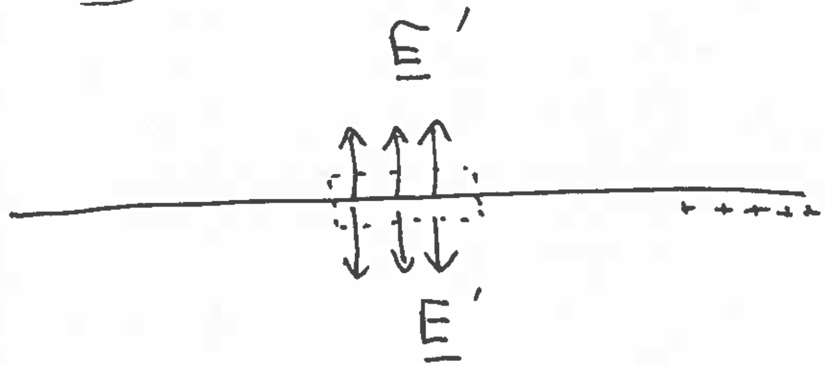
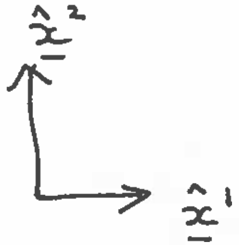
Relativity Interactive Session

1) S'





$$2AE'_2 = \frac{A\sigma_0}{\varepsilon_0}$$

For $x^2 > 0$ $\quad E'_2 = \frac{\sigma_0}{2\varepsilon_0}$

$x^2 < 0$ $\quad E'_2 = -\frac{\sigma}{2\varepsilon_0}$

$$E'_2 = \frac{\sigma}{2\varepsilon_0}\,\mathrm{sign}[x^2]$$

By symmetry: $\quad E'_1 = E'_3 = 0$

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

Reminder

$$\Lambda^{\delta}{}_{\gamma} = \begin{array}{c c} & \begin{array}{cccc} \gamma \rightarrow & & & \\ 0 & 1 & 2 & 3 \end{array} \\ \begin{array}{c} \delta \downarrow 0 \\ 1 \\ 2 \\ 3 \end{array} & \left(\begin{array}{cc|cc} \gamma & -\gamma\beta & 0 & 0 \\ -\gamma\beta & \gamma & 0 & 0 \\ \hline 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{array} \right) \end{array}$$

$$F^{\alpha\beta} = \begin{array}{c c} & \begin{array}{cccc} \beta \rightarrow & & & \\ 0 & 1 & 2 & 3 \end{array} \\ \begin{array}{c} \alpha \downarrow 0 \\ 1 \\ 2 \\ 3 \end{array} & \left(\begin{array}{cccc} 0 & -E_1/c & -E_2/c & -E_3/c \\ E_1/c & 0 & -B_3 & B_2 \\ E_2/c & B_3 & 0 & -B_1 \\ E_3/c & -B_2 & B_1 & 0 \end{array} \right) \end{array}$$

2) $$F'^{\mu\nu} = \begin{bmatrix} 0 & 0 & -E_z'/c & 0 \\ 0 & 0 & 0 & 0 \\ E_z'/c & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

3) (a) $$F^{\mu\nu} = (\Lambda^{-1})^{\mu}{}_{\alpha} (\Lambda^{-1})^{\nu}{}_{\beta} F'^{\alpha\beta}$$

(b) $$F^{\mu\nu} = \underset{\substack{\uparrow \\ \delta^{2}{}_{2}}}{(\Lambda^{-1})^{\mu}{}_{2}} (\Lambda^{-1})^{\nu}{}_{0} F'^{20}$$

$$\therefore \quad F^{2\nu} = (\Lambda^{-1})^{\nu}{}_{0} F'^{20}$$ (only non-zero terms)

Two non-zero terms in $\left(\Lambda^{-1}\right)^{\nu}{}_{0}$ give:

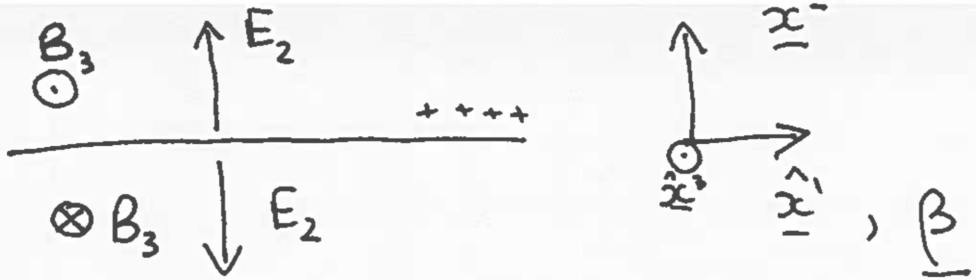
$$\frac{E_2}{c} = F^{20} = \left(\Lambda^{-1}\right)^{0}{}_{0} \frac{E_2'}{c} = \gamma \frac{E_2'}{c}$$

$$B_3 = F^{21} = \left(\Lambda^{-1}\right)^{1}{}_{0} \frac{E_2'}{c} = \gamma\beta \frac{E_2'}{c}$$

$$F^{\mu\nu} = \begin{bmatrix} 0 & 0 & -\gamma\frac{E_2'}{c} & 0 \\ 0 & 0 & -\gamma\beta\frac{E_2'}{c} & 0 \\ \gamma\frac{E_2'}{c} & \gamma\beta\frac{E_2'}{c} & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$= \begin{bmatrix} 0 & 0 & & \\ 0 & 0 & & \\ E_2/c & \beta E_2/c & & \\ 0 & 0 & & \end{bmatrix}$$

4) S



5) Direction of $\underline{B}$ field make sense from right-hand rule

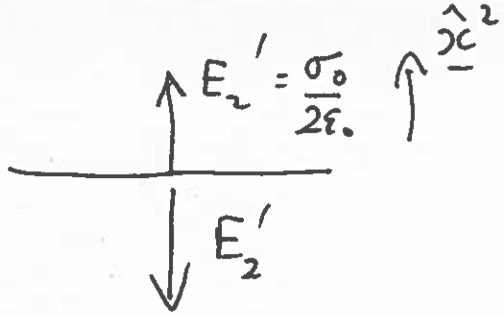
$$\underline{j} \times \underline{r}$$

or from Lecture 15 $\underline{B} = \frac{1}{c} \underline{\beta} \times \underline{E}$

6) Because of length contraction $\Delta x = \dfrac{\Delta x'}{\gamma}$

$$\sigma_{\text{frame } S} = \gamma \sigma_0$$

7) S'



$$V' = -|x^2| E_2' = -\frac{\sigma_0}{2\varepsilon_0}|x^2|$$

$$A'^{\mu} = \left[-\frac{\sigma_0 |x^2|}{2\varepsilon_0 c}, 0, 0, 0\right]$$