

1. Radioactive radiations (without any external aids/spontaneous)

(a) α -particle: $q_\alpha = +2e$, $m_\alpha = 2(m_p + m_n)$, $(E_k)_\alpha \sim 5\text{ MeV}$, ${}^4_2\text{He}$ (He^{2+})

(b) β -particle: $q_\beta = -1e$, $m_\beta = m_e = 9.1 \times 10^{-31}\text{ kg}$, $\sim \text{a few meter}$, ${}^0_{-1}e$
 $E = (E_k + E_{\text{rest}})$

(c) γ -rays: photon $q_\gamma = 0$, $m_\gamma = 0$ $\sim 200\text{ km}$ γ

penetrating power: $\gamma > \beta > \alpha$
 (E_k)

ionization power: $\alpha > \beta > \gamma$
 (mass)

2. Radioactive Disintegration

(a) α -decay ${}_Z^AX \rightarrow {}_{Z-2}^{A-4}Y + {}^4_2\text{He} + E$

(b) β -decay ${}_Z^AX \rightarrow {}_Z^AY + {}^0_{-1}e + E$
 ${}_6^{14}\text{N} \rightarrow {}_6^{14}\text{C} + {}^0_{-1}e$

(c) γ -radiation ${}_Z^AX \rightarrow {}_Z^AX + \gamma + E$

Conservation (i) γ mass-energy
 (ii)
 (iii)

Matter Wave
$\lambda_d = \frac{h}{p} = \frac{h}{mv}$

Wavelength of Electron
$\lambda_d = \frac{h}{mv} = \frac{h}{\sqrt{2eVm}} = \frac{h}{\sqrt{2E_k m}}$

de Broglie's Theory

Quantum Theory of Radiation

Photoelectric Effect

Photon
$E = hf = \frac{hc}{\lambda}$
$p = \frac{hf}{c} = \frac{h}{\lambda}$

Energy of Photoelectron
$E_{K_{\max}} = hf - W_0$
$\frac{1}{2}mv_{\max}^2 = hf - W_0$
$W_0 = hf_0 = \frac{hc}{\lambda_0}$

Stopping Potential
$V_s = \frac{hf}{e} - \frac{W_0}{e}$
$I_{\text{sat}} = \frac{Ne}{t}$

Compton Effect
$\lambda' = \lambda + \frac{h}{m_e c} (1 - \cos \varphi)$
$\Delta \lambda = \frac{h}{m_e c} (1 - \cos \varphi)$