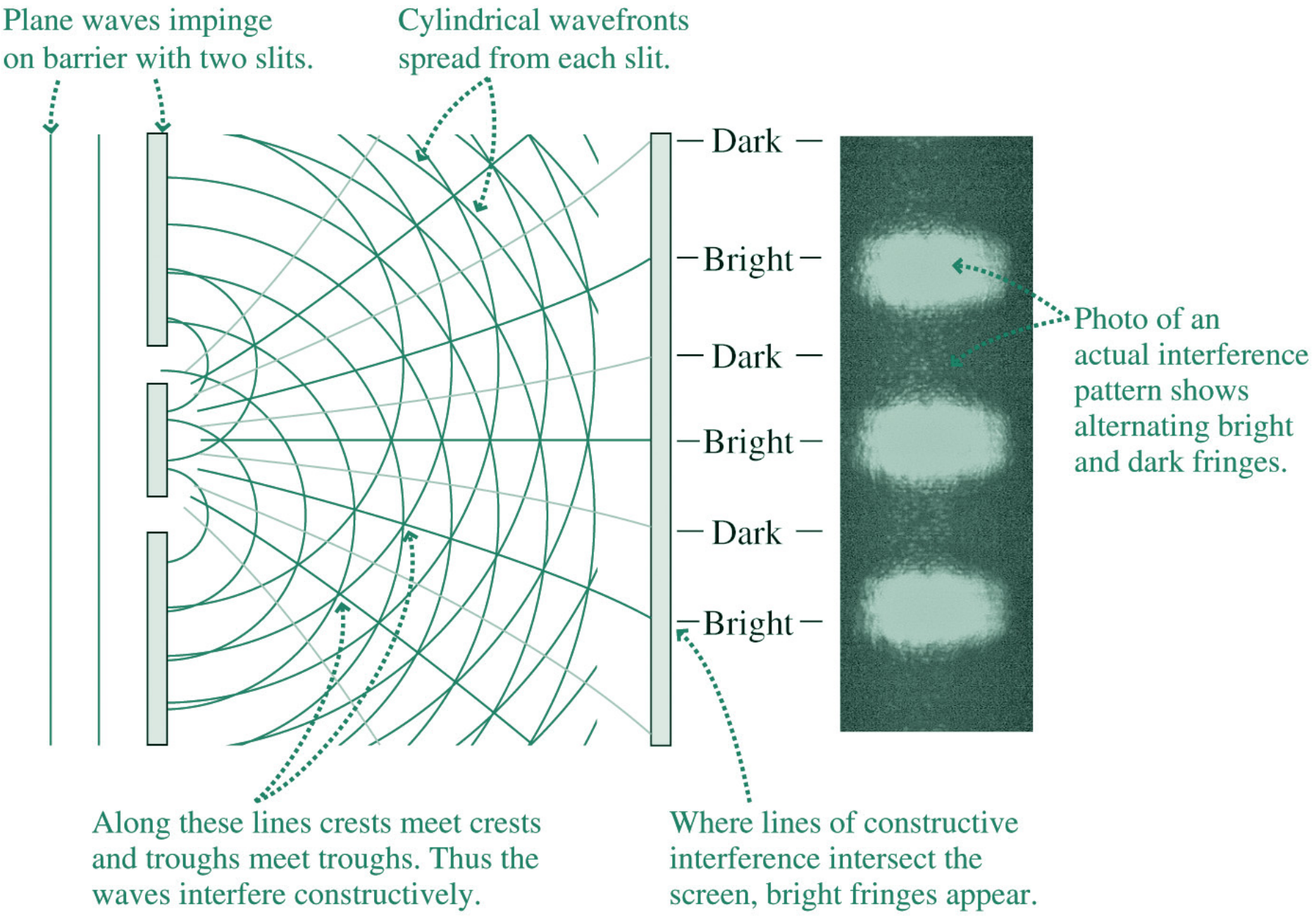
Chapter 32: Interference and Diffraction
Tuesday December 6th

