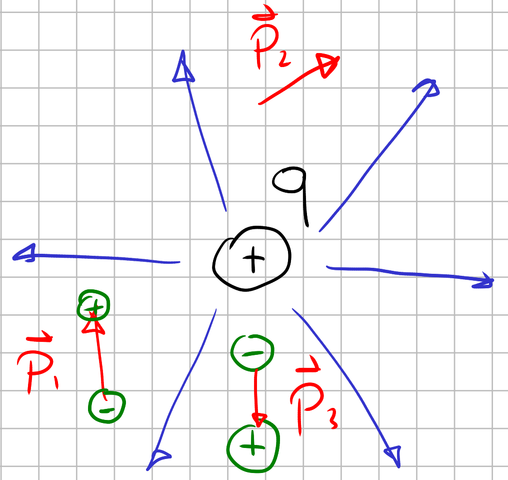
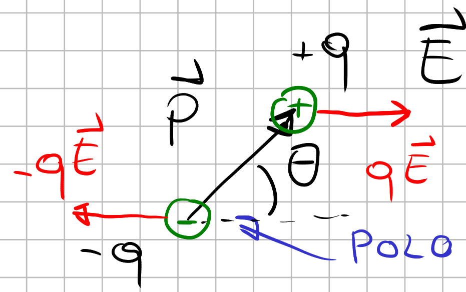
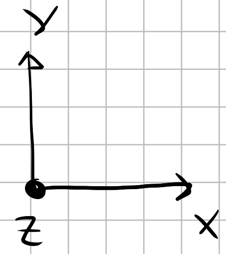
FORZE E MOMENTI SU DIPOLI



SEMPLIFICHIAMO $\longrightarrow$





$$\vec{M} = \vec{r} \times \vec{F} = \vec{a} \times \vec{F}_e = (\vec{a}) \times (q\vec{E}) =$$

