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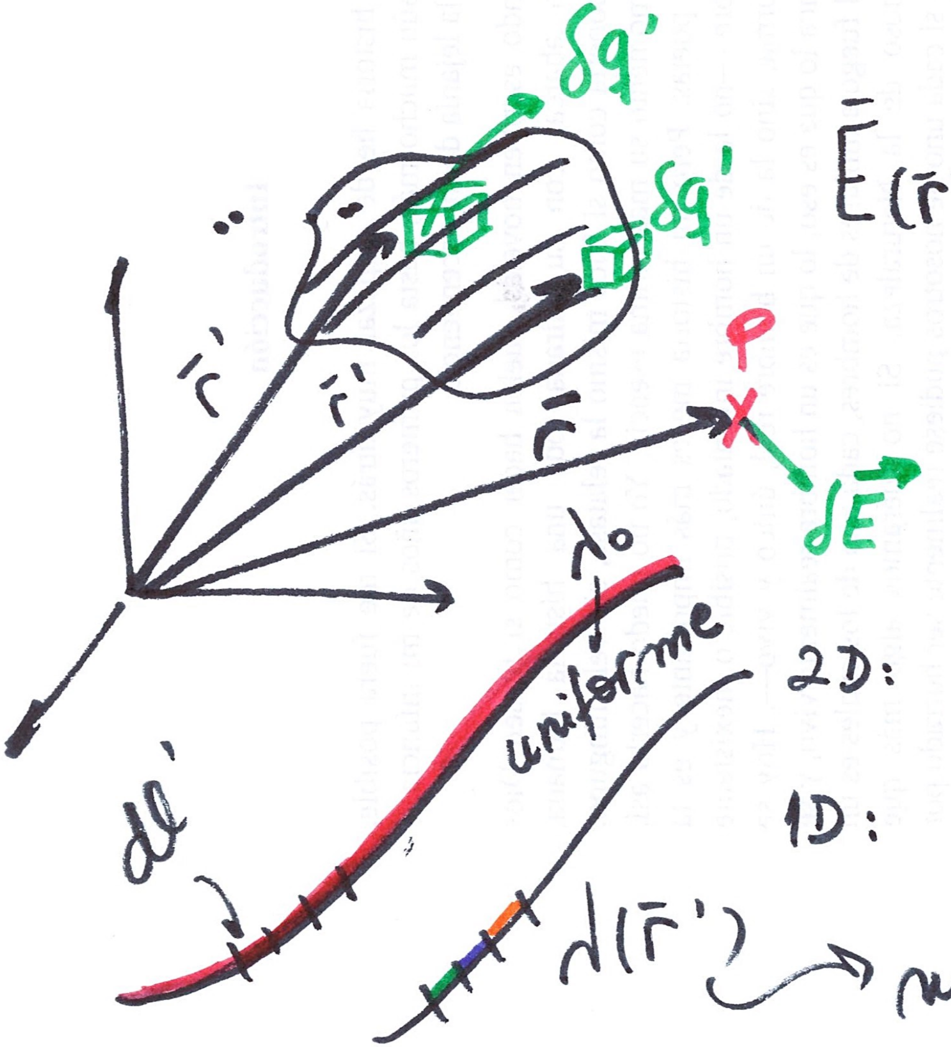
$q \longrightarrow \bar{E}(\bar{r}) = \dfrac{kq\,(\bar{r}-\bar{r}_q)}{|\bar{r}-\bar{r}_q|^3}$

$N\ q_i \longrightarrow \bar{E}(\bar{r}) = k\displaystyle\sum_{i=1}^{N} \dfrac{q_i\,(\bar{r}-\bar{r}_i)}{|\bar{r}-\bar{r}_i|^3}$

DIST. DISCRETAS

$\bar{E}(\bar{r}) = k\displaystyle\int \dfrac{\delta q'\,(\bar{r}-\bar{r}')}{|\bar{r}-\bar{r}'|^3}$

