Observing Exoplanet Transits at the UMD Observatory

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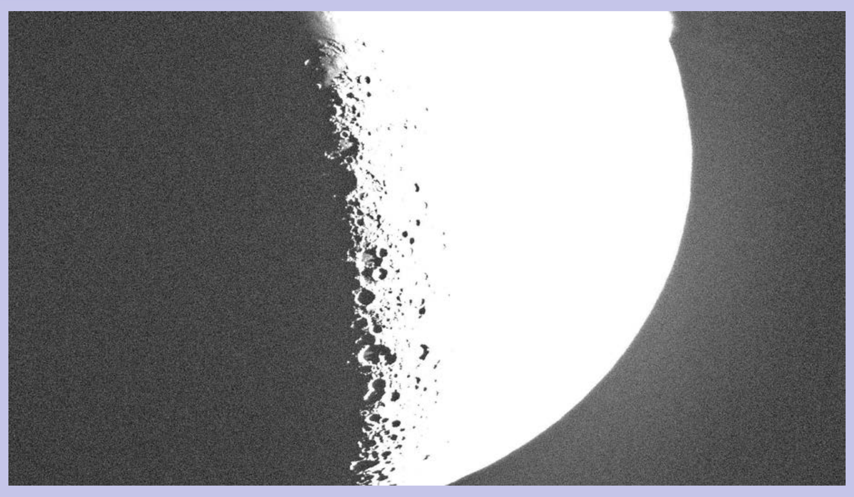
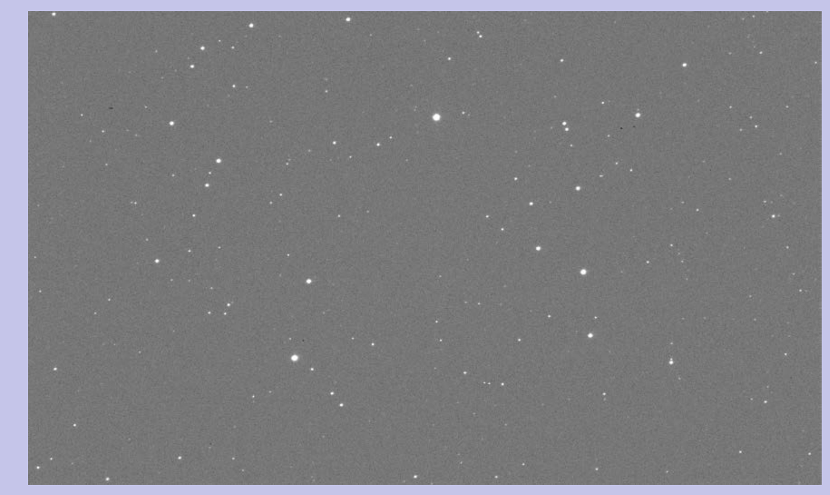




Introduction

Exoplanets are planet-sized objects orbiting around a star found outside of our solar system. There are more than 1000 confirmed exoplanets, which have been discovered with many different methods. One method used to find or observe exoplanets is called the transit method. In this technique, the view from Earth is head-on, which means that one can observe the exoplanet passing directly in front of its star. This action slightly dims the brightness of the star at periodic intervals.

Site Information:

Name: University of Maryland Observatory
Address: Metzerott Rd. between Adelphi Rd. and University Blvd in College Park, MD.
Supervisor: Ms. Elizabeth Warner
Site mission: To educate both Astronomy students and the public about astronomical observations.
My goal: To use the telescopes and cameras at the observatory to observe and take pictures of exoplanet transits, then analyze the data and obtain a light curve with AstroImageJ.

