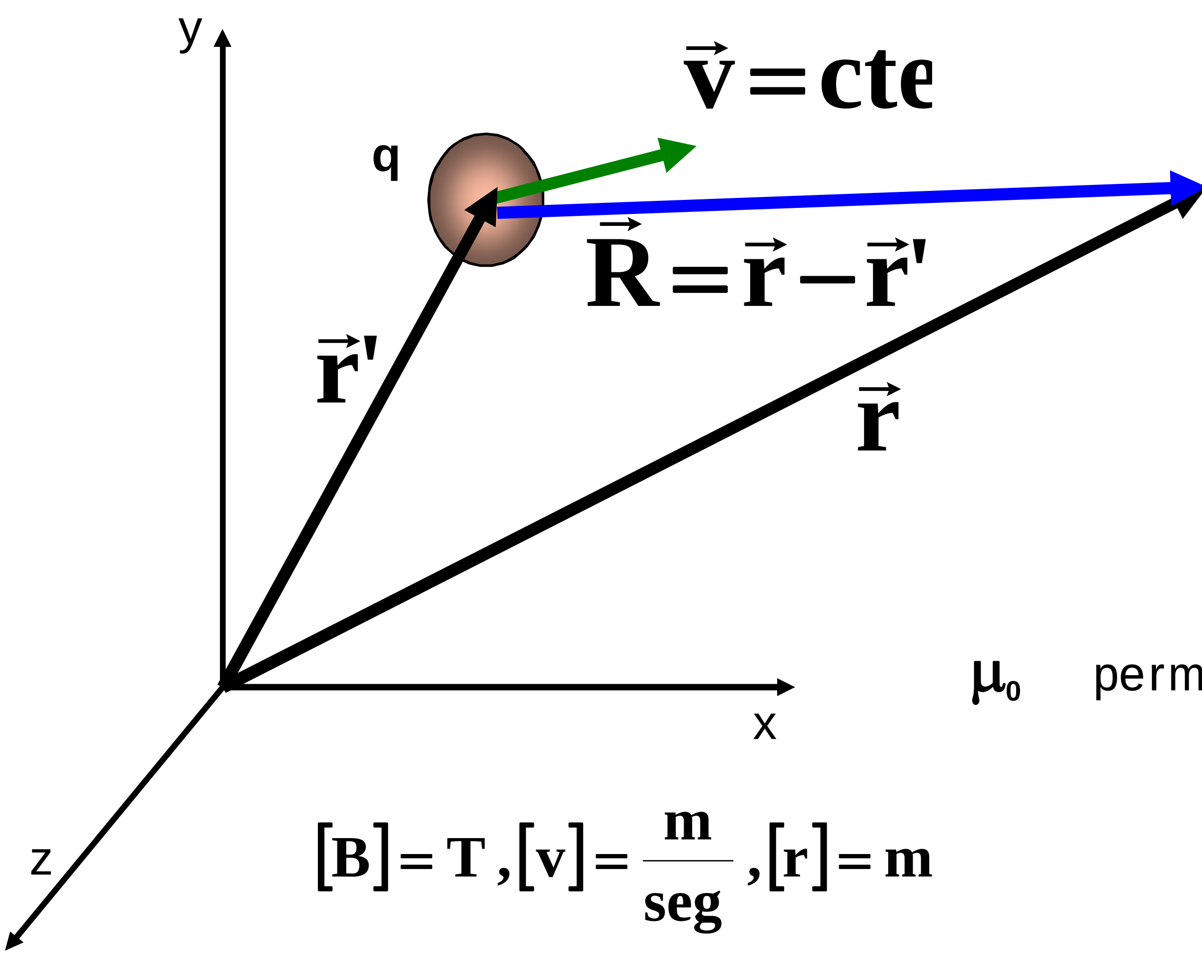
Magnetostática

Bibliografía consultada

- **Sears- Zemasnky -Tomo II**
- **Fisica para Ciencia de la Ingeniería, Mckelvey**
- **Serway- Jewett --Tomo II**

CAMPO MAGNETOSTATICO



q se nueve con **v** cte en el vacío

v<<c

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

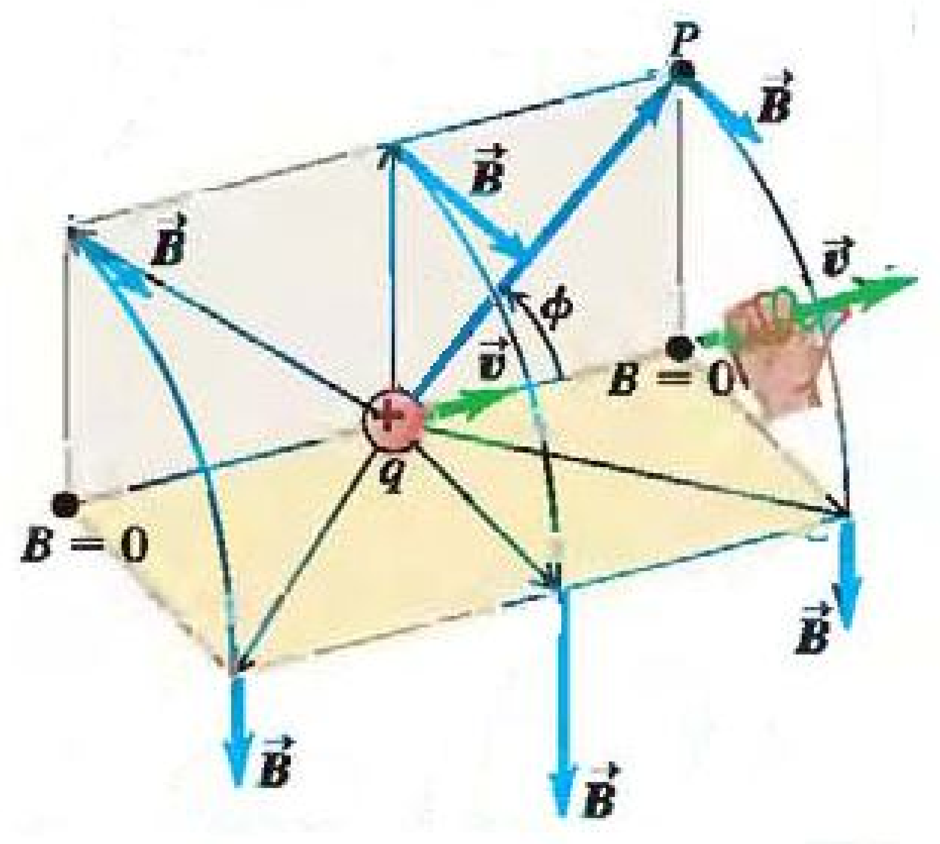
$$\boxed{\vec{B} = \frac{\mu_0}{4\pi} q \frac{\vec{v} \times (\vec{r} - \vec{r}')}{|\vec{r} - \vec{r}'|^3}}$$

