10^{-11}%, SF≤4×10^{-12}%
		231	5/2+	33.816	25.52 h *1*	β−, α≈4×10^{-11}%
		232	0+	35.452	1.40×10^{10} y *1* **100%**	α, SF 1.1×10^{-9}%
		233	1/2+	38.737	21.83 m *4*	β−
		234	0+	40.615	24.10 d *3*	β−
		235	(1/2+)	44.26	7.2 m *1*	β−
		236	0+	46.5s	37.3 m *15*	β−
		237	(5/2+)	50.2s	4.7 m *6*	β−
		238	0+	52.6s	9.4 m *20*	β−
		239		56.6s		
91	**Pa**	212		21.61	5.1 ms +*61*−*19*	α
		213		19.66	5.3 ms +*40*−*16*	α
		214		19.49	17 ms *3*	α≤100%
		215		17.87	14 ms *2*	α
		216		17.80	0.15 s +*6*−*4*	α≈98%, ε≈2%
		217		17.07	3.6 ms *8*	α
		217m		18.92	1.2 ms *2*	α 73%, IT 27%
		218		18.68	113 μs *10*	α
		219m	9/2−	18.54	53 ns *10*	α
		220m		20.40	0.78 μs *16*	α, ε 3.0×10^{-7}%
		221	9/2−	20.38	5.9 μs *17*	α
		222		22.11s	2.9 ms +*6*−*4*	α
		223		22.32	5.1 ms *6*	α
		224		23.861	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−)	26.831	38.3 m *3*	α 85%, ε 15%
		228	3+	28.921	22.4 h *10*	ε 98.15%, α 1.85%
		229	(5/2+)	29.898	1.50 d *5*	ε 99.52%, α 0.48%
		230	(2−)	32.173	17.4 d *5*	ε 92.2%, β− 7.8%, α 3.2×10^{-3}%
		231	3/2−	33.425	3.276×10^{4} y *11*	α, SF≤2×10^{-11}%
		232	(2−)	35.941	1.32 d *2*	β−, ε
		233	3/2−	37.491	26.975 d *13*	β−
		234	4+	40.342	6.70 h *5*	β−
		234m	(0−)	40.416	1.159 m *11*	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−
		239	(3/2)	53.3s	1.8 h *5*	β−
		240		56.8s		β−?
		241		59.7s		
92	**U**	217		22.71	16 ms +*21*−*6*	α≤100%
		218	0+	21.91	0.51 ms +*17*−*10*	α
		218m	(8+)	24.02	0.56 ms +*26*−*14*	α
		219		23.30	42 μs +*34*−*13*	α
		220	0+	23.0s		α?, ε?

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Nuclide Z El A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
92 U 221	(9/2+)	24.6s	700 ns	
222	0+	24.3s	1.0 μs +*12–4*	α
223		25.84	18 μs +*10–5*	α, ε 0.2%
224	0+	25.71	0.9 ms *3*	α
225		27.38	95 ms *15*	α
226	0+	27.33	0.35 s *15*	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+)	31.209	58 m *3*	ε≈80%, α≈20%
230	0+	31.613	20.8 d	α, SF<1×10^{-10}%, ^{22}Ne 5×10^{-12}%
231	(5/2–)	33.807	4.2 d *1*	ε, α≈4.0×10^{-3}%
232	0+	34.604	68.9 y *4*	α, SF 3×10^{-12}%
233	5/2+	36.921	1.592×10^{5} y *2*	α, ^{24}Ne 9×10^{-10}%, SF<6×10^{-11}%, ^{28}Mg<$1.\times10^{-13}$%
234	0+	38.148	2.455×10^{5} y *6* **0.0054% *5***	α, SF 1.6×10^{-9}%, Mg 1×10^{-11}%, Ne 9×10^{-12}%
235	7/2–	40.921	7.04×10^{8} y *1* **0.7204% *6***	α, SF 7.0×10^{-9}%, ^{28}Mg $8.\times10^{-10}$%, Ne≈$8.\times10^{-10}$%
235m	1/2+	40.921	≈26 m	IT
236	0+	42.447	2.342×10^{7} y *4*	α, SF 9.4×10^{-8}%
237	1/2+	45.393	6.75 d *1*	β–
238	0+	47.310	4.468×10^{9} y *3* **99.2742% *10***	α, SF 5.5×10^{-5}%
239	5/2+	50.575	23.45 m *2*	β–
240	0+	52.716	14.1 h *1*	β–
241		56.2s		β–?
242	0+	58.6s	16.8 m *5*	β–
243		62.4s		
93 Np 225	(9/2–)	31.59		α
226		32.74s	35 ms *10*	α
227		32.56	0.51 s *6*	α
228		33.59	61.4 s *14*	ε 60%, α 40%
229		33.78	4.0 m *2*	α 68%, ε 32%
230		35.24	4.6 m *3*	ε≤97%, α≥3%
231	(5/2)	35.62	48.8 m *2*	ε 98%, α 2%
232	(4+)	37.4s	14.7 m *3*	ε, α 2.0×10^{-4}%
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–)	43.37	153×10^{3} y *5*	ε 86.3%, β– 13.5%, α 0.16%
236m	1	43.37	22.5 h *4*	β– 50%, ε 50%
237	5/2+	44.874	2.144×10^{6} y *7*	α, SF≤2×10^{-10}%
238	2+	47.457	2.117 d *2*	β–
239	5/2+	49.313	2.356 d *3*	β–
240	(5+)	52.32	61.9 m *2*	β–

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Nuclide Z El A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
93 Np 240m	(1+)	52.32	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−
245		65.9s		
94 Pu 228	0+	36.08	1.1 s *+20−5*	α
229	(3/2+)	37.39	67 s *+41−19*	ε 50%, α 50%, SF < 7%
230	0+	36.93	102 s *10*	α ≤ 100%
231	(3/2+)	38.28	8.6 m *5*	ε ≤ 99.8%, α > 0.2%
232	0+	38.36	33.8 m *7*	ε 90%, α 10%
233		40.05	20.9 m *4*	ε 99.88%, α 0.12%
234	0+	40.348	8.8 h *1*	ε ≈ 94%, α ≈ 6%
235	(5/2+)	42.18	25.3 m *5*	ε, α $2.8{\times}10^{-3}$%
236	0+	42.896	2.858 y *8*	α, SF $1.9{\times}10^{-7}$%
237	7/2−	45.094	45.64 d *4*	ε, α $4.2{\times}10^{-3}$%
237m	1/2+	45.240	0.18 s *2*	IT
238	0+	46.166	87.7 y *1*	α, SF $1.9{\times}10^{-7}$%
239	1/2+	48.591	24110 y *30*	α, SF $3.{\times}10^{-10}$%
240	0+	50.128	6561 y *7*	α, SF $5.7{\times}10^{-6}$%
241	5/2+	52.958	14.325 y *6*	β−, α $2.5{\times}10^{-3}$%, SF < $2{\times}10^{-14}$%
242	0+	54.719	$3.75{\times}10^{5}$ y *2*	α, SF $5.5{\times}10^{-4}$%
243	7/2+	57.756	4.956 h *3*	β−
244	0+	59.806	$8.00{\times}10^{7}$ y *9*	α 99.88%, SF 0.12%
245	(9/2−)	63.18	10.5 h *1*	β−
246	0+	65.40	10.84 d *2*	β−
247		69.1s	2.27 d *23*	β−
95 Am 230			≈17 s	ε
231		42.4s		α?, ε?
232		43.4s	79 s *2*	ε ≈ 97%, α ≈ 3%
233		43.2s	3.2 m *8*	α > 3%, ε
234		44.5s	2.32 m *8*	ε, α
235	5/2−	44.62	10.3 m *6*	ε 99.6%, α 0.4%
236	5−	46.0s	3.6 m *2*	α, ε
236m	(1−)	46.0s	2.9 m *2*	α, ε
237	5/2(−)	46.57s	73.6 m *8*	ε 99.97%, α 0.03%
238	1+	48.42	98 m *2*	ε, α $1.0{\times}10^{-4}$%
239	(5/2)−	49.393	11.9 h *1*	ε 99.99%, α 0.01%
240	(3−)	51.51	50.8 h *3*	ε, α $1.9{\times}10^{-4}$%
240m		54.51	0.94 ms *4*	SF ≤ 100%
241	5/2−	52.937	432.6 y *6*	α, SF $4{\times}10^{-10}$%
242	1−	55.471	16.02 h *2*	β− 82.7%, ε 17.3%
242m	5−	55.520	141 y *2*	IT 99.55%, α 0.45%, SF < $4.7{\times}10^{-9}$%
242m	(2+,3−)	57.671	14.0 ms *10*	SF, IT, α < $5.0{\times}10^{-3}$%
243	5/2−	57.177	7370 y *40*	α, SF $3.7{\times}10^{-9}$%
244	(6−)	59.882	10.1 h *1*	β−
244m		59.882	0.90 ms *15*	SF ≤ 100%
244m	1+	59.968	26 m *1*	β− 99.96%, ε 0.04%

