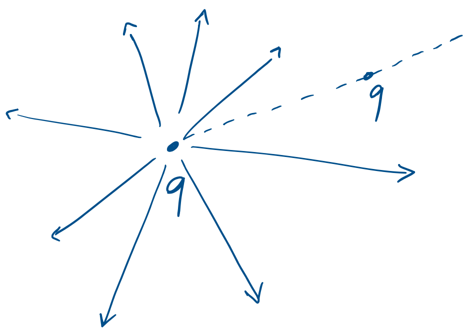
Lezione #13

16/04/2025

$$F_c = \frac{1}{4\pi\varepsilon_0}\,\frac{q_1 q_2}{r_{12}^2}$$

Cariche pTiformi



Campo elettrico: deformazione dell'universo ad opera di una carica in un pTo dello spazio

attrazione

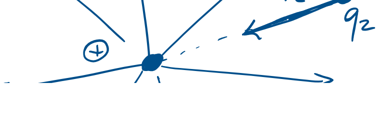
repulsione

$$\boxed{\vec{E} = \frac{\vec{F_c}}{q}}$$

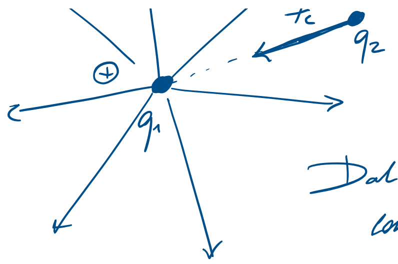
$$[E] = \frac{N}{C}$$

Come lo misuriamo $\vec{E}$ in un pTo?

$$E_1 = F_c / q$$



$$E_1 = F_c / q_2$$



$$E_1 = F_c / q_2$$

Dal momento che q_2 genera un campo anch'esso $\Rightarrow q_2 \ll q_1$

$\Rightarrow E_2 \ll E_1$ $\cancel{E_2}$

Se q_2 piccola $E_1 = \frac{F_c}{q_2} = \frac{1}{4\pi\varepsilon_0} \frac{q_1 \cancel{q_2}}{r_{12}^2} \frac{1}{\cancel{q_2}}$

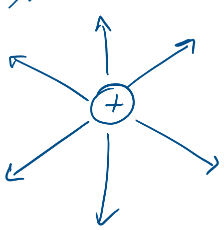
Per una carica puntiforme

$$\boxed{E = \frac{1}{4\pi\varepsilon_0} \frac{q}{r^2}}$$

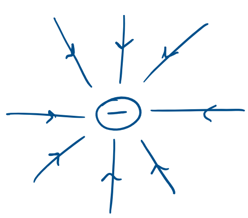
Modulo

LINEE DI FORZA DEL CAMPO ELETTRICO:

1) Densità delle linee di forza è $\propto$ all'intensità del campo
2) Una linea d.f. esce sempre da ⊕



