FIORD errata list

(Typographical and other errors in **Fundamentals of Ionizing Radiation Dosimetry**, Wiley 2017)

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PAGE

xxiii - In the list of symbols for '**A, a**' the first entry for A should be replaced by atomic mass number or nucleon number (dimensionless). When an expression includes N_A/A, A is in g mol^{-1}, i.e., it corresponds to the molar mass M.

xxviii - In the list of symbols for '**M, m**' the entry for M (3rd item) should be replaced by molar mass, M=A g mol^{-1}.

xxxv - In the list of symbols for '**Lambda** (Λ, λ)' a second definition for λ should be added, so that:

λ decay constant of a radionuclide
photon wavelength

9 - End the top sentence with multiplied by the molar mass constant M_u (= 1 g mol^{-1}), i.e., the molar mass.

In the last sentence, the word 'non-relativistic' should be inserted so that it reads "...yield the following non-relativistic expressions for the particle kinetic..."

18 - In caption to Figure 1.5, the 2nd line, should read "(a) and (b) show the probabilities of a given emission....".

20 - In Table 1.3 the c_0 and c_1 fitting coefficients for the L-shell fluorescence yield in the Z range 26-51 should be

Fluorescence yield	Range of Z	Fitting coefficient c_0	c_1	c_2	c_3	c_4
ω_L	26-51	-9.2521×10^{-2}	8.7531×10^{-3}	-2.8087×10^{-4}	3.4823×10^{-6}	–

21 - The legend of Figure 1.6(b) should read "Mean fluorescence x-ray energies, $\bar{k}_i$ (dashed lines), in the K, L1 and M1 shells; for comparison, the binding energies, $U_B(i)$ are also shown (solid lines)".

28 - The solutions to exercise #3 are correct but the non-relativistic expression given in the *Solutions to Exercises* book (page 2) does not yield the solutions provided. The student can derive E from Eq. (1.27), to arrive at

$$E = m_0c^2\left(\frac{1}{\sqrt{1-\beta^2}} - 1\right) = m_0c^2\tau$$

which is also given as Eq. (2.95) in page 82.

28 - The solutions to exercise #5 are correct but the expression for the Birge ratio given in the *Solutions to Exercises* book (page 3) should be

$$R_{\text{Birge}} = \frac{s(\bar{x}_w)_{\text{ext}}}{s(\bar{x}_w)_{\text{int}}} = 2.2$$

47 - First line below Eq. (2.37), "atomic mass A" should be replaced by "atomic mass number A".

64 - Three lines below Eq. (2.75), "cm^2 g^{-1}" should be replaced by "cm^2 mol^{-1}".

79 - Figure 2.22 and its legend should be replaced by

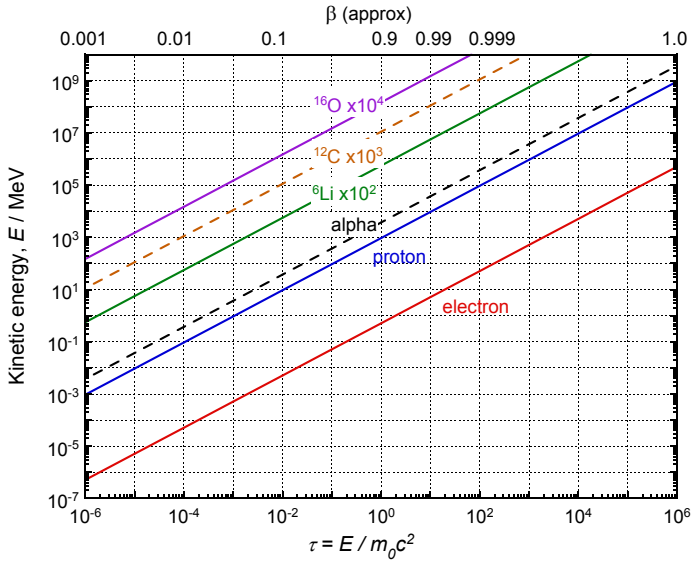

Figure 2.22. Graphical representation of the relation between a particle kinetic energy E (MeV) and its equivalent in terms of the particle rest energy, $\tau = E/m_0c^2$, for electrons and some heavy charged particles and ions. The upper abscissa provides the relation with the relativistic velocity, $\beta = v/c$. For better visualization, the rest masses of ^{6}Li, ^{12}C and ^{16}O have been multiplied by 10^2, 10^3 and 10^4, respectively.

83 - Second paragraph, second line, "scaled by the atomic mass" should be replaced by "scaled by the atomic mass number".