DIST. CONTINUA



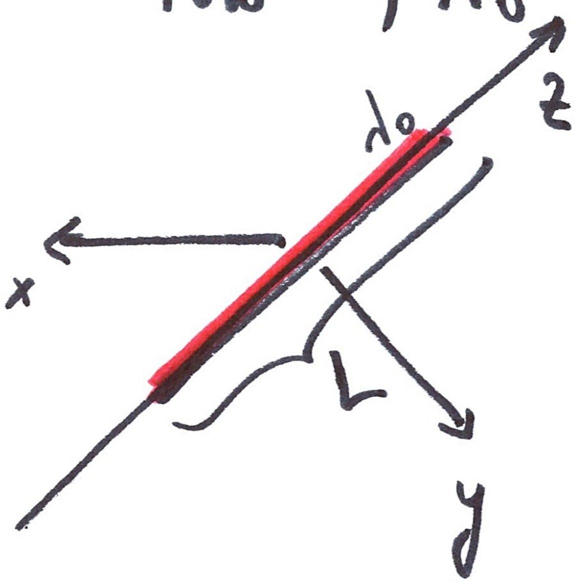
DENSIDAD DE CARGA

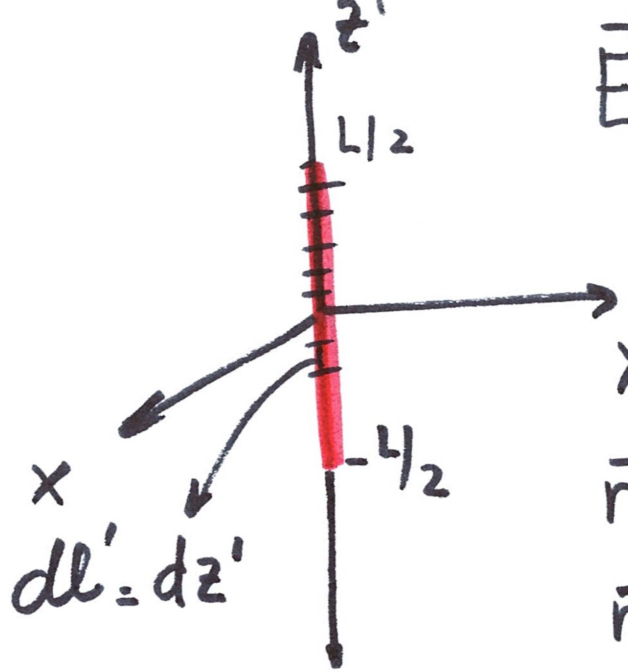
3D: $\rho \longrightarrow \delta q' = \rho\, dV'$; $[\rho] = C/m^3$

2D: $\sigma \longrightarrow \delta q' = \sigma\, ds'$; $[\sigma] = C/m^2$

1D: $\lambda \longrightarrow \delta q' = \lambda\, dl'$; $[\lambda] = C/m$

hilo L, λ_0 ; en todo el espacio





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$$\vec{E}(\bar{r}) = k \int \frac{\overbrace{\lambda_0 \, dl'}^{\delta q'} \, (\bar{r} - \bar{r}')}{|\bar{r} - \bar{r}'|^3}$$

$dl' = dz'$

$\vec{r} = x\hat{x} + y\hat{y} + z\hat{z}$ PTO. CAMPO

$\vec{r}\,' = z'\hat{z}$ PTO. FUENTE

$\left(-\frac{L}{2} \leq z' \leq \frac{L}{2}\right)$

$$\bar{E}(\bar{r}) = k\lambda_0 \int_{-L/2}^{L/2} \frac{dz' \, \left(x\hat{x} + y\hat{y} + (z - z')\hat{z}\right)}{\left(x^2 + y^2 + (z - z')^2\right)^{3/2}}$$

$\left\{ \begin{array}{l} |\ \ | = (\ \ )^{1/2} \\ |\ \ |^3 = (\ \ )^{3/2} \end{array} \right.$

$\hookrightarrow$ 3 integrales 1D $\left\{ \begin{array}{l} E_x \\ E_y \\ E_z \end{array} \right.$

$$E_x = k\,\lambda_0 \int_{-L/2}^{L/2} \frac{dz'\; x}{\left(x^2+y^2+(z-z')^2\right)^{3/2}}$$

$$E_y = k\,\lambda_0 \int_{-L/2}^{L/2} \frac{dz'\; y}{\left(x^2+y^2+(z-z')^2\right)^{3/2}}$$

es la misma integral

$$E_z = k\,\lambda_0 \int_{-L/2}^{L/2} \frac{dz'\,(z-z')}{\left(x^2+y^2+(z-z')^2\right)^{3/2}}$$

