Rachel M. White Statement
[University], 2025

My path to physics was unconventional: I began at The Ohio State University as a Maximus Scholar Theatre major with the intention of ending up on a Broadway stage. Theatre instilled in me many valuable skills, including public speaking, creativity, confidence, and adaptability, but I soon realized I was dragging my feet to class. Science, in contrast, had never felt like work in previous courses; it was engaging and rewarding. It was once I switched to a major in Astronomy and Astrophysics that I discovered the thrill of challenge and discovery. **I will pursue a Ph.D. in Physics focused on uniting instrumentation and computation in particle physics while promoting mentorship and sustainability within the field.**

My first exposure to physics research came through Ohio State's Polaris Mentorship Program, which paired undergraduates with graduate mentors for a ten-week research project. I worked closely with a physics Ph.D. candidate to model laser aberrations and their effects on orbital angular momentum. While the projects were designed primarily as introductions rather than cutting-edge research, I found myself captivated by the process of translating theoretical concepts into models. Polaris piqued my early interest in experimental work, giving me the tools and confidence to seek out more advanced research.

My professional career began in [Professor]'s lab at the Center for Cosmology and Astro-Particle Physics (CCAPP) in collaboration with [Professor]'s group. I explored **radio neutrino detector analysis for the Antarctic Impulsive Transient Antenna (ANITA) experiment**, which was a NASA long-duration balloon experiment designed to detect radio signals from astrophysical neutrino interactions within the Antarctic ice. Using the ANITA Monte Carlo framework (iceMC), I developed correlation maps for use in a convolutional neural network aimed at improving neutrino event reconstruction. I additionally examined the simulation's health through detailed trigger-efficiency studies.

This experience strengthened my computational skills in Python and C++, introduced me to high-performance computing clusters, and, most importantly, immersed me in the collaborative, investigative nature of cutting-edge academic research. Working with the ANITA simulation showed me how theory, hardware, and computation intersect to extract meaningful signals from complex data. I found deep satisfaction in the process of translating a physical idea into code, testing it, and seeing real improvements in model performance. It was the first time I felt that my work contributed to something larger than myself—expanding how we detect and understand the universe's most elusive particles. Our results are currently being prepared for publication, an experience that has further developed my skills in scientific communication and collaboration.

Because I enjoyed computational work within neutrino physics, I wanted to deepen my understanding of experimental research by gaining hands-on experience with instrumentation. This motivated my application to Penn State University's REU in summer 2025. I contributed to Project 8 under [Professor], an experiment aiming to directly measure the absolute neutrino mass. My work focused on the **electromagnetic simulation, construction, and characterization of resonant cavity and antenna prototypes**, essential components for Project 8 detector development. By systematically mapping electromagnetic fields and optimizing antenna placement, I identified designs that maximize signal detection while minimizing interference, providing crucial guidance for future instrumentation to the collaboration.

This project allowed me to see theory come alive in the lab, as calculations and simulations became physical systems I could manipulate and improve. Working directly with a detector system, analyzing responses, and iteratively refining designs gave me a tangible sense of impact and ownership over the research process. Presenting these results at the REU symposium, a Project 8 Collaboration meeting, and the SACNAS NDiSTEM conference strengthened my ability to communicate complex technical work to diverse audiences. Above all, this experience solidified my passions for experimental physics and the advancement of our understanding of fundamental particles.

Besides performing research, I have found a passion for mentorship in physics. Beyond introducing me to hands-on research, the Polaris Program immersed me in a uniquely supportive community that emphasized mentorship and student engagement—values that were rare in my early coursework. Feeling inspired to recreate that environment for others, I co-founded an undergraduate mentorship program titled MoMentUM: MOdel MENTors for Undergraduate Mechanics. The program

pairs upperclassmen mentors with underclassmen in core physics courses to build community, reduce feelings of isolation, and improve class success rates. I led mentor training sessions, established expectations and goals for mentor-mentee relationships, and facilitated bi-weekly meetings on topics including academic success, careers in physics and research, and imposter syndrome. In the club's first semester, I formed over thirty mentorship pairs, building a stronger and more collaborative department community. Guiding my own mentee was especially rewarding. Since we began working together, I saw her build stronger connections with peers, including joining a study group after my encouragement, and improve her performance on exams using study strategies we developed together.

