Survey Spectroscopy in the Large Plasma Device (LAPD)

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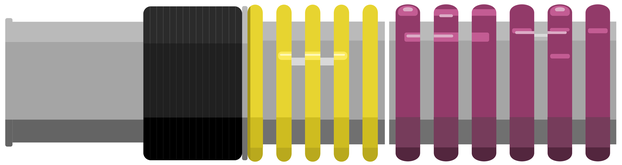
Summary

- Initial implementation of a survey spectrometer (with a range of 300 to 700 nm) on the LAPD -- a 20 meter long device used to study basic plasmas
- Created a **graphical user interface** compatible with an OceanInsight survey spectrometer (**box 2**)
- **Identification of species** within the LAPD, including carbon, nitrogen and hydrogen **impurities** (**boxes 3 and 4**)
- Implemented ColRadPy, a **collisional radiative solver**, to produce synthetic spectra for identification of and comparison to observed spectra (**box 5**)
  - Only requires an electron density and temperature
  - Provides the ability to comfirm temperatures by comparing line ratios of the same species

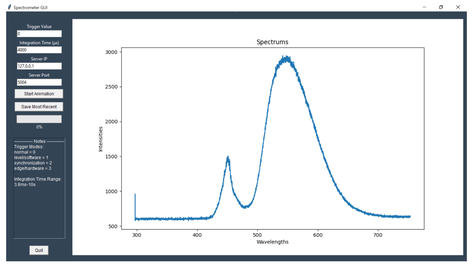


Front of the LAPD

1

Development of a Graphical User Interface (GUI) for the Spectrometer

- GUI that **communicates** between the machine and control rooms, while displaying incoming data
- Ability to **live update** inputs like trigger mode and integration time
- Uses SeaBreeze to collect the data, a server to send the data, and Tkinter for the GUI



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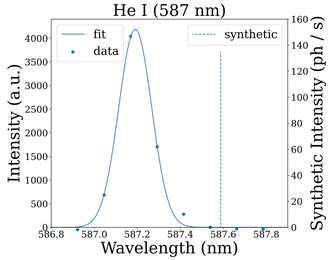
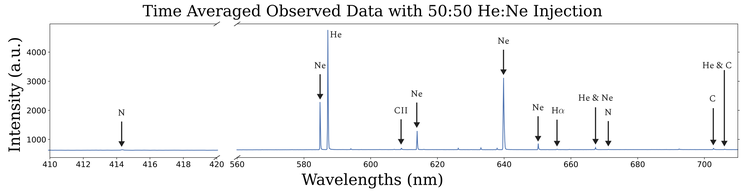
Overview of Line Identification within the LAPD

- **Lack of calibration** results in an offset for some wavelengths
- The inputted density for ColRadPy is from interferometry measurements
- Identifying lines allows for **tracking of expected species**, like helium, and unwanted impurities
  - Impurities contaminate the plasma, introducing a factor that is not controlled

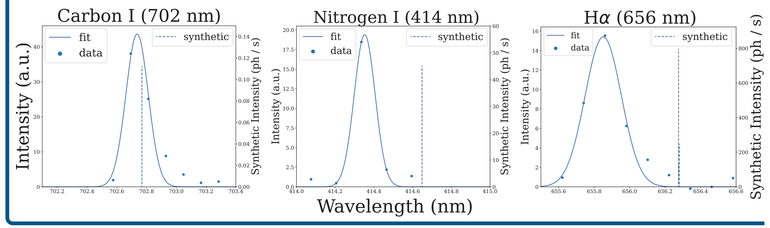




3

Detection of Impurities (Carbon, Nitrogen and Hydrogen)

- Possible impurities within the LAPD include carbon, nitrogen and hydrogen
- A **LaB6 plasma source** with a graphite heater, along with the walls of LAPD, create a source of **carbon**
- **Nitrogen** and **hydrogen** come from the atmosphere seeping into the machine



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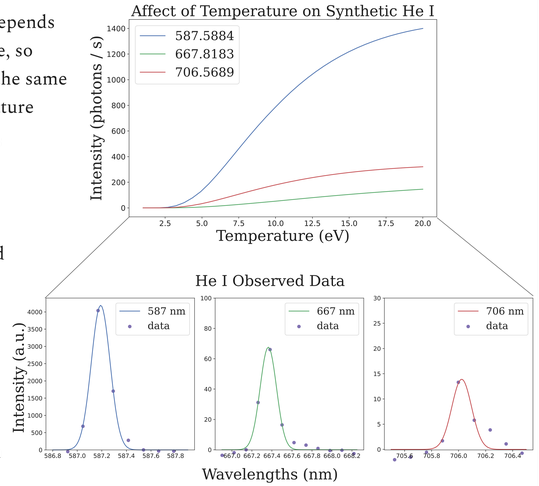
Synthetic Spectra and Observed Data Comparison

- The intensity of the line depends heavily on the temperature, so **comparing line ratios** of the same species confirm a temperature
- The observed helium lines do not exactly match up with the synthetic, as the observed 667 nm line is stronger than the observed 706 nm line
  - This is telling of **another line at 667 nm**, like neon, adding to the intensity
  - In runs without neon, the helium lines match up



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Discussion and Future Work

Discussion

- This research provided a proof of concept, displaying the advantages of survey spectroscopy within the LAPD
- ColRadPy is a useful tool to model relative intensities between different lines emitted by the same species

Possible Future Work

- Line ratios as a method to determine density and temperature from observed lines
- Implementation of multiple views along the machine to understand the spatial evolution
- Machine learning classification algorithm to determine lines

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