

NUCLEAR WALLET CARDS

January 2000

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DATA CENTER**

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(Sixth edition)

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for

The U.S. Nuclear Data Program

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U.S. Nuclear Data Program

(<http://www.nndc/usndp/>)

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INTRODUCTION

This is an updated edition of the 1995 booklet of the same name[†].

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

The data given here are taken mostly from the adopted properties of the various nuclides as given in the *Evaluated Nuclear Structure Data File* (ENSDF)[1]. The data in ENSDF are based on experimental results and are published in *Nuclear Data Sheets*[2] for $A \geq 44$ and in *Nuclear Physics*[3,4] for $A < 44$. For nuclides for which either there are no data in ENSDF or those data have since been superseded, the half-life and the decay modes are taken either from recent literature[5] or from other sources[e.g., 6,7,8]. The ground-state mass excesses are from the mass adjustments by G. Audi and A. H. Wapstra[9]. The isotopic abundances are those of N. E. Holden[10].

For other references, experimental data, and information on the data measurements, please refer to the original evaluations [1–4]. The data[1] were updated to **July 31, 1999**.

[†]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)[12]. The subsequent editions, third in 1985, fourth in 1990, and the fifth edition in 1995, were produced by J. K. Tuli, NNDC, Brookhaven National Laboratory.

Explanation of Table

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

Nuclides are listed in order of increasing atomic number (Z), and are subordered by increasing mass number (A). All isotopic species are included as well as all isomers with half-life ≥ 0.1 s, and some with half-life ≥ 1 ms which decay by SF, α or p emissions. A nuclide is included even if only its mass estimate or its production cross section is available. For the latter nuclides $T_{1/2}$ limit or an approximate value is given as estimated from systematics[8].

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

The ^{235}U thermal fission products, with fractional cumulative yields $\geq 10^{-6}$, are *italicized* in the table. The information on fission products is taken from the ENDF/B-VI fission products file[11].

The names for elements $Z=104-109$ are those adopted by the International Union of Pure and Applied Chemistry (1997).

Column 2, $J\pi$:

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

Explanation of Table (cont.)

Column 3, Mass Excess, Δ :

Mass excesses, $M-A$, are given in MeV with $\Delta(^{12}\text{C})=0$, by definition. For isomers the values are obtained by adding the excitation energy to the $\Delta(\text{g.s.})$ values. Wherever the excitation energy is not known, the mass excess for the next lower isomer (or g.s.) is given. The values are given to the accuracy determined by uncertainty in $\Delta(\text{g.s.})$ (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.

Column 4, $T_{1/2}$, Γ or Abundance:

The half-life and the abundance (in **bold face**) are shown followed by their units ("% symbol in the case of abundance) which are followed by the uncertainty, in *italics*, in the last significant figure. For example, $8.1 \text{ s } 10$ means $8.1 \pm 1.0 \text{ s}$. For some very short-lived nuclei, level widths rather than half-lives are given. There also, the width is followed by units (*e.g.*, eV, keV, or MeV) which are followed by the uncertainty in *italics*, if known. As stated above when a limit or an approximate value is given it is based on systematics, mostly from [8].

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

If a new measurement of $T_{1/2}$ has since become available it is presented in place of the evaluated value in ENSDF.

Explanation of Table (cont.)

Column 5, Decay Mode:

Decay modes are given in decreasing strength from left to right, followed by the percentage branching, if known ("w" indicates a weak branch). The percentage branching is omitted where there is no competing mode of decay or no other mode has been observed. A "?" indicates an expected but not observed mode of decay[8]. The various modes of decay are given below:

β^-	β^- decay
ϵ	ϵ (electron capture), or $\epsilon + \beta^+$, or β^+ decay
IT	isomeric transition (through γ or conversion-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, ...
β^-n , β^-p , $\beta^- \alpha$, ...	delayed n, p, α , ... emission following β^- decay
ϵp , $\epsilon \alpha$, ϵSF , ...	delayed p, α , SF, ... decay following ϵ or β^+ decay

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Nuclear Wallet Cards

Isotope				Δ	T½, Γ , or	
Z	El	A	J π	(MeV)	Abundance	Decay Mode
0	n	1	1/2+	8.071	10.24 m 2	β^-
1	H	1	1/2+	7.289	99.985% 1	
		2	1+	13.136	0.015% 1	
		3	1/2+	14.950	12.33 y 6	β^-
		4	2-	25.9	4.6 MeV 9	n
		5		36.8	5.7 MeV 21	n
		6		41.9	1.4 MeV 3	3n?
2	He	3	1/2+	14.931	0.000137% 3	
		4	0+	2.425	99.999863% 3	
		5	3/2-	11.39	0.60 MeV 2	α , n
		6	0+	17.594	806.7 ms 15	β^-
		7	(3/2)-	26.11	160 keV 30	n
		8	0+	31.598	119.0 ms 15	β^- , β -n 16%
		9	(1/2-)	40.82	65 keV 37	n
		10	0+	48.81	0.17 MeV 11	2n?
3	Li	4	2-	25.3	6.03 MeV	p
		5	3/2-	11.68	≈ 1.5 MeV	α , p
		6	1+	14.086	7.59% 4	
		7	3/2-	14.908	92.41% 4	
		8	2+	20.946	838 ms 6	β^- , β - α
		9	3/2-	24.954	178.3 ms 4	β^- , β -n 50.8%
		10	(1-,2-)	33.05	1.2 MeV 3	n
		11	3/2-	40.80	8.5 ms 2	β^- , β -n α 0.027%, β -n
		12		50.1 s	<10 ns	n?
4	Be	5	(1/2+)	38.s		p
		6	0+	18.375	92 keV 6	α , 2p
		7	3/2-	15.769	53.29 d 7	ϵ
		8	0+	4.942	6.8 eV 17	α
		9	3/2-	11.348	100.%	
		10	0+	12.607	1.51×10^6 y 6	β^-
		11	1/2+	20.174	13.81 s 8	β^- , β - α 3.1%
		12	0+	25.08	21.3 ms 1	β^- , β -n <1%
		13	(1/2-)	33.7	0.17 MeV 11	n
		14	0+	39.9	4.35 ms 17	β^- , β -n 81%, β -2n 5%
5	B	7	(3/2-)	27.87	1.4 MeV 2	p, α
		8	2+	22.921	770 ms 3	ϵ , $\epsilon\alpha$
		9	3/2-	12.416	0.54 keV 21	p,
		10	3+	12.051	19.8% 3	
		11	3/2-	8.668	80.2% 3	
		12	1+	13.369	20.20 ms 2	β^- , β -3 α 1.58%
		13	3/2-	16.562	17.36 ms 16	β^-
		14	2-	23.66	12.3 ms 3	β^- , β -n 6.04%
		15		28.97	9.87 ms 7	β^- , β -n 93.6%, β -2n 0.4%
		16	0-	37.08	<190 ps	n
		17	(3/2-)	43.7	5.08 ms 5	β^- , β -n 63%, β -2n 11%, β -3n 3.5%, β -4n 0.4%
		18	(4-)	52.3 s	<26 ns	n?

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	Abundance	
5	B	19	(3/2-)	59.4s	>200 ns β^- ?
6	C	8	0+	35.09	230 keV 50 p, α
		9	(3/2-)	28.914	126.5 ms 9 ϵ , ϵp 23%, $\epsilon \alpha$ 17%
		10	0+	15.699	19.255 s 53 ϵ
		11	3/2-	10.651	20.39 m 2 ϵ
		12	0+	0.000	98.89% 1
		13	1/2-	3.125	1.11% 1
		14	0+	3.020	5730 y 40 β^-
		15	1/2+	9.873	2.449 s 5 β^-
		16	0+	13.694	0.747 s 8 β^- , $\beta^- n$ 99%
		17		21.04	193 ms 13 β^- , $\beta^- n$ 32%
		18	0+	24.92	95 ms 10 β^- , $\beta^- n$ 19%
		19		32.8	49 ms 4 $\beta^- n$ 61%, β^-
		20	0+	37.6	14 ms +6-5 β^- , $\beta^- n$ 72%
		21	(1/2+)	46.0s	<30 ns n ?
		22	0+	52.6s	>200 ns β^- ?
7	N	10	(1-)	39.7s	p ?
		11m	1/2+	25.3	1.58 MeV +75-52 p
		12	1+	17.338	11.000 ms 16 ϵ , $\epsilon 3\alpha$ 3.44%
		13	1/2-	5.345	9.965 m 4 ϵ
		14	1+	2.863	99.634% 20
		15	1/2-	0.101	0.366% 20
		16	2-	5.683	7.13 s 2 β^- , $\beta^- \alpha$ 0.0012%
		17	1/2-	7.87	4.173 s 4 β^- , $\beta^- n$ 95.1%
		18	1-	13.12	624 ms 12 β^- , $\beta^- n$ 14.3%, $\beta^- \alpha$ 12.2%
		19		15.86	290 ms 90 β^- , $\beta^- n$ 62.4%
		20		21.77	142 ms 19 β^- , $\beta^- n$ 66.1%
		21	(1/2-)	25.23	87 ms 6 β^- , $\beta^- n$ 80%
		22		32.1	18 ms 5 β^- , $\beta^- n$ 35%
		23	(1/2-)	37.7s	>200 ns β^- ?
		24		47.0s	<52 ns n ?
8	O	12	0+	32.05	0.40 MeV 25 p
		13	(3/2-)	23.111	8.58 ms 5 ϵ , $\epsilon p \approx 100\%$
		14	0+	8.007	70.606 s 18 ϵ
		15	1/2-	2.855	122.24 s 16 ϵ
		16	0+	-4.737	99.762% 16
		17	5/2+	-0.809	0.038% 1
		18	0+	-0.782	0.200% 14
		19	5/2+	3.334	26.91 s 8 β^-
		20	0+	3.797	13.51 s 5 β^-
		21	(1/2,3/2,5/2)+	8.06	3.42 s 10 β^-
		22	0+	9.28	2.25 s 15 β^- , $\beta^- n$ <22%
		23	(1/2+)	14.6	82 ms 37 β^- , $\beta^- n$ 31%
		24	0+	19.0	61 ms 26 β^- , $\beta^- n$ 58%
		25	(3/2+)	27.1s	<50 ns n ?
		26	0+	35.2s	<40 ns n ?
9	F	14	(2-)	33.6s	p
		15	(1/2+)	16.8	1.0 MeV 2 p
		16	0-	10.680	40 keV 20 p
		17	5/2+	1.952	64.49 s 16 ϵ

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	(MeV)	Abundance	
9 F	18	1+	0.873	109.77 m 5	ϵ
	19	1/2+	-1.487	100%	
	20	2+	-0.017	11.163 s 8	β^-
	21	5/2+	-0.048	4.158 s 20	β^-
	22	4+,(3+)	2.79	4.23 s 4	β^- , $\beta^-n < 11\%$
	23	(3/2,5/2)+	3.33	2.23 s 14	β^- , $\beta^-n < 14\%$
	24	(1,2,3)+	7.54	0.34 s 8	β^- , $\beta^-n < 11\%$
	25	(5/2+)	11.27	59 ms 40	β^- , $\beta^-n 15\%$
	26		18.3	190 ms 110	β^- , $\beta^-n < 32\%$
	27	(5/2+)	25.0	>200 ns	$\beta^-?$
	28		33.2s	<40 ns	n?
	29	(5/2+)	40.3s	>200 ns	β^-
10 Ne	16	0+	23.99	122 keV 37	p
	17	1/2-	16.49	109.2 ms 6	ϵ , $\epsilon p \approx 100\%$, $\epsilon\alpha$
	18	0+	5.307	1672 ms 8	ϵ
	19	1/2+	1.751	17.22 s 2	ϵ
	20	0+	-7.042	90.48% 3	
	21	3/2+	-5.732	0.27% 1	
	22	0+	-8.024	9.25% 3	
	23	5/2+	-5.154	37.24 s 12	β^-
	24	0+	-5.95	3.38 m 2	β^-
	25	(1/2,3/2)+	-2.06	602 ms 8	β^-
	26	0+	0.43	0.197 s 1	β^- , $\beta^-n 0.13\%$
	27	(3/2+)	7.09	32 ms 2	β^- , $\beta^-n 2\%$
	28	0+	11.3	17 ms 4	β^- , $\beta^-n 22\%$
	29	(3/2+)	18.0	200 ms 100	β^- , $\beta^-n?$
	30	0+	22.2	>200 ns	β^-
	31	(7/2-)	30.8s	>260 ns	$\beta^-?$, $\beta^-n?$
	32	0+	37.2s	>200 ns	$\beta^-?$, $\beta^-n?$
11 Na	18	(1-)	25.3s		p?, $\epsilon?$
	19	(5/2+)	12.93	<40 ns	p
	20	2+	6.845	447.9 ms 23	ϵ , $\epsilon\alpha 20.05\%$
	21	3/2+	-2.184	22.49 s 4	ϵ
	22	3+	-5.182	2.6019 y 4	ϵ
	23	3/2+	-9.530	100%	
	24	4+	-8.418	14.9512 h 32	β^-
	25	5/2+	-9.358	59.1 s 6	β^-
	26	3+	-6.90	1.072 s 9	β^-
	27	5/2+	-5.58	301 ms 6	β^- , $\beta^-n 0.13\%$
	28	1+	-1.03	30.5 ms 4	β^- , $\beta^-n 0.58\%$
	29	3/2	2.62	44.9 ms 12	β^- , $\beta^-n 22\%$, $\beta^-2n 1.2\%$
	30	2+	8.59	48 ms 2	β^- , $\beta^-n 30\%$, $\beta^-2n 0.9\%$, $\beta^- \alpha 5.5 \times 10^{-50}\%$
	31	3/2+	12.7	17.0 ms 4	β^- , $\beta^-n 37\%$, $\beta^-2n 0.9\%$
	32	(3-,4-)	18.3	13.2 ms 4	β^- , $\beta^-n 24\%$, $\beta^-2n 5.1\%$
	33		26.	8.2 ms 4	β^- , $\beta^-n 52\%$, $\beta^-2n 12\%$
	34		33.s	5.5 ms 10	β^- , β^-n

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode	
Z	El	A	J π	Abundance		
11 Na	35			41.s	1.5 ms 5	β^- , β^-n
12 Mg	20		0+	17.57	90.8 ms 24	ϵ , $\epsilon p \approx 27\%$
	21	(3/2,5/2)+	10.91	122 ms 3	ϵ , ϵp 29.3%	
	22	0+	−0.397	3.857 s 9	ϵ	
	23	3/2+	−5.473	11.317 s 11	ϵ	
	24	0+	−13.933	78.99% 4		
	25	5/2+	−13.193	10.00% 1		
	26	0+	−16.215	11.01% 3		
	27	1/2+	−14.587	9.458 m 12	β^-	
	28	0+	−15.019	20.915 h 9	β^-	
	29	3/2+	−10.66	1.30 s 12	β^-	
	30	0+	−8.88	335 ms 17	β^-	
	31		−3.22	230 ms 20	β^- , β^-n 6.2%	
	32	0+	−0.80	120 ms 20	β^- , β^-n 2.4%	
	33		5.2	90 ms 20	β^- , β^-n 17%	
	34	0+	8.5	20 ms 10	β^- , β^-n	
	35	(7/2−)	16.3 s	70 ms 40	β^- , β^-n 52%	
	36	0+	20.9 s	>200 ns	β^-	
	37	(7/2−)	29.1 s	>260 ns	β^- , β^-n	
13 Al	21	(1/2+)	26.1 s	<35 ns	p	
	22		18.18 s	59 ms 3	ϵ , $\epsilon p > 0\%$, $\epsilon 2p > 0\%$, $\epsilon \alpha > 0\%$	
	23	(5/2+)	6.77	0.47 s 3	ϵ , ϵp	
	24	4+	−0.055	2.053 s 4	ϵ , $\epsilon \alpha$ 0.04%, ϵp 0.0012%	
	24m	1+	0.371	131.3 ms 25	IT 82%, ϵ 18%, $\epsilon \alpha$ 0.03%	
	25	5/2+	−8.916	7.183 s 12	ϵ	
	26	5+	−12.210	7.17×10 ⁵ y 24	ϵ	
	26m	0+	−11.982	6.3452 s 19	ϵ	
	27	5/2+	−17.197	100%		
	28	3+	−16.851	2.2414 m 12	β^-	
	29	5/2+	−18.215	6.56 m 6	β^-	
	30	3+	−15.87	3.60 s 6	β^-	
	31	(3/2,5/2)+	−14.95	644 ms 25	β^-	
	32	1+	−11.06	33 ms 4	β^- , $\beta^-n < 12\%$	
	33		−8.50	>1 μ s	β^- , $\beta^-n < 43\%$	
	34		−2.86	60 ms 18	β^- , β^-n 12.5%	
	35		−0.1	150 ms 50	β^- , β^-n 26%	
	36		5.9	90 ms 40	β^- , $\beta^-n < 31\%$	
	37		9.6		β^-	
	38		15.7 s	>200 ns	β^- ?	
	39	(3/2+)	20.4 s	>200 ns	β^-	
	40			>260 ns	β^- , β^-n	
14 Si	22	0+	32.2 s	29 ms 2	ϵ , ϵp 32%	
	23	(3/2+)	23.8 s	>200 ns	ϵ ?	
	24	0+	10.75	102 ms 35	ϵ , $\epsilon p \approx 7\%$	
	25	5/2+	3.83	220 ms 3	ϵ , ϵp	
	26	0+	−7.145	2.234 s 13	ϵ	
	27	5/2+	−12.384	4.16 s 2	ϵ	
	28	0+	−21.493	92.230% 19		

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV) Abundance	
14 Si		29	1/2+	-21.895	4.683% 8
		30	0+	-24.433	3.087% 5
		31	3/2+	-22.949	157.3 m 3 β^-
		32	0+	-24.081	172 y 4 β^-
		33		-20.49	6.332 s 29 β^-
		34	0+	-19.96	2.77 s 20 β^-
		35		-14.36	0.78 s 12 β^-
		36	0+	-12.4	0.45 s 6 β^- , β^-n 12.4%
		37	(7/2-)	-6.5	90 ms 60 β^- , β^-n 17%
		38	0+	-3.7	>1 μ s β^- , β^-n
		39	(7/2-)	2.1 s	>1 μ s β^-
		40	0+	5.4 s	>200 ns $\beta^-?$
		41		11.8 s	>200 ns $\beta^-?$
		42	0+	15.0 s	>200 ns $\beta^-?$
15 P		24	(1+)	32.0 s	p?, $\epsilon?$
		25	(1/2+)	18.9 s	<30 ns p
		26	(3+)	11.0 s	20 ms +35-15 ϵ , ϵp 2%, $\epsilon 2p$ 2%
		27	(1/2+)	-0.75	260 ms 80 ϵ , ϵp 6%
		28	3+	-7.161	270.3 ms 5 ϵ , ϵp , $\epsilon \alpha$
		29	1/2+	-16.952	4.142 s 15 ϵ
		30	1+	-20.201	2.498 m 4 ϵ
		31	1/2+	-24.441	100%
		32	1+	-24.305	14.262 d 14 β^-
		33	1/2+	-26.338	25.34 d 12 β^-
		34	1+	-24.558	12.43 s 8 β^-
		35	1/2+	-24.858	47.3 s 7 β^-
		36		-20.25	5.6 s 3 β^-
		37		-18.99	2.31 s 13 β^-
		38		-14.5	0.64 s 14 β^- , β^-n 12%
		39		-12.6	0.16 s +30-10 β^- , β^-n 41%
		40		-8.3	260 ms 80 β^- , β^-n 30%
		41		-4.8	120 ms 20 β^- , β^-n 30%
		42		0.1 s	110 ms 30 β^- , β^-n 50%
		43		3.1 s	33 ms 3 β^- , β^-n
		44		9.2 s	>200 ns β^-
		45		14.1 s	>200 ns $\beta^-?$
		46		22.2 s	>200 ns β^-
16 S		26	0+	26.0 s	$\approx$ 10 ms 2p?
		27	(5/2+)	17.5 s	21 ms 4 ϵ , $\epsilon 2p$
		28	0+	4.1	125 ms 10 ϵ , ϵp
		29	5/2+	-3.16	187 ms 4 ϵ , ϵp
		30	0+	-14.063	1.178 s 5 ϵ
		31	1/2+	-19.045	2.572 s 13 ϵ
		32	0+	-26.016	95.02% 9
		33	3/2+	-26.586	0.75% 1
		34	0+	-29.932	4.21% 8
		35	3/2+	-28.846	87.38 d 3 β^-
		36	0+	-30.664	0.02% 1
		37	7/2-	-26.896	5.05 m 2 β^-
		38	0+	-26.861	170.3 m 7 β^-
		39	(3/2,5/2,7/2)-	-23.16	11.5 s 5 β^-
		40	0+	-22.8	8.8 s 22 β^-

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode	
Z	El	A	J π	(MeV)		Abundance
16	S	41	(7/2-)	-18.6	2.6 s 14	β^- , β^-n
		42	0+	-17.2	0.56 s 6	β^- , β^-n < 4%
		43		-12.5	220 ms 65	β^- , β^-n 40%
		44	0+	-10.9s	123 ms 10	β^- , β^-n 18%
		45		-4.8s	82 ms 13	β^- , β^-n 54%
		46	0+	-0.4s	>200 ns	β^-
		47		7.1 s	>200 ns	$\beta^-?$
		48	0+	12.1 s	>200 ns	$\beta^-?$
		49		20.5 s	<200 ns	n
17	Cl	28	(1+)	26.6 s		p?
		29	(3/2+)	13.1 s	<20 ns	p
		30	(3+)	4.4 s	<30 ns	p?
		31		-7.06	150 ms 25	ϵ , ϵp , $\epsilon 2p$, $\epsilon 3p$
		32	1+	-13.331	298 ms 1	ϵ , $\epsilon \alpha$ 0.01%, ϵp 7.0×10 ⁻³ %
		33	3/2+	-21.003	2.511 s 3	ϵ
		34	0+	-24.441	1.5264 s 14	ϵ
		34m	3+	-24.295	32.00 m 4	ϵ 55.4%, IT 44.6%
		35	3/2+	-29.014	75.77% 4	
		36	2+	-29.522	3.01×10 ⁵ y 2	β^- 98.1%, ϵ 1.9%
		37	3/2+	-31.761	24.23% 4	
		38	2-	-29.798	37.24 m 5	β^-
		38m	5-	-29.127	715 ms 3	IT
		39	3/2+	-29.801	55.6 m 2	β^-
		40	2-	-27.56	1.35 m 2	β^-
		41	(1/2,3/2)+	-27.34	38.4 s 8	β^-
		42		-25.0	6.8 s 3	β^-
		43		-24.0	3.3 s 2	β^-
		44		-20.0	0.56 s 11	β^- , β^-n < 8%
		45		-18.9	400 ms 40	β^- , β^-n 24%
		46		-14.8s	223 ms 37	β^- , β^-n 60%
		47		-11.2 s	>200 ns	β^- , β^-n ≤ 3%
		48		-4.8 s	>200 ns	β^-
		49		-0.1 s	≥170 ns	$\beta^-?$
		51	(3/2+)	12.6 s	>200 ns	β^-
18	Ar	30	0+	20.1 s	<20 ns	p?
		31	(5/2+,3/2+)	11.3 s	15.1 ms 12	ϵ , ϵp 55%, $\epsilon 2p$, $\epsilon 3p$
		32	0+	-2.18	98 ms 2	ϵ , ϵp
		33	1/2+	-9.38	173.0 ms 20	ϵ , ϵp 38.7%
		34	0+	-18.378	844.5 ms 34	ϵ
		35	3/2+	-23.048	1.775 s 4	ϵ
		36	0+	-30.230	0.3365% 30	
		37	3/2+	-30.948	35.04 d 4	ϵ
		38	0+	-34.715	0.0632% 5	
		39	7/2-	-33.242	269 y 3	β^-
		40	0+	-35.040	99.6003% 30	
		41	7/2-	-33.067	109.34 m 12	β^-
		42	0+	-34.42	32.9 y 11	β^-
		43	(3/2,5/2)	-31.98	5.37 m 6	β^-
		44	0+	-32.26	11.87 m 5	β^-
		45		-29.72	21.48 s 15	β^-
		46	0+	-29.72	8.4 s 6	β^-

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode	
Z	El	A	J π	(MeV)		Abundance
18	Ar	47		−25.9	≈700 ms	β^- , $\beta^-n<1\%$
		48	0+	−23.2s		β^- ?
		49		−16.6s	≥170 ns	β^-
		50	0+	−13.1s	≥170 ns	β^- ?
		51		−6.3s	>200 ns	β^- ?
		52	0+	−1.7s	10 ms	β^-
		53	(5/2−)	6.s	3 ms <i>SY</i>	β^- , β^-n
19	K	32		20.4s		p?
		33	(3/2+)	6.8s	<25 ns	p
		34	(1+)	−1.5s	<25 ns	p
		35	3/2+	−11.17	190 ms <i>30</i>	ϵ , ϵp 0.37%
		36	2+	−17.425	342 ms <i>2</i>	ϵ , ϵp 0.05%, $\epsilon\alpha$ 3.4×10 ^{−3} %
		37	3/2+	−24.799	1.226 s <i>7</i>	ϵ
		38	3+	−28.802	7.636 m <i>18</i>	ϵ
		38m	0+	−28.672	923.9 ms <i>6</i>	ϵ
		39	3/2+	−33.807	93.2581% 44	
		40	4−	−33.535	1.277×10 ⁹ y <i>8</i> 0.0117% 1	β^- 89.28%, ϵ 10.72%
		41	3/2+	−35.559	6.7302% 44	
		42	2−	−35.021	12.360 h <i>3</i>	β^-
		43	3/2+	−36.593	22.3 h <i>1</i>	β^-
		44	2−	−35.81	22.13 m <i>19</i>	β^-
		45	3/2+	−36.61	17.3 m <i>6</i>	β^-
		46	(2−)	−35.42	105 s <i>10</i>	β^-
		47	1/2+	−35.697	17.50 s <i>24</i>	β^-
		48	(2−)	−32.12	6.8 s <i>2</i>	β^- , β^-n 1.14%
		49	(3/2+)	−30.32	1.26 s <i>5</i>	β^- , β^-n 86%
		50	(0−,1,2−)	−25.4	472 ms <i>4</i>	β^- , β^-n 29%
		51	(1/2+,3/2+)	−22.0s	365 ms <i>5</i>	β^- , β^-n 47%
		52	2−	−16.2s	105 ms <i>5</i>	β^- , β^-n ≈64%
		53	(3/2+)	−12.0s	30 ms <i>5</i>	β^- , β^-n ≈67%, β^-2n ≈17%
		54		−5.6s	10 ms <i>5</i>	β^- , $\beta^-n>0\%$
20	Ca	34	0+	13.2s	<35 ns	p
		35		4.44s	25.7 ms <i>2</i>	ϵ , ϵp , $\epsilon 2p$
		36	0+	−6.44	102 ms <i>2</i>	ϵ , ϵp 57%
		37	3/2+	−13.16	181.1 ms <i>11</i>	ϵ , ϵp 76%
		38	0+	−22.059	440 ms <i>8</i>	ϵ
		39	3/2+	−27.276	859.6 ms <i>14</i>	ϵ
		40	0+	−34.846	96.94% 16	
		41	7/2−	−35.138	1.03×10 ⁵ y <i>3</i>	ϵ
		42	0+	−38.547	0.647% 23	
		43	7/2−	−38.408	0.135% 10	
		44	0+	−41.469	2.09% 11	
		45	7/2−	−40.813	162.61 d <i>9</i>	β^-
		46	0+	−43.135	>0.28×10 ¹⁶ y 0.004% 3	2 β^-
		47	7/2−	−42.340	4.536 d <i>3</i>	β^-
		48	0+	−44.215	>4×10 ¹⁹ y 0.187% 21	2 β^-
		49	3/2−	−41.290	8.718 m <i>6</i>	β^-

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode	
Z	El	A	J π	(MeV)		Abundance
20	Ca	50	0+	-39.571	13.9 s 6	β^-
		51	(3/2-)	-35.89	10.0 s 8	β^- , β^-n
		52	0+	-32.5	4.6 s 3	β^- , β^-n <2%
		53	(3/2-,5/2-)	-27.9s	90 ms 15	β^- , β^-n >30%
		54	0+	-23.6s		β^-
		56	0+	-13.2s	10 ms	β^-
21	Sc	36		13.9s		p?
		37		2.8s		p?
		38	(2-)	-4.9s	<300 ns	p
		39		-14.17	<300 ns	p
		40	4-	-20.526	182.3 ms 7	ϵ , ϵp 0.44%, $\epsilon\alpha$ 0.02%
		41	7/2-	-28.642	596.3 ms 17	ϵ
		42	0+	-32.121	680.67 ms 28	ϵ
		42m	7+, (5,6)+	-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-	-41.069	100%	
		45m	3/2+	-41.057	318 ms 7	IT
		46	4+	-41.759	83.79 d 4	β^-
		46m	1-	-41.616	18.75 s 4	IT
		47	7/2-	-44.332	3.3492 d 6	β^-
		48	6+	-44.493	43.67 h 9	β^-
		49	7/2-	-46.552	57.2 m 2	β^-
		50	5+	-44.54	102.5 s 5	β^-
		50m	(2,3)+	-44.28	0.35 s 4	IT>97.5%, β^- <2.5%
		51	(7/2)-	-43.22	12.4 s 1	β^-
		52	3+	-40.4	8.2 s 2	β^-
		53	(7/2-)	-38.0s	>3 s	β^- , β^-n
		54		-34.5	225 ms 40	β^-
		55	(7/2-)	-30.s	120 ms 40	β^- , β^-n
		56	3+	-25.5s	80 ms	β^-
		57		-21.4s		β^- , β^-n
22	Ti	38	0+	9.1s	<120 ns	2p?
		39		1.2s	26 ms 8	ϵ , $\epsilon\alpha$?, $\epsilon 2p$?
		40	0+	-8.9	50 ms 15	ϵ , ϵp
		41	3/2+	-15.71s	80 ms 2	ϵ , ϵp ≈100%
		42	0+	-25.121	199 ms 6	ϵ
		43	7/2-	-29.320	509 ms 5	ϵ
		44	0+	-37.548	60.0 y 11	ϵ
		45	7/2-	-39.007	184.8 m 5	ϵ
		46	0+	-44.125	8.25% 3	
		47	5/2-	-44.932	7.44% 2	
		48	0+	-48.487	73.72% 3	
		49	7/2-	-48.558	5.41% 2	
		50	0+	-51.426	5.18% 2	
		51	3/2-	-49.727	5.76 m 1	β^-
		52	0+	-49.464	1.7 m 1	β^-
		53	(3/2)-	-46.8	32.7 s 9	β^-
		54	0+	-45.8	>1 μs	β^-
		55	(3/2-)	-41.8	0.32 s 6	β^-

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV) Abundance	
22 Ti	56		0+	-39.1	0.19 s 4 β^- , β^-n
	57			-34.6s	0.18 s 3 β^- , β^-n
	58		0+	-31.6s	>150 ns β^-
	61			-16.8s	≈ 10 ms β^- ?
23 V	40			10.3s	p?
	41			-0.2s	p?
	42		(2-)	-8.2s	<55 ns p
	43			-18.0s	>800 ms ϵ
	44		(2+)	-23.85s	111 ms 7 ϵ , $\epsilon\alpha$
	44m		(6+)	-23.85s	150 ms 3 ϵ
	45		7/2-	-31.87	547 ms 6 ϵ
	46		0+	-37.074	422.50 ms 11 ϵ
	47		3/2-	-42.004	32.6 m 3 ϵ
	48		4+	-44.475	15.9735 d 25 ϵ
	49		7/2-	-47.956	330 d 15 ϵ
	50		6+	-49.217	1.4×10^{17} y 4 ϵ 83%, 0.250% 2 β^- 17%
	51		7/2-	-52.197	99.750% 2
	52		3+	-51.437	3.743 m 5 β^-
	53		7/2-	-51.845	1.60 m 4 β^-
	54		3+	-49.89	49.8 s 5 β^-
	55		(7/2-)	-49.1	6.54 s 15 β^-
	56		3+	-46.2	0.24 s 4 β^- , β^-n 0.06%
	57		(7/2-)	-44.4	0.34 s 8 β^- , β^-n 0.04%
	58			-40.4	205 ms 20 β^-
	59			-37.9	118 ms 24 β^-
	60		(3+)	-33.1	0.20 s 4 β^- , β^-n
	61			-30.4s	>150 ns β^- ?
	62		(3+)	-25.0s	>150 ns β^-
	63		(7/2-)	-21.7s	>150 ns β^-
	64				>150 ns β^-
24 Cr	42		0+	6.0s	>350 ns ϵ , 2p?
	43		(3/2+)	-2.14s	21 ms +4-3 ϵ , ϵp 18%, $\epsilon 2p$
	44		0+	-13.5s	53 ms +4-3 ϵ , ϵp >7%
	45			-19.4s	50 ms 6 ϵ , ϵp >27%
	46		0+	-29.47	0.26 s 6 ϵ
	47		3/2-	-34.55	500 ms 15 ϵ
	48		0+	-42.815	21.56 h 3 ϵ
	49		5/2-	-45.325	42.3 m 1 ϵ
	50		0+	-50.255	$>1.8 \times 10^{17}$ y 2 ϵ 4.345% 13
	51		7/2-	-51.445	27.7025 d 24 ϵ
	52		0+	-55.413	83.789% 18
	53		3/2-	-55.281	9.501% 17
	54		0+	-56.928	2.365% 7
	55		3/2-	-55.103	3.497 m 3 β^-
	56		0+	-55.289	5.94 m 10 β^-
	57		3/2-, 5/2-, 7/2-	-52.39	21.1 s 10 β^-
	58		0+	-51.9	7.0 s 3 β^-
	59			-47.9	0.74 s 24 β^-
	60		0+	-46.8	0.57 s 6 β^-
	61			-42.8	0.27 s 2 β^-

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
24	Cr	62	0+	-41.2	0.19 s 3 β^- , β^-n 1.04%
		63		-35.5s	0.11 s 7 β^- , β^-n 1.42%
		64	0+	-33.3s	>1 μ s β^- ?
		65	(1/2-)	-27.6s	>150 ns β^-
		66	0+		>150 ns β^-
		67			$\approx$ 50 ms β^- ?
25	Mn	44	(2-)	6.4s	<105 ns ϵ , p
		45	(7/2-)	-5.1s	<70 ns p
		46	(4+)	-12.4s	41 ms +7-6 ϵ , ϵ p 22%
		47		-22.3s	100 ms 50 ϵ , ϵ p 3.4%
		48	4+	-29.00s	158.1 ms 22 ϵ , ϵ p 0.28%, $\epsilon\alpha < 6.0 \times 10^{-4}\%$
		49	5/2-	-37.61	382 ms 7 ϵ
		50	0+	-42.621	283.29 ms 8 ϵ
		50m	5+	-42.393	1.75 m 3 ϵ
		51	5/2-	-48.237	46.2 m 1 ϵ
		52	6+	-50.701	5.591 d 3 ϵ
		52m	2+	-50.323	21.1 m 2 ϵ 98.25%, IT 1.75%
		53	7/2-	-54.684	3.74×10^6 y 4 ϵ
		54	3+	-55.551	312.11 d 5 ϵ , $\beta^- < 2.9 \times 10^{-4}\%$
		55	5/2-	-57.706	100%
		56	3+	-56.906	2.5789 h 1 β^-
		57	5/2-	-57.485	85.4 s 18 β^-
		58	1+	-55.90	3.0 s 1 β^-
		58m	(4)+	-55.83	65.2 s 5 $\beta^- \approx 80\%$, IT $\approx 20\%$
		59	3/2-, 5/2-	-55.47	4.6 s 1 β^-
		60	0+	-52.9	51 s 6 β^- , β^-n 0.03%
		60m	3+	-52.6	1.77 s 2 β^- 88.5%, IT 11.5%
		61	(5/2)-	-51.7	0.67 s 4 β^-
		62	(3+)	-48.5	671 ms 5 β^-
		63		-46.8	275 ms 4 β^-
		64		-43.1	89 ms 4 β^- , β^-n 1.42%
		65		-40.9	88 ms 4 β^- , β^-n 6.92%
		66		-36.5s	66 ms 4 β^- , β^-n 10.88%
		67	(5/2-)	-33.7s	42 ms 4 β^- , β^-n
		68			28 ms 4 β^- , β^-n
		69	5/2-		14 ms 4 β^- , β^-n 23.6%
26	Fe	45	(3/2+)	13.6s	>350 ns p?, 2p?
		46	0+	0.8s	20 ms +20-8 ϵ , ϵ p
		47		-6.6s	27 ms +32-10 ϵ , ϵ p
		48	0+	-18.1s	44 ms 7 ϵ , ϵ p 3.6%
		49	(7/2-)	-24.6s	70 ms 3 ϵ , ϵ p 52%
		50	0+	-34.47	155 ms 11 ϵ , ϵ p?
		51	5/2-	-40.22	305 ms 5 ϵ
		52	0+	-48.33	8.275 h 8 ϵ
		52m	(12+)	-41.51	45.9 s 6 ϵ
		53	7/2-	-50.941	8.51 m 2 ϵ
		53m	19/2-	-47.901	2.526 m 24 IT
		54	0+	-56.248	$> 3.1 \times 10^{22}$ y 2 ϵ
					5.845% 35
		55	3/2-	-57.475	2.73 y 3 ϵ
		56	0+	-60.601	91.754% 36

