Ground-Based Light Curve Follow-up Validation Observations of TESS Object of Interest TOI 5585.01

AUTHORS & AFFILIATIONS

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ABSTRACT

The Transiting Exoplanet Survey Satellite (TESS) mission is instrumental in discovering and characterizing exoplanets orbiting nearby stars. This study focuses on the follow-up observations of the exoplanet candidate TOI 5585.01, characterized by a radius of 8.05828 Earth radii and an orbital period of 1.8434549 days. Using data collected on March 14, 2024, from the GMU observatory telescope, this paper aims to determine whether a predicted transit of TOI 5585.01 occurs within the expected ingress and egress times. Observations included 35 science images and calibration data, analyzed through AstroImageJ and utilizing Alnitak for plate-solving. The results indicated that no reference stars passed the NEB check, and the majority of detected light was from TOI 5585.01. While the data showed fluctuations in the light curve and a potential depth of 8.61 ppt, the observations were inconclusive due to early data cutoff and limited coverage. Consequently, the study could not confirm a definitive transit event. Further observations are recommended to gather additional data and enhance the analysis, as current findings do not provide conclusive evidence of the transit.

INTRODUCTION

The NASA Transiting Exoplanet Survey Satellite (TESS) mission plays a crucial role in advancing humanity's understanding of nearby exoplanets and their potential habitability, as well as the search for extraterrestrial life. Launched in April 2018, TESS's primary objective is to survey the nearest and brightest stars to identify transiting exoplanets—planets that cross in front of their host stars from various observatories' vantage points on Earth. This mission significantly enhances our ability to discover and characterize exoplanets, particularly those in the habitable zones of their stars, which are prime candidates for further investigation regarding conditions suitable for life.

Examining a specific TESS (Transiting Exoplanet Survey Satellite) object of interest is crucial due to the vast number of candidates that need validation to accurately identify and

characterize exoplanets. With thousands of potential exoplanetary signals detected, prioritizing a focused study on one particular object allows for in-depth analysis and verification that can confirm its planetary status and provide detailed insights into its properties. This targeted approach helps refine our understanding of exoplanetary systems and their diversity, ultimately improving the accuracy of the data we use to explore planetary formation, habitability, and the potential for extraterrestrial life. Without such focused investigations, the wealth of data gathered by TESS could remain underutilized, hindering our progress in the field of exoplanet research.

In this paper, follow-up observations of TOI 5585.01 are presented. TOI 5585.01 has a R_p ($R_\oplus$) of 8.05828 and a P (days) of 1.8434549±0.0009500. The goal of this paper is to examine whether or not a transit with the predicted depth occurs between the predicted ingress and egress times based on data collected using the GMU observatory telescope.

METHODOLOGY

Data consisted of 10 darks and flats, each with exposure time of 85.0 seconds. 35 science images were provided, as well as a number of focuser images. Data was collected on Thursday, March 14th, 2024 between 20:15 and 4:30, using an R filter. The RA and Dec of TOI 5585.01 are 08:37:56.010 and +37:44:07.16 respectively.

Preliminary visual data inspection and filtering of bad images, as well as aperture photometry, was performed using AstroImageJ. Plate-solving using AstroImageJ and an Astronomy.net API key was attempted, but it was ultimately more successful to use Alnitak to plate-solve due to the many network errors and aborted solves found during use of the AstroImageJ method.

NEB check, light curve, and seeing profile were all generated using AstroImageJ.

RESULTS

No reference stars cleared the NEB check; all are inconclusive. Majority of light detected was emitted by the star TOI 5585, as seen in the seeing profile (Fig. 3).

Most data seems to cut off relatively early into the period of time between expected ingress and egress, with the exception of rel_flux_T1 (transit model). Data points from rel_flux_T1 (normalized) (ppt) seem to fluctuate before the predicted ingress time, then dip and sharply spike upwards near 0.62 (See fig. 1). Estimated depth is 8.61 ppt.

CONCLUSION & FUTURE WORK

As not only does the data cut off extremely early into the predicted ingress/egress time, but the data is also relatively few compared to other targets, no conclusive transit can be observed from the data analyzed. While the possibility of errors in the process of data analysis are certainly possible (plate solving failures, bad science images, bad data, etc.), the current status of this data is unable to provide conclusive proof of a transit occurring.

