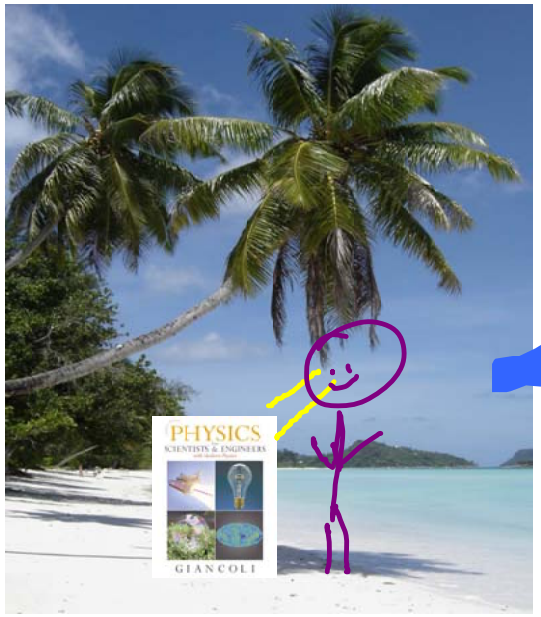
Physics 114 – March 5, 2015

- Exam 2 cometh!

This week
Spring Break
Week after Sp. break
Following Wk

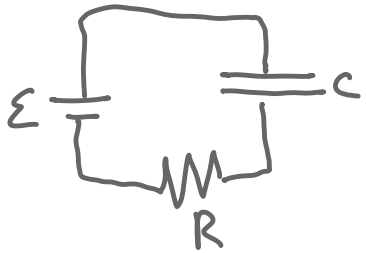
Exam 2 Tues March 24 0800 TBA

Will be in touch soon about Material coverage

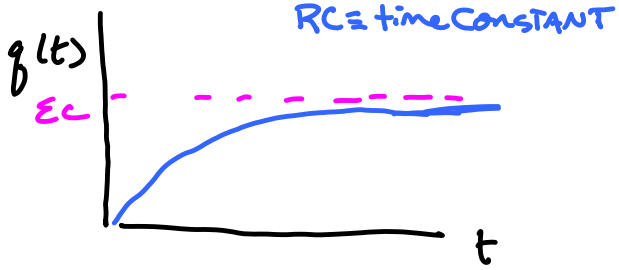


Last Time — RC Circuits

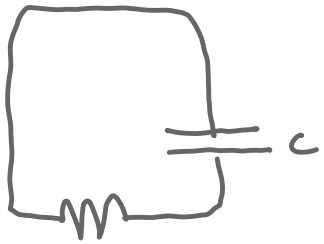
Charging



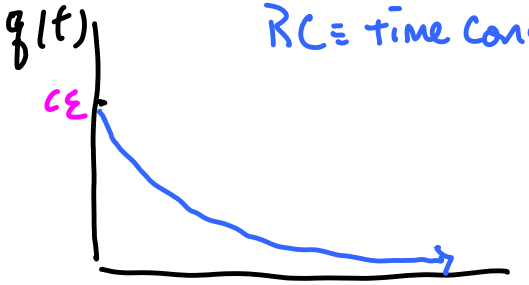
$$q(t) = \varepsilon C\left(1 - e^{-t/RC}\right)$$



Discharging



$$q(t) = q_0 e^{-t/RC}$$



Magnetism

Let there be a magnetic field $\vec{B}$

units → Tesla (mks)

gauss 1 Tesla = 10000 Gauss

$|\vec{B}|_{earth} \cong 0.5$ gauss

$|\vec{B}|_{\substack{typical \\ bar\ magnet}} \cong 100$ gauss

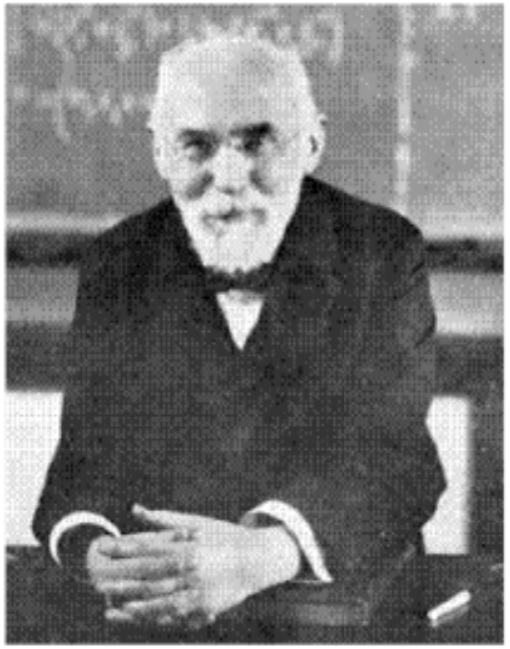
$|\vec{B}|_{electromagnet} \approx 2$ Tesla

