**Experiment 5: Michelson Interferometer**

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**Abstract**

The polarization of light is studied using combinations of linear polarizing films, reflective surfaces, and a quarter wave plate. To get quantitative data, a power meter is used to measure the amount of light being transmitted through a system. It’s found that reflected light is polarized in a plane along the traveling ray of light but perpendicular to the plane made by the incoming, refracted and reflected rays. When the orientation of incoming light is perpendicular to that of the polarized filter, light does not pass but using another filter in between can negate that effect. Quarter wave plates can be used to take polarized light and make it circularly rotate.

**Introduction**

A Michaelson Interferometer is an optical set up that allows for the measurement of a light’s wavelength. It allows this by splitting the beam of light in two, and directing each along separate optical arms of adjustable length before re-aligning them and sending them to some diagnostic where a diffraction pattern can be measured. However, a diffraction pattern is only discernable when there’s sufficient contrast between bright and dark areas referred to as fringes, and these fringes are a result of differing path lengths traveled by each of the two light components. When the optical path difference is equal to half of the light’s wavelength, the field contributions of one beam and the shifted one results in a cancellation, and a dark fringe appears. Note that in this lab, our eye was used as a diagnostic.

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lab, our eye served as our diagnostic.

In one axis, the mirror can be pivoted so that the beams are better aligned once re-combined. The other axis has a mirror at the end of it who’s position along its axis can be adjusted using a combination of lever and micrometer.

A Mercury [Hg] lamp was used as a light source with a known wavelength of 5461 Angstrom or 5.461\*10^-7 meters.

**Analysis & Discussion**

With the Mercury lamp as a source, an eye was placed at the exit of the interferometer and a diffraction pattern was seen though difficult to make out due to the fine spacing of the fringes. Adjusting the angle of one mirror allowed for centering of the zero-th order fringe.

The It was observed that as the mirror was moved in, shortening the optical length of that arm, the fringes moved toward the center: the opposite is true for moving the mirror in the other direction. At the value where the fringes appeared to neither move outward or inward is where we took the optical path length to be as close to zero as possible. This length was read out from the micrometer: 11.75 +- 0.5 um. It needs to be noted that—due to the mechanics of the lever which the micrometer moves to adjust the longitudinally mobile mirror—units read out from the micrometer need to be divided by 5 to get the true value: meaning that the true value is in fact 2.35 +- .1 um.

**Conclusion**

Reflected light off a surface has an angle at which it gets perfectly polarized. This effect was observed when viewing the reflection through a polarizing film and rotating it. Full cancellation of the light could be observed to happen 90 degrees from the angle of maximum transmission.

Light emitted from a laser in the lab was found to be polarized by using the same method as with the reflected light but using a meter which detected the lights power at the exit of the system. A plot of the data matched as well as could be expected to the theoretical equation with an R Squared value of 0.9972.

Just as orienting a polarizer perpendicular with an incoming wave will block all the light, this is assured with two polarizing films oriented at angles orthogonal to each other. Though some light can be expected to pass through when placing a third polarizer in-between, all light can be passed through the second when using a quarter wave plate as it’s effect is to circularly polarize the light. The maximum field amplitude of such light will reoccur at locations separated distances of integer wavelength.