

## APPENDIX E. NUCLEAR MOMENTS

Table 1 contains the nuclear magnetic and quadrupole moments from the *Table of Isotopes*. Most of these moments are from the compilation of Raghavan<sup>1</sup> except for values which have since been updated in the *Nuclear Data Sheets*. The nuclear species for which moments are reported are identified in the first four columns of Table 1. The level energies (in keV), half-lives, and spin/parities are given in columns 5-7. Magnetic dipole moments ( $\mu$ ), in column 8, are given in units of nuclear magnetons, and are based on the uncorrected proton moment, 2.79277564 6 nm.<sup>2</sup> magnetic moments are corrected for diamagnetic shielding wherever applicable. Electric quadrupole moments (Q), in column 9, are given in units of barns. Signs of magnetic and quadrupole moments are given as reported by the original authors, and absence of a sign indicates that it is undetermined. Tabulated uncertainties are printed in italics. In some instances two possible moment values exist and these are separated by "or".

<sup>1</sup> P. Raghavan, *At. Data Nucl. Data Tables* **42**, 189 (1989).

<sup>2</sup> E.R. Cohen and B.N. Taylor, *Rev. Mod. Phys.* **59**, 1121 (1987).

Table 1. Table of Nuclear Moments

Nucleus Z El A	Level energy	Half-life	J <sup><math>\pi</math></sup>	$\mu$ (nm)	Q (b)	Nucleus Z El A	Level energy	Half-life	J <sup><math>\pi</math></sup>	$\mu$ (nm)	Q (b)	
0 n	1	0	616.3 s	1/2 <sup>+</sup>	-1.91304275 45	11 Na	23	0	stable	3/2 <sup>+</sup>	+2.217520 2	+0.1006 20
1 H	1	0	stable	1/2 <sup>+</sup>	+2.79284739 7	11 Na	24	0	14.9590 h	4 <sup>+</sup>	+1.6903 8	
1 H	2	0	stable	1 <sup>+</sup>	+0.857438230 24	11 Na	24	472.207	20.20 ms	1 <sup>+</sup>	-1.931 3	
1 H	3	0	12.33 y	1/2 <sup>+</sup>	+2.97896248 7	11 Na	25	0	59.1 s	5/2 <sup>+</sup>	+3.683 4	-0.10 5
2 He	3	0	stable	1/2 <sup>+</sup>	-2.12762485 7	11 Na	26	0	1.072 s	3 <sup>+</sup>	+2.851 2	-0.08 5
3 Li	6	0	stable	1 <sup>+</sup>	+0.8220473 6	11 Na	27	0	301 ms	5/2 <sup>+</sup>	+3.895 5	-0.06 5
3 Li	7	0	stable	3/2 <sup>-</sup>	+3.2564268 17	11 Na	28	0	30.5 ms	1 <sup>+</sup>	+2.426 3	-0.02 4
3 Li	8	0	838 ms	2 <sup>+</sup>	+1.653560 18	11 Na	29	0	44.9 ms	3/2	+2.449 8	+0.03 5
3 Li	9	0	178.3 ms	3/2 <sup>-</sup>	3.4391 6	11 Na	30	0	48 ms	2 <sup>+</sup>	+2.083 10	
3 Li	11	0	8.5 ms	3/2 <sup>-</sup>	3.6678 25	11 Na	31	0	17.0 ms		+2.305 8	
4 Be	9	0	stable	3/2 <sup>-</sup>	-1.1778 9	12 Mg	24	1368.675	1.35 ps	2 <sup>+</sup>	+1.02 4	-0.166 6
5 B	8	0	770 ms	2 <sup>+</sup>	1.0355 3	12 Mg	24	4122.874	24 fs	4 <sup>+</sup>	+1.6 12	
5 B	10	0	stable	3 <sup>+</sup>	+1.8006448 6	12 Mg	24	4238.36	49 fs	2 <sup>+</sup>	+1.2 4	
5 B	10	718.35	0.707 ns	1 <sup>+</sup>	+0.63 12	12 Mg	24	6010.32	58 fs	4 <sup>+</sup>	+2.0 16	
5 B	11	0	stable	3/2 <sup>-</sup>	+2.6886489 10	12 Mg	25	0	stable	5/2 <sup>+</sup>	-0.85545 8	+0.201 3
5 B	12	0	20.20 ms	1 <sup>+</sup>	+1.00306 15	12 Mg	26	1808.70	476 fs	2 <sup>+</sup>	+1.0 3	-0.135 20
5 B	13	0	17.36 ms	3/2 <sup>-</sup>	+3.1778 5	13 Al	25	0	7.183 s	5/2 <sup>+</sup>	3.6455 12	
6 C	11	0	20.39 m	3/2 <sup>-</sup>	-0.964 1	13 Al	26	416.852	1.25 ns	3 <sup>+</sup>	+2.0 5	
6 C	12	4438.91	0.0108 ev	2 <sup>+</sup>	+1.00306 15	13 Al	27	0	stable	5/2 <sup>+</sup>	+3.6415069 7	+0.150 6
6 C	13	0	stable	1/2 <sup>-</sup>	+0.7024118 14	13 Al	28	0	2.2414 m	3 <sup>+</sup>	3.242 5	0.175 14
6 C	13	3853.807	8.60 ps	5/2 <sup>+</sup>	1.40 4	13 Al	28	30.6383	2.07 ns	2 <sup>+</sup>	+4.3 4	
6 C	14	6728.2	66 ps	3 <sup>-</sup>	0.816 21	14 Si	27	0	4.16 s	5/2 <sup>+</sup>	(-)0.8554 4	
6 C	15	0	2.449 s	1/2 <sup>+</sup>	1.32 7	14 Si	28	1779.030	475 fs	2 <sup>+</sup>	+1.12 18	+0.165 18
6 C	15	740.0	2.61 ns	5/2 <sup>+</sup>	-1.76 3	14 Si	29	0	stable	1/2 <sup>+</sup>	-0.5529 3	
7 N	12	0	11.000 ms	1 <sup>+</sup>	+0.4573 5	14 Si	30	2235.33	248 fs	2 <sup>+</sup>	+0.76 18	-0.05 4
7 N	13	0	9.965 m	1/2 <sup>-</sup>	0.3222 4	14 Si	32	1941.5	420 fs	2 <sup>+</sup>	-0.16 2 or -0.13 2	
7 N	14	0	stable	1 <sup>+</sup>	+0.40376100 6	15 P	29	0	4.140 s	1/2 <sup>+</sup>	1.2349 3	
7 N	14	5105.89	4.35 ps	2 <sup>-</sup>	1.32 8	15 P	31	0	stable	1/2 <sup>+</sup>	+1.13160 3	
7 N	14	5834.25	8.30 ps	3 <sup>-</sup>	>1.5	15 P	31	1266.15	520 fs	3/2 <sup>+</sup>	+0.30 8	
7 N	15	0	stable	1/2 <sup>-</sup>	-0.28318884 5	15 P	31	2233.7	250 fs	5/2 <sup>+</sup>	+2.8 5	
7 N	15	5270.155	1.79 ps	5/2 <sup>+</sup>	+2.35 18	15 P	32	0	14.262 d	1 <sup>+</sup>	-0.2524 3	
7 N	16	298.22	91.3 ps	3 <sup>-</sup>	1.60 6	16 S	31	0	2.572 s	1/2 <sup>+</sup>	0.48793 8	
7 N	16	397.27	3.90 ps	1 <sup>-</sup>	-1.83 13	16 S	32	2230.3	168 fs	2 <sup>+</sup>	+0.94 18	-0.149 13
8 O	15	0	122.24 s	1/2 <sup>-</sup>	0.7189 8	16 S	32	4458.9	120 fs	4 <sup>+</sup>	+1.6 6	
8 O	15	5240.9	2.25 ps	5/2 <sup>+</sup>	+0.65 7	16 S	33	0	stable	3/2 <sup>+</sup>	+0.6438212 14	-0.076 10
8 O	16	6129.89	18.4 ps	3 <sup>-</sup>	+1.668 12	16 S	34	2127.564	325 fs	2 <sup>+</sup>	+1.00 16	+0.05 3
8 O	17	0	stable	5/2 <sup>+</sup>	-1.89379 9	16 S	35	0	87.51 d	3/2 <sup>+</sup>	+1.00 4 or -1.07 4	+0.045 10
8 O	18	1982.07	1.94 ps	2 <sup>+</sup>	-0.57 3	17 Cl	33	0	2.511 s	3/2 <sup>+</sup>	+0.7523 16	
8 O	18	3554.8	17.2 ps	4 <sup>+</sup>	2.5 4	17 Cl	35	0	stable	3/2 <sup>+</sup>	+0.8218743 4	-0.08249 2
8 O	19	96.0	1.39 ns	3/2 <sup>+</sup>	-0.72 9	17 Cl	36	0	3.01x10 <sup>5</sup> y	2 <sup>+</sup>	+1.28547 5	-0.0180 4
8 O	20	1637.68	7.3 ps	2 <sup>+</sup>	-0.70 3	17 Cl	37	0	stable	3/2 <sup>+</sup>	+0.6841236 4	-0.06493 2
9 F	17	0	64.49 s	5/2 <sup>+</sup>	+4.72130 20	17 Cl	38	0	37.24 m	2 <sup>-</sup>	2.05 2	
9 F	18	937.20	46.9 ps	3 <sup>+</sup>	+1.68 15	18 Ar	35	0	1.775 s	3/2 <sup>+</sup>	+0.633 2	
9 F	18	1121.36	162 ns	5 <sup>+</sup>	+2.86 3	18 Ar	36	1970.39	320 fs	2 <sup>+</sup>		+0.11 6
9 F	19	0	stable	1/2 <sup>+</sup>	+2.628868 8	18 Ar	37	0	35.04 d	3/2 <sup>+</sup>	+1.145 5	
9 F	19	197.143	89.3 ns	5/2 <sup>+</sup>	+3.607 8	18 Ar	37	1611.27	4.37 ns	7/2 <sup>-</sup>	-1.33 5	
9 F	19	1345.67	2.86 ps	5/2 <sup>-</sup>	0.67 11	18 Ar	39	0	269 y	7/2 <sup>-</sup>	-1.3 3	
9 F	20	0	11.00 s	2 <sup>+</sup>	+2.0935 9	18 Ar	40	1460.859	1.12 ps	2 <sup>+</sup>		+0.01 4
10 Ne	19	0	17.34 s	1/2 <sup>+</sup>	-1.88542 8	19 K	36	0	342 ms	2 <sup>+</sup>	(+)0.548 1	
10 Ne	19	238.27	18.0 ns	5/2 <sup>+</sup>	-0.740 8	19 K	37	0	1.226 s	3/2 <sup>+</sup>	+0.20321 6	
10 Ne	20	1633.674	0.73 ps	2 <sup>+</sup>	+1.08 8	19 K	37	1380.25	10.4 ns	7/2 <sup>-</sup>	+5.2 3	
10 Ne	20	4247.7	64 fs	4 <sup>+</sup>	+0.5 6	19 K	38	0	7.636 m	3 <sup>+</sup>	+1.371 6	
10 Ne	21	0	stable	3/2 <sup>+</sup>	-0.661797 5	19 K	38	3458.0	21.98 $\mu$ s	7 <sup>+</sup> (5 <sup>+</sup> )	+3.836 14	
10 Ne	21	350.728	7.17 ps	5/2 <sup>+</sup>	0.53 7	19 K	39	0	stable	3/2 <sup>+</sup>	+0.3914662 3	+0.049 4
10 Ne	22	1274.542	3.63 ps	2 <sup>+</sup>	+0.65 2	19 K	39	2814.3	47 ps	7/2 <sup>-</sup>	4.0 4	
10 Ne	22	3357.2	225 fs	4 <sup>+</sup>	+2.2 6	19 K	39	3597.5	38 ps	9/2 <sup>-</sup>	2.4 2	
10 Ne	23	0	37.24 s	5/2 <sup>+</sup>	-1.08 1	19 K	40	0	1.277x10 <sup>9</sup> y	4 <sup>-</sup>	-1.298100 3	-0.061 5
11 Na	20	0	447.9 ms	2 <sup>+</sup>	+0.3694 2	19 K	40	29.8299	4.24 ns	3 <sup>-</sup>	-1.29 9	
11 Na	21	0	22.49 s	3/2 <sup>+</sup>	+2.38630 10	19 K	40	2542.8	1.08 ns	7 <sup>+</sup>	+4.1 7	
11 Na	21	331.93	7.08 ps	5/2 <sup>+</sup>	3.7 3	19 K	41	0	stable	3/2 <sup>+</sup>	+0.2148701 2	+0.060 5
11 Na	22	0	2.6019 y	3 <sup>+</sup>	+1.746 3	19 K	41	1293.609	7.2 ns	7/2 <sup>-</sup>	+4.42 5	
11 Na	22	583.03	244 ns	1 <sup>+</sup>	+0.535 10	19 K	41	2527.66	150 ps	11/2 <sup>+</sup>	4.5 10	
11 Na	22	2211.5	14.6 ps	1 <sup>-</sup>	0.36 7	19 K	41	2774.25	51 ps	13/2 <sup>+</sup>	3.0 5	
						19 K	41	4982.9	75 ps	19/2 <sup>-</sup>	7.0 29	
						19 K	42	0	12.360 h	2 <sup>-</sup>	-1.1425 6	
						19 K	43	0	22.3 h	3/2 <sup>+</sup>	+0.1633 8	

