Physics 142 – November 25, 2014

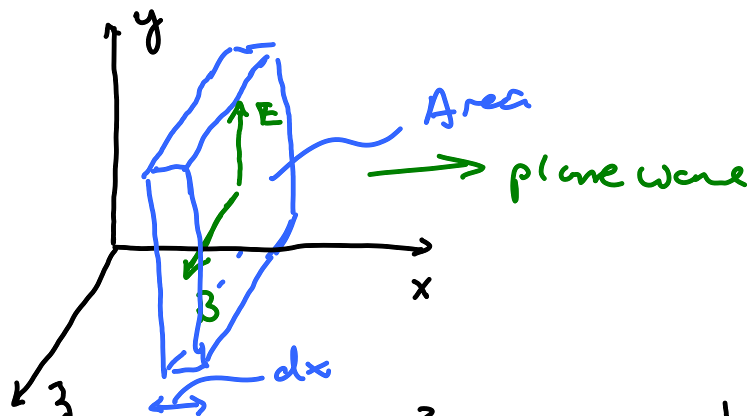
Happy Thanksgiving

- Requests to date:

– EM/chem-Med	Dec 4 (other?)
– Supercond	4, 9, 11
– Musical instr	9, 4
– Rad	11, 9, 4
– Accel / Det	9, 11

Railguns?
Lasers?

Energy Flow

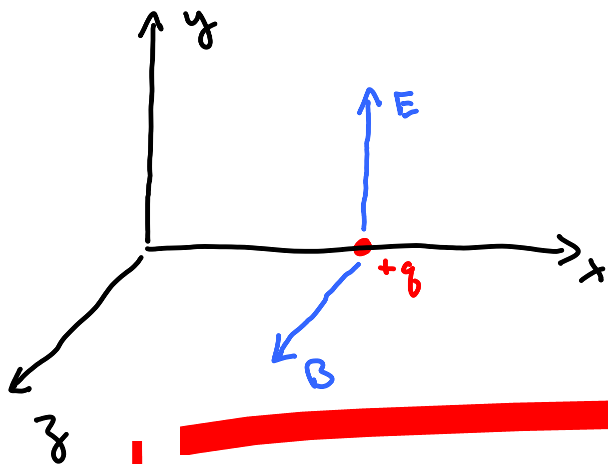


$$u_E = \frac{\epsilon_0}{2} E^2 \qquad u_B = \frac{1}{2\mu_0} B^2$$

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

$$|\vec{S}| \equiv \text{intensity} \qquad \text{Power}/m^2 = \text{watts}/m^2 \cdot s$$

