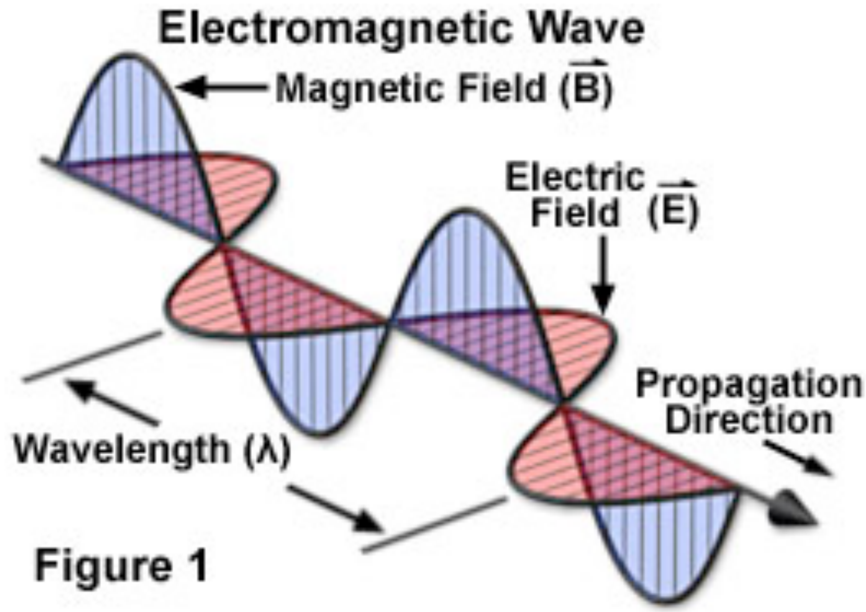
PHY385-H1F Introductory Optics

Class 16 – Outline: Sections 8.1 to 8.4

- Linear Polarization
- Circular Polarization
- Elliptical Polarization
- "Unpolarized" Light
- Dichroism and Polarizers
- Birefringence

