Eruptive stars spectroscopy
Cataclysmics, Symbiotics, Novae, Supernovae

ARAS Eruptive Stars
Information letter n° 13 #2015-01 31-01-2015
Observations of January 2015

Contents

ARAS Spectroscopy

ARAS Web page
http://www.astrosurf.com/aras/

ARAS Forum
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ARAS list
https://groups.yahoo.com/neo/groups/spectro-l/info

ARAS preliminary data base
http://www.astrosurf.com/aras/Aras_DataBase/DataBase.htm

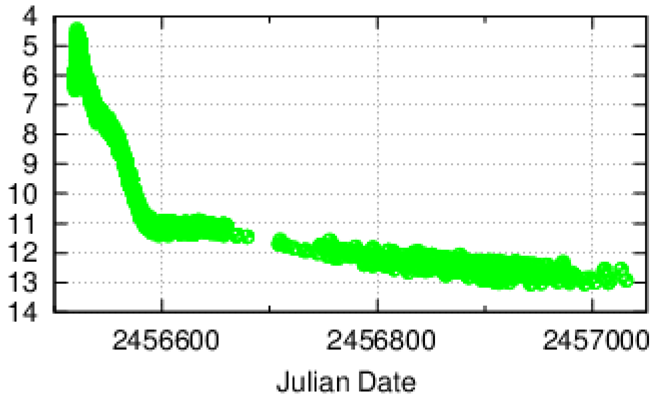
ARAS BeAM
http://arasbeam.free.fr/?lang=en

Acknowledgements :
V band light curves from AAVSO photometric data base

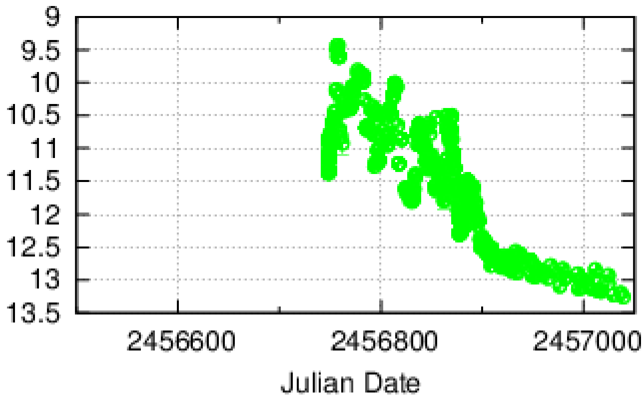
Authors :
F. Teyssier, S. Shore, A. Skopal, P. Somogyi, D. Boyd, J. Edlin, J. Guarro

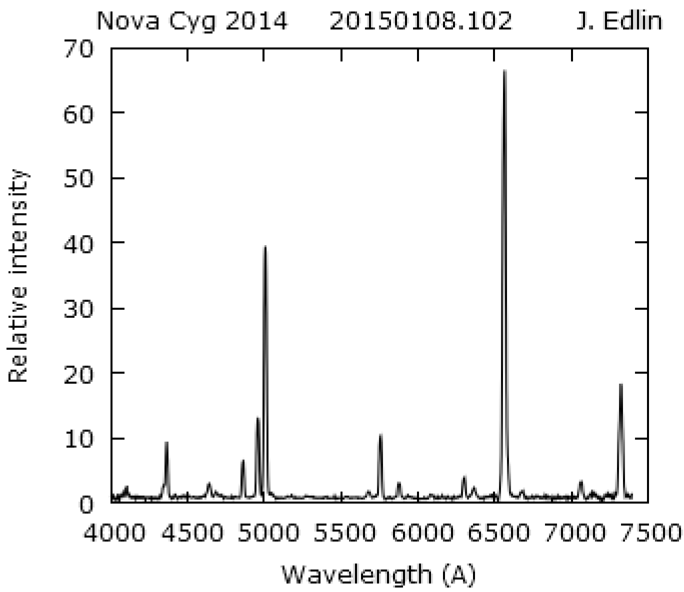
Status of current novae

Nova Del 2013	V339 Del
Maximum	14-08-2013
Days after maximum	535
Current mag V	12.9
Delta mag V	8.5

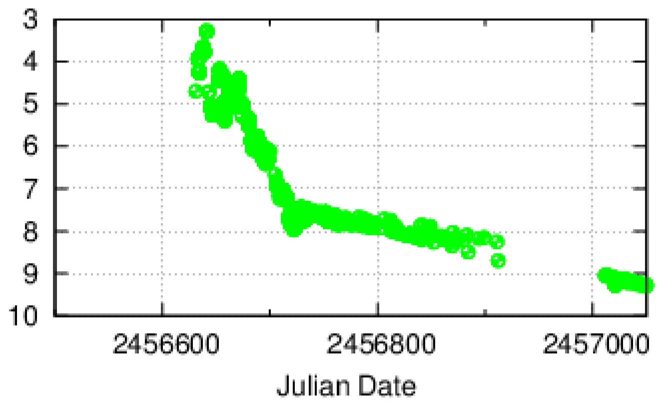


Nova Cyg 2014	V2659 Del
Maximum	09-04-2014
Days after maximum	297
Current mag V	13.2
Delta mag V	3.8





Nova Cen 2013	V1369 Cen
Maximum	14-12-2013
Days after maximum	413
Current mag V	99.3
Delta mag V	5.8

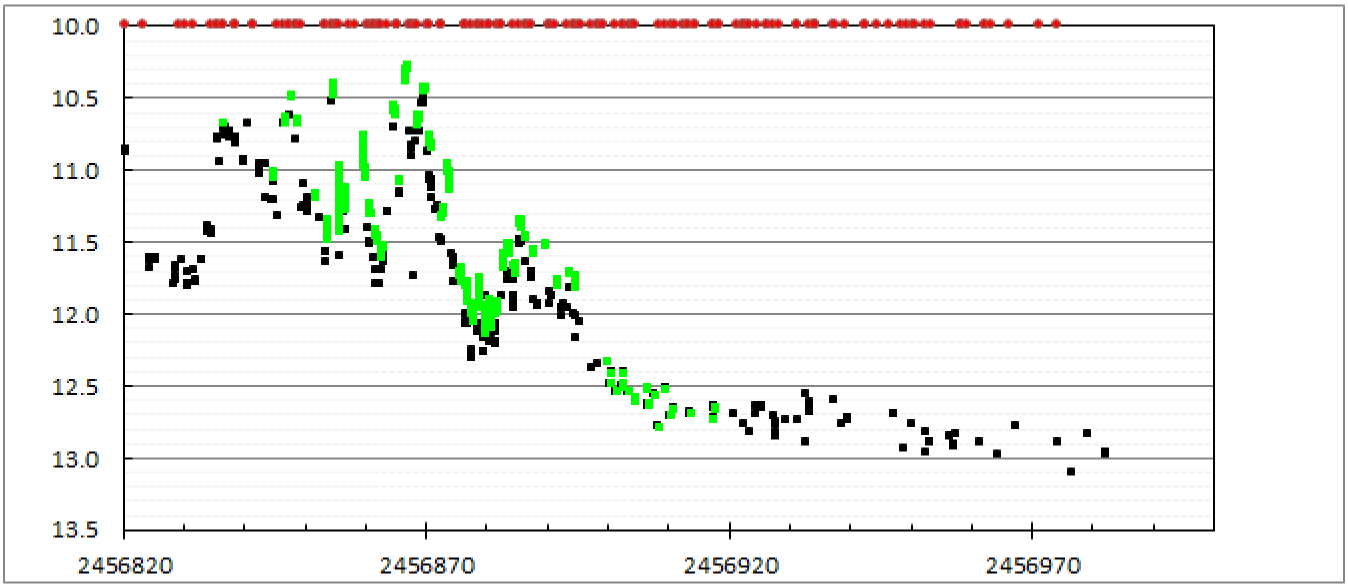


Nova Cyg 2014 = V2659 Cyg

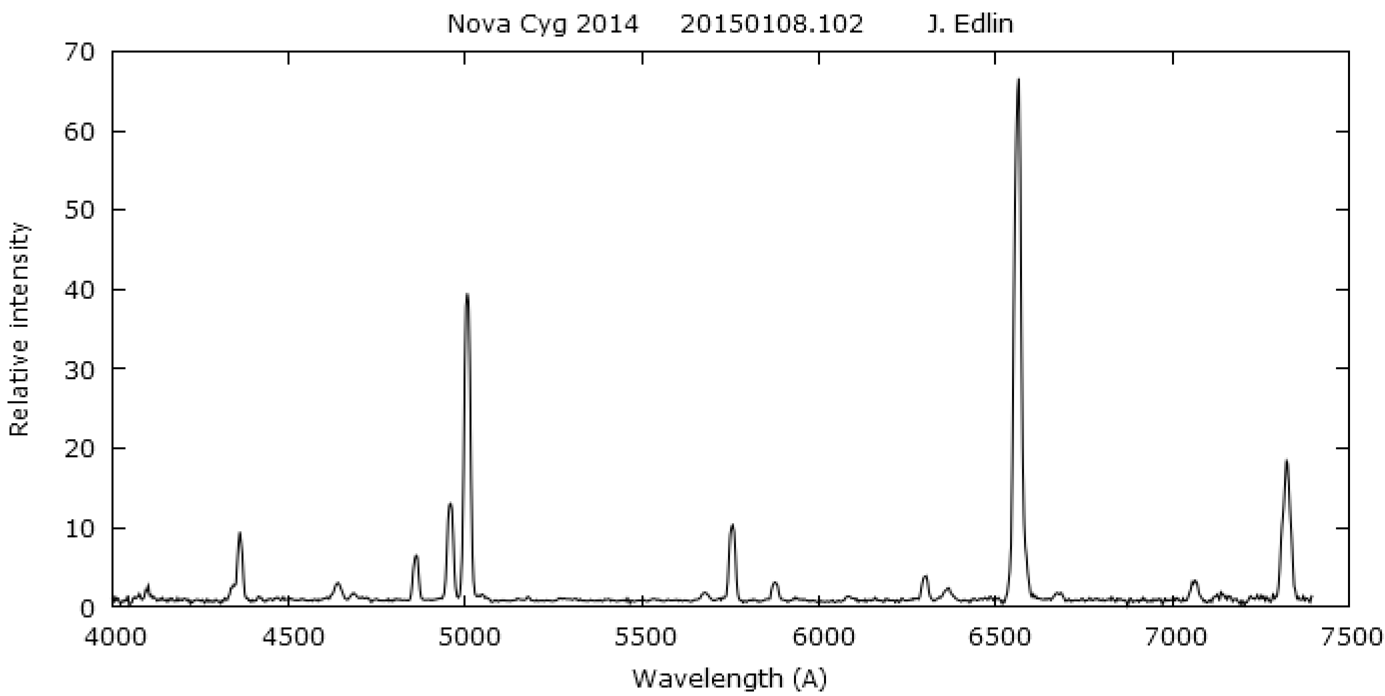
Luminosity
Mag V = 12.9 (01-01-2015)
Slow decline

Spectroscopy
Nova Cyg in nebular phase

Photometry
Slow decline during the nebular phase (0.4 mag / 100 days)
Dark squares : AAVSO
Green squares : Antonio Garcia and Joan Guarro



Spectroscopy
Nebular spectrum with noticelly [OII] intense



Observers : Tim Lester | Christian Buil | Paul Gerlach | Olivier Garde | François Teyssier | Jacques Montier | Antonio Garcia | Joan Guarro
Paolo Berardi | Franck Boubault | Peter Somogyi | Miguel Rodriguez | F. Boubault | O. Thizy

ARAS DATA BASE : 209 spectra http://www.astrosurf.com/aras/Aras_DataBase/Novae/Nova-Cyg-2014.htm
Web Page : http://www.astrosurf.com/aras/novae/NovaCyg2014.html

