Physics 114 - March 17, 2015

Exam 2 Cometh

Tuesday, March 24 0800 Lower Strong

Exam 2 will cover:

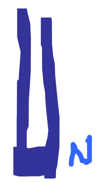
Problem set 3 (last two problems) through problem set 8

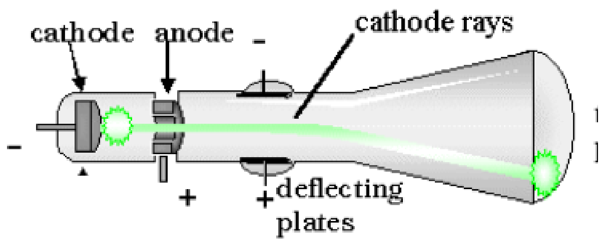
Workshops 3 through 7

Lectures from Feb. 5 (start of potential) through March 5

Text chapters 23 through 27

- My March 24 office hour is 3-4 instead of 2-3 cathode ray tube



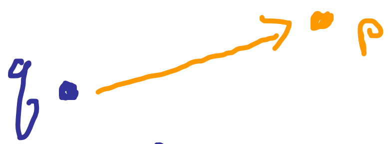


$$\vec{F} = q\vec{E} + q\vec{V} \times \vec{B}$$

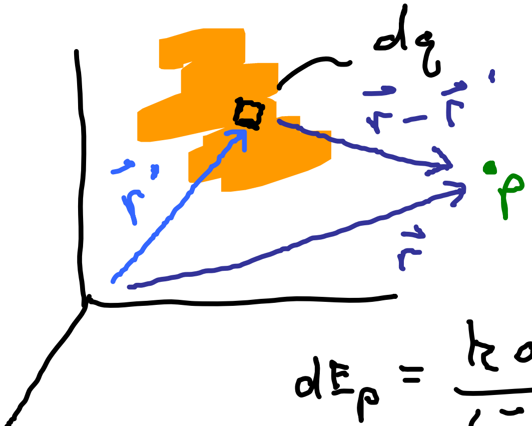
$$\vec{F} = i\vec{l} \times \vec{B} \quad \text{or} \quad l\vec{i} \times \vec{B}$$

Electrostatics

Coulomb's Law



$$\vec{E} = \frac{kq}{r^2}\hat{r}$$

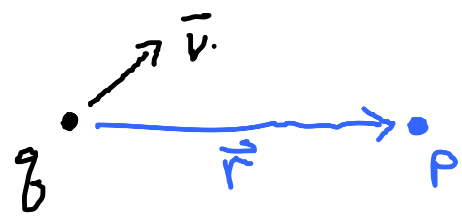


$$dE_p = \frac{k\,dq}{(\vec{r} - \vec{r}\,')^2}$$

$$\widehat{\vec{r} - \vec{r}\,'}$$

Magnetostatics

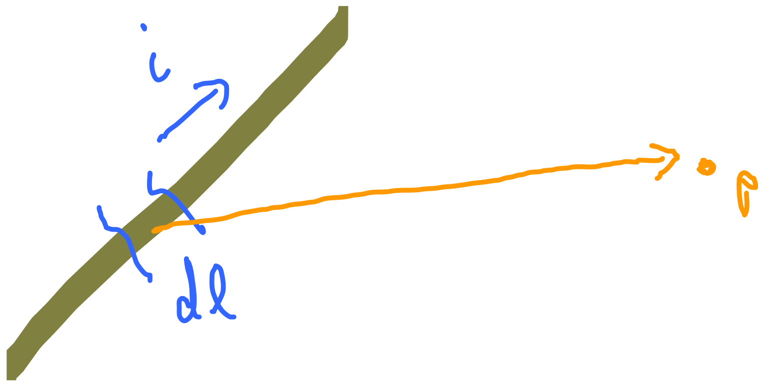
Law of Biot-Savart



$$\vec{B}_{\text{at } p \text{ due to } q} = \frac{\mu_0}{4\pi}\,\frac{q\,\vec{v} \times \hat{r}}{r^2}$$

