AMERICAN INTERNATIONAL UNIVERSITY–BANGLADESH (AIUB)

FACULTY OF SCIENCE & TECHNOLOGY

DEPARTMENT OF PHYSICS

PHYSICS 2 LAB

Summer 2021-2022

Group: 01

LAB REPORT ON

To determine the refractive index of the material of a prism using a spectrometer.

Supervised By

DR. MD. MOZAHAR ALI

Submitted By:

Name	ID	Contribution
1. RABIUL ISLAM BIPUL	21-45121-2	
2. MD. SHAHRIAR SHAON	21-45024-2	Result, Discussion & References
3. MD. Al FAIAZ RAHMAN FAHIM	21-45080-2	Experimental Data & Calculation
4. SHATABDI SARKER	21-45031-2	Theory & Apparatus
5. TRIDIB SARKAR	22-46444-1	Procedure

Date of Submission: July 24, 2022

TABLE OF CONTENTS

1. Theory

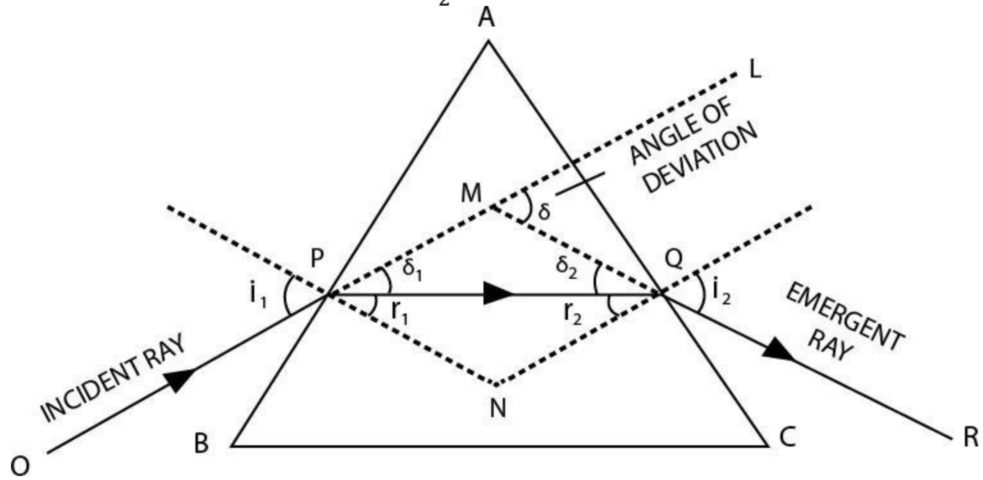
Considering a prism with prism angle A. Letting a ray OP to incident on the first face of a prism and after passing through the principal plane of the prism, finally emerge out through the other face in the direction QR. Let us take i_1 and r_1 be the respective angles of incidence and refraction at the first face of the prism i_2 and r_2 be the corresponding quantities for the second face.

In the position of minimum deviation, as the ray passes symmetrically through the prism so in this position, $i_1 = i_2$ and $r_1 = r_2$

We know, the angle of prism, $A = r_1 + r_2$

In the position of minimum deviation, $A = 2r_1$

$$\therefore r_1 = \frac{A}{2}$$



Now, the deviation of the ray, $= (i_1 - r_1) + (i_2 - r_2)$

$$\Rightarrow \delta = (i_1 + i_2) - (r_1 + r_2)$$
$$\therefore \delta = (i_1 + i_2) - A$$

In the position of minimum deviation, $\delta = \delta_m$. Thus,

$$\delta_m = 2i_1 - A$$
$$\therefore i_1 = \frac{\delta_m + A}{2}$$

From Snell's Law, the refractive index, $\mu = \frac{Sini_1}{Sinr_1}$

$$\mu = \frac{\sin\frac{\delta_m + A}{2}}{\sin\frac{A}{2}} \qquad \text{.......................... (1)}$$

2. Apparatus

- A spectrometer.
- A spirit levels.
- A source of monochromatic light (sodium vapour lamp).
- A glass prism.
- A magnifying lens.
- A reading lamps.

3. Procedure

(A) Telescope adjustment:

a) We arranged the spectrometer and the prism table in horizontal position by using the levelling screws (as shown in fig .2)

b) Then we turned the telescope towards a distant object to receive a clear and sharp image.

c) After That, we illuminated the slit by a sodium vapour lamp. We adjusted suitably the slit and the collimator to receive a narrow, vertical image of the slit.

d) We turned the telescope to receive the direct ray, so that the vertical slit coincides with the vertical crosswire.

Figure 2: Spectrometer.

