The critical role of small ground-based telescopes in the validation and confirmation of exoplanets discovered by the TESS mission

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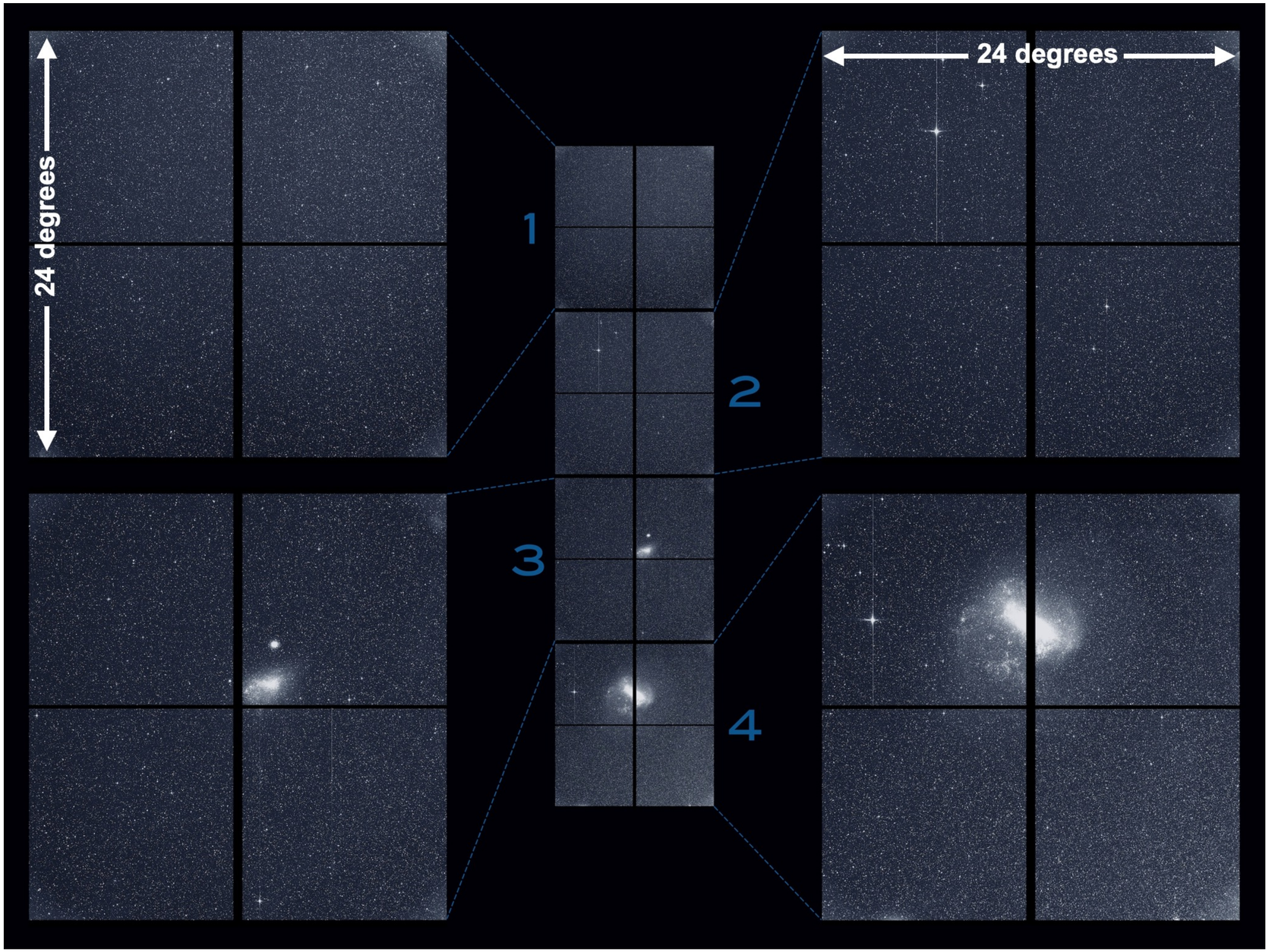
Image credit: NASA/JPL-Caltech

