

Physics 114 - April 11, 2006

Thursday presentations {
optics
Beer run
Aurora
Diamonds
Come-on lines

Bring project evaluation sheets

Last Time

Energy flow of EM wave

$$\text{Poynting vector} = \vec{S} = \frac{\vec{E} \times \vec{B}}{\mu_0}$$

$|\vec{S}| = \text{Intensity in WATTS}/\text{M}^2$

$E/\text{Time}/\text{Area}$

Time
Average
intensity

$$\bar{S} = \langle S \rangle = \left\{ \frac{E_0^2}{2\mu_0 c} = \frac{c B_0^2}{2\mu_0} = \frac{E_0 B_0}{2\mu_0 c} \right\}$$

momentum in Electromagnetic wave

$$\left\{ p = \frac{U}{c} \right\}$$

Radiation pressure
(light absorbed)

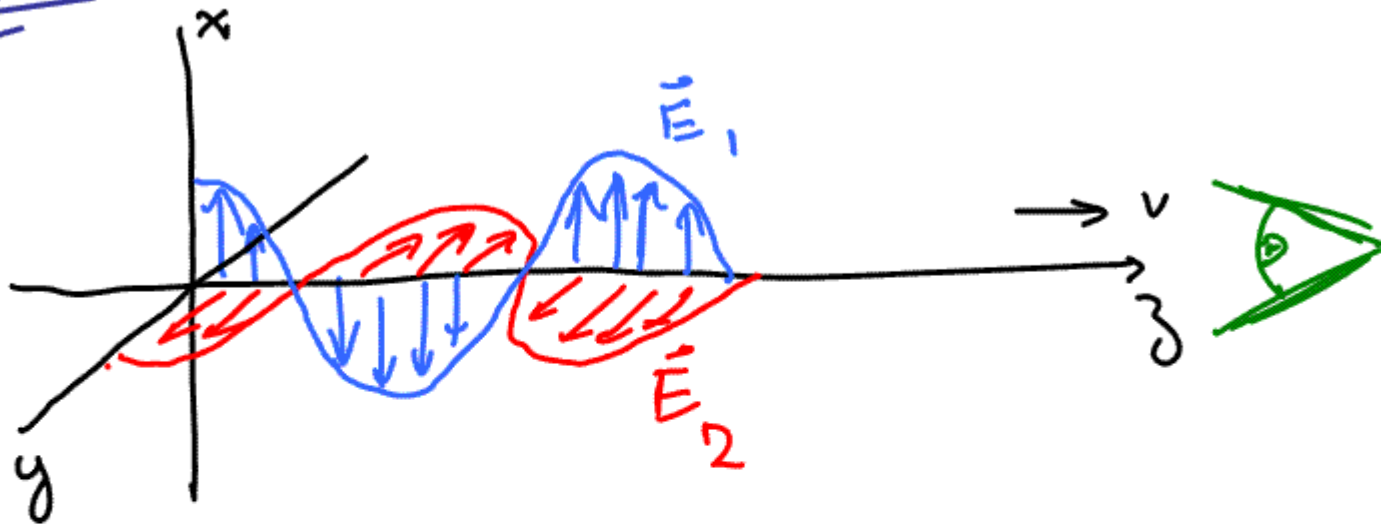
$$= \left\{ \frac{S}{c} \right\}$$

(light reflected)

