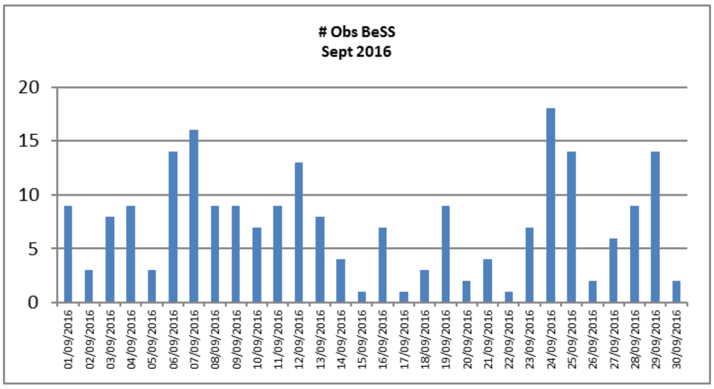
BeSS report – September 2016

Data compiled by Valérie Desnoux
Be projects section by Ernst Pollmann here

Observateur	Nb spec
Thizy	49
TERRY	21
HOUPERT	21
Graham	18
de Bruin	17
Guarro Fló	15
bertrand	12
Lester	11
Lopez DUBREUIL GARREL	8
Broussat	8
Sawicki	7
Fosanelli	5
Pollmann	4
Luckas	3
Sollecchia	3
Favaro	2
Berardi	2
Wilson	2
GARREL	2
Martineau	2
GARDE	2
Heathcote	2
Bohlsen	2
West	1
Dejean	1
JOUAIRE	1

- 115 stars were observed
- 26 Observers contributed this month
- 221 Spectra H-alpha

Most observed are 28 cyg, Gam Cas and Pi Aqr

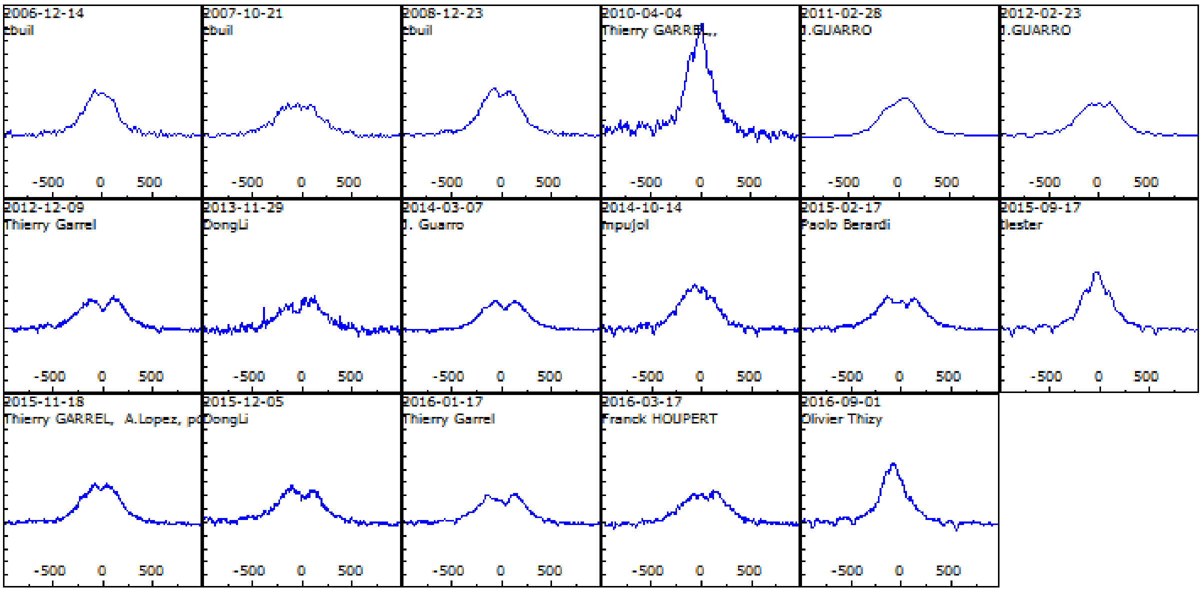


Objects observed

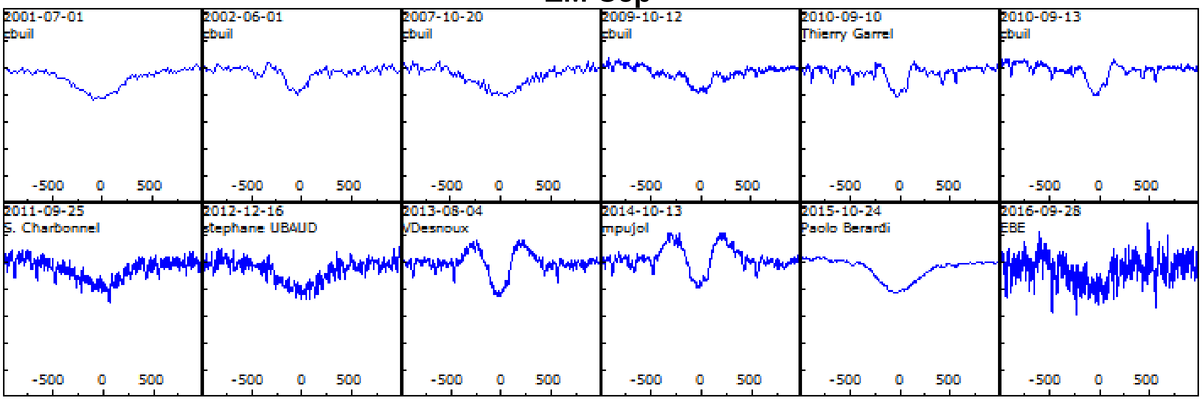
Classique							?	Herbig
gam Cas	28 Cyg	pi Aqr	phi Per	LQ And	V848 Ara	HD 21362	51 Oph	V380 Cep
zet Tau	20 Vul	HD 173817	BK Cam	bet Psc	kap Aql	HD 32188	HD 174571	
PLEIONE	iot Lyr	ALFIRK	60 Cyg	omi Aqr	HD 6343	HD 189689		
V442 And	bet Cyg B	HD 194244	16 Peg	HD 196712	8 Lac B	V438 Aur		
del Sco	64 Ser	14 Lac	ELECTRA	lam Eri	HD 232552	HD 173530		
QR Vul	NW Ser	V2136 Cyg	HD 18552	ALCYONE	8 Lac A	V447 Sct		
SHELIAK	4 Aql	11 Cyg	tet Ari	V2139 Cyg	HD 225095	HD 173371		
66 Oph	HD 205551	psi Per	HD 216057	MEROPE	V817 Cas	HD 203374		
V2119 Cyg	HD 194057	omi And	V813 Cas	V423 Lac	12 Aur	V1463 Aql		
CX Dra	HD 194779	12 Vul	HD 201836	NT Peg	Menkhib	HD 344873		
HD 171780	HD 224544	eps Cas	V777 Cas	V408 Lac	V357 Lac	HD 184767		
V2113 Cyg	V378 And	HD 193182	V764 Cas	HD 199218	EM Cep	HD 187350		
V923 Aql	lam Cyg	V801 Cas	HD 24479	HD 9709	HD 23800	HD 174705		
25 Vul	HD 22780	HD 195407	HD 179343	V846 Ara	6 Cep	lam Pav		
BD-09 4858	V2120 Cyg	HD 203356	V2166 Cyg	V432 Cep	BD+34 113	V2123 Cyg		
HD 171754	HD 197038	BD+36 4145	HD 225985	HD 174775	V450 Cep	V417 Cep		

