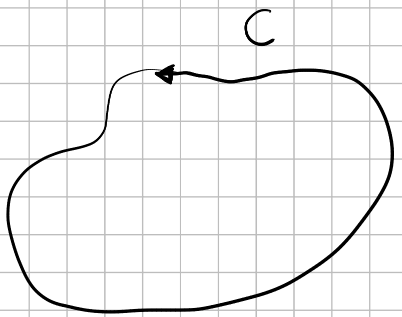
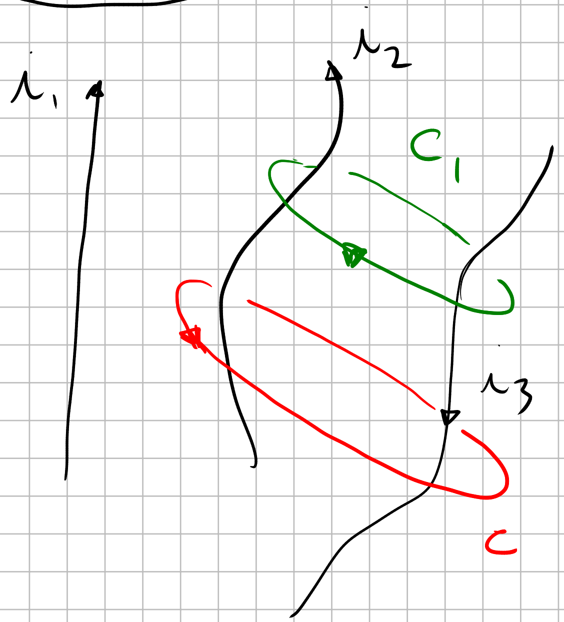
LEGGE DI AMPERE



