



TOI 4600 b and c: Two long-period gas-giant planets orbiting an early K dwarf

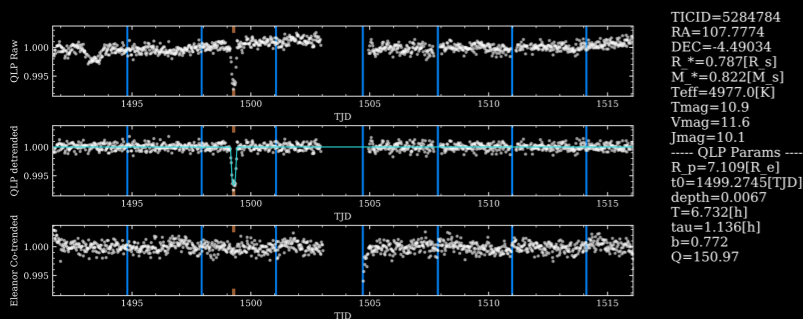
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Introduction

We report the discovery and validation of two long-period gas giants orbiting the early K dwarf TOI 4600 ($V=12.6$, $T=11.9$). The inner planet, TOI 4600 b, is $6.9 R_e$ and has an orbital period of 82.69 d. The outer planet, TOI 4600 c, is $9.4 R_e$ and has a period range of 226-400 d, having transited only once during *TESS* observations. We combine *TESS* photometry and additional ground-based observations to validate the two planets. With equilibrium temperatures of 343 K and <270 K, respectively, TOI 4600 b and c add to the small but growing population of temperate gas giants that bridge the gap between hot/warm Jupiters and the solar system gas giants.

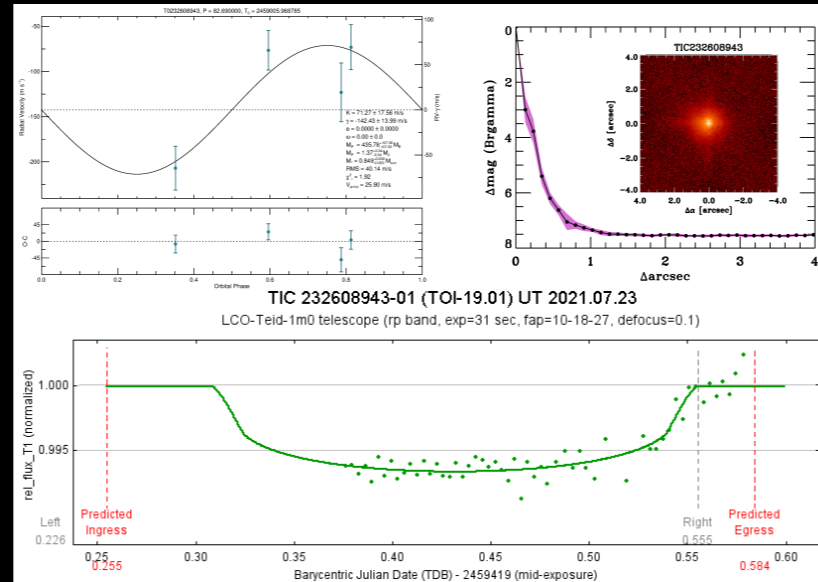
Transit Detections

- Observed in sectors 14-19, 21-26, 40-41, 47-49
- Originally detected by the *TESS* Single Transit Planet Candidate Working Group (TSTPC WG)
- Single transits of TOI 4600 b detected in sectors 16 and 22. Two more transits in sectors 19 and 25 confirmed the 82.69 d period
- Visual inspection revealed a deeper, longer transit in sector 17 unrelated to inner candidate



