Aperture Photometry on Exoplanet Host Stars in the Near-UV

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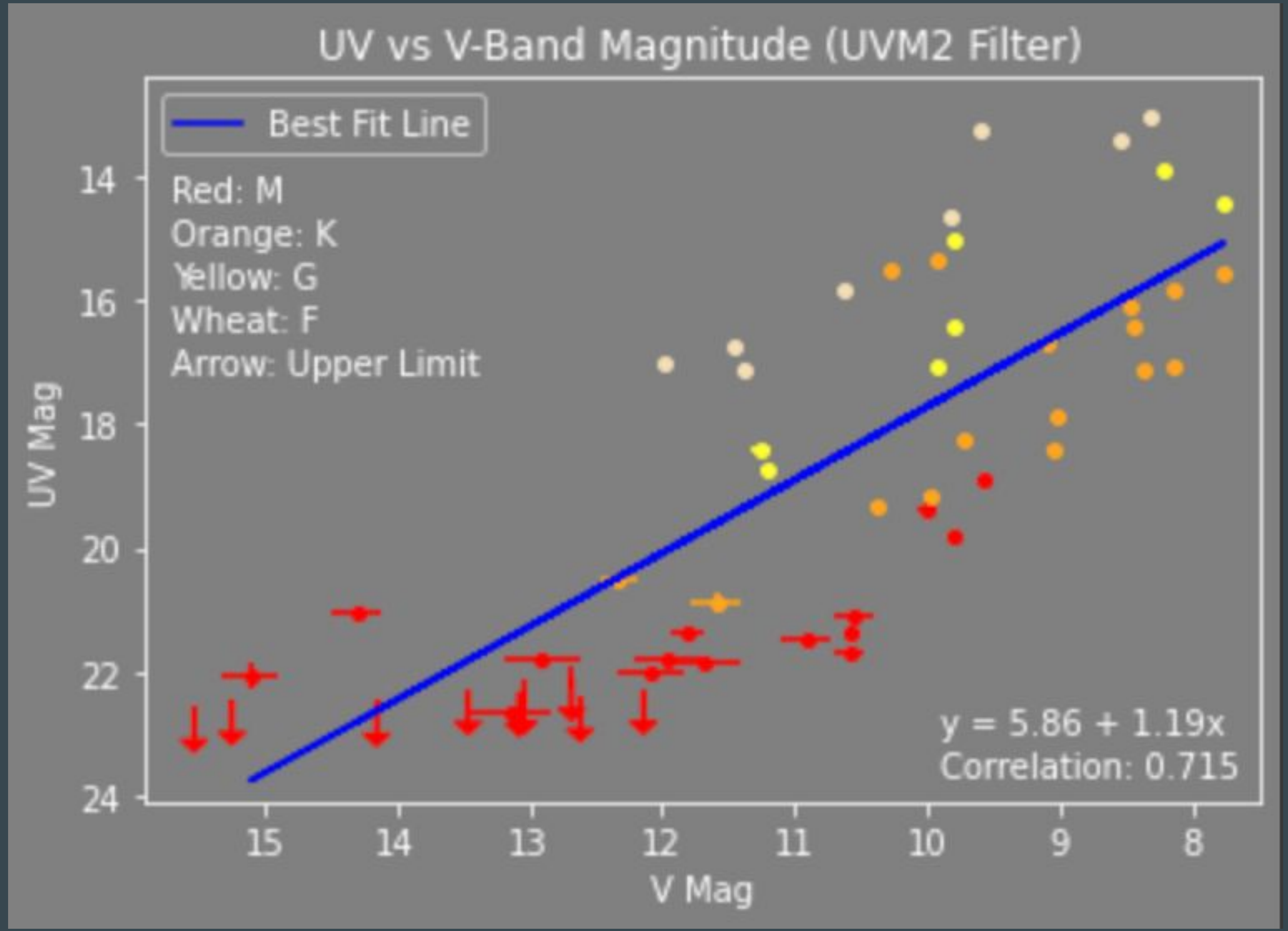
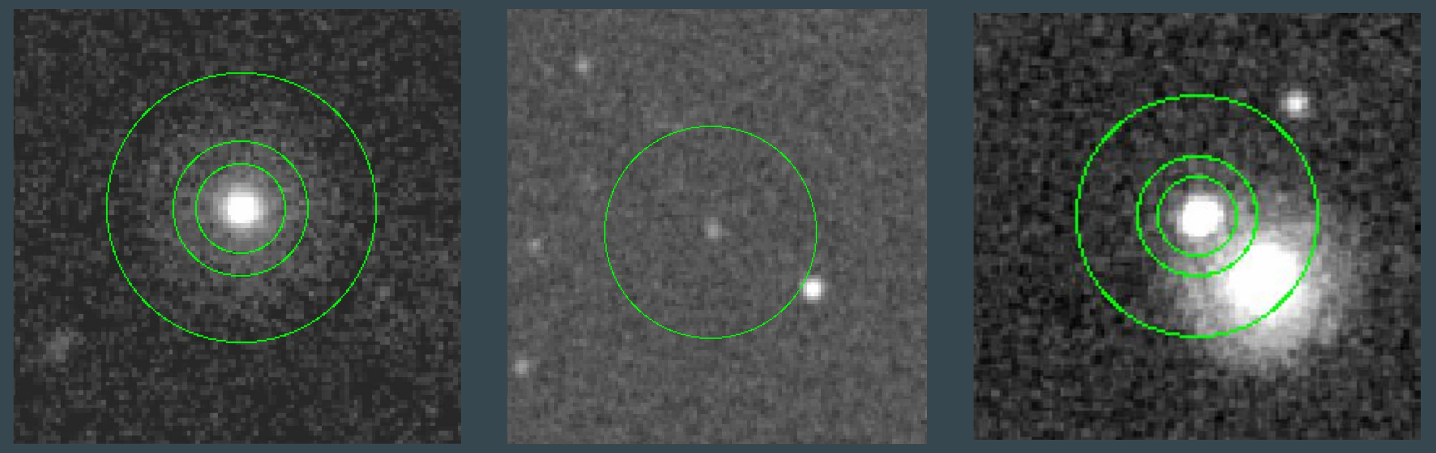
Motivation

