Determine Refractive Index of Material of a prism using Sodium Source

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1 AIM

To Determine Refractive Index of Material of a prism using Sodium Source

2 APPARATUS

Spectrometer, prism, prism clamp, sodium vapour lamp, lens. etc.

3 PROCEDURE

- Focus Telescope on distant object.
- When focus is correct, start button is activated. Then click Start button.
- Switch on the light by clicking Switch On Light button.
- Focus the slit using Slit focus slider.
- Bring Vernier to 0 degree and 180 degree position using Vernier Table Slider.
- Place the prism.
- Bring telescope using Telescope Slider to a position of (180 - 2i) degree by rotating it in anti-clockwise direction, where (i) is the angle of incidence.
- Move Vernier Table in clockwise direction to coincide slit with cross wire.

- Now move telescope in clockwise direction so that refracted ray goes in it and coincide slit with cross wire.
- Note down reading for both Verniers .This will be reading for refracted Ray.
- Remove the Prism.
- Move telescope in anti-clockwise direction to get direct ray in it and coincide slit with cross wire.
- Note down the readings for both Verniers now as well. This will be reading for Direct Ray.

4 PRECAUTIONS

- Slit should be as narrow as possible.
- Vernier numbering should remain fixed throughout the experiment.
- Prism position should be maintained properly.
- Fine adjustment of telescope must be used in each case.

5 OBSERVATIONS

5.1 Least Count of Spectrometer

$27MSD = 30VSD$

$1VSD = \frac{27}{30}$MSD

Least count = $1MSD - 1VSD$

$1MSD$ - $\frac{27}{30}MSD = \frac{3}{30}$MSD

On main scale 20 divisions = 10°

1 division = $(1/2)^\circ$ = 1 MSD

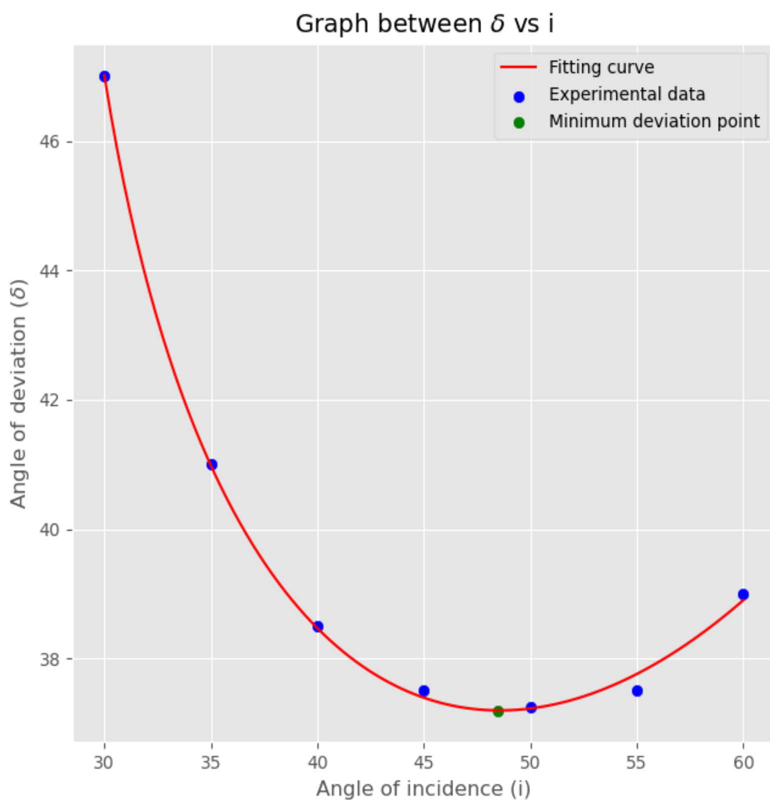
$\therefore L.C = (\frac{3}{30}) \times (\frac{1}{2})^\circ = (\frac{1}{20})^\circ$