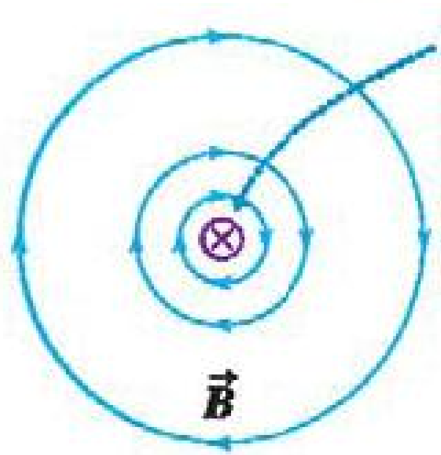
μ_0 permeabilidad magnética del vacío

$$[B] = T, [v] = \frac{m}{seg}, [r] = m$$

$$[q] = C$$

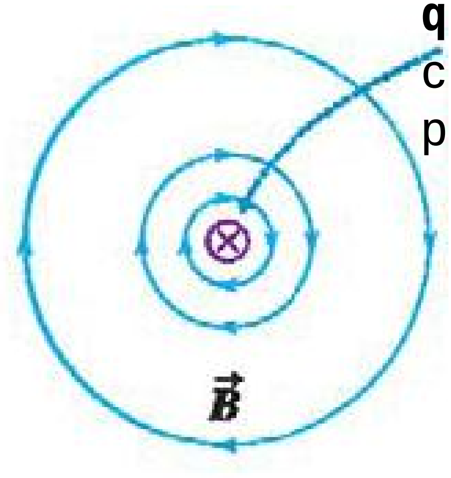
$$\mu_0 = 4\pi 10^{-7} \frac{Tm}{A}$$





q se mueve con **v** entrante al pizarrón

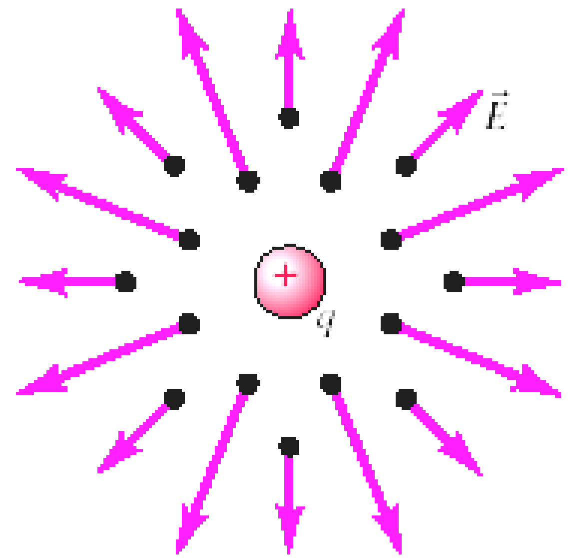
CAMPO MAGNETOSTATICO



q se mueve con **v** cte entrante al pizarrón

$$\vec{B}(x,y,z) = \frac{\mu_0}{4\pi} q \frac{\vec{v} \times (\vec{r} - \vec{r}\,')}{|\vec{r} - \vec{r}\,'|^3}$$

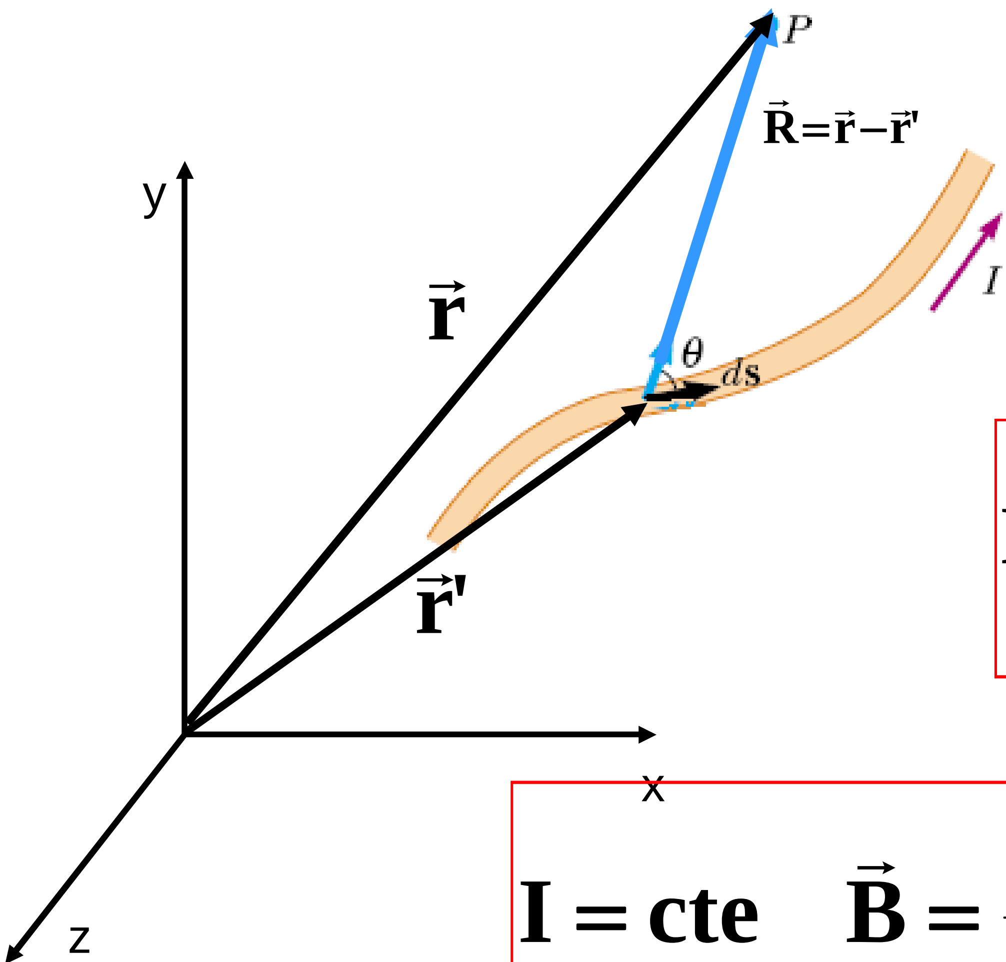
CAMPO *ELECTRO*STATICO



$$\vec{E}(x,y,z) = \frac{1}{4\pi\varepsilon_0} \frac{q(\vec{r} - \vec{r}\,')}{|\vec{r} - \vec{r}|^3}$$

