

Henry Clay NASA Internship Final Report

Executive Summary

My primary mentor was Dr. Jim Green, Senior Adviser in the Office of the Chief Scientist, and former Chief Scientist. Dr. Green tasked Anna and me with researching stellar variability by analyzing data from the Kepler mission. My other mentor was Dr. Louis Barbier, Associate Chief Scientist. Dr. Barbier's main task for me was to create a program utilizing basic natural language processing to produce document matrices for the heliophysics decadal survey. Other activities I did over the summer included attending intern presentations and meeting with people whose careers aligned with my interests. Some of my favorite presentations were "Spaceflight Awareness with Crew-2 Astronauts", "Astronaut Medical Support During Launch, Flight, and Landing", as well as talks with Johnny Kim and Dr. John Mather. I had the opportunity to speak with Ben Johnson, a medical student at Johns Hopkins who plans on being a flight surgeon, about space medicine and his work. I also spoke with Chris Dobbins, a flight director, about ECLSS (space life support system) and his work at Johnson's Mission Control Center. I met regularly with my mentors and Anna to discuss the progress of our work.

Internship Objectives

Under Dr. Green, Anna and I were tasked with answering the research question "How active are different star types?" using Kepler data. The motivation for this question is that stellar activity may affect the habitability of exoplanets. The process of answering this question involved using the Mikulski Archive for Space Telescopes and specific Python packages to access the photometric data associated with the stars Kepler observed.

Under Dr. Barbier, I was tasked with writing a program in Python to return document matrices. The motivation for creating this program was to aid in analyzing the community white papers for the upcoming heliophysics decadal survey.

Accomplishments

A large part of the process to answer Dr. Green's research question was learning the background of the Kepler mission and data. This involved reading several research papers, figuring out the functionality of the Mikulski Archive for Space Telescopes, and learning the package-specific functions in Python. We would later use these in the program that would return the numbers and plots we were interested in. Anna and I met several times with Dr. Jessie Dotson, K2 project Scientist, when we ran into specific questions about the Kepler data and its characteristics.

In the end, Anna and I finalized our Python program, which analyzed over 1700 stars across 6 star types, producing a metric of variability for each of those star types as well as a histogram for each star type illustrating the distribution frequency of the variabilities. We also compiled a final report for Dr. Green outlining our process and full results.

The context for my work for Dr. Barbier is the upcoming 2024 heliophysics decadal survey, which helps to focus NASA's efforts and funding for future heliophysics missions. A part of this process is reading several hundred white papers submitted by the scientific community, which help inform the final recommendations. However, this process is long and

laborious. Consequently, the Office of the Chief Scientist asked the following question: “Is natural language processing a tool that can speed up this process by reading these papers and extracting the key information?”

Dr. Barbier’s first task for me was to create a list of words and phrases that characterized heliophysics as a topic. To do this, I went through the 29 heliophysics missions listed in the SMD Hanging Missions document and pulled out what I thought were the key words and phrases for the overall mission, science objectives, and instrumentation. After I completed this, Dr. Barbier asked if I would like to try writing a short Python program for him, to which I said yes. The final version of my program searches the text of any number of input papers against the keyword list I created and returns tables of values. These tables show what terms in the keyword list appear in the text and how often, as well as other statistics, like which document contains the most matches or in which document a keyword shows up frequently. This allows for a faster analysis of the contents of the paper. Dr. Barbier will use the final version of my program to analyze the hundreds of heliophysics white papers for the decadal survey, evaluating the results as a potential alternative to the standard method of humans reading and analyzing the papers.

This internship also allowed me to learn Python. I was not familiar with it heading into the internship, but working on my tasks, which heavily utilized Python, facilitated the process.

Highlights of the Internship

Aside from the incredible privilege of supporting the work being done at NASA, the highlight of my internship was undoubtedly the people I met and worked with. I think this says a lot about the people in OCS—NASA is an incredible and continually inspiring place to work not only because of the projects and missions being carried out, but also because of its civil servants. Everybody in OCS was so welcoming and supportive, and the same can be said for everyone I met who worked for NASA. I immediately felt like part of the team and that I could speak freely. Working with Anna was also incredibly fun and I’m glad to have made a new friend.



Another part of this internship I thoroughly enjoyed was working how a scientist might work. As a mechanical engineering major, almost all the tasks, homework, and projects I work on are to solve a problem or find a solution. For the research I did with Kepler, it was interesting to be working on a task that was trying to answer a question—not create a solution. To me, the difference between science and engineering is that science is born out of curiosity while engineering is born out of necessity, and the work I did during the internship highlighted that.

Recommendations for Future Interns

Future interns—you'll hear this over and over because of its value: ask questions and don't hesitate to reach out to anyone you're interested in talking with. Engaging with the civil servants at various NASA centers, as well as the people in your office, even in minor ways, will be rewarding. You may make new personal and professional connections or learn some cool things—like an office member had spent months in Antarctica collecting meteorites, or that another was currently underwater in a submarine. Early in the internship I was told that NASA civil servants rarely turn down a chance to talk with interns, and I have found that to be true. I feel lucky to have the connections I made.

I'd also encourage you to attend the office and intern social hours, especially if you're remote. It's very easy to become isolated while working from home and the office social hours are a great way to connect and get to know the people in the office in a less professional setting.

While the work you could be doing may be unlike anything you've done before, say 'yes' to potential work you may not know how to do. Be upfront about your current abilities, but also be willing to take on a task that may require you to step outside your comfort zone and learn something new. As mentioned earlier, my secondary task for Dr. Barbier involved writing a Python program. As I was new to Python this summer, I was hesitant at first but said yes, and the program ended up being the bulk of my work for Dr. Barbier. It grew from its original function and working on it allowed me to get a stronger grasp on Python (which also furthered my work for Dr. Green) as well as be introduced to natural language processing.

My last recommendation is to, at the end of your internship, be prepared with suggestions for your mentor on potential next steps for your work if it is ongoing.

Good luck!