

March 31, 2013

**PHY 712 – Problem Set # 19**

Finish reading Chapter 11 and start reading Chapter 14 of **Jackson**. The problem will be due Wed. Apr. 3, 2013. Note: we are using cgs (Gaussian) units.

1. Consider the electromagnetic field transformations between a "stationary" frame  $S$  relative to a frame  $S'$  which is moving at constant velocity  $v$  along the  $x$  axis. In the  $S'$  frame, there is a plane wave in vacuum propagating along the  $z$  axis with electric field amplitude  $E_0$

$$\mathbf{E}' = E_0 \hat{\mathbf{x}} e^{i\mathbf{k}' \cdot \mathbf{r}' - i\omega' t'}$$

$$\mathbf{B}' = E_0 \hat{\mathbf{y}} e^{i\mathbf{k}' \cdot \mathbf{r}' - i\omega' t'}$$

- (a) Determine the  $\mathbf{E}$  and  $\mathbf{B}$  fields in the stationary frame.
- (b) Check whether the fields in the stationary frame behave like normal plane waves. That is that in cgs (Gaussian) units the amplitudes of the  $\mathbf{E}$  and  $\mathbf{B}$  fields have the same magnitude and the wavevector  $\mathbf{k}$  is perpendicular to both  $\mathbf{E}$  and  $\mathbf{B}$ .