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV) Abundance	
26	Fe	57	1/2−	−60.176	2.119% 10
		58	0+	−62.149	0.282% 4
		59	3/2−	−60.658	44.472 d 8 β −
		60	0+	−61.407	1.5×10 ⁶ y 3 β −
		61	3/2−, 5/2−	−58.92	5.98 m 6 β −
		62	0+	−58.90	68 s 2 β −
		63	(5/2)−	−55.8	6.1 s 6 β −
		64	0+	−55.1	2.0 s 2 β −
		65		−51.3	0.4 s 2 β −
		66	0+	−50.3	0.44 s 6 β −
		67		−46.6	0.47 s 5 β −, β −n 1.13%
		68	0+	−44.2 s	0.10 s 6 β −
		69	1/2−	−39.4 s	0.17 s 3 β −, β −n 6.94%
		70	0+		>150 ns β −
		71	(7/2+)		>150 ns β −
		72	0+		>150 ns β −
27	Co	48		1.6 s	p ?
		49		−9.6 s	<35 ns ϵ , p
		50	(6+)	−17.2 s	44 ms 4 ϵ , ϵ p 54%
		51	(7/2−)	−27.3 s	>200 ns ϵ
		52	6+	−33.92 s	115 ms 23 ϵ , ϵ p
		53	(7/2−)	−42.64	240 ms 20 ϵ
		53m	(19/2−)	−39.45	247 ms 12 $\epsilon \approx 98.5\%$, p $\approx 1.5\%$
		54	0+	−48.005	193.28 ms 7 ϵ
		54m	(7)+	−47.806	1.48 m 2 ϵ
		55	7/2−	−54.024	17.53 h 3 ϵ
		56	4+	−56.035	77.233 d 27 ϵ
		57	7/2−	−59.340	271.74 d 6 ϵ
		58	2+	−59.841	70.86 d 7 ϵ
		58m	5+	−59.817	9.04 h 11 IT
		59	7/2−	−62.224	100%
		60	5+	−61.644	1925.1 d 5 β −
		60m	2+	−61.585	10.467 m 6 IT 99.76%, β − 0.24%
		61	7/2−	−62.895	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−)	−59.16	1.20 s 6 β −
		66	(3+)	−56.1	0.233 s 17 β −
		67	(7/2−)	−55.3	0.425 s 20 β −
		68		−51.8	0.18 s 10 β −
		69	7/2−	−51.0	0.27 s 5 β −
		70		−46.8 s	0.15 s 2 β −, β −n 2.51%
		71		−45.0 s	0.21 s 4 β −, β −n 2.61%
		72		−40.6 s	0.09 s 2 β −, β −n 4.8%
		73	(7/2−)		>150 ns β −
		74	0+		>150 ns β −
		75	(7/2−)		>150 ns β −
28	Ni	49			>350 ns ϵ , p
		50	0+	−3.8 s	>300 ns ϵ
		51	(7/2−)	−11.4 s	>200 ns ϵ

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
28 Ni	52		0+	-22.65s	38 ms 5 ϵ , $\epsilon p > 17\%$
	53		(7/2-)	-29.4s	45 ms 15 ϵ , $\epsilon p \approx 45\%$
	54		0+	-39.21	143 ms 23 ϵ
	55		7/2-	-45.33	204 ms 4 ϵ
	56		0+	-53.90	6.075 d 10 ϵ
	57		3/2-	-56.076	35.60 h 6 ϵ
	58		0+	-60.223	68.077% 9
	59		3/2-	-61.151	7.6×10^4 y 5 ϵ
	60		0+	-64.468	26.223% 8
	61		3/2-	-64.217	1.140% 1
	62		0+	-66.743	3.634% 2
	63		1/2-	-65.509	100.1 y 20 β^-
	64		0+	-67.096	0.926% 1
	65		5/2-	-65.123	2.5172 h 3 β^-
	66		0+	-66.03	54.6 h 3 β^-
	67		(1/2-)	-63.74	21 s 1 β^-
	68		0+	-63.49	29 s 2 β^-
	69		9/2+	-60.4	11.4 s 3 β^-
	70		0+	-59.5	6.0 s 3 β^-
	71			-55.9	2.56 s 3 β^-
	72		0+	-54.7	1.57 s 50 β^- , $\beta^- n$
	73			-50.2s	0.84 s 3 β^- , $\beta^- n$ 0.3%
	74		0+	-48.5s	0.9 s 2 β^- , $\beta^- n$ 4.53%
	75		(7/2+)	-43.8s	0.6 s 2 β^- , $\beta^- n$ 8.43%
	76		0+	-41.6s	0.24 s +55-24 β^- , $\beta^- n$
	77			-36.5s	>150 ns β^- ?
	78		0+	-34.s	>150 ns β^-
29 Cu	52		3+	-2.6s	p
	53		(3/2-)	-13.5s	<300 ns ϵ , p
	54		(3+)	-21.7s	<75 ns p
	55			-31.6s	>200 ns ϵ
	56		4+	-38.6s	78 ms 15 ϵ
	57		3/2-	-47.31	196.3 ms 7 ϵ
	58		1+	-51.660	3.204 s 7 ϵ
	59		3/2-	-56.352	81.5 s 5 ϵ
	60		2+	-58.341	23.7 m 4 ϵ
	61		3/2-	-61.980	3.333 h 5 ϵ
	62		1+	-62.794	9.67 m 3 ϵ
	63		3/2-	-65.576	69.17% 3
	64		1+	-65.421	12.700 h 2 ϵ 61%, β^- 39%
	65		3/2-	-67.260	30.83% 3
	66		1+	-66.254	5.120 m 14 β^-
	67		3/2-	-67.300	61.83 h 12 β^-
	68		1+	-65.54	31.1 s 15 β^-
	68m		(6-)	-64.82	3.75 m 5 IT 84%, β^- 16%
	69		3/2-	-65.740	2.85 m 15 β^-
	70		1+	-62.96	4.5 s 10 β^-
	70m		3-, 4-, 5-	-62.82	47 s 5 β^-
	71		(3/2-)	-62.76	19.5 s 16 β^-
	72		(1+)	-60.1s	6.6 s 1 β^-
	73			-59.2s	3.9 s 3 β^-
	74		(1+, 3+)	-55.7s	1.594 s 10 β^-

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	Abundance	
29 Cu	75	(3/2-)	-54.3 s	1.224 s 3	β^- , β^-n 3.5%
	76m		-50.3 s	0.641 s 6	β^- , β^-n 3%
	76m		-50.3 s	1.27 s 30	β^-
	77		-48.5 s	0.469 s 8	β^-
	78		-44.0 s	342 ms 11	β^-
	79		-41.7 s	188 ms 25	β^- , β^-n 55%
	80		-35.5 s	>150 ns	β^-
30 Zn	54	0+	-6.6 s		2p?
	55		-14.9 s		$\epsilon?$, 2p?
	56	0+	-25.7 s	36 ms 10	ϵ
	57	(7/2-)	-32.7 s	40 ms 10	ϵ , $\epsilon p \geq 65\%$
	58	0+	-42.29	86 ms 18	ϵ
	59	3/2-	-47.26	182.0 ms 18	ϵ , ϵp 0.1%
	60	0+	-54.18	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
	62	0+	-61.17	9.186 h 13	ϵ
	63	3/2-	-62.209	38.47 m 5	ϵ
	64	0+	-65.999	48.63% 60	
	65	5/2-	-65.908	244.26 d 26	ϵ
	66	0+	-68.896	27.90% 27	
	67	5/2-	-67.877	4.10% 13	
	68	0+	-70.004	18.75% 51	
	69	1/2-	-68.415	56.4 m 9	β^-
	69m	9/2+	-67.976	13.76 h 2	IT 99.97%, β^- 0.03%
	70	0+	-69.559	>5 $\times 10^{14}$ y	2 β^-
				0.62% 3	
	71	1/2-	-67.32	2.45 m 10	β^-
	71m	9/2+	-67.16	3.96 h 5	β^- , IT $\leq 0.05\%$
	72	0+	-68.128	46.5 h 1	β^-
	73	(1/2)-	-65.41	23.5 s 10	β^-
	73m	(7/2+)	-65.21	5.8 s 8	β^- , IT
	74	0+	-65.71	95.6 s 12	β^-
	75	(7/2+)	-62.47	10.2 s 2	β^-
	76	0+	-62.0	5.7 s 3	β^-
	77	(7/2+)	-58.6	2.08 s 5	β^-
	77m	(1/2-)	-57.8	1.05 s 10	IT > 50%, β^- < 50%
	78	0+	-57.2	1.47 s 15	β^-
	79	(9/2+)	-53.4 s	0.995 s 19	β^- , β^-n 1.3%
	80	0+	-51.8	0.545 s 16	β^- , β^-n 1%
	81		-46.1 s	0.29 s 5	β^- , β^-n 7.5%
	82	0+	-42.1 s	>150 ns	β^-
	83	(5/2+)		>150 ns	β^-
31 Ga	56		-4.7 s		p?
	57		-15.9 s		p?
	58		-24.0 s		p?
	59		-34.1 s		p?
	60		-40.0 s	>1.2 μ s	$\epsilon?$
	61	3/2-	-47.3 s	0.15 s 3	ϵ
	62	0+	-52.00	116.12 ms 30	ϵ

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV) Abundance	
31 Ga	63	3/2 ⁻ , 5/2 ⁻	-56.7	32.4 s 5	ϵ
	64	0 ⁺	-58.835	2.627 m 12	ϵ
	65	3/2 ⁻	-62.653	15.2 m 2	ϵ
	66	0 ⁺	-63.721	9.49 h 7	ϵ
	67	3/2 ⁻	-66.877	3.2612 d 6	ϵ
	68	1 ⁺	-67.083	67.629 m 24	ϵ
	69	3/2 ⁻	-69.321	60.108% 9	
	70	1 ⁺	-68.905	21.14 m 3	β^- 99.59%, ϵ 0.41%
	71	3/2 ⁻	-70.137	39.892% 9	
	72	3 ⁻	-68.587	14.10 h 2	β^-
	73	3/2 ⁻	-69.704	4.86 h 3	β^-
	74	(3 ⁻)	-68.05	8.12 m 12	β^-
	74m	(0)	-67.99	9.5 s 10	IT 75%, β^- < 50%
	75	(3/2 ⁻)	-68.464	126 s 2	β^-
	76	(2 ⁺ , 3 ⁺)	-66.20	32.6 s 6	β^-
	77	(3/2 ⁻)	-65.87	13.2 s 2	β^-
	78	(3 ⁺)	-63.66	5.09 s 5	β^-
	79	(3/2 ⁻)	-62.5	2.847 s 3	β^- , β^- -n 0.089%
	80	(3)	-59.1	1.697 s 11	β^- , β^- -n 0.89%
	81	(5/2 ⁻)	-58.0	1.217 s 5	β^- , β^- -n 11.9%
	82	(1, 2, 3)	-52.9s	0.599 s 2	β^- , β^- -n 22.3%
	83		-49.5s	0.31 s 1	β^- , β^- -n 40%
	84		-44.4s	0.085 s 10	β^- , β^- -n 70%
	85	(3/2 ⁻)		>150 ns	β^-
	86			>150 ns	β^-
32 Ge	58	0 ⁺	-8.4s		2p?
	59		-17.0s		2p?
	60	0 ⁺	-27.8s	$\approx$ 30 ms	ϵ ?, 2p?
	61	(3/2 ⁻)	-33.7s	40 ms 15	ϵ , ϵ p $\approx$ 80%
	62	0 ⁺	-42.2s	>150 ns	ϵ ?
	63		-46.9s	95 ms +23-20	ϵ
	64	0 ⁺	-54.4	63.7 s 25	ϵ
	65	(3/2 ⁻)	-56.4	30.9 s 5	ϵ
	66	0 ⁺	-61.62	2.26 h 5	ϵ
	67	1/2 ⁻	-62.654	18.9 m 3	ϵ
	68	0 ⁺	-66.977	270.8 d 3	ϵ
	69	5/2 ⁻	-67.094	39.05 h 10	ϵ
	70	0 ⁺	-70.560	20.37% 18	
	71	1/2 ⁻	-69.905	11.43 d 3	ϵ
	72	0 ⁺	-72.586	27.31% 26	
	73	9/2 ⁺	-71.297	7.76% 8	
	73m	1/2 ⁻	-71.230	0.499 s 11	IT
	74	0 ⁺	-73.422	36.73% 15	
	75	1/2 ⁻	-71.856	82.78 m 4	β^-
	75m	7/2 ⁺	-71.716	47.7 s 5	IT 99.97%, β^- 0.03%
	76	0 ⁺	-73.213	0.8 $\times$ 10 ²⁵ y	2 β^-
				7.83% 7	
	77	7/2 ⁺	-71.214	11.30 h 1	β^-
	77m	1/2 ⁻	-71.054	52.9 s 6	β^- 81%, IT 19%
	78	0 ⁺	-71.862	88.0 m 10	β^-
	79	(1/2 ⁻)	-69.49	18.98 s 3	β^-
	79m	(7/2 ⁺)	-69.30	39.0 s 10	β^- 96%, IT 4%

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	Abundance	
32	Ge	80	0+	-69.45	29.5 s 4 β^-
		81	(9/2+)	-66.3	7.6 s 6 β^-
		81m	(1/2+)	-65.6	7.6 s 6 β^-
		82	0+	-65.6	4.60 s 35 β^-
		83	(5/2+)	-61.0s	1.85 s 6 β^-
		84	0+	-58.4s	0.947 s 11 β^- , β^-n 10.8%
		85		-53.4s	535 ms 47 β^- , β^-n 14%
		86	0+	-50.0s	>150 ns $\beta^-?$, $\beta^-n?$
		87	(5/2+)		>150 ns β^-
		88	0+		>150 ns β^-
		89			>150 ns β^-
33	As	60		-6.4s	p?
		61		-18.1s	p?
		62		-25.0s	p?
		63		-33.8s	p?
		64		-39.5s	>1.2 μ s $\epsilon?$
		65		-47.1s	0.19 s +11-7 ϵ
		66		-51.8s	95.77 ms 23 ϵ
		67	(5/2-)	-56.6	42.5 s 12 ϵ
		68	3+	-58.9	151.6 s 8 ϵ
		69	5/2-	-63.08	15.2 m 2 ϵ
		70	4(+)	-64.34	52.6 m 3 ϵ
		71	5/2-	-67.892	65.28 h 15 ϵ
		72	2-	-68.229	26.0 h 1 ϵ
		73	3/2-	-70.956	80.30 d 6 ϵ
		74	2-	-70.860	17.77 d 2 ϵ 66%, β^- 34%
		75	3/2-	-73.033	100%
		76	2-	-72.290	1.0778 d 20 β^-
		77	3/2-	-73.916	38.83 h 5 β^-
		78	2-	-72.816	90.7 m 2 β^-
		79	3/2-	-73.636	9.01 m 15 β^-
		80	1+	-72.12	15.2 s 2 β^-
		81	3/2-	-72.533	33.3 s 8 β^-
		82	(1+)	-70.3	19.1 s 5 β^-
		82m	(5-)	-70.3	13.6 s 4 β^-
		83	(5/2-,3/2-)	-69.9	13.4 s 3 β^-
		84	(3-)	-66.1s	3.24 s 26 β^- , β^-n 0.28%
		85	(3/2-)	-63.5s	2.021 s 10 β^- , β^-n 59.4%
		86		-59.4s	0.945 s 8 β^- , β^-n 33%
		87	(3/2-)	-56.3s	0.48 s 4 β^- , β^-n 15.4%
		88		-51.6s	>150 ns $\beta^-?$, $\beta^-n?$
		89		-47.3s	$\beta^-?$
		90			>150 ns $\beta^-?$
		91			>150 ns β^-
		92			>150 ns β^-
34	Se	65		-32.9s	<50 ms ϵ
		66	0+	-41.7s	>1.2 μ s ϵ
		67		-46.5s	60 ms +17-11 ϵ , ϵp 0.5%
		68	0+	-54.1s	35.5 s 7 ϵ
		69	(1/2-,3/2-)	-56.30	27.4 s 2 ϵ , ϵp 0.05%
		70	0+	-61.9s	41.1 m 3 ϵ
		71	5/2-	-63.1s	4.74 m 5 ϵ

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
34 Se	72		0+	-67.89	8.40 d 8 ϵ
	73		9/2+	-68.22	7.15 h 8 ϵ
	73m		3/2-	-68.19	39.8 m 13 IT 72.6%, ϵ 27.4%
	74		0+	-72.213	0.89% 4
	75		5/2+	-72.169	119.779 d 4 ϵ
	76		0+	-75.252	9.37% 29
	77		1/2-	-74.599	7.63% 16
	77m		7/2+	-74.437	17.36 s 5 IT
	78		0+	-77.026	23.77% 28
	79		7/2+	-75.917	1.1 $\times$ 10 ⁶ y 2 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+	-77.593	0.83 $\times$ 10 ²⁰ y 12 2 β^-
					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+	-75.95	3.10 m 10 β^-
	85		(5/2+)	-72.43	31.7 s 9 β^-
	86		0+	-70.54	15.3 s 9 β^-
	87		(5/2+)	-66.58	5.29 s 11 β^- , β^- -n 0.36%
	88		0+	-63.88	1.53 s 6 β^- , β^- -n 0.99%
	89		(5/2+)	-59.6s	0.41 s 4 β^- , β^- -n 7.8%
	90		0+	-56.4s	>150 ns β^- ?
	91			-50.9s	0.27 s 5 β^- , β^- -n 21%
	92		0+	-47.2s	>150 ns β^-
	93		(1/2+)		>150 ns β^-
	94		0+		>150 ns β^-
35 Br	67			-32.8s	p?
	68			-38.9s	<1.2 μ s p?
	69			-46.4s	<24 ns p
	70			-51.6s	79.1 ms 8 ϵ
	70m			-51.6s	2.2 s 2 ϵ
	71		(5/2)-	-56.6s	21.4 s 6 ϵ
	72		3+	-59.2	78.6 s 24 ϵ
	72m		1-	-59.1	10.6 s 3 IT $\approx$ 100%, ϵ
	73		1/2-	-63.5	3.4 m 2 ϵ
	74		(0-)	-65.31	25.4 m 3 ϵ
	74m		4(+)	-65.29	46 m 2 ϵ
	75		3/2-	-69.14	96.7 m 13 ϵ
	76		1-	-70.289	16.2 h 2 ϵ
	76m		(4)+	-70.186	1.31 s 2 IT > 99.4%, ϵ < 0.6%
	77		3/2-	-73.234	57.036 h 6 ϵ
	77m		9/2+	-73.128	4.28 m 10 IT
	78		1+	-73.452	6.46 m 4 ϵ $\geq$ 99.99%, β^- $\leq$ 0.01%
	79		3/2-	-76.068	50.69% 7
	79m		9/2+	-75.860	4.86 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-	-77.974	49.31% 7

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV) Abundance	
35 Br	82	5-	-77.496	35.30 h 2	β^-
	82m	2-	-77.450	6.13 m 5	IT 97.6%, β^- 2.4%
	83	3/2-	-79.009	2.40 h 2	β^-
	84	2-	-77.78	31.80 m 8	β^-
	84m	6-	-77.46	6.0 m 2	β^-
	85	3/2-	-78.61	2.90 m 6	β^-
	86	(2-)	-75.64	55.1 s 4	β^-
	87	3/2-	-73.86	55.60 s 15	β^- , β^- -n 2.52%
	88	(1,2-)	-70.73	16.29 s 6	β^- , β^- -n 6.58%
	89	(3/2-, 5/2-)	-68.57	4.40 s 3	β^- , β^- -n 13.8%
	90		-64.61	1.91 s 1	β^- , β^- -n 25.2%
	91		-61.51	0.541 s 5	β^- , β^- -n 20%
	92	(2-)	-56.58	0.343 s 15	β^- , β^- -n 33.1%
	93	(5/2-)	-53.0s	102 ms 10	β^- , β^- -n 10%
	94		-47.8s	70 ms 20	β^- , β^- -n 30%
	95	(3/2-)		>150 ns	β^-
	96			>150 ns	β^-
	97	(3/2-)		>150 ns	β^-
36 Kr	69		-32.3s	32 ms 10	ϵ , ϵ p
	70	0+	-41.0s	>1.2 μ s	ϵ ?
	71	(5/2)-	-46.1s	100 ms 3	ϵ , ϵ p 5.2%
	72	0+	-54.1	17.2 s 3	ϵ
	73	5/2-	-56.9	27.0 s 12	ϵ , ϵ p 0.68%
	74	0+	-62.17	11.50 m 11	ϵ
	75	5/2+	-64.24	4.29 m 17	ϵ
	76	0+	-68.98	14.8 h 1	ϵ
	77	5/2+	-70.171	74.4 m 6	ϵ
	78	0+	-74.160	$\geq 0.9 \times 10^{20}$ y	2 ϵ
				0.35% 1	
	79	1/2-	-74.442	35.04 h 10	ϵ
	79m	7/2+	-74.312	50 s 3	IT
	80	0+	-77.893	2.28% 6	
	81	7/2+	-77.694	2.29×10^5 y 11	ϵ
	81m	1/2-	-77.503	13.10 s 3	IT, ϵ $2.5 \times 10^{-3}\%$
	82	0+	-80.589	11.58% 14	
	83	9/2+	-79.982	11.49% 6	
	83m	1/2-	-79.940	1.83 h 2	IT
	84	0+	-82.431	57.00% 4	
	85	9/2+	-81.481	3934.4 d 14	β^-
	85m	1/2-	-81.176	4.480 h 8	β^- 78.6%, IT 21.4%
	86	0+	-83.266	17.30% 22	
	87	5/2+	-80.710	76.3 m 6	β^-
	88	0+	-79.69	2.84 h 3	β^-
	89	3/2(+)	-76.72	3.15 m 4	β^-
	90	0+	-74.96	32.32 s 9	β^-
	91	5/2(+)	-71.31	8.57 s 4	β^-
	92	0+	-68.79	1.840 s 8	β^- , β^- -n 0.03%
	93	1/2+	-64.0	1.286 s 10	β^- , β^- -n 1.95%
	94	0+	-61.1s	0.20 s 1	β^- , β^- -n 5.7%
	95	1/2	-56.0s	0.78 s 3	β^-
	96	0+	-53.0s	>50 ms	β^- ?
	97		-47.9s	>150 ns	β^-

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
36	Kr	98	0+	>150 ns	β^- ?
		99	(3/2+)	>150 ns	β^-
		100	0+	>150 ns	β^-
37	Rb	71		-32.3 s	p ?
		72	(3+)	-38.1 s	p
		73	(5/2-)	-46.2 s	p
		74	(0+)	-51.7	64.9 ms 5
		75	(3/2-)	-57.222	19.0 s 12
		76	1(-)	-60.480	36.5 s 6
		77	3/2-	-64.826	3.77 m 4
		78	0(+)	-66.936	17.66 m 8
		78m	4(-)	-66.833	5.74 m 5
		79	5/2+	-70.797	22.9 m 5
		80	1+	-72.173	33.4 s 7
		81	3/2-	-75.456	4.576 h 5
		81m	9/2+	-75.370	30.5 m 3
		82	1+	-76.189	1.273 m 2
		82m	5-	-76.120	6.472 h 6
		83	5/2-	-79.073	86.2 d 1
		84	2-	-79.750	32.77 d 14
		84m	6-	-79.286	20.26 m 4
		85	5/2-	-82.168	72.17% 2
		86	2-	-82.747	18.631 d 18
					β^- 99.99%, ϵ $5.2 \times 10^{-3}\%$
		86m	6-	-82.191	1.017 m 3
		87	3/2-	-84.595	4.75×10^{10} y 4
					27.83% 2
		88	2-	-82.606	17.78 m 11
		89	3/2-	-81.711	15.15 m 12
		90	0-	-79.355	158 s 5
		90m	3-	-79.248	258 s 4
		91	3/2(-)	-77.748	58.4 s 4
		92	0-	-74.775	4.492 s 20
		93	5/2-	-72.626	5.84 s 2
		94	3(-)	-68.551	2.702 s 5
		95	5/2-	-65.84	377.5 ms 8
		96	2+	-61.21	202.8 ms 33
		97	3/2+	-58.36	169.9 ms 7
		98	(1,0)	-54.30	114 ms 5
					β^- , β^- n 13.8%, β^- 2n 0.05%
		99	(5/2+)	-50.8	50.3 ms 7
		100		-46.7 s	51 ms 8
					β^- , β^- n 6%, β^- 2n 0.16%
		101	(3/2+)	-43.6	32 ms 5
					β^- , β^- n 28%
38	Sr	73		-31.7 s	ϵ , ϵ p
		74	0+	-40.7 s	ϵ
		75	(3/2-)	-46.6 s	71 ms +71-24
		76	0+	-54.4 s	8.9 s 3
		77	5/2+	-58.0	9.0 s 2
		78	0+	-63.174	2.5 m 3
		79	3/2(-)	-65.477	2.25 m 10
		80	0+	-70.305	106.3 m 15
					ϵ

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
38	Sr	81	1/2−	−71.526	22.3 m 4 ϵ
		82	0+	−76.009	25.55 d 15 ϵ
		83	7/2+	−76.797	32.41 h 3 ϵ
		83m	1/2−	−76.538	4.95 s 12 IT
		84	0+	−80.644	0.56% 1
		85	9/2+	−81.103	64.84 d 2 ϵ
		85m	1/2−	−80.864	67.63 m 4 IT 86.6%, ϵ 13.4%
		86	0+	−84.522	9.86% 1
		87	9/2+	−84.878	7.00% 1
		87m	1/2−	−84.490	2.811 h 27 IT 99.7%, ϵ 0.3%
		88	0+	−87.920	82.58% 1
		89	5/2+	−86.207	50.53 d 7 β −
		90	0+	−85.942	28.79 y 6 β −
		91	5/2+	−83.639	9.63 h 5 β −
		92	0+	−82.875	2.71 h 1 β −
		93	5/2+	−80.088	7.423 m 24 β −
		94	0+	−78.842	75.3 s 2 β −
		95	1/2+	−75.117	23.90 s 14 β −
		96	0+	−72.95	1.07 s 1 β −
		97	1/2+	−68.79	429 ms 5 β −, β -n $\leq 0.05\%$
		98	0+	−66.63	0.653 s 2 β −, β -n 0.25%
		99	3/2+	−62.1	0.269 s 1 β −, β -n 0.1%
		100	0+	−60.2	202 ms 3 β −, β -n 0.78%
		101	(5/2−)	−55.4	118 ms 3 β −, β -n 2.37%
		102	0+	−53.1	69 ms 6 β −, β -n 4.8%
		103		−47.6s	>150 ns β −
		104	0+	−44.4s	>150 ns β −
		105			>150 ns β −
39	Y	77		−46.9s	<1.2 μ s ϵ , ϵ p
		78	(0+)	−52.6s	55 ms 12 ϵ
		78m	(5+)	−52.1s	5.8 s 6 ϵ
		79	(5/2+)	−58.4	14.8 s 6 ϵ , ϵ p
		80	4−	−61.2s	30.1 s 5 ϵ
		80m	1−	−60.9s	4.7 s 3 ϵ , IT
		81	(5/2+)	−66.02	70.4 s 10 ϵ
		82	1+	−68.2	8.3 s 2 ϵ
		83	(9/2+)	−72.33	7.08 m 6 ϵ
		83m	(3/2−)	−72.27	2.85 m 2 ϵ 60%, IT 40%
		84	1+	−74.16	4.6 s 2 ϵ
		84m	(5−)	−74.16	39.5 m 8 ϵ
		85	(1/2)−	−77.85	2.68 h 5 ϵ
		85m	9/2+	−77.83	4.86 h 13 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 0.7%
		87	1/2−	−83.017	79.8 h 3 ϵ
		87m	9/2+	−82.636	13.37 h 3 IT 98.43%, ϵ 1.57%
		88	4−	−84.297	106.65 d 13 ϵ
		89	1/2−	−87.702	100%
		89m	9/2+	−86.793	15.28 s 17 IT
		90	2−	−86.488	64.00 h 21 β −
		90m	7+	−85.806	3.19 h 6 IT, β − 1.8×10 ^{−3} %
		91	1/2−	−86.346	58.51 d 6 β −

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode	
Z	El	A	J π	(MeV)		Abundance
39	Y	91m	9/2+	−85.791	49.71 m 4	IT, $\beta^- < 1.5\%$
		92	2−	−84.815	3.54 h 1	β^-
		93	1/2−	−84.22	10.18 h 8	β^-
		93m	7/2+	−83.47	0.82 s 4	IT
		94	2−	−82.350	18.7 m 1	β^-
		95	1/2−	−81.204	10.3 m 1	β^-
		96	0−	−78.34	5.34 s 5	β^-
		96m	(8)+	−78.34	9.6 s 2	β^-
		97	(1/2−)	−76.26	3.75 s 3	β^- , β^-n 0.058%
		97m	(9/2)+	−75.59	1.17 s 3	$\beta^- > 99.3\%$, IT < 0.7%, $\beta^-n < 0.08\%$
		97m	(27/2−)	−72.74	142 ms 8	IT > 80%, $\beta^- < 20\%$
		98	(0)−	−72.45	0.548 s 2	β^- , β^-n 0.33%
		98m	(4,5)	−72.04	2.0 s 2	β^- 90%, IT < 20%, β^-n 3.4%
		99	(5/2+)	−70.20	1.470 s 7	β^- , β^-n 2.5%
		100	1−, 2−	−67.29	735 ms 7	β^- , β^-n 0.92%
		100m	(3,4,5)	−67.29	0.94 s 3	β^-
		101	(5/2+)	−64.91	0.45 s 2	β^- , β^-n 1.5%
		102m		−61.89	0.30 s 1	β^- , β^-n 4%
		102m		−61.89	0.36 s 4	β^- , β^-n 4%
		103	(5/2+)	−58.7s	0.19 s 5	β^- , β^-n 8%
		104		−54.5s	180 ms 60	β^- , β^-n
		105		−51.1s	>150 ns	β^- ?
		106		−46.4s	>150 ns	β^-
		107	(5/2+)		30 ms	β^-
		108			>150 ns	β^- , β^-n
40	Zr	79		−47.4s	56 ms 30	ϵ
		80	0+	−55.4s	3.9 s 5	ϵ
		81	(3/2−)	−58.9	5.3 s 5	ϵ , ϵp 0.12%
		82	0+	−64.2	32 s 5	ϵ
		83	(1/2−)	−66.46	44 s 1	ϵ , ϵp
		84	0+	−71.5s	25.9 m 7	ϵ
		85	7/2+	−73.2	7.86 m 4	ϵ
		85m	(1/2−)	−72.9	10.9 s 3	IT $\leq 92\%$, $\epsilon > 8\%$
		86	0+	−77.81	16.5 h 1	ϵ
		87	(9/2)+	−79.348	1.68 h 1	ϵ
		87m	(1/2)−	−79.012	14.0 s 2	IT
		88	0+	−83.62	83.4 d 3	ϵ
		89	9/2+	−84.869	78.41 h 12	ϵ
		89m	1/2−	−84.282	4.161 m 17	IT 93.77%, ϵ 6.23%
		90	0+	−88.768	51.45% 40	
		90m	5−	−86.449	809.2 ms 20	IT
		91	5/2+	−87.891	11.22% 5	
		92	0+	−88.455	17.15% 8	
		93	5/2+	−87.117	1.53×10^6 y 10	β^-
		94	0+	−87.266	17.38% 28	
		95	5/2+	−85.658	64.02 d 5	β^-
		96	0+	−85.441	>2.2×10 ¹⁹ y	2 β^-
					2.80% 9	
		97	1/2+	−82.949	16.744 h 11	β^-
		98	0+	−81.28	30.7 s 4	β^-

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode	
Z	El	A	J π	(MeV)		Abundance
40	Zr	99	(1/2+)	-77.77	2.1 s 1	β^-
		100	0+	-76.60	7.1 s 4	β^-
		101	(3/2+)	-73.46	2.3 s 1	β^-
		102	0+	-71.74	2.9 s 2	β^-
		103	(5/2-)	-68.4	1.3 s 1	β^-
		104	0+	-66.3s	1.2 s 3	β^-
		105		-62.4s	0.6 s 1	β^-
		106	0+	-59.7s	>150 ns	β^- ?
		107		-55.1s	150 ms	β^- ?
		108	0+	-51.9s	>150 ns	β^- , β^-n
		109			>150 ns	β^- , β^-n
	110	0+		>150 ns	β^-	
41	Nb	81		-47.5s	≈ 0.8 s	ϵ ? , ϵp ? , p ?
		82		-53.0s	50 ms 4	ϵ
		83	(5/2+)	-59.0	4.1 s 3	ϵ
		84	3+	-61.9s	12 s 3	ϵ , ϵp
		85	(9/2+)	-67.2	20.9 s 7	ϵ
		86	(5+)	-69.83	88 s 1	ϵ
		86m		-69.83	56 s 8	ϵ
		87	(9/2+)	-74.18	2.6 m 1	ϵ
		87m	(1/2-)	-74.18	3.7 m 1	ϵ
		88	(8+)	-76.4s	14.5 m 1	ϵ
		88m	(4-)	-76.4s	7.8 m 1	ϵ
		89	(9/2+)	-80.58	2.03 h 7	ϵ
		89m	(1/2)-	-80.54	66 m 2	ϵ
		90	8+	-82.657	14.60 h 5	ϵ
		90m	4-	-82.532	18.81 s 6	IT
		91	9/2+	-86.638	6.8×10^2 y 13	ϵ
		91m	1/2-	-86.533	60.86 d 22	IT 96.6% , ϵ 3.4%
		92	(7)+	-86.449	3.47×10^7 y 24	ϵ , $\beta^- < 0.05\%$
		92m	(2)+	-86.314	10.15 d 2	ϵ
		93	9/2+	-87.209	100%	
		93m	1/2-	-87.178	16.13 y 14	IT
		94	(6)+	-86.365	2.03×10^4 y 16	β^-
		94m	3+	-86.324	6.263 m 4	IT 99.5% , β^- 0.5%
		95	9/2+	-86.783	34.997 d 6	β^-
		95m	1/2-	-86.547	86.6 h 8	IT 94.4% , β^- 5.6%
		96	6+	-85.604	23.35 h 5	β^-
		97	9/2+	-85.607	72.1 m 7	β^-
		97m	1/2-	-84.864	58.7 s 18	IT
		98	1+	-83.526	2.86 s 6	β^-
		98m	(5+)	-83.442	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	2.6 m 2	$\beta^- > 96.2\%$, IT < 3.8%
		100	1+	-79.94	1.5 s 2	β^-
		100m	(4+,5+)	-79.44	2.99 s 11	β^-
		101	(5/2+)	-78.94	7.1 s 3	β^-
		102m	1+	-76.35	1.3 s 2	β^-
		102m		-76.35	4.3 s 4	β^-
		103	(5/2+)	-75.32	1.5 s 2	β^-
		104	(1+)	-72.2	4.9 s 3	β^- , β^-n 0.06%
		104m		-72.0	0.92 s 4	β^- , β^-n 0.05%

