

Personal, Background, and Future Goals Statement

Like most children, I wanted to be two things when I grew up: an astronaut and a ballerina. Unlike most, I was able to achieve one of those aspirations, and after years of training, became a professional ballet dancer. While the path from the performing arts to astrophysics is not a linear one, upon reflection it becomes clear that dance and science require a complementary set of skills. The creativity and patience and sheer determination that are necessary to thrive in the arts are the same qualities needed to succeed in academia. I trained my eye for detail at the barre, learned to become comfortable with the uncertainty that accompanies the moments before creativity or discovery. I loved hearing the phrase “*what happens if we try...?*”, and I relished existing in an environment that encouraged experimentation, that showed me how minor details and the big picture are intertwined. I am the scientist I am today not because of education or experience, but because of the studio and stage. **The arts taught me how to understand people; through astrophysics, I hope to understand the universe around us.**

My career in the arts ended abruptly with the pandemic. The shutdown of theaters pushed me back toward an academic environment, and I enrolled in community college. Over the next two years, I rekindled my love for space and science, and in addition to coursework, participated in NASA-funded programs such as NASA Community College Aerospace Scholars and the Lucy Student Pipeline Accelerator and Competency Enabler Mission Concept Academy (L’SPACE MCA). I applied to North Carolina State University in 2022 and was accepted both to the university and to the Transfer 2025 Cohort of the Goodnight Scholars Program, which provides students seeking degrees in STEM with a full tuition scholarship. **I am proud to say that, despite my non-traditional, nonlinear journey, I am in the final year of completing a B.S. in Physics, with minors in Mathematics and Computer Programming.**

However, before I was a ballet dancer, or even a physicist, I was a young Black girl with an innate love for learning. My parents saw that spark of curiosity long before I could put a name to the feeling, and because our community was not conducive to educational success, took the responsibility of my education upon themselves through homeschooling. The world became my classroom, and the library my second home. And while my artistic and academic pursuits were encouraged, I did not see myself in the role models and heroes that shaped my adolescent aspirations. The faces that I saw in textbooks and museums, on the stage and screen, were dissonant from the features in my own reflection. Black women pursuing careers in science, particularly physics, were an outlier, particularly within my community. I quickly understood that while my role models did not reflect me, I had the potential to change that for the next generation of scientists. Because of this goal, **I will be the first person in my family to pursue and earn a Ph.D. in any field.**

Intellectual Merit

I was encouraged by my physics professor to apply to summer research experiences the semester before I transferred to a four-year institution and was pleasantly surprised when I was accepted to the inaugural, 6-person cohort of Georgia State University’s Physics and Astronomy REU in Summer 2022. I worked with Professor Viacheslav Sadykov on the development of a machine-learning (ML) algorithm for magnetograms of solar active regions. **I built a pipeline to acquire, identify, and clean overlapping data from the Solar Dynamics Observatory and the Solar and Heliospheric Observatory, and implemented a ML linear regression model to cross-correlate these measurements.** Through this study, I supported the development of improved prediction models for solar activity, and helped quantify long-term magnetic trends in the active Sun. This experience taught me that *research is a nonlinear process, and the speed of a study’s progress does not define scientific success*— while my peers had updates to present at group meetings, it took me nine weeks to obtain preliminary results. I continued refining and expanding upon the initial study during my first semester at NC State, presented our results

at AGU 2022 and AAS 241, and was awarded an undergraduate Chambliss Astronomy Achievement Student Award for my poster presentation at the latter conference.

In addition to continuing my research in solar physics during Fall 2022, I participated in the L'SPACE NASA Proposal Writing and Evaluation Experience (NPWEE) through Arizona State University. **I worked as the primary researcher on a team that developed and wrote a top-scoring proposal in response to a technology solicitation from NASA Marshall Space Flight Center (MSFC).** In addition, I served as a primary reviewer on a proposal panel with Dr. John Carr, the current Deputy Center Chief Technologist at MSFC. While this experience was not a traditional research project, I gained hands-on exposure to the intricacies of technology development, scientific project management, and proposal writing and reviewing.

My time at GSU awakened my passion for research in computational astrophysics, and I set a personal goal to pursue research experiences across vastly different astrophysical scales. In Spring 2023, I applied to the Simons-NSBP Scholars Program and was selected as a member of that year's cohort. That summer, I interned with the Flatiron Institute in the Center for Computational Astrophysics. There, I worked closely with Professor Vera Gluscevic and Dr. Ethan Nadler on characterizing the warm dark matter (WDM) structure evolution in Milky-Way sized galaxies with the N-body simulation suite COZMIC¹. **I investigated the redshift-dependence of the subhalo mass function through a variety of statistical methods for six WDM models and measured the fluctuation in WDM subhalo population over time.** This work allowed us to begin investigating unanswered questions about structure evolution in galaxies, and provided theoretical measurements that could directly connect to observations of our Local Group. The results of this study were presented at AAS 243. Unlike my work in solar physics, this study focused on new theory and measurements, rather than building on the work and data of previous studies. This gave me a newfound freedom to truly conduct independent research. The experience of presenting preliminary results to my advisors, asking for their input or interpretation, and hearing the words "actually, I'm not sure what that means" was revolutionary—it showed me the power of being able to say *I don't know yet, but we can find an answer together.*

