

Enhancing the Science from



TESS with NGTS

Daniel Bayliss
d.bayliss@warwick.ac.uk



On behalf of the NGTS Consortium

1: Next Generation Transit Survey (NGTS)

NGTS is an exoplanet hunting facility situated at ESO's Paranal Observatory in Chile [1]. Key features of NGTS:

- 12 robotic/automated 20cm telescopes
- Field-of-view = 8 deg² per telescope
- Imaging = 12 Andor red-sensitive cameras (e2v, 2x2K deep depletion CCDs)
- Imaging cadence = 13 sec (10s exposure times).
- Spatial resolution = 5 arcsec per pixel
- Guiding = ultra-stable (milli-pixel precision).



Figure 1: The 12 NGTS telescopes housed in the enclosure at ESO's Paranal Observatory.

3: TESS Bright Star Follow-Up

NGTS is following-up bright ($T < 10.5$) transiting planet candidates from TESS. Key goals are:

- To provide photometric follow-up for stars that are too bright for telescopes with smaller FOVs (i.e. no reference stars).
- To provide higher temporal and spatial resolution light-curves for transits down to depths of ~ 200 ppm.
- To search for TTVs over an extended observing baseline.

We are using multiple NGTS telescopes to reach similar photometric precision to TESS for bright candidates.

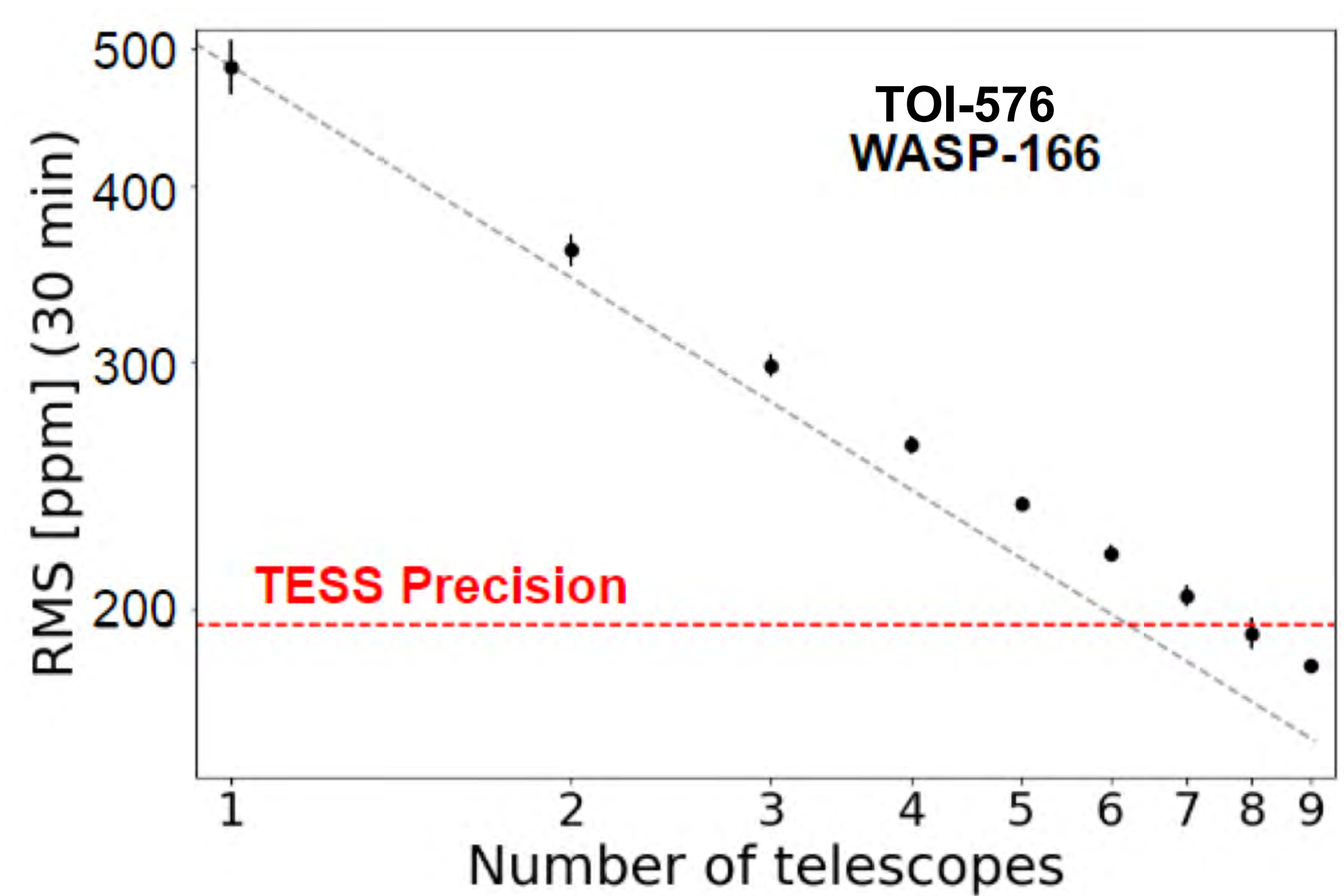


Figure 3: The NGTS photometric precision using multiple NGTS telescopes for TOI-576 (WASP-166)

