Eruptive stars spectroscopy

Cataclysmics, Symbiotics, Nova Supernovae

ARAS Eruptive Stars
Information Letter n° 26 #2016-04 16-05-2016
Observations of April 2016

News

Symbiotic AG Dra in outburst (hot type) in April, 2016

New symbiotic star SU Lyn

StHa 169 in outburst

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Analysis by Peter Somogyi
CH Cyg : ongoing campaign
T CrB : “superactive state”

New symbiotic star SU Lyn

Notes

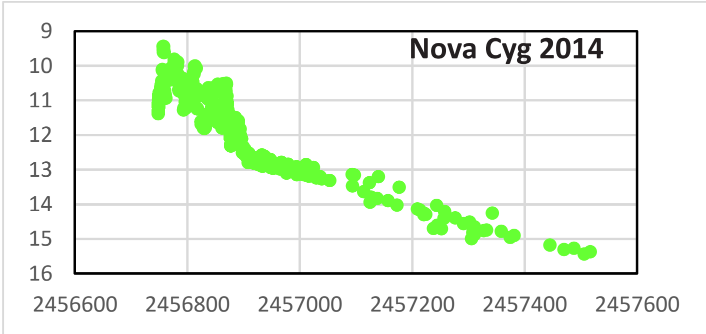
Titre
Steve Shore

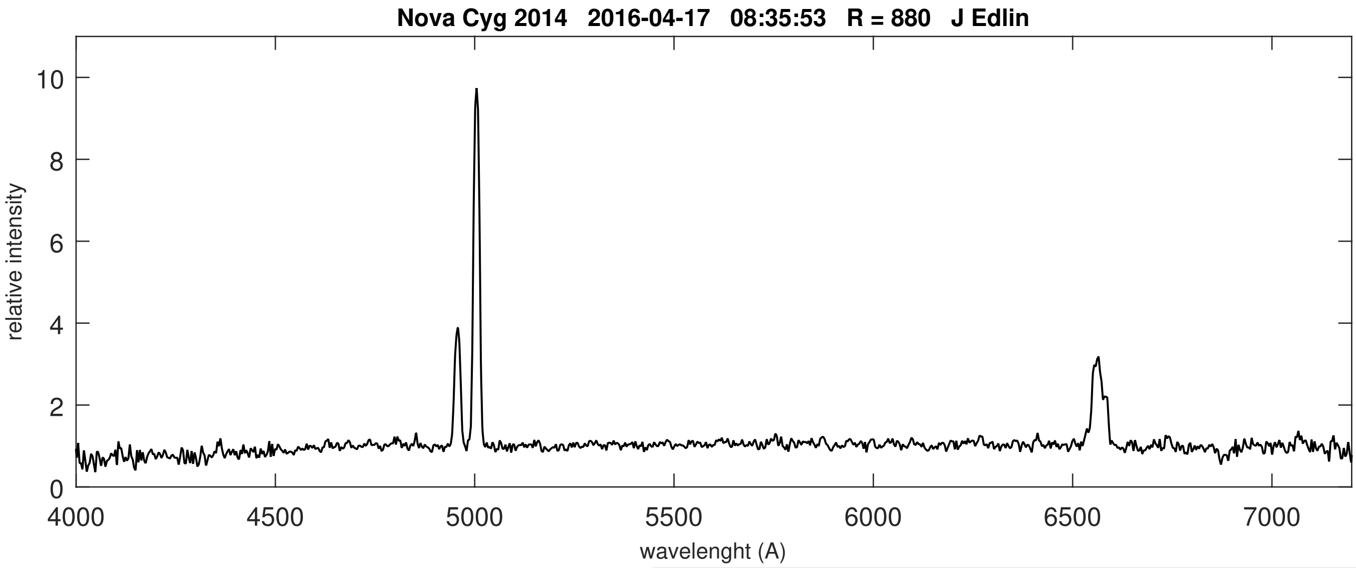
Authors : F. Teyssier, P. Somogyi, D. Boyd, J. Montier, P. Berardi, A. Wilson, T. Lester, U Sollecchia, F. Campos, K. Graham, J. Edlin, O. Garde

“We acknowledge with thanks the variable star observations from the AAVSO International Database contributed by observers worldwide and used in this letter.”
Kafka, S., 2015, Observations from the AAVSO International Database, http://www.aavso.org

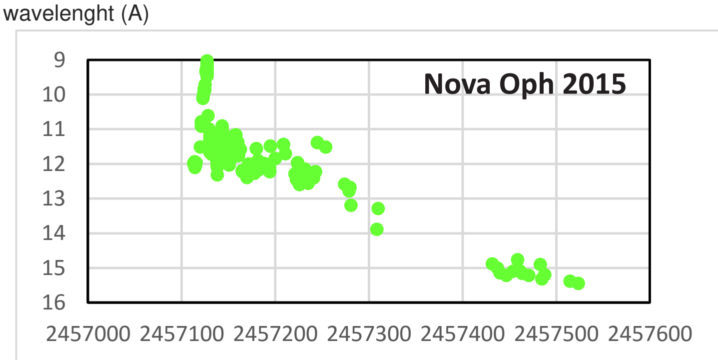
Novae in nebular phase

J. Edlin obtained the spectra of Nova Cyg 2014 and Nova Oph 2015 in nebular phase with his 24" scope and a LISA (R = 1000)
The V magnitude are respectively 15.36 and 15.44
Note the strong [NII] 5755 line in Nova Oph 2015 spectrum

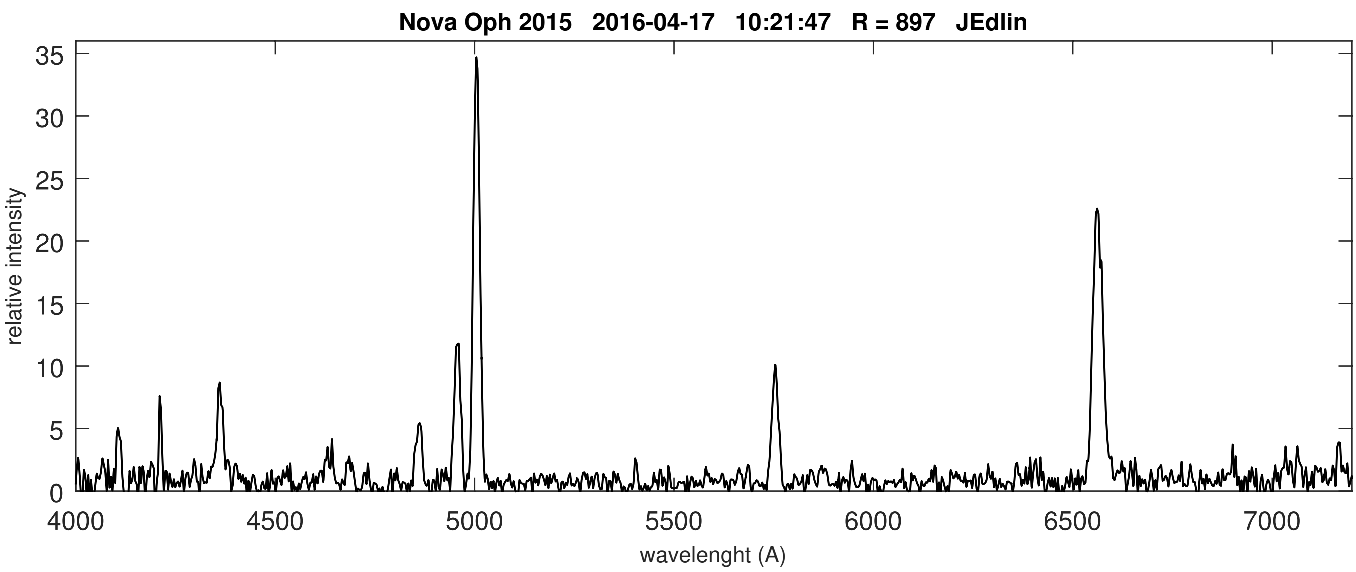




V = 15.36



V = 15.44



Symbiotics in April

CH Cygni : ongoing campaign upon the request of Augustin Skopal

V694 Mon : strong luminosity outburst. Declining

AG Dra : short outburst

T CrB : superactive phase

Observing : main targets

Ungoing campaign : **CH Cygni** for A Skopal (low resolution and H alpha profile at R > 10000)
Now, in the morning sky. Almost one spectrum a month.
CI Cygni, also in the morning sky

T CrB : high cadency coverage should be welcome until the next nova outburst (could take a few years)

AG Dra : in outburst
Advice from Steve : "please concentrate on the Raman pair (both lines, it's really important), especially the ratio of 7083/6825. Also for the He I 6678 vs. He II 4686."

AG Peg in the morning sky after its historic symbiotic outburst in 2015

StHa 169 in outburst
See David Boyd's spectra in May :
http://www.astrosurf.com/aras/Aras_DataBase/Symbiotics/StHa169.htm

And also : **V443 Her, YY Her, CI Cyg, BF Cyg, V1016 Cyg ...**

S Y M B I O T I C S

Symbiotics in ARAS Data Base Update : 05-04-2016

#	Name	AD	DE	Nb	First	Last spectrum
1	EG And	0 44 37.1	40 40 45.7	44	12/08/2010	24/02/2016
2	AX Per	1 36 22.7	54 15 2.5	98	04/10/2011	31/03/2016
3	V471 Per	1 58 49.7	52 53 48.4	3	06/08/2013	04/02/2016
4	o Ceti	2 19 20.7	-2 58 39.5	6	28/11/2015	20/02/2016
5	BD Cam	3 42 9.3	63 13 0.5	15	08/11/2011	06/03/2016
6	UV Aur	5 21 48.8	32 30 43.1	38	24/02/2011	07/03/2016
7	V1261 Ori	5 22 18.6	-8 39 58	5	16/01/2016	20/02/2016
8	StHA 55	5 46 42	6 43 48	2	17/01/2016	25/01/2016
9	SU Lyn	06 42 55.1	+55 28 27.2	2	02/05/2016	04/05/2016
10	ZZ CMi	7 24 13.9	8 53 51.7	32	29/09/2011	05/04/2016
11	BX Mon	7 25 24-	3 36 0	36	04/04/2011	12/03/2016
12	V694 Mon	7 25 51.2	-7 44 8	165	03/03/2011	21/04/2016
13	NQ Gem	7 31 54.5	24 30 12.5	40	01/04/2013	17/04/2016
14	GH Gem	7 4 4.9	12 2 12	3	10/03/2016	29/03/2016
15	CQ Dra	12 30 06	69 12 04	4	11/06/2015	02/04/2016
16	TX CVn	12 44 42	36 45 50.6	31	10/04/2011	01/05/2016
17	IV Vir	14 16 34.3	-21 45 50	2	28/02/2015	09/05/2015
18	T CrB	15 59 30.1	25 55 12.6	96	01/04/2012	05/05/2016
19	AG Dra 1	6 1 40.5	66 48 9.5	111	03/04/2013	14/05/2016
20	V503 Her	17 36 46	23 18 18	1	05/06/2013	05/06/2013
21	RS Oph	17 50 13.2	-6 42 28.4	16	23/03/2011	16/09/2015
22	V934 Her	17 6 34.5	23 58 18.5	11	09/08/2013	05/05/2016
23	AS 270	18 05 33.7	-20 20 38	2	01/08/2013	02/08/2013
24	AS 289	18 12 22	-11 40 13			
25	YY Her	18 14 34.3	20 59 20	18	25/05/2011	05/05/2016
26	FG Ser	18 15 6.2	0 18 57.6	3	26/06/2012	24/07/2014
27	StHa 149	18 18 55.9	27 26 12	3	05/08/2013	14/10/2015
28	V443 Her	18 22 8.4	23 27 20	24	18/05/2011	05/05/2016
29	FN Sgr	18 53 52.9	-18 59 42	4	10/08/2013	02/07/2014
30	V335 Vul	19 23 14.2	24 27 40.2			
31	BF Cyg	19 23 53.4	29 40 25.1	71	01/05/2011	07/11/2015
32	CH Cyg	19 24 33	50 14 29.1	335	21/04/2011	06/05/2016
33	V919 Sgr	19 3 46	-16 59 53.9	2	10/08/2013	10/08/2013
34	V1413 Aql	19 3 51.6	16 28 31.7	5	10/08/2013	26/09/2015
35	HM Sge	19 41 57.1	16 44 39.9	7	20/07/2013	11/11/2015
36	QW Sge	19 45 49.6	18 36 50			
37	CI Cyg	19 50 11.8	35 41 3.2	106	25/08/2010	01/05/2016
38	StHA 169	19 51 28.9	46 23 6	1	12/05/2016	12/05/2016
39	V1016 Cyg	19 57 4.9	39 49 33.9	7	15/04/2015	01/11/2015
40	PU Vul	20 21 12	21 34 41.9	14	20/07/2013	23/11/2015
41	LT Del	20 35 57.3	20 11 34	1	28/11/2015	28/11/2015
42	ER Del	20 42 46.4	8 40 56.4	3	02/09/2011	05/11/2014
43	V1329 Cyg	20 51 1.1	35 34 51.2	4	08/08/2015	26/09/2015
44	V407 Cyg	21 2 13	45 46 30			
45	StHA 190	21 41 44.8	2 43 54.4	14	31/08/2011	08/11/2015
46	AG Peg	21 51 1.9	12 37 29.4	160	06/12/2009	13/01/2016
47	V627 Cas	22 57 41.2	58 49 14.9	12	06/08/2013	18/02/2016
48	Z And	23 33 39.5	48 49 5.4	58	30/10/2010	05/02/2016
49	R Aqr	23 43 49.4	-15 17 4.2	27	25/09/2010	25/01/2016

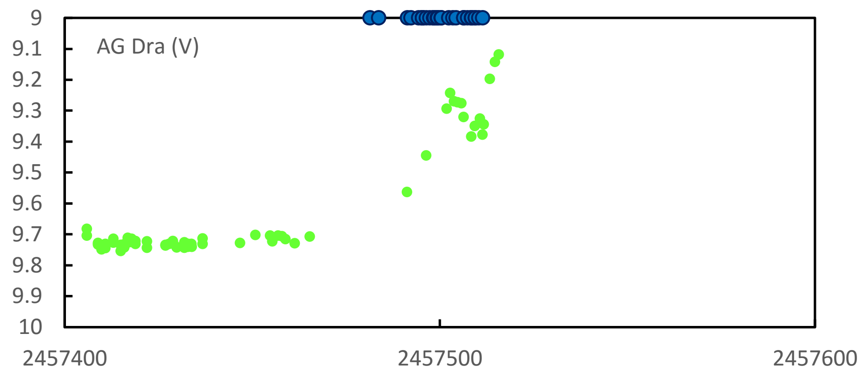
ARAS Data Base Symbiotics : http://www.astrosurf.com/aras/Aras_DataBase/Symbiotics.htm

SYMBIOTICS

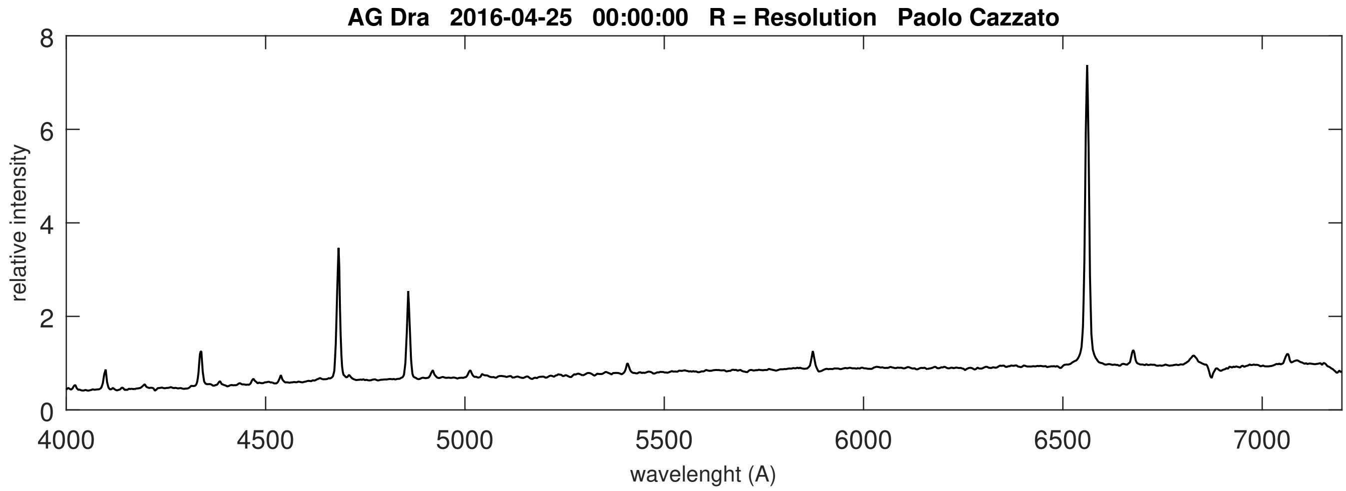
AG Dra

Coordinates (2000.0)	
R.A.	16 01 41.0
Dec	+66 48 10.1

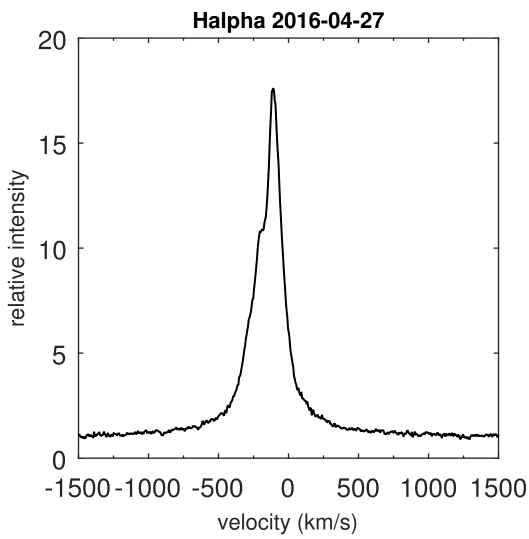
AG Dra underwent a short outburst in April, detected by David Boyd in photometry and spectroscopy (Apr, 12) 32 spectra have gathered by ARAS observers in April.



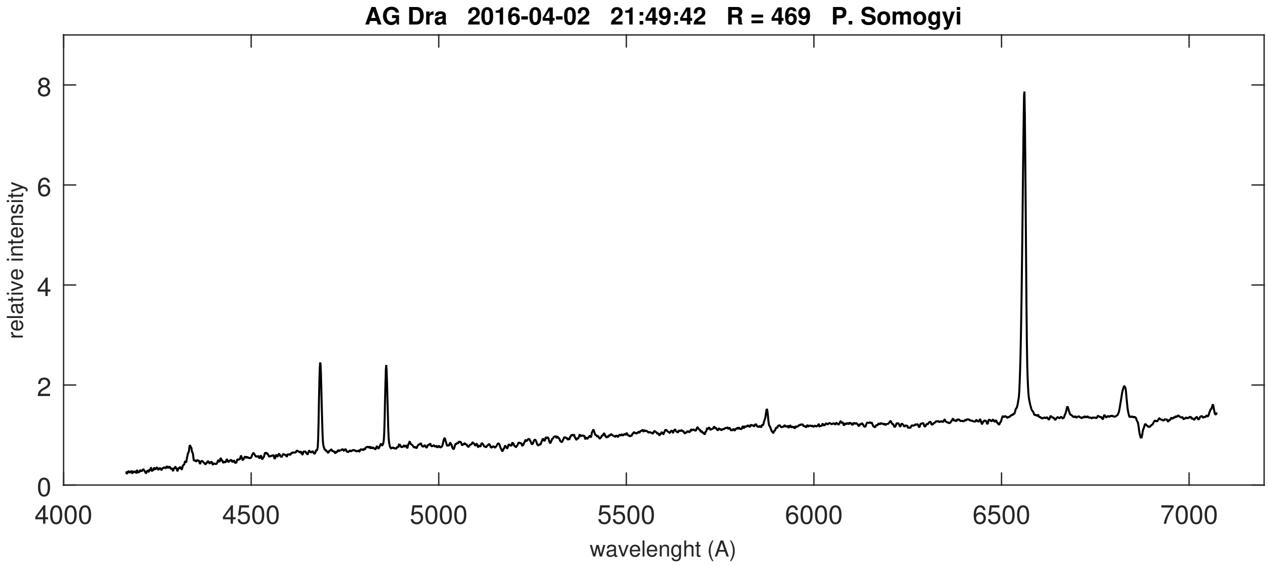
The AAVSO light curve in 2016 (Vband)
The outburst began around April, 7th (JD 2457486) at mag V ~ 9.7
AG Dra reaches a first maximum at mag V = 9.21 (2016-04-24) and declines to mag V ~ 9.37 (2016-05-02). The star then undergoes a new rise in luminosity to Mag V = 9.12 (2016-05-07)

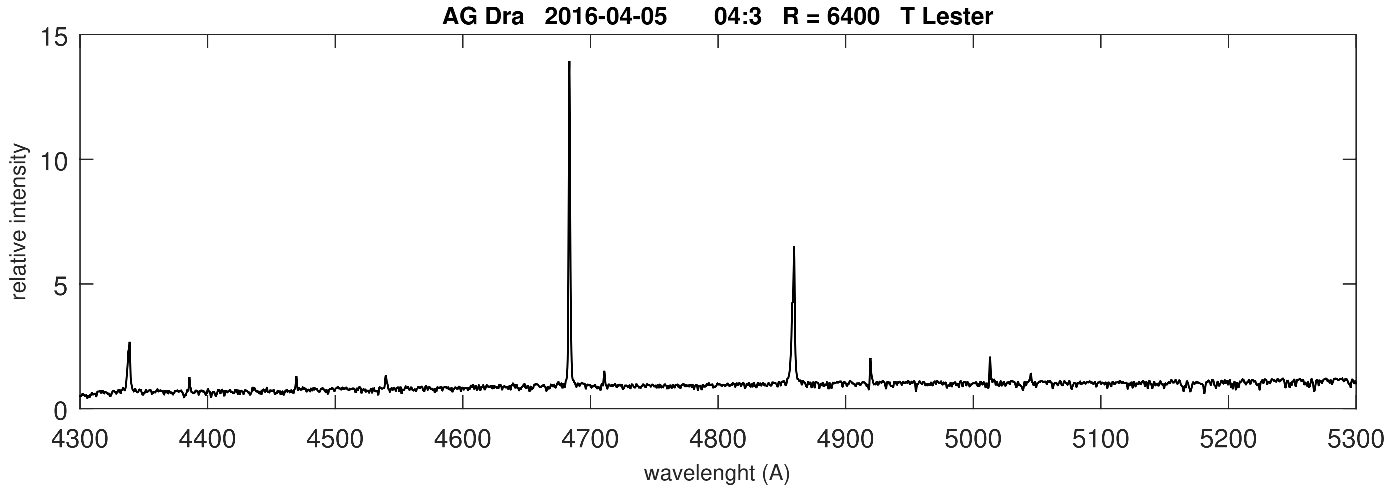


Hα profile
Andrew Wilson
Lhires III R = 12000
The line is blue-shifted due to high sytemic velocity of this galactic halo star: −140 km.s^{-1} (Schmid & Nussbaumer 1993) or −148 km.s^{-1} (Schmid & Schild 1997.
The line is single-peaked, with asymetry on the blue side and often shows a dip.
A broad symmetric, low intensity component up to 1000/1500 km.s^{-1} is observed



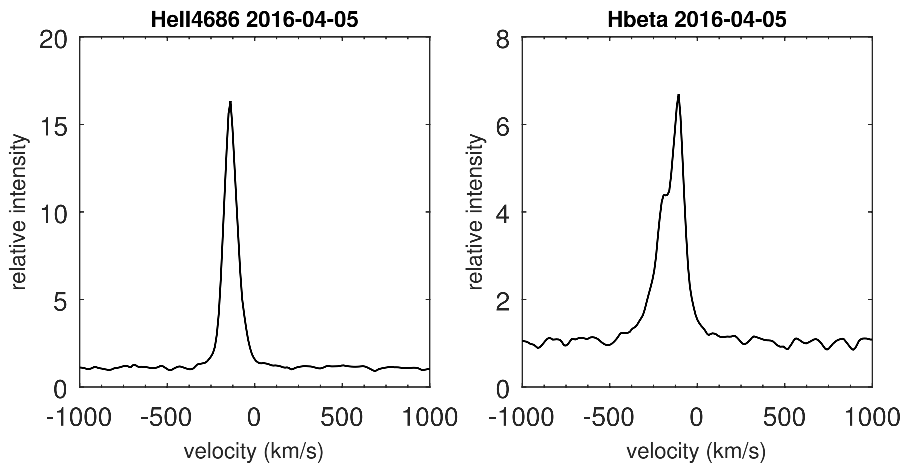
AG Dra

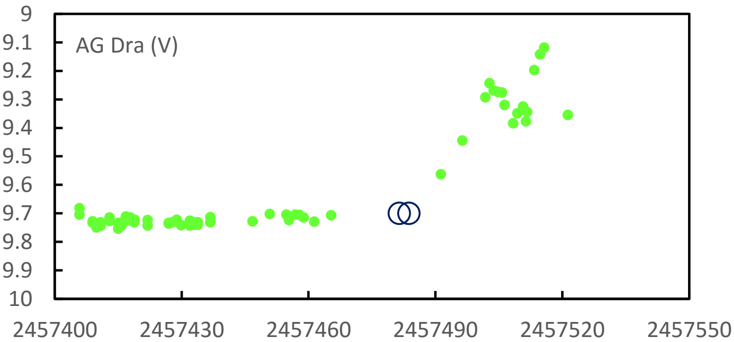




Spectra obtained by Peter Somogyi (Lhires III, 150 l/mm R = 800) and Tim Lester (R = 9000) just before or at the beginning of the outburst. He II 4686 is already strong in Tim's spectrum: EW(He II) = 23.9 HeII4686/Hb = 1.42

Right : He II 4686 and Hβ lines in Tim's spectrum. Note the single absorption in the blue edge of Hβ

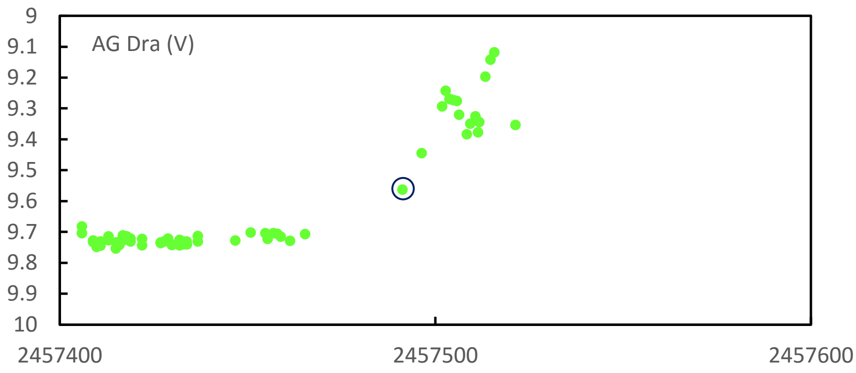


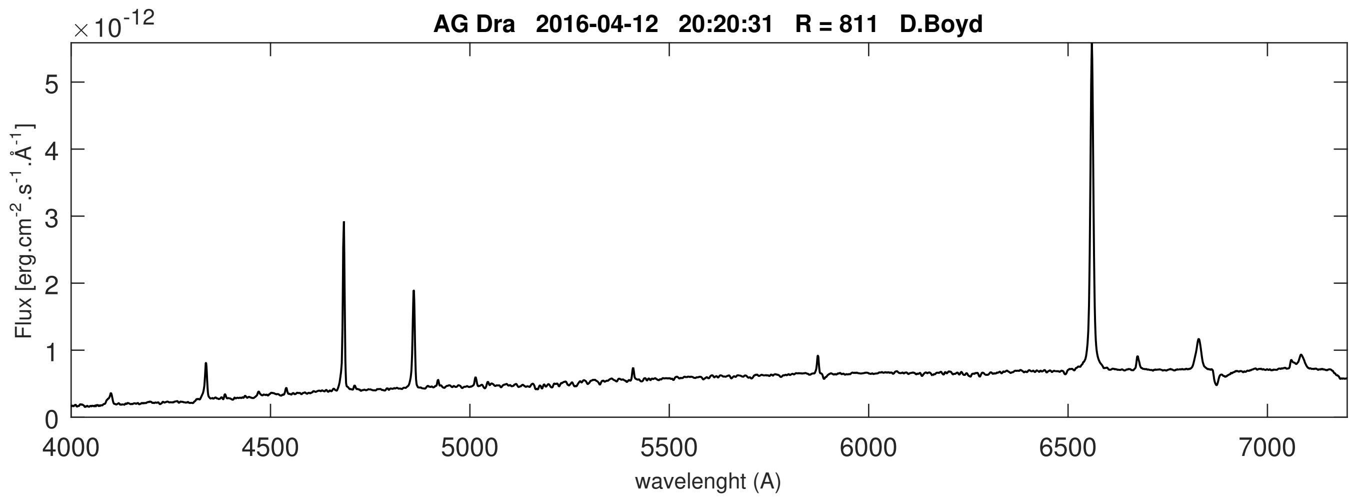


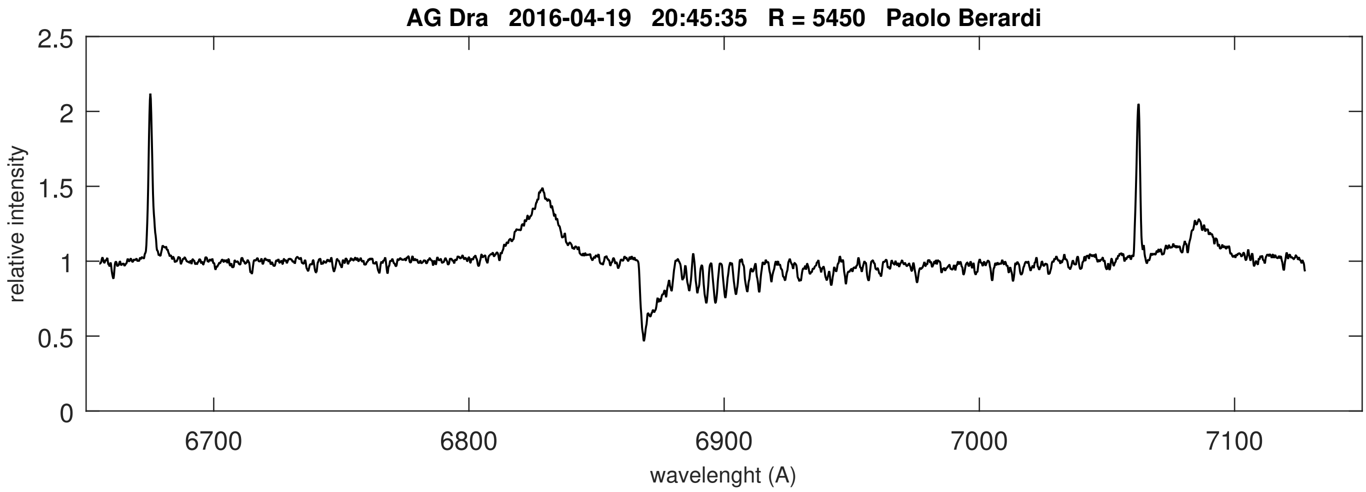
AG Dra

David Boyd detected the outburst with a spectrum of AG Dra obtained at the beginning of the rise (Apr 12.848 UT) and photometry
(V = 9.564 B = 10.76.1 on Apr 12.84 UT)

Note the enhancement of He II 4686 in comparison to Peter's spectrum.
HeII/ H$\beta = 1.42$
Raman OVI 6825 and 7088 remains intense. The outburst is "hot" according to the nomenclature introduced by Gonzalez-Riestra et al. (1999, A&A 347, 478)
But, we'll see that the development of the outburst is more complex than this taxonomic classification.



