Eruptive stars spectroscopy

Cataclysmics, Symbiotics, Nova Supernovae

ARAS Eruptive Stars
Information Letter n° 22 #2015-10 15-01-2016
Observations of December 2015

NEWS

New outburst of the micro-quasar V404 Cyg in December

Contents

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"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

Symbiotics in December

CH Cygni : remains at high state Mag V >
The observed profiles of Balmer lines in Decmeber show a classical shape with central absorption, and no absorptions in the blue edge of the line

AG Peg : declining during the secondary outburst.

CI Cyg : luminosity increases in V band with fast evolution of the shapes of Balmer lines

V694 Mon : narrow absorption (Vmax = 1100 km/s)

Observing : main targets

Ungoing campaign : CH Cygni for A Skopal (low resolution and H alpha profile at R > 10000)

AG Peg during the decline of its secondary outburst
CI Cyg : evolution of Balmer lines
AX Per

V694 Mon

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Symbiotics in ARAS Data Base Update : 08-01-2015

#	Name	AD (2000)	DE (2000)	Nb. Of spectra	First spectrum	Last spectrum	Last Spectrum(days)
1	EG And	0 44 37.1	40 40 45.7	34	12/08/2010	26/12/2015	14
2	AX Per	1 36 22.7	54 15 2.5	68	04/10/2011	02/01/2016	7
3	o Ceti	2 19 20.7	-2 58 39.5				
4	BD Cam	3 42 9.3	63 13 0.5	9	08/11/2011	28/11/2015	42
5	UV Aur	5 21 48.8	32 30 43.1	34	24/02/2011	02/01/2016	7
6	V1261 Ori	5 22 18.6	-8 39 58				
7	StHA 55	5 46 42	6 43 48				
8	ZZ CMi	7 24 13.9	8 53 51.7	25	29/09/2011	03/01/2016	6
9	BX Mon	7 25 24	-3 36 0 24		04/04/2011	31/12/2015	9
10	V694 Mon	7 25 51.2	-7 44 8 66		03/03/2011	31/12/2015	9
11	NQ Gem	7 31 54.5	24 30 12.5	27	01/04/2013	03/12/2015	37
12	GH Gem	7 4 4.9	12 2 12				
13	CQ Dra	12 30 06	69 12 04	1	11/06/2015	11/06/2015	212
14	TX CVn	12 44 42	36 45 50.6	22	10/04/2011	31/12/2015	9
15	IV Vir	14 16 34.3	-21 45 50	3	28/02/2015	09/05/2015	245
16	T CrB	15 59 30.1	25 55 12.6	62	01/04/2012	31/12/2015	9
17	AG Dra 1	6 1 40.5	66 48 9.5	60	03/04/2013	31/12/2015	9
18	V503 Her	17 36 46	23 18 18	1	05/06/2013	05/06/2013	948
19	RS Oph	17 50 13.2	-6 42 28.4	16	23/03/2011	16/09/2015	115
20	V934 Her	17 6 34.5	23 58 18.5	9	09/08/2013	20/06/2015	203
21	AS 270	18 05 33.7	-20 20 38	2	01/08/2013	02/08/2013	890
22	AS 289	18 12 22	-11 40 13				
23	YY Her	18 14 34.3	20 59 20	17	25/05/2011	07/09/2015	124
24	FG Ser	18 15 6.2	0 18 57.6	3	26/06/2012	24/07/2014	534
25	StHa 149	18 18 55.9	27 26 12	3	05/08/2013	14/10/2015	87
26	V443 Her	18 22 8.4	23 27 20	20	18/05/2011	19/07/2015	174
27	FN Sgr	18 53 52.9	-18 59 42	4	10/08/2013	02/07/2014	556
28	V335 Vul	19 23 14.2	24 27 40.2				
29	BF Cyg	19 23 53.4	29 40 25.1	71	01/05/2011	07/11/2015	63
30	CH Cyg	19 24 33	50 14 29.1	321	21/04/2011	30/12/2015	10
31	V919 Sgr	19 3 46	-16 59 53.9	2	10/08/2013	10/08/2013	882
32	V1413 Aql	19 3 51.6	16 28 31.7	5	10/08/2013	26/09/2015	105
33	HM Sge	19 41 57.1	16 44 39.9	7	20/07/2013	11/11/2015	59
34	QW Sge	19 45 49.6	18 36 50				
35	CI Cyg	19 50 11.8	35 41 3.2	102	25/08/2010	26/12/2015	14
36	StHA 169	19 51 28.9	46 23 6				
37	V1016 Cyg	19 57 4.9	39 49 33.9	7	15/04/2015	01/11/2015	69
38	PU Vul	20 21 12	21 34 41.9	14	20/07/2013	23/11/2015	47
39	LT Del	20 35 57.3	20 11 34				
40	ER Del	20 42 46.4	8 40 56.4	3	02/09/2011	05/11/2014	430
41	V1329 Cyg	20 51 1.1	35 34 51.2	4	08/08/2015	26/09/2015	105
42	V407 Cyg	21 2 13	45 46 30				
43	StHA 190	21 41 44.8	2 43 54.4	14	31/08/2011	08/11/2015	62
44	AG Peg	21 51 1.9	12 37 29.4	158	06/12/2009	02/01/2016	7
45	V627 Cas	22 57 41.2	58 49 14.9	9	06/08/2013	30/12/2015	10
46	Z And	23 33 39.5	48 49 5.4	54	30/10/2010	30/12/2015	10
47	R Aqr	23 43 49.4	-15 17 4.2	26	25/09/2010	21/11/2015	49

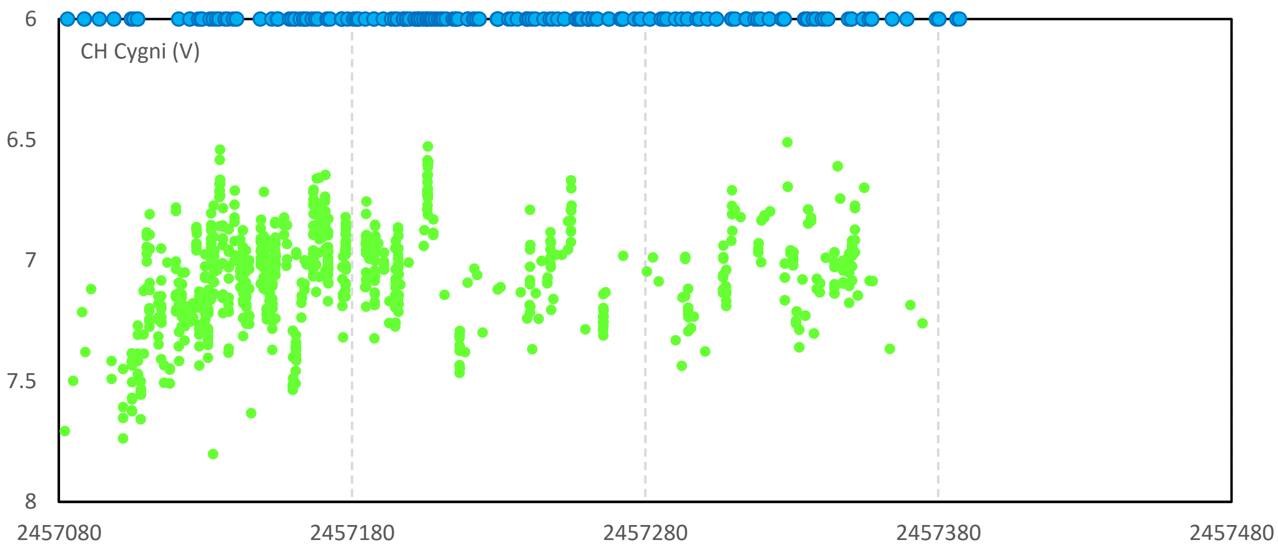
ARAS Data Base Symbiotics : http://www.astrosurf.com/aras/Aras_DataBase/Symbiotics.htm

SYMBIOTICS

CH Cyg

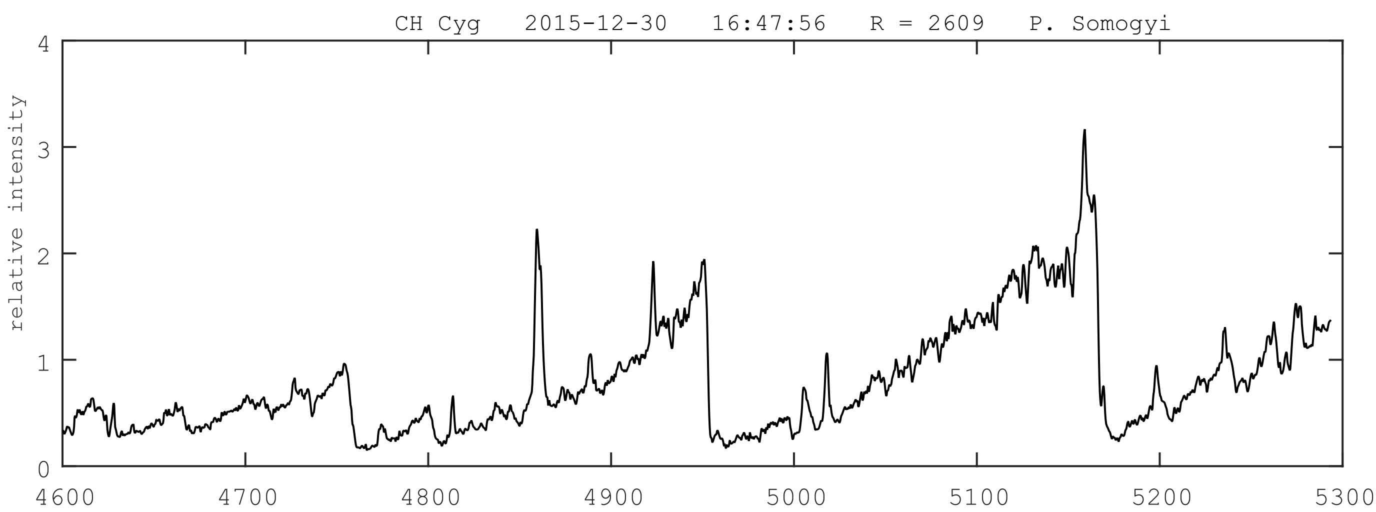
Coordinates (2000.0)	
R.A.	18 22 59.35
Dec	-19 14 11.8

In December, CH Cygni remains in high state; flickering between 6.6 and 7.4 in V band.
Ungoing observations in ARAS database : the H alpha profile is classical on all the observations with only a deep central absorption. No phenomenon of multiple absorption in the blue edge of the line.



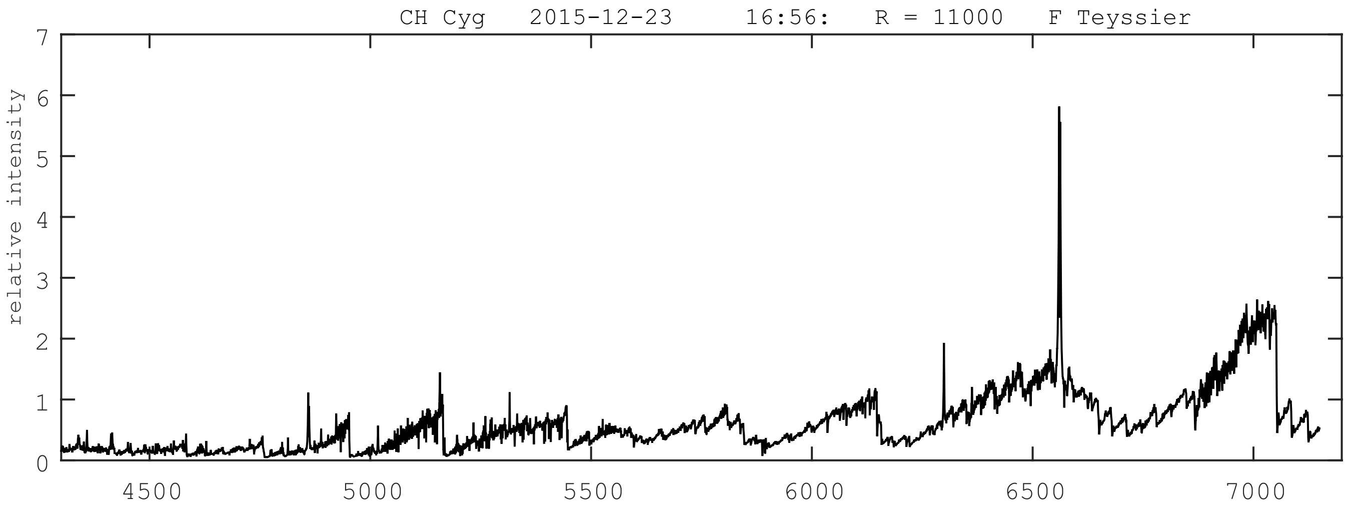
AAVSO V in 2015 and ARAS spectra (blue dots)

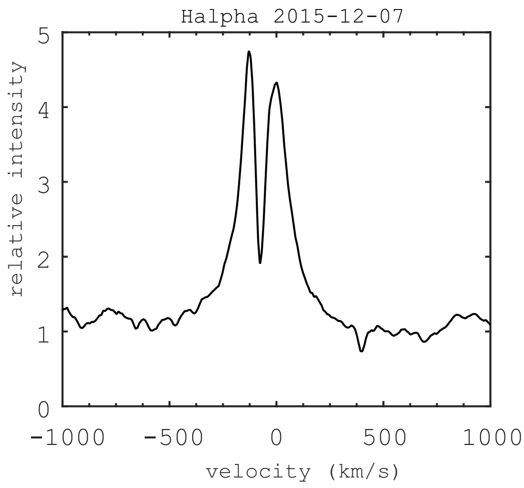
221 spectra (from R = 600 to 20000) have been collected in ARAS Database in 2015 upon the request of A. Skopal

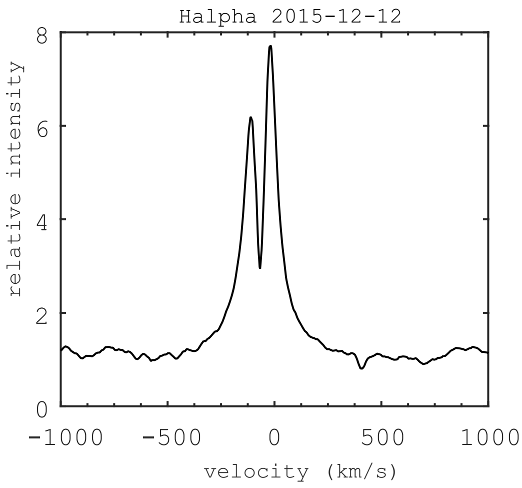


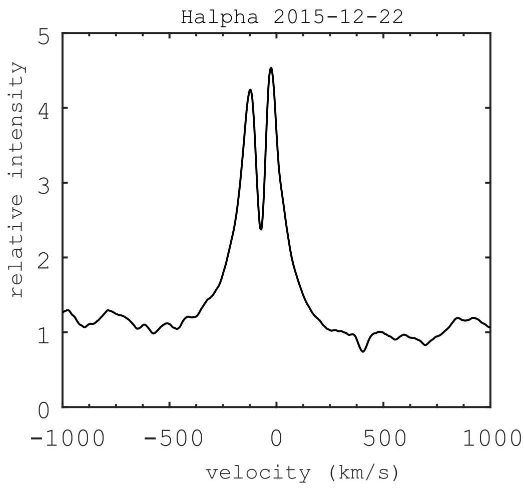
CH Cyg Hb region by Peter Somogyi with a LHIRES III 600 l/mm at R = 2600

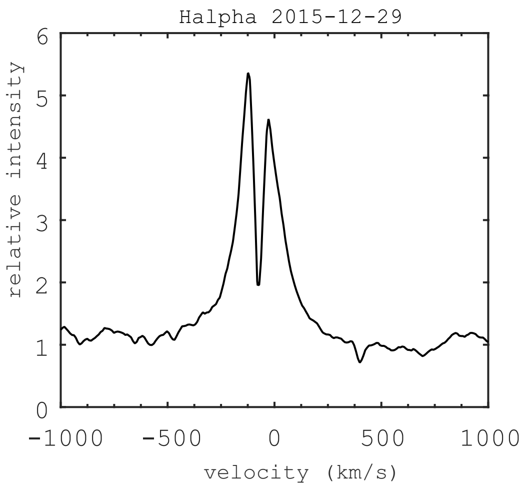
CH Cyg



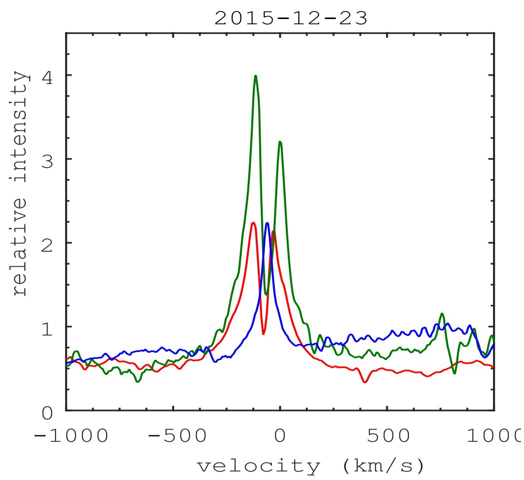






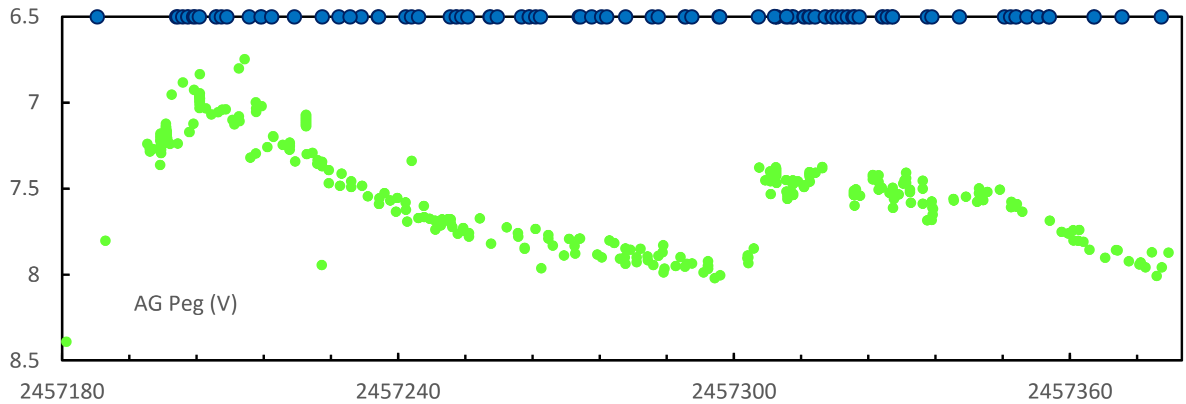


Hα profiles
F. Teyssier | R 11000 : 07-12, 12-12, 23-12,29-12
J. Guarro | R = 6000 : 22-12