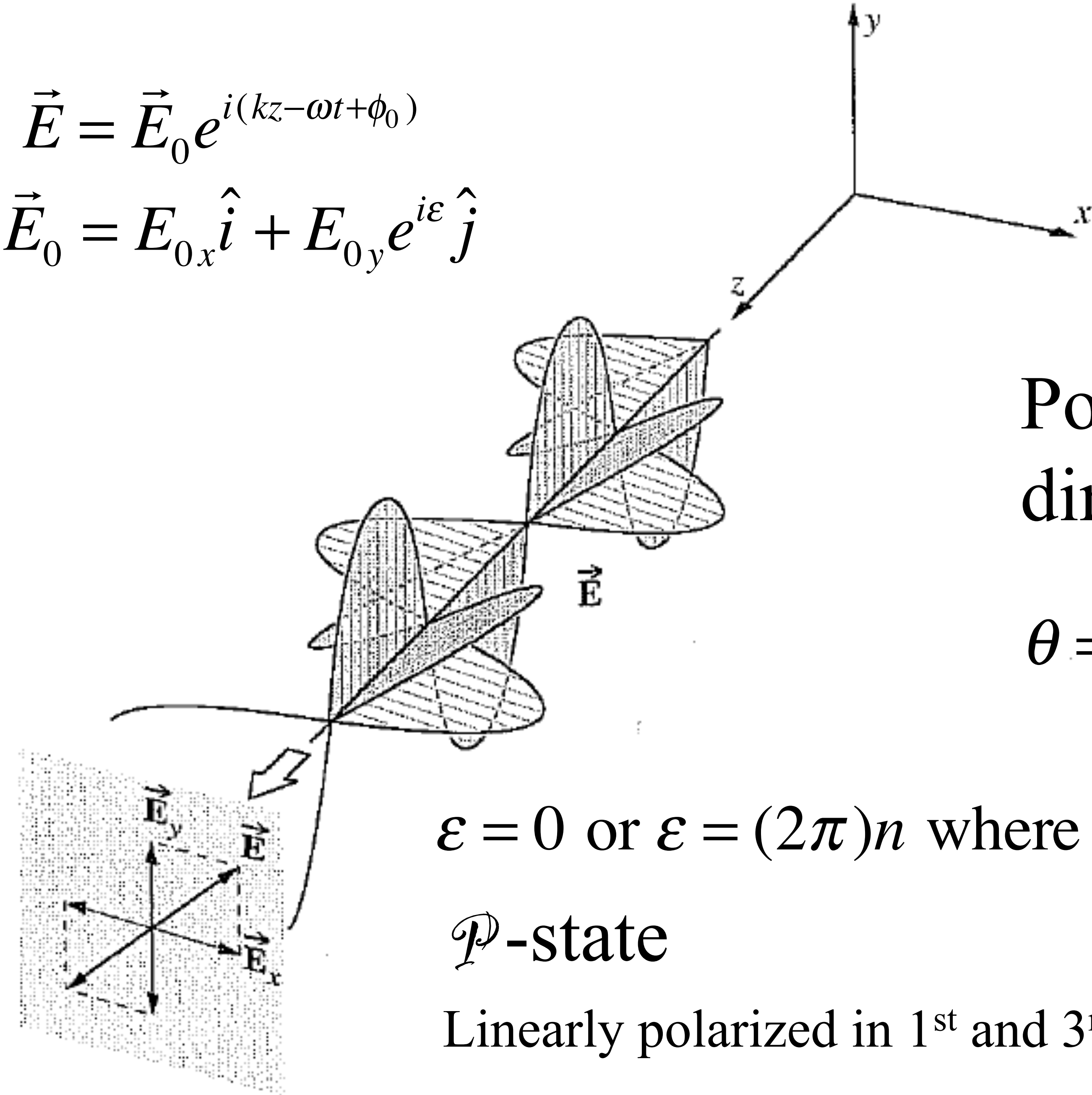


Question: What is the polarization direction of the wave shown above?

1. Horizontal
2. Vertical

$$\vec{E} = \vec{E}_0 e^{i(kz-\omega t+\phi_0)}$$

$$\vec{E}_0 = E_{0x}\hat{i} + E_{0y}e^{i\varepsilon}\hat{j}$$



Polarization direction:

$$\theta = \tan^{-1}\left(\frac{E_{0y}}{E_{0x}}\right)$$

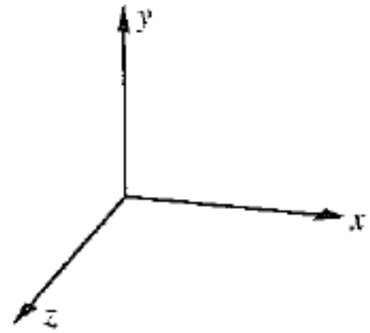
$\varepsilon = 0$ or $\varepsilon = (2\pi)n$ where $n = 0, \pm 1, \pm 2, ...$

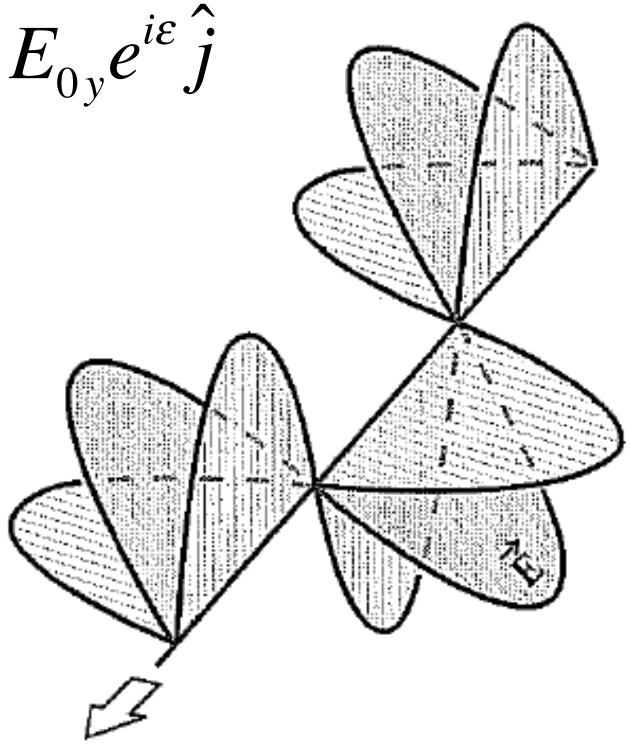
$\mathscr{P}$-state

Linearly polarized in 1st and 3rd quadrants.

