SOPHIE velocimetry of *Kepler* transit candidates

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Abstract

As *CoRoT*, the *Kepler* space mission found a large amount of planetary transit candidates for which radial velocity follow-up is necessary in order to establish the planetary nature and then, to characterize the mass of the transiting companion. We are following up some interesting *Kepler* candidates with the SOPHIE spectrograph mounted at the 1.93-m telescope in Observatoire de Haute Provence (France). More than one year after the first *Kepler* release, we will present the strategy used to select the most promising *Kepler* candidates, within reach of a detection with SOPHIE, using the experience of more than 4 years of *CoRoT*, SWASP and HAT radial velocity follow-up. We will also highlight the results of the first year of observations that led to the discovery of several new transiting exoplanets and help the understanding of the false positive rate of the *Kepler* mission.

1. Introduction

Since 2007 with the exoplanet-dedicated space mission *CoRoT* [1] and *Kepler* [4], scientific community have access to publicly-available very high accuracy photometry light curves, up to a few tens of ppm for very long times scales. This allow interesting discoveries like the super-earthes CoRoT-7b [9, 12] and its twin Kepler-10b [2] or the planetary systems Kepler-9b [7] and Kepler-11b [10] or long-period giant planet like CoRoT-9b [6].

The first six-month of *Kepler* data has permit to identify 1235 planetary candidates around 997 stars [4] including fifteen planets fully characterized (with measured radius and mass) [8, 14], two planets without measured mass [13], three pre-launch ground-based discoveries and an eclipsing low-mass star [5]. On the 1214 remaining candidates, we have selected a few candidates up to magnitude $K_p \sim 15$ to follow-up with the SOPHIE spectrograph (Observatoire de Haute Provence, France).

2. Best candidates selection

Most of transiting planets share the same transit proprieties like the transit shape, duration and depth compatible with their orbital period and the radius of their star. We will describe the strategy used on *Kepler* candidates to select the most promising ones based on the experience of more than four years of radial velocity follow-up of the *CoRoT* space mission and Super-WASP and HAT ground-based mission, we will discuss the ratio of the unlikely planetary candidates.

3. New *Kepler* planets

From our candidates selection, we followed up them using the SOPHIE spectrograph mounted on the 1.93-m telescope in Observatoire de Haute-Provence, France. Theses observations led to the discovery of new *Kepler* / SOPHIE planets that we will highlight in this presentation, e.g. KOI-428b [14] (see Figure 1, 2).

4. Estimation of the *Kepler* false positive probability

On the total of *Kepler* candidates, the false positive probability has been estimated to be between less than 10% [11] and up to 60% [3]. In this presentation, we will present some false positive (e.g. Figure 3) that help the understanding of the false positive probability of the *Kepler* mission.
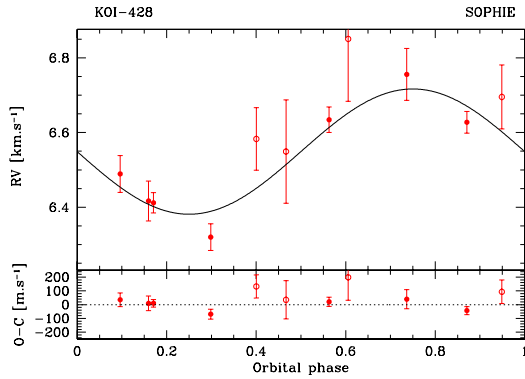
Figure 1: Phase-folded radial velocity curve of KOI-428b obtain with the SOPHIE spectrograph and the best-circular fit.
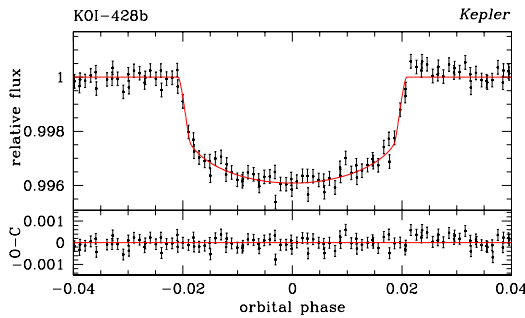

Figure 2: Kepler phase-folded transit light-curve of KOI-428b and the best-fit.

5 Summary

In this presentation, we will present our strategy to select the most promising *Kepler* candidates within reach of a detection with SOPHIE, as well as new *Kepler* / SOPHIE planets found using this strategy and finally we will discuss the false positive rate of *Kepler* based on our candidates set.
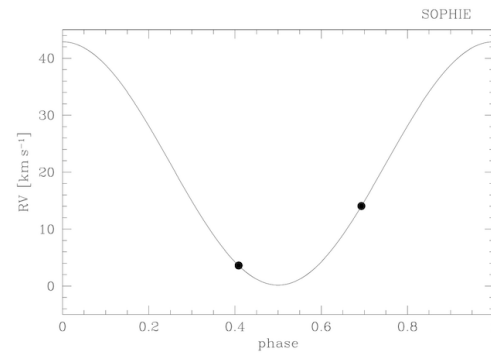
Acknowledgements

Figure 3: Phase-folded radial velocity curve obtain with SOPHIE of a spectroscopic low-mass star found in the *Kepler* candidates.

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