Schrodinger's Time Dependent Eqn : (STDE)

* We know :

$$\frac{1}{u^2}\frac{\partial^2 y}{\partial t^2} = \frac{\partial^2 y}{\partial x^2}, \quad \text{where } f = f(x,t)$$

ODE : ordinary diff. eqn

PDE : partial DE

* Goal : We have to find differential eqn (ODE/PDE), which will describe the micro level or quantum level description of the particle.

* Wave eqn : $f(x,t) = Ae^{i(\omega t - Kx)}$

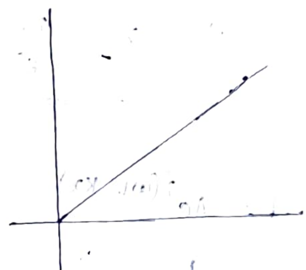
$$\frac{\partial f}{\partial t} = i\omega f \qquad \frac{\partial f}{\partial x} = -iKf$$

$$\frac{\partial^2 f}{\partial t^2} = (i\omega)^2 f \qquad \frac{\partial^2 f}{\partial x^2} = (-iK)^2 f$$

put in above eqn

$$\therefore \frac{\omega^2}{u^2} = K^2 \quad (\text{or}) \quad \omega = Ku.$$

$$\boxed{K = \frac{\omega}{c}} \rightarrow \text{module - 1}$$



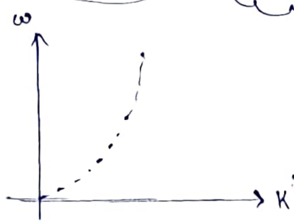
(dispersion relation).

* For Quantum level :

$$E = \frac{p^2}{2m}, \quad \text{if } V(x) = 0, \quad p = \hbar K, \quad \hbar = \frac{h}{2\pi}$$

$$\Rightarrow \hbar\omega = \frac{\hbar^2 K^2}{2m}$$

$$\Rightarrow \underline{\omega \propto K^2}$$



* If we have to satisfy this dispersion relation, what is the governing ODE / PDE ?

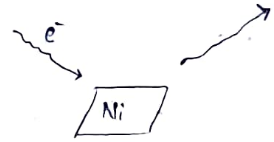
$$\boxed{E = \frac{hc}{\lambda} = h\nu = 2\pi\hbar\left(\frac{\omega}{2\pi}\right) = \hbar\omega}$$

de-Broglie

$$\boxed{\lambda = \frac{h}{p} \Rightarrow p = \frac{h}{\lambda} \Rightarrow p = \frac{h\nu}{c} \Rightarrow p = \frac{h}{2\pi}\left(\frac{\omega}{c}\right) = \frac{hK}{2\pi} = \hbar K}$$

DAIRSSON GERMER : (WAVE NATURE OF PARTICLE).

Wave Nature	Particle Nature.
Braggs Theory	de- Broglie
λ_{Bragg}	$\lambda_{de\text{-}brog}$.



$$\boxed{2d \sin\theta = n\lambda}$$

$$\lambda_{Bragg} = \lambda_{debrog}$$

HEISENBERG UNCERTAINITY THEORY :

* $\Delta P_x \cdot \Delta x \geq \hbar/2 = \frac{h}{4\pi}$

  $\Delta P_y \cdot \Delta y \geq \hbar/2$

  $\Delta P_z \cdot \Delta z \geq \hbar/2$.

* $\Delta E \cdot \Delta t \geq \hbar/2$

* $\Delta J \cdot \Delta \phi \geq \hbar/2$.

$J \rightarrow$ angular momentum.

$\phi \rightarrow$ angle.

WAVE FUNCTION :

* Notation $\longrightarrow$ $\Psi = \Psi(\vec{r}, t)$ Psi

  $\psi = \psi(\vec{r})$ psi.

* Ψ is in general complex.

* $|\Psi|^2$ has meaning. It represents the probability density of

$|\Psi|^2 \cdot dx$ is the probability of finding the object (e^-, proton, etc) b/w x & $x + dx$.