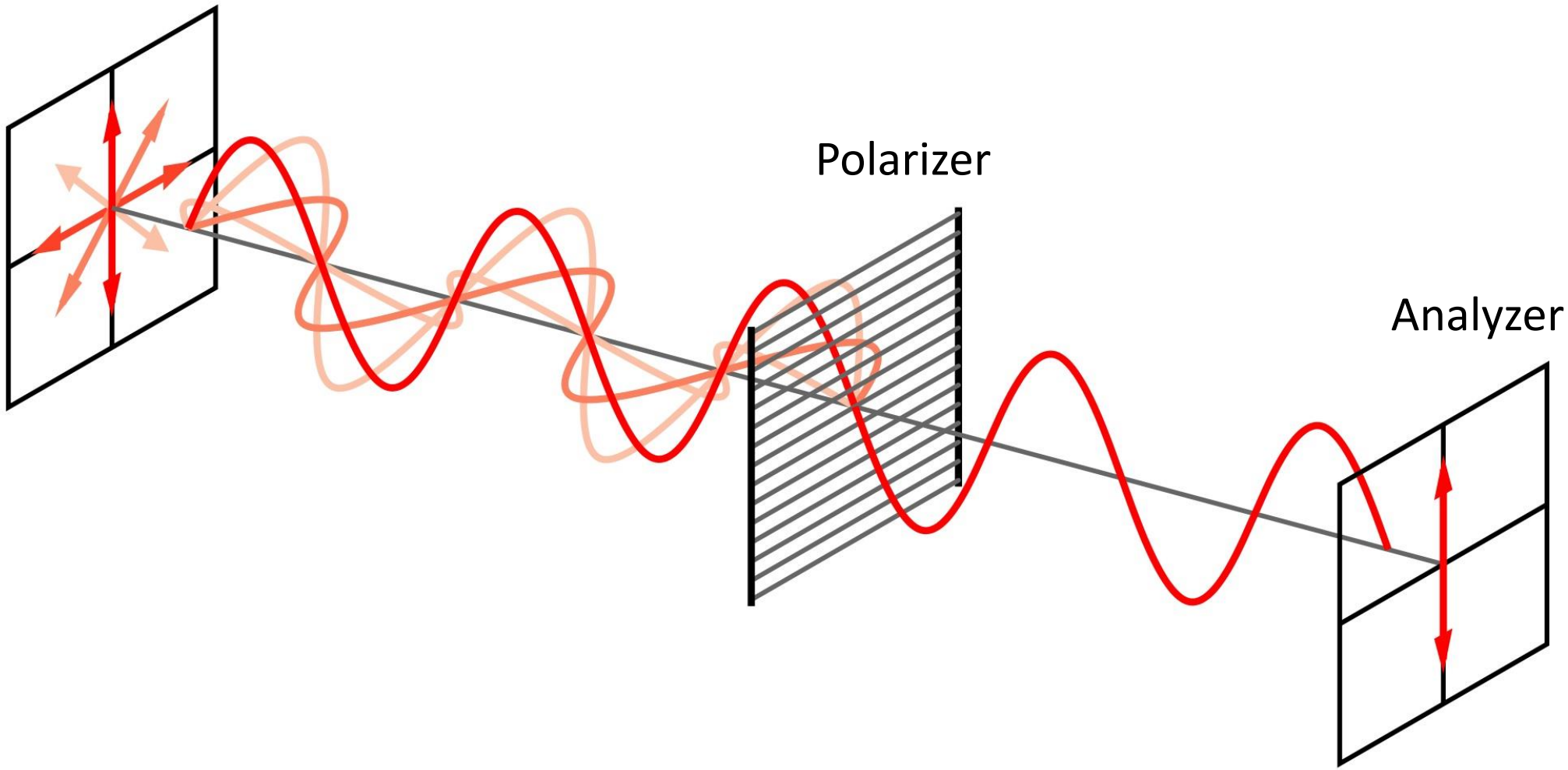
Module 1 Unit 2
Polarization of light

– Dr. Suren Patwardhan

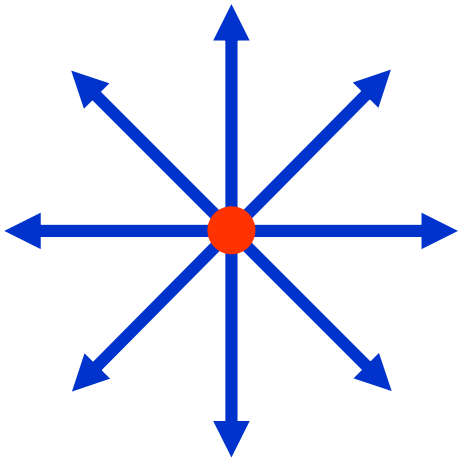
Contents

Polarization of light

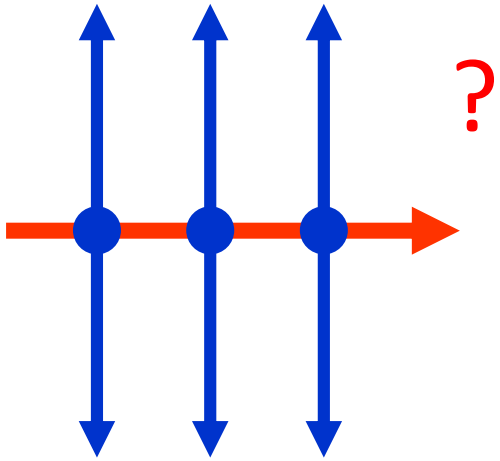


