Experiment No. 02

<u>Name of the Exp</u>: Determination of the wavelength of sodium light using newton's rings.

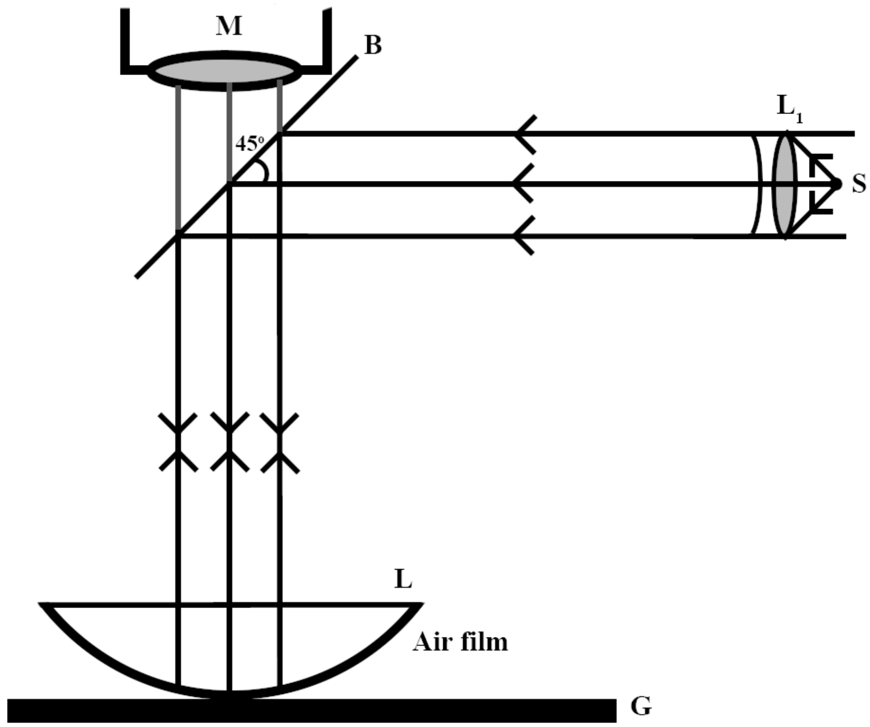


fig.1

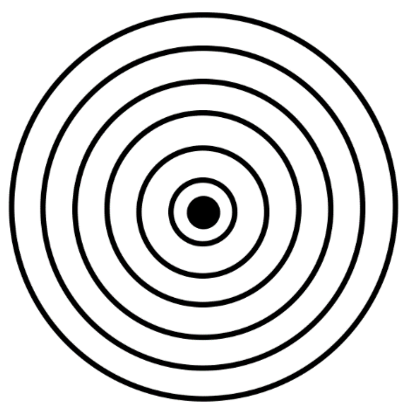


fig.2

Theory: The arrangement used is shown in fig-1 S is a source of sodium light. A parallel beam of light is reflected from the lens L_1 is reflected by the glass plate *B* inclined at an angle 45° to the horizontal. L is a piano-convex lens of large focal length. Newton's rings are viewed through B by the travelling microscope focused on the air film. Circular bright and dark rings with the center dark are seen with the help of a travelling microscope, we measured the diameter of the n^{th} center dark ring. If the diameter of the nth dark ring is D_n then,

$$\frac{D_n^2}{4R} = n\lambda$$

$$or, \ \ D_n^2 = 4Rn\lambda \ \ ------(i)$$

Hence,

- Λ = Have length of monochromic light used.
- *R* = Radius of curvature of the convex lens.

Again, the diameter of the m^{th} (m>n) dark ring be D_m then,

$$D_m^2 = 4Rm\lambda \ \ ------(ii)$$

$$Now \ \ (ii - i)$$

$$D_m^2 - D_n^2 = 4Rm\lambda - 4Rn\lambda$$

$$or, \ \ D_m^2 - D_n^2 = 4R(m-n)\lambda$$

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

We will get the same equation for bright rings. Now determining the diameter of n^{th} & m^{th} ring and the radius *R* we got the value of the wavelength λ.

Apparatus:

1. Travelling microscope.
2. Two convex lenses.
3. Sodium lamp.
4. Glass plate.

Procedure:

1. At first, we made the apparatus horizontal by using the spirit level. Then we focused the cross wire of the microscope.
2. We determined the vernier constant of the microscope.
3. Source *S* was set on the focus on the lens of L_1 so that, beams are parallel after refraction at this position, rings are seen maximum clear.
4. Taking the microscope at left side, we took the reading for convenient rings. Following the same procedure, we took the reading for the rings at the right side, same as we took the 5^{th},6^{th},7^{th} and so on, and at the right side we took the reading for the same numbers as at the left side.
5. We draw a graph establishing the number of rings towards X axis and the square of the diameter of rings toward Y-axis. From the graph we determined the diameter of two rings

Experimental data:

$$Least\ constant\ (k) = \frac{Pitch}{total\ number\ of\ division\ of\ circular\ scale}$$