Emission increase since last observations

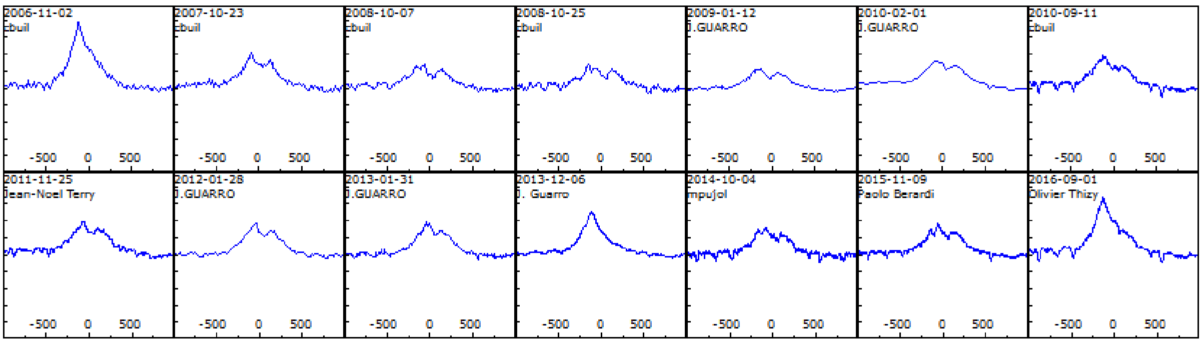
12 Aur



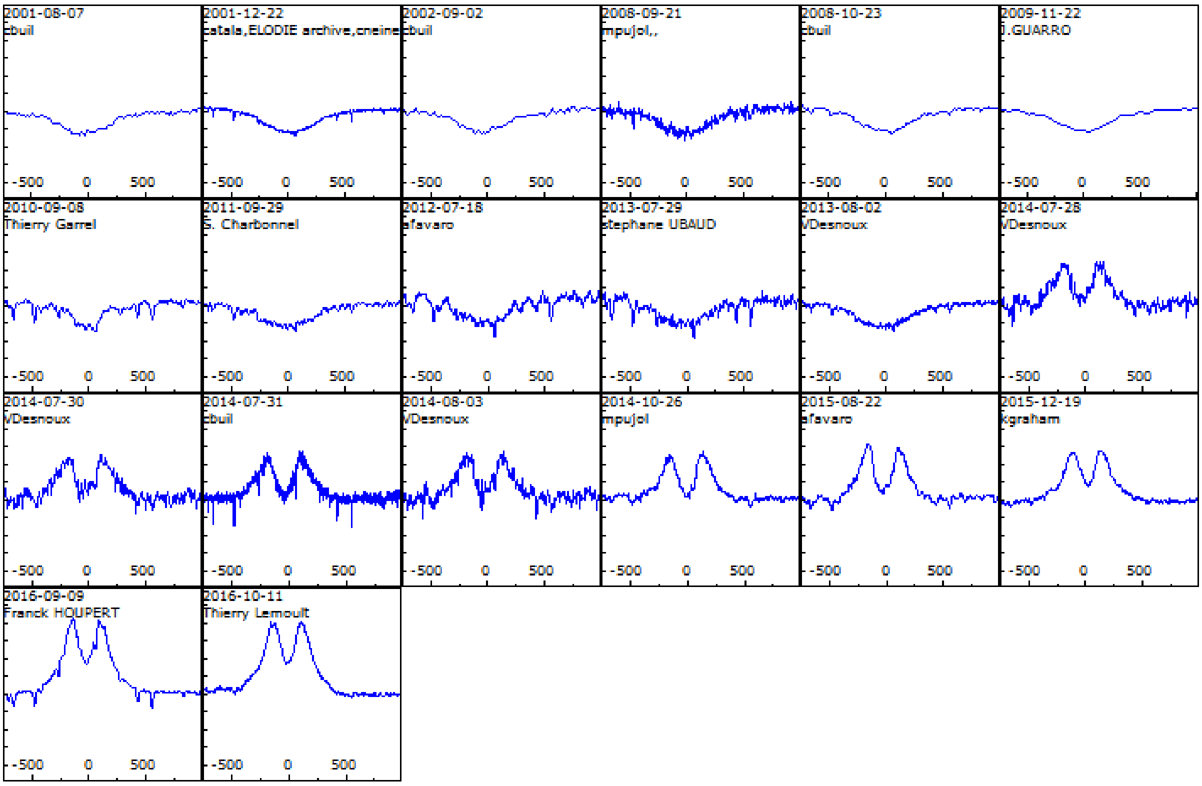
EM Cep



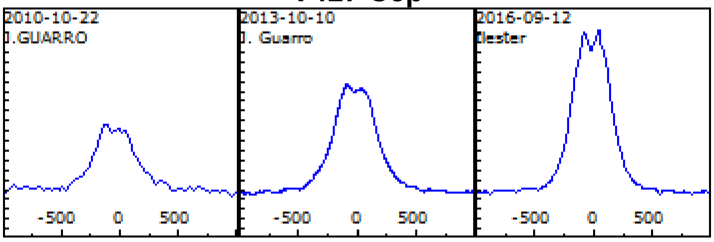
HD 23800



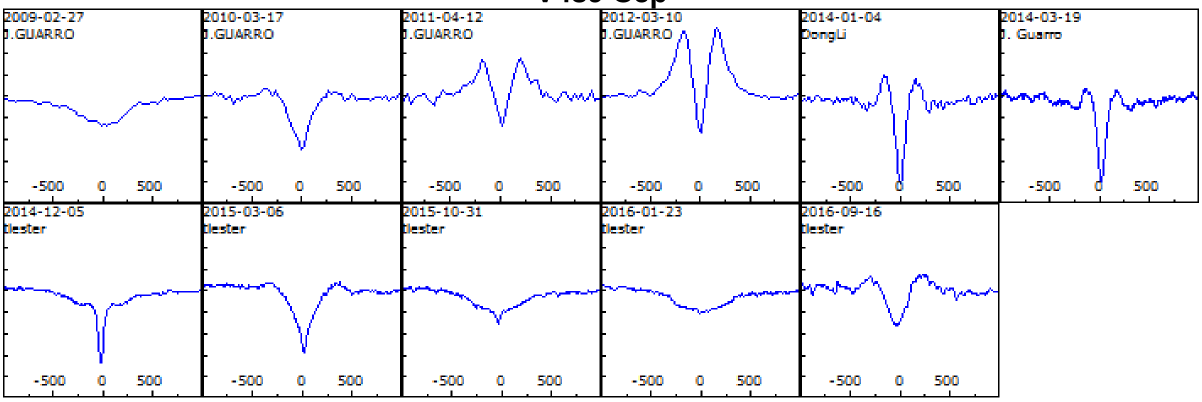
HD 224544



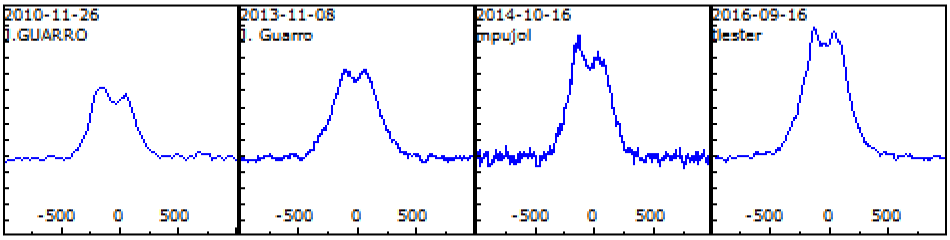
V417 Cep



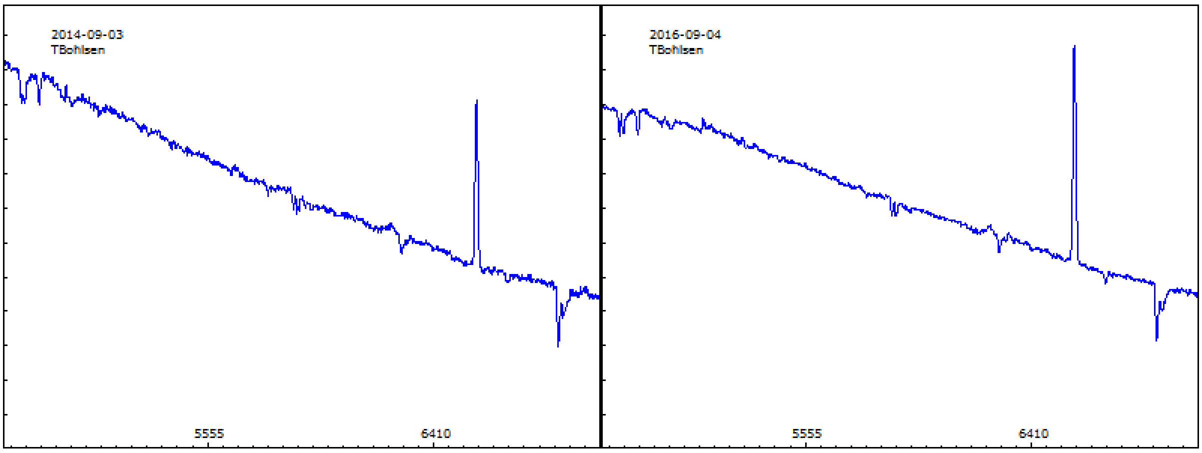
V439 Cep



V817 Cas



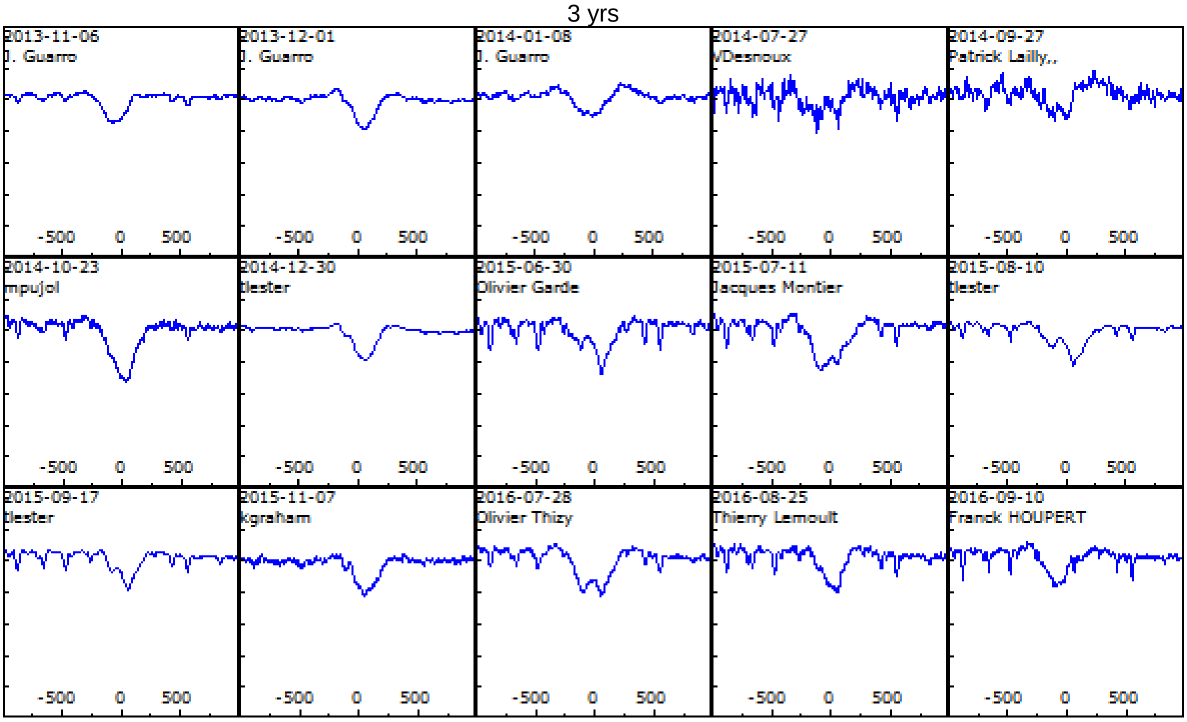
V826 Ara



Moderate evolutions of H-alpha line

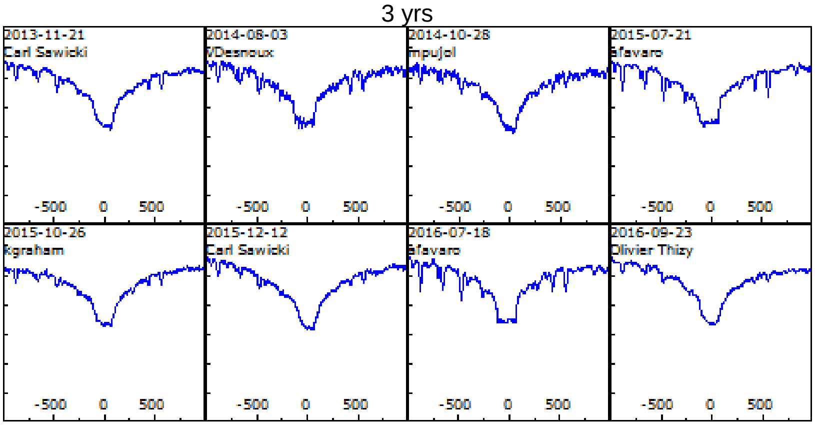
14 Lac

3 yrs



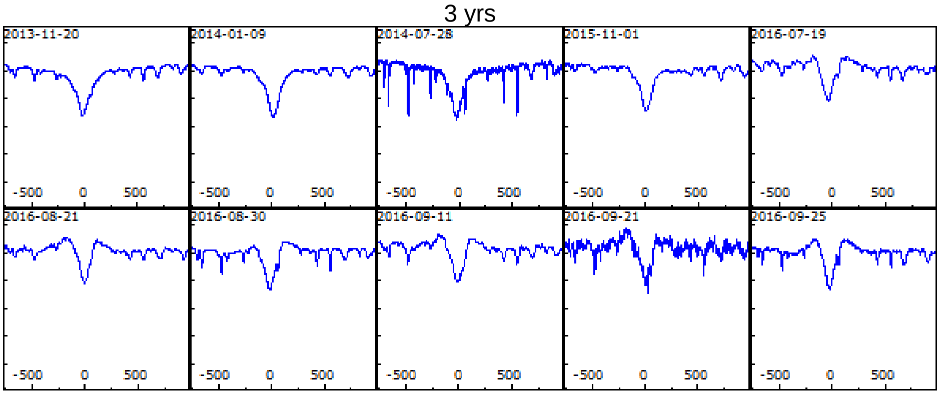
16 Peg

3 yrs

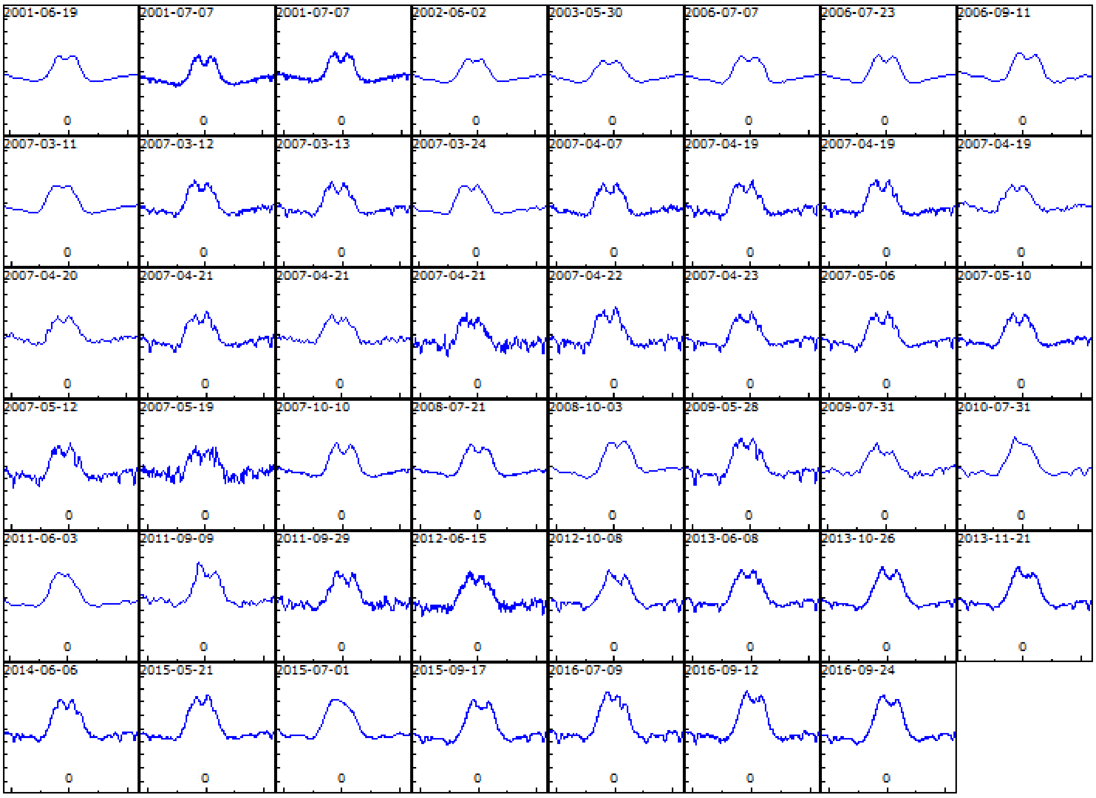


Bet Cep

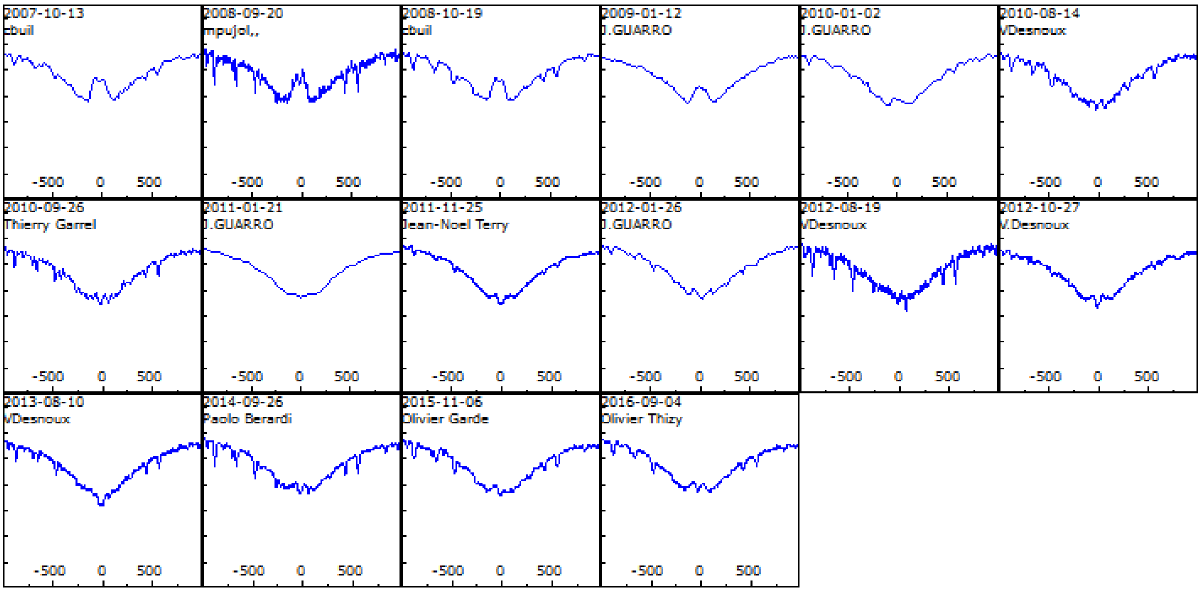
3 yrs



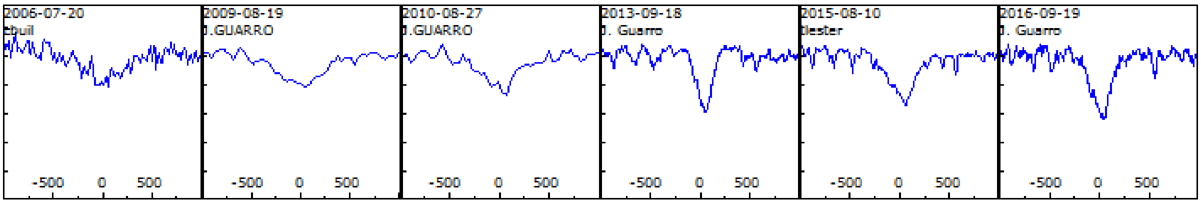
64 Ser



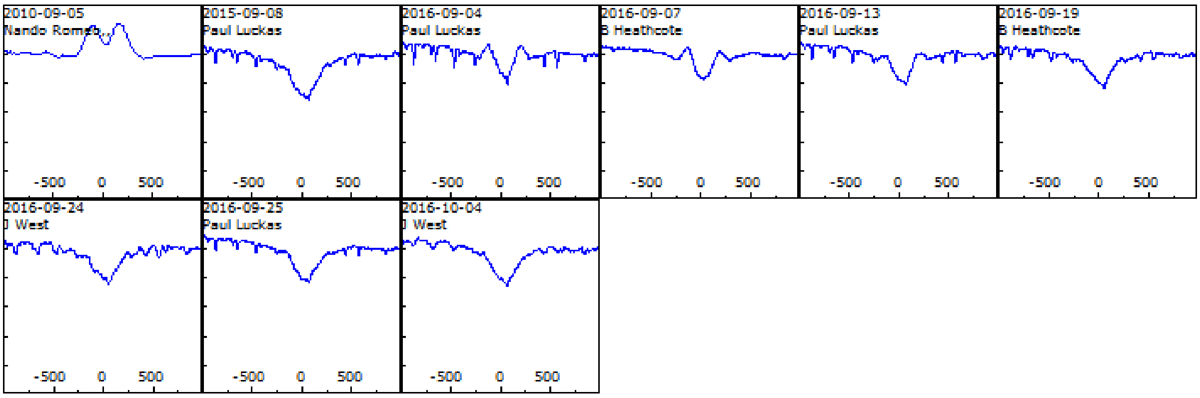