“Drawing” Polarization

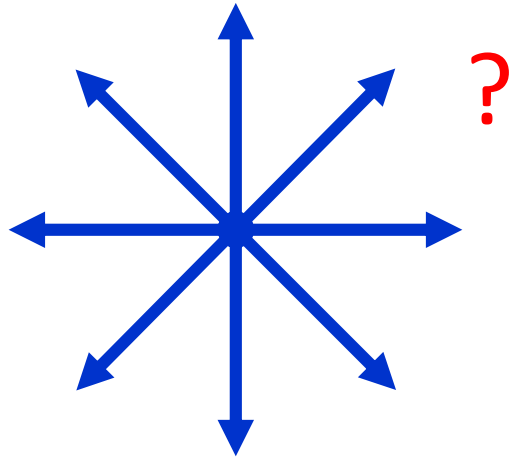
Un-polarized



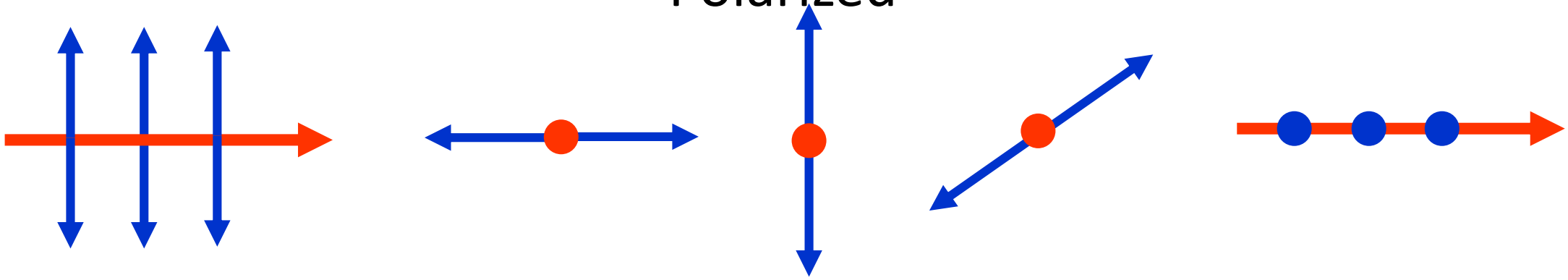
Un-polarized



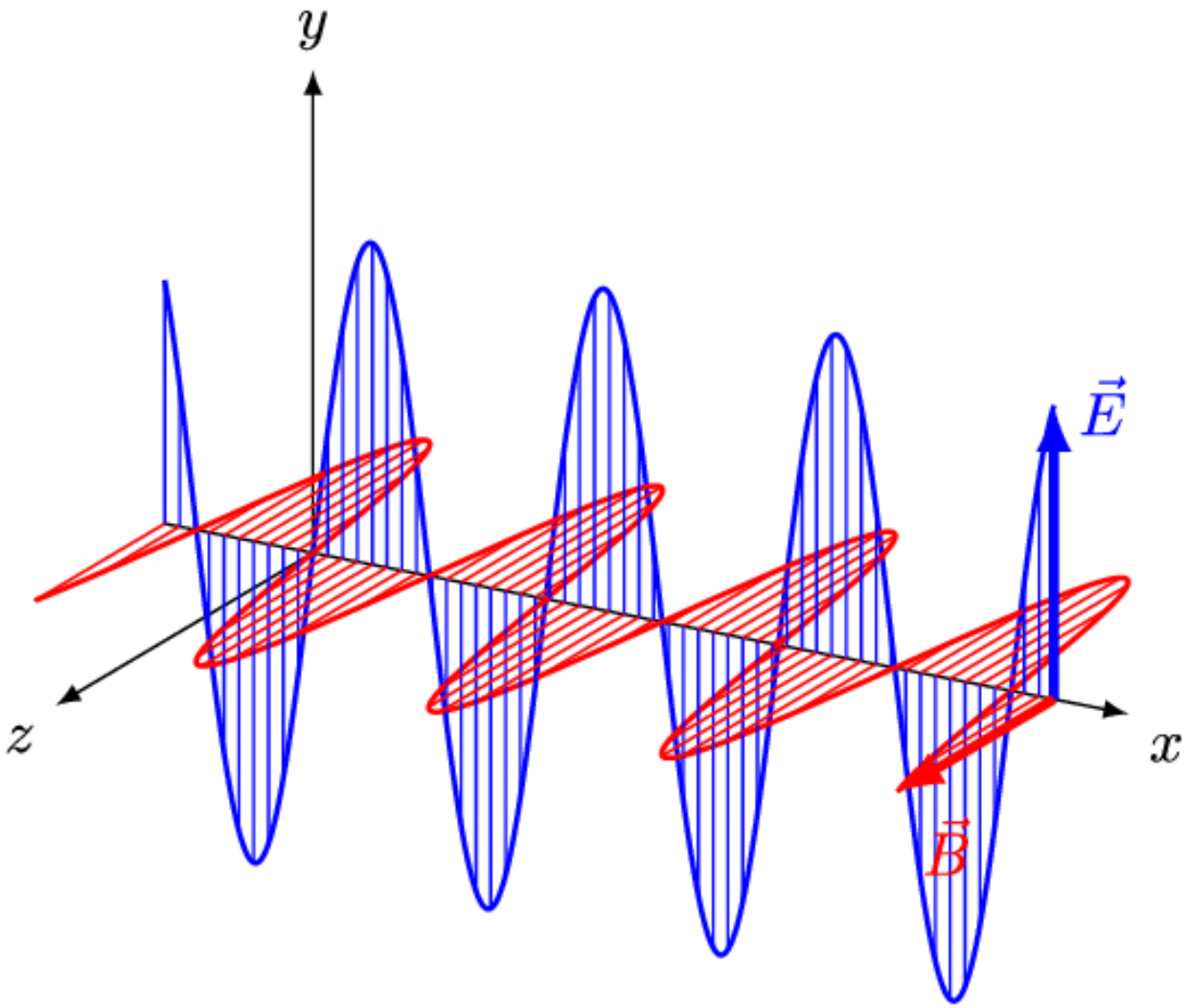
Un-polarized (uncommon)



