Transit Timing Variations with NGTS

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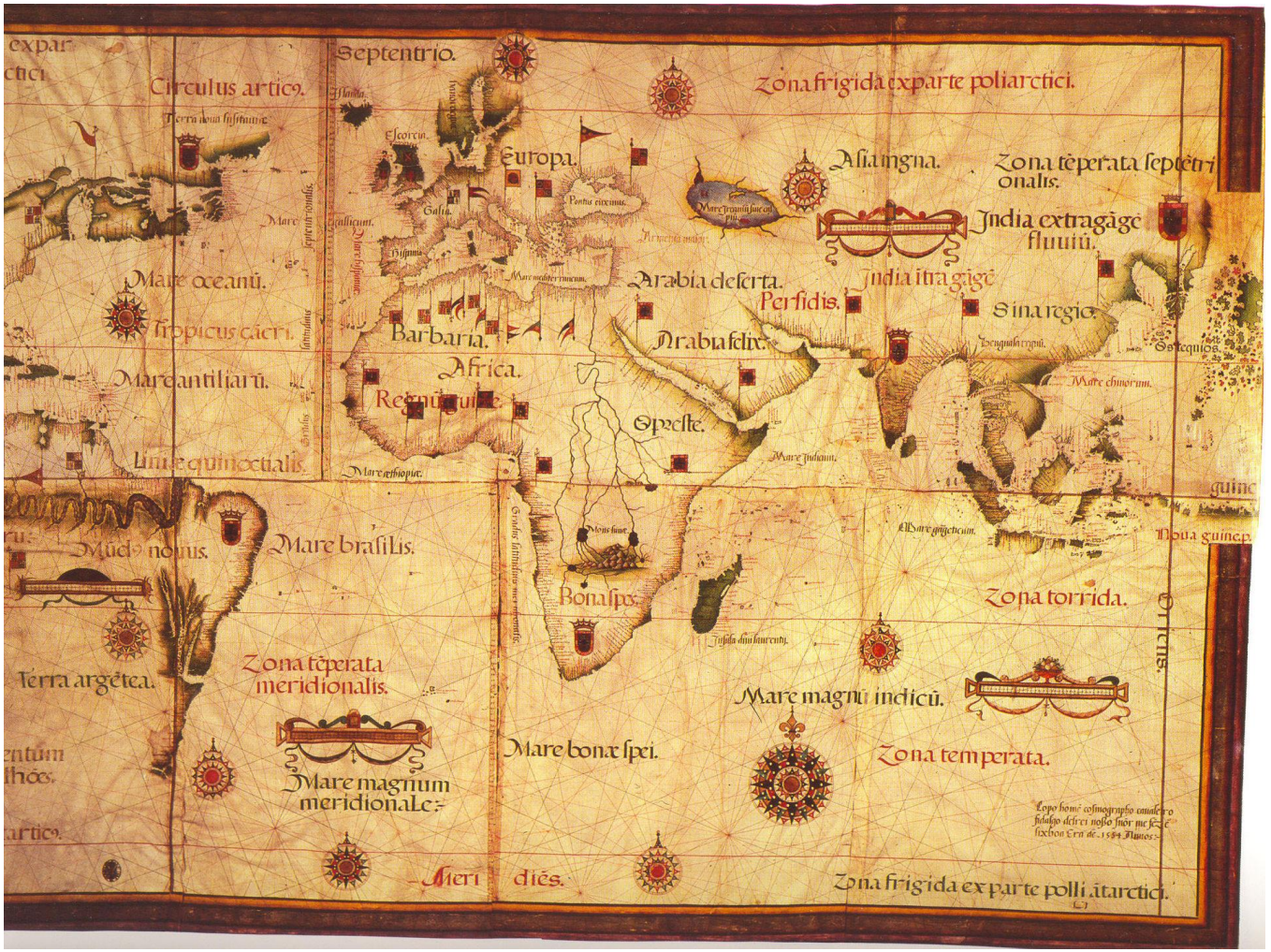
On behalf of the NGTS Consortium

