Supplementary Intermediate Report (July 2022) to the Spectroscopic Monitoring of the 2017–2019 Eclipse of VV Cephei

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Abstract In a report that we previously published on spectroscopic monitoring of VV Cephei, time-series analysis yielded a different period (52 d) for the radial velocity of the violet (V) emission lobe of Hα than for the other features of Hα (42 d). Here, an analysis incorporating extensive new data resolves this discrepancy, giving an improved period of 43.8 ± 0.1 d for all Hα features.

1. Results

Based on the already published campaign results (Pollmann and Bennett 2020), a new geometric structure of the emission sources was developed in collaboration with Phil Bennett. Among other things, it was found that the gravitational force of the M star in VV Cep exerts an enforced angular momentum on the orbital companion star of spectral class B and its accretion disk, which results in a 43-day precession period of the disk rotation axis as well as the axis-oriented upper V emission lobe and the lower R Emission lobe. This periodic precession of the disk rotation axis would inevitably lead to a simultaneous periodic variation of the radial velocity (RV), at least the V-line flow (upper emission lobe of Figure 10 in Pollmann and Bennett 2020). However, in the *JAAVSO* publication we found within the time period JD 2457873–2458911 a 52-day period for the V emission lobe instead, with the ca. 10-day period difference not being resolved at the time of publication. A now expanded data set of RV measurements from JD 2458951 to JD 2459777 of the V emission lobe up to July 2022 (Figure 1) allowed a new period analysis to clarify this discrepancy.

Figures 3 and 4 show the period analysis of the trend-adjusted RV data (detrended by fitting a 6th order polynomial) in Figure 2, now from 415 spectra obtained up to July 2022, giving a significantly improved period of 43.8 days (± 0.1). This result now very well confirms the expected 43-day periodic precession movement of the disk rotation axis of the B star, including its accretion disk. The causes of the slow RV variation in Figure 1 are still unclear to this day, which is why further, longer phase sections are awaited to clarify them. However, it should be mentioned again that this RV has been evaluated as a relative RV with respect to the resting M supergiant (cf. the description in the *JAAVSO* paper mentioned above).

The companion star is currently in the orbital phase 0.87, which is why it will be interesting to see to what extent the precession period of 43 days persists (or not) after the periastron passage March 2025 to the orbital phase 0.5 (apastron).

The new results presented here will soon be included in a comprehensive description of this theoretical work.

Reference

Pollmann, E., and Bennett, P. D. 2020, *J. Amer. Assoc. Var. Stars*, **48**, 118.

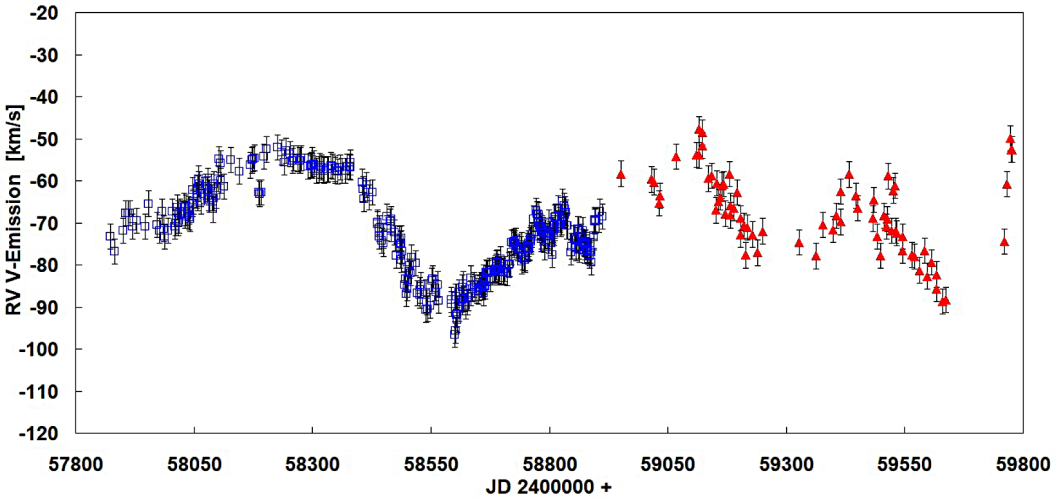

Figure 1. Extended data (red triangles, JD 2458951–2459777) from RV measurements of the maximum line flux of the V emission lobe from spectra of the ARAS spectroscopy group; blue squares are from the 2017–2019 monitoring, published already in Pollmann and Bennett (2020).

