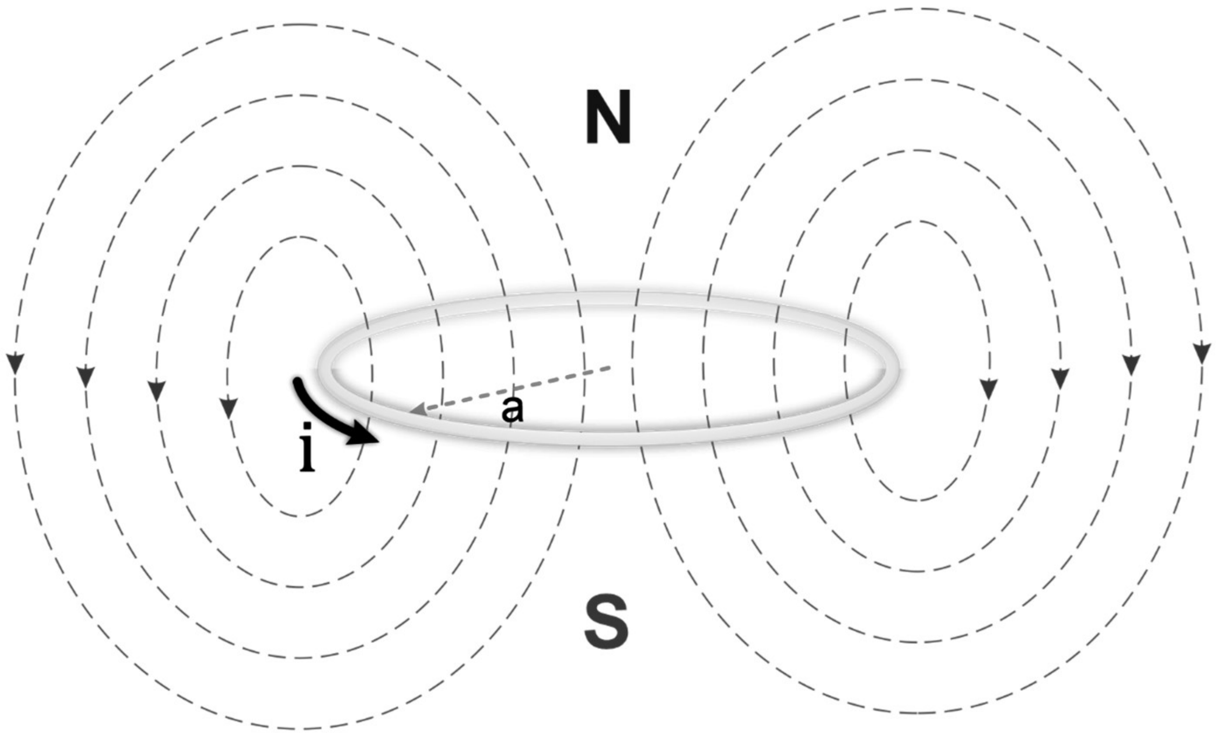
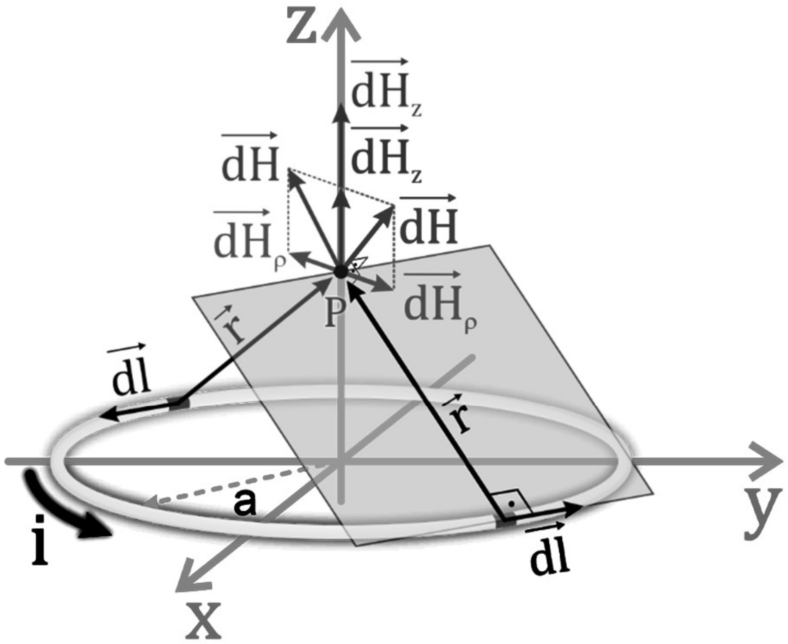
Assuntos abordados

