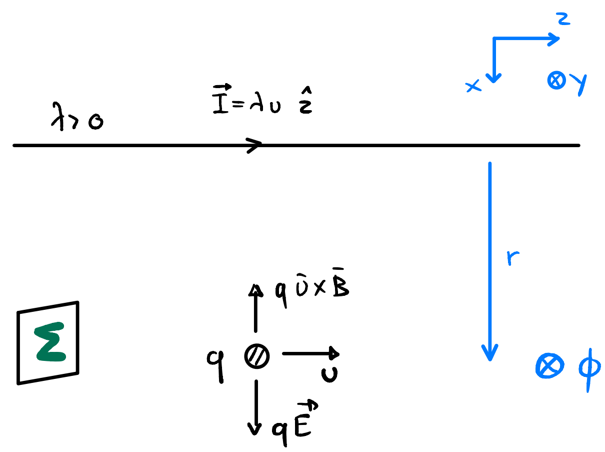
γραμμική κατανομή φορτίου



$$\oint \vec{B}\, d\vec{\ell} = \mu_0 I$$

για $\phi = 0$

$$\vec{B} = \frac{\mu_0 I}{2\pi r}\,\hat{\phi}$$

$$\vec{\upsilon}\times\vec{B} = (\upsilon\,\hat{z})\times\left(\frac{\mu_0 I}{2\pi r}\,\hat{\phi}\right) = \frac{\mu_0 I \upsilon}{2\pi r}(-\hat{r})$$

$$\oiint \vec{E}\, d\vec{S} = q/\varepsilon_0$$

$$\hat{r}\,(2\pi r L)\, E\,\hat{r} = \frac{L\cdot\lambda}{\varepsilon_0}$$

$$\vec{E} = \frac{\lambda}{2\pi\varepsilon_0 r}\,\hat{r}$$

$$\vec{E} = \frac{\lambda}{2\pi\varepsilon_0 r}\,\hat{r} = \frac{\lambda}{2\pi\varepsilon_0 r}\,\hat{x}$$

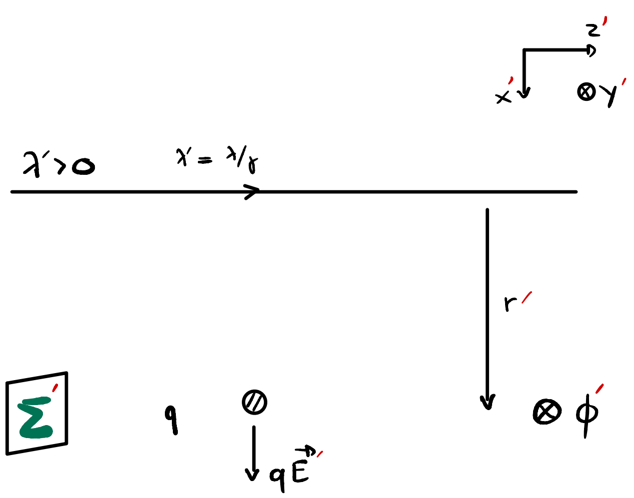
$$\vec{B} = \frac{\mu_0\lambda\upsilon}{2\pi r}\,\hat{\phi} = \frac{\mu_0\lambda\upsilon}{2\pi r}\,\hat{y}$$

$$\vec{F}_L = q\left(\vec{E} + \vec{\upsilon}\times\vec{B}\right)$$

$$\vec{F}_L = q\left(\frac{\lambda}{2\pi\varepsilon_0 r} - \frac{\mu_0\lambda\upsilon^2}{2\pi r}\right)\hat{r} = \frac{q\lambda}{2\pi\varepsilon_0 r}\left(1 - \mu_0\varepsilon_0\upsilon^2\right) = \frac{q\lambda}{2\pi\varepsilon_0 r}\left(1 - \frac{\upsilon^2}{c^2}\right)$$

$$\mu_0\varepsilon_0 = \frac{1}{c^2} \qquad \gamma = \frac{1}{\sqrt{1-\upsilon^2/c^2}}$$

$$\vec{F}_L = \frac{q\lambda/\gamma^2}{2\pi\varepsilon_0 r}\,\hat{r}$$



$$\vec{E}' = \frac{\lambda/\gamma}{2\pi\varepsilon_0 r}\,\hat{r} = \frac{\lambda/\gamma}{2\pi\varepsilon_0 r}\,\hat{x}$$

