

OPTICS 380A

Lab 6: Linear Polarization

Part A: Basic Polarization and Malus's Law

- (A) Using the fact that light that reflected off of a surface (such as the lab tables) at glancing incidence is horizontally polarized: Determine the axis of polarization of linear polarizer. Describe the orientation with respect to the holder.
- (B) Set up two linear polarizers, one after the other in front of a white light source. Orient the first polarizer so that its axis is vertical. The second polarizer we'll now use as an analyzer. Looking back at the light source through the analyzer, describe what happens as you rotate the analyzer 360°. Draw a vector diagram to show what is happening for analyzer positions of 0°, 45°, 90°, 135°, and 180°.
- (C) Repeat the same experiment but in a quantitative manner. Replace your eye with a detector. Record the output of the detector (volts) as a function of θ , the angle that the analyzer makes with respect to the axis of the linearly polarized input beam. Do this as you rotate the analyzer through 2 complete revolutions, 720°, taking data every 10°.

Use a computer spreadsheet to:

- (D) Plot your raw data, volts vs. θ
- (E) Plot the raw data offset-corrected, shifted, and normalized so that the curve has a minimum of 0, and a peak at 0°.
- (F) Make another plot that shows our corrected data along with data predicted using Malus's Law. How well do your data agree with Malus's Law?
- (G) Take a linear polarizer outside, and describe the polarization, if any, of light coming from various parts of the sky. Reference your observations with respect to the location of the sun. **DO NOT LOOK DIRECTLY AT THE SUN AT ANY TIME!!** (For evening labs, do Section G and H first.)
- (H) Describe the polarization of light reflected off of various objects out-of-doors, including the ground, leaves, clouds, windows, etc.

Part B: Brewster's Angle

- (I) Describe (AND CARRY OUT) an experiment to measure Brewster's angle for the glass prism on the spectrometer table, using just the laser and the prism.
- (J) How is the plane of incidence oriented in your experiment? (horizontally or vertically?).
- (K) In your experiment, which is the s-plane of polarization, and which is the p-plane of polarization?
- (L) The laser is set to provide output polarization in a particular direction. Determine the polarization direction of the laser with a polarizer. Is it s or p polarized?
- (M) What is your measured value of Brewster's angle for the glass prism?
- (N) What is the index of refraction of the prism at the laser wavelength of 632.8nm?

Part C: Fresnel Reflection

- (O) Describe (AND CARRY OUT) an experiment to measure the reflection of s- and p-polarized laser light from the glass prism. Make sure you take a reading of the full laser beam power to be able to convert your measured light levels to reflectance. Also take a dark reading.
- (P) Use a computer spreadsheet to plot your data:
 - subtract the dark reading from all of your voltages
 - convert your voltage readings to reflectance (by dividing each value by the voltage corresponding to the full laser beam power)