Polarized



Principle of Polarization – Light as Electromagnetic Wave



Q. Which field is responsible for polarization?

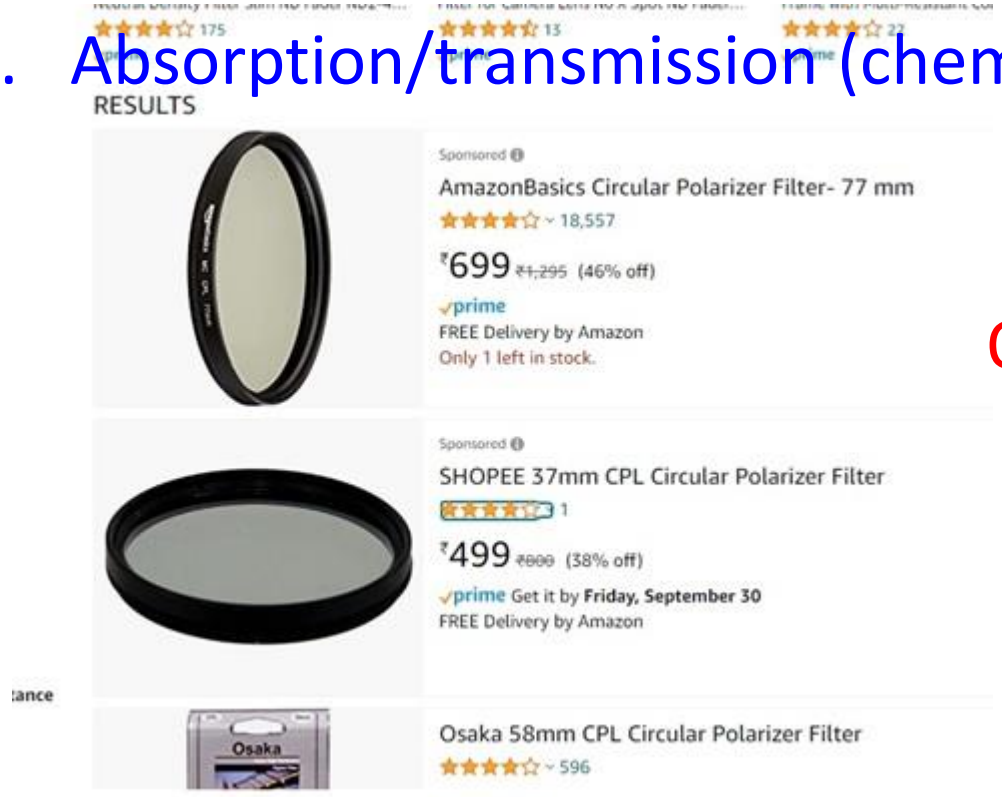
(a) Electric ✔

(b) Magnetic

(c) Both

Production of Polarized Light

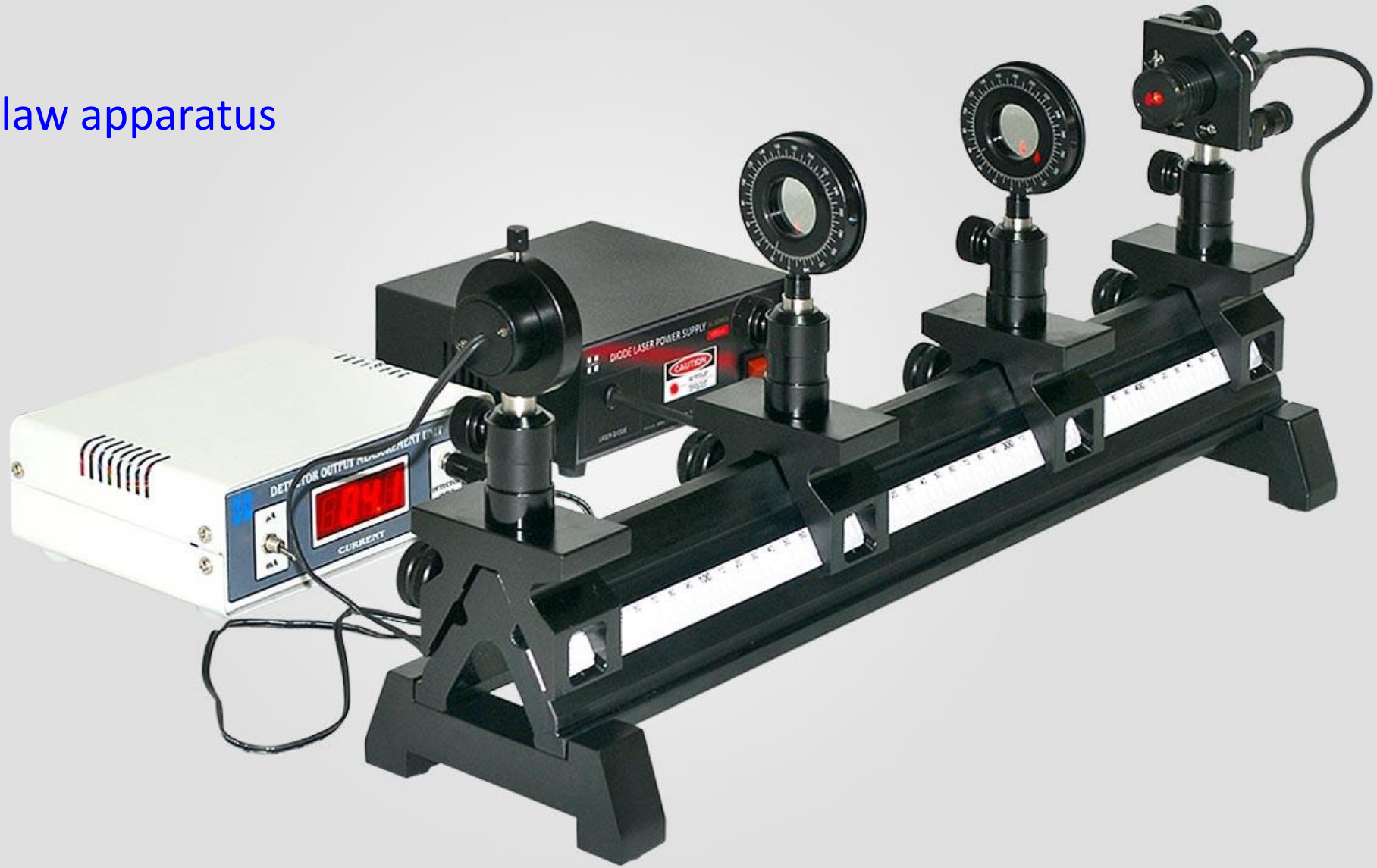
1. Polarization by reflection/refraction (Brewster's law)
2. Scattering/diffraction (Rayleigh scattering or blue sky)
3. Birefringence or double refraction (Nichol prism)
4. ✓ Absorption/transmission (chemicals, polymers)



