Exercises for Experimental Physics 3 – IPSP

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Exercise Sheet 5 (WS 2012/13)

Date of Issue to Students: Nov. 9th 2012

Date of Submission: Nov. 16th 2012

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. You and your engineering crew are in charge of setting up a wireless telephone network for a village in a mountainous region. The transmitting antenna of one station is an electric dipole antenna located atop a mountain 2.00 km above sea level. There is a nearby mountain that is 4.00 km from the antenna and is also 2.00 km above sea level. At that location, one member of the crew measures the intensity of the signal to be $4.00 \cdot 10^{-12}$ W/m^2. What should be the intensity of the signal at the village that is located at sea level and 1.50 km from the transmitter? (5 Points)

2. Regulations require that licensed radio stations have limits on their broadcast power so as to avoid interference with signals from distant stations. You are in charge of checking compliance with the law. At a distance of 30.0 km from a radio station that broadcasts from a single vertical electric dipole antenna at a frequency of 800 kHz, the intensity of the electromagnetic wave is $2.00 \cdot 10^{-13}$ W/m^2. What is the total power radiated by the station? (9 Points)

3. Show that any function of the form $\vec{E} = y(x,t) = f(x - vt)$ or $\vec{E} = y(x,t) = g(x + vt)$ satisfies the wave equation $\frac{\partial^2 \vec{E}}{\partial x^2} = \frac{1}{c^2} \frac{\partial^2 \vec{E}}{\partial t^2}$. (6 Points)

4. A small private plane approaching an airport is flying at an altitude of 2.50 km above sea level. As a flight controller at the airport, you know your system uses a vertical electric dipole antenna to transmit 100 W at 24.0 MHz. What is the intensity of the signal at the plane's receiving antenna when the plane is 4.00 km from the airport? Assume the airport is at sea level.