- **V. IMPORTANT: Final exam will be in HCB103/316**
  - **HCB316, last names A to J; HCB103, last names K to Z**
- **Check your exam scores online**
- **Still 31 unregistered *i*Clickers; see list.**

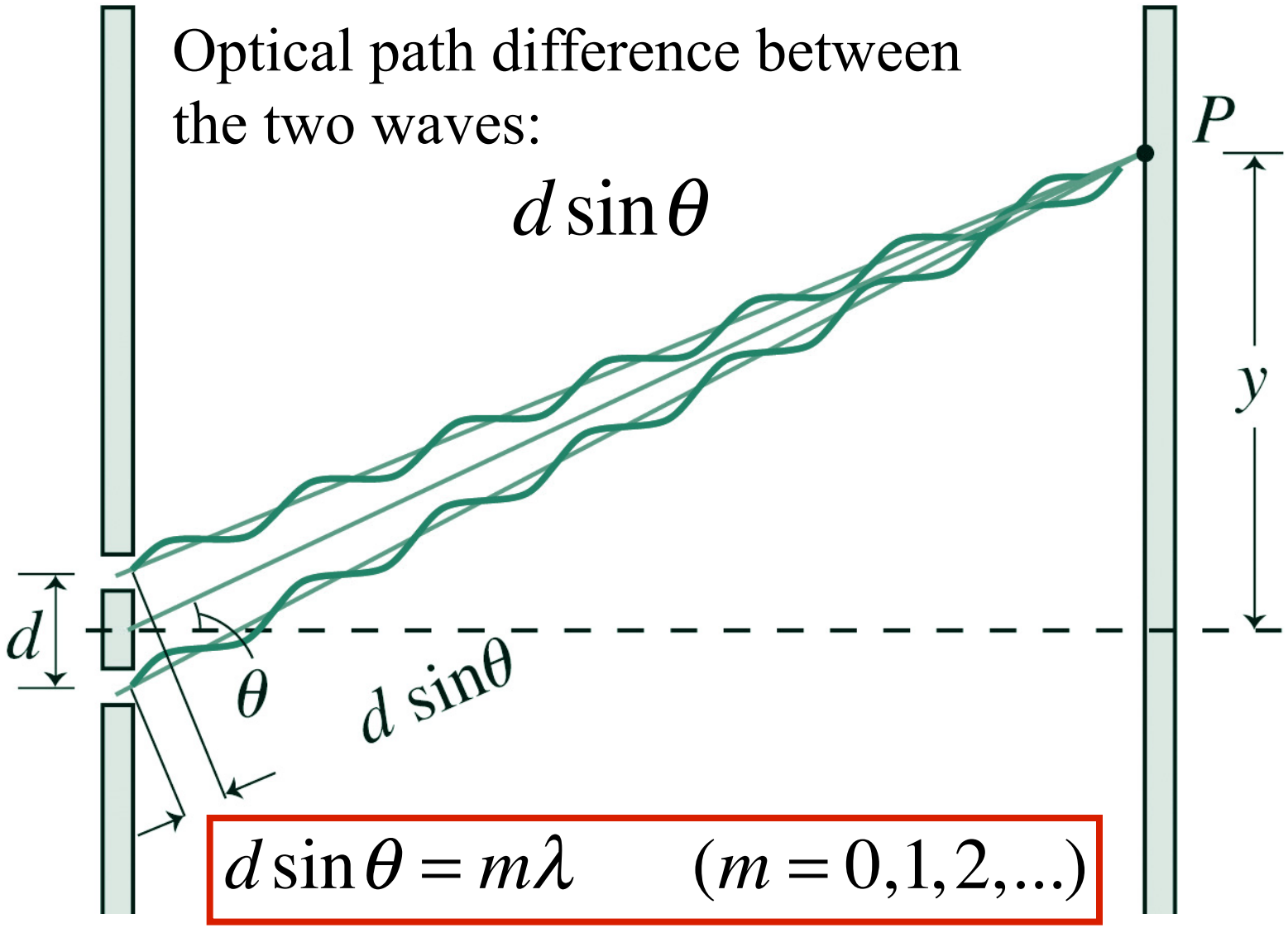
- Few words on mini-exam 6 (solutions Thursday)
- Review of two-slit interference
- Multiple-slit interference and diffraction gratings
- Interference from a thin film
- Review of single-slit diffraction (if time)

