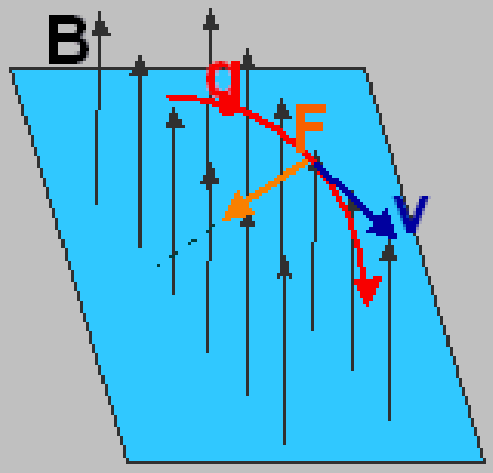
Forze su cariche in movimento

Forza di Lorentz

$$\mathbf{F} = \underbrace{q\mathbf{E}}_{elettrica} + \underbrace{q\mathbf{v}\times\mathbf{B}}_{magnetica}$$

Moto in campo uniforme



$$\mathbf{F} = q\mathbf{v}\times\mathbf{B} \rightarrow \mathbf{F} \perp \mathbf{v}$$

Forza cambia la direzione di v, ma non il modulo

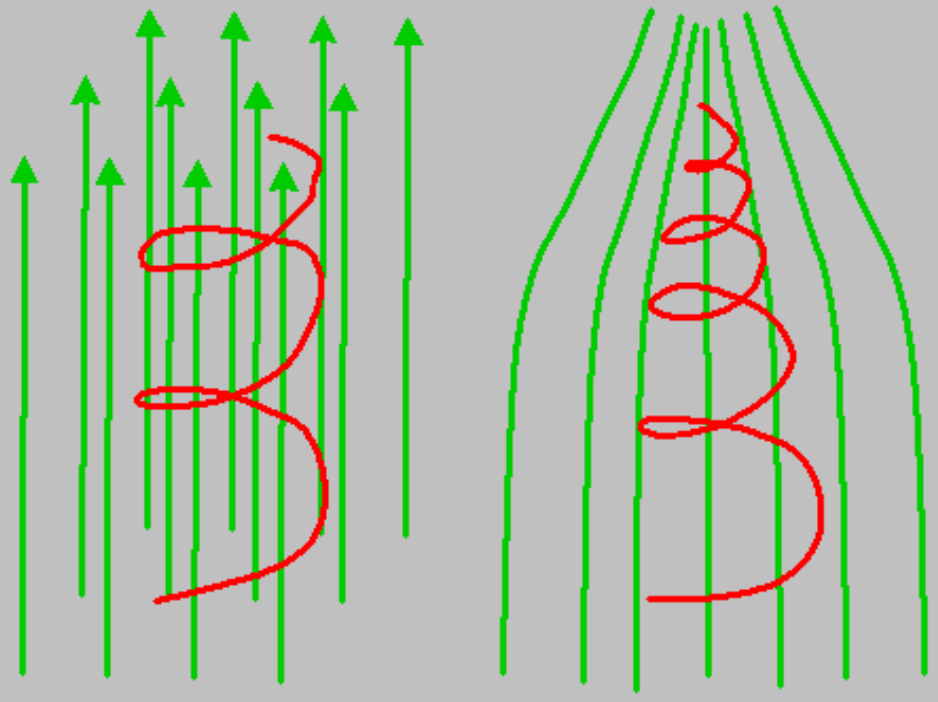
Se velocita' iniziale perp. a B:

moto circolare uniforme

$$\left.\begin{aligned} F &= \frac{mv^2}{r} \\ F &= qvB \end{aligned}\right\} \rightarrow r = \frac{mv}{qB}, \omega = \frac{v}{r} = \frac{qB}{m}$$

Moto di cariche in campi magnetici

Se **v** non e' perp. a **B**:



