CONTEXT

Trojans are bodies that share their orbit around the star. Typically, the less massive inhabits the **Lagrangian regions L4** and **L5** of the most massive one, which are 60 deg leading and trailing it

CONFIRMED Trojans	
Mercury	0
Venus	1
Earth	2
Mars	15
Jupiter	> 15 000
Saturn	1
Uranus	2
Neptune	28
Exoplanets	0

The *TROY* **project** [1] is a **multi-technique observational effort** to detect them [for the first time] in exoplanetary systems

The premise:

- Planetary-mass Trojans are long-term stable [2]
- They could form *in-situ* with the planet [3, 4]

Hence, **current instruments could detect them**

SAMPLE

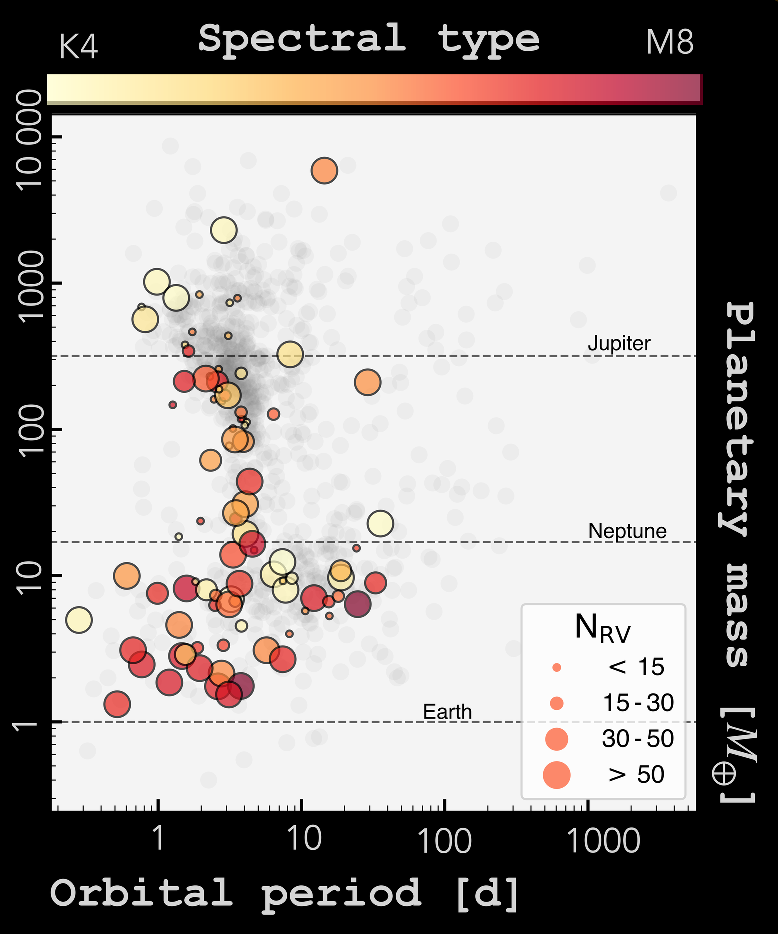
We inspected **all transiting planets** around **low-mass stars** [later than K4] confirmed with RV signals to search for Trojan companions to them [0]

94 planets

[85%] P < 10 days

[50%] $M < M_{Neptune}$

[15%] $M > M_{Jupiter}$



EXOTROJANS
around

THE TECHNIQUE

We might be overlooking exotrojans, since their RVs can be identical to those of single planets

The key: a **mass imbalance** between **L4 and L5** [a Trojan] produces **a shift** between the physical eclipse (**photometrical** transit) and the zero velocity in RV (**spectroscopical** transit)

