- Wave Particle duality:

Photon: wave (interference / diffraction) or particle (Compton, PEE)

Ans: BOTH !

- de Broglie: "Everything (matter & radiation) has both particle & wave nature!"

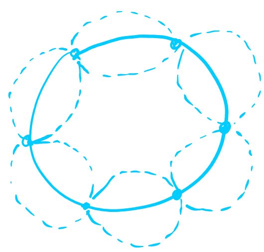
$$\boxed{\lambda_{dB} = \frac{h}{p}} \rightsquigarrow \left\{ \lambda_{dB} = \lambda_{photon} = \frac{h}{p_{photon}} = \frac{c}{\nu} \right\}$$

for relativistic speeds $\lambda_{dB} = \frac{h}{p_{rel}} = \frac{h}{\sqrt{(E/c)^2 - (m_0 c)^2}}$

- Agrees with Bohr Quantization: $mvr = \frac{nh}{2\pi} = n\hbar \Rightarrow$ if $\frac{mv}{h} = \frac{1}{\lambda_{dB}}$

$$\boxed{n\lambda_{dB} = 2\pi r}$$

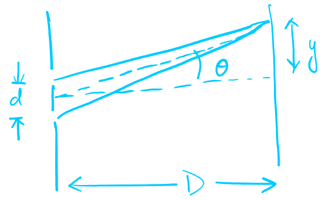
↳ Stable Orbits



"Standing wave of electrons in some sense."

- YDSE (photons)

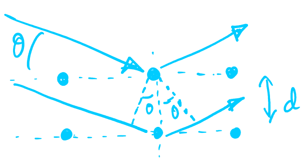
if $d << D$. Path diff $\Delta x \simeq d\sin\theta$



if $d\sin\theta = n\lambda$ — Constructive interference

$d\sin\theta = (n+\frac{1}{2})\lambda$ — Destructive interference

- Bragg's Law for X-ray Diffraction:



$\Delta x = 2d\sin\theta$.

For diffraction $\boxed{n\lambda = 2d\sin\theta}$ $\rightsquigarrow$ usually only 1st order is significant $\Rightarrow \lambda = 2d\sin\theta$

- Davisson Germer for electron-Diffraction:

(The concept is the same as Bragg's but the measured ∠ is diff)

Effective dist btwn layers = $d\sin\left(\frac{\phi}{2}\right)$

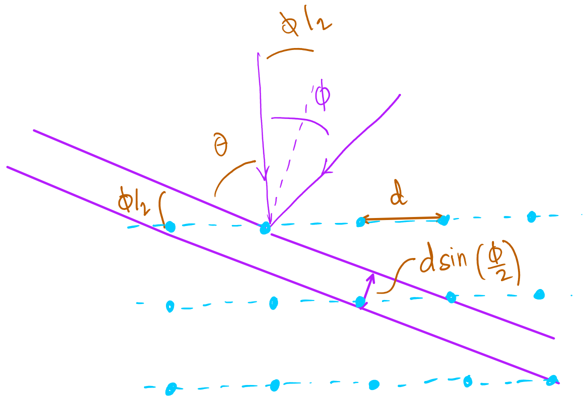
Effective incidence angle: $\frac{\phi}{2}$

Effective incident angle: $\frac{\phi}{2}$

$$\therefore \quad \Delta x = 2d_{eff}\sin(\theta_{eff}) = 2d\sin\frac{\phi}{2}\cos\frac{\phi}{2}$$

$$\boxed{\Delta x = d\sin\phi}$$

$$n\lambda = d\sin\phi = \frac{nh}{m_e v} \Rightarrow \boxed{\frac{nh}{\sqrt{2m_eV_1}} = d\sin\phi}$$



Braggs: $\Delta x = 2d_{eff} \times \sin(\theta_{eff})$

$$= 2 \times d\sin\left(\frac{\phi}{2}\right) \times \sin\left(90 - \frac{\phi}{2}\right)$$

$$= 2d\sin\left(\frac{\phi}{2}\right)\cos\left(\frac{\phi}{2}\right) = d\sin\phi$$