Phys 4910 Spectroscopy
Refractive Index and Dispersion

IMPORTANT

In this laboratory we will be using lasers. For the most part the lasers are low power and are not a serious hazard. The exception to this is the Argon ion (Ar^+) laser, whose output power is significantly higher. Light falling on your skin will do no damage, but light entering your eye can damage the retina.

The most important safety feature in the laboratory is your own common sense

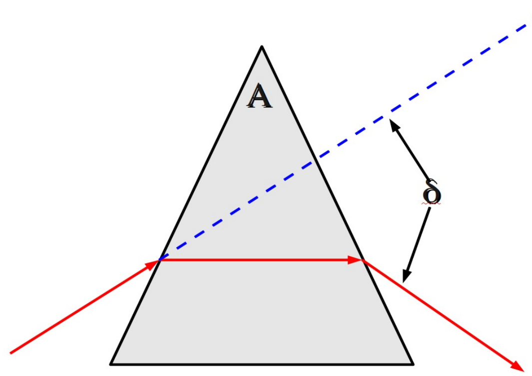
- Be aware of all laser beams in the room, including those which result from reflection off optical surfaces. As light both enters and leaves your prism some of it will be reflected, giving rise of stray beams in unexpected directions. Often it is these beams that present the greatest hazard.
- Try to keep all beams at table top height, or just above, and your head no closer than a foot from table height. This will minimize the chance of stray beams entering your eye.
- Place a beam stop in the beam to block the light from traveling any further. A book makes a good beam stop.

Introduction

This laboratory exercise measures the refractive index of a glass prism as a function of wavelength. Light of different wavelengths is derived from a variety of lasers (see table).

Angle of minimum deviation

When light passes through a prism it is deviated by some angle δ relative to its original direction of travel. It is easy to show (see General Physics textbooks[(1)]) that the angle δ varies according to the initial direction of the beam relative to the prism, but has a minimum value with is related to the refractive index of the glass and the apex angle of the prism by the relationship



1 (see for example "Physics for Scientists and Engineers", by R A Serway, 3rd edition, p 996).

$$n = \frac{\sin\left(\frac{(A+\delta)}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

which gives a convenient means of calculating the refractive index.

Lasers

You are given the following lasers

Laser	Wavelength (nm)
Red helium neon	632.8
Yellow helium neon	594.1
Green helium neon	543
Double Nd:YAG (green)	532
Ar^+	528.7 514.5 (strong green) 501.7 496.5 488.0 (strong blue) 476.5 472.7 465.8 457.9

Lab objectives

1. Devise a procedure for determining the refractive index of the prism glass. Be careful about any assumptions that you have made.
   a. Note that the blue line in the first diagram represents the undeviated beam, that is the beam before you introduce the prism. It would be a good idea to mark this beam first.
   b. You will find that you have multiple beams arising from reflection as the beam encounters the surfaces of the prism. Some might even be coming from the set up on a neighboring table. Make sure that you are tracking the correct beam.
2. For each wavelength listed above make the appropriate measurements, and calculate the refractive index.
3. Make a reasonable estimate of the uncertainties in your results. These should be based on your estimate of how well you can measure angles.
4. Plot the refractive index as a function of wavelength, including error bars associated with the uncertainties