Explore the Universe

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CPS Program: http://www.scholars.umd.edu/SDU/
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Research Question/Goal

To get a better understanding of how astronomers collect and analyze data of a celestial object.

Research Context

The Explore the Universe program is a CPS SDU program focused on giving people insight into what astronomers do. Students can choose between the options of learning how to take and calibrate images of:

1. Exoplanets,
2. Variable stars
3. Asteroids

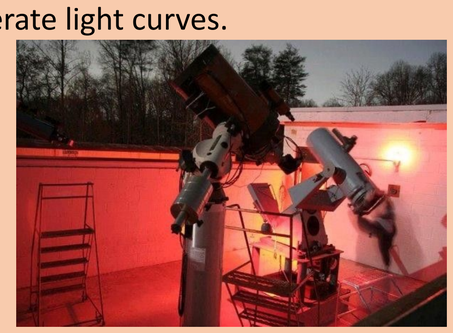
For this project, I chose to focus on how to take and calibrate images of exoplanets. I learned the factors that make an exoplanet a good target like:

1. Its period,
2. Its path across the sky
3. Its time duration
4. Its start time

From there I learned how to use the observatory's telescope to collect data from the target star and then use the application AstroImageJ in order to calibrate the images and then generate light curves.

Methodology

1. Using the Exoplanet Transit Database determine what exoplanets would be good to observe for the night.
    1. Use the criteria listed above to help filter the potential targets.
2. Take raw data of exoplanet using observatory's telescope.
    1. First cool down the temperature of the telescope (to remove thermal heat).
    2. Using a guide in the form of a keypad, set the telescope to face the target star.
    3. Use the observatory computer to create a file containing all the information needed to be collected.
3. Calibrate raw images using AstroimageJ by inputting the science images, bias frames, dark frames, flat frames into the CCD Data Processor.
4. Generate light curves.



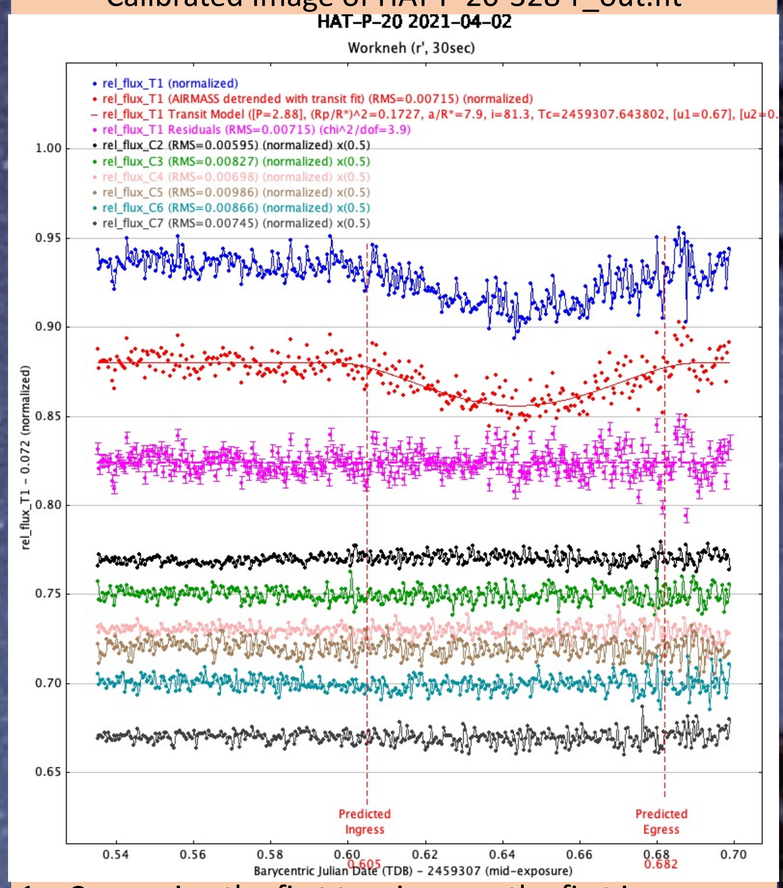
Limitation

Because the Exoplanet Transit Database website was used in order to determine what exoplanets would be good for observing for the night, there are some nights where observing is nearly impossible since the exoplanet's start time is too late, or the time duration is too long or its location in the sky isn't favorable since they may be blocked by the tall trees.

