Pocketbook of Data for Nuclear Engineers

rev. 01 - February 2013

Contents

Foreword

The *Pocketbook of Data for Nuclear Engineers* is a compilation of nuclear data available from different sources online (NIST, IAEA-NDS, evaluated data libraries). It was conceived as an extension of BNL *Nuclear Data Cards* to include other important nuclear data used in the Nuclear Physics course at Instituto Balseiro and other courses. The document is typeset in 10 pt font to be printed as a A5 or A6 booklet.

This compilation is supplied "as is" with no warranties implied. It is recommended that the data contained in this pocketbook be checked against the sources before used for any important application. If you think data should be corrected, added or removed from this compilation, please contact the author at: `marquezj@cab.cnea.gov.ar`

This pocketbook can be distributed freely, and the data should be used citing the original source.

The latest version of this pocketbook can be found at:

`http://ib.cnea.gov.ar/~moderna/nuclear/pdne.html`

Chapter 1

Physical constants and unit conversions

Wave relationships:

$$E = h\nu, p = h/\lambda$$

Speed of light:

$$c = \lambda\nu = 2.99792458 \times 10^8 \text{ m/s}$$

Planck's constant:

$$h = 6.626069 \times 10^{-34} \text{ J s} = 4.135667 \times 10^{-15} \text{ eV s}$$

$$\hbar c = 1.97326961 \times 10^{-11} \text{ MeV cm}$$

Electron charge:

$$e = 1.602176 \times 10^{-19} \text{ C}$$

$$\frac{e^2}{4\pi\epsilon_0} = 1.4399759 \times 10^{-13} \text{ MeV cm}$$

Atomic mass unit:

$$1 \text{ u} = 931.494 \text{ MeV/c}^2$$

Electron mass:

$$m_e = 0.511 \text{ MeV/c}^2$$

Boltzmann's constant:

$$k_B = 8.617 \times 10^{-11} \text{ MeV/K}$$

$$1 \text{ eV}/k_B = 1.1605 \times 10^4 \text{ K}$$

Nuclear Radius:

$$r \approx 1.3 \text{ fm} \times A^{1/3} = 1.3 \times 10^{-15} \text{ m} \times A^{1/3}$$

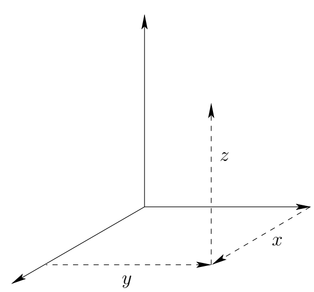
Source: NIST CODATA (`http://physics.nist.gov/cuu/Constants/index.html`).

Chapter 2

Some useful mathematical formulas and properties

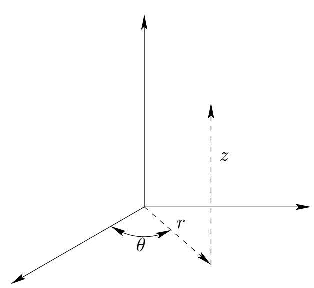
2.1 Laplacian operator $\left(\nabla^2\right)$

- Cartesian coordinates:



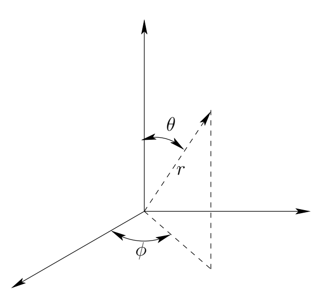
$$\nabla^2 = \frac{\partial^2}{\partial^2 x} + \frac{\partial^2}{\partial^2 y} + \frac{\partial^2}{\partial^2 z} \tag{2.1}$$

- Cylindrical coordinates:



$$\nabla^2 = \frac{1}{r}\frac{\partial}{\partial r} r \frac{\partial}{\partial r} + \frac{1}{r^2}\frac{\partial^2}{\partial^2 \theta} + \frac{\partial}{\partial^2 z} \tag{2.2}$$

- Spherical coordinates:



$$\nabla^2 = \frac{1}{r^2}\frac{\partial}{\partial r} r^2 \frac{\partial}{\partial r} + \frac{1}{r^2 \sin\theta}\frac{\partial}{\partial \theta}\left(\sin\theta \frac{\partial}{\partial\theta}\right) + \frac{1}{r^2 \sin^2\theta}\frac{\partial^2}{\partial^2 \phi} \tag{2.3}$$

2.2 Taylor series expansion

$$f(x) = f(x_0) + f'(x_0)\,(x - x_0) + \frac{1}{2!} f''(x_0)\,(x - x_0)^2 + \ldots \tag{2.4}$$

2.3 Legendre polynomials

- Defining equation:

$$\left(1 - x^2\right) f''(x) - 2x f'(x) + \ell(\ell+1) f(x) = 0, \quad l = \text{integer} \tag{2.5}$$

- Rodrigues' formula:

$$P_\ell(x) = \frac{1}{2^\ell \ell!}\frac{d^\ell}{d^\ell}\left(x^2 - 1\right)^\ell \tag{2.6}$$

- First Legendre polynomials:

$$\begin{aligned} P_0(x) &= 1 & P_4(x) &= \frac{1}{8}\left(35x^4 - 30x^2 + 3\right) \\ P_1(x) &= x & P_5(x) &= \frac{1}{8}\left(63x^5 - 70x^3 + 15x\right) \\ P_2(x) &= \frac{1}{2}\left(3x^2 - 1\right) & P_6(x) &= \frac{1}{16}\left(231x^6 - 315x^4 + 105x^2 - 5\right) \\ P_3(x) &= \frac{1}{2}\left(5x^3 - 3x\right) & P_7(x) &= \frac{1}{16}\left(429x^7 - 693x^5 + 315x^3 - 35x\right) \end{aligned}$$

- Orthogonality of Legendre polynomials:

$$\int_{-1}^{1} dx P_\ell(x) P_{\ell'}(x) = \frac{2}{2\ell + 1}\delta_{\ell\ell'} \tag{2.7}$$

- Recurrence formulas:

$$P'_{\ell+1}(x) - x P'_\ell(x) = (\ell + 1)\, P_\ell(x) \tag{2.8}$$

$$(\ell + 1)\, P_{\ell+1}(x) - (2\ell + 1)\, x P_\ell(x) + \ell P_{\ell-1}(x) = 0 \tag{2.9}$$

$$x P'_\ell(x) - P'_{\ell-1}(x) = \ell P_\ell(x) \tag{2.10}$$

Source: Spiegel, Lipschutz, Liu. Mathematical Handbook of Formulas and Tables. McGraw Hill.

Chapter 3

A useful triangle in relativity

Contributed by Abraham Kestelman

Disclaimer: What follows does not have the pretension to be a lecture on the special theory of relativity. Furthermore, we will not delve into the exact definition of terms like mass, rest mass, etc., and we will ignore the fact that strictly speaking, mass is considered to be an invariant in relativity, given by the expression: $mc^2 = \sqrt{E^2 - (pc)^2}$. On the contrary, we will be loosely speaking of mass as usually referring to the rest mass of the object, m0, which is the Newtonian mass as measured by an observer moving along with the object. We then take from the special theory of relativity the well known formula that gives the "variation of mass" with speed (supposedly known to "everybody"), and from there we deduce a relationship that allows us to draw the triangle mentioned in the title.

With the reservations expressed above, we start with the formula given by the special theory of relativity which relates the mass m of a body with its speed v:

$$m = \frac{m_0}{\sqrt{1 - \dfrac{v^2}{c^2}}}$$

where c is the speed of light.

Multiplying this last equation by c^2, and taking into account that the linear momentum is given by $p = mv$, with some algebra we get:

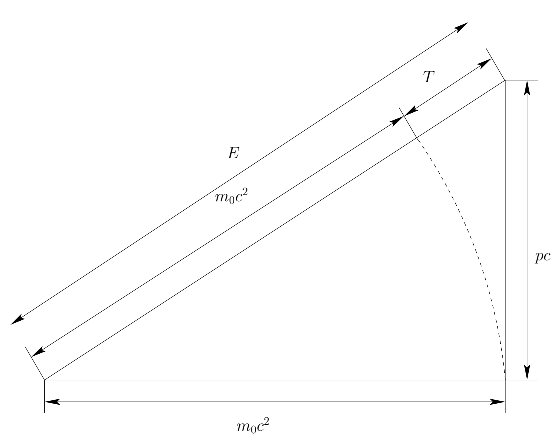
$$m^2c^4 = m_0^2c^4 + p^2c^2$$

that we can write as:

$$\left(mc^2\right)^2 = \left(m_0c^2\right)^2 + (pc)^2$$

This last expression is of the form: $a^2 = b^2 + c^2$ which defines a right triangle with a hypotenuse of length a. In our case the hypotenuse is mc^2 and the sides m_0c^2 and pc.

All this is shown in the following drawing, where we also show the kinetic energy, T, given by the difference between total energy and rest mass energy: $T = E - m_0c^2$



When faced with the question: "to solve this problem, do I use classical mechanics or do I have to use relativistic mechanics?", the answer is given by the shape of the triangle. Considering extreme cases: if the hypotenuse is almost horizontal, that is, $T \ll m_0c^2$, then the problem can be treated with classical mechanics; on the contrary, if the hypotenuse is almost vertical, $T \gg m_0c^2$, the problem has to be treated with relativistic mechanics. In brief, and for in between cases:

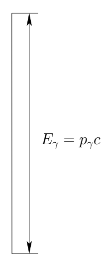
$$T \ll m_0c^2 \longrightarrow \text{use classical mechanics}$$
$$T \gtrsim m_0c^2 \longrightarrow \text{use relativistic mechanics}$$

For instance, we will see that the mass of the electron (in units commonly used in atomic and nuclear physics) is $m_e = 511$ keV, and that the kinetic energy of, say an electron emitted in a β decay, is usually of the order of 1 or 2 MeV. Then, for treating most electrons we have to use relativistic mechanics (1 or $2 \gtrsim 0.511$). However, we can use classical mechanics for an electron typical of an atomic transition which usually have a kinetic energy in the order of a few eV (few eV $\ll 511000$ eV). On the other hand, using the same units, a proton has a mass of 938 Mev ($1836m_e$) and usually we are concerned with protons and neutrons with kinetic energies below, say, 50 MeV. Therefore, when treating protons and neutrons (a neutron has a mass approximately equal to that of a proton) we usually use ($50 \ll 938$).

Another example in the use of the triangle: We want to know the expression of the linear momentum p, as a function of the kinetic energy T in relativity. From the triangle above, and straightforward algebra:

$$(pc)^2 = \left(T + m_0c^2\right)^2 - \left(m_0c^2\right)^2 = T^2 + 2m_0c^2T = \left(1 + \frac{2m_0c^2}{T}\right)$$
$$\therefore\ p = \frac{T}{c}\sqrt{1 + \frac{2m_0c^2}{T}}$$

From the expression $m = \dfrac{m_0}{\sqrt{1 - \dfrac{v^2}{c^2}}}$ we note that an object with mass cannot accelerate to the speed of light $v = c$. However, a massless object, like a photon, always moves exactly at the speed of light: for a photon with linear momentum p_γ, energy E_γ and mass $m_0 = 0$ the triangle above reduces to:



Remembering the known expression for the energy of a gamma ray, $E_\gamma = h\nu$, and observing the drawing above, we can write:

$$E_\gamma = h\nu = p_\gamma c \therefore p_\gamma \frac{h\nu}{c} = \frac{h}{\lambda} \therefore \lambda = \frac{h}{p_\lambda}$$

Where h is Planck's constant and where we have used the known relationship: $\lambda = \dfrac{c}{\nu}$.

In 1924 de Broglie postulated that the last expression, $\lambda = \dfrac{h}{p_\gamma}$, valid for an electromagnetic wave, is also valid for a massive particle. That is, that the wavelength associated with an electron, say, is given by the expression:

$$\lambda_e = \frac{h}{p_e}$$

(this is called the de Broglie wavelength).

This bold hypothesis of de Broglie postulating that particles could have wave-like properties, was confirmed through a famous experiment performed by Davisson and Germer in 1927. By firing electrons at a crystalline nickel target, they were able to show a diffraction pattern in the path of the electrons scattered by the atoms in the nickel surface.

The de Broglie hypothesis showed that wave particle duality was not merely the behavior of light, but rather was a fundamental principle exhibited by both radiation and matter. As such, it becomes possible to use wave equations to describe material behavior, so long as one properly applies the de Broglie wavelength.

Chapter 4

Mass attenuation and mass energy absorption coefficients

In the following figures the total (μ/ρ) and partial mass attenuation coefficients are plotted for Hydrogen, Carbon, Nitrogen, Oxygen, Copper, Tin, Lead, and Uranium. Partial mass attenuation coefficients are plotted for photoelectric absorption, coherent and incoherent (Compton) scattering, and pair production. The mass absorption energy coefficient (μ_{en}/ρ) is also plotted for the same materials.

Sources:
NIST X-COM Database (`http://www.nist.gov/pml/data/xcom/index.cfm/`)
NIST X-Ray Mass Attenuation Coefficients (`http://www.nist.gov/pml/data/xraycoef/index.cfm/`)
NIST also distributes a program (XCOM) to tabulate and plot mass attenuation coefficients.

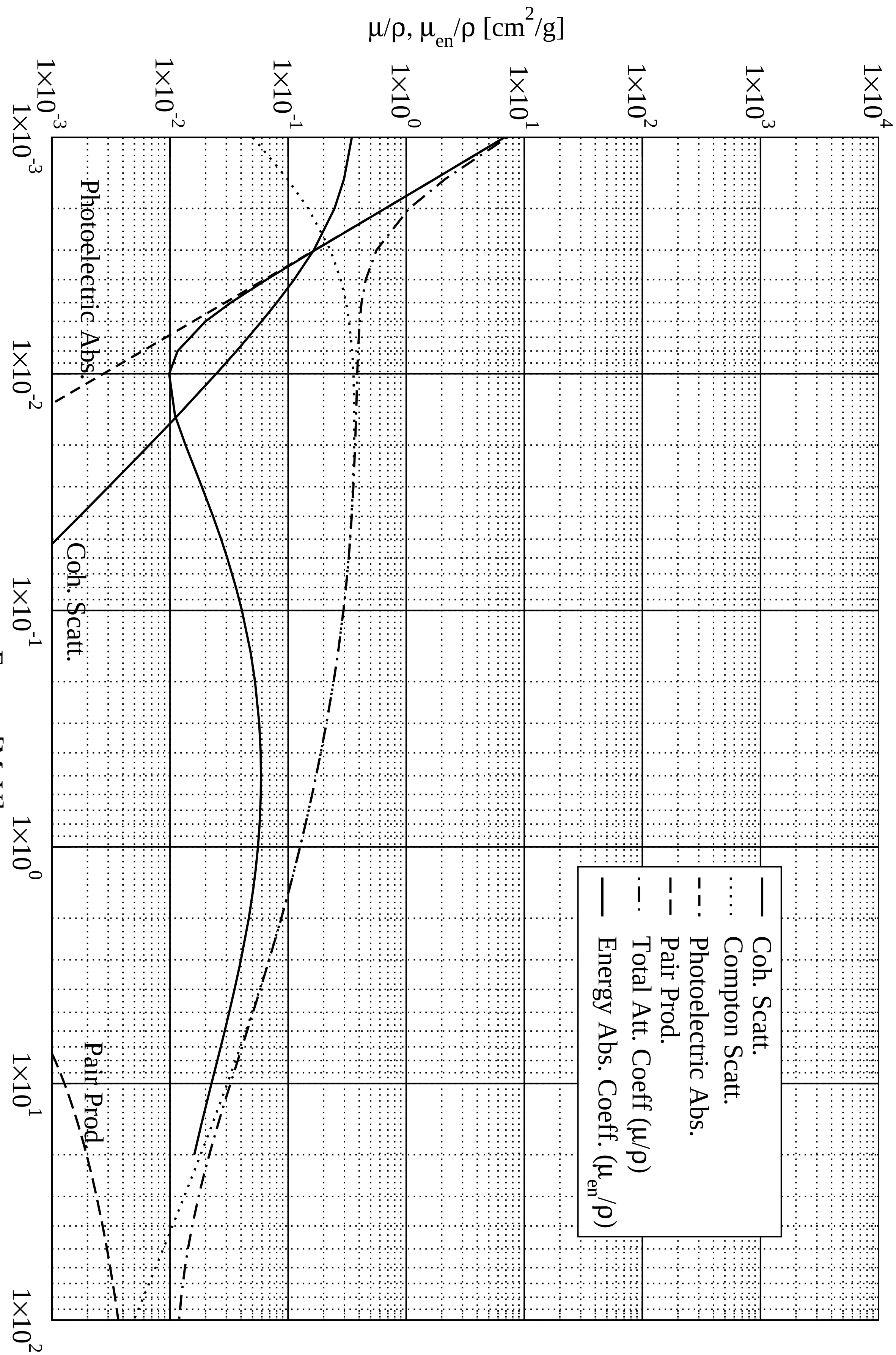


Figure 4.1: Mass attenuation (μ/ρ) and mass energy absorption coefficient (μ_{en}/ρ) for Hydrogen, $Z = 1$.

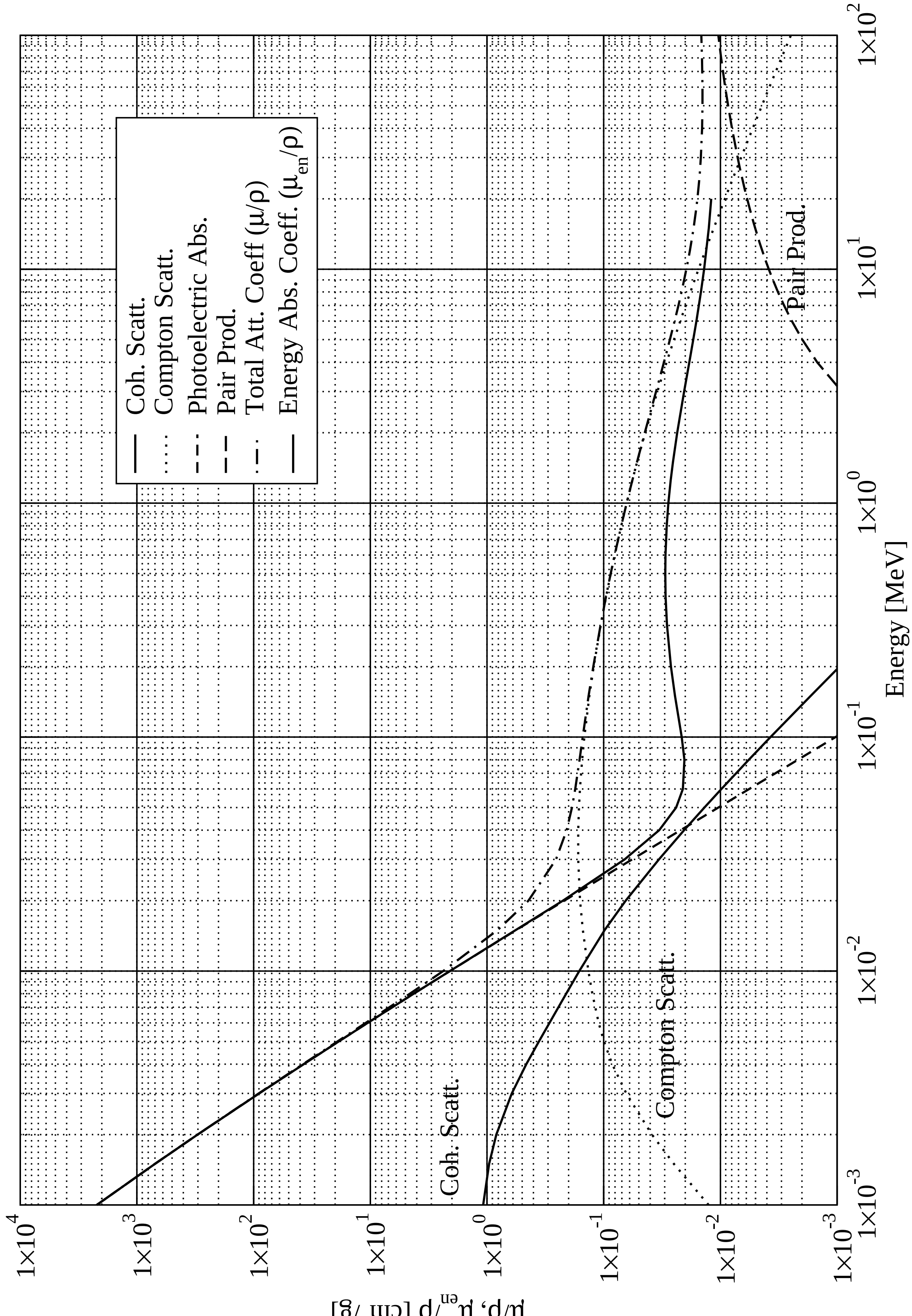


Figure 4.2: Mass attenuation (μ/ρ) and mass energy absorption coefficients (μ_{en}/ρ) for Carbon, $Z = 6$.

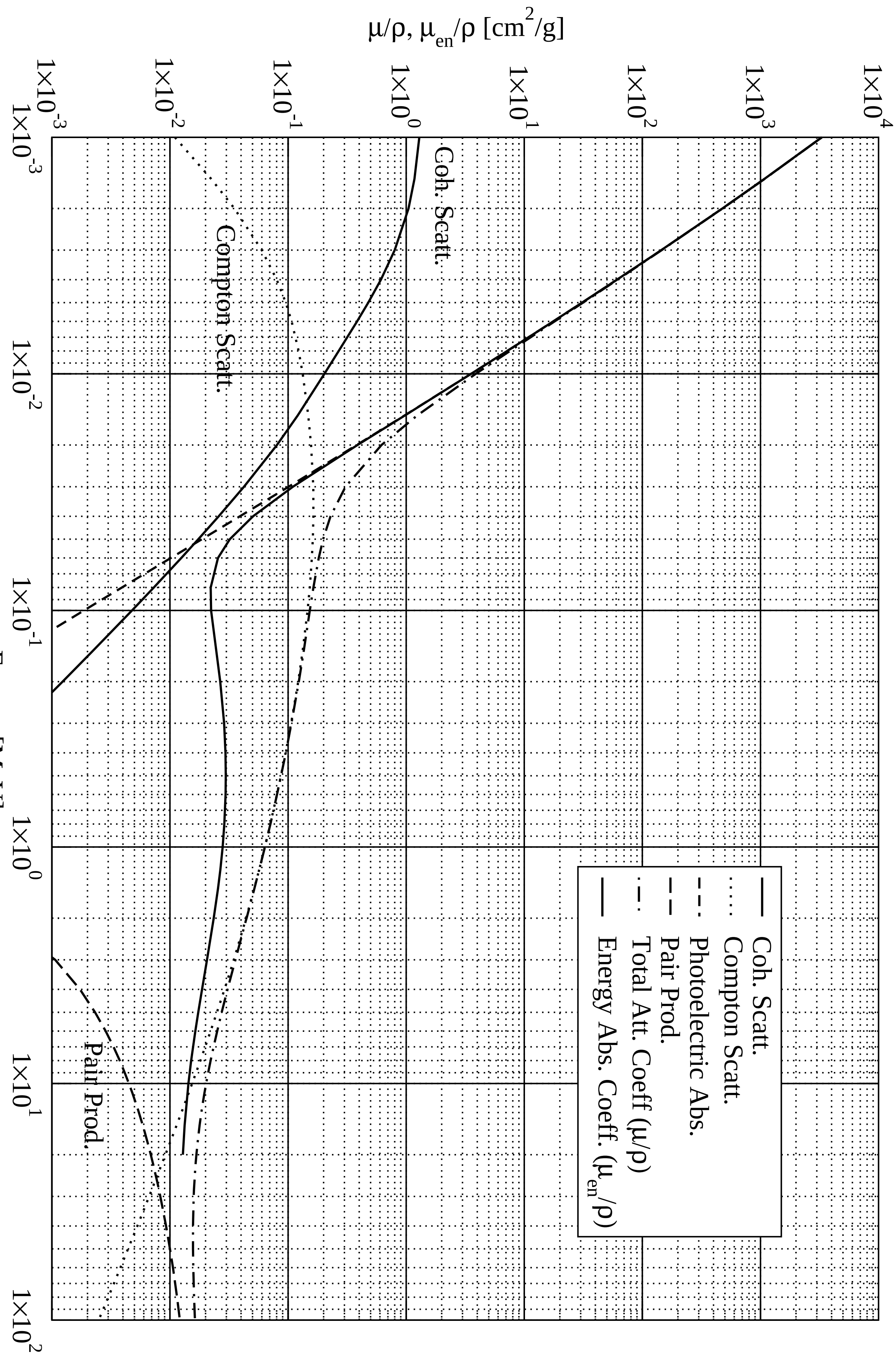


Figure 4.3: Mass attenuation (μ/ρ) and mass energy absorption coefficients (μ_{en}/ρ) for Nitrogen, $Z = 7$.

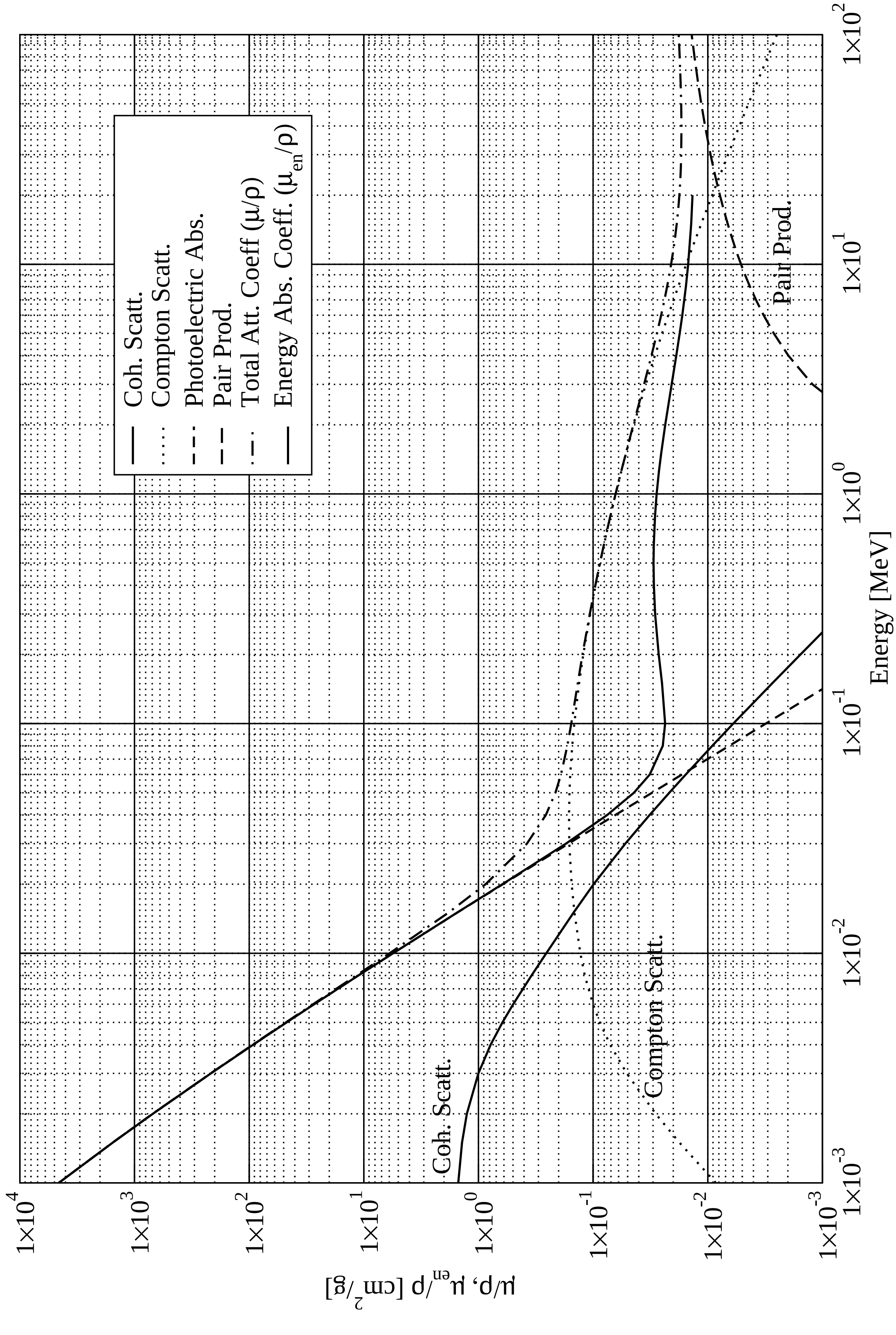


Figure 4.4: Mass attenuation (μ/ρ) and mass energy absorption coefficients (μ_{en}/ρ) for Oxygen, $Z = 8$.

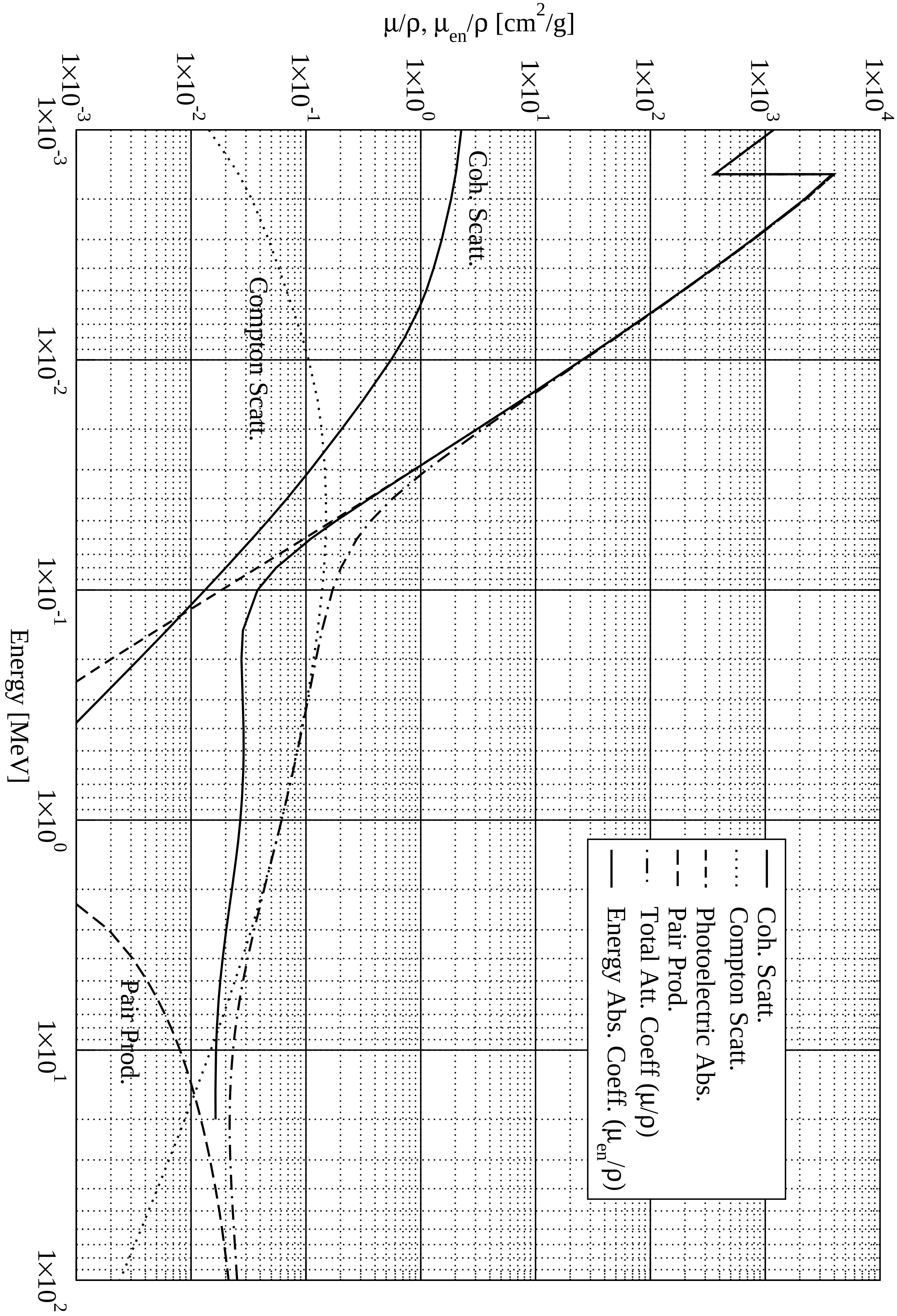


Figure 4.5: Mass attenuation (μ/ρ) and mass energy absorption coefficients (μ_{en}/ρ) for Alumimum, $Z = 13$.

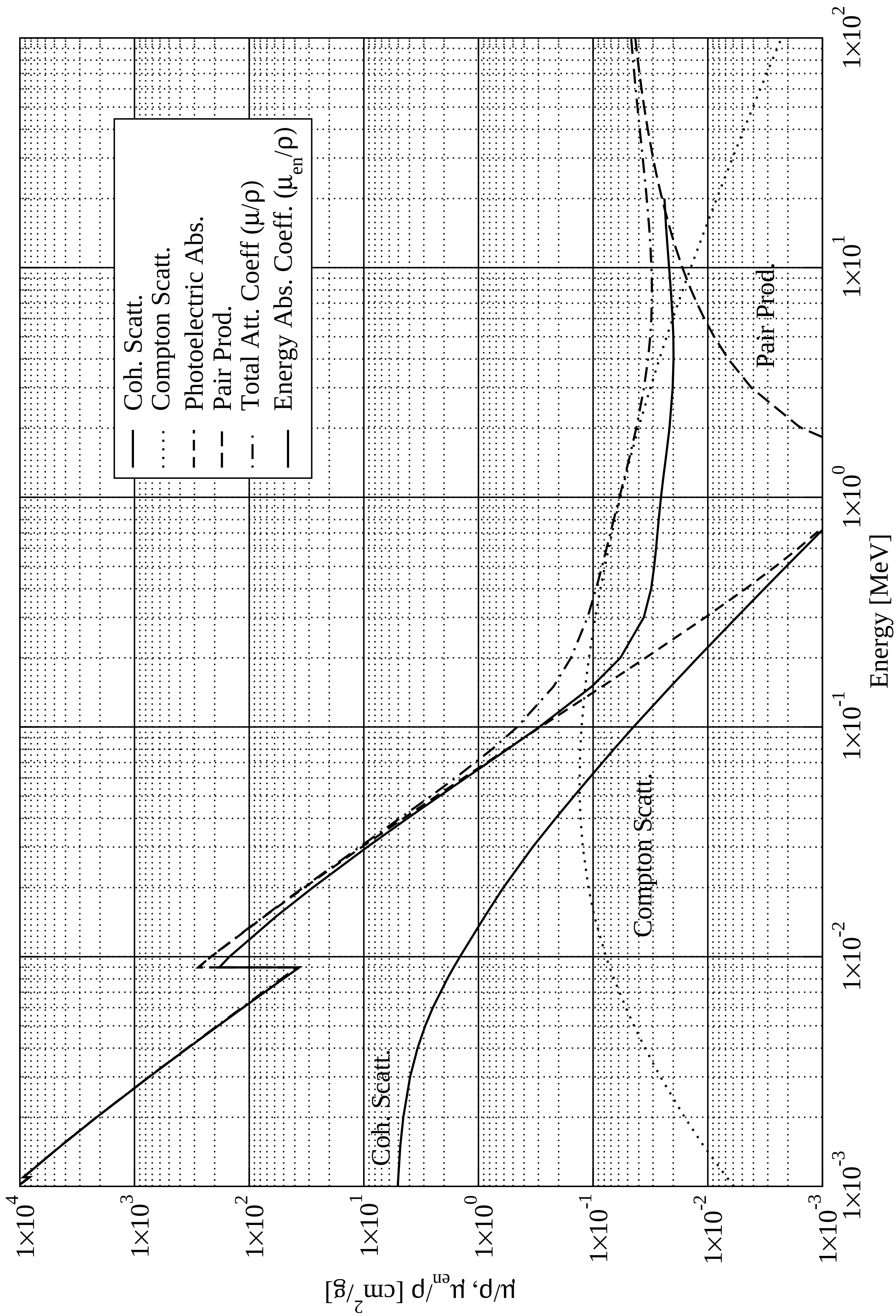


Figure 4.6: Mass attenuation (μ/ρ) and mass energy absorption coefficients (μ_{en}/ρ) for Copper, $Z = 29$.

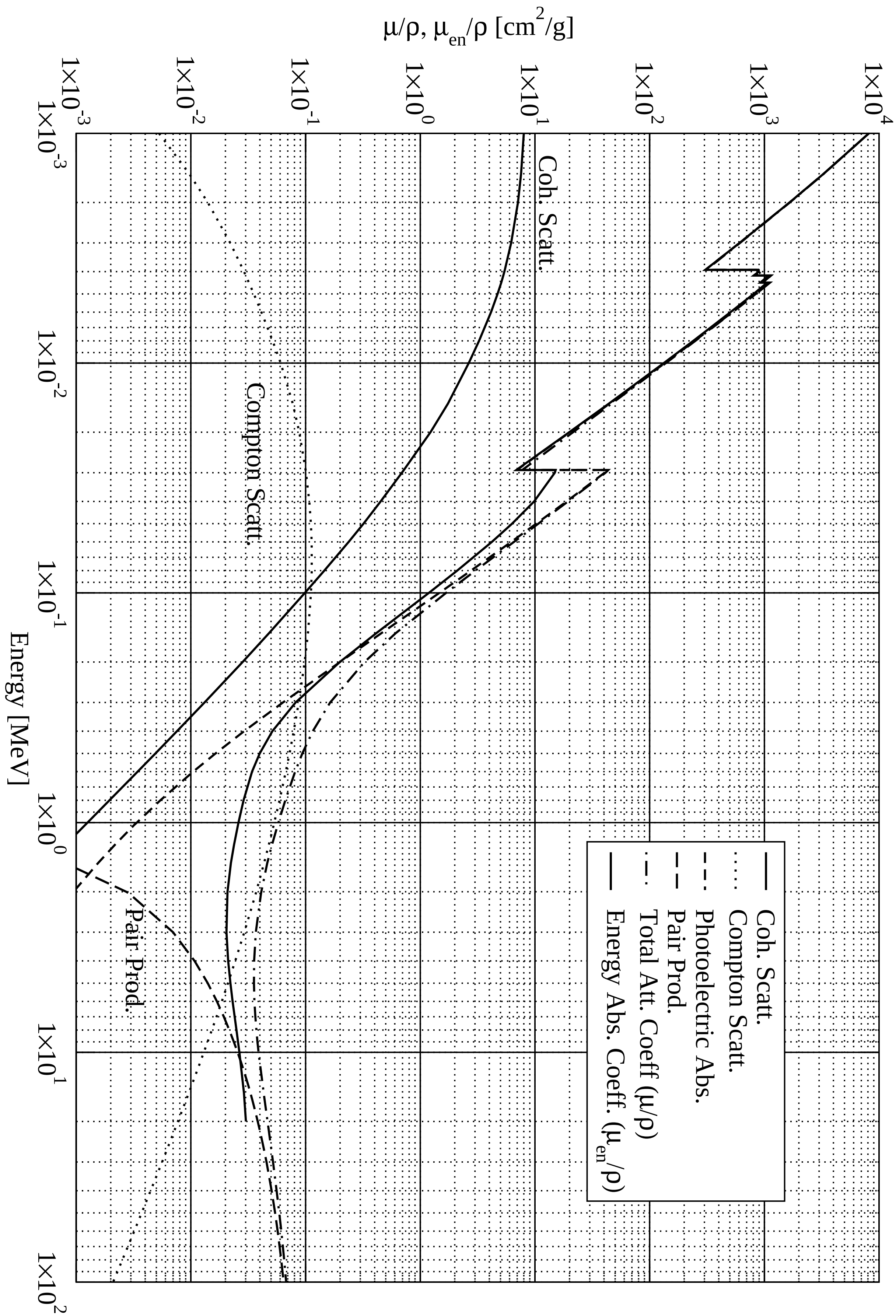


Figure 4.7: Mass attenuation (μ/ρ) and mass energy absorption coefficients (μ_{en}/ρ) for Tin, $Z = 50$.

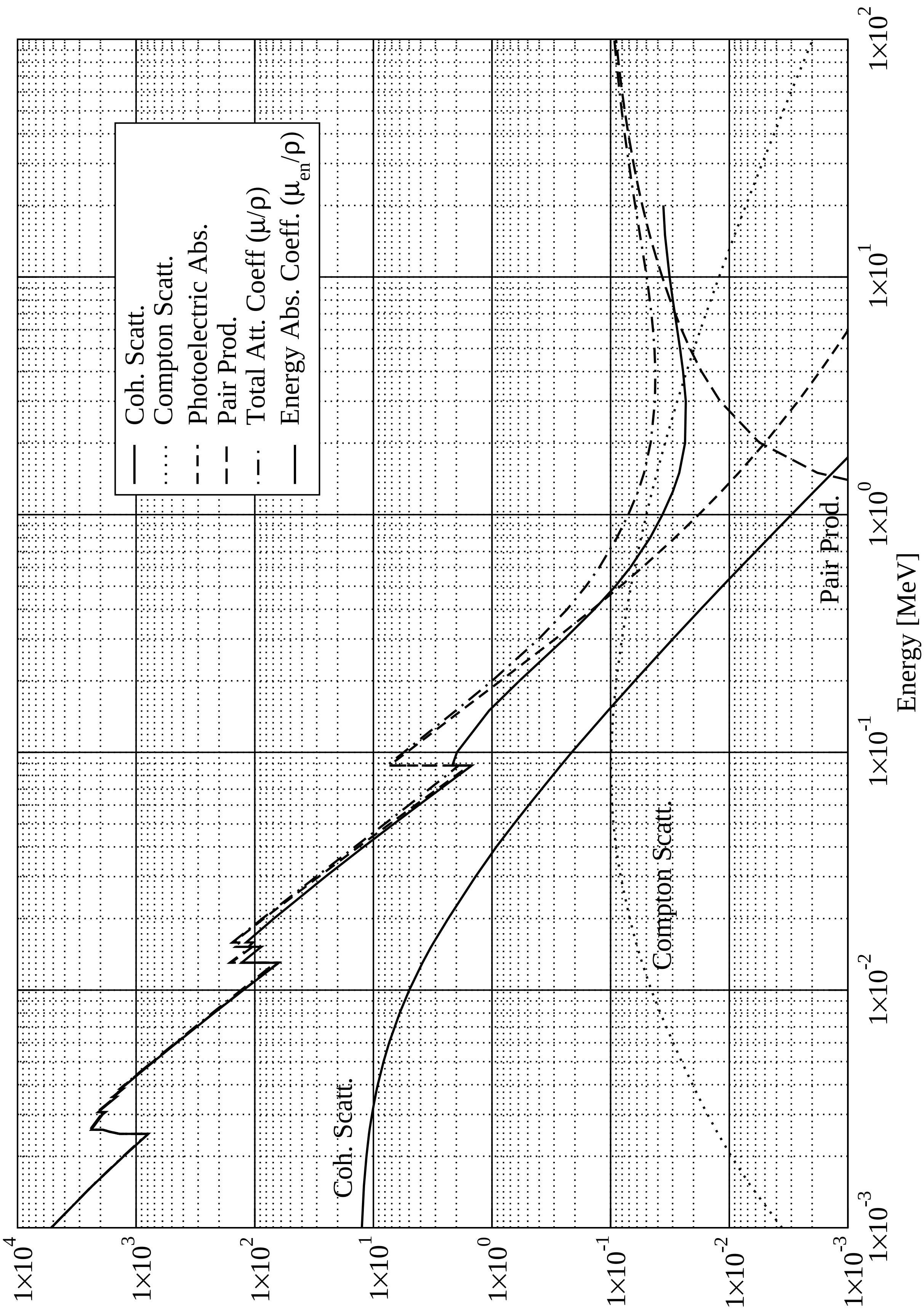


Figure 4.8: Mass attenuation (μ/ρ) and mass energy absorption coefficients (μ_{en}/ρ) for Lead, $Z = 82$.

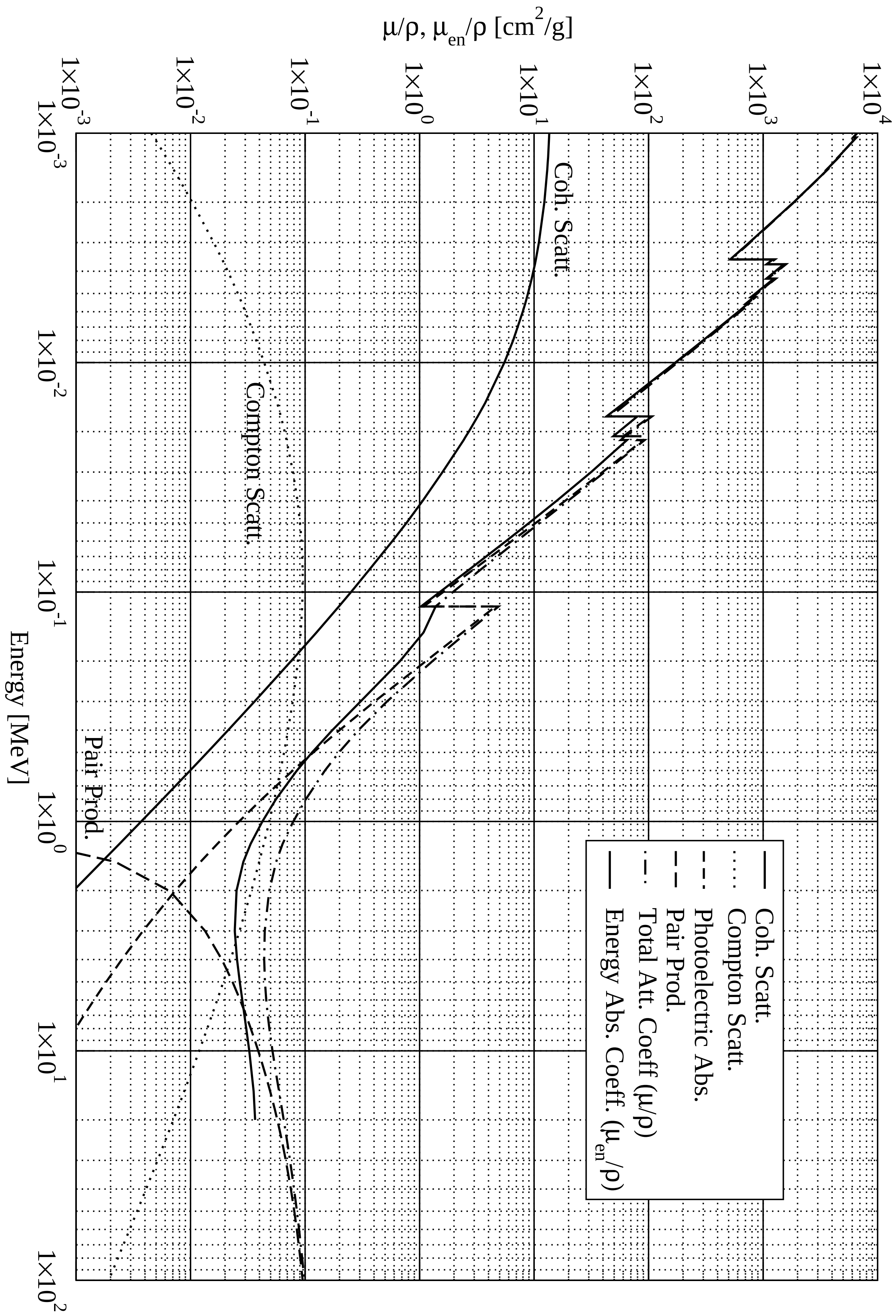


Figure 4.9: Mass attenuation (μ/ρ) and mass energy absorption coefficients (μ_{en}/ρ) for Uranium, $Z = 92$.

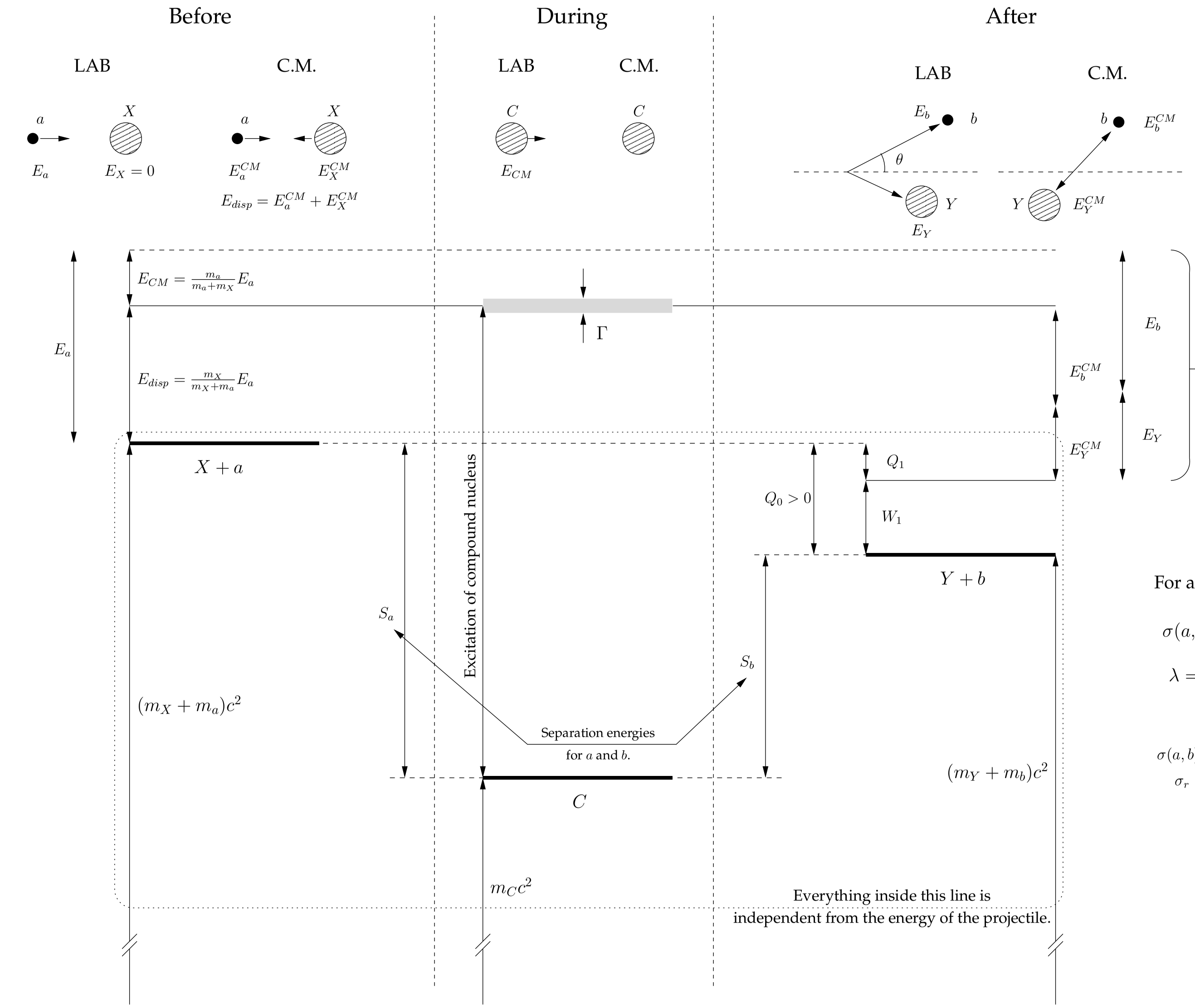
Chapter 5

Energy diagrams

Compound nucleus reaction can be understood as a three stage process on which an excited nucleus is formed by the absorption of the incident particle, followed by the decay of this nucleus.

Conservation of mass-energy in these processes can be visualized in the following diagram. Below the diagram, the *Q equation* for non-relativistic collisions is shown. This equation combines conservation of energy and linear momentum for collisions for a target that is at rest in the laboratory system.

Source: Meyerhof, W. Elements of Nuclear Physics. McGraw-Hill, 1967.



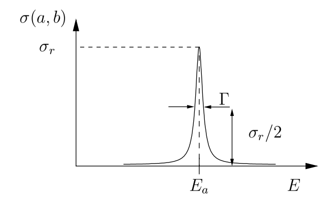
The distribution among E_b y E_Y is given by the conservation of linear momentum.

For a reaction with a resonance at E_a:

$$\sigma(a,b) = g_J \left(\frac{\lambda}{2\pi}\right)^2 \frac{\Gamma_a \Gamma_b}{\Gamma^2/4 + (E - E_1)^2}$$

$$\lambda = \frac{h}{p_a^{CM}} = \frac{h}{\sqrt{2 m_a E_{disp}}} = \frac{hc}{\sqrt{2 m_a c^2 E_{disp}}}$$

$$\Gamma = \Gamma_a + \Gamma_b + ...$$



$$Q_0 = Q_1 + W_1$$

$$Q_1 = E_b + E_Y - E_a$$

$$m_X + m_a = m_Y + m_b + Q_0/c^2$$

$$Q_0 = \Delta(m_X) + \Delta(m_a) - \Delta(m_Y) - \Delta(m_b)$$

$$Q_1 = \left(1 + \frac{m_b}{m_Y}\right) E_b - \left(1 - \frac{m_a}{m_Y}\right) E_a - \frac{2\sqrt{m_a m_b}}{m_Y} \sqrt{E_a}\sqrt{E_b} \cos\theta$$

Diagram for the exoergic reaction $X(a,b)Y^*$ in which particle a impinges with energy E_a on target X, which is at rest. The reaction produces an energy Q_1, emits particle b with energy E_b at an angle θ and leaves nucleus Y with excitation W_1. Nucleus Y recoils with energy E_Y.

Chapter 6

X-ray and gamma standards

The following table presents the recommended values of decay parameters of many common radionuclides routinely used for X-ray and gamma-ray detector calibration. For each radionuclide the following parameters are listed:

- Decay mode.
- Half life $(T_{1/2}))$ in days.
- ID of the spectral line, in the case of X-rays.
- Energy of the γ or X-ray in keV.
- Emission probability (# of photons emitted per parent decay).

Source: X-ray and gamma-ray standards for detector calibration. IAEA-TECDOC-619 (1991). (http://www-nds.iaea.org/publications/tecdocs/iaea-tecdoc-0619.pdf).

Note: it must be noted that for technical applications, the information contained in this chapter has been superseded by new IAEA-NDS X Ray and Gamma standards (http://www-nds.iaea.org/xgamma_standards/)

Table 6.1: X-ray and gamma standards.

