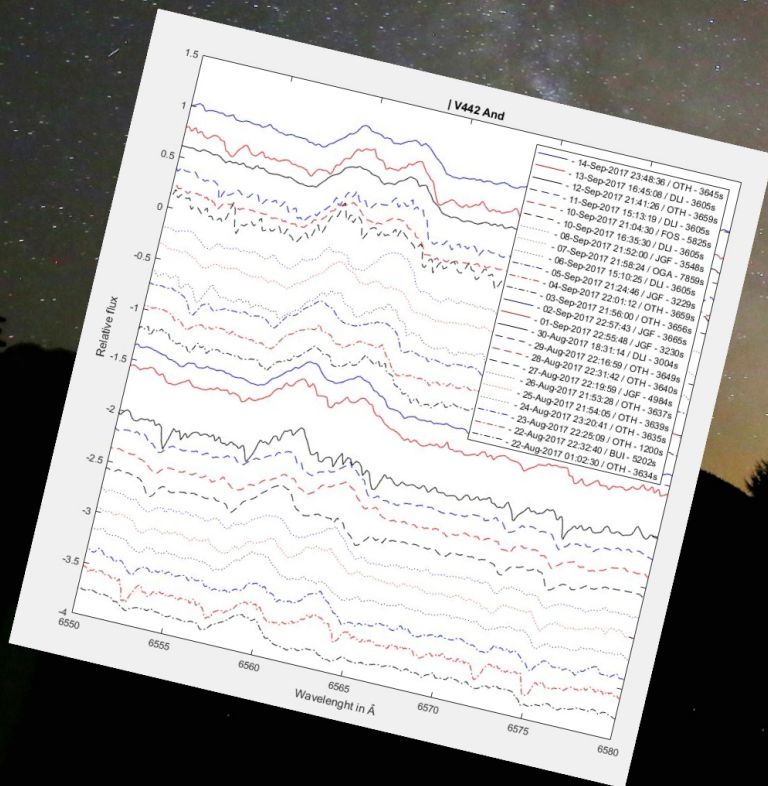


V442 Andromedae

August 2017 outburst



Olivier Thizy (thizy@free.fr)
BeSS 10th anniversary workshop
Meudon / Paris observatory
October 24th, 2017

Content

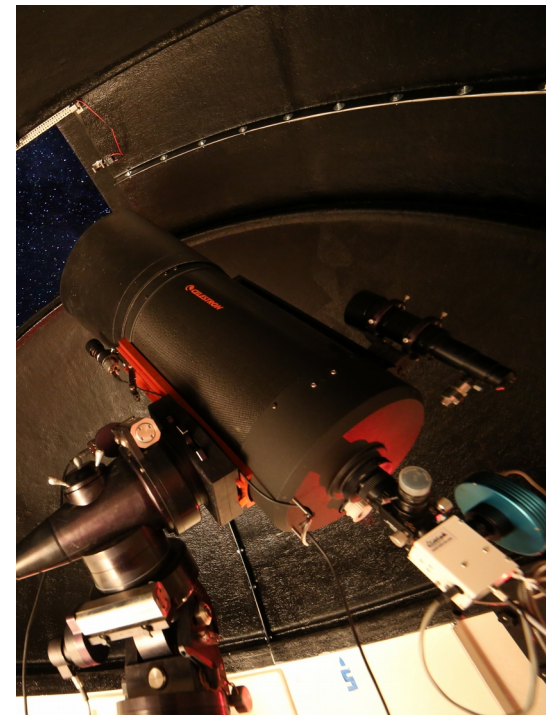


- Observatory of Belle Etoile
 - Overview
 - Be stars program
- V442 And outburst
 - Discovery
 - Evolution
 - Possible scenario ?
- Learning from this event

Observatory of Belle Etoile



- In my backyard, 840m elevation
 - Average sky, poor seeing
- 2.7m dome, 0.28m telescope
- R~10000 echelle spectrograph
- All equipment operated with PRISM v10 software
- Since July 2015 "opening"
 - 100 nights, 725 hours observations
 - 427h total exposure time (59% "efficiency")



Typical observing screen



Gemini

PRISM - Version Pro 10.3.35.361 {TU : 17/10/2017 22:26:45} Alloué > 44 997 268 -> Log désactivé, Processus 2500 [16,14]

Fichier Edition Carte du ciel Visualisation Traitements Addition-Recalage Imagerie Couleur Analyse Spectrographie Observatoire Configuration Fenêtres Aide

V442And-9 | 1374x1099 - Monochrome - Réels(32bits) [Zoom = 1]

ATIK HS | 658x492 - Monochrome - Réels(32bits) [Zoom = 1]

En survi OUEST

LST 00:36:35
RA 01:05:14
Dec 47:44:04
HA -00:29:56
To Limit 02:31:35

Inv RA
Inv Dec

Vitesse
● G ● C ● S

Suivi PEC

Func Park Setup

Déconnecter

ATIK HS
ATIK HS

ARTEMIS CCD ATIK-460ex -> -10.0...
ARTEMIS CCD ATIK-460ex

STOP ABANDONNER

Temps: 119 sec

Pose en sec. 0.25 Bouclage Bouclage infini

Nbre de boucles 10 Délai (s) 1

BinX: 1 BinY: 1 Lier

Exp Longue Exp. courte Sequence

Caméra Options Guidage Information

Calibration Calibration AD

Démarrer Guidage Cal. Sharplock

Abandon

Trouver l'étoile de guidage automatiquement

Port de guidage : ASCOM compliant guider

Minimiser

Evolution du maximum

Evolution du maximum

Max
ADU

Temps (sec)

Tracking Inspector

Etat (03h 23m 50s) Echec : Pas d'étoile détectée !

Positions Axe RA : -6.55 Pix +255ms Répétition

Positions Axe DEC : -4.24 Pix 0ms

Décalage (Pixels, angle) 7.80 -147.08°

Direction moyenne 119°

Erreur de suivi moyen 5.92 Pix 3.46°

Flux

Moniteur de nuages 856 ADU 189 ADU rms

Plus >>>

0.25 s Bin:1x1 0.0°C MX=0 MY=0 Filt.= Foc=2610.0 mm sca

V0442_And

(Xmax,1) (000) (1,1) ATIK Titan

Zoom=1024 Alpha= 01h04m29.057s Delta= +47°40'45.38" Eq Objets: 13 And Champ=16' x 18' Mode car

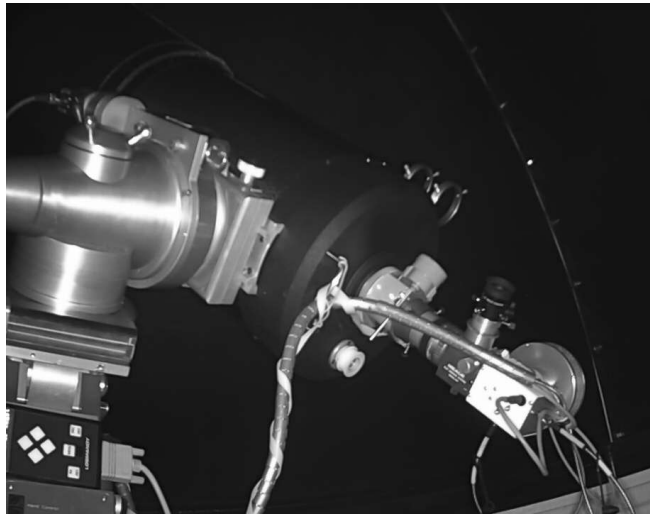
Format 1374x1099x1 [Réels 32bits] Zoom = 1

"BeSS" stars program



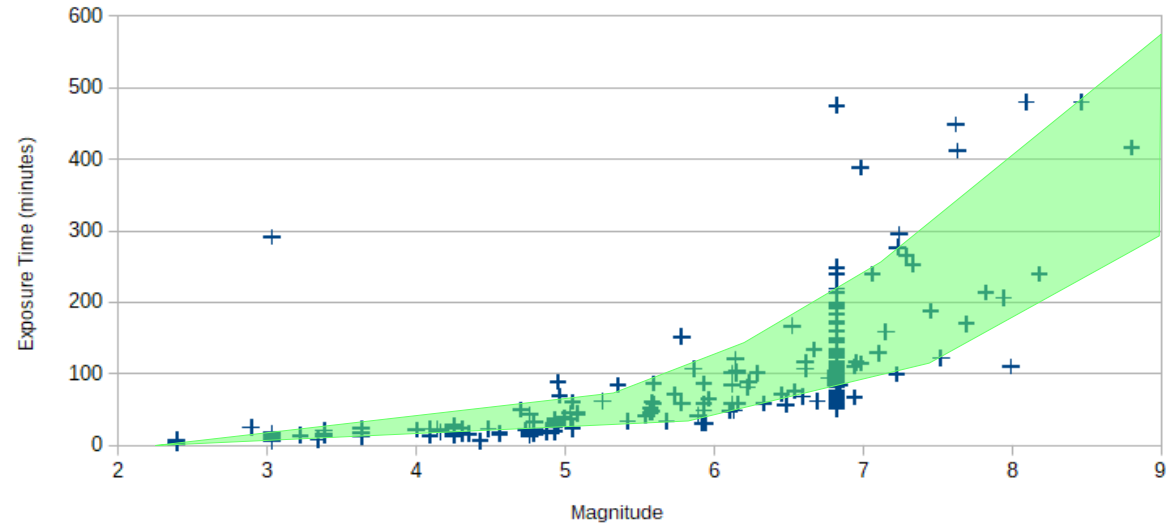
- Around 660 spectra (14000 orders) in BeSS
- 400+ spectra (~9500 orders) since July 2015
 - **100+ spectra of V442 And**
 - *Note: 74% of my spectra are "BeSS" stars*
- ARASBeAm web / Robot to select targets
 - Look usually for Mag < 7-8 & DEC > -10°
 - Max individual exposure time 20min
 - Limit total exp. time 2h or **SNR ~100** near H α
- Manual data reduction with ISIS 5.8.0 (C.Buil)
& BeSS upload during the night