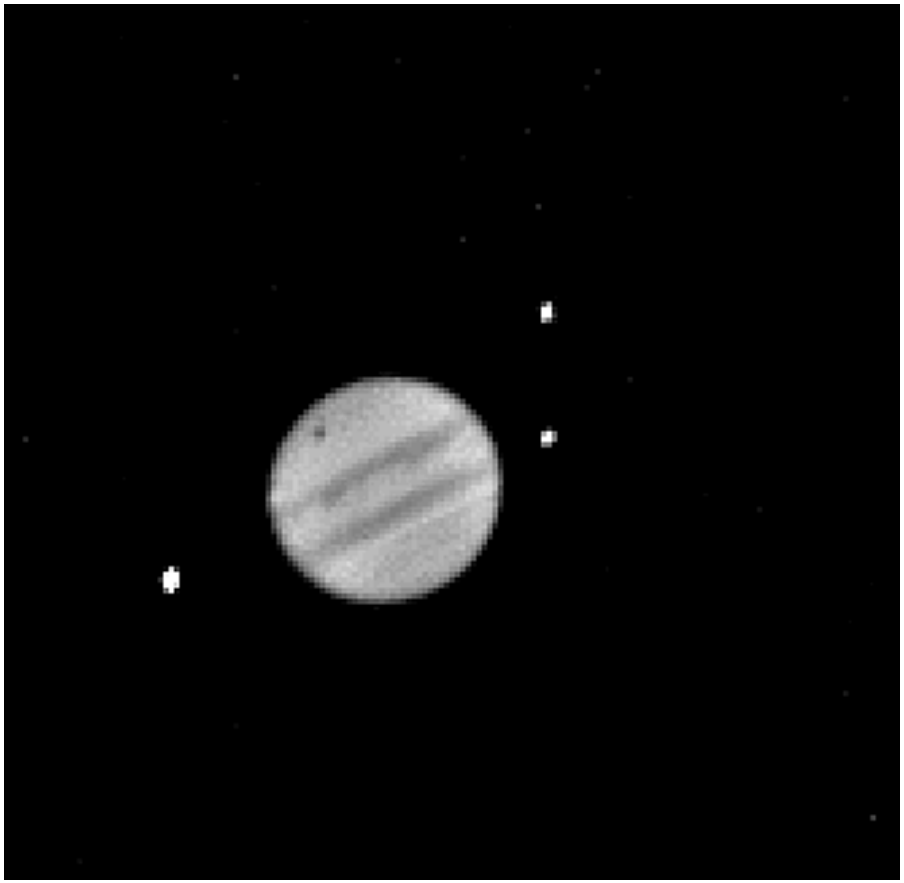
UNIVERSITY OF WARWICK

Science and Technology Facilities Council

1554 Lopo Homem world map

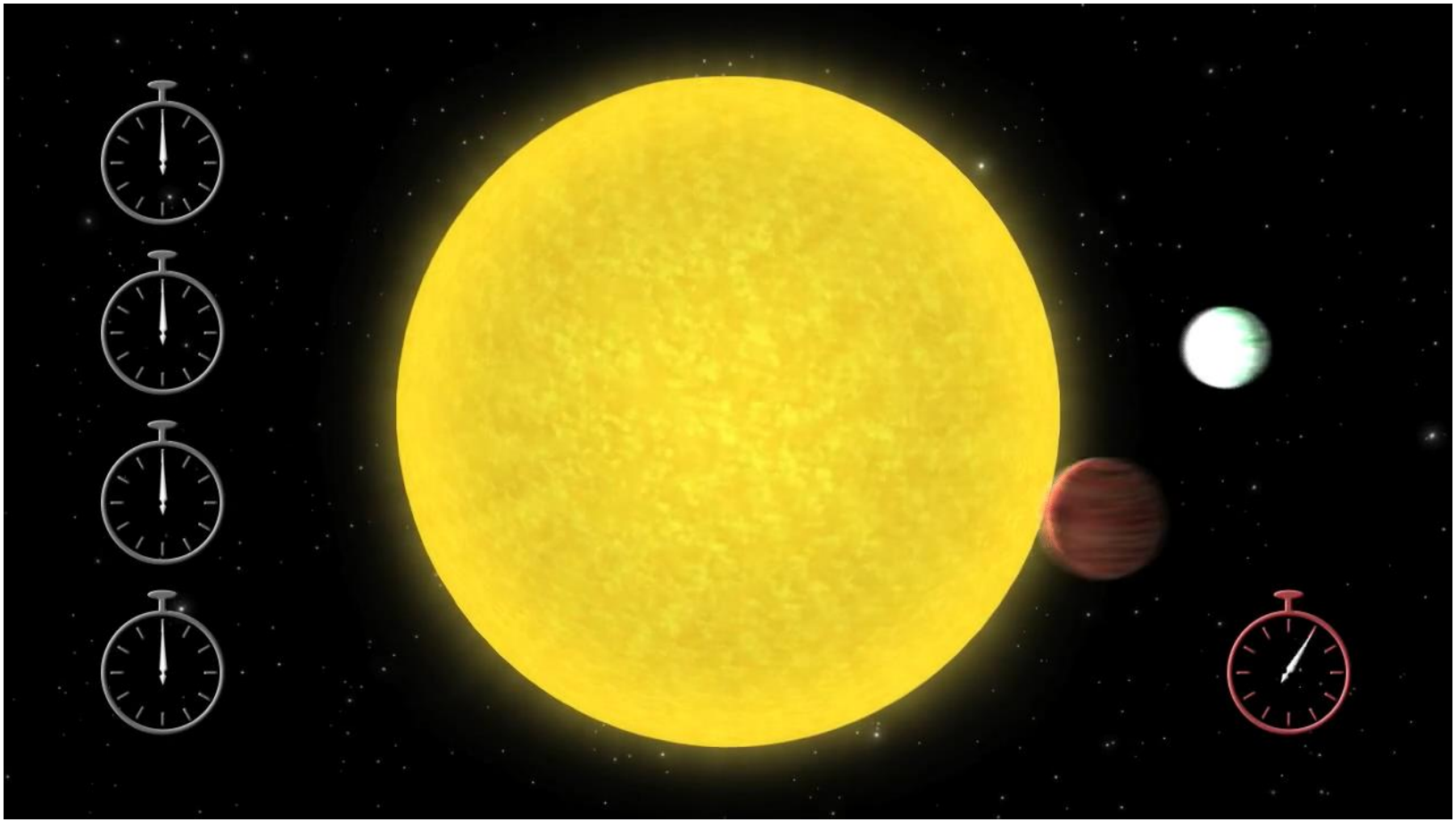


17th Century - Transit timing to map the new worlds



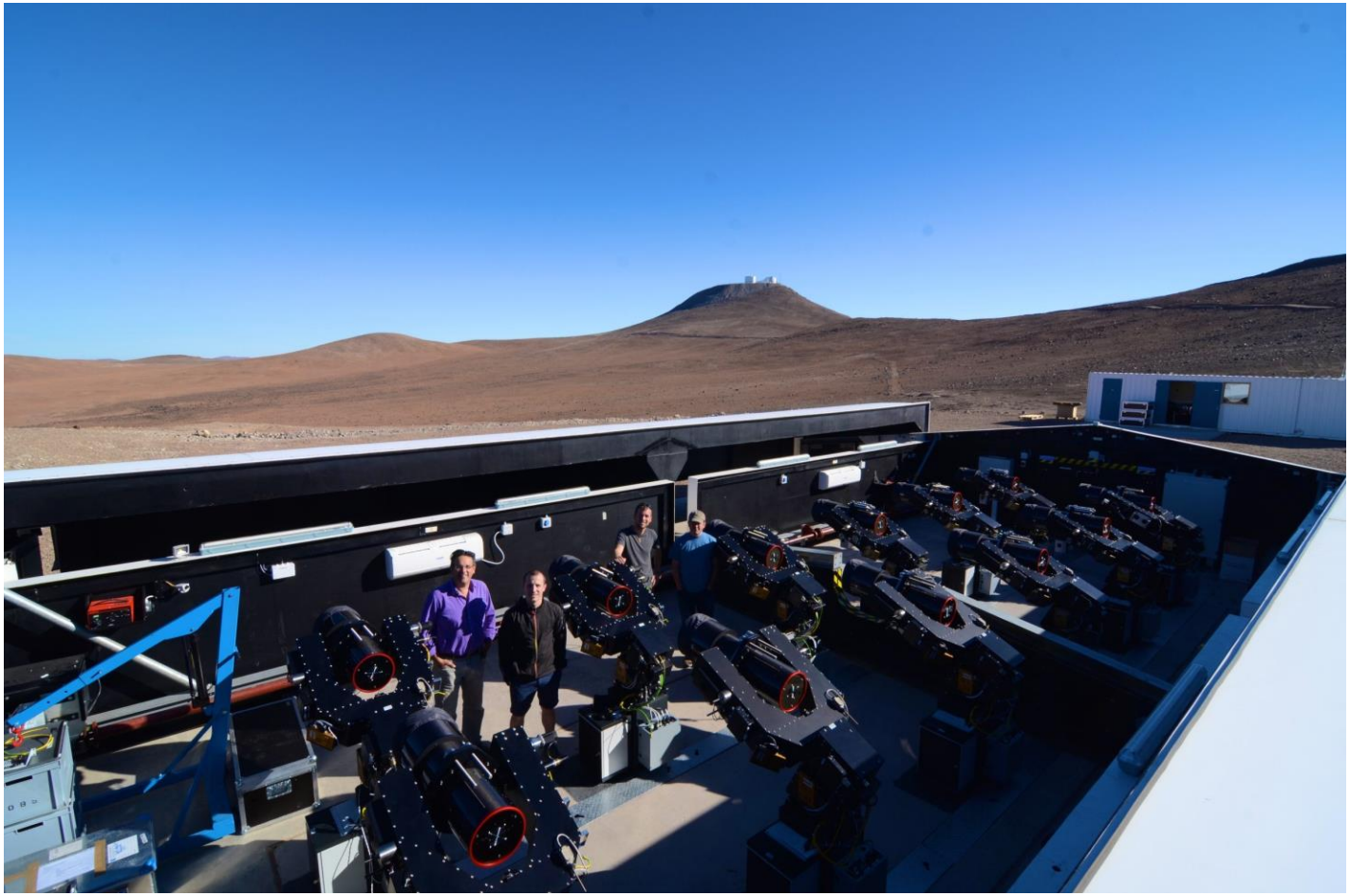
2h observation of Jupiter (Bruce Gray)

