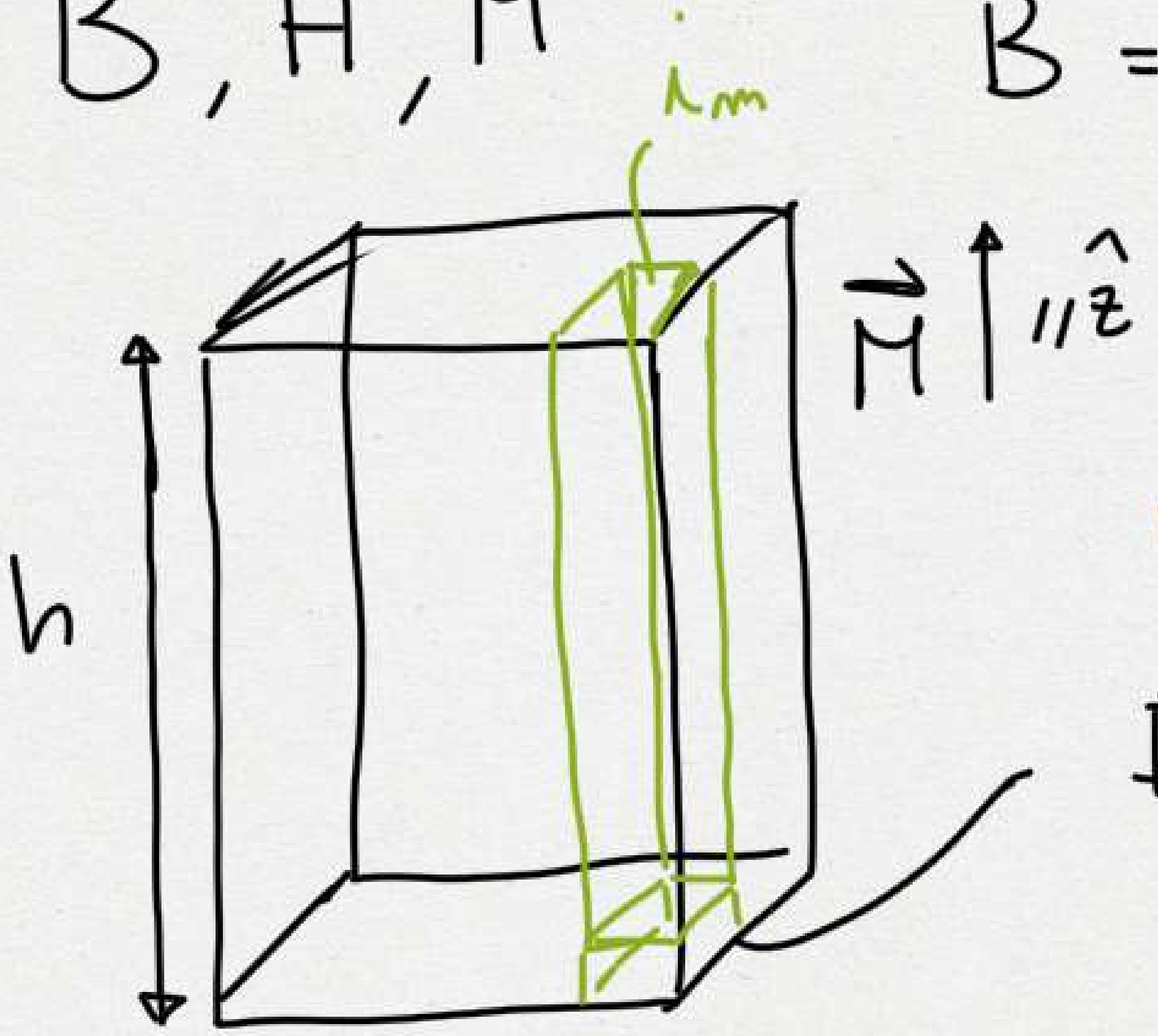
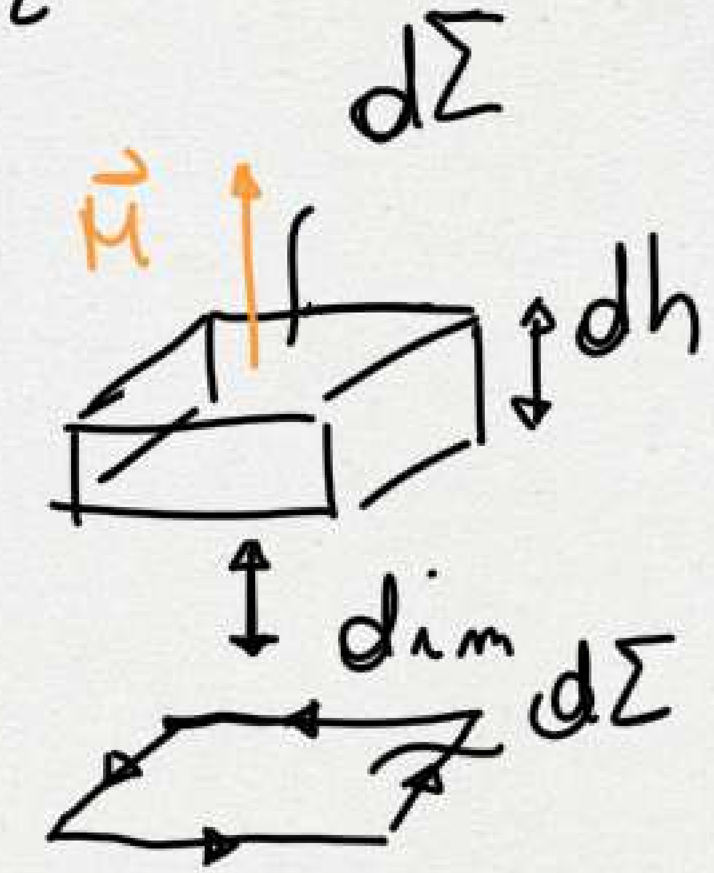
$\vec{B}, \vec{H}, \vec{M}$ $\qquad \vec{B} = \mu_0(\vec{H}+\vec{M})$, $\vec{H} \equiv \dfrac{\vec{B}_0}{\mu_0}$