$$\oint_c \vec{B}\cdot d\vec{s} = \mu_0 \sum_k \boxed{i_k}$$

↳ CORRENTI CONCATENATE

ESEMPIO



in questo caso le correnti concatenate sono i_2 e i_3

$$\oint_c \vec{B}\cdot d\vec{s} = \mu_0 (i_2 - i_3)$$

$$\oint_{c_1} \vec{B}\cdot d\vec{s} = \mu_0 (-i_2 + i_3)$$

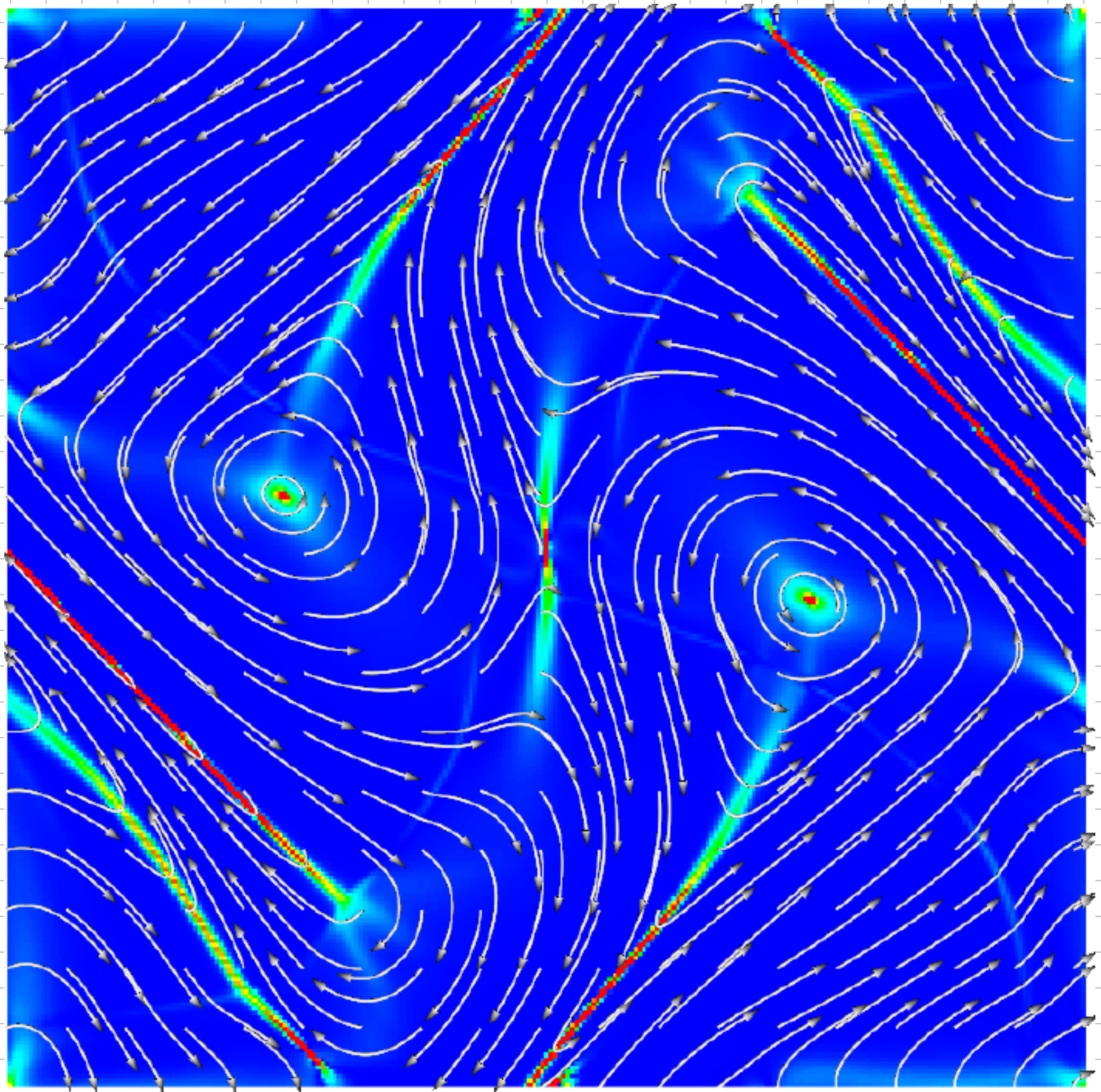
FORMA LOCALE

$$\oint_{c} \vec{B}\cdot d\vec{s} = \int_{\boxed{\Sigma(c)}} \vec{\nabla}\times\vec{B}\cdot\hat{n}\, d\Sigma \quad , \quad \mu_0 i = \mu_0 \int_{\boxed{\Sigma(c)}} \vec{J}\cdot\hat{n}\, d\Sigma$$

STESSA SUPERFICIE

$$\int_{\Sigma(c)} \overbrace{\vec{\nabla}\times\vec{B}}\cdot\hat{n}\, d\Sigma = \overbrace{\mu_0 \int_{\Sigma(c)} \vec{J}}\cdot\hat{n}\, d\Sigma \quad \Rightarrow \quad \vec{\nabla}\times\vec{B} = \mu_0 \vec{J}$$

IL ROTORE

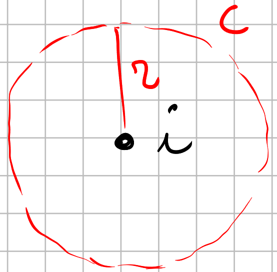


$$\vec{\nabla} \times \vec{B} = \mu_0 \vec{J}$$

$$\vec{\nabla} \times \vec{E} = 0$$

APPLICAZIONI DELLA LEGGE DI AMPERE

FILO INDEFINITO



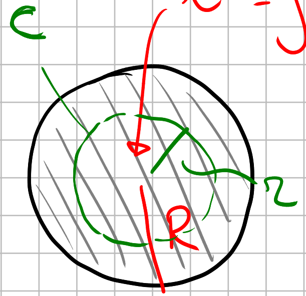
$$\oint_C \vec{B} \cdot d\vec{s} = \int_C B\,ds = B\int_C ds = B\,2\pi r \overset{\text{LEGGE DI AMPERE}}{=} \mu_0 i \Rightarrow$$

