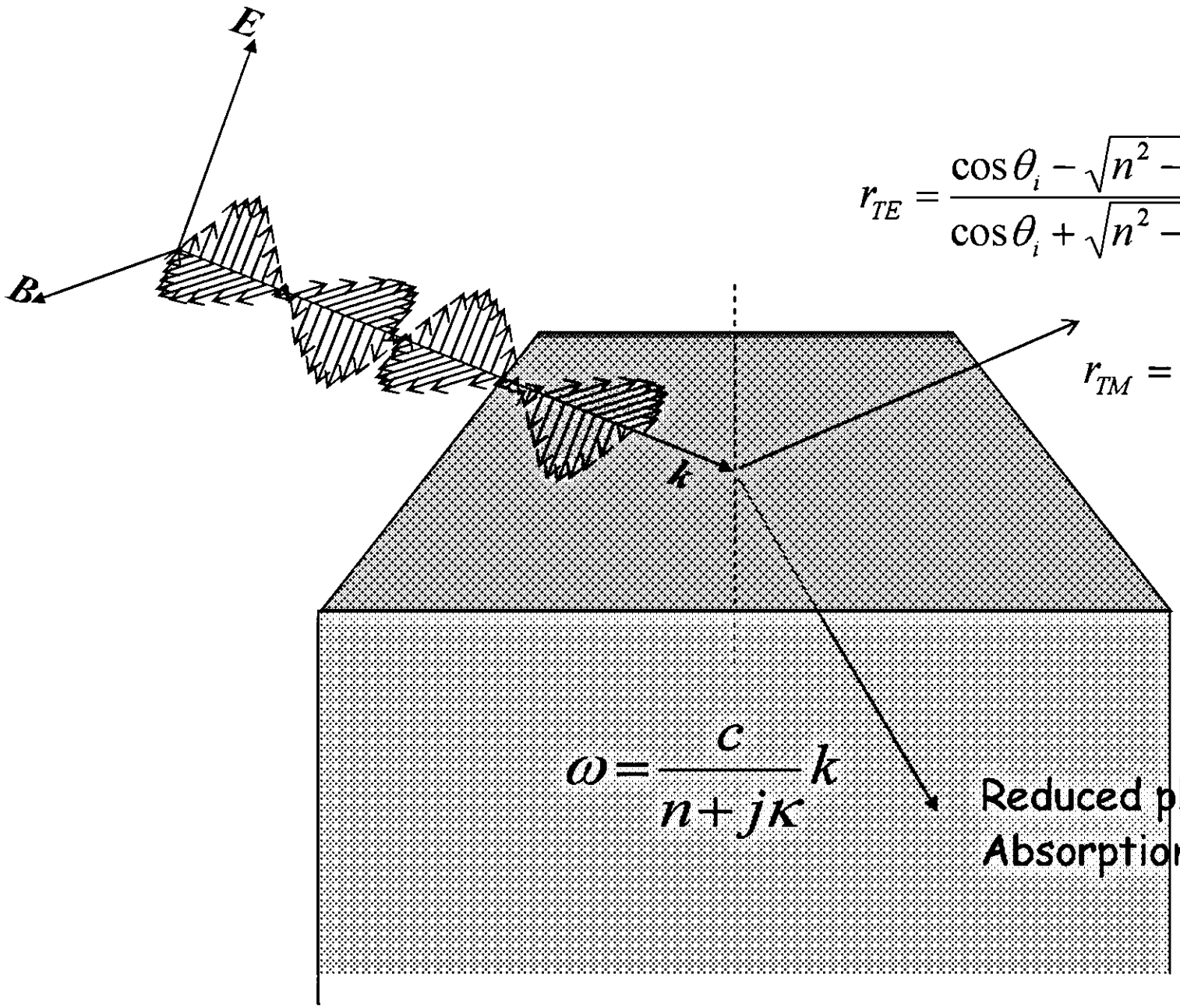
# Through the Looking Glass and What We Found There




$$r_{TE} = \frac{\cos\theta_i - \sqrt{n^2 - \sin^2\theta_i}}{\cos\theta_i + \sqrt{n^2 - \sin^2\theta_i}}$$