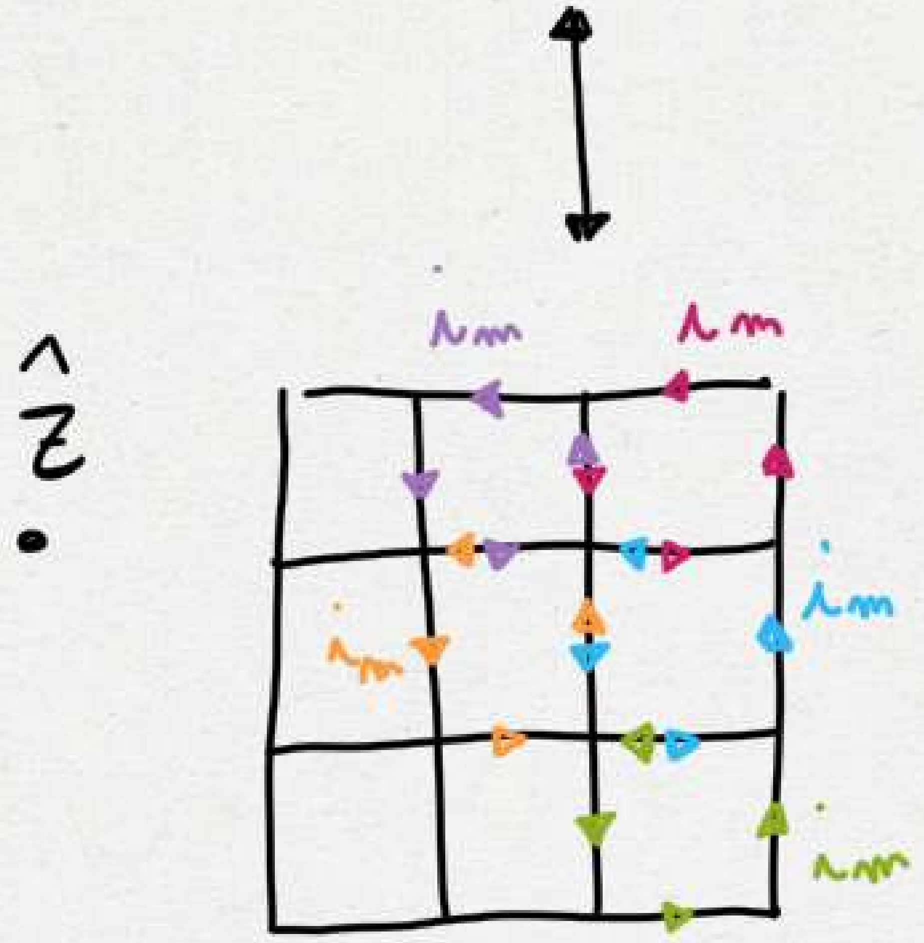
$$d\vec{m} = \vec{M}\,d\tau = \vec{M}\,d\Sigma\,dh = \overbrace{M\,dh}^{di_m}\,d\Sigma\,\hat{z}$$

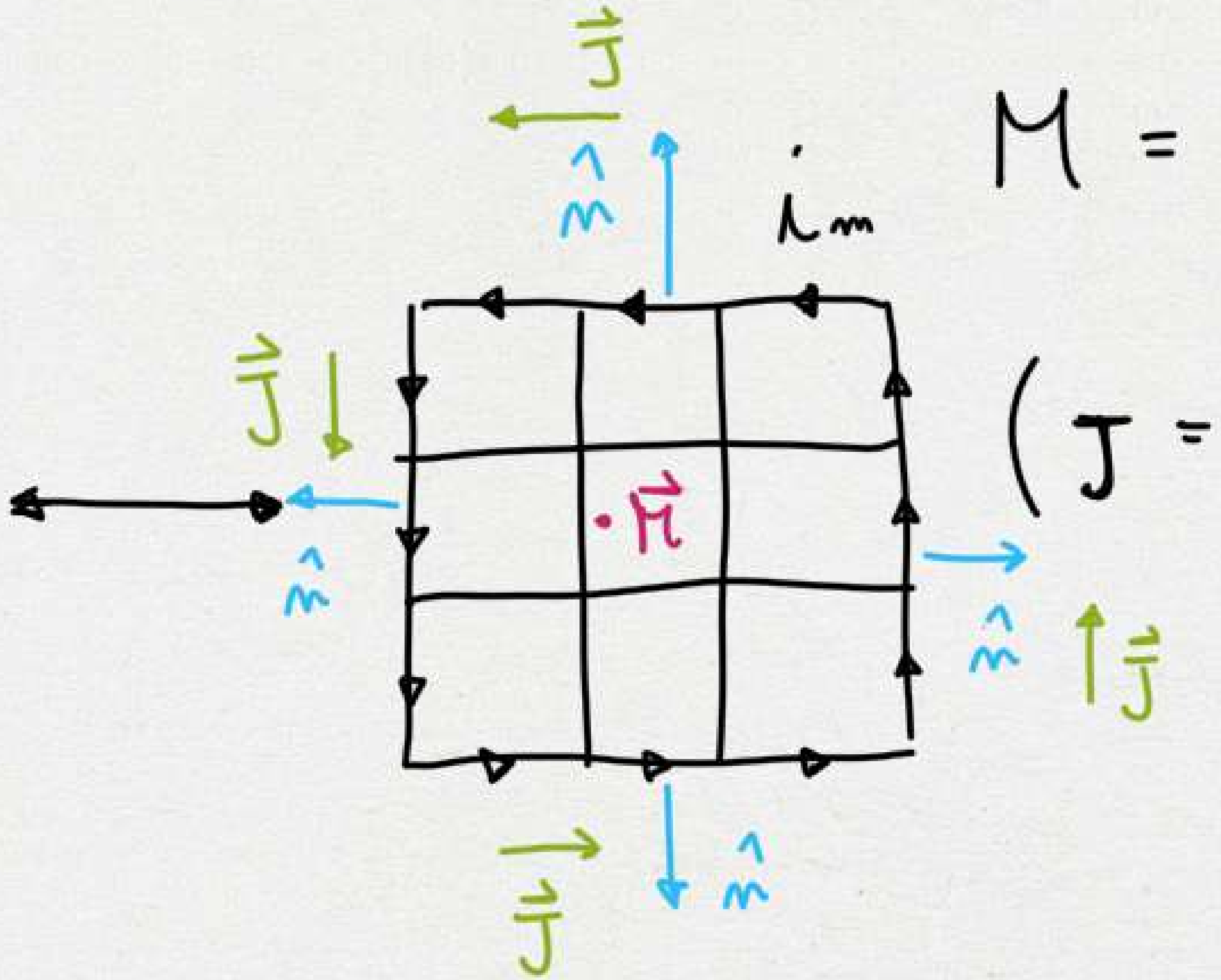
PER UNA SPIRA $\vec{m} = i\Sigma\hat{n}$

