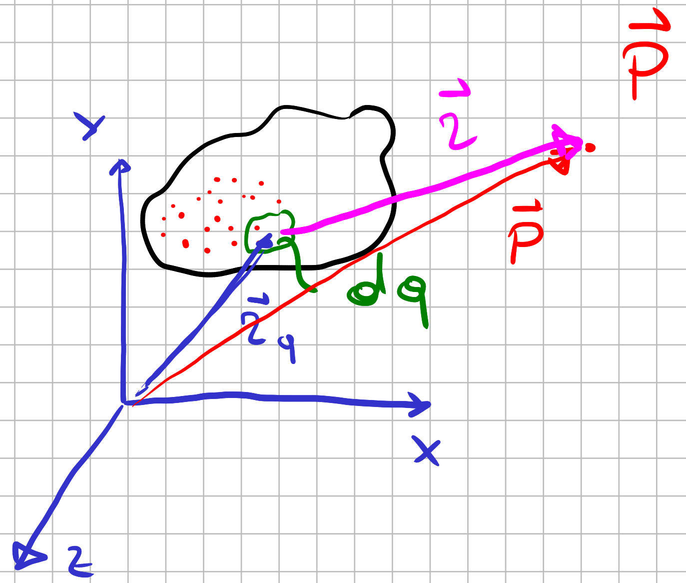
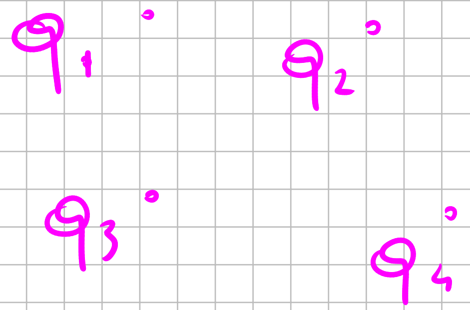
DISTRIBUZIONI CONTINUE DI CARICHE

$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\sum_{i=1}^{N} \frac{q_i \hat{r}_i}{\boxed{r_i^2}} \qquad \vec{E}(\vec{P}) = \frac{1}{4\pi\varepsilon_0}\int_V \frac{dq}{r^2}\,\hat{r}$$

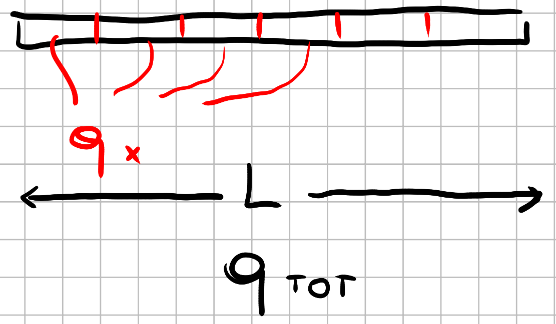
LA USIAMO ST...





DISTRIBUZIONI DI CARICA UNIFORME

"1D"



$$\lambda \equiv \frac{q_{TOT}}{L}$$ DENSITÀ LINEARE DI CARICA

$$[\lambda] = \frac{C}{m}$$

$$dq = \lambda \, d\ell$$

"2D"

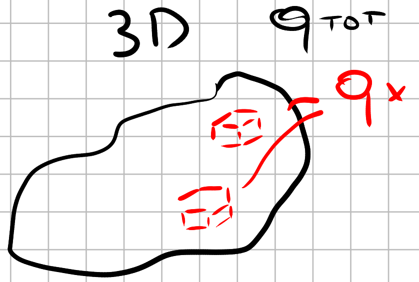
$$\sigma \equiv \frac{q_{TOT}}{\Sigma}$$ (Σ AREA DELL'OGGETTO)

