BeSS report – Fev 2018

Data compiled by Valérie Desnoux – H-alpha monitoring
***Be projects section by Ernst Pollmann** here*

- 57 stars were observed
- 15 Observers contributed this month
- 129 Spectra

Observers…

Observateur	Nb spec
bertrand	34
HOUPERT	23
GARDE	16
Guarro Fló	12
de Bruin	11
Sawicki	9
Bohlsen	5
Daglen	3
Stiewing	3
Graham	3
Pollmann	3
Leonardi	3
KREIDER	2
Martineau	1
James	1

Events of the month…

EE: Emission Event, ME: Moderate Events, DE: Decreasing Event

EE	ME	DE
CX Dra	zet Tau	OT Gem
EW Lac	PLEIONE	ome Ori
phi Per	nu Gem	QR Vul
lam Eri	FY CMa	V594 Cas
bet Mon A	I Hya	ACHERNAR
HD 29866	HD 24479	HD 37149
HD 38856	eta Ori	
FW CMa		
HD 57682		

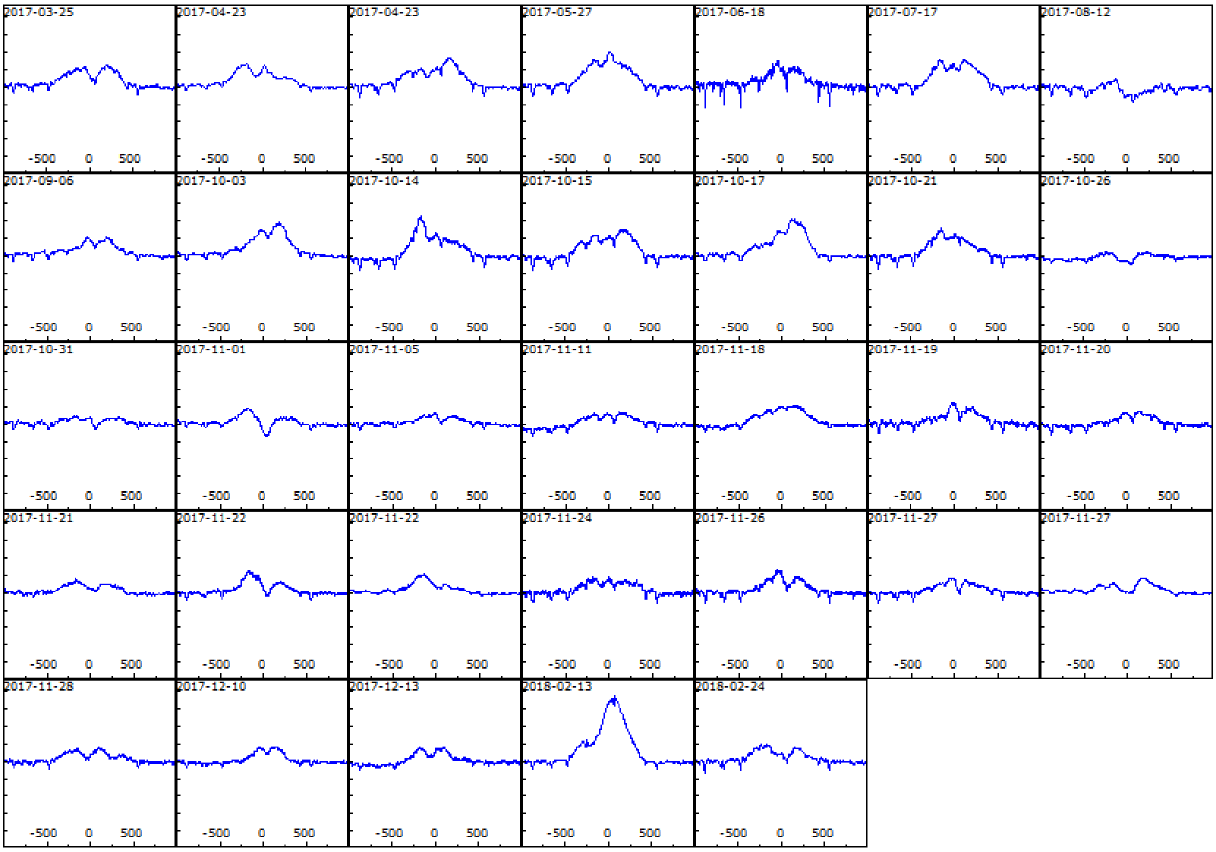
EE	ME	DE
B2.5Ve	B2IVe	B2Ve
B3IVpe	B8IVev	B2IIIe
B2Vpe	B6IIIe	B3Ve
B2IVne	B1IIe	B8I[e]
B3Ve	B5Ve	B6Vpe
B8IVne	B9.5Ve	B8Ve
B5Ve	B0.5Ve	
B2Vne		
O9Ve		

Objects observed

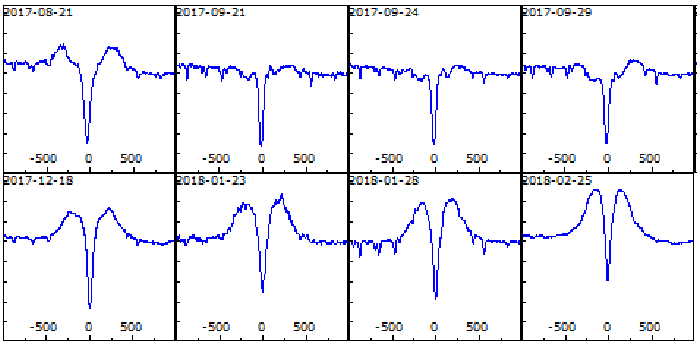
Classique							Classic or Herbig	B[e]
gam Cas	nu Gem	phi And	ELECTRA	V1369 Ori	HD 37149	FS CMa	V742 Mon	V594 Cas
zet Tau	V1165 Tau	28 Cyg	omi Cas	HD 62367	HD 26398	FW CMa		
PLEIONE	FY CMa	iot Lyr	25 Ori	bet Mon A	HD 245310	HD 57682		
OT Gem	I Hya	EW Lac	HD 24479	HD 71072	69 Ori	HD 47160		
5 Cnc	del Sco	psi Per	lam Eri	Menkhib	V378 Pup	V746 Mon		
tet CrB	QR Vul	eps Cas	ALCYONE	HD 29866	HD 47054	V803 Cas		
bet CMi	CX Dra	phi Per	MEROPE	HD 21362	HD 38856	BD+62 287		
ome Ori	15 Mon	BK Cam	eta Ori	ACHERNAR	QY Gem			