Quick introduction to TESS



So Many Planet Candidates, So Few Planets

6400 TOIs (so far!)

62 sectors

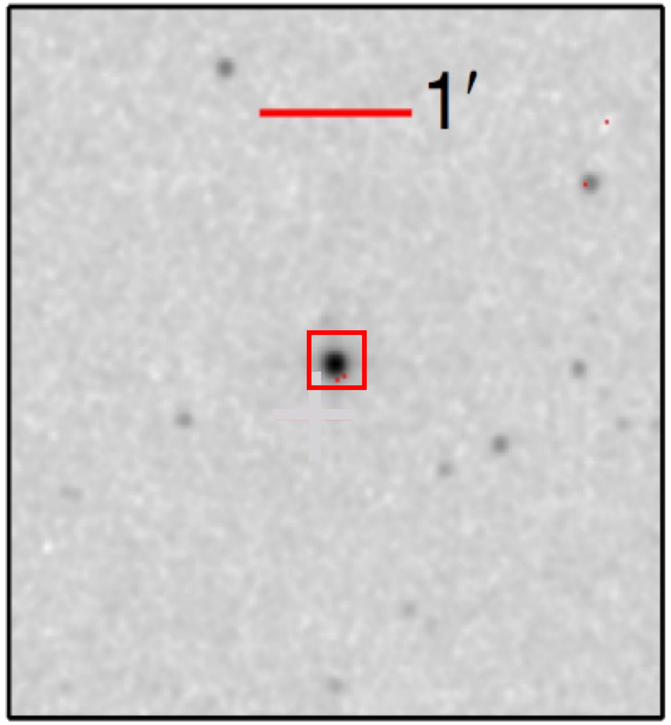
1367 TOIs with TESS Rp < 4 Re

1701 false positives

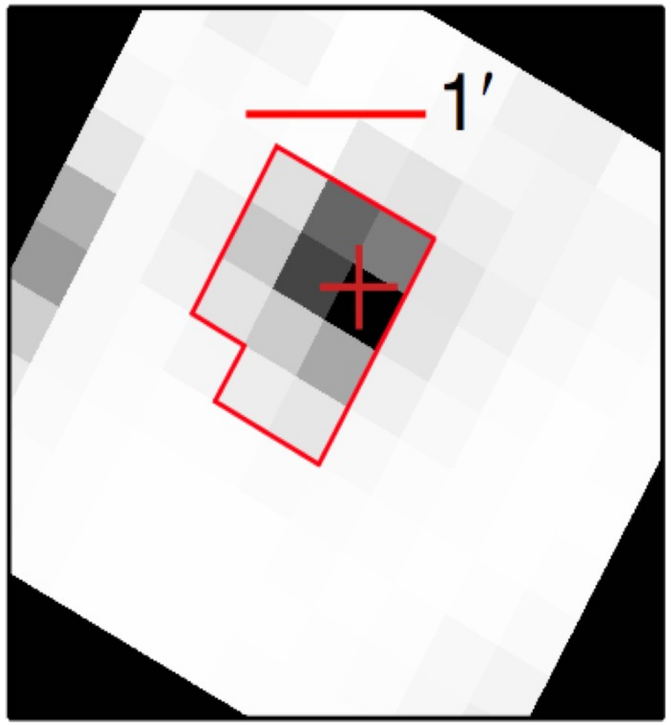
329 confirmed TESS Planets

Last updated: 4/13/2023

2MASS: October 2000
J–band

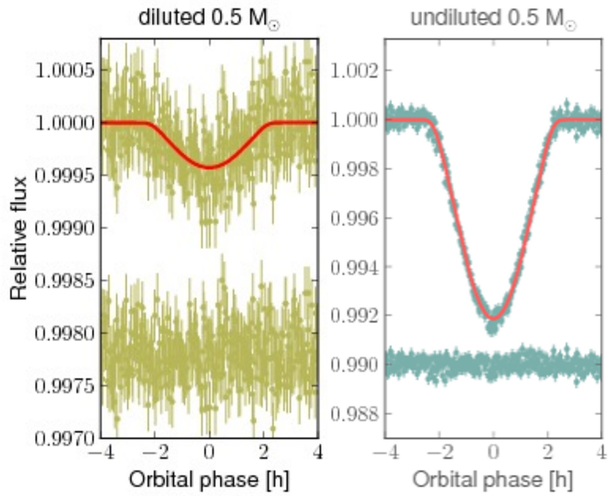


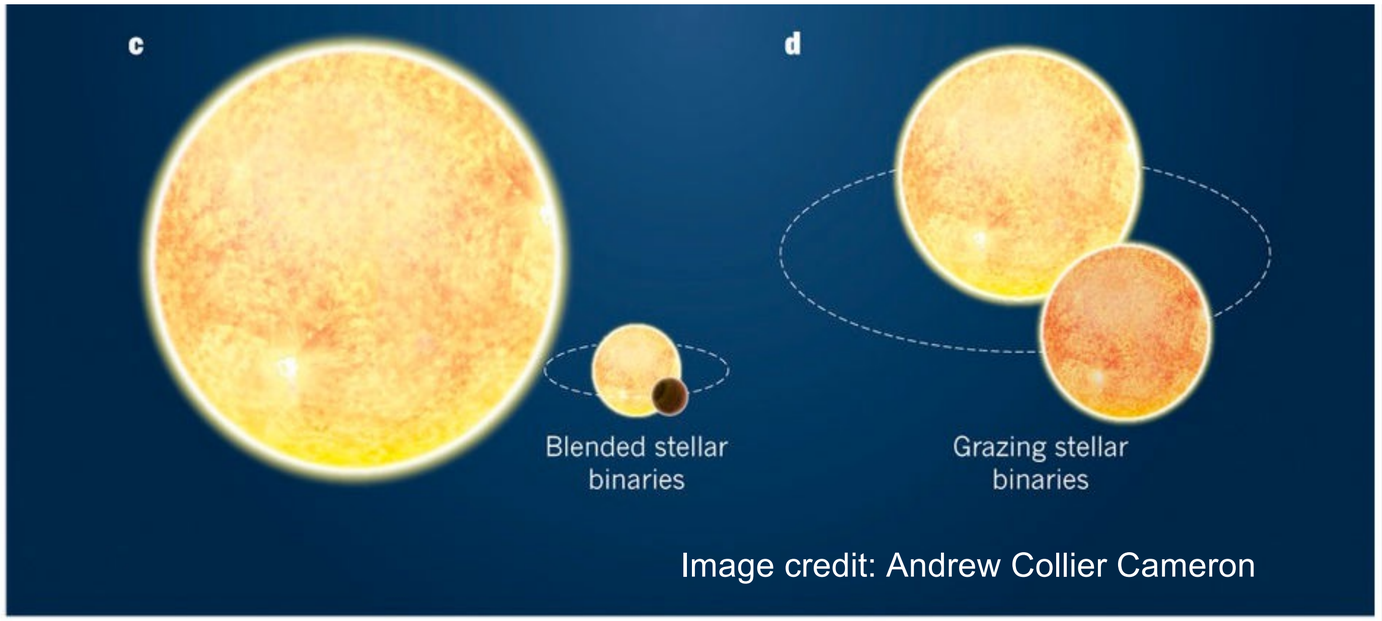
TESS: 2018

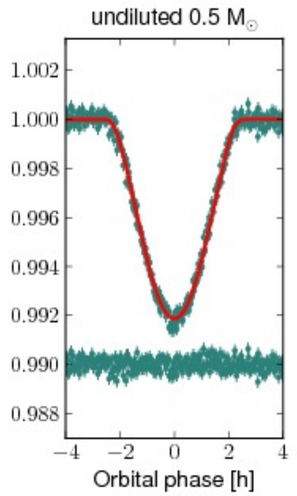


1 TESS pixel = 21’’ (arcseconds)

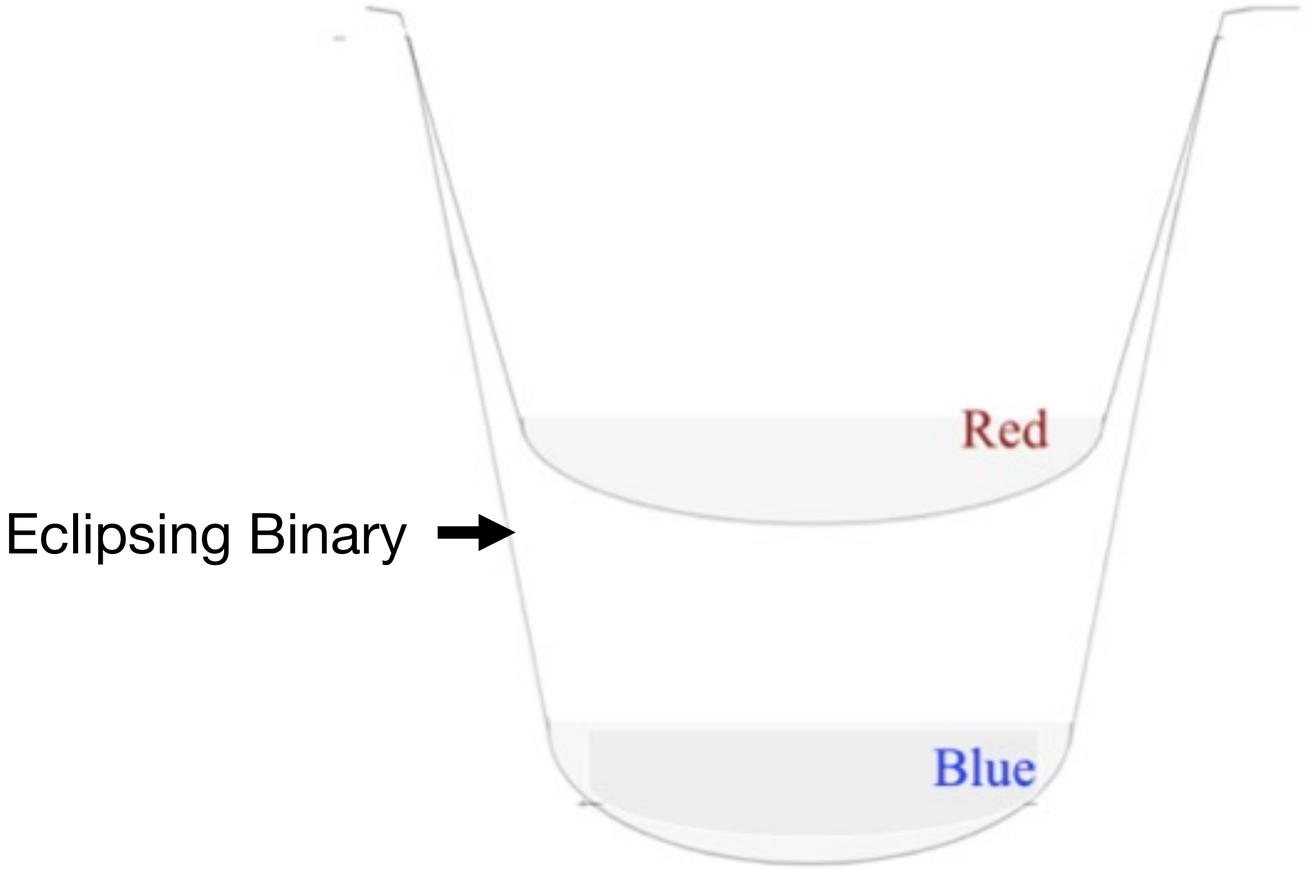
False Positives and how seeing-limited photometry can help identify them