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	Abundance	
41	Nb	105	(5/2+)	-70.86	2.95 s 6 β^- , β^-n 1.7%
		106		-66.9s	1.02 s 5 β^- , β^-n 4.5%
		107		-64.9s	330 ms 50 β^- , β^-n 6%
		108	(2+)	-60.5s	0.193 s 17 β^- , β^-n 6.2%
		109	(5/2)	-58.1s	0.19 s 3 β^- , β^-n 31%
		110		-53.4s	0.17 s 2 β^- , β^-n 40%
		111	(5/2+)		>150 ns β^-
		112	(2+)		>150 ns β^-
		113			>150 ns β^-
42	Mo	83		-47.7s	≈ 0.4 s ϵ ?
		84	0+	-55.8s	>150 ns ϵ
		85	(1/2-)	-59.1s	3.2 s 2 ϵ , ϵp 0.14%
		86	0+	-64.6	19.6 s 11 ϵ
		87	(7/2+)	-67.7	13.6 s 11 ϵ , ϵp 15%
		88	0+	-72.70	8.0 m 2 ϵ
		89	(9/2+)	-75.00	2.11 m 10 ϵ
		89m	(1/2-)	-74.62	190 ms 15 IT
		90	0+	-80.168	5.56 h 9 ϵ
		91	9/2+	-82.20	15.49 m 1 ϵ
		91m	1/2-	-81.55	64.6 s 6 ϵ 50%, IT 50%
		92	0+	-86.805	>1.9 $\times 10^{20}$ y 2 ϵ
				14.84% 35	
		93	5/2+	-86.804	4.0 $\times 10^3$ y 8 ϵ
		93m	21/2+	-84.379	6.85 h 7 IT 99.88%, ϵ 0.12%
		94	0+	-88.410	9.25% 12
		95	5/2+	-87.708	15.92% 13
		96	0+	-88.791	16.68% 2
		97	5/2+	-87.541	9.55% 8
		98	0+	-88.112	24.13% 31
		99	1/2+	-85.966	65.94 h 1 β^-
		100	0+	-86.185	0.95 $\times 10^{19}$ y 11 2 β^-
				9.63% 23	
		101	1/2+	-83.512	14.61 m 3 β^-
		102	0+	-83.56	11.3 m 2 β^-
		103	(3/2+)	-80.85	67.5 s 15 β^-
		104	0+	-80.33	60 s 2 β^-
		105	(3/2+)	-77.34	35.6 s 16 β^-
		106	0+	-76.26	8.4 s 5 β^-
		107	(7/2-)	-72.9	3.5 s 5 β^-
		108	0+	-71.2s	1.09 s 2 β^-
		109	(7/2-)	-67.2s	0.53 s 6 β^-
		110	0+	-65.5s	0.30 s 4 β^- , β^-n 0.04%
		111		-61.0s	>150 ns β^- ?
		112	0+	-58.8s	>150 ns β^- ?
		113		-54.0s	>150 ns β^- , β^-n
		114	0+		>150 ns β^-
		115			>150 ns β^- , β^-n
43	Tc	85		-47.6s	≈ 0.5 s ϵ ?
		86		-53.2s	47 ms 12 ϵ
		87	(9/2+)	-59.1s	>150 ns ϵ ?
		88	(3+)	-62.6s	5.8 s 2 ϵ
		88m	(6+)	-62.6s	6.4 s 8 ϵ

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
43	Tc	89	(9/2+)	-67.5	12.8 s 9 ϵ
		89m	(1/2-)	-67.4	12.9 s 8 ϵ
		90m	1+	-71.2	8.7 s 2 ϵ
		90m	(6+)	-70.7	49.2 s 4 ϵ
		91	(9/2)+	-76.0	3.14 m 2 ϵ
		91m	(1/2)-	-75.8	3.3 m 1 ϵ , IT<1%
		92	(8)+	-78.94	4.23 m 15 ϵ
		93	9/2+	-83.603	2.75 h 5 ϵ
		93m	1/2-	-83.211	43.5 m 10 IT 76.6%, ϵ 23.4%
		94	7+	-84.155	293 m 1 ϵ
		94m	(2)+	-84.080	52.0 m 10 ϵ , IT<0.1%
		95	9/2+	-86.017	20.0 h 1 ϵ
		95m	1/2-	-85.979	61 d 2 ϵ 96.12%, IT 3.88%
		96	7+	-85.818	4.28 d 7 ϵ
		96m	4+	-85.784	51.5 m 10 IT 98%, ϵ 2%
		97	9/2+	-87.221	4.21×10 ⁶ y 16 ϵ
		97m	1/2-	-87.124	91.4 d 8 IT, ϵ 3.94%
		98	(6)+	-86.428	4.2×10 ⁶ y 3 β^-
		99	9/2+	-87.323	2.111×10 ⁵ y 12 β^-
		99m	1/2-	-87.180	6.01 h 1 IT, β^- 3.7×10 ⁻³ %
		100	1+	-86.016	15.8 s 1 β^- , ϵ 1.8×10 ⁻³ %
		101	9/2+	-86.34	14.22 m 1 β^-
		102	1+	-84.568	5.28 s 15 β^-
		102m	(4,5)	-84.568	4.35 m 7 β^- 98%, IT 2%
		103	5/2+	-84.60	54.2 s 8 β^-
		104	(3+)	-82.49	18.3 m 3 β^-
		105	(5/2+)	-82.29	7.6 m 1 β^-
		106	(1,2)	-79.78	35.6 s 6 β^-
		107	(3/2-)	-79.1	21.2 s 2 β^-
		108	(2)+	-75.9	5.17 s 7 β^-
		109	(5/2+)	-74.9s	0.86 s 4 β^- , β^- -n 0.08%
		110	(1+,2+)	-71.4s	0.92 s 3 β^- , β^- -n 0.04%
		111		-69.8s	0.30 s 3 β^- , β^- -n 0.85%
		112		-65.9s	0.29 s 2 β^- , β^- -n 1.5%
		113		-64.0s	0.17 s 2 β^- , β^- -n 2.1%
		114		-59.7s	0.15 s 3 β^- , β^- -n 1.3%
		115		-57.5s	>150 ns β^- , β^- -n
		116			>150 ns β^-
		117	(5/2+)		>150 ns β^-
		118			>150 ns β^-
44	Ru	87		-47.3s	>1.5 μ s ϵ ?
		88	0+	-55.5s	>150 ns ϵ ?
		89		-59.5s	ϵ ?
		90	0+	-65.4s	11 s 3 ϵ
		91	(9/2+)	-68.6	9 s 1 ϵ
		91m	(1/2-)	-68.6	7.6 s 8 ϵ >0%, ϵ p>0%, IT
		92	0+	-74.4s	3.65 m 5 ϵ
		93	(9/2)+	-77.27	59.7 s 6 ϵ
		93m	(1/2)-	-76.53	10.8 s 3 ϵ 78%, IT 22%, ϵ p 0.03%
		94	0+	-82.57	51.8 m 6 ϵ
		95	5/2+	-83.45	1.643 h 14 ϵ

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	EI	A	J π	(MeV) Abundance	
44 Ru	96		0+	-86.072	5.54% 14
	97		5/2+	-86.112	2.791 d 4 ϵ
	98		0+	-88.225	1.87% 3
	99		5/2+	-87.617	12.76% 14
	100		0+	-89.219	12.60% 7
	101		5/2+	-87.950	17.06% 2
	102		0+	-89.098	31.55% 14
	103		3/2+	-87.259	39.26 d 2 β^-
	104		0+	-88.091	18.62% 27
	105		3/2+	-85.930	4.44 h 2 β^-
	106		0+	-86.324	373.59 d 15 β^-
	107		(5/2)+	-83.9	3.75 m 5 β^-
	108		0+	-83.7	4.55 m 5 β^-
	109		(5/2+)	-80.85	34.5 s 10 β^-
	110		0+	-80.1	14.6 s 10 β^-
	111			-76.8s	2.12 s 7 β^-
	112		0+	-75.9s	1.75 s 7 β^-
	113			-72.2s	0.80 s 5 β^-
	114		0+	-70.8s	0.53 s 6 β^-
	115			-66.8s	740 ms 80 β^- , β^-n
	116		0+	-65.1s	>150 ns β^- ?
	117			-60.7s	>150 ns β^- ?
	118		0+	-58.7s	>150 ns β^- ?
	119				>150 ns β^-
	120		0+		>150 ns β^-
45 Rh	89			-47.2s	>1.5 μ s ϵ ?
	90			-53.2s	>150 ns ϵ ?
	91			-59.1s	>0.1 μ s ϵ ?
	92			-63.4s	>100 ns ϵ
	93		(9/2+)	-69.2s	ϵ
	94m		(8+)	-72.9s	25.8 s 2 ϵ
	94m		(3+)	-72.9s	70.6 s 6 ϵ
	95		(9/2)+	-78.3	5.02 m 10 ϵ
	95m		(1/2)-	-77.8	1.96 m 4 IT 88%, ϵ 12%
	96		(6+)	-79.63	9.90 m 10 ϵ
	96m		(3+)	-79.57	1.51 m 2 IT 60%, ϵ 40%
	97		9/2+	-82.59	30.7 m 6 ϵ
	97m		1/2-	-82.33	46.2 m 16 ϵ 94.4%, IT 5.6%
	98		(2)+	-83.17	8.7 m 2 ϵ
	98m		(5+)	-83.17	3.5 m 3 ϵ >0%, IT
	99		1/2-	-85.574	16.1 d 2 ϵ
	99m		9/2+	-85.510	4.7 h 1 ϵ >99.84%, IT <0.16%
	100		1-	-85.59	20.8 h 1 ϵ
	100m		(5+)	-85.59	4.6 m 2 IT $\approx$ 98.3%, $\epsilon \approx$ 1.7%
	101		1/2-	-87.41	3.3 y 3 ϵ
	101m		9/2+	-87.25	4.34 d 1 ϵ 92.8%, IT 7.2%
	102		(1-, 2-)	-86.775	207 d 3 ϵ 80%, β^- 20%
	102m		6(+)	-86.634	$\approx$ 2.9 y ϵ 99.77%, IT 0.23%
	103		1/2-	-88.022	100%
	103m		7/2+	-87.982	56.114 m 9 IT
	104		1+	-86.950	42.3 s 4 β^- 99.55%, ϵ 0.45%

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
45 Rh	104m		5+	-86.821	4.34 m 3 IT 99.87%, β^- 0.13%
	105		7/2+	-87.847	35.36 h 6 β^-
	105m		1/2-	-87.717	43.0 s 3 IT
	106		1+	-86.364	29.80 s 8 β^-
	106m		(6)+	-86.227	131 m 2 β^-
	107		7/2+	-86.86	21.7 m 4 β^-
	108		1+	-85.0	16.8 s 5 β^-
	108m		(5+)	-85.0	6.0 m 3 β^-
	109		7/2+	-85.01	80 s 2 β^-
	110m		1+	-82.9	3.2 s 2 β^-
	110m		(>3)	-82.9	28.5 s 15 β^-
	111		(7/2+)	-82.3 s	11 s 1 β^-
	112m		1+	-79.5 s	3.45 s 37 β^-
	112m		(4,5,6)	-79.5 s	6.73 s 15 β^-
	113		(7/2+)	-78.8 s	2.80 s 12 β^-
	114		1+	-75.6 s	1.85 s 5 β^-
	114m		(>3)	-75.6 s	1.85 s 5 β^-
	115		(7/2+)	-74.4	0.99 s 5 β^-
	116m		1+	-71.1 s	0.68 s 6 β^-
	116m		(5,6,7)	-71.1 s	0.9 s 4 β^-
	117		(7/2+)	-69.5 s	0.44 s 4 β^-
	118		0+	-65.7 s	>150 ns β^- ?
	119			-63.9 s	>150 ns β^- ?
	120			-59.8 s	>150 ns β^- ?
	121			-57.7 s	>150 ns β^- ?
	122				$\approx$ 50 ms β^- ?
46 Pd	91			-47.1 s	>1 μ s ϵ ?
	92		0+	-55.5 s	>150 ns ϵ ?
	93			-59.7 s	60 s 20 ϵ
	94		0+	-66.3 s	9.0 s 5 ϵ
	95			-70.2 s	$\approx$ 10 s ϵ ?
	95m		(21/2+)	-68.2 s	13.3 s 3 $\epsilon \geq 91.3\%$, IT $\leq 9.7\%$, ϵp 0.9%
	96		0+	-76.2	122 s 2 ϵ
	97		(5/2+)	-77.8	3.10 m 9 ϵ
	98		0+	-81.30	17.7 m 3 ϵ
	99		(5/2)+	-82.19	21.4 m 2 ϵ
	100		0+	-85.23	3.63 d 9 ϵ
	101		5/2+	-85.43	8.47 h 6 ϵ
	102		0+	-87.926	1.02% 1
	103		5/2+	-87.479	16.991 d 19 ϵ
	104		0+	-89.391	11.14% 8
	105		5/2+	-88.414	22.33% 8
	106		0+	-89.905	27.33% 3
	107		5/2+	-88.372	6.5×10^6 y 3 β^-
	107m		11/2-	-88.158	21.3 s 5 IT
	108		0+	-89.522	26.46% 9
	109		5/2+	-87.604	13.7012 h 24 β^-
	109m		11/2-	-87.415	4.696 m 3 IT
	110		0+	-88.35	11.72% 9
	111		5/2+	-86.03	23.4 m 2 β^-
	111m		11/2-	-85.86	5.5 h 1 IT 73%, β^- 27%

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode	
Z	El	J π	(MeV)	Abundance		
46	Pd	112	0+	−86.34	21.03 h 5	β^-
		113	(5/2+)	−83.69	93 s 5	β^-
		113m	(9/2−)	−83.61	0.3 s 1	IT
		114	0+	−83.49	2.42 m 6	β^-
		115	(5/2+)	−80.40	25 s 2	β^-
		115m	(11/2−)	−80.31	50 s 3	β^- 92%, IT 8%
		116	0+	−79.96	11.8 s 4	β^-
		117	(5/2+)	−76.5s	4.3 s 3	β^-
		118	0+	−75.5	1.9 s 1	β^-
		119		−72.0s	0.92 s 13	β^-
		120	0+	−70.8s	0.5 s 1	β^-
		121		−66.9s	>150 ns	β^- ?
		122	0+	−65.4s	>150 ns	β^- ?
		123		−61.2s	>150 ns	β^- ?
124	0+		≈0.2 s	β^- ?		
47	Ag	93				ϵ
		94	0+	−53.3s	15 ms CA	ϵ
		94m	(9+)	−53.3s	0.42 s 5	ϵ , ϵ p
		95		−60.1s	2.0 s 1	ϵ , ϵ p
		96	(8+,9+)	−64.6s	5.1 s 4	ϵ , ϵ p 12%
		97	(9/2+)	−70.8s	25.3 s 3	ϵ
		98	(6+)	−72.9	46.7 s 9	ϵ , ϵ p 1.1×10 ^{−3} %
		99	(9/2)+	−76.8	124 s 3	ϵ
		99m	(1/2−)	−76.3	10.5 s 5	IT
		100	(5)+	−78.18	2.01 m 9	ϵ
		100m	(2)+	−78.17	2.24 m 13	ϵ , IT
		101	9/2+	−81.2	11.1 m 3	ϵ
		101m	(1/2)−	−81.0	3.10 s 10	IT
		102	5+	−81.97	12.9 m 3	ϵ
		102m	2+	−81.96	7.7 m 5	ϵ 51%, IT 49%
		103	7/2+	−84.79	65.7 m 7	ϵ
		103m	1/2−	−84.66	5.7 s 3	IT
		104	5+	−85.112	69.2 m 10	ϵ
		104m	2+	−85.105	33.5 m 20	ϵ 99.93%, IT<0.07%
		105	1/2−	−87.07	41.29 d 7	ϵ
		105m	7/2+	−87.04	7.23 m 16	IT 99.66%, 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+	−87.604	2.37 m 1	β^- 97.15%, ϵ 2.85%
		108m	6+	−87.494	418 y 21	ϵ 91.3%, IT 8.7%
		109	1/2−	−88.720	48.161% 8	
109m	7/2+	−88.632	39.6 s 2	IT		
110	1+	−87.457	24.6 s 2	β^- 99.7%, ϵ 0.3%		
110m	6+	−87.340	249.76 d 4	β^- 98.64%, IT 1.36%		
111	1/2−	−88.217	7.45 d 1	β^-		
111m	7/2+	−88.158	64.8 s 8	IT 99.3%, β^- 0.7%		
112	2(−)	−86.63	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+	−84.94	4.6 s 1	β^-		

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode	
Z	El	A	J π	(MeV)		Abundance
47	Ag	115	1/2−	−84.99	20.0 m 5	β −
		115m	7/2+	−84.95	18.0 s 7	β − 79%, IT 21%
		116	(2)−	−82.57	2.68 m 10	β −
		116m	(5+)	−82.49	8.6 s 3	β − 94%, IT 6%
		117	(1/2−)	−82.27	72.8 s +20−7	β −
		117m	(7/2+)	−82.24	5.34 s 5	β − 94%, IT 6%
		118	1(−)	−79.57	3.76 s 15	β −
		118m	4(+)	−79.44	2.0 s 2	β − 59%, IT 41%
		119m	(7/2+)	−78.56	2.1 s 1	β −
		119m	(1/2−)	−78.56	6.0 s 5	β −
		120	3(+)	−75.65	1.23 s 4	β −, β −n < 3.0×10 ^{−3} %
		120m	6(−)	−75.44	0.32 s 4	β −≈63%, IT≈37%
		121	(7/2+)	−74.7	0.78 s 1	β −, β −n 0.08%
		122	(3+)	−71.4s	0.520 s 14	β −, β −n 0.186%
		123	(7/2+)	−70.0s	0.293 s 7	β −, β −n 0.55%
		124		−66.6s	0.172 s 5	β −, β −n > 0.1%
		125	(7/2+)	−64.7s	166 ms 7	β −, β −n
		126		−61.0s	107 ms 12	β −
		127	(1/2−)	−58.8s	79 ms 3	β −
		128			58 ms 5	β −, β −n
		129			46 ms 5	β −, β −n
48	Cd	96	0+	−56.1s	≈1 s	ϵ ?
		97		−60.6s	2.8 s 6	ϵ , ϵ p
		98	0+	−67.5s	9.2 s 3	ϵ , ϵ p < 0.03%
		99	(5/2+)	−69.9s	16 s 3	ϵ , ϵ p 0.17%, $\epsilon\alpha$ < 1.0×10 ^{−4} %
		100	0+	−74.31	49.1 s 5	ϵ
		101	(5/2+)	−75.7	1.36 m 5	ϵ
		102	0+	−79.38	5.5 m 5	ϵ
		103	(5/2)+	−80.65	7.3 m 1	ϵ
		104	0+	−83.976	57.7 m 10	ϵ
		105	5/2+	−84.33	55.5 m 4	ϵ
		106	0+	−87.134	≥2.6×10 ¹⁷ y	2 ϵ
					1.25% 6	
		107	5/2+	−86.988	6.50 h 2	ϵ
		108	0+	−89.253	0.89% 3	
		109	5/2+	−88.505	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	48.30 m 15	IT
		112	0+	−90.581	24.13% 21	
		113	1/2+	−89.050	7.7×10 ¹⁵ y 3	β −
					12.22% 12	
		113m	11/2−	−88.786	14.1 y 5	β − 99.86%, IT 0.14%
		114	0+	−90.021	28.73% 42	
		115	1/2+	−88.091	53.46 h 5	β −
		115m	(11/2)−	−87.910	44.56 d 24	β −
		116	0+	−88.720	≥3.75×10 ¹⁹ y	2 β −
					7.49% 18	
		117	1/2+	−86.426	2.49 h 4	β −
		117m	(11/2)−	−86.289	3.36 h 5	β −
		118	0+	−86.71	50.3 m 2	β −

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	Abundance	
48	Cd	119	3/2+	-83.91	2.69 m 2 β^-
		119m	(11/2-)	-83.76	2.20 m 2 β^-
		120	0+	-83.97	50.80 s 21 β^-
		121	(3/2+)	-81.06	13.5 s 3 β^-
		121m	(11/2-)	-80.84	8.3 s 8 β^-
		122	0+	-80.6s	5.24 s 3 β^-
		123	(3/2)+	-77.31	2.10 s 2 β^-
		123m	(11/2-)	-76.99	1.82 s 3 β^- , IT
		124	0+	-76.71	1.25 s 2 β^-
		125	(3/2+)	-73.36	0.65 s 2 β^-
		125m	(11/2-)	-73.31	0.48 s 3 β^-
		126	0+	-72.33	0.506 s 15 β^-
		127	(3/2+)	-68.53	0.37 s 7 β^-
		128	0+	-67.3	0.34 s 3 β^-
		129	(3/2+)	-63.1s	0.27 s 4 β^-
		130	0+	-61.5s	β^- , $\beta^-n \approx 4\%$
		131		≈ 0.18 s	β^-
49	In	98		-53.8s	ϵ ?
		99	(9/2+)	-60.9s	ϵ
		100		-64.1	7.0 s 8 ϵ , $\epsilon_p > 3.9\%$
		101		-68.4s	15.1 s 3 $\epsilon \approx 100\%$, ϵ_p
		102	(6+)	-70.1	22 s 1 ϵ , $\epsilon_p 9.3 \times 10^{-3}\%$
		103	(9/2)+	-74.60	60 s 1 ϵ
		103m	(1/2-)	-73.97	34 s 2 ϵ , IT $\approx 30\%$
		104	5(+)	-76.1	1.80 m 3 ϵ
		104m	(3+)	-76.0	15.7 s 5 IT 80%, ϵ 20%
		105	(9/2+)	-79.48	5.07 m 7 ϵ
		105m	(1/2-)	-78.81	48 s 6 IT, $\epsilon \approx 25\%$
		106	7+	-80.61	6.2 m 1 ϵ
		106m	(3+)	-80.58	5.2 m 1 ϵ
		107	9/2+	-83.56	32.4 m 3 ϵ
		107m	1/2-	-82.88	50.4 s 6 IT
		108	7+	-84.10	58.0 m 12 ϵ
		108m	2+	-84.07	39.6 m 7 ϵ
		109	9/2+	-86.485	4.2 h 1 ϵ
		109m	1/2-	-85.835	1.34 m 7 IT
		109m	(19/2+)	-84.384	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+	-88.389	2.8047 d 5 ϵ
		111m	1/2-	-87.852	7.7 m 2 IT
		112	1+	-87.995	14.97 m 10 ϵ 56%, β^- 44%
		112m	4+	-87.839	20.56 m 6 IT
		113	9/2+	-89.366	4.29% 5
		113m	1/2-	-88.975	99.476 m 23 IT
		114	1+	-88.570	71.9 s 1 β^- 99.5%, ϵ 0.5%
		114m	5+	-88.379	49.51 d 1 IT 96.75%, ϵ 3.25%
		115	9/2+	-89.537	4.41×10^{14} y 25 β^-
				95.71% 5	
		115m	1/2-	-89.201	4.486 h 4 IT 95%, β^- 5%
		116	1+	-88.250	14.10 s 3 β^- 99.97%, $\epsilon < 0.06\%$
		116m	5+	-88.123	54.29 m 17 β^-

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Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
49	In	116m	8-	-87.960	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+	-87.230	5.0 s 5 β^-
		118m	5+	-87.170	4.45 m 5 β^-
		118m	8-	-87.030	8.5 s 3 IT 98.6%, β^- 1.4%
		119	9/2+	-87.704	2.4 m 1 β^-
		119m	1/2-	-87.392	18.0 m 3 β^- 94.4%, IT 5.6%
		120	1+	-85.73	3.08 s 8 β^-
		120	(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-	-85.53	3.88 m 10 β^- 98.8%, IT 1.2%
		122	1+	-83.58	1.5 s 3 β^-
		122m	5+	-83.58	10.3 s 6 β^-
		122m	8-	-83.38	10.8 s 4 β^-
		123	9/2+	-83.43	5.98 s 6 β^-
		123m	1/2-	-83.10	47.8 s 5 β^-
		124	3+	-80.88	3.11 s 10 β^-
		124m	(8-)	-80.83	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	1.60 s 10 β^-
		126m	7,8,9	-77.71	1.64 s 5 β^-
		127	(9/2+)	-76.99	1.09 s 1 β^- , β^- -n $\leq 0.03\%$
		127m	(1/2-)	-76.53	3.67 s 4 β^- , β^- -n 0.69%
		128	(3+)	-74.36	0.84 s 6 β^-
		128m	(8-)	-74.02	0.72 s 10 β^-
		129	(9/2+)	-73.0	0.61 s 1 β^- , β^- -n 0.25%
		129m	(1/2-)	-72.6	β^- > 99.7%, β^- -n 2.5%, IT < 0.3%
		130	1(-)	-70.00	β^- , β^- -n 0.9%
		130m	(10-)	-69.95	β^- , β^- -n < 1.67%
		130m	(5+)	-69.60	β^- , β^- -n $\leq 1.65\%$
		131	(9/2+)	-68.22	β^- , β^- -n $\leq 2\%$
		131m	(1/2-)	-67.85	β^- $\geq 99.98\%$, β^- -n $\leq 2\%$, IT $\leq 0.02\%$
		131m	(21/2+)	-63.95	β^- > 99%, IT < 1%, β^- -n 0.03%
		132	(7-)	-62.49	β^- , β^- -n 6.2%
		133	(9/2+)	-57.4s	180 ms 15 β^- , β^- -n 85%
		134		-51.5s	138 ms 8 β^- , β^- -n 65%
		135			≈ 0.1 s β^- ?
50	Sn	100	0+	-56.9s	0.94 s +54-27 ϵ , ϵ p < 17%
		101		-59.6s	3 s 1 ϵ , ϵ p
		102	0+	-64.7s	4.5 s 7 ϵ
		103		-66.9s	7 s 3 ϵ
		104	0+	-71.6	20.8 s 5 ϵ
		105		-73.22	31 s 6 ϵ , ϵ p
		106	0+	-77.43	115 s 5 ϵ
		107	(5/2+)	-78.56	2.90 m 5 ϵ
		108	0+	-82.00	10.30 m 8 ϵ

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
50	Sn	109	5/2(+)	-82.636	18.0 m 2 ϵ
		110	0+	-85.83	4.11 h 10 ϵ
		111	7/2+	-85.944	35.3 m 6 ϵ
		112	0+	-88.659	0.97% 1
		113	1/2+	-88.330	115.09 d 4 ϵ
		113m	7/2+	-88.253	21.4 m 4 IT 91.1%, ϵ 8.9%
		114	0+	-90.558	0.66% 1
		115	1/2+	-90.033	0.34% 1
		116	0+	-91.525	14.54% 9
		117	1/2+	-90.398	7.68% 7
		117m	11/2-	-90.083	13.60 d 4 IT
		118	0+	-91.653	24.22% 9
		119	1/2+	-90.067	8.59% 4
		119m	11/2-	-89.978	293.1 d 7 IT
		120	0+	-91.103	32.58% 9
		121	3/2+	-89.203	27.06 h 4 β^-
		121m	11/2-	-89.197	55 y 5 IT 77.6%, β^- 22.4%
		122	0+	-89.945	4.63% 3
		123	11/2-	-87.820	129.2 d 4 β^-
		123m	3/2+	-87.795	40.06 m 1 β^-
		124	0+	-88.236	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	$\approx 1 \times 10^5$ y β^-
		127	(11/2-)	-83.51	2.10 h 4 β^-
		127m	(3/2+)	-83.50	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+)	-80.6	2.23 m 4 β^-
		129m	(11/2-)	-80.6	6.9 m 1 β^- , IT $< 2.0 \times 10^{-3}\%$
		130	0+	-80.25	3.72 m 4 β^-
		130m	(7-)	-78.30	1.7 m 1 β^-
		131	(3/2+)	-77.39	56.0 s 5 β^-
		131m	(11/2-)	-77.15	58.4 s 5 β^- , IT $\leq 4.0 \times 10^{-4}\%$
		132	0+	-76.62	39.7 s 5 β^-
		133	(7/2-)	-70.97	1.45 s 3 β^- , β^-n 0.08%
		134	0+	-66.6	1.12 s 8 β^- , β^-n 17%
		135		-60.8s	> 150 ns β^- , β^-n
		136	0+	-56.5s	> 150 ns $\beta^-?$, $\beta^-n?$
		137		-50.5s	> 150 ns $\beta^-?$
51	Sb	103		-55.8s	> 1.5 μ s $\epsilon?$
		104		-59.3s	0.44 s +15-11 ϵ , $\epsilon p < 7\%$, $p < 1\%$
		105		-63.8	1.12 s 16 ϵ , $p \approx 1\%$
		106	(4+)	-66.4s	0.6 s 2 ϵ
		107	(5/2+)	-70.7s	4.6 s 8 ϵ , α
		108	(4+)	-72.5s	7.4 s 3 ϵ
		109	(5/2+)	-76.26	17.0 s 7 ϵ
		110	(4+)	-77.5s	23.0 s 4 ϵ
		111	(5/2+)	-80.8s	75 s 1 ϵ
		112	3+	-81.60	51.4 s 10 ϵ
		113	5/2+	-84.41	6.67 m 7 ϵ
		114	3+	-84.7	3.49 m 3 ϵ

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	(MeV)	Abundance	
51	Sb	115	5/2+	-87.00	32.1 m 3 ϵ
		116	3+	-86.818	15.8 m 8 ϵ
		116m	8-	-86.435	60.3 m 6 ϵ
		117	5/2+	-88.641	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+	-89.473	38.19 h 22 ϵ
		119m (27/2+)		-86.632	0.85 s 9 IT
		120	1+	-88.423	15.89 m 4 ϵ
		120m	8-	-88.272	5.76 d 2 ϵ
		121	5/2+	-89.593	57.21% 5
		122	2-	-88.328	2.7238 d 2 β - 97.59%, ϵ 2.41%
		122m	(8)-	-88.164	4.191 m 3 IT
		123	7/2+	-89.223	42.79% 5
		124	3-	-87.619	60.20 d 3 β -
		124m	5+	-87.608	93 s 5 IT 75%, β - 25%
		124m	(8)-	-87.582	20.2 m 2 IT
		125	7/2+	-88.261	2.75856 y 25 β -
		126	(8)-	-86.40	12.46 d 3 β -
		126m	(5)+	-86.38	19.15 m 8 β - 86%, IT 14%
		126m	(3)-	-86.36	$\approx$ 11 s IT
		127	7/2+	-86.709	3.85 d 5 β -
		128	8-	-84.61	9.01 h 3 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)-	-82.39	39.5 m 8 β -
		130m	(5)+	-82.39	6.3 m 2 β -
		131	(7/2+)	-82.02	23.03 m 4 β -
		132	(4+)	-79.72	2.79 m 5 β -
		132m	(8)-	-79.72	4.10 m 5 β -
		133	(7/2+)	-78.96	2.5 m 1 β -
		134m	(0-)	-74.01	0.78 s 6 β -
		134m	(7-)	-74.01	10.22 s 9 β - , β -n 0.091%
		135	(7/2+)	-69.7	1.68 s 2 β - , β -n 17.6%
		136		-64.6s	0.82 s 2 β - , β -n 24%
		137		-60.3s	>150 ns β - ? , β -n ?
		138		-55.0s	>150 ns β - ? , β -n ?
52	Te	106	0+	-58.0s	60 μ s +30-10 α
		107		-60.5s	3.1 ms 1 α 70%, ϵ 30%
		108	0+	-65.7	2.1 s 1 ϵ 51%, α 49%, ϵ p 2.4%
		109	(5/2+)	-67.57	4.6 s 3 ϵ 96.1%, ϵ p 9.4%, α 3.9%, $\epsilon\alpha < 5.0 \times 10^{-3}\%$
		110	0+	-72.28	18.6 s 8 $\epsilon \approx 100\%$, $\alpha \approx 3.0 \times 10^{-3}\%$
		111	(5/2+)	-73.48	19.3 s 4 ϵ , ϵ p
		112	0+	-77.3	2.0 m 2 ϵ
		113	(7/2+)	-78.3s	1.7 m 2 ϵ
		114	0+	-81.9s	15.2 m 7 ϵ
		115	7/2+	-82.4	5.8 m 2 ϵ

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode	
Z	El	A	J π	(MeV)		Abundance
52	Te	115m	(1/2)+	-82.3	6.7 m 4	$\epsilon \leq 100\%$, IT
		116	0+	-85.31	2.49 h 4	ϵ
		117	1/2+	-85.11	62 m 2	ϵ
		117m	11/2-	-84.81	103 ms 3	IT
		118	0+	-87.72	6.00 d 2	ϵ
		119	1/2+	-87.180	16.03 h 5	ϵ
		119m	11/2-	-86.919	4.70 d 4	ϵ , IT 8.0×10 ⁻³ %
		120	0+	-89.40	0.09% 1	
		121	1/2+	-88.56	19.16 d 5	ϵ
		121m	11/2-	-88.26	154 d 7	IT 88.6%, ϵ 11.4%
		122	0+	-90.311	2.55% 12	
		123	1/2+	-89.169	>6×10 ¹⁴ y	ϵ
					0.89% 3	
		123m	11/2-	-88.921	119.7 d 1	IT
		124	0+	-90.523	4.74% 14	
		125	1/2+	-89.028	7.07% 15	
		125m	11/2-	-88.883	57.40 d 15	IT
		126	0+	-90.070	18.84% 25	
		127	3/2+	-88.289	9.35 h 7	β^-
		127m	11/2-	-88.201	109 d 2	IT 97.6%, β^- 2.4%
		128	0+	-88.994	7.7×10 ²⁴ y 4	2 β^-
					31.74% 8	
		129	3/2+	-87.006	69.6 m 3	β^-
		129m	11/2-	-86.900	33.6 d 1	IT 63%, β^- 37%
		130	0+	-87.353	>5.6×10 ²² y	2 β^-
					34.08% 62	
		131	3/2+	-85.211	25.0 m 1	β^-
		131m	11/2-	-85.029	30 h 2	β^- 77.8%, IT 22.2%
		132	0+	-85.21	3.204 d 13	β^-
		133	(3/2+)	-82.96	12.5 m 3	β^-
		133m	(11/2-)	-82.63	55.4 m 4	β^- 82.5%, IT 17.5%
		134	0+	-82.40	41.8 m 8	β^-
		135	(7/2-)	-77.83	19.0 s 2	β^-
		136	0+	-74.42	17.5 s 2	β^- , β^-n 1.3%
		137	(7/2-)	-69.6	2.49 s 5	β^- , β^-n 2.69%
		138	0+	-65.9s	1.4 s 4	β^- , β^-n 6.3%
		139		-60.8s	>150 ns	β^- ?, β^-n ?
		140	0+	-57.1s	>150 ns	β^- ?, β^-n ?
		141		-51.8s	>150 ns	β^- ?, β^-n ?
		142	0+	-48.0s		β^- ?
53	I	108	(1)	-52.8s	36 ms 6	α 91%, ϵ 9%, p < 1%
		109	(5/2+)	-57.6	100 μ s 5	p $\approx$ 100%, α < 0.5%
		110		-60.3s	0.65 s 2	ϵ 83%, α 17%, ϵp 11%, $\epsilon \alpha$ 1.1%
		111	(5/2+)	-64.9s	2.5 s 2	ϵ 99.9%, $\alpha \approx$ 0.1%
		112		-67.1s	3.42 s 11	ϵ , $\alpha \approx$ 1.2×10 ⁻³ %
		113	(5/2+)	-71.12	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	$\epsilon \leq 100\%$, IT $\leq 100\%$
		115	(5/2+)	-76.5s	1.3 m 2	ϵ
		116	1+	-77.6	2.91 s 15	ϵ
		117	(5/2)+	-80.44	2.22 m 4	ϵ

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
53	I	118	2-	-80.69	13.7 m 5 ϵ
		118m	(7-)	-80.59	8.5 m 5 $\epsilon < 100\%$, IT > 0%
		119	5/2+	-83.67	19.1 m 4 ϵ
		120	2-	-83.79	81.0 m 6 ϵ
		120m	(7-)	-83.47	53 m 4 ϵ
		121	5/2+	-86.29	2.12 h 1 ϵ
		122	1+	-86.077	3.63 m 6 ϵ
		123	5/2+	-87.935	13.27 h 8 ϵ
		124	2-	-87.364	4.1760 d 3 ϵ
		125	5/2+	-88.842	59.400 d 10 ϵ
		126	2-	-87.915	13.11 d 5 ϵ 56.3%, β^- 43.7%
		127	5/2+	-88.987	100%
		128	1+	-87.742	24.99 m 2 β^- 93.1%, ϵ 6.9%
		129	7/2+	-88.504	1.57×10^7 y 4 β^-
		130	5+	-86.933	12.36 h 3 β^-
		130m	2+	-86.893	9.0 m 1 IT 84%, β^- 16%
		131	7/2+	-87.445	8.02070 d 11 β^-
		132	4+	-85.70	2.295 h 13 β^-
		132m	(8-)	-85.58	1.387 h 15 IT 86%, β^- 14%
		133	7/2+	-85.88	20.8 h 1 β^-
		133m (19/2-)		-84.24	9 s 2 IT
		134	(4)+	-83.95	52.5 m 2 β^-
		134m	(8)-	-83.63	3.60 m 10 IT 97.7%, β^- 2.3%
		135	7/2+	-83.79	6.57 h 2 β^-
		136	(1-)	-79.50	83.4 s 10 β^-
		136m	(6-)	-78.86	46.9 s 10 β^-
		137	(7/2+)	-76.50	24.5 s 2 β^- , β^- -n 6.97%
		138	(2-)	-72.30	6.49 s 7 β^- , β^- -n 5.5%
		139	(7/2+)	-68.84	2.280 s 11 β^- , β^- -n 10%
		140	(3)	-64.1s	0.86 s 4 β^- , β^- -n 9.3%
		141		-60.7s	0.43 s 2 β^- , β^- -n 22%
		142		-55.7s	≈ 0.2 s β^-
		143		-52.1s	>150 ns β^- ?
		144		-46.9s	>150 ns β^- ?
54	Xe	110	0+	-51.7s	≈ 0.2 s α , ϵ
		111		-54.4s	0.74 s 20 ϵ , α
		112	0+	-59.9	2.7 s 8 ϵ 99.16%, α 0.84%
		113		-62.05	2.74 s 8 $\epsilon \approx 100\%$, ϵ p 7%, $\alpha \approx 0.01\%$, $\epsilon\alpha \approx 7.0 \times 10^{-3}\%$
		114	0+	-66.9s	10.0 s 4 ϵ
		115	(5/2+)	-68.4s	18 s 4 ϵ , ϵ p 0.34%
		116	0+	-72.9s	59 s 2 ϵ
		117	5/2(+)	-74.0	61 s 2 ϵ , ϵ p $2.9 \times 10^{-3}\%$
		118	0+	-78.	3.8 m 9 ϵ
		119	(5/2+)	-78.7	5.8 m 3 ϵ
		120	0+	-81.83	40 m 1 ϵ
		121	5/2(+)	-82.54	40.1 m 20 ϵ
		122	0+	-85.19	20.1 h 1 ϵ
		123	(1/2)+	-85.26	2.08 h 2 ϵ
		124	0+	-87.658	$\geq 1.1 \times 10^{17}$ y 2 ϵ
					0.095% 3

