

5. Experimental Examples

5.1 Observe Magneto-Optic Modulation Effect

Experimental Procedure:

- 1) Use a BNC cable to connect “Sine Curve Output” to “Audio Input” on the front panel of the main control unit, and use the “Demodulation cable” (2-core/BNC) to connect the “Demodulation Output” to an oscilloscope.
- 2) Adjust “AC Amplitude Adjustor” while observing the demodulation output signal on the oscilloscope.
- 3) Rotate the analyzer finely until the demodulation output signal (1 kHz) is observed clearly on the oscilloscope.

5.2 Measure Modulation Depth and Range of Modulated Faraday Rotation Angle

Experimental Procedure:

- 1) Rotate the analyzer while monitoring the demodulation output signal on the oscilloscope until a maximum amplitude is observed on the oscilloscope.
- 2) Read the maximum/minimum values (peak/valley) from the demodulation signal curve on the oscilloscope, as I_{\max} and I_{\min} , respectively. Use equations (17) and (23) to calculate the modulation depth (η) and the range of modulated Faraday rotation angle (α_{F0}).

5.3 Measure Range of Modulated Faraday Rotation Angle vs Magnetic Induction

Experimental Procedure:

- 1) Vary the modulation amplitude of the exciting current (i_0) and measure the corresponding I_{\max} and I_{\min} .
- 2) Calculate η and α_{F0} at each value of i_0 . Plot the α_{F0} - i_0 curve using the data obtained. The measured α_{F0} - i_0 curve is corresponding to the α_{F0} - B curve because magnetic induction B is linearly proportional to the exciting current in the coil (this condition is met when i_0 is less than 1.0 A).

5.4 Measure Faraday Rotation Angle vs DC Exciting Current

- 1) Rotate the analyzer until the light intensity reading of the optical power meter is zero or minimum. Record the angular scale of the rotary holder for the analyzer.
- 2) Adjust “DC Current Adjustor” to increase the exciting current of large coil to 0.5 A. Now the reading on the optical power meter will change.
- 3) Rotate the analyzer again until the reading on the optical power meter becomes minimum again. Record the angular scale of the analyzer and compare with the angular scale recorded in step 1. The angle rotated by the analyzer is the Faraday rotation angle, α_F . In the meantime, use the Teslameter to measure the magnetic induction B at the sample location.
- 4) Then **gradually** reduce the exciting current to zero (**note**: do not just turn off the electric power to the electromagnet, otherwise the remanence would adversely affect the measurement result). Rotate the analyzer until the reading on the optical power meter is

zero or minimum. The angle rotated by the analyzer this time is called the repetitive error.

- 5) Repeat steps 2 to 5 three times to get averaged data.
- 6) Increase the exciting current in interval of 0.5 A. Repeat steps 2 to 5. Plot the measured $\alpha_F \sim B$ curve using the table below.

Exciting Current (A)	Magnetic Induction	Rotation Angle	Error	Mean	Error
0.5					
1.0					
1.5					
2.0					

5.5 Demonstrate Optical Communication using Magneto-Optic Modulation

- 1) Input an audio signal from a radio, a recorder, a CD player, or a computer to the “Audio Input” socket of the main control unit (i.e. using the cable of BNC/3.5 mm earphone plug).
- 2) Connect the “Demodulation Output” to the speaker and the input audio signal can be heard from the speaker. The volume of the speaker can be controlled by “AC Amplitude Adjustor”.
- 3) Block the laser beam with a hand, the sound from the speaker should stop; remove the hand from the laser beam, the sound should be heard again from the speaker. This indicates the audio signal is indeed modulated by magneto-optic effect.