Planets around GIANT stars

E. Fontanet, S. Udry, D. Ségransan, P. Figueira

Département d'Astronomie, University of Geneva

Hello! My name is **Emile** and I just started my **2nd year** of PhD at the **University of Geneva**. I currently work on the CASCADES survey on the detection of **exoplanets around giant stars**. Do not hesitate to contact me in person or at *emile.fontanet@unige.ch*!

OUR SURVEY

The Coralie Search For Planetary Companions Around Evolved Stars (CASCADES) survey was started more than **15 years ago** with the aim of detecting **exoplanets** around evolved stars of intermediate masses, which we refer to as **giant stars**. Giant stars offer the opportunity to study the population of exoplanets around stars more massive than the Sun, which is particularly challenging while they are still on the main sequence because of their fast rotation rates and high effective temperatures. Knowing more about exoplanet statistics around stars more massive than the Sun would yield essential information for topics like planet formation, answering the question of planet occurrence rate versus host star metallicity and mass. CASCADES is a **volume-limited** survey on **~650 giant stars** (Fig. 1) located at less than 300 pc and studied with the CORALIE spectrograph mounted on the Swiss telescope (Fig. 2). The survey was already presented in Ottoni et al 2022[1] and I will continue to work on it in the context of my PhD thesis.

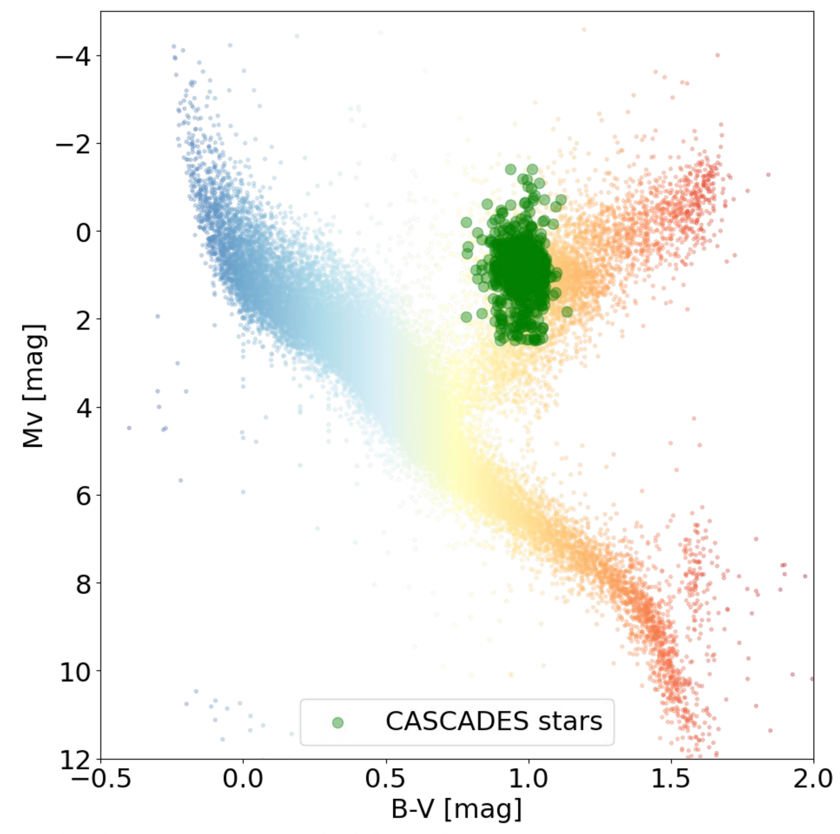


Fig. 1. Location of the CASCADES targets on a HR diagram. This diagram shows all Hipparcos targets with paralax error < 15%