$$= q\vec{a} \times \vec{E} = \vec{p} \times \vec{E} = -|\vec{M}|\,\hat{z} =$$

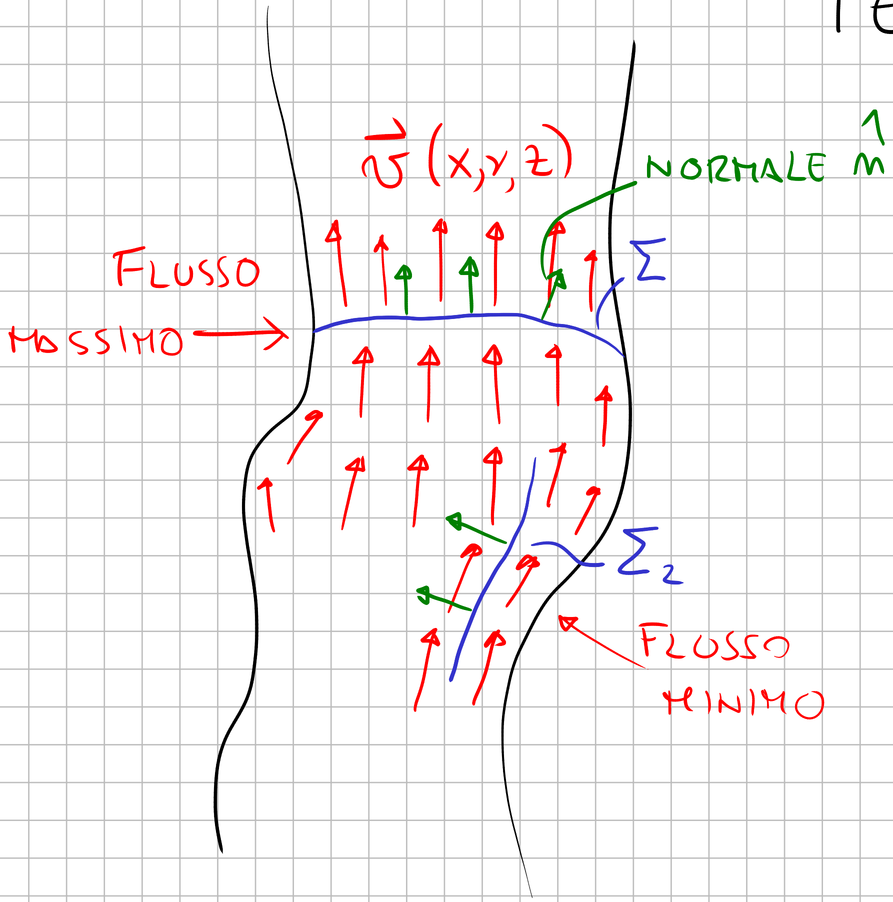
$$= -pE\sin\theta\,\hat{z}$$

$$W = \int_{\theta_0}^{\theta_1} M_z\, d\theta = -\int_{\theta_0}^{\theta_1} pE\sin\theta\, d\theta = -pE\int_{\theta_0}^{\theta_1} \sin\theta\, d\theta = pE\cos\theta\Big|_{\theta_0}^{\theta_1} =$$

$$= pE\cos\theta_1 - pE\cos\theta_0 = -\Delta U_e = -\left(U_e(\theta_1) - U_e(\theta_0)\right) \Rightarrow$$

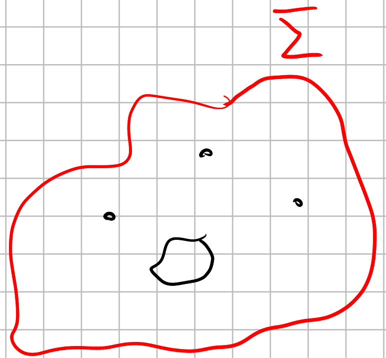
$$\boxed{U_e(\theta) = -pE\cos\theta = -\vec{p}\cdot\vec{E}}$$

TEOREMA DI GAUSS



$$\Phi_{\Sigma}(\vec{v}) = \iint_{\Sigma} \vec{v} \cdot \hat{n} \, d\Sigma$$

GAUSS PER $\vec{E}$



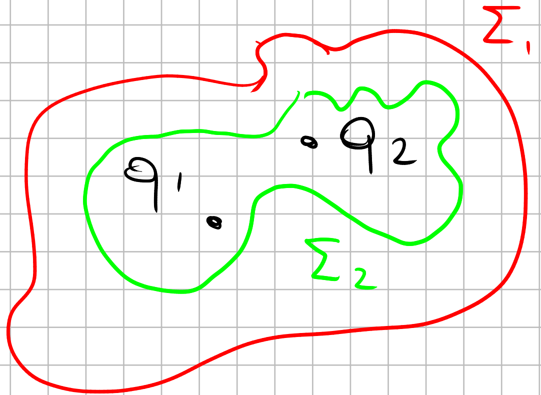
$$\Phi_{\Sigma}(\vec{E}) = \oiint_{\Sigma} \vec{E} \cdot \boxed{\hat{n}}\, d\Sigma = \frac{Q_{INT}}{\varepsilon_0}$$

NORMALE USCENTE

$$Q_{INT} = \sum_{i \in \tau(\Sigma)} q_i \quad , \quad Q_{INT} = \int_{\tau(\Sigma)} dq = \int_{\tau(\Sigma)} \rho\, d\tau$$