μ_0 = constant = permeability of free space

$$= 4\pi \times 10^{-7}\ \frac{T \cdot m}{A}$$

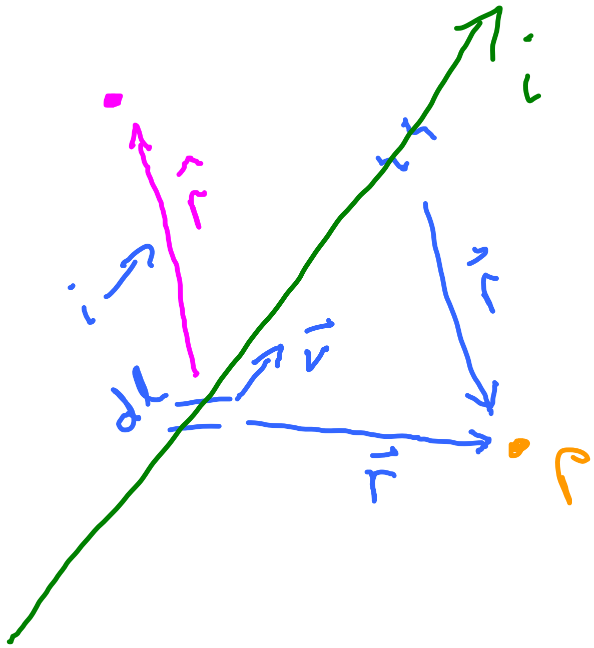


$$dB_P = \frac{\mu_0}{4\pi}\,\frac{i\,d\vec{l}\times\hat{r}}{r^2}$$

due to dl of current

$$B_P = \frac{\mu_0}{4\pi}\int \frac{i\,d\vec{l}\times\hat{r}}{r^2}$$

current DIST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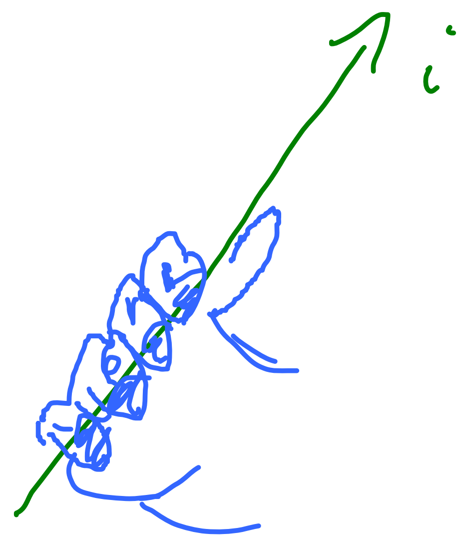