Selected list of bright symbiotics stars of interest

Target						Refrence Star					
#	Name	AD (2000)	DE (2000)	Mag V *	Interest	Name	AD (2000)	DE (2000)	Mag V	E(B-V)	Sp Type
1	AX Per	1 36 22.7	54 15 2.5	11.6	++	HD 6961	01 11 06.2	+55 08 59.6	4.33	0	A7V
2	UV Aur	5 21 48.8	32 30 43.1	10		HD 39357	05 53 19.6	+27 36 44.1	4.557		A0V
3	ZZ CMi	7 24 13.9	8 53 51.7	10.2		HD 61887	07 41 35.2	+03 37 29.2	5.955		A0V
4	BX Mon	7 25 24	-3 36 0	10.4	+	HD 55185	07 11 51.9	- 00 29 34.0	4.15		A2V
5	V694 Mon	7 25 51.2	-7 44 8	10.5	++	HD 55185	07 11 51.9	- 00 29 34.0	4.15		A2V
6	NQ Gem	7 31 54.5	24 30 12.5	8.2		HD 64145	07 53 29.8	+26 45 56.8	4.977		A3V
7	T CrB	15 59 30.1	25 55 12.6	10.4	++	HD 143894	16 02 17.7	+22 48 16.0	4.817	0	A3V
8	AG Dra	16 1 40.5	66 48 9.5	9.7	++	HD 145454	16 06 19.7	+67 48 36.5	5.439	0	A0Vn
9	RS Oph	17 50 13.2	-6 42 28.4	10.4	++	HD 164577	18 01 45.2	+01 18 18.3	4.439	0	A2Vn
10	YY Her	18 14 34.3	20 59 20	12.9	++	HD 166014	18 07 32.6	+28 45 45.0	3.837	0.02	B9.5V
11	V443 Her	18 22 8.4	23 27 20	11.3	++	HD 171623	18 35 12.6	+18 12 12.3	5.79	0	A0Vn
12	BF Cyg	19 23 53.4	29 40 25.1	10.8	++	HD 180317	19 15 17.4	+21 13 55.6	5.654	0	A4V
13	CH Cyg	19 24 33	50 14 29.1	7	+	HD 184006	19 29 42.4	+51 43 47.2	3.769	0	A5V
14	CI Cyg	19 50 11.8	35 41 3.2	10.5	++	HD 187235	19 47 27.8	+38 24 27.4	5.826	0.02	B8Vn
15	StHA 190	21 41 44.8	2 43 54.4	10.3	+	HD 207203	21 47 14.0	+02 41 10.0	5.631	0	A1V
16	AG Peg	21 51 1.9	12 37 29.4	8.6	++	HD 208565	21 56 56.4	+12 04 35.4	5.544	0	A2Vnn
18	Z And	23 33 39.5	48 49 5.4	9.65	++	HD 222439	23 40 24.5	+44 20 02.2	4.137	0	A0V
19	R Aqr	23 43 49.4	-15 17 4.2	9.9	++	HD 222847	23 44 12.1	- 18 16 37.0	5.235	0	B9V

Mag V * : 01-04-2014

Observing

CH Cygni campaign

See Information Letter #11

AX Per returning to quiescent state

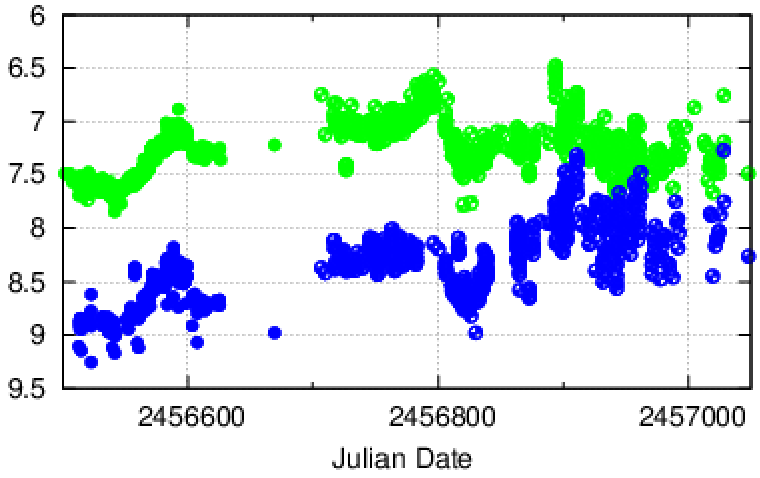
Detect high state of V694 Mon - Activity increased in January

ARAS DATA BASE | http://www.astrosurf.com/aras/Aras_DataBase/Symbiotics.htm

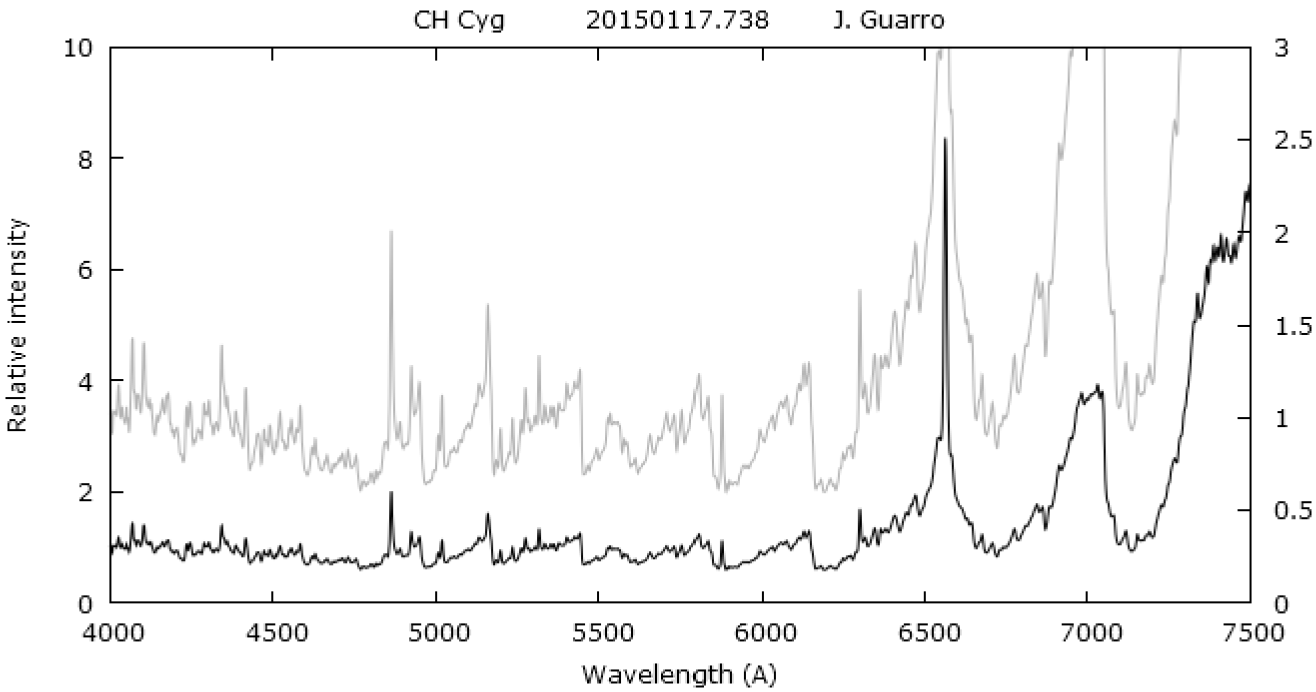
CH Cygni campaign

Coordinates (2000.0)	
R.A.	19 24 33.0
Dec.	+50 14 29.1

See details for the campaign page



B and V light curves in AAVSO database
Note the decrease of B -V



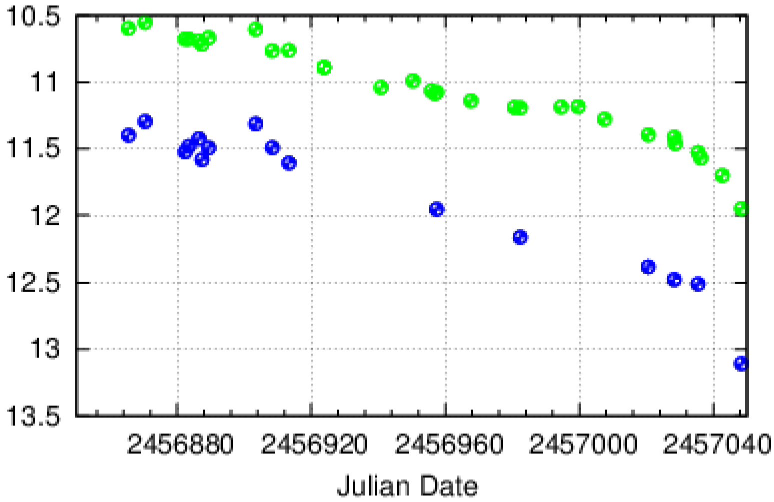
CH Cyg at low resolution - J. Guarro- Home made spectroscop - R = 800 - 13-12-2014

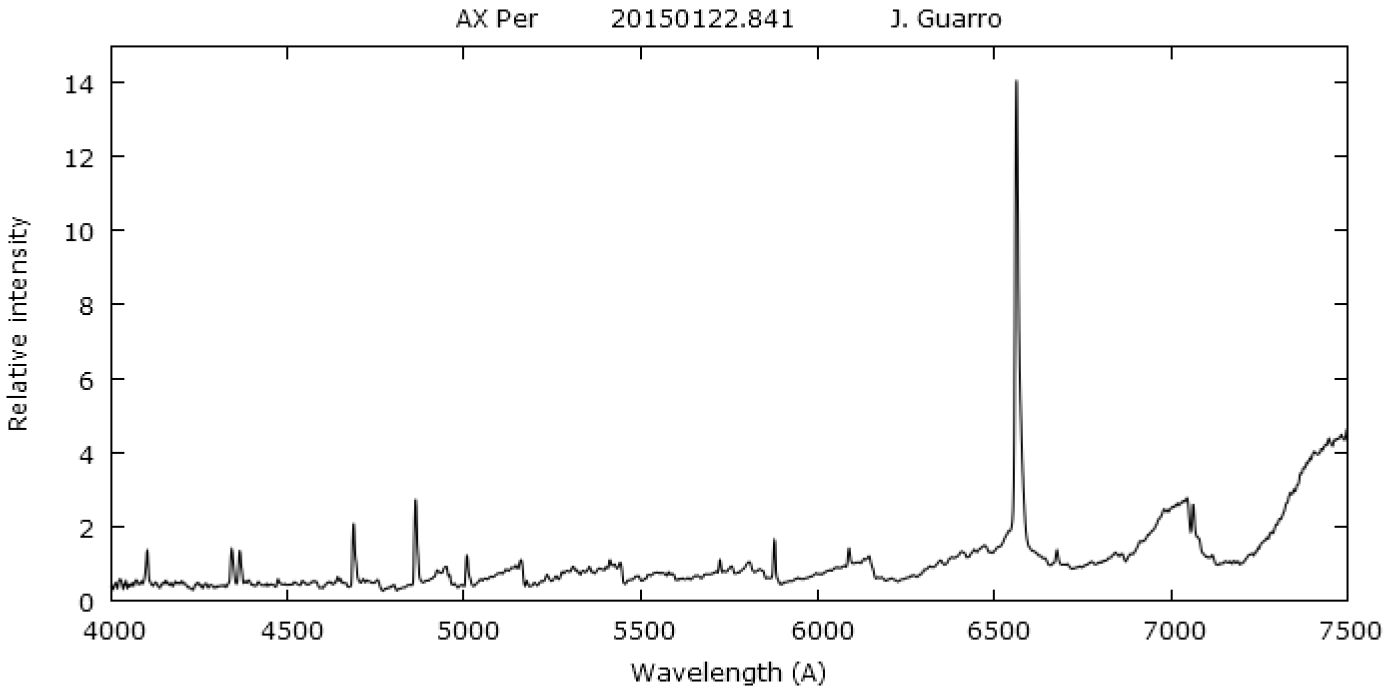
AX Per Outburst

The prototype Symbiotic **AX Per** has been detected in outburst in august 2014 by ANS collaboration See [ATel #6382]
The current mag is about 10.9 (declining)
Spectra of this event are welcome for ARAS data base [Data Base AX Per]
Aras topic for exchanges [Forum]

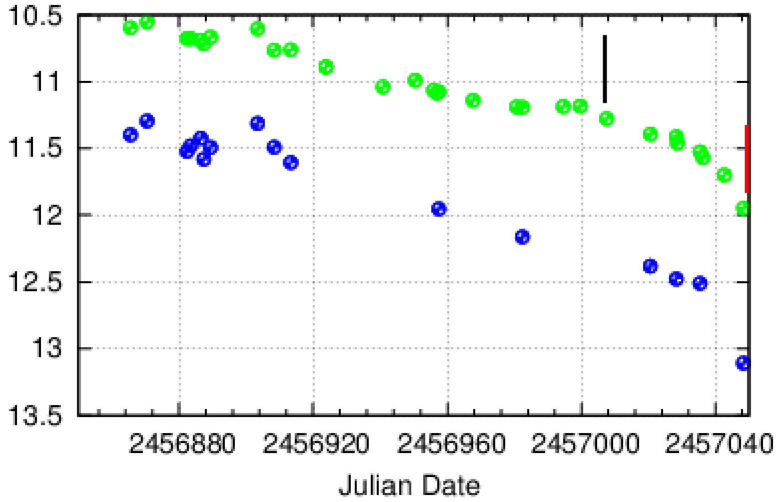
Coordinates (2000.0)	
R.A.	**01 h 36 m 22.7 s**
Dec.	**+54° 15' 2.5"**

Mag ~ 11.95 31-01-2015





Spectroscopic evolution during the visual decline throw Joan's Spectra.
Increase of [Fe VII] 5726, 6087 lines with the hardening of the radiation (Fig. 2)
And also, increase of [OIII] 4363 : decrease of electronic temperature (Fig. 3)



