Astronomy first interested me because I thought space was cool. That interest motivated me to take physics and calculus in high school, and teach myself how to code, but I did not have any context for what astronomy was or what a career in the field meant. Once I started taking astronomy classes and doing research, I found that the compelling thing about astronomy is the challenge it introduces into science: Unlike an experiment at a lab bench, an astronomical experiment cannot be replicated. The mystery of space was what first drew me to astronomy, but mentorship and support, along with hard work, are what have kept me here. **My goal for graduate school is to continue working on research that I am passionate about, while helping others to feel as supported as I did within astronomy when I first entered the field.**

As an undergraduate, I worked 20 hours a week, first in a food service job and then as a tutor and a grader for a physics course, because my parents weren't able to help me pay for college outside of tuition. Having work obligations on top of research and coursework required a level of focus and efficiency that was challenging but has served me well, especially in grad school, with its many conflicting demands on my time. I also have severe depression, and learning to account for my mental health while I was so busy was challenging but fundamentally important. One way I manage my mental health is powerlifting, which I have done for the past 3 years. It not only keeps me active and happier, but has also taught me lessons in patience, hard work, and focus that have reinforced what I have learned in academia.

**The fundamental appeal of astronomy is the opportunity it provides to explore hard problems with a limited set of tools: the only way we can understand astronomical objects is studying the light they emit.** Although we have found many ways to extract information from that light, our options are inherently limited, which presents a challenge when trying to understand physical, changing systems. Trying to understand the most complex physical systems that exist with limited ways to verify theories can be profoundly frustrating, but the feeling of making a breakthrough on one of these topics is unrivaled by anything else I've experienced.

***Intellectual Merit.*** **Throughout my undergraduate studies I carried out several research projects, one of which has already resulted in a published first-author paper.** I began my first research project in the fall of my sophomore year, working with Prof. Daniel Wang and the CHANG-ES (Continuum HAlos in Nearby Galaxies - an EVLA Survey) collaboration. I worked with another undergraduate and a graduate student to identify active galactic nuclei (AGN) in edge-on galaxies, where the central black hole is obscured by the galactic material. AGN impact star formation in galaxies through feedback, so an accurate count of AGN-hosting galaxies informs our interpretation of star formation across the universe. I reduced much of the interferometric data, helped develop our analysis technique, and analyzed one of the galaxies in our sample. **My work on this project lead to a coauthorship on *CHANG-ES VIII. Uncovering hidden AGN activity in radio polarization,* MNRAS, 2017.**

Next, I worked on a class project that began with my first observing experience: 4 nights at the WIYN 0.9m telescope at Kitt Peak National Observatory. I worked with a colleague to study blue compact dwarf galaxies (BCDs), supervised by Dr. (now Prof.) Anne Jaskot. The reasons for star formation initiation and quenching, and the cause(s) of the disproportionately high star formation rates in BCDs, are not known. We developed, proposed for, and carried out a project to see if the intense star formation in BCDs is caused by a merger with another smaller galaxy. We selected a sample of BCDs with previously observed HI companion clouds, imaged them in a clear optical filter, and analyzed them to see if there was optical signal indicating that the cloud was actually a faint dwarf galaxy. We did not detect any counterparts, but we were able to set upper limits on the existence of faint dwarf galaxy companions. We did discover a new tail of young stars in one BCD that is evidence of star formation caused by either a merger or some previously unknown disruption. **I PIed an observing proposal that was awarded two nights to make follow-up observations of this tail and obtain photometric colors to start to constrain the age of the stars, although we were ultimately weathered out.**

My third undergraduate research project began as an NSF Research Experience for Undergraduates (REU) project with Dr. Lisa Prato at Lowell Observatory. I used five years' worth of high-resolution near-infrared (NIR) spectroscopy to study two binary star systems which are in the same star forming region, and thus of about the same age. These systems are surrounded by hot gas that is falling onto the stellar surface, making their photospheres extremely hard to observe. The fundamental properties of young stars inform our understanding of core star formation and stellar evolution physics, which affects interpretation at scales from planet to galaxy formation. I identified key photospheric lines and used them to determine the spectral types of the four stars in the two binary systems. I showed that the temperatures are similar, which (since they are all the same age) implies that the stars are all about the same mass.

