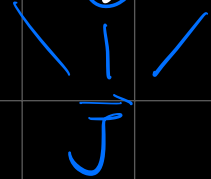


$$N = n \times \text{Area} \times \text{Length} \quad \vec{F} = q(\vec{v} \times \vec{B})$$

$$\vec{F}(\text{total}) = (nALq_e)(\vec{v} \times \vec{B})$$

$$\vec{J} = nq_e \vec{v}_d$$

$$(nALq_e)(\vec{v} \times \vec{B})$$



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

$$\vec{F} = \int d\vec{F}$$

$$\Phi_B = \int \vec{B} \cdot d\vec{A}$$

$$\oint \vec{B} \cdot d\vec{A} = 0 \quad \oint \vec{B} \cdot d\vec{A} = \mu_0 M_{enc} = 0$$

$$\vec{F}_B = q(\vec{v} \times \vec{B})$$

$$\vec{B} = \frac{\mu_0}{4\pi} \cdot \frac{q\vec{v} \times \vec{r}}{r^2} \quad (\text{moving charge})$$

Bio-savart Law

$$d\vec{B} = \frac{\mu_0}{4\pi} \cdot \frac{I d\vec{L} \times \vec{r}}{r^3}$$

Formulas:

$$\mu_0 = 4\pi \times 10^{-7} \text{ N/A}^2 = 1.26 \times 10^{-6} \text{ N/A}^2$$

$$I = neSv \quad (nq_e Sv) \quad \text{电流}$$

$$\vec{F}_B = q(\vec{v} \times \vec{B}) \quad \text{洛伦兹力} \quad (\text{非直导线})$$

$$J = nev \quad (nq_e v) \quad \text{电流密度}$$

$$\vec{F} = BIL \quad \text{安培力} \quad (\text{直导线}), \quad d\vec{F} = I \cdot d\vec{L} \times \vec{B}$$

在空间某点处点电荷运动激发磁场:

$$B = \frac{\mu_0 q_e v \sin\theta}{4\pi r^2}$$

$$\vec{B} = \frac{\mu_0}{4\pi} \cdot \frac{q\vec{v} \times \vec{r}}{r^3}$$

(矢量形式)

通电长直导线(电流)激发磁场:

$$B = \frac{\mu_0 I}{2\pi r}$$

同向导线相吸, 异向排斥, 力为:

$$F = \frac{\mu_0 I_1 I_2 L}{2\pi r}$$

平行运动点电荷之间受力为:

$$F = \frac{\mu_0 q_1 q_2 v_1 v_2}{4\pi r^2}$$

r → distance

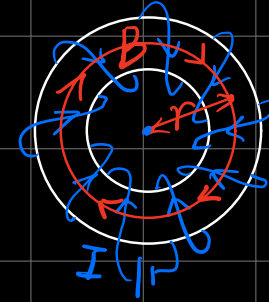
(同向同种电荷: 相吸)

(异向异种电荷: 相吸)

(其它情况: 排斥)

单匝或多匝导线(电流)产生磁场:  $B = \frac{\mu_0 I}{2r} N$  (距离较短, 不计横向长度)  $\left( \begin{array}{l} R \rightarrow \text{半径} \\ N \rightarrow \text{匝数} \\ B \rightarrow \text{中心磁场} \end{array} \right)$   
 one or multiple loops

长通电螺线管:  $B = \frac{\mu_0 I N}{L}$   $B = \mu_0 I n$   $\left( \begin{array}{l} n = \frac{N}{L} \\ N \rightarrow \text{匝数} \\ L \rightarrow \text{长度} \\ n \rightarrow \text{单位长度的匝数} \end{array} \right)$   
 (Solenoids)

圆形绕圈通电螺线管:  $B = \frac{\mu_0 I N}{2\pi r}$   $\Rightarrow$    
 (Toroids)  $\left( \begin{array}{l} N \rightarrow \text{匝数} \\ r \rightarrow \text{到圆心的距离} \end{array} \right)$  (只有内部有磁场)

$\times$  Biot-Savart Law:

$$\vec{B} = \frac{\mu_0}{4\pi} \int \frac{I d\vec{l} \times \vec{r}}{r^3}$$

$$B = \frac{\mu_0}{4\pi} \int \frac{I dl \sin\theta}{r^2}$$

$$B = \frac{\mu_0}{4\pi} \int \frac{I \cdot d\vec{l} \times \hat{r}}{r^2}$$

$$dB = \frac{\mu_0}{4\pi} \frac{I d\vec{l} \times \hat{r}}{r^2}$$

推导运动点电荷激发磁场:

$$\left\{ \begin{array}{l} \vec{B} = \frac{\mu_0}{4\pi} \int \frac{I d\vec{l} \times \vec{r}}{r^3} \\ I = \frac{dq}{dt} \end{array} \right. \Rightarrow \vec{B} = \frac{\mu_0}{4\pi} \int \frac{\frac{dq}{dt} \cdot d\vec{l} \times \vec{r}}{r^3}$$

$$= \frac{\mu_0}{4\pi} \int \frac{dq \cdot \frac{d\vec{l}}{dt} \times \vec{r}}{r^3}$$

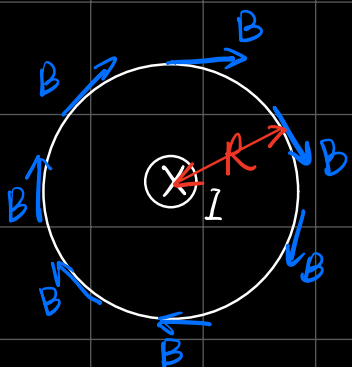
$$= \frac{\mu_0}{4\pi} \int \frac{dq \cdot \vec{v} \times \vec{r}}{r^3}$$

$$= \frac{\mu_0}{4\pi} \frac{qv \sin\theta}{r^2}$$

$\times$  安培环路定律:  $\oint_s \vec{B} \cdot d\vec{l} = \mu_0 I_{enc}$   
 (Ampere's Law)

推导通电螺线管激发磁场:

推导长直导线激发磁场:

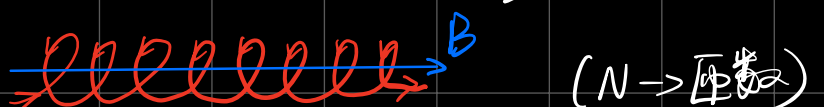


$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{enc}$$

$$\oint d\vec{l} = 2\pi R$$

$$B \cdot 2\pi R = \mu_0 I$$

$$B = \frac{\mu_0 I}{2\pi R}$$



$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{enc}$$

$$\int_0^L \vec{B} \cdot d\vec{l} = B \int_0^L d\vec{l} = BL = \mu_0 NI$$

$$B = \frac{\mu_0 I N}{L} = \mu_0 I n$$