21st Century - Transit timing to map the new worlds



Credit: NASA Ames/Kepler mission

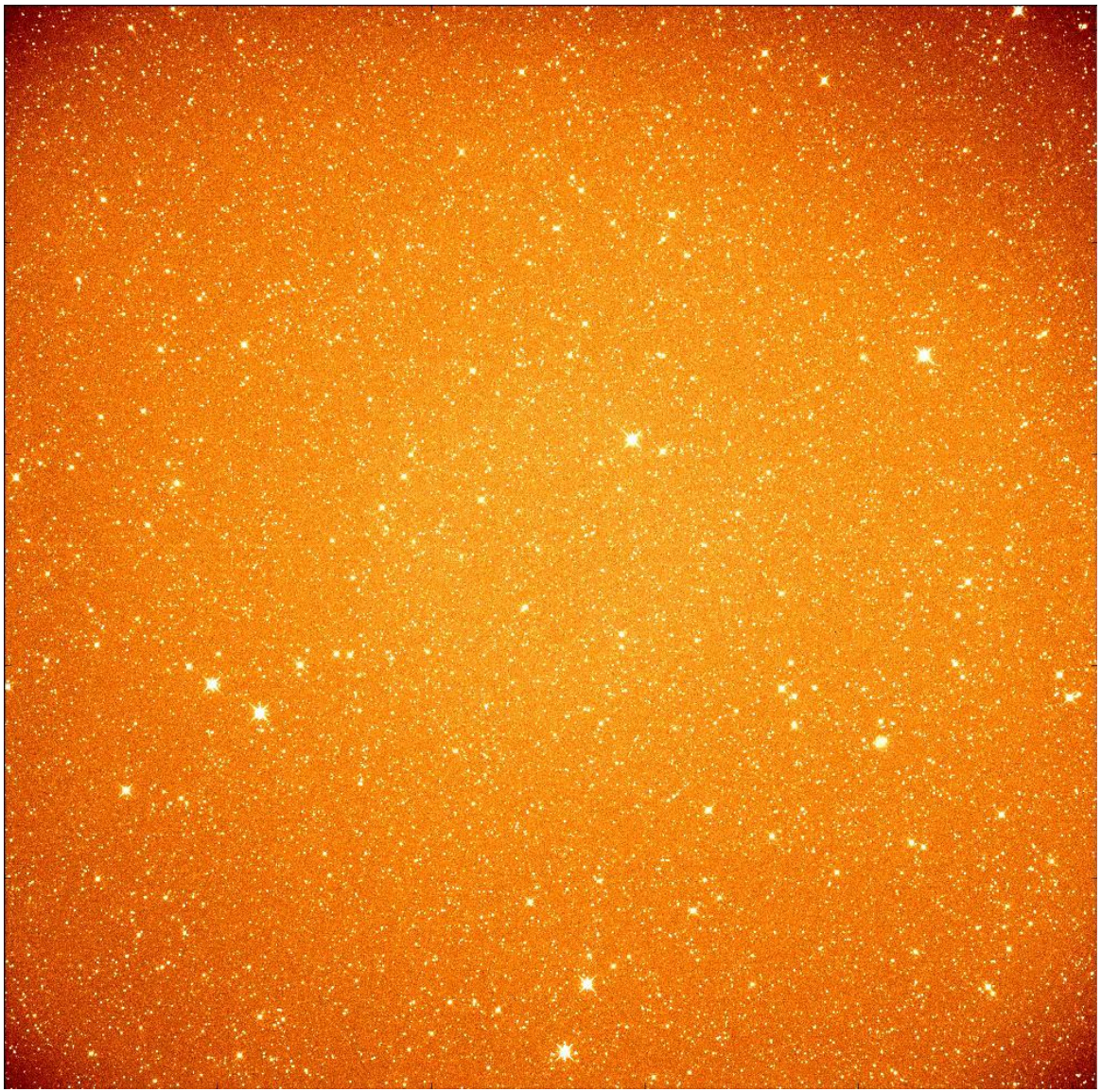
NGTS Facility – 12 x 20cm telescopes at Paranal Observatory