$$d\vec{m} = di_m\,d\Sigma\,\hat{z} \quad , \quad di_m \equiv M\,dh$$

$$i_m = \int_0^h di_m = Mh$$

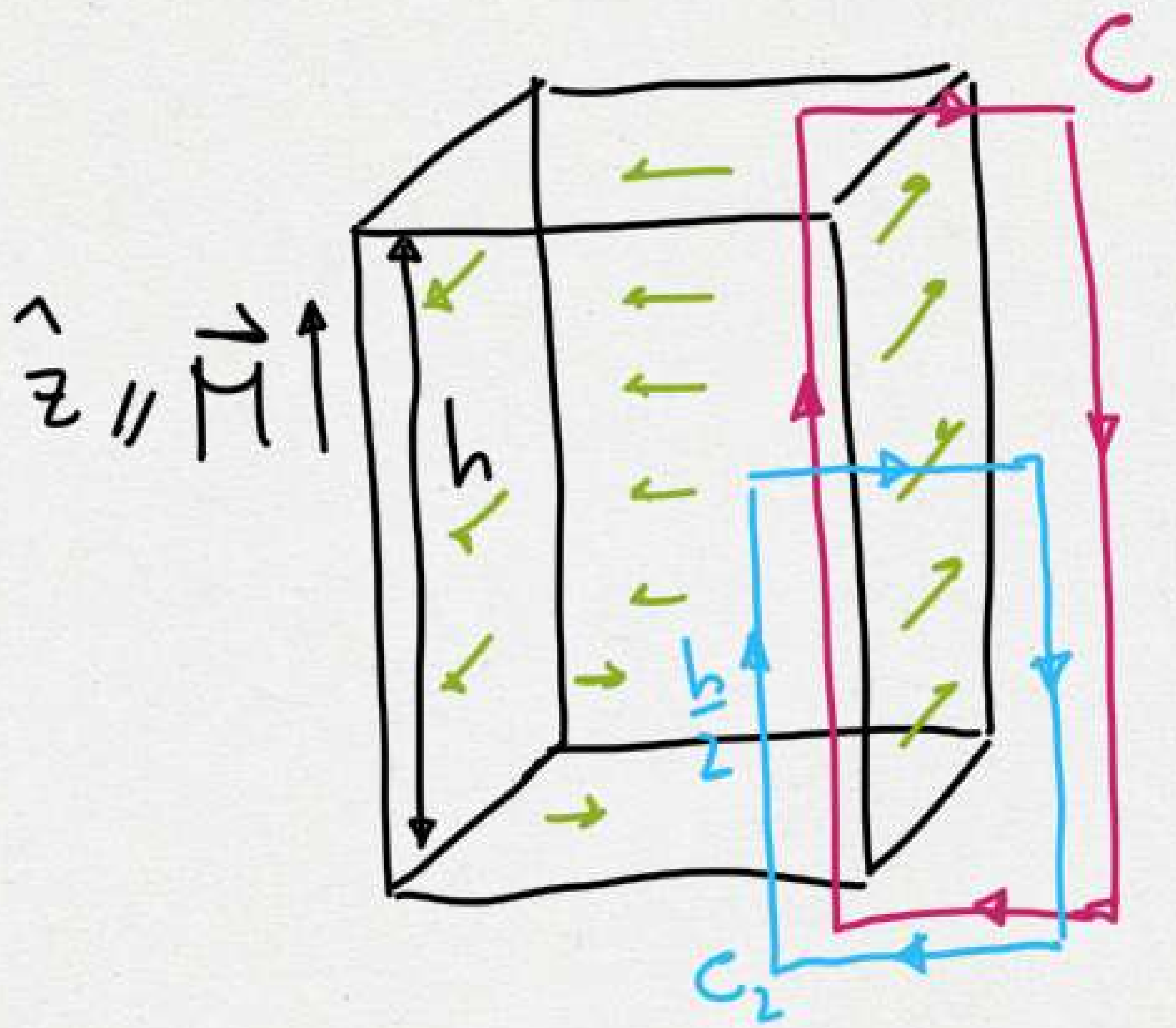
$$M = \frac{i_m}{h} \equiv J_m$$ DENSITÀ LINEARE DI CORRENTE (MICROSCOPICA O AMPERIANA)