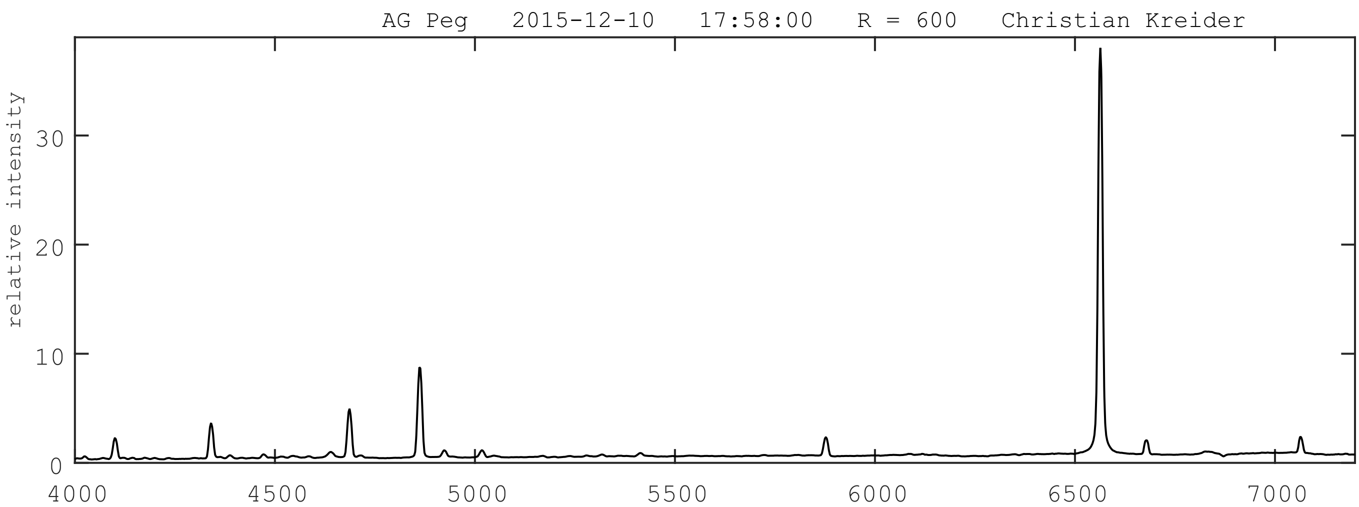
AG Peg

Coordinates (2000.0)	
R.A.	21 51 02.0
Dec	+12 37 32.1



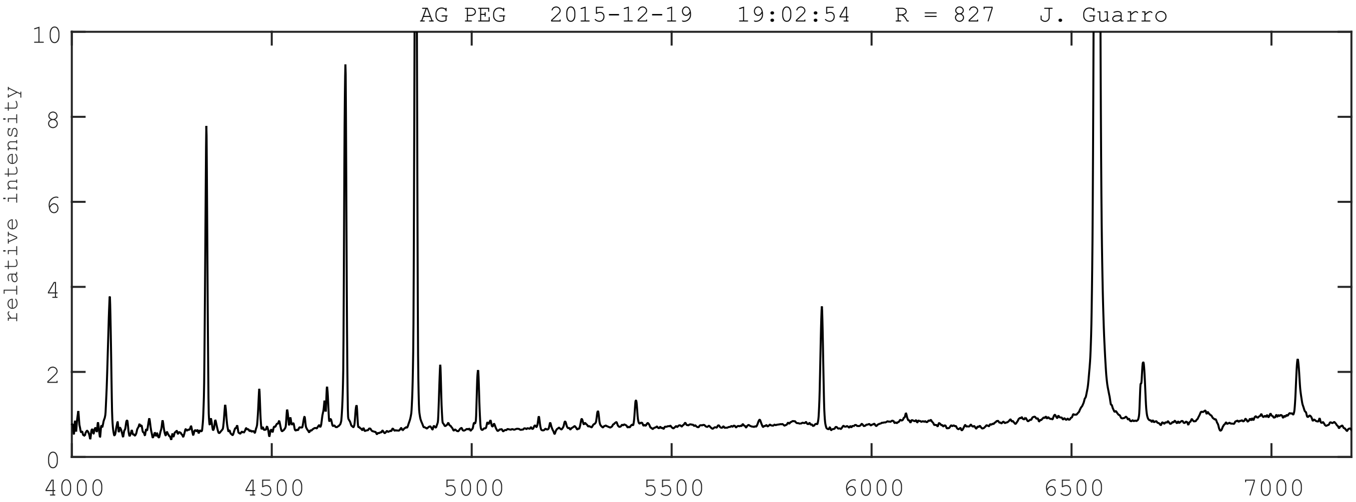
AAVSO V in 2015 and ARAS spectra (blue dots)
The first symbiotic outburst observed for AG Peg began ~ 7th of June from V = 8.4 and raised V = 6.9 about the 30th of June (Delta mag ~ 1.5). The system declined to mag V ~ 8.0 (2d of October) and undergone a secondary outburst, reaching V ~ 7.4, the 09-10-2015 (Delta V ~ 0.6) before declining again in two steps (Mag V = 8.0 at the end of December, 2015).

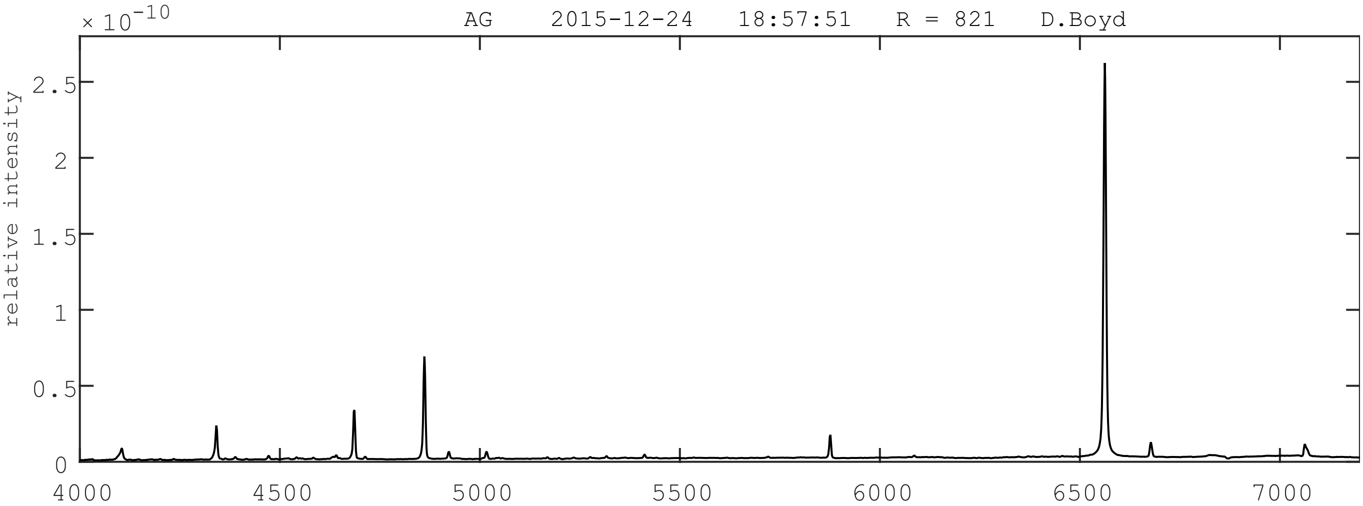
116 spectra (from R = 600 to 20000) have been collected in ARAS Database in 2015.

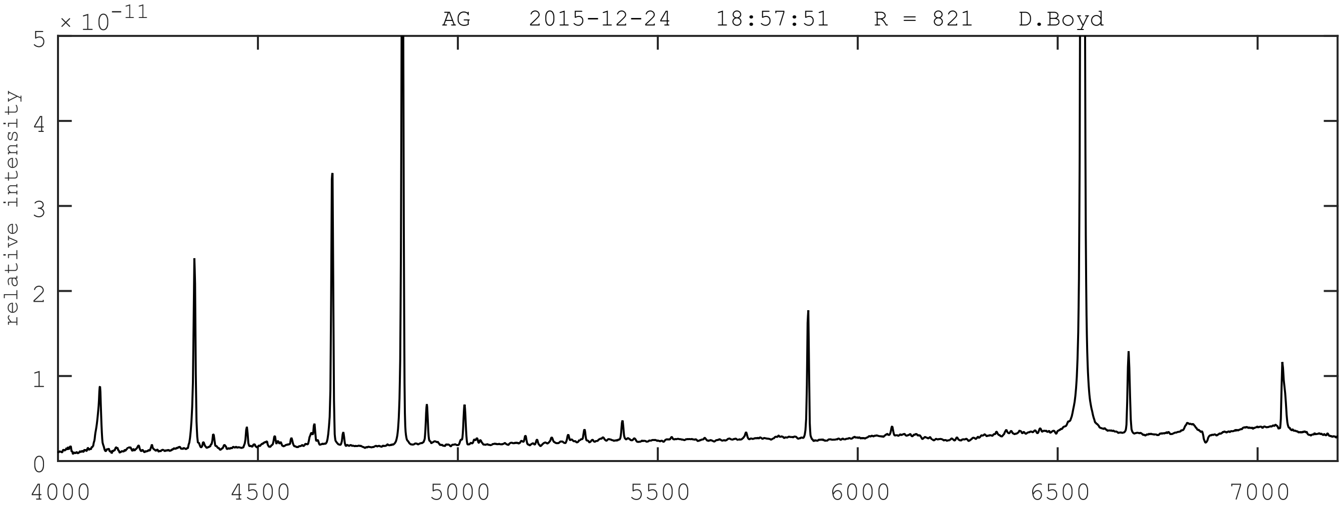


Low resolution spectrum from Christian Kreider with an Alpy
The Raman OVI band appears clearly

AG Peg


AG PEG 2015-12-19 19:02:54 R = 827 J. Guarro
relative intensity
0
2
4
6
8
10
4000
4500
5000
5500
6000
6500
7000


AG 2015-12-24 18:57:51 R = 821 D.Boyd
× 10^-10
relative intensity
0
0.5
1
1.5
2
2.5
4000
4500
5000
5500
6000
6500
7000


AG 2015-12-24 18:57:51 R = 821 D.Boyd
× 10^-11
relative intensity
0
1
2
3
4
5
4000
4500
5000
5500
6000
6500
7000

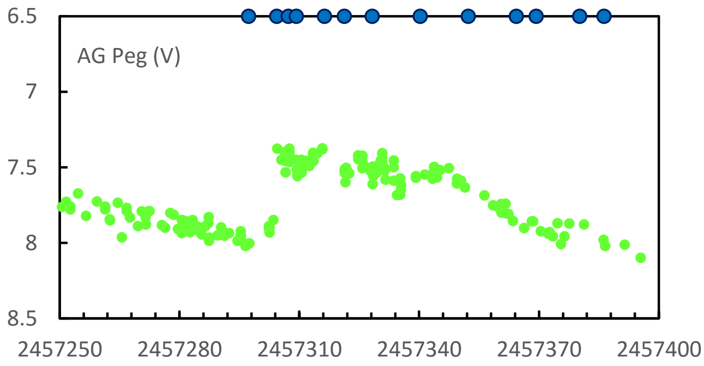
SYMBIOTICS

AG Peg : the secondary outburst throw eshel spectra

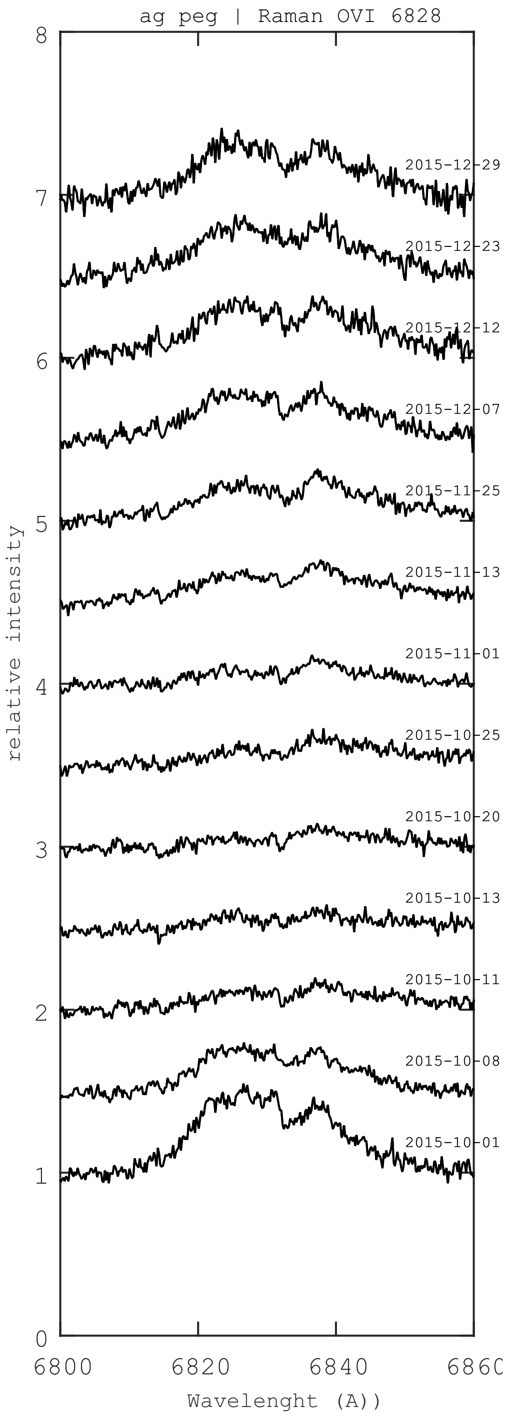
The monitoring of the secondary outburst of AG Peg at R = 11000 shows clearly the vanashing of high excitation lines such as [Fe VII] 6087 or OVI Raman 6830 during the outburst

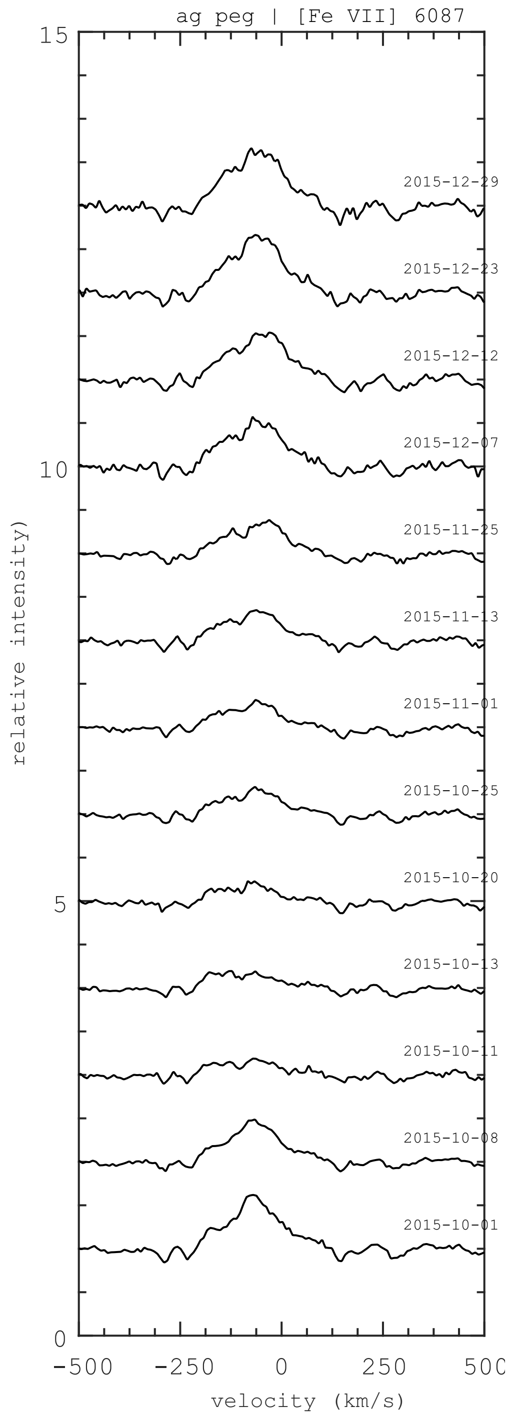
Date	Time	J.D.	Res.	I min	Imax
01/10/2015	19:48	2457297.335	11000	4370	7157
08/10/2015	20:23	2457304.355	11000	4400	7100
11/10/2015	18:41	2457307.284	11000	4209	7157
13/10/2015	18:38	2457309.284	11000	4220	7150
20/10/2015	19:55	2457316.334	11000	4209	7157
25/10/2015	17:55	2457321.255	11000	4209	7157
01/11/2015	18:30	2457328.275	11000	4210	7156
13/11/2015	17:58	2457340.256	11000	4209	7157
25/11/2015	19:13	2457352.306	11000	4209	7152
07/12/2015	19:19	2457364.309	11000	4200	7150
12/12/2015	19:16	2457369.31	11000	4210	7150
23/12/2015	17:38	2457380.238	11000	4210	7150
29/12/2015	18:16	2457386.266	11000	4287	7161

Log of observations. F. Teyssier EShel SC 14”



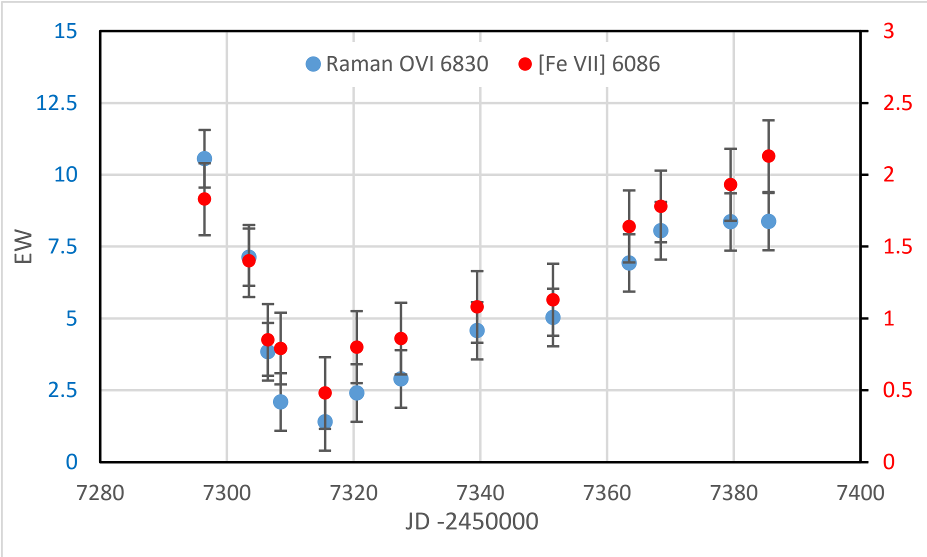
AAVSO V light curve and spectra (blue dots)