$$c = \frac{1}{\sqrt[2]{\mu_0 \varepsilon_0}}$$

Ley de Biot - Savart

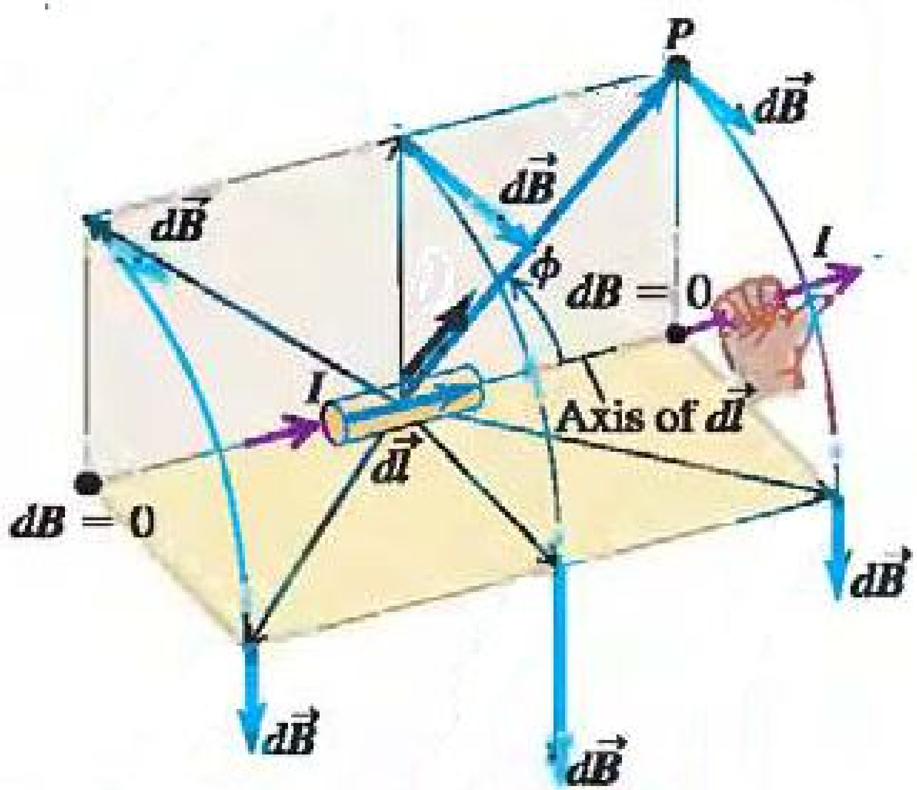


$$d\vec{B} = \frac{\mu_0}{4\pi} dq \frac{\vec{v} \times \vec{R}}{|\vec{R}|^3} = \frac{\mu_0}{4\pi} dq \frac{d\vec{l}}{dt} \times \frac{\vec{R}}{|\vec{R}|^3}$$

$$d\vec{B} = \frac{\mu_0}{4\pi} I\, d\vec{l} \times \frac{\vec{R}}{|\vec{R}|^3}$$

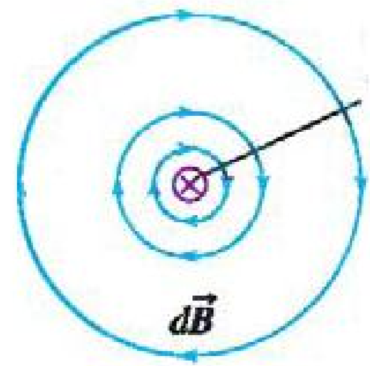
$$\vec{B} = \int \frac{\mu_0}{4\pi} I\, d\vec{l} \times \frac{(\vec{r} - \vec{r}')}{|\vec{r} - \vec{r}'|^3}$$

$$I = cte \quad \vec{B} = \frac{\mu_0}{4\pi} I \int d\vec{l} \times \frac{(\vec{r} - \vec{r}')}{|\vec{r} - \vec{r}'|^3}$$



$$\vec{\mathbf{B}} = \int \frac{\mu_0}{4\pi} \mathbf{I}\, \mathbf{d}\vec{\mathbf{l}} \times \frac{(\vec{\mathbf{r}} - \vec{\mathbf{r}}')}{\left|\vec{\mathbf{r}} - \vec{\mathbf{r}}'\right|^3}$$

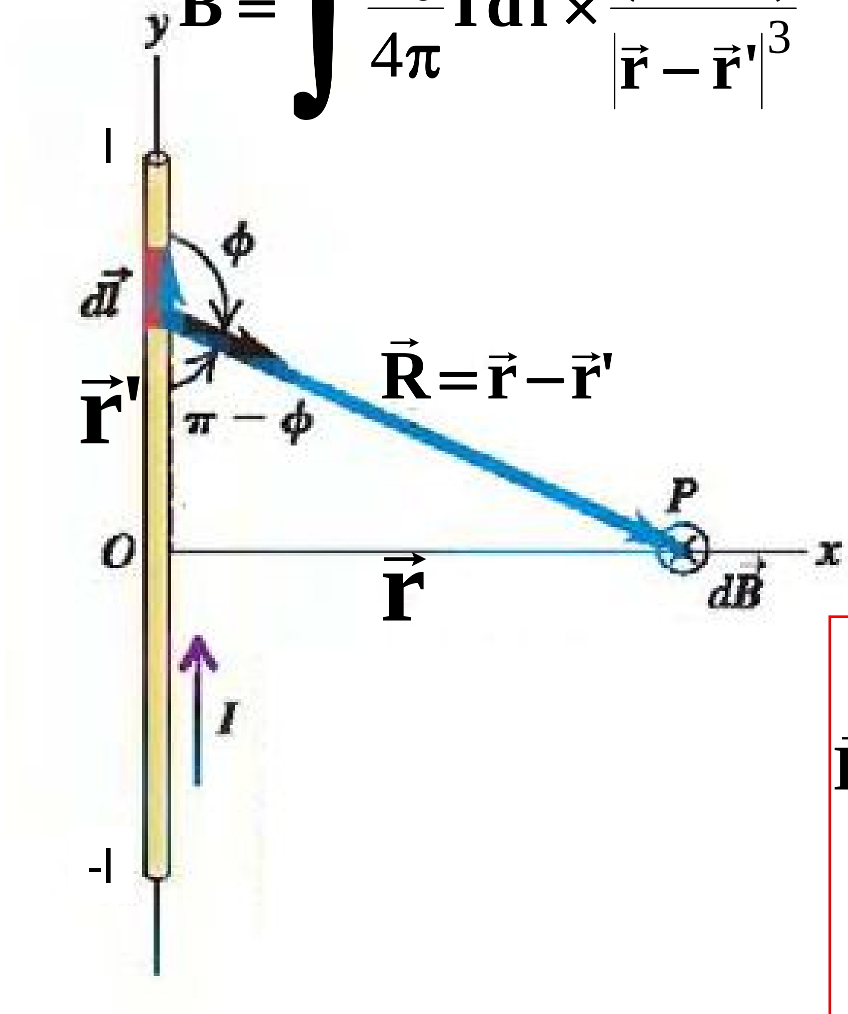
I entrante al pizarrón



B creada por un conductor fino de longitud 2l por el cual circula una corriente I

$$\vec{B} = \int \frac{\mu_0}{4\pi} I\, d\vec{l} \times \frac{(\vec{r}-\vec{r}\,')}{|\vec{r}-\vec{r}\,'|^3}$$

