Senior Project Proposal

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I. Title of Project: Luminous Blue Variables: Why do they vary?

II. Statement of Purpose:

How do we observe luminous blue variables (LBVs) and understand the data that we collect on LBVs? To figure this out, I must first learn what LBVs are and learn the answers to the following questions. How do we know if a star is an LBV? How do LBVs interact with other cosmic bodies? Why do we study LBVs? How do we study LBVs? What kind of code is needed to study LBVs?

III. Background:

In my fifth-grade science class, my teacher finished the last unit with some time left in the year so she filled that time by teaching astronomy. From the moment I learned about the sun and moon, I was captivated, and it only got more interesting as time went on. I learned about the stars outside of our solar system, how they formed, and how they died, and I learned about time changing when near a black hole. Everything about astronomy interested me.

A year later, my grandparents got me a telescope for Christmas. Before even opening the rest of my gifts, I ran outside, set it up, and pointed at the sky. I could barely wait for nighttime so that I could look at the moon and planets. The first thing I did was point it at Jupiter. It was the first time I was ever able to see its red spot. This only furthered my love for astronomy. Now, I am allowed to further explore my curiosity and I cannot wait.

IV. Prior Research:

LBVs are stars that are usually bright and blue due to how massive they are and how evolved they are, but they are mostly characterized by their unpredictability and variations in brightness. As of right now, only 20 LBVs have been discovered. This means that they are exceedingly rare and hard to find. This also means that they are hard to observe and research due to their rarity.

LBVs were first discovered in 1922 but they were too difficult to research at the time. Even now, they are still difficult to research, however, there is now one way to research them. In April of 2018, the Transiting Exoplanet Survey Satellite (TESS) was launched into Earth's orbit. We are now able to slowly observe and collect some data on LBVs. Not long after being able to observe these stars, the research on them was met with another roadblock. The data collected was unpredictable and difficult to understand.

Dr. Noel Richardson, a professor at Embry-Riddle Aeronautical University (ERAU), is currently trying to understand this data. He is working with a student at ERAU to come up with a code to help make this data more understandable. A few years ago, someone had been able to come up with a code that fits well with the data. However, this was soon learned to be false because of errors within the code. Now, Dr. Richardson is working on fixing the coding to continue studying LBV's

V. Significance:

LBVs are studied because of their rarity, instability, and life span. Because they are some of the biggest stars in the observable universe, they have a very short life span. This also causes them to be very rare because stars are rarely this large and they die quickly. When they die, they will likely cause a supernova. They are also very unstable. Their size, luminosity, and brightness are constantly changing. Therefore, they are studied to learn about the mysteries of the universe.

Because their luminosity, size, and brightness are inconsistent, researchers have been trying to find a way to predict these values but it is hard to tell. I hope to work with Dr. Noel Richardson to discover a way to find any patterns in the way that these stars change. I hope to bring fresh eyes to a long-studied problem and help as much as I can with the research. This will hopefully spark new ideas in many astronomers around the world.

VI. Description:

For the first week, I will be doing mostly internet research and interviews. This is to make sure I fully understand what I will be doing and what my responsibilities will be. After that, I will be doing observations. I will be gathering data on the stars that I am observing using telescopes. Lastly, I will be doing experiments to

understand the data that I have collected. My final product will hopefully be a complete understanding of the data that we have gathered and contribute to the ongoing research of Embry Riddle University on the subject.

VII. Methodology:

First, I will get a more in-depth understanding of my mentor's research on the topic. Second, I will gather data about LBVs with my mentor. Third, I will work with my mentor to create a code that will help us understand the data that we gathered. Fourth, if step three works out, we will be left with good and understandable data that we will put together to help us further understand these stars.

VIII. Problems:

The most likely issue I see is errors in the code. There is never a code that has been created without any bugs. We will need to run experiments to make sure that the code works as intended. Another problem I see occurring is even if we get the code working well, it may not be working out to be as well as we think. These stars are called variable for a reason and that is because they are random and hard to study. It may be beyond our understanding to fully know why these stars behave the way they do.

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