$$\left(J = \frac{i}{\Sigma}\right)$$

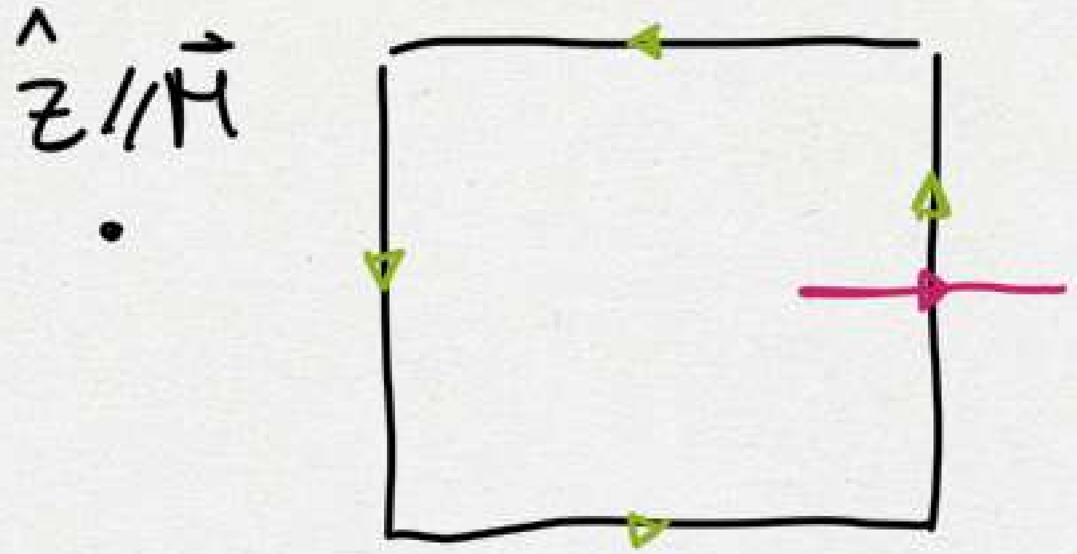
$$\boxed{\vec{J}_m = \vec{M}\times\hat{n}} \longleftrightarrow \boxed{\sigma_p = \vec{P}\cdot\hat{n}}$$

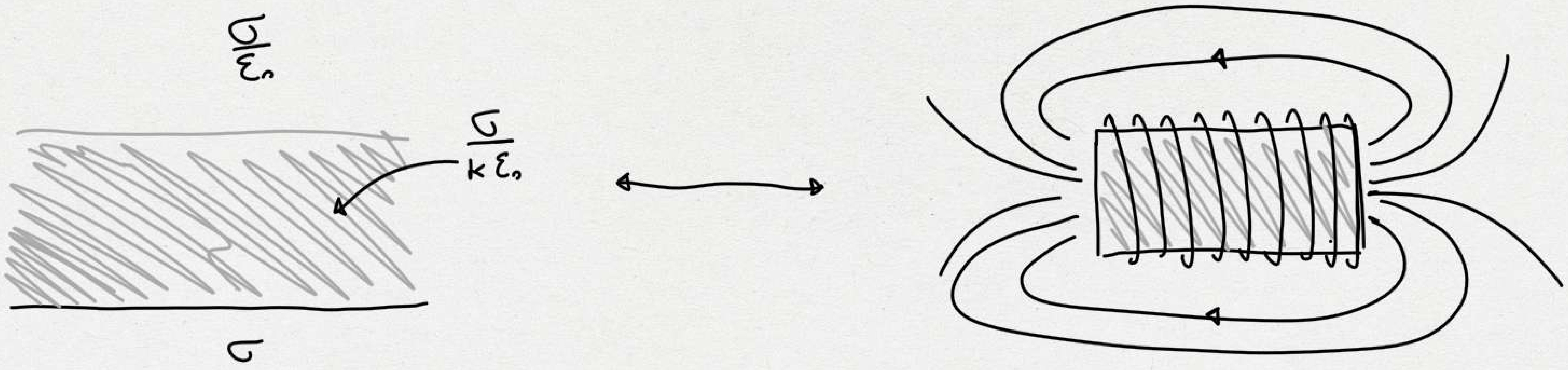


$$\oint_C \vec{M}\cdot d\vec{s} = M\int_0^h dh' = Mh = \frac{i_m}{\cancel{h}}\cancel{h} = i_m \Rightarrow$$

