Lab 9: Interference and diffraction

Goals: To measure the wavelength of light using various diffraction slits.

1. *Measurement of wavelength with a double slit*

Direct the light from the diode laser, rated with a wavelength $\lambda = 650 \pm 10$ nm, at the double slit pattern with $a = 0.25 \pm 0.01$ mm between the slits and slit widths of $b = 0.040 \pm 0.005$ mm. See Fig. 1. Observe the diffraction pattern on the screen; sample data is shown in Fig. 2. From the interference pattern determine the wavelength. Further, from the diffraction pattern determine the ratio of a/b. Compare values to nominal values.

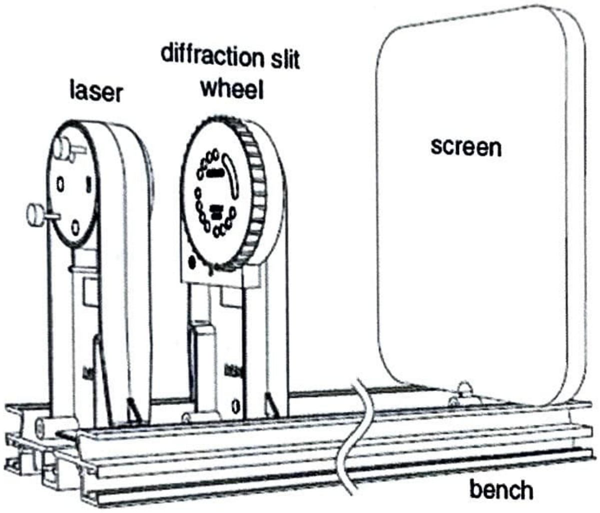

Figure 1. Set-up for experiment 1.

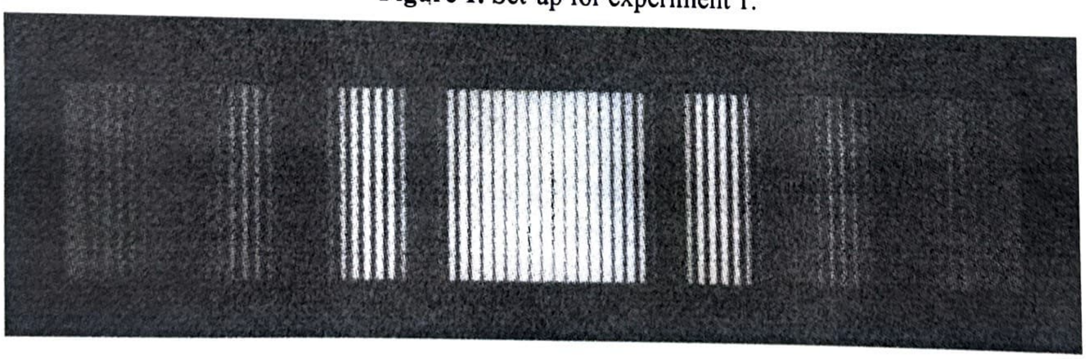

Figure 2. The interference pattern with closely spaced fringes is modified by the much broader diffraction pattern. The spacing of the fringes is determined by a and the first zero of the diffraction pattern by b.

2. *Measurement of wavelength with a diffraction grating*

With more slits the interference peaks become narrower making the measurement of wavelength more precise. Spectrometers, such as Ocean Optics, therefore use a grating with many slits to create an interference pattern that is recorded on a CCD camera. To get a sense of this we will look at the spectrum from two sources and use our eye as the CCD camera to determine the wavelengths, as in Fig. 3. Use both the hydrogen lamp as the source and at least one LED, and compile the measured wavelengths in a table. Compare with expected wavelengths. Also include the observed width of the peaks.

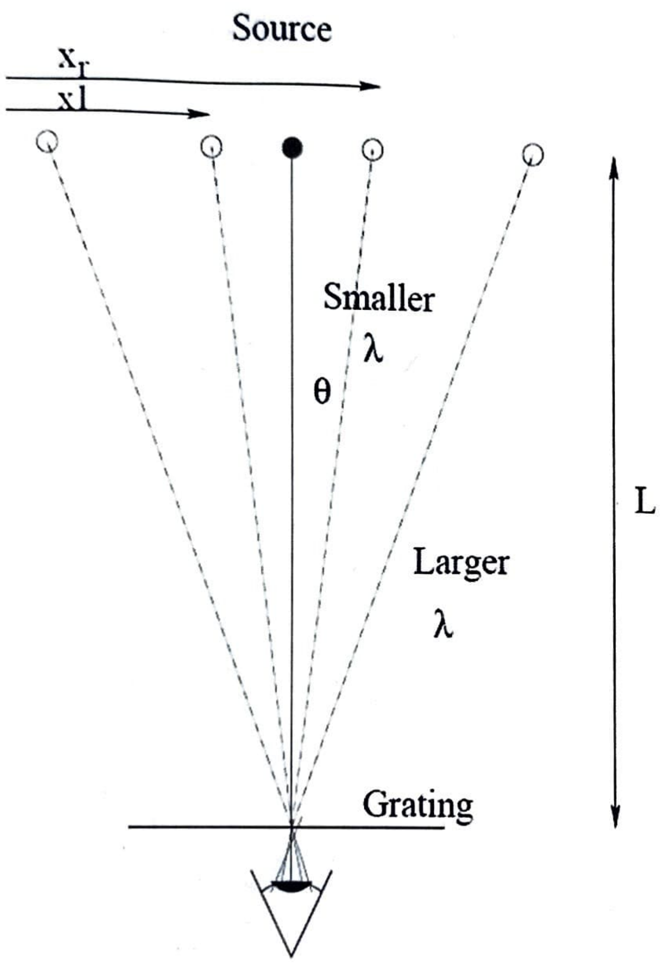

Figure 3 While looking at a source through the grating, observe the interference fringes and find the wavelength(s) of the source using $\lambda = \sin\theta d$, where d is the distance between lines in the diffraction grating.