EXPERIMENT NO: INSTRUMENT NO.- NR_ **DATE:**

TITLE: DETERMINATION OF THE RADIUS OF CURVATURE OF THE CONVEX SURFACE OF A LENS BY MEANS OF NEWTON'S RING

APPARATUS

1. Sodium lamp
2. Convex lens
3 Plano Convex lens
4. Travelling Microscope
5. Plane Glass plate

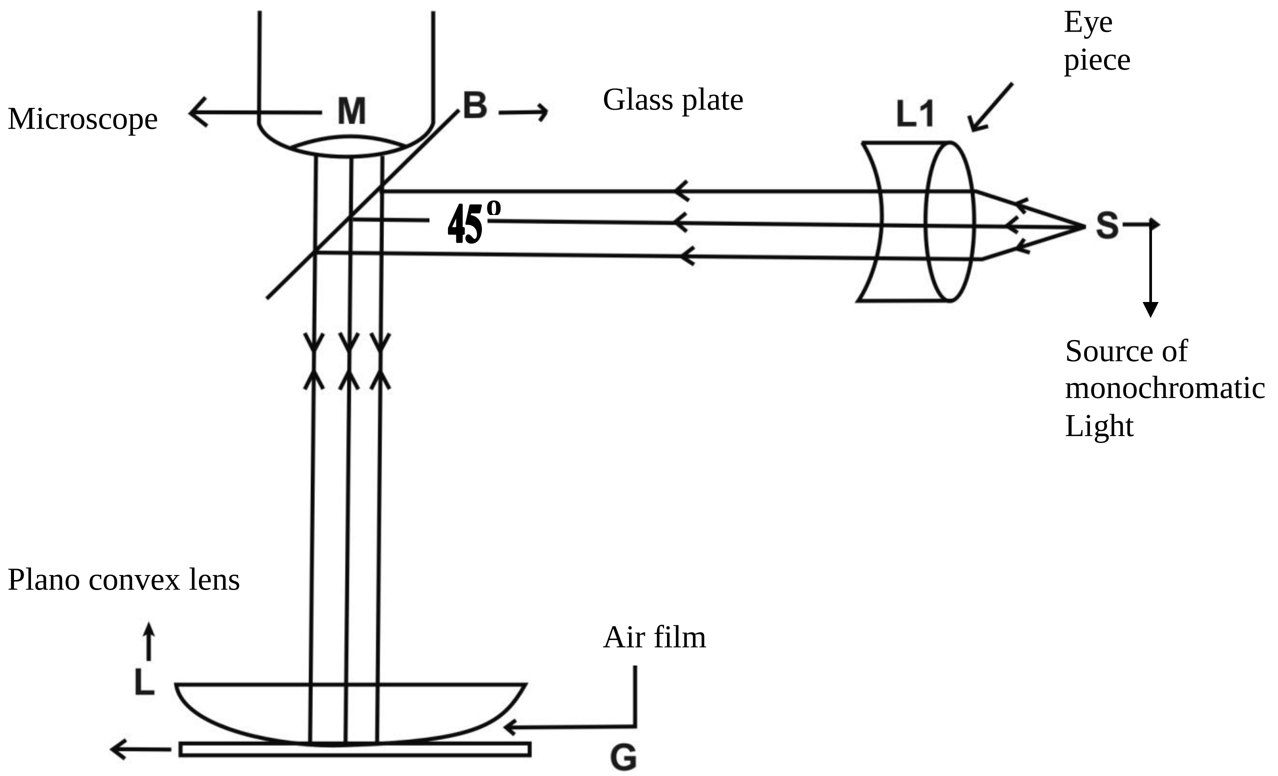


Fig-1. Expeimental Set up for Newton's ring

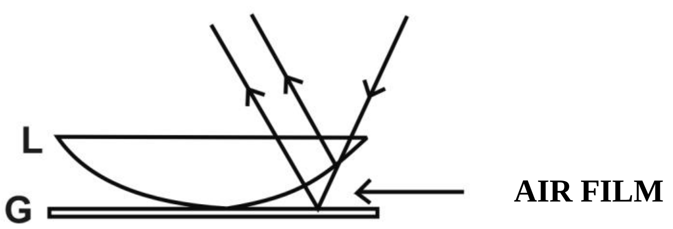


Fig 2 : Formation of Newton's ring

AIR FILM

Fig. 3 NEWTON'S RING

THEORY: When a monochromatic beam if light coming from an extended source is incident on a combination of L and G as shown in fig. 1 a part of it is reflected from the lower surface of the lens and a part, after refraction through the film between L and G is reflected back from the surface of the Plate G. These two parts are in a condition to interfere and give rise to a system of alternate dark and bright rings with O, the point of contact (between L and G) as centre.

If the angle of incidence of the rays which fall on G is θ and μ is the refractive index of the film between L and G then the diameter D_n of the n^{th} dark or bright ring is given by

$$D^2n / 4 = n\lambda R / \mu\cos\theta \text{ (for dark rings)}$$

And $$D^2_n / 4 = \{(2n + 1)/2 * (\lambda R) / (\mu\cos\theta) \text{ (for bright rings)}$$

Where λ is the wavelength of the light used and R is the radius of curvature of the lower surface of the lens L.

For normal incidence ($\theta = 0$) as in the arrangement shown in fig.-1 and with $\mu = 1$ i.c. with an air film between L and G we have

$$D^2_n = 4n\lambda R / \text{ (for dark rings)}$$

And $$D^2_n = 2(2n + 1)/\lambda R \text{ (for bright rings)}$$

Knowing λ and measuring the diameter of the n^{th} dark or bright ring R, the radius of curvature of the convex surface of the lens in contact with the plate G, may be determined.

