The nodding Disk of the B star in VV Cep

(by Ernst Pollmann, 2018-09-18)

The violet (V) component of the Hα double peak profile in VV Cep can be understand as the main emission source of the disk- or shell-like gas around the B star. The discovered 43.5 day period of the Hα V/R ratio in Fig. 1 bottom (IBVS, 2018) leads to the question of the causes of this process.

Against this background and the necessity to find a plausible explanation for the Hα V/R periodicity in VV Cep, the investigation presented here is the measurement of the radial velocity (RV) of the V component of the double-peaked Hα emission (Fig. 1, middle).

The reason why the RV of the V component have been measured, are the results of the investigation of Schaefer et al. (2010), performed at the binary Be star ζ Tau. They found that position angle variations of the long axis of zeta Tau´s disk are significant and probably responsible to the V/R variation (see Fig. 6 of that publication).

With this kind of investigation they have been able to model so-called nodding movements of the disk with the consequence of a precession of the disk rotational axis (see also: http://astrospectroscopy.de/media/files/disk-nodding_slow.AVI). It seems to be plausible that such a nodding- and or precession-movements leads inevitably to corresponding radial velocity variations of the Hα emitting disk.

For the presented investigation only spectra are used, which have been taken with LHIRES III spectrographs by the ARAS observer C. Sawicki, E. Bertrand, M. Schwarz, J. Martin, E. Pollmann (spectra of ARAS data base). With these spectrographs the spectral resolution R > 15000 is high enough to measure the RV precisely.

The spectra are re-calibrated with lines of the M star (FeI = 6546.245; TiI = 6556.066; CaI = 6572.781; FeI = 6593.878). These RV measurements relative to the RV of the M star have been done with VSpec, by wavelength determination of the flux maximum of the violet component of the Hα emission. The error of the wavelength calibration in that way is less than (+/-) 1km/s.

A comparison of the RV (Fig. 1, middle) with the V/R curve (Fig. 1, top) shows the obvious antisynchronous behavior of both. Unfortunately the density of spectra for the determination of the radial velocity observation is clearly lower than for V/R, so it is hardly possible to find there the 43.5 day period.

But the fact of the antisynchronous behavior of the RV to the flux maximum of the violet (V) Hα component, boost the thesis that the observed 43.5 day V/R period is caused by a precession movement (RV) of the disk- or shell-like emission source around the B star.