## E-2

Nucleus	Level	Half-life	$J^{\pi}$	$\mu$	Q	Nucleus	Level	Half-life	$J^{\pi}$	$\mu$	Q
Z El A	energy			(nm)	(b)	Z El A	energy			(nm)	(b)
19 K 43	738.1	200 ns	$7/2^{-}$	+4.43 5		27 Co 60	0	5.2714 y	$5^{+}$	+3.799 8	+0.44 5
19 K 44	0	22.13 m	$2^{-}$	-0.856 4		27 Co 60	58.59	10.47 m	$2^{+}$	+4.40 9	+0.3 5
19 K 45	0	17.3 m	$3/2^{+}$	+0.1734 8		28 Ni 57	0	35.60 h	$3/2^{-}$	0.88 6	
19 K 46	0	105 s	$(2^{-})$	-1.051 6		28 Ni 58	1454.45	644 fs	$2^{+}$	-0.12 24	-0.10 6
19 K 47	0	17.5 s	$1/2^{+}$	+1.933 9		28 Ni 59	339.421	68 ps	$5/2^{-}$	+0.43 19	
20 Ca 39	0	859.6 ms	$3/2^{+}$	1.02168 12		28 Ni 60	1332.516	0.713 ps	$2^{+}$	+0.18 24	+0.03 5
20 Ca 40	3736.69	47 ps	$3^{-}$	+1.60 22		28 Ni 61	0	stable	$3/2^{-}$	-0.75002 4	+0.162 15
20 Ca 40	4491.43	290 ps	$5^{-}$	+2.6 5		28 Ni 61	67.412	5.34 ns	$5/2^{-}$	+0.480 6	-0.20 3
20 Ca 41	0	$1.03 \times 10^{5}$ y	$7/2^{-}$	-1.594781 9	-0.080 8	28 Ni 62	1172.91	1.45 ps	$2^{+}$	+0.66 12	+0.05 12
20 Ca 41	3829.78	3.1 ns	$15/2^{+}$	+2.18 15		28 Ni 63	87.15	1.67 $\mu$ s	$5/2^{-}$	+0.752 3	
20 Ca 42	1524.73	0.82 ps	$2^{+}$		-0.19 8	28 Ni 64	1345.79	0.88 ps	$2^{+}$	+0.92 26	+0.35 20
20 Ca 42	3189.33	5.36 ns	$6^{+}$	-2.49 9		28 Ni 65	0	2.5172 h	$5/2^{-}$	0.69 6	
20 Ca 43	0	stable	$7/2^{-}$	-1.317643 7	-0.049 5	29 Cu 60	0	23.7 m	$2^{+}$	+1.219 3	
20 Ca 44	1157.047	2.61 ps	$2^{+}$	-0.6 2	-0.14 7	29 Cu 61	0	3.333 h	$3/2^{-}$	+2.14 4	
20 Ca 45	0	163.8 d	$7/2^{-}$	-1.3274 14	+0.046 14	29 Cu 62	0	9.74 m	$1^{+}$	-0.380 4	
20 Ca 47	0	4.536 d	$7/2^{-}$	-1.380 24	+0.021 4	29 Cu 62	40.84	4.57 ns	$2^{+}$	+1.32 3	
21 Sc 41	0	596.3 ms	$7/2^{-}$	5.535 4		29 Cu 62	390.21	11 ns	$4^{+}$	+2.67 16	
21 Sc 43	0	3.891 h	$7/2^{-}$	+4.62 4	-0.26 6	29 Cu 63	0	stable	$3/2^{-}$	+2.22329 18	-0.211 4
21 Sc 43	151.9	438 $\mu$ s	$3/2^{+}$	+0.348 6		29 Cu 63	4496.7	4.1 ns	$17/2^{+}$	+1.56 10	
21 Sc 43	3123.2	468 ns	$(11/2 \text{ to } 19/2)$	+3.122 7	0.199 14	29 Cu 64	0	12.700 h	$1^{+}$	-0.217 2	
21 Sc 44	0	3.927 h	$2^{+}$	+2.56 3	+0.10 5	29 Cu 64	1594.23	20.4 ns	$(6^{-})$	+1.06 3	
21 Sc 44	67.875	155.6 ns	$1^{-}$	+0.344 5	0.21 2	29 Cu 65	0	stable	$3/2^{-}$	+2.38167 25	-0.195 4
21 Sc 44	234.7	6.1 ns	$2^{-}$	+0.68 10		29 Cu 65	1115.556	0.285 ps	$5/2^{-}$	+4.6 9	
21 Sc 44	271.13	58.6 h	$6^{+}$	+3.88 1	-0.19 2	29 Cu 66	0	5.088 m	$1^{+}$	-0.282 2	
21 Sc 44	349.84	3.1 ns	$4^{+}$	+3.6 5		29 Cu 66	1154.2	600 ns	$(6^{-})$	+1.038 3	
21 Sc 45	0	stable	$7/2^{-}$	+4.7564866 18	-0.22 1	30 Zn 63	0	38.47 m	$3/2^{-}$	-0.28164 5	+0.29 3
21 Sc 46	0	83.79 d	$4^{+}$	+3.03 2	+0.119 6	30 Zn 64	991.54	1.80 ps	$2^{+}$	+0.92 20	-0.124 12
21 Sc 47	0	3.345 d	$7/2^{-}$	+5.34 2	-0.22 3	30 Zn 64	4635.6	94 ps	$7^{-}$	1.61	
21 Sc 47	766.83	274 ns	$(3/2)^{+}$	0.35 5		30 Zn 65	0	244.26 d	$5/2^{-}$	+0.7690 2	-0.023 2
22 Ti 43	0	509 ms	$7/2^{-}$	0.70 7		30 Zn 65	115.127	444 ps	$3/2^{-}$	-0.78 20	
22 Ti 43	3066	560 ns	$7/2^{-}$	+7.22 1	0.30 7	30 Zn 65	206.94	150 ps	$3/2^{-}$	+0.73 25	
22 Ti 45	0	184.8 m	$7/2^{-}$	0.095 2	0.015 15	30 Zn 65	1065.51	575 ps	$9/2^{+}$	-1.7 5	
22 Ti 45	39.71	11.29 ns	$5/2^{-}$	-0.133 10		30 Zn 66	1039.39	1.65 ps	$2^{+}$	+0.52 16	
22 Ti 45	329.50	1.099 ns	$3/2^{+}$	+1.05 24		30 Zn 66	4076.0	29.8 ps	$(6^{-})$	0.9	-0.081 13
22 Ti 46	889.286	5.1 ps	$2^{+}$	+0.98 24	-0.21 6	30 Zn 66	4252.1	133 ps	$(7^{-})$	0.98	
22 Ti 47	0	stable	$5/2^{-}$	-0.78848 1	+0.29 1	30 Zn 67	0	stable	$5/2^{-}$	+0.875479 9	+0.150 15
22 Ti 47	159.369	210 ps	$7/2^{-}$	-1.9 6		30 Zn 67	93.312	9.16 $\mu$ s	$1/2^{-}$	+0.587 11	
22 Ti 48	983.519	4.27 ps	$2^{+}$	+0.86 38	-0.177 8	30 Zn 67	184.579	1.04 ns	$3/2^{-}$	+0.50 6	
22 Ti 49	0	stable	$7/2^{-}$	-1.10417 1	+0.24 1	30 Zn 67	604.49	333 ns	$9/2^{+}$	-1.097 9	0.60 6
22 Ti 50	1553.792	1.074 ps	$2^{+}$	2.7 9	+0.08 16	30 Zn 68	1077.37	1.51 ps	$2^{+}$	+1.00 18	-0.106 16
22 Ti 50	3198.735	418 ps	$6^{+}$	+9.3 10		30 Zn 69	438.64	13.76 h	$9/2^{+}$	(-1.14 2	-0.51 5
23 V 46	801.52	1.02 ms	$3^{+}$	+1.64 3		30 Zn 70	884.8	2.9 ps	$2^{+}$	+0.60 14	-0.233 22
23 V 48	0	15.9735 d	$4^{+}$	2.012 11		30 Zn 71	157.7	3.96 h	$9/2^{+}$	(-1.035 18	
23 V 48	308.27	7.11 ns	$2^{+}$	+0.444 16		31 Ga 66	66.14	23.0 ns	$1^{+}, 2^{+}$	1.011 18	
23 V 49	0	330 d	$7/2^{-}$	4.47 5		31 Ga 66	1464.22	57.3 ns	$(7)$	+0.903 21	0.78 4
23 V 49	152.928	19.90 ns	$3/2^{-}$	+2.37 12		31 Ga 66	3043.34	0.208 ns	$(9)$	4.2 9	
23 V 50	0	$1.4 \times 10^{11}$ y	$6^{+}$	+3.3456889 14	+0.209 40	31 Ga 67	0	3.2612 d	$3/2^{-}$	+1.8507 3	0.195
23 V 51	0	stable	$7/2^{-}$	+5.14870573 18	-0.052 10	31 Ga 67	359.123	49 ps	$5/2^{-}$	1.4 7	
23 V 51	320.0852	184 ps	$5/2^{-}$	+3.86 33		31 Ga 67	3577.95	0.16 ns	$15/2^{+}$	-1.7 5	
24 Cr 49	0	42.3 m	$5/2^{-}$	0.476 3		31 Ga 68	0	67.629 m	$1^{+}$	0.01175 5	0.0277 14
24 Cr 50	783.30	8.87 ps	$2^{+}$	+1.18 20	-0.36 7	31 Ga 68	1230.05	64 ns	$(7^{+})$	+0.735 21	0.72 2
24 Cr 51	0	27.702 d	$7/2^{-}$	-0.934 5		31 Ga 69	0	stable	$3/2^{-}$	+2.01659 5	+0.168
24 Cr 51	749.10	3.3 ns	$3/2^{-}$	-0.86 12		31 Ga 70	879.1	22.7 ns	$4^{-}$	-0.26 10	
24 Cr 52	1434.090	0.679 ps	$2^{+}$	+3.00 50	-0.082 16	31 Ga 71	0	stable	$3/2^{-}$	+2.562266 18	+0.106
24 Cr 53	0	stable	$3/2^{-}$	-0.47454 3	-0.15 5	31 Ga 72	0	14.10 h	$3^{-}$	-0.13224 2	+0.52
24 Cr 53	1289.52	1.17 ps	$7/2^{-}$	+2.8 49		32 Ge 67	751.70	110.9 ns	$9/2^{+}$	-0.849 18	
24 Cr 54	834.855	7.9 ps	$2^{+}$	+1.12 20	-0.21 8	32 Ge 68	3696.43	0.48 ps	$6^{+}$	+2.4	
25 Mn 51	0	46.2 m	$5/2^{-}$	3.5683 13	0.42 7	32 Ge 68	3883.57	132 ps	6	0.53 11	
25 Mn 52	0	5.591 d	$6^{+}$	+3.0622 12	+0.50 7	32 Ge 68	4054.39	118 ps	$7^{-}$	0.78 12	
25 Mn 52	377.740	21.1 m	$2^{+}$	0.00768 8		32 Ge 68	4837.71	1.04 ps	$8^{+}$	+0.80 32	
25 Mn 53	0	$3.74 \times 10^6$ y	$7/2^{-}$	5.024 7		32 Ge 68	5050.02	0.49 ps	$8^{+}$	-2.2 10	
25 Mn 53	377.89	117 ps	$5/2^{-}$	+3.25 30		32 Ge 69	0	39.05 h	$5/2^{-}$	0.735 7	0.024 5
25 Mn 54	0	312.3 d	$3^{+}$	+3.2819 13	+0.33 3	32 Ge 69	397.946	2.81 $\mu$ s	$9/2^{+}$	-1.0011 32	
25 Mn 54	54.87	49 ps	$2^{+}$	3.4 +28-16		32 Ge 70	1039.25	1.30 ps	$2^{+}$	+0.936 52	+0.03 6 or +0.09 6
25 Mn 54	156.30	186 ps	$4^{+}$	+5.1 10		32 Ge 71	0	11.43 d	$1/2^{-}$	+0.547 5	
25 Mn 54	368.29	6.9 ps	$5^{+}$	+38 21		32 Ge 71	174.949	79 ns	$5/2^{-}$	+1.018 10	
25 Mn 54	407.55	1.8 ps	$3^{+}$	<+18		32 Ge 71	198.367	20.40 ms	$9/2^{+}$	-1.0413 7	0.34 5
25 Mn 54	1073.3	220 ps	$6^{+}$	2.8 15		32 Ge 72	834.14	3.35 ps	$2^{+}$	+0.80 7	-0.13 6
25 Mn 55	0	stable	$5/2^{-}$	+3.4532 13	+0.33 1	32 Ge 73	0	stable	$9/2^{+}$	-0.8794677 2	-0.173 26
25 Mn 55	125.949	259 ps	$7/2^{-}$	4.4 7		32 Ge 73	13.275	2.95 $\mu$ s	$5/2^{+}$	-0.0941 25	-0.4 3
25 Mn 56	0	2.5785 h	$3^{+}$	+3.2266 2		32 Ge 74	595.852	12.35 ps	$2^{+}$	+0.87 4	-0.25 6
26 Fe 53	741.11	63.5 ns	$3/2^{-}$	-0.386 15		32 Ge 74	1204.209	4.9 ps	$2^{+}$	+0.82 24	
26 Fe 54	1408.19	0.80 ps	$2^{+}$	+2.4 3	-0.05 14	32 Ge 75	0	82.78 m	$1/2^{-}$	+0.510 5	
26 Fe 54	2949.2	1.215 ns	$6^{+}$	8.22 18		32 Ge 76	562.93	18.2 ps	$2^{+}$	+0.84 5	-0.19 6
26 Fe 54	6527.1	364 ns	$10^{+}$	+7.281 10	+0.297 4	33 As 69	0	15.2 m	$5/2^{-}$	1.2 2	
26 Fe 55	931.29	8 ps	$5/2^{-}$	+2.7 12		33 As 69	1306.66	1.35 ns	$(9/2^{+})$	+4.7 6	
26 Fe 55	1316.54	2.1 ps	$7/2^{-}$	+2 2		33 As 70	0	52.6 m	$4(1^{-})$	+2.1061 2	+0.094 24
26 Fe 55	1408.45	37.9 ps	$7/2^{-}$	-2.4 5		33 As 71	0	65.28 h	$5/2^{-}$	(+1.6735 18	-0.021 6
26 Fe 56	846.776	6.07 ps	$2^{+}$	+1.22 16	-0.23 3	33 As 71	1000.21	19.8 ns	$9/2^{+}$	+5.15 9	
26 Fe 57	0	stable	$1/2^{-}$	+0.09044 7		33 As 72	0	26.0 h	$2^{-}$	-2.1566 3	-0.082 24
26 Fe 57	14.41300	98.1 ns	$3/2^{-}$	-0.1549 2	+0.082 8	33 As 72	213.69	85 ns	$3^{+}$	+1.580 18	
26 Fe 57	136.4745	8.7 ns	$5/2^{-}$	+0.935 10		33 As 73	67.03	4.95 ns	$5/2^{-}$	+1.63 10	0.356 12
26 Fe 57	366.759	10.5 ps	$3/2^{-}$	<0.6		33 As 73	427.76	5.7 $\mu$ s	$9/2^{+}$	+5.234 14	
26 Fe 58	810.764	6.54 ps	$2^{+}$	+0.92 26	-0.273 50	33 As 74	0	17.77 d	$2^{-}$	-1.597 3	
26 Fe 59	0	44.503 d	$3/2^{-}$	0.29 3		33 As 74	259.25	26.8 ns	$(4)$	+3.24 4	
27 Co 55	0	17.53 h	$7/2^{-}$	+4.822 3		33 As 75	0	stable	$3/2^{-}$	+1.43947 6	+0.314 6
27 Co 56	0	77.27 d	$4^{+}$	3.851 12	+0.25 9	33 As 75	264.6584	11.2 ps	$3/2^{-}$	+0.98 19	
27 Co 57	0	271.79 d	$7/2^{-}$	+4.720 10	+0.52 9	33 As 75	279.5441	280 ps	$5/2^{-}$	+0.81 9	
27 Co 57	1377.65	19 ps	$3/2^{-}$	+3.0 6	+0.22 3	33 As 76	0	26.32 h	$2^{-}$	-0.906 5	7 8
27 Co 58	0	70.82 d	$2^{+}$	+4.044 8	+0.22 3	33 As 76	45.0	1.93 $\mu$ s	$(1^{+})$	+0.559 5	
27 Co 58	53.06	10.4 $\mu$ s	$4^{+}$	+4.194 8		33 As 77	264.401	0.35 ns	$5/2^{-}$	+0.83 7	
27 Co 58	111.52	0.18 ns	$3^{+}$	+4.22 39		33 As 77	475.428	114.0 $\mu$ s	$9/2^{+}$	+5.525 9	
27 Co 59	0	stable	$7/2^{-}$	+4.627 9	+0.404 40	33 As 77	631.799	60 ps	$5/2^{+}$	+2.5 4	

## E-3

Nucleus				Level	Half-life	$J^{\pi}$	$\mu$	Q	Nucleus							
Z	El	A	energy				(nm)	(b)	Z	El	A	Level	Half-life	$J^{\pi}$	$\mu$	Q
												energy			(nm)	(b)
34	Se	75	0	119.779 d	5/2 <sup>+</sup>	0.67 4		1.0	40	Zr	88	2887.79	1.320 $\mu$ s	(8 <sup>+</sup> )	-1.811 16	+0.51 3
34	Se	76	559.101	12.3 ps	2 <sup>+</sup>	+0.80 22		-0.34 7	40	Zr	89	2995.23	5.12 ns	(21/2) <sup>+</sup>	+9.3 4	
34	Se	77	0	stable	1/2 <sup>-</sup>	+0.5350422 6			40	Zr	90	2319.000	809.2 ms	5 <sup>-</sup>	6.25 13	
34	Se	77	249.7868	9.68 ns	5/2 <sup>-</sup>	+1.12 2		1.1 5	40	Zr	90	3589.419	131 ns	8 <sup>+</sup>	+10.85 6	-0.51 3
34	Se	77	439.4507	23.0 ps	5/2 <sup>-</sup>	+1.02 28			40	Zr	91	0	stable	5/2 <sup>+</sup>	-1.30362 2	-0.206 10
34	Se	78	613.727	9.7 ps	2 <sup>+</sup>	+0.82 22		-0.26 9	40	Zr	91	2287.89	29.0 ns	(15/2) <sup>-</sup>	+5.25 8	
34	Se	79	0	6.5 $\times$ 10 <sup>11</sup> y	7/2 <sup>+</sup>	-1.018 15		+0.8	40	Zr	91	3167.3	4.35 $\mu$ s	(21/2) <sup>+</sup>	+9.82 8	(-0.86 5
34	Se	80	666.16	8.56 ps	2 <sup>+</sup>	+0.84 24		-0.31 7	40	Zr	92	934.49	5.0 ps	2 <sup>+</sup>	-0.06 10	
34	Se	82	654.69	13.1 ps	2 <sup>+</sup>	+0.86 24		-0.22 7	40	Zr	94	918.75	7.7 ps	2 <sup>+</sup>	-0.52 12	
35	Br	73	240.3	35.0 ns	(3/2,5/2) <sup>-</sup>	1.97 13			40	Zr	97	1264.41	103 ns	7/2 <sup>+</sup>	+1.37 14	
35	Br	74	0+x	46 m	4( <sup>-</sup> )	1.45 13			40	Zr	100	212.530	0.58 ns	2 <sup>+</sup>	0.44 10	
35	Br	75	0	96.7 m	3/2 <sup>-</sup>	0.75 11			41	Nb	90	0	14.60 h	8 <sup>+</sup>	4.961 4	
35	Br	76	0	16.2 h	1 <sup>-</sup>	-0.54821 2		0.270 3	41	Nb	90	122.370	63 $\mu$ s	6 <sup>+</sup>	+3.720 24	
35	Br	77	0	57.036 h	3/2 <sup>-</sup>	0.92 5			41	Nb	90	1880.21	472 ns	(11 <sup>-</sup> )	+8.778 33	
35	Br	77	129.64	9.3 ns	5/2 <sup>+</sup>			0.4	41	Nb	91	1984.23	10.0 ns	(13/2) <sup>-</sup>	+8.14 13	
35	Br	78	32.3	8.3 ns	(2 <sup>-</sup> )	-1.12 4			41	Nb	91	2034.36	3.76 $\mu$ s	(17/2) <sup>-</sup>	+10.82 14	
35	Br	78	180.82	119.2 $\mu$ s	(4 <sup>+</sup> )	+4.114 12			41	Nb	91	3467.03		(21/2) <sup>+</sup>	+12.4 19	
35	Br	79	0	stable	3/2 <sup>-</sup>	+2.106400 4		+0.331 4	41	Nb	92	135.5	10.15 d	(2) <sup>+</sup>	6.137 4	
35	Br	80	0	17.68 m	1 <sup>+</sup>	0.5140 6		0.196 3	41	Nb	92	225.7	5.9 $\mu$ s	(2) <sup>-</sup>	-1.398 14	
35	Br	80	37.0526	7.43 ns	2 <sup>-</sup>	-1.67 12		0.173 6	41	Nb	92	2203.3	167 ns	(11 <sup>-</sup> )	+9.68 33	
35	Br	80	85.843	4.4205 h	5 <sup>-</sup>	+1.3177 6		+0.751 10	41	Nb	93	0	stable	9/2 <sup>+</sup>	+6.1705 3	-0.32 2
35	Br	81	0	stable	3/2 <sup>-</sup>	+2.270562 4		+0.276 4	41	Nb	95	0	34.975 d	9/2 <sup>+</sup>	6.141 5	
35	Br	81	536.20	34.6 $\mu$ s	9/2 <sup>+</sup>	5.694 45			41	Nb	96	0	23.35 h	6 <sup>+</sup>	4.976 4	
35	Br	82	0	35.30 h	5 <sup>-</sup>	+1.6270 5		+0.751 10	41	Nb	97	0	72.1 m	9/2 <sup>+</sup>	6.153 5	
36	Kr	78	455.04	23.9 ps	2 <sup>+</sup>	+1.08 10			42	Mo	90	2875.1	1.12 $\mu$ s	(8 <sup>+</sup> )	-1.391 14	0.58 3
36	Kr	79	147.07	77.7 ns	5/2 <sup>-</sup>	+1.124 10		0.45 3	42	Mo	91	2267.4	47 ns	21/2 <sup>+</sup>	+8.88 6	
36	Kr	83	0	stable	9/2 <sup>+</sup>	-0.970669 3		+0.253 5	42	Mo	91	2279.6	38 ns	(17/2) <sup>-</sup>	+4.51 6	
36	Kr	83	9.396	147 ns	7/2 <sup>+</sup>	-0.943 2		+0.495 10	42	Mo	92	2760.1	190 ns	8 <sup>+</sup>	+11.30 5	-0.34
36	Kr	84	3235.9	1.84 $\mu$ s	(8 <sup>+</sup> )	-1.968 16			42	Mo	92	4485.7	8.77 ns	(11 <sup>-</sup> )	+13.86 28	
36	Kr	84	5373.2	45 ns	(12 <sup>+</sup> )	+1.7 4			42	Mo	93	2424.89	6.85 h	21/2 <sup>+</sup>	(+9.93 8	
36	Kr	85	0	10.756 y	9/2 <sup>+</sup>	1.000 2		+0.433 9	42	Mo	94	871.087	2.88 ps	2 <sup>+</sup>		-0.13 8 or +0.01 8
36	Kr	87	0	76.3 m	5/2 <sup>+</sup>	-1.018 5			42	Mo	94	2955.85	98 ns	(8 <sup>+</sup> )	+10.54 12	0.47 1
36	Kr	93	0	1.286 s	(1/2 <sup>+</sup> )	-0.4			42	Mo	95	0	stable	5/2 <sup>+</sup>	-0.9142 1	-0.022 1
37	Rb	76	0	39.1 s	1	-0.3726228 14		+0.38 15	42	Mo	95	204.1176	751 ps	3/2 <sup>+</sup>	-0.404 12	
37	Rb	77	0	3.75 m	3/2 <sup>-</sup>	+0.6544680 16		+0.70 4	42	Mo	96	778.245	3.66 ps	2 <sup>+</sup>		-0.20 8 or +0.04 8
37	Rb	78	103.3+x	5.74 m	4( <sup>-</sup> )	+2.5485 21		0.81 4	42	Mo	97	0	stable	5/2 <sup>+</sup>	-0.9335 1	+0.255 13
37	Rb	79	0	22.9 m	5/2 <sup>+</sup>	+3.3579 12		-0.098 22	42	Mo	98	787.384	3.49 ps	2 <sup>+</sup>	+0.68 36	-0.26 9
37	Rb	80	0	34 s	1 <sup>+</sup>	-0.0836 6		+0.348 20	42	Mo	99	0	65.94 h	1/2 <sup>+</sup>	0.375 3	
37	Rb	80	486.0+x	1.60 $\mu$ s	(6,7)	0.51 5			42	Mo	99	97.785	15.5 $\mu$ s	5/2 <sup>+</sup>	-0.775 5	
37	Rb	81	0	4.576 h	3/2 <sup>-</sup>	+2.0595 14		+0.398 23	42	Mo	100	535.57	13.6 ps	2 <sup>+</sup>	+0.68 36	-0.42 9 or -0.10 9
37	Rb	81	86.31	30.5 m	9/2 <sup>+</sup>	+5.5980 17		-0.743 57	42	Mo	102	296.597	114 ps	2 <sup>+</sup>	0.84 14	
37	Rb	82	0	1.273 m	1 <sup>+</sup>	+0.5545083 11		+0.19 7	42	Mo	104	192.3	721 ps	2 <sup>+</sup>	0.48 30	
37	Rb	82	80	6.472 h	5 <sup>-</sup>	+1.5133 24		+1.01 12	43	Tc	93	0	2.75 h	9/2 <sup>+</sup>	6.26 10	
37	Rb	83	0	86.2 d	5/2 <sup>-</sup>	+1.4249 8		+0.196 22	43	Tc	93	2185.16	10.2 $\mu$ s	(17/2) <sup>-</sup>	+10.46 5	
37	Rb	84	0	32.77 d	2 <sup>-</sup>	-1.324116 2		-0.015 35	43	Tc	94	0	293 m	7 <sup>+</sup>	5.08 8	
37	Rb	84	463.62	20.26 m	6 <sup>-</sup>	+0.2129331 10		+0.57 27	43	Tc	95	0	20.0 h	9/2 <sup>+</sup>	5.89 10	
37	Rb	85	0	stable	5/2 <sup>-</sup>	+1.3533515 8		+0.23 4	43	Tc	96	0	4.28 d	7 <sup>+</sup>	+5.04 8	
37	Rb	85	514.0083	1.015 $\mu$ s	9/2 <sup>+</sup>	+6.046 10			43	Tc	96	121.26	25.6 ns	(2) <sup>-</sup>	-0.466 22	
37	Rb	85	2826.57	12.5 ns	(19/2) <sup>-</sup>	$\leq$ 1.6			43	Tc	99	0	2.11 $\times$ 10 <sup>5</sup> y	9/2 <sup>+</sup>	+5.6847 4	-0.129 6
37	Rb	86	0	18.631 d	2 <sup>-</sup>	-1.6920 14		+0.19 3	43	Tc	99	140.5108	0.19 ns	7/2 <sup>+</sup>	+3.60 88	
37	Rb	86	556.0	1.017 m	6 <sup>-</sup>	+1.8150 10		+0.37 10	43	Tc	99	181.0939	3.61 ns	5/2 <sup>+</sup>	+3.291 63	
37	Rb	87	0	4.75 $\times$ 10 <sup>10</sup> y	3/2 <sup>-</sup>	+2.751818 2		+0.127 1	44	Ru	93	2082.5	2.15 $\mu$ s	(21/2) <sup>+</sup>	+8.970 21	+0.04 1
37	Rb	88	0	17.78 m	2 <sup>-</sup>	+0.508 5		-0.01 10	44	Ru	93	2279.3	35 ns	(17/2) <sup>-</sup>	+4.36 17	
37	Rb	90	106.90	258 s	3 <sup>-</sup>	+1.61598 64		+0.204 45	44	Ru	94	2498.45	65 ns	(6 <sup>+</sup> )	+8.12 5	
37	Rb	91	0	58.4 s	3/2( <sup>-</sup> )	+2.1815 15		+0.154 26	44	Ru	94	2644.55	71 $\mu$ s	(8 <sup>+</sup> )	+11.10 4	
37	Rb	93	0	5.84 s	5/2 <sup>-</sup>	+1.4095 16		+0.18 4	44	Ru	95	0	1.643 h	5/2 <sup>+</sup>	(-0.861 7	
37	Rb	94	0	2.702 s	3( <sup>-</sup> )	+1.4984 18		+0.163 50	44	Ru	95	2539.8	10.05 ns	21/2( <sup>+</sup> )	+9.17 7	
37	Rb	95	0	377.5 ms	5/2 <sup>-</sup>	+1.3336 34		+0.21 7	44	Ru	96	832.57	3.0 ps	2 <sup>+</sup>		-0.13 9
37	Rb	96	0	0.199 s	2 <sup>+</sup>	+1.4658 17		+0.25 6	44	Ru	97	0	2.9 d	5/2 <sup>+</sup>	(-0.787 8	
37	Rb	97	0	169.9 ms	3/2( <sup>+</sup> )	+1.8410 21		+0.581 44	44	Ru	97	2738.8	7.8 ns	(21/2) <sup>+</sup>	+9.2 8	
38	Sr	78	278.5	155 ps	(2 <sup>+</sup> )			3.29 19	44	Ru	98	652.44	6.42 ps	2 <sup>+</sup>	+0.8 6	-0.20 9 or -0.01 9
38	Sr	78	782.2	5.1 ps	(4 <sup>+</sup> )			3.47 17	44	Ru	99	0	stable	5/2 <sup>+</sup>	-0.641 5	+0.079 4
38	Sr	79	0	2.25 m	(3/2 <sup>-</sup> )	-0.474 2		+0.74 6	44	Ru	99	89.68	20.5 ns	3/2 <sup>+</sup>	-0.284 6	+0.231 12
38	Sr	81	0	22.3 m	1/2 <sup>-</sup>	+0.5440 4			44	Ru	100	539.53	12.8 ps	2 <sup>+</sup>	+0.94 12	-0.43 7 or -0.20 7
38	Sr	83	0	32.41 h	7/2 <sup>+</sup>	-0.8298 3		+0.823 50	44	Ru	101	0	stable	5/2 <sup>+</sup>	-0.7188 60	+0.457 23
38	Sr	83	259.15	4.95 s	1/2 <sup>-</sup>	+0.582 1			44	Ru	101	127.23	0.655 ns	3/2 <sup>+</sup>	-0.210 5	
38	Sr	84	793.30	3.2 ps	2 <sup>+</sup>	+0.84 10			44	Ru	102	475.079	18.3 ps	2 <sup>+</sup>	+0.71 6	-0.57 7 or -0.35 7
38	Sr	84	3332.25	157 ps	(8 <sup>+</sup> )	-1.14 58			44	Ru	103	0	39.26 d	3/2 <sup>+</sup>	(-0.200 7	(+0.62 2
38	Sr	85	0	64.84 d	9/2 <sup>+</sup>	-1.0005 3		+0.323 20	44	Ru	104	358.02	56.4 ps	2 <sup>+</sup>	+0.82 10	-0.70 8 or -0.35 8
38	Sr	85	238.66	67.63 m	1/2 <sup>-</sup>	+0.6008 4			44	Ru	105	0	4.44 h	3/2 <sup>+</sup>	(-0.32 +8-20	
38	Sr	86	1076.68	1.66 ps	2 <sup>+</sup>	+0.55 10			45	Rh	95	2236.36	19 ns	(17/2) <sup>-</sup>	+10.88 34	
38	Sr	86	2955.63	0.45 $\mu$ s	(8 <sup>+</sup> )	-1.928 24			45	Rh	99	64.3	4.7 h	9/2 <sup>+</sup>	5.668 12	
38	Sr	87	0	stable	9/2 <sup>+</sup>	-1.0936030 13		+0.335 20	45	Rh	100	74.78	214 ns	(2) <sup>+</sup>	+4.324 8	
38	Sr	87	388.532	2.803 h	1/2 <sup>-</sup>	+0.6282 6			45	Rh	100	219.6	130 ns	(7 <sup>+</sup> )	+4.8 4	
38	Sr	88	1836.087	0.162 ps	2 <sup>+</sup>	+2.30 34			45	Rh	101	157.32	4.34 d	9/2 <sup>+</sup>	+5.475 12	
38	Sr	89	0	50.53 d	5/2 <sup>+</sup>	-1.1488 7		-0.274 19	45	Rh	102	0	207 d	(1 <sup>-</sup> ,2 <sup>-</sup> )	0.45 35	
38	Sr	91	0	9.63 h	5/2 <sup>+</sup>	-0.8868 6		+0.044 4	45	Rh	102	140.75	2.9 y	6( <sup>+</sup> )	4.044 12	
38	Sr	93	0	7.423 m	5/2 <sup>+</sup>	-0.7942 5		+0.265 19	45	Rh	103	0				

