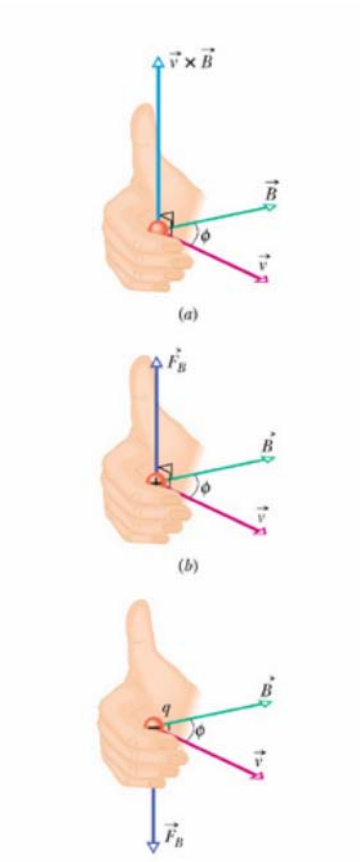
Magnetismo

- Il campo magnetico
- Campo magnetico e correnti
- Induzione elettromagnetica (auto e mutua)
- Campi magnetici nella materia

Campo Magnetico



$$\vec{F} = q\vec{v} \wedge \vec{B}$$

$$\vec{F} = q\vec{E}$$

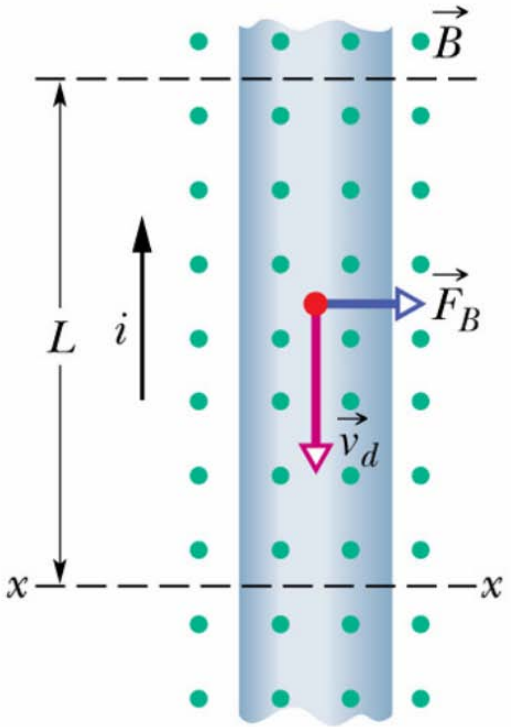
Campo Magnetico

$$\vec{F} = q\vec{v} \wedge \vec{B}$$

$$[B] = (N/C)(s/m) = \frac{N}{Am} = T \text{ (Tesla)}$$

$$1G = 10^{-4}T$$

Forza su un filo



$$\vec{F} = Nq\vec{v}_d \wedge \vec{B}$$

$$= nALq\vec{v}_d \wedge \vec{B}$$

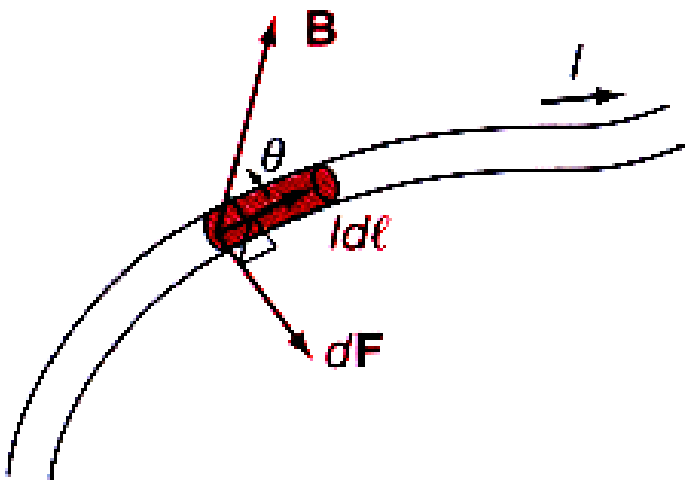
$$= nqv_d A\vec{L} \wedge \vec{B}$$

$$\vec{F} = I\vec{L} \wedge \vec{B}$$

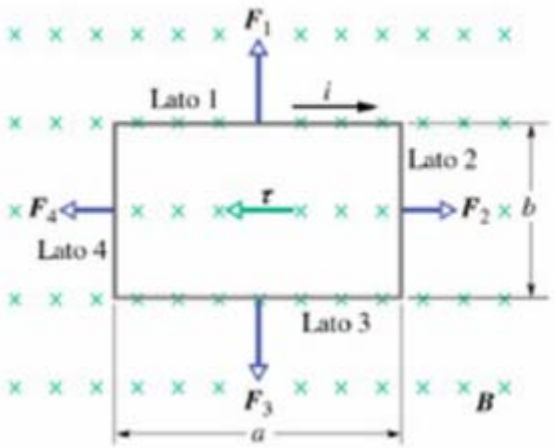
