MDSGC SUMMER EXCHANGE PROGRAM:
ROCKET PAYLOAD DEVELOPMENT

Sam Lawson
ABOUT ME

• School: Capitol Technology University

• Major: Astronautical Engineering

• Year: Junior, graduating May 2020

• Interests: Software Design/Programming, 3D Modeling, Spacecraft Design
PROJECT SUMMARY

• Project Title: Air Breakdown and Plasma Spectroscopy at Low Pressures and High Flow Rates
• Mentor: Dr. Romero-Talamás
• Purpose: Design, build, and test a spectroscopy experiment for a sounding rocket payload
THE EXPERIMENT

• Purpose: Seeking sodium in the upper atmosphere

• Transformer steps 7.4V up to ~40000V, allowed to arc through air
• Arc ionizes air, causing various wavelengths of light to be released
• Spectrometer gathers light and reports relative intensity of each wavelength
• Spectral lines then analyzed to determine what elements were present in the arc

Example spectrum of a standard fluorescent light
MY OBJECTIVES

- Project broken into three parts for three interns. My objectives were as follows:
  - Develop a software interface to allow a Raspberry Pi to control and retrieve data from the Flame Spectrometer
  - Verify that the spectrometer can function in high vacuum (~5e-5 Torr)
  - Test with the spectrometer and spark gap to identify the optimal integration (stare) time to get our data
  - Get a final calibration for the spectrometer before flight
  - Assist with other objectives as needed
INTERFACING WITH THE SPECTROMETER

- Used an API called SeaBreeze to create Linux based programs for the spectrometer
- Code was written in a combination of C and C++
- Created a program that retrieves a new spectrum every 3.5 seconds and stores that data in a unique text file where it can later be accessed and transmitted

Example Data File >>

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Example Data File >>

<< Section From Code
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TESTING THE SPECTROMETER

- Built a test rig to go in a vacuum chamber and be pumped down to 5e-5 torr
  - Proved that the spectrometer can function in high vacuum
- Created program to average and noise-subtract many data sets at once
  - Analysis of data showed an integration time of 3.5s ideal
CALIBRATING THE SPECTROMETER

Argon Calibration

NIST Data
CHALLENGES

• Interfacing with other peoples’ uncommented & poorly styled code

• Waiting on supplies we didn’t think we needed to ship

• Locating a new vacuum chamber when the one we planned on using broke
WHAT I’VE LEARNED

• How to write software that interfaces with something other than a console user

• How to read, understand, and use spectrographic data

• The more important it is that something succeed on its first try, the less likely it is to succeed on its first try

• Regardless of how loose it seems, giving a nut an extra half-turn can have disastrous consequences
MOVING FORWARD

- Finalize the Spectrometer’s Calibration
- Prepare Software to Analyze the Flight Data When it is Received
- Document Everything I Have Done for Future Reference
ACKNOWLEDGEMENTS

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QUESTIONS?