CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)

Michael Kuhn; Spencer Price

Project Number

S1514

Project Title

Two Teens, a Laser, and a Garage: The Story of the Ten Dollar Interferometer

Abstract

Objectives/Goals

The question we are answering is: Is the wavelength that is emitted by our laser a constant. We are using a cheap, non-professional laser, to find out if the quality of the laser affects the constancy of the laser. We have hyposthsized that becuase of the low-grade construction, there will be variations in the wavelength of the laser beam.

Methods/Materials

We are using a Michealson/Morley interferometer in order to prove or disprove our hypothesis. This requires anti-vibration support structure with a metallic sheet on the top. On magnetic blocks, are the components of the interferometer. The laser is shot through a beam splitter, reflected off mirrors, back through the beam splitter, through a diverging lens, which amplifies an interference pattern on to a screen. When the two beams are in-sync, there will be only one interference pattern, but when one mirror is moved, the beams are out of sync, and a second interfernce pattern will appear. By plotting the movement of one mirror against the seperation between the two interference pattern, we can form a sine wave. Whenever this sine wave crosses the X axis, there is only one interference pattern, at the maximums, the second interference pattern is to the right of the center pattern, the minimums represent a second interference pattern that is to the left of the center pattern. By measuring the maximums, minimums and x-intercepts, we can find out if the wavelength is constant.

Results

Our results showed us very clearly the the x-intercepts were evenly spaced, and that the minimums and maximums havve the same Y value every time that they occur.

Conclusions/Discussion

From this data, we can conclude that the wavelength of light emitted from our laser is a constant. We can conclude this becuase interference can be looked at as two beams of light traveling through the same cartesian plane, as a sine wave. One interfernce pattern is viewed when only one sine wave can be seen on the cartesian plane. When one beam is shifted laterally, two beams can now be seen, criss-crossing. By proving that the x-intercepts are evenly spaced, we have proven that only one beam on the cartesian plane can be seen when one beam is moved a certain constant distance. By proving the the minimums and maxiumums are the same, whenever they occur, we can say that the crests and troughs of the wavelength are constant as well. Thus, we have proved a constant laser beam.

Summary Statement

We use a Michealson/Morley interferometer to figure out whether light from our laser is constant or variable.

Help Received

Used lab equipment from University of California at Santa Barbara in our garage, supervised by Dr. Mark Sherwin