

Compact hierarchical triple star candidates in and near the Northern Continuous Viewing Zone of *TESS*

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Context: Hierarchical triple (and multiple) stellar systems are key objects in order to fully understand all aspects of stellar evolution, therefore, we have to continuously increase the number of the known systems. For this purpose, we perform a similar survey on available *TESS* data as Borkovits et al. (2016) did on *Kepler* data.

Methods: From an international collaboration, we received the most complete list of variable stars showing eclipse-like variations observed in at least one *TESS* Sector (yet unpublished, Brian P. Powell, priv. comm.). For the ETV survey, we sorted out 5139 objects from this list that are in or near the Northern Continuous Viewing Zone and have at least 8 Sectors of *TESS* observations available. This amount of data should be sufficient to detect the signals of light travel time effect and/or dynamical perturbations caused by additional components in the ETVs of these objects in order to increase the known sample of compact hierarchical triple or multiple (candidate) systems. For this purpose, we obtained the light curves of the above-mentioned 5139 sample objects from the *TESS* Full-Frame Images with a convolution-based differential photometric pipeline based on the FITSH software package (Pál 2012). We analyze these systems using a newly developed interactive program with a graphical user interface utilizing the Tkinter module of Python. This program allows the user to quickly load and view any raw light curve with several useful interactive features that help to analyze the light curve and quickly derive the ETV curve of an object. The already implemented features are: i) interactive detrending of the raw light curve using the WOTAN package (Hippke et al. 2019); ii) multiple period searching methods e.g. Lomb-Scargle (LS) Periodogram, Box Least Squares (BLS) Periodogram and Phase Dispersion Minimization (PDM) in order to determine the orbital period of the system; iii) reference epoch determination with the calculation of the (folded) orbital phase curve; iv) determination of the times of eclipsing minima or out-of-eclipse maxima with the fitting of higher-order polynomials; v) showing the ETV curve of the object calculated from the previously determined minima/maxima using the previously found orbital period and reference epoch; vi) coherently save the latest results in a database that will allow us to do more complex external analyses on the candidate systems, and also to load the previous results from the database if it is available for a specific light curve opened in the future for any re-analysis that will ensure reproducibility. We tested the above-mentioned features for around 300 different objects so far and it works as intended allowing the quick determination of the ETV curve and a fast analysis of each system by eye. The current version of the program was written for our specific analysis, but after some modifications, it could be used for any sets of light curves, hence we also plan to make it publicly available as a general, interactive light and ETV curve analyzer in the near future.

Results: Currently, this is still a work in progress. After the preliminary interactive determination and analysis of around 300 ETV curves there are around 50 out of them that we signed as a candidate target for further external analysis to filter out false positives. However, there are several systems where multiple TIC objects show the same variations, therefore this preliminary candidate number is already a bit overestimated. Here, we show a sample of the most promising candidates among them.

References:

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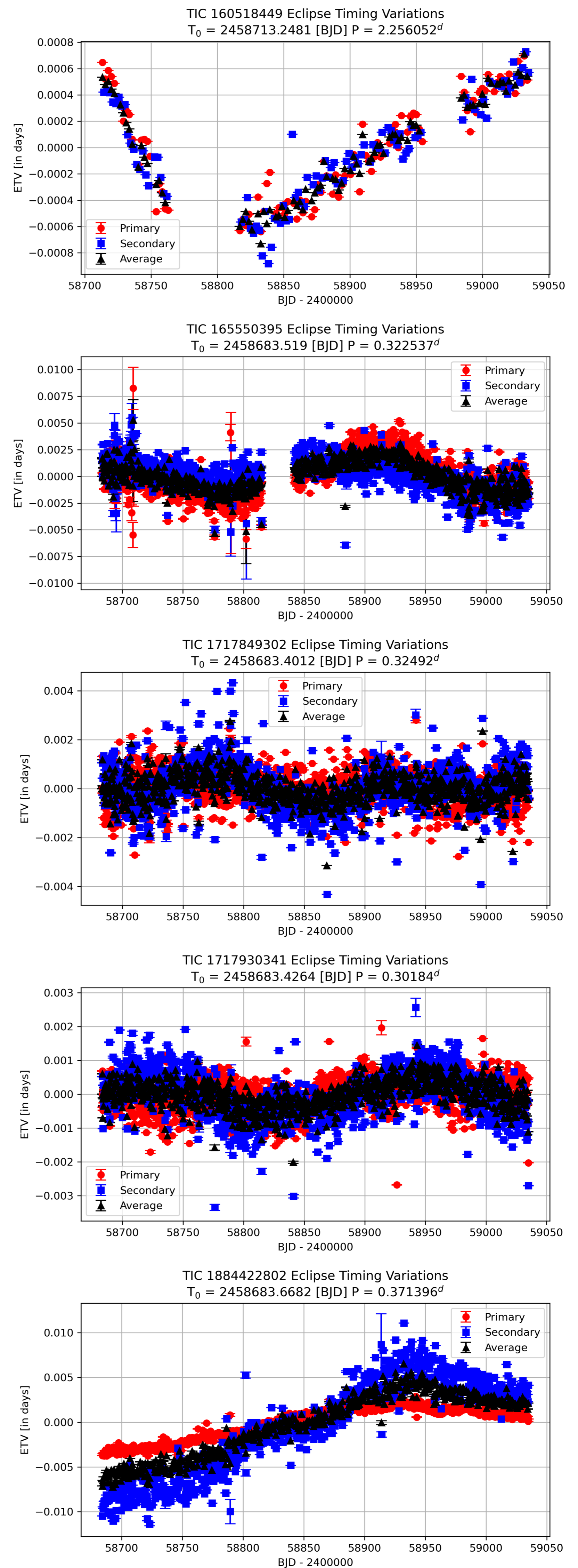


Fig. 1. Gallery of a sample of the most promising hierarchical triple candidates found so far. Red circles, blue squares and black triangles sign ETV points calculated from primary and secondary minima and their average, respectively.

Acknowledgements: Funding for the *TESS* mission is provided by the NASA Science Mission Directorate.