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
54	Xe	125	1/2(+)	-87.189	16.9 h 2 ϵ
		125m	9/2(-)	-86.937	56.9 s 9 IT
		126	0+	-89.173	0.089% 1
		127	1/2+	-88.325	36.4 d 1 ϵ
		127m	9/2-	-88.027	69.2 s 9 IT
		128	0+	-89.861	1.910% 22
		129	1/2+	-88.697	26.40% 18
		129m	11/2-	-88.461	8.88 d 2 IT
		130	0+	-89.882	4.071% 53
		131	3/2+	-88.416	21.232% 62
		131m	11/2-	-88.252	11.934 d 21 IT
		132	0+	-89.280	26.909% 68
		133	3/2+	-87.648	5.243 d 1 β^-
		133m	11/2-	-87.415	2.19 d 1 IT
		134	0+	-88.124	10.436% 29
		134m	7-	-86.159	290 ms 17 IT
		135	3/2+	-86.44	9.14 h 2 β^-
		135m	11/2-	-85.91	15.29 m 5 IT > 99.4%, β^- < 0.6%
		136	0+	-86.424	> 3.6 $\times 10^{20}$ y 2 β^-
					8.857% 33
		137	7/2-	-82.379	3.818 m 13 β^-
		138	0+	-80.12	14.08 m 8 β^-
		139	3/2-	-75.65	39.68 s 14 β^-
		140	0+	-73.00	13.60 s 10 β^-
		141	5/2(-)	-68.33	1.73 s 1 β^- , β^- -n 0.04%
		142	0+	-65.5	1.22 s 2 β^- , β^- -n 0.41%
		143	5/2-	-60.7s	0.30 s 3 β^-
		144	0+	-57.5s	1.15 s 20 β^-
		145	(3/2-)	-52.5s	900 ms 300 β^-
		145		-52.5s	0.9 s 3 β^- -n
		146	0+	-49.1s	β^-
		147		-43.8s	> 150 ns β^- ?, β^- -n?
55	Cs	112		-46.3s	500 μ s 100 p?, α ?
		113	(5/2+)	-51.7	16.7 μ s 7 p $\approx$ 100%, $\epsilon \approx$ 0.03%
		114	(1+)	-54.6s	0.57 s 2 $\epsilon \approx$ 100%, ϵ p 8.6%, $\epsilon\alpha$ 0.16%, α 0.02%
		115		-59.7s	1.4 s 8 ϵ , ϵ p $\approx$ 0.07%
		116m	(1+)	-62.5	0.70 s 4 ϵ , $\epsilon\alpha$ > 0%, ϵ p > 0%
		116m	$\geq$ 5+	-62.5	3.85 s 13 ϵ , $\epsilon\alpha$ > 0%, ϵ p > 0%
		117	(9/2+)	-66.47	8.4 s 6 ϵ
		117m	(3/2+)	-66.32	6.5 s 4 ϵ
		118	2	-68.41	14 s 2 ϵ , ϵ p < 0.04%, $\epsilon\alpha$ < 2.4 $\times 10^{-3}\%$
		118m	6,7,8	-68.41	17 s 3 ϵ , ϵ p < 0.04%, $\epsilon\alpha$ < 2.4 $\times 10^{-3}\%$
		119	9/2+	-72.31	43.0 s 2 ϵ
		119m	3/2(+)	-72.31	30.4 s 1 ϵ
		120	2	-73.888	64 s 3 ϵ , $\epsilon\alpha$ 2.0 $\times 10^{-5}\%$, ϵ p 7.0 $\times 10^{-6}\%$
		120m	(7)	-73.888	57 s 6 ϵ
		121	3/2(+)	-77.14	155 s 4 ϵ
		121m	9/2(+)	-77.07	122 s 3 ϵ 83%, IT 17%

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	EI	A	J π	(MeV)	
55	Cs	122	1+	-78.13	21.0 s 7 ϵ
		122m	8-	-78.06	3.70 m 11 ϵ
		122m	(5)-	-78.00	0.36 s 2 IT
		123	1/2+	-81.05	5.87 m 5 ϵ
		123m	(11/2)-	-80.89	1.64 s 12 IT
		124	1+	-81.74	30.8 s 5 ϵ
		124m	(7)+	-81.28	6.3 s 2 IT
		125	1/2(+)	-84.091	46.7 m 1 ϵ
		126	1+	-84.35	1.63 m 3 ϵ
		127	1/2+	-86.240	6.25 h 10 ϵ
		128	1+	-85.932	3.66 m 2 ϵ
		129	1/2+	-87.501	32.06 h 6 ϵ
		130	1+	-86.903	29.21 m 4 ϵ 98.4%, β - 1.6%
		130m	5-	-86.740	IT 99.84%, ϵ 0.16%
		131	5/2+	-88.063	9.689 d 16 ϵ
		132	2+	-87.160	6.479 d 7 ϵ 98.13%, β - 1.87%
		133	7/2+	-88.076	100%
		134	4+	-86.896	754.5 d 2 β -, ϵ $3.0 \times 10^{-4}\%$
		134m	8-	-86.757	2.903 h 8 IT
		135	7/2+	-87.587	2.3×10^6 y 3 β -
		135m	19/2-	-85.954	53 m 2 IT
		136	5+	-86.344	13.16 d 3 β -
		136m	8-	-86.344	19 s 2 β -, IT > 0%
		137	7/2+	-86.551	30.07 y 3 β -
		138	3-	-82.893	33.41 m 18 β -
		138m	6-	-82.813	2.91 m 8 IT 81%, β - 19%
		139	7/2+	-80.707	9.27 m 5 β -
		140	1-	-77.056	63.7 s 3 β -
		141	7/2+	-74.48	24.94 s 6 β -, β -n 0.035%
		142	0-	-70.52	1.684 s 14 β -, β -n 0.09%
		143	3/2+	-67.69	1.78 s 1 β -, β -n 1.62%
		144	1	-63.32	1.01 s 1 β -, β -n 3.2%
		144m	(≥ 4)	-63.32	<1 s β -
		145	3/2+	-60.19	0.594 s 13 β -, β -n 14.3%
		146	1-	-55.74	0.321 s 2 β -, β -n 14.2%
		147	(3/2+)	-52.3	0.235 s 3 β -, β -n 43%
		148		-47.6	158 ms 7 β -, β -n 25.1%
		149		-44.0s	>50 ms β ?, β -n ?
		150		-39.2s	>50 ms β -, β -n
		151		-35.4s	>50 ms β ?, β -n ?
56	Ba	114	0+	-45.7s	0.43 s +30-15 $\epsilon \approx 100\%$, ϵ p 20%, α
		115	(3/2-)	-48.7s	0.45 s 5 ϵ , ϵ p > 15%
		116	0+	-54.3s	1.3 s 2 ϵ , ϵ p 3%
		117	3/2+	-57.0s	1.75 s 7 ϵ , $\epsilon\alpha > 0\%$, ϵ p > 0%
		118	0+	-62.0s	5.2 s 2 ϵ
		119	(5/2+)	-64.	5.4 s 3 ϵ , ϵ p < 25%
		120	0+	-68.9	24 s 2 ϵ
		121	5/2(+)	-70.3	29.7 s 15 ϵ , ϵ p 0.02%
		122	0+	-74.3s	1.95 m 15 ϵ
		123	5/2+	-75.6s	2.7 m 4 ϵ
		124	0+	-79.09	11.0 m 5 ϵ
		125	1/2(+)	-79.5	3.5 m 4 ϵ

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode	
Z	El	A	J π	(MeV)		Abundance
56	Ba	126	0+	−82.68	100 m 2	ϵ
		127	1/2+	−82.8	12.7 m 4	ϵ
		127m	7/2−	−82.7	1.9 s 2	IT
		128	0+	−85.41	2.43 d 5	ϵ
		129	1/2+	−85.07	2.23 h 11	ϵ
		129m	7/2+	−85.06	2.16 h 2	$\epsilon \leq 100\%$, IT
		130	0+	−87.271	$\geq 3.5 \times 10^{14}$ y	2 ϵ
					0.106% 1	
		131	1/2+	−86.693	11.50 d 6	ϵ
		131m	9/2−	−86.506	14.6 m 2	IT
		132	0+	−88.440	0.101% 1	
		133	1/2+	−87.558	3848.9 d 7	ϵ
		133m	11/2−	−87.270	38.9 h 1	IT 99.99%, ϵ 9.6×10 ^{−3} %
		134	0+	−88.954	2.417% 18	
		135	3/2+	−87.856	6.592% 12	
		135m	11/2−	−87.588	28.7 h 2	IT
		136	0+	−88.892	7.854% 24	
		136m	7−	−86.861	0.3084 s 19	IT
		137	3/2+	−87.727	11.232% 24	
		137m	11/2−	−87.065	2.552 m 1	IT
		138	0+	−88.267	71.698% 42	
		139	7/2−	−84.919	83.06 m 28	β −
		140	0+	−83.276	12.752 d 3	β −
		141	3/2−	−79.730	18.27 m 7	β −
		142	0+	−77.828	10.6 m 2	β −, β −n 0.09%
		143	5/2−	−73.94	14.33 s 8	β −
		144	0+	−71.78	11.5 s 2	β −, β −n 3.6%
		145	5/2−	−68.07	4.31 s 16	β −
		146	0+	−65.11	2.22 s 7	β −
		147	(3/2+)	−61.49	0.893 s 1	β −, β −n 0.06%
		148	0+	−58.0	0.607 s 25	β −, β −n 0.4%
		149		−53.6s	0.344 s 7	β −, β −n 0.43%
150	0+	−50.7s	0.3 s	β −		
151		−45.9s	>150 ms	β −?		
152	0+	−42.7s	≈0.1 s	β −?		
153		−37.6s	≈0.08 s	β −?		
57	La	117		−46.6s	≈0.5 s	ϵ ?
		118		−49.8s	≈1 s	ϵ ?
		119		−55.0s	≈2 s	ϵ ?
		120		−57.7s	2.8 s 2	ϵ , ϵ p>0%
		121		−62.4s	5.3 s 2	ϵ
		122		−64.5s	8.7 s 7	ϵ , ϵ p
		123		−68.7s	17 s 3	ϵ
		124m	low	−70.3s	<1 s	ϵ
		124m	(7,8−)	−70.3s	29 s 1	ϵ
		125		−73.9s	64.8 s 12	ϵ
		125m		−73.8s	0.4 s 2	IT
		126	low	−75.1s	<50 s	ϵ
		126	high	−75.1s	54 s 2	ϵ
		127	(11/2−)	−78.1s	5.1 m 1	ϵ
		127m	(3/2+)	−78.1s	3.7 m 4	ϵ , IT

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
57	La	128	(5+)	-78.8	5.23 m 15 ϵ
		128m	(1+,2-)	-78.8	<1.4 m ϵ
		129	3/2+	-81.35	11.6 m 2 ϵ
		129m	11/2-	-81.18	0.56 s 5 IT
		130	3(+)	-81.7s	8.7 m 1 ϵ
		131	3/2+	-83.7	59 m 2 ϵ
		132	2-	-83.73	4.8 h 2 ϵ
		132m	6-	-83.54	24.3 m 5 IT 76%, ϵ 24%
		133	5/2+	-85.3	3.912 h 8 ϵ
		134	1+	-85.24	6.45 m 16 ϵ
		135	5/2+	-86.66	19.5 h 2 ϵ
		136	1+	-86.02	9.87 m 3 ϵ
		136m		-85.79	114 ms 3 IT
		137	7/2+	-87.13	6×10^4 y 2 ϵ
		138	5+	-86.529	1.05×10^{11} y 2 ϵ 66.4%, β^- 33.6%
					0.090% I
		139	7/2+	-87.236	99.910% I
		140	3-	-84.326	1.6781 d 3 β^-
		141	(7/2+)	-82.943	3.92 h 3 β^-
		142	2-	-80.039	91.1 m 5 β^-
		143	(7/2)+	-78.19	14.2 m 1 β^-
		144	(3-)	-74.90	40.8 s 4 β^-
		145	(5/2+)	-72.99	24.8 s 20 β^-
		146	2-	-69.21	6.27 s 10 β^-
		146m	(6-)	-69.21	10.0 s 1 β^-
		147	(5/2+)	-67.24	4.015 s 8 β^- , β^-n 0.04%
		148	(2-)	-63.2	1.05 s 1 β^- , β^-n 0.15%
		149		-61.1s	1.05 s 3 β^- , β^-n 1.4%
		150	(3-)	-57.2s	0.51 s 3 β^- , β^-n 2.7%
		151		-54.4s	>150 ns $\beta^-?$
		152		-50.2s	>150 ns $\beta^-?$
		153		-47.1s	>150 ns $\beta^-?$
		154		-42.5s	≈ 0.1 s $\beta^-?$
		155		-39.0s	≈ 0.06 s $\beta^-?$
58	Ce	119		-44.0s	≈ 0.2 s $\epsilon?$
		120	0+	-49.7s	≈ 0.25 s $\epsilon?$
		121		-52.5s	1.1 s 1 ϵ , $\epsilon p \approx 1\%$
		122	0+	-57.7s	≈ 2 s $\epsilon?$, $\epsilon p?$
		123	(5/2)	-60.1s	3.8 s ϵ , ϵp
		124	0+	-64.7s	6 s 2 ϵ
		125	(5/2+)	-66.6s	10.2 s 4 ϵ , ϵp
		126	0+	-70.7s	50 s 3 ϵ
		127	(5/2+)	-72.0s	31 s 2 ϵ
		128	0+	-75.6s	3.93 m 2 ϵ
		129	5/2+	-76.3s	3.5 m 5 $\epsilon > 0\%$
		130	0+	-79.5s	25 m 2 ϵ
		131	(7/2+)	-79.7	10.2 m 3 ϵ
		131m	(1/2+)	-79.7	5.0 m 10 ϵ
		132	0+	-82.4s	3.51 h 11 ϵ
		133	1/2+	-82.4s	97 m 4 ϵ
		133m	9/2-	-82.4s	4.9 h 4 ϵ
		134	0+	-84.7	3.16 d 4 ϵ

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
58	Ce	135	1/2(+)	-84.63	17.7 h 3 ϵ
		135m	(11/2-)	-84.18	20 s 1 IT
		136	0+	-86.50	0.185% 2
		137	3/2+	-85.90	9.0 h 3 ϵ
		137m	11/2-	-85.65	34.4 h 3 IT 99.22%, ϵ 0.78%
		138	0+	-87.57	0.251% 2
		139	3/2+	-86.958	137.640 d 23 ϵ
		139m	11/2-	-86.204	56.54 s 13 IT
		140	0+	-88.088	88.450% 18
		141	7/2-	-85.445	32.501 d 5 β^-
		142	0+	-84.543	$>5 \times 10^{16}$ y $2\beta^-$
				11.114% 17	
		143	3/2-	-81.616	33.039 h 6 β^-
		144	0+	-80.441	284.893 d 8 β^-
		145	(3/2-)	-77.10	3.01 m 6 β^-
		146	0+	-75.74	13.52 m 13 β^-
		147	(5/2-)	-72.18	56.4 s 10 β^-
		148	0+	-70.4	56 s 1 β^-
		149	(3/2-)	-66.80	5.3 s 2 β^-
		150	0+	-65.0	4.0 s 6 β^-
		151		-61.4s	1.02 s 6 β^-
		152	0+	-59.3s	1.4 s 2 β^-
		153		-55.3s	>150 ns $\beta^-?$
		154	0+	-52.8s	>150 ns $\beta^-?$
		155		-48.4s	>150 ns $\beta^-?$
		156	0+	-45.4s	≈ 0.15 s $\beta^-?$
		157		-40.7s	≈ 0.05 s $\beta^-?$
59	Pr	121		-41.6s	1.4 s 8 p, $\epsilon?$
		122		-45.0s	≈ 0.5 s $\epsilon?$
		123		-50.3s	≈ 0.8 s $\epsilon?$
		124		-53.1s	1.2 s 2 ϵ , ϵp
		125		-57.9s	3.3 s 7 ϵ , ϵp
		126	(3,4,5)	-60.3s	3.14 s 22 ϵ , ϵp
		127		-64.4s	4.2 s 3 ϵ
		128	4,5,6	-66.3s	3.1 s 2 ϵ
		129	(11/2-)	-70.0s	32 s 3 $\epsilon > 0\%$
		130		-71.4s	40.0 s 4 ϵ
		131	(3/2+)	-74.5	94 s 4 ϵ
		131m	(11/2-)	-74.3	5.7 s 2 IT 96.4%, ϵ 3.6%
		132		-75.3s	1.6 m 3 ϵ
		133	(3/2+)	-78.1s	6.5 m 3 ϵ
		134	2-	-78.6s	17 m 2 ϵ
		134m	(5-)	-78.6s	≈ 11 m ϵ
		135	3/2(+)	-80.9	24 m 2 ϵ
		136	2+	-81.37	13.1 m 1 ϵ
		137	5/2+	-83.20	1.28 h 3 ϵ
		138	1+	-83.14	1.45 m 5 ϵ
		138m	7-	-82.77	2.12 h 4 ϵ
		139	5/2+	-84.829	4.41 h 4 ϵ
		140	1+	-84.700	3.39 m 1 ϵ
		141	5/2+	-86.026	100%
		142	2-	-83.797	19.12 h 4 β^- 99.98%, ϵ 0.02%

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
59 Pr	142m	5-	-83.794	14.6 m 5	IT
	143	7/2+	-83.078	13.57 d 2	β^-
	144	0-	-80.760	17.28 m 5	β^-
	144m	3-	-80.701	7.2 m 3	IT 99.93%, β^- 0.07%
	145	7/2+	-79.636	5.984 h 10	β^-
	146	(2)-	-76.77	24.15 m 18	β^-
	147	(3/2+)	-75.47	13.4 m 4	β^-
	148	1-	-72.49	2.29 m 2	β^-
	148m	(4)	-72.40	2.01 m 1	β^-
	149	(5/2+)	-70.99	2.26 m 7	β^-
	150	(1)-	-68.00	6.19 s 16	β^-
	151	(3/2-)	-66.86	18.90 s 7	β^-
	152	(4-)	-63.7s	3.63 s 12	β^-
	153		-61.8s	4.28 s 11	β^-
	154	(3+,2+)	-58.3s	2.3 s 1	β^-
	155		-55.9s	>300 ns	β^- ?
	156		-52.1s	>300 ns	β^- ?
	157		-49.2s	$\approx$ 0.3 s	β^- ?
	158		-44.9s	$\approx$ 0.2 s	β^- ?
	159		-41.7s	$\approx$ 0.1 s	β^- ?
60 Nd	126	0+	-53.0s	$\approx$ 1 s	ϵ ?
	127		-55.4s	1.8 s 4	ϵ , ϵp
	128	0+	-60.2s		ϵ
	129	(5/2+)	-62.2s	7 s 1	ϵ , ϵp
	130	0+	-66.3s	28 s 3	ϵ
	131	(5/2)	-67.9	33 s 3	ϵ , ϵp
	132	0+	-71.6s	80 s 7	ϵ
	133	(7/2+)	-72.5s	70 s 10	ϵ
	133m	(1/2)+	-72.3s	$\approx$ 70 s	ϵ
	134	0+	-75.8s	8.5 m 15	ϵ
	135	9/2(-)	-76.2s	12.4 m 6	ϵ
	135m	(1/2+)	-76.1s	5.5 m 5	ϵ > 99.97%, IT < 0.03%
	136	0+	-79.16	50.65 m 33	ϵ
	137	1/2+	-79.51	38.5 m 15	ϵ
	137m	11/2-	-78.99	1.60 s 15	IT
	138	0+	-82.0s	5.04 h 9	ϵ
	139	3/2+	-82.04	29.7 m 5	ϵ
	139m	11/2-	-81.81	5.50 h 20	ϵ 88.2%, IT 11.8%
	140	0+	-84.48	3.37 d 2	ϵ
	141	3/2+	-84.203	2.49 h 3	ϵ
	141m	11/2-	-83.446	62.0 s 8	IT, ϵ < 0.05%
	142	0+	-85.960	27.2% 5	
	143	7/2-	-84.012	12.2% 2	
	144	0+	-83.757	2.29 $\times$ 10 ¹⁵ y 16	α
				23.8% 3	
	145	7/2-	-81.442	8.3% 1	
	146	0+	-80.936	17.2% 3	
	147	5/2-	-78.156	10.98 d 1	β^-
	148	0+	-77.418	5.7% 1	
	149	5/2-	-74.385	1.728 h 1	β^-

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode	
Z	El	A	(MeV)	Abundance		
60	Nd	150	0+	−73.694	>6.8×10 ¹⁸ y	2β−
					5.6% 2	
		151	3/2+	−70.957	12.44 m 7	β−
		152	0+	−70.16	11.4 m 2	β−
		153	(3/2)−	−67.35	31.6 s 10	β−
		154	0+	−65.7	25.9 s 2	β−
		155		−62.8	8.9 s 2	β−
		156	0+	−60.4s	5.49 s 7	β−
		157		−56.6s	≈2 s	β− ?
		158	0+	−54.1s	≈0.7 s	β− ?
		159		−49.9s	≈0.7 s	β− ?
		160	0+	−47.1s	≈0.3 s	β− ?
		161		−42.5s	≈0.2 s	β− ?
61	Pm	128		−48.2s	≈0.8 s	ε ?
		129		−52.9s	≈1 s	ε ?
		130		−55.5s	2.2 s 5	ε , εp
		131		−59.8s	≈4 s	ε ? , εp ?
		132	(3+)	−61.7s	6.3 s 7	ε , εp ≈ 5.0×10 ^{−5} %
		133	(11/2−)	−65.5s	15 s 3	ε
		134	(2+)	−66.6s	≈5 s	ε
		134m	(5+)	−66.6s	22 s 1	ε
		135m	(11/2−)	−70.2s	45 s 4	ε
		135m	(3/2+,5/2+)	−70.2s	49 s 3	ε
		136	(2+)	−71.3	47 s 2	ε
		136	5(+),6−	−71.3	107 s 6	ε
		137	11/2−	−73.9s	2.4 m 1	ε
		138	1+	−75.0s	10 s 2	ε
		138m	(3+)	−75.0s	3.24 m 5	ε
		138m	(5−)	−75.0s	3.24 m	ε
		139	(5/2)+	−77.54	4.15 m 5	ε
		139m	(11/2)−	−77.35	180 ms 20	IT , ε ?
		140	1+	−78.43	9.2 s 2	ε
		140m	8−	−78.43	5.95 m 5	ε
		141	5/2+	−80.47	20.90 m 5	ε
		142	1+	−81.09	40.5 s 5	ε
		143	5/2+	−82.970	265 d 7	ε
		144	5−	−81.426	363 d 14	ε
		145	5/2+	−81.279	17.7 y 4	ε , α 3×10 ^{−7} %
		146	3−	−79.464	5.53 y 5	ε 66%, β− 34%
		147	7/2+	−79.052	2.6234 y 2	β−
		148	1−	−76.878	5.370 d 9	β−
		148m	6−	−76.740	41.29 d 11	β− 95.8%, IT 4.2%
		149	7/2+	−76.076	53.08 h 5	β−
		150	(1−)	−73.61	2.68 h 2	β−
		151	5/2+	−73.399	28.40 h 4	β−
		152	1+	−71.27	4.12 m 8	β−
		152m	4−	−71.12	7.52 m 8	β−
		152m	(8)	−71.12	13.8 m 2	β− ≤ 100%, IT ≥ 0%
		153	5/2−	−70.69	5.25 m 2	β−
		154	(3,4)	−68.42	2.68 m 7	β−
		154m	(0,1)	−68.42	1.73 m 10	β−
		155	(5/2−)	−66.98	41.5 s 2	β−

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
61 Pm	156		4(−)	−64.22	26.70 s 10 β −
	157		(5/2−)	−62.2s	10.56 s 10 β −
	158			−59.0s	4.8 s 5 β −
	159			−56.7s	2 s 1 β −
	160			−53.1s	$\approx$ 2 s β −?
	161			−50.4s	$\approx$ 0.7 s β −?
	162			−46.3s	$\approx$ 0.5 s β −?
	163			−43.3s	$\approx$ 0.2 s β −?
62 Sm	130		0+	−47.9s	$\approx$ 0.5 s ϵ ?
	131			−50.4s	1.2 s 2 ϵ , $\epsilon p > 0\%$
	132		0+	−55.1s	4.0 s 3 ϵ , ϵp
	133			−57.1s	3.7 s 7 ϵ , ϵp
	134		0+	−61.5s	10 s 1 ϵ
	135		(3/2+, 5/2+)	−63.0s	10.3 s 5 ϵ , ϵp 0.02%
	136		0+	−66.8s	47 s 2 ϵ
	137		(9/2−)	−68.0	45 s 1 ϵ
	138		0+	−71.2s	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+	−75.95	10.2 m 2 ϵ
	141m		11/2−	−75.77	22.6 m 2 ϵ 99.69%, IT 0.31%
	142		0+	−79.00	72.49 m 5 ϵ
	143		3/2+	−79.528	8.83 m 1 ϵ
	143m		11/2−	−78.774	66 s 2 IT 99.76%, ϵ 0.24%
	144		0+	−81.976	3.07% 7
	145		7/2−	−80.662	340 d 3 ϵ
	146		0+	−81.006	10.3×10^7 y 5 α
	147		7/2−	−79.276	1.06×10^{11} y 2 α
					14.99% 18
	148		0+	−79.347	7×10^{15} y 3 α
					11.24% 10
	149		7/2−	−77.147	$> 2 \times 10^{15}$ y α ?
					13.82% 7
	150		0+	−77.061	7.38% 1
	151		5/2−	−74.586	90 y 8 β −
	152		0+	−74.773	26.75% 16
	153		3/2+	−72.569	46.284 h 4 β −
	154		0+	−72.465	$\geq 2.3 \times 10^{18}$ y 2β −
					22.75% 29
	155		3/2−	−70.201	22.3 m 2 β −
	156		0+	−69.372	9.4 h 2 β −
	157		(3/2−)	−66.74	482 s 4 β −
	158		0+	−65.22	5.30 m 3 β −
	159		(5/2−)	−62.2s	11.37 s 15 β −
	160		0+	−60.4s	9.6 s 3 β −
	161			−57.0s	4.8 s 8 β −
	162		0+	−54.8s	$\approx$ 2 s β −?
	163			−50.9s	$\approx$ 1 s β −?
	164		0+	−48.2s	$\approx$ 0.5 s β −?
	165			−43.8s	$\approx$ 0.2 s β −
63 Eu	131		(3/2)+		26 ms 6 p

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
63	Eu	132		-42.7s	$\epsilon?$
		133		-47.6s	$\epsilon?$
		134		-50.0s	$\epsilon, \epsilon p > 0\%$
		135		-54.3s	$\epsilon, \epsilon p$
		136m	(7+)	-56.4s	$\epsilon, \epsilon p 0.09\%$
		136m	(3+)	-56.4s	$\epsilon, \epsilon p 0.09\%$
		137	(11/2-)	-60.4s	ϵ
		138	(6-)	-62.0s	ϵ
		139	(11/2)-	-65.4s	ϵ
		140	1+	-66.99	ϵ
		140m	(5-)	-66.80	IT, $\epsilon < 1\%$
		141	5/2+	-69.97	ϵ
		141m	11/2-	-69.87	IT 87%, $\epsilon 13\%$
		142	1+	-71.35	ϵ
		142m	8-	-71.35	ϵ
		143	5/2+	-74.25	ϵ
		144	1+	-75.66	ϵ
		145	5/2+	-78.002	ϵ
		146	4-	-77.128	ϵ
		147	5/2+	-77.555	$\epsilon, \alpha 2.2 \times 10^{-3}\%$
		148	5-	-76.24	$\epsilon, \alpha 9.4 \times 10^{-7}\%$
		149	5/2+	-76.451	ϵ
		150	5(-)	-74.800	ϵ
		150m	0-	-74.758	$\beta- 89\%, \epsilon 11\%,$ IT $\leq 5.0 \times 10^{-8}\%$
		151	5/2+	-74.663	47.81% 3
		152	3-	-72.898	13.516 y 6 $\epsilon 72.1\%, \beta- 27.9\%$
		152m	0-	-72.853	9.3116 h 13 $\beta- 72\%, \epsilon 28\%$
		152m	8-	-72.750	96 m 1 IT
		153	5/2+	-73.377	52.19% 3
		154	3-	-71.748	8.592 y 4 $\beta- 99.98\%, \epsilon 0.02\%$
		154m	(8-)	-71.603	46.3 m 4 IT
		155	5/2+	-71.828	4.7611 y 13 $\beta-$
		156	0+	-70.094	15.19 d 8 $\beta-$
		157	5/2+	-69.471	15.18 h 3 $\beta-$
		158	(1-)	-67.21	45.9 m 2 $\beta-$
		159	5/2+	-66.057	18.1 m 1 $\beta-$
		160	1(-)	-63.4s	38 s 4 $\beta-$
		161		-61.8s	26 s 3 $\beta-$
		162		-58.6s	10.6 s 10 $\beta-$
		163		-56.6s	$\beta-?$
		164		-53.1s	≈ 2 s $\beta-?$
		165		-50.6s	≈ 1 s $\beta-?$
		166		-46.6s	≈ 0.4 s $\beta-$
		167		-43.7s	≈ 0.2 s $\beta-?$
64	Gd	135			1.1 s 2 $\epsilon, \epsilon p \approx 2\%$
		136	0+	-49.3s	≈ 1 s $\epsilon?$
		137		-51.6s	7 s 3 ϵ
		138	0+	-55.9s	≈ 5 s $\epsilon?$
		139		-57.7s	4.9 s 10 $\epsilon, \epsilon p$
		140	0+	-61.5s	15.8 s 4 ϵ
		141	(1/2+)	-63.1s	14 s 4 $\epsilon, \epsilon p 0.03\%$

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
64 Gd	141m	(11/2-)	-62.8s	24.5 s 5	ϵ 89%, IT 11%
	142	0+	-66.9s	70.2 s 6	ϵ
	143	(1/2)+	-68.2	39 s 2	ϵ
	143m	(11/2-)	-68.1	112 s 2	ϵ
	144	0+	-71.9s	4.5 m 1	ϵ
	145	1/2+	-72.95	23.0 m 4	ϵ
	145m	11/2-	-72.20	85 s 3	IT 94.3%, ϵ 5.7%
	146	0+	-76.098	48.27 d 10	ϵ
	147	7/2-	-75.368	38.06 h 12	ϵ
	148	0+	-76.280	74.6 y 30	α
	149	7/2-	-75.138	9.28 d 10	ϵ , α 4.3 $\times 10^{-4}\%$
	150	0+	-75.772	1.79 $\times 10^6$ y 8	α
	151	7/2-	-74.199	124 d 1	ϵ , $\alpha \approx 8.0 \times 10^{-7}\%$
	152	0+	-74.717	1.08 $\times 10^{14}$ y 8	α
				0.20% 1	
	153	3/2-	-72.893	240.4 d 10	ϵ
	154	0+	-73.716	2.18% 3	
	155	3/2-	-72.080	14.80% 12	
	156	0+	-72.545	20.47% 9	
	157	3/2-	-70.834	15.65% 2	
	158	0+	-70.700	24.84% 7	
	159	3/2-	-68.572	18.479 h 4	β -
	160	0+	-67.952	$\geq 1.3 \times 10^{21}$ y	2 β -
				21.86% 19	
	161	5/2-	-65.516	3.66 m 5	β -
	162	0+	-64.291	8.4 m 2	β -
	163	(5/2-, 7/2+)	-61.5s	68 s 3	β -
	164	0+	-59.7s	45 s 3	β -
	165		-56.5s	10.3 s 16	β -
	166	0+	-54.4s	≈ 7 s	β -
	167		-50.7s	≈ 3 s	β -?
	168	0+	-48.1s	≈ 0.3 s	β -?
	169		-43.9s	≈ 1 s	β -?
65 Tb	138		-43.9s	≈ 0.4 s	ϵ ?
	139		-48.4s	≈ 0.7 s	ϵ ?
	140	5	-50.7s	2.4 s 2	ϵ , ϵp 0.26%
	141	(5/2-)	-54.8s	3.5 s 2	ϵ
	141m		-54.8s	7.9 s 6	ϵ
	142	1+	-57.0s	597 ms 17	ϵ , ϵp 2.2 $\times 10^{-3}\%$
	142m	(5-)	-56.7s	303 ms 17	IT, $\epsilon < 0.5\%$
	143	(11/2-)	-60.8s	12 s 1	ϵ
	143m	(5/2+)	-60.8s	<21 s	IT
	144	(1+)	-62.8s	≈ 1 s	ϵ
	144m	(6-)	-62.5s	4.25 s 15	IT 66%, ϵ 34%
	145	(3/2+)	-66.2s	≈ 20 m	ϵ ?
	145m	(11/2-)	-66.2s	30.9 s 7	ϵ
	146	1+	-67.83	8 s 4	ϵ
	146m	5-	-67.83	23 s 2	ϵ
	147	(1/2+)	-70.76	1.7 h 1	ϵ
	147m	(11/2)-	-70.71	1.83 m 6	ϵ
	148	2-	-70.52	60 m 1	ϵ
	148m	9+	-70.43	2.20 m 5	ϵ

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
65	Tb	149	1/2+	-71.500	4.118 h 25 ϵ 83.3%, α 16.7%
		149m	11/2-	-71.464	4.16 m 4 ϵ 99.98%, α 0.02%
		150	(2-)	-71.116	3.48 h 16 ϵ , α < 0.05%
		150m	9+	-70.642	5.8 m 2 ϵ
		151	1/2(+)	-71.634	17.609 h 1 ϵ , α $9.5 \times 10^{-3}\%$
		151m	(11/2-)	-71.534	25 s 3 IT 93.8%, ϵ 6.2%
		152	2-	-70.73	17.5 h 1 ϵ , α < $7.0 \times 10^{-7}\%$
		152m	8+	-70.23	4.2 m 1 IT 78.8%, ϵ 21.2%
		153	5/2+	-71.324	2.34 d 1 ϵ
		154	0	-70.15	21.5 h 4 ϵ , β - < 0.1%
		154m	3-	-70.15	9.4 h 4 ϵ 78.2%, IT 21.8%, β - < 0.1%
		154m	7-	-70.15	22.7 h 5 ϵ 98.2%, IT 1.8%
		155	3/2+	-71.26	5.32 d 6 ϵ
		156	3-	-70.101	5.35 d 10 ϵ , β - ?
		156m	(7-)	-70.051	24.4 h 10 IT
		156m	(0+)	-70.013	5.3 h 2 ϵ , IT
		157	3/2+	-70.774	71 y 7 ϵ
		158	3-	-69.480	180 y 11 ϵ 83.4%, β - 16.6%
		158m	0-	-69.370	10.70 s 17 IT, β - < 0.6%, ϵ < 0.01%
		159	3/2+	-69.542	100%
		160	3-	-67.846	72.3 d 2 β -
		161	3/2+	-67.472	6.88 d 3 β -
		162	1-	-65.68	7.60 m 15 β -
		163	3/2+	-64.605	19.5 m 3 β -
		164	(5+)	-62.1	3.0 m 1 β -
		165	(3/2+)	-60.7s	2.11 m 10 β -
		166		-57.7s	21 s 6 β -
		167		-55.8s	19.4 s 27 β -
		168	(4-)	-52.5s	8.2 s 13 β -
		169		-50.1s	$\approx$ 2 s β - ?
		170		-46.3s	$\approx$ 3 s β - ?
		171		-43.5s	$\approx$ 0.5 s β -
66	Dy	139			$\approx$ 0.2 s ϵ ?
		141	(9/2-)	-45.5s	0.9 s 2 ϵ , ϵ p
		142	0+	-50.1s	2.3 s 3 ϵ , ϵ p 0.06%
		143		-52.3s	3.9 s 4 ϵ , ϵ p
		144	0+	-56.8s	9.1 s 4 ϵ , ϵ p
		145	(1/2+)	-58.7s	10.5 s 15 ϵ
		145m	(11/2-)	-58.7s	13.6 s 10 ϵ
		146	0+	-62.7	29 s 3 ϵ
		146m	(10+)	-59.7	150 ms 20 IT
		147	1/2+	-64.39	40 s 10 ϵ , ϵ p > 0%
		147m	11/2-	-63.64	55.7 s 7 ϵ 65%, IT 35%
		148	0+	-67.83	3.1 m 1 ϵ
		149	(7/2-)	-67.69	4.20 m 14 ϵ
		149m	(27/2-)	-65.03	0.490 s 15 IT 99.3%, ϵ 0.7%
		150	0+	-69.322	7.17 m 5 ϵ 64%, α 36%
		151	7/2(-)	-68.763	17.9 m 3 ϵ 94.4%, α 5.6%
		152	0+	-70.129	2.38 h 2 ϵ 99.9%, α 0.1%
		153	7/2(-)	-69.153	6.4 h 1 ϵ 99.99%, α $9.4 \times 10^{-3}\%$