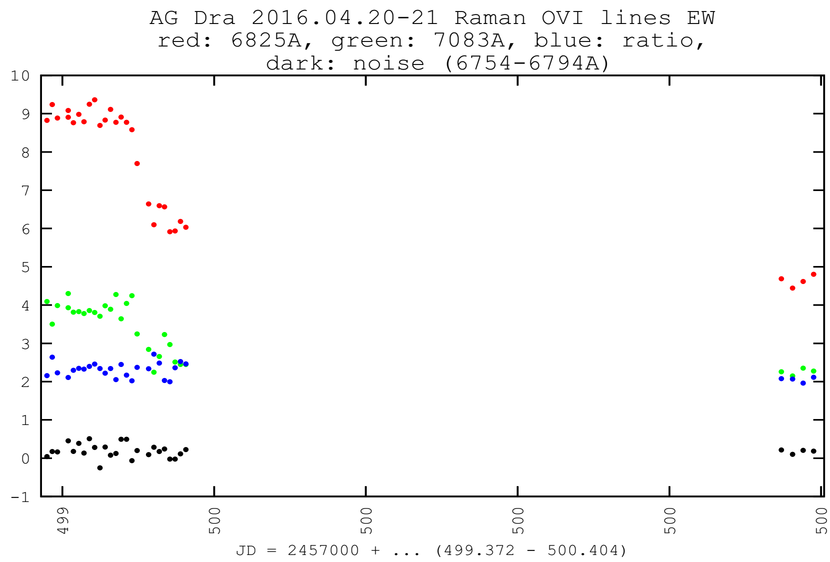


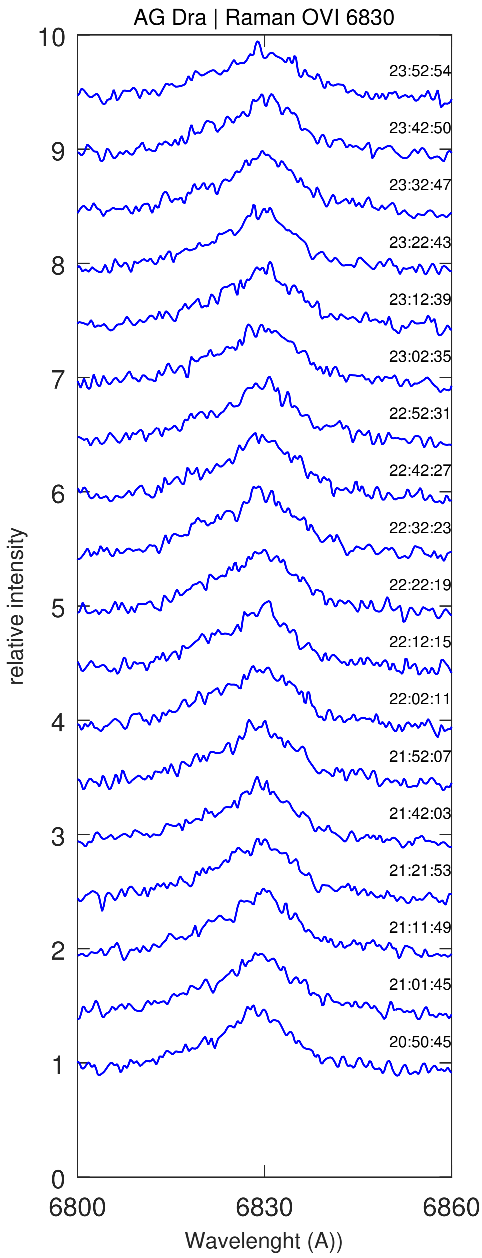


He I 6678, 7065 and Raman OVI 6830, 7088
Paolo Berardi Lhires III 1200 l/mm R = 6000

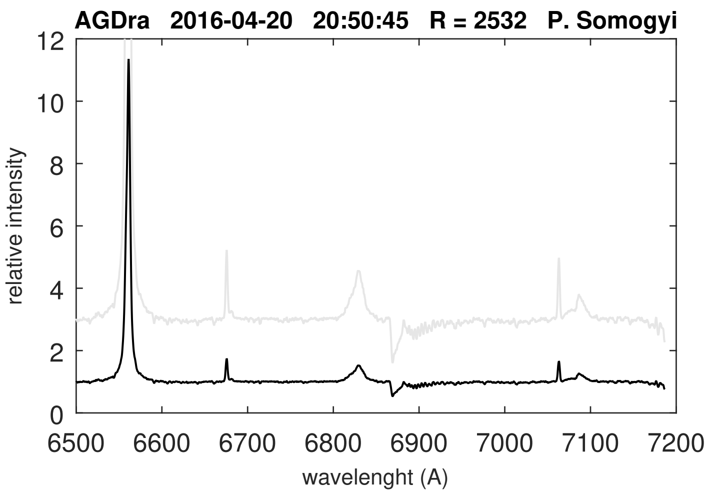
AG Dra : rapid fading of Raman bands detected by P. Somogyi

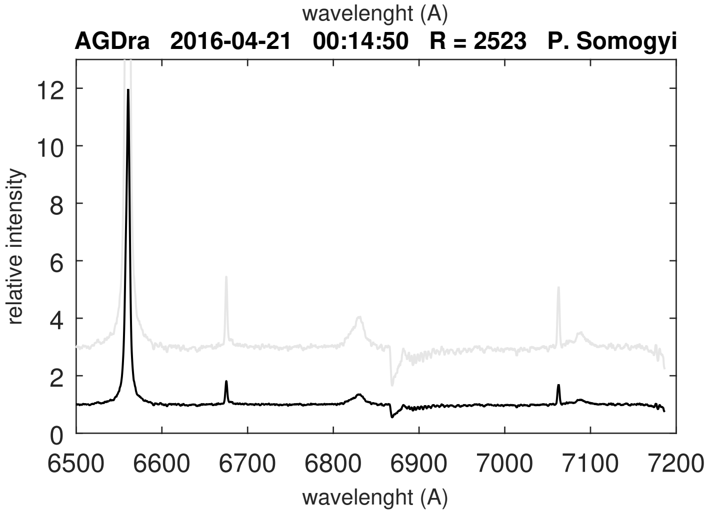
During Apr., 20-21 night, Peter Somogyi detected a rapid drop of Raman OVI 6825, 7088 intensity. He computed EW for the two bands.
The ratio 6825/7088 increased from during this event.





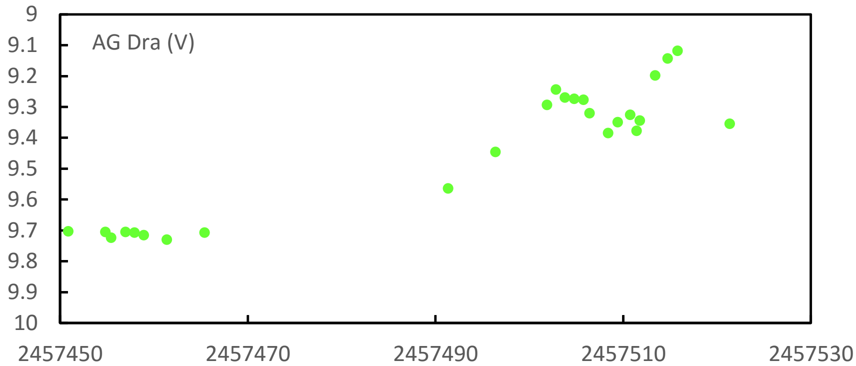
Raman OVI 6830 time series 2016-04-20



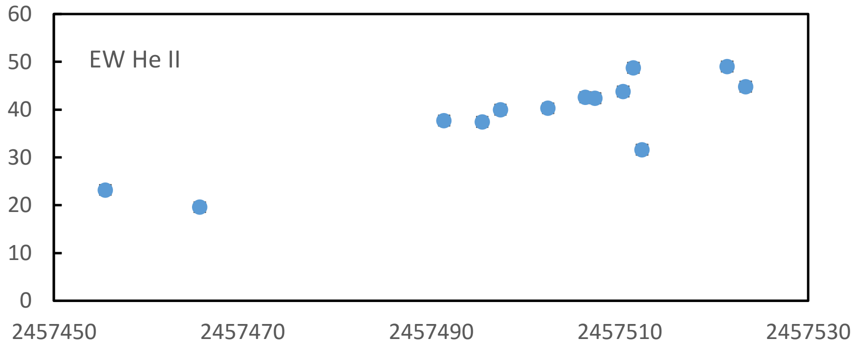


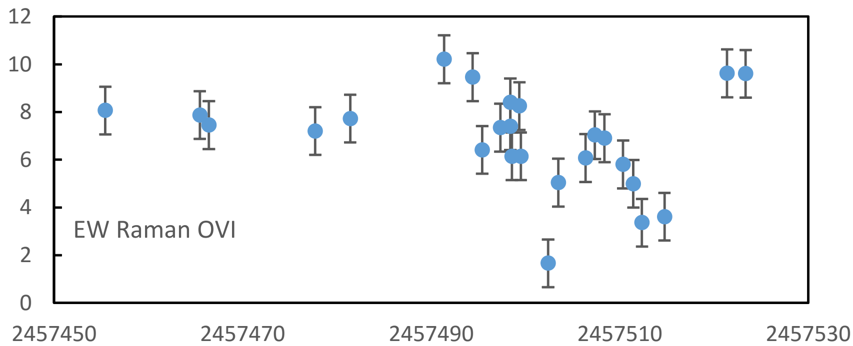
Spectra at the beginning (up) and the end (bottom) of the time series.
Lhires III, 600 l/mm, R = 2500

AG Dra : evolution of lines intensity during the outburst

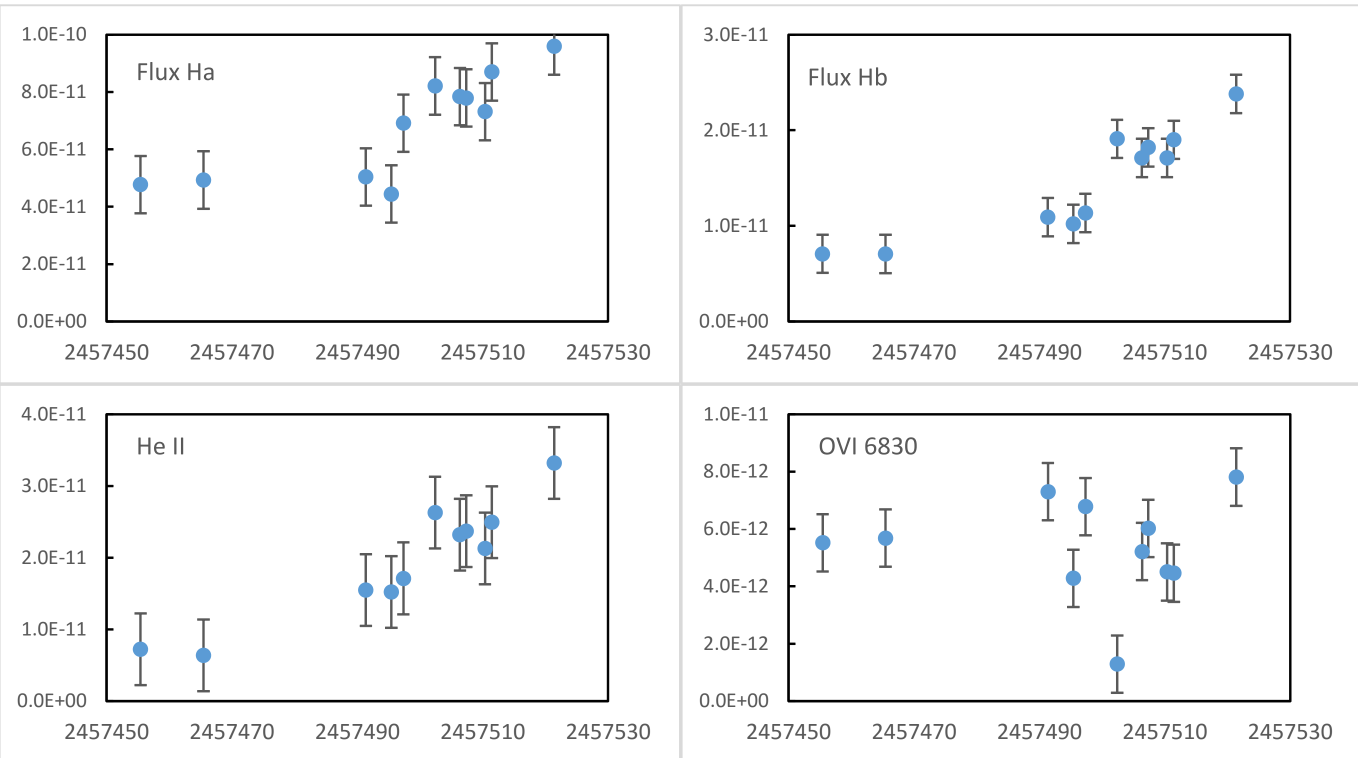


Equivalent width of He II and Raman OVI 6830 during the outburst
(Mar. 1 to Apr 15)
He II increases almost monotonically, while the bahavior of Raman OVI is complex, increasing from EW = 8 to 10, then decreasing rapidly (see Peter's series).
A very low intensity is detected Apr. 23.90

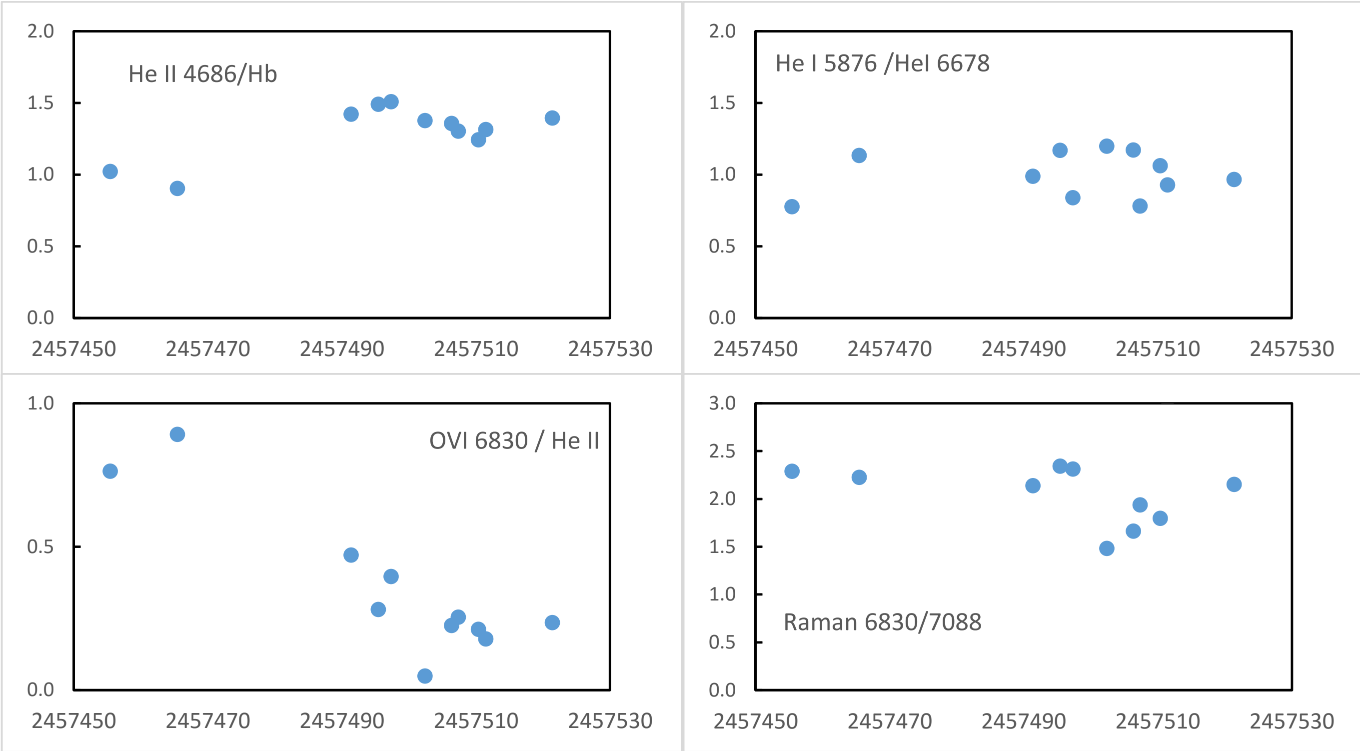


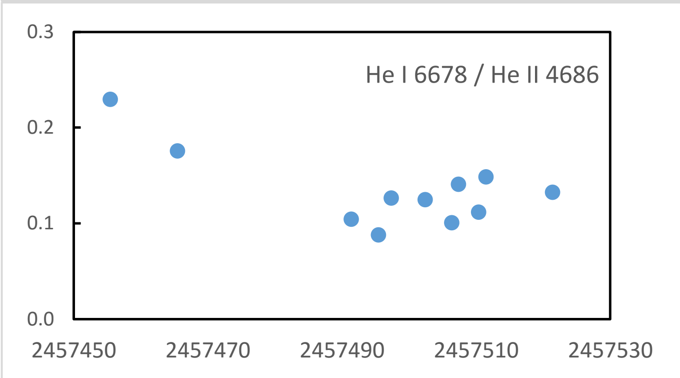


Hα, Hβ, He II 4686 and Raman OVI 6830 flux (in $erg.cm^{-2}.s^{-1}$) from flux calibrated spectra

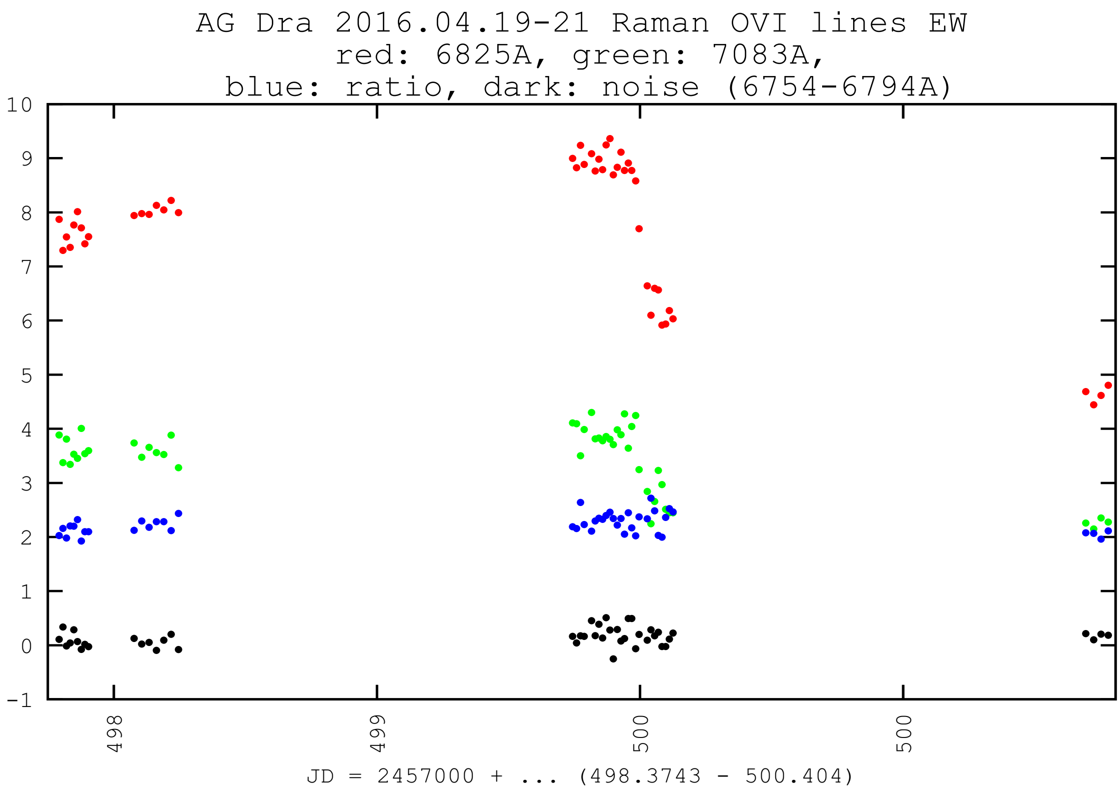


AG Dra : evolution of diagnostic ratios during the outburst





Bottom: Peter Somogyi's time series on 3 days : 19-20-21 April



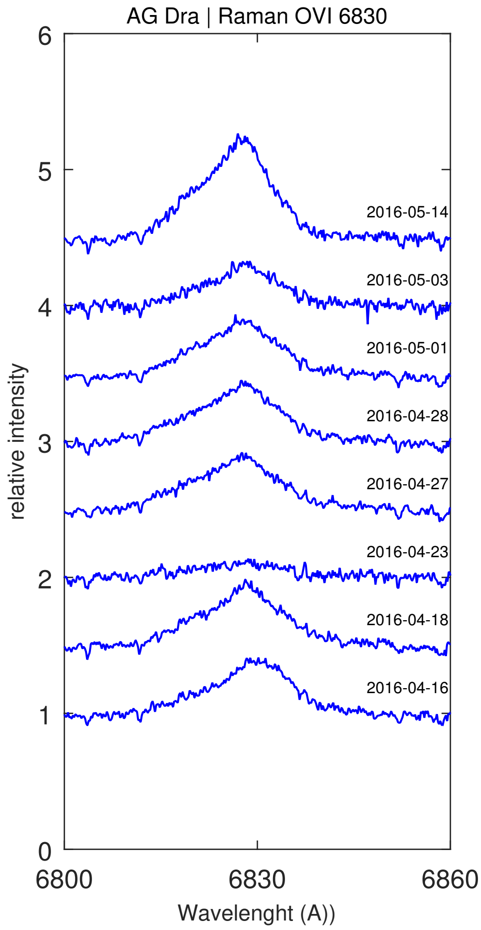
S Y M B I O T I C S

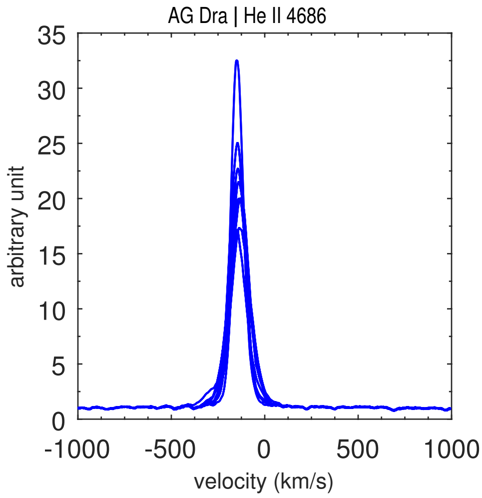
AG Dra : evolution of lines intensity during the outburst

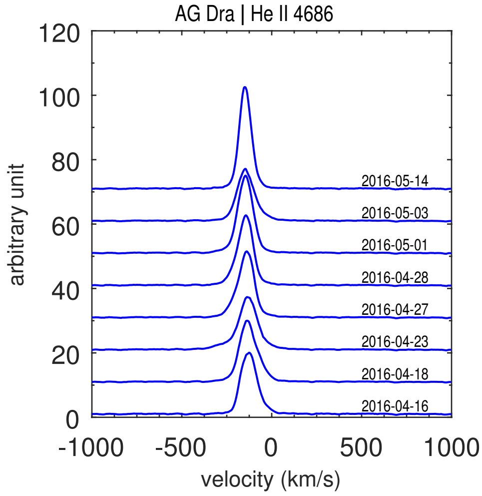
Lines evolution during the outburst from eshel spectra (R = 110000) F. Teyssier.