Be stars spectra performances



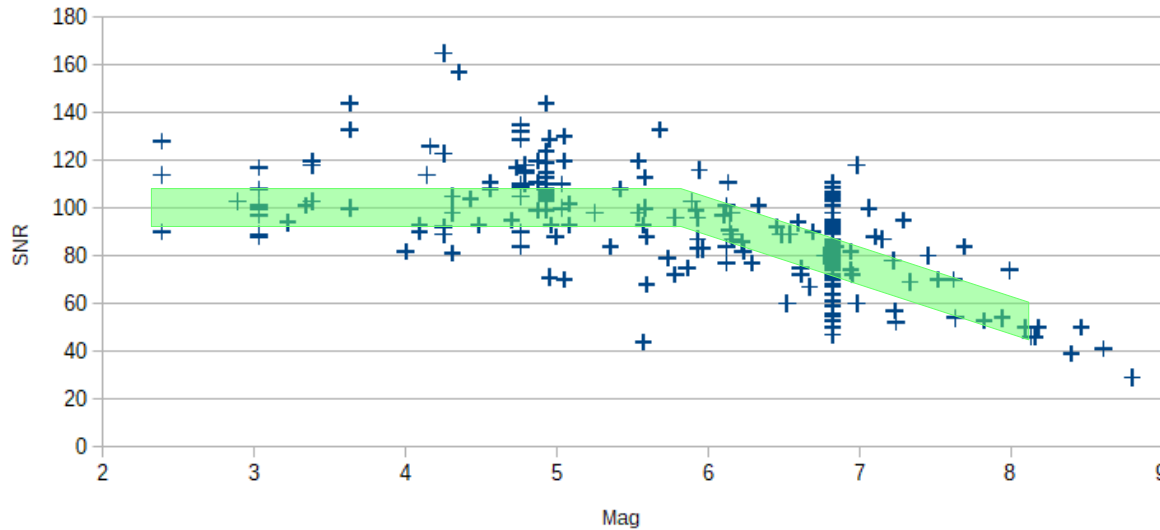
Be stars - Exposure Time (min) to reach SNR=100 Vs Magnitude

C11 + echelle + Atik460ex / Observatoire de la Belle Etoile



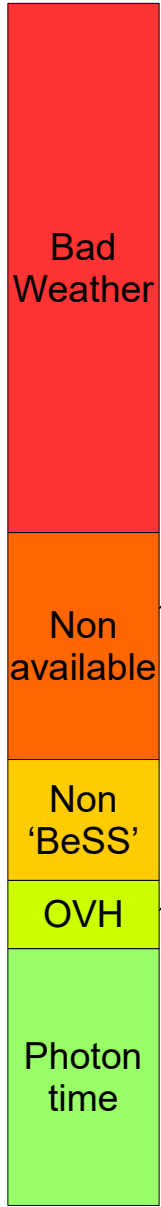
Be stars - SNR obtained per V Mag

C11 + echelle + Atik460ex / Observatoire de la Belle Etoile

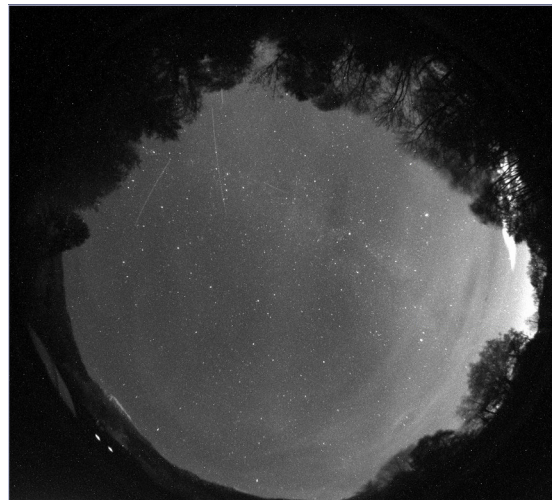


Date	Etoile	Exp.(s)	NbExp.	Max_kADU	SNR2	Mag(Be)
19/10/17	28 Cyg	800	3	45	110	4,93
19/10/17	V2163 Cyg	1200	3	11	74	6,94
19/10/17	V442 And	1200	5	11	82	6,82
19/10/17	V442 And	1200	6	11	84	6,82
19/10/17	V413 Aur	1200	8	4	46	8,13
19/10/17	V715 Mon	1200	4	12	89	6,15
19/10/17	OT Gem	1200	3	13	92	6,45

Current / Futur Improvements



- Remote observation since sep. 16th, 2017
- AllSky camera added last week
- Next steps: more scripting & automation
- Improve "efficiency": 78% in sep.-oct. 2017
- Automate Reduction / Archival / Dashboard ?

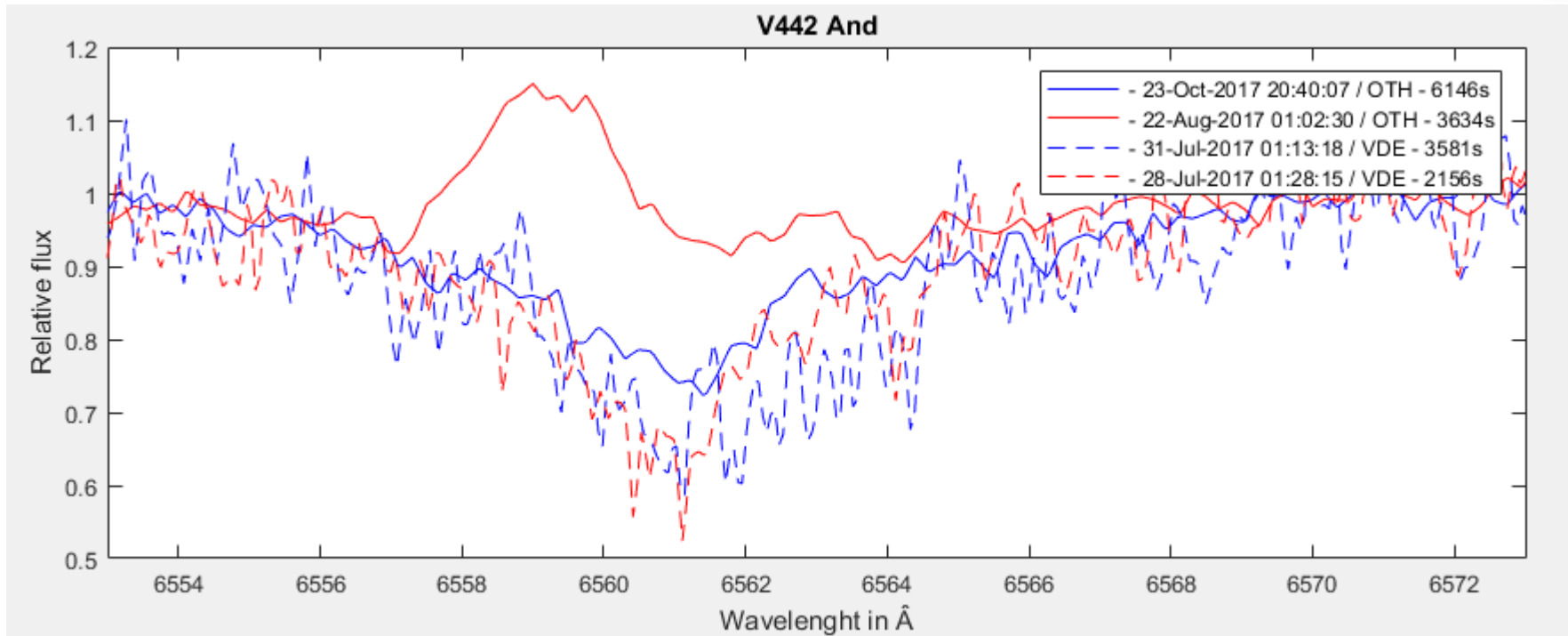


V442 And (HD6226)



- First emission detected by McCollum et al. (2000)
- Bozic & Harmanec (2004) article on V442 And:
 - Star rotation 2.61507 days
 - 24-29 days period suspected
 - 630 days irregular period between outburst ?
 - T_{eff} 17000K; 5 solar masses; 11 solar radius
 - Inclination of 19° (almost pole on)