Nucleus	Level	Half-life	$J^\pi$	$\mu$	Q	Nucleus	Level	Half-life	$J^\pi$	$\mu$	Q
Z El A	energy			(nm)	(b)	Z El A	energy			(nm)	(b)
46 Pd 105	644.53	126 ps	$7/2^-$	-1.49 <sub>9</sub>		49 In 122	0+x	10.3 s	$5^+$	+4.318 <sub>5</sub>	+0.806 <sub>20</sub>
46 Pd 106	511.851	12.1 ps	$2^+$	+0.80 <sub>4</sub>	-0.51 <sub>7</sub>	49 In 122	220	10.8 s	$8^-$	+3.781 <sub>6</sub>	+0.592 <sub>21</sub>
46 Pd 106	1128.01	3.12 ps	$2^+$	+0.60 <sub>12</sub>		49 In 123	0	5.98 s	$9/2^+$	+5.491 <sub>7</sub>	+0.757 <sub>9</sub>
46 Pd 108	433.938	23.4 ps	$2^+$	+0.72 <sub>6</sub>	-0.58 <sub>4</sub>	49 In 123	327.21	47.8 s	$1/2^-$	-0.400 <sub>4</sub>	
46 Pd 110	373.81	43 ps	$2^+$	+0.62 <sub>6</sub>	-0.72	49 In 124	0	3.17 s	$3^+$	+4.043 <sub>11</sub>	+0.61 <sub>7</sub>
47 Ag 101	0	11.1 m	$9/2^+$	5.627 <sub>11</sub>		49 In 124	190	2.4 s	(5 to 8)	+3.888 <sub>9</sub>	+0.664 <sub>9</sub>
47 Ag 102	0	12.9 m	$5^+$	4.6 <sub>7</sub>		49 In 125	0	2.36 s	$9/2^+(\gamma)$	+5.502 <sub>9</sub>	+0.710 <sub>36</sub>
47 Ag 102	9.3	7.7 m	$2^+$	+4.14 <sub>25</sub>		49 In 125	360.12	12.2 s	$1/2^-(\gamma)$	-0.433 <sub>4</sub>	
47 Ag 103	0	65.7 m	$7/2^+$	+4.47 <sub>5</sub>		49 In 126	0	1.60 s	$3(\gamma)$	+4.034 <sub>11</sub>	+0.494 <sub>49</sub>
47 Ag 104	0	69.2 m	$5^+$	+3.919 <sub>3</sub>		49 In 126	102	1.64 s	$7^-8^-9^-$	+4.061 <sub>4</sub>	0.683 <sub>12</sub>
47 Ag 104	6.9	33.5 m	$2^+$	+3.7 <sub>2</sub>		49 In 127	0	1.09 s	$(9/2^+)$	+5.522 <sub>8</sub>	+0.59 <sub>3</sub>
47 Ag 105	0	41.29 d	$1/2^-$	0.1014 <sub>10</sub>		50 Sn 108	2365.1	7.6 ns	$6^+$	-0.24 <sub>12</sub>	
47 Ag 105	25.465	7.23 m	$7/2^+$	+4.414 <sub>13</sub>		50 Sn 108	3561.2	71 ps	$8^+$	>0.8	
47 Ag 105	1733.90	5.1 ns	$(15/2)^+$	+3.73 <sub>14</sub>		50 Sn 109	0	18.0 m	$5/2^+(\gamma)$	-1.079 <sub>6</sub>	+0.31 <sub>10</sub>
47 Ag 106	0	23.96 m	$1^+$	+2.85 <sub>20</sub>		50 Sn 110	2479.9	5.6 ns	$6^+$	0.072 <sub>18</sub>	0.34 <sub>4</sub>
47 Ag 106	89.66	8.28 d	$6^+$	(+3.709 <sub>4</sub> )	+1.08 <sub>6</sub>	50 Sn 111	0	35.3 m	$7/2^+$	+0.608 <sub>4</sub>	+0.18 <sub>9</sub>
47 Ag 107	0	stable	$1/2^-$	-0.113570 <sub>20</sub>		50 Sn 111	979.6	9.2 ns	$11/2^-$	-1.26 <sub>11</sub>	
47 Ag 107	93.13	44.3 s	$7/2^+$	(+4.398 <sub>5</sub> )	0.98 <sub>11</sub>	50 Sn 112	1256.85	0.37 ps	$2^+$	+0.74 <sub>26</sub>	-0.03 <sub>11</sub>
47 Ag 107	324.81	5.0 ps	$3/2^-$	+0.94 <sub>14</sub>		50 Sn 112	2549.30	13.7 ns	$6^+$	+0.534 <sub>30</sub>	0.25 <sub>2</sub>
47 Ag 107	423.15	29.8 ps	$5/2^-$	+1.03 <sub>18</sub>		50 Sn 113	0	115.09 d	$1/2^+$	-0.8791 <sub>6</sub>	
47 Ag 108	0	2.37 m	$1^+$	2.6884 <sub>7</sub>		50 Sn 113	738.4	86 ns	$11/2^-$	-1.298 <sub>22</sub>	0.41 <sub>4</sub>
47 Ag 108	109.440	418 y	$6^+$	3.580 <sub>20</sub>	+1.32 <sub>7</sub>	50 Sn 114	1299.92	0.30 ps	$2^+$	+	
47 Ag 108	215.382	45.8 ns	$3^+$	+3.891 <sub>15</sub>		50 Sn 114	3087.4	733 ns	$7^-$	-0.567 <sub>4</sub>	0.32 <sub>1</sub>
47 Ag 109	0	stable	$1/2^-$	-0.130563 <sub>23</sub>		50 Sn 115	0	stable	$1/2^+$	-0.91883 <sub>7</sub>	
47 Ag 109	88.0341	39.6 s	$7/2^+$	+4.400 <sub>6</sub>	(+1.02 <sub>12</sub> )	50 Sn 115	612.8	3.26 $\mu$ s	$7/2^+$	+0.683 <sub>10</sub>	0.26
47 Ag 109	311.38	5.9 ps	$3/2^-$	+0.99 <sub>15</sub>	-0.7	50 Sn 115	713.4	159 $\mu$ s	$11/2^-$	-1.378 <sub>11</sub>	0.38 <sub>6</sub>
47 Ag 109	415.21	32.6 ps	$5^+$	+0.90 <sub>13</sub>	-0.3	50 Sn 116	1293.54	0.374 ps	$2^+$	-0.32 <sub>20</sub>	-0.17 <sub>4</sub>
47 Ag 110	0	24.6 s	$1^+$	+2.7271 <sub>8</sub>	0.24	50 Sn 116	2365.92	348 ns	$5^-$	-0.376 <sub>3</sub>	0.26 <sub>1</sub>
47 Ag 110	117.59	249.79 d	$6^+$	+3.607 <sub>4</sub>	+1.44 <sub>10</sub>	50 Sn 116	3547.0	833 ns	$10^+$	-2.326 <sub>15</sub>	0.50
47 Ag 110	118.718	36.7 ns	$3^+$	+3.768 <sub>28</sub>		50 Sn 117	0	stable	$1/2^+$	-1.00104 <sub>7</sub>	
47 Ag 111	0	7.45 d	$1/2^-$	-0.146 <sub>2</sub>		50 Sn 117	158.562	0.279 ns	$3/2^+$	+0.658 <sub>46</sub>	
47 Ag 112	0	3.130 h	$2(\gamma)$	0.0547 <sub>5</sub>		50 Sn 117	314.58	13.60 d	$11/2^-$	-1.3955 <sub>10</sub>	-0.42 <sub>5</sub>
47 Ag 113	0	5.37 h	$1/2^-$	0.159 <sub>2</sub>		50 Sn 118	1229.652	0.485 ps	$2^+$	+0.04 <sub>20</sub>	-0.05 <sub>14</sub>
48 Cd 100	2547.9	73 ns	$(8^+)$	9.9 <sub>5</sub>		50 Sn 118	2321.24	21.7 ns	$5^-$	-0.300 <sub>25</sub>	0.16 <sub>2</sub>
48 Cd 102	2718.2	56 ns	$8^+$	+10.32 <sub>24</sub>		50 Sn 118	2574.92	230 ns	$7^-$	-0.689 <sub>4</sub>	0.32
48 Cd 103	0	7.3 m	$(5/2^+)$	-0.81 <sub>3</sub>	-0.8 <sub>7</sub>	50 Sn 118	3108.07	2.52 $\mu$ s	$9^+,10^+$	-2.447 <sub>7</sub>	0.41
48 Cd 105	0	55.5 m	$5/2^+$	-0.7393 <sub>2</sub>	+0.43 <sub>4</sub>	50 Sn 119	0	stable	$1/2^+$	-1.04728 <sub>7</sub>	
48 Cd 105	2517.3	(21/2 <sup>+</sup> )	$(21/2^+)$	+9.17 <sub>7</sub>	(+11.17 <sub>1</sub> )	50 Sn 119	23.871	18.03 ns	$3/2^+$	+0.633 <sub>3</sub>	0.094 <sub>4</sub>
48 Cd 106	632.64	7.27 ps	$2^+$	+0.80 <sub>20</sub>	-0.28 <sub>8</sub>	50 Sn 119	89.531	293.1 d	$11/2^-$	-1.40 <sub>8</sub>	0.21 <sub>2</sub>
48 Cd 106	4659.71	62 ns	$12(\gamma)$	+8.88 <sub>24</sub>		50 Sn 120	1171.34	0.642 ps	$2^+$	-0.28 <sub>14</sub>	-0.05 <sub>10</sub>
48 Cd 107	0	6.50 h	$5/2^+$	-0.6150554 <sub>11</sub>	+0.68 <sub>7</sub>	50 Sn 120	2284.3	5.55 ns	$5^-$	-0.37 <sub>5</sub>	0.021 <sub>8</sub>
48 Cd 107	845.54	71 ns	$11/2^-$	-1.041 <sub>11</sub>	(-0.94 <sub>1</sub> )	50 Sn 121	0	27.06 h	$3/2^+$	+0.6978 <sub>10</sub>	-0.02 <sub>2</sub>
48 Cd 107	2678.88	55 ns	$21/2^+$	+9.10 <sub>10</sub>	+1.21 <sub>6</sub>	50 Sn 121	6.30	55 y	$11/2^-$	-1.3877 <sub>9</sub>	-0.14 <sub>3</sub>
48 Cd 108	632.96	6.9 ps	$2^+$	+0.68 <sub>18</sub>	-0.45 <sub>8</sub>	50 Sn 122	1140.55	0.76 ps	$2^+$	-0.14 <sub>22</sub>	<+0.14
48 Cd 109	0	462.6 d	$5/2^+$	-0.8278461 <sub>15</sub>	+0.69 <sub>7</sub>	50 Sn 123	0	129.2 d	$11/2^-$	-1.3700 <sub>9</sub>	+0.03 <sub>4</sub>
48 Cd 109	463.0	10.9 $\mu$ s	$11/2^-$	-1.096 <sub>2</sub>	(-0.92)	50 Sn 124	1131.64	0.92 ps	$2^+$	-0.30 <sub>20</sub>	-0.01 <sub>17</sub>
48 Cd 110	657.7638	5.39 ps	$2^+$	+0.56 <sub>8</sub>	-0.40 <sub>4</sub>	50 Sn 125	0	9.64 d	$11/2^-$	-1.348 <sub>2</sub>	+0.09 <sub>17</sub>
48 Cd 111	0	stable	$1/2^+$	-0.5948861 <sub>9</sub>		51 Sb 112	796.4	0.56 $\mu$ s	$(8^-)$	+2.192 <sub>8</sub>	0.71 <sub>7</sub>
48 Cd 111	245.42	85.0 ns	$5/2^+$	-0.7656 <sub>25</sub>	+0.77 <sub>12</sub>	51 Sb 114	495.5	219 $\mu$ s	$(8^-)$	+2.265 <sub>5</sub>	0.66 <sub>11</sub>
48 Cd 111	396.22	48.54 m	$11/2^-$	-1.1051 <sub>4</sub>	-0.85 <sub>9</sub>	51 Sb 115	0	32.1 m	$5/2^+$	+3.46 <sub>1</sub>	-0.36 <sub>6</sub>
48 Cd 111	620.2	9.7 ps	$5/2^+$	+0.28 <sub>12</sub>		51 Sb 115	1300.2	6.2 ns	$11/2^-$	+5.53 <sub>8</sub>	
48 Cd 112	617.57	6.51 ps	$2^+$	+0.64 <sub>16</sub>	-0.37 <sub>4</sub>	51 Sb 115	2796.2	159 ns	$(19/2)^-$	+2.54 <sub>4</sub>	0.52 <sub>6</sub>
48 Cd 113	0	$9.3 \times 10^{-10}$ y	$1/2^+$	-0.6223009 <sub>9</sub>		51 Sb 116	0	15.8 m	$3^+$	2.715 <sub>9</sub>	
48 Cd 113	263.59	14.1 y	$11/2^-$	-1.087784 <sub>2</sub>	-0.71 <sub>7</sub>	51 Sb 116	93.99	200 ns	$1^+$	+2.47 <sub>9</sub>	
48 Cd 113	298.49	29 ps	$3/2^+$	-0.39 <sub>80</sub>		51 Sb 117	0	2.80 h	$5/2^+$	+3.43 <sub>6</sub>	-0.30 <sub>21</sub>
48 Cd 113	584.14	6.9 ps	$5/2^+$	+0.15 <sub>12</sub>		51 Sb 117	1322.5	3.8 ns	$11/2^-$	+5.35 <sub>9</sub>	
48 Cd 114	558.456	10.2 ps	$2^+$	+0.58 <sub>14</sub>	-0.36 <sub>8</sub>	51 Sb 117	3130.7	355 $\mu$ s	$(25/2)^+$	+1.500 <sub>9</sub>	0.75 <sub>9</sub>
48 Cd 115	0	53.46 h	$1/2^+$	-0.6484259 <sub>12</sub>		51 Sb 117	3230.6	290 ns	$(23/2)^-$	+5.03 <sub>6</sub>	>1.7
48 Cd 115	181.0	44.6 d	$11/2^-$	-1.0410343 <sub>15</sub>	-0.54 <sub>5</sub>	51 Sb 118	0	3.6 m	$1^+$	2.47 <sub>7</sub>	
48 Cd 116	513.40	14.07 ps	$2^+$	+0.60 <sub>14</sub>	-0.42 <sub>4</sub>	51 Sb 118	50.811	20.6 $\mu$ s	$(2,3)^+$	+2.63 <sub>5</sub>	0.57 <sub>14</sub>
49 In 105	0	5.07 m	$(9/2)^+$	+5.675 <sub>5</sub>	+0.83 <sub>5</sub>	51 Sb 118	249	5.00 h	$8^-$	2.32 <sub>4</sub>	
49 In 106	0	6.2 m	$7^+$	+4.916 <sub>7</sub>	+0.97 <sub>6</sub>	51 Sb 118	269.82	13.3 ns	$(3)^-$	-3.76 <sub>9</sub>	0.25 <sub>5</sub>
49 In 107	0	32.4 m	$9/2^+$	+5.585 <sub>8</sub>	+0.807 <sub>52</sub>	51 Sb 118	963.88	22.6 ns	$(7)^+$	+4.76 <sub>13</sub>	1.75 <sub>30</sub>
49 In 108	0	58.0 m	$7^+$	+4.561 <sub>3</sub>	+1.005 <sub>7</sub>	51 Sb 119	0	38.19 h	$5/2^+$	+3.45 <sub>1</sub>	-0.37 <sub>6</sub>
49 In 108	29.75	39.6 m	$2^+$	+4.935 <sub>5</sub>	+0.467 <sub>14</sub>	51 Sb 119	2552.9	134 ns	$(19/2)^-$	+0.336 <sub>15</sub>	
49 In 109	0	4.2 h	$9/2^+$	+5.538 <sub>4</sub>	+0.841 <sub>27</sub>	51 Sb 120	0	15.89 m	$1^+$	2.34 <sub>22</sub>	
49 In 110	0	4.9 h	$7^+$	+4.713 <sub>8</sub>	+1.000 <sub>22</sub>	51 Sb 120	0+x	5.76 d	$8^-$	2.34 <sub>4</sub>	
49 In 110	62.09	69.1 m	$2^+$	+4.365 <sub>4</sub>	+0.35	51 Sb 120	78.16	246 ns	$3^+$	+2.571 <sub>6</sub>	0.41 <sub>4</sub>
49 In 111	0	2.8049 d	$9/2^+$	+5.503 <sub>7</sub>	+0.804 <sub>22</sub>	51 Sb 121	0	stable	$5/2^+$	+3.3634 <sub>3</sub>	-0.36 <sub>4</sub>
49 In 111	2716.9	14.3 ns	$21/2^+$	+5.27 <sub>19</sub>		51 Sb 121	37.133	3.46 ns	$7/2^+$	+2.518 <sub>7</sub>	-0.48 <sub>5</sub>
49 In 112	0	14.97 m	$1^+$	+2.82 <sub>3</sub>	+0.087	51 Sb 122	0	2.70 d	$2^-$	-1.905 <sub>20</sub>	+0.85 <sub>11</sub>
49 In 112	156.58	20.56 m	$4^+$	+5.277 <sub>4</sub>	+0.714 <sub>10</sub>	51 Sb 122	61.4131	1.86 $\mu$ s	$3^+$	+2.983 <sub>12</sub>	0.41 <sub>4</sub>
49 In 112	350.82	0.69 $\mu$ s	$7^+$	+4.725 <sub>42</sub>	1.1 <sub>1</sub>	51 Sb 122	137.4726	0.53 ms	$5^+$	+3.05 <sub>10</sub>	
49 In 112	613.73	2.81 $\mu$ s	$8^-$	+3.08 <sub>4</sub>	-0.086 <sub>3</sub>	51 Sb 123	0	stable	$7/2^+$	+2.5498 <sub>2</sub>	-0.49 <sub>5</sub>
49 In 113	0	stable	$9/2^+$	+5.5289 <sub>2</sub>	+0.799	51 Sb 124	0	60.20 d	$3^-$	1.20 <sub>2</sub>	+1.9 <sub>4</sub>
49 In 113	391.691	1.6582 h	$1/2^-$	-0.21074 <sub>2</sub>		51 Sb 124	40.8040	3.2 $\mu$ s	$3^+,4^+$	+2.970 <sub>33</sub> for J=3	
49 In 114	0	71.9 s	$1^+$	+2.817 <sub>11</sub>		51 Sb 124	125.2310	86 ns	$6^-$	+0.384 <sub>12</sub>	
49 In 114	190.34	49.51 d	$5^+$	+4.653 <sub>5</sub>	+0.739 <sub>12</sub>	51 Sb 125	0	2.7582 y	$7/2^+$	+2.630 <sub>35</sub>	
49 In 115	0	$4.41 \times 10^{14}$ y	$9/2^+$	+5.5408 <sub>2</sub>	+0.86 <sub>4</sub>	51 Sb 126	0	12.46 d	$(8)^-$	1.28 <sub>7</sub>	
49 In 115	336.24	4.486 h	$1/2^-$	-0.24398 <sub>5</sub>		51 Sb 127	0	3.85 d	$7/2^+$	2.59 <sub>12</sub>	
49 In 115	828.58	5.78 ns	$3/2^+$	+0.74 <sub>13</sub>	-0.60 <sub>2</sub>	51 Sb 128	0	9.01 h	$8^-$	1.31 <sub>19</sub>	
49 In 116	0	14.10 s	$1^+$	2.7863 <sub>10</sub>	0.09 <sub>2</sub>	52 Te 115	280.3	7.5 $\mu$ s	$11/2^-$	-0.954 <sub>5</sub>	0.8
49 In 116	127.267	54.41 m	$5^+$	+4.435 <sub>15</sub>	+0.802 <sub>12</sub>	52 Te 117	274.4	19			

