Co-op Presentation

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July 1, 2025 – December 19, 2025

Agenda

- Spectrometer Quality Control
  - Software
  - Hardware
- Lower-Level Laser Quality Control
  - LIV Measurement
- Spectrometer Automation
  - CCD Image/Live plotting
  - Frontend/Spectrum Plot
  - Image Processing
- Documentation and Handoff
- Final Remarks

What is Raman spectroscopy?

- The act of shooting a laser at a substance to identify the vibrational modes of molecules
- Each molecule has a unique spectrum that acts as a fingerprint
- Can determine chemicals by matching this sample against known fingerprint
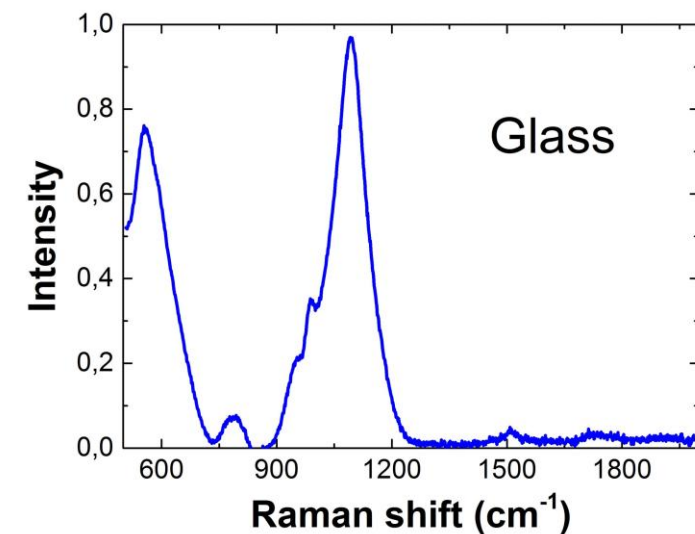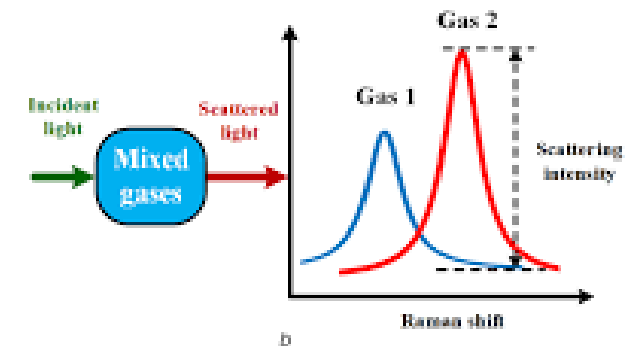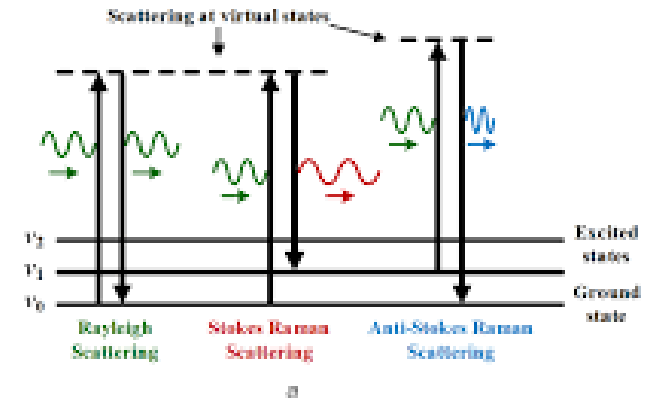
Spectrometer QC Software

- Design a QC app for spectrometers to ensure they are calibrated and have high throughput (input : output)

