Natasha Latouf – Personal Statement

Throughout my schooling, my teachers would say to read chapters 1-3 and I would be on chapter 7 before I realized what had happened. I never could stop reading, whether it was fiction, nonfiction, or a textbook, because I didn't want to stop learning. Education spoke to me, and one field more than most. I was a child of Syrian immigrants raised in a rural farming community in the middle of Ohio Amish Country. My parents depended on me to provide insight into American culture, while I was trying to learn how the gears of the system worked myself, guided only by what I saw around me. At the same time, I was helping my younger siblings with their schooling, all while we were the only immigrants in this hopelessly small town, trapped in a time long past. The culture shock was enormous to the residents of the town and my family as both tried to learn and understand the other. Learning everything for myself while teaching it to my family allowed me to come into independence early. The benefit to this rural living was that at night, you could see every single star with perfect clarity. They were peaceful, dependable. I was taken with them. My calling found me in those peaceful long nights, head thrown upwards, looking at the stars.

My high school was small, offering only 4 AP classes, most of which were populated with only a handful of students, and minimal help for applying to colleges. Between my immigrant parents who had not navigated the US collegiate system, and a school that did not have experience sending students to colleges out of state, I had to navigate that process myself, relying on my learned independence. So the journey to astrophysics did not have an easy beginning, and only became more difficult upon attending a 30,000+ student university, while working full-time almost every semester in order to afford my education. Then, I joined my research group and became a researcher, and I found a graduate-student mentor who gave gentle guidance in the right direction and supported my endeavors. I also formed a study group from a gaggle of diverse students in the physics department and my path opened wide, with fewer obstacles, and none that couldn't be borne with the help I had found. I have started developing an education and mentoring program at my university, and alongside my educational journey I will nurture that program and advocate for equity and equal rights for all scientists. **I will pursue a Ph.D. in astrophysics, followed by postdoctoral research, and with my education and knowledge, I will pioneer programs to educate minority students in STEM, provide mentors and mentoring opportunities, and empower the next generation to confidently embrace their field.**

Intellectual Merit

I am currently a senior undergraduate student at George Mason University, pursuing a Bachelor of Science degree in Physics with a concentration in Astrophysics (GPA of 3.42 as of August 2020), and will graduate in May 2021. As a full-time student, I experienced a broad and diverse range of topics in my coursework for my degree, from Computational Physics and Planetary Science to Stars and the Interstellar Medium. Throughout my coursework, I was also employed full-time at a myriad jobs, including minimum-wage work, tutoring, and research in order to fund my studies, which led to a dip in grades in Fall 2019. In the following semester, I rebounded, doubled down in my studies, and succeeded in earning all A's. Over the course of both my studies and my research experience, I have gained proficiency at coding in Python, Matlab, Mathematica, and command line linux environments. I was the recipient of the George Mason Excellence Scholarship, Dean's List, and was chosen by the Physics and Astronomy department to receive the Eugenie V. Mielczarek scholarship, an endowed scholarship given to an accomplished undergraduate.

My path to research began early in my tenure at George Mason. When I began my freshman year, approximately in October, I strode confidently into my academic advisor's office, and proclaimed that I wanted to do research with him. Of course he said no, because I had no experience in theoretical physics. However, he pointed me to another professor in the department, an exoplaneteer with projects that an inexperienced student could aid with, and for the last three years I have conducted research with Dr. Peter Plavchan in the realm of exoplanets. I was fortunate enough to be an observer and use instruments such as the Keck Observatory HIRES spectrometer and NASA's Infrared Telescope using iShell multiple times.

This has resulted in two publications, including *Newly Formed Planets within the Debris Disk of the Nearest Pre-Main Sequence Star AU Mic*, published in Nature.

Under Dr. Plavchan's guidance, I participated in the NASA Probe Mission Concept Study EarthFinder, as one of the two researchers on the atmospheric impact team for the project. My work consisted of co-writing and running Python scripts to simulate the Doppler method of exoplanet detection, the impact of the atmosphere on our observed data (hereafter called tellurics), and common telluric mitigation techniques to quantify the error induced by tellurics on our ground-based exoplanet observations. **This was published as a NASA probe mission concept study as input to the 2020 Decadal Survey, and will also be published as a separate peer-reviewed paper.** I presented this work as a sophomore in 2019 at the international conference Extreme Precision Radial Velocities IV as one of 48 individuals selected to give a 15 minute talk. I also presented this work as posters at a George Mason University Office of Student Scholarship, Creative Activities, & Research (OSCAR) student celebration in 2018 and at the 235th American Astronomical Society conference in Hawaii in 2020. From this project I gained an understanding of astrophysical computational methods that go beyond the scope of undergraduate coursework. Initially I used a synthetic G star to do the runs for the EarthFinder study, but after the study concluded, I continued the project and reapplied the previously written scripts to a synthetic M-dwarf star. This project is still ongoing, as the scripts must be revised and continuously rechecked to ensure the mathematical integrity of the work. **This project will result in my first first-author publication.** Going into this project, I did not have any experience in Python coding. The learning curve was steep, and daunting. I struggled, made mistakes, and learned many, many different Python errors. However, one evening, I broke through in the form of a correctly formed plot. It was thrilling to feel that I had succeeded, even in that small way. I had created something useful, that helped to visualize and analyze results, and contributed meaningfully to an active research project. **I learned that error is just as much a part, if not a greater part, in the scientific journey as success.**