Nuclide	Decay Mode	$T_{1/2}$	XR ID	E [keV]	Emission Prob.
22Na	EC	950.8(9)		1274.542(7)	0.99935(15)
		[major 511.033 annihiliation radiation]			
24Na	β^-	0.62356(17)		1368.633(6)	0.999936(15)
				2754.030(14)	0.99855(5)
26Sc	β^-	83.79(4)		889.277(3)	0.999844(16)
				1120.545(4)	0.999874(11)
51Cr	EC	27.706(7)	VKa	4.95	0.201(3)
			VKx	4.95 - 5.43	0.228(3)
			VKβ	5.43	0.027(1)
				320.0842(9)	0.0986(5)
54Mn	EC	312.3(4)	CrKa	5.41	0.226(7)
			CrKx	5.41 - 5.95	0.256(8)
			CrKβ	5.95	0.030(1)
				834.843(6)	0.999758(24)
55Fe	EC	999(8)	MnKx	5.89 - 6.49	0.283(10)
			MnKa	5.89	0.249(9)
			MnKβ	6.49	0.034(1)
56Co	EC	77.31(19)		846.764(6)	0.99933(7)
				1037.884(4)	0.1413(5)
				1175.099(8)	0.02239(11)
				1238.287(6)	0.6607(19)
				1360.206(6)	0.04256(15)
				1771.350(15)	0.1549(5)
				2015.179(11)	0.03029(13)
				2034.759(11)	0.07771(27)
				2598.460(10)	0.1696(6)
				3201.954(14)	0.0313(9)
				3253.417(14)	0.0762(24)
				3272.998(14)	0.0178(6)
				3451.154(13)	0.0093(4)
				3548.27(10)	0.00178(9)
57Co	EC	271.79(9)	FeKa	6.4	0.510(7)
			FeKx	6.40 - 7.06	0.579(8)
			FeKβ	7.06	0.069(1)
				14.4127(4)	0.0916(15)
				122.0614(3)	0.8560(17)
				136.4743(5)	0.1068(8)
58Co	EC	70.86(7)	FeKx	6.40 - 7.06	0.267(3)
			FeKa	6.4	0.235(3)
			FeKβ	7.06	0.032(1)
				810.775(9)	0.9945(1)
60Co	β^-	1925.5(5)		1173.238(4)	0.99857(22)

Continued on next page

Table 6.1 – *Continued from previous page*

Nuclide	Decay Mode	$T_{1/2}$	XR ID	E [keV]	Emission Prob.
				1332.502(5)	0.99983(6)
65Zn	EC	244.26(26)	CuKa	8.03 - 8.05	0.341(6)
			CuKx	8.03 - 8.91	0.387(6)
			CuKβ	8.91	0.046(1)
				1115.546(4)	0.5060(24)
75Se	EC	119.64(24)	AsKa	10.51 - 10.54	0.493(11)
			AsKx	10.51 - 11.95	0.568(13)
			AsKβ	11.72 - 11.95	0.075(2)
				96.7344(10)	0.0341(4)
				121.1171(14)	0.171(1)
				136.0008(6)	0.588(3)
				264.6580(17)	0.590(2)
				279.5431(22)	0.250(1)
				400.6593(13)	0.115(1)
85Sr	EC	64.849(4)	RbKx	13.34 - 15.29	0.587(4)
			RbKa	13.34 - 13.40	0.500(3)
			RbKβ	14.96 - 15.29	0.087(2)
				514.0076(22)	0.984(4)
88Y	EC	106.63(25)	SrKx	14.10 - 16.19	0.616(7)
			SrKa	14.10 - 14.17	0.522(6)
			SrKβ	15.83 - 16.19	0.094(2)
				898.042(4)	0.940(3)
				1836.063(13)	0.9936(3)
93mNb	IT	5890(50)	NbKx	16.52 - 19.07	0.1104(35)
			NbKa	16.52 - 16.62	0.0925(30)
			NbKβ	18.62 - 19.07	0.0179(7)
94Nb	β^-	7.3(9) $\times$ 106		702.645(6)	0.9979(5)
				871.119(4)	0.9986(5)
95Nb	β^-	34.975(7)		765.807(6)	0.9981(3)
109Cd	EC	462.6(7)	AgKa	21.99 - 22.16	0.821(9)
			AgKx	21.99 - 25.60	0.994(10)
			AgKβ	24.93 - 25.60	0.173(3)
				88.0341(11)	0.0363(2)
111In	EC	2.8047(5)	CdKa	22.98 - 23.17	0.684(5)
			CdKx	22.98 - 26.80	0.830(5)
			CdKβ	26.09 - 26.80	0.146(3)
				171.28(3)	0.9078(10)
				245.35(4)	0.9416(6)
113Sn	EC	115.09(4)	InKx	24.00 - 28.02	0.968(6)
			InKa	24.00 - 24.21	0.796(6)
			InKβ	27.27 - 28.02	0.172(3)

Continued on next page

Table 6.1 – *Continued from previous page*

Nuclide	Decay Mode	$T_{1/2}$	XR ID	E [keV]	Emission Prob.
				391.702(4)	0.6489(13)
125Sb	β^-	1007.7(6)		176.313(1)	0.0685(7)
				380.452(8)	0.01518(16)
				427.875(6)	0.297(3)
				463.365(5)	0.1048(11)
				600.600(4)	0.1773(18)
				606.718(3)	0.0500(5)
				635.954(5)	0.1121(12)
125I	EC	59.43(6)	TeKa	27.20 - 27.47	1.135(21)
			TeKx	27.20 - 31.88	1.390(25)
			TeKβ	30.98 - 31.88	0.255(6)
				35.4919(5)	0.0658(8)
134Cs	β^-	754.28(22)		475.364(3)	0.0149(2)
				563.240(4)	0.0836(3)
				569.328(3)	0.1539(6)
				604.720(3)	0.9763(6)
				795.859(5)	0.854(3)
				801.948(5)	0.0869(3)
				1038.610(7)	0.00990(5)
				1167.968(5)	0.01792(7)
				1365.185(7)	0.03016(11)
137Cs	β^-	1.102(6) × 104	BaKa	31.82 - 32.19	0.0566(16)
			BaKx	31.82 - 37.45	0.0700(20)
			BaKβ	36.36 - 37.45	0.0134(5)
				661.660(3)	0.851(2)
133Ba	EC	3862(15)	CsKa	30.63 - 30.97	0.980(14)
			CsKx	30.63 - 36.01	1.210(16)
			CsKβ	34.97 - 36.01	0.230(5)
				80.998(5)	0.3411(28)
				276.398(1)	0.07147(30)
				302.853(1)	0.1830(6)
				356.017(2)	0.6194(14)
				383.851(3)	0.08905(29)
139Ce	EC	137.64(23)	LaKa	33.03 - 33.44	0.643(18)
			LaKx	33.03 - 38.93	0.797(22)
			LaKβ	37.78 - 38.93	0.154(5)
				165.857(6)	0.7987(6)
152Eu	EC	4933(11)	SmKx	39.52 - 46.82	0.740(12)
			(Sm+Gd)Kx	39.52 - 50.21	0.748(12)
			SmKa	39.52 - 40.12	0.591(12)
			GdKa	42.31 - 43.00	0.00648(22)
			GdKx	42.31 - 50.21	0.00824(28)
			SmKβ	45.38 - 46.82	0.149(3)
			GdKβ	48.65 - 50.21	0.00176(18)
				121.7824(4)	0.2837(13)

Continued on next page

Table 6.1 – *Continued from previous page*

Nuclide	Decay Mode	$T_{1/2}$	XR ID	E [keV]	Emission Prob.
				244.6989(10)	0.0753(4)
				344.2811(19)	0.2657(11)
				411.126(3)	0.02238(10)
				443.965(4)	0.03125(14)
				778.903(6)	0.1297(6)
				867.390(6)	0.04214(25)
				964.055(4)	0.1463(6)
				1085.842(4)	0.1013(5)
				1089.767(14)	0.01731(9)
				1112.087(6)	0.1354(6)
				1212.970(13)	0.01412(8)
				1299.152(9)	0.01626(11)
				1408.022(4)	0.2085(9)
154Eu	β^-	3136.8(29)	GdKx	42.31 - 50.21	0.256(6)
			GdKa	42.31 - 43.00	0.205(6)
			GdKβ	48.65 - 50.21	0.051(2)
				123.071(1)	0.412(5)
				247.930(1)	0.0695(9)
				591.762(5)	0.0499(6)
				692.425(4)	0.0180(3)
				723.305(5)	0.202(2)
				756.804(5)	0.0458(6)
				873.190(5)	0.1224(15)
				996.262(6)	0.1048(13)
				1004.725(7)	0.182(2)
				1274.436(6)	0.350(4)
				1494.048(9)	0.0071(2)
				1596.495(18)	0.0181(2)
155Eu	β^-	1770(50)			
198Au	β^-	2.6943(8)	HgKx	68.89 - 82.78	0.0280(10)
			HgKa	68.89 - 70.82	0.0219(8)
			HgKβ	80.12 - 82.78	0.0061(3)
				411.8044(11)	0.9557(47)
204Hg	β^-	46.595(13)	TlLx	8.95 - 14.40	0.060(12)
			TlKa2	70.83 0.038(2)	
			TlKx	70.83 - 85.19	0.130(4)
			TlKa1	72.87 0.064(2)	
			TlKβ'1	82.43 0.022(1)	
			TlKβ'2	85.19 0.0063(3)	
				279.1967(12)	0.8148(8)
207Bi	EC	1.16(7) × 104	PbLx	9.19 - 14.91	0.325(13)
			PbKx	72.80 - 87.63	0.777(26)
			PbKa2	72.8	0.226(12)
			PbKa1	74.97	0.382(20)
			PbKβ'1	84.79	0.130(10)
			PbKβ'2	87.63	0.039(3)
				569.702(2)	0.9774(3)
				1063.662(4)	0.745(2)

Continued on next page

Table 6.1 – *Continued from previous page*

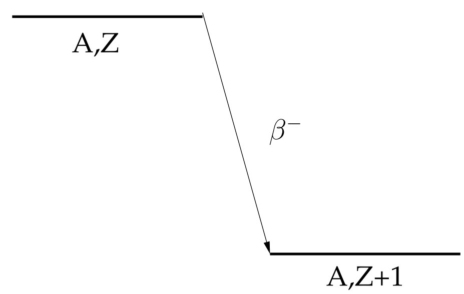
Nuclide	Decay Mode	$T_{1/2}$	XR ID	E [keV]	Emission Prob.
				1770.237(9)	0.0687(4)
228Th	α	698.2(6)		84.373(3)	0.0122(2)
				238.632(2) *	0.435(4)
				240.987(6) *	0.0410(5)
				277.358(10) *	0.0230(3)
				300.094(10) *	0.0325(3)
				510.77(10) *	0.0818(10)
				583.191(2) *	0.306(2)
				727.330(9) *	0.0669(9)
				860.564(5) *	0.0450(4)
				1620.735(10) *	0.0149(5)
				2614.533(13) *	0.3586(6)
		* Indicates daughter in equilibrium with the parent radionuclide			
239Np	β^-	2.35(4)		106.123(2)	0.267(4)
				228.183(1)	0.1112(15)
				277.599(2)	0.1431(20)
241Am	α	1.5785(24) $\times$ 105	NpLl	11.871	0.0085(3)
			NpLa	13.927	0.132(4)
			NpLβ'	17.611	0.194(6)
			NpLh	-20.997	0.049(2)
				26.345(1)	0.024(1)
				59.537(1)	0.360(4)
243Am	α	2.69(8) $\times$ 106		43.53(1)	0.0594(11)
				74.66(1)	0.674(10)

Chapter 7

Beta decay

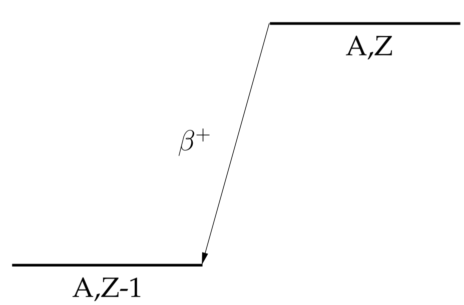
Source: Meyerhof, W. Elements of Nuclear Physics. McGraw-Hill, 1967.

7.1 Energetics of beta decay



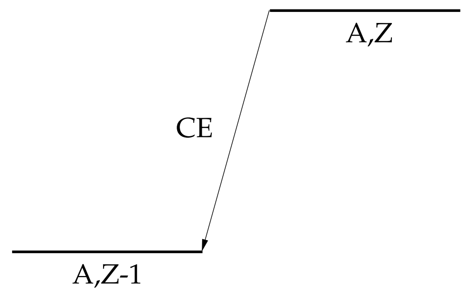
	β^- decay
	$(A, Z) \to (A, Z+1) + \beta^- + \bar{\nu}$
Atomic mass (Mass Excess Δ)	$M_A(A, Z) = M_A(A, Z+1) + m_e + Q - m_e$ $Q = \Delta(A, Z) - \Delta(A, Z+1)$

* * *



	β^+ decay
	$(A, Z) \to (A, Z-1) + \beta^+ + \nu$
Atomic mass (Mass Excess Δ)	$M_A(A, Z) = M_A(A, Z-1) + m_e + Q + m_e$ $Q = \Delta(A, Z) - \Delta(A, Z-1) - 2m_e$

* * *



	EC decay
	$(A,Z) + e^{-} \rightarrow (A,Z-1) + \nu$
Atomic mass (Mass Excess Δ)	$M_A(A,Z) + m_e = M_A(A,Z-1) + Q + m_e$ $Q = \Delta(A,Z) - \Delta(A,Z-1)$

Chapter 8

CSDA Range for protons

In the following figures range of protons in Carbon, Aluminum, Iron, Copper, Tin, Lead and Uranium. The range was computed using the *continuous slowing down approximation* (CSDA) which constitutes an upper bound of the real range.

The range for a different heavy charged particle i in the same materials can be approximated as:

$$R_i \simeq \frac{M_i}{z_i^2 M_p} R_{p^+}\bigg|_{E_{p^+}=\frac{M_p}{M}E_i} \tag{8.1}$$

Sources:
NIST PSTAR Database (`http://physics.nist.gov/PhysRefData/Star/Text/PSTAR.html`)

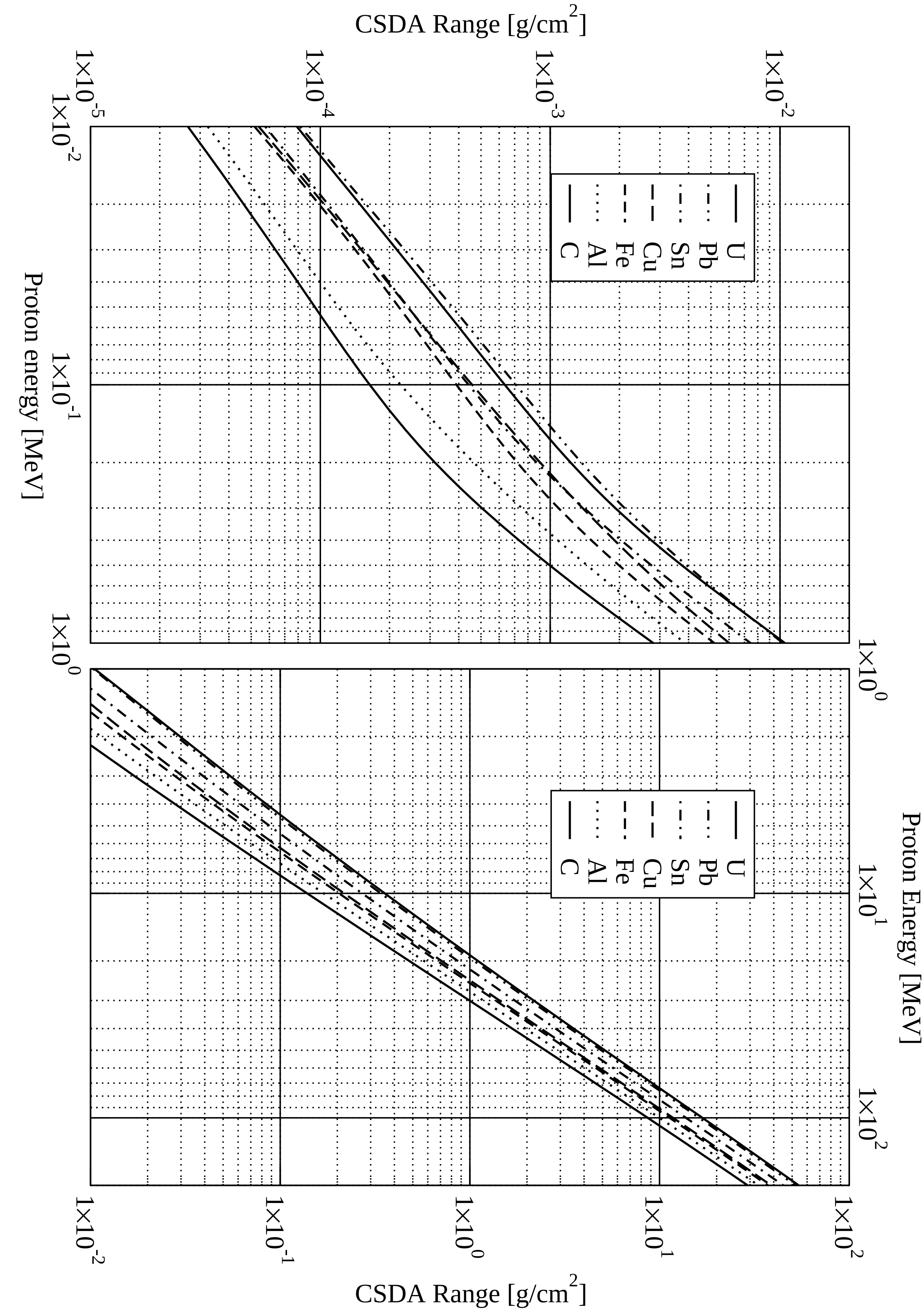


Figure 8.1: Mass attenuation (μ/ρ) and mass energy absorption coefficents (μ_{en}/ρ) for Nitrogen, $Z = 7$.

Chapter 9

How to compute number densities

Definitions:

N_i: number density of the element (isotope or molecule) i. Units: molecules/cm^3, atoms/cm^3
ρ_i: density of i. Units: grams/cm^3
n_i: number of moles of the molecule or atom i. Unit: mol.
m_i: mass of i. Unit: grams.
M_i: atomic weight of i. Units: atomic mass unit (u) or grams/mol.

By definition, atomic weight is:

$$M_i \equiv \frac{m_i}{n_i}$$

then, the moles number of i is:

$$n_i = \frac{m_i}{M_i}$$

In one mole of matter there are $N_A = 6.0221 \cdot 10^{23}$ particles. Then, the atomic density of i is:

$$N_i = \frac{\rho_i N_A}{M_i} \tag{9.1}$$

For doing this we need to know the density of i and its average atomic weight. As we usually work with mixtures, compounds or solutions we will learn how to compute this.

The weight fraction of i is:

$$w_i \equiv \frac{m_i}{\sum_j m_j}$$

and the mole or atomic fraction:

$$y_i \equiv \frac{n_i}{\sum_j n_j}$$

In general, the isotopic abundance is commonly written as an atomic fraction, and the enrichment is written as mass weight fraction (wt%)

Using these definitions, we can now calculate the average atomic weight for mixtures or compounds.

$$\bar{M} = \frac{m_{\text{total}}}{n_{\text{total}}} = \frac{\sum_j n_j M_j}{n_{\text{total}}} = \frac{n_{\text{total}} \sum_j y_j M_j}{n_{\text{total}}} = \sum_j y_j M_j \tag{9.2}$$

or also:

$$\bar{M} = \frac{m_{\text{total}}}{n_{\text{total}}} = \frac{m_{\text{total}}}{\sum_j m_j/M_j} = \frac{m_{\text{total}}}{m_{\text{total}} \sum_j w_j/M_j} = \frac{1}{\sum_j w_j/M_j} \tag{9.3}$$

In the case we need to convert from weight fraction to atomic fraction or viceversa, we can do:

$$w_i = \frac{m_i}{m_{\text{total}}} = \frac{n_i M_i}{\sum_j n_j M_j} = \frac{n_{\text{total}} y_i M_i}{n_{\text{total}} \sum_j y_j M_j} = \frac{y_i M_i}{\sum_j y_j M_j} = \frac{y_i M_i}{\bar{M}} \tag{9.4}$$

$$y_i = \frac{n_i}{n_{\text{total}}} = \frac{m_i/M_i}{\sum_j m_j/M_j} = \frac{m_{\text{total}} w_i/M_i}{m_{\text{total}} \sum_j w_j/M_j} = \frac{w_i/M_i}{\sum_j w_j/M_j} = \frac{w_i \bar{M}}{M_i}$$

Example:
UO_2 with 3% enrichment, and $\rho = 10$ g/cm^3.
We can calculate the isotopic masses of ^{235}U and ^{238}U using the mass delta from the Nuclear Wallet Card.

$$M_i = A + \Delta/931.5 \frac{\text{Mev/c}^2}{\text{g/mol}}$$

$$M_{235} = 235 \text{ g/mol} + \frac{40.914\text{Mev/c}^2}{931.5\frac{\text{Mev/c}^2}{\text{g/mol}}} = 235.0439 \text{ g/mol}$$

$$M_{238} = 238 \text{ g/mol} + \frac{47.304\text{Mev/c}^2}{931.5\frac{\text{Mev/c}^2}{\text{g/mol}}} = 238.0508 \text{ g/mol}$$

and the atomic weight for the oxygen is obtained from Nuclear Wallet Card, Appendix-I.

$$M_{\text{O}} = 15.9994 \text{ g/mol} \quad M_{235} = 235.0439 \text{ g/mol} \quad M_{238} = 238.0508 \text{ g/mol}$$

$$\bar{M}_{\text{U}} = \frac{1}{\varepsilon/M_{235} + (1-\varepsilon)/M_{238}} = \frac{1}{0.03/235.0439 \text{ g/mol} + 0.97/238.0508 \text{ g/mol}} = 237.9595 \text{ g/mol}$$

$$M_{\text{UO}_2} = M_{\text{U}} + 2M_{\text{O}} = 237.9595 \text{ g/mol} + 2 \cdot 15.999 \text{ g/mol} = 269.9583 \text{ g/mol}$$

Here, the small fraction of ^{234}U present -if any- was neglected. For low enriched uranium this is appropriate, but it might be important to take it into account if the enrichment is high.

Now, the number density of molecules of UO_2 is:

$$N_{\text{UO}_2} = \frac{10 \text{ g/cm}^3 \cdot 6.0221 \cdot 10^{23} 1/\text{mol}}{269.9583 \text{ g/mol}} = 2.2308 \cdot 10^{22} \text{ 1/cm}^3$$

For each molecule of UO_2 there is one atom of uranium and two of oxygen, then

$$N_{\text{U}} = N_{\text{UO}_2} = 2.2308 \cdot 10^{22} \text{ 1/cm}^3$$

$$N_{\text{O}} = 2N_{\text{UO}_2} = 4.4615 \cdot 10^{22} \text{ 1/cm}^3$$

Then, to calculate the amount of ^{235}U and ^{238}U we need the atomic fraction of ^{235}U:

$$y_{235} = \frac{\varepsilon \bar{M}_U}{M_{235}} = \frac{0.03 \cdot 237.9595 \text{ g/mol}}{235.0439 \text{ g/mol}} = 3.04\%$$

and using that:

$$N_{235} = y_{235} N_{\text{U}} = 3.04\% \cdot 2.2308 \cdot 10^{22} \text{ 1/cm}^3 = 6.7753 \cdot 10^{20} \text{1/cm}^3$$

$$N_{238} = (1 - y_{235}) N_{\text{U}} = (1 - 3.04\%) \cdot 2.2308 \cdot 10^{22} \text{ 1/cm}^3 = 2.1630 \cdot 10^{22} \text{ 1/cm}^3$$

Another way to solve it:

Because the enrichment is a weight fraction, we could convert everything to mass fraction. The atomic fraction of uranium and oxygen in the uranium dioxide are:

$$y_{\mathrm{U}} = \frac{1}{1+2} = \frac{1}{3}$$
$$y_{\mathrm{O}} = \frac{2}{1+2} = \frac{2}{3}$$

and, using (9.4):

$$w_{\mathrm{U}} = \frac{y_{\mathrm{U}} \cdot \bar{M}_{\mathrm{U}}}{y_{\mathrm{U}} \cdot \bar{M}_{\mathrm{U}} + y_{\mathrm{O}} \cdot \bar{M}_{\mathrm{O}}} = \frac{1/3 \cdot 237.9595 \text{ g/mol}}{1/3 \cdot 237.9595 \text{ g/mol} + 2/3 \cdot 15.9994 \text{ g/mol}} = 88.147\%$$

Then, the weight fraction of ^{235}U respect to the total amount is:

$$w_{235} = \varepsilon \cdot w_{\mathrm{U}} = 2.644\%$$

for ^{238}U:

$$w_{238} = (1-\varepsilon) \cdot w_{\mathrm{U}} = 85.502\%$$

and for oxygen:

$$w_{\mathrm{O}} = 1 - w_{\mathrm{U}} = 11.853\%$$

finally we just do:

$$N_{235} = \frac{w_{235} \rho N_A}{M_{235}} = 6.7753 \cdot 10^{20} \text{ 1/cm}^3$$
$$N_{238} = \frac{w_{238} \rho N_A}{M_{238}} = 2.1630 \cdot 10^{22} \text{ 1/cm}^3$$
$$N_{\mathrm{O}} = \frac{w_{\mathrm{O}} \rho N_A}{M_{\mathrm{O}}} = 4.4615 \cdot 10^{22} \text{ 1/cm}^3$$

Chapter 10

Ground and isomeric states properties

The properties of ground and isomeric states for all nuclides included in NuDat 2.6 are listed in the following table. For each state the following data is given:

- Atomic number (Z), chemical symbol and mass number (A).
- Spin and parity $(J\pi)$.
- Mass excess: $\Delta = M - A$, where M is the mass a neutral atom. Mass excess is given in MeV; to convert to atomic mass units, the relationship 1 u $= 931.494$ MeV/c^2 can be used.
- Half life $(T_{1/2})$ or level width (Γ)
- Abundance (isotope atom fraction) of natural occurring nuclides.
- Decay modes, followed by emission probability in %:

  $\beta-$: $\beta-$ decay.
  ϵ: electron capture, $\beta+$ decay, or $EC + \beta+$.
  IT: isomeric transition (γ emission or conversion electron).
  n, p, α, $\ldots$: n, p, α, $\ldots$ emission.
  SF: spontaneous fission.
  $\beta - p$, $\beta - \alpha$, $\beta - n$, $\ldots$: delayed p, α, n, $\ldots$ emission following $\beta-$ decay.
  $\epsilon - p$, $\epsilon - \alpha$, $\epsilon - n$, $\ldots$: delayed p, α, n, $\ldots$ emission following $\beta+$ or EC decay.
  ^{12}C, ^{24}Ne, $\ldots$: ^{12}C, ^{24}Ne, $\ldots$ nuclei emission.

Source:
IAEA NuDat 2.6 `http://www-nds.iaea.org/nudat2/`.

Table 10.1: Ground and isomeric states properties (Adapted from IAEA NuDat 2.6).

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
0	**n**	1	1/2+	8.0713 (5)	10.183 ± 0.017 m		β^- 100%
1	**H**	1	1/2+	7.2889 (10)	**stable**	99.9885% ± 0.007%	
		2	1+	13.1357 (15)	**stable**	0.0115% ± 0.007%	
		3	1/2+	14.9498 (22)	12.32 ± 0.02 y		β^- 100%
2	**He**	3	1/2+	14.9312 (23)	**stable**	0.000134% ± 3e-06%	
		4	0+	2.4249 (6)	**stable**	99.999866% ± 3e-06%	
		6	0+	17.5928 (4)	801 ± 10 ms		β^- 100%
		8	0+	31.6096 (18)	119.1 ± 1.2 ms		β^- 100%; $\beta^- n$ 16%
3	**Li**	6	1+	14.0868 (15)	**stable**	7.59% ± 0.04%	
		7	3/2-	14.907 (4)	**stable**	92.41% ± 0.04%	
		8	2+	20.9457 (5)	839.9 ± 0.9 ms		β^- 100%; $\beta^-\alpha$ 100%
		9	3/2-	24.9549 (9)	178.3 ± 0.4 ms		β^- 100%; $\beta^- n$ 50.8%
		11	3/2-	40.7284 (11)	8.75 ± 0.14 ms		$\beta^-\alpha, n$ 0.027%; β^- 100%; $\beta^- n$ 83%; $\beta^- 2n$ 4.1%
4	**Be**	7	3/2-	15.7689 (7)	53.24 ± 0.04 d		ϵ 100
		9	3/2-	11.3484 (8)	**stable**	100%	
		10	0+	12.6074 (8)	1.387E+6 ± 0.012E+6 y		β^- 100
		11	1/2+	20.1771 (24)	13.81 ± 0.08 s		β^- 100; $\beta^-\alpha$ 3.1
		12	0+	25.077 (4)	21.49 ± 0.03 ms		β^- 100; $\beta^- n \leq 1.00$
		14	0+	39.95 (13)	4.35 ± 0.17 ms		β^- 100; $\beta^- n$ 81; $\beta^- 2n$ 5
5	**B**	8	2+	22.9215 (10)	770 ± 3 ms		ϵ 100; $\epsilon\alpha$ 100
		10	3+	12.0507 (4)	**stable**	19.9% ± 0.7%	
		11	3/2-	8.6679 (4)	**stable**	80.1% ± 0.7%	
		12	1+	13.3688 (14)	20.20 ± 0.02 ms		β^- 100; $\beta^- 3\alpha$ 1.58
		13	3/2-	16.5621 (11)	17.33 ± 0.17 ms		β^- 100
		14	2-	23.664 (21)	12.5 ± 0.5 ms		β^- 100
		15	0	28.964 (22)	9.93 ± 0.07 ms		β^- 100; $\beta^- n$ 93.6; $\beta^- 2n$ 0.4
		17	(3/2-)	43.77 (17)	5.08 ± 0.05 ms		β^- 100; $\beta^- n$ 63; $\beta^- 2n$ 11; $\beta^- 3n$ 3.5; $\beta^- 4n$ 0.4
		19	(3/2-)	58.8 (4)	2.92 ± 0.13 ms		β^- 100; $\beta^- n$ 72; $\beta^- 2n$ 16
6	**C**	9	(3/2-)	28.9094 (21)	126.5 ± 0.9 ms		ϵ 100; ϵp 61.6; $\epsilon\alpha$ 38.4
		10	0+	15.6986 (4)	19.308 ± 0.004 s		ϵ 100
		11	3/2-	10.6503 (10)	20.334 ± 0.024 m		ϵ 100
		12	0+	0 ()	**stable**	98.93% ± 0.08%	
		13	1/2-	3.125 (21)	**stable**	1.07% ± 0.08%	
		14	0+	3.0198 (4)	5700 ± 30 y		β^- 100
		15	1/2+	9.8731 (8)	2.449 ± 0.005 s		β^- 100
		16	0+	13.694 (4)	0.747 ± 0.008 s		β^- 100; $\beta^- n$ 99
		17	3/2+	21.032 (17)	193 ± 13 ms		β^- 100; $\beta^- n$ 32
		18	0+	24.92 (3)	92 ± 2 ms		$\beta^- n$ 31.5; β^- 100
		19	1/2+	32.41 (10)	49 ± 4 ms		β^- ; $\beta^- n$ 61
		20	0+	37.56 (24)	14 +6-5 ms		β^- 100; $\beta^- n$ 72
		22	0+	52.1 (5)	6.1 +1.4-1.2 ms		β^- 100; $\beta^- n$ 61; $\beta^- 2n <$ 37.00
7	**N**	12	1+	17.338 (10)	11.000 ± 0.016 ms		ϵ 100
		13	1/2-	5.3454 (3)	9.965 ± 0.004 m		ϵ 100
		14	1+	2.8634 (19)	**stable**	99.636% ± 0.02%	
		15	1/2-	0.1014 (6)	**stable**	0.364% ± 0.02%	
		16	2-	5.684 (3)	7.13 ± 0.02 s		β^- 100; $\beta^-\alpha$ 0.0012
		17	1/2-	7.87 (15)	4.173 ± 0.004 s		β^- 100; $\beta^- n$ 95.1
		18	1-	13.113 (19)	620 ± 8 ms		$\beta^-\alpha$ 12.2; $\beta^- n$ 7; β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		19	0	15.857 (16)	336 ± 3 ms		β^- 100; $\beta^- n$ 41.8
		20	2-	21.77 (6)	136 ± 3 ms		β^- 100; $\beta^- n$ 42.9
		21	(1/2-)	25.25 (10)	83 ± 8 ms		β^- 100; $\beta^- n$ 90.5
		22	(0-,1-)	32.04 (19)	20 ± 2 ms		β^- 100; $\beta^- n$ 33; $\beta^- 2n$ 12
		23	0	38.4 (3)	14.5 ± 1.4 ms		β^- 100; $\beta^- n$; $\beta^- 2n$
8	**O**	13	(3/2-)	23.115 (10)	8.58 ± 0.05 ms		ϵ 100; ϵp 100
		14	0+	8.0074 (11)	70.620 ± 0.015 s		ϵ 100
		15	1/2-	2.8556 (5)	122.24 ± 0.16 s		ϵ 100
		16	0+	-4.737 (16)	**stable**	99.757% ± 0.016%	
		17	5/2+	-0.8087 (6)	**stable**	0.038% ± 0.001%	
		18	0+	-0.7828 (7)	**stable**	0.205% ± 0.014%	
		19	5/2+	3.334 (3)	26.88 ± 0.05 s		β^- 100
		20	0+	3.7961 (9)	13.51 ± 0.05 s		β^- 100
		21	(5/2+)	8.062 (12)	3.42 ± 0.1 s		β^- 100
		22	0+	9.28 (6)	2.25 ± 0.09 s		β^- 100; $\beta^- n < 22.00$
		23	1/2+	14.62 (9)	97 ± 8 ms		β^- 100; $\beta^- n$ 7
		24	0+	18.5 (11)	65 ± 5 ms		$\beta^- n$ 58; β^- 100
9	**F**	17	5/2+	1.9517 (25)	64.49 ± 0.16 s		ϵ 100
		18	1+	0.8731 (5)	109.77 ± 0.05 m		ϵ 100
		19	1/2+	-1.4874 (9)	**stable**	100%	
		20	2+	-0.0174 (3)	11.07 ± 0.06 s		β^- 100
		21	5/2+	-0.0476 (18)	4.158 ± 0.02 s		β^- 100
		22	(4+)	2.793 (12)	4.23 ± 0.04 s		β^- 100; $\beta^- n < 11.00$
		23	5/2+	3.31 (10)	2.23 ± 0.14 s		β^- 100
		24	(1,2,3)+	7.56 (7)	390 ± 70 ms		β^- 100; $\beta^- n < 5.90$
		25	5/2+	11.36 (8)	80 ± 9 ms		β^- 100; $\beta^- n$ 23.1
		26	(1+)	18.67 (8)	9.7 ± 0.7 ms		$\beta^- n$ 11; β^- 100
		27	(5/2+)	24.63 (19)	5.0 ± 0.2 ms		β^- 100; $\beta^- n$ 77
		29	(5/2+)	40 (6)	2.5 ± 0.3 ms		β^- 100; $\beta^- n$ 100
10	**Ne**	17	1/2-	16.5004 (4)	109.2 ± 0.6 ms		ϵp 100; $\epsilon\alpha$; ϵ 100
		18	0+	5.3176 (4)	1.6670 ± 0.0017 s		ϵ 100
		19	1/2+	1.752 (16)	17.22 ± 0.02 s		ϵ 100
		20	0+	-7.0419 (16)	**stable**	90.48% ± 0.03%	
		21	3/2+	-5.7317 (4)	**stable**	0.27% ± 0.01%	
		22	0+	-8.0247 (18)	**stable**	9.25% ± 0.03%	
		23	5/2+	-5.154 (10)	37.24 ± 0.12 s		β^- 100
		24	0+	-5.9516 (5)	3.38 ± 0.02 m		β^- 100
		25	1/2+	-2.06 (4)	602 ± 8 ms		β^- 100
		26	0+	0.479 (18)	197 ± 1 ms		$\beta^- n$ 0.13; β^- 100
		27	(3/2+)	7.04 (7)	31.5 ± 1.3 ms		β^- 100; $\beta^- n$ 2
		28	0+	11.29 (10)	18.9 ± 0.4 ms		β^- 100; $\beta^- n$ 12; β^- 3.6
		29	(3/2+)	18.4 (10)	14.8 ± 0.3 ms		β^- 100; $\beta^- n$ 28; $\beta^- 2n$ 4
		30	0+	23 (3)	7.3 ± 0.3 ms		$\beta^- n$ 13; β^- 8.9; β^- 100
		31	0	30.8 (16)	3.4 ± 0.8 ms		β^- 100; $\beta^- n$
		32	0+	37 (5)	3.5 ± 0.9 ms		β^- 100; $\beta^- n$
11	**Na**	20	2+	6.8502 (10)	447.9 ± 2.3 ms		ϵ 100; $\epsilon\alpha$ 20.05
		21	3/2+	-2.1846 (3)	22.49 ± 0.04 s		ϵ 100
		22	3+	-5.1815 (17)	2.6027 ± 0.001 y		ϵ 100
		23	3/2+	-9.5298 (18)	**stable**	100%	
		24	4+	-8.4179 (4)	14.997 ± 0.012 h		β^- 100
		24m	1+	-7.9457 (4)	20.18 ± 0.1 ms		IT 99.95; $\beta^- \approx 0.05$
		25	5/2+	-9.3578 (12)	59.1 ± 0.6 s		β^- 100
		26	3+	-6.861 (4)	1.07128 ± 2.5E-4 s		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J$^{\pi}$	Δ[MeV]	$\mathbf{T_{1/2}}, \mathbf{\Gamma}$	Abundance	Decay Mode
		27	5/2+	-5.518 (4)	301 ± 6 ms		$\beta^- n$ 0.13; β^- 100
		28	1+	-0.988 (10)	30.5 ± 0.4 ms		β^- 100; $\beta^- n$ 0.58
		29	3/2+	2.67 (12)	44.9 ± 1.2 ms		β^- 100; $\beta^- n$ 21.5
		30	2+	8.374 (23)	48 ± 2 ms		β^- 100; $\beta^- n$ 30; $\beta^- 2n$ 1.15; $\beta^- \alpha$ 5.5e-05
		31	3/2(+)	12.54 (10)	17.0 ± 0.4 ms		$\beta^- n$ 37; $\beta^- 2n$ 0.87; $\beta^- 3n < 0.05$; β^- 100
		32	(3-,4-)	18.81 (12)	13.2 ± 0.4 ms		β^- 100; $\beta^- n$ 24; $\beta^- 2n$ 8
		33	(3/2+)	24 (6)	8.0 ± 0.4 ms		β^- 100; $\beta^- n$ 47; $\beta^- 2n$ 13
		34	0	31.3 (5)	5.5 ± 1 ms		$\beta^- n \approx$ 15.00; β^- 100; $\beta^- 2n \approx$ 50.00
		35	0	37.8 (6)	1.5 ± 0.5 ms		β^- 100; $\beta^- n$
12	**Mg**	20	0+	17.56 (3)	90.8 ± 2.4 ms		ϵ 100; $\epsilon p \approx$ 27.00
		21	5/2+	10.913 (16)	122 ± 3 ms		$\epsilon\alpha < 0.50$; ϵ 100; ϵp 32.6
		22	0+	-0.3999 (3)	3.8755 ± 0.0012 s		ϵ 100
		23	3/2+	-5.4732 (7)	11.317 ± 0.011 s		ϵ 100
		24	0+	-13.9335 (13)	**stable**	78.99% ± 0.04%	
		25	5/2+	-13.1927 (5)	**stable**	10% ± 0.01%	
		26	0+	-16.2145 (3)	**stable**	11.01% ± 0.03%	
		27	1/2+	-14.5866 (5)	9.458 ± 0.012 m		β^- 100
		28	0+	-15.0186 (20)	20.915 ± 0.009 h		β^- 100
		29	3/2+	-10.603 (11)	1.30 ± 0.12 s		β^- 100
		30	0+	-8.892 (13)	335 ± 17 ms		β^- 100
		31	1/2(+)	-3.19 (17)	232 ± 15 ms		β^- 100; $\beta^- n$ 1.7
		32	0+	-0.912 (18)	86 ± 5 ms		β^- 100; $\beta^- n$ 5.5
		33	3/2-	4.947 (22)	90.5 ± 1.6 ms		β^- 100; $\beta^- n$ 14
		34	0+	8.56 (9)	20 ± 10 ms		β^- 100; $\beta^- n$
		35	(7/2-)	15.64 (18)	70 ± 40 ms		β^- 100; $\beta^- n$ 52
		36	0+	20.4 (5)	3.9 ± 1.3 ms		$\beta^- n$; β^- 100
13	**Al**	22	4+	18.2 (4)	91.1 ± 0.5 ms		$\epsilon 2p$ 1.1; $\epsilon\alpha$ 0.04; ϵ 100; ϵp 54.5
		23	5/2+	6.748 (3)	446 ± 6 ms		ϵ 100; ϵp 1.22
		24	4+	-0.0489 (10)	2.053 ± 0.004 s		ϵ 100; ϵp 0.0016; $\epsilon\alpha$ 0.04
		24m	1+	0.3768 (10)	130 ± 3 ms		IT 82.5; ϵ 17.5; $\epsilon\alpha$ 0.03
		25	5/2+	-8.9161 (5)	7.183 ± 0.012 s		ϵ 100
		26	5+	-12.2101 (6)	7.17E+5 ± 0.24E+5 y		ϵ 100
		26m	0+	-11.9818 (6)	6.3464 ± 7.0E-4 s		ϵ 100
		27	5/2+	-17.1967 (10)	**stable**	100%	
		28	3+	-16.8504 (12)	2.2414 ± 0.0012 m		β^- 100
		29	5/2+	-18.2153 (12)	6.56 ± 0.06 m		β^- 100
		30	3+	-15.872 (14)	3.62 ± 0.06 s		β^- 100
		31	(3/2,5/2)+	-14.955 (20)	644 ± 25 ms		β^- 100
		32	1+	-11.06 (9)	33.0 ± 0.2 ms		β^- 100; $\beta^- n$ 0.7
		33	(5/2)+	-8.44 (7)	41.7 ± 0.2 ms		$\beta^- n$ 8.5; β^- 100
		34	0	-3.05 (6)	42 ± 6 ms		β^- 100; $\beta^- n$ 27
		35	0	-0.22 (7)	37.2 ± 0.8 ms		β^- 100; $\beta^- n$ 38
		36	0	5.95 (10)	90 ± 40 ms		β^- 100; $\beta^- n < 31.00$
		37	0	9.81 (12)	10.7 ± 1.3 ms		β^- 100
		38	0	16.21 (25)	7.6 ± 0.6 ms		β^- ; $\beta^- n$
		39	0	21 (6)	7.6 ± 1.6 ms		$\beta^- n$; β^-
14	**Si**	22	0+	33 (4)	29 ± 2 ms		ϵ 100; ϵp 32
		23	(5/2)+	23.1 (4)	42.3 ± 0.4 ms		ϵ 100; ϵp 71; $\epsilon 2p$ 3.6
		24	0+	10.755 (19)	140.5 ± 1.5 ms		ϵ 100; ϵp 45
		25	5/2+	3.827 (10)	220 ± 3 ms		ϵ 100; ϵp 35

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		26	0+	-7.1409 (11)	2.229 ± 0.003 s		ϵ 100
		27	5/2+	-12.3843 (14)	4.15 ± 0.04 s		ϵ 100
		28	0+	-21.4927 (4)	**stable**	92.223% ± 0.019%	
		29	1/2+	-21.895 (5)	**stable**	4.685% ± 0.008%	
		30	0+	-24.4329 (22)	**stable**	3.092% ± 0.011%	
		31	3/2+	-22.949 (4)	157.3 ± 0.3 m		β^- 100
		32	0+	-24.0776 (3)	153 ± 19 y		β^- 100
		33	3/2+	-20.5143 (7)	6.11 ± 0.21 s		β^- 100
		34	0+	-19.957 (14)	2.77 ± 0.2 s		β^- 100
		35	0	-14.36 (4)	0.78 ± 0.12 s		β^- 100; $\beta^- n < 5.00$
		36	0+	-12.42 (6)	0.45 ± 0.06 s		β^- 100; $\beta^- n < 10.00$
		37	(7/2-)	-6.59 (8)	90 ± 60 ms		β^- 100; $\beta^- n$ 17
		39	0	2.32 (9)	47.5 ± 2 ms		β^- ; $\beta^- n$
		40	0+	5.43 (23)	33.0 ± 1 ms		β^- ; $\beta^- n$
		41	0	12.1 (4)	20.0 ± 2.5 ms		β^- ; $\beta^- n$?
		42	0+	16.6 (5)	12.5 ± 3.5 ms		β^- 100; $\beta^- n$
15	**P**	26	(3+)	10.97 (20)	43.7 ± 0.6 ms		ϵ 100; ϵp
		27	1/2+	-0.72 (3)	260 ± 80 ms		ϵp 0.07; ϵ 100
		28	3+	-7.149 (11)	270.3 ± 0.5 ms		ϵ 100; ϵp 0.0013; $\epsilon\alpha$ 0.00086
		29	1/2+	-16.9526 (6)	4.142 ± 0.015 s		ϵ 100
		30	1+	-20.2006 (3)	2.498 ± 0.004 m		ϵ 100
		31	1/2+	-24.4405 (7)	**stable**	100%	
		32	1+	-24.3048 (4)	14.262 ± 0.014 d		β^- 100
		33	1/2+	-26.3373 (11)	25.35 ± 0.11 d		β^- 100
		34	1+	-24.5486 (8)	12.43 ± 0.08 s		β^- 100
		35	1/2+	-24.8578 (19)	47.3 ± 0.7 s		β^- 100
		36	4-	-20.251 (13)	5.6 ± 0.3 s		β^- 100
		37	0	-19 (4)	2.31 ± 0.13 s		β^- 100
		38	(0-:4-)	-14.64 (7)	0.64 ± 0.14 s		β^- 100; $\beta^- n$ 12
		39	(1/2+)	-12.8 (8)	0.28 ± 0.04 s		β^- 100; $\beta^- n$ 26
		40	(2-,3-)	-8.07 (11)	125 ± 25 ms		β^- 100; $\beta^- n$ 15.8
		41	(1/2+)	-4.98 (8)	100 ± 5 ms		β^- 100; $\beta^- n$ 30
		42	0	1.01 (21)	48.5 ± 1.5 ms		β^- 100; $\beta^- n$ 50
		43	(1/2+)	4.7 (4)	36.5 ± 1.5 ms		β^- 100; $\beta^- n$ 100
		44	0	10.4 (8)	18.5 ± 2.5 ms		β^- ; $\beta^- n$
16	**S**	27	(5/2+)	17 (4)	15.5 ± 1.5 ms		ϵp 2.3; $\epsilon 2p$ 1.1; ϵ 100
		28	0+	4.07 (16)	125 ± 10 ms		ϵ 100; ϵp 20.7
		29	5/2+	-3.16 (5)	187 ± 4 ms		ϵ 100; ϵp 47
		30	0+	-14.062 (3)	1.178 ± 0.005 s		ϵ 100
		31	1/2+	-19.043 (10)	2.572 ± 0.013 s		ϵ 100
		32	0+	-26.0155 (13)	**stable**	94.99% ± 0.26%	
		33	3/2+	-26.5858 (14)	**stable**	0.75% ± 0.02%	
		34	0+	-29.9316 (6)	**stable**	4.25% ± 0.24%	
		35	3/2+	-28.8461 (4)	87.37 ± 0.04 d		β^- 100
		36	0+	-30.6641 (19)	**stable**	0.01% ± 0.01%	
		37	7/2-	-26.8964 (20)	5.05 ± 0.02 m		β^- 100
		38	0+	-26.861 (7)	170.3 ± 0.7 m		β^- 100
		39	(7/2)-	-23.16 (5)	11.5 ± 0.5 s		β^- 100
		40	0+	-22.93 (11)	8.8 ± 2.2 s		β^- 100
		41	(7/2-)	-19.09 (6)	1.99 ± 0.05 s		β^- 100; $\beta^- n$
		42	0+	-17.68 (12)	1.03 ± 0.03 s		β^- 100
		43	0	-12.07 (10)	0.28 ± 0.03 s		$\beta^- n$ 40; β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J$^\pi$	Δ[MeV]	$\mathbf{T_{1/2}, \Gamma}$	Abundance	Decay Mode
		44	0+	-9.1 (14)	100 ± 1 ms		β^- 100; $\beta^- n$ 18
		45	0	-4 (7)	68 ± 2 ms		β^- 100; $\beta^- n$ 54
		46	0+	0 (AP)	50 ± 8 ms		β^- 100
17	**Cl**	31	0	-7.07 (5)	150 ± 25 ms		ϵ 100; ϵp 0.7
		32	1+	-13.3351 (9)	298 ± 1 ms		ϵ 100; $\epsilon\alpha$ 0.05; ϵp 0.03
		33	3/2+	-21.0032 (4)	2.511 ± 0.004 s		ϵ 100
		34	0+	-24.44 (7)	1.5264 ± 0.0014 s		ϵ 100
		34m	3+	-24.2936 (7)	32.00 ± 0.04 m		ϵ 55.4; IT 44.6
		35	3/2+	-29.0135 (4)	**stable**	75.76% ± 0.1%	
		36	2+	-29.5219 (4)	3.01E+5 ± 0.02E+5 y		β^- 98.1; ϵ 1.9
		37	3/2+	-31.7615 (5)	**stable**	24.24% ± 0.1%	
		38	2-	-29.7981 (10)	37.24 ± 0.05 m		β^- 100
		38m	5-	-29.1267 (10)	715 ± 3 ms		IT 100
		39	3/2+	-29.8002 (17)	56.2 ± 0.6 m		β^- 100
		40	2-	-27.56 (3)	1.35 ± 0.02 m		β^- 100
		41	(1/2+)	-27.31 (7)	38.4 ± 0.8 s		β^- 100
		42	0	-24.91 (14)	6.8 ± 0.3 s		β^- 100
		43	(1/2+)	-24.41 (21)	3.13 ± 0.09 s		β^- 100
		44	(2-)	-20.61 (14)	0.56 ± 0.11 s		β^- 100; $\beta^- n < 8.00$
		45	(1/2+)	-18.36 (10)	413 ± 25 ms		β^- 100; $\beta^- n$ 24
		46	0	-13.81 (16)	232 ± 2 ms		β^- 100; $\beta^- n$ 60
		47	0	-10.1 (8)	101 ± 6 ms		β^- 100; $\beta^- n > 0.00$
18	**Ar**	31	5/2(+)	11.29 (21)	14.4 ± 0.6 ms		ϵ 100; ϵp 62; $\epsilon 2p$ 8.5
		32	0+	-2.2003 (18)	100.5 ± 0.3 ms		ϵ 100; ϵp 35.6
		33	1/2+	-9.3843 (4)	173.0 ± 2 ms		ϵ 100; ϵp 38.7
		34	0+	-18.3773 (3)	844.5 ± 3.4 ms		ϵ 100
		35	3/2+	-23.0473 (7)	1.7756 ± 0.001 s		ϵ 100
		36	0+	-30.2315 (3)	**stable**	0.3336% ± 0.0021%	
		37	3/2+	-30.9476 (21)	35.04 ± 0.04 d		ϵ 100
		38	0+	-34.7147 (25)	**stable**	0.0629% ± 0.0007%	
		39	7/2-	-33.242 (5)	269 ± 3 y		β^- 100
		40	0+	-35.0398 (22)	**stable**	99.6035% ± 0.0025%	
		41	7/2-	-33.0675 (3)	109.61 ± 0.04 m		β^- 100
		42	0+	-34.423 (6)	32.9 ± 1.1 y		β^- 100
		43	(5/2-)	-32.01 (5)	5.37 ± 0.06 m		β^- 100
		44	0+	-32.6732 (16)	11.87 ± 0.05 m		β^- 100
		45	5/2-,7/2-	-29.7707 (5)	21.48 ± 0.15 s		β^- 100
		46	0+	-29.73 (4)	8.4 ± 0.6 s		β^- 100
		47	(3/2)-	-25.21 (9)	1.23 ± 0.03 s		β^- 100; $\beta^- n < 0.20$
		48	0+	-22.6 (7)	475 ± 40 ms		β^- 100
		49	0	-16.8 (8)	170 ± 50 ms		β^- 100; $\beta^- n$ 65
		50	0+	-12.8 (9)	85 ± 30 ms		β^- 100; $\beta^- n$ 35
19	**K**	35	3/2+	-11.1729 (5)	178 ± 8 ms		ϵ 100; ϵp 0.37
		36	2+	-17.4173 (3)	342 ± 2 ms		ϵ 100; ϵp 0.05; $\epsilon\alpha$ 0.0034
		37	3/2+	-24.8001 (9)	1.226 ± 0.007 s		ϵ 100
		38	3+	-28.8006 (25)	7.636 ± 0.018 m		ϵ 100
		38m	0+	-28.6702 (25)	924.3 ± 0.3 ms		ϵ 99.97; IT 0.03
		39	3/2+	-33.8071 (5)	**stable**	93.2581% ± 0.0044%	
		40	4-	-33.5354 (6)	1.248E+9 ± 0.003E+9 y	0.0117% ± 0.0001%	β^- 89.28; ϵ 10.72
		41	3/2+	-35.5595 (4)	**stable**	6.7302% ± 0.0044%	
		42	2-	-35.022 (11)	12.321 ± 0.025 h		β^- 100
		43	3/2+	-36.5753 (4)	22.3 ± 0.1 h		β^- 100
		44	2-	-35.7814 (4)	22.13 ± 0.19 m		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		45	3/2+	-36.6156 (5)	17.81 $\pm$ 0.61 m		β^- 100
		46	(2-)	-35.4139 (7)	105 $\pm$ 10 s		β^- 100
		47	1/2+	-35.709 (3)	17.50 $\pm$ 0.24 s		β^- 100
		48	(2-)	-32.2852 (23)	6.8 $\pm$ 0.2 s		β^- 100; $\beta^- n$ 1.14
		49	(1/2+,3/2+)	-29.612 (3)	1.26 $\pm$ 0.05 s		β^- 100; $\beta^- n$ 86
		50	(0-,1-,2-)	-25.736 (10)	472 $\pm$ 4 ms		β^- 100; $\beta^- n$ 29
		51	(1/2+,3/2+)	-21.6 (6)	365 $\pm$ 5 ms		$\beta^- n$ 47; β^- 100
		52	(2-)	-16 (7)	118 $\pm$ 6 ms		β^- 100; $\beta^- n \approx 73.00$
		53	(3/2+)	-11.1 (7)	30 $\pm$ 5 ms		β^- 100; $\beta^- n$ $\approx$ 75.00; $\beta^- 2n < 10$
		54	0	-4.3 (9)	10 $\pm$ 5 ms		β^- 100; $\beta^- n > 0.00$
20	**Ca**	35	0	4.79 (20)	25.7 $\pm$ 0.2 ms		ϵ 100; ϵp 95.9; $\epsilon 2p$ 4.1
		36	0+	-6.45 (4)	102 $\pm$ 2 ms		ϵ 100; ϵp 54.3
		37	3/2+	-13.1357 (8)	181.1 $\pm$ 1 ms		ϵ 100; ϵp 82.1
		38	0+	-22.0584 (3)	440 $\pm$ 12 ms		ϵ 100
		39	3/2+	-27.2827 (6)	859.6 $\pm$ 1.4 ms		ϵ 100
		40	0+	-34.8463 (21)	$>$ 3.0E+21 y	96.94% $\pm$ 0.16%	2ϵ
		41	7/2-	-35.1379 (14)	1.02E+5 $\pm$ 0.07E+5 y		ϵ 100
		42	0+	-38.5472 (15)	**stable**	0.647% $\pm$ 0.023%	
		43	7/2-	-38.4089 (23)	**stable**	0.135% $\pm$ 0.01%	
		44	0+	-41.4688 (3)	**stable**	2.09% $\pm$ 0.11%	
		45	7/2-	-40.8123 (4)	162.61 $\pm$ 0.09 d		β^- 100
		46	0+	-43.1399 (22)	$>$ 0.28E+16 y	0.004% $\pm$ 0.003%	$2\beta^-$
		47	7/2-	-42.345 (22)	4.536 $\pm$ 0.003 d		β^- 100
		48	0+	-44.2234 (22)	$>$ 5.8E22 y	0.187% $\pm$ 0.021%	$2\beta^-$ 75
		49	3/2-	-41.2986 (22)	8.718 $\pm$ 0.006 m		β^- 100
		50	0+	-39.588 (3)	13.9 $\pm$ 0.6 s		β^- 100
		51	(3/2-)	-35.87 (9)	10.0 $\pm$ 0.8 s		β^- 100; $\beta^- n$
		52	0+	-32.5 (7)	4.6 $\pm$ 0.3 s		β^- 100; $\beta^- n \leq 2.00$
		53	(3/2-,5/2-)	-27.5 (5)	90 $\pm$ 15 ms		β^- 100; $\beta^- n > 30.00$
		54	0+	-23 (7)	86 $\pm$ 7 ms		β^- 100
		55	(5/2-)	-17 (8)	22 $\pm$ 2 ms		β^- 100; $\beta^- n$
		56	0+	-12.4 (9)	11 $\pm$ 2 ms		β^- ; $\beta^- n$?
21	**Sc**	40	4-	-20.523 (3)	182.3 $\pm$ 0.7 ms		ϵ 100; ϵp 0.44; $\epsilon\alpha$ 0.02
		41	7/2-	-28.6424 (8)	596.3 $\pm$ 1.7 ms		ϵ 100
		42	0+	-32.1211 (17)	681.3 $\pm$ 0.7 ms		ϵ 100
		42m	(7)+	-31.5048 (17)	61.7 $\pm$ 0.4 s		ϵ 100
		43	7/2-	-36.1881 (19)	3.891 $\pm$ 0.012 h		ϵ 100
		44	2+	-37.8163 (18)	3.97 $\pm$ 0.04 h		ϵ 100
		44m	6+	-37.5453 (18)	58.61 $\pm$ 0.1 h		IT 98.8; ϵ 1.2
		45	7/2-	-41.0703 (6)	**stable**	100%	
		45m	3/2+	-41.0579 (6)	318 $\pm$ 7 ms		IT 100
		46	4+	-41.7596 (6)	83.79 $\pm$ 0.04 d		β^- 100
		46m	1-	-41.6171 (6)	18.75 $\pm$ 0.04 s		IT 100
		47	7/2-	-44.3367 (19)	3.3492 $\pm$ 6.0E-4 d		β^- 100
		48	6+	-44.503 (5)	43.67 $\pm$ 0.09 h		β^- 100
		49	7/2-	-46.56 (3)	57.18 $\pm$ 0.13 m		β^- 100
		50	5+	-44.546 (15)	102.5 $\pm$ 0.5 s		β^- 100
		50m	2+,3+	-44.289 (15)	0.35 $\pm$ 0.04 s		$IT > 97.50$; $\beta^- < 2.50$
		51	(7/2)-	-43.227 (20)	12.4 $\pm$ 0.1 s		β^- 100
		52	3(+)	-40.36 (19)	8.2 $\pm$ 0.2 s		β^- 100
		53	(7/2-)	-37.5 (3)	2.4 $\pm$ 0.6 s		β^- 100; $\beta^- n$?