Emission increase since last observations

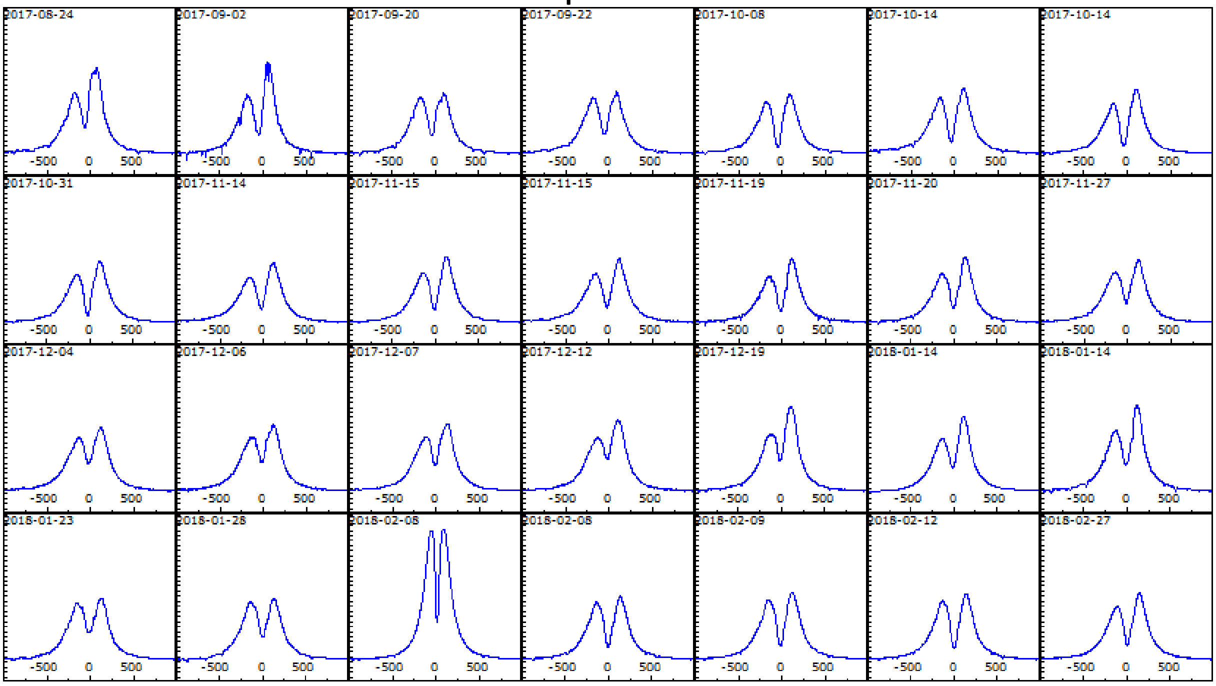
CX Dra



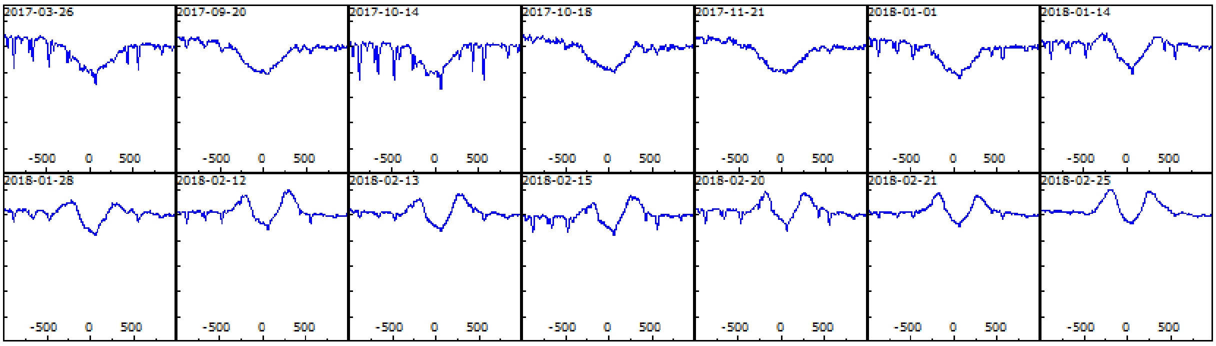
EW Lac

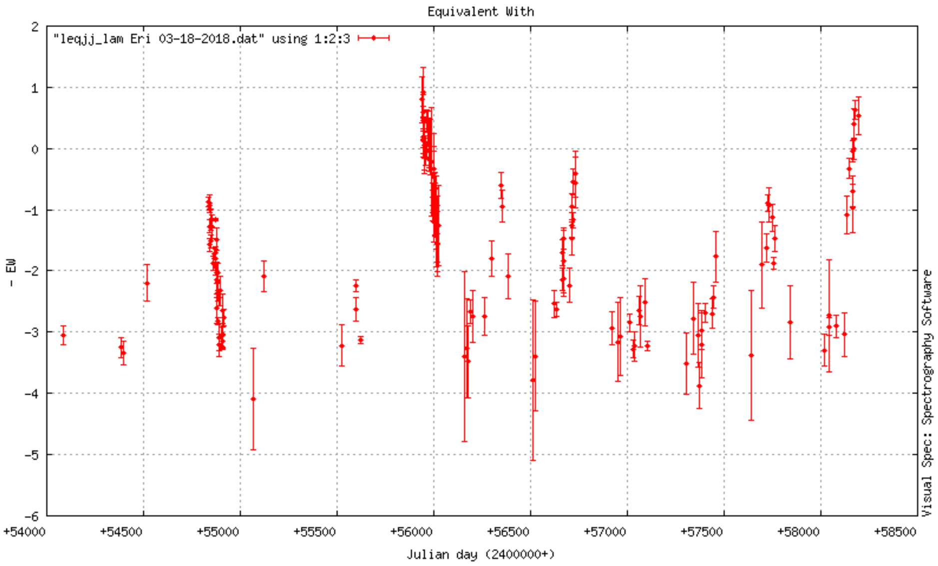


phi Per



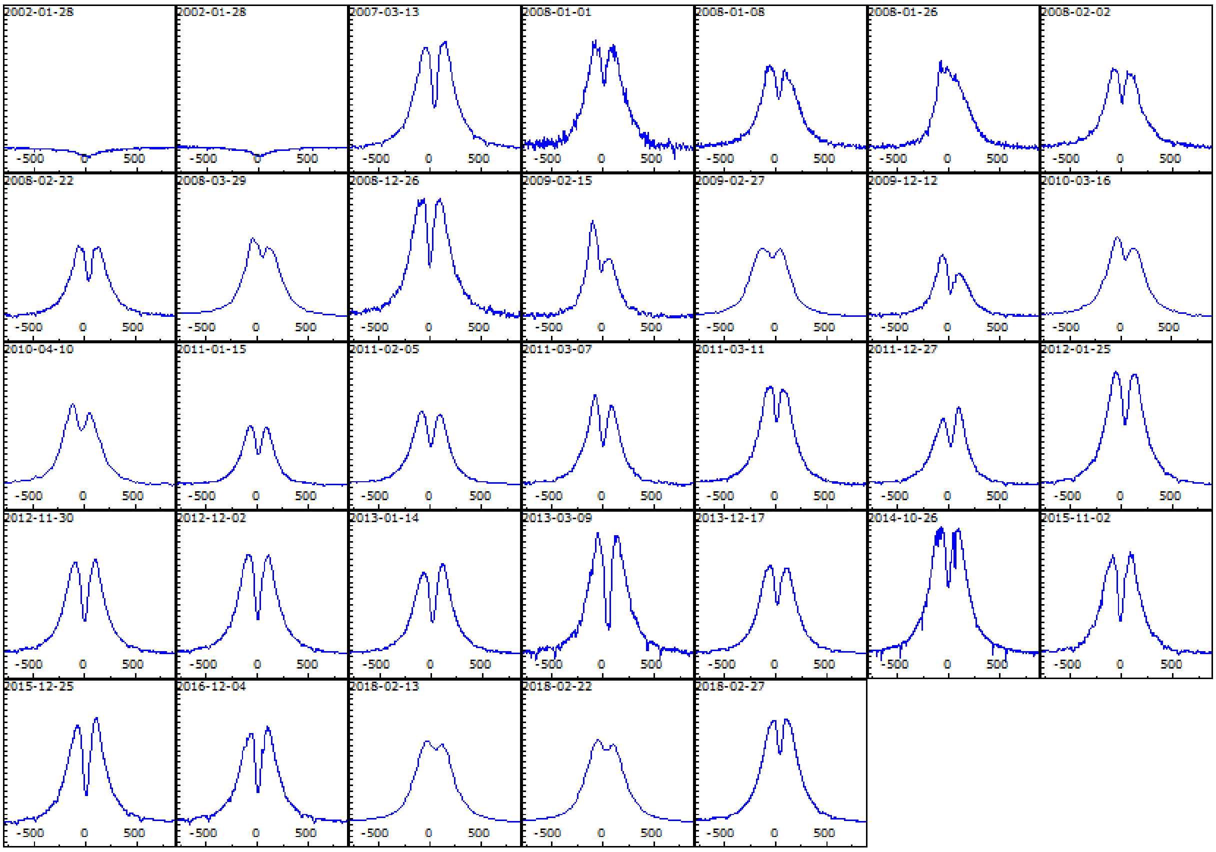
lam Eri



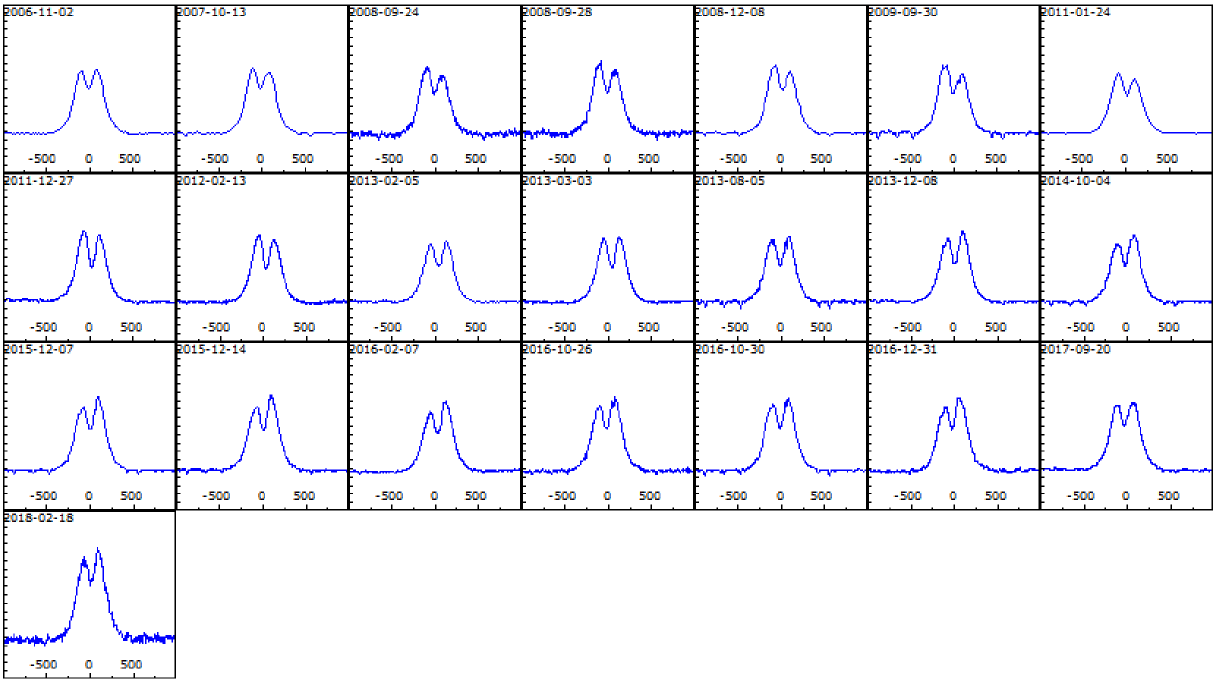


