Physics 312

Lab 12: Rotation of light

Goals: To rotate light using three different physical realizations: 1) birefringence 2) circular birefringence and 3) Faraday rotation.

1. *Half waveplates*

Place the half-wave plate between the two perpendicular polarizers as shown in Fig. 1. Rotate the half-wave plate and record the voltage values from the photodetector. To avoid a non-linear signal, the iris in front of the photodiode should be adjusted so that the output of the photodetector remains below 220 mV. Fit the intensity to $I_0 \sin^2 2\theta$, where I_0 is the maximum intensity and θ is defined as in Fig. 1.

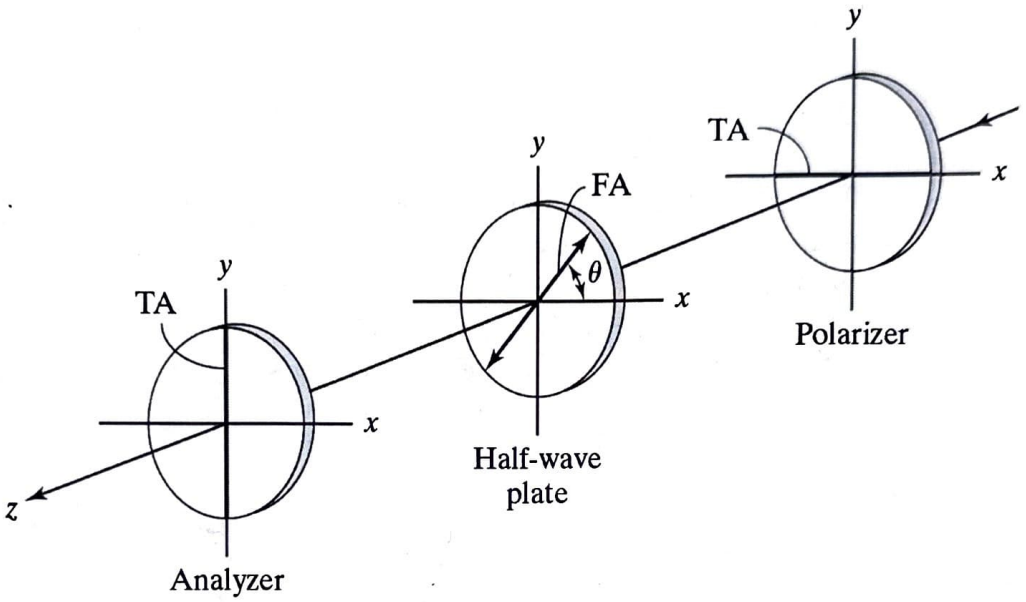

Figure 1. The laser strikes a linear polarizer, behind which the λ/2 polarizer is placed. After that, the second linear polarizer is aligned with the transmission axis perpendicular to that of the first polarizer. The photodetector (not shown) measures the intensity of the light transmitted through the wave plate and polarizers.

2 *Circular birefringence: Saccharimetry*

If linearly polarized light passes through a sugar solution, then the amount that the polarization is rotated is proportional to the concentration of the sugar solution and to the length of the light path through it. Determine the constant of proportionality using the setup shown in Fig. 2 using several concentration values. It is best to start with a strong concentration and dilute the mixture. Saturation point is about 0.3 g/cm^3, for example 22 g and 72 ml of water.

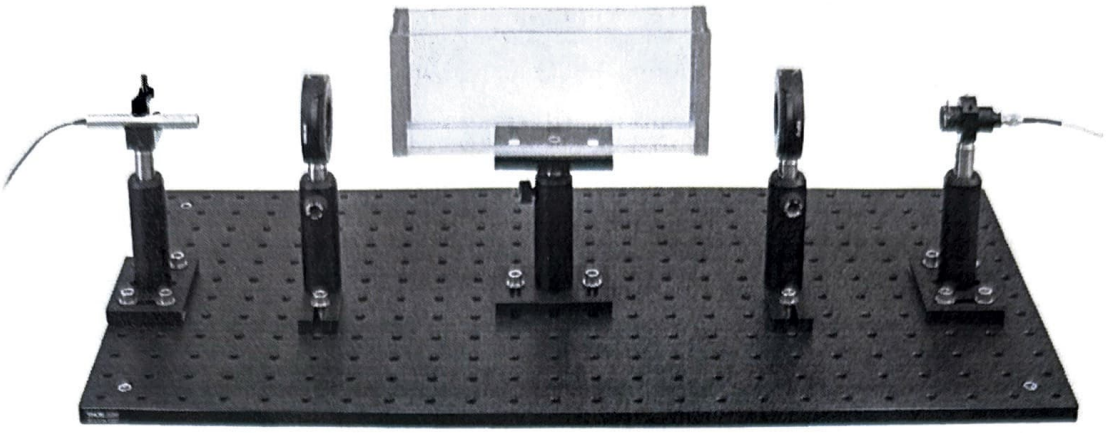

Figure 2 Setting up the saccharimeter: The laser light first passes through a polarizer, then the sugar solution, and finally the last polarizer and photodetector are used to measure the change in the polarization.

3. Faraday rotation: construction of an optical oscillator

Set up the experiment as in Fig. 3. Confirm that light coming out of the Faraday rotator is 45 degrees rotated from the beam going into the Faraday rotator. Explain your reasoning. Reverse the positions of the laser and the photodetector without changing the iris in front of the photodetector. Compare the power transmitted in this direction as compared to the previous direction. Explain the result.

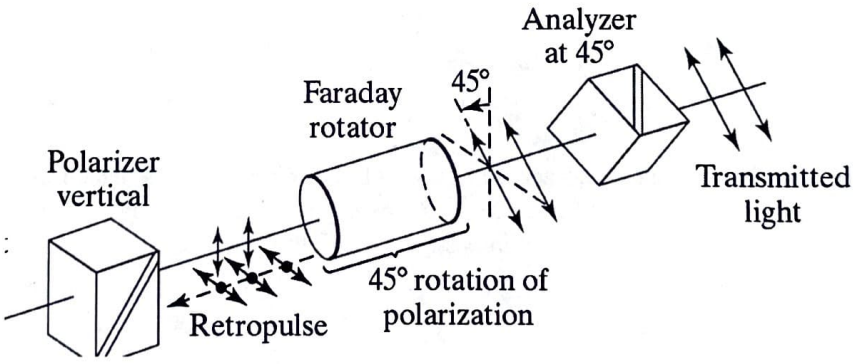

Figure 3 Faraday rotator used between a polarizer-analyzer pair to produce optical isolation of the optical system. An unpolarized HeNe laser will be used for the incident light and a photodetector will be used to measure the intensity of the transmitted light.