Forza su un filo

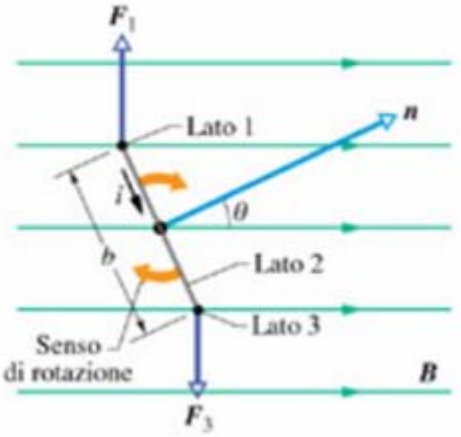
$$\overrightarrow{dF} = I\,\overrightarrow{dL} \wedge \overrightarrow{B}$$

$$\overrightarrow{F} = \int I\,\overrightarrow{dL} \wedge \overrightarrow{B}$$



Momento su una spira



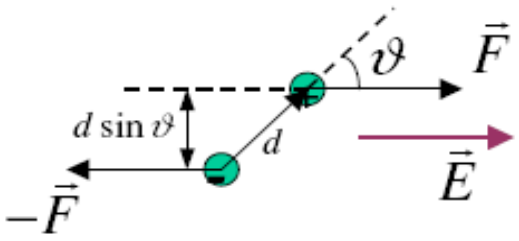


$$\tau_1 = \frac{b}{2} F_1 \sin\theta$$

$$\tau = \tau_1 + \tau_2 = baIB\sin\theta = ISB\sin\theta$$

$$\vec{\tau} = NI\vec{S} \wedge \vec{B}$$

Dipolo elettrico ↔ Dipolo magnetico

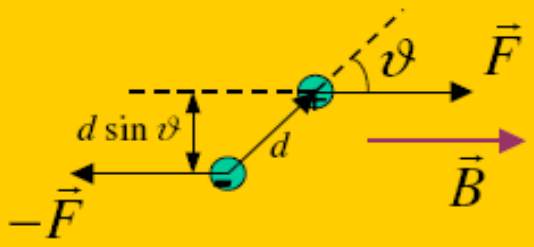


$$\vec{\mathcal{M}} = \vec{p} \wedge \vec{E}$$

$$\vec{p} = qd\hat{d}$$

$$U_E = q\Delta V_+ - q\Delta V_- = -\frac{d}{2}Eq\cos\vartheta - \frac{d}{2}Eq\cos\vartheta$$