V442 And outburst discovery

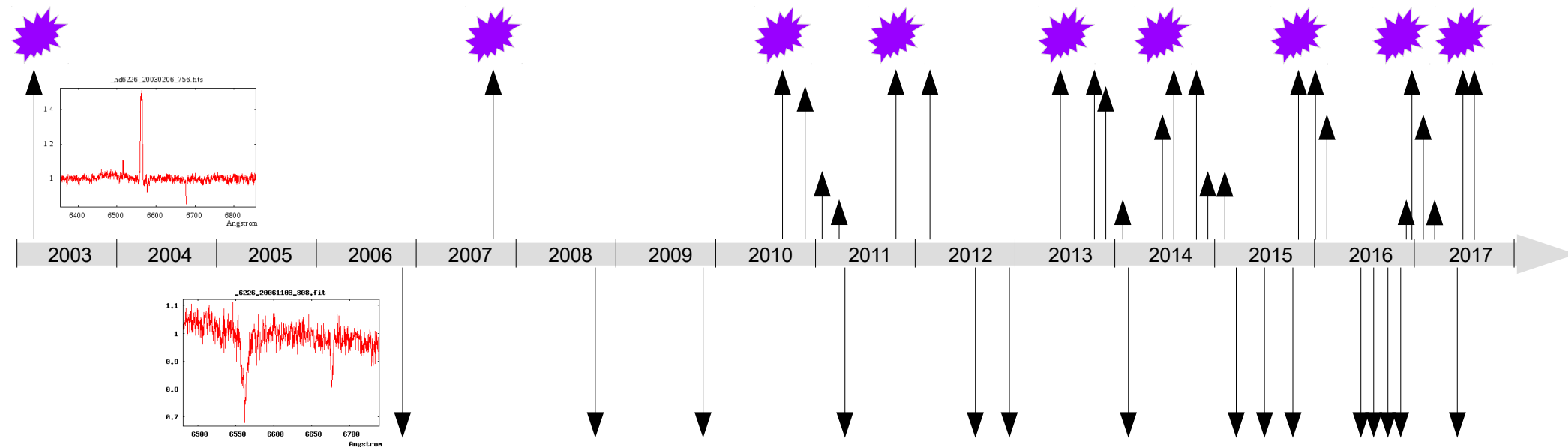


- Alert through Spectro-L Yahoo discussion group
- Regular status/infos on ARAS forum
- ARASBeAm "ideal period" quickly changed to 1d

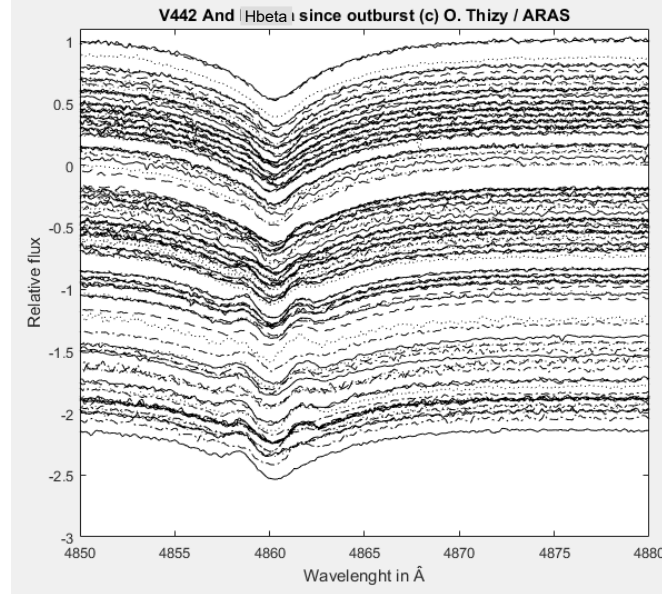
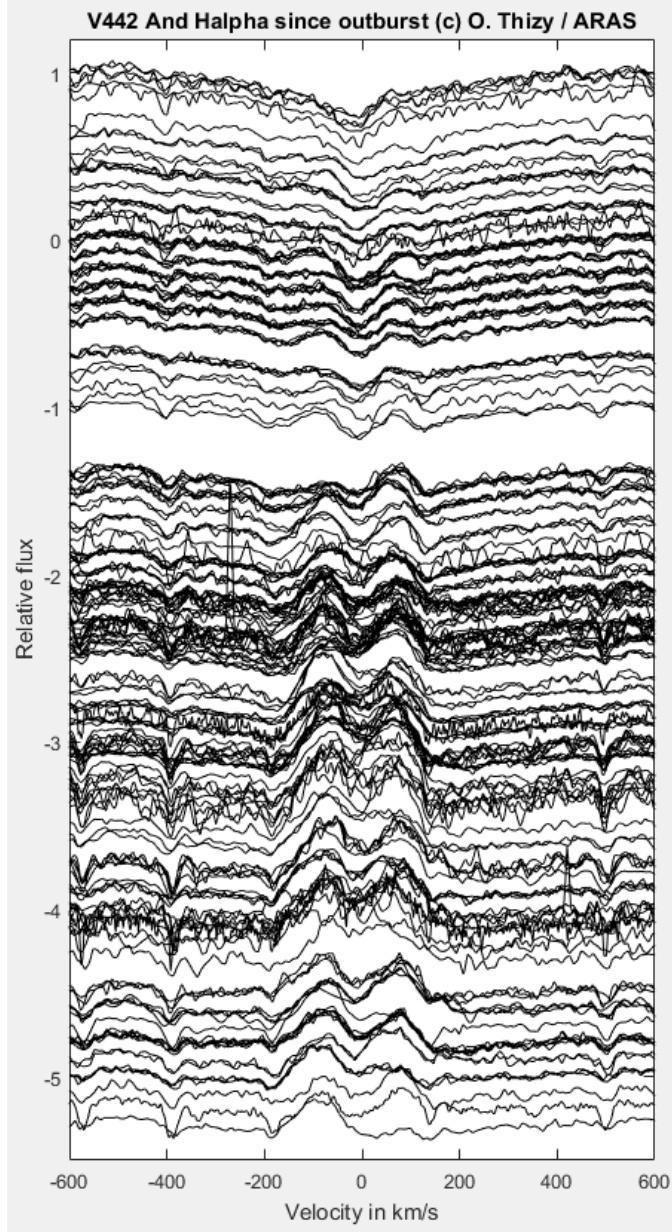
BeSS history



- Emission phases seem to last 3 to 6 months
- Intervals (quiescence): 8 to ~21 months



