Tutorial Session on Ray Optics & Wave Optics:

Note Title 8/3/2018

Example 1: Dispersion in a prism (min)

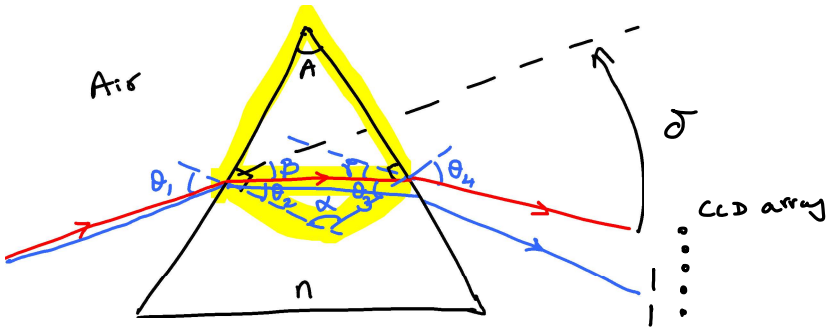
$\frac{c}{n(\lambda)}$ → velocity of light within a medium

$n_{blue} = 1.34$

$n_{red} = 1.33$

Paraxial approximation

$n_1 \theta_1 = n_2 \theta_2$



$\delta = (n-1)A$

$A = 10^\circ$

$\delta_{red} = (1.33 - 1)10^\circ = 3.3^\circ$

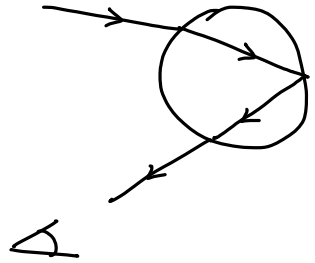
$\delta_{blue} = (1.34 - 1)10^\circ = 3.4^\circ$

$\Rightarrow 0.1$ deg

$\alpha + A = 180^\circ$

$\theta_2 + \theta_3 + \alpha = 180^\circ$

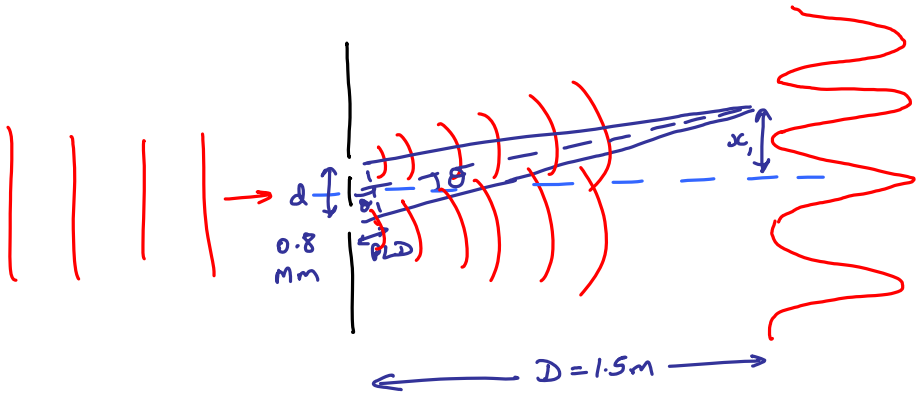
$\Rightarrow A = \theta_2 + \theta_3$



$\delta = \beta + \gamma = \theta_1 - \theta_2 + \theta_4 - \theta_3 = \theta_1 + \theta_4 - A$

$= n\theta_2 + n\theta_3 - A = (n-1)A$

Example 2: Can you discriminate different colours using Young's double slit ?



$\lambda_{red} = 650$ nm

$\lambda_{orange} = 600$ nm

$x_1^r = D \tan(\theta_r)$

$= \underline{1.218 \text{ mm}}$

$x_1^o = \underline{1.125 \text{ mm}}$

$x_1^r - x_1^o = 93 \ \mu m$

slit width $= \frac{x_1^r - x_1^o}{2} = \underline{46.5 \ \mu m}$

$\sin\theta = \frac{PLD}{d}$

$PLD = d \sin\theta$

$\phi_1 - \phi_2 = 2\pi m$

$\frac{2\pi}{\lambda} n d \sin\theta_m = 2\pi m$ (Constructive interference)

For $m=1$ ($n=1$) $\quad \theta_1^r = \sin^{-1}\left(\frac{\lambda_r}{d}\right) = \sin^{-1}\left(\frac{0.65 \times 10^{-6}}{0.8 \times 10^{-3}}\right) = 0.8$ mrad