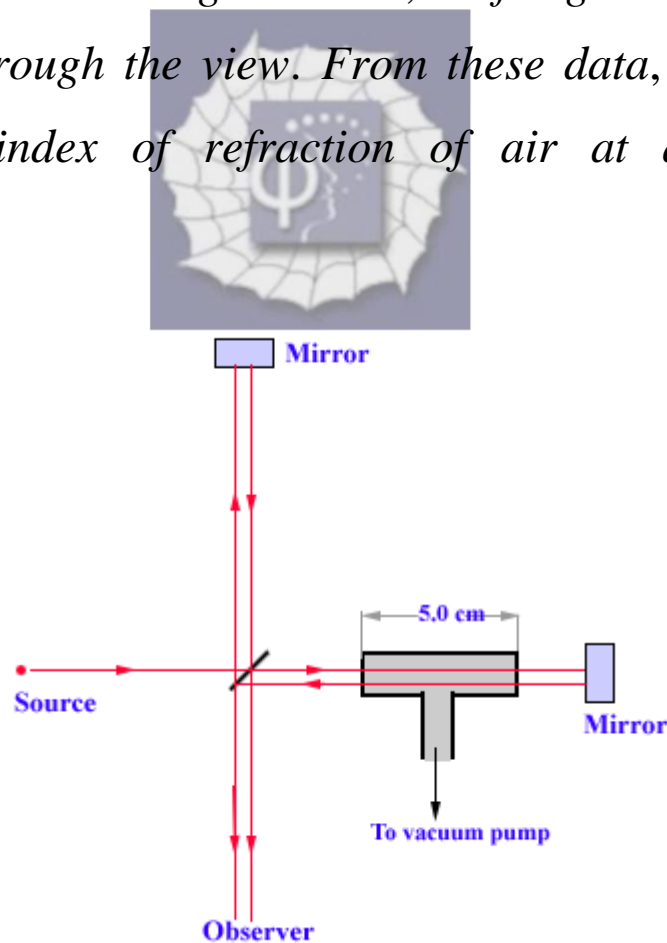


650.

**Problem 45.51 (RHK)**

*An air tight chamber 5.0 cm long with glass windows is placed in one arm of a Michelson interferometer, as shown in the figure. Light of wavelength  $\lambda = 500 \text{ nm}$  is used. The air is slowly evacuated from the chamber using a vacuum pump. While the air is being removed, 60 fringes are observed to pass through the view. From these data, we have to find the index of refraction of air at atmospheric pressure.*



**Solution:**

Change in phase when air is evacuated from the 5.0 cm long tube, as shown in the figure, will be

$$\begin{aligned}\Delta\phi &= 2\pi \times (10 \times 10^{-2}) \times \left( \frac{n}{\lambda} - \frac{1}{\lambda} \right) \\ &= 2\pi \times 10^{-1} \frac{(n-1)}{\lambda},\end{aligned}$$

where the vacuum wavelength of light used in the experiment is

$$\lambda = 500 \times 10^{-9} \text{ m.}$$

It is observed that when the tube is evacuated 60 fringes are observed to pass through the view. For a change of phase of  $2\pi$  a fringe is shifted by another fringe. We therefore have

$$\Delta\phi = 2\pi \times 60.$$

We thus have the relation

$$10^{-1} \times \frac{(n-1)}{500 \times 10^{-9}} = 60,$$

or

$$(n-1) = 3 \times 10^{-4},$$

and

$$n = 1.0003.$$

