

# Physics 8.03

# Vibrations and Waves

Lecture 21

Diffraction + Interference

Diffraction gratings

# Interference so far

- Linear array of  $N$  sources separated by  $d$
- Adjacent sources have relative intrinsic phase  $\Delta\phi$
- $I$  is intensity at observation angle  $\psi$

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

$$\delta = \frac{2\pi}{\lambda} d \sin \psi + \Delta\phi$$

# Diffraction so far

- Huygens-Fresnel principle
  - Treat aperture as an array of many infinitesimal radiating sources that superpose (interfere)
- Aperture of size  $D$
- In the far field (Fraunhofer zone)
- $I$  is intensity at observation angle  $\psi$

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

$$\delta_D = \frac{2\pi}{\lambda} D \sin \psi$$

# Diffraction gratings

- Interference and Diffraction
- Spectroscopy
- Metrology