- Combined 4 different applications into 1 cutting time down by 35%

- Used Python and PySide6 library to create GUI app

- Created and deployed to production

- Graphed and analyzed live wavelength data from external hardware

- Data saving/managing using JSON
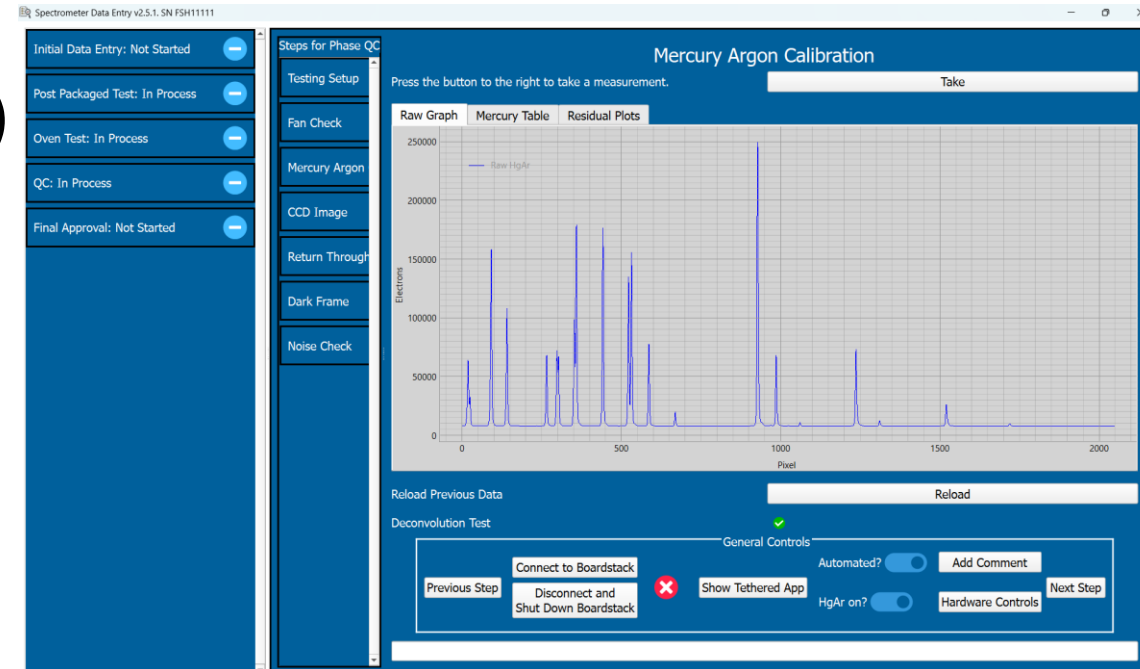
Spectrometer QC Hardware

- Built the board stack/chassy and wiring the station

- Found and reduced as much external noise as possible for accurate measurements

- Connected external MCU to output voltages for switching
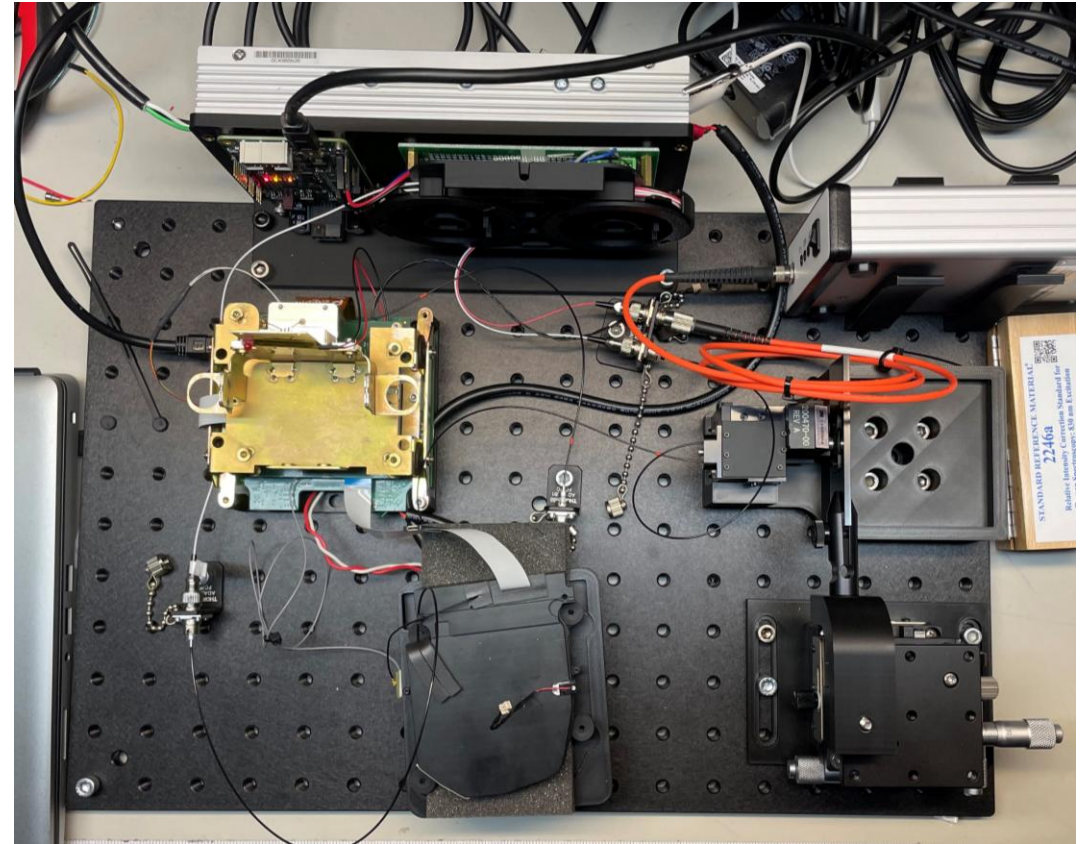
Lower-Level Laser