After working on solar and galactic scales, I was able to find the right fit in Professor Carla Fröhlich's group at NC State. I began simulating core-collapse supernovae (CCSNe) with her group in early 2023 and started work on my current project that fall. **Over the past year, I have used a 1D pipeline to model the collapse, supernovae, nucleosynthesis, and lightcurves of a grid of 9-40 M_{sun} progenitor stars.** Through this study, I have gained experience with a variety of computational methods, including the hydrodynamic code Agile/PUSH, the nuclear reaction network CFNET, and the radiative transport code SNEC. I am currently working to develop a comprehensive statistical analysis of simulated and observed SNe lightcurves using the methods of Barker et al. 2022, 2023. This study directly connects CCSNe theory to observation and furthers our understanding of how to accurately infer progenitor properties and SNe characteristics from limited electromagnetic data. *The results of this study are currently being prepared for publication and will be presented at AAS 245 in January 2025.* Because I have conducted the bulk of my research with the Fröhlich Group, I have gained far more than scientific skills. I have had the opportunity to research and exist as part of a collective, not only working towards the progress of my own project but making contributions to the work of others as well. This past summer, I served as a mentor for the group's REU student, and had the privilege to provide scientific guidance, advice, and support while Professor Fröhlich was absent.

Broader Impacts

During my time at community college, I began to pursue my goal of increasing STEM accessibility and exposure in my childhood community. **In collaboration with a local afterschool program, I developed and taught a curriculum designed to introduce coding skills and concepts to underrepresented students in grades 2-5.** After transferring to NC State, I continued these efforts with the Goodnight Scholars Program, and spent a week traveling across North Carolina to facilitate STEM

enrichment activities in rural middle schools, giving students and hands-on introduction to key physics concepts and the engineering design process.

I also embraced the opportunity to pay it forward at NC State, both within the Physics Department and the broader College of Sciences (COS) community. COS Ambassadors is a student-founded collective that represents the College at internal and university-wide events for students, alumni, and donors. Serving as an Ambassador has allowed me to encourage community and engagement throughout the College of Sciences, interact with College and University leadership, and most importantly, make a direct impact on prospective students and their families during the uncertainty of college application season. Within the NC State Physics Department, I have been involved in several student organizations, such as Society of Physics Students (SPS), Women in Physics, and National Society of Black Physicists (NSBP), and worked as a lab TA. Notably, I serve as a mentor for first-year students through our SPS Mentorship Program and am currently president of our chapter of NSBP.

However, my most impactful experience within Physics was serving as an Undergraduate Coordinator for the Computational and Data Science in Astrophysics REU this past summer. In addition to mentoring the student who joined the Fröhlich Group, I organized and moderated a weekly astrophysics journal club for incoming undergraduate researchers to promote scientific collaboration and discussion. I was also offered the opportunity to have hands-on teaching experience and presented an introductory lesson on supernovae remnants.

In addition to the scientific community at NC State, I have also been involved in the planetary science community through NASA L'SPACE. After participating as a student in MCA and NPWEE, I began volunteering as an MCA Astrophysics Mentor in Spring 2023. This opportunity let me work with student-lead teams on the development of mock planetary science mission proposals, and during the next year, I directly mentored 100+ students during the creation and writing of preliminary design reviews. **I now serve as the current MCA Science Advisor and a Lucy Mission Intern, and facilitate the training, operation, and professional development of the Science Mentor team.** I also work directly with L'SPACE staff and advisors to develop training materials that increase student proficiency in science-driven mission development and leadership, and advise student leaders on teaming and scientific project management.

Collectively, these experiences have allowed me to directly impact the current and upcoming generations of scientists in a variety of environments, and I aim to use the skills I've gained to continue this work in the near future. Accessible science education made my journey in astrophysics possible, so I plan to continue developing STEM outreach initiatives in order to reach underrepresented communities like mine. **It is not enough to simply be the representation I want to see in the scientific community.** I want to ensure that not only do those from underrepresented backgrounds see a role model who looks like them, but also have access and exposure to engaging, hands-on STEM experiences outside of the traditional classroom model.

Future Goals

In the near future, **I plan to pursue my Ph.D. in Astrophysics under the guidance of Professor Sean Couch at Michigan State University and continue investigating the physics and observables of core-collapse supernovae.** My current research spans the interface between theory and observation of these transient events, and I aim to continue this direction of investigation in my future research. After earning my doctorate, I will seek a position as a civil servant at a national lab, with the goal of furthering astrophysics research, supporting accessible, public science, and eventually transitioning into mission development and scientific project management. I firmly believe the NSF Graduate Research Fellowship Program is the first step towards this goal and am confident that this fellowship is an excellent fit for me—a young Black astrophysicist at the precipice of her career.