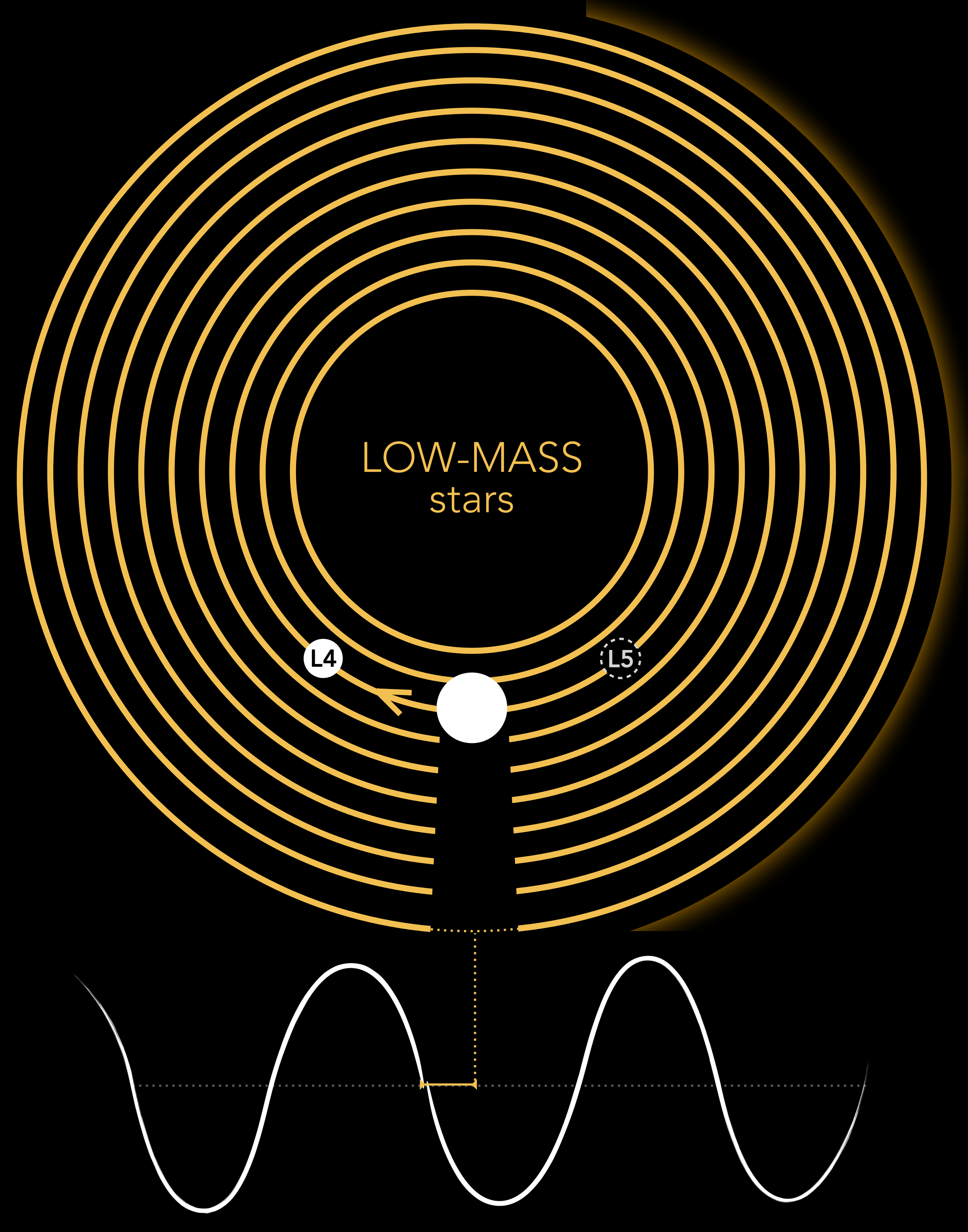
Generalized RV equation [5]:

$$RV(t) = K[(\alpha - 2c)\cos nt - \sin nt + c\cos 2nt + d\sin 2nt]$$

where $\alpha \propto \frac{M_{Trojan}}{M_{planet}}$

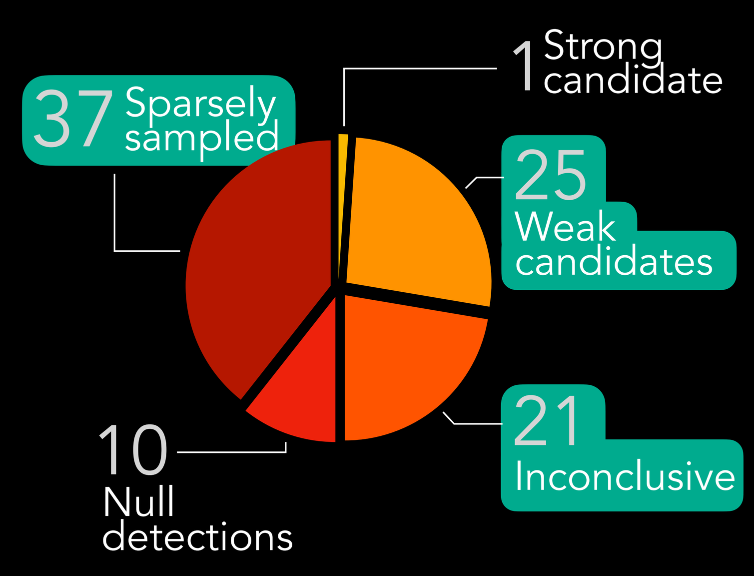
We can give **upper limits** to **Trojan masses** for any transiting planet

Exotrojan candidate → If α is significantly different from zero



A SEARCH WITH A RADIAL VELOCITY (RV) CLOCK

THE RV EFFORT



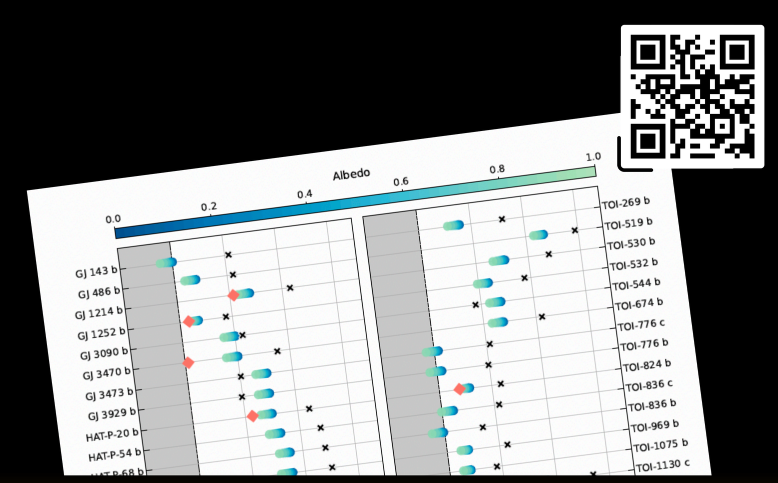
More RV needed to have conclusive results for the majority of the targets [>1 m/s required!]