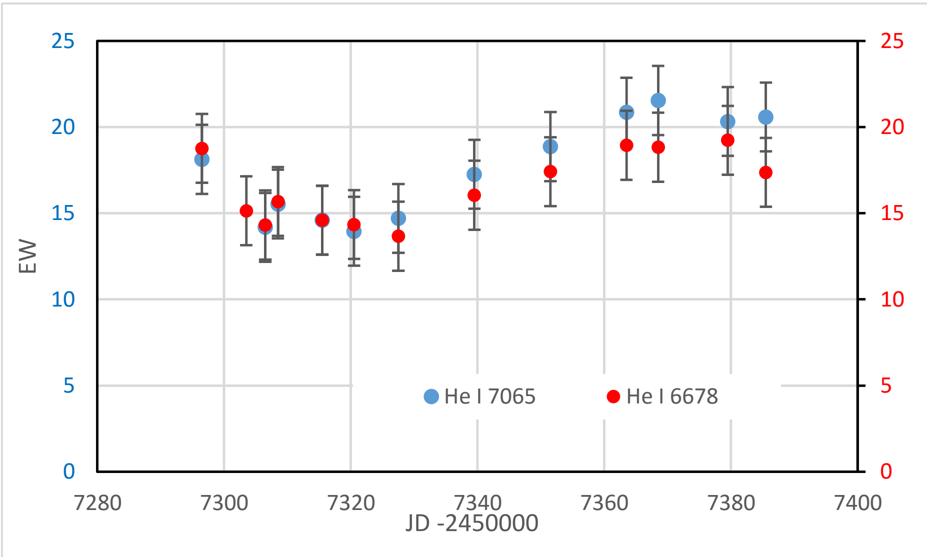


SYMBIOTICS

AG Peg : the secondary outburst throw eshel spectra



Equivalent width OVI Raman 6830 and [Fe VII] 6087

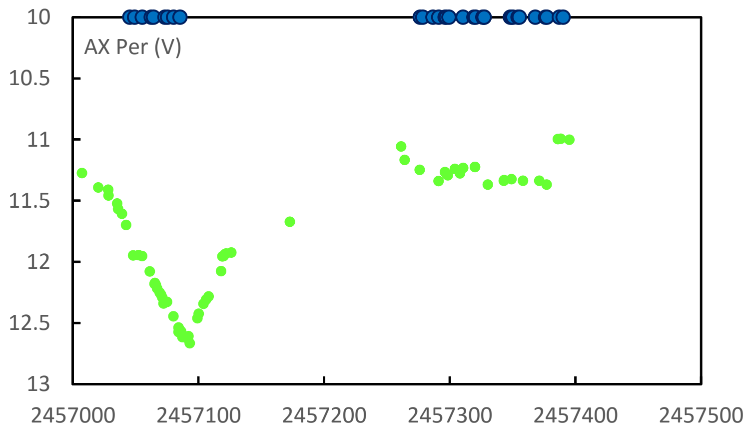


Equivalent width the singlet He I 6678 and triplet He I 7065

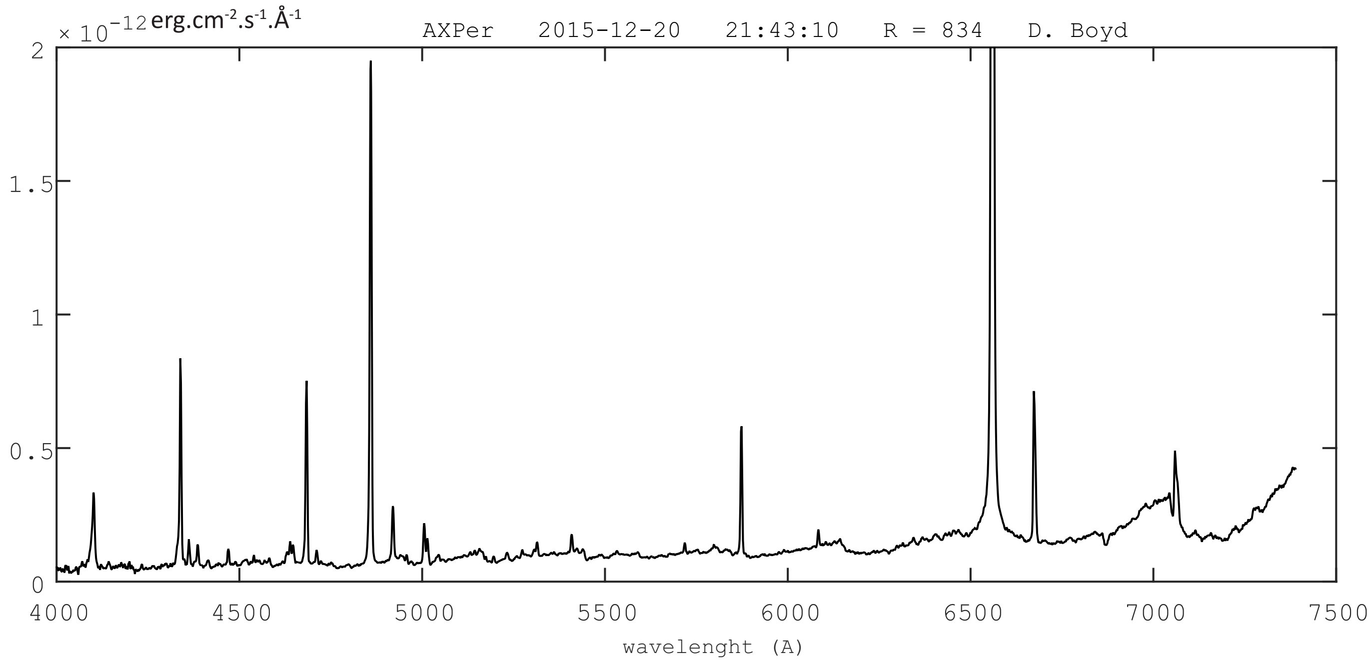
Other lines and results : http://www.astronomie-amateur.fr/feuilles/Spectroscopie/SyS/AGPeg_2.html

AX Per

Coordinates (2000.0)	
R.A.	1 36 22.7
Dec	54 15 2.5
Mag	11.3 (V)

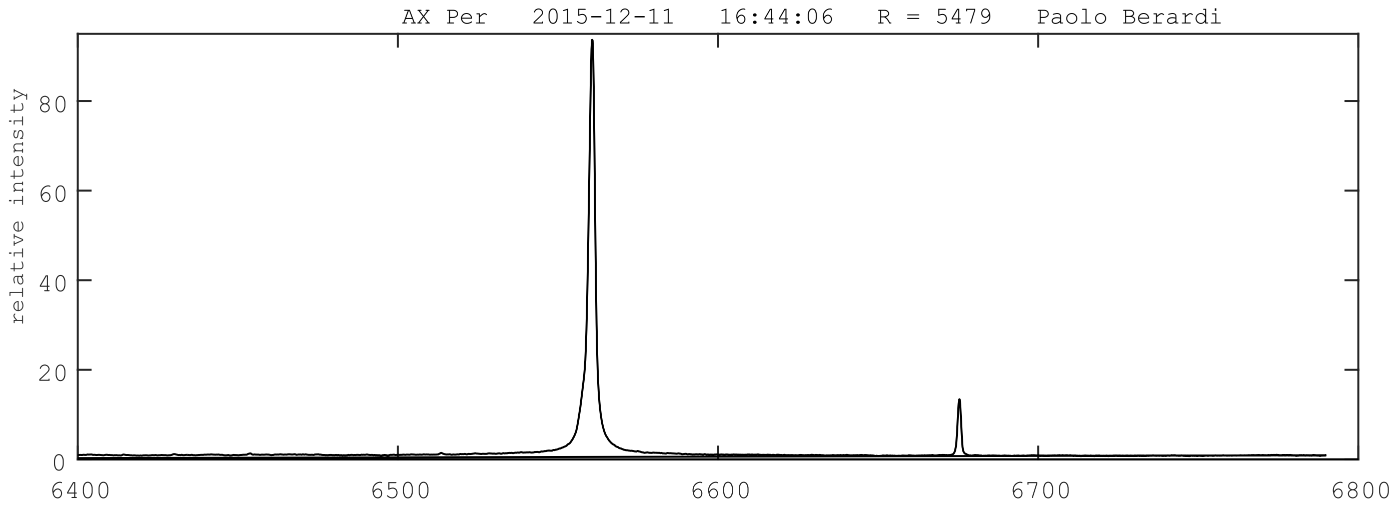


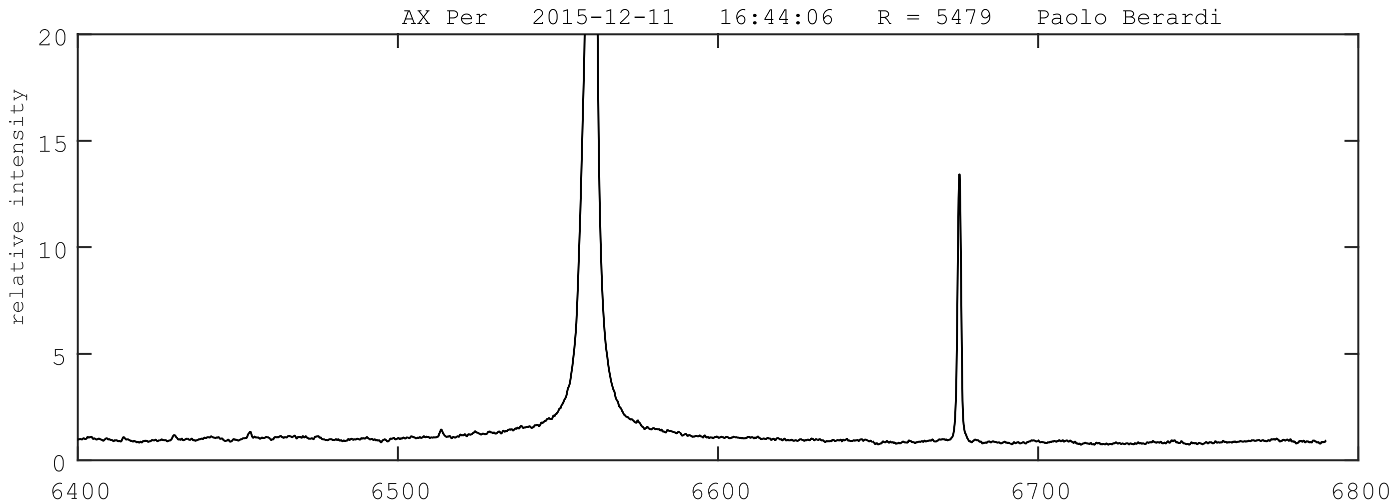
Increasing luminosity (V) between 20-12 and 29-12 from V = 11.4 to 11.0 (+0.4)

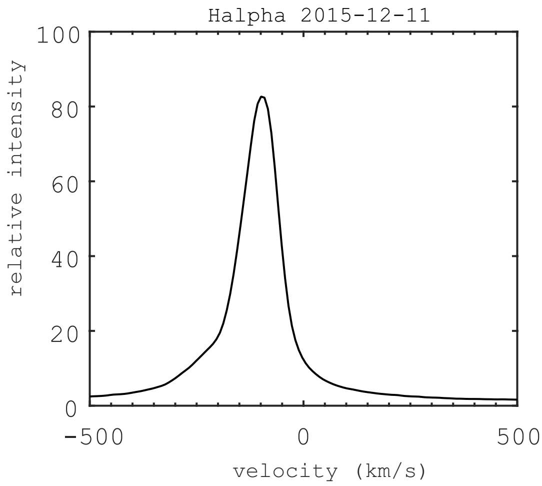


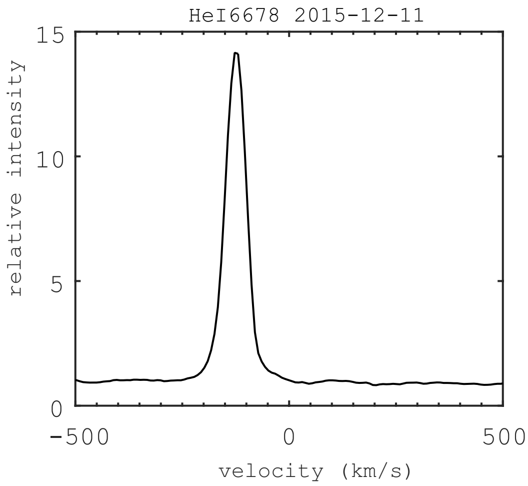
AX Per

The Hα range by Paolo Berardi with Lhires III 1200 l/mm R = 5000



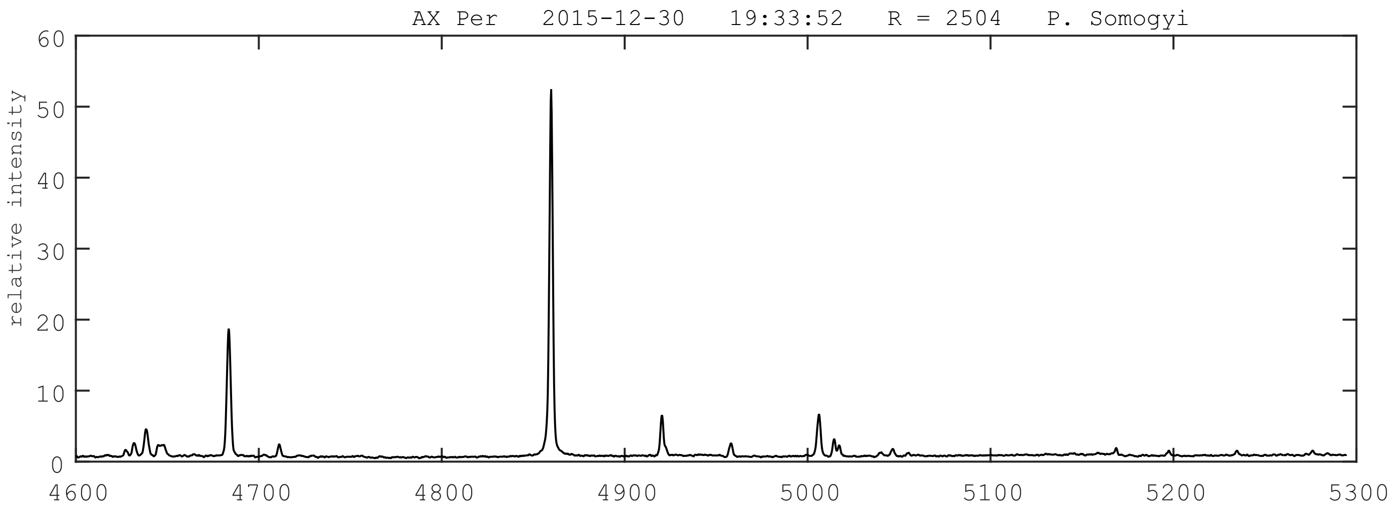


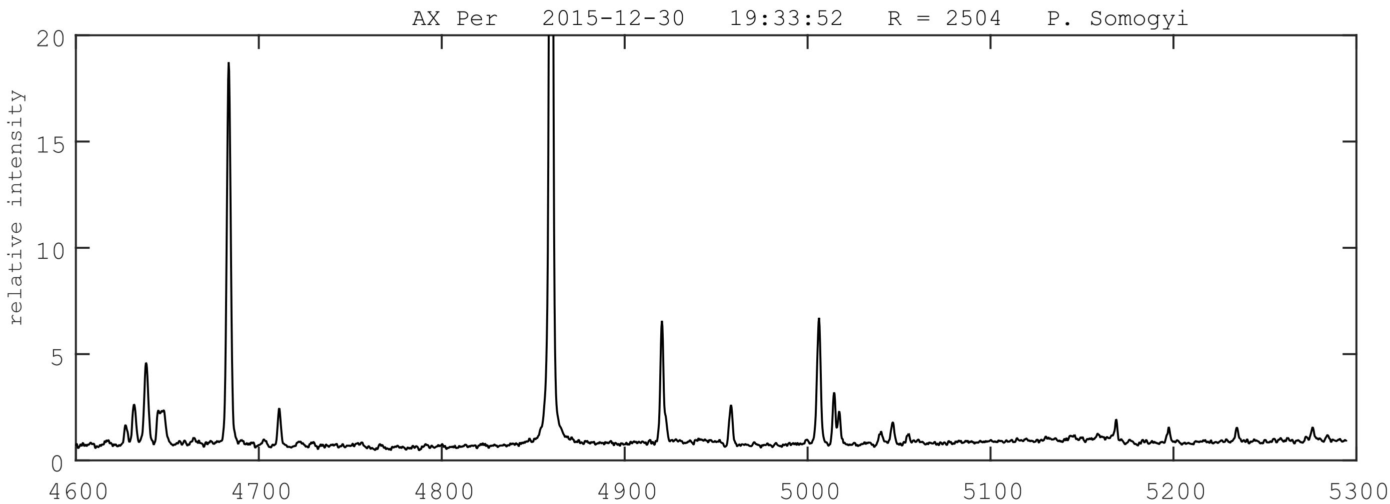




AX Per

The Hβ range by Peter Somogyi with Lhires III 600 l/mm R = 2500

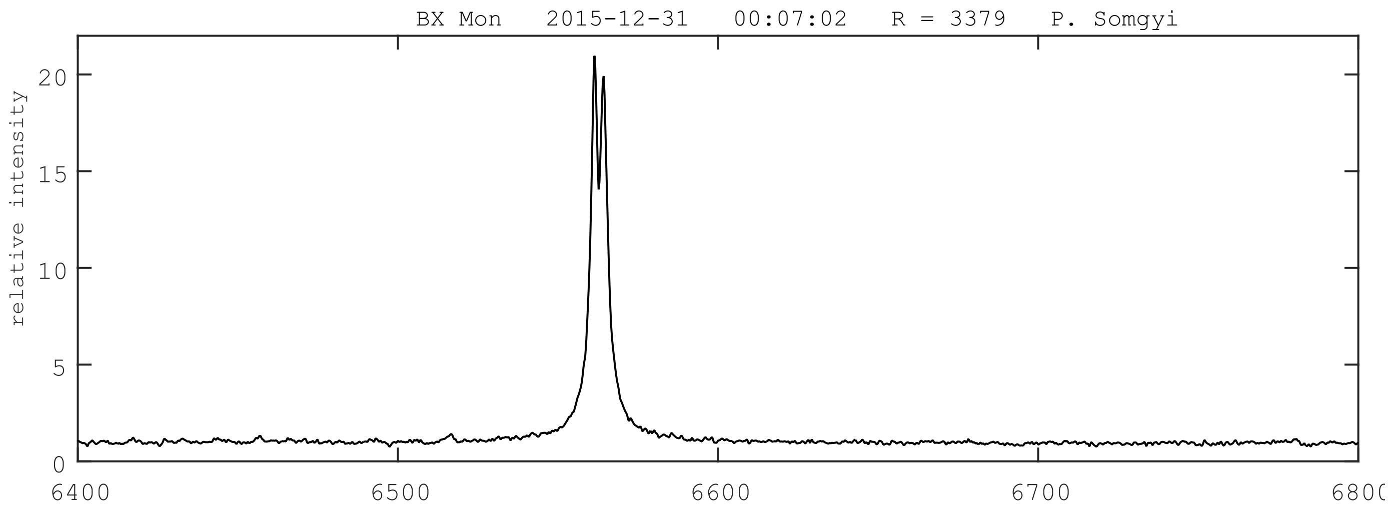




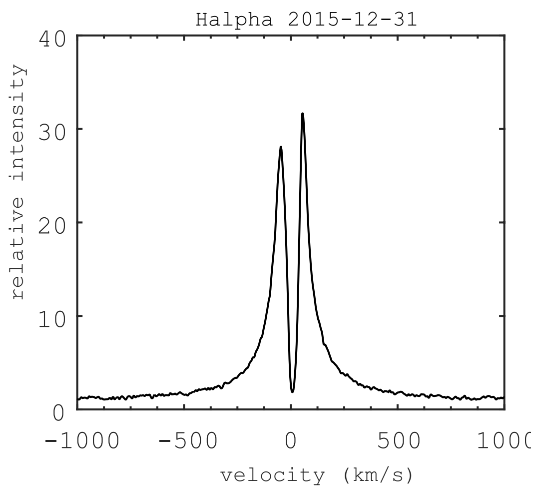
S Y M B I O T I C S

BX Mon

Coordinates (2000.0)	
R.A.	07 25 22.8
Dec	-03 35 50.8
Mag	



Peter Somogyi
Hα range 2015-12-31.912
Lhires III 600 l/mm
R = 3500



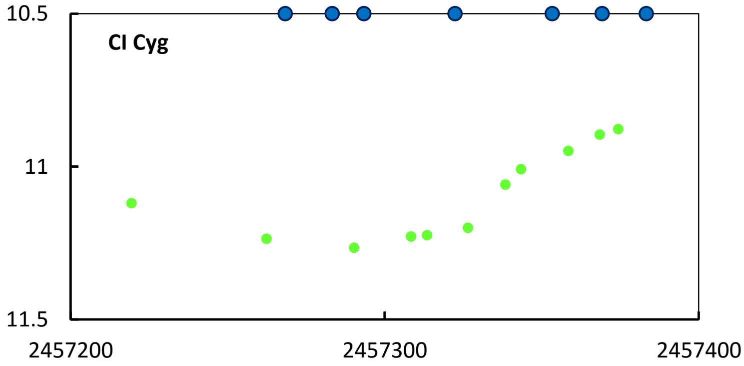
Hα line
2015-12-31.912
Lhires III 2400 l/mm
R = 15000