I continued my REU project as my senior honors thesis, which I completed in December 2017. The goal of my work was to understand the environments where these stars evolve. It also demonstrated that binary stars of equal masses, from the same star-forming region, can present a laboratory to study the range of variations in the stellar assembly process, even in identical environments. I found that the four stars in these systems all show variability, indicating that they are accreting material from their circumstellar disks onto their surfaces, but the level of variability is different for each star. I examined the accretion variability in these two systems and found that the observed variability is caused by material falling onto the star in a more complex way than previously thought. **This work resulted in my first first-author paper ('*S and VV Corona Australis: Spectroscopic Variability in Two Young Binary Star Systems*', Sullivan et al. 2019, ApJ).** I also presented my work as a poster at the American Astronomical Society meeting in January 2018, and at *Star and Planet Formation 2,* a focused topical meeting in June 2018.

I designed a follow up experiment to study the accretion variability in young stars on hour-to-day timescales, then **wrote and successfully proposed (as PI) for four half-nights on the NASA IRTF telescope this summer to perform my study**. I have continued to study young stars at UT Austin as a graduate student, working with Prof. Adam Kraus on young binary star population statistics. I am currently preparing a publication quantifying the effects that undetected binary stars have on our understanding of young stellar population statistics.

***Broader Impacts (Outreach, Education, and Mentoring).*** I will develop and present a seminar series of workshops to introduce key astronomical terminology to underrepresented minority students in the TAURUS internship program, which provides research experience for underrepresented astronomy students. I will facilitate retention of these students by increasing their comprehension of jargon and giving the students a greater sense of belonging in astronomy.

As an undergraduate, I discovered a love of teaching and outreach. I spent 2.5 years as a peer tutor at the campus free tutoring center, teaching math, physics, and astronomy to other undergraduates in individual and group settings. I also served as a peer mentor and evaluator for other tutors. From tutoring, I learned the importance of engaging students in their own learning. **My seminar series will incorporate the skills I learned from tutoring, especially student-driven learning and peer-to-peer instruction, which are proven pedagogical techniques.**

I was one of the founding members of Minorities in Astronomy and Physics (MAP) at UMass, which supported and advocated for students in underrepresented minorities in physics and astronomy, including women, LGBTQ students, and students of color. When that group was absorbed into the pre-existing physics and astronomy clubs, I joined the astronomy club as the inaugural Diversity Officer, to continue the work I had been doing with MAP. I also started doing outreach at the Astronomy Club's on-campus telescope, and was eventually elected as the President of the Astronomy Club and the Assistant Director of the observatory for my senior semester. **As the Assistant Director, I was one of a group of three undergraduates running public observing nights for greater than 50 attendees per week. This experience reinforced my love of making astronomy accessible and understandable for people of all backgrounds.**

In graduate school, I have mentored two UT undergraduates since the inception of a grad-undergrad mentoring program, and I have helped with events such as Girl Day, a math and science outreach event for middle-school girls. My most impactful outreach has been with the TAURUS internship program this summer: I mentored an undergraduate from the TAURUS cohort, gave a talk to the TAURUS scholars, and accompanied them on a trip to McDonald Observatory to help teach them observing skills.

The TAURUS scholars come to UT with varied familiarity with astronomy, so some of them have no astronomy background, and they come from home institutions where they do not have opportunities for research. For students with limited exposure to research and astronomy, the frequent use of obscure definitions presents a concrete limitation to their interest in and access to the field. **Terminology is an unavoidable aspect of scientific communication, so one way to help the TAURUS scholars feel more comfortable in astronomy and potentially increase the retention rate of these students is to teach them the scientific shorthand that they will commonly encounter.** Thus, I will create and facilitate a workshop that offers an overview of astronomy basics. For example, **I plan to have one meeting cover of flux units, magnitudes, unit conversion, CCDs, and data reduction, to give a general overview of techniques in observational astronomy.**

Through tutoring, I have extensive experience in teaching individually and in small groups. I also learned how to synthesize complex material to communicate relevant points. Especially in astronomy, this is necessary because of the extensive historical context and complexity behind each concept. Through outreach, I have learned how to explain complicated ideas at levels that are accessible to people at many different levels of knowledge, which is critical to bring new students into the field and engage with the public about our important work.

When I decided to be an astronomer ten years ago, I had no idea what that path would look like. I have received support and encouragement in my path from many people, and I have already been able to give back. My future plans are to pursue a career as a research scientist at either a university or a research center, and I plan to remain actively involved in outreach, teaching, and mentoring, especially of underrepresented and marginalized students. An NSF Graduate Fellowship award will allow me to concentrate on work that I love while giving other students the same level of support that I was lucky enough to receive as I found my path.