Matter waves

$f \rightarrow$ frequency $\quad \lambda \rightarrow$ wavelength $\quad v \rightarrow$ velocity

$$v = f\lambda$$

$$E = hf \quad ; \quad \lambda = \frac{h}{p}$$

$U = \pi c$ (π → Momentum density; U → Energy density)

$p \rightarrow$ momentum of photon

$U = nhf$ (n → number density)

$$\pi = n \times p = \frac{nhf}{c} = \frac{nh}{\lambda}$$

$$\boxed{c = f\lambda}$$

Massive particles : de broglie waves

$$n\lambda = 2d\sin\theta$$

provided we assign → $\lambda = \frac{h}{p}$ (p → known; λ → associated)

$p, E \rightarrow$ particle

$f, \lambda \rightarrow$ wave

$$\vec{p} = m\vec{v} \quad ; \quad E = \frac{1}{2}mv^2 = \frac{\vec{p}^{\,2}}{2m}$$

$v = f\lambda$ → Is $v_{par.}$ same as v_{wave} ? Find out

$$E = hf = \frac{p^2}{2m}$$

$f \rightarrow \omega$: angular freq.

$\lambda \rightarrow k$: wave number

$$E = hf = h\frac{\omega}{2\pi} = \hbar\omega \qquad \hbar = \frac{h}{2\pi}$$

$\because \omega = 2\pi f$

$$p = \frac{h}{\lambda} = \frac{2\pi\hbar}{\lambda}$$

$$= \hbar\left(\frac{2\pi}{\lambda}\right) = \hbar k \qquad k = \frac{2\pi}{\lambda}$$

$\boxed{\omega = ck}$ → dispersion relation

$\omega = c(k')\,k'$ → for different medium different speed but same ω

matter waves

$$\lambda_m = \frac{h}{p} \quad ; f_m = \frac{E}{h}$$

Non realistic case

$$E = \frac{p^2}{2m}$$

$$\lambda_m f_m = v_{debroglie} = \left(\frac{E}{p}\right)$$

$$v_{\substack{matterwave \\ mw}} = \lambda_{mw} W_{mw}$$

$$= \frac{E}{p} = \frac{1}{2} \frac{mv^2}{mv} \rightarrow \text{particles velocity}$$

$$= \frac{v}{2}$$

Relativistic Matter waves

$$E = hf \quad ; \quad p = \frac{h}{\lambda} \quad ; \quad f = \frac{E}{h} \quad ; \quad \lambda = \frac{h}{p}$$

$$v = \lambda f = \frac{E}{p}$$

$E \rightarrow \frac{m_0 c^2}{\sqrt{1 - v^2/c^2}}$

$p \rightarrow \frac{m_0 v}{\sqrt{1 - v^2/c^2}}$

$$\boxed{v_{wave} = \frac{c^2}{v}} \rightarrow v_{wave} < c$$

v → particle velocity

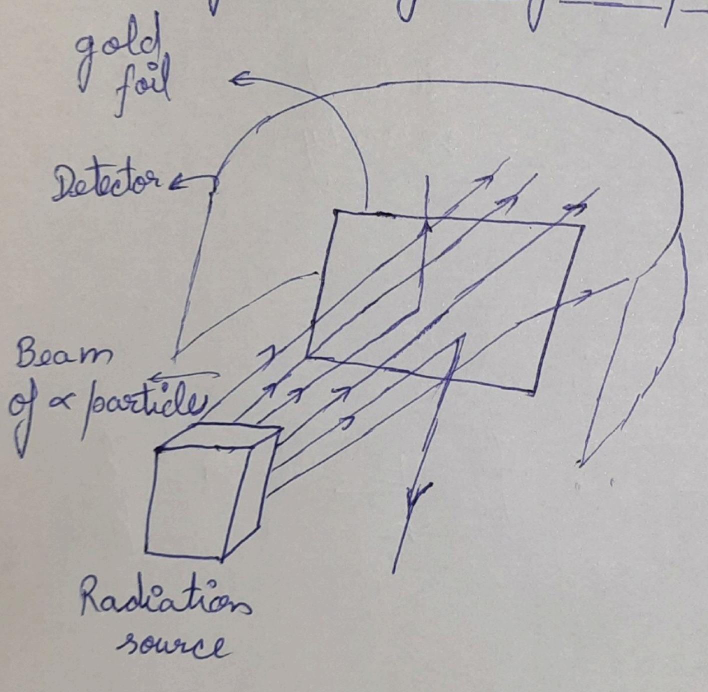
Structure of the atoms

Atoms → fundamental units of chemical reaction

Atom's Models

- Plum pudding model → Thompson
- Planetary model → Rutherford
- Bohr's model

Rutherfords gold foil experiment



Observations	Interpretation
1) Most α particles travel through foil undeflected	Atom is mostly empty
2) Some particles deflect by small angels	Nucleus is positively charged, as is the α particle
3) ~~Eo~~ Very few part. deflect back from foil	nucleus carries most of atoms mass