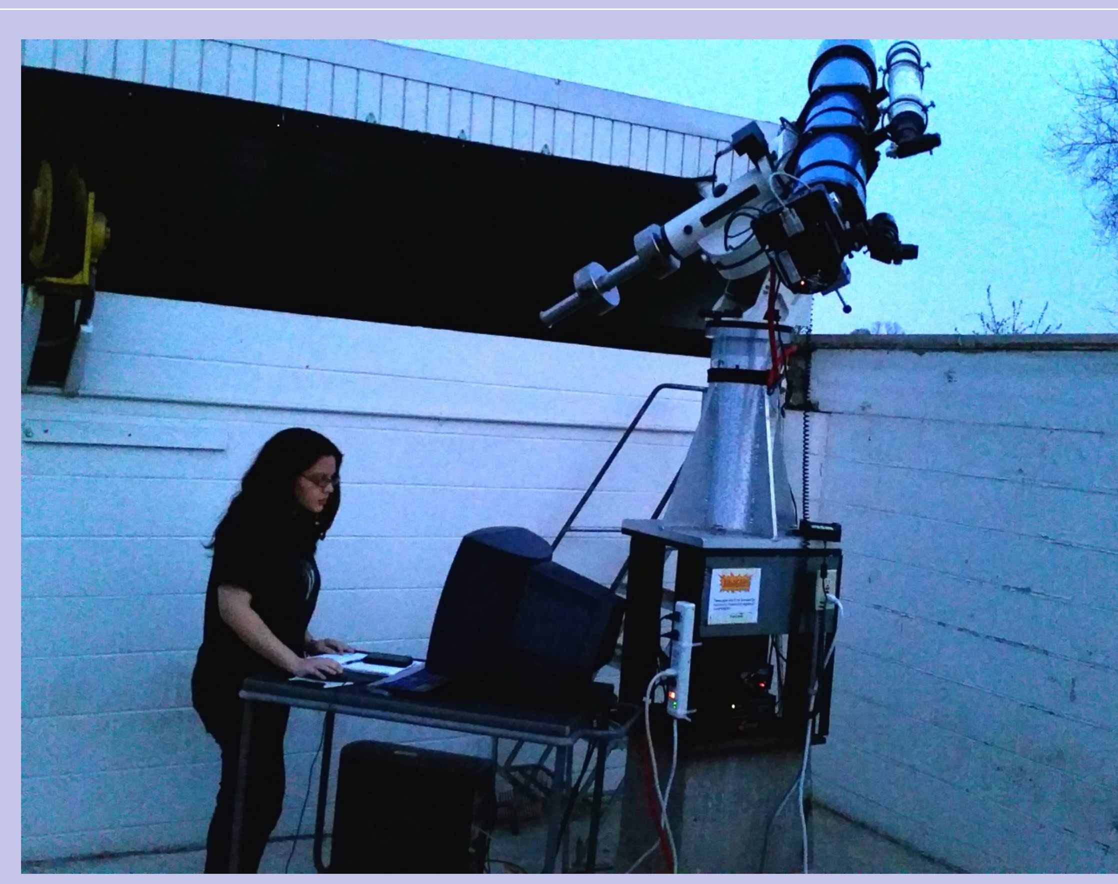
Issues:

Being able to observe phenomena depends mostly on the weather and the target availability. Ideal conditions for observation include clear skies and little wind. For many of the times we went to the observatory, skies were overcast with possible rain. Another issue is that the cameras need to be cooled down so that frost does not accumulate on the lens. This process often takes about 3 hours. An additional issue is the difficulty of locating the target star. For exoplanet transits, we needed to find the star by first syncing with the closest major star in that section of the sky. The next step was to move to the target star's coordinates, and pinpoint it directly by comparing a picture of it online to the picture taken with the camera.

Activities:

During fall semester of 2014, I attended weekly classes at the observatory. Ms. Warner taught us how to use the telescopes and cameras. We practiced using the equipment by locating and taking pictures of stars and planetary nebulas, such as Alberio and M57 (the Ring Nebula), respectively. We also took a few pictures of the Moon. As the semester progressed, we began focusing more on our projects. Ms. Warner divided us into groups based on what we wished to research. My team began to practice syncing the telescope with stars. A few weeks before the fall semester ended and a few weeks into the spring semester, we practiced locating target stars for exoplanet transits. This was a challenge, because we needed to sync with a star and then go to the nearest coordinates, which we needed to estimate for the telescope finder. It was also difficult to compare the picture to the image finder, because the image was often reversed or turned in a different direction. By the time we found the target star, the transit was over. After spring break, we began going to the observatory as often as possible, whenever there were clear nights. Unfortunately, we were hard-pressed in obtaining data. Many of the nights that we chose were overcast and rainy, and on the clear days, we did not have enough time after cooling the cameras to sync the telescope and locate the target before the transit began.

Top Left: Test image of the moon
Top Center: Alberio, a binary star system
Top Right: Test image that may include target star HAT P 29



Left: Me taking flat field images with the 7-inch telescope at the UMD observatory

Discussion:

This research project was a unique opportunity that allowed me to experience direct astronomical observations. I have always wanted to try using telescopes to take pictures, especially since I am interested in astronomy. However, I did not expect for the process to be so trying and tedious. It requires a lot of skill and patience to properly utilize the equipment and locate the target. Clear conditions are also imperative to making observations and obtaining good data. Due to bad weather and difficulty with locating the target star for the exoplanet transit, my teammate and I were unable to take pictures of the entire transit, and thus had no data to analyze. However, if we had obtained our own original data, we would have been able to plot a light curve from the sequence of pictures of the transit. If it was done correctly, we should have seen a curve similar to and upside-down bell curve. This represents the brightness of the star over time, which dims as the exoplanet eclipses the star. The results vary, depending on the duration of the transit, as well as the size of the exoplanet, and can reveal more information about it.

Future Work:

I hope that in the future I can continue to work with telescopes. However, I feel that this will be more of a volunteer or hobby activity. I think that this experience truly opened my eyes to the observational aspect of astronomy. I have no doubt that I would like to continue doing this type of work in the future.

Acknowledgments:

I would like to thank my SGC professors: Dr. John Merck and Dr. Thomas Holtz; my mentor: Ms. Elizabeth Warner; my teammate: Matt Livas; and my astronomy professor, Dr. Douglas Hamilton, for helping me obtain this research opportunity. Thank you very much!