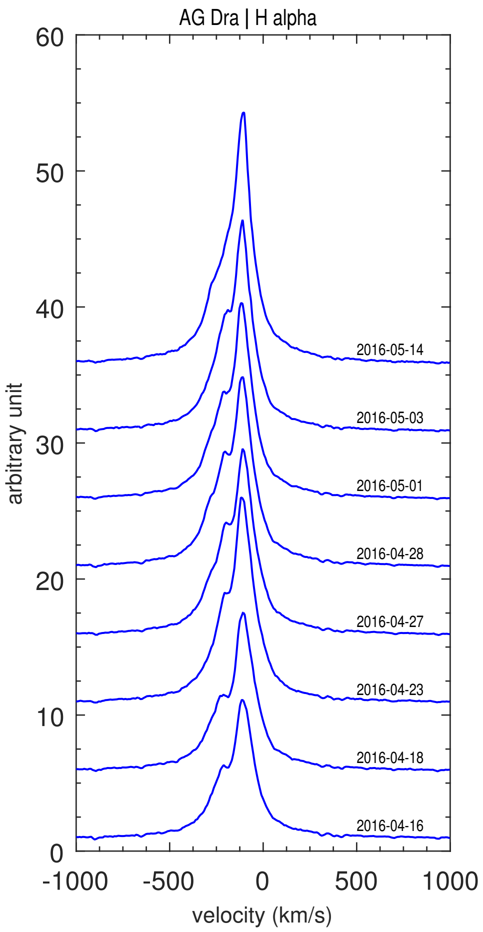
Strong variation of He II 46486 intensity

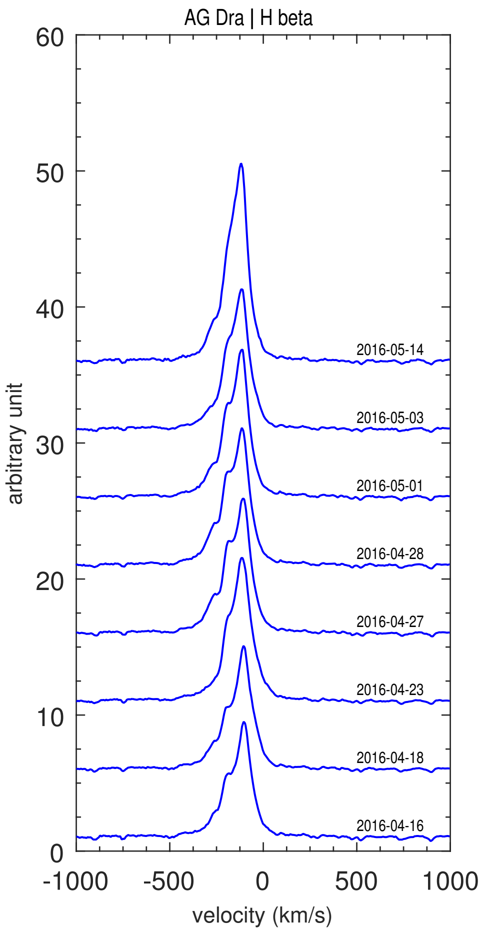
Vanishing of OVI 6830 detected Apr. 23.9 UT



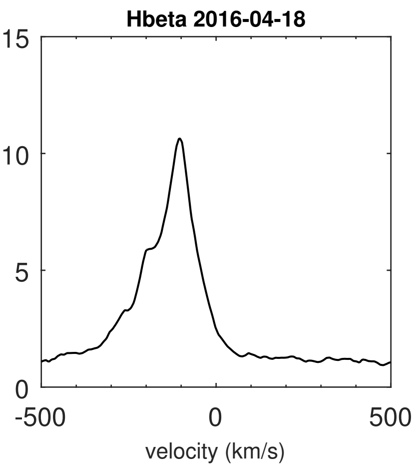




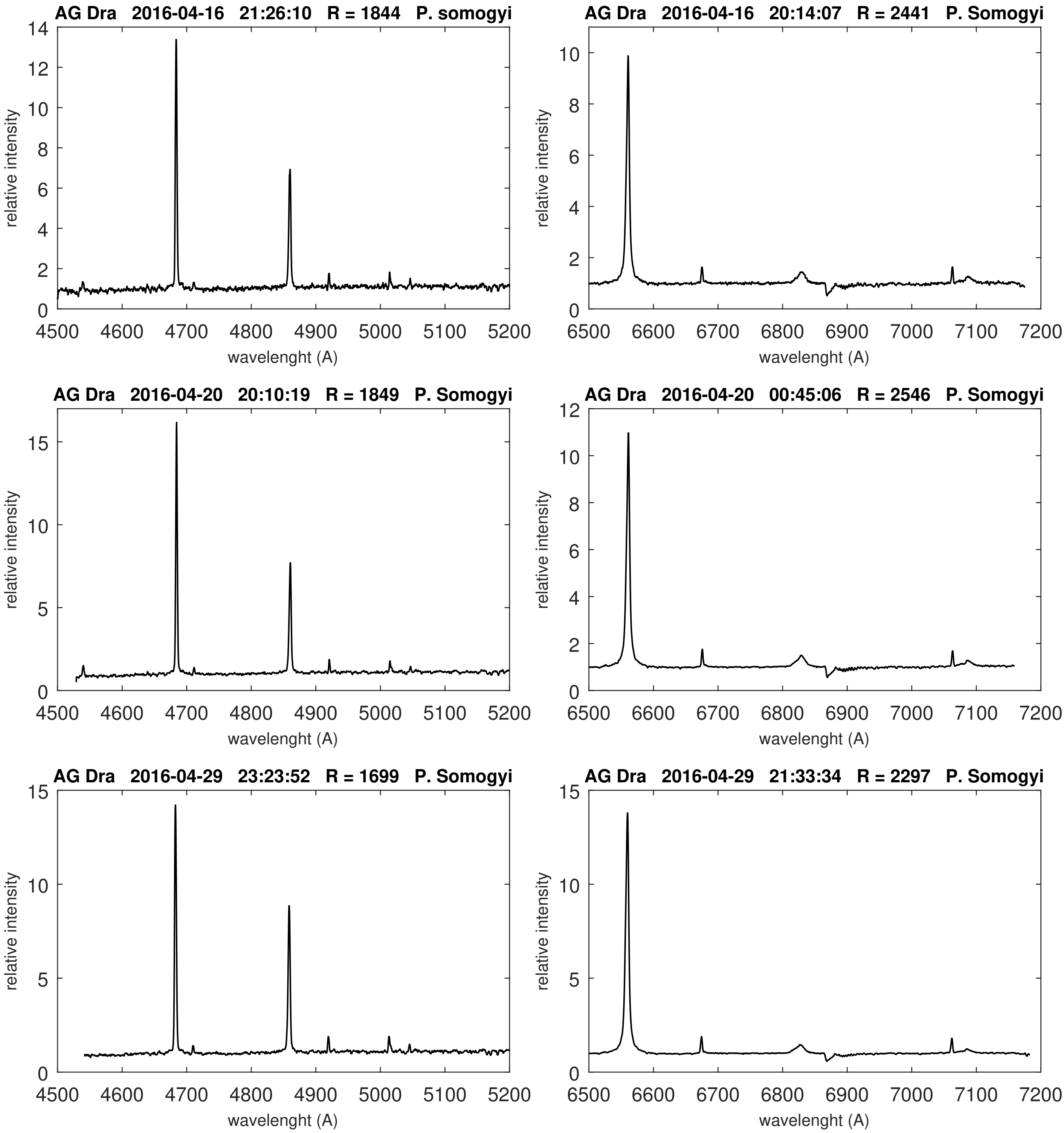




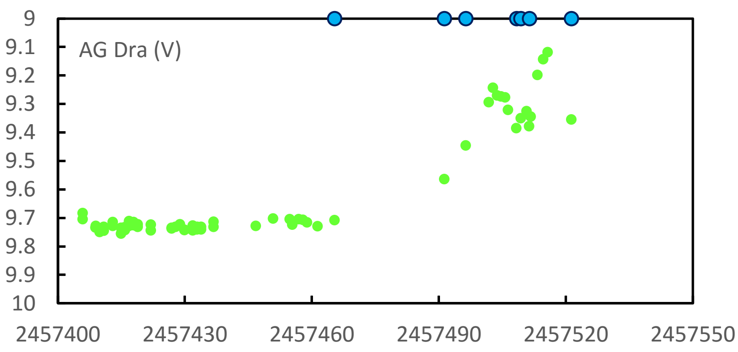
dip is often observed in the blue dge of Balmer lines of AG Dra. uring the outburst, the Hb pro- e shows a double dip (-74 and 15 km.s^{-1} from the maximum tensity

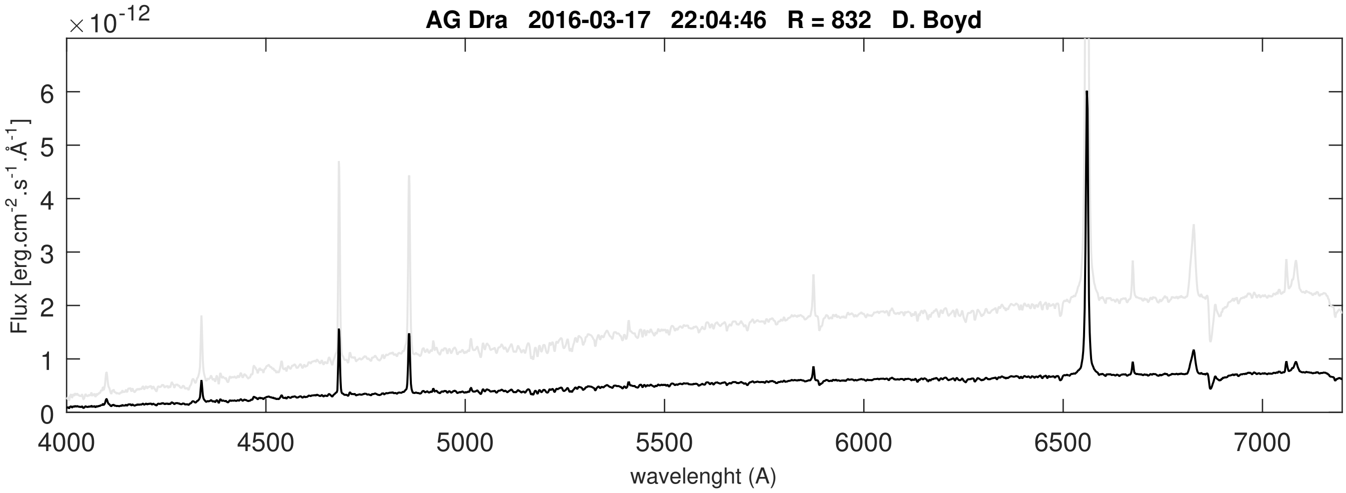


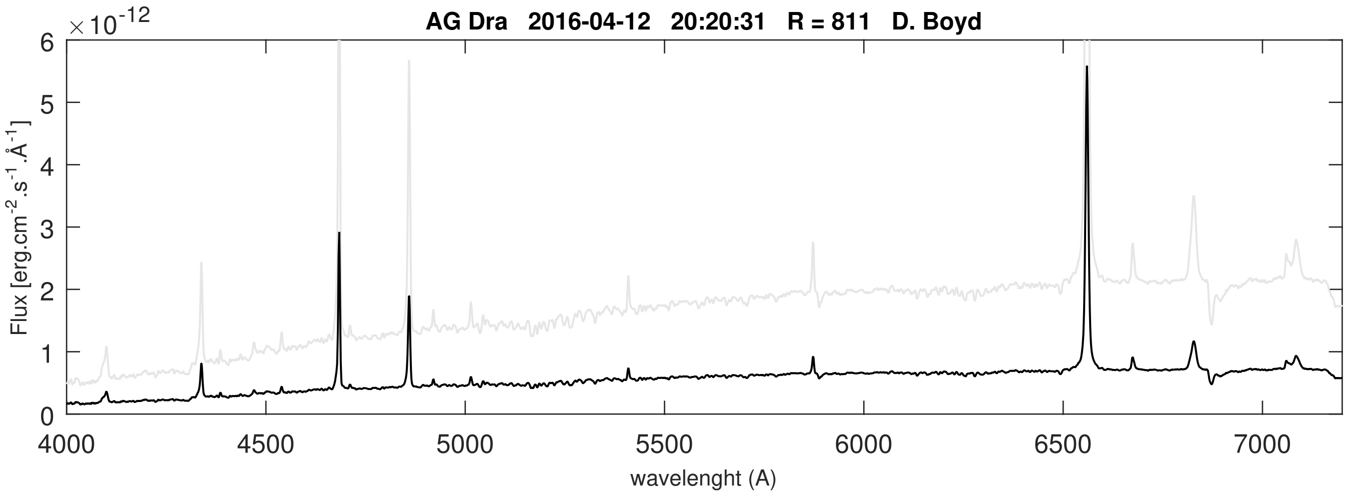
Hα and Hβ regions by Peter Somogyi, with a Lhires III 600 l/mm R = 2500

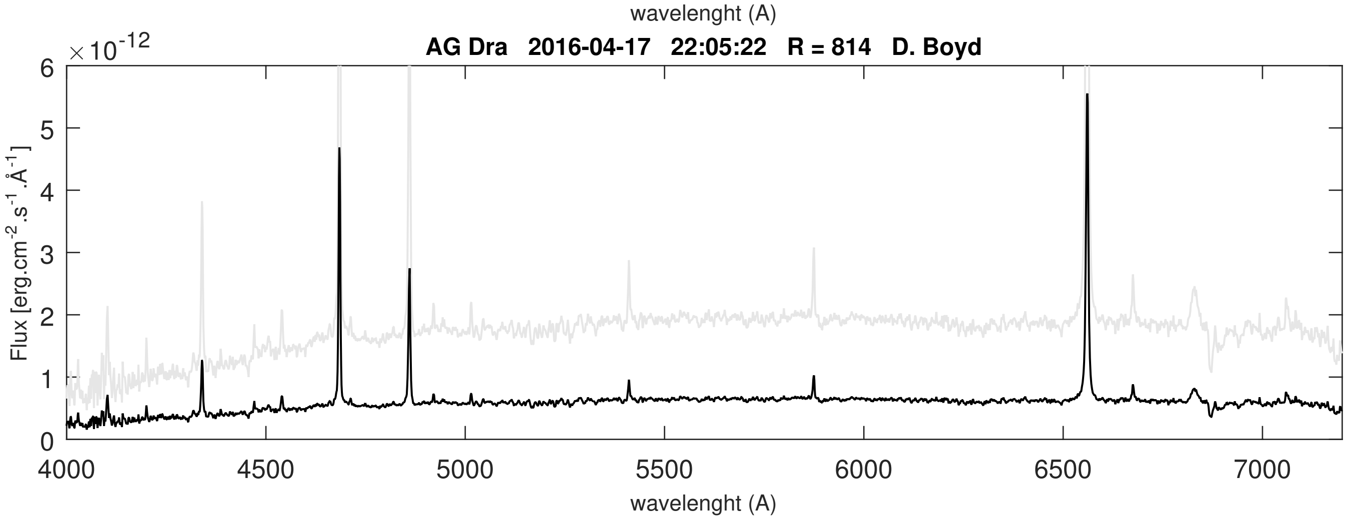


AG Dra


AG Dra (V)
9
9.1
9.2
9.3
9.4
9.5
9.6
9.7
9.8
9.9
10
2457400
2457430
2457460
2457490
2457520
2457550

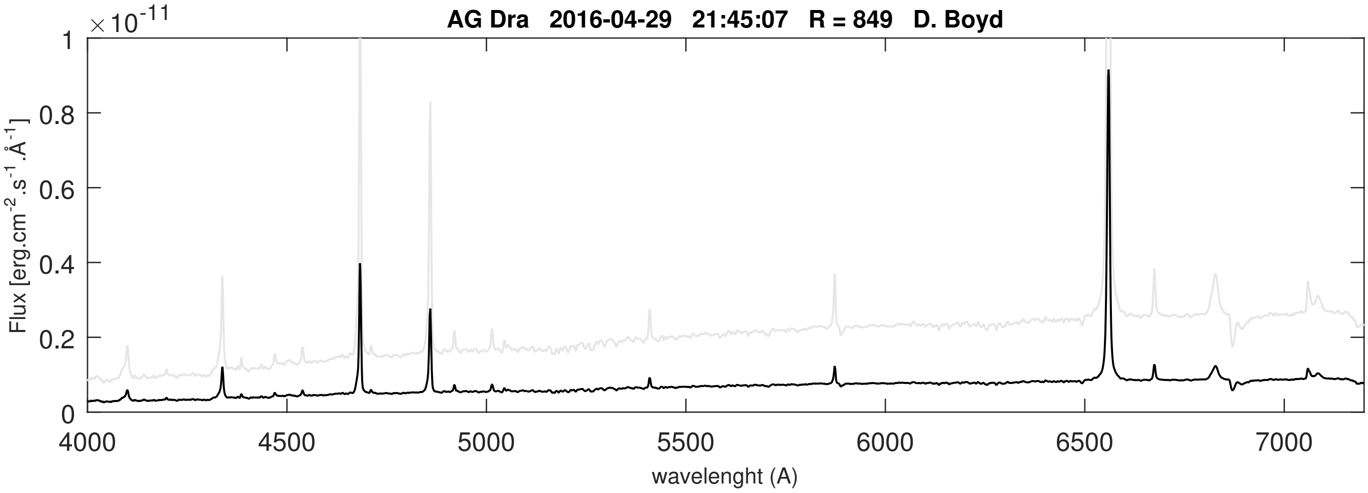

AG Dra 2016-03-17 22:04:46 R = 832 D. Boyd
×10^-12
Flux [erg.cm-2.s-1.Å-1]
wavelenght (A)


AG Dra 2016-04-12 20:20:31 R = 811 D. Boyd
×10^-12
Flux [erg.cm-2.s-1.Å-1]
wavelenght (A)

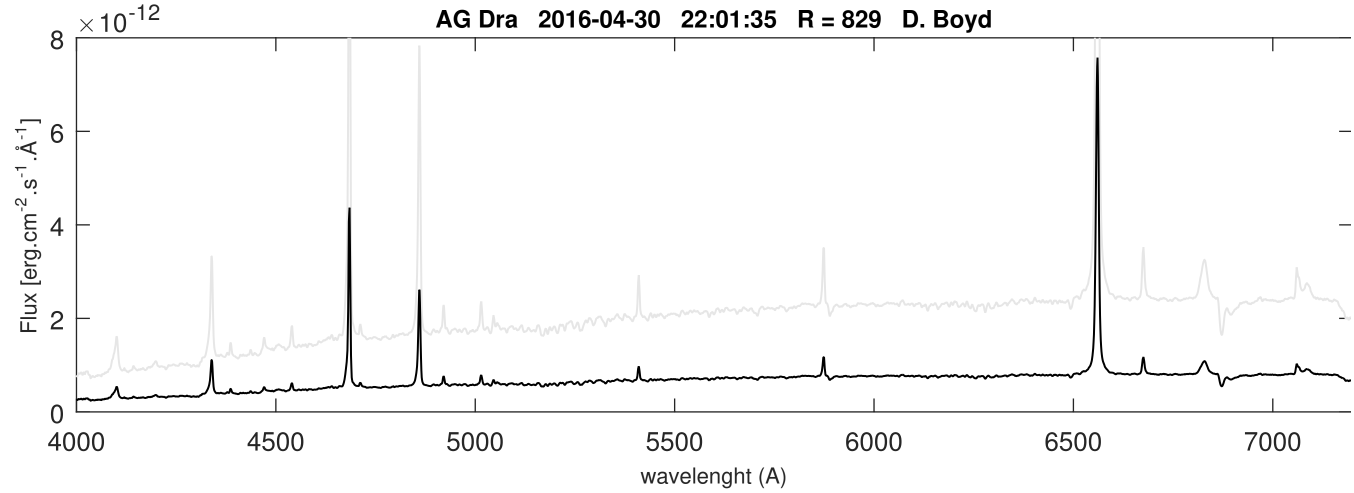

AG Dra 2016-04-17 22:05:22 R = 814 D. Boyd
×10^-12
Flux [erg.cm-2.s-1.Å-1]
wavelenght (A)

AG Dra

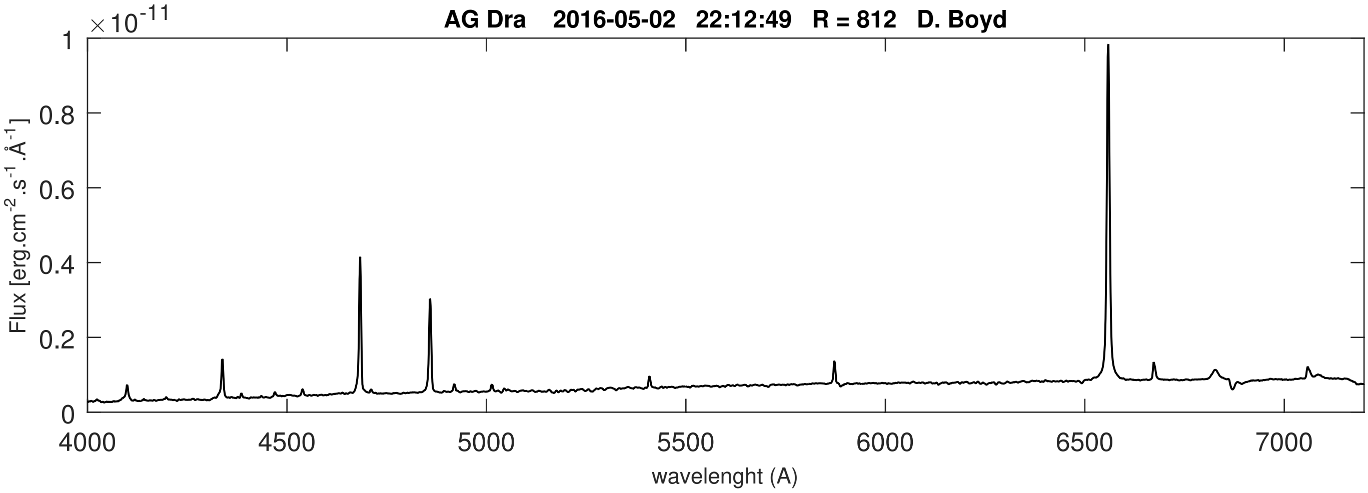
AG Dra 2016-04-29 21:45:07 R = 849 D. Boyd



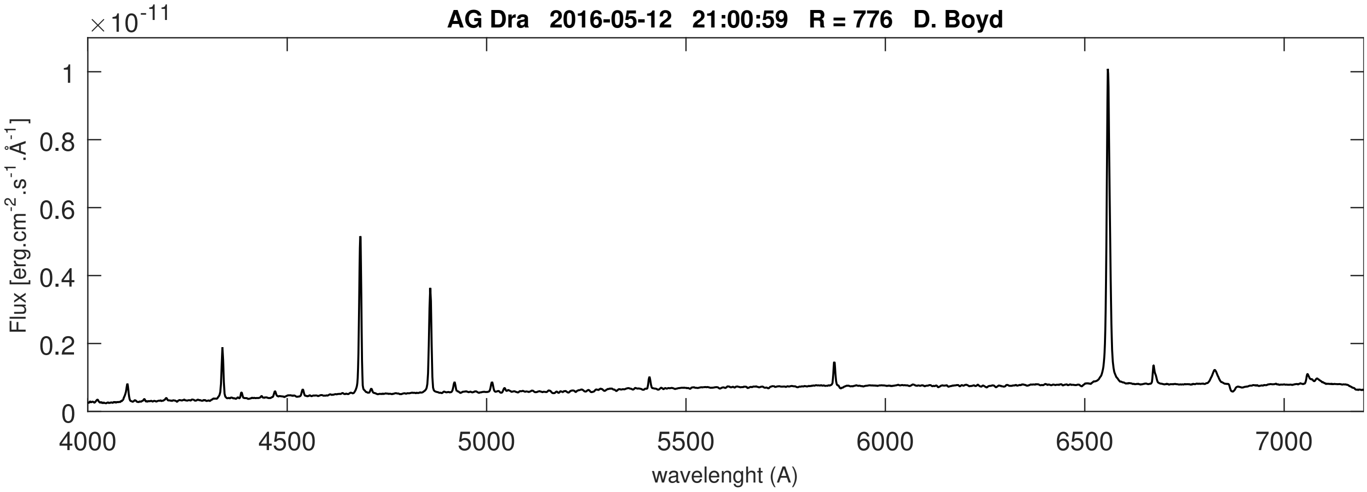
AG Dra 2016-04-30 22:01:35 R = 829 D. Boyd



AG Dra 2016-05-02 22:12:49 R = 812 D. Boyd



AG Dra 2016-05-12 21:00:59 R = 776 D. Boyd



Selected lectures about AG Dra

Spectroscopic view on the outburst activity of the symbiotic binary AG Draconis
Leedjärv, L. Gà¡lis, R. Hric, L. Merc, J. Burmeister, M.
Monthly Notices of the Royal Astronomical Society, 456, 2016
http://adsabs.harvard.edu/abs/2016MNRAS.456.2558L

The hot and the cool otbursts in the symbiotic system AG Draconis
Cikala, M. Mikolajewski, M. Osiwala, J. Tomov, T. Leedjarv, L. Burmeister, M.
ArXiv e-prints, 1102, 2011
http://adsabs.harvard.edu/abs/2011arXiv1102.5210C

The spectroscopic evolution of the symbiotic star AG Draconis. I. The O VI Raman, Balmer, and helium emission line variations during the outburst of 2006-2008
Shore, S. N. Wahlgren, G. M. Genovali, K. Bernabei, S. Koubsky, P. Å lechta, M. Å koda, P. Skopal, A. Wolf, M.
Astronomy and Astrophysics, 510, 2010
http://adsabs.harvard.edu/abs/2010A%26A...510A..70S

Emission lines in the spectrum of the symbiotic star AG Draconis from 1997 to 2003
Leedjärv, L. Burmeister, M. Mikolajewski, M. Puss, A. Annuk, K. Galan, C.
Astronomy and Astrophysics, 415, 2004
http://adsabs.harvard.edu/abs/2004A%26A...415..273L

Hydrogen and helium emission of the symbiotic binary AG Draconis during an active phase (1996-1997)
Tomov, N. Tomova, M.
Astronomy and Astrophysics, 388, 2002
http://adsabs.harvard.edu/abs/2002A%26A...388..202T

Spectral observations of AG Draconis during quiescence and outburst (1993-1995)
Tomova, M. T. Tomov, N. A.
Astronomy and Astrophysics, 347, 1999
http://adsabs.harvard.edu/abs/1999A%26A...347..151T

IUE observations of the high-velocity symbiotic star AG Draconis. III. A compendium of 17 years of UV monitoring, and comparison with optical and X-ray observations
Gonzà¡lez-Riestra, R. Viotti, R. Iijima, T. Greiner, J.
Astronomy and Astrophysics, 347, 1999
http://adsabs.harvard.edu/abs/1999A%26A...347..478G

Evolution of the symbiotic binary system AG Draconis
Mikolajewska, Joanna Kenyon, Scott J. Mikolajewski, Maciej Garcia, Michael R. Polidan, Ronald S.
The Astronomical Journal, 109, 1995
http://adsabs.harvard.edu/abs/1995AJ....109.1289M

AG Dra

After the aborted 2015 attempt, the supersoft X-ray symbiotic star AG Dra is finally entering a bright outburst

ATel #8975; U. Munari (INAF Padova-Asiago), G. L. Righetti (ANS Collaboration)
on 20 Apr 2016; 19:52 UT

http://www.astronomerstelegram.org/?read=8975

After seven years of flat quiescence following the 2006-08 major outburst, in the late spring of 2015, AG Dra begun rising again in brightness toward what appeared to be a new outburst (#Atel 7582). However, in a few weeks the trend reversed and the object returned to flat quiescence. The peak amplitude of that attempt was 0.3 mag in the B band.

This time AG Dra seems doing it right. In a couple of weeks, the brightness in the B band has increased by a whole magnitude, from 11.3 on April 5 to 10.3 on April 19, already covering almost half of the way to the peak B=9.0 reached in September 2006 during the last 2006-08 major outburst (Munari et al. 2009, PASP 121, 1070). We are tightly monitoring AG Dra both photometrically and spectroscopically with various ANS Collaboration telescopes and the Asiago 1.22m and 1.82m telescopes. On April 18.869 UT we measured B=10.351, V=9.360, Rc=8.610, and Ic=8.013, and on April 19.854 UT its was U=9.832, B=10.322, V=9.355, Rc=8.560, and Ic=8.003.

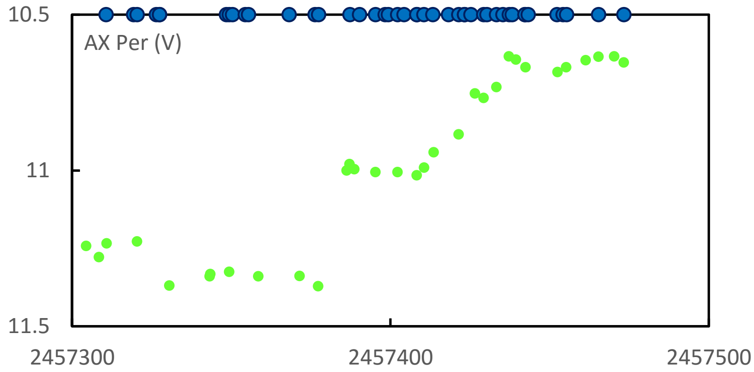
Large spectroscopic changes are accompanying the rapid increase in optical brightness. A low resolution spectrum (range 3450-8150 Ang, dispersion 2.31 Ang/pix), obtained on April 19.91 UT with the Asiago 1.22m telescope, shows a strong blue continuum veiling the redder quiescence spectrum, and the Balmer continuum has turned into outstanding emission. Compared to a similar spectrum we obtained a month ago for AG Dra in quiescence (March 19.97 UT), all emission lines have increased their integrated absolute flux. In units of 10(-12) erg cm(-2) sec(-1), Halpha increased from 54 to 70, HeI 5876 from 1.4 to 2.4, Raman 6825 band from 6.2 to 8.1, and HeII 4686 truly jumped up, from 6.8 to 31. Particularly noteworthy is the increase in the HeII/Hbeta ratio from 0.94 to 1.84. Following the nomenclature introduced by Gonzalez-Riestra et al. (1999, A&A 347, 478) the current outburst is of the “hot” type. An Echelle spectrum (range 3600-7400 Ang, resolving power 23000) obtained with the Asiago 1.82m telescope on April 19.95 UT, shows the emission lines to be sharp and with simple profiles, and no obvious P-Cyg absorptions. The FWHM of HeI lines is 75 km/s, 120 km/s is that of HeII 4686 and 5412, and 190 km/s for Balmer lines.

