**What I can do to help further humanity's expansion into space**

Interplanetary travel and even interstellar travel are not going to happen on their own. It will take years of collaboration, finances, and time to develop the necessary technology. I hope to be a small part of that effort so three generations from now, humanity can travel among the stars.

Ever since I have stumbled into the niche area of propulsion that is solar sails, I have been infatuated with the idea that light could be used as a "propellant." In August 2020, I was able to publish my research on the application of graphene to solar sail gossamer films, discovering by my rudimentary setups that graphene can significantly improve the reflectivity of these thin films. This is an exciting discovery, but the technology is not possible at this time. The largest monolayer piece of graphene created was about the size of a credit card, which is certainly not large enough to cover a future solar sail. Solar sails will only get bigger, but graphene technology is much more meticulous. This may sound discouraging; however, if we are not learning what needs to be improved, we will not have the time to improve it. We need people to explore the seemingly impossible, so we can eventually make it possible.

Last summer, I had the privilege of interning at NASA Marshall Space Flight Center, in which I was lucky enough to work on developing another type of in-space propulsion: electric sails, or e-sails. While this propulsion device is still in conceptual stages, it shows what I believe to be great potential. More specifically, an e-sail would theoretically be able to accelerate longer than a solar sail. Last summer, I worked with a team attempting to measure e-sail thrust within a lab setting – the first time anyone has tested this that I am aware of. I was able to help the team with testing design and help get them to a phase where preliminary testing was feasible.

I have already created and been involved in multiple efforts to further the capabilities of humankind to travel through the galaxy. Since the beginning of my professional career, this is a desire that I hold close to my heart. Although I know I will not live to see my efforts fully pay off, I believe the world needs people like me to help get humanity closer to interstellar travel. Although my e-sail internship concluded last summer, my desire to advance the technologies of in-space propulsion devices did not. Under the advice of a colleague, I hope to repeat my research on graphene and its application to solar sails with higher precision. I also have a few questions about the combined material's tensile and electromagnetic properties that have been left unanswered. The pandemic has placed this goal on hold, but once lab spaces are more accessible, I plan to continue this study.

This summer, I will be working with NASA Marshall and NASA Langley on Lunar Space Haven, a sustainable astronaut habitat on the moon. This work is obviously still at a very conceptual and theoretical stage, but hopefully, it will be put to good use when needed. More specifically, I will analyze potential structures made of varying materials based on their efficiency to shield astronauts from radiation and micrometeoroids for longer periods of time. This project is directly correlated to the efforts of expanding humanity into space.

Following my internship, I will begin my undergraduate degree at the University of Central Florida. When I visited the campus, I reached out to a nanomaterials lab to get the chance to see some of the interesting research happening at UCF. Following my tour of the lab space, I was offered a lab assistant position for Fall 2021. The lab works with graphene, aerogels, thin-film coatings, lunar dust mitigation, and many other niche areas. I plan to begin working there as soon as I start classes to gain more research experience. I believe the research occurring there is utterly unique, and it would give me the chance to put my nanomaterial knowledge to the test. While the lab is more of a development lab, the applications of these materials will likely have ripple effects in the future of human spaceflight.

These are just a few examples of my near-term goals to help the effort of space exploration. I am an advocate for the increased NASA funding proposed by the Planetary Society to the Biden Administration. I believe the ways in which we search the cosmos will have benefits on our planet as well. There is interesting work being done at MIT called Space Enabled. This team works to put space technologies to use on our own planet to mitigate carbon emissions and slow the climate crisis. I hope to someday be in a position where I can advocate more publicly for space exploration and its importance for humankind.

In the long term, there are so many things I hope to be a part of that will help our expansion to space. I am interested in other in-space propulsion devices besides solar sails and e-sails, as well as unique research that will make a difference in the future of spaceflight. Being a materials engineering major, I am naturally drawn to the material challenges that prevent us from testing and launching other propulsion devices, but I am also interested in the engineering and logistic challenges that keep us from launching devices such as e-sail and many others. I am incredibly impressed by the prior generations that managed to journey to the heliopause with the Voyager missions, but I believe we can and will do better than that. I believe humans will live to see photos, videos and potentially travel to distant worlds. But that will not be possible without people taking interests in space exploration at its elementary phases.

When we work together, we accomplish great things. I hope my future career will be riddled with collaboration and ingenuity that will lead to groundbreaking discoveries. They may not be applicable during my lifetime, but I hope that my research efforts will help generations to come to venture to places we could only dream of today.