Laboratory of Physics 1
Institute of Physics – CSE
Silesian University of Technology

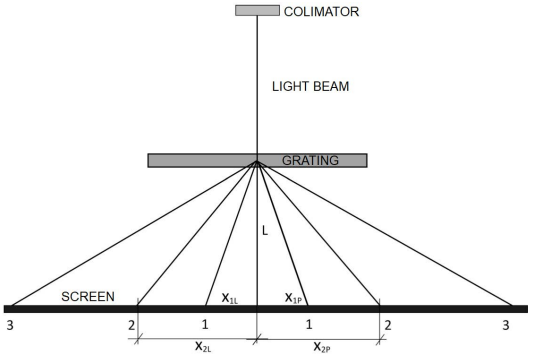
P1-O5. Determining the wavelength of laser light using a diffraction grating

Theoretical background

Diffraction of light wave at a slit. Diffraction grating. Interference.

1 Measuring system

The measurements are carried out in a system consisting of an optical bench with a millimeter strip, a laser light source, and a screen. The diffraction grating is placed on a movable holder. The distance of the interference fringes from the direction of the primary beam for a given distance of the grating from the screen is subject to measurement.
The aim of the exercise is to determine the wavelength of the laser light.



2 Measurements

1. Place the diffraction grating on the table perpendicular to the direction of the laser light. Protect your eyes from direct exposure to laser light.
2. Measure the distance between the grating and the screen.
3. Record the distances of the interference fringes from the zeroth-order fringe, to the right and left for three diffraction orders.
4. Perform similar measurements for five different distances between the grating and the screen.

3 Data analysis

1. For each pair x_L and x_P, calculate the average value of x_N, where N is the row of the interference fringe.
2. For each average value, calculate the wavelength of the laser light using the formula

$$\lambda = \frac{d}{N} \frac{x_N}{\sqrt{x_N^2 + L^2}},$$

where d - the constant of the diffraction grating, L - the distance of the grating from the screen.

3. Using the law of uncertainty propagation, calculate the uncertainty of the wavelength λ, taking into account the measurement uncertainties of the distance devices used.
4. Average all the values of λ using the weighted mean with its uncertainty.
5. Record the result in the appropriate final notation.