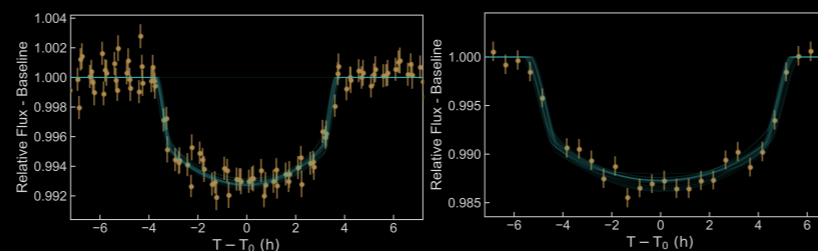
Follow-up Observations

- TRES recon spectra to rule out an EB on target
- Palomar AO imaging to rule out a BEB
- Ground-based photometry from LCO and other observatories confirmed an on-target transit for TOI 4600 b



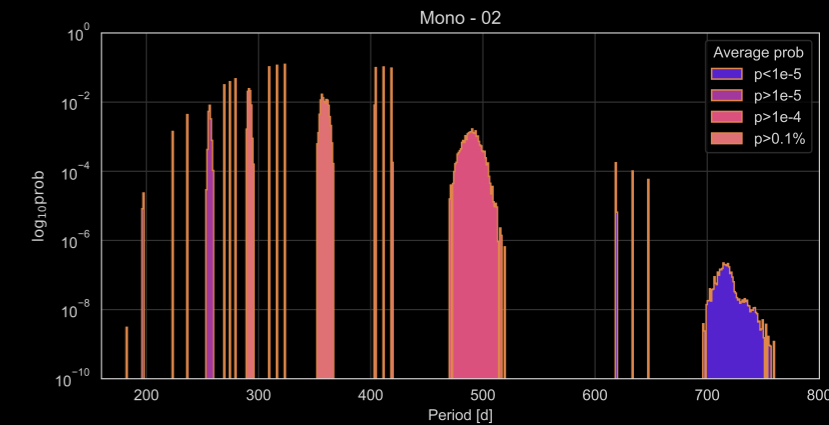
Modeling and Fitting

- Use *isochrones*¹ package to model TRES spectra + archival photometry + *Gaia* astrometry and derive stellar parameters
- Use *allesfitter*² to fit for both planets' parameters using *TESS* and ground-based photometry
- No constraints on outer planet's period but eccentricities for both planets are fixed to 0



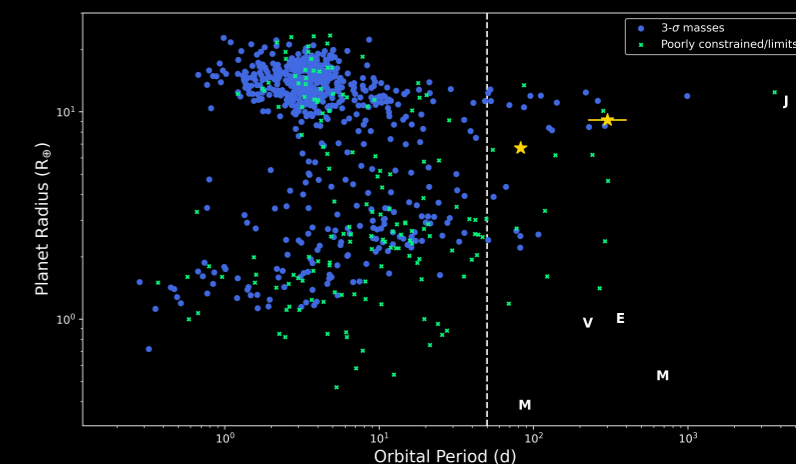
Outer Planet Period

- Use *MonoTools*³ to determine possible periods and their relative probabilities by incorporating all *TESS* coverage
- Many windows will be tested when TOI 4600 is observed in sectors 51-60



Future Plans + Broader Context

- Radial velocities to obtain masses and orbits as well as search for additional planets
- TOI 4600 c will be among the longest period planets discovered by *TESS*
- Together they add to the growing list of temperate/cool gas giants
- As a multi-planet system, TOI 4600 will give insight into planet formation and evolution



1. Morton, T.D. 2015, *Astrophysics Source Code Library*. ascl:1503.010
 2. Günther, M.N. & Daylan, T. 2021, *ApJS*, 254, 13. doi:10.3847/1538-4365/abe70e
 3. <https://github.com/hposborn/MonoTools>