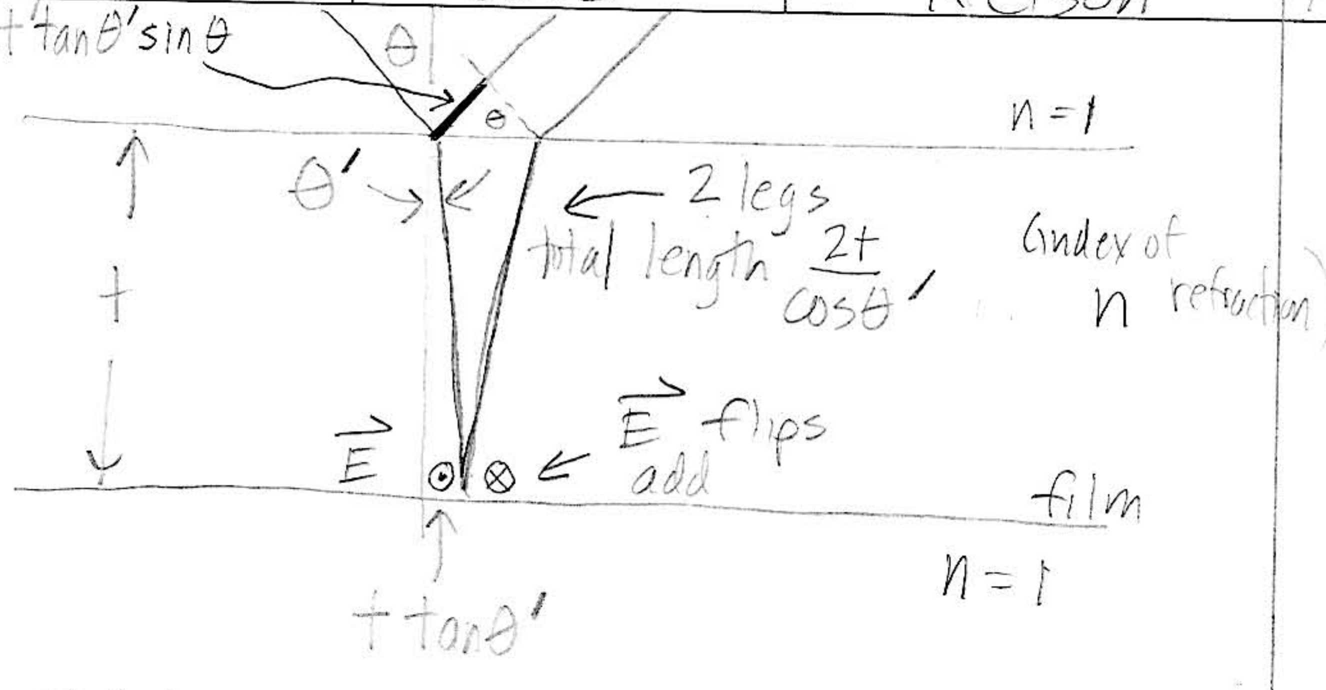


Total phase difference between paths : phase of reflection off top − phase of journey to bottom + its reflection

$$\phi = \frac{2\pi}{\lambda_0} \cdot 2t \cdot \tan\theta' \sin\theta - \frac{2\pi}{\lambda} \cdot \frac{2t}{\cos\theta'} - \pi$$

wavelength in vacuum

wavelength in film, $= \frac{\lambda_0}{n}$

snell = $n \sin\theta'$

$$\phi = \frac{4\pi t}{\lambda_0} \cdot \left[\tan\theta' \sin\theta - \frac{n}{\cos\theta'} \right] - \pi$$