$$\underbrace{B = \frac{\mu_0 i}{2\pi r}}$$ CAMPO GENERATO DA UN FILO INDEFINITO

↳ LEGGE DI BIOT - SAVART

FILO INDEFINITO DI SEZIONE FINITA

$i = J\pi R^2$



$$\hookrightarrow \boxed{J = \frac{i}{\pi R^2}} \quad , \qquad \oint_c \vec{B}\cdot d\vec{l} = B\, 2\pi r$$

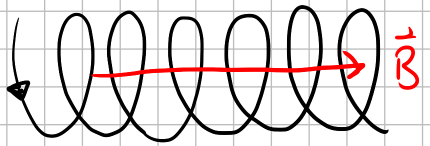
↑ STESSO PROCEDIMENTO DI PRIMA

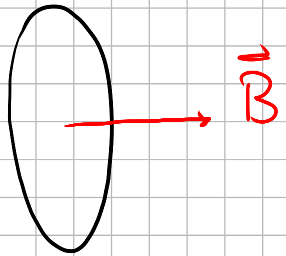
$$\mu_0 i(r) = \mu_0 \boxed{J} \pi r^2 = \frac{\mu_0 i}{\pi}\frac{\pi r^2}{R^2} \Rightarrow$$

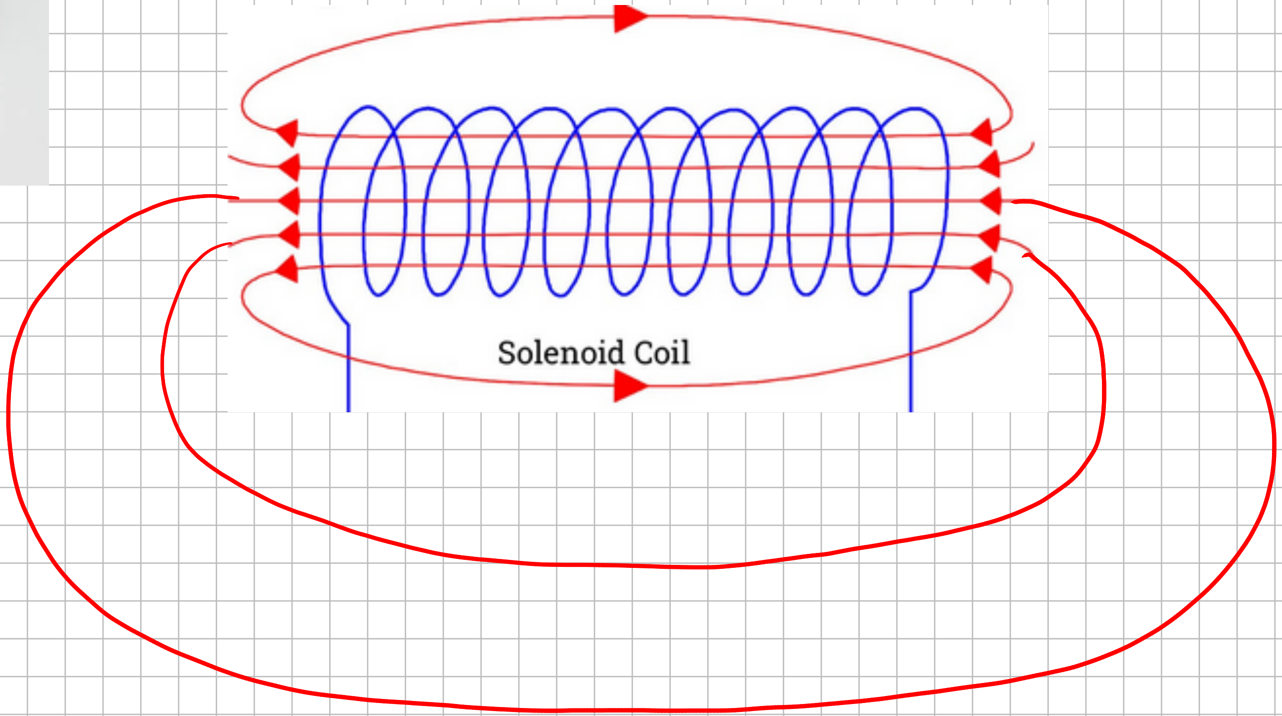
$$B\, 2\pi r = \frac{\mu_0 i}{\cancel{\pi}}\frac{\cancel{\pi} r^2}{R^2} \Rightarrow \begin{cases} B = \mu_0 i \dfrac{r^{\cancel{2}}}{R^2}\dfrac{1}{2\pi \cancel{r}} = \boxed{\dfrac{\mu_0 i r}{2\pi R^2}} & \text{per } r \le R \\[2em] B = \dfrac{\mu_0 i}{2\pi r} & \text{per } r > R \end{cases}$$