OCCULTATIONS OPPORTUNITY

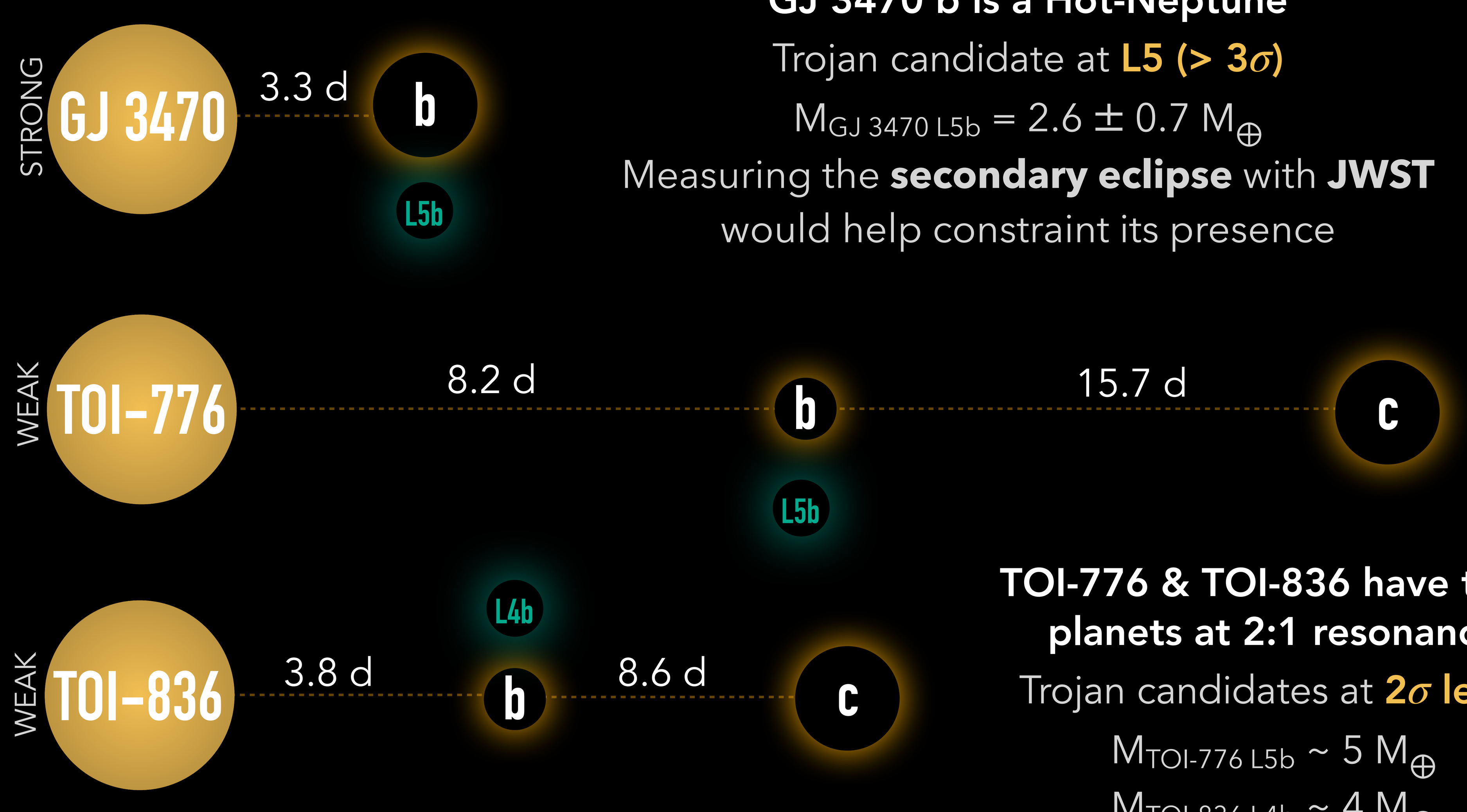
Only the **secondary transit** of the planet can break the **eccentricity-Trojan degeneracy**

- Demote False positives
- Improve α precision ~factor 2

We provide an estimation of the occultation depths for the 95 planets. The majority are detectable! (See Fig. 5, [0])



