



A Low-Cost experimental setup for quick formation of Newton's Rings

M. Venkata Ramana and Y.Vijayakumar

Department of Physics, Anurag University, Venkatapur, Hyderabad -500088, India.

Abstract

This paper deals with a low-cost experimental setup for the instantaneous formation of the Newton's Rings, an under-graduate laboratory experiment. A card board module is designed to facilitate the much needed glass plate to be kept at 45° . This module is tested with 124 students and 11 faculty members and has taken time varying from 1 min to 3 min for the complete formation of rings from scratch.

Introduction

Newton's Rings experiment is a basic undergraduate experiment for the demonstration of Interference of light. This experiment was included as a laboratory exercise in all most all the courses that are related to the optics in Under-graduate Physics programmes. This experiment has been in syllabus and examinations for the last few decades. However most of the students and teachers feel there is a lot of difficulty involved in the formation of the Newton's Rings. Various scientific companies have come up with different experimental set-ups for easy formation of these rings. As a slight disturbance in these setups, like rotation of any of the screws that these set-ups contain, moves away these rings away from the field of view, to spend a large amount of time has become a common practice in performing this experiment. It is not exaggerating to say that, sometimes even the time slot allotted for the lab duration is not sufficient for the formation of rings and the students have to postpone the experiment for the next slot. In order to avoid such complexity in performing the experiment, a low-cost experimental setup for quick formation, almost instantaneous formation, of Newton's Rings with the use of conventional equipment and newly designed and developed accessory is presented here.

Theory

The theory involved in the formation of Newton's rings was discussed by many authors in their Under-graduate Physics text books. The reader is advised to refer any basic text book that deals with interference of light. Giasuddin Ahmad and Shahabuddin [1] has presented a simple and exhaustive theory in their book entitled "Practical Physics for Degree students". The complete derivation for path differences, condition for bright and dark rings and discussion over the size of the rings were presented by Venkata Ramana et al [2].

Experimental Details

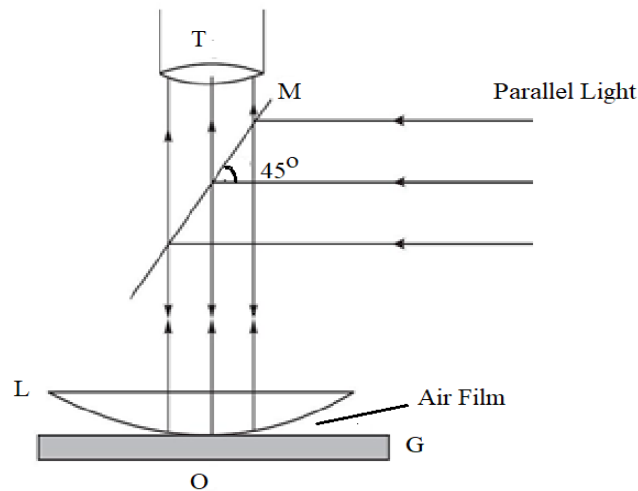


Fig.1. Experimental Setup used for Newton's Rings formation

The general experimental arrangement of the apparatus is shown in Fig.1. Light from an extended monochromatic source S (sodium lamp) falls on the glass plate G, inclined at an angle of 45° , and are reflected downwards normally on to a Plano-convex Lens and plane glass plate combination. The reflected and thus interfered beams are observed from the microscope to view the Newton's rings. In this the key aspect is placing the glass plate G at an angle of 45° and thus leading to the formation of Newton's rings.

In the present paper we report the experimental setup which we have developed with a simple design involving no cost.

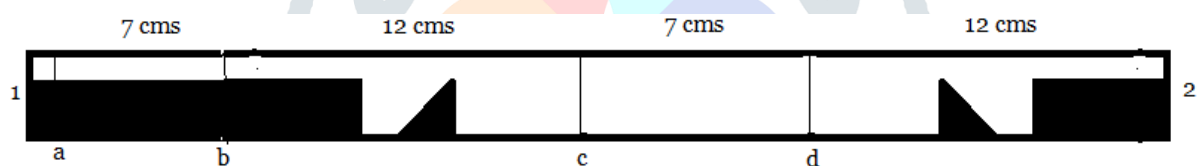


Fig.2. Card board cut to form a module to hold glass plate at 45°

A card board is cut the shape as shown in the figure.2. The right angled triangles shown in the figure have their two equal sides as 2.5cms. Then the card board was folded at four places (a,b,c,d) to form a rectangle, as shown in figure. The ends 1 and 2 are pinned together with the help of a stapler.

A glass plate of size 4cm x 9cm was placed on the slanted slot. This gives a bright field of view through microscope which even disappears the white dot in the bright background. After the final formation of the rings, this glass plate is glued to the card board., for repeated usage. The final arrangement of this cardboard module with glass plate and microscope is shown in figure 3.

