Physics 202, Lecture 28

Today’s Topics

- Diffraction
  - Reminder of Single-slit Diffraction
  - Reminder of Two-slit Interference
  - Double-Slit Diffraction
  - Diffraction on Circular Apertures
  - The Rayleigh Criterion
Reminder: Single-slit Diffraction

\[ I = I_0 \left( \frac{\sin(\beta/2)}{\beta/2} \right)^2 \]

\[ \beta \equiv \frac{2\pi}{\lambda} \frac{D \sin \theta}{\lambda} \]

Separation between minima = \( \frac{\lambda}{D} \)

\[ \sin \theta_{\text{dark}} = \frac{2\lambda}{D} \]

\[ \sin \theta_{\text{dark}} = \frac{\lambda}{D} \]

\[ \sin \theta_{\text{dark}} = -\frac{\lambda}{D} \]

\[ \sin \theta_{\text{dark}} = -\frac{2\lambda}{D} \]
Reminder: Two-slit Interference

Path length difference $\delta = dsin\theta \sim d\theta \sim d\frac{y}{l}$

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

Separation between minima $= \frac{\lambda}{d}$
Two-slit Diffraction

\[ I = I_0 \left[ \frac{\sin(\beta/2)}{\beta/2} \right]^2 \]

\[ \beta \equiv \frac{2\pi}{\lambda} D \sin \theta \]

\[ I = I_0 \cos^2 \left( \frac{\delta}{2} \right) \]

\[ \delta = \frac{2\pi}{\lambda} d \sin \theta \]

\[ I = I_0 \left[ \frac{\sin(\beta/2)}{\beta/2} \right]^2 \cos^2 \left( \frac{\delta}{2} \right) \]

\[ \Delta \theta = \frac{\lambda}{D} \]

\[ \Delta \theta = \frac{\lambda}{d} \]
Diffraction on Circular Apertures

- Light through apertures will produce diffractive patterns depending on their shape. For circular apertures the diffractive pattern is made of concentric rings.

Separation between minima = \( 1.22 \frac{\lambda}{D} \)
Resolution of Single-slit and Circular Apparatus

two separate beams
each smeared due to diffraction

Rayleigh’s Criterion

Separable
Minimally separable
Not separable

→ Single slit: \( \theta_{\text{min}} = \frac{\lambda}{D} \)
→ Circular opening: \( \theta_{\text{min}} = 1.22 \frac{\lambda}{D} \)