Newton's Ring Experiment

SGTB Khalsa College, University of Delhi

Preetpal Singh(2020PHY1140)

Paper Title: Waves and Optics Lab

Submitted on: June 8, 2021

Due On: June 10, 2021

File Name: 2020PHY1140_Newton_Ring

B.Sc(H) Physics Sem II

Submitted to: Dr. Nimmi Singh

1 AIM

To determine the radius of curvature of the lower surface of a plano-convex lens by using Newton's rings apparatus.

2 APPARATUS

A plano-convex lens of large radius of curvature , optical arrangement for Newton's rings, plane glass plate, sodium lamp, spherometer and a travelling microscope.

3 THEORY

- Light from Na lamp(which is monochromatic) is made to fall on convex lens through which we get the parallel beam of light.
- This is reflected by glass plate kept at 45 and made to fall normally on the plano convex lens.
- There is a thin film of air between its convex surface and glass plate.
- Both beams after reflection observed through travelling microscope.

4 PROCEDURE

- Adjust the lens to obtain ring pattern.
- Central ring will appear to be dark as we are observing reflecting system.
- Note the least count of travelling microscope used.
- Slide the microscope knob from left to right and right to left to ensure that the readings are within the scale.
- Set the cross wire at k^{th} ring then move towards 20^{th} and note down the reading.

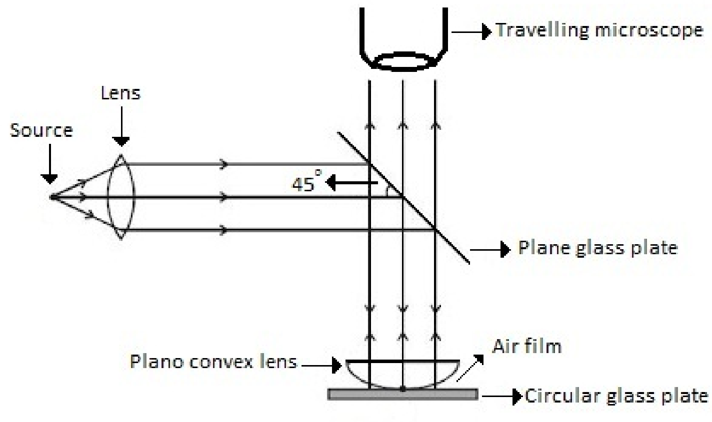


Figure 1: Newton's Ring Experiment

- Then start moving back towards k^{th} ring and then keep on sliding microscope and take readings till you reach 20^{th} ring on the left side.

5 FORMULA

Radius of curvature, $R = \frac{slope(m)}{4\lambda}$

where, l = wavelength of light (Sodium lamp, l=5893 Å)
m = Slope of line drawn between D_n^2 and n

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

$Here$, D_{n+p} is the diameter of $(n+p)^{th}$ ring and D_n that of n^{th} ring.

6 OBSERVATIONS

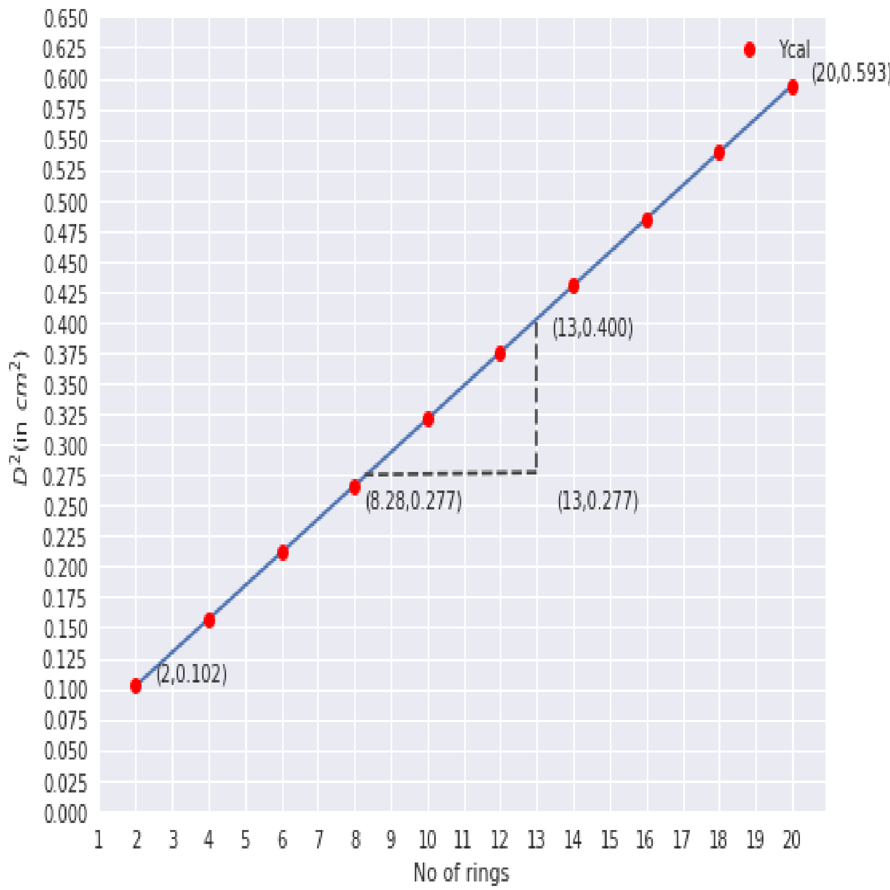
Table 1: Table for determination of diameter(D) of rings