Equivalent width curve for 2006 to feb 2018 - BeSS observations R>5000

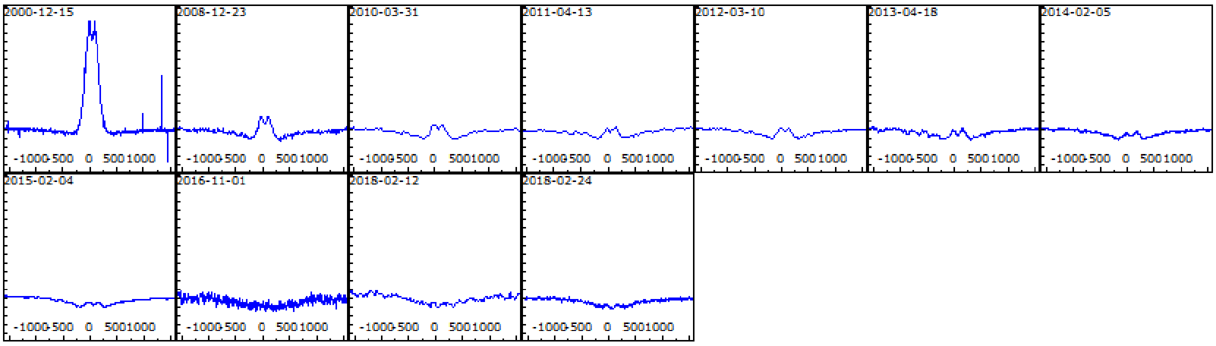
bet Mon A



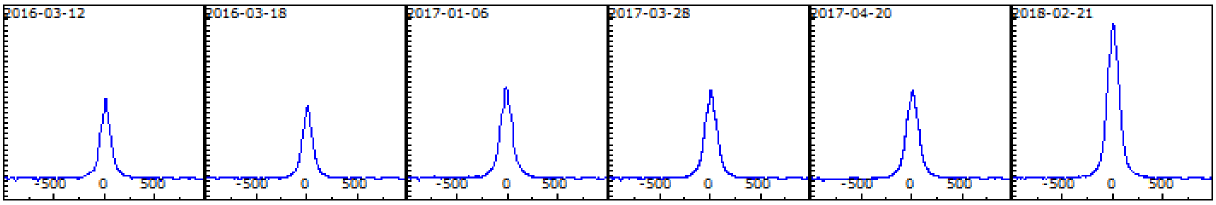
HD 29866



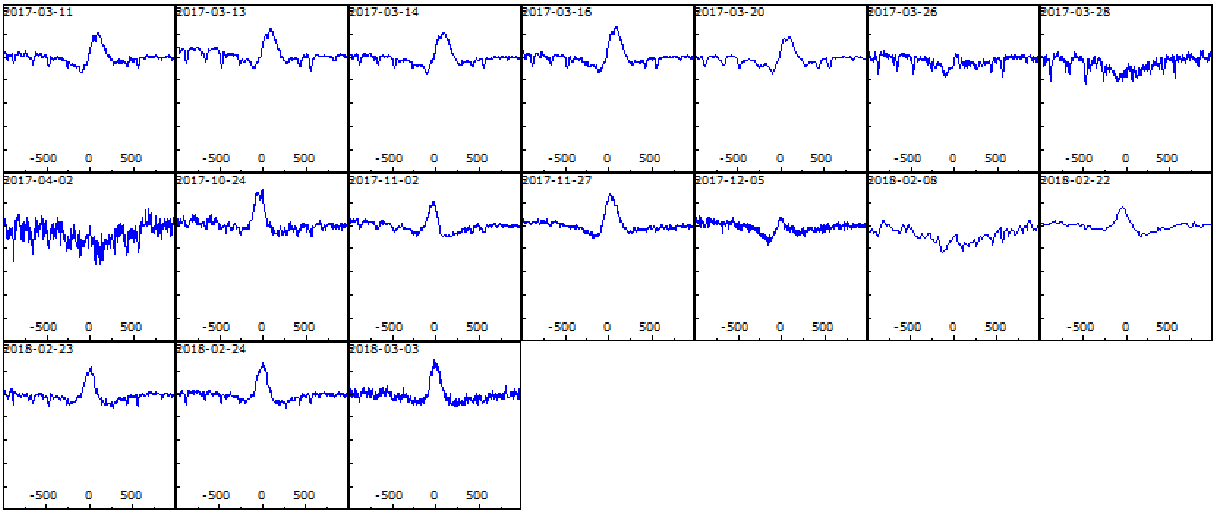
HD 38856



FW CMa

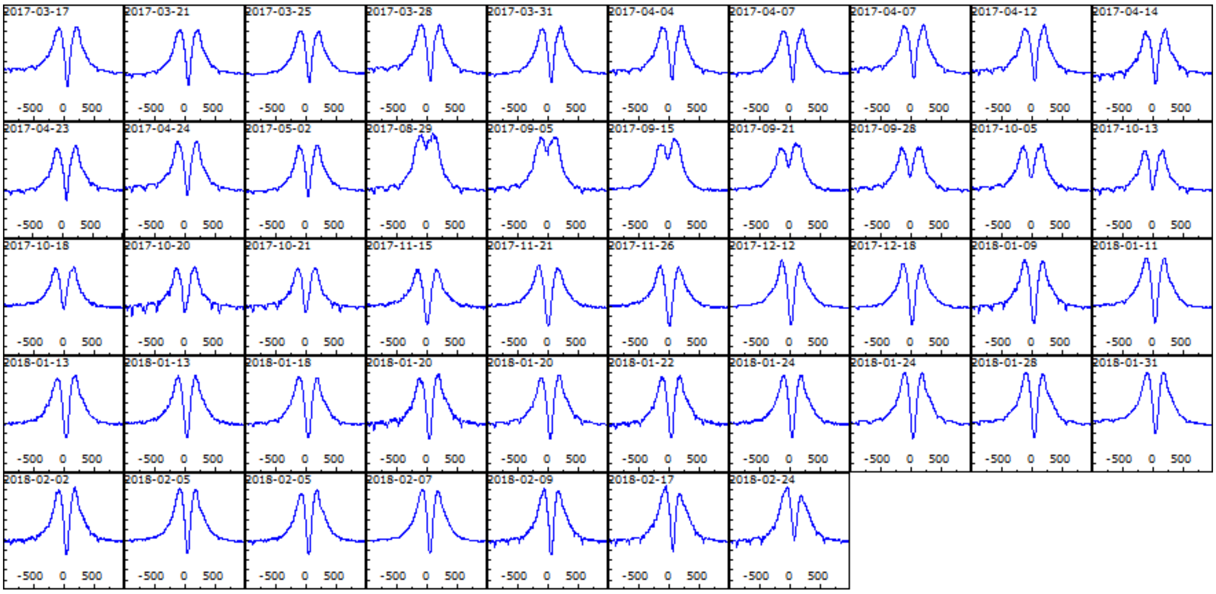


HD 57682

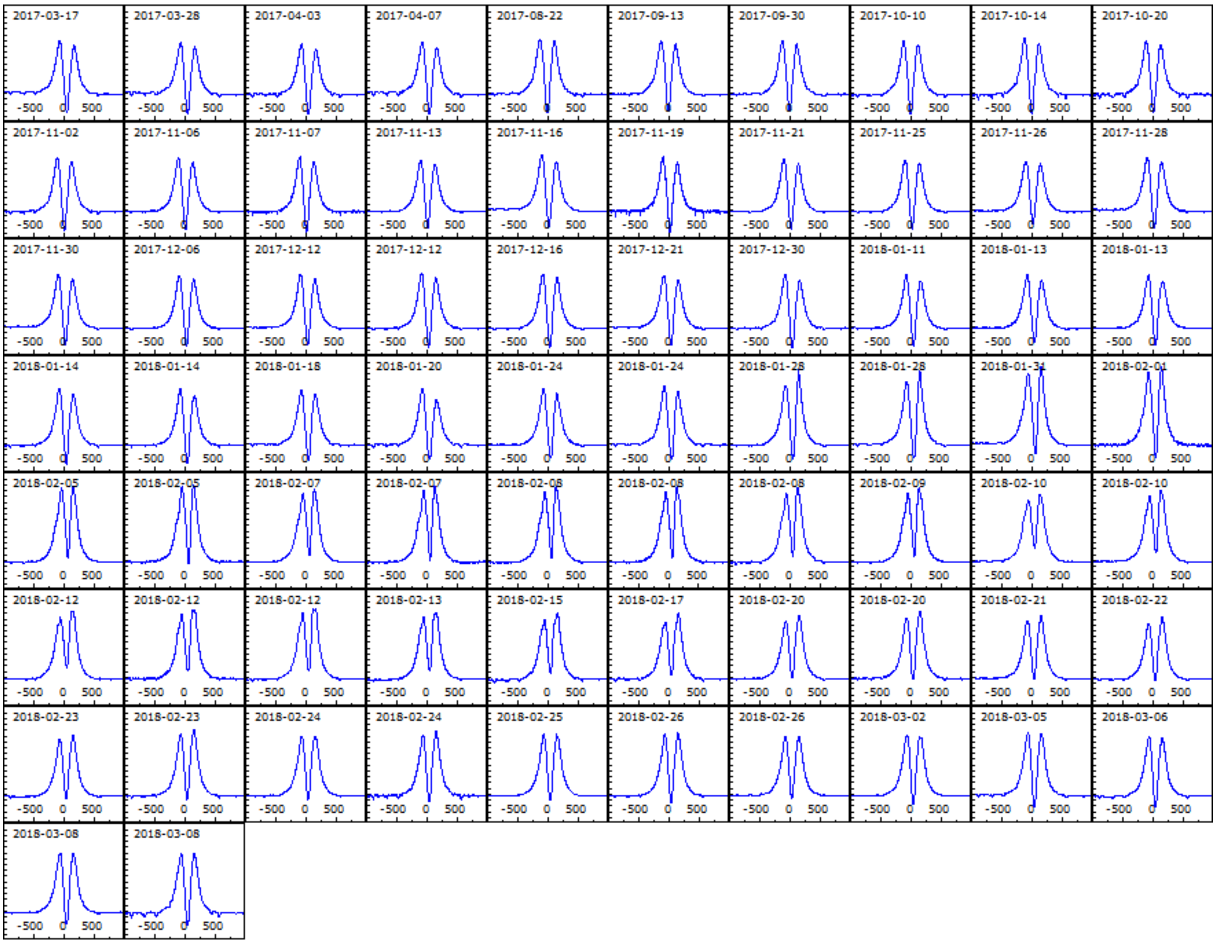


