Universität Leipzig, Fakultät für Physik und Geowissenschaften

Exercises for Experimental Physics 3 – IPSP

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Exercise Sheet 11 (WS 2012/13)

Date of Issue to Students: Jan. 11^{th} 2013

Date of Submission: Jan. 18^{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. A plano-convex glass lens of radius of curvature 2.00 m rests on an optically flat glass plate. The arrangement is illuminated from above with monochromatic light of 520-nm wavelength. The indexes of refraction of the lens and plate are 1.60. Determine the radii of the first and second bright fringe from the center in the reflected light. You can use Figure 1. (6 Points)

2. Suppose that before the lens of Problem 1 is placed on the plate, a film of oil of refractive index 1.82 is deposited on the plate. What will then be the radii of the first and second bright fringes? (6 Points)

3. A diffraction grating has n lines per unit length. Show that the angular separation ($\Delta\theta$) of two lines of wavelengths λ and $\lambda + \Delta\lambda$ is approximately

   $$\Delta\theta = \frac{\Delta\lambda}{\frac{1}{n^2m^2} - \lambda^2}$$

   where m is the order number. (8 Points)

4. Measuring the distance to the moon (lunar ranging) is routinely done by firing short-pulse lasers and measuring the time it takes for the pulses to reflect back from the moon. A pulse is fired from Earth. To send the pulse out, the pulse is expanded so that it fills the aperture of a 6.00-in-diameter telescope. Assuming the only thing spreading the beam out is diffraction and that the light wavelength is 500 nm, how large will the beam be when it reaches the Moon, $3.82 \cdot 10^5$ km away?

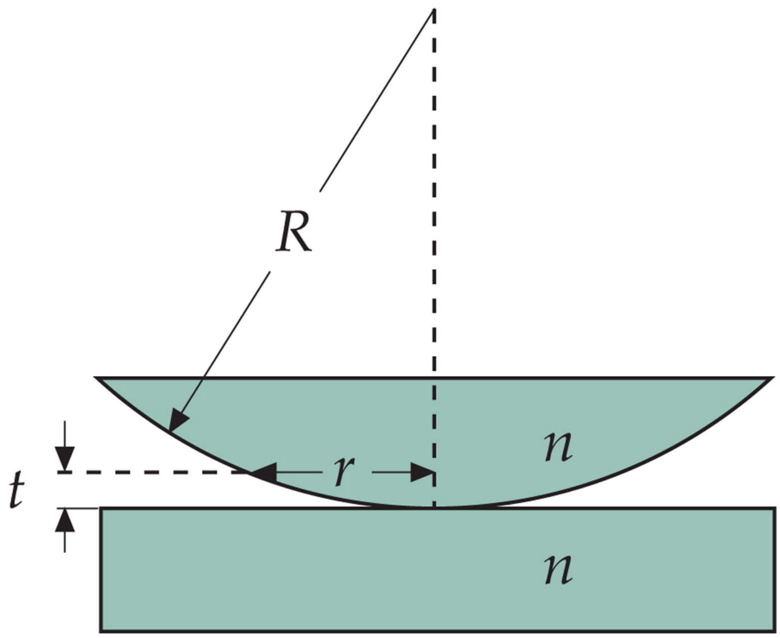

Figure 1: Exercise 1,2