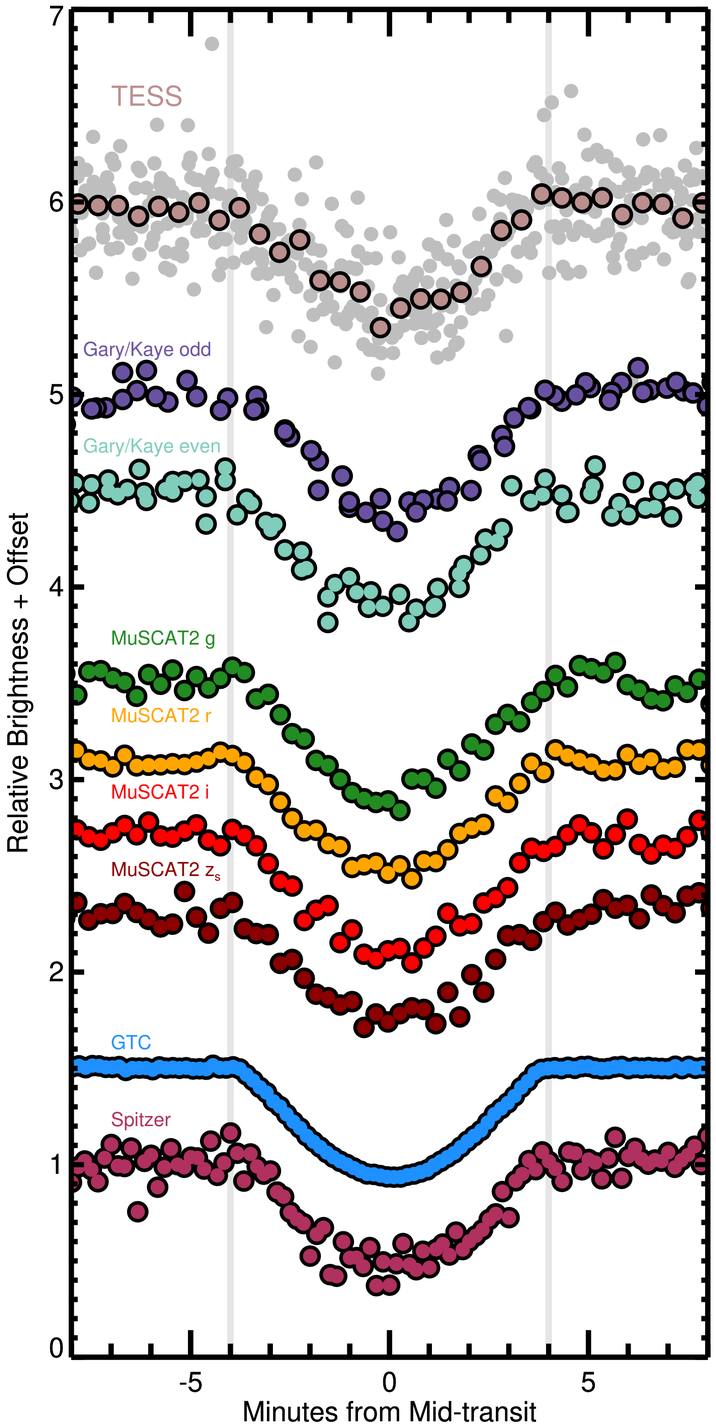


Testing for On-Target Eclipsing Binaries with Small Ground-Based Telescopes

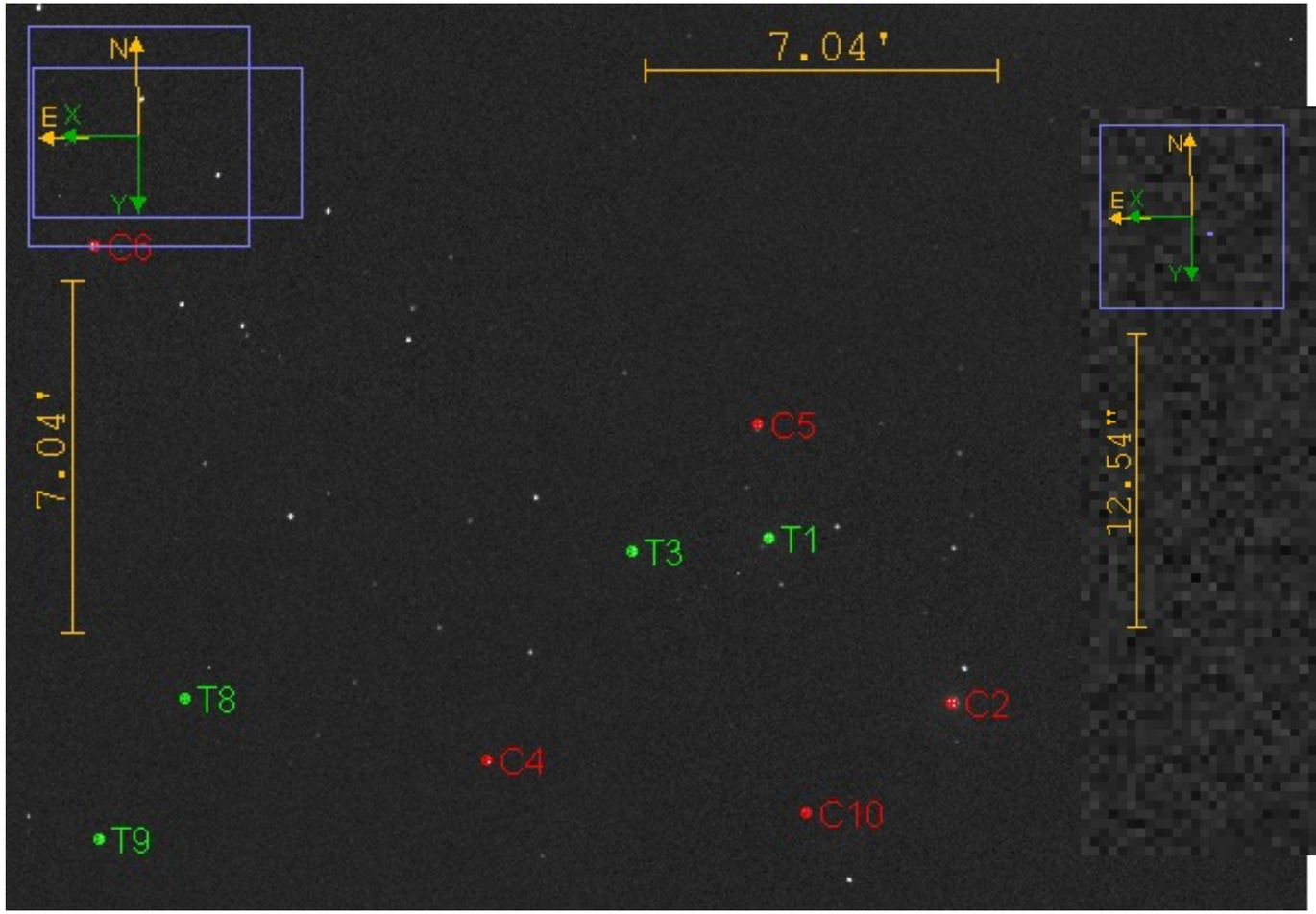


Eclipsing Binary →

