Be outbursts

How can we detect more outbursts and improve the follow-up?

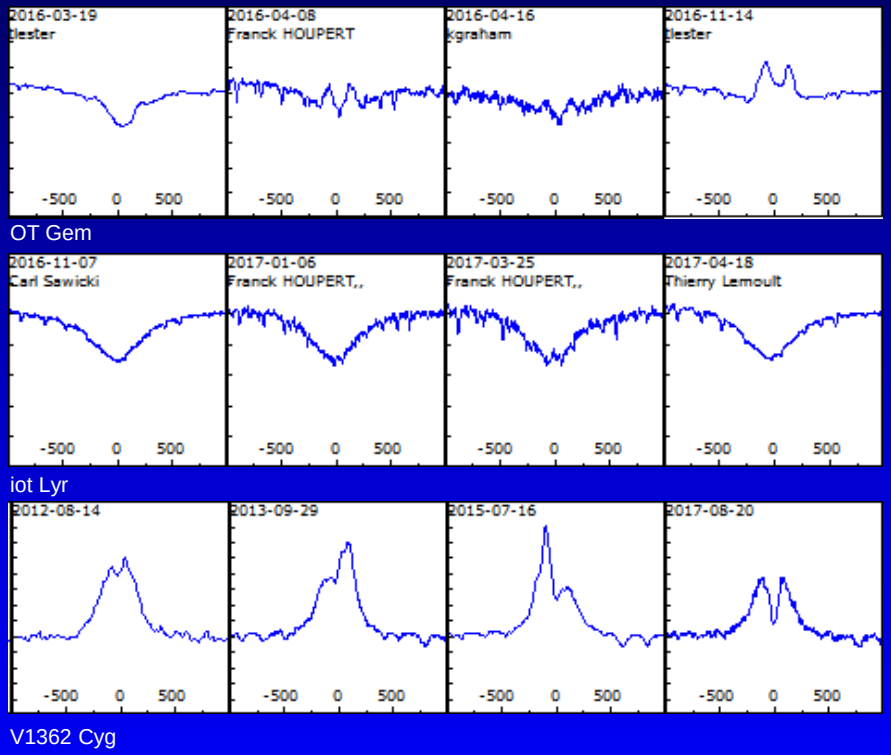
Valérie Desnoux

Celebrating the 10 year anniversary of BeSS

23-27 Oct 2017 Meudon (France)

- How to define a outburst
- How many did we get so far
- Can we identify some predictor factor
- How do we communicate with the observer community