## E-5

Nucleus	Level	Half-life	$J^\pi$	$\mu$	Q	Nucleus	Level	Half-life	$J^\pi$	$\mu$	Q
Z El A	energy			(nm)	(b)	Z El A	energy			(nm)	(b)
52 Te 125	0	stable	1/2 <sup>+</sup>	-0.88850513 43		55 Cs 128	0	3.66 m	1 <sup>+</sup>	+0.974 5	-0.570 8
52 Te 125	35.4919	1.48 ns	3/2 <sup>+</sup>	+0.605 4	-0.31 2	55 Cs 129	0	32.06 h	1/2 <sup>+</sup>	+1.491 8	
52 Te 125	144.795	57.40 d	11/2 <sup>-</sup>	-0.985 6	-0.06 2	55 Cs 129	575.44	0.69 $\mu$ s	11/2 <sup>-</sup>	+6.55 10	
52 Te 125	321.107	0.703 ns	9/2 <sup>-</sup>	-0.918 32	0.12 +5-9	55 Cs 130	0	29.21 m	1 <sup>+</sup>	+1.460 7	-0.059 6
52 Te 125	443.556	19.1 ps	3/2 <sup>+</sup>	+0.59 9		55 Cs 130	163.25	3.46 m	5 <sup>-</sup>	+0.629 4	+1.45 5
52 Te 125	463.3677	13.2 ps	5/2 <sup>+</sup>	+0.80 22		55 Cs 131	0	9.689 d	5/2 <sup>+</sup>	+3.543 2	-0.575 6
52 Te 125	525.249	160 ps	7/2 <sup>-</sup>	<0		55 Cs 131	133.615	8.7 ns	5/2 <sup>+</sup>	+1.86 8	
52 Te 125	671.447	1.26 ps	5/2 <sup>+</sup>	-0.6 7		55 Cs 132	0	6.479 d	2 <sup>+</sup>	+2.222 7	+0.508 7
52 Te 126	666.338	4.52 ps	2 <sup>+</sup>	+0.68 8	-0.20 9	55 Cs 133	0	stable	7/2 <sup>+</sup>	+2.582025 4	-0.00371 14
52 Te 126	2975.2	13.5 ns	10 <sup>+</sup>	-1.52 9		55 Cs 133	80.997	6.27 ns	5/2 <sup>+</sup>	+3.45 2	-0.33 2
52 Te 127	0	9.35 h	3/2 <sup>+</sup>	+0.635 4		55 Cs 133	160.614	190 ps	5/2 <sup>+</sup>	+2.0 2	
52 Te 127	88.26	109 d	11/2 <sup>-</sup>	-1.041 6		55 Cs 134	0	2.062 y	4 <sup>+</sup>	+2.9937 9	+0.389 3
52 Te 127	340.1	0.41 ns	(9/2) <sup>-</sup>	-0.963 63		55 Cs 134	11.2461	45.7 ns	5 <sup>+</sup>	+3.35 7	
52 Te 128	743.219	3.32 ps	2 <sup>+</sup>	+0.50 6	-0.06 5	55 Cs 134	138.7474	2.91 h	8 <sup>-</sup>	+1.0978 2	+0.98 8
52 Te 129	0	69.6 m	3/2 <sup>+</sup>	0.702 4	0.055 13	55 Cs 135	0	2.3 $\times$ 10 <sup>6</sup> y	7/2 <sup>+</sup>	+2.7324 2	+0.050 2
52 Te 129	105.50	33.6 d	11/2 <sup>-</sup>	-1.091 7		55 Cs 135	1632.9	53 m	19/2 <sup>-</sup>	+2.18 1	+0.89 7
52 Te 130	839.494	2.30 ps	2 <sup>+</sup>	+0.62 8	-0.15 10	55 Cs 136	0	13.16 d	5 <sup>+</sup>	+3.711 15	+0.225 10
52 Te 131	0	25.0 m	3/2 <sup>+</sup>	0.696 9		55 Cs 136	0+x	19 s	8 <sup>-</sup>	+1.319 7	+0.74 10
52 Te 131	182.250	30 h	11/2 <sup>-</sup>	-1.04 4		55 Cs 137	0	30.07 y	7/2 <sup>+</sup>	+2.8413 1	+0.051 1
52 Te 132	1774.10	145 ns	6 <sup>+</sup>	+4.7 6		55 Cs 138	0	33.41 m	3 <sup>-</sup>	+0.700 4	+0.125 18
52 Te 134	1692.0	165 ns	6 <sup>+</sup>	+5.08 15		55 Cs 138	79.9	2.91 m	6 <sup>-</sup>	+1.713 9	-0.40 3
52 Te 135	1555.3	0.51 $\mu$ s	(19/2 <sup>-</sup> )	-3.8 4		55 Cs 139	0	9.27 m	7/2 <sup>+</sup>	+2.696 4	-0.075 11
53 I 117	0	2.22 m	(5/2) <sup>+</sup>	3.1 2		55 Cs 140	0	63.7 s	1 <sup>-</sup>	+0.1338953 5	-0.112 7
53 I 118	0	13.7 m	2 <sup>-</sup>	2.0 2		55 Cs 141	0	24.94 s	7/2 <sup>+</sup>	+2.438 10	-0.36 4
53 I 118	0+x	8.5 m	(7 <sup>-</sup> )	4.2 2		55 Cs 143	0	1.78 s	3/2 <sup>+</sup>	+0.870 4	+0.47 3
53 I 119	0	19.1 m	5/2 <sup>+</sup>	(+2.9 1		55 Cs 144	0	1.01 s	1	-0.546 3	+0.30 1
53 I 119	306.9	34.6 ns	9/2 <sup>+</sup>	+5.40 14		55 Cs 145	0	0.594 s	3/2 <sup>+</sup>	+0.784 4	+0.62 6
53 I 120	0	81.0 m	2 <sup>-</sup>	1.23 3		55 Cs 146	0	0.343 s	1 <sup>-</sup>	-0.515 2	+0.22 3
53 I 120	0+x	53 m	4 to 8	4.2 2		56 Ba 121	0	29.7 s	5/2 <sup>(+)</sup>	+0.660 1	+1.79 12
53 I 121	0	2.12 h	5/2 <sup>+</sup>	2.3 1		56 Ba 123	0	2.7 m	5/2 <sup>+</sup>	+0.680 1	+1.49 12
53 I 121	2353.1	80 ns	(21/2)	+12.6 11		56 Ba 125	0	3.5 m	1/2 <sup>(+)</sup>	+0.177 12	
53 I 122	0	3.63 m	1 <sup>+</sup>	0.94 3		56 Ba 127	0	12.7 m	1/2 <sup>(+)</sup>	+0.089 12	
53 I 123	0	13.27 h	5/2 <sup>+</sup>	2.818 7		56 Ba 127	80.2	1.9 s	7/2 <sup>(-)</sup>	-0.7227 5	1.62 13
53 I 123	2659.9	27.2 ns	(21/2 <sup>+</sup> )	+10.9 9		56 Ba 129	0	2.23 h	1/2 <sup>+</sup>	-0.398 16	
53 I 124	0	4.18 d	2 <sup>-</sup>	1.14 8		56 Ba 129	8.42	2.17 h	7/2 <sup>+</sup>	+0.930 17	+1.60 13
53 I 125	0	59.408 d	5/2 <sup>+</sup>	2.821 5	-0.889	56 Ba 130	357.38	37 ps	2 <sup>+</sup>	+0.70 6	-0.86 8
53 I 125	188.414	0.34 ns	3/2 <sup>+</sup>	+1.06 7		56 Ba 131	0	11.50 d	1/2 <sup>+</sup>	0.708113 15	
53 I 126	0	13.11 d	2 <sup>-</sup>	1.436 5		56 Ba 131	187.14	14.6 m	9/2 <sup>-</sup>	-0.870 18	+1.46 13
53 I 126	110.85	55 ns	5/2 <sup>+</sup>	-2.235 18		56 Ba 132	464.588	15.1 ps	2 <sup>+</sup>	+0.68 6	
53 I 127	0	stable	5/2 <sup>+</sup>	+2.81327 9	-0.79	56 Ba 133	0	10.52 y	1/2 <sup>+</sup>	-0.771674 16	
53 I 127	57.606	1.95 ns	7/2 <sup>+</sup>	+2.54 5	-0.71	56 Ba 133	12.322	7.0 ns	3/2 <sup>+</sup>	+0.51 7	
53 I 127	202.860	0.39 ns	3/2 <sup>+</sup>	+0.97 7		56 Ba 133	288.247	38.9 h	11/2 <sup>-</sup>	-0.91 5	+0.89 7
53 I 128	137.849	0.845 $\mu$ s	4 <sup>-</sup>	-0.720 28		56 Ba 134	604.705	5.1 ps	2 <sup>+</sup>	+0.86 10	-0.26 8 or +0.15 8
53 I 129	0	1.57 $\times$ 10 <sup>7</sup> y	7/2 <sup>+</sup>	+2.6210 3	-0.553	56 Ba 134	2956.9	2.6 $\mu$ s	(10 <sup>+</sup> )	-2.0 1	
53 I 129	27.78	16.8 ns	5/2 <sup>+</sup>	+2.8045 26	-0.685	56 Ba 135	0	stable	3/2 <sup>+</sup>	+0.837943 17	+0.160 3
53 I 131	0	8.02070 d	7/2 <sup>+</sup>	+2.742 1	-0.40 1	56 Ba 135	268.219	28.7 h	11/2 <sup>-</sup>	-1.001 15	+0.96 8
53 I 131	149.715	0.95 ns	5/2 <sup>+</sup>	+2.8 5		56 Ba 136	818.515	1.930 ps	2 <sup>+</sup>	+0.69 10	-0.19 6 or +0.07 7
53 I 131	1797.073	5.9 ns	9/2 <sup>-</sup> , 11/2 <sup>-</sup> , 13/2 <sup>-</sup>	0.75		56 Ba 136	2140.222	1.6 ns	5 <sup>-</sup>	-1.9 2	
53 I 132	0	2.295 h	4 <sup>+</sup>	3.088 7	0.09 1	56 Ba 137	0	stable	3/2 <sup>+</sup>	+0.937365 20	+0.245 4
53 I 132	49.720	7.14 ns	3 <sup>+</sup>	+2.24 30	0.23 7	56 Ba 137	661.660	2.552 m	11/2 <sup>-</sup>	-0.992 26	+0.78 9
53 I 132	277.86	1.42 ns	1 <sup>+</sup>	+1.88 11	(-)-0.170 6	56 Ba 138	1435.811	0.206 ps	2 <sup>+</sup>	+1.44 22	-0.14 7 or +0.08 7
53 I 133	0	20.8 h	7/2 <sup>+</sup>	+2.856 5	-0.27 1	56 Ba 138	1898.609	2.17 ns	4 <sup>+</sup>	3.20 56	
54 Xe 117	0	61 s	5/2 <sup>(+)</sup>	-0.5938 15		56 Ba 138	2090.55	0.8 $\mu$ s	6 <sup>+</sup>	+5.86 12	
54 Xe 119	0	5.8 m	(5/2 <sup>+</sup> )	0.59 6		56 Ba 139	0	83.06 m	7/2 <sup>-</sup>	-0.973 5	-0.573 13
54 Xe 121	0	40.1 m	5/2 <sup>(+)</sup>	0.65 3		56 Ba 141	0	18.27 m	3/2 <sup>-</sup>	-0.337 5	+0.454 10
54 Xe 123	185.18	5.49 $\mu$ s	7/2 <sup>(-)</sup>	-0.902 7	1.33 14	56 Ba 142	359.596	0.066 ns	2 <sup>+</sup>	0.852 96	
54 Xe 123	206.27	11.8 ns	(9/2)		1.06 64	56 Ba 143	0	14.33 s	5/2 <sup>-</sup>	+0.443 11	-0.879 22
54 Xe 124	354.02	56 ps	2 <sup>+</sup>	+0.46 4		56 Ba 144	199.326	0.70 ns	2 <sup>+</sup>	0.68 10	
54 Xe 125	296.0	140 ns	(7/2) <sup>+</sup>	+0.931 35	1.40 15	56 Ba 145	0	4.31 s	5/2 <sup>-</sup>	-0.285 7	+1.224 21
54 Xe 126	388.634	41.3 ps	2 <sup>+</sup>	0.74 14		56 Ba 146	181.02	0.86 ns	2 <sup>+</sup>	+0.54 14	
54 Xe 127	0	36.4 d	1/2 <sup>+</sup>	-0.5039 2		57 La 133	535.60	62 ns	11/2 <sup>-</sup>	7.5 5	
54 Xe 127	342.23	36.7 ns	7/2 <sup>+</sup>	+0.850 32		57 La 135	2737.0	50 ns	7/2 <sup>+</sup>	0.04 20	
54 Xe 128	442.910	23.8 ps	2 <sup>+</sup>	+0.82 14		57 La 137	0	6 $\times$ 10 <sup>4</sup> y	7/2 <sup>+</sup>	+2.695 6	+0.24 7
54 Xe 128	2786.8	63 ns	8 <sup>-</sup>	-0.290 73		57 La 137	10.56	89 ns	5/2 <sup>+</sup>		+0.24 7
54 Xe 129	0	stable	1/2 <sup>+</sup>	-0.7779763 84		57 La 137	1869.5	364 ns	9/2 <sup>-</sup>	+2.337 57	
54 Xe 129	39.578	0.97 ns	3/2 <sup>+</sup>	+0.58 9	-0.41 4	57 La 138	0	1.05 $\times$ 10 <sup>11</sup> y	5 <sup>+</sup>	+3.713646 7	+0.45 2
54 Xe 129	236.14	8.88 d	11/2 <sup>-</sup>	-0.891223 4		57 La 138	72.57	116 ns	(3 <sup>+</sup> )	+2.886 48	
54 Xe 130	536.085	8.6 ps	2 <sup>+</sup>	+0.66 8		57 La 139	0	stable	7/2 <sup>+</sup>	+2.7830455 9	+0.20 1
54 Xe 130	2972.33	5.17 ns	10 <sup>+</sup>	-1.58 21		57 La 140	0	1.6781 d	3 <sup>-</sup>	+0.730 15	+0.094 10
54 Xe 131	0	stable	3/2 <sup>+</sup>	+0.6918619 39	-0.120 12	58 Ce 126	2886.9	8 ps	(10 <sup>+</sup> )	+10	
54 Xe 131	163.931	11.84 d	11/2 <sup>-</sup>	-0.994048 6		58 Ce 126	3316.3	4 ps	(12 <sup>+</sup> )	+12	
54 Xe 132	667.720	4.7 ps	2 <sup>+</sup>	+0.76 8		58 Ce 134	3208	336 ns	10 <sup>+</sup>	-1.87 2	+1.32 12
54 Xe 132	2214.06	90 ns	(7 <sup>-</sup> )	-0.063 28	0.010 5	58 Ce 135	2125.3	8.2 ns	(19/2 <sup>+</sup> )	-0.66 10	
54 Xe 132	2752.27	8.39 ms	(10 <sup>+</sup> )	(-)-1.95 5		58 Ce 136	3095.5	2.2 $\mu$ s	10 <sup>+</sup>	-1.80 2	1.11 11
54 Xe 133	0	5.243 d	3/2 <sup>+</sup>	+0.81340 7	+0.145 14	58 Ce 137	0	9.0 h	3/2 <sup>+</sup>	0.96 4	
54 Xe 133	233.221	2.19 d	11/2 <sup>-</sup>	-1.08247 15		58 Ce 137	254.29	34.4 h	11/2 <sup>-</sup>	1.01 4	
54 Xe 135	0	9.14 h	3/2 <sup>+</sup>	0.90305 22		58 Ce 138	3539.1	81 ns	10 <sup>+</sup>	-1.70 3	0.77
54 Xe 135	526.551	15.29 m	11/2 <sup>-</sup>	1.10304 20		58 Ce 139	0	137.640 d	3/2 <sup>+</sup>	0.91 14	
54 Xe 136	1694.387	1.32 ns	4 <sup>+</sup>	3.2 6		58 Ce 139	2631.0	70 ns	(19/2 <sup>-</sup> )	+3.85 8	
54 Xe 137	0	3.818 m	7/2 <sup>-</sup>	-0.9704 10	-0.490 17	58 Ce 140	2083.25	3.45 ns	4 <sup>+</sup>	+4.35 10	0.35 7
54 Xe 139	0	39.68 s	3/2 <sup>-</sup>	-0.304 10	+0.40 2	58 Ce 140	3715.3	23.1 ns	10 <sup>+</sup>	+10.3 4	
54 Xe 141	0	1.73 s	5/2 <sup>+</sup>	+0.010 4	-0.58 2	58 Ce 141	0	32.501 d	7/2 <sup>-</sup>	1.09 4	
54 Xe 143	0	0.30 s	5/2 <sup>-</sup>	-0.4599 14	+0.93 3	58 Ce 142	641.286	5.56 ps	2 <sup>+</sup>		-0.37 5 or -0.16 5
55 Cs 118	0+x	14 s	2	+3.876 5	+1.4 2	58 Ce 143	0	33.039 h	3/2 <sup>-</sup>	1	
55 Cs 118	0+y	17 s	6,7,8	5.4 11 for J=6		58 Ce 146	258.47	0.25 ns	2 <sup>+</sup>	+0.48 10	
55 Cs 119	0	43.0 s	9/2 <sup>+</sup>	+5.46 3	+2.8 1	58 Ce 148	158.468	1.01 ns	2 <sup>+</sup>	+0.74 12	
55 Cs 119	0+x	30.4 s	3/2 <sup>(+)</sup>	+0.838 5	+0.9 1	59 Pr 139	113.92	2.60 ns	7/2 <sup>+</sup>	1.19 21	
55 Cs 120	x+0	64 s	2	+3.87 2	+1.45 2	59 Pr 139	821.98	43.4 ns	11/2 <sup>-</sup>	+6.6 5	
55 Cs 121	0	155 s	3/2 <sup>(+)</sup>	+0.770 4	+0.838 9	59 Pr 141	0	stable	5/2 <sup>+</sup>	+4.2754 5	-0.0589 42
55 Cs 121	68.5	122 s	9/2 <sup>(+)</sup>	+5.41 3	+2.69 5	59 Pr 141	145.440	1.85 ns	7/2 <sup>+</sup>	+2.95 9	
55 Cs 122	0	21.0 s	1 <sup>+</sup>	-0.1333 9	-0.19 1	59 Pr 141	1117.7	4.8 ns	11/2 <sup>-</sup>	+6.2 4	
55 Cs 122	500	4.5 m	8 <sup>-</sup>	+4.77 2	+3.29 8	59 Pr 141	1796.7	1.0 ns	15/2<		