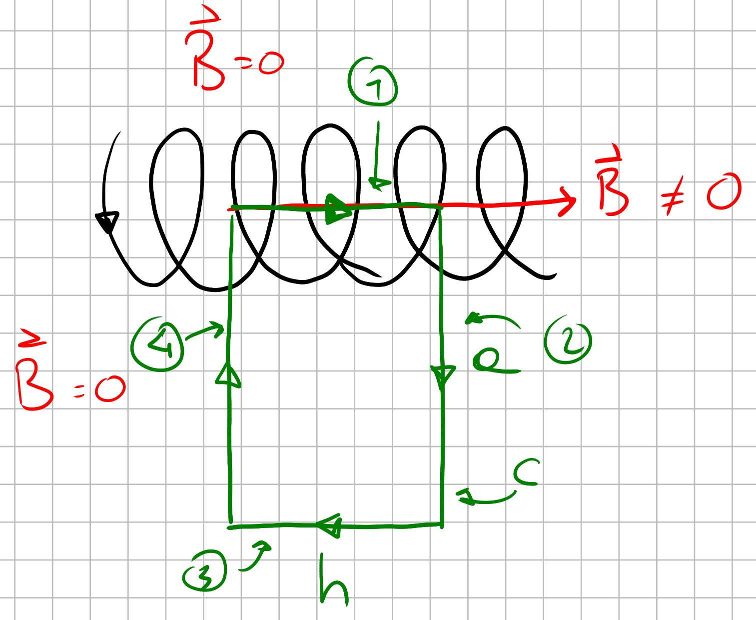
perché il cammino concatena <u>tutta</u> la corrente

SOLENOIDE INDEFINITO









$[n] = m^{-1}$

dimensioni di n

CALCOLO DI $\vec{B}$

$$\oint_c \vec{B}\cdot d\vec{s}$$

il campo su ③ è 0 → l'integrale vale 0

su ② e ④ $d\vec{s} \perp \vec{B}$ all'interno del solenoide (all'esterno $\vec{B}=0$) ⟹ $\vec{B}\cdot d\vec{s} = 0$