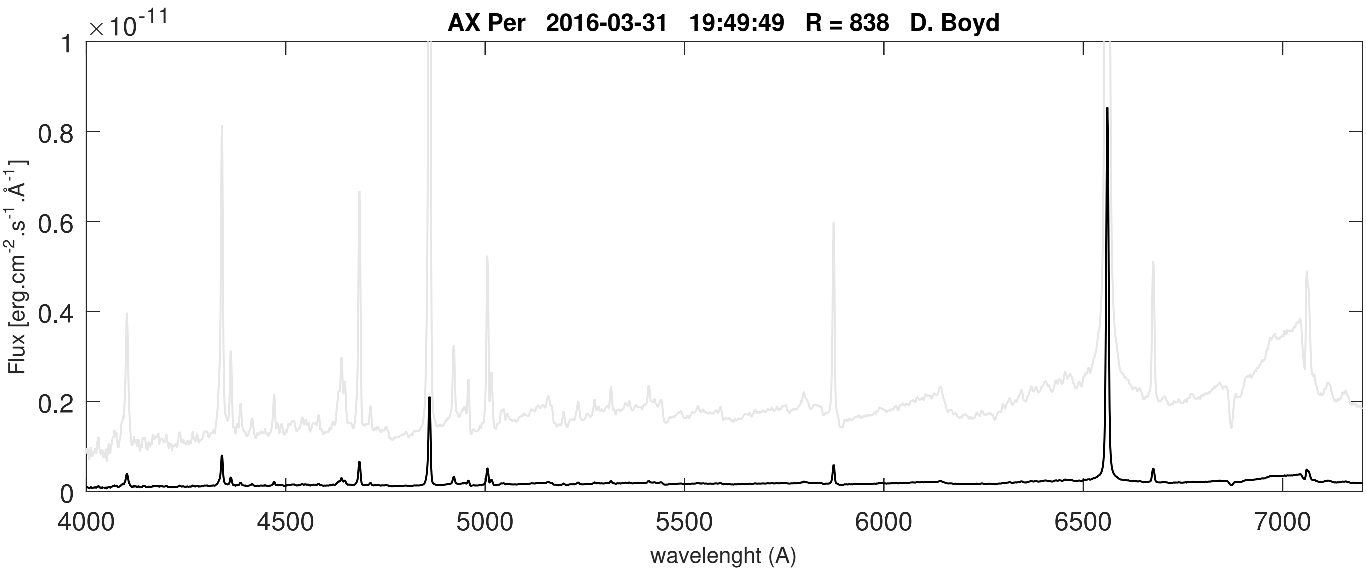
AG Draconis is the brightest symbiotic star in X-rays and one of the prototypes of the supersoft X-ray source class. During the 2006-08 outburst, XMM observations by Gonzalez-Riestra et al. (2008, A&A 481, 725) found a marked anti-correlation between X-ray flux and optical brightness, suggesting that during outburst the WD radiation increases, but is strongly absorbed by the circumstellar ionized gas. New X-ray observations during the current outburst would be relevant to test and refine the picture.

AX Per

Coordinates (2000.0)	
R.A.	1 36 22.7
Dec	54 15 2.5
Mag	10.7 (V)

AX Per remains at high luminosity



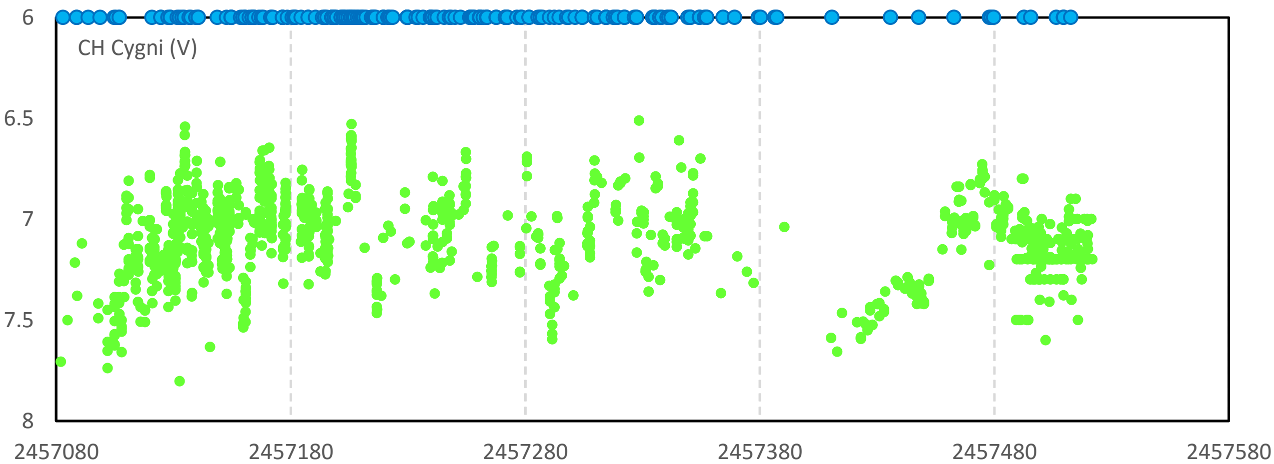


SYMBIOTICS

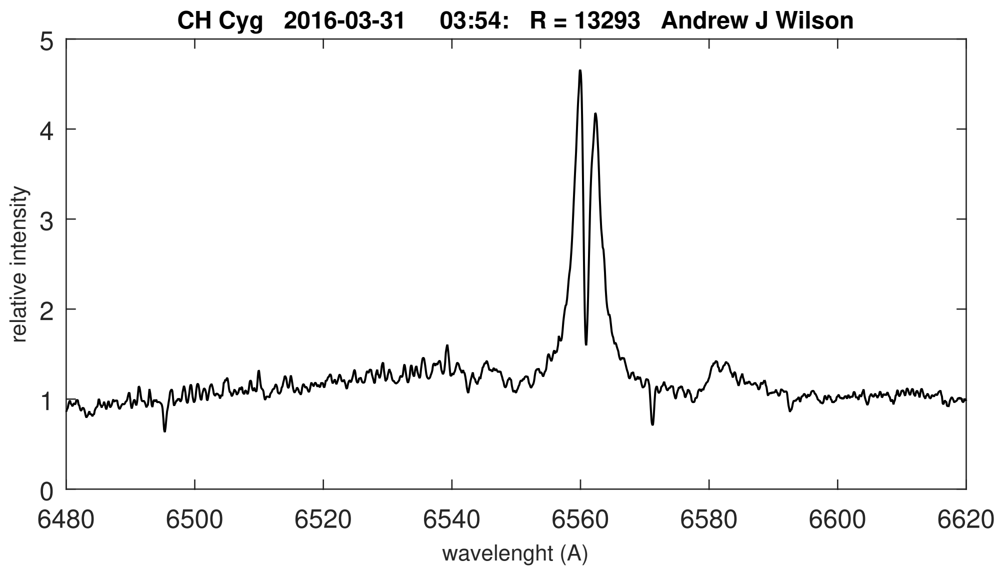
CH Cyg

Coordinates (2000.0)	
R.A.	19 24 33.1
Dec	+50 14 29.1
Mag	

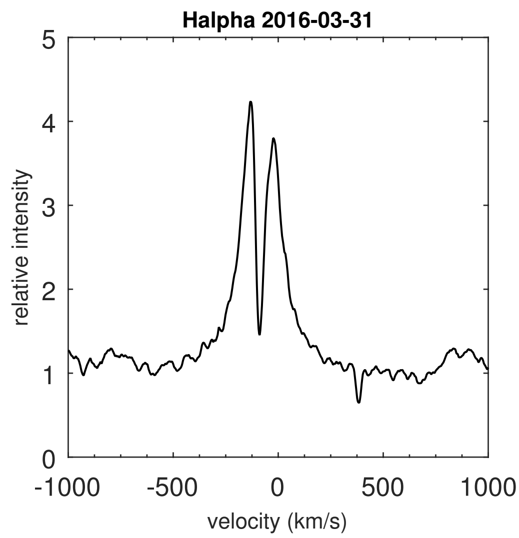
Ongoing cmapaign upon the request of Augustin Skopal
At least one spectrum (high resolution and low resolution, with a correct atmospheric response)

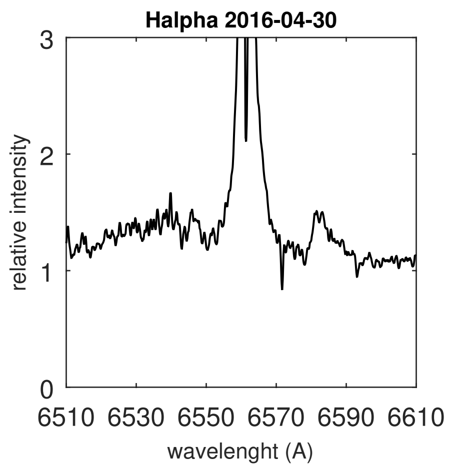


AAVSO light curve V in 2015-2016
ARAS Spectra blue dots



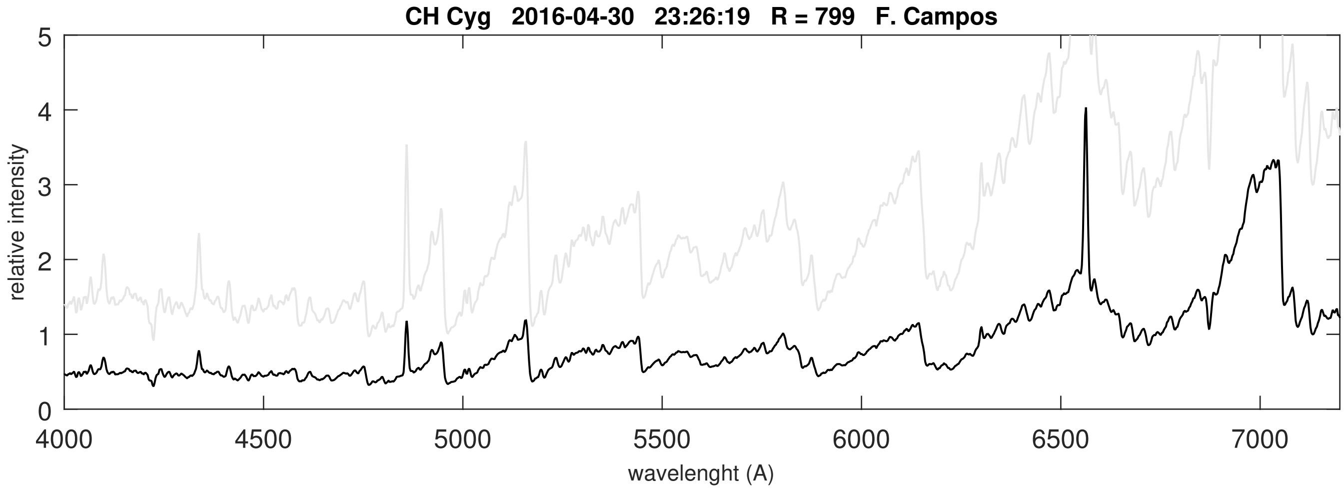
H alpha line by Andrew J. Wilson with a Lhires III 2400 l/mm



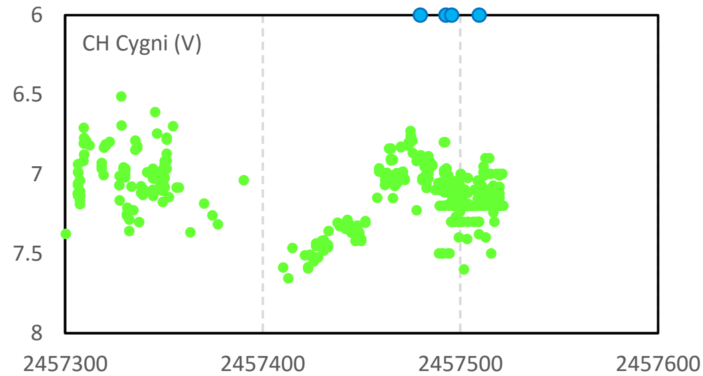


Left : Ha region (eshel, F. Teyssier) - Note the double peaked lines [N II] 6548 and 6583

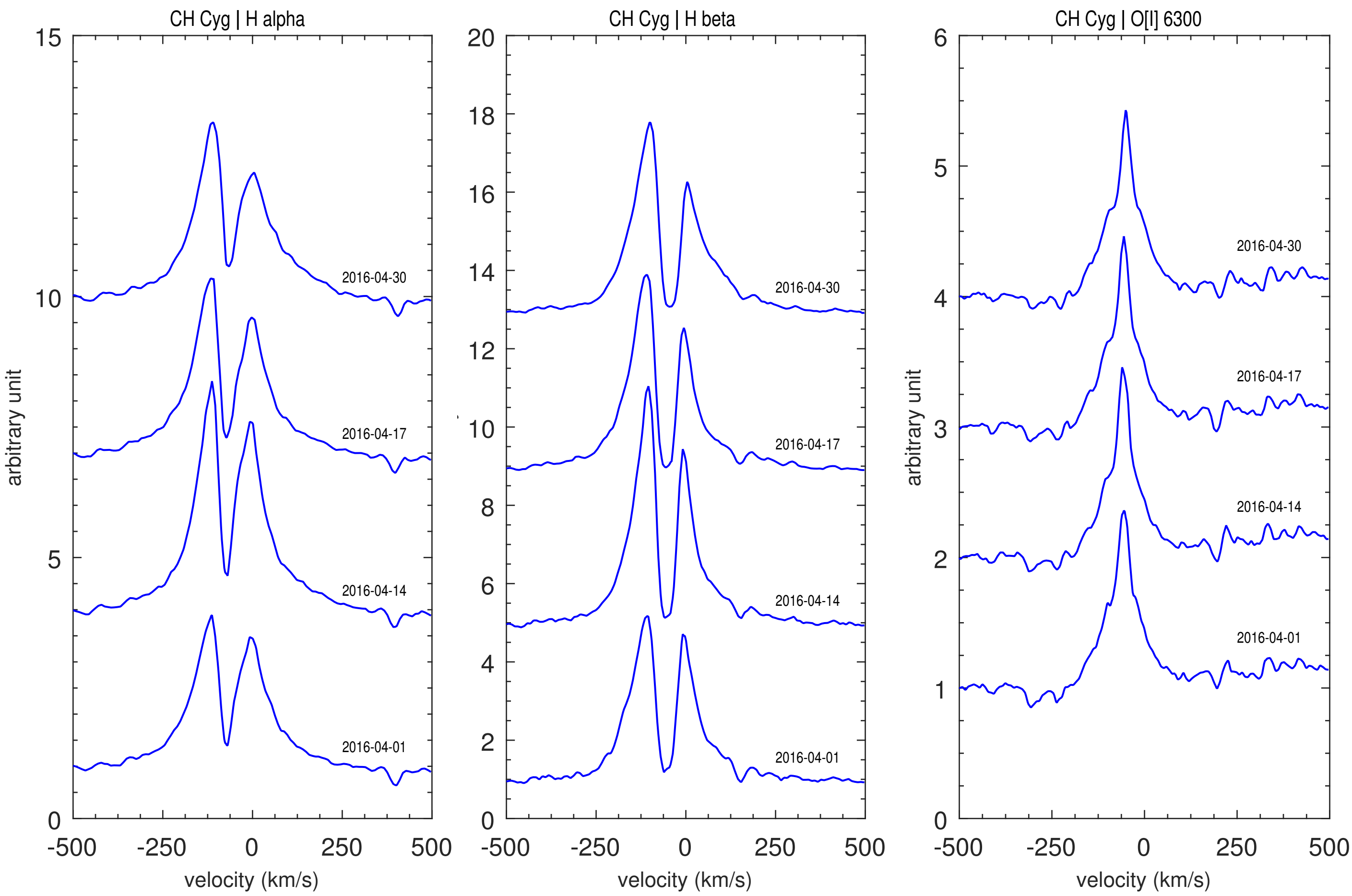
CH Cyg



Spectrum obtained by Frederico Campos with a DADOS spectrograph. The resolution is suffisant to resolve [OIII] 5007 and He I 5016

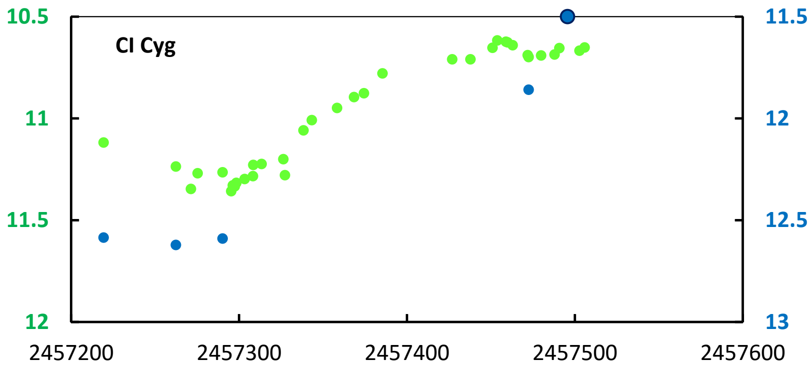


Hα, Hβ and [O I] lines in April.
F. Teyssier (eshel, R = 11 000)

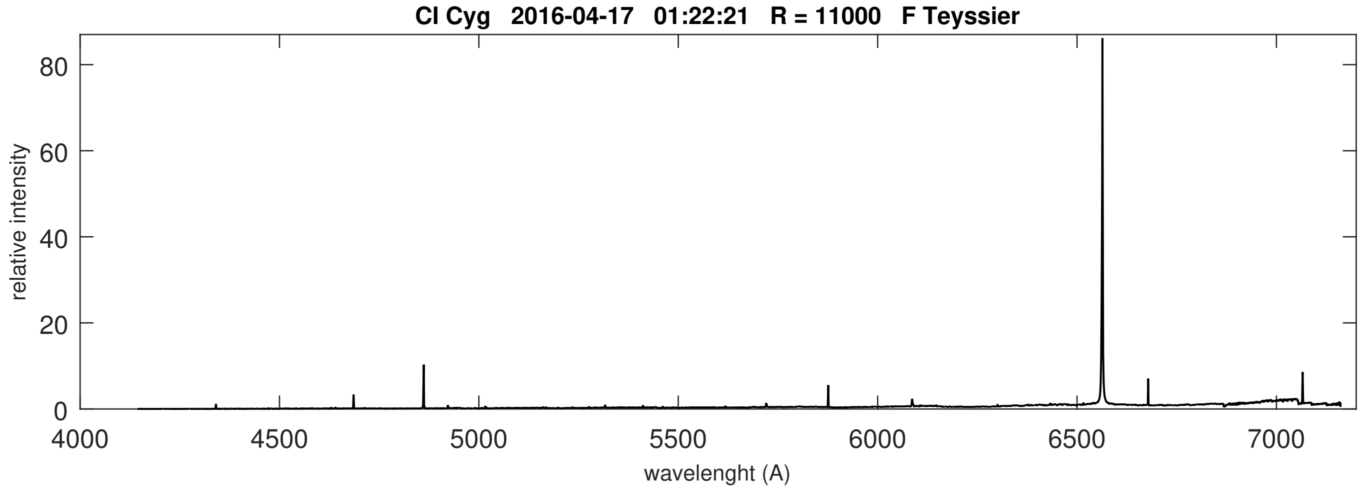


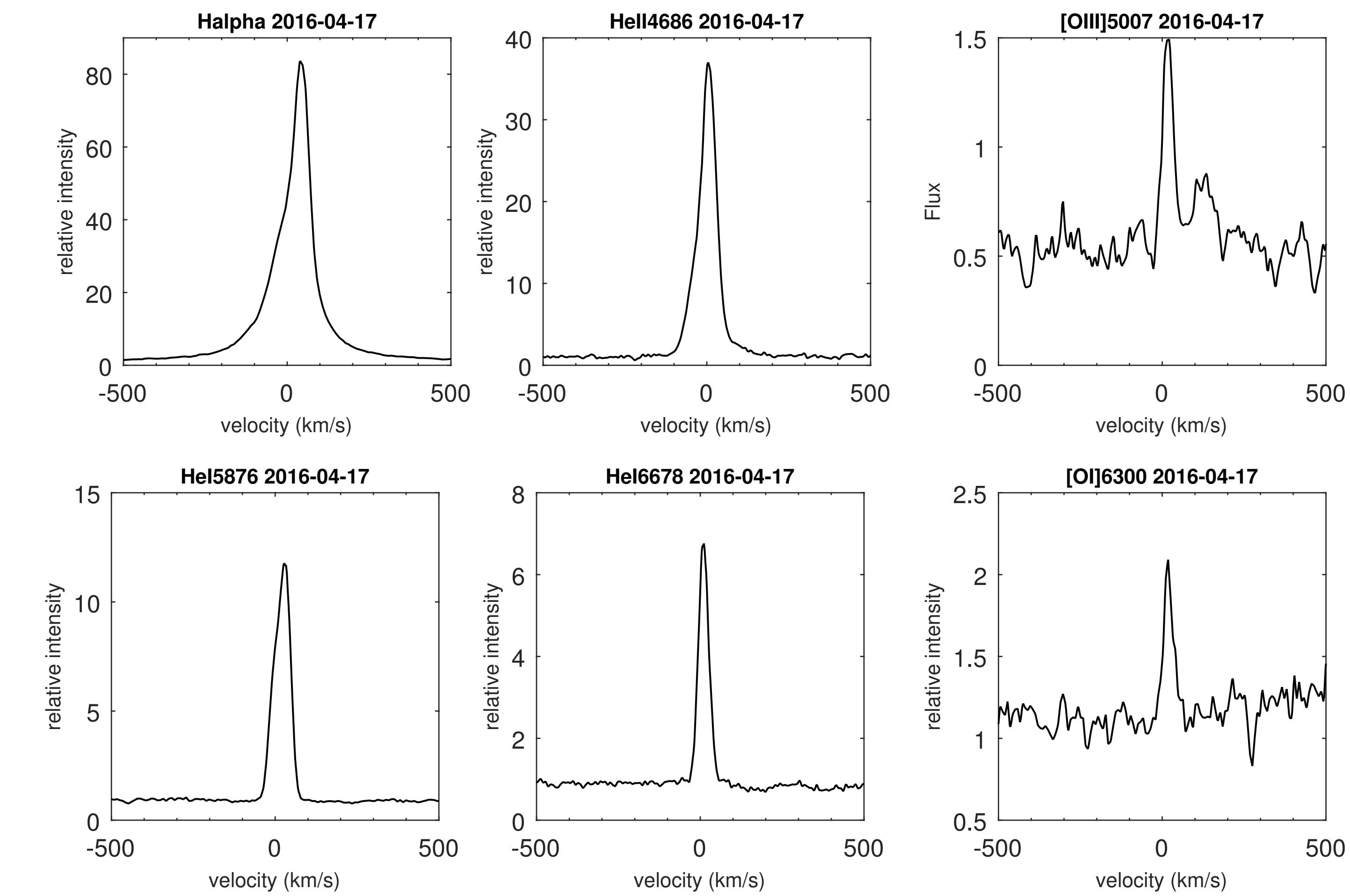
CI Cyg

Coordinates (2000.0)	
R.A.	19 50 11.8
Dec	35 41 30
Mag	10.6 (04-2016)



AAVSO V (green dots) and B (blue dots)

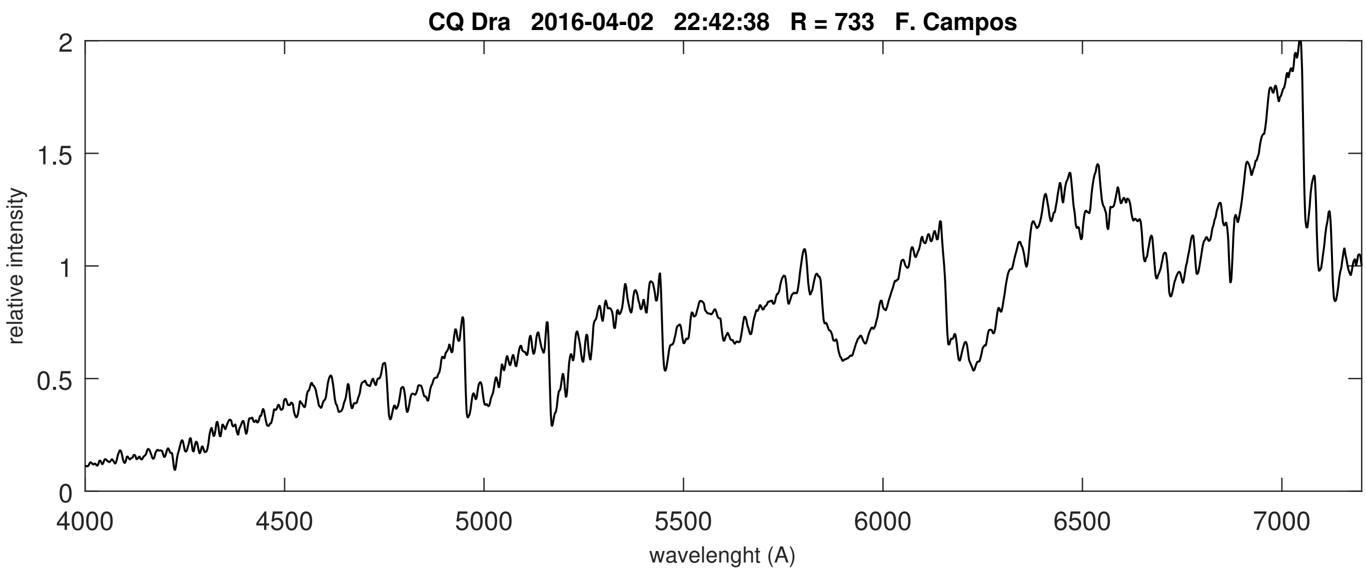




SYMBIOTICS

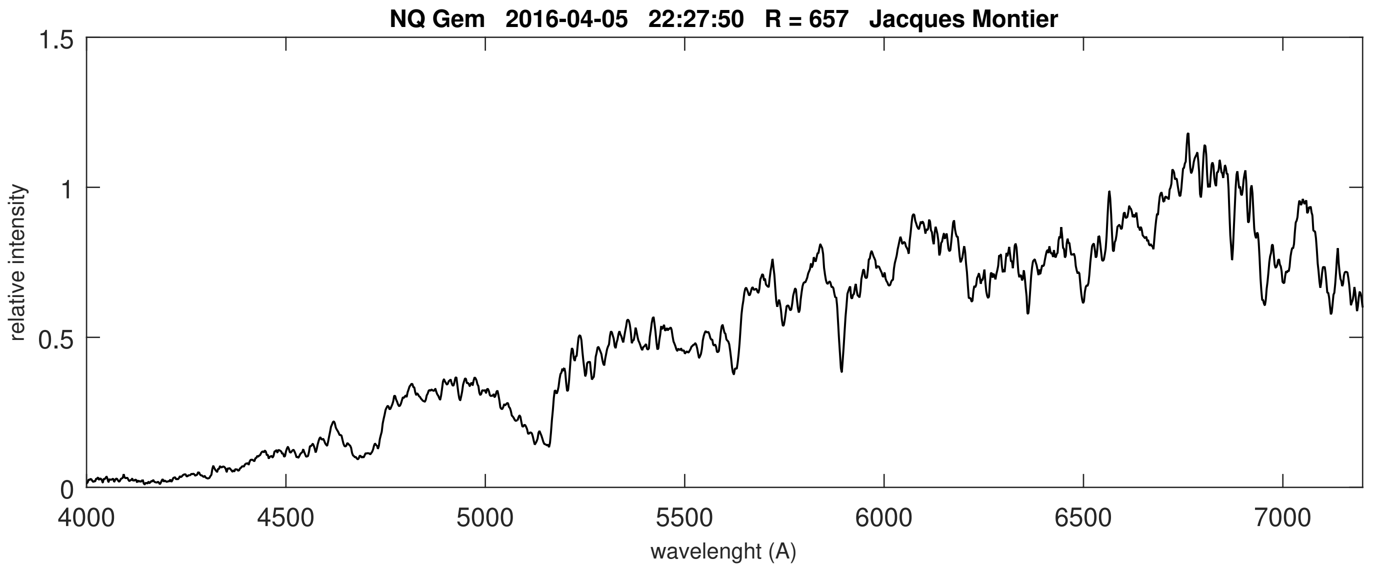
CQ Dra

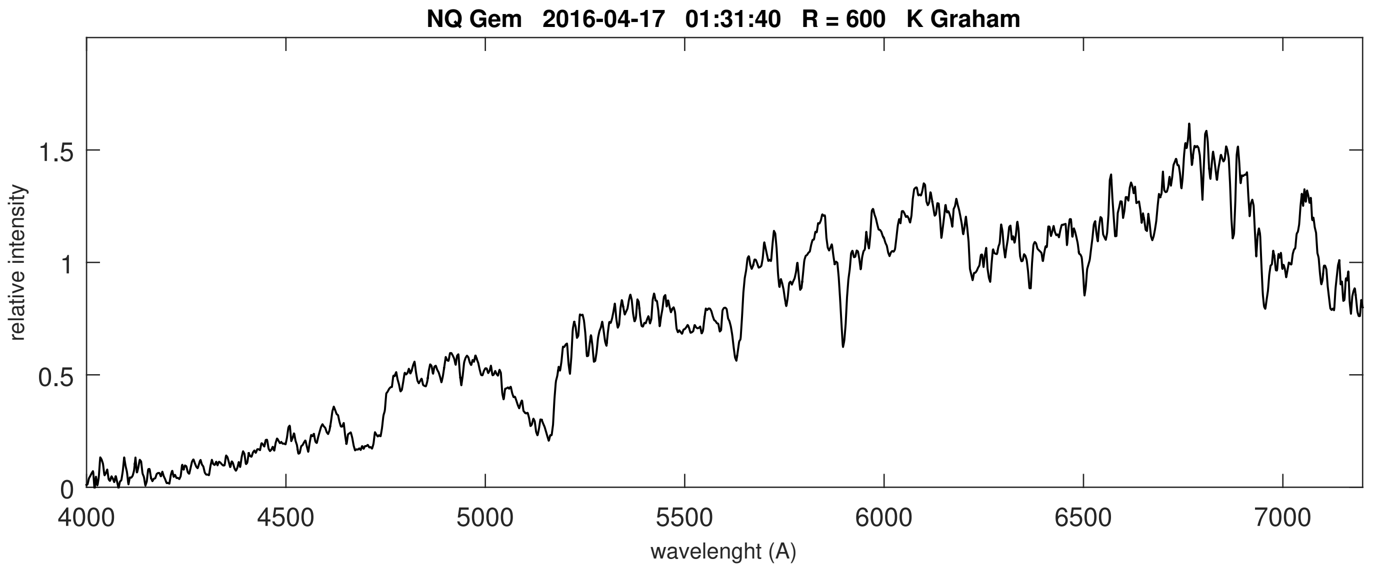
Coordinates (2000.0)	
R.A.	12 30 06.65
Dec	+69 12 04.0
Mag	5