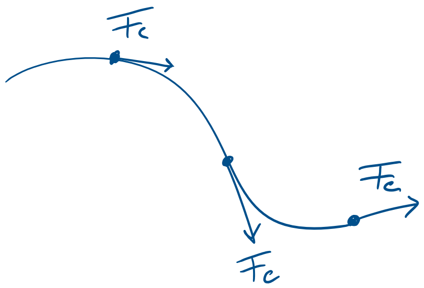
ed entra sempre in una ⊖



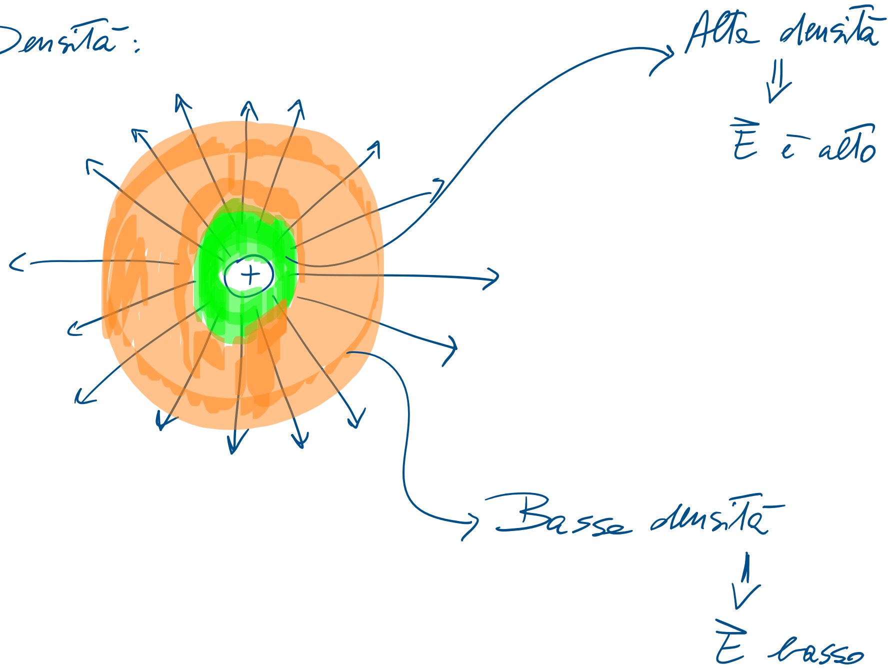
Non si possono MAI intersecare

3) La Tg ad ogni linea rappresenta direzione e verso della F in quel pto

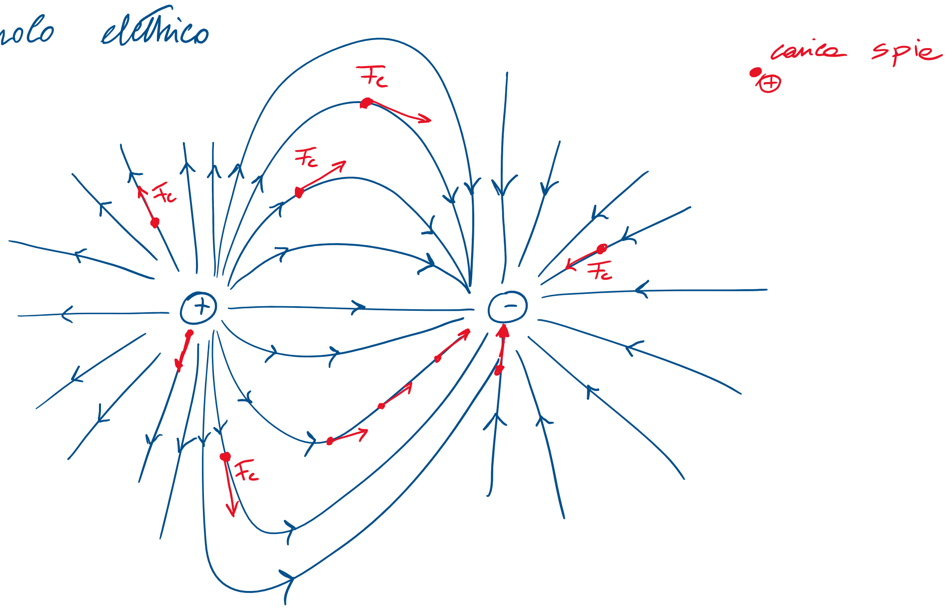
F_c in quel pto

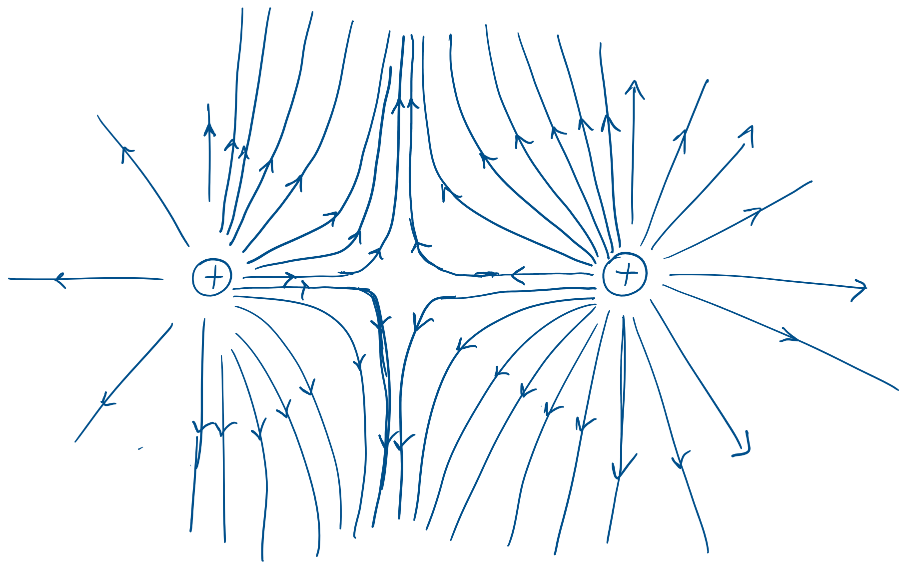


Densità:



