Abstract

The Faraday effect is magnetically induced birefringence. Linearly polarized monochromatic light while transmitting through an optically inactive material, under the influence of an axial magnetic field, is rotated by an angle θ as shown in Figure 1.

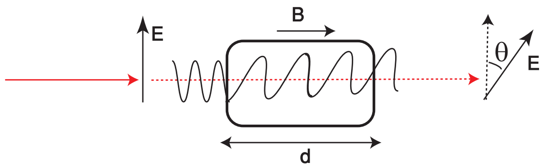

Figure 1: Faraday rotation, Plane of polarization of light is rotated under the action of axial magnetic field

The angle of Faraday rotation θ is given by

$$\theta = VBd,$$

provided the magnetic field **B** remains uniform throughout the length, d of sample. For non uniform magnetic field, θ is given by,

$$\begin{aligned} \theta &= V \int_0^d \mathbf{B}(z) \cdot d\mathbf{z} \\ &= V \int_0^d B(z) dz. \end{aligned}$$

The constant V is a parameter of material, called the **Verdet constant** which is a function of wavelength of light, temperature and refractive index of the material. It is the rotation per unit path length per unit magnetic field and is small in magnitude, of the order of μrad/ G cm, difficult to measure using conventional lab techniques. A simple experimental setup using lock in amplifier and alternating magnetic field is made to observe Faraday rotation in different materials. We describe the origin of the Faraday rotation, and discuss the synchronous or phase sensitive method to determine the Verdet constant. This method enables one to measure the exceedingly small birefringence using low-cost electromagnets. We evaluate the performance of our system and go on to characterize TGG crystal and various liquids samples.