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



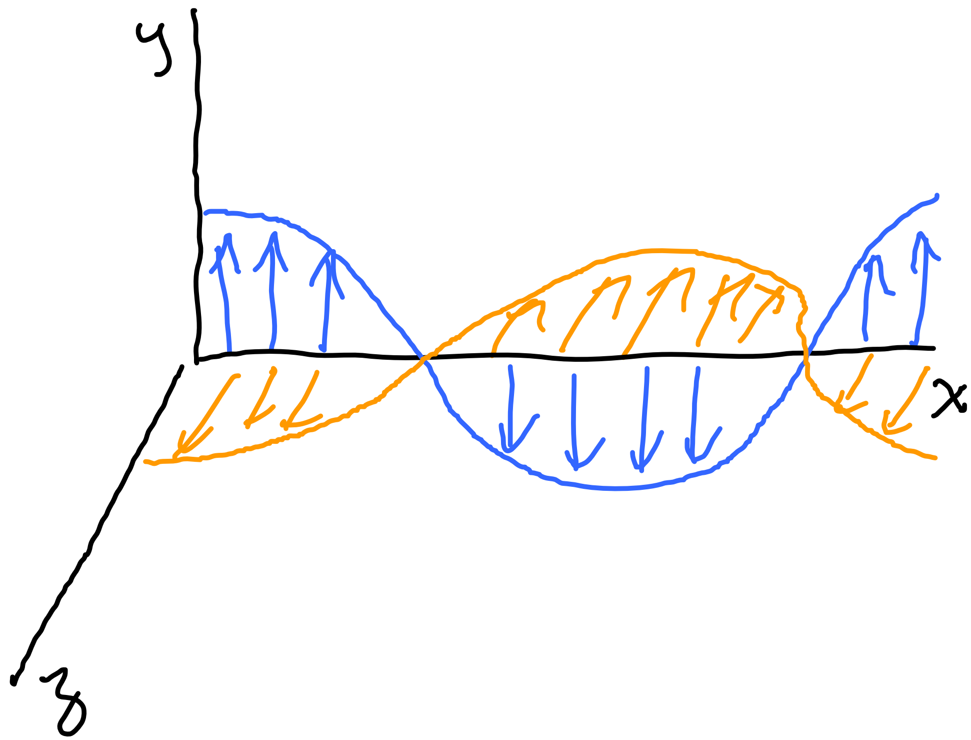
Momentum of EM wave $P = U/c$

If wave absorbed

Radiation Pressure $= S/c$

Ave. Radiation Pressure $= \langle S \rangle / c$

x2 if wave is reflected



$\vec{E} = E_0 \sin(kx - \omega t)\,\hat{j}$

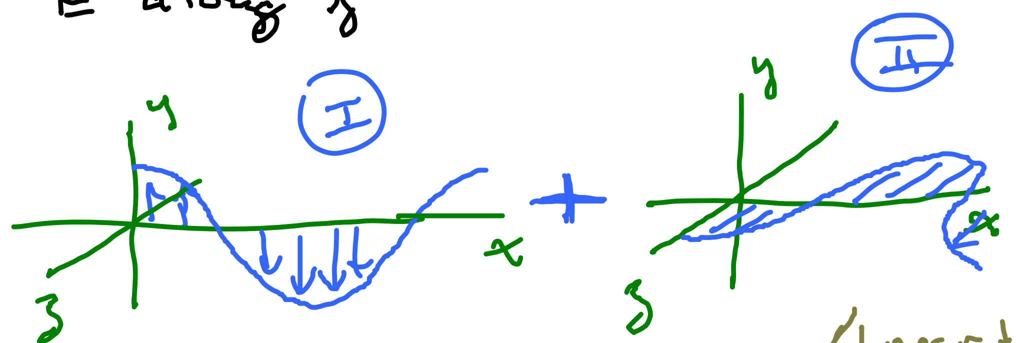
$\vec{B}$

Polarization

EM plane wave prop in x direction
Not constrain $\vec{E}$ along $\hat{y}$

General Solution

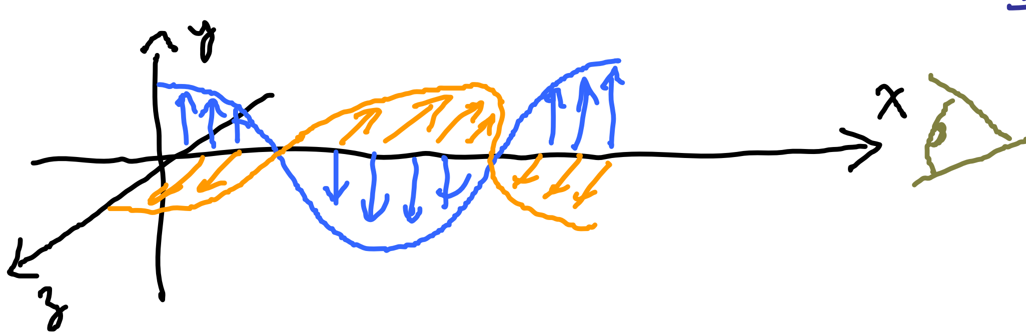
$\vec{E}$ made up of BASIS set



(linearly polarized)