$$\boxed{\oint_C \vec{M}\cdot d\vec{s} = i_m}$$

$$\oint_{C_2} \vec{M}\cdot d\vec{s} = \frac{i_m}{2}$$

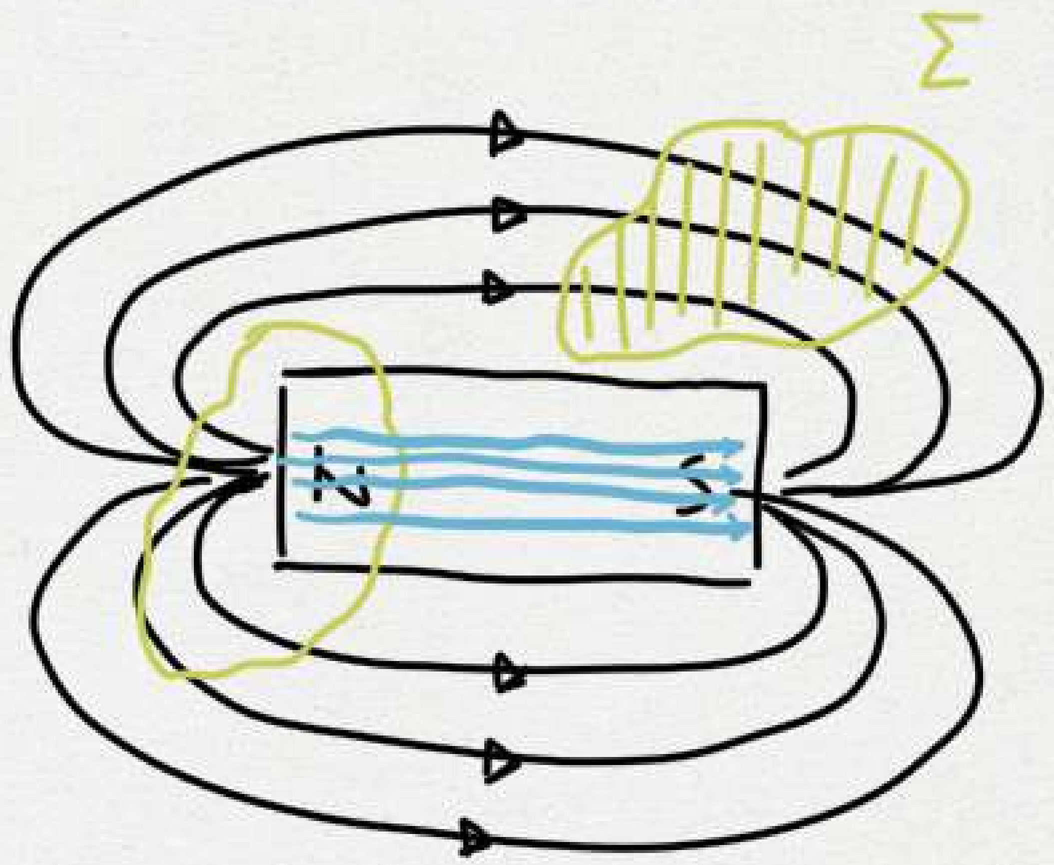



σ/ε_0
$\dfrac{\sigma}{\kappa\varepsilon_0}$
σ

TEOREMA DI GAUSS PER $\vec{B}$

$$\oint_\Sigma \vec{E}\cdot\hat{n}\,d\Sigma = \frac{Q_{INT}}{\varepsilon_0} = \int_{\tau(\Sigma)} \rho\,d\tau \quad , \quad \Phi_\Sigma(\vec{E})$$

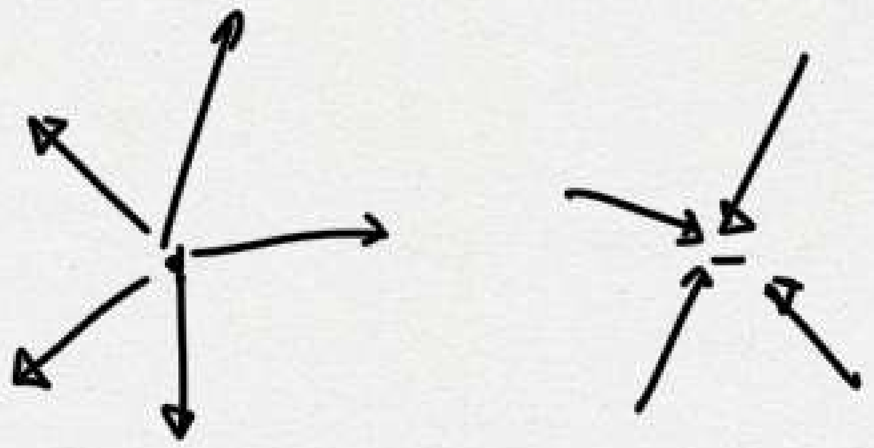
$$\Phi_\Sigma(\vec{B}) = \oint_\Sigma \vec{B}\cdot\hat{n}\,d\Sigma \quad , \quad \boxed{\oint_\Sigma \vec{B}\cdot\hat{n}\,d\Sigma = 0} \Rightarrow$$ $\vec{B}$ È UN CAMPO SOLENOIDALE

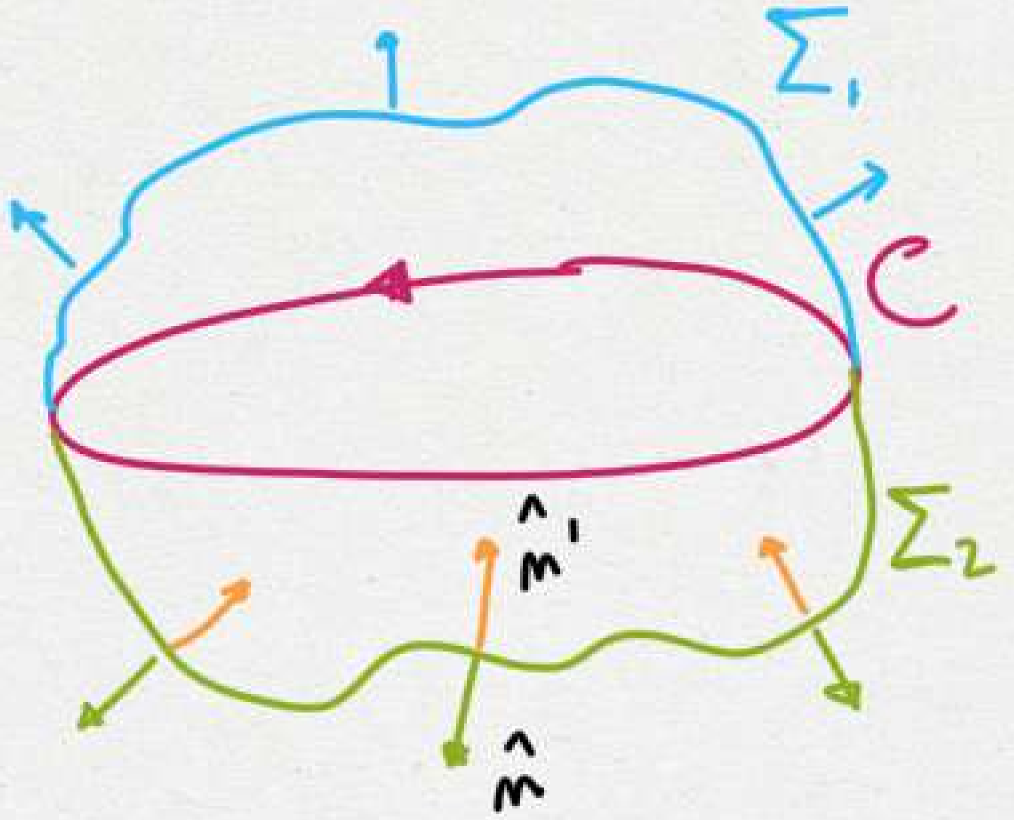


$$\oint_\Sigma \vec{B}\cdot\hat{n}\,d\Sigma = \int_{\tau(\Sigma)} \vec{\nabla}\cdot\vec{B}\,d\tau = 0 \Rightarrow$$