DENSITÀ SUPERFICIALE DI CARICA

$$[\sigma] = \frac{C}{m^2}$$

$$dq = \sigma \, d\Sigma$$

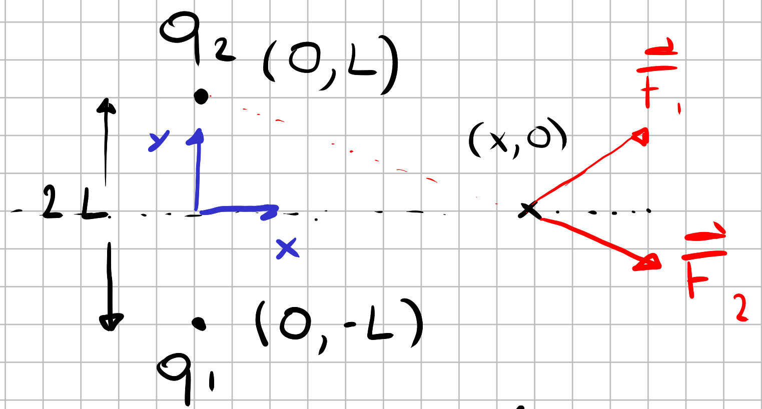
3D



$$\rho = \frac{q_{TOT}}{V}$$ DENSITÀ VOLUMETRICA DI CARICA

$$[\rho] = \frac{C}{m^3}, \quad dq = \rho \boxed{dV}$$ "$d\tau$"

ESEMPIO



$$\vec{E} = \vec{E}(x,0) \quad , \quad q_1 = q_2 = q$$

$$\vec{r}_1 = (x,0) - (0,-L) = (x,L) \, , \quad r_1 = \sqrt{x^2+L^2}$$

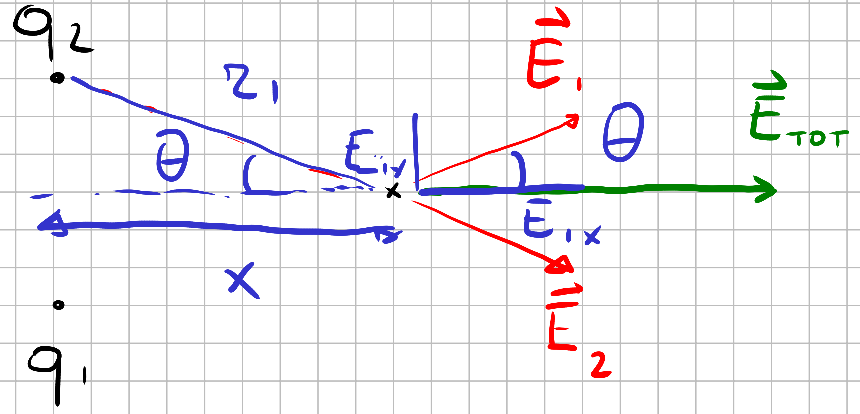
$$\vec{r}_2 = (x,0) - (0,L) = (x,-L) \, , \quad r_2 = \sqrt{x^2+L^2}$$

$$\vec{E}_1 = \frac{q}{4\pi\varepsilon_0} \frac{\hat{r}_1}{r_1^2} = \frac{q}{4\pi\varepsilon_0} \underbrace{\frac{(x,L)}{\sqrt{x^2+L^2}}}_{\hat{r}_1} \frac{1}{x^2+L^2} = \frac{q}{4\pi\varepsilon_0} \frac{(x,L)}{(x^2+L^2)^{3/2}}$$

$$\vec{E}_2 = \frac{q}{4\pi\varepsilon_0} \frac{(x,-L)}{(x^2+L^2)^{3/2}}$$

$$\Rightarrow \quad \vec{E}_{TOT} = \vec{E}_1 + \vec{E}_2 = \frac{q}{4\pi\varepsilon_0 (x^2+L^2)^{3/2}} \left[(x,L) + (x,-L) \right]$$

$$= \frac{q}{4\pi\varepsilon_0 (x^2+L^2)^{3/2}} (2x, 0)$$



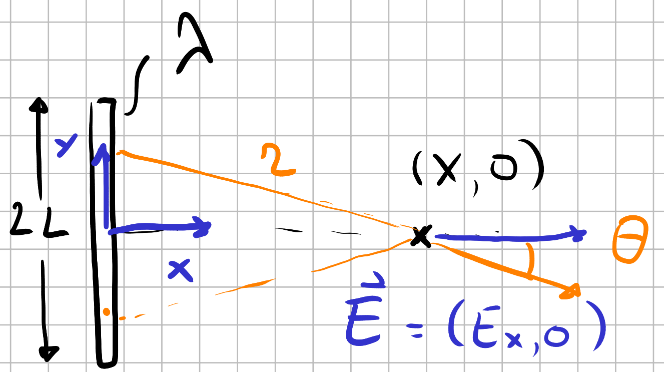
$$\vec{E}_{TOT} = (2E_{1x}, 0) \quad , \quad E_{1x} = E_{2x}$$