$$\vec{r} = (x,0,0) \qquad \vec{r}\,' = (0,y',0)$$



$$\vec{r}-\vec{r}\,' = (x,´-y',0)$$

$$|\vec{r}-\vec{r}\,'| = \sqrt{x^2+y'^2}$$

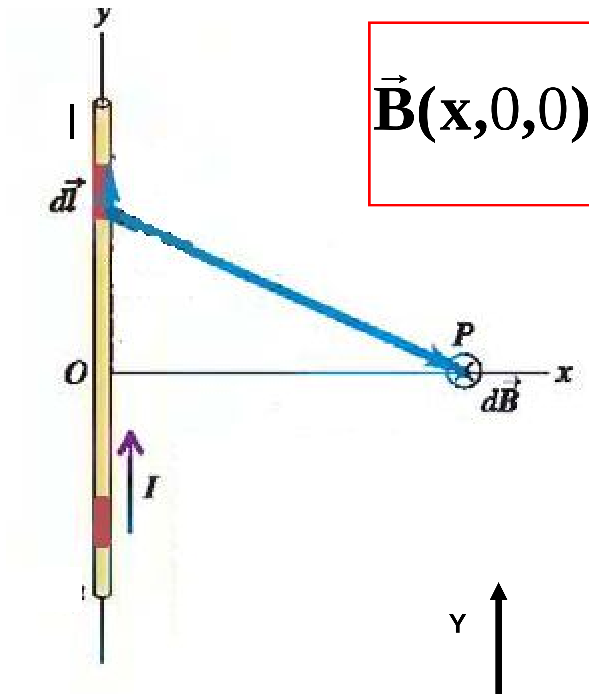
$$d\vec{l} = (dy',0,0)$$

$$d\vec{l} \times \frac{(\vec{r}-\vec{r}\,')}{|\vec{r}-\vec{r}\,'|^3} = dy\,\hat{y} \times \frac{(x\hat{x} - y'\hat{y})}{(x^2+y'^2)^{\frac{3}{2}}}$$

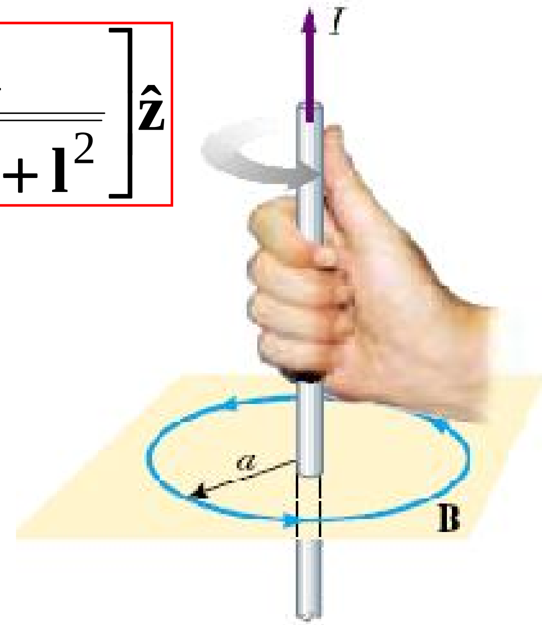
$$\vec{B}(x,0,0) = \frac{\mu_0}{4\pi} I \int_{-l}^{l} \frac{-x}{(x^2+y'^2)^{\frac{3}{2}}} dy'\,\hat{z} =$$

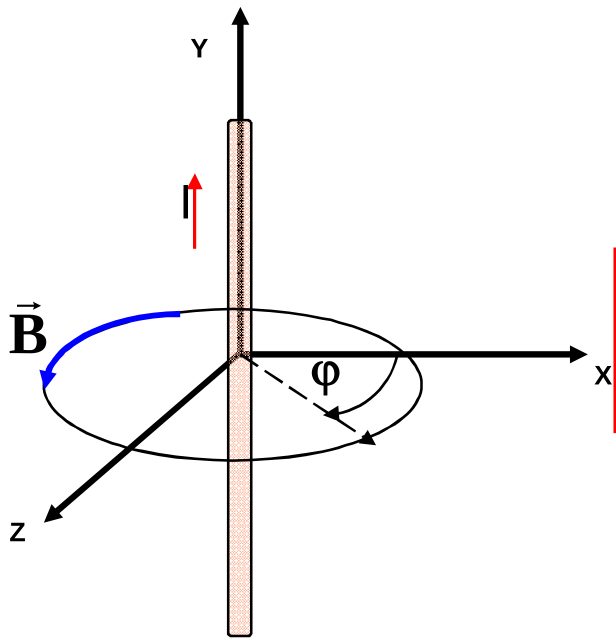
$$= -\frac{\mu_0}{2\pi}\frac{I}{x}\left[\frac{l}{\sqrt{x^2+l^2}}\right]\hat{z}$$

Como es simétrico respecto al eje e



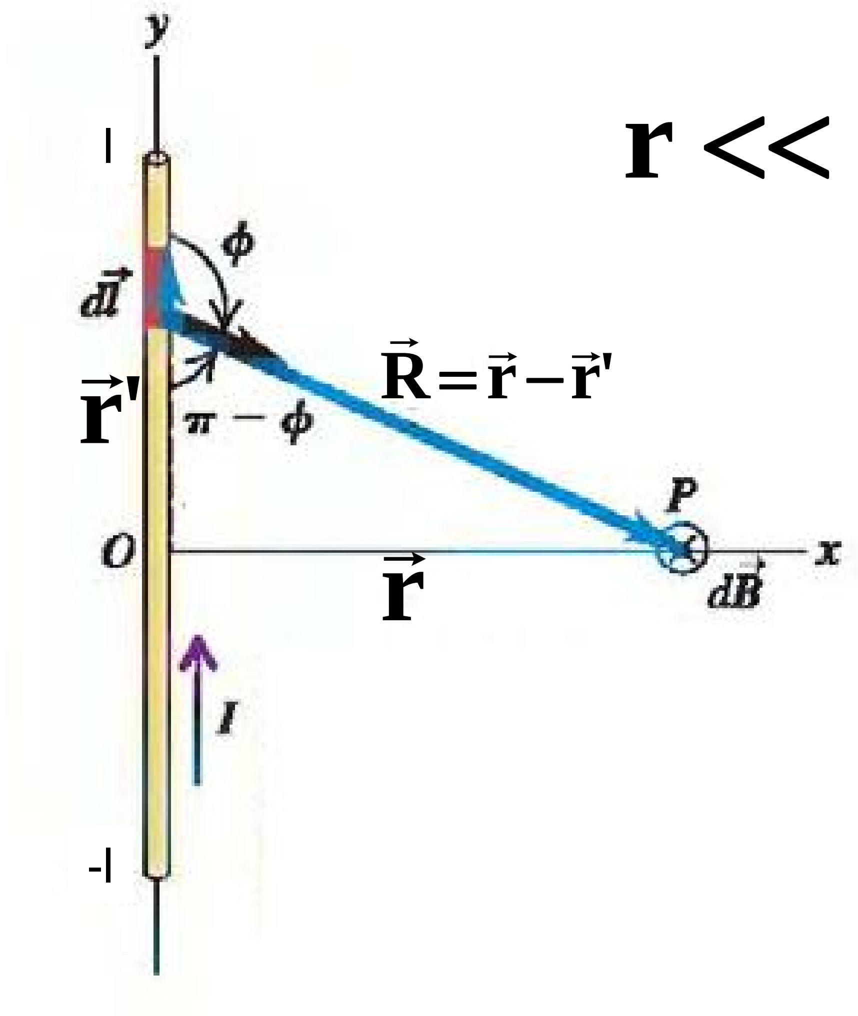
$$\vec{B}(x,0,0) = -\frac{\mu_0}{2\pi}\frac{I}{x}\left[\frac{l}{\sqrt{x^2+l^2}}\right]\hat{z}$$