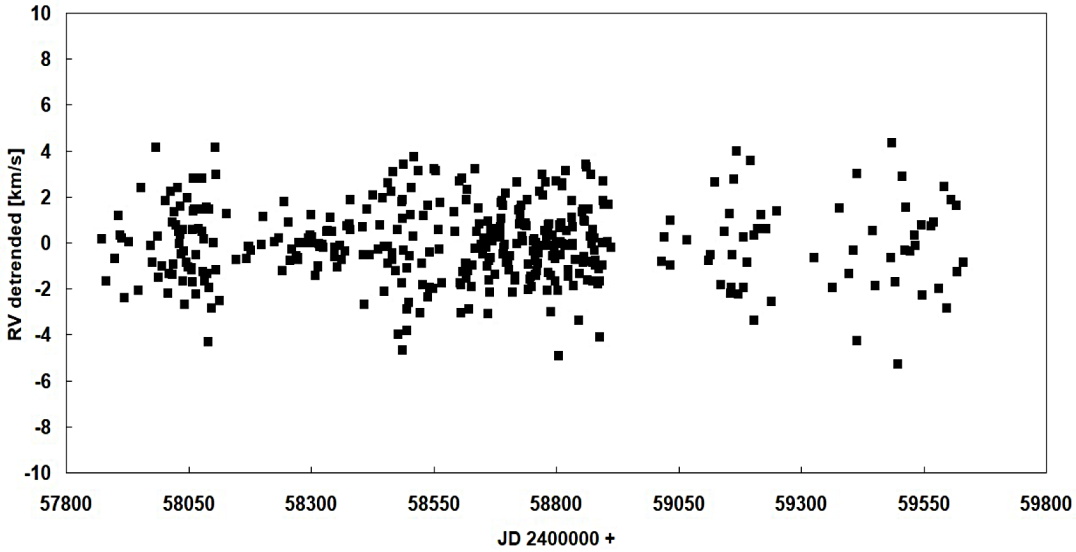

Figure 2. Trend-adjusted RV from Figure 1.

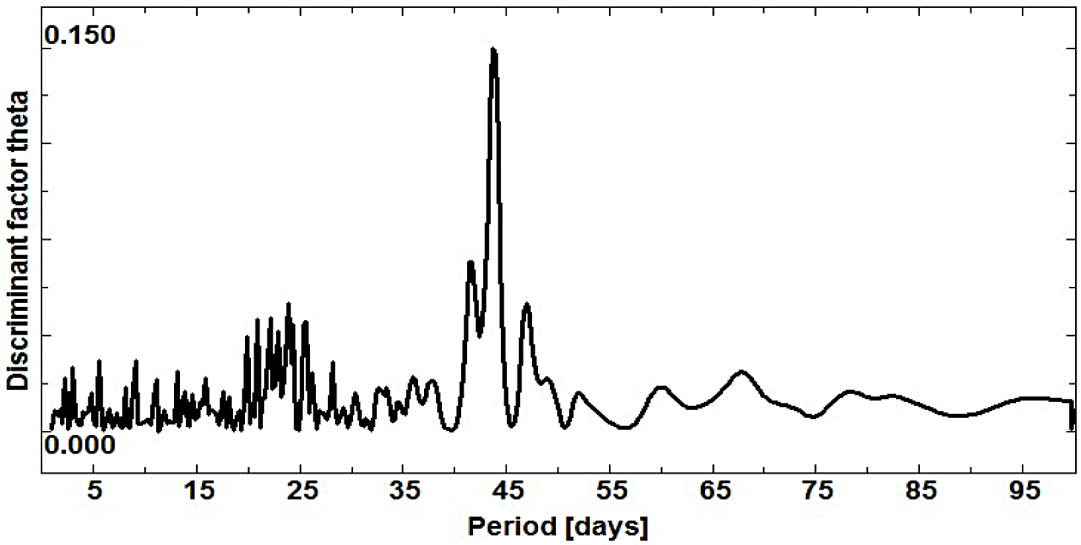

Figure 3. Scargle Period Analysis; P = 43.8 d (± 0.1).

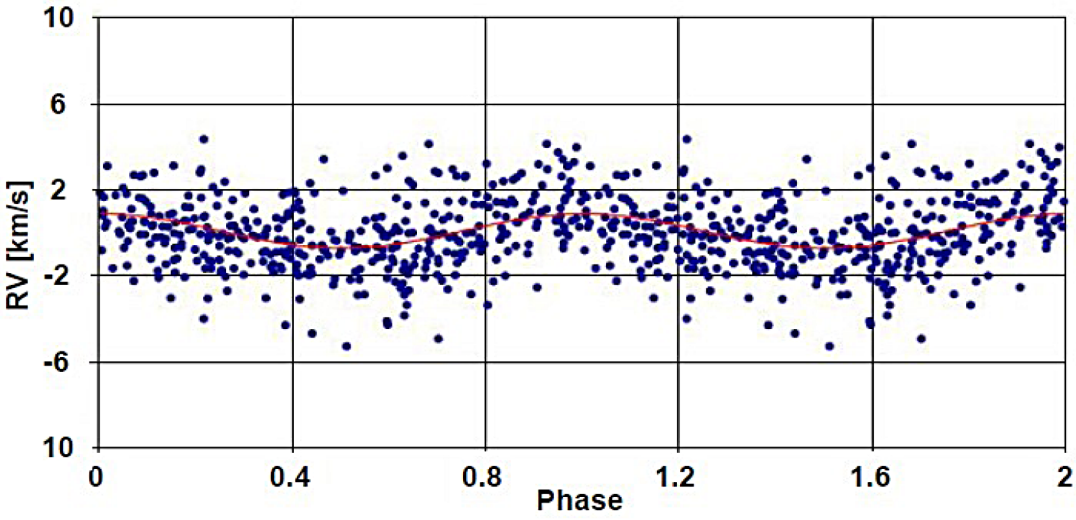

Figure 4. Phase diagram from Figure 3.