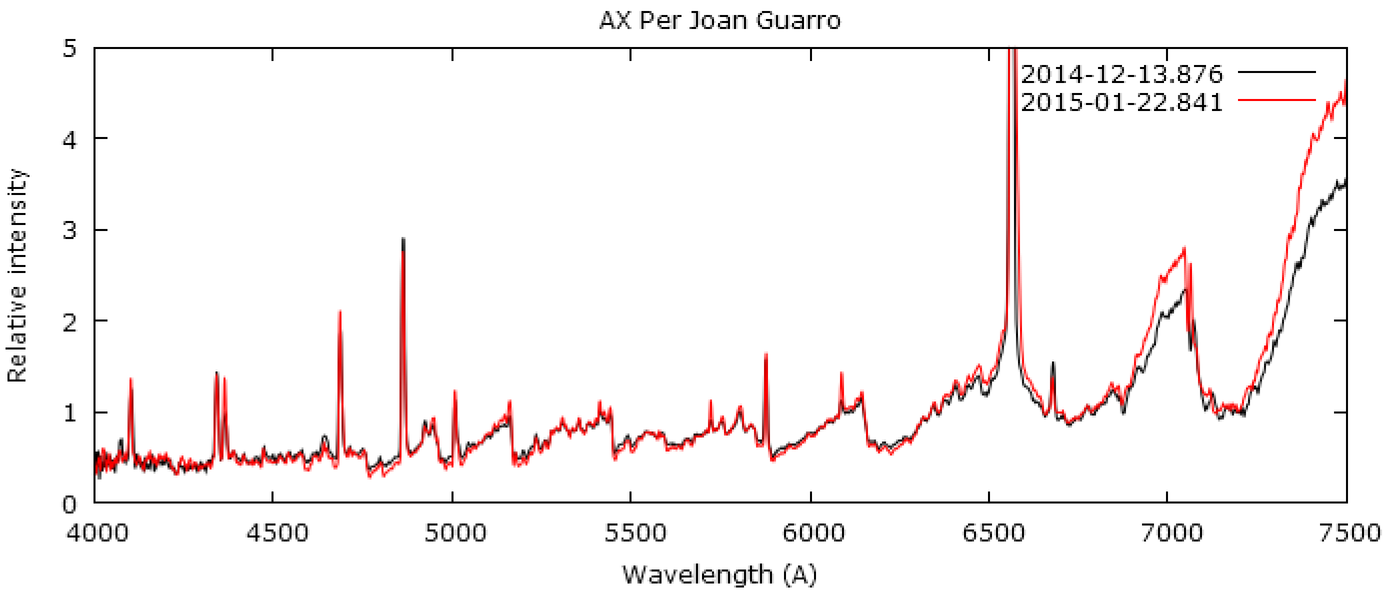


Fig. 1 - Comparison of the spectrum between 2014, 13th december (Mag V = 11.3) and 2015, 22th january (Mag V = 12)

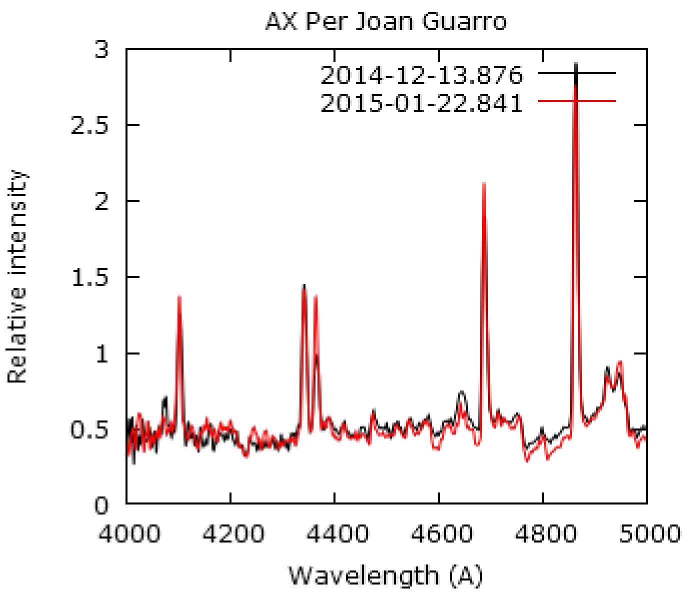


Fig. 2 - [OIII] 4363

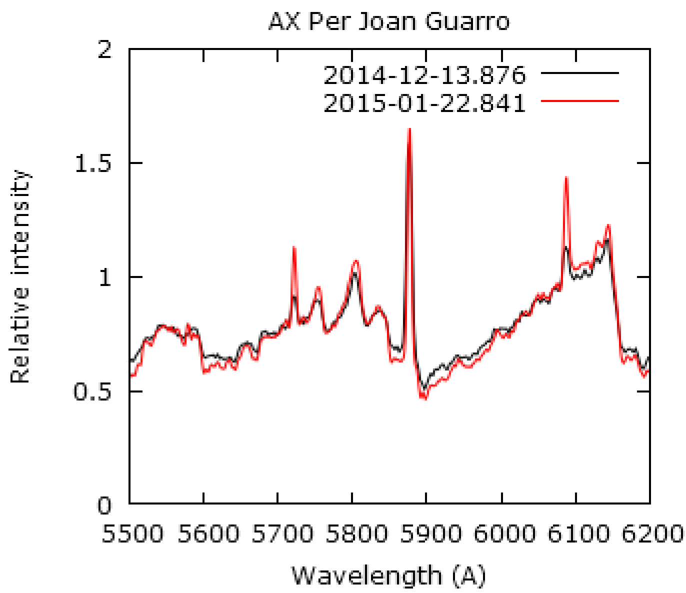


Fig. 3 - [Fe VII] 6723 and 6087

Symbiotics

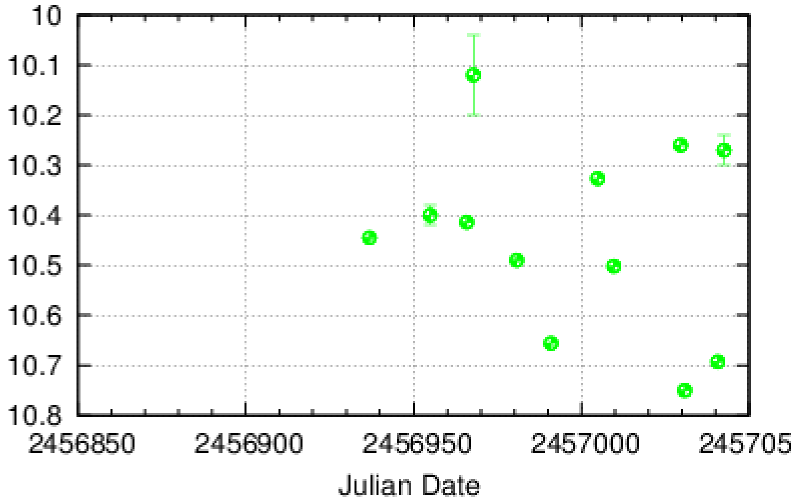
Coordinates (2000.0)	
R.A.	07 h 25 m 51.2 s
Dec.	-07° 44' 08"

Spectroscopy : increasing activity in January

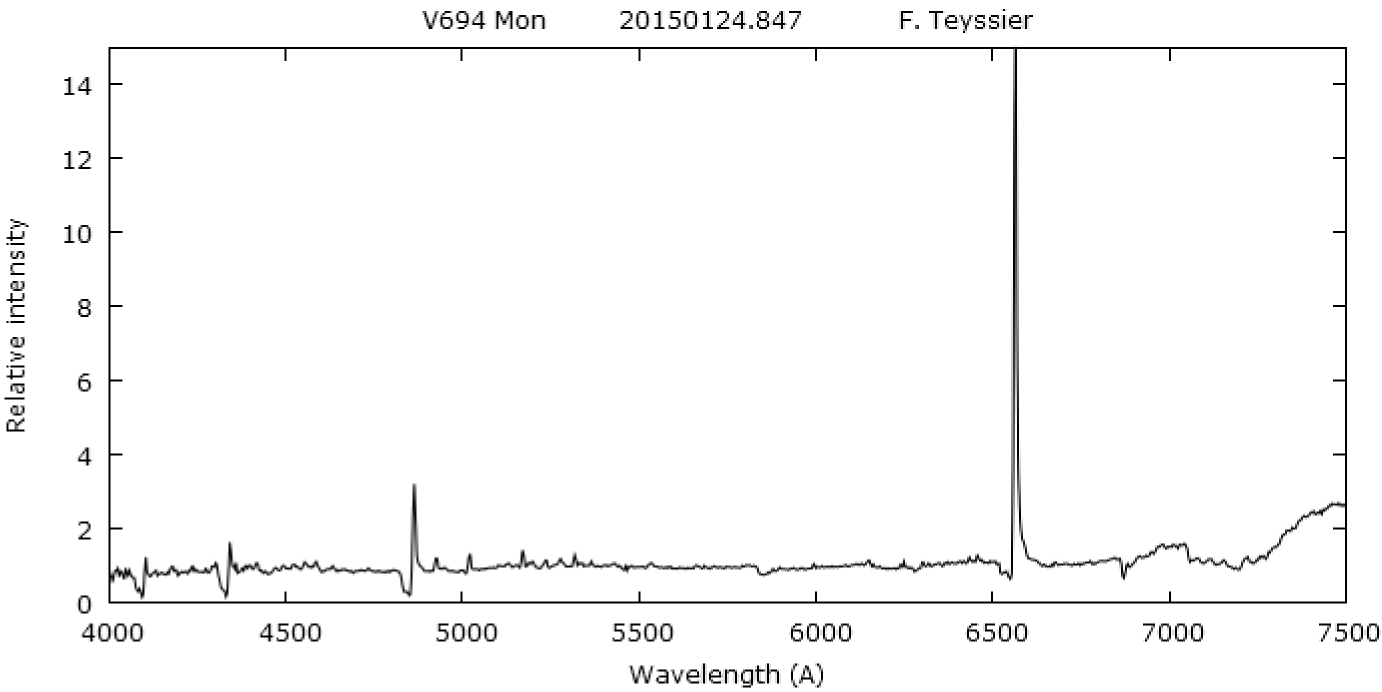
Observing : detect high state
Daily coverage should be must !

See also :