In graduate school at [University], I hope to continue this work through mentorship programs. As someone who navigated the transition into physics from a nontraditional background, I can help design programming that better supports students from diverse academic paths. My previous experiences as a mentor can help me give back to the departments by establishing lasting relationships with other students. I am also eager to join in on science demonstration shows to younger audiences. By combining my performance skills with my love for science, I can engage audiences of all ages and foster new excitement for science.

In addition to mentorship, I have developed a strong commitment to sustainability in experimental physics. Penn State's REU program emphasized the intersection of physics and environmental responsibility through faculty presentations and guided discussions on sustainable research practices. Through this program, I became a certified Sustainability in Research practitioner through the REU and an ambassador for My Green Lab, an organization that promotes environmental accountability in laboratories worldwide through certification and community engagement. These experiences opened my eyes to the often-overlooked environmental costs of research: energy-intensive computation, fossil-fuel powered facilities, and large-scale construction for experiments. **I aim to improve sustainability practices by promoting My Green Lab Certifications across departments at [University] and in my research collaborations**. By integrating environmental responsibility into experimental practice, I will demonstrate that advancing fundamental knowledge and cultivating responsible, supportive research communities can progress hand in hand.

After receiving my Ph.D., I aspire to become a professor of physics, where I can combine my passions for research, mentorship, and sustainability. I will lead a laboratory that advances experimental physics while fostering an engaging, environmentally responsible research culture. My experiences guiding undergraduates, leading student programs, and communicating complex ideas have shown me how effectively I can inspire and support the next generation of scientists. Graduate study at [University] would allow me to deepen these abilities while pursuing physics with the same curiosity and excitement that I felt in my first days in the laboratory.

[University] offers the ideal environment to achieve these goals. **I am eager to continue advancing astroparticle research at a university that values mentorship and community as deeply as [University] does.** I would be thrilled to contribute to the student-led Physics Graduate Organization (PGO) and the Women and Minorities in Physical Sciences (WaMPS) organization. I especially admire the SL@MS outreach initiative, as I am passionate about broadening participation in science and inspiring future scientists. Additionally, my background in theatre and choral performance would make joining the Grand Canonical Ensemble Physics Choir an especially meaningful way to connect with the department.

Within the High Energy Physics (HEP) group, I am particularly drawn to **research that integrates data analysis with detector instrumentation.** My work on radio neutrino detection and cavity instrumentation has prepared me to contribute effectively and independently to efforts like IceCube, the IceCube-Gen2 Upgrade, and P-ONE. [Professor]'s group, at the intersection of experimental particle physics and high-energy astrophysics, aligns closely with my past experiences and future research goals. [Professor]'s and [Professor]'s leadership in IceCube and Gen2 development resonates with my interest in advancing next-generation neutrino instrumentation and analysis methods. I also find strong overlap with [Professor]'s and [Professor]'s work on multimessenger astronomy and detector simulations. Additionally, I am interested in broadening my experimental perspective through accelerator-based

physics experiments with [Professor] and [Professor], whose work on neutrino oscillations, dark matter, and neutrino mass through DUNE and SBN complements my background from the Project 8 experiment.

Having completed my undergraduate studies at Ohio State, I have experienced firsthand the breadth of research opportunities, mentorship, and collaborative culture a university can provide. In my search for graduate school programs, I am seeking a department that upholds these same values, preparing me for a successful, life-long career in physics. I am excited to pursue a Ph.D. in Physics at [University], contributing to particle physics research within a community that provides the environment, people, and cutting-edge research allowing me to thrive as a scientist.