Nuclear Wallet Cards

Nuclide Z El A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
95 Am 245	(5/2)+	61.901	2.05 h *1*	β−
246	(7−)	65.00	39 m *3*	β−
246m	2(−)	65.00	25.0 m *2*	β−, IT<0.02%
247	(5/2)	67.2s	23.0 m *13*	β−
248		70.6s	≈10 m	β−
249		73.1s		β−?
96 Cm 233	(3/2+)	47.29	23 s *+13−6*	ε 80%, α 20%
234	0+	46.72	51 s *12*	α≈40%, SF≈40%, ε≈20%
235		47.9s		α?, ε?
236	0+	47.86		ε, α
237		49.25		ε, α<1%
238	0+	49.44	2.4 h *1*	ε≥90%, α≤10%
239	(7/2−)	51.15	≈2.9 h	ε, α<0.1%
240	0+	51.719	27 d *1*	SF 3.9×10^{-6}%, α>99.5%, ε<0.5%
241	1/2+	53.704	32.8 d *2*	ε 99%, α 1%
242	0+	54.806	162.8 d *2*	α, SF 6.2×10^{-6}%, ^{34}Si $1.\times10^{-14}$%
243	5/2+	57.184	29.1 y *1*	α 99.71%, ε 0.29%, SF 5.3×10^{-9}%
244	0+	58.455	18.1 y *1*	α, SF 1.4×10^{-4}%
244m	6+	59.495	34 ms *2*	IT
245	7/2+	61.006	8423 y *74*	α, SF 6.1×10^{-7}%
246	0+	62.619	4706 y *40*	α 99.97%, SF 0.03%
247	9/2−	65.535	1.56×10^{7} y *5*	α
248	0+	67.393	3.48×10^{5} y *6*	α 91.61%, SF 8.39%
249	1/2+	70.751	64.15 m *3*	β−
250	0+	72.99	≈8.3×10^{3} y	SF≈74%, α≈18%, β−≈8%
251	(1/2+)	76.65	16.8 m *2*	β−
252	0+	79.1s	<2 d	
97 Bk 234			1.4×10^{2} s *+14−5*	α≥80%, ε≤20%
235		52.7s		ε?, α?
236		53.4s		
237		53.1s	≈1 m	ε?, α?
238		54.3s	144 s *5*	ε, εSF 0.048%
239m	(7/2+,3/2−)	54.3s		ε>99%, α<1%, SF<1%
240		55.7s	4.8 m *8*	ε, εSF 2.0×10^{-3}%
241	(7/2+)	56.1s	4.6 m *4*	α, ε
242		57.7s	7.0 m *13*	ε≤100%
243	(3/2−)	58.692	4.5 h *2*	ε≈99.85%, α≈0.15%
244	(4−)	60.72	4.35 h *15*	ε 99.99%, α 6.0×10^{-3}%
245	3/2−	61.816	4.95 d *3*	ε 99.88%, α 0.12%
246m	2(−)	63.97	1.80 d *2*	ε
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}%

Nuclear Wallet Cards

Nuclide Z El A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
97 Bk 250	2−	72.952	3.212 h *5*	β−
251	(3/2−)	75.23	55.6 m *11*	β−
252		78.5s		
253		80.9s		β−?
254		84.4s		
98 Cf 237	(3/2+)	57.94	0.8 s *2*	SF 70%, α 30%
238	0+	57.2s	21 ms *2*	SF
239		58.1s	39 s *+37−12*	ε, α
240	0+	58.01	64 s *9*	α 98.5%, SF 1.5%
241	(7/2−)	59.3s	3.78 m *70*	ε ≈ 75%, α ≈ 25%
242	0+	59.38	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+	61.473	19.4 m *6*	α ≤ 100%
245	1/2+	63.388	45.0 m *15*	ε 64.7%, α 35.3%
246	0+	64.093	35.7 h *5*	α, ε < 4.0×10^{-3}%, SF 2.4×10^{-4}%
246m		66.593	45 ns *10*	SF ≤ 100%
247	(7/2+)	66.10	3.11 h *3*	ε 99.97%, α 0.04%
248	0+	67.241	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+	71.173	13.08 y *9*	α 99.92%, SF 0.08%
251	1/2+	74.137	898 y *44*	α, SF
252	0+	76.035	2.645 y *8*	α 96.91%, SF 3.09%
253	(7/2+)	79.302	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		α?, ε?
241		63.8s	8 s *+6−5*	ε, α
242		64.9s	17.8 s *16*	α 57%, ε 43%
243	(7/2+)	64.7s	23 s *3*	α 61%, ε 39%, SF < 1%
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	7.5 m *5*	ε 90.1%, α 9.9%
247	(7/2+)	68.58	4.55 m *26*	ε ≈ 93%, α ≈ 7%
247m		68.58	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−)	74.513	33 h *1*	ε 99.5%, α 0.5%
252	(5−)	77.29	471.7 d *19*	α 78%, ε 22%
253	7/2+	79.015	20.47 d *3*	SF 8.7×10^{-6}%, α
254	(7+)	81.993	275.7 d *5*	α, β− 1.7×10^{-4}%, SF < 3.0×10^{-6}%
254m	2+	82.077	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}%