91 - In Section 2.4.12, line 7, "trasversed" should be replaced by "traversed".

99 - In Figure 2.34, the labeling of the electronic stopping power curves $(S_{\rm el}/\rho)$ is incorrect: C should be the top curve and U the bottom curve, i.e.,

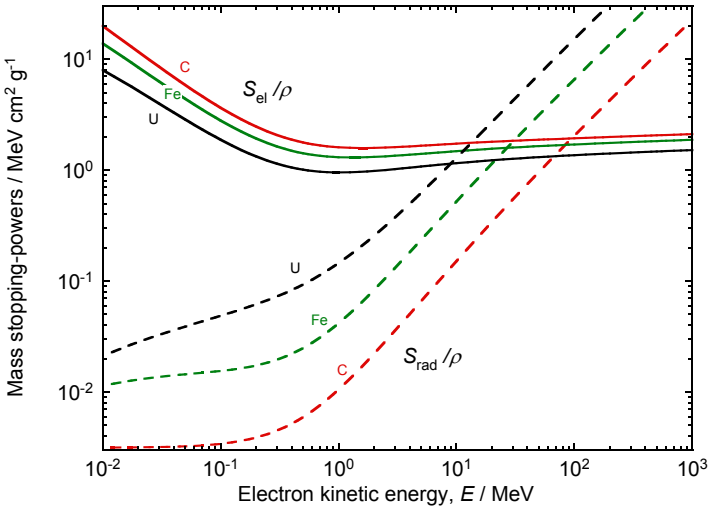

Figure 2.34. Mass radiative (dashed lines) and electronic (solid lines) stopping powers as a function of the kinetic energy of electrons in carbon ($Z = 6$), iron ($Z = 26$), and uranium ($Z = 92$). (Data from ICRU, 1984b).

104 - First sentence, "atomic weight" should be replaced by "atomic mass number".

105 - In Figure 2.38, the label of the horizontal axis should just be "Kinetic energy", as proton data are also included in the plot.

114 - Four lines after Eq. (2.157), "absorber atomic mass" should be replaced by "absorber atomic mass number".

122 - At the bottom of the page, in the last step of Eq. (2.180), the Thomas-Fermi radius should be squared, i.e.,

$$\frac{4\pi}{q^2 + (1/R_{\mathrm{TF}})^2}$$

.

136 - The left hand side of Eq. (2.247), should not have $\mathrm{d}\mathcal{W}$, i.e., the equation should be $\mathrm{d}\sigma = 2\pi\, b\, \mathrm{d}b$.

136 - Two and three lines above Section 2.11.3.3, item (iv) should read "is proportional to $\mathcal{W}^{-2}$ (instead of $\mathcal{W}^2$).

156 - In Eqs. (3.31) – (3.34), the polarization angle ϕ should be replaced by φ, and the last term of Eq. (3.33) should have E_0^2 instead of E_0, i.e.,

$$B_{\mathrm{out}} = \frac{e}{4\pi\varepsilon_0}\,\frac{\dot{v}\,\sin\varphi}{c^3\, r} = \frac{E_{\mathrm{out}}}{c} \tag{3.31}$$

$$S_{\mathrm{out}} = \frac{E_{\mathrm{out}} B_{\mathrm{out}}}{\mu_0} = \frac{E_{\mathrm{out}}^2}{c\,\mu_0} = \varepsilon_0\, c\, E_{\mathrm{out}}^2 = \varepsilon_0\, c \left(\frac{e}{4\pi\varepsilon_0 c^2}\,\frac{\dot{v}\,\sin\varphi}{r}\right)^2 \tag{3.32}$$

$$S_{\mathrm{out}} = \varepsilon_0\, c \left(\frac{e}{4\pi\varepsilon_0 c^2}\,\frac{\sin\varphi}{r}\right)^2 \left(\frac{e}{m_{\mathrm{e}}}\, E_0 \sin\omega t\right)^2 = \varepsilon_0\, c\, \frac{r_{\mathrm{e}}^2\, E_0^2\, \sin^2\omega t\, \sin^2\varphi}{r^2} \tag{3.33}$$

$$\bar{S}_{\mathrm{out}} = \varepsilon_0\, c\, \overline{E_{\mathrm{out}}^2} = \varepsilon_0\, c\, \frac{r_{\mathrm{e}}^2\, E_0^2\, \overline{\sin^2\omega t}\;\overline{\sin^2\varphi}}{r^2} = \frac{1}{2}\,\varepsilon_0\, c\, r_{\mathrm{e}}^2\, E_0^2\, \frac{\overline{\sin^2\varphi}}{r^2} \tag{3.34}$$

160 - In Figure 3.9, the label of the y-axis should have a capital X, i.e., "Atomic form factor, $F(X, Z)$".

