RN – 03 - Predavanje 06 – 19.10.2021.

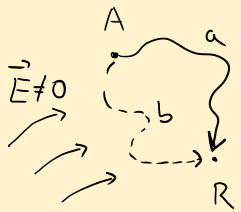
Studijski program: Energetika, elektronika i telekomunikacije (E1)

19.10.2021. godine

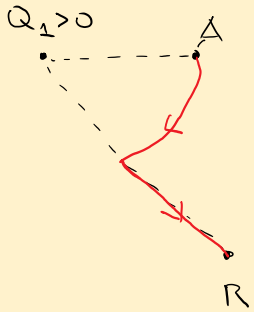


$\vec{E}_A(r_A)$

$V_A = \int_A^R \vec{E}\cdot d\vec{l}$

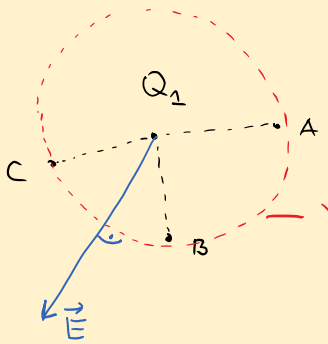


$V_A^a \equiv V_A^b$



$V_A = \frac{1}{4\pi\varepsilon_0}\frac{Q_1}{r_A}$

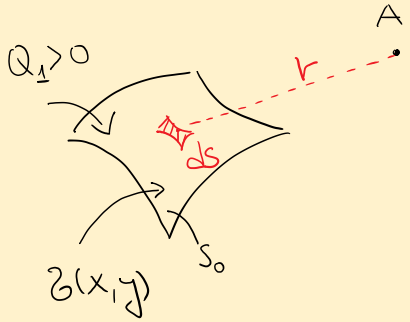
R: $r_R \to \infty$



$V_A = V_B = V_C$

— V-const.

$\vec{E} \perp$ na ekvipot. površ

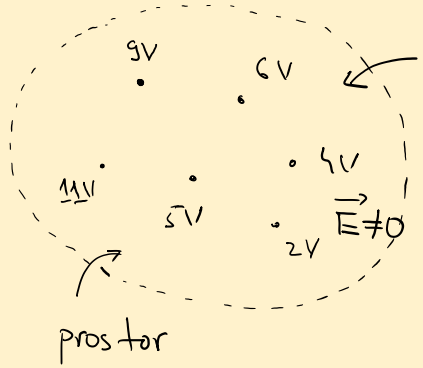


V_A - ?

$ds, dQ \Rightarrow ds \to 0 \Rightarrow$ elementarni del posmatramo kao tačkasto naelektrisanje.

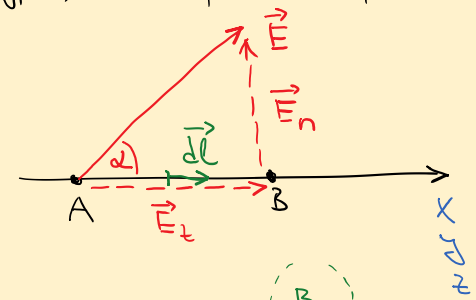
$\Rightarrow dV_A = \frac{1}{4\pi\varepsilon_0}\frac{dQ}{r} = \frac{1}{4\pi\varepsilon_0}\frac{z(x,y)\cdot ds}{r}$

$\Rightarrow V_A = \int_{S_0} dV_A = \frac{1}{4\pi\varepsilon_0}\int_{S_0}\frac{z(x,y)}{r}ds \underset{ds=dx\,dy}{=\!=} \frac{1}{4\pi\varepsilon_0}\iint_{x\,y}\frac{z(x,y)}{r}dx\,dy$



$V(x,y,z)$ – raspodela potencijala ✓ $\Rightarrow \vec{E}$ - ?

pretpostavka: $V_B = V_A + dV \Rightarrow V_B > V_A$



$\vec{dl} = dl\,(+\vec{i}_0) \Rightarrow dl \to 0 \Rightarrow E_t$ - const.

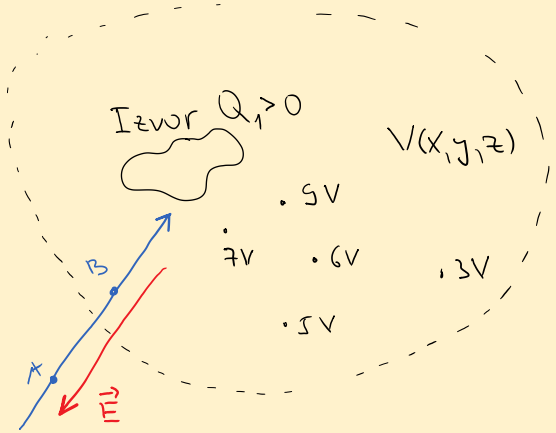
$-dV = V_A - V_B = \int_A^B \vec{E}\cdot d\vec{l} = \int_A^B \vec{E}_t\cdot d\vec{l} = \int_A^B E_t\,dl = E_t\,\Delta l = E_x\,dx \Rightarrow E_x = -\frac{dV(x,y,z)}{dx}$