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
66 Dy	154		0+	-70.400	3.0×10^6 y 15 α
	155		3/2-	-69.16	9.9 h 2 ϵ
	156		0+	-70.534	0.06% 1
	157		3/2-	-69.432	8.14 h 4 ϵ
	158		0+	-70.417	0.10% 1
	159		3/2-	-69.177	144.4 d 2 ϵ
	160		0+	-69.682	2.34% 8
	161		5/2+	-68.065	18.91% 24
	162		0+	-68.190	25.51% 26
	163		5/2-	-66.390	24.90% 16
	164		0+	-65.977	28.18% 37
	165		7/2+	-63.621	2.334 h 1 β^-
	165m		1/2-	-63.513	IT 97.76%, β^- 2.24%
	166		0+	-62.593	81.6 h 1 β^-
	167		(1/2-)	-59.94	6.20 m 8 β^-
	168		0+	-58.5s	8.7 m 3 β^-
	169		(5/2-)	-55.6	39 s 8 β^-
	170		0+	-53.4s	≈ 30 s $\beta^-?$
	171			-49.9s	≈ 6 s β^-
	172		0+	-47.4s	≈ 3 s β^-
	173			-43.4s	≈ 2 s $\beta^-?$
67 Ho	140				6 ms 3 p
	141		(7/2-)		4.1 ms 3 p
	142			-37.4s	≈ 0.3 s $\epsilon?$
	143			-42.2s	≈ 0.3 s $\epsilon?$
	144			-45.0s	0.7 s 1 $\epsilon, \epsilon p$
	145			-49.5s	2.4 s 1 ϵ
	146		(10+)	-52.1s	3.6 s 3 ϵ
	147		(11/2-)	-56.0s	5.8 s 4 $\epsilon, \epsilon p$
	148		1+	-58.4s	2.2 s 11 ϵ
	148m		6-	-58.4s	9.59 s 15 $\epsilon, \epsilon p$ 0.08%
	149		(11/2-)	-61.67	21.1 s 2 ϵ
	149m		(1/2+)	-61.63	56 s 3 ϵ
	150		2-	-62.1s	72 s 4 ϵ
	150m		(9+)	-61.3s	23.3 s 3 ϵ
	151		(11/2-)	-63.64	35.2 s 1 ϵ 78%, α 22%
	151m		(1/2+)	-63.60	47.2 s 10 α 80%, ϵ 20%
	152		2-	-63.58	161.8 s 3 ϵ 88%, α 12%
	152m		9+	-63.42	50.0 s 4 ϵ 89.2%, α 10.8%
	153		11/2-	-65.023	2.01 m 3 ϵ 99.95%, α 0.05%
	153m		1/2+	-64.955	9.3 m 5 ϵ 99.82%, α 0.18%
	154		2-	-64.649	11.76 m 19 ϵ 99.98%, α 0.02%
	154m		8+	-64.649	3.10 m 14 $\epsilon, \alpha < 1.0 \times 10^{-3}\%$, IT $\approx 0\%$
	155		5/2+	-66.06	48 m 1 ϵ
	156		(5+)	-65.5s	56 m 1 ϵ
	156m		(2+)	-65.4s	9.5 s 15 IT
	157		7/2-	-66.89	12.6 m 2 ϵ
	158		5+	-66.19	11.3 m 4 ϵ
	158m		2-	-66.12	28 m 2 IT > 81%, $\epsilon < 19\%$
	158m		(9+)	-66.01	21.3 m 23 $\epsilon \geq 93\%$, IT $\leq 7\%$
	159		7/2-	-67.339	33.05 m 11 ϵ

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
67	Ho	159m	1/2+	-67.133	8.30 s 8 IT
		160	5+	-66.39	25.6 m 3 ϵ
		160m	2-	-66.33	5.02 h 5 IT 65%, ϵ 35%
		160m	(9+)	-66.22	3 s IT
		161	7/2-	-67.206	2.48 h 5 ϵ
		161m	1/2+	-66.995	6.76 s 7 IT
		162	1+	-66.050	15.0 m 10 ϵ
		162m	6-	-65.944	67.0 m 7 IT 62%, ϵ 38%
		163	7/2-	-66.387	STABLE
		163	7/2-	-66.387	4570 y 25 ϵ
		163m	1/2+	-66.089	1.09 s 3 IT
		164	1+	-64.990	29 m 1 ϵ 60%, β - 40%
		164m	6-	-64.850	37.5 m +15-5 IT
		165	7/2-	-64.907	100%
		166	0-	-63.080	26.763 h 4 β -
		166m	(7)-	-63.074	1.20×10 ³ y 18 β -
		167	7/2-	-62.292	3.1 h 1 β -
		168	3+	-60.08	2.99 m 7 β -
		168m	(6+)	-60.03	132 s 4 IT≥99.5%, β -≤0.5%
		169	7/2-	-58.81	4.7 m 1 β -
		170	(6+)	-56.25	2.76 m 5 β -
		170m	(1+)	-56.13	43 s 2 β -
		171	(7/2-)	-54.5	53 s 2 β -
		172		-51.4s	25 s 3 β -
		173		-49.1s	≈10 s β -?
		174		-45.5s	≈8 s β -?
		175		-42.8s	≈5 s β -?
68	Er	144	0+	-36.7s	≈0.4 s ϵ ?
		145	(11/2-)	-39.6s	0.9 s 3 ϵ , ϵ p
		146	0+	-44.6s	1.7 s 6 ϵ , ϵ p
		147	(11/2-)	-47.2s	2.5 s 2 ϵ , ϵ p>0%
		147m	(1/2+)	-47.2s	≈2.5 s ϵ , ϵ p>0%
		148	0+	-51.8s	4.6 s 2 ϵ
		149	(1/2+)	-53.9s	4 s 2 ϵ , ϵ p 7%
		149m	(11/2-)	-53.1s	8.9 s 2 ϵ 96.5%, IT 3.5%, ϵ p 0.18%
		150	0+	-58.0s	18.5 s 7 ϵ
		151	(7/2-)	-58.3s	23.5 s 13 ϵ
		151m	(27/2-)	-55.7s	0.58 s 2 IT 95.3%, ϵ 4.7%
		152	0+	-60.47	10.3 s 1 α 90%, ϵ 10%
		153	(7/2-)	-60.46	37.1 s 2 α 53%, ϵ 47%
		154	0+	-62.618	3.73 m 9 ϵ 99.53%, α 0.47%
		155	7/2-	-62.22	5.3 m 3 ϵ 99.98%, α 0.02%
		156	0+	-64.26	19.5 m 10 ϵ , α 5×10 ⁻⁶ %
		157	3/2-	-63.39	18.65 m 10 ϵ ≈100%, α <0.02%
		158	0+	-65.3s	2.29 h 6 ϵ
		159	3/2-	-64.571	36 m 1 ϵ
		160	0+	-66.06	28.58 h 9 ϵ
		161	3/2-	-65.203	3.21 h 3 ϵ
		162	0+	-66.346	0.139% 5
		163	5/2-	-65.177	75.0 m 4 ϵ
		164	0+	-65.953	1.601% 3

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV) Abundance	
68	Er	165	5/2−	−64.531	10.36 h 4 ϵ
		166	0+	−64.935	33.503% 36
		167	7/2+	−63.299	22.869% 9
		167m	1/2−	−63.091	2.269 s 6 IT
		168	0+	−62.999	26.978% 18
		169	1/2−	−60.931	9.40 d 2 β −
		170	0+	−60.118	$\geq 3.2 \times 10^{17}$ y 2 β −
				14.910% 36	
		171	5/2−	−57.729	7.516 h 2 β −
		172	0+	−56.493	49.3 h 3 β −
		173	(7/2−)	−53.7s	1.4 m 1 β −
		174	0+	−51.8s	3.2 m 2 β −
		175	(9/2+)	−48.5s	1.2 m 3 β −
		176	0+	−46.3s	≈ 20 s β −?
		177		−42.5s	≈ 3 s β −?
69	Tm	145	(11/2−)		3.5 μ s 10 p
		146	(5−, 6−)	−31.2s	62 ms +19−14 p
		146m	(10+)	−31.2s	206 ms 25 p
		147	(11/2−)	−36.3s	0.559 s 26 $\epsilon \approx 90\%$, p $\approx 10\%$
		148m	(10+)	−39.5s	0.7 s 2 ϵ
		149	(11/2−)	−44.1s	0.9 s 2 ϵ , ϵ p 0.2%
		150	(6−)	−46.9s	2.2 s 2 ϵ
		151	(11/2−)	−50.8s	4.17 s 10 ϵ
		151m	(1/2+)	−50.8s	6.6 s 14 ϵ
		152	(2)−	−51.9s	8.0 s 10 ϵ
		152m	(9)+	−51.9s	5.2 s 6 ϵ
		153	(11/2−)	−54.00	1.48 s 1 α 91%, ϵ 9%
		153m	(1/2+)	−53.96	2.5 s 2 α 92%, ϵ 8%
		154	(2)−	−54.6s	8.1 s 3 α 54%, ϵ 46%
		154m	(9+)	−54.6s	3.30 s 7 α 58%, ϵ 42%, IT
		155	(11/2−)	−56.64	21.6 s 2 ϵ 98.1%, α 1.9%
		155m	(1/2+)	−56.60	45 s 3 $\epsilon > 92\%$, $\alpha < 8\%$
		156	2−	−56.81	83.8 s 18 ϵ 99.94%, α 0.06%
		156m		−56.81	19 s 3 α
		157	1/2+	−58.9	3.63 m 9 ϵ
		158	2−	−58.7s	3.98 m 6 ϵ
		159	5/2+	−60.72	9.13 m 16 ϵ
		160	1−	−60.5	9.4 m 3 ϵ
		160m	5	−60.4	74.5 s 15 IT 85%, ϵ 15%
		161	7/2+	−62.04	33 m 3 ϵ
		162	1−	−61.51	21.70 m 19 ϵ
		162m	5+	−61.51	24.3 s 17 IT 82%, ϵ 18%
		163	1/2+	−62.738	1.810 h 5 ϵ
		164	1+	−61.99	2.0 m 1 ϵ
		164	6−	−61.99	5.1 m 1 IT $\approx 80\%$, $\epsilon \approx 20\%$
		165	1/2+	−62.939	30.06 h 3 ϵ
		166	2+	−61.89	7.70 h 3 ϵ
		167	1/2+	−62.551	9.25 d 2 ϵ
		168	3+	−61.320	93.1 d 2 ϵ 99.99%, β − 0.01%
		169	1/2+	−61.282	100%
		170	1−	−59.804	128.6 d 3 β − 99.87%, ϵ 0.13%
		171	1/2+	−59.219	1.92 y 1 β −

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
69 Tm	172		2-	-57.384	63.6 h 2 β -
	173		(1/2+)	-56.262	8.24 h 8 β -
	174		(4)-	-53.87	5.4 m 1 β -
	175		1/2+	-52.32	15.2 m 5 β -
	176		(4+)	-49.4	1.9 m 1 β -
	177		(1/2+)	-47.5 s	85 s +10-15 β -
	178			-44.1 s	$\approx$ 30 s β - ?
	179			-41.6 s	$\approx$ 20 s β - ?
70 Yb	148		0+	-31.0 s	$\approx$ 0.25 s ϵ ?
	149			-34.0 s	$\approx$ 0.6 s ϵ ?
	150		0+	-39.1 s	$\approx$ 0.7 s ϵ ?
	151		(1/2+)	-41.7 s	1.6 s 1 ϵ , ϵ p
	151m		(11/2-)	-41.7 s	1.6 s 1 $\epsilon \approx 100\%$, ϵ p, IT ?
	152		0+	-46.4 s	3.04 s 6 ϵ , ϵ p
	153		7/2-	-47.3 s	4.2 s 2 α 50%, ϵ 50%
	154		0+	-50.1 s	0.409 s 2 α 92.6%, ϵ 7.4%
	155		(7/2-)	-50.5 s	1.800 s 20 α 89%, ϵ 11%
	156		0+	-53.24	26.1 s 7 ϵ 90%, α 10%
	157		7/2-	-53.41	38.6 s 10 ϵ 99.5%, α 0.5%
	158		0+	-56.022	1.49 m 13 ϵ , $\alpha \approx 2.1 \times 10^{-3}\%$
	159		5/2(-)	-55.75	1.58 m 14 ϵ
	160		0+	-58.2 s	4.8 m 2 ϵ
	161		3/2-	-57.9 s	4.2 m 2 ϵ
	162		0+	-59.8 s	18.87 m 19 ϵ
	163		3/2-	-59.4	11.05 m 35 ϵ
	164		0+	-61.0 s	75.8 m 17 ϵ
	165		5/2-	-60.18	9.9 m 3 ϵ
	166		0+	-61.591	56.7 h 1 ϵ
	167		5/2-	-60.597	17.5 m 2 ϵ
	168		0+	-61.577	0.13% 1
	169		7/2+	-60.373	32.026 d 5 ϵ
	169m		1/2-	-60.349	46 s 2 IT
	170		0+	-60.772	$\geq 1.6 \times 10^{17}$ y 2 β -
				3.04% 15	
	171		1/2-	-59.315	14.28% 57
	172		0+	-59.264	21.83% 67
	173		5/2-	-57.560	16.13% 27
	174		0+	-56.953	31.83% 92
	175		7/2-	-54.704	4.185 d 1 β -
	176		0+	-53.497	12.76% 41
	176m		(8)-	-52.447	11.4 s 3 IT $\geq 90\%$, β - $\leq 10\%$
	177		(9/2+)	-50.993	1.911 h 3 β -
	177m		(1/2-)	-50.662	6.41 s 3 IT
	178		0+	-49.70	74 m 3 β -
	179		(1/2-)	-46.4 s	8.0 m 4 β -
	180		0+	-44.4 s	2.4 m 5 β -
	181			-40.8 s	$\approx$ 1 m β - ?
71 Lu	150			-25.5 s	35 ms 10 p 80%
	151		(11/2-)	-30.6 s	80 ms 2 p 70%
	152		(5-,6-)	-33.9 s	0.7 s 1 ϵ , ϵ p 15%
	153		11/2-	-38.5 s	0.9 s 2 $\alpha \approx 70\%$, $\epsilon \approx 30\%$
	154		(2-)	-40.0 s	$\approx$ 2 s ϵ ?

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
71	Lu	154m	(9+)	-40.0s	1.12 s 8 ϵ
		155	(11/2-)	-42.6s	70 ms 1 α 79%, ϵ 21%
		155m	(1/2+)	-42.6s	136 ms 9 ϵ , α
		155m	(25/2-)	-40.8s	2.71 ms 3 α
		156m		-43.9s	198 ms 2 $\alpha \geq 75\%$, $\epsilon \leq 25\%$
		156m		-43.9s	494 ms 12 $\alpha \approx 95\%$, ϵ 5%
		157	(1/2+, 3/2+)	-46.48	6.8 s 18 $\alpha > 0\%$
		157m	(11/2-)	-46.45	4.79 s 12 ϵ 94%, α 6%
		158		-47.3s	10.6 s 3 ϵ 99.09%, α 0.91%
		159		-49.73	12.1 s 10 ϵ , α 0.04%
		160		-50.3s	36.1 s 3 ϵ , $\alpha \leq 1.0 \times 10^{-4}\%$
		160m		-50.3s	40 s 1 $\epsilon \leq 100\%$, α
		161	(5/2+)	-52.6s	72 s ϵ
		162	(1-)	-52.9s	1.37 m 2 $\epsilon \leq 100\%$
		162m	(4-)	-52.9s	1.5 m $\epsilon \leq 100\%$
		162m		-52.9s	1.9 m $\epsilon \leq 100\%$
		163	1/2(+)	-54.8	3.97 m 13 ϵ
		164		-54.8s	3.14 m 3 ϵ
		165	1/2+	-56.26	10.74 m 10 ϵ
		166	(6-)	-56.1	2.65 m 10 ϵ
		166m	(3-)	-56.1	1.41 m 10 ϵ 58%, IT 42%
		166m	(0-)	-56.1	2.12 m 10 $\epsilon > 80\%$, IT < 20%
		167	7/2+	-57.5	51.5 m 10 ϵ
		168	(6-)	-57.10	5.5 m 1 ϵ
		168m	3+	-56.88	6.7 m 4 $\epsilon > 95\%$, IT < 5%
		169	7/2+	-58.080	34.06 h 5 ϵ
		169m	1/2-	-58.051	160 s 10 IT
		170	0+	-57.31	2.012 d 20 ϵ
		170m	(4-)	-57.22	0.67 s 10 IT
		171	7/2+	-57.836	8.24 d 3 ϵ
		171m	1/2-	-57.765	79 s 2 IT
		172	4-	-56.744	6.70 d 3 ϵ
		172m	1-	-56.703	3.7 m 5 IT
		173	7/2+	-56.889	1.37 y 1 ϵ
		174	(1-)	-55.579	3.31 y 5 ϵ
		174m	(6-)	-55.408	142 d 2 IT 99.38%, ϵ 0.62%
		175	7/2+	-55.174	97.41% 2
		176	7-	-53.391	3.73×10^{10} y 1 β -
					2.59% 2
		176m	1-	-53.268	3.664 h 19 β - 99.9%, ϵ 0.1%
		177	7/2+	-52.392	6.734 d 12 β -
		177m	23/2-	-51.422	160.4 d 3 β - 78.3%, IT 21.7%
		178	1(+)	-50.346	28.4 m 2 β -
		178m	(9-)	-50.226	23.1 m 3 β -
		179	7/2(+)	-49.067	4.59 h 6 β -
		180	(3+)	-46.69	5.7 m 1 β -
		181	(7/2+)	-44.7s	3.5 m 3 β -
		182	(0,1,2)	-41.7s	2.0 m 2 β -
		183	(7/2+)	-39.5s	58 s 4 β -
		184	(3+)	-36.2s	20 s 3 β -
72	Hf	154	0+	-33.3s	2 s 1 $\epsilon \approx 100\%$, $\alpha \approx 0\%$
		155		-34.7s	0.89 s 12 ϵ , α

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode			
Z	El	A	J π	(MeV)		Abundance		
72	Hf	156	0+	−38.0s	23 ms	<i>1</i>	α	
		157	7/2−	−39.0s	115 ms	<i>1</i>	α 86%, ϵ 14%	
		158	0+	−42.2s	2.85 s	7	ϵ 56%, α 44%	
		159		−42.8s	5.2 s	<i>1</i>	ϵ 59%, α 41%	
		160	0+	−45.91	13.6 s	2	ϵ 99.3%, α 0.7%	
		161		−46.27	18.7 s	<i>1</i>	ϵ 99%, α 1%	
		162	0+	−49.18	39.4 s	9	ϵ 99.99%, α 8.0×10 ^{−30} %	
		163		−49.3s	40.0 s	6	ϵ , α <1.0×10 ^{−40} %	
		164	0+	−51.8s	111 s	8	ϵ	
		165	(5/2−)	−51.7s	76 s	4	ϵ	
		166	0+	−53.8s	6.77 m	30	ϵ	
		167	(5/2)−	−53.5s	2.05 m	5	ϵ	
		168	0+	−55.3s	25.95 m	20	ϵ	
		169	(5/2)−	−54.81	3.24 m	4	ϵ	
		170	0+	−56.2s	16.01 h	13	ϵ	
		171	(7/2+)	−55.4s	12.1 h	4	ϵ	
		172	0+	−56.39	1.87 y	3	ϵ	
		173	1/2−	−55.3s	23.6 h	1	ϵ	
		174	0+	−55.852	2.0×10 ¹⁵ y	4	α	
					0.16% <i>1</i>			
			175	5/2−	−54.490	70 d	2	ϵ
			176	0+	−54.584	5.26%	7	
			177	7/2−	−52.890	18.60%	9	
			177m	23/2+	−51.575	1.08 s	6	IT
			177m	37/2−	−50.150	51.4 m	5	IT
			178	0+	−52.445	27.28%	7	
			178m	8−	−51.298	4.0 s	2	IT
			178m	16+	−49.999	31 y	1	IT
			179	9/2+	−50.473	13.62%	2	
			179m	1/2−	−50.098	18.67 s	4	IT
			179m	25/2−	−49.367	25.05 d	25	IT
			180	0+	−49.790	35.08%	16	
			180m	8−	−48.648	5.5 h	1	IT 99.7%, β − 0.3%
			181	1/2−	−47.414	42.39 d	6	β −
			182	0+	−46.060	9×10 ⁶ y	2	β −
			182m	8−	−44.887	61.5 m	15	β − 58%, IT 42%
			183	(3/2−)	−43.29	1.067 h	17	β −
			184	0+	−41.50	4.12 h	5	β −
			184m	8−	−41.50	48 s	10	β −
			185		−38.4s	3.5 m	6	β −
			186	0+	−36.4s	2.6 m	12	β −
73	Ta	155	(11/2−)		12 μ s	+4−3	p	
		156	(2−)	−26.4s	144 ms	24	p	
		156m	(7,8,9)+	−26.3s	375 ms	54	ϵ , p 4.2%	
		157	(1/2+)	−29.7s	10.1 ms	4	α 96.6%, p 3.4%	
		157m	high	−29.7s	1.7 ms	1	α	
		157m		−29.7s	4.3 ms	1	α	
		158	(2−)	−31.3s	72 ms	12	α	
		158m	(9+)	−31.2s	37.7 ms	15	α 93%, ϵ 7%	
		159	(1/2+)	−34.5s	0.544 s	16	α 80%, ϵ 20%	
		159m	(11/2−)	−34.5s	1.1 s	1	α	

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
73	Ta	160		-36.0s	1.55 s 4 ϵ 66%, α 34%
		161		-38.78	4.9 s 8 $\epsilon \approx 95\%$, α 5%
		162		-39.9s	3.57 s 12 ϵ 99.93%, α 0.07%
		163		-42.55	10.6 s 18 $\epsilon \approx 99.8\%$, $\alpha \approx 0.2\%$
		164	(3+)	-43.2s	14.2 s 3 ϵ
		165		-45.8s	31.0 s 15 ϵ
		166	(2)+	-46.1s	34.4 s 5 ϵ
		167	(3/2+)	-48.5s	80 s 4 ϵ
		168	(2-,3+)	-48.6s	2.0 m 1 ϵ
		169	(5/2-)	-50.4s	4.9 m 4 ϵ
		170	(3+)	-50.2s	6.76 m 6 ϵ
		171	(5/2-)	-51.7s	23.3 m 3 ϵ
		172	(3+)	-51.5	36.8 m 3 ϵ
		173	5/2-	-52.6s	3.14 h 13 ϵ
		174	3+	-52.01	1.14 h 8 ϵ
		175	7/2+	-52.5s	10.5 h 2 ϵ
		176	(1)-	-51.5	8.09 h 5 ϵ
		177	7/2+	-51.724	56.56 h 6 ϵ
		178	1+	-50.5	9.31 m 3 ϵ
		178	(7)-	-50.5	2.36 h 8 ϵ
		179	7/2+	-50.362	1.82 y 3 ϵ
		180	1+	-48.935	8.152 h 6 ϵ 86%, β - 14%
		180m	9-	-48.860	$>1.2 \times 10^{15}$ y β -?, ϵ ?
					0.012% 2
		181	7/2+	-48.441	99.988% 2
		182	3-	-46.433	114.43 d 3 β -
		182m	5+	-46.417	283 ms 3 IT
		182m	10-	-45.913	15.84 m 10 IT
		183	7/2+	-45.296	5.1 d 1 β -
		184	(5-)	-42.84	8.7 h 1 β -
		185	(7/2+)	-41.40	49.4 m 15 β -
		186	(2-,3-)	-38.61	10.5 m 5 β -
		187		-36.9s	≈ 2 m β -?
		188		-33.8s	≈ 20 s β -?
74	W	158	0+	-24.3s	0.9 ms 3 α
		159		-25.8s	8.2 ms 7 $\alpha \approx 92\%$, ϵ
		160	0+	-29.5s	91 ms 5 α 87%
		161		-30.7s	409 ms 18 $\alpha \approx 73\%$, ϵ
		162	0+	-34.1s	1.36 s 7 ϵ 54.8%, α 45.2%
		163		-34.9s	2.8 s 2 ϵ 87%, α 13%
		164	0+	-38.21	6.0 s 3 ϵ 97.4%, α 2.6%
		165	(5/2-)	-38.81	5.1 s 5 ϵ , $\alpha < 0.2\%$
		166	0+	-41.90	18.8 s 4 ϵ 99.97%, α 0.04%
		167	(+)	-42.2s	19.9 s 5 ϵ 99.96%, α 0.04%
		168	0+	-44.8s	53 s 2 $\epsilon \approx 100\%$, α $3.2 \times 10^{-3}\%$
		169	(5/2-)	-44.9s	80 s 6 ϵ
		170	0+	-47.2s	2.42 m 4 ϵ
		171	(5/2-)	-47.1s	2.38 m 4 ϵ
		172	0+	-49.0s	6.6 m 9 ϵ
		173	5/2-	-48.6s	7.6 m 2 ϵ
		174	0+	-50.2s	33.2 m 21 ϵ

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
74 W	175	(1/2-)	-49.6s	35.2 m 6	ϵ
	176	0+	-50.7s	2.5 h 1	ϵ
	177	(1/2-)	-49.7s	135 m 3	ϵ
	178	0+	-50.4	21.6 d 3	ϵ
	179	(7/2)-	-49.30	37.05 m 16	ϵ
	179m	(1/2)-	-49.08	6.40 m 7	IT 99.72%, ϵ 0.28%
	180	0+	-49.643	$>7.4 \times 10^{16}$ y	α
				0.12% 1	
	181	9/2+	-48.253	121.2 d 2	ϵ
	182	0+	-48.246	$>8.3 \times 10^{18}$ y	α
				26.50% 16	
	183	1/2-	-46.366	$>1.9 \times 10^{18}$ y	α
				14.31% 4	
	183m	11/2+	-46.056	5.2 s 3	IT
	184	0+	-45.706	$>4 \times 10^{18}$ y	α
				30.64% 2	
	185	3/2-	-43.388	75.1 d 3	β^-
	185m	11/2+	-43.191	1.67 m 3	IT
	186	0+	-42.511	$>6.5 \times 10^{18}$ y	α
				28.43% 19	
	187	3/2-	-39.907	23.72 h 6	β^-
	188	0+	-38.669	69.4 d 5	β^-
	189	(3/2-)	-35.5	10.8 m 3	β^-
	190	0+	-34.3	30.0 m 15	β^-
75 Re	160		-17.2s	0.79 ms 16	p 91%, α 9%
	161	(1/2+)	-20.8s	0.37 ms 4	p
	161m	(11/2-)	-20.7s	16 ms 1	p 4.8%, α
	162	(2-)	-22.6s	107 ms 13	α 94%, ϵ 6%
	162m	(9+)	-22.5s	77 ms 9	α 91%, ϵ 9%
	163	(1/2+)	-26.1s	390 ms 72	ϵ 68%, α 32%
	163m	(11/2-)	-26.0s	214 ms 5	α 66%, ϵ 34%
	164		-27.6s	0.38 s 16	$\alpha \approx 58\%$, $\epsilon \approx 42\%$
	165	(1/2+)	-30.69	≈ 1 s	ϵ , α
	165m	(11/2-)	-30.64	2.1 s 3	ϵ 87%, α 13%
	166		-31.9s	2.8 s 3	α
	167	(9/2-)	-34.9s	5.9 s 3	$\epsilon \approx 99\%$, $\alpha \approx 1\%$
	167m		-34.9s	3.4 s 4	α
	168	(5+,6+,7+)	-35.8s	4.4 s 1	$\epsilon \approx 100\%$, $\alpha \approx 5.0 \times 10^{-3}\%$
	169		-38.3s	8.1 s 5	$\epsilon \approx 100\%$, $\alpha \approx 1.0 \times 10^{-4}\%$
	169m		-38.3s	16.3 s 8	α
	170	(5+)	-39.0s	9.2 s 2	ϵ
	171	(9/2-)	-41.4s	15.2 s 4	ϵ
	172m	(5)	-41.7s	15 s 3	ϵ
	172m	(2)	-41.7s	55 s 5	ϵ
	173	(5/2-)	-43.7s	1.98 m 26	ϵ
	174		-43.7s	2.40 m 4	ϵ
	175	(5/2-)	-45.3s	5.89 m 5	ϵ
	176	3+	-45.1s	5.3 m 3	ϵ
	177	(5/2-)	-46.3s	14 m 1	ϵ
	178	(3+)	-45.8	13.2 m 2	ϵ

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode	
Z	El	A	J π	(MeV)		Abundance
75	Re	179	(5/2)+	-46.59	19.5 m	<i>1</i> ϵ
		180	(1)-	-45.84	2.44 m	<i>6</i> ϵ
		181	5/2+	-46.51	19.9 h	<i>7</i> ϵ
		182	7+	-45.4	64.0 h	<i>5</i> ϵ
		182m	2+	-45.4	12.7 h	<i>2</i> ϵ
		183	5/2+	-45.810	70.0 d	<i>14</i> ϵ
		184	3(-)	-44.223	38.0 d	<i>5</i> ϵ
		184m	8(+)	-44.035	169 d	<i>8</i> IT 75.4%, ϵ 24.6%
		185	5/2+	-43.821	37.40% 2	
		186	1-	-41.930	3.7183 d	<i>11</i> β - 92.53%, ϵ 7.47%
		186m	(8+)	-41.781	2.0×10 ⁵ y	IT
		187	5/2+	-41.218	4.35×10 ¹⁰ y	<i>13</i> β - , 62.60% 2 α <1.0×10 ⁻⁴⁰ %
		188	1-	-39.018	17.005 h	<i>4</i> β -
		188m	(6)-	-38.846	18.6 m	<i>1</i> IT
		189	5/2+	-37.979	24.3 h	<i>4</i> β -
		190	(2)-	-35.6	3.1 m	<i>3</i> β -
		190m	(6-)	-35.4	3.2 h	<i>2</i> β - 54.4%, IT 45.6%
		191	(3/2+,1/2+)	-34.35	9.8 m	<i>5</i> β -
		192		-31.7s	16 s	<i>1</i> β -
		76	Os	162	0+	-15.1s
163				-16.7s	5.5 ms	<i>6</i> α ≈100%, ϵ
164	0+			-20.6s	27 ms	<i>4</i> α ≈98%, ϵ ≈2%
165	(7/2-)			-21.9s	71 ms	<i>3</i> α >60%, ϵ <40%
166	0+			-25.6s	220 ms	<i>7</i> α 72%, ϵ 18%
167				-26.5s	0.81 s	<i>6</i> α 57%, ϵ 43%
168	0+			-29.96	2.1 s	<i>1</i> ϵ , α 40%
169				-30.67	3.6 s	<i>2</i> ϵ 89%, α 11%
170	0+			-33.93	7.3 s	<i>2</i> ϵ 88%, α 12%
171	(5/2-)			-34.4s	8.3 s	<i>2</i> ϵ 98.2%, α 1.8%
172	0+			-37.2s	19.2 s	<i>5</i> ϵ , α 1.1%
173	(5/2-)			-37.5s	22.4 s	<i>9</i> ϵ , α 0.4%
174	0+			-39.9s	44 s	<i>4</i> ϵ 99.98%, α 0.02%
175	(5/2-)			-40.0s	1.4 m	<i>1</i> ϵ
176	0+			-42.0s	3.6 m	<i>5</i> ϵ
177	(1/2-)			-41.9s	2.8 m	<i>3</i> ϵ
178	0+			-43.5	5.0 m	<i>4</i> ϵ
179	(1/2-)			-42.9s	6.5 m	<i>3</i> ϵ
180	0+			-44.4s	21.5 m	<i>4</i> ϵ
181	1/2-			-43.5	105 m	<i>3</i> ϵ
181m	(7/2)-			-43.5	2.7 m	<i>1</i> ϵ
182	0+			-44.54	22.10 h	<i>25</i> ϵ
183	9/2+			-43.7s	13.0 h	<i>5</i> ϵ
183m	1/2-			-43.5s	9.9 h	<i>3</i> ϵ 85%, IT 15%
184	0+			-44.255	>5.6×10 ¹³ y	α
					0.02% 1	
185	1/2-			-42.809	93.6 d	<i>5</i> ϵ
186	0+			-42.999	2.0×10 ¹⁵ y	<i>11</i> α
					1.59% 3	
187	1/2-	-41.221	1.6% 3			
188	0+	-41.139	13.29% 8			
189	3/2-	-38.988	16.21% 5			

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode	
Z	El	A	J π	(MeV)		Abundance
76	Os	189m	9/2−	−38.957	5.8 h 1	IT
		190	0+	−38.708	26.36% 2	
		190m	(10)−	−37.003	9.9 m 1	IT
		191	9/2−	−36.395	15.4 d 1	β −
		191m	3/2−	−36.321	13.10 h 5	IT
		192	0+	−35.882	40.93% 19	
		192m	(10−)	−33.867	5.9 s 1	IT>87%, β −<13%
		193	3/2−	−33.396	30.11 h 1	β −
		194	0+	−32.435	6.0 y 2	β −
		195		−29.7	$\approx$ 9 m	β −?
		196	0+	−28.30	34.9 m 2	β −
77	Ir	164			$\approx$ 1 ms	p?, α ?
		165		−11.6s	<1 μ s	p?, α ?
		166	(2−)	−13.5s	10.5 ms 22	α 93.1%, p 6.9%
		166m	(9+)	−13.3s	15.1 ms 9	α 98.2%, p 1.8%
		167	(1/2+)	−17.2s	35.2 ms 20	α 48%, p 32%, ϵ
		167m	(11/2−)	−17.0s	30.0 ms 6	α 80%, ϵ 20%, p 0.4%
		168		−18.7s	0.161 ms 21	α 82%
		169	(1/2+)	−21.99	0.6 ms +5−2	α 50%
		169m	(11/2−)	−21.84	0.32 s +9−7	α 84%, ϵ , p
		170		−23.3s	0.83 s 3	α 63%, ϵ
		171	(11/2−)	−26.3s	1.46 s 9	α 58%, $\epsilon \leq$ 42%
		172	(3+)	−27.3s	4.4 s 3	ϵ 98%, $\alpha \approx$ 2%
		172m	(7+)	−27.2s	2.0 s 1	ϵ 77%, α 23%
		173m	(11/2−)	−30.1s	2.4 s 9	ϵ , α 7%
		173m	(3/2+,5/2+)	−30.1s	9.0 s 8	$\epsilon >$ 93%, $\alpha <$ 7%
		174	(3+)	−30.9s	7.9 s 6	ϵ 99.5%, α 0.5%
		174m	(7+)	−30.7s	4.9 s 3	ϵ 97.5%, α 2.5%
		175	(5/2−)	−33.3s	9 s 2	ϵ 99.15%, α 0.85%
		176		−34.0s	8.3 s 6	ϵ 96.9%, α 3.1%
		177	(5/2−)	−36.2s	30 s 2	ϵ 99.94%, α 0.06%
		178		−36.3s	12 s 2	ϵ
		179	(5/2)−	−38.1s	79 s 1	ϵ
		180		−38.0s	1.5 m 1	ϵ
		181	(5/2)−	−39.5	4.90 m 15	ϵ
		182	(5+)	−39.0	15 m 1	ϵ
		183	5/2−	−40.2s	57 m 4	ϵ
		184	5−	−39.7	3.09 h 3	ϵ
		185	5/2−	−40.4s	14.4 h 1	ϵ
		186	5+	−39.17	16.64 h 3	ϵ
		186m	2−	−39.17	1.90 h 5	$\epsilon \approx$ 75%, IT $\approx$ 25%
		187	3/2+	−39.718	10.5 h 3	ϵ
		188	1−	−38.329	41.5 h 5	ϵ
		189	3/2+	−38.46	13.2 d 1	ϵ
		190	(4−)	−36.7	11.78 d 10	ϵ
		190m	(1−)	−36.7	1.120 h 3	IT
		190m	(11)−	−36.3	3.087 h 12	ϵ 91.4%, IT 8.6%
		191	3/2+	−36.709	37.3% 2	
		191m	11/2−	−36.538	4.94 s 3	IT
		191m		−34.662	5.5 s 7	IT
		192	4+	−34.836	73.827 d 13	β − 95.13%, ϵ 4.87%
		192m	1−	−34.779	1.45 m 5	IT 99.98%, β − 0.02%

