

# Monotransits in TESS - Predicted Yield and Early Results

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background image credit: NASA

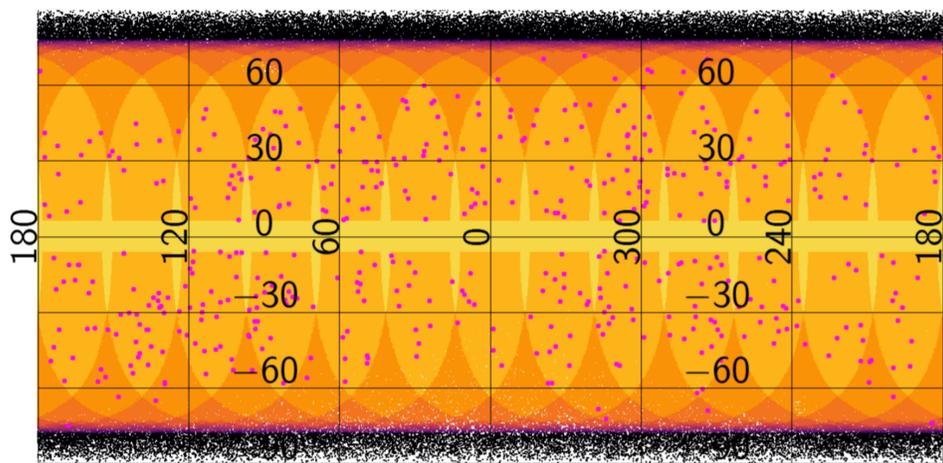
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## Abstract

- During its 2-year mission TESS will observe  $\sim 85\%$  of the sky with  $\geq 60\%$  observed for a maximum of 27 days.
- The majority of transiting exoplanets with periods  $\geq 27$  days will transit once at most in TESS, as will some shorter period systems.
- We predict upwards of 4700 transiting exoplanets will be found by TESS of which  $\sim 460$  will only show one visible transit during TESS observations.
- We have begun to search for these systems in the 2min and FFI data sets and have recovered a number of promising candidates for follow-up.

## 2. Monotransit Simulation

To predict the number of expected monotransits to be found by TESS we carried out a simulation [1]. This simulation took the TIC CTL (3.8 million stars) and seeded them with planets based on current occurrence rates. TESS observations of the systems were then run for a length of time corresponding to their sky position and thus sector coverage. The number of transits observed by TESS with  $SNR \geq 7.3$  was then recorded.

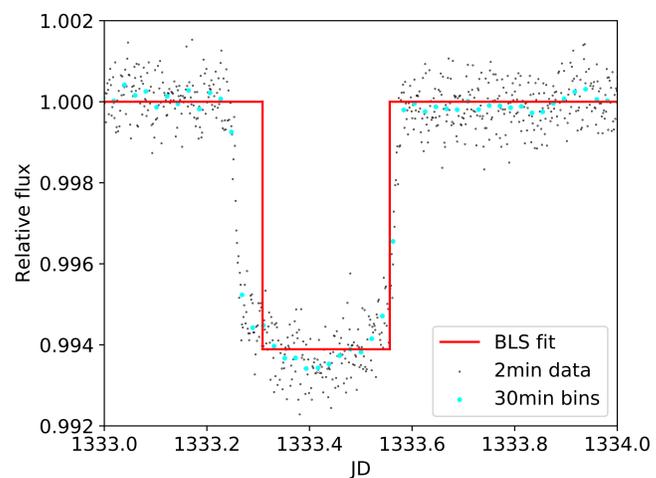


**Figure 1:** Distribution of simulated planets. Planets are coloured by number of TESS sectors to observe them and monotransiting planets are in pink.

## 4. Monotransit Search

To complement our monotransit simulation we have begun a systematic search of the TESS light curves for monotransiting systems. From our simulation we expect  $\sim 20$  **monotransiting systems per sector of data**, with  $\sim 5$  coming from 2min targets and  $\sim 15$  coming from FFI.

