Homework Set No. 5, Physics 836

Deadline – Wednesday, May 14, 2008

1. (10 pts) Jackson Problem 12.16 (a)

2. (10 pts) Similar to how it was done in class for retarded Green function start from

$$G(x) \; = \; - \int \frac{d^4 k}{(2\pi)^4} \, e^{-ik\cdot x} \, \frac{1}{k^2} \tag{1}$$

integrate over k_0 using the *advanced* contour (see Fig. 12.7 in Jackson) and integrate over other momentum components to obtain the *advanced* Green function as given in Eq. (12.132) (or, equivalently, in the second Eq. (12.133)) in Jackson.

3. (10 pts) Start from Lienard-Wiechert potentials

$$\Phi(\vec{x}, t) \; = \; \left[\frac{e}{(1 - \hat{n} \cdot \vec{\beta}) \, R} \right]_{ret} \tag{2}$$

$$\vec{A}(\vec{x}, t) \; = \; \left[\frac{e \, \vec{\beta}}{(1 - \hat{n} \cdot \vec{\beta}) \, R} \right]_{ret} \tag{3}$$

where the charge moves along the trajectory $\vec{r}(t)$, $\vec{\beta} = (1/c) d\vec{r}/dt$,

$$\vec{R}(t) = \vec{x} - \vec{r}(t), \tag{4}$$

$R(t) = |\vec{R}(t)|$, $\hat{n} = \vec{R}/R$ and the subscript *ret* means that everything is evaluated at the time t_{ret} defined by

$$t_{ret} = t - \frac{R(t_{ret})}{c}. \tag{5}$$

Show by direct differentiation that the electric field

$$\vec{E} = -\vec{\nabla}\Phi - \frac{1}{c} \frac{\partial \vec{A}}{\partial t} \tag{6}$$

is given by Eq. (14.14) in Jackson.