Universität Leipzig, Fakultät für Physik und Geowissenschaften

Exercises for Experimental Physics 3 – IPSP

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Exercise Sheet 12 (WS 2012/13)

Date of Issue to Students: Jan. 18^{th} 2013

Date of Submission: Jan. 25^{th} 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. The star Mizar in Ursa Major is a binary system of stars of nearly equal magnitudes. The angular separation between the two stars is 14 seconds of arc. What is the minimum diameter of the pupil that allows resolution of the two stars using light that has a wavelength equal to 550 nm? Draw a sketch! (6 Points)

2. Sodium light that has a wavelength equal to 589 nm falls normally on a 2.00-cm-square diffraction grating ruled with 4000 lines per centimeter. The Fraunhofer diffraction pattern is projected onto a screen a distance of 1.50 m from the grating by a 1.50-m-focal-length lens that is placed immediately in front of the grating. Find (a) the distance of the first and second order intensity maxima from the central intensity maximum, (b) the width of the central maximum, and (c) the resolution in the first order. (Assume the entire grating is illuminated.) (8 Points)

3. A radio telescope is situated at the edge of a lake. The telescope is looking at light from a radio galaxy that is just rising over the horizon. If the height of the antenna is 20 m above the surface of the lake, at what angle above the horizon will the radio galaxy be when the telescope is centered in the first intensity interference maximum of the radio waves? Assume the wavelength of the radio waves is 20 cm. (6 Points)

4. A Fabry-Perot interferometer (Figure 1) consists of two parallel, half-silvered mirrors that face each other and are separated by a small distance a. A half-silvered mirror is one that transmits 50% of the incident intensity and reflects 50% of the incident intensity. Show that when light is incident on the interferometer at an angle of incidence θ, the transmitted light will have maximum intensity when $2a = m\lambda/\cos\theta$ ($m = 0, 1, 2, ...$).

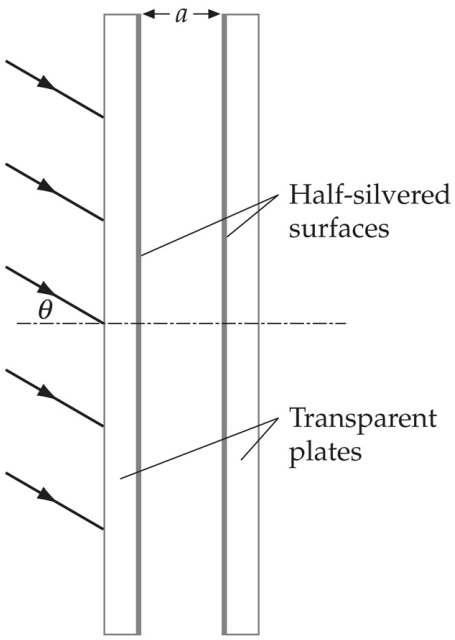

Figure 1: Exercise 4