Phys 2120-4 12/03/12

Note Title 12/3/2012

Chap 32

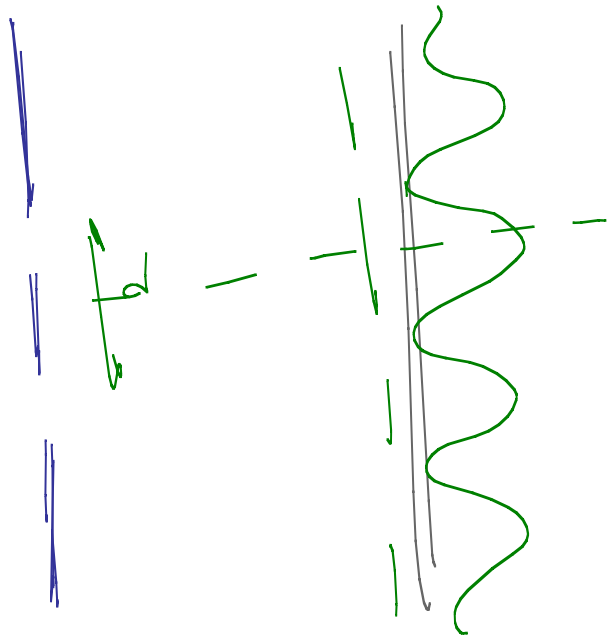
Interference

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

$m = 0, 1, 2, \ldots$

Min $d \sin\theta = (m + \frac{1}{2})\lambda$

$m = 0, 1, 2, \ldots$



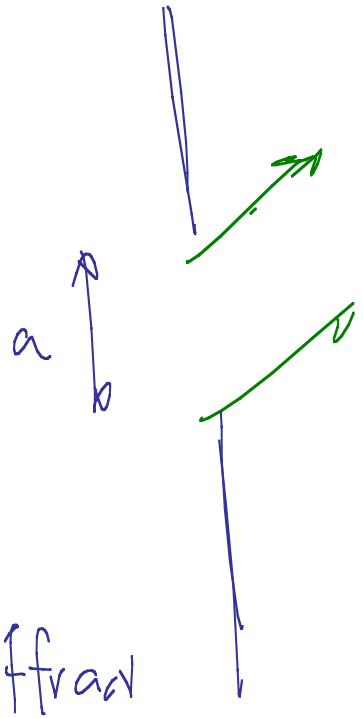
Diffraction

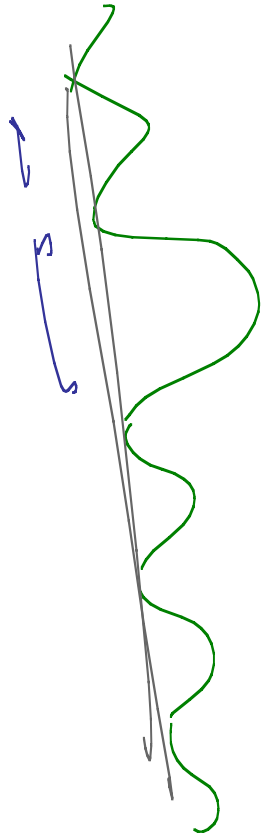
Minima:

$$a \sin\theta = m\lambda$$

$m = 1, 2, 3, 4$

single-slit diffrac





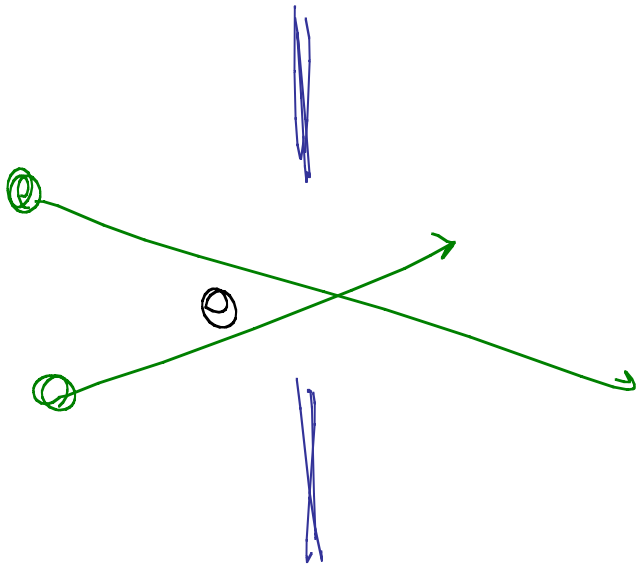
Resolving power

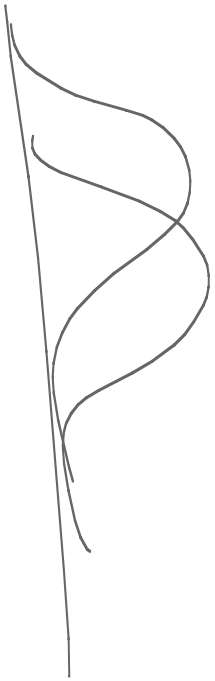
slit

$$\theta_{min} = \lambda / a$$

Circular opening

$$\theta_{min} = 1.22 \, \lambda / D$$





Telescopes Are limited in resolution.

What limits resolution of telescope

Size of telescope (D) not problem on ground, atmosphere main culprit.

$$\theta_m = 1.22 \frac{\lambda}{D}$$

$\theta_{min} \approx 1$ arcsec

$= \frac{1}{60} \times \frac{1}{60} \times 1$ degree.

