Universität Leipzig, Fakultät für Physik und Geowissenschaften

Exercises for Experimental Physics 3 – IPSP

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Exercise Sheet 7 (WS 2010/11)

Date of Issue to Students: Nov. 25th 2010

Date of Submission: Dec. 2nd 2010

Submission Place: Marked mailbox next to room 302 (Linnestr. 5)
Submission Time: 11:00 a.m. at the submission day noted above

Please note: Write your name and matriculation number on EACH sheet of paper.
Only submit the calculations and results for exercise 1-3, exercise 4 will be discussed during the instruction classes.

Exercises:

1. Use Maxwell's equations to show for a plane wave, in which $\vec{E}$ and $\vec{B}$ are independent of y and z, that

$$\frac{\partial E_z}{\partial x} = \frac{\partial B_y}{\partial t} \text{ and } \frac{\partial B_y}{\partial x} = \mu_0 \in_0 \frac{\partial E_z}{\partial t}.$$

   You can use figure 1 and 2 for explanation (7 Points).

2. Ole Römer discovered the finiteness of the speed of light by observing Jupiter's moons. Approximately how sensitive would the timing apparatus need to be in order to detect a shift in the predicted time of the moon's eclipses that occur when the moon happens to be at perigee ($3.63 \cdot 10^5$ km) and those that occur when the moon is at apogee ($4.06 \cdot 10^5$ km)? Assume that an instrument should be able to measure to at least one-tenth the magnitude of the effect it is to measure. (3 Points)

3. Sodium has excited states 2.11 eV, 3.20 eV, and 4.35 eV above the ground state. Assume that the atoms of the gas are all in the ground state prior to irradiation. (a) What is the maximum wavelength of radiation that will result in resonance fluorescence? What is the wavelength of the fluorescent radiation? (b) What wavelength will result in excitation of the state 4.35 eV above the ground state? If that state is excited, what are the possible wavelengths of resonance fluorescence that might be observed? (5 Points)

4. An intense point source of light radiates 1.00 MW isotropically (uniformly in all directions). The source is located 1.00 m above an infinite, perfectly reflecting plane. Determine the force that the radiation pressure exerts on the plane.

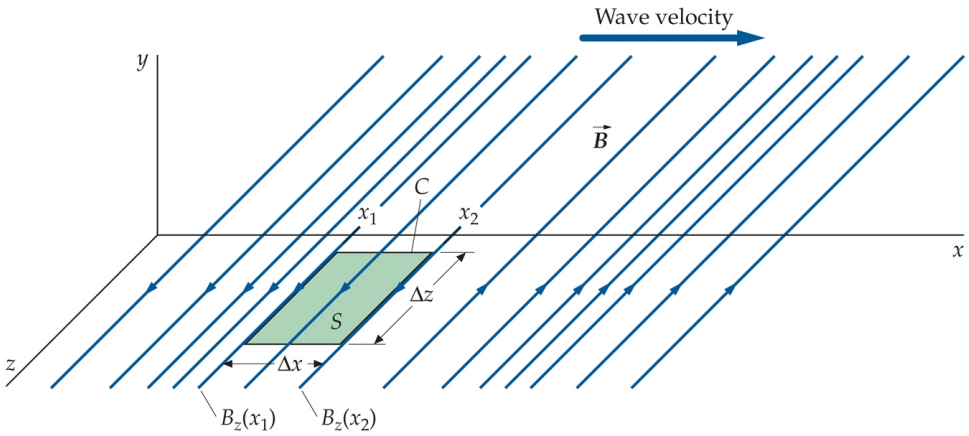

Figure 1: Exercise 1

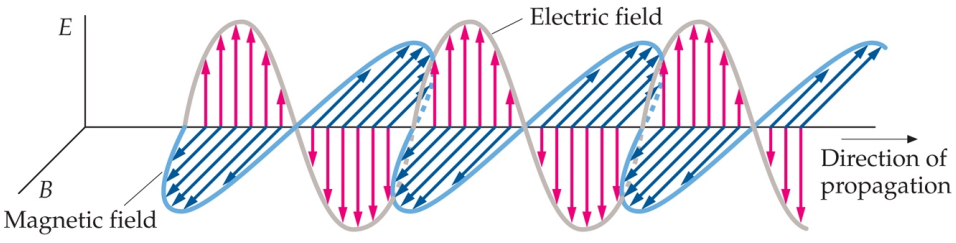

Figure 2: Exercise 1