As part of my research journey, I applied and received several grants to fund my projects. In the summer of 2018 I won the above mentioned OSCAR Student Research Grant for $5,000, culminating in a poster presentation for my work at an exclusive student celebration. In the following summer of 2019, I was accepted into the SCI-STEPS Summer Research Program, an NSF INCLUDES Design and Development Launch Pilot for women and underrepresented groups in STEM, which included a grant of $5,000. I also received the OSCAR Student International Travel Grant for $800 to fund my trip to present my research in Hawaii. Throughout my research, I have worked with several leaders of the field, and made lasting, important connections through conferences and my work on wide-reaching projects, including colleagues in China, Switzerland, and the UK, amongst others. I have become closely acquainted with the status of the field, which places me in a strong position to leap into graduate work and hit the ground running. The opportunities to present to multiple levels of audiences has also sharpened my communication skills to many different levels and fields of scientists, while still maintaining levity.

Broader Impacts

I believe that the work of a scientist is enhanced when they communicate their work to the public, foster science education at all levels, and encourage students to pursue STEM. I had the honor of being a featured exoplanet commentator in the Emmy-nominated STEM in 30, a program for students produced by the Smithsonian Air and Space Museum, in episode 7, *Diamonds in the Sky: Stars and Exoplanets*. This program is aimed at middle-school students and geared to teach high-level science at an understandable level to capture the interest of students and encourage science as a career path. This taught me how to effectively communicate to non-experts in an interesting way, and offered me a chance to encourage younger students to follow STEM as a career path. In addition, throughout my tenure at George Mason University, **I have consistently been involved in tutoring and mentoring to help teach students about STEM and encourage them to stay in the field.** I was a peer tutor to student athletes for

a year, teaching physics I and II, calculus I and II, discrete mathematics, linear algebra, and other mathematics and physics as requested by students. I also offered my tutoring services to grade-school students virtually for the duration of my undergraduate career. I mentored other undergraduates in STEM through the Aspiring Scientists' Summer Internship Program (ASSIP) for a year, which involved bringing interns into our research group and mentoring them on both the existing projects and their involvement, including giving basic classes on Shell and Python coding. This program also helps to increase retention and improves understanding of the core courses for physics undergraduates. However, the efforts to retain women and minorities in STEM tends to be the far more difficult battle.

It is no secret that STEM fields have biases against women and minorities, a failing which I am actively working to end. **I was a co-writer of the newly implemented George Mason University Physics and Astronomy Department Code of Professional Conduct, which laid a basis for equity for all students, regardless of race, gender, sexual orientation, or research concentration**. I am also President and co-founder of the new George Mason University group Spectrum, which is a completely student led and developed program dedicated to equity and diversity in STEM. My peers and I started Spectrum after we realized how alone we all felt going into the field of Astrophysics at the start of our journeys. It was not until we found a group of like-minded peers that we began to feel that we could feasibly belong in the field. We realized that many students are being pushed out of STEM fields, especially Physics, due to the overwhelming combination of imposter syndrome and the difficulty of the field. We decided to change this and give younger students the support network and education that we never had, and thus Spectrum was born. Spectrum is a multi-faceted program, including a peer-mentorship program to aid in student retention and provide a strong support system to underclassmen. The mentorship program was well-received by faculty and students alike, with 11 mentors and 5 mentees signing up within a week of the application going live. Spectrum also sponsors a professional development lunch which provides information to undergraduates on graduate school applications, job searching, and fellowship opportunities, as well as self-care and social education topics, such as stress management, microinequities, and bias and inclusion training. I am extremely passionate about Spectrum, and I believe that the change it will bring to our department will enable us to implement it across other universities. **I am committed to pushing for change through programs like Spectrum that enhance mentoring and information to undergraduates.**

Future Goals

Moving forward in my career, I will continue to improve the research and communication skills I've developed while also increasing my involvement in science education and outreach. **As such, I hope to continue my work on exoplanet simulation and mitigation method analysis at George Mason University under the direction of Dr. Peter Plavchan.** This work, combined with the ever-growing list of confirmed exoplanets, places me in the middle of a booming field, ripe with research opportunities and discoveries to hunt down. **As a female minority in STEM, I am dedicated to inspiring and aiding the next generation of scientists to be diverse, inclusive, and committed to equity**. I aim to become more enmeshed in science communication, so that hopefully a budding female scientist somewhere can say "hey, that person looks like me." And know that they can do it too, regardless of race, ethnicity, or gender. I have been developing these goals within me for far longer than my undergraduate career, but now there is a path forward and a plan. The NSF GRFP will give me the support and resources that I need to ensure that both my research and commitment to diversity can grow into a powerful position that can effect change.

References

1. NSF Includes SCI-STEPS Summer Research Program, 2017, https://rb.gy/zs3zgd
2. Smithsonian Museum, *Diamonds in the Sky: Stars and Exoplanets*, 2019, https://rb.gy/d1cg7g
3. George Mason University Spectrum Group, 2020, https://rb.gy/iecsrr