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
77	Ir	192m	(11-)	-34.668	241 y 9 IT
		193	3/2+	-34.536	62.7% 2
		193m	11/2-	-34.456	10.53 d 4 IT
		194	1-	-32.532	19.28 h 13 β^-
		194m	(10,11)	-32.342	171 d 11 β^-
		195	3/2+	-31.692	2.5 h 2 β^-
		195m	11/2-	-31.592	3.8 h 2 β^- 95%, IT 5%
		196	(0-)	-29.45	52 s 1 β^-
		196m	(10,11-)	-29.04	1.40 h 2 $\beta^- \approx 100\%$, IT < 0.3%
		197	3/2+	-28.28	5.8 m 5 β^-
		197m	11/2-	-28.17	8.9 m 3 β^- 99.75%, IT 0.25%
		198		-25.8s	8 s 1 β^-
		199		-24.42	≈ 20 s β^- ?
78	Pt	166	0+		0.3 ms 1 α
		167	(7/2-)		0.7 ms 2 α
		168	0+	-11.1s	2.0 ms 4 $\alpha \leq 100\%$
		169		-12.6s	5 ms 3 $\alpha \leq 100\%$
		170	0+	-16.5s	13.8 ms 5 α 98%
		171		-17.5s	34 ms 9 $\alpha \approx 98\%$, ϵ 2%
		172	0+	-21.07	0.096 s 3 α 94%, ϵ 6%
		173		-21.9	376 ms 11 α 83%, ϵ
		174	0+	-25.33	0.889 s 17 α 76%, ϵ 24%
		175		-25.8s	2.4 s 3 α 56%, ϵ
		176	0+	-28.9s	6.7 s 7 ϵ , α 42%
		177	(5/2-)	-29.4s	11 s 1 ϵ 94.4%, α 5.6%
		178	0+	-31.9s	21.1 s 6 ϵ 92.3%, α 7.7%
		179	1/2-	-32.2s	21.2 s 4 ϵ 99.76%, α 0.24%
		180	0+	-34.3s	52 s 3 ϵ , $\alpha \approx 0.3\%$
		181	1/2-	-34.3s	52.0 s 22 ϵ , $\alpha \approx 0.08\%$
		182	0+	-36.1	3.0 m 2 ϵ 99.96%, α 0.04%
		183	1/2-	-35.7s	6.5 m 10 ϵ , $\alpha \approx 1.3 \times 10^{-3}\%$
		183m	(7/2-)	-35.6s	43 s 5 $\epsilon \approx 100\%$, $\alpha < 4.0 \times 10^{-4}\%$, IT
		184	0+	-37.4s	17.3 m 2 ϵ , $\alpha \approx 0.001\%$
		185	9/2+	-36.6	70.9 m 24 ϵ , α ?
		185m	1/2-	-36.5	33.0 m 8 $\epsilon > 98\%$, IT < 2%, α ?
		186	0+	-37.79	2.08 h 5 ϵ , $\alpha \approx 1.4 \times 10^{-4}\%$
		187	3/2-	-36.7s	2.35 h 3 ϵ
		188	0+	-37.823	10.2 d 3 ϵ , $\alpha 2.6 \times 10^{-5}\%$
		189	3/2-	-36.48	10.87 h 12 ϵ
		190	0+	-37.325	6.5×10^{11} y 3 α 0.014% 1
		191	3/2-	-35.690	2.802 d 25 ϵ
		192	0+	-36.296	0.782% 7
		193	1/2-	-34.480	50 y 6 ϵ
		193m	13/2+	-34.330	4.33 d 3 IT
		194	0+	-34.779	32.967% 99
		195	1/2-	-32.812	33.832% 10
		195m	13/2+	-32.553	4.02 d 1 IT
		196	0+	-32.663	25.242% 41
		197	1/2-	-30.438	19.8915 h 19 β^-
		197m	13/2+	-30.038	95.41 m 18 IT 96.7%, β^- 3.3%

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	(MeV)	Abundance	
78	Pt	198	0+	-29.923	7.163% 55
		199	5/2-	-27.408	30.80 m 21 β^-
		199m	(13/2)+	-26.984	13.6 s 4 IT
		200	0+	-26.62	12.5 h 3 β^-
		201	(5/2-)	-23.76	2.5 m 1 β^-
		202	0+	-22.6s	44 h 15 β^-
79	Au	171	(1/2+)	-7.7s	17 μ s +9-5 p
		171m	(11/2-)	-7.4s	1.02 ms 10 α 54%, p 46%
		172		-9.2s	6.3 ms 15 $\alpha \leq 100\%$, p < 2%
		173	(1/2+)	-12.7	20 ms +9-6 α 94%
		173m	(11/2-)	-12.5	12 ms +3-2 α 92%
		174		-14.1s	120 ms 20 $\alpha > 0\%$
		175		-17.2s	185 ms 30 α 94%, ϵ 6%
		176		-18.4s	1.08 s 17 ϵ , α
		177		-21.2s	1.3 s 2 $\epsilon \geq 60\%$, $\alpha \leq 40\%$
		178		-22.4s	2.6 s 5 $\epsilon \leq 60\%$, $\alpha \geq 40\%$
		179		-24.8s	3.3 s 13 ϵ 78%, α 22%
		180		-25.7s	8.1 s 3 $\epsilon \leq 98.2\%$, $\alpha \geq 1.8\%$
		181	(3/2-)	-28.0s	13.7 s 14 ϵ 97.3%, α 2.7%
		182		-28.3s	15.6 s 4 ϵ 99.87%, α 0.13%
		183	(5/2-)	-30.2s	42.8 s 10 ϵ 99.45%, α 0.55%
		184	5+	-30.3s	21 s 1 ϵ
		184m	2+	-30.2s	48 s 1 ϵ 99.98%, α 0.02%, IT
		185	5/2-	-31.9	4.25 m 6 ϵ 99.74%, α 0.26%
		185m		-31.9	6.8 m 3 $\epsilon < 100\%$, IT
		186	3-	-31.7	10.7 m 5 ϵ , α $8.0 \times 10^{-4}\%$
		187	1/2+	-33.0s	8.4 m 3 ϵ , α $3.0 \times 10^{-3}\%$
		187m	9/2-	-32.9s	2.3 s 1 IT
		188	1(-)	-32.5s	8.84 m 6 ϵ
		189	1/2+	-33.6s	28.7 m 3 ϵ , $\alpha < 3.0 \times 10^{-5}\%$
		189m	11/2-	-33.4s	4.59 m 11 ϵ , IT > 0%
		190	1-	-32.88	42.8 m 10 ϵ , $\alpha < 1.0 \times 10^{-6}\%$
		190m	(11-)	-32.88	125 ms 20 IT $\approx 100\%$, ϵ
		191	3/2+	-33.86	3.18 h 8 ϵ
		191m	(11/2-)	-33.59	0.92 s 11 IT
		192	1-	-32.78	4.94 h 9 ϵ
		192m	(11-)	-32.35	160 ms 20 IT
		193	3/2+	-33.411	17.65 h 15 ϵ
		193m	11/2-	-33.121	3.9 s 3 IT 99.97%, $\epsilon \approx 0.03\%$
		194	1-	-32.29	38.02 h 10 ϵ
		194m	(5+)	-32.18	600 ms 8 IT
		194m	(11-)	-31.81	420 ms 10 IT
		195	3/2+	-32.586	186.098 d 47 ϵ
		195m	11/2-	-32.267	30.5 s 2 IT
		196	2-	-31.157	6.183 d 10 ϵ 92.8%, β^- 7.2%
		196m	5+	-31.073	8.1 s 2 IT
		196m	12-	-30.562	9.6 h 1 IT
		197	3/2+	-31.157	100%
		197m	11/2-	-30.748	7.73 s 6 IT
		198	2-	-29.598	2.69517 d 21 β^-
		198m	(12-)	-28.786	2.27 d 2 IT

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	EI	A	J π	(MeV)	
79 Au	199		3/2+	-29.111	3.139 d 7 β^-
	200		1(-)	-27.28	48.4 m 3 β^-
	200m		12-	-26.31	18.7 h 5 β^- 82%, IT 18%
	201		3/2+	-26.416	26 m 1 β^-
	202		(1-)	-24.4	28.8 s 19 β^-
	203		3/2+	-23.160	60 s 6 β^-
	204		(2-)	-20.8s	39.8 s 9 β^-
	205		3/2+	-19.0s	31 s 2 β^-
80 Hg	172		0+		0.25 ms +35-9 α
	173				0.93 ms +57-36 α
	174		0+		2.1 ms +18-7 α 99.6%
	175			-8.0s	8 ms 8 α
	176		0+	-11.72	34 ms +18-9 α
	177			-12.7	0.114 s 15 α 85%, ϵ 15%
	178		0+	-16.32	0.287 s 23 $\alpha \approx 70\%$, $\epsilon \approx 30\%$
	179			-17.0s	0.93 s 11 $\alpha \approx 53\%$, $\epsilon \approx 47\%$, $\epsilon p \approx 0.15\%$
	180		0+	-20.2s	2.6 s 8 ϵ 52%, α 48%
	181		1/2(-)	-20.7s	3.6 s 1 ϵ 69%, α 31%, ϵp 0.02%, $\epsilon \alpha$ $1.1 \times 10^{-5}\%$
	182		0+	-23.5s	10.83 s 6 ϵ 84.8%, α 15.2%
	183		1/2-	-23.7s	9.4 s 7 ϵ 74.5%, α 25.5%, ϵp $5.6 \times 10^{-4}\%$
	184		0+	-26.2s	30.9 s 3 ϵ 98.89%, α 1.11%
	185		1/2-	-26.1s	49.1 s 10 ϵ 94%, α 6%
	185m		13/2+	-26.0s	21.6 s 15 IT 54%, ϵ 46%, $\alpha \approx 0.03\%$
	186		0+	-28.4	1.38 m 6 ϵ 99.98%, α 0.02%
	187		13/2+	-28.1s	2.4 m 3 ϵ , $\alpha > 1.2 \times 10^{-4}\%$
	187m		3/2-	-28.1s	1.9 m 3 ϵ , $\alpha > 2.5 \times 10^{-4}\%$
	188		0+	-30.2s	3.25 m 15 ϵ , α $3.7 \times 10^{-5}\%$
	189		3/2-	-29.7s	7.6 m 1 ϵ , $\alpha < 3.0 \times 10^{-5}\%$
	189m		13/2+	-29.7s	8.6 m 1 ϵ , $\alpha < 3.0 \times 10^{-5}\%$
	190		0+	-31.4s	20.0 m 5 ϵ , $\alpha < 5.0 \times 10^{-5}\%$
	191		(3/2-)	-30.68	49 m 10 ϵ
	191m		13/2+	-30.68	50.8 m 15 ϵ
	192		0+	-32.1s	4.85 h 20 ϵ
	193		3/2-	-31.07	3.80 h 15 ϵ
	193m		13/2+	-30.93	11.8 h 2 ϵ 92.8%, IT 7.2%
	194		0+	-32.25	444 y 77 ϵ
	195		1/2-	-31.08	9.9 h 5 ϵ
	195m		13/2+	-30.90	41.6 h 8 IT 54.2%, ϵ 45.8%
	196		0+	-31.843	0.15% 1
	197		1/2-	-30.557	64.14 h 5 ϵ
	197m		13/2+	-30.258	23.8 h 1 IT 91.4%, ϵ 8.6%
	198		0+	-30.971	9.97% 20
	199		1/2-	-29.563	16.87% 22
	199m		13/2+	-29.031	42.6 m 2 IT
	200		0+	-29.520	23.10% 19
	201		3/2-	-27.679	13.18% 9
	202		0+	-27.362	29.86% 26

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	EI	A	J π	(MeV)	
80	Hg	203	5/2-	-25.283	46.612 d 18 β^-
		204	0+	-24.707	6.87% 15
		205	1/2-	-22.304	5.2 m 1 β^-
		206	0+	-20.96	8.15 m 10 β^-
		207	(9/2+)	-16.2	2.9 m 2 β^-
		208	0+	-13.1s	41 m +5-4 β^-
81	Tl	177	(1/2+)	-2.9s	18 ms 5 α 73%, p 27%
		178		-4.4s	≈ 60 ms $\alpha?$, $\epsilon?$
		179	(11/2-)	-7.9s	0.43 s 35 α
		179m	(9/2-)	-7.9s	1.5 ms 3 $\alpha \approx 100\%$
		180		-9.1s	1.5 s 3 ϵ SF $\approx 1 \times 10^{-4}\%$, ϵ , α
		181	(1/2+)	-12.2s	3.2 s 3 ϵ , α
		181m		-12.2s	1.4 s 5 α
		182	(7+)	-13.4s	3.1 s 10 $\epsilon > 96\%$, $\alpha < 4\%$
		183	(1/2+)	-16.1s	6.9 s 7 $\epsilon > 0\%$
		183m	(9/2-)	-15.6s	60 ms 15 $\alpha < 0.01\%$, IT?
		184	(2+)	-17.0s	11 s 1 ϵ 97.9%, α 2.1%
		185	(1/2+)	-19.5s	19.5 s 5 ϵ
		185m	(9/2-)	-19.0s	1.83 s 12 α , IT
		186m	(7+)	-20.0s	27.5 s 10 ϵ , $\alpha \approx 6.0 \times 10^{-3}\%$
		186m	(10-)	-19.6s	2.9 s 2 IT
		187	(1/2+)	-22.2s	≈ 51 s $\epsilon < 100\%$, $\alpha > 0\%$
		187m	(9/2-)	-21.9s	15.60 s 12 $\epsilon < 99.9\%$, IT $< 99.9\%$, α 0.15%
		188m	(2-)	-22.4s	71 s 2 ϵ
		188m	(7+)	-22.4s	71 s 1 ϵ
		189	(1/2+)	-24.5s	2.3 m 2 ϵ
		189m	(9/2-)	-24.2s	1.4 m 1 ϵ , IT $< 4\%$
		190m	(2-)	-24.4s	2.6 m 3 ϵ
		190m	(7+)	-24.4s	3.7 m 3 ϵ
		191	(1/2+)	-26.2s	? $\epsilon?$
		191m	9/2(-)	-25.9s	5.22 m 16 ϵ
		192	(2-)	-25.9s	9.6 m 4 ϵ
		192m	(7+)	-25.8s	10.8 m 2 ϵ
		193	1/2+	-27.4s	21.6 m 8 ϵ
		193m	9/2-	-27.1s	2.11 m 15 IT $\leq 75\%$, $\epsilon \leq 25\%$
		194	2-	-27.0s	33.0 m 5 ϵ , $\alpha < 1.0 \times 10^{-7}\%$
		194m	(7+)	-27.0s	32.8 m 2 ϵ
		195	1/2+	-28.3s	1.16 h 5 ϵ
		195m	9/2-	-27.8s	3.6 s 4 IT
		196	2-	-27.5s	1.84 h 3 ϵ
		196m	(7+)	-27.1s	1.41 h 2 ϵ 95.5%, IT 4.5%
		197	1/2+	-28.38	2.84 h 4 ϵ
		197m	9/2-	-27.77	0.54 s 1 IT
		198	2-	-27.51	5.3 h 5 ϵ
		198m	7+	-26.97	1.87 h 3 ϵ 54%, IT 46%
		199	1/2+	-28.12	7.42 h 8 ϵ
		200	2-	-27.064	26.1 h 1 ϵ
		201	1/2+	-27.20	72.912 h 17 ϵ
		202	2-	-26.00	12.23 d 2 ϵ
		203	1/2+	-25.775	29.524% 14
		204	2-	-24.360	3.78 y 2 β^- 97.1%, ϵ 2.9%

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
81	Tl	205	1/2+	-23.835	70.476% 14
		206	0-	-22.267	4.200 m 17 β^-
		206m	(12-)	-19.624	3.74 m 3 IT
		207	1/2+	-21.044	4.77 m 2 β^-
		207m	11/2-	-19.696	1.33 s 11 IT
		208	5(+)	-16.763	3.053 m 4 β^-
		209	(1/2+)	-13.647	2.161 m 7 β^-
		210	(5+)	-9.25	1.30 m 3 β^- , β^-n 7.0 $\times$ 10 ⁻³ %
82	Pb	180	0+		4 s +4-2 α
		181	(13/2+)	-3.1s	45 ms 20 α <100%, ϵ $\approx$ 2%
		182	0+	-6.82	55 ms +40-35 α $\leq$ 100%
		183	(1/2-)	-7.5s	300 ms 80 α $\approx$ 94%, ϵ $\approx$ 6%
		184	0+	-11.0s	0.55 s 6 α >0%, ϵ ?
		185		-11.6s	4.1 s 3 α $\leq$ 100%
		186	0+	-14.6s	4.82 s 3 ϵ , α 38%
		187m		-14.9s	15.2 s 3 ϵ , α
		187m	(13/2+)	-14.9s	18.3 s 3 ϵ >90%, α <10%
		188	0+	-17.6s	24 s 2 ϵ , α 9.3%
		189m		-17.8s	51 s 3 ϵ >99%, α $\approx$ 0.4%
		190	0+	-20.3	1.2 m 1 ϵ 99.1%, α 0.9%
		191	(3/2-)	-20.3s	1.33 m 8 ϵ 99.99%, α 0.01%
		191m	(13/2+)	-20.2s	2.18 m 8 ϵ , α $\approx$ 0.02%
		192	0+	-22.6s	3.5 m 1 ϵ 99.99%, α 5.9 $\times$ 10 ⁻³ %
		193	(3/2-)	-22.3s	ϵ
		193m	(13/2+)	-22.3s	5.8 m 2 ϵ
		194	0+	-24.3s	12.0 m 5 ϵ , α 7.3 $\times$ 10 ⁻⁶ %
		195	3/2-	-23.8s	$\approx$ 15 m ϵ
		195m	13/2+	-23.6s	15.0 m 12 ϵ
		196	0+	-25.4s	37 m 3 ϵ $\approx$ 100%, α $\leq$ 3.0 $\times$ 10 ⁻⁵ %
		197	3/2-	-24.8s	8 m 2 ϵ
		197m	13/2+	-24.5s	43 m 1 ϵ 81%, IT 19%
		198	0+	-26.10s	2.40 h 10 ϵ
		199	3/2-	-25.23	90 m 10 ϵ
		199m	13/2+	-24.81	12.2 m 3 IT 93%, ϵ 7%
		200	0+	-26.25	21.5 h 4 ϵ
		201	5/2-	-25.29	9.33 h 3 ϵ
		201m	13/2+	-24.66	61 s 2 IT>99%, ϵ <1%
		202	0+	-25.948	52.5 $\times$ 10 ³ y 28 ϵ , α <1%
		202m	9-	-23.778	3.53 h 1 IT 90.5%, ϵ 9.5%
		203	5/2-	-24.801	51.873 h 9 ϵ
		203m	13/2+	-23.975	6.3 s 2 IT
		203m	29/2-	-21.851	0.48 s 2 IT
		204	0+	-25.124	$\geq$ 1.4 $\times$ 10 ¹⁷ y α ?
					1.4% 1
		204m	9-	-22.938	67.2 m 3 IT
		205	5/2-	-23.784	1.53 $\times$ 10 ⁷ y 7 ϵ
		206	0+	-23.801	24.1% 1
		207	1/2-	-22.467	22.1% 1
		207m	13/2+	-20.834	0.806 s 6 IT
		208	0+	-21.764	52.4% 1

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode	
Z	El	A	J π	(MeV)		Abundance
82	Pb	209	9/2+	−17.629	3.253 h 14	β^-
		210	0+	−14.743	22.3 y 3	β^- , α 1.9×10 ^{−6} %
		211	9/2+	−10.497	36.1 m 2	β^-
		212	0+	−7.557	10.64 h 1	β^-
		213	(9/2+)	−3.3 s	10.2 m 3	β^-
		214	0+	−0.188	26.8 m 9	β^-
83	Bi	186	(3+)	−3.3 s	15.0 ms 17	α
		186m	(10−)	−3.3 s	9.8 ms 13	α ≈100%
		187	(9/2−)	−6.1 s	32 ms 3	α 53%
		188m		−7.3 s	44 ms 3	ϵ , α
		188m		−7.3 s	218 ms 50	ϵ , α
		189	(9/2−)	−9.8 s	728 ms 40	α >50%, ϵ <50%
		189m	(1/2+)	−9.7 s	4.8 ms 5	α >50%, ϵ <50%
		190m	(10−)	−10.7 s	6.2 s 1	α 70%, ϵ 30%
		190m	(3+)	−10.7 s	6.3 s 1	α ≈90%, ϵ ≈10%
		191	(9/2−)	−13.0 s	12.3 s 5	α 60%, ϵ 40%
		191m	(1/2+)	−12.7 s	150 ms 15	α 75%, ϵ ≤25%
		192	(3+)	−13.6 s	34.6 s 9	ϵ 88%, α 12%
		192m	(10−)	−13.6 s	39.6 s 4	ϵ 90%, α 10%
		193	(9/2−)	−15.8 s	67 s 3	ϵ 96.5%, α 3.5%
		193m	(1/2+)	−15.5 s	3.2 s 6	α 90%, ϵ 10%
		194	(3+)	−16.1 s	95 s 3	ϵ 99.54%, α 0.46%
		194m	(10−)	−16.1 s	115 s 4	ϵ 99.8%, α 0.2%
		194m	(6+,7+)	−16.1 s	125 s 2	ϵ
		195	(9/2−)	−17.9 s	183 s 4	ϵ 99.97%, α 0.03%
		195m	(1/2+)	−17.5 s	87 s 1	ϵ 67%, α 33%
		196	(3+)	−18.1 s	308 s 12	ϵ ≈100%, α 1.2×10 ^{−3} %
		196m	(7+)	−17.9 s	0.6 s 5	IT, ϵ
		196m	(10−)	−17.8 s	240 s 3	ϵ 74.2%, IT 25.8%, α 3.8×10 ^{−4} %
		197	(9/2−)	−19.6	9.33 m 50	ϵ , α 1.0×10 ^{−4} %
		197m	(1/2+)	−19.1	5.04 m 16	α 55%, ϵ 45%, IT<0.3%
		198	(2+,3+)	−19.5	10.3 m 3	ϵ
		198m	(7+)	−19.5	11.6 m 3	ϵ
		198m	(10−)	−19.3	7.7 s 5	IT
		199	9/2−	−20.9	27 m 1	ϵ
		199m	(1/2+)	−20.2	24.70 m 15	ϵ ≥98%, IT≤2%, α ≈0.01%
		200	7+	−20.36	36.4 m 5	ϵ
		200m	(2+)	−20.36	31 m 2	ϵ >90%, IT<10%
		200m	(10−)	−19.93	0.40 s 5	IT
		201	9/2−	−21.45	108 m 3	ϵ , α <1.0×10 ^{−4} %
		201m	1/2+	−20.61	59.1 m 6	ϵ >93%, IT≤6.8%, α ≈0.3%
		202	5+	−20.80	1.72 h 5	ϵ , α <1.0×10 ^{−5} %
		203	9/2−	−21.55	11.76 h 5	ϵ , α ≈1.0×10 ^{−5} %
		203m	1/2+	−20.45	303 ms 5	IT
		204	6+	−20.67	11.22 h 10	ϵ
		205	9/2−	−21.075	15.31 d 4	ϵ
		206	6(+)	−20.043	6.243 d 3	ϵ

Nuclear Wallet Cards

Isotope			Δ	$T\frac{1}{2}$, Γ , or		Decay Mode		
Z	El	A	$J\pi$	(MeV)	Abundance			
83	Bi	207	9/2−	−20.069	31.55 y 5	ϵ		
		208	(5)+	−18.885	3.68×10 ⁵ y 4	ϵ		
		209	9/2−	−18.273	100%			
		210	1−	−14.806	5.013 d 5	β −, α 1.3×10 ^{−4} %		
		210m	9−	−14.535	3.04×10 ⁶ y 6	α		
		211	9/2−	−11.869	2.14 m 2	α 99.72%, β − 0.28%		
		212	1(−)	−8.130	60.55 m 6	β − 64.06%, α 35.94%, β − α 0.014%		
		212m	(9−)	−7.880	25.0 m 2	α 67%, β − 33%		
		212m		−6.220	7.0 m 3	β −		
		213	9/2−	−5.240	45.59 m 6	β − 97.91%, α 2.09%		
		214	1−	−1.21	19.9 m 4	β − 99.98%, α 0.02%		
		215		1.71	7.6 m 2	β −		
		216	(1−)	5.8 s	2.17 m 5	β −≤100%		
		217			97 s 3	β −?		
		84	Po	190	0+	−4.6 s	2.53 ms 33	α , ϵ 0.1%
				191	(3/2−)	−5.0 s	22 ms 1	α
				191m	(13/2+)	−4.9 s	98 ms 8	α
192	0+			−7.9 s	33.2 ms 14	α ≈99.5%, ϵ ≈0.5%		
193m	(13/2+)			−8.3 s	0.24 s 1	α ≤100%		
193m	(3/2−)			−8.3 s	0.42 s 4	α ≤100%		
194	0+			−10.9	0.392 s 4	α		
195	(3/2−)			−11.1 s	4.64 s 9	α 75%, ϵ 25%		
195m	(13/2+)			−10.9 s	1.92 s 2	α ≈90%, ϵ ≈10%, IT<0.01%		
196	0+			−13.5 s	5.8 s 2	α ≈98%, ϵ ≈2%		
197	(3/2−)			−13.4 s	1.4 m 2	ϵ 56%, α 44%		
197m	(13/2+)			−13.2 s	31 s 2	α 84%, ϵ 16%, IT 0.01%		
198	0+			−15.5 s	1.87 m 10	α 57%, ϵ 43%		
199	(3/2−)			−15.3 s	4.58 m 52	ϵ 92.5%, α 7.5%		
199m	13/2+			−15.0 s	4.13 m 43	ϵ 73.5%, α 24%, IT 2.5%		
200	0+			−17.0 s	10.9 m 11	ϵ 88.9%, α 11.1%		
201	3/2−			−16.6 s	15.3 m 2	ϵ 98.4%, α 1.6%		
201m	13/2+			−16.1 s	8.9 m 2	IT 56%, ϵ 41%, α ≈2.9%		
202	0+			−17.98 s	44.7 m 5	ϵ 98.08%, α 1.92%		
203	5/2−			−17.31	36.7 m 5	ϵ 99.89%, α 0.11%		
203m	13/2+			−16.67	45 s 2	IT≈100%, α ≈0.04%		
204	0+			−18.34	3.53 h 2	ϵ 99.34%, α 0.66%		
205	5/2−			−17.54	1.66 h 2	ϵ 99.96%, α 0.04%		
206	0+			−18.197	8.8 d 1	ϵ 94.55%, α 5.45%		
207	5/2−			−17.160	5.80 h 2	ϵ 99.98%, α 0.02%		
207m	19/2−			−15.777	2.79 s 8	IT		
208	0+			−17.483	2.898 y 2	α , ϵ		
209	1/2−			−16.380	102 y 5	α 99.52%, ϵ 0.48%		
210	0+			−15.968	138.376 d 2	α		
211	9/2+			−12.448	0.516 s 3	α		
211m	(25/2+)			−10.986	25.2 s 6	α 99.98%, IT 0.02%		
212	0+			−10.384	0.299 μ s 2	α		
212m	(18+)			−7.463	45.1 s 6	α 99.93%, IT 0.07%		

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode	
Z	El	A	J π	(MeV)		Abundance
84	Po	213	9/2+	−6.667	3.65 μ s 4	α
		214	0+	−4.484	164.3 μ s 20	α
		215	9/2+	−0.545	1.781 ms 4	α , β − 2.3×10 ^{−4} %
		216	0+	1.775	0.145 s 2	α
		217		5.8s	1.47 s 5	α >95%, β −<5%
		218	0+	8.352	3.10 m 2	α 99.98%, β − 0.02%
		219			≈2 m	α ?, β −?
85	At	193		0.2s	40 ms	α
		193m		0.2s	≈40 ms	α
		194m		−1.0s	≈40 ms	α
		194m		−1.0s	≈250 ms	α
		195		−3.2s	146 ms +21−17	α >75%, ϵ <25%
		195m		−3.2s	385 ms +69−51	ϵ , α
		196		−4.0s	0.253 s 9	α >0%
		197	(9/2−)	−6.3s	0.37 s +9−6	α 96%, ϵ 4%
		197m	(1/2+)	−6.2s	3.7 s 25	α ≤100%, ϵ
		198	(3+)	−6.8s	4.6 s +18−10	α 90%, ϵ 10%
		198m	(10−)	−6.6s	1.3 s +8−3	α 84%, ϵ 16%
		199	(9/2−)	−8.7s	7.2 s 5	α 90%, ϵ 10%
		200	(3+)	−9.0s	43 s 1	α 57%, ϵ 43%
		200m	(7+)	−8.9s	47 s 1	ϵ ≤57%, α 43%
		200m	(10−)	−8.7s	3.5 s 2	IT≈84%, α ≈10.5%, ϵ ≈4.5%
		201	(9/2−)	−10.7	89 s 3	α 71%, ϵ 29%
		202	(2,3)+	−10.8	184 s 1	ϵ 82%, α 18%
		202m	(7+)	−10.8	182 s 2	ϵ 91.3%, α 8.7%
		202m	(10−)	−10.4	0.46 s 5	IT 99.7%, ϵ 0.25%, α 0.1%
		203	9/2−	−12.3	7.4 m 2	ϵ 69%, α 31%
		204	7+	−11.87	9.2 m 2	ϵ 96.2%, α 3.8%
		204m	(10−)	−11.28	108 ms 10	IT
		205	9/2−	−13.01	26.2 m 5	ϵ 90%, α 10%
		206	(5)+	−12.48	30.6 m 13	ϵ 99.11%, α 0.89%
		207	9/2−	−13.25	1.80 h 4	ϵ 91.4%, α 8.6%
		208	6+	−12.50	1.63 h 3	ϵ 99.45%, α 0.55%
		209	9/2−	−12.893	5.41 h 5	ϵ 95.9%, α 4.1%
		210	(5)+	−11.987	8.1 h 4	ϵ 99.82%, α 0.18%
		211	9/2−	−11.662	7.214 h 7	ϵ 58.2%, α 41.8%
		212	(1−)	−8.631	0.314 s 2	α , ϵ <0.03%, β −<2.0×10 ^{−6} %
		212m	(9−)	−8.409	0.119 s 3	α >99%, IT<1%
		213	9/2−	−6.594	125 ns 6	α
		214	1−	−3.394	558 ns 10	α
		215	9/2−	−1.266	0.10 ms 2	α
		216	1−	2.244	0.30 ms 3	α , β −<6.0×10 ^{−3} %, ϵ <3.0×10 ^{−7} %
		217	9/2−	4.387	32.3 ms 4	α 99.99%, β − 0.01%
		218		8.09	1.5 s 3	α 99.9%, β − 0.1%
		219		10.52	56 s 3	α ≈97%, β −≈3%
		220	3	14.3s	3.71 m 4	β − 92%, α 8%
		221		16.9s	2.3 m 2	β −
		222		20.8s	54 s 10	β −

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	Abundance	
85	At	223		23.6 s	50 s 7 β^-
86	Rn	196m	0+	2.2 s	3 ms +7-2 $\alpha > 0\%$
		197	(3/2-)	1.5 s	65 ms +25-14 α
		197m	(13/2+)	1.5 s	19 ms +8-4 α
		198	0+	-1.1	84 ms +16-12 ϵ, α
		199	(3/2-)	-1.6 s	0.62 s 3 α 94%, ϵ 6%
		199m	(13/2+)	-1.6 s	0.32 s 2 α 97%, ϵ 3%
		200	0+	-4.0 s	0.96 s 3 $\alpha \approx 98\%$, $\epsilon \approx 2\%$
		201	(3/2-)	-4.2 s	7.1 s 8 $\alpha \approx 80\%$, $\epsilon \approx 20\%$
		201m	(13/2+)	-3.9 s	3.8 s 1 $\alpha \approx 90\%$, $\epsilon \approx 10\%$, IT $\approx 0\%$
		202	0+	-6.3 s	10.0 s 3 α 86%, ϵ 14%
		203	(3/2, 5/2)-	-6.2 s	42 s 3 α 66%, ϵ 34%
		203m	(13/2+)	-5.9 s	26.7 s 5 $\alpha \approx 80\%$, $\epsilon \approx 20\%$, IT $< 0.1\%$
		204	0+	-8.0 s	1.17 m 18 α 73%, ϵ 27%
		205	5/2-	-7.8 s	2.8 m 1 ϵ 77%, α 23%
		206	0+	-9.17 s	5.67 m 17 α 62%, ϵ 38%
		207	5/2-	-8.64	9.25 m 17 ϵ 79%, α 21%
		208	0+	-9.66	24.35 m 14 α 62%, ϵ 38%
		209	5/2-	-8.96	28.5 m 10 ϵ 83%, α 17%
		210	0+	-9.61	2.4 h 1 α 96%, ϵ 4%
		211	1/2-	-8.770	14.6 h 2 ϵ 72.6%, α 27.4%
		212	0+	-8.673	23.9 m 12 α
		213	(9/2+)	-5.712	25.0 ms 2 α
		214	0+	-4.335	0.27 μ s 2 α
		215	9/2+	-1.184	2.30 μ s 10 α
		216	0+	0.241	45 μ s 5 α
		217	9/2+	3.646	0.54 ms 5 α
		218	0+	5.204	35 ms 5 α
		219	5/2+	8.826	3.96 s 1 α
		220	0+	10.604	55.6 s 1 α
		221	7/2(+)	14.4 s	25.7 m 5 β^- 78%, α 22%
		222	0+	16.367	3.8235 d 3 α
		223	7/2	20.3 s	23.2 m 4 β^-
		224	0+	22.4 s	107 m 3 β^-
		225	7/2-	26.5 s	4.66 m 4 β^-
		226	0+	28.8 s	7.4 m 1 β^-
		227	5/2	33.0 s	22.5 s 7 β^-
		228	0+	35.5 s	65 s 2 β^-
87	Fr	199			12 ms +10-4 α
		200	(3+)	6.1 s	19 ms +13-6 α
		200m	(10-)	6.3 s	0.57 s +27-14 α
		201	(9/2-)	3.7 s	69 ms +16-11 $\alpha, \epsilon < 1\%$
		202	(3+)	3.1 s	0.23 s +8-4 $\alpha \approx 97\%$, $\epsilon \approx 3\%$
		202m	(10-)	3.2 s	0.23 s +14-5 $\alpha \approx 97\%$, $\epsilon \approx 3\%$
		203	(9/2-)	1.0 s	0.55 s 2 $\alpha \approx 95\%$, $\epsilon \approx 5\%$
		204	(3+)	0.6 s	1.7 s 3 $\alpha \approx 80\%$, $\epsilon \approx 20\%$
		204m	(7+)	0.6 s	2.6 s 3 $\alpha \leq 100\%$
		204m	(10-)	0.9 s	≈ 1 s $\alpha \leq 100\%$, IT
		205	(9/2-)	-1.2	3.85 s 10 $\alpha, \epsilon < 1\%$
		206	(2+, 3+)	-1.4	≈ 16 s $\alpha \approx 84\%$, $\epsilon \approx 16\%$