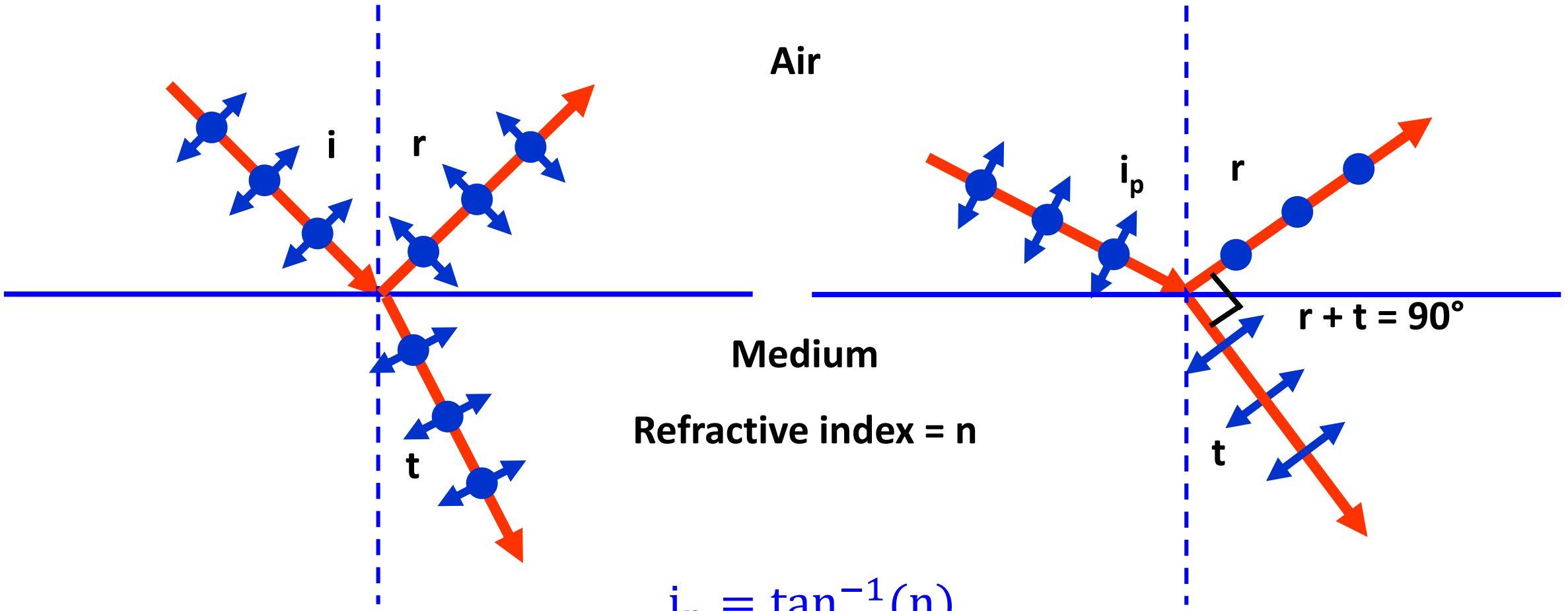
On which method do they work?

Detection of Polarized Light

Malus' law apparatus



Brewster's Law

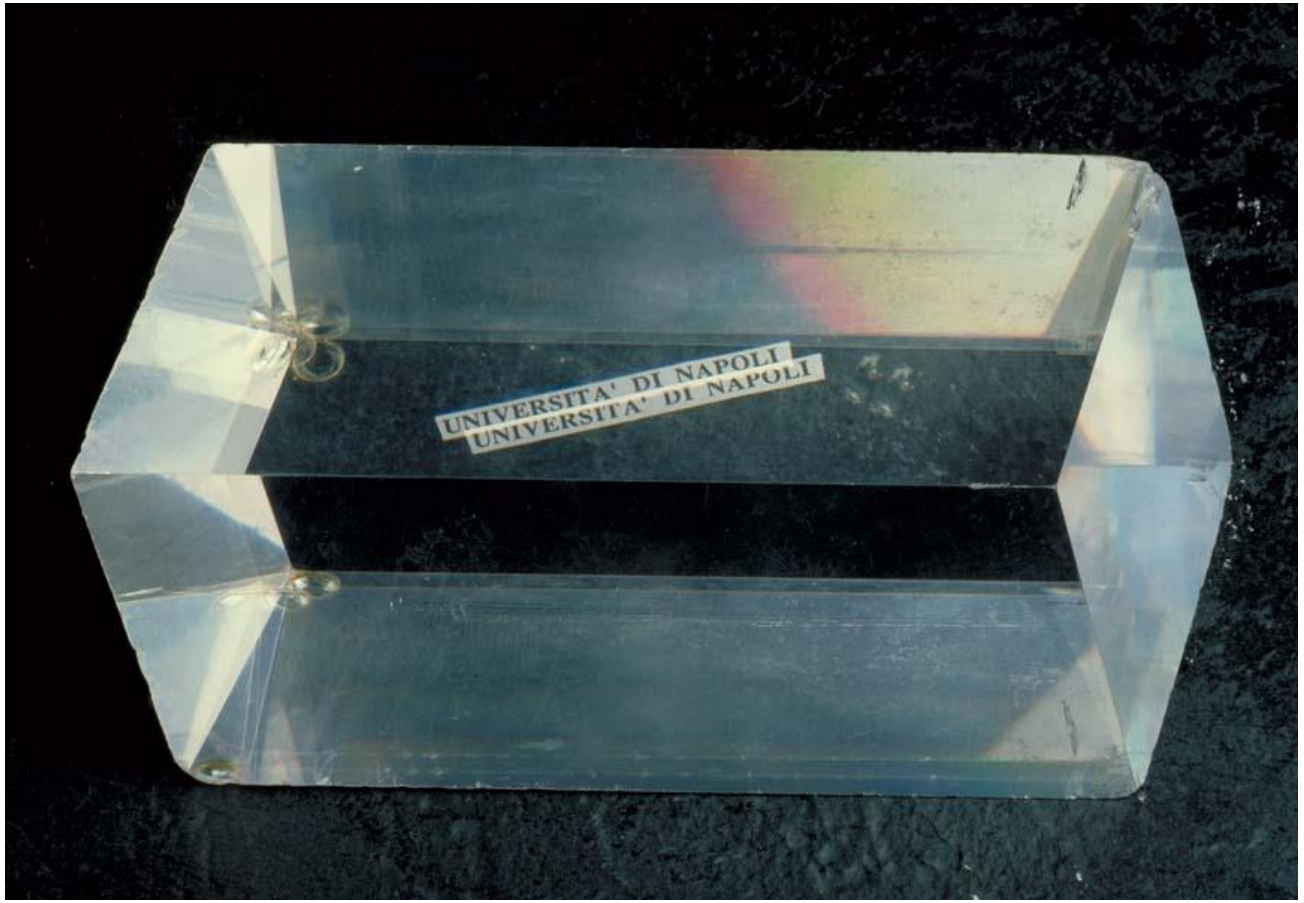


$$i_p = \tan^{-1}(n)$$

Birefringence (Double Refraction)

- decomposition of light into two parts on passing through certain medium
- The medium is called anisotropic medium e.g. calcite crystal
- R I of medium is different for light waves with different polarization