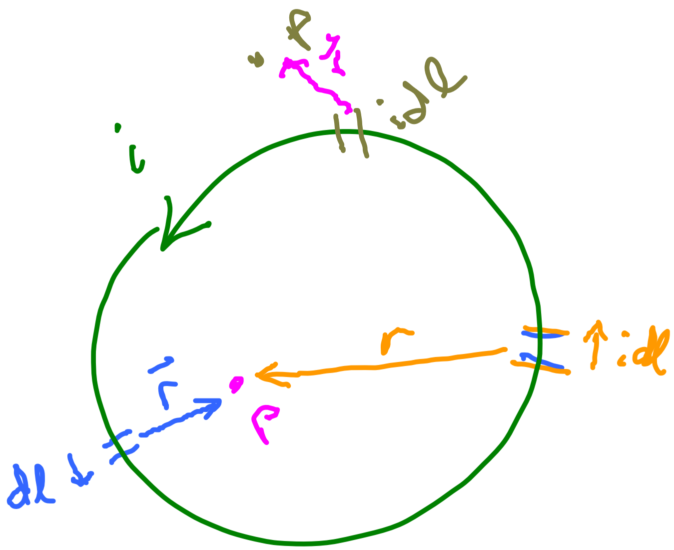
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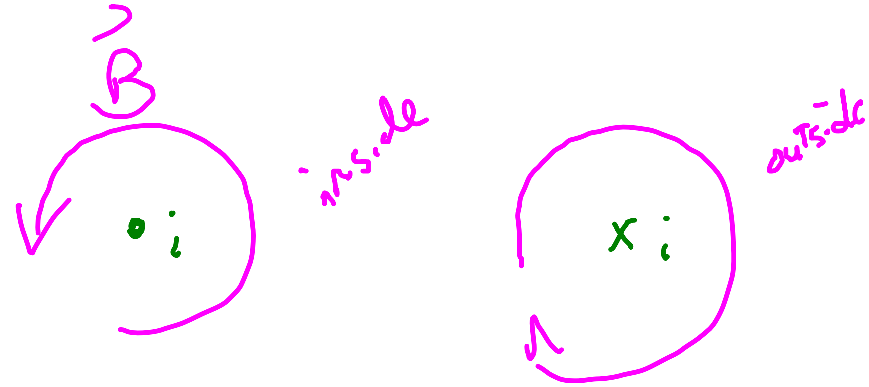
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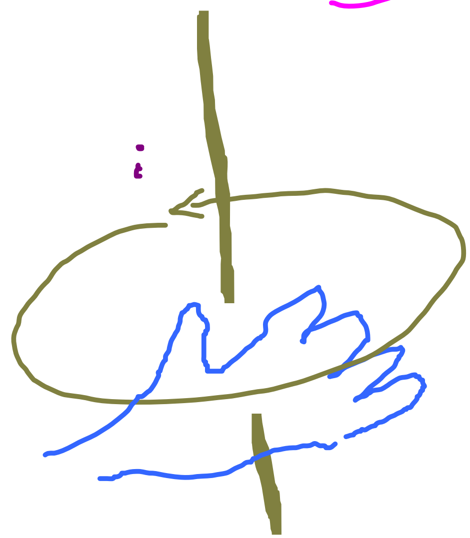
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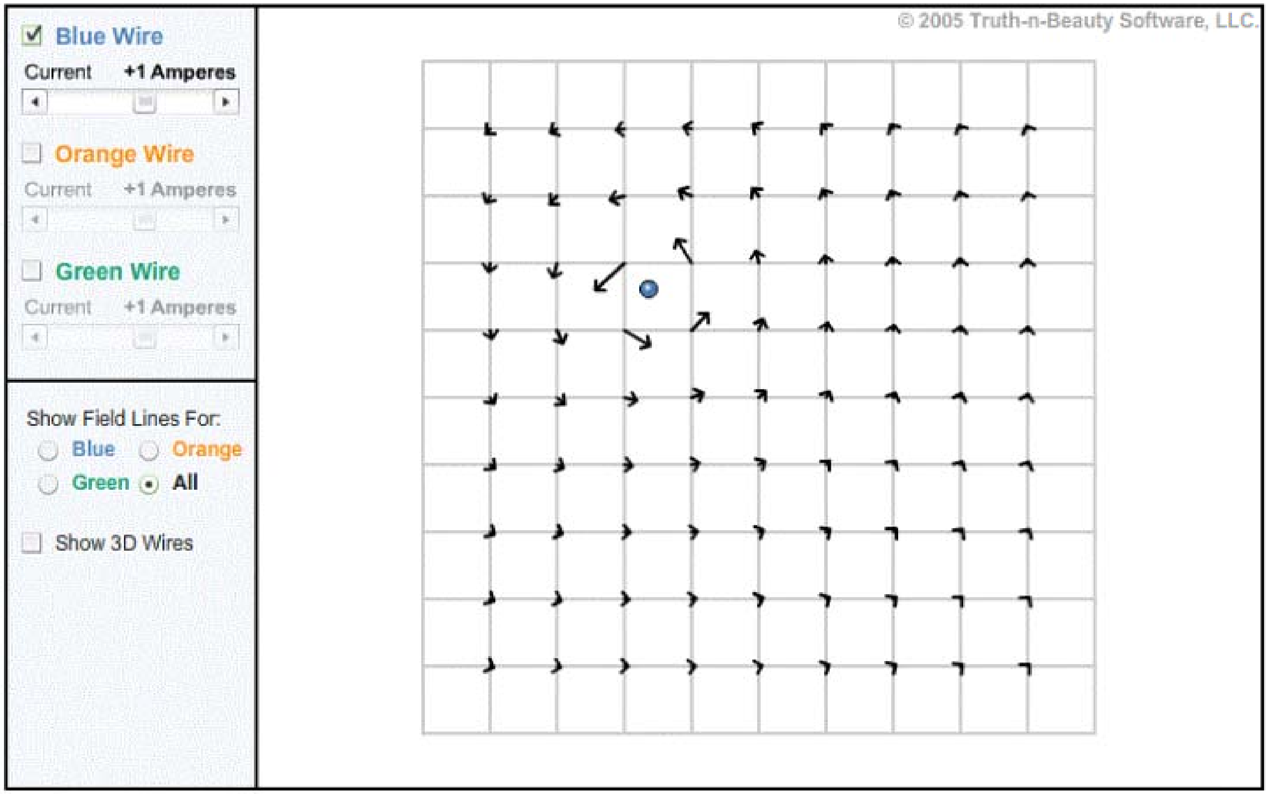
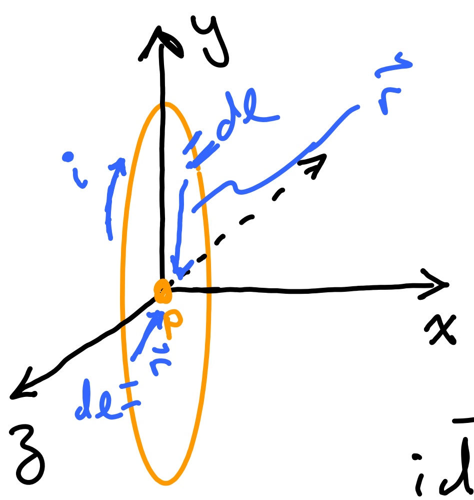
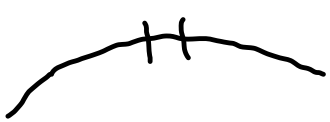
java applet showing B field around current carrying wires