- *A espira circular;*
  - *Um eletroímã;*
  - *Campo magnético produzido: aplicação da lei de Biot-Savart;*
- *Bobinas:*
  - *O Solenoide:*
    - *Análise física;*
    - *Campo no interior: aplicação da lei de Ampère;*
  - *O Toróide:*
    - *Análise física;*
    - *Campo em todo o espaço: aplicação da lei de Ampère;*

A Espira Circular



A Espira Circular



$$i)\ \overrightarrow{dl} = a \cdot d\varphi \hat{a}_{\varphi}$$

$$ii)\ \vec{r} = a\hat{a}_{\rho} + z\hat{a}_z$$

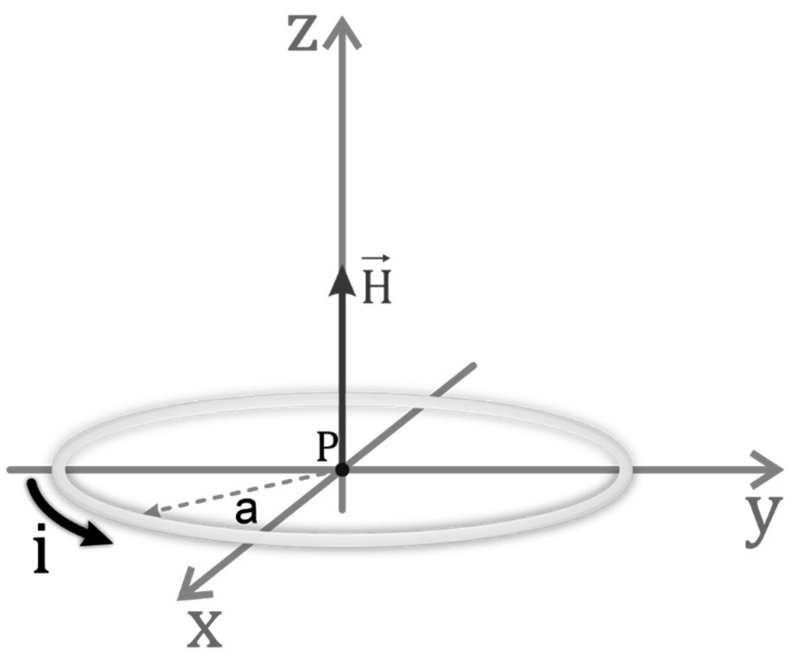
$$iii)\ \overrightarrow{dl} \times \vec{r} = a \cdot d\varphi \hat{a}_{\varphi} \times \left(a\hat{a}_{\rho} + z\hat{a}_z\right)$$

$$\rightarrow \overrightarrow{dl} \times \vec{r} = a^2 \cdot d\varphi \hat{a}_z + a \cdot z \cdot d\varphi \hat{a}_{\rho}$$

$$iv)\ \overrightarrow{\mathrm{d}H_z} = \frac{\mathrm{i}}{4 \cdot \pi \cdot r^3} \cdot a^2 \cdot d\varphi \hat{a}_z$$

$$\rightarrow \overrightarrow{\mathrm{d}H_z} = \frac{\mathrm{i}}{4 \cdot \pi \cdot (a^2 + z^2)^{3/2}} \cdot a^2 \cdot d\varphi \hat{a}_z$$

