Data Analysis

The difference in the distance traveled by each beam of light was measured along with the intensity of the individual and combined beams. These data then were fit to equation 1

$$r(L) = (A_{sum}/A)^2 = 4cos(aL)^2 \tag{1}$$

with,

$$a = v_o\pi/c \tag{2}$$

Where A_{sum} is the amplitude of the two summed waves, A is the amplitude of each individual wave, L is the difference in the distance traveled by the two beams of light, v_o is the modulated frequency ($2x10^7$ Hz) and c is the speed of light. The result of the non-linear fitting procedure and the raw data itself can be seen in figure 1. By finding the a that best fit the data, the experimental speed of light could be computed using equation 2. Error in this value was computed first by using the fitted model to find the statistical error in a, which was then added to the estimated systematic error. This was then propagated through equation 2 to find the error in c. This produced a speed of light equal to $3.025x10^8 \pm 0.007x10^8$. This method yielded results inconsistent with the known speed of light.The entire analysis was also run with data points 6, 8 and 9 removed, as these appeared to not fit the model. This new model and the data used can be seen in figure 2. However, since there was no observed experimental issue with these measurements, the first analysis is still valid. This method produced a speed of light equal to $3.02x10^8 \pm 0.02x10^8$ this method produced results that were inconsistent with the known speed of light.

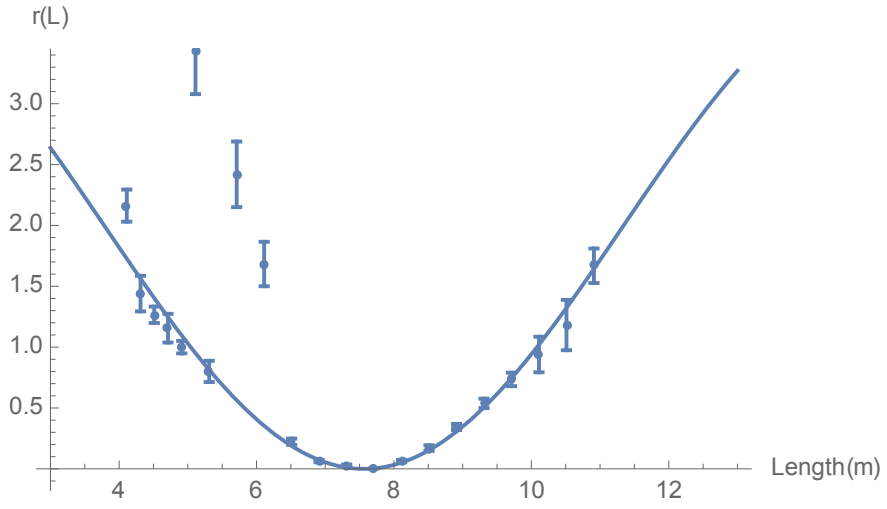

Figure 1: All the measured L values, respective r(L) values and errors. The fitted model can also be seen.

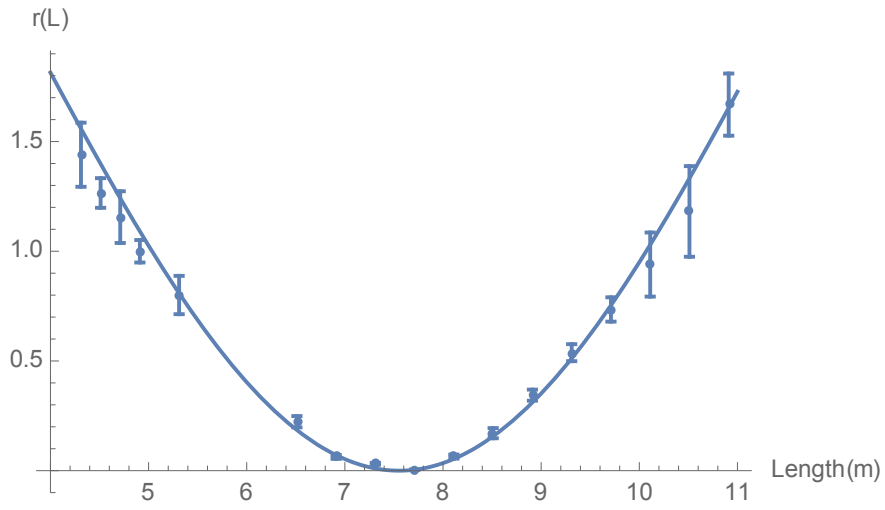

Figure 2: All the measured L values, respective r(L) values and errors for the model with removed outliers. The fitted model can also be seen.