$$\vec{\nabla}\cdot\vec{B} = 0$$

$$\vec{\nabla}\cdot\vec{E} = \frac{\rho}{\varepsilon_0}$$





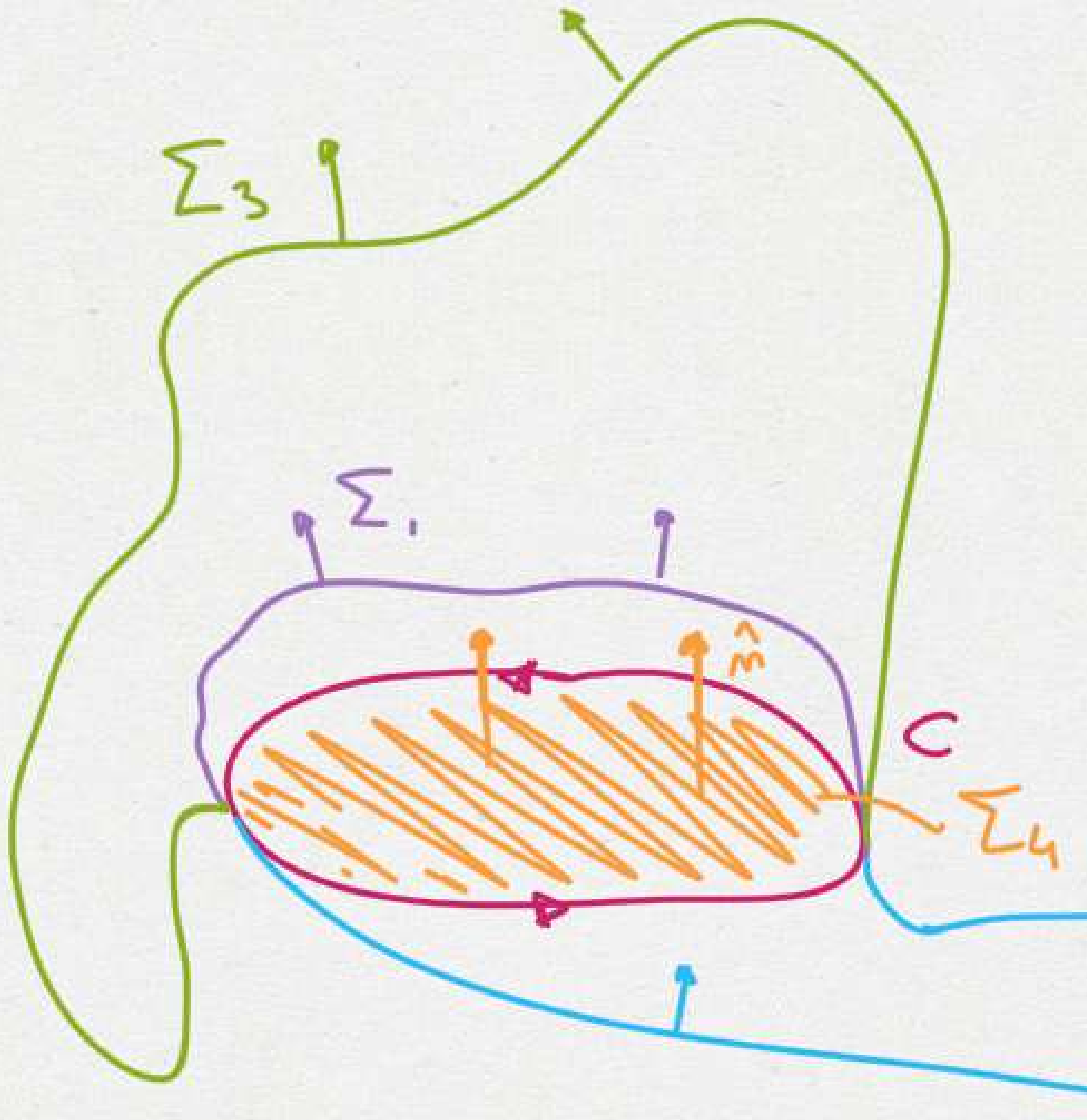
$$\oint_{\Sigma} \vec{B} \cdot \hat{n} \, d\Sigma = \Phi_{\Sigma_1}(\vec{B}) + \Phi_{\Sigma_2}(\vec{B}) = 0$$

$$\oint_{\Sigma_2} \vec{B} \cdot \hat{n}' \, d\Sigma = - \oint \vec{B} \cdot \hat{n} \, d\Sigma = - \Phi_{\Sigma_2}(\vec{B}) \equiv \Phi'_{\Sigma_2}(\vec{B})$$

$$\hat{n}' = - \hat{n}$$

$$\Rightarrow \Phi_{\Sigma_1}(\vec{B}) - \Phi'_{\Sigma_2}(\vec{B}) = 0 \Rightarrow$$

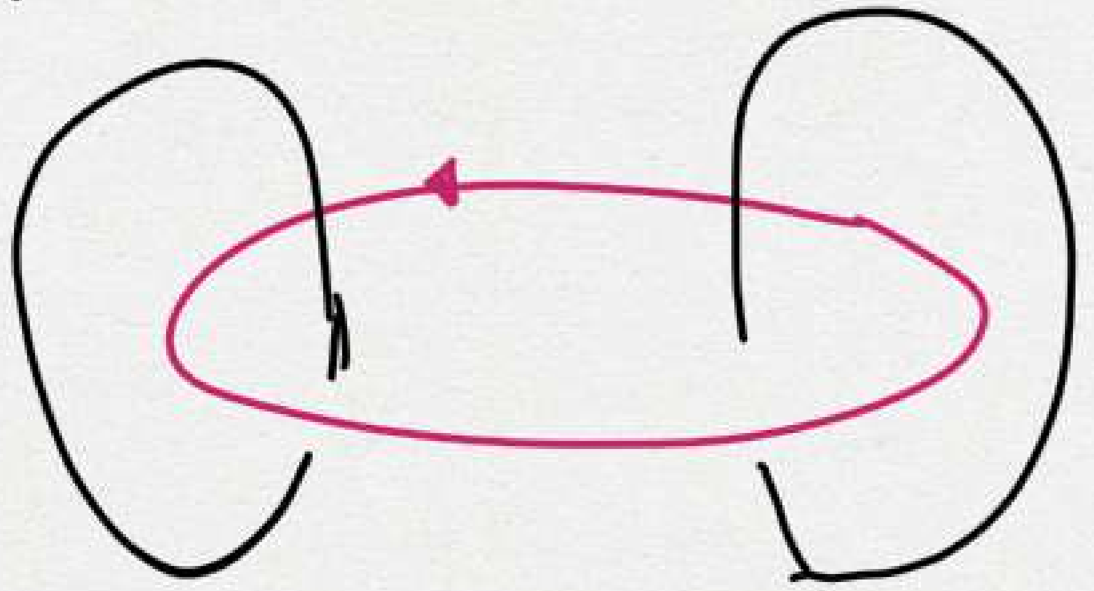
$$\Phi_{\Sigma_1}(\vec{B}) = \Phi'_{\Sigma_2}(\vec{B})$$