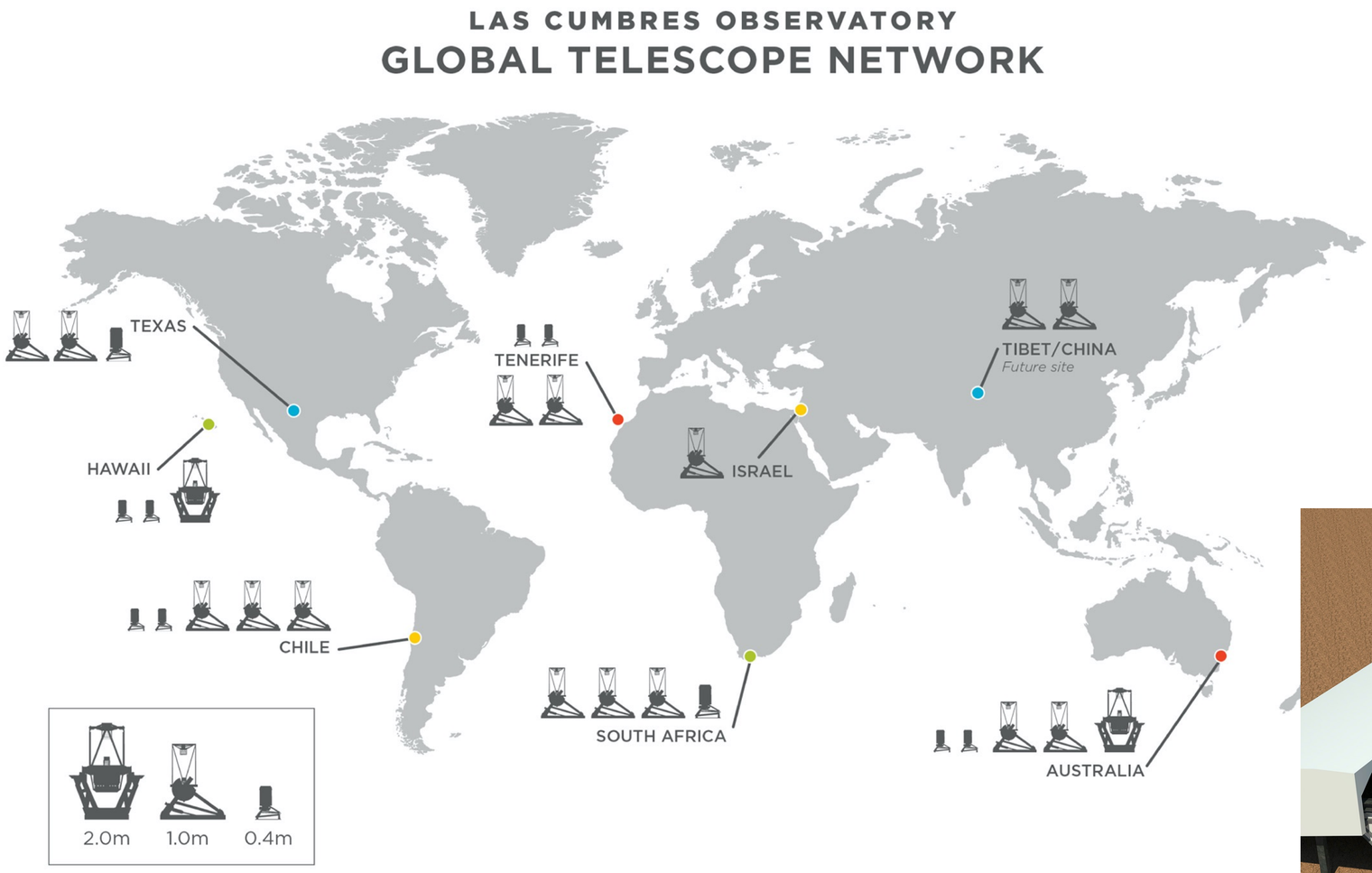
Planet →



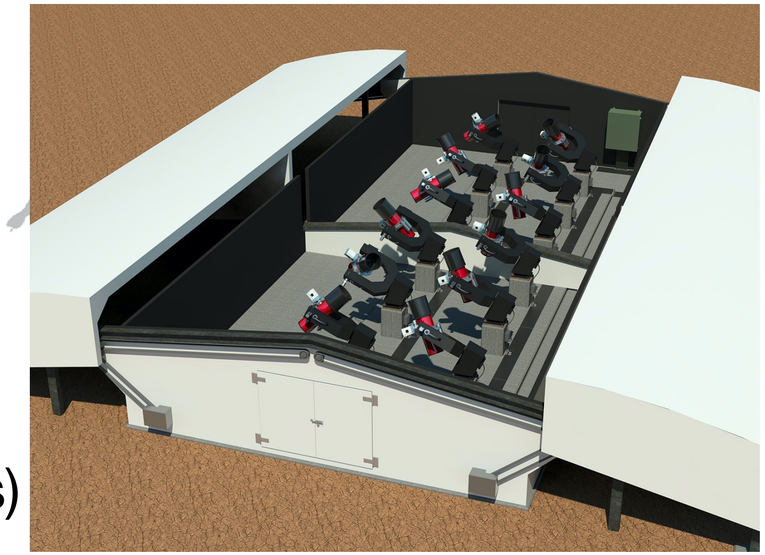
Testing for Nearby Eclipsing Binaries with Small Ground-Based Telescopes