$\Rightarrow E_y = -\frac{dV}{dy}$

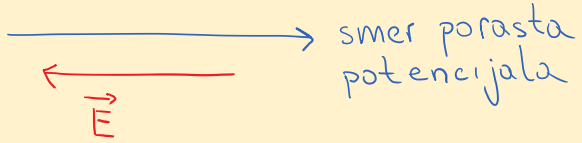
$\Rightarrow \vec{E} = E_x(+\vec{i}_x) + E_y(+\vec{i}_y) + E_z(+\vec{i}_z) = -\left[\frac{dV(x,y,z)}{dx}\vec{i}_x + \frac{dV}{dy}\vec{i}_y + \frac{dV}{dz}\vec{i}_z\right] \Rightarrow E_z = -\frac{dV}{dz}$

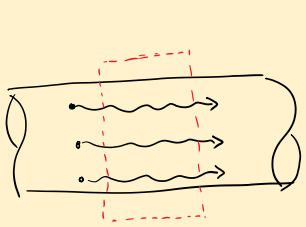
pričamo o putanji

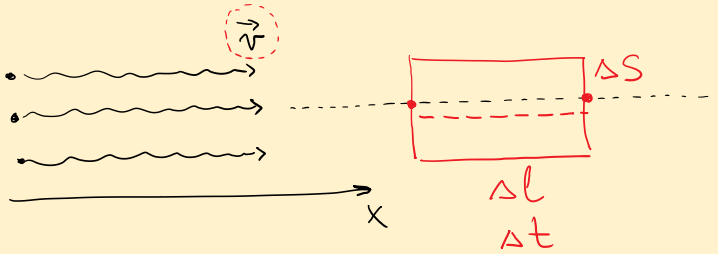
GAUSOV ZAKON



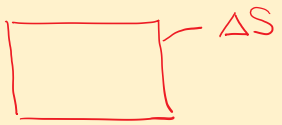
$\vec{E} = -[\ldots + \ldots + \ldots]$ $\quad V_B > V_A$





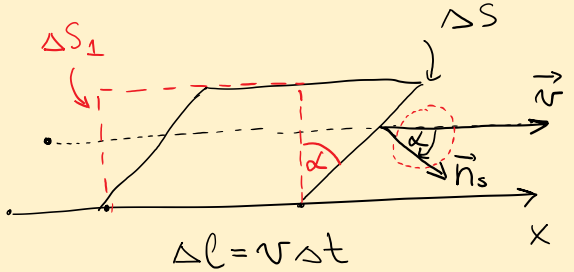


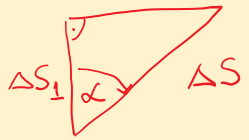
$\Rightarrow$



$\Delta l = v \Delta t$

$\text{Protok} = \Delta S \, \Delta l = \Delta S \, v \, \Delta t$





$\Delta S_1 = \Delta S \cos\alpha$

$\text{Protok} = \Delta S_1 \, \Delta l = \Delta S \cos\alpha \, \Delta l$

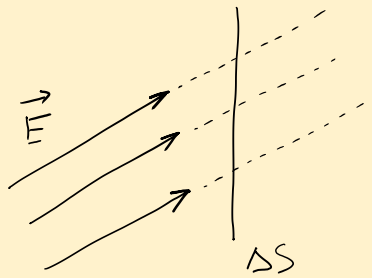
$\Rightarrow \text{Protok} = \Delta S \cos\alpha \, v \, \Delta t = \Delta S \, v \cos\alpha \, \Delta t$

$= \Delta \vec{S} \cdot \vec{v} \cdot \Delta t = \vec{v} \cdot \Delta \vec{S} \, \Delta t$

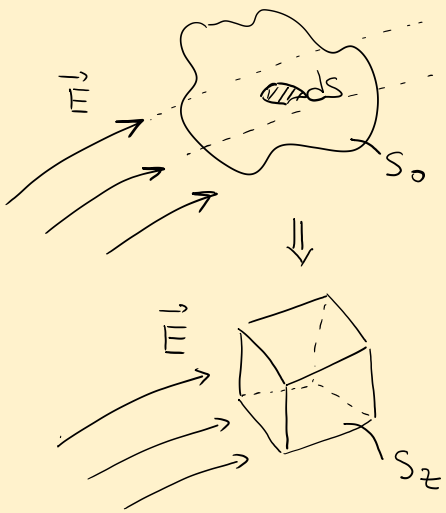
$\vec{v}$

$\vec{\Delta S} = \Delta S \vec{n}_s$

$\Rightarrow \dfrac{\text{Protok}}{\Delta t} = \vec{v} \cdot \Delta \vec{S} = \Delta \Psi_{\vec{v}}$

