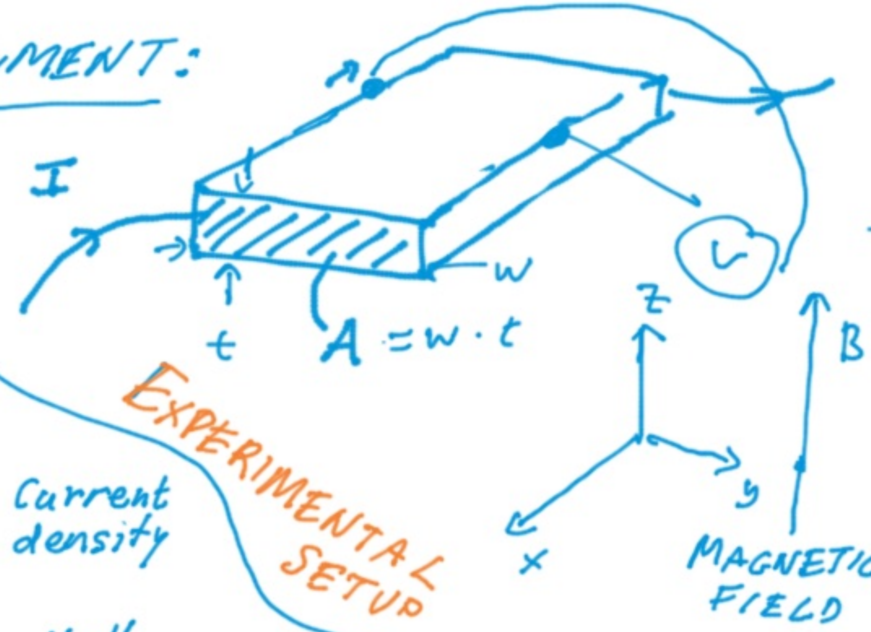
HALL EFFECT EXPERIMENT:



$$R_{xx} = \frac{V_x}{I_x}$$

$$\rho_{xx} = \frac{E_x}{j_x} = \text{Resistivity}$$

$$\rho_{xy} = \frac{E_y}{j_x}$$

$$R_{xy} = \frac{V_x}{I_x}$$

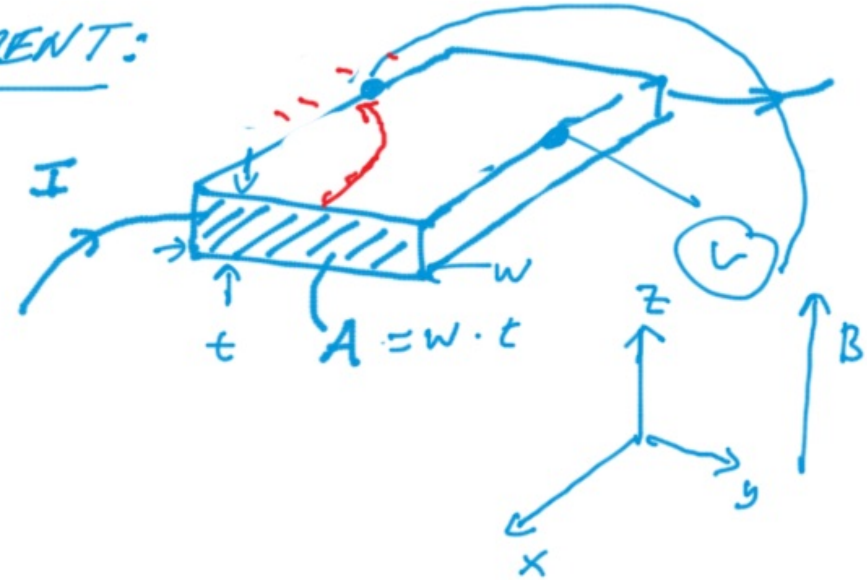
$$j_x = \frac{I_x}{w \cdot t} = \text{current density}$$

$$V_y = w E_y = \text{Hall Voltage}$$

$$R_{xy} = \frac{V_y}{I_x} = \frac{\cancel{w} E_y}{j_x \cdot \cancel{w} t} = \frac{1}{t} \frac{E_y}{j_x} = \frac{1}{t} \cdot \rho_{xy}$$

