PHYSICS LABORATORY

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Advanced Optics Lab

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January-April, 2013

Atul Singh Arora: *Physics Laboratory,* Advanced Optics Lab,

I don't have any specific talent. I am just passionately curious.

ACKNOWLEDGEMENTS

I express my sincere gratitude to our instructor Dr. Mandip Singh for guidance and providing an enjoyable laboratory experience.

I also thank Vivek Sagar (MS11017) and Prashansa Gupta (MS11021) for their valuable contribution to this report as my team members, who made the task of performing experiments immensely comfortable and productive at the same time.

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ACRONYMS

1 MICHELSON INTERFEROMETER

January 8 and 19, 2012

1.1 AIM

To determine

1. the average wavelength of a monochromatic source
2. the seperation in wavelength of a dichromatic source

1.2 THEORY

The theory given in the manual is roughly sufficient. Finer points have been discussed here. We start with posing some questions and then discuss them to develop a better understanding of the subject.

1. What is the wavefront of the waves after they go through a diffuser?
2. Can the interference pattern be obtained without the diffuser? How does the diffuser help?
3. When the average distance of the mirrors from the partly reflecting mirror is higher, why is it harder to get circular fringes
4. Why are the fringes circular? Explain using Huygen's principle (the ray optic method is rather simple).
5. Are the fringes real or virtual?
6. If the light source was in fact a point source, what type of an interference pattern will you obtain? (courtesy sir)
7. In a typical YDSE setup, if we don't use a screen, are we expected to observe fringes?
8. How can we span all angles using just two knobs in the mirror?
9. Can you apply the idea of beats to explain the increase decrease of contrast?
10. What is the expected pattern for a plain wavefront?
11. For a plain wavefront, when a 'dark' pattern is obtained (you'll know once you solve the previous question), where does the energy of the electromagnetic wave disappear? (sir asked this)

1.2.1 *'Practical' Theory*

Some more questions whose answers become clear after playing with the apparatus for sufficiently long

1. What causes the backlash error primarily in

1.3 PROCEDURE

1.3.1 *Obtaining the ring*

It is assumed that you've setup the michelson interferometer in accordance with the diagram in Jenkins White.

1. Move the coarsely moveable mirror to (roughly) the smallest distance from the beam splitter.
2. Now move the other mirror to a slightly larger (you can use smaller also, but then the steps would change correspondingly) distance from the beam splitter, than that of the coarsely movable mirror.
3. Ensure that the pin hole disk is being used.
4. Align the mirror using the three screws provided such that all the four spots coincide (you can choose to look directly without the telescope; in fact that works better usually).
5. Now remove the pin hole disk from the view and put the diffuser (if not already present).
6. Move the moveable mirror at most four times using the coarse movement drum (ensure the movement knob is unlocked) until the fringe pattern is observed. If the pattern is too dense (more than roughly 15 fringes), then follow from the mirror alignment step.
7. Assuming you have roughly 10 fringes at this stage, you now need to bring the centre of the rings into view (if it is already, you're running on beginner's luck).
    a) There are two screws on the mirror and they can roughly be thought of as adjusting the X and Y offset.
    b) You'll know you're on the right track if the fringes magnify as you adjust
    c) Note that you must leave the knob to know where it really is. Simply holding it also causes the position of the knob to change.

8. If you want further magnification, you can continue rotating and aligning the centre as you go if the need be.

CAVEAT: For certain path differences, the contrast will become very low (as is clear from theory); don't panic.

1.3.2 *Finding* $\lambda_{average}$

Assuming you have obtained the ring already;

1. Set the movement to fine using the lock knob on the apparatus.
2. Place the telescope if you haven't done that already, such that one of the rings is just at the cross-wire.
3. Move the fine rotation knob until the fringes just start to move.
4. Now keep track of the rotations and count 20 fringes as they cross the cross-wire.
5. Repeat this to get sufficient observations

1.3.3 *Finding* $\lambda_{separation}$

Assuming you've obtained the ring;

1. Lock the movement to fine using the lock knob
2. Move the fine rotation until all the fringes disappear and just begin to appear
3. Note the position at this point
4. Now continue rotating the knob until the fringes disappear again and just begin to appear
5. Note this position again
6. Repeat this to get sufficient observations

COLOPHON

This document was typeset using the typographical look-and-feel `classicthesis` developed by André Miede, for LaTeX.
The style was inspired by Robert Bringhurst's seminal book on typography "*The Elements of Typographic Style*".

The latest version of this document is available online at:

https://github.com/toAtulArora/IISER_repo