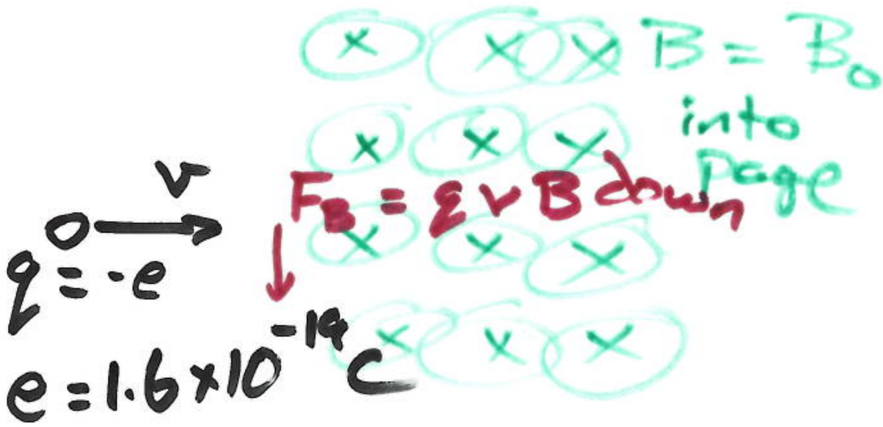
Physics 201 — Day 13

Magnetic Forces

$$\vec{F} = q\,\vec{v} \times \vec{B}$$

$$\vec{F} = I\,\vec{l} \times \vec{B}$$



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later on

circular path. What radius?

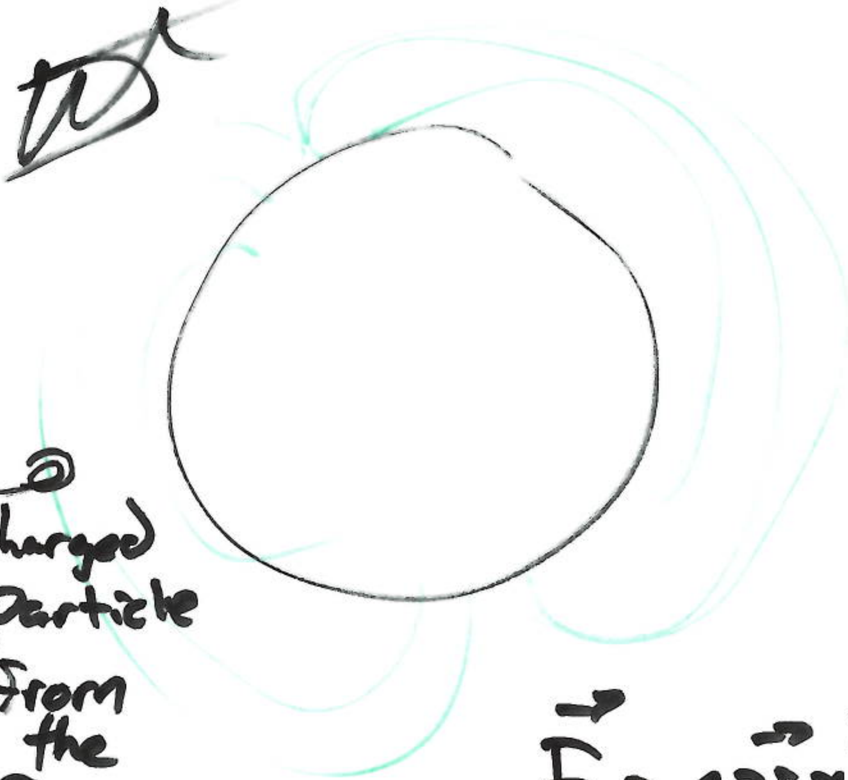
given: $m\ q\ v\ B$.

$$\Sigma \vec{F} = m\vec{a}$$

$$qvB = ma_c \qquad a_c = \frac{v^2}{r}$$

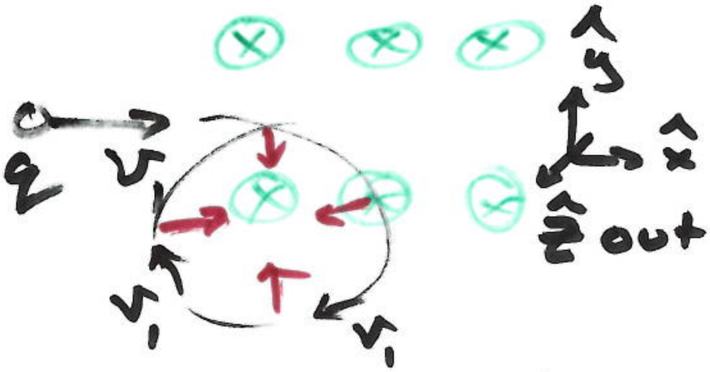
$$q\cancel{v}B = m\frac{v^{\cancel{2}}}{r}$$