200+ spectra taken



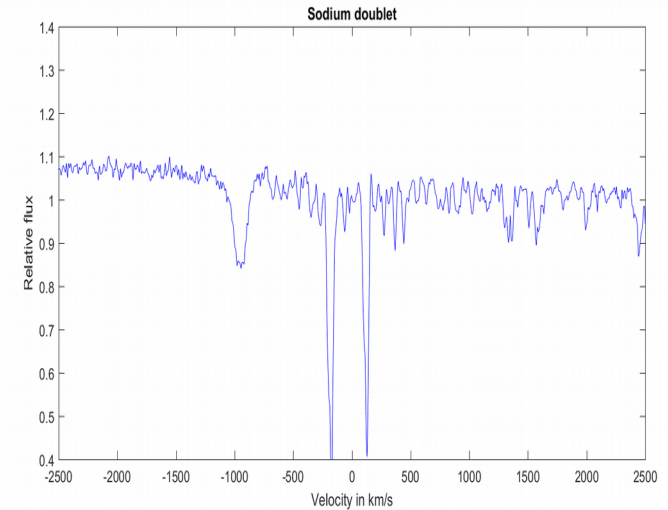
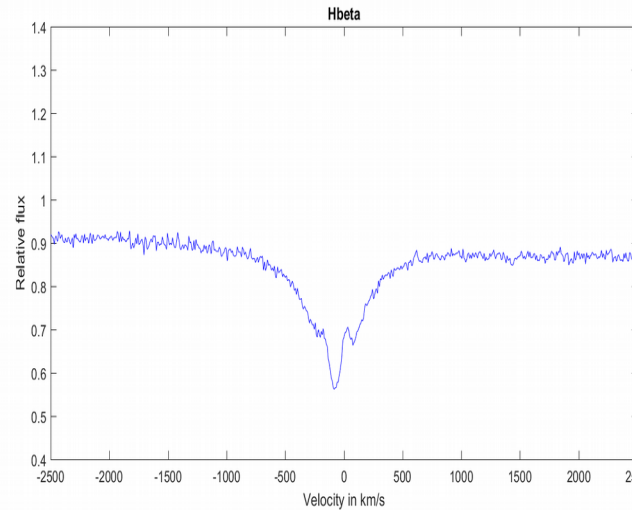
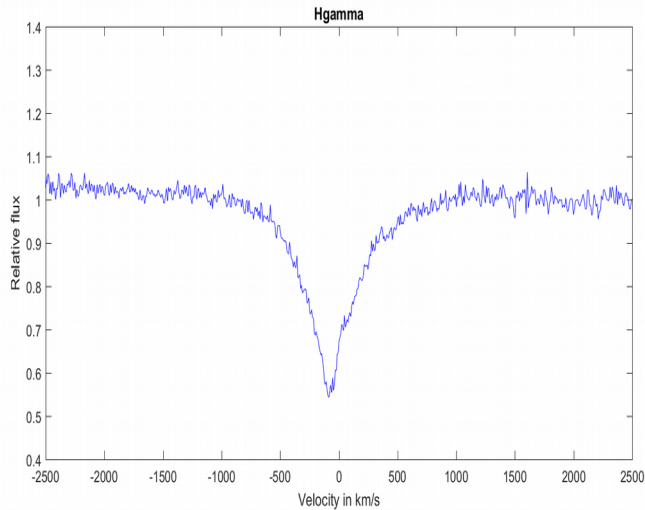
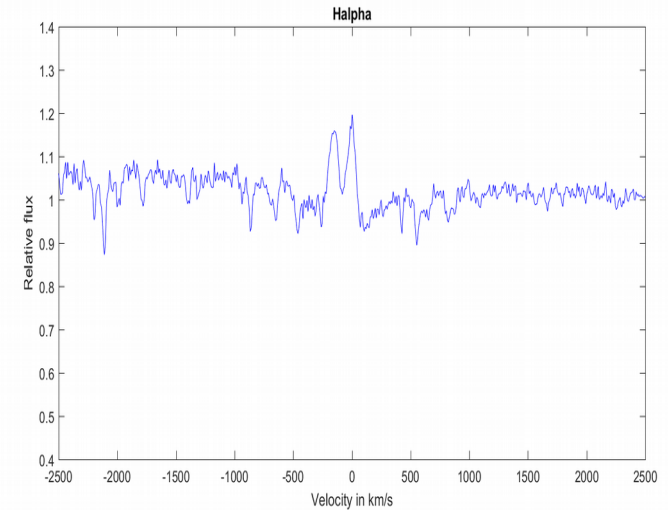
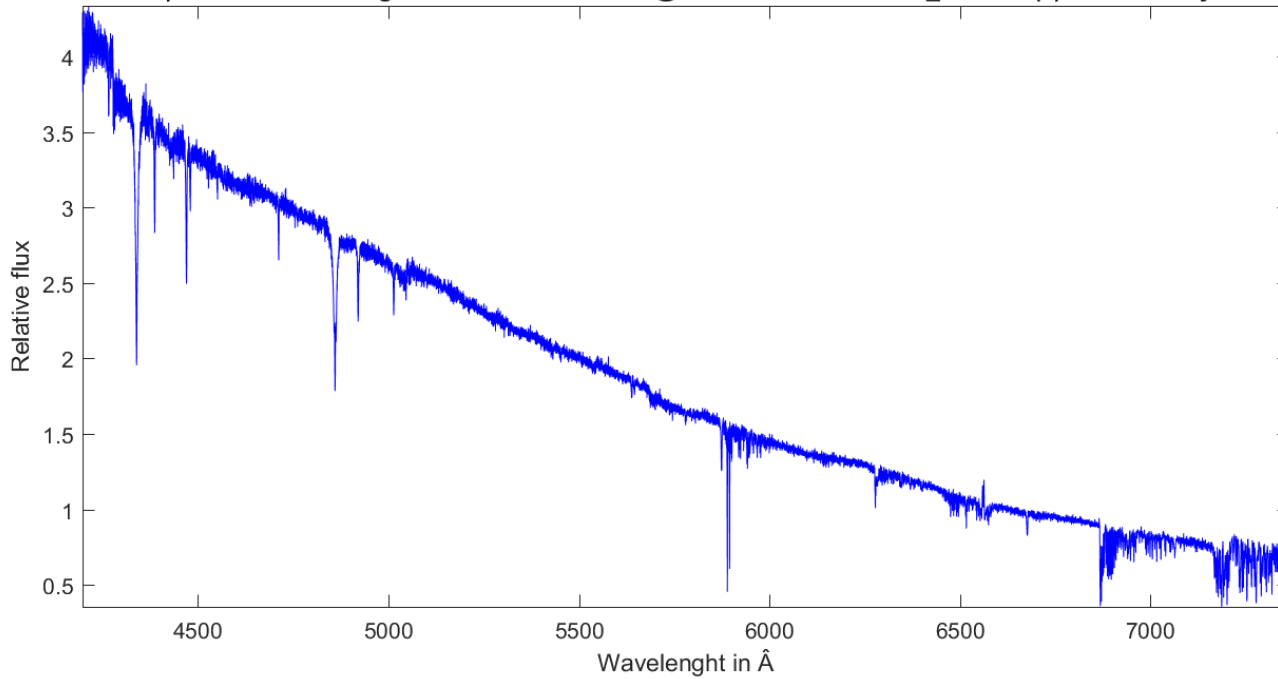
Total exposure time :		245	hours		
Observer	Spectro.	#	SNR	AvgExp(s)	
OTH	Olivier Thizy	echelle 110	85	4124	
DLI	Dong Li	Littrow 44	40	4032	
JGF	Juan Guarro Flo	echelle 32	106	3401	
OGA	Olivier Garde	echelle 8	113	7557	
FOS	Patrick Fosaneli	Littrow 6	100	6242	
BUI	Christian Buil	echelle 4	41	4089	
JNT	Jean-Noël Terry	Littrow 3	57	3191	
VDE	Valérie Desnoux	Littrow 2	50	3003	
ADB	Arnold de Bruin	Littrow 1	165	5405	
Total Nb of spectra		210			

ID	File	Observer	Exp(s)	SNR	JD	V	Vo	R	Ro	Hel6678
121	v442and_20170924_962_full	OTH	3671	83	2458021,48295	0,26	6559,96	0,21	6562,48	6676,74
122	v442and_20170924_948_full_BUI	BUI	7400	117	2458021,49094	0,28	6559,93	0,20	6562,50	6676,60
123	v442and_20170925_005_full	OTH	2436	83	2458021,51870	0,27	6559,87	0,21	6562,49	6676,64
124	v442and_20170925_582_DongLi	DLI	4206	21	2458022,10670	0,25	6559,45	0,19	6562,49	0,00
125	v442and_20170925_955_full	OTH	7302	70	2458022,49708	0,26	6559,57	0,20	6562,18	6676,48
126	v442and_20170926_836_full	OTH	1200	58	2458023,34263	0,27	6559,42	0,25	6562,67	6676,91
127	v442and_20170926_894_JGF	JGF	4566	133	2458023,41998	0,27	6559,45	0,24	6562,77	6676,87
128	v442and_20170926_904_full_OGA	OGA	7254	106	2458023,44631	0,28	6559,42	0,24	6562,89	6677,07
129	v442and_20170927_890_full	OTH	6145	67	2458024,42516	0,27	6559,75	0,22	6563,09	6676,47
130	v442and_20170927_961_full	OTH	6158	79	2458024,49678	0,26	6559,75	0,22	6562,88	6676,43
131	v442and_20170928_841_full	OTH	3648	76	2458025,36252	0,19	6559,73	0,26	6562,53	6676,55
132	v442and_20170928_871_J_Guarro	JGF	3021	165	2458025,38804	0,20	6559,76	0,26	6562,50	6676,57
133	v442and_20170928_884_full	OTH	3669	100	2458025,40527	0,18	6559,76	0,26	6562,58	6676,62
134	v442and_20170928_927_full	OTH	3671	84	2458025,44817	0,18	6559,72	0,25	6562,57	6676,66
135	v442and_20170928_970_full	OTH	4907	64	2458025,49832	0,19	6559,54	0,26	6562,60	6676,69
136	v442and_20170929_827_full	OTH	3651	87	2458026,34792	0,15	6559,85	0,23	6562,82	6676,92
137	v442and_20170929_869_full	OTH	3647	71	2458026,39042	0,15	6559,80	0,24	6562,82	6676,92
138	v442and_20170929_897_JGF	JGF	4235	133	2458026,42170	0,16	6559,48	0,23	6562,91	6676,82
139	v442and_20170929_912_full	OTH	3680	73	2458026,43329	0,15	6559,62	0,24	6562,84	6676,88
140	v442and_20170929_899_full	OGA	7253	123	2458026,44056	0,15	6559,68	0,24	6563,00	6676,97
141	v442and_20171003_779_full_OGA	OGA	7257	117	2458030,32098	0,19	6559,24	0,17	6562,87	6676,41
142	v442and_20171003_919_J_Guarro	JGF	3621	80	2458030,43994	0,19	6559,23	0,17	6562,95	6676,49
143	v442and_20171004_834_full	OTH	14842	75	2458031,42015	0,15	6559,51	0,17	6563,31	6677,05
144	v442and_20171005_818_full	OTH	6112	108	2458032,35378	0,14	6559,50	0,18	6562,77	6676,43