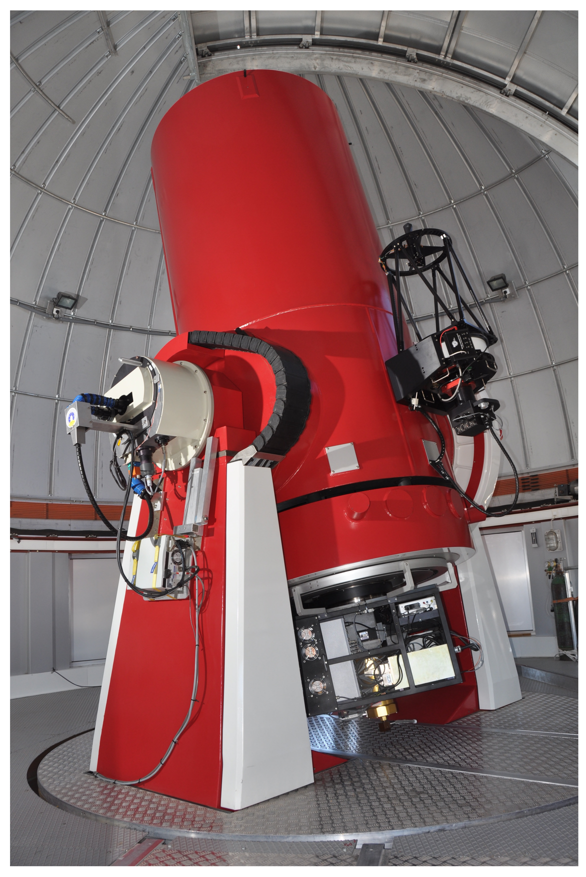


Fig. 2. The 1.2m Euler Swiss telescope, located in La Silla, Chile, with which the CASCADES survey is conducted

CURRENT DETECTIONS

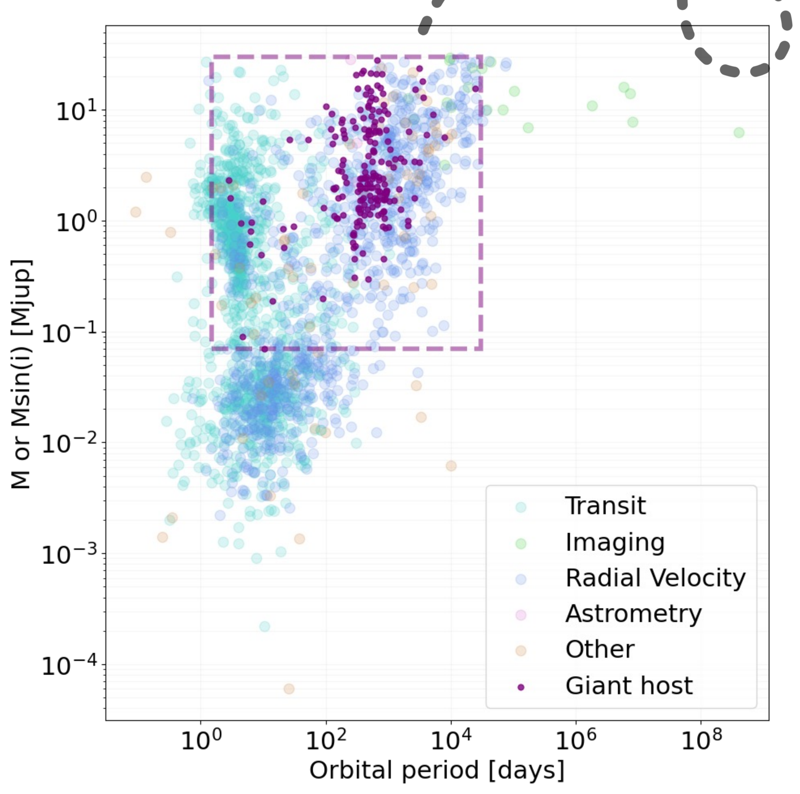


Fig. 3. Mass-period diagram of all exoplanets detected as of May 2024. Different colors correspond to different methods of detection. The purple dots correspond to the exoplanets in orbit around a giant star.

