

Since my research career began, I have been fascinated by the neutrino—nature’s most abundant yet most elusive fundamental particle. Its weakly interacting nature makes it one of physics’ greatest experimental challenges, and developing our understanding of it has become the focus of my academic journey. Throughout my undergraduate studies at The Ohio State University, I have pursued this passion through academic excellence and particle physics research. I am a four-time awardee of the Maximus Scholarship, a three-time awardee of the Ralph J. and Mabel C. Gooding Memorial Scholarship, and have been on the Dean’s List every semester. Yet what has most defined my education is my growing dedication to experimental neutrino physics, where instrumentation and computation intersect. **At [University], I will pursue a Ph.D. in Physics focused on uniting instrumentation and computation in experimental 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.

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.