$$\Phi_{\Sigma_1} = \Phi_{\Sigma_2} = \Phi_{\Sigma_3}$$

FLUSSO CONCATENATO A C

per i campi solenoidali il flusso è una proprietà del cammino!



$$\oint_c \vec{B}\cdot d\vec{s} = \mu_0 (i + i_m) = \mu_0 \left(i + \oint_c \vec{M}\cdot d\vec{s}\right) \Rightarrow$$

$$\oint_c (\vec{B} - \mu_0 \vec{M})\cdot d\vec{s} = \mu_0 i \quad , \quad \vec{B} = \mu_0 (\vec{M} + \vec{H}) \Rightarrow \vec{B} - \mu_0 \vec{M} = \mu_0 \vec{H} \Rightarrow$$

$$\oint_c \cancel{\mu_0} \vec{H}\cdot d\vec{s} = \cancel{\mu_0} i \Rightarrow \oint_c \vec{H}\cdot d\vec{s} = i \longleftrightarrow \int_\Sigma \vec{D}\cdot \hat{n}\, d\Sigma = q_0$$

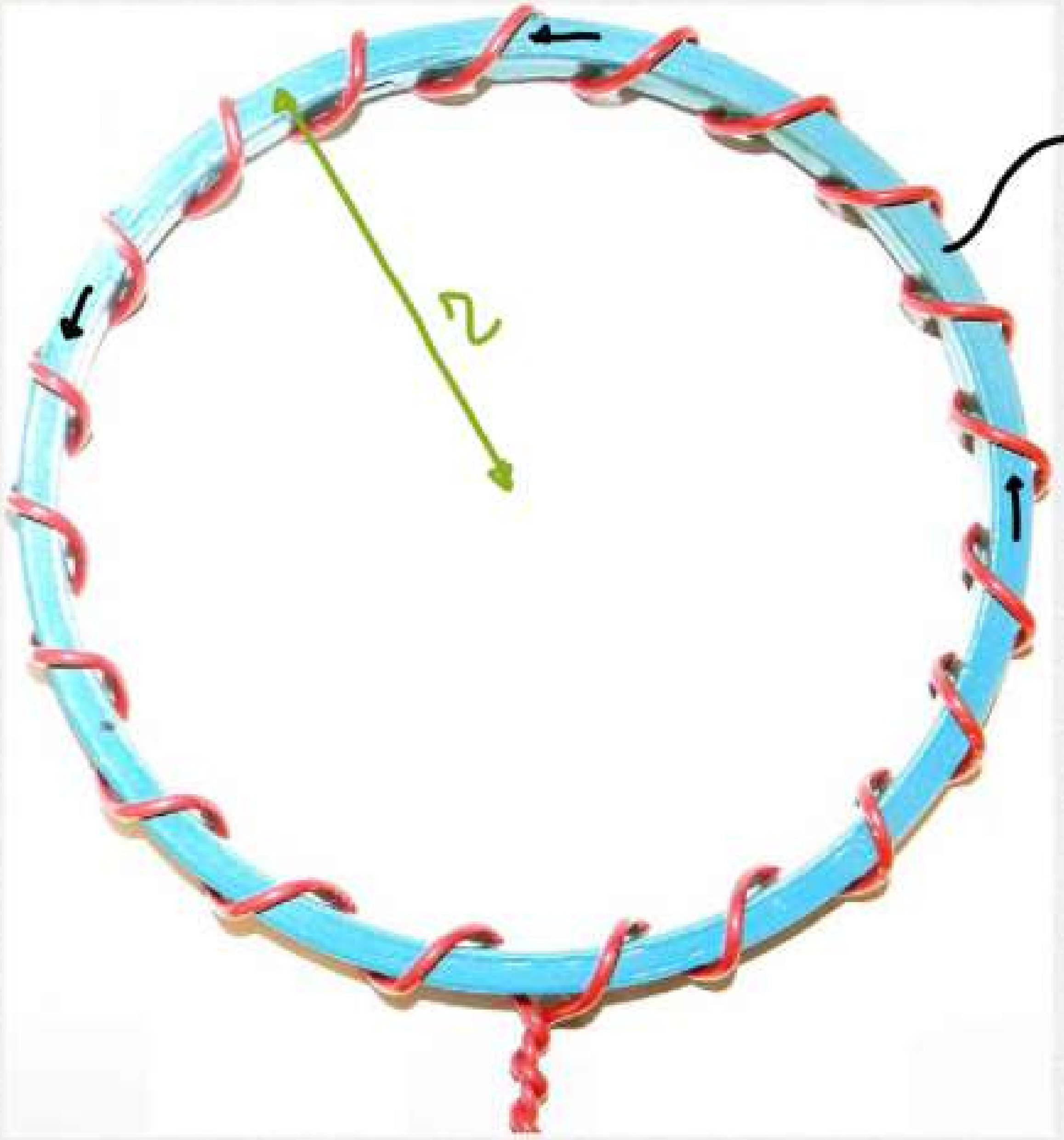
$$\oint_c \vec{H}\cdot d\vec{s} \underset{\uparrow \text{STOKES}}{=} \int_{\Sigma(c)} \vec{\nabla}\times\vec{H}\cdot\hat{n}\, d\Sigma = \int_{\Sigma(c)} \vec{J}\cdot\hat{n}\, d\Sigma \Rightarrow \vec{\nabla}\times\vec{H} = \vec{J}$$