HD 24479



HD 174705

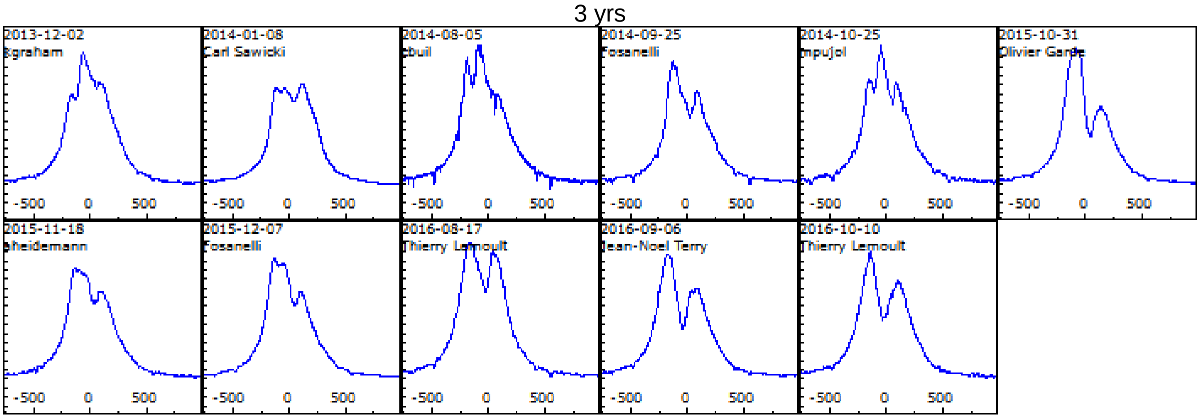


Lam Pav

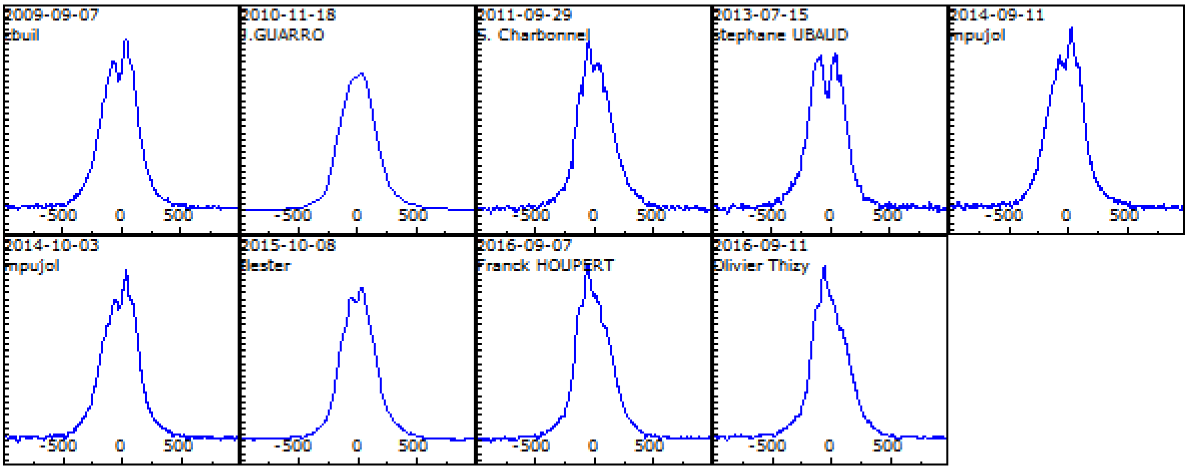


Phi Per

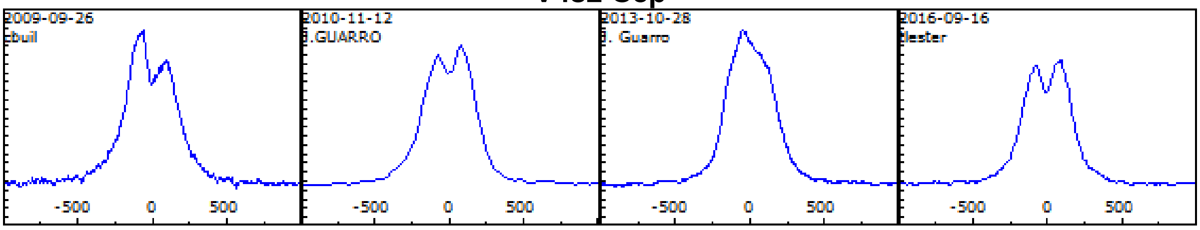
3 yrs



V423 Lac

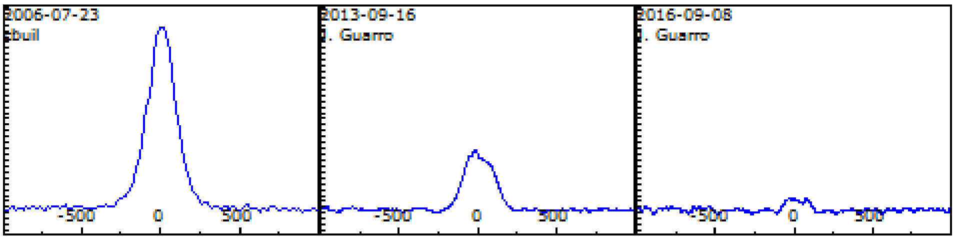


V432 Cep

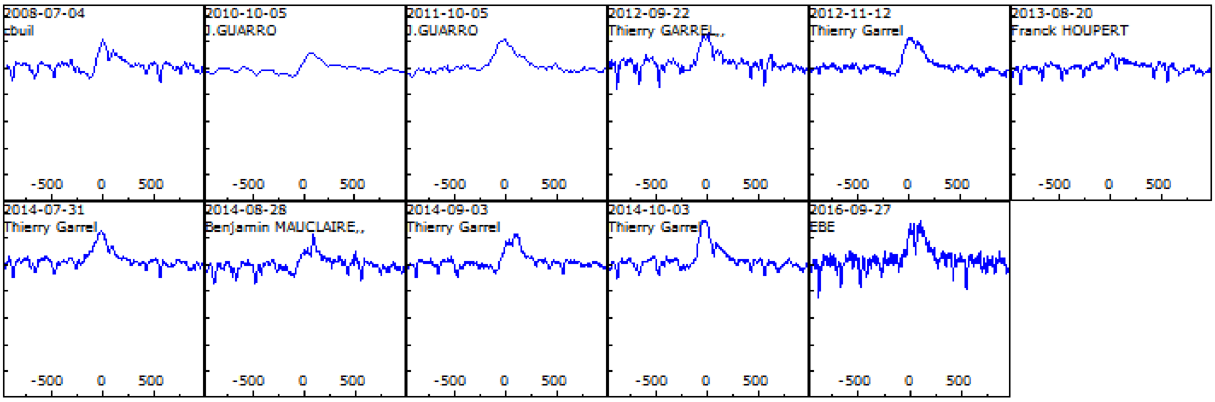


Emission decrease of H-alpha line

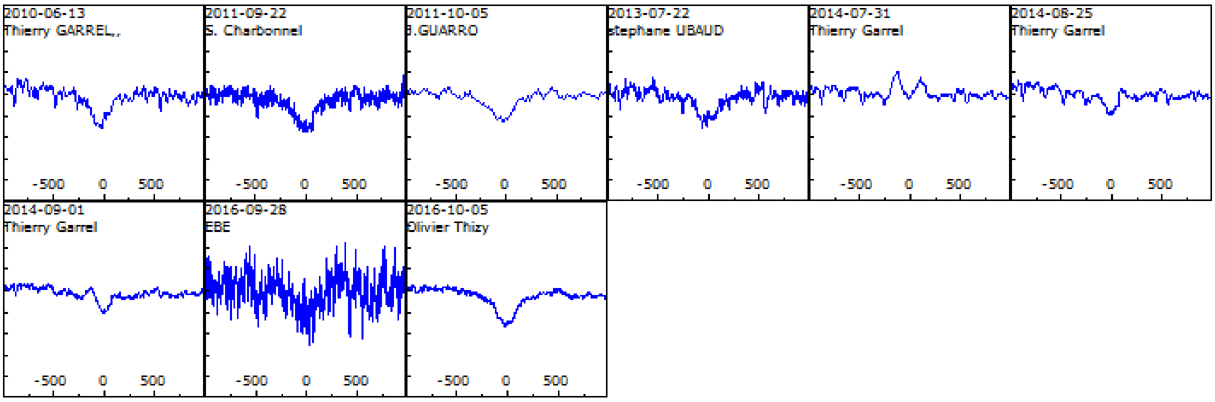
BD-09 4858



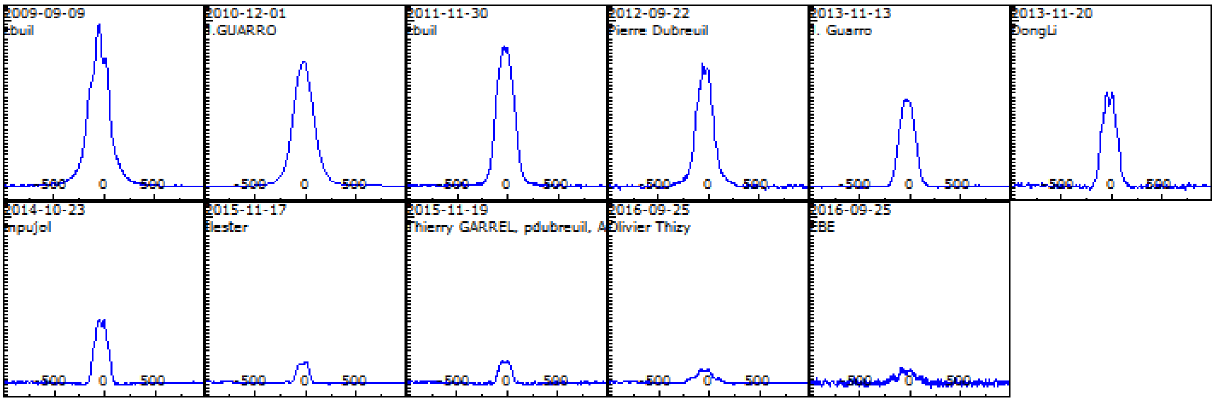
HD 194057



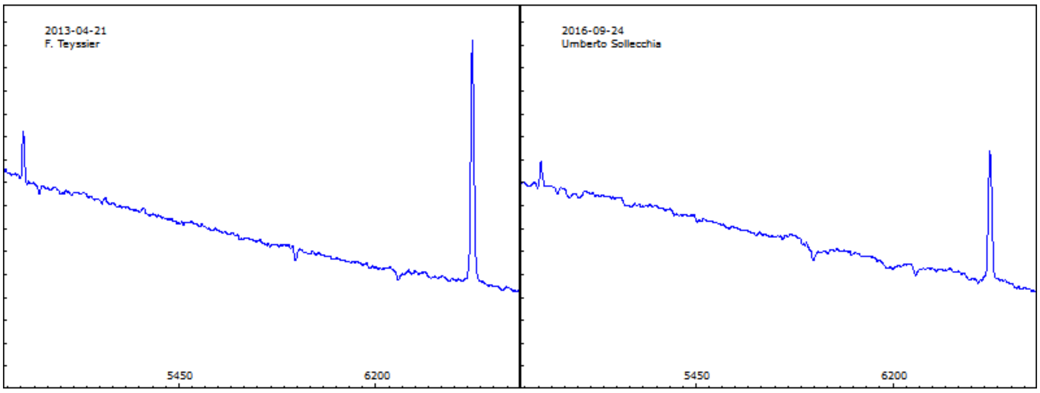
HD 194779



HD 225095

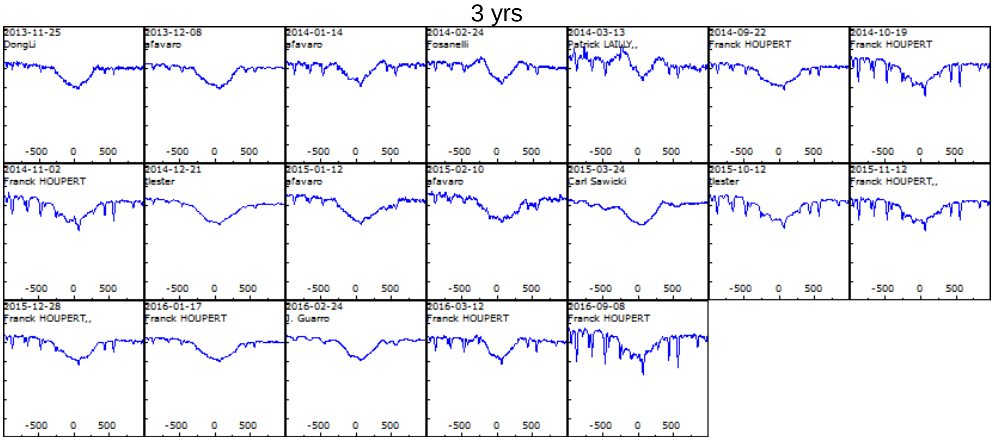


HD 225985

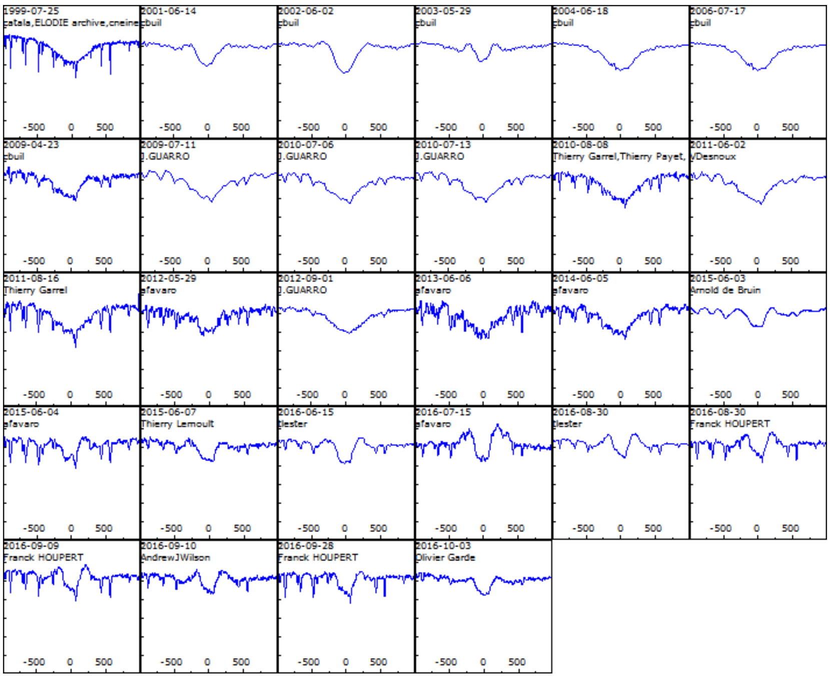


Lam Eri

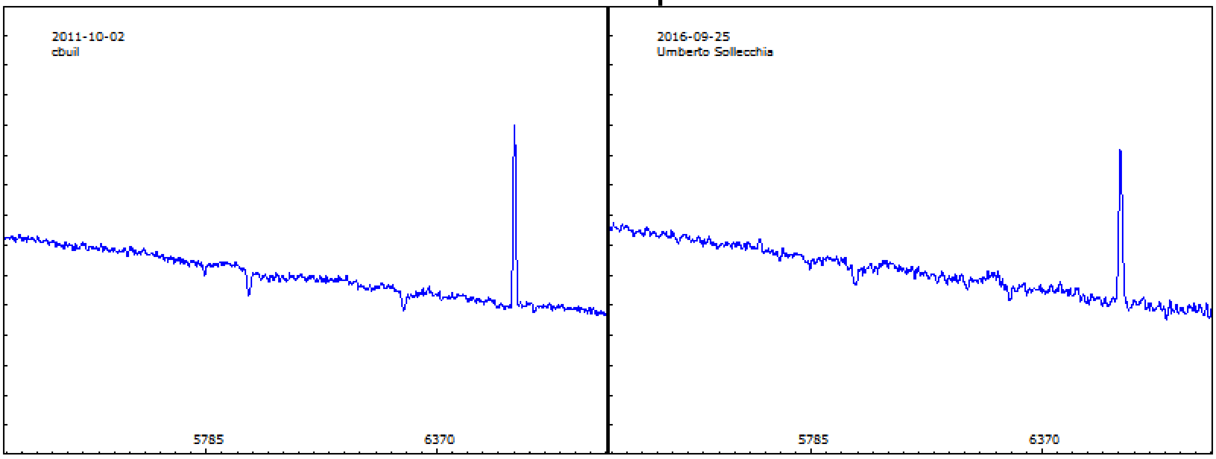
3 yrs



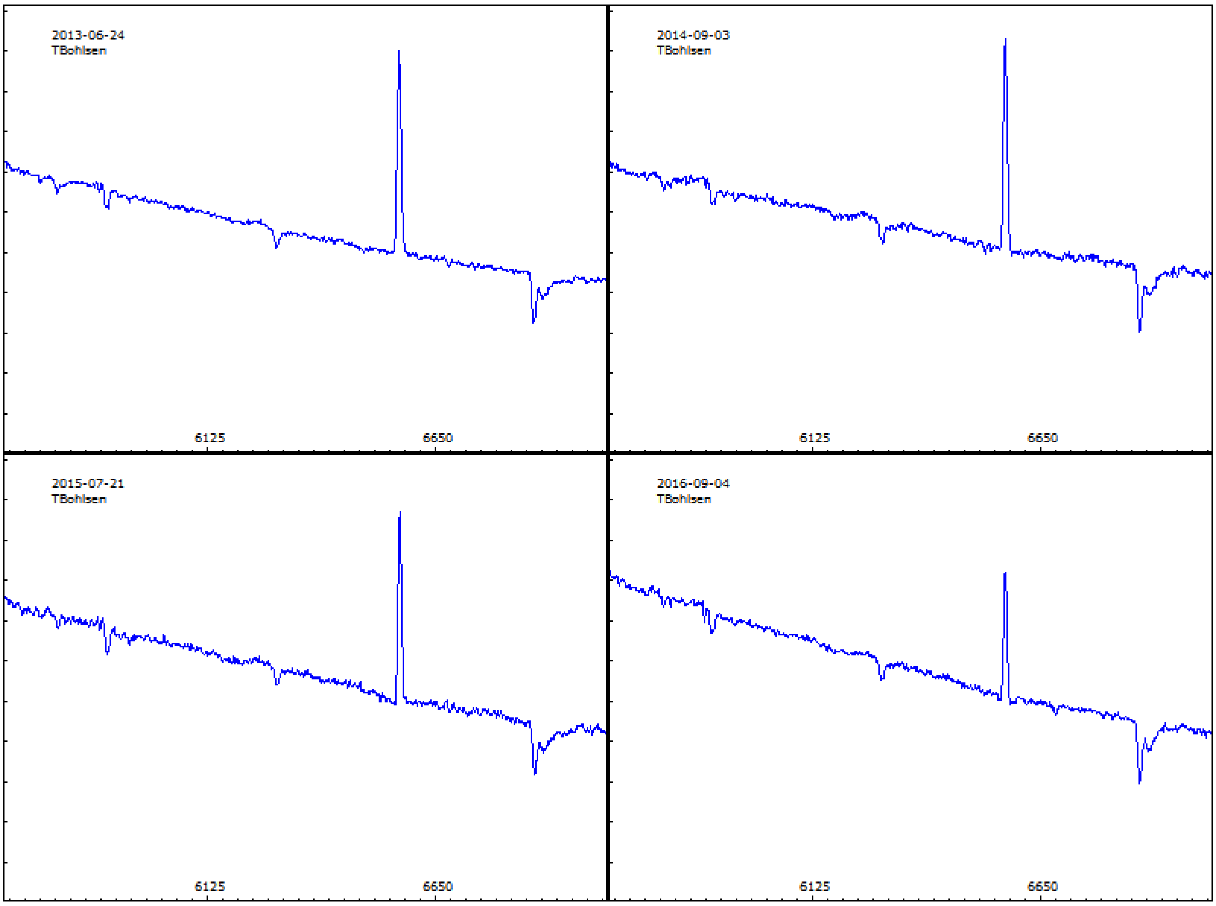
NW Ser



V450 Cep



V848 Ara



Be monitoring projects