$$U_E = -\vec{p}\cdot\vec{E}$$



$$\vec{\mathcal{M}} = \vec{m} \wedge \vec{B}$$

$$U_B = -\vec{m}\cdot\vec{B}$$

$$\vec{\tau} = \vec{m} \wedge \vec{B}$$

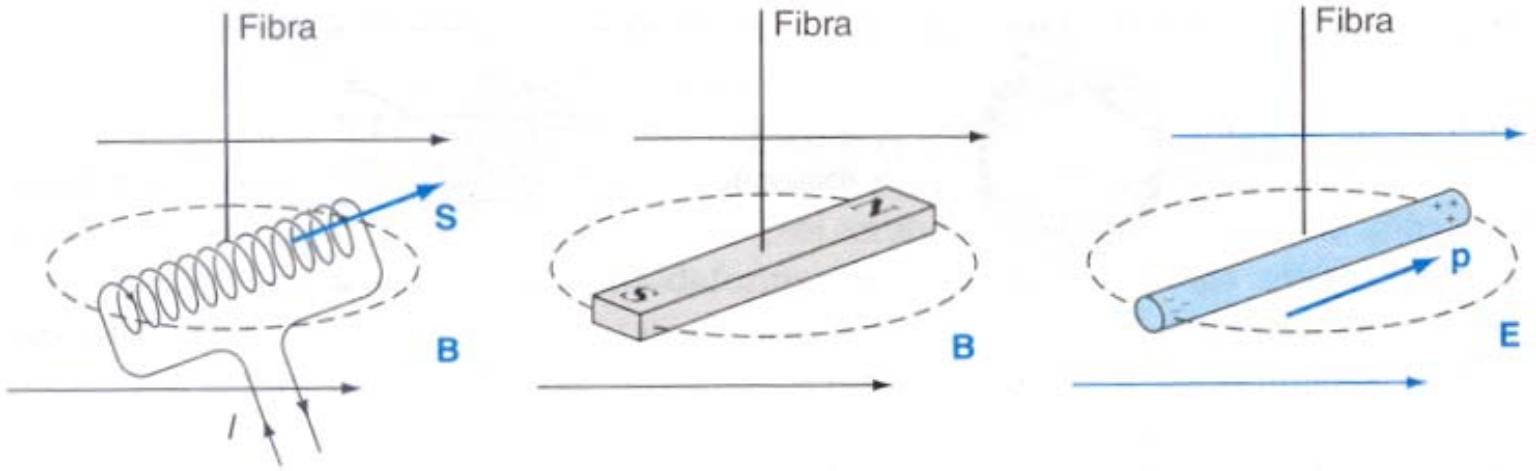
$$dW = \tau d\theta = -mB(sen\theta)d\theta$$

$$U(\theta_2) - U(\theta_1) = -\int_{\theta_1}^{\theta_2} dW = mB\int_{\theta_1}^{\theta_2} sen\theta d\theta =$$

$$= mB\left[-\cos\theta\right]_{\theta_1}^{\theta_2} = -mB\cos\theta_2 + mB\cos\theta_1$$

