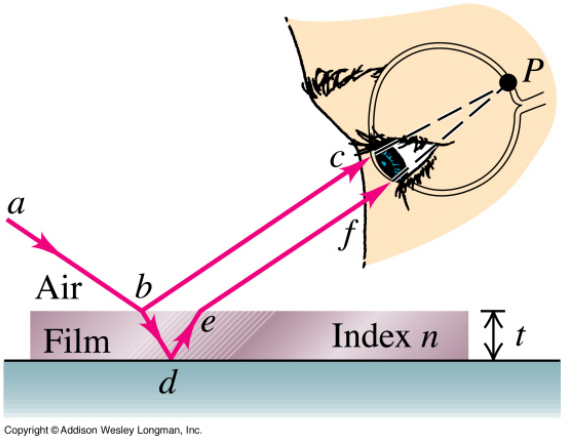
35-4. Interference in Thin Films



Normal incidence

Constructive reflection, no phase shift

$2t = m\lambda$, m=0, 1, 2, 3...

Destructive reflection

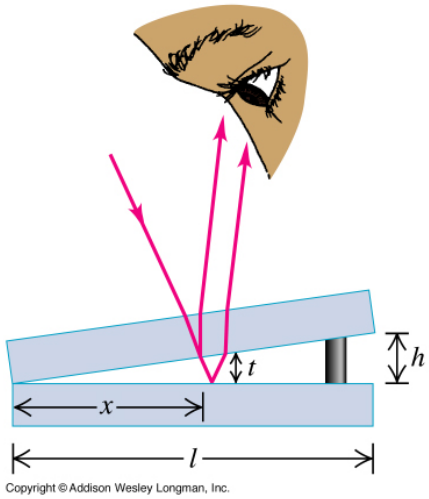
$2t = (m+1/2)\lambda$, m=0, 1, 2, 3...

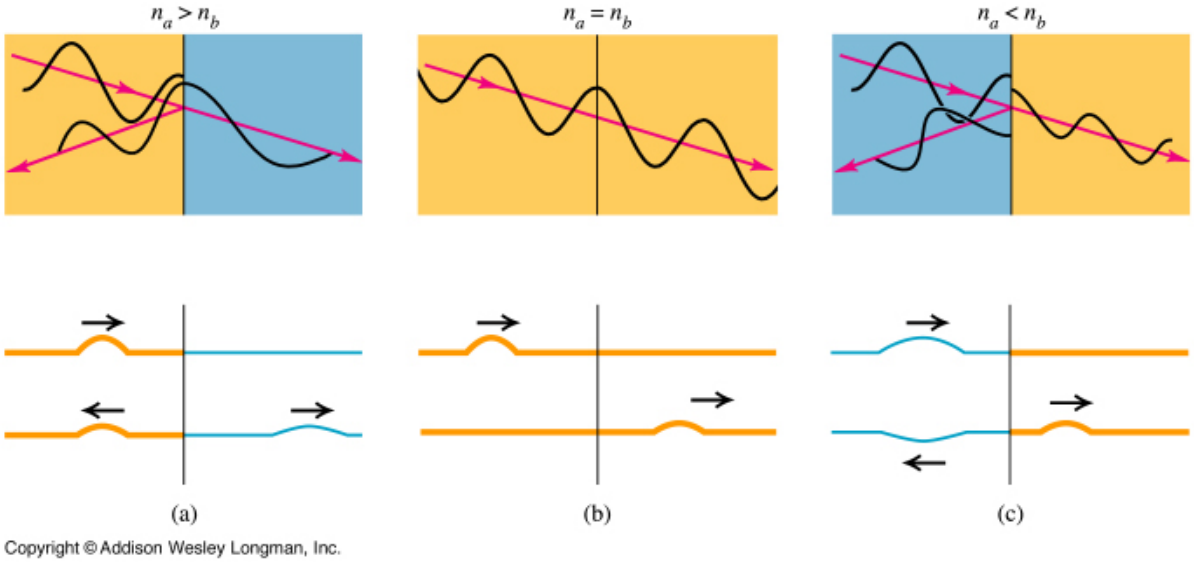
λ: Light wavelength in the film

λ_o: Light wavelength in air

$\lambda = \lambda_o/n$

Phase Shift at Interface





When $n_a < n_b$, phase shift of π, or half-wavelength, occurs.

Thus Destructive reflection $2t = m\lambda$, m=0, 1, 2, 3...

Constructive reflection $2t = (m+1/2)\lambda$, m=0, 1, 2, 3...

