

Polarization of light in classical, nonlinear, and quantum optics

1. Polarization of light: definition, brief history, role in photonics. Demonstration of double refraction in calcite.
2. Jones vector and Jones matrices. Transformations with phase plates and rotators.
3. Stokes observables and Müller matrices. Poincare sphere representation.
4. Geometrical phase. Pancharatnam phase.
5. Crystal optics: birefringence, ellipsoid of wave normals
6. Crystal optics: uniaxial and biaxial crystals, walkoff, liquid crystals.
7. Polarization optical elements that we use in the lab.
8. Polarization in nonlinear optics: phase and group matching.
9. Polarization in quantum optics: operators.
10. Polarization in quantum optics: states. 'Hidden polarization' effect.
11. Polarization entangled photons: Bell inequality violation.
12. Quantum key distribution with polarized photons.