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VARIABILITY OF THE HeI 6678 EMISSION IN δ Sco

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Introduction

δ Scorpii (HD143275, HR5953) is a 2.3 magnitudes bright and 1976 by McAllister (1978) interferrometrically discovered Be binary star. But its binary nature was first reported by Innes (1901). The star was first classified as a Be star when it showed an emission profile on the wings of an absorption core of a spectrum taken in 1990 by Cote & van Kerkwijk (1993) and is today considered to be a typical B0.3IV star.

This binary system with its large eccentric orbit (e > 0.9) (Tango et al. 2009) exhibits a strong mass loss that has resulted in a circumstellar gaseous disk formation. HeI lines are good tracers of matter very close to the star, where temperature and density are the highest and ionisation is the strongest. The HeI 6678 line profile of δ Sco suggest that one sees some optically-thick outflow and a lot of matter in the line of sight. The outflow should add more mass to the disk and as a result, the disk will gradually grow outwards. This is very interesting since the inclination angle if the circumstellar disk is about 45 degrees [36°, Miroshnichenko et al. 2013); 38° ± 5 Miroshnichnko et al. (2001); 48.5 ± 6.6 Hartkopf et al. (1996); 70°, Bedding (1993)].

During each periastron (period = 10.8 years) some ring material may flow from the primary´s Roche lobe into the secondary´s Roche lobe. During that process the disk becomes denser and single-, double- or triple peak profiles may be observable. Outside of each periastron the He6678 line is emitted in an extended rotating elliptical disk or ring around the central star, where the ring is not centred on the central star. The situation might be more complex since the companion is triggering the disk/ring formation or destruction through tidal effect on the circumstellar disk/ring. There seems to be two physical effects going on in δ Sco: one is the ejection of material from the photosphere, the other is the formation of "blobs" of gas in the disk or ring(s) probably from viscosity affects. The blobs rotate in a more or less Keplerian mode, eventually to fall back closer to the star (Miroshnichenko, A. S., privat communication 07/2004).

