

Repeat the steps 4 and 5 several times, tabulate the observed data in Table 2. Finally, obtain an averaged value of the change in optical path with the translation of the biprism and determine the base-angle using the formula given in the table.

Observations

Table 1

Determination of wavelength of the laser source

| Number of fringes collapsed/ appeared (m) | | N | Microme | ter Posi | | 1 1 1 1 1 | | | |
|---|---------|-----|-----------|----------|-----|-----------------|-------------|---------------------|------------------------------|
| | Initial | | | Final | | | b - a | d | Wavelength |
| | MSR | CSR | Total (a) | MSR | CSR | Total (b) (rom) | =d1 (mm) | =d ₁ /10 | $(\lambda = 2d / m)$ $(n m)$ |
| 52 | 10 | 17 | 10.17 | 9.5 | 49 | 9.99 | 6.18 | 0.018 | 692.31 |
| 54 | 9.5 | 46 | 9.96 | 10 | 14 | 10.14 | 0.18 | 0.018 | 73.333 |
| 55 | 10 | 30 | 10.30 | 10 | 12 | 10.12 | 0.18 | 0.018 | 654-54 |
| 53 | 10.5 | 49 | 10.99 | 10.5 | 31 | 10.81 | 0.18 | 0.018 | 679.25 |
| 56 | 10.5 | 32 | 10.82 | 11 | D | 11-00 | 0.18 | 0.018 | 642.86 |

Important note: The distance travelled by the mirror must be read off on the micrometer screw and divided by ten (lever reduction 1:10).

Table 2

Determination of the base-angle of the Fresnel's biprism

Wavelength of laser source (λ) = ...661.13 nm

Refractive index of the material of the Fresnel's biprism (n) = 1.1.49...

Least count of the translation stage =0:01 mm

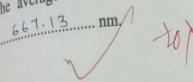
| Number of fringes collapsed/ appeared (m) | | Tra | nslation | stage P | | | | | |
|---|---------|-----|----------------|---------|-----|----------------|---|----------------------------|----------------------|
| | Initial | | | Final | | | 10 | t | |
| | MSR | VSR | Total (a) (Cm) | MSR | VSR | Total (b) (cm) | $\begin{vmatrix} \mathbf{b} - a \\ = I \end{vmatrix}$ | $=\frac{m\lambda}{2(n-1)}$ | $\phi = \frac{l}{l}$ |
| 52 | 12 | 18 | 12.018 | 11.8 | 46 | 11.846 | 0.172 | 36.14 | 0.021 |
| 54 | 11.75 | 34 | 11.784 | 11.55 | 48 | 11.598 | 0.186 | 31.53 | 0.020 |
| 55 | 11.6 | 8 | 11.608 | 11.4 | 28 | 11.428 | 6.180 | 38-22 | 0.021 |
| 53 | 11.45 | 21 | 11-471 | 11-25 | 41 | 11-291 | 0.180 | 36.83 | 0.020 |
| 56 | 1). 7 | 22 | 11.722 | 11.5 | 46 | 11.546 | 0-176 | 38.91 | 0.022 |

14/1/2

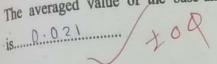


Results

The averaged value of the wavelength of the laser source obtained from Table 1 is



The averaged value of the base-angle of the Fresnel's biprism obtained from Table 2



Error calculations

(i) The wavelength of the laser source is given by: $\lambda = \frac{2 d}{m}$

Find:
$$\frac{\delta \lambda}{\lambda} = 2 \frac{\delta d}{d} + \frac{\delta m}{m}$$

The '2' factor that appears with $\frac{\delta d}{d}$ term in the above expression is related to the fact that dis obtained as a difference of two scale readings, each with an error equal to the least count of the instrument.

$$\frac{\delta\lambda}{\lambda} = 2 \times \frac{0.001}{0.018} + \frac{1}{52}$$

$$\frac{\delta\lambda}{\lambda} = \frac{61}{468} \Rightarrow \frac{\delta\lambda}{\lambda} = 0.13$$

(ii) The base-angle of the Fresnel's biprism is given by: $\phi = \frac{t}{l}; \ \phi = \frac{m \lambda}{2 (n-1) l}$

Find:
$$\frac{\delta\phi}{\phi} = \frac{\delta m}{m} + \frac{\delta\lambda}{\lambda} + 2\frac{\delta l}{l}$$

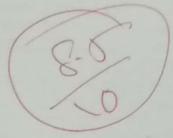
The '2' factor that appears with $\frac{\delta l}{l}$ term in the above expression is related to the fact that l is obtained as a difference of two scale readings, each with an error equal to the least count of the instrument.



$$\frac{\delta\phi}{\phi} = \frac{\delta m}{m} + \frac{\delta\lambda}{\lambda} + 2 \cdot \frac{\delta1}{1}$$

$$\frac{\delta\phi}{\phi} = \frac{1}{52} + \frac{61}{468} + 2 \times \frac{0.001}{6.172}$$

$$\frac{\delta\phi}{\phi} = \frac{811}{5031} \Rightarrow \frac{\delta\phi}{\phi} = 0.161$$



Precautions

- (i) Never look directly into a non attenuated laser beam.
- (ii) Align the interferometer very carefully. Do not disturb it once the fringes are obtained.
- (iii) The interferometer is very sensitive to vibrations on the table and also on the floor. Avoid touching the table on which the experiment is set-up.

Questions

- 1. What do you understand by interference of light?
- 2. What is a coherent light source?
- 3. What is the role of coherence of the light source in the Michelson interferometer?
- 4. What would happen if a thin-glass-slide of refractive index 1.55 (at 632.8 nm) and thickness 20 microns is introduced in one of the arms of the Michelson interferometer? Can you make an estimate of the number of fringes that collapse / appear?
- 5. According to you, what could be the possible applications of studying interferometry?

References

- 1. Optics by E. Hecht
- 2. Optics by A. Ghatak
- 3. PHYWE, LEP 2.2.05, Michelson Interferometer

wave of greater, lower on same amplitude

- e. Two waves are called coherent if they have a constant phase difference and the same frequency and the same waveform.
- 3. To obtain stable interference pattern.

4.
$$\Delta x = (\mu - 1) + 10 - 5 m$$



- 5. a) precise maps of surfaces
 - b) Astronomers use interferometers to combine signale from telescopes. so
 - c) Metrology

Discussion

- Michelson interrferometer uses the principle of superposition of light woves to produces resultant wave of higher, lower on equal intensity. This produces a cincular fringe pattern of bright and dank patches.
- Through this experiment I came to know about superposition of two coherent light sources to produce circular fringe pattern. I also learnt how Michelson Interfenometer could be utilised to determine the wavelength of a light source and to determine base angle of Fresnel biprism.