$|\vec{B}|_{\substack{very\ strong \\ lab\ magnet}} \approx 10$ Tesla

$|\vec{B}|_{\substack{high\ fields\ for \\ study}} \approx 100$ Tesla

Lorentz Force law

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

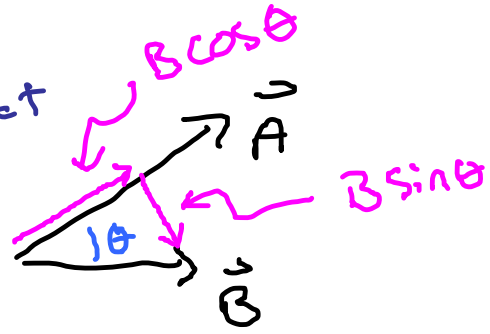


Hendrik Antoon Lorentz
(1853 - 1928)

Dutch - 1902 Nobel Prize

What is a "cross-product", i.e., $\vec{V} \times \vec{B}$

dot product

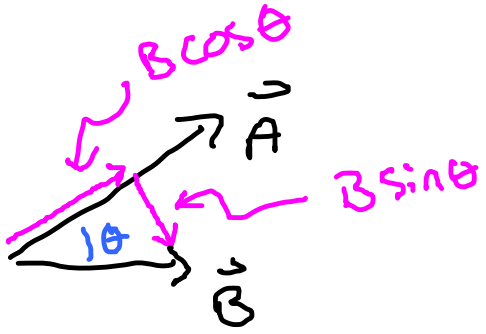


$$\vec{A} \cdot \vec{B} = |\vec{A}||\vec{B}| \cos\theta$$

$$\vec{A} \cdot \vec{B} = A_x B_x + A_y B_y + A_z B_z$$

Scalar

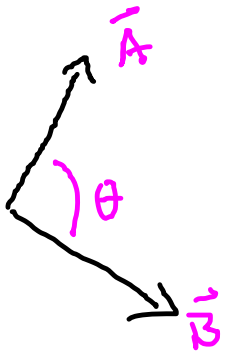
#, NOT a vector

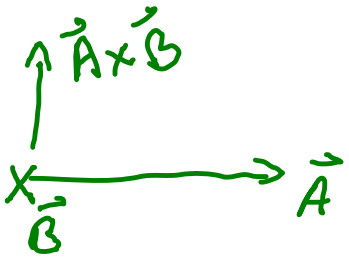


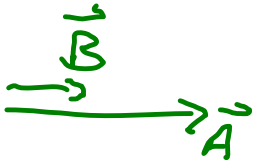
, AND Bound

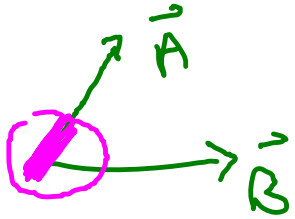
$$|\vec{A} \times \vec{B}| = |\vec{A}||\vec{B}| \sin\theta$$

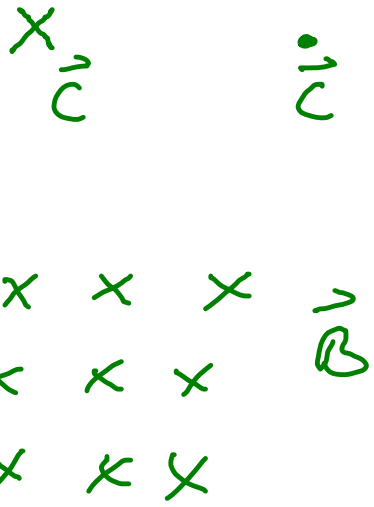
Vector direction is given by right-hand rule

