Lab 13: Fresnel equations

Goals: To measure the reflectance from plexiglass as a function of the angle of incidence θ and compare it to theoretical expressions for both TE and TM waves. Fitting routines in Matlab will allow for the comparison and measurement of the index of refraction *n*. The accepted value of *n* for plexiglass is 1.49.

The light source for this experiment is a green diode laser. In order to create equal parts TE and TM polarization the light must be polarized to 45 degrees. A λ/2 plate, placed between the laser and a polaroid set to 45 degrees, can be used to rotate the light coming from the laser. After the light is reflected from a semi-cylindrical plexiglass, its intensity is measured with a voltage-biased photodiode. The output is a voltage which is proportional to the light intensity incident on the cell. The sensor requires +10 volts to bias the diode. The photodiode is quite sensitive; for each measurement taken a background signal (laser blocked) must also be acquired so that it can be subtracted off.

In order to distinguish the reflection of the TE vs the TM wave a square polaroid (see Fig. 1) is placed in front of the photodetector. It is easily rotated by 90 degrees. A photograph of the apparatus (without the meter or power supply) is shown in Fig. 2. By rotating the plexiglass along with the photodetector, the angle of incidence can be varied. Make sure to take data over a large range of angles.

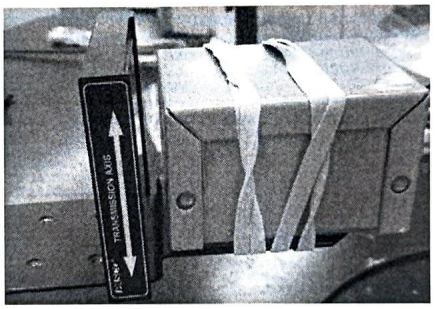

Figure 1. The square polarizer's transmission axis is clearly labeled.

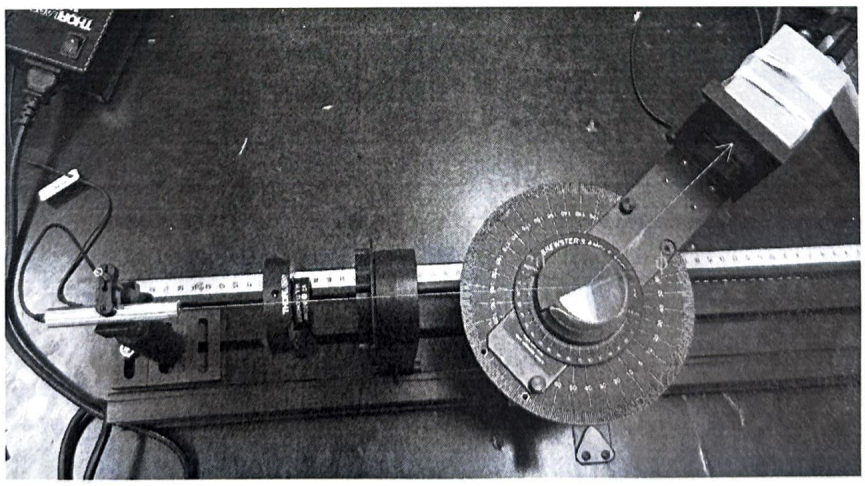

Figure 2. The beam from the laser strikes a λ/2 waveplate, set to maximize the transmission through the linear polarizer, and subsequently the semi-cylindrical plexiglass. The reflection from the plexiglass is measured by the photodetector after passing through a square polarizer; see Fig. 1. Keep in mind $\theta = (180 - \phi)/2$.