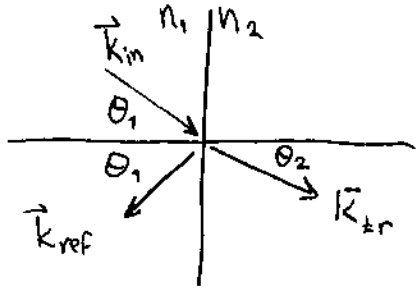
P3320 LECTURE 17

Continuing discussion of polarized waves incident on a dielectric:

Recall the angles:



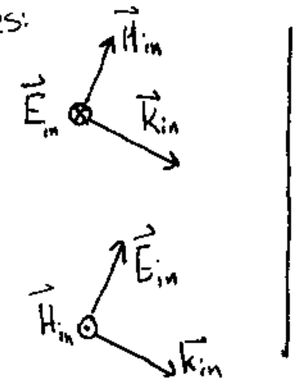
where (Snell's Law):

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

Two linear polarization states:

$\vec{E} \perp$ plane of incidence.

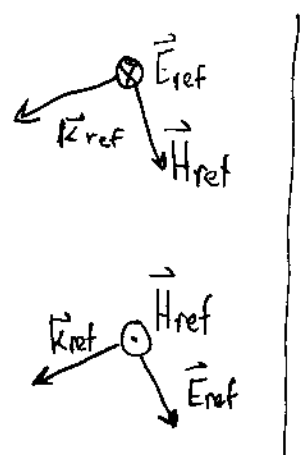
$\vec{E} \parallel$ plane of incidence.



Since parallel components of E, H are continuous at boundary only normal components can reverse sign. So polarization of reflected waves will be:

$E\perp$:

$E_{\parallel}$:



$E_{\parallel}$ case: Component of $\vec{E}$ parallel to surface is continuous:

$$E^0_{in}\cos\theta_1 - E^0_{ref}\cos\theta_1 = E^0_{tr}\cos\theta_2$$

H constraints: $H_{in}^{0} + H_{ref}^{0} = H_{tr}^{0}$

$$\Longrightarrow n_1 E_{in}^{0} + n_1 E_{ref}^{0} = n_2 E_{tr}^{0}$$

Solving: $\left(E_{in}^{0} - E_{ref}^{0}\right)\cos\theta_1 = E_{tr}^{0}\cos\theta_2$

$$= \frac{n_1}{n_2}\left(E_{in}^{0} + E_{ref}^{0}\right)\cos\theta_2$$

So $E_{ref}^{0}\left(\frac{n_1}{n_2}\cos\theta_2 + \cos\theta_1\right) = E_{in}^{0}\left(\cos\theta_1 - \frac{n_1}{n_2}\cos\theta_2\right)$

$$\Longrightarrow \boxed{\frac{E_{ref}^{0}}{E_{in}^{0}} = \frac{\tan(\theta_1 - \theta_2)}{\tan(\theta_1 + \theta_2)}}$$

Also, through ugly algebra, find $\boxed{\frac{E_{tr}^{0}}{E_{in}^{0}} = \frac{2\cos\theta_1 \sin\theta_2}{\sin(\theta_1+\theta_2)\cos(\theta_1-\theta_2)}}$

Fresnel Equations:

Note that E_{ref}^{0} vanishes if $\tan(\theta_1+\theta_2) \to \infty$!
If $\theta_1 + \theta_2 = 90°$, then there is no reflected wave for $E \parallel$ to plane of incidence. This occurs if

$$\tan\theta_1 = \frac{n_2}{n_1}.$$