Emission variations



BeSS monthly reports

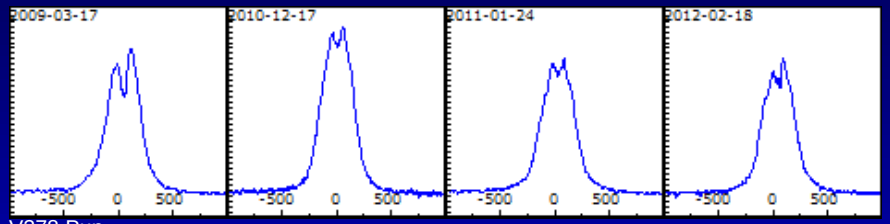
Since June 2012

EE – Emission Event

ME – Moderate Emission Event

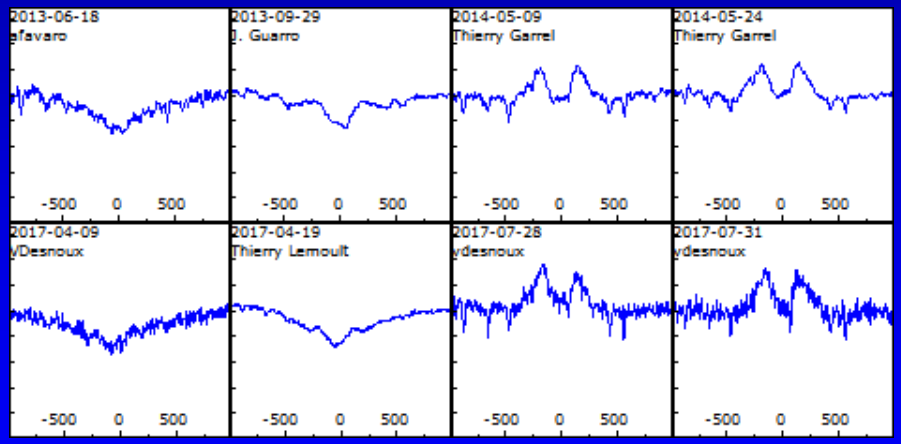
DE – Decreasing Event

Emission Event



V378 Pup

Emission increase, from already existing emission



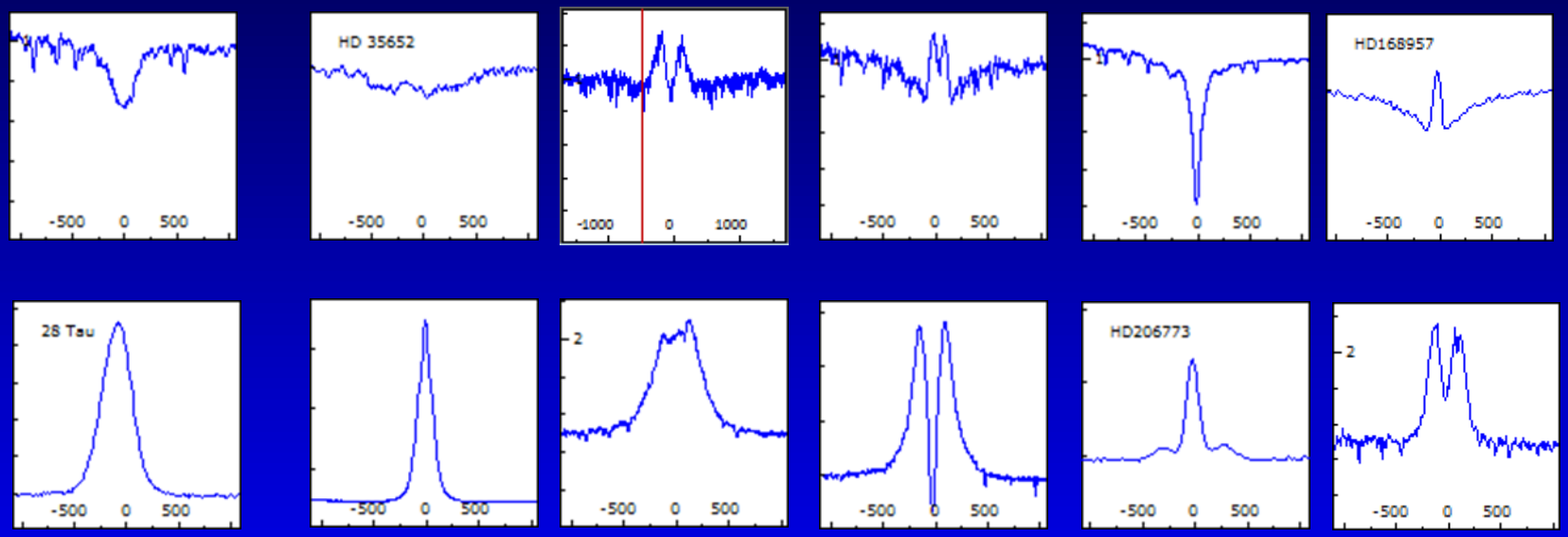
V532 Lyr

Emission appearing, from a phase close to absorption

Profile shape sequence repetition

EW will mask shape, is there a way to encode profile ?

Be H-alpha line profiles

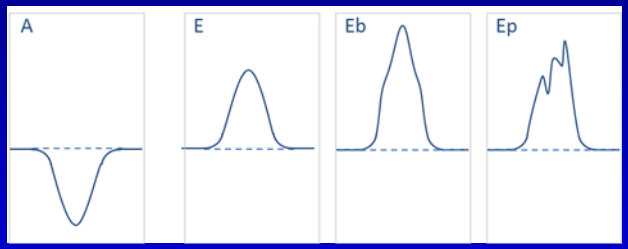


Be stars profile are dependant of the physics, of the orientation, of the dynamic of the system

Can we simply find a pure descriptive encoding ?

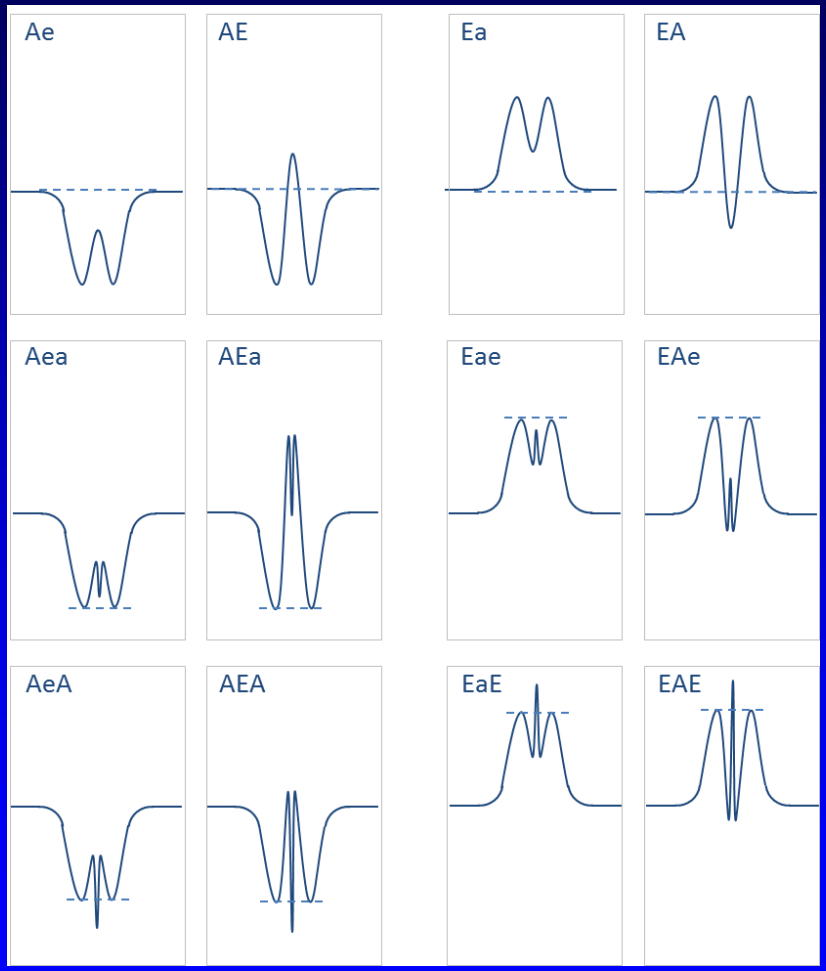
Be profile proposed encoding

The first letter A or E indicate if the first line is in absorption on in emission.
We can find some shape variations in emission profile



if there is a second line intricated it will have a similar code A or E.

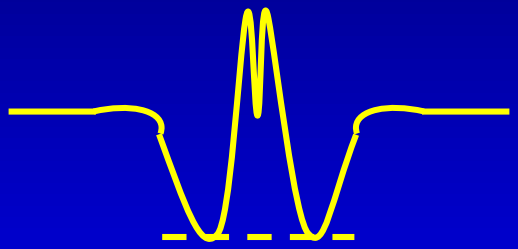
Encoding with Uppercase or Lowercase will depend of the relative strength or depth of the line regarding the base of the previsous line.