Reading: up to page 575 in the text book (Ch. 32)

Double-Slit Interference

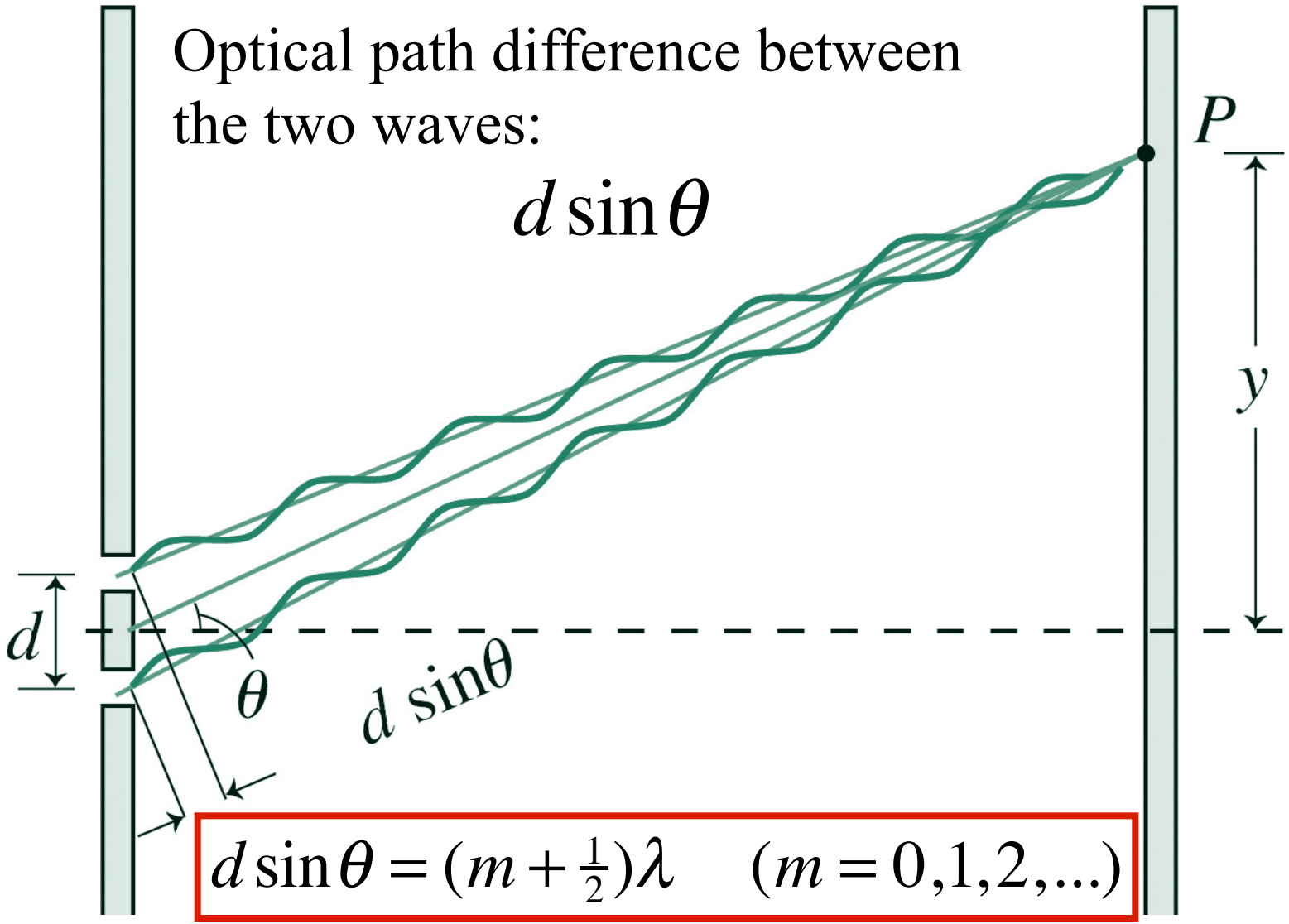


Double-Slit Interference



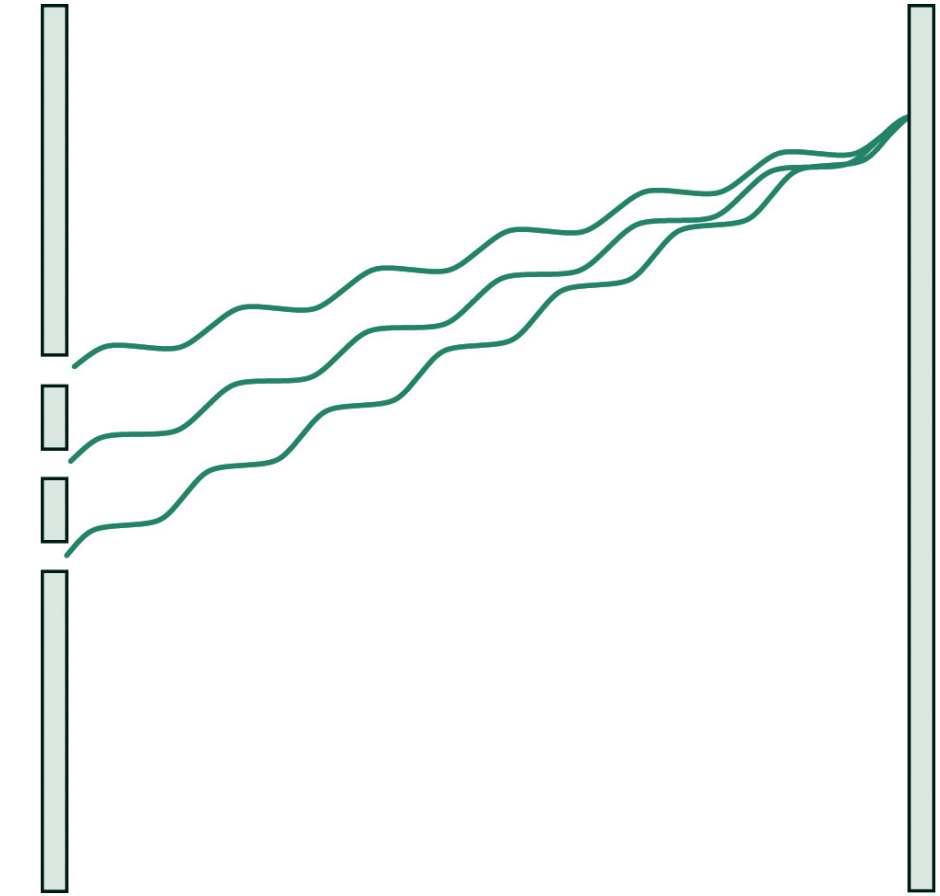
When equal to an integer number of wavelengths, constructive interference occurs, i.e., bright fringes.