Biot-Savart example





Find $\vec{B}$ at origin

By RHR $\vec{B}$ is in $-\hat{x}$ direction

$$\vec{B}_p = \frac{\mu_0}{4\pi}\int_{dist} \frac{i\,d\vec{l}\times\hat{r}}{r^2} = \frac{\mu_0}{4\pi}\int_{dist}\frac{i\,dl}{r^2}\,(-\hat{x})$$

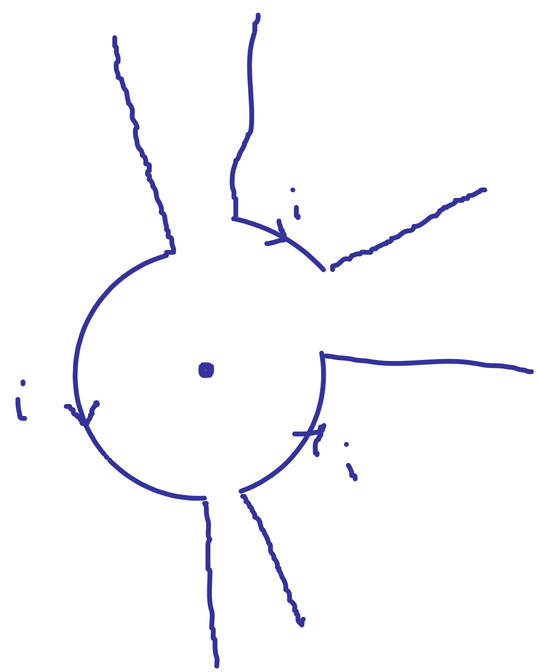
$i\,d\vec{l}\times\hat{r} \longrightarrow i\,dl$