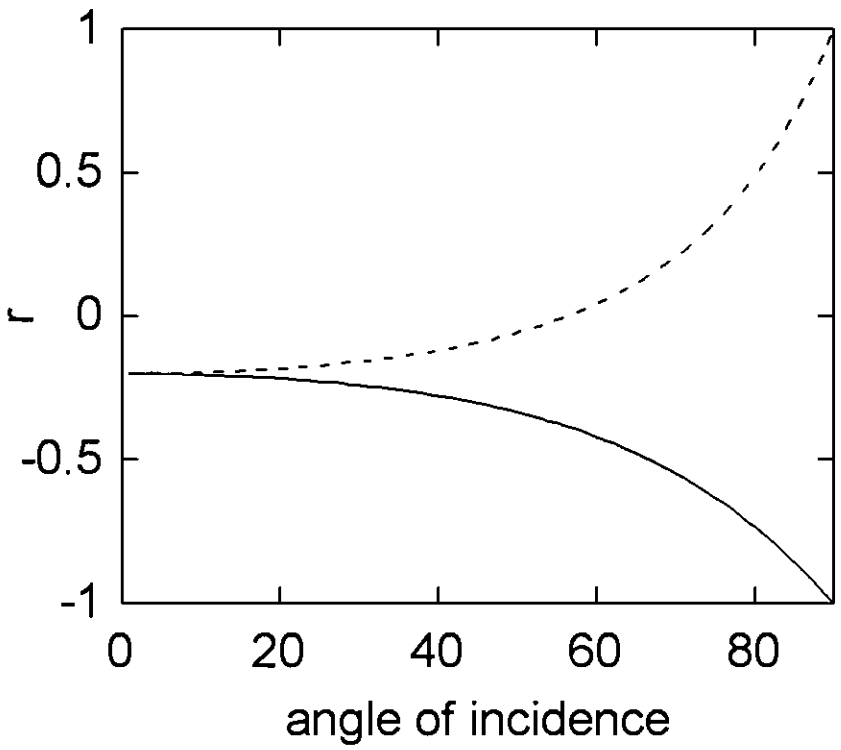
$$r_{TM} = \frac{-n^2\cos\theta_i + \sqrt{n^2 - \sin^2\theta_i}}{n^2\cos\theta_i + \sqrt{n^2 - \sin^2\theta_i}}$$

