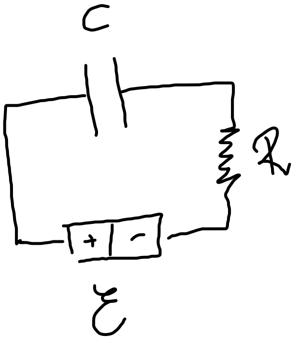
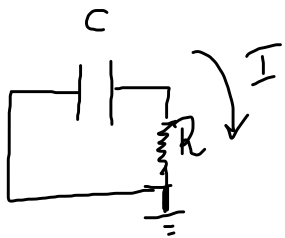


$$\mathcal{E} = \underbrace{RI}_{\Delta V_R} + \underbrace{\frac{Q}{C}}_{\Delta V_C}$$

$$Q(t) = \frac{\mathcal{E}}{C}\left(1 - e^{-t/\tau}\right)$$

$$\tau = RC$$

$$t \approx 5\tau \qquad Q > 0.99\, Q_0$$



$$\Delta V_C = \Delta V_R$$

$$C = \frac{Q}{\Delta V_C} \Rightarrow \Delta V_C = \frac{Q}{C} \qquad \Delta V_R = RI$$

cond

$$\frac{Q}{C} = RI \qquad I = -\frac{dQ}{dt}$$

cond

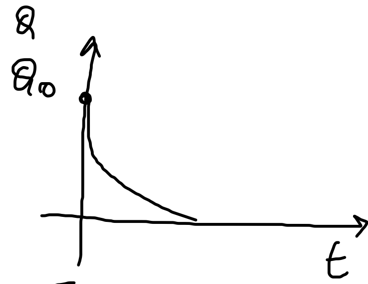
$$\frac{Q}{C} = -\frac{dQ}{dt} R \; ;$$

$$\frac{Q}{C} = -R\frac{dQ}{dt} ; \qquad \tau \stackrel{def}{=} RC$$

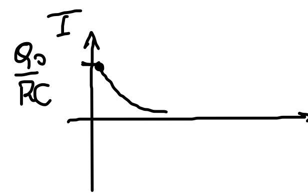
$$\int_0^t \frac{dt}{RC} = -\int_{Q_0}^{Q(t)} \frac{dQ}{Q} \qquad \frac{1}{\tau}\, t \Big|_0^t = -\ln Q \Big|_{Q_0}^{Q(t)}$$

$$-t/\tau = +\ln\left[\frac{Q(t)}{Q_0}\right] ;$$

$$\frac{Q(t)}{Q_0} = e^{-t/\tau} ; \qquad \boxed{Q(t) = Q_0\, e^{-t/\tau}}$$



$$I(t) = -\frac{dQ}{dt} = -\frac{d}{dt}\left(Q_0\, e^{-t/\tau}\right) = \frac{Q_0}{\tau}\, e^{-t/\tau} = \frac{Q_0}{RC}\, e^{-t/\tau}$$



$t > 5\tau$

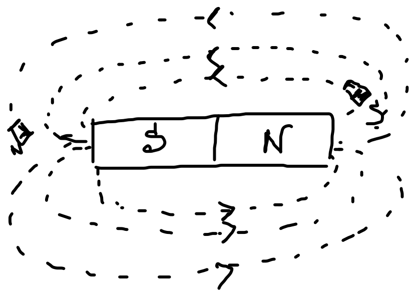
$Q < Q_0\, e^{-5} \approx 0.1\%\, Q_0$

Campi magnetici

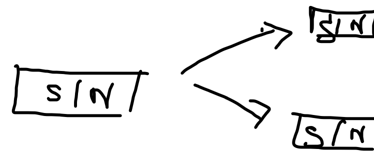
1) ∃ materiali (detti magneti) che si attraggono

2) ∃ " che indicano sempre il nord geografico

3)

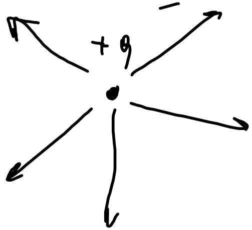


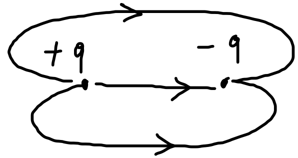
4)



