Università
degli Studi
di Padova

Fisica 1

Lezione 47: Capacità

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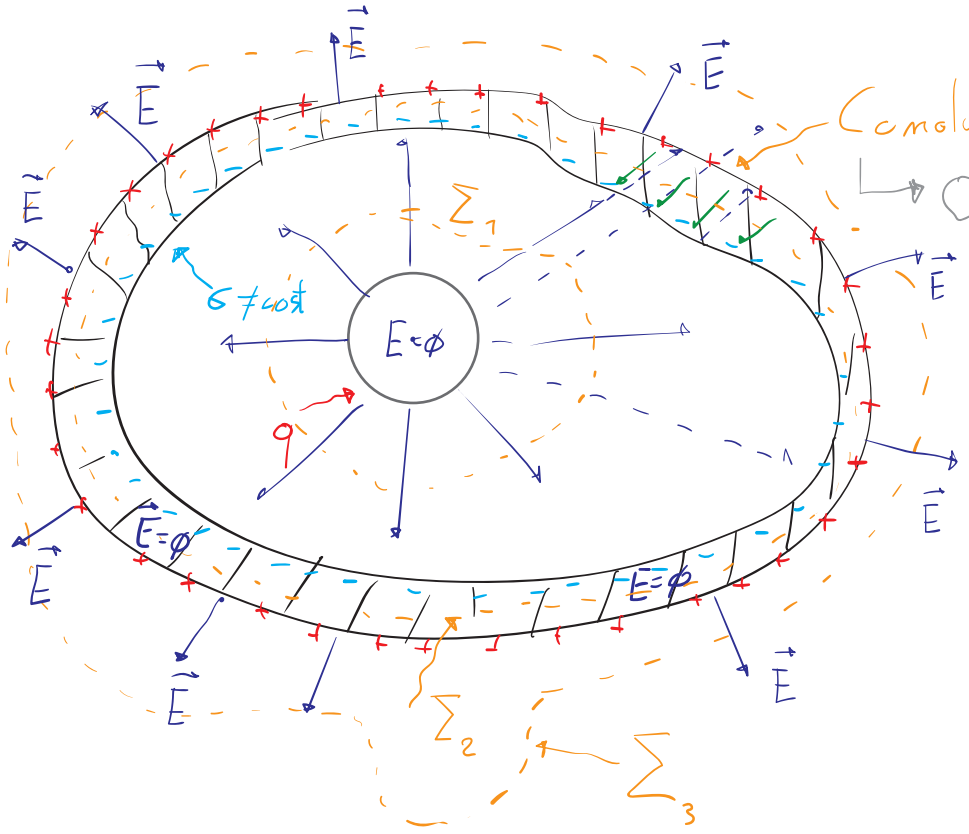
UNIVERSITÀ DEGLI STUDI DI PADOVA

Induzione completa



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

$$\Phi_{\Sigma_2}(\vec{E}) = \phi = \frac{q + \int \sigma}{\varepsilon_0} \Rightarrow \oint \sigma = -q$$

