杨南函. 20200112 19

1. $D = \phi \cdot S/\rho$

$\frac{S}{\rho} = (\frac{z}{z_p})^2 (\frac{S}{\rho})_\varepsilon = z^2 (\frac{S}{\rho})_\varepsilon$. $\varepsilon = \frac{M_p}{M} E = 1 MeV \rightarrow (\frac{S}{\rho})_\varepsilon = 229.41\ MeV \cdot cm^2/g$

$= 917.64\ MeV \cdot cm^2/g = 1.468224 \times 10^{-11}\ J \cdot m^2/kg$.

$\rightarrow D \simeq 1.468 \times 10^{-8}\ J \cdot s^{-1} \cdot kg^{-1}$.

2. $(R_{\beta max})_{Pb} = \frac{(z/M_A)_{Al} \cdot \rho_{Al}}{(z/M_A)_{Pb} \cdot \rho_{Pb}} (R_{\beta max})_{Al}$

$(R_{\beta max})_{Al} = 1.23\ g/cm^2$. $(z/M_A)_{Al} = \frac{13}{27}$. $(z/M_A)_{Pb} = \frac{82}{207}$. $\rho_{Al} = 2.7\ g\ cm^{-3}$ $\rho_{Pb} = 11.3\ g\ cm^{-3}$

$\rightarrow (R_{\beta max})_{Pb} \simeq 0.353\ g/cm^2$

3. 

$\dot{X} = \frac{T \times A_l \times \Theta}{h}$, $h = 2m$, $T = 2.503 \times 10^{-18}\ C \cdot m^2 \cdot kg^{-1} Bq^{-1} \cdot s^{-1}$,

$A_l = 2.1 \times 10^9\ Bq/cm^3 \times 1 cm^2 = 2.1 \times 10^9\ Bq/cm = 2.1 \times 10^{11}\ Bq \cdot m^{-1}$.

$\Theta \simeq 0.4623$

$\rightarrow \dot{X} \simeq 1.219 \times 10^{-7}\ C \cdot kg^{-1} s^{-1}$

$\dot{K} = \dot{X} \cdot \frac{[K]}{T} \simeq 4.22 \times 10^{-6}\ Gy \cdot s^{-1}$

4. $E_\beta = 545.914 keV$.

$\rightarrow$ 有机玻璃厚度习为 0.1524 cm

$\dot{D} = 4.59 \times 10^{-8} A Z (\frac{\mu_{en}}{\rho})_\beta (\frac{E_\beta}{R})^2 e^{-\mu R_1}$, $A = 3.7 \times 10^2\ Bq$, $Z = 6.3$, $(\frac{\mu_{en}}{\rho})_\beta \simeq 2.6 \times 10^{-2}\ cm^2/g$. $R = 2m$.

$\simeq 0.207\ mGy/h$

$\dot{D}_0 = 5 \mu Gy/h$

$K = \frac{\dot{D}}{\dot{D}_0} \simeq 41.4$

$\rightarrow$ 铅厚度 $d \approx 2.4 cm$.

若取例. 所需有机玻璃厚度增加，以阻挡 β 射线逃逸.

铅厚度可减少，因为不再需要阻挡 γ 射线.

5. $d = \frac{1}{\Sigma} \ln\left(\frac{\xi \cdot B_n \cdot q}{4\pi r^2 \cdot \varphi_L}\right)$, $\Sigma = 0.118\,cm^{-1}$, $\xi = A\gamma = 5\times10^{7}\,s^{-1}$, $\varphi_L = 5.88\,cm^{-2}s^{-1}$

$B_n = 5$, $q = 1$

$\rightarrow d \approx 49.4\,cm$

6. $\dot{H} = \frac{1mSv}{4h} = 250\,\mu Sv/h$

$\dot{X} = \frac{\Gamma A}{R^2} = 0.13\,C/kg/h$, $\Gamma = 6.312\times10^{-19}\,C\cdot m^2\cdot kg^{-1}\cdot Bq^{-1}\cdot s^{-1}$, $R = 0.3m$.

$= 3.611\times10^{-5}\,C\cdot kg^{-1}\cdot s^{-1}$.

$\rightarrow A = 5.149\times10^{12}\,Bq$

$K \geq \frac{1.4\times10^{5} A \Gamma q}{\dot{H}\cdot r^2} = 455$

$d \approx 5.86\,cm$