Moderate evolutions of H-alpha line

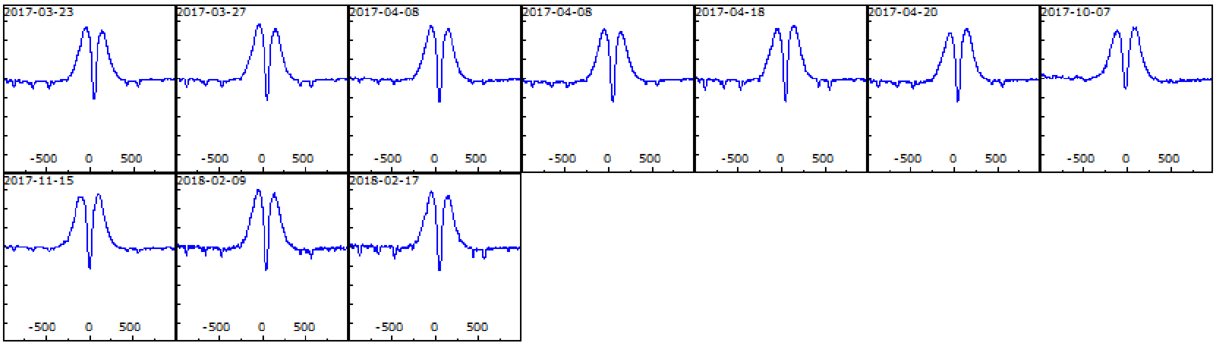
zet Tau



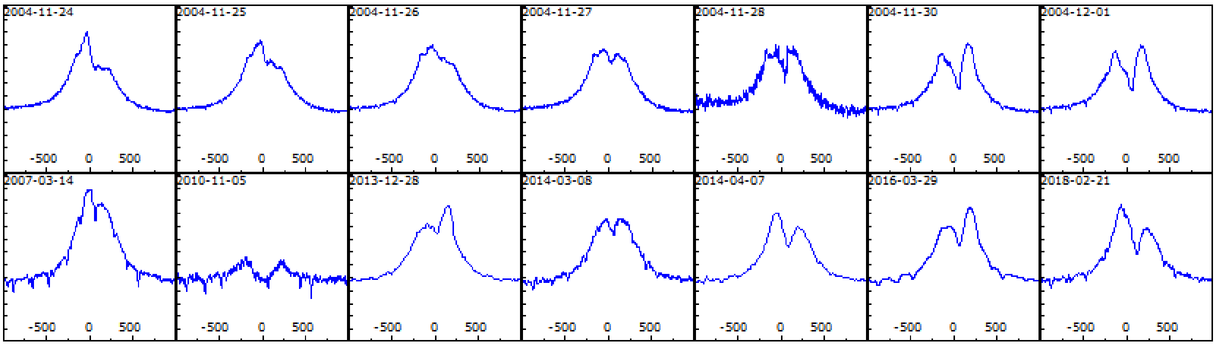
PLEIONE



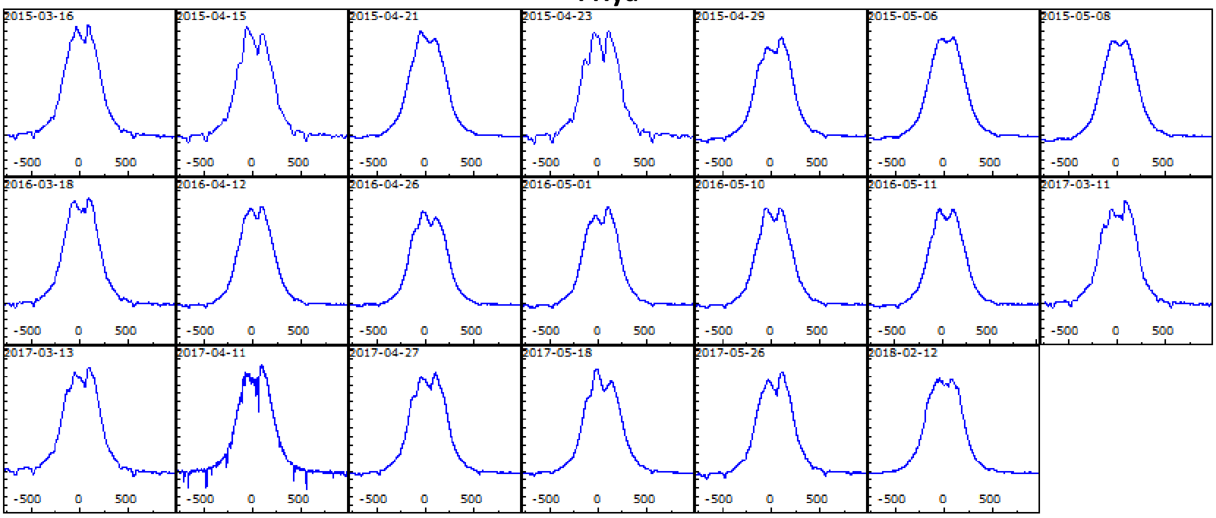
nu Gem



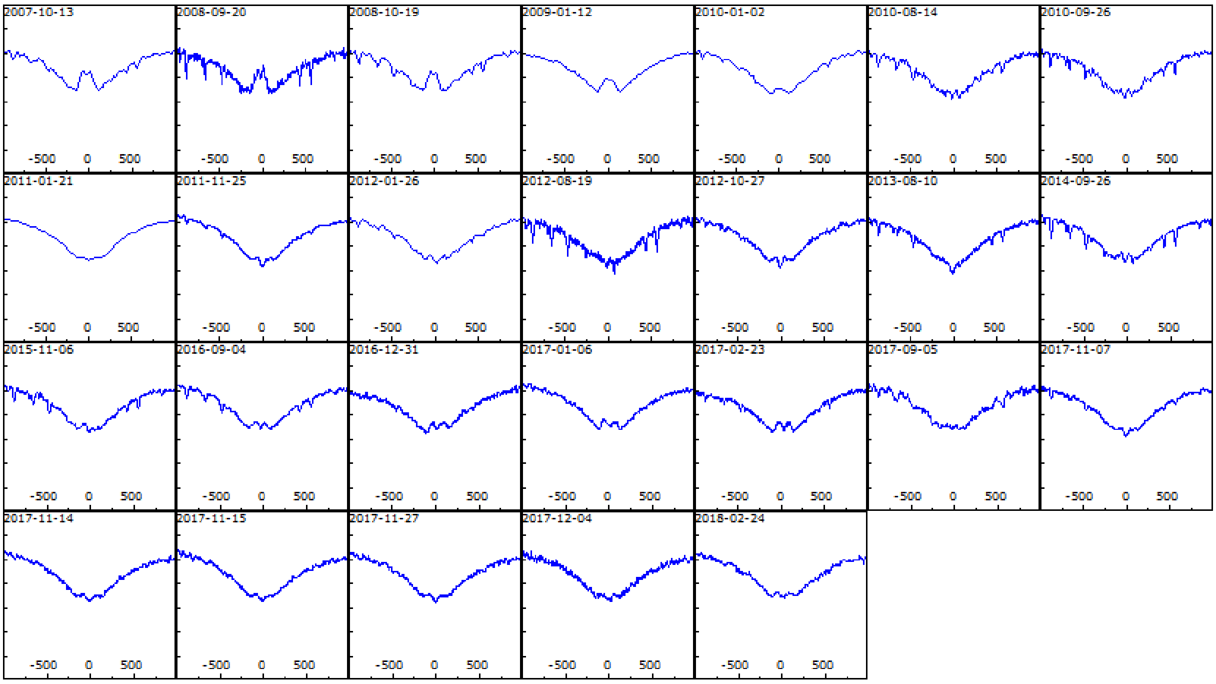
FY CMa



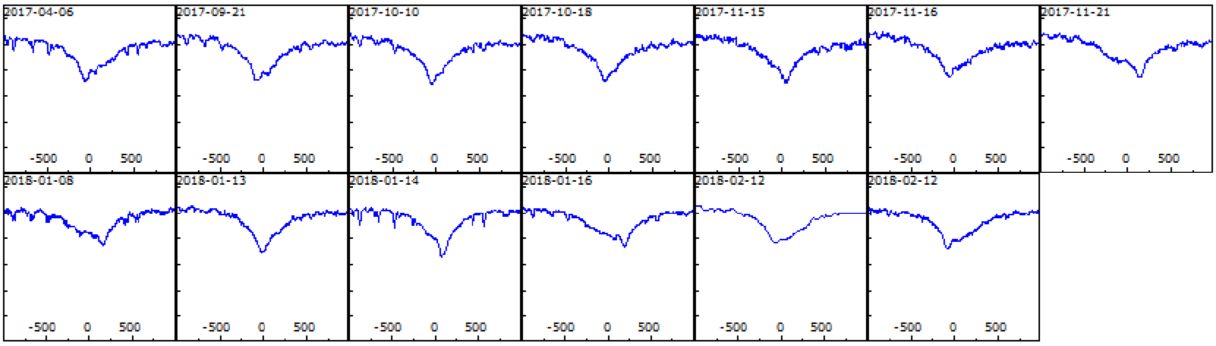
I Hya



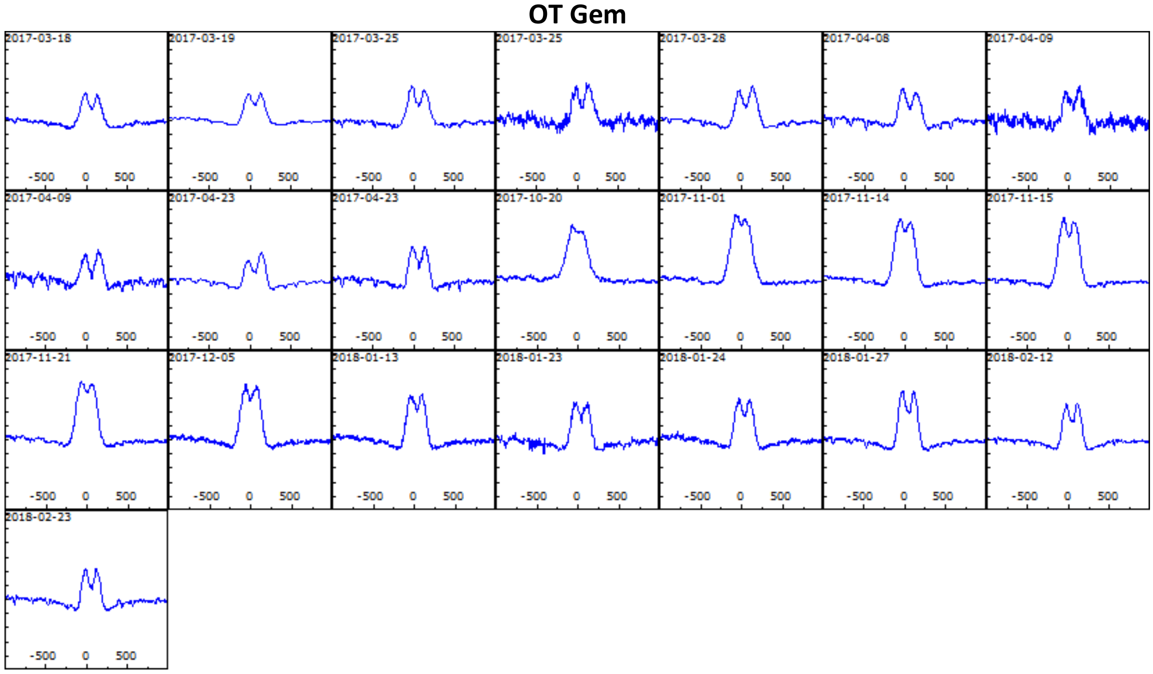