I plane polarized along y-axis
$\vec{E}$ along y

II plane (linearly) pol. along z axis
$\vec{E}$ along z-axis

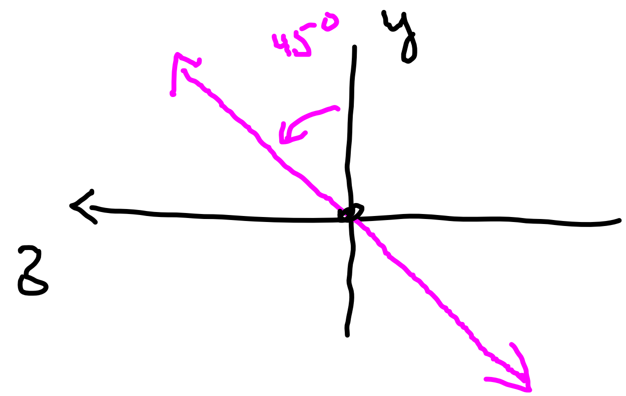


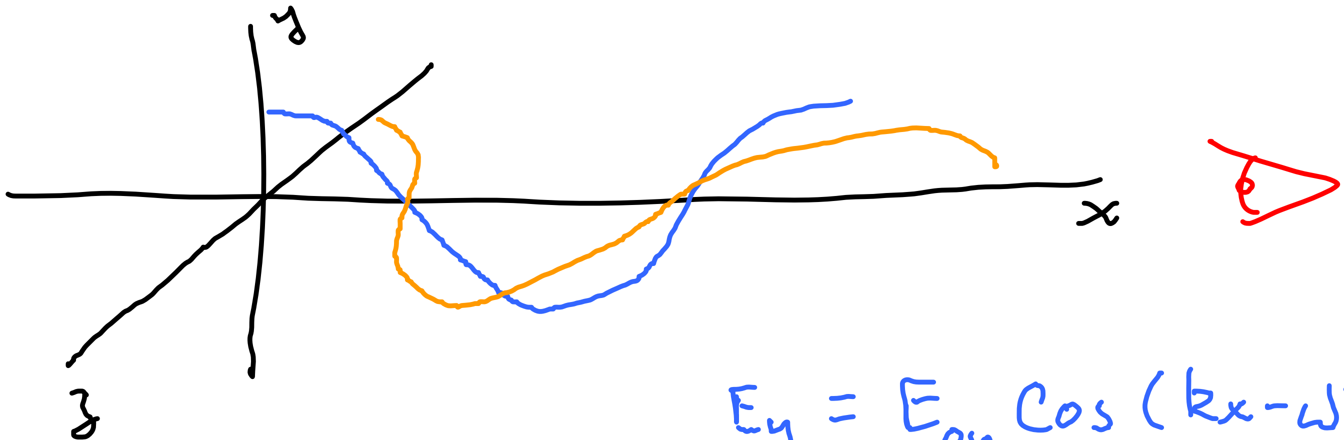
let phase and magnitudes of 2 solutions be the same