Dipolo elettrico

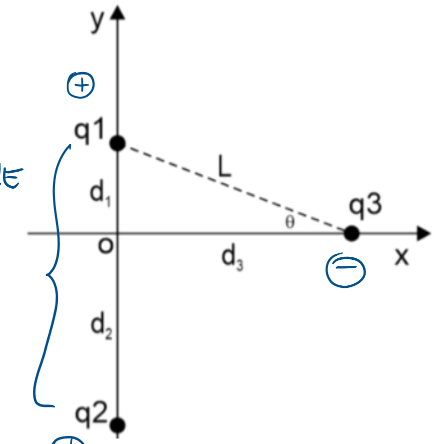




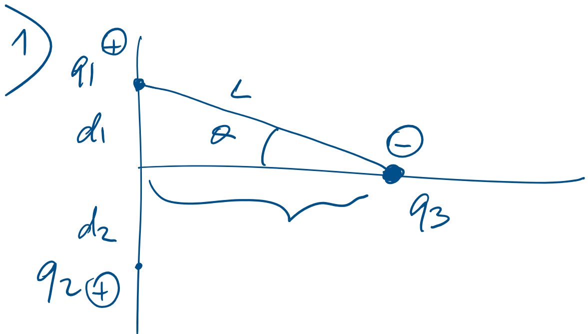
Esercizio:

Tre cariche puntiformi q1, q2 e q3, sono tenute ferme nella configurazione riportata in figura. Le cariche valgono: $q1 = q2 = 3.20 \cdot 10^{-19}$ C e $q3 = -2q1$. Le cariche q1, q2 e q3 sono distanti d1, d2 e d3 dall'origine degli assi O. La lunghezza L = 3 cm, l'angolo $\theta = 30^{\circ}$ e d2 = 2.5 cm. [Si ricorda che $1/(4\pi\varepsilon_0) = 8.99 \cdot 10^9$ N m^2/C^2]. Calcolare:

1. La Forza di Coulomb esercitata dalla carica q2 sulla carica q1.
2. Disegnare le linee di forza dei campi elettrici generati dalle 3 cariche.
3. Il modulo del campo elettrico totale generato da TUTTE LE CARICHE ~~q1 e q2 nel punto (trascurare la presenza della carica q3) nel punto O.~~
4. ~~... il campo elettrico calcolato al punto 3 sia nullo.~~
5. ~~Il modulo del campo elettrico nell'origine degli assi quando si considera anche q3.~~



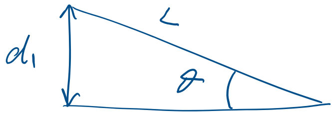
1)



$$F_{12} = \frac{1}{4\pi\varepsilon_0} \frac{|q_1||q_2|}{r_{12}^2}$$

$\uparrow$ $\quad \hookrightarrow ?$

$r_{12} = d_1 + d_2$ $\qquad d_1 = ?$



$d_1 = L \sin\theta$ ✓

$r_{12} = L \sin\theta + d_2 = 0{,}03 \sin(30°) + 0{,}025$

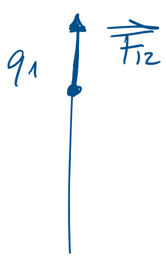
$$\boxed{r_{12} = 0{,}04\ m}$$

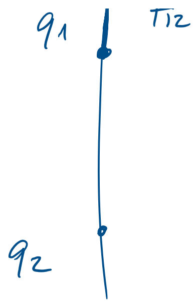
$$F_{12} = (8{,}99\ 10^9)\ \frac{(3{,}2\ 10^{-19})(3{,}2\ 10^{-19})}{\cancel{(0{,}04)^2}\ \ (4\ 10^{-2})^2}$$

