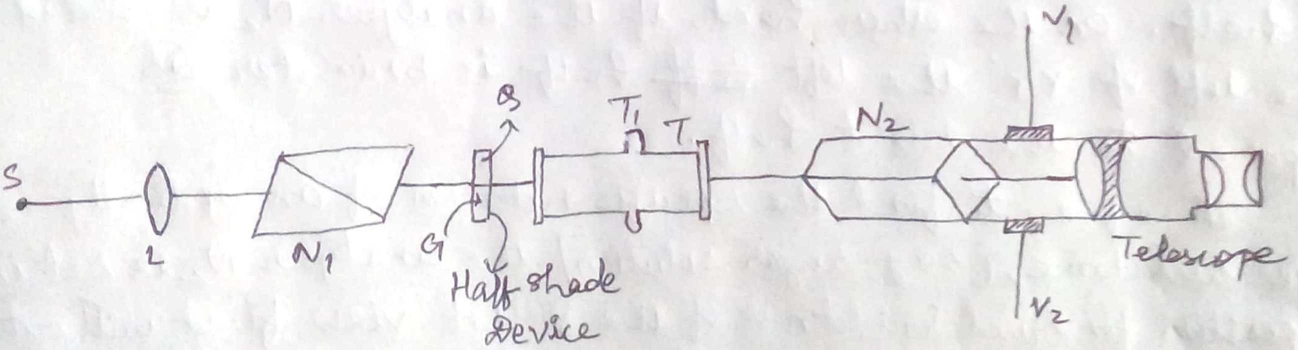
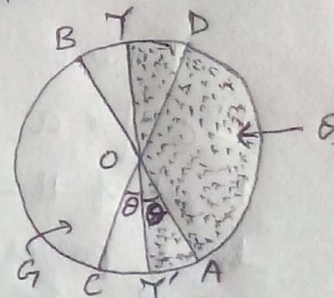
Laurent's Half shade polarimeter:

It consists of two nicol prisms N_1 and N_2. N_1 is a polarizer and N_2 is an analyser. Behind N_1, there is a half wave plate of quartz Q which covers one half of the field of view, while the other half G is a glass plate.



The glass plate G absorbs the same amount of light as the quartz plate Q. T is a hollow glass tube having a large diameter at its middle portion. When this tube is filled with the solution containing an optically active substance and closed at the ends by cover slips and metal covers, there will be no air bubbles in the path of light. The air bubbles (if any) will appear at the upper portion of the wide bore T_1 of the tube.

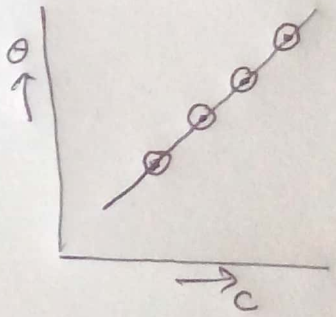
Light from the monochromatic source S is incident on the converging lens L. After passing through N_1, the beam is plane polarised. One half of the beam passes through the quartz plate Q and the other half passes through the glass plate G. Suppose the plane of vibration of the plane polarized light incident on the half shade plate is along AB.



Here AB makes an angle θ with YY'. On passing through the quartz plate Q, the beam is split up into ordinary and extraordinary components which travel along the same direction but with different speeds and on emergence a phase difference of π or a path difference of $\lambda/2$ is introduced between them. The vibrations of the beam emerging out of the glass plate will be along AB. If the analyser N_2 has its principal plane or section along YY' i.e. along the direction which bisects the angle AOC, the amplitudes of the light incident on the analyser N_2 from both the halves will be equal. Therefore, the field of view will be equaly bright.

If the analyser N_2 is rotated to the right of YY', then the right half will be brighter as compared to the left half. On the other hand, if the analyser N_2 is rotated to the left of YY', the left ~~half~~ half is brighter as compared to the right half.

Therefore, to find the specific rotation of an optically active substance, [say, sugar solution], the analyser N_2 is set in the position for equal brightness of the field of view, first without the solution in the tube T. The readings of the verniers V_1 and V_2 are noted. When a tube containing the solution of known concentration is placed, the vibrations from the quartz half and the glass half are rotated. In the case of sugar solution AB and CD are rotated in the clockwise direction. Therefore on the introduction of the tube containing the sugar solution, the field of view is not equally bright. The analyser is rotated in the clockwise direction and is brought to a position so that the whole field of view is equally bright. The new positions of the verniers V_1 and V_2 on the circular scale are read. Thus, the angle through which the analyser has been rotated gives the angle through which the plane of vibration of the incident beam has been rotated by the sugar solution. In the actual experiment, for various concentrations of the sugar solution, the corresponding angles of rotation are determined. A graph is plotted between concentration c and the angle of rotation θ. The graph is a straight line.



Then from the relation

$S_\lambda' = \frac{10\theta}{lc}$, the specific rotation of the optically active substance is calculated.

Scanned by CamScanner