- Took LIV from 0 to 600 mA at incremental steps of 2 mA
- Created and deployed to production
- Stored/managed data as JSON
- Connected external power meter from ThorLabs
- Created QObject to connect GUI application to Arroyo instruments using serial communication
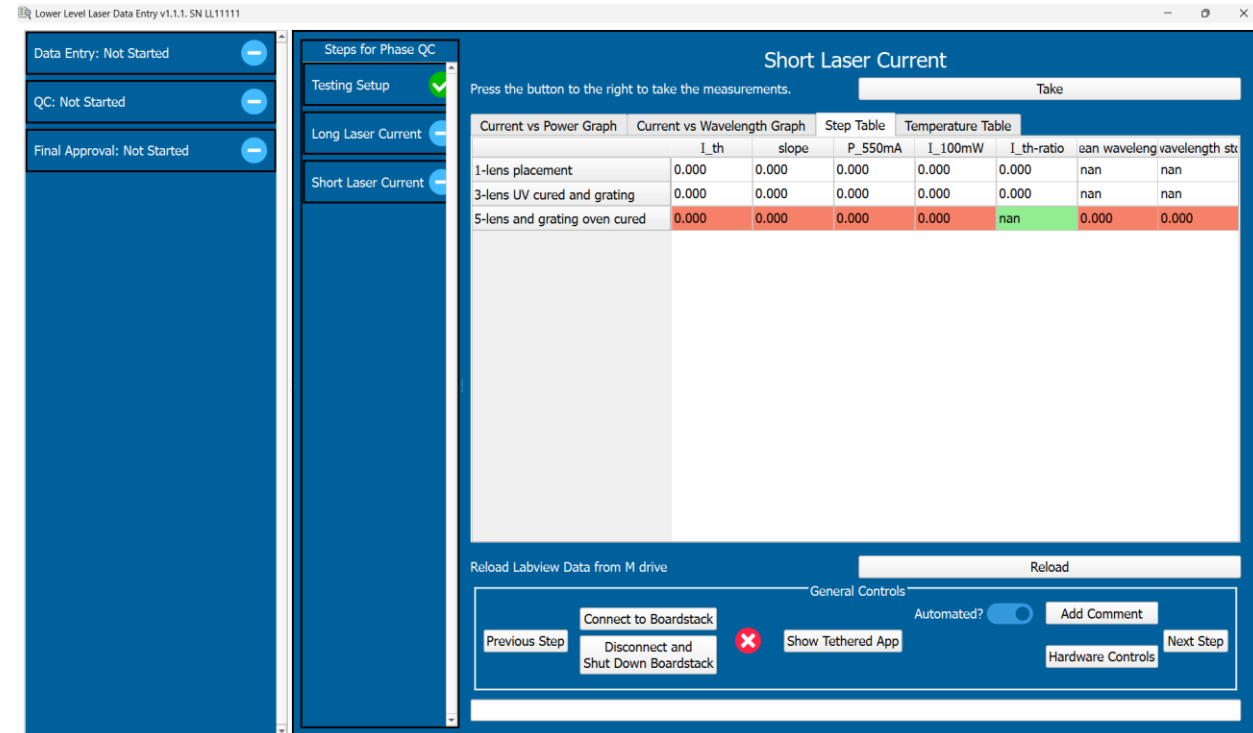
Spectrometer Automation