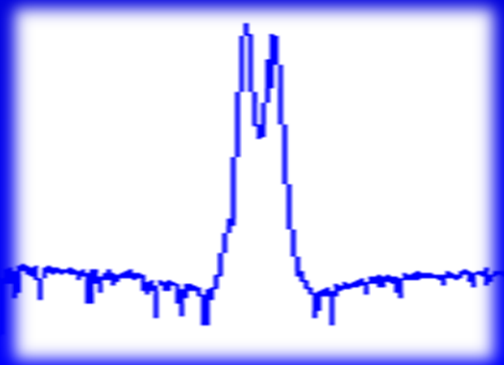


Profiling…

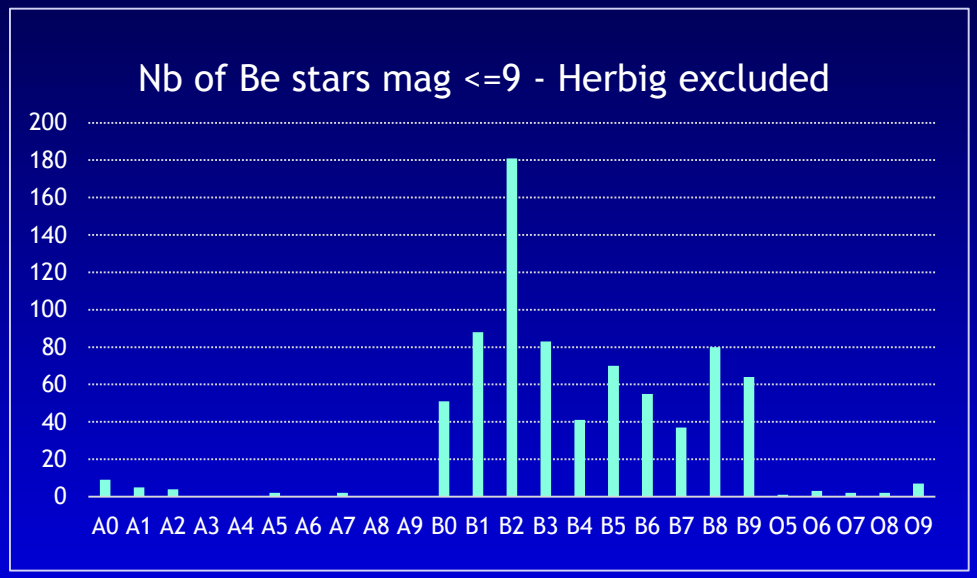
Etoile	HD	RA	DEC	Mag	Période	Profil	Variabilité
2 Cet	225132	+00 03 44.4	-17 20 09.6	4.54	365	Aea	Aea-Aea
10 Cas	144	+00 06 26.5	+64 11 46.2	5.57	365	AEa	
V742 Cas	698	+00 11 37.1	+58 12 42.6	7.08	365	Ep	
omi Cas	4180	+00 44 43.5	+48 17 03.7	4.48	365	E	
gam Cas	5394	+00 56 42.5	+60 43 00.3	2.47	30	Ep	Ep
V442 And	6226	+01 03 53.4	+47 38 32.3	6.82	7, 30	Ea	A-Ea-A-Ea
HD 6343	6343	+01 05 53.0	+65 58 15.8	7.26	365	AE	
phi And	6811	+01 09 30.1	+47 14 30.5	4.25	365	Ae	
V764 Cas	7636	+01 17 26.3	+57 37 55.5	6.89	365	Eb	
HD 9709	9709	+01 36 03.1	+47 06 52.1	7.07	365	AEa	
HD 9612	9612	+01 37 22.2	+74 18 03.4	6.59	365	AEa	
phi Per	10516	+01 43 39.6	+50 41 19.4	4.09	365	Ep	Ea, V/R
eps Cas	11415	+01 54 23.7	+63 40 12.4	3.34	365	A	
V777 Cas	11606	+01 55 42.9	+59 16 24.4	7.02	365	Ea	
V787 Cas	13590	+02 15 13.0	+64 01 28.0	7.9	365	Ea	Ea
tet Ari	14191	+02 18 07.5	+19 54 04.2	5.58	365	AeA	
HD 17505	17505	+02 51 08.0	+60 25 03.9	7.1	365	A	
HD 18552	18552	+03 00 11.9	+38 07 54.3	6.12	365	Ea	
V801 Cas	19243	+03 08 54.2	+62 23 04.5	6.5	365	Eb	
HD 20134	20134	+03 16 59.8	+60 04 03.0	7.47	90	A	A-Ae-AE-Aea-A
BK Cam	20336	+03 19 59.3	+65 39 08.3	4.73	365	Ea	
HD 21362	21362	+03 28 52.3	+49 50 54.2	5.58	365	AEa	A 2001, AEa 2008
HD 21455	21455	+03 29 26.3	+46 56 16.3	6.23	365	AEa	
HD 21650	21650	+03 31 15.7	+41 43 35.2	7.33	365	Ea	
HD 21620	21620	+03 31 29.3	+49 12 35.2	6.28	365	AeA	
HD 21641	21641	+03 31 33.1	+47 51 44.7	6.77	365	AEa	
psi Per	22192	+03 36 29.4	+48 11 33.5	4.31	365	Ea	V/R
CT Cam	22258	+03 38 01.0	+55 10 15.1	7.69	120	Ea	Ea
HD 22780	22780	+03 41 07.9	+37 34 48.7	5.54	90	AEa	Aea-AeA-A-AEa
13 Tau	23016	+03 42 18.9	+19 42 00.9	5.68	365	AeA	
ELECTRA	23302	+03 44 52.5	+24 06 48.0	3.71	120	AeA	Aea - AeA
MEROPE	23480	+03 46 19.6	+23 56 54.1	4.16	365	Aea	AEa -VR - A increase
ALCYONE	23630	+03 47 29.1	+24 06 18.5	2.87	365	AEa	
HD 23552	23552	+03 48 18.1	+50 44 12.4	6.15	365	AEa	
PLEIONE	23862	+03 49 11.2	+24 08 12.2	5.05	7, 30	EA	Ea-EA
HD 23800	23800	+03 50 25.1	+52 28 54.9	6.98	365	Ea	Ea & A
HD 24479	24479	+03 57 25.4	+63 04 20.1	4.95	365	AeA	AeA - VR - E central raie