(B) Measurement of the angle of minimum deviation:

a) We placed the prism so that its center coincides with the center of the prism table and light falls on one of the polished faces and emerges out of the other polished face, after refraction. Then we turned the telescope to view the refracted image of the slit on the other face. (As shown in fig. 3).

b) After that we turned in the vernier table slowly such a direction that the image of slit is moved directed towards the directed ray, i.e.., in the direction of decreasing angle of deviation.

c) Then we found that at a certain position, the image is stationary for some moment. Vernier table is fixed at the position where the image remains stationary. Using telescope fine we adjusted slider and made coincide the slit with cross wire.

d) We noted corresponding main scale and vernier scale reading in both vernier (vernier I and vernier II).

e) We carefully removed the prism from the prism table. After that we turned the telescope parallel to collimator and noted the direct ray readings.

f) We found the difference between the direct ray readings and deviated readings. This angle is called angle of minimum deviation (δm). At last, we determined refractive index of the material of the prism by using eq. (1)

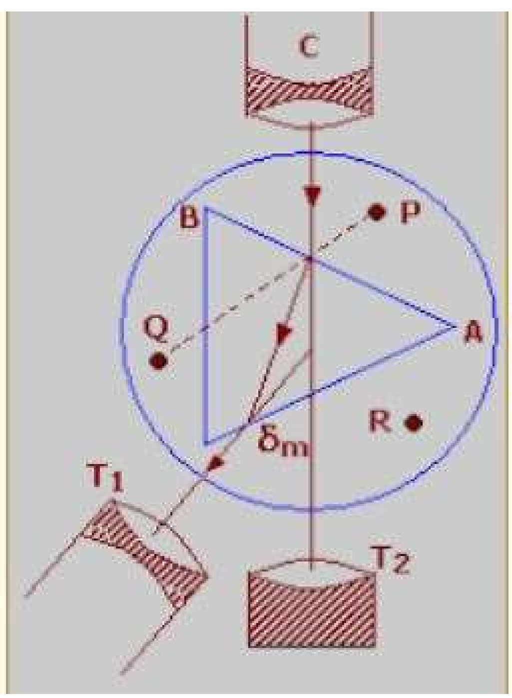


Figure 3: Arrangement to determine the angle of minimum deviation

4. Experimental Data & Calculation

(A) Vernier Constant (VC) = $\frac{1}{60}$ = 0.0167

(B) Wavelength of light used = 589 nm

(C) Angle of prism, A = 60°

(D) Table for the angle of minimum deviation:

Vernier Number	No. of Observation	Readings for minimum deviation position				Readings for direct position				Angle of minimum dev, δ_m = M~N	Mean δ_m	Refractive index, $\mu = \frac{\sin\frac{\delta_m+A}{2}}{\sin\frac{A}{2}}$
		Main scale reading (s)	Vernier scale division	Vernier scale reading V = vd x VC	Total M = S+V	Main scale reading (s)	Vernier scale division	Vernier scale reading V = vd x VC	Total N = S+V			
1.	**1**	**51**	**1**	**0.0167**	**51.0167**	**90**	**10**	**0.167**	**90.167**	**39.1503**	**38.894**	**1.519**
	2	**36**	**4**	**0.0668**	**36.0668**	**74**	**3**	**0.0501**	**74.0501**	**37.9833**		
	3	**43**	**4**	**0.0668**	**43.0668**	**4**	**1**	**0.0167**	**4.0167**	**39.0501**		
2.	**1**	**230**	**1**	**0.167**	**230.167**	**269**	**5**	**0.0835**	**269.0835**	**39.0668**		
	2	**215**	**4**	**0.0668**	**215.0668**	**254**	**10**	**0.167**	**254.167**	**39.1002**		
	3	**223**	**3**	**0.0501**	**223.0501**	**184**	**2**	**0.033**	**184.033**	**39.0171**		

$$\text{Percentage of error} = \left|\frac{Standard\ value - Experimental\ value}{Standard\ value}\right| \times 100\%$$

$$= \left|\frac{1.52-1.519}{1.52}\right| \times 100\%$$

$$= 0.66\%$$

5. Result

Refractive index of the material of the prism is 1.519

6. Discussion

a) The telescope and collimator were individually set for parallel rays.

b) Slit was as narrow as possible.

c) Both verniers were read.

d) The prism was properly placed on the prism table for the measurement of angle of the prism as well as for the angle of minimum deviation.

7. References

- **Fundamentals of Physics:** The Law of Refraction (Chapter 35, page 1048)
  Wavelength and Index of Refraction (Chapter 35, page 1050)
- Video link: https://www.youtube.com/watch?v=oRch7irmLv