CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

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Project Number

S1602

Project Title

Underwater Interferometric Seismometer

Abstract

Objectives/Goals

In recent years, due to the great strides in nanotechnology and other fields, it has become a priority to measure microscopic distances. This project was designed to enhance the effectiveness of an interferometer, a device used to measure such distances, with a simple and inexpensive method.

Methods/Materials

A Michelson interferometer was assembled using a 532 nm wavelength green laser, a steel frame, two 50/50 cube beamsplitters, two 25 mm radius mirrors, a 25 mm square mirror, two 22 mm diverging lenses with a -15 mm focal length, and a large reflector. A measurement system was assembled using two photodetectors, two amplifiers, and a data acquisition unit. For each test one mirror was submerged in a liquid, and one mirror was left above the liquid to act as a control. The amount of light shining on the photodetectors was recorded in 0.5 second intervals for each test. This would record any lines of darkness called #fringes# that pass over the photodetectors. The first test was a control to determine if the 2 mirrors had the same sensitivity. The following 5 tests involved submerging the test mirror in 5 different liquids. The data was saved in a spreadsheet format and copied to a computer where it was put through a series of calculations to determine the average amount of time it takes each fringe to pass over the photodetector.

Results

After the data was adjusted for the 12.7% difference in the control test, the first test where the test mirror was submerged in water, there was a 6.9% increase from the reference mirror and the test mirror. In the second test (Karo syrup), there was a 15.8% increase from the reference mirror and the test mirror. In the third test (mineral oil), there was a 18.6% increase from the reference mirror to the test mirror. In the fourth test (olive oil), there was a 9.5% increase from the reference mirror to the test mirror. In the fifth test (methyl alcohol), there was a 27.9% increase from the reference mirror to the test mirror.

Conclusions/Discussion

Overall, the data did support the hypothesis. Submerging the reference mass of an interferometer in liquid showed up to a 28% increase in sensitivity. Some sources of error that may have altered the results of this experiment include vibrations that were not in the center of gravity of the 2 mirrors and the lid used to halt vibrations on the surface of the liquid may have bumped the mirrors and caused them to vibrate.

Summary Statement

To study of the effect of submerging the reference mass of an interferometer in optically clear liquids

Help Received

Father helped with welding, buying parts, and epoxy for construction of interferometer