

Exploring Faraday Rotation: Measuring the Verdet Constant & Verifying Malus' Law

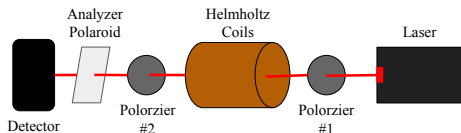
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Introduction

Faraday rotation occurs when linearly polarized light experiences a rotation in its plane of polarization as it travels through a magnetic field. In this experiment, we first, verify Malus' Law by measuring the intensity of transmitted light through two polarizers. We then aim to determine the Verdet constant of an unknown material.

Experimental Procedure

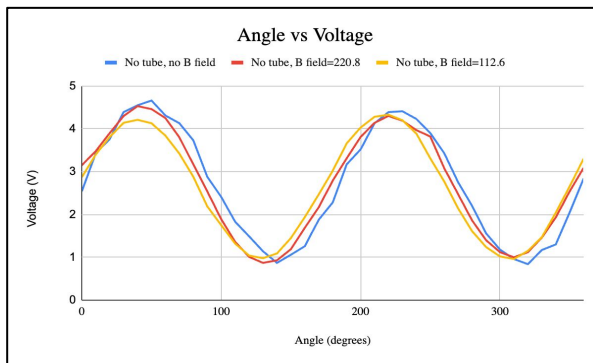
The setup below has the laser travel through the polarizers and applied magnetic field so that the detector can then measure the voltage on a multimeter. A gaussmeter was used to determine the B field.



Malus' Law

Polarizer #2 was rotated from 0° to 350° in increments of 10° , and the voltage was noted at each angle.

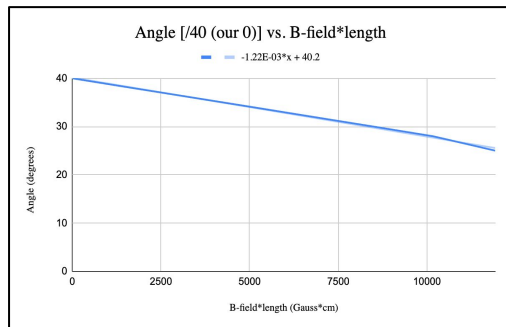
$$I = I_0 \cos^2(\theta)$$



Verdet Constant

$$\theta = v(Bl)$$

Current (A)	Angle (degrees)	v (degree/G*cm)
1	38	0.022
2	36	0.011
3	34	0.007
4	32	0.005
5	30	0.004
6	28	0.003
7	25	0.002



Discussion

Malus' Law was verified in three different scenarios: No B-field present, B-field=220.8G, B-field=112.6G. All three followed the expected curve with minimal error.

The Verdet constant for an unknown material is then calculated with data ranging from 1-7 Amperes. Calculations for each current are in the table. From the trendline slope given by the graph, there is a Verdet constant = 1.22×10^{-3} degrees/G*cm = 21.36 rad/T*m.

Errors included but not limited to:

- Light in the room affecting data collection
- Equipment limitations

For future experiments, it is worth exploring measuring the Verdet constant for multiple different materials and comparing results.

References

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