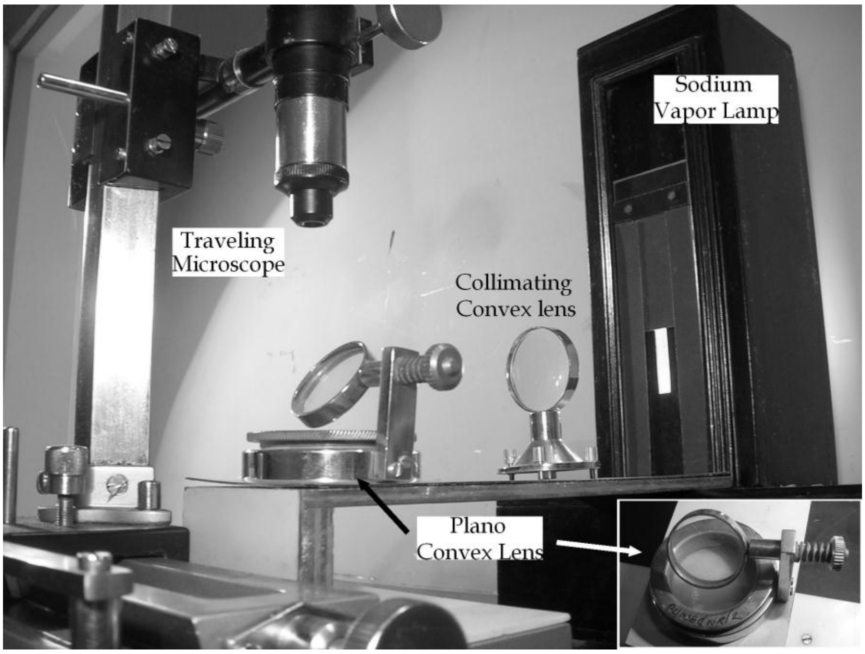
But it is always found that due to deformation of the surface near the point of contact, a few rings round the central dark spot are not circular. Further, due to presence of dust particles the central fringe may not be dark. In order to eliminate difficulties arising out of these factors the following procedure may be adopted for the determination of R.

If D_{m+n} and D_n be the diameters of the $(m+n)^{th}$ and nth dark or bright rings then,

$D^2_{m+n} - D^2_n = 4m\lambda R$ (for the dark or bright rings).

The above relation indicates that R may be determined even without knowing the exact ring number (m+n) or n.

Thus by measuring the diameters of any dark or bright rings by means of a microscope and counting the number of dark or bright rings lying between them R may be determined.



EXPERIMENTAL PROCEDURE AND DATA TABLES:

1) **Level the traveling microscope.**

2) **Adjust the positions of the Collimating Convex Lens and Plano Convex Lens (Newton's Apparatus) on the wooden platform to form the Newton's Ring.**

3) **Place the crosswire of the eyepiece of the traveling microscope on the tangent position of the 10^{th} dark ring at the left position from the centre ring.**

4) **Take the scale reading on the horizontal scale of the traveling microscope.**

5) **By only using the tangent screw of the traveling microscope place the crosswire on the 8^{th} dark ring and record the scale reading on the horizontal scale of the traveling microscope.**

6) **Repeat the step (5) for 6^{th}, 4th and 2^{nd} dark rings.**

7) **Now place the crosswire of the eyepiece on the tangent position of the 2nd dark ring at the right side from the centre ring.**

8) **Take the scale reading on the horizontal scale of the traveling microscope.**

9) **Repeat the step(7) and step(8) for 4th ,6th ,8th and 10th dark rings at the right hand side .**

10) **Calculate diameter of the rings from Table 1.**

TABLE 1. Measurement of the diameter of the rings :

RING NO.	READING OF THE MICROSCOPE						DIAMETER D_n
	LEFT			RIGHT			
	MAIN SCALE (c.m.)	VERNIER SCALE (c.m.)	TOTAL (R_l) (c.m.)	MAIN SCALE (c.m.)	VERNIER SCALE (c.m.)	TOTAL (R_r (c.m.)	(R_l ~ R_r) (cm.)
10							
8							
6							
4							
2							

TABLE 2:To draw the graph of diameter^2 vs Ring No

RING NO.	D_n (c.m.)	D_n^2 (cm^2)
10		
8		
6		
4		
2		

11) **Use Table 2 to draw the graph between diameter^2 vs Ring No. By using slope of the graph calculate Radius of Curvature of the Plano Convex Lens.**

Calculation of slope:

Mean wavelength of sodium light (λ) = 5893 Å

Calculation of Radius of Curvature:

$$R = \frac{D^2_{m+n} - D^2_n}{4m\lambda} =$$

DISCUSSIONS :

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1. The plano-convex lens used for the formation of Newton's rings should have a spherical surface of large radius of curvature. This is necessary because the rings observer have then a large diameter and hence the error in the measurement of their diameters will be minimum.

2. It may so happen that the rings seen ate not circular but elliptic. This is mainly due to unclean surface of the lens and the plate. For this reason, the surfaces are to be cleaned before the commencement of the experiment.

3. The centre of the ring systems, according to the theory, should be dark. Sometimes, the central spot appears bright. The reason for this is that the thickness at the point of contact, instead of being zero, has a small value.

4. A few rings near the central spot are rather indistinct and wide. These rings' should not be taken into consideration.

5. While moving the microscope right or left, the cross-wire should intersect the rings tangentially.

BIBLIOGRAPHY

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2. Optics by Ajay Ghatak.