$$= \left\{ \frac{2S}{c} \right\}$$

Polarization

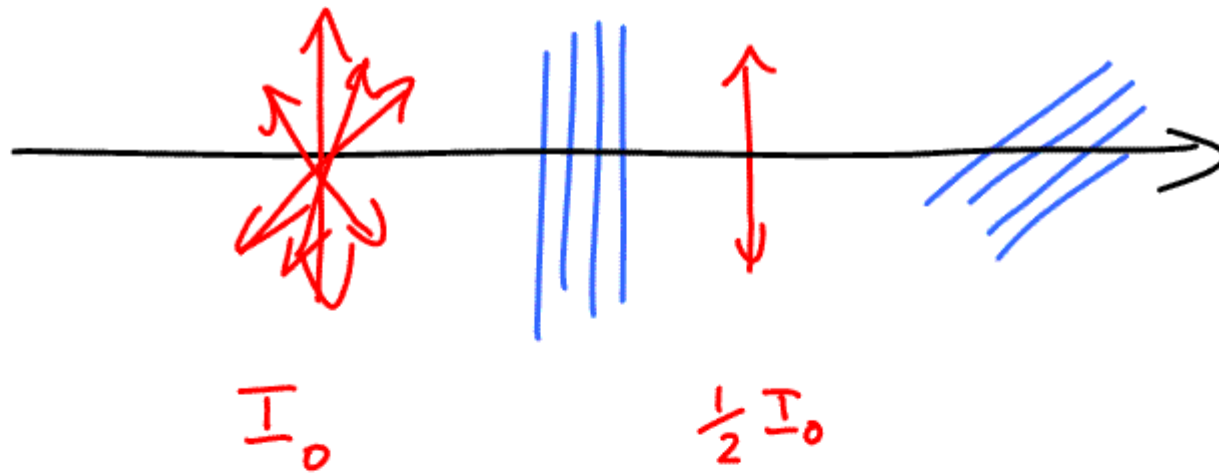
General Solution for EM plane wave



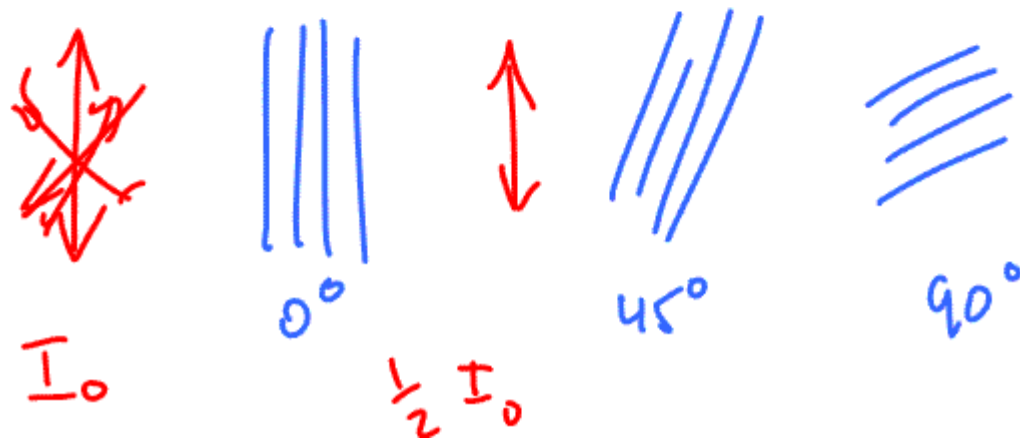
$$\vec{E}_1 = E_{0x} \cos(kx - \omega t) \hat{x}$$

$$\vec{E}_2 = E_{0x} \cos(kx - \omega t) \hat{y}$$

Relative phase of the orthogonal plane wave
Solutions determines the polarization