Data/Analysis

Raw Image of HAT-P-20-328-r.fit

Calibrated Image of HAT-P-20-328-r_out.fit

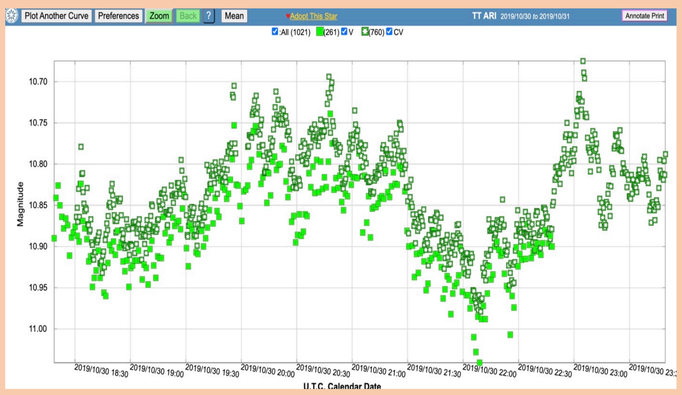


1. Comparing the first two images, the first image (raw) has dust spots (called artifacts) while the second one (calibrated) doesn't. This is one-way calibrating images provides a clearer image of what you're viewing in the sky.
2. The third image shows the light curve for HAT-P-20. The red line is the model fit. The last 6 lines are the light curves for the comparison stars and the pink graph shows the light curve's residuals.

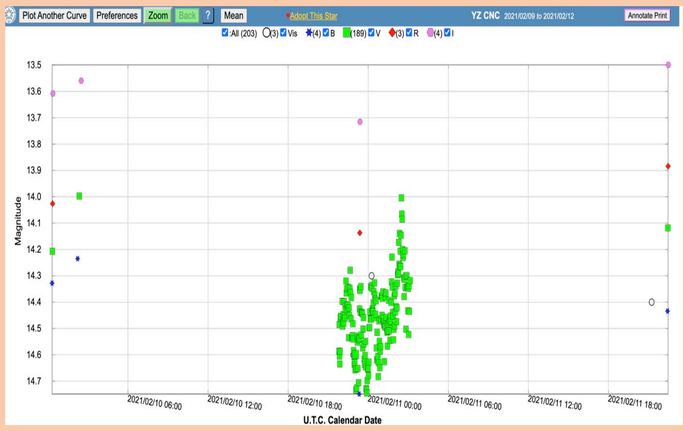
Suggestion for Future Research

If I get the opportunity to conduct another research project, I want to observe variable stars (Because I'm a Biochemistry major, it's highly unlikely I'll have the chance to do a future research project). Determining whether or not a variable star is considered a good target follows a different set of requirements.

1. Eclipsing variable stars are better targets than cataclysmic variable stars because they don't have periodic outbursts of light that are unpredictable.
2. Variable stars that have shorter periods are favorable and for the particular time of year we are in, any star that can be found in the eastern region of the sky is the best to watch.
3. Just like exoplanets, the start time also matters, but time duration doesn't matter.



TT Arietis-Eclipsing Binary Star Light Curve (aavso.org)



YZ Cnc Star-Cataclysmic Variable Star Light Curve (aavso.org)

Citations

Enhanced LCG, www.aavso.org/LCGv2/.

"Exoplanet Observing by Amateur Astronomers." *Exoplanet Observing*, astrodennis.com/.

[www.webservices.cz], WebServices. *ETD - Exoplanet Transit Database*, var2.astro.cz/ETD/predictions.php.

Acknowledgements

I would like to thank Ms. Warner for being my mentor for this project.