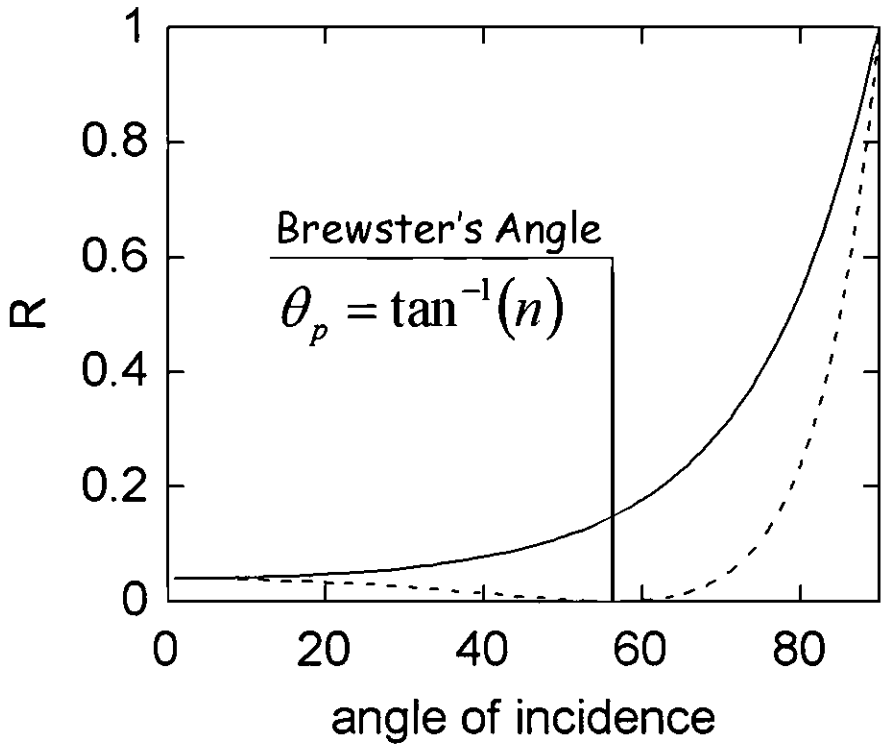
$$\omega = \frac{c}{n + j\kappa}k$$

Reduced phase velocity: $n$

Absorption: $\kappa$

TE ——  TM ------

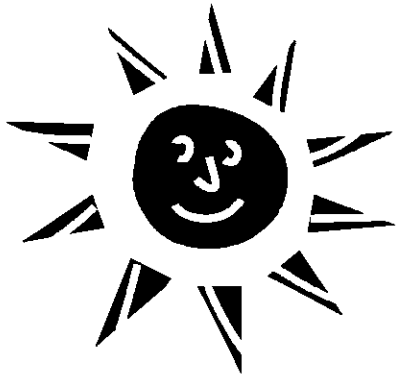


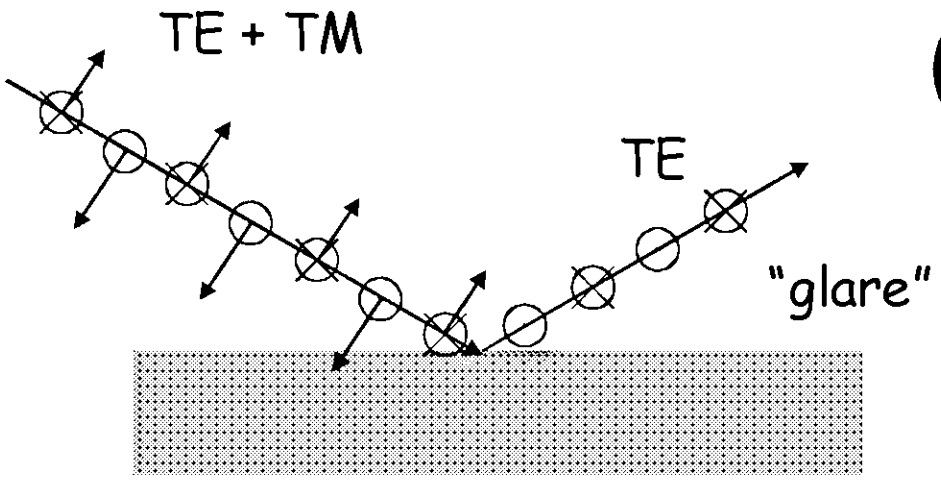



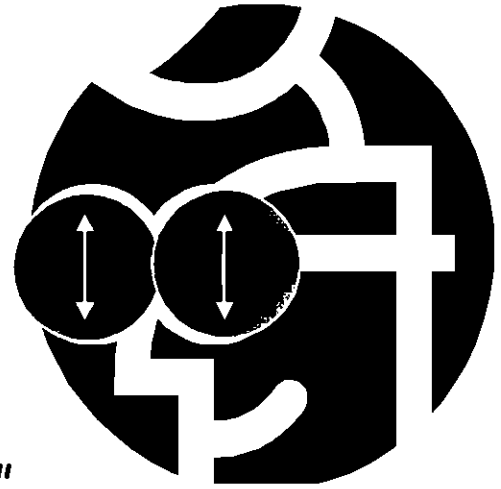

At Brewster's Angle, the Transverse Magnetic mode is not reflected, leaving only a Transverse Electric polarized reflection.