$\swarrow$

$i\,ds$

$$\vec{B}_p = \frac{\mu_0}{4\pi}\,\frac{i}{r^2}\int_0^{2\pi r} ds\,(-\hat{x})$$

$$= \frac{\mu_0}{4\pi}\,\frac{i}{r^2}\,2\pi r(-\hat{x}) = \frac{\mu_0 i}{2r}(-\hat{x})$$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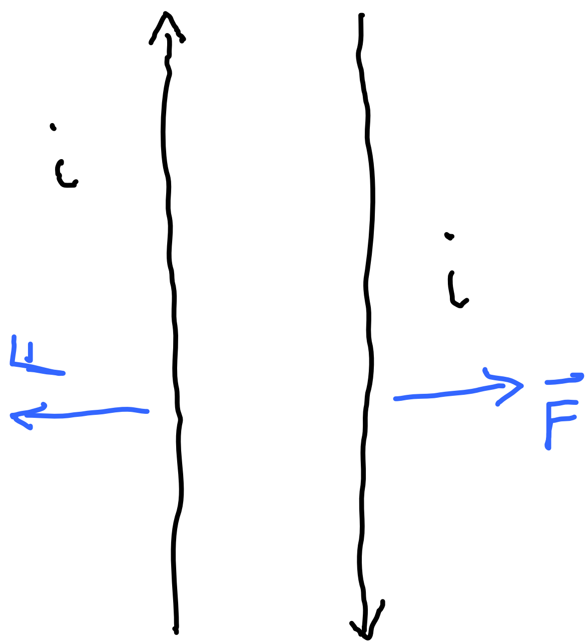

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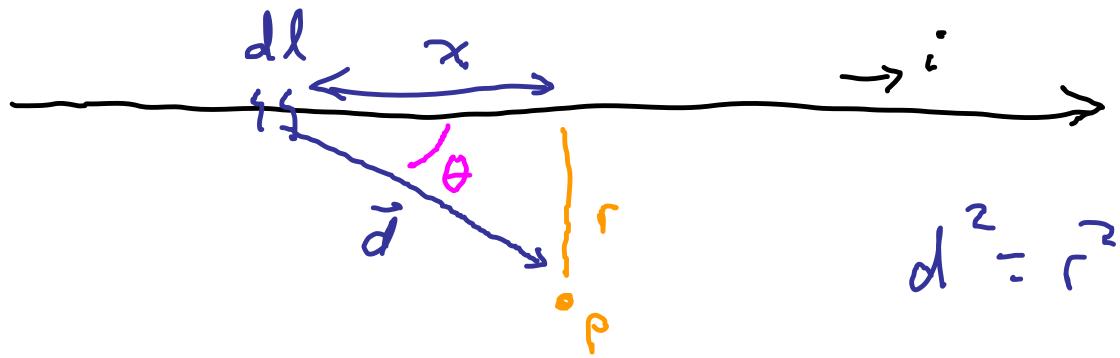

$$d^2 = r^2 + x^2$$

$$\vec{B}_P = \frac{\mu_0}{4\pi}\int_{-\infty}^{\infty}\frac{i\,d\vec{l}\times\hat{d}}{d^2}$$

into Board

$$|d\vec{l}\times\hat{d}| = |d\vec{l}|\sin\theta$$

$$\sin\theta = \frac{r}{d}$$

$$\vec{B}_P = \frac{\mu_0}{4\pi}2i\int_0^{\infty}\frac{\sin\theta\,dx}{r^2+x^2}\ (\widehat{\text{into Board}})$$

$$\vec{B}_P = \frac{\mu_0 2ir}{4\pi}\int_0^{\infty}\frac{dx}{(r^2+x^2)^{3/2}}$$

⟿ doable But a pain ⟿ Ampere's Law!