Personal, Background, and Future Goals Statement - Sydnee O'Donnell, 2022

I am an ideal candidate for the Graduate Fellowship because I have experience in computational astrophysics research, I have the resources of prior class work and relationships with professors to support me in this opportunity, and I am a strong leader among my undergraduate peers as the President of the Society of Physics Students.

Background

As a first-generation college student growing up in a rural town, when I said I wanted to do "cosmology," I was often mistaken for wanting to do "cosmetology." Since 5th grade, I have had a single-minded determination to become an astrophysicist. I have had the unique fortune of unwavering passion, something I have found to set me apart from my peers and has driven me to where I am today. My high school was small and lacked significant funding for advanced courses. After attaining my associate's degree at the local state college, I transferred to the University of Florida and began taking classes directly pertaining to my degree. My lack of resources from high school and my associates, as well as the added difficulty of being a transfer student during the pandemic, made attending university its own unique challenge at the time. These struggles have proven my grit, dedication, and passion for astrophysics. I have seen firsthand that I am able to offer a unique perspective to problem-solving due to my untraditional background. Therefore, I am a valuable asset to any team I join. **I will pursue a Ph.D. in astrophysics, followed by attaining a position somewhere I can continue researching.**

Intellectual Merit

In high school, my drive to pursue astrophysics had me nearly obsessed with enrolling in a summer program where I could experience research firsthand. The summer before my senior year, I was accepted into the University of Florida'sFlorida's Student Science Training Program (SSTP) and paired with High Energy Physicist Dr. Darin Acosta. Dr. Acosta'sAcosta's mentorship opened my eyes to an entirely new field of science. That summer, I learned a few basic fundamentals of python and **analyzed muon detection rates from the track finder system on the Central Muon Solenoid (CMS) experiment of the Large Hadron Collider (LHC)**. In that program, I was finally surrounded by like-minded young adults passionate about science. SSTP was a pivotal experience for me because I finally felt like I belonged in STEM and that a degree in astrophysics was something feasible for me to pursue.

Following graduating high school, I enrolled in college immediately after graduation and started attending classes that summer. I could physically not wait to begin the journey that would lead me to where I am today. At Gulf Coast State College, I was also a transient student and eventually a transfer student at the neighboring Florida State University satellite campus. There, I found a group of students attempting to form a group to compete in an autonomous boat competition - Robo Boat. Immediately I was interested.

In 2019 I competed at Daytona Beach in the international Robo Boat competition, where our team won ""best rookie team,"" a prize of $1000 for our achievements, and sponsorship from NVIDIA. The team consisted of myself, an aspiring astrophysicist, three mechanical engineering majors, and four electrical engineering majors, a mix of students from Florida State University and Gulf Coast State College. When our team began, our most experienced member had taken up to programing two, and I was starting from a rudimentary knowledge of the basics. However, through collaboration and effective

communication, we could navigate the intricacies of building an autonomous boat entirely from scratch, all while learning to program. In addition, I was primarily responsible for ensuring that our external sensors were able to communicate with the software on the boat and establishing a stable connection between the computers on board and a host computer where we could monitor the autonomy on the boat. The competition was a fantastic opportunity to explore the world of programming, improve my communication and presentation skills, and work with a diverse team.

Shortly after the Robo boat competition, I finished my coursework in Panama City and transferred to the University of Florida amidst covid. This period of change was novel because I had to navigate a new style of classes at a school far larger than I had previously experienced. It was daunting at times to be alone in a new place. However, I find I am rarely able to sit still for long. I immediately started to search for ways to connect and involve myself at the university. I contacted Dr. Stephen Eikenbery, who gave me a series of short projects before transferring institutions. I used python to analyze and visualize the tip, tilt, and other properties of mirrors he was building for the MIRADAS Consortium. This work allowed me the opportunity to explore instrumentation work within astrophysics, a very valuable field; however, I decided it was not for me. My attention was, and still is, directed toward studying the laws of the universe in a more direct manner.

Now, I work with Dr. Laura Blecha. In some ways, the tasks I completed for Robo Boat helped translate into my current research at the University of Florida. Similar to my experience on the team, I was thrown into a situation where I knew little about the subject matter. Cosmological magnetohydrodynamical simulations, the code that runs the simulations, or the code to interpret the data were all new to me. I remember my first research meeting with the group. I hardly understood the jargon being causally tossed around. As a new member of the group and an undergraduate student, I felt as if I had something to prove. I spent a large portion of my time trying to understand and interpreting the data from the simulations. Now, I can confidently attend group meetings and understand the significance of the research happening around me. Each day I am in awe of the research I get to be a part of. For Dr. Blecha, I look at data for the Illustris TNG simulation, where I focus on early star-forming galaxies and their metallicities. I have been able to characterize where these galaxies are in their simulations. Additionally, **using machine learning, I have produced feature importance plots of the different properties in the halo, such as magnitudes, metalicities, velocities, Etc., as compared to the star formation rate of the galaxies**. These plots allow us to look at the most important properties a young star-forming galaxy needs to “turn on” star formation and compare why other galaxies at similar redshifts might not be star-forming yet within the simulation.

Each day I am in awe at how far I have come and that I have been almost able to realize my lifelong dream of researching in astrophysics.

Broader Impacts

I have always enjoyed science communication and service. My background of being from a rural community drives me to share opportunities and resources with all those that I can impact. My first act of service was tutoring fellow students at my high school. I so badly wanted others to succeed because it meant that I could have other people to share my excitement for learning. My first professional experience with service came when I ran to be the Service Chair of the Student Government Council at Florida State University and won. This role had been newly created only a term before I received the office. I essentially built the position from the ground up and laid the foundation for the service chairs that

would come after me. In this position, I coordinated with local and national organizations to offer community service events to the university's students, faculty, and staff. The campus I was at was not located in a college town, and as such, there was a large disconnect between the residents of Panama City and the University. I wanted to help bridge that gap through service and utilizing the multitude of resources available by the university to give back to the community. In this role, I organized multiple clean-up efforts, a food pantry, tutoring services, and STEM camps.

In addition to my role as Service Chair, I was the Outreach Coordinator/Chair for the club Students Pursuing Engineering Applications in Robotics (SPEAR). My teammates and I created this club after competing in the Roboboat competition to ensure that students after us had a foundation to continue Roboboat and other similar competitions without having to start from the beginning as we did. As outreach coordinator in SPEAR, I contacted local schools ad robotic clubs for us to give demonstrations with our retired autonomous boat.

At the University of Florida, I have continued my service by becoming the President of UF'sUF's Society of Physics Students (SPS). I took the mantle of President as people became more comfortable attending university events. The two administrations prior to me were largely dormant due to the pandemic. When I inherited the position, I found that even though SPS at UF had been established for a while, I was still left with nearly nothing. At some point in the prior two administrations, essential documents and guidelines went missing, and funding was not applied for this year's term. However, building a position is not something I am new to. We have still managed to have an impactful semester thus far. SPS has hosted colloquium talks, weekly social events, fundraisers, and advisory panels, with only more to come.

In addition to SPS, I am a Physics Inclusion Diversity and Equity Alliance (Phys IDEA) member. Physics IDEA aims to promote inclusion and diversity within the department. I utilize my platform with SPS to work closely with the alliance and host events in tandem. Due to our efforts this semester, I have noticed a fundamental change in the department. Previously, there was a strict division between graduate students, undergraduates, and faculty. Now, more than ever, I see all three groups interacting and getting to know one another on a deeper level than academics. Building these interpersonal connections makes the work we do so much more impactful.