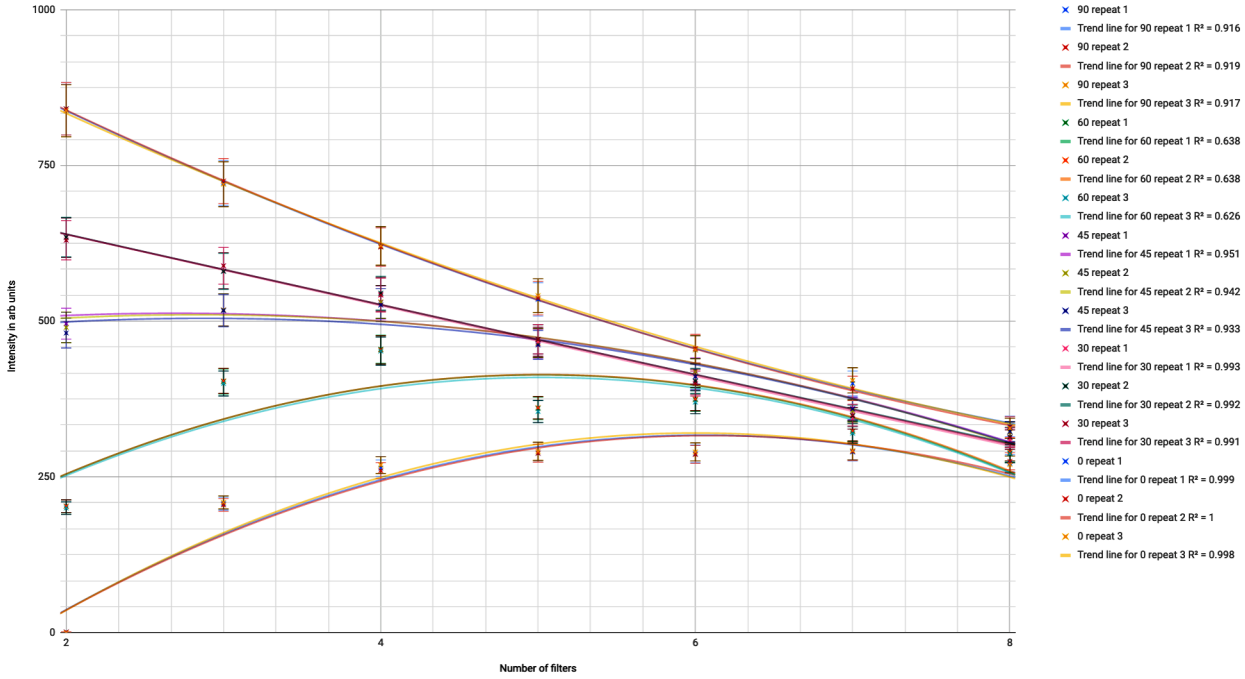
Experiment 3

Evaluation of Procedure

This method was considerably more complex than the other two experiments. Each filter had to be aligned with the calculated offset, stacked, and placed into position. This was easy for the larger angles (90 and 60 degrees), but as the total angle reduced, the intervals with higher numbers of filters became harder to accurately measure. When the total angle was 30 degrees, the intervals at 6-8 filters were too small to accurately measure. This will lead to some higher inaccuracies with smaller angles and more filters, which will have to be accounted for in the error bars.



Evaluation of Results

Three repeats were taken for each interval, each of which were plotted on the graph. I decided to plot all of the results on the same graph, in order to better evaluate them. Error bars were calculated by finding the average greatest deviation from the average over the range of results, which resulted in a 5% error range.

Again, there were no anomalous readings, so the lines of best fit were calculated for both. Due to the unknown relationship, polynomial curves were used. These fit most of readings, with acceptable coefficients for each angle, with the coefficients of determination mostly above 0.910, an acceptable level of accuracy.

However, the line of best fit for the 60 degrees results is noticeably worse than all of the other results, with coefficients of around 0.630. This is probably due to the use of a polynomial approximation of the line of best fit. After trying with a moving average, power series, exponential, and logarithmic approximation, none made any improvements with the coefficients of determination.

Analysis of Results

From these results, we can see how the two factors affecting the intensity combine. Firstly, there is the direct effect of increasing intensity by adding more filters between the same angle, reducing the angle between each filter and the next. Secondly, there is also the effect of decreasing intensity by adding more filters, where the neutral density of each filter decreases the intensity.

These two factors have different effects at different angles. At zero degrees, where there is no effect of polarisation, we see only the effect of the neutral density decreasing the intensity. So, we get a line of best fit of approximately a line.

At 90 degrees, we first see mainly the effect of the angle between each filter, so the curve initially has a positive gradient. Then, as the effect of decreasing the angle between each filter decreases, the gradient decreases to zero, and the neutral density effect of the filters takes over, and the intensity begins to decrease. So, we get a line of best fit of approximately a parabola.

At the angles between those, we see the effect differ. At smaller initial angles, the line of best fit is closer to being linear. At greater initial angles, the line of best fit is closer to being parabolic. Despite the poor coefficients of determination, the results at 60 degrees still follow this trend.

The graph below shows the results with the 5% error bars and equations of lines of best fit