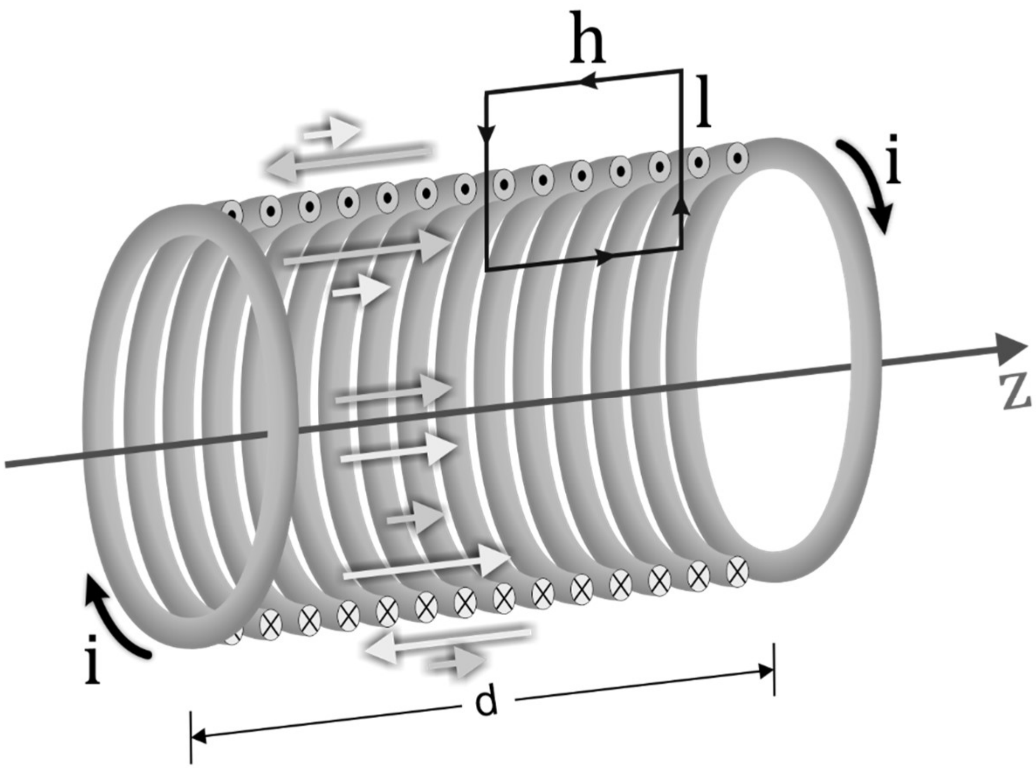
$$\rightarrow \boxed{\vec{H} = \frac{\mathrm{i} \cdot a^2}{2 \cdot (a^2 + z^2)^{3/2}} \hat{a}_z}$$



$$iv)\ \vec{H} = \frac{\mathrm{i} \cdot a^2}{2 \cdot (a^2 + z^2)^{3/2}}\,\hat{a}_z$$

$$v)\ \ no\ centro:\ z = 0$$

$$\rightarrow \boxed{\vec{H} = \frac{\mathrm{i}}{2 \cdot a}\,\hat{a}_z}$$



Se o comprimento de um solenoide é muito maior do que o seu raio: H_{ext}=0.

$$i)\ \vec{dl} = dz\hat{a}_z$$

$$ii)\ \vec{H}(\rho) = H(\rho)\hat{a}_z$$

$$iii)\ \oint_l \vec{H} \cdot \vec{dl} = i_{env}$$

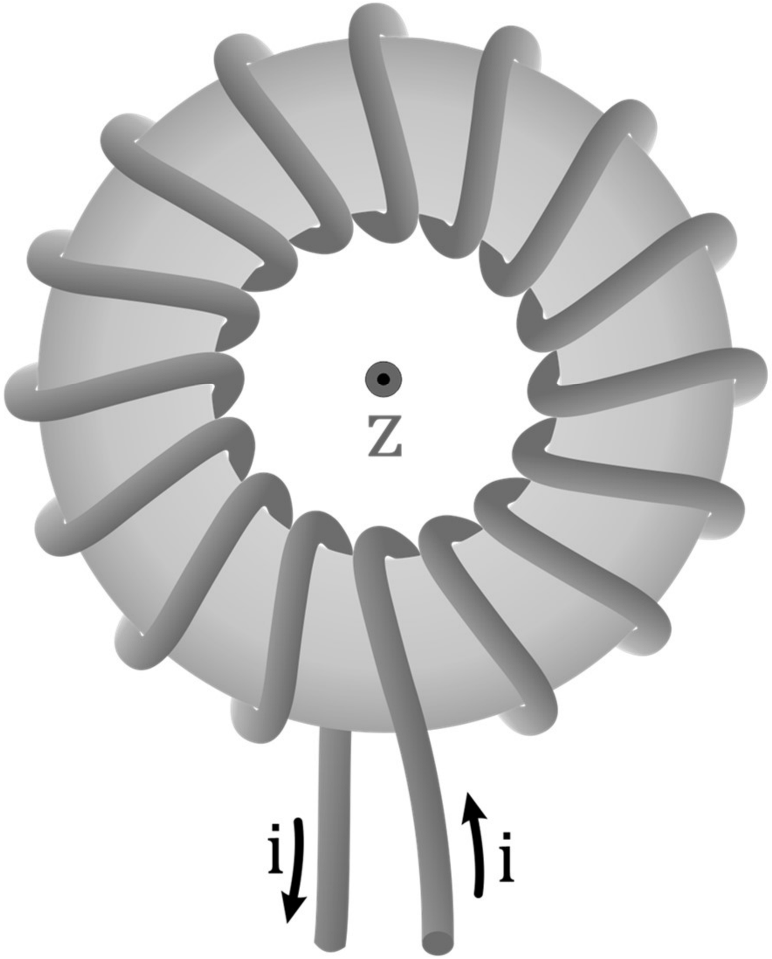
$$\rightarrow \int_0^h H(\rho)\hat{a}_z \cdot dz\hat{a}_z = N \cdot i$$