unpolarized
light





$$\frac{1}{2} \epsilon$$



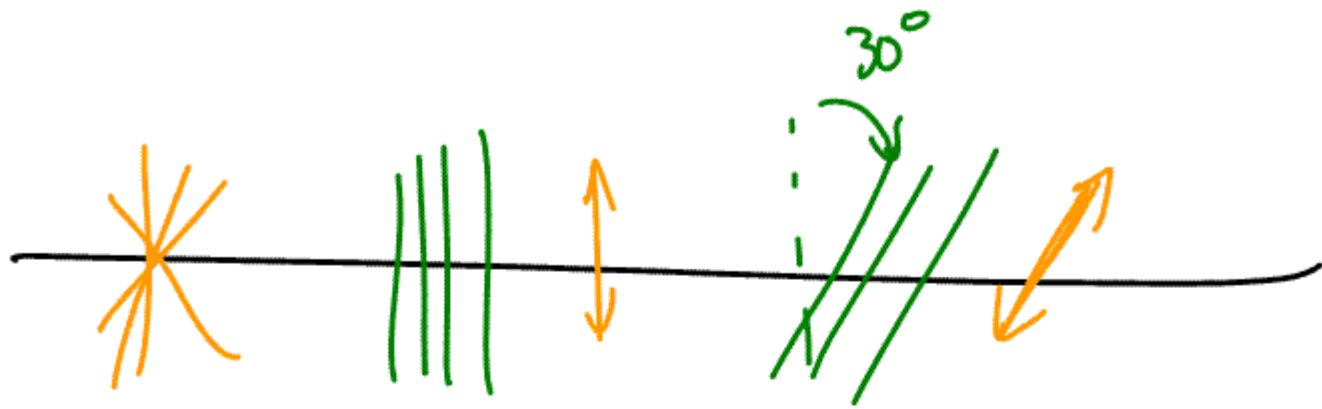
$$I \sim E^2 \cos^2 \theta_1$$

≡



comes thru

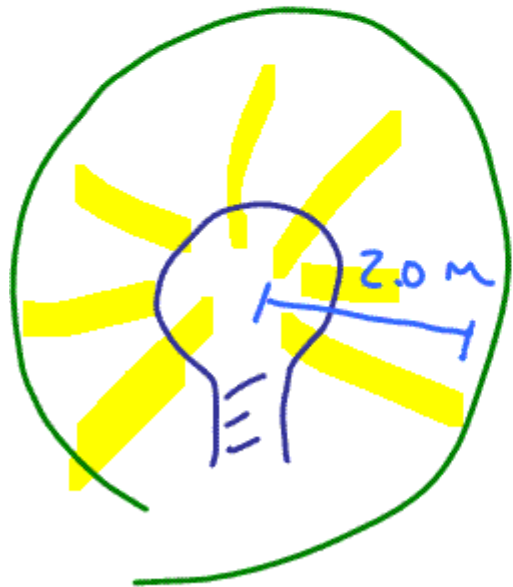
$$I \sim \cos^2 \theta_2$$



I_0

$\frac{1}{2} I_0$

$$I = \frac{1}{2} I_0 \cos^2 30$$



60 WATTS

$$\times \frac{1}{2} = 30 \text{ WATTS}$$

$$I = \frac{\text{WATTS}}{\text{M}^2} = \frac{30}{4\pi \frac{r^2}{2}} = \frac{30}{16\pi}$$

$$c = \frac{1}{\sqrt{\epsilon_0 \mu_0}}$$

light travels more slowly in a material

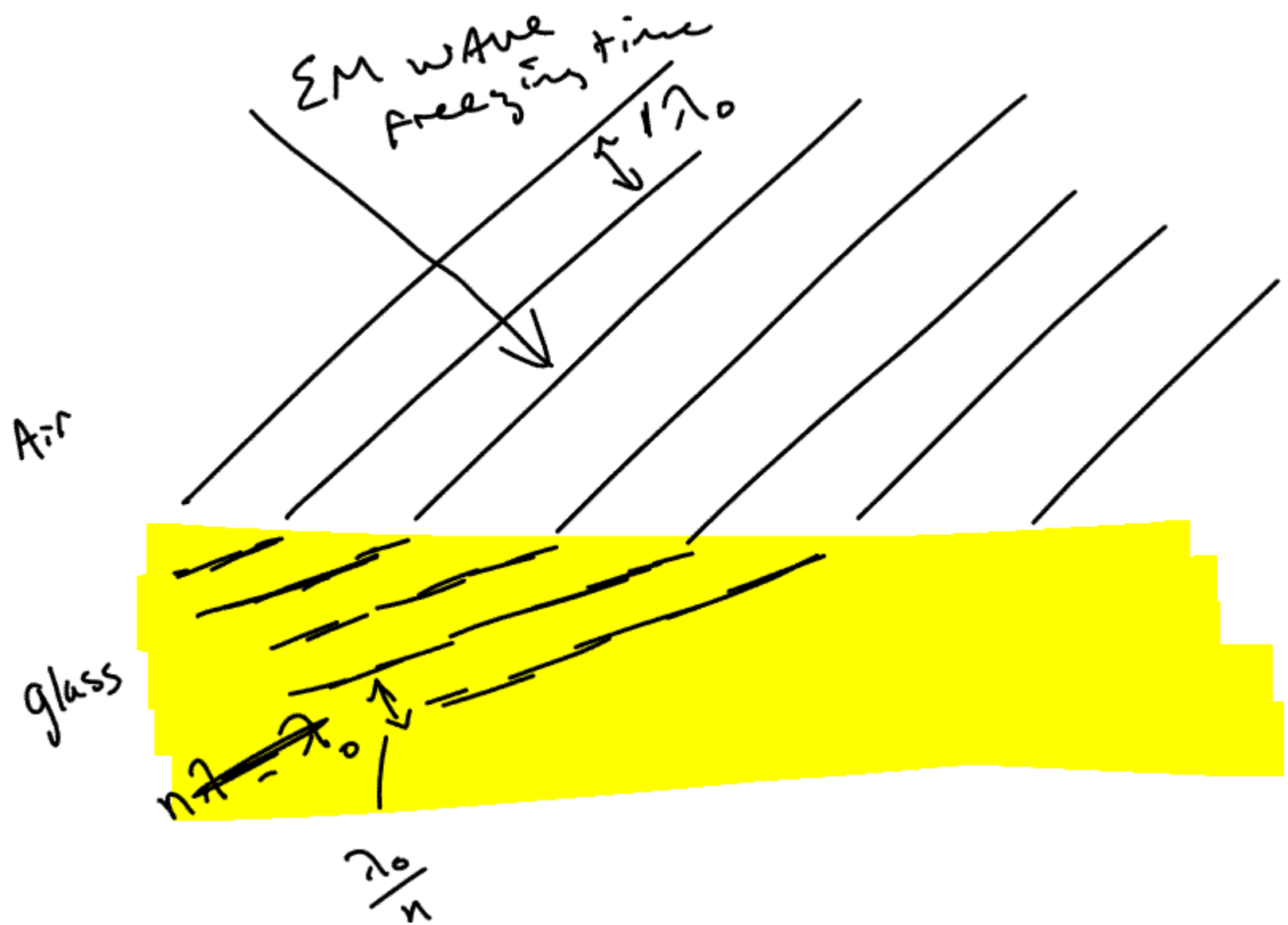
$$v < \frac{c}{v} = n \quad \text{index of refraction}$$

