SEARCHING FOR ADDITIONAL COMPANIONS TO WASP PLANETS

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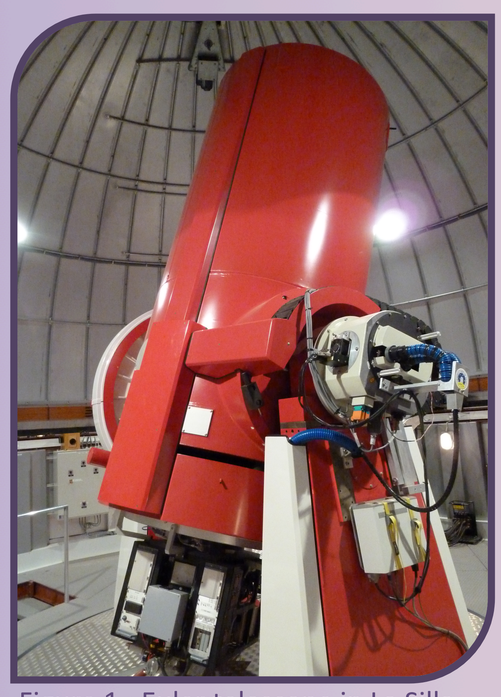

Figure 1 : Euler telescope in La Silla

The discoveries of hot Jupiters have shed new light on planet formation theories, leading to migration mechanisms being called upon.

Observations of obliquities of hot-Jupiters using Rossiter-McLaughlin effect, suggested misaligned systems are common, and tides play an important role for the low inclinations. Models using the Kozai mechanism due to an outer binary companion (Fabrycky & Tremaine (2007) and Wu et al. (2007)) seem to reproduce quite well the observations. Models using scattering processes between planets (Nagasawa et al. (2008)), where the outer planet drives Kozai cycles on the inner planet, also predict orbits with a wide range distribution of inclinations and eccentricities.

Since 2007 an intensive follow up program is ongoing with the high resolution échelle spectrograph CORALIE, mounted on the 1.2m Euler Swiss Telescope at La Silla (Chile), to observe WASP transiting candidates. In parallel a special effort has been carried out to search for additional long-term radial velocity variabilities, suggesting the presence of extra stellar or planetary companions.

Our sample is made of 71 WASP planetary systems visible in the southern hemisphere, for a total of 1400 measurements to date. Ephemerides of planets in these systems are characterized. The distribution of the targets in terms of number of RV measurements and duration of the follow-up is presented in Figure 2.