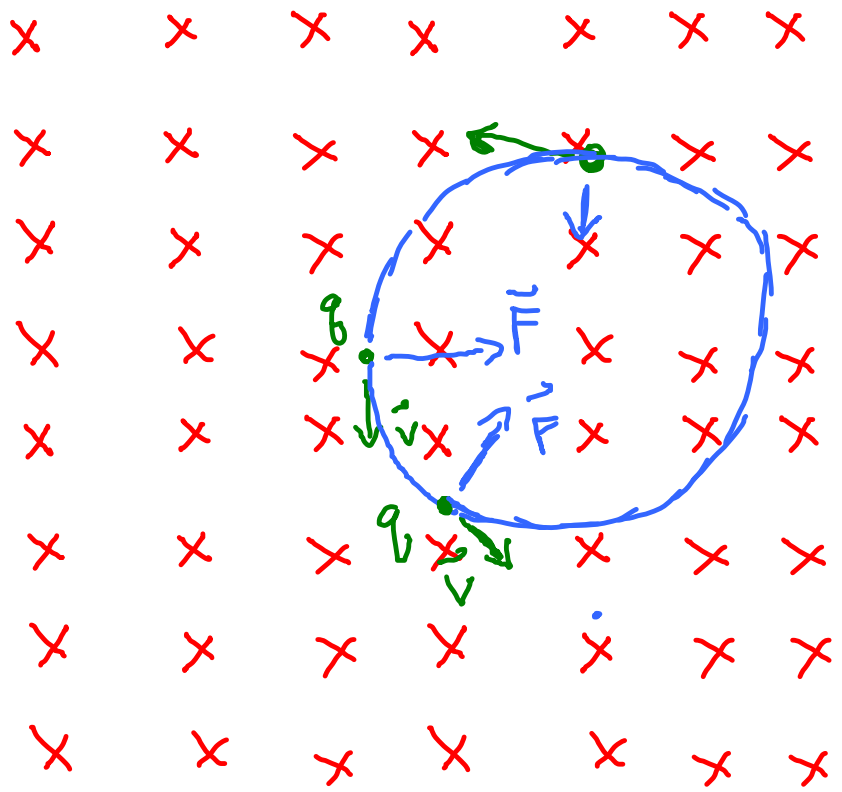

$\vec{A}$
θ
$\vec{B}$


$\vec{A}\times\vec{B}$
$\vec{A}$
$\vec{B}$


$\vec{B}$
$\vec{A}$


$\vec{A}$
$\vec{B}$


$\vec{C}$
$\vec{C}$
$\vec{B}$



uniform $\vec{B}$

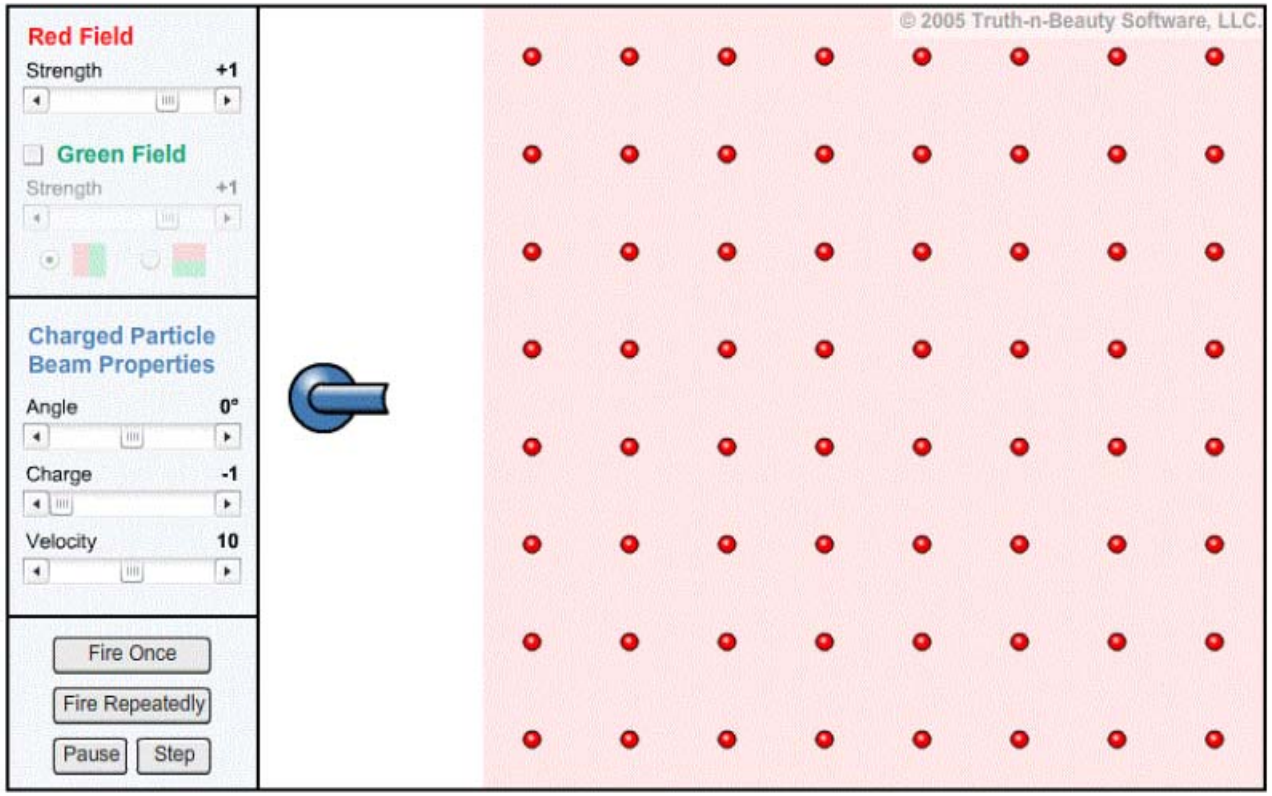
circular motion

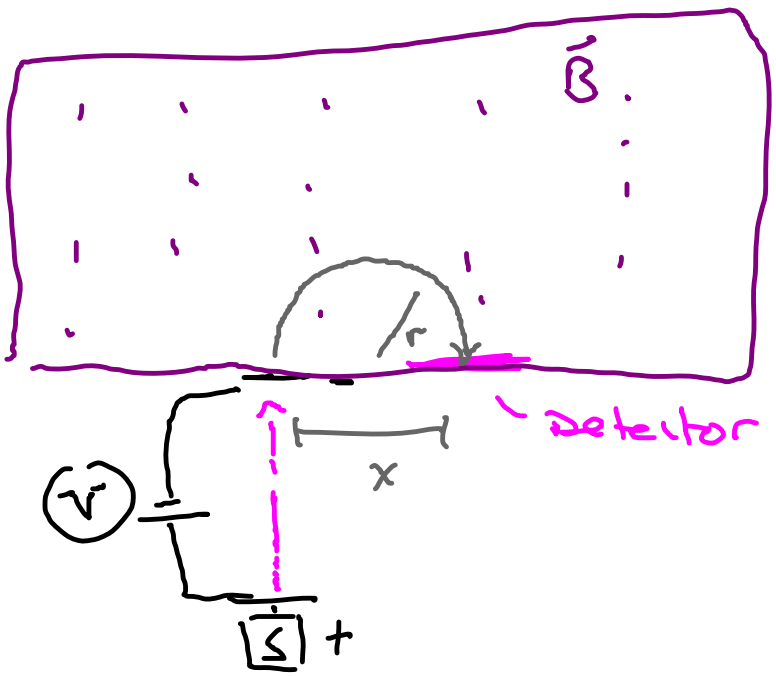
$$F_{centripetal} = \frac{mv^2}{r}$$

$$q\vec{v} \times \vec{B} = qvB \quad \text{in magnitude}$$