## E-6

Nucleus Z El A	Level energy	Half-life	$J^{\pi}$	$\mu$ (nm)	Q (b)	Nucleus Z El A	Level energy	Half-life	$J^{\pi}$	$\mu$ (nm)	Q (b)
60 Nd 134	294.30	64 ps	2 <sup>+</sup>	+1.2 4		63 Eu 153	103.1794	3.88 ns	3/2 <sup>+</sup>	+2.048 6	1.254 13
60 Nd 134	2816.9	9.0 ps	10 <sup>+</sup>	0		63 Eu 154	0	8.593 y	3 <sup>-</sup>	-2.005 6	+2.84 10
60 Nd 135	0	12.4 m	9/2 <sup>(-)</sup>	0.78 3	+2.0 4	63 Eu 155	0	4.7611 y	5/2 <sup>+</sup>	+1.56 10	+2.34 21
60 Nd 135	198.5	35.3 ps	(11/2 <sup>-</sup> )	-0.5 3		63 Eu 155	104.3346	0.104 ns	5/2 <sup>-</sup>	+9.6 10	
60 Nd 136	3296.5	51 ps	10 <sup>+</sup>	+11.7 39		63 Eu 157	0	15.18 h	5/2 <sup>+</sup>	1.5 2	2.6 3
60 Nd 136	3686.5	19 ps	12 <sup>+</sup>	+14.0 46		63 Eu 158	0	45.9 m	(1 <sup>-</sup> )	1.44 2	0.66 14
60 Nd 137	0	38.5 m	1/2 <sup>+</sup>	-0.633 5		63 Eu 159	0	18.1 m	5/2 <sup>+</sup>	1.38 2	
60 Nd 138	3173.8	0.41 $\mu$ s	(10 <sup>+</sup> )	-1.74 4		64 Gd 144	3433	145 ns	(10 <sup>+</sup> )	+12.76 14	-1.46 6
60 Nd 139	0	29.7 m	3/2 <sup>+</sup>	0.907 7	+0.30 9	64 Gd 146	1579.4	1.06 ns	3 <sup>-</sup>	+2.1 9	
60 Nd 140	3621.2	22 ns	10 <sup>+</sup>	-1.92 12		64 Gd 146	2982.0	7.2 ns	7 <sup>-</sup>	+8.98 19	
60 Nd 141	0	2.49 h	3/2 <sup>+</sup>	1.013 9	+0.34 13	64 Gd 147	0	38.06 h	7/2 <sup>-</sup>	1.02 9	
60 Nd 143	0	stable	7/2 <sup>-</sup>	-1.065 5	-0.63 6	64 Gd 147	997.1	21.4 ns	13/2 <sup>+</sup>	+0.487 20	-0.73 7
60 Nd 144	696.513	4.51 ps	2 <sup>+</sup>	+0.30 4	-0.18 12	64 Gd 147	2760.47	4.5 ns	21/2 <sup>+</sup>	+7.6 12	
60 Nd 144	1314.54	7.4 ps	4 <sup>+</sup>	+2.2 23		64 Gd 147	3581.97	26.8 ns	27/2 <sup>-</sup>	+11.34 23	-1.26 8
60 Nd 145	0	stable	7/2 <sup>-</sup>	-0.656 4	-0.33 3	64 Gd 147	8587.8	510 ns	(49/2 <sup>+</sup> )	+10.9 2	-3.24 18
60 Nd 145	72.50	0.72 ns	5/2 <sup>-</sup>	-0.320 4		64 Gd 148	2694.6	16.5 ns	9 <sup>-</sup>	-0.162 18	1.01 5
60 Nd 146	453.86	21.6 ps	2 <sup>+</sup>	+0.50 8	-0.78 9	64 Gd 149	0	9.28 d	7/2 <sup>-</sup>	0.88 4	
60 Nd 147	0	10.98 d	5/2 <sup>-</sup>	0.578 3	0.9 3	64 Gd 149	164.988	1.7 ns	5/2 <sup>-</sup>	-0.90 23	
60 Nd 148	301.702	78.0 ps	2 <sup>+</sup>	+0.64 8	-1.46 13	64 Gd 151	0	124 d	7/2 <sup>-</sup>	0.77 6	
60 Nd 148	3621	330 ns	10 <sup>+</sup>	-1.75 9		64 Gd 151	108.094	2.80 ns	5/2 <sup>-</sup>	-1.24 17	
60 Nd 149	0	1.728 h	5/2 <sup>-</sup>	0.351 10	1.3 3	64 Gd 151	395.445	0.29 ns	3/2 <sup>-</sup>	-2.6 8	
60 Nd 150	130.1	1.44 ns	2 <sup>+</sup>	+0.644 18	-2.0 5	64 Gd 152	344.282	31.9 ps	2 <sup>+</sup>	+0.96 8	
60 Nd 150	381.4	63 ps	4 <sup>+</sup>	+1.28 20		64 Gd 153	0	241.6 d	3/2 <sup>-</sup>	0.38 8	
61 Pm 143	0	265 d	5/2 <sup>+</sup>	+3.8 5		64 Gd 153	109.76	0.243 ns	(5/2 <sup>-</sup> )	+0.40 15	
61 Pm 143	959.8	24.0 ns	11/2 <sup>-</sup>	+6.8 4		64 Gd 153	129.15	2.52 ns	3/2 <sup>-</sup>	+0.37 7	
61 Pm 143	1898.3	10.5 ns	15/2 <sup>+</sup>	+7.7 4		64 Gd 154	123.0714	1.186 ns	2 <sup>+</sup>	+0.96 6	-1.82 4
61 Pm 144	0	363 d	5 <sup>-</sup>	1.69 14		64 Gd 155	0	stable	3/2 <sup>-</sup>	-0.2591 5	+1.30 2
61 Pm 147	0	2.6234 y	7/2 <sup>+</sup>	+2.58 7	+0.74 20	64 Gd 155	60.0087	0.193 ns	5/2 <sup>-</sup>	-0.44 2	-0.44 2
61 Pm 147	91.10	2.50 ns	5/2 <sup>+</sup>	+3.22 16	0.6 3	64 Gd 155	86.5460	6.50 ns	5/2 <sup>+</sup>	-0.525 2	+0.111 7
61 Pm 148	0	5.370 d	1 <sup>-</sup>	+2.08 21	+0.2 2	64 Gd 155	105.3109	1.16 ns	3/2 <sup>+</sup>	+0.143 5	+0.96 3
61 Pm 148	137.9	41.29 d	6 <sup>-</sup>	1.82 18		64 Gd 156	88.9666	2.21 ns	2 <sup>+</sup>	+0.774 8	-1.93 4
61 Pm 149	0	53.08 h	7/2 <sup>+</sup>	3.3 5		64 Gd 156	288.1799	111.9 ps	4 <sup>+</sup>	+1.24 8	
61 Pm 149	114.312	2.53 ns	5/2 <sup>+</sup>	+2.13 15		64 Gd 156	584.706	15.8 ps	6 <sup>+</sup>	+1.5 13	
61 Pm 149	188.631	3.27 ns	3/2 <sup>+</sup>	+1.09 15		64 Gd 156	1416.034	1.90 ps	10 <sup>+</sup>	+3.4 5	
61 Pm 149	211.307	80 ps	5/2 <sup>+</sup>	+2.20 35		64 Gd 156	1510.539	190 ps	4 <sup>+</sup>	+3.24 11	
61 Pm 149	270.169	2.59 ns	7/2 <sup>-</sup>	+2.19 11		64 Gd 157	0	stable	3/2 <sup>-</sup>	-0.3398 7	+1.36 2
61 Pm 151	0	28.40 h	5/2 <sup>+</sup>	1.8 2	1.9 3	64 Gd 157	54.533	130 ps	5/2 <sup>-</sup>	-0.464 11	-0.46 2
61 Pm 151	255.692	0.93 ns	3/2 <sup>+</sup>	1.8 2		64 Gd 157	63.917	0.46 $\mu$ s	5/2 <sup>+</sup>	+2.45 5	
62 Sm 139	0	2.57 m	(1/2 <sup>+</sup> )	-0.53 3		64 Gd 158	79.510	2.52 ns	2 <sup>+</sup>	+0.762 8	-2.01 4
62 Sm 140	3172.0	22.3 ns	10 <sup>+</sup>	-1.76 20	1.67 48	64 Gd 158	261.440	0.148 ns	4 <sup>+</sup>	+1.636 60	
62 Sm 140	3210.8	6.2 ns	10 <sup>+</sup>	+12.7 9		64 Gd 158	538.983		6 <sup>+</sup>	2.46 24	
62 Sm 141	0	10.2 m	1/2 <sup>+</sup>	-0.737 23		64 Gd 158	904.6	5.1 ps	8 <sup>+</sup>	3.4 4	
62 Sm 141	175.8	22.6 m	11/2 <sup>-</sup>	-0.83 2	+1.63 44	64 Gd 158	1350.7	1.85 ps	10 <sup>+</sup>	3.2 4	
62 Sm 142	2371.8	170 ns	7 <sup>-</sup>	+0.42	+1.12 27	64 Gd 159	0	18.479 h	3/2 <sup>-</sup>	-0.44 3	
62 Sm 143	0	8.83 m	3/2 <sup>+</sup>	+1.01 2	+0.41 21	64 Gd 160	75.26	2.69 ns	2 <sup>+</sup>	+0.72 4	-2.08 4
62 Sm 145	0	340 d	7/2 <sup>-</sup>	-1.11 6	-0.59 17	64 Gd 160	248.45		4 <sup>+</sup>	1.5 2	
62 Sm 147	0	1.06 $\times$ 10 <sup>11</sup> y	7/2 <sup>-</sup>	-0.8148 7	-0.26 3	64 Gd 160	514.76		6 <sup>+</sup>	2.3 3	
62 Sm 147	121.220	0.80 ns	5/2 <sup>-</sup>	-0.449 25	-0.45 19	64 Gd 160	1308		10 <sup>+</sup>	3.3	
62 Sm 147	197.4	1.24 ns	3/2 <sup>-</sup>	-0.29 7		65 Tb 149	0	4.118 h	1/2 <sup>+</sup>	1.35 2	
62 Sm 148	550.265	7.70 ps	2 <sup>+</sup>	+0.508 42	-0.97 27	65 Tb 149	2518.4	2.4 ns	(27/2 <sup>-</sup> )	4.8 12	
62 Sm 149	0	2 $\times$ 10 <sup>15</sup> y	7/2 <sup>-</sup>	-0.6717 7	+0.075 8	65 Tb 152	0	17.5 h	2 <sup>-</sup>	0.9 1	+0.5 16
62 Sm 149	22.507	7.12 ns	5/2 <sup>-</sup>	-0.6238 8	+1.01 9	65 Tb 153	0	2.34 d	5/2 <sup>+</sup>	3.5 7	
62 Sm 150	333.99	49.7 ps	2 <sup>+</sup>	+0.77 6	-1.32 19	65 Tb 154	0+v	9.4 h	3 <sup>-</sup>	1.8 4	+2.9 15
62 Sm 150	773.36	6.5 ps	4 <sup>+</sup>	+1.43 20		65 Tb 154	0+w	22.7 h	7 <sup>-</sup>	0.9 3	
62 Sm 150	1046.18	0.86 ps	2 <sup>+</sup>	+0.72 17		65 Tb 155	0	5.32 d	3/2 <sup>+</sup>	2.0 2	
62 Sm 150	1193.83	1.3 ps	2 <sup>+</sup>	+0.83 14		65 Tb 156	0	5.35 d	3 <sup>-</sup>	1.41 18	+2.3 8
62 Sm 150	1278.91		6 <sup>+</sup>	+2.3 5		65 Tb 157	0	99 y	3/2 <sup>+</sup>	2.0 1	
62 Sm 151	0	90 y	5/2 <sup>-</sup>	-0.3630 5	+0.67 7	65 Tb 158	0	180 y	3 <sup>-</sup>	+1.758 7	+2.7 5
62 Sm 151	91.532	78 ns	(9/2 <sup>+</sup> )	-0.95 5		65 Tb 159	0	stable	3/2 <sup>+</sup>	+2.014 4	+1.432 8
62 Sm 151	104.831	0.48 ns	3/2 <sup>-</sup>	+0.31 11		65 Tb 159	58.00	53.6 ps	5/2 <sup>+</sup>	1.62 9 or 2.32 13	
62 Sm 151	167.750	0.38 ns	5/2 <sup>+</sup>	+1.8 5		65 Tb 160	0	72.3 d	3 <sup>-</sup>	+1.790 7	+3.85 5
62 Sm 152	121.7825	1.428 ns	2 <sup>+</sup>	+0.84 5	-1.666 16	65 Tb 161	0	6.88 d	3/2 <sup>+</sup>	2.2 1	+1.2 6
62 Sm 152	366.4814	57.7 ps	4 <sup>+</sup>	+1.68 20		66 Dy 147	0	40 s	1/2 <sup>+</sup>	-0.915 9	
62 Sm 152	706.96	10.1 ps	6 <sup>+</sup>	+2.39 33		66 Dy 147	750.5	55 s	11/2 <sup>-</sup>	-0.655 10	+0.67 10
62 Sm 152	810.465	7.2 ps	2 <sup>+</sup>	+0.76 19		66 Dy 149	0	4.20 m	(7/2 <sup>-</sup> )	-0.119 7	-0.62 5
62 Sm 152	1085.897	0.85 ps	2 <sup>+</sup>	+0.82 21		66 Dy 151	0	17.9 m	7/2 <sup>(-)</sup>	-0.945 7	-0.30 5
62 Sm 152	1125.35	3.15 ps	8 <sup>+</sup>	+2.79 53		66 Dy 152	6129	13.7 ns	21	+11.6 12	
62 Sm 152	1609.34	1.38 ps	10 <sup>+</sup>	+3.7 17		66 Dy 153	0	6.4 h	7/2 <sup>(-)</sup>	-0.782 6	-0.02 5
62 Sm 153	0	46.27 h	3/2 <sup>+</sup>	-0.0216 1	+1.26 13	66 Dy 155	0	9.9 h	3/2 <sup>-</sup>	-0.385 4	+1.04 3
62 Sm 154	81.976	3.02 ns	2 <sup>+</sup>	+0.784 36	-1.87 4	66 Dy 156	137.83	0.823 ns	2 <sup>+</sup>	+0.78 8	
62 Sm 154	266.79	172 ps	4 <sup>+</sup>	+1.35 15	-2.2 8	66 Dy 157	0	8.14 h	3/2 <sup>-</sup>	-0.301 2	+1.30 2
62 Sm 154	543.74	22.7 ps	6 <sup>+</sup>	+1.90 28		66 Dy 158	98.911	1.67 ns	2 <sup>+</sup>	+0.72 5	
62 Sm 154	902.65	5.9 ps	8 <sup>+</sup>	2.8 4		66 Dy 158	317.124	72 ps	4 <sup>+</sup>	+1.40 24	
62 Sm 155	0	22.3 m	3/2 <sup>-</sup>		1.13 13	66 Dy 158	637.72	9.1 ps	6 <sup>+</sup>	2.2 4	
63 Eu 138	0	12.1 s	(6 <sup>-</sup> )	5.2 7		66 Dy 158	1043.88	2.9 ps	8 <sup>+</sup>	+3.3 10	
63 Eu 140	0	1.51 s	1 <sup>+</sup>	+1.365 13	+0.31 4	66 Dy 159	0	144.4 d	3/2 <sup>-</sup>	-0.354 3	+1.37 2
63 Eu 141	0	40.0 s	5/2 <sup>+</sup>	+3.494 8	+0.85 4	66 Dy 160	86.7882	2.02 ns	2 <sup>+</sup>	+0.725 17	1.76 39
63 Eu 142	0	2.34 s	1 <sup>+</sup>	+1.536 19	+0.12 5	66 Dy 160	283.824	103 ps	4 <sup>+</sup>	+1.25 18	
63 Eu 142	0+x	1.22 m	8 <sup>-</sup>	+2.978 11	+1.41 6	66 Dy 160	966.174	1.31 ps	2 <sup>+</sup>	+0.56 8	
63 Eu 143	0	2.63 m	5/2 <sup>+</sup>	+3.673 8	+0.51 3	66 Dy 161	0	stable	5/2 <sup>+</sup>	-0.4803 25	+2.507 20
63 Eu 144	0	10.2 s	1 <sup>+</sup>	+1.893 13	+0.10 3	66 Dy 161	25.65150	29.1 ns	5/2 <sup>-</sup>	+0.594 3	+2.506 20
63 Eu 145	0	5.93 d	5/2 <sup>+</sup>	+3.993 7	+0.29 2	66 Dy 161	43.8211	0.83 ns	7/2 <sup>+</sup>	-0.141 5	+0.53 13
63 Eu 145	716.0	490 ns	11/2 <sup>-</sup>	+7.46 5		66 Dy 161	74.56710	3.14 ns	3/2 <sup>-</sup>	-0.403 4	+1.45 6
63 Eu 146	0	4.59 d	4 <sup>-</sup>	+1.425 11	-0.18 6	66 Dy 162	80.660	2.20 ns	2 <sup>+</sup>	+0.686 28	
63 Eu 147	0	24.1 d	5/2 <sup>+</sup>	+3.724 8	+0.55 3	66 Dy 162	265.665	0.132 ns	4 <sup>+</sup>	1.4	
63 Eu 147	625.3	0.765 $\mu$ s	11/2 <sup>-</sup>	+7.05 3		66 Dy 162	548.531	18.4 ps	6 <sup>+</sup>	2.0	
63 Eu 148	0	54.5 d	5 <sup>-</sup>	+2.340 10	+0.35 6	66 Dy 162	920.99	4.2 ps	8 <sup>+</sup>	2.7	
63 Eu 148	720.4	235 ns	9 <sup>+</sup>	+6.12 5		66 Dy 163	0	stable	5/2 <sup>-</sup>	+0.6726 35	+2.648 21
63 Eu 149	0	93.1 d	5/2 <sup>+</sup>	+3.565 6	0.75 2	66 Dy 164	73.392	2.39 ns	2 <sup>+</sup>	+0.70 3	-2.08 15
63 Eu 149	496.386	2.45 $\mu$ s	11/2 <sup>-</sup>	+6.99 27		66 Dy 164	242.230	201 ps	4 <sup>+</sup>	+1.47 48	
63 Eu 150	0	35.8 y	5 <sup>(-)</sup>	+2.708 11	+1.13 5	66 Dy 164	501.32	27.2 ps	6 <sup>+</sup>	+1.68 48	
63 Eu 151	0	stable	5/2 <sup>+</sup>	+3.4717 6	+0.903 10	66 Dy 164	761.86	4.6 ps	2 <sup>+</sup>	+0.63 20	
63 Eu 151	21.532	9.6 ns	7/2 <sup>+</sup>	+2.591 2	+1.28 2	66 Dy 164	843.67	7.2 ps	8 <sup>+</sup>	+2.2 8	
63 Eu 152	0	13.542 y	3 <sup>-</sup>	-1.9414 13							