$$\vec{B}(x,0,0) = -\frac{\mu_0}{2\pi}\frac{I}{r}\left[\frac{l}{\sqrt{r^2+l^2}}\right]\hat{\varphi}$$

B creada por un conductor fino infinito por el cual circula una corriente I

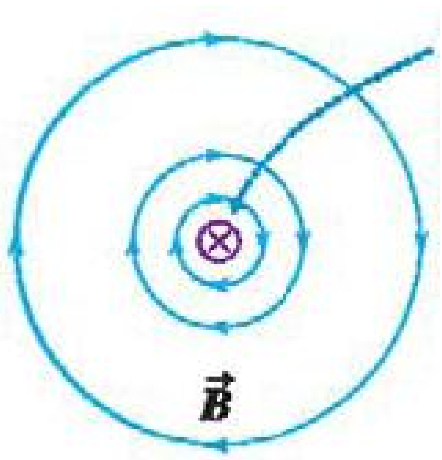


$$r << l$$

$$\vec{B}(x,0,0) = -\frac{\mu_0}{2\pi}\frac{I}{r}\left[\frac{l}{\sqrt{r^2+l^2}}\right]\hat{\varphi}$$

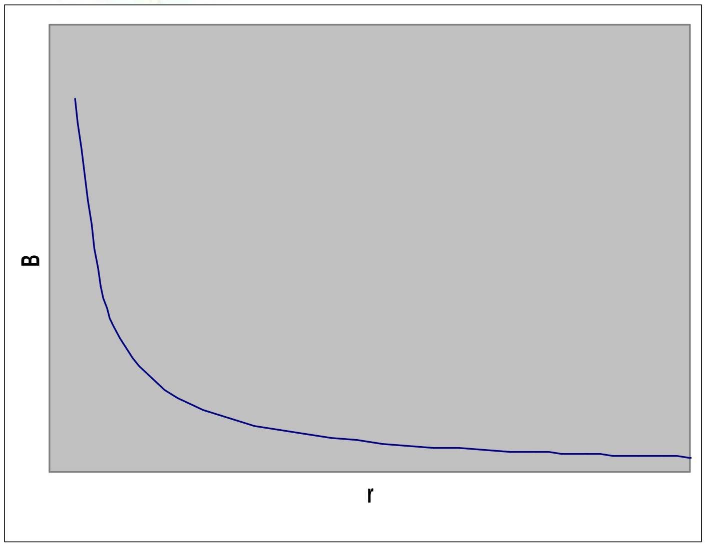
$$\vec{B}(r) = -\frac{\mu_0}{2\pi}\frac{I}{r}\hat{\varphi}$$

CAMPO MAGNETOSTATICO CONDUCTOR INFINITO, CORRIENTE I

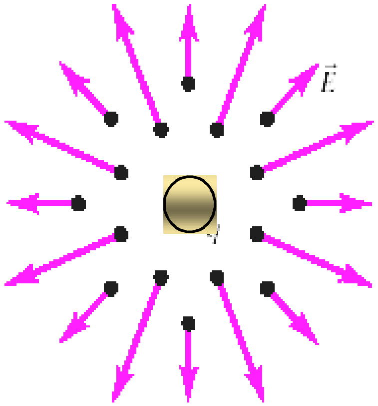


I entrante al pizarrón

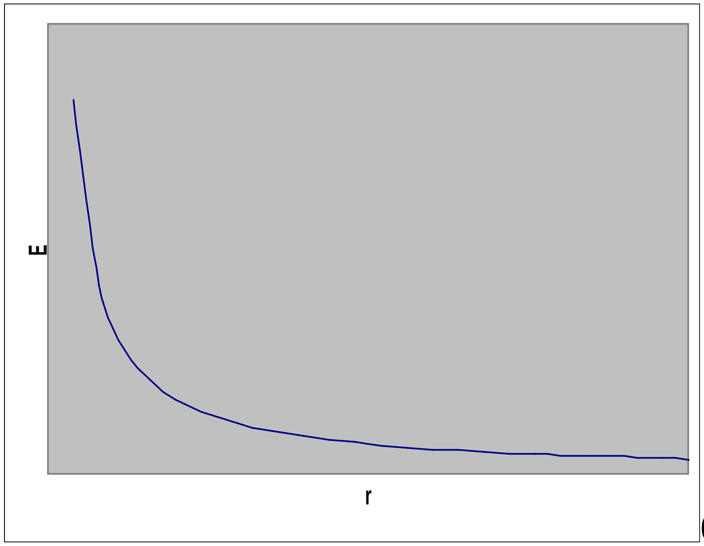
$$\vec{\mathbf{B}}(\mathbf{r}) = -\frac{\mu_0}{2\pi}\frac{\mathbf{I}}{\mathbf{r}}\hat{\varphi}$$



CAMPO ELECTROSTATICO DE UN DENSIDAD LINEAL INFINITA DE CARGA λ



$$\vec{\mathbf{E}}(\vec{\mathbf{r}}) = \frac{1}{2\pi\varepsilon_0}\frac{\lambda}{\mathbf{r}}\hat{\mathbf{r}}$$