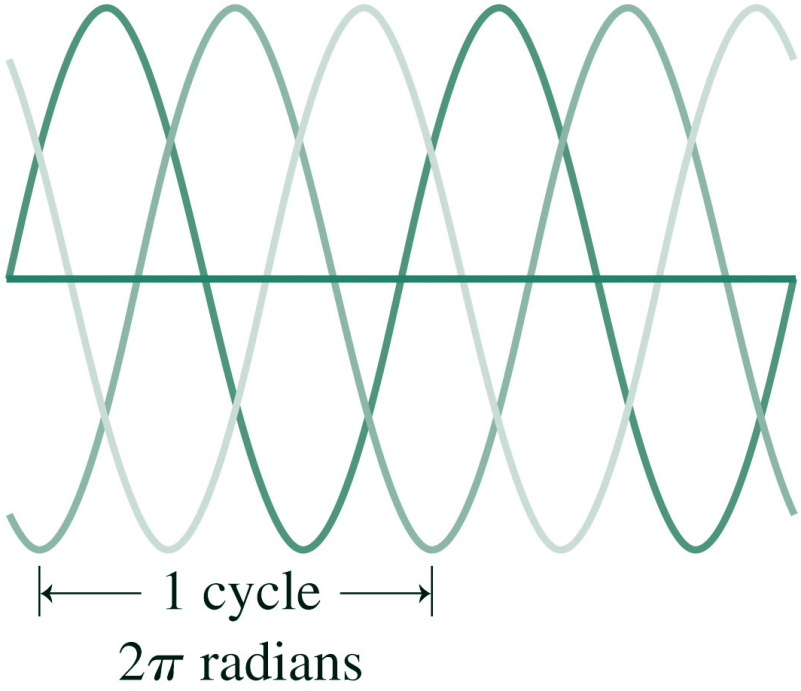
Double-Slit Interference



When equal to a half integer number of wavelengths, destructive interference occurs, i.e., dark fringes.

