

Advanced Optics II, Homework 4
due Wednesday, March 4, 2021

1) Compare 3 methods of rotating linear polarization by 90°.

The three methods to be compared are:

1. A half wave plate
2. Two Rhomb prisms
3. 3 sheet polarizers (assuming 100% transmission in one direction, 0% in the orthogonal direction of the sheet).

Specific questions:

- a) How would you orient each element?
- b) Assuming all elements are antireflection coated, give the transmitted intensity for each of the three cases.
- c) Rank the three elements in terms of bandwidth.

2) Transmission through glass in a magnetic field

You are sending right circularly polarized light through 10 cm long cylinder of BK7 glass, at 500 nm. A magnetic field is applied along the axis of the cylinder. The change of index for right circular is $\Delta n_+ = 2 \cdot 10^{-7} B$ where B is the field in Tesla, and $\Delta n_- = -2 \cdot 10^{-7} B$. Given a field of 10 Tesla,

1. what is the phase shift of right circular light sent along the axis of the glass?
2. What is the change in polarization for a *linearly* polarized beam sent along the axis of the glass?

3) Design a “bichromatic” quarter wave plate

The objective is to make a half plate at 780 nm which is simultaneously a full wave plate at 390 nm, with a quartz crystal. the ordinary and extraordinary indices are given below.

Wavelength	n_o	n_e	Δn
390	1.55846	1.567972	0.009512
780	1.53903	1.54789	0.00886

1. Find the shortest length for which this wave plate is rotating the polarization at 780 nm.
2. Find the shortest length for which this wave plate is leaving the polarization direction unchanged at 390 nm.
3. Find the thickness ℓ for which the wave plate has both functions simultaneously.