

## Long-term spectroscopic survey of seven interesting CP stars

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**Abstract.** We present a long-term spectroscopic monitoring of seven CP stars in which binarity has either been established or signs of possible companions have been indicated. The primary goal of the survey was to examine the radial velocities (RVs) variations of the stars published earlier and to study multiplicity of the objects.

**Key words:** stars: chemically peculiar; stars: binaries

### 1. Introduction

This campaign was motivated by the presentation of Juraj Zverko at the conference "Observing techniques, instrumentation and science for metre-class telescopes" held in Tatranská Lomnica in 2013 (Zverko, 2014), where these stars were recommended for observations with this class of telescopes. Initially the stars became interesting for their apparently different projected rotational velocities when determined using two different spectral lines, namely the Ca II at 3933 Å and Mg II 4481 Å. In studies cited in Zverko (2014) signs of their possible binary nature had been identified, that become evident via varying RVs, an uniform reduction of line depths and/or an incidence of spectral lines of a companion. The spectroscopic observations were performed at the observatories SL (Pribulla et al., 2015) and SP,<sup>1</sup> and RVs were determined by means of CCF (Zverko et al., 2007). The RVs were measured in the blue part of the spectrum, where the Mg II 4481 Å is the strongest metallic line in these stars. Here we present a summary of up-to-date status of observations. The commentaries

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<sup>1</sup><https://www.ta3.sk/l3.php?p3=sto>

below for each of the investigated stars refer to figures that are accessible in <https://www.ta3.sk/~vanko/RVs/>.

## 2. The current status of the study

**HD 2913** (51 Psc, B9V,  $V = 5.9$ ). We acquired 37 SL and 14 SP spectra that disclose a RV curve with values from  $-3$  to  $+28 \text{ km s}^{-1}$  following the previous values introduced in Zverko et al. (2011) and the literature cited there. An extreme value occurs in the SP data, namely the one, reaching  $+41 \text{ km s}^{-1}$  near the maximum of the curve. Observations are continued to complete the curve, to explain that one extreme value, as well as to investigate the scatter reaching nearly  $10 \text{ km s}^{-1}$  within an individual observing windows.

**HD 47152** (53 Aur, B9Mn+F0m,  $V = 5.7$ ). Fifty-eight SL and 26 SP spectra cover approx.  $1/9$  portion of the supposed period 38.9 y. The measured values spread within  $\sim 10 \text{ km s}^{-1}$  in both SL and SP spectra.

**HD 47964** (HR 2461, B8III,  $V = 5.7$ ). Although former studies show RV to vary within 0 and  $20 \text{ km s}^{-1}$ , no signs of a secondary spectrum were detected with a  $S/N=1100$  (Zverko et al., 2013). We acquired 45 SL and 5 SP spectra that do not outline any rational RV curve except the increase between HJD 2458200 and 2458600 which calls for further observations.

**HD 90569** (CX Leo, B8V,  $V = 3.4$ ) This magnetic sharp-lined CP star is an SB1 binary with a long period  $P = 34.6$  years, showing low velocity variations (Abt & Snowden, 1973). We monitor whether our modern observations confirm the orbit derived in Pourbaix et al. (2005). We obtained 56 SL and 17 SP. A slow increase from  $-10$  to  $-9 \text{ km s}^{-1}$  during the campaign is indicated. In order to confirm the unsure long period continuing observations would be advisable.

**HD 138527** ( $12\tau^2$  Ser, B9V,  $V = 6.2$ ). We obtained 56 SL and 12 SP spectra which do not show any long-term increase or decline over the time-span of our campaign. Anyhow, the values spread between  $-24$  and  $-11 \text{ km s}^{-1}$ , in compliance with earlier results where RV-s go from  $-6$  to  $-26.5 \text{ km s}^{-1}$

**HD 183986** (HR 7419, B9.5III,  $V = 6.2$ ). We acquired 43 SL and 11 SP spectra. Earlier measurements of RVs showed values from  $-6$  to  $+22 \text{ km s}^{-1}$ . Our observations allow to discover a radial velocity curve suggesting  $P_{\text{orb}} \approx 1300$  d. We hope to cover the anticipated peak during spring of 2020.

**HD 214923** (42 Peg, B8V,  $V = 3.4$ ) is a small-amplitude, slowly pulsating B (SPB) star oscillating in a non-radial g-mode with a period of  $P = 0.95633$  day, with amplitude  $\sim 0.5$  mmag (Goebel, 2007). Thirty-seven SL spectra show a weak increase from  $\approx +5 \text{ km s}^{-1}$  at the beginning of the campaign to  $\approx +7 \text{ km s}^{-1}$  at its end, similarly 16 SP spectra show an increase from  $\approx +2 \text{ km s}^{-1}$  at the beginning to  $\approx +4 \text{ km s}^{-1}$  at its end. The figure also shows a scatter reaching  $5 \text{ km/s}$  in each of the observing windows. Taking into account that the star is slowly pulsating, the spread of the data may be due to the pulsations.

### 3. Conclusion

This is a progress report on our long-term monitoring of seven CP stars suspected of binarity. Two of them were known as very long-period binaries before: HD 47152 and HD 90569. Our observations lasting for 6 yrs cover only a fraction of their orbital periods. In the case of HD 2913 and HD 183986 their binarity is confirmed. HD 47964 does not show a varying RV except for the last group of observations, with a RV increase of about  $3 \text{ km s}^{-1}$ . HD 138527 and HD 214923 embodies a remarkable scatter of the values reaching 7-10  $\text{km s}^{-1}$  inside each observational window, that advert to possible slow pulsations that stars of this spectral types undergo. The internal accuracy of our single RV measurement is better than  $1 \text{ km s}^{-1}$  corroborated with HD 90569 and HD 183986. This reveals that the remaining stars, with the scatter extending beyond a few  $\text{km s}^{-1}$ , are worth further observations aiming at disclosing pulsations. Helpful and conclusive will be additional photometry (e.g. space based photometry, *BRITE*, *SMEI*, *TESS*, etc.).

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