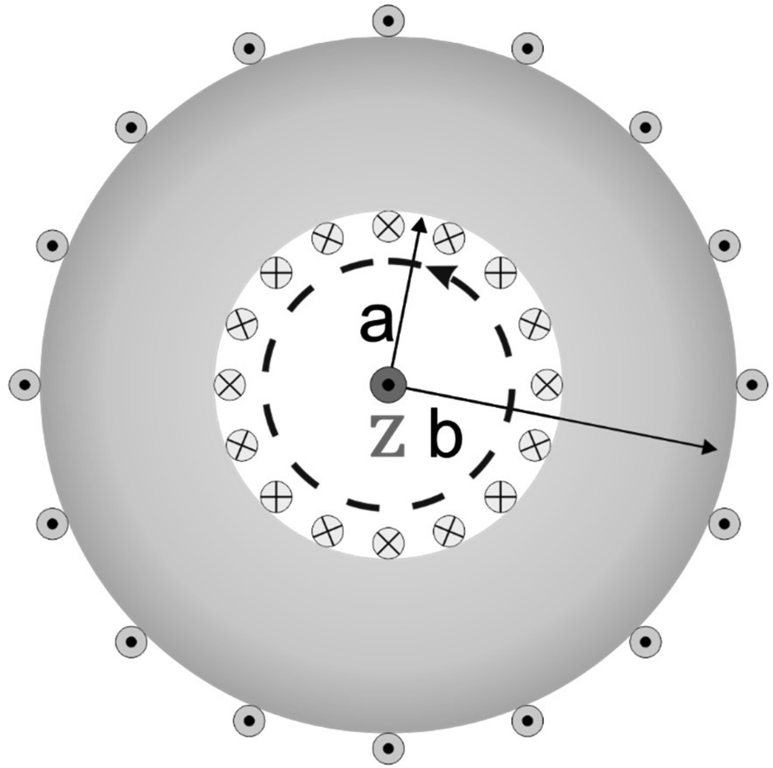
$$\rightarrow H(\rho) \cdot h = N \cdot i$$

$$\rightarrow \boxed{H(\rho) = \frac{N}{h} \cdot i \equiv n \cdot i}$$

'n' é o número de espiras por metro do solenoide.

