Phys 2120-4 12/5/12

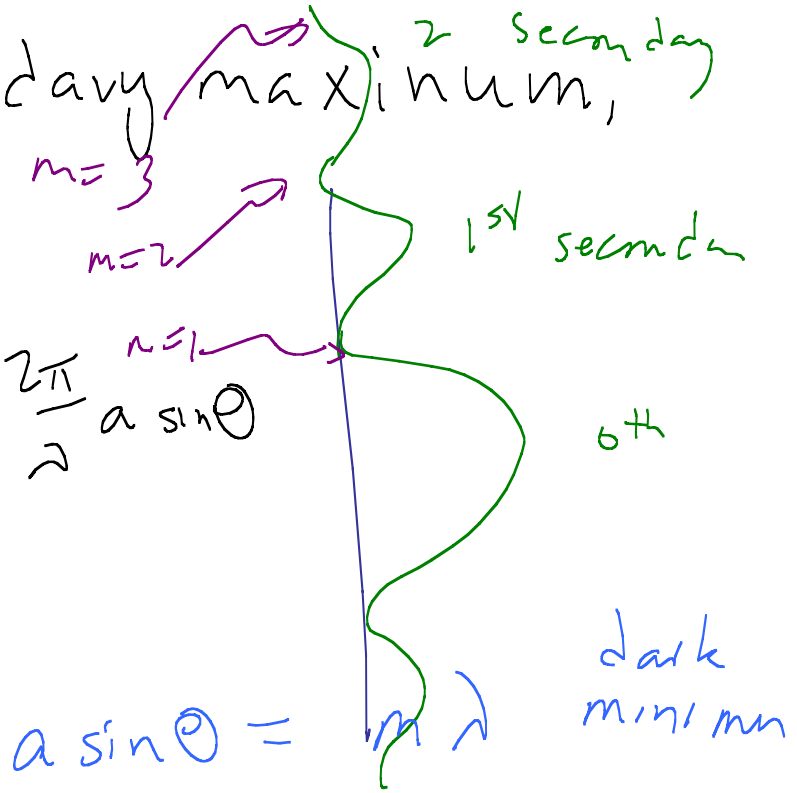
Note Title 12/5/2012

32.29 Second secondary maximum, intensity

Diffraction.

$$\bar{S} = \bar{S}_0 \left[\frac{\sin(\phi/2)}{\phi/2} \right]^2$$

$$\phi = \frac{2\pi}{\lambda} a \sin\theta$$



2^{nd} min: $\sin\theta = \frac{2\lambda}{a}$

3^{rd} min: $\sin\theta = \frac{3\lambda}{a}$

Max in question in between these, $\sin\theta = \frac{5\lambda}{2a}$

Then $\phi = 5\pi$, plug in

$$\left[\frac{\sin(5\pi/2)}{5\pi/2}\right]^2 = 1.6 \times 10^{-2}$$

32.16 Three-slit system first min occurs at angle 5°. Where is next minimum?

N-slit pattern

$d \sin\theta = \frac{m}{N}\lambda$ $N = \#$ slits

$m =$ integer not multiple of N

Minima

5° $m = 1$ $d \sin 5^\circ = 1 \cdot \frac{\lambda}{3}$ $\frac{d}{\lambda} = 3.824$

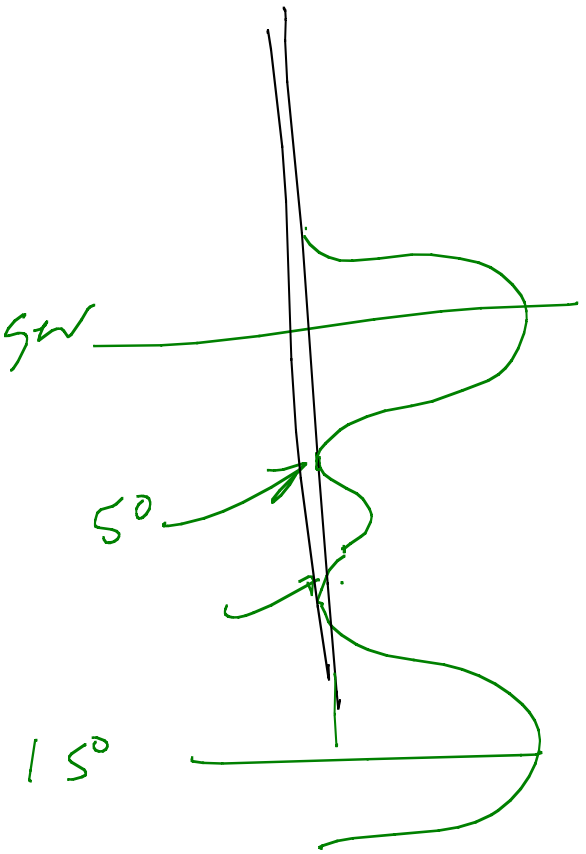
Next maximum?

