I. EXPERIMENTAL DESIGN (A SUMMARY)

The experiment which was conducted sought to measure the speed of light (c) in three different ways. These methods measures c through through various mediums and to different ends. The first method implements a simple arrangement of a pulse generator, laser, mirror, and detector to analyze the phase shift of the signal and detected pulses through an oscilloscope effectively measuring c through air. The second method uses an identical arrangement with the exception of the mirror and instead implements a fiber optic cable to direct the light to the detector thus measuring c through the fiber material. The third and final method applies the pulse generator and oscilloscope in a similar fashion to a coaxial cable and variable resistor. By minimizing reflections seen through the cable through impedance matching with a variable resistor one can determine the impedance of the wire itself. Then by measuring the phase shift of the signal and reflection, the reduction in c due to the medium can be determined by comparing it to the propagation of light through a vacuum.

II. RESULTS AND ANALYSIS FOR THE SPEED OF LIGHT

For our measurement of c in air we find the value to be $3.0 \pm 0.3 \times 10^8$ m/s which is in agreement with the known value of 2.997×10^8 m/s. We derived this value by accounting for a measured instrumental lag time of 305±2 ns to produce a total travel time for the light of 33±3 ns. Then given that the distance traveled was 10.0 0.2 m determining the speed is quite simple. For c through the fiber optic cable we find the value to be $2.4 \pm 0.3 \times 10^8$ m/s given a traversal time and distance of 12.0±0.8 ns and 2.127±0.001 m respectively. This value then implies that the index of refraction for the the optical fiber is 1.67 ± 0.09 which falls in line with the expected, but approximate value of 1.5. When measuring c through the coaxial cable, it was found that the characteristic impedance of the cable was determined to be 100±2 ohms, where reflections are apparent for resistances which are both higher and lower than the characteristic impedance of the cable. The value of c through the coaxial cable was then determined to be $2.34 \pm 0.04 \times 10^8$ m/s which is equivalently $(0.78 \pm 0.01)c$ using a measured travel time of 2.600±0.004 μs and a known cable length of 1000 ft or 304.8 m.