Some of the telescopes used

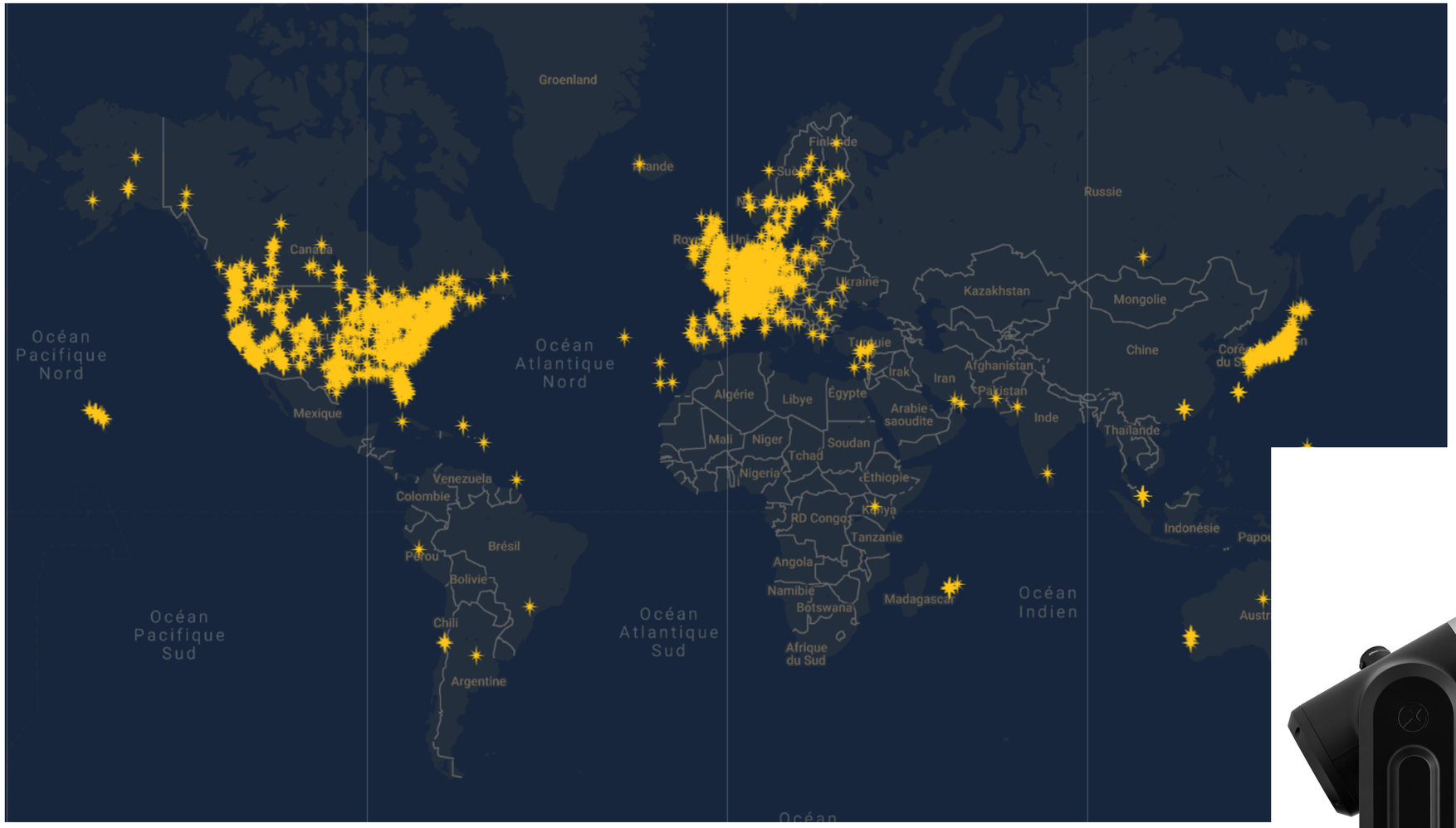


PEST Observatory (Credit: TG Tan)



NGTS (12 20-cm telescopes)