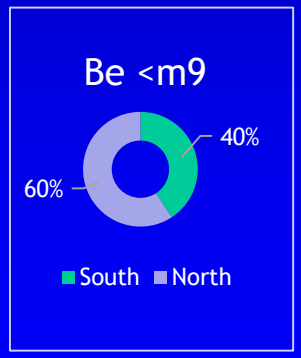
HD22780
Profil actuel
A…Ea

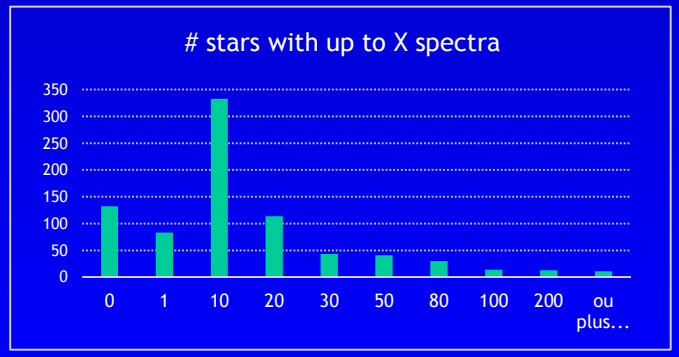




Population screened







837 Be stars mag <= 9

- 23 Herbig
- 807 Classique
- 7 classique or Herbig
- 137 has 0 spectra, all in South, except HBHA 3703-48
- 599 non herbig stars had 2 or more spectra

73% Be Stars has more than one spectra in BeSS

Informations recorded

Each star having exhibited noticeable variation of H-alpha line profile were logged, profile was encoded, informations on type of variability and Emission Event was recorded

Etoile	HD	RA	DEC	Mag	Period	Type	Typ	Variabilité	Emission event	EE1	EE2	EE3
EM Cep	208392	21 53 48.1	+62 36	7.03	365	Classique	B0.5Ve	A-AeA-A-AeA-A-AEa-A-AeA	A/AeA 2002 - AeA-A 2011 - EE A/AEA juil 2013	A/AeA	A/AeA	A/AEA
HD 208682	208682	21 55 31.0	+65 19	5.94	365	Classique	B2.5Ve	Ea-Aea-A	DE			
V2172 Cyg	235668	21 56 45.0	+51 34	8.17	365	Classique	B2e	Ea	V/R			
V439 Cep	209145	21 59 19.7	+60 17	7.67	120	Classique	B1Ve	AEA-A-AEA-A-AEA	EE Aout 2013 EE aout 2016	A/AEA	A/AEA	
omi Aqr	209409	22 03 18.8	-02 09	4.7	365	Classique	B7IVe	Ea-A-Ea-EA-Ea	Check 2002 A, 2010 tres faible E			
25 Peg	210129	22 07 50.3	+21 42	5.78	365	Classique	B7Vne	AE-Ep-Ea	Ea/Ea 2006-2008 - faire courbe EW	Ea/Ea		
V404 Lac	211835	22 19 00.2	+45 48	8.4	365	Classique	B3Ve	E-Ep-Ea	E/E jul 2007 - Ea/Ea Sept 2015 continue Oct 2016	E/E	Ea/Ea	
V357 Lac	212044	22 20 22.7	+51 51	6.98	120	Classique	B1Vnn	AEa-Ea-Ep	AEa/Ea depuis 2001 -max 2011 - EE aout 2016	AEa/Ea	Ea/Ea	
31 Peg	212076	22 21 31.1	+12 12	4.81	365	Classique	B2IVe	Eb	EE 1997-2001, 2005-2010, 2011, 2012, 2016 - check	Eb/Eb	Eb/Eb	Eb/Eb
HD 212666	212666	22 24 53.0	+52 07	8.49	365	Classique	B3e	A-Ea-AEa	EE 2013, 2015 croit	A/Ea	Ea/Ea	
V408 Lac	212791	22 25 41.8	+52 26	8.02	365	Classique	B4e	AE-E	AE/E nov 2010-2012	AE/E		
8 Lac B	214168	22 35 52.1	+39 37	6.48	365	Classique	B2Ve	Ae	raie A shape assym			
8 Lac A	214167	22 35 52.3	+39 38	5.73	120	Classique	B2Ve	Ea-Ep-AEa	EE 2002, V/R assym 2003-2014 - now DE			
HD 215227	215227	22 42 57.3	+44 43	8.81	365	Classique	B5ne	Ep	V/R			
HD 216057	216057	22 48 47.9	+54 24	6.13	365	Classique	B5Vne	AeA-Ae-AeA	AE/AeA 2011	Ae/AeA		
14 Lac	216200	22 50 21.8	+41 57	5.93	30	Classique	B3IVe	AEA-Ae-A-AEA-AeA-AEA-AeA-AEA-AeA-A-AEA-AeA	AeA ou A -AEA 2002,2007, 2009, 2012, 2013, 2014 ,	AeA/AEA	AeA/AEA	AeA/AEA
V423 Lac	216851	22 55 47.1	+43 33	7.97	365	Classique	B3Vne	Ea-Ep-Ea-Ep	Ea/Ep sept 2011, sept 2014, sept 2016 - assym V/R			
HD 217061	217061	22 56 42.6	+62 37	8.8	365	Classique	B1Vne	A-Ae-A-Ae	EE 2010, 2016	A/Ae	A/Ae	
EW Lac	217050	22 57 04.5	+48 41	5.42	365	Classique	B3IVne	EA-AEA	V/R puis DE 2012, voire almost no E 2017			
V378 And	217543	23 00 54.7	+38 42	6.56	365	Classique	B3Vpe	A-Ae-AEA-AeA-A-AEA-EA-Ea-EA-AEA	EE A/AEA 2007 - A/AEA sept 2010 - AEA/EA july	A/AEA	A/AEA	AEA/EA
omi And	217675	23 01 55.3	+42 19	3.63	90	Classique	B6IIIpe	A-AeA-AEA-A-AEA-A-AeA-A-AEA	AeA/AEa 1995 - AeA/AEa 2003 - AeA/AEa 2009 -	A/AeA	AeA/AEa	A/AEA
bet Psc	217891	23 03 52.6	+03 49	4.49	365	Classique	B6Ve	Eb	Check EW curve for change in E, EE 2007-2011	Eb/Eb		
CW Cep	218066	23 04 02.2	+63 23	7.67	120	Classique	B1Vve	AE-Ep-Ea-Ep	EE 2009-2012, oct 2016	AE/Ep	Ep/Ep	
KX And	218393	23 07 06.2	+50 11	7.02	365	Classique	Bpe	Ea-EA	V/R assym R peak max 2010, 2016	Ea/EA	EA/EA	
KY And	218674	23 09 16.7	+49 39	6.76	365	Classique	B3IVe	AEA-AEa-AEA-AEa	AEA/AEA 2009 - AEA/AEA 2014 - AEA/AEa 2016 -	AEA/AEA	AEA/AEA	AEA/AEa