167 - In line below Eq. (3.77), the reference should be to figure 3.16a instead of 3.15a, i.e., "and is shown in Figure 3.16a. The cross section....".

169 - In Figure 3.16(b), the label of the y-axis should be "$\mathrm{d}\sigma_{\mathrm{c,KN}}/\mathrm{d}\phi$ /(mb electron^{-1} rad^{-1})".

173 - In Eq. (3.95), $m_{\mathrm{e}}c^2$ on both sides of the equation should be squared, i.e.,

$$E'^{\,2}_{\mathrm{tot}} - \left(m_{\mathrm{e}}c^2\right)^2 = c^2\left(q^2 + 2\,\mathbf{q}\cdot\mathbf{p}_{\mathrm{e}}\right) + E_{\mathrm{tot}}^2 - \left(m_{\mathrm{e}}c^2\right)^2 \tag{3.95}$$

180 - In Figure 3.25, the symbols E_+ and E_- should, for consistency with the text, be replaced by E^+ and E^-.

191 - In first line below the section header **3.8.2 Cross Section**, a space is missing between "Using" and "$\epsilon = k/m_{\mathrm{e}}c^2$..."

195 - In first line after Eq. (3.156), "A is the atomic mass" should be replaced by "A is the atomic mass number multiplied by the molar mass constant M_{u} (1 g mol^{-1})".

196 - In Figure 3.33 lower panel (b), the horizontal axis number labels don't match up with the grid, see upper panel (a).

197 - In Figure 3.34, the vertical axis label should be $\bar{f}_{\mathrm{ph}}$, to be consistent with Eq. (3.161), instead of f_{p}.

213 - The second answer to exercise #15 should be corrected as:

Answer: $n_{\rm av} = \dfrac{\ln \dfrac{E_{\rm fin}}{E_{\rm in}}}{\ln\left[\dfrac{M^2+m_{\rm n}^2}{(M+m_{\rm n})^2}\right]}$; $n_{\rm min} = \dfrac{\ln \dfrac{E_{\rm min,fin}}{E_{\rm in}}}{\ln\left[\dfrac{(M-m_{\rm n})^2}{(M+m_{\rm n})^2}\right]}$

as there was an error in the expression for the minimum neutron kinetic energy. The solution (for the Exercises book) then becomes

$$E_{{\rm min},f} = E_i - Q_{\rm max} = E_i \left[\frac{(M-m_{\rm n})^2}{(M+m_{\rm n})^2}\right] \sim E_i \,[\text{m'-ratio}]$$

and for $n_{\rm min}$ interactions

$$E_{\rm min,fin} = E_{\rm in} \left[\frac{(M-m_{\rm n})^2}{(M+m_{\rm n})^2}\right]^{n_{\rm min}}$$

from where the corrected expression for $n_{\rm min}$ is obtained.

249 - In Table 4.2 the photon attenuation values should be

Primary radiation energy (MeV)	Photon attenuation (%) over maximum secondary electron range	Neutron attenuation (%) over maximum secondary proton range
0.1	0.25	0.05
1.0	2.31	0.04
10	10.2	0.5
30	20.0	1.5

250 - In Figure 4.15, the scale of the vertical axis (4.0×10^{-14} to 1.0×10^{-13}) should be replaced by 4.0×10^{-12} to 1.0×10^{-11}.

258 - The answer to exercise #13 should be:
Answer: $K = 7.65 \times 10^5\,{\rm erg\,g^{-1}} = 76.5\,{\rm Gy}$; $K_{\rm el} = 5.58 \times 10^5\,{\rm erg\,g^{-1}} = 55.8\,{\rm Gy}$.
as there was a typo in the erg–to–MeV conversion. The full solution (for the Exercises book) then becomes

(a) For kerma, $K = \Psi\,(\mu_{\rm tr}/\rho)_{\rm Pb}$, where

$$\Psi = 3.5 \times 10^6\,\frac{\rm phot}{\rm cm^2\,s} \times 6.048 \times 10^5\,{\rm s} \times \frac{6\,{\rm MeV}}{\rm phot} \times \frac{1.6022 \times 10^{-6}\,{\rm erg}}{\rm MeV} = 2.0349 \times 10^7\,\frac{\rm erg}{\rm cm^2}$$

and from the Data Tables

$$(\mu_{\rm tr}/\rho)_{\rm Pb,6MeV} = 0.0376\,{\rm cm^2/g}$$

therefore

$$K = 2.0349 \times 10^7\,\frac{\rm erg}{\rm cm^2} \times 0.0376\,\frac{\rm cm^2}{\rm g} = 7.6513 \times 10^5\,\frac{\rm erg}{\rm g} = 76.51\ {\rm Gy}$$

