Equazione di continuità della corrente

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

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

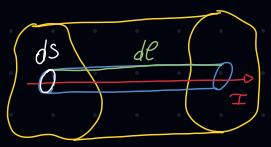
$$-\frac{1}{dt} \int \rho \, dV = \oint \vec{J} \, \hat{n} \, dS \qquad \rho \text{ è del tipo: } \rho(x,y,z,t) \Rightarrow \frac{d\rho}{dt} = \frac{\partial \rho}{\partial t}$$

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

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

Correnti stazionarie $\rightarrow$ ρ = costante $\Rightarrow \frac{\partial \rho}{\partial t} = 0 \Rightarrow \vec{\nabla} \cdot \vec{J} = 0$

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



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

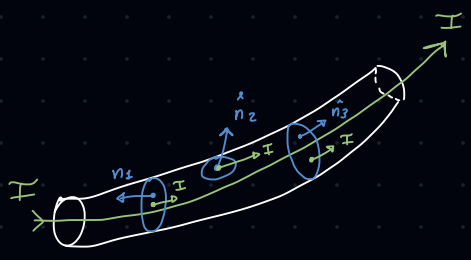
$$\rightarrow V = b \times h \Rightarrow dV = d\vec{S} \cdot de \qquad \vec{de} = \vec{v} \cdot dt \rightarrow dV = d\vec{S} \cdot (\vec{v} \cdot dt)$$

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

($\frac{dQ}{dt} = I$, $\rho \vec{v} = \vec{J}$)

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

APPLICAZIONI



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

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

$\vec{J} \cdot \hat{n} \cdot \cos(\theta) = -J$

$\cos(\varphi) = 0$, $\vec{J} \perp \hat{n}$

$\vec{J} = 0$

$$\Rightarrow \phi = -\oint J \, dS_1 + \oint J \, dS_3 \qquad S_1 = S_2 \Rightarrow \phi = 0$$

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

Tanta I entra quanta esce