Università degli Studi di Padova

# Fisica 1

## Lezione 43: Th. Gauss e dintorni

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# Th. Gauss

Non dipende dalla geometria!

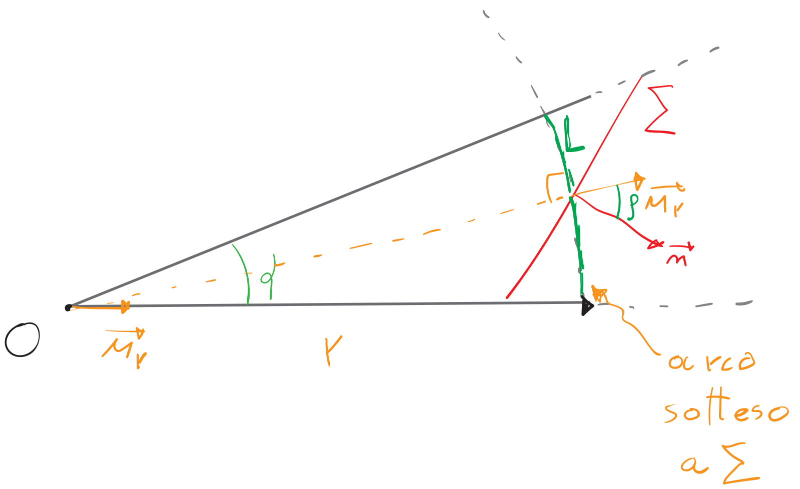
$$\phi(\vec{E}(r)) = 4\pi K q = \boxed{q/\varepsilon_0} \quad , \quad K = \frac{1}{4\pi\varepsilon_0}$$

Sfera

$\varepsilon_0 \rightarrow \simeq 8.85 \cdot 10^{-12}$ [F/m]