$$U(\theta) = -mB\cos\theta = -\vec{m}\cdot\vec{B}$$

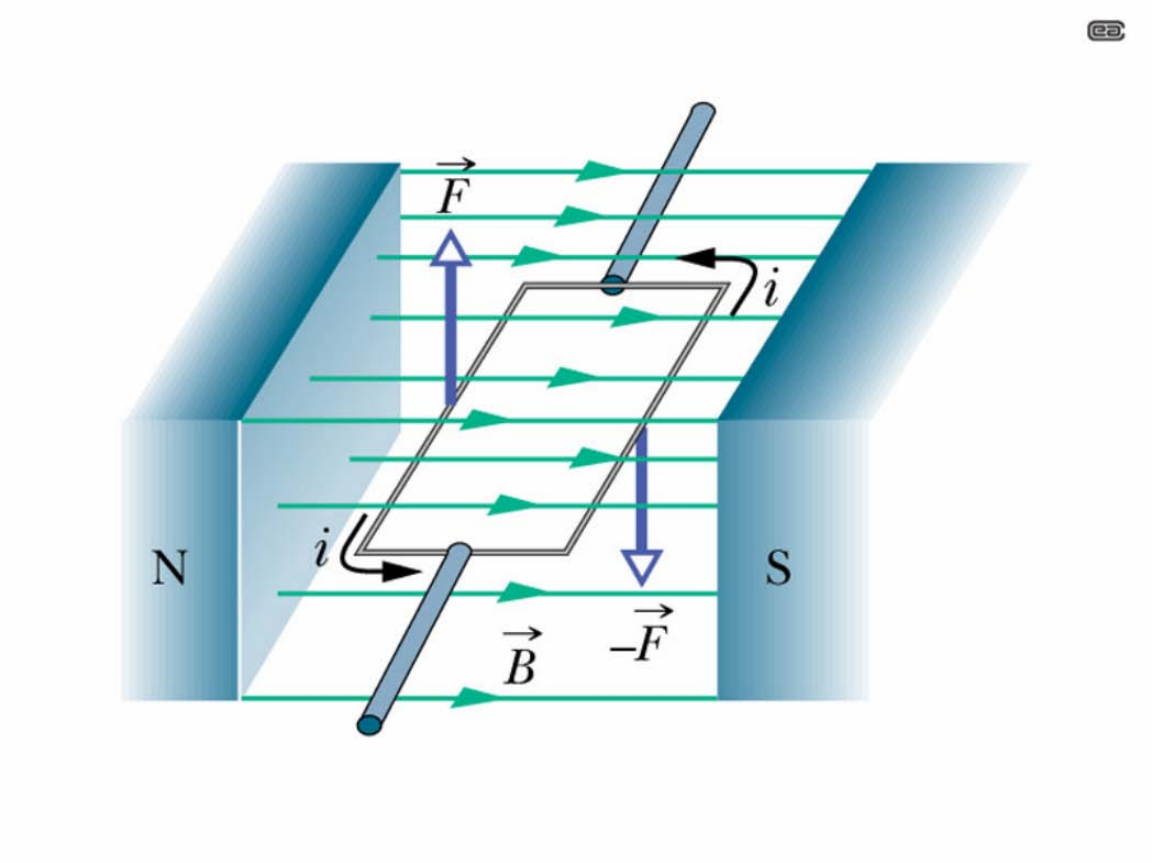
Momento di dipolo magnetico



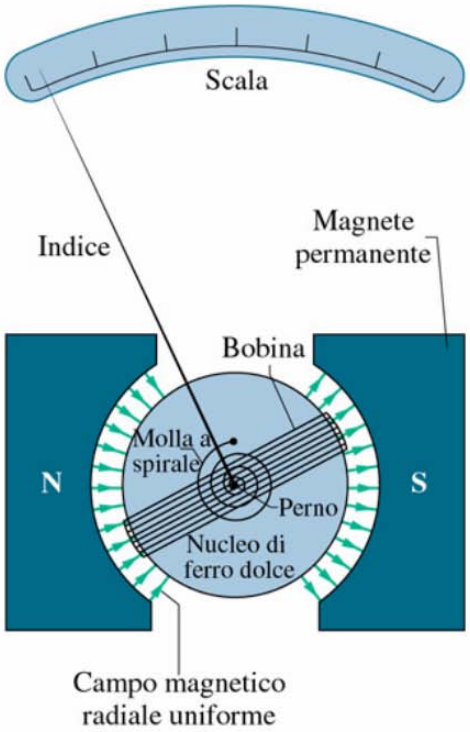
$$\vec{\tau} = \vec{m} \wedge \vec{B} \qquad \vec{\tau} = NI\vec{S} \wedge \vec{B}$$

