Homework 1. PHY 564

Problem 1. 2 points. Lorentz transformations

Show explicitly that two successive Lorentz transformations in the same direction are equivalent to a single Lorentz transformation with $v = \frac{v_1 + v_2}{1 + (v_1 v_2 / c^2)}$.

Problem 2. 2 points. 4-invarints

Show that trace of a tensor is 4-invariant, i.e. $F_i^i \equiv \sum_{i=0}^{3} F_i^i = inv$.

Problem 3. 6 points, Orbit of the antiparticle

Consider an accelerator with time independent (DC) magnetic elements, i.e. there is no electric field and know beam trajectory for a particle with charge *e*, energy γmc^2 and known trajectory $\vec{r}(t)$. Prove that placing at the same position antiparticle with opposite charge -*e*, the same energy and opposite direction of the momentum

$$\vec{r}_{e+} = \vec{r}_{e-}; \ \vec{p}_{e+} = -\ \vec{p}_{e-}$$

will result in the same trajectory traveled in the opposite direction.