costante dielettrica vuoto

## Angolo sotteso segmento

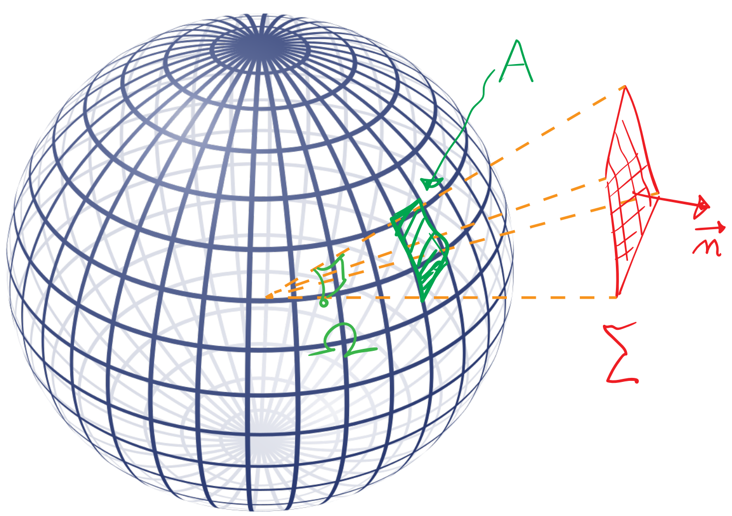



$$L = \Sigma \cos\rho = r\vartheta$$

$$= \Sigma\, \vec{n} \cdot \vec{u}_r = r\vartheta$$

$$\vartheta = \frac{\Sigma\, \vec{n}\, \vec{u}_r}{r}$$

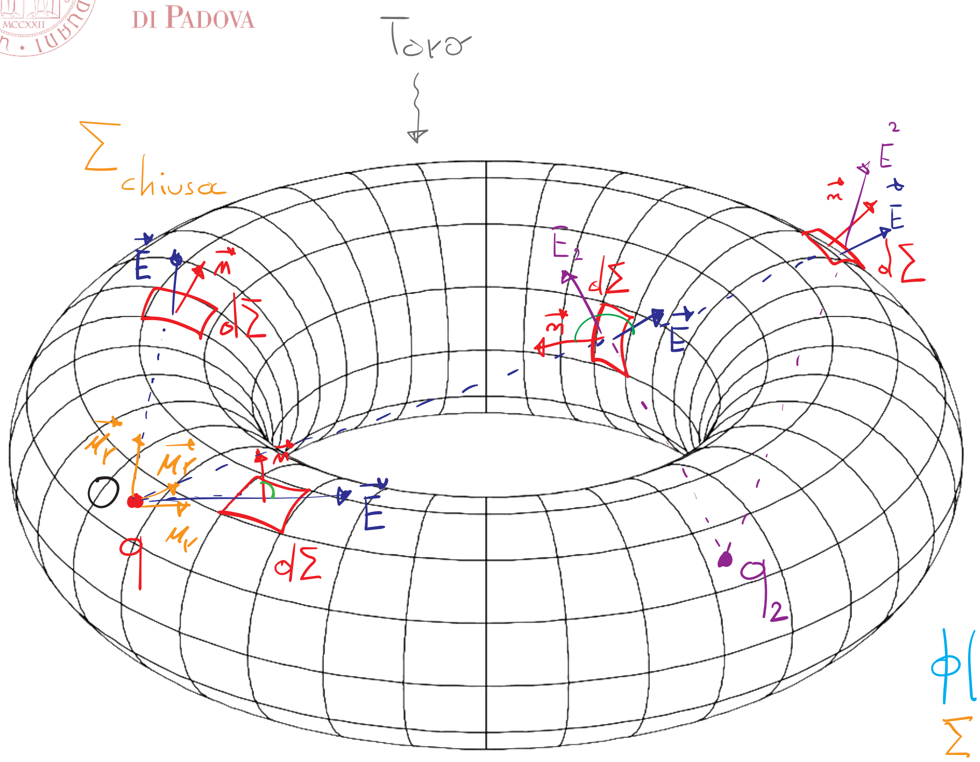
## Angolo solido sotteso superficie Σ




$$\Omega = \frac{\Sigma\, \vec{n}\, \vec{u}_r}{r^2}$$

angolo solido sotteso a Σ

$$d\Omega = \frac{d\Sigma\, \vec{n}\, \vec{u}_r}{r^2}$$




$$\underset{\Sigma}{\phi}(\vec{E})$$

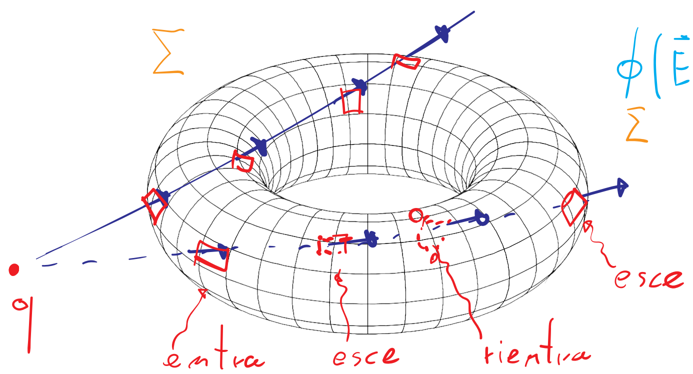
$$d\phi(\vec{E}) = Kq\,\frac{d\Sigma\,\vec{n}\cdot\vec{u}_r}{r^2}$$

$$\underset{\Sigma}{\phi}(\vec{E}) = d\phi(\vec{E})$$

$$\underset{\Sigma}{\phi}(\vec{E}) = \oiint_{\Sigma} Kq\,\underbrace{\frac{d\Sigma\,\vec{n}\cdot\vec{u}_r}{r^2}}_{d\Omega}$$

dipende solo da $\Omega$
↳ vale per ogni superficie !!

$$\underset{\Sigma}{\phi}(\vec{E}) = Kq \oiint_{\Omega = 4\pi} d\Omega = Kq4\pi = \frac{4\pi}{4\pi\varepsilon_0}q = \frac{q}{\varepsilon_0}$$




$$\underset{\Sigma}{\phi}(\vec{E}) = 0$$

$$\boxed{\underset{\Sigma}{\phi}(\vec{E}) = \frac{q_{\text{interno}\,\Sigma}}{\varepsilon_0}}$$

$\sum q_i \in \Sigma$

Gauss

Principio di sovrapposizione $\Rightarrow \underset{\Sigma}{\phi}(\vec{E}) = \dfrac{\sum_i q_i}{\varepsilon_0}$