E_x, E_y

$$\int_{-\frac{L}{2}}^{L/2} \frac{dz'}{(x^2+y^2+(z-z')^2)^{3/2}} = \int_{z+\frac{L}{2}}^{z-\frac{L}{2}} \frac{-dv}{(x^2+y^2+v^2)^{3/2}} = -\int_{z+\frac{L}{2}}^{z-L/2} \boxed{\frac{dv}{(a^2+v^2)^{3/2}}}$$

$$\begin{cases} v = z - z' \\ dv = -dz' \end{cases}$$

$x^2+y^2 \to a^2$

(TABLA)

$$\boxed{\frac{v}{a^2(v^2+a^2)^{1/2}}}$$

E_z

$$\int_{-L/2}^{L/2} \frac{dz'(z-z')}{(x^2+y^2+(z-z')^2)^{3/2}} = \int_{z+L/2}^{z-L/2} \boxed{\frac{-dv\, v}{(a^2+v^2)^{3/2}}}$$

$x^2+y^2 \to a^2$

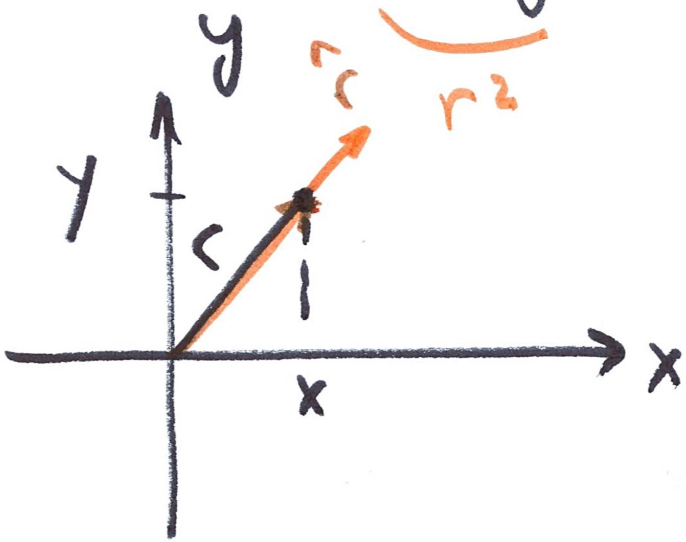
(TABLA)

$$\boxed{\frac{-1}{(v^2+a^2)^{1/2}}}$$

$\boxed{\bar{E}}$

$$\bar{E}(\bar{r}) = k\lambda_0 \left\{ \left[\frac{(z+L/2)}{\underbrace{(x^2+y^2)}_{r^2}\left(\underbrace{x^2+y^2}_{r^2}+\left(z+\frac{L}{2}\right)^2\right)^{1/2}} - \frac{(z-L/2)}{\underbrace{(x^2+y^2)}_{r^2}\left(\underbrace{x^2+y^2}_{r^2}+\left(z-\frac{L}{2}\right)^2\right)^{1/2}} \right] \underbrace{(x\hat{x}+y\hat{y})}_{r\hat{r}} + \right.$$

$$\left. + \left[\frac{1}{\left(\underbrace{x^2+y^2}_{r^2}+\left(z-\frac{L}{2}\right)^2\right)^{1/2}} - \frac{1}{\left(\underbrace{x^2+y^2}_{r^2}+\left(z+\frac{L}{2}\right)^2\right)^{1/2}} \right] \hat{z} \right\}$$