$$\vec{E} = \vec{E}_0 e^{i(kz - \omega t + \phi_0)}$$

$$\vec{E}_0 = E_{0x}\hat{i} + E_{0y}e^{i\varepsilon}\hat{j}$$

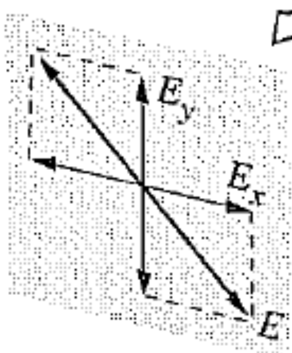




Polarization direction:

$$\theta = -\tan^{-1}\left(\frac{E_{0y}}{E_{0x}}\right)$$

$$\varepsilon = \pi \text{ or } \varepsilon = (2\pi)\left(n + \tfrac{1}{2}\right)$$



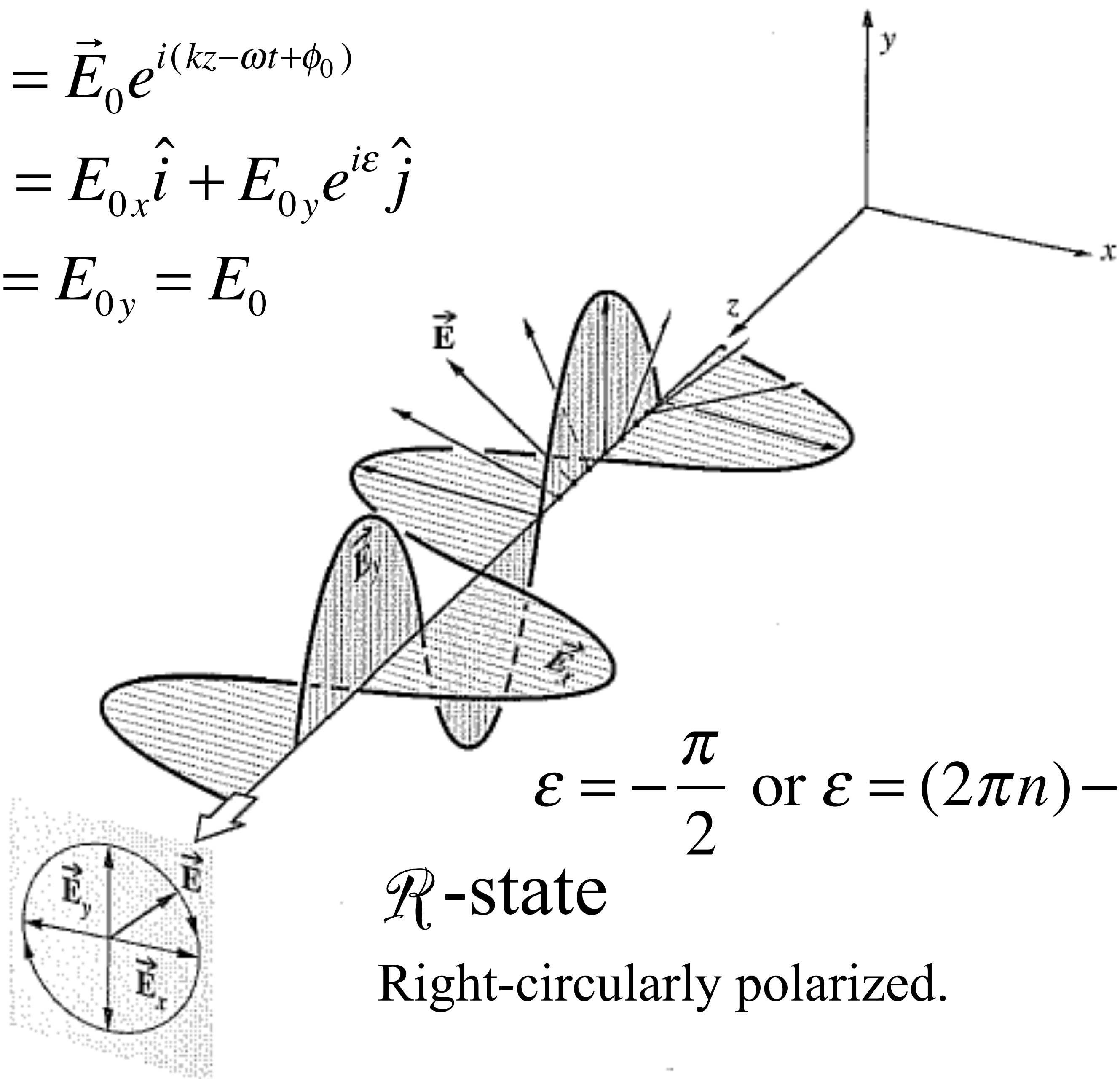
$\mathscr{P}$-state

Linearly polarized in 2nd and 4th quadrants.