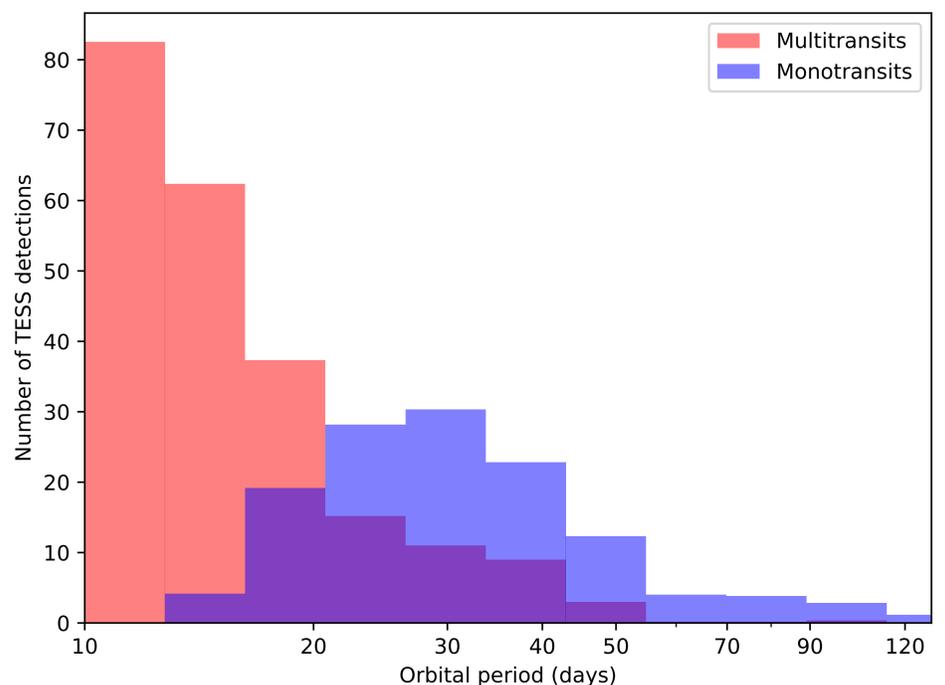
We find these transits by running a BLS type search through the flattened 2min light curves. Each detection is then tested and given a corresponding depth, duration and SNR. We then perform a number of cuts on the data and then examine the best candidates by eye.



**Figure 3:** 2min light curve of TOI-173. The data are then binned to 30min and the BLS fit as found via our monotransit search is shown.

## 3. Simulation Results

We found that TESS will discover a lower bound of **4700 transiting planets** during its 2-year mission. Of these discoveries  $\sim 460$  planets will only be seen to transit once during TESS observations. These monotransits are expected to be split 1:3 between 2min and FFI targets respectively.

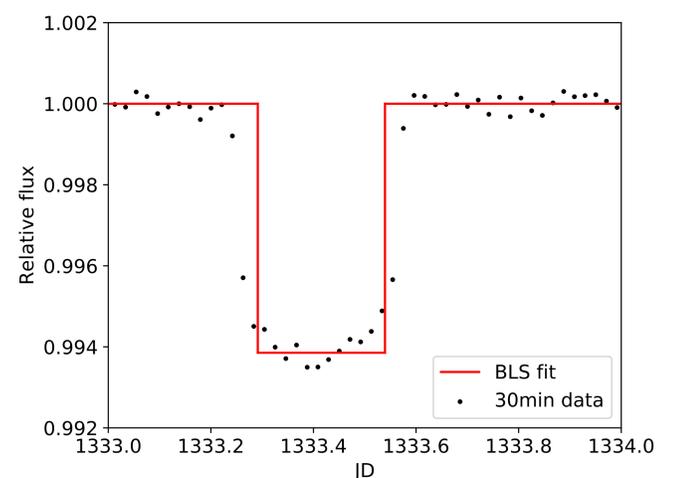


**Figure 2:** Histogram of simulated TESS detections. Shown are all planets with  $\delta \geq 0.005$  and  $P \geq 10$  days. Multiple transits are shown in red, monotransits are in blue.

## 5. Search Results

Currently our work has been focused on the 2min light curves. Using the PDCSAP data **we have discovered  $\sim 10$  monotransit candidates per sector** with about half of these being strong candidates for follow-up. This fits well with our simulations of 2min monotransit detections.

Work on searching FFI light curves has just begun using the DIA light curves of Oelkers and Stassun [2]. These light curves require careful flattening but **preliminary tests have identified a number of as yet unknown candidates.**



**Figure 4:** DIA FFI light curve of TOI-173 and BLS fit.

## References

[1] B. F. Cooke, D. Pollacco, R. West, et al. *Astronomy & Astrophysics*, 619:A175, 2018.

[2] R. J. Oelkers and K. G. Stassun. *The Astronomical Journal*, 156:132, 2018.