It would be best to gather more data on TOI 5585.01 before performing additional data analysis, as relatively little information seems to exist on this target; therefore, it is vital to continue researching it.

Figures and Table

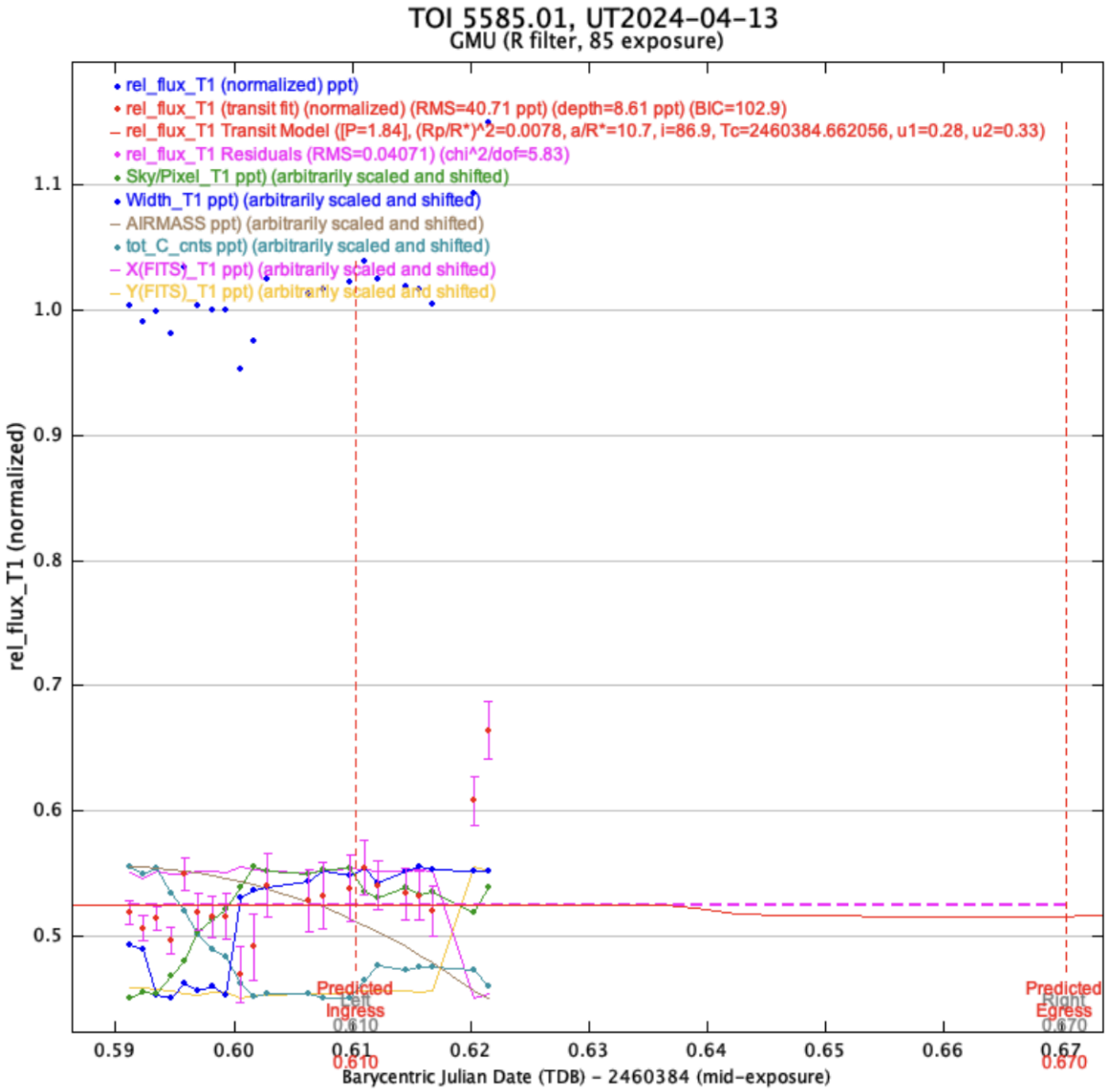

Fig. 1

