PHYSICS 110B – Spring 2012

Midterm Review

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1. Let frame O' move with speed v in the x-direction relative to O. A photon with frequency ν measured in O moves at an angle θ relative to the x-axis.

   (a) Determine the frequency of the photon in O'
   (b) Find the angle θ at which no Doppler shift is observed.
   (c) High energy cosmic ray protons scatter off a CMB photon. Use the Compton scattering formula to determine the max energy of the scattered photon.

2. Harmonic oscillating charge:

A charge q executes simple harmonic motion with amplitude A and frequency w. Calculate the far field components of E and B, and the rate of energy loss.

3. Barn and pole: (Schutz 1.17 (a-d))

A runner carries a 20-m long pole running toward a 15-m long barn at velocity 0.8 c. A stationary friend observes and waits until the back end of the pole just enters the barn door to close the door.

   (a) What is the length of the pole in the friend's frame?
   (b) How long does it take for the front end of the pole to reach the back wall of the barn after the door is closed? Compute the interval between the events of shutting the door and hitting the wall. Is it spacelike, timelike, or null?
   (c) What are the lengths of the pole and the barn in the runner's frame?
   (d) Does the runner believe that the pole is entirely inside the barn when its front end hits the wall? Why or why not?