$$= 8{,}99\ (3{,}2)^2\ 10^{-38}\ 10^9\ \frac{1\ 10^4}{4^2\ \cancel{10^{-4}}}$$

$$= \frac{8{,}99\ (3{,}2)^2}{16}\ 10^{-25} = 5{,}7536\ 10^{-25}\ N$$

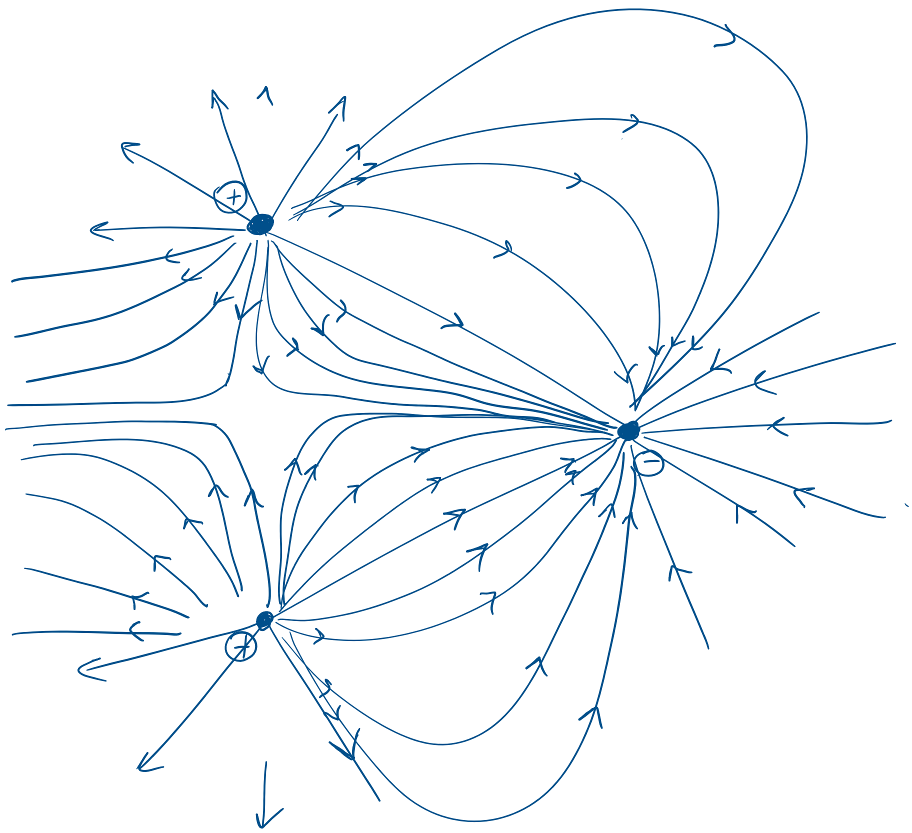
$$\boxed{F_{12} = 5{,}7536\ 10^{-25}\ N \simeq 6\ 10^{-25}\ N}$$



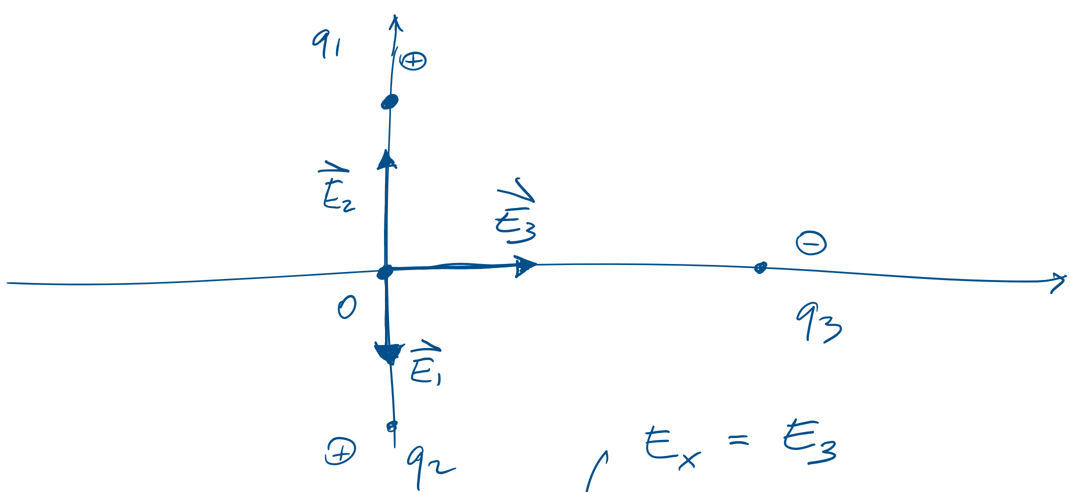


⇒ Attenzione le lezioni 22 e 23/9 sono spostate alle settimane successive!!!