NQ Gem

Coordinates (2000.0)	
R.A.	07 31 54.5
Dec	+24 30 12.5
Mag	7.9





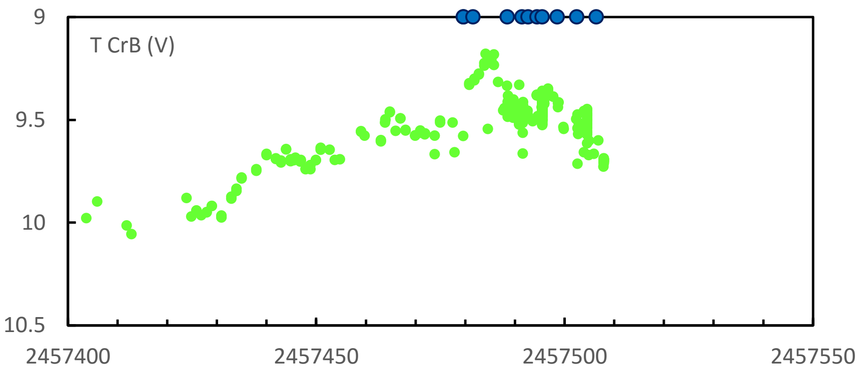
T CrB

Coordinates (2000.0)	
R.A.	15 59 30.2
Dec	+25 55 12.6
Mag	

The recurrent nova T CrB has entered in 2015 a phase of unprecedented high activity.

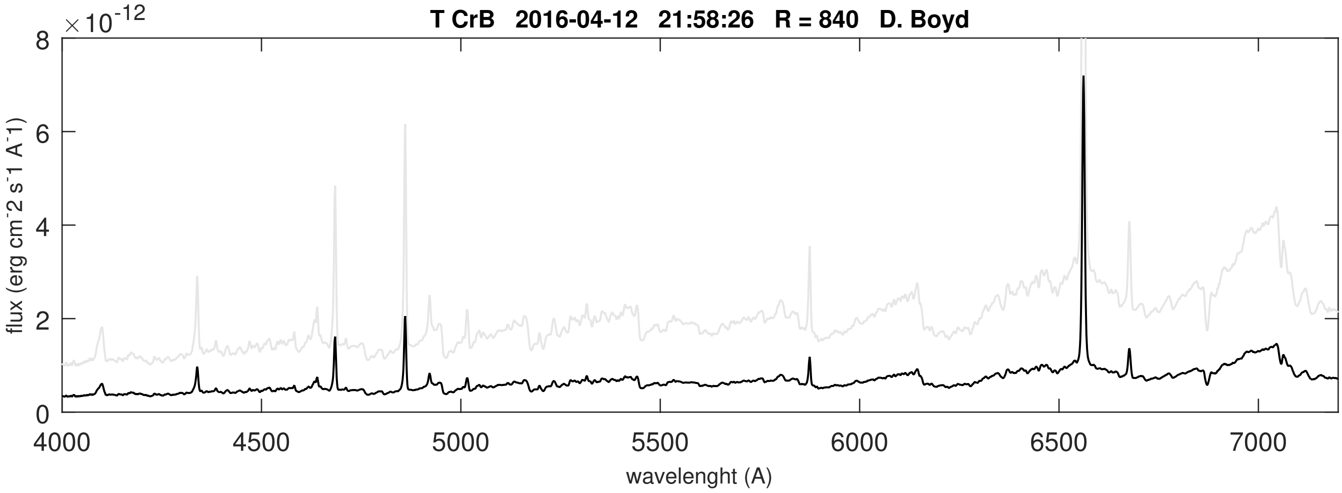
Is therefore everything in place for a new nova outburst in 2026, again 80 years past the last eruption ?

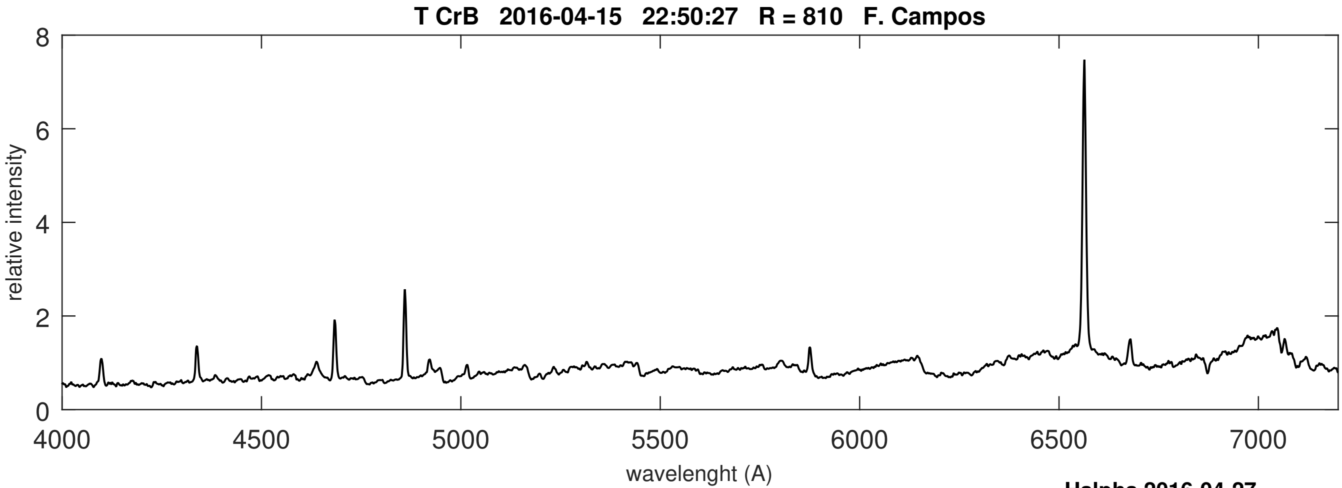
See Munari & al., 2016



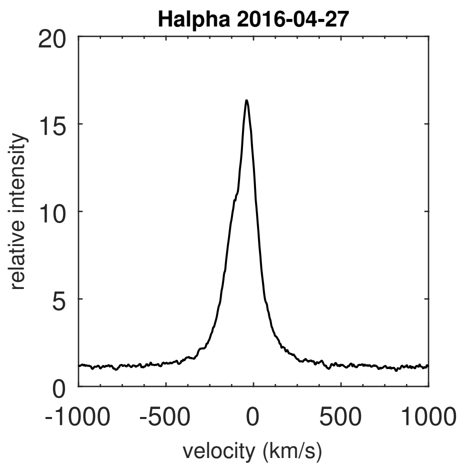
AAVSO V Band lightcurve 2016
ARAS Spectra in April : blue dots

Declining in April, from mag V = 9.2 to 9.7



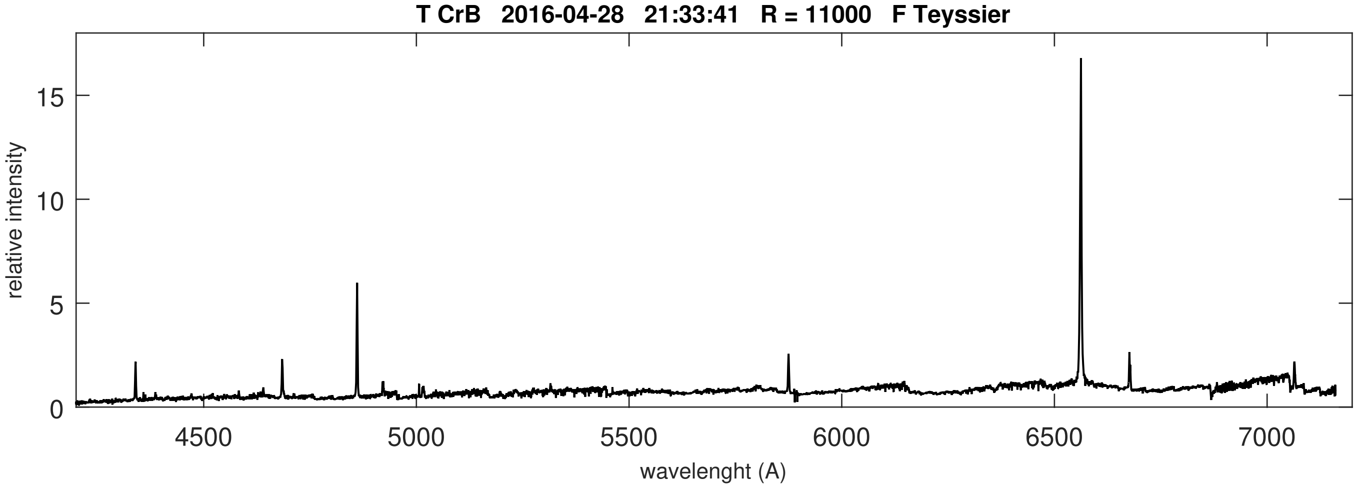


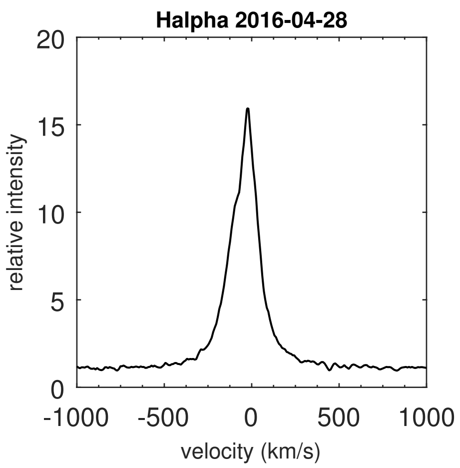
Hα profile
A. Wilson
Lhires III R = 13000
2016-04-27.887 UT

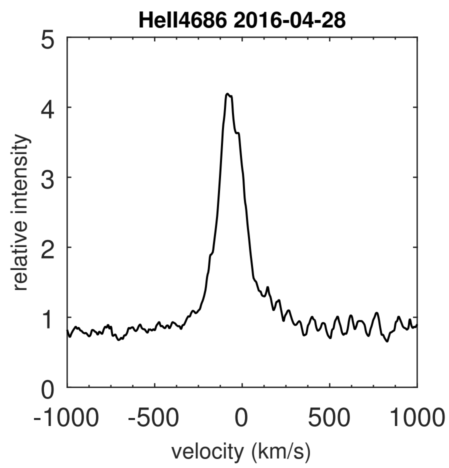


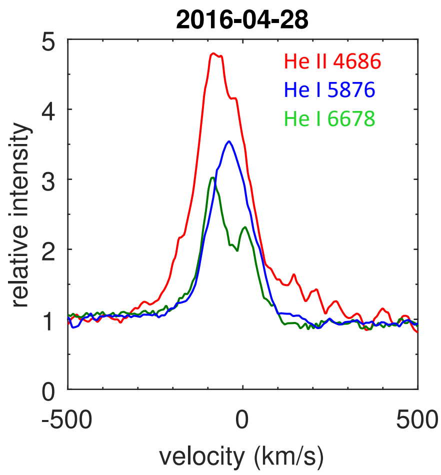
T CrB

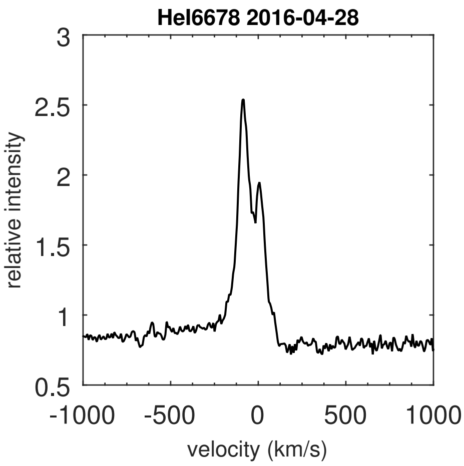
T CrB in april
eShel spectroscop - R = 11000
F. Teyssier

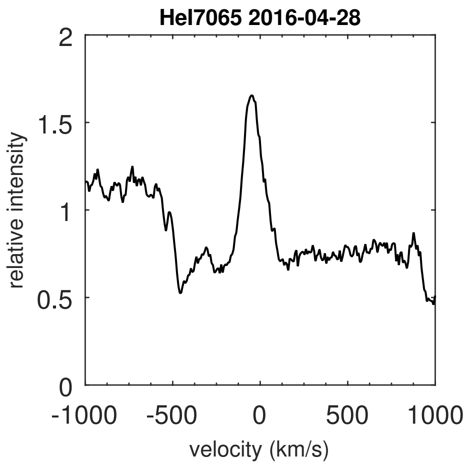


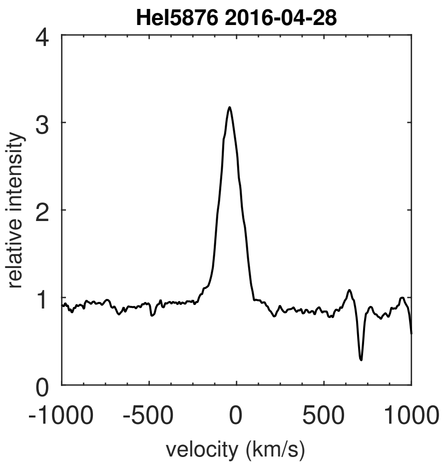






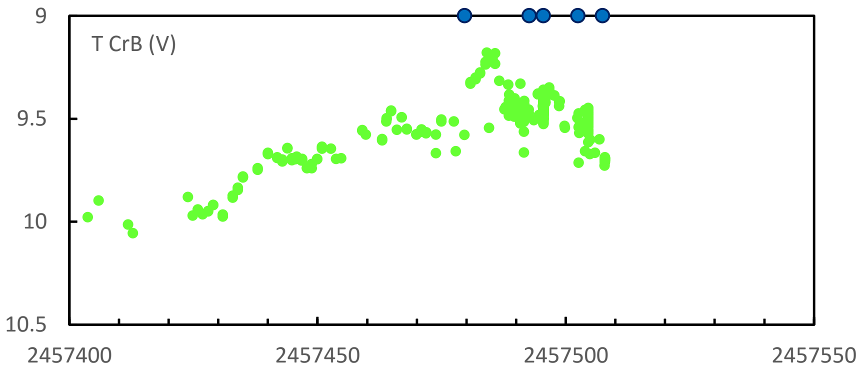


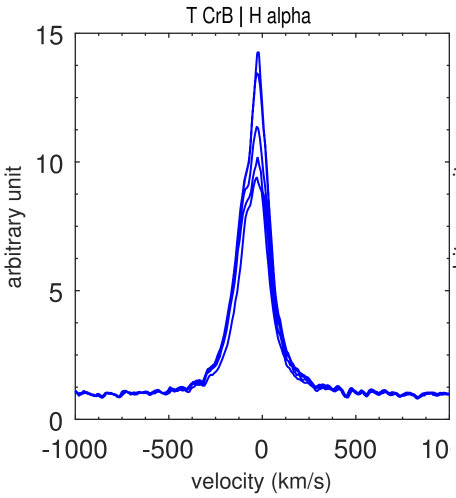


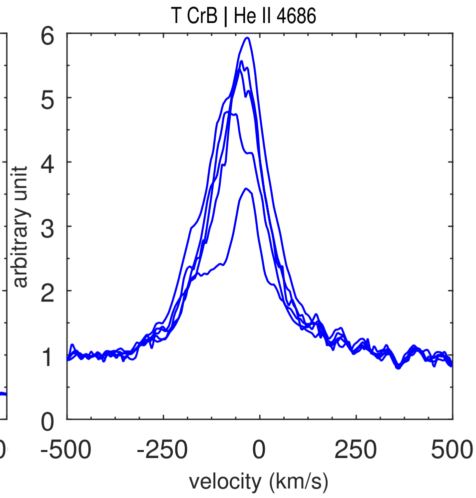


Note the strong difference between He I singlets and doublets shapes

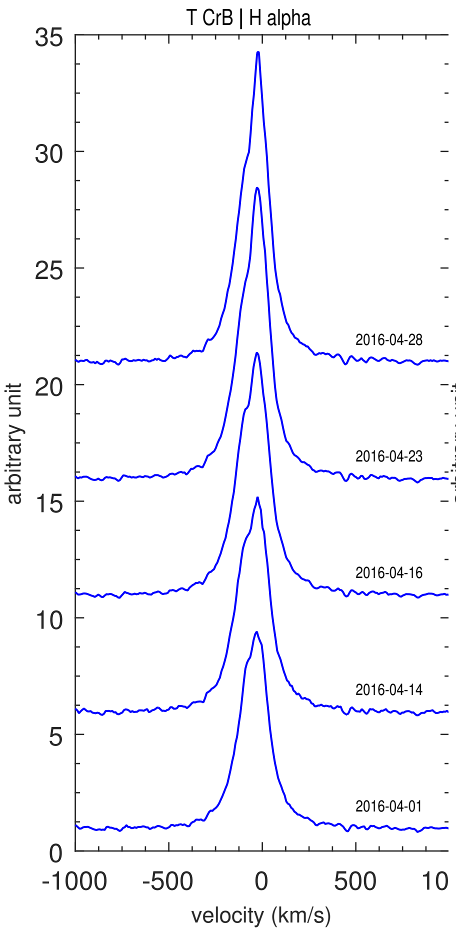
T CrB

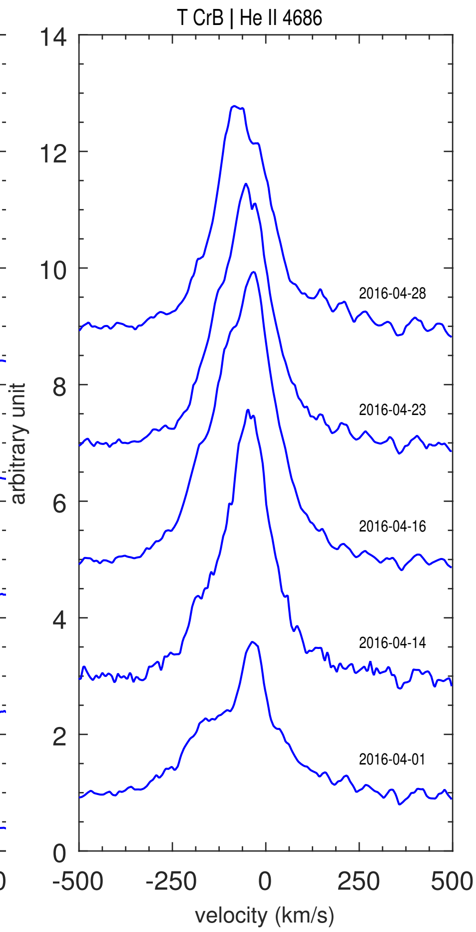


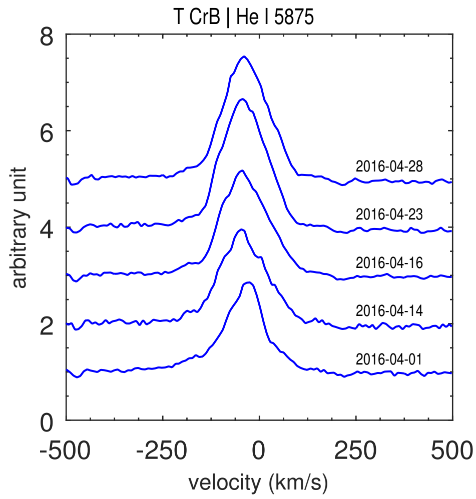


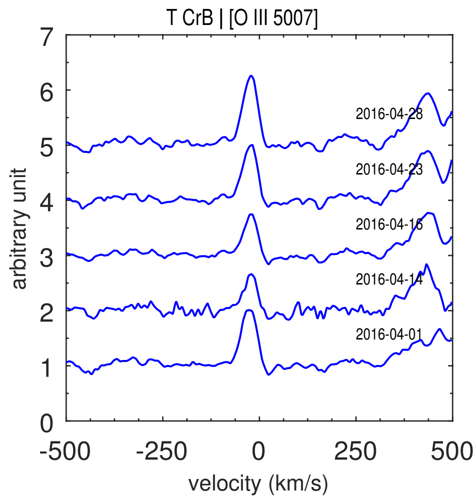


Impressive changes of He II Profile



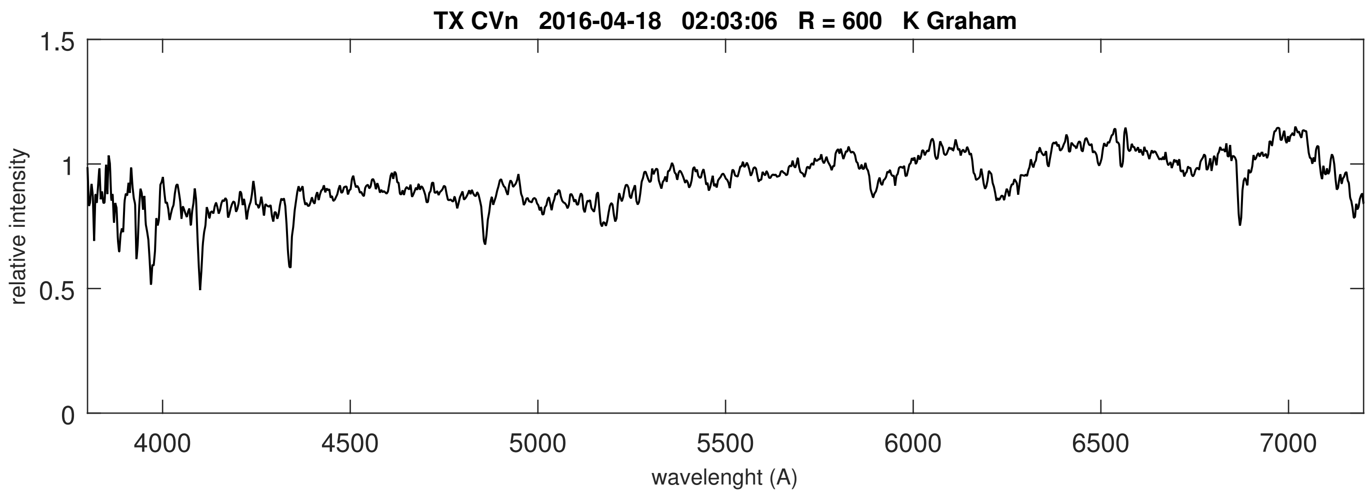


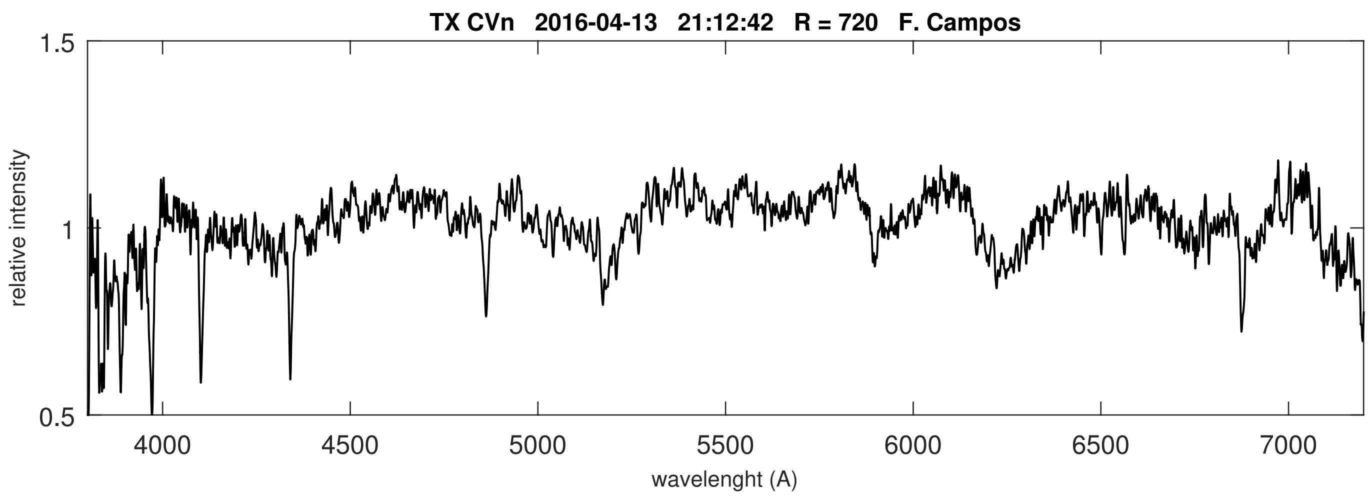


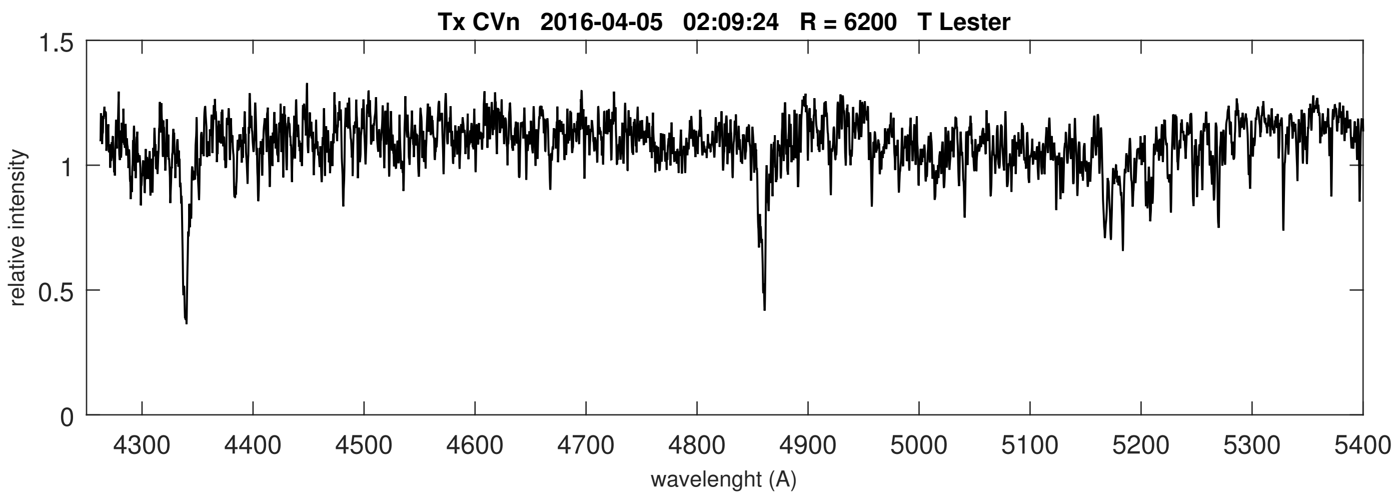


TX CVn

Coordinates (2000.0)	
R.A.	12 44 42.0
Dec	+36 45 50.7
Mag	10 (04-2016)