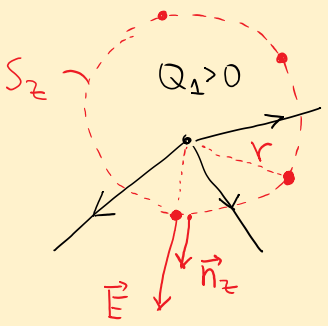


$$\Delta\tau_{\vec{E}} = \vec{E}\cdot\Delta\vec{S}$$



$$\tau_{\vec{E}} = \int_{S_0} \vec{E}\cdot d\vec{S} \quad - \text{ fluks } \vec{E} \text{ kroz } S_0$$

$$\tau_{\vec{E}}^{S_z} = \oint_{S_z} \vec{E}\cdot d\vec{S}$$

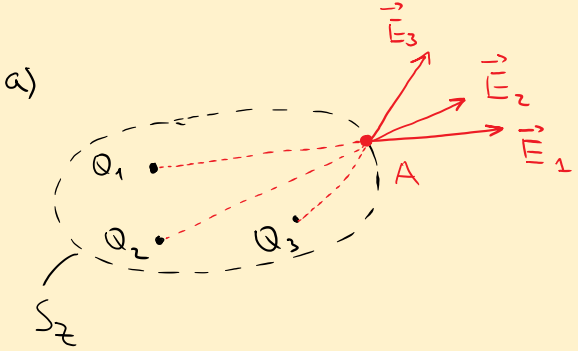


$$\tau_{\vec{E}}^{S_z} = \oint_{S_z} \vec{E}\cdot d\vec{S} = \oint_{S_z} E\,dS\,\cancel{\cos 0^{\circ}}^{1} = \oint_{S_z} E\,dS = E(r)\oint_{S_z} dS = E(r)\,4\pi r^2 = \frac{1}{\cancel{4\pi}\varepsilon_0}\frac{Q_1}{\cancel{r^2}}\cancel{4\pi r^2} = \frac{Q_1}{\varepsilon_0}$$

$\vec{E} \parallel \vec{n}_z$

$$\Rightarrow \boxed{\oint_{S_z} \vec{E}\cdot d\vec{S} = \frac{Q_1}{\varepsilon_0} = \frac{Q_{unutar\,S_z}}{\varepsilon_0}}$$ Gausov zakon

a)

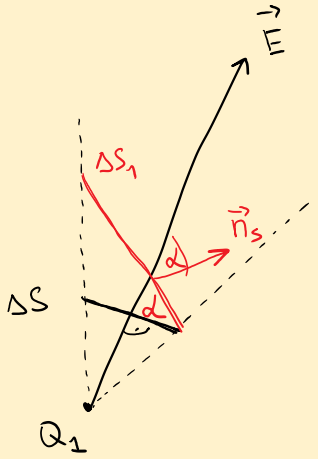


$$\oint_{S_z} \vec{E}_{rez} \cdot d\vec{S} = \oint_{S_z} [\vec{E}_1 + \vec{E}_2 + \vec{E}_3] \cdot d\vec{S} = \oint_{S_z} \vec{E}_1 \cdot d\vec{S} + \oint_{S_z} \vec{E}_2 \cdot d\vec{S} + \oint_{S_z} \vec{E}_3 \cdot d\vec{S}$$

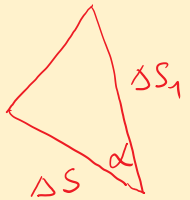
$$= \frac{Q_1}{\varepsilon_0} + \frac{Q_2}{\varepsilon_0} + \frac{Q_3}{\varepsilon_0} = \frac{Q_1 + Q_2 + Q_3}{\varepsilon_0} = \frac{Q_{uk\ unutar\ S_z}}{\varepsilon_0}$$

$$\Rightarrow \oint_{S_z} \vec{E} \cdot d\vec{S} = \frac{Q_{uk\ unutar\ S_z}}{\varepsilon_0}$$

b)

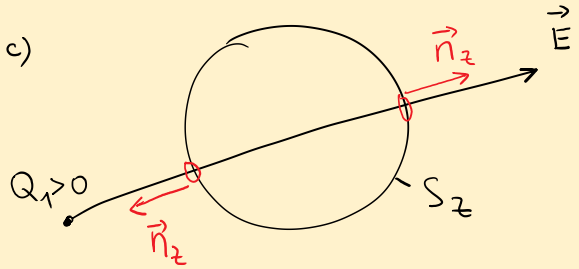


$$\Psi_{\vec{E}}^{\Delta S} \stackrel{?}{=} \Psi_{E}^{\Delta S_1}$$



$$\Psi_{\vec{E}}^{\Delta S_1} = \vec{E} \cdot \Delta\vec{S}_1 = E \underbrace{\Delta S_1 \cos\alpha}_{\Delta S} = E\,\Delta S = \Psi_{\vec{E}}^{\Delta S}$$

c)



$$\Psi_{\vec{E}} = \oint_{S_z} \vec{E} \cdot d\vec{S} = 0$$ - izvor je izvan S_z $\Rightarrow$ u G.Z. ih ne moramo računati

$$\Psi_{\vec{E}}^{ulazu} + \Psi_{\vec{E}}^{izlazu} = 0$$

$\vec{E} \uparrow\downarrow \vec{n}_z$ $\quad$ $\vec{E} \uparrow\uparrow \vec{n}_z$