$$E_{1x} = E_1 \cos\theta$$

$$E_1 = \frac{q}{4\pi\varepsilon_0} \frac{1}{r_1^2} \quad , \quad \cos\theta = \frac{x}{r_1} \Rightarrow$$

$$E_{TOT,x} = 2E_{1x} = \frac{2q}{4\pi\varepsilon_0} \frac{x}{r_1^3} = \frac{2q}{4\pi\varepsilon_0} \frac{x}{(x^2+L^2)^{3/2}}$$

ESEMPIO "CONTINUO"

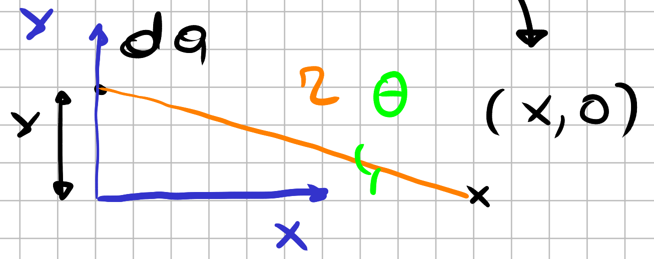


$$dE_x = \frac{dq}{2\pi\varepsilon_0}\,\frac{\cos\theta}{r^2} = ,\qquad r\cos\theta = x \Rightarrow r = \frac{x}{\cos\theta}$$

$$= \frac{dq}{2\pi\varepsilon_0}\,\frac{\cos^3\theta}{x^2}$$

$dq = \lambda\, dy$,

notando che

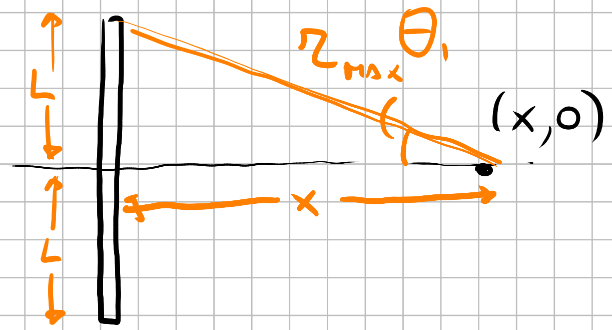


$$y = x\,\mathrm{tg}\,\theta \Rightarrow dy = \frac{x\,d\theta}{\cos^2\theta} \Rightarrow$$

$$dE_x = \frac{dq}{2\pi\varepsilon_0}\,\frac{\cos^3\theta}{x^2} = \frac{\lambda\,dy}{2\pi\varepsilon_0}\,\frac{\cos^3\theta}{x^2} =$$

$$= \frac{\lambda\,\cancel{x}}{2\pi\varepsilon_0}\,\frac{d\theta}{\cancel{\cos^2}\theta}\,\frac{\cancel{\cos^3}\theta}{x^{\cancel{2}}} = \frac{\lambda}{2\pi\varepsilon_0 x}\cos\theta\, d\theta$$

$$E_x = \int_0^{\theta_1} dE_x = \frac{\lambda}{2\pi\varepsilon_0 x}\int_0^{\theta_1}\cos\theta\, d\theta = \frac{\lambda}{2\pi\varepsilon_0 x}\left(\sin\theta_1 - \cancel{\sin 0}\right) = \frac{\lambda\sin\theta_1}{2\pi\varepsilon_0 x}$$



$$r_{max} = \sqrt{x^2+L^2}, \quad r_{max}\sin\theta_1 = L \iff$$

$$\sin\theta_1 = \frac{L}{\sqrt{x^2+L^2}}$$

LINEE DI CAMPO (O FORZA)