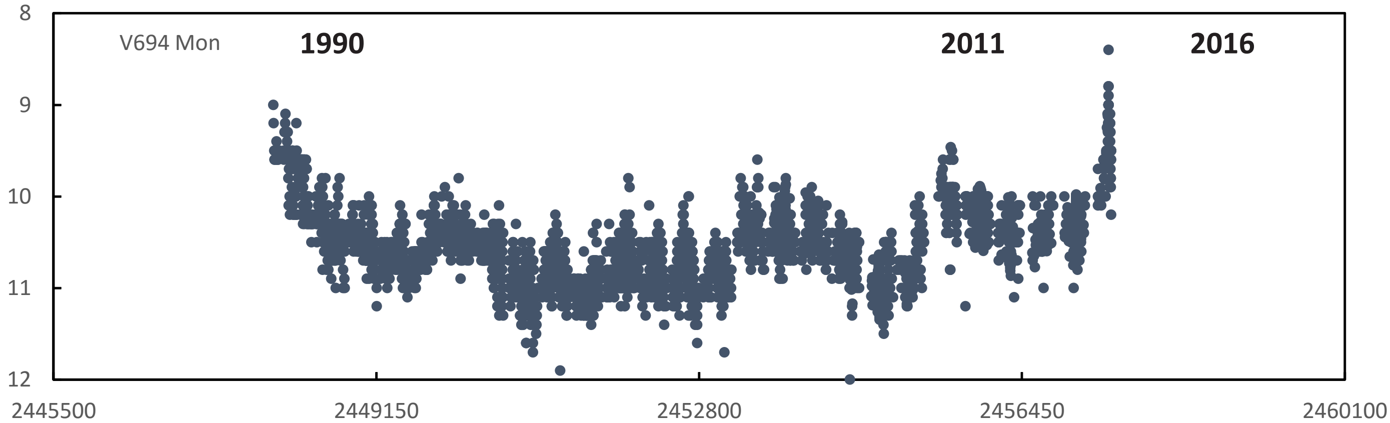


SYMBIOTICS

V694 Mon

Coordinates (2000.0)	
R.A.	07 25 51.3
Dec	-07 44 08.1
Mag	9.8 (12-2015)

V694 Mon Field
18th Feb., 2016
David Boyd

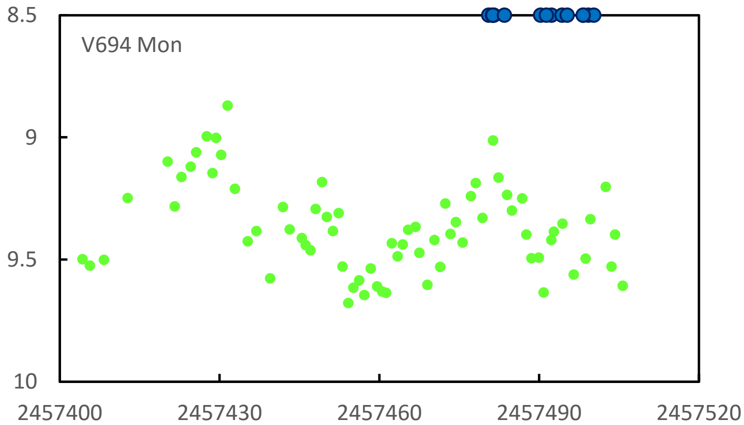


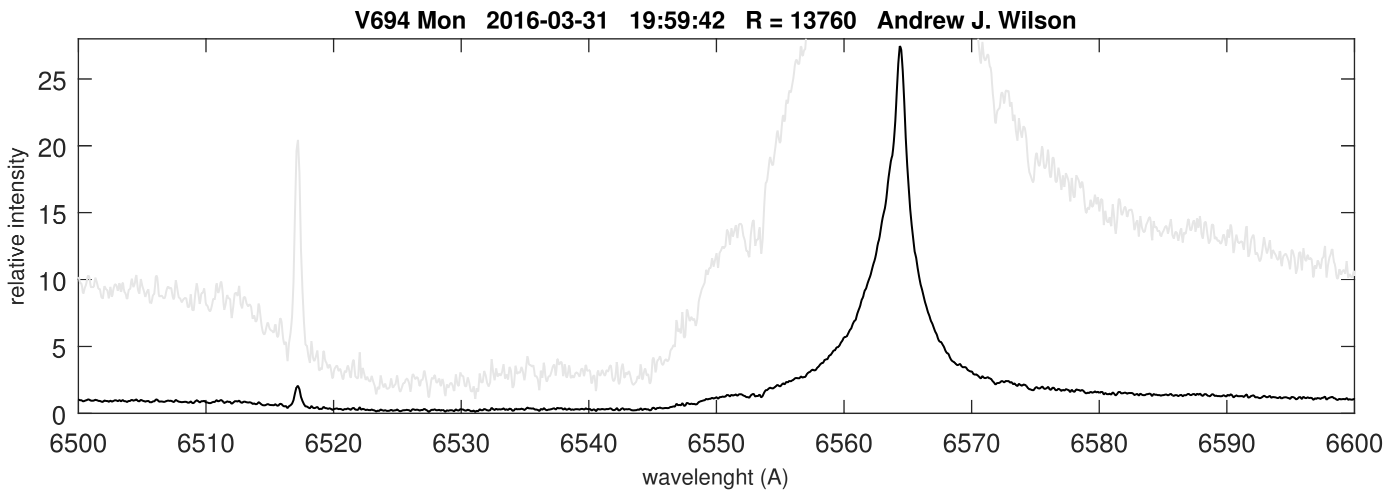
Long term AAVSO light curve in V and Visual. 2016 outburst brighter than 1990

AAVSO V band database 2016, 01-16 to 01-05
ARAS Spectra in April (15): blue dots

At date, the maximum velocity of absorptions still remains at about 2300 km/s. No plateau detected between absorption and emission.

Observing : next season



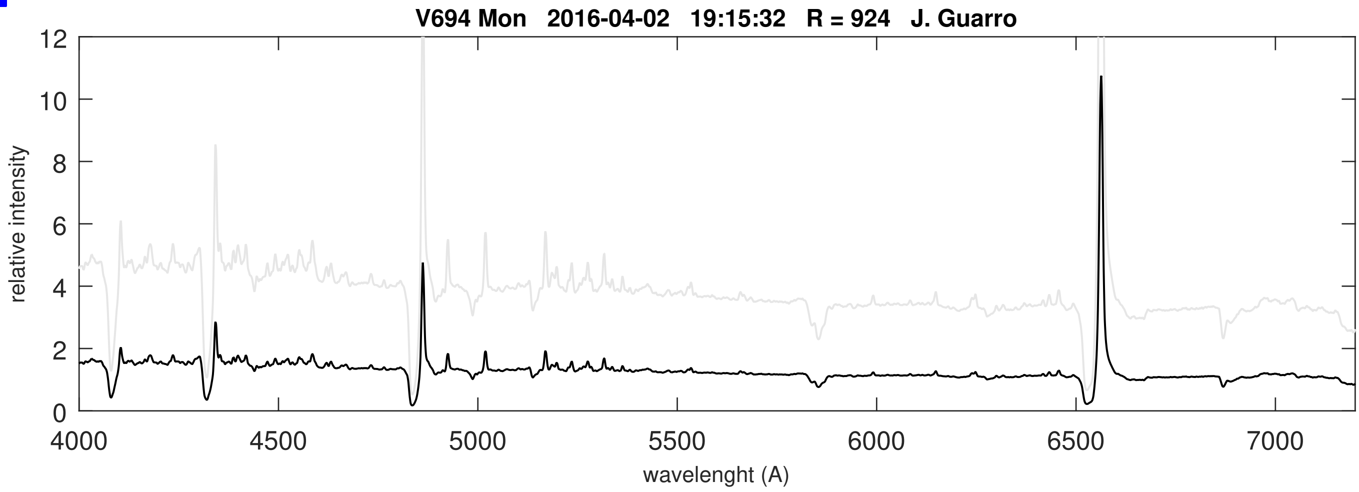


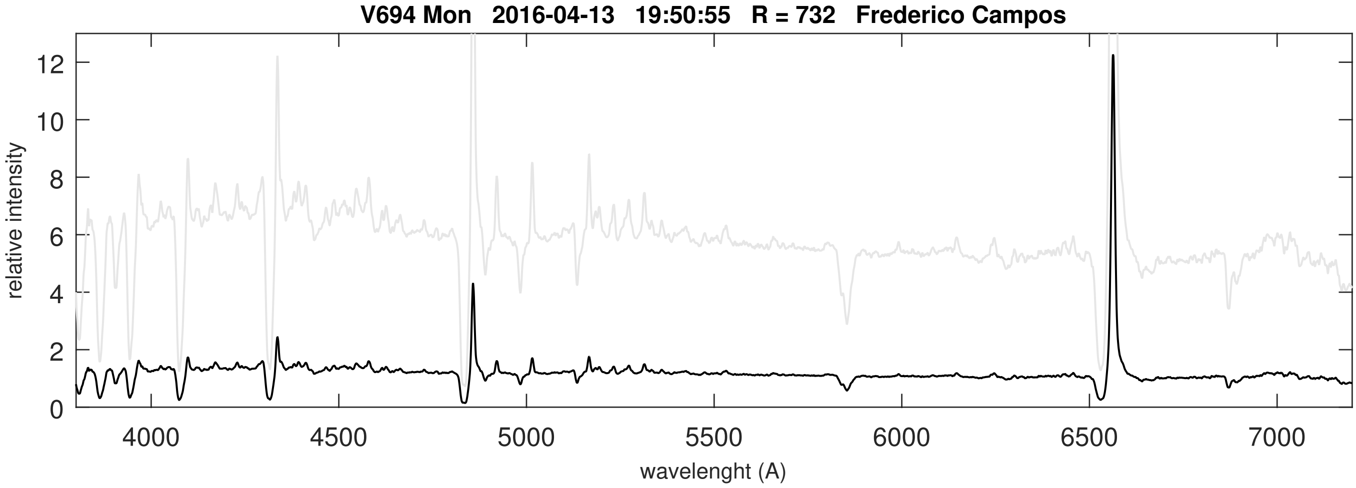
V694 Mon

Dramatic radio enhancement from the 26th anniversary outburst of jet-driving symbiotic binary MWC 560

ATel #8957; Adrian B. Lucy (Columbia), J. H. S. Weston (NRAO Green Bank), J. L. Sokoloski (Columbia) on 15 Apr 2016; 19:15 UT

We report the first detection of radio emission from the reputedly jet-driving symbiotic star MWC 560, which is currently undergoing a multi-wavelength outburst (ATel #8653, #8832, and references therein). On 2016 April 4.94 UT, the Jansky Very Large Array (VLA, C configuration) detected MWC 560, unresolved with a flux density of 82 +/- 5 microJy at 9.85 GHz (X band, with 3-bit samplers to cover a 3.65 GHz-wide broadband). This constitutes at least an order of magnitude enhancement over a Jansky VLA non-detection that we obtained on 2014 October 2.45 UT, before the outburst. At that time the 2*RMS upper limit was 6 microJy in this broadband.

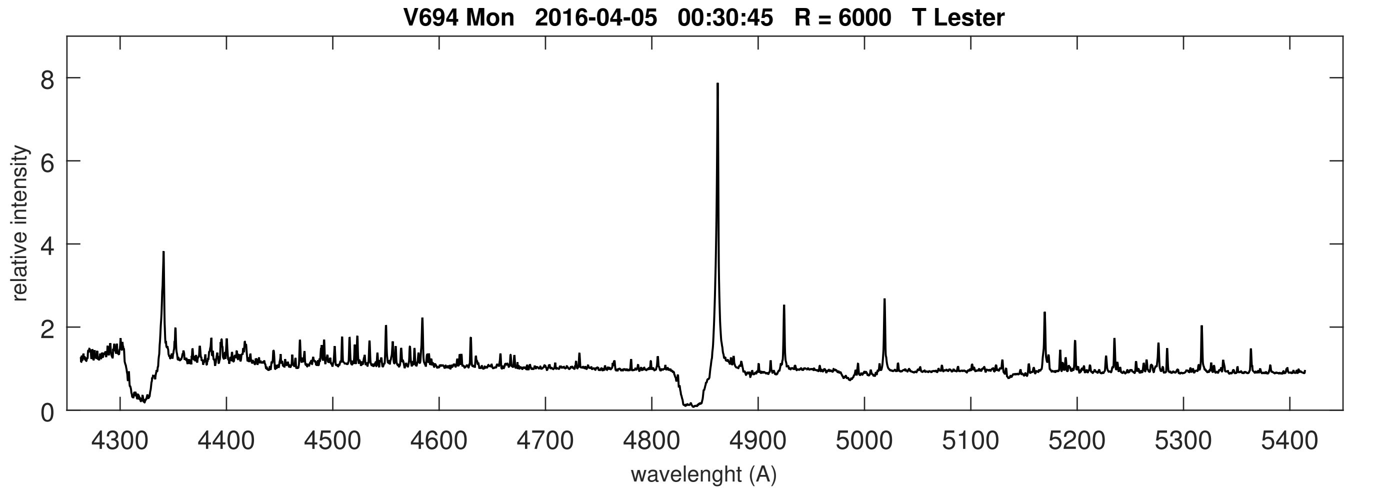


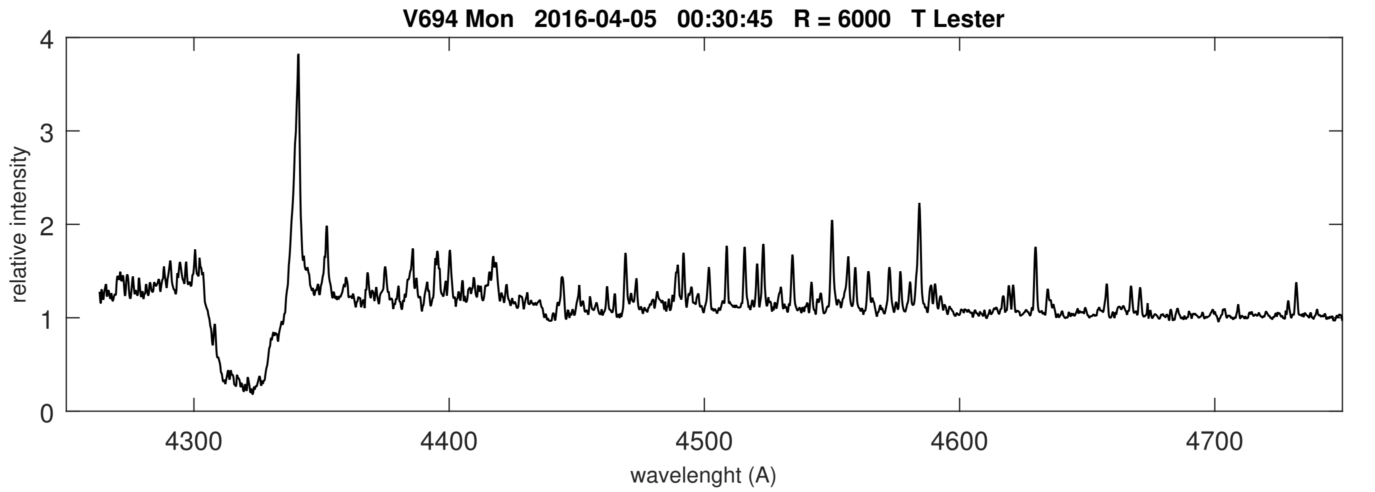


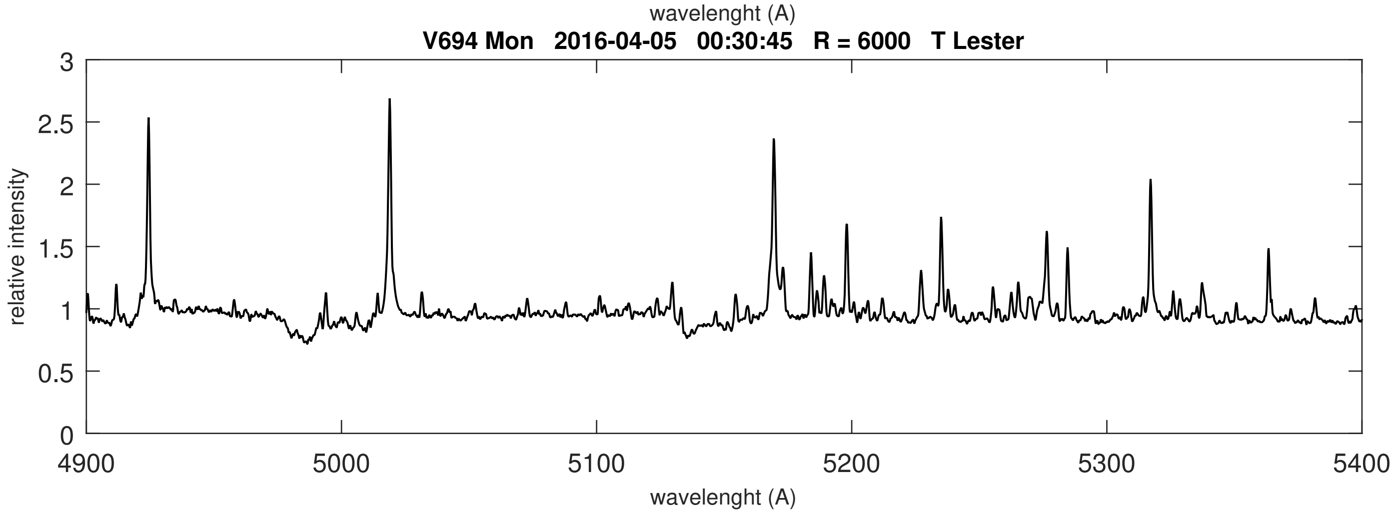
F. Campos - DADOS spectrograph - R = 1000

