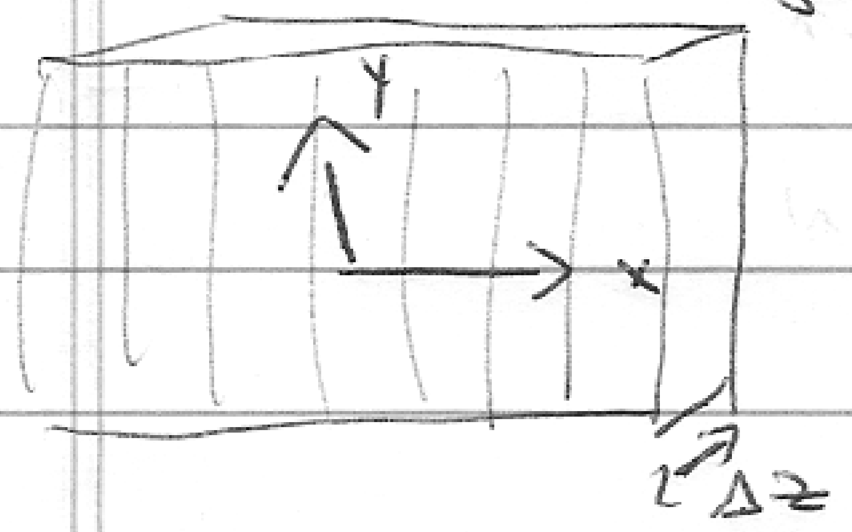
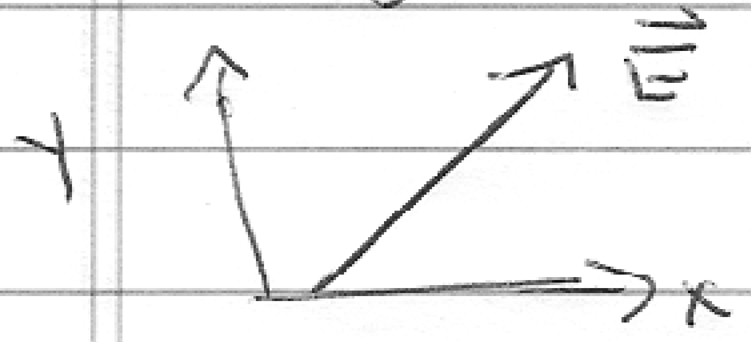
Bi-refringent 1/4-wave plate



birefringent material has different refractive indices in x & y directions n_x & n_y means speed of light and k-vector magnitude different in 2 directions

Incident linear polarized light at 45° to x-axis



$$\vec{E} = E_0 \sin\omega t \left(\frac{\sqrt{2}}{2}\hat{x} + \frac{\sqrt{2}}{2}\hat{y} \right)$$

x & y components of $\vec{E}$ travel at different speeds (wave in $\hat{z}$ direction)

$$c_x/c_y = n_y/n_x = k_y/k_x = \lambda_x/\lambda_y$$

Compare # of wavelengths in thickness Δz for x & y components

$$N_x = \frac{\Delta z}{\lambda_x} = \frac{n_x \Delta z}{\lambda}$$

$$N_y = \frac{\Delta z}{\lambda_y} = n_y \Delta z/\lambda$$

} λ = wvlgth in air

If $N_x - N_y = 1/4 = \frac{\Delta z}{\lambda}(n_x - n_y)$

Then have phase difference between x & y components leaving plate

$$\vec{E} = E_0 \frac{\sqrt{2}}{2}\left(\hat{x}(\sin \omega t \pm \pi/4) + \hat{y}\sin\omega t\right)$$

circularly polarized!! ⟶

$$= E_0 \frac{\sqrt{2}}{2}\left(\hat{x}\cos\omega t + \hat{y}\sin\omega t\right)$$