Three-Slit Interference



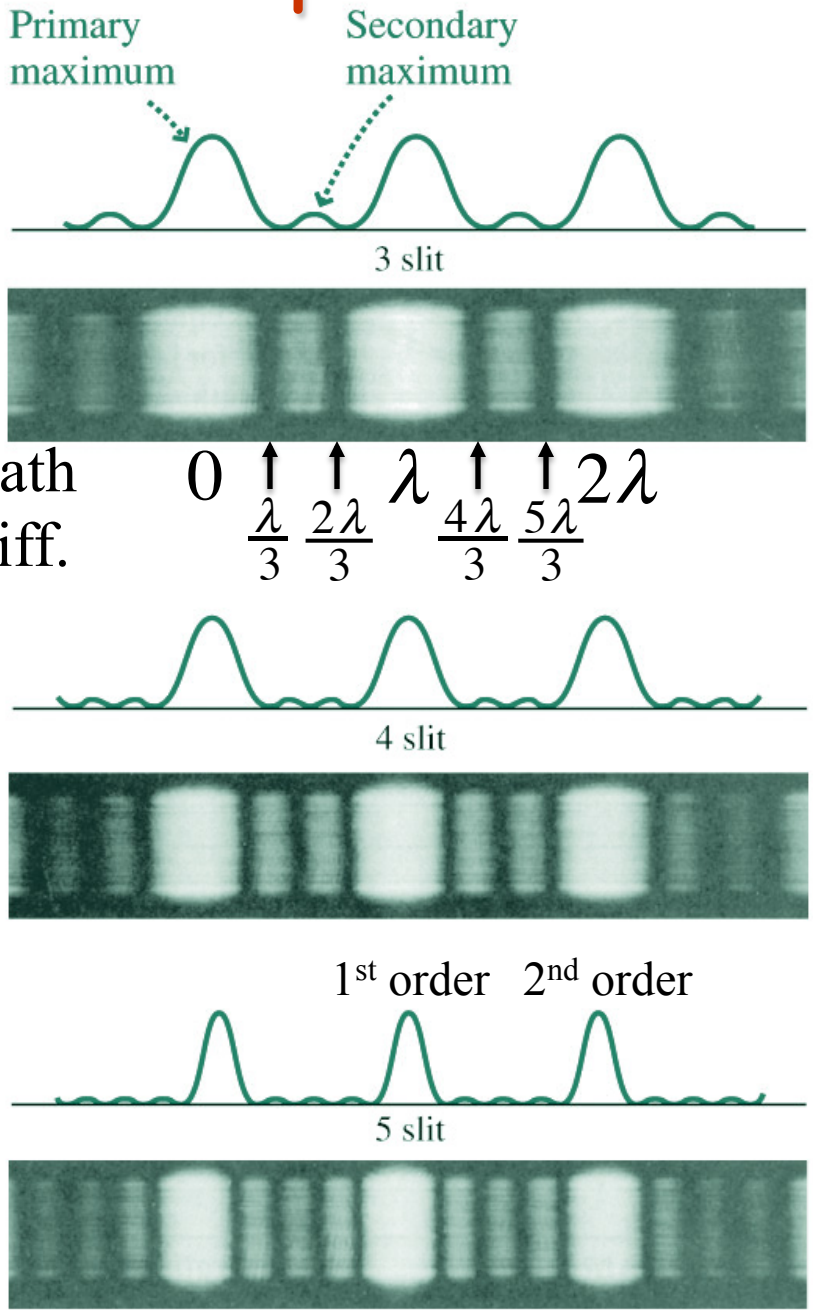


Sum = 0 when waves are out of phase by 1/3 of cycle.

$$d\sin\theta = (m+\tfrac{1}{3})\lambda \quad \text{or} \quad (m+\tfrac{2}{3})\lambda \qquad (m = 0,1,2,\ldots)$$

- Minima occur, i.e., dark fringes, for this condition.
- Condition for primary maxima same as for two slits.

Multiple-Slit and Diffraction Gratings



