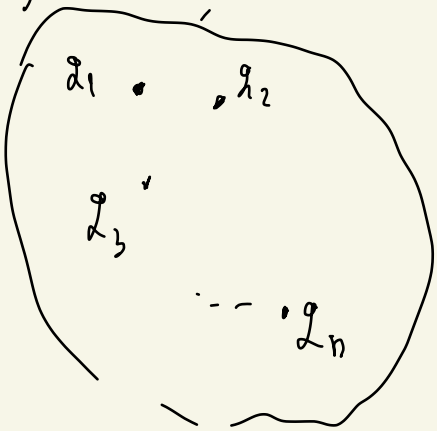
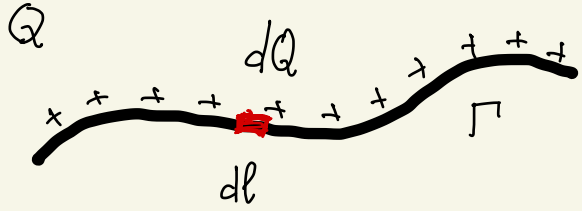
Tipuri de distribuții continue de sarcină

1) Distribuția discretă.



$$\vec{E} = \vec{E}_{1P} + \vec{E}_{2P} + \dots + \vec{E}_{nP}$$

2) Distribuția liniară



$$\lambda = \frac{dQ}{dl} \left(\frac{C}{m} \right)$$

densitate liniară de sarcină electrică

$$dQ = \lambda \, dl$$

$$Q = \int_{\Gamma} dQ = \int_{\Gamma} \lambda \, dl$$

3) Distribuția superficială de sarcină electrică

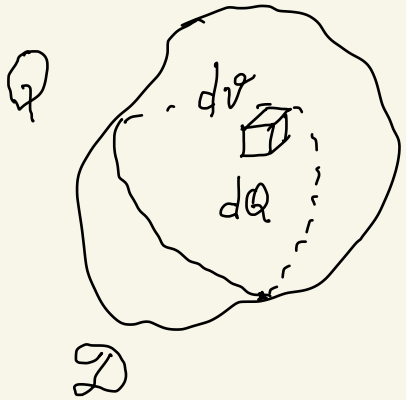
$$\sigma = \frac{dQ}{dS}\left(\frac{C}{m^2}\right)$$

$$dQ = \sigma\, dS$$

$$Q = \int_{\Sigma} \sigma\, dS$$

σ - densitate superficială de sarcină electrică.

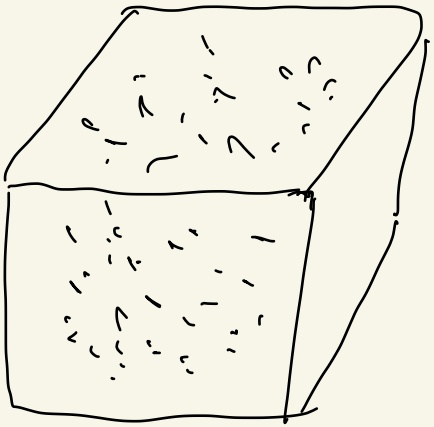
4) Distribuția volumică de sarcină electrică