$$\vec{E} = \vec{E}_0 e^{i(kz - \omega t + \phi_0)}$$

$$\vec{E}_0 = E_{0x}\hat{i} + E_{0y}e^{i\varepsilon}\hat{j}$$

$$E_{0x} = E_{0y} = E_0$$



$$\varepsilon = -\frac{\pi}{2} \text{ or } \varepsilon = (2\pi n) - \pi/2$$

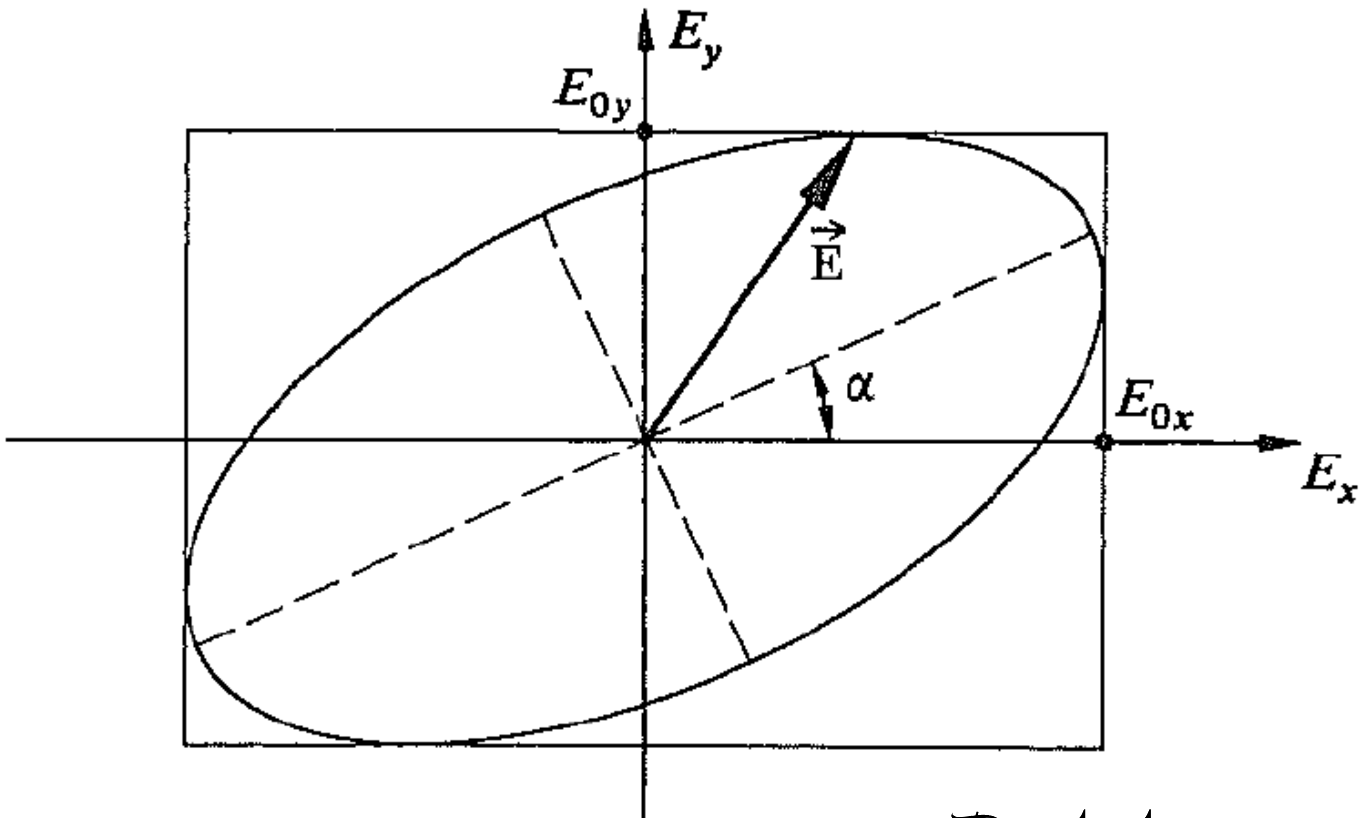
$\mathscr{R}$-state

Right-circularly polarized.