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

Applet – charged particle in a magnetic field



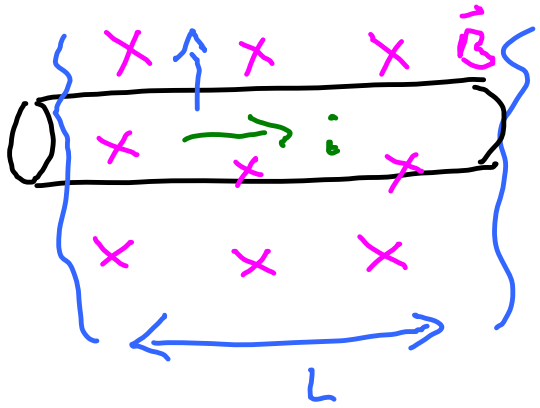


$$r = \frac{mv}{qB} \qquad \frac{q}{m} = \frac{v}{rB}$$

$$qV = \frac{1}{2}mv^2$$

$$v = \sqrt{\frac{2qV}{m}}$$

$$\frac{m}{q} = \frac{r^2B^2}{2V} = \frac{B^2x^2}{8V}$$



$$\vec{F}_{wire} = (q\vec{v}_d \times \vec{B})\, n A L$$

n: # charges / vol; A: x Sect. area

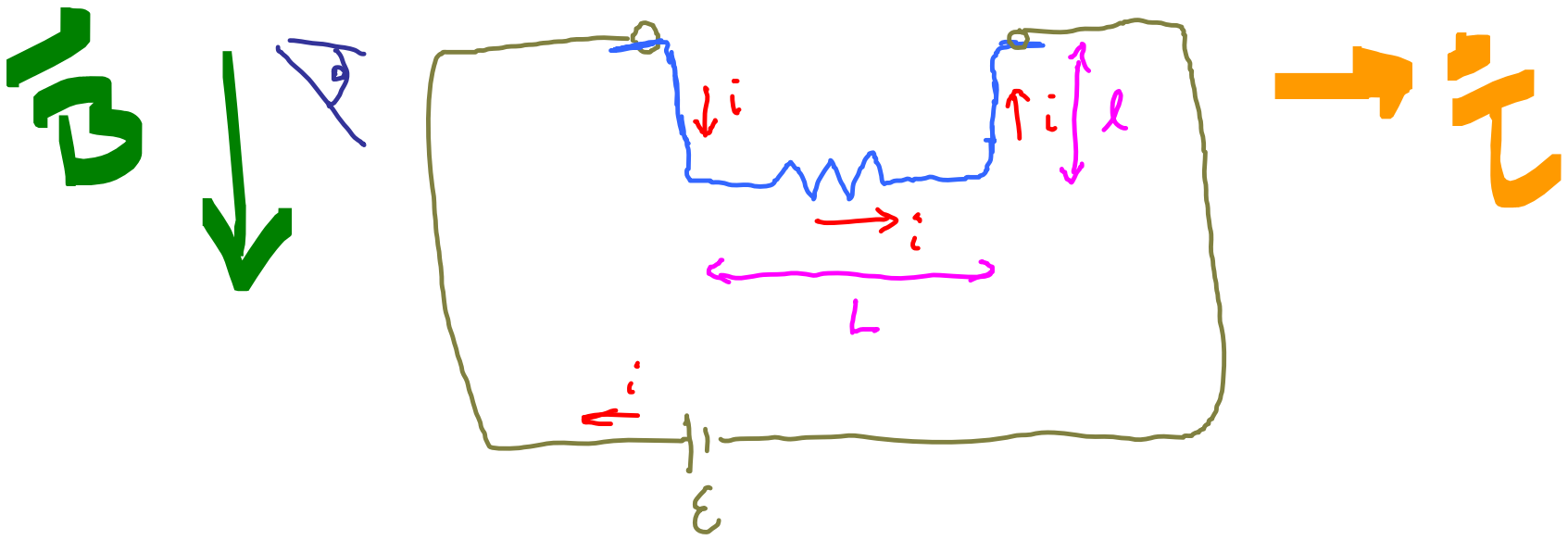
$\vec{v}_d$ = q drift velocity in wire

$$i = n q v_d A$$

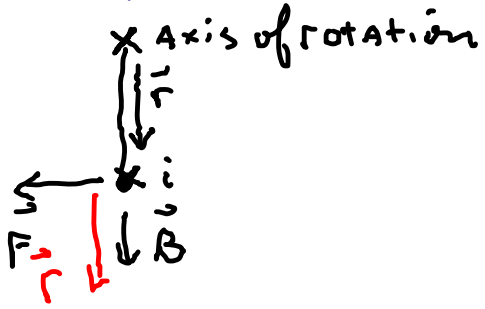
$$\vec{F} = i\vec{L} \times \vec{B}$$

or

$$\vec{F} = L\vec{i} \times \vec{B}$$



What is the torque on the hanging loop?



$$\vec{\tau} = \vec{r} \times \vec{F}$$

$$\tau = rF = \ell i L B$$