$$\left[n \frac{\sin^2\theta'}{\cos\theta'} - \frac{n}{\cos\theta} \right]$$

$$-n \left[\frac{1 - \sin^2\theta'}{\cos\theta'} \right]$$

$$\phi = -\frac{4\pi n t}{\lambda_0}\cos\theta' - \pi$$

and so,

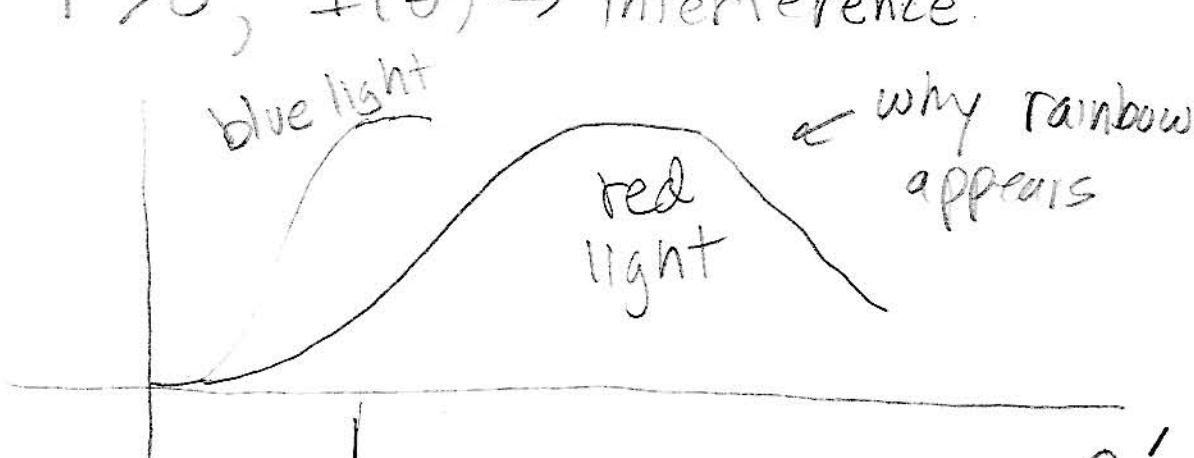
$$I(\theta') \propto \cos^2\frac{\phi}{2} = \cos^2\left[-\frac{2\pi n t}{\lambda_0}\cos\theta' - \frac{\pi}{2}\right]$$

↑ $\sin\theta' = \frac{1}{n}\sin\theta$

Main Points: $t \to 0$, $I(\theta') \to 0$!