Nuclear Wallet Cards

Nuclide Z El A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
99 Es 256	(1+,0−)	87.2s	25.4 m *24*	β−
256m	(8+)	87.2s	7.6 h	β−
257		89.4s	7.7 d *2*	β−, SF
258		92.7s		α?, ε?
100 Fm 241			0.73 ms *6*	SF>78%, α<14%, ε<12%
242	0+	68.4s	<4 μs	SF≤100%
243	(7/2+)	69.3s	231 ms *9*	α 91%, SF 9%, ε<10%
244	0+	69.0s	3.12 ms *8*	SF>97%, ε<2%, α<1%
245		70.2s	4.2 s *13*	α≤100%
246	0+	70.19	1.54 s *4*	α 93.2%, SF 6.8%, ε≤1.3%
247	(7/2+)	71.6s	31 s *1*	α≥84%, ε≤16%
247m	(1/2+)	71.6s	5.1 s *2*	α 84%
248	0+	71.894	36 s *2*	α 93%, ε 7%, SF 0.1%
249	(7/2+)	73.521	2.6 m *7*	ε 67%, α 33%
250	0+	74.074	30 m *3*	α>90%, ε<10%, SF 6.9×10^{-3}%
250m		74.074	1.93 s *15*	IT
251	(9/2−)	75.95	5.30 h *8*	ε 98.2%, α 1.8%
252	0+	76.818	25.39 h *4*	SF 2.3×10^{-3}%, α
253	(1/2)+	79.349	3.00 d *12*	ε 88%, α 12%
254	0+	80.905	3.240 h *2*	α 99.94%, SF 0.06%
255	7/2+	83.801	20.07 h *7*	α, SF 2.4×10^{-5}%
256	0+	85.487	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+	95.8s	≈4 ms	SF
101 Md 245	(1/2−)	75.3s	0.90 ms *25*	α, SF
245m	(7/2)	75.6s	0.35 s *+23−16*	ε, α
246m		76.2s	0.9 s *2*	α
246m		76.2s	4.4 s *8*	ε>77%, α<23%
246m		76.2s	0.9 s *2*	SF?, ε?
247	(7/2−)	75.9s	1.2 s *1*	α 99.9%, SF<0.1%
247m	(1/2−)	75.9s	0.25 s *4*	α 79%, SF 21%
248		77.1s	13 s *+15−4*	α 58%, ε 42%
249	(7/2−)	77.3s	21.7 s *20*	α>60%, ε≤40%
249m	(1/2−)	77.3s	1.9 s *9*	α?
250		78.6s	25 s *+10−5*	ε 93%, α 7%
251	(7/2−)	78.97	4.3 m *6*	ε 90%, α 10%
252		80.5s	2.3 m *8*	ε≤100%
253	(7/2−)	81.18s	6 m *+12−3*	ε≤100%, α
254m		83.5s	28 m *8*	ε≤100%
254m		83.5s	10 m *3*	ε≤100%
255	(7/2−)	84.844	27 m *2*	ε 92%, α 8%, SF<0.15%
256	(1−)	87.61	77 m *2*	ε 90.8%, α 9.2%, SF<3%
257	(7/2−)	88.997	5.52 h *5*	ε 85%, α 15%, SF<1%
258		91.689	51.5 d *3*	α, SF

Nuclear Wallet Cards

Nuclide Z El A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
101 Md 258m		91.689	57.0 m *9*	ε ≥ 70%, SF
259		93.6s	96 m *3*	SF, α < 1.3%
260		96.6s	31.8 d *5*	SF ≥ 42%, α ≤ 25%, ε ≤ 23%, β− ≤ 10%
261		98.6s		α?
262		101.6s		SF?, α?
102 No 248	0+	80.6s	<2 µs	SF?
249		81.8s		
250	0+	81.6s	4.2 µs +*12*−*9*	SF, α < 2%
251	(7/2+)	82.8s	0.80 s *1*	α 84%, SF < 0.3%, ε
251m	(1/2+)	82.9s	1.02 s *3*	α
252	0+	82.867	2.47 s *2*	α 70.7%, SF 29.3%, ε < 1.1%
252m	(8−)	82.867	110 ms *10*	IT
253	(9/2−)	84.360	1.62 m *15*	α ≈ 80%, 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+	86.81	3.52 m *21*	ε 70%, α 30%
256	0+	87.825	2.91 s *5*	α 99.47%, SF 0.53%
257	(7/2+)	90.251	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	(3/2+)	98.5s		α?
262	0+	100.1s	≈5 ms	SF
263		103.1s		α?, SF?
264	0+	105.2s		α?
103 Lr 251		87.9s		ε?, α?
252		88.7s	0.27 s +*18*−*8*	α, ε
253	(7/2−)	88.7s	0.57 s +*7*−*6*	α ≈ 98.7%, SF ≈ 1.3%
253m	(1/2−)	88.7s	1.49 s +*30*−*21*	α 92%, SF 8%
254		89.9s	18.4 s *18*	α 71.7%, ε 28.3%
255	1/2−	89.95	31.1 s *13*	α 85%, ε 15%
255m	7/2−	89.98	2.53 s *13*	IT 60%, α 40%
256		91.75	27 s *3*	α 85%, ε 15%, SF < 0.03%
257		92.61s	≈4 s	α ≤ 100%
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		102.0s	≈4 h	SF < 10%, ε, α
263		103.7s		α?
264		106.4s		SF?, α?
265		108.3s		SF?, α?
266		111.4s		α?, SF?
104 Rf 253m		93.8s	48 µs +*17*−*10*	SF ≤ 100%, α
253m		93.8s	≈1.8 s	α ≈ 50%, SF ≈ 50%

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
104 Rf	254	0+	93.2s	23 μs *3*	SF≤100%
	255	(9/2–)	94.2s	2.3 s *+8–5*	α 52%, SF 48%, ε ?1%
	256	0+	94.22	6.4 ms *2*	SF 99.68%, α 0.32%
	257	(1/2+)	95.87	4.7 s *3*	α<100%, SF≤1.4%, ε>0%
	257m	(11/2–)	95.87	4.1 s *7*	α<100%, SF≤1.4%, ε>0%
	258	0+	96.34	14.7 ms *+12–10*	SF 69%, α 31%
	259		98.36s	3.2 s *6*	α 92%, SF 8%
	259m		98.36s	2.5 s *+4–3*	ε 15%
	260	0+	99.2s	21 ms *1*	SF≤100%, α?
	261m		101.32	1.9 s *4*	SF 73%, α 27%
	261m		101.32	78 s *+11–6*	α>74%, ε<15%, SF<11%
	262	0+	102.4s	2.3 s *4*	SF≤100%, α<3%
	263		104.8s	10 m *2*	SF, α
	264	0+	106.2s		α?
	265m		108.8s		SF
	266	0+	110.2s		SF?, α?
	267		113.4s		
	268	0+	115.4s		α?, SF?
105 Db	255		99.7s	1.6 s *+6–4*	α 80%, SF≈20%
	256		100.5s	1.9 s *4*	α≈70%, ε≈30%, SF≈0.02%
	257	(9/2+)	100.3s	1.82 s *+27–21*	α 94%, SF≈6%
	257m		100.3s	0.58 s *+13–9*	α, SF
	258		101.8s	4.2 s *+4–3*	α 65%, ε 35%, SF<1%
	258m		101.8s	20 s *10*	ε
	259		101.99	0.51 s *16*	α
	260		103.36	1.52 s *13*	α≥90.4%, SF≤9.6%, ε<2.5%
	261		104.2s	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		α?
	265		110.5s		α?
	266		112.7s		α?, SF?
	267m		114.2s	73 m *+350–33*	SF
	268m		117.0s	32 h *+11–7*	SF
	269		119.1s		α?, SF?
	270m		122.0s	23 h	SF, α
106 Sg	258	0+	105.3s	2.9 ms *+13–7*	SF≤100%, α?
	259	(1/2+)	106.5s	0.32 s *+8–6*	α 96%, SF 4%
	259m		106.5s	0.28 s *5*	
	260	0+	106.54	3.6 ms *9*	SF 50%, α 50%
	260m		106.54	4.95 ms *33*	SF 71%, α 29%
	261		108.01	0.23 s *6*	α, SF<1%
	262	0+	108.4s	6.9 ms *+38–18*	SF≥78%, α≤22%
	263		110.19s	1.0 s *2*	α>70%, SF<30%
	263m		110.19s	0.12 s	IT, α
	264	0+	110.8s	37 ms *+27–11*	SF, α<36%
	265m		112.8s	16.2 s *+47–35*	α≥65%, SF≤35%

