Monitoring the radial velocity of ζ Tauri

(by Ernst Pollmann)

The Be-binary star ζ Tau shows periodic behaviour in the radial velocity of the HeI 6678 absorption line. There is a serious request from professional astronomers to amateurs to contribute their observations to the monitoring of this parameter. Fortunately it´s fairly easy, even with relative small instruments, to take part in this kind of monitoring project. One of the most interesting publications regarding radial velocity in zeta Tau is "Long term and orbital changes of zeta Tauri", by Ruzdjak et al [1].

It is a pleasing coincidence, that some of the current amateur observer community (B. Mauclaire, France; R. Bücke, Germany; E. Pollmann, Germany) started their long-term observing campaign of the HeI6678 line of this star at the time when the investigations of the researchers of the mentioned paper ended, approximately at JD 2454500.

Our findings on the long-term variability of the radial velocity of the HeI6678 line is shown in Fig.1 (100 measurements). After subtraction of the long-term component (4^{th} order polynomial) we are left with the residuals in Fig.2. One of the aims of our investigation is to compare our period analysis of the residuals (see phase plot in Fig.3) with the results of Ruzdjak et al. (800 measurements) in Fig. 4 and table 3.

Our result:

Period [d]	= 133.2 ± 0.8 (program PERIOD04)
	= 133.3 ± 0.9 (program SPS)
To	= 2454499.000
K [km/s]	= 8.0 ± 0.8
Rms [km/s]	= 5.42

As can be seen, our findings are very close to those of Ruzdjak et al. for the most important parameters.

Sometimes significant intensity variations of the continuum in the area of the blue and/or red side, as well within the wings of the HeI6678 absorption line, are seen (Fig. 5). So-called "co-rotating circumstellar clouds and/or matter" in the outer photosphere of the primary could be the cause [2]. Because of this phenomenon we cannot expect a smooth continuum within this area all the time. Long-term monitoring of this behaviour has been running since 2007.

References:

[1] Ruzdjak, D. et al., A&A 506, 1319-1333 (2009)
[2] Balona, L. A. & A. B. Kaye, ApJ, 521, 407-413, 1999

Webpages:

Ernst Pollmann:	http://astrospectroscopy.de
Benjamin Mauclaire:	http://bmauclaire.free.fr/astronomie/spectro/atlas/bestars/zet_tau/
Roland Bücke:	http://astro.buecke.de

