

When I began my undergraduate career at the University of Maryland, Baltimore County (UMBC) as a physics major and astrophysics minor, I had very broad interests in astrophysics research. Since then, my research experiences and academic preparation have led me to pursue theoretical and observational research in cosmology and astro-particle physics. I aspire to pursue my PhD in Physics in order to gain a deeper level of understanding in these fields. I am highly interested in studying dark matter and dark energy, gravitational lensing, and using numerical simulations to explore the evolution of the Universe. I strive to have a research career at a university or national laboratory where I can lead my own research group and further uncover the nature of dark matter and dark energy. Pursuing my PhD will prepare me with the educational background, research training, and mentoring experience needed to accomplish my research and career goals. At UMBC, I am a member of the Meyerhoff Scholars Program, which has been an exceptionally important aspect of my undergraduate career, as I am passionate about increasing the number of underrepresented minorities and women in science. One such way I have begun these efforts is by co-founding UMBC's Undergraduate Women in Physics Group. Through every stage of my career I intend to be involved in mentoring and outreach activities to continue promoting diversity in science.

My first research experience began during the second semester of my freshman year when I joined Dr. Eileen Meyer's High Energy Astrophysics Group at UMBC. Our group studies active galactic nuclei (AGN) with a primary focus on the relativistic jets of plasma powered by the central supermassive blackhole. When I first joined the group, I trained in observational methods related to radio-wavelength astronomy and quickly became an expert in radio imaging with the Very Large Array (VLA) and the Atacama Large Millimeter/submillimeter Array (ALMA). I have contributed multiwavelength imaging of AGN jets to several graduate student projects, which resulted in three co-authored papers. My sophomore year, I began my own project with Dr. Meyer to study the emission mechanisms of AGN jets. It is well accepted that the radio emission is synchrotron emission from relativistic electrons in the jet, however, the emission mechanisms responsible for the optical/UV and X-ray emission remain poorly understood. For this project, I reduced radio observations from ALMA and VLA, as well as optical observations from the Hubble Space Telescope, to create spectral energy distributions (SEDs) for individual emitting regions in each jet. We discovered multiple jets that display a synchrotron spectrum that unexpectedly turns over at approximately 100 GHz, and hence does not account for the optical/UV emission. This disproves the previous consensus that the optical/UV emission arises from the radio synchrotron component. Combining this result with the X-ray spectral hardness of these sources, we have concluded that at least three distinct emission components are required to fully explain the jet emission. We are currently preparing our results for submission to the Monthly Notices of the Royal Astronomical Society Journal, where I am second author.

Throughout my years with this group, I have learned many important aspects of being a scientist in addition to the technical details of my research. I have learned how to effectively communicate my research findings and have given poster presentations on my research with the UMBC group at three conferences. In January of 2021, I will be giving another poster presentation on this research at the 237th AAS meeting. Additionally, I have learned that conducting research inevitably means experiencing setbacks and challenges, as I have already experienced at times in my own research. However, I have learned how to troubleshoot problems that arise and have gained a strong skill set to aid me in overcoming any research obstacles that I may face. I have also gained experience in mentoring and teaching, which are important aspects of a research career. I was chosen by Dr. Meyer to mentor a high school researcher who joined our group for an academic year. I taught this student the skills and background needed to work with me on my project. I am also a peer advisor to a younger Meyerhoff scholar and have worked as a learning assistant for the introductory physics course at UMBC. I greatly enjoyed these opportunities and I hope to one day mentor students while leading my own research group.

The summer after my sophomore year, I worked with Dr. Meg Urry and Dr. Meredith Powell at Yale University to investigate the host galaxy properties of AGN. For extremely luminous AGN, the emission from the host galaxy is overpowered by the AGN emission, making it very difficult to measure the host galaxy properties. I used AGN of varying luminosity from the Stripe 82 X-ray Survey to

establish the maximum luminosity to which these host galaxy properties could still be determined. To accomplish this, I produced full SEDs for the 2757 Stripe 82 X-ray sources with spectroscopic redshifts using CIGALE (Code Investigating GALaxy Emission). I further used this tool to derive estimates and uncertainties for the host galaxy stellar masses and star formation rates of these sources. I contributed my results to Dr. Powell's project investigating the clustering of luminous AGN. This contribution led to the conclusion that clustering differences between AGN samples selected by varying methods are a result of selection biases, as opposed to a previously claimed luminosity dependence. I gave an oral presentation on this research at the Leadership Alliance National Symposium and I am a co-author on a paper published in the *Astrophysical Journal* describing our results.

While at Yale, I explored areas of physics that are not thoroughly researched at my home institution. I was very interested in learning more about particle physics and its use in astrophysics and cosmology research. I attended many research presentations, spoke with graduate students, and arranged a meeting with Dr. Charles Baltay to discuss his astro-particle physics research. These experiences led me to become increasingly interested in how the mysterious dark matter and dark energy that permeate our Universe cannot be described by the Standard Model of Particle Physics. Since then, I have been driven to pursue research on this exciting topic.

This past summer, I worked with Dr. Tobias Marriage at Johns Hopkins University (JHU) as part of the Cosmology Large Angular Scale Surveyor (CLASS) team. The main goal of CLASS is to map the polarization pattern of the cosmic microwave background (CMB) to reveal fundamental aspects about the nature of the early Universe. I studied the circular polarization of galactic synchrotron emission from the Milky Way galaxy, and its role as a foreground to detecting the circular polarization of the CMB. I cross-correlated a data-driven model of galactic circular polarization with the CLASS circular polarization maps in order to determine if CLASS is sensitive enough to detect the expectedly weak galactic circular polarization signal. I ultimately determined that CLASS is not currently able to detect this signal, however, I succeeded in producing upper limit estimates on the contribution of galactic circular polarization to the CLASS maps. I greatly appreciate how this project gave me direct experience applying theoretical models to observational data. During this work, I also participated in two summer schools at JHU, a theory-based cosmology course and a computational course focused on CMB analysis techniques. These courses, in conjunction with my research project, solidified my desire to pursue a research career in cosmology and further prepared me to succeed in this field.

I am very excited by the possibility of pursuing my PhD in physics at the University of Texas at Austin (UT Austin) because of the broad array of cosmology and dark matter research being conducted at this institution. I am particularly interested in working with Dr. Katherine Freese, Dr. Kimberly Boddy, or Dr. Can Kilic. I would like to work with Dr. Freese because her theoretical research on dark matter strongly aligns with what I aspire to study. Dr. Freese is an inspiring woman in physics and an impressive leader in her field and I would be truly honored to pursue my graduate studies in her research group. Additionally, Dr. Boddy's dark matter research is of high interest to me. I am specifically interested in her research on using the CMB to search for dark matter interactions. I have gained a lot of experience in working with CMB data from my research at JHU and I would like to apply these skills to work with Dr. Boddy to search for dark matter in the Universe. Furthermore, I am very interested in Dr. Kilic's theoretical particle physics work on dark matter because I desire to work at the intersection of particle physics and cosmology to uncover the particle nature of dark matter. During graduate school, I would also like to be involved in outreach and mentoring activities to promote diversity in physics. I was excited to learn about the Graduate Minorities in Physics Program (GeM) that exists at UT Austin and I aspire to be highly involved in this group and its mentoring program. I believe my prior research training, my current interests, and my desire to foster a diverse and inclusive scientific community makes me an excellent fit for UT Austin's physics PhD program.