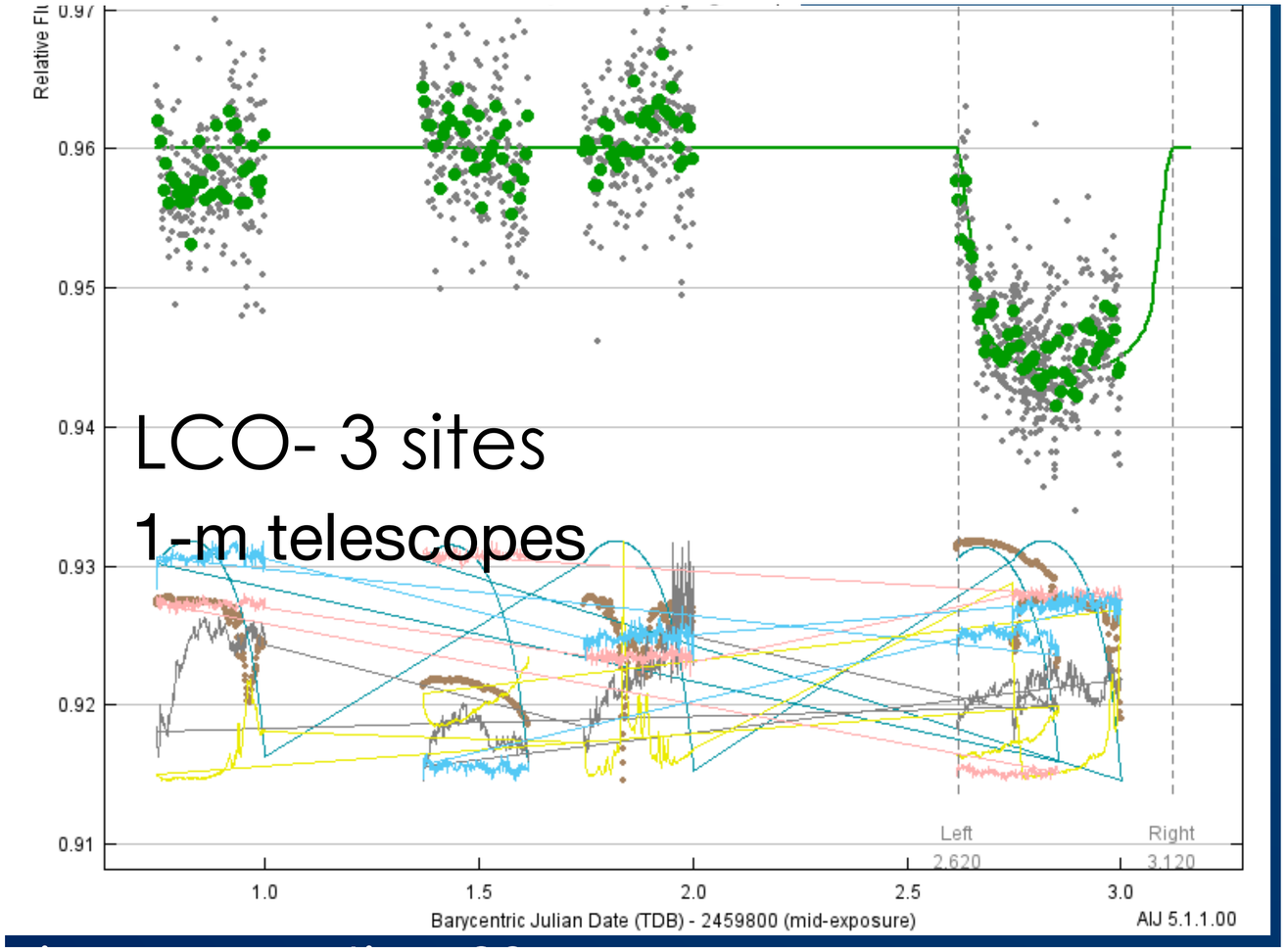
Some of the telescopes used – citizen scientists/amateur astronomers



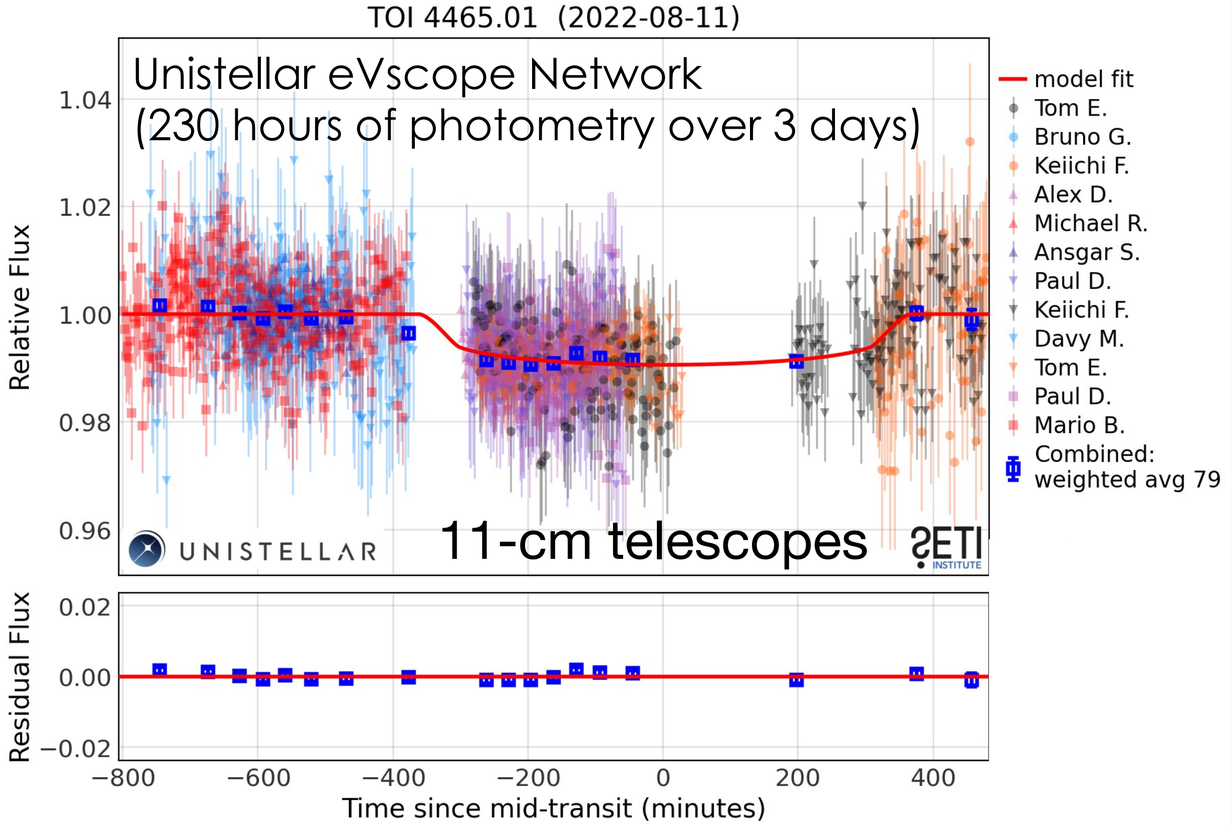
Unistellar network

PEST Observatory (Credit: TG Tan)