2: Primary NGTS Survey

Highlights from the main NGTS survey include:

- NGTS-1b (Bayliss et al., 2018, [2]) – largest exoplanet found transiting an M-dwarf
- NGTS-4b (West et al., 2018, [3]) – a $3R_E$ planet in the “Neptune Desert”. The shallowest transit ever discovered from a ground-based survey (1300ppm).
- NGTS-5b (Eigmüller et al., 2019, [4]) – a highly inflated sub-Jovian planet.
- NGTS-6b (Vines et al., 2019, [5]) – an ultra-short period hot Jupiter with $P=21.7$ h

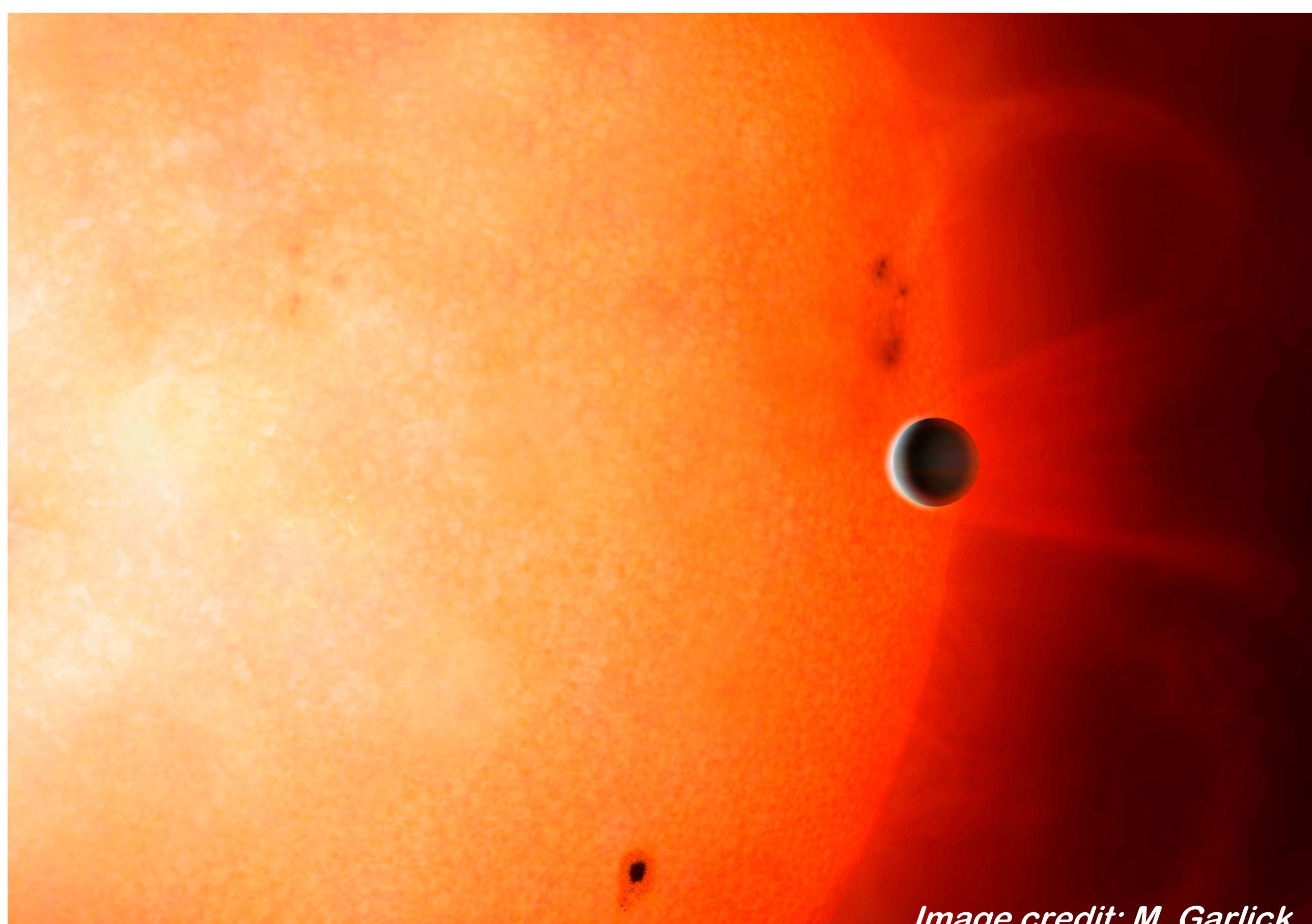


Figure 2: Artist's impression of NGTS-4b, a $3R_E$ planet in a $P=1.3$ d orbit.

4: TESS Single-Transit Follow-Up

NGTS is following-up single-transit events from the TESS light curves. This is being carried out with two approaches:

- Monitoring single-transit event candidates over a full observing campaign (many months) in survey mode.
- Multi-telescope targeted monitoring of single-transit candidates when we have an estimated ephemeris from previous imaging (“pre-discovery”) or spectroscopy.