$$\vec{m} = NI\vec{S} \qquad [m] = Am^2$$

Rotazione della spira

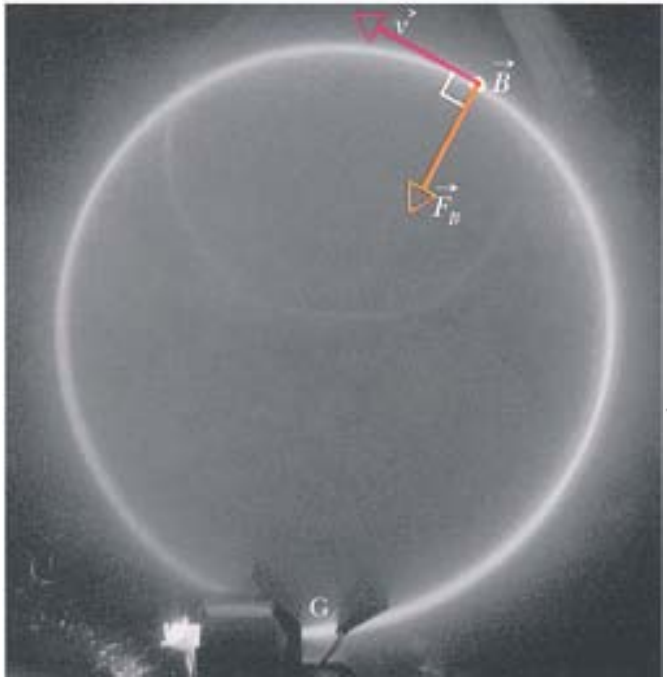


Galvanometro

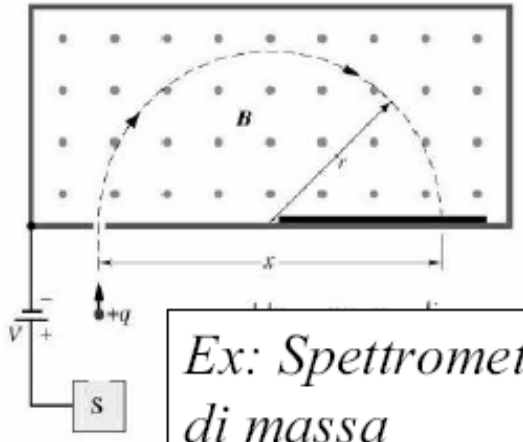


Moto di cariche in campi E e B

$$qvB \underset{\text{Lorentz}}{=} F \underset{\text{II Newton}}{=} ma \underset{\text{moto circolare}}{=} m\frac{v^2}{r} \longrightarrow r = \frac{mv}{qB} \quad ; \quad T = \frac{2\pi r}{v} = \frac{2\pi m}{qB}$$