SYMBIOTICS

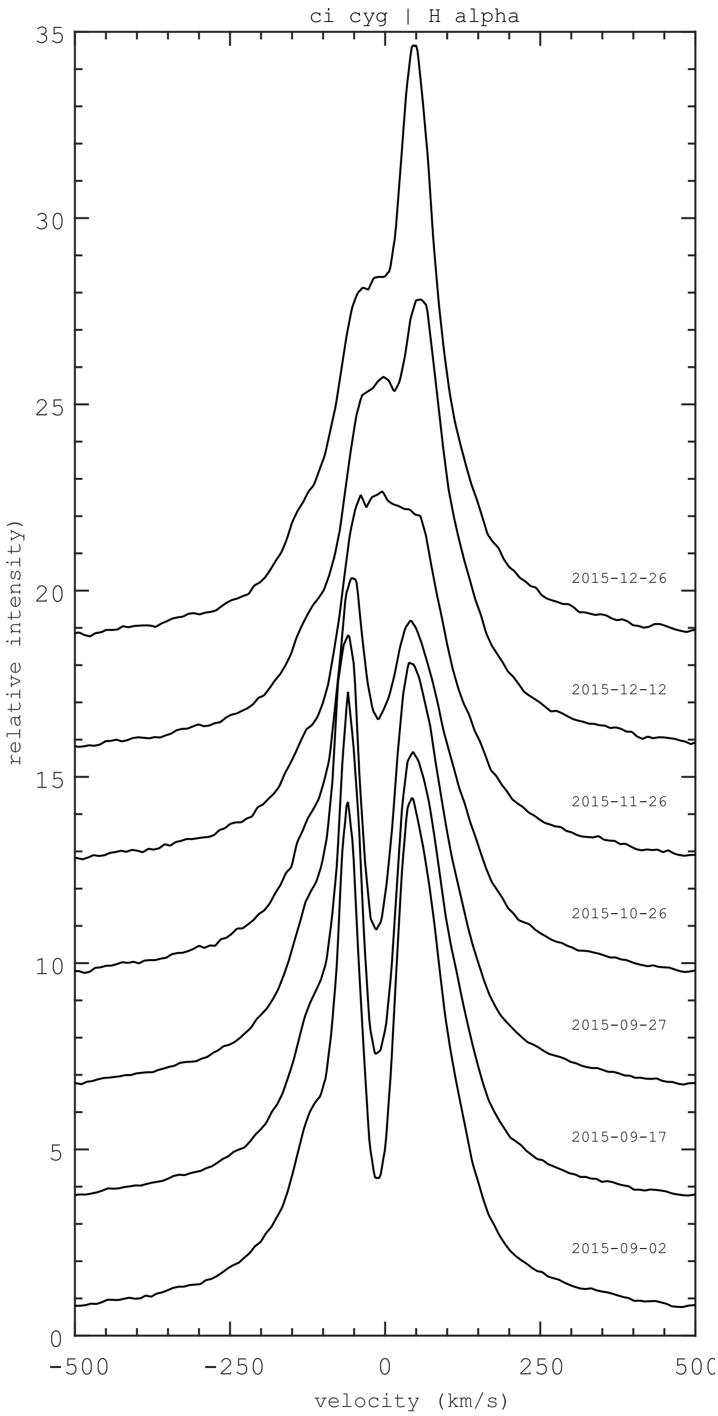
CI Cyg

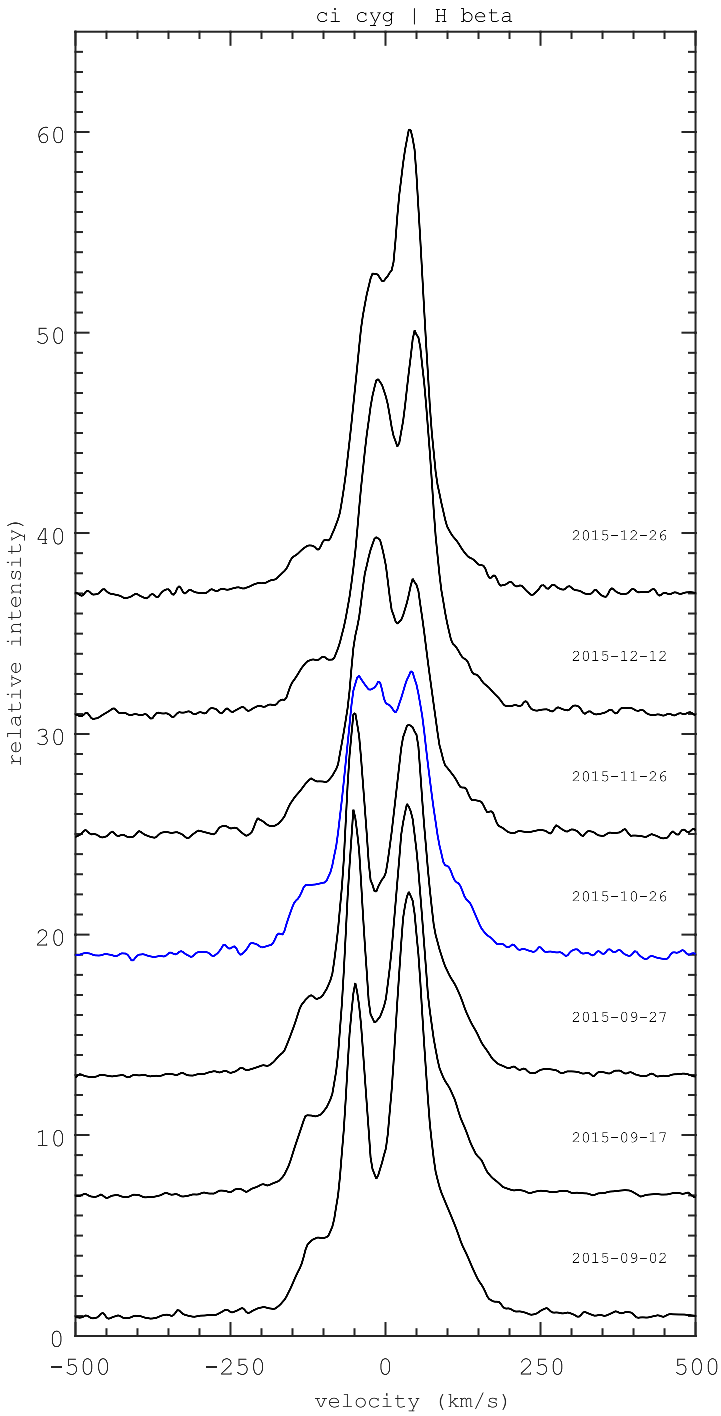
Coordinates (2000.0)	
R.A.	19 50 11.8
Dec	35 41 3.2
Mag	10.8 (V)

Increasing luminosity in November/ December
Fast change of Balmer profiles. See the delay between Ha and Hb variations

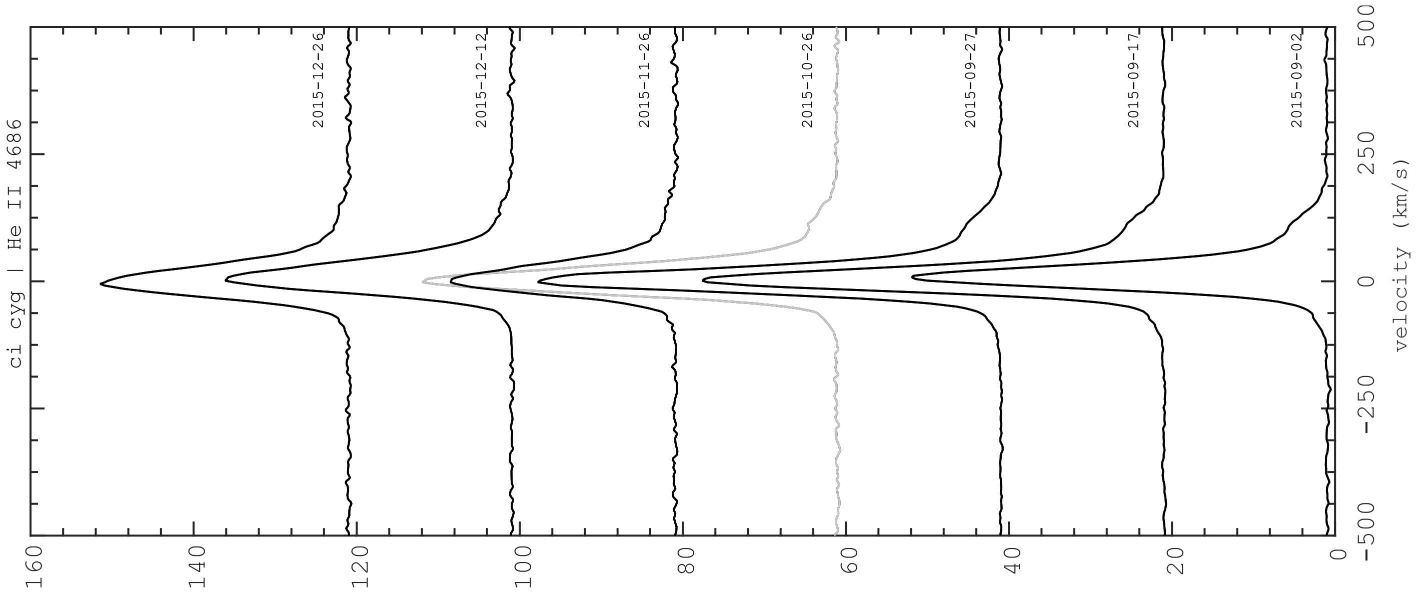


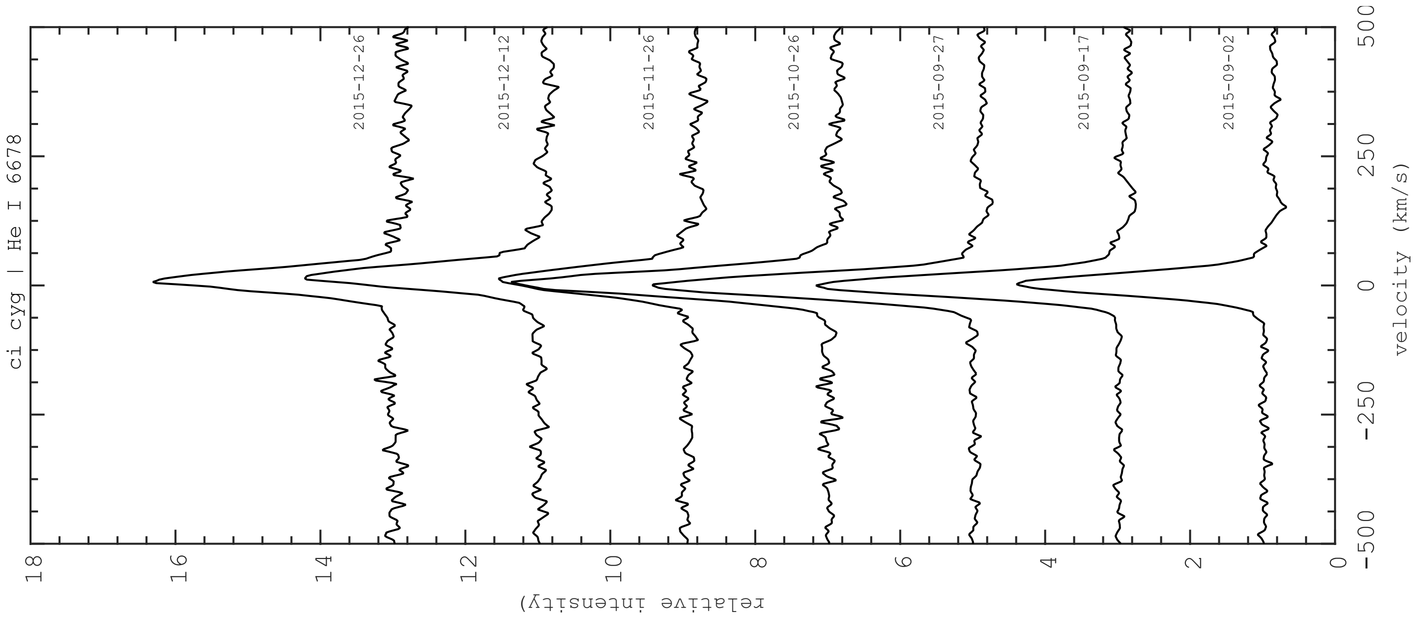
Spectra : F. Teyssier - eShel - R = 11000

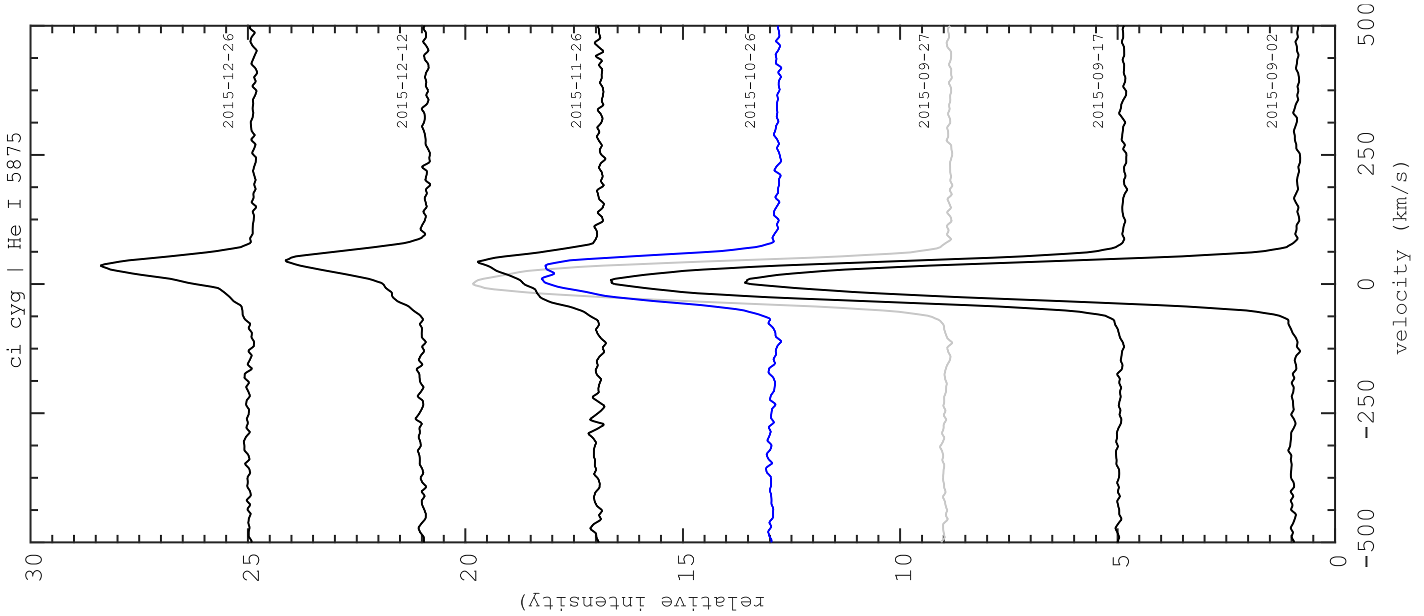




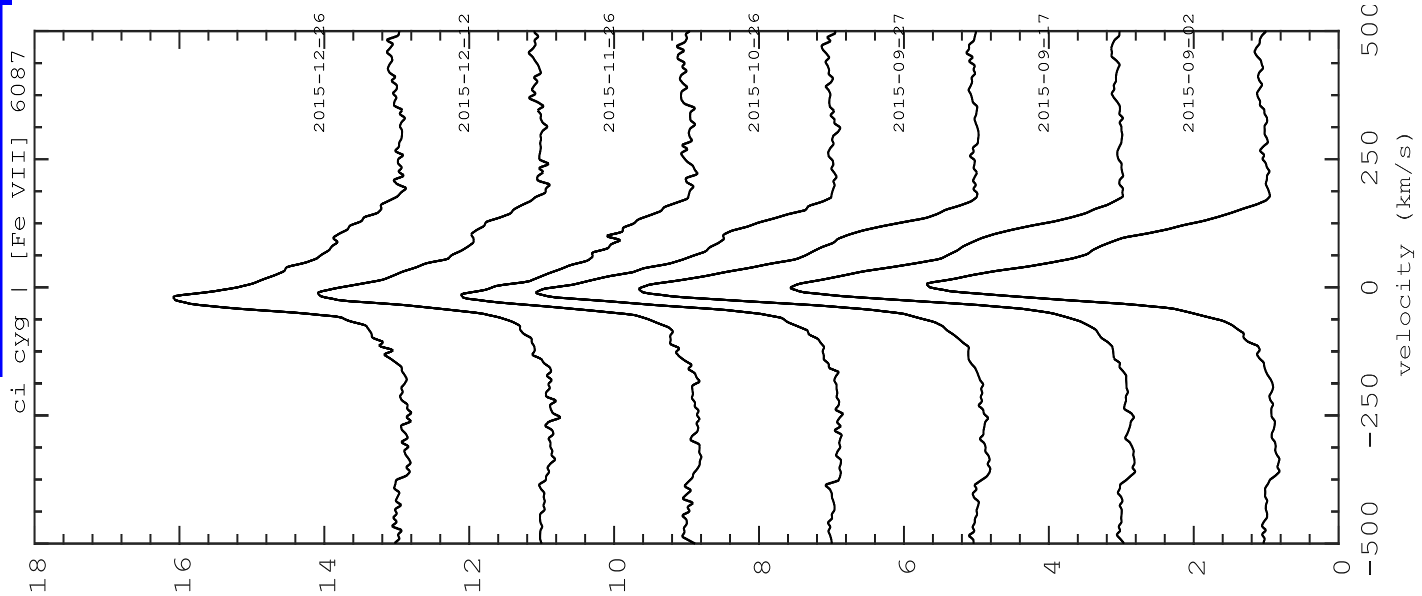
CI Cyg

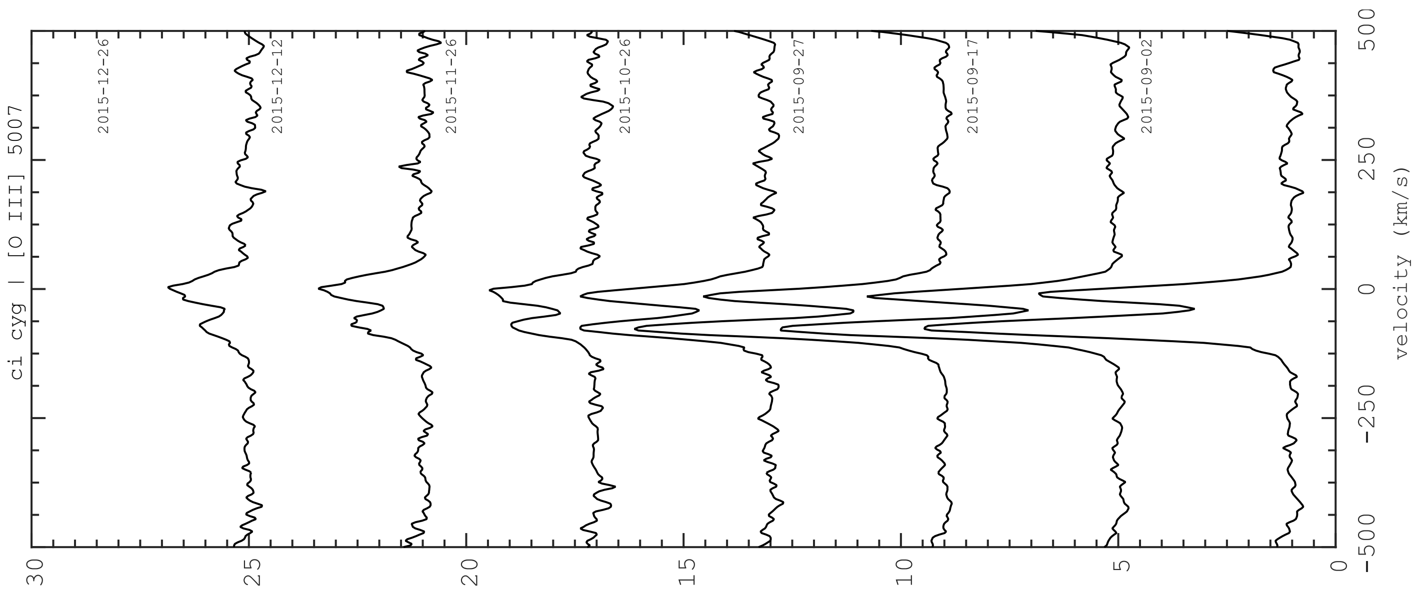

ci cyg | He II 4686
relative intensity
velocity (km/s)
2015-12-26
2015-12-12
2015-11-26
2015-10-26
2015-09-27
2015-09-17
2015-09-02