Nuclear Wallet Cards

Nuclide Z El	A	Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
106 Sg	265m		113.0s	8.9 s *+27–19*	
	266	0+	113.7s	21 s *+20–12*	SF>50%, α>18%
	267		115.9s		
	268	0+	116.9s		SF?, α?
	269		120.0s		
	270	0+	121.3s		α?, SF?
	271m		124.4s	2.4 m *+43–10*	α≈50%, SF≈50%
	272	0+	126.4s		α?, SF?
	273		129.8s		SF?
107 Bh	260		113.3s	35 ms *+19–9*	α≤100%
	261		113.2s	11.8 ms *+39–24*	α
	262m		114.5s	22 ms *4*	α<100%
	262m		114.5s	83 ms *14*	α<100%
	263		114.5s		α?
	264		115.7s	0.44 s *+60–16*	α≤100%
	265		116.4s	0.9 s *+7–3*	α
	266m		118.2s	1.7 s *+82–8*	α
	267m		118.9s	17 s *+14–6*	α
	268		120.9s		
	269		121.7s		
	270?		124.2s	6×10^{1} s *+29–3*	α
	271?		125.8s		α?
	272m		128.6s	10 s *+12–4*	α
	273		130.5s		α?, SF?
	274		133.3s	0.9 m *+42–4*	α, SF
	275		135.4s		SF?
108 Hs	263		120.0s	0.74 ms *+48–21*	α≤100%, SF<8.4%
	264	0+	119.56	≈0.8 ms	SF≈50%, α≈50%
	265		121.17	1.9 ms *2*	α<100%, SF≤1%
	265m		121.47	0.3 ms *+2–1*	α<100%
	266	0+	121.1s	2.3 ms *+13–6*	α, SF<1.4%
	267	(3/2+)	122.65s	52 ms *+13–8*	α≥80%, SF<20%
	267m		122.65s	0.8 s *+38–4*	α
	268	0+	122.8s	0.4 s *+18–2*	α
	269		124.6s	3.6 s *+8–14*	α
	269m		124.6s	9.7 s *+97–33*	α
	270	0+	125.1s	22 s	α
	271		127.8s		α?, SF?
	272	0+	129.1s		SF?, α?
	273		132.1s		α
	274	0+	133.3s		SF?, α?
	275m		136.3s	0.15 s *+27–6*	α
	276	0+	138.0s		α?, SF?
	277		141.1s		
109 Mt	265		126.6s		α?
	266m		128.0s	1.7 ms *+18–16*	α≤100%
	267		127.8s		α?
	268m		128.9s	21 ms *+8–5*	α
	269		129.3s		
	270m		130.8s	5.0 ms *+24–3*	α
	271		131.5s		α?

Nuclear Wallet Cards

Nuclide Z El A		Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
109 Mt	272		133.7s		α?, SF?
	273		134.8s		α?, SF?
	274m		137.1s	0.44 s +*81–17*	α, SF
	275?		138.4s	9.7 ms +*460–44*	α
	276m		140.9s	0.72 s +*87–25*	α
	277		142.5s		
	278m		145.1s	8 s +*37–4*	α, SF
	279		146.8s		α?, SF?
110 Ds	267m		134.3s	2.8 μs +*133–12*	α
	268?	0+	133.6s	1	α
	269m		135.03	179 μs +*245–66*	α
	270	0+	134.7s	0.10 ms +*14–4*	α, SF<0.2%
	270m		135.9s	6.0 ms +*82–22*	α>70%, IT≤30%
	271		135.95s	1.63 ms +*44–29*	α
	271m		135.95s	69 ms +*56–21*	α>0%, IT?
	272	0+	136.0s		SF
	273		138.4s	0.17 ms +*17–6*	α
	274?	0+	138.9s		SF?, α?
	275?		141.2s		α?
	276?	0+	142.2s		SF?, α?
	277?		145.3s		α?
	278?	0+	145.8s		SF?, α?
	279m		148.6s	0.18 s +*5–3*	SF≈90%, α≈10%
	280	0+	149.6s		
	281		152.4s	20 s +*20–7*	SF 85%, α 15%
	281m		152.4s	9.6 s +*50–25*	SF
111 Rg	272m		142.8s	3.8 ms +*14–8*	α
	273		143.1s		α?
	274m		144.7s	6.4 ms +*307–29*	α
	275?		145.4s		α?
	276?		147.4s		α?, SF?
	277?		148.4s		SF?, α?
	278m		150.4s	4.2 ms +*76–17*	α, SF
	279m		151.3s	0.17 s +*81–8*	α
	280m		153.4s	3.6 s +*43–13*	α
	281m		154.6s	26 s +*25–8*	SF, α
	282m		156.7s	0.5 s +*25–2*	α, SF
	283?		158.1s		SF?, α?
112 Cn	276	0+	150.6s		
	277		152.4s		
	278?	0+	152.7s		α?, SF?
	279?		154.7s		SF?, α?
	280?	0+	155.4s		α?, SF?
	281m		158.1s		α
	282m		158.2s	0.50 ms +*33–14*	SF
	283m		160.7s	4.0 s +*13–7*	α≥90%, SF≤10%
	283m		160.7s	6.9 s +*69–23*	SF 50%, α 50%
	284m		161.5s	101 ms +*41–22*	SF
	285		164.1s	30 s +*30–10*	α
113	278m		159.0s	0.24 ms +*114–11*	α
	279		159.5s		

Nuclear Wallet Cards

Nuclide Z El A		Jπ	Δ (MeV)	T½, Γ, or Abundance	Decay Mode
113	280		161.2s		
	281		161.9s		
	282m		163.6s	0.07 s +*13–3*	α
	283m		164.0s	100 ms +*490–45*	α
	284m		166.0s	0.48 s +*58–17*	α
	285m		166.9s	5.5 s +*50–18*	α, SF
	286m		168.9s	20 s +*94–9*	α, SF
	287?		170.1s		α?, SF?
114	285m		171.2s		α
	286m	0+	171.0s	0.16 s +*7–3*	SF≈60%, α≈40%
	287		173.2s	0.51 s +*18–10*	α
	288	0+	174.0s	0.52 s +*22–13*	α
	289		176.5s	0.97 s +*97–32*	α
	289m		176.5s	2.7 s +*14–7*	α
115	287?		177.2s	32 ms +*155–14*	α
	288m		179.0s	87 ms +*105–30*	α
	289		179.8s	0.22 s +*26–8*	α, SF
	290		181.6s	16 ms +*76–7*	α, SF
	291?		182.8s		α?, SF?
116	289		184.8s		
	290	0+	184.4s	15 ms +*26–6*	α
	291		186.6s	6.3 ms +*116–25*	α
	292	0+	187.2s	18 ms +*16–6*	α
	293		189.6s	53 ms +*62–19*	α
117	291?		191.0s		SF?, α?
	292?		192.7s		SF?, α?
	293		193.4s	14 ms +*11–4*	α, SF
	294		195.1s	0.08 s +*37–4*	α
118	294		198.7s	0.9 ms +*11–3*	α, SF≤50%
	295		200.7s		

