When I entered college, I started as a double major in saxophone performance and physics. I had always enjoyed the freedom and creative outlet being a musician offered but the overly competitive nature of the major pushed me away. I wanted something that would not only enable me to be free to explore ideas and be creative but also would let me explore those in a collaborative setting. While I have always been fascinated with space, I never considered astronomy a career choice until I took a class for non-majors. I found the content of the class fascinating and excelled in the course so much so that the professor suggested that I consider pursuing astronomy. I eventually took them up on that offer, switched my major to physics and astronomy, and have enjoyed the freedom of ideas it has allowed me to explore ever since. **As an astronomer in academia, my goal is to continue to push the bounds of discovery in understanding the mechanisms driving star formation and to promote greater access to astronomy for youth and the general public.**

Intellectual Merit:

As an undergraduate at the University of Kansas (KU), I got involved in research on the interstellar medium (ISM) with Dr. Mills in the Spring of 2022 while taking a class she taught on the subject. My project has focused on the dust-embedded star clusters in the nearby galaxy NGC 253. These clusters are a fantastic test bed to analyze extreme star formation and function as great analogs to the heightened star formation in the early universe. I specifically am looking at the properties of the dust surrounding these clusters using the highest resolution Band 9 (690 GHz) data from the Atacama Large Millimeter Array (ALMA) to date. Currently, I have shown the Band 9 optical depth is four times the depth found at Band 7 (350 GHz), which fits models for dust optical depth related to frequency. I have also shown that the dust optical depth for the majority of the star clusters is optically thick which has impacted how we determine the gas mass of these clusters. My work to characterize these extremely obscured clusters will play a key role in interpreting our team's incoming JWST data.

In addition to my research at KU, I participated in the summer 2023 Research Experience for Undergraduates (REU) at the Institute for Astronomy (IfA) in Hawaii under the direction of Dr. Thales Gutcke. At the IfA, I explored hydrodynamical simulations of galaxy formation using the highest-resolution dwarf galaxy simulation to date called LYRA. This simulation, and others like it, allow us to study the hierarchical nature of galaxy formation (the build-up from small systems to larger systems) and are excellent test beds for us to test feedback mechanisms, such as energy and momentum imparted by supernovae. LYRA is unique in that it resolves individual supernovas and includes a full multiphase ISM down to 10K. At the start of my project, LYRA was still in its infancy and minimal work had been done to compare the results of the gas properties to observed dwarf galaxies of similar size. My project utilized my knowledge of the ISM and coding skills I developed from my other project to compare the gas output to Local Group Dwarfs. My work has shown that the simulation fits well with most observed gas

properties of Local Group dwarfs. However, the abundance ratios of elements such as carbon and nitrogen, which have metallicity-dependent yields for their total amount, have significant offsets. This discovery shows that more work needs to be done on all levels to better model supernova feedback where such metallicity-dependent yields occur in order to properly simulate the chemical evolution of gas in galaxies. This work has led to a draft as the first author of an upcoming paper. While my research interests lie outside the scope of this project, having experience working with simulations has better equipped me to be able to strongly relate observations to theoretical predictions.

Broader Impacts:

On top of my dedication to my work as a researcher, I am extremely involved in many aspects of my institution's physics and astronomy department. I am currently serving my second term as the president of the Society of Physics Students (SPS) KU chapter. SPS provides students with professional development not typically seen in a classroom such as CV development and provides students with the resources to learn about current research and get involved in research at the university. Furthermore, majoring in physics and/or astronomy can be very isolating and intimidating with the much smaller class sizes which have only been exacerbated by the national decrease in physics and astronomy majors. By participating in SPS, students have a social space for undergraduates at all levels to interact and support each other. When I began my first term in 2022, participation was at an all-time low, as a result of the pandemic. I set out to increase student participation and solidify the club's standing and involvement in the department. Today, participation in the club has more than quadrupled, and SPS is involved in all undergraduate aspects of the department. As president, I've helped more than 20 students get involved in research by inviting faculty to come to meetings to advertise their research and by hosting REU workshops to help students prepare applications.

I've also helped organize and run numerous k-12 outreach events throughout the academic year. Each year this includes the Carnival of Chemistry in the fall, an outreach event organized by the chemistry department, and demos at elementary school science fairs in the spring. These events allow students to share the joys of physics and astronomy while also practicing explaining concepts to a general audience. It's a fantastic way to promote science to youth and helps inspire the next generation of scientists. At many of these events for youth, I have introduced them to free online computer demos that allow them to play with and learn physics concepts and to explore their ideas such as "What if I increase the mass of the earth? How will that affect the moon's orbit?" and see visually what would happen.

I also serve as an Undergraduate Representative in the KU physics and astronomy department assembly and in the Undergraduate committee where I relay the opinions of the undergraduate body on matters such as curriculum development, class offerings, and improving undergraduate classes. As with involvement in SPS, how we teach and set up our classes is a key aspect for retaining physics and

astronomy majors. By having students involved in the discussion of that process, class curriculums can be better tailored to student's needs in preparation for graduate school or work in industry.

In this role, I proposed and created the Undergraduate Ambassador Program. This program is designed to help with the process of recruiting and/or promoting physics and astronomy at KU to prospective undergraduate students. As ambassadors, current students meet with prospective students to answer questions about majoring in physics and astronomy from a student prospective. Going to college is a scary process for most, so having someone around your same age in the same degree talk to you about what it's like is extremely reassuring. Recently, KU hosted a majors fair where high school students had the opportunity to tour KU and learn about various majors offered. As an ambassador, I helped run the physics and astronomy booth where I advertised the majors we offer and directly answered students' questions about coursework and classes. The success of this event and other early trials of the program has led to the program becoming a part-time pay position for undergraduates in the department.

My enjoyment of discovery and being creative through research and sharing that interest through outreach has compelled me to apply to graduate school. I specifically want to pursue a Ph.D. in astronomy where I'll specialize in observational radio, millimeter, and infrared astronomy. I want to focus this specialization on continuing to study the ISM so I may help unravel the unique physics and chemistry at play in the gas that shapes a galaxy. With a doctorate in astronomy, I want to work as a faculty member at a university so that I may continue to conduct research as well as teach and do outreach. I plan to create a vibrant research group of fellow colleagues at all levels and will mentor undergraduate and graduate students. Staying in academia will not only allow me to push the bounds of discovery in the ISM but will enable me to expand the outreach we do to drive interest in astronomy in the general public. The NSF GRFP will help me pursue my goals by providing the resources I need to focus on research.