

# Equazione di continuità della corrente

$$-dQ = \phi_s dt \rightarrow -dQ = \oint \vec{J} \cdot \hat{n} ds \frac{dt}{dt} \rightarrow -\frac{dQ}{dt} = \oint \vec{J} \cdot \hat{n} ds$$

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

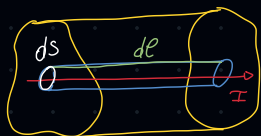
$$-\frac{1}{dt} \int \rho dV = \oint \vec{J} \cdot \hat{n} ds \quad \rho \text{ e' del tipo: } \rho(x, y, z, t) \Rightarrow \frac{d\rho}{dt} = \frac{\partial \rho}{\partial t}$$

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

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

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

Come Troviamo  $I = \oint \vec{J} \cdot \hat{n} ds$ ?



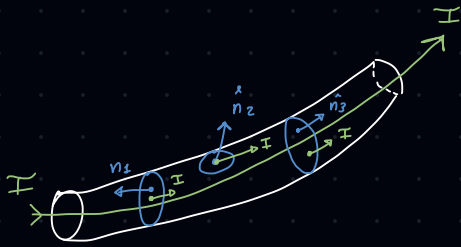
$$\rho = \frac{dQ}{dV} \rightarrow \rho dV = dQ \Rightarrow Q = \int_V \rho dV \quad (1)$$

$$\rightarrow V = \underbrace{\underbrace{b}_{S}} \times \underbrace{h}_{e} \Rightarrow dV = d\vec{S} \cdot d\vec{e} \quad \underline{d\vec{e} = \vec{v} \cdot dt} \rightarrow dV = d\vec{S} \cdot (\vec{v} \cdot dt)$$

$$\rightarrow (1) \rightarrow dQ = \rho ds \cdot \vec{v} \cdot dt \rightarrow \underbrace{\left(\frac{dQ}{dt}\right)}_I = \underbrace{\rho \vec{v}}_{\vec{J}} \cdot d\vec{S} \Rightarrow I = \vec{J} \cdot d\vec{S}$$

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

## APPLICAZIONI



$$\begin{aligned}\phi_{\text{TOT}} &= \phi_{\hat{n}_1} + \phi_{\hat{n}_2} + \phi_{\hat{n}_3} \\ &= \int_S \underbrace{\vec{J} \cdot \vec{n}_1}_{\substack{\downarrow \\ J \cdot n \cdot \cos(\theta) \\ = -J}} ds_1 + \int_S \underbrace{\vec{J} \cdot \vec{n}_2}_{\substack{\downarrow \\ \cos(\varphi)=0 \\ \vec{J} \perp \hat{n}}} ds_2 + \int_S \underbrace{\vec{J} \cdot \vec{n}_3}_{\substack{\downarrow \\ \vec{J}^0}} ds_3\end{aligned}$$

$$\Rightarrow \phi = -\int J ds_1 + \int J ds_3$$

$$\hookrightarrow \int J ds_1 = \int J ds_3$$

$$S_1 = S_3 \Rightarrow \phi = 0$$

Tanta I Entra  
quanta esce