

Constantes fundamentais e factores de conversão

$h=6,626 \times 10^{-34}$ Js	$k=1,381 \times 10^{-23}$ JK ⁻¹ = $8,617 \times 10^{-5}$ eV K ⁻¹	$m_e=0,511$ MeV/c ²
$e=1,602 \times 10^{-19}$ C	$\alpha = e^2/4\pi\epsilon_0\hbar c \approx 1/137$	$m_p=938,271$ MeV/c ²
$N_A=6,022 \times 10^{23}$ mol ⁻¹	$r_e = e^2/4\pi\epsilon_0 m_e c^2 = 2,818 \times 10^{-15}$ m	$m_n=939,565$ MeV/c ²
1 barn = 10^{-24} cm ²	$r_0 = 1,3$ fm	1 u = 931,5 MeV/c ²

Perda de energia de partículas carregadas

$$Q_{\max} = \frac{4mME}{(M+m)^2} \quad Q_{\max} = \frac{2mV_i^2\gamma^2}{1+2\gamma m/M+(m/M)^2} \quad -\frac{dE}{dx} = 2\pi N_A r_e^2 m_e c^2 \rho \frac{Z}{A} \frac{Z^2}{\beta^2} \left[\ln \left(\frac{2m_e c^2 \gamma^2 \beta^2 T_{\max}}{I^2} \right) - 2\beta^2 - \delta - 2\frac{C}{Z} \right]$$

$$\frac{1}{\rho} \frac{dE}{dx} = \frac{\omega_1}{\rho_1} \left(\frac{dE}{dx} \right)_1 + \frac{\omega_2}{\rho_2} \left(\frac{dE}{dx} \right)_2 + \dots \quad \rho X_0 \approx \frac{716,4A}{Z(Z+1) \ln(287/\sqrt{Z})} \text{ g/cm}^2 \quad Y \approx \frac{3 \times 10^{-4} Z(T/m_e c^2)}{1+3 \times 10^{-4} Z(T/m_e c^2)}$$

$$E_c \approx \frac{1600 m_e c^2}{Z} \text{ (MeV)} \quad \cos \theta = \frac{1}{\beta n}$$

$$\frac{R_1(\beta)}{R_2(\beta)} = \frac{Z_1^2 M_1}{Z_2^2 M_2} \quad \frac{R_1}{R_2} = \frac{\rho_2 \sqrt{A_1}}{\rho_1 \sqrt{A_2}} \quad \begin{array}{l} \text{Alcance alfas no ar} \\ R=0,56E \quad E < 4\text{MeV} \quad (R \text{ em cm}) \\ R=1,24E-2,62 \quad 4 < E < 8\text{MeV} \end{array}$$

Fotões

$$\frac{1}{E_y} - \frac{1}{E_y} = \frac{1}{m_e c^2} (1 - \cos \theta) \quad \frac{\mu_{tr}}{\rho} = \frac{\mu_{foto}}{\rho} \left(1 - \frac{\delta}{h\nu} \right) + \frac{\mu_a^c}{\rho} + \frac{\mu^{par}}{\rho} \left(1 - \frac{2m_e c^2}{h\nu} \right)$$

Detectores

$$\epsilon_g = \frac{1}{2} (1 - \cos \theta) \quad \cos \theta = \frac{d}{\sqrt{r^2 + d^2}} \quad E_e = \frac{E_y^2 (1 - \cos \theta_y)}{mc^2 + E_y (1 - \cos \theta_y)}$$

Aceleradores

$$\frac{\Delta N_{ev}}{\Delta t} = L \sigma \epsilon \quad L = \frac{n_1 n_2 n f}{A}$$

Energia de ligação

$$B = Z m_p c^2 + (A - Z) m_n c^2 + Z m_e c^2 - M_{atom} c^2 \quad B = a_v A - a_s A^{2/3} - a_c Z(Z-1) A^{-1/3} - a_s \frac{(A-2Z)^2}{A} + \delta$$

Decaimentos

$$N_2(t) = N_0 \frac{\lambda_1}{\lambda_2 - \lambda_1} (e^{-\lambda_1 t} - e^{-\lambda_2 t}) \quad dN_j = (\lambda_{j-1} N_{j-1} - \lambda_j N_j) dt$$

Activação

$$R \approx I_0 \frac{x}{\lambda} = I_0 \frac{\rho \sigma N_A x}{A} \quad R \approx \phi N_a \sigma \quad N(t) = \frac{R}{\lambda} (1 - e^{-\lambda t})$$

Decaimento Alfa

$$T_\alpha = \frac{Q}{\left(1 + \frac{4}{A}\right)} \quad 2G = 3,95 \frac{Z}{\sqrt{1-\alpha}} - 2,97 \sqrt{ZR} \quad R \text{ em fm, } T \text{ em MeV}$$

Decaimento beta

$$n(p_e) = \text{cte } F(Z, E_e) p_e^2 (E - E_e)^2 \quad (Q - T_e) \propto \sqrt{\frac{n(p_e)}{p_e^2 F(Z, E_e)}}$$

Decaimento gama

$$\Delta E = E_y + \frac{E_y^2}{2m_N c^2} \quad E_y = \Delta E - \frac{\Delta E^2}{2m_N c^2} \quad E'_y = E_y \left(1 + \frac{v}{c}\right) \quad E'_y - E_y = 2E_R$$

$$\alpha(EL) \approx \frac{Z^3}{n^3} \left(\frac{L}{L+1} \right) \left(\frac{e^2}{4\pi\epsilon_0 \hbar c} \right)^4 \left(\frac{2m_e c^2}{E} \right)^{L+5/2} \quad \alpha(ML) \approx \frac{Z^3}{n^3} \left(\frac{e^2}{4\pi\epsilon_0 \hbar c} \right)^4 \left(\frac{2m_e c^2}{E} \right)^{L+3/2} \quad \begin{array}{l} \Delta\pi = \text{n\~{a}o} \rightarrow M1, E2, M3, E4, \dots \\ \Delta\pi = \text{sim} \rightarrow E1, M2, E3, M4, \dots \end{array}$$

Neutrões

$$\frac{E_{kf}}{E_{ki}} = \frac{A^2 + 2A \cos \theta + 1}{(1+A)^2} \quad \xi = \left\langle \log \frac{E_i}{E_f} \right\rangle \quad \xi = 1 + \frac{(A-1)^2}{2A} \log \left(\frac{A-1}{A+1} \right) \quad \langle \log E_{i,n} \rangle = \langle \log E_i \rangle - n\xi$$

$$K = \eta \epsilon p f (1-l_f)(1-l_t) \quad \frac{dN}{dt} = \frac{N(K-1)}{\tau}$$

Dosimetria

$$H_{T,R} = w_R D_{T,R} \quad E = \sum w_T H_T$$