Video of Linear, Circular, Elliptical Polarizations

http://www.youtube.com/watch?feature=fvwp&v=Q0qrU4nprB0&NR=1

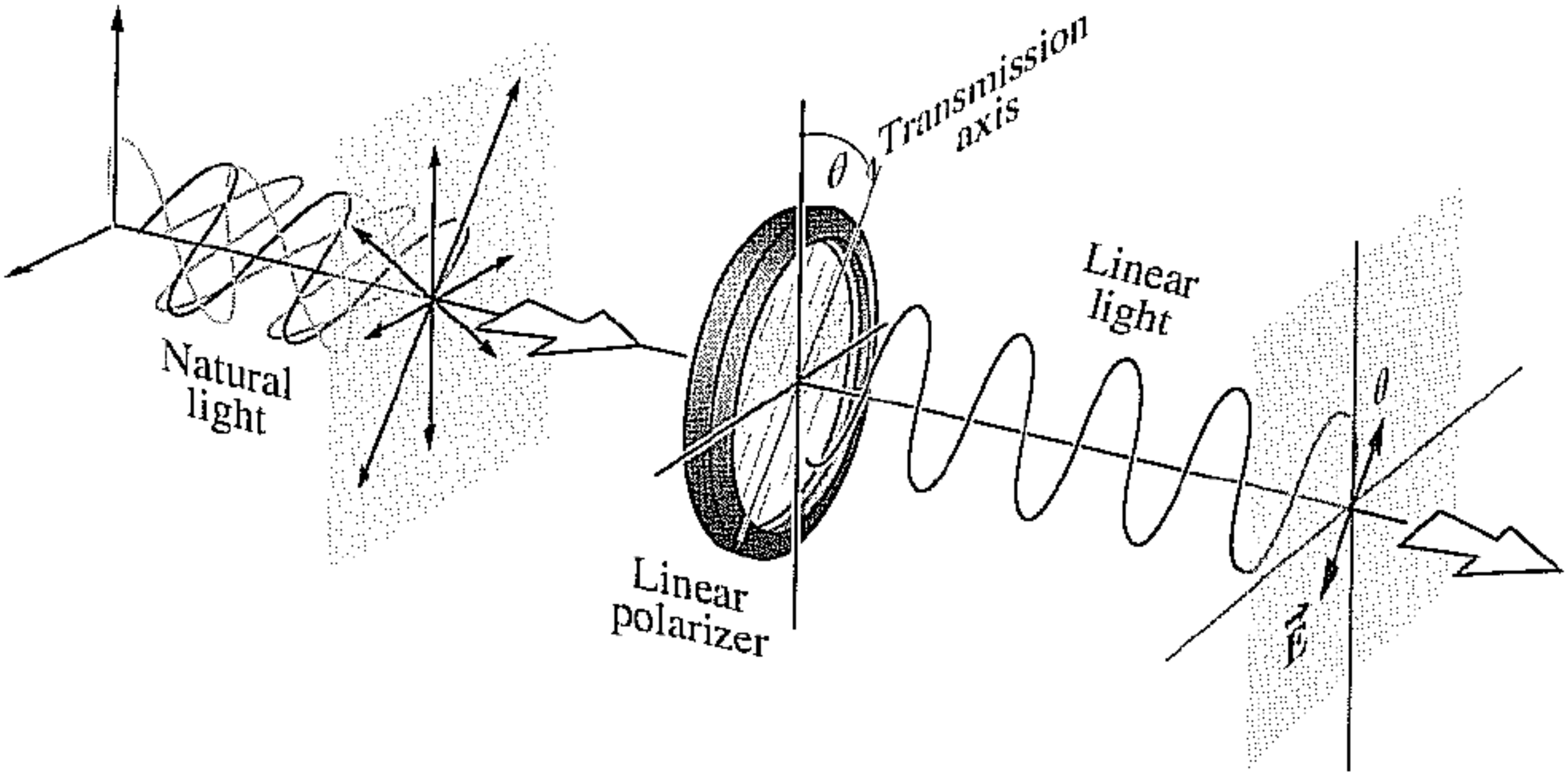
Elliptical polarization



$\mathbb{E}$-state

Elliptically polarized.
Elliptical polarization is the most general form of polarized light.
Linear and circular are special cases.

Dichroism



"Unpolarized" light incident on a linear polarizer tilted at an angle θ with respect to the vertical

Birefringence

$$n_x \neq n_y$$