$$E_y = E_{oy} \cos(kx - \omega t)\, \hat{y}$$

$$E_z = E_{oz} \cos(kx - \omega t)\, \hat{z}$$

$E_{oz} = E_{oy}$

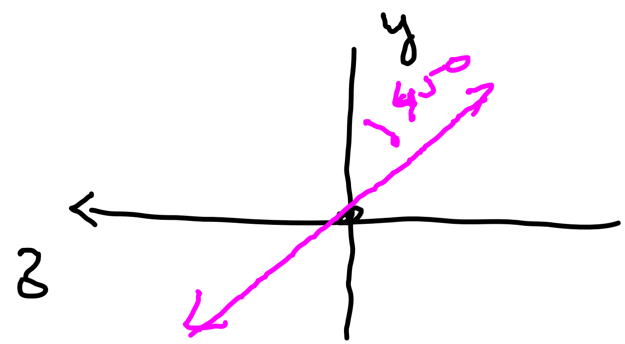


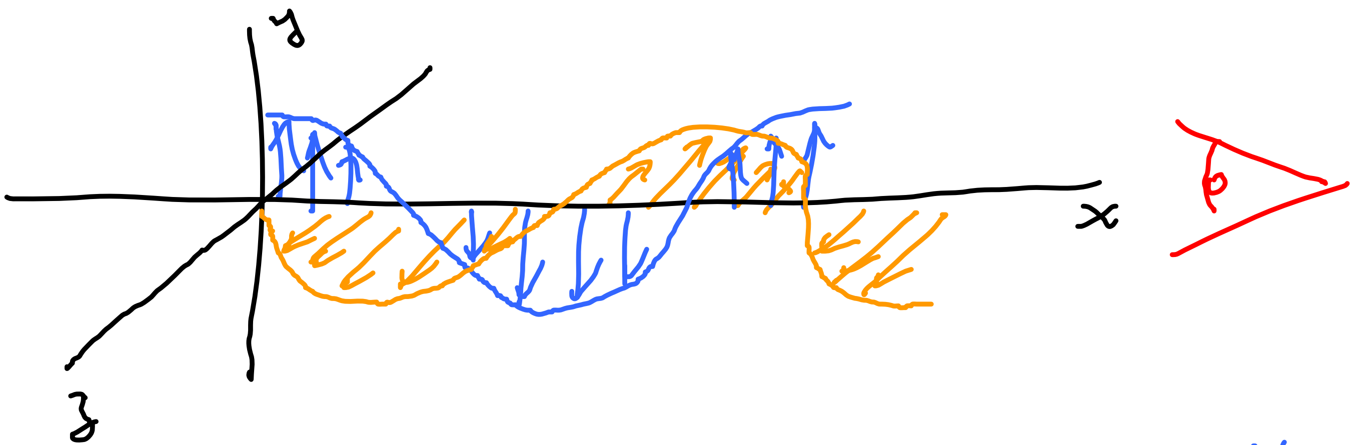


linear Polarization

$$E_y = E_{0y}\cos(kx-\omega t)\,\hat{y}$$

$$E_z = E_{0z}\cos(kx-\omega t+\pi)\,\hat{z}$$





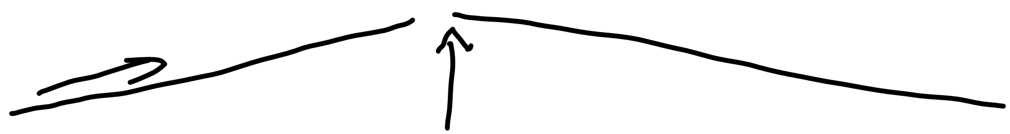
lasers
11, 9, 4

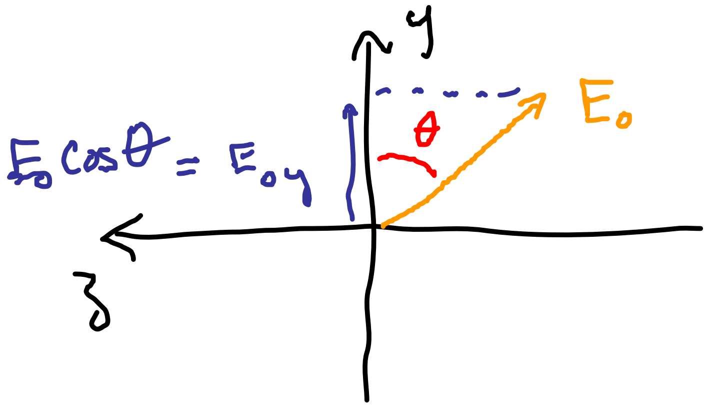
$E_y = E_{0y} \cos(kx - \omega t)\ \hat{y}$