HD 24479

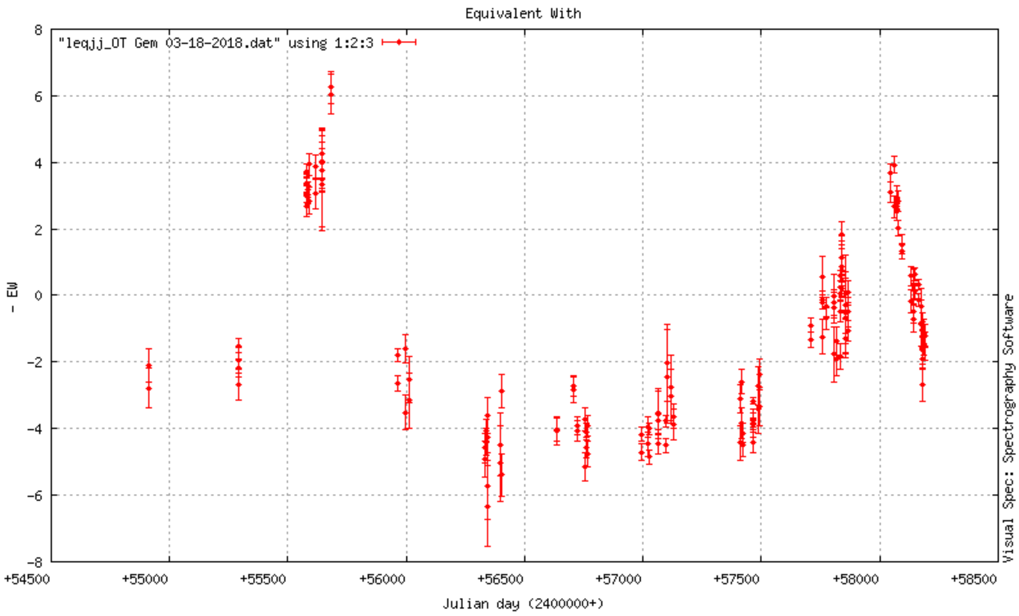


eta Ori



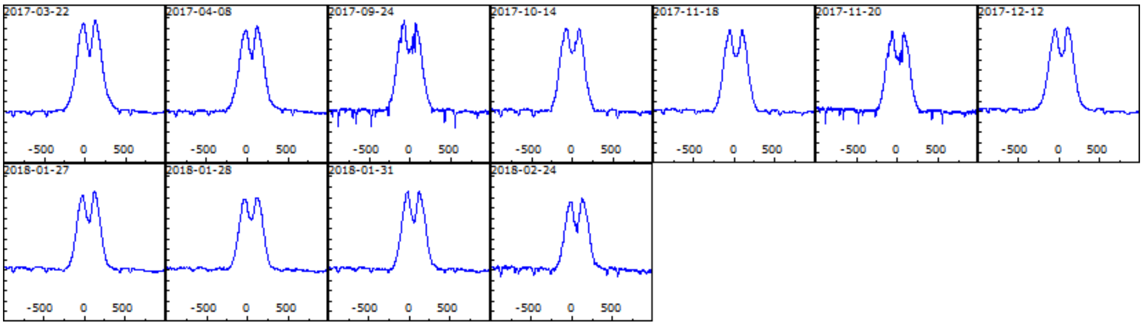
Emission decrease of H-alpha line



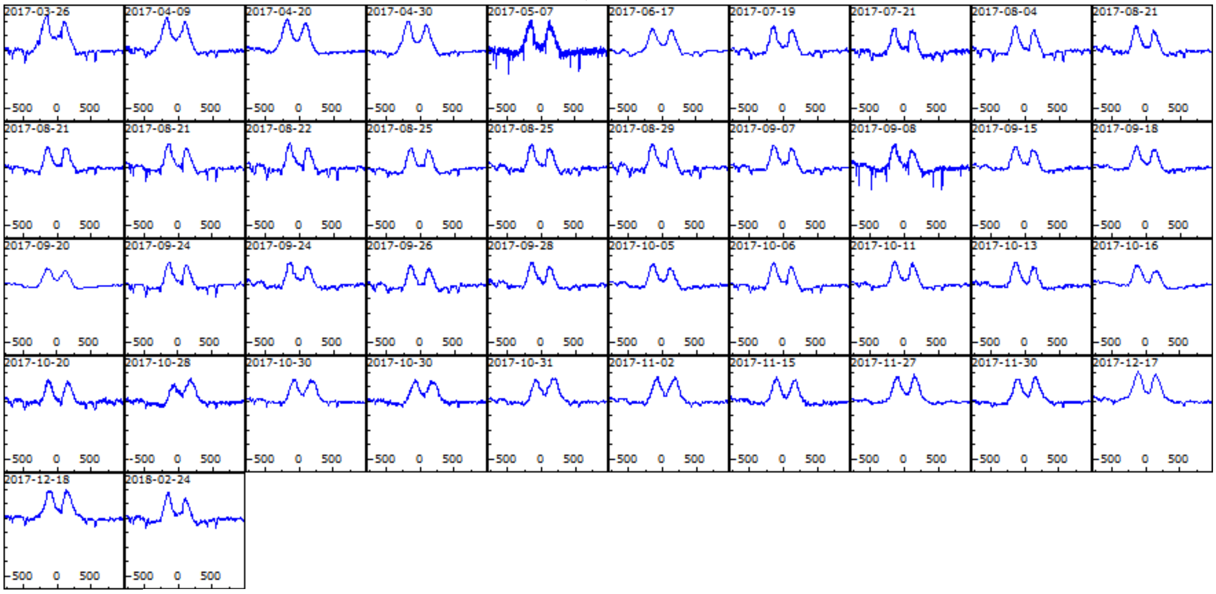


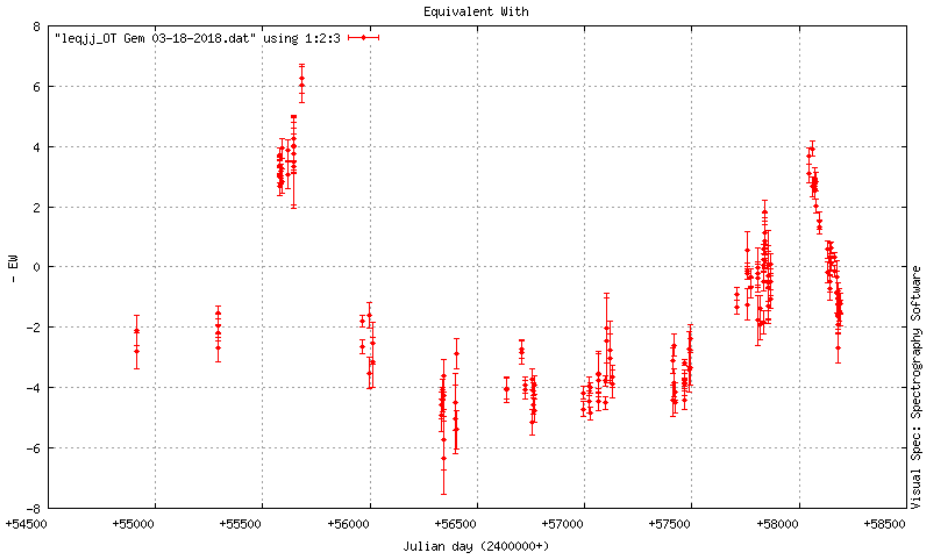
Equivalent width curve for 2009 to feb 2018 - BeSS observations R>5000

