8/26 Class Notes

→ recall we can use the div. angle of the Gaussian beam to determine λ.
→ we can use Gaussian beams...
- as range finders!

2nd experiment: Polarization

→ Recall that light is a transverse wave. For a plane wave,

$$\vec{E}_x(z,t) = \hat{\imath}\, E_{0x} \cos(kz - \omega t)$$
$$\vec{B}_y(z,t) = \hat{\jmath}\, B_{0y} \cos(kz - \omega t)$$

→ Recall Ohm's Law:

$$\vec{j} = \sigma \vec{E}$$

- where the direction of $\vec{E}$ is determined with Lenz' law.

→ and the Biot-Savart Law:

$$B = \frac{\mu_0 N I}{2R} \quad \text{and} \quad d\vec{B} = \frac{\mu_0 I}{4\pi} \cdot \frac{d\vec{s} \times \hat{r}}{r^2}$$

→ because the electric field only oscillates in one direction, we say that the beam is polarized.
- laser: polarized!
- sunlight: not polarized.

→ $\vec{E} \times \vec{B}$ will result in your propagation direction k (because $\vec{E} \perp \vec{B}$).

→ polarizers:
- a polarizer is an optical filter that lets light waves of a specific polarization through.
- allow a particular polarized direction of light through.
- change the intensity of polarized light as a function of the angle.

→ if the electric field passing through the polarizer is

$$\vec{E}_x(z,t) = \hat{\imath}\, E_{0x} \cos(kz - \omega t)$$

→ optical rotation

- aka polarization rotation or circular birefringence
- rotation of the orientation of the orientation of the plane of polarization about the optical axis of linearly polarized light as it travels thru certain materials.
- only occurs in chiral materials: lacking mirror symmetry.

→ incident light is reflected, absorbed, scattered, reflected, etc, which affect intensity.

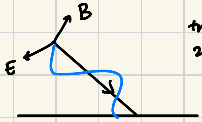
$$I_0 = I_{transmittance} + I_{absorbance} + I_{Reflectance}$$

reflectance $R = I_R / I_0$

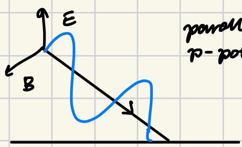
transmittance $T = I_T / I_0$

absorbance $A = I_A / I_0$

$R + T + A = 1$



transverse electric
zenkrecht-polarized

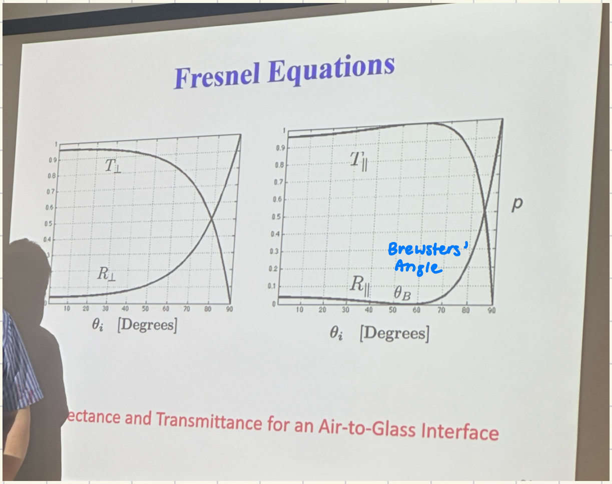


parallel electric
p-polarized light

→ Fresnel Equations

$$R_s = \left| \frac{n_i \cos\vartheta_i - n_t \cos\vartheta_t}{n_i \cos\vartheta_i + n_t \cos\vartheta_t} \right|^2$$

$$R_p = \left| \frac{n_t \cos\vartheta_i - n_i \cos\vartheta_t}{n_t \cos\vartheta_i + n_i \cos\vartheta_t} \right|^2$$



→ what direction are our sunglasses polarized in?

↳ what polarization do we want to block?