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	1.008	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	6.94	0.534[c]	180.5	1342	1
4	Be	9.012182 *3*	1.848[c]	1287	2471 (5 mm)	2
5	B	10.81	2.34[h]	2075	4000 (subl.)	3
6	C	12.011	1.8 to 2.1[i]	≈3550	4827	2,3,4
7	N	14.007	0.0012506[j]	−210.00	−195.798	3,5
8	O	15.999	0.001308[k]	−218.79	−182.953	2
9	F	18.9984032 *5*	0.001696	−219.67[g]	−188.12[g]	1
10	Ne	20.1797 *6*	8.9990×10^{-4}	−248.609	−246.053[g]	0
11	Na	22.98976928 *2*	0.971[c]	97.80	883	1
12	Mg	24.3050 *6*	1.738[c]	650	1090	2
13	Al	26.9815386 *8*	2.6989[c]	660.32	2519	3
14	Si	28.085	2.33[e]	1414	3265	4
15	P	30.973762 *2*	1.82[l]	44.15[l]	280.5[l]	3,5
16	S	32.06	2.07[cm]	115.21[m]	444.61	2,4,6
17	Cl	35.45	0.003214	−101.5	−34.04	1,3,5,7
18	Ar	39.948	0.0017837	−189.36	−185.85	0
19	K	39.0983	0.89	63.5	759	1
20	Ca	40.078 *4*	1.54[c]	842	1484	2
21	Sc	44.955912 *6*	2.989[e]	1541	2836	3
22	Ti	47.867	4.51	1668	3287	2 to 4
23	V	50.9415	6.0 (18.7°C)	1910	3407	2 to 5
24	Cr	51.9961 *6*	7.15[c]	1907	2671	2,3,6
25	Mn	54.938045 *5*	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	58.933195 *5*	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	65.38 *2*	7.134[e]	419.53	907	2
31	Ga	69.723	5.904 (29.6°C)	29.76	2204	2,3
32	Ge	72.63	5.323[e]	938.25	2833	2,4
33	As	74.92160 *2*	5.75[o]	817[o] (28 atm)	616[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	83.798 *2*	0.003733	−157.36	−153.34	0
37	Rb	85.4678 *3*	1.532[c]	39.30	688	1
38	Sr	87.62	2.64	777	1382	2
39	Y	88.90585 *2*	4.469[e]	1522	3345	3
40	Zr	91.224 *2*	6.52[c]	1855	4409	2 to 4
41	Nb	92.90638 *2*	8.57[c]	2477	4744	2,3,4?,5
42	Mo	95.96 *2*	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*	12.1[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*	8.69[c]	321.07	767	2
49	In	114.818 *3*	7.31[c]	156.60	2072	1 to 3
50	Sn	118.710 *7*	5.77[q]	231.93	2602	2,4
51	Sb	121.760	6.68[c]	630.63	1587	0,±3,5
52	Te	127.60 *3*	6.23[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[w]	−111.74	−108.09	0
55	Cs	132.9054519 *2*	1.873[c]	28.44	671	1
56	Ba	137.327 *7*	3.62[c]	727	1897	2
57	La	138.90547 *7*	6.145[e]	920	3464	3
58	Ce	140.116	6.770[e]	799	3443	3,4
59	Pr	140.90765 *2*	6.773[r]	931	3520	3
			6.64[s]			
60	Nd	144.242 *3*	7.008	1016	3074	3
61	Pm	(145)	7.264[e]	1042	3000	3
62	Sm	150.36 *2*	7.520[r]	1072	1794	2,3
			7.40[s]			
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	162.500	8.551[e]	1412	2567	3
67	Ho	164.93032 *2*	8.795[e]	1472	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	173.054 *5*	6.903[r]	824	1196	2,3
			6.966[s]			
71	Lu	174.9668	9.841[e]	1663	3402	3
72	Hf	178.49 *2*	13.31[c]	2233	4603	4
73	Ta	180.94788 *2*	16.4	3017	5458	2?,3,4?,5
74	W	183.84	19.3[c]	3422	5555	2 to 6
75	Re	186.207	20.8[c]	3185	5596	4,6,7
76	Os	190.23 *3*	22.587	3033	5012	0 to 8
77	Ir	192.217 *3*	22.562[c]	2446	4428	3,4
78	Pt	195.084 *9*	21.45[c]	1768.2	3825	1?,2,3
79	Au	196.966569 *4*	≈19.3[c]	1064.18	2856	1,3
80	Hg	200.59 *2*	13.546[c]	−38.83	356.62	1,2
81	Tl	204.38	11.85[c]	304	1473	1,3
82	Pb	207.2	11.35[c]	327.46	1749	2,4
83	Bi	208.98040	9.747[c]	271.4	1564	3,5
84	Po	(209)	9.20	254	962	0,±2,3?,4,6
85	At	(210)		302		1,3,5,7
86	Rn	(222)	0.00973[x]	−71	−61.7	0
87	Fr	(223)		27		1
88	Ra	(226)	5	696		2
89	Ac	(227)	10.07[t]	1050	3198	3
90	Th	232.03806 *2*	11.72	1750	4788	2?,3?,4
91	Pa	231.03588 *2*	15.37[t]	1572		4,5
92	U	238.02891 *3*	19.1	1135	4131	2 to 6
93	Np	(237)	20.25[c]	644	3902	3 to 6

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]
94	Pu	(244)	19.84[e]	640	3228	3,to 6
95	Am	(243)	12[c]	1176	2011	2 to 6
96	Cm	(247)	13.51[t]	1345		3,4
97	Bk	(247)	14[t]	996		3,4
98	Cf	(251)	15.1	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
103	Lr	(262)		1627		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 M. E. Wieser, T.B. Coplen *Pure Appl. Chem.* 83, 359 (2011). 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, 92nd edition, 2011.* 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.

e) At 25°C.

f) For gas; density (liquid)=0.125 g/cc at b.p.

g) At 1 atm.

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

Appendix–I Table of Elemental Properties

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.
For Ozone: density=0.001962; m.p.=–193, b.p.=–111.35

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)=2.00 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)=7.29 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.

w) For gas; density (liquid)=2.95 g/cc at –109°C.

x) For gas; density (liquid)=4.4 g/cc at –62°C.

Appendix–II Frequently–Used Constants

The frequently used constants are given below in familiar units. Only approximate values are given; see App–IIa 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: 2006.*[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]

$$\mu_0 = 4\pi\times10^{-7}\ \mathrm{m\cdot kg\cdot s^{-2}\cdot A^{-2}} = 4\pi\times10^{-7}\ \mathrm{N\cdot A^{-2}} = 4\pi\times10^{-7}\ \mathrm{T\cdot A^{-1}}$$
$$\varepsilon_0 = 1/\mu_0 c^2$$

