Università
degli Studi
di Padova

Fisica 1

Lezione 41: Campo e potenziale E

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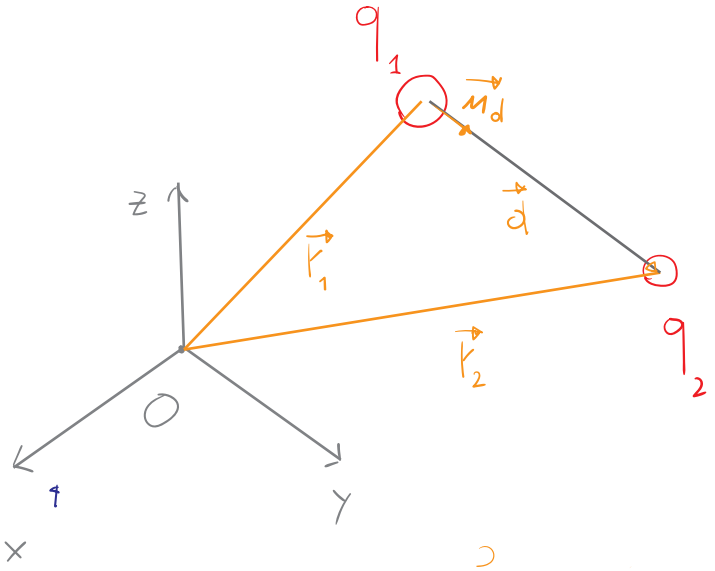
Campo Elettrico

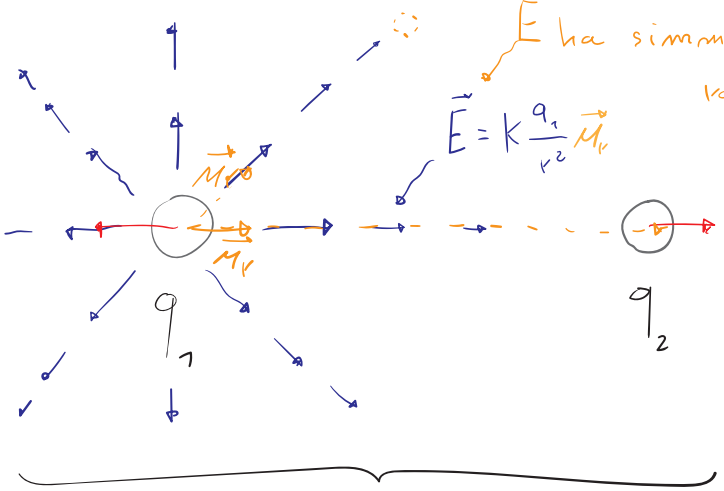


$$\vec{d} = \vec{r}_2 - \vec{r}_1 \qquad \vec{u}_d = \frac{\vec{r}_2 - \vec{r}_1}{|\vec{r}_2 - \vec{r}_1|}$$

$$\vec{F} = K \frac{q_1 q_2}{d^2} \vec{u}_d$$

$$\vec{F} = \left(K \frac{q_1}{d^2} \vec{u}_d \right) q_2$$

per carica singola $\vec{E}$ ha simmetria radiale



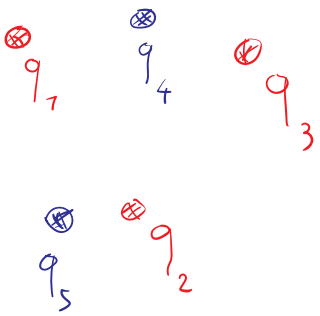
$$\vec{F} = \vec{E} q_2$$

$$\left[\frac{N}{C} \right] \text{ Campo Elettrico}$$

Principio di sovrapposizione

$\rightarrow \sum$ vettoriale

$\rightarrow \sum$ per componente



- $\vec{E} = ?$

$$= \vec{E}_1 + \vec{E}_2 + \vec{E}_3 + \vec{E}_4 + \vec{E}_5$$

Potenziale V o φ

Scalare

$$V = -\int \vec{E}\, d\vec{s} + K$$

$$V \equiv -K\frac{q}{r}$$

↓ carica puntiforme o a simmetria sferica

$$\vec{E} = -\nabla V$$

↳ gradiente

$$\nabla \rightarrow \begin{pmatrix} \partial/\partial x \\ \partial/\partial y \\ \partial/\partial z \end{pmatrix}$$

$$[E] = [N/C]$$

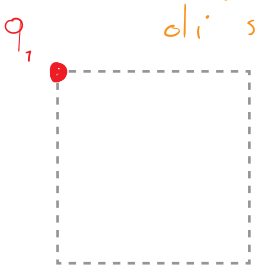
$$[V] = \left[\frac{Nm}{C}\right] = [J/C]$$

Energia potenziale Elettrostatica

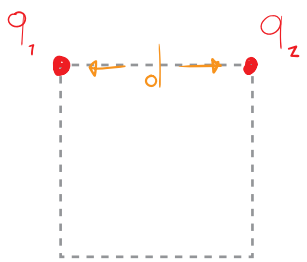
$$U_e = qV \quad [C\,\tfrac{J}{C}] = [J]$$