$$\theta_p = \tan^{-1}\left(n_{glass}\right)$$

$$\theta_p \approx 56^\circ$$

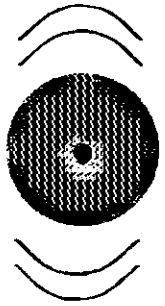




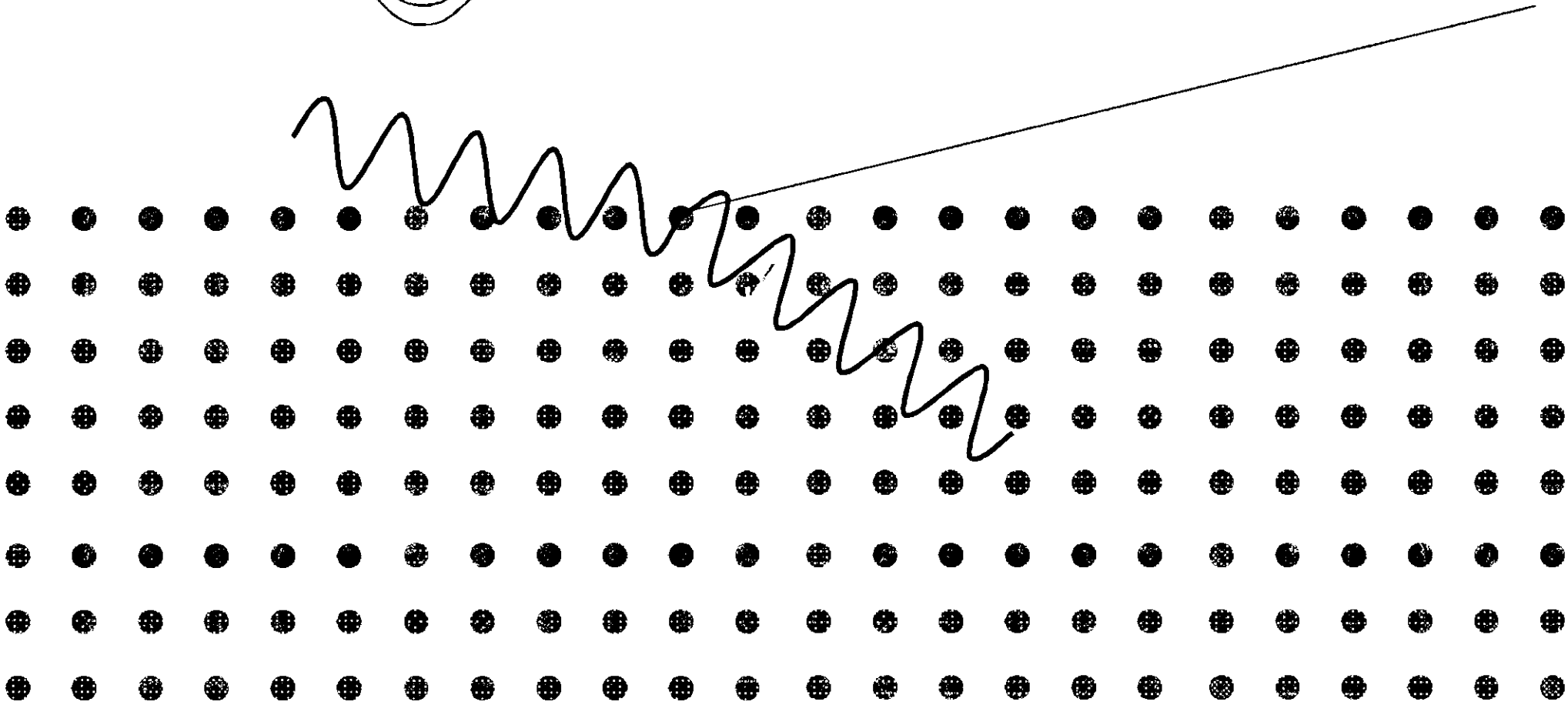



# Physical Interpretation

An oscillating charge radiates strongest perpendicular to the oscillation, and zero along the oscillation.



At Brewster's angle, the refracted beam causes dipoles to oscillate along the reflected direction.