Sequence encoded

EE dates

EE transition encoding

Out of the 599 stars, 389 has presented some level of variability

Ouburst definition

Outburst definition: new emission of matter from the star surface to the disk

- If the star is transitioning from Absorption to Emission the outburst is clear
- If the star is already in emission, if Emission was stable or decreasing previously this Emission Event can be qualify as Outburst
- From the informations recorded, at least we can count all stars which had at least one outburst

Outburst identification

- On 389 stars « profiled »… Filter was applied on the first Emission Event observed which is considered as outburst

Etoile	Type	Variabilité	Emission event	EE1	EE2	EE3	EE4	EE5
105 Tau	B2Ve	E-Ep-E	EW max en 2008, 2009, 2010 then slow increase in 2016	E/E	E/E	E/E	E/E	
11 Cam	B2.5Ve	Eb	EE max Ew in 2011, now DE	E/E				
12 Aur	B5e	Ea-Ep-Ea-Ep-Ea	Ep/E avr 2010, Ea/Ep sept 2015, Ep/E sept 2016	Ep/E	Ea/Ep	Ep/E		
12 Vul	B2.5Ve	AEa-AeA-AEa-AeA-AEa-AeA-A	EE 2005, 2011	AeA/AEa	AeA/AEa			
120 Tau	B2IVe	Eb-Ep-Ea	max EW nov 2010, EE nov 2015	Ep/Ep	Ea/Ea			
17 Sex	A1Ve	A-AeA	A/AeA jan 2009	A/AeA				
18 And	B9Ve	Aea	A en 2010 ?	A/Aea				
2 Ori	A1Vne	AeA-A-AeA	A-AeA 2010	A/AeA				
228 Eri	B2Vne	Ea-Ep-EA-Ep	V/R jan 2014 - E increase since 2013	Ea/Ep				
25 Ori	B1Vpe	Ea-Ep-Eb	Ea/Ep oct 2012, VR nov 2013	Ea/Ep	Ep/EP	Ep/Ep		
25 Peg	B7Vne	AE-Ep-Ea	Ea/Ea 2006-2008 - make EW curve	Ea/Ea				
25 Vul	B8IIIne	AEa-AEp-AEa-AEp	EE 2015	AEa/AEp				
27 CMa	B3IIIe	EA-Ea -EA	EA/Ea fev 2009, V/R	EA/Ea				
28 Cyg	B2.5Ve	AEa	DE steady up to 2011 - EE 2012-2014 then stable	AEa/AEa				
31 Peg	B2IVe	Eb	EE 1997-2001, 2005-2010, 2011, 2012, 2016 - check EW curve	Eb/Eb	Eb/Eb	Eb/Eb	Eb/Eb	Eb/Eb

This is just an extract for illustration

254 stars had one or more outburst

Population summary

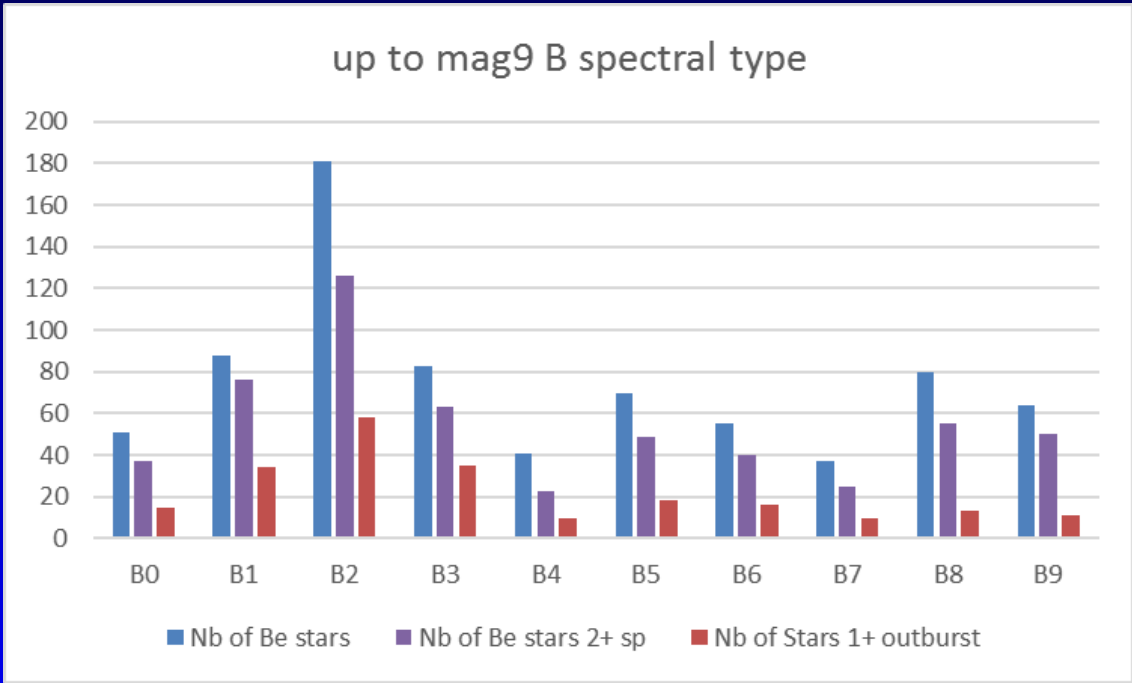
On a cohort of 814 patients having magnitude inferior or equal to 9, 599 had 2 or more spectra in BeSS. Out of these 599, 210 were not showing any variations symptoms