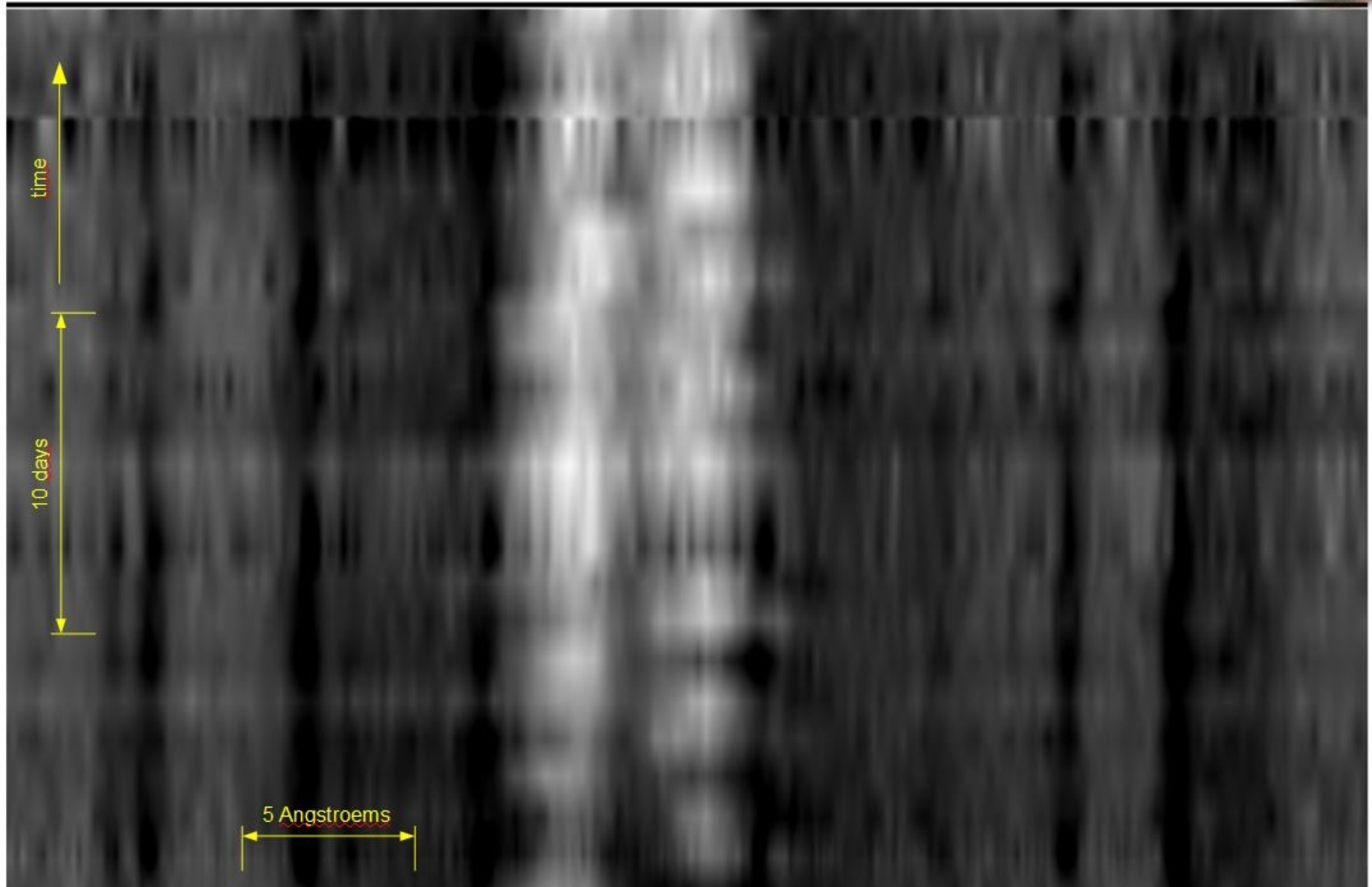
Exemple of an echelle spectrum



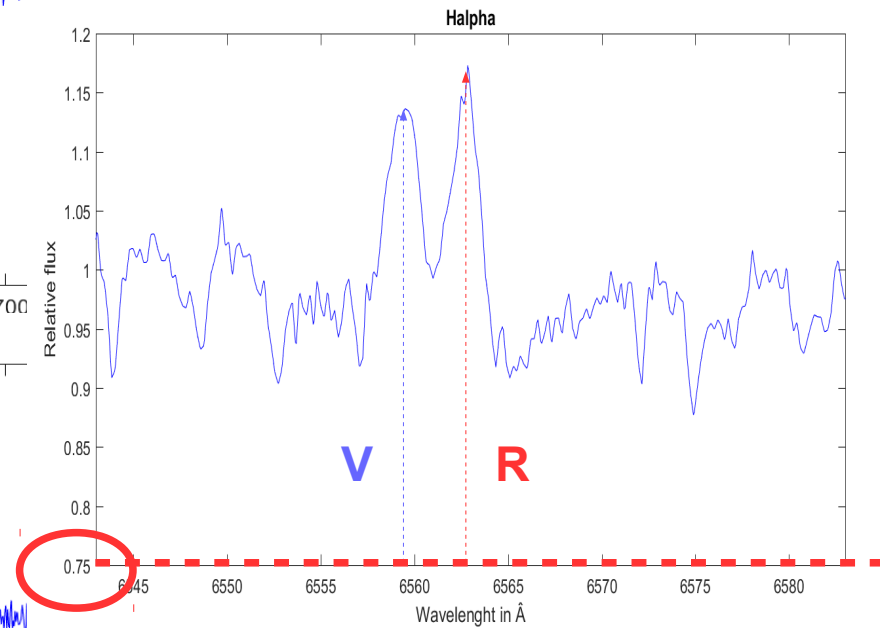
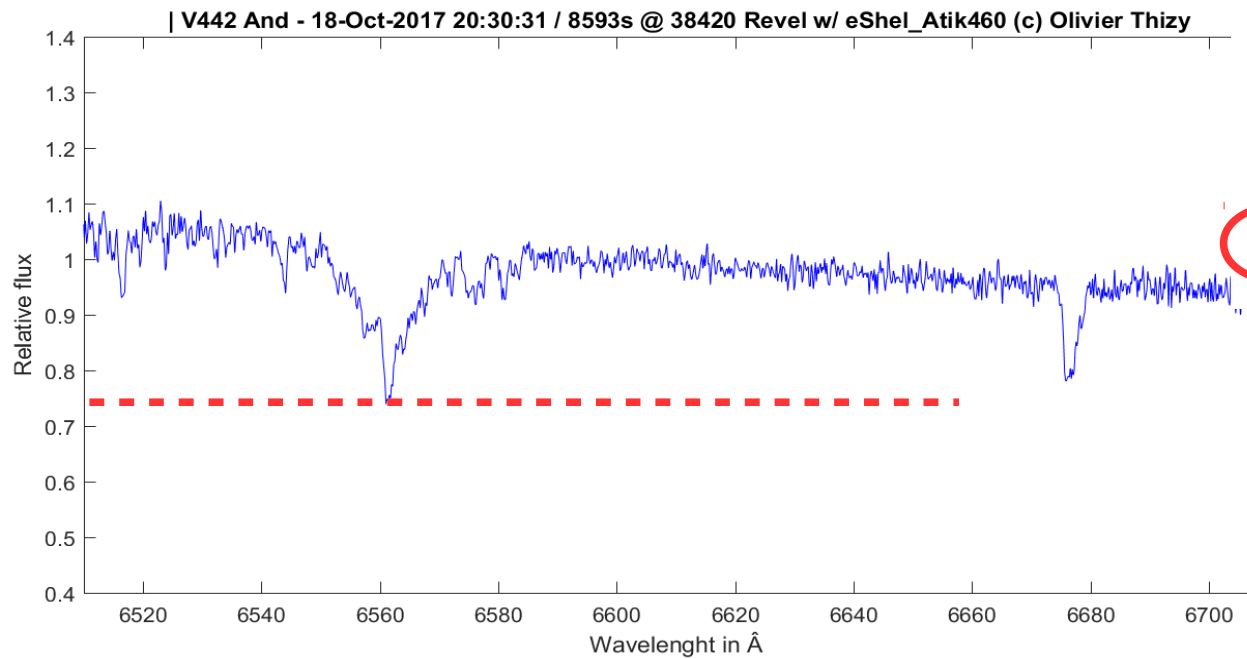
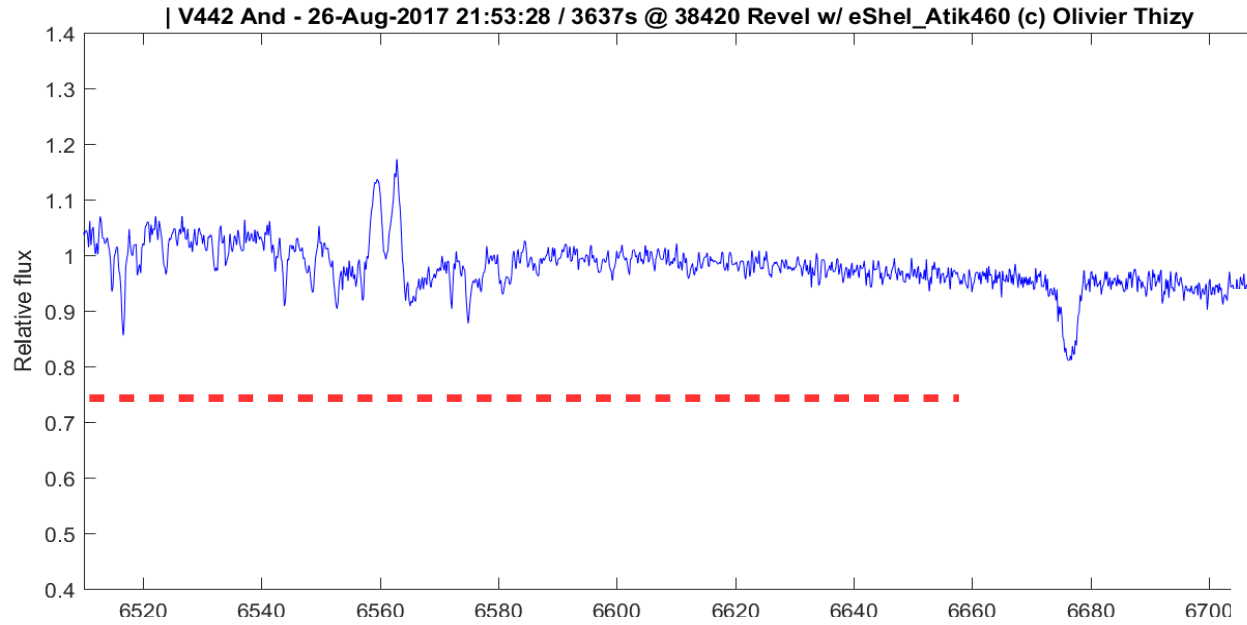
| V442 And - 26-Aug-2017 21:53:28 / 3637s @ 38420 Revel w/ eShel_Atik460 (c) Olivier Thizy