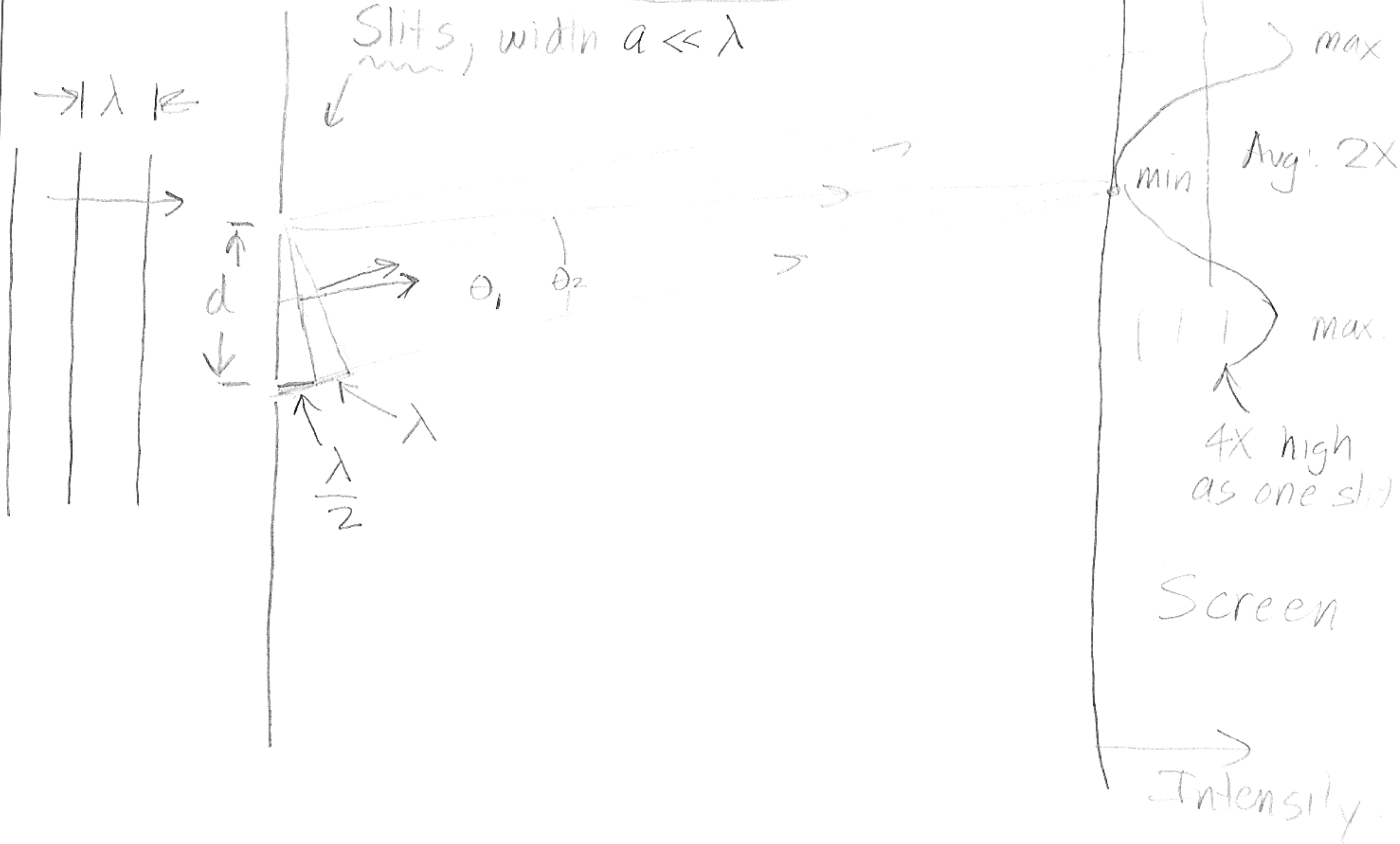
Reflection off a very thin refracting layer is 0! This is how antiglare coatings work. Physical basis is: reflection off of one surface has its field reversed.

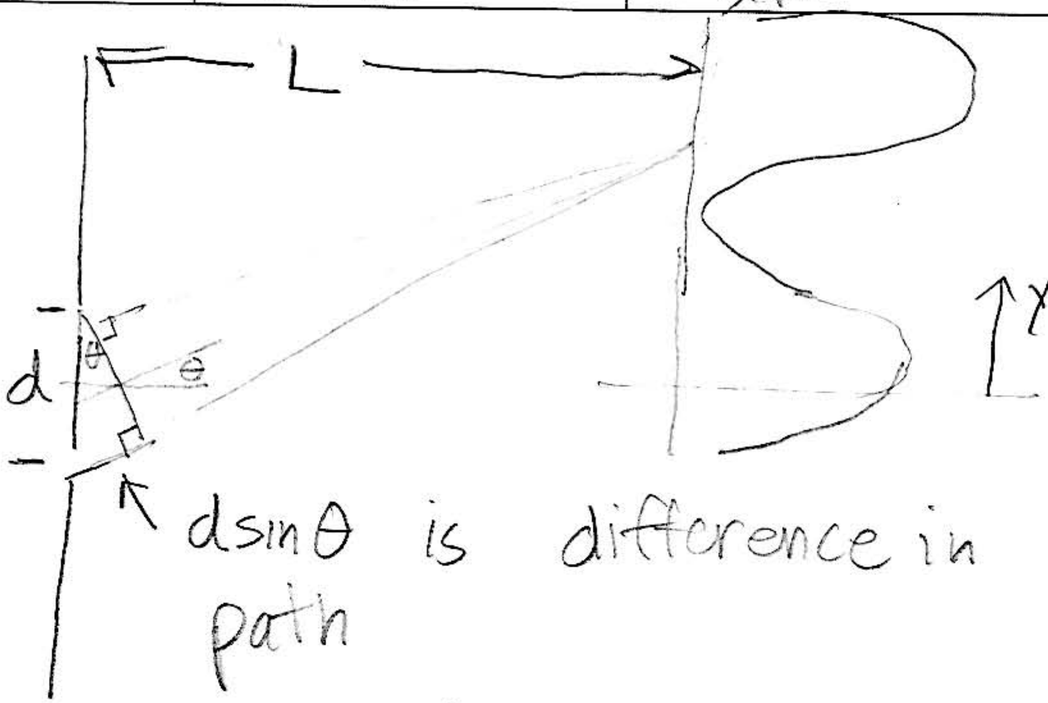
$t > 0$, $I(\theta') \to$ interference.