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		54	(3)+	-33.7 (5)	526 ± 15 ms		β^- 100
		55	(7/2)-	-29.6 (7)	96 ± 2 ms		β^- 100; $\beta^- n$ 17
		56	(1+)	-24.5 (7)	26 ± 6 ms		β^- 100; $\beta^- n$?; β^- 100; $\beta^- n > 14.00$
		57	(7/2-)	-20.1 (7)	22 ± 2 ms		β^- 100; $\beta^- n$
		58	0	-14.4 (8)	12 ± 5 ms		β^- 100; $\beta^- n$
22	**Ti**	39	(3/2+)	2.2 (3)	31 +6-4 ms		ϵ 100; ϵp 100
		40	0+	-8.85 (16)	52.4 ± 0.3 ms		ϵ ; ϵp 97.5
		41	3/2+	-15.1 (4)	80.4 ± 0.9 ms		ϵ 100; ϵp 100
		42	0+	-25.1046 (3)	199 ± 6 ms		ϵ 100
		43	7/2-	-29.321 (7)	509 ± 5 ms		ϵ 100
		44	0+	-37.5485 (7)	60.0 ± 1.1 y		ϵ 100
		45	7/2-	-39.0083 (8)	184.8 ± 0.5 m		ϵ 100
		46	0+	-44.127 (3)	**stable**	8.25% ± 0.03%	
		47	5/2-	-44.9364 (4)	**stable**	7.44% ± 0.02%	
		48	0+	-48.4917 (4)	**stable**	73.72% ± 0.03%	
		49	7/2-	-48.5628 (4)	**stable**	5.41% ± 0.02%	
		50	0+	-51.4307 (4)	**stable**	5.18% ± 0.02%	
		51	3/2-	-49.7318 (6)	5.76 ± 0.01 m		β^- 100
		52	0+	-49.469 (7)	1.7 ± 0.1 m		β^- 100
		53	(3/2)-	-46.83 (10)	32.7 ± 0.9 s		β^- 100
		54	0+	-45.59 (12)	1.5 ± 0.4 s		β^- 100
		55	(1/2)-	-41.67 (15)	1.3 ± 0.1 s		β^- 100
		56	0+	-38.94 (20)	0.200 ± 0.005 s		$\beta^- n$; β^- 100
		57	(5/2-)	-33.5 (5)	98 ± 5 ms		β^- 100; $\beta^- n$
		58	0+	-30.7 (5)	57 ± 10 ms		β^- 100; $\beta^- n$
		59	(5/2-)	-25 (5)	27.5 ± 2.5 ms		β^- 100
		60	0+	-21.5 (6)	22.4 ± 2.5 ms		β^-
		61	(1/2-)	-15.5 (7)	15 ± 4 ms		β^- 100; $\beta^- n$
23	**V**	43	0	-18.02 (23)	79.3 ± 2.4 ms		ϵ 100
		44	(2+)	-24.12 (12)	111 ± 7 ms		ϵ 100; $\epsilon\alpha$; ϵ 100
		45	7/2-	-31.88 (17)	547 ± 6 ms		ϵ 100
		46	0+	-37.0744 (3)	422.50 ± 0.11 ms		ϵ 100
		46m	3+	-36.2729 (3)	1.02 ± 0.07 ms		IT 100
		47	3/2-	-42.0056 (3)	32.6 ± 0.3 m		ϵ 100
		48	4+	-44.4764 (11)	15.9735 ± 0.0025 d		ϵ 100
		49	7/2-	-47.9609 (9)	330 ± 15 d		ϵ 100
		50	6+	-49.224 (9)	> 2.1E+17 y	0.25% ± 0.002%	$\epsilon > 92.90$; $\beta^- < 7.10$
		51	7/2-	-52.2039 (9)	**stable**	99.75% ± 0.002%	
		52	3+	-51.4438 (9)	3.743 ± 0.005 m		β^- 100
		53	7/2-	-51.85 (3)	1.543 ± 0.014 m		β^- 100
		54	3+	-49.892 (15)	49.8 ± 0.5 s		β^- 100
		55	(7/2-)	-49.15 (10)	6.54 ± 0.15 s		β^- 100
		56	1+	-46.08 (20)	0.216 ± 0.004 s		β^- 100; $\beta^- n$
		57	(7/2-)	-44.19 (23)	0.32 ± 0.03 s		β^- 100; $\beta^- n$
		58	(1+)	-40.21 (25)	191 ± 10 ms		β^- 100; $\beta^- n$
		59	(5/2-)	-37.1 (3)	97 ± 2 ms		β^- 100; $\beta^- n < 3.00$
		60	0	-32.6 (5)	68 ± 5 ms		β^- ; $\beta^- n$; β^- 100; $\beta^- n$; β^- 100
		61	(3/2-)	-29.5 (3)	52.6 ± 4.2 ms		β^- 100; $\beta^- n \geq 6.00$
		62	0	-24.6 (4)	33.5 ± 2 ms		β^- 100; $\beta^- n$
		63	7/2-	-21.1 (5)	19.2 ± 2.4 ms		β^- 100; $\beta^- n \approx 35.00$
		64	0	-15.6 (5)	19 ± 8 ms		β^- 100
24	**Cr**	42	0+	6.5 (3)	13.3 ± 1 ms		ϵ 100; ϵp 94.4

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		43	(3/2+)	-1.94 (20)	20.6 $\pm$ 0.9 ms		ϵ 100; ϵp 81; $\epsilon 2p$ 7.1; $\epsilon 3p$ 0.08
		44	0+	-13.14 (20)	42.8 $\pm$ 0.6 ms		ϵp 14; ϵ 100
		45	(7/2-)	-19.4 (20)	60.9 $\pm$ 0.4 ms		ϵ 100; ϵp 34.4
		46	0+	-29.473 (20)	0.26 $\pm$ 0.06 s		ϵ 100
		47	3/2-	-34.558 (14)	500 $\pm$ 15 ms		ϵ 100
		48	0+	-42.822 (7)	21.56 $\pm$ 0.03 h		ϵ 100
		49	5/2-	-45.3329 (24)	42.3 $\pm$ 0.1 m		ϵ 100
		50	0+	-50.2619 (9)	$>$ 1.3E+18 y	4.345% $\pm$ 0.013%	2ϵ
		51	7/2-	-51.4512 (9)	27.7025 $\pm$ 0.0024 d		ϵ 100
		52	0+	-55.418 (6)	**stable**	83.789% $\pm$ 0.018%	
		53	3/2-	-55.2858 (6)	**stable**	9.501% $\pm$ 0.017%	
		54	0+	-56.9336 (6)	**stable**	2.365% $\pm$ 0.007%	
		55	3/2-	-55.1086 (6)	3.497 $\pm$ 0.003 m		β^- 100
		56	0+	-55.2812 (19)	5.94 $\pm$ 0.1 m		β^- 100
		57	(3/2)-	-52.5241 (19)	21.1 $\pm$ 1 s		β^- 100
		58	0+	-51.83 (20)	7.0 $\pm$ 0.3 s		β^- 100
		59	(1/2-)	-47.89 (24)	1.05 $\pm$ 0.09 s		β^- 100
		60	0+	-46.5 (21)	0.49 $\pm$ 0.01 s		β^- 100
		61	(5/2-)	-42.2 (3)	243 $\pm$ 11 ms		β^- 100; $\beta^- n$
		62	0+	-40.4 (3)	206 $\pm$ 12 ms		β^- 100; $\beta^- n$
		63	1/2-	-35.6 (3)	129 $\pm$ 2 ms		β^- 100; $\beta^- n$
		64	0+	-33.3 (3)	42 $\pm$ 2 ms		β^- 100
		65	(1/2-)	-27.8 (3)	28 $\pm$ 3 ms		β^- 100
		66	0+	-24.3 (5)	23 $\pm$ 4 ms		β^- 100
25	**Mn**	46	(4+)	-11.96 (11)	36.2 $\pm$ 0.4 ms		ϵ 100; ϵp 57
		47	(5/2-)	-22.26 (16)	88.0 $\pm$ 1.3 ms		ϵ 100; $\epsilon p < 1.70$
		48	4+	-29.32 (11)	158.1 $\pm$ 2.2 ms		ϵ 100; ϵp 0.28; $\epsilon\alpha < 6.0$E-4
		49	5/2-	-37.615 (24)	382 $\pm$ 7 ms		ϵ 100
		50	0+	-42.6274 (9)	283.19 $\pm$ 0.1 ms		ϵ 100
		50m	5+	-42.4021 (9)	1.75 $\pm$ 0.03 m		ϵ 100
		51	5/2-	-48.2437 (9)	46.2 $\pm$ 0.1 m		ϵ 100
		52	6+	-50.7068 (19)	5.591 $\pm$ 0.003 d		ϵ 100
		52m	2+	-50.3291 (19)	21.1 $\pm$ 0.2 m		ϵ 98.25; IT 1.75
		53	7/2-	-54.689 (6)	3.74E+6 $\pm$ 0.04E+6 y		ϵ 100
		54	3+	-55.5565 (12)	312.12 $\pm$ 0.06 d		ϵ 100; $\beta^- < 2.9$E-4
		55	5/2-	-57.7117 (4)	**stable**	100%	
		56	3+	-56.9108 (5)	2.5789 $\pm$ 1.0E-4 h		β^- 100
		57	5/2-	-57.4861 (15)	85.4 $\pm$ 1.8 s		β^- 100
		58	1+	-55.827 (3)	3.0 $\pm$ 0.1 s		β^- 100
		58m	4+	-55.756 (3)	65.4 $\pm$ 0.5 s		$\beta^- \approx$ 90.00; $IT \approx$ 10.00
		59	(5/2)-	-55.5252 (23)	4.59 $\pm$ 0.05 s		β^- 100
		60	1+	-52.9678 (23)	0.28 $\pm$ 0.02 s		β^- 100
		60m	4+	-52.6959 (23)	1.77 $\pm$ 0.02 s		β^- 88.5; IT 11.5
		61	(5/2)-	-51.742 (23)	0.67 $\pm$ 0.04 s		β^- 100
		62	(3+)	-48.181 (3)	671 $\pm$ 5 ms		β^- 100; $\beta^- n$; $\beta^- n$; β^- 100
		63	5/2-	-46.887 (4)	0.275 $\pm$ 0.004 s		β^- 100; $\beta^- n$
		64	(1+)	-42.989 (4)	90 $\pm$ 4 ms		β^- 100; $\beta^- n$ 33
		65	(5/2-)	-40.967 (4)	84 $\pm$ 8 ms		β^- 100
		66	0	-36.75 (11)	65 $\pm$ 2 ms		β^- 100
		67	(5/2+)	-32.8 (4)	51 $\pm$ 4 ms		β^- 100; $\beta^- n > 10.0$
		68	(>3)	-28 (5)	28 $\pm$ 3 ms		$\beta^- n$; β^- 100
		69	5/2-	-24.4 (6)	18 $\pm$ 4 ms		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
26	**Fe**	45	(3/2+)	13.79 (20)	1.89 +0.49-0.21 ms		$\epsilon 3p$ 3.3; $2p$ 70; $\epsilon \leq$ 30.00; ϵp 19; $\epsilon 2p$ 7.8
		46	0+	0.8 (4)	13.0 ± 2 ms		ϵ 100; ϵp 78.7
		47	(7/2-)	-6.6 (3)	21.9 ± 0.2 ms		ϵ 100; ϵp 88.4; $\epsilon 2p$
		48	0+	-18.16 (7)	45.3 ± 0.6 ms		ϵ 100; ϵp 15.9
		49	(7/2-)	-24.82 (15)	64.7 ± 0.3 ms		ϵ 100; ϵp 56.7
		50	0+	-34.49 (6)	155 ± 11 ms		ϵ 100; ϵp ?
		51	5/2-	-40.221 (15)	305 ± 5 ms		ϵ 100
		52	0+	-48.333 (7)	8.275 ± 0.008 h		ϵ 100
		52m	12+	-41.375 (7)	45.9 ± 0.6 s		ϵ 100; $IT <$ 4.0E-3
		53	7/2-	-50.9467 (17)	8.51 ± 0.02 m		ϵ 100
		53m	19/2-	-47.9063 (17)	2.54 ± 0.02 m		IT 100
		54	0+	-56.2538 (5)	**stable**	5.845% ± 0.035%	
		55	3/2-	-57.4806 (5)	2.744 ± 0.009 y		ϵ 100
		56	0+	-60.6063 (5)	**stable**	91.754% ± 0.036%	
		57	1/2-	-60.1811 (5)	**stable**	2.119% ± 0.01%	
		58	0+	-62.1544 (5)	**stable**	0.282% ± 0.004%	
		59	3/2-	-60.6641 (5)	44.495 ± 0.009 d		β^- 100
		60	0+	-61.413 (3)	2.62E+6 ± 0.04E+6 y		β^- 100
		61	3/2-,5/2-	-58.92 (3)	5.98 ± 0.06 m		β^- 100
		62	0+	-58.878 (3)	68 ± 2 s		β^- 100
		63	(5/2-)	-55.636 (4)	6.1 ± 0.6 s		β^- 100
		64	0+	-54.969 (5)	2.0 ± 0.2 s		β^- 100
		65	(1/2-)	-51.221 (7)	0.81 ± 0.05 s		β^- 100
		65m	(9/2+)	-50.819 (7)	1.12 ± 0.15 s		β^- 100
		66	0+	-50.068 (4)	440 ± 60 ms		β^- 100
		67	(1/2-)	-45.7 (4)	0.40 ± 0.04 s		β^- 100
		68	0+	-43.1 (7)	180 ± 19 ms		β^- 100
		69	1/2-	-38.4 (5)	110 ± 6 ms		β^- 100
		70	0+	-36.3 (6)	71 ± 10 ms		β^- 100
		71	0	-31 (8)	28 ± 5 ms		β^- 100; $\beta^- n$
27	**Co**	50	(6+)	-17.19 (17)	38.8 ± 0.2 ms		ϵ 100; ϵp 70.5; $\epsilon 2p$
		52	(6+)	-33.92 (7)	115 ± 23 ms		ϵ 100
		53	(7/2-)	-42.6585 (18)	240 ± 9 ms		ϵ 100
		53m	(19/2-)	-39.4615 (18)	247 ± 12 ms		$\epsilon \approx$ 98.50; $p \approx$ 1.50
		54	0+	-48.0092 (5)	193.28 ± 0.07 ms		ϵ 100
		54m	7+	-47.8122 (5)	1.48 ± 0.02 m		ϵ 100
		55	7/2-	-54.0292 (5)	17.53 ± 0.03 h		ϵ 100
		56	4+	-56.0397 (6)	77.236 ± 0.026 d		ϵ 100
		57	7/2-	-59.3449 (6)	271.74 ± 0.06 d		ϵ 100
		58	2+	-59.8465 (12)	70.86 ± 0.06 d		ϵ 100
		58m	5+	-59.8215 (12)	9.10 ± 0.09 h		IT 100
		59	7/2-	-62.229 (5)	**stable**	100%	
		60	5+	-61.6496 (5)	1925.28 ± 0.14 d		β^- 100
		60m	2+	-61.591 (5)	10.467 ± 0.006 m		IT 99.76; β^- 0.24
		61	7/2-	-62.8975 (9)	1.650 ± 0.005 h		β^- 100
		62	2+	-61.431 (20)	1.50 ± 0.04 m		β^- 100
		62m	5+	-61.409 (20)	13.91 ± 0.05 m		$\beta^- >$ 99.00; $IT <$ 1.00
		63	7/2-	-61.839 (20)	27.4 ± 0.5 s		β^- 100
		64	1+	-59.792 (20)	0.30 ± 0.03 s		β^- 100
		65	(7/2)-	-59.1851 (21)	1.16 ± 0.03 s		β^- 100
		66	(3+)	-56.408 (14)	0.20 ± 0.02 s		β^- 100
		67	(7/2-)	-55.322 (6)	0.425 ± 0.02 s		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		68	(7-)	-51.91 (13)	0.199 ± 0.021 s		β^- 100; β^- 100
		69	7/2-	-50 (3)	229 ± 24 ms		β^- 100
		70	(6-)	-45.6 (8)	108 ± 7 ms		β^- 100; β^- 100
		71	(7/2-)	-43.9 (8)	80 ± 3 ms		β^- 100; $\beta^- n \leq 6.00$
		72	(6-,7-)	-39.7 (6)	59.9 ± 1.7 ms		$\beta^- n \geq 6.00$; β^- 100
		73	0	-37.2 (7)	41 ± 4 ms		β^-
		74	0+	-32.7 (8)	25 ± 5 ms		β^- ; $\beta^- n \approx 18.00$
28	**Ni**	48	0+	18 (5)	2.1 +1.4-0.6 ms		$2p \approx 70.00$; ϵ
		49	0	8.7 (4)	7.5 ± 1 ms		ϵp 83; ϵ 100
		50	0+	-3.6 (3)	18.5 ± 1.2 ms		ϵ 100; ϵp 86.7; $\epsilon 2p$
		51	(7/2-)	-11.5 (3)	23.8 ± 0.2 ms		ϵ ; ϵp 87.2
		52	0+	-22.89 (20)	40.8 ± 0.2 ms		ϵ 100; ϵp 31.4
		53	(7/2-)	-29.7 (3)	55.2 ± 0.7 ms		ϵ 100; ϵp 23.4
		54	0+	-39.22 (5)	104 ± 7 ms		ϵ 100
		55	7/2-	-45.3351 (8)	204.7 ± 3.7 ms		ϵ 100
		56	0+	-53.9068 (5)	6.075 ± 0.01 d		ϵ 100
		57	3/2-	-56.0831 (7)	35.60 ± 0.06 h		ϵ 100
		58	0+	-60.2281 (5)	**stable**	68.077% ± 0.009%	
		59	3/2-	-61.156 (5)	7.6E+4 ± 0.5E+4 y		ϵ 100
		60	0+	-64.4725 (5)	**stable**	26.223% ± 0.008%	
		61	3/2-	-64.2212 (5)	**stable**	1.1399% ± 0.0013%	
		62	0+	-66.7458 (5)	**stable**	3.6346% ± 0.004%	
		63	1/2-	-65.5122 (5)	101.2 ± 1.5 y		β^- 100
		64	0+	-67.0984 (5)	**stable**	0.9255% ± 0.0019%	
		65	5/2-	-65.1252 (6)	2.5175 ± 5.0E-4 h		β^- 100
		66	0+	-66.0062 (14)	54.6 ± 0.3 h		β^- 100
		67	(1/2)-	-63.743 (3)	21 ± 1 s		β^- 100
		68	0+	-63.464 (3)	29 ± 2 s		β^- 100
		69	9/2+	-59.979 (4)	11.2 ± 0.9 s		β^- 100
		69m	1/2-	-59.658 (4)	3.5 ± 0.9 s		β^- 100
		70	0+	-59.2136 (22)	6.0 ± 0.3 s		β^- 100
		71	(9/2+)	-55.4059 (23)	2.56 ± 0.03 s		β^- 100
		71m	(1/2-)	-54.9069 (23)	2.3 ± 0.3 s		β^- 100
		72	0+	-54.2258 (23)	1.57 ± 0.05 s		β^- 100
		73	(9/2+)	-50.1079 (25)	0.84 ± 0.03 s		β^- 100
		74	0+	-48.7 (4)	0.68 ± 0.18 s		β^- 100; $\beta^- n$
		75	(7/2+)	-44.1 (4)	344 ± 25 ms		β^- 100; $\beta^- n$ 10
		76	0+	-41.6 (5)	0.238 +0.015-0.018 s		β^- 100; $\beta^- n$
		77	0	-36.7 (5)	128 +36-32 ms		β^- 100; $\beta^- n$ 30
		78	0+	-34.1 (8)	0.11 +0.1-0.06 s		$\beta^- n$; β^- 100
29	**Cu**	55	(3/2-)	-31.6 (3)	27 ± 8 ms		ϵ 100; ϵp 15
		56	(4+)	-38.2 (4)	93 ± 3 ms		ϵp 0.4; ϵ 100
		57	3/2-	-47.3082 (6)	196.3 ± 0.7 ms		ϵ 100
		58	1+	-51.6671 (7)	3.204 ± 0.007 s		ϵ 100
		59	3/2-	-56.3577 (6)	81.5 ± 0.5 s		ϵ 100
		60	2+	-58.3445 (16)	23.7 ± 0.4 m		ϵ 100
		61	3/2-	-61.9837 (10)	3.333 ± 0.005 h		ϵ 100
		62	1+	-62.7869 (7)	9.673 ± 0.008 m		ϵ 100
		63	3/2-	-65.5792 (5)	**stable**	69.15% ± 0.15%	
		64	1+	-65.424 (5)	12.701 ± 0.002 h		ϵ 61.5; β^- 38.5
		65	3/2-	-67.2633 (7)	**stable**	30.85% ± 0.15%	
		66	1+	-66.2579 (7)	5.120 ± 0.014 m		β^- 100
		67	3/2-	-67.3187 (12)	61.83 ± 0.12 h		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		68	1+	-65.567 (16)	30.9 ± 0.6 s		β^- 100
		68m	(6-)	-64.8454 (16)	3.75 ± 0.05 m		IT 84; β^- 16
		69	3/2-	-65.7362 (14)	2.85 ± 0.15 m		β^- 100
		70	(6-)	-62.9763 (11)	44.5 ± 0.2 s		β^- 100
		70m	(3-)	-62.8752 (11)	33 ± 2 s		β^- 52; IT 48
		70m2	1+	-62.7337 (11)	6.6 ± 0.2 s		IT 6.8; β^- 93.2
		71	3/2(-)	-62.7111 (15)	19.4 ± 1.6 s		β^- 100
		72	(2)	-59.783 (14)	6.63 ± 0.03 s		β^- 100
		73	(3/2-)	-58.9872 (20)	4.2 ± 0.3 s		β^- 100
		74	(1+,3+)	-56.006 (6)	1.594 ± 0.01 s		β^- 100
		75	(5/2-)	-54.471 (24)	1.222 ± 0.008 s		β^- 100; $\beta^- n$ 3.5
		76	(3,4)	-50.976 (7)	637 ± 7 ms		β^- 100; $\beta^- n$ 7.2; β^- 100
		77	(5/2-)	-48.3 (5)	468.1 ± 2 ms		$\beta^- n$ 30.3; β^- 100
		78	(4-,5-,6-)	-44.5 (5)	335 ± 11 ms		β^- 100; $\beta^- n > 65.00$
		79	0	-41.9 (4)	188 ± 25 ms		β^- 100; $\beta^- n$ 55
		80	0	-36.4 (6)	0.17 +0.11-0.05 s		β^-
30	**Zn**	54	0+	-6 (4)	1.59 +0.6-0.35 ms		$2p$ 92
		55	(5/2-)	-14.4 (4)	19.8 ± 1.3 ms		ϵ 100; ϵp 91
		56	0+	-25.2 (4)	30.0 ± 1.7 ms		ϵ 100; ϵp 86
		57	(7/2-)	-32.55 (21)	38 ± 4 ms		ϵ 100; $\epsilon p \geq 65.00$
		58	0+	-42.3 (5)	86 ± 8 ms		ϵ 100; $\epsilon p < 3.00$
		59	3/2-	-47.2149 (8)	182.0 ± 1.8 ms		ϵ 100; ϵp 0.1
		60	0+	-54.1737 (6)	2.38 ± 0.05 m		ϵ 100
		61	3/2-	-56.343 (16)	89.1 ± 0.2 s		ϵ 100
		61m	1/2-	-56.255 (16)	< 430 ms		IT
		61m2	3/2-	-55.925 (16)	0.14 ± 0.07 s		IT
		61m3	5/2-	-55.587 (16)	< 0.13 s		IT
		62	0+	-61.1674 (7)	9.186 ± 0.013 h		ϵ 100
		63	3/2-	-62.213 (16)	38.47 ± 0.05 m		ϵ 100
		64	0+	-66.0036 (7)	≥ 7.0E20 y	49.17% ± 0.75%	2ϵ
		65	5/2-	-65.9116 (7)	243.93 ± 0.09 d		ϵ 100
		66	0+	-68.899 (9)	**stable**	27.73% ± 0.98%	
		67	5/2-	-67.88 (9)	**stable**	4.04% ± 0.16%	
		68	0+	-70.0068 (9)	**stable**	18.45% ± 0.63%	
		69	1/2-	-68.4175 (9)	56.4 ± 0.9 m		β^- 100
		69m	9/2+	-67.9789 (9)	13.76 ± 0.02 h		IT 99.97; β^- 0.03
		70	0+	-69.5646 (20)	≥ 2.3E+17 y	0.61% ± 0.1%	$2\beta^-$
		71	1/2-	-67.329 (3)	2.45 ± 0.1 m		β^- 100
		71m	9/2+	-67.171 (3)	3.96 ± 0.05 h		β^- 100; $IT \leq 0.05$
		72	0+	-68.1454 (21)	46.5 ± 0.1 h		β^- 100
		73	(1/2)-	-65.5934 (19)	23.5 ± 1 s		β^- 100; β^- ; IT
		73m	(5/2+)	-65.3979 (19)	13.0 ± 0.2 ms		IT 100
		74	0+	-65.757 (3)	95.6 ± 1.2 s		β^- 100
		75	(7/2+)	-62.5589 (20)	10.2 ± 0.2 s		β^- 100
		76	0+	-62.303 (15)	5.7 ± 0.3 s		β^- 100
		77	(7/2+)	-58.7891 (20)	2.08 ± 0.05 s		β^- 100
		77m	(1/2-)	-58.0167 (20)	1.05 ± 0.1 s		$IT > 50.00$; $\beta^- < 50.00$
		78	0+	-57.4832 (19)	1.47 ± 0.15 s		β^- 100
		79	(9/2+)	-53.4322 (22)	0.995 ± 0.019 s		β^- 100; $\beta^- n$ 1.3
		80	0+	-51.649 (3)	0.54 ± 0.02 s		β^- 100; $\beta^- n$ 1
		81	(5/2+)	-46.2 (5)	304 ± 13 ms		β^- 100; $\beta^- n$ 7.5
31	**Ga**	60	(2+)	-39.78 (20)	70 ± 13 ms		$\epsilon\alpha < 0.02$; ϵ 98.4; ϵp 1.6
		61	3/2-	-47.09 (5)	167 ± 3 ms		ϵ 100; $\epsilon p < 0.25$

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		62	0+	-51.9864 (7)	116.121 ± 0.021 ms		ϵ 100; ϵp
		63	3/2-	-56.547 (13)	32.4 ± 0.5 s		ϵ 100
		64	0+	-58.8334 (15)	2.627 ± 0.012 m		ϵ 100
		65	3/2-	-62.6572 (8)	15.2 ± 0.2 m		ϵ 100
		66	0+	-63.724 (3)	9.49 ± 0.03 h		ϵ 100
		67	3/2-	-66.8788 (12)	3.2617 ± 5.0E-4 d		ϵ 100
		68	1+	-67.0857 (15)	67.71 ± 0.09 m		ϵ 100
		69	3/2-	-69.3277 (12)	**stable**	60.108% ± 0.009%	
		70	1+	-68.91 (12)	21.14 ± 0.03 m		β^- 99.59; ϵ 0.41
		71	3/2-	-70.139 (8)	**stable**	39.892% ± 0.009%	
		72	3-	-68.5882 (8)	14.10 ± 0.02 h		β^- 100
		73	3/2-	-69.6993 (17)	4.86 ± 0.03 h		β^- 100
		74	(3-)	-68.049 (4)	8.12 ± 0.12 m		β^- 100
		74m	(0)	-67.989 (4)	9.5 ± 1 s		IT 75; $\beta^- < 50.00$
		75	3/2-	-68.4645 (24)	126 ± 2 s		β^- 100
		76	2+	-66.2966 (20)	32.6 ± 0.6 s		β^- 100
		77	3/2-	-65.9923 (24)	13.2 ± 0.2 s		β^- 100
		78	2+	-63.7059 (19)	5.09 ± 0.05 s		β^- 100
		79	3/2-	-62.5476 (19)	2.847 ± 0.003 s		β^- 100; $\beta^- n$ 0.09
		80	3	-59.224 (3)	1.676 ± 0.014 s		β^- 100; $\beta^- n$ 0.86
		81	5/2-	-57.628 (3)	1.217 ± 0.005 s		β^- 100; $\beta^- n$ 11.9
		82	(1,2,3)	-52.9307 (24)	0.599 ± 0.002 s		β^- 100; $\beta^- n$ 19.8
		83	0	-49.257 (3)	308.1 ± 1 ms		β^- 100; $\beta^- n$ 62.8
		84	(0-)	-44.3 (4)	0.085 ± 0.01 s		β^- 100; $\beta^- n$ 74; β^- 100; $\beta^- n$?
		85	(1/2- ,3/2-)	-40.2 (5)	< 100 ms		β^- ; $\beta^- n > 35.0$
32	**Ge**	61	(3/2-)	-33.7 (3)	44 ± 6 ms		ϵ 100; $\epsilon p > 58.00$
		62	0+	-42.24 (14)	129 ± 35 ms		ϵ 100; ϵp
		63	3/2-	-46.92 (4)	150 ± 9 ms		ϵ 100
		64	0+	-54.315 (4)	63.7 ± 2.5 s		ϵ 100
		65	3/2-	-56.481 (3)	30.9 ± 0.5 s		ϵ 100; ϵp 0.01
		66	0+	-61.6069 (24)	2.26 ± 0.05 h		ϵ 100
		67	1/2-	-62.658 (5)	18.9 ± 0.3 m		ϵ 100
		68	0+	-66.9787 (19)	270.95 ± 0.16 d		ϵ 100
		69	5/2-	-67.1005 (13)	39.05 ± 0.1 h		ϵ 100
		70	0+	-70.5618 (8)	**stable**	20.57% ± 0.27%	
		71	1/2-	-69.9064 (8)	11.43 ± 0.03 d		ϵ 100
		71m	9/2+	-69.708 (8)	20.41 ± 0.18 ms		IT 100
		72	0+	-72.5856 (5)	**stable**	27.45% ± 0.32%	
		73	9/2+	-71.2972 (5)	**stable**	7.75% ± 0.12%	
		73m	1/2-	-71.2305 (5)	0.499 ± 0.011 s		IT 100
		74	0+	-73.4221 (5)	**stable**	36.5% ± 0.2%	
		75	1/2-	-71.8561 (5)	82.78 ± 0.04 m		β^- 100
		75m	7/2+	-71.7164 (5)	47.7 ± 0.5 s		IT 99.97; β^- 0.03
		76	0+	-73.2128 (9)	**stable**	7.73% ± 0.12%	
		77	7/2+	-71.2138 (4)	11.30 ± 0.01 h		β^- 100
		77m	1/2-	-71.0541 (4)	52.9 ± 0.6 s		IT 19; β^- 81
		78	0+	-71.862 (4)	88.0 ± 1 m		β^- 100
		79	(1/2)-	-69.53 (4)	18.98 ± 0.03 s		β^- 100
		79m	(7/2+)	-69.34 (4)	39.0 ± 1 s		β^- 96; IT 4
		80	0+	-69.5353 (21)	29.5 ± 0.4 s		β^- 100
		81	(9/2+)	-66.2916 (21)	7.6 ± 0.6 s		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		81m	(1/2+)	-65.6125 (21)	7.6 ± 0.6 s		β^- 100
		82	0+	-65.415 (22)	4.56 ± 0.26 s		β^- 100
		83	(5/2)+	-60.9764 (24)	1.85 ± 0.06 s		β^- 100
		84	0+	-58.148 (3)	0.954 ± 0.014 s		$\beta^- n$ 10.2; β^- 100
		85	(1/2+,5/2+)	-53.123 (4)	0.56 ± 0.05 s		β^- 100; $\beta^- n$ 14
		87	(5/2+)	-44.2 (5)	≈ 0.14 s		β^- 100; $\beta^- n$
33	**As**	64	0	-39.4 (3)	18 +43-7 ms		ϵ 100
		65	0	-46.94 (8)	128 ± 16 ms		ϵ 100
		66	(0+)	-52.03 (3)	95.77 ± 0.23 ms		ϵ 100
		67	(5/2-)	-56.5859 (14)	42.5 ± 1.2 s		ϵ 100
		68	3+	-58.8945 (18)	151.6 ± 0.8 s		ϵ 100
		69	5/2-	-63.09 (3)	15.2 ± 0.2 m		ϵ 100
		70	4+	-64.34 (5)	52.6 ± 0.3 m		ϵ 100
		71	5/2-	-67.893 (4)	65.30 ± 0.07 h		ϵ 100
		72	2-	-68.229 (4)	26.0 ± 0.1 h		ϵ 100
		73	3/2-	-70.952 (4)	80.30 ± 0.06 d		ϵ 100
		74	2-	-70.8597 (17)	17.77 ± 0.02 d		ϵ 66; β^- 34
		75	3/2-	-73.0337 (9)	**stable**	100%	
		75m	9/2+	-72.7298 (9)	17.62 ± 0.23 ms		IT 100
		76	2-	-72.2908 (9)	1.0942 ± 7.0E-4 d		β^- 100
		77	3/2-	-73.9164 (17)	38.83 ± 0.05 h		β^- 100
		78	2-	-72.817 (10)	90.7 ± 0.2 m		β^- 100
		79	3/2-	-73.636 (5)	9.01 ± 0.15 m		β^- 100
		80	1+	-72.171 (16)	15.2 ± 0.2 s		β^- 100
		81	3/2-	-72.533 (3)	33.3 ± 0.8 s		β^- 100
		82	(2-)	-70.103 (4)	19.1 ± 0.5 s		β^- 100
		82m	(5-)	-69.956 (4)	13.6 ± 0.4 s		β^- 100
		83	(5/2-,3/2-)	-69.669 (3)	13.4 ± 0.3 s		β^- 100
		84	(3-)	-65.853 (3)	4.2 ± 0.5 s		β^- 100; $\beta^- n$ 0.18
		85	(3/2-)	-63.189 (3)	2.021 ± 0.01 s		β^- 100; $\beta^- n$ 59.4
		86	0	-58.962 (3)	0.945 ± 0.008 s		β^- 100; $\beta^- n$ 26
		87	(3/2-)	-55.618 (3)	0.56 ± 0.08 s		β^- 100; $\beta^- n$ 15.4
34	**Se**	65	(3/2-)	-32.9 (6)	33 ± 4 ms		ϵ 100; ϵp 100
		67	0	-46.58 (7)	136 ± 12 ms		ϵ 100; ϵp 0.5
		68	0+	-54.1894 (5)	35.5 ± 0.7 s		ϵ 100
		69	(1/2-,3/2-)	-56.3 (3)	27.4 ± 0.2 s		ϵ 100; ϵp 0.05
		70	0+	-61.9298 (16)	41.1 ± 0.3 m		ϵ 100
		71	(5/2-)	-63.146 (3)	4.74 ± 0.05 m		ϵ 100
		72	0+	-67.8681 (20)	8.40 ± 0.08 d		ϵ 100
		73	9/2+	-68.227 (7)	7.15 ± 0.08 h		ϵ 100
		73m	3/2-	-68.201 (7)	39.8 ± 1.3 m		IT 72.6; ϵ 27.4
		74	0+	-72.2127 (3)	**stable**	0.89% ± 0.04%	
		75	5/2+	-72.169 (3)	119.79 ± 0.04 d		ϵ 100
		76	0+	-75.2518 (7)	**stable**	9.37% ± 0.29%	
		77	1/2-	-74.5993 (10)	**stable**	7.63% ± 0.16%	
		77m	7/2+	-74.4374 (10)	17.4 ± 0.8 s		IT 100
		78	0+	-77.0258 (20)	**stable**	23.77% ± 0.28%	
		79	7/2+	-75.9173 (24)	2.95E+5 ± 0.38E+5 y		β^- 100
		79m	1/2-	-75.8215 (24)	3.92 ± 0.01 m		IT 99.94; β^- 0.06
		80	0+	-77.7598 (15)	**stable**	49.61% ± 0.41%	$2\beta^-$
		81	1/2-	-76.3894 (15)	18.45 ± 0.12 m		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		81m	7/2+	-76.2864 (15)	57.28 $\pm$ 0.02 m		IT 99.95; β^- 0.05
		82	0+	-77.594 (15)	**stable**	8.73% $\pm$ 0.22%	
		83	9/2+	-75.341 (3)	22.3 $\pm$ 0.3 m		β^- 100
		83m	1/2-	-75.112 (3)	70.1 $\pm$ 0.4 s		β^- 100
		84	0+	-75.9476 (20)	3.26 $\pm$ 0.1 m		β^- 100
		85	(5/2+)	-72.414 (3)	32.9 $\pm$ 0.3 s		β^- 100
		86	0+	-70.503 (3)	14.3 $\pm$ 0.3 s		β^- 100
		87	(5/2+)	-66.4261 (22)	5.50 $\pm$ 0.12 s		β^- 100; $\beta^- n$ 0.2
		88	0+	-63.884 (3)	1.53 $\pm$ 0.06 s		β^- 100; $\beta^- n$ 0.67
		89	(5/2+)	-58.992 (4)	0.41 $\pm$ 0.04 s		β^- 100; $\beta^- n$ 7.8
		91	0	-50.3 (5)	0.27 $\pm$ 0.05 s		β^- 100; $\beta^- n$ 21
35	**Br**	70	0+	-51.426 (15)	79.1 $\pm$ 0.8 ms		ϵ 100
		70m	9+	-49.133 (15)	2.2 $\pm$ 0.2 s		ϵ 100
		71	(5/2)-	-56.502 (5)	21.4 $\pm$ 0.6 s		ϵ 100
		72	1+	-59.067 (7)	78.6 $\pm$ 2.4 s		ϵ 100
		72m	(3-)	-58.966 (7)	10.6 $\pm$ 0.3 s		IT 100; ϵ
		73	1/2-	-63.648 (7)	3.4 $\pm$ 0.2 m		ϵ 100
		74	(0-)	-65.285 (6)	25.4 $\pm$ 0.3 m		ϵ 100
		74m	4(+)	-65.271 (6)	46 $\pm$ 2 m		ϵ 100
		75	3/2-	-69.107 (4)	96.7 $\pm$ 1.3 m		ϵ 100
		76	1-	-70.289 (9)	16.2 $\pm$ 0.2 h		ϵ 100
		76m	(4)+	-70.186 (9)	1.31 $\pm$ 0.02 s		$IT > 99.40$; $\epsilon < 0.60$
		77	3/2-	-73.235 (3)	57.036 $\pm$ 0.006 h		ϵ 100
		77m	9/2+	-73.129 (3)	4.28 $\pm$ 0.1 m		IT 100
		78	1+	-73.452 (4)	6.45 $\pm$ 0.04 m		$\epsilon \geq 99.99$; $\beta^- \leq 0.01$
		79	3/2-	-76.0684 (15)	**stable**	50.69% $\pm$ 0.07%	
		79m	9/2+	-75.8608 (15)	5.1 $\pm$ 0.4 s		IT 100
		80	1+	-75.8894 (15)	17.68 $\pm$ 0.02 m		β^- 91.7; ϵ 8.3
		80m	5-	-75.8035 (15)	4.4205 $\pm$ 8.0E-4 h		IT 100
		81	3/2-	-77.9755 (13)	**stable**	49.31% $\pm$ 0.07%	
		82	5-	-77.4972 (13)	35.282 $\pm$ 0.007 h		β^- 100
		82m	2-	-77.4513 (13)	6.13 $\pm$ 0.05 m		IT 97.6; β^- 2.4
		83	3/2-	-79.006 (5)	2.40 $\pm$ 0.02 h		β^- 100
		84	2-	-77.79 (3)	31.76 $\pm$ 0.08 m		β^- 100
		84m	(6)-	-77.47 (3)	6.0 $\pm$ 0.2 m		β^- 100
		85	3/2-	-78.575 (3)	2.90 $\pm$ 0.06 m		β^- 100
		86	(1-)	-75.632 (3)	55.1 $\pm$ 0.4 s		β^- 100
		87	3/2-	-73.892 (3)	55.65 $\pm$ 0.13 s		$\beta^- n$ 2.6; β^- 100
		88	(2-)	-70.716 (3)	16.29 $\pm$ 0.06 s		β^- 100; $\beta^- n$ 6.58
		89	(3/2-,5/2-)	-68.274 (3)	4.40 $\pm$ 0.03 s		β^- 100; $\beta^- n$ 13.8
		90	0	-64 (3)	1.91 $\pm$ 0.01 s		β^- 100; $\beta^- n$ 25.2
		91	0	-61.107 (4)	0.541 $\pm$ 0.005 s		β^- 100; $\beta^- n$ 20
		92	(2-)	-56.233 (7)	0.343 $\pm$ 0.015 s		$\beta^- n$ 33.1; β^- 100
		93	(5/2-)	-52.85 (20)	102 $\pm$ 10 ms		β^- 100; $\beta^- n$ 68
		94	0	-47.6 (4)	70 $\pm$ 20 ms		β^- 100; $\beta^- n$ 68
36	**Kr**	69	0	-32.4 (4)	32 $\pm$ 10 ms		ϵ 100
		70	0+	-41.6 (4)	52 $\pm$ 17 ms		ϵ 100; $\epsilon p \leq 1.30$
		71	(5/2-)	-46.33 (13)	100 $\pm$ 3 ms		ϵ 100; ϵp 2.1
		72	0+	-53.94 (8)	17.1 $\pm$ 0.2 s		ϵ 100; $\epsilon p <$ 1.0E-6
		73	3/2-	-56.552 (7)	27.3 $\pm$ 1 s		ϵ 100; ϵp 0.25
		74	0+	-62.3315 (20)	11.50 $\pm$ 0.11 m		ϵ 100
		75	5/2+	-64.324 (8)	4.29 $\pm$ 0.17 m		ϵ 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		76	0+	-69.014 (4)	14.8 ± 0.1 h		ϵ 100
		77	5/2+	-70.1694 (20)	74.4 ± 0.6 m		ϵ 100
		78	0+	-74.1795 (7)	≥ 1.5E+21 y	0.355% ± 0.003%	2ϵ
		79	1/2-	-74.443 (4)	35.04 ± 0.1 h		ϵ 100
		79m	7/2+	-74.313 (4)	50 ± 3 s		IT 100
		80	0+	-77.8925 (8)	**stable**	2.286% ± 0.01%	
		81	7/2+	-77.6947 (14)	2.29E+5 ± 0.11E+5 y		ϵ 100
		81m	1/2-	-77.5041 (14)	13.10 ± 0.03 s		ϵ 0.0025; IT 100
		82	0+	-80.5902 (9)	**stable**	11.593% ± 0.031%	
		83	9/2+	-79.99 (3)	**stable**	11.5% ± 0.019%	
		83m	1/2-	-79.9484 (3)	1.85 ± 0.03 h		IT 100
		84	0+	-82.4393 (4)	**stable**	56.987% ± 0.015%	
		85	9/2+	-81.4803 (20)	10.752 ± 0.025 y		β^- 100
		85m	1/2-	-81.1753 (20)	4.480 ± 0.008 h		β^- 78.6; IT 21.4
		86	0+	-83.2656 (4)	**stable**	17.279% ± 0.041%	
		87	5/2+	-80.7095 (25)	76.3 ± 0.5 m		β^- 100
		88	0+	-79.691 (3)	2.84 ± 0.03 h		β^- 100
		89	3/2(+)	-76.5357 (21)	3.15 ± 0.04 m		β^- 100
		90	0+	-74.9592 (19)	32.32 ± 0.09 s		β^- 100
		91	5/2(+)	-70.9739 (22)	8.57 ± 0.04 s		β^- 100
		92	0+	-68.769 (3)	1.840 ± 0.008 s		β^- 100; $\beta^- n$ 0.03
		93	1/2+	-64.136 (3)	1.286 ± 0.01 s		β^- 100; $\beta^- n$ 1.95
		94	0+	-61.348 (12)	212 ± 5 ms		β^- 100; $\beta^- n$ 1.11
		95	1/2(+)	-56.159 (19)	0.114 ± 0.003 s		β^- 100; $\beta^- n$ 2.87
		96	0+	-53.08 (20)	80 ± 6 ms		β^- 100; $\beta^- n$ 3.7
		97	(3/2+)	-47.42 (13)	63 ± 4 ms		β^- 100; $\beta^- n$ 6.7
		98	0+	-44.5 (5)	46 ± 8 ms		β^- 100; $\beta^- n$ 7
		99	0	-38.8 (5)	13 +34-6 ms		β^- 100; $\beta^- n$ 11
		100	0+	-35.2 (5)	7 +11-3 ms		β^- 100; $\beta^- n$
37	**Rb**	74	(0+)	-51.917 (4)	64.9 ± 0.5 ms		ϵ 100
		75	(3/2-)	-57.2186 (16)	19.0 ± 1.2 s		ϵ 100
		76	1(-)	-60.478 (12)	36.5 ± 0.6 s		ϵ 100; $\epsilon\alpha$ 3.8e-07
		77	3/2-	-64.8304 (13)	3.77 ± 0.04 m		ϵ 100
		78	0(+)	-66.936 (7)	17.66 ± 0.03 m		ϵ 100
		78m	4(-)	-66.825 (7)	5.74 ± 0.03 m		ϵ 91; IT 9
		79	5/2+	-70.8029 (21)	22.9 ± 0.5 m		ϵ 100
		80	1+	-72.1754 (19)	33.4 ± 0.7 s		ϵ 100
		81	3/2-	-75.456 (5)	4.572 ± 0.004 h		ϵ 100
		81m	9/2+	-75.37 (5)	30.5 ± 0.3 m		IT 97.6; ϵ 2.4
		82	1+	-76.188 (3)	1.2575 ± 2.0E-4 m		ϵ 100
		82m	5-	-76.119 (3)	6.472 ± 0.006 h		IT < 0.33; ϵ 100
		83	5/2-	-79.0706 (23)	86.2 ± 0.1 d		ϵ 100
		84	2-	-79.756 (3)	32.82 ± 0.07 d		ϵ 96.1; β^- 3.9
		84m	6-	-79.293 (3)	20.26 ± 0.04 m		IT 100
		85	5/2-	-82.1673 (5)	**stable**	72.17% ± 0.02%	
		86	2-	-82.747 (20)	18.642 ± 0.018 d		β^- 99.99; ϵ 0.0052
		86m	6-	-82.1909 (20)	1.017 ± 0.003 m		IT 100; β^- < 0.30
		87	3/2-	-84.5977 (6)	4.81E+10 ± 0.09E+10 y	27.83% ± 0.02%	β^- 100
		88	2-	-82.6089 (16)	17.773 ± 0.011 m		β^- 100
		89	3/2-	-81.712 (5)	15.15 ± 0.12 m		β^- 100
		90	0-	-79.365 (7)	158 ± 5 s		β^- 100
		90m	3-	-79.258 (7)	258 ± 4 s		β^- 97.4; IT 2.6
		91	3/2(-)	-77.746 (8)	58.4 ± 0.4 s		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		92	0-	-74.773 (6)	4.492 ± 0.02 s		β^- 100; $\beta^- n$ 0.01
		93	5/2-	-72.62 (8)	5.84 ± 0.02 s		β^- 100; $\beta^- n$ 1.39
		94	3(-)	-68.562 (3)	2.702 ± 0.005 s		β^- 100; $\beta^- n$ 10.5
		95	5/2-	-65.894 (20)	377.7 ± 0.8 ms		β^- 100; $\beta^- n$ 8.7
		96	2(-)	-61.354 (3)	203 ± 3 ms		β^- 100; $\beta^- n$ 13.3
		97	3/2+	-58.518 (5)	169.1 ± 0.6 ms		β^- 100; $\beta^- n$ 25.5
		98	(0,1)	-54.03 (5)	102 ± 4 ms		β^- 100; $\beta^- n$ 13.8; $\beta^- 2n$ 0.05
		98m	(3,4)	-53.76 (5)	96 ± 3 ms		β^- 100
		99	(5/2+)	-51.22 (11)	54 ± 4 ms		β^- 100; $\beta^- n$ 15.8
		100	(3+,4-)	-46.55 (20)	51 ± 8 ms		β^- 100; $\beta^- n$ 6; $\beta^- 2n$ 0.16
		101	(3/2+)	-42.97 (22)	32 ± 5 ms		β^- 100; $\beta^- n$ 28
		102	0	-37.9 (3)	37 ± 3 ms		β^- 100; $\beta^- n$ 18
38	**Sr**	73	0	-31.9 (4)	> 25 ms		ϵ 100; $\epsilon p > 0.00$
		75	(3/2-)	-46.62 (22)	88 ± 3 ms		ϵ 100; ϵp 5.2
		76	0+	-54.25 (3)	7.89 ± 0.07 s		ϵ 100; ϵp 3.4e-05
		77	5/2+	-57.803 (8)	9.0 ± 0.2 s		ϵ 100; $\epsilon p < 0.25$
		78	0+	-63.174 (7)	160 ± 8 s		ϵ 100
		79	3/2(-)	-65.477 (8)	2.25 ± 0.1 m		ϵ 100
		80	0+	-70.311 (3)	106.3 ± 1.5 m		ϵ 100
		81	1/2-	-71.528 (3)	22.3 ± 0.4 m		ϵ 100
		82	0+	-76.01 (6)	25.34 ± 0.02 d		ϵ 100
		83	7/2+	-76.798 (7)	32.41 ± 0.03 h		ϵ 100
		83m	1/2-	-76.538 (7)	4.95 ± 0.12 s		IT 100
		84	0+	-80.6493 (13)	**stable**	0.56% ± 0.01%	
		85	9/2+	-81.103 (3)	64.850 ± 0.007 d		ϵ 100
		85m	1/2-	-80.864 (3)	67.63 ± 0.04 m		IT 86.6; ϵ 13.4
		86	0+	-84.5232 (11)	**stable**	9.86% ± 0.01%	
		87	9/2+	-84.88 (11)	**stable**	7% ± 0.01%	
		87m	1/2-	-84.4915 (11)	2.815 ± 0.012 h		IT 99.7; ϵ 0.3
		88	0+	-87.9213 (11)	**stable**	82.58% ± 0.01%	
		89	5/2+	-86.2087 (11)	50.53 ± 0.07 d		β^- 100
		90	0+	-85.949 (3)	28.90 ± 0.03 y		β^- 100
		91	5/2+	-83.653 (6)	9.63 ± 0.05 h		β^- 100
		92	0+	-82.867 (3)	2.66 ± 0.04 h		β^- 100
		93	5/2+	-80.086 (8)	7.43 ± 0.03 m		β^- 100
		94	0+	-78.843 (7)	75.3 ± 0.2 s		β^- 100
		95	1/2+	-75.124 (6)	23.90 ± 0.14 s		β^- 100
		96	0+	-72.933 (9)	1.07 ± 0.01 s		β^- 100
		97	1/2+	-68.592 (10)	429 ± 5 ms		β^- 100; $\beta^- n \leq 0.05$
		98	0+	-66.437 (10)	0.653 ± 0.002 s		β^- 100; $\beta^- n$ 0.25
		99	3/2+	-62.529 (7)	0.269 ± 0.001 s		β^- 100; $\beta^- n$ 0.1
		100	0+	-59.833 (10)	202 ± 3 ms		β^- 100; $\beta^- n$ 0.78
		101	(5/2-)	-55.57 (8)	118 ± 3 ms		β^- 100; $\beta^- n$ 2.37
		102	0+	-52.4 (21)	69 ± 6 ms		β^- 100; $\beta^- n$ 5.5
		103	0	-47.53 (20)	68 +48-20 ms		β^-
		104	0+	-43.9 (4)	43 +9-7 ms		β^-
		105	0	-38.6 (5)	40 +36-13 ms		β^-
39	**Y**	77	(5/2+)	-46.78 (6)	57 +22-12 ms		ϵ 100; ϵp ; p
		78	(0+)	-52.5 (4)	53 ± 8 ms		ϵ 100; ϵp ; ϵp ; ϵ 100
		79	(5/2+)	-58.4 (5)	14.8 ± 0.6 s		ϵ 100; ϵp
		80	(4-)	-61.148 (6)	30.1 ± 0.5 s		ϵ 100; ϵp
		80m	(1-)	-60.92 (6)	4.8 ± 0.3 s		IT 81; ϵ 19