NGTS Facility – Fully automated and robotic

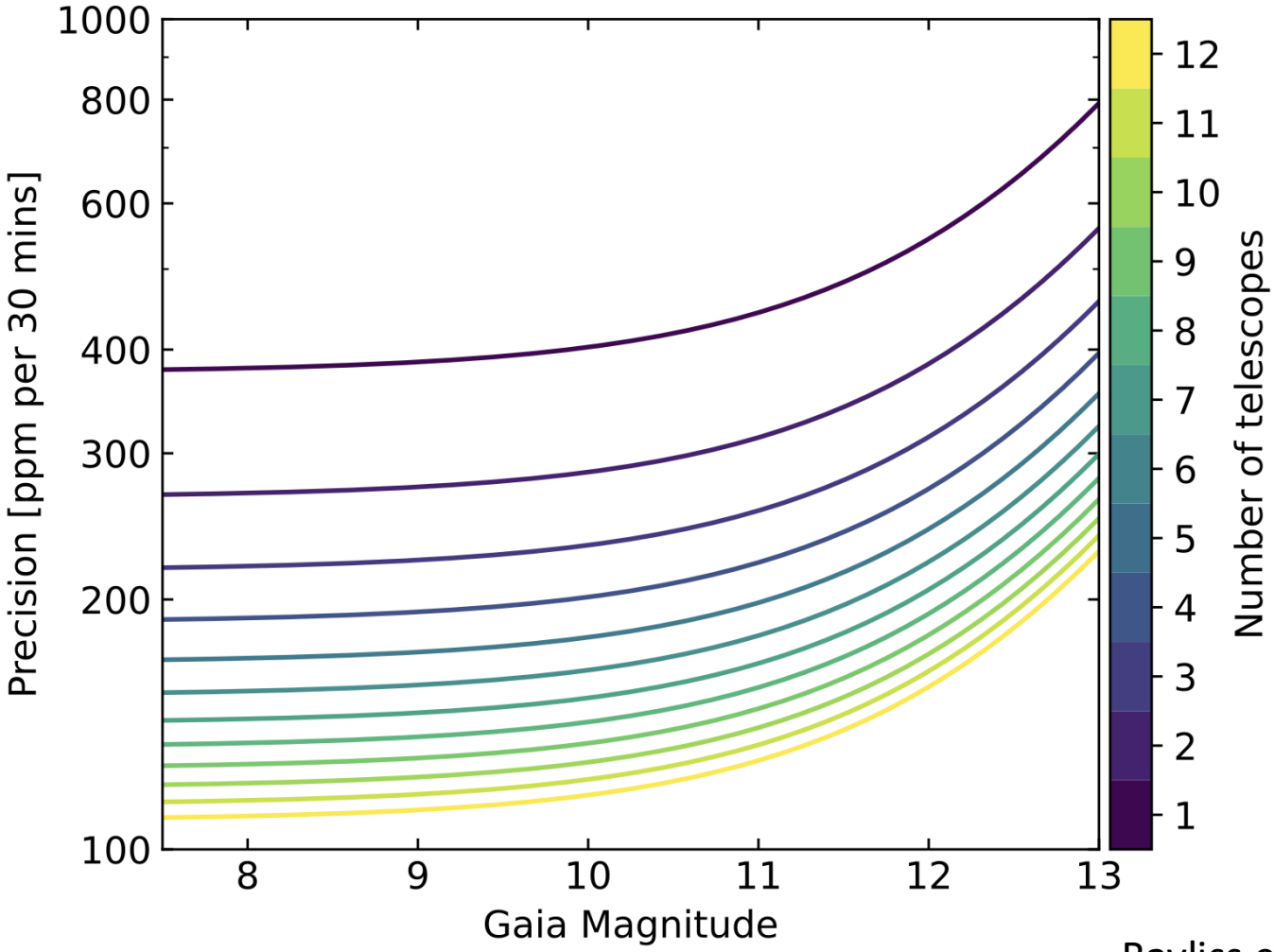
Wheatley et al., 2018

13s cadence in wide (R+I) band



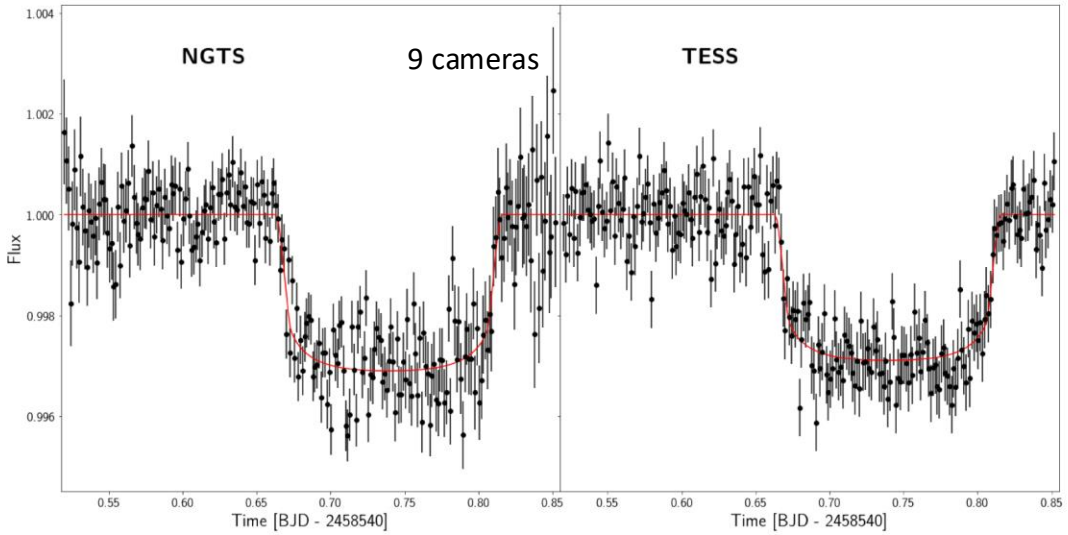
5’’ pixels
2.8x2.8 deg FOV

Precision for 1 to 12 telescopes

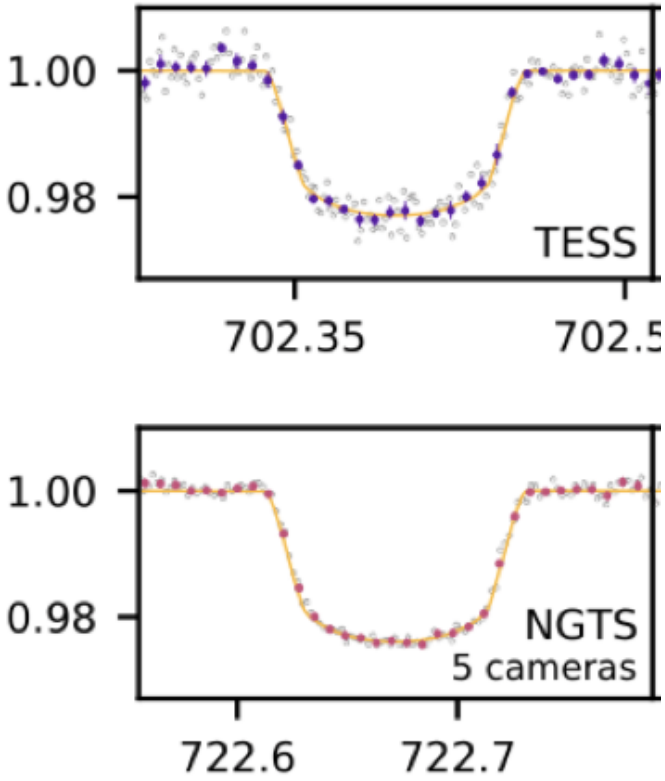


Bayliss et al., 2022.

Photometric precision similar to TESS



Simultaneous transits of WASP-166b on 25 February 2019 , Bryant et al., 2020.



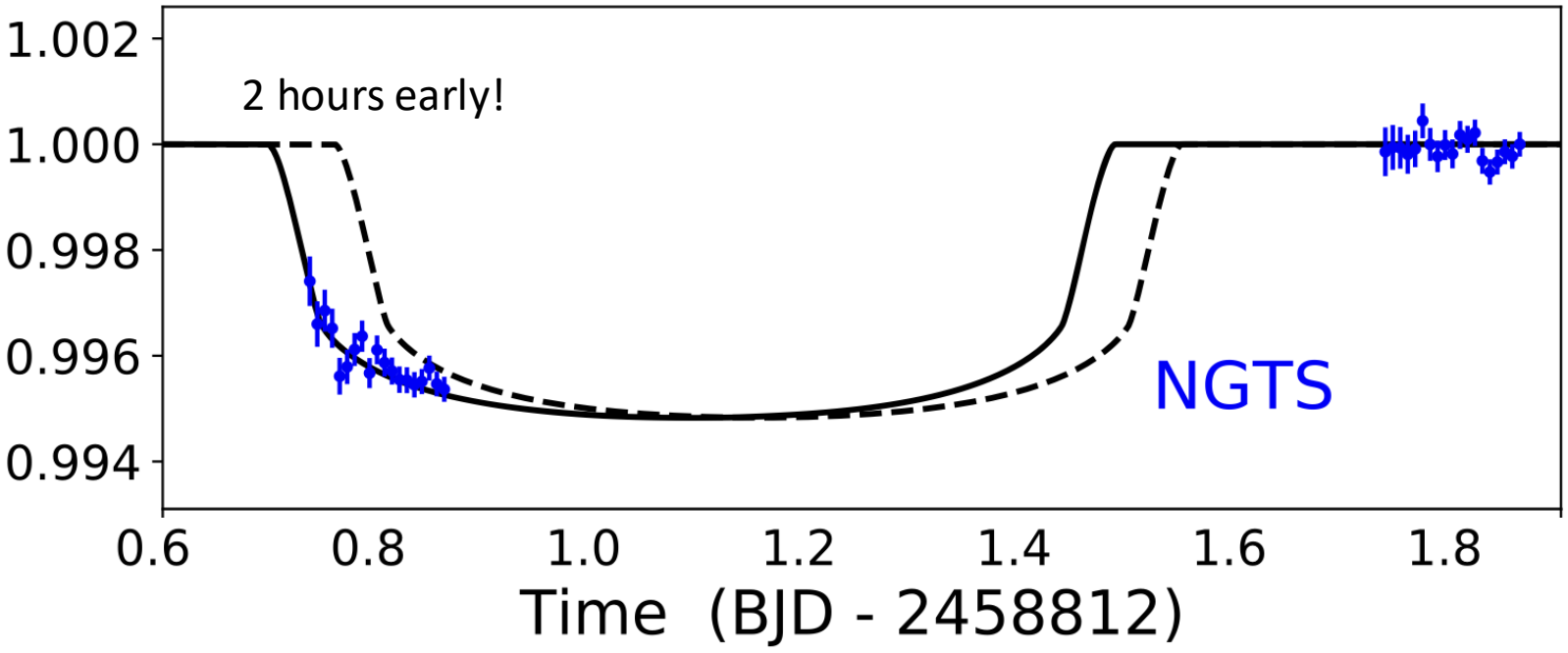
Transits of WASP-39b, Ahrer et al., 2023.

1. NGTS Orbital Decay Program

- Sample of 12 very hot Jupiters well suited to measuring TTVs to detect orbital decay.
- Began in 2019. Transits measured several times per year. Aim to build up a decade-long homogeneous set of transits.

2. Multi-planet TTV program

- Sample of ~10 bright star multi-planet systems from TESS.
- Example: HIP-41378f (Bryant et al., 2021)



