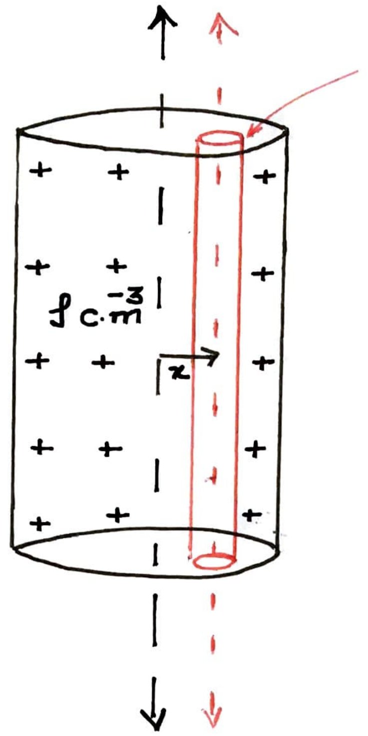
Electric Field inside a cylindrical cavity



Let there is a non-conducting cylinder of ∞ length & volume charge density $\rho\, C\cdot m^{-3}$ having a cylindrical cavity running parallel to its length at a separation x.

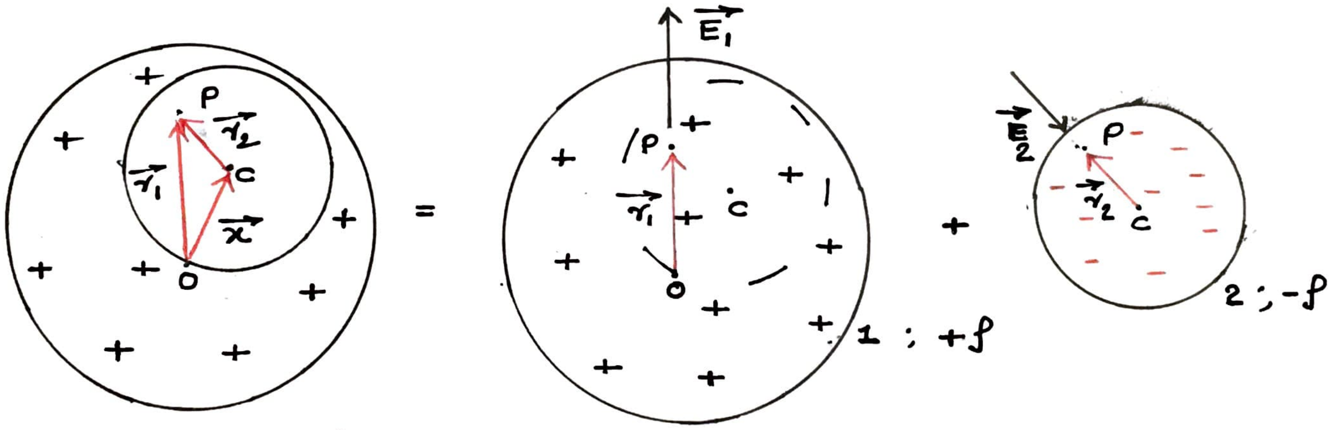
in $\triangle OPC$

$$\vec{OC} + \vec{CP} = \vec{OP}$$

$$\vec{x} + \vec{r_2} = \vec{r_1}$$

$$\therefore \quad \vec{r_1} - \vec{r_2} = \vec{x} \quad \text{——} (1)$$

Top-view



$\because$ Electric field inside a non-conducting cylinder

$$\vec{E} = \frac{\rho \cdot \vec{r}}{2\varepsilon_0} \quad (\text{for +ve charge})$$

$$\& \quad \vec{E} = -\frac{\rho \cdot \vec{r}}{2\varepsilon_0} \quad (\text{for -ve charge})$$

$\therefore$ Total electric field at point P

$$\vec{E_P} = \vec{E_1} + \vec{E_2} = \left[\frac{\rho}{2\varepsilon_0} \cdot \vec{r_1}\right] + \left[-\frac{\rho \cdot \vec{r_2}}{2\varepsilon_0}\right]$$

$$= \frac{\rho}{2\varepsilon_0} \cdot (\vec{r_1} - \vec{r_2})$$

$$\therefore \quad \vec{E_P} = \frac{\rho \cdot \vec{x}}{2\varepsilon_0} \ N/C$$

ie; const. everywhere within the cavity.

$\therefore$ Electric field inside a non-conducting cavity is const. & only depends upon position vector of cavity axis.