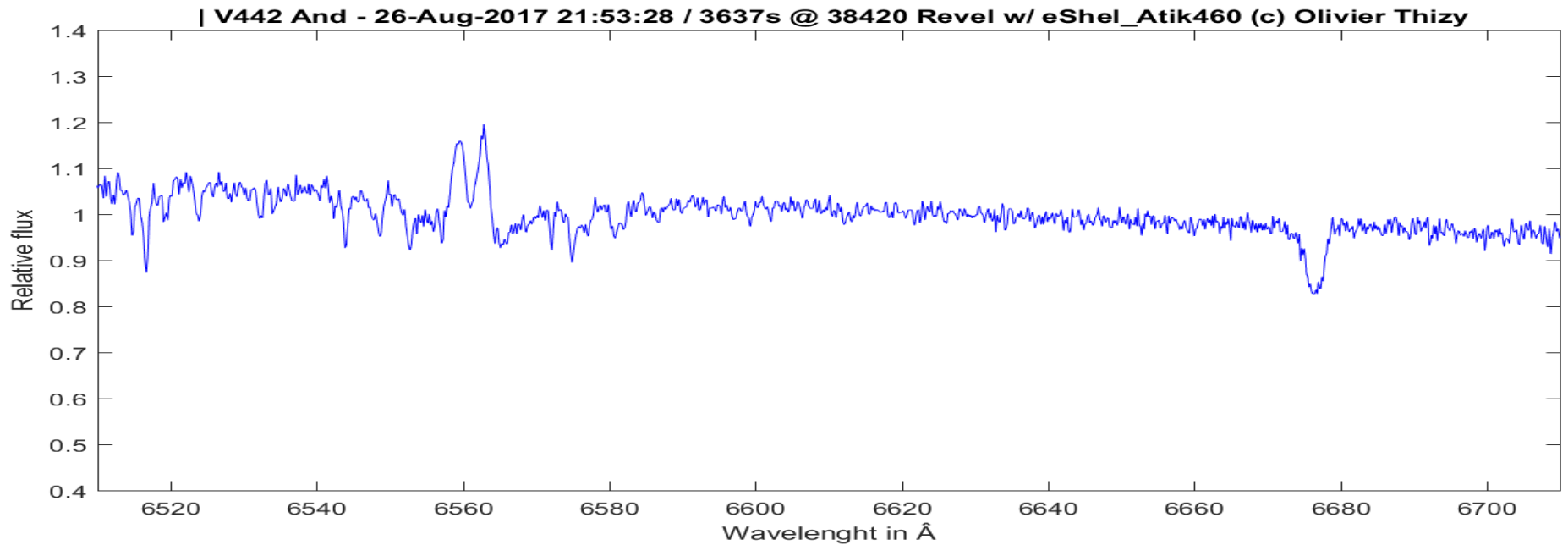
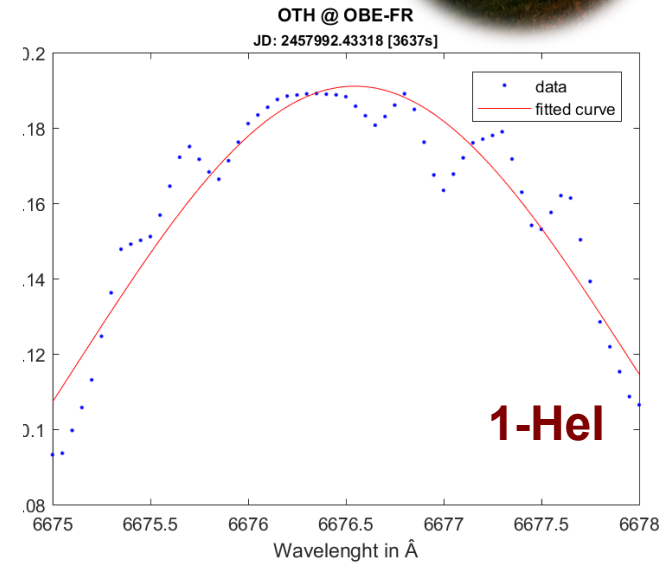
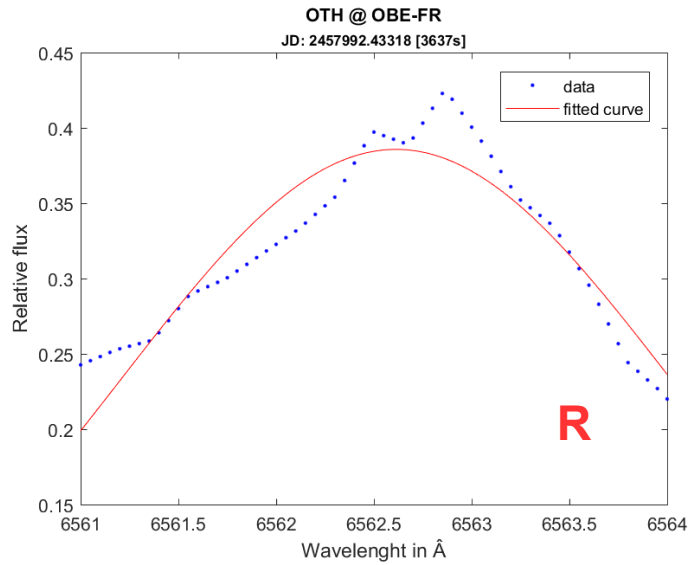
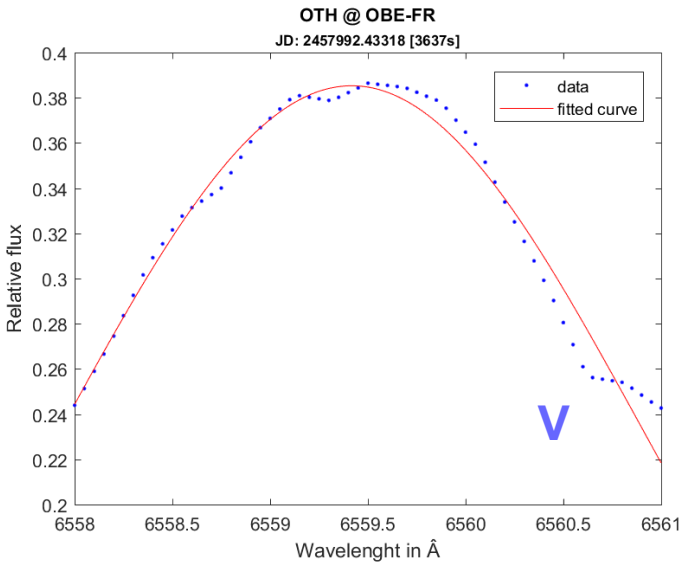
H α evolution – periodic ?



