Universität Leipzig, Fakultät für Physik und Geowissenschaften

Exercises for Experimental Physics 4 – IPSP

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Exercise Sheet 3 (Summer Term 2013)

Date of Issue to Students: April 30th 2013

Date of Submission: May 7th 2013

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 vehicle of mass 2000 kg is driving along the highway and approaches a 10-m-wide bridge. What has to be the speed of the vehicle that its wavelength reaches a size that crossing the bridge acts as driving through a single slit and diffraction occurs? Compare the results with normal conditions, i.e. normal speed of a car on a highway with 30 m/s. (6 Points)

2. When light of wavelength λ_1 is incident on the cathode of a photoelectric tube, the maximum kinetic energy of the emitted electrons is 1.8 eV. If the wavelength is reduced to $1/2\,\lambda_1$, the maximum kinetic energy of the emitted electrons is 5.5 eV. Find the work function ϕ of the cathode material. (6 Points)

3. A 100-W incandescent light bulb radiates 2.6 W of visible light uniformly in all directions. (a) Find the intensity of the light from the bulb at a distance of 1.5 m. (b) If the average wavelength of the visible light is 650 nm, and counting only those photons in the visible spectrum, find the number of photons per second that strike a surface that has an area equal to 1.0 cm^2, is oriented so that the line to the bulb is perpendicular to the surface, and is a distance of 1.5 m from the bulb. (8 Points)

4. An incident photon of energy E_i undergoes Compton scattering at an angle of θ. Show that the energy E_s of the scattered photon is given by

$$E_s = \frac{E_i}{1 + \left(\frac{E_i}{m_e c^2}\right)(1 - \cos\theta)}.$$