Nicol Prism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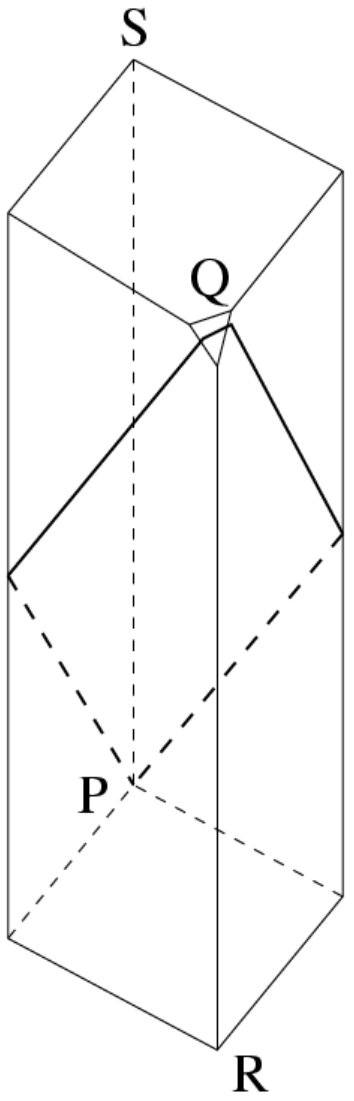
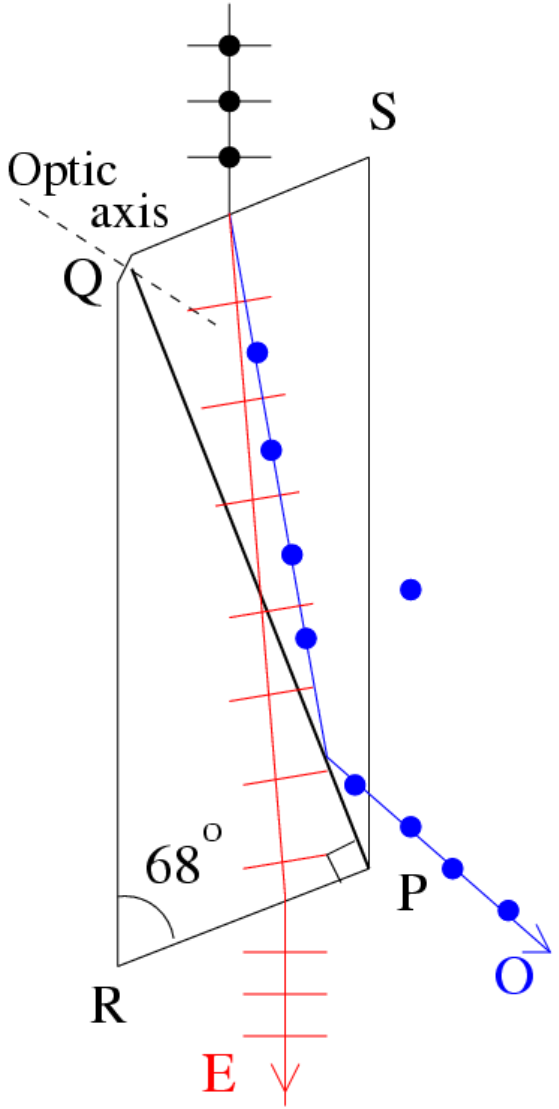

S
Q
P
R


S
Optic
axis
Q
68°
P
O
R
E

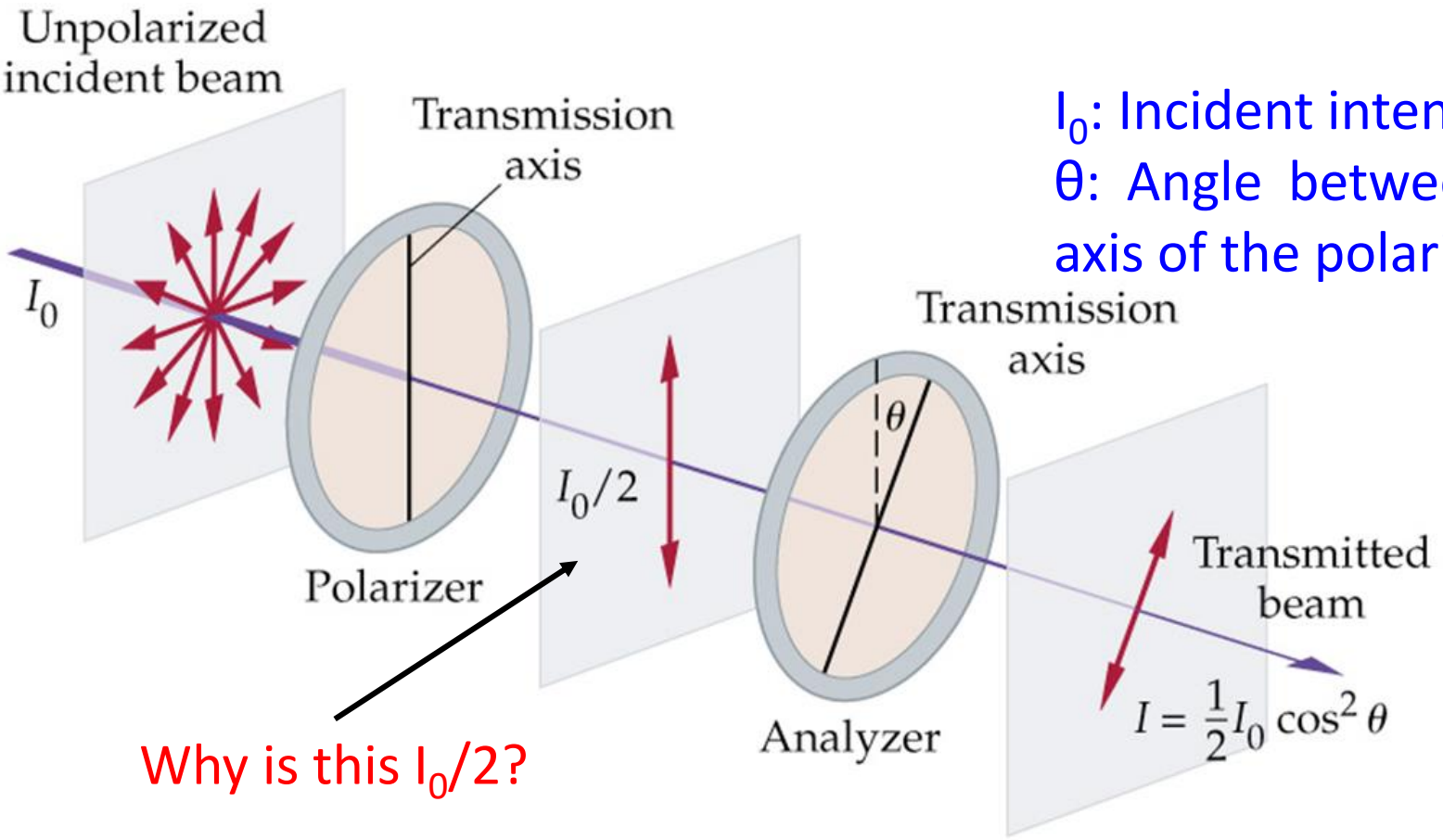
Malus' Law

Intensity of (polarized) light passing through a polarizer is is given by

$$I = I_o \cos^2(\theta)$$

I_0: Incident intensity (assuming polarized light)

