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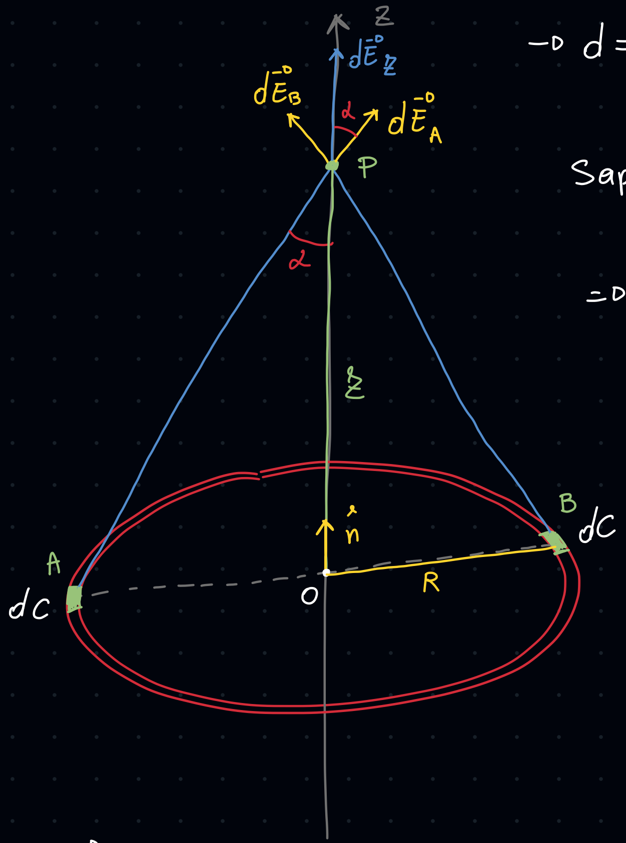

$\overline{AP} = \sqrt{R^2 + z^2}$ Siccome $|\vec{E}| = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{d^2}$

$\Rightarrow d = AP \Rightarrow dE_A = \frac{1}{4\pi\varepsilon_0} \cdot \frac{dq}{R^2+z^2}$

Sappiamo che λ = dens. lineare $\Rightarrow \lambda = \frac{dQ}{d\ell}$

$\Rightarrow dQ = \lambda\, d\ell \Rightarrow Q_{TOT} = \int \lambda\, d\ell$

ma ℓ non è altro che la circonferenza

$\Rightarrow Q_{TOT} = \int \lambda\, dc$

Dal disegno sappiamo che $d\vec{E}_{\hat{n}} = d\vec{E}_A + d\vec{E}_B$

è SOLO LUNGO z $\Rightarrow$ Sommiamo solo le comp lungo z, dato che le altre si eliminano a 2 a 2.

$\Rightarrow d\vec{E}_z = d\vec{E}_A \cos\alpha = \frac{\lambda\, dc}{4\pi\varepsilon_0(R^2+z^2)} \cdot \cos\theta$

Per definizione $\cos\alpha = \frac{Cat}{Hip} = \frac{z}{AP} = \frac{z}{\sqrt{R^2+z^2}}$

$\Rightarrow d\vec{E}_z = \frac{\lambda\, dc}{4\pi\varepsilon_0(R^2+z^2)} \cdot \frac{z}{\sqrt{R^2+z^2}} \Rightarrow E_z = \int_C \frac{\lambda}{4\pi\varepsilon_0(R^2+z^2)} \frac{z}{\sqrt{R^2+z^2}}\, dc$

$\frac{1}{R^2+z^2} \cdot \frac{1}{\sqrt{R^2+z^2}} = \frac{1}{(R^2+z^2)\cdot(R^2+z^2)^{\frac{1}{2}}} = \frac{1}{(R^2+z^2)^{1+\frac{1}{2}}}$

$\Rightarrow E_z = \frac{\lambda z}{4\pi\varepsilon_0(R^2+z^2)^{\frac{3}{2}}} \cdot \int_C dc = \frac{\cancel{2}\pi R\, \lambda z}{2\,\cancel{4}\pi\varepsilon_0(R^2+z^2)^{\frac{3}{2}}}$ (1)

$$\Rightarrow \vec{E}_z = \frac{R z \lambda}{2\varepsilon_0(R^2+z^2)^{\frac{3}{2}}}\hat{n}$$

E se $z \gg R$? Siccome $Q = \int \lambda\, dc = \lambda 2\pi R$

$\Rightarrow$ dalla (1) $\frac{\overbrace{2\pi R \lambda}^{Q_{TOT}} z}{4\pi\varepsilon_0(R^2+z^2)^{\frac{3}{2}}} = \frac{Q_{TOT}\cdot z}{4\pi\varepsilon_0(R^2+z^2)^{\frac{3}{2}}}$

Se $z \gg R$ $E_z = \frac{Q_{TOT}\cdot \cancel{z}}{4\pi\varepsilon_0(z^{\cancel{2}})^{\frac{3}{2}\,2}}$

$$\Rightarrow \vec{E}_z = \frac{Q_{TOT}}{4\pi\varepsilon_0 z^2}\hat{n}$$

Legge di Coulomb per la carica puntiforme