$m = 1$ maximum

$d \sin\theta = m\lambda$ m = integer

use $\frac{d}{\lambda}$

$\sin\theta = \frac{\lambda}{d}$ $\theta = 15.16°$

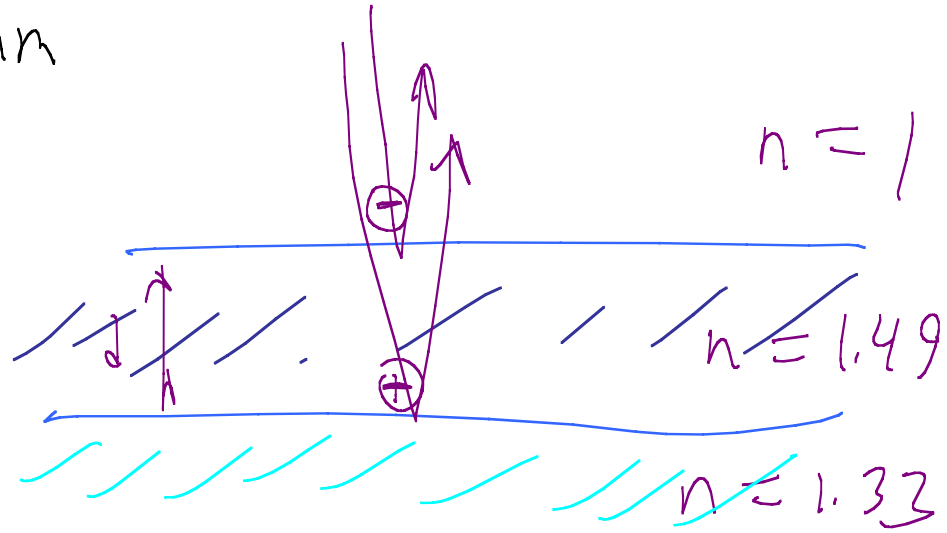


16.44 A thin film of toluene ($n = 1.49$) floats on water. Find minimum film thickness if most strongly reflected light has $\lambda = 460$ nm

In phase

$$2d = \left(m + \tfrac{1}{2}\right)\frac{\lambda}{n_{\text{film}}}$$

$m = 0$ min thk $\Longrightarrow$ d



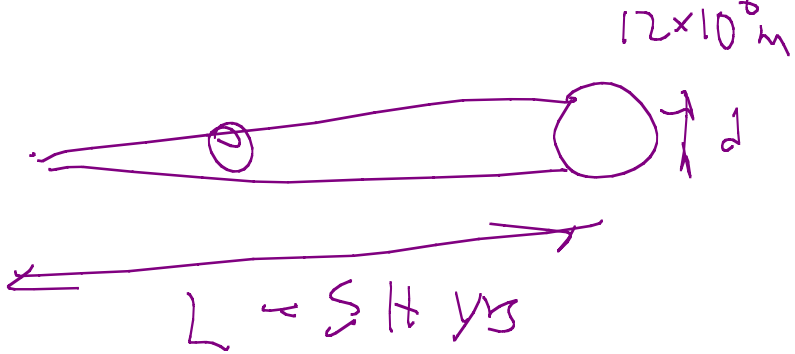
etc.

$$d = \frac{460\ \text{nm}}{2\ (1.49)^2} = 77.2\ \text{nm}$$

32.45 Single-mirror telescope resolve earth-sized planet 5 light yrs away.

$\lambda = 550\ \text{nm}$

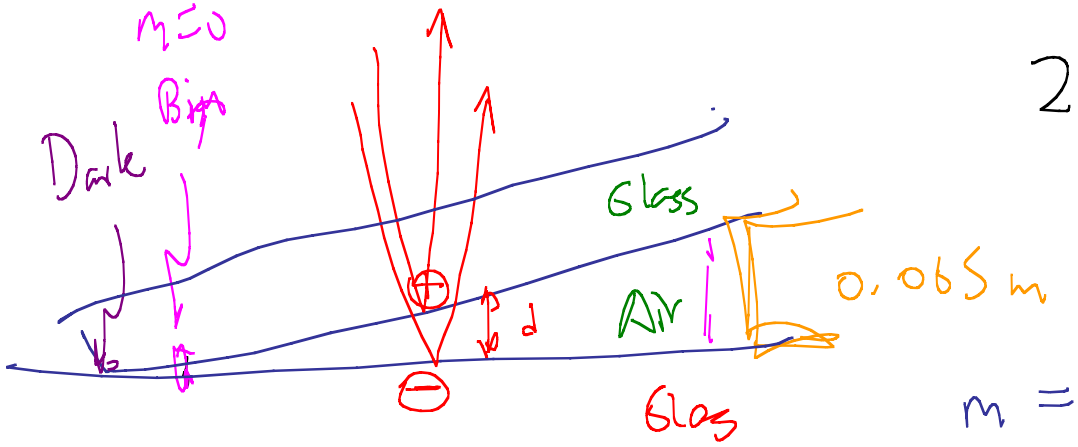
$\theta = \frac{d}{L} = 2.54 \times 10^{-10}$



$$= \theta_{min} = 1.22 \frac{\lambda}{D} = 2.54 \times 10^{-10}$$

$$D = 2.6 \times 10^{3}\ m \quad \text{(Big!)}$$

32.51 Two perfectly flat glass plates sep'd one end by paper, 0.065 mm. 550 nm. How many bright bands appear to observer above?



Bright

$$2d = \left(m + \tfrac{1}{2}\right)\lambda$$

When $d = 0.065$ mm what is m 236 for fringes

$m = 235.8 \Rightarrow 235$

32.62 On ground $\theta_{min} = 1$ arcsecond

$= \frac{1}{3600}$ degree

If no air, what aperture size corresponds to this

$\theta_{min} = 1.22 \frac{\lambda}{D}$ $\quad \lambda = 550 \times 10^{-9}$ m

$= \frac{1}{3600} \cdot 1 \text{ deg} \cdot \left(\frac{\pi}{180}\right) = 4.85 \times 10^{-6}$ rad

$D = 0.138$ m

$= 14$ cm