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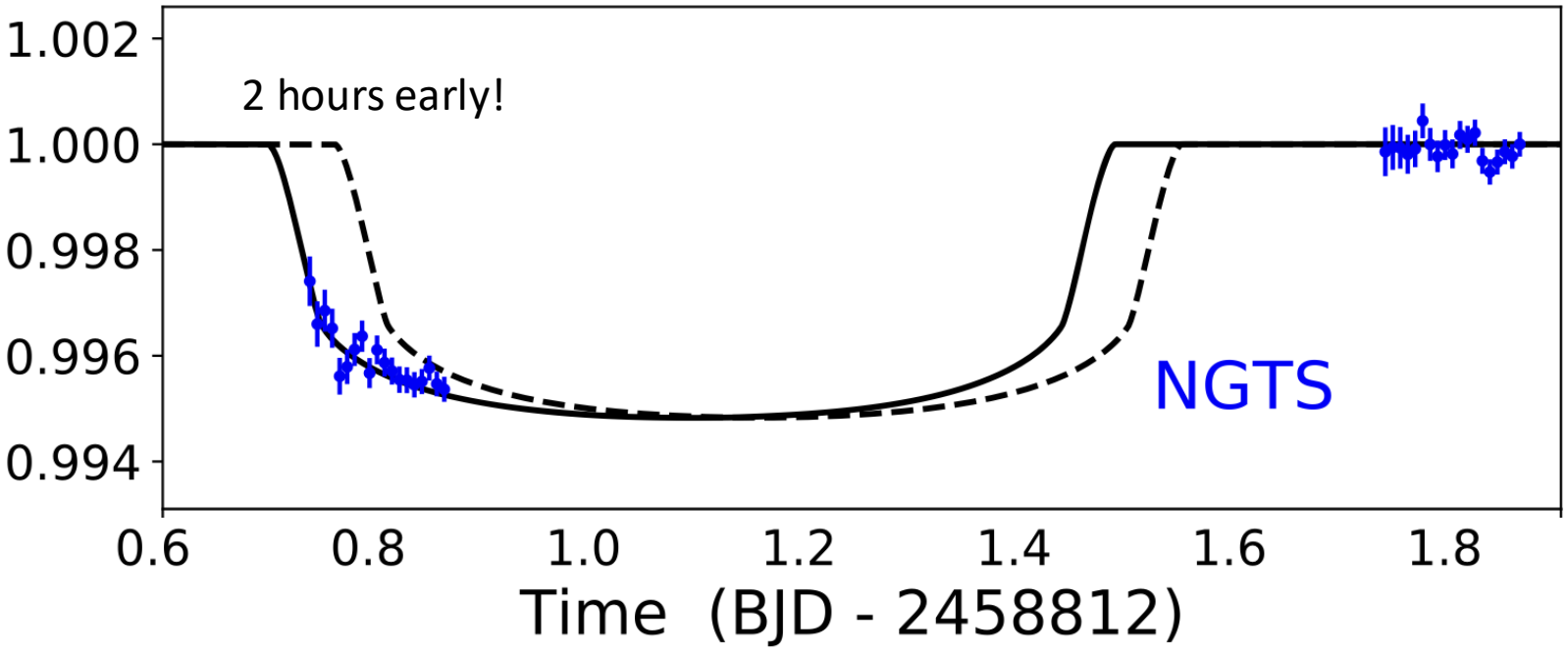
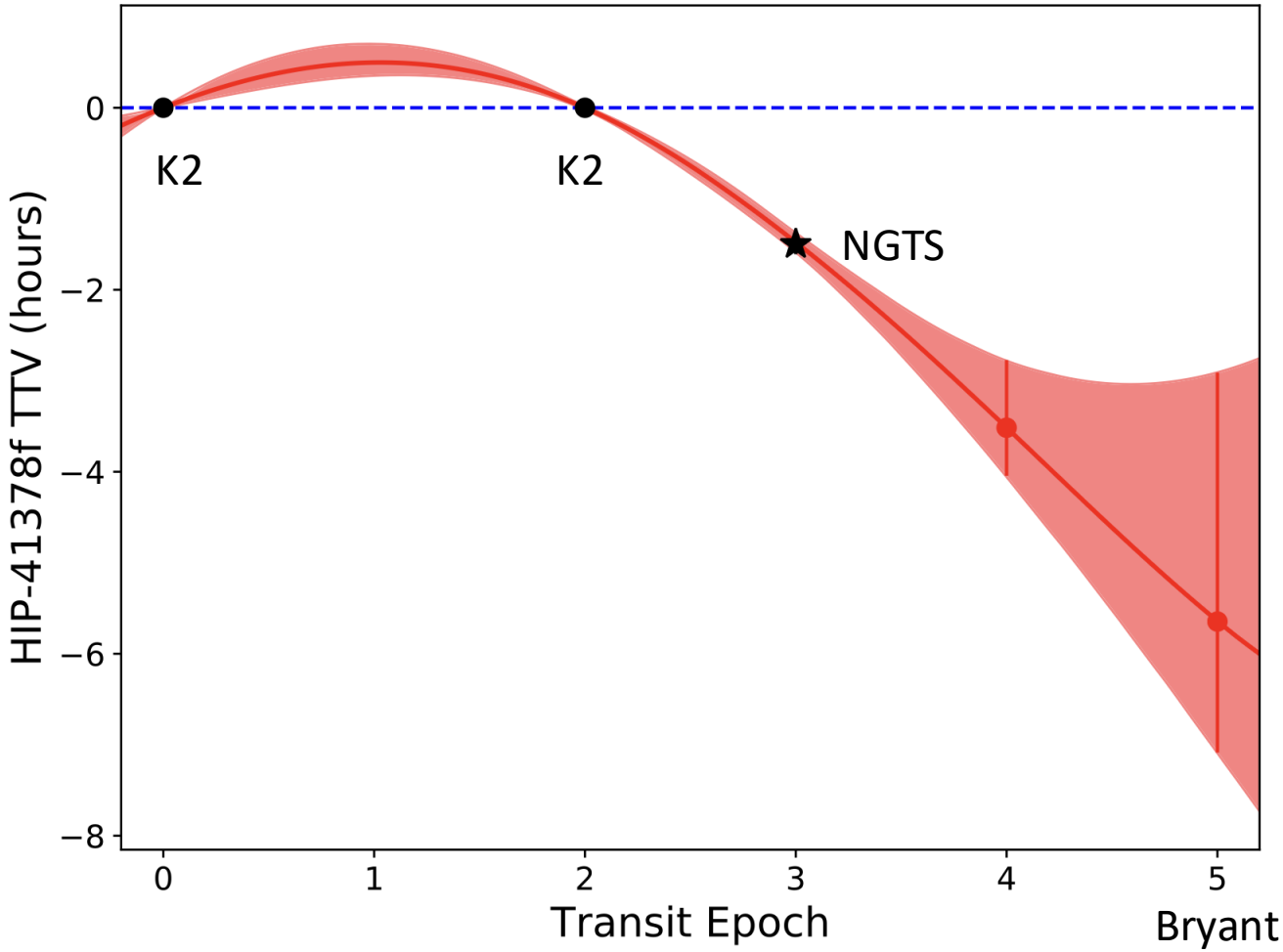


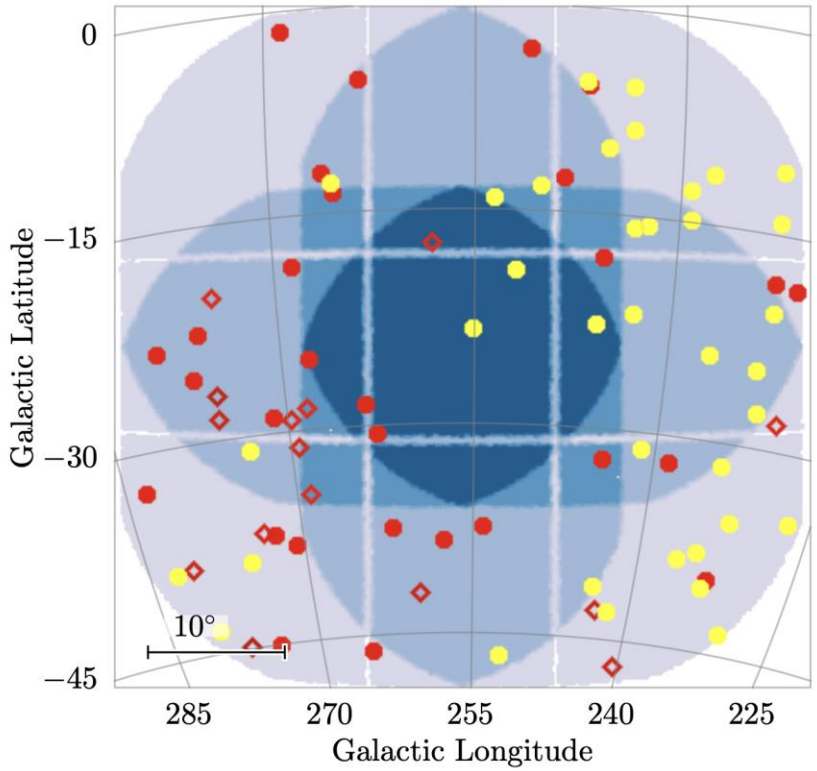
Crucial TTV discovery for HIP-41378f



Bryant et al., 2021

3. PLATO LOPS2 TTV program

- Sample “long period” (P>20d) transiting planets, focusing on the PLATO LOPS2 FOV .