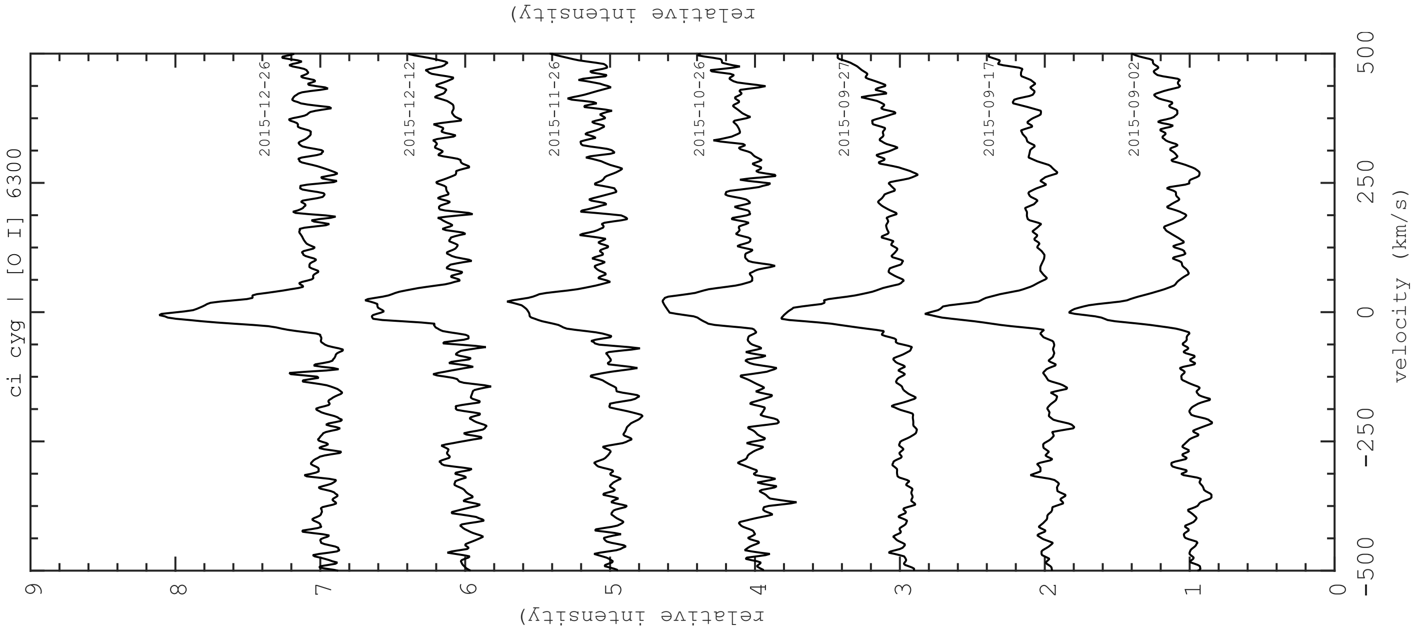

ci cyg | He I 6678
relative intensity
velocity (km/s)
2015-12-26
2015-12-12
2015-11-26
2015-10-26
2015-09-27
2015-09-17
2015-09-02


ci cyg | He I 5875
relative intensity
velocity (km/s)
2015-12-26
2015-12-12
2015-11-26
2015-10-26
2015-09-27
2015-09-17
2015-09-02

CI Cyg


ci cyg | [Fe VII] 6087
2015-12-26
2015-12-12
2015-11-26
2015-10-26
2015-09-27
2015-09-17
2015-09-02
relative intensity
velocity (km/s)


ci cyg | [O III] 5007
2015-12-26
2015-12-12
2015-11-26
2015-10-26
2015-09-27
2015-09-17
2015-09-02
relative intensity
velocity (km/s)

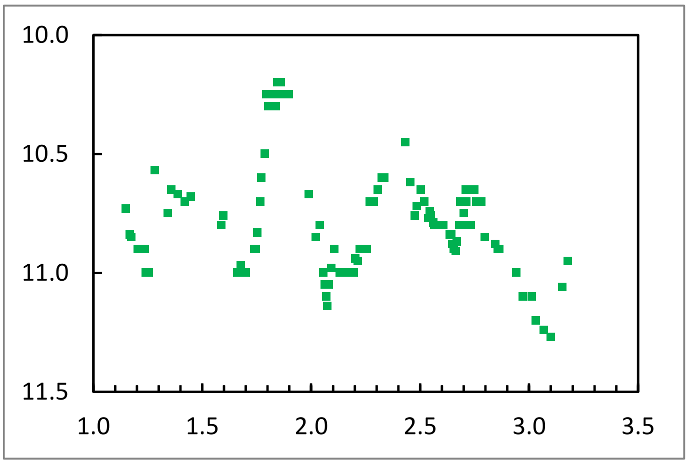

ci cyg | [O I] 6300
2015-12-26
2015-12-12
2015-11-26
2015-10-26
2015-09-27
2015-09-17
2015-09-02
relative intensity
velocity (km/s)

CI Cyg Long term monitoring 1/2

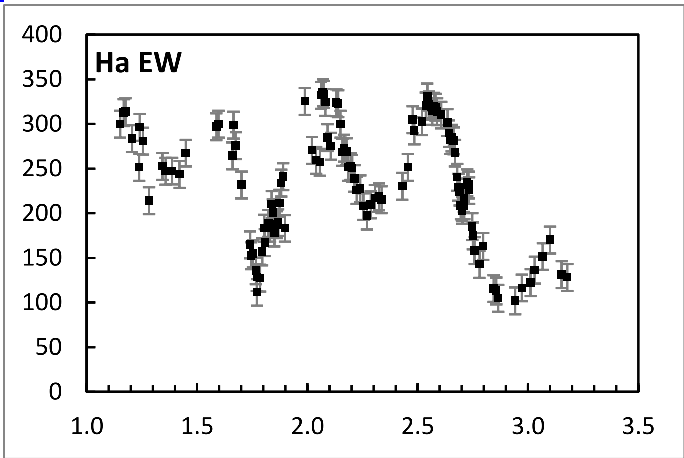
Here's an update of a long term monitoring of the classical symbiotic CI Cygni. It begings in 2011 after the 2010 outburst of this system.
130 Spectra at R ~ 1000 :
- 2011-2014 : F. Teyssier
- 2015 : D. Boyd - J. Guarro Flo

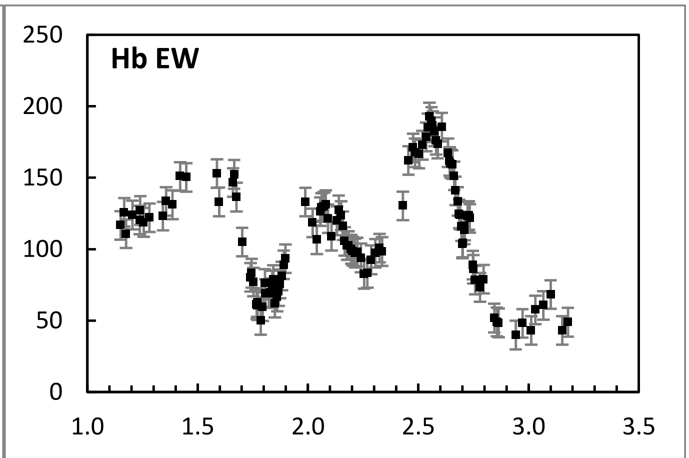
Spectra are dereddened for E(B-V) =0.4

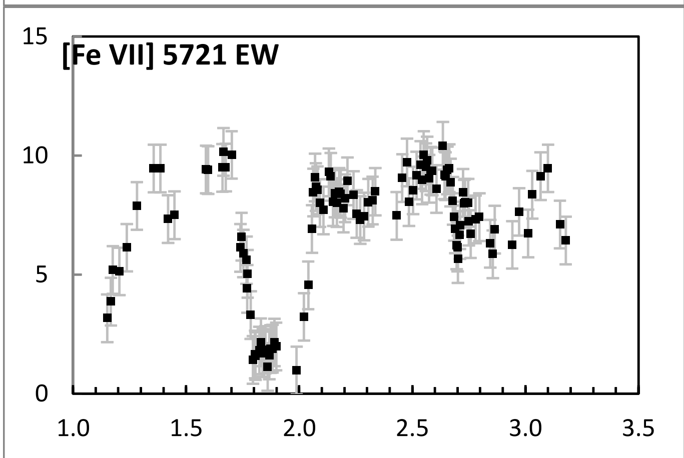
Ephemeris according Fekel & al., 2000
JD0 = 2442690 E=853.8 days
We adopted :
Phase 0 = 27/10/2010 (JD 2455497)
Phase 1 = 27/02/2013 (JD 2456350.8)
Phase 2 = 01/07/2015 (JD 2457204.6)
Phase 3 = 31/10/2017 (JD 2458058.4)