“Round the World” Light Curve Examples



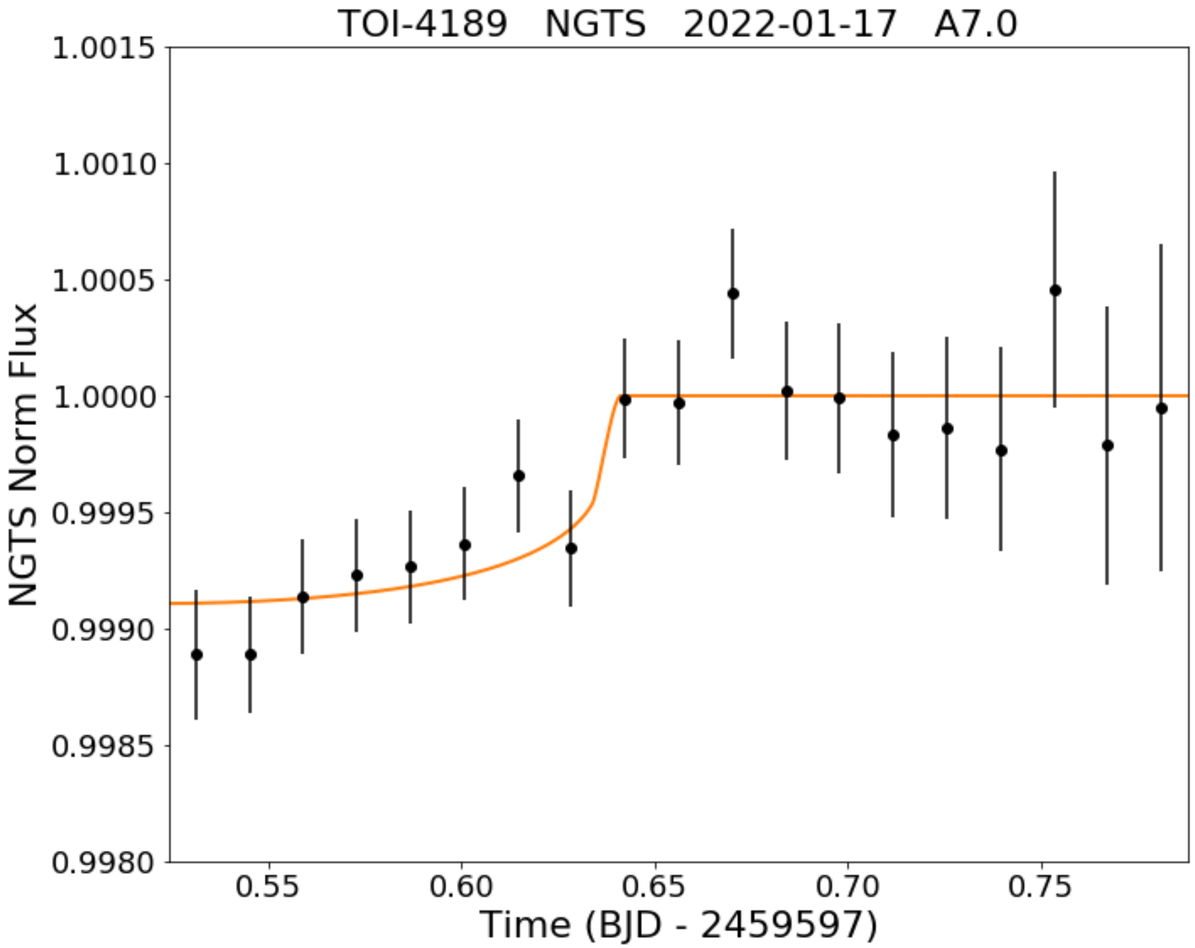
Transit detection from LCO (K. Collins)



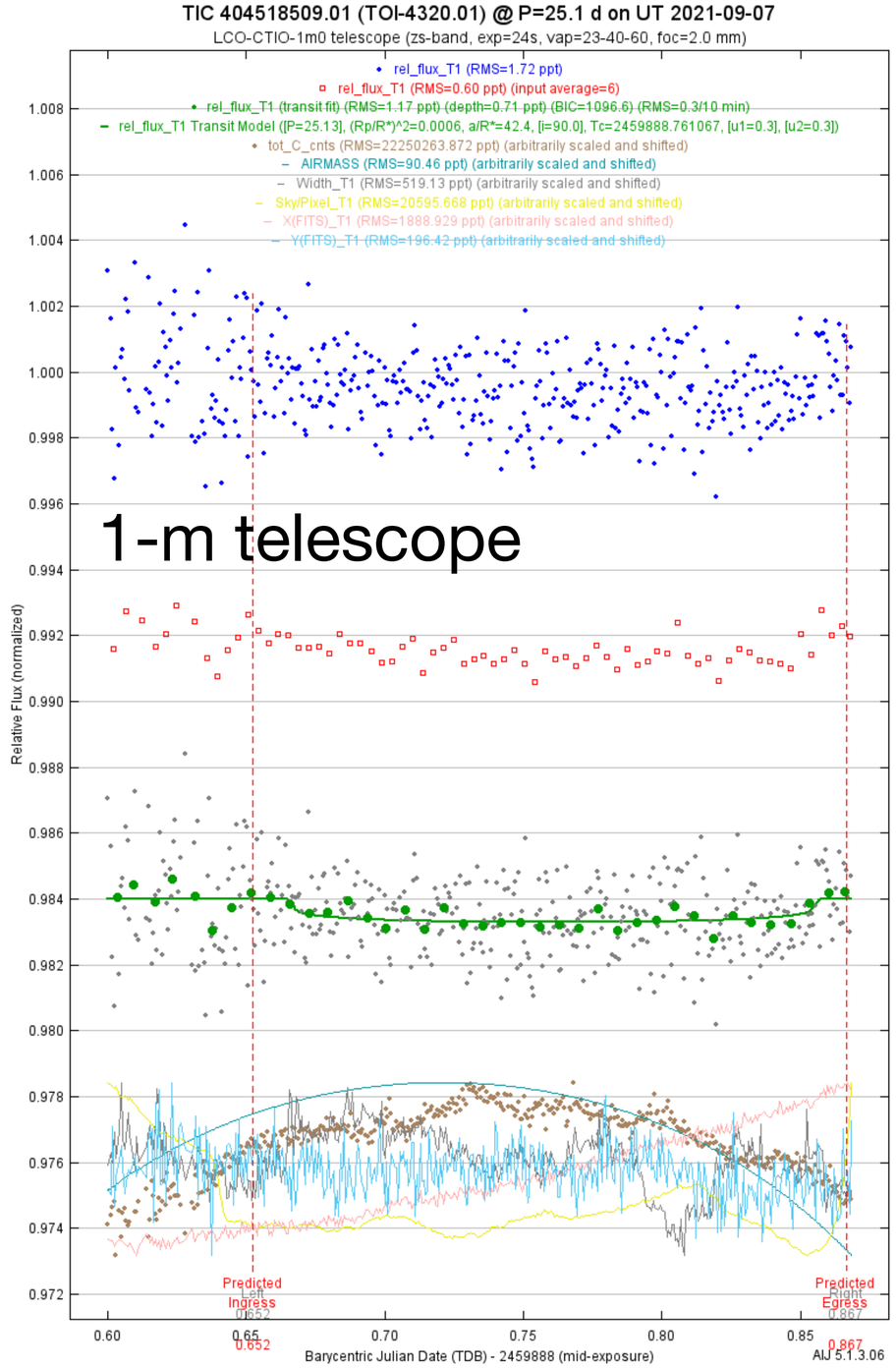
Unistellar eVscope Network (P. Dalba)

Dragomir, Dalba et al., in prep.

