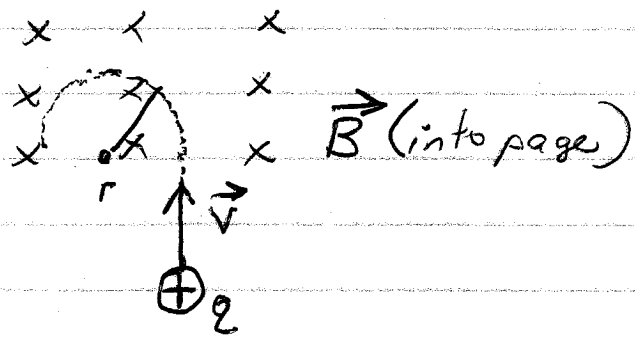
Application of force on current: Motor

Application of force on a charge: Mass Spec.

Particle Flying in a magnetic Field

① Ignore gravity, air resistance



$$r = \frac{mv}{qB}$$

$\vec{F} = |q|vB$ (Left)

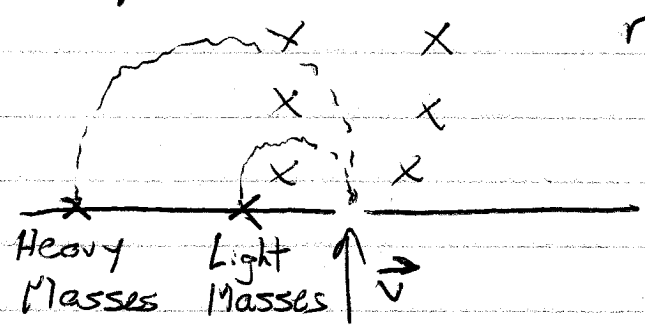
The force makes the particle follow a circle of radius r.

Recall circular motion: $a = \frac{v^2}{r}$

$$F = ma$$

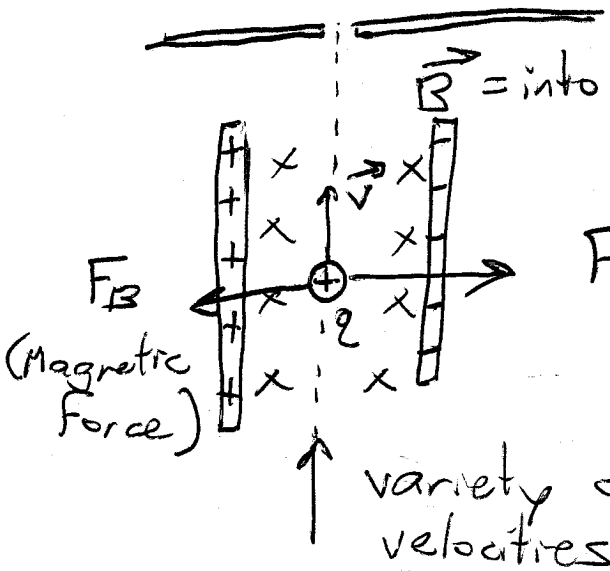
$$qvB = \frac{mv^2}{r} \longrightarrow r = \frac{mv^2}{qvB} = \frac{mv}{qB}$$

Mass Spec:



$$r = \frac{mv}{qB}$$

How do we give particles the same $\vec{v}$?
Build a velocity selector.



$$F_E = F_B$$

$$qE = qvB$$

If $\boxed{v = \frac{E}{B}}$, the particle goes straight.

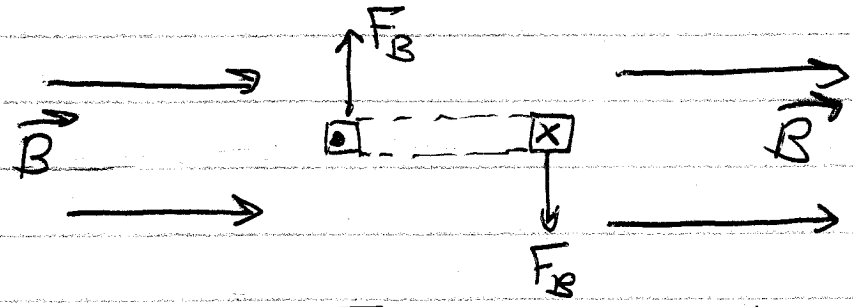
- Too Fast: F_B is too strong, ⊕ bends left.
- Too Slow: F_B is too weak, ⊕ bends right.

Then, the particles go into Mass Spec.

$$r = \frac{m\boxed{v}}{qB}$$

(3)

Force on a coil: (p 670)



Force on ⊡: Force is in +y direction

Force on ⊠: Force is in −y

The two forces are equal & opposite.

