Practice Problem Set #2

September 24, 2016

1. Qualitatively, how do measures of distance and time transform when one changes inertial reference frames in Galilean relativity? In special relativity?

2. An electron travel $1.6km$ through a linear accelerator at $.999999c$ before colliding with a positron (an anti-electron).

   (a) In the laboratory's reference frame how far did the electron travel before colliding with the positron?

   (b) In the electron's reference frame how long was the track through which it traveled?

   (c) In the laboratory's frame of reference how long did the electron travel before its positron collision?

   (d) In the electron's frame of reference how long did it travel through the accelerator?

   (e) Recalculate (b) directly using the Lorentz transformations for space. (If you already have, try recalculating (b) using length contraction formula.) (Hint: Proper distances should be measured simultaneously in the primed frame (i.e. $t'_1 = t'_2$).)

   (f) Recalculate (d) directly using the Lorentz transformations for time. (If you already have, try recalculating (d) using the time dialation formula.) (Hint: The electron travels a distance $x_2 - x_1 = v(t_2 - t_1)$ in the laboratory frame.)

3. (Ch. 33, Q. 44) Derive the Lorentz transformations for time

$$t' = \gamma \left(t - \frac{vx}{c^2} \right) \tag{1}$$

   from the transformations for space

$$x' = \gamma(x - vt). \tag{2}$$