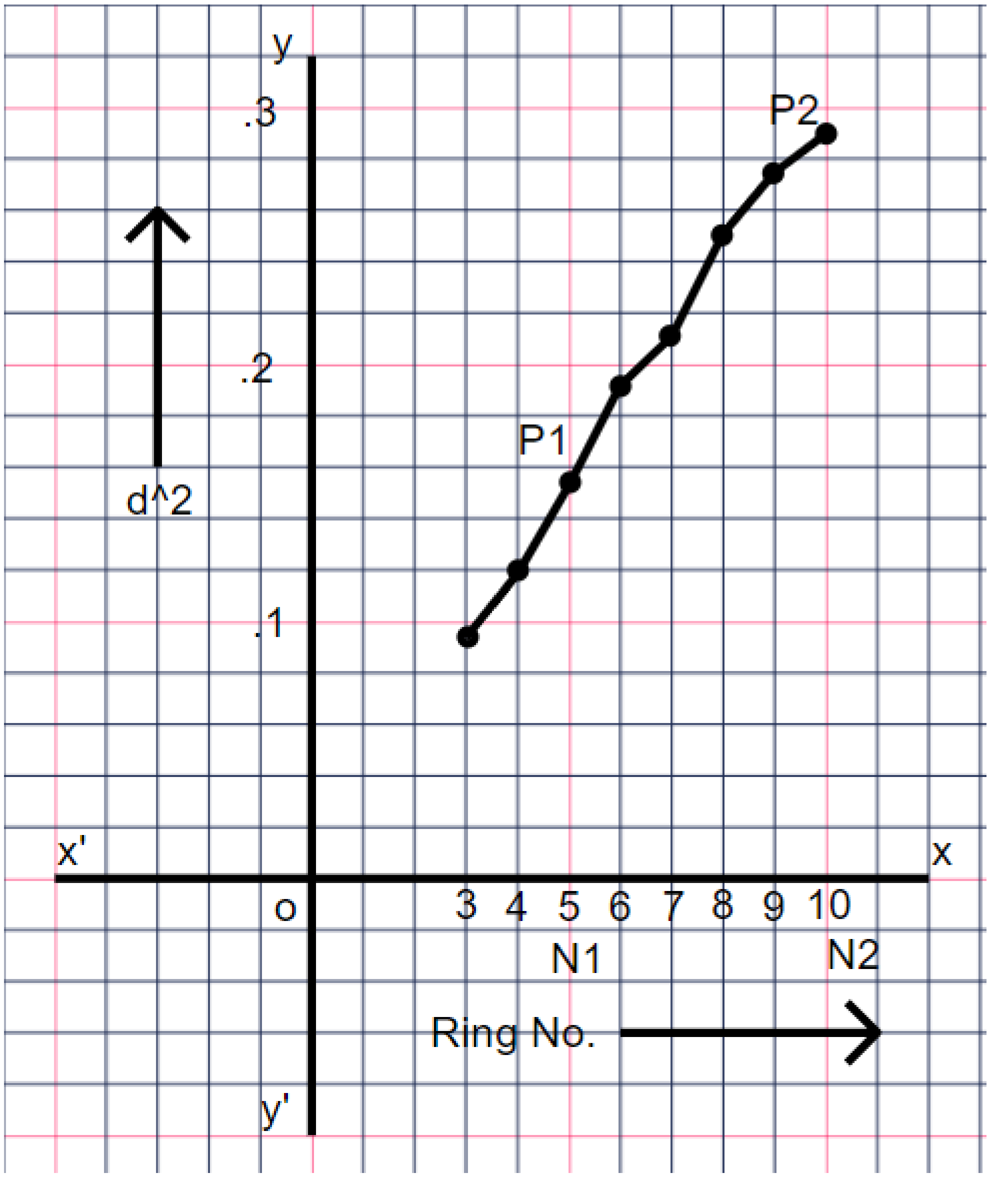
$$= \frac{1mm}{100} = 0.01mm = 0.001cm$$

Radius of the convex lens, $R = 136.5cm$

Table .1

Ring No.	Reading of microscope								Diameter d = x~y cm	d^2 cm
	Left side				Right side					
	Main scale reading L cm	Circular scale reading N	Least constant K cm	Total reading x=(L+N+K)	Main scale reading L cm	Circular scale reading N	Least constant K cm	Total reading x=(L+N+K)		
10	4.7	76	0.001	4.776	5.3	32	0.001	5.332	0.556	0.309
9	4.7	92	0.001	4.792	5.3	19	0.001	5.319	0.527	0.278
8	4.7	5	0.001	4.805	5.3	5	0.001	5.305	0.500	0.250
7	4.7	19	0.001	4.819	5.3	83	0.001	5.283	0.464	0.215
6	4.7	34	0.001	4.834	5.3	70	0.001	5.270	0.436	0.190
5	4.7	53	0.001	4.853	5.3	45	0.001	5.245	0.392	0.154
4	4.7	83	0.001	4.883	5.3	28	0.001	5.228	0.345	0.119
3	4.7	2	0.001	4.902	5.3	7	0.001	5.207	0.305	0.093

Graph.



Calculation: From the graph,

Ring no

$n = 5 \quad , \quad m = 10$

$D_n^2 = P_1 N_1 = 0.77 \qquad , \qquad D_m^2 = P_2 N_2 = 3.09$

$$\therefore \quad \lambda = \frac{D_m^2 - D_n^2}{4R(m-n)} = \frac{3.09 - 0.77}{4 \times 136.5 \times (10-5)} = \frac{2.32}{2730} = 8.498 \times 10^{-4}\ cm$$

Result: The wavelength of the sodium light

$$\lambda = 8498\ \text{Å}$$

Precautions and Discussion:

1. The width of the inner ring was wider than the outer ring, so that the cross wire was taken in between them.
2. The contact of lens and glass plate was uniform.
3. We tried to take the readings for better and continuous rings.