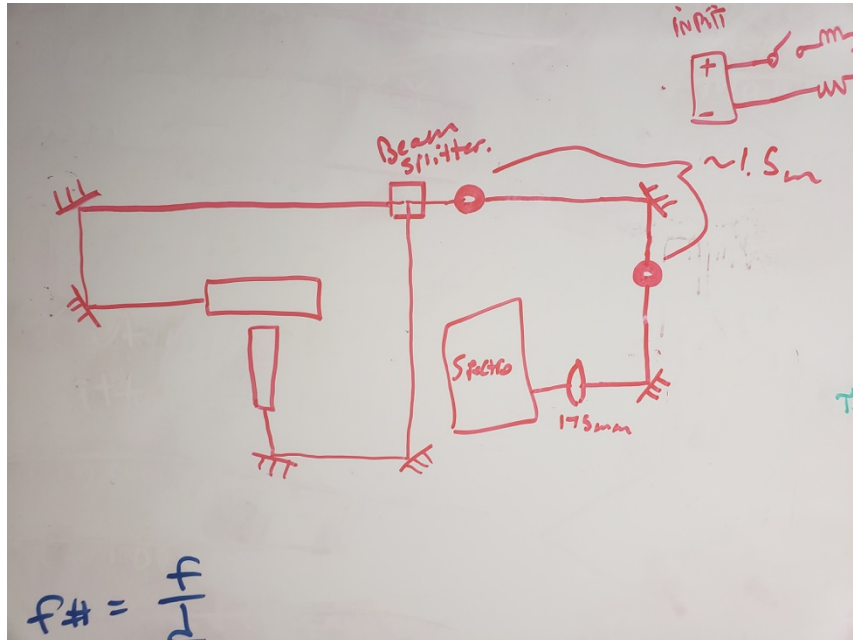


Journal for Fall Spectrometer Project

- Set up red HeNe and green HeNe to couple into spectrometer for calibration. Setup shown below:



- Chose 175mm lens to ~fit specified $f/7$ $f\#$. Diameter of lenses are 25.4mm
- Using Equation:

$$W_f = \frac{\lambda f}{\pi W_0} \quad W_0 \sim 0.38\text{mm (Radius) So } W_f \text{ needs to be multiplied by 2 in final calculation}$$

$$W_f \times 2 = 1.856 \times 10^{-4}\text{m}$$

12.5microns/step for slit -> ~15 steps for slit to be opened.

Order of scan: green-red

- Ran scans multiple times to find peaks. Ran scans from 104350 to 156525 in increments of 11 steps, entrance slit=2, and exit slit=30 or 40.

Peaks appear at data points 2369 and 4318 each time.

$$2369 \times 11 = 26,059 \text{ steps from start} = \text{position } 130,409$$

$4318 \times 11 = 47,498$ steps from start = position 151,848

- Now, going to run scan with 1 increment steps near those positions to confirm...

Green:

1st attempt: 130,309-130,509, increments of 1, entrance at 2, exit at 30, integration 4, gain 10.

Result: Data is slightly off from the expected 130,409 mark, actually appears at 130,389.

2nd attempt: Same parameters as above.

Result: Data, again, slightly off from expected 130,409 mark, actually appears at 130,392

Red:

1st attempt: 151,748-151,948, increments of 1, entrance at 2, exit at 30, integration 4, gain 10

Result: Data is slightly off from expected 151,848 mark, actually appears at 151,835.

2nd attempt: Same parameters as above

Result: Data, again, slightly off from expected 151,848 mark, actually appears at 151,835

- Attempting to find ghost peak (?) observed earlier:

1st attempt: 0-130,309, increments of 27, entrance at 2, exit at 30, integration 4, gain 10
Result: Nothing stood out in the data! Yay!

2nd attempt: Same parameters. Physically watched this time.

Result: Nothing in the data except at the beginning, A full reflection of the whole beam appears near 0. Going to run it again to see where it falls off and that will be the limit!

3rd attempt: 0-5000, increments of 1, entrance at 2, exit at 30, integration at 4, gain 10
Result: Get noise (medium level intensity values) up until about 45. Would suggest limiting to ~70 or so

