Equazione di continuità della corrente

$$-dQ = \phi_S\, dt \rightarrow -dQ = \oint \vec{J}\cdot\hat{n}\, dS\; dt \rightarrow -\frac{dQ}{dt} = \oint \vec{J}\, \hat{n}\, dS$$

$$\rho = \frac{dQ}{dV} \Rightarrow \rho\, dV = dQ \rightarrow Q = \int \rho\, dV$$

$$-\frac{1}{dt}\int \rho\, dV = \oint \vec{J}\, \hat{n}\, dS$$

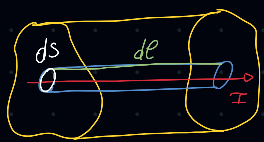
ρ è del tipo: $\rho(x,y,z,t) \Rightarrow \dfrac{d\rho}{dt} = \dfrac{\partial \rho}{\partial t}$

$$\Rightarrow -\int_V \frac{\partial \rho}{\partial t}\, dV = \oint \vec{J}\cdot\hat{n}\, dS \rightarrow \int \vec{A}\cdot\hat{n}\, dS = \int_V (\vec{\nabla}\vec{A})\cdot dV$$

$$\Rightarrow -\int_V \frac{\partial \rho}{\partial t}\, \cancel{dV} = \int_V (\vec{\nabla}\vec{J})\cdot \cancel{dV} \rightarrow -\frac{\partial \rho}{\partial t} = \vec{\nabla}\vec{J} \Rightarrow \vec{\nabla}\vec{J} + \frac{\partial \rho}{\partial t} = 0$$

Corrente stazionaria $\rightarrow \rho = \text{costante} \Rightarrow \dfrac{\partial \rho}{\partial t} = 0 \Rightarrow \vec{\nabla}\cdot\vec{J} = 0$

Come troviamo $I = \oint J\, \hat{n}\, dS$?



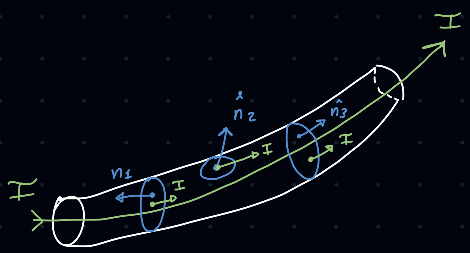
$$\rho = \frac{dQ}{dV} \rightarrow \rho\, dV = dQ \Rightarrow Q = \int_V \rho\, dV \quad (1)$$

$\rightarrow V = \underset{S}{b} \times \underset{l}{h} \Rightarrow dV = d\vec{S}\cdot dl \qquad d\vec{l} = \vec{v}\cdot dt \rightarrow dV = d\vec{S}(\vec{v}\cdot dt)$

$$\rightarrow (1) \rightarrow dQ = \rho\, dS\cdot \vec{v}\, dt \rightarrow \underbrace{\frac{dQ}{dt}}_{I} = \underbrace{\rho\, \vec{v}}_{\vec{J}}\, d\vec{S} \Rightarrow I = \vec{J}\cdot d\vec{S}$$

$$\rightarrow I = \oint \vec{J}\cdot\hat{n}\, dS$$

APPLICAZIONI



$$\phi_{TOT} = \phi_{\hat{n}_1} + \phi_{\hat{n}_2} + \phi_{\hat{n}_3}$$

$$= \oint_S \vec{J} \cdot \hat{n}_1 \, dS_1 + \cancel{\oint_S \vec{J} \cdot \hat{n}_2 \, dS_2} + \oint \vec{J} \cdot \hat{n}_3 \, dS_3$$

$J \cdot n \cdot \cos(\theta) = -J$

$\cos(\varphi) = \emptyset$ $\quad \vec{J} \perp \hat{n}$

$\vec{J}$

$$\rightarrow \phi = \cancel{-\oint J \, dS_1} + \cancel{\oint J \, dS_3} \qquad S_1 = S_2 \quad \Rightarrow \quad \phi = \emptyset$$

$$\hookrightarrow \oint J \, dS_1 = \oint J \, dS_2$$

Tanta I entra quanta esce