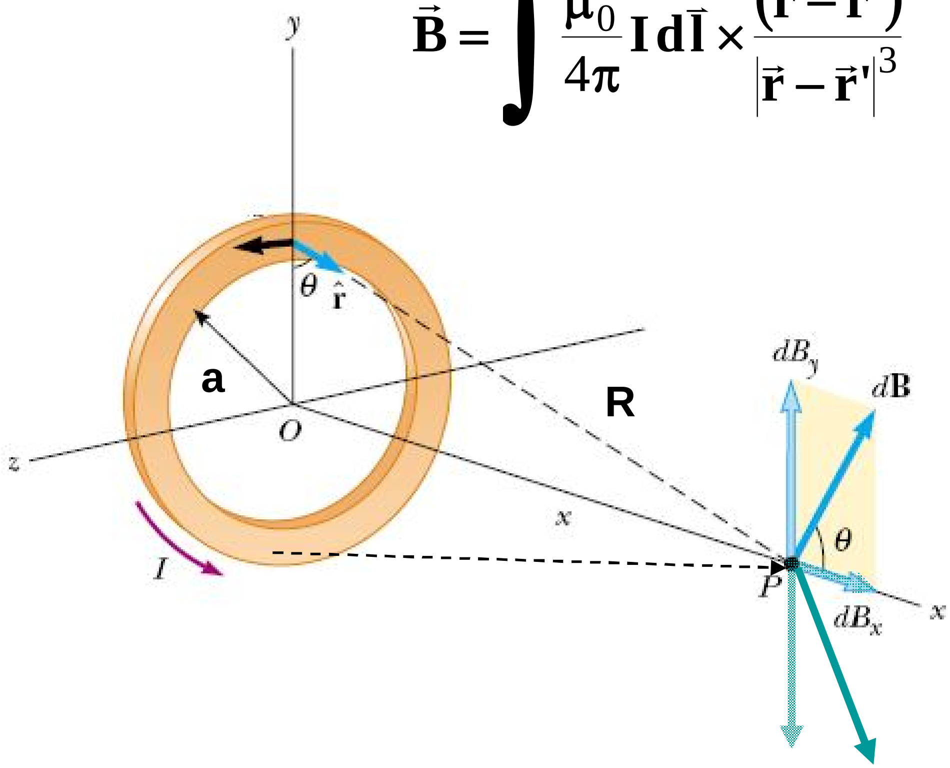
0

B creada por espira de corriente I

$$\vec{B} = \int \frac{\mu_0}{4\pi} I\, d\vec{l} \times \frac{(\vec{r}-\vec{r}\,')}{|\vec{r}-\vec{r}\,'|^3}$$

$$\vec{r} = (x,0,0)$$

$$\vec{r}\,' = (0, a\cos\theta, a\,\mathrm{sen}\theta)$$



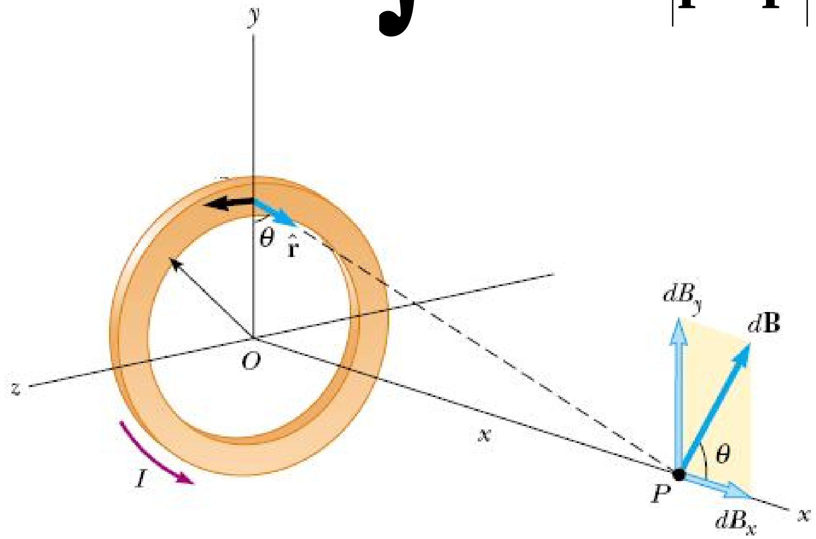
$$\vec{r}-\vec{r}\,' = (x, -a\cos\theta, -a\,\mathrm{sen}\theta)$$

$$|\vec{r}-\vec{r}\,'| = \sqrt{x^2 + a^2}$$

$$d\vec{l} = (0, -a\,\mathrm{sen}\theta\, d\theta, a\cos\theta\, d\theta)$$

$$d\vec{l} \times \frac{(\vec{r}-\vec{r}\,')}{|\vec{r}-\vec{r}\,'|^3} = \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ 0 & -a\,\mathrm{sen}\theta\, d\theta & a\cos\theta\, d\theta \\ x & -a\cos\theta & -a\,\mathrm{sen}\theta \end{vmatrix} = a^2 d\theta\, \hat{x} + a x\cos\theta\, d\theta\, \hat{y} + a x\,\mathrm{sen}\theta\, d\theta\, \hat{z}$$

$$\vec{B} = \int \frac{\mu_0}{4\pi} I\, d\vec{l} \times \frac{(\vec{r} - \vec{r}')}{|\vec{r} - \vec{r}'|^3}$$



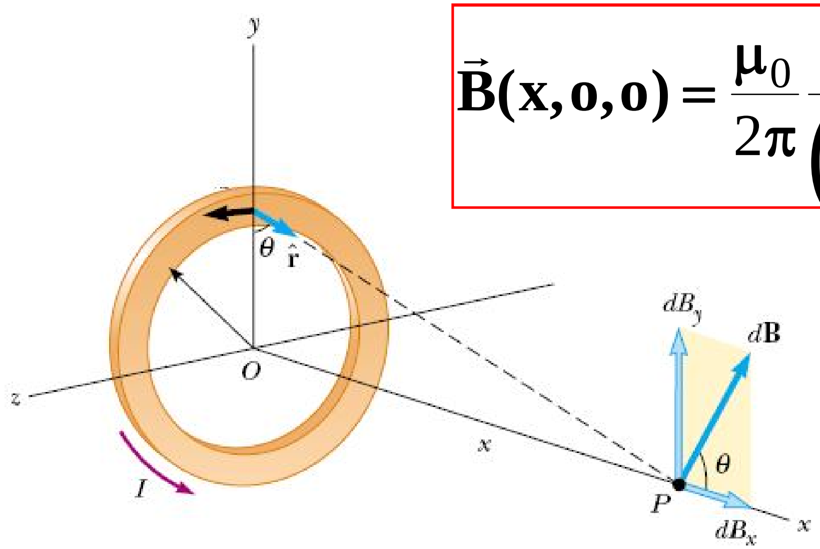
$$\vec{B} = \int_0^{2\pi} \frac{\mu_0}{4\pi} I \frac{\left(a^2\,\hat{x} + ax\cos\theta\,\hat{y} + ax\text{sen}\theta\,\hat{z}\right)}{\left(a^2 + x^2\right)^{3/2}} d\theta$$

$$\vec{B}(x,o,o) = \frac{\mu_0}{2\pi} \frac{I\,\pi a^2}{\left(x^2 + a^2\right)^{3/2}} \hat{x}$$