Campo uniforme:
elica cilindrica

Campo non uniforme:
spirale a raggio variabile

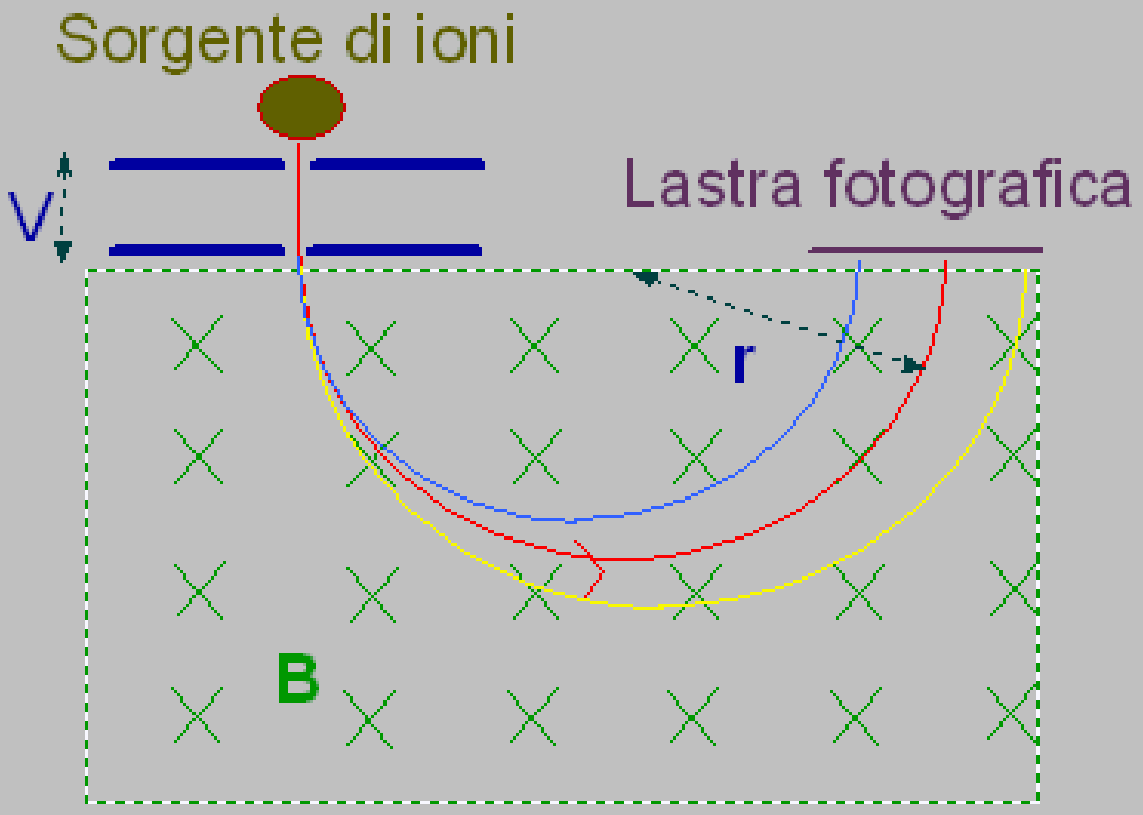
In ogni caso:

$$\mathbf{F}_{magn} = q\mathbf{v}\times\mathbf{B} \rightarrow \mathbf{F}_{magn} \perp \mathbf{v}$$

$$\rightarrow dL_{magn} = \mathbf{F}_{magn}\cdot d\mathbf{s} = \mathbf{F}_{magn}\cdot\frac{d\mathbf{s}}{dt}dt = \mathbf{F}_{magn}\cdot\mathbf{v}dt = 0$$

$\rightarrow$ La forza magnetica non compie lavoro sulle cariche!

Spettrometro di massa



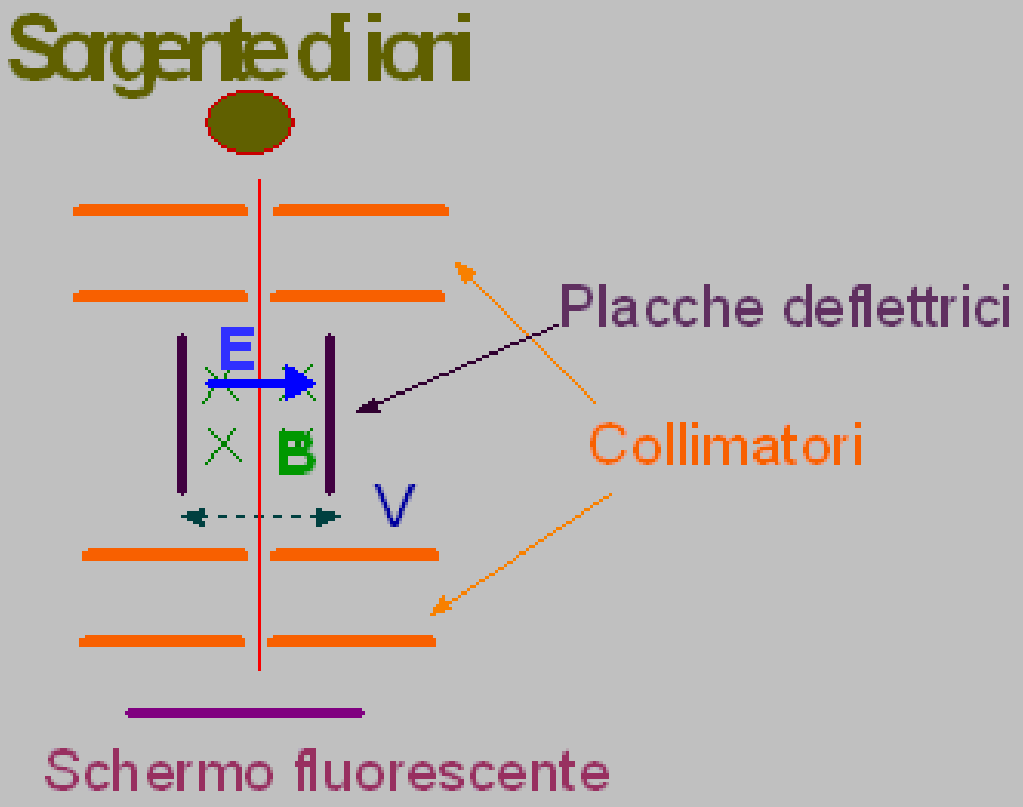
$$E = \frac{1}{2} m v^2 = qV \quad \text{en. cinetica dopo accelerazione}$$