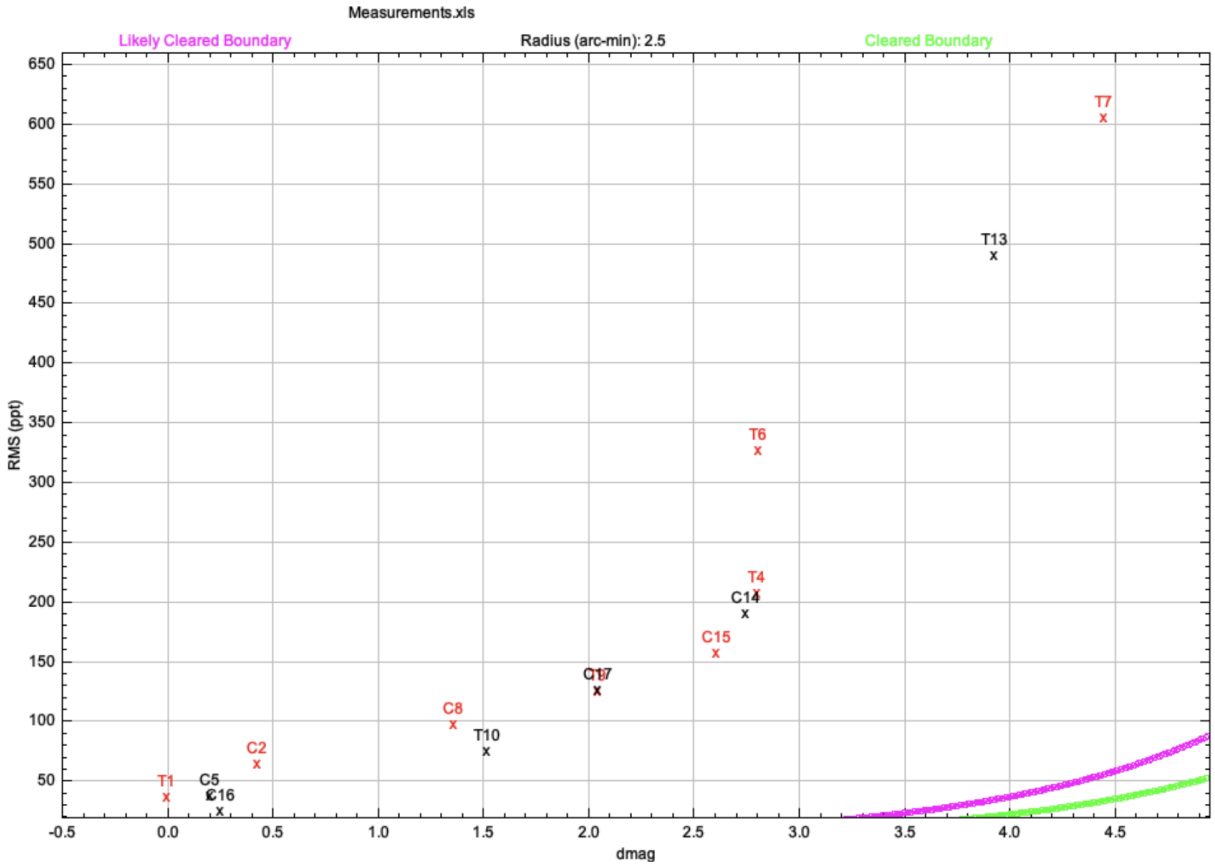
Measurements.xls
Likely Cleared Boundary
Radius (arc-min): 2.5
Cleared Boundary
RMS (ppt)
dmag
650
600
550
500
450
400
350
300
250
200
150
100
50
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
T7
T13
T6
T4
C14
C15
C17
C8
T10
C2
T1
C5
C16