Measuring V & R peaks



MatLab gaussian fits

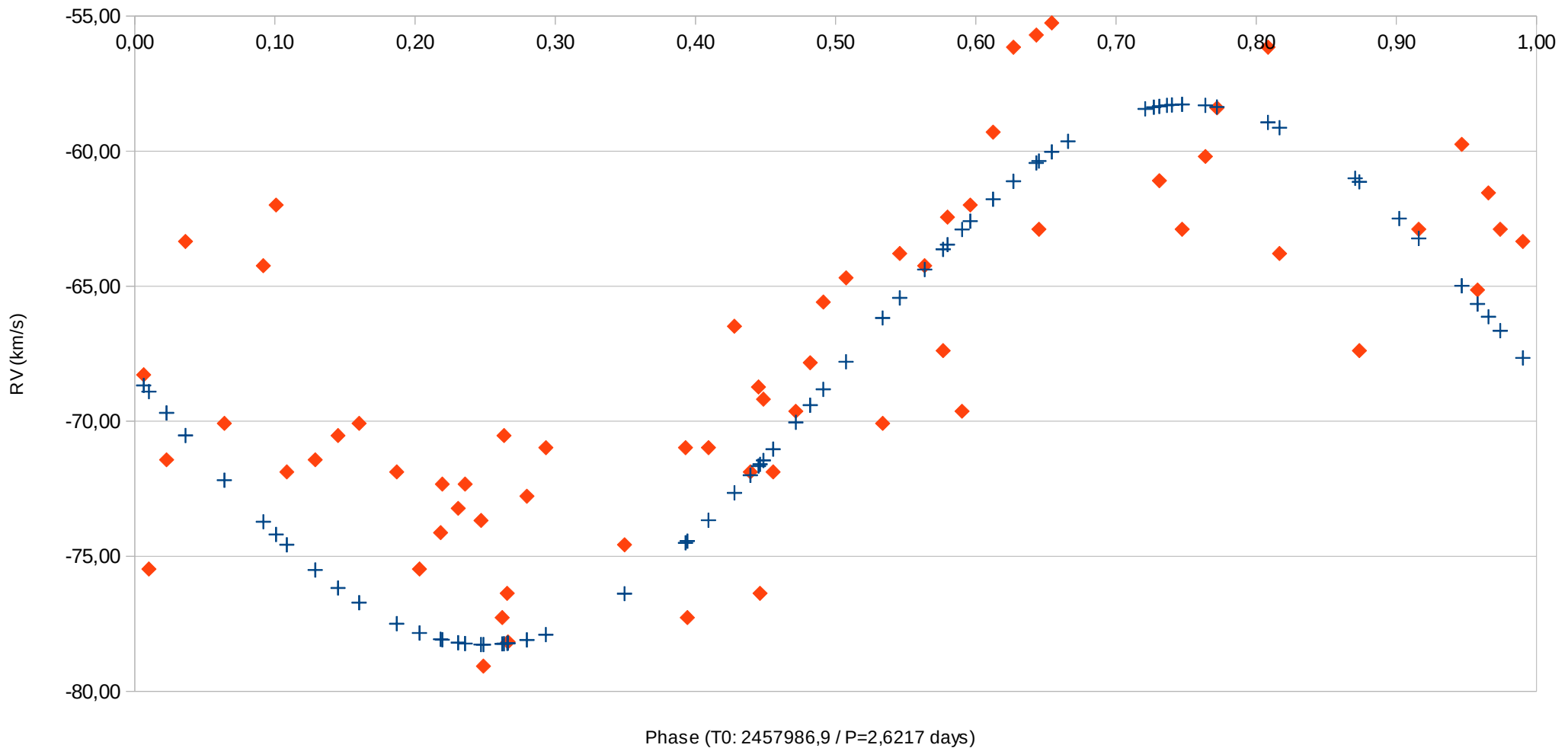


He I: stellar rotation period



He I 6678 Radial Velocity

ARAS group (O. Thizy, J. Guarro Flo, C. Buil, O. Garde)

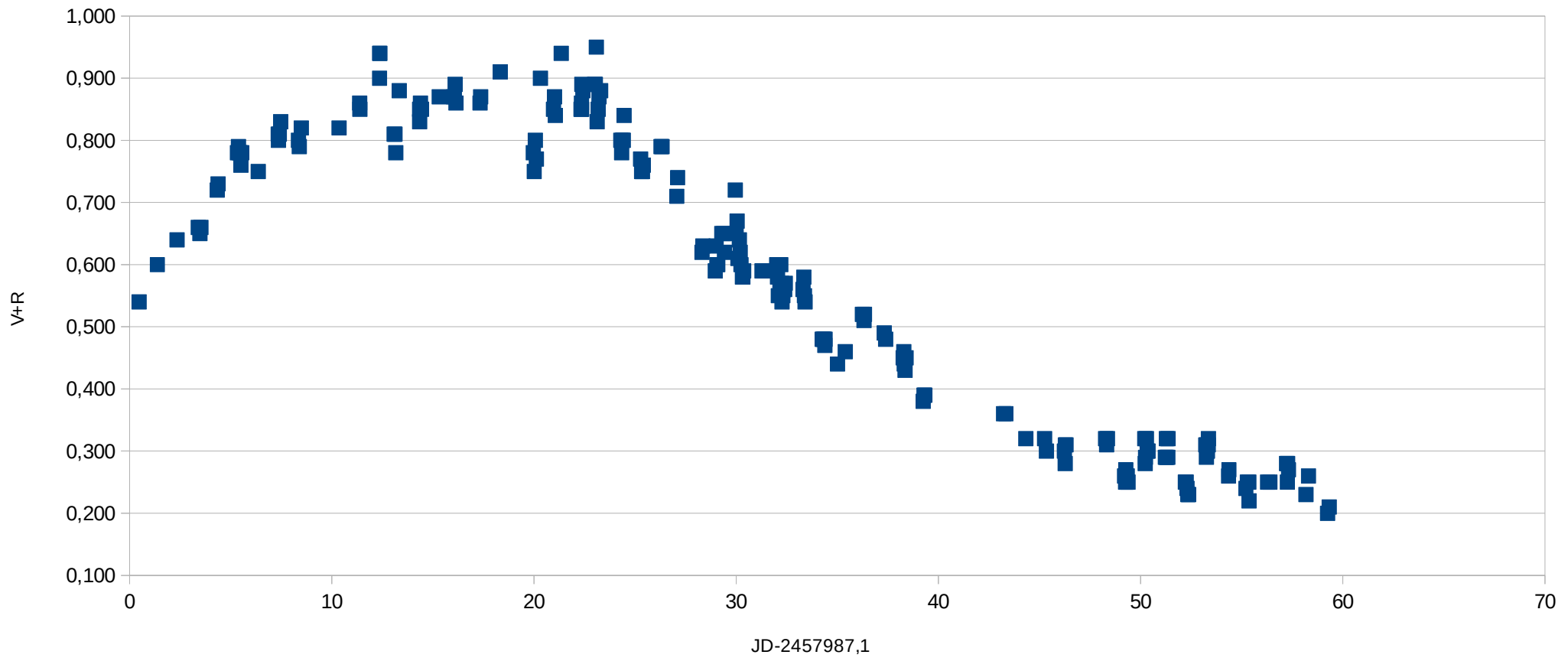


V+R evolution



V442 And - V+R evolution after outburst discovery

ARAS group (O. Thizy, J. Guarro Flo, O. Garde, Dong Li, C. Buil, P. Fosaneli, V. Desnoux, J.N. Terry)

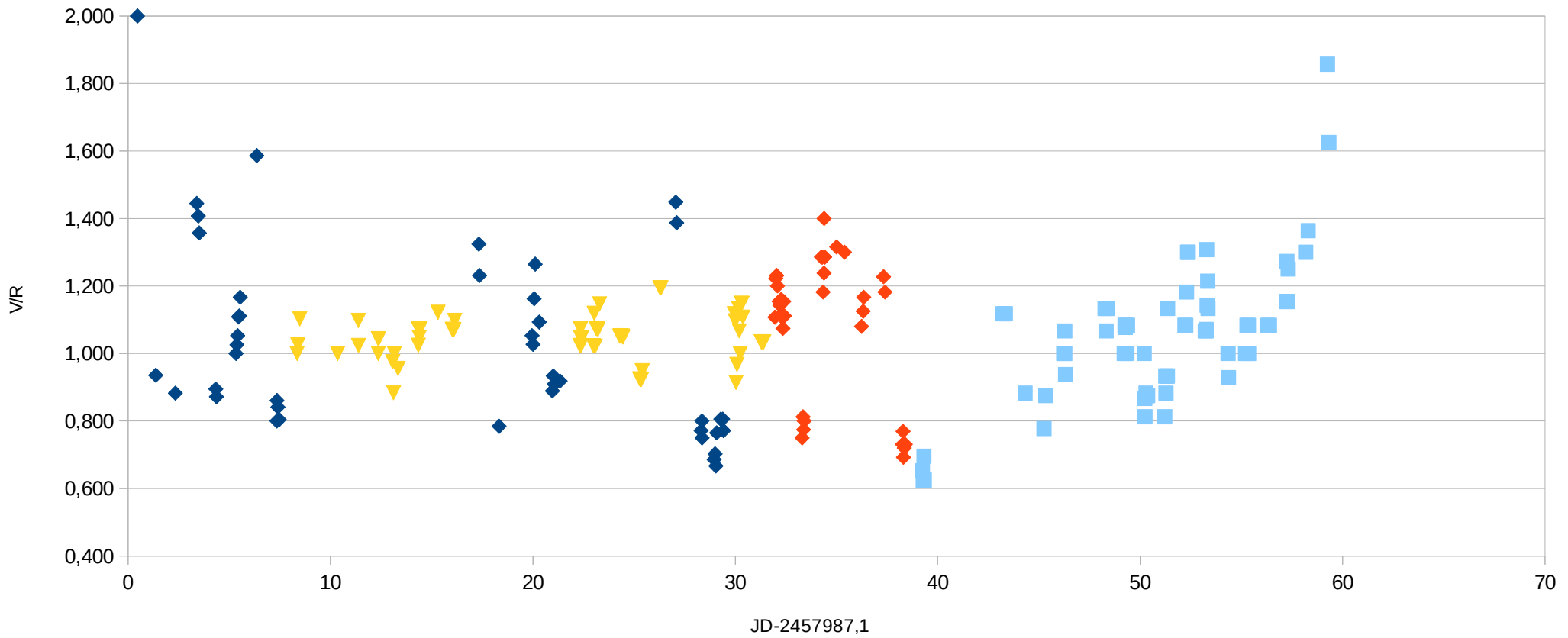


V/R evolution



V442 And - V/R evolution after outburst discovery

ARAS group (O. Thizy, J. Guarro Flo, O. Garde, Dong Li, C. Buil, P. Fosaneli, V. Desnoux, J.N. Terry)