Available Range: 70-208705

632.8nm peaks at 151,835

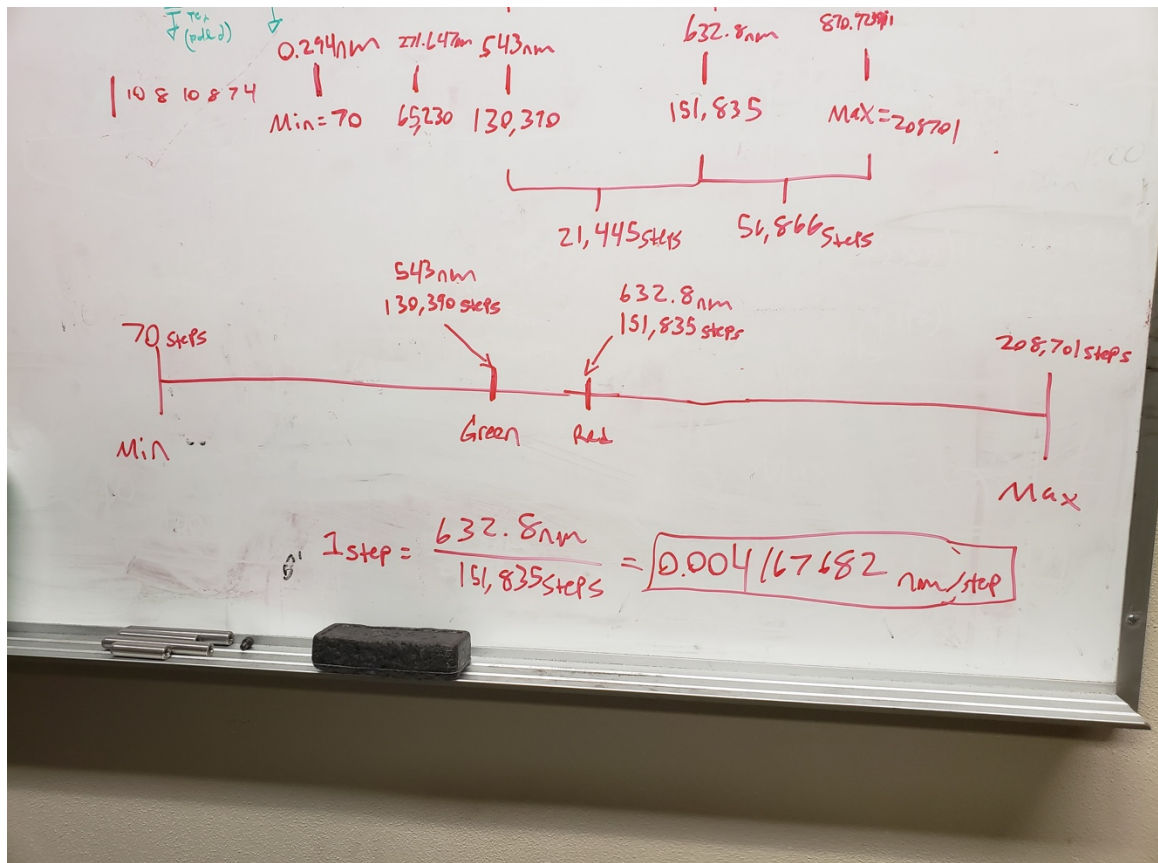
543nm peaks at 130,390 or so...

- Attempting to find max step the device can achieve...

1st attempt: 203701-208701, increments of 1, entrance at 2, exit at 30, integration at 4, gain 10.

Result: No hiccups in the data. Should be able to read up to 208,701 steps

- In calibration, tried to take the difference between the red and green peaks to calculate the step size, however, it didn't line up well with the actual values and step sizes. Instead, the value obtained from dividing the 632.8nm wavelength by its step position, gave a better representation of the actual values. Here is the calibration data:



Step size = $632.8 \text{ nm} / 151,835 = 0.004167682 \text{ nm}$

Minimum wavelength = $(632.8 / 151,835) * 70 = 0.2917377416 \text{ nm}$

Maximum wavelength = $(632.8 / 151,835) * 208,701 = 869.7994059341 \text{ nm}$

- Attempted to calculate step size according to the manual:

From manual: 1200lines/mm grating = 0.00625nm step size
300lines/mm grating = 0.025nm step size

We are using an 1800lines/mm grating

$$(1200\text{lines/mm}) \cdot (0.00625\text{nm}) = (300\text{lines/mm}) \cdot (x) \rightarrow x=0.025\text{nm}$$

$$(1200\text{lines/mm}) \cdot (0.00625\text{nm}) = (1800\text{lines/mm}) \cdot (x) \rightarrow x=0.0041666667\text{nm/step}$$

For the other grating we have (600lines/mm):

$$(1200\text{lines/mm}) \cdot (0.00625\text{nm}) = (600\text{lines/mm}) \cdot (x) \rightarrow x=0.0125\text{ nm/step}$$

1800 lines/mm grating (Default) \rightarrow 0.0041666667nm/step

600 lines/mm grating \rightarrow 0.0125nm/step

1800 lines/mm grating step size was basically confirmed in our data. We had calculated 0.004167682nm/step!

- To test this, I am going to test each beam 1 at a time.

$$0.0041666667 \cdot x = 632.8\text{nm}$$

$x=151,872$ steps \rightarrow This is where the red beam should occur

Running scan for red at 632.8nm (should appear at 151,872 steps.

1st attempt: 149,872-153,872, 1 step increments, entrance at 2, exit at 30, integration 4, gain 10. Expect to see peak at about point 2000

Result: Peak appears at 1959...Corresponding to step number 151,831 = 632.6292nm

$$0.0041666667 \cdot x = 543\text{nm}$$

$x=130,320$ steps \rightarrow This is where the green beam should occur

1st attempt: 128,320-132,320, same parameters as above. Expect to see peak at about 2000.

Result: Peak appears at 2064...Corresponding to step number 130,384 = 543.2667nm

- Used wave measuring device to confirm that the beam is actually 632.83nm wavelength. Slightly off from measured 632.6292nm. Probably just some error in how beam is sent in. Going to ignore it and move on to GUI
- Measured grating to be the 76x76mm option. Means we need to be using an f/# of f/5.3 instead of the f/7 being used now. This could have caused the error in the measurement because the mirror may not be getting filled completely.