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	5.2917721092 *17*	10^{-11} m	10^{-9} cm
$\alpha=e^2/\hbar c[4\pi\varepsilon_0]$ $1/\alpha$	Fine structure constant	0.0072973525698 *24* 137.035999679 *94*		
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	3.74177153 *17*	10^{-16} W m^2	10^{-5} erg cm^2 s^{-1}
$c_2=hc/k$	Second radiation constant	1.4387770 *13*	10^{-2} m K	cm K
e	Elementary charge	1.602176565 *35*	10^{-19} C	10^{-20} emu
2e/h	Josephson frequency–voltage ratio	4.83597870 *11*	10^{14} Hz V^{-1}	
$-e/m_e$	Electron specific charge	–1.758820088 *39*	10^{11} C kg^{-1}	10^{7} emu g^{-1}
$F=N_Ae$	Faraday constant	9.64853365 *21*	10^{4} C mol^{-1}	10^{3} emu mol^{-1}
γ_p	Gyromagnetic ratio of proton	2.675222005 *63*	10^{8} s^{-1} T^{-1}	10^{4} s^{-1} G^{-1}
	Proton magnetic shielding correction	0.000025694 *14*		
G	Gravitational constant	6.67384 *80*	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	6.62606957 *29*	10^{-34} J s	10^{-27} erg s
$\hbar = h/2\pi$		1.054571726 *47*	10^{-34} J s	10^{-27} erg s
h/2e	Quantum of magnetic flux	2.067833758 *46*	10^{-15} Wb	10^{-7} G cm^2
$k=R/N_A$	Boltzmann constant	1.3806488 *13*	10^{-23} J K^{-1}	10^{-16} erg K^{-1}
$\lambda_{C,e}=h/m_e c$	Compton wavelength of electron	2.4263102389 *16*	10^{-12} m	10^{-10} cm
$\lambda_{C,p}=h/m_p c$	Compton wavelength of proton	1.32140985623 *94*	10^{-15} m	10^{-13} cm
$\lambda_{C,n}=h/m_n c$	Compton wavelength of neutron	1.3195909068 *11*	10^{-15} m	10^{-13} cm
m_e	Electron mass	5.4857990946 *22*	10^{-4} u	10^{-4} u
m_H	Mass of hydrogen atom	1.00782503207 *10*(c)	u	u
m_μ	Muon mass	0.1134289267 *29*	u	u
m_n	Neutron mass	1.00866491600 *55*	u	u
m_p	Proton mass	1.007276466812 *90*	u	u
$m_{\pi\pm}$	$\pi^{\pm}$ mass	139.57018 *35*(d)	MeV	
$m_{\pi 0}$	π^0 mass	134.9766 *6*(d)	MeV	

Appendix–IIa Fundamental Constants

Symbol	Constant	Value	Units (SI)[b]	Units (cgs)[b]
$\mu_B=[c]e\hbar/2m_ec$	Bohr magneton	9.27400968 *20*	10^{-24} J T^{-1}	10^{-21} erg G^{-1}
μ_e/μ_B	Magnetic moment of electron in units of μ_B	–1.00115965218076 *27*		
μ_μ	Muon magnetic moment	–4.49044807 *15*	10^{-26} J T^{-1}	10^{-23} erg Gs^{-1}
$\mu_N=[c]e\hbar/2m_pc$	Nuclear magneton	5.05078353 *11*	10^{-27} J T^{-1}	10^{-24} erg G^{-1}
N_A	Avogadro constant	6.02214129 *27*	10^{23} mol^{-1}	10^{23} mol^{-1}
R	Molar gas constant	8.3144621 *75*	J mol^{-1} K^{-1}	10^7 erg mol^{-1} K^{-1}
$R_\infty=m_ec\alpha^2/2h$	Rydberg constant for infinite mass	1.0973731568539 *55*	10^7 m^{-1}	10^5 cm^{-1}
$r_e=\hbar\alpha/m_ec$	Classical e^- radius	2.8179403267 *27*	10^{-15} m	10^{-13} cm
$\sigma=(\pi^2/60)k^4/\hbar^3c^2$	Stefan–Boltzmann constant	5.670373 *21*	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*[(c)] 931.494013 *37*[(c)]	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, B.N. Taylor, and D.B. Newell *Jl. of Phys. and Chem. Ref. Data* 37, 1187 (2008); *Rev. Mod. Phys.* 80, 633 (2008). Data taken from 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, C. Amsler, *et al.*, *Physics Letters* B667, 1 (2008); http://pdg.lbl.gov/

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

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

Appendix–III Energy–Equivalent Factors†

units	erg	eV	s^{-1}	cm^{-1}
erg	1.0	$1.602176565\ \mathit{35}\times10^{-12}$	$6.62606957\ \mathit{29}\times10^{-27}$	$1.986445684\ \mathit{88}\times10^{-16}$
eV	$6.24150934\ \mathit{14}\times10^{11}$	1.0	$4.135667516\ \mathit{91}\times10^{-15}$	$1.239841930\ \mathit{27}\times10^{-4}$
s^{-1}	$1.509190311\ \mathit{67}\times10^{26}$	$2.417989348\ \mathit{53}\times10^{14}$	1.0	$2.99792458\ \times10^{10}$
cm^{-1}	$5.03411701\ \mathit{22}\times10^{15}$	$8.06554429\ \mathit{18}\times10^{3}$	$3.335640951\times10^{-11}$	1.0
K	$7.2429716\ \mathit{22}\times10^{15}$	$1.1604519\ \mathit{11}\times10^{4}$	$4.7992434\ \mathit{44}\times10^{-11}$	$1.4387770\ \mathit{13}$
g	$1.112650056\times10^{-21}$	$1.782661845\ \mathit{39}\times10^{-33}$	$7.37249668\ \mathit{33}\times10^{-48}$	$2.210218902\ \mathit{98}\times10^{-37}$
u	$6.70053662\ \mathit{53}\times10^{2}$	$1.073544150\ \mathit{24}\times10^{-9}$	$4.4398216689\ \mathit{31}\times10^{-24}$	$1.33102505120\ \mathit{94}\times10^{-13}$

(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:

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

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

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

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

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

Appendix–III Energy–Equivalent Factors†

units	deg K	g	u
erg	$1.3806488\ \mathit{13} \times 10^{-16}$	$8.987551787 \times 10^{20}$	$1.492417954\ \mathit{66} \times 10^{-3}$
eV	$8.6173324\ \mathit{78} \times 10^{-5}$	$5.60958885\ \mathit{12} \times 10^{32}$	$9.31494061\ \mathit{21} \times 10^{8}$
s^{-1}	$2.0836618\ \mathit{19} \times 10^{10}$	$1.356392608\ \mathit{60} \times 10^{47}$	$2.2523427168\ \mathit{16} \times 10^{23}$
cm^{-1}	$6.9503476\ \mathit{63} \times 10^{-1}$	$4.52443873\ \mathit{20} \times 10^{36}$	$7.5130066042\ \mathit{53} \times 10^{12}$
K	1.0	$6.5096582\ \mathit{59} \times 10^{36}$	$1.08095408\ \mathit{98} \times 10^{13}$
g	$1.5361790\ \mathit{14} \times 10^{-37}$	1.0	$1.660538921\ \mathit{73} \times 10^{-24}$
u	$9.2510868\ \mathit{84} \times 10^{-14}$	$6.02214129\ \mathit{27} \times 10^{23}$	1.0

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

Example: $1u \equiv 1.492.. \times 10^{-3}$ erg = $9.314.. \times 10^{8}$ eV = $3.567.. \times 10^{-11}$ cal, etc.