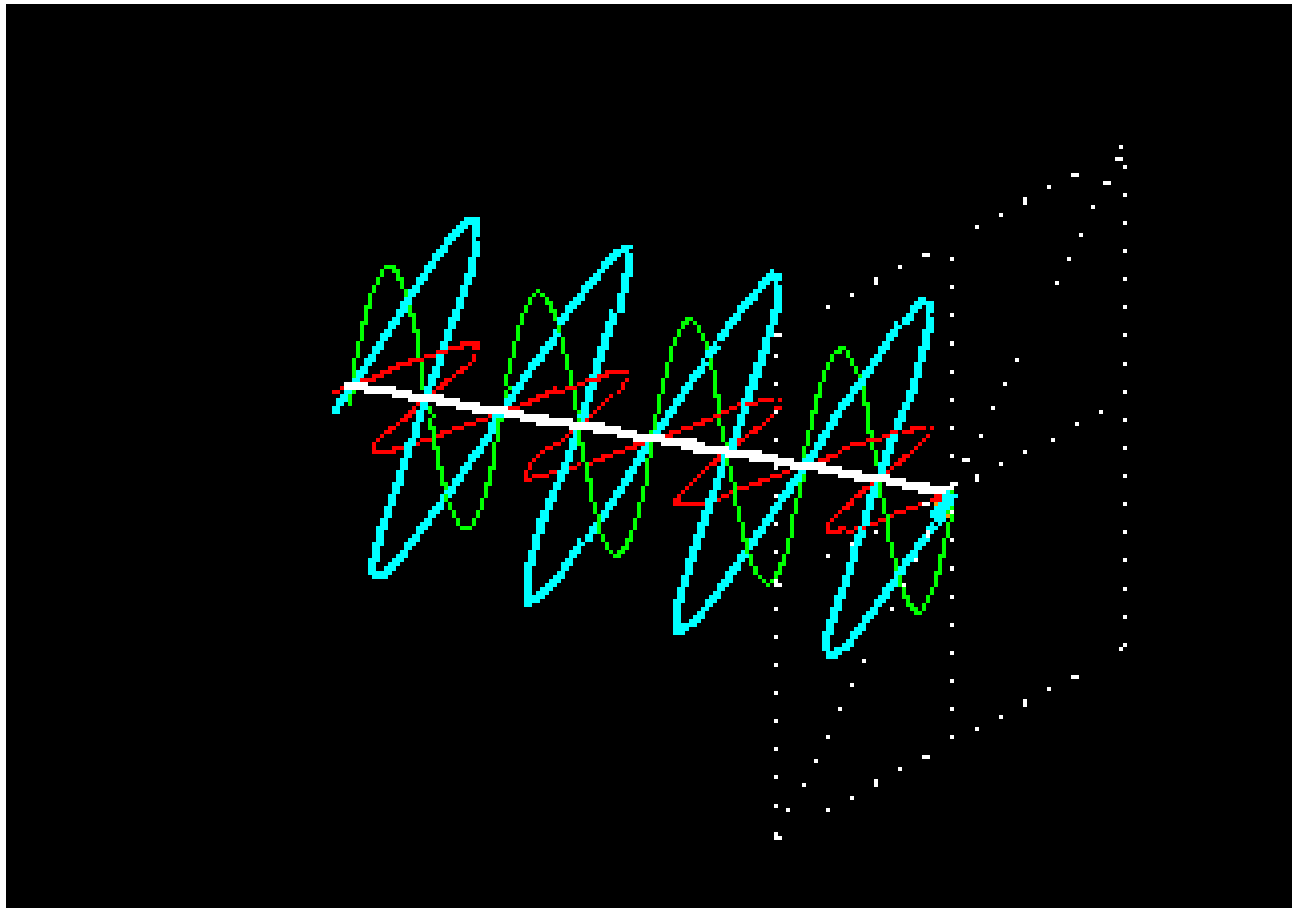
θ: Angle between direction of polarization and axis of the polarizer

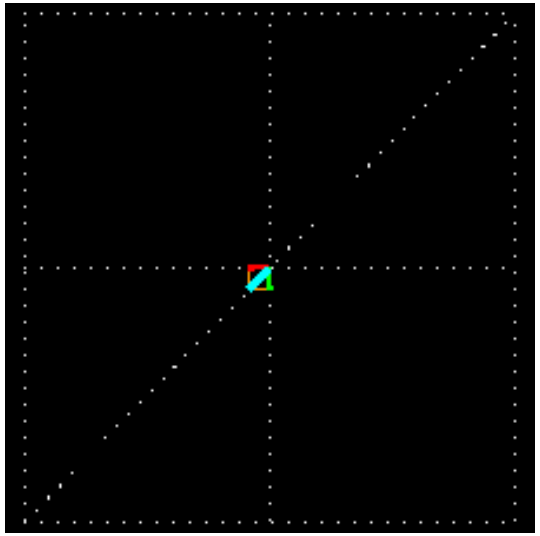


Why is this $I_0/2$?