- **Steve's notes page xxx**
- **Information letter # 2014-11, p. 16-14**



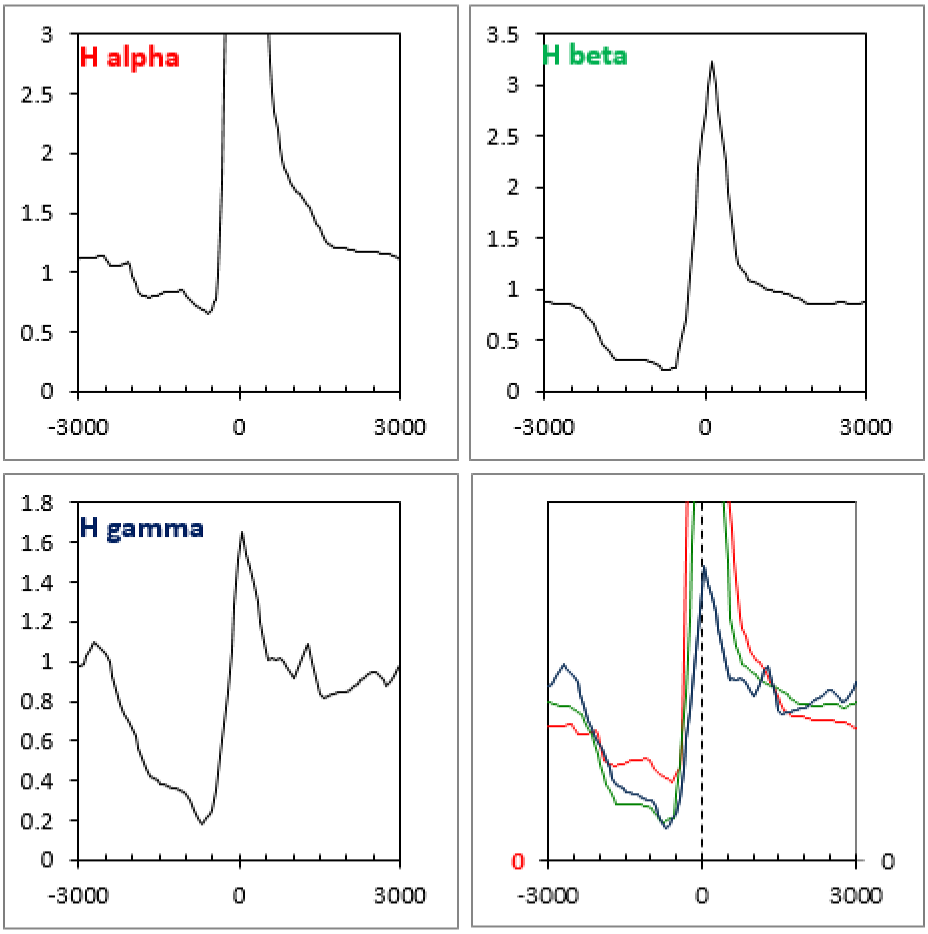
AAVSO - V band light curve



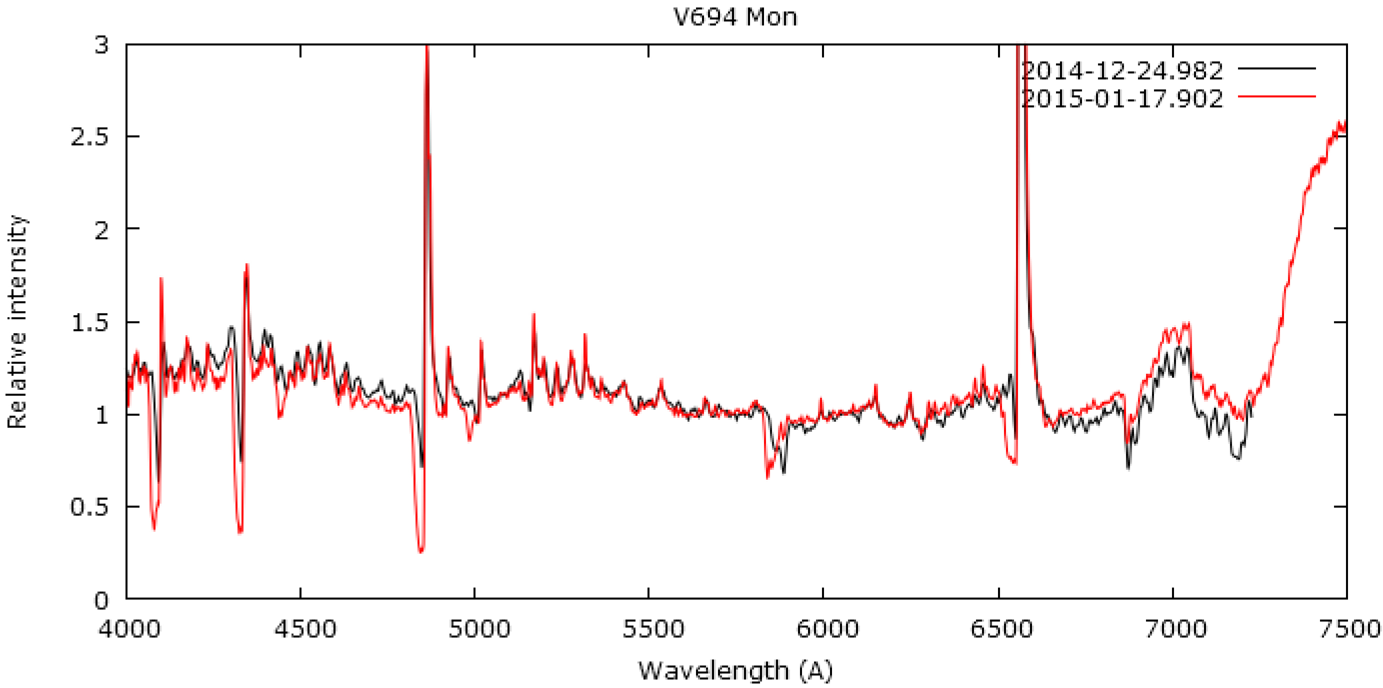
2015-01-24.847 LISA R = 1100

The maximum velocity of the absorption in Balmer lines has significantly increased (v max ~ 2600 km.s^{-1})
The absorption profile is type A(nr) according to Iijima (2002) classification

It's a shame we don't have the UV but there are some neat effects there. This is one for which it might be interesting doing low resolution, high cadence monitoring (e.g. a spectrum every ten minutes, for instance), to see if there is some high frequency variability analogous to the flickering.
Steve Shore's comment (31-01-2015)



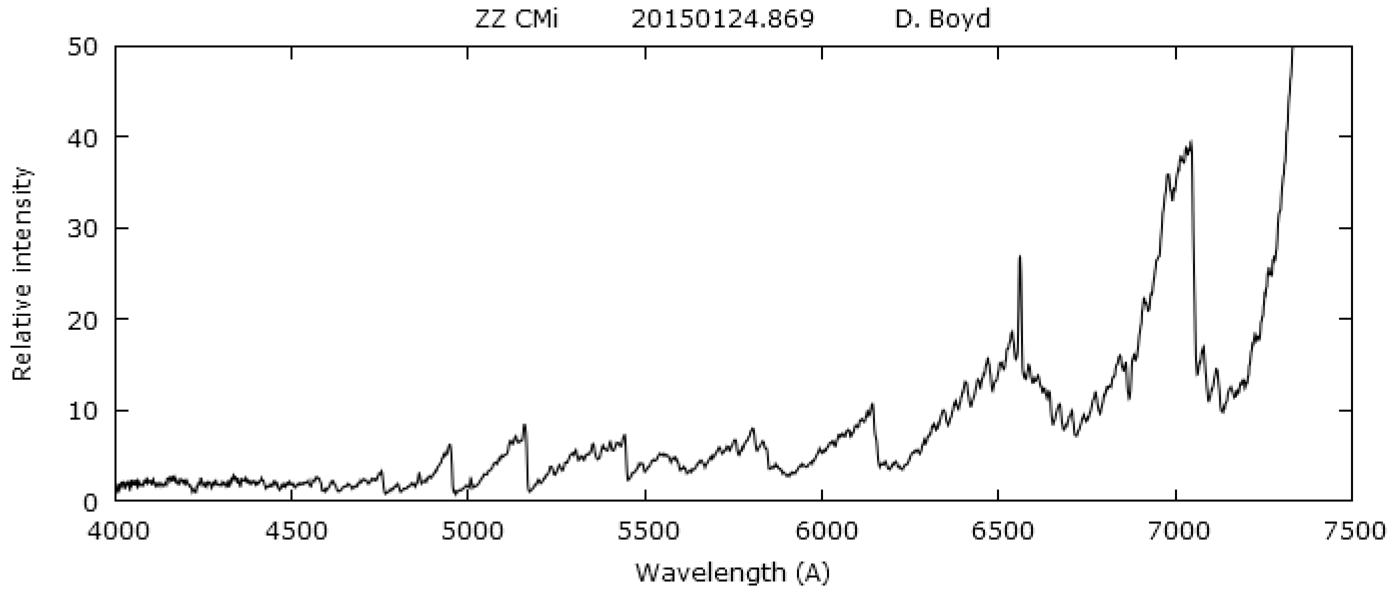
Absorptions of Balmer lines
Scale : radial velocity in km/s
F. Teyssier' spectrum
2015-01-24.847 LISA R = 1100

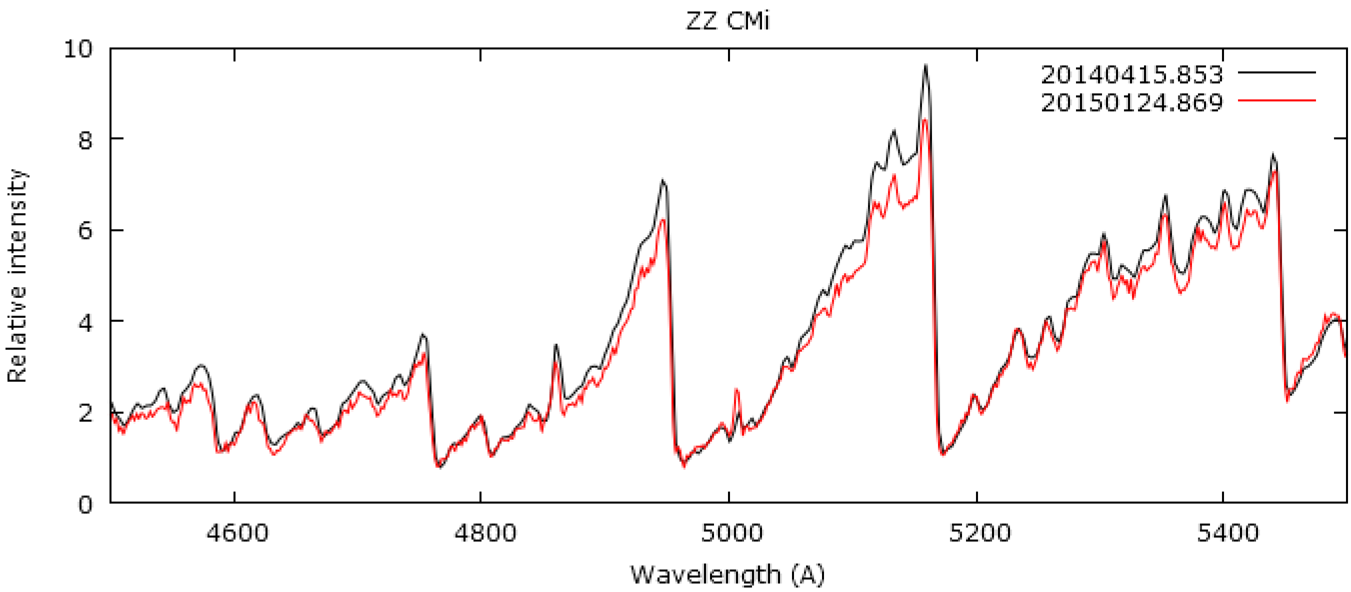


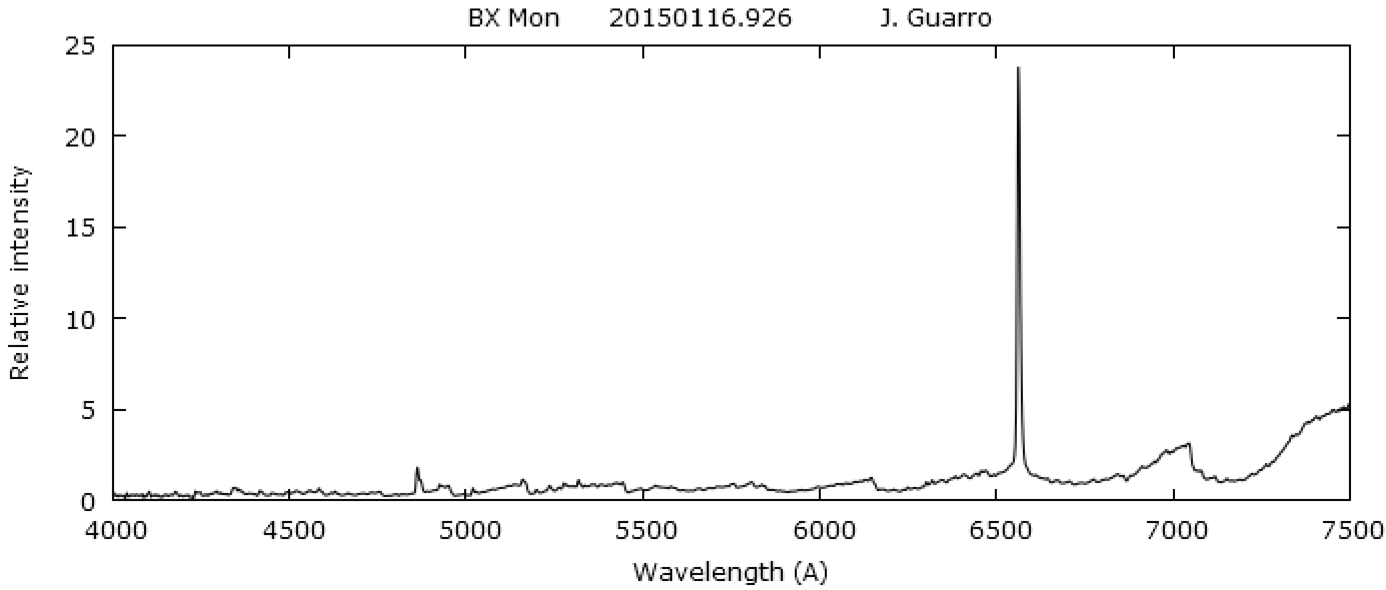
Comparison of spectra between 2014, december 24th (Peter Somogyi, Alpy 600) and 2015, January, 17th (Joan Guarro, Home made spectroscop
Showing the significant evolution of absorptions in Balmer lines (intensity and velocity). Note also the changes in HeI 5876 / Na I D range