$$\rho = \frac{dQ}{dv}\left(\frac{C}{m^3}\right)$$

$$dQ = \rho \cdot dv$$

$$Q = \int_{D} \rho\, dv$$



$NaCl$

↓

$Na^+ + Cl^-$

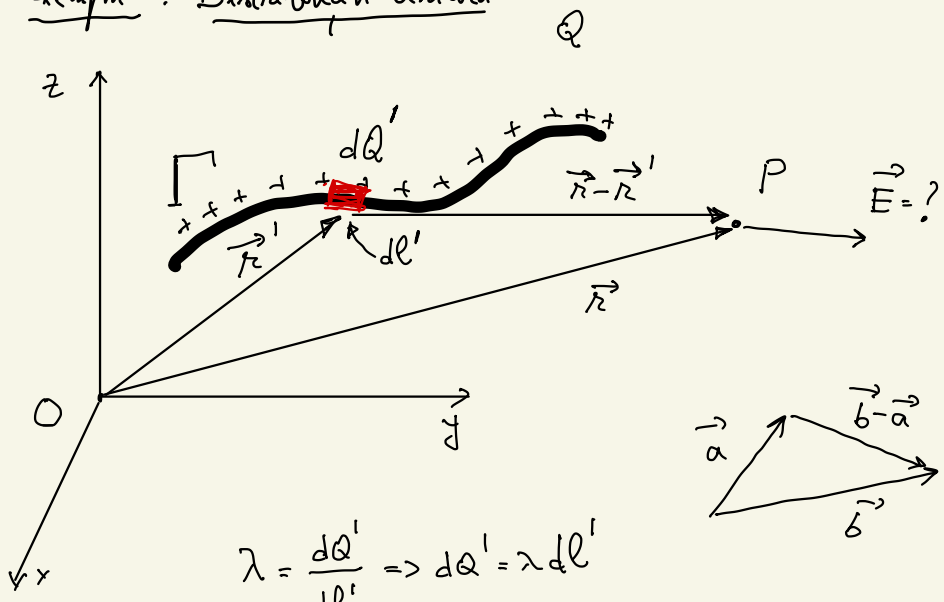
$\lambda \rightarrow \frac{C}{m}$

$\sigma \rightarrow \frac{C}{m^2}$

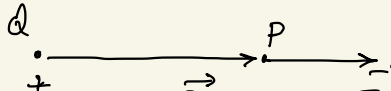
$\rho \rightarrow \frac{C}{m^3}$

$\vec{E}$ = Suma vectorială a tuturor câmpurilor produse de sarcinile punctiforme care formează corpul macroscopic nepunctiform.

Exemplu : Distribuție liniară



$$\lambda = \frac{dQ'}{dl'} \Rightarrow dQ' = \lambda\, dl'$$

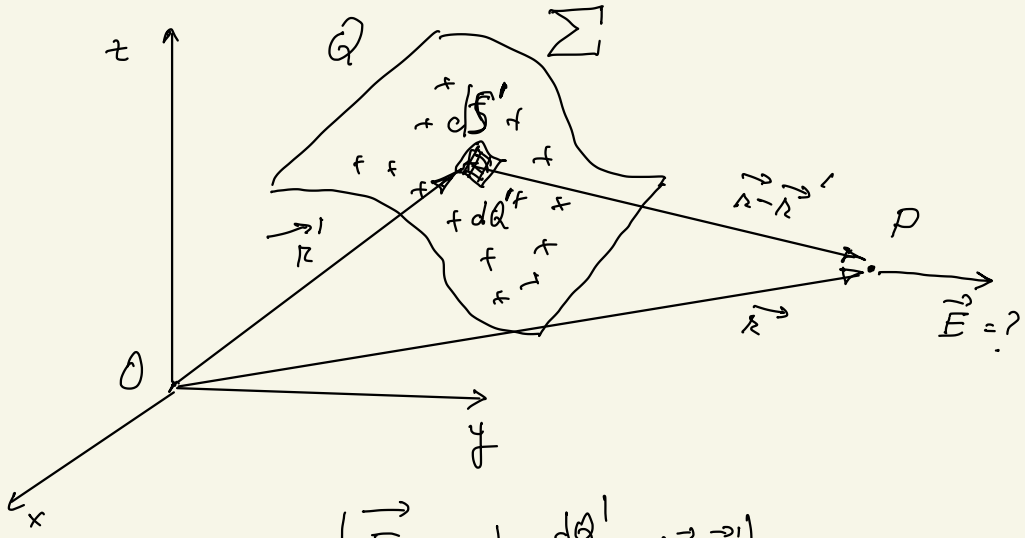


$\vec{E} = k\frac{Q}{r^3}\vec{r}$ ← punctiformă

$$d\vec{E}_P = k\,\frac{dQ'}{|\vec{r}-\vec{r}'|^3}(\vec{r}-\vec{r}') = k\cdot\frac{\lambda\, dl'}{|\vec{r}-\vec{r}'|^3}(\vec{r}-\vec{r}')$$

$$\vec{E}_P = \int d\vec{E}_P = \int_{\Gamma} k\cdot\frac{\lambda\, dl'}{|\vec{r}-\vec{r}'|^3}(\vec{r}-\vec{r}')$$