Destructive interference when:

$$d\sin\theta = \frac{m}{N}\lambda \qquad \left(\frac{m}{N} \neq \text{integer}\right)$$

Constructive interference (primary) maxima when:

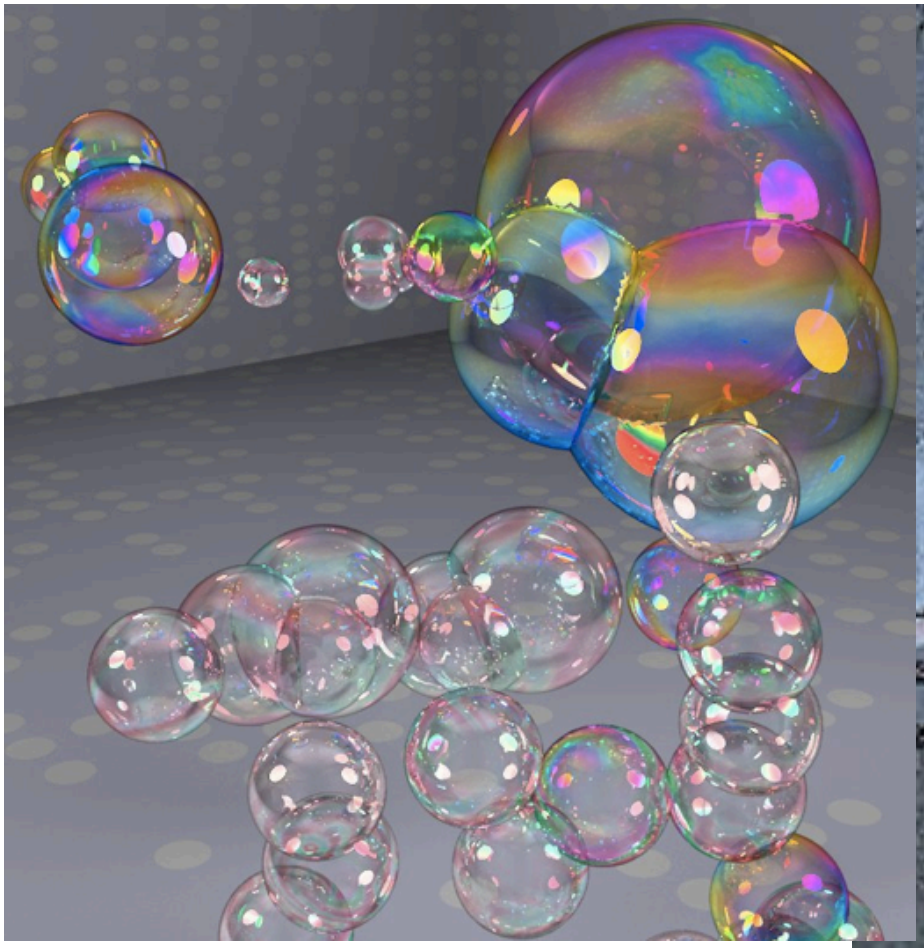
$$\frac{m}{N} = \text{integer}$$

- Major source of confusion (me included) when labeling the order of primary maxima.
- Use the two-slit formula:

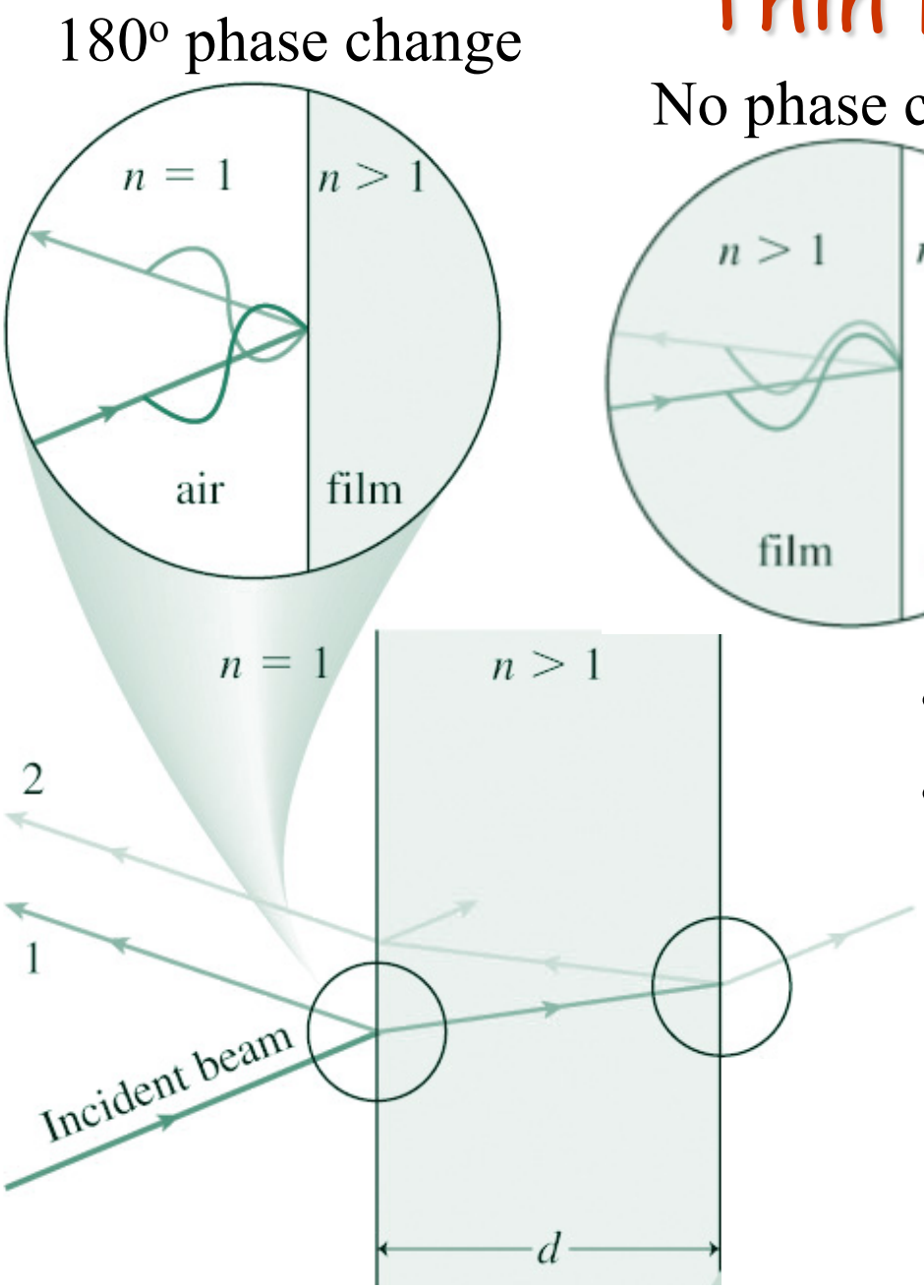
$$d\sin\theta = m\lambda$$

m = order of interference

Thin Films



Thin Films

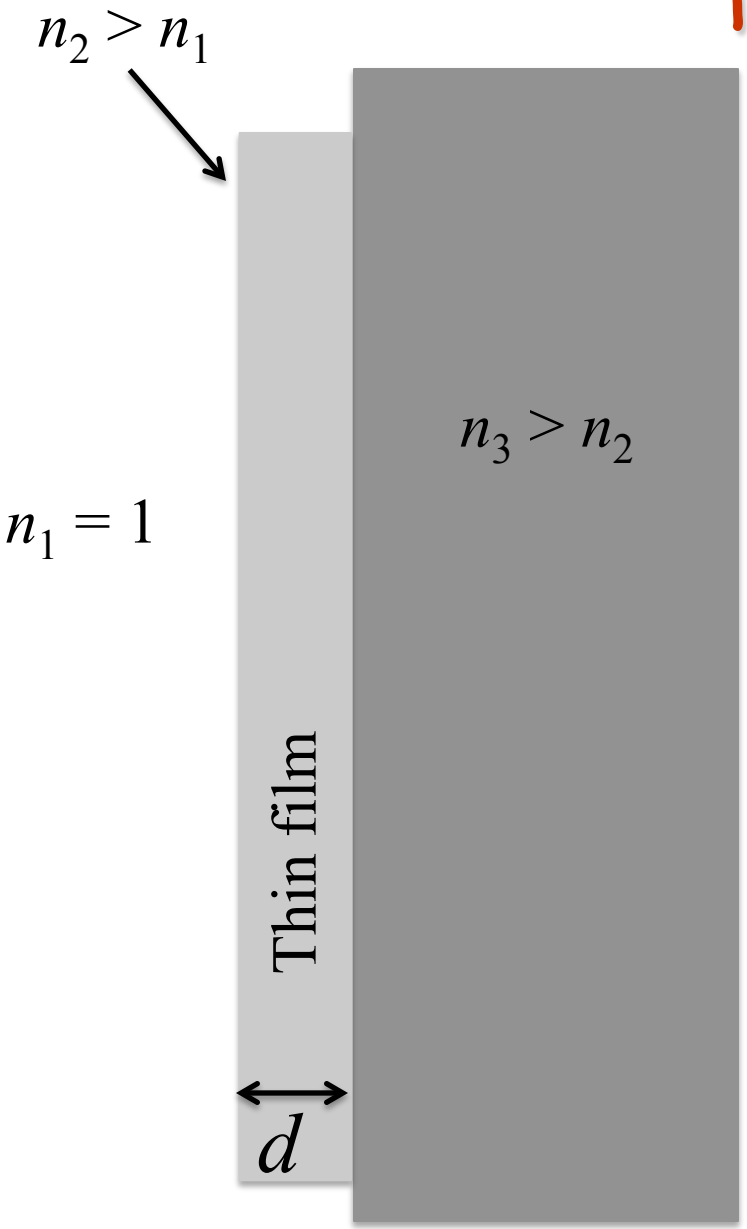


- 180° phase change if $n_1 < n_2$.
- No phase change if $n_1 > n_2$.

- Extra path length in the film = $2nd$
- Therefore, because of the $\pi/2$ phase shift at the first interface, the condition for constructive interference at **normal incidence** is:

$$2nd = (m + \tfrac{1}{2})\lambda$$

Thin Films



- 180° phase change at first interface because $n_2 > n_1$.
- Also 180° phase change at 2nd interface because $n_3 > n_2$.

- Extra path length in the film = $2nd$
- Therefore, because of the $\pi/2$ phase shift at both interfaces, we no longer need the factor of ½. The condition for constructive interference at **normal incidence** is then:

$$2nd = m\lambda$$