Based on an ephemeris from CORALIE RVs, we successfully observed a transit around TOI-222 with 9 NGTS telescopes.

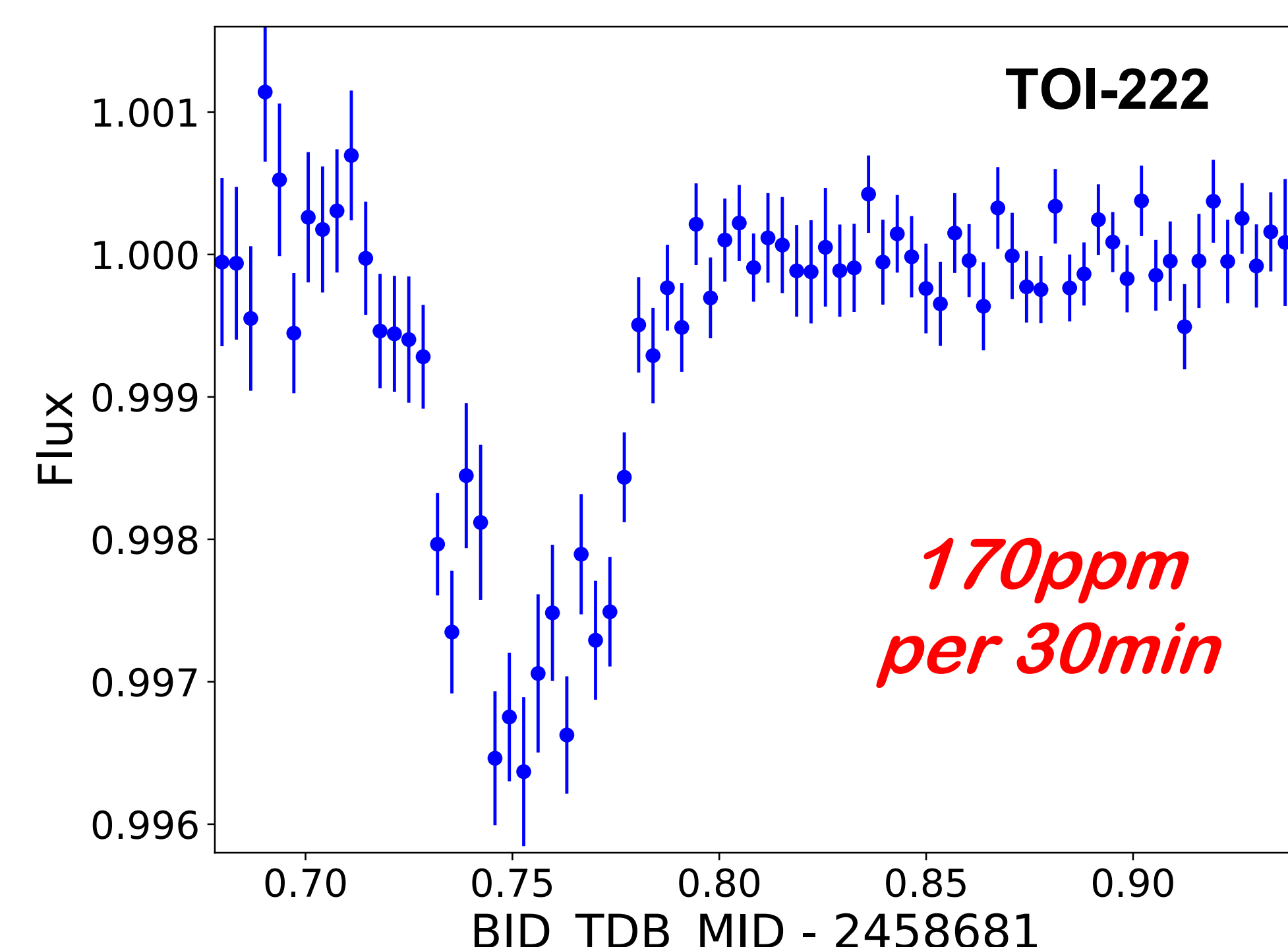


Figure 4: The discovery of a transit of TOI-222 using 9 NGTS telescopes on 17 July 2019.

References

- [1] Wheatley et al., 2018, *The Next Generation Transit Survey (NGTS)*, MNRAS, 475, 4476
- [2] Bayliss et al., 2018 *NGTS-1b: a hot Jupiter transiting an M-dwarf*, MNRAS, 475, 4467
- [3] West et al., 2019 *NGTS-4b: A sub-Neptune Transiting in the Desert*, MNRAS, 486, 5094
- [4] Eigmüller et al., 2019 *NGTS-5b: a highly inflated planet in the sub-Jovian desert*, A&A, 625, A142
- [5] Vines et al., 2019 *NGTS-6b: An Ultra Hot-Jupiter Orbiting a Metal-rich star*, accepted to MNRAS