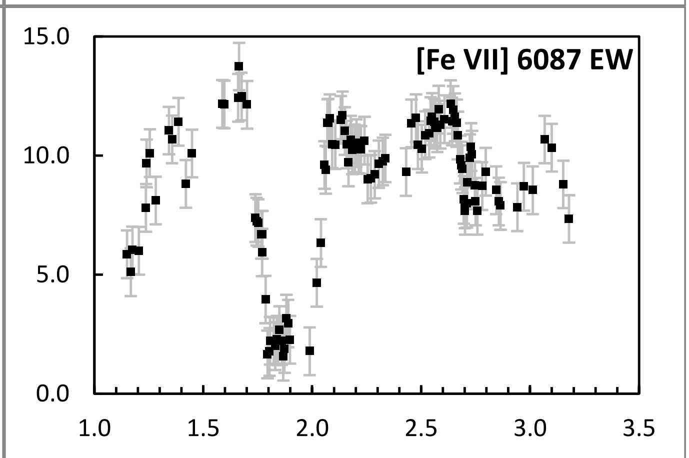


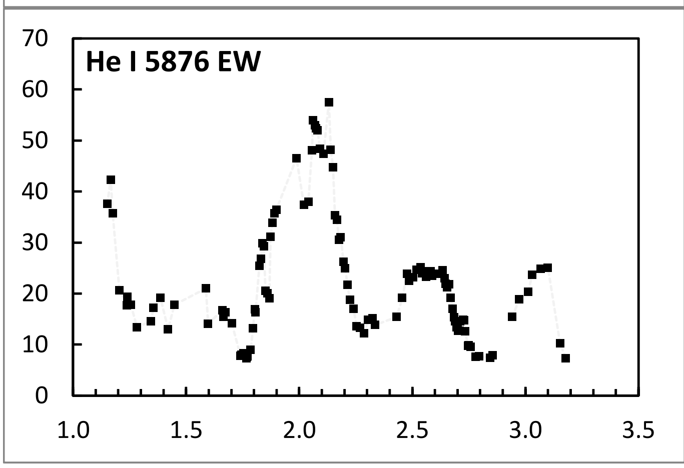
V mag adopted from AAVSO data base

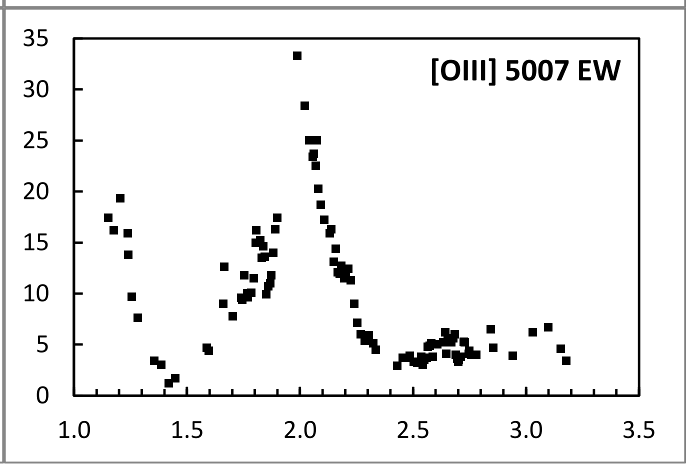




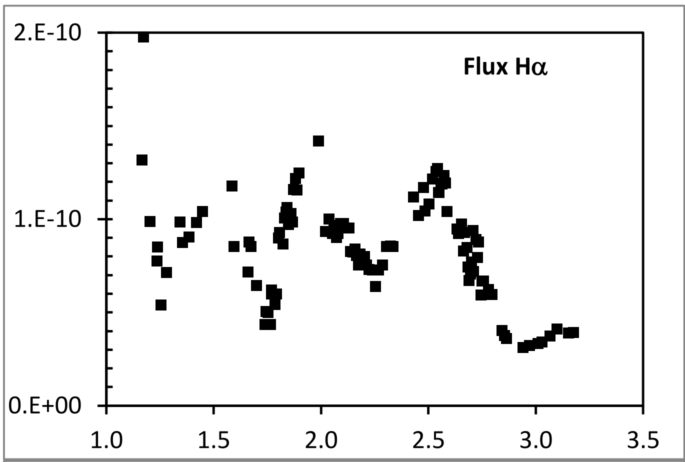


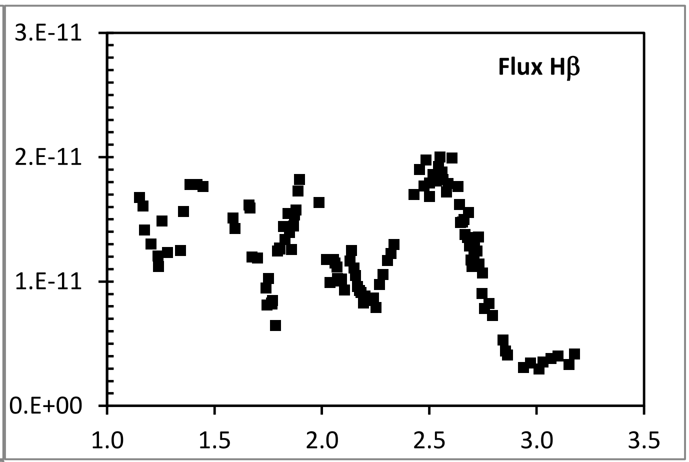


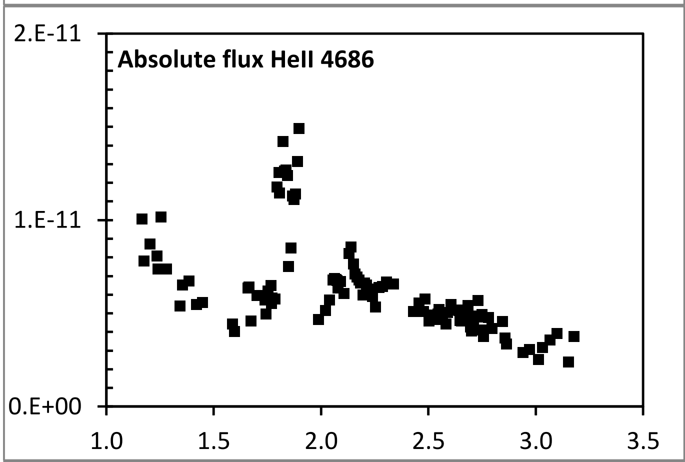


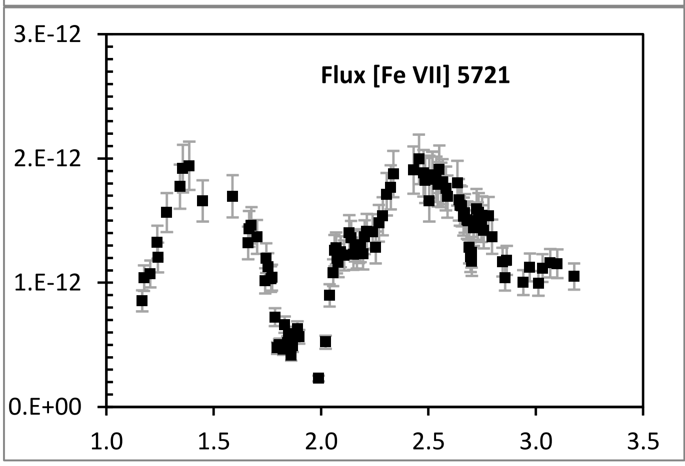


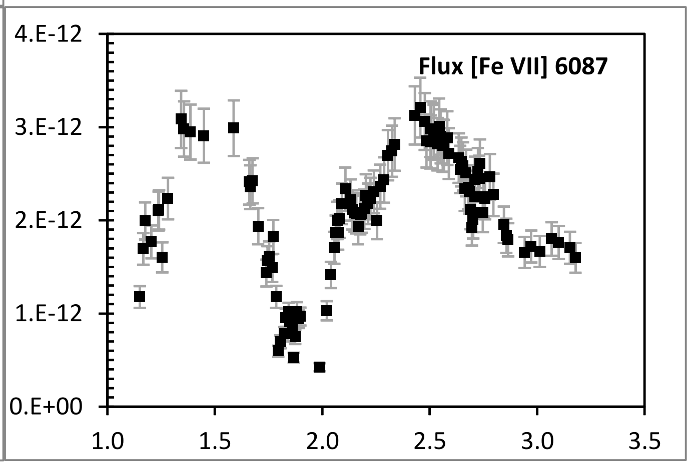
CI Cyg Long term monitoring 2/2

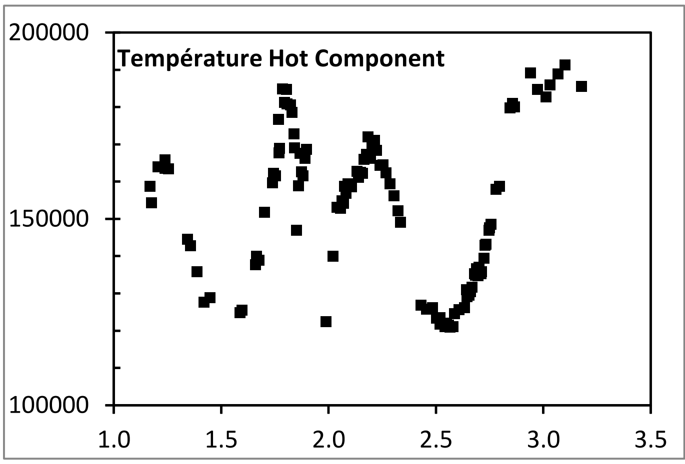




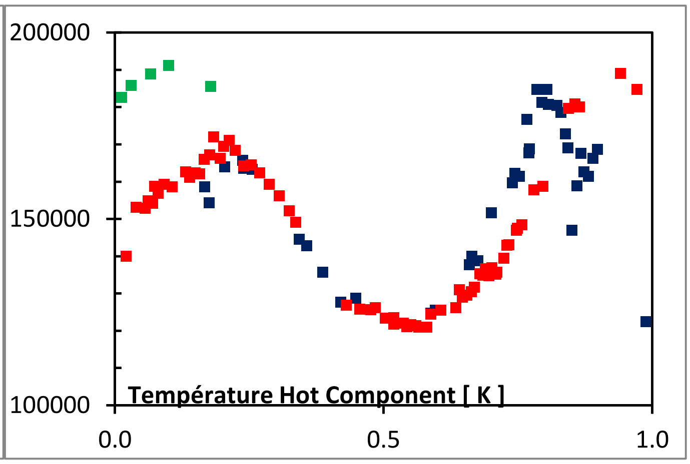








Temperature deduced from He II and He I intensity

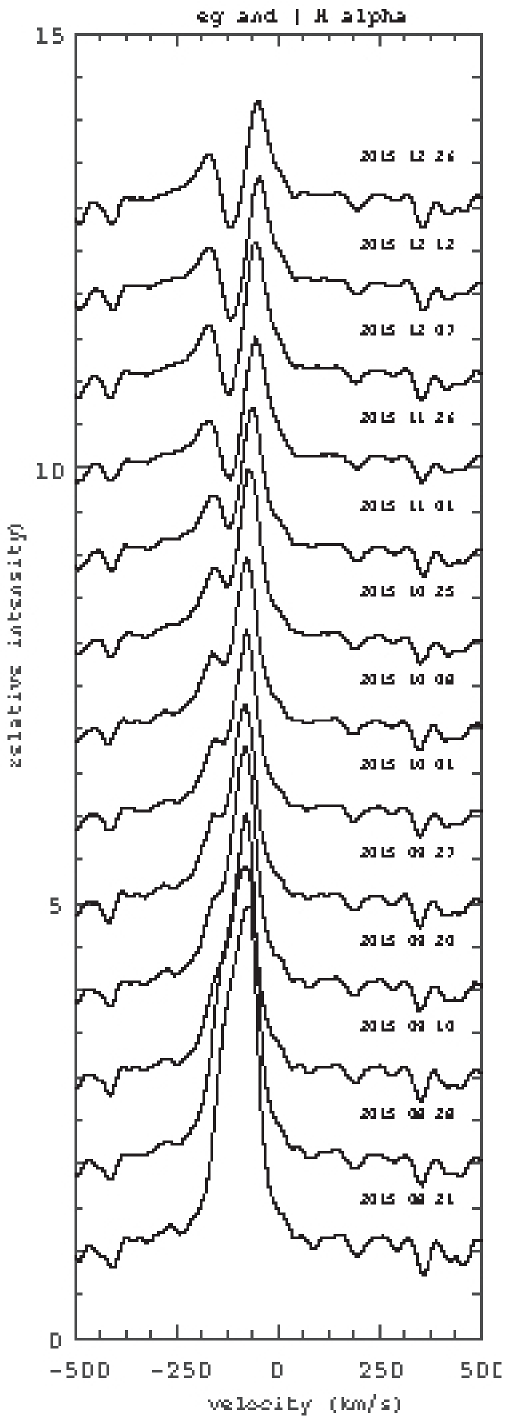


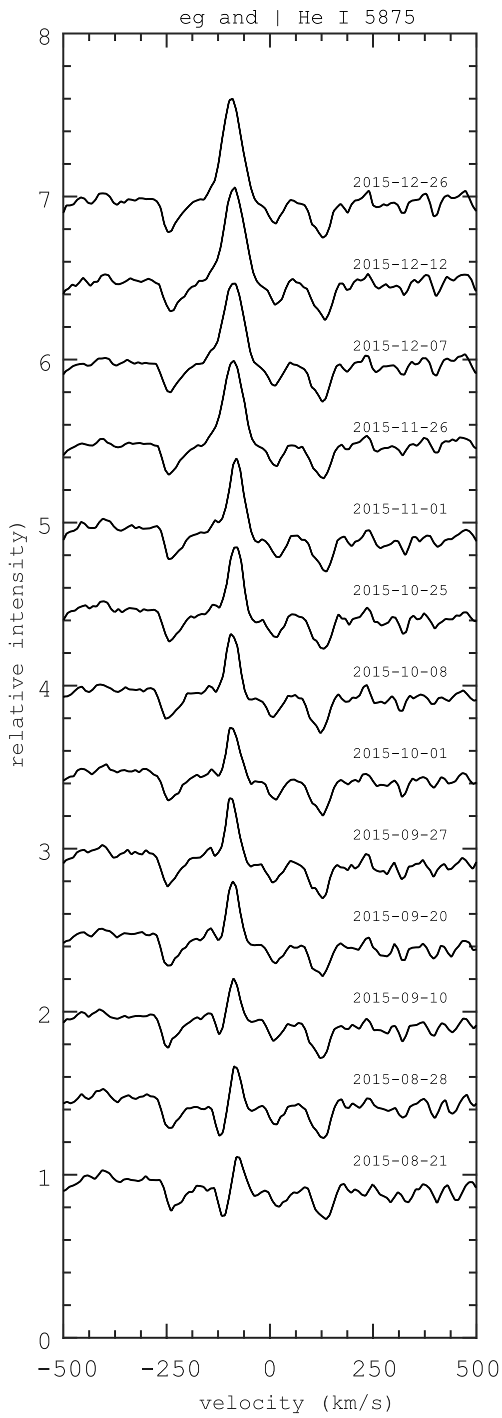
Blue : orbit #1 Red : orbit #2 Green : orbit #3

EG And

Coordinates (2000.0)	
R.A.	0 44 37.1
Dec	40 40 45.7
Mag	7.4

H alpha and He I 5876 evolution in 5 months,
from late August to December, 2015
eShel spectra R = 11000 F. Teyssier

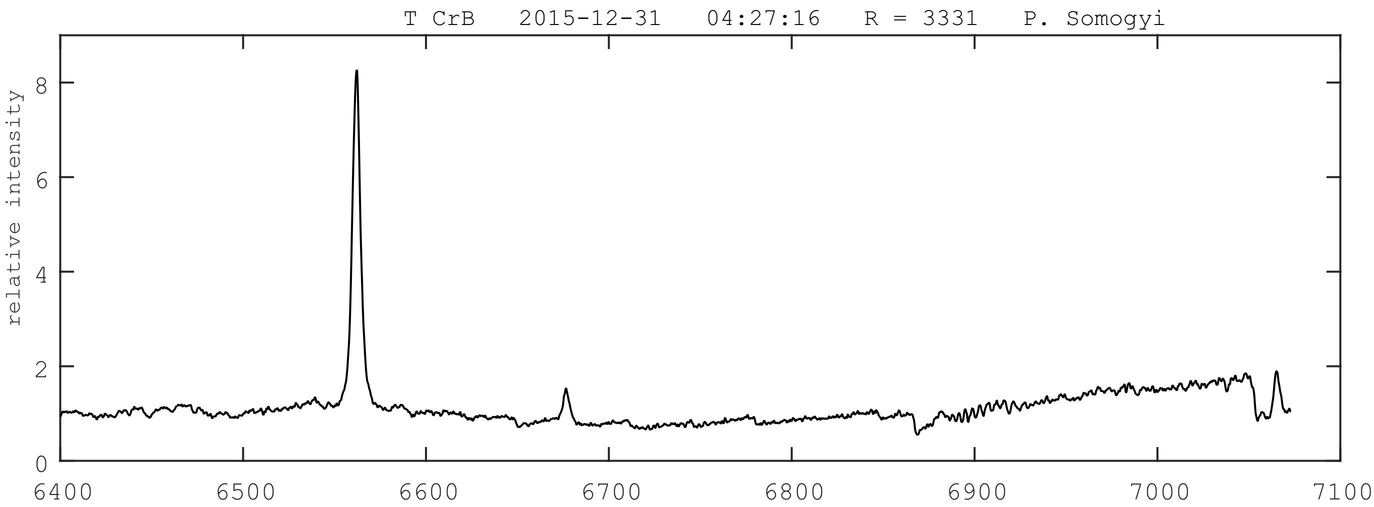


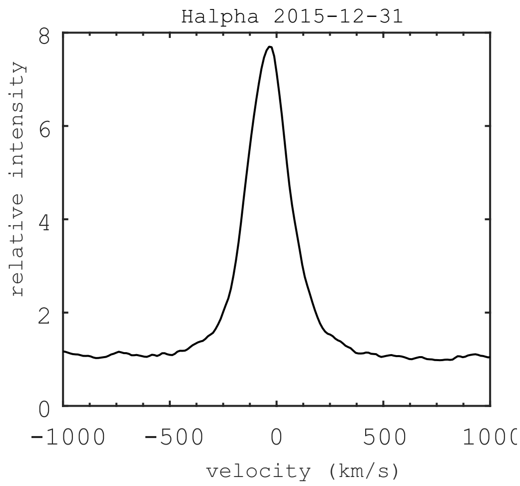


SYMBIOTICS

T CrB

Coordinates (2000.0)	
R.A.	15 59 30.2
Dec	+25 55 12.6
Mag	9.8

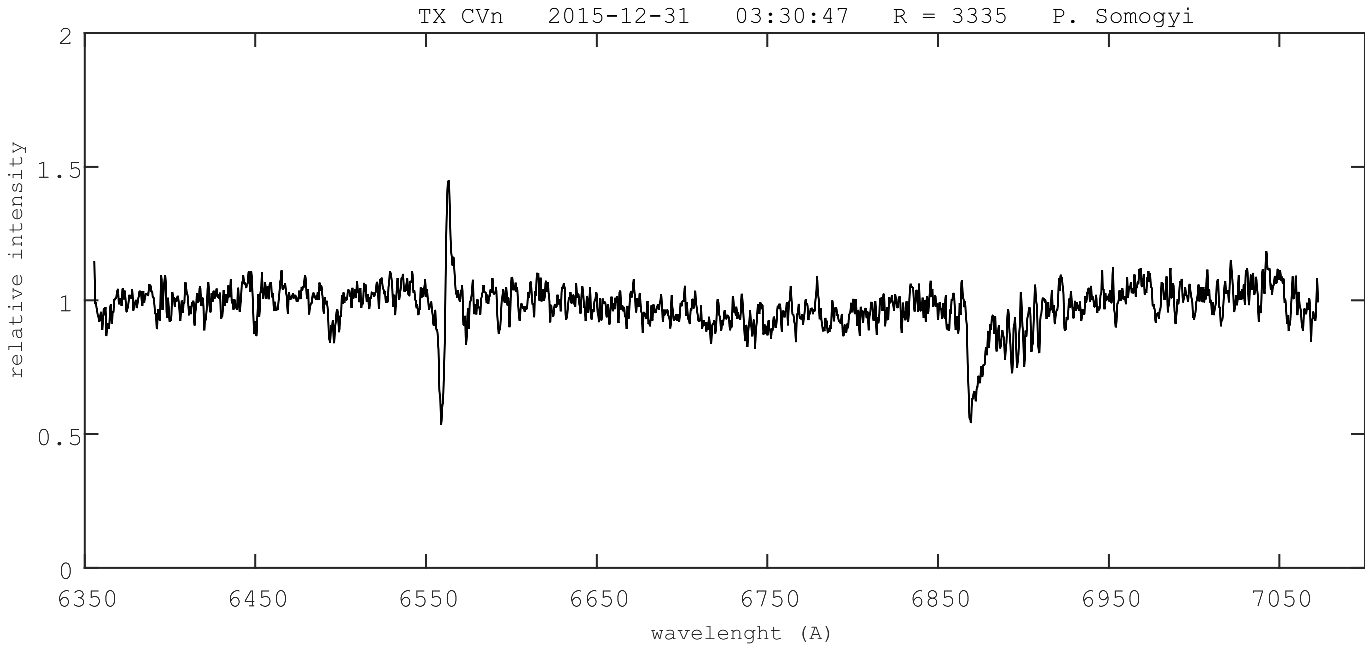




S Y M B I O T I C S

TX CVn

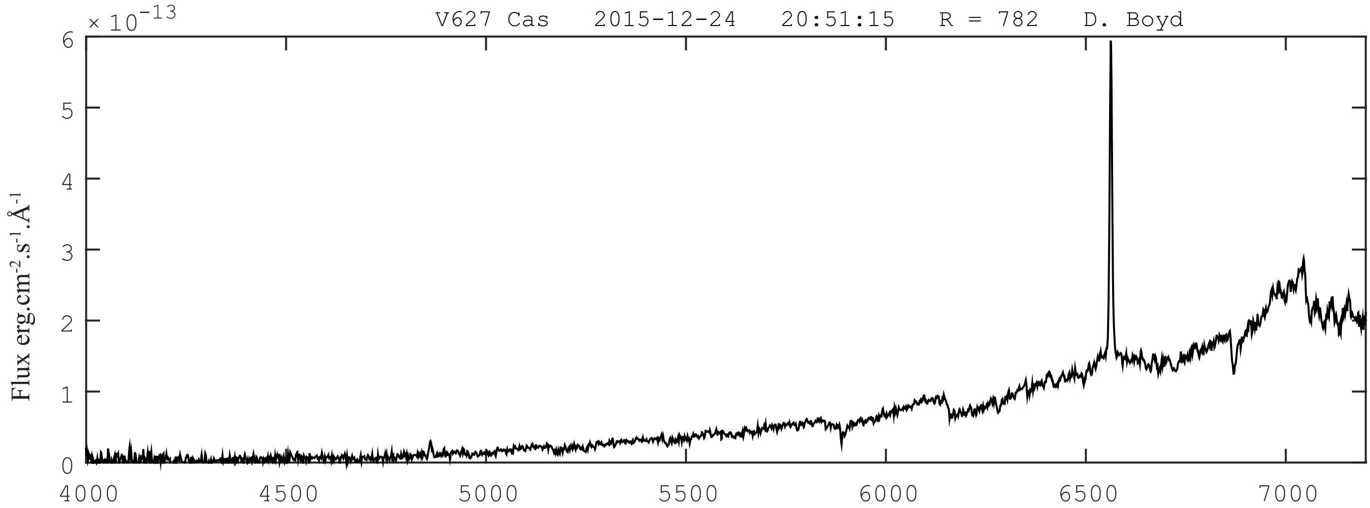
Coordinates (2000.0)	
R.A.	12 44 42.1
Dec	+36 45 50.7
Mag	10.0

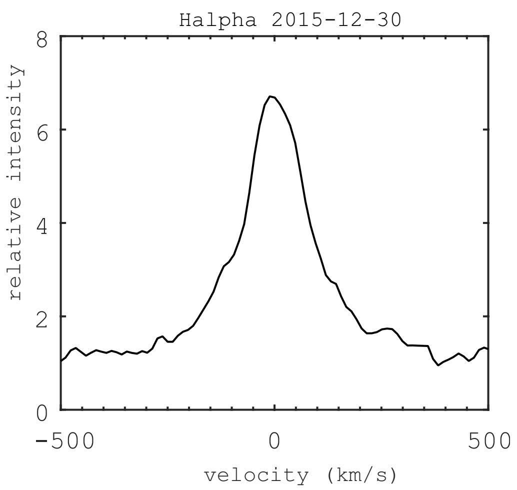


S Y M B I O T I C S

V627 Cas

Coordinates (2000.0)	
R.A.	22 57 41.2
Dec	58 49 14.9
Mag	12.7 (V)





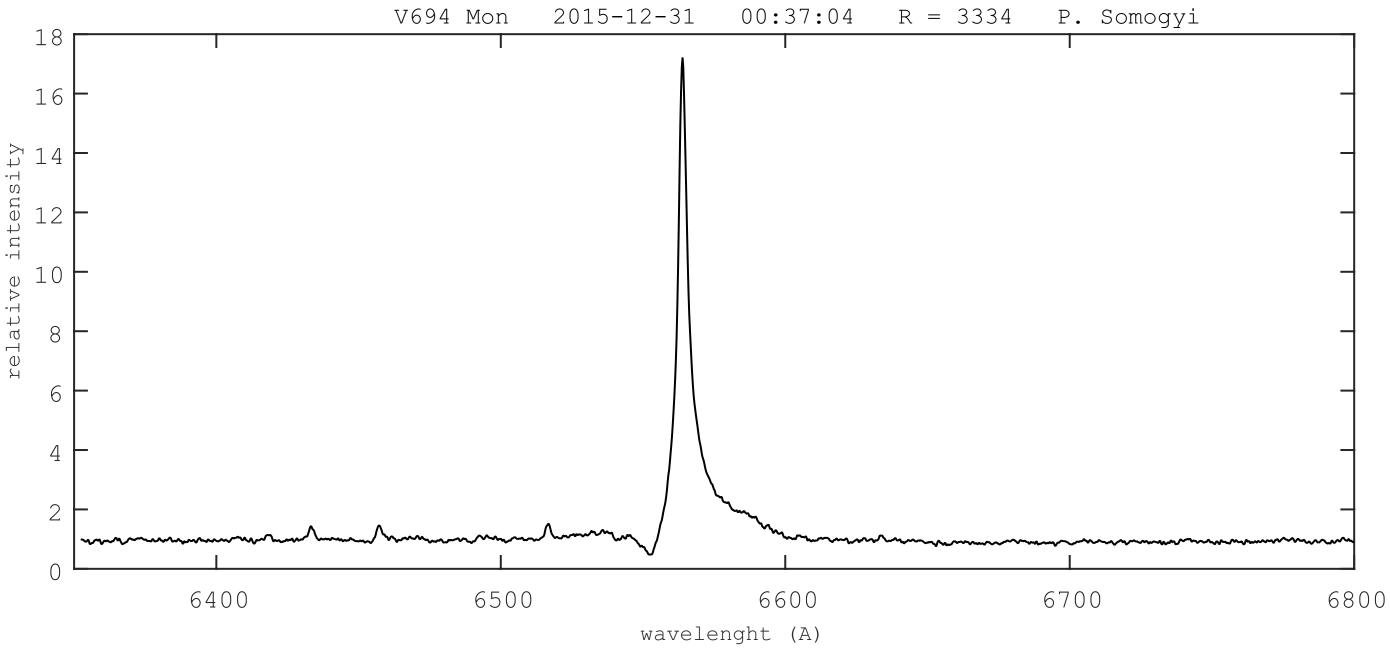
P. Somogyi
Hα Profile

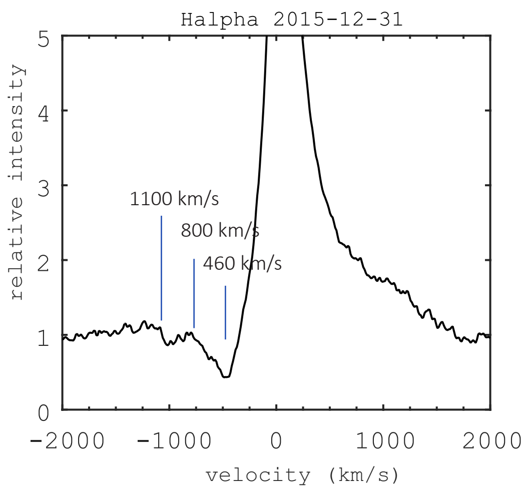
SYMBIOTICS

V694 Mon

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

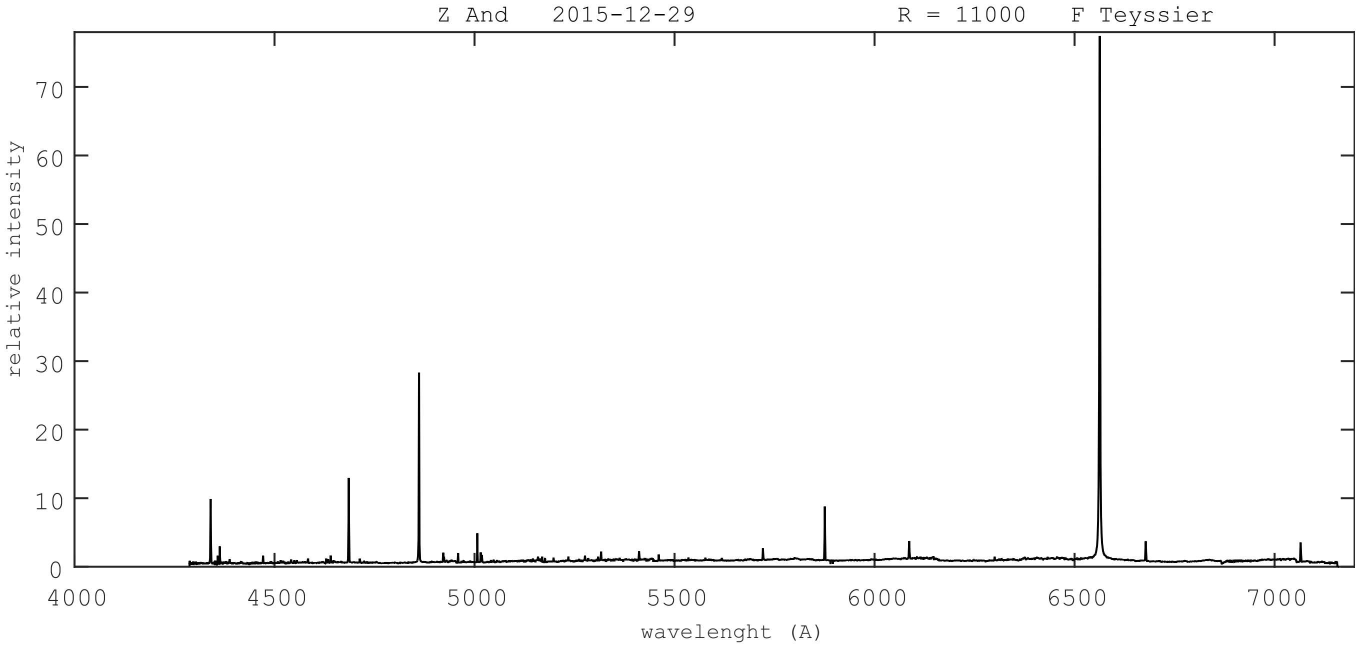
V mag = 9.8 from last data in AAVSO database
Narrow absorption (v max = -1100 km.s^{-1}) in
Peter Somogyi spectrum

