

Determining the wavelength of light with a diffraction grating

Introduction

In this experiment you will be determining the wavelength of light emitted by a laser. The laser beam will pass through a diffraction grating resulting in a pattern of light on a screen at a distance from the grating. By taking simple measurements of distances with magnitudes in the order of cm and m you will determine a result which is of an order significantly less than that which is directly measurable.

You are expected to be familiar with the formula $n\lambda = d \sin \theta$ relating the angle of the bright spot from the central position to the wavelength.

Aims

- To determine the wavelength of the laser light
- To consider uncertainty
- To consider the effect of qualitative changes

Intended class time

- 45 to 60 minutes

Equipment

- laser, class 2, <1 mW
- diffraction grating of known lines per mm
- stand, clamp and boss to support diffraction grating
- metre rules

Health and safety

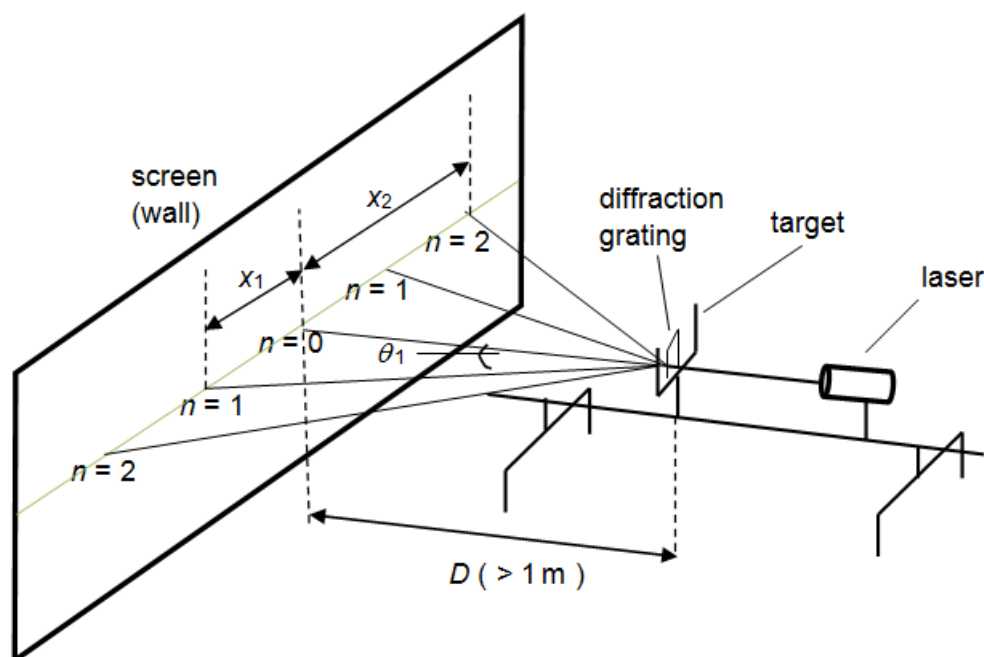
- The CLEAPSS guidelines for use of lasers in schools should be followed, including Student Safety Sheet 12 “*Electromagnetic Radiation*” (also SSS012 and PS052 on CLEAPSS website).

Do not target the laser towards any students or surfaces which could reflect the beam towards the class.

Ensure that the target area is a matt surface with no potential for reflection.

Do not look into the laser beam.

Procedure



1. Set up the apparatus as shown.
2. Measure the distance D to the screen.
3. Measure the distance x_1 from the central bright spot to the first bright spot, $n = 1$.
4. Calculate the angle θ_1 using these two measurements.
5. Calculate the distance d , for the spacing of the slits in the diffraction grating based on the data given for your particular grating. This is normally given in “*lines per mm*”.
6. Now use the formula $n\lambda = d \sin \theta$ to calculate λ .
7. Repeat the calculations for $n = 2$, the second bright spot.

Evaluation

8. Compare the value for λ given by each calculation.
9. Which has the least uncertainty in measurement?
10. How can you reduce that uncertainty?

Extension Opportunities

What effect will the following have on the pattern produced? Explain your reasoning.

- increasing distance to screen, D
- changing from red light to green light
- rotating the diffraction grating through ninety degrees
- using a point source of white light

This document may have been modified from the original – the master version is on the OCR qualification page.

Recording

As evidence for the Practical Endorsement you should have your measurements and the collected information from the class in a clear and logical format. All work should be clearly dated.

In addition, in preparation for the assessment of practical work in the written examinations and to help you develop your understanding, you should:

- have used the data collected to calculate a value for the wavelength, explaining clearly how you used the data in the calculation and showing all working,
- discuss the uncertainty and ways to reduce this,
- consider the extension opportunities and write a reasoned response to each point.