What Environmental Effects Can An Interferometer Detect?

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Abstract

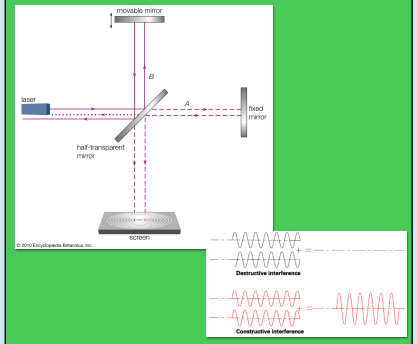
Interferometers are instruments which have been used for over a century. Interferometers exploit the wave nature of light by interfering two beams of light to display interference fringes. Interferometers are sensitive instruments used for measuring a wide range of effects.

Interferometers can be as large as the 4km LIGO gravitational wave detectors, or as small as the one made here.

4km LIGO Interferometer in Richland, WA

Hypothesis

If you build an interferometer, then you can learn concepts in physics & optics by using it to detect motions & vibrations.



Interferometer & Interference

Set Up & Results

An interferometer was built on a fixed budget, and in a way which makes it easy to reuse.

Components Used:

1) Light source (laser pointer)
2) Beamsplitter
3) Two Mirrors
4) Mounts (fixed mirror mount, paper clip, magnets, etc.)
5) Steel platform

Additionally, a beam-expanding lens, photodetector, and oscilloscope were also used to view and analyze the interferometer output.

The interferometer was built several times, and this experience pointed out the importance of alignment. With the "paper clip mounts", some of the parts would drift. Also had to make there the angle was "just right" for the laser pointer.

With practice, a working interferometer was built, and interference fringes were repeatedly observed.

With the interferometer, we primarily focused on vibrational effects. It was very easy to observe motion by tapping on the interferometer platform, and by also bumping the table the interferometer was on. When the photodetector & oscilloscope were used we were able to visually see movements easer

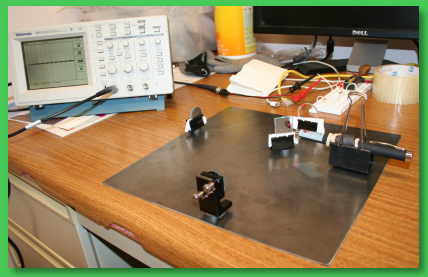
References

- http://www.ligo-wa.caltech.edu/teachers_corner/lessons/interferometer_9t12.pdf
- The Magnetic Michelson, Ewan Douglas, https://dcc.ligo.org/LIGO-T0900393-v1

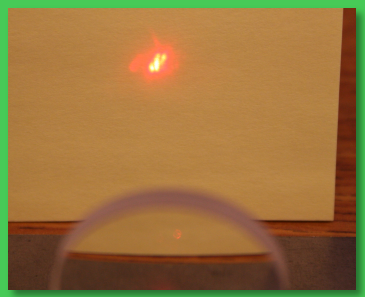
Conclusion

With an economical parts list, an interferometer was built. Building a working interferometer was not trivial. The adventure in building a functioning scientific instrument with components such as magnets, rubber bands, and paper clips was interesting.

A small interferometer could be used to detect local/close ground motion. To improve sensitivity, better mounts and more alignment practice would help.



Interferometer set up with oscilloscope



Interference Fringes!

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