Electric currents and magnetic fields

Force on an electric current in a magnetic field

Magnetic force on a current-carrying wire

The electrons in a current-carrying wire in a magnetic field experience a force.

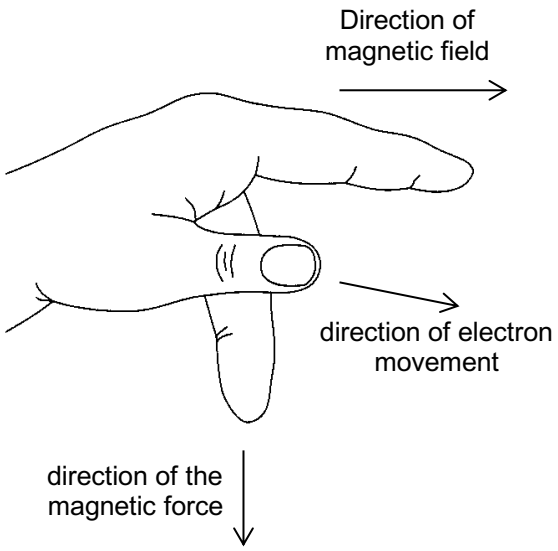
The direction of the magnetic force is perpendicular to

- the direction of the magnetic field
- the direction of motion of the electrons in the wire

Electrons moving parallel to the magnetic field lines do not experience a magnetic force.

"Three-finger rule" (left hand):

- Thumb: direction of the electron motion (opposite to the direction of the current)
- Index finger: direction of magnetic field
- Middle finger: direction of force on electron current



Magnetic field *B*

Definition: The *magnitude* of the magnetic field can be defined as:

$$B = \frac{F}{I \cdot \ell} \qquad [B] = \frac{1\ \text{N}}{1\ \text{A} \cdot 1\ \text{m}} = 1\ \text{T} \quad \text{(1 Tesla)}$$

Where *F* is the magnitude of the force acting upon

- a straight wire of length ℓ
- carrying a current of magnitude *I*
- when the wire is perpendicular to the magnetic field.

The *directions* of the magnetic field, the electron movement and the magnetic force are determined by the "Three-finger rule" (left hand).