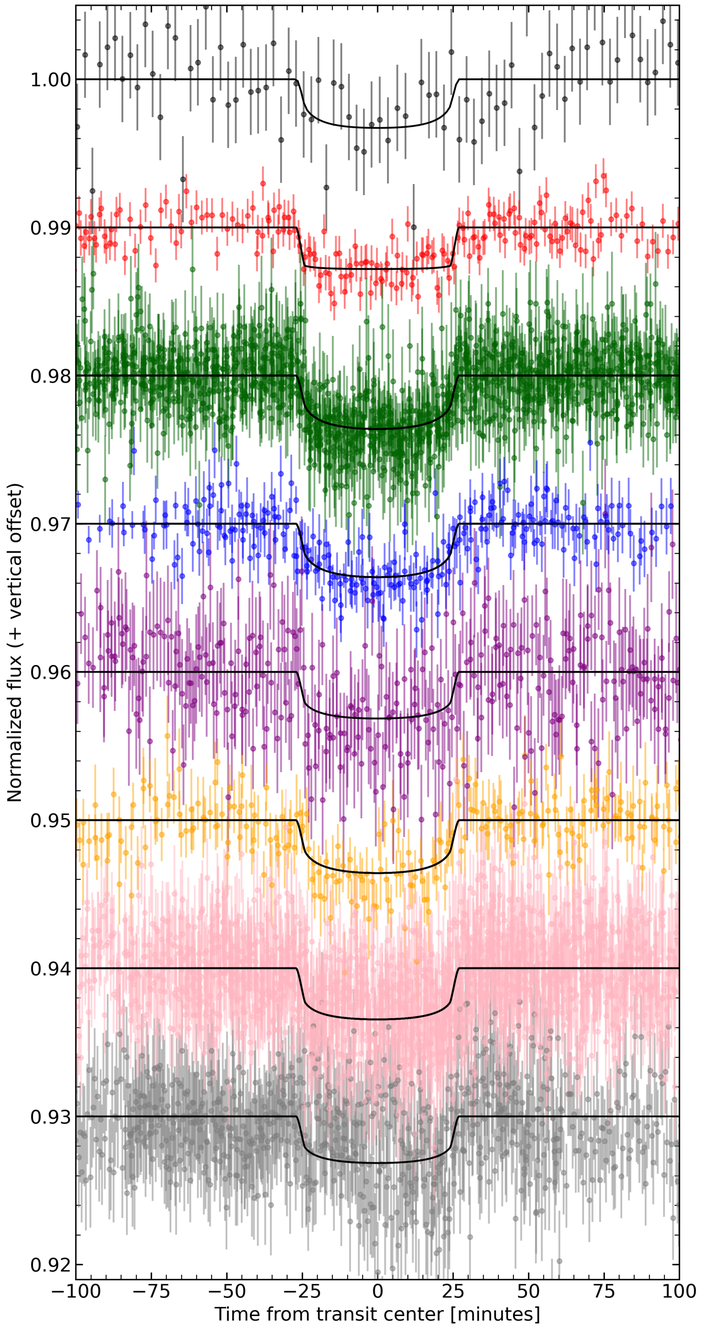
Shallow Light Curve Examples

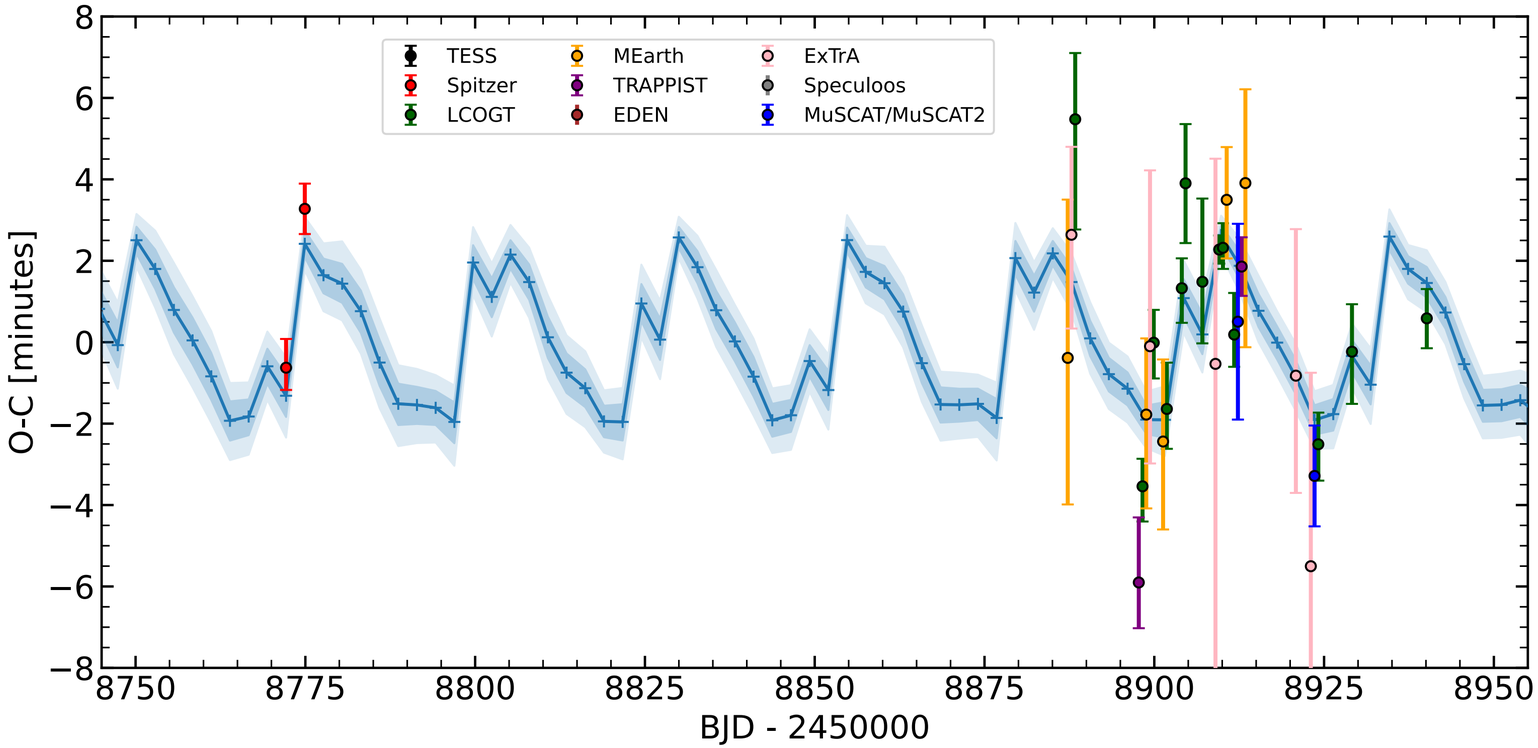


Combined observations from
<u>seven</u> 20-cm telescopes



Transit Timing Variation Light Curve Examples





Peterson et al. (2023), Nature

Takeaway Points

A small telescope in space is discovering thousands of transiting exoplanet science

But it alone cannot verify which candidates are true planets

Small (0.1 – 1m) ground-based telescopes come to the rescue

With ground-based seeing-limited photometry, we can:

- Check for chromaticity in the depth of the transit events (chromaticity = eclipsing binary)
- Test whether the transit events are actually off-target (e.g. a nearby eclipsing binary)
- Do both of the above for long transits, while also improving the constraints on the period of the planets
- Provide observations of multiple transits of Transit Timing Variation analyses