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode	
Z	El	A	J π	(MeV)		Abundance
87	Fr	206m	(7+)	−1.4	15.9 s 1	α 84%, ϵ 16%
		206m	(10−)	−0.9	0.7 s 1	IT, $\alpha \approx 12\%$
		207	9/2−	−2.9	14.8 s 1	α 95%, ϵ 5%
		208	7+	−2.67	59.1 s 3	α 90%, ϵ 10%
		209	9/2−	−3.80	50.0 s 3	α 89%, ϵ 11%
		210	6+	−3.35	3.18 m 6	α 60%, ϵ 40%
		211	9/2−	−4.16	3.10 m 2	$\alpha > 80\%$, $\epsilon < 20\%$
		212	5+	−3.54	20.0 m 6	ϵ 57%, α 43%
		213	9/2−	−3.563	34.6 s 3	α 99.45%, ϵ 0.55%
		214	(1−)	−0.974	5.0 ms 2	α
		214m	(8−)	−0.852	3.35 ms 5	α
		215	9/2−	0.304	86 ns 5	α
		216	(1−)	2.97	0.70 μ s 2	α , $\epsilon < 2.0 \times 10^{-7}\%$
		217	9/2−	4.300	22 μ s 5	α
		218	1−	7.045	1.0 ms 6	α
		218m		7.131	22.0 ms 5	$\alpha \leq 100\%$, IT
		219	9/2−	8.608	20 ms 2	α
		220	1+	11.469	27.4 s 3	α 99.65%, β − 0.35%
		221	5/2−	13.270	4.9 m 2	α , β − < 0.1%, ^{14}C $9 \times 10^{-13}\%$
		222	2−	16.34	14.2 m 3	β −
		223	3/2(−)	18.379	22.00 m 7	β − 99.99%, α $6.0 \times 10^{-3}\%$
		224	1−	21.64	3.33 m 10	β −
		225	3/2−	23.85	4.0 m 2	β −
		226	1−	27.33	49 s 1	β −
		227	1/2+	29.65	2.47 m 3	β −
		228	2−	33.3s	38 s 1	β − $\leq 100\%$
		229	(1/2+)	35.8s	50.2 s 4	β −
		230		39.6s	19.1 s 5	β −
		231		42.3s	17.5 s 8	β −
		232		46.3s	5 s 1	β −
88	Ra	202	0+		0.7 ms +33−3	α
		203	(3/2−)	8.6s	1.1 ms +50−5	α
		203m	(13/2+)	8.6s	33 ms +22−10	α
		204	0+	6.0s	59 ms +12−9	α
		205	(3/2−)	5.8s	0.21 s +6−4	ϵ , α
		205m	(13/2+)	5.8s	0.17 s +6−4	α
		206	0+	3.5s	0.24 s 2	α
		207	(5/2−, 3/2−)	3.5s	1.3 s 2	$\alpha \approx 90\%$, $\epsilon \approx 10\%$
		207m	(13/2+)	3.9s	55 ms 10	IT 85%, α 15%, $\epsilon \approx 0.35\%$
		208	0+	1.7s	1.3 s 2	α 95%, ϵ 5%
		209	5/2−	1.8s	4.6 s 2	$\alpha \approx 90\%$, $\epsilon \approx 10\%$
		210	0+	0.42s	3.7 s 2	$\alpha \approx 96\%$, $\epsilon \approx 4\%$
		211	5/2(−)	0.83	13 s 2	$\alpha > 93\%$, $\epsilon < 7\%$
		212	0+	−0.20	13.0 s 2	$\alpha \approx 90\%$, $\epsilon \approx 15\%$
		213	1/2−	0.32	2.74 m 6	α 80%, ϵ 20%
		213m		2.09	2.1 ms 1	IT $\approx 99\%$, $\alpha \approx 1\%$
		214	0+	0.08	2.46 s 3	α 99.94%, ϵ 0.06%
		215	(9/2+)	2.519	1.59 ms 9	α
		216	0+	3.277	182 ns 10	α , $\epsilon < 1.0 \times 10^{-8}\%$

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Isotope			Δ	T½, Γ , or	Decay Mode	
Z	El	A	(MeV)	Abundance		
88	Ra	217	(9/2+)	5.874	1.6 μ s 2	α
		218	0+	6.64	25.6 μ s 11	α
		219	(7/2)+	9.379	10 ms 3	α
		220	0+	10.26	18 ms 2	α
		221	5/2+	12.955	28 s 2	α , ^{14}C $1\times 10^{-12}\%$
		222	0+	14.309	38.0 s 5	α , ^{14}C $3.0\times 10^{-8}\%$
		223	3/2+	17.230	11.435 d 4	α , ^{14}C $6.4\times 10^{-8}\%$
		224	0+	18.818	3.66 d 4	α , ^{14}C $4.0\times 10^{-9}\%$
		225	1/2+	21.987	14.9 d 2	β^-
		226	0+	23.662	1600 y 7	α , ^{14}C $3.2\times 10^{-9}\%$
		227	3/2+	27.172	42.2 m 5	β^-
		228	0+	28.936	5.75 y 3	β^-
		229	5/2(+)	32.43	4.0 m 2	β^-
		230	0+	34.54	93 m 2	β^-
		231	(7/2-,1/2+)	38.4s	103 s 3	β^-
		232	0+	40.7s	250 s 50	β^-
	233	(1/2+)	44.7s	30 s 5	β^-	
	234	0+	47.1s	30 s 10	β^-	
89	Ac	206m			11 ms +9-3	α
		206m	(3+)		22 ms +9-5	α
		206m	(10-)		33 ms +22-9	α
		207	(9/2-)	11.3s	27 ms +11-6	α
		208	(3+)	10.7s	95 ms +24-16	α , ϵ 1%
		208m	(10-)	11.2s	25 ms +9-5	IT<10%, ϵ 1%, α
		209	(9/2-)	8.9	0.10 s 5	$\alpha\approx 99\%$, $\epsilon\approx 1\%$
		210		8.6	0.35 s 5	$\alpha\approx 96\%$, $\epsilon\approx 4\%$
		211		7.1	0.25 s 5	α
		212		7.28	0.93 s 5	$\alpha\approx 97\%$, $\epsilon\approx 3\%$
		213		6.12	0.80 s 5	$\alpha\leq 100\%$
		214		6.42	8.2 s 2	$\alpha\geq 89\%$, $\epsilon\leq 11\%$
		215	9/2-	6.01	0.17 s 1	α 99.91%, ϵ 0.09%
		216	(1-)	8.12	≈ 0.33 ms	α
		217	9/2-	8.69	69 ns 4	α , $\epsilon\leq 2\%$
		218	(1-)	10.83	1.08 μ s 9	α
		219	9/2-	11.56	11.8 μ s 15	α
		220	(3-)	13.74	26.4 ms 2	α , ϵ $5.0\times 10^{-4}\%$
		221		14.51	52 ms 2	α
		222	1-	16.608	5.0 s 5	α 99%, ϵ 1%
		222m		16.608	63 s 3	$\alpha\geq 88\%$, IT $\leq 10\%$, $\epsilon\geq 0.7\%$
		223	(5/2-)	17.816	2.10 m 5	α 99%, ϵ 1%
		224	0-	20.221	2.78 h 17	ϵ 90.9%, α 9.1%, $\beta^-<1.6\%$
		225	(3/2-)	21.630	10.0 d 1	α , ^{14}C $6\times 10^{-10}\%$
		226	(1)	24.302	29.37 h 12	β^- 83%, ϵ 17%, α $6.0\times 10^{-3}\%$
		227	3/2-	25.846	21.773 y 3	β^- 98.62%, α 1.38%
	228	3+	28.890	6.15 h 2	β^-	
	229	(3/2+)	30.67	62.7 m 5	β^-	
	230	(1+)	33.6	122 s 3	β^-	
	231	(1/2+)	35.9	7.5 m 1	β^-	
	232	(1+)	39.1	119 s 5	β^-	

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	Abundance	
89 Ac	233	(1/2+)	41.5 s	145 s 10	β^-
	234		45.1 s	44 s 7	β^-
	235		47.6 s	≈ 40 s	β^- ?
	236		51.4 s	≈ 2 m	β^- ?
90 Th	209	(5/2-)		3.8 ms +69-15	α
	210	0+	14.0 s	9 ms +17-4	α
	211		13.8 s	37 ms +28-11	ϵ , α
	212	0+	12.0 s	30 ms +20-10	α , $\epsilon \approx 0.3\%$
	213		12.1 s	140 ms 25	$\alpha \leq 100\%$
	214	0+	10.67 s	100 ms 25	α
	215	(1/2-)	10.92	1.2 s 2	α
	216	0+	10.29	0.028 s 2	α , $\epsilon \approx 0.01\%$
	217	(9/2+)	12.17	0.252 ms 7	α
	218	0+	12.36	109 ns 13	α
	219		14.46	1.05 μ s 3	α
	220	0+	14.66	9.7 μ s 6	α , $\epsilon 2.0 \times 10^{-7}\%$
	221	(7/2+)	16.93	1.68 ms 6	α
	222	0+	17.19	2.8 ms 3	α
	223	(5/2)+	19.371	0.60 s 2	α
	224	0+	19.99	1.05 s 2	α
	225	(3/2)+	22.301	8.72 m 4	$\alpha \approx 90\%$, $\epsilon \approx 10\%$
	226	0+	23.185	30.57 m 10	α
	227	(1/2+)	25.801	18.72 d 2	α
	228	0+	26.763	1.9116 y 16	α , $^{20}\text{O} 1 \times 10^{-11}\%$
	229	5/2+	29.580	7340 y 160	α
	230	0+	30.857	7.538×10^4 y 30	α , SF $< 4. \times 10^{-11}\%$
	231	5/2+	33.811	25.52 h 1	β^- , $\alpha \approx 1.0 \times 10^{-8}\%$
	232	0+	35.444	1.405×10^{10} y 6	α , SF $1.2 \times 10^{-8}\%$, Ne
				100%	
	233	1/2+	38.729	22.3 m 1	β^-
	234	0+	40.609	24.10 d 3	β^-
	235	(1/2+)	44.25	7.1 m 2	β^-
	236	0+	46.3 s	37.5 m 2	β^-
	237	(5/2+)	50.2 s	5.0 m 9	β^-
	238	0+	52.4 s	≈ 20 m	β^- ?
91 Pa	212			5.1 ms +61-19	α
	213	(9/2-)	19.7	5.3 ms +40-16	α
	214		19.3	17 ms 3	α
	215	(9/2-)	17.8	15 ms 4	α
	216		17.8	105 ms 12	$\alpha \approx 98\%$, $\epsilon \approx 2\%$
	217	(9/2-)	17.04	2.3 ms +5-3	α
	217m	(29/2+)	18.89	1.5 ms +9-4	α
	218		18.64	0.11 ms 2	α
	219	9/2-	18.52	53 ns 10	α
	221	9/2-	20.37	4.9 μ s 8	α
	222		22.10 s	3.3 ms 3	α
	223		22.32	5 ms 1	α
	224		23.86	0.85 s 2	α
	225		24.33	1.7 s 2	α
	226		26.02	1.8 m 2	$\alpha 74\%$, $\epsilon 26\%$
	227	(5/2-)	26.821	38.3 m 3	$\alpha 85\%$, $\epsilon 15\%$
	228	3+	28.911	22 h 1	$\epsilon 98\%$, $\alpha 2\%$

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	J π	(MeV)	
91	Pa	229	(5/2+)	29.890	1.50 d 5 ϵ 99.52%, α 0.48%
		230	(2-)	32.167	17.4 d 5 ϵ 91.6%, β^- 8.4%, α $3.2 \times 10^{-3}\%$
		231	3/2-	33.421	32760 y 110 α , Ne $13 \times 10^{-10}\%$, SF $< 2 \times 10^{-11}\%$
		232	(2-)	35.939	1.31 d 2 β^- , ϵ $3.0 \times 10^{-3}\%$
		233	3/2-	37.484	26.967 d 2 β^-
		234	4+	40.336	6.70 h 5 β^-
		234m	(0-)	40.410	1.17 m 3 β^- 99.84%, IT 0.16%
		235	(3/2-)	42.32	24.5 m 2 β^-
		236	1(-)	45.3	9.1 m 1 β^-
		237	(1/2+)	47.6	8.7 m 2 β^-
		238	(3-)	50.76	2.3 m 1 β^- , SF $< 2.6 \times 10^{-6}\%$
		239	(1/2+)	53.2s	106 m 30 β^-
		240		56.8s	≈ 2 m β^- ?
92	U	218	0+	21.88s	1.5 ms +73-7 α
		219	(9/2+)	23.21	42 μ s +34-13 α
		220	0+	23.0s	≈ 60 ns $\alpha?$, $\epsilon?$
		221		24.5s	≈ 0.7 μ s $\alpha?$, $\epsilon?$
		222	0+	24.3s	1.0 μ s +10-4 α
		223	(7/2+)	25.82	55 μ s 10 α
		224	0+	25.70	0.9 ms 3 α
		225		27.37	60 ms 10 α
		226	0+	27.33	0.35 s 15 α
		227	(3/2+)	29.01	1.1 m 1 α
		228	0+	29.22	9.1 m 2 $\alpha > 95\%$, $\epsilon < 5\%$
		229	(3/2+)	31.201	58 m 3 $\epsilon \approx 80\%$, $\alpha \approx 20\%$
		230	0+	31.603	20.8 d α , SF $< 1 \times 10^{-10}\%$
		231	(5/2-)	33.803	4.2 d 1 ϵ
		231	(3/2+, 5/2+)	33.803	4.2 d 1 $\alpha \approx 4 \times 10^{-3}\%$
		232	0+	34.602	68.9 y 4 α , Ne $9 \times 10^{-10}\%$, SF $< 1 \times 10^{-12}\%$
		233	5/2+	36.913	1.592×10^5 y 2 α , SF $< 6 \times 10^{-11}\%$, Ne $7 \times 10^{-11}\%$
		234	0+	38.141	2.455×10^5 y 6 0.0054% 5 α , SF $1.6 \times 10^{-9}\%$, Mg $1 \times 10^{-11}\%$, Ne $9 \times 10^{-12}\%$
		235	7/2-	40.914	703.8×10^6 y 5 0.7204% 6 α , SF $7.0 \times 10^{-9}\%$, Ne $8 \times 10^{-10}\%$
		235m	1/2+	40.914	≈ 25 m IT
		236	0+	42.441	2.342×10^7 y 3 α , SF $9.4 \times 10^{-8}\%$, ^{30}Mg
		237	1/2+	45.386	6.75 d 1 β^-
		238	0+	47.304	4.468×10^9 y 3 α , SF $5.4 \times 10^{-5}\%$ 99.2742% 10
		239	5/2+	50.569	23.45 m 2 β^-
		240	0+	52.709	14.1 h 1 β^-
		241		56.2s	≈ 5 m β^- ?
		242	0+	58.6s	16.8 m 5 β^-
93	Np	225	(9/2-)	31.58	> 2 μ s α

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or		
Z	El	A	J π	(MeV)	Abundance	Decay Mode
93 Np						
	226			32.72 s	35 ms 10	α
	227			32.56	0.51 s 6	α
	228			33.7 s	61.4 s 14	ϵ 60%, α 40%
	229			33.76	4.0 m 2	α > 50%, ϵ < 50%
	230			35.22	4.6 m 3	ϵ $\leq$ 97%, α $\geq$ 3%
	231	(5/2)		35.61	48.8 m 2	ϵ 98%, α 2%
	232	(4+)		37.4 s	14.7 m 3	ϵ
	233	(5/2+)		37.94	36.2 m 1	ϵ , α $\leq$ 1.0 $\times$ 10 ⁻³ %
	234	(0+)		39.950	4.4 d 1	ϵ
	235	5/2+		41.038	396.1 d 12	ϵ , α 2.6 $\times$ 10 ⁻³ %
	236	(6-)		43.37	154 $\times$ 10 ³ y 6	ϵ 87.3%, β - 12.5%, α 0.16%
	236m	1		43.43	22.5 h 4	ϵ 52%, β - 48%
	237	5/2+		44.868	2.144 $\times$ 10 ⁶ y 7	α , SF $\leq$ 2 $\times$ 10 ⁻¹⁰ %
	238	2+		47.451	2.117 d 2	β -
	239	5/2+		49.305	2.3565 d 4	β -
	240	1(+)		52.32	7.22 m 2	β - 99.89%
	240	(5+)		52.32	61.9 m 2	β -
	241	(5/2+)		54.26	13.9 m 2	β -
	242m	(1+)		57.4 s	2.2 m 2	β -
	242m	(6)		57.4 s	5.5 m 1	β -
	243	(5/2-)		59.87 s	1.85 m 15	β -
	244	(7-)		63.2 s	2.29 m 16	β -
94 Pu						
	228	0+		36.07	$\approx$ 0.2 s	α
	229	(3/2+)		37.39	>2 μ s	α
	230	0+		36.93	$\approx$ 200 s	α $\leq$ 100%
	231	(3/2+)		38.4 s	8.6 m 5	ϵ 90%, α 10%
	232	0+		38.36	34.1 m 7	ϵ 80%, α 20%
	233			40.04	20.9 m 4	ϵ 99.88%, α 0.12%
	234	0+		40.338	8.8 h 1	ϵ $\approx$ 94%, α $\approx$ 6%
	235	(5/2+)		42.18	25.3 m 5	ϵ , α 2.7 $\times$ 10 ⁻³ %
	236	0+		42.894	2.858 y 8	α , SF 1.9 $\times$ 10 ⁻⁷ %
	237	7/2-		45.088	45.2 d 1	ϵ , α 4.2 $\times$ 10 ⁻³ %
	237m	1/2+		45.234	0.18 s 2	IT
	238	0+		46.159	87.7 y 3	α , SF 1.8 $\times$ 10 ⁻⁷ %
	239	1/2+		48.583	24110 y 30	α , SF 3 $\times$ 10 ⁻¹⁰ %
	240	0+		50.121	6564 y 11	α , SF 5.7 $\times$ 10 ⁻⁶ %
	241	5/2+		52.951	14.290 y 6	β - , α 2.5 $\times$ 10 ⁻³ % , SF > 2. $\times$ 10 ⁻¹⁴ %
	242	0+		54.713	3.733 $\times$ 10 ⁵ y 12	α , SF 5.5 $\times$ 10 ⁻⁴ %
	243	7/2+		57.750	4.956 h 3	β -
	244	0+		59.800	8.00 $\times$ 10 ⁷ y 9	α 99.88%, SF 0.12%
	245	(9/2-)		63.10	10.5 h 1	β -
	246	0+		65.39	10.84 d 2	β -
	247			69.0 s	2.27 d 23	β -
95 Am						
	231			42.4 s	$\approx$ 10 s	ϵ ? , α ?
	232			43.4 s	79 s 2	ϵ $\approx$ 98%, α $\approx$ 2%
	233			43.3 s	$\approx$ 2 m	ϵ ? , α ?
	234			44.5 s	2.32 m 8	ϵ 99.96%, α 0.04%
	235			44.7 s	15 ms 5	ϵ
	236			46.2 s	4.4 m 8	ϵ
	237	5/2(-)		46.55	73.0 m 10	ϵ 99.98%, α 0.03%

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	EI	A	(MeV)	Abundance	
95 Am					
238		1+	48.42	98 m 2	$\epsilon > 99.99\%$, $\alpha 1.0 \times 10^{-4}\%$
239	(5/2)–		49.386	11.9 h 1	$\epsilon 99.99\%$, $\alpha 0.01\%$
240	(3–)		51.50	50.8 h 3	ϵ , $\alpha 1.9 \times 10^{-4}\%$
241	5/2–		52.930	432.2 y 7	α , SF $4 \times 10^{-10}\%$
242	1–		55.464	16.02 h 2	β – 82.7%, $\epsilon 17.3\%$
242m	5–		55.513	141 y 2	IT 99.54%, $\alpha 0.46\%$, SF $< 4.7 \times 10^{-9}\%$
242m			57.664	14.0 ms 10	SF $\approx 100\%$, $\alpha < 1.5\%$, IT $> 0\%$
243	5/2–		57.168	7370 y 40	α , SF $3.7 \times 10^{-9}\%$
244	(6–)		59.876	10.1 h 1	β –
244m	1+		59.964	≈ 26 m	β – 99.96%, $\epsilon 0.04\%$
245	(5/2)+		61.894	2.05 h 1	β –
246	(7–)		64.99	39 m 3	β –
246m	2(–)		64.99	25.0 m 2	β –, IT $< 0.02\%$
247	(5/2)		67.1 s	23.0 m 13	β –
248			70.6 s	≈ 10 m	β –
249			73.1 s	≈ 2 m	β – ?
96 Cm					
232	0+			1 m ?	SF $< 30.3\%$
233			47.3 s	≈ 1 m	ϵ ?, α ?
234	0+		46.8 s	≈ 2 m	ϵ ?, α ?
235			48.1 s	≈ 5 m	ϵ ?, α ?
236	0+		47.9 s	≈ 10 m	ϵ , α
237			49.3 s	≈ 20 m	ϵ ?, α ?
238	0+		49.38	2.4 h 1	$\epsilon \geq 90\%$, $\alpha \leq 10\%$
239	(7/2–)		51.2 s	≈ 2.9 h	ϵ , $\alpha < 0.1\%$
240	0+		51.716	27 d 1	$\alpha > 99.5\%$, $\epsilon < 0.5\%$, SF $3.9 \times 10^{-6}\%$
241	1/2+		53.698	32.8 d 2	$\epsilon 99\%$, $\alpha 1\%$
242	0+		54.799	162.8 d 2	α , SF $6.4 \times 10^{-6}\%$, ^{34}Si
243	5/2+		57.177	29.1 y 1	$\alpha 99.71\%$, $\epsilon 0.29\%$, SF $5.3 \times 10^{-9}\%$
244	0+		58.448	18.10 y 2	α , SF $1.4 \times 10^{-4}\%$
245	7/2+		60.999	8500 y 100	α , SF $6.1 \times 10^{-7}\%$
246	0+		62.613	4760 y 40	$\alpha 99.97\%$, SF $2.6 \times 10^{-2}\%$
247	9/2–		65.528	1.56×10^7 y 5	α
248	0+		67.386	3.48×10^5 y 6	$\alpha 91.61\%$, SF 8.39%
249	1/2(+)		70.744	64.15 m 3	β –
250	0+		72.98	≈ 9700 y	SF $\approx 80\%$, $\alpha \approx 11\%$, β – $\approx 9\%$
251	(1/2+)		76.64	16.8 m 2	β –
252	0+		79.1 s	< 2 d	β –
97 Bk					
235			52.7 s	≈ 20 s	ϵ ?, α ?
236			53.4 s	≈ 1 m	α ?, ϵ ?
237			53.2 s	≈ 1 m	ϵ ?, α ?
238			54.3 s	144 s 5	ϵ , ϵ SF 0.048%, α
239	(7/2+)		54.4 s	≈ 3 m	ϵ ?
240			55.7 s	4.8 m 8	$\epsilon \approx 100\%$, ϵ SF w
241	(7/2+)		56.1 s	≈ 3 m	α ?, ϵ ?

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode	
Z	El	A	J π	(MeV)		Abundance
97	Bk	242		57.8s	7.0 m 13	ϵ
		243	(3/2-)	58.686	4.5 h 2	$\epsilon \approx 99.85\%$, $\alpha \approx 0.15\%$
		244	(1-)	60.70	4.35 h 15	ϵ 99.994%, α $6.0 \times 10^{-3}\%$
		245	3/2-	61.810	4.94 d 3	ϵ 99.88%, α 0.12%
		246m	2(-)	63.96	1.80 d 2	ϵ , $\alpha < 0.2\%$
		247	(3/2-)	65.483	1380 y 250	$\alpha \leq 100\%$
		248		68.07s	>9 y	α
		248m	1(-)	68.07s	23.7 h 2	β^- 70%, ϵ 30%
		249	7/2+	69.843	330 d 4	β^- , α $1.4 \times 10^{-3}\%$, SF $4.7 \times 10^{-8}\%$
		250	2-	72.946	3.217 h 5	β^-
		251	(3/2-)	75.22	55.6 m 11	β^-
		252		78.5s	≈ 2 m	$\beta^-?$, $\alpha?$
		253		80.9s	≈ 10 m	$\beta^-?$
		254		84.4s	≈ 2 m	$\beta^-?$
98	Cf	237		57.8s	2.1 s 3	$\alpha?$, SF $\approx 10\%$
		238	0+	57.2s	21. ms 2	SF
		239		58.3s	39 s +37-12	ϵ , α
		240	0+	58.0s	1.06 m 15	SF $\approx 2.1\%$, α
		241		59.4s	3.78 m 70	$\epsilon \approx 75\%$, $\alpha \approx 25\%$
		242	0+	59.33	3.4 m 2	SF $\leq 0.014\%$, α
		243	(1/2+)	60.9s	10.7 m 5	$\epsilon \approx 86\%$, $\alpha \approx 14\%$
		244	0+	61.470	19.4 m 6	α
		245	(5/2+)	63.4s	45.0 m 15	ϵ 64%, α 36%
		246	0+	64.086	35.7 h 5	α , $\epsilon < 4.0 \times 10^{-3}\%$, SF $2.3 \times 10^{-4}\%$
		247	(7/2+)	66.129	3.11 h 3	ϵ 99.97%, α 0.04%
		248	0+	67.233	333.5 d 28	α , SF $2.9 \times 10^{-3}\%$
		249	9/2-	69.719	351 y 2	α , SF $5.0 \times 10^{-7}\%$
		250	0+	71.166	13.08 y 9	α 99.92%, SF 0.08%
		251	1/2+	74.128	898 y 44	α , SF
		252	0+	76.028	2.645 y 8	α 96.91%, SF 3.09%
		253	(7/2+)	79.295	17.81 d 8	β^- 99.69%, α 0.31%
		254	0+	81.33	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, $\beta^- < 1\%$, $\alpha \approx 1.0 \times 10^{-6}\%$
99	Es	241	(3/2-)	64.0s	8 s +6-4	α
		242		64.9s	23.9 s 28	ϵ , α , ϵ SF
		243		64.9s	19 s 4	$\epsilon \leq 70\%$, $\alpha \geq 30\%$
		244		66.1s	37 s 4	ϵ 96%, α 4%
		245	(3/2-)	66.4s	1.1 m 1	ϵ 60%, α 40%
		246m		68.0s	7.7 m 5	ϵ 90.1%, α 9.9%, ϵ $3.0 \times 10^{-3}\%$
		247	(7/2+)	68.60s	4.55 m 26	$\epsilon \approx 93\%$, $\alpha \approx 7\%$
		248	(2-,0+)	70.29s	27 m 5	ϵ 99.7%, $\alpha \approx 0.25\%$
		249	7/2+	71.17s	102.2 m 6	ϵ 99.43%, α 0.57%
		250	1(-)	73.3s	2.22 h 5	$\epsilon \geq 99\%$, $\alpha \leq 1\%$
		250	(6+)	73.3s	8.6 h 1	$\epsilon > 97\%$, $\alpha < 3\%$
		251	(3/2-)	74.504	33 h 1	ϵ 99.5%, α 0.5%
		252	(5-)	77.29	471.7 d 19	α 78%, ϵ 22%, $\beta^- \approx 0.01\%$

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or		Decay Mode	
Z	El	A	(MeV)	Abundance			
99	Es	253	7/2+	79.007	20.47 d	3	α , SF 8.7×10 ⁻⁶ %
		254	(7+)	81.986	275.7 d	5	α , ϵ <1.0×10 ⁻⁴ % , SF<3.0×10 ⁻⁶ % , β - 1.7×10 ⁻⁶ %
		254m	2+	82.064	39.3 h	2	β - 98%, IT<3%, α 0.33%, ϵ 0.08%, SF<0.05%
		255	(7/2+)	84.08	39.8 d	12	β - 92%, α 8%, SF 4.1×10 ⁻³ %
		256	(1+,0-)	87.2s	25.4 m	24	β -
		256m	(8+)	87.2s	7.6 h		β -
		257		89.4s	7.7 d	2	β -, SF
100	Fm	242	0+	68.4s	0.8 ms	2	SF
		243		69.4s	0.18 s	+8-4	α ≤100%, SF≤0.4%
		244	0+	69.0s	3.3 ms	4	SF≤100%
		245		70.2s	4.2 s	13	α ≤100%, SF≤0.1%
		246	0+	70.12	1.1 s	2	α 92%, SF 8%, ϵ ≤1%
		247?		71.6s	35 s	4	α ≥50%, ϵ ≤50%
		247m		71.6s	9.2 s	23	α ≤100%
		248	0+	71.90	36 s	3	α 97%, ϵ 3%, SF 0.1%
		249	(7/2+)	73.6s	2.6 m	7	ϵ 67%, α 33%
		250	0+	74.07	33 m	3	α >90%, ϵ <10%, SF 7.1×10 ⁻³ %
		250m		75.07	1.8 s	1	IT>80%, SF≤0.8×10 ⁻⁴ %
		251	(9/2-)	75.979	5.30 h	8	ϵ 98.2%, α 1.8%
		252	0+	76.811	25.39 h	4	α , SF 2.3×10 ⁻³ %
		253	(1/2)+	79.341	3.00 d	12	ϵ 88%, α 12%
		254	0+	80.898	3.240 h	2	α 99.94%, SF 0.06%
		255	7/2+	83.793	20.07 h	7	α , SF 2.4×10 ⁻⁵ %
		256	0+	85.480	157.6 m	13	SF 91.9%, α 8.1%
		257	(9/2+)	88.584	100.5 d	2	α 99.79%, SF 0.21%
		258	0+	90.4s	360 μ s	20	SF
		259		93.7s	1.5 s	3	SF
260	0+		≈4 ms		SF		
101	Md	245	(1/2-)	75.5s	900 μ s	250	SF, α 0.26%
		245m		75.6s	0.35 s	+23-16	ϵ , α
		246m		76.3s	1.0 s	4	α >0%, ϵ >0%, SF
		247		76.2s	0.38 s	8	SF≈55%, α 45%
		248		77.2s	7 s	3	ϵ 80%, α 20%, SF≤0.05%
		249		77.3s	24 s	4	α >60%, ϵ ≤40%
		250		78.7s	52 s	6	ϵ 93%, α 7%
		251		79.1s	4.0 m	5	ϵ ≥90%, α ≤10%
		252		80.7s	2.3 m	8	ϵ ≤100%
		253	(1/2-)	81.3s	6 m	+12-3	ϵ ≤100%, α
		254		83.6s	10 m	3	ϵ ≤100%
		254		83.6s	28 m	8	ϵ ≤100%
		255	(7/2-)	84.836	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%

Nuclear Wallet Cards

Isotope			Δ	T½, Γ , or	Decay Mode
Z	El	A	(MeV)	Abundance	
101 Md	257	(7/2−)	88.990	5.52 h 5	ϵ 85%, α 15%, SF < 1%
	258	(8−)	91.683	51.5 d 3	α , SF ≤ 0.003%
	258m	(1−)	91.683	57.0 m 9	ϵ ≥ 70%, SF ≤ 30%, α 1.2%
	259		93.6s	96 m 3	SF ≈ 100%, α < 1.3%
	260		96.5s	31.8 d 5	SF ≥ 42%, α ≤ 25%, ϵ ≤ 23%, β − ≤ 10%
102 No	249		81.8s		ϵ ?, α ?
	250	0+	81.5s	0.25 ms 5	SF, α ≈ 0.05%
	251	(7/2+)	82.9s	0.8 s 3	α ≤ 100%, ϵ , SF ≤ 8%
	252	0+	82.87	2.27 s 14	α 58%, ϵ 23%, SF 19%
	253	(9/2−)	84.4s	1.62 m 15	α ≤ 100%, ϵ
	254	0+	84.72	54 s 3	α 90%, ϵ 10%, SF 0.19%
	254m		85.22	0.28 s 4	IT > 80%, SF ≥ 0.2%
	255	(1/2+)	86.85	3.1 m 2	α 61%, ϵ 39%
	256	0+	87.817	2.91 s 5	α 99.47%, SF 0.53%
	257	(7/2+)	90.22	25 s 2	α ≤ 100%, SF ≤ 1.5%
	258	0+	91.5s	1.2 ms 2	SF, α 0.001%
	259		94.1s	58 m 5	α 75%, ϵ 25%, SF < 10%
	260	0+	95.6s	106 ms 8	SF
	261		98.5s		β −, α
	262	0+	100.2s	5 ms 1	SF
103 Lr	251		87.9s		ϵ ?, α ?
	252		88.8s	0.36 s +11−7	α ≈ 90%, ϵ ≈ 10%, SF < 1%
	253m		88.7s	0.57 s +7−6	α 90%, ϵ , SF < 2%
	253m		88.7s	1.5 s +3−2	α 90%, ϵ , SF < 2%
	254		90.0s	13 s 2	α 78%, ϵ 22%, SF < 0.1%
	255		90.1s	22 s 4	α 85%, ϵ < 30%, SF ≤ 0.1%
	256		92.0s	27 s 3	α 85%, ϵ 15%, SF < 0.03%
	257		92.8s	0.646 s 25	α ≤ 100%, SF ≤ 0.03%
	258		94.9s	3.9 s 4	α > 95%, ϵ < 5%, SF < 5%
	259		95.93s	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		102.2s	3.6 h 2	ϵ , SF < 10%
	263		103.8s		
104 Rf	253m		93.8s	48 μ s +17−10	SF ≤ 100%, α
	253m		93.8s	≈ 1.8 s	SF ≈ 50%, α ≈ 50%
	254	0+	93.3s	23 μ s 3	SF ≈ 100%, α ≈ 0.3%
	255	(9/2−)	94.5s	1.5 s 2	α 52%, SF 48%
	255m		94.5s	0.8 s +5−2	α ≤ 100%
	256	0+	94.25	6.4 ms 2	SF 99.68%, α 0.32%
	257	(1/2+)	96.0s	4.7 s 3	α < 100%, SF ≤ 1.4%, ϵ > 0%

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Isotope Z El A	J π	Δ (MeV)	T $\frac{1}{2}$, Γ , or Abundance	Decay Mode
104 Rf 257m		96.0s	3.9 s 4	$\alpha < 100\%$, SF $\leq 1.4\%$, $\epsilon > 0\%$
258	0+	96.5s	12 ms 2	SF $\approx 87\%$, $\alpha \approx 13\%$
259		98.39s	3.2 s 6	α 92%, SF 8%
260	0+	99.1s	21 ms 1	SF $\leq 100\%$, α ?
261		101.3s	65 s 10	$\alpha > 80\%$, $\epsilon < 15\%$, SF $< 10\%$
262	0+	102.4s	2.1 s 2	SF
263		104.8s	10 m 2	SF $\approx 100\%$, α
264	0+	106.2s		
105 Db 255		100.0s	1.6 s +6-4	$\alpha \approx 80\%$, SF $\approx 20\%$
256		100.7s	1.9 s +5-3	$\alpha \leq 90\%$, SF $\leq 40\%$, $\epsilon \approx 35\%$
257		100.5s	0.76 s +15-11	$\alpha \geq 94\%$, SF $\leq 6\%$
257m		100.5s	1.50 s +19-15	$\alpha \geq 81\%$, SF 19%
258		101.9s	4.4 s +9-6	α 67%, ϵ 33%, SF $< 1\%$
258m		101.9s	20 s 10	ϵ
259		102.2s		
260		103.8s	1.52 s 13	$\alpha \geq 90.4\%$, SF $\leq 9.6\%$, $\epsilon < 2.5\%$
261		104.4s	1.8 s 4	$\alpha \geq 82\%$, SF $\leq 18\%$
262		106.3s	34 s 4	α 64%, SF 33%, $\epsilon \approx 3\%$
263		107.2s	27 s +10-7	SF 57%, α 43%
264		109.4s		
265		110.5s		
106 Sg 258	0+	105.4s	2.9 ms +13-7	SF $\approx 100\%$, α
259	(1/2+)	106.8s	0.48 s +28-13	α 90%, SF $< 20\%$
260	0+	106.60	3.6 ms 9	α 50%, SF 50%
261		108.2s	0.23 s 6	$\alpha \approx 100\%$, SF $< 1\%$
262	0+	108.5s		
263		110.2s	1.0 s 2	$\alpha > 70\%$, SF $< 30\%$
263m		110.2s	0.12 s	α , IT
264	0+	110.8s		
265	(9/2+)	112.8s	8 s 3	SF $\leq 57\%$, $\alpha \geq 43\%$
266	0+	113.6s	21 s +20-12	α 50%, SF
269			?	α
107 Bh 260		113.5s		$\alpha \leq 100\%$
261		113.5s	12 ms +5-3	α 95%, SF $< 10\%$
262		114.6s	102 ms 26	$\alpha \geq 89\%$, SF $\leq 11\%$
262m		114.9s	8.0 ms 21	$\alpha \geq 89\%$, SF $\leq 11\%$
263		114.7s		
264		116.2s	0.44 s +60-16	$\alpha \leq 100\%$
265		116.6s		
266		118.3s		
108 Hs 263		119.9s		$\alpha \leq 100\%$
264	0+	119.61	≈ 0.8 ms	$\alpha \approx 50\%$, SF $\approx 50\%$
265		121.1s	2.0 ms +3-2	$\alpha \approx 100\%$, SF $\leq 1\%$
266	0+	121.1s		
267	(9/2+)	122.7s	26 ms +20-10	α , SF ?
269	(3/2+)	124.9s	9 s 4	α
273			1.2 s +17-6	α