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$q$ $[C]$ carica $\qquad q_0 \simeq 1.6 \cdot 10^{-19}\, C$

$$\vec{E}_{\text{carica puntiforme}} = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}\vec{u}_r$$

↳ costante dielettrica vuoto $\simeq 8.85 \cdot 10^{-12}\ [F/m]$

$$\vec{E} = -\nabla V \qquad \vec{F} = q\vec{E}$$

$$V = \int \vec{E}\, d\vec{s} \qquad U_e = qV$$

(insieme di più cariche $U_{e_{TOT}} = \frac{1}{2}\sum_{i,j} U_{i,j}$)

$$\phi_\Sigma(\vec{E}) = \frac{q}{\varepsilon_0}$$

interna a $\Sigma$

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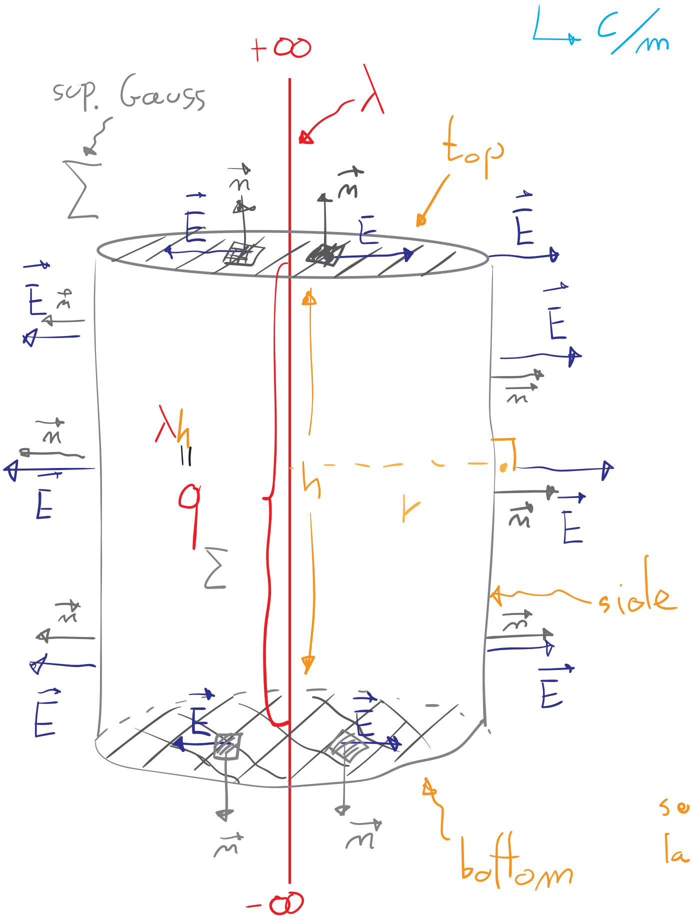
# Filo carico

$\lambda$ = densità di carica lineare

↳ $C/m$




$$\phi_\Sigma(\vec{E}) = \oint_\Sigma \vec{E}\cdot d\vec{\Sigma}$$

costante sulla parete

$$= \underbrace{\oint_{top} \vec{E}\cdot d\vec{\Sigma}}_{\emptyset} + \underbrace{\oint_{bottom} \vec{E}\cdot d\vec{\Sigma}}_{\emptyset} + \oint_{pareti} \vec{E}\cdot d\vec{\Sigma}$$

$$= \oint_{pareti} \vec{E}\cdot d\vec{\Sigma} = \oint_{pareti} E\, d\Sigma = E \oint_{pareti} d\Sigma$$

$\vec{E} \parallel \vec{n}$ se tutta la parete

$$\frac{\lambda h}{\varepsilon_0} = \frac{q}{\varepsilon_0} = \phi_\Sigma(E) = E\, 2\pi r h$$

$$E = \frac{\lambda}{2\pi r \varepsilon_0} = \frac{2K\lambda}{r}$$

# Conduttori

↳ cariche libere di muoversi

Semiconduttori

Isolanti → cariche non si muovono

Elettrostatica → cariche sono $\boxed{\text{ferme}}$

↳ $\sum_i F_i = 0$

?

Ampere

$[C] = [A \cdot s]$

↳ Corrente