Las Cumbres Observatory Key Project:

Standing on the shoulders of the network -

Follow-up of TESS planet candidates with LCO

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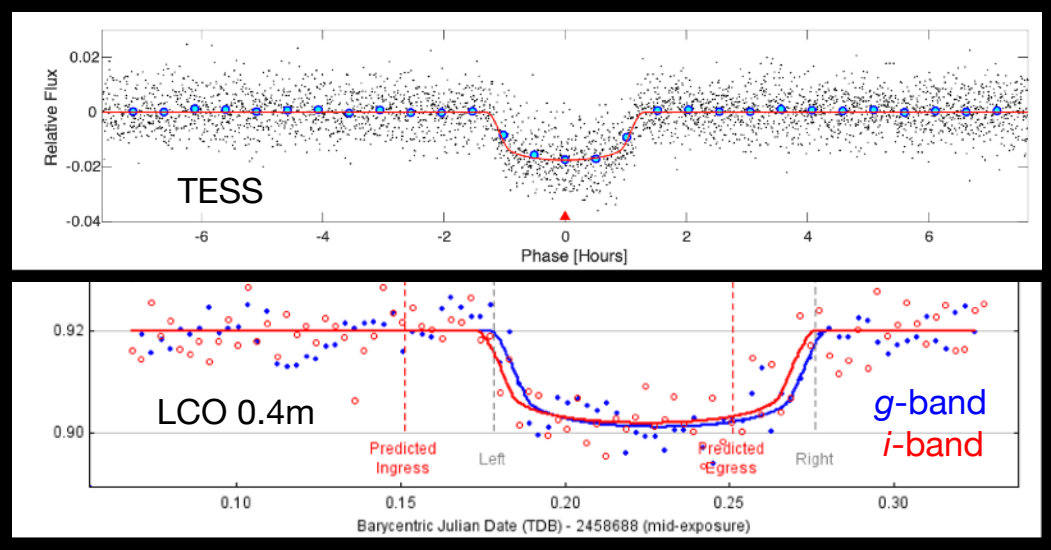
Accomplishing the exoplanet science enabled by TESS requires follow-up of many transiting planet candidates throughout the entire sky, to identify false positives (FPs) and confirm real planets. This Las Cumbres Observatory (LCO, lco.global) Key Project is designed to do that by combining three critical elements:

- Telescopes + Instruments providing high quality data.
- A large amount of telescope time on a global robotic telescope network.
- A dedicated group of astronomers that analyze the data.

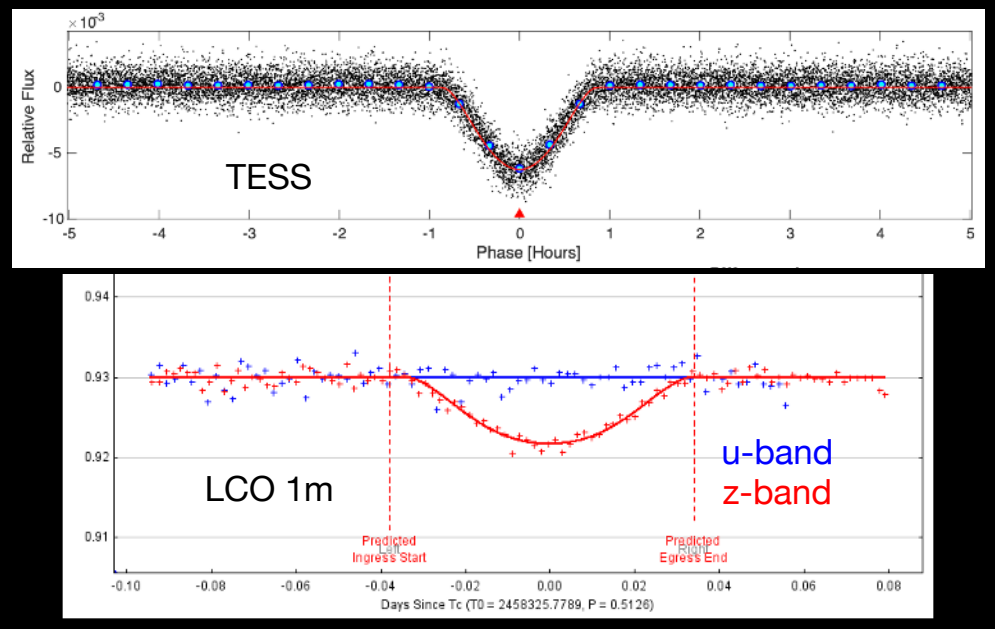
The Key project (PI: Avi Shporer, Co-PIs: Karen Collins, Marshall Johnson) uses ≈2,500 hours of telescope time per semester for 6 semesters, 2020B - 2023A. LCO telescopes are fully automated, including 10 x 0.4m, 11 x 1.0m, and 2 x 2.0m telescopes in 7 sites worldwide. We are using all LCO telescopes, equipped with imagers, and also the high resolution NRES spectrographs, mounted on four 1m telescopes.

Imagers are used to observe the TESS candidates during transit and check if the transit signal seen in TESS data originates from the target or from a nearby star blended with the target in the TESS wide PSF.