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		81	(5/2+)	-65.713 (6)	70.4 ± 1 s		ϵ 100
		82	1+	-68.064 (6)	8.30 ± 0.2 s		ϵ 100
		83	9/2+	-72.206 (19)	7.08 ± 0.06 m		ϵ 100
		83m	3/2-	-72.144 (19)	2.85 ± 0.02 m		IT 40; ϵ 60
		84	(6+)	-73.894 (4)	39.5 ± 0.8 m		ϵ 100
		84m	1+	-73.827 (4)	4.6 ± 0.2 s		ϵ 100
		85	(1/2)-	-77.842 (19)	2.68 ± 0.05 h		ϵ 100
		85m	9/2+	-77.822 (19)	4.86 ± 0.2 h		ϵ 100; $IT < 2.0E-3$
		86	4-	-79.283 (14)	14.74 ± 0.02 h		ϵ 100
		86m	(8+)	-79.065 (14)	48 ± 1 m		IT 99.31; ϵ 0.69
		87	1/2-	-83.0183 (16)	79.8 ± 0.3 h		ϵ 100
		87m	9/2+	-82.6375 (16)	13.37 ± 0.03 h		ϵ 1.57; IT 98.43
		88	4-	-84.2987 (19)	106.626 ± 0.021 d		ϵ 100
		89	1/2-	-87.7096 (25)	**stable**	100%	
		89m	9/2+	-86.8006 (25)	15.663 ± 0.005 s		IT 100
		90	2-	-86.4953 (25)	64.053 ± 0.02 h		β^- 100
		90m	7+	-85.8136 (25)	3.19 ± 0.06 h		IT 100; β^- 0.0018
		91	1/2-	-86.353 (3)	58.51 ± 0.06 d		β^- 100
		91m	9/2+	-85.797 (3)	49.71 ± 0.04 m		IT 100; $\beta^- < 1.50$
		92	2-	-84.818 (9)	3.54 ± 0.01 h		β^- 100
		93	1/2-	-84.228 (11)	10.18 ± 0.08 h		β^- 100
		93m	(9/2)+	-83.47 (11)	0.82 ± 0.04 s		IT 100
		94	2-	-82.353 (7)	18.7 ± 0.1 m		β^- 100
		95	1/2-	-81.213 (7)	10.3 ± 0.1 m		β^- 100
		96	0-	-78.345 (7)	5.34 ± 0.05 s		β^- 100
		96m	8+	-77.205 (7)	9.6 ± 0.2 s		β^- 100
		97	(1/2-)	-76.13 (7)	3.75 ± 0.03 s		β^- 100; $\beta^- n$ 0.06
		97m	(9/2)+	-75.463 (7)	1.17 ± 0.03 s		$\beta^- n < 0.08$; $\beta^- > 99.30$; $IT < 0.70$
		97m2	(27/2-)	-72.608 (7)	142 ± 8 ms		IT 98.4; β^- 1.6
		98	(0)-	-72.304 (8)	0.548 ± 0.002 s		β^- 100; $\beta^- n$ 0.33
		98m	(4,5)	-71.894 (8)	2.0 ± 0.2 s		$\beta^- > 80.00$; $IT < 20.00$; $\beta^- n$ 3.4
		99	(5/2+)	-70.659 (7)	1.484 ± 0.007 s		β^- 100; $\beta^- n$ 1.7
		100	1-,2-	-67.336 (11)	735 ± 7 ms		$\beta^- n$ 0.92; β^- 100
		100m	(3,4,5)	-67.191 (11)	0.94 ± 0.03 s		β^- 100
		101	(5/2+)	-65.07 (8)	0.45 ± 0.02 s		β^- 100; $\beta^- n$ 1.94
		102	HighJ	-61.21 (20)	0.36 ± 0.04 s		β^- 100; $\beta^- n$ 4.9; β^- 100; $\beta^- n$ 4.9
		103	(5/2+)	-58.5 (10)	0.23 ± 0.02 s		β^- 100; $\beta^- n$ 8
		104	0	-54.1 (4)	197 ± 4 ms		β^- 100; $\beta^- n$
		105	0	-50.8 (5)	85 +5-4 ms		β^- ; $\beta^- n < 82.00$
		106	0	-46.1 (5)	62 +25-14 ms		β^-
		107	(5/2+)	-42.4 (5)	41 +15-9 ms		β^- 100
		108	0	-37.3 (6)	25 +66-10 ms		β^- ; $\beta^- n$
40	**Zr**	79	0	-47.1 (4)	56 ± 30 ms		ϵ ; ϵp
		80	0+	-55.5 (15)	4.6 ± 0.6 s		ϵ 100; ϵp
		81	(3/2-)	-58.4 (16)	5.5 ± 0.4 s		ϵ 100; ϵp 0.12
		82	0+	-63.94 (20)	32 ± 5 s		ϵ 100
		83	(1/2-)	-65.912 (7)	41.6 ± 2.4 s		ϵ 100; ϵp
		84	0+	-71.422 (6)	25.8 ± 0.5 m		ϵ 100
		85	(7/2+)	-73.175 (7)	7.86 ± 0.04 m		ϵ 100
		85m	(1/2-)	-72.883 (7)	10.9 ± 0.3 s		$IT \leq 92.00$; $\epsilon > 8.00$
		86	0+	-77.969 (4)	16.5 ± 0.1 h		ϵ 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		87	(9/2)+	-79.348 (4)	1.68 ± 0.01 h		ϵ 100
		87m	(1/2)-	-79.012 (4)	14.0 ± 0.2 s		IT 100
		88	0+	-83.629 (6)	83.4 ± 0.3 d		ϵ 100
		89	9/2+	-84.877 (4)	78.41 ± 0.12 h		ϵ 100
		89m	1/2-	-84.289 (4)	4.161 ± 0.017 m		IT 93.77; ϵ 6.23
		90	0+	-88.7742 (22)	**stable**	51.45% ± 0.4%	
		90m	5-	-86.4552 (22)	809.2 ± 2 ms		IT 100
		91	5/2+	-87.8973 (22)	**stable**	11.22% ± 0.05%	
		92	0+	-88.4607 (22)	**stable**	17.15% ± 0.08%	
		93	5/2+	-87.1238 (22)	1.61E+6 ± 0.05E+6 y		β^- 100
		94	0+	-87.2725 (23)	**stable**	17.38% ± 0.28%	
		95	5/2+	-85.6633 (22)	64.032 ± 0.006 d		β^- 100
		96	0+	-85.4477 (25)	2.35E+19 ± 0.21E+19 y	2.8% ± 0.09%	$2\beta^-$
		97	1/2+	-82.9515 (25)	16.749 ± 0.008 h		β^- 100
		98	0+	-81.296 (9)	30.7 ± 0.4 s		β^- 100
		99	(1/2+)	-77.626 (11)	2.1 ± 0.1 s		β^- 100
		100	0+	-76.384 (8)	7.1 ± 0.4 s		β^- 100
		101	(3/2+)	-73.173 (9)	2.3 ± 0.1 s		β^- 100
		102	0+	-71.595 (9)	2.9 ± 0.2 s		β^- 100
		103	(5/2-)	-67.825 (10)	1.32 ± 0.11 s		β^- 100; $\beta^- n \leq 1.00$
		104	0+	-65.733 (10)	0.87 ± 0.06 s		β^- 100; $\beta^- n \leq 1.00$
		105	0	-61.474 (12)	0.66 ± 0.07 s		β^- 100; $\beta^- n \leq 2.00$
		106	0+	-59 (3)	191 ± 19 ms		β^- 100; $\beta^- n \leq 7.00$
		107	0	-54.3 (3)	138 ± 4 ms		β^- 100; $\beta^- n \leq 23.00$
		108	0+	-51.4 (4)	73 ± 4 ms		β^- 100; $\beta^- n$
		109	0	-46.2 (5)	63 +38-17 ms		β^- ; $\beta^- n$
		110	0+	-42.9 (6)	37 +17-9 ms		β^-
41	**Nb**	82	(0+)	-52.2 (3)	50 ± 5 ms		ϵ 100; ϵp
		83	(5/2+)	-58.4 (3)	3.8 ± 0.2 s		ϵ 100
		84	(1+,2+,3+)	-61 (3)	9.8 ± 0.9 s		ϵ 100; ϵp
		85	(9/2+)	-66.28 (4)	20.5 ± 1.2 s		ϵ 100; IT ; ϵ ; ϵ ; IT
		86	(6+)	-69.134 (6)	88 ± 1 s		ϵ 100
		87	(1/2-)	-73.875 (7)	3.75 ± 0.09 m		ϵ 100
		87m	(9/2+)	-73.871 (7)	2.6 ± 0.1 m		ϵ
		88	(8+)	-76.18 (5)	14.55 ± 0.06 m		ϵ 100; ϵ 100
		89	(9/2+)	-80.65 (3)	2.03 ± 0.07 h		ϵ 100
		89m	(1/2)-	-80.62 (3)	66 ± 2 m		ϵ 100
		90	8+	-82.663 (5)	14.60 ± 0.05 h		ϵ 100
		90m	4-	-82.538 (5)	18.81 ± 0.06 s		IT 100
		91	9/2+	-86.639 (4)	6.8E+2 ± 1.3E+2 y		ϵ 100
		91m	1/2-	-86.535 (4)	60.86 ± 0.22 d		IT 96.6; ϵ 3.4
		92	(7)+	-86.455 (3)	3.47E+7 ± 0.24E+7 y		ϵ 100; $\beta^- < 0.05$
		92m	(2)+	-86.319 (3)	10.15 ± 0.02 d		ϵ 100
		93	9/2+	-87.2142 (23)	**stable**	100%	
		93m	1/2-	-87.1834 (23)	16.12 ± 0.12 y		IT 100
		94	6+	-86.3704 (23)	2.03E+4 ± 0.16E+4 y		β^- 100
		94m	3+	-86.3295 (23)	6.263 ± 0.004 m		IT 99.5; β^- 0.5
		95	9/2+	-86.7863 (16)	34.991 ± 0.006 d		β^- 100
		95m	1/2-	-86.5506 (16)	3.61 ± 0.03 d		IT 94.4; β^- 5.6
		96	6+	-85.608 (4)	23.35 ± 0.05 h		β^- 100
		97	9/2+	-85.6103 (23)	72.1 ± 0.7 m		β^- 100
		97m	1/2-	-84.8669 (23)	58.7 ± 1.8 s		IT 100
		98	1+	-83.533 (6)	2.86 ± 0.06 s		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		98m	(5+)	-83.449 (6)	51.3 ± 0.4 m		β^- 99.9; $IT < 0.20$
		99	9/2+	-82.33 (12)	15.0 ± 0.2 s		β^- 100
		99m	1/2-	-81.965 (12)	2.5 ± 0.2 m		$\beta^- > 96.20$; $IT < 3.80$
		100	1+	-79.806 (8)	1.5 ± 0.2 s		β^- 100
		100m	(5+)	-79.492 (8)	2.99 ± 0.11 s		β^- 100
		101	(5/2+)	-78.886 (4)	7.1 ± 0.3 s		β^- 100
		102	(4+)	-76.314 (4)	4.3 ± 0.4 s		β^- 100; β^- 100
		103	(5/2+)	-75.023 (4)	1.5 ± 0.2 s		β^- 100
		104	(1+)	-71.828 (4)	4.9 ± 0.3 s		β^- 100; $\beta^- n$ 0.06
		104m	0	-71.613 (4)	0.94 ± 0.04 s		β^- 100; $\beta^- n$ 0.05
		105	(5/2+)	-69.91 (4)	2.95 ± 0.06 s		β^- 100; $\beta^- n$ 1.7
		106	0	-66.198 (5)	0.93 ± 0.04 s		β^- 100; $\beta^- n$ 4.5
		107	0	-63.718 (8)	300 ± 9 ms		β^- 100; $\beta^- n$ 8
		108	(2+)	-59.56 (10)	220 ± 18 ms		β^- 100; $\beta^- n$ 8
		109	(5/2)	-56.8 (3)	106 ± 9 ms		β^- 100; $\beta^- n < 15.00$
		110	0	-52.3 (3)	86 ± 6 ms		β^- 100; $\beta^- n$ 40
		111	(5/2+)	-49 (4)	51 +6-5 ms		β^-
		112	(2+)	-44.4 (5)	33 +9-6 ms		β^-
42	**Mo**	83	0	-46.7 (4)	6 +30-3 ms		ϵ 100
		84	0+	-54.5 (4)	2.3 ± 0.3 s		ϵ 100; ϵp
		85	(1/2-)	-57.51 (16)	3.2 ± 0.2 s		ϵ ; $\epsilon p \approx 0.14$
		86	0+	-64.11 (4)	19.1 ± 0.3 s		ϵ 100
		87	7/2+	-66.883 (4)	14.02 ± 0.26 s		ϵ 100; ϵp 15
		88	0+	-72.686 (4)	8.0 ± 0.2 m		ϵ 100
		89	(9/2+)	-75.015 (4)	2.11 ± 0.1 m		ϵ 100
		89m	(1/2-)	-74.627 (4)	190 ± 15 ms		IT 100
		90	0+	-80.174 (6)	5.56 ± 0.09 h		ϵ 100
		91	9/2+	-82.208 (11)	15.49 ± 0.01 m		ϵ 100
		91m	1/2-	-81.555 (11)	64.6 ± 0.6 s		ϵ 50; IT 50
		92	0+	-86.809 (4)	**stable**	14.53% ± 0.3%	
		93	5/2+	-86.808 (4)	4.0E+3 ± 0.8E+3 y		ϵ 100
		93m	21/2+	-84.383 (4)	6.85 ± 0.07 h		IT 99.88; ϵ 0.12
		94	0+	-88.4141 (15)	**stable**	9.15% ± 0.09%	
		95	5/2+	-87.7119 (15)	**stable**	15.84% ± 0.11%	
		96	0+	-88.7949 (15)	**stable**	16.67% ± 0.15%	
		97	5/2+	-87.5448 (15)	**stable**	9.6% ± 0.14%	
		98	0+	-88.1161 (15)	**stable**	24.39% ± 0.37%	
		99	1/2+	-85.9702 (15)	65.976 ± 0.024 h		β^- 100
		100	0+	-86.1878 (20)	7.3E+18 ± 0.4E+18 y	9.82% ± 0.31%	$2\beta^-$ 100
		101	1/2+	-83.5147 (20)	14.61 ± 0.03 m		β^- 100
		102	0+	-83.573 (9)	11.3 ± 0.2 m		β^- 100
		103	(3/2+)	-80.97 (10)	67.5 ± 1.5 s		β^- 100
		104	0+	-80.359 (9)	60 ± 2 s		β^- 100
		105	(5/2-)	-77.346 (9)	35.6 ± 1.6 s		β^- 100
		106	0+	-76.144 (9)	8.73 ± 0.12 s		β^- 100
		107	(5/2+)	-72.561 (10)	3.5 ± 0.5 s		β^- 100
		108	0+	-70.766 (10)	1.09 ± 0.02 s		β^- 100; $\beta^- n < 0.50$
		109	(7/2-)	-66.676 (11)	660 ± 45 ms		β^- 100; $\beta^- n$ 1.3
		110	0+	-64.552 (24)	0.27 ± 0.01 s		β^- 100; $\beta^- n$ 2
		111	0	-60.06 (20)	220 +41-36 ms		β^- ; $\beta^- n \leq 12$
		112	0+	-57.6 (3)	120 +13-11 ms		β^-
		113	0	-52.9 (3)	78 +6-5 ms		β^-
		114	0+	-50 (4)	60 +13-9 ms		β^-

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		115	0	-44.7 (4)	51 +79-19 ms		β^- ; $\beta^- n$
43	**Tc**	85	0	-46 (4)	≈ 0.5 s		p ?
		86	(0+)	-51.3 (3)	54 ± 7 ms		ϵ 100; ϵp
		87	(9/2+)	-57.69 (4)	2.2 ± 0.2 s		ϵ 100
		88	(3+)	-61.679 (4)	5.8 ± 0.2 s		ϵ 100; ϵ 100
		89	(9/2+)	-67.395 (4)	12.8 ± 0.9 s		ϵ 100
		89m	(1/2-)	-67.332 (4)	12.9 ± 0.8 s		ϵ 100; $IT < 0.01$
		90	1+	-70.724 (3)	8.7 ± 0.2 s		ϵ 100
		90m	(6+)	-70.224 (3)	49.2 ± 0.4 s		ϵ 100
		91	(9/2)+	-75.987 (3)	3.14 ± 0.02 m		ϵ 100
		91m	(1/2)-	-75.848 (3)	3.3 ± 0.1 m		ϵ 100; $IT < 1.00$
		92	(8)+	-78.925 (4)	4.25 ± 0.15 m		ϵ 100
		93	9/2+	-83.607 (4)	2.75 ± 0.05 h		ϵ 100
		93m	1/2-	-83.215 (4)	43.5 ± 1 m		IT 77.4; ϵ 22.6
		94	7+	-84.158 (4)	293 ± 1 m		ϵ 100
		94m	(2)+	-84.082 (4)	52.0 ± 1 m		ϵ 100; $IT < 0.10$
		95	9/2+	-86.021 (5)	20.0 ± 0.1 h		ϵ 100
		95m	1/2-	-85.982 (5)	61 ± 2 d		ϵ 96.12; IT 3.88
		96	7+	-85.822 (5)	4.28 ± 0.07 d		ϵ 100
		96m	4+	-85.787 (5)	51.5 ± 1 m		IT 98; ϵ 2
		97	9/2+	-87.224 (4)	4.21E+6 ± 0.16E+6 y		ϵ 100
		97m	1/2-	-87.128 (4)	91.0 ± 0.6 d		IT 96.06; ϵ 3.94
		98	(6)+	-86.432 (4)	4.2E+6 ± 0.3E+6 y		β^- 100
		99	9/2+	-87.3271 (17)	2.111E+5 ± 0.012E+5 y		β^- 100
		99m	1/2-	-87.1844 (17)	6.0067 ± 5.0E-4 h		IT 100; β^- 0.0037
		100	1+	-86.0202 (20)	15.46 ± 0.19 s		β^- 100; ϵ 0.0026
		101	9/2+	-86.339 (24)	14.02 ± 0.01 m		β^- 100
		102	1+	-84.569 (9)	5.28 ± 0.15 s		β^- 100; β^- 98; IT 2
		103	5/2+	-84.6 (10)	54.2 ± 0.8 s		β^- 100
		104	(3+)	-82.509 (25)	18.3 ± 0.3 m		β^- 100
		105	(3/2-)	-82.29 (4)	7.6 ± 0.1 m		β^- 100
		106	(2+)	-79.774 (13)	35.6 ± 0.6 s		β^- 100
		107	(3/2-)	-78.746 (9)	21.2 ± 0.2 s		β^- 100
		108	(2)+	-75.919 (9)	5.17 ± 0.07 s		β^- 100
		109	(5/2+)	-74.279 (10)	0.86 ± 0.04 s		β^- 100; $\beta^- n$ 0.08
		110	(2+)	-71.031 (10)	0.92 ± 0.03 s		β^- 100; $\beta^- n$ 0.04
		111	(5/2+)	-69.021 (11)	350 ± 21 ms		β^- 100; $\beta^- n$ 0.85
		112	0	-65.253 (6)	0.29 ± 0.02 s		β^- 100; $\beta^- n$ 4
		113	>5/2	-62.88 (10)	160 +50-40 ms		β^- ; $\beta^- n$ 2.1
		114	>3	-58.85 (20)	100 ± 20 ms		β^- 100; $\beta^- n$?; β^- 100; $\beta^- n$?
		115	0	-56.1 (3)	83 +20-13 ms		β^- ; $\beta^- n$
		116	0	-51.5 (3)	56 +15-10 ms		β^-
		117	(5/2+)	-48.4 (4)	85 +95-30 ms		β^-
44	**Ru**	88	0+	-54.4 (3)	1.2 +0.3-0.2 s		ϵ 100
		89	(9/2+)	-58.1 (3)	1.5 ± 0.2 s		ϵ 100; $\epsilon p < 0.15$
		90	0+	-64.883 (4)	11.7 ± 0.9 s		ϵ 100
		91	(9/2+)	-68.239 (3)	7.9 ± 0.4 s		ϵ 100; IT ; $\epsilon > 0.00$; $\epsilon p >$ 0.00
		92	0+	-74.301 (3)	3.65 ± 0.05 m		ϵ 100
		93	(9/2)+	-77.214 (4)	59.7 ± 0.6 s		ϵ 100
		93m	(1/2)-	-76.479 (4)	10.8 ± 0.3 s		ϵ 78; IT 22; ϵp 0.03
		94	0+	-82.579 (4)	51.8 ± 0.6 m		ϵ 100
		95	5/2+	-83.458 (10)	1.643 ± 0.013 h		ϵ 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		96	0+	-86.0804 (15)	**stable**	5.54% ± 0.14%	
		97	5/2+	-86.12 (3)	2.83 ± 0.23 d		ϵ 100
		98	0+	-88.225 (6)	**stable**	1.87% ± 0.03%	
		99	5/2+	-87.6202 (20)	**stable**	12.76% ± 0.14%	
		100	0+	-89.2222 (20)	**stable**	12.6% ± 0.07%	
		101	5/2+	-87.9529 (20)	**stable**	17.06% ± 0.02%	
		102	0+	-89.1012 (20)	**stable**	31.55% ± 0.14%	
		103	3/2+	-87.262 (20)	39.247 ± 0.013 d		β^- 100
		104	0+	-88.092 (3)	**stable**	18.62% ± 0.27%	
		105	3/2+	-85.931 (3)	4.44 ± 0.02 h		β^- 100
		106	0+	-86.321 (6)	371.8 ± 1.8 d		β^- 100
		107	(5/2)+	-83.859 (9)	3.75 ± 0.05 m		β^- 100
		108	0+	-83.658 (9)	4.55 ± 0.05 m		β^- 100
		109	(5/2+)	-80.735 (9)	34.5 ± 1 s		β^- 100
		110	0+	-80.069 (9)	11.6 ± 0.6 s		β^- 100
		111	5/2+	-76.782 (10)	2.12 ± 0.07 s		β^- 100
		112	0+	-75.627 (10)	1.75 ± 0.07 s		β^- 100
		113	(1/2+)	-71.87 (4)	0.80 ± 0.05 s		β^- 100; β^- 100
		114	0+	-70.215 (12)	0.52 ± 0.05 s		β^- 100
		115	(3/2+)	-66.19 (9)	318 ± 19 ms		β^- ; β^- 100; $\beta^- n$; β^- 100; $\beta^- n$; β^- 100; $\beta^- n$
		116	0+	-64.16 (20)	204 +32-29 ms		β^-
		117	0	-59.56 (20)	142 +18-17 ms		β^- 100
		118	0+	-57.3 (3)	123 +48-35 ms		β^- 100; $\beta^- n$
45	**Rh**	90	0	-52 (4)	12 +9-4 ms		ϵ ?; ϵ ?
		91	(9/2+)	-58.8 (4)	1.47 ± 0.22 s		ϵ ; ϵ
		92	(6+)	-62.999 (4)	4.66 ± 0.25 s		ϵ 100; ϵ 100
		93	(9/2+)	-69.017 (3)	12.2 ± 0.7 s		ϵ 100
		94	(4+)	-72.907 (4)	66 ± 6 s		ϵp 1.8; ϵ 100
		94m	(8+)	-72.607 (4)	25.8 ± 0.2 s		ϵ 100
		95	9/2+	-78.342 (4)	5.02 ± 0.1 m		ϵ 100
		95m	(1/2)-	-77.799 (4)	1.96 ± 0.04 m		IT 88; ϵ 12
		96	GE 6+	-79.688 (10)	9.90 ± 0.1 m		ϵ 100
		96m	3+	-79.636 (10)	1.51 ± 0.02 m		IT 60; ϵ 40
		97	9/2+	-82.6 (4)	30.7 ± 0.6 m		ϵ 100
		97m	1/2-	-82.34 (4)	46.2 ± 1.6 m		ϵ 94.4; IT 5.6
		98	(2)+	-83.175 (12)	8.72 ± 0.12 m		ϵ 100; IT 89; ϵ 11
		99	1/2-	-85.577 (7)	16.1 ± 0.2 d		ϵ 100
		99m	9/2+	-85.512 (7)	4.7 ± 0.1 h		$\epsilon > 99.84$; $IT < 0.16$
		100	1-	-85.587 (18)	20.8 ± 0.1 h		ϵ 100
		100m	(5+)	-85.479 (18)	4.6 ± 0.2 m		$IT \approx 98.30$; $\epsilon \approx 1.70$
		101	1/2-	-87.412 (6)	3.3 ± 0.3 y		ϵ 100
		101m	9/2+	-87.254 (6)	4.34 ± 0.01 d		ϵ 92.8; IT 7.2
		102	(1-,2-)	-86.778 (5)	207.3 ± 1.7 d		ϵ 78; β^- 22
		102m	6(+)	-86.638 (5)	3.742 ± 0.01 y		ϵ 99.77; IT 0.23
		103	1/2-	-88.026 (3)	**stable**	100%	
		103m	7/2+	-87.986 (3)	56.114 ± 0.009 m		IT 100
		104	1+	-86.953 (3)	42.3 ± 0.4 s		β^- 99.55; ϵ 0.45
		104m	5+	-86.824 (3)	4.34 ± 0.03 m		β^- 0.13; IT 99.87
		105	7/2+	-87.849 (4)	35.36 ± 0.06 h		β^- 100
		105m	1/2-	-87.719 (4)	42.9 ± 0.3 s		IT 100
		106	1+	-86.36 (6)	30.07 ± 0.35 s		β^- 100
		106m	(6)+	-86.223 (6)	131 ± 2 m		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		107	7/2+	-86.861 (12)	21.7 ± 0.4 m		β^- 100
		108	1+	-85.031 (14)	16.8 ± 0.5 s		β^- 100; β^- 100; IT
		109	7/2+	-85.011 (6)	80 ± 2 s		β^- 100
		110	(GE4)	-82.844 (19)	28.5 ± 1.5 s		β^- 100; β^- 100
		111	(7/2+)	-82.304 (7)	11 ± 1 s		β^- 100
		112	1+	-79.73 (4)	3.45 ± 0.37 s		β^- 100; β^- 100
		113	(7/2+)	-78.767 (7)	2.80 ± 0.12 s		β^- 100
		114	1+	-75.71 (7)	1.85 ± 0.05 s		β^- 100
		114m	(7-)	-75.51 (7)	1.86 ± 0.06 s		β^- 100
		115	(7/2+)	-74.23 (8)	0.99 ± 0.05 s		β^- 100
		116	1+	-70.74 (7)	0.68 ± 0.06 s		β^- 100
		116m	(6-)	-70.59 (7)	0.57 ± 0.05 s		β^- 100
		117	(7/2+)	-68.897 (9)	0.44 ± 0.04 s		β^- 100
		118	0	-64.887 (24)	266 +22-21 ms		β^- 100; $\beta^- n$ 3.1
		119	(7/2+)	-62.85 (20)	171 ± 18 ms		β^- 100; $\beta^- n$ 6.4
		120	0	-58.81 (20)	136 +14-13 ms		β^- 100; $\beta^- n < 5.40$
		121	0	-56.4 (3)	151 +67-58 ms		β^- 100; $\beta^- n$
46	**Pd**	92	0+	-55.1 (5)	0.7 +0.4-0.2 s		ϵ 100
		93	(9/2+)	-59.1 (4)	1.00 ± 0.09 s		ϵ 100; ϵp
		94	0+	-66.102 (5)	9.6 ± 0.2 s		ϵ 100
		95	(9/2+)	-69.966 (5)	5 ± 3 s		ϵ 100
		95m	(21/2+)	-68.091 (5)	13.3 ± 0.3 s		ϵ 89; IT 11; ϵp 0.93
		96	0+	-76.183 (4)	122 ± 2 s		ϵ 100
		97	(5/2+)	-77.806 (5)	3.10 ± 0.09 m		ϵ 100
		98	0+	-81.32 (5)	17.7 ± 0.3 m		ϵ 100
		99	(5/2)+	-82.184 (5)	21.4 ± 0.2 m		ϵ 100
		100	0+	-85.226 (18)	3.63 ± 0.09 d		ϵ 100
		101	5/2+	-85.432 (5)	8.47 ± 0.06 h		ϵ 100
		102	0+	-87.929 (3)	**stable**	1.02% ± 0.01%	
		103	5/2+	-87.483 (3)	16.991 ± 0.019 d		ϵ 100
		104	0+	-89.393 (3)	**stable**	11.14% ± 0.08%	
		105	5/2+	-88.416 (3)	**stable**	22.33% ± 0.08%	
		106	0+	-89.906 (3)	**stable**	27.33% ± 0.03%	
		107	5/2+	-88.371 (3)	6.5E+6 ± 0.3E+6 y		β^- 100
		107m	11/2-	-88.156 (3)	21.3 ± 0.5 s		IT 100
		108	0+	-89.521 (3)	**stable**	26.46% ± 0.09%	
		109	5/2+	-87.603 (3)	13.7012 ± 0.0024 h		β^- 100
		109m	11/2-	-87.414 (3)	4.696 ± 0.003 m		IT 100
		110	0+	-88.348 (7)	**stable**	11.72% ± 0.09%	
		111	5/2+	-86.003 (7)	23.4 ± 0.2 m		β^- 100
		111m	11/2-	-85.831 (7)	5.5 ± 0.1 h		IT 73; β^- 27
		112	0+	-86.323 (7)	21.03 ± 0.05 h		β^- 100
		113	(5/2+)	-83.591 (7)	93 ± 5 s		β^- 100
		113m	(9/2-)	-83.51 (7)	0.3 ± 0.1 s		IT 100
		114	0+	-83.491 (7)	2.42 ± 0.06 m		β^- 100
		115	(5/2+)	-80.426 (14)	25 ± 2 s		β^- 100
		115m	(11/2-)	-80.337 (14)	50 ± 3 s		β^- 92; IT 8
		116	0+	-79.831 (7)	11.8 ± 0.4 s		β^- 100
		117	(5/2+)	-76.424 (7)	4.3 ± 0.3 s		β^- 100
		118	0+	-75.391 (8)	1.9 ± 0.1 s		β^- 100
		119	0	-71.408 (8)	0.92 ± 0.01 s		β^- 100
		120	0+	-70.31 (9)	0.5 ± 0.1 s		β^- 100
		121	(3/2+)	-66.3 (5)	285 ± 24 ms		β^- 100; $\beta^- n \leq 0.80$

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		122	0+	-64.7 (4)	175 $\pm$ 16 ms		β^- $\geq$ 97.50; $\beta^- n$ $\leq$ 2.50
		123	0	-60.6 (6)	174 +38-34 ms		β^-
		124	0+	-58.8 (5)	38 +38-19 ms		β^- 100
47	**Ag**	94	(0+)	-52.4 (6)	26 +26-9 ms		ϵ 100; ϵp ; ϵ 100; ϵp 20
		94m	(21+)	-45.7 (6)	0.40 $\pm$ 0.04 s		ϵ 95.4; ϵp 27; p 4.1; $2p$ 0.5
		95	(9/2+)	-59.6 (4)	1.75 $\pm$ 0.12 s		ϵp ; ϵ 100
		95m	(1/2-)	-59.3 (4)	$<$ 500 ms		IT 100
		96	(8)+	-64.62 (6)	4.40 $\pm$ 0.06 s		ϵ 100; ϵp 8.5; ϵ 100; ϵp 18
		97	(9/2+)	-70.83 (11)	25.5 $\pm$ 0.3 s		ϵ 100
		98	(6+)	-73.05 (4)	47.5 $\pm$ 0.3 s		ϵ 100; ϵp 0.0011
		99	(9/2)+	-76.712 (6)	124 $\pm$ 3 s		ϵ 100
		99m	(1/2-)	-76.206 (6)	10.5 $\pm$ 0.5 s		IT 100
		100	(5)+	-78.138 (5)	2.01 $\pm$ 0.09 m		ϵ 100
		100m	(2)+	-78.122 (5)	2.24 $\pm$ 0.13 m		ϵ ; IT
		101	9/2+	-81.334 (5)	11.1 $\pm$ 0.3 m		ϵ 100
		101m	(1/2)-	-81.06 (5)	3.10 $\pm$ 0.1 s		IT 100
		102	5(+)	-82.247 (8)	12.9 $\pm$ 0.3 m		ϵ 100
		102m	2+	-82.237 (8)	7.7 $\pm$ 0.5 m		ϵ 51; IT 49
		103	7/2+	-84.8 (4)	65.7 $\pm$ 0.7 m		ϵ 100
		103m	1/2-	-84.666 (4)	5.7 $\pm$ 0.3 s		IT 100
		104	5+	-85.114 (5)	69.2 $\pm$ 1 m		ϵ 100
		104m	2+	-85.108 (5)	33.5 $\pm$ 2 m		ϵ 99.93; IT $<$ 0.07
		105	1/2-	-87.071 (5)	41.29 $\pm$ 0.07 d		ϵ 100
		105m	7/2+	-87.045 (5)	7.23 $\pm$ 0.16 m		IT 99.66; ϵ 0.34
		106	1+	-86.94 (4)	23.96 $\pm$ 0.04 m		ϵ 99.5; β^- $<$ 1.00
		106m	6+	-86.851 (4)	8.28 $\pm$ 0.02 d		ϵ 100
		107	1/2-	-88.405 (3)	**stable**	51.839% $\pm$ 0.008%	
		107m	7/2+	-88.312 (3)	44.3 $\pm$ 0.2 s		IT 100
		108	1+	-87.606 (3)	2.382 $\pm$ 0.011 m		β^- 97.15; ϵ 2.85
		108m	6+	-87.496 (3)	438 $\pm$ 9 y		ϵ 91.3; IT 8.7
		109	1/2-	-88.7195 (20)	**stable**	48.161% $\pm$ 0.008%	
		109m	7/2+	-88.6315 (20)	39.6 $\pm$ 0.2 s		IT 100
		110	1+	-87.4574 (20)	24.6 $\pm$ 0.2 s		β^- 99.7; ϵ 0.3
		110m	6+	-87.3398 (20)	249.76 $\pm$ 0.04 d		β^- 98.64; IT 1.36
		111	1/2-	-88.2179 (22)	7.45 $\pm$ 0.01 d		β^- 100
		111m	7/2+	-88.1581 (22)	64.8 $\pm$ 0.8 s		IT 99.3; β^- 0.7
		112	2(-)	-86.5837 (24)	3.130 $\pm$ 0.009 h		β^- 100
		113	1/2-	-87.03 (17)	5.37 $\pm$ 0.05 h		β^- 100
		113m	7/2+	-86.986 (17)	68.7 $\pm$ 1.6 s		IT 64; β^- 36
		114	1+	-84.931 (5)	4.6 $\pm$ 0.1 s		β^- 100
		115	1/2-	-84.983 (18)	20.0 $\pm$ 0.5 m		β^- 100
		115m	7/2+	-84.942 (18)	18.0 $\pm$ 0.7 s		β^- 79; IT 21
		116	(0-)	-82.543 (3)	237 $\pm$ 5 s		β^- 100
		116m	(3+)	-82.495 (3)	20 $\pm$ 1 s		β^- 93; IT 7
		116m2	(6-)	-82.413 (3)	9.3 $\pm$ 0.3 s		β^- 92; IT 8
		117	(1/2-)	-82.182 (14)	72.8 +2-0.7 s		β^- 100
		117m	(7/2+)	-82.153 (14)	5.34 $\pm$ 0.05 s		β^- 94; IT 6
		118	1(-)	-79.554 (3)	3.76 $\pm$ 0.15 s		β^- 100
		118m	4(+)	-79.426 (3)	2.0 $\pm$ 0.2 s		β^- 59; IT 41
		119	(1/2-)	-78.646 (15)	6.0 $\pm$ 0.5 s		β^- 100; β^- 100
		120	3(+)	-75.651 (4)	1.23 $\pm$ 0.04 s		β^- 100; $\beta^- n$ $<$ 3.0E-3
		120m	6(-)	-75.448 (4)	0.40 $\pm$ 0.03 s		β^- $\approx$ 63.00; IT $\approx$ 37.00
		121	(7/2+)	-74.403 (12)	0.78 $\pm$ 0.02 s		β^- 100; $\beta^- n$ 0.08

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		122	(3+)	-71.11 (4)	0.529 ± 0.013 s		β^- 99.8; $\beta^- n$ 0.2; β^- ; IT ; $\beta^- n$
		122m	(9-)	-71.03 (4)	0.20 ± 0.05 s		β^- ; $\beta^- n$
		123	(7/2+)	-69.55 (3)	0.300 ± 0.005 s		β^- 100; $\beta^- n$ 0.55
		124	—>2	-66.2 (3)	0.172 ± 0.005 s		β^- 100; $\beta^- n$ 1.3
		125	(9/2+)	-64.43 (20)	166 ± 7 ms		β^- 100; $\beta^- n$
		126	0	-60.85 (20)	107 ± 12 ms		β^- 100; $\beta^- n$
		127	0	-58.8 (3)	109 ± 25 ms		β^- 100
		128	0	-54.9 (3)	58 ± 5 ms		β^- 100; $\beta^- n$
		129	(9/2+)	-52.6 (4)	46 +5-9 ms		β^- 100; $\beta^- n$; β^- ; $\beta^- n$
		130	0	-46.3 (3)	≈ 50 ms		β^- ; $\beta^- n$
48	**Cd**	96	0+	-55.6 (4)	1.03 +0.24-0.21 s		ϵ 100
		97	(9/2+)	-60.5 (3)	1.10 ± 0.07 s		ϵ 100; ϵp 12; ϵ 100; ϵp 25
		98	0+	-67.62 (5)	9.2 ± 0.3 s		ϵ 100; $\epsilon p < 0.03$
		99	(5/2+)	-69.9311 (16)	16 ± 3 s		$\epsilon\alpha <$ 1.0E-4; ϵp 0.17; ϵ 100
		100	0+	-74.1946 (17)	49.1 ± 0.5 s		ϵ 100
		101	(5/2+)	-75.8361 (14)	1.36 ± 0.05 m		ϵ 100
		102	0+	-79.6597 (17)	5.5 ± 0.5 m		ϵ 100
		103	(5/2)+	-80.6521 (18)	7.3 ± 0.1 m		ϵ 100
		104	0+	-83.9683 (17)	57.7 ± 1 m		ϵ 100
		105	5/2+	-84.3339 (13)	55.5 ± 0.4 m		ϵ 100
		106	0+	-87.1304 (17)	> 3.6E+20 y	1.25% ± 0.06%	2ϵ
		107	5/2+	-86.99 (17)	6.50 ± 0.02 h		ϵ 100
		108	0+	-89.2524 (21)	> 1.9E+18 y	0.89% ± 0.03%	2ϵ
		109	5/2+	-88.5043 (16)	461.4 ± 1.2 d		ϵ 100
		110	0+	-90.3503 (17)	**stable**	12.49% ± 0.18%	
		111	1/2+	-89.2547 (17)	**stable**	12.8% ± 0.12%	
		111m	11/2-	-88.8585 (17)	48.50 ± 0.09 m		IT 100
		112	0+	-90.5777 (17)	**stable**	24.13% ± 0.21%	
		113	1/2+	-89.0464 (16)	8.00E15 ± 0.26E15 y	12.22% ± 0.12%	β^- 100
		113m	11/2-	-88.7829 (16)	14.1 ± 0.5 y		β^- 99.86; IT 0.14
		114	0+	-90.018 (16)	> 2.1E18 y	28.73% ± 0.42%	$2\beta^-$
		115	1/2+	-88.0876 (17)	53.46 ± 0.05 h		β^- 100
		115m	(11/2)-	-87.9066 (17)	44.56 ± 0.24 d		β^- 100
		116	0+	-88.7164 (17)	3.3E+19 ± 0.4E+19 y	7.49% ± 0.18%	$2\beta^-$
		117	1/2+	-86.4223 (20)	2.49 ± 0.04 h		β^- 100
		117m	(11/2)-	-86.2859 (20)	3.36 ± 0.05 h		β^- 100
		118	0+	-86.706 (20)	50.3 ± 0.2 m		β^- 100
		119	3/2+	-83.98 (4)	2.69 ± 0.02 m		β^- 100
		119m	(11/2-)	-83.83 (4)	2.20 ± 0.02 m		β^- 100
		120	0+	-83.957 (4)	50.80 ± 0.21 s		β^- 100
		121	(3/2+)	-81.06 (8)	13.5 ± 0.3 s		β^- 100
		121m	(11/2-)	-80.84 (8)	8.3 ± 0.8 s		β^- 100
		122	0+	-80.616 (4)	5.24 ± 0.03 s		β^- 100
		123	(3/2+)	-77.32 (4)	2.10 ± 0.02 s		β^- 100
		123m	(11/2-)	-77 (4)	1.82 ± 0.03 s		$\beta^- \leq$ 100.00; IT
		124	0+	-76.697 (9)	1.25 ± 0.02 s		β^- 100
		125	(3/2+)	-73.35 (6)	0.68 ± 0.04 s		β^- 100; β^- 100
		126	0+	-72.256 (4)	0.515 ± 0.017 s		β^- 100
		127	(3/2+)	-68.44 (6)	0.37 ± 0.07 s		β^- 100
		128	0+	-67.25 (17)	0.28 ± 0.04 s		β^- 100
		129	(3/2+)	-63.31 (20)	0.27 ± 0.04 s		
		130	0+	-61.54 (16)	162 ± 7 ms		$\beta^- n$ 3.5; β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		131	(7/2-)	-55.38 (20)	68 ± 3 ms		β^- 100; $\beta^- n$ 3.5
		132	0+	-50.9 (3)	97 ± 10 ms		β^- 100; $\beta^- n$ 60
		133	(7/2-)	()	57 ± 10 ms		β^- 100; $\beta^- n$; $\beta^- 2n$
49	**In**	98	0	-53.9 (20)	32 +32-11 ms		ϵ ; ϵ
		99	0	-61.38 (20)	3.0 ± 0.8 s		ϵ
		100	(6+,7+)	-64.34 (18)	5.9 ± 0.2 s		ϵ 100; ϵp 1.6
		101	(9/2+)	-68.6 (3)	15.1 ± 0.3 s		ϵ ; ϵp
		102	(6+)	-70.695 (5)	23.3 ± 0.1 s		ϵ 100; ϵp 0.0093
		103	(9/2)+	-74.629 (9)	65 ± 7 s		ϵ 100
		103m	(1/2-)	-73.998 (9)	34 ± 2 s		IT 33; ϵ 67
		104	(6+)	-76.183 (6)	1.80 ± 0.03 m		ϵ 100
		104m	(3+)	-76.089 (6)	15.7 ± 0.5 s		IT 80; ϵ 20
		105	9/2+	-79.64 (10)	5.07 ± 0.07 m		ϵ 100
		105m	(1/2-)	-78.966 (10)	48 ± 6 s		IT 100
		106	7+	-80.604 (11)	6.2 ± 0.1 m		ϵ 100
		106m	(2)+	-80.575 (11)	5.2 ± 0.1 m		ϵ 100
		107	9/2+	-83.564 (10)	32.4 ± 0.3 m		ϵ 100
		107m	1/2-	-82.886 (10)	50.4 ± 0.6 s		IT 100
		108	7+	-84.116 (9)	58.0 ± 1.2 m		ϵ 100
		108m	2+	-84.086 (9)	39.6 ± 0.7 m		ϵ 100
		109	9/2+	-86.488 (4)	4.167 ± 0.018 h		ϵ 100
		109m	1/2-	-85.838 (4)	1.34 ± 0.07 m		IT 100
		109m2	(19/2+)	-84.387 (4)	0.209 ± 0.006 s		IT 100
		110	7+	-86.472 (12)	4.9 ± 0.1 h		ϵ 100
		110m	2+	-86.41 (12)	69.1 ± 0.5 m		ϵ 100
		111	9/2+	-88.393 (4)	2.8047 ± 4.0E-4 d		ϵ 100
		111m	1/2-	-87.856 (4)	7.7 ± 0.2 m		IT 100
		112	1+	-87.993 (5)	14.97 ± 0.1 m		ϵ 56; β^- 44
		112m	4+	-87.836 (5)	20.56 ± 0.06 m		IT 100
		113	9/2+	-89.3683 (15)	**stable**	4.29% ± 0.05%	
		113m	1/2-	-88.9766 (15)	99.476 ± 0.023 m		IT 100
		114	1+	-88.5708 (15)	71.9 ± 0.1 s		β^- 99.5; ϵ 0.5
		114m	5+	-88.3805 (15)	49.51 ± 0.01 d		IT 96.75; ϵ 3.25
		115	9/2+	-89.5363 (12)	4.41E+14 ± 0.25E+14 y	95.71% ± 0.05%	β^- 100
		115m	1/2-	-89.2001 (12)	4.486 ± 0.004 h		IT 95; β^- 5
		116	1+	-88.2497 (22)	14.10 ± 0.03 s		ϵ 0.02; β^- 99.98
		116m	5+	-88.1224 (22)	54.29 ± 0.17 m		β^- 100
		116m2	8-	-87.96 (22)	2.18 ± 0.04 s		IT 100
		117	9/2+	-88.943 (5)	43.2 ± 0.3 m		β^- 100
		117m	1/2-	-88.628 (5)	116.2 ± 0.3 m		β^- 52.9; IT 47.1
		118	1+	-87.228 (8)	5.0 ± 0.5 s		β^- 100
		118m	5+	-87.168 (8)	4.45 ± 0.05 m		β^- 100
		118m2	8-	-87.028 (8)	8.5 ± 0.3 s		IT 98.6; β^- 1.4
		119	9/2+	-87.699 (8)	2.4 ± 0.1 m		β^- 100
		119m	1/2-	-87.388 (8)	18.0 ± 0.3 m		β^- 95.6; IT 4.4
		120	1+	-85.73 (4)	3.08 ± 0.08 s		β^- 100; β^- 100
		120m	(5)+	-85.66 (4)	46.2 ± 0.8 s		β^- 100
		121	9/2+	-85.84 (3)	23.1 ± 0.6 s		β^- 100
		121m	1/2-	-85.52 (3)	3.88 ± 0.1 m		β^- 98.8; IT 1.2
		122	1+	-83.57 (5)	1.5 ± 0.3 s		β^- 100
		122m	5+	-83.53 (5)	10.3 ± 0.6 s		β^- 100
		122m2	(8-)	-83.28 (5)	10.8 ± 0.4 s		β^- 100
		123	(9/2)+	-83.428 (23)	6.17 ± 0.05 s		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		123m	(1/2)-	-83.1 (23)	47.4 ± 0.4 s		β^- 100
		124	(1)+	-80.87 (3)	3.12 ± 0.09 s		β^- 100
		124m	(8-)	-80.82 (3)	3.7 ± 0.2 s		β^- 100
		125	9/2+	-80.48 (3)	2.36 ± 0.04 s		β^- 100
		125m	1/2(-)	-80.12 (3)	12.2 ± 0.2 s		β^- 100
		126	3(+)	-77.81 (4)	1.53 ± 0.01 s		β^- 100
		126m	(8-)	-77.71 (4)	1.64 ± 0.05 s		β^- 100
		127	(9/2+)	-76.892 (22)	1.09 ± 0.01 s		β^- 100; $\beta^- n \leq$ 0.03
		127m	(1/2-)	-76.43 (22)	3.67 ± 0.04 s		β^- 100; $\beta^- n$ 0.69
		127m2	(21/2-)	-75.029 (22)	1.04 ± 0.1 s		β^- 100
		128	(3)+	-74.36 (5)	0.84 ± 0.06 s		β^- 100; $\beta^- n <$ 0.05
		128m	(8-)	-74.02 (5)	0.72 ± 0.1 s		β^- 100; $\beta^- n <$ 0.05
		129	(9/2+)	-72.81 (4)	0.61 ± 0.01 s		β^- 100; $\beta^- n$ 0.25
		129m	(1/2-)	-72.44 (4)	1.23 ± 0.03 s		$IT <$ 0.30; $\beta^- >$ 99.70; $\beta^- n$ 2.5
		129m2	(23/2-)	-71.18 (4)	0.67 ± 0.1 s		β^- 100
		130	1(-)	-69.89 (4)	0.29 ± 0.02 s		β^- 100; $\beta^- n$ 0.93
		130m	(10-)	-69.84 (4)	0.54 ± 0.01 s		β^- 100; $\beta^- n$ 1.65
		130m2	(5+)	-69.49 (4)	0.54 ± 0.01 s		β^- 100; $\beta^- n$ 1.65
		131	(9/2+)	-68.05 (20)	0.28 ± 0.03 s		β^- 100; $\beta^- n \leq$ 2.00
		131m	(1/2-)	-67.748 (20)	0.35 ± 0.05 s		$\beta^- n \leq$ 2.00; $IT \leq$ 0.02; $\beta^- \geq$ 99.98
		131m2	(21/2+)	-64.286 (20)	0.32 ± 0.06 s		$\beta^- >$ 99.00; $IT <$ 1.00; $\beta^- n \approx$ 0.03
		132	(7-)	-62.41 (6)	0.207 ± 0.006 s		β^- 100; $\beta^- n$ 6.3
		133	(9/2+)	-57.8 (3)	165 ± 3 ms		β^- 100; $\beta^- n$ 85
		133m	(1/2-)	-57.4 (3)	180 ± 15 ms		IT ; $\beta^- n$; β^-
		134	(4- to 7-)	-52 (4)	140 ± 4 ms		β^- 100; $\beta^- n$ 65
		135	0	-47.2 (5)	92 ± 10 ms		β^- 100; $\beta^- n$
50	**Sn**	100	0+	-56.9 (6)	0.86 +0.37-0.2 s		ϵ 100; $\epsilon p <$ 17.00
		101	(5/2+)	-59.9 (3)	1.7 ± 0.3 s		ϵp 26; ϵ 100
		102	0+	-64.93 (10)	3.8 ± 0.2 s		ϵ 100
		103	(5/2+)	-66.97 (7)	7.0 ± 0.2 s		ϵ 100; ϵp 1.2
		104	0+	-71.625 (6)	20.8 ± 0.5 s		ϵ 100
		105	(5/2+)	-73.338 (4)	32.7 ± 0.5 s		ϵ 100; ϵp 0.01
		106	0+	-77.354 (5)	115 ± 5 s		ϵ 100
		107	(5/2+)	-78.512 (5)	2.90 ± 0.05 m		ϵ 100
		108	0+	-82.071 (5)	10.30 ± 0.08 m		ϵ 100
		109	5/2+	-82.633 (8)	18.0 ± 0.2 m		ϵ 100
		110	0+	-85.844 (14)	4.11 ± 0.1 h		ϵ 100
		111	7/2+	-85.941 (6)	35.3 ± 0.6 m		ϵ 100
		112	0+	-88.6579 (17)	< 1.3E+21 y	0.97% ± 0.01%	2ϵ
		113	1/2+	-88.3303 (22)	115.09 ± 0.03 d		ϵ 100
		113m	7/2+	-88.2528 (22)	21.4 ± 0.4 m		IT 91.1; ϵ 8.9
		114	0+	-90.5594 (15)	**stable**	0.66% ± 0.01%	
		115	1/2+	-90.0338 (15)	**stable**	0.34% ± 0.01%	
		116	0+	-91.5259 (10)	**stable**	14.54% ± 0.09%	
		117	1/2+	-90.3977 (5)	**stable**	7.68% ± 0.07%	
		117m	11/2-	-90.0831 (5)	13.76 ± 0.04 d		IT 100
		118	0+	-91.6528 (5)	**stable**	24.22% ± 0.09%	
		119	1/2+	-90.065 (7)	**stable**	8.59% ± 0.04%	
		119m	11/2-	-89.9755 (7)	293.1 ± 0.7 d		IT 100
		120	0+	-91.0982 (22)	**stable**	32.58% ± 0.09%	
		121	3/2+	-89.1971 (22)	27.03 ± 0.04 h		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		121m	11/2-	-89.1908 (22)	43.9 ± 0.5 y		IT 77.6; β^- 22.4
		122	0+	-89.943 (3)	**stable**	4.63% ± 0.03%	
		123	11/2-	-87.818 (3)	129.2 ± 0.4 d		β^- 100
		123m	3/2+	-87.793 (3)	40.06 ± 0.01 m		β^- 100
		124	0+	-88.237 (14)	> 1.2E+21 y	5.79% ± 0.05%	$2\beta^-$
		125	11/2-	-85.8988 (15)	9.64 ± 0.03 d		β^- 100
		125m	3/2+	-85.8713 (15)	9.52 ± 0.05 m		β^- 100
		126	0+	-86.021 (11)	2.30E+5 ± 0.14E+5 y		β^- 100
		127	(11/2-)	-83.47 (10)	2.10 ± 0.04 h		β^- 100
		127m	(3/2+)	-83.465 (10)	4.13 ± 0.03 m		β^- 100
		128	0+	-83.34 (3)	59.07 ± 0.14 m		β^- 100
		128m	(7-)	-81.24 (3)	6.5 ± 0.5 s		IT 100
		129	(3/2+)	-80.59 (3)	2.23 ± 0.04 m		β^- 100
		129m	(11/2-)	-80.56 (3)	6.9 ± 0.1 m		β^- 100; $IT < 2.0E-3$
		130	0+	-80.137 (9)	3.72 ± 0.07 m		β^- 100
		130m	(7-)	-78.19 (9)	1.7 ± 0.1 m		β^- 100
		131	(3/2+)	-77.272 (9)	56.0 ± 0.5 s		β^- 100; β^- 100; IT
		132	0+	-76.548 (6)	39.7 ± 0.8 s		β^- 100
		133	7/2-	-70.847 (23)	1.46 ± 0.03 s		β^- 100; $\beta^- n$ 0.03
		134	0+	-66.32 (15)	1.050 ± 0.011 s		β^- 100; $\beta^- n$ 17
		135	(7/2-)	-60.6 (4)	530 ± 20 ms		β^- 100; $\beta^- n$ 21
		136	0+	-56.3 (5)	0.25 ± 0.03 s		β^- 100; $\beta^- n$ 30
		137	0	-50.3 (6)	190 ± 60 ms		β^- 100; $\beta^- n$ 58
51	**Sb**	104	0	-59.17 (22)	0.44 +0.15-0.11 s		$p < 1.00$; ϵ 100; $\epsilon p < 7.00$
		105	(5/2+)	-63.853 (16)	1.22 ± 0.11 s		ϵ 99; p 1
		106	(2+)	-66.473 (7)	0.6 ± 0.2 s		ϵ
		107	(5/2+)	-70.653 (4)	4.0 ± 0.2 s		ϵ 100
		108	(4+)	-72.445 (5)	7.4 ± 0.3 s		ϵ 100
		109	(5/2+)	-76.251 (5)	17.0 ± 0.7 s		ϵ 100
		110	(3+,4+)	-77.45 (6)	23.0 ± 0.4 s		ϵ 100
		111	(5/2+)	-80.837 (9)	75 ± 1 s		ϵ 100
		112	3+	-81.601 (18)	51.4 ± 1 s		ϵ 100
		113	5/2+	-84.417 (17)	6.67 ± 0.07 m		ϵ 100
		114	3+	-84.496 (22)	3.49 ± 0.03 m		ϵ 100
		115	5/2+	-87.003 (16)	32.1 ± 0.3 m		ϵ 100
		116	3+	-86.822 (5)	15.8 ± 0.8 m		ϵ 100
		116m	8-	-86.439 (5)	60.3 ± 0.6 m		ϵ 100
		117	5/2+	-88.642 (9)	2.80 ± 0.01 h		ϵ 100
		118	1+	-87.996 (3)	3.6 ± 0.1 m		ϵ 100
		118m	8-	-87.746 (3)	5.00 ± 0.02 h		ϵ 100
		119	5/2+	-89.474 (8)	38.19 ± 0.22 h		ϵ 100
		119m	(27/2+)	-86.632 (8)	0.85 ± 0.09 s		IT 100
		120	1+	-88.417 (7)	15.89 ± 0.04 m		ϵ 100; ϵ 100
		121	5/2+	-89.6 (3)	**stable**	57.21% ± 0.05%	
		122	2-	-88.335 (3)	2.7238 ± 2.0E-4 d		β^- 97.59; ϵ 2.41
		122m	(8)-	-88.171 (3)	4.191 ± 0.003 m		IT 100
		123	7/2+	-89.2261 (22)	**stable**	42.79% ± 0.05%	
		124	3-	-87.6223 (22)	60.20 ± 0.03 d		β^- 100
		124m	5+	-87.6114 (22)	93 ± 5 s		IT 75; β^- 25
		124m2	(8)-	-87.5855 (22)	20.2 ± 0.2 m		IT 100
		125	7/2+	-88.258 (3)	2.75856 ± 2.5E-4 y		β^- 100
		126	(8-)	-86.4 (3)	12.35 ± 0.06 d		β^- 100
		126m	(5+)	-86.38 (3)	19.15 ± 0.08 m		β^- 86; IT 14

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		126m2	(3-)	-86.36 (3)	≈ 11 s		IT 100
		127	7/2+	-86.701 (5)	3.85 ± 0.05 d		β^- 100
		128	8-	-84.61 (3)	9.01 ± 0.04 h		β^- 100; β^- 96.4; IT 3.6
		129	7/2+	-84.629 (21)	4.40 ± 0.01 h		β^- 100
		129m	(19/2-)	-82.778 (21)	17.7 ± 0.1 m		β^- 85; IT 15
		130	(8-)	-82.29 (16)	39.5 ± 0.8 m		β^- 100
		130m	(4,5)+	-82.285 (16)	6.3 ± 0.2 m		β^- 100
		131	(7/2+)	-81.976 (11)	23.03 ± 0.04 m		β^- 100
		132	(4)+	-79.669 (10)	2.79 ± 0.07 m		β^- 100; β^- 100
		133	(7/2+)	-78.94 (3)	2.34 ± 0.05 m		β^- 100
		134	(0-)	-74.17 (4)	0.78 ± 0.06 s		β^- 100
		134m	(7-)	-73.89 (4)	10.07 ± 0.05 s		β^- 100; $\beta^- n$ 0.09
		135	(7/2+)	-69.79 (5)	1.679 ± 0.015 s		$\beta^- n$ 22; β^- 100
		136	1-	-64.5 (3)	0.923 ± 0.014 s		β^- 100; $\beta^- n$ 16.3
		137	(7/2+)	-60.4 (4)	492 ± 25 ms		β^- 100; $\beta^- n$ 49
		138	0	-54.8 (3)	350 ± 15 ms		β^- 100; $\beta^- n$ 72
		139	0	-50.3 (5)	93 +14-3 ms		β^- 100; $\beta^- n$ 90
52	**Te**	107	0	-60.54 (7)	3.1 ± 0.1 ms		α 70; ϵ 30
		108	0+	-65.784 (6)	2.1 ± 0.1 s		ϵ 51; α 49; ϵp 2.4
		109	(5/2+)	-67.715 (4)	4.6 ± 0.3 s		$\epsilon\alpha$ < 5.0E-3; ϵ 96.1; ϵp 9.4; α 3.9
		110	0+	-72.23 (7)	18.6 ± 0.8 s		ϵ 100; $\alpha \approx$ 3.0E-3
		111	(5/2)+	-73.587 (6)	19.3 ± 0.4 s		ϵ 100; ϵp
		112	0+	-77.567 (8)	2.0 ± 0.2 m		ϵ 100
		113	(7/2+)	-78.35 (3)	1.7 ± 0.2 m		ϵ 100
		114	0+	-81.89 (3)	15.2 ± 0.7 m		ϵ 100
		115	7/2+	-82.06 (3)	5.8 ± 0.2 m		ϵ 100
		115m	(1/2)+	-82.04 (3)	6.7 ± 0.4 m		IT ; $\epsilon \leq$ 100.00
		116	0+	-85.27 (3)	2.49 ± 0.04 h		ϵ 100
		117	1/2+	-85.097 (13)	62 ± 2 m		ϵ 100
		117m	(11/2-)	-84.801 (13)	103 ± 3 ms		IT 100
		118	0+	-87.684 (19)	6.00 ± 0.02 d		ϵ 100
		119	1/2+	-87.181 (8)	16.05 ± 0.05 h		ϵ 100
		119m	11/2-	-86.92 (8)	4.70 ± 0.04 d		ϵ 100; IT < 8.0E-3
		120	0+	-89.37 (3)	**stable**	0.09% ± 0.01%	
		121	1/2+	-88.55 (3)	19.17 ± 0.04 d		ϵ 100
		121m	11/2-	-88.25 (3)	164.2 ± 0.8 d		ϵ 11.4; IT 88.6
		122	0+	-90.3158 (16)	**stable**	2.55% ± 0.12%	
		123	1/2+	-89.1735 (16)	> 9.2E+16 y	0.89% ± 0.03%	ϵ 100
		123m	11/2-	-88.926 (16)	119.2 ± 0.1 d		IT 100
		124	0+	-90.5266 (16)	**stable**	4.74% ± 0.14%	
		125	1/2+	-89.0243 (16)	**stable**	7.07% ± 0.15%	
		125m	11/2-	-88.8795 (16)	57.40 ± 0.15 d		IT 100
		126	0+	-90.0666 (16)	**stable**	18.84% ± 0.25%	
		127	3/2+	-88.283 (16)	9.35 ± 0.07 h		β^- 100
		127m	11/2-	-88.1947 (16)	106.1 ± 0.7 d		IT 97.6; β^- 2.4
		128	0+	-88.9937 (9)	2.41E+24 ± 0.39E+24 y	31.74% ± 0.08%	$2\beta^-$ 100
		129	3/2+	-87.0048 (9)	69.6 ± 0.3 m		β^- 100
		129m	11/2-	-86.8993 (9)	33.6 ± 0.1 d		IT 63; β^- 37
		130	0+	-87.3529 (11)	≥ 3.0E+24 y	34.08% ± 0.62%	$2\beta^-$ 100
		131	3/2+	-85.211 (6)	25.0 ± 0.1 m		β^- 100
		131m	11/2-	-85.0287 (6)	33.25 ± 0.25 h		β^- 74.1; IT 25.9
		131m2	(23/2+)	-83.271 (6)	93 ± 12 ms		IT 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		132	0+	-85.18 (7)	3.204 ± 0.013 d		β^- 100
		133	(3/2+)	-82.944 (24)	12.5 ± 0.3 m		β^- 100
		133m	(11/2-)	-82.61 (24)	55.4 ± 0.4 m		β^- 83.5; IT 16.5
		134	0+	-82.559 (11)	41.8 ± 0.8 m		β^- 100
		135	(7/2-)	-77.903 (15)	19.0 ± 0.2 s		β^- 100
		136	0+	-74.479 (25)	17.63 ± 0.08 s		β^- 100; $\beta^- n$ 1.31
		137	(7/2-)	-69.29 (12)	2.49 ± 0.05 s		β^- 100; $\beta^- n$ 2.99
		138	0+	-65.76 (12)	1.4 ± 0.4 s		β^- 100; $\beta^- n$ 6.3
53	**I**	108	(1)	-52.65 (21)	36 ± 6 ms		α 91; ϵ 9; $p < 1.00$
		110	0	-60.46 (5)	0.65 ± 0.02 s		ϵ 83; α 17; ϵp 11; $\epsilon\alpha$ 1.1
		111	(5/2+)	-64.954 (5)	2.5 ± 0.2 s		$\alpha \approx 0.10$; ϵ 99.9
		112	0	-67.063 (10)	3.42 ± 0.11 s		ϵ 100; $\alpha \approx$ 1.2E-3
		113	5/2+	-71.119 (8)	6.6 ± 0.2 s		ϵ 100; α 3.3e-07
		114	1+	-72.8 (3)	2.1 ± 0.2 s		ϵ 100; ϵp
		114m	(7)	-72.5 (3)	6.2 ± 0.5 s		ϵ 91; IT 9
		115	(5/2+)	-76.34 (3)	1.3 ± 0.2 m		ϵ 100
		116	1+	-77.49 (10)	2.91 ± 0.15 s		ϵ 100
		117	(5/2)+	-80.43 (3)	2.22 ± 0.04 m		ϵ 100
		118	2-	-80.971 (20)	13.7 ± 0.5 m		ϵ 100
		118m	(7-)	-80.867 (20)	8.5 ± 0.5 m		$\epsilon < 100.00$; IT
		119	5/2+	-83.77 (3)	19.1 ± 0.4 m		ϵ 100
		120	2-	-83.755 (15)	81.6 ± 0.2 m		ϵ 100
		120m	(7-)	-83.435 (15)	53 ± 4 m		ϵ 100
		121	5/2+	-86.253 (5)	2.12 ± 0.01 h		ϵ 100
		122	1+	-86.082 (5)	3.63 ± 0.06 m		ϵ 100
		123	5/2+	-87.945 (4)	13.2235 ± 0.0019 h		ϵ 100
		124	2-	-87.367 (24)	4.1760 ± 3.0E-4 d		ϵ 100
		125	5/2+	-88.8385 (16)	59.407 ± 0.01 d		ϵ 100
		126	2-	-87.912 (4)	12.93 ± 0.05 d		ϵ 52.7; β^- 47.3
		127	5/2+	-88.985 (4)	**stable**	100%	
		128	1+	-87.739 (4)	24.99 ± 0.02 m		β^- 93.1; ϵ 6.9
		129	7/2+	-88.507 (3)	1.57E+7 ± 0.04E+7 y		β^- 100
		130	5+	-86.936 (3)	12.36 ± 0.01 h		β^- 100
		130m	2+	-86.896 (3)	8.84 ± 0.06 m		IT 84; β^- 16
		131	7/2+	-87.4427 (6)	8.0252 ± 6.0E-4 d		β^- 100
		132	4+	-85.698 (6)	2.295 ± 0.013 h		β^- 100
		132m	(8-)	-85.578 (6)	1.387 ± 0.015 h		IT 86; β^- 14
		133	7/2+	-85.886 (5)	20.83 ± 0.08 h		β^- 100
		133m	(19/2-)	-84.252 (5)	9 ± 2 s		IT 100
		134	(4)+	-84.072 (8)	52.5 ± 0.2 m		β^- 100
		134m	(8)-	-83.756 (8)	3.52 ± 0.04 m		IT 97.7; β^- 2.3
		135	7/2+	-83.791 (7)	6.58 ± 0.03 h		β^- 100
		136	(1-)	-79.572 (19)	83.4 ± 1 s		β^- 100
		136m	(6-)	-78.932 (19)	46.9 ± 1 s		β^- 100
		137	(7/2+)	-76.51 (3)	24.5 ± 0.2 s		β^- 100; $\beta^- n$ 7.14
		138	(2-)	-71.9 (10)	6.23 ± 0.03 s		β^- 100; $\beta^- n$ 5.56
		139	(7/2+)	-68.53 (12)	2.280 ± 0.011 s		β^- 100; $\beta^- n$ 10
		140	(4-)	-63.6 (12)	0.86 ± 0.04 s		β^- 100; $\beta^- n$ 9.3
		141	0	-60.3 (13)	0.43 ± 0.02 s		β^- 100; $\beta^- n$ 21.2
		142	0	-55 (4)	222 ± 12 ms		β^- 100; $\beta^- n$?
		143	0	-51.1 (4)	130 ± 45 ms		β^- ?
54	**Xe**	109	(7/2+)	-45.9 (3)	13 ± 2 ms		α 100
		110	0+	-51.92 (10)	93 ± 3 ms		ϵp ; α 64; ϵ