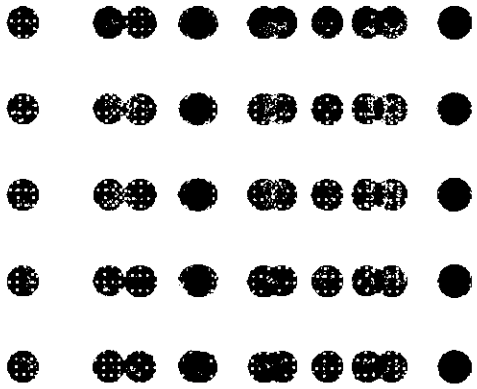


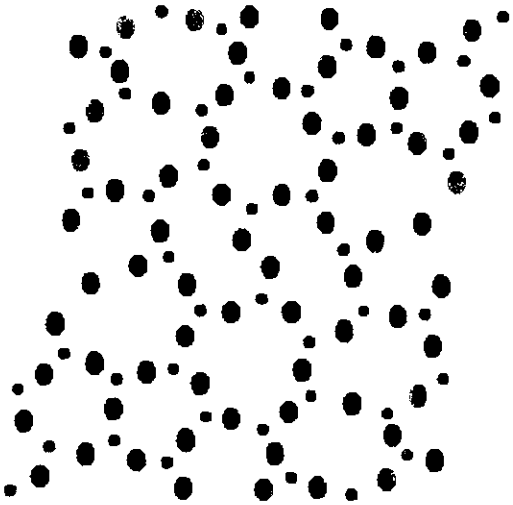
Homogeneous - same properties at all points.

opposite: *inhomogeneous*

Isotropic - same properties in all directions.