$= (\frac{1}{20} \times 60)' = 3'$

5.2 Angle of Deviation

$\angle i^\circ$	vs	$\angle r^\circ$	$\angle d^\circ$	$(\angle r^\circ - \angle d^\circ)$	$\angle mean^\circ$
30°	$V1$	$42^\circ\ 30'$	$89^\circ\ 30'$	47°	47°
	$V2$	$222^\circ\ 30'$	$269^\circ\ 30'$	47°	
35°	$V1$	$53^\circ\ 30'$	$94^\circ\ 30'$	41°	41°
	$V2$	$233^\circ\ 30'$	$274^\circ\ 30'$	41°	
40°	$V1$	61°	$99^\circ\ 30'$	$38^\circ\ 30'$	$38^\circ\ 30'$
	$V2$	241°	$279^\circ\ 30'$	$38^\circ\ 30'$	
45°	$V1$	67°	$104^\circ\ 30'$	$37^\circ\ 30'$	$37^\circ\ 30'$
	$V2$	247°	$284^\circ\ 30'$	37°	
50°	$V1$	$72^\circ\ 30'$	$109^\circ\ 30'$	37°	$37^\circ\ 15'$
	$V2$	252°	$289^\circ\ 30'$	$37^\circ\ 30'$	
55°	$V1$	77°	$114^\circ\ 30'$	$37^\circ\ 30'$	$37^\circ\ 30'$
	$V2$	257°	$294^\circ\ 30'$	$37^\circ\ 30'$	
60°	$V1$	$80^\circ\ 30'$	$119^\circ\ 30'$	$39^\circ\ 30'$	39°
	$V2$	$260^\circ\ 30'$	$299^\circ\ 30'$	39°	

5.2.1 Take observation for angle of deviation for various angles of incidence i



6 RESULT AND DISCUSSION

Minimum angle of deviation is 37°11'45"

- We just went through the theory of experiment by sharing links with info of concerned points and definitions.
- We just worked together on simulator by sharing screen via Gmeet.

- We evaluated the readings taken.
- We discussed the error part.

7 Contribution of Team Mates

Anjali : She did most of the theoretical part including working on simulator.

Preetpal Singh : He did Python programming and Latex part.

8 Programming Code

```python
import matplotlib.pyplot as plt
from scipy.optimize import curve_fit
import numpy as np

def rad(x):
    return (x * np.pi/180)

def func(i,A,n):
    return i - A + np.arcsin(n * np.sin(A - np.arcsin(np.sin(i)/n))
    )

def min_dev(y_cal,xlim):
    list = []
    for j in range(len(y_cal)):
        xlim[j]
        if y_cal[j] == np.min(y_cal):
            list.append(xlim[j])
            list.append(np.min(y_cal))
    mini = np.array(list)
    print("\nCoordinates of minima of the graph (x,y):\n",mini)
    print("\n Angle of minimum deviation from Graph is: ",min(y_cal
    ))
    return mini


if __name__ == "__main__":
    datax = np.array([30,35,40,45,50,55,60])
    mean_dev_deg = np.array([47,41,38,37,37,37,39])
    mean_dev_min = np.array([0,0,30,30,15,30,0])
    datay= np.array((mean_dev_deg) + (mean_dev_min/60))
    xlim = np.linspace(30,60,100)

    popt, pcov = curve_fit(func,rad(datax),rad(datay))
```

```
    print("\nAngle of prism and Refractive index of the prism from fitting:\n",popt,"\n")
    y_cal = np.array(func(rad(xlim),*popt)) * 180/np.pi
    print(y_cal)
    mini = min_dev(y_cal,xlim)

    plt.style.use("ggplot")
    plt.title("Graph between $\delta$ vs i")
    plt.xlabel('Angle of incidence (i)')
    plt.ylabel('Angle of deviation ($\delta$)')
    plt.scatter(datax,datay,color = "b",label = "Experimental data")
    plt.scatter(mini[0],mini[1],c = "g",label = "Minimum deviation point")
    plt.plot(xlim,np.array(func(rad(xlim),*popt) * 180/np.pi),color = "r",label = "Fitting curve")
    plt.legend()
    plt.show()
```

9 References

https://vlab.amrita.edu/