$$\vec{B}' = \vec{0}$$

$$\vec{F}_L' = q\,\frac{\lambda'}{2\pi\varepsilon_0 r}\,\hat{r}$$

$$\vec{F}_L = \frac{q\lambda'/\gamma}{2\pi\varepsilon_0 r}\,\hat{r}$$

$$\boxed{\vec{F}_L = \vec{F}_L'/\gamma}$$

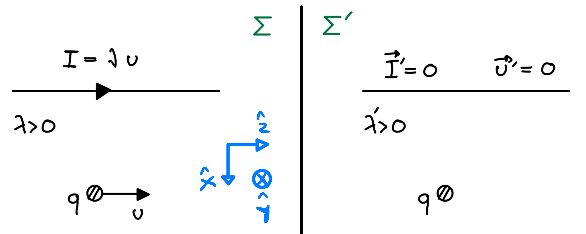
μετασχηματισμος Lorentz
στα H/M

$$\vec{E}, \vec{B} \longrightarrow \vec{E}', \vec{B}'$$

$$F^{\mu\nu} = \begin{bmatrix} 0 & E_x & E_y & E_z \\ -E_x & 0 & B_z & -B_y \\ -E_y & -B_z & 0 & B_x \\ -E_z & B_y & -B_x & 0 \end{bmatrix}$$

$$T'^{\mu\nu} \equiv \Lambda^\mu{}_\kappa \Lambda^\nu{}_\lambda T^{\kappa\lambda}$$

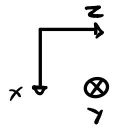
$$T'^\mu \equiv \Lambda^\mu{}_\nu T^\nu$$



$$\vec{E} = \frac{\lambda}{2\pi\varepsilon_0 r}\,\hat{x} \qquad \vec{E}' = \frac{\lambda/\gamma}{2\pi\varepsilon_0 r}\,\hat{x}$$

$$\vec{B} = \frac{\mu_0 \lambda \upsilon}{2\pi r}\,\hat{y} \qquad \vec{B}' = \vec{0}$$

$$\phi = 0$$



$$\vec{E} = \underbrace{\frac{\lambda}{2\pi\varepsilon_0 r}}_{A}\,\hat{x} \qquad \vec{E}' = \frac{\lambda/\gamma}{2\pi\varepsilon_0 r}\,\hat{x}$$

$$\vec{B} = \frac{\mu_0 \lambda \upsilon}{2\pi r}\,\hat{y} \qquad \vec{B}' = \vec{0}$$

$$\vec{E} = A\,\hat{x}, \quad \vec{B} = \mu_0\varepsilon_0 A\upsilon\,\hat{y} \quad \Big| \quad \vec{E} = A\,\hat{x}, \quad \vec{B} = A\upsilon\,\hat{y}$$

$$c^2 = \frac{1}{\mu_0\varepsilon_0} \qquad c = 1$$

$$\gamma(1-\upsilon^2) = \frac{1}{\sqrt{1-\upsilon^2}}(1-\upsilon^2) = \frac{1}{\gamma}$$

$$F^{\mu\nu} = \begin{bmatrix} 0 & A & 0 & 0 \\ -A & 0 & 0 & -A\upsilon \\ 0 & 0 & 0 & 0 \\ 0 & A\upsilon & 0 & 0 \end{bmatrix}$$

$$F'^{\mu\nu} = \Lambda^\mu{}_\kappa F^{\kappa\lambda} \Lambda^\nu{}_\lambda$$

$$F' = \Lambda F \Lambda^T$$

$$F'^{\mu\nu} = \begin{bmatrix} \gamma & 0 & 0 & -\gamma\upsilon \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -\gamma\upsilon & 0 & 0 & \gamma \end{bmatrix} \begin{bmatrix} 0 & A & 0 & 0 \\ -A & 0 & 0 & -A\upsilon \\ 0 & 0 & 0 & 0 \\ 0 & A\upsilon & 0 & 0 \end{bmatrix} \begin{bmatrix} \gamma & 0 & 0 & -\gamma\upsilon \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -\gamma\upsilon & 0 & 0 & \gamma \end{bmatrix} =$$

$$= \begin{bmatrix} 0 & A/\gamma & 0 & 0 \\ -A & 0 & 0 & -A\upsilon \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} \gamma & 0 & 0 & -\gamma\upsilon \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -\gamma\upsilon & 0 & 0 & \gamma \end{bmatrix} = \begin{bmatrix} 0 & A/\gamma & 0 & 0 \\ -A/\gamma & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$\begin{bmatrix} 0 & E_x' & E_y' & E_z' \\ -E_x' & 0 & B_z' & -B_y' \\ -E_y' & -B_z' & 0 & B_x' \\ -E_z' & B_y' & -B_x' & 0 \end{bmatrix}$$

$$\vec{B}' = \vec{0} \qquad \vec{E}' = A/\gamma\,\hat{x}$$

$$E^2 - B^2 = A^2 - A^2\upsilon^2 = A^2(1-\upsilon^2) = A^2/\gamma^2$$

$$E'^2 - B'^2 = \left(A/\gamma\right)^2 - 0 = A^2/\gamma^2 = E^2 - B^2$$