$$r = \frac{mv}{qB} = \frac{m}{q}\,\frac{v}{B}$$



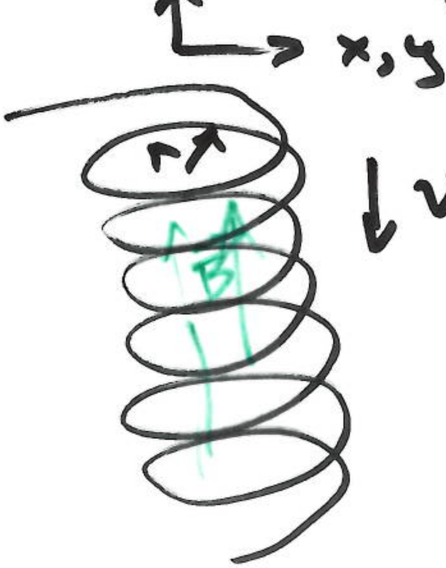
Charged Particle from the Sun.

$$\vec{F} = q\vec{v} \times \vec{B}$$



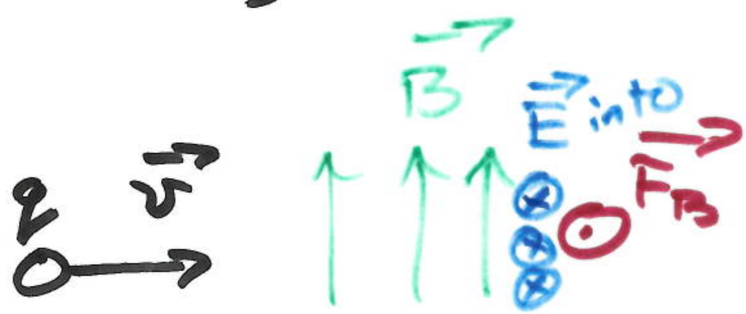
$$\vec{v} = v_1 \hat{x} + v_2 \hat{z}$$

small?



$v_2 =$ const.

Velocity selector:



$$\vec{F} = q\vec{v} \times \vec{B}$$

$$\vec{F} = q\vec{E}$$

given: $q\,\vec{v}\,\vec{B}$ + picture
where should $\vec{E}$ go so that into page
$\sum \vec{F} = 0$ on this q?

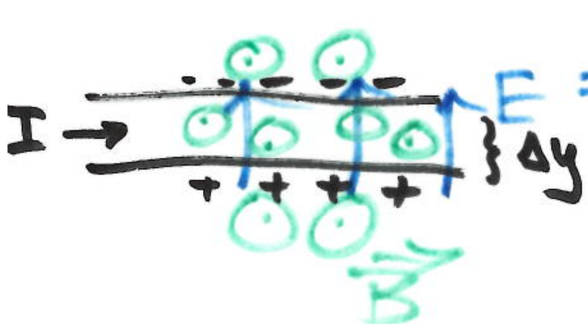
What is E in terms of: $q\,v\,B, m$

$$\cancel{q}E = \cancel{q}vB$$

$$E = vB. \quad \text{or} \quad v = \frac{E}{B}$$

the right velocity to go straight.

Hall Effect:
how to measure $\vec{B}$?



$E = E_{Hall}$ develops until $\sum F = 0$ on the next electron.

$$qE = qvB$$

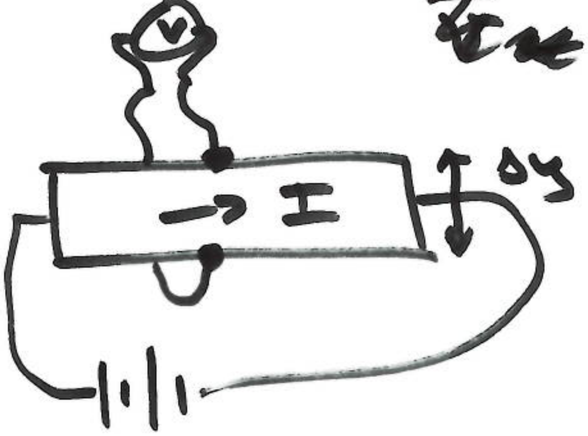
Hall Voltage

and $E = -\frac{dV}{dy}\hat{y}$ so $\Delta V = \underbrace{\Delta y}_{\text{width}} E.$

$B = \frac{E}{v}$ and $E = \Delta V / \Delta y$

$B = \frac{\Delta V}{\Delta y \cdot v}$

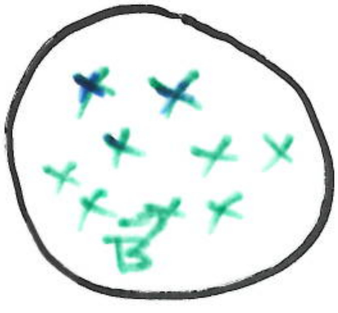
$B = \Delta V / \Delta y \, v$ ← $v \propto I$ (the current)