In case of further studies of the physical properties of δ Sco´s disk, I want to refer on the following important publications (it would be too comprehensivly to describe here in detail all the interesting aspects of these investigations):

"Properties of the δ Sco circumstellar disk from continuum modelling", Carciofi et al. (2006); "Disk geometry and kinematics before the 2011 periastron", Maillard et al., (2011); "Imaging disk distortion of Be binary system δ Scorpii near periastron", Che et al. (2012); "The circumstellar disk evolution after the periastron", Maillard et al. (2013).

Observation and results

Following the generally accepted assumption that the disk of this binary system is being fed due to outbursts of matter ejected from the stellar surface (Miroshnichenko et al., 2003), and since the He I 6678 line forms near the photosphere of the primary component one can expect a correlation between the equivalent width of the Hα and and He I 6678 lines (Fig. 1). Such a correlation might be interpreted as a result of a disk feeding process. However we can not exclude, that this reflects only contemporaneous density variations within the line formation zones.

This study of a correlation between Hα- and He I 6678 equivalent width (EW) and the behavior of the He I 6678 line profiles (Fig. 1) have been performed by the author at the observatory of the "Vereinigung der Sternfreunde Köln" (Germany) with a 40 cm Schmidt-Cassegrain-telescope C14, the slit-grating-spectrograph LHIRES III with a spectral resolving power R ~ 17000 and a CCD-camera (768 x 512 pixel, pixel size 9µ. This instrumental configuration provides spectra within the range from 6500 to 6700 Å), in collaboration with observers of the ARAS group (http://www.astrosurf.com/aras) at different locations, different telescopes (aperture 20 to 40 cm) and different spectrographs with spectral resolving power of 10000 to 20000 (signal to noise ratio S/N of these spectra ca. 200-300).

With exposure times of 300 to 350 sec for one individual spectrum, the S/N in a sum spectrum of 10 individual spectra, reached values mostly more than 1000. The spectra have been reduced manually with standard procedures (instr. response, normalisation, wavelength calibration) by using the programs Maxim-DL (http://www.cyanogen.com), VSpec (http://www.astrosurf.com/vdesnoux) & MK32 (http://www.appstate.edu/~grayro/spectrum).

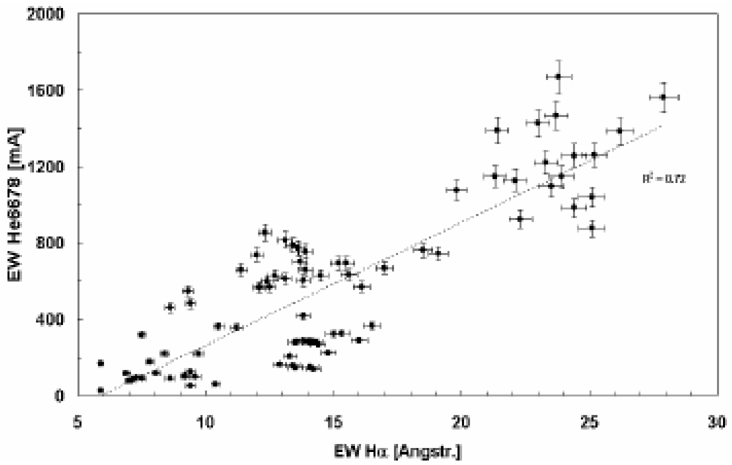

Figure 1: Correlation between the equivalent width of HeI 6678 and Hα from 04/2005 to 04/2016

Since April 2005, during every observing season, the observed correlation impressively supports the existence of this disk-feeding process, in which the slope of the linear fit shown in Fig. 1 reflects the quantitative correlation.

In addition to the variability of the EW (measured and analyzed in the same spectra) the He I 6678 line double-peaked profile exhibits a variable ratio V/R of the relative intensities of the violet component Iv to the red component Ir. For the first time it was possible to analyze eleven complete cycles of the V/R variations from April 2005 to March 2016 (Fig. 2). In the earlier seasons, merely the descent could be measured. On this occasion I would like to emphasize particularly that, amongst others, members of the ARAS group, made a significant contribution to the frequent observations.

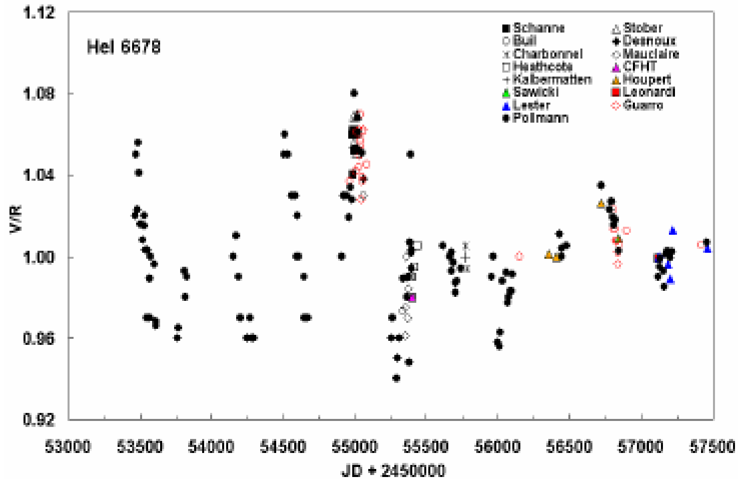

Figure 2: Long-term monitoring of the V/R ratio
from April 2005 to March 2016

The V/R measurements of these eleven cycles presented here permitted an analysis of possible periodicities. For the analysis of the period (Fig. 3) and the phase diagram (Fig. 4) the method of the PDM [phase dispersed minimization of Stellingwerf (1978)] within the program package AVE (www.gea.cesca.es) was used.

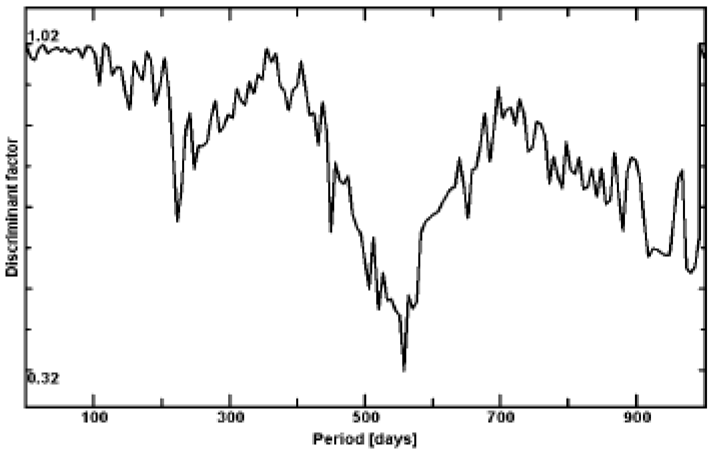

Figure 3: The method of the PDM analysis revealed
a period of 553 d of the V/R data in Fig. 2

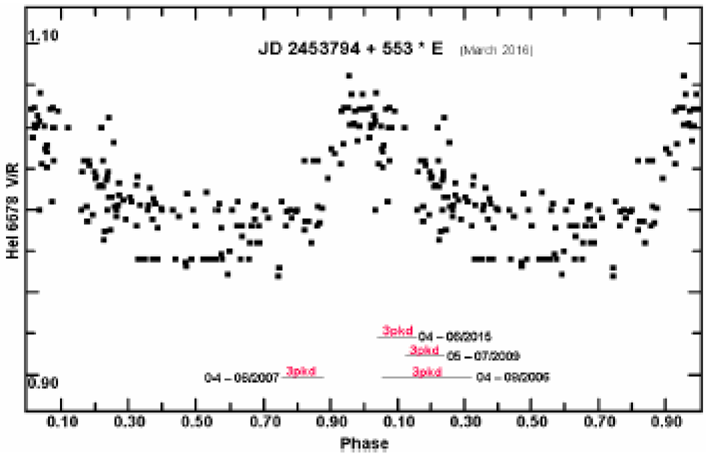

Figure 4: Phase diagram of the found period of 553 d (± 2.3) with T0 = 2453794 (± 7.8) in Fig. 3 and the marked phase sections of the triple-peak (3pkd) appearance

As very clear result the period of 553 d (± 2.3) with the output epoch T0 = JD 2453794 (± 7.8) could be found. The V/R-ratio has been measured of course only in the spectra for which the double peak profiles are apparent. Against the background of that result it is interesting to have a look on the cyclic behaviour of the Hα EW within our long-term monitoring of that star from July 2000 to May 2015 (Fig. 5).

