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A search for very low amplitude magnetoacoustic pulsations with HARPS

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Abstract. We have obtained time-resolved spectroscopic observations for a sample of 10 cool Ap stars using the ultra-stable spectrograph HARPS at the ESO 3.6-m telescope. The aim of our study was to search for low-amplitude oscillations in Ap stars with no or inconclusive evidence of pulsational variability. Here we report initial results of our investigation. We confirm the presence of $\approx$ 16-min period pulsations in β CrB (HD 137909) and demonstrate multiperiodic character of oscillations in this star. Furthermore, we discovered very low amplitude 9-min pulsations in HD 75445 – an object spectroscopically very similar to known roAp stars.

Key words: stars: atmospheres – stars: chemically peculiar – stars: oscillations – stars: individual: HD 75445, HD 137909

1. Introduction

Many recent time-resolved spectroscopic studies of the rapidly oscillating Ap (roAp) stars (e.g., Kurtz *et al.*, 2006; Ryabchikova *et al.*, 2007) have focused on the known, high-amplitude pulsators and did not address the fundamental question of what distinguishes pulsating and non-oscillating Ap (noAp) stars. Ryabchikova *et al.* (2004) suggested that there might exist no real dichotomy between roAp and noAp stars, and weak pulsational variability is present in all cool Ap stars. With the aim to test this hypothesis and to obtain the first complete picture of the incidence of pulsations in Ap stars, we used the ultra-stable spectrograph HARPS at ESO to obtain time-resolved spectra for a sample of 10 noAp and weakly oscillating Ap stars. Here we summarize preliminary results of the analysis of HARPS spectra of HD 75445 and HD 137909 (β CrB).

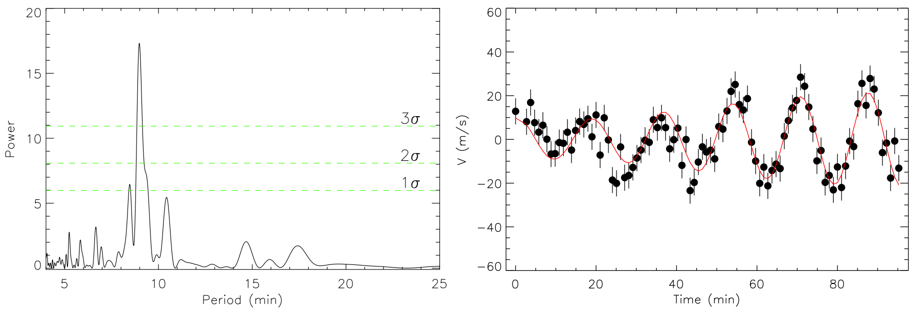

Figure 1. *Left panel:* Periodogram showing discovery of 9-min pulsational signal in the combined RVs of 29 Nd III lines in HD 75445. *Right panel:* Mean RV variation of 40 Ce II lines in β CrB. Multiperiodic character of oscillation is clearly evident.

2. HD 75445

Ryabchikova *et al.* (2004) performed an abundance analysis of HD 75445, finding this star to be a spectroscopic twin of the well-known roAp star γ Equ. We have obtained a set of 120 HARPS spectra of HD 75445. Pulsational analysis of Nd III lines reveals oscillations with 8.98 min period and an amplitude of 20 ± 3 m s^{-1}. Thus, HD 75445 is a new roAp star, and the first one discovered with HARPS.

3. β CrB

Kochukhov *et al.* (2002) found a tentative evidence of the 11.5-min RV variation in β CrB. This period was not confirmed by Hatzes and Mkrtichian (2004), who reported definite 16.2-min oscillation. Using HARPS we obtained 93 high-precision observations of β CrB. The RV analysis of Ce II lines reveals pulsational variability close to the previously reported 16.2-min period. Moreover, our time-series shows strong amplitude modulation (Fig. 1), indicating the presence of at least two frequencies. A least-squares fit yields periods 17.2 ± 0.2 and 15.7 ± 0.5 min with amplitudes 15.4 ± 2 and 6.3 ± 2 m s^{-1}, respectively.

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