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		111	(7/2+)	-54.39 (9)	0.81 ± 0.2 s		ϵ 90; α 10
		112	0+	-60.028 (8)	2.7 ± 0.8 s		ϵ 99.16; α 0.84
		113	(5/2+)	-62.204 (7)	2.74 ± 0.08 s		ϵ ; ϵp 7; $\alpha \approx$ 0.01; $\epsilon\alpha \approx$ 7.0E-3
		114	0+	-67.086 (11)	10.0 ± 0.4 s		ϵ 100
		115	(5/2+)	-68.657 (12)	18 ± 4 s		ϵp 0.34; α 0.0003; ϵ 100
		116	0+	-73.047 (13)	59 ± 2 s		ϵ 100
		117	5/2(+)	-74.185 (10)	61 ± 2 s		ϵ 100; ϵp 0.0029
		118	0+	-78.079 (10)	3.8 ± 0.9 m		ϵ 100
		119	(5/2+)	-78.794 (10)	5.8 ± 0.3 m		ϵ 100
		120	0+	-82.172 (12)	40 ± 1 m		ϵ 100
		121	5/2(+)	-82.473 (11)	40.1 ± 2 m		ϵ 100
		122	0+	-85.355 (11)	20.1 ± 0.1 h		ϵ 100
		123	(1/2)+	-85.249 (10)	2.08 ± 0.02 h		ϵ 100
		124	0+	-87.6612 (18)	≥ 1.6E+14 y	0.0952% ± 0.0003%	2ϵ
		125	1/2(+)	-87.1932 (18)	16.9 ± 0.2 h		ϵ 100
		125m	9/2(-)	-86.9406 (18)	57 ± 1 s		IT 100
		126	0+	-89.146 (4)	**stable**	0.089% ± 0.0002%	
		127	1/2+	-88.322 (4)	36.346 ± 0.003 d		ϵ 100
		127m	9/2-	-88.025 (4)	69.2 ± 0.9 s		IT 100
		128	0+	-89.8602 (11)	**stable**	1.9102% ± 0.0008%	
		129	1/2+	-88.696 (6)	**stable**	26.4006% ± 0.0082%	
		129m	11/2-	-88.4599 (6)	8.88 ± 0.02 d		IT 100
		130	0+	-89.8804 (9)	**stable**	4.071% ± 0.0013%	
		131	3/2+	-88.4136 (22)	**stable**	21.232% ± 0.03%	
		131m	11/2-	-88.2497 (22)	11.84 ± 0.04 d		IT 100
		132	0+	-89.2789 (5)	**stable**	26.9086% ± 0.0033%	
		132m	(10+)	-86.5267 (5)	8.39 ± 0.11 ms		IT 100
		133	3/2+	-87.6435 (24)	5.2475 ± 5.0E-4 d		β^- 100
		133m	11/2-	-87.4103 (24)	2.198 ± 0.013 d		IT 100
		134	0+	-88.1245 (8)	> 5.8E+22 y	10.4357% ± 0.0021%	$2\beta^-$
		134m	7-	-86.1589 (8)	290 ± 17 ms		IT 100
		135	3/2+	-86.418 (5)	9.14 ± 0.02 h		β^- 100
		135m	11/2-	-85.891 (5)	15.29 ± 0.05 m		$IT >$ 99.40; $\beta^- <$ 0.60
		136	0+	-86.4291 (10)	> 2.4E+21 y	8.8573% ± 0.0044%	$2\beta^-$
		137	7/2-	-82.3833 (11)	3.818 ± 0.013 m		β^- 100
		138	0+	-79.975 (3)	14.08 ± 0.08 m		β^- 100
		139	3/2-	-75.6445 (21)	39.68 ± 0.14 s		β^- 100
		140	0+	-72.9864 (23)	13.60 ± 0.1 s		β^- 100
		141	5/2(-)	-68.197 (3)	1.73 ± 0.01 s		β^- 100; $\beta^- n$ 0.04
		142	0+	-65.23 (3)	1.23 ± 0.02 s		β^- 100; $\beta^- n$ 0.21
		143	5/2-	-60.203 (5)	0.511 ± 0.006 s		β^- 100; $\beta^- n$ 1
		144	0+	-56.872 (5)	0.388 ± 0.007 s		β^- 100; $\beta^- n$ 3
		145	0	-51.493 (11)	188 ± 4 ms		β^- 100; $\beta^- n$ 5
		146	0+	-47.955 (24)	146 ± 6 ms		β^- 100; $\beta^- n$ 6.9
		147	(3/2-)	-42.5 (4)	0.10 +0.1-0.05 s		β^- ; $\beta^- n <$ 8.00
55	**Cs**	114	(1+)	-54.68 (7)	0.57 ± 0.02 s		ϵ 99.98; ϵp 8.7; $\epsilon\alpha$ 0.19; α 0.02
		115	0	-59.7 (3)	1.4 ± 0.8 s		ϵ 100; $\epsilon p \approx$ 0.07
		116	(1+)	-62.07 (10)	0.70 ± 0.04 s		$\epsilon\alpha$ 0.05; ϵ 100; ϵp 2.8
		116m	4+,5,6	-61.97 (10)	3.85 ± 0.13 s		ϵ 100; ϵp 0.51; $\epsilon\alpha$ 0.008
		117	(9/2+)	-66.49 (6)	8.4 ± 0.6 s		ϵ 100; ϵ

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		118	2	-68.409 (13)	14 ± 2 s		ϵ 100; $\epsilon p < 0.04$; $\epsilon\alpha <$ 2.4E-3; $\epsilon\alpha <$ 2.4E-3; ϵ 100; $\epsilon p < 0.04$
		119	9/2+	-72.305 (14)	43.0 ± 0.2 s		ϵ 100; ϵ 100
		120	2(+)	-73.889 (10)	61.3 ± 1.1 s		ϵ 100; $\epsilon\alpha$ 2e-05; ϵp 7e-06; ϵ 100
		121	3/2(+)	-77.1 (14)	155 ± 4 s		ϵ 100
		121m	9/2(+)	-77.032 (14)	122 ± 3 s		ϵ 83; IT 17
		122	1+	-78.14 (3)	21.18 ± 0.19 s		ϵ 100
		122m	(5)-	-78.01 (3)	0.36 ± 0.02 s		IT 100
		122m2	8(-)	-78 (3)	3.70 ± 0.11 m		ϵ 100
		123	1/2+	-81.044 (12)	5.88 ± 0.03 m		ϵ 100
		123m	(11/2)-	-80.887 (12)	1.64 ± 0.12 s		IT 100
		124	1+	-81.731 (8)	30.9 ± 0.4 s		ϵ 100
		124m	(7)+	-81.269 (8)	6.3 ± 0.2 s		IT 100
		125	1/2(+)	-84.088 (8)	46.7 ± 0.1 m		ϵ 100
		126	1+	-84.345 (12)	1.64 ± 0.02 m		ϵ 100
		127	1/2+	-86.24 (6)	6.25 ± 0.1 h		ϵ 100
		128	1+	-85.931 (5)	3.66 ± 0.02 m		ϵ 100
		129	1/2+	-87.499 (5)	32.06 ± 0.06 h		ϵ 100
		130	1+	-86.9 (8)	29.21 ± 0.04 m		ϵ 98.4; β^- 1.6
		130m	5-	-86.736 (8)	3.46 ± 0.06 m		IT 99.84; ϵ 0.16
		131	5/2+	-88.059 (5)	9.689 ± 0.016 d		ϵ 100
		132	2+	-87.1557 (19)	6.480 ± 0.006 d		ϵ 98.13; β^- 1.87
		133	7/2+	-88.0709 (8)	**stable**	100%	
		134	4+	-86.8911 (16)	2.0652 ± 4.0E-4 y		ϵ 0.0003; β^- 100
		134m	8-	-86.7524 (16)	2.912 ± 0.002 h		IT 100
		135	7/2+	-87.5818 (10)	2.3E+6 ± 0.3E+6 y		β^- 100
		135m	19/2-	-85.9489 (10)	53 ± 2 m		IT 100
		136	5+	-86.339 (19)	13.04 ± 0.03 d		β^- 100
		136m	8-	-85.8211 (19)	17.5 ± 0.2 s		β^- ; $IT > 0.00$
		137	7/2+	-86.5459 (4)	30.08 ± 0.09 y		β^- 100
		138	3-	-82.887 (9)	33.41 ± 0.18 m		β^- 100
		138m	6-	-82.807 (9)	2.91 ± 0.08 m		β^- 19; IT 81
		139	7/2+	-80.701 (3)	9.27 ± 0.05 m		β^- 100
		140	1-	-77.05 (8)	63.7 ± 0.3 s		β^- 100
		141	7/2+	-74.48 (10)	24.84 ± 0.16 s		β^- 100; $\beta^- n$ 0.04
		142	0-	-70.525 (11)	1.684 ± 0.014 s		β^- 100; $\beta^- n$ 0.09
		143	3/2+	-67.675 (22)	1.791 ± 0.007 s		β^- 100; $\beta^- n$ 1.64
		144	1(-)	-63.27 (3)	0.994 ± 0.006 s		β^- 100; $\beta^- n$ 3.03; β^-
		145	3/2+	-60.056 (11)	0.587 ± 0.005 s		β^- 100; $\beta^- n$ 14.7
		146	1-	-55.57 (4)	0.321 ± 0.002 s		β^- 100; $\beta^- n$ 14.2
		147	(3/2+)	-52.02 (5)	0.230 ± 0.001 s		β^- 100; $\beta^- n$ 28.5
		148	0	-47.3 (6)	146 ± 6 ms		β^- 100; $\beta^- n$ 25.1
		149	0	-43.84 (20)	> 50 ms		β^- ; $\beta^- n$
		150	0	-39 (3)	> 50 ms		β^- ; $\beta^- n$
		151	0	-35.1 (4)	> 50 ms		β^- ; $\beta^- n$
56	**Ba**	114	0+	-45.96 (11)	0.43 +0.3-0.15 s		ϵ 99.1; ϵp 20; α 0.9; $^{12}C <$ 0.0034
		115	(5/2+)	-49 (6)	0.45 ± 0.05 s		ϵ 100; $\epsilon p > 15.00$
		116	0+	-54.6 (4)	1.3 ± 0.2 s		ϵ 100; ϵp 3
		117	(3/2)	-57.5 (3)	1.75 ± 0.07 s		ϵ 100; $\epsilon\alpha > 0.00$; $\epsilon p > 0.00$
		118	0+	-62.37 (20)	5.5 ± 0.2 s		ϵ 100; ϵp
		119	(5/2+)	-64.59 (20)	5.4 ± 0.3 s		ϵ 100; $\epsilon p < 25.00$

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		120	0+	-68.9 (3)	24 ± 2 s		ϵ 100
		121	5/2(+)	-70.74 (14)	29.7 ± 1.5 s		ϵ 100
		122	0+	-74.61 (3)	1.95 ± 0.15 m		ϵ 100
		123	5/2(+)	-75.655 (12)	2.7 ± 0.4 m		ϵ 100
		124	0+	-79.09 (12)	11.0 ± 0.5 m		ϵ 100
		125	1/2(+)	-79.668 (11)	3.3 ± 0.3 m		ϵ 100
		126	0+	-82.67 (12)	100 ± 2 m		ϵ 100
		127	1/2+	-82.815 (11)	12.7 ± 0.4 m		ϵ 100
		127m	7/2-	-82.735 (11)	1.9 ± 0.2 s		IT 100
		128	0+	-85.379 (5)	2.43 ± 0.05 d		ϵ 100
		129	1/2+	-85.064 (11)	2.23 ± 0.11 h		ϵ 100
		129m	7/2+	-85.056 (11)	2.16 ± 0.02 h		$\epsilon \leq$ 100.00; IT
		130	0+	-87.262 (3)	**stable**	0.106% ± 0.001%	2ϵ
		130m	8-	-84.787 (3)	9.4 ± 0.4 ms		IT 100
		131	1/2+	-86.684 (3)	11.50 ± 0.06 d		ϵ 100
		131m	9/2-	-86.496 (3)	14.6 ± 0.2 m		IT 100
		132	0+	-88.4349 (11)	> 3.0E+21 y	0.101% ± 0.001%	2ϵ
		133	1/2+	-87.5535 (10)	10.551 ± 0.011 y		ϵ 100
		133m	11/2-	-87.2652 (10)	38.93 ± 0.1 h		IT 99.99; ϵ 0.01
		134	0+	-88.9501 (3)	**stable**	2.417% ± 0.018%	
		135	3/2+	-87.8508 (3)	**stable**	6.592% ± 0.012%	
		135m	11/2-	-87.5826 (3)	28.7 ± 0.2 h		IT 100
		136	0+	-88.8872 (3)	**stable**	7.854% ± 0.024%	
		136m	7-	-86.8567 (3)	0.3084 ± 0.0019 s		IT 100
		137	3/2+	-87.7215 (3)	**stable**	11.232% ± 0.024%	
		137m	11/2-	-87.0598 (3)	2.552 ± 0.001 m		IT 100
		138	0+	-88.2619 (3)	**stable**	71.698% ± 0.042%	
		139	7/2-	-84.914 (3)	83.06 ± 0.28 m		β^- 100
		140	0+	-83.27 (8)	12.7527 ± 0.0023 d		β^- 100
		141	3/2-	-79.733 (5)	18.27 ± 0.07 m		β^- 100
		142	0+	-77.845 (6)	10.6 ± 0.2 m		β^- 100
		143	5/2-	-73.937 (7)	14.5 ± 0.3 s		β^- 100
		144	0+	-71.767 (7)	11.5 ± 0.2 s		β^- 100
		145	5/2-	-67.516 (8)	4.31 ± 0.16 s		β^- 100
		146	0+	-64.941 (20)	2.22 ± 0.07 s		β^- 100
		147	(3/2-)	-60.264 (20)	0.894 ± 0.01 s		β^- 100; $\beta^- n$ 0.06
		148	0+	-57.59 (6)	0.612 ± 0.017 s		β^- 100; $\beta^- n$ 0.4
		149	0	-53.17 (20)	0.344 ± 0.007 s		β^- 100; $\beta^- n$ 0.43
		150	0+	-50.3 (4)	0.3 ± 0 s		β^- 100; $\beta^- n$
57	**La**	117	(3/2+,3/2-)	-46.5 (4)	23.5 ± 2.6 ms		p 93.9; ϵ 6.1
		117m	(9/2+)	-46.3 (4)	10 ± 5 ms		ϵ 2.6; p 97.4
		120	0	-57.7 (5)	2.8 ± 0.2 s		ϵ 100; $\epsilon p > 0.00$
		121	0	-62.4 (5)	5.3 ± 0.2 s		ϵ 100
		122	0	-64.5 (3)	8.6 ± 0.5 s		ϵ 100; ϵp
		123	0	-68.71 (20)	17 ± 3 s		ϵ 100
		124	(8-)	-70.26 (6)	29.21 ± 0.17 s		ϵ 100; ϵ 100
		125	(3/2+)	-73.76 (3)	64.8 ± 1.2 s		ϵ 100
		125m	0	-73.65 (3)	0.39 ± 0.04 s		
		126	(5+)	-74.97 (9)	54 ± 2 s		$\epsilon > 0.00$; ϵ ; IT
		127	(11/2-)	-77.9 (3)	5.1 ± 0.1 m		ϵ 100
		127m	(3/2+)	-77.88 (3)	3.7 ± 0.4 m		ϵ 100; IT
		128	(5+)	-78.63 (5)	5.18 ± 0.14 m		ϵ 100; ϵ 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		129	3/2+	-81.326 (21)	11.6 $\pm$ 0.2 m		ϵ 100
		129m	11/2-	-81.154 (21)	0.56 $\pm$ 0.05 s		IT 100
		130	3(+)	-81.63 (3)	8.7 $\pm$ 0.1 m		ϵ 100
		131	3/2+	-83.77 (3)	59 $\pm$ 2 m		ϵ 100
		132	2-	-83.72 (4)	4.8 $\pm$ 0.2 h		ϵ 100
		132m	6-	-83.54 (4)	24.3 $\pm$ 0.5 m		IT 76; ϵ 24
		133	5/2+	-85.49 (3)	3.912 $\pm$ 0.008 h		ϵ 100
		134	1+	-85.219 (20)	6.45 $\pm$ 0.16 m		ϵ 100
		135	5/2+	-86.651 (10)	19.5 $\pm$ 0.2 h		ϵ 100
		136	1+	-86.04 (5)	9.87 $\pm$ 0.03 m		ϵ 100
		136m	(8+)	-85.81 (5)	114 $\pm$ 3 ms		IT 100
		137	7/2+	-87.106 (12)	6E+4 $\pm$ 2E+4 y		ϵ 100
		138	5+	-86.521 (3)	1.02E+11 $\pm$ 0.01E+11 y	0.08881% $\pm$ 0.00071%	ϵ 65.6; β^- 34.4
		139	7/2+	-87.2282 (23)	**stable**	99.9119% $\pm$ 0.0071%	
		140	3-	-84.3179 (23)	1.67855 $\pm$ 1.2E-4 d		β^- 100
		141	(7/2+)	-82.934 (4)	3.92 $\pm$ 0.03 h		β^- 100
		142	2-	-80.022 (7)	91.1 $\pm$ 0.5 m		β^- 100
		143	(7/2)+	-78.171 (7)	14.2 $\pm$ 0.1 m		β^- 100
		144	(3-)	-74.833 (18)	40.8 $\pm$ 0.4 s		β^- 100
		145	(5/2+)	-72.832 (12)	24.8 $\pm$ 2 s		β^- 100
		146	2-	-69.05 (3)	6.27 $\pm$ 0.1 s		β^- 100; β^- 100
		147	(3/2+)	-66.678 (11)	4.06 $\pm$ 0.04 s		β^- 100; $\beta^- n$ 0.04
		148	(2-)	-62.709 (19)	1.26 $\pm$ 0.08 s		β^- 100; $\beta^- n$ 0.15
		149	(3/2-)	-60.22 (20)	1.05 $\pm$ 0.03 s		β^- 100; $\beta^- n$ 1.43
		150	(3+)	-56.55 (20)	0.86 $\pm$ 0.05 s		β^- 100; $\beta^- n$ 2.7
58	**Ce**	121	(5/2)	-52.5 (5)	1.1 $\pm$ 0.1 s		ϵ 100; $\epsilon p \approx$ 1.00
		123	(5/2)	-60.1 (3)	3.8 $\pm$ 0.2 s		ϵ 100; $\epsilon p >$ 0.00
		124	0+	-64.6 (3)	6 $\pm$ 2 s		ϵ 100
		125	(7/2-)	-66.66 (20)	9.7 $\pm$ 0.3 s		ϵ 100; ϵp
		126	0+	-70.82 (3)	51.0 $\pm$ 0.3 s		ϵ 100
		127	(1/2+)	-71.98 (6)	34 $\pm$ 2 s		ϵ 100
		127m	(5/2+)	-71.97 (6)	28.6 $\pm$ 0.7 s		ϵ 100
		128	0+	-75.53 (3)	3.93 $\pm$ 0.02 m		ϵ 100
		129	5/2+	-76.29 (3)	3.5 $\pm$ 0.5 m		$\epsilon >$ 0.00
		130	0+	-79.42 (3)	22.9 $\pm$ 0.5 m		ϵ 100
		131	7/2+	-79.71 (3)	10.3 $\pm$ 0.3 m		ϵ 100
		131m	(1/2+)	-79.64 (3)	5.4 $\pm$ 0.4 m		ϵ 100; IT
		132	0+	-82.471 (20)	3.51 $\pm$ 0.11 h		ϵ 100
		132m	(8-)	-80.13 (20)	9.4 $\pm$ 0.3 ms		IT 100
		133	1/2+	-82.423 (16)	97 $\pm$ 4 m		ϵ 100
		133m	9/2-	-82.386 (16)	5.1 $\pm$ 0.3 h		ϵ ; IT
		134	0+	-84.836 (20)	3.16 $\pm$ 0.04 d		ϵ 100
		135	1/2(+)	-84.625 (11)	17.7 $\pm$ 0.3 h		ϵ 100
		135m	(11/2-)	-84.179 (11)	20 $\pm$ 1 s		IT 100
		136	0+	-86.474 (12)	$>$ 0.7E+14 y	0.185% $\pm$ 0.002%	2ϵ
		137	3/2+	-85.884 (12)	9.0 $\pm$ 0.3 h		ϵ 100
		137m	11/2-	-85.629 (12)	34.4 $\pm$ 0.3 h		IT 99.21; ϵ 0.79
		138	0+	-87.564 (10)	$\geq$ 0.9E+14 y	0.251% $\pm$ 0.002%	2ϵ 100
		138m	7-	-85.435 (10)	8.65 $\pm$ 0.2 ms		IT 100
		139	3/2+	-86.95 (7)	137.641 $\pm$ 0.02 d		ϵ 100
		139m	11/2-	-86.196 (7)	54.8 $\pm$ 1 s		IT 100
		140	0+	-88.0786 (22)	**stable**	88.45% $\pm$ 0.051%	
		141	7/2-	-85.4354 (22)	32.508 $\pm$ 0.013 d		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		142	0+	-84.532 (3)	> 5E+16 y	11.114% ± 0.051%	$2\beta^-$
		143	3/2-	-81.605 (3)	33.039 ± 0.006 h		β^- 100
		144	0+	-80.431 (3)	284.91 ± 0.05 d		β^- 100
		145	(5/2-)	-77.09 (4)	3.01 ± 0.06 m		β^- 100
		146	0+	-75.641 (18)	13.52 ± 0.13 m		β^- 100
		147	(5/2-)	-72.014 (9)	56.4 ± 1 s		β^- 100
		148	0+	-70.398 (11)	56 ± 1 s		β^- 100
		149	(3/2-)	-66.67 (10)	5.3 ± 0.2 s		β^- 100
		150	0+	-64.849 (12)	4.0 ± 0.6 s		β^- 100
		151	(5/2+)	-61.225 (18)	1.76 ± 0.06 s		β^- 100; β^-
		152	0+	-59.31 (20)	1.4 ± 0.2 s		β^- 100
59	**Pr**	121	(3/2)	-41.4 (7)	10 +6-3 ms		p 100
		122	0	-44.7 (5)	≈ 0.5 s		ϵ ?
		123	0	-50.1 (6)	≈ 0.8 s		ϵ ?
		124	0	-53 (6)	1.2 ± 0.2 s		$\epsilon p > 0.00$; ϵ 100
		125	0	-57.7 (4)	3.3 ± 0.7 s		ϵ 100; ϵp
		126	>3	-60.14 (20)	3.14 ± 0.22 s		ϵ 100; ϵp
		127	0	-64.32 (20)	4.2 ± 0.3 s		ϵ 100
		128	4,5,6	-66.33 (3)	2.84 ± 0.09 s		ϵ 100
		129	(11/2-)	-69.77 (3)	30 ± 4 s		$\epsilon > 0.00$
		130	(7,8)	-71.18 (6)	40 ± 4 s		ϵ 100; ϵ 100; ϵ 100
		131	(3/2+)	-74.3 (5)	1.51 ± 0.02 m		ϵ 100
		131m	(11/2-)	-74.15 (5)	5.73 ± 0.2 s		IT 96.4; ϵ 3.6
		132	(2)+	-75.21 (6)	1.6 ± 0.3 m		ϵ 100
		133	(3/2+)	-77.937 (12)	6.5 ± 0.3 m		ϵ 100
		133m	(11/2-)	-77.745 (12)	1.1 ± 0.2 s		IT 100
		134	(6-)	-78.51 (4)	≈ 11 m		ϵ 100; ϵ 100
		135	3/2(+)	-80.936 (12)	24 ± 1 m		ϵ 100
		136	2+	-81.329 (12)	13.1 ± 0.1 m		ϵ 100
		137	5/2+	-83.179 (11)	1.28 ± 0.03 h		ϵ 100
		138	1+	-83.127 (14)	1.45 ± 0.05 m		ϵ 100
		138m	7-	-82.763 (14)	2.12 ± 0.04 h		ϵ 100
		139	5/2+	-84.821 (8)	4.41 ± 0.04 h		ϵ 100
		140	1+	-84.691 (6)	3.39 ± 0.01 m		ϵ 100
		141	5/2+	-86.0158 (22)	**stable**	100%	
		142	2-	-83.7877 (22)	19.12 ± 0.04 h		β^- 99.98; ϵ 0.02
		142m	5-	-83.784 (22)	14.6 ± 0.5 m		IT 100
		143	7/2+	-83.0674 (23)	13.57 ± 0.02 d		β^- 100
		144	0-	-80.75 (3)	17.28 ± 0.05 m		β^- 100
		144m	3-	-80.691 (3)	7.2 ± 0.3 m		IT 99.93; β^- 0.07
		145	7/2+	-79.626 (7)	5.984 ± 0.01 h		β^- 100
		146	(2)-	-76.69 (4)	24.15 ± 0.18 m		β^- 100
		147	(5/2+)	-75.444 (16)	13.4 ± 0.3 m		β^- 100
		148	1-	-72.535 (15)	2.29 ± 0.02 m		β^- 100
		148m	(4)	-72.445 (15)	2.01 ± 0.07 m		β^- 100
		149	(5/2+)	-71.039 (10)	2.26 ± 0.07 m		β^- 100
		150	(1)-	-68.299 (9)	6.19 ± 0.16 s		β^- 100
		151	(3/2-)	-66.78 (12)	18.90 ± 0.07 s		β^- 100
		152	(4+)	-63.758 (19)	3.57 ± 0.18 s		β^- 100
		153	0	-61.581 (14)	4.28 ± 0.11 s		β^- 100
		154	(3+)	-58.19 (15)	2.3 ± 0.1 s		β^- 100
60	**Nd**	125	(5/2)	-47.4 (4)	0.65 ± 0.15 s		ϵ 100; $\epsilon p > 0.00$
		127	0	-55.3 (4)	1.8 ± 0.4 s		ϵ 100; ϵp

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		128	0+	-60.07 (20)	5 ± 0 s		ϵ 100; ϵp
		129	(5/2+)	-62.23 (20)	4.9 ± 0.2 s		$\epsilon > 0.00$; $\epsilon p > 0.00$
		130	0+	-66.6 (3)	21 ± 3 s		ϵ 100
		131	(5/2+)	-67.77 (3)	25.4 ± 0.9 s		ϵ 100; $\epsilon p > 0.00$
		132	0+	-71.426 (24)	94 ± 8 s		ϵ 100
		133	(7/2+)	-72.33 (5)	70 ± 10 s		ϵ 100
		133m	(1/2+)	-72.2 (5)	≈ 70 s		ϵ ; IT
		134	0+	-75.646 (12)	8.5 ± 1.5 m		ϵ 100
		135	9/2(-)	-76.214 (19)	12.4 ± 0.6 m		ϵ 100
		135m	(1/2+)	-76.149 (19)	5.5 ± 0.5 m		$\epsilon > 99.97$; $IT < 0.03$
		136	0+	-79.199 (12)	50.65 ± 0.33 m		ϵ 100
		137	1/2+	-79.584 (12)	38.5 ± 1.5 m		ϵ 100
		137m	11/2-	-79.065 (12)	1.60 ± 0.15 s		IT 100
		138	0+	-82.018 (12)	5.04 ± 0.09 h		ϵ 100
		139	3/2+	-82.01 (3)	29.7 ± 0.5 m		ϵ 100
		139m	11/2-	-81.78 (3)	5.50 ± 0.2 h		ϵ 88.2; IT 11.8
		140	0+	-84.25 (3)	3.37 ± 0.02 d		ϵ 100
		141	3/2+	-84.193 (4)	2.49 ± 0.03 h		ϵ 100
		141m	11/2-	-83.436 (4)	62.0 ± 0.8 s		IT 100; $\epsilon < 0.05$
		142	0+	-85.9493 (18)	**stable**	27.152% ± 0.04%	
		143	7/2-	-84.0015 (18)	**stable**	12.174% ± 0.026%	
		144	0+	-83.7473 (18)	2.29E+15 ± 0.16E+15 y	23.798% ± 0.019%	α 100
		145	7/2-	-81.4312 (18)	**stable**	8.293% ± 0.012%	
		146	0+	-80.9252 (18)	**stable**	17.189% ± 0.032%	
		147	5/2-	-78.146 (18)	10.98 ± 0.01 d		β^- 100
		148	0+	-77.4068 (24)	**stable**	5.756% ± 0.021%	
		149	5/2-	-74.3743 (24)	1.728 ± 0.001 h		β^- 100
		150	0+	-73.683 (3)	0.79E19 ± 0.07E19 y	5.638% ± 0.028%	
		151	3/2+	-70.946 (3)	12.44 ± 0.07 m		β^- 100
		152	0+	-70.152 (25)	11.4 ± 0.2 m		β^- 100
		153	(3/2)-	-67.34 (3)	31.6 ± 1 s		β^- 100
		154	0+	-65.68 (11)	25.9 ± 0.2 s		β^- 100
		155	0	-62.47 (15)	8.9 ± 0.2 s		β^- 100
		156	0+	-60.52 (20)	5.06 ± 0.13 s		β^- 100
61	**Pm**	128	0	-47.6 (5)	1.0 ± 0.3 s		ϵ 100; α ; ϵp
		129	(5/2-)	-52.5 (4)	2.4 ± 0.9 s		ϵ 100
		130	(4,5,6)	-55.2 (3)	2.6 ± 0.2 s		ϵ 100; ϵp
		131	(11/2-)	-59.59 (20)	6.3 ± 0.8 s		ϵ 100
		132	(3+)	-61.64 (20)	6.2 ± 0.6 s		ϵ 100; $\epsilon p \approx$ 5.0E-5
		133	(3/2+)	-65.41 (5)	13.5 ± 2.1 s		ϵ 100
		133m	(11/2-)	-65.28 (5)	< 8.8 s		IT ; ϵ
		134	(2+)	-66.74 (6)	≈ 5 s		ϵ 100; ϵ 100
		135	(3/2+,5/2+)	-69.98 (6)	49 ± 3 s		ϵ 100
		135m	(11/2-)	-69.91 (6)	45 ± 4 s		ϵ 100
		136	(5-)	-71.2 (8)	107 ± 6 s		ϵ 100; ϵ 100
		137	11/2-	-74.073 (13)	2.4 ± 0.1 m		ϵ 100
		138	0	-74.94 (3)	10 ± 2 s		ϵ 100
		138m	0	-74.92 (3)	3.24 ± 0.05 m		ϵ
		139	(5/2)+	-77.5 (14)	4.15 ± 0.05 m		ϵ 100
		139m	(11/2)-	-77.312 (14)	180 ± 20 ms		IT 99.94; ϵ 0.06
		140	1+	-78.21 (4)	9.2 ± 0.2 s		ϵ 100; ϵ 100
		141	5/2+	-80.523 (14)	20.90 ± 0.05 m		ϵ 100
		142	1+	-81.16 (3)	40.5 ± 0.5 s		ϵ 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		142m	(8)-	-80.27 (3)	2.0 ± 0.2 ms		IT 100
		143	5/2+	-82.96 (3)	265 ± 7 d		ϵ 100
		144	5-	-81.416 (3)	363 ± 14 d		ϵ 100
		145	5/2+	-81.267 (3)	17.7 ± 0.4 y		ϵ 100; α 2.8e-07
		146	3-	-79.454 (4)	5.53 ± 0.05 y		ϵ 66; β^- 34
		147	7/2+	-79.0416 (18)	2.6234 ± 2.0E-4 y		β^- 100
		148	1-	-76.865 (6)	5.368 ± 0.002 d		β^- 100
		148m	5-,6-	-76.727 (6)	41.29 ± 0.11 d		β^- 95.8; IT 4.2
		149	7/2+	-76.063 (3)	53.08 ± 0.05 h		β^- 100
		150	(1-)	-73.596 (20)	2.68 ± 0.02 h		β^- 100
		151	5/2+	-73.389 (5)	28.40 ± 0.04 h		β^- 100
		152	1+	-71.26 (3)	4.12 ± 0.08 m		β^- 100
		152m	(8)	-71.11 (3)	13.8 ± 0.2 m		β^- 100; IT $\geq$ 0.00; β^- 100
		153	5/2-	-70.678 (11)	5.25 ± 0.02 m		β^- 100
		154	(3,4)	-68.49 (4)	2.68 ± 0.07 m		β^- 100; β^- 100
		155	5/2-	-66.97 (3)	41.5 ± 0.2 s		β^- 100
		156	4-	-64.21 (3)	26.70 ± 0.1 s		β^- 100
		157	(5/2-)	-62.37 (11)	10.56 ± 0.1 s		β^- 100
		158	0	-59.12 (11)	4.8 ± 0.5 s		β^- 100
		159	0	-56.82 (15)	1.5 ± 0.2 s		β^- 100
62	**Sm**	129	(1/2+,3/2+)	-41.3 (7)	0.55 ± 0.1 s		ϵ 100; $\epsilon p > 0.00$
		131	0	-49.6 (3)	1.2 ± 0.2 s		ϵ 100; $\epsilon p > 0.00$
		132	0+	-54.7 (3)	4.0 ± 0.3 s		ϵ 100; ϵp
		133	(5/2+)	-56.83 (20)	2.89 ± 0.16 s		ϵ 100; $\epsilon p > 0.00$; ϵ ; IT ; ϵp
		134	0+	-61.22 (20)	9.5 ± 0.8 s		ϵ 100
		135	(3/2+,5/2+)	-62.86 (15)	10.3 ± 0.5 s		ϵp 0.02; ϵ 100
		136	0+	-66.811 (12)	47 ± 2 s		ϵ 100
		137	(9/2-)	-68.03 (4)	45 ± 1 s		ϵ 100
		138	0+	-71.498 (12)	3.1 ± 0.2 m		ϵ 100
		139	1/2+	-72.38 (11)	2.57 ± 0.1 m		ϵ 100
		139m	11/2-	-71.923 (11)	10.7 ± 0.6 s		IT 93.7; ϵ 6.3
		140	0+	-75.456 (12)	14.82 ± 0.12 m		ϵ 100
		141	1/2+	-75.934 (9)	10.2 ± 0.2 m		ϵ 100
		141m	11/2-	-75.758 (9)	22.6 ± 0.2 m		ϵ 99.69; IT 0.31
		142	0+	-78.987 (4)	72.49 ± 0.05 m		ϵ 100
		143	3/2+	-79.517 (3)	8.75 ± 0.06 m		ϵ 100
		143m	11/2-	-78.763 (3)	66 ± 2 s		IT 99.76; ϵ 0.24
		143m2	23/2(-)	-76.723 (3)	30 ± 3 ms		IT 100
		144	0+	-81.9657 (25)	**stable**	3.07% ± 0.07%	
		145	7/2-	-80.6515 (25)	340 ± 3 d		ϵ 100
		146	0+	-80.996 (3)	10.3E+7 ± 0.5E+7 y		α 100
		147	7/2-	-79.2657 (18)	1.060E11 ± 0.011E11 y	14.99% ± 0.18%	α 100
		148	0+	-79.3358 (18)	7E+15 ± 3E+15 y	11.24% ± 0.1%	α 100
		149	7/2-	-77.135 (18)	**stable**	13.82% ± 0.07%	
		150	0+	-77.0504 (17)	**stable**	7.38% ± 0.01%	
		151	5/2-	-74.5755 (17)	90 ± 8 y		β^- 100
		152	0+	-74.7622 (17)	**stable**	26.75% ± 0.16%	
		153	3/2+	-72.5593 (17)	46.284 ± 0.004 h		β^- 100
		153m	11/2-	-72.4609 (17)	10.6 ± 0.3 ms		IT 100
		154	0+	-72.4549 (19)	**stable**	22.75% ± 0.29%	
		155	3/2-	-70.1905 (19)	22.3 ± 0.2 m		β^- 100
		156	0+	-69.363 (9)	9.4 ± 0.2 h		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		157	(3/2-)	-66.73 (5)	8.03 ± 0.07 m		β^- 100
		158	0+	-65.2 (8)	5.30 ± 0.03 m		β^- 100
		159	5/2-	-62.25 (7)	11.37 ± 0.15 s		β^- 100
		160	0+	-60.42 (20)	9.6 ± 0.3 s		β^- 100
		161	0	-56.75 (14)	4.8 ± 0.4 s		β^- 100
		162	0+	-54.8 (5)	2.4 ± 0.5 s		β^- 100
63	**Eu**	131	3/2+	-38.7 (4)	17.8 ± 1.9 ms		p 89; ϵ 11
		134	0	-49.72 (20)	0.5 ± 0.2 s		ϵ 100; $\epsilon p > 0.00$
		135	0	-54.1 (3)	1.5 ± 0.2 s		ϵ 100; ϵp
		136	(7+)	-56.1 (20)	3.3 ± 0.3 s		ϵ 100; ϵp 0.09; ϵ 100; ϵp 0.09
		137	(11/2-)	-60.02 (20)	11 ± 2 s		ϵ 100
		138	(6-)	-61.75 (3)	12.1 ± 0.6 s		ϵ 100
		139	(11/2)-	-65.398 (13)	17.9 ± 0.6 s		ϵ 100
		140	1+	-66.99 (5)	1.51 ± 0.02 s		ϵ 100; IT 100; $\epsilon < 1.00$
		141	5/2+	-69.926 (13)	40.7 ± 0.7 s		ϵ 100
		141m	11/2-	-69.829 (13)	2.7 ± 0.3 s		IT 87; ϵ 13
		142	1+	-71.31 (3)	2.34 ± 0.12 s		ϵ 100; ϵ 100
		143	5/2+	-74.242 (11)	2.59 ± 0.02 m		ϵ 100
		144	1+	-75.619 (11)	10.2 ± 0.1 s		ϵ 100
		145	5/2+	-77.992 (4)	5.93 ± 0.04 d		ϵ 100
		146	4-	-77.117 (6)	4.61 ± 0.03 d		ϵ 100
		147	5/2+	-77.544 (3)	24.1 ± 0.6 d		ϵ 100; α 0.0022
		148	5-	-76.299 (10)	54.5 ± 0.5 d		ϵ 100; α 9.4e-07
		149	5/2+	-76.44 (4)	93.1 ± 0.4 d		ϵ 100
		150	5-	-74.791 (6)	36.9 ± 0.9 y		ϵ 100
		150m	0-	-74.75 (6)	12.8 ± 0.1 h		ϵ 11; $IT \leq$ 5.0E-8; β^- 89
		151	5/2+	-74.6517 (18)	≥ 1.7E+18 y	47.81% ± 0.03%	α
		152	3-	-72.8871 (18)	13.528 ± 0.014 y		ϵ 72.1; β^- 27.9
		152m	0-	-72.8415 (18)	9.3116 ± 0.0013 h		β^- 72; ϵ 28
		152m2	8-	-72.7392 (18)	96 ± 1 m		IT 100
		153	5/2+	-73.3661 (18)	**stable**	52.19% ± 0.06%	
		154	3-	-71.737 (18)	8.601 ± 0.01 y		ϵ 0.02; β^- 99.98
		154m	8-	-71.5916 (18)	46.3 ± 0.4 m		IT 100
		155	5/2+	-71.8169 (18)	4.753 ± 0.014 y		β^- 100
		156	0+	-70.085 (6)	15.19 ± 0.08 d		β^- 100
		157	5/2+	-69.46 (5)	15.18 ± 0.03 h		β^- 100
		158	(1-)	-67.2 (8)	45.9 ± 0.2 m		β^- 100
		159	5/2+	-66.046 (7)	18.1 ± 0.1 m		β^- 100
		160	1	-63.25 (6)	38 ± 4 s		β^- 100
		161	0	-61.8 (6)	26 ± 3 s		β^- 100
		162	0	-58.69 (6)	10.6 ± 1 s		β^- 100
		163	0	-56.8 (10)	7.7 ± 0.4 s		β^- 100
		164	0	-53.4 (4)	4.2 ± 0.2 s		β^- 100
		165	0	-50.8 (5)	2.3 ± 0.2 s		β^- 100
64	**Gd**	135	(5/2+)	-44 (5)	1.1 ± 0.2 s		ϵ 100; ϵp 18
		137	(7/2)	-51.2 (4)	2.2 ± 0.2 s		ϵ 100; ϵp
		138	0+	-55.66 (20)	4.7 ± 0.9 s		ϵ 100
		139	(9/2-)	-57.63 (20)	5.8 ± 0.9 s		$\epsilon p > 0.00$; $\epsilon > 0.00$; $\epsilon p > 0.00$; $\epsilon > 0.00$
		140	0+	-61.78 (3)	15.8 ± 0.4 s		ϵ 100
		141	1/2+	-63.224 (20)	14 ± 4 s		ϵ 100; ϵp 0.03
		141m	11/2-	-62.846 (20)	24.5 ± 0.5 s		ϵ 89; IT 11
		142	0+	-66.96 (3)	70.2 ± 0.6 s		ϵ 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		143	(1/2)+	-68.23 (20)	39 $\pm$ 2 s		ϵ 100
		143m	(11/2-)	-68.08 (20)	110.0 $\pm$ 1.4 s		ϵ 100
		144	0+	-71.76 (3)	4.47 $\pm$ 0.06 m		ϵ 100
		145	1/2+	-72.927 (19)	23.0 $\pm$ 0.4 m		ϵ 100
		145m	11/2-	-72.178 (19)	85 $\pm$ 3 s		IT 94.3; ϵ 5.7
		146	0+	-76.087 (4)	48.27 $\pm$ 0.1 d		ϵ 100
		147	7/2-	-75.357 (3)	38.06 $\pm$ 0.12 h		ϵ 100
		148	0+	-76.2696 (25)	70.9 $\pm$ 1 y		α 100
		149	7/2-	-75.127 (4)	9.28 $\pm$ 0.1 d		α 0.00043; ϵ 100
		150	0+	-75.763 (6)	1.79E+6 $\pm$ 0.08E+6 y		α 100
		151	7/2-	-74.188 (3)	123.9 $\pm$ 1 d		ϵ 100; $\alpha \approx$ 8.0E-7
		152	0+	-74.7065 (17)	1.08E14 $\pm$ 0.08E14 y	0.2% $\pm$ 0.01%	α 100
		153	3/2-	-72.8821 (17)	240.4 $\pm$ 1 d		ϵ 100
		154	0+	-73.7055 (17)	**stable**	2.18% $\pm$ 0.03%	
		155	3/2-	-72.0694 (17)	**stable**	14.8% $\pm$ 0.12%	
		155m	11/2-	-71.9484 (17)	31.97 $\pm$ 0.27 ms		IT 100
		156	0+	-72.5345 (17)	**stable**	20.47% $\pm$ 0.09%	
		157	3/2-	-70.823 (17)	**stable**	15.65% $\pm$ 0.02%	
		158	0+	-70.6891 (17)	**stable**	24.84% $\pm$ 0.07%	
		159	3/2-	-68.5609 (17)	18.479 $\pm$ 0.004 h		β^- 100
		160	0+	-67.9409 (18)	> 3.1E+19 y	21.86% $\pm$ 0.19%	$2\beta^-$
		161	5/2-	-65.505 (20)	3.66 $\pm$ 0.05 m		β^- 100
		162	0+	-64.28 (4)	8.4 $\pm$ 0.2 m		β^- 100
		163	(5/2-,7/2+)	-61.47 (7)	68 $\pm$ 3 s		β^- 100
		164	0+	-59.9 (4)	45 $\pm$ 3 s		β^- 100
		165	0	-56.6 (5)	10.3 $\pm$ 1.6 s		β^- 100
		166	0+	-54.5 (6)	4.8 $\pm$ 1 s		β^- 100
65	**Tb**	139	0	-48 (3)	1.6 $\pm$ 0.2 s		ϵ ; ϵp ?
		140	(7+)	-50.5 (8)	2.0 $\pm$ 0.5 s		ϵp 0.26; ϵ 100
		141	(5/2-)	-54.54 (11)	3.5 $\pm$ 0.2 s		ϵ 100; ϵ 100
		142	1+	-56.6 (7)	597 $\pm$ 17 ms		ϵ 100; ϵp 0.0022
		142m	5-	-56.3 (7)	303 $\pm$ 17 ms		IT 100
		143	(11/2-)	-60.42 (5)	12 $\pm$ 1 s		ϵ 100; ϵ
		144	1+	-62.37 (3)	$\approx$ 1 s		ϵ 100
		144m	(6-)	-61.97 (3)	4.25 $\pm$ 0.15 s		IT 66; ϵ 34
		146	1+	-67.76 (4)	8 $\pm$ 4 s		ϵ 100; ϵ 100
		146m	(10+)	-66.98 (4)	1.18 $\pm$ 0.02 ms		IT 100
		147	(1/2+)	-70.743 (8)	1.64 $\pm$ 0.03 h		ϵ 100
		147m	(11/2-)	-70.692 (8)	1.83 $\pm$ 0.06 m		ϵ 100
		148	2-	-70.54 (13)	60 $\pm$ 1 m		ϵ 100
		148m	(9)+	-70.45 (13)	2.20 $\pm$ 0.05 m		ϵ 100
		149	1/2+	-71.489 (4)	4.118 $\pm$ 0.025 h		α 16.7; ϵ 83.3
		149m	11/2-	-71.453 (4)	4.16 $\pm$ 0.04 m		ϵ 99.98; α 0.02
		150	(2-)	-71.105 (7)	3.48 $\pm$ 0.16 h		ϵ 100; α < 0.05
		150m	9+	-70.631 (7)	5.8 $\pm$ 0.2 m		ϵ
		151	1/2(+)	-71.623 (4)	17.609 $\pm$ 0.014 h		ϵ 99.99; α 0.0095
		151m	(11/2-)	-71.523 (4)	25 $\pm$ 3 s		IT 93.4; ϵ 6.6
		152	2-	-70.72 (4)	17.5 $\pm$ 0.1 h		α < 7.0E-7; ϵ 100
		152m	8+	-70.21 (4)	4.2 $\pm$ 0.1 m		IT 78.8; ϵ 21.2
		153	5/2+	-71.313 (4)	2.34 $\pm$ 0.01 d		ϵ 100
		154	0	-70.15 (5)	21.5 $\pm$ 0.4 h		ϵ 100; β^- < 0.10; ϵ 98.2; IT 1.8; ϵ 78.2; IT 21.8; β^- < 0.10