GEOMETRY FACTOR

HALL EFFECT EXPERIMENT:



$$F = -e\left(E + \vec{v} \times \vec{B}\right)$$

= LORENTZ FORCE

$$E_y = -V_x \cdot B_z$$

$$j_x = -env_x$$

$$V_y = -E_y \cdot w = +V_x \cdot B_z \cdot w = \frac{-j_x}{en} \cdot B_z \cdot W = \frac{-I_x}{en\cancel{w}t} B_z \cancel{w}$$

$$R_{xy} = \frac{V_y}{I_x} = \frac{-1}{en}\frac{1}{t} \cdot B_z$$

$$\rho_{xy} = t \cdot R_{xy} = \frac{-1}{en} B_z$$

$$\boxed{\begin{aligned} \rho_{xy} &= R_H \cdot B_z = \text{HALL RESISTANCE} \\ R_H &= \frac{-1}{ne} = \text{HALL COEFFICIENT} \end{aligned}}$$

CHARGED PARTICLE IN MAGNETIC FIELD

$$\hbar \frac{dk}{dt} = -e\,\vec{v}\times\vec{B}$$

$$= -e\,\frac{dr}{dt}\,B_z$$

$$\Downarrow$$

$$dk = \frac{-eB_z}{\hbar}\,dr$$

CIRCUMFERENCE OF ORBIT →

$$\boxed{\begin{aligned} l_S &= 2\pi k_F \\ l_A &= 2\pi \frac{eB_z}{\hbar} k_F \end{aligned}}$$

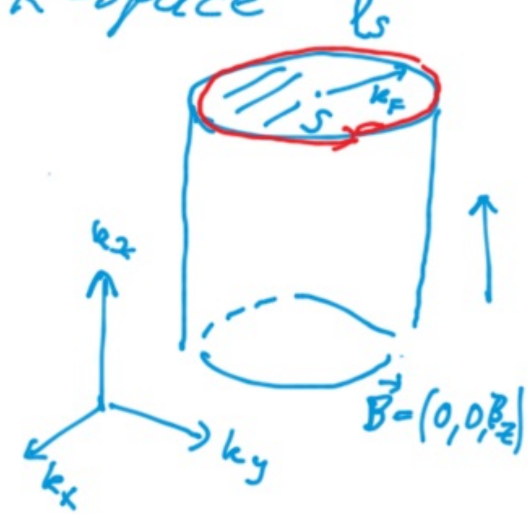
AREA OF ORBIT →

$$\boxed{\begin{aligned} S &= \pi k_F^2 \\ A &= \left(\frac{\hbar}{eB_z}\right)^2 S \end{aligned}}$$

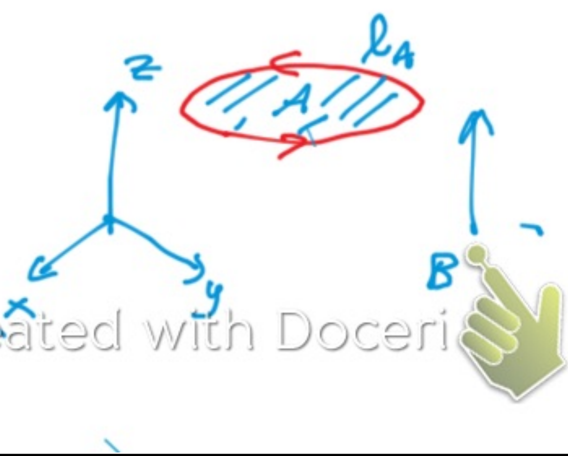
Flux: →

$$\boxed{\begin{aligned} \Phi &= B_z A \\ &= \left(\frac{\hbar}{e}\right)^2 \frac{}{B_z} \end{aligned}}$$

k-Space



REAL SPACE



Flux: $\rightarrow$ $$\boxed{\begin{aligned}\Phi &= B_z \cdot A \\ &= \left(\frac{\hbar}{e}\right)^2 \overline{B_z}\end{aligned}}$$