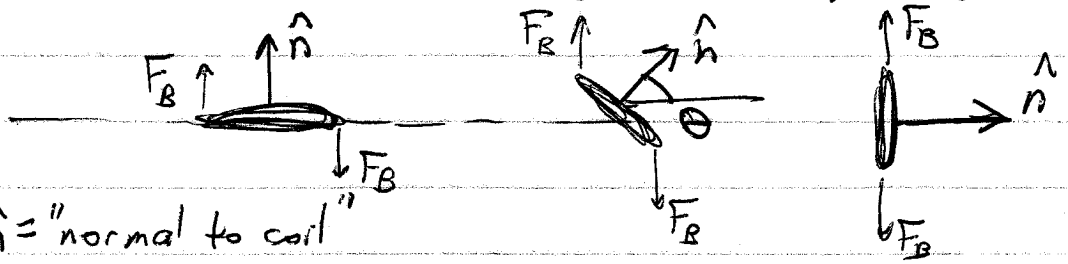
- No net force
- But, they act in different places.

There is a net <u>torque</u>.

$$\tau_{max} = NBAI$$

- I: current
- A: area of a single loop
- N: # loops of wire

Once the coil rotates, the torque gets weaker.



$\hat{n}$ = "normal to coil"

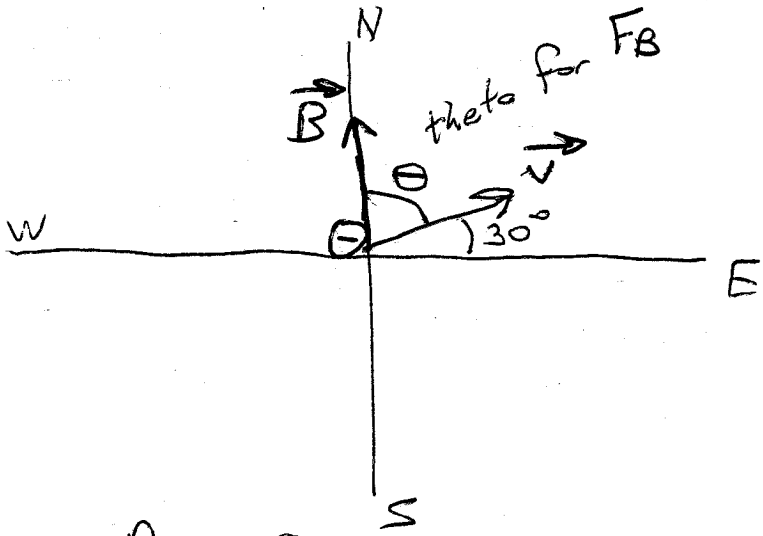
$\tau = \tau_{max}$ $\qquad$ $\tau = 0$

$$\tau = \tau_{max} \sin\theta$$

θ: angle from $\vec{B}$ to $\hat{n}$

HW3-8

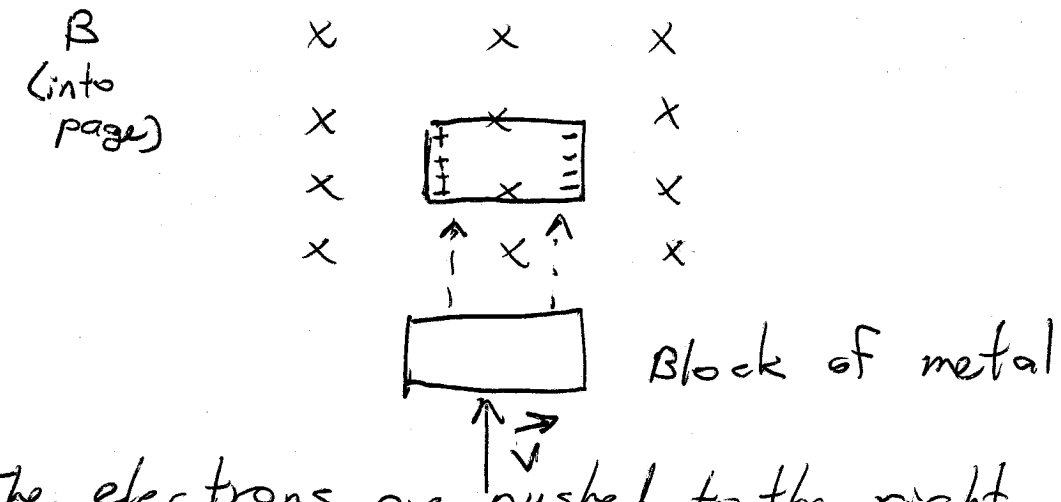
Electron moves 30° N of E.
B is N.



$F = qvB\sin\theta$

↑ Angle From $\vec{v}$ to $\vec{B}$

Motional EMF



The electrons are pushed to the right.
Leaves ⊕ on left.
The edges of the metal form a velocity selector. $E = vB$ Motional EMF