

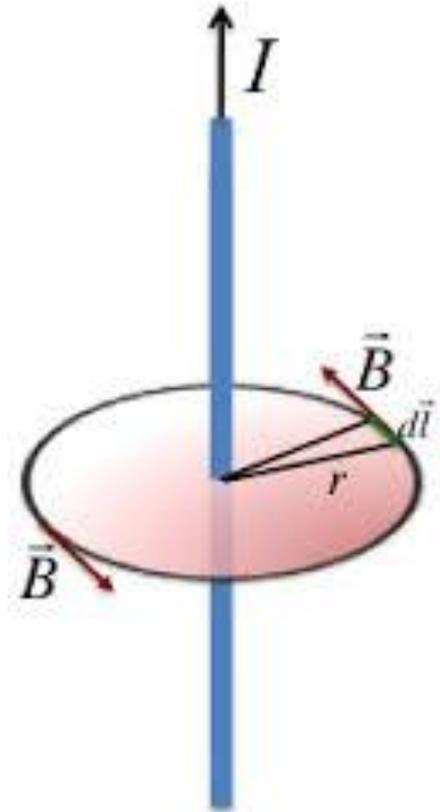
# Ampere's Law for Infinite Wire

Consider a straight infinite wire carrying current  $I$ . Magnetic field at distance  $r$  from it is:

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

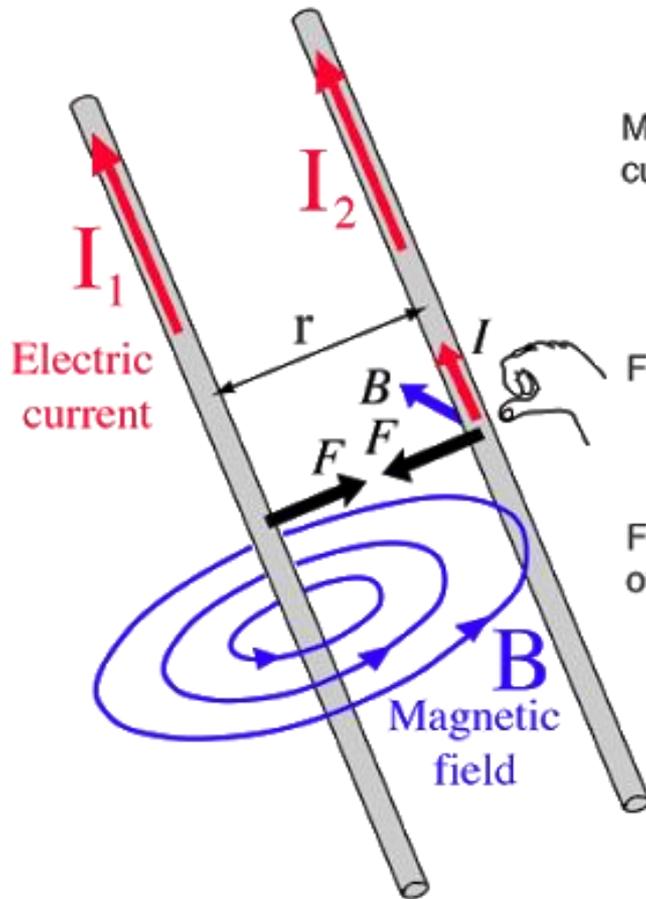
$$\mu_0 = 4\pi \cdot 10^{-7} \text{ T} \cdot \text{m/A}$$

Direction of  $\mathbf{B}$  is determined by the right hand rule.



# Magnetic Force Between Wires

We combine Ampere's Law with Lorentz Force,  $F=I\Delta LB$ :



Magnetic field at wire 2 from current in wire 1:

$$B = \frac{\mu_0 I_1}{2\pi r}$$

Force on a length  $\Delta L$  of wire 2:

$$F = I_2 \Delta L B$$

Force per unit length in terms of the currents:

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

# Homework

Two parallel wires of radius  $r=0.1 \text{ mm}$  each, are placed right next to each other (i. e. distance between their centers is  $2r$ ). The same current  $I$  is run through each wire. Find the value of  $I$ , at which the magnetic force between the wires is equal to the weight of each of them. Density of copper is  $9000 \text{ kg/m}^3$ .