Flux quantization

$$\Phi = (n+\gamma)\frac{h}{e} \quad ; \gamma = 1/2 \; ; n = 0, 1, 2, 3 \ldots$$

$$S = \left(\frac{e}{\hbar}\right)^2 \cdot B_z \cdot \Phi = \left(\frac{e}{\hbar}\right)^2 \cdot B \cdot (n+\gamma)\frac{2\pi\hbar}{e}$$

$$= \frac{2\pi e}{\hbar} B(n+\gamma)$$

Flux quantization

$$\Phi = (n+\gamma)\frac{h}{e} \quad ; \quad \gamma = \tfrac{1}{2} \ ; \ n = 0, 1, 2, 3 \ldots$$

$$S = \left(\frac{e}{\hbar}\right)^2 \cdot B_z \cdot \Phi = \left(\frac{e}{\hbar}\right)^2 \cdot B \cdot (n+\gamma)\frac{2\pi\hbar}{e} = \frac{e\,2\pi}{\hbar} B(n+\gamma)$$

Define: $\Delta B = B_{n+1} - B_n$

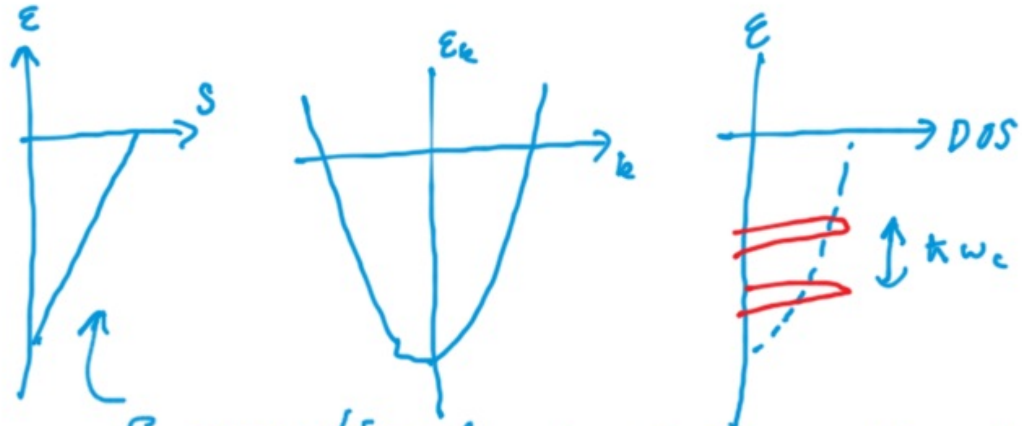
$$S_{n+1} = \cancel{\frac{e\,2\pi}{\hbar}} B_{n+1}(n+1+\gamma) = S_n = \cancel{\frac{2\pi e}{\hbar}} B_n (n+\gamma)$$

$$\Downarrow \quad B_{n+1}(n+1+\gamma) = (B_{n+1} - \Delta B)(n+\gamma)$$

$$\Downarrow \quad -\Delta B(n+\gamma) = B_{n+1}$$

$$\Downarrow \quad n+\gamma = \frac{-B_{n+1}}{\Delta B}$$

$$S_n = -\frac{2\pi e}{\hbar}\frac{B_n B_{n+1}}{\Delta B} \Rightarrow S_n\left(\frac{1}{B_{n+1}} - \frac{1}{B_n}\right) = \frac{2\pi e}{\hbar}$$



LANDAU LEVELS

$$E_n = (n - 1/2)\hbar\omega_c$$

S quantized ⇒ ε_k quantized ⇒ DOS PEAK = LANDAU LEVELS

Centripetal Force = $\frac{mv^2}{r} = eBv$

ORBIT PERIOD = $T = \frac{2\pi r}{v}$

FREQUENCY = $F = 1/T = \frac{v}{2\pi r}$

CYCLOTRON FREQUENCY

$$\omega_c = 2\pi F = \frac{eB}{m}$$

$$\hbar\omega_c(1T) \simeq 10^{-4}\,\text{eV}$$