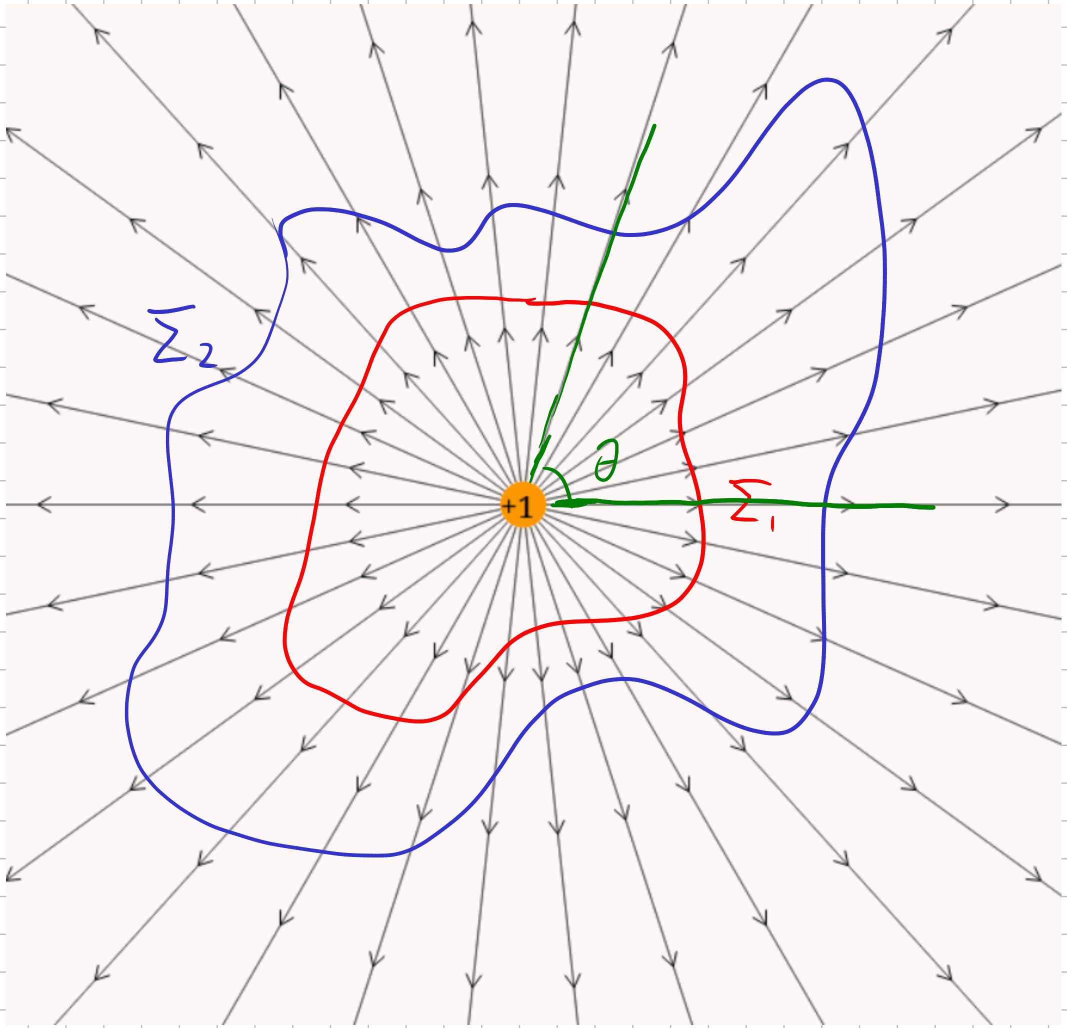
CASO DISCRETO

CASO CONTINUO

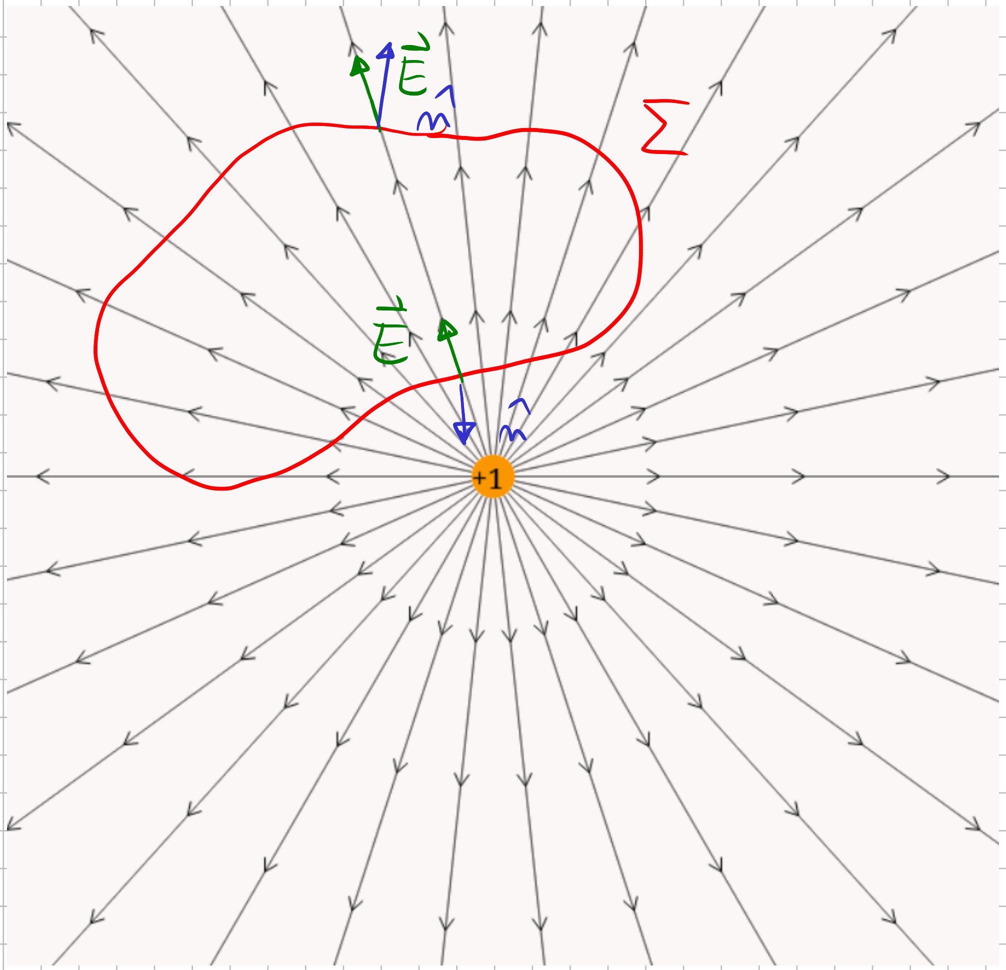


$$\Phi_{\Sigma_1}(\vec{E}) = \Phi_{\Sigma_2}(\vec{E}) = \frac{q_1 + q_2}{\varepsilon_0}$$

DIMOSTRAZIONE QUALITATIVA



$$\Phi_{\Sigma_1}(\vec{E}) = \Phi_{\Sigma_2}(\vec{E}) = \frac{q}{\varepsilon_0}$$



$$\Phi_{\Sigma}(\vec{E}) = 0$$

I EQUAZIONE DI MAXWELL

$$\oint_{\Sigma} \vec{E} \cdot \hat{n}\, d\Sigma = \int_{\tau(\Sigma)} \boxed{\vec{\nabla} \cdot \vec{E}}\, d\tau = \frac{Q_{INT}}{\varepsilon_0} = \frac{1}{\varepsilon_0} \int_{\tau(\Sigma)} \rho\, d\tau = \int_{\tau(\Sigma)} \boxed{\frac{\rho}{\varepsilon_0}}\, d\tau \Rightarrow$$