ome Ori



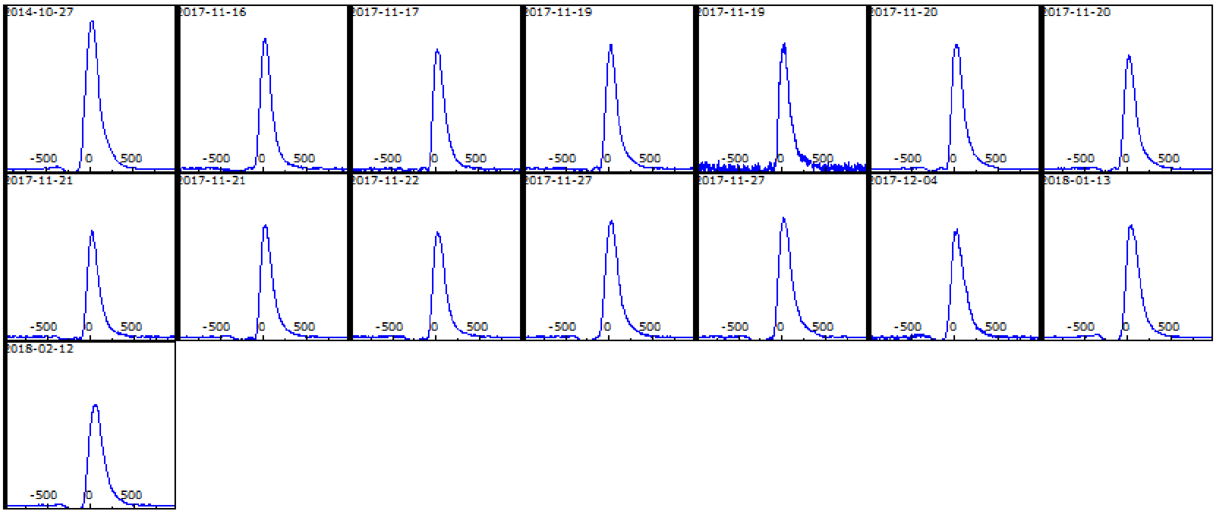
QR Vul



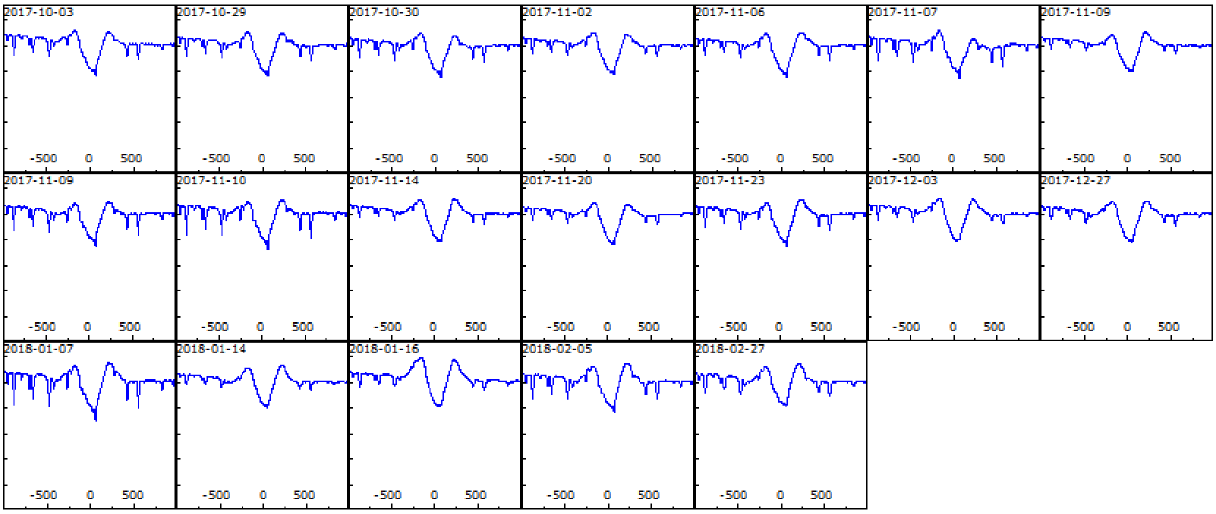


Equivalent width curve for 2016 to feb 2018 - BeSS observations R>5000

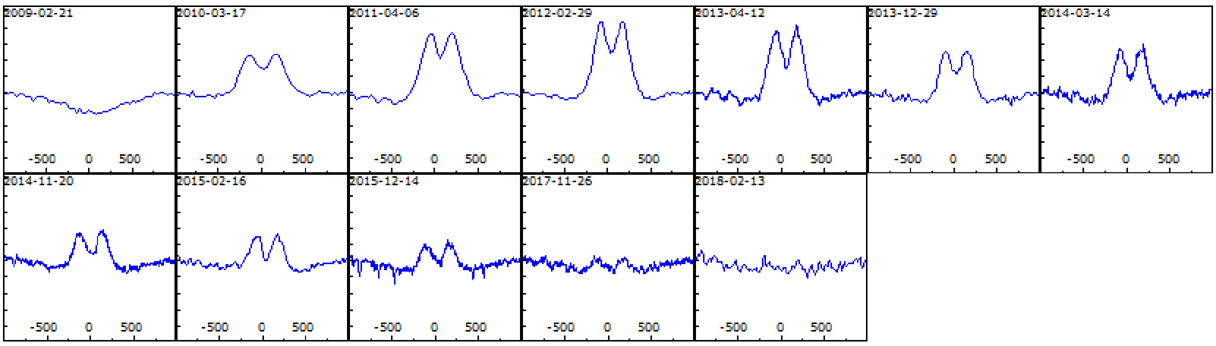
V594 Cas



ACHERNAR



HD 37149



Be monitoring projects

By Ernst Pollmann

Precession of the Disk in Pleione

Study of the Hα Line Profile

(prior printed publication; will published in IBVS Journal Vol. 62, No. 6239)

Abstract

Medium-resolution spectroscopy of the binary system Pleione (28 Tau), obtained over the time period October 2004 (JD 2453300) to March 2018 (JD 2458185) by the ARAS Spectroscopy Group, has been used to determine the central absorption depth (CA), V/R ratio, radial velocity and equivalent width of the Hα emission, in order to study the disk precession as a consequence of the periastron passages of the companion. We found an exact coincidence of the CA maxima with the minima of V/R and RV as a result of the disk precession. This has never before been observed during the maximum shell phase in the years around 1980, or during the initial shell phase around August/October 1974.

Introduction

Pleione (28 Tau, HD 23862) is a B8Vpe star (Hoffleit & Jaschek 1982) and a member of the Pleiades cluster. Hα emission was first detected in 28 Tau by E. C. Pickering in 1890. It is known to exhibit prominent long-term spectroscopic variations and cyclic changes in its spectrum from a Be phase to a Be-shell phase since the 19th century. Since 1938, an alternation of Be-shell and Be phases has been reported with a 35-36 years cycle. A comprehensive summary of observations of this star is given at Hirata (1995) and Hirata et al. (2000). The variation of the spectrum of 28 Tau from 1938 to 1975, have been described in detail by Gulliver (1977) who give a well documented bibliography of the star. Because of the periodic changes of the spectral characteristics of a Be phase to a Be-shell phase (and back), and because the disk "for some reason" (probably caused by the companion star in the periastron) is not in the equatorial plane but slanted to the equator and precesses around the central star, corresponding variations of the Hα line profile are observable (Hummel, 1998)

The observation and study of the Hα emission line and its profile of this binary system reveals at least five types of variabilities:

1. the equivalent width (EW)
2. the red and blue line wings
3. the intensitiy ratio of the V to R component of the Hα line profile
4. the radial velocity (RV)
5. the central absorption depth (CA)

Fig. 1 shows the variation of the Hα line profile at some typical epochs:

1974: the early shell phase
1981: the shell maximum phase
1999: the Be phase with maximum emission
2004: the Be phase

One can readily see that the profiles changed from the edge-on type (shell-line profile) to the surface-on type (wine-bottle type), implying that the disk inclination angle changed significantly.

Katahira et al. (1996) analyzed shell RV´s from the two consecutive shell phases separated by some 34 years, and concluded that 28 Tau is a spectroscopic binary with an orbital period of 218 days. The forming of a new disk and its observation of the Hα EW and the line wings between November 2005 and May 2007 have been impressively documented by Katahira et al. (2006), Tanaka et al. (2007) and Iliev (2000). The ARAS spectroscopy community (http://www.astrosurf.com/aras/) has been investigating the change of the V/R ratio and the radial velocity (RV) of the Hα double peak profile since 2012 (Pollmann 2015). The RV results in that investigation were very well in agreement with that of Katahira et al. (1996) and Nemravova et al. (2010).

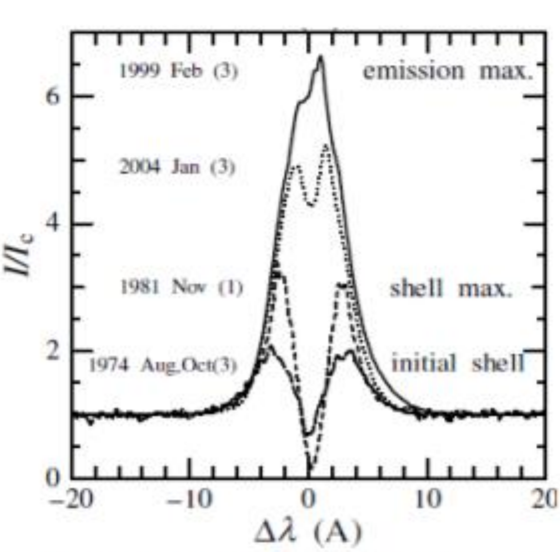


Fig. 1: Variation of the Hα line profile at some typical epochs
(with friendly permission of R. Hirata, ASP Conference Series, Vol. 361, 2007)

But the question regarding point 5 is, how can we understand the causes of the variability of the Hα CA?

