THE HIGH PRECISION SEARCH FOR NORTHERN NEPTUNES AND SUPER-EARTHS WITH SOPHIE (1/3)

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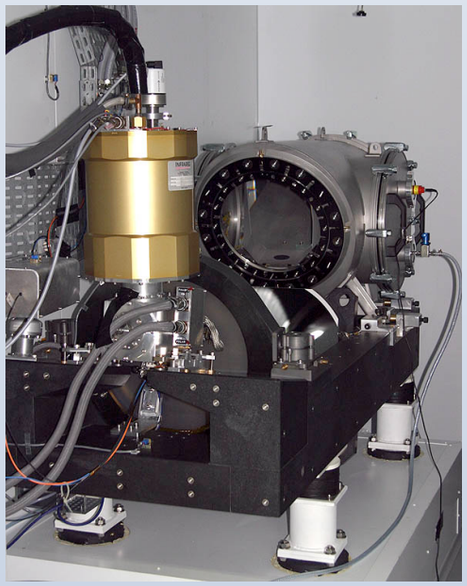
The SOPHIE spectrometer

The SOPHIE Spectrometer is installed on the 1.93m telescope at the Observatoire de Haute Provence (France). It has a resolution of 70000 and covers the 380-680nm range. It has been upgraded in 2011 including octogonal fibers. With a new correction of the systematics, the actual **RV precision is of ~2 m/s on all timescales**.



The SOPHIE spectrometer

The 1.93m telescope at the OHP

The SOPHIE high precision program

The SOPHIE high precision survey has been running since june 2011 and uses **~50 nights/year**. Its catalog includes **190 G and K stars** with the following characteristics :

- within 35 pcs
- slow rotation rate (Vsini<4.5 km/s), quiet stellar activity
- not intensively followed with HIRES or HARPS-N
- no known giant planet or binaries

The observational strategy is focused on the detection of short period planets (<100days). The expected yield is **~20 new low mass exoplanets**. A similar program is focused on **60 M dwarf** for an **additional ~50 nights/year**.

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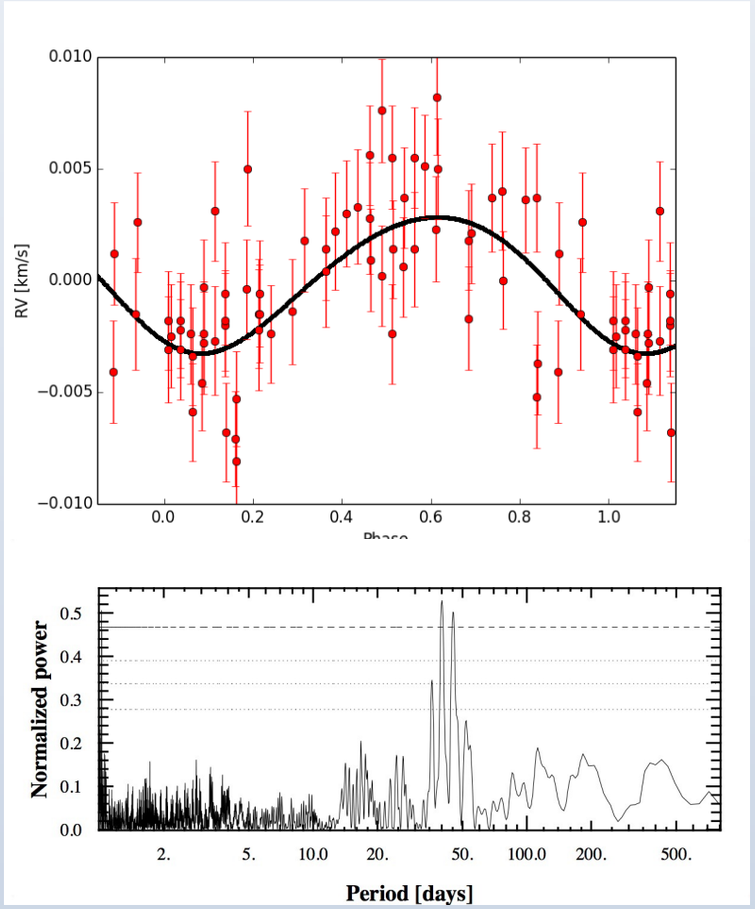
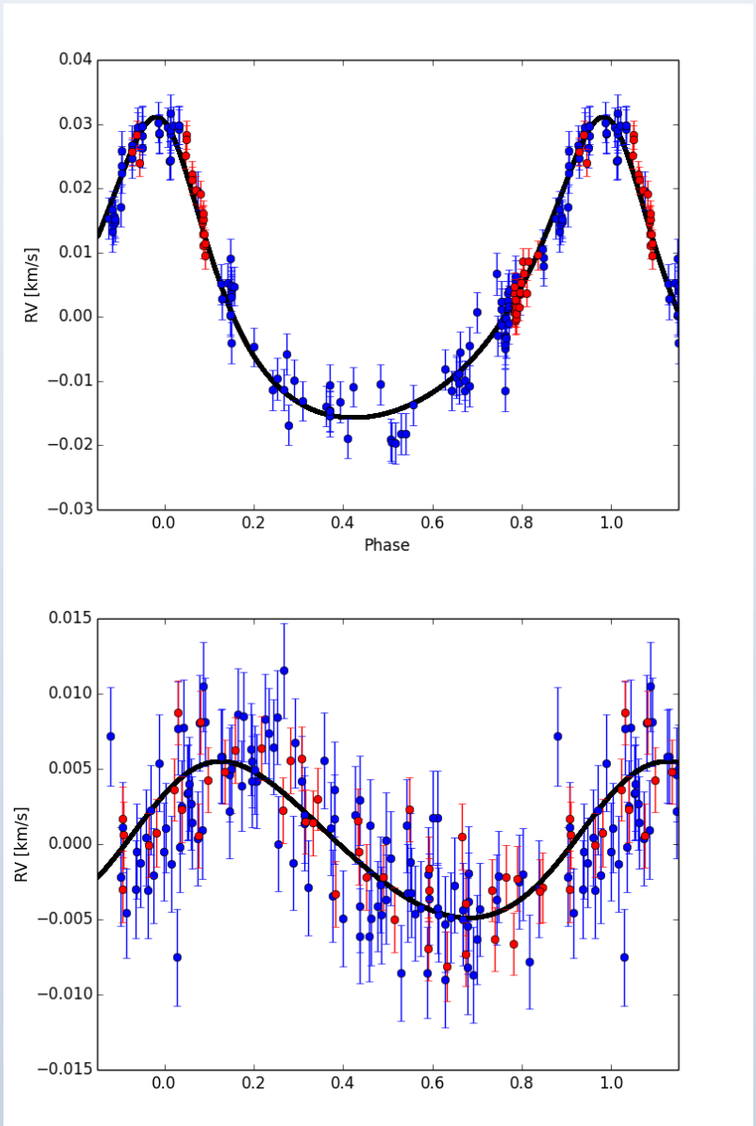
Preliminary results