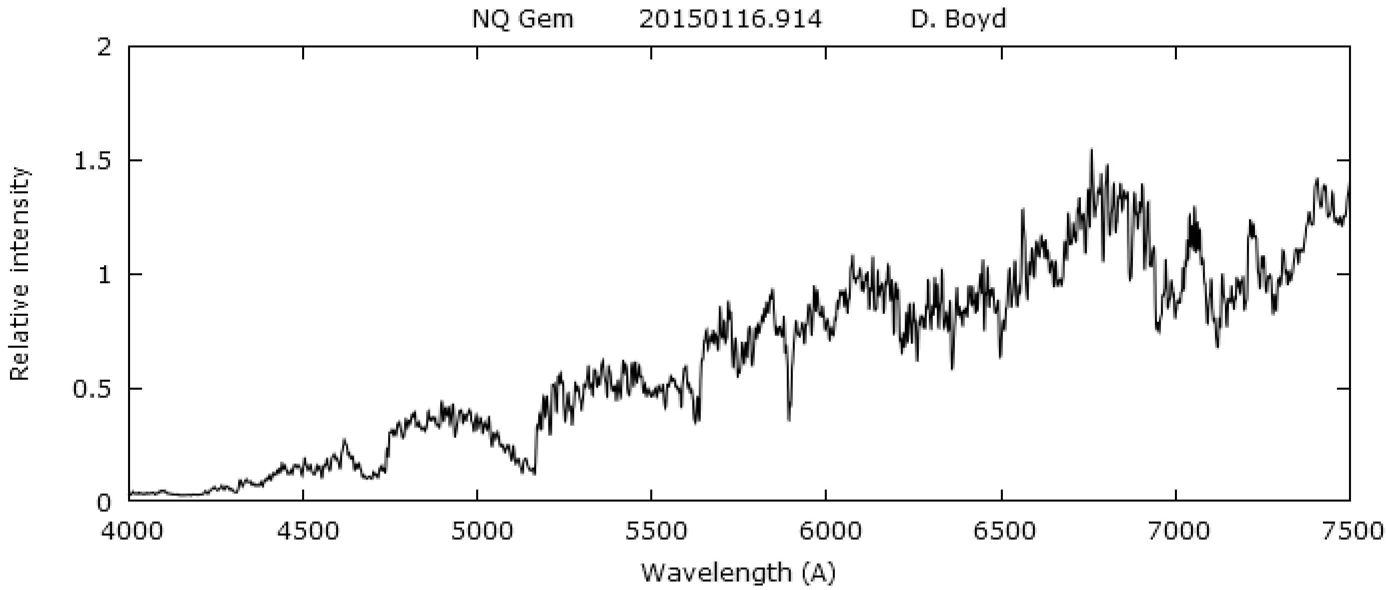
Coordinates (2000.0)	
R.A.	07 h 24 m 13.9 s
Dec.	08° 53' 52"

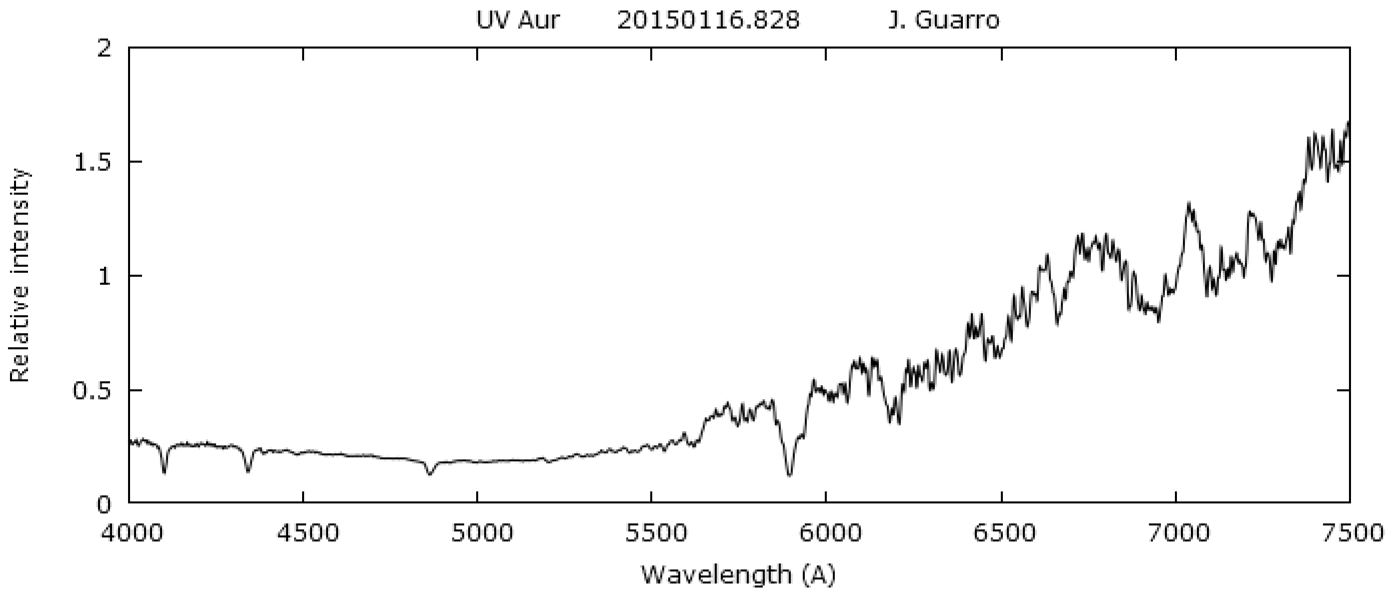
ZZ Cmi is a poorly studied star, with very few published spectra
Davis Boyd's spectra (LISA, R=1000) show a tiny variation of [O III] (2014, Apr. And 2015, Jan)






BX Mon 20150116.926 J. Guarro
Relative intensity
Wavelength (A)
0
5
10
15
20
25
4000
4500
5000
5500
6000
6500
7000
7500


NQ Gem 20150116.914 D. Boyd
Relative intensity
Wavelength (A)
0
0.5
1
1.5
2
4000
4500
5000
5500
6000
6500
7000
7500


UV Aur 20150116.828 J. Guarro
Relative intensity
Wavelength (A)
0
0.5
1
1.5
2
4000
4500
5000
5500
6000
6500
7000
7500

Request for observations of the symbiotic star CH Cygni (Dr A. Skopal)

Field of CH Cygni - Christian Buil - 15-03-2012

CH Cygni

Coordinates (2000.0)	
R.A.	19 24 33
Dec.	+54 14 29.1

Current magnitude V = 7.4 to 7.6 (Flickering)

Reference stars

MILES Standart for high resolution spectra

Name	RA (2000)	Dec (20002)	Sp. Type	Mag. V	E_{B-V}
HD 192640	20:14:31.9	+36:48:22.7	A2V	4.96	0.026

Reference for low resolution spectra

Name	RA (2000)	Dec (20002)	Sp. Type	Mag. V	E_{B-V}
HD 183534	19:27:42	+52:19:14	A1V	5.7	0

Observing

High resolution spectra
Eshel
LHIRES III 2400 l/mm (H alpha)

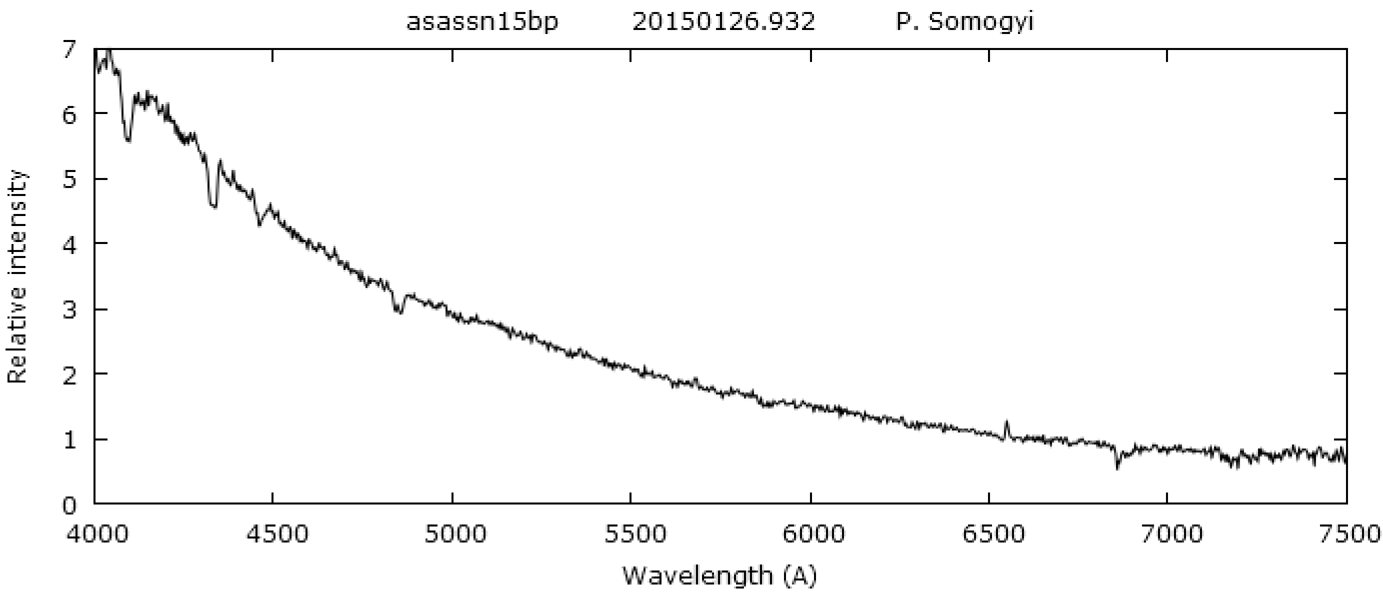
Low resolution spectra (minimum R = 600)

Send spectra

To francoismathieu.teyssier at bbox.fr

File name : _chcygni_aaaammdd_hhh.fit
And _chcygni_aaaammdd_hhh.zip for eShel

ARAS Data Base for CH Cygni
http://www.astrosurf.com/aras/Aras_DataBase/Symbiotics/CHCyg.htm
See also former campaign :
www.astrosurf.com/aras/surveys/chcyg/index.html



Spectrum of ASASSN 15bp by Peter Somogyi (Alpy 600)
Typical spectrum of a CV in outburst

Astronomer's telegram #6981

A Very Bright, High-Amplitude CV Candidate Discovered by ASAS-SN

G. Simonian, A. B. Danilet, K. Z. Stanek, C. S. Kochanek, T. W.-S. Holoien, U. Basu, N. Goss, J. F. Beacom (Ohio State), B. J. Shappee (Hubble Fellow, Carnegie Observatories), J. L. Prieto (Diego Portales; MAS), D. Bersier (LJMU), Subo Dong (KIAA-PKU), P. R. Wozniak (LANL), J. Brimacombe (Coral Towers Observatory), D. Szczygiel, G. Pojmanski (Warsaw University Observatory)
on 23 Jan 2015; 17:50 UT

During the ongoing All Sky Automated Survey for SuperNovae (ASAS-SN or "Assassin"), using data from the quadruple 14-cm "Brutus" telescope in Haleakala, Hawaii, we discovered a new transient source:

Object	RA (J2000)	DEC (J2000)	Disc. UT Date	Disc. V mag
ASASSN-15bp	12:12:40.410	+04:16:56.21	2015-01-23.52	11.9

ASASSN-15bp was discovered at V=11.9 in ``Brutus'' images taken on 2015-01-23.52, but not present (V>17.2) in images taken on 2015-01-20.52. At the position of the transient, Vizier reports a match to a faint g=20.5 blue SDSS source, as well as a nearby GALEX NUV=20.9 source. Archival observations from the Catalina Real-time Transient Survey (CRTS) do not show outbursts, but do indicate variability spanning two magnitudes, possibly due to eclipses.

CH Cygni is a particularly intriguing symbiotic star. It is very bright, with V between about 6 and 9 mag, and well placed in the northern hemisphere (delta ~ +50 degrees), which makes it a perfect target for multifrequency ground-based observations. In addition, on the basis of *Hipparcos* measurements, the distance of CH Cygni was determined to 244 +49/-35 pc. CH Cygni is thus one of the closest symbiotic systems. Despite this advantage, the nature of its activity, fundamental parameters and even its basic configuration, are poorly understood.

1. Enigma of the symbiotic activity

The symbiotic phenomenon of CH Cyg has no counterpart to other symbiotics in any of its main features. Perhaps, the best example is its light curve (see Fig. 1), whose profile does not resemble the typical wave-like orbitally-related variations observed in the light curves of other classical symbiotic stars during quiescent phases. Also active phases / brightenings / flares seen in the light curve are very heterogeneous, and are not comparable in the profile with any other well observed symbiotic star. During active phases, spectrum of CH Cygni develops emission lines of low excited species (e.g. HI, HeI and metals like FeII, TiII, CrII, [FeII] etc.) and a blue continuum with a characteristic temperature of 6–10 10^3 K. During quiescent phases the symbiotic phenomenon practically disappears and the spectrum resembles that of an M giant.