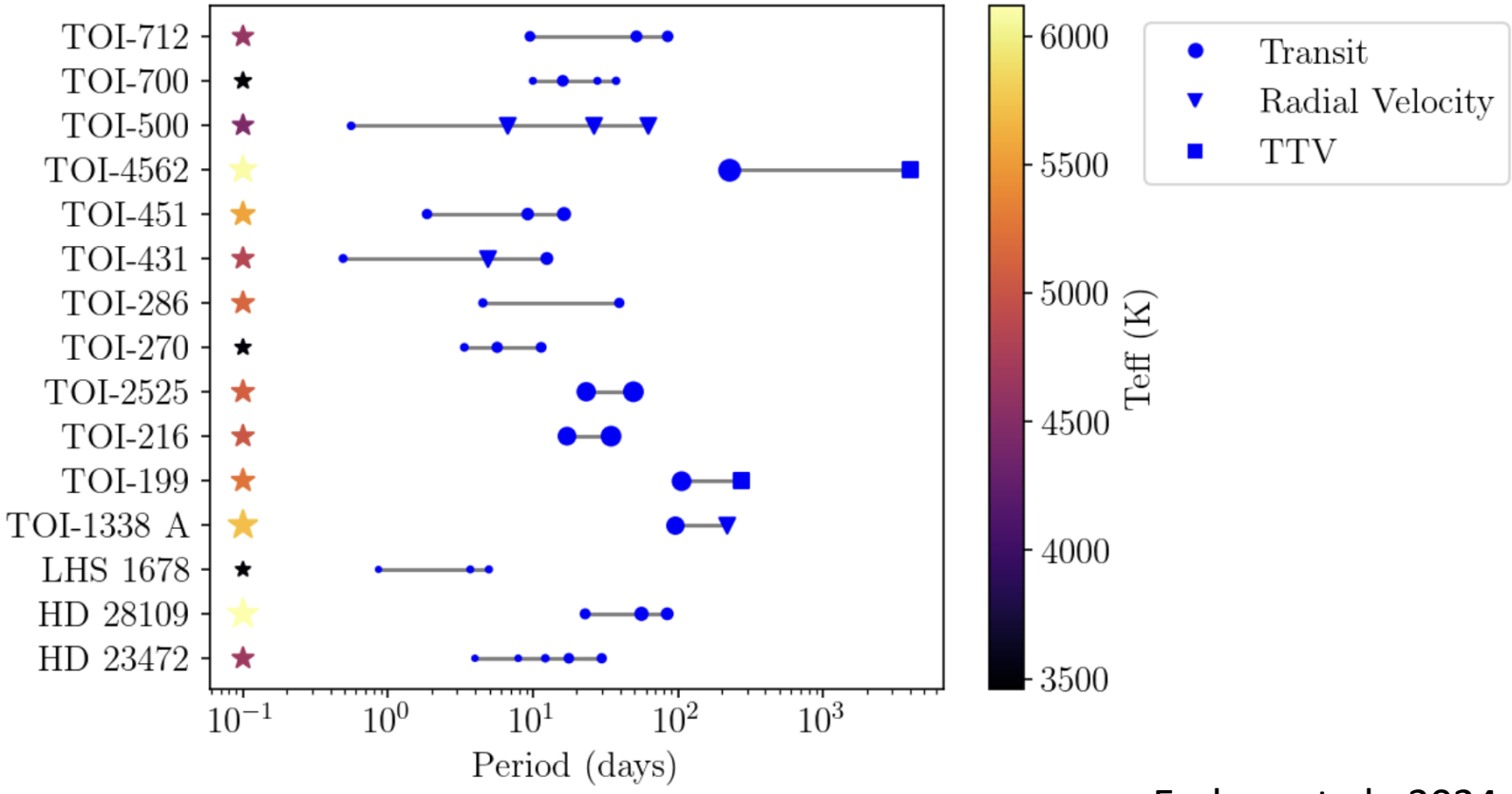
Yellow – Known transiting planets

Red – TESS discovered transiting planets

Diamonds – Multi-planet systems

Eschen et al., 2024

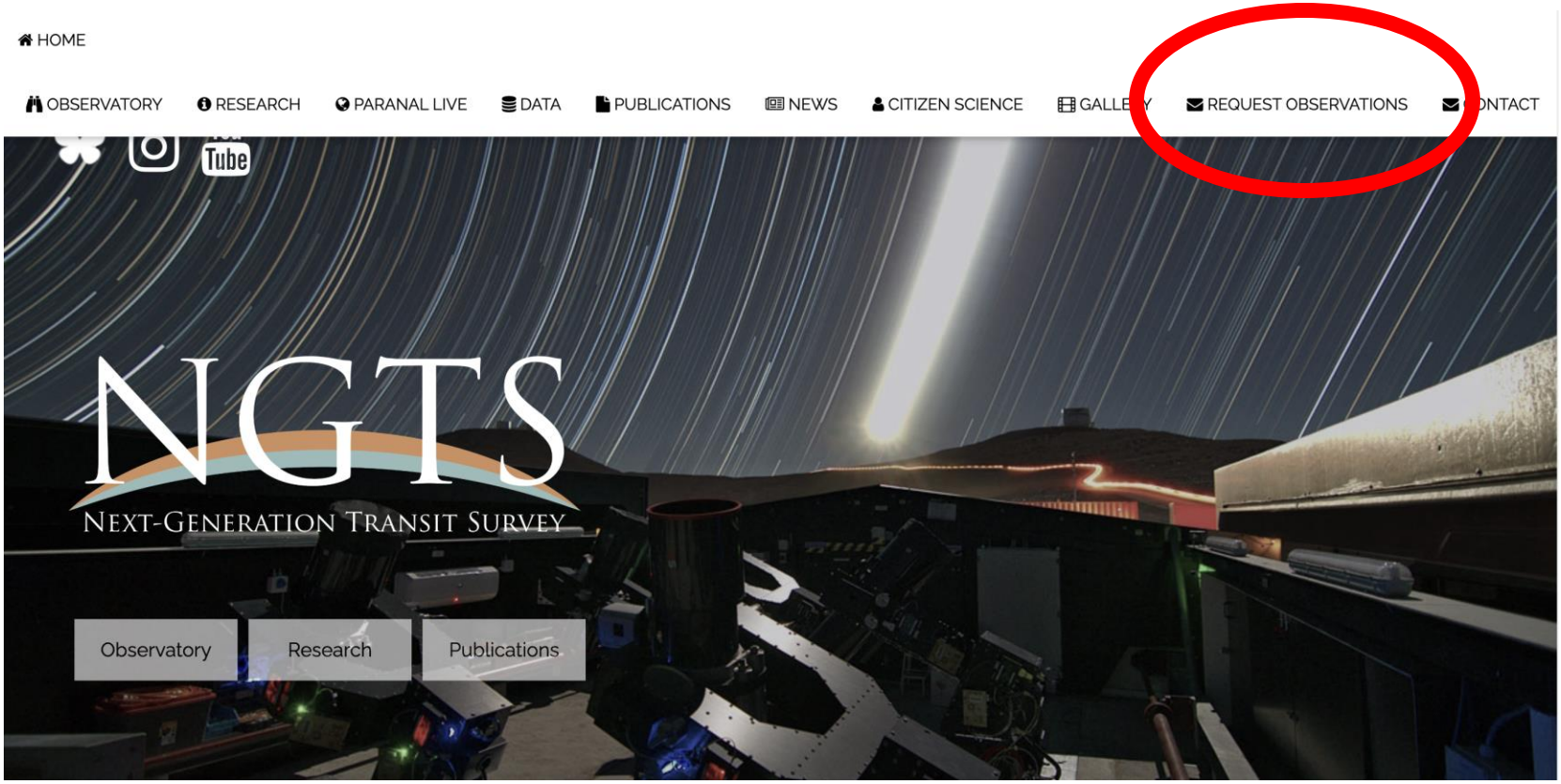
Multi-planet Systems in PLATO LOPS2 FOV



Eschen et al., 2024

4. [Insert your target(s) here]

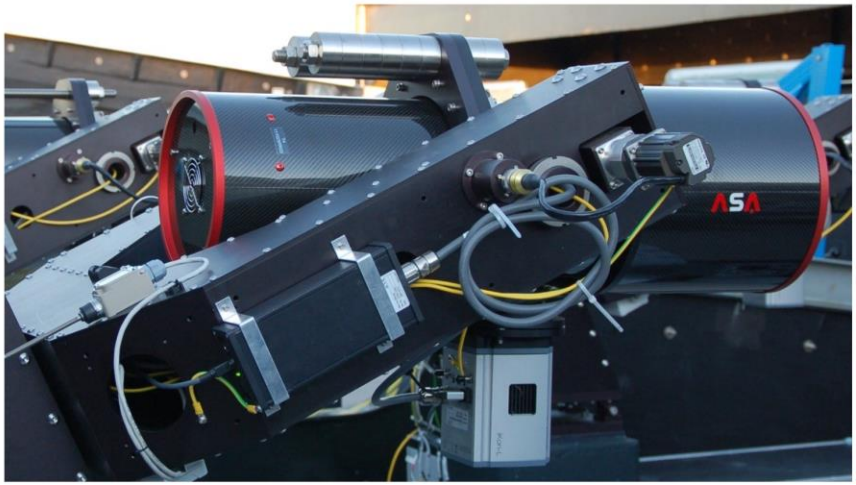
ngtransits.org



Obrigado!