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		155	3/2+	-71.247 (12)	5.32 ± 0.06 d		ϵ 100
		156	3-	-70.09 (4)	5.35 ± 0.1 d		ϵ 100
		156m	(7-)	-70.04 (4)	24.4 ± 1 h		IT 100
		156m2	(0+)	-70.002 (4)	5.3 ± 0.2 h		$IT < 100.00$; $\epsilon > 0.00$
		157	3/2+	-70.7629 (17)	71 ± 7 y		ϵ 100
		158	3-	-69.4697 (19)	180 ± 11 y		ϵ 83.4; β^- 16.6
		158m	0-	-69.3594 (19)	10.70 ± 0.17 s		ϵ < 0.01; IT 100; β^- < 0.60
		159	3/2+	-69.5315 (18)	**stable**	100%	
		160	3-	-67.8354 (18)	72.3 ± 0.2 d		β^- 100
		161	3/2+	-67.4607 (19)	6.89 ± 0.02 d		β^- 100
		162	1-	-65.67 (4)	7.60 ± 0.15 m		β^- 100
		163	3/2+	-64.594 (4)	19.5 ± 0.3 m		β^- 100
		164	(5+)	-62.08 (10)	3.0 ± 0.1 m		β^- 100
		165	(3/2+)	-60.66 (20)	2.11 ± 0.1 m		β^- 100
		166	(2-)	-57.88 (7)	25.1 ± 2.1 s		β^- 100
		167	(3/2+)	-55.9 (4)	19.4 ± 2.7 s		β^- 100
		168	(4-)	-52.6 (5)	8.2 ± 1.3 s		β^- 100
66	**Dy**	139	(7/2+)	-37.6 (5)	0.6 ± 0.2 s		ϵ ; ϵp
		141	(9/2-)	-45.2 (3)	0.9 ± 0.2 s		ϵ 100; ϵp
		142	0+	-49.9 (7)	2.3 ± 0.3 s		ϵp 0.06; ϵ 100
		143	(1/2+)	-52.169 (13)	5.6 ± 1 s		ϵ 100; ϵp
		143m	(11/2-)	-51.858 (13)	3.0 ± 0.3 s		ϵ 100; ϵp
		144	0+	-56.57 (7)	9.1 ± 0.4 s		ϵ 100; ϵp
		145	(1/2+)	-58.243 (7)	6 ± 2 s		ϵ 100; $\epsilon p \approx 50.00$
		145m	(11/2-)	-58.124 (7)	14.1 ± 0.7 s		$\epsilon p \approx 50.00$; ϵ 100
		146	0+	-62.555 (7)	29 ± 3 s		ϵ 100
		146m	(10+)	-59.619 (7)	150 ± 20 ms		IT 100
		147	(1/2+)	-64.195 (8)	67 ± 7 s		ϵ 100; ϵp 0.05
		147m	(11/2-)	-63.444 (8)	55.2 ± 0.5 s		ϵ 68.9; IT 31.1
		148	0+	-67.86 (9)	3.3 ± 0.2 m		ϵ 100
		149	(7/2-)	-67.703 (9)	4.20 ± 0.14 m		ϵ 100
		149m	(27/2-)	-65.042 (9)	0.490 ± 0.015 s		IT 99.3; ϵ 0.7
		150	0+	-69.311 (5)	7.17 ± 0.05 m		ϵ 64; α 36
		151	7/2(-)	-68.752 (4)	17.9 ± 0.3 m		ϵ 94.4; α 5.6
		152	0+	-70.118 (5)	2.38 ± 0.02 h		ϵ 99.9; α 0.1
		153	7/2(-)	-69.143 (4)	6.4 ± 0.1 h		ϵ 99.99; α 0.0094
		154	0+	-70.393 (8)	3.0E+6 ± 1.5E+6 y		α 100
		155	3/2-	-69.152 (12)	9.9 ± 0.2 h		ϵ 100
		156	0+	-70.522 (6)	**stable**	0.056% ± 0.003%	
		157	3/2-	-69.42 (6)	8.14 ± 0.04 h		ϵ 100
		157m	11/2-	-69.221 (6)	21.6 ± 1.6 ms		IT 100
		158	0+	-70.405 (3)	**stable**	0.095% ± 0.003%	
		159	3/2-	-69.1661 (21)	144.4 ± 0.2 d		ϵ 100
		160	0+	-69.6711 (19)	**stable**	2.329% ± 0.018%	
		161	5/2+	-68.0541 (19)	**stable**	18.889% ± 0.042%	
		162	0+	-68.1798 (19)	**stable**	25.475% ± 0.036%	
		163	5/2-	-66.3795 (19)	**stable**	24.896% ± 0.042%	
		164	0+	-65.9663 (19)	**stable**	28.26% ± 0.054%	
		165	7/2+	-63.6109 (19)	2.334 ± 0.001 h		β^- 100
		165m	1/2-	-63.5027 (19)	1.257 ± 0.006 m		IT 97.76; β^- 2.24
		166	0+	-62.5831 (20)	81.6 ± 0.1 h		β^- 100
		167	(1/2-)	-59.93 (6)	6.20 ± 0.08 m		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		168	0+	-58.56 (14)	8.7 $\pm$ 0.3 m		β^- 100
		169	(5/2)-	-55.6 (3)	39 $\pm$ 8 s		β^- 100
67	**Ho**	140	(6-,0-,8+)	-29.2 (5)	6 $\pm$ 3 ms		p 100
		141	7/2-	-34.3 (5)	4.1 $\pm$ 0.3 ms		p 100
		142	(7-,8+)	-37.2 (5)	0.4 $\pm$ 0.1 s		ϵ 100; $\epsilon p > 0.00$
		144	(5-)	-44.609 (8)	0.7 $\pm$ 0.1 s		ϵ 100; ϵp
		145	(11/2-)	-49.12 (7)	2.4 $\pm$ 0.1 s		ϵ 100
		146	(10+)	-51.238 (7)	3.6 $\pm$ 0.3 s		ϵ 100
		147	(11/2-)	-55.757 (5)	5.8 $\pm$ 0.4 s		ϵ 100
		148	(1+)	-57.99 (8)	2.2 $\pm$ 1.1 s		ϵ 100; ϵ 100; ϵp 0.08
		148m	(10+)	-57.3 (8)	2.35 $\pm$ 0.04 ms		IT 100
		149	(11/2-)	-61.664 (14)	21.1 $\pm$ 0.2 s		ϵ 100
		149m	(1/2+)	-61.616 (14)	56 $\pm$ 3 s		ϵ 100
		150	2-	-61.946 (14)	72 $\pm$ 4 s		ϵ 100
		150m	(9)+	-61.446 (14)	24.1 $\pm$ 0.5 s		ϵ 100;
		151	(11/2-)	-63.623 (8)	35.2 $\pm$ 0.1 s		ϵ 78; α 22
		151m	(1/2+)	-63.582 (8)	47.2 $\pm$ 1.3 s		α 80; ϵ 20
		152	2-	-63.608 (13)	161.8 $\pm$ 0.3 s		ϵ 88; α 12
		152m	9+	-63.448 (13)	50.0 $\pm$ 0.4 s		ϵ 89.2; α 10.8
		153	11/2-	-65.013 (5)	2.01 $\pm$ 0.03 m		ϵ 99.95; α 0.05
		153m	1/2+	-64.944 (5)	9.3 $\pm$ 0.5 m		ϵ 99.82; α 0.18
		154	2-	-64.639 (8)	11.76 $\pm$ 0.19 m		α 0.02; ϵ 99.98; ϵ 100; $\alpha <$ 1.0E-3
		155	5/2+	-66.04 (18)	48 $\pm$ 1 m		ϵ 100
		156	4-	-65.47 (6)	56 $\pm$ 1 m		ϵ 100
		156m	1-	-65.42 (6)	9.5 $\pm$ 1.5 s		IT 100; ϵ 75; IT 25
		157	7/2-	-66.832 (23)	12.6 $\pm$ 0.2 m		ϵ 100
		158	5+	-66.18 (3)	11.3 $\pm$ 0.4 m		ϵ 100
		158m	2-	-66.12 (3)	28 $\pm$ 2 m		$IT > 81.00$; $\epsilon < 19.00$
		158m2	(9+)	-66 (3)	21.3 $\pm$ 2.3 m		$\epsilon \geq 93.00$; $IT \leq 7.00$
		159	7/2-	-67.328 (3)	33.05 $\pm$ 0.11 m		ϵ 100
		159m	1/2+	-67.123 (3)	8.30 $\pm$ 0.08 s		IT 100
		160	5+	-66.381 (15)	25.6 $\pm$ 0.3 m		ϵ 100
		160m	2-	-66.321 (15)	5.02 $\pm$ 0.05 h		IT 73; ϵ 27
		160m2	(9+)	-66.211 (15)	3 $\pm$ 0 s		IT 100
		161	7/2-	-67.196 (3)	2.48 $\pm$ 0.05 h		ϵ 100
		161m	1/2+	-66.985 (3)	6.76 $\pm$ 0.07 s		IT 100
		162	1+	-66.04 (4)	15.0 $\pm$ 1 m		ϵ 100
		162m	6-	-65.934 (4)	67.0 $\pm$ 0.7 m		IT 62; ϵ 38
		163	7/2-	-66.3769 (19)	4570 $\pm$ 25 y		ϵ 100
		163m	1/2+	-66.079 (19)	1.09 $\pm$ 0.03 s		IT 100
		164	1+	-64.9801 (23)	29 $\pm$ 1 m		ϵ 60; β^- 40
		164m	6-	-64.8403 (23)	37.5 +1.5-0.5 m		IT 100
		165	7/2-	-64.8977 (20)	**stable**	100%	
		166	0-	-63.07 (20)	26.824 $\pm$ 0.012 h		β^- 100
		166m	7-	-63.064 (20)	1.20E3 $\pm$ 0.18E3 y		β^- 100
		167	7/2-	-62.28 (6)	3.003 $\pm$ 0.018 h		β^- 100
		168	3+	-60.06 (3)	2.99 $\pm$ 0.07 m		β^- 100
		168m	(6+)	()	132 $\pm$ 4 s		$IT \geq 99.50$; $\beta^- \leq 0.50$
		169	7/2-	-58.796 (20)	4.72 $\pm$ 0.1 m		β^- 100
		170	(6+)	-56.24 (5)	2.76 $\pm$ 0.05 m		β^- 100
		170m	(1+)	-56.12 (5)	43 $\pm$ 2 s		β^- 100
		171	(7/2-)	-54.5 (6)	53 $\pm$ 2 s		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		172	0	-51.48 (20)	25 ± 3 s		β^- 100
68	**Er**	145m	(11/2-)	-39.2 (4)	1.0 ± 0.3 s		ϵ 100; ϵp
		146	0+	-44.322 (7)	1.7 ± 0.6 s		ϵp 100; ϵ 100
		147	(1/2+)	-46.61 (4)	2.5 ± 0.2 s		ϵ 100; $\epsilon p > 0.00$; ϵ 100; $\epsilon p > 0.00$
		148	0+	-51.479 (10)	4.6 ± 0.2 s		ϵ 100
		149	(1/2+)	-53.74 (3)	4 ± 2 s		ϵ 100; ϵp 7
		149m	(11/2-)	-53 (3)	8.9 ± 0.2 s		ϵ 96.5; IT 3.5; ϵp 0.18
		150	0+	-57.831 (17)	18.5 ± 0.7 s		ϵ 100
		151	(7/2-)	-58.266 (16)	23.5 ± 2 s		ϵ 100
		151m	(27/2-)	-55.68 (16)	0.58 ± 0.02 s		IT 95.3; ϵ 4.7
		152	0+	-60.5 (9)	10.3 ± 0.1 s		α 90; ϵ 10
		153	(7/2-)	-60.476 (9)	37.1 ± 0.2 s		α 53; ϵ 47
		154	0+	-62.606 (5)	3.73 ± 0.09 m		ϵ 99.53; α 0.47
		155	7/2-	-62.209 (6)	5.3 ± 0.3 m		α 0.02; ϵ 99.98
		156	0+	-64.213 (24)	19.5 ± 1 m		ϵ 100; α 1.7e-05
		157	3/2-	-63.41 (3)	18.65 ± 0.1 m		ϵ 100
		157m	(9/2+)	-63.26 (3)	76 ± 6 ms		IT 100
		158	0+	-65.3 (3)	2.29 ± 0.06 h		ϵ 100
		159	3/2-	-64.56 (4)	36 ± 1 m		ϵ 100
		160	0+	-66.058 (25)	28.58 ± 0.09 h		ϵ 100
		161	3/2-	-65.199 (9)	3.21 ± 0.03 h		ϵ 100
		162	0+	-66.3329 (19)	**stable**	0.139% ± 0.005%	
		163	5/2-	-65.166 (5)	75.0 ± 0.4 m		ϵ 100
		164	0+	-65.941 (3)	**stable**	1.601% ± 0.003%	
		165	5/2-	-64.52 (3)	10.36 ± 0.04 h		ϵ 100
		166	0+	-64.9245 (21)	**stable**	33.503% ± 0.036%	
		167	7/2+	-63.2897 (21)	**stable**	22.869% ± 0.009%	
		167m	1/2-	-63.0819 (21)	2.269 ± 0.006 s		IT 100
		168	0+	-62.9897 (21)	**stable**	26.978% ± 0.018%	
		169	1/2-	-60.9216 (21)	9.392 ± 0.018 d		β^- 100
		170	0+	-60.108 (24)	**stable**	14.91% ± 0.036%	
		171	5/2-	-57.7183 (24)	7.516 ± 0.002 h		β^- 100
		172	0+	-56.483 (4)	49.3 ± 0.3 h		β^- 100
		173	(7/2-)	-53.65 (20)	1.4 ± 0.1 m		β^- 100
		174	0+	-51.9 (3)	3.2 ± 0.2 m		β^- 100
		175	(9/2+)	-48.7 (4)	1.2 ± 0.3 m		β^- 100
69	**Tm**	146	(5-)	-31.2 (4)	80 ± 10 ms		p ; ϵ
		146m	(8+)	-31.1 (4)	200 ± 10 ms		p ; ϵ
		147	11/2-	-35.974 (7)	0.58 ± 0.03 s		ϵ 85; p 15
		148	(10+)	-38.765 (10)	0.7 ± 0.2 s		ϵ 100
		149	(11/2-)	-43.9 (3)	0.9 ± 0.2 s		ϵ 100; ϵp 0.2
		150	(6-)	-46.49 (20)	2.20 ± 0.06 s		ϵ 100
		150m	(10+)	-45.82 (20)	5.2 ± 0.3 ms		IT 100
		151	(11/2-)	-50.778 (20)	4.17 ± 0.11 s		ϵ 100; ϵ 100
		152	(2)-	-51.77 (7)	8.0 ± 1 s		ϵ 100; ϵ 100
		153	(11/2-)	-53.991 (14)	1.48 ± 0.01 s		α 91; ϵ 9
		153m	(1/2+)	-53.948 (14)	2.5 ± 0.2 s		α 92; ϵ 8
		154	(2-)	-54.427 (14)	8.1 ± 0.3 s		α 54; ϵ 46; α 58; ϵ 42; IT
		155	11/2-	-56.626 (10)	21.6 ± 0.2 s		ϵ 99.11; α 0.89
		155m	1/2+	-56.585 (10)	45 ± 3 s		$\epsilon > 98.00$; $\alpha < 2.00$
		156	2-	-56.84 (15)	83.8 ± 1.8 s		ϵ 99.94; α 0.06
		157	1/2+	-58.71 (3)	3.63 ± 0.09 m		ϵ 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		158	2-	-58.7 (3)	3.98 ± 0.06 m		ϵ 100; ϵ ?
		159	5/2+	-60.57 (3)	9.13 ± 0.16 m		ϵ 100
		160	1-	-60.3 (3)	9.4 ± 0.3 m		ϵ 100
		160m	5	-60.23 (3)	74.5 ± 1.5 s		IT 85; ϵ 15
		161	7/2+	-61.9 (3)	30.2 ± 0.8 m		ϵ 100
		162	1-	-61.47 (3)	21.70 ± 0.19 m		ϵ 100; IT 81; ϵ 19
		163	1/2+	-62.727 (6)	1.810 ± 0.005 h		ϵ 100
		164	1+	-61.904 (24)	2.0 ± 0.1 m		ϵ 100; $IT \approx$ 80.00; $\epsilon \approx$ 20.00
		165	1/2+	-62.929 (3)	30.06 ± 0.03 h		ϵ 100
		166	2+	-61.887 (12)	7.70 ± 0.03 h		ϵ 100
		166m	(6-)	-61.778 (12)	340 ± 25 ms		IT 100
		167	1/2+	-62.5429 (23)	9.25 ± 0.02 d		ϵ 100
		168	3+	-61.312 (3)	93.1 ± 0.2 d		ϵ 99.99; β^- 0.01
		169	1/2+	-61.2745 (21)	**stable**	100%	
		170	1-	-59.7952 (21)	128.6 ± 0.3 d		β^- 99.87; ϵ 0.13
		171	1/2+	-59.2103 (23)	1.92 ± 0.01 y		β^- 100
		172	2-	-57.374 (6)	63.6 ± 0.2 h		β^- 100
		173	(1/2+)	-56.253 (5)	8.24 ± 0.08 h		β^- 100
		174	(4)-	-53.86 (4)	5.4 ± 0.1 m		β^- 100
		174m	0+	-53.61 (4)	2.29 ± 0.01 s		IT 99; $\beta^- <$ 1.00
		175	(1/2+)	-52.31 (5)	15.2 ± 0.5 m		β^- 100
		176	(4+)	-49.37 (10)	1.9 ± 0.1 m		β^- 100
		177	(7/2-)	-47.5 (3)	90 ± 6 s		β^- 100
70	**Yb**	149	(1/2+,3/2+)	-33.2 (5)	0.7 ± 0.2 s		ϵp 100; ϵ 100
		151	(1/2+)	-41.5 (3)	1.6 ± 0.1 s		ϵ 100; $\epsilon p >$ 0.00; ϵ 100; $IT \approx$ 0.40; ϵp
		152	0+	-46.31 (21)	3.03 ± 0.06 s		ϵ 100; ϵp
		153	7/2-	-47.06 (20)	4.2 ± 0.2 s		ϵ 40; α 60
		154	0+	-49.932 (17)	0.409 ± 0.002 s		α 92.6; ϵ 7.4
		155	(7/2-)	-50.503 (17)	1.793 ± 0.019 s		α 89; ϵ 11
		156	0+	-53.265 (9)	26.1 ± 0.7 s		ϵ 90; α 10
		157	7/2-	-53.43 (10)	38.6 ± 1 s		ϵ 99.5; α 0.5
		158	0+	-56.009 (8)	1.49 ± 0.13 m		$\alpha \approx$ 2.1E-3; ϵ 100
		159	5/2(-)	-55.836 (18)	1.67 ± 0.09 m		ϵ 100
		160	0+	-58.163 (16)	4.8 ± 0.2 m		ϵ 100
		161	3/2-	-57.838 (15)	4.2 ± 0.2 m		ϵ 100
		162	0+	-59.825 (15)	18.87 ± 0.19 m		ϵ 100
		163	3/2-	-59.298 (15)	11.05 ± 0.35 m		ϵ 100
		164	0+	-61.016 (15)	75.8 ± 1.7 m		ϵ 100
		165	5/2-	-60.29 (3)	9.9 ± 0.3 m		ϵ 100
		166	0+	-61.594 (7)	56.7 ± 0.1 h		ϵ 100
		167	5/2-	-60.589 (5)	17.5 ± 0.2 m		ϵ 100
		168	0+	-61.5804 (21)	**stable**	0.123% ± 0.003%	
		169	7/2+	-60.3761 (21)	32.018 ± 0.005 d		ϵ 100
		169m	1/2-	-60.3519 (21)	46 ± 2 s		IT 100
		170	0+	-60.7636 (21)	**stable**	2.982% ± 0.039%	
		171	1/2-	-59.3068 (21)	**stable**	14.09% ± 0.14%	
		171m	7/2+	-59.2115 (21)	5.25 ± 0.24 ms		IT 100
		172	0+	-59.255 (21)	**stable**	21.68% ± 0.13%	
		173	5/2-	-57.551 (21)	**stable**	16.103% ± 0.063%	
		174	0+	-56.9443 (21)	**stable**	32.026% ± 0.08%	
		175	(7/2-)	-54.6954 (21)	4.185 ± 0.001 d		β^- 100
		175m	1/2-	-54.1805 (21)	68.2 ± 0.3 ms		IT 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J$^{\pi}$	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		176	0+	-53.4885 (23)	**stable**	12.996% $\pm$ 0.083%	
		176m	8-	-52.4387 (23)	11.4 $\pm$ 0.3 s		IT 100
		177	(9/2+)	-50.9836 (23)	1.911 $\pm$ 0.003 h		β^- 100
		177m	(1/2-)	-50.6521 (23)	6.41 $\pm$ 0.02 s		IT 100
		178	0+	-49.693 (10)	74 $\pm$ 3 m		β^- 100
		179	(1/2-)	-46.4 (3)	8.0 $\pm$ 0.4 m		β^- 100
		180	0+	-44.4 (4)	2.4 $\pm$ 0.5 m		β^- 100
71	**Lu**	150	(2+)	-24.6 (5)	45 $\pm$ 3 ms		p 70.9; ϵ 29.1
		151	11/2-	-30.1 (4)	80.6 $\pm$ 2 ms		p 63.4; ϵ 36.6
		152	(4-,5-,6-)	-33.42 (20)	0.7 $\pm$ 0.1 s		ϵ 100; ϵp 15
		153	11/2-	-38.41 (21)	0.9 $\pm$ 0.2 s		$\alpha \approx$ 70.00; $\epsilon \approx$ 30.00
		155	11/2-	-42.55 (20)	68 $\pm$ 1 ms		α 90; ϵ 10
		155m	1/2+	-42.53 (20)	138 $\pm$ 8 ms		α 76; ϵ 24
		155m2	(25/2-)	-40.769 (20)	2.69 $\pm$ 0.03 ms		α 100
		156	(2)-	-43.75 (7)	494 $\pm$ 12 ms		$\alpha \approx$ 95.00; $\epsilon \approx$ 5.00; α 100
		157	(1/2+,3/2+)	-46.459 (15)	6.8 $\pm$ 1.8 s		$\alpha >$ 0.00
		157m	(11/2-)	-46.433 (15)	4.79 $\pm$ 0.12 s		ϵ 94; α 6
		158	0	-47.213 (15)	10.6 $\pm$ 0.3 s		ϵ 99.09; α 0.91
		159	0	-49.71 (4)	12.1 $\pm$ 1 s		ϵ 100; α 0.1
		160	0	-50.27 (6)	36.1 $\pm$ 0.3 s		ϵ 100; $\alpha \leq$ 1.0E-4; $\epsilon \leq$ 100.00; α
		161	1/2+	-52.56 (3)	77 $\pm$ 2 s		ϵ 100
		161m	(9/2-)	-52.4 (3)	7.3 $\pm$ 0.4 ms		IT
		162	1-	-52.84 (8)	1.37 $\pm$ 0.02 m		$\epsilon \leq$ 100.00; $\epsilon \leq$ 100.00; $\epsilon \leq$ 100.00
		163	1/2(+)	-54.79 (3)	3.97 $\pm$ 0.13 m		ϵ 100
		164	1(-)	-54.64 (3)	3.14 $\pm$ 0.03 m		ϵ 100
		165	1/2+	-56.44 (3)	10.74 $\pm$ 0.1 m		ϵ 100
		166	6-	-56.02 (3)	2.65 $\pm$ 0.1 m		ϵ 100
		166m	3(-)	-55.99 (3)	1.41 $\pm$ 0.1 m		ϵ 58; IT 42
		166m2	0-	-55.98 (3)	2.12 $\pm$ 0.1 m		$\epsilon >$ 80.00; $IT <$ 20.00
		167	7/2+	-57.5 (3)	51.5 $\pm$ 1 m		ϵ 100; ϵ ; IT
		168	6(-)	-57.07 (5)	5.5 $\pm$ 0.1 m		ϵ 100
		168m	3+	-56.87 (5)	6.7 $\pm$ 0.4 m		$IT <$ 0.80; $\epsilon >$ 99.60
		169	7/2+	-58.083 (4)	34.06 $\pm$ 0.05 h		ϵ 100
		169m	1/2-	-58.054 (4)	160 $\pm$ 10 s		IT 100
		170	0+	-57.305 (17)	2.012 $\pm$ 0.02 d		ϵ 100
		170m	(4)-	-57.212 (17)	0.67 $\pm$ 0.1 s		IT 100
		171	7/2+	-57.829 (3)	8.24 $\pm$ 0.03 d		ϵ 100
		171m	1/2-	-57.757 (3)	79 $\pm$ 2 s		IT 100
		172	4-	-56.737 (3)	6.70 $\pm$ 0.03 d		ϵ 100
		172m	1-	-56.695 (3)	3.7 $\pm$ 0.5 m		IT 100
		173	7/2+	-56.8811 (22)	1.37 $\pm$ 0.01 y		ϵ 100
		174	(1)-	-55.5707 (22)	3.31 $\pm$ 0.05 y		ϵ 100
		174m	(6)-	-55.3999 (22)	142 $\pm$ 2 d		IT 99.38; ϵ 0.62
		175	7/2+	-55.1661 (19)	**stable**	97.401% $\pm$ 0.013%	
		176	7-	-53.3828 (19)	3.76E+10 $\pm$ 0.07E+10 y	2.599% $\pm$ 0.013%	β^- 100
		176m	1-	-53.26 (19)	3.664 $\pm$ 0.019 h		β^- 99.9; ϵ 0.09
		177	7/2+	-52.3843 (20)	6.647 $\pm$ 0.004 d		β^- 100
		177m	23/2-	-51.4141 (20)	160.44 $\pm$ 0.06 d		β^- 78.6; IT 21.4
		177m2	(39/2-)	-49.6443 (20)	6 +3-2 m		IT ?; β^- 100
		178	1(+)	-50.338 (3)	28.4 $\pm$ 0.2 m		β^- 100
		178m	(9-)	-50.214 (3)	23.1 $\pm$ 0.3 m		β^- 100
		179	7/2+	-49.059 (5)	4.59 $\pm$ 0.06 h		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		179m	1/2+	-48.467 (5)	3.1 ± 0.9 ms		IT 100
		180	5+	-46.68 (7)	5.7 ± 0.1 m		β^- 100
		181	(7/2+)	-44.7 (3)	3.5 ± 0.3 m		β^- 100
		182	0	-41.88 (20)	2.0 ± 0.2 m		β^- 100
		183	(7/2+)	-39.5 (3)	58 ± 4 s		β^- 100
		184	(3+)	-36.4 (4)	19 ± 2 s		β^- 100
72	**Hf**	154	0+	-32.7 (5)	2 ± 1 s		ϵ 100; α ?
		155	0	-34.1 (4)	0.84 ± 0.03 s		ϵ 100
		156	0+	-37.85 (21)	23 ± 1 ms		α 100
		157	7/2-	-38.75 (20)	110 ± 6 ms		α 86; ϵ 14
		158	0+	-42.103 (17)	2.85 ± 0.07 s		ϵ 55.7; α 44.3
		159	7/2-	-42.853 (17)	5.6 ± 0.4 s		α 35; ϵ 65
		160	0+	-45.938 (9)	13.6 ± 0.2 s		ϵ 99.3; α 0.7
		161	0	-46.316 (23)	18.2 ± 0.5 s		$\epsilon > 99.87$; $\alpha < 0.13$
		162	0+	-49.167 (9)	39.4 ± 0.9 s		ϵ 99.99; α 0.008
		163	0	-49.29 (3)	40.0 ± 0.6 s		ϵ 100; $\alpha <$ 1.0E-4
		164	0+	-51.829 (19)	111 ± 8 s		ϵ 100
		165	(5/2-)	-51.64 (3)	76 ± 4 s		ϵ 100
		166	0+	-53.86 (3)	6.77 ± 0.3 m		ϵ 100
		167	(5/2)-	-53.47 (3)	2.05 ± 0.05 m		ϵ 100
		168	0+	-55.36 (3)	25.95 ± 0.2 m		ϵ 100
		169	5/2-	-54.72 (3)	3.24 ± 0.04 m		ϵ 100
		170	0+	-56.25 (3)	16.01 ± 0.13 h		ϵ 100
		171	7/2+	-55.43 (3)	12.1 ± 0.4 h		ϵ 100
		171m	1/2-	-55.41 (3)	29.5 ± 0.9 s		$IT \leq$ 100.00; ϵ
		172	0+	-56.403 (24)	1.87 ± 0.03 y		ϵ 100
		173	1/2-	-55.41 (3)	23.6 ± 0.1 h		ϵ 100
		174	0+	-55.845 (3)	2.0E+15 ± 0.4E+15 y	0.16% ± 0.01%	α 100
		175	5/2(-)	-54.483 (3)	70 ± 2 d		ϵ 100
		176	0+	-54.5769 (21)	**stable**	5.26% ± 0.07%	
		177	7/2-	-52.885 (21)	**stable**	18.6% ± 0.09%	
		177m	23/2+	-51.5695 (21)	1.09 ± 0.05 s		IT 100
		177m2	37/2-	-50.145 (21)	51.4 ± 0.5 m		IT 100
		178	0+	-52.4396 (21)	**stable**	27.28% ± 0.07%	
		178m	8-	-51.2922 (21)	4.0 ± 0.2 s		IT 100
		178m2	16+	-49.9935 (21)	31 ± 1 y		IT 100
		179	9/2+	-50.4673 (21)	**stable**	13.62% ± 0.02%	
		179m	1/2-	-50.0923 (21)	18.67 ± 0.04 s		IT 100
		179m2	25/2-	-49.3616 (21)	25.05 ± 0.25 d		IT 100
		180	0+	-49.7838 (21)	**stable**	35.08% ± 0.16%	
		180m	8-	-48.6423 (21)	5.47 ± 0.04 h		IT 99.7; β^- 0.3
		181	1/2-	-47.4072 (21)	42.39 ± 0.06 d		β^- 100
		181m	(25/2-)	-45.6653 (21)	1.5 ± 0.5 ms		IT 100
		182	0+	-46.054 (6)	8.90E+6 ± 0.09E+6 y		β^- 100
		182m	(8-)	-44.881 (6)	61.5 ± 1.5 m		β^- 54; IT 46
		183	(3/2-)	-43.29 (3)	1.018 ± 0.002 h		β^- 100
		184	0+	-41.5 (4)	4.12 ± 0.05 h		β^- 100
		184m	(8-)	-40.23 (4)	48 ± 10 s		IT 100
		185	0	-38.36 (20)	3.5 ± 0.6 m		β^- 100
		186	0+	-36.4 (3)	2.6 ± 1.2 m		β^- 100
73	**Ta**	155	11/2-	-24 (5)	2.9 +1.5-1.1 ms		p 100
		156	(2-)	-25.8 (4)	144 ± 24 ms		p 100; ϵ
		156m	9+	-25.7 (4)	0.36 ± 0.04 s		ϵ 95.8; p 4.2

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		157	1/2+	-29.63 (21)	10.1 $\pm$ 0.4 ms		α 96.6; p 3.4
		157m	11/2-	-29.61 (21)	4.3 $\pm$ 0.1 ms		α 100
		157m2	(25/2-)	-28.04 (21)	1.7 $\pm$ 0.1 ms		α 100
		158	(2-)	-31.02 (20)	55 $\pm$ 15 ms		$\alpha \approx$ 91.00; $\epsilon \approx$ 9.00
		158m	(9+)	-30.88 (20)	36.7 $\pm$ 1.5 ms		α 95; ϵ 5
		159	1/2+	-34.445 (20)	0.83 $\pm$ 0.18 s		ϵ 66; α 34
		159m	11/2-	-34.381 (20)	0.56 $\pm$ 0.06 s		α 55; ϵ 45
		160	0	-35.87 (7)	1.55 $\pm$ 0.04 s		ϵ 66; α 34;
		162	0	-39.78 (5)	3.57 $\pm$ 0.12 s		ϵ 99.93; α 0.07
		163	0	-42.54 (4)	10.6 $\pm$ 1.8 s		$\epsilon \approx$ 99.80; $\alpha \approx$ 0.20
		164	(3+)	-43.28 (3)	14.2 $\pm$ 0.3 s		ϵ 100
		165	0	-45.854 (16)	31.0 $\pm$ 1.5 s		ϵ 100
		166	(2)+	-46.1 (3)	34.4 $\pm$ 0.5 s		ϵ 100
		167	(3/2+)	-48.35 (3)	80 $\pm$ 4 s		ϵ 100
		168	(2-,3+)	-48.39 (3)	2.0 $\pm$ 0.1 m		ϵ 100
		169	(5/2+)	-50.29 (3)	4.9 $\pm$ 0.4 m		ϵ 100
		170	(3+)	-50.14 (3)	6.76 $\pm$ 0.06 m		ϵ 100
		171	(5/2-)	-51.72 (3)	23.3 $\pm$ 0.3 m		ϵ 100
		172	(3+)	-51.33 (3)	36.8 $\pm$ 0.3 m		ϵ 100
		173	5/2-	-52.4 (3)	3.14 $\pm$ 0.13 h		ϵ 100
		174	3+	-51.74 (3)	1.14 $\pm$ 0.08 h		ϵ 100
		175	7/2+	-52.41 (3)	10.5 $\pm$ 0.2 h		ϵ 100
		176	(1)-	-51.37 (3)	8.09 $\pm$ 0.05 h		ϵ 100
		177	7/2+	-51.719 (4)	56.56 $\pm$ 0.06 h		ϵ 100
		178	(1+)	-50.503 (15)	9.31 $\pm$ 0.03 m		ϵ 100; ϵ 100
		178m	15-	-49.035 (15)	58 $\pm$ 4 ms		IT 100
		178m2	(21-)	-47.6 (15)	290 $\pm$ 12 ms		IT 100
		179	7/2+	-50.3617 (21)	1.82 $\pm$ 0.03 y		ϵ 100
		179m	(25/2+)	-49.0445 (21)	9.0 $\pm$ 0.2 ms		IT 100
		179m2	(37/2+)	-47.7222 (21)	54.1 $\pm$ 1.7 ms		IT 100
		180	1+	-48.9365 (23)	8.154 $\pm$ 0.006 h		ϵ 86; β^- 14
		180m	9-	-48.8594 (23)	$>$ 1.2E+15 y	0.01201% $\pm$ 0.00032%	ϵ ?; β^- ?
		181	7/2+	-48.4419 (19)	**stable**	99.98799% $\pm$ 0.00032%	
		182	3-	-46.4335 (19)	114.74 $\pm$ 0.12 d		β^- 100
		182m	5+	-46.4172 (19)	283 $\pm$ 3 ms		IT 100
		182m2	10-	-45.9139 (19)	15.84 $\pm$ 0.1 m		IT 100
		183	7/2+	-45.2964 (19)	5.1 $\pm$ 0.1 d		β^- 100
		184	(5-)	-42.84 (3)	8.7 $\pm$ 0.1 h		β^- 100
		185	(7/2+)	-41.396 (14)	49.4 $\pm$ 1.5 m		β^- 100
		185m	(21/2)	-40.138 (14)	$>$ 1 ms		
		186	(2-,3-)	-38.61 (6)	10.5 $\pm$ 0.3 m		β^- 100; β^- 100
		187	(7/2+)	-36.77 (20)	2.3 $\pm$ 0.6 m		β^- 100
		187m	(27/2-)	-34.98 (20)	22 $\pm$ 9 s		β^- ?; IT ?
		187m2	(41/2+)	-33.83 (20)	$>$ 5 m		β^- ?; IT ?
		188	0	-33.66 (20)	19.6 $\pm$ 2 s		β^-
		190	0	-28.7 (4)	5.3 $\pm$ 0.7 s		β^- 100
		192	(1,2)	-23.1 (6)	2.2 $\pm$ 0.7 s		β^- 100
74	**W**	157	(7/2-)	-19.3 (5)	275 $\pm$ 40 ms		ϵ
		158	0+	-23.7 (5)	1.25 $\pm$ 0.21 ms		α 100
		159	0	-25.2 (4)	7.3 $\pm$ 2.7 ms		$\alpha \approx$ 99.90; $\epsilon \approx$ 0.10
		160	0+	-29.36 (21)	91 $\pm$ 5 ms		α 87
		161	0	-30.41 (20)	409 $\pm$ 18 ms		α 73; ϵ 27
		162	0+	-34.001 (18)	1.36 $\pm$ 0.07 s		ϵ 54.8; α 45.2

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		163	7/2-	-34.91 (5)	2.67 ± 0.1 s		ϵ 86; α 14
		164	0+	-38.235 (10)	6.3 ± 0.2 s		ϵ 96.2; α 3.8
		165	(5/2-)	-38.861 (25)	5.1 ± 0.5 s		ϵ 100; $\alpha < 0.20$
		166	0+	-41.886 (10)	19.2 ± 0.6 s		ϵ 99.96; α 0.04
		167	(+)	-42.089 (19)	19.9 ± 0.5 s		ϵ 99.96; α 0.04
		168	0+	-44.897 (15)	50.9 ± 1.9 s		ϵ 100; α 0.0032
		169	(5/2-)	-44.918 (15)	74 ± 6 s		ϵ 100
		170	0+	-47.294 (15)	2.42 ± 0.04 m		ϵ 100
		171	(5/2-)	-47.09 (3)	2.38 ± 0.04 m		ϵ 100
		172	0+	-49.1 (3)	6.6 ± 0.9 m		ϵ 100
		173	5/2-	-48.73 (3)	7.6 ± 0.2 m		ϵ 100
		174	0+	-50.23 (3)	33.2 ± 2.1 m		ϵ 100
		175	(1/2-)	-49.63 (3)	35.2 ± 0.6 m		ϵ 100
		176	0+	-50.64 (3)	2.5 ± 0.1 h		ϵ 100
		177	1/2-	-49.7 (3)	132 ± 2 m		ϵ 100
		178	0+	-50.411 (15)	21.6 ± 0.3 d		ϵ 100
		179	7/2-	-49.296 (15)	37.05 ± 0.16 m		ϵ 100
		179m	1/2-	-49.074 (15)	6.40 ± 0.07 m		IT 99.71; ϵ 0.29
		180	0+	-49.6365 (24)	≥ 6.6E+17 y	0.12% ± 0.01%	2ϵ 100
		181	9/2+	-48.253 (5)	121.2 ± 0.2 d		ϵ 100
		182	0+	-48.2475 (8)	**stable**	26.5% ± 0.16%	
		183	1/2-	-46.3671 (8)	> 1.3E+19 y	14.31% ± 0.04%	α
		183m	11/2+	-46.0576 (8)	5.2 ± 0.3 s		IT 100
		184	0+	-45.7075 (9)	**stable**	30.64% ± 0.02%	
		185	3/2-	-43.3899 (9)	75.1 ± 0.3 d		β^- 100
		185m	11/2+	-43.1925 (9)	1.67 ± 0.03 m		IT 100
		186	0+	-42.5109 (15)	> 2.3E+19 y	28.43% ± 0.19%	2β^-
		186m	(16+)	-38.9681 (15)	> 3 ms		IT
		187	3/2-	-39.9061 (15)	24.000 ± 0.004 h		β^- 100
		188	0+	-38.67 (3)	69.78 ± 0.05 d		β^- 100
		189	(3/2-)	-35.48 (20)	10.7 ± 0.5 m		β^- 100
		190	0+	-34.3 (16)	30.0 ± 1.5 m		β^- 100
		190m	(10-)	-31.92 (16)	≤ 3.1 ms		IT 100
75	**Re**	161m	11/2-	-20.75 (21)	14.7 ± 0.3 ms		α 93; p 7
		162	(2-)	-22.35 (20)	107 ± 13 ms		α 94; ϵ 6
		162m	(9+)	-22.18 (20)	77 ± 9 ms		α 91; ϵ 9
		163	1/2+	-26.008 (19)	390 ± 72 ms		ϵ 68; α 32
		163m	11/2-	-25.893 (19)	214 ± 5 ms		α 66; ϵ 34
		164	0	-27.52 (7)	0.85 +0.14-0.11 s		$\alpha \approx 58.00$; $\epsilon \approx 42.00$
		164m	0	-27.45 (7)	0.86 +0.15-0.11 s		IT ; $\alpha \approx 3.00$
		165	(1/2+)	-30.649 (25)	≈ 1 s		α ; ϵ
		165m	(11/2-)	-30.601 (25)	2.1 ± 0.3 s		ϵ 87; α 13
		166	0	-31.89 (7)	2.25 ± 0.21 s		$\epsilon > 76.00$; $\alpha < 24.00$
		167	(9/2-)	-34.84 (5)	5.9 ± 0.3 s		$\alpha \approx 1.00$; $\epsilon \approx 99.00$; α 100
		168	(7+)	-35.79 (3)	4.4 ± 0.1 s		ϵ 100; $\alpha \approx$ 5.0E-3
		169	(9/2-)	-38.41 (11)	8.1 ± 0.5 s		ϵ 100; $\alpha < 0.01$; ϵ ; IT ; $\alpha \approx 0.20$
		170	(5+)	-38.92 (3)	9.2 ± 0.2 s		ϵ 100
		171	(9/2-)	-41.25 (3)	15.2 ± 0.4 s		ϵ 100
		172	(2)	-41.52 (5)	55 ± 5 s		ϵ 100; ϵ 100
		173	(5/2-)	-43.55 (3)	1.98 ± 0.26 m		ϵ 100
		174	(LE 4)	-43.67 (3)	2.40 ± 0.04 m		ϵ 100
		175	(5/2-)	-45.29 (3)	5.89 ± 0.05 m		ϵ 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		176	(3+)	-45.06 (3)	5.3 ± 0.3 m		ϵ 100
		177	5/2-	-46.27 (3)	14 ± 1 m		ϵ 100
		178	(3+)	-45.65 (3)	13.2 ± 0.2 m		ϵ 100
		179	5/2+	-46.585 (24)	19.5 ± 0.1 m		ϵ 100
		180	(1)-	-45.837 (21)	2.44 ± 0.06 m		ϵ 100
		181	5/2+	-46.523 (13)	19.9 ± 0.7 h		ϵ 100
		182	7+	-45.45 (10)	64.0 ± 0.5 h		ϵ 100; ϵ 100
		183	5/2+	-45.811 (8)	70.0 ± 1.4 d		ϵ 100
		183m	(25/2)+	-43.903 (8)	1.04 ± 0.04 ms		IT 100
		184	3(-)	-44.225 (4)	35.4 ± 0.7 d		ϵ 100
		184m	8(+)	-44.037 (4)	169 ± 8 d		IT 74.5; ϵ 25.5
		185	5/2+	-43.8225 (12)	**stable**	37.4% ± 0.02%	
		186	1-	-41.9306 (12)	3.7186 ± 5.0E-4 d		ϵ 7.47; β^- 92.53
		186m	(8+)	-41.7816 (12)	2.0E+5 ± 0 y		IT 100
		187	5/2+	-41.2184 (15)	4.33E+10 ± 0.07E+10 y	62.6% ± 0.02%	β^- 100; $\alpha < 1.0E\text{-}4$
		188	1-	-39.0189 (15)	17.003 ± 0.003 h		β^- 100
		188m	(6)-	-38.8468 (15)	18.59 ± 0.04 m		IT 100
		189	5/2+	-37.981 (8)	24.3 ± 0.4 h		β^- 100
		190	(2)-	-35.57 (15)	3.1 ± 0.3 m		β^- 100
		190m	(6-)	-35.36 (15)	3.2 ± 0.2 h		β^- 54.4; IT 45.6
		191	(3/2+,1/2+)	-34.352 (10)	9.8 ± 0.5 m		β^- 100
		192	0	-31.77 (20)	16 ± 1 s		β^- 100
		194	0	-27.4 (3)	5 ± 1 s		β^- 100; β^- 100; β^- 100
		195	0	-25.6 (4)	6 ± 1 s		β^-
		196	0	-22.5 (5)	3 +1-2 s		β^- 100
76	**Os**	162	0+	-14.5 (5)	2.1 ± 0.1 ms		$\alpha \approx 99.00$
		163	(7/2-)	-16.1 (4)	5.5 ± 0.6 ms		α 100; ϵ
		164	0+	-20.46 (21)	21 ± 1 ms		α 98; ϵ 2
		165	(7/2-)	-21.65 (20)	71 ± 3 ms		$\alpha > 60.00$; $\epsilon < 40.00$
		166	0+	-25.437 (18)	199 ± 3 ms		α 72; ϵ 18
		167	(7/2-)	-26.5 (7)	0.81 ± 0.06 s		α 57; ϵ 43
		168	0+	-29.992 (10)	2.1 ± 0.1 s		α 43; ϵ 57
		169	(5/2-)	-30.72 (3)	3.43 ± 0.14 s		ϵ 86.3; α 13.7
		170	0+	-33.921 (11)	7.37 ± 0.18 s		ϵ 90.5; α 9.5
		171	(5/2-)	-34.293 (19)	8.3 ± 0.2 s		ϵ 98.2; α 1.8
		172	0+	-37.245 (13)	19.2 ± 0.9 s		ϵ 99.8; α 0.2
		173	(5/2-)	-37.438 (15)	22.4 ± 0.9 s		ϵ ; α 0.4
		174	0+	-39.997 (11)	44 ± 4 s		ϵ 99.98; α 0.02
		175	(5/2-)	-40.111 (13)	1.4 ± 0.1 m		ϵ 100
		176	0+	-42.1 (3)	3.6 ± 0.5 m		ϵ 100
		177	1/2-	-41.949 (16)	3.0 ± 0.2 m		ϵ 100
		178	0+	-43.547 (16)	5.0 ± 0.4 m		ϵ 100; α
		179	1/2-	-43.02 (18)	6.5 ± 0.3 m		ϵ 100
		180	0+	-44.355 (20)	21.5 ± 0.4 m		ϵ 100
		181	1/2-	-43.55 (3)	105 ± 3 m		ϵ 100
		181m	7/2-	-43.5 (3)	2.7 ± 0.1 m		ϵ 100; $IT \leq 3.00$
		182	0+	-44.609 (22)	21.84 ± 0.2 h		ϵ 100
		183	9/2+	-43.66 (5)	13.0 ± 0.5 h		ϵ 100
		183m	1/2-	-43.49 (5)	9.9 ± 0.3 h		ϵ 85; IT 15
		184	0+	-44.2566 (13)	> 5.6E13 y	0.02% ± 0.01%	α
		185	1/2-	-42.8098 (13)	93.6 ± 0.5 d		ϵ 100
		186	0+	-43.0023 (15)	2.0E+15 ± 1.1E+15 y	1.59% ± 0.03%	α 100
		187	1/2-	-41.2209 (15)	**stable**	1.96% ± 0.02%	