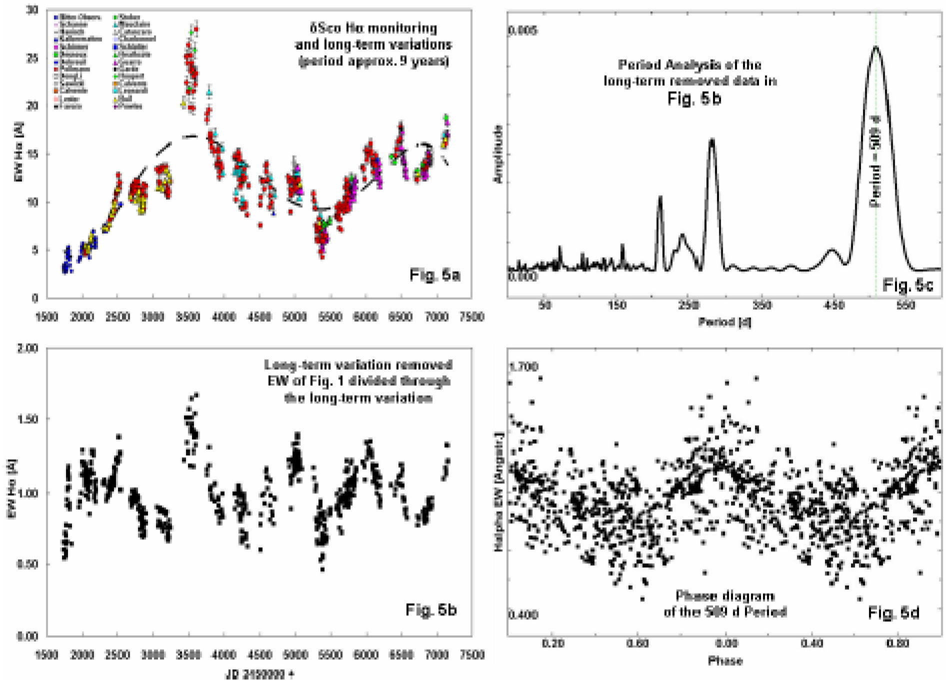

Figure 5: Hα-Monitoring of δ Sco and the long-term period analysis

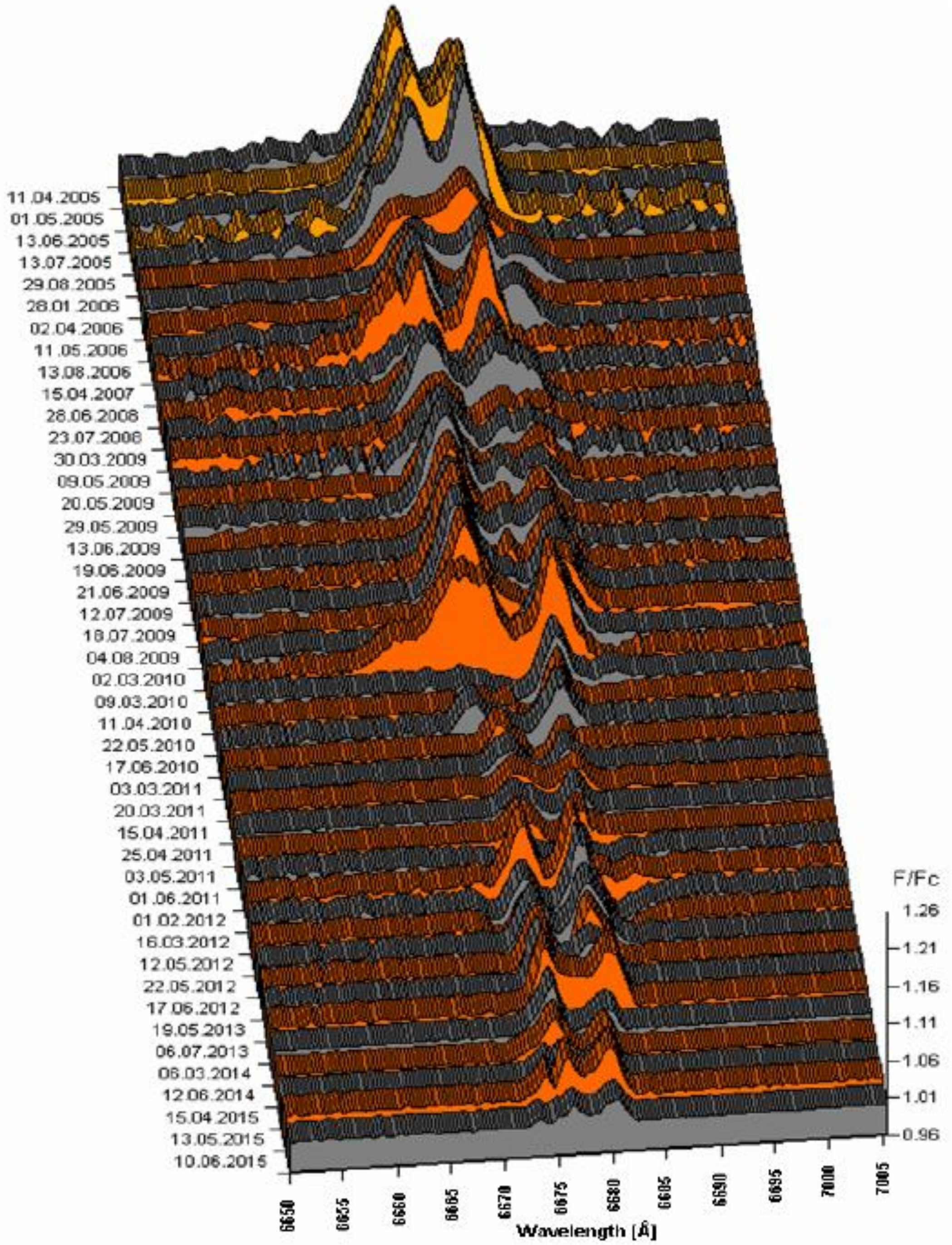

Figure 6: Three-dimensional plot to show the appearance of the third emission component (the triple-peak profile), observed within the phase interval ~ 0.06 to ~ 0.3 (04-08/2006), ~ 0.75 (04/2007), ~ 0.1 to ~ 0.24 (05-07/2009) and ~ 0.03 to ~ 0.13 (04-06/2015).

After subtraction of the long-term wave of approx. 9 years in Fig. 5a, I could derive a period of 509 days (Fig. 5b-5d), which is very close to the period of HeI 6678 in this paper. These close coincidences of the periodic behavior led to the suspicion of identical physical causes. The long-term behavior of the Hα emission of δ Sco might be a further paper here.

An inspection of the spectra shown in the three-dimensonal plot in Fig. 6 shows that the third emission component (the triple-peak profile) was observed within the phase interval ~ 0.06 to ~ 0.3 (04-08/2006), ~ 0.75 (04/2007), ~ 0.1 to ~ 0.24 (05-07/2009) and ~ 0.03 to ~ 0.13 (04-06/2015). These phases are marked (in red as 3pkd) in Fig. 4. The last triple peak phase from April to June 2016 (approx. JD 2457114 to 2457175) has been observed very weakly as a consequence of the very small emission intensity.

The plot of the emission intensity long-term monitoring in Fig. 7 as equivalent width EW of HeI 6678 versus time, confirms with the EW minimum at that time this fact. One can say that there is no certain phase preference for the appearance of this bizarre and mystery line profile characteristic, in the HeI 6678 emission of the spectra of δ Sco. This might be due to the presence of a density enhancement some times in front of the star and some times hidden behind it at other phases.

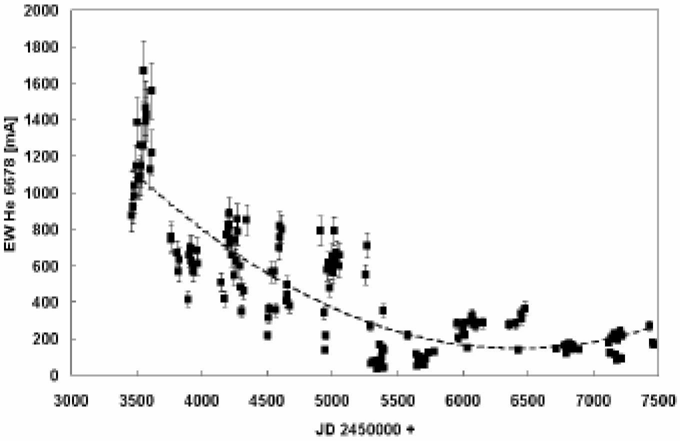

Figure 7: EW long-term monitoring of the HeI 6678 emission line since April 2005 to March 2016

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BeSS database at http://basebe.obspm.fr/basebe/
ArasBeAM portal at http://arasbeam.free.fr/

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