## E-7

Nucleus	Level	Half-life	$J^\pi$	$\mu$	Q	Nucleus	Level	Half-life	$J^\pi$	$\mu$	Q
Z El A	energy			(nm)	(b)	Z El A	energy			(nm)	(b)
67 Ho 152	160	49.5 s	9 <sup>+</sup>	+5.94 5	-1.3 8	70 Yb 163	0	11.05 m	3/2 <sup>-</sup>	-0.374 8	+1.24 2
67 Ho 153	0	2.0 m	11/2 <sup>-</sup>	+6.81 5	-1.1 5	70 Yb 165	0	9.9 m	5/2 <sup>-</sup>	+0.478 8	+2.48 4
67 Ho 153	68	9.3 m	1/2 <sup>+</sup>	+1.19 1		70 Yb 167	0	17.5 m	5/2 <sup>-</sup>	+0.623 8	+2.70 4
67 Ho 154	0	11.76 m	(2) <sup>-</sup>	-0.643 6	+0.19 10	70 Yb 169	0	32.026 d	7/2 <sup>+</sup>	-0.635 8	+3.54 6
67 Ho 154	320	3.10 m	8 <sup>+</sup>	+5.65 6	-1.0 5	70 Yb 169	24.199	46 s	1/2 <sup>-</sup>	+0.507 8	
67 Ho 155	0	48 m	5/2 <sup>+</sup>	+3.50 3	+1.52 12	70 Yb 170	84.2551	1.60 ns	2 <sup>+</sup>	+0.674 8	2.12 36
67 Ho 156	0	56 m	(4 <sup>+</sup> )	+2.99 3	+2.34 18	70 Yb 170	277.45		4 <sup>+</sup>	1.3 8	
67 Ho 157	0	12.6 m	7/2 <sup>-</sup>	+4.35 3	+2.97 13	70 Yb 170	573.54		6 <sup>+</sup>	1.9 12	
67 Ho 158	0	11.3 m	5 <sup>+</sup>	+3.77 3	+4.1 4	70 Yb 170	963.67	2.97 ps	8 <sup>+</sup>	2.3 14	
67 Ho 158	67.200	28 m	2 <sup>-</sup>	+2.44 3	+1.62 17	70 Yb 170	1437.97	1.16 ps	10 <sup>+</sup>	2.6 17	
67 Ho 159	0	33.05 m	7/2 <sup>-</sup>	+4.28 3	+3.19 13	70 Yb 170	1983.78	0.77 ps	12 <sup>+</sup>	2.7 17	
67 Ho 160	0	25.6 m	5 <sup>+</sup>	+3.70 3	+3.95 23	70 Yb 171	0	stable	1/2 <sup>-</sup>	+0.49367 1	
67 Ho 160	59.98	5.02 h	2 <sup>-</sup>	+2.51 3	+1.78 17	70 Yb 171	66.721	0.81 ns	3/2 <sup>-</sup>	0.350 2	1.59 27
67 Ho 161	0	2.48 h	7/2 <sup>-</sup>	+4.25 3	+3.22 11	70 Yb 171	75.878	1.64 ns	5/2 <sup>-</sup>	+1.015 5	2.16 37
67 Ho 162	0	15.0 m	1 <sup>+</sup>	2.32 3	0.71 3	70 Yb 172	78.7436	1.65 ns	2 <sup>+</sup>	+0.669 16	2.16 37
67 Ho 162	106	67.0 m	6 <sup>-</sup>	+3.60 4	+3.9 7	70 Yb 172	260.260	0.122 ns	4 <sup>+</sup>	+1.37 5	-2.3 12
67 Ho 163	0	4570 y	7/2 <sup>-</sup>	+4.23 4	+3.6 6	70 Yb 172	1172.376	8.14 ns	3 <sup>+</sup>	+0.65 4	2.87 41
67 Ho 165	0	stable	7/2 <sup>-</sup>	+4.132 5	+3.58 2	70 Yb 172	1757.367		(2) <sup>-</sup>	-3.44 10	
67 Ho 165	94.700	22.0 ps	9/2 <sup>-</sup>	4.09 20	3.43 4	70 Yb 172	1821.583		3 <sup>+</sup>	1.97 10	
67 Ho 166	5.985	1.20×10 <sup>3</sup> y	(7) <sup>-</sup>	3.60 5	-3.4 34	70 Yb 173	0	stable	5/2 <sup>-</sup>	-0.67989 3	+2.80 4
67 Ho 166	54.2399	3.44 ns	2 <sup>-</sup>	+0.068 10		70 Yb 173	78.647	46 ps	7/2 <sup>-</sup>	-0.19 7	
68 Er 152	2182.7	1.8 ns	(8 <sup>+</sup> )	-0.56 64		70 Yb 173	179.364	32 ps	9/2 <sup>-</sup>	+0.20	
68 Er 152	4518.4	1.2 ns	(16 <sup>+</sup> )	+4.6 21		70 Yb 173	350.764	0.45 ns	7/2 <sup>+</sup>	-0.48	
68 Er 153	0	37.1 s	(7/2) <sup>-</sup>	-0.934 5	-0.42 2	70 Yb 174	76.471	1.79 ns	2 <sup>+</sup>	+0.676 8	2.12 25
68 Er 154	3025	39 ns	11 <sup>-</sup>	+0.169 13		70 Yb 174	253.117	144 ps	4 <sup>+</sup>	-1.8 12	
68 Er 155	0	5.3 m	7/2 <sup>-</sup>	-0.669 4	-0.27 2	70 Yb 175	0	4.185 d	7/2 <sup>-</sup>	0.58 8	
68 Er 155	563.22	34.8 ns	13/2 <sup>+</sup>	-0.55 3		70 Yb 176	82.13	1.76 ns	2 <sup>+</sup>	+0.675 30	2.22 38
68 Er 156	344.51	34.0 ps	2 <sup>+</sup>	0.80		70 Yb 176	271.70	0.11 ns	4 <sup>+</sup>	-0.9 12	
68 Er 157	0	18.65 m	3/2 <sup>-</sup>	-0.412 3	+0.92 2	71 Lu 171	0	8.24 d	7/2 <sup>+</sup>	2.03 10	
68 Er 157	x+266.36	54 ps	(17/2 <sup>+</sup> )	0.4 4		71 Lu 172	0	6.70 d	4 <sup>-</sup>	2.25 10	
68 Er 158	192.15	277 ps	2 <sup>+</sup>	0.72		71 Lu 173	0	1.37 y	7/2 <sup>+</sup>	2.34 9	
68 Er 158	527.22	14.2 ps	4 <sup>+</sup>	1.4		71 Lu 174	0	3.31 y	(1) <sup>-</sup>	1.94 28	
68 Er 158	970.34	2.7 ps	6 <sup>+</sup>	2.2		71 Lu 174	170.83	142 d	(6) <sup>-</sup>	2.34 33	
68 Er 158	1493.47	0.91 ps	8 <sup>+</sup>	2.9		71 Lu 175	0	stable	7/2 <sup>+</sup>	+2.2327 11	+3.49 2
68 Er 159	0	36 m	3/2 <sup>-</sup>	-0.304 2	+1.17 1	71 Lu 175	113.804	99 ps	9/2 <sup>+</sup>	+2.01 15	
68 Er 159	785	9.1 ps	21/2 <sup>+</sup>	<0.74		71 Lu 175	251.463	32.1 ps	11/2 <sup>+</sup>	+2.6 10	
68 Er 160	389.9	32.3 ps	4 <sup>+</sup>	1.28		71 Lu 176	0	3.78×10 <sup>10</sup> y	7 <sup>-</sup>	+3.1692 45	+4.92 3
68 Er 160	765.6	5.4 ps	6 <sup>+</sup>	1.92		71 Lu 176	123.0	3.635 h	1 <sup>-</sup>	+0.318 3	-1.47 1
68 Er 160	1229.3	1.7 ps	8 <sup>+</sup>	2.56		71 Lu 177	0	6.734 d	7/2 <sup>+</sup>	+2.239 11	+3.39 2
68 Er 161	0	3.21 h	3/2 <sup>-</sup>	-0.365 3	+1.361 14	71 Lu 177	121.6211	0.117 ns	9/2 <sup>+</sup>	+2.21 78	
68 Er 162	102.04	1.17 ns	2 <sup>+</sup>	<0		71 Lu 177	150.392	122 ns	9/2 <sup>-</sup>	+5.5 3	
68 Er 162	900.73	1.24 ps	2 <sup>+</sup>	1.8 6		71 Lu 177	970.1749	160.4 d	23/2 <sup>-</sup>	2.93 17	4.23 67
68 Er 163	0	75.0 m	5/2 <sup>-</sup>	+0.557 4	+2.55 3	71 Lu 179	0	4.59 h	7/2(†)	3.3	
68 Er 164	91.40	1.47 ns	2 <sup>+</sup>	0.697 15	<0	72 Hf 172	1037.47		8 <sup>+</sup>	1.1 3	
68 Er 164	860.18	1.9 ps	2 <sup>+</sup>	2.39 26		72 Hf 172	1684.73	4.8 ns	(6 <sup>+</sup> )	+5.59 61	
68 Er 165	0	10.36 h	5/2 <sup>-</sup>	+0.643 3	+2.71 3	72 Hf 172	2005.84	163 ns	(8 <sup>-</sup> )	+7.955 65	
68 Er 165	242.935	0.31 ns	3/2 <sup>-</sup>	+0.62 21		72 Hf 173	1982.1	19.5 ns	(23/2) <sup>-</sup>	+6.63 23	
68 Er 166	80.577	1.82 ns	2 <sup>+</sup>	+0.632 10	-1.9 4	72 Hf 174	1549.3	138 ns	(6 <sup>+</sup> )	+5.419 49	
68 Er 166	264.991	118 ps	4 <sup>+</sup>	+1.26 7	-2.7 9	72 Hf 175	0	70 d	5/2 <sup>-</sup>	0.539 32	+2.8 4
68 Er 166	545.455		6 <sup>+</sup>	+1.55 7		72 Hf 176	88.351	1.43 ns	2 <sup>+</sup>	+0.539 41	-2.10 2
68 Er 166	785.910	3.26 ps	2 <sup>+</sup>	+0.56 9	2.18 20	72 Hf 177	0	stable	7/2 <sup>-</sup>	+0.7935 6	+3.365 29
68 Er 166	911.210	4.2 ps	8 <sup>+</sup>	+2.1 4		72 Hf 177	112.9499	0.583 ns	9/2 <sup>-</sup>	+0.91 2	1.30 2
68 Er 166	1215.964		6 <sup>+</sup>	+1.52 19		72 Hf 177	249.6744	104 ps	11/2 <sup>-</sup>	+1.48 52	
68 Er 166	1349.64	1.7 ps	10 <sup>+</sup>	+2.0 8		72 Hf 177	321.3163	0.66 ns	9/2 <sup>+</sup>	-0.73 9	
68 Er 167	0	stable	7/2 <sup>+</sup>	-0.56385 12	+3.565 29	72 Hf 178	93.180	1.48 ns	2 <sup>+</sup>	+0.480 28	-2.02 2
68 Er 168	79.804	1.88 ns	2 <sup>+</sup>	+0.642 12		72 Hf 178	1147.423	4.0 s	8 <sup>-</sup>	1.4 to 5.3	
68 Er 168	264.089	114 ps	4 <sup>+</sup>	+1.21 15	-2.2 10	72 Hf 178	1553.998	77.5 ns	6 <sup>+</sup>	+5.837 49	
68 Er 168	548.745	11.6 ps	6 <sup>+</sup>	+1.97 28		72 Hf 178	2446.05	31 y	16 <sup>+</sup>	7.36 10	
68 Er 168	821.169	2.73 ps	2 <sup>+</sup>	+0.72 14	2.25 23	72 Hf 179	0	stable	9/2 <sup>+</sup>	-0.6409 13	+3.79 3
68 Er 168	928.306	3.6 ps	8 <sup>+</sup>	+2.65 50		72 Hf 179	122.7909	37 ps	11/2 <sup>+</sup>	1.88 3	
68 Er 168	1094.040	109.0 ns	4 <sup>+</sup>	+0.96 4		72 Hf 179	1105.84	25.05 d	25/2 <sup>-</sup>	7.4 3	
68 Er 168	1396.835	1.48 ps	10 <sup>+</sup>	+3.22 80		72 Hf 180	93.326	1.50 ns	2 <sup>+</sup>	+0.533 30	-2.00 2
68 Er 169	0	9.40 d	1/2 <sup>-</sup>	+0.515 25		72 Hf 180	308.582	71 ps	4 <sup>+</sup>	+2.2 4	
68 Er 170	78.68	1.89 ns	2 <sup>+</sup>	0.633 13	-1.94 23	72 Hf 180	1141.48	5.5 h	8 <sup>-</sup>	+8.7 10	+4.6 3
68 Er 170	260.18	135 ps	4 <sup>+</sup>	+1.09 15	-2.2 10	73 Ta 173	0	3.14 h	5/2 <sup>-</sup>	1.703 34	-1.9 2
68 Er 170	934.03	1.7 ps	2 <sup>+</sup>	1.95 33		73 Ta 175	0	10.5 h	7/2 <sup>+</sup>	2.270 45	(+3.65 35)
68 Er 171	0	7.516 h	5/2 <sup>-</sup>	0.659 10	2.86 9	73 Ta 177	0	56.56 h	7/2 <sup>+</sup>	2.250 45	
69 Tm 156	0	83.8 s	2 <sup>-</sup>	+0.40 3	-0.48 11	73 Ta 177	70.45	73 ns	(5/2) <sup>+</sup>	+4.8 5	
69 Tm 157	0	3.63 m	1/2 <sup>+</sup>	+0.476 15		73 Ta 177	186.1	3.6 μs	(5/2) <sup>-</sup>	+2.05 13	
69 Tm 158	0	3.98 m	2 <sup>-</sup>	+0.042 17	+0.74 11	73 Ta 177	1355.4	5.02 μs	(21/2 <sup>-</sup> )	+0.080 14	
69 Tm 159	0	9.13 m	5/2 <sup>+</sup>	+3.42 4	+1.93 7	73 Ta 178	y+0	9.31 m	1 <sup>+</sup>	+2.740 12	+0.65 6
69 Tm 160	0	9.4 m	1 <sup>-</sup>	+0.156 18	+0.582 44	73 Ta 180	75.3	1.2×10 <sup>15</sup> y	9 <sup>-</sup>	4.77 5	
69 Tm 161	0	33 m	7/2 <sup>+</sup>	+2.40 2	+2.90 7	73 Ta 181	0	stable	7/2 <sup>+</sup>	+2.3705 7	+3.28 6
69 Tm 162	0	21.70 m	1 <sup>-</sup>	+0.068 8	+0.69 3	73 Ta 181	6.238	6.05 μs	9/2 <sup>-</sup>	+5.28 9	+3.71 7
69 Tm 163	0	1.810 h	1/2 <sup>+</sup>	-0.082 1		73 Ta 181	136.266	39.5 ps	9/2 <sup>+</sup>	+2.57 67	
69 Tm 164	0	2.0 m	1 <sup>+</sup>	+2.37 2	+0.71 5	73 Ta 181	482.182	10.8 ns	5/2 <sup>+</sup>	+3.29 3	(+2.35 6)
69 Tm 165	0	30.06 h	1/2 <sup>+</sup>	-0.139 2		73 Ta 182	0	114.43 d	3 <sup>-</sup>	(+3.02 3)	2.9
69 Tm 166	0	7.70 h	2 <sup>+</sup>	+0.092 1	+2.14 3	73 Ta 183	0	5.1 d	7/2 <sup>+</sup>	(+2.36 3)	
69 Tm 167	0	9.25 d	1/2 <sup>+</sup>	-0.197 2		74 W 168	199.3	213 ps	2 <sup>+</sup>	+0.50 10	
69 Tm 168	0	93.1 d	3(†)	+0.227 11	+3.23 7	74 W 168	562.3	12 ps	4 <sup>+</sup>	+1.36 76	
69 Tm 169	0	stable	1/2 <sup>+</sup>	-0.2316 15		74 W 168	2722.2	60.6 ps	12 <sup>+</sup>	-2.52 84	
69 Tm 169	8.4103	4.08 ns	3/2 <sup>+</sup>	+0.5148 45	-1.2 1	74 W 180	103.557	1.28 ns	2 <sup>+</sup>	0.509 34	2.12 35
69 Tm 169	118.1902	62 ps	5/2 <sup>+</sup>	+0.761 45		74 W 182	100.1065	1.369 ns	2 <sup>+</sup>	+0.521 16	-2.13 35
69 Tm 169	138.9341	302 ps	7/2 <sup>+</sup>	+1.39 5		74 W 182	329.4287	64 ps	4 <sup>+</sup>	+0.88 17	
69 Tm 169	316.1482	660 ns	7/2 <sup>-</sup>	+0.156 8		74 W 182	1289.1610	1.12 ns	2 <sup>-</sup>	+1.74 24	
69 Tm 169	379.2690	52.6 ns	7/2 <sup>-</sup>	0.963 75		74 W 182	1373.8418	78 ps	3 <sup>-</sup>	0.96 27	
69 Tm 170	0	128.6 d	1 <sup>-</sup>	+0.2476 36	+0.74 2	74 W 183	0	1.1×10 <sup>17</sup> y	1/2 <sup>-</sup>	+0.11778476 9	
69 Tm 171	0	1.92 y	1/2 <sup>+</sup>	-0.2303 36		74 W 183	46.4839	0.188 ns	3/2 <sup>-</sup>	-0.1 1	1.77 42
69 Tm 171	116.652	55 ps	5/2 <sup>+</sup>	+0.82 37		74 W 183	99.0793	0.77 ns	5/2 <sup>-</sup>	+0.912 38	1.95 33
69 Tm 171	129.042	415 ps	7/2 <sup>+</sup>	+1.27 12		74 W 184	111.208	1.251 ns	2 <sup>+</sup>	+0.578 14	-1.87 20
69 Tm 171	635.57	1.26 ns	7/2 <sup>+</sup>	+1.15 21		74 W 184	364.056	48 ps	4 <sup>+</sup>	+1.17 9	
70 Yb 155	0	1.75 s	(7/2 <sup>-</sup> )	-0.84 8	-1.2 10	74 W 184	748.310	5.4 ps	6 <sup>+</sup>	+1.79 26	
70 Yb 157	0	38.6 s	7/2 <sup>-</sup>	-0.639 8		74 W 184	903.281	1.71 ps	2 <sup>+</sup>	+0.24 8	+0.1 4