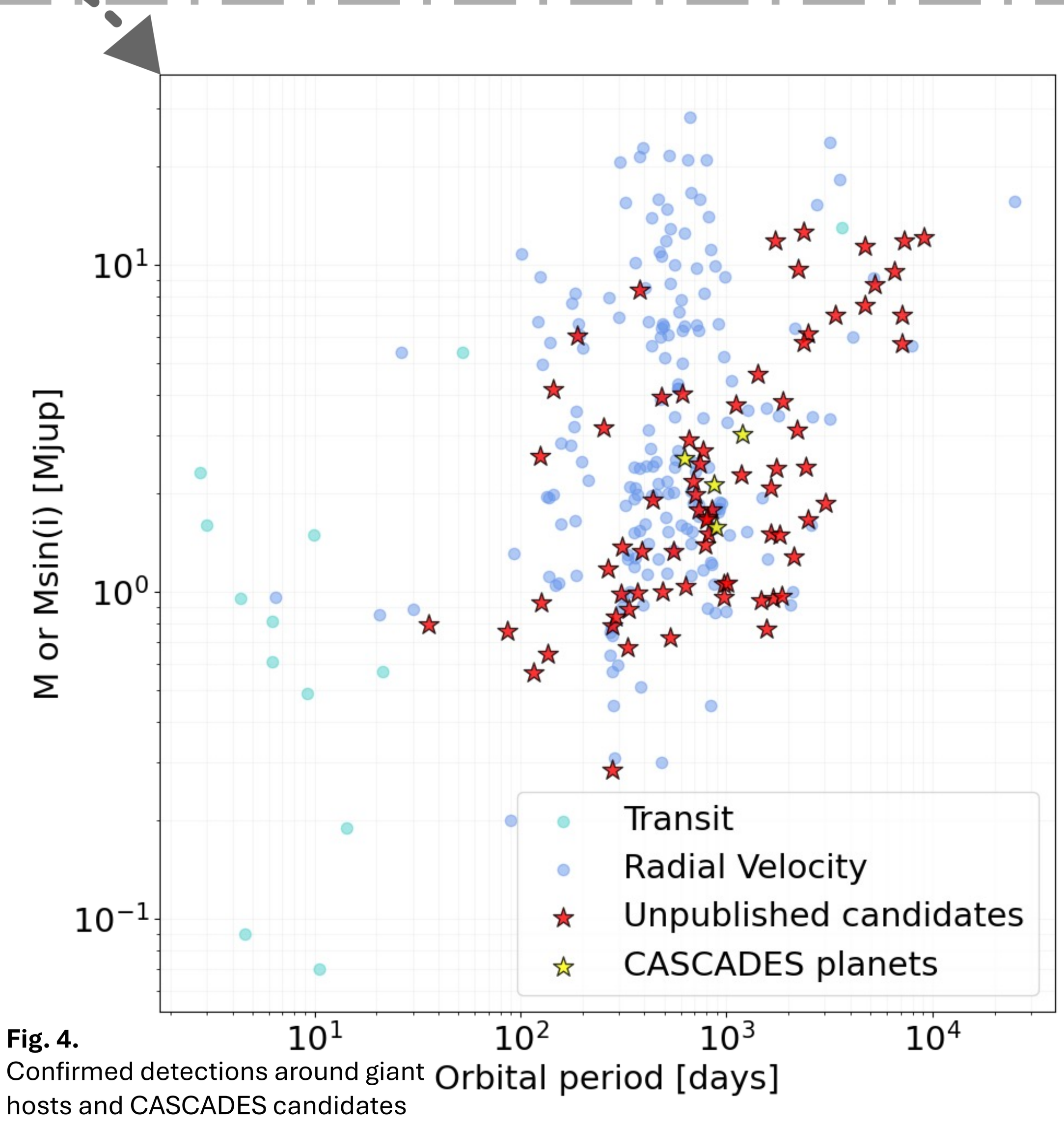
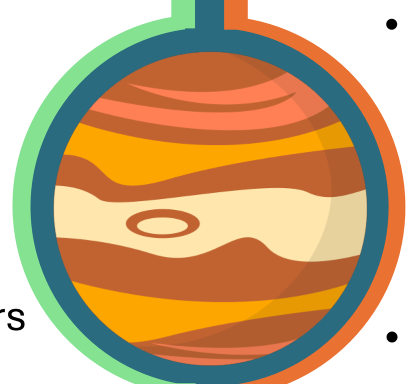


Fig. 4. Confirmed detections around giant hosts and CASCADES candidates

Out of the more than 5000 exoplanet detections, only **fewer than 250** of them are thought to be orbiting a giant star (Fig. 3). In the context of the CASCADES survey, 4 detections of exoplanets have already been made. 3 of them by Ottoni et al. 2022[1] and 1 by Pezzoti et al 2022[2]. This year, we are planning to publish **7 more detections** (Fontanet et al. in prep) to increase the total number of detections of CASCADES to 11 (some of them can be found in Fig 5, 6 & 7). With **more than 50** other unpublished **candidates** (Fig 4), we expect that CASCADES alone will increase the total number of known exoplanets around giant stars by **more than ~20%**. However, giant stars are known to be intrinsically variable. Stellar activity related effects can produce periodic signals of high amplitudes (>100 m/s) at periods ranging from a few days to a few hundreds of days, making it particularly challenging to distinguish them from planetary signals (e.g Fig 8-11). For this reason, we also want to work intensively on the understanding of the observed intrinsic variability of giant stars to be fully confident of the planetary origin of the effects seen in RVs for the candidates still to publish.

