CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

Clement J. Decker

Project Number

S1706

Project Title

Comparing Quantum and Classical Explanations for the Non-Interference of Orthogonally Polarized Beams

Abstract

Objectives/Goals

Determine whether the patterns produced by orthogonally polarized waves sent through a double-slit apparatus are examples of quantum or classical phenomena.

Methods/Materials

A Vernier diffraction apparatus is used for this experiment. The slit width was 0.08 mm and the distance between slits was 0.5 mm. The laser used had the wavelength 636 nm. To destroy interference, two polarizers with respectively orthogonal axes were placed after the slits. In a second experiment, a polarizer with an axis of 45 degrees to the horizontal was placed after the initial polarizers. A third experiment utilized two polarizers whose axes differed by 45 degrees placed after the slits. Using Logger Pro Software, data were recorded on a computer.

Results

In the first experiment, double-slit slit interference was destroyed while single-slit diffraction patterns were observed. In the second experiment, double-slit interference was restored. Furthermore, the origin of interference was calculated to be the slits. In the third experiment, the intensities of the patterns were too dim to provide conclusive data.

Conclusions/Discussion

The result of the first experiment suggests a quantum explanation. This is because the slits were calculated to be the origin of interference. However, it should be noted that the results may also be explained by classical mechanics. The second experiment suggests evidence of classical phenomena. This is because according to quantum mechanics, when which-path information is available the wave-function collapses and the light should not diffract. From the last experiment, no conclusive data are available. Thus, it is necessary to do more research to provide more conclusive results.

Summary Statement

My project investigated whether the patterns produced by orthogonally polarized beams sent through a double-slit apparatus were more accurately explained by quantum or classical mechanics

Help Received

Used lab equipment at LMU thanks to Dr. Michael Berg, Dr. Jeff Sanny, and Mr. Anatole Hoemk. Dad helped throughout and Dr. Randy Friedl and Dr. Jeff Sanny helped edit my abstract.