Fig. 2

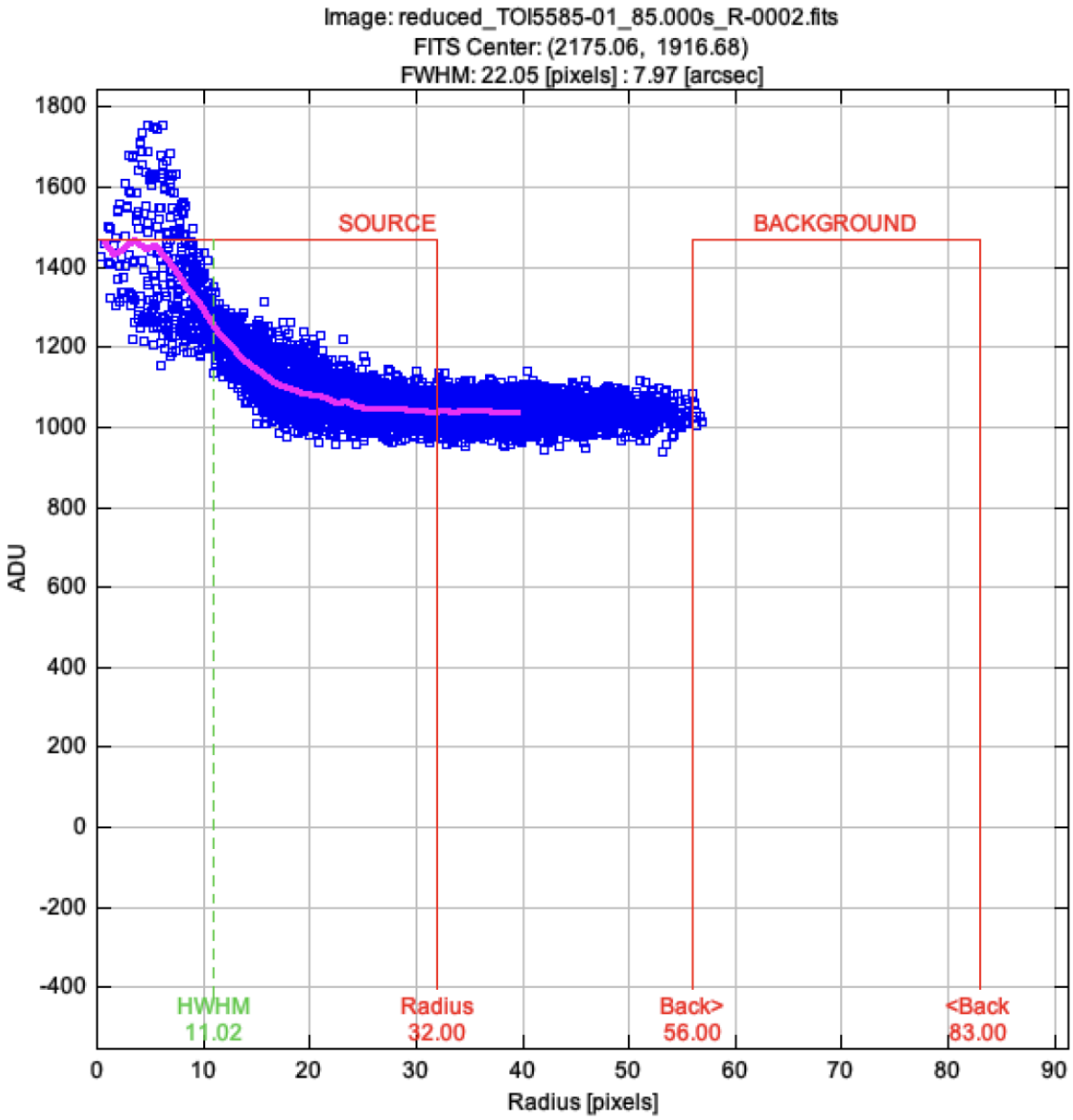
Image: reduced_TOI5585-01_85.000s_R-0002.fits
FITS Center: (2175.06, 1916.68)
FWHM: 22.05 [pixels] : 7.97 [arcsec]
SOURCE
BACKGROUND
HWHM
11.02
Radius
32.00
Back>
56.00
<Back
83.00
ADU
Radius [pixels]
1800
1600
1400
1200
1000
800
600
400
200
0
-200
-400
0
10
20
30
40
50
60
70
80
90

Fig. 3