LATEST DISCOVERIES



EASY ONES

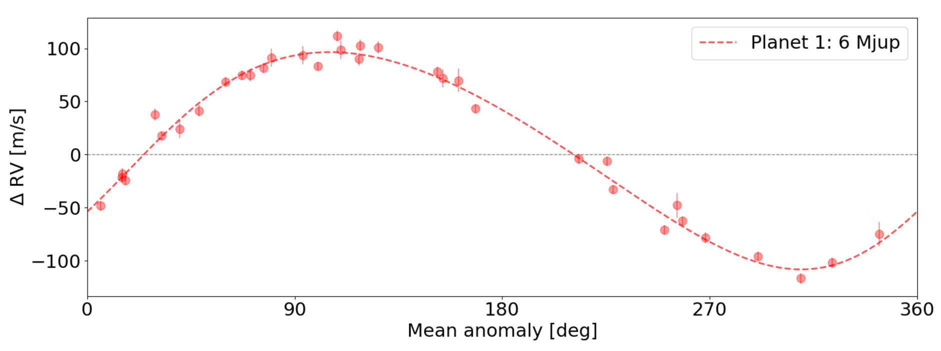


Fig. 5.

- Number of planets: 1
- Period: 250 d
- M*sin(i): $6M_{jup}$
- Time span of data: ~12 years

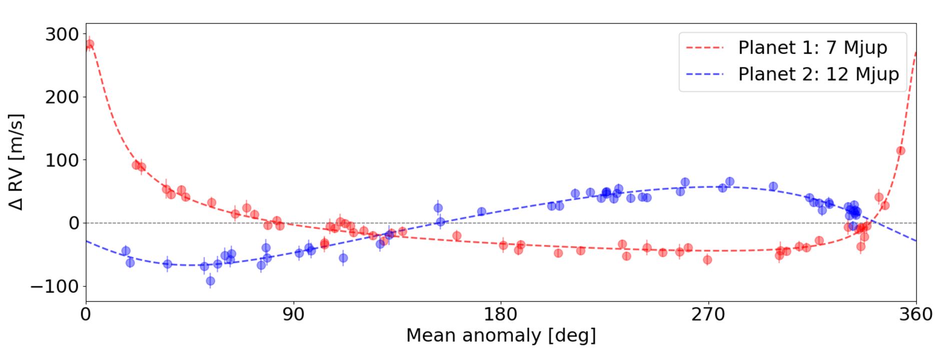


Fig. 6.

- Number of planets: 2
- Periods: 480 d & 8200 d
- M*sin(i): $7M_{jup}$ & $12M_{jup}$
- Time span of data: ~17 years

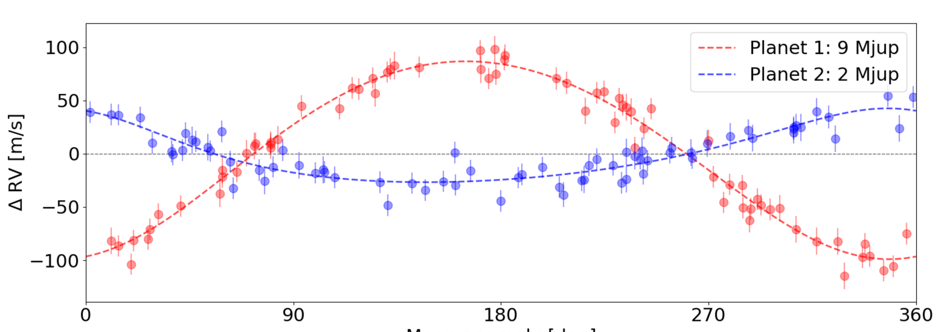
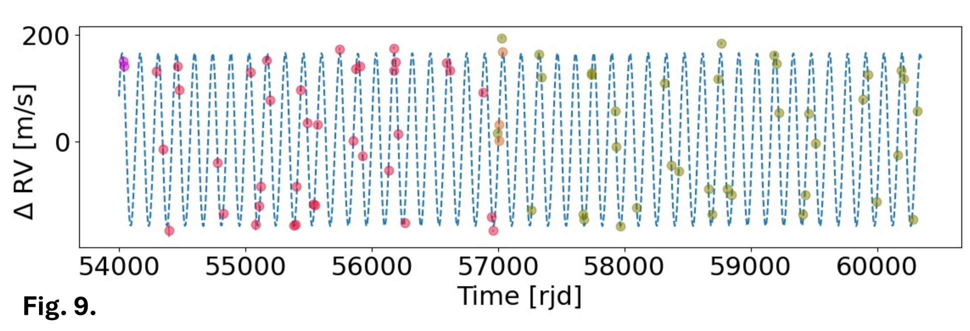


Fig. 7.

