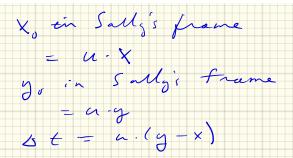
1. You observe two events at space-times coordinates x and y. You also observe Sally moving with four-velocity u. Express the time difference between the events that Sally would observe in terms of invariants involving x, y and u.



2. You observe uniform electric and magnetic fields,

$$\vec{E} = E_x \hat{x} + E_y \hat{y},$$

$$\vec{B} = B_x \hat{x}.$$

The strengths of the fields are such that $B_x < E_x$ and $B_x > E_y$. Answer TRUE or FALSE to the following questions.

- (a) There exists a finite velocity by which you can boost to find a frame where $\vec{B}'=0$
- (b) There exists a finite velocity by which you can boost to find a frame where $\vec{E}'=0$
- (c) If you boost along the z axis, the \vec{B} field will stay the same
- (d) If you boost along the z axis, the \vec{E} field will stay the same



- 3. Beginning with $F^{\alpha\beta} = \partial^{\alpha}A^{\beta} \partial^{\beta}A^{\alpha}$, and $\tilde{F}^{\alpha\beta} = (1/2)\epsilon^{\alpha\beta\gamma\delta}F_{\gamma\delta}$, express $F^{\alpha\beta}\tilde{F}_{\alpha\beta}$ in terms of \vec{E} and \vec{B} using

$$\vec{E} = -\nabla A_0 - \partial_t \vec{A},$$

$$\vec{B} = \nabla \times \vec{A}.$$

Show your work (Don't simply write the answer).

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