CANDIDATES



GJ 3470 b is a Hot-Neptune

Trojan candidate at **L5 (> 3σ)**

$M_{GJ\,3470\,L5b} = 2.6 \pm 0.7\ M_\oplus$

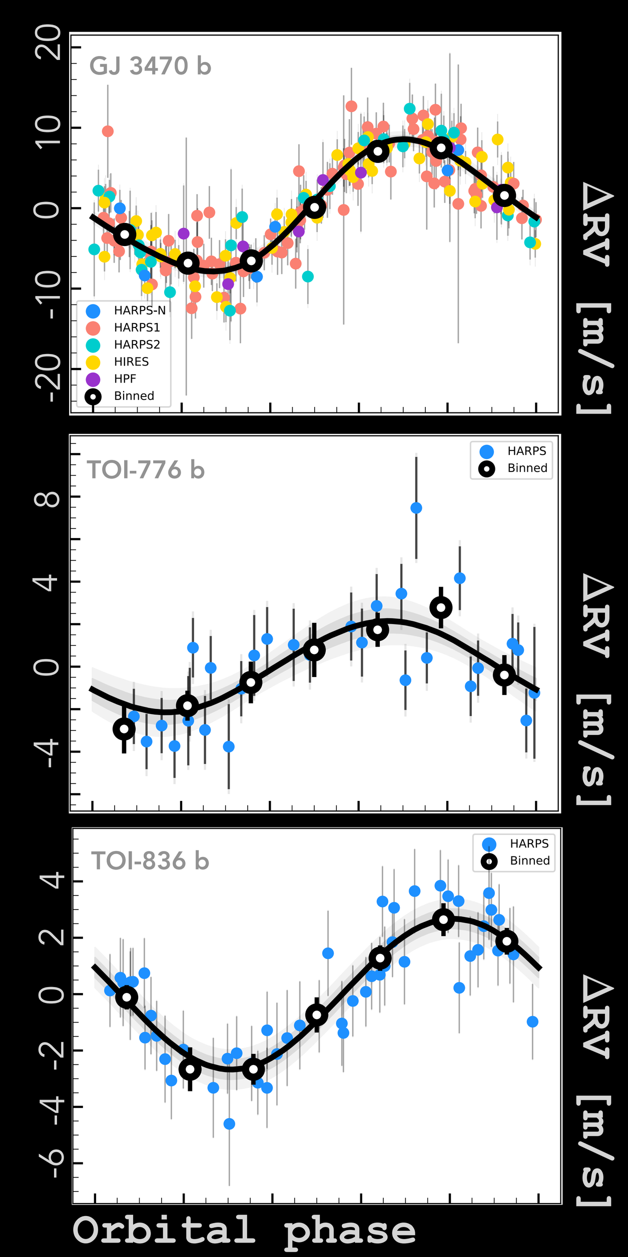
Measuring the **secondary eclipse** with **JWST** would help constraint its presence

TOI-776 & TOI-836 have their planets at 2:1 resonance

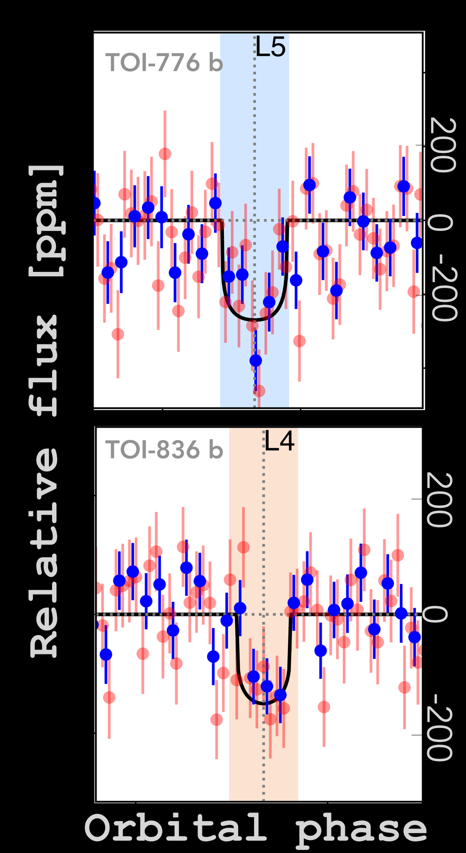
Trojan candidates at **2σ level**

$M_{TOI\text{-}776\,L5b} \sim 5\ M_\oplus$

$M_{TOI\text{-}836\,L4b} \sim 4\ M_\oplus$



TESS show **compatible dimmings** for the Trojan candidates in **TOI-776 L5b** & **TOI-836 L4b** [following-up with CHEOPS]



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[0] TROY III [THIS WORK] - Balsalobre-Ruza et al. (2024), A&A, 689, A53

[1] The *TROY* project - Lillo-Box et al. (2018), A&A, 609, A96

[2] Similar-mass Trojans - Laughlin & Chambers (2002), AJ, 124, 592

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[4] PDS 70 L5b - Balsalobre-Ruza et al. (2023), A&A, 675, A172

[5] RV-transit technique - Leleu et al. (2017), A&A, 599, L7

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Hey! I am searching for a Postdoc to start by June 2026