

## Anna McElhannon's NASA Final Report 2022

### Executive Summary

The Henry Clay internship program at NASA was a life-changing experience that greatly influenced my research and communication abilities. I learned how to develop a research plan and implement it using Kepler data and python notebooks. Then I learned how to write in many useful formats such as research papers, governmental briefings, and article interviews. The entire Office of the Chief Scientist was welcoming and friendly, and they taught me how to enrich my skills in every area- including ones I never thought would be important to my career. They encouraged creativity and offered endless opportunities to improve my knowledge of NASA and anything else I was interested in.

### Internship Objectives

This internship consisted of three main projects: stellar activity research, NASA Citizen Science redesign and briefing, and a Paul Hertz interview.

Half of my internship was spent conducting research with Will Anderson, the other Henry Clay intern, and Dr. James Green. The goal of this project was to determine the relationship between stellar activity and star type. This would hopefully help in determining the habitability of planets orbiting specific stars.

At the beginning of the internship, I worked extensively on coming up with user-friendly designs for the NASA Citizen Science Page. That led to working with the incredible Citizen Science Communications team on weekly social media posts as well as initiatives to encourage more people to get involved with citizen science. The main project I worked on in this area was writing a briefing about citizen science that would be given to leaders across NASA to show what citizen science is and how they could use it to their advantage.

Halfway through the internship, my mentor, Maria Santos, got a new job at NOAA, so my work on Citizen Science decreased. Afterward, Dr. Mamta Nagaraja took over, and we set up a project together for the last five weeks. I conducted a series of interviews with Paul Hertz who has been the NASA Astrophysics Division Director since January 2012. He spoke about his experiences with astrophysics and his inspirations throughout his life. I wrote a magazine-style interview about his six rules for working in a bureaucratic organization.

### Accomplishments

With my prior experience in analyzing variable stars (RR Lyrae stars, specifically) I was able to really find my place in learning the concepts of the NASA research. We began by trying to replicate the results of another research paper titled "The Sun is less active than other solar-like stars" by Reinhold et al. In this paper, the authors used the photometric variability index,  $R_{var}$ , to determine the stellar activity of solar-like stars. They produced histograms outlining the variation of  $R_{var}$  values, created light curve graphs, and plotted the 95th and 5th percentile fluxes about the normalized median.

Using this paper, I created a journal club presentation that I presented to OCS. They gave me helpful presenting tips that I incorporated into our final presentation. This experience also helped me learn more about what we were researching because teaching a concept is often the best way to understand it truly.

Afterward, we applied the processes outlined in the paper to each solar-type that we queried in the Kepler database. Because Kepler only observed stars within the effective temperature ( $T_{\text{eff}}$ ) range of approximately 3,100- 19,000 Kelvin, we were not able to study O-type stars ( $T_{\text{eff}}$  of +30,000 Kelvin). Furthermore, the B-type ( $T_{\text{eff}}$  of 10,000 - 30,000 Kelvin) stars that we could observe were limited to 79 because of the temperature range and the requirement that each star has 18 observation quarters (i.e. Kepler observed each of them for the same amount of time).

By the end of the internship, we had created several histograms detailing the variability of each star type using a sample size of 369 stars per type. The only exceptions were M and B type stars that did not contain enough data; their sample sizes were 229 and 79 respectively. Because the research was not completed before the end of the program, we created an instruction manual including background, procedure, and results for any incoming interns.

For the other half of my internship, I worked on the NASA Citizen Science web page and on the communications team. At first, I was given a list of videos that would be added to a new "Videos" page. I organized them by topic and length, and then I proposed a new introduction video for the "Projects" page.

Afterward, I came up with new visuals for the "Projects" and "Publications" pages and presented them to the web design team. Along with the communications team, we troubleshooted the visuals and arrived at a finalized version that should be implemented later in the year.

To conclude my work with citizen science, I wrote a briefing describing the history, objectives, procedures, and leaders of the NASA program. The goal of this briefing is for leaders and directors at NASA to read it and understand what citizen science is and how it can benefit them with their research.

The last project I worked on was interviewing Paul Hertz, the Astrophysics Division Director at NASA. He was an inspiring person who had a fascinating story. He loved physics ever since he was a kid and saw the Apollo missions on television. Early in his career, he made the decision to have a healthy work/life balance, which he says led him away from being a professor. Somehow, though, he was able to conduct research for NASA and eventually became the Astrophysics Division Director. When he explained how he managed his impressive career, he told me about his six rules of surviving in a bureaucratic organization. Those rules, along with some snippets of his life, are in a magazine-style interview that I wrote at the end of my internship.

### **Highlights of the Internship**

The highlight of this internship, other than the never-ending excitement of working for NASA, was getting to know everyone in the office. We had meetings every morning at 9:30 where we would talk about our goals for the day. Every time the meetings ended, I had a smile on my face because everyone in the office is kind, funny, and thoughtful. Will Anderson, the other intern, also became a fast friend over the course of our internship.



Something that surprised me about the internship was how free I was to run with my ideas. I like being creative and adding more to what I am working on, and my mentors always encouraged me to go with my gut.

For instance, I have a small obsession with tornadoes, and I read a book titled *Storm Kings* by Lee Sandlin. It is about the history of tornado chasers in the United States, and it describes a lot about the scientists who researched meteorology. No one would expect this to come in handy while working at NASA, but I was actually able to use the history I learned to write the citizen science briefing. William C. Redfield used a form of citizen science to map hurricane wind speeds by collecting ship logs from sailors in the Atlantic storms. James Espy, on the other hand, used official barometric readings to achieve the same thing. Unfortunately, Espy's data was fatally inaccurate likely because his readings didn't come from the places that were most impacted by the storms. Redfield's research, the research that used citizen science, was accurate and likely saved thousands of lives. This example fits perfectly in the "History" section of the Briefing, and it wove throughout the rest of the paper in a way that was fun to write.

### **Recommendations for Future Interns**

Be creative. Even if you think your idea is a long shot, still make the suggestion.

The past interns said "don't be afraid to ask," and I echo that statement. I had so many cool opportunities just because I voiced my interest in various topics. The people in that office want you to be there, and they want you to succeed, so don't be afraid to ask for advice or for help.

Lastly, just have fun. If you are in this internship, you likely have most of the tools you need to succeed. So don't worry too much, and remember to enjoy the experience.