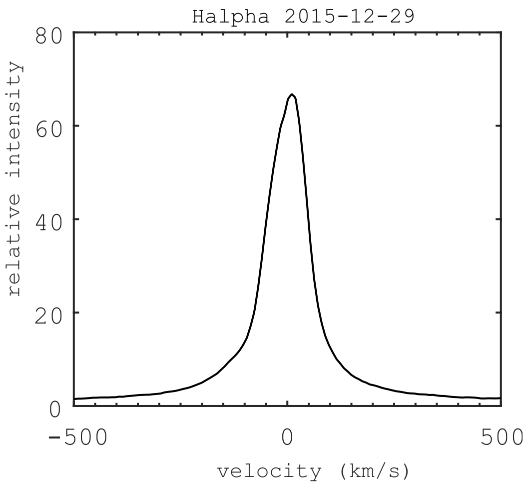


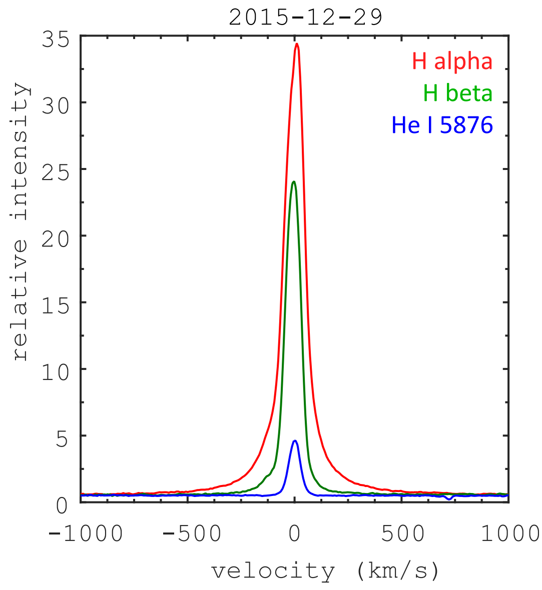


Z And

Coordinates (2000.0)	
R.A.	23 43 49.4
Dec	48 49 5.4
Mag	10.1

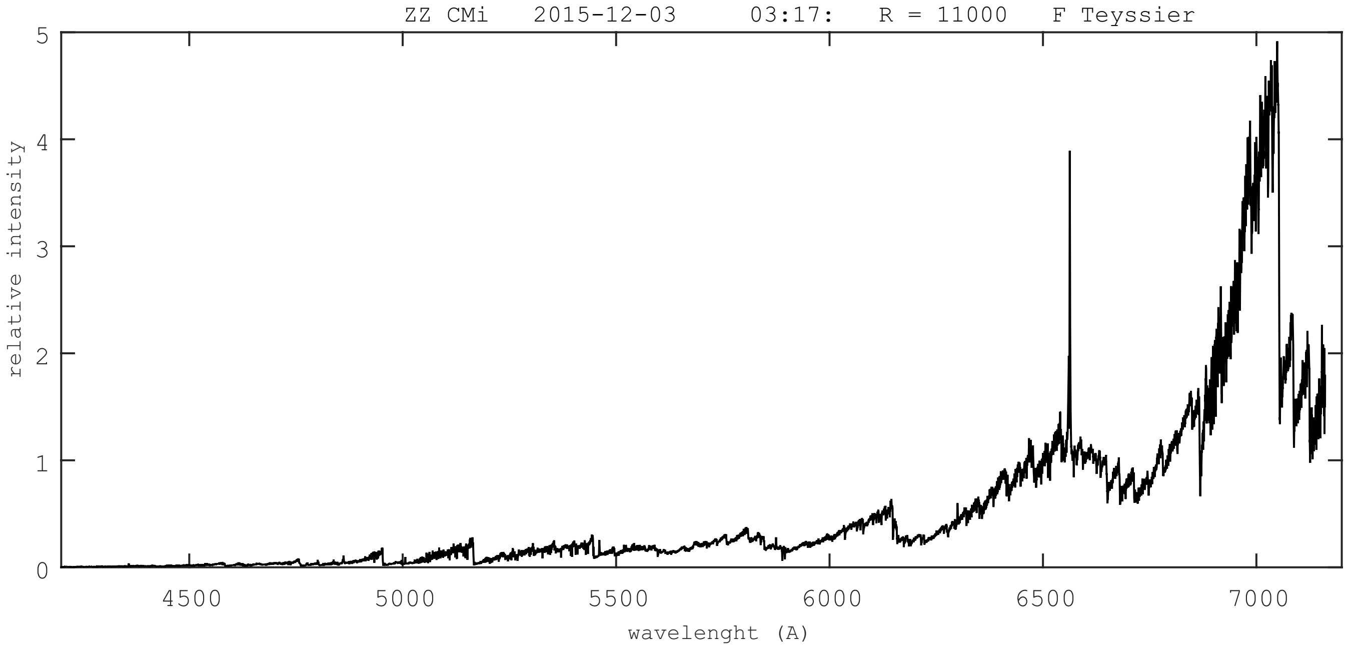


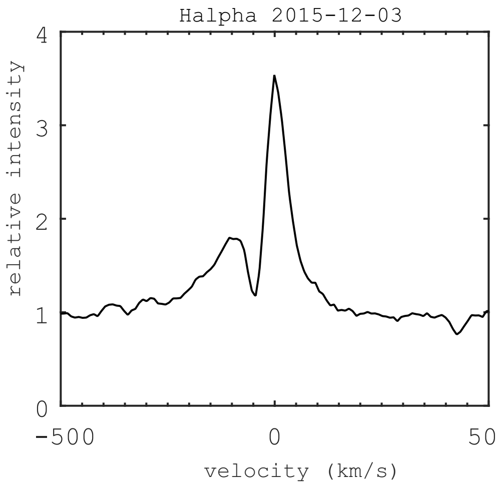


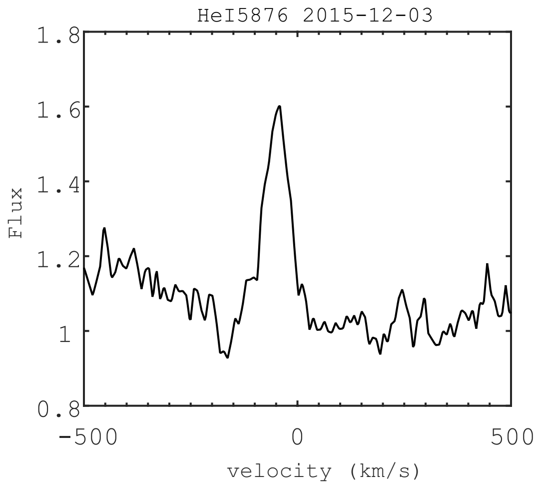


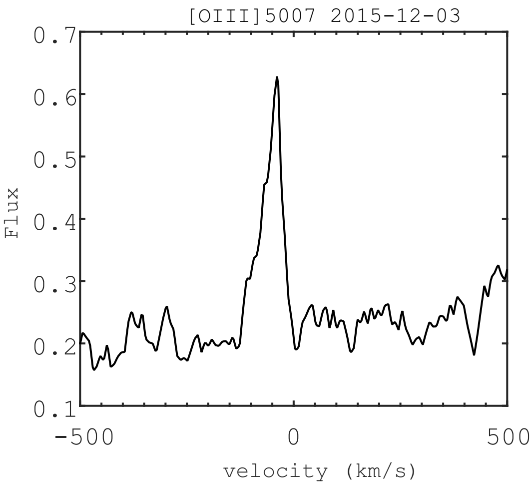
ZZ CMi

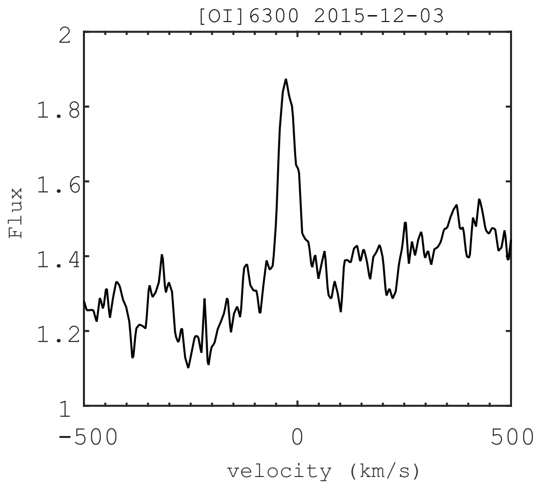
Coordinates (2000.0)	
R.A.	07 24 14.0
Dec	+08 53 51.8
Mag	10.2



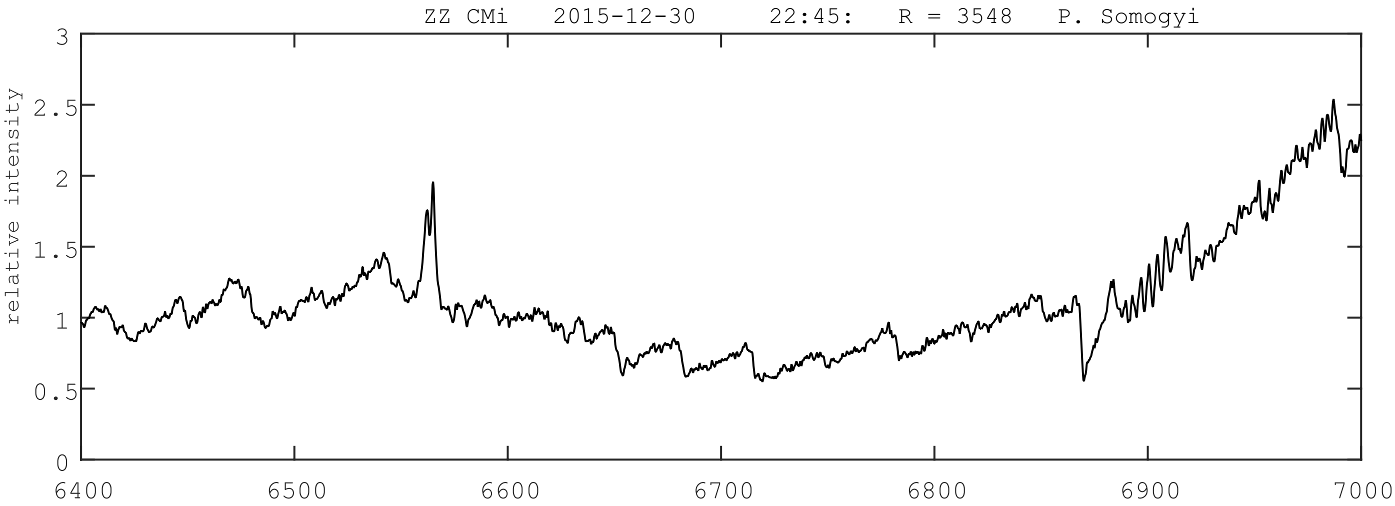






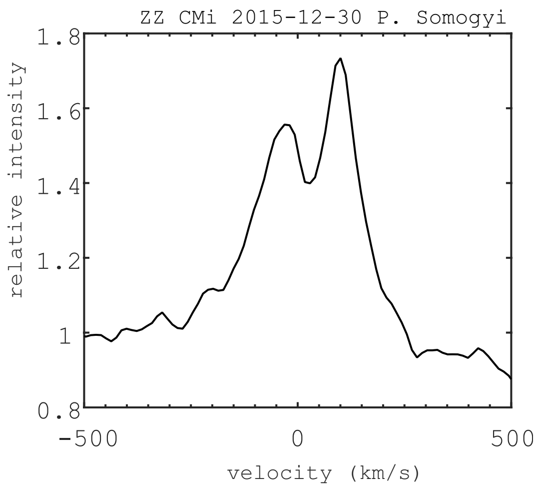


ZZ CMi



Peter Somogyi
Lhires III 600 l/mm R = 3500

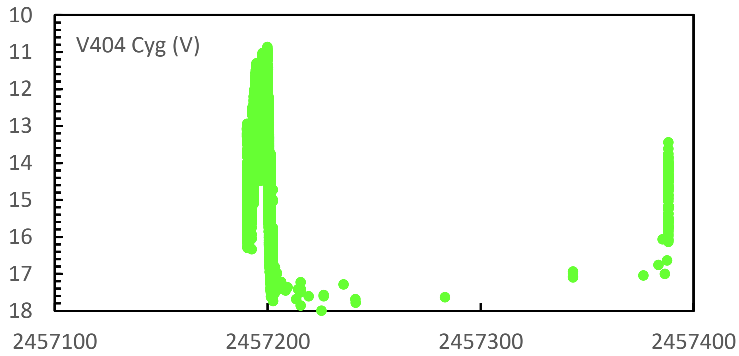
H alpha profile

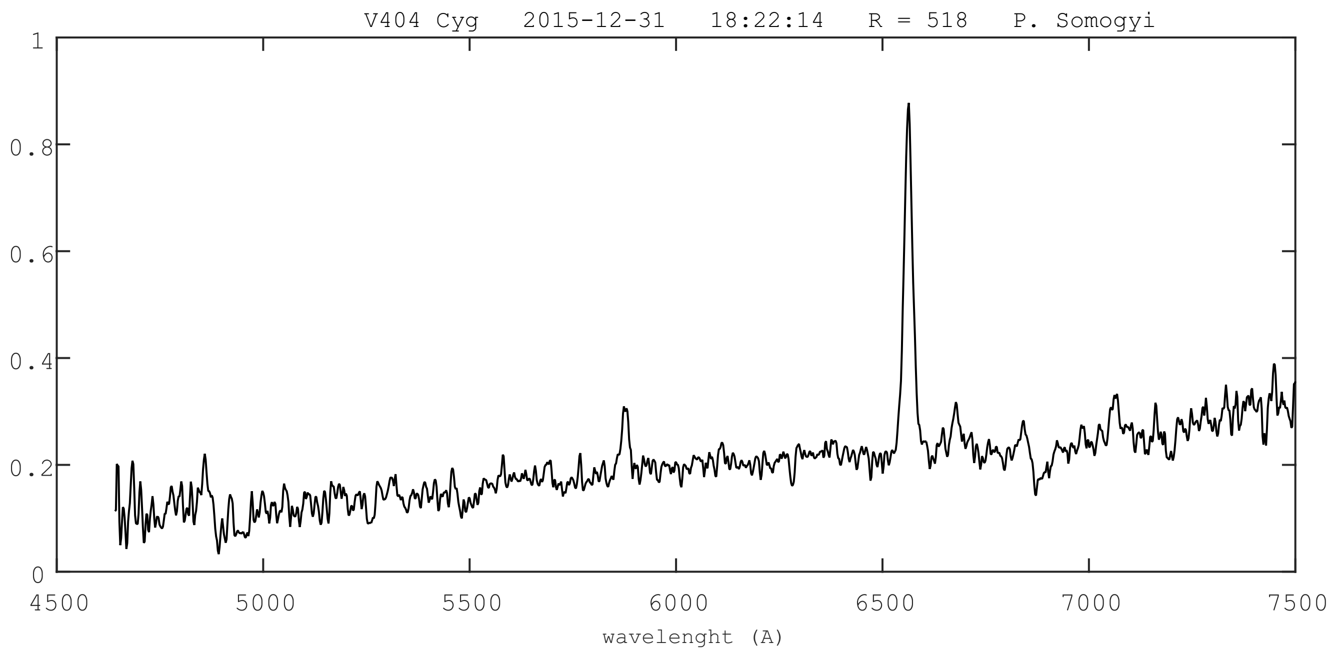


V404 Cyg

Coordinates (2000.0)	
R.A.	23 43 49.4
Dec	48 49 5.4
Mag	

The micro quasar V404 Cyg undergone a second outburst in 2015
Peter Somogyi obtained a time-series during this event while Tamas Tordai got V band photometry





Optical spectroscopy of V404 Cyg during its latest outburst

The Astronomer's Telegram

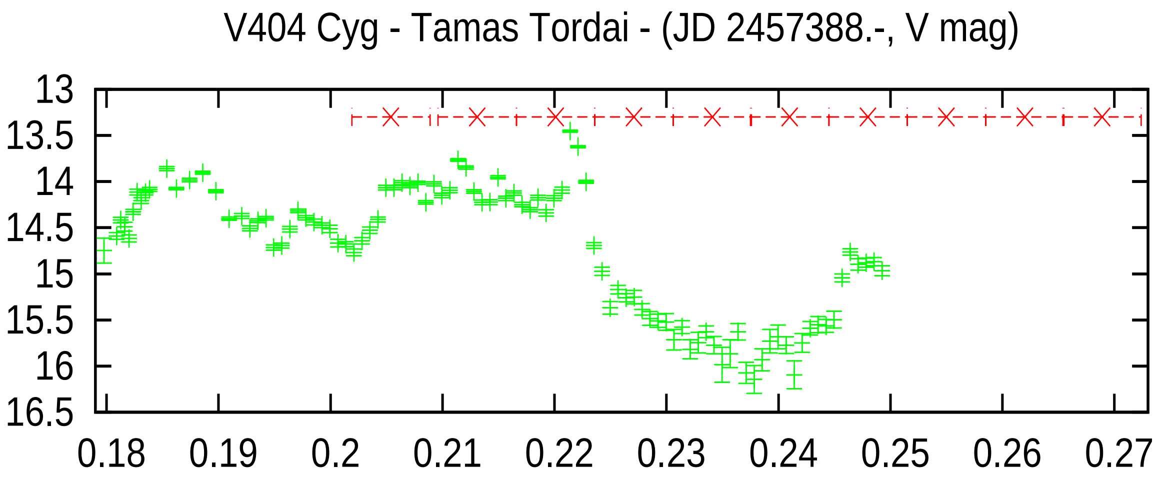
ATel #8508; Peter Somogyi
on 6 Jan 2016; 02:28 UT
Credential Certification: S. N. Shore (shore@df.unipi.it)

Low resolution spectra were obtained during the current outburst (announced in ATel #8453) of the microquasar V404 Cyg. Ten 600 sec exposures were obtained on 2015 Dec. 31 (JD 2457388.202 - 0.27) with a 250 mm Newtonian reflector using an LHires III spectrograph with 150 line/mm grating (R ~ 500) spanning 4500-7500A with the combined S/N ~ 10 (continuum at 6000A; calibration used the standard HD192640). The spectrum showed strong Halpha emission with EW = 104+/-10A and He I 5876 with EW = 21+/-2A. Weak but detectable emission was also present at He I 6678 and 7065. The spectrum was deconvolved using the Richardson-Lucy algorithm and a gaussian lsf. The recovered Halpha FWZI was 2300 km/s, the He I 5876 FWZI was similar. The lower limit for Halpha/Hbeta ratio was about 4, uncorrected for reddening. Using the extinction obtained by Hynes et al. (2009, MNRAS, 399, 2239) of E(B-V)=1.3 a power law fit to the continuum (in wavelength) gives an exponent of -1.6+/-0.1. No statistically significant line variations were detectable among the individual spectra. The data are available through the ARAS Spectral Database and further observations are planned.