$$\vec{\nabla} \cdot \vec{E} = \mathrm{div}\, \vec{E}$$

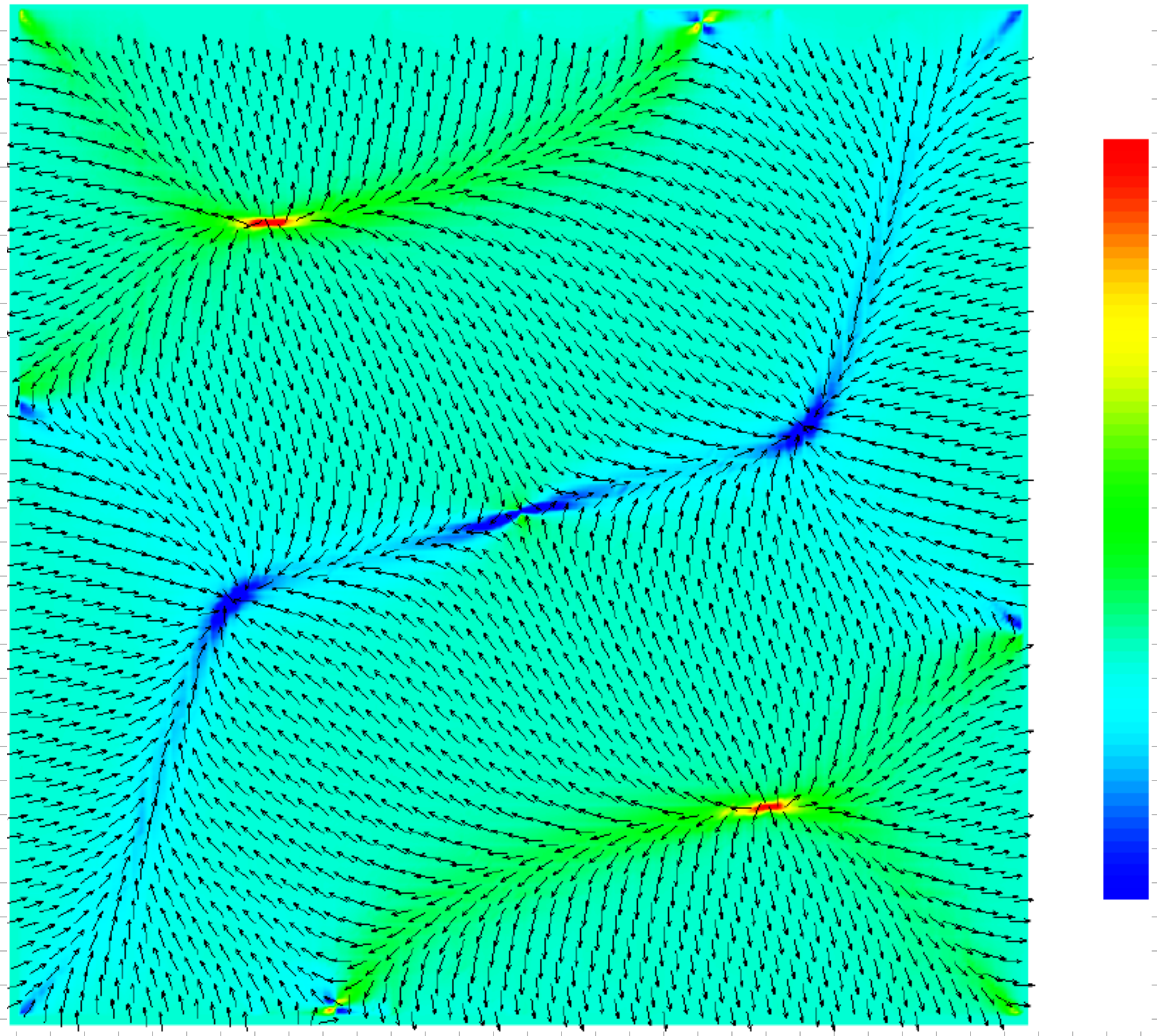
$$\vec{\nabla} \cdot \vec{E} = \mathrm{div}\, \vec{E} = \frac{\rho}{\varepsilon_0} \quad , \quad \mathrm{div}\, \vec{E} = \frac{\partial E_x}{\partial x} + \frac{\partial E_y}{\partial y} + \frac{\partial E_z}{\partial z} = \vec{\nabla} \cdot \vec{E}$$

$$\vec{\nabla} = \left(\frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial z} \right), \quad \vec{E} = (E_x, E_y, E_z)$$

$$\boxed{\vec{\nabla} \cdot \vec{E} = \frac{\rho}{\varepsilon_0}}$$ I legge di Maxwell

$$\vec{\nabla} \cdot (-\vec{\nabla} V) = -\nabla^2 V = \frac{\rho}{\varepsilon_0}, \quad \boxed{\nabla^2 V = -\frac{\rho}{\varepsilon_0}}$$ EQUAZIONE DI POISSON

