Experiment

Object - To study the polarisation of light by reflection and to verify the Brewster's law.

Apparatus Required -

Spectrometer, prism, polarimeter, Sodium lamp.

Theory - When an unpolarised light is reflected from a transparent reflecting surface (such as glass), the reflected light is partially polarised which contains more component of vibrations perpendicular to the plane of incidence and less component of vibrations parallel to the plane of incidence. In the reflected light the intensity of polarised light having vibrations perpendicular to the plane of incidence, depends on the angle of incidence. On gradually changing the angle of incidence, at a particular angle of incidence the reflected light becomes perfectly plane polarised with vibrations perpendicular to the plane of incidence. This angle of incidence is called the polarising angle or the Brewster's angle and it is represented by i_p. According to Brewster, polarising angle i_p depends on the refractive index μ of the medium. It is given as -

$$\mu = \tan i_p$$

This is called Brewster's law. For air-glass, the value of polarising angle i_p is nearly 57° and for air-water, its value is nearly 53°.

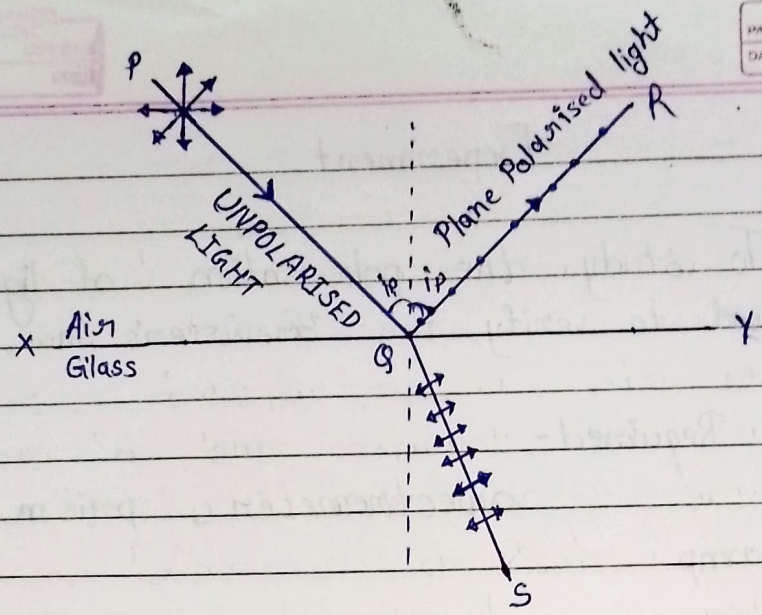

Fig. - Polarisation of light by reflection

It may be mentioned here that if the angle of incidence is less than or greater than the polarising angle (i.e., $i < i_p$ or $i > i_p$), the reflected light is partially polarised with more vibrations perpendicular to the plane of incidence and less vibrations parallel to the plane of incidence. But when the angle of incidence becomes equal to the polarising angle (i.e., $i = i_p$), the reflected light is completely plane polarised.

Formula Used : $\boxed{\mu = \tan i_p}$

where

μ = refractive index

i_p = Polarising angle

$$\boxed{i_p = 90 - \theta/2}$$

θ = Angle between polarised light and direct slit image.

Procedure -

1) Adjustment of spectrometer -

Before the experiment, the spectrometer is so adjusted that

(i) the axes of collimator and telescope intersect each other on the vertical axis of the telescope,

(ii) the prism table is horizontal.

(iii) ~~the telescope and collimator are focused for the parallel rays.~~

(i) To test whether the axes of collimator and telescope intersect each other on the vertical axis of telescope or not, a vertical pin is fixed at the centre of prism table and the slit is made wide. Then taking the eyepiece out of the telescope, the pin is seen through the telescope by moving it in various angular positions. If in each position, the pin is seen in the middle of objective, the adjustment is correct, otherwise with the help of screws provided below the telescope and collimator, they are slightly raised up or lowered down so that the pin is seen in the middle of objective of telescope.

(ii) To make the prism table horizontal, the prism is kept on the prism table such that its refracting edge is at the centre of prism table and the refracting face AC is perpendicular to the line joining the two levelling screw P and Q as shown in fig (a). Then the prism table is rotated and it is adjusted in such a position that the parallel

rays incident from collimator get reflected equally equally from both the refracting faces AB and AC of the prism. Now the prism table is clamped and the telescope is moved to the left side so as to see through the telescope the image of the slit formed by the rays reflected from the face AC of the prism. Now the screws P and Q are adjusted such that the image of slit is obtained exactly in the centre of field of view. Then the telescope is turned on the other side to see the image of slit, through the telescope, formed by the rays reflected from the face AB of the prism and only the screw R is adjusted so as to bring the image of the slit again in the centre of field of view. The process is repected several times till the image of slit is seen exactly in the centre of field of view in the telescope on either side. Now the prism table is said to be optically plane (or horizontal).