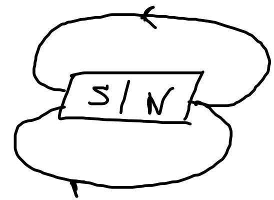
5)

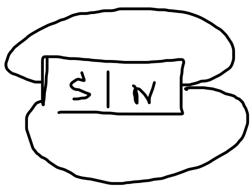
Campo el. $\underline{E}$





Linee di $\underline{B}$ sono sempre chiuse

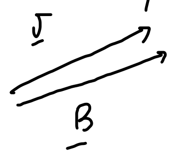




+q

Se q è ferma, non succede niente

Se q è in movimento con $\underline{v} \neq \underline{0}$



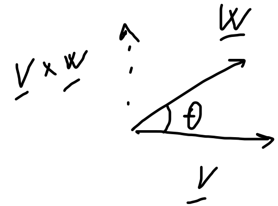
Se $\underline{v} \parallel \underline{B}$: non succede niente

Se q ha $\underline{v} \perp \underline{B}$: allora $\exists$ forza $\propto q v B$

$\underline{F} = q\,(\underbrace{\underline{v} \times \underline{B}}_{\text{prodotto vettore}})$

Prodotto vettore:

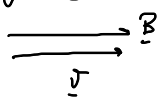
$\underline{V} \times \underline{W}$: vettore $\left\{ \begin{array}{l} \text{direzione nel piano } \perp \underline{V} \text{ e } \underline{W} \\ \text{verso: regola mano DX} \end{array} \right.$



modulo:
$VW \operatorname{sen}\theta$

Se $q = 0$ oppure $v = 0$: $\underline{F} = \underline{0}$

Se $\underline{v} \parallel \underline{B}$: $\theta = 0$ $\qquad \|\underline{v} \times \underline{B}\| = 0$



$[B] = \left[\dfrac{F}{qv}\right] = \dfrac{N}{C \cdot m/s} = \text{Tesla}$

$B \approx 30\ T$ max lab stazionario

$B_{Terra} \approx 0.5 \cdot \underbrace{10^{-4}\ T}_{1\ \text{Gauss}}$

$B_{magn} \sim$ qualche Gauss

Lavoro della forza $\underline{F} = q(\underline{v} \times \underline{B})$?

$\underbrace{\delta L}_{\text{lavoro infinitesimo}} = \underline{F} \cdot d\underline{s}$ $\quad d\underline{s}$: spost. infinitesimo

$\underbrace{\delta L = \Delta K}_{\underline{th} \text{ lavoro-energia}}$

$\underline{Oss}$ $\quad d\underline{s} \parallel \underline{v} \quad \underline{v} = d\underline{s}/dt$

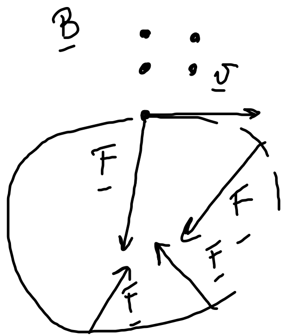
$$\delta L = \underbrace{q(\underline{v} \times \underline{B})}_{\perp \underline{v}, \underline{B}} \cdot \underbrace{d\underline{s}}_{\parallel \underline{v}} = 0 \Rightarrow K = \text{cost} \Rightarrow |\underline{v}| = \text{cost}$$

$\underline{B} = \overrightarrow{\text{const}}$

$\underline{v} \perp \underline{B}$ $\qquad$ $\underline{F} = q(\underline{v} \times \underline{B})$ $\qquad$ × × × × $\underline{B}$ entrante

Se $\underline{v} \perp \underline{B}$: $|\underline{F}| = qvB\,\text{sen}(90°) = qvB$ $\qquad$ • • • $\underline{B}$ uscente

$\underline{F} \perp \underline{v}$



Moto circolare uniforme (v = cost) attorno alla linea di campo

$r \qquad \omega$

$$m\frac{v^2}{r} = \underbrace{m\,a_{centr}}_{F_{centr}} = qvB; \quad \boxed{r_L = \frac{mv}{qB}} \qquad r \propto m, v$$

