Introduction to the UNCP Magneto-Optical Facility

W.D. Brandon

Department of Chemistry and Physics
University of North Carolina - Pembroke

The Faraday Effect, named for physicist Michael Faraday, is a magneto-optical phenomenon characterizing the rotation of the plane of polarization of light—a form of optical activity due to Zeeman splitting.

\[ \theta = V B l \]

\( \theta \): Verdet constant
\( B \): magnetic field strength
\( l \): sample length

\[ V = \frac{\pi}{2} \left( a + \frac{b}{a^2 - \lambda^2} \right) \]

\[ nV = a \left( 1 + (1 + b)^{1/2} - (1 + b)^{-1/2} \right) - \frac{4}{B^2} \left( 2 - (1 - b)^{1/2} - (1 + b)^{1/2} \right) \]

**Data Analysis Utilizing Various Theories**, via nonlinear curve fitting, characterizes the dispersion of the Verdet constant for samples of interest.

**Applications** (to name a few)
- optical - switches, rotators, circulators, isolators, modulators
- laser gyroscopes
- satellite altitude monitors
- sensors - magnetic field & electric current
- quantum computing
- characterizing astrophysical phenomena
- nonlinear quantum electromagnetics (photon interaction)
- search for dark matter (axions)

\( \theta = V B l \rightarrow V(\Delta) \): spectral capabilities

Laser Diodes (LD) - wavelengths shown in nm = 10^9 m
- LD1: single diode (fixed) 448.0
- LD2: triple diode (switch selectable) 448.0, 511.7, 638.8
- LD3: single diode (fixed) 588.3
- LD4: single diodes (interchangeable) 405.1, 448.0, 511.7, 640.3


signal processing 1: Lock-in amplifier: SR830-LIA (inputs: Aux-V_{ac} (avg. sig.), R-V_{dc} (PSD sig.), outputs: \( \sim \)-AC voltage & ref frequency, ratio = R/Aux = V_{dc}/V_{ac}, \theta - phase).

signal processing 2: SW-850-Science Workshop 850 interface and PC with Capstone software.