sup. interna

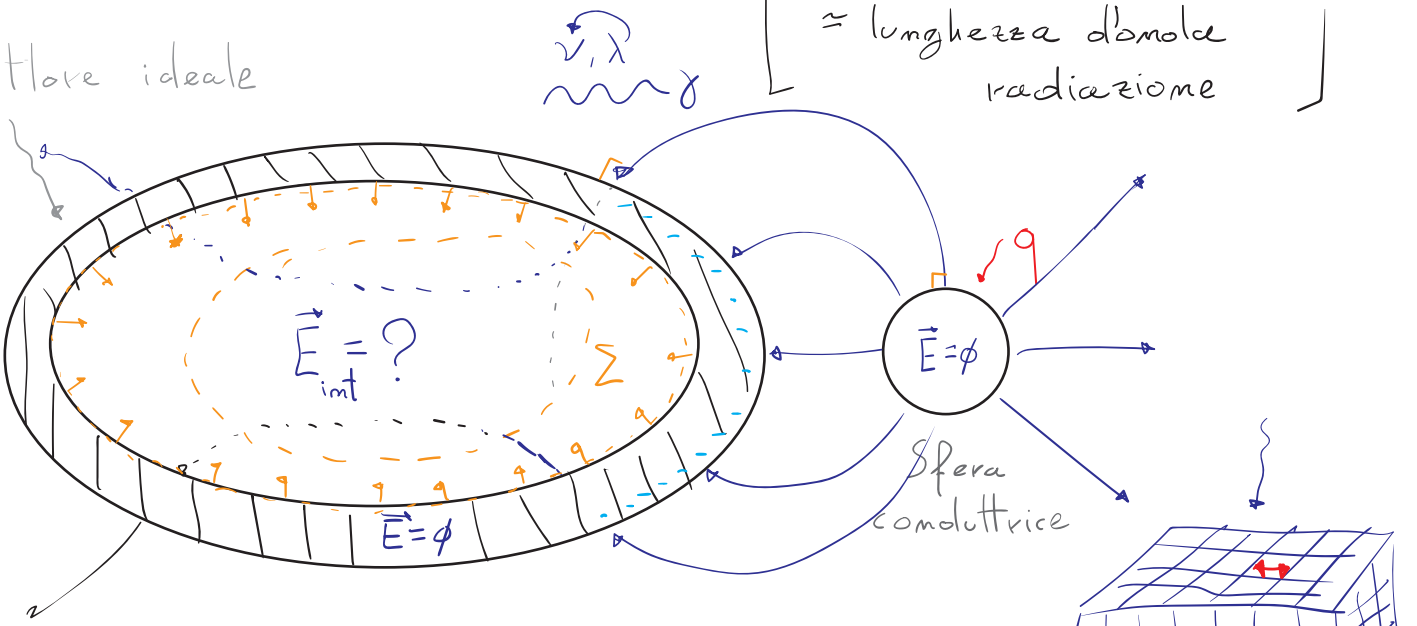
$$\Phi_{\Sigma_3}(\vec{E}) = q/\varepsilon_0 \Rightarrow \oint \sigma = q$$

sup. esterna

Schermo elettrostatico

[vero fintanto che non ci sono aperture $\simeq$ lunghezza d'onda radiazione]

Conduttore ideale



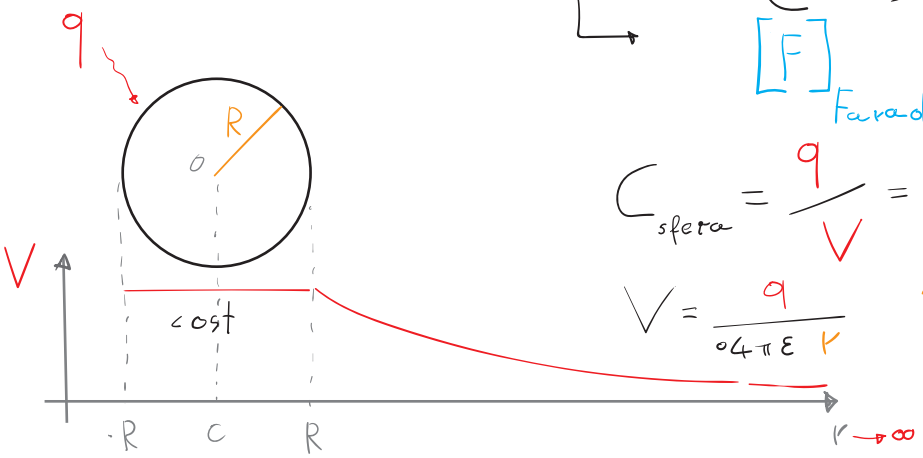
$$\Phi_{\Sigma}(\vec{E}) = \frac{q_{int}}{\varepsilon_0} = \phi$$

$$\vec{E}_{int} = \phi$$

Capacità

$$C = \frac{q}{V} \qquad [F]_{Farad}$$

$$1\,F_{arad} = \frac{1\,Coulomb}{1\,Volt}$$

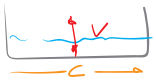


$$V = \frac{q}{4\pi\varepsilon r}$$

Solo geometria

$$C_{sfera} = \frac{q}{V} = \frac{q}{\frac{q}{4\pi\varepsilon_0 R}} = 4\pi\varepsilon_0 R = 4\pi\varepsilon R \quad [F]$$