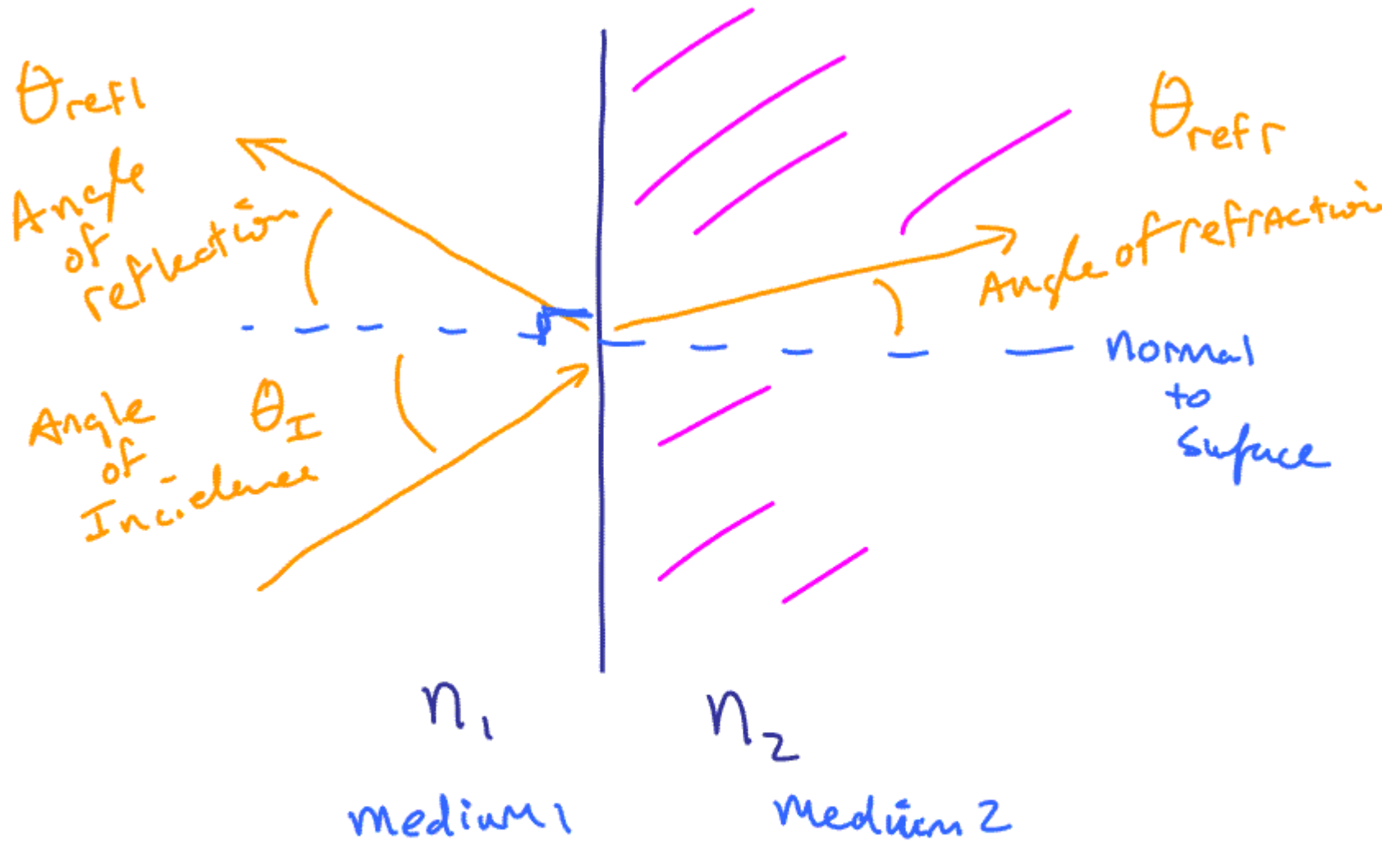
$$\frac{c}{n} = v \quad \text{of light in material of index } n$$

