Diffraction Grating

1 Objective

Calculating wavelengths using a Diffraction Grating.

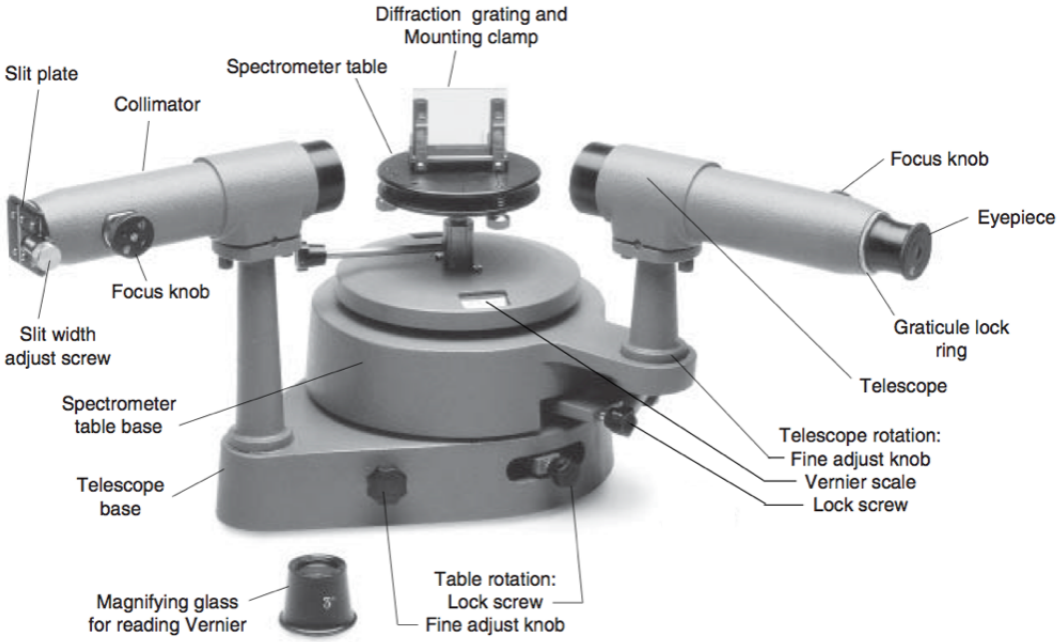
2 Prelab Questions

1. Briefly explain the phenomenon of light diffraction.
2. Write a short description of a Diffraction Grating and explain how it diffracts light.
3. By using an illustration, compare between the spectra obtained from a diffraction grating and from a prism.

3 Principles

Light from a light source with a discrete spectrum is passed through a collimator. The light is then diffracted by a grating and studied using a telescope.

4 Apparatus



5 Precautions

1. Optical systems are sensitive and are often fine-tuned. Be very careful with the equipment, as a slight nudge might damage the equipment.
2. The Diffraction Grating is a delicate component. Do not scratch the surface or touch it with your fingers.
3. Stray light can obscure the images seen through the telescope. Preform the experiment in pitch-black darkness.

6 Experimental Steps

6.1 Calibration:

1. Align the collimator and the telescope so that the vertical cross-hairs (seen through the telescope) are aligned with the slit (seen through the collimator).

2. Loosen the spectrometer table lock-screw. Align the vernier scale on the spectrometer table so that it is collinear with the optical axes of the telescope and collimator. Tighten the lock-screw.

3. Use the spectrometer table fine adjust knob to make sure that they are perfectly collinear.

6.2 Experiment:

1. Place the vertical cross-hair directly on top the slit and record the angle of zero diffraction θ_0.

2. Rotate the telescope towards the right hand side to find the first bright slit image (colour), continue rotating it across the rest of the colours until the same slit image (colour) appears again. Observe how the spectrum repeats itself, growing fainter the farther you are from the angle of zero diffraction.

3. Go back to the first slit image (colour). Carefully align the vertical cross-hair with the image and measure the angle of diffraction θ_R. Which order of diffraction n are you observing?

4. Now rotate the telescope towards the left hand side, past the zero diffraction angle, to find an identical slit image (same colour).

5. Carefully align the vertical cross-hair with the image and measure the angle of diffraction θ_L.

6. Repeat steps [3-5], recording the angles for each colour in the first order of diffraction.

7. Now move on to the second order of diffraction. It should be slightly fainter than the first. Repeat the steps [3-5], recording the angles for each colour in the second order of diffraction.

7 Evaluation

1. Calculate the angle of diffraction for the right hand side $\Delta\theta_R$ and for the left handside $\Delta\theta_L$

2. Using the diffraction grating equation, calculate the wavelength of each colour:

$$\lambda = \frac{a \sin\theta}{n} \tag{1}$$

8 Postlab Questions:

1. Explain the reason behind the observed correlation between: the higher the order of diffraction n, the fainter the light appears.

2. Name a few real-life examples exhibiting the phenomenon of light diffraction.

3. If a monochromatic light source was used instead of the one used in this experiment, what do you expect to observe?

4. In a diffraction grating experiment, a certain colour emerges at an angle of 15° in the first order. At what angle would this same colour emerge if the same light source and grating was used?