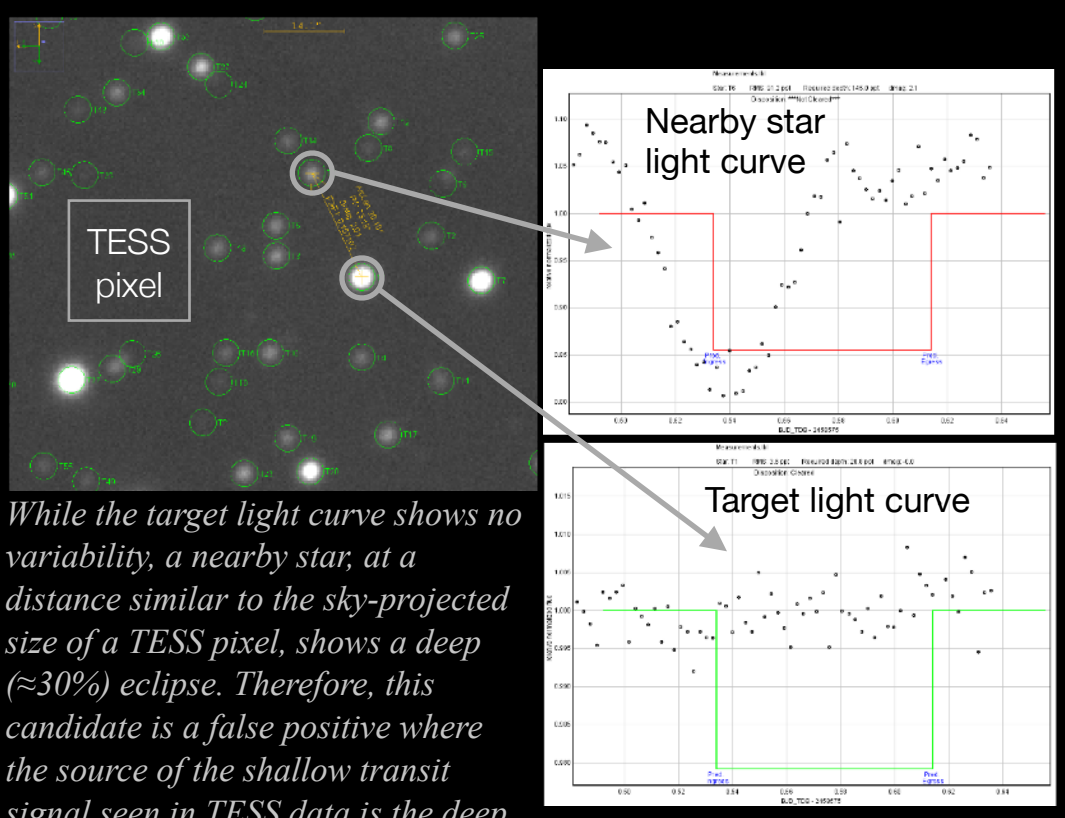
The NRES spectrographs are used for measuring the stellar parameters of bright TESS candidate host stars down to about 10th magnitude, identifying obvious FPs (SB1, SB2), and measuring the orbits of massive planets.



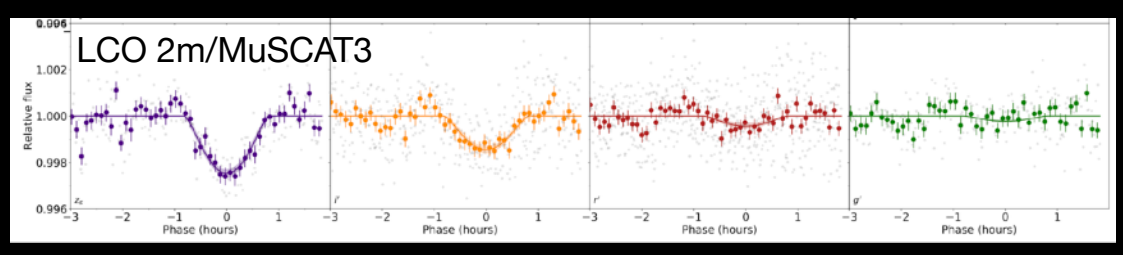
***TOI 1886**: TESS light curve (top panel) and LCO 0.4m light curves in g and i bands (bottom panel). The TESS and two LCO light curves have the same transit depth, showing the transit is achromatic.*



***TOI 187**: TESS light curve (top panel) and LCO 1m light curves in u and z bands (bottom panel). The transit depths seen in the two LCO light curves is clearly wavelength dependent, meaning chromatic. Therefore this system is a stellar binary.*



While the target light curve shows no variability, a nearby star, at a distance similar to the sky-projected size of a TESS pixel, shows a deep (≈30%) eclipse. Therefore, this candidate is a false positive where the source of the shallow transit signal seen in TESS data is the deep eclipse on a faint nearby star.



***TOI 1865**: Simultaneous 4-band light curve obtained with the LCO/MuSCAT3 instrument, mounted on the LCO 2m in Haleakala, Hawaii. The clear chromaticity shows this candidate is a false positive, an eclipsing binary.*

Key Project scheduling and observations are fully automated. Photometric data analysis is done with the AstroImageJ (AIJ) graphical user interface (GUI)-based program (Collins et al. 2017, AJ, 153, 77). The conclusion from the results is sent to TFOP SG1. All data we collect and/or the results derived from that data is uploaded to ExoFOP-TESS.

This Key Project is part of most TESS planet discoveries, and has contributed so far to over 30 publications.

We often collaborate with groups or individuals outside the Key Project. For any inquiries about potential collaboration please email Avi Shporer at shporer@mit.edu.