Lecture 30

Optical Activity
Induced Birefringence
Optical Devices
Homework Due Friday
Quarter/Half Waveplates

Fast axis and slow axis
Optical activity

Materials that are naturally Birefringent are optically active

Calcite
Induced Birefringence

Can we manually change the Birefringence?
Photoelasticity
aka stress induced birefringence

\[ \sigma = \frac{F}{A} \]

Effective optic axis in the direction of the stress

\[ \Delta n \propto \sigma \]
Applications
Acoustic-optic modulators

Can be used to induce a phase shift or act as grating
Faraday effect

Magnetic fields can change the birefringence

$$\beta = \nu B d$$
Uses

- Optical Modulator
- Optical "Diode"
Electro-Optic Effect

Kerr effect

\[ \Delta n = \lambda K E^2 \]

\[ \Delta \phi = \frac{2\pi K l V^2}{d^2} \]
Pockel’s Cell

\[ \Delta \phi = \frac{2\pi n_o^3 r V}{\lambda} \]

\[ \Delta \phi = \pi \rightarrow V = V_{1/2} \]

Optical Shutters

KDP (KH$_2$PO$_4$) \( r \sim 10^{-11} \text{m/V} \)

\[ V_{1/2} \sim 7600 \text{V} \]
Liquid Crystal Displays

Applied voltage changes the orientation of crystals to induce Birefringence
Free-Space Electro-optic sampling

- Optical Pulse
- THz
- EO Crystal
- Modified Optical Pulse
- Polarizer
- EO Signal

Graphs:
- Time Delay [ps] vs. E-O signal [arb. units]
- Frequency [THz] vs. Amp [arb. units]