PHYC 511: Electrodynamics

Spring 2019

Homework Assignment #6

(Due April 3, 2019)

1- An electromagnetic plane wave is propagating along the z direction and its eelctric field is given by:

$$\vec{E}(\vec{x},t) = E_0 \hat{e}_0 e^{i(kz-\omega t)} \quad , \quad \hat{e}_0 = \left(\cos\frac{\theta}{2}\hat{x} + e^{i\phi}\sin\frac{\theta}{2}\hat{y} \right) ,$$

where θ and ϕ are arbitrary real constannts.

(a) Write $\hat{e}_0$ as a linear combination of the vectors $\hat{e}_\pm = (\hat{x} \pm i\hat{y})/\sqrt{2}$, $\hat{e}_0 = \alpha\hat{e}_+ + \beta\hat{e}_-$, and show that α and β have magnitudes $\sqrt{(1+\sin\theta\sin\phi)/2}$ and $\sqrt{(1-\sin\theta\sin\phi)/2}$, respectively, and their phase difference $\Delta\psi$ is given by:

$$\tan\Delta\psi = \tan\theta \, \cos\phi \, .$$

(b) Transform to a new circular-polarization basis that is rotated relative to the original basis by angle δ, and show that a particular choice of δ can completely eliminate the relative phase $\Delta\psi$. How is this choice related to the orientation of the polarization ellipse of the plane wave?

(c) Find the ratio of the major-to-minor axes and the sense of rotation of the tip of the electric field vector on the ellipse.

2- Problem 7.3, part (a), Jackson.

3- Problem 7.4, Jackson.

4- Problem 7.6, parts (a) and (b), Jackson.

5- Problem 7.17, parts (a) and (b), Jackson.