V694 Mon

Hβ region by Tim Lester with its home built spectrograph at R = 6000

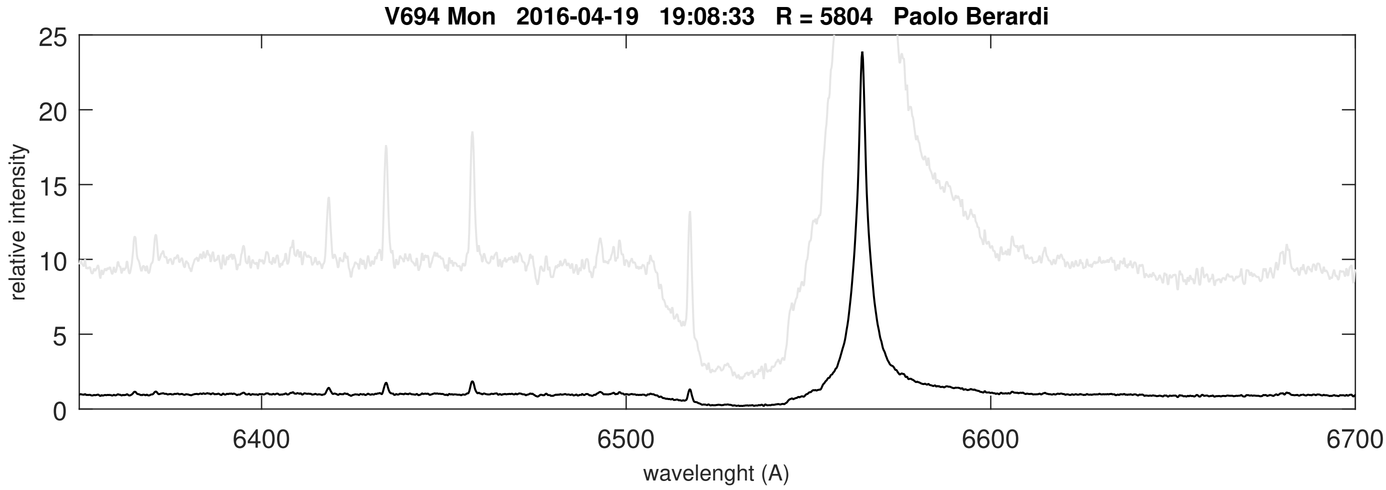


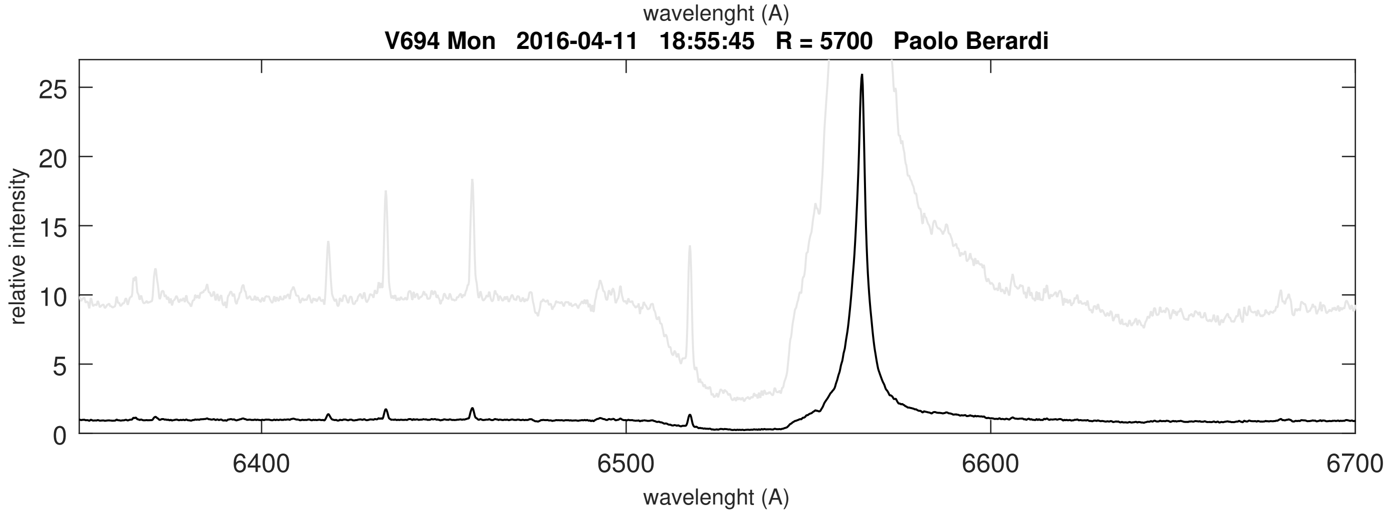


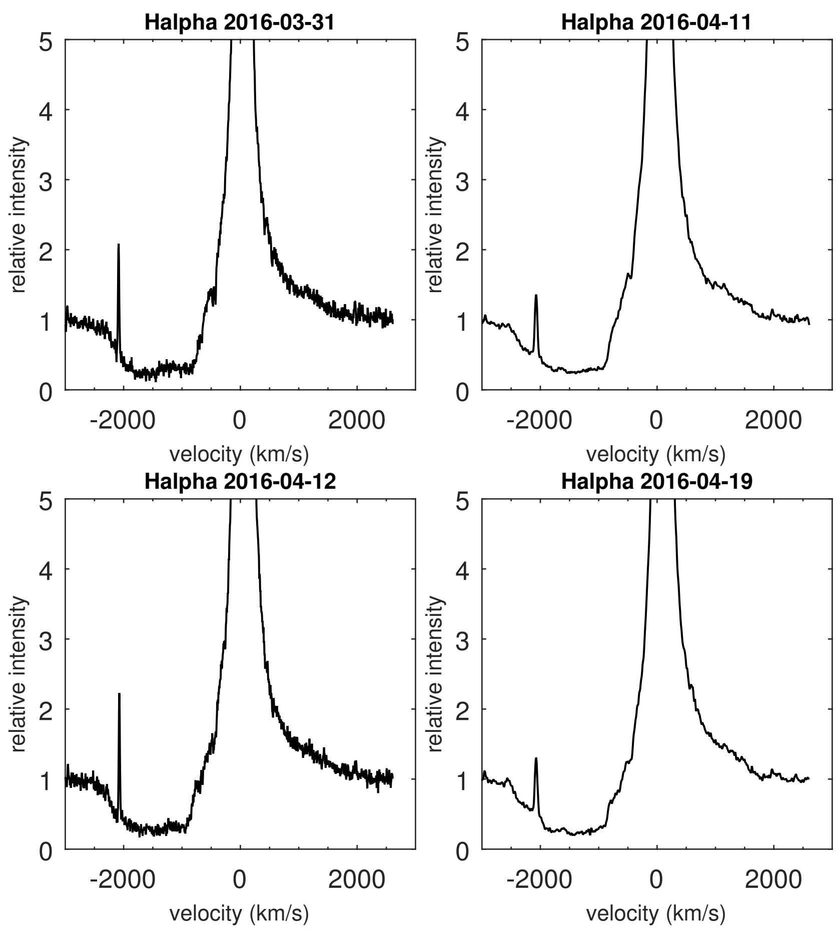


V694 Mon

Hα region by Paolo Berardi with a Lhires III at R = 6000



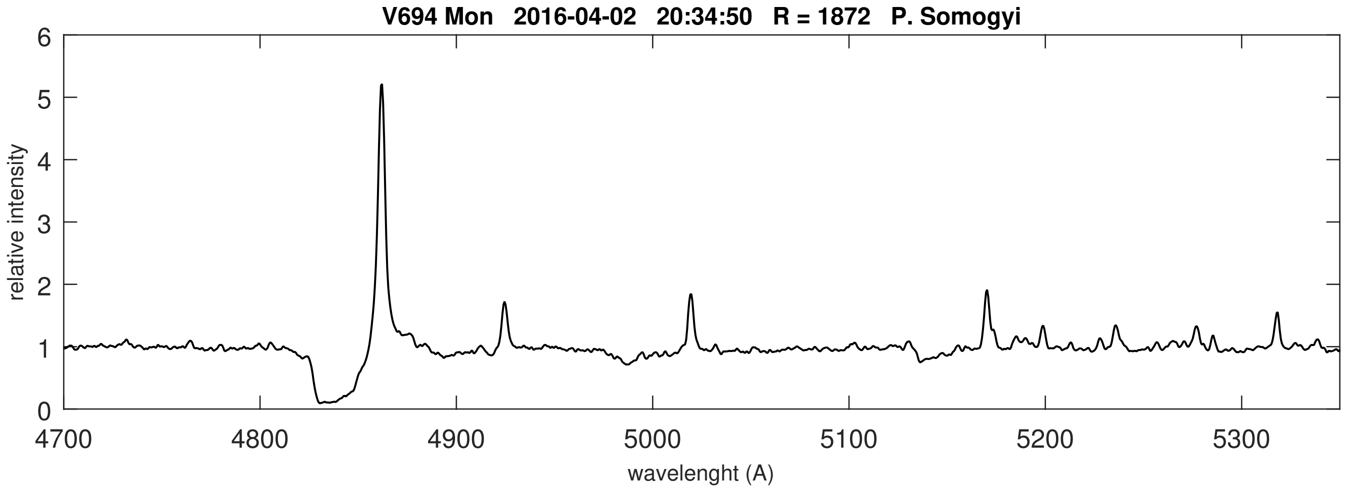


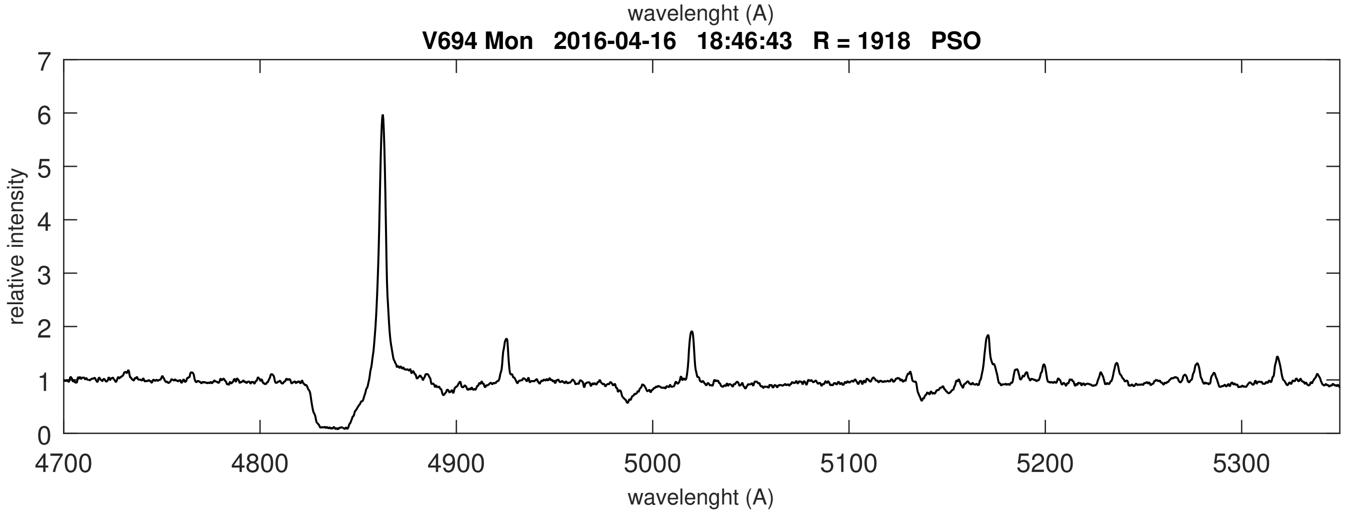


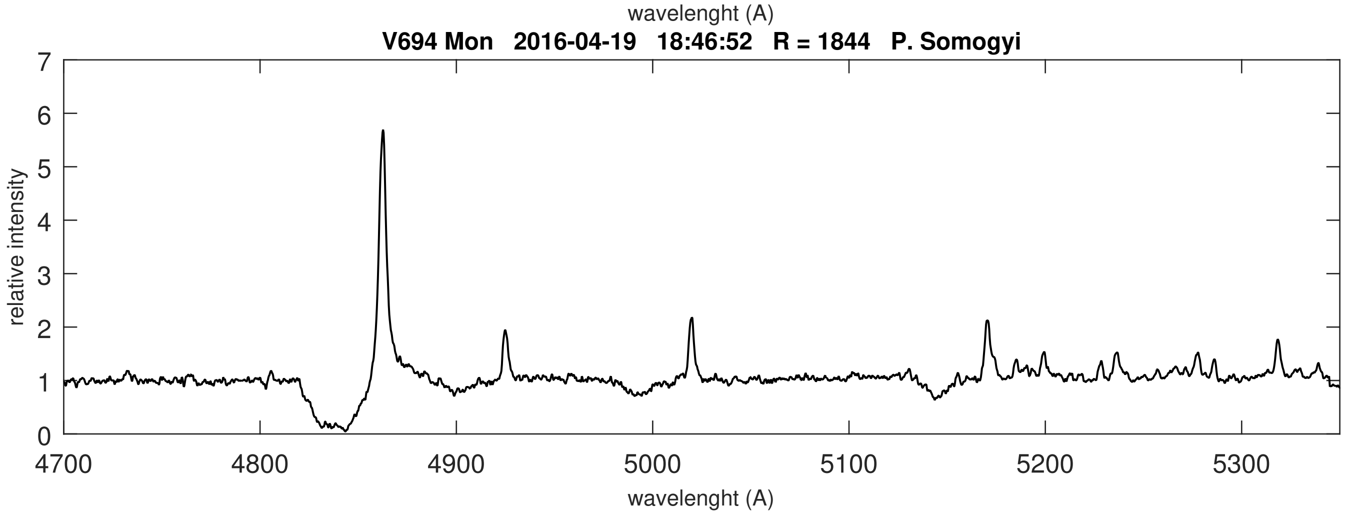
Hα profiles
Andrew J. Wilson:31-03 & 12-04
Paolo Berardi: 11-04 & 19-04

V694 Mon

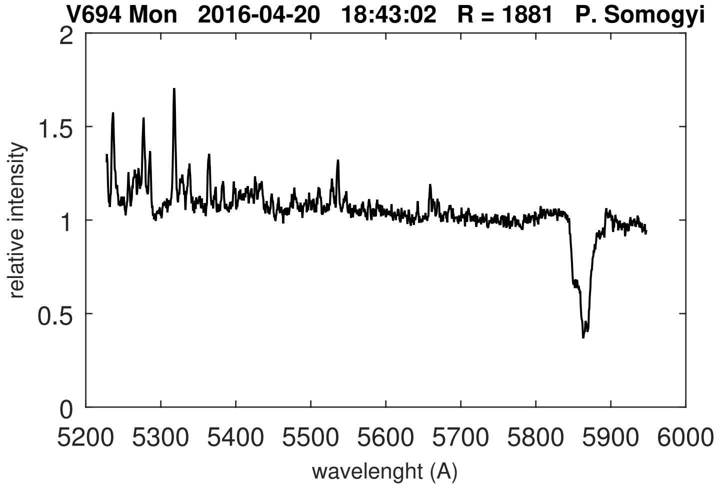
Hβ region - Peter Somogyi - Lhires III - 600 l/mm R = 2000

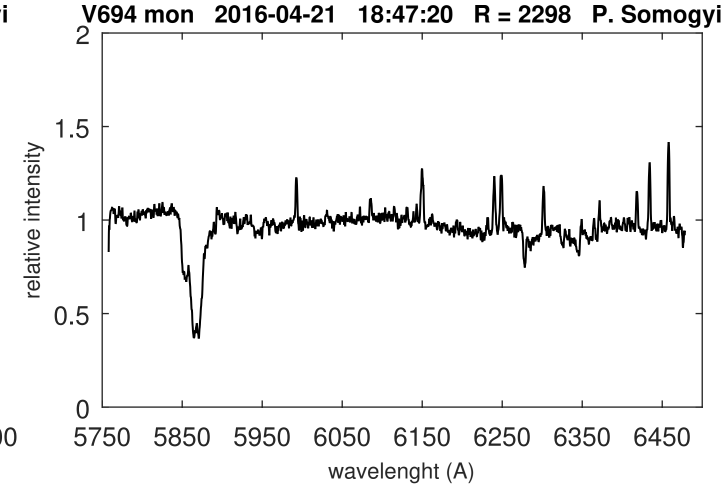






Na I D region- Peter Somogyi - Lhires III - 600 l/mm R = 2000





V694 Mon compilation 2016.01.20 - 2016.04.21 by Peter Somogyi

V694 Mon has had an outburst peaked by visual magnitude
on 2016.02.11 (JD=2457430) / 2016.02.12 (2457431).

It has triggered dense observations uploaded to ARAS Database of 84 spectra I could download (of approx. 40-50 could use per relevant feature, either full spectrum or tied to the given feature)

This gave me excellent occasion to experiment with metrics that could be used across different resolutions:

- 42 low res (R~500 - 1100)
- 26 low-med res (R~1900 - R~2500)
- 15 high-med res (R~5600 - R~13000)

The low-medres spectra are mostly mine, some of them repetative around outburst or switching to different wavelength during the same night. Aim here would be to do an aftermath what did we achieve in overall, and examine which metrics usable across these many resolutions, based mostly on the use of many low resolution spectra. (It's also the highest potential in amateur spectroscopy I can see these days.) This means I fully skip any high resolution analysis, that's aslo far beyond my knowledge and understanding.

This compilation project is also a big learning step, where I've gathered ability of mastering gnuplot and deep dive in IRAF metrics, all via an automated way. Please take this compilation as my non-professional attempt to show consistent or most typical correlations, giving a concrete overview about the effort we did and where we are. But I will not be able to give any high level analysis about physics, that's remain for deep experts (who would also need to go through such a processing like I did). The most demanding step requiring human intervention is still a proper and accurate continuum rectification (that doesn't necessarily require precise reference star to observe, when always rectifying it locally it's not that much problemmatic).

Pre-processing per main features:

- H-beta region: rectified continuum to regions 4677:4715,4738:4756,4767:4794,5037:5088 A, and shifted all spectra to FeII 5019 (more precisely to 5019.452 chosen by simple average)
This way I avoided to do any heliocentric correction (arguable, but it should be fixing other calibration errors, and seemingly it arranges the graphs very nicely)
After then just used below 1 or above cut, assuming continuum at 1. (This assumption gets a bit fuzzy at FeII absorption triplet near H-beta.)

- NaI 5890 / HeI 5876: rectified continuum to 5700:5800 A, did a 2nd order spline correction for 5500:6200 with rejecting iterations. (All scripted, of course.)

- H-alpha region: rectified continuum to 6400:6500,6600:6650 A, shifted spectra to a common H-alpha peak (chosen 6563A).

- a global low res. view, to provide UBVR ratio overview: all spectra mutliplied by a constant to have a common mean in V.

As for determining the maximum velocity of H-beta and H-alpha (= the most typical question arise on the forum), I've developed a tricky method on my own:

- H-beta: bounce the absorption at half continuum, and cut its top at 0.33, then scale to 1 again
- H-alpha: bounce the absorption at 0.75 continuum (it's much less thick!), multiply the bouncing spectra by 2, then cut on top at half

The "bouncing" is produced via simple max/min cut and negation (* -1), just the very basic math operations (after local continuum and spectral shift mentioned already above).

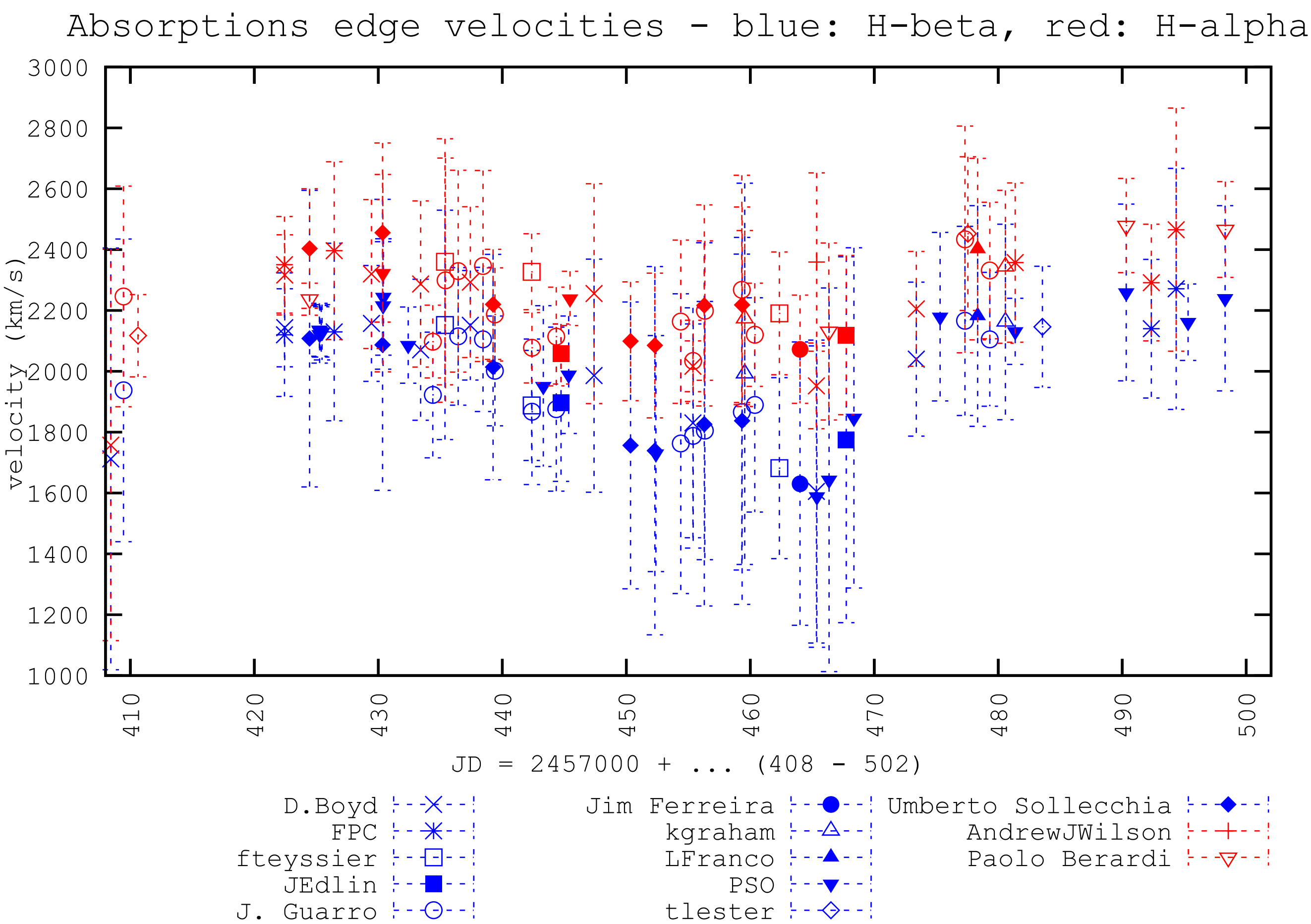


Figure 1. Hα Hβ maximum velocity

This view shows the most frequent metric we read the very first. There is a systemmatic difference between H-alpha and H-beta, must be due to subtle difference in determination of the edge. I would say - especially for the H-alpha - it just depends on the tricky metrics we chose. Maybe fine tuning was necessary I had not enough time to dive in.

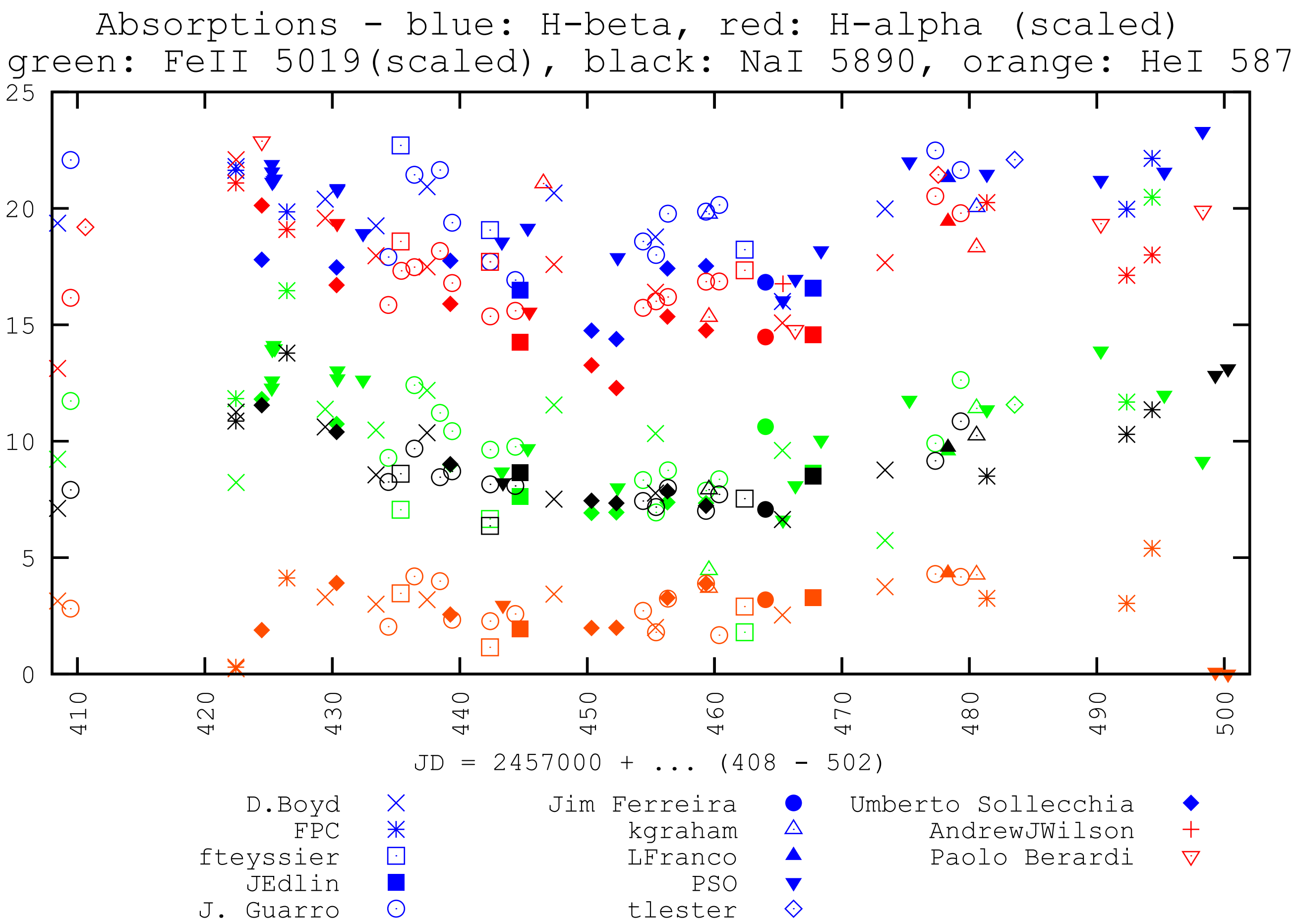


Figure 2. Absorption flux Hα Hβ Fe II 5019 Na I 5890 He I 5876

Let's switch now to a trivial measurement style that avoids personal beliefs and tricks. From here, I use trivial summation of pixel values on spectra between two different (self-chosen) wavelength regions, per each feature:

- H-beta absorption: 4790-4867A
- H-alpha abs.: 6450-6563A
- FeII 5019A: 4930-5021A
- NaI 5890: 5846-5882A

The NaI 5890 absorption flux is correlating very well with FeII 5019 absorption features (and other FeII). It is now a surprise to me, and should validate the NaI/HeI double feature where to split them.

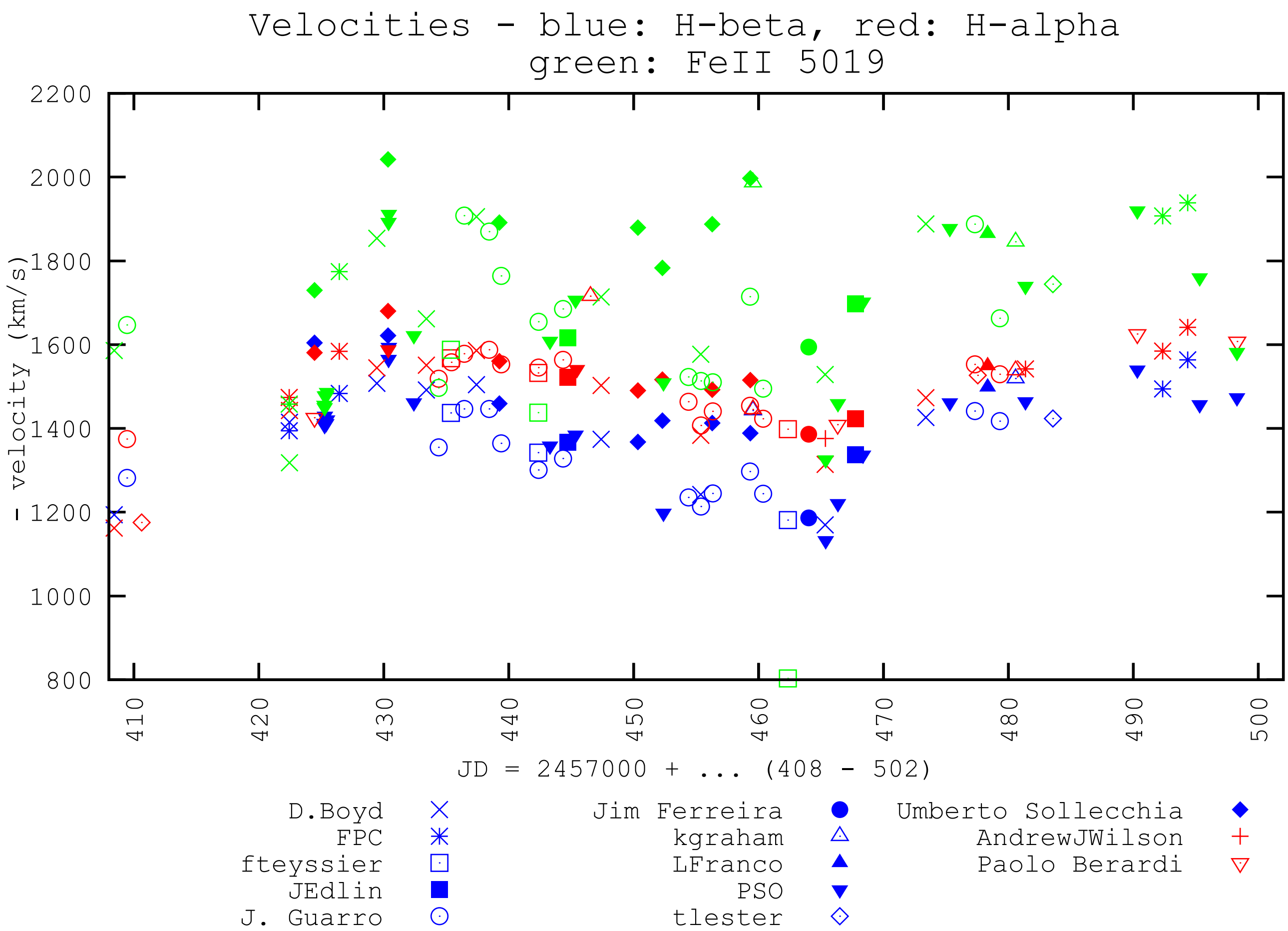


Figure 3. Velocities Hα Hβ Fe II 5019

Let's not forget, for absorptions I always did a maximum cut at 1 (continuum level). However, for H-beta at some of the lowest resolutions (R~500) the emissions intrumental widening may be disturbing here.

V694 Mon

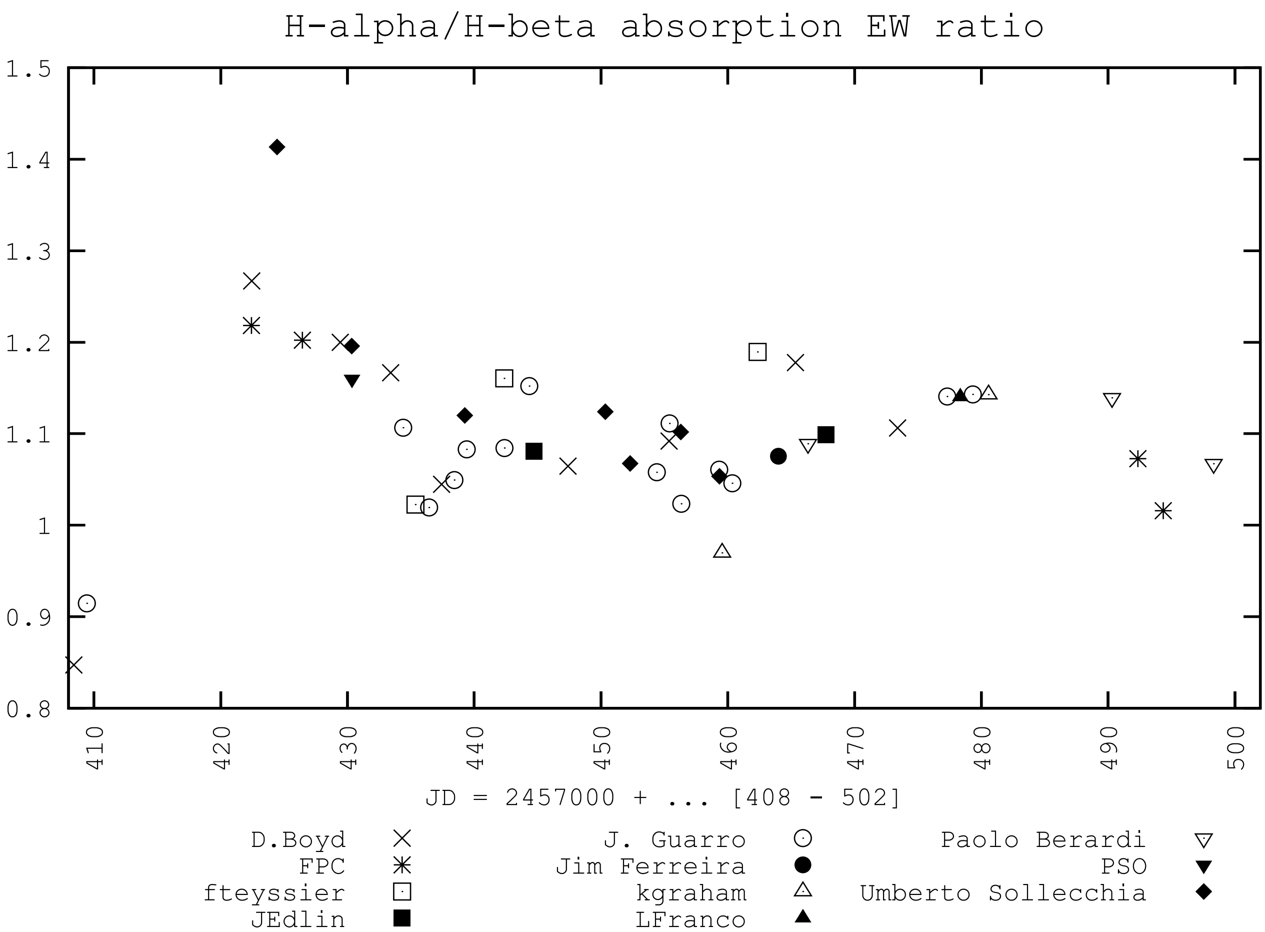


Figure 4. Equivalent width ratio Hα/Hβ

Here I wanted to show the opacity of Balmer absorption. This is a simple ratio of EW(H-alpha abs.)/ EW(H-beta abs.).

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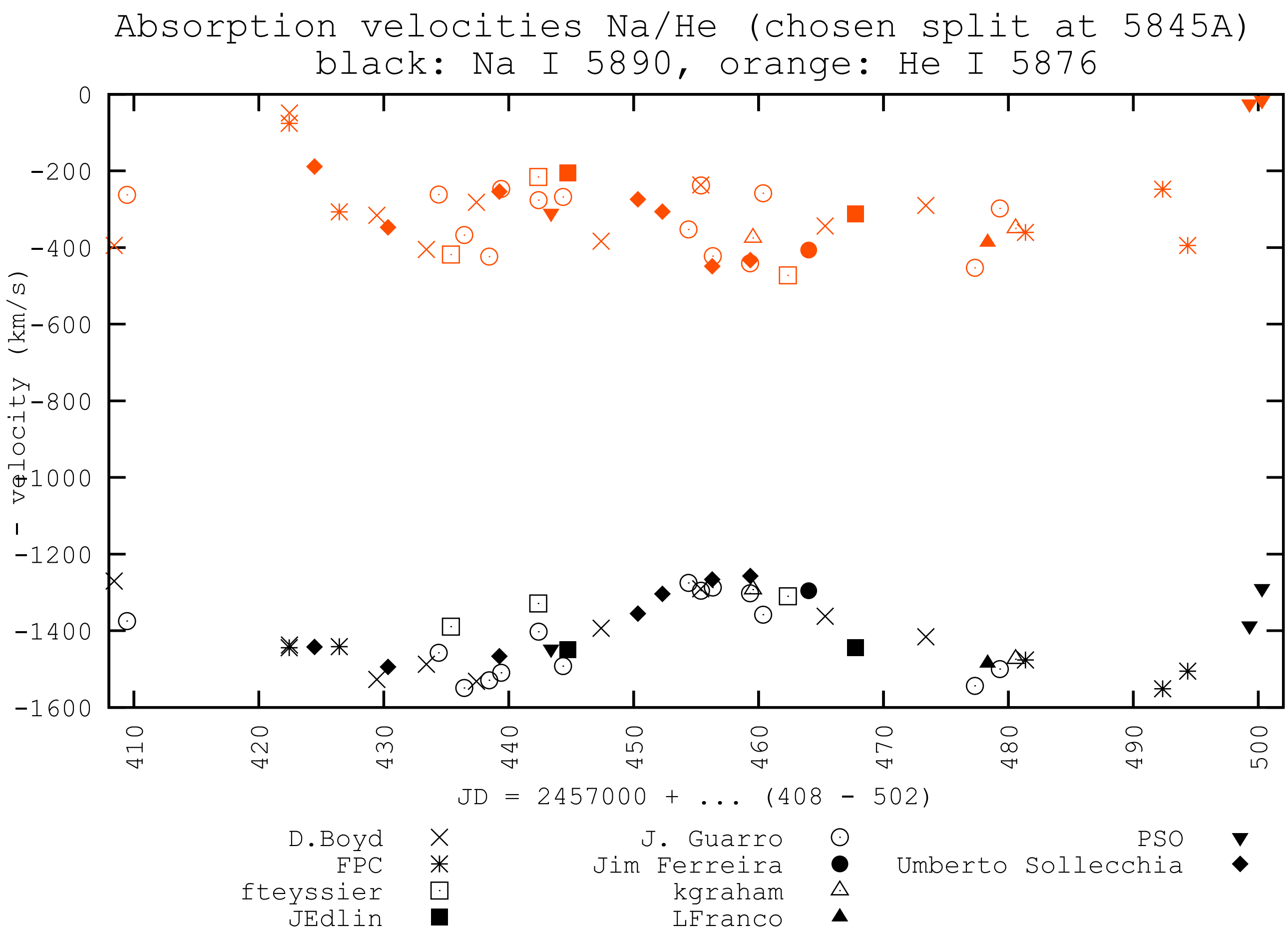


Figure 5. Absorption velocities Na I 5890 He I 5876

Here I was taking the EW center velocity of the double feature:

- 5846-5882A for NaI 5890
- 5810-5846A for HeI 5876

The sinusoid shape looks interesting to me, though my last observation on 04.20-21 showed HeI completely vanished and NaI shrinked (I did find such shapes in ARAS DB from last year, so I'd assume it's not that unusual).