$r \propto \frac{1}{q}, \frac{1}{B}$

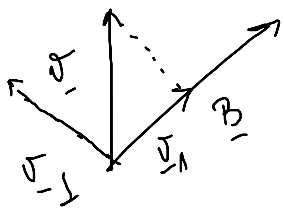
raggio di Larmor

$$\omega = \frac{2\pi}{T} \qquad v = \frac{\overbrace{2\pi r_L}^{\text{lungh. circonf.}}}{T} \;;\; T = \frac{2\pi r_L}{v} = \frac{2\pi}{\cancel{v}}\,\frac{m\cancel{v}}{qB} = \frac{2\pi m}{qB}$$

$$r_L = \frac{mv}{qB} \qquad T \text{ non dip. da } v$$

$$\omega = \frac{\cancel{2\pi}}{\cancel{2\pi}\, m / qB} = \frac{qB}{m} \qquad \text{non dip. } v$$

$$r_L = \frac{mv}{qB} \qquad \omega = \frac{qB}{m}$$



$$\underline{v} = \underline{v}_\parallel + \underline{v}_\perp$$

$$\underline{F} = q\,\underline{v} \times \underline{B} = q\,(\underline{v}_\parallel + \underline{v}_\perp) \times \underline{B}$$

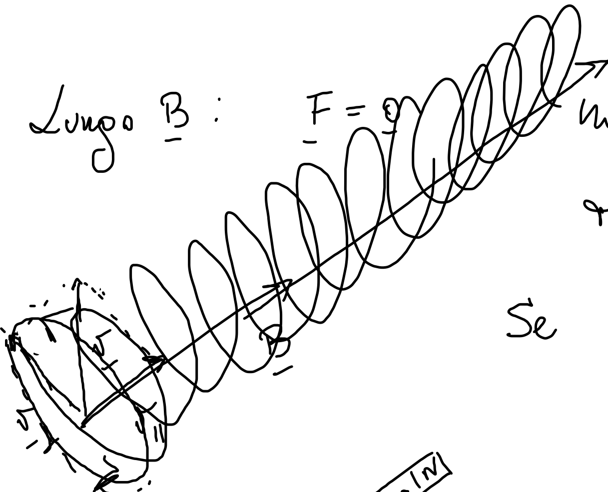
$$= \cancel{q\,\underline{v}_\parallel \times \underline{B}} + q\,\underline{v}_\perp \times \underline{B} = q\,\underline{v}_\perp \times \underline{B}$$

Nel piano $\perp \underline{B}$: moto circolare uniforme

$$r_L = \frac{m v_\perp}{qB} \qquad \omega_L = \frac{qB}{m}$$

Lungo $\underline{B}$: $\underline{F} = \underline{0}$ moto rettilineo uniforme con velocità $v_\parallel$

moto complessivo è elicoidale



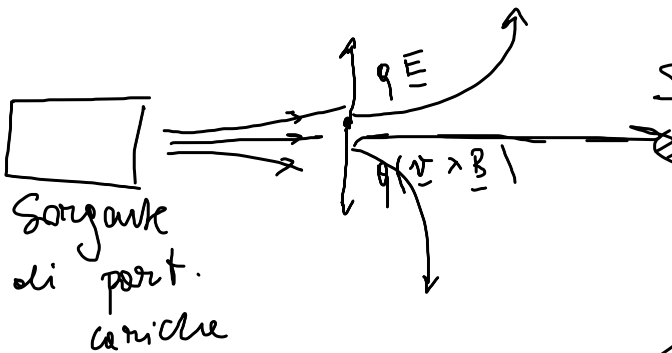
Se $\underline{E} \neq \underline{0}$ $\qquad \underline{F}_E = q\underline{E}$ $\qquad$ Vale pr. sovrapp.

$\underline{B} \neq \underline{0}$ $\qquad \underline{F}_B = q(\underline{v} \times \underline{B})$ $\qquad \underline{F}_{TOT} = \underline{F}_E + \underline{F}_B$

$$= q\underline{E} + q(\underline{v} \times \underline{B}) = q\left[\underline{E} + (\underline{v} \times \underline{B})\right]$$

forza di Lorentz

Selettore di velocità



Se $q\underline{E} > q(\underline{v} \times \underline{B})$

Se $q\underline{E} < q(\underline{v} \times \underline{B})$

$\cancel{q}E = \cancel{q}vB$; $v = E/B$