↓ principio di sovrapposizione

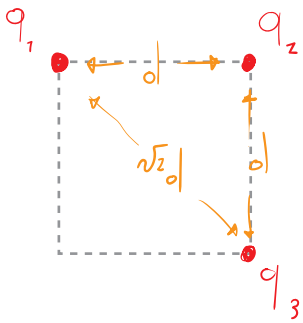
$$U_e = \frac{1}{2}\sum_{i=1}^{N}\sum_{j=1, j\neq i}^{N} K\frac{q_i q_j}{d_{ij}}$$



$$U_1 = \phi$$

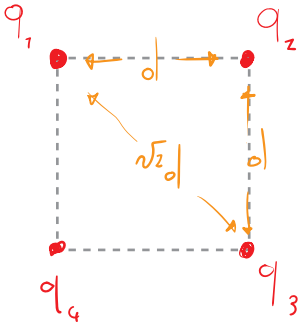


$$U_2 = -K\frac{q_1}{d}q_2$$



$$U_2 = -K\frac{q_1}{d}q_2$$

$$U_3 = -K\frac{q_1}{\sqrt{2}d}q_3 - K\frac{q_2}{d}q_3$$



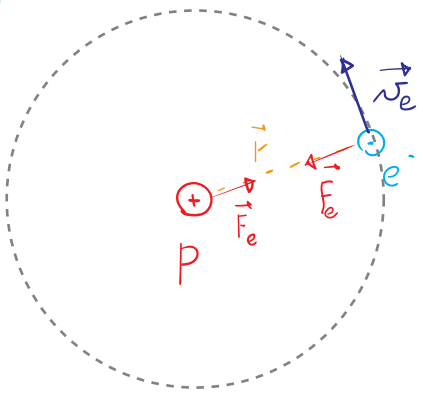
$$U_2 = -K\frac{q_1}{d}q_2$$

$$U_3 = -K\frac{q_1}{d}q_3 - K\frac{q_2}{\sqrt{2}d}q_3$$

$$U_4 = -K\frac{q_1}{d}q_4 - K\frac{q_2}{\sqrt{2}d}q_4 - K\frac{q_3}{d}q_4$$

Ex: atomo di Bohr

H



$q_p = +1.6 \cdot 10^{-19}\,C$

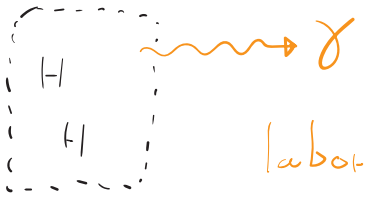
$q_{e^-} = -1.6 \cdot 10^{-19}\,C$

$m_e \simeq 9 \cdot 10^{-31}\,Kg$

$$\begin{cases} U = U_e + E_K = -K\dfrac{q^2}{r} + \dfrac{1}{2} m_e v_e^2 \\ |\vec{F}_e| = |\vec{F}_c| \quad K\dfrac{q^2}{r^2} = m_e \dfrac{v_e^2}{r} \end{cases}$$

F_e $\quad$ F_c

$U \equiv E$ fotone



laboratorio ← $U = -K\dfrac{q^2}{r} + \dfrac{1}{2}K\dfrac{q^2}{r} = -\dfrac{1}{2}K\dfrac{q^2}{r}$

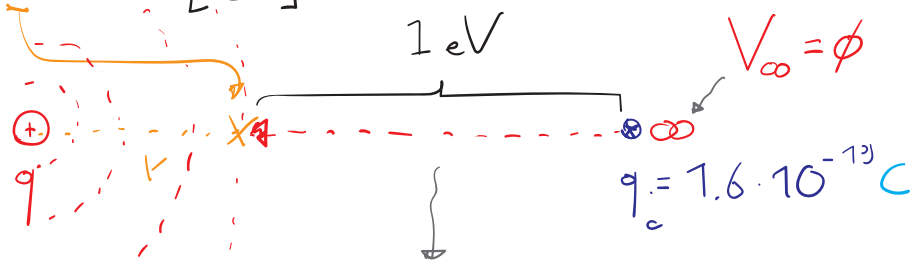
chiuso legato

$U < 0$

$U \simeq 13.6\,[eV]$

linee equipotenziali

$V = 1\left[\dfrac{J}{C}\right] \equiv 1V$



$U_e = V_q$

$1eV = 1.6 \cdot 10^{-19}\,J$

Lavoro (energia) necessaria ad portare $1e^-$ al potenziale di $1V \equiv 1\,J/C$

$$r = \frac{1}{2}K\frac{q^2}{U}$$

$$= \frac{1}{2} 9 \cdot 10^9 \frac{(1.6 \cdot 10^{-19})^2}{13.6 \cdot 1.6 \cdot 10^{-19}}$$

$$= \frac{4.5}{13.6} 10^{9} \cdot 1.6 \cdot 10^{-19}$$

$$\simeq 0.5 \cdot 10^{-10}\,m$$

$$\simeq 0.5\,\text{Å}$$

Ångström