

# PHYS 3345: OPTICS

## Assignment 09: Chapter 09 DUE: April 16, 2008

Spring 2008

- Work through the math to show explicitly (skip no steps) how to get from Equation 9.7 to Equation 9.11.  
IF YOU WERE MISSING STEPS, I AM HAPPY TO SHOW YOU WHATEVER PIECES YOU NEED TO SEE.

- Hecht, Problem 9.9

$$y_m = m \left( \frac{s\lambda}{a} \right)$$

$$y_o = 0$$

$$y_1 = \frac{s\lambda}{a}$$

$$\Delta y = \frac{s\lambda}{a}$$

$$s = \frac{a\Delta y}{\lambda}$$

$$s = \frac{(0.1 \times 10^{-3} \text{ m})(0.01 \text{ m})}{(487.99 \times 10^{-9} \text{ m})}$$

$$s = 2.05 \text{ m}$$

BOTH 9.27 AND 9.47 DEAL WITH THIN FILM INTERFERENCE. SET UP ONCE, SOLVE TWICE. ASSUME NEAR-NORMAL INCIDENCE.

FOR WAVES WITH NO RELATIVE PHASE DIFFERENCE, A PATH LENGTH DIFFERENCE = WAVELENGTH KEEPS WAVES IN PHASE:

$$2d = m\lambda$$

CONSTRUCTIVE INTERFERENCE WHEN FILM THICKNESS IS HALF A WAVELENGTH:

$$d = m \left( \frac{\lambda_2}{2} \right)$$

$$d = m \left( \frac{\lambda_o}{2n_2} \right)$$

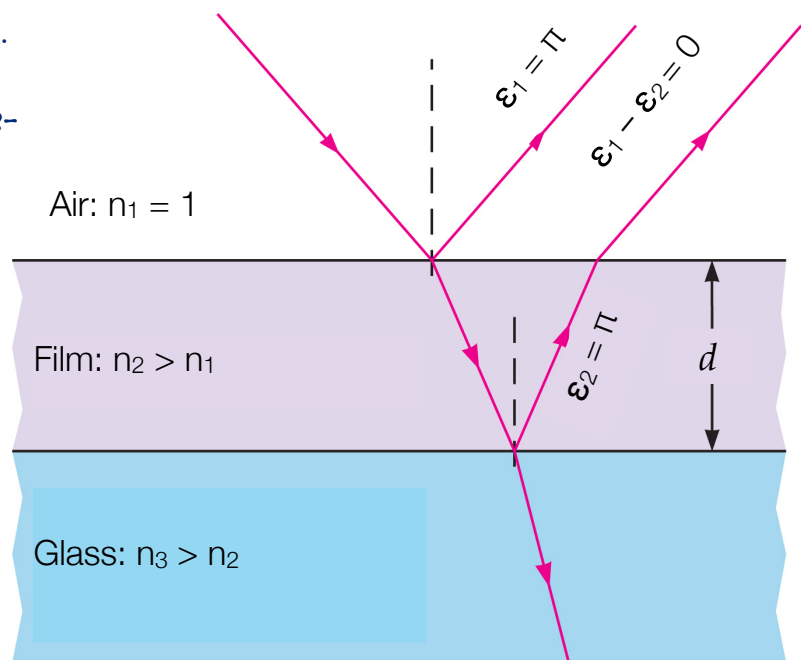
A PATH LENGTH DIFFERENCE = (1/2) WAVELENGTH KEEPS WAVES OUT OF PHASE:

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

DESTRUCTIVE INTERFERENCE WHEN FILM THICKNESS IS ONE QUARTER WAVELENGTH:

$$d = m \left( \frac{\lambda_2}{4} \right)$$

$$d = m \left( \frac{\lambda_o}{4n_2} \right)$$



Copyright © 2007 Pearson Prentice Hall, Inc.

- Hecht, Problem 9.27

$$d = (1) \left( \frac{500 \text{ nm}}{2(1.36)} \right) = 184 \text{ nm}$$

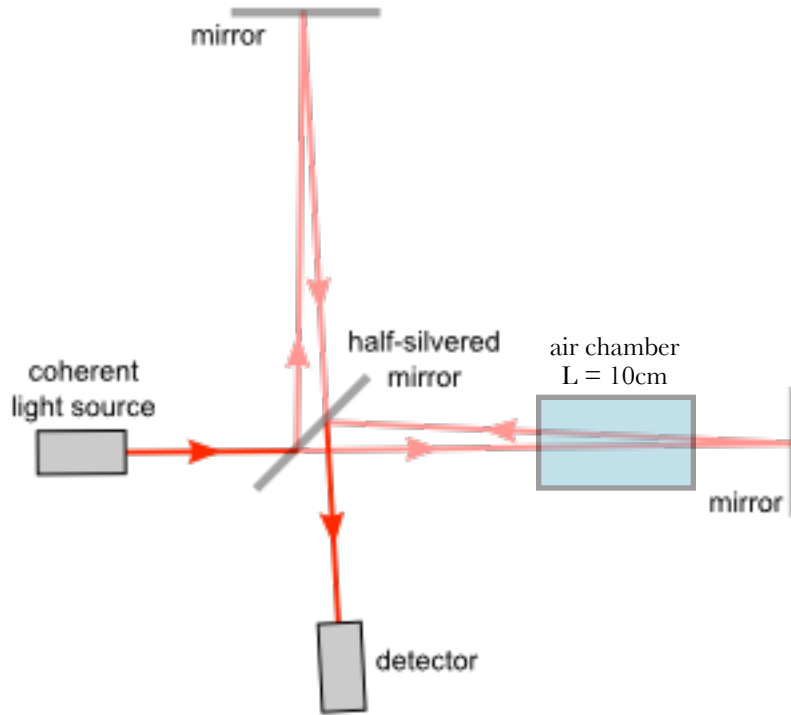
- Hecht, Problem 9.47

$$d = (1) \left( \frac{500 \text{ nm}}{4(1.3)} \right) = 96.2 \text{ nm}$$

# Assignment 09: Chapter 09

## DUE: April 16, 2008

Spring 2008



5. Hecht, Problem 9.37

YOU PLACE THE AIR CHAMBER BETWEEN THE SPLITTER AND THE MOVEABLE MIRROR. INSTEAD OF MOVING THE MIRROR, EVACUATE THE CHAMBER. THE CHANGE IN INDEX CREATES THE CHANGE IN PATH LENGTH:

$$\Delta d = \frac{N\lambda_o}{2}$$

$$\Delta d = (n_{air} - n_{vac})\ell$$

$$N = \frac{2(n_{air} - n_{vac})\ell}{\lambda_o}$$

$$N = \frac{2(1.00029 - 1)(0.10\text{m})}{(600 \times 10^{-9}\text{m})}$$

$$N = 97 \text{ fringes}$$