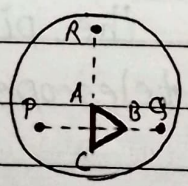

fig. (a)

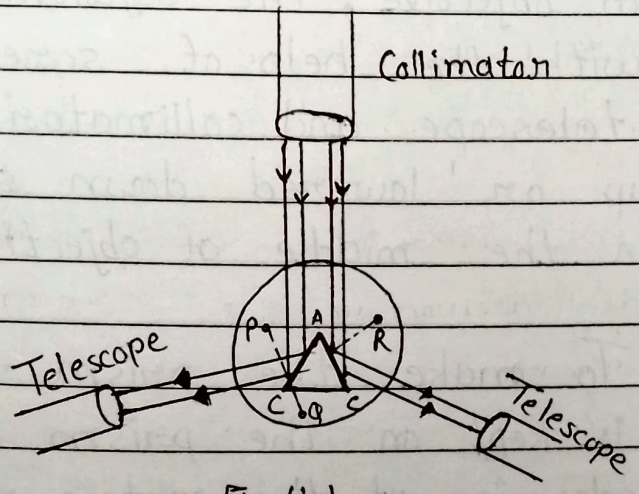

Fig. (b)

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2) Determination of angle θ :-

i) First find the least count of the scale provided on the ~~spectr~~ spectrometer.

ii) Now the prism is kept on the prism table such that the vertex A of the prism is at the centre of Prism table and its base is normal to the direction of indipendent light (Fig. 25). In this position, the parallal rays coming from the ~~light~~ Collimeter fall on the faces AB and AC of the prism and they get reflected from these faces.

iii) Illuminate the slit of Collimeter with the Sodium lamp.

iv) Now the telescope is turned towards the facce AB of the prism and the image of slite formed by the light reflected from this face is brought on the cross-wires of telescope. The telescope is then clamped with the help of screw and it is moved slowly with the help of tangential screw to obtain the image of slite on the vertical Cross-wire.

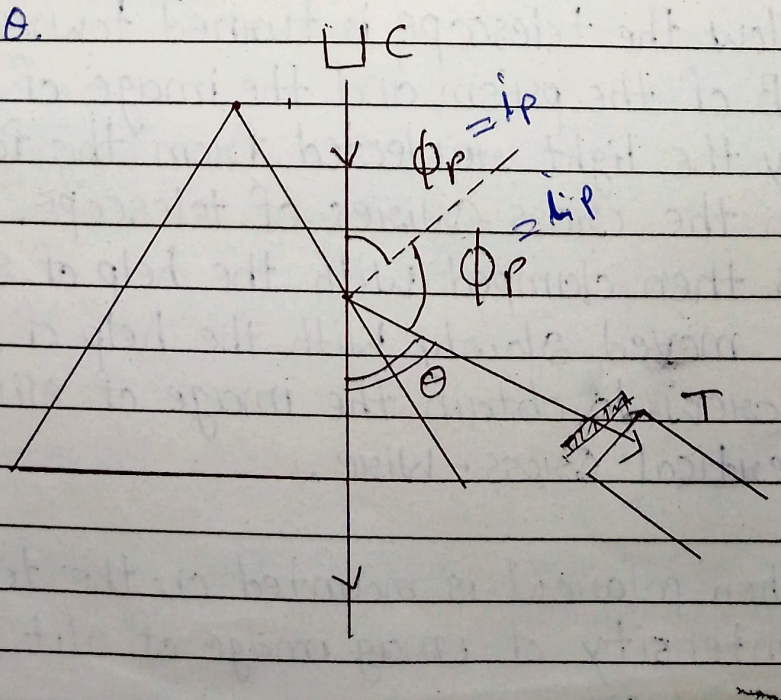
v) Then polaroid is mounted on the telescop and intensity of ~~emag~~ image of slit is set to minimum.

6) Than Prism, table and telescop are moved together to ~~to~~ ~~gather~~ slowly to opt- obtain position of minimum intensity for image of slit and prism, table, is fixed on this position

7) This position of telescope is read with the help of both vernier scales on the circuls scale.

8) Now the prism is removed from the prism table and the telescope is brought just in front of the axis of collimator and the image of slit is made to coincide with the vertical cross-wire of the telescope. This position of telescope is again noted by talking the readings of both veriers on the circular scale.

9) Than taking the diffrence in the two readings of each vernier separately, find their mean value. This will give the angle θ.



Observation Table :-

S.No.	Vernier Scale	Reading of Telescope for light reflected at polarising angle (a)	Reading of Telescope for direct slit image (b)	Difference between readings Angle $\theta = a - b$
1.	V_1			
2.	V_2			

Mean Angle θ =

Calculation :-

$$\mu = \tan ip$$

$$ip = 90 - \theta/2$$

Precautions:

1) Before the experiment spectrometer must be well adjusted.
2) We must take the difference in two readings of the same vernier

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