Newton’s Ring Experiment

Aim/Objective

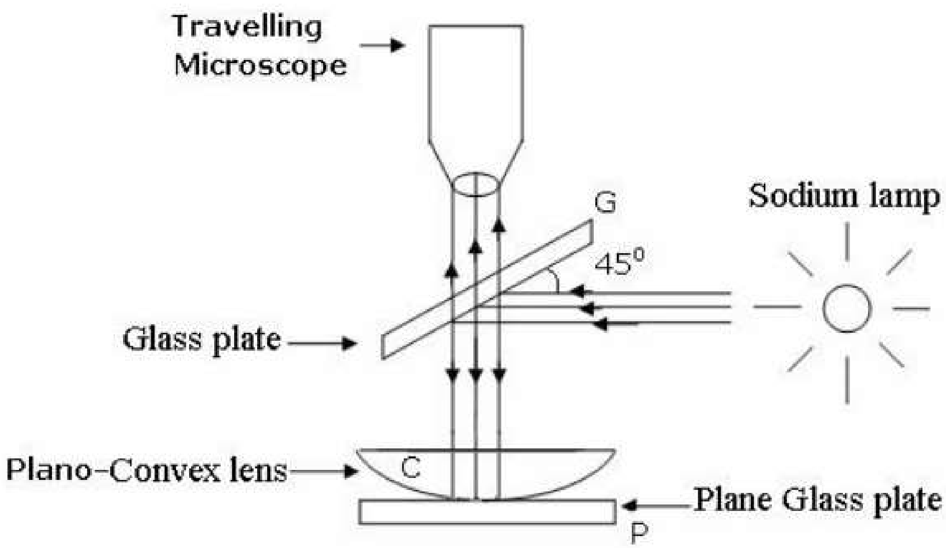
To determine the wavelength of sodium light by Newton’s Ring method.

Apparatus Required

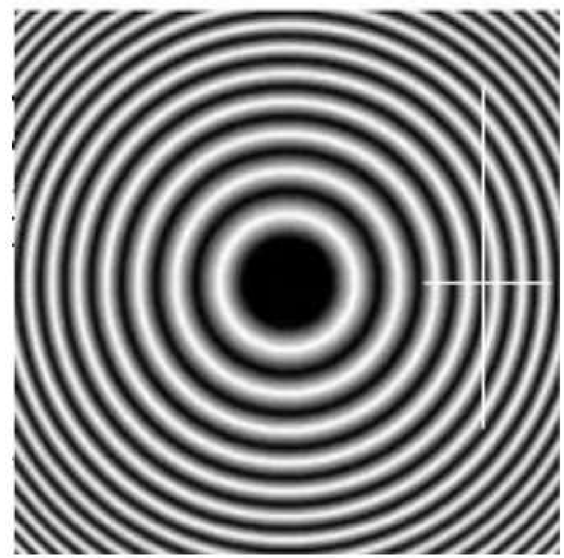
- A monochromatic source of light (source of sodium light),
- A Plano-convex lens C,
- A plane glass plate P,
- A flat glass plate G inclined at an angle of 45°,
- A travelling microscope with measuring scale and a Spherometer.

Theory

When a parallel beam of monochromatic light is incident normally on a combination of a Plano-convex lens C and a glass plate P, as shown in fig.1(a), a part of each incident ray is reflected from the lower surface of the lens, and a part, after refraction through the film between the lens and the plate, is reflected back from the surface of glass plate. These two reflected rays are coherent, hence they will interfere and produce a system of alternate dark and bright rings (see fig.1(b)) with the point of contact between the lens and the plate at the center. These rings are known as Newton's rings.