- Coded a 6-axis robot for automating manufacturing within .1 um tolerance

- Integrated external camera to view and capture live feed

- Displayed live data capture from CCD in 1D and 2D

- Designed a PCB to expand motor control in KiCAD

- Soldered PCBs, wired motors, sensors, limit switches, LEDs, and relays

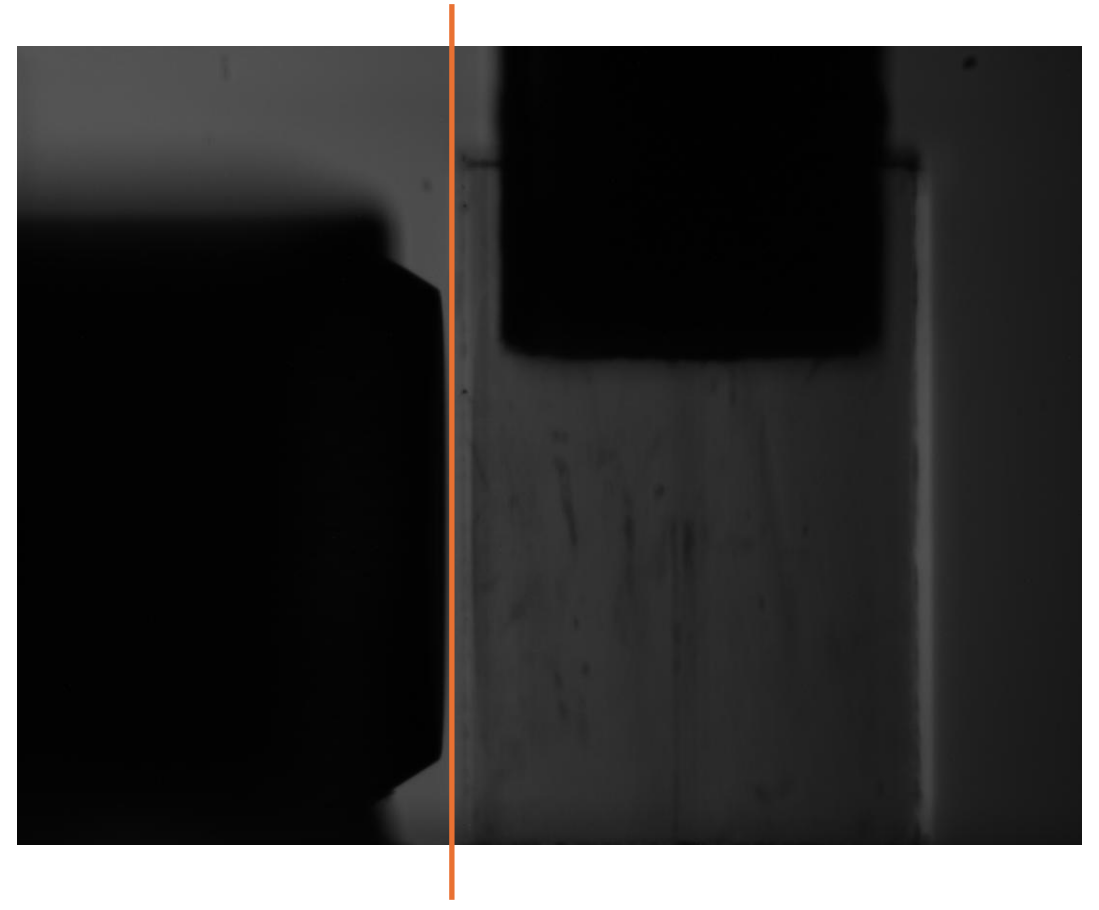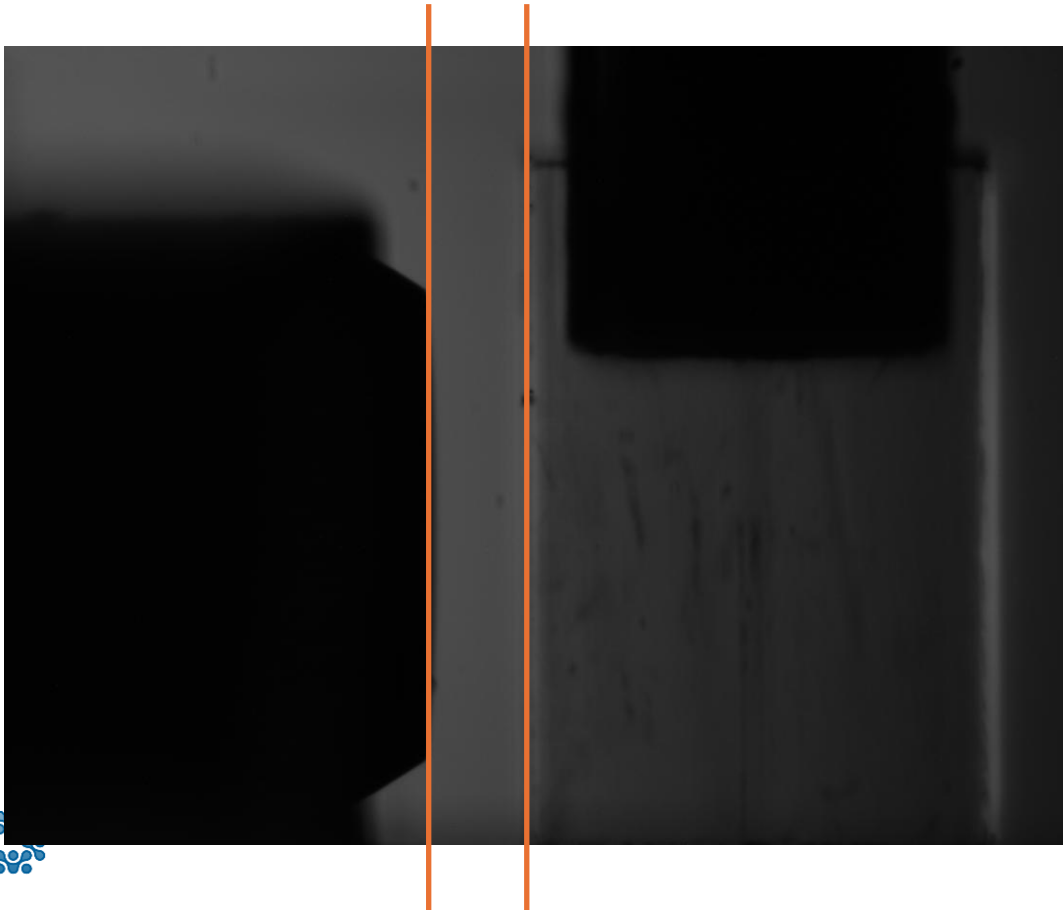- Used GitLab and Git to organize features into different branches