In the last 4 years, **~110 stars have been observed with high precision measurements**, 29 of them with more than 30 data points. Promising candidates are more intensively followed, leading to the **detection of the first exoplanet of the program**. This Neptune-size planet orbits in 40 days around a solar analog (Courcol et al, submitted). With a RV semi-amplitude of only 3 m/s, it is the **smallest signal ever detected with SOPHIE**. An analysis of the known planetary system HD190360, observed with SOPHIE for scientific validation purposes, confirmed an actual stability better than for HIRES data on the 10m Keck telescope.



Phase folded RV data of a planet of Msini=16.1±2.7 M_e on a 40.0d period (Courcol et al, submitted).

Lomb-Scargle Periodogram with 1e-5 FAP level (dashed line)



Phase folded RV data of HD190360 b (top) and c (bottom). HIRES observations are in blue and SOPHIE in red.

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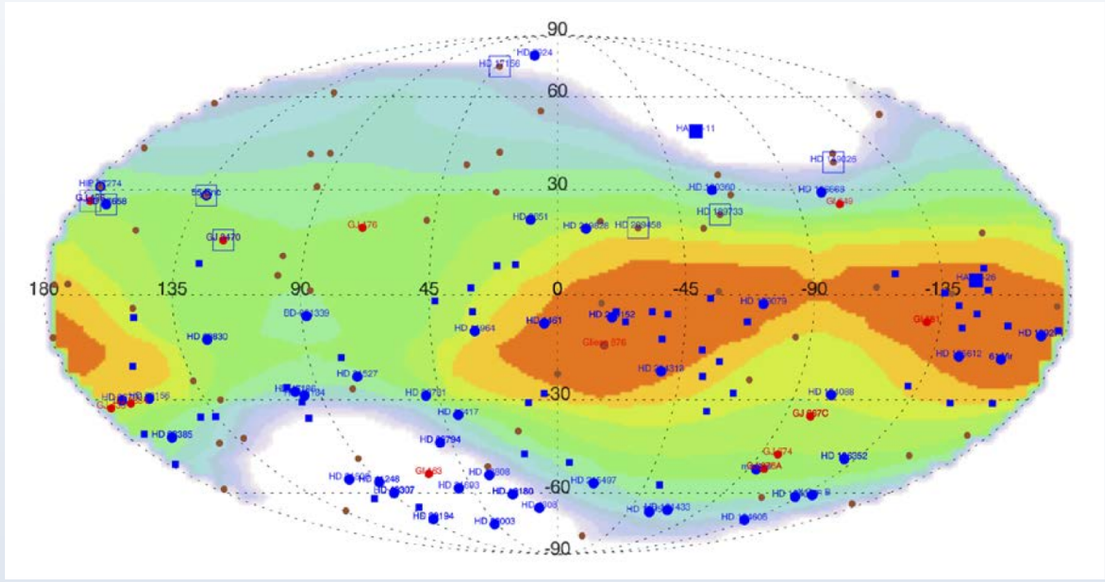
Link with CHEOPS

The CHEOPS ESA mission, scheduled for launch in 2017, will follow known planetary systems to detect their potential transits and provide precise radii. The observing strategy is now optimized to provide **new targets** for CHEOPS. An additional effort is put on stars in the CHEOPS visibility field, especially for declinations lower than 30°. Likewise, the emphasis on short period planets means a **high transit probability**.

Another observing program in 2015B and 2016A (PI : B. Courcol) will enable CHEOPS observations by **better constraining the orbital parameters and ephemeris** of other CHEOPS targets.



Example of a preliminary target list for CHEOPS displayed on a Mollweide sky projection. The colour gradient indicate the time that CHEOPS could spent pointing at given coordinates. White regions cannot be observed due to the Sun, while orange regions can be observed for 2000+ hours per years.

References

- Courcol et al. (submitted)
- Bouchy et al. 2013 A&A 549, A49
- CHEOPS Definition Study Report http://sci.esa.int/cosmic-vision/53541-cheops-definition-study-report-red-book/
- SOPHIE Webpage http://www.obs-hp.fr/guide/sophie/sophie-eng.shtml