(a) Experimental set-up



(b) Newton's rings

Figure 1

Formula used: The wavelength λ of monochromatic light is given by,

$$\lambda = \frac{D_{n+p}^2 - D_n^2}{4pR}$$

where D_{n+p} = Diameter of $(n+p)^{th}$ dark ring,

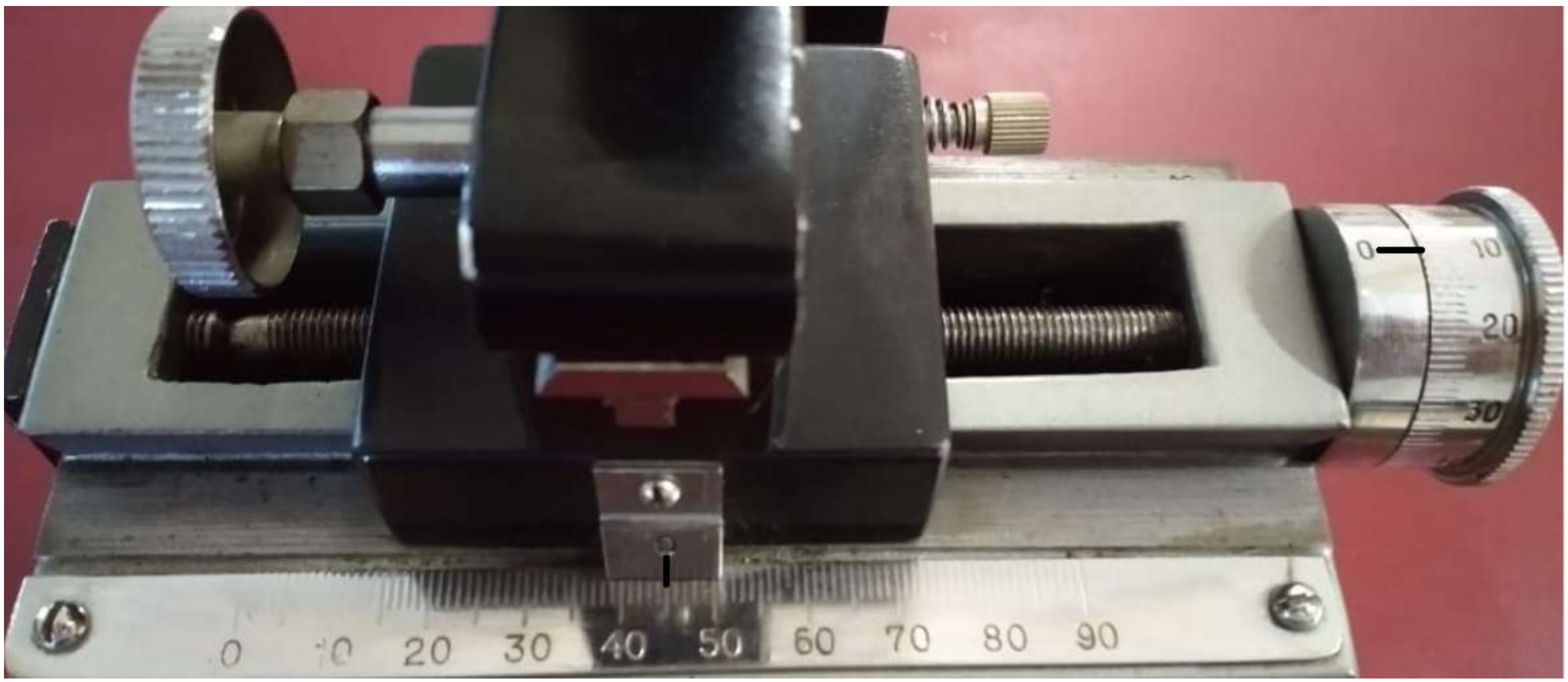
D_n = Diameter of n^{th} dark ring,

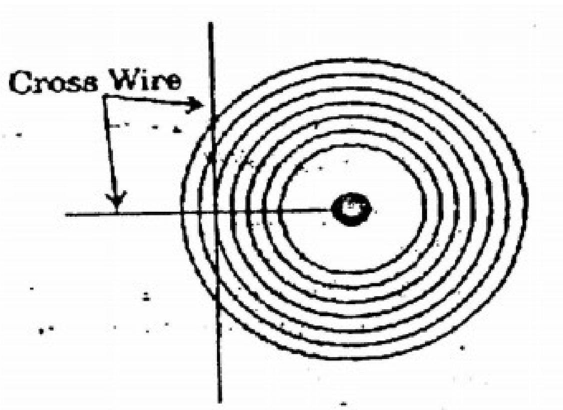
p = any integer, and

R = Radius of curvature of the convex surface of the plano-convex Lens.

Experimental Set up

Experimental Set up





Observations: Least count of the traveling microscope (if based on vernier principle)

$$\text{Least count} = \frac{\textit{Value of 1 main scale division}}{\textit{Number of division on vernier scale}}$$

=.........cm

Table 1: To determine the diameter of the rings.

n	Microscope reading						D=(a-b) cm	D^2 cm^2	D^2_{n+p}- D^2_n cm^2	Mean D^2_{n+p}-D^2_n	p
	Left hand side			Right hand side							
	M.S. cm	C.S. cm	Total 'a' cm	M.S. cm	C.S. cm	Total 'b' cm					
20	....	....	....	....	....	....	....	....			
18	....	....	....	....	....	....	....	....			
16	....	....	....	....	....	....	....	....			
14	....	....	....	....	....	....	....	....			
12	....	....	....	....	....	....	....	....			
10	....	....	....	....	....	....	....	....			
8	....	....	....	....	....	....	....	....			
6	....	....	....	....	....	....	....	....			

The wavelength λ of monochromatic light is given by,

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

Results: The wavelength of sodium light as determined by calculation=.......Å

Standard value of wavelength (λ) = 5893 Å

$$\text{Percentage error} = \frac{\text{Observed value} - \text{Standard value}}{\text{Standard value}} \times 100\% = \cdots \%$$

Precautions:

1. The glass plate and the lens should be thoroughly cleaned.
2. The microscope's eyepiece should be properly focused on its cross-wire.
3. The microscope should be moved only in one direction to avoid backlash error.
4. The lens used should be of large radius of curvature.
5. The range of microscope should be properly adjusted before measuring the diameter of the rings.

Sample viva questions

What do you understand by the interference of light?

2. What are essential conditions for obtaining interference of light?
3. What do you understand by coherent sources?
4. Is it possible to observe interference pattern by having two independent sources such as two sodium lamp?
5. For the interference to happen, why two sources should be monochromatic?
6. Why are the Newton’s rings circular?
7. Why is central ring dark?
8. Where are these rings formed?
9. Sometimes these rings are elliptical or distorted, why?
10. What is the difference between the rings observed by reflected light and those observed by transmitted light?
11. What will happen if the glass plate is silvered on the front surface?
12. Why do the rings gets closer and finer as we move away from the center?
13. What will happen when a little water is introduced in between the Plano-convex lens and the plate?
14. How does the diameter of rings change on the introduction of liquid?
15. Can you find out the refractive index of a liquid by this experiment?