Solution Put telescope in space

Hubble telescope

32.27 Light with wavelength 633 nm incident on 2.5 μm - wide slit.

Find angular width of central peak of diff pattern. (Ang sep of 1st two minima)

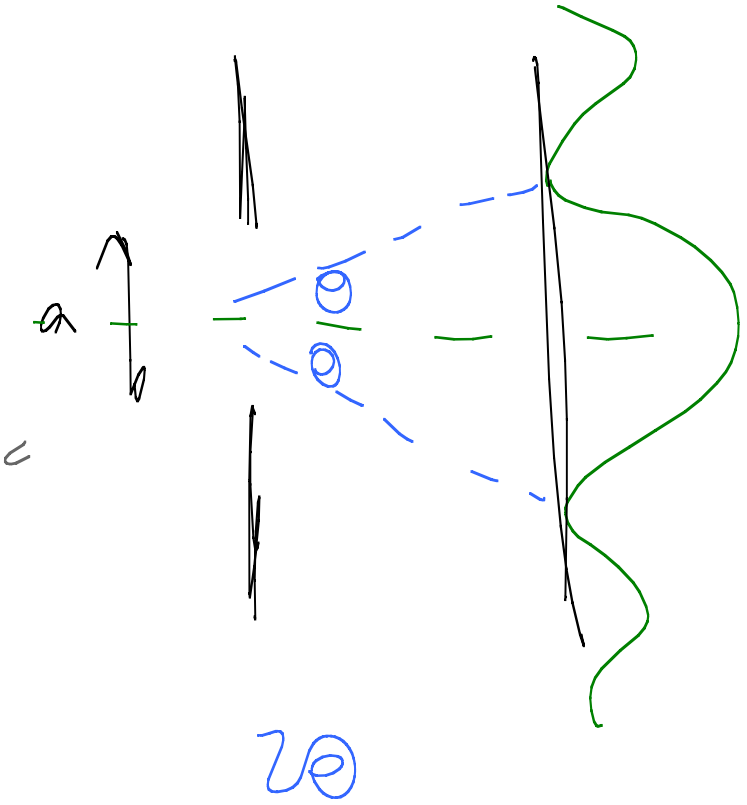
$a \sin\theta = m\lambda$

$m = 1, 2, 3, 4$

$m = 1$ $\quad a = 2.5\,\mu m$ etc

$\theta = 14.7°$

$2\theta = 29.3°$

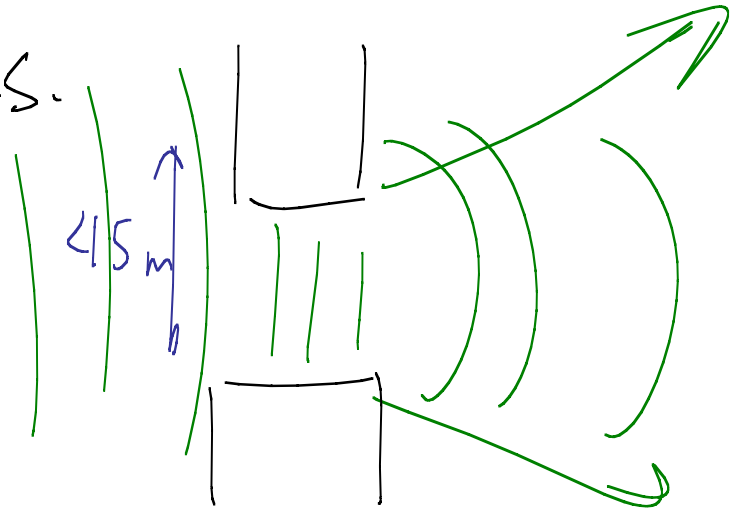


32.24 Beam parallel ray, radio CD

29-MHz encounter buildings

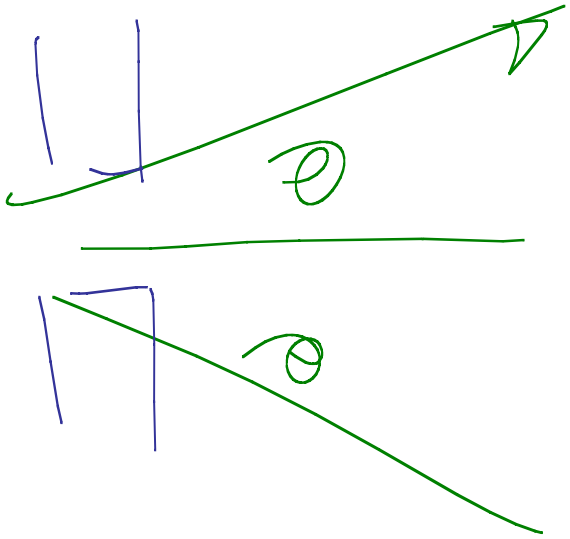
45 m apart. What's the beam's angular width when it emerges.

$\lambda = \frac{c}{f} = 10.34\ m$



1 min for diffraction

$a \sin\theta = m \lambda \quad m = 1$



etc. $\theta = 13.3$

$\Longrightarrow \boxed{2\theta = 26.6^\circ}$

32.29 Find the intensity as a function of central peak intensity for the second secondary maximum in singlet-slit diffraction, assume peak lies between 2nd, 3rd minima.

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