Since the discovery by Graff in 1924, CH Cygni was known as a rather typical red semiregular variable, and used as a standard of the spectral type M6-7III. Symbiotic activity was recorded for the first time at the beginning of the 1960s by Deutsch (1964, Ann. Rep. Mt. Wilson and Palomar obs., p. 11), who found in the spectrum of CH Cygni emission lines of HI, FeI, FeII and [FeII] and a hot blue continuum superposed over the late-type spectrum. Why CH Cygni was inactive for a long time, until ~1960, remains a puzzle, in spite of a trial to explain it by the so-called *Kozai resonance* operating in a special triple-star systems (see below, Section 2). The symbiotic-like character of the spectrum lasted to ~1965, then occurred again during 1967 – 1970 and during 1977 – 1986 - the

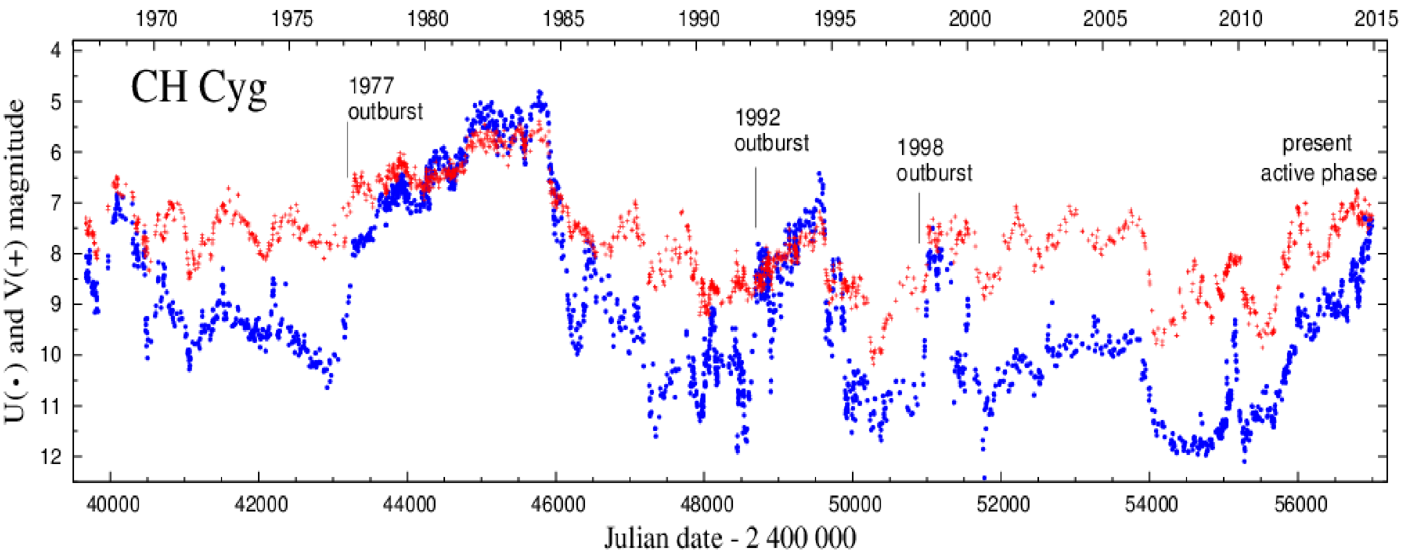


Fig. 1 - **U** and **V** light curves of CH Cygni from its first photoelectric measurements to the present (2015). Active phases start with an eruption of the hot star, an event indicated by an increase of the brightness by 2-3 mag in U, so that U ~ V. The present active phase is characterized with a slow increase of the hot star's brightness on a time-scale of years. Data are from the literature (e.g. Skopal et al. 2012, AN, 333, p. 242 and references therein); after 2011.8 they are unpublished.

strongest to date recorded active phase. According to the light curve profile, following episodes of activity were indicated during 1992 – 1995, 1998 – 2000, and recently a slow gradual increase in the U light from around 2010 with the latest (December 2014) U magnitudes of 7-8 signalizes a strong and long-lasting active phase of CH Cygni (see Fig. 1).

Each active phase is followed with a pronounced rapid light variability on the time-scale of minutes to hours, appearance of a warm continuum produced by a white dwarf's pseudophotosphere that veils features of the cool giant continuum mainly from the blue part of the spectrum, and a complex structure of the emission/absorption line profiles with signatures of a high-velocity mass-outflow from the accretor. As a result, it was very difficult to determine basic configuration of the CH Cygni system and fundamental parameters (luminosity, radii and temperatures) of its components by standard methods.

2. Puzzle of the CH Cygni configuration: binary or triple-star system?

Nevertheless, after 16 years of intensive observations from the beginning of activity, Yamashita & Maehara (1979, PASJ, 31, 307) succeeded in searching for a reliable periodicity in radial velocities in the red spectrum. They suggested the binary model for CH Cygni, consisting of a red giant and a white dwarf with an orbital period of 15.6 years. In the 1980s the elements of the binary model were improved by more authors (e.g. Mikolajewski, Mikolajewska & Tomov 1987, Ap&SS, 131, 733) and confirmed by the

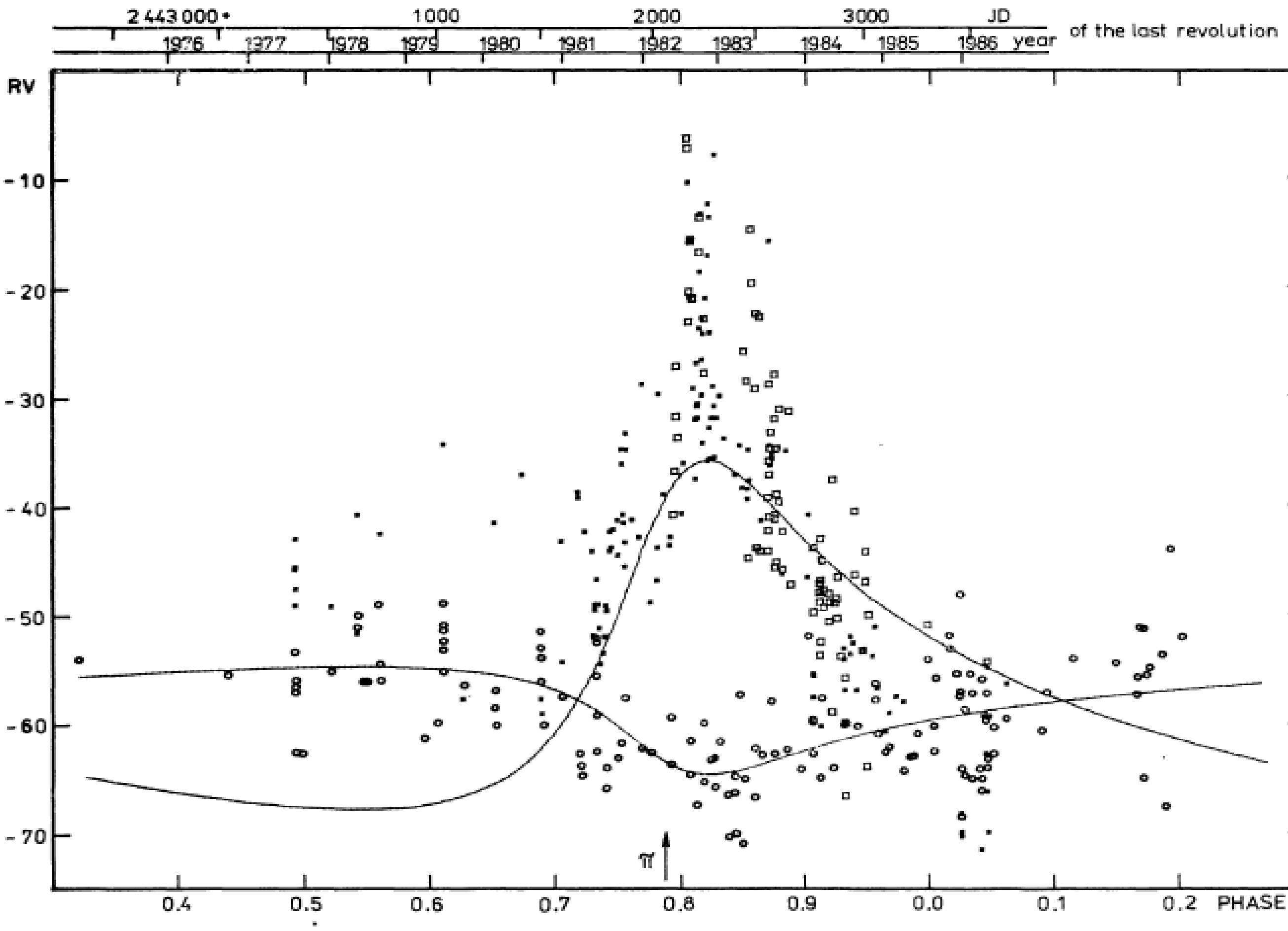


Figure 2. Radial velocities of absorption components of ionized metals and central absorption of the H-beta line (squares) and neutral metals of the giant component (circles). Corresponding orbital motions of the binary components are determined by radial velocity curves (lines). The large scatter in measured values is caused by complex and variable line profiles (see below Fig. 3). Figure adapted from Skopal et al. (1989, BAICz, 40, p. 333).

radial velocity for the active component. Example is shown in Fig. 2.

A new avenue in the investigation of CH Cygni was set by Hinkle et al. (1993, AJ, 105. p. 1074), who suggested a triple-star model on the basis of precise radial velocity measurements in the infrared spectrum. In their model, the inner 2.1-yr period binary (the symbiotic pair) is orbited by an unseen G-K dwarf on a 14.5-yr orbit. The triple-star model was confirmed and modified by identifying eclipses in the system which show that all three stars in the system are likely to be in coplanar orbits, and that the star on the long-period orbit is a second giant (Skopal et al. 1996, A&A, 308, L9). Another modification of the triple-star model was motivated to explain the puzzle of the CH Cygni activity: why this system was inactive for a very long time, until 1960 (Seppo & Kiyotaka, 1998, AJ, 116, p. 444). The authors proposed that the system consists of an inner 2.1-yr period binary (3.5 $M_{\odot}$ red giant + 0.5 M(Sun) dim star of unknown type) that is orbited by a white dwarf of mass ~1 $M_{\odot}$. If the inner orbit is at a high inclination with respect to the white dwarf orbit, then the activity on the white dwarf is driven by the *Kozai resonance* which causes large eccentricity variations in the inner binary. When the system is in the high-eccentricity state, the gas is expelled from the red giant, causing activity on the white dwarf. In their model, the eccentricity is growing steadily from 1900 (e<0.1) to 2050 (e~0.7),
which could switch on the activity of CH Cygni from around 1960.

However, later studies of some authors put doubts to the triple-star model for CH Cygni. Hinkle et al. (2009, ApJ, 692, p. 1360) continued in measuring of infrared radial velocities and refined orbital elements of the CH Cygni orbit. In this way they confirmed the two previously identified periods, and revised their values to 15.6 +/- 0.1 yr and to 2.05-yr. However, they suggested that the long period results from a binary orbit with a 0.7 solar masses white dwarf and 2 solar masses giant, while the shorter period could be caused by non-radial pulsations of the cool giant. Thus they concluded that the CH Cygni system is a 15.6-yr period binary and not a triple system. In the following study, Pedretti et al. (2009, MNRAS, 397, p. 325) analyzed infrared interferometric observations with the aim to understand the nature of the mysterious 2.1-year oscillation in radial velocities. Using the Infrared Optical Telescope Array interferometer and the Keck-I telescope, they detected asymmetry of the CH Cygni image, changes of which correlated with the 2.1-yr period found in the radial velocity measurements. They argued that such the time-dependent asymmetry can be modelled either as the orbit of a low-mass companion around the M giant, or as an asymmetric 20% change in brightness across the M giant. Their analysis suggested that such the flux oscillation is unlikely to be explained only in term of non-radial pulsation. As a result, they suggested that the combined effect of pulsation and the presence of a low-mass companion could explain the behaviour revealed by the radial velocity curves and the time-dependent asymmetry of the CH Cyg image. In addition, they did not find any trace of a second giant companion in their data. Therefore, they concluded that if CH Cyg is a typical long period variable, then these variations could be explained by the effect of an orbiting low-mass companion around the M giant, i.e. a triple-star model, where the M giant with a faint companion is orbited by the white dwarf on the 15.6-yr orbit. The subsequent paper on the basic configuration of the CH Cygni system presented the resolved two stellar components with bispectrum speckle interferometry (Mikolajewska et al. 2010, MNRAS, 403, L21). In this way, the authors supported the long-period symbiotic binary composition for CH Cygni.

Irrespective to these arguments prioritizing the binary model for the CH Cygni system, the minima – eclipses – measured during the active phase in 1992 and 1994, separated just by 2.1 years, located at the position of the inferior conjunction of the giant in the symbiotic pair (i.e. the inner binary of the original Hinkle's et al. (1993) triple-star model), and during which all signatures of the active star temporary disappeared (the UV continuum as measured by the IUE satellite and the flickering variability in the optical), cannot be explained within the long 15-yr period symbiotic binary model. Therefore, in my opinion, the basic stellar configuration of the CH Cygni system remains a big mystery.