$E_z = E_{0z} \cos(kx - \omega t + \pi/2)\ \hat{z}$

clockwise
rotation

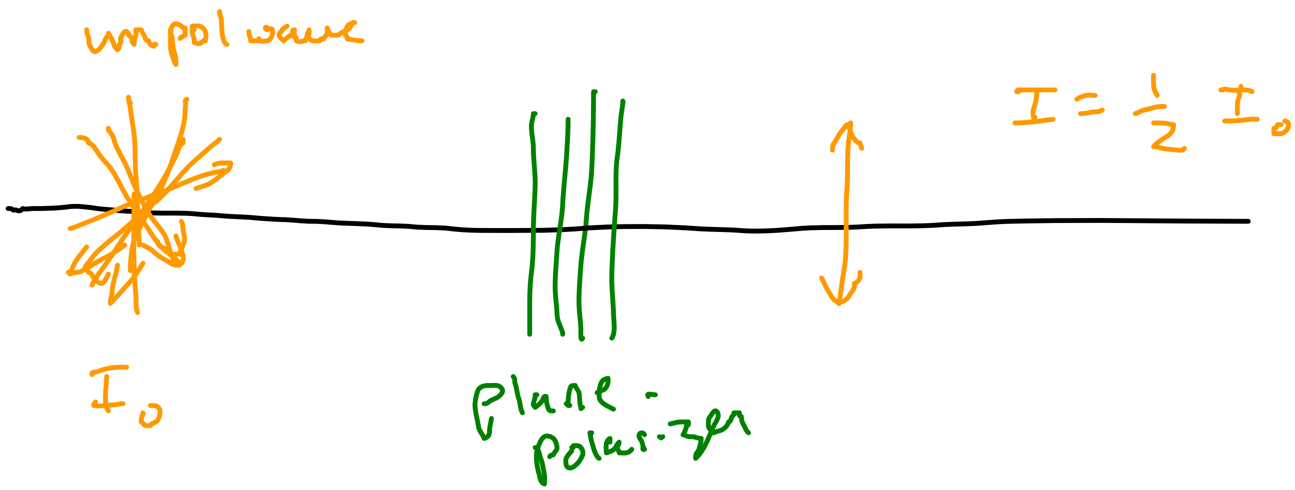
Right handed circular polarization



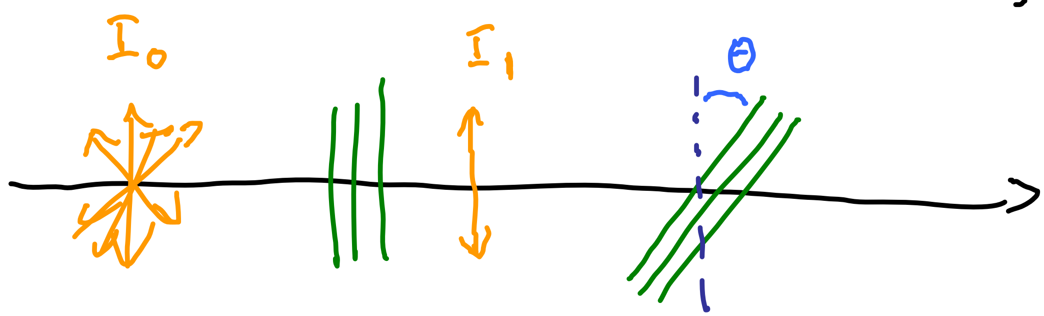


$$I_{new} = E_0^2 \cos^2\theta = I_{initial} \cos^2\theta$$

new intensity

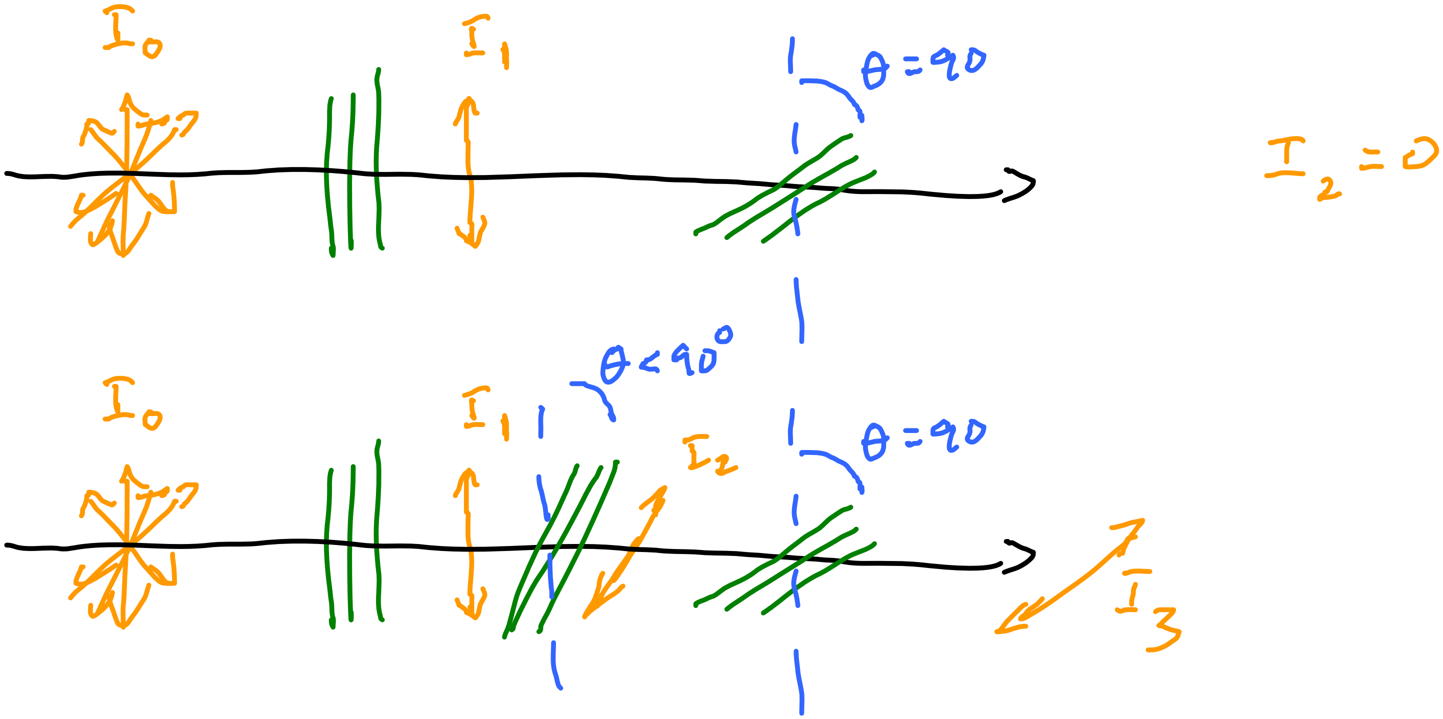


Send initially unpolarized light through 2 linear polarizers at angle θ



$I_1 = \frac{1}{2} I_0$

$I_2 = I_1 \cos^2\theta = \frac{1}{2} I_0 \cos^2\theta$


I_0
I_1
$\theta = 90$
$I_2 = 0$
I_0
I_1
$\theta < 90^\circ$
I_2
$\theta = 90$
I_3