Polarizing elements using anisotropic media

Ref: Longhurst, Propagation of light in crystals

Nicol prism produce single plane polarized beam of light

exploits double refraction in calcite \((n_o = 1.656, n_e = 1.49)\)

Principle section

- Calcite crystal is cut on diagonal
- Two halves cemented together with Canada balsam (intermediate in between \(O\) and \(E\) waves of calcite) \(\Rightarrow\) Ne = 1.55
- \(E\) wave transmitted, \(O\) wave is totally absorbed by black coating on edge of prism
- \(O\) and \(E\) waves only separated for small range of entrance angles

- Can use 2 in series
  - 1st - Polarize light
  - 2nd - Analyzer
Babinet & Soleil Compensators

Crystal plate of variable thickness is a compensator.

**Babinet**

- 2 quartz wedges at small angle
- Light enter from above
- Wedges are small enough to neglect separation of O & E rays
- Fix upper wedge, but can rotate lower
- Enter 1st wedge
  - O-ray travels faster than E-ray (quartz is + uniaxial)
  - Optic axis of second wedge 90° to first (O ray 1st wedge → e ray 2nd wedge) & vice versa
- Control phase cut by move inc. point or moving lower wedge → adjust δ
- Disadvantage: effective thickness plate depends on point of incidence

**Soleil**

- 2 thin wedges & plane parallel piece
- Can move bottom wedge
- δ does not depend on point of incidence
- Combined effect of wedges = plane parallel plate of variable thickness
- With top plate = thin plate of uniform variable thickness