$$m \frac{v^2}{r} = qvB \quad \text{eq. forza centripeta}$$

$$\rightarrow \frac{2qV}{r} = qvB = q\left(\frac{2qV}{m}\right)^{1/2} B$$

$$\rightarrow \frac{q}{m} = \frac{2V}{r^2 B^2}$$

Filtro di velocita'



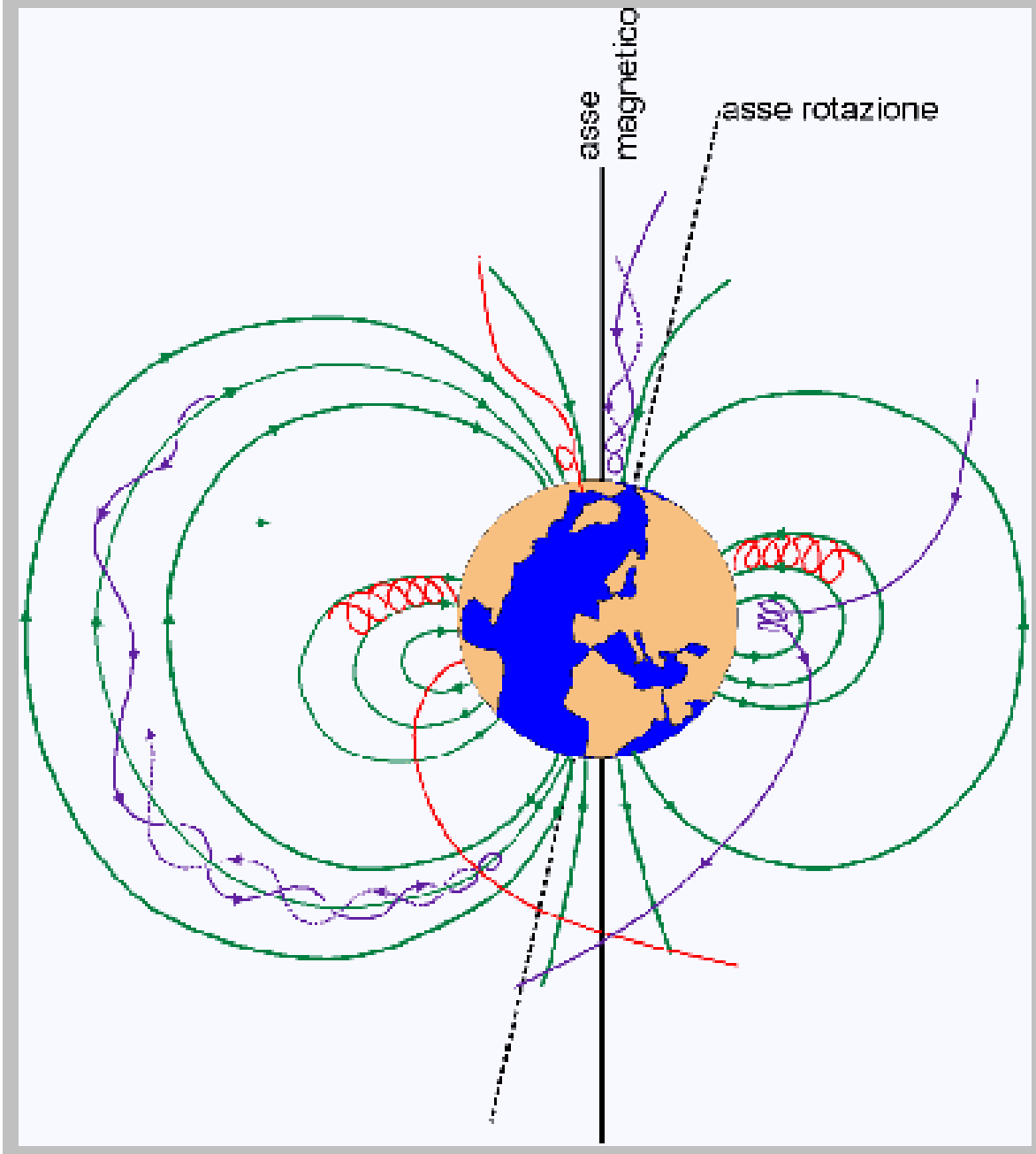
$$\mathbf{F}_e = q\mathbf{E}$$

$$\mathbf{F}_m = q\mathbf{v} \times \mathbf{B} \rightarrow \| \mathbf{E}$$

Per equilibrio (fascio indeflesso)

