PHYS 532 **HOMEWORK 8 (CHAPTER 11)** **Due Mon. 4/9/07**

One problem:

A star of radius a rotates with angular velocity $\omega\,\hat{\mathbf{e}}_z$ relative to an inertial frame I, in which the star's center is at rest. According to an observer seated uncomfortably on the surface, and at rest with respect to it, there is no electric field at the surface, and the magnetic field is given by

$$\mathbf{B} = \frac{M\left[3\,\hat{\mathbf{e}}_r(\hat{\mathbf{e}}_r\cdot\hat{\mathbf{e}}_z) - \hat{\mathbf{e}}_z\right]}{a^3}$$

where $\hat{\mathbf{e}}_z$ is a unit vector parallel to the rotation axis and $\hat{\mathbf{e}}_r$ is a unit vector radially out from the center.

(If you are worried about defining fields in a non-inertial frame, you may assume that this non-inertial observer gets the same answers for **E** and **B** as an inertial observer who instantaneously is at rest with respect to the non-inertial observer.)

(a) What is the surface magnetic field, as measured in the inertial frame *I*?

(b) What is the surface electric field, as measured in the inertial frame *I*?

(c) What is the total charge inside the star according to measurements made in frame *I*? Is your answer consistent with the fact that **E** = 0 on the surface, according to corotating observers, and the fact that charge is a Lorentz invariant? Why or why not? Assume that $\omega a << c$.