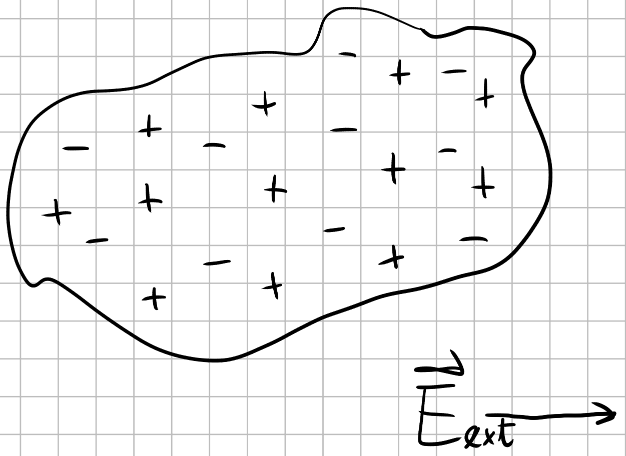
DIVERGENZA DI UN CAMPO



$\vec{\nabla} \cdot \vec{E}$

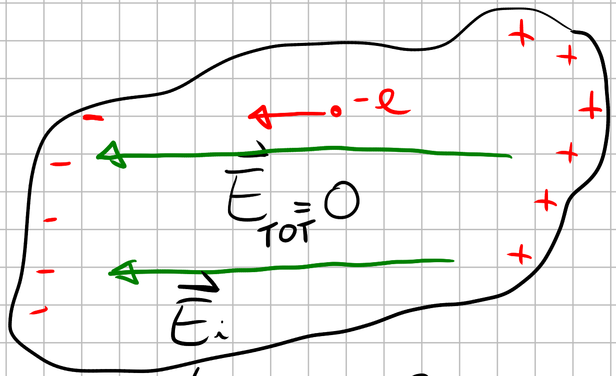
CONDUTTORI

Materiali in cui sono presenti cariche libere



- applicato il campo → PERIODO TRANSIENTE
- si genera un $\vec{E}_i$ la cui intensità aumenta cost
- all'equilibrio $\vec{E}_i = -\vec{E}_{ext} \Leftrightarrow \vec{E}_{TOT} = 0$

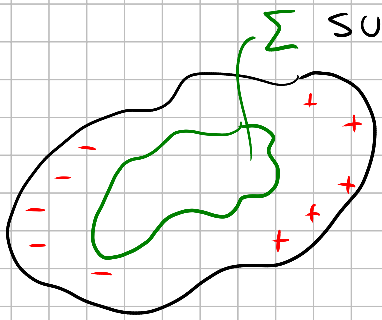
↑ NEL CONDUTTORE



↳ CAMPO INDOTTO

PROPRIETÀ DEI CONDUTTORI

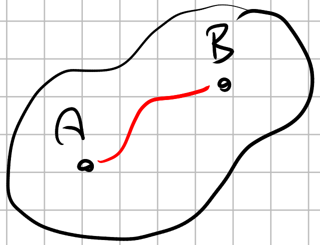
- $\vec{E}_{TOT} = 0$

- 

$$\Phi_\Sigma(\vec{E}) = \oint_\Sigma \vec{E}\cdot\hat{n}\, d\Sigma = 0 = \frac{Q_{INT}}{\varepsilon_0} \Rightarrow$$

$$Q_{INT} = 0$$

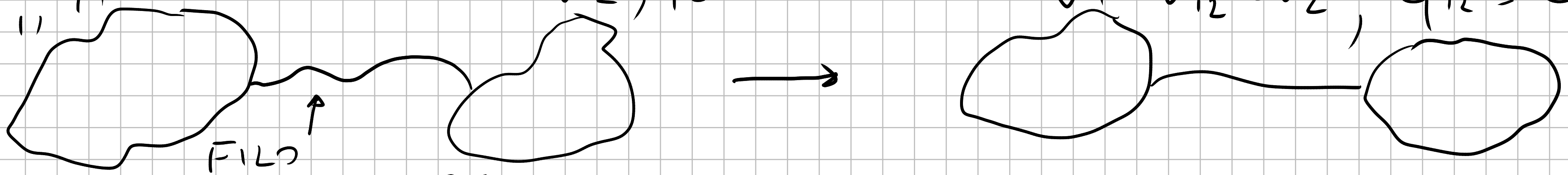
LE CARICHE SI DISPONGONO SULLE SUPERFICI