$$\omega = \frac{v}{r} = \frac{|q|B}{m}$$ Frequenza ciclotronica



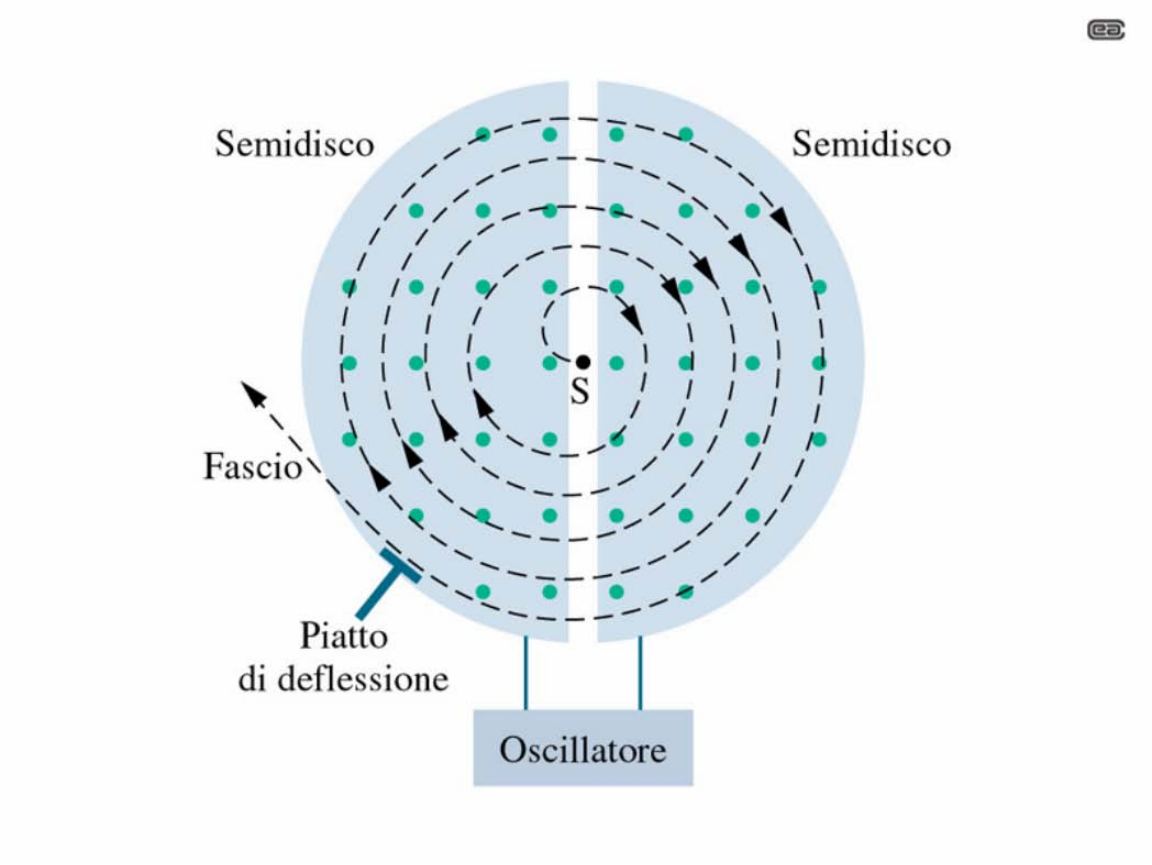
Ex: Spettrometro di massa