Spectrometer Automation

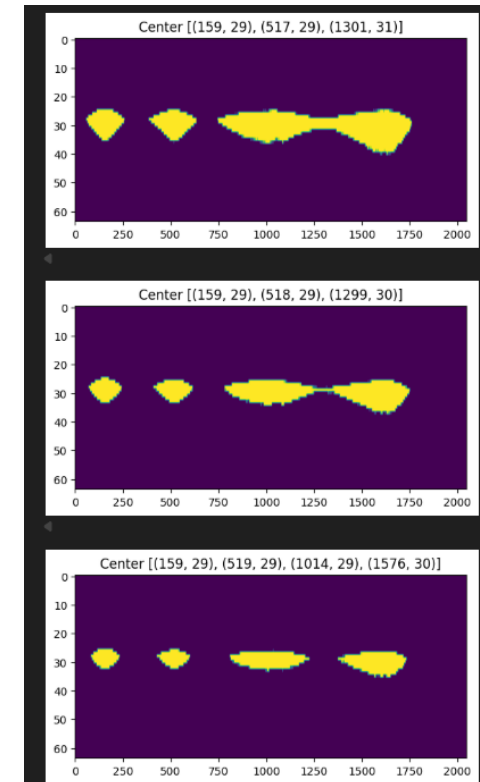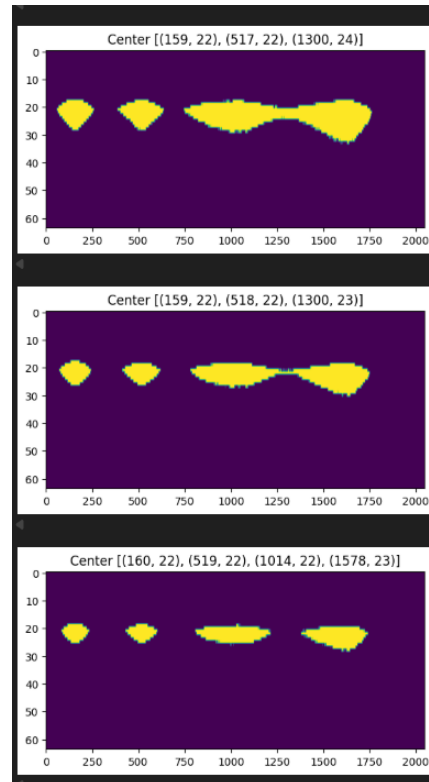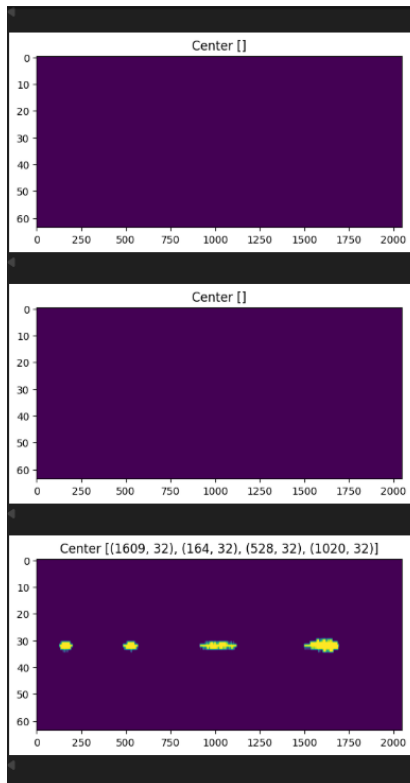- Displaying live data to align mercury argon peaks
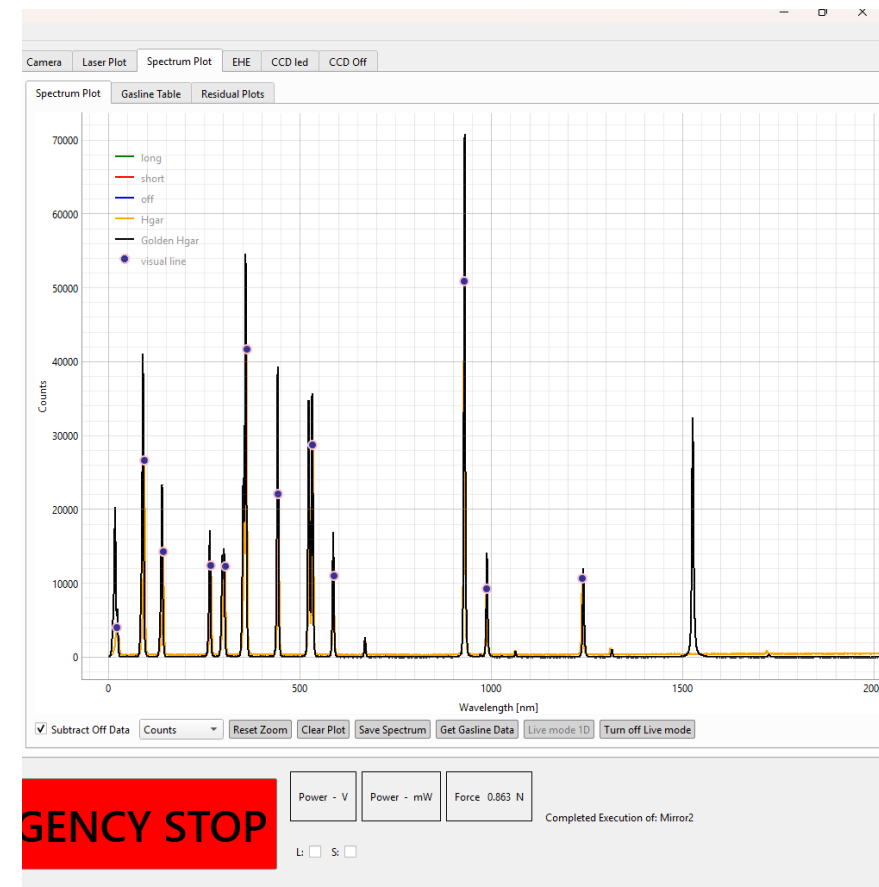
Improving Imaging Part 1

- Created image processing functions for unique components including edge detection, thresholding, and center of mass

Improving Imaging Part 2

- Developed auto thresholding methods to automatically change the thresholding to consistently find four blobs

Documentation and Handoff

- Created documentation for multiple automation stations
- Included detailed descriptions of each component with images
- Preparing the next co-op with information to allow fluid transition

Thank You!