## E-8

Nucleus	Level	Half-life	$J^{\pi}$	$\mu$	Q	Nucleus	Level	Half-life	$J^{\pi}$	$\mu$	Q
Z El A	energy			(nm)	(b)	Z El A	energy			(nm)	(b)
74 W 186	737.86	4.6 ps	2 <sup>+</sup>	+0.39 8	+1.3 3	78 Pt 197	0	18.3 h	1/2 <sup>-</sup>	0.51 2	
74 W 186	808.61	4.1 ps	6 <sup>+</sup>	+1.90 37		78 Pt 197	53.088	16.58 ns	5/2 <sup>-</sup>	+0.851 25	
74 W 187	0	23.72 h	3/2 <sup>-</sup>	0.621 15		78 Pt 198	407.22	22.25 ps	2 <sup>+</sup>	+0.69 6	+0.42 12 or +0.54 12
75 Re 179	0	19.5 m	(5/2) <sup>+</sup>	2.8 4		78 Pt 198	774.72	27 ps	2 <sup>+</sup>	+0.72 13	
75 Re 181	0	19.9 h	5/2 <sup>+</sup>	3.190 65		78 Pt 198	985.08	3.3 ps	4 <sup>+</sup>	+1.44 25	
75 Re 181	356.78	96 ns	5/2 <sup>-</sup>	+2.03 10		79 Au 185	0	4.25 m	5/2 <sup>-</sup>	+2.170 17	
75 Re 182	0	64.0 h	7 <sup>+</sup>	2.84 6	+4.1 3	79 Au 186	0	10.7 m	3 <sup>-</sup>	-1.26 3	
75 Re 182	0+x	12.7 h	2 <sup>+</sup>	3.26 10	+1.8 2	79 Au 187	0	8.4 m	1/2 <sup>+</sup>	+0.531 12	
75 Re 182	235.736+x	585 ns	2 <sup>-</sup>	2.12 8		79 Au 188	0	8.84 m	1( )	-0.067 28	
75 Re 183	0	70.0 d	5/2 <sup>+</sup>	+3.168 15	+2.3 2	79 Au 189	0	28.7 m	1/2 <sup>+</sup>	+0.49 3	
75 Re 183	496.231	7.8 ns	9/2 <sup>-</sup>	+5.14 11	(+3.8 3)	79 Au 189	247.23	4.59 m	11/2 <sup>-</sup>	+6.19 3	
75 Re 184	0	38.0 d	3( )	(+2.53 5)	+2.8 2	79 Au 190	0	42.8 m	1 <sup>-</sup>	-0.065 7	
75 Re 184	188.01	169 d	8( )	(+2.86 13)		79 Au 191	0	3.18 h	3/2 <sup>+</sup>	+0.137 1	-1.3 1
75 Re 185	0	stable	5/2 <sup>+</sup>	+3.1871 3	+2.18 2	79 Au 191	266.2	0.92 s	(11/2 <sup>-</sup> )	6.6 6	
75 Re 185	125.3581	10.2 ps	7/2 <sup>+</sup>	2.10 81		79 Au 191	2447	0.89 ns	(27/2 <sup>-</sup> )	<20.25	
75 Re 186	0	90.64 h	1 <sup>-</sup>	+1.739 3	+0.618 6	79 Au 192	0	4.94 h	1 <sup>-</sup>	-0.009 24	
75 Re 186	314.009	25.4 ns	(3) <sup>+</sup>	+2.18 6		79 Au 193	0	17.65 h	3/2 <sup>+</sup>	+0.140 1	
75 Re 186	330	17.0 ns	(5 <sup>+</sup> )	+4.62 11		79 Au 193	290.17	3.9 s	11/2 <sup>-</sup>	6.18 9	
75 Re 187	0	4.35×10 <sup>10</sup> y	5/2 <sup>+</sup>	+3.2197 3	+2.07 2	79 Au 193	1946.9	10.4 ns	(21/2 <sup>+</sup> )	+6.48 11	
75 Re 187	134.243	11.0 ps	7/2 <sup>+</sup>	+1.9 9		79 Au 193	2377.7	0.79 ns	(27/2 <sup>-</sup> )	≤+9.5	
75 Re 187	206.244	555.3 ns	9/2 <sup>-</sup>	+5.11 9	3.04 5	79 Au 193	2476.4	3.52 ns	(31/2 <sup>-</sup> )	+4.7 31	
75 Re 188	0	16.98 h	1 <sup>-</sup>	+1.788 5	+0.572 6	79 Au 193	2700.9	1.80 ns	(35/2 <sup>-</sup> )	+2.3 19	
76 Os 182	7049.7	150 ns	(25 <sup>+</sup> )		4.2 2	79 Au 194	0	38.02 h	1 <sup>-</sup>	+0.075 4	
76 Os 183	0	13.0 h	9/2 <sup>+</sup>	(-0.794 14)	+3.12 27	79 Au 195	0	186.09 d	3/2 <sup>+</sup>	+0.149 1	
76 Os 184	119.80	1.184 ns	2 <sup>+</sup>	-2.4 11	-1.63 4	79 Au 196	0	6.183 d	2 <sup>-</sup>	+0.5906 5	0.81 7
76 Os 186	137.155	818 ps	2 <sup>+</sup>	+0.562 16		79 Au 196	595.66	9.7 h	12 <sup>-</sup>	+5.72 8	
76 Os 186	1774.65	8.1 ns	7 <sup>-</sup>	-0.22 14		79 Au 197	0	stable	3/2 <sup>+</sup>	+0.145746 9	+0.547 16
76 Os 187	0	stable	1/2 <sup>-</sup>	+0.06465189 6		79 Au 197	77.351	1.91 ns	1/2 <sup>+</sup>	+0.420 3	
76 Os 188	155.021	0.71 ns	2 <sup>+</sup>	+0.584 20	-1.46 4	79 Au 197	278.99	18.6 ps	5/2 <sup>+</sup>	+0.525 50	
76 Os 188	477.94	19.4 ps	4 <sup>+</sup>	+1.43 14		79 Au 197	409.15	7.73 s	11/2 <sup>-</sup>	(+5.98 9)	+1.35 22
76 Os 188	633.015	6.6 ps	2 <sup>+</sup>	+0.78 7	+1.00 25	79 Au 197	502.5	1.77 ps	5/2 <sup>+</sup>	+3.0 5	
76 Os 188	940.31	3.1 ps	(6 <sup>+</sup> )	+2.5 4		79 Au 197	547.5	4.61 ps	7/2 <sup>+</sup>	+0.84 8	
76 Os 188	965.65	6.5 ps	4 <sup>+</sup>	+1.6 5		79 Au 197	736.7	1.09 ps	7/2 <sup>+</sup>	+1.7 5	
76 Os 188	1771.0	14.0 ns	(7 <sup>-</sup> )	-0.17 11		79 Au 197	855.5	2.67 ps	9/2 <sup>+</sup>	+1.5 6	
76 Os 188	2121.2		(3 <sup>-</sup> )		1.69 9	79 Au 197	1231	0.91 ps	11/2 <sup>+</sup>	+2.0 10	
76 Os 189	0	stable	3/2 <sup>-</sup>	+0.659933 4	+0.856 28	79 Au 198	0	2.69517 d	2 <sup>-</sup>	+0.5934 4	+0.68 2
76 Os 189	36.202	0.53 ns	1/2 <sup>-</sup>	+0.226 29		79 Au 198	312.042	124 ns	5 <sup>+</sup>	-1.105 20	
76 Os 189	69.537	1.62 ns	5/2 <sup>-</sup>	+0.988 6	-0.629 23	79 Au 198	811.7	2.30 d	(12 <sup>+</sup> )	(+5.85 9)	
76 Os 189	95.254	0.23 ns	3/2 <sup>-</sup>	-0.320 46		79 Au 199	0	3.139 d	3/2 <sup>+</sup>	+0.2715 7	+0.55 3
76 Os 190	186.718	363 ps	2 <sup>+</sup>	+0.676 20	-1.18 3	79 Au 200	962	18.7 h	12 <sup>-</sup>	5.90 9	
76 Os 190	547.854	14.1 ps	4 <sup>+</sup>	+1.52 20		80 Hg 181	0	3.6 s	1/2( )	+0.5071 7	
76 Os 190	557.979	13.9 ps	2 <sup>+</sup>	+0.66 8	0.9 4	80 Hg 183	0	9.4 s	1/2 <sup>-</sup>	+0.524 5	
76 Os 190	1705.4	9.9 m	(10) <sup>-</sup>	-0.56 +8-12		80 Hg 185	0	49.1 s	1/2 <sup>-</sup>	+0.508 3	
76 Os 191	0	15.4 d	9/2 <sup>-</sup>		+2.53 16	80 Hg 185	99.3	21.6 s	13/2 <sup>+</sup>	-1.017 9	+0.20 33
76 Os 192	205.79561	288 ps	2 <sup>+</sup>	+0.792 20	-0.96 3	80 Hg 187	0	2.4 m	13/2 <sup>+</sup>	-1.044 11	+0.45 33
76 Os 192	489.0628	32.7 ps	2 <sup>+</sup>	+0.584 44	-0.8 3	80 Hg 187	134	1.9 m	3/2 <sup>-</sup>	-0.594 4	-0.75 25
76 Os 192	580.2812	13.4 ps	4 <sup>+</sup>	+1.56 12		80 Hg 188	2724.0	134 ns	(12 <sup>+</sup> )	-2.02 12	0.91 11
76 Os 192	909.595	17 ps	4 <sup>+</sup>	+1.72 36		80 Hg 189	0	7.6 m	3/2 <sup>-</sup>	-0.6086 8	-0.76 35
76 Os 193	0	30.5 h	3/2 <sup>-</sup>	+0.75 3	+0.47 6	80 Hg 189	0+x	8.6 m	13/2 <sup>+</sup>	-1.058 6	+0.66 26
77 Ir 184	0	3.09 h	5 <sup>-</sup>	0.696 5	+2.1 3	80 Hg 190	2620.8	23 ns	(12 <sup>+</sup> )	-2.52 24	1.17 14
77 Ir 185	0	14.4 h	5/2 <sup>-</sup>	2.605 13	-2.06 14	80 Hg 191	0	49 m	(3/2 <sup>-</sup> )	-0.618 11	-0.80 25
77 Ir 186	0	16.64 h	5 <sup>+</sup>	3.88 5	-2.54 16	80 Hg 191	0+x	50.8 m	13/2 <sup>+</sup>	-1.068 5	+0.64 25
77 Ir 187	433.81	152 ns	11/2 <sup>-</sup>	+6.21 5	3.1 3	80 Hg 193	0	3.80 h	3/2 <sup>-</sup>	-0.62757 18	-0.72 38
77 Ir 188	0	41.5 h	1 <sup>-</sup>	0.302 10	+0.543 18	80 Hg 193	140.76	11.8 h	13/2 <sup>+</sup>	-1.0584297 26	+0.916 97
77 Ir 189	0	13.2 d	3/2 <sup>+</sup>	0.13 +3-4	+1.04 20	80 Hg 195	0	9.9 h	1/2 <sup>-</sup>	+0.5414749 14	
77 Ir 190	0	11.78 d	(4) <sup>+</sup>	0.04 1	+2.85 14	80 Hg 195	176.07	41.6 h	13/2 <sup>+</sup>	-1.0446473 26	+1.08 11
77 Ir 191	0	stable	3/2 <sup>+</sup>	+0.1507 6	0.816 9	80 Hg 196	426.10	15.2 ps	2 <sup>+</sup>	-0.010 80	
77 Ir 191	82.425	4.08 ns	1/2 <sup>+</sup>	+0.600 6		80 Hg 196	1061.50		4 <sup>+</sup>	-0.31 13	
77 Ir 191	129.430	123 ps	5/2 <sup>+</sup>	+0.450 23		80 Hg 196	1757.09	0.555 ns	5 <sup>-</sup>	-0.24 25	
77 Ir 191	171.28	4.94 s	11/2 <sup>-</sup>	6.026 36		80 Hg 196	1841.39	5.25 ns	7 <sup>-</sup>	-0.29 13	
77 Ir 191	178.955	39 ps	3/2 <sup>+</sup>	+1.40 38		80 Hg 197	0	64.14 h	1/2 <sup>-</sup>	+0.5273744 9	
77 Ir 191	343.19	20 ps	(7/2 <sup>+</sup> )	+1.68 25		80 Hg 197	133.96	8.07 ns	5/2 <sup>-</sup>	+0.855 15	-0.081 6
77 Ir 191	502.5	9.6 ps	(9/2 <sup>+</sup> )	+3.1 11		80 Hg 197	298.93	23.8 h	13/2 <sup>+</sup>	-1.0276844 26	+1.24 14
77 Ir 191	686.3	2.7 ps	(7/2 <sup>+</sup> )	+0.53 73		80 Hg 198	411.8047	23.16 ps	2 <sup>+</sup>	+1.04 20	+0.68 12 or +0.84 12
77 Ir 192	0	73.831 d	4( )	+1.924 10	+2.28 6	80 Hg 198	1683.3	6.9 ns	7 <sup>-</sup>	-0.22 11	
77 Ir 193	0	stable	3/2 <sup>+</sup>	+0.1637 6	+0.751 9	80 Hg 199	0	stable	1/2 <sup>-</sup>	+0.5058855 9	
77 Ir 193	73.041	6.09 ns	1/2 <sup>+</sup>	+0.519 2		80 Hg 199	158.37950	2.45 ns	5/2 <sup>-</sup>	+0.88 3	+0.95 7
77 Ir 193	138.89	81.9 ps	5/2 <sup>+</sup>	+0.528 30		80 Hg 199	208.20616	69 ps	3/2 <sup>-</sup>	-0.29 15	+0.62 15
77 Ir 193	180.06	59 ps	3/2 <sup>+</sup>	+1.03 38		80 Hg 199	413.84	115 ps	5/2 <sup>-</sup>	-0.70 25	
77 Ir 193	357.69	19.8 ps	7/2 <sup>+</sup>	+1.65 25		80 Hg 199	532.48	42.6 m	13/2 <sup>+</sup>	-1.014703 3	+1.2 5
77 Ir 193	521.90	12.7 ps	(9/2 <sup>+</sup> )	+3.8 11		80 Hg 200	367.944	46.4 ps	2 <sup>+</sup>	+0.68 10	+0.96 11 or +1.11 11
77 Ir 193	621.22	4.6 ps	7/2 <sup>+</sup>	+0.53 39		80 Hg 201	0	stable	3/2 <sup>-</sup>	-0.5602257 14	+0.385 40
77 Ir 194	0	19.15 h	1 <sup>-</sup>	0.39 1	+0.339 12	80 Hg 201	32.138	0.1 ns	3/2 <sup>-</sup>		0.3 15 or 0.09 20
78 Pt 183	0	6.5 m	1/2 <sup>-</sup>	+0.521 27		80 Hg 202	439.59	27.3 ps	2 <sup>+</sup>	+0.88 18	+0.87 13 or +1.01 13
78 Pt 185	0	70.9 m	9/2 <sup>+</sup>	-0.83 1	+4.3 5	80 Hg 203	0	46.612 d	5/2 <sup>-</sup>	+0.84895 13	+0.343 36
78 Pt 185	103.4	33.0 m	1/2 <sup>-</sup>	+0.540 9		80 Hg 204	436.552	40.4 ps	2 <sup>+</sup>	+0.86 18	+0.24 20 or +0.39 20
78 Pt 187	0	2.35 h	3/2 <sup>-</sup>	-0.397 5	-1.13 5	80 Hg 205	0	5.2 m	1/2 <sup>-</sup>	+0.6010 1	
78 Pt 189	0	10.87 h	3/2 <sup>-</sup>	0.434 9	-0.65 26	80 Hg 206	2102.6	2.15 μs	5 <sup>-</sup>	+5.45 5	0.74 15
78 Pt 191	0	2.9 d	3/2 <sup>-</sup>	-0.500 10	-0.64 26	81 Tl 188	0+x	71 s	(7 <sup>+</sup> )	0.5	
78 Pt 192	316.50819	43.7 ps	2 <sup>+</sup>	+0.559 45	+0.55 21	81 Tl 189	281	1.4 m	(9/2 <sup>-</sup> )	+3.8776 63	-2.29 4
78 Pt 192	612.46669	26.5 ps	2 <sup>+</sup>	+0.72 14		81 Tl 190	0+x	2.6 m	(2 <sup>-</sup> )	0.25	
78 Pt 192	784.58033	4.2 ps	4 <sup>+</sup>	+1.6 11		81 Tl 190	0+y	3.7 m	(7 <sup>+</sup> )	+0.495 4	
78 Pt 193	149.78	4.33 d	13/2 <sup>+</sup>	(-0.753 15)		81 Tl 191	0	stable	(1/2 <sup>-</sup> )	1.588 4	
78 Pt 194	328.453	41.8 ps	2 <sup>+</sup>	+0.505 12	+0.48 14	81 Tl 191	299	5.22 m	9/2( )	+3.9034 48	-2.28 3
78 Pt 194	621.995	35 ps	2 <sup>+</sup>	+0.686 63	-0.5 5	81 Tl 192	0+x	9.6 m	(2 <sup>-</sup> )	+0.200 3	-0.337 11
78 Pt 194	811.318	3.7 ps	4 <sup>+</sup>		+0.5 10	81 Tl 192	0+y	10.8 m	(7 <sup>+</sup> )	+0.5180 36	+0.477 20
78 Pt 195	0	stable	1/2 <sup>-</sup>	+0.60952 6		81 Tl 192	250.6+y	296 ns	(8 <sup>-</sup> )	+1.656 40	0.44 7
78 Pt 195	98.882	0.170 ns	3/2 <sup>-</sup>	-0.62 6		81 Tl 193	0	21.6 m	1/2( )	+1.5912 22	
78 Pt 195	129.777	0.67 ns	5/2 <sup>-</sup>	+0.90 6		81 Tl 193	365.2+x	2.11 m	(9/2 <sup>-</sup> )	+3.9482 39	-2.20 2
78 Pt 195	211.398	49 ps	3/2 <sup>-</sup>	+0.156 32		81 Tl 194	0	33.0 m	2 <sup>-</sup>	0.14 1	
78 Pt 195	239.269	70 ps	5/2 <sup>-</sup>	+0.523 50		81 Tl 194	0+s	32.8 m	(7 <sup>+</sup> )	+0.540 5	0.62
78 Pt 195	259.30	4.02 d	13/2 <sup>+</sup>	0.606 15	+1.42 60	81 Tl 195	0	1.16 h	1/2 <sup>+</sup>	+1.58 4	
78 Pt 196											