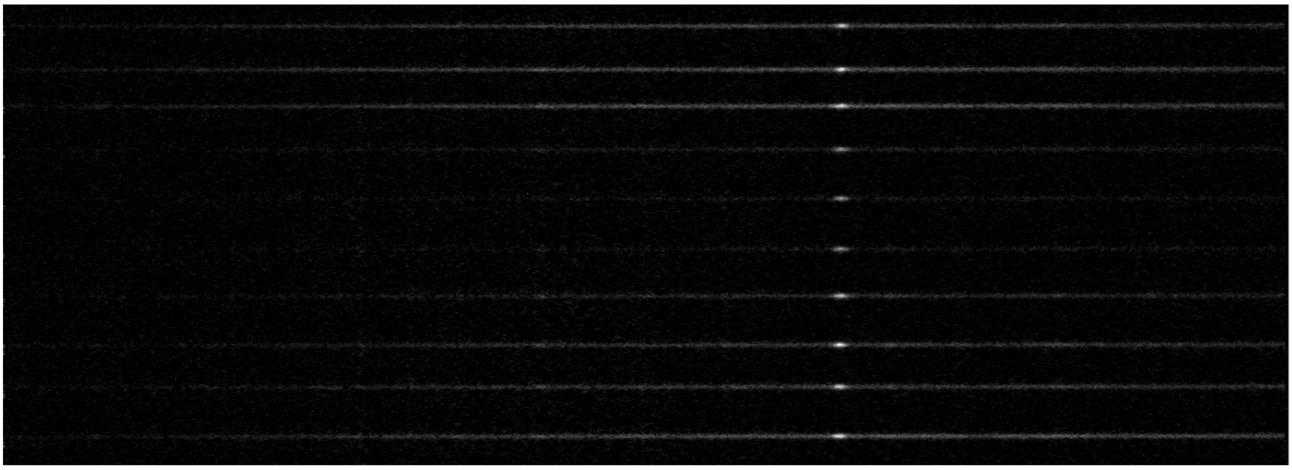
A.R.A.S Spectral Data Base

See also : https://www.aavso.org/aavso-observers-contribute-understanding-black-hole-binary-v404-cygni

V404 Cyg



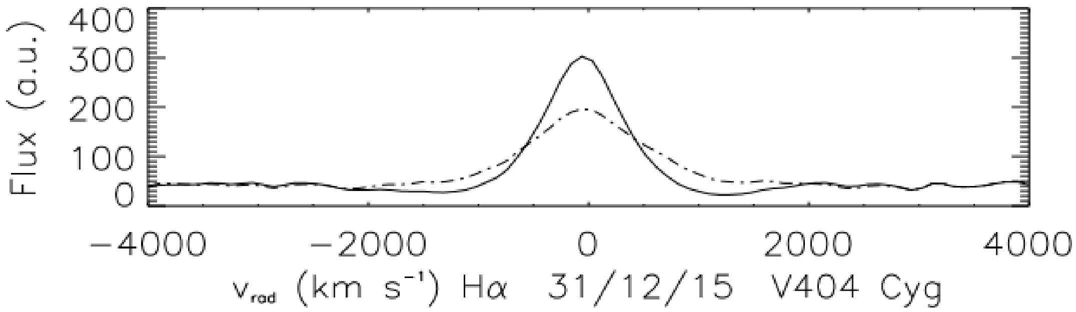
Green : V band photometry obtained by Tamas Tordai
Red : Spectra obtained by Peter Somogyi

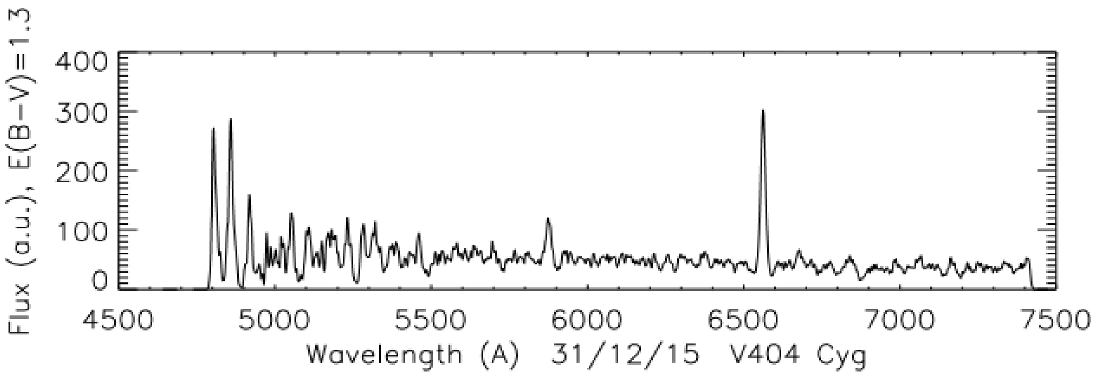


Log of observation JD = 2457388 +

1.: .2019 - .2089
2.: .2096 - .2166
3.: .2166 - .2236
4.: .2236 - .2306
5.: .2306 - .2376
6.: .2375 - .2445
7.: .2445 - .2515
8.: .2515 - .2585
9.: .2585 - .2654
10: .2654 - .2724

V404 Cyg





Deconvolution of H alpha profile and deredded spectrum by Steve Shore
(See above)

... the most important result is the He I sequence. ... the lines are He I 5876, 6678, 7065. Their widths are consistent with the Balmer lines. The Hbeta line is weakly present, Halpha/Hbet > 4 is a good measure of the extinction. The study by Hynes et al. (http://arxiv.org/pdf/0907.4376v1.pdf) gives A_V = 4.04 (with a rather large range) so E(B-V)=1.3. Using that, the extinction corrected spectrum is the one I've attached (normalized at 5000A for the uncorrected spectrum). For the equivalent widths, EW(Halpha)=104+/-10A, EW(5876)=21+/-2A (in both cases the estimate is about 10% uncertainty, the individual measurmemnts are more precise but not "accurate"), and the FWZI width for both lines is about 3000A. That's a problem because of the resolution but deconvolving gives a better estimate, 2000 km/s. I'm enclosing the plot. The dashed line is the original Halpha profile, the solid line is the deconvolved profile. The total flux is the same, a constraint on the algorithm (this is a Richardson-Lucy procedure that is very stable, even with this S/N ratio).

A small tutorial
on spectral types, colors, and effective temperatures

Steve Shore

1 Spectral classification - static atmospheres

A great success of spectroscopy, one of the first things realized in the 19th century when observing stars, was the development of a separation scheme for distinguishing the complexity of the absorption line distribution. You can order the *complexity* of the spectra and then link the line behavior with changes in the thermodynamic state of the gas (ionization, excitation, and so on). The problem of winds, extended structures, and nonlocal radiation because of scattering and external illumination we've already discussed (e.g. the Raman scattering lines, remember?). But to capture all of this information in a few symbols is an amazing power of spectroscopy -- applied to normal objects -- and one that serves well in a very broad sense to distinguish the normal from the bizarre. We can link the spectral properties to the luminosities and temperatures of the photospheres in different wavelength regimes and, from this, obtain estimates of masses and even abundances. All of this is the standard stuff of textbooks. But there are issues that you, as the *new generation* of spectroscopists, might think about. The change in mindset that coms from being able to obtain flux calibrated spectra, and the soon to be available parallaxes from *Gaia* (and already available from *Hipparcos*) can lead to new insights that are often impeded by the use of older tmethods of analyzing the data. Let me be specific, an I hope this will make sense.

2 Colors

The standard system we've known and loved for over 70 years, the broadband minimal filter set called the *Johnson-Morgan UBV* system, was created top address a specific need, born from desperation. In the post-WW II period, although telescope spectrographs had improved, the most important new instrument introduced to astronomers was the photoelectric photmultiplier tube. Specifically, the 1P21 photocathode developed by RCA and associated electronics had been invented for registering weak light signals with high counting rates and broadband sensitivity. Because it is a low noise detector, especially when cooled in a bath of dry ice, the photomultiplier tube (PMT) it i a *photon counting device* (i.e. registers pulses each of which corresponds to the arrival of a single photon and the liberation of a cloud of electrons depending on the energy of the absorbed light) it could be provide something unmeasurable with very nonlinear and individual photographic emulsions: actual fluxes. In other words, photometry provides absolute information that can only be obtained relatively from photographic spectra. You're used to normalizing continua and measuring the equivalent widths of absorption (or emission) lines. This is a relative flux measurement and similar to magnitudes for which you neither know nor care about the zero point. A PMT can, instead, be pointed toward a known light source nd then through the same telescope and optics observe a celestial object with the two then being precisely calibrated. Now we use CCDs and other photon counting linear devices so it may seem a very distant epoch when that wasn't possible. But the CCD was only introduced in the 1980's , buy which time PMTs had a long heritage. In the 1920s, Stebbins had experimented with some kind of color measurement knowing that the continuum distribution (spectral energy distribution, SED) can be characterized by a few single filters placed in front of a plate. This was the c*olor index* and, estimating the brightness of images on the plates and two filters one could recover the information in the Hertzprung-Russell diagram. At least in a general way. The problem of the stability of the color measurements, even from on observation to other, came from the development process for the photographs. The PMT was a way around that and promised a stable way of obtaining colors and magnitudes.

Morgan, who had refined the Harvard spectral types by adding measure of the line widths for surface gravities, hence luminosities, to the temperature sequence, wanted to distinguish stars, to apply some sort of classification-like index-based method, using a minimal set of filters that captured the complexity of the *lines* and continua. Since most stars have a small set of strong lines in the visible, the Balmer and helium lines from neutral atoms, Ca II, Na I, and

A small tutorial
on spectral types, colors, and effective temperatures

Steve Shore

he broader distribution of metallic absorbers (e.g. Fe II, Mn II) and molecules (e.g. TiO, ZrO, VO), looking at the line distributions he chose a three central wavelengths and moderate bandwidths (resolutions of about 5) to cover the spectrum from 3300 - 8000 \AA. This is a wider range than anything available from single photographic emulsions. The three filters, UBV, were chosen to span the Balmer discontinuity (the ionization edge at 3647 Å), Ca II H and K, and the line convergence, one that included the He I, Si II, and Balmer lines (Hβ, Hγ), and one that was free of Balmer lines. The widths were chosen to approximately cover the continuum and used available glasses and matched the 1P21 response curve. The project was given to his graduate student Johnson, and the result was a measurement of the UBV magnitudes and colors (U-B, B-V) for a few thousand stars for which MK classifications were available. Then the link was made between the mean colors (*not magnitudes*) and the spectral type of the stars. Th sample was moderate and the result depended on eliminating the effects of reddening, but in th end a correspondence was obtained. This as later (in 1982) further improved by Schimidt-Kaler and this is now the standard. To extend the power of the photometry, Strömgren (1960's) further narrowed the bandpasses and increased their number to four, uvby, to include more detail of the individual strong line transitions. The Geneva Observatory system used seven filters and an automatic recoding procedure with absolute calibration of the photometr, and there are many others. The main point is that all o this was to find a minimal, sensitive means for obtaining the qualitative information provided by spectral types and the quantitative information about luminosities and, perhaps, temperatures.

There are several combinations that reduce or remove the effects o the interstellar dust on the colors, indices formed of filter combinations, whose aim was to recover the intrinsic spectral distribution in absence of information about the spectral types. Remember, an O star seen through enough junk in the ISM can be as red as an M star but will have an almost featureless spectrum at low resolution (look at the novae in the database toward the Galactic center or toward the anticenter, you'll see the difference immediately). So this method works because -- and only because -- the spectral types are meaningful. The color excess, E(B-V) can be derived for *normal* spectra because there's a stable atmosphere producing them. For novae, cataclysmics, symbiotics, and even AGN, this just isn't so.

In other words, filter photometry is t*he lowest resolution form of spectrophotometry* and requires throwing away all of the information obtained from CCD spectra. The *only* advantage is its brightness limit. A spectrum with a resolution of 10,000, compared to bands with the resolution of about 10 (for narrow bands) is about 8 mags less sensitive (because of the dispersion and light per pixel) so what takes some time for you would take a factor of 30 times less for filter photometry. But the information contained in the calibrated CCD spectra is completely lost, indeed unrecoverable. Now with multi-fiber spectrographs, even the multiple object (broad field) advantage of photometry is vastly reduced. The only exception is imaging but eventual will come eventually for spectroscopy. The objective prism, which became the focal plane grism like that used for the Sloan Survey, is the bridge between the two methods.

The main point here is that the limits of photometry are also its advantages, it reduces the information content but permits absolute flux measurements. But any advantage is severely limited by the requirement that the objects behave in a standard, taxonomically stable way. Novae, supernovae, even LBVs and strong wind objects, don't.

3 Effective temperature

This is, I think, the most misunderstood concept in spectroscopy and photometry so please pardon my obsessive description here. The question came from one of my students last week and I realized it might have occurred to you too.

If we measure a flux, it's at a single wavelength λ so is F_λ. OK, no big deal. We measure a few of these, put them together, and obtain the bolometric flux *F*. Knowing the radius (which we rarely do) we can then obtain the luminosity by multiplying by the surface area. For MK spectral types, this is the same as taking the luminosity class to obtain the gravity and the photometry to give you the flux and a mass calibration from somewhere to convert surface gravity to radius. Then the slope of the continuum, B-V and U-B, are linked to some sort of temperature, really the P *color temperature* so calling it a temperature you can separate stars according to their and T_{color}. But knowing the input flux in absolute units and the surface gravity, a modeler can compute a theoretical atmospheric structure in pressure and thermal equilibrium, including all the lines and continuum processes we've talked about, and obtain a predicted spectrum. *It doesn't matter what the temperature of the input flux is, it only maters that you know the surface gravity and luminosity* and you can then *define* the *effective temperature* as the root ratio T_{eff} = (L/[surface\ area])$^{1/4}$. Since the total i*ntegrated* flux is constant throughout the atmosphere, only the SED changes with depth, this number is a global characteristic of the emergent spectrum. It is *not* the real temperature of the gas, in general, we've already discussed all of the caveats regarding the thermal equilibrium and weird level populations that result from low densities and scattering processes (not absorptions and collisions), but the emergent spectrum can be said to have an associated radiation temperature. The computed spectrum is then compared with those of real stars for which spectral types have been assigned and *vuoi la*, you have a correspondence between the B-V and T_{eff} .

This is *not* the same as the kinetic temperature of the atoms, or their excitations, unless the stellar atmosphere corresponds to the physical conditions assumed in the model. This is why I've been persistently recalling, when discussing any of the weirder systems that are time dependent and dynamical, that the physical conditions depart from those for which such numbers are meaningful. These global measures are not independent, for instance, of the abundances of individual elements that contribute lines and ionization continua to the spectra, nor the are the effects of scattering included, so the T_{eff} is *not* the same as a blackbody emissivity measure.

The stability of classification derives from the stability of the atmospheres that produce those spectra. So there is a link to this measurement and it's useful as a way of encapsulating the SED so it's not something to be thrown away. But to talk about it as anything bu an ordering of the spectral complexity is to give it more physical power than it possesses.

Final comments for this installment

In the next installment, I promise to explain in more detail how models are produced for normal stellar spectra and for accretion disks. I know this gets heavy at times, and ask your pardon and for your patience. The aim is to put what you're doing in a broader context and provide a guide to the literature. And, perhaps, to expose the underbelly of the business so you'll be able to go farther than many of the professionals.

And once again, very best wishes for the new year, my dear friends.

Steve Shore, 14-01-2016

Recent publications

Symbiotics

Evolved stars as donors in symbiotic binaries
A. Skopal, M. Sekeras, N. Shagatova
Proceedings from the conference: "The Physics of Evolved Stars: A Conference Dedicated to the Memory of Olivier Chesneau"
Journal-ref: EAS Publications Series, Volume 71-72, 2015, pp.189-192
http://arxiv.org/pdf/1512.08803.pdf

The Bright Symbiotic Mira EF Aquilae
Bruce Margon, J. Xavier Prochaska, Nicolas Tejos, TalaWanda Monroe
Accepted for publication in Publications of the Astronomical Society of the Pacific, Volume 128 (2016)
http://arxiv.org/ftp/arxiv/papers/1512/1512.04075.pdf

Spectroscopic view on the outburst activity of the symbiotic binary AG Draconis
Laurits Leedjärv, Rudolf Gális, Ladislav Hric, Jaroslav Merc, Maria Burmeister
Accepted to MNRAS
http://arxiv.org/pdf/1512.03209.pdf

New Photometric Observations and the 2015 Eclipse of the Symbiotic Nova Candidate ASAS J174600-2321.3
Franz-Josef Hambsch, Stefan Hümmerich, Klaus Bernhard, Sebastián Otero
Accepted for publication in JAAVSO
http://arxiv.org/ftp/arxiv/papers/1512/1512.01467.pdf

Recent publications

EF Aql

Identified as a new symbiotic (Mira)
A nice target for Alpy and Lisa in 2016

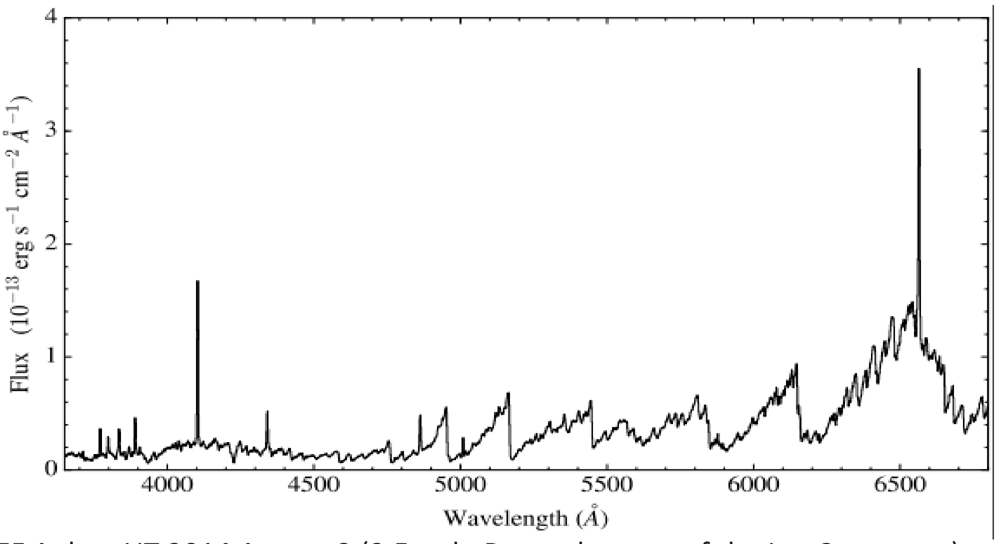
Coordinates (2000.0)	
R.A.	19 51 51.7
Dec	-05 48 16.6
Mag	12.4-15.5

The Bright Symbiotic Mira EF Aquilae

Bruce Margon, J. Xavier Prochaska, and Nicolas Tejos
Publications of the Astronomical Society of the Pacific
Volume 128, 2016
http://arxiv.org/ftp/arxiv/papers/1512/1512.04075.pdf

Abstract
An incidental spectrum of the poorly studied long period variable EF Aquilae shows [O III] emission indicative of a symbiotic star. Strong GALEX detections in the UV reinforce this classification, providing overt evidence for the presence of the hot subluminous companion. Recent compilations of the photometric behavior strongly suggest that the cool component is a Mira variable. Thus EF Aql appears to be a member of the rare symbiotic Mira subgroup.

Other data :
12.4 < V < 15.5 (GCVS)
Period of 329.4 d, with amplitude >2.4 mag. Classification : Mira.
Richwine et al. (2005)



EF Aql on UT 2014 August 2 (2.5m du Pont telescope of the Las Campanas)

Definition of Symbiotic Star
in *A catalogue of symbiotic stars, K. Belczynski, J. Mikolajewska, U. Munari, R. J. Ivison, and M. Friedjung (2000)*

To classify an object as symbiotic star we adopted the following criteria:

1. The presence of the absorption features of a late-type giant; in practice, these include (amongst others) TiO, H2O, CO, CN and VO bands, as well as Ca I, Ca II, Fe I and Na i absorption lines.
2. The presence of strong emission lines of H I and He I and either – emission lines of ions with an ionization potential of at least 35eV (e.g. [O III]), or – an A- or F-type continuum with additional shell absorption lines from H i, He i, and singly-ionized metals. The latter corresponds to the appearance of a symbiotic star in outburst.
3. The presence of the λ 6825 emission feature, even if no features of the cool star (e.g. TiO bands) are found.

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

Further informations
francoismathieu.teyssier at bbox.fr