Ground-based light curve follow-up validation observations of TESS object of interest TOI 5886.01

Maxim Wang, Dr Peter Plavchan

Abstract

We aim to verify the transit of TESS object of interest TOI 5886.01 using the data from ground observation obtained from George Mason University. We used AstroimageJ to process the data and plot the lightcurve. We encountered no issues with weather. 17 of the total 222 sciences had to be removed due to distortion. No stars within a 2.5 arcminute radius of the target star were detected. The results we found are not definitive and will need to be followed-up upon. We found that there is a dip in brightness, indicating a transit is present.

Intro

Exoplanets since discovery in 1990 have always been a subject of great interest. By looking at them, we can learn things about Earth and perhaps a world similar to ours. TESS was a launched by NASA in 2018 The transit method consists of analyzing the brightness of stars and specifically looking for dips in luminance. The logic behind this is that the star from our perspective will dim when an object, or in this case, an exoplanet, orbits in front of the star. Papers similar to ours will have the same goals with similar methods, as there have been many exoplanets observed by TESS. We aim to contribute to the larger goal of having exoplanet transit data for a future researcher to use. In this paper, we present the follow-up observation of TOI 5886.01. It has a radius roughly 12 times the size of Earth. It has an orbital period of 0.97 days. Our goal is to verify that the transit occurs at the predicted depth and epoch. In Section 2 we present observation results from George Mason University observatory. In Section 3 we present our analysis of the TESS light curve TOI 5886.01 and our ground based analysis. In section 4 we present our light curve results. In Section 5 we discuss our results and in Section 5 we discuss our results and in Section 6 we present our conclusion and future work.

In Section 2.1 we present TESS object of interest TOI 5886.01 exoplanet and host star properties from the TESS input catalog. In Section 2.2 we present the final light curve.

There are a total of 222 exposures. 17 of them had to be deleted due to bad quality. The exposure time was 85 seconds. Exposures started in 10480.6919 BJD and ended in 10480.7428, taken on 6/18/2024. A red filter was applied. The RA and Dec of the target of interest is 20:27:57.32, +37:08:46.88. Total 20 darks with 3 second and 85 second exposure with a fifty fifty split. Flats were taken with an exposure of 3 seconds. Observation done by Dr. Peter Plavchan,

In this section we present out method to produce and analyze the light curve of TOI 5886.01, as well as the final analysis of our ground-based light curve. We used AstroimageJ to perform data processing on the raw sciences, and to generate the light curve. Prior to data processing we visualized the sciences in AstroimageJ to remove any bad images. Around 17 sciences were removed in this step. We performed data reduction steps as described in section 3.6 of this document[1]. All reference stars were used. No detrending parameters graphed.

Results

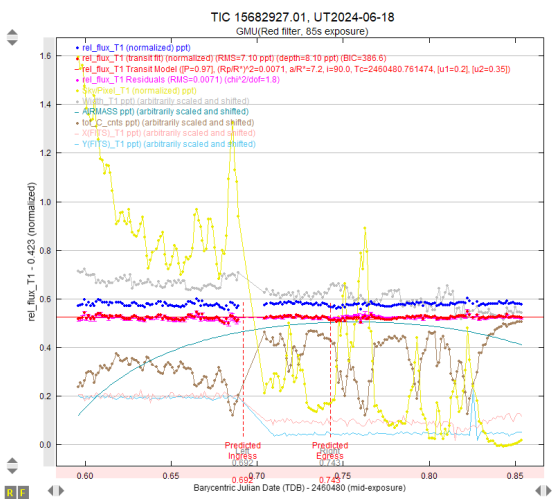

Figure 1

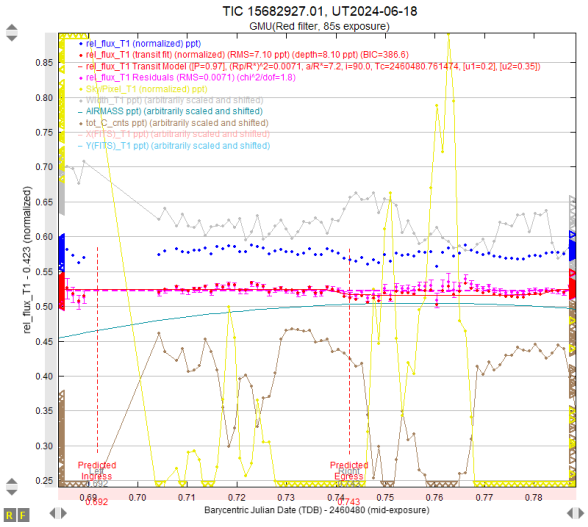

Figure 2

Figure 1 contains a whole view of the data, while figure 2 has been zoomed in on the transit. We can confirm visually that a dip in flux occurred after the predicted ingress and egress. With a depth of 8.10, drastically greater than the predicted 3.10.

Discussion

In this section we present our interpretation of the results and put them in the context of TESS follow-up. The transit occurred right the predicted Egress, and it did not occur at the predicted depth of 3.1. PPT Additionally the parameter Sky/pixel showed a lot of variance throughout the data. The original sciences should be reviewed for anything disrupting the data. Deleted sciences should also be reviewed.

NEB analysis showed no stars in a 2.5 arcminute radius. While data was sufficient enough to reach a conclusion, further follow-up will be needed to rule out possibilities of other false positives.

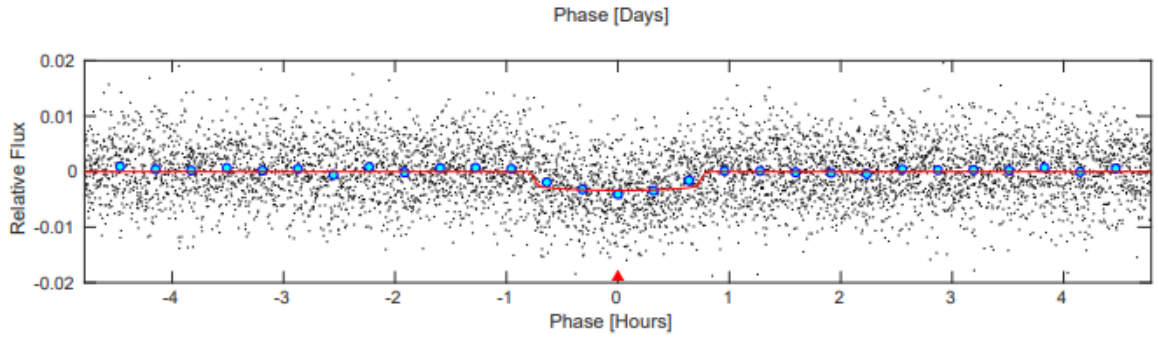

Figure 3

When we compare this to the plot we can see we have a similar dip in flux, relative to the baseline flux. We can confirm this by just the graph but further follow-up of in-depth statistical analysis is necessary.

Conclusion and Future work

In conclusion, we do not have conclusive evidence to confirm the transit of TOI 5886.01. This may be due to any noise in data. Original sciences should also be revisited. Further follow-up will need to be done to verify the transit we found and to review the original data for anything possible that could be disrupting the data. Or any mistake on our part during our work on TOI 5886.01. Further Statistical Analysis may be required to confirm the transit of any false positives and negatives.

Refrences

1. https://docs.google.com/document/d/1MZU2kb9ahNhv7tdghKX7EUUo-ub_7mJr/edit
2. https://mast.stsci.edu/portal/Mashup/Clients/Mast/Portal.html
3. https://tess.mit.edu/science/tess/
4. https://www.astro.louisville.edu/software/astroimagej/