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		188	0+	-41.1392 (15)	**stable**	13.24% $\pm$ 0.08%	
		189	3/2-	-38.9883 (16)	**stable**	16.15% $\pm$ 0.05%	
		189m	9/2-	-38.9575 (16)	5.81 $\pm$ 0.06 h		IT 100
		190	0+	-38.7093 (16)	**stable**	26.26% $\pm$ 0.02%	
		190m	(10)-	-37.0039 (16)	9.9 $\pm$ 0.1 m		IT 100
		191	9/2-	-36.3967 (16)	15.4 $\pm$ 0.1 d		β^- 100
		191m	3/2-	-36.3223 (16)	13.10 $\pm$ 0.05 h		IT 100
		192	0+	-35.884 (3)	**stable**	40.78% $\pm$ 0.19%	
		192m	(10-)	-33.868 (3)	5.9 $\pm$ 0.1 s		$IT > 87.00$; $\beta^- < 13.00$
		193	3/2-	-33.396 (3)	30.11 $\pm$ 0.01 h		β^- 100
		194	0+	-32.437 (3)	6.0 $\pm$ 0.2 y		β^- 100
		195	0	-29.7 (5)	$\approx$ 9 m		β^-
		196	0+	-28.28 (4)	34.9 $\pm$ 0.2 m		β^- 100
		197	0	-25.31 (20)	2.8 $\pm$ 0.6 m		β^- 100
		199	0	-20.5 (4)	5 +4-2 s		β^- 100
		200	0+	-18.9 (5)	6 +4-3 s		β^- 100
77	**Ir**	166	(2-)	-13.2 (20)	10.5 $\pm$ 2.2 ms		α 93; p 7
		166m	(9+)	-13.03 (20)	15.1 $\pm$ 0.9 ms		α 98.2; p 1.8
		167	1/2+	-17.078 (19)	35.2 $\pm$ 2 ms		p 32; ϵ 20; α 48
		167m	11/2-	-16.903 (19)	25.7 $\pm$ 0.8 ms		α 80; ϵ 20; p 0.4
		168	0	-18.72 (7)	222 +60-40 ms		$\alpha \leq 100.00$; ϵ ; p ; α 77; $\epsilon \leq 23.00$; p
		169	(1/2+)	-22.083 (24)	0.353 $\pm$ 0.004 s		α 45; ϵ ; p
		169m	(11/2-)	-21.93 (24)	0.281 $\pm$ 0.004 s		α 72; ϵ ; p
		170	(3-)	-23.36 (9)	0.87 +0.18-0.12 s		ϵ 94.8; α 5.2; α 38; $IT \leq 62.00$; $\epsilon \leq 62.00$
		171	(1/2+)	-26.43 (4)	3.2 +1.3-0.7 s		$\alpha > 0.00$; p ; ϵ ; α 58; $p \leq 42.00$; $\epsilon \leq 42.00$
		172	(3+)	-27.38 (3)	4.4 $\pm$ 0.3 s		ϵ 98; $\alpha \approx 2.00$
		172m	(7+)	-27.24 (3)	2.0 $\pm$ 0.1 s		ϵ 77; α 23
		173	(3/2+,5/2+)	-30.27 (12)	9.0 $\pm$ 0.8 s		$\epsilon > 93.00$; $\alpha < 7.00$
		173m	(11/2-)	-30.044 (12)	2.4 $\pm$ 0.9 s		ϵ ; α 7
		174	(3+)	-30.87 (3)	7.9 $\pm$ 0.6 s		ϵ 99.5; α 0.5
		174m	(7+)	-30.68 (3)	4.9 $\pm$ 0.3 s		ϵ 97.5; α 2.5
		175	(5/2-)	-33.386 (13)	9 $\pm$ 2 s		ϵ 99.15; α 0.85
		176	0	-33.861 (20)	8.7 $\pm$ 0.5 s		α 3.1; ϵ 96.9
		177	5/2-	-36.047 (20)	30 $\pm$ 2 s		ϵ 99.94; α 0.06
		178	0	-36.252 (20)	12 $\pm$ 2 s		ϵ 100
		179	(5/2)-	-38.077 (11)	79 $\pm$ 1 s		ϵ 100
		180	(4,5)	-37.977 (22)	1.5 $\pm$ 0.1 m		ϵ 100
		181	5/2-	-39.47 (3)	4.90 $\pm$ 0.15 m		ϵ 100
		182	3+	-39.052 (21)	15 $\pm$ 1 m		ϵ 100
		183	5/2-	-40.2 (3)	57 $\pm$ 4 m		ϵ 100
		184	5-	-39.61 (3)	3.09 $\pm$ 0.03 h		ϵ 100
		185	5/2-	-40.34 (3)	14.4 $\pm$ 0.1 h		ϵ 100
		186	5+	-39.173 (17)	16.64 $\pm$ 0.03 h		ϵ 100; $\epsilon \approx 75.00$; $IT \approx 25.00$
		187	3/2+	-39.532 (6)	10.5 $\pm$ 0.3 h		ϵ 100
		187m	9/2-	-39.346 (6)	30.3 $\pm$ 0.6 ms		IT 100
		188	1-	-38.351 (10)	41.5 $\pm$ 0.5 h		ϵ 100
		188m	0	-37.428 (10)	4.2 $\pm$ 0.2 ms		ϵ ?; IT
		189	3/2+	-38.457 (13)	13.2 $\pm$ 0.1 d		ϵ 100
		189m	11/2-	-38.084 (13)	13.3 $\pm$ 0.3 ms		IT 100
		189m2	(25/2)+	-36.123 (13)	3.7 $\pm$ 0.2 ms		IT 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J$^\pi$	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		190	4-	-36.7555 (20)	11.78 ± 0.1 d		ϵ 100
		190m	(1-)	-36.7294 (20)	1.120 ± 0.003 h		IT 100
		190m2	(11)-	-36.3791 (20)	3.087 ± 0.012 h		ϵ 91.4; IT 8.6
		191	3/2+	-36.7107 (19)	**stable**	37.3% ± 0.2%	
		191m	11/2-	-36.5394 (19)	4.899 ± 0.023 s		IT 100
		191m2	0	-34.664 (19)	5.5 ± 0.7 s		IT 100
		192	4+	-34.8375 (19)	73.829 ± 0.011 d		β^- 95.24; ϵ 4.76
		192m	1-	-34.7808 (19)	1.45 ± 0.05 m		β^- 0.02; IT 99.98
		192m2	(11-)	-34.6694 (19)	241 ± 9 y		IT 100
		193	3/2+	-34.5382 (19)	**stable**	62.7% ± 0.2%	
		193m	11/2-	-34.458 (19)	10.53 ± 0.04 d		IT 100
		194	1-	-32.5337 (19)	19.28 ± 0.13 h		β^- 100
		194m	4+	-32.3866 (19)	31.85 ± 0.24 ms		IT 100
		194m2	(10,11)	-32.3437 (19)	171 ± 11 d		β^- 100
		195	3/2+	-31.6942 (19)	2.5 ± 0.2 h		β^- 100
		195m	11/2-	-31.5942 (19)	3.8 ± 0.2 h		β^- 95; IT 5
		196	(0-)	-29.44 (4)	52 ± 1 s		β^- 100
		196m	(10,11-)	-29.03 (4)	1.40 ± 0.02 h		β^- 100; $IT < 0.30$
		197	3/2+	-28.266 (20)	5.8 ± 0.5 m		β^- 100
		197m	11/2-	-28.151 (20)	8.9 ± 0.3 m		β^- 99.75; IT 0.25
		198	0	-25.82 (20)	8 ± 1 s		β^- 100
		199	0	-24.4 (4)	6 +5-4 s		β^-
		202	(1-,2-)	-17 (4)	11 ± 3 s		β^- 100
78	**Pt**	168	0+	-11.04 (21)	2.02 ± 0.1 ms		α 100
		169	(7/2-)	-12.36 (20)	7.0 ± 0.2 ms		α 100
		170	0+	-16.304 (19)	13.8 ± 0.5 ms		α 98; ϵ
		171	(7/2-)	-17.47 (7)	45.5 ± 2.5 ms		α 90; ϵ 10
		172	0+	-21.103 (11)	97.6 ± 1.3 ms		ϵ 6; α 94
		173	(5/2-)	-21.94 (6)	382 ± 2 ms		α 100; ϵ ?
		174	0+	-25.313 (11)	0.889 ± 0.017 s		α 76; ϵ 24
		175	7/2-	-25.69 (19)	2.53 ± 0.06 s		α 64; ϵ 36
		176	0+	-28.935 (13)	6.33 ± 0.15 s		ϵ 60; α 40
		177	5/2-	-29.371 (15)	10.6 ± 0.4 s		α 5.7; ϵ 94.3
		178	0+	-31.999 (11)	20.7 ± 0.7 s		ϵ 92.3; α 7.7
		179	1/2-	-32.27 (8)	21.2 ± 0.4 s		ϵ 99.76; α 0.24
		180	0+	-34.436 (11)	56 ± 2 s		ϵ 100; $\alpha \approx 0.30$
		181	1/2-	-34.375 (15)	52.0 ± 2.2 s		ϵ 100; $\alpha \approx 0.08$
		182	0+	-36.17 (16)	2.67 ± 0.12 m		ϵ 99.96; α 0.04
		183	1/2-	-35.773 (16)	6.5 ± 1 m		ϵ 100; $\alpha \approx$ 1.3E-3
		183m	(7/2)-	-35.738 (16)	43 ± 5 s		ϵ 100; $\alpha <$ 4.0E-4; IT
		184	0+	-37.332 (18)	17.3 ± 0.2 m		ϵ 100; $\alpha \approx$ 1.0E-3
		184m	8-	-35.492 (18)	1.01 ± 0.05 ms		IT 100
		185	9/2+	-36.68 (4)	70.9 ± 2.4 m		$\epsilon < 100.00$
		185m	1/2-	-36.58 (4)	33.0 ± 0.8 m		ϵ 99; $IT < 2.00$
		186	0+	-37.864 (22)	2.08 ± 0.05 h		ϵ 100; $\alpha \approx$ 1.4E-4
		187	3/2-	-36.71 (3)	2.35 ± 0.03 h		ϵ 100
		188	0+	-37.829 (6)	10.2 ± 0.3 d		ϵ 100; α 2.6e-05
		189	3/2-	-36.485 (11)	10.87 ± 0.12 h		ϵ 100
		190	0+	-37.325 (6)	6.5E+11 ± 0.3E+11 y	0.012% ± 0.002%	α 100
		191	3/2-	-35.701 (5)	2.83 ± 0.02 d		ϵ 100
		192	0+	-36.292 (3)	**stable**	0.782% ± 0.024%	
		193	1/2-	-34.4816 (20)	50 ± 6 y		ϵ 100
		193m	13/2+	-34.3318 (20)	4.33 ± 0.03 d		IT 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		194	0+	-34.7625 (9)	**stable**	32.86% ± 0.4%	
		195	1/2-	-32.7962 (9)	**stable**	33.78% ± 0.24%	
		195m	13/2+	-32.5369 (9)	4.010 ± 0.005 d		IT 100
		196	0+	-32.6468 (9)	**stable**	25.21% ± 0.34%	
		197	1/2-	-30.4219 (9)	19.8915 ± 0.0019 h		β^- 100
		197m	13/2+	-30.0223 (9)	95.41 ± 0.18 m		IT 96.7; β^- 3.3
		198	0+	-29.9056 (22)	**stable**	7.36% ± 0.13%	
		199	5/2-	-27.3903 (22)	30.80 ± 0.21 m		β^- 100
		199m	(13/2)+	-26.9663 (22)	13.6 ± 0.4 s		IT 100
		200	0+	-26.601 (20)	12.6 ± 0.3 h		β^- 100
		201	(5/2-)	-23.74 (5)	2.5 ± 0.1 m		β^- 100
		202	0+	-22.6 (20)	44 ± 15 h		β^- 100
		203	(1/2-)	-19.7 (3)	10 ± 3 s		β^- 100
		204	0+	-18.1 (4)	10.3 ± 1.4 s		β^- 100
79	**Au**	171m	(11/2-)	-7.317 (21)	1.02 ± 0.1 ms		α 54; p 46
		172	0	-9.37 (8)	22 +6-4 ms		α 100; ϵ ; p ; $p < 0.02$; ϵ ; α 100
		173	(1/2+)	-12.822 (24)	25 ± 1 ms		α 94; ϵ ; p
		173m	(11/2-)	-12.608 (24)	14.0 ± 0.9 ms		α 92; p ; ϵ
		174	0	-14.24 (9)	139 ± 3 ms		$\alpha > 0.00$
		177	(1/2+,3/2+)	-21.547 (11)	1.53 ± 0.07 s		α 40; ϵ
		177m	11/2-	-21.389 (11)	1.00 ± 0.2 s		α 66; ϵ
		178	0	-22.33 (6)	2.6 ± 0.5 s		$\alpha \geq 40.00$; $\epsilon \leq 60.00$
		179	(1/2+,3/2+)	-24.98 (13)	7.1 ± 0.3 s		ϵ 78; α 22
		180	0	-25.596 (21)	8.1 ± 0.3 s		$\epsilon \leq 98.20$; $\alpha \geq 1.80$
		181	(3/2-)	-27.871 (20)	13.7 ± 1.4 s		ϵ 97.3; α 2.7
		182	(2+)	-28.301 (20)	15.5 ± 0.4 s		ϵ 99.87; α 0.13
		183	(5/2)-	-30.187 (10)	42.8 ± 1 s		α 0.55; ϵ 99.45
		184	5+	-30.319 (22)	20.6 ± 0.9 s		ϵ 100; $\alpha \leq 0.02$
		184m	2+	-30.25 (22)	47.6 ± 1.4 s		ϵ 70; IT 30; $\alpha \leq 0.02$
		185	5/2-	-31.87 (3)	4.25 ± 0.06 m		ϵ 99.74; α 0.26; $\epsilon < 100.00$; IT
		186	3-	-31.715 (21)	10.7 ± 0.5 m		α 0.0008; ϵ 100
		187	1/2(+)	-33.01 (3)	8.3 ± 0.2 m		ϵ 100; α 0.003
		187m	9/2(-)	-32.88 (3)	2.3 ± 0.1 s		IT 100
		188	1(-)	-32.301 (20)	8.84 ± 0.06 m		ϵ 100
		189	1/2+	-33.582 (20)	28.7 ± 0.3 m		ϵ 100; $\alpha <$ 3.0E-5
		189m	11/2-	-33.335 (20)	4.59 ± 0.11 m		ϵ 100
		190	1-	-32.883 (16)	42.8 ± 1 m		ϵ 100; $\alpha <$ 1.0E-6; IT 100
		191	3/2+	-33.81 (4)	3.18 ± 0.08 h		ϵ 100
		191m	(11/2-)	-33.55 (4)	0.92 ± 0.11 s		IT 100
		192	1-	-32.776 (16)	4.94 ± 0.09 h		ϵ 100
		192m	(5)+	-32.64 (16)	29 ± 0 ms		IT 100
		192m2	(11-)	-32.344 (16)	160 ± 20 ms		IT 100
		193	3/2+	-33.406 (9)	17.65 ± 0.15 h		ϵ 100
		193m	11/2-	-33.116 (9)	3.9 ± 0.3 s		IT 99.97; $\epsilon \approx 0.03$
		194	1-	-32.262 (10)	38.02 ± 0.1 h		ϵ 100
		194m	(5+)	-32.154 (10)	600 ± 8 ms		IT 100
		194m2	(11-)	-31.786 (10)	420 ± 10 ms		IT 100
		195	3/2+	-32.5694 (14)	186.098 ± 0.047 d		ϵ 100
		195m	11/2-	-32.2508 (14)	30.5 ± 0.2 s		IT 100
		196	2-	-31.14 (3)	6.1669 ± 6.0E-4 d		ϵ 93; β^- 7
		196m	5+	-31.055 (3)	8.1 ± 0.2 s		IT 100
		196m2	12-	-30.544 (3)	9.6 ± 0.1 h		IT 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		197	3/2+	-31.1409 (7)	**stable**	100%	
		197m	11/2-	-30.7317 (7)	7.73 ± 0.06 s		IT 100
		198	2-	-29.5819 (7)	2.6948 ± 0.0012 d		β^- 100
		198m	(12-)	-28.7702 (7)	2.272 ± 0.016 d		IT 100
		199	3/2+	-29.0948 (7)	3.139 ± 0.007 d		β^- 100
		200	(1-)	-27.27 (5)	48.4 ± 0.3 m		β^- 100
		200m	12-	-26.31 (5)	18.7 ± 0.5 h		β^- 84; IT 16
		201	3/2+	-26.401 (3)	26.0 ± 0.8 m		β^- 100
		202	(1-)	-24.4 (17)	28.4 ± 1.2 s		β^- 100
		203	3/2+	-23.143 (3)	60 ± 6 s		β^- 100
		204	(2-)	-20.75 (20)	39.8 ± 0.9 s		β^- 100
		205	(3/2+)	-18.9 (3)	32.5 ± 1.4 s		β^- 100
		205m	(11/2-)	-18 (3)	6 ± 2 s		IT ; β^-
80	**Hg**	174	0+	-6.646 (20)	2.1 +1.8-0.7 ms		α 99.6
		175	(7/2-)	-7.97 (7)	10.6 ± 0.4 ms		α 100
		176	0+	-11.778 (12)	20.3 ± 1.4 ms		α 94
		177	(7/2-)	-12.78 (8)	118 ± 8 ms		α 100
		178	0+	-16.311 (12)	266.5 ± 2.4 ms		$\alpha \approx$ 70.00; $\epsilon \approx$ 30.00
		179	(7/2-)	-16.92 (3)	1.05 ± 0.03 s		$\epsilon p \approx$ 0.15; α 55; ϵ 45
		180	0+	-20.251 (13)	2.58 ± 0.01 s		ϵ 52; α 48
		181	1/2-	-20.661 (15)	3.6 ± 0.1 s		ϵ 73; α 27; ϵp 0.01; $\epsilon\alpha$ 9e-06
		182	0+	-23.577 (10)	10.83 ± 0.06 s		ϵ 84.8; α 15.2
		183	1/2-	-23.806 (7)	9.4 ± 0.7 s		ϵp 0.00026; ϵ 88.3; α 11.7
		184	0+	-26.349 (10)	30.87 ± 0.26 s		ϵ 98.89; α 1.11
		185	1/2-	-26.176 (16)	49.1 ± 1 s		ϵ 94; α 6
		185m	13/2+	-26.076 (16)	21.6 ± 1.5 s		IT 54; ϵ 46; $\alpha \approx$ 0.03
		186	0+	-28.54 (11)	1.38 ± 0.06 m		ϵ 99.98; α 0.02
		187	3/2(-)	-28.118 (14)	2.4 ± 0.3 m		ϵ 100; $\alpha <$ 3.7E-4; ϵ 100; $\alpha <$ 3.7E-4
		188	0+	-30.202 (12)	3.25 ± 0.15 m		ϵ 100; α 3.7e-05
		189	3/2-	-29.63 (3)	7.6 ± 0.1 m		ϵ 100; $\alpha <$ 3.0E-5; ϵ 100; $\alpha <$ 3.0E-5
		190	0+	-31.371 (16)	20.0 ± 0.5 m		$\alpha <$ 3.4E-7; ϵ 100
		191	3/2(-)	-30.594 (23)	49 ± 10 m		ϵ 100; α 5e-06; ϵ 100
		192	0+	-32.012 (16)	4.85 ± 0.2 h		ϵ 100
		193	3/2(-)	-31.063 (16)	3.80 ± 0.15 h		ϵ 100
		193m	13/2(+)	-30.922 (16)	11.8 ± 0.2 h		ϵ 92.8; IT 7.2
		194	0+	-32.193 (13)	444 ± 77 y		ϵ 100
		195	1/2-	-31 (23)	10.53 ± 0.03 h		ϵ 100
		195m	13/2+	-30.824 (23)	41.6 ± 0.8 h		ϵ 45.8; IT 54.2
		196	0+	-31.827 (3)	**stable**	0.15% ± 0.01%	
		197	1/2-	-30.541 (3)	64.14 ± 0.05 h		ϵ 100
		197m	13/2+	-30.242 (3)	23.8 ± 0.1 h		IT 91.4; ϵ 8.6
		198	0+	-30.9548 (5)	**stable**	9.97% ± 0.2%	
		199	1/2-	-29.5464 (4)	**stable**	16.87% ± 0.22%	
		199m	13/2+	-29.0139 (4)	42.67 ± 0.09 m		IT 100
		200	0+	-29.5035 (4)	**stable**	23.1% ± 0.19%	
		201	3/2-	-27.6629 (6)	**stable**	13.18% ± 0.09%	
		202	0+	-27.3456 (6)	**stable**	29.86% ± 0.26%	
		203	5/2-	-25.2698 (17)	46.594 ± 0.012 d		β^- 100
		204	0+	-24.6902 (5)	**stable**	6.87% ± 0.15%	
		205	1/2-	-22.288 (4)	5.14 ± 0.09 m		β^- 100
		205m	13/2+	-20.731 (4)	1.09 ± 0.04 ms		IT 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		206	0+	-20.946 (20)	8.32 ± 0.07 m		β^- 100
		207	(9/2+)	-16.22 (15)	2.9 ± 0.2 m		β^- 100
		208	0+	-13.27 (3)	41 +5-4 m		β^- 100
		209	0	-8.54 (15)	35 +9-6 s		β^- 100
81	**Tl**	176	(3-,4-,5-)	0.58 (8)	5.2 +3-1.4 ms		p 100
		177	(1/2+)	-3.33 (23)	18 ± 5 ms		α 73; p 27
		178	0	-4.79 (10)	254 +11-9 ms		$\alpha \approx$ 53.00; $\epsilon \approx$ 47.00
		179	(1/2+)	-8.3 (4)	0.23 ± 0.04 s		$\alpha <$ 100.00; ϵ ; p ; ϵ ; IT ; $\alpha \leq$ 100.00; p
		180	(4-,5-)	-9.26 (6)	1.09 ± 0.01 s		ϵ 94; α 6; $\epsilon SF \approx$ 1.0E-4
		181	(1/2+)	-12.799 (9)	3.2 ± 0.3 s		ϵ ; $\alpha \leq$ 10.00
		181m	(9/2-)	-11.963 (9)	1.40 ± 0.03 ms		IT 99.6; α 0.4
		182	(7+)	-13.35 (8)	3.1 ± 1 s		ϵ 97.5; $\alpha <$ 5.00
		183	(1/2+)	-16.589 (9)	6.9 ± 0.7 s		α ; $\epsilon >$ 0.00
		183m	(9/2-)	-15.959 (9)	53.3 ± 0.3 ms		IT ; ϵ ; α 2
		184	0	-16.89 (5)	10.1 ± 0.5 s		ϵ 97.9; α 2.1
		185	(1/2+)	-19.76 (5)	19.5 ± 0.5 s		ϵ
		185m	(9/2-)	-19.3 (5)	1.93 ± 0.08 s		α ; IT
		186	(7+)	-19.87 (3)	27.5 ± 1 s		$\alpha \approx$ 6.0E-3; ϵ 100
		186m	(10-)	-19.5 (3)	2.9 ± 0.2 s		IT 100
		187	(1/2+)	-22.443 (8)	≈ 51 s		ϵ 100; $\alpha \approx$ 0.03
		187m	(9/2-)	-22.109 (8)	15.60 ± 0.12 s		$\epsilon <$ 99.90; $IT <$ 99.90; α 0.15
		188	(2-)	-22.35 (3)	71 ± 2 s		ϵ 100; ϵ 100
		188m	(9-)	-22.08 (3)	41 ± 4 ms		ϵ ; IT 100
		189	(1/2+)	-24.602 (11)	2.3 ± 0.2 m		ϵ 100
		189m	(9/2-)	-24.344 (11)	1.4 ± 0.1 m		$\epsilon <$ 100.00; $IT <$ 4.00
		190	2(-)	-24.311 (14)	2.6 ± 0.3 m		ϵ 100; ϵ 100
		192	(2-)	-25.87 (3)	9.6 ± 0.4 m		ϵ 100
		192m	(7+)	-25.72 (3)	10.8 ± 0.2 m		ϵ 100
		193	1/2(+)	-27.3 (8)	21.6 ± 0.8 m		ϵ 100
		193m	(9/2-)	-26.93 (8)	2.11 ± 0.15 m		$IT \leq$ 75.00; $\epsilon \geq$ 25.00
		194	2-	-26.83 (14)	33.0 ± 0.5 m		ϵ 100; $\alpha <$ 1.0E-7; ϵ 100
		195	1/2+	-28.155 (14)	1.16 ± 0.05 h		ϵ 100
		195m	9/2-	-27.673 (14)	3.6 ± 0.4 s		IT 100
		196	2-	-27.497 (12)	1.84 ± 0.03 h		ϵ 100
		196m	(7+)	-27.102 (12)	1.41 ± 0.02 h		ϵ 96.2; IT 3.8
		197	1/2+	-28.341 (16)	2.84 ± 0.04 h		ϵ 100
		197m	9/2-	-27.733 (16)	0.54 ± 0.01 s		IT 100
		198	2-	-27.49 (8)	5.3 ± 0.5 h		ϵ 100
		198m	7+	-26.95 (8)	1.87 ± 0.03 h		ϵ 55.9; IT 44.1
		198m2	(10-)	-26.75 (8)	32.1 ± 1 ms		IT 100
		199	1/2+	-28.06 (3)	7.42 ± 0.08 h		ϵ 100
		199m	9/2-	-27.31 (3)	28.4 ± 0.2 ms		IT 100
		200	2-	-27.047 (6)	26.1 ± 0.1 h		ϵ 100
		200m	7+	-26.294 (6)	34.0 ± 0.9 ms		IT 100
		201	1/2+	-27.183 (15)	3.0421 ± 0.0017 d		ϵ 100
		201m	(9/2-)	-26.264 (15)	2.01 ± 0.07 ms		IT 100
		202	2-	-25.985 (14)	12.31 ± 0.08 d		ϵ 100
		203	1/2+	-25.762 (13)	**stable**	29.524% ± 0.001%	
		204	2-	-24.3468 (13)	3.783 ± 0.012 y		β^- 97.08; ϵ 2.92
		205	1/2+	-23.8215 (13)	**stable**	70.48% ± 0.01%	
		206	0-	-22.254 (14)	4.202 ± 0.011 m		β^- 100
		206m	(12-)	-19.6109 (14)	3.74 ± 0.03 m		IT 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		207	1/2+	-21.034 (5)	4.77 $\pm$ 0.03 m		β^- 100
		207m	11/2-	-19.686 (5)	1.33 $\pm$ 0.11 s		IT 100
		208	5+	-16.7523 (20)	3.053 $\pm$ 0.004 m		β^- 100
		209	(1/2+)	-13.638 (8)	2.161 $\pm$ 0.007 m		β^- 100
		210	(5+)	-9.247 (12)	1.30 $\pm$ 0.03 m		β^- 100; $\beta^- n$ 0.007
		213	0	1.76 (6)	101 $\pm$ 0 s		β^-
82	**Pb**	179	(9/2-)	2.05 (8)	3.5 +1.4-0.8 ms		α 100
		180	0+	-1.935 (13)	4.2 $\pm$ 0.5 ms		α 100
		181	(9/2-)	-3.1 (8)	36 $\pm$ 2 ms		α 100; α < 100.00
		182	0+	-6.821 (13)	55 $\pm$ 5 ms		$\epsilon \approx$ 2.00; $\alpha \approx$ 98.00
		183	(3/2-)	-7.57 (3)	535 $\pm$ 30 ms		$\alpha \approx$ 90.00
		183m	(13/2+)	-7.47 (3)	415 $\pm$ 20 ms		α 100
		184	0+	-11.052 (13)	490 $\pm$ 25 ms		α 80; ϵ 20
		185	3/2-	-11.541 (16)	6.3 $\pm$ 0.4 s		ϵ ; α 34; α 50; ϵ
		186	0+	-14.682 (11)	4.82 $\pm$ 0.03 s		ϵ 60; α 40
		187	(13/2+)	-14.99 (6)	18.3 $\pm$ 0.3 s		ϵ 88; α 12
		187m	(3/2-)	-14.957 (6)	15.2 $\pm$ 0.3 s		ϵ 90.5; α 9.5
		188	0+	-17.816 (11)	25.1 $\pm$ 0.1 s		ϵ 90.7; α 9.3
		189	(3/2-)	-17.88 (3)	39 $\pm$ 8 s		ϵ 100; α < 1.00
		189m	(13/2+)	-17.84 (3)	50 $\pm$ 3 s		ϵ 100; α < 1.00
		190	0+	-20.418 (12)	71 $\pm$ 1 s		α 0.4; ϵ 99.6
		191	(3/2-)	-20.25 (4)	1.33 $\pm$ 0.08 m		ϵ 99.99; α 0.01; ϵ 100; $\alpha \approx$ 0.02
		192	0+	-22.556 (13)	3.5 $\pm$ 0.1 m		ϵ 99.99; α 0.0059
		194	0+	-24.209 (17)	10.7 $\pm$ 0.6 m		α 7.3e-06; ϵ 100
		195	3/2-	-23.714 (23)	$\approx$ 15 m		ϵ 100
		195m	13/2+	-23.511 (23)	15.0 $\pm$ 1.2 m		ϵ 100
		196	0+	-25.361 (14)	37 $\pm$ 3 m		ϵ ; $\alpha \leq$ 3.0E-5
		197	3/2-	-24.749 (6)	8.1 $\pm$ 1.7 m		ϵ 100
		197m	13/2+	-24.429 (6)	42.9 $\pm$ 0.9 m		ϵ 81; IT 19
		198	0+	-26.051 (15)	2.4 $\pm$ 0.1 h		ϵ 100
		199	3/2-	-25.232 (10)	90 $\pm$ 10 m		ϵ 100
		199m	(13/2+)	-24.807 (10)	12.2 $\pm$ 0.3 m		$\epsilon \approx$ 7.00; $IT \approx$ 93.00
		200	0+	-26.256 (11)	21.5 $\pm$ 0.4 h		ϵ 100
		201	5/2-	-25.258 (22)	9.33 $\pm$ 0.03 h		ϵ 100
		201m	13/2+	-24.629 (22)	60.8 $\pm$ 1.8 s		IT 100
		202	0+	-25.937 (3)	52.5E+3 $\pm$ 2.8E+3 y		ϵ 100
		202m	9-	-23.767 (3)	3.54 $\pm$ 0.02 h		IT 90.5; ϵ 9.5
		203	5/2-	-24.787 (7)	51.92 $\pm$ 0.03 h		ϵ 100
		203m	13/2+	-23.962 (7)	6.21 $\pm$ 0.11 s		IT 100
		203m2	29/2-	-21.838 (7)	480 $\pm$ 7 ms		IT 100
		204	0+	-25.1105 (12)	$\geq$ 1.4E+17 y	1.4% $\pm$ 0.1%	α
		204m	9-	-22.9246 (12)	66.93 $\pm$ 0.1 m		IT 100
		205	5/2-	-23.7709 (12)	1.73E+7 $\pm$ 0.07E+7 y		ϵ 100
		205m	13/2+	-22.7571 (12)	5.55 $\pm$ 0.02 ms		IT 100
		206	0+	-23.7862 (12)	**stable**	24.1% $\pm$ 0.1%	
		207	1/2-	-22.4527 (12)	**stable**	22.1% $\pm$ 0.1%	
		207m	13/2+	-20.8193 (12)	0.806 $\pm$ 0.005 s		IT 100
		208	0+	-21.7492 (12)	**stable**	52.4% $\pm$ 0.1%	
		209	9/2+	-17.6153 (18)	3.253 $\pm$ 0.014 h		β^- 100
		210	0+	-14.7291 (15)	22.20 $\pm$ 0.22 y		β^- 100; α 1.9e-06
		211	9/2+	-10.491 (3)	36.1 $\pm$ 0.2 m		β^- 100
		212	0+	-7.553 (22)	10.64 $\pm$ 0.01 h		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		213	(9/2+)	-3.201 (7)	10.2 ± 0.3 m		β^- 100
		214	0+	-0.1816 (23)	26.8 ± 0.9 m		β^- 100
		215	0	4.5 (3)	147 ± 12 s		β^-
83	**Bi**	184	0	1.19 (8)	13 ± 2 ms		α 100; α 100
		186	(3+)	-3.17 (8)	15.0 ± 1.7 ms		α 100; α 100
		187	(9/2-)	-6.385 (10)	37 ± 2 ms		α 100
		188	(10-)	-7.2 (5)	265 ± 15 ms		α 100; ϵ ?; α 100; ϵ ?
		189	(9/2-)	-10.06 (5)	674 ± 11 ms		$\alpha > 50.00$; $\epsilon < 50.00$
		189m	(1/2+)	-9.88 (5)	5.0 ± 0.1 ms		$\alpha > 50.00$; $\epsilon < 50.00$
		190	(3+)	-10.59 (3)	6.3 ± 0.1 s		α 90; ϵ 10; α 70; ϵ 30
		191	(9/2-)	-13.24 (7)	12.4 ± 0.3 s		α 51; ϵ 49
		191m	(1/2+)	-12.999 (7)	125 ± 13 ms		α 68; IT 32; ϵ
		192	(3+)	-13.55 (3)	34.6 ± 0.9 s		ϵ 88; α 12
		192m	(10-)	-13.4 (3)	39.6 ± 0.4 s		ϵ 90; α 10
		193	(9/2-)	-15.873 (10)	63.6 ± 3 s		ϵ 96.5; α 3.5
		193m	(1/2+)	-15.565 (10)	3.2 ± 0.5 s		α 84; ϵ 16
		194	(3+)	-15.968 (15)	95 ± 3 s		ϵ 99.54; α 0.46; ϵ 100; ϵ 99.8; α 0.2
		195	(9/2-)	-18.026 (5)	183 ± 4 s		ϵ 99.97; α 0.03
		195m	(1/2+)	-17.625 (5)	87 ± 1 s		ϵ 67; α 33
		196	(3+)	-18.009 (24)	308 ± 12 s		ϵ 100; α 0.0012
		196m	(7+)	-17.84 (24)	0.6 ± 0.5 s		ϵ ; IT
		196m2	(10-)	-17.738 (24)	240 ± 3 s		ϵ 74.2; IT 25.8; α 0.00038
		197	(9/2-)	-19.687 (8)	9.33 ± 0.5 m		ϵ 100; α 0.0001
		197m	(1/2+)	-19.187 (8)	5.04 ± 0.16 m		α 55; ϵ 45; $IT < 0.30$
		198	(2+,3+)	-19.37 (3)	10.3 ± 0.3 m		ϵ 100; ϵ 100
		198m	10-	-19.12 (3)	7.7 ± 0.5 s		IT 100
		199	9/2-	-20.799 (12)	27 ± 1 m		ϵ 100
		199m	(1/2+)	-20.132 (12)	24.70 ± 0.15 m		ϵ 99; $IT \leq 2.00$; $\alpha \approx 0.01$
		200	7+	-20.371 (24)	36.4 ± 0.5 m		ϵ 100; $\epsilon \leq 100.00$
		200m	(10-)	-19.943 (24)	0.40 ± 0.05 s		IT 100
		201	9/2-	-21.416 (15)	103 ± 3 m		ϵ 100
		201m	1/2+	-20.569 (15)	57.5 ± 2.1 m		$\epsilon > 91.10$; $IT \leq 8.60$; $\alpha \approx 0.30$
		202	5+	-20.742 (15)	1.71 ± 0.04 h		ϵ 100
		203	9/2-	-21.524 (13)	11.76 ± 0.05 h		ϵ 100
		203m	1/2+	-20.426 (13)	305 ± 5 ms		IT 100
		204	6+	-20.646 (9)	11.22 ± 0.1 h		ϵ 100
		204m	10-	-19.84 (9)	13.0 ± 0.1 ms		IT 100
		204m2	17+	-17.812 (9)	1.07 ± 0.03 ms		IT 100
		205	9/2-	-21.065 (5)	15.31 ± 0.04 d		ϵ 100
		206	6+	-20.029 (8)	6.243 ± 0.003 d		ϵ 100
		207	9/2-	-20.0553 (24)	31.55 ± 0.04 y		ϵ 100
		208	5+	-18.8709 (24)	3.68E+5 ± 0.04E+5 y		ϵ 100
		208m	10-	-17.2998 (24)	2.58 ± 0.04 ms		IT 100
		209	9/2-	-18.2593 (15)	**stable**	100%	
		210	1-	-14.7926 (14)	5.012 ± 0.005 d		β^- 100; α 0.00013
		210m	9-	-14.5213 (14)	3.04E+6 ± 0.06E+6 y		α 100
		211	9/2-	-11.859 (5)	2.14 ± 0.02 m		α 99.72; β^- 0.28
		212	1(-)	-8.1201 (20)	60.55 ± 0.06 m		β^- 64.06; α 35.94
		212m	(8-,9-)	-7.8701 (20)	25.0 ± 0.2 m		α 67; β^- 33; $\beta^-\alpha$ 30
		212m2	—>16	-6.2101 (20)	7.0 ± 0.3 m		β^- 100
		213	9/2-	-5.23 (5)	45.59 ± 0.06 m		β^- 97.8; α 2.2
		214	1-	-1.201 (11)	19.9 ± 0.4 m		β^- 99.98; α 0.02

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		215	(9/2-)	1.649 (15)	7.6 ± 0.2 m		β^- 100
		215m	>23/2-	2.996 (15)	36.9 ± 0.6 s		IT 76.2; β^- 23.8
		216	(6-,7-)	5.874 (11)	2.25 ± 0.05 m		$\beta^- \leq 100.00$; $\beta^- \leq 100.00$
		217	(9/2-)	8.89 (20)	98.5 ± 0.8 s		β^- 100
		218	0	13.2 (4)	33 ± 1 s		β^- 100
84	**Po**	187	(1/2- ,5/2-)	2.83 (3)	1.40 ± 0.25 ms		α 100
		189	(7/2-)	-1.42 (19)	3.5 ± 0.5 ms		α 100
		190	0+	-4.564 (13)	2.46 ± 0.05 ms		α 100
		191	(3/2-)	-5.055 (12)	22 ± 1 ms		α 99
		191m	(13/2+)	-5.015 (12)	93 ± 3 ms		α 96
		192	0+	-8.071 (11)	32.2 ± 0.3 ms		$\alpha \approx 99.50$; $\epsilon \approx 0.50$
		193	(13/2+)	-8.36 (3)	245 ± 22 ms		$\alpha \leq 100.00$; $\alpha \leq 100.00$
		194	0+	-11.006 (13)	0.392 ± 0.004 s		α 100; ϵ
		195	(3/2-)	-11.07 (4)	4.64 ± 0.09 s		α 75; ϵ 25
		195m	(13/2+)	-10.84 (4)	1.92 ± 0.02 s		$\alpha \approx 90.00$; $\epsilon \approx 10.00$; $IT < 0.01$
		196	0+	-13.474 (13)	5.8 ± 0.2 s		$\alpha \approx 98.00$; $\epsilon \approx 2.00$
		197	(3/2-)	-13.36 (5)	84 ± 16 s		ϵ 56; α 44
		197m	(13/2+)	-13.15 (5)	32 ± 2 s		α 84; ϵ 16; IT 0.01
		198	0+	-15.474 (17)	1.77 ± 0.03 m		α 57; ϵ 43
		199	(3/2-)	-15.215 (23)	5.47 ± 0.15 m		ϵ 92.5; α 7.5
		199m	(13/2+)	-14.905 (23)	4.17 ± 0.05 m		IT 2.5; ϵ 73.5; α 24
		200	0+	-16.955 (14)	11.51 ± 0.08 m		ϵ 88.9; α 11.1
		201	3/2-	-16.525 (6)	15.6 ± 0.1 m		ϵ 98.87; α 1.13
		201m	13/2+	-16.101 (6)	8.96 ± 0.12 m		IT 56.2; ϵ 41.4; α 2.4
		202	0+	-17.925 (15)	44.6 ± 0.4 m		ϵ 98.08; α 1.92
		203	5/2-	-17.311 (9)	36.7 ± 0.5 m		ϵ 99.89; α 0.11
		203m	13/2+	-16.669 (9)	45 ± 2 s		IT 100; ϵ
		204	0+	-18.346 (11)	3.519 ± 0.012 h		ϵ 99.33; α 0.67
		205	5/2-	-17.509 (20)	1.74 ± 0.08 h		ϵ 99.96; α 0.04
		205m2	19/2-	-16.048 (20)	57.4 ± 0.9 ms		IT 100
		206	0+	-18.185 (3)	8.8 ± 0.1 d		α 5.45; ϵ 94.55
		207	5/2-	-17.146 (7)	5.80 ± 0.02 h		ϵ 99.98; α 0.02
		207m	19/2-	-15.763 (7)	2.79 ± 0.08 s		IT 100
		208	0+	-17.4703 (18)	2.898 ± 0.002 y		α 100; ϵ 0.004
		209	1/2-	-16.3667 (18)	102 ± 5 y		α 99.52; ϵ 0.48
		210	0+	-15.9538 (12)	138.376 ± 0.002 d		α 100
		211	9/2+	-12.4333 (13)	0.516 ± 0.003 s		α 100
		211m	(25/2+)	-10.9713 (13)	25.2 ± 0.6 s		IT 0.02; α 99.98
		212m	(18+)	-7.4482 (13)	45.1 ± 0.6 s		α 99.93; IT 0.07
		215	9/2+	-0.54 (3)	1.781 ± 0.004 ms		α 100; β^- 0.00023
		216	0+	1.778 (22)	0.145 ± 0.002 s		α 100
		217	(9/2+)	5.886 (6)	1.53 ± 0.05 s		α
		218	0+	8.3578 (23)	3.098 ± 0.012 m		α 99.98; β^- 0.02
		221	0	19.78 (6)	112 +58-28 s		β^- ?
		222	0+	22.48 (7)	550 ± 430 s		β^- ?
85	**At**	191	(1/2+)	3.862 (16)	1.7 +1.1-0.5 ms		α 100
		191m	(7/2-)	3.917 (16)	2.1 +0.4-0.3 ms		α 100
		192	0	2.92 (6)	11.5 ± 0.6 ms		α 100; α 100
		193	(1/2+)	-0.07 (5)	28 +5-4 ms		α 100
		193m	(7/2-)	-0.06 (5)	21 ± 5 ms		α 100
		193m2	(13/2+)	0 (AP)	27 +4-3 ms		IT 76; α 24

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		194	(9-10-)	-0.7 (3)	310 ± 8 ms		α ; α
		195	1/2+	-3.476 (9)	328 ± 20 ms		α 100; α 100
		196	(3+)	-3.92 (6)	0.388 ± 0.007 s		$\alpha \approx 95.10$; $\epsilon \approx 4.90$
		197	(9/2-)	-6.34 (5)	0.388 ± 0.006 s		α 96.1; ϵ 3.9
		197m	(1/2+)	-6.29 (5)	2.0 ± 0.2 s		$\alpha \leq 100.00$; ϵ ; $IT \leq$ 4.0E-3
		198	(3+)	-6.65 (15)	3.8 ± 0.4 s		α 90; ϵ 10
		198m	(10-)	-6.548 (15)	1.04 ± 0.15 s		α 84; ϵ 16
		199	(9/2-)	-8.822 (6)	7.03 ± 0.15 s		α 90; ϵ 10
		200	(3+)	-8.988 (24)	43 ± 1 s		α 52; ϵ 48
		200m	(7+)	-8.876 (24)	47 ± 1 s		$\epsilon \leq 57.00$; α 43
		200m2	(10-)	-8.644 (24)	7.3 +2.6-1.5 s		$\epsilon < 89.50$; $IT < 89.50$; $\alpha \approx 10.50$
		201	(9/2-)	-10.789 (8)	85.2 ± 1.6 s		α 71; ϵ 29
		202	(2+,3+)	-10.59 (3)	184 ± 1 s		ϵ 63; α 37; ϵ 91.3; α 8.7
		202m	(10-)	-10.2 (3)	0.46 ± 0.05 s		IT 99.9; α 0.1
		203	9/2-	-12.164 (12)	7.4 ± 0.2 m		ϵ 69; α 31
		204	7+	-11.876 (24)	9.12 ± 0.11 m		α 3.91; ϵ 96.09
		204m	10-	-11.289 (24)	108 ± 10 ms		IT 100
		205	9/2-	-12.971 (15)	26.9 ± 0.8 m		ϵ 90; α 10
		206	(5)+	-12.429 (15)	30.6 ± 0.8 m		ϵ 99.1; α 0.9
		207	9/2-	-13.227 (12)	1.81 ± 0.03 h		ϵ 91.4; α 8.6
		208	6+	-12.47 (9)	1.63 ± 0.03 h		ϵ 99.45; α 0.55
		209	9/2-	-12.883 (5)	5.41 ± 0.05 h		ϵ 95.9; α 4.1
		210	(5)+	-11.973 (8)	8.1 ± 0.4 h		ϵ 99.82; α 0.18
		211	9/2-	-11.648 (3)	7.214 ± 0.007 h		ϵ 58.2; α 41.8
		212	(1-)	-8.6289 (24)	0.314 ± 0.002 s		α 100; $\epsilon < 0.03$; $\beta^- <$ 2.0E-6
		212m	(9-)	-8.4059 (24)	0.119 ± 0.003 s		$\alpha > 99.00$; $IT < 1.00$
		217	9/2-	4.396 (5)	32.3 ± 0.4 ms		α 99.99; β^- 0.007
		218	0	8.098 (12)	1.5 ± 0.3 s		α 99.9; β^- 0.1
		219	0	10.397 (4)	56 ± 3 s		$\beta^- \approx 3.00$; $\alpha \approx 97.00$
		220	3	14.35 (5)	3.71 ± 0.04 m		β^- 92; α 8
		221	0	16.81 (20)	2.3 ± 0.2 m		β^- 100
		222	0	20.6 (3)	54 ± 10 s		β^- 100
		223	0	23.4 (4)	50 ± 7 s		β^- 100
		224	0	27.71 (6)	76 ± 0 s		β^- ?
86	**Rn**	193	(3/2-)	9.045 (23)	1.15 ± 0.27 ms		α 100
		195	3/2-	5.06 (5)	6 +3-2 ms		α 100
		195m	13/2+	5.12 (5)	5 +3-2 ms		α 100
		196	0+	1.97 (14)	4.4 +1.3-0.9 ms		α 99.9; $\epsilon \approx 0.10$
		197	(3/2-)	1.48 (6)	53 +7-5 ms		α 100; α 100
		198	0+	-1.231 (13)	65 ± 3 ms		α ; ϵ
		199	(3/2-)	-1.51 (6)	0.59 ± 0.03 s		α 94; ϵ 6
		199m	(13/2+)	-1.33 (6)	0.31 ± 0.02 s		α 97; ϵ 3
		200	0+	-4.005 (13)	1.03 +0.2-0.11 s		α 86; ϵ 14
		201	(3/2-)	-4.07 (5)	7.0 ± 0.4 s		α ; ϵ ; α ; ϵ
		202	0+	-6.275 (18)	9.7 ± 0.1 s		α 78; ϵ 22
		203	(3/2-)	-6.16 (24)	44 ± 2 s		α 66; ϵ 34
		203m	(13/2+)	-5.798 (24)	26.9 ± 0.5 s		α 75; ϵ 25
		204	0+	-7.984 (15)	74.5 ± 1.4 s		α 72.4; ϵ 27.6
		205	5/2-	-7.71 (5)	170 ± 4 s		α 24.6; ϵ 75.4
		206	0+	-9.116 (15)	5.67 ± 0.17 m		α 62; ϵ 38
		207	5/2-	-8.635 (8)	9.25 ± 0.17 m		ϵ 79; α 21

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		208	0+	-9.66 (11)	24.35 ± 0.14 m		α 62; ϵ 38
		209	5/2-	-8.929 (20)	28.5 ± 1 m		ϵ 83; α 17
		210	0+	-9.601 (4)	2.4 ± 0.1 h		α 96; ϵ 4
		211	1/2-	-8.756 (7)	14.6 ± 0.2 h		ϵ 72.6; α 27.4
		212	0+	-8.66 (3)	23.9 ± 1.2 m		α 100
		213	(9/2+)	-5.699 (6)	19.5 ± 0.1 ms		α 100
		218	0+	5.2166 (24)	35 ± 5 ms		α 100
		219	5/2+	8.831 (3)	3.96 ± 0.01 s		α 100
		220	0+	10.6075 (22)	55.6 ± 0.1 s		α 100
		221	7/2+	14.474 (6)	25 ± 2 m		β^- 78; α 22
		222	0+	16.3731 (23)	3.8235 ± 3.0E-4 d		α 100
		223	7/2	20.396 (10)	24.3 ± 0.4 m		β^- 100
		224	0+	22.435 (15)	107 ± 3 m		β^- 100
		225	7/2-	26.556 (21)	4.66 ± 0.04 m		β^- 100
		226	0+	28.739 (16)	7.4 ± 0.1 m		β^- 100
		227	0	32.875 (18)	20.8 ± 0.7 s		β^- 100
		228	0+	35.249 (22)	65 ± 2 s		β^- 100
		229	0	39.362 (13)	12.0 +1.2-1.3 s		β^- 100
87	**Fr**	199	0	6.76 (4)	12 +10-4 ms		$\alpha > 0.00$; ϵ
		200	(3+)	6.12 (8)	49 ± 4 ms		α 100
		201	(9/2-)	3.6 (7)	62 ± 5 ms		α 100; α 100
		202	(3+)	3.163 (15)	0.30 ± 0.05 s		α 100; α 100
		203	(9/2-)	0.877 (6)	0.55 ± 0.01 s		$\alpha \leq 100.00$
		204	(3+)	0.607 (25)	1.8 ± 0.3 s		ϵ 8; α 92
		204m	(7+)	0.648 (25)	1.6 +0.5-0.3 s		α 90; ϵ 10
		204m2	(10-)	0.923 (25)	0.8 ± 0.2 s		α 74; ϵ 26
		205	(9/2-)	-1.31 (8)	3.97 ± 0.04 s		α 98.5; ϵ 1.5
		206	(2+,3+)	-1.24 (3)	≈ 16 s		$\alpha \approx 84.00$; $\epsilon \approx 16.00$; $\alpha \approx 84.00$; $\epsilon \approx 16.00$
		206m	(10-)	-0.71 (3)	0.7 ± 0.1 s		IT 95; α 5
		207	9/2-	-2.84 (5)	14.8 ± 0.1 s		α 95; ϵ 5
		208	7+	-2.67 (5)	59.1 ± 0.3 s		α 89; ϵ 11
		209	9/2-	-3.769 (15)	50.5 ± 0.7 s		α 89; ϵ 11
		210	6+	-3.332 (15)	3.18 ± 0.06 m		α 71; ϵ 29
		211	9/2-	-4.14 (12)	3.10 ± 0.02 m		α 87; ϵ 13
		212	5+	-3.516 (9)	20.0 ± 0.6 m		ϵ 57; α 43
		213	9/2-	-3.553 (5)	34.82 ± 0.14 s		α 99.44; ϵ 0.56
		214	(1-)	-0.959 (9)	5.0 ± 0.2 ms		α 100
		214m	(8-)	-0.837 (9)	3.35 ± 0.05 ms		α 100
		218	1-	7.058 (5)	1.0 ± 0.6 ms		α 100
		218m	0	7.144 (5)	22.0 ± 0.5 ms		$\alpha \leq 100.00$; IT
		219	9/2-	8.618 (7)	20 ± 2 ms		α 100
		220	1+	11.48 (4)	27.4 ± 0.3 s		α 99.65; β^- 0.35
		221	5/2-	13.278 (5)	286.1 ± 1 s		α 100; $\beta^- < 0.10$
		222	2-	16.349 (21)	14.2 ± 0.3 m		β^- 100
		223	3/2(-)	18.384 (24)	22.00 ± 0.07 m		β^- 99.99; α 0.006
		224	1-	21.65 (5)	3.33 ± 0.1 m		β^- 100
		225	3/2-	23.82 (3)	3.95 ± 0.14 m		β^- 100
		226	1-	27.37 (10)	49 ± 1 s		β^- 100
		227	1/2+	29.65 (10)	2.47 ± 0.03 m		β^- 100
		228	2-	33.29 (20)	38 ± 1 s		$\beta^- \leq 100.00$
		229	(1/2+)	35.82 (4)	50.2 ± 2 s		β^- 100
		230	0	39.5 (3)	19.1 ± 0.5 s		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		231	(1/2+)	42.3 (3)	17.6 $\pm$ 0.6 s		β^- 100
		232	(5)	46.1 (21)	5.5 $\pm$ 0.6 s		β^- 100
88	**Ra**	201	(13/2+)	11.84 (12)	1.6 +7.7-0.7 ms		α 100; ϵ
		202	0+	9.09 (24)	16 +30-7 ms		α 100
		203	(3/2-)	8.66 (8)	31 +17-9 ms		α 100; α 100
		204	0+	6.056 (15)	57 +11-5 ms		α 100
		205	(3/2-)	5.84 (7)	210 +60-40 ms		$\alpha \leq 100.00$; ϵ ; $\alpha \leq 100.00$; ϵ
		206	0+	3.565 (18)	0.24 $\pm$ 0.02 s		α 100
		207	(3/2- ,5/2-)	3.54 (6)	1.35 +0.22-0.13 s		$\alpha \approx 86.00$; $\epsilon \approx 14.00$
		207m	(13/2+)	4.09 (6)	59 $\pm$ 4 ms		$IT \geq 85.00$; $\alpha \leq 15.00$
		208	0+	1.714 (15)	1.3 $\pm$ 0.2 s		α 95; ϵ 5
		209	5/2-	1.85 (5)	4.6 $\pm$ 0.2 s		$\alpha \approx 90.00$; $\epsilon \approx 10.00$
		210	0+	0.459 (15)	3.7 $\pm$ 0.2 s		$\alpha \approx 96.00$; $\epsilon \approx 4.00$
		211	5/2(-)	0.832 (8)	13 $\pm$ 2 s		$\epsilon < 7.00$; $\alpha > 93.00$
		212	0+	-0.204 (11)	13.0 $\pm$ 0.2 s		$\alpha \approx 85.00$; $\epsilon \approx 15.00$
		213	1/2-	0.358 (20)	2.73 $\pm$ 0.05 m		α 80; ϵ 20
		213m	(17/2-)	2.128 (20)	2.20 $\pm$ 0.05 ms		$IT \approx 99.40$; $\alpha \approx 0.60$
		214	0+	0.096 (5)	2.46 $\pm$ 0.03 s		α 99.94; ϵ 0.06
		215	(9/2+)	2.533 (8)	1.55 $\pm$ 0.07 ms		α 100
		219	(7/2)+	9.393 (8)	10 $\pm$ 3 ms		α 100
		220	0+	10.272 (9)	18 $\pm$ 2 ms		α 100
		221	5/2+	12.963 (5)	28 $\pm$ 2 s		α 100; ^{14}C 1e-12
		222	0+	14.32 (5)	38.0 $\pm$ 0.5 s		α 100; ^{14}C 3e-08
		223	3/2+	17.235 (3)	11.43 $\pm$ 0.05 d		^{14}C 8.9e-08; α 100
		224	0+	18.8213 (22)	3.6319 $\pm$ 0.0023 d		α 100; ^{14}C 4e-09
		225	1/2+	21.995 (3)	14.9 $\pm$ 0.2 d		β^- 100
		226	0+	23.6686 (23)	1600 $\pm$ 7 y		α 100; ^{14}C 3.2e-09
		227	3/2+	27.1785 (23)	42.2 $\pm$ 0.5 m		β^- 100
		228	0+	28.946 (3)	5.75 $\pm$ 0.03 y		β^- 100
		229	5/2+	32.555 (15)	4.0 $\pm$ 0.2 m		β^-
		230	0+	34.516 (10)	93 $\pm$ 2 m		β^- 100
		231	(5/2+)	38.226 (20)	104.1 $\pm$ 0.8 s		β^- 100
		232	0+	40.498 (12)	4.2 $\pm$ 0.8 m		β^- 100
		233	0	44.6 (4)	30 $\pm$ 5 s		β^- 100
		234	0+	47.2 (5)	30 $\pm$ 10 s		β^- 100
89	**Ac**	206	(3+)	13.53 (5)	22 +9-5 ms		α 100; α 100
		207	(9/2-)	11.15 (5)	27 +11-6 ms		α 100
		208	(3+)	10.76 (6)	95 +24-16 ms		$\alpha \approx 99.00$; $\epsilon \approx 1.00$
		208m	(10-)	11.27 (6)	25 +9-5 ms		$\epsilon \approx 10.00$; $\alpha \approx 90.00$
		209	(9/2-)	8.84 (5)	0.10 $\pm$ 0.05 s		$\alpha \approx 99.00$; $\epsilon \approx 1.00$
		210	0	8.79 (6)	0.35 $\pm$ 0.05 s		α 91; $\epsilon \approx 9.00$
		211	0	7.2 (7)	0.21 $\pm$ 0.03 s		α 100
		212	0	7.27 (7)	0.93 $\pm$ 0.05 s		$\alpha \approx 57.00$; $\epsilon \approx 43.00$
		213	0	6.16 (5)	738 $\pm$ 16 ms		$\alpha \leq 100.00$
		214	(5+)	6.445 (15)	8.2 $\pm$ 0.2 s		$\alpha \geq 89.00$; $\epsilon \leq 11.00$
		215	9/2-	6.031 (12)	0.17 $\pm$ 0.01 s		α 99.91; ϵ 0.09
		220	(3-)	13.743 (6)	26.4 $\pm$ 0.2 ms		α 100; ϵ 0.0005
		221	(3/2-)	14.52 (5)	52 $\pm$ 2 ms		α 100
		222	1-	16.621 (5)	5.0 $\pm$ 0.5 s		α 99; ϵ 1; $\alpha \geq 88.00$; $IT \leq 10.00$; $\epsilon \geq 0.70$
		223	(5/2-)	17.826 (7)	2.10 $\pm$ 0.05 m		α 99; ϵ 1
		224	0-	20.232 (4)	2.78 $\pm$ 0.17 h		ϵ 90.9; α 9.1; $\beta^- < 1.60$

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^π	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		225	(3/2-)	21.638 (5)	10.0 $\pm$ 0.1 d		α 100; ^{14}C 4e-12
		226	(1)	24.31 (3)	29.37 $\pm$ 0.12 h		β^- 83; ϵ 17; α 0.006
		227	3/2-	25.8512 (24)	21.772 $\pm$ 0.003 y		β^- 98.62; α 1.38
		228	3+	28.9 (3)	6.15 $\pm$ 0.02 h		β^- 100
		229	(3/2+)	30.75 (3)	62.7 $\pm$ 0.5 m		β^- 100
		230	(1+)	33.8 (3)	122 $\pm$ 3 s		β^- 100; $\beta^- SF$ 1.2e-06
		231	(1/2+)	35.92 (10)	7.5 $\pm$ 0.1 m		β^- 100
		232	(1+)	39.15 (10)	119 $\pm$ 5 s		β^- 100
		233	(1/2+)	41.48 (10)	145 $\pm$ 10 s		β^- 100
		234	0	45.05 (20)	44 $\pm$ 7 s		β^- 100
		235	0	47.6 (3)	60 $\pm$ 4 s		β^- 100
90	**Th**	208	0+	16.68 (3)	1.7 +1.7-0.6 ms		α 100
		209	(5/2-)	16.54 (9)	2.5 +1.7-0.7 ms		α
		210	0+	14.059 (19)	16 $\pm$ 4 ms		α 99; $\epsilon \approx$ 1.00
		211	0	13.91 (7)	0.04 +0.03-0.01 s		α
		212	0+	12.097 (16)	31.7 $\pm$ 1.3 ms		α 100; $\epsilon \approx$ 0.30
		213	0	12.12 (7)	144 $\pm$ 21 ms		$\alpha \leq$ 100.00
		214	0+	10.711 (16)	87 $\pm$ 10 ms		α 100
		215	(1/2-)	10.922 (9)	1.2 $\pm$ 0.2 s		α 100
		216	0+	10.294 (12)	26.0 $\pm$ 0.2 ms		α 100; $\epsilon \approx$ 0.01
		221	(7/2+)	16.937 (9)	1.68 $\pm$ 0.06 ms		α 100
		222	0+	17.202 (12)	2.8 $\pm$ 0.3 ms		α 100
		223	(5/2)+	19.385 (9)	0.60 $\pm$ 0.02 s		α 100
		224	0+	19.995 (11)	0.81 $\pm$ 0.1 s		α 100
		225	(3/2+)	22.309 (5)	8.75 $\pm$ 0.04 m		$\alpha \approx$ 90.00; $\epsilon \approx$ 10.00
		226	0+	23.196 (5)	30.57 $\pm$ 0.1 m		α 100
		227	1/2+	25.806 (3)	18.68 $\pm$ 0.09 d		α 100
		228	0+	26.7663 (22)	1.9116 $\pm$ 0.0016 y		α 100; ^{20}O 1e-11
		229	5/2+	29.588 (3)	7932 $\pm$ 28 y		α 100
		229m	(3/2+)	29.588 (3)	2 $\pm$ 1 m		IT ?
		230	0+	30.8633 (18)	7.54E+4 $\pm$ 0.03E+4 y		α 100; ^{24}Ne 6e-11; $SF \leq$ 4E-12
		231	5/2+	33.8166 (18)	25.52 $\pm$ 0.01 h		β^- 100; $\alpha \approx$ 4E-11
		232	0+	35.4526 (22)	1.40E10 $\pm$ 0.01E10 y	100%	α 100; SF 1.1e-09
		233	1/2+	38.7376 (22)	21.83 $\pm$ 0.04 m		β^- 100
		234	0+	40.615 (4)	24.10 $\pm$ 0.03 d		β^- 100
		235	(1/2+)	44.26 (5)	7.2 $\pm$ 0.1 m		β^- 100
		236	0+	46.45 (20)	37.3 $\pm$ 1.5 m		β^- 100
		237	(5/2+)	50.2 (4)	4.7 $\pm$ 0.6 m		β^- 100
		238	0+	52.6 (3)	9.4 $\pm$ 2 m		β^- 100
91	**Pa**	212	0	21.61 (7)	5.1 +6.1-1.9 ms		α 100
		213	0	19.66 (7)	5.3 +4-1.6 ms		α 100
		214	0	19.49 (8)	17 $\pm$ 3 ms		$\alpha \leq$ 100.00
		215	0	17.87 (9)	14 $\pm$ 2 ms		α 100
		216	0	17.8 (7)	0.15 +0.06-0.04 s		$\alpha \approx$ 98.00; $\epsilon \approx$ 2.00
		217	0	17.07 (5)	3.6 $\pm$ 0.8 ms		α 100
		217m	0	18.92 (5)	1.2 $\pm$ 0.2 ms		α 73; IT 27
		222	0	22.12 (7)	2.9 +0.6-0.4 ms		α 100
		223	0	22.32 (7)	5.1 $\pm$ 0.6 ms		α 100
		224	0	23.861 (8)	0.85 $\pm$ 0.02 s		α 100
		225	0	24.34 (7)	1.7 $\pm$ 0.2 s		α 100
		226	0	26.032 (11)	1.8 $\pm$ 0.2 m		α 74; ϵ 26
		227	(5/2-)	26.831 (7)	38.3 $\pm$ 0.3 m		α 85; ϵ 15

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		228	3+	28.921 (4)	22.4 $\pm$ 1 h		α 1.85; ϵ 98.15
		229	(5/2+)	29.898 (3)	1.50 $\pm$ 0.05 d		ϵ 99.52; α 0.48
		230	(2-)	32.174 (3)	17.4 $\pm$ 0.5 d		ϵ 92.2; β^- 7.8; α 0.0032
		231	3/2-	33.4259 (22)	3.276E+4 $\pm$ 0.011E+4 y		α 100; $SF \leq$ 2E-11
		232	(2-)	35.942 (8)	1.32 $\pm$ 0.02 d		β^- 100; ϵ
		233	3/2-	37.4915 (21)	26.975 $\pm$ 0.013 d		β^- 100
		234	4+	40.342 (5)	6.70 $\pm$ 0.05 h		β^- 100
		234m	(0-)	40.416 (5)	1.159 $\pm$ 0.011 m		β^- 99.84; IT 0.16
		235	(3/2-)	42.33 (5)	24.44 $\pm$ 0.11 m		β^- 100
		236	1(-)	45.35 (20)	9.1 $\pm$ 0.1 m		β^- 100
		237	(1/2+)	47.64 (10)	8.7 $\pm$ 0.2 m		β^- 100
		238	(3-)	50.77 (6)	2.27 $\pm$ 0.09 m		β^- 100
		239	(3/2)	53.34 (20)	1.8 $\pm$ 0.5 h		β^- 100
92	**U**	217	0	22.71 (9)	16 +21-6 ms		$\alpha \leq$ 100.00
		225	0	27.376 (12)	95 $\pm$ 15 ms		α 100
		226	0+	27.328 (13)	0.35 $\pm$ 0.15 s		α 100
		227	(3/2+)	29.021 (17)	1.1 $\pm$ 0.1 m		α 100
		228	0+	29.224 (15)	9.1 $\pm$ 0.2 m		$\alpha >$ 95.00; $\epsilon <$ 5.00
		229	(3/2+)	31.21 (6)	58 $\pm$ 3 m		$\epsilon \approx$ 80.00; $\alpha \approx$ 20.00
		230	0+	31.614 (5)	20.8 $\pm$ 0 d		α 100; $SF <$ 1E-10; ^{22}Ne 5e-12
		231	(5/2-)	33.808 (3)	4.2 $\pm$ 0.1 d		ϵ 100; $\alpha \approx$ 4.0E-3
		232	0+	34.6048 (22)	68.9 $\pm$ 0.4 y		α 100; SF 3e-12
		233	5/2+	36.921 (3)	1.592E+5 $\pm$ 0.002E+5 y		α 100; ^{24}Ne 9e-10; $SF <$ 6E-11; $^{28}Mg <$ 1.E-13
		234	0+	38.148 (18)	2.455E+5 $\pm$ 0.006E+5 y	0.0054% $\pm$ 0.0005%	Ne 9e-12; α 100; SF 1.6e-09; Mg 1e-11
		235	7/2-	40.9218 (18)	7.04E+8 $\pm$ 0.01E+8 y	0.7204% $\pm$ 0.0006%	α 100; SF 7e-09; ^{28}Mg 8e-10; $Ne \approx$ 8.E-10
		235m	1/2+	40.9219 (18)	$\approx$ 26 m		IT 100
		236	0+	42.4476 (18)	2.342E7 $\pm$ 0.004E7 y		α 100; SF 9.4e-08
		237	1/2+	45.3932 (19)	6.75 $\pm$ 0.01 d		β^- 100
		238	0+	47.31 (19)	4.468E9 $\pm$ 0.003E9 y	99.2742% $\pm$ 0.001%	α 100; SF 5.5e-05
		239	5/2+	50.575 (19)	23.45 $\pm$ 0.02 m		β^- 100
		240	0+	52.716 (5)	14.1 $\pm$ 0.1 h		β^- 100
		242	0+	58.62 (20)	16.8 $\pm$ 0.5 m		β^- 100
93	**Np**	226	0	32.74 (9)	35 $\pm$ 10 ms		α 100
		227	0	32.56 (7)	0.51 $\pm$ 0.06 s		α 100
		228	0	33.59 (5)	61.4 $\pm$ 1.4 s		ϵ 60; α 40
		229	0	33.78 (9)	4.0 $\pm$ 0.2 m		α 68; ϵ 32
		230	0	35.24 (5)	4.6 $\pm$ 0.3 m		$\epsilon \leq$ 97.00; $\alpha \geq$ 3.00
		231	(5/2)	35.62 (5)	48.8 $\pm$ 0.2 m		ϵ 98; α 2
		232	(4+)	37.35 (10)	14.7 $\pm$ 0.3 m		ϵ 100; α 0.0002
		233	(5/2+)	37.95 (5)	36.2 $\pm$ 0.1 m		ϵ 100; $\alpha \leq$ 1.0E-3
		234	(0+)	39.958 (9)	4.4 $\pm$ 0.1 d		ϵ 100
		235	5/2+	41.0458 (20)	396.1 $\pm$ 1.2 d		ϵ 100; α 0.0026
		236	(6-)	43.37 (5)	153E+3 $\pm$ 5E+3 y		ϵ 86.3; β^- 13.5; α 0.16; β^- 50; ϵ 50
		237	5/2+	44.8746 (18)	2.144E+6 $\pm$ 0.007E+6 y		α 100; $SF \leq$ 2E-10
		238	2+	47.4576 (18)	2.117 $\pm$ 0.002 d		β^- 100
		239	5/2+	49.3137 (21)	2.356 $\pm$ 0.003 d		β^- 100
		240	(5+)	52.316 (15)	61.9 $\pm$ 0.2 m		β^- 100; β^- 99.88; IT 0.12
		241	5/2+	54.26 (7)	13.9 $\pm$ 0.2 m		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		242	(1+)	57.42 (20)	2.2 $\pm$ 0.2 m		β^- 100; β^- 100
		243	(5/2-)	59.88 (3)	1.85 $\pm$ 0.15 m		β^- 100
		244	(7-)	63.2 (3)	2.29 $\pm$ 0.16 m		β^- 100
94	**Pu**	228	0+	36.08 (3)	1.1 +2-0.5 s		α 100
		229	(3/2+)	37.39 (5)	67 +41-19 s		ϵ 50; α 50; $SF < 7.00$
		230	0+	36.933 (15)	102 $\pm$ 10 s		$\alpha \leq 100.00$
		231	(3/2+)	38.28 (3)	8.6 $\pm$ 0.5 m		$\epsilon \leq 99.80$; $\alpha > 0.20$
		232	0+	38.365 (18)	33.8 $\pm$ 0.7 m		ϵ 90; α 10
		233	0	40.05 (5)	20.9 $\pm$ 0.4 m		ϵ 99.88; α 0.12
		234	0+	40.349 (7)	8.8 $\pm$ 0.1 h		$\alpha \approx 6.00$; $\epsilon \approx 94.00$
		235	(5/2+)	42.184 (21)	25.3 $\pm$ 0.5 m		ϵ 100; α 0.0028
		236	0+	42.8968 (22)	2.858 $\pm$ 0.008 y		α 100; SF 1.9e-07
		237	7/2-	45.0946 (22)	45.64 $\pm$ 0.04 d		ϵ 100; α 0.0042
		237m	1/2+	45.2406 (22)	0.18 $\pm$ 0.02 s		IT
		238	0+	46.1661 (18)	87.7 $\pm$ 0.1 y		α 100; SF 1.9e-07
		239	1/2+	48.5912 (18)	24110 $\pm$ 30 y		SF 3e-10; α 100
		240	0+	50.1283 (18)	6561 $\pm$ 7 y		α 100; SF 5.7e-06
		241	5/2+	52.9581 (18)	14.325 $\pm$ 0.006 y		β^- 100; α 0.0025; $SF <$ 2E-14
		242	0+	54.7196 (19)	3.75E+5 $\pm$ 0.02E+5 y		α 100; SF 0.00055
		243	7/2+	57.757 (3)	4.956 $\pm$ 0.003 h		β^- 100
		244	0+	59.807 (5)	8.00E+7 $\pm$ 0.09E+7 y		SF 0.12; α 99.88
		245	(9/2-)	63.179 (14)	10.5 $\pm$ 0.1 h		β^- 100
		246	0+	65.396 (15)	10.84 $\pm$ 0.02 d		β^- 100
		247	0	69.11 (20)	2.27 $\pm$ 0.23 d		β^- 100
95	**Am**	230	0	()	$\approx$ 17 s		ϵ 100
		232	0	43.4 (3)	79 $\pm$ 2 s		$\epsilon \approx 97.00$; $\alpha \approx 3.00$
		233	0	43.17 (10)	3.2 $\pm$ 0.8 m		$\alpha > 3.00$; ϵ
		234	0	44.53 (21)	2.32 $\pm$ 0.08 m		ϵ 100; α
		235	5/2-	44.63 (5)	10.3 $\pm$ 0.6 m		ϵ 99.6; α 0.4
		236	5-	46.04 (11)	3.6 $\pm$ 0.2 m		α ; ϵ ; α ; ϵ
		237	5/2(-)	46.57 (6)	73.6 $\pm$ 0.8 m		ϵ 99.97; α 0.03
		238	1+	48.42 (5)	98 $\pm$ 2 m		α 0.0001; ϵ 100
		239	(5/2)-	49.3931 (24)	11.9 $\pm$ 0.1 h		ϵ 99.99; α 0.01
		240	(3-)	51.513 (14)	50.8 $\pm$ 0.3 h		ϵ 100; α 0.00019
		241	5/2-	52.9373 (18)	432.6 $\pm$ 0.6 y		α 100; SF 4e-10
		242	1-	55.471 (18)	16.02 $\pm$ 0.02 h		β^- 82.7; ϵ 17.3
		242m	5-	55.5196 (18)	141 $\pm$ 2 y		IT 99.55; α 0.45; $SF <$ 4.7E-9
		242m2	(2+,3-)	57.671 (18)	14.0 $\pm$ 1 ms		SF 100; IT ; $\alpha <$ 5.0E-3
		243	5/2-	57.1774 (23)	7370 $\pm$ 40 y		α 100; SF 3.7e-09
		244	(6-)	59.8823 (21)	10.1 $\pm$ 0.1 h		β^- 100; $SF \leq 100.00$
		244m	1+	59.9684 (21)	26 $\pm$ 1 m		ϵ 0.04; β^- 99.96
		245	(5/2)+	61.901 (3)	2.05 $\pm$ 0.01 h		β^- 100
		246	(7-)	64.996 (18)	39 $\pm$ 3 m		β^- 100; β^- 100; $IT <$ 0.02
		247	(5/2)	67.16 (10)	23.0 $\pm$ 1.3 m		β^- 100
		248	0	70.56 (20)	$\approx$ 10 m		β^- 100
96	**Cm**	233	(3/2+)	47.29 (7)	23 +13-6 s		ϵ 80; α 20
		234	0+	46.723 (18)	51 $\pm$ 12 s		$SF \approx 40.00$; $\epsilon \approx 20.00$; $\alpha \approx 40.00$
		238	0+	49.444 (12)	2.4 $\pm$ 0.1 h		$\epsilon \geq 90.00$; $\alpha \leq 10.00$
		239	(7/2-)	51.15 (5)	$\approx$ 2.9 h		ϵ 100; $\alpha < 0.10$