Bonus Slides

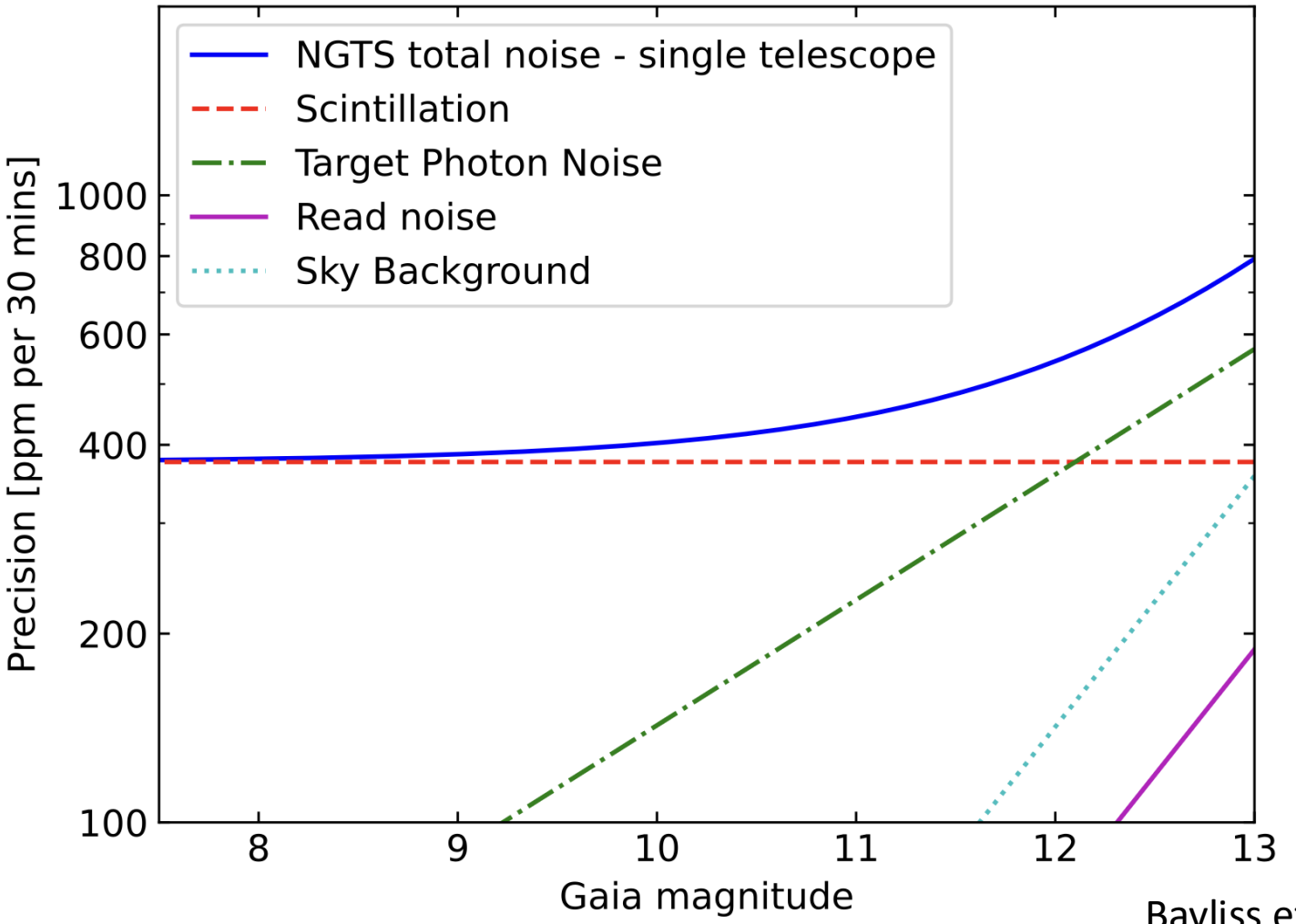
NGTS CCD Camera Details



Description	iKon-L 936 (CCD)
Active pixels	2048 × 2048
Detector size	27.6×27.6 mm
Pixel size	13.5×13.5 µm
Read Noise	12 e- in fast readout mode (1.5 s)
Dark Current	0.006 e-/pix/s at -80°C
Sensor Type	e2v BR-DD
QE	peak QE > 95% at 800nm
Full Frame Readout Time	1.5 s
Operating temperature	-70°C
Shutter	45 mm programable shutter