† From CODATA Values of Fundamental Physical Constants: 2006, P.J. Mohr, B.N. Taylor, and D.B. Newell, *Jour. of Phys. and Chem. Ref. Data* 37, 1187 (2008), *Rev. Mod. Phys.* 80, 633 (2008). Data taken from http://physics.nist.gov/constants (Aug, 2011)

Appendix–IV Observed Λ Hypernuclides†

El	A	J(g.s.)	B_Λ(g.s.)	Excited states (MeV)
H	3	1/2+	0.13 *5*	
	4	0+	2.04 *4*	1.05 *4* 1+
He	4	0+	2.39 *3*	1.15 *4* 1+
	5	1/2+	3.12 *2*	
	6		4.18 *10*	
	8		7.16 *70*	
Li	6			
	7	1/2+[a]	5.58 *3*	0.692 *2* 3/2+,2.050 *1* 5/2+, 2.521 *2* 7/2+,3.878 *5* 1/2+
	8	1–	6.80 *3*	
	9		8.50 *12*	
Be	7	1/2+	5.16 *8*	
	8		6.84 *5*	
	9	1/2+	6.71 *4*	3.024 *4* 5/2+, 3.067 *4* 3/2+
	10		9.11 *22*	
B	9		8.29 *18*	
	10		8.89 *12*	
	11		10.24 *5*	0.263 *1* 7/2+, 1.483 *1* 1/2+, 1.987 *1* 3/2+
	12	1–	11.37 *6*	
C	12	1–	10.80 *18*[b]	0.161 *1* 2–, 2.832 *3* 1–
	13	1/2+	11.69 *12*	4.88 *2* 3/2+,10.83 *6* 3/2–, 10.98 *6* 1/2–
	14		12.17 *33*	
N	14			
	15	3/2+[c]		2.268 *1* 1/2+, 4.229 *1* 1/2+, 4.710 *1* 3/2+
	16		13.76 *16*[d]	
O	16	0–	12.42 *5*	0.026 *2* 1–, 6.562 *2* 1–, 6.786 *6* 2–
	18			
Al	27			
	28	e		
Si	28		16.6 *2*	BΛ=7.0 *2* (p)
S	32			
Ca	40			
V	51		20.0 *2*	BΛ=11.2 *3* (p), 2.6 *3* (d)
Fe	56			
Y	89		23.1 *5*	BΛ=16.5 *14* (p), 9.1 *13* (d), 2.3 *12* (f)
La	139		24.5 *12*	BΛ=20.4 *6* (p), 14.3 *6* (d), 8.0 *6* (f), 1.6 *6* (g)
Pb	208		26.3 *8*	BΛ=21.9 *6* (p), 16.8 *7* (d), 11.7 *6* (f), 6.6 *6* (g)
Bi	209			

Appendix–IV Observed Λ Hypernuclides†

† This table has been prepared by **D.J. Millener** (BNL). The Λ binding energies (s_Λ single–particle energies), BΛ, for A≤14 come from emulsion data compiled by D.H. Davis and J. Pniewski, *Contemp. Phys.* 27, 91 (1986). Most of the rest of the data comes from a review by O. Hashimoto and H Tamura, *Prog. Part. Nucl. Phys.* 57, 564 (2006), which lists all counter experiments for hypernuclei up to 2004. The BΛ values for A>16 from (π+,K+) reactions, as do the Λ single–particle binding energies for higher orbits (listed by their orbital angular momentum p, d, f, or g).

The precise excitation energies given for bound excited states of hypernuclei from A=7 to A=16 come from γ–rays measured in coincidence with the outgoing meson in (π+,K+) or (K−,π−) reactions by a Ge detector array (NaI for A=13); for the latest results, see H. Tamura *et al., Nucl. Phys.* A835, 3 (2010). Many particle unbound states of these nucei are seen in (π+,K+),(K−,π−), and (e,e'K+) reactions.

In addition to these single–Λ hypernuclides, several instances of double–Λ species have been reported, including the important case of ${}^{6}_{\Lambda\Lambda}\mathrm{He}$, as reviewed by K. Nakazawa *Nucl. Phys.* A835, 207 (2010).

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c M. Agnello *et al., Phys. Lett.* B681, 139 (2009).

d F. Cusanno *et al., Phys. Rev. Lett.* 103, 202501 (2009).

e O. Hashimoto *Nucl. Phys.* A835, 121 (2010).

Half–lives of fully–ionized (bare) and highly–charged atoms†

El	A	T1/2(bare)	T1/2(neutral)	Decay mode	Ref
Ne	19	18.5(6) s #	17.22(2) s	ε	[1]
Mn	52m	22.7(30) m	21.1(2) m	ε,IT	[2]
Fe	52	12.5(+15–12) h	8.275(8) h	ε	[2]
	53	8.5(3) m	8.51(2) m	ε	[2]
	53m	2.48(5) m	2.54(2) m	IT	[2]
Sb	133m	>60 μs	16.54(19) μs	IT?	[15]
Ce	125m	2.2(+11–1) m	4.4 s (est.)	IT	[3]
Pr	140	7.3(4) m	3.39(1) m	ε	[5]
		3.04(9) m &			[5]
		3.84(17) m $			[5]
Pm	142	56.4(32) s	40.5(5) s	ε	[6]
		39.2(7) s &			[6]
		39.6(14) s $			[6]
Tb	144m	12(2) s	4.25(15) s	ε,IT	[7]
Dy	149m	11(1) s	0.490(15) s	IT,ε	[7]
	163	47(+5–4) d	stable	β–	[8]
Ho	163	beta–stable	4570(25) y	ε	[8]
Er	151m	19(3) s	0.58(2) s	IT,ε	[7]
Hf	183m	10(+48–5) s &		IT,β–?	[16]
	184m1	1.9(+12–7) m	48(10) s	IT	[16]
	184m2	12(+10–4) m		IT,β–?	[16]
	186m	>20 s		IT,β–?	[16]
Ta	168	5.2(7) m	2.0(1) m	ε	[4]
	186m	3.4(+24–14) m &	1.54(5) m	IT,β–?	[16]
	187	2.3(6) m		β–	[16]
	187m1	22(9) s		IT,β–?	[16]
	187m2	>5 m		IT,β–?	[16]
Re	187	32.9(20) y	$4.33(7)\times10^{10}$ y	β–	[9]
	192m	61(+40–20) s		IT	[18]
Hg	205	5.61(9) m	5.14(9) m	β–	[11]
Tl	207	4.25(19) m	4.77(3) m	β–	[10]
	207	4.72(19) m	4.77(3) m	β–	[11]
	207m	1.47(32) s	1.33(11) s	IT	[12]
	213	1.7(+81–8) m		β–	[14]
Po	221	1.9(+10–5) m @		β–	[14]
	222	2.4(+116–11) m		β–	[14]
At	224	1.3(+23–4) m @		β–	[14]
Ac	234	45(2) s $	44(7) s	β–	[13]
	235	62(4) s &	6% longer (est.)	β–	[13]
	236	1.2(+58–6) m		β–	[14]

& H–like
$ He–like
# 11% contamination by beta–decay of O–15 is suggested [1].
@ Can be a mixture of bare, H–like and He–like states [14].

† Table prepared by **Yuri A. Litvinov** (GSI, Darmstadt and MPI, Heidelberg) and **Balraj Singh** (McMaster Univ.) September 12, 2011, on the basis of review article [17] and other papers cited here for fully–ionized (bare) or highly–charged (H–like, He–like) atoms.