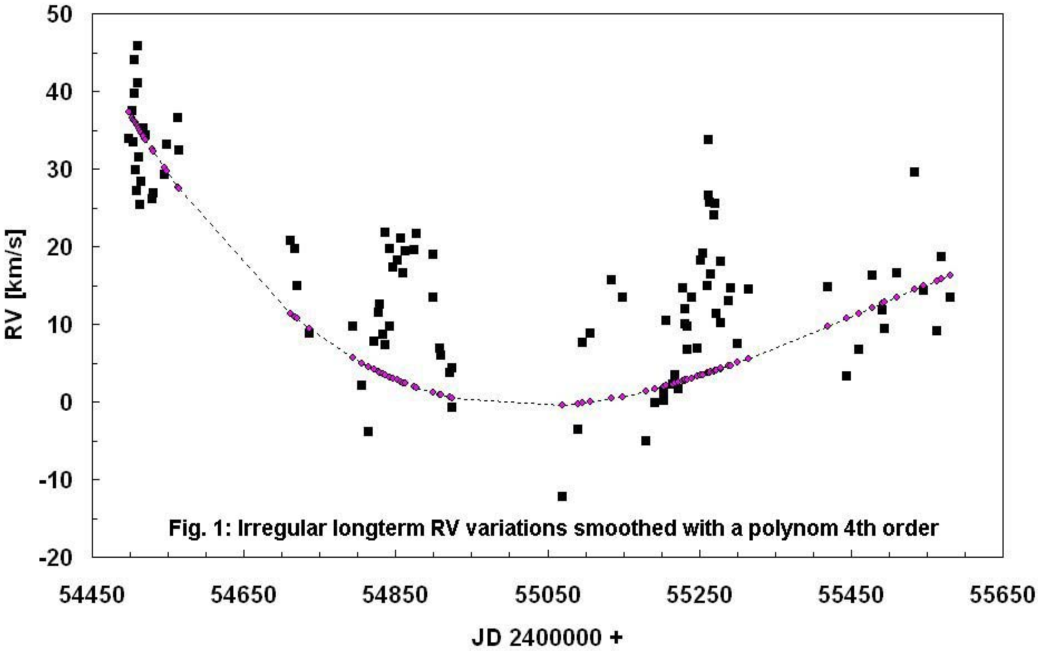

Fig. 1: Irregular longterm RV variations smoothed with a polynom 4th order

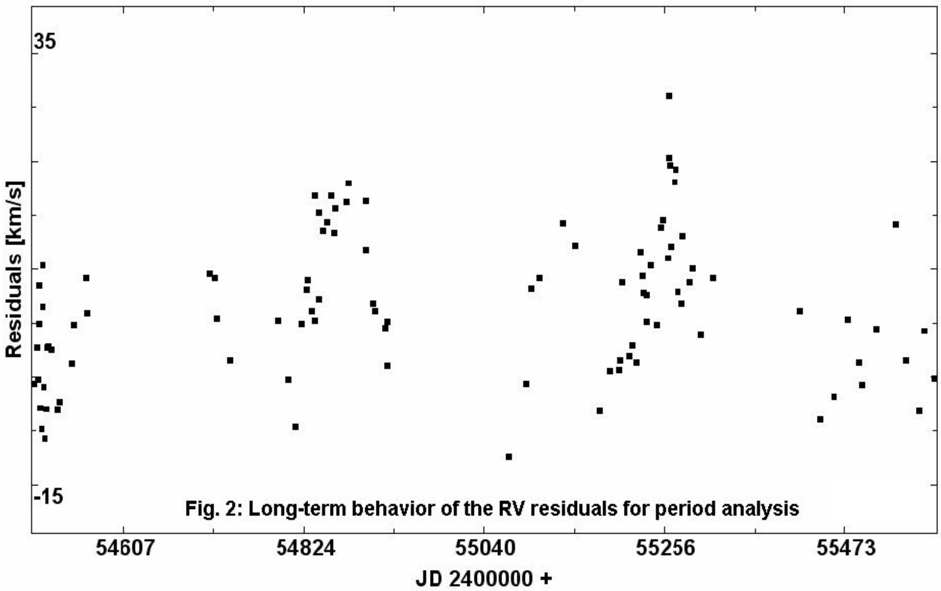

Fig. 2: Long-term behavior of the RV residuals for period analysis

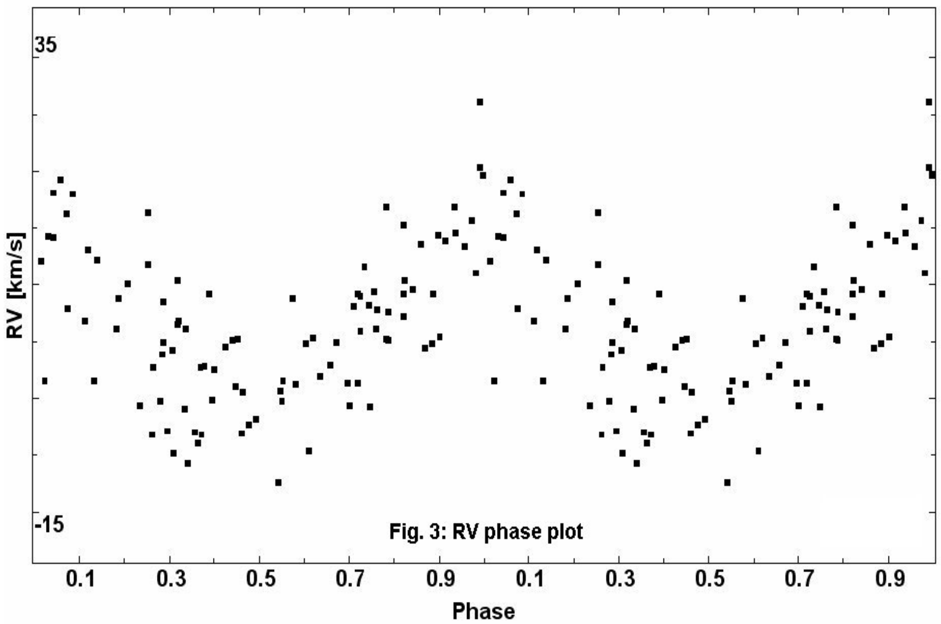

Fig. 3: RV phase plot

Table 3. Trial solutions for the H I shell RVs, He I RVs and a combination of Hα emission-wing RVs with He I RVs measured via cross-correlation in Jarad (1987).

Element	Sol. 3	Sol. 4	Sol. 5
P (d)	132.920	133.000	132.901
	±0.013	±0.034	±0.044
$T_{\mathrm{RV\,max.}}$	47016.4 ±3.6	47027.2 ±3.5	47027.9 ±1.3
K (km s^{-1})	9.74 ±0.41	7.6 ±1.2	8.29 ±0.61
rms (km s^{-1})	8.09	16.25	4.44
No. of RVs	801	509	178

Solution 3 for the H I shell RVs was formally calculated as an eccentric orbit solution with $e = 0.25$ and $\omega = 305°$, the remaining two solutions are derived for a circular orbit.