2)



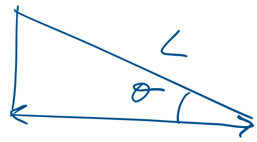
3)



$E_x = E_3$

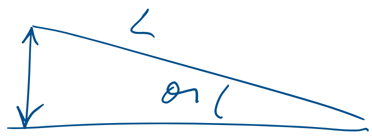
$$\vec{E} = \vec{E}_1 + \vec{E}_2 + \vec{E}_3 \qquad \left\{ \begin{array}{l} \\ E_y = E_2 - E_1 \end{array} \right.$$

$$E_x = \frac{1}{4\pi\varepsilon_0}\left[\frac{2q_1}{r_3^2}\right]$$



$r_3 = L\cos\theta$

$$E_y = \frac{1}{4\pi\varepsilon_0}\left[\frac{q_1}{d_2^2} - \frac{q_1}{r_1^2}\right]$$



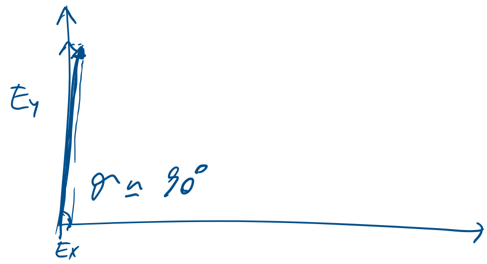
$r_1 = L\sin\theta$

$$\left\{ \begin{array}{l} E_x = \dfrac{1}{4\pi\varepsilon_0}\dfrac{2q_1}{(L\cos\theta)^2} \\[2ex] E_y = \dfrac{1}{4\pi\varepsilon_0}(q_1)\left[\dfrac{1}{d_2^2} - \dfrac{1}{(L\sin\theta)^2}\right] \end{array} \right.$$

$$\left\{ \begin{array}{l} E_x = 5{,}75 \; 10^{-9} \; \dfrac{N}{C} \\[2ex] E_y = 3{,}4095 \; 10^{-7} \; N/C \end{array} \right.$$

$$|\vec{E}| = \sqrt{E_x^2 + E_y^2} = 3{,}4100 \; 10^{-7} \; N/C$$

$$\boxed{|\vec{E}| \simeq 3 \; 10^{-7} \; N/C}$$



$\vartheta = ?$

$$\vartheta = \operatorname{arctg}\left(\frac{E_y}{E_x}\right) = \operatorname{arctg}\left(\frac{3{,}40 \; 10^{-7}}{5{,}75 \; 10^{-9}}\right)$$

$$\boxed{\vartheta = 89{,}03^\circ \simeq 90^\circ}$$

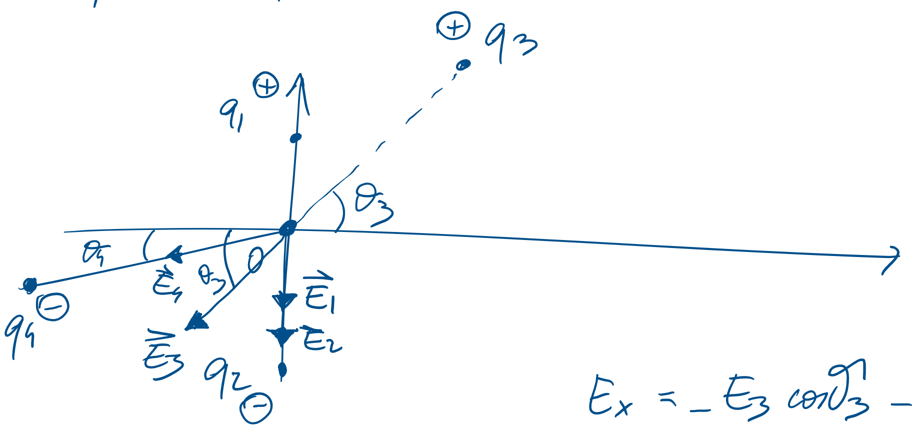
Altro esempio:

$$|q_1| = |q_2| = |q_3| = |q_4| = q$$

$\vartheta_3 ; \vartheta_4$

$$q_2 = q_4 = -q$$

$r_1 ; r_2 ; r_3 ; r_4$



$$E_x = -E_3 \cos\vartheta_3 - E_4 \cos\vartheta_4$$

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

$$\begin{cases} \\ E_y = -E_1 - E_2 - E_3 \sin\vartheta_3 - E_4 \sin\vartheta_4 \end{cases}$$