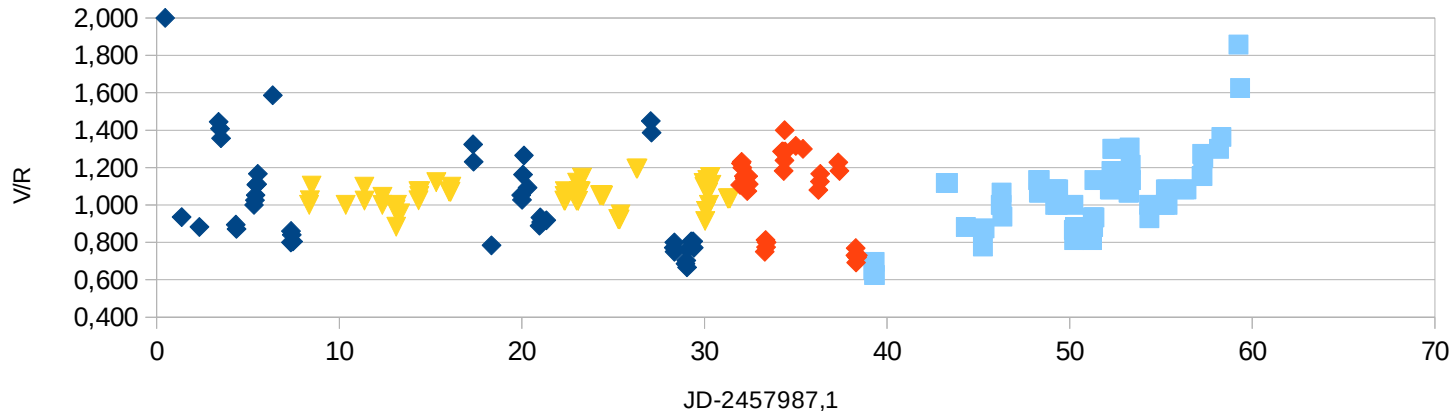


V/R "phased" evolution



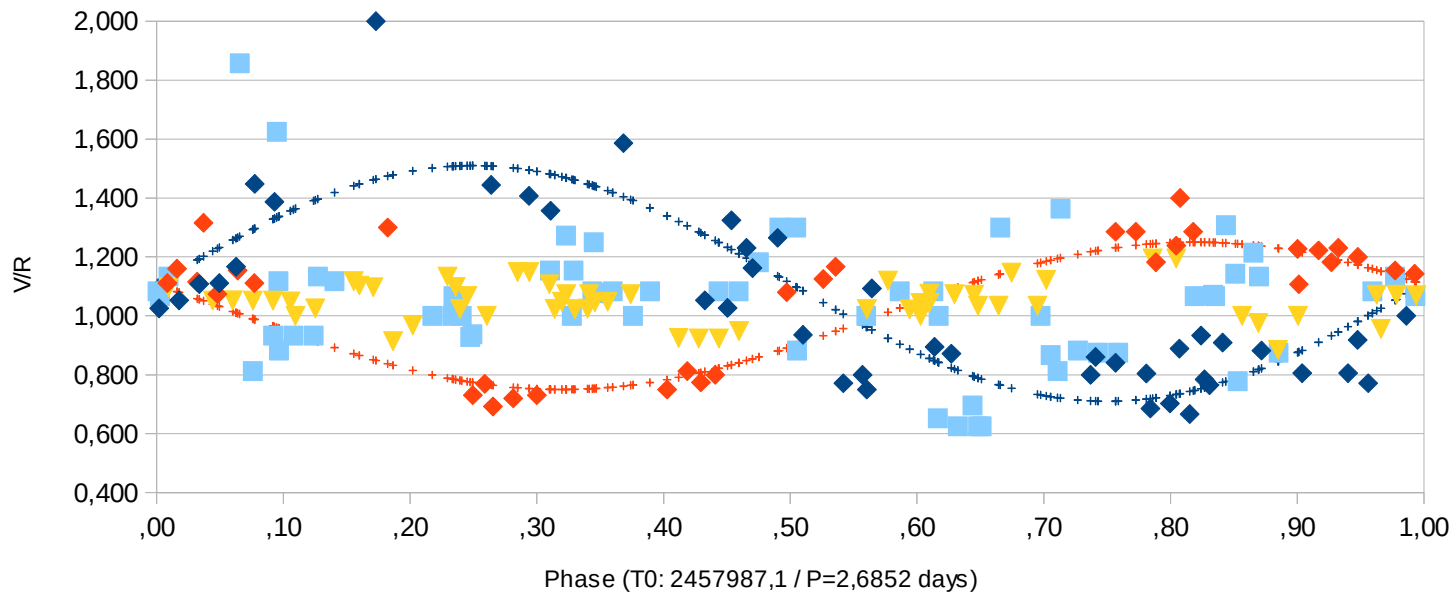
V442 And - V/R evolution after outburst discovery

ARAS group (O. Thizy, J. Guarro Flo, O. Garde, Dong Li, C. Buil, P. Fosanelli, V. Desnoux, J.N. Terry)



V42 And - V/R evolution after outburst discovery

ARAS group (O. Thizy, J. Guarro Flo, O. Garde, Dong Li, C. Buil, P. Fosanelli, V. Desnoux, J.N. Terry)



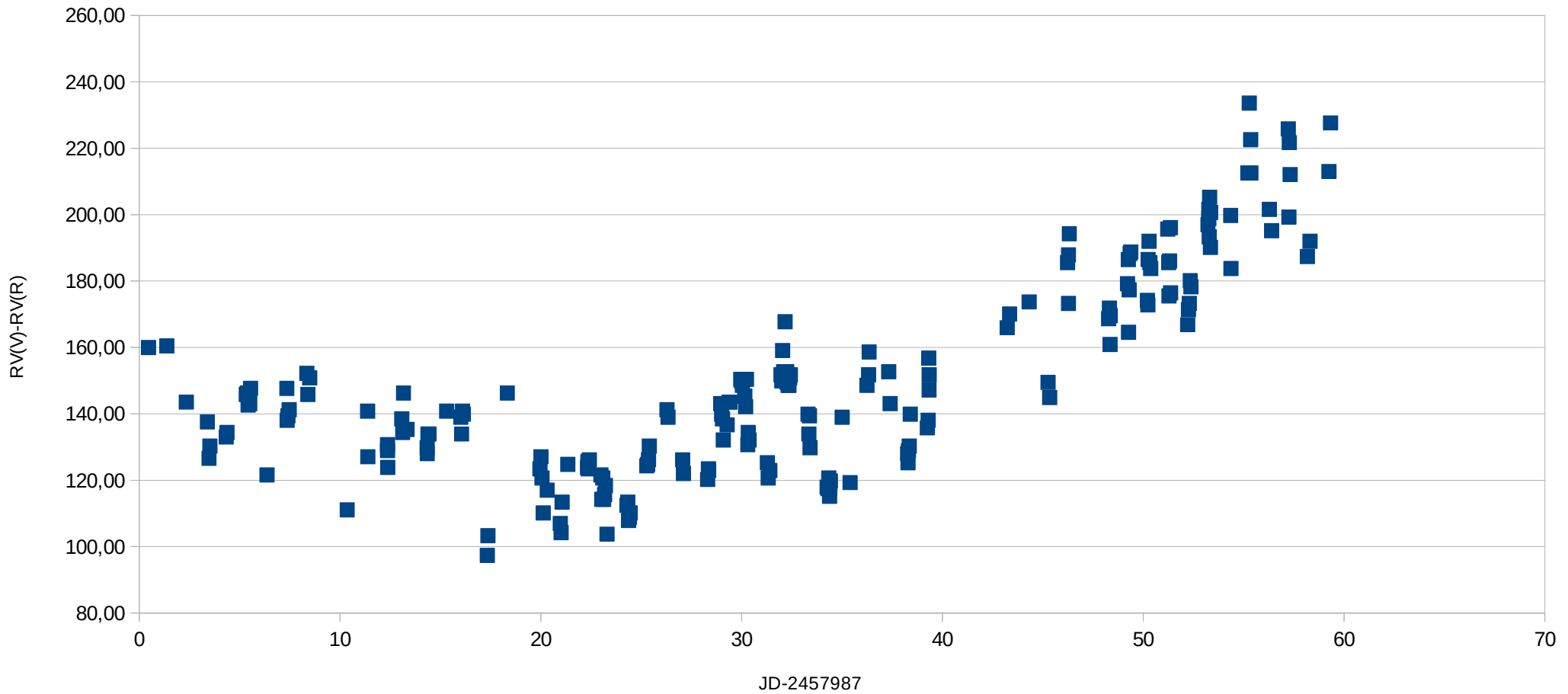
- A blob is ejected over the photosphere, one on each side (august 21st spectrum)
 - Material remains close to photosphere ~8d
 - System remains stable for about 5 days
- Another ejection ~4d + 4d
- Another ejection ~3d + 2d
- Then another ejection but with another phase
- Emission is now fainter and V/R more erratic

V & R peaks separation



V442 And - V-R Radial Velocities after outburst discovery

ARAS group (O. Thizy, J. Guarro Flo, O. Garde, Dong Li, C. Buil, P. Fosanelli, V. Desnoux, J.N. Terry)



Learning from this event



- Checking spectra quickly & community alert is important
- Good (but not excellent) response from the observing community: Europe, China
- Lack of observers in USA/America's time zone
- Frequent update on ARAS forum and Yahoo Spectro-L discussion group helps for the group motivation
- Good reaction from Coralie Neiner & Noël Richardson: motivation, suggestions, explanations... THANKS!
- A publication is being prepared with additional observations – *to be continued...*

Quotes from Noël Richardson



- Early on: *"The quick V/R changes seem consistent with a blob ejected from the star and in orbit just above the stellar surface. This should make a very interesting project. Many thanks to you for arranging the spectroscopy and to all of the observers for their time, dedication, and enthusiasm."*
- 100 spectra: *"this seems like a rare opportunity to trace the mechanisms of how small ejections in Be stars operate to build a disk. Please keep observing!"*
- 200 spectra: *"From what I've seen, we haven't had such a great set of data on this (or any other) Be star on the onset and disappearance of a disk before."*

THANK YOU !

