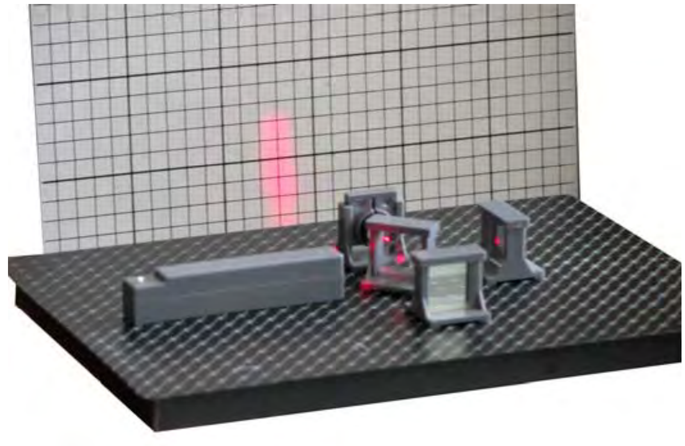
614-0200 (50-040) Michelson Interferometer



Introduction: for many years, it was believed by many scientists that the universe contained an "aether" which could be found between planets, stars and other bodies. This fluid was postulated as the medium light waves propagated through. In the 19th century, this idea became firmly entrenched in physics theories at that time, and numerous experiments were conducted to look for the aether.

In 1187 the now famous Michelson-Morely experiment took place. It was conducted by American physicists, Albert Michelson and Edward Morely. The premise was that as the earth moved through the aether, a measurable "aether wind" would be produced. At that time, it was thought that by measuring the speed of light on earth, it would be possible to detect the aether wind because of the small perturbations it would produce. To carry out this experiment, Michelson used a device of his own design, the interferometer. This used a coherent light source, two standard mirrors, a half silvered mirror, and an eyepiece. The half silvered mirror would reflect some light and allow some light to pass through it, which split an incoming light beam into two, at right angles to each other. These would be reflected by the two mirrors, converging on the eyepiece. As the two light beams collided, they would interfere with each other, causing bands of constructive interference separated by bands of destructive interference. In other words, the light would appear to be in stripes. The theory was that the aether wind would interfere with the light beams, causing small variations in the bands of light. These could then be observed and measured, yielding proof for the existence of the aether.

Today, the Michelson Morely experiment is sometimes called the "the most famous failed experiment." Although the interferometer was sensitive enough, it failed to detect any evidence for the aether. At first the device was blamed for this, but some scientists, including Albert Einstein, viewed this as evidence for the non-existence of the aether.

The interferometer is still useful today. It can be used for Fourier transform spectroscopy, as well as potentially sensing gravity. However, this application would require an interferometer millions of kilometers in size. An interesting application of the device is examining light radiating from stars, and looking for shifts in order to find orbiting planets.

Operation: your Michelson interferometer is a precision instrument. Although it lacks some of the features of the original, such as being floated on a lake of mercury, it is a close replica. You will notice a white detector sheet, a base, a laser generator, two mirrors, one half reflective mirror, an eyepiece, and a stand containing three rods.

To use, place the base on a table and set up the detector sheet about 30 cm away. You will notice the base contains markings. The + signs are precisely 1 cm apart, and the diagonal lines intersect them at a precise 45° angle. Set up the laser at the edge of the base. The half mirror should be placed a few centimeters away at right angles to the laser beam. You will notice how the beam splits into two separate ones after striking the half mirror. These two beams are at right angles to each other. Place the other two mirrors so that they reflect the split beam. After doing this, put the lens so that it is struck by the two reflected beams and focuses them onto the detector. To achieve the best results, fine-tune the projected image by slightly tweaking the angle of the two mirrors. The goal is an image with clear bands of light and dark.

After you have set up the interferometer, you can begin experimenting. First, observe the bands. They should be uniform and unchanging. Now, there are several ways you can affect the placement of the bands. One of the ways is to attach one of the mirrors to the stand and rod set. After getting the mirror in position, heat the rod. As it expands, you will notice that the placement of the light bands will change. By measuring the change you can determine how much the bar expanded. Try this for all three rods. Also, try using chalk dust or another colloid to diffuse the laser light. This is similar to the effects the aether would have on this experiment, albeit on a much larger scale.

Note: your laser generator is powered by one included AAA battery. This will need to be replaced after some time.

Warranty and Parts:
We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.

May we suggest:

654-0100 Light Measurement and Stellar Distance Kit: Light Measurement and Stellar Distance Kit Your students can now determine the luminosity of the sun using a 200-watt light bulb. They can explore the relationship between the apparent brightness of a luminous object and the distance to the object. Using a null photometer constructed from paraffin and aluminum foil, a student can compare two light sources to determine the luminosity of — or the distance to — one of the sources. The photometer is then used to compare a 200-watt light bulb with the sun to estimate the sun's luminosity. The kit also contains a 1-foot length of .01-inch optical fiber that, when taped to a flashlight, becomes an "artificial star." With an output of one-millionth of a watt, this small source of light is compared to a star in the sky and the distance to the star can be estimated.

614-0105 Hands on Optics Kit: Students learn more about the wave nature of light. They visibly see the differences between ultraviolet, infrared and visible light by constructing a model of the electromagnetic spectrum. Students explore applications of infrared light through the use of television remote controls and an infrared thermometer. Ultraviolet beads are used to detect ultraviolet emissions from black lights. The module concludes with a series of activities where students explore various types of luminescence through fluorescent materials and minerals, glow sticks, and surprising substances that exhibit luminescence.

611-1615 Acrylic Refraction Rod: Use our precision machined Acrylic Rod to demonstrate how information travels along a fiber optic line. Show internal reflection around a loop, despite the fact that light travels in straight lines. A must for today's high technology world!

614-0701 Cylindrical Spectroscope: Metal teaching spectroscope. Great colors are produced by superior optics and highly accurate diffraction grating. View the spectral diffractions of various light sources and excited gasses. Includes focusing adjuster.