Homework 4

PH507 Grad EM

due 5 Nov. 2007

posted: 27 October 2007

Reading: Heald and Marion, 14.1-14.8

1) HM 14.5. Decompose the vector **x** into components that are perpendicular and parallel to the velocity, then use the boost equations to put this in vector form. Optional: this result should agree with what you get by directly rotating the Lorentz transform matrix with a similarity transform. When I do it (by checking with a rotation about the y-axis), I get a sign discrepancy in the last row and last column.
2) HM 14.6. This is a straightforward application of the results of the previous problem.
3) Show that the quantity $E^2 - B^2$ is a scalar invariant by calculating directly (as I did in class for $\mathbf{E}\cdot\mathbf{B}$) from the field transformation equations 14.77. Next, show that the quantity $S^2 - c^2\mathsf{E}^2$ is invariant, where S is the magnitude of the Poynting vector and E is the energy density of the fields.