3. On the accretion and ejection by CH Cygni

Basic condition of interaction between the components of a symbiotic binary is the mass-loss by the cool giant – a natural phenomenon of evolved stars with a large radius (i.e. with a low gravity at their surface) and a high luminosity. A fraction of the material, lost by the giant, is captured by the gravitational field of the compact companion, and because of a viscosity the material gradually losses its binding energy (kinetic and gravitationally-potential) for the benefit of a heat, which causes its helical trajectory and increase in temperature towards the accretor. This process forms an accretion disk around the central star, which thus effectively converts the gravitationaly-potential energy of the accreting material into the (high-energy) radiation. CH Cygni belongs to a small group of symbiotics, whose total energy output during active phases is as small as a few times 1 – 10 solar luminosities, which can be generated solely by the accretion process onto a white dwarf, because it is given by the mass and radius of the accretor and the accretion rate (= amount of mass accreted per unit of time). For the CH Cygni luminosity of ~30 $L_{\odot}$, as measured during its 1992-95 activity (see Skopal, 2005, A&A, 440, p. 995), a typical accretion rate of 10^{-8} $M_{\odot}$ per year and the mass of the accretor of ~1 $M_{\odot}$ require the accretor's radius of 0.01 $R_{\odot}$, which represents a typical value for a white dwarf. This simple estimate thus confirms the presence of a white dwarf in CH Cygni as the accretor.

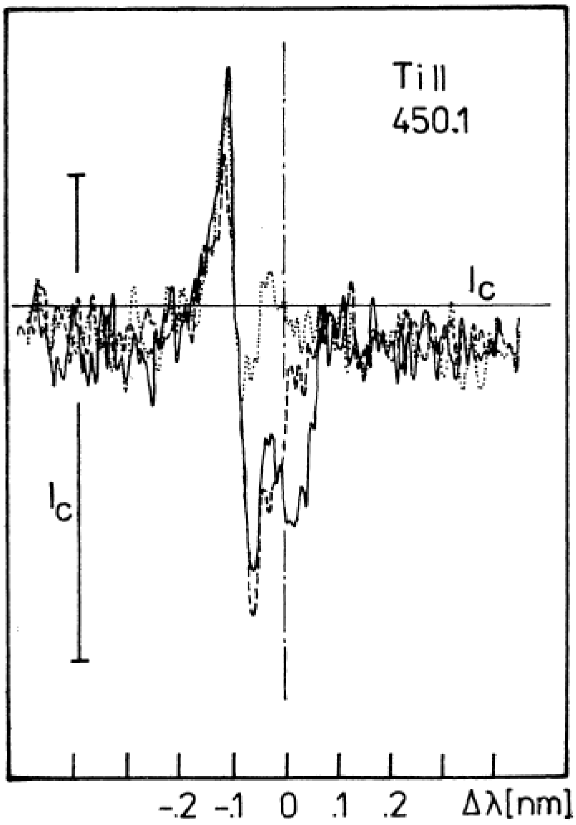
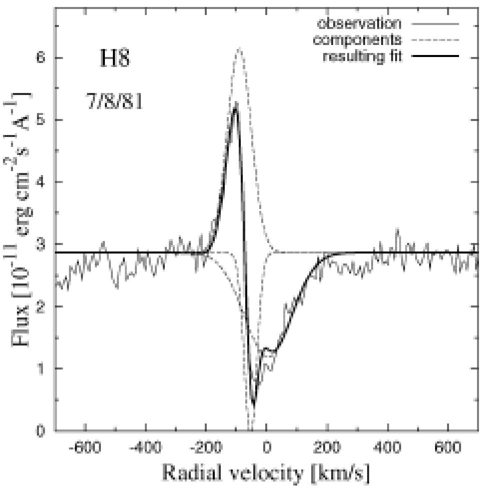


Figure 3. Evolution of the Ti II 4501 A line profile from July 12 (dotted line) to August 7 (solid line) 1981. Vertical dot-dashed line represents the position in the spectrum corrected for the systemic velocity of -58 km/s (adapted from Skopal et al. 1989, BACz, 40, p. 333). Red-shifted absorption features thus indicate a mass infall to the central star.

However, the result of accretion process in symbiotic stars, and especially in CH Cygni, as observed during active phases, is extremely complex. In my opinion, the most startling features in the line spectrum of CH Cygni developed in 1981, i.e. around/after the middle of the strongest active phase (see Fig. 1), when variable *inverse* P-Cygni type of profiles occurred, and were present in the spectrum to the end of the optical maximum in July 1984. Figure 3 shows an example of such the evolution in the Ti II 4501 A line profile during July-August 1981. This is a very rare direct indication of the mass *infall* to the accretor at simultaneous mass-outflow from it, as indicated by the blue-shifted absorption and emission wings seen simultaneously in profiles. In spite that this phenomenon was well documented by more authors (e.g. Wallerstein, 1983, PASP, 95, p.135; Yoo & Yamashita, 1984, PASJ, 36, p. 567; Skopal et al. 1989, BAICz, 40, p. 333), it has not been discussed in more detail and even approached theoretically. Qualitatively, we can speculate that the redward-shifted absorption reflects a warping of the inner parts of the disk, resulting in re-accretion of a larger fraction of the disk material onto the white dwarf, which then keeps its activity for a long time of years. A dramatic change happened after July 1984, when the optical brightness dropped by ~1.5 mag, the line profiles displayed very broad emission wings that could be matched by a spherically symmetric ionized wind at a high-velocity, while in the radio domain highly-collimated bipolar jets were observed for the first time (Taylor et al. 1986, Nature, 319, p. 38). This situation was probably connected with a final bustling re-accretion from the disk, which caused its destruction resulting in disappearance of the warm pseudophotosphere (i.e. caused the drop in the optical brightness), increased significantly accretion rate and thus made the accretor to be much hotter as indicated by a shift of the energy distribution to the ultraviolet and appearance of a strong nebular radiation, seen in the spectrum for wavelengths > ~2000 Å. The radiation of such the white dwarf could also more easily drive out the rest of the surrounding material in the form of the ionized wind as indicated by the broad wings of the lines expanding to 1000 – 2500 km/s (see Fig. 4). The total energy of material, accreted onto the white dwarf at very high rate from the warping inner disk, could not be probably processed by the white dwarf only by a standard way as noted above. Because of the rotation, the infalling material swirling down to the compact accretor throughout its steep gravitational field has a high angular momentum that has to be conserved. In this situation, a fraction of such the abruptly accreted material can be accelerated from the vicinity of the accretor to, at least, its escape velocity and ejected along the rotational axes in the form of highly-collimated jets. Similar jet activity was detected also during/after 1992-98 and 1999-2001 active phases, being still detectable even during quiescence (2008) at different spectral domains. Especially, in the radio by the VLA, in the optical by the *HST* and in the X-rays by the *Chandra* satellite. Figure 5 shows examples of this fascinating phenomenon.

4. The present active phase

According to photometric and spectroscopic measurements made during 2014, there are no doubts that CH Cygni entered a new active phase. Usually, the first indication of an activity is directly given by evolution in the multicolour light curves, when the brightness in U approaches gradually that in V (see Fig. 1). Especially in the case of CH Cygni, it is important to measure the object in short wavelength passbands, because of a dominant contribution from the giant in the optical, whose radiation is, in addition, highly variable. Saying this by other words, it would be difficult to recognize any active phase of CH Cygni on the basis of only V light curve (e.g. using



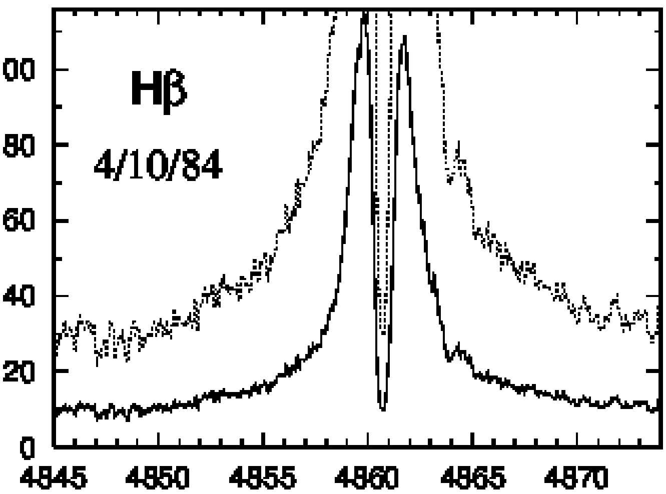


Figure 4. Left: During the maximum of activity, redward shifted absorption running from ~0 to ~+200 km/s was often very pronounced. Right: After the 1984.6 drop in the brightness, very extended emission wings in hydrogen Balmer lines developed. Assuming that they are caused by the kinematics of the ionized hydrogen, we can derive the mass-loss rate from the active star to a few times 10^{-6} $M_{\odot}$ per year (see Skopal et al., 2002, MNRAS, 335, 1109).

only the visual estimates from AAVSO database). Second photometric indication of activity is represented by rapid light variations on the time-scale of a few times 1-10 minutes. The former reflects a gradual increase of radiation produced by the warm white dwarf pseudophotosphere that contributes predominately to the shorter wavelength in the optical, while the nature of the latter effect is not understood well. The problem, however, is the starting point of the present activity, because the giant's radiation is significant even within the U band during quiescence, and the simultaneous increase in V and U can thus reflect only an intrinsic variation of the giant (see e.g. the brightening during 2010-2011 in Fig. 1). To answer the question, "when the recent active phase began", I will model the low-resolution spectra (3600 – 7500 Å) to recognize when the contribution from the white dwarf pseudophotosphere starts to be recognizable in the spectrum, and will determine its parameters (the luminosity and temperature) and their evolution. This will naturally provoke questions about the fuel required to explain the observed energy output: e.g., at which rate the material has to be accreted, and where does it come from? Of course that from the giant, but the giant in the 16-year or 2.1-year orbit? Spectroscopic observations with a higher resolution can inform us about the kinematics of the ionized and neutral regions, where the strongest lines in the spectrum are originated. I have in mind mainly evolution in the hydrogen lines of Balmer series. Their presence and evolution in fluxes can be also helping to answer the primary question about the beginning of the present CH Cygni activity, because their emission measure is proportional to the flux of hydrogen ionizing photons that are produced by the white dwarf (no hope to get sufficient flux of photons with wavelength < 912 A, i.e. ionizing hydrogen atoms, from the cool giant). In particular, I have a hope to obtain an information about the orbital motion of the active star from measuring radial velocities of the central absorption in the hydrogen line profiles (mainly the H-beta and H-alpha lines). Their origin during quiescent phases of symbiotic stars was explained in the last Information letter (No. 12 of 2014) by Steven Shore. However, during active phases of symbiotic stars the neutral medium, where the absorption and scattering processes attenuate emission in hydrogen lines, is located not only around the giant itself, but also around the active star in the form of the neutral disk-like formation. As a result, an absorption component can also be created in the `atmosphere' above the white dwarf's (~10000 K warm) pseudophotosphere, which thus follows its orbital motion. However, the real situation is not so ideal. Such absorption component will be affected by expansion of the shell, causing a shift, and also by intrinsic variability, causing a scatter in radial velocities. In addition, the component from the white dwarf pseudophotosphere has to dominate the central cut off in the line, which depends on the level of activity. Altogether, to obtain an appropriate result, we need another strong and long-lasting active phase, comparable with that during 1977 – 1985. According to my experience with light curves of symbiotic stars, slowly-starting active phases usually keep a stronger activity for a longer time. Hoping that this will be the case also for CH Cygni. However, now this knows only CH Cygni, and it is really intriguing star.

Augustin Skopal
29/01/2015

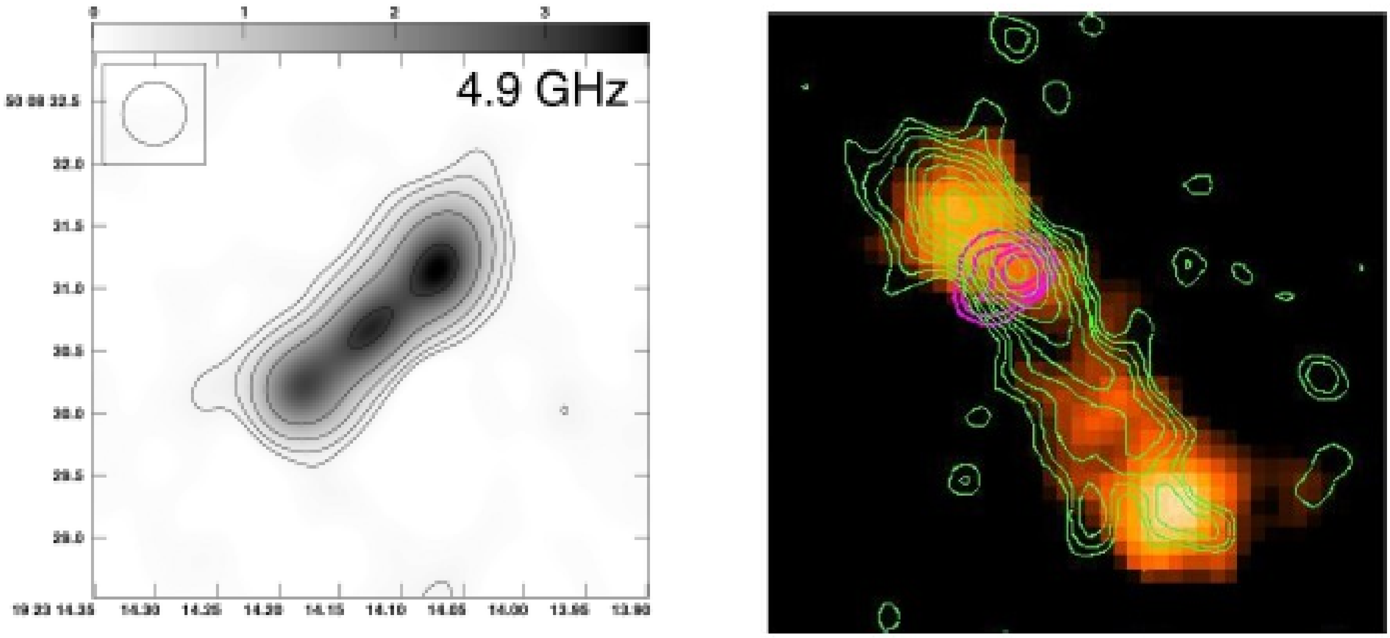


Figure 5. Images of the jet-like structure in CH Cygni. Left: VLA map at 4.9 GHz from March 20, 1986 (adapted from Crocker et al. 2001, MNRAS, 326, p. 781). Right: *Chandra* soft (0.2-2 keV) image with overlaid contours at harder energies (6-7 keV, magenta) and the VLA 5 GHz image (green contours). X-ray observations were carried out on June 8-10, 2008 and the VLA observations on October 4, 2008 (adapted from Karovska et al. 2010, ApJ, 710, L132).