$$\frac{2\pi n t}{\lambda_0}\cos\theta' = \frac{\pi}{2}, \quad \cos\theta' = \frac{\pi n t}{4\lambda_0}$$

Interference





↖ $d\sin\theta$ is difference in path

$$\phi = 2\pi \frac{d\sin\theta}{\lambda} = \begin{matrix} 0,\ 2\pi,\ 4\pi & \text{maximum} \\ \pi,\ 3\pi,\ 5\pi & \text{minimum} \end{matrix}$$

$$I \propto \cos^2\frac{\phi}{2} = \cos^2\left(\frac{\pi d\sin\theta}{\lambda}\right)$$

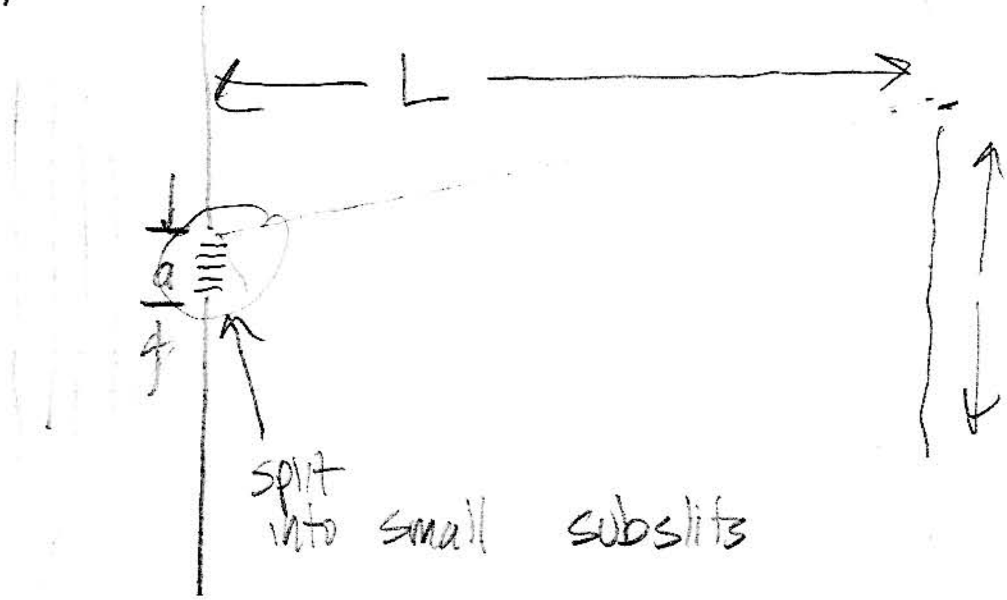
$$\sin\theta \simeq \frac{y}{L}$$

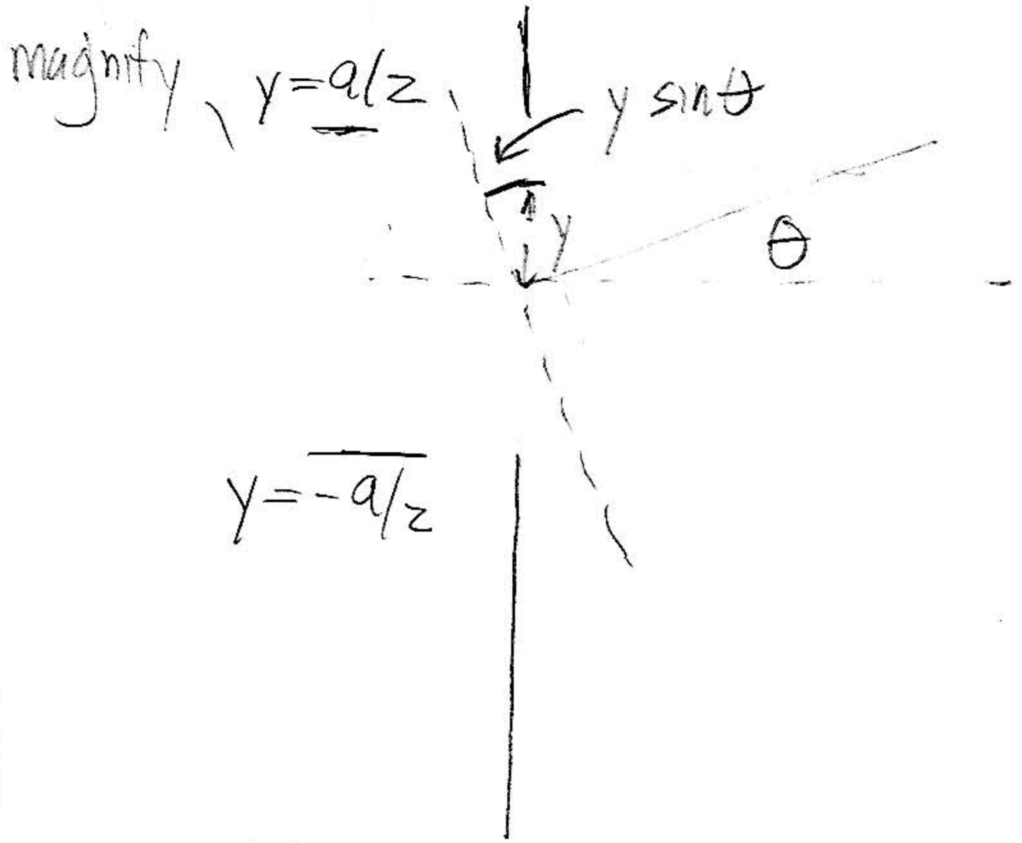
$$I \propto \cos^2\left(\frac{\pi d y}{\lambda L}\right)$$

Diffraction: 1-d

What happens when $a \sim \lambda$?

(a ↗ width of slit.)





$$\phi(y) = \frac{2\pi}{\lambda} y \sin\theta$$

each subslit contributes $dy \cdot e^{i\phi(y)}$

$$E_{tot}(\theta) \propto \int_{-a/2}^{a/2} dy\, e^{i\phi(y)} = \int_{-a/2}^{a/2} dy\, e^{\frac{2\pi i}{\lambda}\sin\theta\, y}$$

$$\propto \left(\frac{\lambda}{2\pi i \sin\theta}\right) e^{\frac{2\pi i}{\lambda}\sin\theta\, y} \Big|_{-a/2}^{a/2}$$

$$E_{tot}(\theta) \propto \frac{\lambda}{\pi \sin\theta} \sin\left(\frac{\pi \sin\theta\, a}{\lambda}\right)$$

$$\boxed{I(\theta) \propto \frac{\sin^2\left(\frac{\pi \sin\theta\, a}{\lambda}\right)}{\sin^2\theta}}$$

$$\sin\theta \cong \frac{Y}{L}$$

$$I(\theta) \propto \left(\frac{\sin \frac{2\pi y a}{\lambda L}}{\left(\frac{2\pi y a}{\lambda L}\right)}\right)^2$$

$$y \to 0, \quad I(\theta) \to \underline{1}$$