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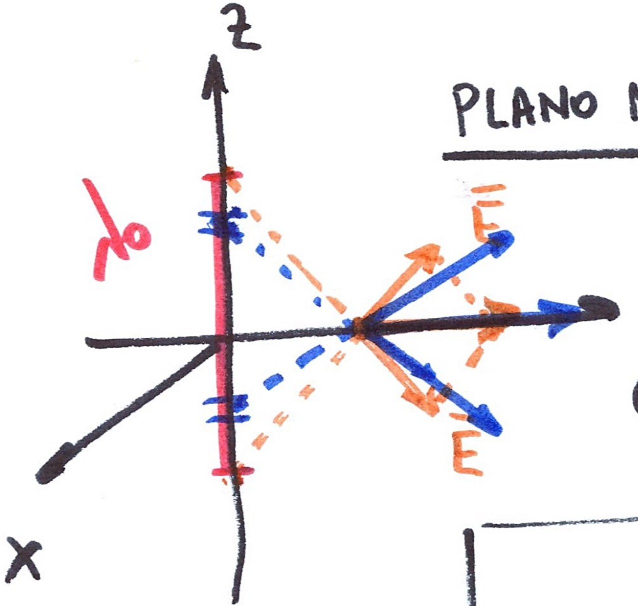
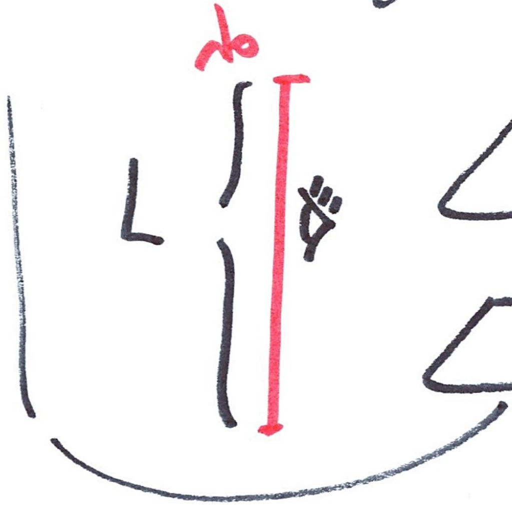
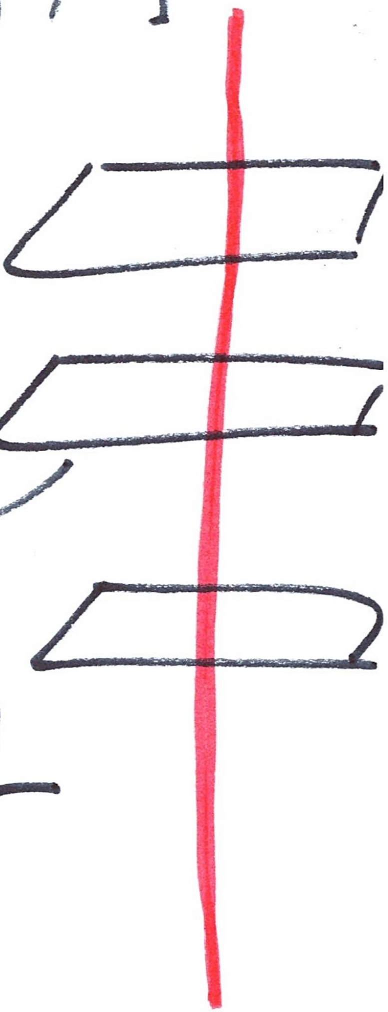
$$\bar{E}(\bar{r}) = \frac{k\lambda_0}{r}\left[\frac{(z+L/2)}{\left(r^2+\left(z+\frac{L}{2}\right)^2\right)^{1/2}} - \frac{(z-L/2)}{\left(r^2+\left(z-\frac{L}{2}\right)^2\right)^{1/2}}\right]\hat{r} + k\lambda_0\left[\frac{1}{\left(r^2+\left(z-\frac{L}{2}\right)^2\right)^{1/2}} - \frac{1}{\left(r^2+\left(z+\frac{L}{2}\right)^2\right)^{1/2}}\right]\hat{z}$$



PLANO MEDIATRIZ $\rightarrow z = 0 \rightarrow E_z = 0$

$\bar{E}$ $\hat{r}$





Campo en $\hat{r}$ $\forall$ pto. $\begin{cases} \text{hilo infinito} \\ z, r \ll L \end{cases}$

