Universität Leipzig, Fakultät für Physik und Geowissenschaften

Exercises for Experimental Physics 3 – IPSP

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Exercise Sheet 6 (WS 2010/11)

Date of Issue to Students: Nov. 18th 2010

Date of Submission: Nov. 25th 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. A pulsed laser fires a 1000-MW pulse that has a 200-ns duration at a small object that has a mass equal to 10.0 mg and is suspended by a fine fiber that is 4.00 cm long. If the radiation is completely absorbed by the object, what is the maximum angle of deflection of this pendulum? (Think of the system as a ballistic pendulum and assume the small object was hanging vertically before the radiation hit it.) (5 Points)

2. Estimate the force on Earth due to the pressure of the radiation on Earth by the Sun, and compare this force to the gravitational force of the Sun on Earth. (At Earth's orbit, the intensity of sunlight is 1.37 kW/m^2.) (4 Points)

3. A circular loop of wire can be used to detect electromagnetic waves. Suppose the signal strength from a 100-MHz FM radio station 100 km distant is 4.0 $\mu W/m^2$, and suppose the signal is vertically polarized. What is the maximum rms voltage induced in your antenna, assuming your antenna is a 10.0-cm-radius loop? (6 Points)

4. When an electromagnetic wave at normal incidence on a perfectly conducting surface is reflected, the electric field of the reflected wave at the reflecting surface is equal and opposite to the electric field of the incident wave at the reflecting surface. (a) Explain why this assertion is valid. (b) Show that the superposition of incident and reflected waves results in a standing wave. (c) Are the magnetic fields of the incident waves and reflected waves at the reflecting surface equal and opposite as well? Explain your answer.