Faraday's Law of Induction

$$V = -\frac{d}{dt} \underbrace{\int \vec{B} \cdot d\vec{a}}_{\text{magnetic flux or } \Phi_B}$$

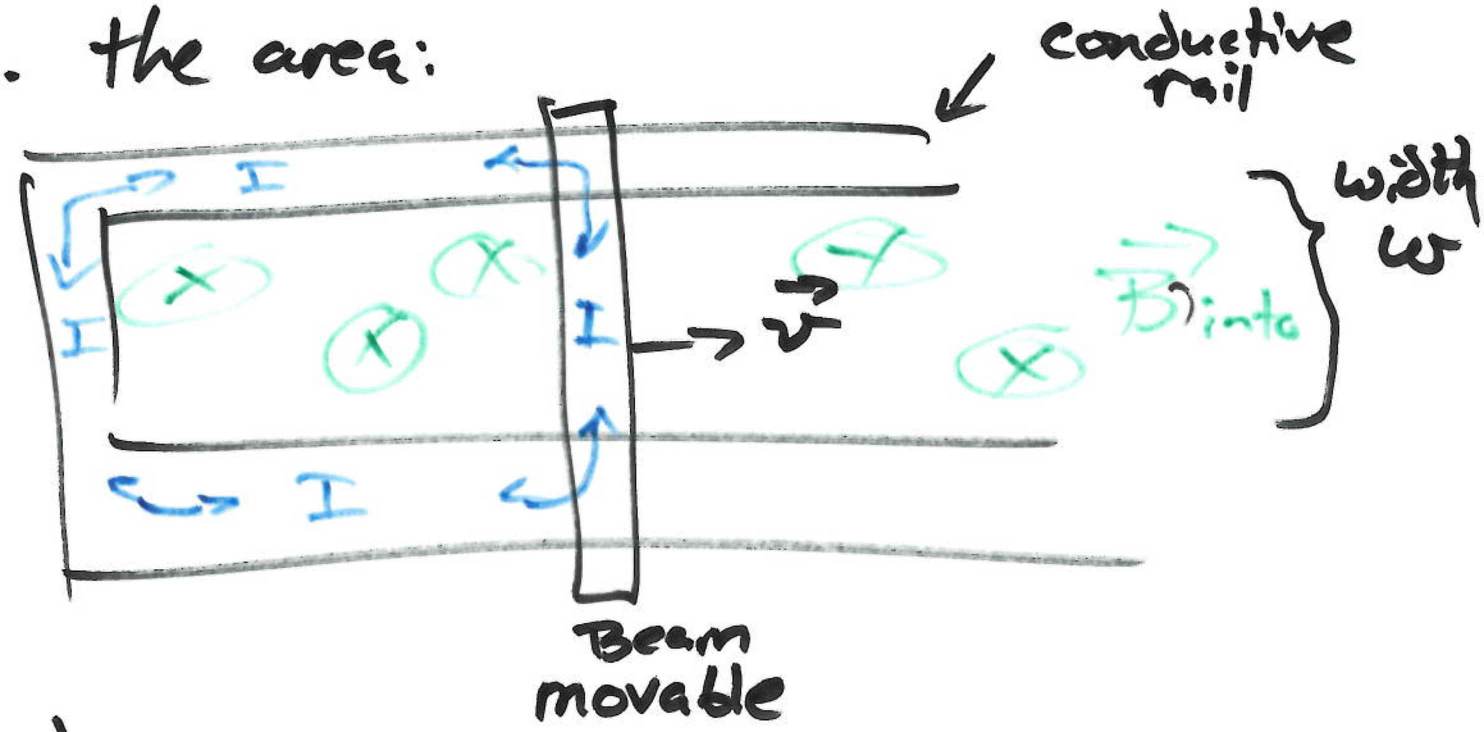
sometimes called EMF or $\mathcal{E}$



3 options to change the flux:

1. make B bigger or smaller.
2. Make area bigger or smaller
3. Change θ between $\vec{B}$, $d\vec{a}$

2. the area:



Need:

B, v, w + picture.

The direction of current I given by Lenz's Law.

$$V = -\frac{d}{dt}\int \vec{B}\cdot\vec{da} = \underbrace{\frac{d}{dt}\int B\,da}_{\text{B constant in space and time.}}$$

$$V = B\frac{d}{dt}\underbrace{\overbrace{\int da}^{\text{area}}}_{L(t)\cdot w} = \underbrace{B\frac{d}{dt}L(t)\cdot w}_{\text{width constant}}$$

$$= B\,w\,\frac{dL}{\underbrace{dt}_{v}} = B\,w\,v$$

Lenz's Law:

The current will produce its own B which will counter the change in flux in loop.

This goes counter-clock wise