Lab 3: January 21st, 2025

The goal of this session is to tune the interferometer to produce the bullseye circles as shown in the experiment description and online resources. To begin, a phone camera was setup on a stand to observe the light pattern coming out of the interferometer. A polarizing lens was placed in between lens 1 and lens 2 of the system and allowed to isolate the yellow spectrum of the neon light. The light pattern displayed is still parallel lines, therefore the next steps are to tune the interferometer.

Lens 1 and lens 2 were moved slightly such that the angle of incidence of light is completely normal to the front surfaces of the interferometer mirrors. After performing this, a bullseye pattern emerged, but only a vertical slit was visible to the camera. It was determined that the vertical slit behaviour comes from the first lens on the interferometer and its purpose is to only allow a certain threshold of wavelengths. This was determined by opening the slit and more colors of the neon spectrum were observed.

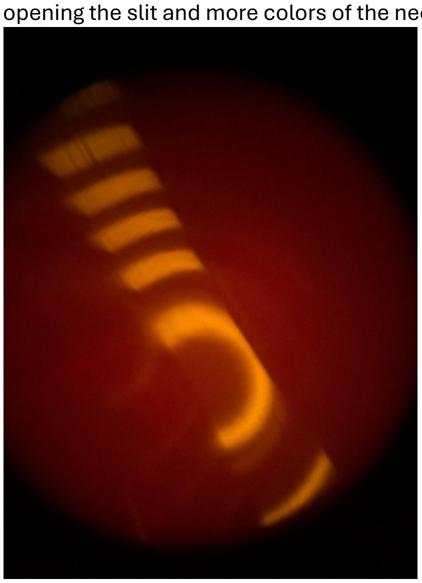

Figure 1: First bullseye pattern observed from the interferometer

For this experiment, the primary measurement is the distance from the π lines to the σ lines, thus the vertical slit is fine if the distance is measurable. The bullseye was centered by moving the lens of the interferometer. The magnetic field was turned on to test if the splitting of the Zeeman lines was observable and it was successful. They were determined to be normal Zeeman lines since they only split into the $\pm\sigma$ lines corresponding to $\pm m_l$ and the π line remained the at the same radius from the centre of the bullseye.

The camera was then set up and the magnets power supply was turned on to record data for Zeeman splitting. The current was varied beginning at 0A to its maximum of 0.80A in increments of 0.05A. At each increment, a photo was taken of the bullseye pattern and the Zeeman splitting was first observed at approximately 0.15A. This data was sent to the computer and uploaded to GitHub for analysis.

Table 1: Trials with supplied current to electromagnet and the recorded picture number.

Photo Number	Current [$\pm 0.005A$]
0	0.00
1	0.05
2	0.10
3	0.15
4	0.20
5	0.25
6	0.30
7	0.35
8	0.40
9	0.45
10	0.50
11	0.55
12	0.60
13	0.65
14	0.70
15	0.75
16	0.80

A python code using OpenCv was started to analyze the images by first converting them to greyscale and then outputting a 2D array that categorized each pixel with a corresponding intensity. Code was also created to rotate and zoom into each image to be able to discern the clearest line through.

After rotating the image and turning to gray scale, the following image was the output.

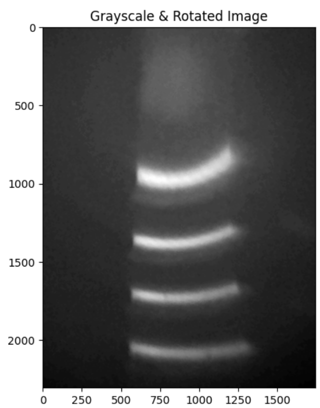

Figure 2: Grayscale and rotated image of bottom portion of bullseye pattern with zero magnetic field applied

To determine the location of the peaks, a plot was created of a vertical line on the grayscale image vs. pixel intensity that clearly shows the location of the peaks in the data and their relative separation.

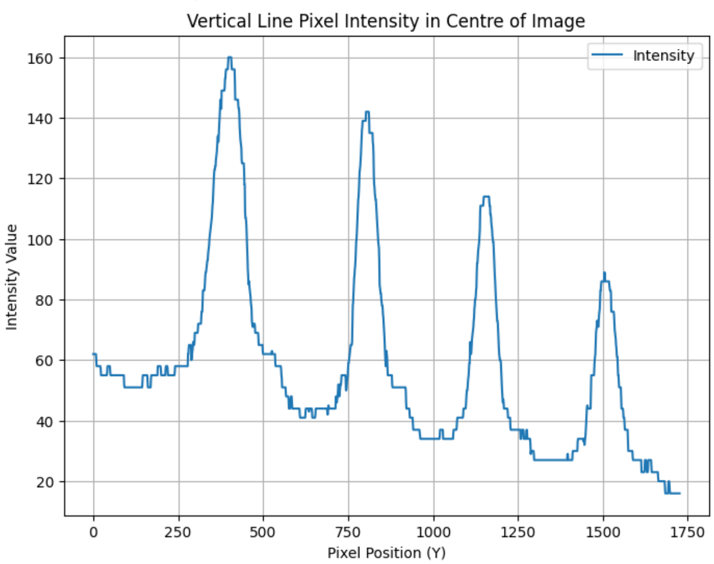

Figure 3: Pixel intensity of a vertical line of the processed grayscale and rotated image displaying the locations of the rings in the bullseye pattern