The Laboratory

Two-Point Source Interference Lab
Teacher's Guide

Topic:

Light and Color

The following information is provided to the student:

> **Question:**
> What are the limitations of the two methods of calculating the wavelength of light from an interference pattern?
>
> **Purpose:**
> To analyze a two-point source interference pattern using both the path difference equation and Young's equation and to compare the effectiveness of each equation in determining the wavelength.
>
> A complete lab write-up includes a Title, a Purpose, a Data section, and a Conclusion/Discussion. The Data section should include the provided diagram and data table; work should be clearly shown and labeled for the couple of calculations which are performed. The Conclusion/Discussion should include a description of your results and a comparison of the calculated wavelengths with the measured wavelength. Comments should be made about which method (equation) is most effective; the evidence for your comments should be discussed.

Materials Required:

Two Point Source Interference Pattern (provided in a separate file); metric ruler.

Description of Procedure:

Students are given a two point source interference pattern to analyze. They draw a line down the center of the pattern - the central antinodal line. They mark a point along this line a significant distance from the sources. They draw a second line perpendicular to the central antinodal line to represent *the screen* upon which the two point source interference pattern is projected. They select a second point at the location where the first antinodal line intersects *the screen*. This point on the first antinodal line is labeled as **P**. Students then use a metric ruler to measure y, d, L, S_1P and S_2P. Finally, they use the metric ruler to measure the wavelength of the waves on the pattern. Two equations - the path difference equation and Young's equation - are used to calculate the wavelength based on the measured quantities.

Alternative Materials and Procedure:

If a ripple tank and accompanying equipment is available, consider demonstrating the production of the pattern by two vibrating sources positioned at one end of the tank. Measurements can be made for the pattern and the same calculations can be performed.

Safety Concern:

There is always a higher than usual level of risk associated with working in a science lab. Teachers should be aware of this and take the necessary precautions to insure that the working environment is as safe as possible. Student *horseplay* and off-task behaviors should not be tolerated.

Suggestions, Precautions, Notes:

The Laboratory

1. This lab should be used after the derivation or the discussion of Young's equation. The meaning of the variables should be clearly defined in order to allow students to analyze a pattern.
2. In the presentation of Young's equation, there is the assumption that L >>> y. This assumption is not fully met by the patterns provided for this lab. As such, the Young's equation calculation of wavelength may be in error compared to the calculation of wavelength from the path difference equation.
3. The wavelength of the waves can be measured (top table) by measuring the distance of 5 or 6 or 7 or ... complete waves along the bottom of the pattern. Caution students to select waves which are concentric about the same source and to measure the distance along a line which is directed radially out from the source.
4. In order to reduce copying of lab results from one student to another and to allow students a chance to analyze their own pattern, there is a collection of 12 patterns available for use in this lab. These patterns have been placed in a separate file.

    View separate file as a: PDF file   MS Word file

Auxiliary Materials:

The following page is provided to the student for completion and inclusion in the Data section of their lab notebook.

Tape the two tables below into the Data Section of your lab. You will also need to leave room in the Data section for a graphic to be handed out in class.

Pattern #	y (cm)	L (cm)	d (cm)	S_1P (cm)	S_2P (cm)	Ave. λ (meas.)

Show your work in the boxes below.

Pattern #	Measured PD from $|S_1P - S_2P|$	Calculated λ from $PD_{measured} = m\,\lambda$	Calculated λ from $\lambda = y\,d\,/\,m\,L$

Scoring Rubric:

L2.	Two-Point Source Analysis Lab	Score
____	Included, labeled and organized all parts of the lab report.	
____	Data section includes the provided graphic and the completed table.	____/____
	Calculations of wavelength are accurate; work is clearly shown for the two methods.	
____	Conclusion/Discussion describes the results of the analysis and compares the effectiveness of the two methods (equations) in calculating the wavelength. The more accurate method should be identified; evidence to support this conclusion is intelligently discussed.	

Connections to The Physics Classroom Tutorial:

The following readings are a suitable accompaniment to this lab:

The Laboratory

Connections to Minds on Physics Internet Modules:

There are no sublevels of Minds on Physics which pertain to the topic of two-point source interference.