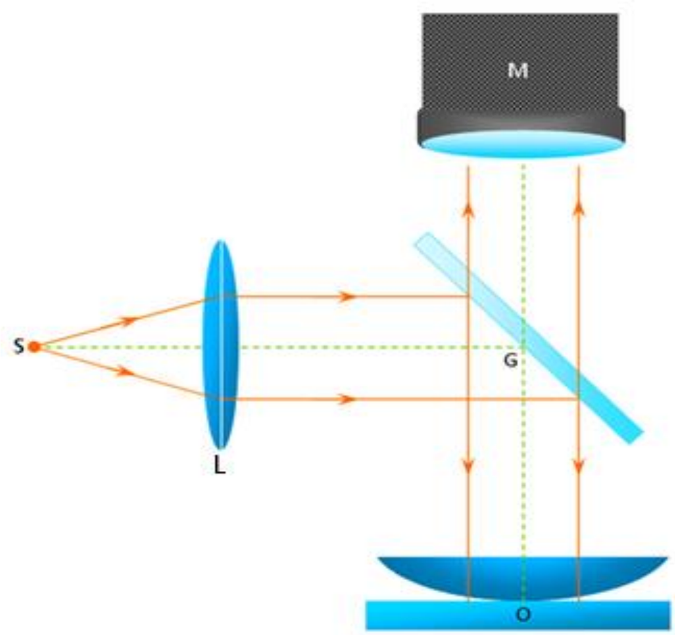
EXPERIMENT No. - 1

Aim of the Experiment: To determine the wavelength of sodium light using Newton's rings method

Apparatus Required: Source of sodium light, a plano-convex lens, an optically flat glass plates and a traveling microscope.

Theory: When a parallel beam of monochromatic light is incident normally on a combination of a plano-convex lens L and a glass plate G, a part of each incident ray is reflected from the lower surface of the lens and a part from the plate surface. These two reflected rays are coherent; hence they will interfere and produce a system of alternate dark and bright rings with the point of contact between the lens and the plate as the center. These rings are known as Newton's ring.



It can be found that the diameters of various order dark rings are:

$$\boxed{D_n{}^2 = 4nR\lambda}$$

Determination of λ

Diameters of n^{th} and m^{th} order Dark rings are

$$D_n{}^2 = 4nR\lambda$$

$$D_m{}^2 = 4mR\lambda$$

$$D_n{}^2 - D_m{}^2 = 4R(n-m)\,\lambda \quad \Longrightarrow \quad \boxed{\lambda = \frac{D_n{}^2 - D_m{}^2}{4R(n-m)}}$$

Procedure:

1. Level the traveling microscope with its axis vertical. Arrange the set-up as shown in Fig.1 and focus the microscope on the air-film. Newton’s Rings will be clearly seen.

2. Adjust the glass plate G for maximum visibility of the point of contact of lens with the glass plate and hence for maximum visibility of Newton’s Rings. In this orientation, G is at 45^0 to the incident beam of light.

3. Move the microscope to the left of the central dark spot and set cross-wire tangent to the 20^{th} dark ring. Record the microscope position from the horizontal scale. Move the microscope towards right to bring crosswire tangential to 15^{th} dark then to 10^{th} dark and to 5^{th} dark rings and every time record the position of these rings.

4. Then move the crosswire to the right side of central dark and bring it tangent to 5^{th}, 10^{th}, 10^{th}, 15^{th} and 20^{th} ring noting the position of each ring.

5. For better accuracy again move the crosswire from right to left from 20^{th} dark right ring to 20^{th} dark left ring noting down the positions of 20^{th}, 15^{th}, 10^{th} , 5^{th} rings on right side and 5^{th}, 10^{th}, 10^{th}, 15^{th} and 20^{th} ring on left side in the same order as they appear in the sequence.

6. From these measurements, evaluate the diameters of different rings by taking the average of two values of diameters of each ring obtained during left to right sequence of movement and vice versa.

7. Calculate at least five values of λ using following formula and diameters of different combinations of two rings. Take average of these values of wavelengths; which will be the result of our calculations.

Formula used:

$$\boxed{\lambda = \frac{D_n{}^2 - D_m{}^2}{4R(n-m)}}$$

Observations:

Ring No. (n)	Position		$D_n = x_L - x_R$	Position		$D_n = x_L - x_R$	Mean D_n
	Left (x_L)	Right (x_R)		Left (x_L)	Right (x_R)		
5							
10							
15							
20							

Calculation and Results:

Vernier constant the Travelling microscope : __________

Radius of curvature of Plano-convex lens : __________ cm

Wavelength of sodium light is : __________ A^o

Questions:

1. In the Newton's ring experiment, how does interference occur?
2. Where have the fringes been formed?
3. Why are the fringes circular?
4. Are all rings equi-spaced?
5. Why is an extended source used in this experiment?
6. What will happen if a point source or an illuminated slit is used instead of the extended source?
7. In place of lens, if a wedge shaped film formed by two glass plates is supplied to you, will you be able to observe Newton's ring? Why?
8. Why the central spot in Newton ring experiment is dark?
9. Instead of reflected rays, if you look at transmitted rays, what would you observe?
10. What happens to the central spot when a liquid is introduced between the lens and the glass plate?
11. Is it possible to determine the refractive index of the liquid by this experiment?
12. What do you expect to see in the experiment if you use a white light source?
13. What would happen if a glass plate is replaced by a plane mirror?