$$\frac{1}{2}mv^2 = qV \Rightarrow v = \sqrt{\frac{2qV}{m}}$$

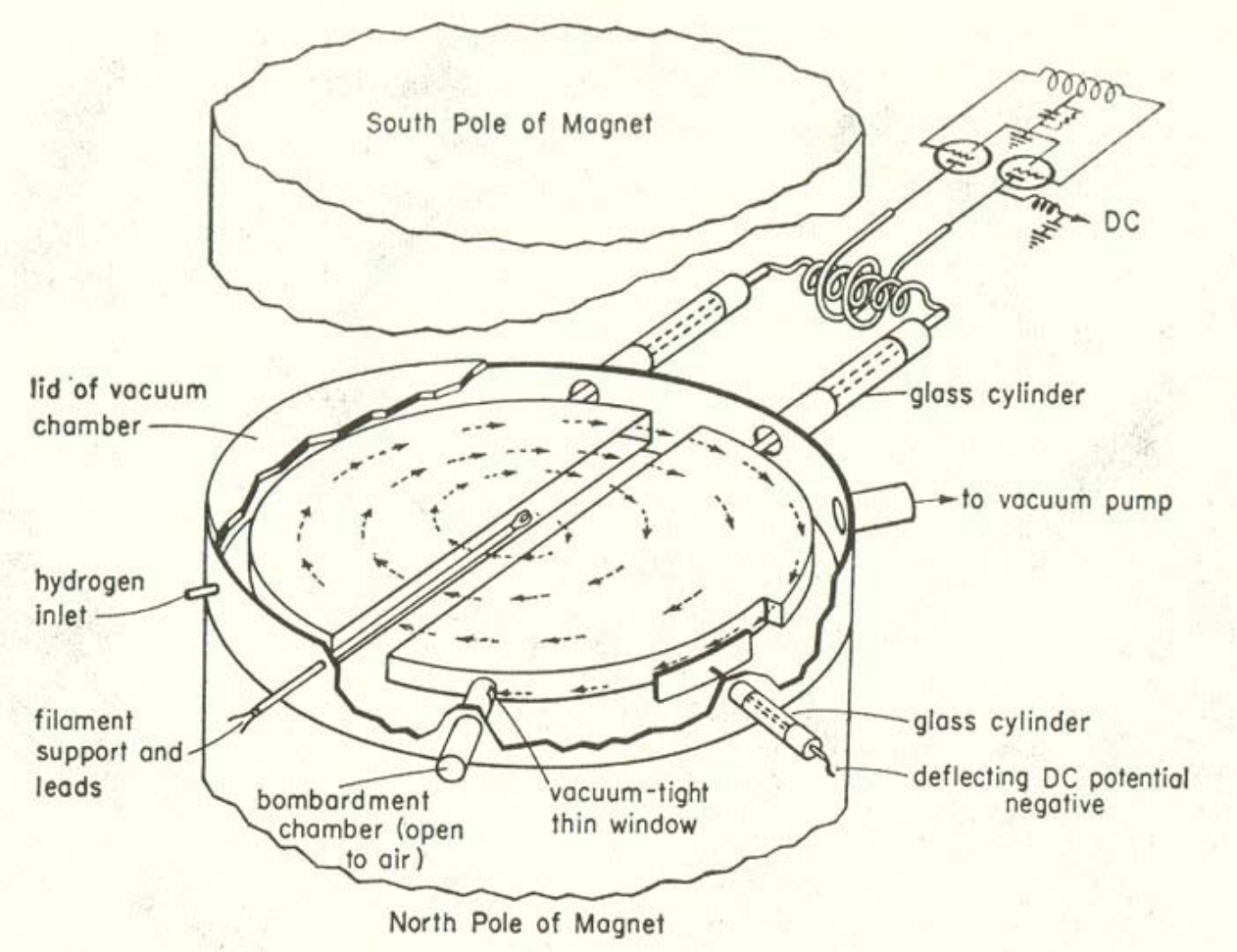
$$x = 2r = \frac{2mv}{qB} = \frac{2}{B}\sqrt{\frac{2mV}{q}}$$