$$\lambda_0 v = c$$

$$\lambda v = v = \frac{c}{n}$$

$$\lambda_n = \frac{c}{v} = \lambda_0$$



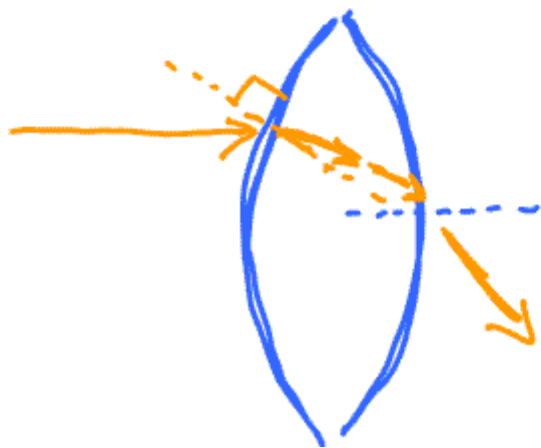
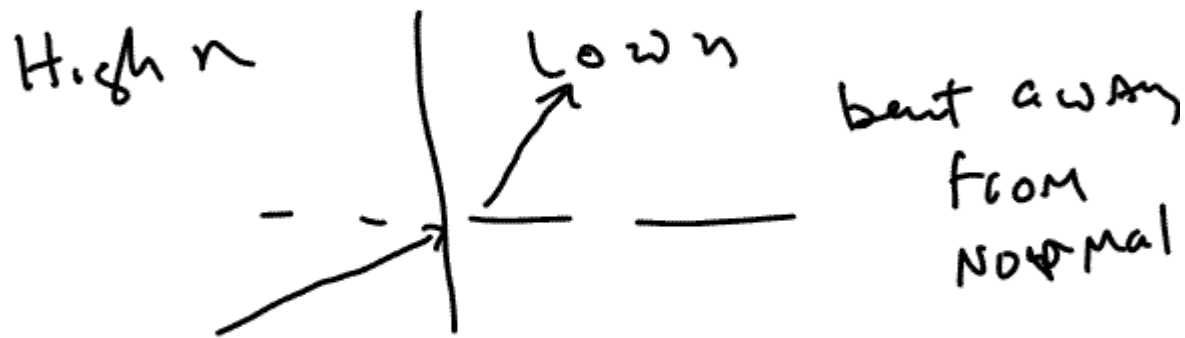


$$\theta_I = \theta_{refl}$$

Law of reflection

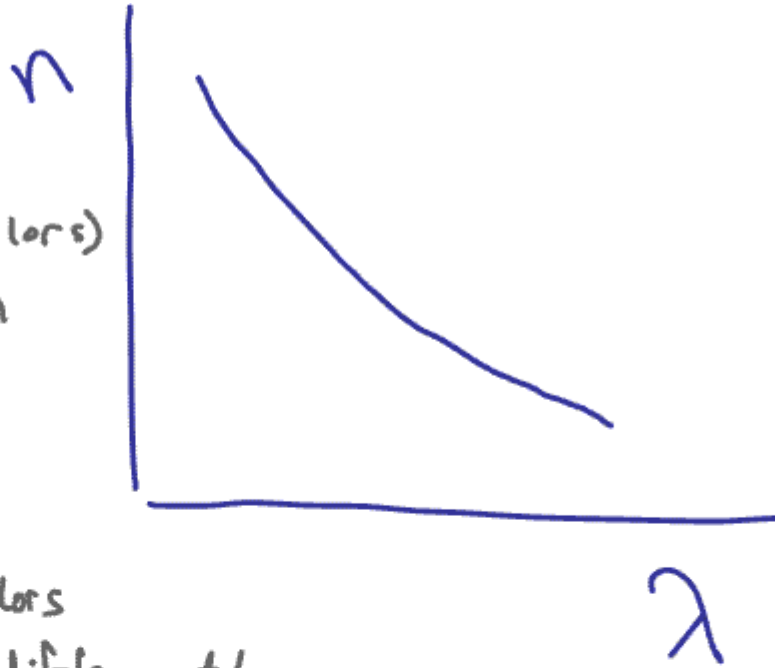
$$n_1 \sin \theta_I = n_2 \sin \theta_{refr}$$

Snell's Law



Dispersion

Different frequencies (colors) of light have different n



This means different colors will bend (refract) differently at interface between two media according to Snell's Law

v smaller