V694 Mon

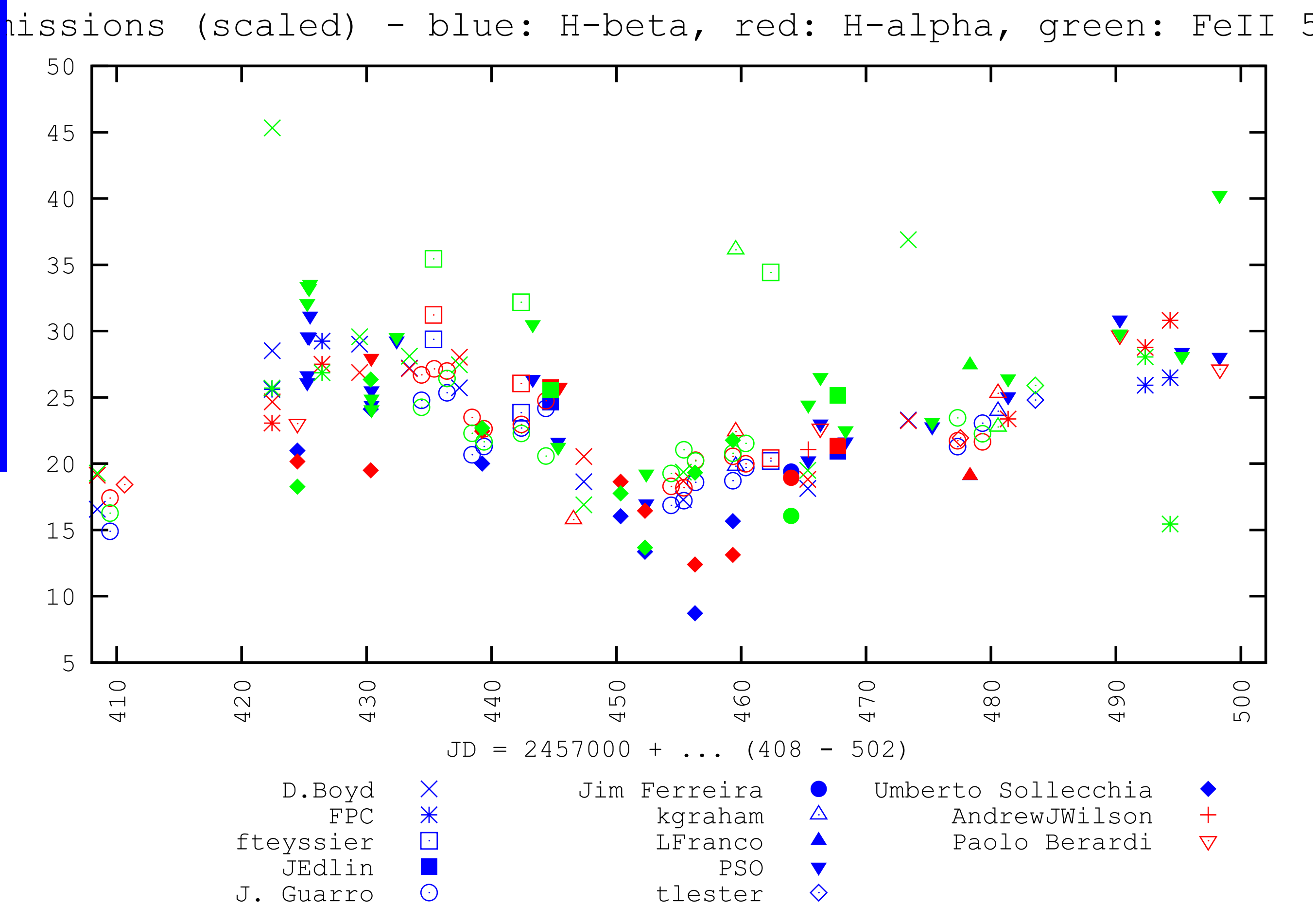
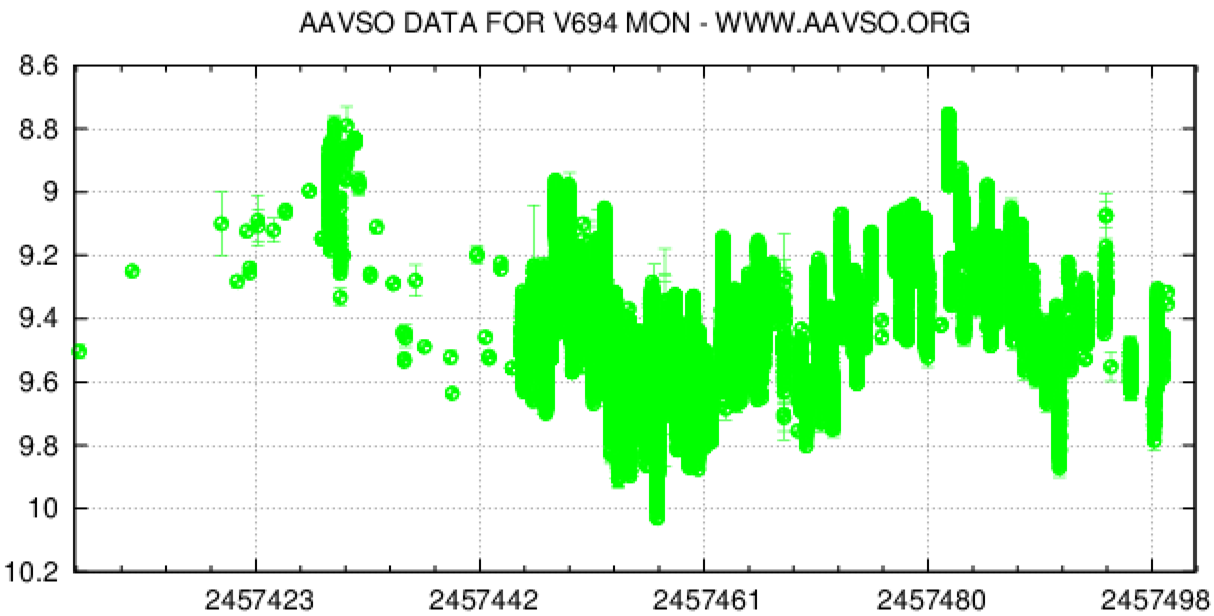


Figure 6. Emissions Hα Hβ Fe II 5019

This graph meant to show tendencies of Balmer emission lines and FeII (here only 5019 showed). The FeII line is very thin, it has a bigger noise. (For space reasons not attaching the other 2 prominent lines, but they just follow the same trend.)



V694 Mon

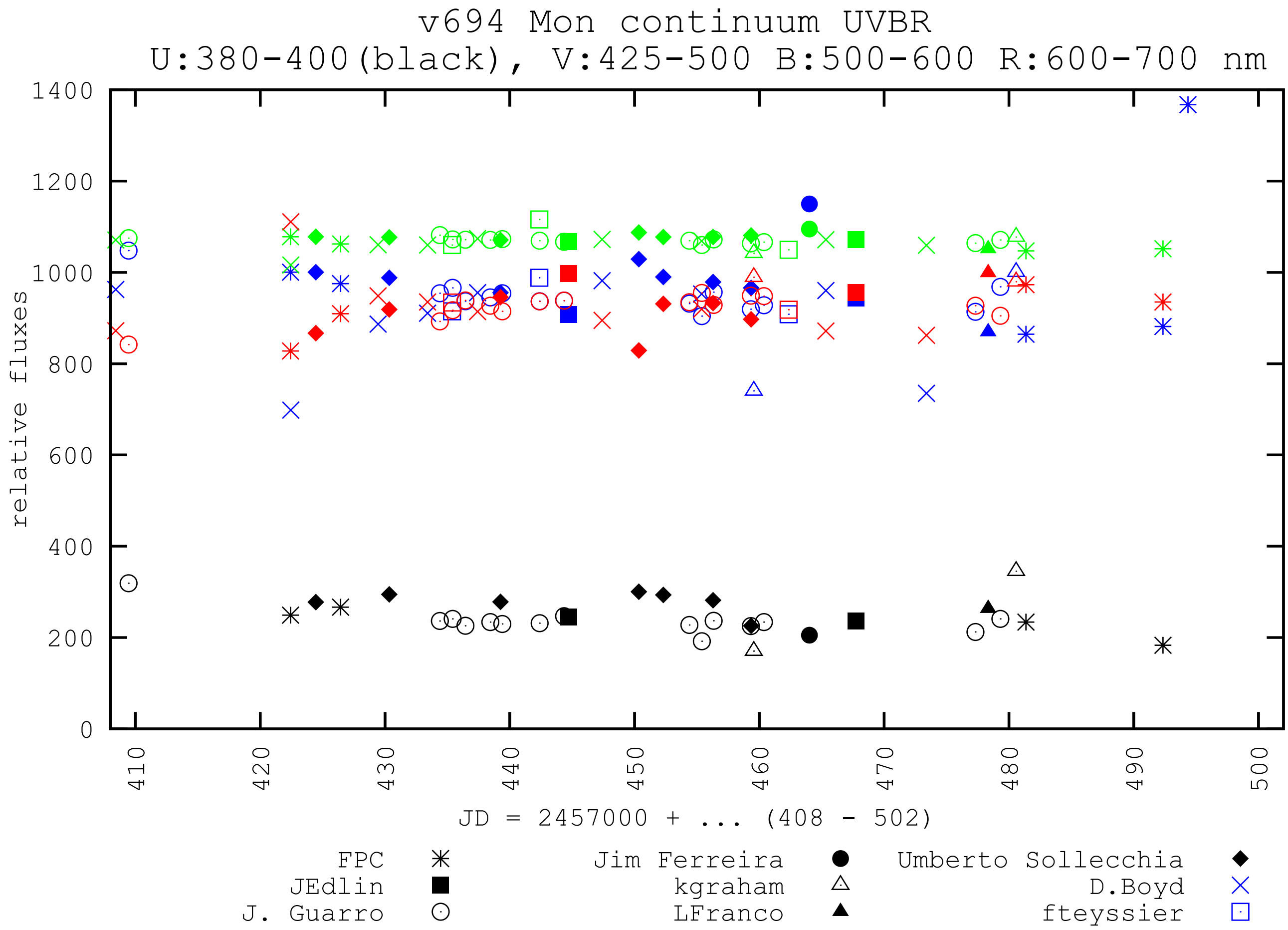


Figure 7. UBVR continuum

This diagram was produced by approximation of continuum using manually chosen regions avoiding any large features (3714:3825,3986:4041,4118:4282,4354:4790,5051:5805,5882:6408,6647:6828, 6794:7200 A) and fit by a legendre polynom of order 7. Then taken 3800-4000A for U (could use Alpy results only), 4250-5000 for B (4250A to include all spectrographs), V (5000-6000A), R (6000-7000A). Ignored I for continuum as found it too hard to include properly.
I was sticking to continuum measurement due to being aware that features (emissions/absorp.) change quickly and drastically (otherwise I have that graph too, but not really different).

Final words

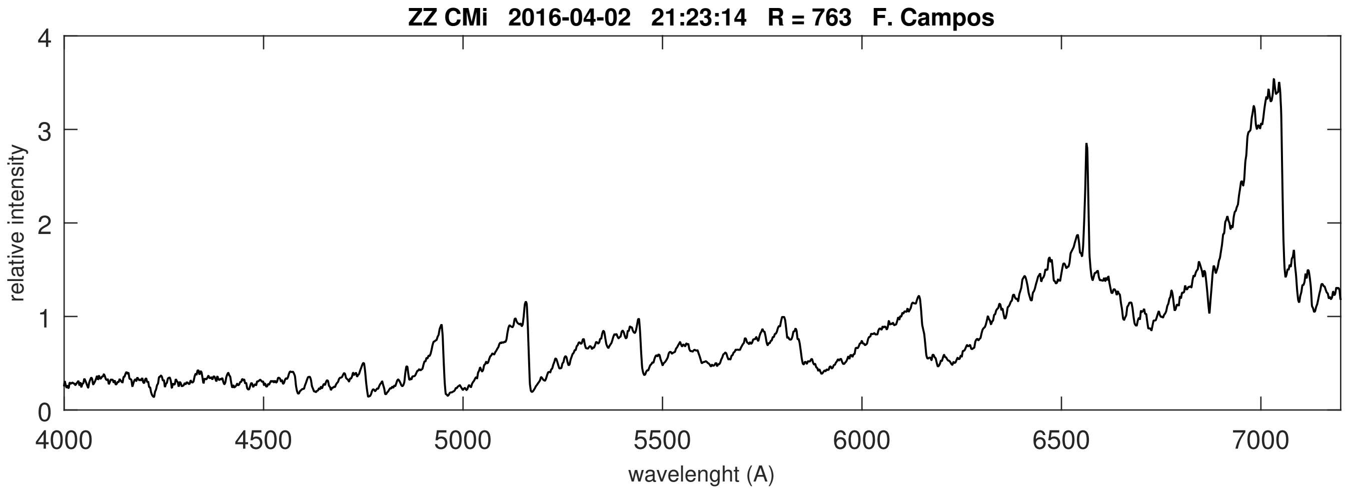
Just for the record, there was an ATEL#8957 (2016 April 4.94 UT = JD 2457483.5) of radio emission (X band) However, observations got scarce after that time, and can't see anything drastic change on these diagrams.

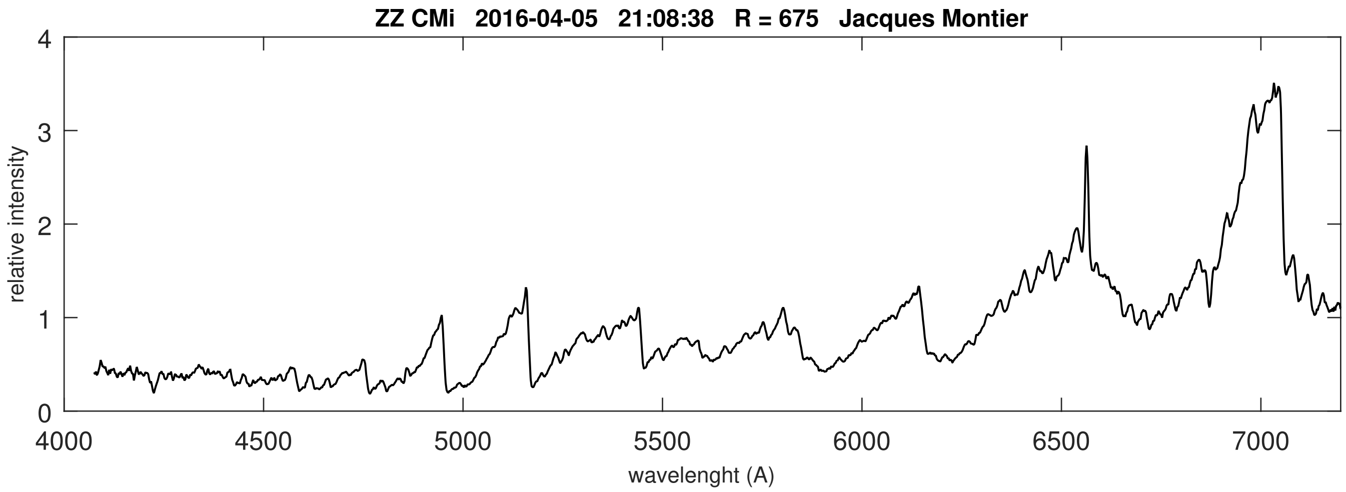
Looking at AAVSO data of magnitudes, these features change in most of the times very independently.
Please also be aware, that producing these graph required considerable amount of self learning, and could be done even better (with investing more time). My current aim was just to deliver a quick overview from available aspects within a reasonable time, and develop a script system to visualize quickly what we have (still needs lots of personal care, continuum rectification is a critical step, requiring deep human verification and high care!). This dataset gave a unique occasion to develop such a helper script toolset. Hope it's getting more and more useful and I can contribute better quality with time.

Enjoy!
Peter Somogyi

ZZ CMi

Coordinates (2000.0)	
R.A.	07 24 14.0
Dec	+08 53 51.8
Mag	10.2





Recent publications

Symbiotics

SU Lyncis, a hard X-ray bright M giant: Clues point to a large hidden population of symbiotic stars

Mukai, K.; Luna, G. J. M.; Cusumano, G.; Segreto, A.; Munari, U.; Sokoloski, J. L.; Lucy, A. B.; Nelson, T.; Nunez, N. E.New Astronomy, Volume 47, p. 7-15
http://arxiv.org/abs/1604.08483

Abstract : Symbiotic star surveys have traditionally relied almost exclusively on low resolution optical spectroscopy. However, we can obtain a more reliable estimate of their total Galactic population by using all available signatures of the symbiotic phenomenon. Here we report the discovery of a hard X-ray source, 4PBC J0642.9+5528, in the Swift hard X-ray all-sky survey, and identify it with a poorly studied red giant, SU Lyn, using pointed Swift observations and ground-based optical spectroscopy. The X-ray spectrum, the optical to UV spectrum, and the rapid UV variability of SU Lyn are all consistent with our interpretation that it is a symbiotic star containing an accreting white dwarf. The symbiotic nature of SU Lyn went unnoticed until now, because it does not exhibit emission lines strong enough to be obvious in low resolution spectra. We argue that symbiotic stars without shell-burning have weak emission lines, and that the current lists of symbiotic stars are biased in favor of shell-burning systems. We conclude that the true population of symbiotic stars has been underestimated, potentially by a large factor.

Symbiotic stars in X-rays III: Suzaku observations

N. E. Nuñez, T. Nelson, K. Mukai, J. L. Sokoloski, G. J. M. Luna
(Submitted on 20 Apr 2016)
http://arxiv.org/abs/1604.05980

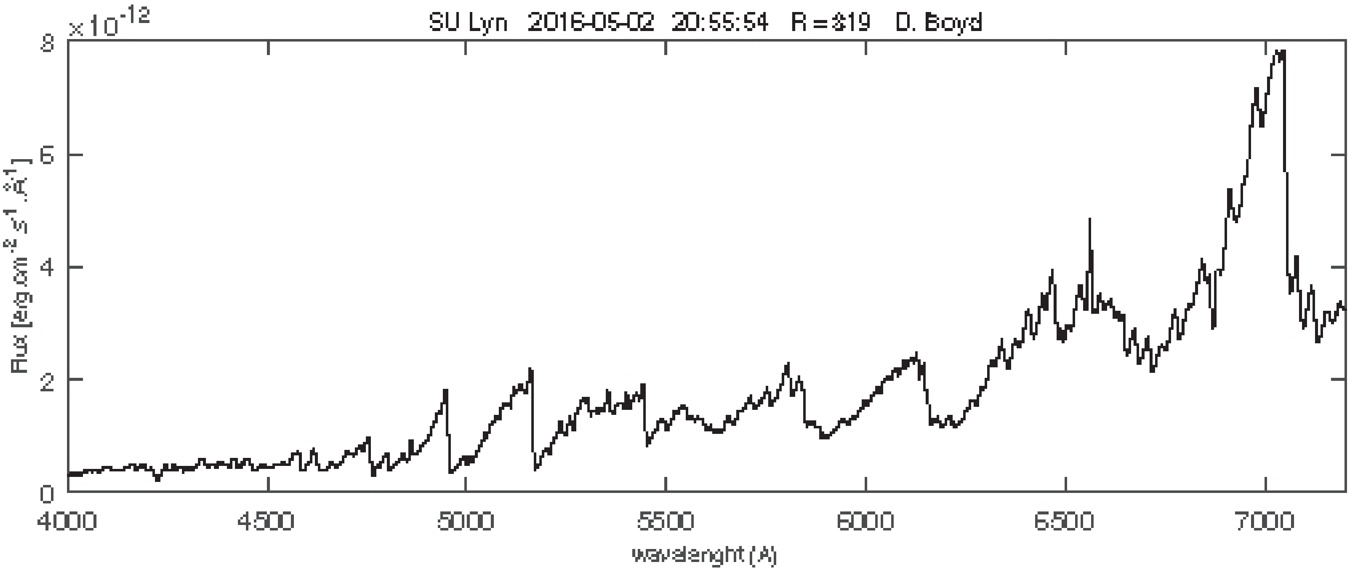
Abstract : We describe the X-ray emission as observed with Suzaku from five symbiotic stars that we selected for deep Suzaku observations after their initial detection with ROSAT, ASCA and Swift. We find that the X-ray spectra of all five sources can be adequately fit with absorbed, optically thin thermal plasma models, with either single- or multi-temperature plasmas. These models are compatible with the X-ray emission originating in the boundary layer between an accretion disk and a white dwarf. The high plasma temperatures of kT >3 keV for all five targets were greater than expected for colliding winds. Based on these high temperatures, as well as previous measurements of UV variability and UV luminosity, and the large amplitude of X-ray flickering in 4 Dra, we conclude that all five sources are accretion-powered through predominantly optically thick boundary layers. Our X-ray data allow us to observe a small, optically thin portion of the emission from these boundary layers. Given the time between previous observations and these observations, we find that the intrinsic X-ray flux and the intervening absorbing column can vary by factors of three or more on a time scale of years. However, the location of the absorber and the relationship between changes in accretion rate and absorption are still elusive.

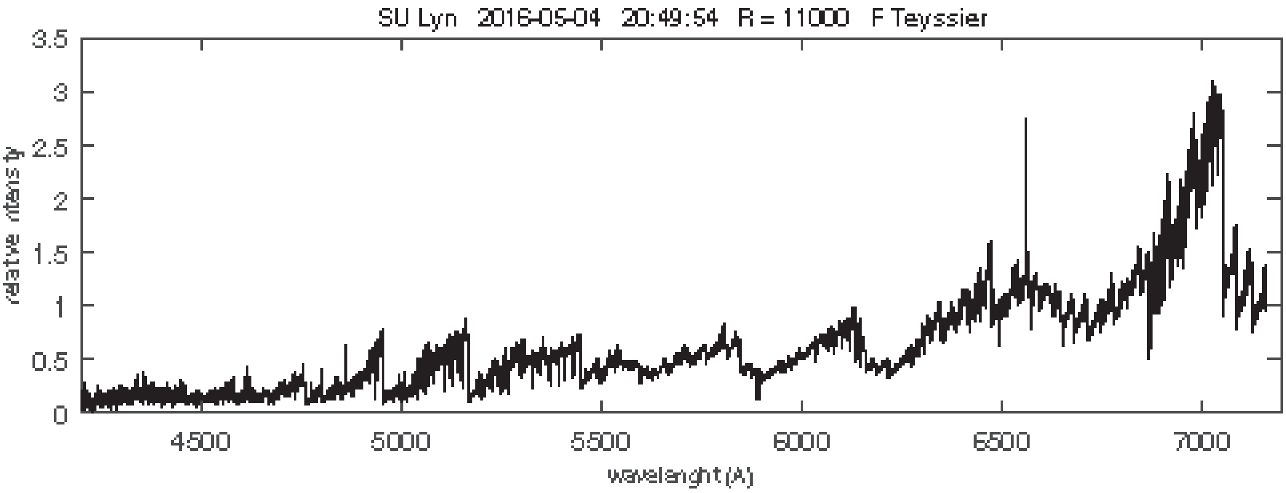
SU Lyncris

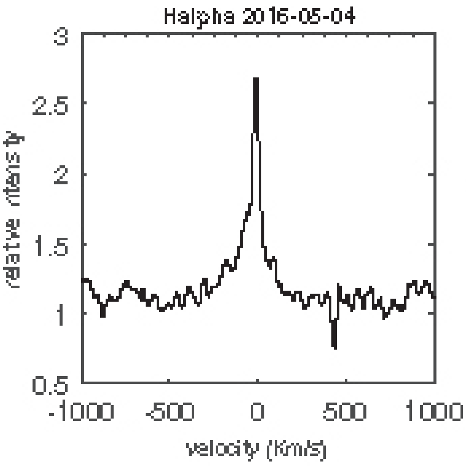
The new symbiotic star SU Lyn
(Mukai al., 2016)

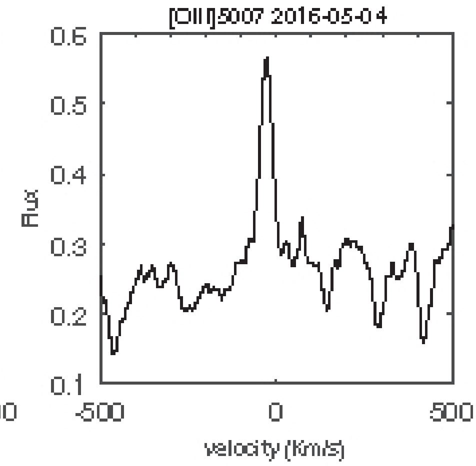
Coordinates (2000.0)	
R.A.	06 42 55.1
Dec	+55 28 27.2

Field of SU Lyn (David Boyd)
V = 8.62 (2016-05-02.973)









About ARAS initiative

Astronomical Ring for Access to Spectroscopy (ARAS) is an informal group of volunteers who aim to promote cooperation between professional and amateur astronomers in the field of spectroscopy.

To this end, ARAS has prepared the following roadmap:

• Identify centers of interest for spectroscopic observation which could lead to useful, effective and motivating cooperation between professional and amateur astronomers.
• Help develop the tools required to transform this cooperation into action (i.e. by publishing spectrograph building plans, organizing group purchasing to reduce costs, developing and validating observation protocols, managing a data base, identifying available resources in professional observatories (hardware, observation time), etc.
•Develop an awareness and education policy for amateur astronomers through training sessions, the organization of pro/am seminars, by publishing documents (web pages), managing a forum, etc.
• Encourage observers to use the spectrographs available in mission observatories and promote collaboration between experts, particularly variable star experts.
• Create a global observation network.

By decoding what light says to us, spectroscopy is the most productive field in astronomy. It is now entering the amateur world, enabling amateurs to open the doors of astrophysics. Why not join us and be one of the pioneers!

Be Monthly report

Previous issues :
http://www.astrosurf.com/aras/surveys/beactu/index.htm

VV Cep campaign

http://www.spectro-aras.com/forum/viewforum.php?f=19

Submit your spectra

Please :
- respect the procedure
- check your spectra BEFORE sending them
Resolution should be at least R = 500
For new transcients, supernovae and poorly observed objects,
SA spectra at R = 100 are welcome

1/ reduce your data into BeSS file format
2/ name your file with:
_ObjectName_yyyymmdd_hhh_Observer

Exemple: _chcyg_20130802_886_toto.fit

3/ send you spectra to
Novae, Symbiotics : François Teyssier
Supernovae : Christian Buil
VV Cep Stars : Olivier Thizy