Half–lives of fully–ionized (bare) and highly–charged atoms†

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Radioactive Decay Chains in Nature

The following three radioactive decay chains occur in nature:

The Thorium Series:

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

The Uranium Series:

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

The Actinium Series

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

Radioactive Nuclides in Nature

Nuclide	Half–life	Decay Modes
1 H 3	12.32 y	β–
4 Be 7	53.24 d	ε
6 C 14	5700 y	β–
19 K 40	1.248×10^{9} y	β–
23 V 50	$>2.1\times10^{17}$ y	ε , β–
37 Rb 87	4.81×10^{10} y	β–
48 Cd 113	8.00×10^{15} y	β–
49 In 115	4.41×10^{14} y	β–
52 Te 123	$>9.2\times10^{16}$ y	ε
57 La 138	1.02×10^{11} y	ε , β–
60 Nd 144	2.29×10^{15} y	α
62 Sm 147	1.060×10^{11} y	α
148	7×10^{15} y	α
64 Gd 152	1.08×10^{14} y	α
71 Lu 176	3.76×10^{10} y	β–
72 Hf 174	2.0×10^{15} y	α
73 Ta 180m	$>1.2\times10^{15}$ y	ε , β–
75 Re 187	4.33×10^{10} y	β– , α
76 Os 186	2.0×10^{15} y	α
78 Pt 190	6.5×10^{11} y	α
81 Tl 206	4.202 m	β–
207	4.77 m	β–
208	3.053 m	β–
210	1.3 m	β– , β–n
82 Pb 210	22.2 y	β– , α
211	36.1 m	β–
212	10.64 h	β–
214	26.8 m	β–
83 Bi 210	5.012 d	β– , α
211	2.14 m	α , β–
212	1.009 h	β– , α
214	19.9 m	β– , α
215	7.6 m	β–
84 Po 210	138.4 d	α
211	0.516 s	α
212	0.299 μs	α
214	164.3 μs	α
215	1.781 ms	α , β–
216	0.145 s	α
218	3.098 m	α , β–
85 At 215	0.1 ms	α
218	1.5 s	α , β–
219	56 s	α , β–
86 Rn 219	3.96 s	α
220	55.6 s	α

Radioactive Nuclides in Nature

Nuclide		Half-life	Decay Modes
86 Rn	222	3.823 d	α
87 Fr	223	22 m	$\beta-$, α
88 Ra	223	11.43 d	α , ^{14}C
	224	3.632 d	α , ^{14}C
	226	1600 y	α , ^{14}C
	228	5.75 y	$\beta-$
89 Ac	227	21.77 y	$\beta-$, α
	228	6.15 h	$\beta-$
90 Th	227	18.68 d	α
	228	1.912 y	α , ^{20}O
	230	7.54×10^{4} y	α , Ne , SF
	231	1.063 d	$\beta-$, α
	232	1.40×10^{10} y	α , SF
	234	24.1 d	$\beta-$
91 Pa	231	3.276×10^{4} y	α , SF
	234	6.7 h	$\beta-$
92 U	234	2.455×10^{5} y	α , SF , Mg , Ne
	235	7.04×10^{8} y	α , SF , Mg , Ne
	238	4.468×10^{9} y	α , SF

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	Cn 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	Meitnerium	Mt	109
Aluminum	Al	13	Mendelevium	Md	101
Americium	Am	95	Mercury	Hg	80
Antimony	Sb	51	Molybdenum	Mo	42
Argon	Ar	18	Neodymium	Nd	60
Arsenic	As	33	Neon	Ne	10
Astatine	At	85	Neptunium	Np	93
Barium	Ba	56	Nickel	Ni	28
Berkelium	Bk	97	Niobium	Nb	41
Beryllium	Be	4	Nitrogen	N	7
Bismuth	Bi	83	Nobelium	No	102
Bohrium	Bh	107	Osmium	Os	76
Boron	B	5	Oxygen	O	8
Bromine	Br	35	Palladium	Pd	46
Cadmium	Cd	48	Phosphorus	P	15
Calcium	Ca	20	Platinum	Pt	78
Californium	Cf	98	Plutonium	Pu	94
Carbon	C	6	Polonium	Po	84
Cerium	Ce	58	Potassium	K	19
Cesium	Cs	55	Praseodymium	Pr	59
Chlorine	Cl	17	Promethium	Pm	61
Chromium	Cr	24	Protactinium	Pa	91
Cobalt	Co	27	Radium	Ra	88
Copernicium	Cn	112	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

Appendix–VIc List of Elements – by Z

Z	Symbol	Name
1	H	Hydrogen
2	He	Helium
3	Li	Lithium
4	Be	Beryllium
5	B	Boron
6	C	Carbon
7	N	Nitrogen
8	O	Oxygen
9	F	Fluorine
10	Ne	Neon
11	Na	Sodium
12	Mg	Magnesium
13	Al	Aluminum
14	Si	Silicon
15	P	Phosphorus
16	S	Sulfur
17	Cl	Chlorine
18	Ar	Argon
19	K	Potassium
20	Ca	Calcium
21	Sc	Scandium
22	Ti	Titanium
23	V	Vanadium
24	Cr	Chromium
25	Mn	Manganese
26	Fe	Iron
27	Co	Cobalt
28	Ni	Nickel
29	Cu	Copper
30	Zn	Zinc
31	Ga	Gallium
32	Ge	Germanium
33	As	Arsenic
34	Se	Selenium
35	Br	Bromine
36	Kr	Krypton
37	Rb	Rubidium
38	Sr	Strontium
39	Y	Yttrium
40	Zr	Zirconium
41	Nb	Niobium
42	Mo	Molybdenum
43	Tc	Technetium
44	Ru	Ruthenium
45	Rh	Rhodium
46	Pd	Palladium
47	Ag	Silver
48	Cd	Cadmium
49	In	Indium
50	Sn	Tin
51	Sb	Antimony
52	Te	Tellurium
53	I	Iodine
54	Xe	Xenon
55	Cs	Cesium
56	Ba	Barium

Z	Symbol	Name
57	La	Lanthanum
58	Ce	Cerium
59	Pr	Praseodymium
60	Nd	Neodymium
61	Pm	Promethium
62	Sm	Samarium
63	Eu	Europium
64	Gd	Gadolinium
65	Tb	Terbium
66	Dy	Dysprosium
67	Ho	Holmium
68	Er	Erbium
69	Tm	Thulium
70	Yb	Ytterbium
71	Lu	Lutetium
72	Hf	Hafnium
73	Ta	Tantalum
74	W	Tungsten
75	Re	Rhenium
76	Os	Osmium
77	Ir	Iridium
78	Pt	Platinum
79	Au	Gold
80	Hg	Mercury
81	Tl	Thallium
82	Pb	Lead
83	Bi	Bismuth
84	Po	Polonium
85	At	Astatine
86	Rn	Radon
87	Fr	Francium
88	Ra	Radium
89	Ac	Actinium
90	Th	Thorium
91	Pa	Protactinium
92	U	Uranium
93	Np	Neptunium
94	Pu	Plutonium
95	Am	Americium
96	Cm	Curium
97	Bk	Berkelium
98	Cf	Californium
99	Es	Einsteinium
100	Fm	Fermium
101	Md	Mendelevium
102	No	Nobelium
103	Lr	Lawrencium
104	Rf	Rutherfordium
105	Db	Dubnium
106	Sg	Seaborgium
107	Bh	Bohrium
108	Hs	Hassium
109	Mt	Meitnerium
110	Ds	Darmstadtium
111	Rg	Roentgenium
112	Cn	Copernicium

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National Nuclear Data Center
Brookhaven National Laboratory
Building 197D
P.O. Box 5000
Upton, New York 11973–5000
U.S.A.

E–mail: nndc@bnl.gov
Tel: (631) 344–2902
Fax: (631) 344–2806