On the 399 remaining population, we excluded 134 patients with decreasing emission symptom, V/R variations, peculiar variations

254 patients had at least one ouburst

- 192 were classified as Emission to Emission outburst
- 62 were classified as Absorption to Emission outburst

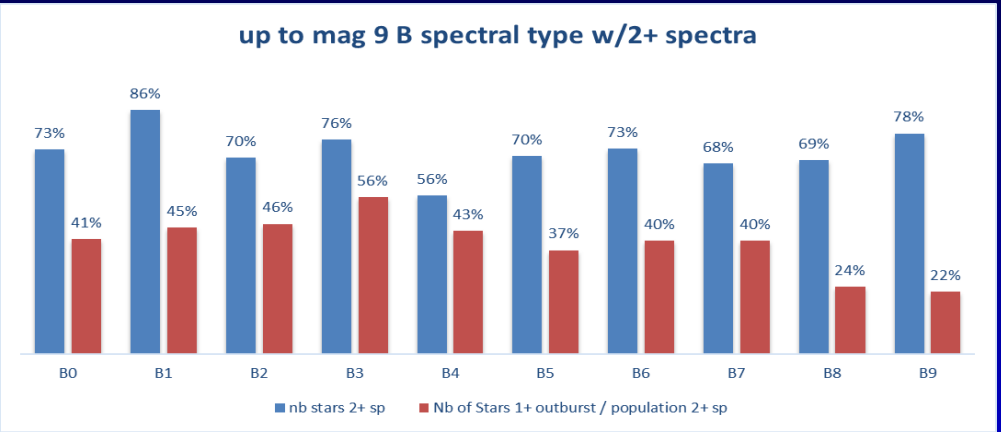
Spectral distribution – B type

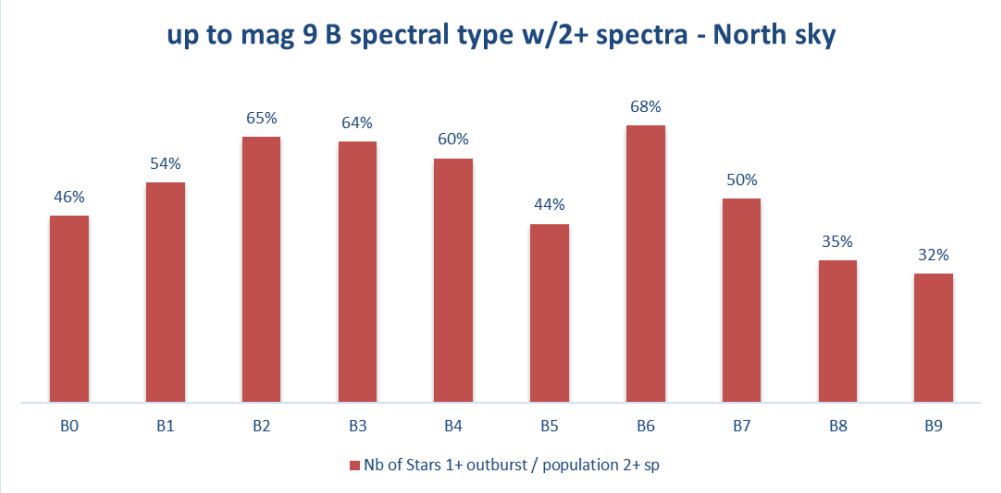


Number of Be Stars up to magnitude 9 having exhibited in BeSS at least one ourburst

Maximum for B2 stars

Ratio per temperature class





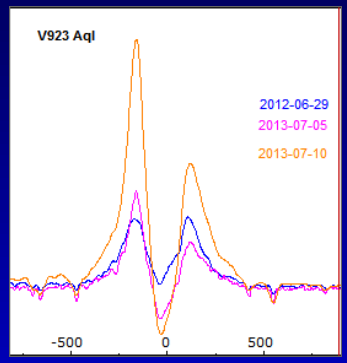
Proportion of Be stars by class of temperature

Data series in South hemisphere has a lower coverage so let's look at North set

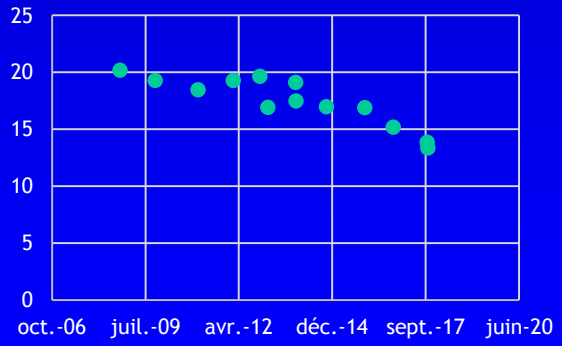
On the north hemisphere data set, compared to the number of Be star per class of temperature, the B6 class has the highest ratio… then B2, B3 and B4

