TOI-1710 b: warm Neptune orbiting a G5V dwarf star

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Context & Introduction

We report the detection and characterization of TOI-1710 b, a new warm Neptune exoplanet.

Gaussian process (GP) attempt to statistically simulate the quasi-periodic behaviour of the activity *jitter*[2,3].

Light Curve & RVs

Combined in one simultaneous model, the analysis of the **TESS transit light curve** with the **HARPS-N** and **SOPHIE follow-up radial velocities** (RV) lead to the characterization of the new **exoplanetary candidate TOI-1710 b**.

Scientific Problem

Stellar **activity *jitter*** scrambles both the photometric and the spectroscopic signal. One can aim to account for its **quasi-periodic** behaviour via **Gaussian process** modelling towards an improved characterisation of the planet[1].

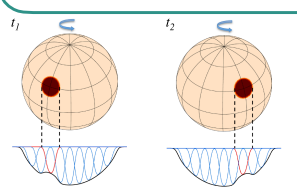
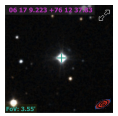


Figure 1: Stellar activity *jitter* impact on the spectral line profile.

TOI-1710, G5VI star

The **stellar properties** of TOI-1710 were defined from the SED obtained with the spectrograph HARPS-N.



- M_* = 0.984 ± 0.059 $M_\odot$
- R_* = 0.968 ± 0.016 $R_\odot$
- log g = 4.459 ± 0.031
- T_{eff} = 5709 ± 43 K
- [Fe/H] = 0.11 ± 0.02

→ **G5V dwarf star**

Data sets

TESS Light Curve:
- 51264 data points
- Time sampling 2 min
- Sectors 19, 20 and 26

HARPS-N & SOPHIE RVs:
- 31 + 30 data points
- Time span 232 days
- Resolution R ≥ 75,000

Stellar Activity Modelling

The activity *jitter* originates from temporary magnetic active regions on the stellar surface. Due to stellar rotation, this perturbation shows a quasi-periodic evolution.

Stochastically-driven damped Harmonic Oscillator GP kernel[3]

$$S(\omega) = \sqrt{\frac{2}{\pi}} \frac{S_0 \omega_0^4}{(\omega^2 - \omega_0^2)^2 + \omega_0^2 \omega^2 / Q^2}$$

- S_0 - maximum power
- ω_0 - undamped frequency → $\sigma_0 = \sqrt{S_0\, \omega_0\, Q}$
- Q - quality factor

where σ_0 corresponds to the standard deviation of the process, i.e. the amplitude of the *jitter*.

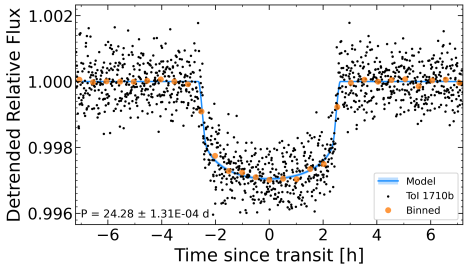


Figure 2: Phase-folded TESS light curve of TOI-1710 with best transit fit.

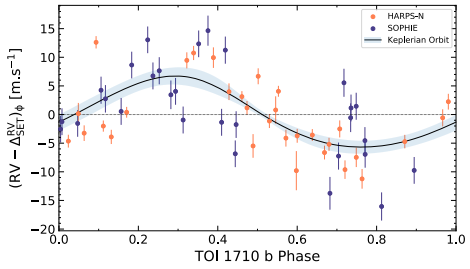


Figure 3: HARPS-N & SOPHIE RV variations of TOI-1710 with RV model. (without the GPs part)

Preliminary Results

Paper: König et al. 2021, *A&A*, *in prep.*

We establish the planetary nature of the TESS candidate and characterise the **warm Neptune TOI-1710 b**.

Planetary Parameters

P	[d]	**24.28301**	± 1.4 10^{-4}
R_p	[$R_\oplus$]	**5.84**	± 0.30
M_p	[$M_\oplus$]	**30.0**	± 5.7
e		**0.13**	± 0.09

Jitter Parameters

$\sigma_{0,\,LC}$	**2.5 10^{-4}**	± 0.4 10^{-4}
$\sigma_{0,\,RV}$	**4.3**	± 0.8 m s^{-1}

In this study

We developed a MCMC model which simultaneously fits the Keplerian orbit and the transit.

The Gaussian Process kernel successfully tracks the photometric stellar activity *jitter* and gauge its RV amplitude.

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Acknowledgements

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References

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