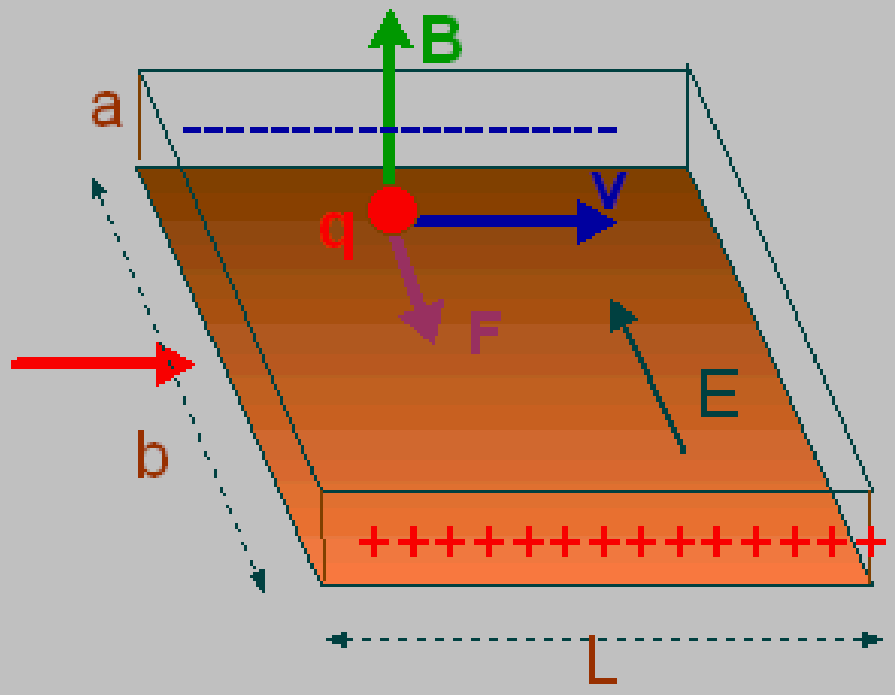
$$qE = qvB \rightarrow v = \frac{E}{B}$$

Traiettorie nel campo terrestre



Effetto Hall

Lamina percorsa da corrente



E: campo creato dall'accumulo di cariche sui lati, dovuto all'effetto di **F**

$qvB = qE$ condizione di equilibrio

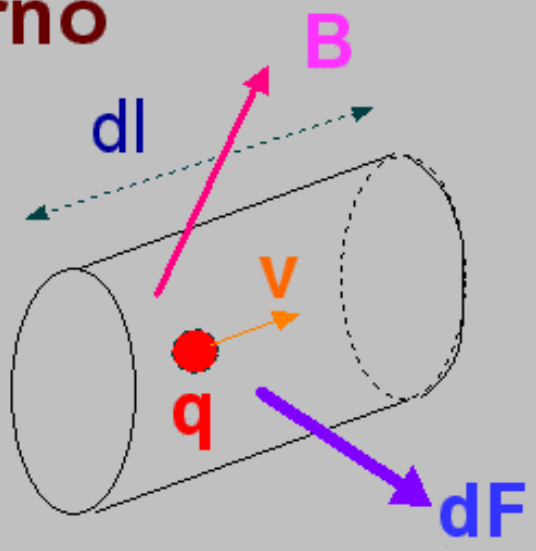
$\Delta V = Eb = vBb$

$$i = jA = qnvab \rightarrow v = \frac{i}{qnab}$$

$$\rightarrow \Delta V_H = \frac{iBb}{qnab} = \frac{iB}{qna}$$ tensione di Hall

$$\rightarrow R_H = \frac{\Delta V_H}{i} = \frac{B}{qna}$$ resistenza di Hall

Forza su circuito in campo esterno



Forza sull'elemento di circuito: II legge di Laplace

$$\mathbf{F} = q\mathbf{v}\times\mathbf{B} \quad \text{singola carica}$$

$$\rightarrow d\mathbf{F} = nS\left|d\mathbf{l}\right| q\mathbf{v}\times\mathbf{B}$$

$$\mathbf{v} \parallel d\mathbf{l}$$

$$\rightarrow d\mathbf{F} = i d\mathbf{l}\times\mathbf{B}$$