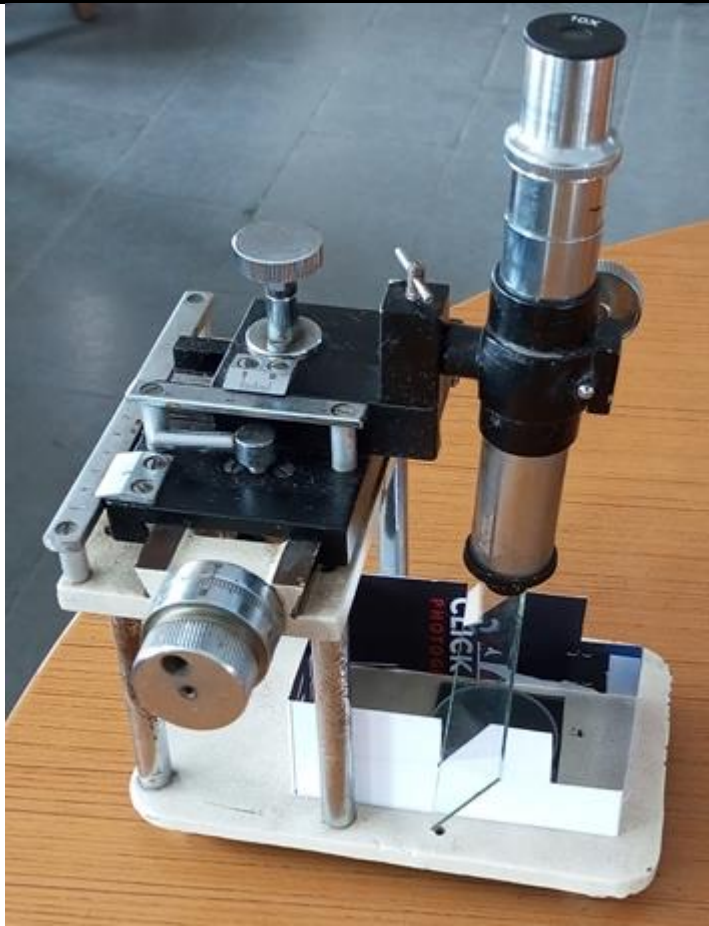


Fig.3. Final experimental setup along with the cardboard module.

Procedure for formation of the Rings.

The surfaces of the Plano-convex lens and the glass plates were cleaned with benzene by means of cotton.

The circular circumference of the plano-convex lens was drawn on a square shaped black paper whose side is equal to the diameter of the lens. A white dot with correcting fluid at the centre of the black paper.

This white dot is focussed with the help of microscope. A plane glass plate which is equal in size to the black paper is placed on the black paper. Slight adjustment will once again focusses the white spot. The plano-convex lens L is placed on it with convex surface touching the upper side of the glass plate, in such a way that the centre of the lens is exactly above the dot and is vertically below the microscope objective.

The whole cardboard module along with the glass plate in the slanted slot is placed around the lens and glass plate system. This gives a bright field of view through microscope which even disappears the white dot in the bright background. A slight upward movement of the eyepiece will make the rings appear in the field of view. In case the rings are formed slightly away from the centre of the field of view, the microscope or the lens-glass combination can be adjusted such that the centre of field of view and the centre of the ring pattern coincides.

Slight adjustments of the cardboard module in the form of rotation either clockwise or anticlockwise will give a contrasted pattern of Newton's Rings pattern, with bright and dark circular rings. The Newton rings thus obtained were presented in figure.4.

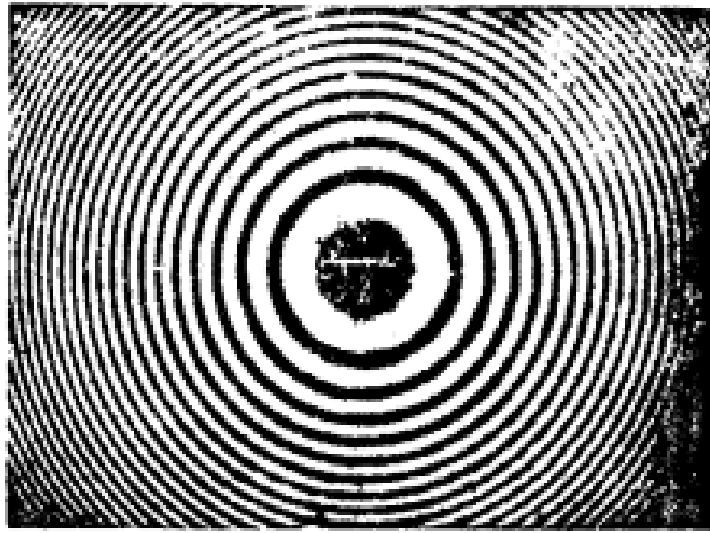


Fig.4. Newton's Rings Pattern formed with the cardboard module

Conclusions

A Low-Cost experimental setup for quick formation of Newton's rings was designed using card board and glass plate. The whole adjustment and the formation of the Newton's Rings using this card-board module can be done on an average between 1 minute to 3 minutes, as experimented over 124 students and 11 faculty members.

Acknowledgements

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References

1. Practical Physics for Degree students, Giasuddin Ahmad and Md.Shahabuddin ,Fourth edition, Hafeez Book Store, Dhaka, 1969.
2. Applied Physics for Engineering, Venkata Ramana.M, Srinivasa Reddy. M, Vijayakumar.Y and Sharmila R.Chaudhari, First edition, Nirali Prakashan, Pune, 2023.