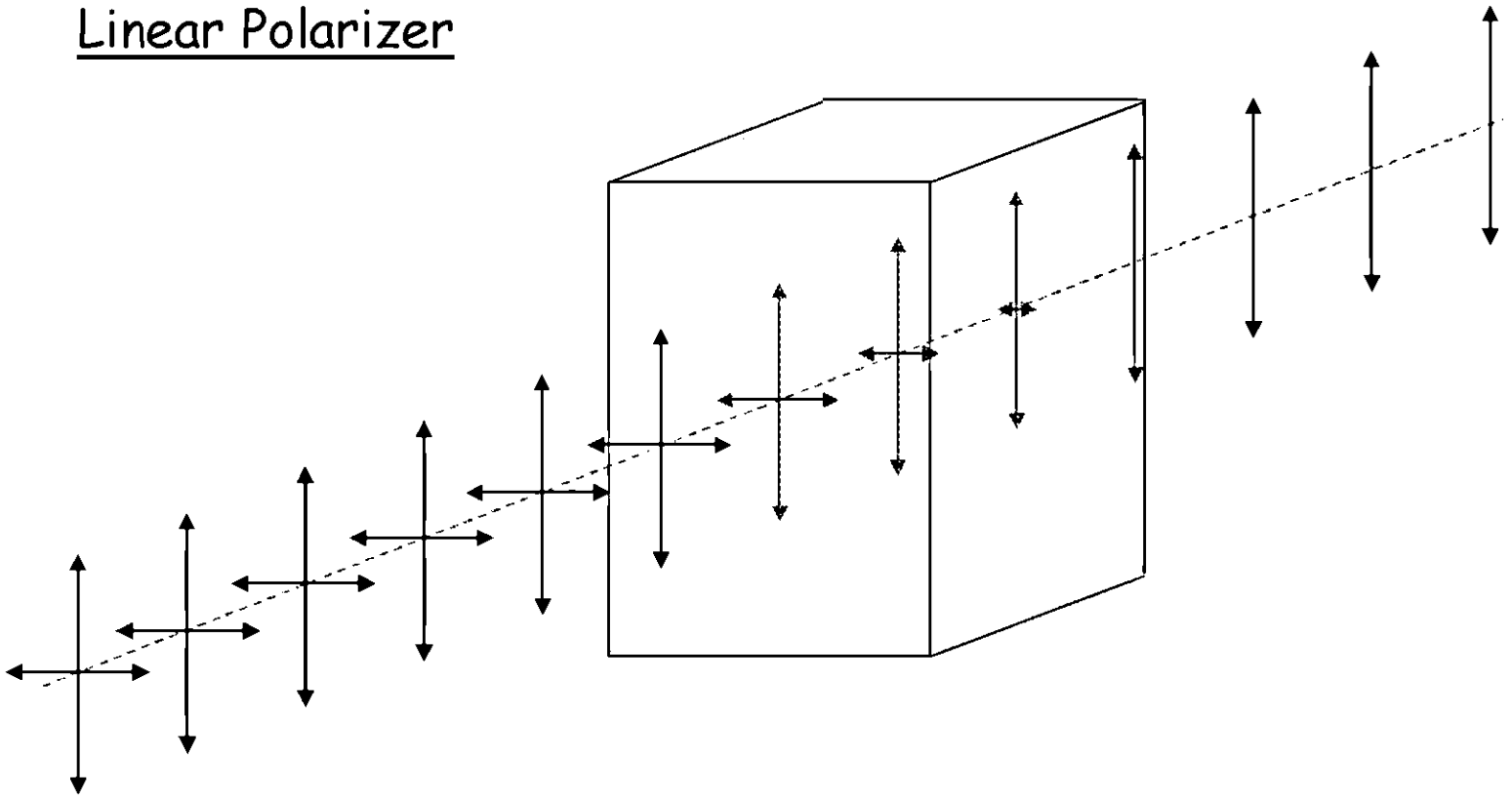
opposite: *anisotropic*





Polarizers, phase retarders, and rotators: based on anisotropy in $n+j\kappa$

## Linear Polarizer

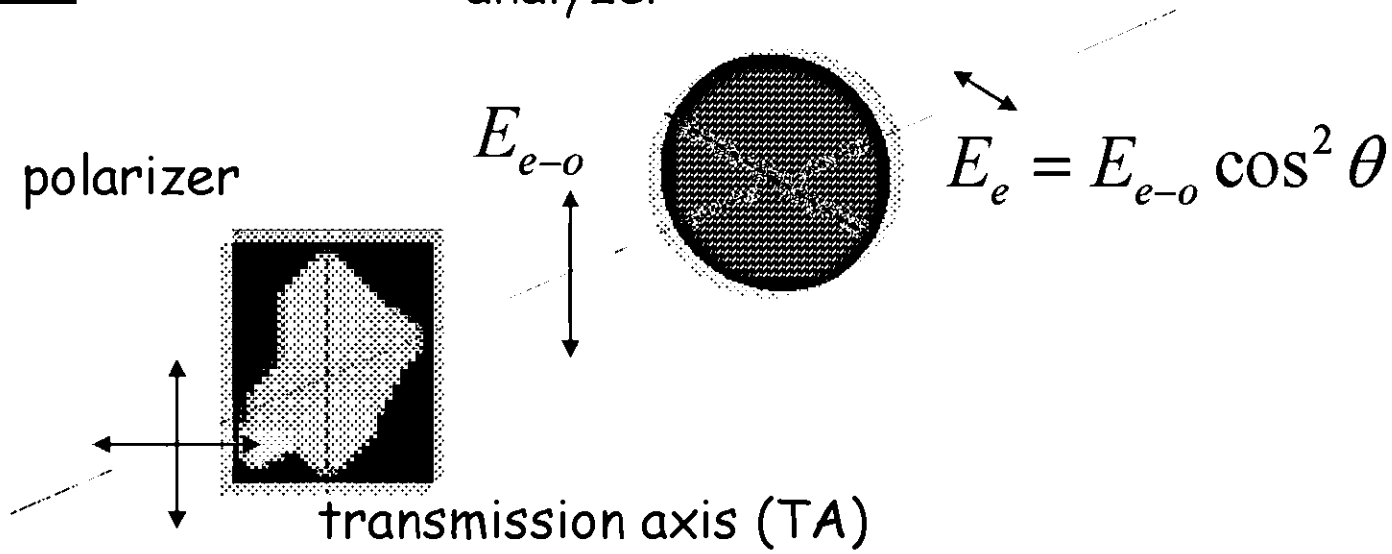


"dichroism"

1. The effect of causing white light to be split into colors.

2. The effect of causing different polarizations to be absorbed by different amounts (anisotropy in $\kappa$).

## Linear Polarizer




The effect of a polarizing element is described by its Jones Matrix, which multiplies the light's Jones Vector.

$$\begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix}$$ TA vertical

$$\begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}$$ TA horizontal

$$\begin{bmatrix} \cos^2\theta & \sin\theta\cos\theta \\ \sin\theta\cos\theta & \sin^2\theta \end{bmatrix}$$ TA at $\theta$