Position of d1					Position of d2					D=d1-d2	$D(cm)$	$D^2(\mathrm{cm}^2)$
n1	MSR (in mm)	VSD	VSR (VSR*LC)	d1 (MSR+VSR)	n2	MSR (in mm)	VSD	VSR (MSR*VSR)	d2 (MSR+VSR)			
20	40	47	0.47	40.47	-20	48	19	0.19	48.19	7.719	0.771	0.595
18	40	81	0.81	40.81	-18	48	2	0.02	48.02	7.21	0.721	0.519
16	40	98	0.98	40.98	-16	47	87	0.87	47.87	6.89	0.689	0.474
14	41	19	0.19	41.19	-14	47	69	0.690	47.69	6.5	0.65	0.422
12	41	35	0.350	41.35	-12	47	52	0.52	47.52	6.17	0.617	0.38
10	41	40	0.4	41.4	-10	47	33	0.33	47.33	5.93	0.593	0.351
8	41	69	0.690	41.69	-8	47	16	0.16	47.16	5.469	0.546	0.299
6	41	76	0.76	41.76	-6	46	93	0.93	46.93	5.17	0.517	0.267
4	42	90	0.9	42.9	-4	45	67	0.67	45.67	2.77	0.277	0.076
2	42	21	0.21	42.21	-2	45	33	0.33	45.33	3.11	0.311	0.0973

6.1 Data Plotting

Table 2: Data For Graph Plotting

x	y	slope	intercept	Ycal
20	0.595	0.027321	0.047466	0.593890909
18	0.519			0.53924848476
16	0.474			0.48460606052
14	0.422			0.42996363628
12	0.38			0.37532121204
10	0.351			0.3206787878
8	0.299			0.26603636356
6	0.267			0.21139393932
4	0.076			0.15675151508
2	0.097			0.10210909084



7 CALCULATIONS

Least count for vernier of microscope $= 0.01m = 0.001cm$

From Excel sheet, slope: $= \tan\theta = 0.027321$ cm^2 and $\lambda = \frac{\tan\theta}{4R} \Rightarrow$

$R = \frac{\tan\theta}{4\lambda} = \frac{0.027321\text{cm}^2}{4\times5893\times10^{-8}\text{ cm}} = 115.904$ cm

Log Error: R$= \frac{\tan\theta}{4\lambda} \Rightarrow \log R = \log\tan\theta - \log 4 - \log(\lambda)$

$$\Rightarrow \frac{\Delta R}{R} = \frac{\Delta\tan\theta}{\tan\theta}$$

but

$$\frac{\Delta \tan\theta}{\tan\theta} = \frac{\Delta PQ}{PQ} + \frac{\Delta QR}{QR}$$

$\Delta PQ = 2\times$(least count of y axis)$= 2 \times 0.0025 = 0.0050$ cm^2

$\Delta QR = 2 \times$ (least count of x-axis) $= 2 \times 0.1 = 0.2$

$PQ = (0.400 - 0.277) = 0.123\text{cm}^2$

$QR = (13 - 8.28) = 4.72$

$\therefore \frac{\Delta \tan\theta}{\tan 0} = \frac{0.0050}{0.123} + \frac{0.1}{4.72} = 0.0406 + 0.0211 = 0.0617$

and $\frac{\triangle R}{R} = \frac{\Delta \tan\theta}{\tan\theta} = 0.0617\text{cm}$

8 RESULT

Radius of curvature of plano convex lens is (115.904 ± 0.061) cm