Zoom on the B6 Class

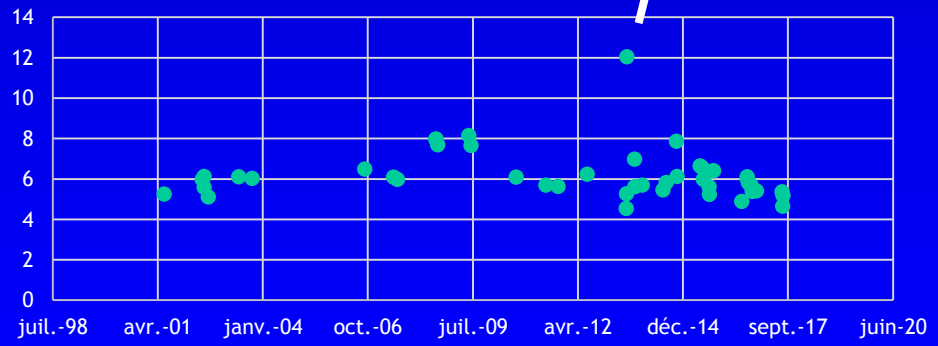
Etoile	Mag	TySp	Vsini	Nb Sp	Seq	EE
bet Psc	4.486	B6Ve	95	80	Eb	Eb/Eb
ELECTRA	3.705	B6IIIe	170	75	AeA-AEa-Aea	AeA/AEa
HD 181709	8.77	B6IIIe	249	5	Ea-Ep	Ea/Ep
HD 197434	8.01	B6e	220	5	EA-Ea	EA/Ea
HD 201836	6.492	B6IVe	120	13	AEa-AEp-AEa-AEp-AEa	AEa/AEp
HD 21362	5.578	B6Vne	385	26	A-AEa	A/Aea
HD 21650	7.33	B6e	230	11	Ea	Ea/Ea
HD 224544	6.524	B6IVe	260	24	A-AEa	A/AEa
HD 37115	7.16	B6Ve		9	Ea	Ea/Ea
HD 37330	7.38	B6Ve		9	Ea	Ea/Ea
HD 44996	6.12	B6.5Ve	38	10	AEa-AEp-Ea-Ep-AEa	Ea/Ep
iot Lyr	5.249	B6IVe	310	54	A-AeA-AEA-AeA-A	A/AEA
MEROPE	4.164	B6IVe	240	77	Ea-AEa- AeA	Ea/Ea
omi And	3.633	B6IIIpe	260	101	A-AeA-AEA-A-AEA-A-AeA-A-AEA	A/AeA
tet CrB	4.153	B6Vnne	340	115	A-AeA-A	A/AeA
V3903 Sgr	7.36	B6IIIe		6	Ae[V]-A-Ae[V]-A-Ae[V]	A/Ae
V923 Aql	6.089	B6she	275	46	EA	EA/EA