(b) For the electronic kerma, $K_{\rm el} = \Psi\,(\mu_{\rm en}/\rho)_{\rm Pb}$

$$(\mu_{\rm en}/\rho)_{\rm Pb,6MeV} = 0.0274\,{\rm cm^2/g}$$

therefore

$$K_{\rm el} = 2.0349 \times 10^7\,\frac{\rm erg}{\rm cm^2} \times 0.0274\,\frac{\rm cm^2}{\rm g} = 5.5757 \times 10^5\,\frac{\rm erg}{\rm g} = 55.76\ {\rm Gy}$$

263 - In line -7 from bottom, "A is the atomic weight" should be replaced by "A is the atomic mass number multiplied by the molar mass constant $M_{\rm u}$ (1 g mol^{-1})".

317 - **[NEW]**
On Eq. (7.4): Note that, despite the use of the symbol $K_{\rm air}$, the expression is written in terms of the air electronic kerma $(K_{\rm el})_{\rm air}$. The use of $(K_{\rm el})_{\rm air}$ is strictly correct because radiative interactions of secondary electrons do not contribute to local energy deposition. However, at photon energies below about 200 keV, radiative interactions in air are almost negligible $(1 - g_{\rm air} > 0.999)$, so that $K_{\rm air}$ and $(K_{\rm el})_{\rm air}$ are practically identical as are the corresponding photon coefficients $[\mu_{\rm tr}(E)/\rho]_{\rm air}$ and $[\mu_{\rm en}(E)/\rho]_{\rm air}$, see Eqs. (4.27) and (4.45).

323 - **[NEW]**
In Figure 7.5, the label of the Y-axis should be "Effective energy" instead of "Equivalent energy". It should be emphasized, however, that both terms are used in the literature.

340 - In line above Eq. (7.23), "atomic mass A" should be replaced by "atomic mass number A".

358 - Citation "Andreo, 1991;" above eq. (8.35) should be "Andreo, 1991a;".

368 - In Figure 8.7 the caption cites Andreo (1981) but it should be "Andreo (1991a)".

372 - At the end of the fourth paragraph the reference should be "Andreo (1988a)".

417 - In Figure 9.11, the label of the x-axis should be "y / MV".

524 - Six lines after eq. (12.35), the Boag *et al.* reference should be 1996, instead of 1966.

574 - **[NEW]**
In exercise #2. Add at the end of the statement "and the light path length is 1.0 cm". The same change applies to p.117 of the Book of Exercises.

575 - **[NEW]**
In exercise #4. The cell length should be changed to 1.0 cm, consistent with p.119 of the Book of Exercises. Note that for a length of 1.5 cm the answer would be 314.3 J m^{-2} s^{-1}.

575 - **[NEW]**
In the solution to exercise #8 in p.121 of the Book of Exercises, second line of the fluence, the denominator should be changed to read $[(0.3 \times 10^{-4})^2\ \pi]^2$.

616 - In Figure 14.20, the right-y axis label should be "$[S_{\rm el}(E)/\rho]_{\rm med,w}$".

690 - **[NEW]**
In exercise #5. The three $M_{\rm field}$ values given in the statement should be changed to
$M_{\rm field}$(+250V) = 8.632, $M_{\rm field}$(-250V) = 8.690, $M_{\rm field}$(+80V) = 8.569.
The same changes apply to p.134 of the Book of Exercises.

754 - Second paragraph, in 3rd line "atomic mass (g)" should be replaced by "atomic mass number"; in 7th line delete "mass number or". In the last sentence of footnote no. 4, "atomic mass A" should be replaced by "atomic mass $m_{\rm a}$".

774 - In second line "(amu)" should be replaced by "(u)". Replace "1/12 *of*" by "1/12 of" (i.e., "of" in roman font, not in italics).

842 - In Table A.1, under "Atomic mass constant", delete the factor $\times 10^8$ for the unit of $m_{\rm u}$ in MeV, i.e., $m_{\rm u} = 931.494\ 061(21)$ MeV.

883 - Reference Andreo (1981) should be changed to "Andreo (1991a)".