- Number of planets: 2
- Periods: 820 d & 2500 d
- M*sin(i): $2M_{jup}$ & $9M_{jup}$
- Time span of data: ~17 years

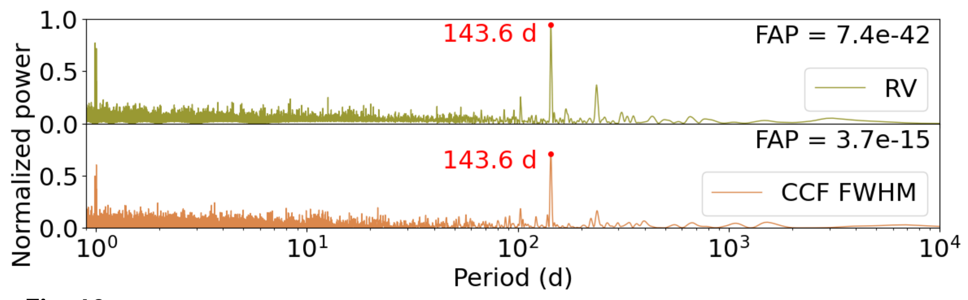
HARD ONE

Fig. 8.



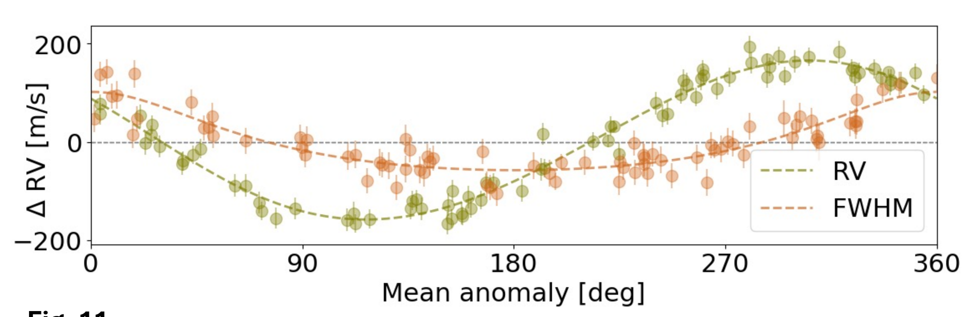
- Persistent, high amplitude periodic signal over ~ 50 periods (17 years of data)

Fig. 9.



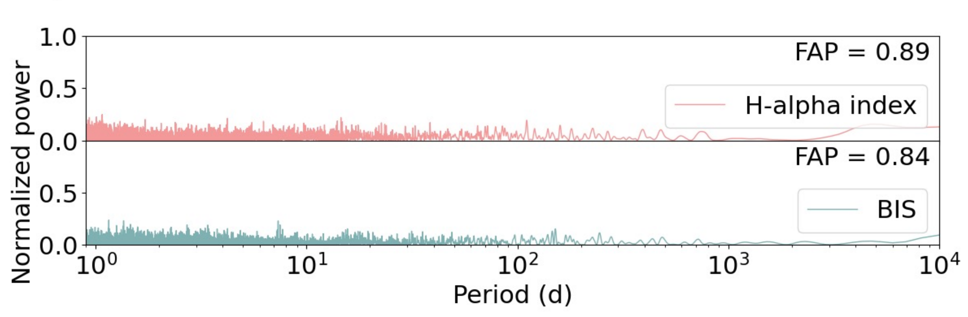
- Clear peak in RV as well as in FWHM at the exact same period

Fig. 10.



- Both signals are phase-shifted by 90°

Fig. 11.



- No sign of activity-related signal in H-alpha, BIS or photometry

What are we looking at?

References: 1. Ottoni, G., et al. (2022) "CORALIE radial-velocity search for companions around evolved stars (CASCADES). I. Sample definition and first results: Three new planets orbiting giant stars", A&A, 657, A87 , 2. Pezzotti, C., et al. (2022) "CORALIE radial-velocity search for companions around evolved stars (CASCADES). III. A new Jupiter host-star: in-depth analysis of HD 29399 using TESS data", A&A, 657, A89. Euler image: credit ESO