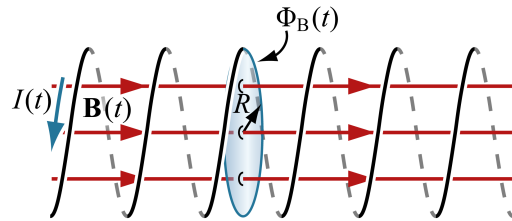


Inductors

Changing current through a loop induces a non-electrostatic electric force, and, thus, emf, that opposes the change in current.

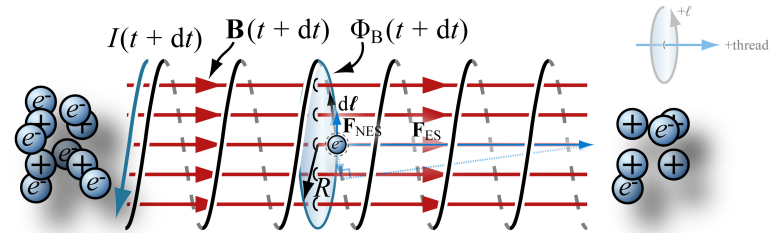
Initial: Time t



$$B(t) = \mu_0 \frac{N}{\ell} I(t)$$

$$\Phi_{\text{EACH LOOP}}(t) = \left[\mu_0 \frac{N}{\ell} I(t) \right] \cdot \pi R^2$$

Final: Time $t + dt$



$$B(t + dt) = \mu_0 \frac{N}{\ell} I(t + dt)$$

$$\Phi_{\text{EACH LOOP}}(t + dt) = \left[\mu_0 \frac{N}{\ell} I(t + dt) \right] \cdot \pi R^2$$

$$\left(\int_{\text{SINGLE TURN}} \vec{\mathbf{F}}_{\text{N.E.S. ON } q} \cdot d\vec{\ell} \right) / q = - \frac{d\Phi_B}{dt} = - \frac{\mu_0 \frac{N}{\ell} I(t + dt) \cdot \pi R^2 - \mu_0 \frac{N}{\ell} I(t) \cdot \pi R^2}{dt}$$

$$\left(\int_{N \text{ TURNS}} \vec{\mathbf{F}}_{\text{N.E.S. ON } q} \cdot d\vec{\ell} \right) / q = - \underbrace{N \cdot \mu_0 \frac{N}{\ell} \cdot \pi R^2}_{\text{"self inductance" } L} \frac{dI}{dt}$$

The relationship between the strength of the induced emf and the rate of change of the current over time depends on the geometry of the coil.

$$\mathcal{E}_{\text{BACK}} = -L \frac{dI}{dt} \quad [L] = \text{H} \quad \Delta U_L = \frac{1}{2} LI^2$$