① $\vec{\nabla} \times \vec{E} = 0$ ③ $\vec{\nabla} \times \vec{B} = \mu_0 \vec{J}$

② $\vec{\nabla} \cdot \vec{E} = \frac{\rho}{\varepsilon_0}$ ④ $\vec{\nabla} \cdot \vec{B} = 0$

$$\left.\begin{array}{l} ③ \rightarrow \vec{\nabla} \times \vec{H} = \vec{J} \\ ② \rightarrow \vec{\nabla} \cdot \vec{D} = \rho \end{array}\right\} \text{in presenza di materiali}$$

EQ. DI MAXWELL STATICHE



N SPIRE , i

K_m

① $\vec{H}, \vec{B}, \vec{M}$?

② $\vec{J}_m$?

$$B_0 = \frac{\mu_0 N i}{2\pi r} \quad , \quad H \equiv \frac{B_0}{\mu_0} = \frac{Ni}{2\pi r}$$

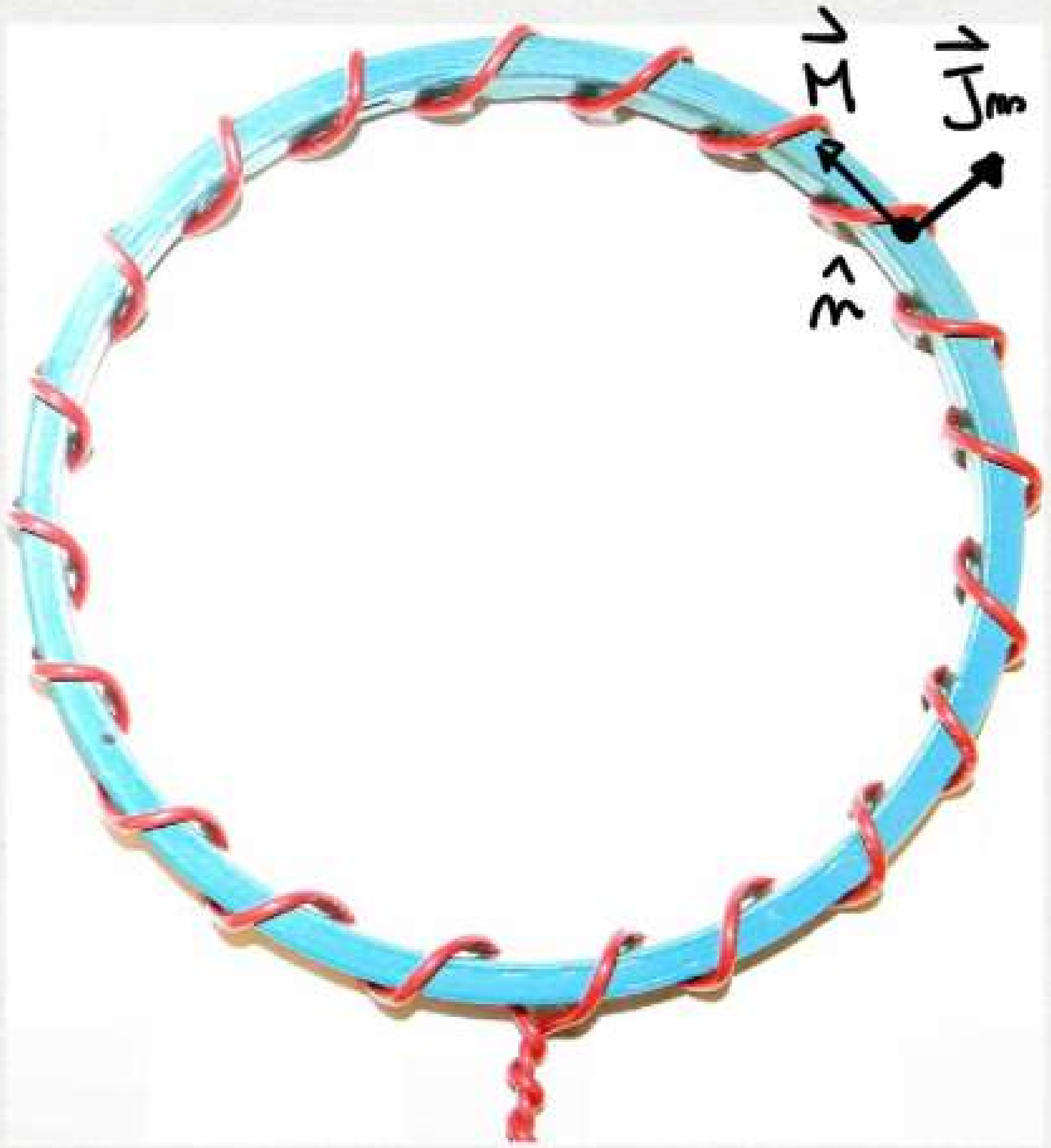
$$\oint_c \vec{H}\cdot d\vec{s} = H 2\pi r = Ni \Rightarrow H = \frac{Ni}{2\pi r}$$

$$B = K_m B_0 = \frac{\mu_0 K_m N i}{2\pi r} = \frac{\mu N i}{2\pi r}$$

$$B = \mu H = \frac{\mu N i}{2\pi r}$$

$$M = \chi_m H = (K_m - 1)\frac{Ni}{2\pi r}$$

$$B = \mu_0 (H + M)$$



$$\vec{J}_m = ?$$

$$i_m = \oint_C \vec{M}\cdot d\vec{l} = M\,2\pi r = \chi_m \frac{Ni}{2\pi r}\,2\pi r = \chi_m N i \Rightarrow$$

$$J_m = \frac{i_m}{2\pi r} \Rightarrow J_m = \chi_m \frac{Ni}{2\pi r} = M$$

$$\vec{J}_m = \vec{M}\times\hat{n} \Rightarrow J_m = M$$