The near-UV is a relatively underexplored region of the electromagnetic spectrum in terms of studying exoplanets. The GALEX telescope made measurements on many host stars during its lifetime, but gaps in the data have remained since its decommissioning in 2013. Our goal is to remedy this by building a catalog of UV (200-250nm) data collected from exoplanet host stars in order to find optimal targets for NUV transit studies.

Methods

- We used the Ultraviolet Optical Telescope (UVOT) on the Swift Space Observatory to perform observations on 56 nearby exoplanet host main-sequence stars ranging from M to B-type.
- We wrote multiple Bash and Python scripts that each utilized the UVOT software package.
- Our first script centers the apertures on the target based on an initial guess. A pitfall of this technique was that some targets proved too dim to detect.
- Our second script uses positions of known stars to stack the images on top of each other, increasing the number of photons in the aperture. This technique still failed when there was a separate bright source in the background or if the target was still too dim.
- Our third script threw out the automatic detection in favor of manually positioning each aperture, bypassing the “bright source in background” problem.
- For the targets that were still too dim, this script also tells us the Sigma of the detection. We decided that for targets with a Sigma < 3, the upper limit data would be cataloged instead.





A) HD 1397 B) GJ 179 C) GJ 143

Figure 2: These are images taken from DS9 of 3 different targets from the catalog. A is a target that was cleanly detected. B is a target that is clearly visible, but too dim to be detected automatically. C is a target that has a separate bright source polluting the background.

Results

Figure 1: A scatter plot showing the possible correlation between our targets' UV Magnitude and V-Band Magnitude. The data samples are shown along with a best fit line, the spectral type associated with each color, the equation of the best fit line, and the Pearson Correlation Coefficient. Errors are present for all data points but some are too small to see. A few upper limit arrows were omitted to eliminate white space.

This linear correlation is showing that stars that are optically bright, are typically also bright in the UV, and vice versa. Though the catalog itself is our main result, this figure serves as an example of the type of analysis possible using the data from a catalog of this nature.

Conclusions

Scan here to view the full catalog:

- This catalog will enable better optimization of targets for studying near-UV transits of known exoplanets.
- In the near future, we plan on expanding this catalog into the X-ray to allow for further analysis and optimization possibilities, such as comparing UV brightness to X-ray brightness.
- We will also be combine the NUV information from Swift and GALEX to search for correlations between host-star UV properties and exoplanet demographics.
- The end goal is to use all of this data to find a threshold where one could say for certain whether or not a given system is a good candidate to do a transit observation for.