MWC 560 = V694 Mon = ?

by Dr Steve Shore

The designation *MWC* refers to a catalog of Balmer emission line objects started by Merrill (yes, the same one as the Raman features, the diffuse interstellar bands, and *The Lines of the Chemical Elements in Astronomical Spectra*). These were not only original observations but were also compiled from the HD and other surveys. But, since the HD was very low resolution, many of the stars were being observed for the first time in this version. Other listings followed (e.g. the Luminous Stars in the Milky Way, and so on) -- Merrill, P. W.; Burwell, C. G. 1943, ApJ, 98, 153. Like SS 433, this was an ``after-thought'', in a supplementary listing. It was also included in the SS listing.

The bizarre behavior of MWC 560 was first noted by Bond, H. E., Pier, J., Pilachowski, C., Slovak, M., & Szkody, P. 1984, BAAS, . 16, 516 who realized that this might be another SS 433-type object, although certainly less extreme. Then came the full paper: Tomov, T et al. 1990, Nature, 346, 637, showing that the absorption features on the Balmer lines displace by up to -6000 km s^{-1}. The photometric and spectroscopic monitoring of this object revealed high and low states, times when the lines appeared more like symbiotic-like spectra than SS 433, and then outbursts that -- as you've seen from the spectra -- happen in very short intervals.

The line profile variations are distinctive. While detached absorption lines are seen in the classical novae you hve been observing, especially V339 Del and V1369 Cen, they are stationary. At least the features are invariant within the broad absorption line boundary. In the MWC 560 profiles, the features displace and are on the Balmer lines. There are no variations of the other lines (Fe II, for instance) of the sort indicating the cross coupling during the optically thick stages.
One good set of profiles is shown in http://www.konkoly.hu/cgi-bin/IBVS?6032.
Another set of profiles, from almost a decade earlier, is shown in
http://cdsads.u-strasbg.fr/abs/2002A\%26A...391..617I .

Iijima, in this last paper, attributes the changes to a precessing disk. While that may be the case, there is nothing to indicate that the period is stable (at least not now) and this is one reason why monitoring iks so useful. Keep in mind that nobody is doing that, a lament you're heard too often from me.

That MWC 560 is somewhere between a symbiotic and a microquasar is supported by the detection of XR emission by Stute, M. & Sahai, R. 2009, A&A, 498, 209 that they attribute to a boundary layer around the WD from which the jet is launched and loqwer energy (soft) emission that they attribute to the jet itself in its passage through the circumstellar wind of the giant. The spectrum of the companion is a ``normal'' M giant, there are indications of long term variations (on timescales of 340 days) that don't seem to be those of a Mira variable so, if they're less than periodic, this could be an asymptotic giant branch (massive) companion that is highly evolved. As far as I know, there are no spectra indicating a Li excess, this is one of the signs of deep mixing in such evolved stars and shell nuclear processing in the deep envelope of the giant (as we see in V407 Cyg, which might somehow be related).

High cadence photometry shows flickering. This is expected from a disk, not a wind, since the timescales are far too short for any dynamical process expected from the outflow of a giant. And a more important, indeed essential, problem is again with the jet and its timescales. Let me explain that for a moment.

In normal wind outflows, the velocity gradient is rather shallow, usually increasing with distance toward the terminal velocity in perhaps 10 stellar radii. The driving depends on the flux from the star so the gradual shift of the lines toward the terminal velocity causes a saturation of the profiles and the wind stops accelerating and coasts. In MWC 560, it seems the velocity gradient is extremely rapid, increasing to the terminal velocity is less than one stellar radius (where here that radius is the WD plus its disk, not the giant whose wind is normal). If there is a pulsation, the accretion may be irregular, even if there's a disk the feeding of that circum-WD environment may render it unstable. This is not an explosive ejection of the V40 Cyg or RS Oph sort. The accretion seems to be more or less steady and there is no thermonuclear runaway. In the 1994 paper, this was modeled by assuming a stationary outflow that gets ``mass loaded'': once in a while more mass is expelled but with the same dynamical properties. That' what a jet would mean if like SS 433. An alternative is that there is no loading but that the precession causes the material to shift from the line of sight. In the UV this would produce a decrease in the absorption from the jet but, perhaps, an increase in the opacity of the disk (the disk isn't hot beyond the boundary layer so there could be a forest of lines like that in an atmosphere). The UV seems to show the same behavior as the optical lines in that there are resonance lines that shift with the optical to high velocity (as I said, this isn't seen in other than Balmer lines in the optical spectrum). That might be due to the optical depth in the Lyman series.

My apologies, this is getting extensively detailed. The problem is that, unlike the novae and other symbiotic systems we've been discussing, here the observations are few and old in the UV and beyond. There is no radio emission so the CH Cyg-like jets are not involved, and the ejection is not like the emission peaks seen in Z And. In other words, we seem to have here a high mass accreting WD, not a black hole (this is a lo mass system) from a high mass loss red giant with an induced expulsion of matter. That there might be, instead, not jets but something more like blobs, optically thick bubbles, is possible but that would not explain the UV.

This is definitely a system to adopt, to follow, and to observe at more than just the Balmer lines.

Steve Shore
03-02-2015

For a brief bibliography:

http://adsabs.harvard.edu/abs/1993ApJ...409L..53M

http://adsabs.harvard.edu/abs/2002A\%26A...391..617I

http://adsabs.harvard.edu/abs/2001A\%26A...377..206S

http://adsabs.harvard.edu/abs/2007A\%26A...463..703G
pulsation with a period of about 340 days

http://adsabs.harvard.edu/abs/2011BlgAJ..16....3Z
flickering, suggest changes in states related to jet activity; their fig. 5 suggests a system with multiple states but the statistics are poor; this paper, http://adsabs.harvard.edu/abs/1995A\%26A...300..769T
instead this suggests the states are separate.
http://adsabs.harvard.edu/abs/2005MNRAS.360.1257M
He 3-1341 an the flickering-jet connection (this is a paper the ARAS observers should read).

and then there's some theoretical modeling of the spectrum:
http://adsabs.harvard.edu/abs/1994AJ....108..671S
that includes the UV and optical activity states. The main reason I suggest this last one is the set of UV spectra.

Novae

Photoionization Heating of Nova Ejecta by the Post-Outburst Supersoft Source
Timothy Cunningham, William M. Wolf, Lars Bildsten
http://arxiv.org/pdf/1501.05690.pdf

A Light Curve Analysis of Classical Novae: Free-free Emission versus Photospheric Emission
Hachisu, Izumi; Kato, Mariko
The Astrophysical Journal, Volume 798, Issue 2, article id. 76, 29 pp. (2015)
http://arxiv.org/abs/1410.7888

Symbiotics

An interesting target for summer nights

The Curious Case of ASAS J174600-2321.3: an Eclipsing Symbiotic Nova in Outburst?
Stefan Hümmerich, Sebastián Otero, Patrick Tisserand, Klaus Bernhard
JAAVSO, Vol. 43, 2015
http://www.aavso.org/sites/default/files/jaavso/ej295.pdf

Wind mass transfer in S-type symbiotic binaries. I. Focusing by the wind compression model
Skopal, A.; Cariková, Z.
Astronomy & Astrophysics, Volume 573
http://arxiv.org/abs/1410.7674

Optical Flickering of the recurrent nova RS Ophiuchi: amplitude - flux relation
R. Zamanov, G. Latev, S. Boeva, J. L. Sokoloski, K. Stoyanov, R. Bachev, B. Spassov, S. Ibryamov, G. Nikolov
http://arxiv.org/pdf/1501.02628.pdf

The Astronomer's Telegram

Large amplitude flare from symbiotic nova BF Cyg in outburst

ATel #7013; ***U. Munari (INAF Padova), A. Siviero (Univ. Padova), S. Dallaporta, L. Buzzi, A. Valisa, G. Cherini, S. Moretti, S. Tomaselli, A. Maitan (ANS Collaboration)***
on ***31 Jan 2015; 11:54 UT***
Credential Certification: U. Munari (ulisse.munari@oapd.inaf.it)

Subjects: Optical, Cataclysmic Variable, Nova, Variables

The symbiotic nova BF Cyg was discovered when it erupted in 1894 peaking at B=9.7. It remained close to maximum for 30 years, and starting with 1924 it begun a slow and gradual descent toward quiescence (Leibowitz and Formiggini 2006, MNRAS 366, 675) when, in August 2006 while at passing through B=13.0, it suddenly erupted again (Munari et al. 2006, CBET 596), reaching initially B=10.3 and later peaking at B=9.7 in October 2008. It has remained around maximum ever since, with the light-curve nicely modulated by the 757 day orbital period.

We are intensively monitoring BF Cyg since 2005, both spectroscopically and photometrically. On top the protracted maximum, now lasting for more than 8 years, a unexpected large amplitude and fast evolving flare has recently developed. It started between 22 Nov 2014, when we measured BF Cyg at B=11.15, V=10.47, Rc=9.64, Ic=8.82, and 21 Dec 2014 when BF was already at B=10.72, V=9.98, Rc=9.30, Ic=8.55. According to our observations, the peak brightness occurred around 26 January 2015 at B=9.95, V=9.44, Rc=9.03, Ic=8.45.

The spectra largely changed in response to the flare. We obtained Echelle spectra of BF Cyg with the Varese 0.61m telescope on 7 Aug 2014 (pre-flare) and 28 Jan 2015 (flare peak), and with the Asiago 1.82m telescope of 6 Jan 2015 (flare rise). Low resolution spectra were obtained with the Asiago 1.22m on 18 Nov 2014 (pre-flare), 26 Dec 2014 (flare rise) and 31 Jan 2015 (flare peak). Pre-flare spectra were dominated by very strong Balmer continuum and lines in emission, and strong and sharp HeI lines with no P-Cyg associated absorption. During the flare rise, HeI and NaI lines broadened and developed strong P-Cyg absorptions with terminal velocities around -250 km/sec. At flare maximum, HeI lines and higher Balmer lines turned into pure absorptions, with only Halpha and Hbeta remaining in emission, and among the great number of weak FeII and other low excitation emission lines, only FeII multiplet 42 lines retained a weak P-Cyg absorption component. No high velocity jet feature has appeared in the emission line profiles.

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 Newsletter

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

Searching for new Be Stars

Andrew Smith and Thierry Lemoult
New ARAS Page
http://www.astrosurf.com/aras/be_candidate/auto-be-candidate.html

T Tauri observations upon the request of Henz Moritz Guenther

(Harvard-Smithsonian Center for Astrophysics)
http://www.spectro-aras.com/forum/viewtopic.php?f=5&t=1033
Almost 200 spectra acquired
http://www.astrosurf.com/aras/Aras_DataBase/Ttauri/T_Tau/TTau.htm

Comet C2014_Q2 LOVEJOY

30 spectra gathered in ARAS data base
http://www.astrosurf.com/aras/Aras_DataBase/Comets/Comets/Comets.htm

Contribution to ARAS data base

From 01-01 to 31-01-2015

D. Boyd
J. Edlin
J. Guarro
P. Somogyi
F. Teyssier

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 welcomed

1/ reduce your data into BeSS file format
2/ name your file with: _novadel2013_yyyymmdd_hhh_Observer
novadel2013: name of the nova, fixed for this object

Exemple: _chcyg_20130802_886_toto.fit

3/ send you spectra to
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Supernovae : Christian Buil
to be included in the ARAS database

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