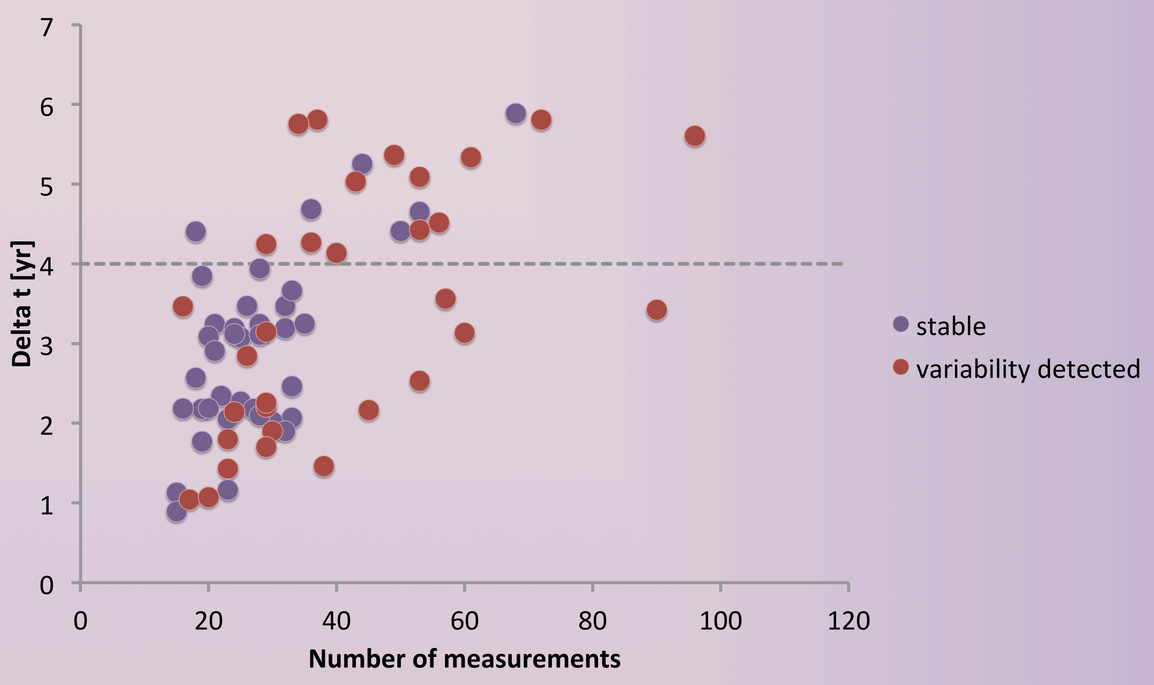

Figure 2 : distribution of systems being more likely of showing variations, compared to those more likely stables. If we consider the systems observed for more than 4 years, we notice that 68% show variability. Our results show that after 4 years of observations, we detect drifts down to 3 m/s/yr. Considering a standard binary distribution (Duquennoy & Mayor (1991)), we should be able to detect only 15% of binaries. This suggests that hot Jupiters are found more preferentially in binary systems with short periods. Nevertheless, some variations could be due to stellar activity. A more detailed analysis of this aspect is ongoing.

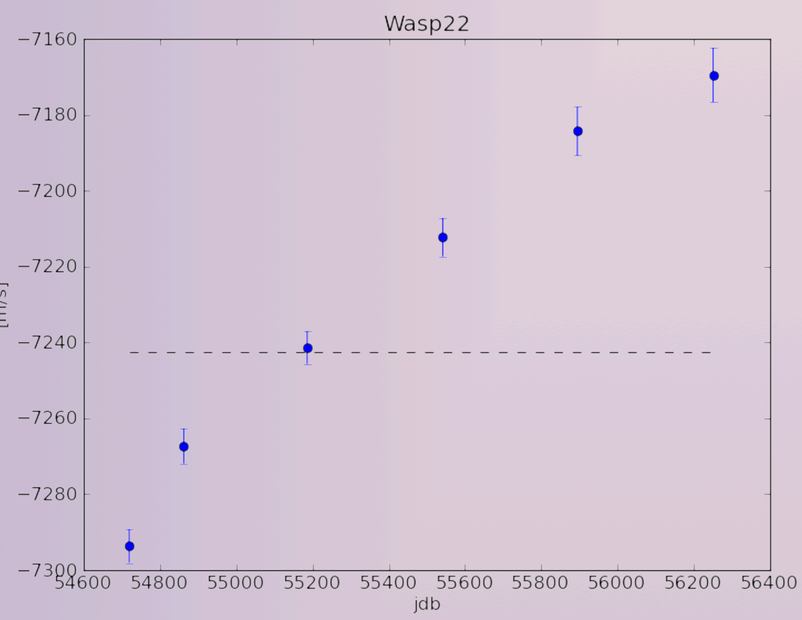

Figure 3 : large variation detected for Wasp-22.
The first step to detect variability in the data is to gather points observed during similar periods into bins. We consider that to each observing season corresponds a different systemic velocity γ. Then we fit a common K_1 for all the data and a γ for each bin.