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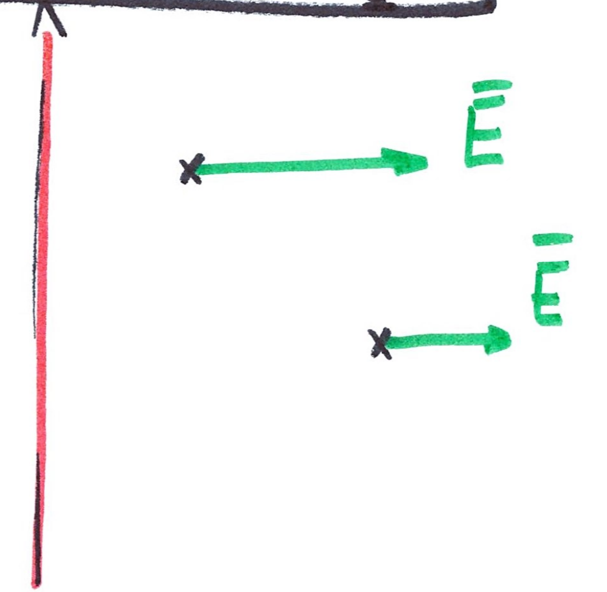
hilo "∞" ; $r, z \ll L$ $(L \to \infty)$

$$E_z \longrightarrow k\lambda_0 \left[\underset{\to 0}{} - \underset{\to 0}{} \right] \checkmark$$

$$E_r \longrightarrow \frac{k\lambda_0}{r} \underbrace{\left[\underbrace{\frac{z + L/2}{\left(r^2 + (z+\frac{L}{2})^2\right)^{1/2}}}_{\to 1} - \underbrace{\frac{z - L/2}{\left(r^2 + (z-\frac{L}{2})^2\right)^{1/2}}}_{\to -1} \right]}_{2}$$

hilo "∞":
$$\boxed{\vec{E} = \frac{2k\lambda_0}{r}\,\hat{r}}$$

z



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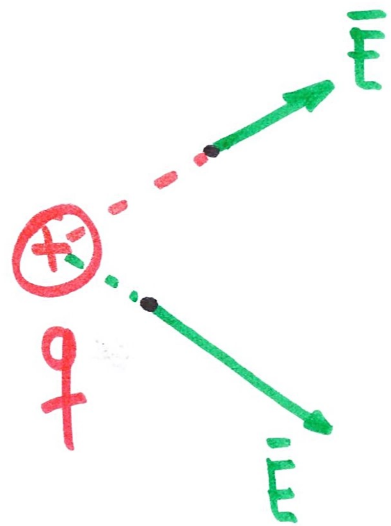
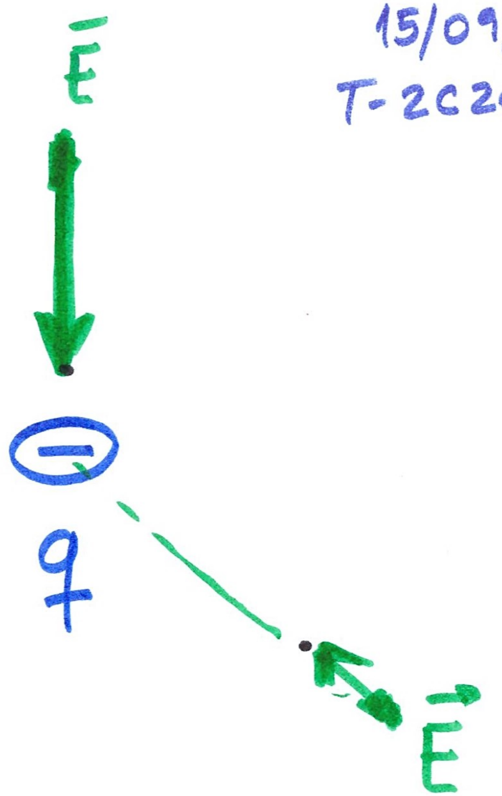
Representación de $\vec{E}$

VECTOR CAMPO ELÉCTRICO: $\bar{E}$



$$\vec{E} = \frac{kq}{r^2}\,\hat{r}$$



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Líneas de Campo

(Líneas de fuerza)

$\downarrow \bar{F} = q\,\bar{E}$