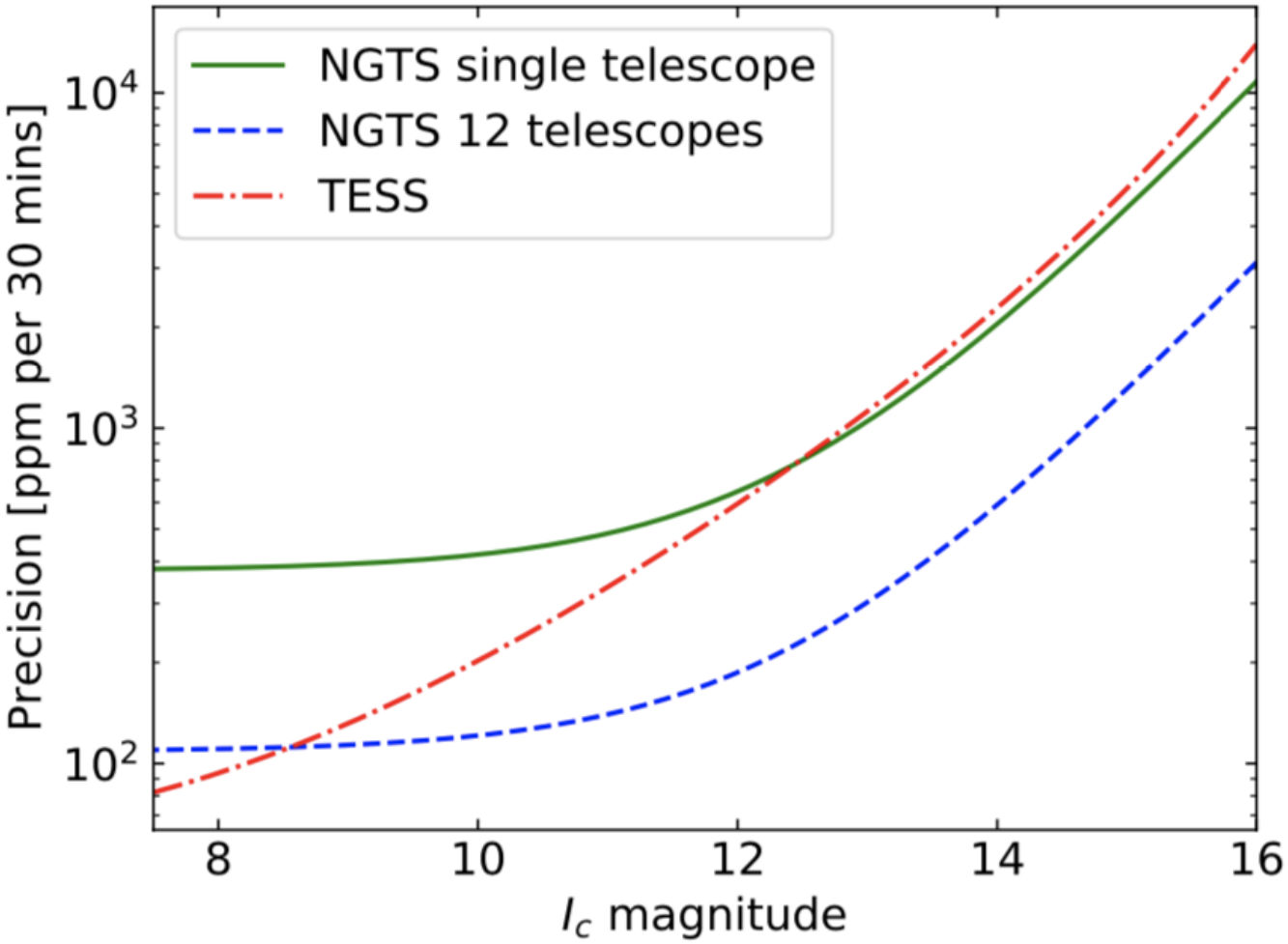
Bayliss et al., 2022

Photometric Noise



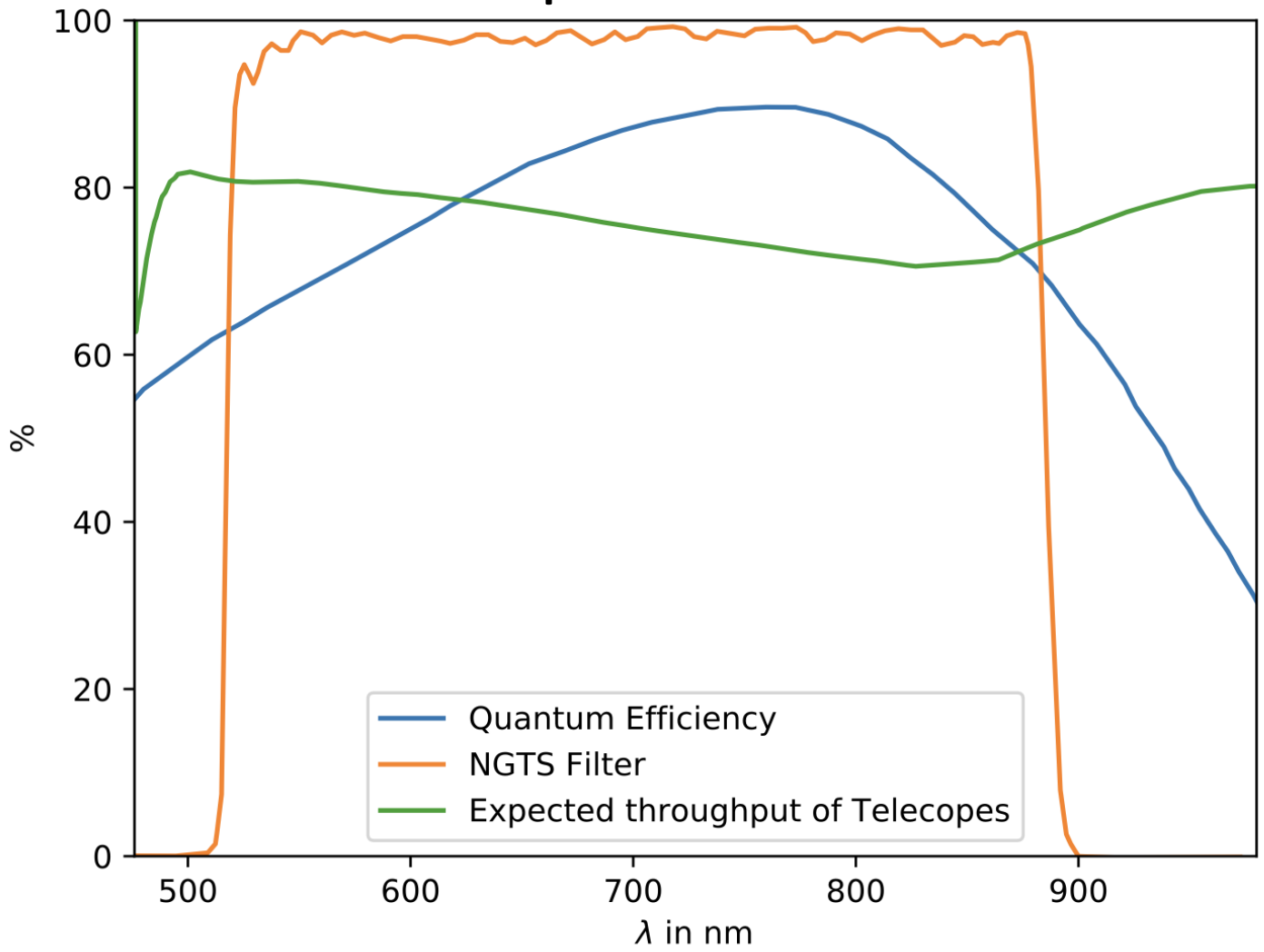
Bayliss et al., 2022

Precision: NGTS v TESS



O'Brien et al., 2022

NGTS passband

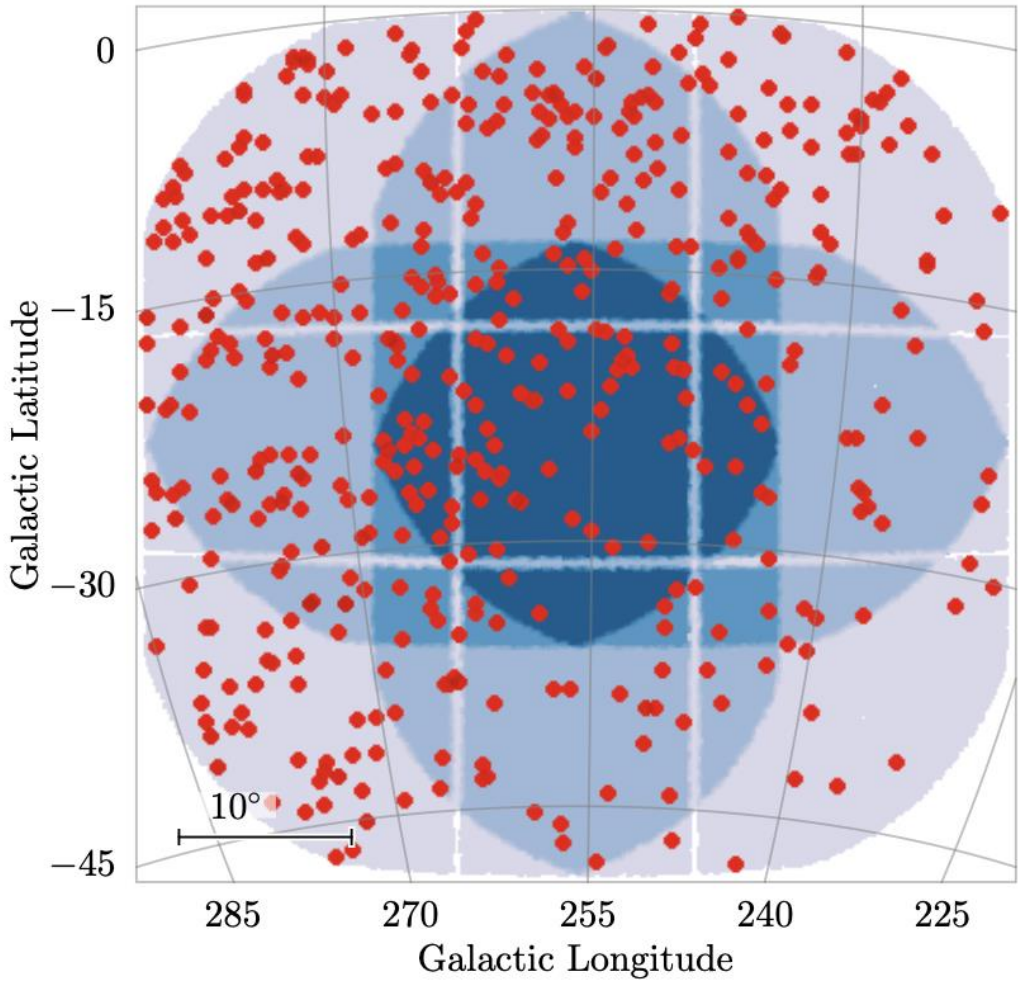


Wheatley et al., 2018

NGTS Details

- Wheatley et al., 2018, Bayliss et al., 2022, Bryant et al., 2020, O'Brien et al., 2022.
- NGTS multi-telescope suited to bright stars (T<10) that are difficult on 1m telescopes.
- Single telescope can get to 1000 ppm per ½ hour.
- Multi-telescope can get to 150 ppm per ½ hour.
- Plate scale is 5 arcsec/pix.

TOI Candidates in PLATO LOPS2



Eschen et al., 2024