## E-9

Nucleus	Level	Half-life	$J^{\pi}$	$\mu$	Q	Nucleus	Level	Half-life	$J^{\pi}$	$\mu$	Q
Z El A	energy			(nm)	(b)	Z El A	energy			(nm)	(b)
81 Ti 200	0	26.1 h	$2^{-}$	0.04 1		84 Po 198	2692+x	750 ns	$12^{+}$	-1.86 4	
81 Ti 201	0	72.912 h	$1/2^{+}$	+1.6051 17		84 Po 199	310	4.13 m	$13/2^{+}$	(-).099 7	
81 Ti 202	0	12.23 d	$2^{-}$	0.06 1		84 Po 200	1773.69	61 ns	$8^{+}$	+7.44 16	1.38 7
81 Ti 202	950.19	572 $\mu$ s	$7^{+}$	+0.90 4		84 Po 200	2596.22	105 ns	$11^{-}$	+11.88 22	
81 Ti 203	0	stable	$1/2^{+}$	+1.62225787 12		84 Po 200	2830	268 ns	$(12^{+})$	-1.788 24	
81 Ti 203	279.1970	278 ps	$3/2^{+}$	+0.16 5		84 Po 201	0	15.3 m	$3/2^{-}$	0.74 11	
81 Ti 203	680.518	0.88 ps	$5/2^{+}$	+2.6 11		84 Po 201	424	8.9 m	$13/2^{+}$	0.99 11	
81 Ti 204	0	3.78 y	$2^{-}$	0.09 1		84 Po 202	1712	98 ns	$(8^{+})$	7.45 12	
81 Ti 204	1104.0	63 $\mu$ s	$(7^{+})$	+1.187 6		84 Po 202	2625	85 ns	$(11^{-})$	11.9 4	
81 Ti 205	0	stable	$1/2^{+}$	+1.63821461 12		84 Po 203	0	36.7 m	$5/2^{-}$	(+).0.742 26	
81 Ti 205	203.747	1.46 ns	$3/2^{+}$	-0.080 45	0.74 15	84 Po 204	1639.03	158 ns	$8^{+}$	+7.38 10	1.14 5
81 Ti 205	619.435	1.0 ps	$5/2^{+}$	+2.03 25		84 Po 204	3564.7	12 ns	$15^{-}$	6.15 30	
81 Ti 205	2623.11		$(5/2)^{-}$	+0.71 15	-0.54 20	84 Po 205	0	1.66 h	$5/2^{-}$	+0.760 55	+0.17
81 Ti 205	3290.63	2.6 $\mu$ s	$25/2^{+}$	+6.80 10		84 Po 205	880.30	645 $\mu$ s	$13/2^{+}$	-0.953 47	
81 Ti 206	1405.47	78 ns	$(5^{+})$	+4.265 60		84 Po 206	1585.9	212 ns	$(8^{+})$	+7.34 7	1.02 4
81 Ti 206	1621.72	10.1 ns	$(6,7)^{+}$	<2.45		84 Po 207	0	5.80 h	$5/2^{-}$	+0.793 55	+0.28
81 Ti 207	0	4.77 m	$1/2^{+}$	+1.876 5		84 Po 207	1115.073	49 $\mu$ s	$13/2^{+}$	-0.910 14	
82 Pb 191	138	2.18 m	$(13/2^{+})$	-1.176 8	0.085 5	84 Po 207	2379.6	43.0 ns	$(25/2)^{+}$	5.413 38	
82 Pb 192	2626	1.10 $\mu$ s	$(12^{+})$	-2.076 24		84 Po 208	1524.18	4.5 ns	$6^{+}$	+5.46	
82 Pb 194	2407.7	18 ns	$(9^{-})$	-0.63 36		84 Po 208	1528.22	350 ns	$(8)^{+}$	+7.37 5	0.90 4
82 Pb 194	2628.5	350 ns	$(12^{+})$	-2.004 24	0.49 3	84 Po 208	2702.7	8.0 ns	$(11^{-})$	12.11 14	
82 Pb 195	203.0	15.0 m	$13/2^{+}$	-1.1318 13	+0.286 95	84 Po 209	0	102 y	$1/2^{-}$	+0.77 7	
82 Pb 195	2901.8	95 ns	$33/2^{+}$	-2.57 10		84 Po 209	1417.59	24.7 ns	$(13/2)^{-}$	6.13 9	
82 Pb 196	1797.51	133 ns	$5^{-}$	0.490 15		84 Po 209	1472.5	93 ns	$(17/2)^{-}$	7.75 5	(-).039 8
82 Pb 196	2692.8	271 ns	$12^{+}$	-1.920 18	0.65 5	84 Po 209	4265.6	119 ns	$(31/2)^{-}$	+9.68 8	
82 Pb 196	3190.5	72 ns	$11^{-}$	10.6 9		84 Po 210	1473.34	42.6 ns	$6^{+}$	5.48 5	
82 Pb 197	0	8 m	$3/2^{-}$	-1.0753 22	-0.08 18	84 Po 210	1556.96	98.9 ns	$8^{+}$	+7.35 5	(-).057
82 Pb 197	319.3	43 m	$13/2^{+}$	-1.1045 27	+0.47 34	84 Po 210	2849.16	19.6 ns	$11^{-}$	+12.20 9	0.85 12
82 Pb 197	1913.3	1.15 $\mu$ s	$(21/2)^{-}$	-0.531 7		84 Po 210	4371.94	54.4 ns	$13^{-}$	6.84 17	0.90 7
82 Pb 197	3167.9	55 ns	$(33/2)^{+}$	-2.51 10		84 Po 210	5057.61	263 ns	$16^{+}$	9.84 8	1.34 8
82 Pb 198	1823.5	50.4 ns	$5^{-}$	0.38 3		84 Po 211	1064.8	15.9 ns	$15/2^{-}$	-0.38 15	
82 Pb 198	2141.4	4.19 $\mu$ s	$(7^{-})$	-0.3768 64		85 At 207	2117.2	108 ns	$(25/2^{+})$	+3.75 13	
82 Pb 198	2820.5	212 ns	$(12^{+})$	-1.862 18	0.75 5	85 At 208	1090.4	46 ns	$(10^{+})$	+2.69 3	
82 Pb 199	0	90 m	$3/2^{-}$	-1.0742 12	+0.08 9	85 At 208	2275.8	1.5 $\mu$ s			1.69 25
82 Pb 199	2564	10.2 $\mu$ s	$29/2^{-}$	-1.076 3		85 At 209	1427.66	25.5 ns	$(21/2)^{-}$	+9.98 21	0.78 8
82 Pb 199	3495	63 ns	$(33/2^{+})$	-2.51 5		85 At 209	2429.25	0.89 $\mu$ s	$(29/2)^{+}$	15.38 14	1.50 15
82 Pb 200	2153.81	44 ns	$7^{-}$	-2.1 10	0.32 2	85 At 210	1363.2	27 ns	$(11^{+})$	+9.79 33	0.65 8
82 Pb 200	2183.3	424 ns	$(9^{-})$	-0.256 10	0.40 2	85 At 210	2549.6	0.48 $\mu$ s	$(15)^{-}$	+15.675 17	1.22 12
82 Pb 200	3005.8	199 ns	$(12^{+})$	-1.836 7	0.79 3	85 At 210	4027.7	5.90 $\mu$ s	$(19)^{+}$	13.26 13	2.20 25
82 Pb 200	5075.7	73 ns	$(19^{-})$	-1.79 13		85 At 211	1416.6	50 ns	$(21/2)^{-}$	+9.56 9	0.53 5
82 Pb 201	0	9.33 h	$5/2^{-}$	+0.6753 5	-0.009 43	85 At 211	2641.4	54 ns	$(29/2)^{+}$	+15.31 13	1.01 19
82 Pb 201	2718.5	63 ns	$25/2^{-}$	-0.788 38	0.46 2	85 At 211	4816.2	4.2 $\mu$ s	$(39/2)^{-}$	13.46 14	1.91 25
82 Pb 201	2718.5+x	508 ns	$(29/2)^{-}$	-1.0107 58		85 At 212	884.5	19.4 ns	$(11^{+})$	5.95 12	
82 Pb 201	4639.3+x	43 ns	$41/2^{+}$	-3.69 82		85 At 212	1614.6	37.4 ns	$(15^{-})$	9.33 15	
82 Pb 202	1382.85	1.97 ns	$4^{+}$	+0.008 16		86 Rn 203	361	28 s	$(13/2^{+})$	-0.960 11	+1.28 13
82 Pb 202	2169.84	3.53 h	$9^{-}$	-0.2276 7	+0.58 9	86 Rn 205	0	2.8 m	$5/2^{-}$	+0.802 9	+0.062 6
82 Pb 202	2208.45	42 ns	$(7^{-})$		0.28 2	86 Rn 206	1924.3	13.5 ns	$(8^{+})$	6.64 40	
82 Pb 202	4090.9+x	110 ns	$(16^{+})$	-0.67 16		86 Rn 206	2475.6	65 ns	$(10^{-})$	11.2 1	
82 Pb 202	5241.9+y	107 ns	$(19^{-})$	-1.881 57		86 Rn 207	0	9.25 m	$5/2^{-}$	+0.816 9	+0.220 22
82 Pb 203	0	51.873 h	$5/2^{-}$	+0.6864 5	+0.095 52	86 Rn 207	899	181 $\mu$ s	$(13/2^{+})$	-0.903 3	
82 Pb 203	1922.26	56 ns	$21/2^{+}$	-0.641 21	0.85 3	86 Rn 208	1828.3	487 ns	$8^{+}$	6.98 8	0.39 5
82 Pb 203	2923.6+x	122 ns	$(25/2^{-})$	-0.738 38		86 Rn 208	2618.1	11.8 ns	$10^{-}$	10.77 10	
82 Pb 204	899.171	2.88 ps	$2^{+}$	<0.02	+0.23 9	86 Rn 209	0	28.5 m	$5/2^{-}$	(+).0.83881 39	+0.311 31
82 Pb 204	1274.00	265 ns	$4^{+}$	+0.225 4	0.44 2	86 Rn 210	x+1664.6	644 ns	$(8^{+})$	7.184 56	0.31 4
82 Pb 205	0	$1.53 \times 10^7$ y	$5/2^{-}$	+0.7117 4	+0.226 37	86 Rn 210	x+2562.3	64 ns	$(11^{-})$	12.16 11	
82 Pb 205	1013.839	5.54 ms	$13/2^{+}$	-0.975 40	0.30 5	86 Rn 210	x+3247.7	76 ns	$(14^{+})$	14.92 10	
82 Pb 205	3195.6	217 ns	$25/2^{-}$	-0.845 14	0.63 3	86 Rn 210	x+3812.0	1.06 $\mu$ s	$(17^{-})$	17.88 9	0.86 10
82 Pb 205	5161.6	71 ns	$(33/2)^{+}$	-2.442 83		86 Rn 210	x+4993.2	12.3 ns	$(20)^{+}$	22.3 1	
82 Pb 206	803.10	8.14 ps	$2^{+}$	<0.030	+0.05 9	86 Rn 210	x+6468.3	1.04 $\mu$ s	$(22)^{+}$	15.42 15	
82 Pb 206	2200.21	125.3 $\mu$ s	$7^{-}$	-0.1519 28	0.33 5	86 Rn 210	x+7310.1	34 ns	$(25)^{-}$	18.33 22	
82 Pb 206	2384.19	29 ps	$6^{-}$	+0.78 42		86 Rn 211	0	14.6 h	$1/2^{-}$	+0.601 7	
82 Pb 206	4027.0	205 ns	$12^{+}$	-1.795 22	0.51 2	86 Rn 211	1577.8+x	596 ns	$(17/2)^{-}$	+7.75 8	0.18 2
82 Pb 207	0	stable	$1/2^{-}$	+0.592583 9		86 Rn 211	3926.1+x	40.2 ns	$(35/2^{+})$	+17.80 21	
82 Pb 207	569.703	130.5 ps	$5/2^{-}$	+0.80 3		86 Rn 211	5245.9+y	14 ns	$(43/2^{+})$	+15.91 43	
82 Pb 208	2614.551	16.7 ps	$3^{-}$	+1.68 22	-0.34 15	86 Rn 211	6100.0+y	28.4 ns	$(49/2^{+})$	+18.77 20	
82 Pb 208	3197.743	294 ps	$5^{-}$	+0.112 37		86 Rn 211	8854.6+y	201 ns	$(63/2)^{-}$	+19.59 22	1.54 22
82 Pb 208	4085.4	0.74 fs	$2^{+}$		-0.7 3	86 Rn 212	1501.5	8.8 ns	$4^{+}$	4.04 24	
82 Pb 209	0	3.253 h	$9/2^{+}$	-1.4735 16	-0.27 17	86 Rn 212	1639.8	118 ns	$(6^{+})$	5.454 48	
82 Pb 210	1195.6	49 ns	$6^{+}$	-1.872 90		86 Rn 212	1694.0	0.91 $\mu$ s	$(8^{+})$	+7.152 16	(-).017 2
82 Pb 210	1279	201 ns	$8^{+}$	-2.496 64		86 Rn 212	3357.6	7.4 ns	$(14^{+})$	14.98 42	
82 Pb 211	0	36.1 m	$9/2^{+}$	-1.4037 8	+0.087 62	86 Rn 212	4066.8	28.9 ns	$(17^{-})$	17.85 17	
83 Bi 199	0	27 m	$9/2^{-}$	4.6 6		86 Rn 212	6167.4+x	109 ns	$(22^{+})$	15.84 22	
83 Bi 202	615	3.04 $\mu$ s	$(10)^{-}$	+2.54 1	0.106 13	86 Rn 212	7135.2+x	18.0 ns	$(25^{-})$	17.75 50	
83 Bi 202	2607.1	310 ns	$(17^{+})$	+2.074 34	0.35 3	86 Rn 212	7870.9+x	14 ns	$(27^{-})$	17.01 81	
83 Bi 203	0	11.76 h	$9/2^{-}$	+4.62 3	-0.68 6	86 Rn 212	8571.0+x	154 ns	$(30^{+})$	19.71 9	
83 Bi 203	1990.6	90 ns	$(21/2^{+})$	2.793 42		86 Rn 213	1664.0	29 ns	$(21/2^{+})$	4.73 11	
83 Bi 203	2041.5	194 ns	$25/2^{+}$	3.325 50		86 Rn 213	1664.0+x	1.00 $\mu$ s	$(25/2^{+})$	7.63 25	
83 Bi 204	0	11.22 h	$6^{+}$	+4.280 24	-0.43 4	86 Rn 213	2186.7+x	1.36 $\mu$ s	$(31/2)^{-}$	9.90 8	
83 Bi 204	805.5	13.0 ms	$10^{-}$	2.591 38	0.056 11	86 Rn 213	3029.3+x	26 ns	$(37/2)^{-}$	13.67 13	
83 Bi 205	0	15.31 d	$9/2^{-}$	+4.16 10		86 Rn 213	3495.4+x	28 ns	$(43/2)^{-}$	15.59 15	
83 Bi 205	2064.64	100 ns	$21/2^{+}$	2.699 42		86 Rn 213	4505.5+x	12 ns	$(49/2^{+})$	19.87 29	
83 Bi 205	2138.9	220 ns	$25/2^{+}$	3.213 50		86 Rn 213	5929+y	164 ns	$(55/2^{+})$	16.61 14	
83 Bi 206	0	6.243 d	$6^{+}$	+4.60 4	-0.20 4	86 Rn 219	0	3.96 s	$5/2^{-}$	-0.442 5	+1.15 12
83 Bi 206	1044.8	0.89 ms	$(10)^{-}$	2.644 14	0.043 7	86 Rn 221	0	25 m	$7/2^{+}$	-0.020 1	-0.38
83 Bi 207	0	31.55 y	$9/2^{-}$	4.081 9	-0.58 11	86 Rn 222	186.10	0.32 ns	$2^{+}$	+0.92 14	
83 Bi 207	2101.49	182 $\mu$ s	$21/2^{+}$	+3.412 63	0.039 6	86 Rn 223	0	23.2 m	$7/2^{-}$	-0.776 8	+0.80
83 Bi 208	1571.1	2.58 ms	$(10)^{-}$	2.672 14		86 Rn 225	0	4.5 m	$7/2^{-}$	-0.696 8	+0.84
83 Bi 209	0	stable	$9/2^{-}$	+4.1106 2	-0.37 3	87 Fr 207	0	14.8 s	$9/2^{-}$	+3.89 8	-0.16 5
83 Bi 209	2564.16	0.015 ps	$(9/2)^{+}$	3.52 70	+0.11 5	87 Fr 208	0	59.1 s	$7^{+}$	+4.75 10	+0.004 38
83 Bi 209	27										

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Nucleus Z El A	Level energy	Half-life	$J^\pi$	$\mu$ (nm)	Q (b)	Nucleus Z El A	Level energy	Half-life	$J^\pi$	$\mu$ (nm)	Q (b)
87 Fr 212	4834.3	4.2 ns	(22 <sup>+</sup> )	22.0 <sub>44</sub>		90 Th 229	0	7340 y	5/2 <sup>+</sup>	+0.46 <sub>4</sub>	+4.3 <sub>9</sub>
87 Fr 212	5854.7	312 ns	(27 <sup>-</sup> )	21.87 <sub>27</sub>	1.65 <sub>24</sub>	91 Pa 228	0	22 h	(3 <sup>+</sup> )	3.48 <sub>33</sub>	
87 Fr 213	0	34.6 s	9/2 <sup>-</sup>	+4.02 <sub>8</sub>	-0.14 <sub>2</sub>	91 Pa 230	0	17.4 d	(2 <sup>-</sup> )	2.00 <sub>29</sub>	
87 Fr 213	1411.0	18 ns	17/2 <sup>-</sup>	7.5 <sub>14</sub>		91 Pa 231	0	32760 y	3/2 <sup>-</sup>	2.01 <sub>2</sub>	-1.72 <sub>5</sub>
87 Fr 213	1590.4	499 ns	21/2 <sup>-</sup>	9.324 <sub>32</sub>		91 Pa 231	84.216	45.1 ns	5/2 <sup>+</sup>		+0.69 <sub>17</sub>
87 Fr 213	2537.6	243 ns	29/2 <sup>+</sup>	15.216 <sub>26</sub>	-0.70 <sub>7</sub>	91 Pa 233	0	26.967 d	3/2 <sup>-</sup>	+3.39 <sub>70</sub>	-3.0
87 Fr 213	4992.7	13 ns	45/2 <sup>-</sup>	22.28 <sub>56</sub>		92 U 233	0	1.592×10 <sup>5</sup> y	5/2 <sup>+</sup>	0.59 <sub>5</sub>	3.663 <sub>8</sub>
87 Fr 213	8094.7	3.1 μs	(65/2 <sup>+</sup> )	22.6 <sub>3</sub>	-2.19 <sub>53</sub>	92 U 233	40.35	0.12 ns	7/2 <sup>+</sup>		0.642 <sub>30</sub>
87 Fr 215	2015.9	4.7 ns	(29/2 <sup>-</sup> )	6.8 <sub>29</sub>		92 U 235	0	7.038×10 <sup>8</sup> y	7/2 <sup>-</sup>	-0.38 <sub>3</sub>	+4.55 <sub>9</sub>
87 Fr 215	2251.3	5.3 ns	(33/2 <sup>+</sup> )	7.8 <sub>17</sub>		92 U 235	46.204	60 ps	9/2 <sup>-</sup>		1.870 <sub>30</sub>
87 Fr 215	3068.9	14.6 ns	(39/2 <sup>-</sup> )	9.17 <sub>20</sub>		92 U 238	0	4.468×10 <sup>9</sup> y	0 <sup>+</sup>		13.9 <sub>20</sub>
87 Fr 220	0	27.4 s	1 <sup>+</sup>	-0.67 <sub>1</sub>	+0.47 <sub>3</sub>	92 U 238	2557.6	225 ns	0 <sup>+</sup>		29 <sub>3</sub>
87 Fr 221	0	4.9 m	5/2 <sup>-</sup>	+1.58 <sub>3</sub>	-1.00 <sub>1</sub>	93 Np 237	0	2.14×10 <sup>6</sup> y	5/2 <sup>+</sup>	+3.14 <sub>4</sub>	+3.886 <sub>6</sub>
87 Fr 222	0	14.2 m	2 <sup>-</sup>	+0.63 <sub>1</sub>	+0.51 <sub>4</sub>	93 Np 237	59.537	67 ns	5/2 <sup>-</sup>	+1.68 <sub>3</sub>	+3.85 <sub>4</sub>
87 Fr 223	0	21.8 m	3/2 <sup>(-)</sup>	+1.17 <sub>2</sub>	+1.17 <sub>1</sub>	93 Np 239	74.664	1.40 ns	5/2 <sup>-</sup>	+2.03 <sub>25</sub>	
87 Fr 224	0	3.30 m	1 <sup>(-)</sup>	+0.40 <sub>1</sub>	+0.517 <sub>4</sub>	94 Pu 237	2600	85 ns		-0.675 <sub>45</sub>	
87 Fr 225	0	4.0 m	3/2 <sup>-</sup>	+1.07 <sub>2</sub>	+1.32 <sub>5</sub>	94 Pu 239	0	24110 y	1/2 <sup>+</sup>	+0.203 <sub>4</sub>	
87 Fr 226	0	48 s	1 <sup>+</sup>	+0.0712 <sub>14</sub>	-1.35 <sub>2</sub>	94 Pu 239	7.861	36 ps	3/2 <sup>+</sup>		-2.319 <sub>7</sub>
87 Fr 227	0	2.47 m	1/2 <sup>+</sup>	+1.50 <sub>3</sub>		94 Pu 239	57.276	101 ps	5/2 <sup>+</sup>		-3.345 <sub>13</sub>
87 Fr 228	0	39 s	2 <sup>-</sup>	-0.76 <sub>2</sub>	+2.38 <sub>5</sub>	94 Pu 239	75.706	83 ps	7/2 <sup>+</sup>		-3.826 <sub>26</sub>
88 Ra 209	0	4.6 s	5/2 <sup>-</sup>	+0.865 <sub>13</sub>	+0.38 <sub>4</sub>	94 Pu 239	285.460	1.12 ns	5/2 <sup>+</sup>	-1.25 <sub>29</sub>	
88 Ra 211	0	13 s	5/2 <sup>(-)</sup>	+0.8780 <sub>38</sub>	+0.46 <sub>5</sub>	94 Pu 241	0	14.35 y	5/2 <sup>+</sup>	-0.683 <sub>15</sub>	+5.6 <sub>20</sub>
88 Ra 212	1958.4	10.9 μs	(8 <sup>+</sup> )	7.104 <sub>72</sub>		95 Am 239	2500	163 ns	(7/2 <sup>+</sup> )	(+2.59 <sub>18</sub> )	
88 Ra 212	2613.4	0.85 μs	(11 <sup>-</sup> )	12.01 <sub>24</sub>		95 Am 241	0	432.2 y	5/2 <sup>-</sup>	+1.61 <sub>3</sub>	+4.2 <sub>13</sub>
88 Ra 213	0	2.74 m	1/2 <sup>-</sup>	+0.6133 <sub>18</sub>		95 Am 242	0	16.02 h	1 <sup>-</sup>	+0.3879 <sub>15</sub>	-2.4 <sub>7</sub>
88 Ra 214	1865.2	67 μs	(8 <sup>+</sup> )	7.080 <sub>32</sub>		95 Am 242	48.63	141 y	5 <sup>-</sup>	1.00 <sub>5</sub>	+6.5 <sub>20</sub>
88 Ra 214	2683.2	295 ns	(11 <sup>-</sup> )	11.94 <sub>11</sub>		95 Am 243	0	7370 y	5/2 <sup>-</sup>	1.53 <sub>3</sub>	+4.30 <sub>3</sub>
88 Ra 214	3478.4	279 ns	(14 <sup>+</sup> )	14.31 <sub>13</sub>		95 Am 243	84.0	2.34 ns	5/2 <sup>+</sup>	+2.74 <sub>14</sub>	4.20 <sub>3</sub>
88 Ra 214	4146.8	225 ns	(17 <sup>-</sup> )	17.48 <sub>12</sub>		96 Cm 243	0	29.1 y	5/2 <sup>+</sup>	0.41	
88 Ra 215	3737	0.59 μs		15.78 <sub>15</sub>		96 Cm 245	0	8500 y	7/2 <sup>+</sup>	0.5	
88 Ra 216	1711.1	1.7 ns	8 <sup>+</sup>	+3.2 <sub>32</sub>		96 Cm 247	0	1.56×10 <sup>7</sup> y	9/2 <sup>-</sup>	0.37	
88 Ra 216	3763.4	6.7 ns	19 <sup>-</sup>	9.69 <sub>57</sub>		96 Cm 248	43.38	121 ps	2 <sup>+</sup>		-2.2 +10 <sup>-5</sup>
88 Ra 221	0	28 s	5/2 <sup>+</sup>	-0.1799 <sub>17</sub>	+1.978 <sub>7</sub>	96 Cm 248	143.8	78 ps	4 <sup>+</sup>		-4.2 +7 <sup>-13</sup>
88 Ra 223	0	11.435 d	3/2 <sup>+</sup>	+0.2705 <sub>19</sub>	+1.254 <sub>3</sub>	96 Cm 248	298.8	33 ps	6 <sup>+</sup>		-6.1 +12 <sup>-30</sup>
88 Ra 223	50.133	0.63 ns	3/2 <sup>-</sup>	+0.43 <sub>6</sub>		96 Cm 248	506.0	13.2 ps	8 <sup>+</sup>		-3.8 +32 <sup>-14</sup>
88 Ra 224	84.373	0.746 ns	2 <sup>+</sup>	+0.92 <sub>22</sub>		96 Cm 248	761.9	9.4 ps	10 <sup>+</sup>		-4.5 +10 <sup>-14</sup>
88 Ra 225	0	14.9 d	1/2 <sup>+</sup>	-0.7338 <sub>15</sub>		96 Cm 248	1062.8	3.8 ps	12 <sup>+</sup>		-3.5 +16 <sup>-8</sup>
88 Ra 227	0	42.2 m	3/2 <sup>+</sup>	-0.4038 <sub>24</sub>	+1.50 <sub>15</sub>	96 Cm 248	1404.3	1.68 ps	14 <sup>+</sup>		-6.6 +8 <sup>-16</sup>
88 Ra 229	0	4.0 m	5/2 <sup>(+)</sup>	+0.5025 <sub>27</sub>	+2.96 <sub>30</sub>	96 Cm 248	1781.6	1.46 ps	16 <sup>+</sup>		-7.1 +13 <sup>-12</sup>
89 Ac 215	1621.0	30 ns	17/2 <sup>-</sup>	7.82 <sub>16</sub>		96 Cm 248	2189.7	0.98 ps	18 <sup>+</sup>		-5.2 +28 <sup>-16</sup>
89 Ac 215	1796.0	185 ns	21/2 <sup>-</sup>	9.66 <sub>20</sub>		96 Cm 248	2623.6	0.71 ps	20 <sup>+</sup>		-3.9 +6 <sup>-4</sup>
89 Ac 215	2438+x	335 ns	(29/2 <sup>+</sup> )	15.13 <sub>30</sub>		97 Bk 249	0	320 d	7/2 <sup>+</sup>	2.0 <sub>4</sub>	
89 Ac 217	0	69 ns	9/2 <sup>-</sup>	3.825 <sub>45</sub>		99 Es 253	0	20.47 d	7/2 <sup>+</sup>	+4.10 <sub>7</sub>	6.7 <sub>8</sub>
89 Ac 217	2013	740 ns	(29/2 <sup>+</sup> )	5.032 <sub>73</sub>							
89 Ac 227	0	21.773 y	3/2 <sup>-</sup>	+1.1 <sub>1</sub>	+1.7 <sub>2</sub>						