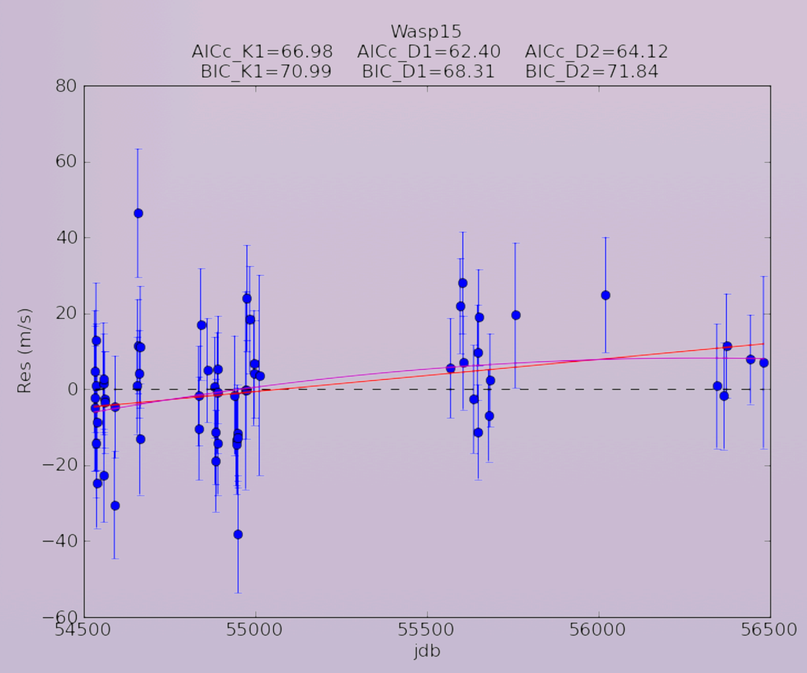

Figure 4 : linear drift revealed for Wasp-15
To characterize all the systems in a more general way, we compare a series of different models. We consider: a single keplerian, a keplerian and a linear drift, and a keplerian and a quadratic drift. The model selection is made using two criterions: the corrected Akaike Information Criterion AIC (Akaike (1974) and Sugiura (1978)), and the Schwarz Bayesian Criterion BIC (Schwarz (1978)). For each system, the model having the minimum AICc and BIC is considered as being more likely

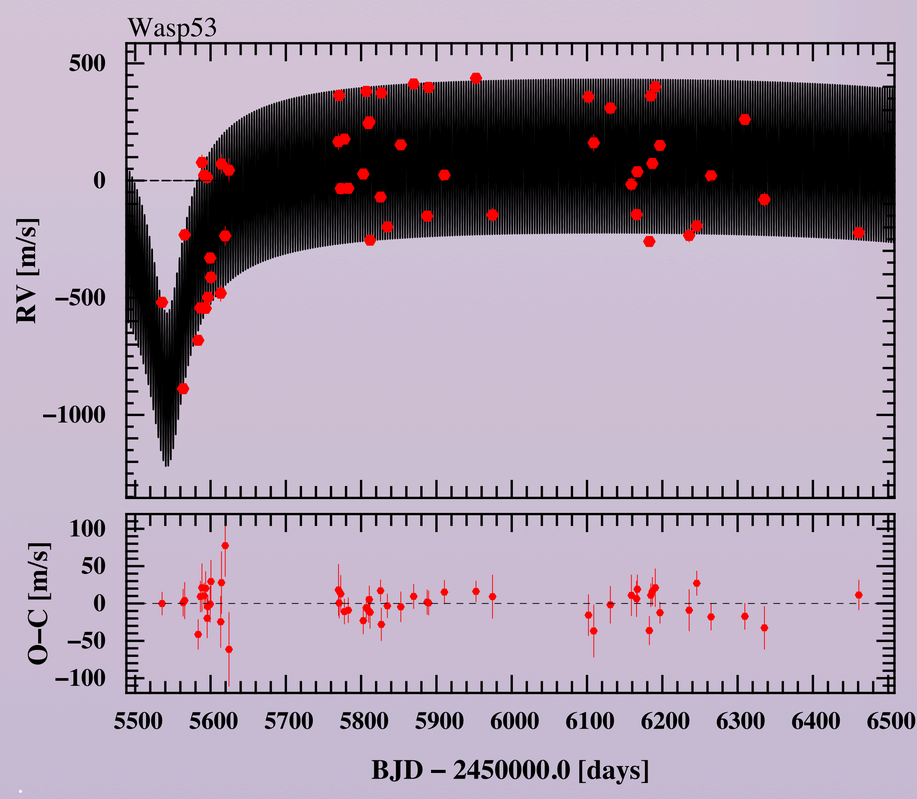

Figure 5 : A second planet around Wasp-53
To date, five systems revealed the presence of a probable planetary companion. The orbits of the companions have eccentricities greater than 0.2. The periods are ranging from few hundreds to several thousands days. Assuming that they are coplanar with the known planet, the companion lies in the giant planet mass regime.
The case of Wasp-53 is particularly exciting. This system has been observed for 2.5 years with a total of 53 measurements to date. The 2nd object has a minimum period of 1300 days, an eccentricity of 0.8, and a minimum mass of 16 M_{jup}.