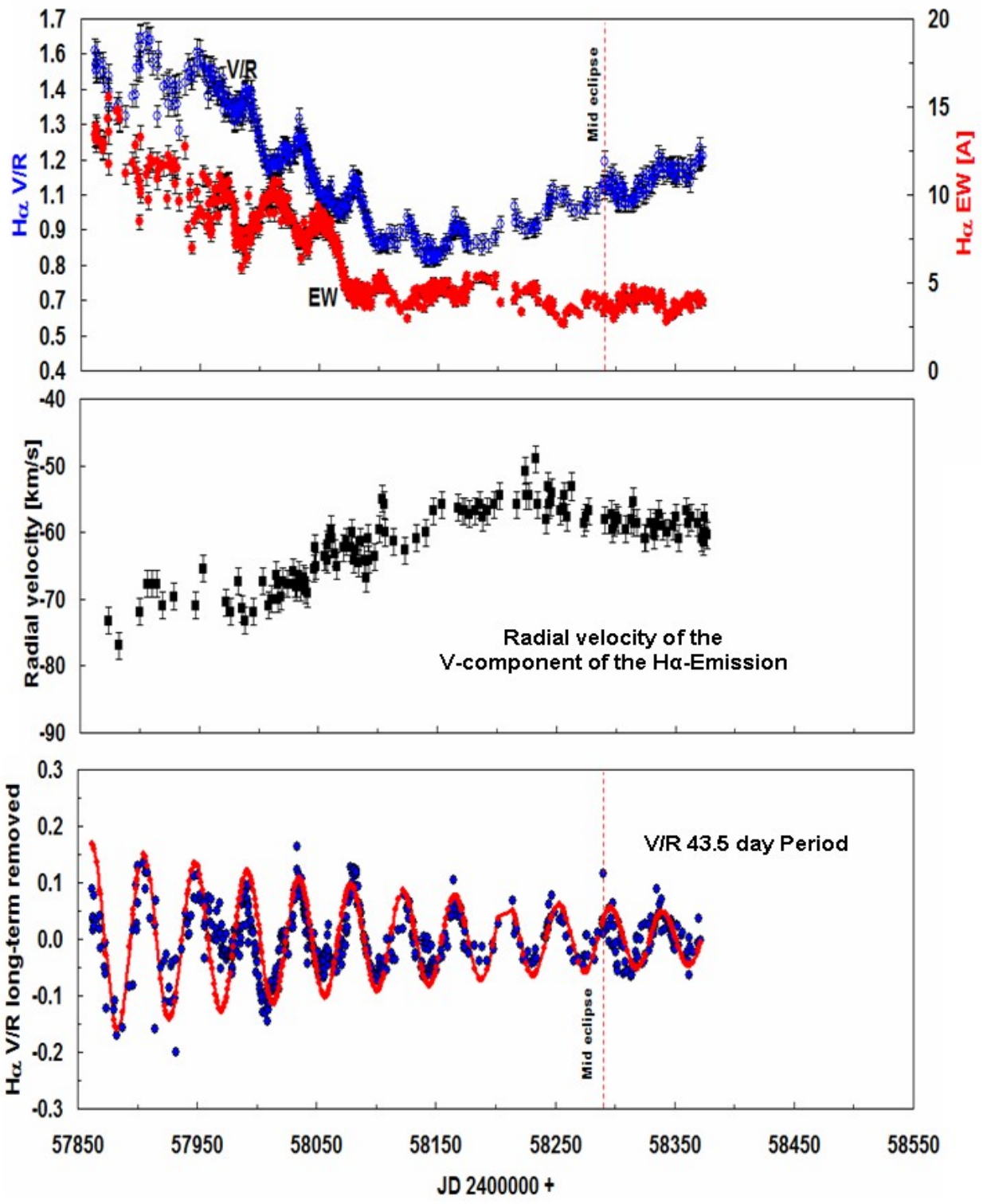

Fig. 1: (top): The total Hα emission (EW) [red points, refer to right axis]. The ratio of the Hα violet component peak flux (V) to the red component peak flux (R) is also shown [blue circles, refer to left axis]. Both parameters have the same 43.5-day period, but the V/R ratio varies antisynchronously with the EW variation; (middle): RV of the violet component; (bottom): 43.5-day V/R period long-term removed.

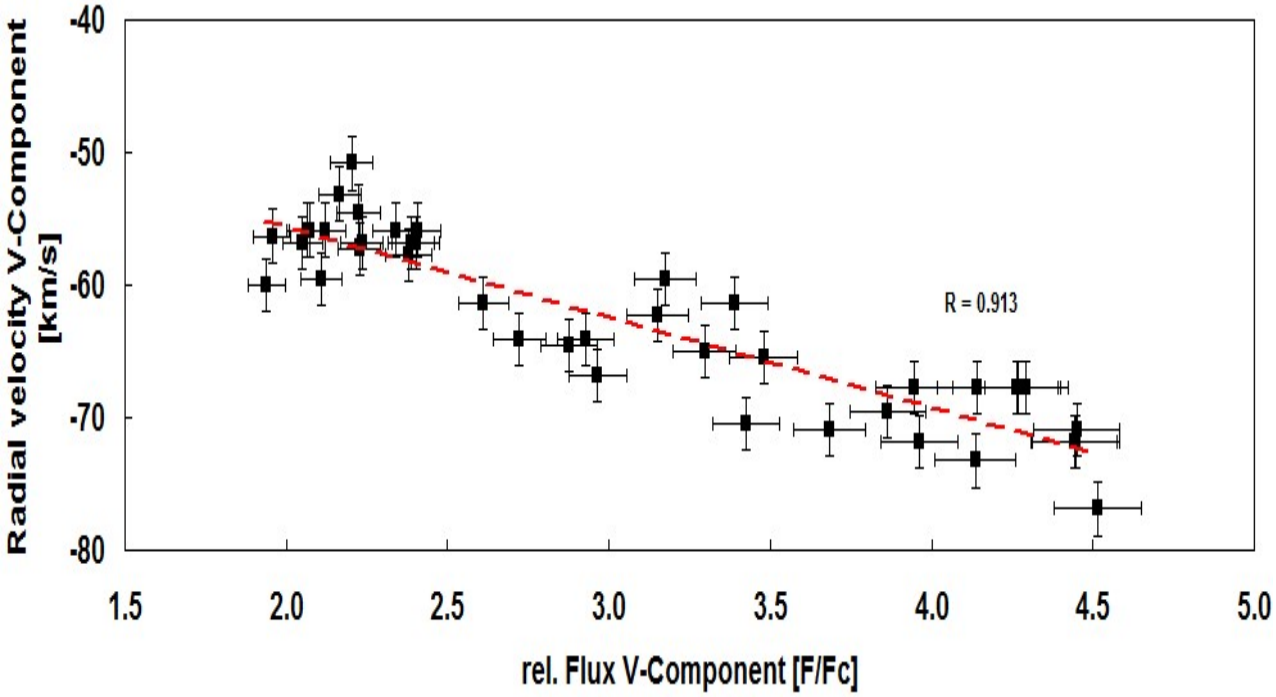

Fig. 2: Correlation of the radial velocity to the line flux (peak) maximum of the V component of the Hα V/R ratio

In order to emphasize the correlation of RV to the flux maximum of the V component, both parameter have been evaluated in 40 selected spectra to cover the total range of RV and line flux variation, observed from 2017/04/29 (out of eclipse) until now. The result shows Fig. 2 with a correlation quality of approx. 90%!

The easy to imagine modell of a disk nodding movement by Schaefer et al. (2010) in zeta Tau, transferred on VV Cep, might mean that a nodding movement of the disk or shell-like gas around the B star should have as consequence a variable Hα emission flux and a variable radial velocity in the line of sight of the observer. Also the 43.5 day periodicity of the Hα equivalent width in Fig. 1 (top, red curve) might be explained with the disk nodding model.

Nevertheless it remains unclear, which process might initiate in VV Cep such a kind of disk nodding and a precession of the disk rotational axis. When in ζ Tau´s disk the one-armed density enhancement is responsible (Schaefer et al. 2010), it seems to be questionable, whether we can to expect a comparable process in VV Cep.

Reference:

Pollmann, E., Bennett, Ph., Vollmann, W., Somogyi, P., 2018, IBVS No. 6249

Schaefer G. H., et al, 2010,The Astronomical Journal, 140:1838–1849, 2010