Distribuția superficială



$$d\vec{E}_P = k\,\frac{dQ'}{|\vec{r}-\vec{r}'|^3}(\vec{r}-\vec{r}')$$

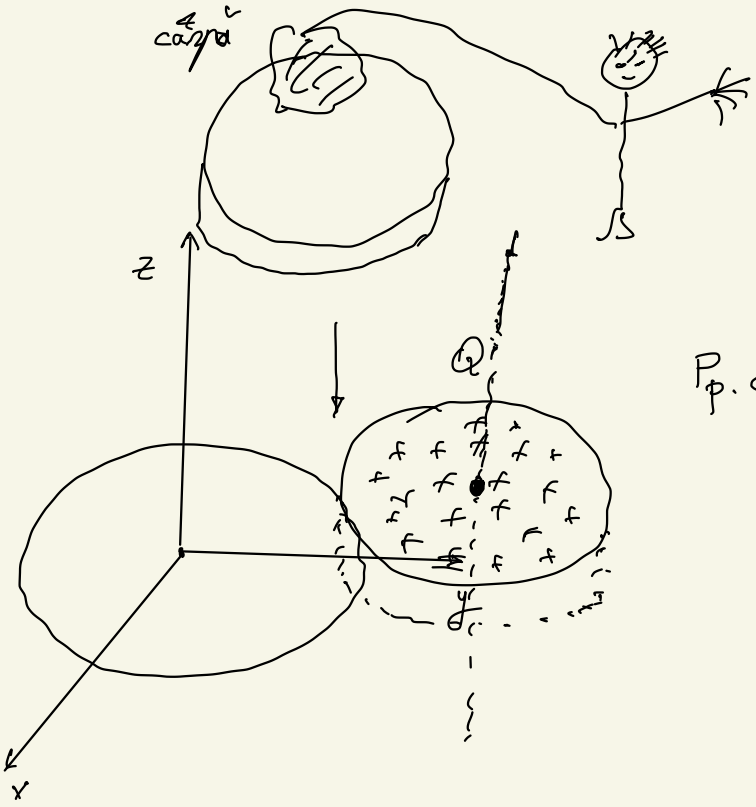
$$\frac{dQ'}{dS'} = \sigma \Rightarrow dQ' = \sigma \cdot dS'$$

$$d\vec{E}_P = \frac{k\,\sigma\,dS'}{|\vec{r}-\vec{r}'|^3}(\vec{r}-\vec{r}')$$

$$\vec{E}_P = \int_{\Sigma} \frac{k\,\sigma\,dS'}{|\vec{r}-\vec{r}'|^3}(\vec{r}-\vec{r}')$$

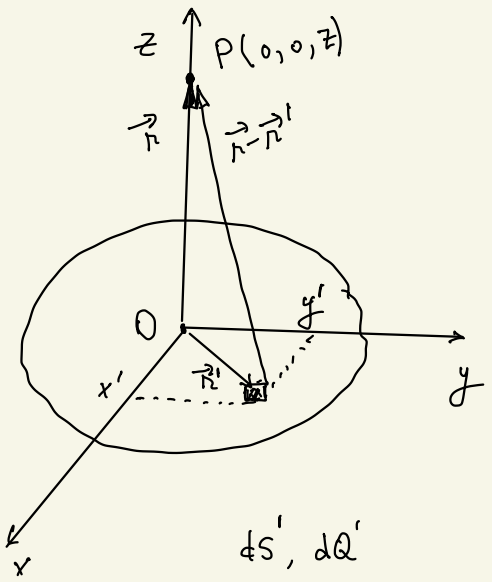
Distribuția volumică $\longrightarrow$ $\vec{E}_P = \int_{\mathcal{D}} \frac{k\,\rho\,dv'}{|\vec{r}-\vec{r}'|^3}(\vec{r}-\vec{r}')$

Calculul câmpului electric produs de o distribuție superficială de sarcină electrică în formă de disc.



P.p. că $\sigma = const.$ $\left(\frac{C}{m^2}\right)$

a, σ



$$d\vec{E}_P = k\frac{dQ'}{|\vec{r}-\vec{r}'|^3}(\vec{r}-\vec{r}')$$

$$dQ' = \sigma \cdot dS'$$

$$d\vec{E}_P = \frac{k\sigma \cdot dS'}{|\vec{r}-\vec{r}'|^3}(\vec{r}-\vec{r}')$$

$$\vec{r}(0,0,z) \Rightarrow \vec{r} = \vec{k}z$$

$$\vec{r}'(x',y',0) \Rightarrow \vec{r}' = x'\vec{i} + y'\vec{j}$$

$$\vec{r}-\vec{r}' = -x'\vec{i} - y'\vec{j} + \vec{k}z$$

$$|\vec{r}-\vec{r}'| = \sqrt{x'^2+y'^2+z^2}$$

$$d\vec{E}_P = \frac{k\sigma \cdot dS'}{\left(\sqrt{x'^2+y'^2+z^2}\right)^3}\left(-x'\vec{i} - y'\vec{j} + \vec{k}z\right)$$

$$\begin{cases} dE_{P,x} = \dfrac{k\sigma\, dS'(-x')}{(x'^2+y'^2+z^2)^{3/2}} \\ dE_{P,y} = \dfrac{k\sigma \cdot dS'(-y')}{(x'^2+y'^2+z^2)^{3/2}} \\ dE_{P,z} = \dfrac{k\sigma \cdot dS' \cdot z}{(x'^2+y'^2+z^2)^{3/2}} \end{cases}$$