Types of Polarization

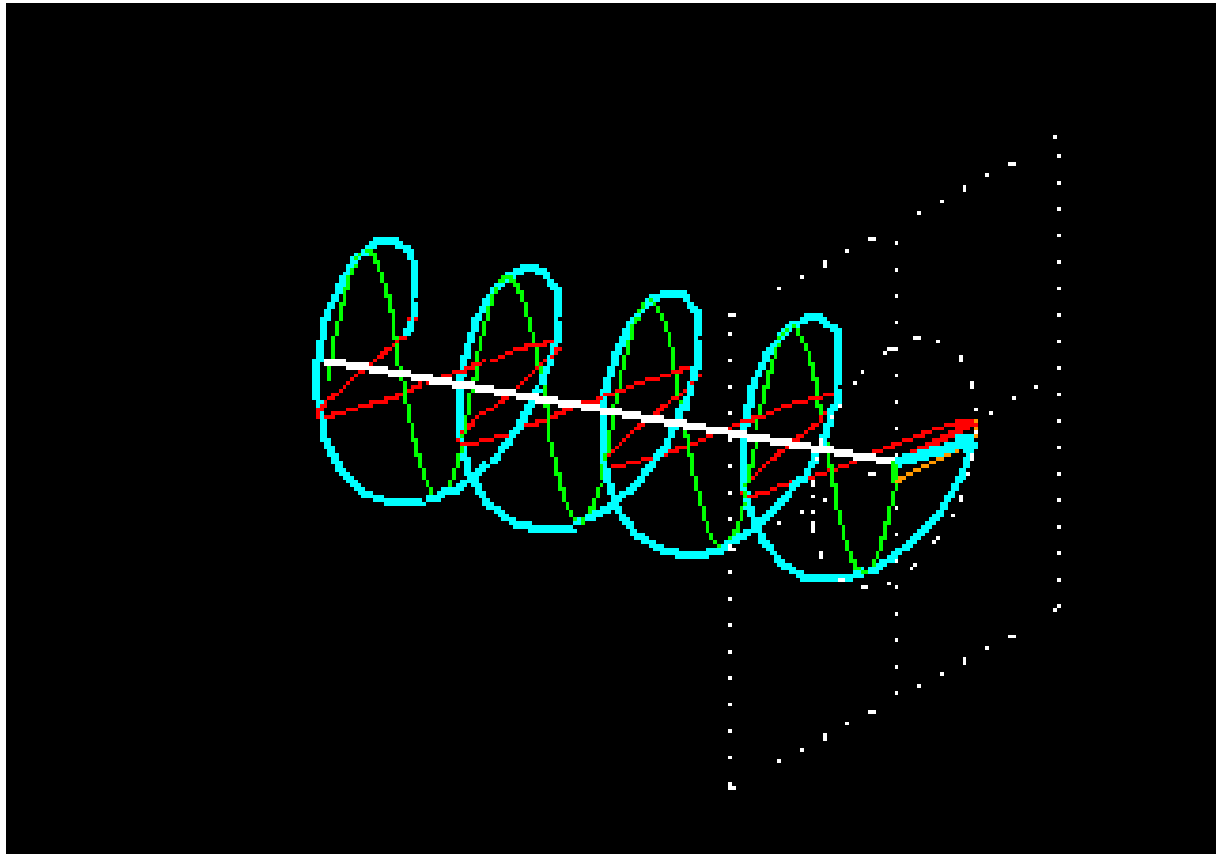
Linearly polarized: the two orthogonal components are in phase

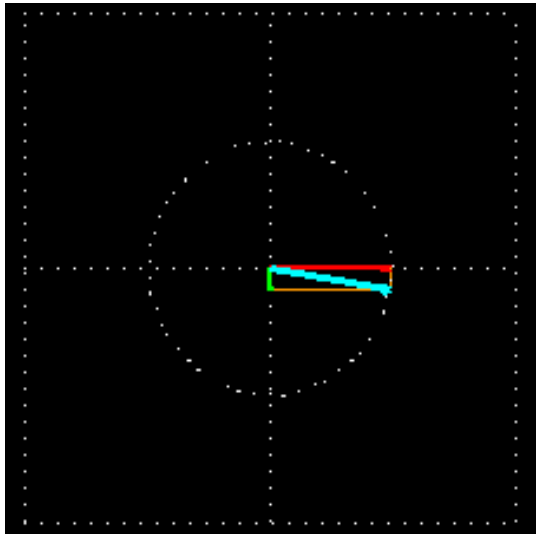




Types of Polarization

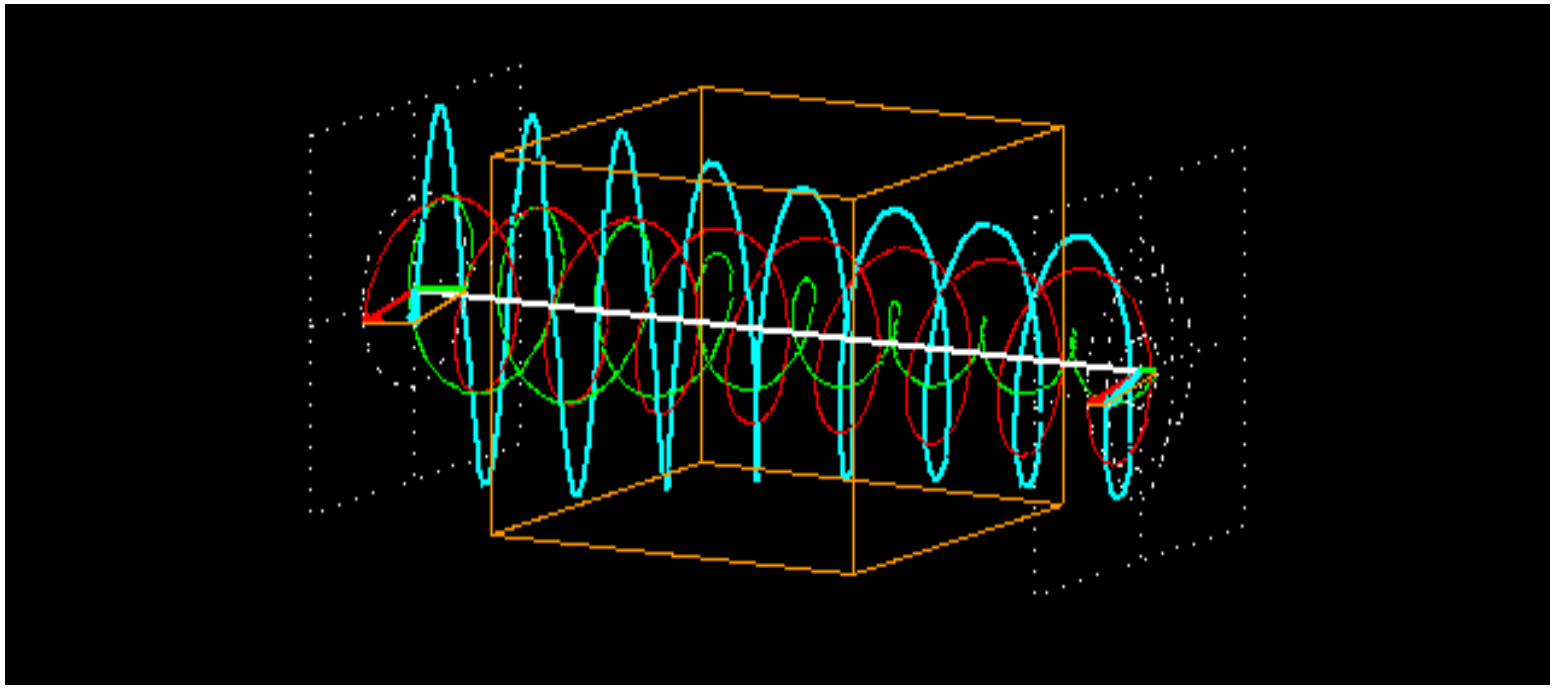
Circularly polarized: the two orthogonal components have same amplitude and +/-90 degrees out of phase the two orthogonal components are in phase