proprietà del mezzo $\left[\frac{F}{m}\right]$



$$C = \frac{q}{V} \qquad V = \frac{q}{C} \qquad q = CV$$

$C \to \infty$, $V \to 0$

W necessario a caricare la sfera

q_T → carica finale sfera

$$W = \int_0^{q_T} V(q)\,dq = \int_0^{q_T} \frac{q}{4\pi\varepsilon_0 R}\,dq = \frac{1}{4\pi\varepsilon_0 R}\int_0^{q_T} q\,dq = \frac{1}{2}\left(\frac{1}{4\pi\varepsilon_0 R}\right) q_T^2$$

$\frac{1}{C_{sfera}}$

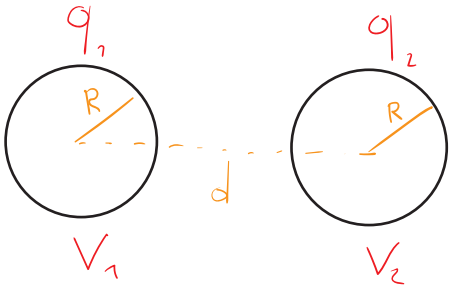
0 → carica iniziale sfera

$$= \frac{1}{2}\frac{Q^2}{C}$$

Energia immagazzinata → $\frac{1}{2}\frac{q^2}{C} = \frac{1}{2}\frac{(CV)^2}{C} = \frac{1}{2}CV^2$

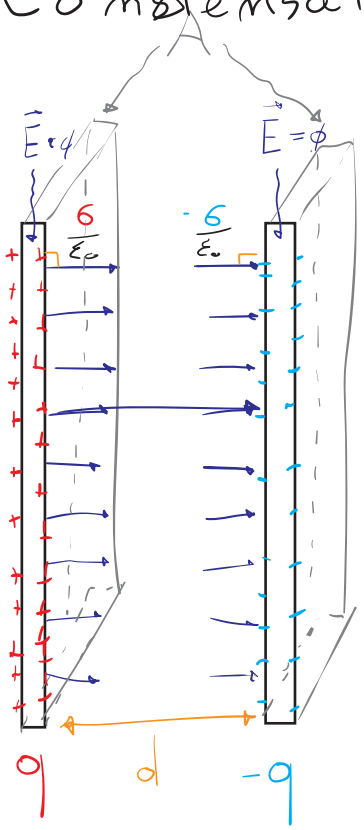
Energia elettrostatica

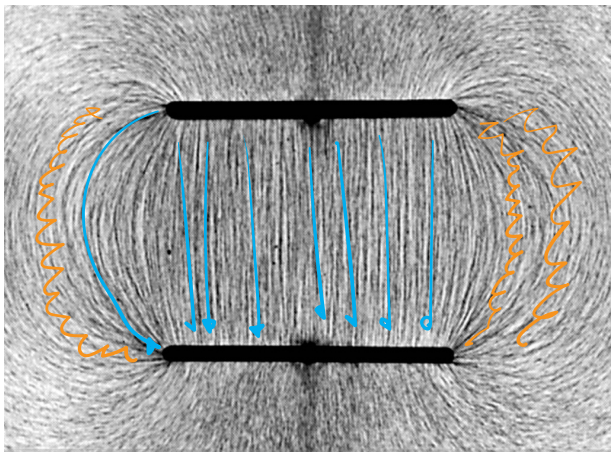
$C_{sfera} = 4\pi\varepsilon_0 R$



$= 4\pi\, 8.85 \cdot 10^{-12} \frac{F}{m}\, 0.1\,m \simeq 10^{-11}\,F \simeq 10\,pF$

Condensatore piano





$$\sigma = \frac{q}{2A}$$

$$\sigma = \frac{-q}{2A}$$

$$\vec{E}_{int} = \vec{E}_+ + \vec{E}_- = \frac{\sigma}{\varepsilon_0} + \frac{\sigma}{\varepsilon_0} = \frac{q}{2A\varepsilon_0} + \frac{q}{2A\varepsilon_0} = \frac{q}{A\varepsilon_0}$$