Pay attention to *n* across interfaces

Phase Difference & Thin Film Interference

Phase Difference

Path difference: $\frac{r_2 - r_1}{\lambda} = \frac{\phi}{2\pi}$

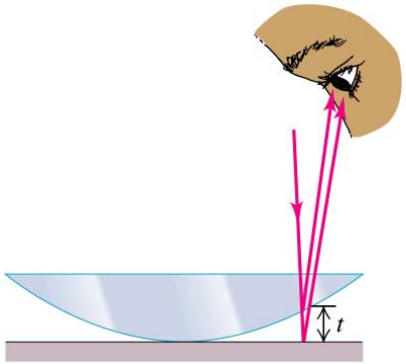
Phase change at the interface: π

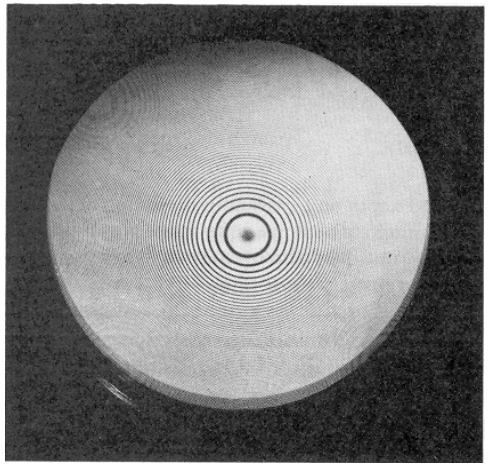
(if reflects off an optically denser material)

Normal incidence	No phase shift or both have π-shift	One of the two wave has π-shift
$2t = m\lambda$	Constructive reflection	Destructive
$2t = (m+1/2)\lambda$	Destructive	Constructive
m=0,1,2,3...		

Applications

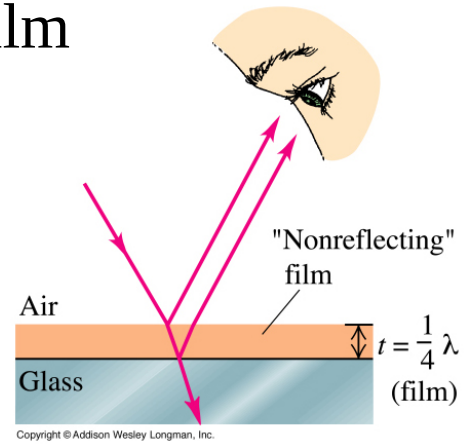
Newton's Ring





Reflection from the top surface?

Nonreflecting film

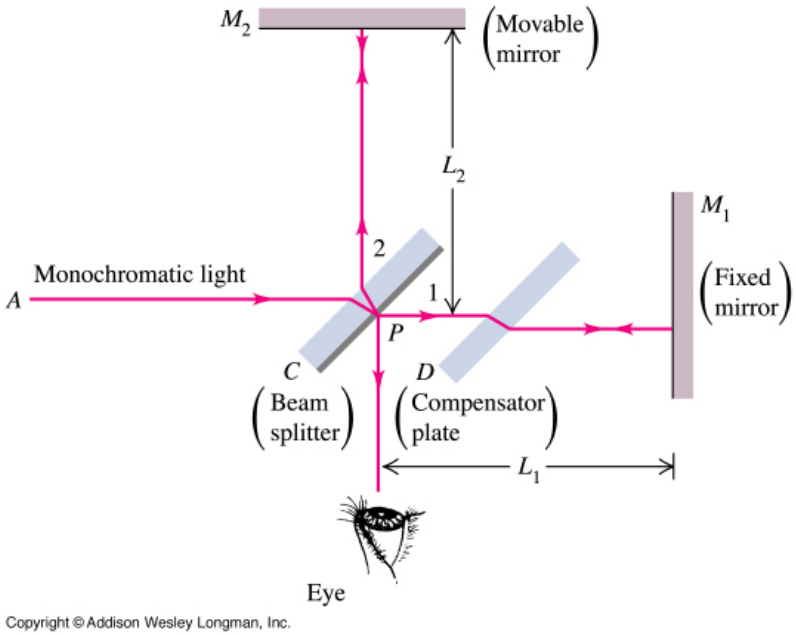


What should film *n* be

w.r.t. those of air & glass?

Eliminate several wavelengths?

35-5. The Michelson Interferometer



Move M_2 by y

Path differs by $2y$

Correspondingly m fringes moved

Then $2y=m\lambda$, or $\lambda=2y/m$

Precise measurement of wavelength

Tested the dependence of speed of light on the motion of the Earth

Albert Abraham Michelson, Nobel Prize, 1907