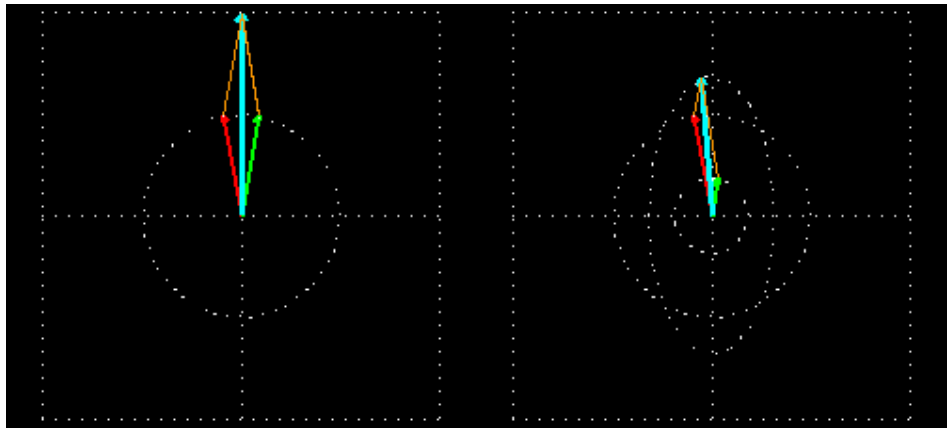




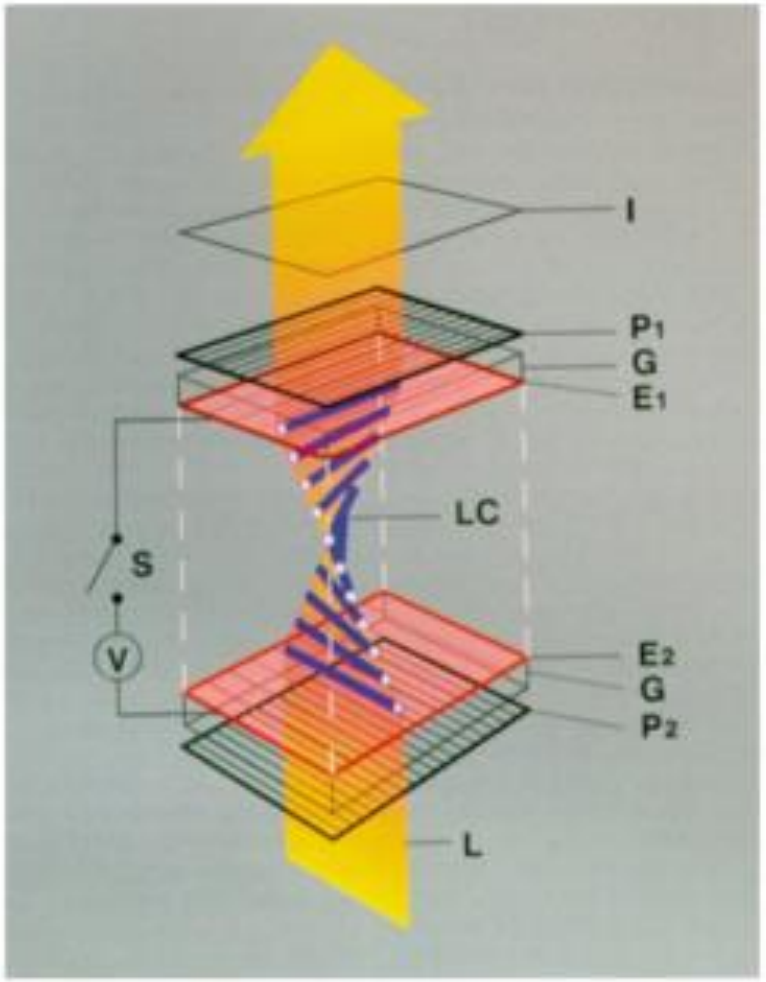
Types of Polarization

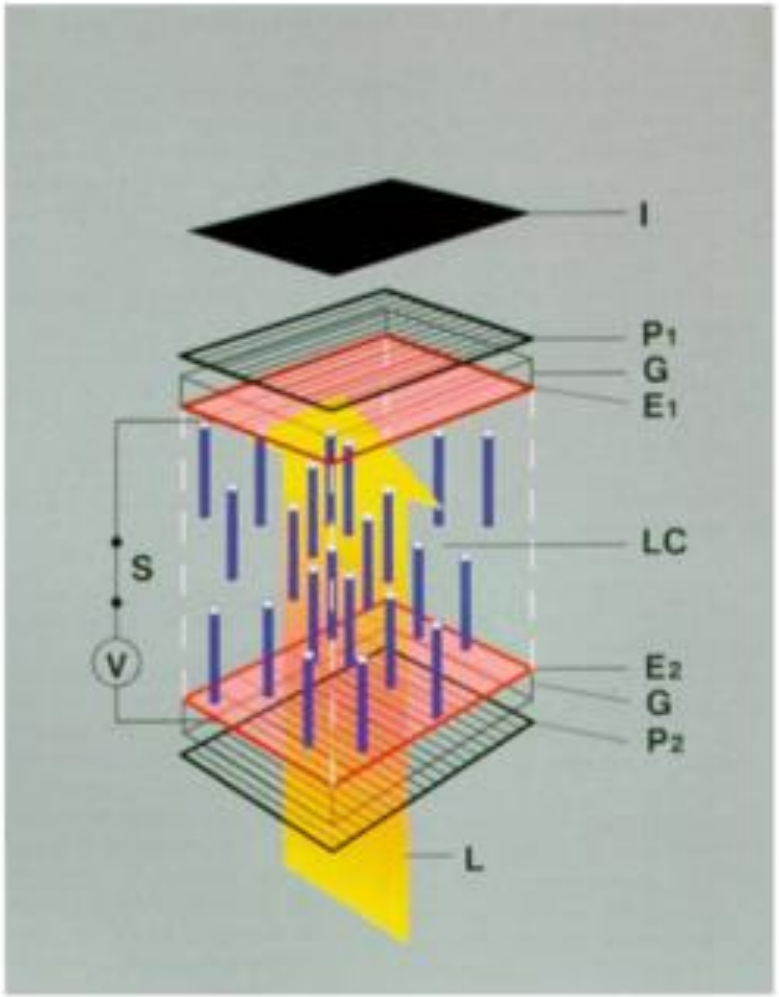
Elliptically polarized: the two components are not in phase and either do not have the same amplitude or not 90 degrees out of phase or both





Application in LCD





Thanks!