- 

$$V(A) - V(B) = \int_A^B \vec{E}\cdot d\vec{s} = 0 \Rightarrow V(A) = V(B)$$

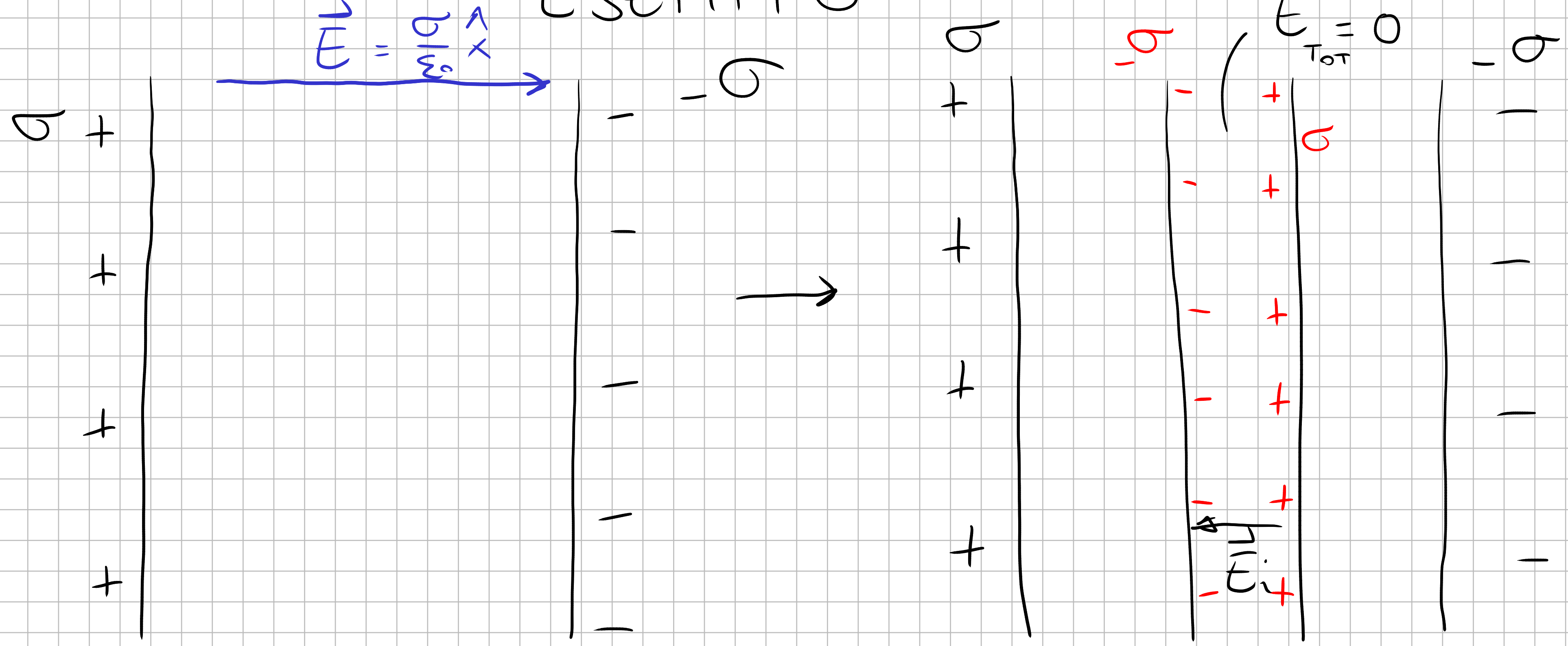
I CONDUTTORI SONO A POTENZIALE <u>COSTANTE</u> (<u>NON ZERO</u>)

V_1, q_1 $\quad$ V_2, q_2



$V_1 < V_{12} < V_2$, $q_{12} = q_1 + q_2$

ESEMPIO



$$\vec{E}_i = -\vec{E} \quad , \quad \Rightarrow \quad \vec{E}_i = -\frac{\sigma}{\varepsilon_0}\hat{x}$$

INDUZIONE COMPLETA