PhysicsTutor

Thin-film Interference

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Problem:

- An extremely thin film of soapy water (n=1.35) sits on top of a flat glass plate with n=1.50. The soap film has an orange-red colour when viewed at normal incidence.
- What is the thickness of the film? The wavelength of the orange-red light is 600 nm.

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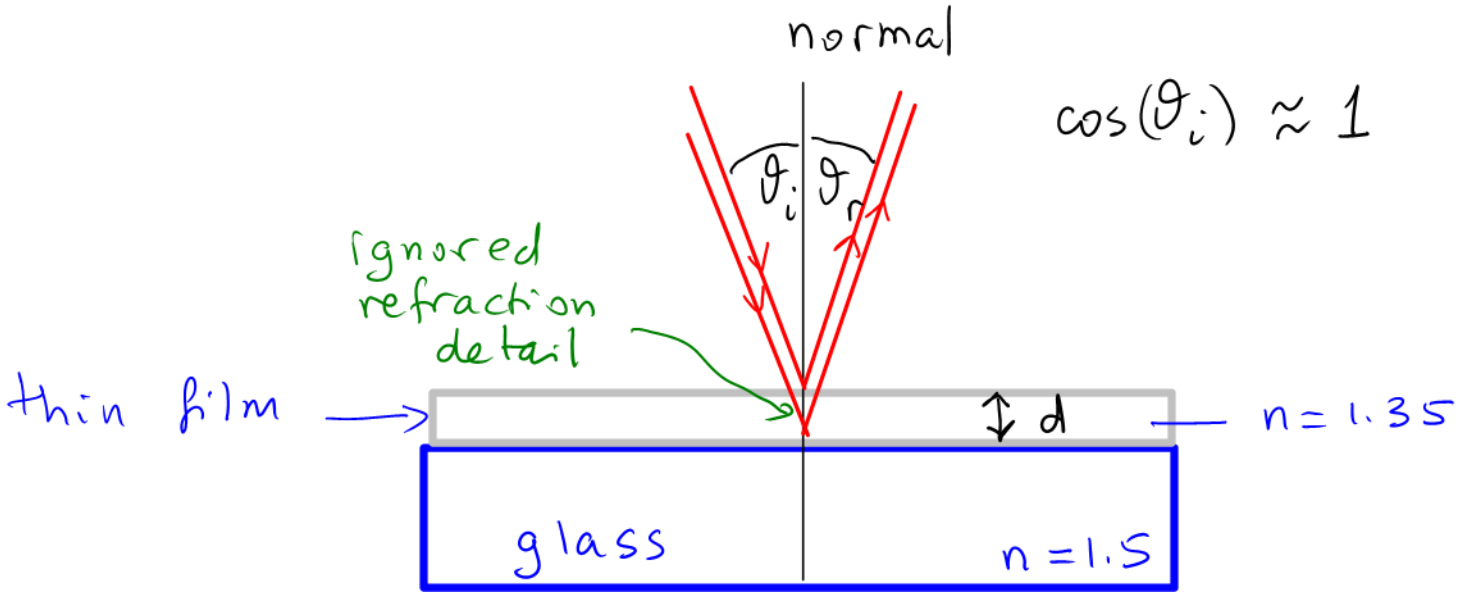

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- Constructive interference of light reflected from the top surface of the film with light reflected from the film-glass interface.
- The number of phase jumps is the same for recombining beams (air to soap and soap to glass).
- Find the optical path length difference between the two beams, phase shift of 2π.

Equations associated with ideas:

$$E_{1/2}(x,t) = E_0 \sin\left(\omega t - \frac{2\pi}{\lambda}x + \phi_{1/2}\right)$$

same x, t : $\phi_1 = 0$, $\phi_2 = \frac{2\pi}{\lambda_{med}}\Delta x = \frac{2\pi}{\lambda_{vac}} n \Delta x$

ϕ_2 is additional accumulated phase

$$\Delta x = \frac{2d}{\cos\vartheta} \simeq 2d$$

$$\Delta\phi = \phi_2 - \phi_1 = \frac{2\pi n}{\lambda_{vac}}\Delta x = 2\pi$$

(chose $m = 1$ for thinnest film)

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- Destructive IF from complementary colour?

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- $d = 0.2\ \mu m$ is thin. It could also be a multiple.
- Note: our colour vision is not only susceptible to beams of light of a given wavelength. Missing some parts of the wavelength range (complementary colour) does also lead to colour perception.