Towards completing extrasolar systems with the **TROY project**

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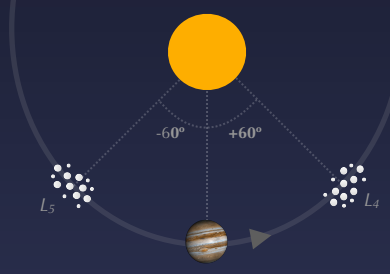
The TROY project aims at detecting and constraining the presence of co-orbital bodies in extrasolar systems. Co-orbitals do exist in the Solar System in the form of small asteroids trapped in the Lagrangian points of six out of the eight planets. However, planet formation theories allow their formation up to planetary sizes and dynamical stability confirms these 1:1 resonances are indeed stable in the long-term. Exploring these configurations has remained in the to-do list of the exoplanet exploration. With the TROY project we aim at filling this gap from an observational point of view with strong implications in planet formation and evolution.

Trojans (or co-orbitals) **are** minor bodies that populate the **Lagrangian points L_4 and L_5** of a planetary orbit.



Jupiter harbors more than 12 000 Trojans according to the *Minor Planet Center*.

(624) Hektor is the largest with **~220 km** of diameter.

The exoplanetary hunting is incomplete since it lacks the detection of Trojans (and moons). The result of a theoretically study was a game changer:

Trojans can be **long-term stable** (up to stellar lifetimes) even being **as massive as the main planet** (*Laughlin & Chambers*, 2002).

Pairs of co-orbitals planets may exist in other planetary systems.

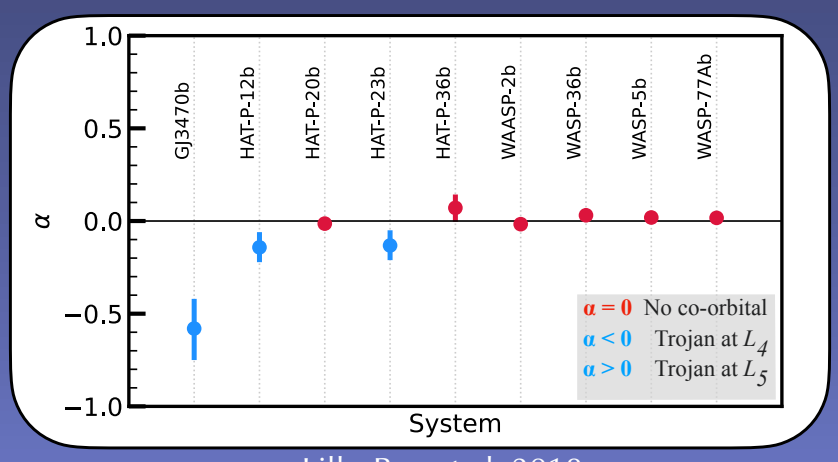
And thus, we could detect exotrojans using current instrumentation and methods.

Exploring the Hot - Jupiter niche

Through a multi technique method using **RV + transits** archival data, we did a search for co-orbitals companions of 46 confirmed Hot - Jupiters.

Why Hot-Jupiters?

For easing the detection. Their trojans could be very massive (Neptune regime), what together with its closeness to the star would induce strong RV modulations. Nonetheless, we have not found **any robust evidence** for the presence of co-orbitals, just three candidates:



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A possible explanation is that during the inwards migration of the Hot-Jupiters, the Trojan companions may be **ejected**. For this reason, we are spreading our search to any orbital period around M and late K dwarfs (Balsalobre-Ruza et al., In prep.).

First hints of exotrojan formation

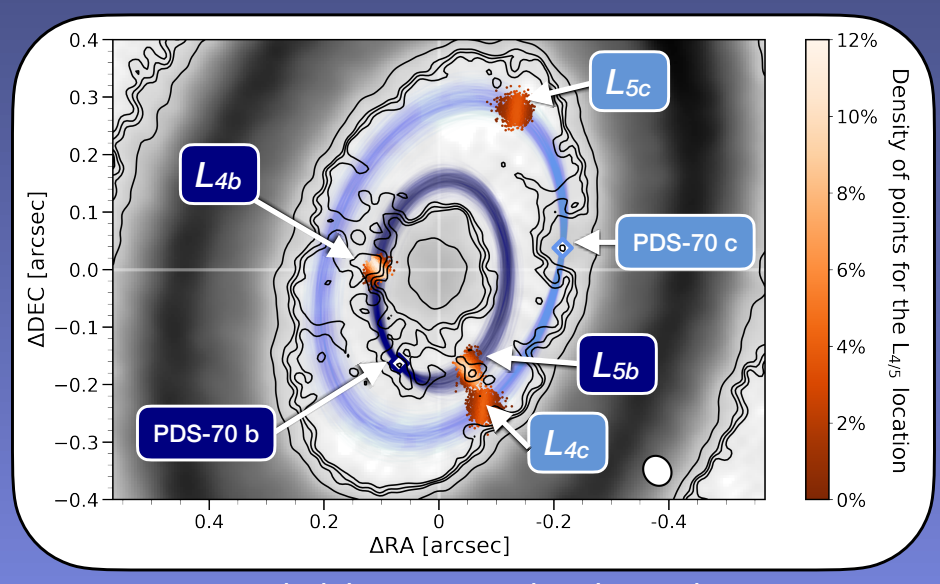
The formation of these bodies has been proven by two different mechanisms through simulations:

In situ & **captures**

In situ: Assembling from planetesimals at the same time as the main planet.

captures: Close encounters (for example during migrations) could lead to the capture of the Trojan.

PDS-70 is the only system with the robust detection of two protoplanets. Projecting both planetary orbits onto a self-calibrated **ALMA** image from archive, we have found a **candidate for a forming Trojan** in the **L_5 point of PDS-70 b**.



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A tentative detection with **4σ** of significance corresponding with a **dust mass up to 0.8 M_{Moon}**.

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