

Homework No. 8: Tensors and 4-Vectors

Due: Monday, April 6, 2009

**1. Lorentz Transformation of Electric and Magnetic Fields.**

Show that  $\mathbf{E} \cdot \mathbf{B}$  is an invariant quantity under a Lorentz transformation, and that therefore if the electric and magnetic fields are perpendicular to one another in one inertial frame, they are perpendicular in all frames. (HINT: Look on p. 129 in Rybicki and Lightman).

**2. Lorentz Transformations and invariants.**

Show that  $\mathbf{B}^2 - \mathbf{E}^2$  is an invariant quantity under a Lorentz transformation.

**3. Maxwell's Equations and Tensor Notation.** Show that Maxwell's equations may be written

$$F_{\mu\nu}{}^{,\nu} = (4\pi/c) j_{\mu}$$

and

$$F_{[\mu\nu,\sigma]} = 0$$