⟹ l'integrale vale 0

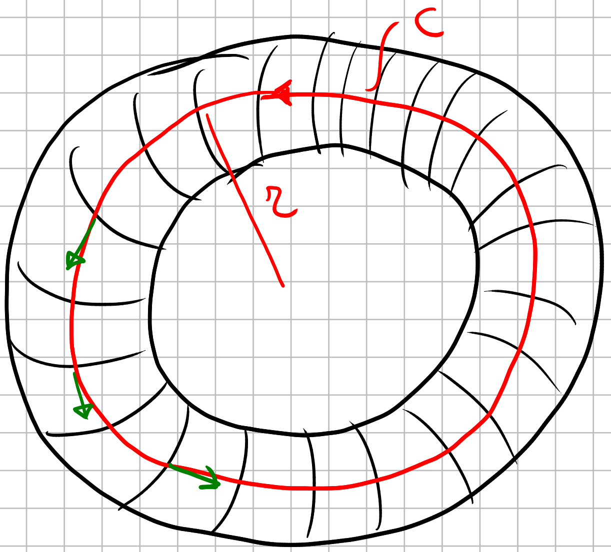
$$\oint_c \vec{B}\cdot d\vec{s} = \int_{①} B\,ds = B\int_{①} ds = Bh$$

$$\mu_0 \sum_k i_k = \mu_0 N(h)\, i \Rightarrow$$

n densità di spire

$$Bh = \mu_0 N(h)\, i \Rightarrow B = \mu_0 \overset{\|}{\boxed{\frac{N(h)\, i}{h}}} = \overline{\mu_0 n i}$$

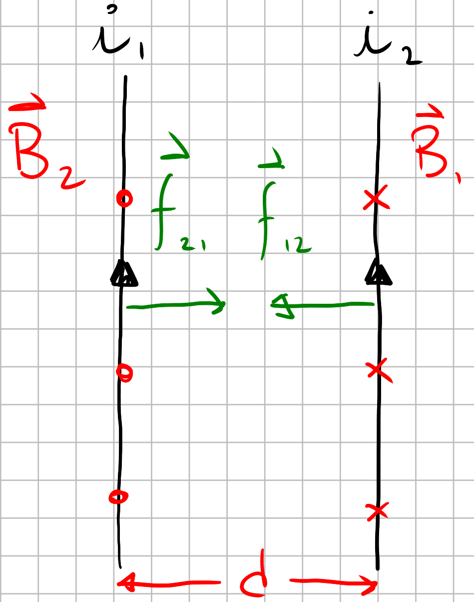
SOLENOIDE TOROIDALE

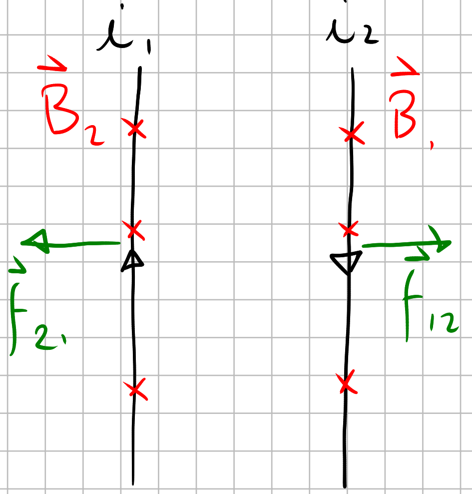


$$\oint_C \vec{B}\cdot d\vec{s} = \oint_C B\,ds = B\oint_C ds = B\,2\pi r$$

$$\mu_0 \sum_k i_k = \mu_0 N i \Rightarrow \boxed{B = \frac{\mu_0 N i}{2\pi r}}$$

per r all'interno del solenoide





FORZE TRA FILI

$$d\vec{F} = i\, d\vec{\ell} \times \vec{B} \Rightarrow \vec{f} = \frac{d\vec{F}}{d\ell} = i\, \underbrace{\hat{t}}_{\text{DIREZIONE DELLA CORRENTE}} \times \vec{B}$$ forza per unità di lungh.

$$\vec{f}_{12} = i_2 \hat{t}_2 \times \vec{B}_1 \,, \quad f_{12} = i_2 B_1 = i_2 \frac{\mu_0 i_1}{2\pi d}$$

$$\vec{f}_{21} = i_1 \hat{t}_1 \times \vec{B}_2 \,, \quad f_{21} = i_1 B_2 = i_1 \frac{\mu_0 i_2}{2\pi d}$$