Nuclear Wallet Cards

Isotope			$J\pi$	Δ (MeV)	T $\frac{1}{2}$, Γ , or Abundance	Decay Mode
Z	El	A				
108	Hs	277			16.5 m	SF
109	Mt	266		128.5 s	0.8 ms 2	α , SF?
		266m		128.9 s	3.8 ms 8	α
		267		128.1 s		
		268	(5+,6+)	129.3 s	0.07 s +10-3	α
110		267	(11/2-)	134.1 s	3 μ s +6-2	α
		269	(1/2+)	135.2 s	0.17 ms +17-6	α
		271	(3/2+)	136.1 s	0.06 s +27-3	α
		271m	(9/2+)	136.1 s	1.1 ms +6-3	α
		272	0+	136.3 s	$\approx$ 8.6 ms	SF
		273	(3/2+)	139.0 s	$\approx$ 0.18 ms	α
		273m	(13/2-)	139.2 s	$\approx$ 120 ms	α
		277			3.0 ms +47-15	α
		281			1.6 m	α
111		272	(5+,6+)	143.0 s	1.5 ms +20-5	α
112		277	(3/2+)		0.24 ms +43-9	α
		281			0.89 ms +130-45	α
		283			81 s +147-32	SF
		285			15.4 m	α
114		285			0.58 ms +87-29	α
		287			5.5 s +10-2	α
		289			30.4 s	α
116		289			0.60 ms +86-30	α
118		293			0.12 ms +18-6	α

Appendix-I Table of Elemental Properties

Z	El	Atomic Weight ^a	Density (g/cc) ^b	Melting Pt. (°C) ^b	Boiling Pt. (°C) ^b	Oxidation States ^b
1	H	1.00794 7	8.988×10 ^{-5d}	-259.34	-252.87	+1,-1
2	He	4.002602 2	1.785×10 ^{-4f}		-268.93	0
				(26 atm)		
3	Li	6.941 2	0.534 ^c	180.5	1342	+1
4	Be	9.012182 3	1.848 ^c	1287	2471	+2
					(5 mm)	
5	B	10.811 5	2.34 ^h	2075	4000	+3
					(subl.)	
6	C	12.011	1.8 to 2.1 ⁱ	≈3550	4827	+2,+4,-4
7	N	14.0067 2	0.0012506 ^j	-210.00	-195.79	+1,+2,+3,+4, +5,-1,-2,-3
8	O	15.9994 3	0.001429 ^k	-218.79	-182.95	-2
9	F	18.9984032 5	0.001696	-219.62 ^g	-188.12 ^g	-1
10	Ne	20.1797 6	8.9990×10 ⁻⁴	-248.59	-246.088 ^g	0
11	Na	22.989770 2	0.971 ^c	97.72	883	+1
12	Mg	24.3050 6	1.738 ^c	650	1090	+2
13	Al	26.981539 5	2.6989 ^c	660.32	2519	+3
14	Si	28.0855 3	2.33 ^e	1414	3265	+2,+4,-4
15	P	30.973761 2	1.82 ^l	44.15 ^l	277 ^l	+3,+5,-3
16	S	32.065 5	2.07 ^{cm}	115.21 ^m	444.60	+4,+6,-2
17	Cl	35.453 2	0.003214	-101.5	-34.04	+1,+5,+7,-1
18	Ar	39.948	0.0017837	-189.35	-185.85	0
19	K	39.0983	0.862 ^c	63.38	759	+1
20	Ca	40.078 4	1.55 ^c	842	1484	+2
21	Sc	44.955910 8	2.989 ^e	1541	2830	+3
22	Ti	47.867	4.54	1668	3287	+2,+3,+4
23	V	50.9415	6.11	1910	3407	+2,+3,+4,+5
			(18.7 °C)			
24	Cr	51.9961 6	7.18 to 7.20 ^c	1907	2671	+2,+3,+6
25	Mn	54.938049 9	7.21 to 7.44 ⁿ	1246	2061	+2,+3,+4,+7
26	Fe	55.845 2	7.874 ^c	1538	2861	+2,+3
27	Co	58.933200 9	8.9 ^c	1495	2927	+2,+3
28	Ni	58.6934 2	8.902 ^e	1455	2913	+2,+3
29	Cu	63.546 3	8.96 ^c	1084.62	2562	+1,+2
30	Zn	65.39 2	7.133 ^e	419.53	907	+2
31	Ga	69.723	5.904	29.76	2204	+3
			(29.6 °C)			
32	Ge	72.64 1	5.323 ^e	938.25	2833	+2,+4
33	As	74.92160 2	5.73 ^o	817 ^o	614 ^o	+3,+5,-3
				(28 atm)	(subl.)	
34	Se	78.96 3	4.79 ^p	221 ^p	685 ^p	+4,+6,-2
35	Br	79.904	3.12 ^u	-7.2	58.78	+1,+5,-1
36	Kr	83.80	0.003733	-157.36	-153.22	0
37	Rb	85.4678 3	1.532 ^c	39.31	688	+1
38	Sr	87.62	2.54	777	1382	+2
39	Y	88.90585 2	4.469 ^e	1526	3336	+3
40	Zr	91.224 2	6.506 ^c	1855	4409	+4
41	Nb	92.90638 2	8.57 ^c	2477	4744	+3,+5
42	Mo	95.94	10.22 ^c	2623	4639	+6
43	Tc	(98)	11.50 ^t	2157	4265	+4,+6,+7
44	Ru	101.07 2	12.41 ^c	2334	4150	+3

Appendix-I Table of Elemental Properties

Z	El	Atomic Weight ^a	Density (g/cc) ^b	Melting Pt. (°C) ^b	Boiling Pt. (°C) ^b	Oxidation States ^b
45	Rh	102.90550 2	12.41 ^c	1964	3695	+3
46	Pd	106.42	12.02 ^c	1554.9	2963	+2,+4
47	Ag	107.8682 2	10.50 ^c	961.78	2162	+1
48	Cd	112.411 8	8.65 ^c	321.07	767	+2
49	In	114.818 3	7.31 ^c	156.60	2072	+3
50	Sn	118.710 7	5.75 ^q	231.93	2602	+2,+4
51	Sb	121.760	6.691 ^c	630.63	1587	+3,+5,-3
52	Te	127.60 3	6.24 ^c	449.51	988	+4,+6,-2
53	I	126.90447 3	4.93 ^v	113.7	184.4	+1,+5,+7,-1
54	Xe	131.293 6	0.005887	-111.75	-108.04	0
55	Cs	132.90545 2	1.873 ^c	28.44	671	+1
56	Ba	137.327 7	3.5 ^c	727	1897	+2
57	La	138.9055 2	6.145 ^e	920	3455	+3
58	Ce	140.115 4	6.770 ^e	799	3424	+3,+4
59	Pr	140.90765 2	6.773 ^r 6.64 ^s	931	3510	+3
60	Nd	144.24 3	7.008	1016	3066	+3
61	Pm	(145)	7.264 ^e	1042	3000	+3
62	Sm	150.36 3	7.520 ^r 7.40 ^s	1072	1790	+2,+3
63	Eu	151.965 9	5.244 ^e	822	1596	+2,+3
64	Gd	157.25 3	7.901 ^e	1314	3264	+3
65	Tb	158.92534 2	8.230	1359	3221	+3
66	Dy	162.50 3	8.551 ^e	1411	2561	+3
67	Ho	164.93032 2	8.795 ^e	1472	2694	+3
68	Er	167.259 3	9.066 ^e	1529	2862	+3
69	Tm	168.93421 2	9.321 ^e	1545	1946	+3
70	Yb	173.04 3	6.903 ^r 6.966 ^s	824	1194	+2,+3
71	Lu	174.967	9.841 ^e	1663	3393	+3
72	Hf	178.49 2	13.31 ^c	2233	4603	+4
73	Ta	180.9479	16.654	3017	5458	+5
74	W	183.84	19.3 ^c	3422	5555	+6
75	Re	186.207	21.02 ^c	3186	5596 (est.)	+4,+6,+7
76	Os	190.23 3	22.57	3033	5012	+3,+4
77	Ir	192.217 3	22.42 (17 °C)	2446	4428	+3,+4
78	Pt	195.08 3	21.45 ^c	1768.4	3825	+2,+4
79	Au	196.96655 2	≈19.3 ^c	1064.18	2856	+1,+3
80	Hg	200.59 2	13.546 ^c	-38.83	356.73	+1,+2
81	Tl	204.3833 2	11.85 ^c	304	1473	+1,+3
82	Pb	207.2	11.35 ^c	327.46	1749	+2,+4
83	Bi	208.98038 2	9.747 ^c	271.40	1564	+3,+5
84	Po	(209)	9.32 ^r	254		+2,+4
85	At	(210)		302		
86	Rn	(222)	0.00973	-71	-61.7	0
87	Fr	(223)		27		+1
88	Ra	(226)	5?	700		+2
89	Ac	(227)	10.07 ^t	1051	3198	+3
90	Th	232.03805 2	11.72	1750	4788	+4

Appendix–I Table of Elemental Properties

Z	El	Atomic Weight ^a	Density (g/cc) ^b	Melting Pt. (°C) ^b	Boiling Pt. (°C) ^b	Oxidation States ^b
91	Pa	(231)	15.37 ^t	1572		+4,+5
92	U	238.02891 3	≈18.95	1135	4131	+3,+4,+5,+6
93	Np	(237)	20.25 ^c	644	3902	+3,+4,+5,+6
					(est.)	
94	Pu	(244)	19.84 ^e	640	3228	+3,+4,+5,+6
95	Am	(243)	13.67 ^c	1176		+3,+4,+5,+6
96	Cm	(247)	13.51 ^t	1345		+3
97	Bk	(247)	14	1050		+3,+4
			(est.)			
98	Cf	(251)		900		+3
99	Es	(252)		860		+3
100	Fm	(257)		1527		+3
101	Md	(258)		827		+2,+3
102	No	(259)		827		+2,+3
103	Lr	(261)		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 N. E. Holden, priv. comm. (12/1999), to be published in *Handbook of Chemistry and Physics* (2000). Uncertainty is 1 in last significant figure, unless expressly given.

Masses are scaled to 12 for ¹²C.

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*, 75th edition, 1994, 4–1, 4–122. Where specified, exact temperature and pressure conditions are given; the conditions for all gases have been inferred to be 0 °C and 1 atm. The densities for the following gaseous elements are for diatomic molecules: H, N, O, F, Cl. In general, densities for gases (in g/cc) may be approximated by the formula: density=MP/82.05T, where M is the molecular weight in g, P the pressure in atm, and T the temperature in °K. The reported oxidation states do not include some uncommon states, or those states predicted by periodicity, but not confirmed chemically.
- c) At 20 °C.
- d) For gas; density (liquid)=0.0708 g/cc at b.p.; density (solid)=0.0706 g/cc at –262 °C.
- f) For gas; density (liquid)=0.1221 g/cc at b.p.
- e) At 25 °C.

Appendix–I Table of Elemental Properties

- f) For gas; density (liquid)=1.221 g/cc at b.p.
- g) At 1 atm.
- h) For crystal form; density (amorphous)=2.37 g/cc.
- i) For amorphous carbon; density (graphite)=1.9 to 2.3 g/cc; density (gem diamond)=3.513 g/cc at 25 °C; density (other diamond)=3.15 to 3.53 g/cc.
- j) For gas; density (liquid)=0.808 g/cc at b.p.; density (solid)=1.026 g/cc at –252 °C.
- k) For gas; density (liquid)=1.14 g/cc at b.p.
- l) For white phosphorus; density (red)=2.20 g/cc; density (black)=2.25 to 2.69 g/cc.
- m) For rhombic sulfur; melting point (monoclinic)=119.0 °C; density (monoclinic)=1.957 g/cc at 20 °C.
- n) Depending on allotropic form.
- o) For gray arsenic; density (yellow)=1.97 g/cc.
- p) For gray selenium; density (vitreous)=4.28 g/cc.
- q) For gray tin; density (white)=7.13 g/cc.
- r) For α modification.
- s) For β modification.
- t) Calculated.
- u) For liquid at 20 °C; 0.00759 g/cc for gas.
- v) For solid at 20 °C; 0.01127 g/cc for gas.

Appendix-II Frequently-Used Constants

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

Symbol	Constant	Value
$1/\alpha = \hbar c/e^2$	Fine structure constant	137.0
c	Speed of light in vacuum	2.998×10^{10} cm/s
h $\hbar = h/2\pi$ $\hbar c$	Planck constant	6.626×10^{-27} erg s 6.582×10^{-22} MeV s 197.3 MeV fm
$k = R/N_A$	Boltzmann constant	8.617×10^{-11} MeV/K
$r_e = e^2/m_e c^2$	Classical e^- radius	2.818 fm
$\lambda_{C,e} = \hbar/m_e c$	Compton wavelength of e^-	386.2 fm
$\lambda_{C,p} = \hbar/m_p c$	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^0}	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
$\mu_N = \hbar e/2m_p c$	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	$\pi = 3.1416$
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–III Fundamental Constants

Unless otherwise noted, the information presented in this table is from *CODATA Values of Fundamental Physical Constants: 1998*.^a The constants are arranged alphabetically according to the symbols by which they are denoted. The numbers in *italics* are the one–standard–deviation uncertainty in the last digits of the values given. The unified atomic mass scale ($^{12}\text{C}\equiv 12$) 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

$$\begin{aligned}\mu_0 &= 4\pi \times 10^{-7} \text{ m} \cdot \text{kg} \cdot \text{s}^{-2} \cdot \text{A}^{-2} = 4\pi \times 10^{-7} \text{ N} \cdot \text{A}^{-2} = 4\pi \times 10^{-7} \text{ T} \cdot \text{A}^{-1} \\ \epsilon_0 &= 1/\mu_0 \text{c}^2\end{aligned}$$

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-III Fundamental Constants

Symbol	Constant	Value	Units (SI) ^b	Units (cgs) ^b
$a_0=r_e/\alpha^2$	Bohr radius	5.291772083 19	10^{-10} m	10^{-9} cm
$\alpha=e^2/\hbar c[4\pi\epsilon_0]$ $1/\alpha$	Fine structure constant	0.007297352533 27 137.0359976 50		
c	Speed of light in vacuum	2.99792458 ^(c)	10^8 m s ⁻¹	10^{10} cm s ⁻¹
$c_1=2\pi\hbar c^2$	First radiation constant	3.74177107 29	10^{-16} W m ²	10^{-5} erg cm ² s ⁻¹
$c_2=\hbar c/k$	Second radiation constant	1.4387752 25	10^{-2} m K	cm K
e	Elementary charge	4.80320420 19 1.602176462 63	10^{-10} esu 10^{-19} C	10^{-20} emu
$2e/h$	Josephson frequency-voltage ratio	4.83597898 19	10^{14} Hz V ⁻¹	
$-e/m_e$	Electron specific charge	-1.758820174 71	10^{11} C kg ⁻¹	10^7 emu g ⁻¹
$F=N_A e$	Faraday constant	9.64853415 39	10^4 C mol ⁻¹	10^3 emu mol ⁻¹
γ_p	Gyromagnetic ratio of proton	2.67522212 11	10^8 s ⁻¹ T ⁻¹	10^4 s ⁻¹ G ⁻¹
γ_p'	Gyromagnetic ratio of proton (uncorrected for diamagnetism of H ₂ O)	2.67515341 11	10^8 s ⁻¹ T ⁻¹	10^4 s ⁻¹ G ⁻¹
G	Gravitational constant	6.673 10	10^{-11} m ³ kg ⁻¹ s ⁻²	10^{-8} cm ⁻³ g ⁻¹ s ⁻²

Appendix-III Fundamental Constants

Symbol	Constant	Value	Units (SI) ^b	Units (cgs) ^b
h	Planck constant	6.62606876 52	10^{-34} J s	10^{-27} erg s
$\hbar=h/2\pi$		1.054571596 82	10^{-34} J s	10^{-27} erg s
$hc/(2e[c])$	Quantum of magnetic flux	2.067833636 81	10^{-15} Wb	10^{-7} G cm ²
$k=R/N_A$	Boltzmann constant	1.3806503 24	10^{-23} J K ⁻¹	10^{-16} erg K ⁻¹
$\lambda_{C,e}=h/m_e c$	Compton wavelength of electron	2.426310215 18	10^{-12} m	10^{-10} cm
$\lambda_{C,p}=h/m_p c$	Compton wavelength of proton	1.321409847 10	10^{-15} m	10^{-13} cm
$\lambda_{C,n}=h/m_n c$	Compton wavelength of neutron	1.319590898 10	10^{-15} m	10^{-13} cm
m_e	Electron mass	5.485799110 12	10^{-4} u	10^{-4} u
m_H	Mass of hydrogen atom	1.007825032 1(c)	u	u
m_μ	Muon mass	0.1134289168 34	u	u
m_n	Neutron mass	1.00866491578 55	u	u
m_p	Proton mass	1.00727646688 13	u	u
$m_{\pi^\pm}$	$\pi^\pm$ mass	0.1498348 4(d)	u	u
m_{π^0}	π^0 mass	0.1449033 6(d)	u	u

Appendix-III Fundamental Constants

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

1 year (sidereal) = 365.25636 days = $3.1558150 \times 10^7 \text{ s}$, 1 year (tropical) = $3.15569 \times 10^7 \text{ s}$

Appendix–III Fundamental Constants

- a) P. J. Mohr and B. N. Taylor, *Jl. of Phys. and Chem. Ref. Data* 28, 1713 (1999); *Rev. Mod. Phys.* 72, 351 (2000). Data taken from *Physics Today* 54, BG6 (2001). See also <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 1995 update to the atomic mass evaluation, G. Audi and A. H. Wapstra, computerized list of recommended values based on authors' publication *Nuclear Physics A* 595, 409 (1995)
- d) D. E. Groom *et al.* Review of Particle Physics, *Eur. Physical Jl. C* 15, 1 (2000); <http://pdg.lbl.gov/>
- e) Speed of light in vacuum is an exact constant as a result of redefinition of meter [P. Giacomo, *Metrologia* 20, 25 (1984)].
- f) General Section by H. L. Anderson and E. R. Cohen in *A Physicist's Desk Reference*, H. L. Anderson, Editor-in-Chief, AIP, New York (1989)

Appendix-IV Energy-Equivalent Factors†

units	erg	eV	s ⁻¹	cm ⁻¹
erg	1.0	1.602176462 63×10 ⁻¹²	6.6260876 52×10 ⁻²⁷	1.98644544 76×10 ⁻¹⁶
eV	6.24150974 24×10 ¹¹	1.0	4.13566727 76×10 ⁻¹⁵	1.239841857 49×10 ⁻⁴
s ⁻¹	1.50919050 72×10 ²⁶	2.417989491 95×10 ¹⁴	1.0	2.99792458 ×10 ¹⁰
cm ⁻¹	5.03411762 39×10 ¹⁵	8.06554477 32×10 ³	3.335640952×10 ⁻¹¹	1.0
K	7.242964 73×10 ¹⁵	1.1604506 20×10 ⁴	4.7992374 84×10 ⁻¹¹	1.4387752 25
g	1.112650056×10 ⁻²¹	1.782661731 70×10 ⁻³³	7.37249578 58×10 ⁻⁴⁸	2.21021863 77×10 ⁻³⁷
u	6.70053662 53×10 ²	1.073544206 43×10 ⁻⁹	4.439821637 34×10 ⁻²⁴	1.331025042 70×10
	(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:

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

Examples: 1 eV = 1.602...×10⁻¹² erg = 1.073...×10⁻⁹ u = 3.829...×10⁻²⁰ cal

$$e/h = 2.417...\times 10^{14} \text{ s}^{-1}, e/(\text{hc}) = 8.0654...\times 10^3 \text{ cm}^{-1}$$

$$e/c^2 = 1.782...\times 10^{-33} \text{ g}, e/mc^2 = 1.073...\times 10^{-9} \text{ u}$$

$$e/k = 1.160...\times 10^4 \text{ K}$$

Appendix-IV Energy-Equivalent Factors†

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

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

Example: 1u ≡ 1.492...×10⁻³ erg = 9.314...×10⁸ eV = 3.567...×10⁻¹¹ cal, etc.

† From CODATA Values of Fundamental Physical Constants:1998, P. J. Mohr and B.N. Taylor, *Jour. of Phys. and Chem. Ref. Data* 28, 1713 (1999), *Rev. Mod. Phys.* 72, 351 (2000), *Physics Today* 54, BG6 (2001); <http://physics.nist.gov/constants>.

Appendix-V Observed Λ Hypernucleides†

EI	A	J(g.s.)	$B_{\Lambda}(\text{g.s.})^*$	Excited (bound) states (MeV)
H	3	1/2	0.13 5	
	4	0	2.04 4	E=1.05 4
He	4	0	2.39 3	E=1.15 4
	5	1/2	3.12 2	
	6	(1)	4.18 10	
	8		7.16 70	
Li	6		4.50	E=8.3,18.3
	7	1/2+	5.58 3	E=0.692 4 3/2 ^a ,2.050 2 5/2 ^a ,8.3,20.2
	8	1	6.80 3	E=0.442? ^b ,1.22 4
	9		8.50 12	
Be	7	1/2	5.16 8	
	8		6.84 5	
	9	1/2	6.71 4	E ^b =3.079 4 [#] ,5.98 84,10.59 72, 16.55 69,22.93 71,27.90 72
	10		9.11 22	
B	9		8.29 18	
	10		8.89 12	E ^c =2.5 2,6.2 2,9.5 3
	11	5/2	10.24 5	
	12	1	11.37 6 ^d	
C	12	1	10.80 18 ^d	E ^c =2.71 13 1-,6.05 18 1-,8.10 38, 10.97 5 2+,12.0 3 ^b ,16.2 2 ^b
	13	1/2+	11.69 12	E ^c =4.9 1 3/2+,9.6 3 3/2-,11.6 2 1/2+, 15.4 1 [#]
	14		12.17 33	
N	14		12.17	E=10.5,19,22
	15		13.59 15	
O	16	1- ^e	12.5	E ^c =6.3 1 1-,10.6 1 2+,0-,16.7 1 2+,0+, 20.0 4 ^b ,23.3 5 ^b
	18			E=13,20,24,30
Al	27			E=7,18 ^b
Si	28		16.6 ^c	E ^c =4.7 4,9.6 3,12.3 3,17.6 8,23.2 5 ^b
S	32		17.5 5	E=11.5,22.5
Ca	40		20.0 5	E ^b =2.9 13,6.1 13,8.3 11,13.9 11, 16.7 11,19.8 11,22.9 13
V	51		19.5 ^f	E ^b =3.5 16,5.7 10,8.4 10,12.1 11, 15.0 10,18.3 11,21.8 10,26.0 10
Fe	56		21	
Y	89		23 2	E ^{b,c} =6.9 16,13.4 16,19.8 16,27.2 16
La	139		23.8 10 ^c	E ^c =3.8 11
Pb	208		26.5 5 ^c	E ^c =5.2 9
Bi	209			E=32,40

Appendix–V Observed Λ Hypernucleides†

Footnotes and References

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

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

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

* Λ binding energy.

Possibly complex.

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

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

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

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

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

f Calculated.

Appendix-VIa Periodic Table of Elements

IA	IIA	IIIB	IVB	VB	VIB	VIIIB	----	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	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	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	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								
*	La 57	Ce 58	Pr 59	Nd 60	Pm 61	Sm 62	Eu 63	Gd 64	Tb 65	Dy 66	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	Fm 100	Md 101	No 102	Lr 103	Actinides	

Appendix-VIb List of Elements – Alphabetical

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

Appendix-VIc List of Elements – by Z

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

Appendix-VII International Nuclear Structure and Decay Data Network

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Appendix-VIII Nuclear Data Centers Network

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Electronic Nuclear Data Access

Introduction

The National Nuclear Data Center (NNDC) and other members of the IAEA-sponsored International Nuclear Structure and Decay Data (NSDD) and Nuclear Reaction Data (NRDC) Networks and the U.S. Nuclear Data Program (USNDP) provide electronic access to many of the bibliographic and numeric databases maintained by members of these groups. Access is available by anonymous FTP, TELNET, and the World Wide Web (W^3). Some databases or programs also are available on CD-ROM from individual Centers.

The contents of these various services are changing and growing continually, as are the methods of accessing them. Most of the W^3 home pages listed below contain current links. If you have problems or questions, please contact the NNDC at services@bnlnd2.dne.bnl.gov.

The NNDC, the International Atomic Energy Agency Nuclear Data Section (NDS), the OECD Nuclear Energy Agency Data Bank (NEADB) and the Russian Nuclear Data Center (RNDC) maintain databases and provide services covering a wide range of nuclear science. The databases and services available from these centers are listed first followed by the methods of electronic access to these centers. Next, other members of the NSDD, NRDC, and USNDP providing electronic access to nuclear data are listed in alphabetical order.

Other data centers and Web sites of interest may be accessed through the NNDC W^3 site or the other Web sites listed below. The USNDP home page (<http://www.nnrc.bnl.gov/usndp/>) also contains this information organized by subject or discipline and from the viewpoints of various user communities.

Members of the USNDP receive some or all of their funding from the Division of Nuclear Physics, Office of High Energy and Nuclear Physics, US Department of Energy (see page *viii*). <http://www.pixe.lth.se/glossary/index.asp?gloss=ndgloss> contains a useful glossary of Internet and nuclear data terminology.

Databases and Services at the NNDC, NDS, NEADB, and RNDC

The NNDC, NDS, NEADB, and RNDC mirror the information available at these four core centers although there are some differences in the contents and version dates of the databases. Current major systems common to the four systems are listed below. The centers providing access to

this information in various formats are shown in the square brackets following the definitions.

CINDA (*Computer Index of Neutron Data*)—Bibliographic references to data on neutron reactions. [[NDS](#), [NEADB](#), [NNDC](#), [RNDC](#)]

Codes—Includes ENDF pre-processing and utility codes and ENSDF analysis and checking codes. [[NDS](#), [NNDC](#)]

[CSISRS](#) (*Cross Section Information Storage and Retrieval System*)—Experimental data on nuclear reactions, along with descriptions. This also is known as **EXFOR** (*Exchange Format*). [[NDS](#), [NEADB](#), [NNDC](#), [RNDC](#)]

Documentation—Includes the NNDC (NDS) On-line Data Service Manual [[NDS](#), [NNDC](#)], the **Evaluated Nuclear Data File**, **Evaluated Nuclear Structure Data File**, and **Nuclear Science References** manuals, and the ENDF/B-VI Summary Documentation [[NDS](#), [NEADB](#), [NNDC](#), [RNDC](#)].

ENDF (*Evaluated Nuclear Data File*) —Evaluated data on nuclear reactions and decays. [[NDS](#), [NEADB](#) (EVA, JEF), [NNDC](#), [RNDC](#)]

ENSDF (*Evaluated Nuclear Structure Data File*)—Evaluated data on adopted levels and their properties, decay schemes, and nuclear structure from reactions for all known nuclides. [[IP](#) (Isotopes Project), [NDS](#), [NNDC](#), [RNDC](#)]

Libraries—Includes the 1995 Update to the Atomic Mass Evaluation [[AMDC](#) (Atomic Mass Data Center), [NDS](#), [NEADB](#), [NNDC](#)], and the International Reactor Dosimetry File—1990 (Version 2) [[NDS](#), [NNDC](#)]

MIRD—Information on radionuclide decay in the format of the **Medical Internal Radiation Dose** Committee. [[NDS](#), [NNDC](#), [RNDC](#)]

NSR (*Nuclear Science References*) —Bibliographic information on nuclear structure, nuclear reactions, and radioactive decay. Some papers on atomic physics are included that are relevant to the physics of nuclear structure. [[IP](#), [NDS](#), [NNDC](#), [RNDC](#)]

NuDat (*Nuclear Data File*)—Evaluated nuclear data, including nuclear levels and γ 's and their properties, nuclear masses, nuclear isomeric properties, radioactive decay radiations, and thermal cross sections and resonance integrals. [[NDS](#), [NEADB](#), [NNDC](#), [RNDC](#)]

PCNuDat—An MS-DOS clone of NuDat. [[NDS](#), [NNDC](#)]

XRAY (Photon Attenuation and Scattering)—Attenuation coefficients and total x-ray cross-sections, and scattering cross-sections for polarized photons. [[NDS](#), [NNDC](#), [RNDC](#)]

XUNDL (*Experimental Unevaluated Nuclear Data List*)—Experimental nuclear structure and decay data compiled in the ENSDF format. [[IP](#), [NNDC](#)]

Other information available at the NNDC and NDS includes: the NNDC (NDS) address list and Newsletter; **UTILITIES** to run nuclear physics analyses and Q-value calculation codes, and **FILES** to view and electronically transfer data files.

National Nuclear Data Center (NNDC), Brookhaven National Laboratory, USA

Anonymous FTP

- <ftp.nndc.bnl.gov>
- Contents: [Codes](#), [documentation](#), and [libraries](#) as described [above](#). Additional contents include MS-DOS versions of the ENSDF analysis and checking codes (including executables), ENSDAT (*Evaluated Nuclear Structure Drawings and Tables*), PCNuDat, and the 5th edition of the Nuclear Wallet Cards.

Terminal Access

- <telnet.nndc.bnl.gov>. User name: NNDC (no password). At the prompt for assigned authorization code, enter the assigned code or GUEST.
- Contents: See [above](#). Also includes a test database of experimental relativistic heavy-ion reaction data.

World Wide Web

- <http://www.nndc.bnl.gov>
- Contents: General information. Nuclear decay data in the MIRD format. [Codes](#), [documentation](#), and [libraries](#) as described [above](#). Mirror site for the Korean Atomic Energy Research Institute's *Table of the Nuclides*. 5th edition of the Nuclear Wallet Cards. Experimental relativistic heavy-ion reaction data. Thermal neutron capture γ 's. [CINDA](#), [CSISRS](#), [ENDF](#), [ENSDF](#), [NSR](#), [NuDat](#), and [XUNDL](#). Interactive calculation of $\log f$'s and internal conversion coefficients.

Nuclear Data Section (NDS), IAEA, Austria

Anonymous FTP

- <iaeand.iaea.or.at>. User name: anonymous. Password: Your e-mail address.
- Contents: [Codes](#), [documentation](#), and [libraries](#) as described [above](#). Additional contents include MS-DOS versions of the ENSDF analysis and checking codes (including executables), ENSDAT (*Evaluated Nuclear Structure Drawings and Tables*), PCNuDat, the

1995 Atomic Mass Evaluation, and the 5th edition of the Nuclear Wallet Cards.

CD-ROM Distribution

- EXFOR
- Evaluated nuclear reaction data in the ENDF format and associated preprocessing and utility codes
- Multigroup cross section libraries

Terminal Access

- iaea.nds.iaea.or.at. User name: IAEANDS (No password). At the prompt for assigned authorization code, enter the assigned code or GUEST.
- Contents: See [above](#).

World Wide Web

- <http://www-nds.iaea.or.at>
- Contents: General information, Nuclear decay data in the MIRD format. [Codes](#), [documentation](#), and [libraries](#) as described [above](#) and the FENDL-2 library (*Fusion Evaluated Nuclear Data Library*. 5th edition of the Nuclear Wallet Cards. Thermal neutron capture γ 's. [CINDA](#), [CSISRS](#), [ENDF](#), [ENSDF](#), [EXFOR](#), NGATLAS (Atlas of neutron capture cross sections), Reference Input Parameter Library (RIPL), NMF-90 (Neutron Metrology File), and [NuDat](#).

Nuclear Energy Agency Data Bank (NEADB), OECD, France

CD-ROM distribution

- JENDL-3.2 Plots on CD-ROM
- JEF-PC. Software for Graphical Display of Nuclear Data

World Wide Web

- <http://www.nea.fr/html/databank/>
- Contents: General Information. Evaluated nuclear reaction data (EVA, JEF). CINDA, EXFOR. Format manuals. Preprocessed reaction data. Atomic masses. Computer codes.

Russian Nuclear Data Center (RNDC), Russia

Terminal Access

- rndc.ippe.obninsk.ru. User name: CJD (no password). At the prompt for assigned authorization code, enter the assigned code or GUEST.
- Contents: See [above](#).

World Wide Web

- <http://rndc.ippe.obninsk.ru/>
- Contents: General Information. BROND-2, RRDF-98 (Russian Radiation Dosimetry File), ADL-3 (Activation Data Library), MENDL (Medium Energy Neutron Data Library).

Astrophysics Program, Oak Ridge National Laboratory, USA

World Wide Web

- <http://www.phy.ornl.gov/astrophysics/astro.html>
- Contents: Nuclear reaction rates and nuclear astrophysics bibliography.

Atomic Mass Data Center (AMDC), Centre de Spectrométrie Nucléaire et de Spectrométrie de Masse, France

Anonymous FTP

- [csnftp.in2p3.fr](ftp://csnftp.in2p3.fr). Change directory to pub/AMDC.
- Contents: General information. The NUBASE database. PC-NUCLEUS program. ENSDF. JvNubase.

World Wide Web

- <http://www-csns.in2p3.fr/amdc/>
- Contents: General information. The 1995 Update to the Atomic Mass Evaluation and the 1993 Atomic Mass Evaluation. NUBASE and jvNubase.

Center for Nuclear Information Technology (CNIT), San Jose State University, USA

World Wide Web

- <http://www.best.com/~sdv/MacNuclide2/MacNukeb.html>
- Contents: MacNuclide 1.0 (MacOS/Windows), MacNuclide 2.x (MacOS), and cross-platform Java MacNuclide (β release).

Center for Photonuclear Experiments Data (CDFE), Moscow State University, Russia

World Wide Web

- <http://depni.npi.msu.su/cdfe/>
- Contents: General information. Photonuclear reaction cross-sections, parameters of the Giant Dipole Resonance and photonuclear reaction thresholds. Photonuclear data index.

γ -ray Spectrometry Center, Idaho Falls National Engineering and Environmental Laboratory, USA

World Wide Web

- <http://id.inel.gov/gamma/>
- Contents: General information. NaI (Tl) and Ge(Li)-Si(Li) Gamma Spectrum Catalogues.

Isotopes Project (IP), Ernest Orlando Lawrence Berkeley National Laboratory, USA

World Wide Web

- <http://ie.lbl.gov/>
- Contents: General information. Isotope Explorer and VuENSDF. NSR, ENSDF, and XUNDL. Table of Super-Deformed Bands and Fission Isomers. Atomic masses and Q-value calculator. Nuclear Astrophysics Data Reference List and Reaction Rates. Thermal neutron capture γ data. Table of Radioactive Isotopes. GAMQUEST.

Nuclear Data Center, Japan Atomic Research Institute, Japan

CD-ROM distribution

- CD-ROM Storing JENDL-3.2 Plots and Data

World Wide Web

- <http://wwwndc.tokai.jaeri.go.jp/index.html>
- Contents: General information. JENDL-3.2. Documentation. Graphs of evaluated cross section data. Tables of Nuclear Data. Chart of the Nuclides. JNDC Nuclear Data Library (fission product decay data).

Nuclear Data Evaluation Project, Triangle Universities Nuclear Laboratory, USA

World Wide Web

- <http://www.tunl.duke.edu/NuclData>
- Contents: General information. Revised post-publication manuscripts for A=3, 4, and 16-20 and preprints for A=5 and 6 (PDF). Modified versions of A=5-10, 11, 13, and 14 (PDF). Energy level diagrams for A=4-20 (GIF, PDF, EPS). Extract of the Table of Isotopes for A=1-20 (PDF, PS). Reference update lists for A=6-10.

T-2 Nuclear Information Service, Los Alamos National Laboratory, USA

Anonymous FTP

- t2.lanl.gov.
- Contents: Similar to the Web site.

World Wide Web

- <http://t2.lanl.gov>
- Contents: General information. Neutron kerma data. High-energy data for accelerator applications. Reaction Q-value and threshold energy calculator. Nuclear reaction rates and astrophysical S-factors. Nuclear Data Viewer. ENDF. Codes (TRANSX 2.15, NJOY, etc.).

**Division of Nuclear Physics,
Office of High Energy and Nuclear Physics,
US Department of Energy**

The Division of Nuclear Physics supports a broad program of basic research in nuclear physics. The Division's World Wide Web site (<http://www.er.doe.gov/production/henp/nucphys.html>) provides an overview of its research program, programmatic activities, and links to research facilities at universities and national laboratories, to some major experiments, and to research publications. One of the Division's sub-programs, Low Energy Nuclear Physics, supports information services on critical nuclear data, and the compilation and dissemination of accurate and complete nuclear data information that is readily accessible and user oriented.

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