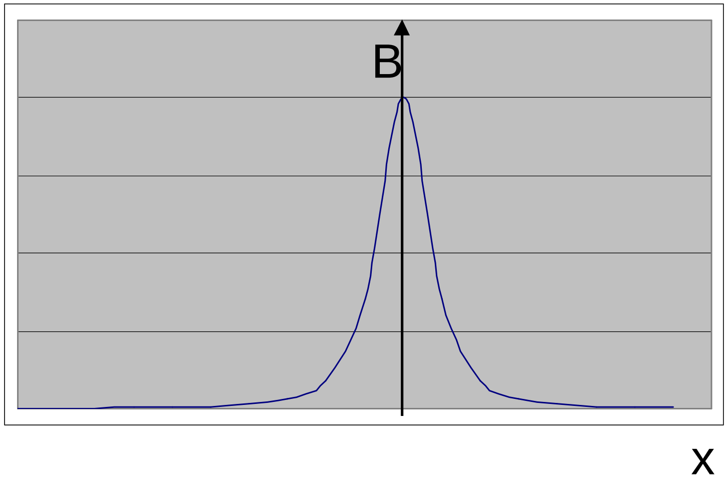
$$\vec{B}(x,o,o) = \frac{\mu_0}{2\pi} \frac{I\,A}{\left(x^2 + a^2\right)^{3/2}} \hat{x} = \frac{\mu_0}{2\pi} \frac{\vec{m}}{\left(x^2 + a^2\right)^{3/2}} \hat{x}$$

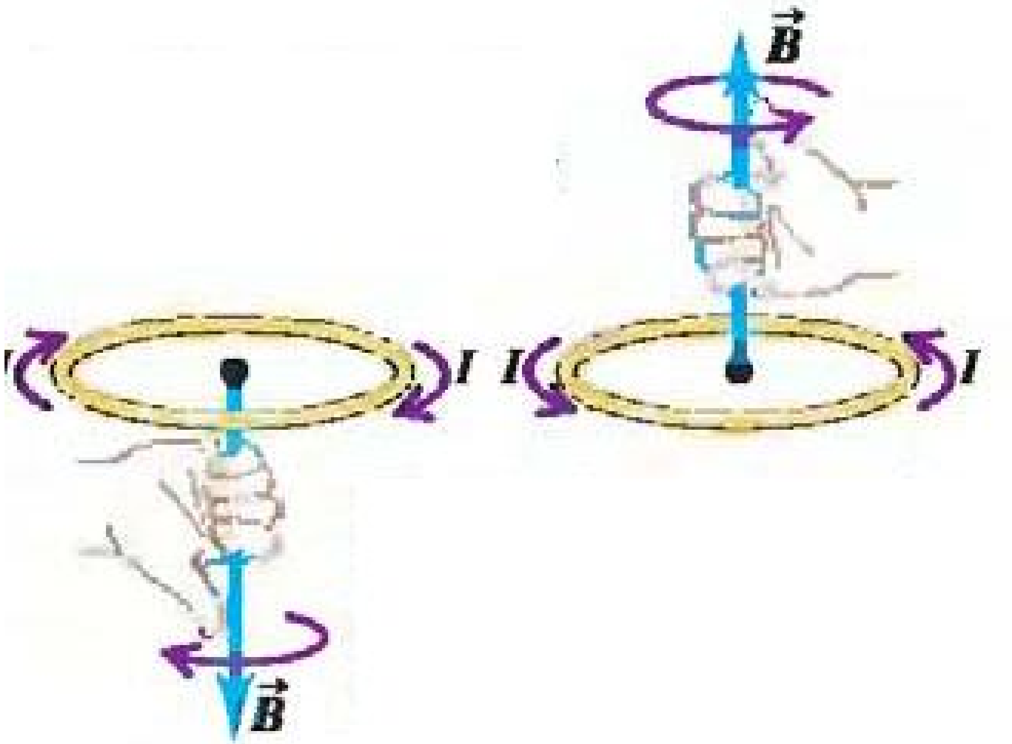
Si x>>a Espira puntual

$$\vec{B}(x,o,o) = \frac{\mu_0}{2\pi} \frac{\vec{m}}{x^3}$$

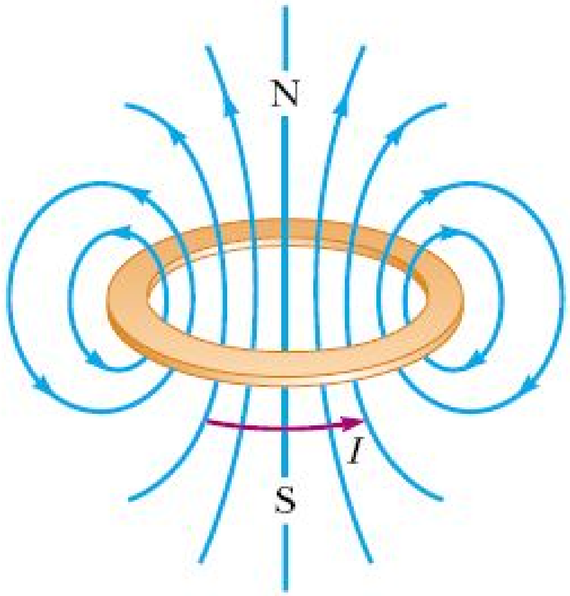


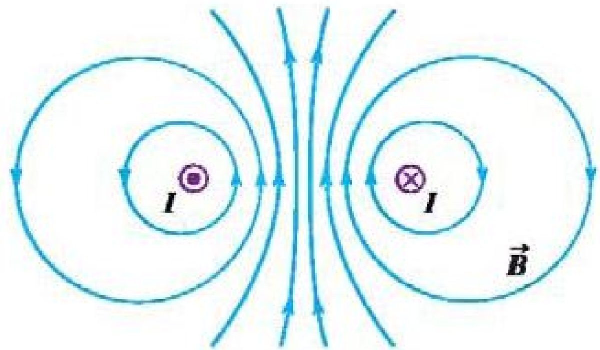
$$\vec{\mathbf{B}}(\mathbf{x},\mathbf{o},\mathbf{o}) = \frac{\mu_0}{2\pi}\frac{\mathbf{I}\,\pi\mathbf{a}^2}{\left(\mathbf{x}^2+\mathbf{a}^2\right)^{3/2}}\hat{\mathbf{x}}$$