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		240	0+	51.7195 (23)	27 ± 1 d		SF 3.9e-06; α > 99.50; ϵ < 0.50
		241	1/2+	53.7047 (22)	32.8 ± 0.2 d		ϵ 99; α 1
		242	0+	54.8066 (18)	162.8 ± 0.2 d		α 100; SF 6.2e-06; ^{34}Si 1e-14
		243	5/2+	57.1849 (21)	29.1 ± 0.1 y		ϵ 0.29; SF 5.3e-09; α 99.71
		244	0+	58.455 (18)	18.1 ± 0.1 y		α 100; SF 0.00014
		244m	6+	59.4952 (18)	34 ± 2 ms		IT 100
		245	7/2+	61.006 (21)	8423 ± 74 y		α 100; SF 6.1e-07
		246	0+	62.6197 (21)	4706 ± 40 y		α 99.97; SF 0.03
		247	9/2-	65.535 (4)	1.56E+7 ± 0.05E+7 y		α 100
		248	0+	67.394 (5)	3.48E+5 ± 0.06E+5 y		SF 8.39; α 91.61
		249	1/2+	70.751 (5)	64.15 ± 0.03 m		β^- 100
		250	0+	72.99 (11)	≈ 8.3E+3 y		SF ≈ 74.00; α ≈ 18.00; β^- ≈ 8.00
		251	(1/2+)	76.65 (23)	16.8 ± 0.2 m		β^- 100
		252	0+	79.1 (3)	< 2 d		
97	**Bk**	234	0	()	1.4E2 +1.4E2-0.5E2 s		$\alpha \geq$ 80.00; $\epsilon \leq$ 20.00
		237	0	53.1 (22)	≈ 1 m		ϵ ?; α ?
		238	0	54.3 (3)	144 ± 5 s		ϵ 100; ϵSF 0.048
		240	0	55.66 (15)	4.8 ± 0.8 m		ϵ ; ϵSF 0.002
		241	(7/2+)	56.11 (20)	4.6 ± 0.4 m		α ; ϵ
		242	0	57.74 (20)	7.0 ± 1.3 m		$\epsilon \leq$ 100.00
		243	(3/2-)	58.692 (5)	4.5 ± 0.2 h		ϵ ≈ 99.85; α ≈ 0.15
		244	(4-)	60.717 (14)	4.35 ± 0.15 h		ϵ 99.99; α 0.006
		245	3/2-	61.8168 (23)	4.95 ± 0.03 d		ϵ 99.88; α 0.12
		246	2(-)	63.97 (6)	1.80 ± 0.02 d		ϵ 100
		247	(3/2-)	65.492 (6)	1380 ± 250 y		$\alpha \leq$ 100.00
		248	0	68.08 (7)	> 9 y		α ; β^- 70; ϵ 30
		249	7/2+	69.851 (3)	330 ± 4 d		β^- 100; α 0.0014; SF 4.7e-08
		250	2-	72.953 (4)	3.212 ± 0.005 h		β^- 100
		251	(3/2-)	75.23 (11)	55.6 ± 1.1 m		β^- 100
98	**Cf**	237	(3/2+)	57.94 (9)	0.8 ± 0.2 s		SF 70; α 30
		238	0+	57.2 (4)	21 ± 2 ms		SF 100
		239	0	58.14 (21)	39 +37-12 s		ϵ ; α
		240	0+	58.01 (3)	64 ± 9 s		α 98.5; SF 1.5
		241	(7/2-)	59.33 (17)	3.78 ± 0.7 m		ϵ ≈ 75.00; α ≈ 25.00
		242	0+	59.386 (13)	3.7 ± 0.5 m		ϵ 20; $SF \leq$ 0.01; α 80
		243	(1/2+)	60.9 (11)	10.7 ± 0.5 m		ϵ ≈ 86.00; α ≈ 14.00
		244	0+	61.473 (3)	19.4 ± 0.6 m		$\alpha \leq$ 100.00
		245	1/2+	63.388 (3)	45.0 ± 1.5 m		ϵ 64.7; α 35.3
		246	0+	64.0931 (21)	35.7 ± 0.5 h		α 100; ϵ < 4.0E-3; SF 0.00024
		247	(7/2+)	66.104 (15)	3.11 ± 0.03 h		ϵ 99.97; α 0.04
		248	0+	67.241 (5)	333.5 ± 2.8 d		α 100; SF 0.0029
		249	9/2-	69.7269 (22)	351 ± 2 y		α 100; SF 5e-07
		250	0+	71.173 (21)	13.08 ± 0.09 y		α 99.92; SF 0.08
		251	1/2+	74.137 (4)	898 ± 44 y		α 100; SF
		252	0+	76.035 (5)	2.645 ± 0.008 y		α 96.91; SF 3.09
		253	(7/2+)	79.302 (6)	17.81 ± 0.08 d		β^- 99.69; α 0.31
		254	0+	81.342 (12)	60.5 ± 0.2 d		SF 99.69; α 0.31
		255	(7/2+)	84.81 (20)	85 ± 18 m		β^- 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		256	0+	87 (3)	12.3 ± 1.2 m		SF 100; β^- < 1.00; $\alpha \approx$ 1.0E-6
99	**Es**	241	0	63.84 (23)	8 +6-5 s		ϵ ; α
		242	0	64.9 (3)	17.8 ± 1.6 s		α 57; ϵ 43
		243	(7/2+)	64.75 (21)	23 ± 3 s		α 61; ϵ 39; SF < 1.00
		244	0	66.02 (18)	37 ± 4 s		ϵ 96; α 4
		245	(3/2-)	66.44 (20)	1.1 ± 0.1 m		α 40; ϵ 60
		246	0	67.9 (22)	7.5 ± 0.5 m		ϵ 90.1; α 9.9
		247	(7/2+)	68.578 (19)	4.55 ± 0.26 m		$\epsilon \approx$ 93.00; $\alpha \approx$ 7.00; α
		248	(2-,0+)	70.3 (5)	27 ± 5 m		ϵ 99.7; $\alpha \approx$ 0.25
		249	7/2+	71.18 (3)	102.2 ± 0.6 m		ϵ 99.43; α 0.57
		250	(6+)	73.23 (10)	8.6 ± 0.1 h		ϵ > 97.00; α < 3.00; $\epsilon \leq$ 100.00
		251	(3/2-)	74.514 (6)	33 ± 1 h		ϵ 99.5; α 0.5
		252	(5-)	77.3 (5)	471.7 ± 1.9 d		α 78; ϵ 22
		253	7/2+	79.015 (3)	20.47 ± 0.03 d		SF 8.7e-06; α 100
		254	(7+)	81.993 (4)	275.7 ± 0.5 d		SF < 3.0E-6; α 100; β^- 0.00017
		254m	2+	82.077 (4)	39.3 ± 0.2 h		β^- 98; IT < 3.00; α 0.32; ϵ 0.08; SF < 0.05
		255	(7/2+)	84.091 (11)	39.8 ± 1.2 d		β^- 92; α 8; SF 0.0041
		256	(1+,0-)	87.19 (10)	25.4 ± 2.4 m		β^- 100; β^- 100
		257	0	89.4 (4)	7.7 ± 0.2 d		β^- ; SF
100	**Fm**	243	(7/2+)	69.26 (22)	231 ± 9 ms		ϵ < 10.00; α 91; SF 9
		244	0+	68.98 (20)	3.12 ± 0.08 ms		SF > 97.00; ϵ < 2.00; α < 1.00
		245	0	70.19 (20)	4.2 ± 1.3 s		$\alpha \leq$ 100.00
		246	0+	70.187 (15)	1.54 ± 0.04 s		α 93.2; SF 6.8; $\epsilon \leq$ 1.30
		247	(7/2+)	71.58 (12)	31 ± 1 s		$\alpha \geq$ 84.00; $\epsilon \leq$ 16.00
		247m	(1/2+)	71.63 (12)	5.1 ± 0.2 s		α 84
		248	0+	71.894 (9)	36 ± 2 s		α 93; ϵ 7; SF 0.1
		249	(7/2+)	73.521 (6)	2.6 ± 0.7 m		ϵ 67; α 33
		250	0+	74.074 (8)	30 ± 3 m		α > 90.00; ϵ < 10.00; SF 0.0069; IT 100
		251	(9/2-)	75.954 (15)	5.30 ± 0.08 h		ϵ 98.2; α 1.8
		252	0+	76.819 (6)	25.39 ± 0.04 h		SF 0.0023; α 100
		253	(1/2)+	79.35 (3)	3.00 ± 0.12 d		ϵ 88; α 12
		254	0+	80.905 (3)	3.240 ± 0.002 h		α 99.94; SF 0.06
		255	7/2+	83.802 (5)	20.07 ± 0.07 h		α 100; SF 2.4e-05
		256	0+	85.487 (7)	157.6 ± 1.3 m		SF 91.9; α 8.1
		257	(9/2+)	88.591 (6)	100.5 ± 0.2 d		α 99.79; SF 0.21
		259	0	93.7 (3)	1.5 ± 0.3 s		SF 100
		260	0+	95.8 (5)	≈ 4 ms		SF 100
101	**Md**	245m	(7/2)	75.6 (3)	0.35 +0.23-0.16 s		ϵ ; α
		246	0	76.2 (3)	0.9 ± 0.2 s		α < 23.00; SF ?; ϵ ?; α 100; ϵ > 77.00
		247	(7/2-)	75.94 (21)	1.2 ± 0.1 s		α 99.9; SF < 0.10; α 79; SF 21
		248	0	77.14 (24)	13 +15-4 s		α 58; ϵ 42
		249	(7/2-)	77.32 (22)	21.7 ± 2 s		α > 60.00; $\epsilon \leq$ 40.00; α ?
		250	0	78.6 (3)	25 +10-5 s		ϵ 93; α 7
		251	(7/2-)	78.967 (19)	4.3 ± 0.6 m		ϵ 90; α 10
		252	0	80.51 (13)	2.3 ± 0.8 m		$\epsilon \leq$ 100.00
		253	(7/2-)	81.18 (3)	6 +12-3 m		$\epsilon \leq$ 100.00; α

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		254	0	83.52 (10)	28 ± 8 m		$\epsilon \leq 100.00$; $\epsilon \leq 100.00$
		255	(7/2-)	84.844 (7)	27 ± 2 m		ϵ 92; α 8; $SF < 0.15$
		256	(1-)	87.61 (7)	77 ± 2 m		ϵ 90.8; α 9.2; $SF < 3.00$
		257	(7/2-)	88.998 (3)	5.52 ± 0.05 h		ϵ 85; α 15; $SF < 1.00$
		258	0	91.689 (5)	51.5 ± 0.3 d		α 100; SF ; $\epsilon \geq 70.00$; SF
		259	0	93.63 (20)	96 ± 3 m		SF 100; $\alpha < 1.30$
		260	0	96.6 (3)	31.8 ± 0.5 d		$SF \geq 42.00$; $\alpha \leq 25.00$; $\epsilon \leq 23.00$; $\beta^- \leq 10.00$
102	**No**	251	(7/2+)	82.76 (11)	0.80 ± 0.01 s		α 84; $SF < 0.30$; ϵ
		251m	(1/2+)	82.87 (11)	1.02 ± 0.03 s		α 100
		252	0+	82.868 (9)	2.47 ± 0.02 s		$\epsilon < 1.10$; α 70.7; SF 29.3; IT 100.1
		253	(9/2-)	84.361 (7)	1.62 ± 0.15 m		$\alpha \approx 80.00$; ϵ
		254	0+	84.725 (10)	51 ± 10 s		α 90; ϵ 10; SF 0.17; $IT >$ 80.00
		255	1/2+	86.807 (15)	3.52 ± 0.21 m		ϵ 70; α 30
		256	0+	87.825 (8)	2.91 ± 0.05 s		SF 0.53; α 99.47
		257	(7/2+)	90.251 (7)	25 ± 3 s		$\alpha \leq 100.00$; $SF \leq 1.50$
		258	0+	91.48 (20)	1.2 ± 0.2 ms		$SF \leq 100.00$
		259	0	94.11 (10)	58 ± 5 m		α 75; ϵ 25; $SF < 10.00$
		260	0+	95.61 (20)	106 ± 8 ms		SF 100
		262	0+	100.1 (4)	≈ 5 ms		SF 100
103	**Lr**	252	0	88.7 (3)	0.27 +0.18-0.08 s		α 100; ϵ
		253	(7/2-)	88.67 (23)	0.57 +0.07-0.06 s		$\alpha \approx 98.70$; $SF \approx 1.30$; α 92; SF 8
		254	0	89.9 (3)	18.4 ± 1.8 s		α 71.7; ϵ 28.3
		255	1/2-	89.947 (18)	31.1 ± 1.3 s		α 85; ϵ 15
		255m	7/2-	89.984 (18)	2.53 ± 0.13 s		IT 60; α 40
		256	0	91.75 (8)	27 ± 3 s		α 85; ϵ 15; $SF < 0.03$
		257	0	92.61 (4)	≈ 4 s		$\alpha \leq 100.00$
		258	0	94.85 (10)	4.1 ± 0.3 s		$SF < 5.00$; $\alpha > 95.00$
		259	0	95.85 (7)	6.2 ± 0.3 s		α 78; SF 22
		260	0	98.27 (12)	180 ± 30 s		α 80; $\epsilon < 40.00$; $SF <$ 10.00
		261	0	99.56 (20)	39 ± 12 m		SF 100
		262	0	101.96 (20)	≈ 4 h		$SF < 10.00$; ϵ ; α
104	**Rf**	255	(9/2-)	94.24 (12)	2.3 +0.8-0.5 s		α 52; SF 48; ϵ ? 1.00
		256	0+	94.218 (18)	6.4 ± 0.2 ms		SF 99.68; α 0.32
		257	(1/2+)	95.868 (11)	4.7 ± 0.3 s		$\alpha < 100.00$; $SF \leq 1.40$; $\epsilon > 0.00$; $\epsilon > 0.00$; $\alpha <$ 100.00; $SF \leq 1.40$
		258	0+	96.34 (3)	14.7 +1.2-1 ms		SF 69; α 31
		259	0	98.36 (7)	3.2 ± 0.6 s		α 92; SF 8; ϵ 15
		260	0+	99.15 (20)	21 ± 1 ms		$SF \leq 100.00$; α ?
		261	0	101.32 (4)	1.9 ± 0.4 s		$\epsilon < 15.00$; $SF < 11.00$; SF 73; α 27; $\alpha > 74.00$
		262	0+	102.4 (3)	2.3 ± 0.4 s		$SF \leq 100.00$; $\alpha < 3.00$
		263	0	104.84 (18)	10 ± 2 m		SF 100; α
105	**Db**	255	0	99.7 (4)	1.6 +0.6-0.4 s		α 80; $SF \approx 20.00$
		256	0	100.5 (3)	1.9 ± 0.4 s		$\alpha \approx 70.00$; $\epsilon \approx 30.00$; $SF \approx 0.02$
		257	(9/2+)	100.3 (23)	1.82 +0.27-0.21 s		α 94; $SF \approx 6.00$; SF ; α 100

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		258	0	101.8 (3)	4.2 +0.4-0.3 s		α 65; ϵ 35; SF < 1.00; ϵ 100
		259	0	101.99 (5)	0.51 $\pm$ 0.16 s		α
		260	0	103.36 (9)	1.52 $\pm$ 0.13 s		$\alpha \geq$ 90.40; $SF \leq$ 9.60; $\epsilon <$ 2.50
		261	0	104.25 (11)	1.8 $\pm$ 0.4 s		$\alpha \geq$ 82.00; $SF \leq$ 18.00
		262	0	106.28 (18)	35 $\pm$ 5 s		$\alpha \approx$ 67.00; SF
		263	0	107.11 (17)	27 +10-7 s		SF 55; α 41; ϵ 3
		267	0	114.2 (5)	73 $\pm$ 0 m		SF 100
		268	0	117 (5)	32 +11-7 h		SF 100
		270	0	122 (6)	23 $\pm$ 0 h		SF 100; α
106	**Sg**	258	0+	105.3 (4)	2.9 +1.3-0.7 ms		$SF \leq$ 100.00; α ?
		259	(1/2+)	106.49 (12)	0.32 +0.08-0.06 s		α 96; SF 4; α <100
		260	0+	106.544 (21)	3.6 $\pm$ 0.9 ms		α 50; SF 50; SF 71; α 29
		261	0	108.007 (19)	0.23 $\pm$ 0.06 s		α 100; SF < 1.00
		262	0+	108.37 (20)	6.9 +3.8-1.8 ms		$SF \geq$ 78.00; $\alpha \leq$ 22.00
		263	0	110.19 (10)	1.0 $\pm$ 0.2 s		α > 70.00; SF < 30.00; IT ; α
		264	0+	110.8 (3)	37 +27-11 ms		SF 100; α < 36.00
		265	0	112.81 (12)	16.2 +4.7-3.5 s		$\alpha \geq$ 65.00; $SF \leq$ 35.00;
		266	0+	113.7 (3)	21 +20-12 s		SF > 50.00; α > 18.00
		271	0	124.4 (6)	2.4 +4.3-1 m		$\alpha \approx$ 50.00; $SF \approx$ 50.00
107	**Bh**	260	0	113.3 (3)	35 +19-9 ms		$\alpha \leq$ 100.00
		261	0	113.22 (23)	11.8 +3.9-2.4 ms		α 100
		262	0	114.5 (3)	22 $\pm$ 4 ms		α < 100.00; α < 100.00
		264	0	115.75 (18)	0.44 +0.6-0.16 s		$\alpha \leq$ 100.00
		265	0	116.36 (23)	0.9 +0.7-0.3 s		α
		266	0	118.23 (20)	1.7 +8.2-0.8 s		α 100
		267	0	118.9 (3)	17 +14-6 s		α 100
		270	0	124.2 (4)	6E+1 +29E+1-3E+1 s		α
		272	0	128.6 (5)	10 +12-4 s		α 100
		274	0	133.3 (6)	0.9 +4.2-0.4 m		α 100; SF
108	**Hs**	265	0	121.17 (5)	1.9 $\pm$ 0.2 ms		$SF \leq$ 1.00; α < 100.00
		266	0+	121.13 (20)	2.3 +1.3-0.6 ms		α 100; SF < 1.40
		267	(3/2+)	122.65 (10)	52 +13-8 ms		$\alpha \geq$ 80.00; SF < 20.00; α 100
		268	0+	122.8 (3)	0.4 +1.8-0.2 s		α
		269	0	124.61 (12)	3.6 +0.8-1.4 s		α 100; α 100
		270	0+	125.1 (3)	22 $\pm$ 0 s		α 100
		275	0	136.3 (6)	0.15 +0.27-0.06 s		α 100
109	**Mt**	266	0	128 (3)	1.7 +1.8-1.6 ms		$\alpha \leq$ 100.00
		268	0	128.91 (23)	21 +8-5 ms		α 100
		270	0	130.84 (20)	5.0 +2.4-0.3 ms		α 100
		274	0	137.1 (4)	0.44 +0.81-0.17 s		α 100; SF
		275	0	138.4 (6)	9.7 $\pm$ 0 ms		α 100
		276	0	140.9 (5)	0.72 +0.87-0.25 s		α 100
		278	0	145.1 (6)	8 +37-4 s		α 100; SF
110	**Ds**	270m	0	135.88 (21)	6.0 +8.2-2.2 ms		α > 70.00; $IT \leq$ 30.00
		271	0	135.95 (10)	1.63 +0.44-0.29 ms		α 100; α > 0.00; IT ?
		279	0	148.6 (6)	0.18 +0.05-0.03 s		$SF \approx$ 90.00; $\alpha \approx$ 10.00
		281	0	152.4 (7)	20 +20-7 s		SF 85; α 15; SF 100
111	**Rg**	272	0	142.8 (3)	3.8 +1.4-0.8 ms		α 100
		274	0	144.74 (21)	6.4 $\pm$ 0 ms		α 100
		278	0	150.4 (4)	4.2 +7.6-1.7 ms		α 100; SF

Continued on next page

Table 10.1 – *Continued from previous page*

Z	El	A	J^{π}	Δ[MeV]	$T_{1/2}, \Gamma$	Abundance	Decay Mode
		279	0	151.3 (6)	0.17 +0.81-0.08 s		α 100
		280	0	153.4 (5)	3.6 +4.3-1.3 s		α 100
		281	0	154.6 (9)	26 +25-8 s		SF 100; α
		282	0	156.7 (6)	0.5 +2.5-0.2 s		α 100; SF
112	**Cn**	283	0	160.7 (6)	4.0 +1.3-0.7 s		$\alpha \geq$ 90.00; $SF \leq$ 10.00; SF 50; α 50
		284	0	161.5 (8)	101 +41-22 ms		SF 100
		285	0	164.1 (7)	30 +30-10 s		α 100
113	**13**	282	0	163.6 (4)	0.07 +0.13-0.03 s		α 100
		283	0	164 (6)	100 ± 0 ms		α 100
		284	0	166 (5)	0.48 +0.58-0.17 s		α 100
		285	0	166.9 (9)	5.5 +5-1.8 s		α 100; SF
		286	0	168.9 (6)	20 +94-9 s		α 100; SF
114	**14**	286	0+	171 (7)	0.16 +0.07-0.03 s		$SF \approx$ 60.00; $\alpha \approx$ 40.00
		287	0	173.2 (6)	0.51 +0.18-0.1 s		α 100
		288	0+	174 (8)	0.52 +0.22-0.13 s		α 100
		289	0	176.5 (7)	0.97 +0.97-0.32 s		α 100; α 100
115	**15**	287	0	177.2 (6)	32 ± 0 ms		α 100
		288	0	179 (6)	87 ± 0 ms		α 100
		289	0	179.8 (9)	0.22 +0.26-0.08 s		α 100; SF
		290	0	181.6 (6)	16 +76-7 ms		α 100; SF
116	**16**	290	0+	184.4 (7)	15 +26-6 ms		α 100
		291	0	186.6 (6)	6.3 ± 0 ms		α 100
		292	0+	187.2 (9)	18 +16-6 ms		α 100
		293	0	189.6 (7)	53 +62-19 ms		α 100
117	**17**	293	0	193.4 (9)	14 +11-4 ms		α 100; SF
		294	0	195.1 (7)	0.08 +0.37-0.04 s		α 100

Chapter 11

Properties of fissile nuclides

Fission-related properties for fissile nuclides and elements are listed in the following tables. For each nuclide the following properties are listed:

- Number of neutrons per fission (ν), MF=1, MT=452†.
- Fission cross section evaluated at $E = 25.3$ meV (2200 m/s)‡.
- Resonance resonance integral‡.
- Components of energy release from fission, MF=1, MT=458:

  E_{FR}: Kinetic energy of fission products [MeV].
  E_{NP}: Kinetic energy of prompt fission neutrons [MeV].
  E_{ND}: Kinetic energy of delayed fission neutrons [MeV].
  E_{GP}: Total energy released by emission of prompt γ rays [MeV].
  E_{GD}: Total energy released by emission of prompt γ rays [MeV].
  E_B: Total energy released by delayed β emission [MeV].
  E_{NU}: Energy carried away by neutrinos [MeV].
  E_R: Total energy less energy carried away by neutrinos ($E_T - ENU$) [MeV].
  E_T: Total energy released in fission (equal to Q value) [MeV].

- Parameters for neutron-induced Watt fission spectrum*:

$$\phi(E) = C \exp(-E/A_1)) \sinh \sqrt{B_1 E}$$

- Parameters for neutron-induced Maxwell fission spectrum*:

$$\phi(E) = C\sqrt{E} \exp(-E/C_1)$$

- Parameters for spontaneous Watt fission spectrum*:

$$\phi(E) = C \exp(-E/A_2) \sinh \sqrt{B_2 E}$$

Sources:
†ENDF/B VII (`http://www-nds.iaea.org/ndspub/download-endf/`).
‡Thermal Cross Sections & Resonance Integrals, from S.F. Mughabghab, Atlas of Neutron Resonances.
(`http://www.nndc.bnl.gov/atlas/atlasvalues.html`)
*X-5 Monte Carlo Team. MCNP-A General Monte Carlo N-Particle Transport Code, Version 5 - Vol I, App. H. 2003.

	$^{227}_{90}$**Th**	$^{228}_{90}$**Th**	$^{229}_{90}$**Th**	$^{230}_{90}$**Th**	$^{232}_{90}$**Th**
ν	2.0647	2.02115	2.0872	-	2.1047
$\sigma_f(2200m/s)$ [b]	202 ± 13	<0.3	30.8 ± 1.5	-	5.2e-05 ± 4e-05
RI [b]	-	-	405 ± 75	965 ± 22	-
E_{FR} [MeV]	-	-	-	163.36 ± 4.37	160.39 ± 0.92
E_{NP} [MeV]	-	-	-	4.700 ± 0.376	4.41 ± 0.12
E_{ND} [MeV]	-	-	-	0.0005 ± 0.0005	0.0220 ± 0.0044
E_{GP} [MeV]	-	-	-	6 ± 2	7.1 ± 0.9
E_{GD} [MeV]	-	-	-	8.1526 ± 0.6522	8.2 ± 0.1
E_B [MeV]	-	-	-	8.3834 ± 0.7126	8.38 ± 0.10
E_{NU} [MeV]	-	-	-	11.27 ± 0.68	11.3 ± 1.1
$\mathbf{E_R}$ **[MeV]**	-	-	-	190.5965 ± 1.2288	188.47 ± 0.31
E_T [MeV]	-	-	-	201.8665 ± 1.0093	199.74 ± 0.28
A_1 [MeV]	-	-	-	-	1.0888
B_1 [MeV^{-}1]	-	-	-	-	1.6871
C_1 [MeV]	-	-	-	-	-
A_2 [MeV]	-	-	-	-	-
B_2 [MeV^{-}1]	-	-	-	-	-

	$^{233}_{90}$**Th**	$^{234}_{90}$**Th**	$^{231}_{91}$**Pa**	$^{232}_{91}$**Pa**	$^{233}_{91}$**Pa**
ν	2.0644	-	2.2441	2.2858	2.1608
$\sigma_f(2200m/s)$ [b]	15 ± 2	<0.01	0.02 ± 0.001	1502 ± 28	<0.1
RI [b]	-	-	-	1075 ± 22	3
E_{FR} [MeV]	-	-	-	-	-
E_{NP} [MeV]	-	-	-	-	-
E_{ND} [MeV]	-	-	-	-	-
E_{GP} [MeV]	-	-	-	-	-
E_{GD} [MeV]	-	-	-	-	-
E_B [MeV]	-	-	-	-	-
E_{NU} [MeV]	-	-	-	-	-
$\mathbf{E_R}$ **[MeV]**	-	-	-	-	-
E_T [MeV]	-	-	-	-	-
A_1 [MeV]	-	-	-	-	-
B_1 [MeV^{-}1]	-	-	-	-	-
C_1 [MeV]	-	-	-	-	1.3294
A_2 [MeV]	-	-	-	-	-
B_2 [MeV^{-}1]	-	-	-	-	-

	$^{232}_{92}$**U**	$^{233}_{92}$**U**	$^{234}_{92}$**U**	$^{235}_{92}$**U**	$^{236}_{92}$**U**
ν	3.13	2.4968	2.3649	2.4367	2.3712
$\sigma_f(2200m/s)$ [b]	76.8 ± 4.8	529.1 ± 1.2	0.067 ± 0.014	582.6 ± 1.1	0.066 ± 0.013
RI [b]	365	775 ± 17	0.56	275 ± 5	4.1 ± 1
E_{FR} [MeV]	-	168.2 ± 0.5	167 ± 2	169.13 ± 0.49	168 ± 2
E_{NP} [MeV]	-	4.9 ± 0.1	4.85 ± 0.43	4.916 ± 0.070	4.70 ± 0.29
E_{ND} [MeV]	-	0.03100 ± 0.00465	0.005 ± 0.001	0.00740 ± 0.00111	0.010 ± 0.002
E_{GP} [MeV]	-	7.72 ± 0.52	7.5 ± 1.0	6.6 ± 0.5	7.3 ± 1.0
E_{GD} [MeV]	-	5.01 ± 0.06	6.13 ± 0.75	6.33 ± 0.05	7.42 ± 0.75
E_B [MeV]	-	5.16 ± 0.06	6.2 ± 0.5	6.50 ± 0.05	7.6 ± 0.5
E_{NU} [MeV]	-	6.93 ± 0.09	8.4 ± 1.1	8.75 ± 0.07	10.2 ± 1.1
$\mathbf{E_R}$ **[MeV]**	-	191.04 ± 0.23	191.84 ± 1.28	193.48 ± 0.15	194.49 ± 1.11
E_T [MeV]	-	197.97 ± 0.21	200.22 ± 0.65	202.23 ± 0.13	204.64 ± 0.12
A_1 [MeV]	-	0.977	-	0.988	-
B_1 [MeV^{-}1]	-	2.546	-	2.249	-
C_1 [MeV]	-	-	1.2955	-	1.2955
A_2 [MeV]	-	-	-	-	-
B_2 [MeV^{-}1]	-	-	-	-	-

	$^{237}_{92}$**U**	$^{238}_{92}$**U**	$^{239}_{92}$**U**	$^{240}_{92}$**U**	$^{241}_{92}$**U**
ν	2.43	2.492088	2.30626	2.492088	2.23426
$\sigma_f(2200m/s)$ [b]	<0.35	3E-06	14 ± 3	-	-
RI [b]	14	1.63 ± 0.16	-	-	-
E_{FR} [MeV]	-	169.8 ± 0.5	-	169.57 ± 0.49	-
E_{NP} [MeV]	-	4.8 ± 0.1	-	5.21 ± 0.10	-
E_{ND} [MeV]	-	0.0180 ± 0.0027	-	0.0180 ± 0.0027	-
E_{GP} [MeV]	-	6.68 ± 0.53	-	6.53 ± 0.53	-
E_{GD} [MeV]	-	8.25 ± 0.07	-	8.25 ± 0.07	-
E_B [MeV]	-	8.48 ± 0.08	-	8.48 ± 0.08	-
E_{NU} [MeV]	-	11.39 ± 0.11	-	11.39 ± 0.11	-
$\mathbf{E_R}$ **[MeV]**	-	198.032 ± 0.316	-	198.06 ± 0.32	-
E_T [MeV]	-	209.4 ± 0.3	-	209.4 ± 0.3	-
A_1 [MeV]	-	0.88111	-	-	-
B_1 [MeV$^-1$]	-	3.4005	-	-	-
C_1 [MeV]	1.2996	-	-	-	-
A_2 [MeV]	-	-	-	-	-
B_2 [MeV$^-1$]	-	-	-	-	-

	$^{235}_{93}$**Np**	$^{236}_{93}$**Np**	$^{237}_{93}$**Np**	$^{238}_{93}$**Np**	$^{239}_{93}$**Np**
ν	2.66385	3.12	2.63581	2.515	-
$\sigma_f(2200m/s)$ [b]	-	3007 ± 90	0.02 ± 0.001	2088 ± 30	-
RI [b]	-	86	4.7 ± 0.23	883 ± 70	-
E_{FR} [MeV]	-	-	171 ± 2	-	-
E_{NP} [MeV]	-	-	5.94 ± 0.48	-	-
E_{ND} [MeV]	-	-	0.00500 ± 0.00125	-	-
E_{GP} [MeV]	-	-	7.13 ± 1.00	-	-
E_{GD} [MeV]	-	-	6.28 ± 0.75	-	-
E_B [MeV]	-	-	6.4 ± 0.5	-	-
E_{NU} [MeV]	-	-	8.6 ± 1.1	-	-
$\mathbf{E_R}$ **[MeV]**	-	-	196.37 ± 1.36	-	-
E_T [MeV]	-	-	205.0 ± 0.8	-	-
A_1 [MeV]	-	-	-	-	-
B_1 [MeV$^-1$]	-	-	-	-	-
C_1 [MeV]	-	-	1.315	-	-
A_2 [MeV]	-	-	-	-	-
B_2 [MeV$^-1$]	-	-	-	-	-

	$^{236}_{94}$**Pu**	$^{237}_{94}$**Pu**	$^{238}_{94}$**Pu**	$^{239}_{94}$**Pu**	$^{240}_{94}$**Pu**
ν	2.814	-	2.895	2.880712	2.803
$\sigma_f(2200m/s)$ [b]	170 ± 35	2455 ± 295	17.9 ± 0.4	748.1 ± 2	0.056 ± 0.03
RI [b]	990 ± 30	-	33 ± 5	303 ± 10	3.16
E_{FR} [MeV]	-	179.75 ± 1.80	174 ± 2	175.6 ± 0.1	174 ± 2
E_{NP} [MeV]	-	3.400 ± 0.272	5.92 ± 0.34	6.07 ± 0.10	6.48 ± 0.36
E_{ND} [MeV]	-	0.0005 ± 0.0005	0.0020 ± 0.0004	0.00280 ± 0.00042	0.0044 ± 0.0008
E_{GP} [MeV]	-	1.29390 ± 0.41404	7.13 ± 1.00	6.74 ± 0.22	6.18 ± 1.00
E_{GD} [MeV]	-	5.6487 ± 0.4519	5.31 ± 0.75	5.17 ± 0.06	6.49 ± 0.75
E_B [MeV]	-	5.8086 ± 0.4937	5.4 ± 0.5	5.31 ± 0.06	6.6 ± 0.5
E_{NU} [MeV]	-	7.8083 ± 0.4685	7.3 ± 1.1	7.14 ± 0.09	8.9 ± 1.1
$\mathbf{E_R}$ **[MeV]**	-	195.9 ± 1.1	197.38 ± 1.13	198.8438 ± 0.2285	199.47 ± 1.12
E_T [MeV]	-	203.71 ± 1.02	204.66 ± 0.24	205.98 ± 0.21	208.35 ± 0.23
A_1 [MeV]	-	-	-	0.966	-
B_1 [MeV$^-1$]	-	-	-	2.842	-
C_1 [MeV]	-	-	1.33	-	-
A_2 [MeV]	-	-	-	-	-
B_2 [MeV$^-1$]	-	-	-	-	-

	$^{241}_{94}$**Pu**	$^{242}_{94}$**Pu**	$^{243}_{94}$**Pu**	$^{244}_{94}$**Pu**	$^{246}_{94}$**Pu**
ν	2.9453	2.81	3.01	-	3.0382
$\sigma_f(2200m/s)$ [b]	1011.1 ± 6.2	<0.2	196 ± 16	-	-
RI [b]	570 ± 15	0.12	550 ± 80	-	-
E_{FR} [MeV]	175.36 ± 0.68	174 ± 2	-	176.81 ± 2.89	-
E_{NP} [MeV]	5.99 ± 0.13	6.76 ± 0.54	-	3.900 ± 0.312	-
E_{ND} [MeV]	0.005 ± 0.001	0.010 ± 0.002	-	0.0005 ± 0.0005	-
E_{GP} [MeV]	7.64 ± 0.69	5.22 ± 1.00	-	-	-
E_{GD} [MeV]	6.40 ± 0.09	7.72 ± 0.75	-	10.9120 ± 0.8729	-
E_B [MeV]	6.58 ± 0.09	7.9 ± 0.5	-	11.221 ± 0.954	-
E_{NU} [MeV]	8.85 ± 0.12	10.6 ± 1.1	-	15.084 ± 0.905	-
$\mathbf{E_R}$ **[MeV]**	201.9801 ± 0.2773	201.58 ± 1.37	-	202.85 ± 1.42	-
E_T [MeV]	210.83 ± 0.25	212.15 ± 0.82	-	217.93 ± 1.09	-
A_1 [MeV]	-	-	-	-	-
B_1 [MeV$^-1$]	-	-	-	-	-
C_1 [MeV]	1.3597	-	-	-	-
A_2 [MeV]	-	0.833668	-	-	-
B_2 [MeV$^-1$]	-	4.431658	-	-	-

	$^{241}_{95}$**Am**	$^{242}_{95}$**Am**	$^{242}_{95}$**Am**	$^{243}_{95}$**Am**	$^{244}_{95}$**Am**
ν	3.08027	3.2718	3.2705	3.272833	3.1518
$\sigma_f(2200m/s)$ [b]	3.2 ± 0.09	2100 ± 200	6200 ± 200	0.1983 ± 0.0043	2300 ± 300
RI [b]	14.4 ± 1	-	1570 ± 80	8.5 ± 0.5	-
E_{FR} [MeV]	176 ± 2	-	-	176 ± 2	-
E_{NP} [MeV]	6.53 ± 0.36	-	-	7.53 ± 0.59	-
E_{ND} [MeV]	0.0020 ± 0.0004	-	-	0.0040 ± 0.0008	-
E_{GP} [MeV]	8 ± 1	-	-	6 ± 1	-
E_{GD} [MeV]	5.51 ± 0.75	-	-	6.62 ± 0.75	-
E_B [MeV]	5.6 ± 0.5	-	-	6.8 ± 0.5	-
E_{NU} [MeV]	7.54 ± 1.10	-	-	9.06 ± 1.10	-
$\mathbf{E_R}$ **[MeV]**	201.9601 ± 1.1259	-	-	203.62 ± 1.41	-
E_T [MeV]	209.50 ± 0.24	-	-	212.68 ± 0.88	-
A_1 [MeV]	-	-	-	-	-
B_1 [MeV$^-1$]	-	-	-	-	-
C_1 [MeV]	-	-	-	-	-
A_2 [MeV]	-	-	-	-	-
B_2 [MeV$^-1$]	-	-	-	-	-

	$^{244}_{95}$**Am**	$^{241}_{96}$**Cm**	$^{242}_{96}$**Cm**	$^{243}_{96}$**Cm**	$^{244}_{96}$**Cm**
ν	3.1518	-	3.44	3.43201	3.24435
$\sigma_f(2200m/s)$ [b]	1600 ± 300	-	<5	617 ± 20	1.04 ± 0.2
RI [b]	-	-	12.9 ± 0.7	1570 ± 100	12.5 ± 2.5
E_{FR} [MeV]	-	186.61 ± 1.87	186.22 ± 1.99	-	-
E_{NP} [MeV]	-	4.7 ± 0.4	5.2 ± 0.4	-	-
E_{ND} [MeV]	-	0.0005 ± 0.0005	0.0005 ± 0.0005	-	-
E_{GP} [MeV]	-	1.14140 ± 0.36524	-	-	-
E_{GD} [MeV]	-	4.8804 ± 0.3904	5.487 ± 0.439	-	-
E_B [MeV]	-	5.01860 ± 0.42658	5.64280 ± 0.47964	-	-
E_{NU} [MeV]	-	6.7463 ± 0.4048	7.5855 ± 0.4551	-	-
$\mathbf{E_R}$ **[MeV]**	-	202.35 ± 1.12	202.55 ± 1.15	-	-
E_T [MeV]	-	209.1 ± 1.0	210.13 ± 1.05	-	-
A_1 [MeV]	-	-	-	-	-
B_1 [MeV$^-1$]	-	-	-	-	-
C_1 [MeV]	-	-	-	-	-
A_2 [MeV]	-	-	0.891	-	0.906
B_2 [MeV$^-1$]	-	-	4.046	-	3.848

	$^{245}_{96}$**Cm**	$^{246}_{96}$**Cm**	$^{247}_{96}$**Cm**	$^{248}_{96}$**Cm**	$^{249}_{96}$**Cm**
ν	3.5964	3.61416	3.8034	-	3.3488
$\sigma_f(2200m/s)$ [b]	2144 ± 58	0.14 ± 0.05	81.9 ± 4.4	0.37 ± 0.05	-
RI [b]	840 ± 40	10.2 ± 0.4	760 ± 50	2.7 ± 0.6	-
E_{FR} [MeV]	-	-	-	183.65 ± 2.96	-
E_{NP} [MeV]	-	-	-	5.2 ± 0.4	-
E_{ND} [MeV]	-	-	-	0.0005 ± 0.0005	-
E_{GP} [MeV]	-	-	-	-	-
E_{GD} [MeV]	-	-	-	9.8068 ± 0.7845	-
E_B [MeV]	-	-	-	10.08400 ± 0.85717	-
E_{NU} [MeV]	-	-	-	13.5560 ± 0.8134	-
$\mathbf{E_R}$ **[MeV]**	-	-	-	208.74 ± 1.38	-
E_T [MeV]	-	-	-	222.29 ± 1.11	-
A_1 [MeV]	-	-	-	-	-
B_1 [MeV$^-1$]	-	-	-	-	-
C_1 [MeV]	-	-	-	-	-
A_2 [MeV]	-	-	-	-	-
B_2 [MeV$^-1$]	-	-	-	-	-

	$^{250}_{96}$**Cm**	$^{249}_{97}$**Bk**	$^{250}_{97}$**Bk**	$^{249}_{98}$**Cf**	$^{250}_{98}$**Cf**
ν	3.39994	3.3464	3.572	3.8869	3.63
$\sigma_f(2200m/s)$ [b]	-	-	960 ± 150	1642 ± 33	-
RI [b]	-	-	-	2380 ± 85	-
E_{FR} [MeV]	-	-	-	-	-
E_{NP} [MeV]	-	-	-	-	-
E_{ND} [MeV]	-	-	-	-	-
E_{GP} [MeV]	-	-	-	-	-
E_{GD} [MeV]	-	-	-	-	-
E_B [MeV]	-	-	-	-	-
E_{NU} [MeV]	-	-	-	-	-
$\mathbf{E_R}$ **[MeV]**	-	-	-	-	-
E_T [MeV]	-	-	-	-	-
A_1 [MeV]	-	-	-	-	-
B_1 [MeV$^-1$]	-	-	-	-	-
C_1 [MeV]	-	-	-	-	-
A_2 [MeV]	-	-	-	-	-
B_2 [MeV$^-1$]	-	-	-	-	-

	$^{251}_{98}$**Cf**	$^{252}_{98}$**Cf**	$^{253}_{98}$**Cf**	$^{254}_{98}$**Cf**	$^{253}_{99}$**Es**
ν	4.14	4.06	-	3.8508	-
$\sigma_f(2200m/s)$ [b]	4895 ± 250	32 ± 4	1300 ± 240	-	-
RI [b]	5900 ± 100	110 ± 30	2000 ± 400	-	-
E_{FR} [MeV]	-	-	-	-	-
E_{NP} [MeV]	-	-	-	-	-
E_{ND} [MeV]	-	-	-	-	-
E_{GP} [MeV]	-	-	-	-	-
E_{GD} [MeV]	-	-	-	-	-
E_B [MeV]	-	-	-	-	-
E_{NU} [MeV]	-	-	-	-	-
$\mathbf{E_R}$ **[MeV]**	-	-	-	-	-
E_T [MeV]	-	-	-	-	-
A_1 [MeV]	-	-	-	-	-
B_1 [MeV$^-1$]	-	-	-	-	-
C_1 [MeV]	-	-	-	-	-
A_2 [MeV]	-	-	1.025	-	-
B_2 [MeV$^-1$]	-	-	2.926	-	-

	$^{254}_{99}$**Es**	$^{255}_{99}$**Es**	$^{255}_{100}$**Fm**
ν	4.0832	3.8748	4.3924
$\sigma_f(2200m/s)$ [b]	1970 ± 200	-	3360 ± 170
RI [b]	1200 ± 250	-	-
E_{FR} [MeV]	-	-	-
E_{NP} [MeV]	-	-	-
E_{ND} [MeV]	-	-	-
E_{GP} [MeV]	-	-	-
E_{GD} [MeV]	-	-	-
E_B [MeV]	-	-	-
E_{NU} [MeV]	-	-	-
$\mathbf{E_R}$ **[MeV]**	-	-	-
E_T [MeV]	-	-	-
A_1 [MeV]	-	-	-
B_1 [MeV$^-1$]	-	-	-
C_1 [MeV]	-	-	-
A_2 [MeV]	-	-	-
B_2 [MeV$^-1$]	-	-	-

Chapter 12

Parameters for some typical nuclear power plants.

Parameters from some typical nuclear power plants are listed in the following tables. The nuclear power plant designs selected are PWR. BWR, Magnox, AGR, RBMK, CANDU, and Siemens' PHWR. All data was extracted from the INSC Nuclear power reactors data base.

Sources:
INSC Nuclear Power Reactor Database (`http://www.insc.anl.gov/pwrmaps/`).

Table 12.1: Parameters for some typical nuclear power plants.

	Atucha 1	Embalse	Flamanville 1	Hinkley Point A1	Hinkley Point B1	Ignalina 1	Limerick 1
Type:	Pressurized Heavy-Water Reactor (PHWR)	Pressurized Heavy-Water Reactor (PHWR)	Pressurized Water Reactor (PWR)	Gas-Cooled Reactor (GCR)	Advanced Gas-Cooled Reactor (AGR)	Light-Water-Cooled, Graphite-Moderated Reactor (LGR)	Boiling Water Reactor (BWR)
Model:		CANDU		Magnox		RBMK-1500	BWR-4
Net Output [MWe]:	335	600	1330	235	585	1380	1055
Initial Criticality	1/1974	3/1983	9/1985	5/1964	9/1976	10/1983	12/1984
Comercial start	6/1974	1/1984	12/1986	4/1965	10/1978	5/1985	2/1986
Fuel and Cladding							
Fuel:	UO2 pellet	UO2 pellet	UO2 pellet	U rod	UO2 pellet	UO2	UO2 pellet
Cladding:	Zry-4	Zry-4	Zry-4	Magnox	SS	Zr/Nb	Zry-2
Initial Enrichment [%]:	nat	nat/dep U	1.5/2.4/2.9	nat	2.01/2.17/2.55	2.00	1.85
Reload [%]:	nat	nat	3.16	nat	2.63/3.42	2.00	3.31
Pellet Height [mm]:	12.0	16.04			15.2	12	9.652
Pellet Inside Diameter [mm]:					5.08	2	
Pellet Diameter [mm]:	10.62	12.15			14.48	11.5	9.550
Clad Thickness [mm]:	0.55	0.42	0.57	2.0	0.381	0.825	0.711
Pin Height [mm]:					994.5	364	4070
Pin Outside Diameter [mm]:					14.86	13.6	11.176
Max. Clad Temp. [°C]:	323	326	350	465	825	335	355
Max. Centerline Temp. [°C]:	2250	1900	1843	595	1350	1900	2500
Fuel Assemblies							
Number of Rods per Assembly:	36	37	264	1	36	36	62/60/74
Fuel Rod Pitch [cm]:	1.43		1.26	94.6	92	364	1.44
Total Number of Assemblies:	253	4560	193	36000	2464	1607	764
Fuel Assembly Pitch [cm]:	27.2	28.58	21.5	19.7	46.0	738	15.24

	Atucha 1	Embalse	Flamanville 1	Hinkley Point A1	Hinkley Point B1	Ignalina 1	Limerick 1
Core Configuration							
Active Core Height [m]:	5.3	5.94	4.267	7.6	8.31	7	3.71
Active Core Diameter [m]:	4.54	6.28	3.37	14.9	9.11	11.8	4.57
Fuel Inventory [tHM]:	38.8	85.73	103.9	352	105.2	178.7	135.52
Average Core Power Density [kWt/liter]:	13.74	10.8	103.0r	0.73	2.96	218	50.04
Peak Core Power Density [kWt/liter]:	35.51	23.1	258.0	1.3	4.8	485	112.1
Avg. Assembly Discharge Burnup [MWd/tU]:	6000	7190	33000	5400	27000	15000	40200
Peak Assemby Discharge Burnup [MWd/tU]:	8000	10000			30000	21600	30000
Axial Blankets:					no	yes	yes
Axially Zoned Fuel:					no	no	yes
Axially Zoned Burnable Poisons:					no	no	yes
Average Linear Fuel Rating [kW/m]:	23.22	24.75	17.20	27.0	42.0	21.80	16.40
Peak Linear Fuel Rating [kW/m]:	60	58.94		48.00		48.5	47.20
Control System							
Control Rod Material:	Hf	H_2O, Cd, Co	Ag/In/Cd	boron steel	Steel/Boron	B_4C	B_4C
Control Rod Drive Type:	electric	elec-mech	elec	low frequency motor	elec	servo	hydraulic
Number of Coarse Control Rods:	3	25	53	89	44	175	185 total
Number of Fine Control Rods:	5			24	37	12	9
Number of Safety Rods:	21	28	12	14	16	24	
Burnable Poison Material:		B/Gd			none		Gd_2O_3
Other Control Systems:	chemical shim	burnable poison	B4C/burnable poison	Fixed absorber	Nitrogen		burnable poison
Primary Coolant							
Coolant Material:	D_2O	D_20	H_2O	CO_2	CO_2	H_2O	H_2O
Weight in Primary Circuit [t]:	111	470		120	130	2235.6	195
Pressure [kg/cm^2]:	115	102	158	14.1	42.4	70	72
Core Inlet Temperature [°C]:	262	266	292.8	185	280	259	277
Core Outlet Temperature [°C]:	296	312	328.7	370	655	284	
Number of Primary Pumps	2	4	4	6	8	8	2
Total Mass Flow [t/h]:	10000	8800	16420	10800	13700	33000	7720

	Atucha 1	Embalse	Flamanville 1	Hinkley Point A1	Hinkley Point B1	Ignalina 1	Limerick 1
Turbines							
Number of Turbines:	1	1	1	3	1	2	1
Turbine Speed [rev/min]:	3000	1500	1500	3000	3000	3000	1800
Turbine Rating [MWe]:	357	648	1335	93	660	750	1150
Stop Valve Pressure [kg/cm^2]:	42.6	46.2	69.5	44.3	163	65	67.8
Stop Valve Temperature [°C]:	254	253	285.3	360	495	279.5	291
Reactor Operations							
Cycle Length [months]:			12		1		24
Normal Planned Outage Length [days]:	30/42/60		60				60
Fuel Loading [tHM/y]:	61	95.0	33.9	44	26	64.9	22
Fraction of Core Reloaded Each Cycle [%:]					2.00		34.00

Chapter 13

Elemental Properties and Periodic Table

13.1 List of Elements by Z

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

13.2 Alphabetical List of Elements

Name	Symbol	Z
Actinium	Ac	89
Aluminum	Al	13
Americium	Am	95
Antimony	Sb	51
Argon	Ar	18
Arsenic	As	33
Astatine	At	85
Barium	Ba	56
Berkelium	Bk	97
Beryllium	Be	4
Bismuth	Bi	83
Bohrium	Bh	107
Boron	B	5
Bromine	Br	35
Cadmium	Cd	48
Calcium	Ca	20
Californium	Cf	98
Carbon	C	6
Cerium	Ce	58
Cesium	Cs	55
Chlorine	Cl	17
Chromium	Cr	24
Cobalt	Co	27
Copper	Cu	29
Curium	Cm	96
Darmstadtium	Ds	110
Dubnium	Db	105
Dysprosium	Dy	66
Einsteinium	Es	99
Erbium	Er	68
Europium	Eu	63
Fermium	Fm	100
Fluorine	F	9
Francium	Fr	87
Gadolinium	Gd	64
Gallium	Ga	31
Germanium	Ge	32

Name	Symbol	Z
Gold	Au	79
Hafnium	Hf	72
Hassium	Hs	108
Helium	He	2
Holmium	Ho	67
Hydrogen	H	1
Indium	In	49
Iodine	I	53
Iridium	Ir	77
Iron	Fe	26
Krypton	Kr	36
Lanthanum	La	57
Lawrencium	Lr	103
Lead	Pb	82
Lithium	Li	3
Lutetium	Lu	71
Magnesium	Mg	12
Manganese	Mn	25
Meitnerium	Mt	109
Mendelevium	Md	101
Mercury	Hg	80
Molybdenum	Mo	42
Neodymium	Nd	60
Neon	Ne	10
Neptunium	Np	93
Nickel	Ni	28
Niobium	Nb	41
Nitrogen	N	7
Nobelium	No	102
Osmium	Os	76
Oxygen	O	8
Palladium	Pd	46
Phosphorus	P	15
Platinum	Pt	78
Plutonium	Pu	94
Polonium	Po	84
Potassium	K	19

Name	Symbol	Z
Praseodymium	Pr	59
Promethium	Pm	61
Protactinium	Pa	91
Radium	Ra	88
Radon	Rn	86
Roentgenium	Rg	111
Rhenium	Re	75
Rhodium	Rh	45
Rubidium	Rb	37
Ruthenium	Ru	44
Rutherfordium	Rf	104
Samarium	Sm	62
Scandium	Sc	21
Selenium	Se	34
Seaborgium	Sg	106
Silicon	Si	14
Silver	Ag	47
Sodium	Na	11
Strontium	Sr	38
Sulfur	S	16
Tantalum	Ta	73
Technetium	Tc	43
Tellurium	Te	52
Terbium	Tb	65
Thallium	Tl	81
Thorium	Th	90
Thulium	Tm	69
Tin	Sn	50
Titanium	Ti	22
Tungsten	W	74
Uranium	U	92
Vanadium	V	23
Xenon	Xe	54
Ytterbium	Yb	70
Yttrium	Y	39
Zinc	Zn	30
Zirconium	Zr	40

13.3 Densities and Atomic Masses

Z	Symbol	Atomic mass [u]	Density [g/cm^3]
1	H	1.00794(7)	$8.988 \times 10^{-5\,(a)}$
2	He	4.002602(2)	$1.785 \times 10^{-4\,(b)}$
3	Li	6.941(2)	$0.534^{(c)}$
4	Be	9.012182(3)	$1.848^{(c)}$
5	B	10.811(7)	$2.34^{(d)}$
6	C	12.0107(8)	1.8 to $2.1^{(e)}$
7	N	14.0067(2)	$0.0012506^{(f)}$
8	O	15.9994(3)	$0.001308^{(g)}$
9	F	18.9984032(5)	0.001696
10	Ne	20.1797(6)	8.9990×10^{-4}
11	Na	22.989770(2)	$0.971^{(c)}$
12	Mg	24.3050(6)	$1.738^{(c)}$
13	Al	26.981538(2)	$2.6989^{(c)}$
14	Si	28.0855(3)	$2.33^{(h)}$
15	P	30.973761(2)	$1.82^{(i)}$
16	S	32.065(5)	$2.07^{(c,j)}$
17	Cl	35.453(2)	0.003214
18	Ar	39.948	0.0017837
19	K	39.0983	$0.862^{(c)}$
20	Ca	40.078(4)	$1.55^{(c)}$
21	Sc	44.955910(8)	$2.989^{(h)}$
22	Ti	47.867	4.54
23	V	50.9415	6.11(18.7°C)
24	Cr	51.9961(6)	7.18 to $7.20^{(c)}$
25	Mn	54.938049(9)	7.21 to $7.44^{(k)}$
26	Fe	55.845(2)	$7.874^{(c)}$
27	Co	58.933200(9)	$8.9^{(c)}$
28	Ni	58.6934(2)	$8.902^{(h)}$
29	Cu	63.546(3)	$8.96^{(c)}$
30	Zn	65.39(2)	$7.133^{(h)}$
31	Ga	69.723	5.904(29.6°C)
32	Ge	72.64	$5.323^{(h)}$
33	As	74.92160(2)	$5.73^{(l)}$
34	Se	78.96(3)	$4.79^{(m)}$
35	Br	79.904	$3.12^{(n)}$
36	Kr	83.80	0.003733
37	Rb	85.4678(3)	$1.532^{(c)}$
38	Sr	87.62	2.54
39	Y	88.90585(2)	$4.469^{(h)}$
40	Zr	91.224(2)	$6.506^{(c)}$
41	Nb	92.90638(2)	$8.57^{(c)}$
42	Mo	95.94	$10.22^{(c)}$
43	Tc	(98)	$11.50^{(n)}$
44	Ru	101.07(2)	$12.41^{(c)}$
45	Rh	102.90550(2)	$12.41^{(c)}$
46	Pd	106.42	$12.02^{(c)}$
47	Ag	107.8682(2)	$10.50^{(c)}$
48	Cd	112.411(8)	$8.65^{(c)}$
49	In	114.818(3)	$7.31^{(c)}$
50	Sn	118.710(7)	$5.75^{(o)}$
51	Sb	121.760	$6.691^{(c)}$
52	Te	127.60(3)	$6.24^{(c)}$
53	I	126.90447(3)	$4.93^{(p)}$
54	Xe	131.293(6)	0.005887
55	Cs	132.90545(2)	$1.873^{(c)}$
56	Ba	137.327(7)	$3.5^{(c)}$
57	La	138.9055(2)	$6.145^{(h)}$
58	Ce	140.116	$6.770^{(h)}$
59	Pr	140.90765(2)	$6.773^{(q)}$, $6.64^{(r)}$
60	Nd	144.24(3)	7.008
61	Pm	(145)	$7.264^{(h)}$
62	Sm	150.36(3)	$7.520^{(q)}$, $7.40^{(r)}$
63	Eu	151.964	$5.244^{(h)}$
64	Gd	157.25(3)	$7.901^{(h)}$
65	Tb	158.92534(2)	8.230
66	Dy	162.50(3)	$8.551^{(h)}$
67	Ho	164.93032(2)	$8.795^{(h)}$
68	Er	167.259(3)	$9.066^{(h)}$
69	Tm	168.93421(2)	$9.321^{(h)}$
70	Yb	173.04(3)	$6.903^{(q)}$, $6.966^{(r)}$
71	Lu	174.967	$9.841^{(h)}$
72	Hf	178.49(2)	$13.31^{(c)}$
73	Ta	180.9479	16.654
74	W	183.84	$19.3^{(c)}$
75	Re	186.207	$21.02^{(c)}$
76	Os	190.23(3)	22.57
77	Ir	192.217(3)	22.42(17°)
78	Pt	195.078(2)	$21.45^{(c)}$
79	Au	196.96655(2)	$\approx 19.3^{(c)}$
80	Hg	200.59(2)	$13.546^{(c)}$
81	Tl	204.3833(2)	$11.85^{(c)}$
82	Pb	207.2	$11.35^{(c)}$
83	Bi	208.98038(2)	$9.747^{(c)}$
84	Po	(209)	$9.32^{(q)}$
85	At	(210)	
86	Rn	(222)	0.00973
87	Fr	(223)	
88	Ra	(226)	5
89	Ac	(227)	$10.07^{(n)}$
90	Th	232.03801	11.72
91	Pa	(231)	15.37
92	U	238.02891(3)	≈ 18.95
93	Np	(237)	$20.25^{(c)}$
94	Pu	(244)	$19.84^{(h)}$
95	Am	(243)	$13.67^{(c)}$
96	Cm	(247)	$13.51^{(n)}$
97	Bk	(247)	$14^{(n)}$
98	Cf	(251)	
99	Es	(252)	
100	Fm	(257)	
101	Md	(258)	
102	No	(259)	

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

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

(c) At 20°C.

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

(e) 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.

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

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

(h) At 25°C.

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

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

(k) Depending on allotropic form.

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

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

(n) Calculated.

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

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

(q) For α modification.

(r) For β modification.

13.4 Periodic Table