$$m = \frac{B^2qx^2}{8V}$$

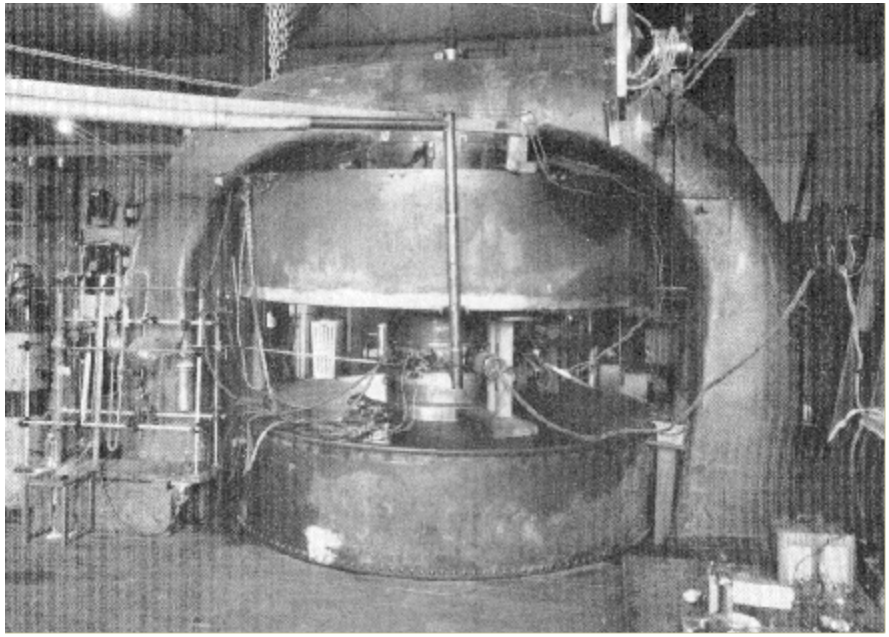
Ciclotrone


Semidisco
Semidisco
S
Fascio
Piatto
di deflessione
Oscillatore

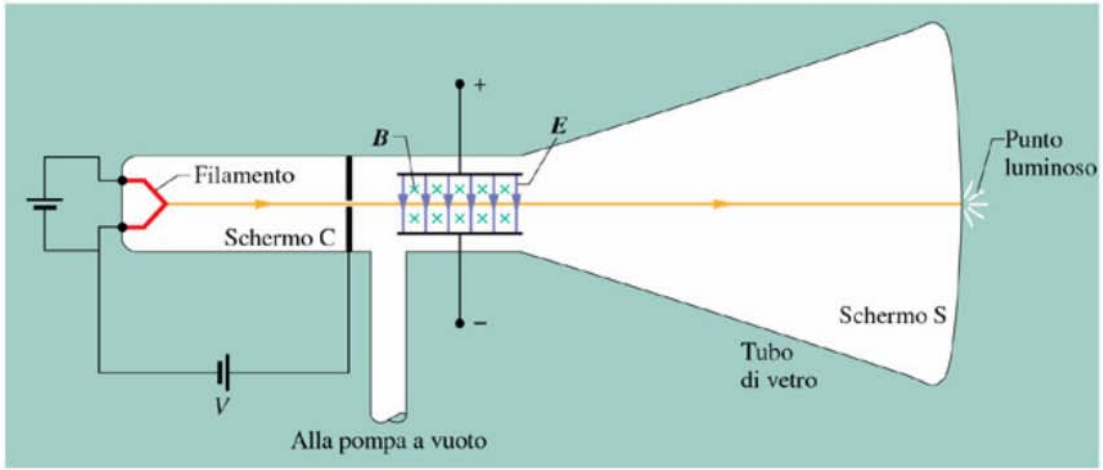
Ciclotrone


South Pole of Magnet
DC
lid of vacuum chamber
glass cylinder
to vacuum pump
hydrogen inlet
filament support and leads
glass cylinder
deflecting DC potential negative
bombardment chamber (open to air)
vacuum-tight thin window
North Pole of Magnet

Ciclotrone

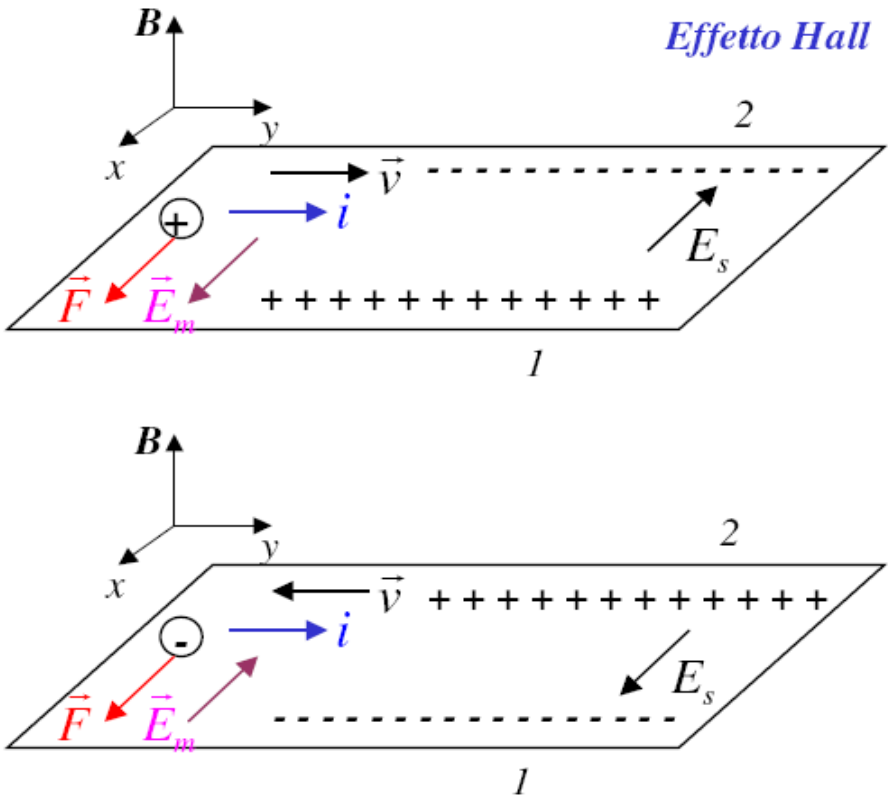


Cinescopio



$$qE = qvB \Rightarrow v = \frac{E}{B}$$

Effetto Hall



$$\mathbf{j} = nqv_d \hat{y}$$

$$F_x = 0 \Rightarrow E_m = v_d B_z$$

$$nqE_m = nqv_d B_z = j_y B_z$$

$$E_m = \frac{j_y B_z}{nq}$$