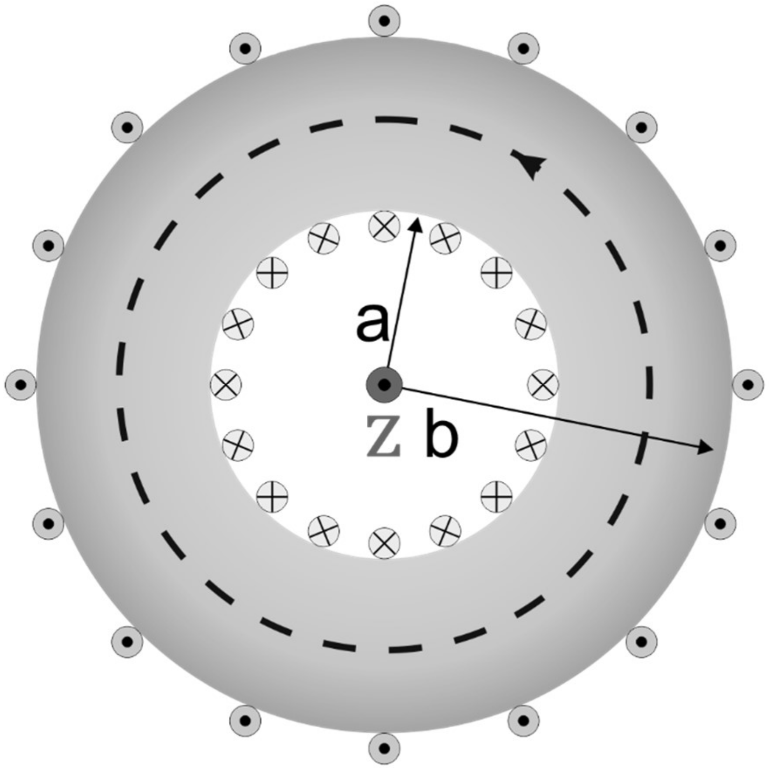
Bobinas: o toroide





$i)\ \ para\ 0 < \rho < a\!:\ i_{env} = 0$

$\rightarrow \boxed{\vec{H} = 0}$



$ii)\ para\ a < \rho < b:\ i_{env} = N \cdot i$

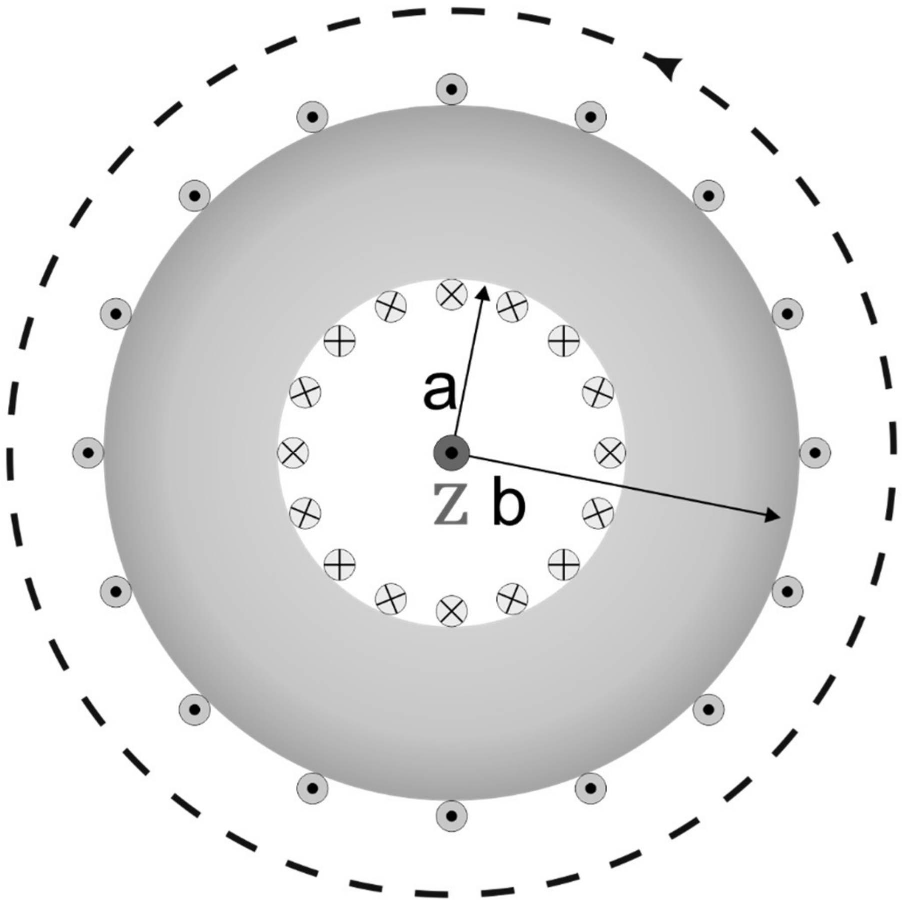
$$\rightarrow \int_0^{2\pi} -H(\rho)\hat{a}_\varphi \cdot \rho d\varphi \hat{a}_\varphi = N \cdot i$$

$$\rightarrow -H(\rho) \cdot \rho \cdot 2 \cdot \pi = N \cdot i$$

$$\rightarrow H(\rho) = -\frac{N}{2 \cdot \pi \cdot \rho} \cdot i$$

$$\rightarrow \boxed{\vec{H}(\rho) = -\frac{N}{2 \cdot \pi \cdot \rho} \cdot i\ \hat{a}_\varphi}$$

Bobinas: o toroide



$$iii)\ \ para\ \rho \geq b\text{: } i_{env} = 0$$

$$\rightarrow \boxed{\vec{H} = 0}$$