Tenth anniversary of 51 Peg-b : Status of and prospects for hot Jupiter studies
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Line bisectors and radial velocity jitter from SARG spectra

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Abstract. We present an analysis of variations of bisectors of spectral lines for a few stars observed during the high precision radial velocity planet survey ongoing at SARG at TNG, and discuss the relation with differential radial velocities. The I_2 cell lines employed in the radial velocities measurements were used to improve the wavelength calibration and then removed before bisector analysis. The line bisectors were then computed from average absorption profiles obtained by cross correlation of the stellar spectra with a mask made from suitable lines of a solar catalog. The run of bisector velocity span against radial velocity was studied searching for correlations between line asymmetries and radial velocity variations. A correlation was seen for HD 166435 due to stellar activity and for HD 8071B due to spectral contamination by the companion. No correlation was seen for 51 Peg and ρ CrB, stars hosting planets. We conclude that this technique may be useful to separate radial velocity variations due to center of mass motion from spurious signal in spectra acquired with the I_2 cell.

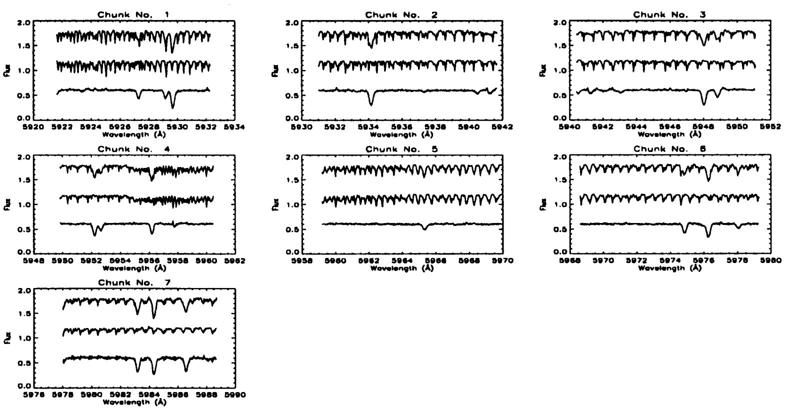

Figure 1. *Spectrum of HD 166435. Upper spectra is from the star with I_2. In the middle are spectra of the B-star with I_2. Lower spectra is free of I_2 after dividing the star by the B-star spectra.*

1. Spectra

We analyze spectra in the range 4580-6170 Å. Spectral orders were divided in 7 chunks of $\sim$10 Å. The spectrum of a B-star, for the radial velocity (RV) determination, was employed to remove the I_2 lines superposed to the stellar spectrum for calibration in λ (see Figure 1).

2. The Cross Correlation Function (CCF)

To compute the CCF a mask is constructed from the solar catalog by Moore et al. (1966), selecting lines separated by ≥ 0.1 Å, intensity of 3 to 30 Fraunhofer, well defined, without blends and avoiding telluric features. The mask is a sum of δ functions: 1 for the selected λ and 0 elsewhere. The CCF is computed for every chunk, multiplied by a weight, added and normalized.

3. The line bisector

A line bisector (LB) is the mid point of the profile. The bisector velocity span (BVS) is the velocity difference between two zones of the profile: one near the wings (Top) and the other near the core (Bottom). These zones were determined for the most significant correlation in the case of HD 166435, i.e., Top centered at 25% of the absorption depth, Bottom at 87% and both of 25% width. The same percentages were considered for all stars to be consistent in the analysis (for details see Martínez Fiorenzano et al. 2005).

4. Analysis

RVs are computed using AUSTRAL (Endl et al. 2000, Desidera et al. 2003). LBs are computed from the same spectra with an IDL code (Martínez Fiorenzano et al. 2005). We find a correlation between BVS and RV for HD 166435 as Queloz et al. (2001), and for HD 8071B likely due to spectral contamination from the companion. It is a member of a visual binary system and the primary has the smallest projected separation ($2.1''$) in the sample of the survey. For 51 Peg and ρ CrB the line bisectors show a constant shape and no correlation between BVS and RV.

5. Conclusions

We studied the variation of LBs in the same spectra acquired through the I_2 cell, employed for high precision RV measurements. We found that such variation, as measured by the BVS, shows spreads fully consistent with internal errors, as determined from photon statistics, spectral resolution and intrinsic line profiles. A significant correlation of BVS and RV was established in two cases: an anticorrelation for HD 166435, as found by Queloz et al. (2001), due to stellar activity, which makes the core of the profiles change from positive to negative values of RV. A positive correlation for HD 8071B, due to contamination of light from the companion star producing an asymmetry in the red wings of the profiles with an inclination of the LBs toward positive RVs. For the stars known to host exoplanets, 51 Peg and ρ CrB, no correlation was found, further supporting the conclusion that RV variations are due to Keplerian motion. We conclude that spectra acquired using the I_2 cell may be used to study variations of line bisectors. In order to achieve the required accuracy, it is necessary to deal with high quality spectra, high S/N to reduce error bars of BVS, or to study spectra where the RV variations are of large amplitude.

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Searching for planets around metal-rich stars

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Abstract. We surveyed a small sample of metal-rich solar-like stars in our planet search program during the last 3 years. Here we present the detection of a brown dwarf and 3 long-period massive planet (or brown dwarf) candidates as well as one short-period planet candidate with $m \sin i \sim 0.1\ M_{Jup}$. Furthermore, we calculated the upper mass limits of possible companions for the other stars.

1. Introduction

Various studies (e.g. Santos et al. 2004) imply that the frequency of planets depends on the metallicity of their host stars. This result has been used as a strong argument for the core accretion scenario. In the previous studies large samples of stars have been observed, which necessarily limited the number of observations per star. Additionally, mostly single and inactive stars were observed.

Here we present a new study in which we selected a rather small sample of only 33 metal-rich stars, but took $\sim$ 1400 radial velocity (RV) measurements of these. The sample has a median metallicity of [Fe/H] = 0.23. We did not exclude active stars nor binaries. If the metallicity effect is real, we expect to find 8–9 stars with planets. However, for 6 of these stars it was already known that they have planets, we thus observed only the remaining stars. Since it was claimed that the detection of planets is easier for metal-rich stars than for metal-poor ones, we also added 8 stars of low metallicity to the target list as a comparison sample.