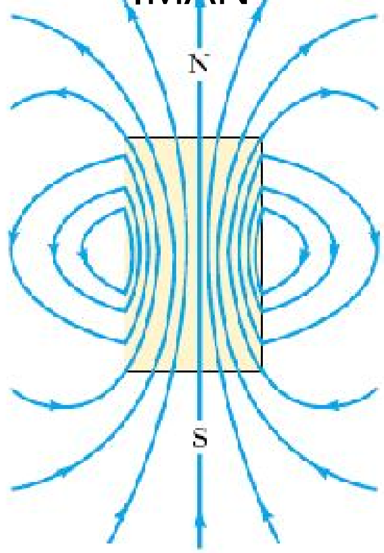


Dirección de B en el eje de un espira



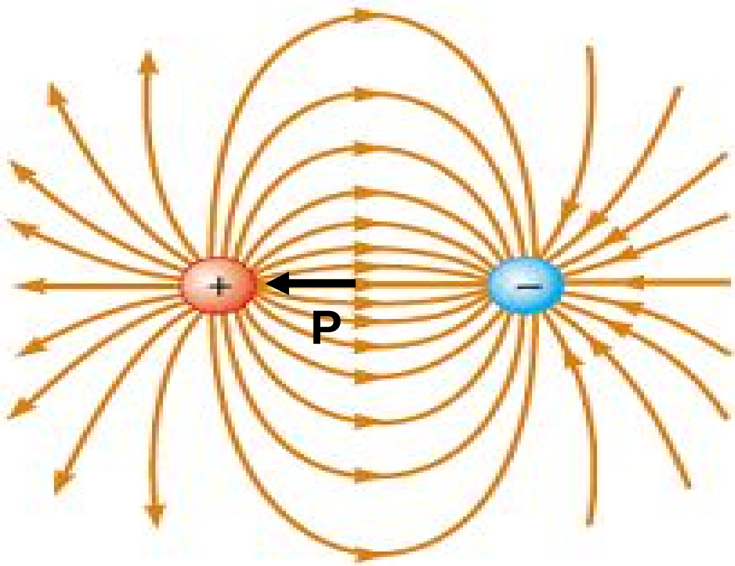


IMAN



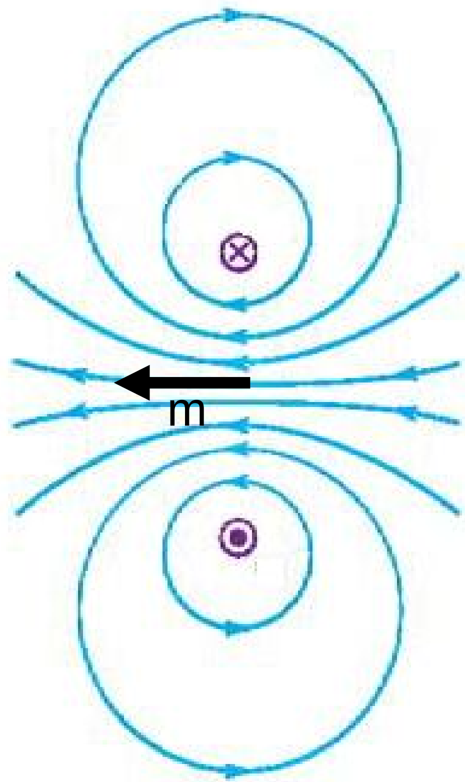
DIPOLO ELECTRICO

$$p = q.d$$

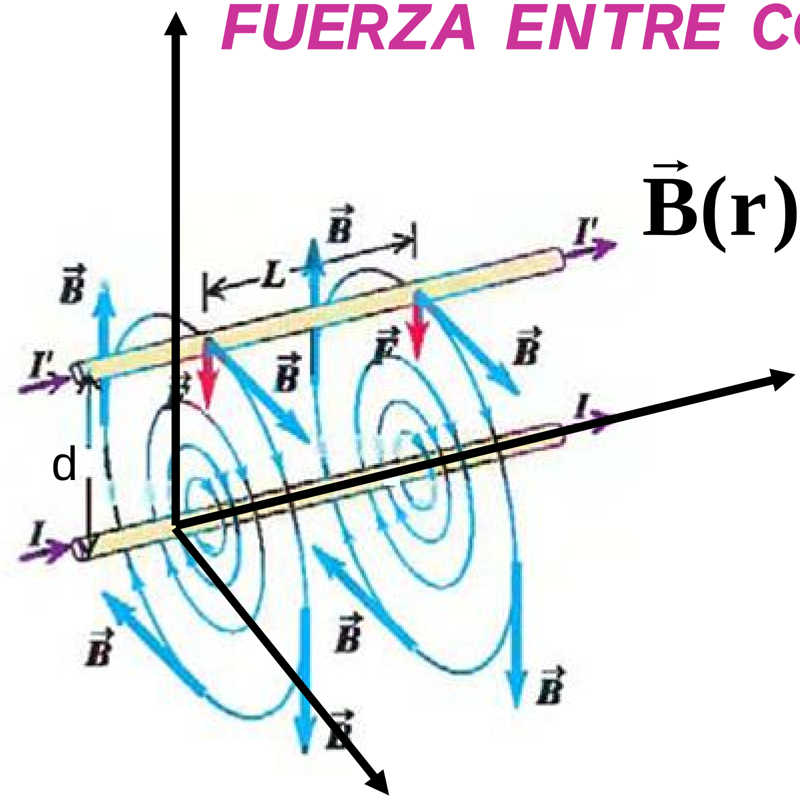


DIPOLO MAGNETICO

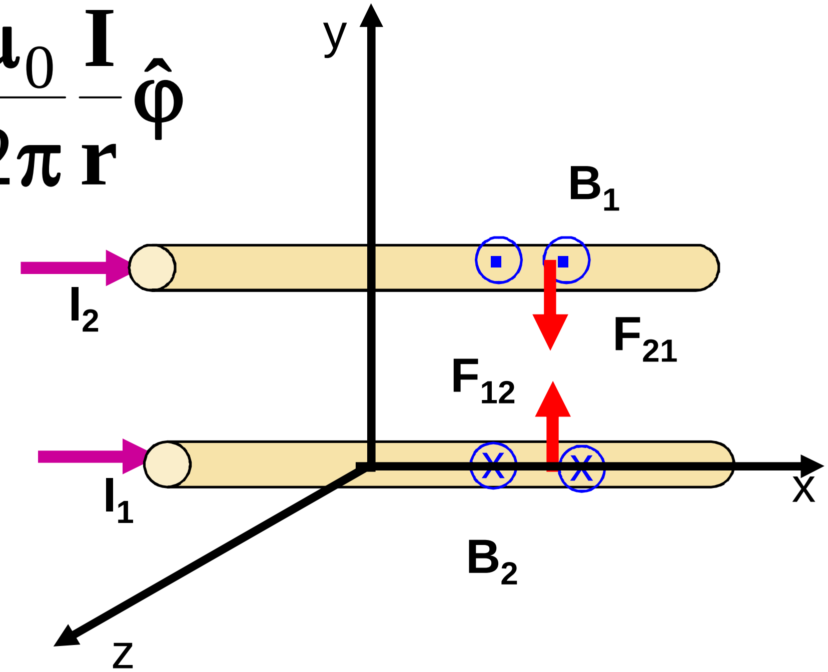
$$\vec{m} = I\,A\,\hat{n}$$



FUERZA ENTRE CONDUCTORES PARALELOS



$$\vec{B}(r) = -\frac{\mu_0}{2\pi}\frac{I}{r}\hat{\varphi}$$



$$B_1(x,d,0) = \frac{\mu_0}{2\pi}\frac{I_1}{d}\hat{z}$$

$$B_2(x,-d,0) = -\frac{\mu_0}{2\pi}\frac{I_2}{d}\hat{z}$$

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

$$F_{21} = -I_1 I_2 L B\,\hat{y}$$

$$F_{12} = I_1 I_2 L B\,\hat{y}$$

Se define A : si para $d = 1\,m$ $\quad \frac{F}{L} = 2\times 10^{-7}\frac{N}{m}$