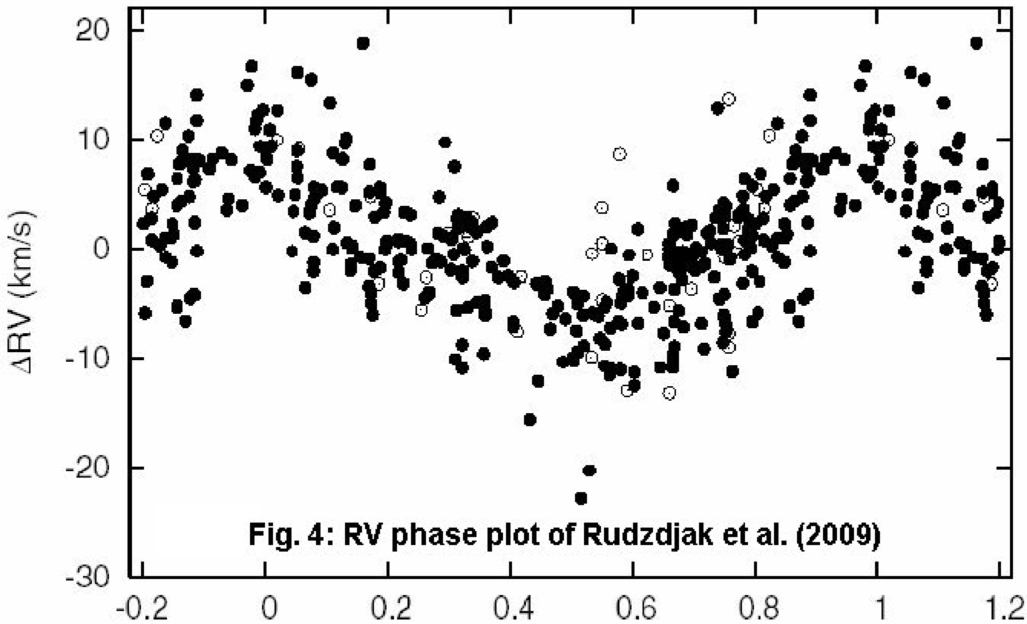

Fig. 4: RV phase plot of Rudzdjak et al. (2009)

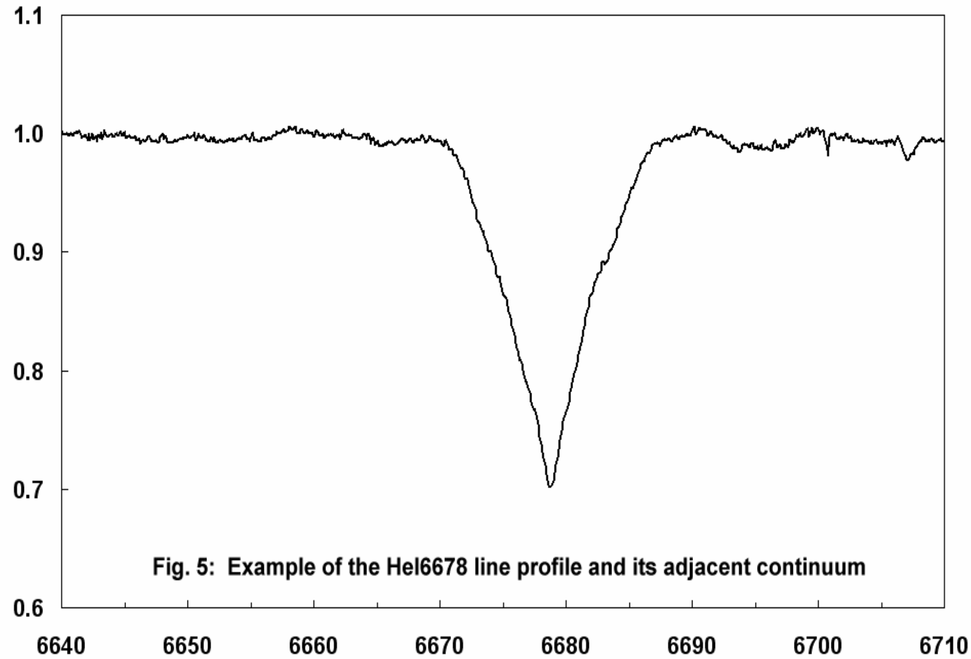

Fig. 5: Example of the HeI6678 line profile and its adjacent continuum