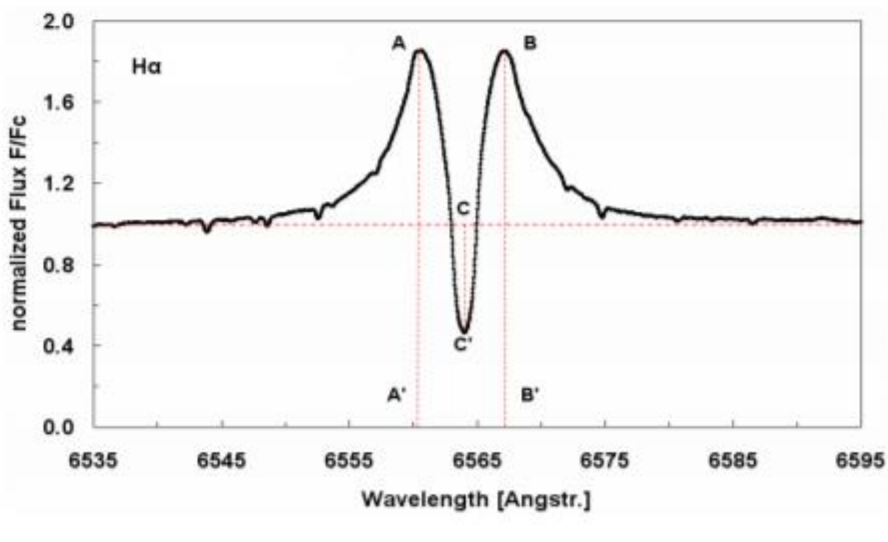


Fig.2: Measured quantities illustrated on an Hα line profile: (AA') and (BB') emission peaks, depth of the central absorption (CC'). The horizontal line marks the normalized continuum.

The depth of the Hα CA is defined as the difference between the local continuum level (equal to unity) and the minimum value at the line minimum intensity (Fig. 2). While the Hα emission line samples the disk as a whole, the region probed by the shell lines, represented by the depth of the central absorption CC', is restricted to the line of sight. The diagnostics they provide should not be ignored, as their properties (absorption depth) reflect the structure and dynamics of the disk in the observer's direction.

In the literature it is assumed (Schaefer et al. 2010) that the changes in CA is caused by a different angle or density distribution of the disk plane with respect to the observer's line of sight, as a consequence of the disk precession around the primary star. Since 28 Tau is a binary, any tilt or change in the projected position angle of the disk may be modulated by the tidal force of the companion.

Observation and Results

For the investigation presented here, 272 representative spectra of the time span October 2004 (JD 2453300) to March 2018 (JD 2458185; end of this investigation period) were taken from the BeSS database. The Hα spectra were obtained with 0.2m to 0.4m telescopes with a long-slit (in most cases) and echelle spectrographs with resolutions of R = 10000-20000. All spectra included the 6400−6700 Å region, with a S/N of ~100 for the continuum near 6600 Å. The spectra have been reduced with standard professional procedures (instrumental response, normalisation, wavelength calibration) using the program VSpec and the spectral classification software package MK32. Fig. 3 shows the CA time behavior from October 2004 to March 2018.

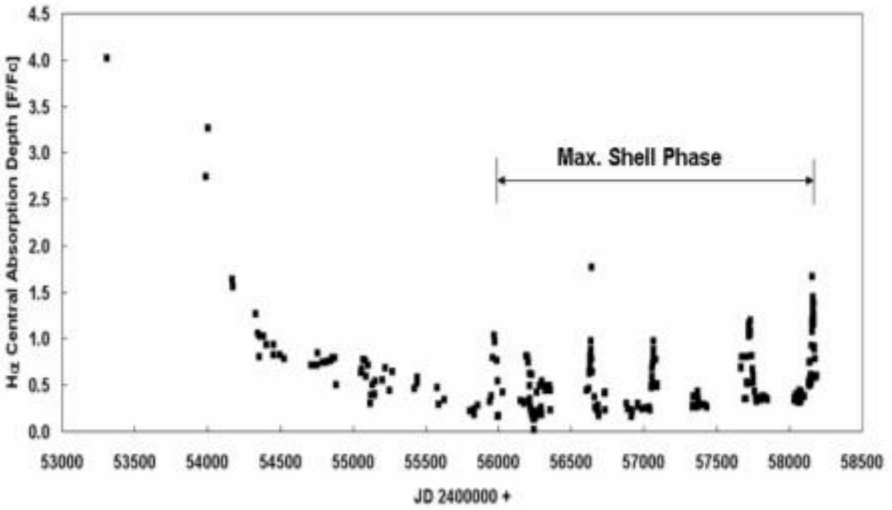


Fig. 3: Central Absorption Depth of the Hα Emission in 28 Tau.
Amateur spectra of the BeSS Database since October 2004 (JD 2453300)
after the Hα EW maximum to March 2018 (JD 2458185)
(CA measurement accuracy ± 5%)

The time span from October 2004 (approx. JD 2453300) until August 2011 (JD 2455800) was dominated by the behavior after the formation of a new disk and the corresponding decrease of the EW and the CA. Noteworthy in Fig. 3 is that the periodic CA variability seen from JD 2455900 until today (March 2018) was not observed in the period prior to at least October 2004.

Activity phases of the star, in which the disk precession as a consequence of the periastron passages of the companion, causes pronounced changes in the radial velocity and the V/R ratio (Pollmann, 2015), as well as the central absorption depth CA. These are called "maximum shell phases" (Hirata, 2007).

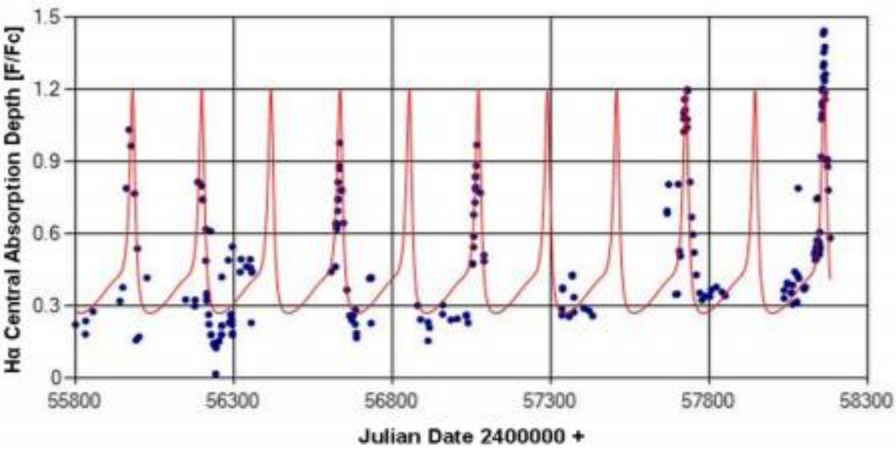


Fig. 4 shows the CA variability during the maximum shell phase since approx. JD 2455900 to JD 2458185 (March 2018). Next we complete a period analysis and these results are shown in Figures 5 and 6.

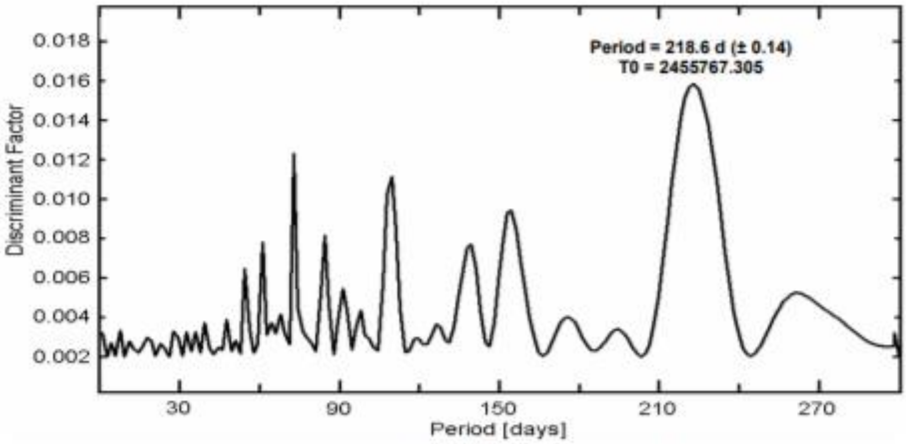


Fig. 5: Periodogram of the CA time series data in Fig. 4

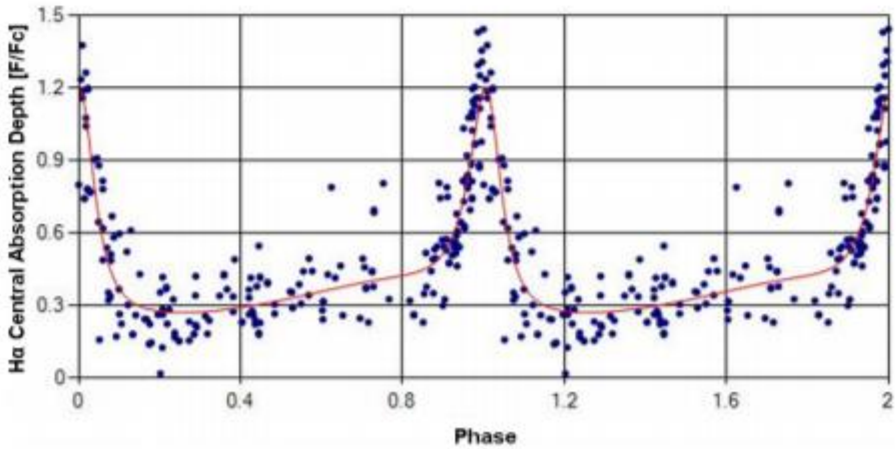


Fig. 6: Phase diagram for the 218.6 day period shown in Fig. 5

The period analysis of the CA time series data in Fig. 4 was performed with the use of the program AVE (Barbera 1998), and produced the Scargle periodogram with the discriminant factor plotted in Fig. 5 and the phase diagram in Fig.6. This period of 218.6 days is exactly in agreement with the period of the V/R ratio and the radial velocity found by Pollmann (2015). The exact coincidence of the CA maxima with the minima of V/R and RV (shown in Fig. 7) as a result of disk precession has never before been observed during the maximum shell phase in the years around 1980, or during the initial shell phase around August/October 1974. It is known that the precession of the disk depends on its size (radius) and its mass due to gravitational effects (Katz et al. 1982, Larwood et al. 1996, Lubow & Ogilvie 2001).

