At the University of Colorado at Boulder, I am working on an honors thesis project using machine learning to create synthetic images of the solar surface, and using these to train a neural network to perform a Fourier filter. This separates solar granulation from resonant spherical harmonics oscillating on the solar surface without the need for an observationally expensive time-series. The experience of modeling and simulating seemingly random physical phenomena has been one of the most rewarding experiences I have had, and is a driving factor in my desire to enter the University of California, Santa Cruz Astronomy and Astrophysics graduate program. This project, which began in 2020, led me to apply to REU programs related to simulations, and **I completed my 2021 (delayed from 2020) REU at Montana State University simulating solar flares**, investigating loop-top ridge heating post-flare, and learning about solar magnetodynamics. These research projects have taught me valuable skills in parameter searches and machine learning, for example, but have most importantly helped me understand that modeling and planetary science is what I wish to pursue in graduate research.

Professor Mark Rast (CU Boulder) and I began working on the previously described machine learning based Fourier filtering project before my REU and is currently ongoing, where I will present my project as an honors thesis in the spring. This project is supported by the Lab of Atmospheric and Space Physics through a scholarship awarded based on the quality of work proposal. More about this scholarship can be found on the Charles A. Barth Scholarship webpage. This project has provided me experience in a section of modeling quickly coming to prominence – **machine learning**. Learning the statistics involved with modeling and machine learning in **Python** as well as the possible applications of machine learning has increased both the types and number of projects I could work on. By pursuing a minor in statistics and building my knowledge of machine learning from the ground up, I have learned how to apply well-established knowledge from these fields while also having experience in learning from scratch without a class to guide me. **It is the experience in machine learning, neural networks, and statistics that I hope to bring to UCSC**, along with the lessons learned in my research experiences: presentation skills, writing, independence, question asking, and more.

My REU experience at Montana State University helped mature my interest in modeling and gave me tangible experience – the results of which will be presented at the annual **AGU conference.** There have been questions about the origin of bright loop-top plasma ridge structures during solar flares, and my work at Montana State was running simulations to test if compressive magnetosonic shocks with drag could reproduce the observed structure, densities, and magnetic field retraction velocities. My work cast doubt on this idea, opening the field for alternative solutions or approaches. Throughout the REU, I spent significant time reading papers, scouring the **IDL** code of the simulations I was running, exploring different parameters that impacted heating after solar flares, and comparing the simulations to existing observations. From beginning to end, it curated my interest and applicable skills in modeling while also developing my knowledge of solar magnetic structure.

However, solar physics is not where my heart necessarily lies, and as such I have used these experiences to develop skillsets in modeling while taking undergraduate and graduate courses in planetary interiors, surfaces, atmospheres, formations, dynamics, and more. During these classes, atmospheres has always been the most interesting topic to me due to the fascinating dynamics within an atmosphere, the differences between atmospheres in our solar system, and the vast problems that lie ahead in the field that I hope to tackle. The combination of my desire to study planetary science and modeling has let me to UCSC – the place I believe most suitable to bring together my studies and work, while furthering my development as a scientist.

There are many topics I am interested in with reference to studies of exoplanets and planetary atmospheres, but the combination of the two is the field I hope to research: **exoplanet atmospheres**. Identifying and understanding exoplanet atmospheric spectral signatures is a difficult, yet critical, part of studies in habitability, characterization, and formation of atmospheres. This is something that my

graduate research would focus on, especially with the launch of JWST, a critical mission in understanding exoplanet atmospheres. Phosphine has been established as an important possible signature of life in these atmospheres, and my goal is to work in this area of modeling what phosphine signatures might look like, how we might use JWST to look for signatures of phosphine, and participate in the search for phosphine signatures in atmospheres via observation. This is ambitious for a graduate student to do alone; in applying to UCSC, this opportunity would allow me to actively participate in research in the area of spectra and characterization/modeling of exoplanet atmospheres. The diversity in strengths of the faculty and research conducted at UCSC would be well-suited to my many interests in planetary sciences. I believe I can bring skills and hard work to the table to make my studies in these programs beneficial for myself and the program. Professor Jonathan Fortney's work in understanding exoplanet atmospheres particularly interests me and aligns with my objectives for graduate study. Modeling and analyzing spectra of Earth-like world would go a long way in developing my skills as a scientist, but I believe my previous experience in modeling and my coursework would be beneficial to the department and a research group.

Throughout my undergraduate career, I have been taking courses at the graduate and undergraduate level to prepare myself for the physics and mathematics that will come with entering a graduate program. I have taken graduate level applied partial differential equations, as well as graduate level planetary surfaces and interiors, both of which I received an A in. These courses have taught me lessons in the mentality shift between undergraduate and graduate level studies, preparing me for this shift to a graduate program. Because of this, I am confident in my ability to adapt to graduate studies, but I am also prepared to take on the more difficult math and physics in a graduate program. I have taken a full year of classical mechanics, electrodynamics, and quantum mechanics, meaning I am confident in succeeding at UCSC. I understand it will be difficult and take perseverance, but the graduate courses have helped me understand that I want to give my best effort.

Along with research, it is an equal, if not higher, priority to spend my career in the lecture hall, classroom, and community, helping students of all ages engage with science and technology. We are in a critical time where science literacy is becoming significantly more important; by engaging students with science that UCSC and the world is participating in, we can do our part in ensuring the future of the scientific community, and society as a whole. Underrepresented and underprivileged communities may have few opportunities to be exposed to the science a university or institute conducts, and it's my goal to do anything in my power to ensure students understand what I have been told throughout my undergraduate career – science is for everyone and can be done by anyone with curiosity and a drive to learn more about the world around them. My interest in science education research and a desire to help my community has placed teaching as a solidified part of my long-term career goals. UCSC's program would be a critical place for me to learn skills and gain experience in teaching while using the available resources to help the community.

My interest in graduate school is a shared sentiment with nearly everyone in the field: a deep desire to learn more about the universe and to share it with the rest of the world. UCSC's programs will help me learn the skills I need to conduct research on planetary systems and exoplanets, while I can, in return, bring the passion, desire to learn, and hard work faculty might want in a graduate student. Beyond graduate studies, I hope to continue research and being as involved with teaching as possible. Being involved in academics at the university level would be the best course to achieve these goals, which is why entering a tenure-track position would be my post-graduate goal. UCSC's program would be the prime place to aid in achieving this goal.

Thank you very much for taking your time reading this statement. I look forward to hearing from you soon and exploring the cosmos!