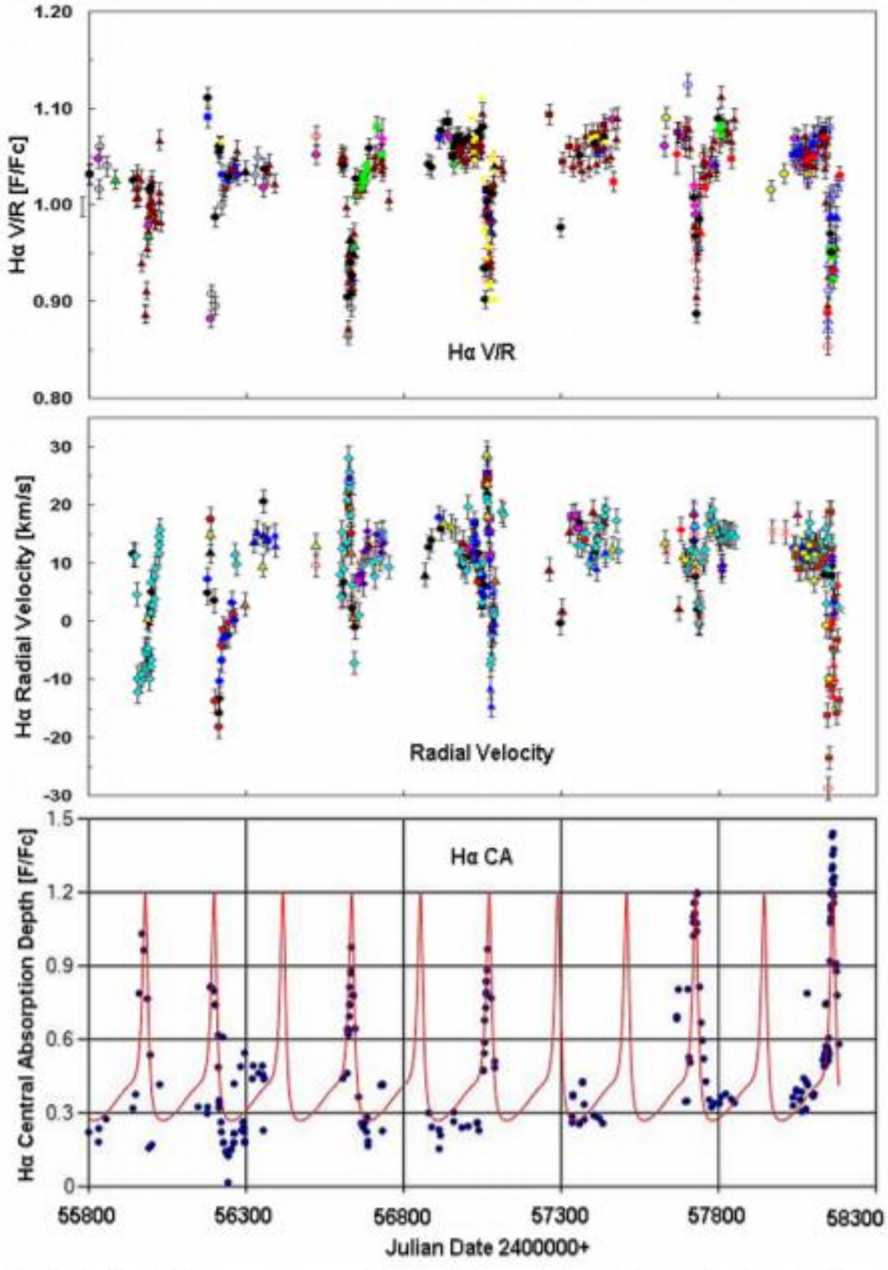


Fig. 7: Illustration of the exact temporal coincidence of the Hα V/R ratio (above), the radial velocity RV (middle) and the central absorption depth CA (bottom) in the time period JD 2455900 to 2458185

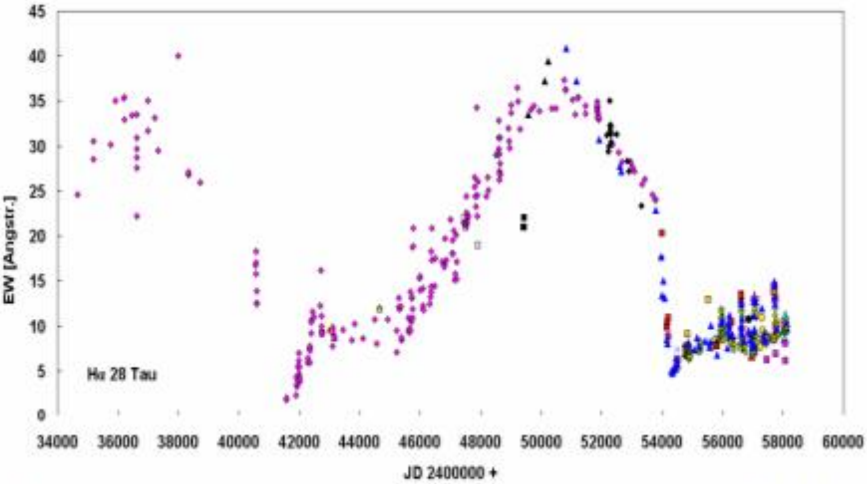


Fig. 8: Long-term monitoring of the Hα EW in 28 Tau since October 1953 by the following observers (the measurements accuracy of the EW determination of the amateur observations since JD 2450840, January 1998 is ± 5%):

It is interesting to locate the time section of the periodic CA variability of Fig. 4 in the long-term monitoring of the Hα EW in Fig. 8. Here we adopt the convention that positive Hα EW is the flux above the continuum. It is noticeable that this time section coincides approximately with an EW range, in which the disk has largely minimal mass and/or minimum density, volume or size. The relatively strong and rapid EW variation during this time may be due to the frequency of observations which were able to capture these changes.
Because of the well-known relationship between mass and precession in a spinning top, it might be interesting to see if the disk's expected increase in size and volume over the next few years will change the precession period of 218.6 days.

We plan to continue this interesting project as collaboration with professional experts. The more ARAS observers that are willing to take part in this project the larger the database we will have to find out a possible link between the CA period to the typically disk parameters (size, volume, mass, density). Also the monitoring of the periodic V/R variability, which reflects the libration of the disk rotational axis – as it has been found at the Be binary ζ Tau (Pollmann, 2017), will be part of further studies.

Acknowledgements
I am grateful for the ARAS spectroscopy group collaboration. I am also grateful to the referee Prof. Carol Evelyn Jones for her helpful suggestions as well Sara and Carl Sawicki (Alpine, Texas) for their improvements in language. The following observers of the ARAS group contributed with their spectra in the BeSS database:

Th. Garrel, C. Sawicki, J. Montier, J. S. Devaux, M. Pujol, M. Leonardi, V. Desnaux, P. Berardi, Ch. Buil, K. Graham, St. Ubaud, B. Mauclaire, H. Kalbermatten, F. Houpert, E. Pollmann, N. Montigiani, M. Mannucci, J. N. Terry, J. Guarro, J. Martin, Th. Lemoult, O. Garde, St. Charbonnel, T. Lester, A. Favaro, Dong Li, P. Fosanelli, A. de Bruin, B. Hanisch, A. Heidemann, E. Bertrand, E. Barbotin, J. Foster, J. Ribeiro, O. Thizy, E. Bryssinck, A. Halsey

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Ernst Pollmann, 2018-03-16

BeSS report Materiel & Method

For each star having a spectrum loaded in BeSS database for the monthly report the last six spectra in BeSS are displayed. A visual check is performed to detect any change in the H-alpha profile. Sometimes a copy/paste is needed for subtle evolutions.
For each star, which exhibits a change, the above series are generated with the following steps. Each spectrum is zoomed on the H-alpha line. Each profile is scaled on the continuum on a region around 6580 angströms. The x-axis is converted into Doppler velocity centered on H-alpha.
If too many spectra of the object are available, a shorter period of observation is displayed and thus the length period is indicated (1yr, 3yrs).
All data are processed with Visual Spec with dedicated function to automatically load BeSS spectra and automatize most of the above processing.

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ArasBeAM portal at http://arasbeam.free.fr/

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International Working Group ASPA
Active Spectroscopy in Astronomy
http://www.astrospectroscopy.de
http://www.astronomie.de/astronomische-fachgebiete