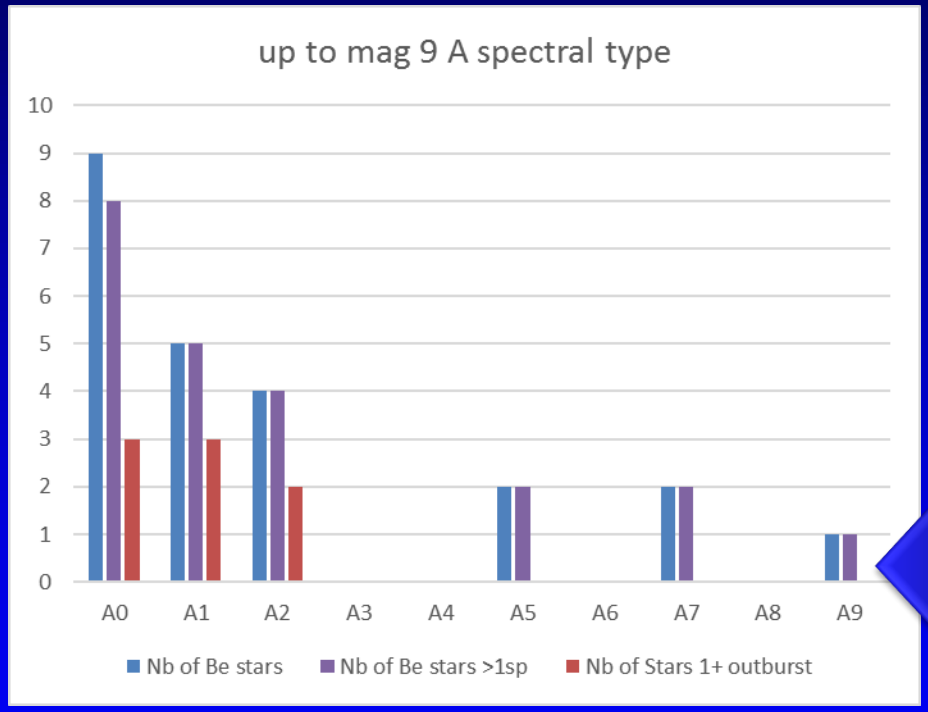
-EW HD 21650

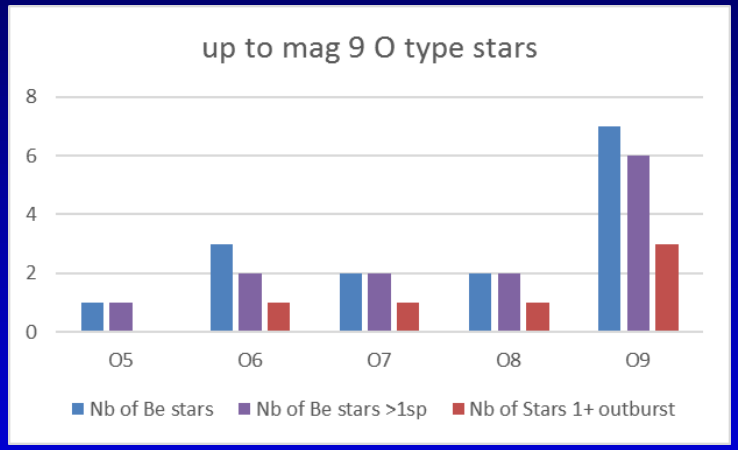


-EW V923 Aql



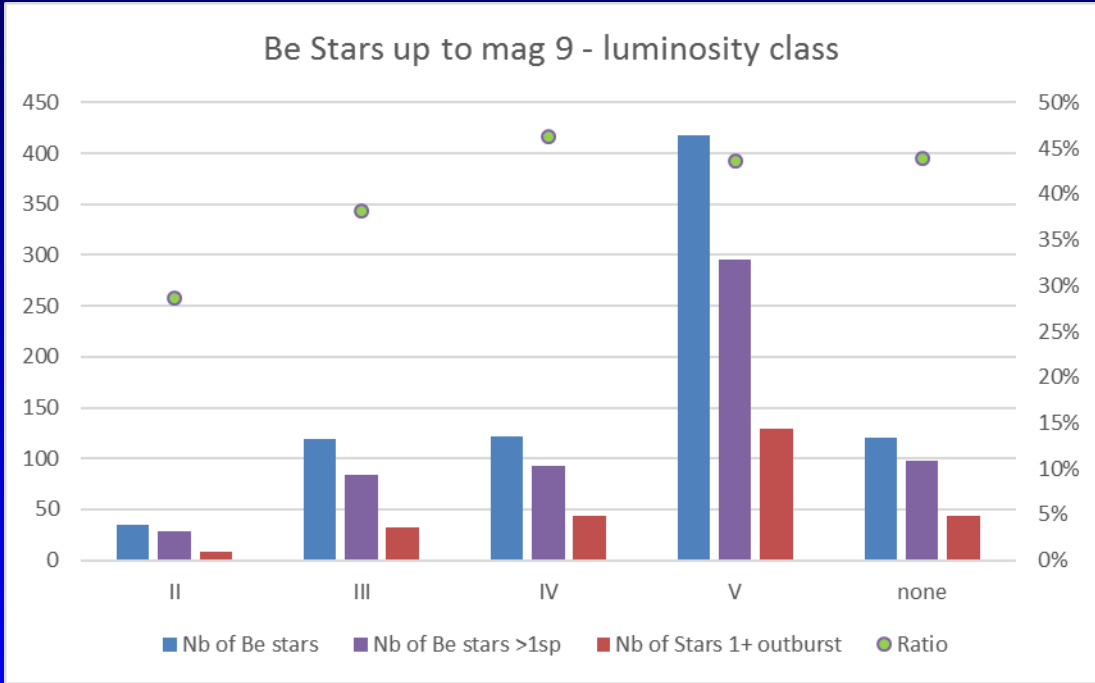
A and O stars



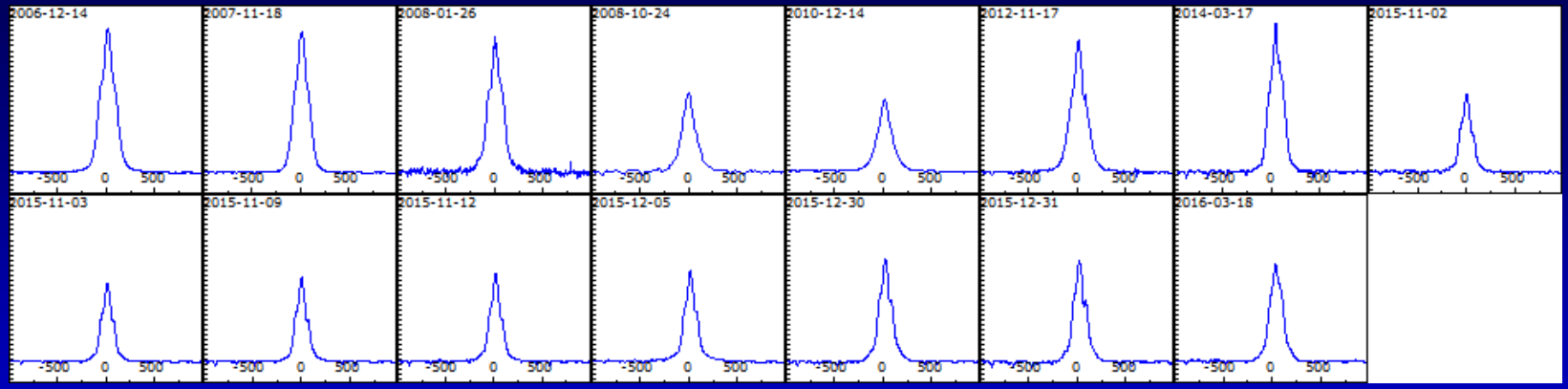


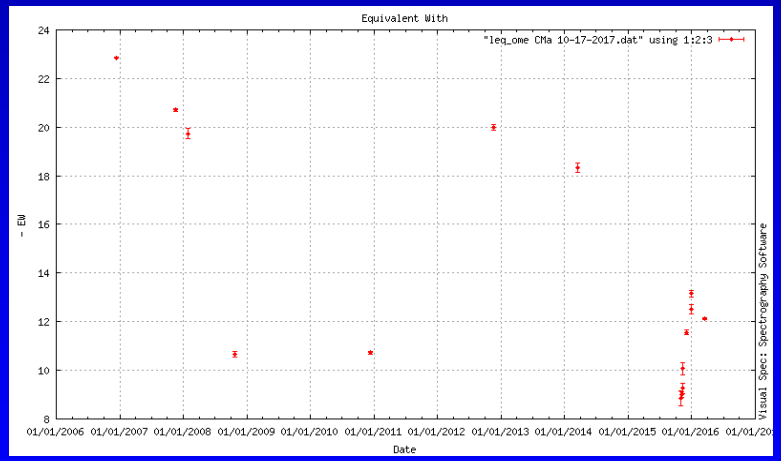
No outburst observed for A5, A7 and A9

Luminosity class



Emission to Emission outburst

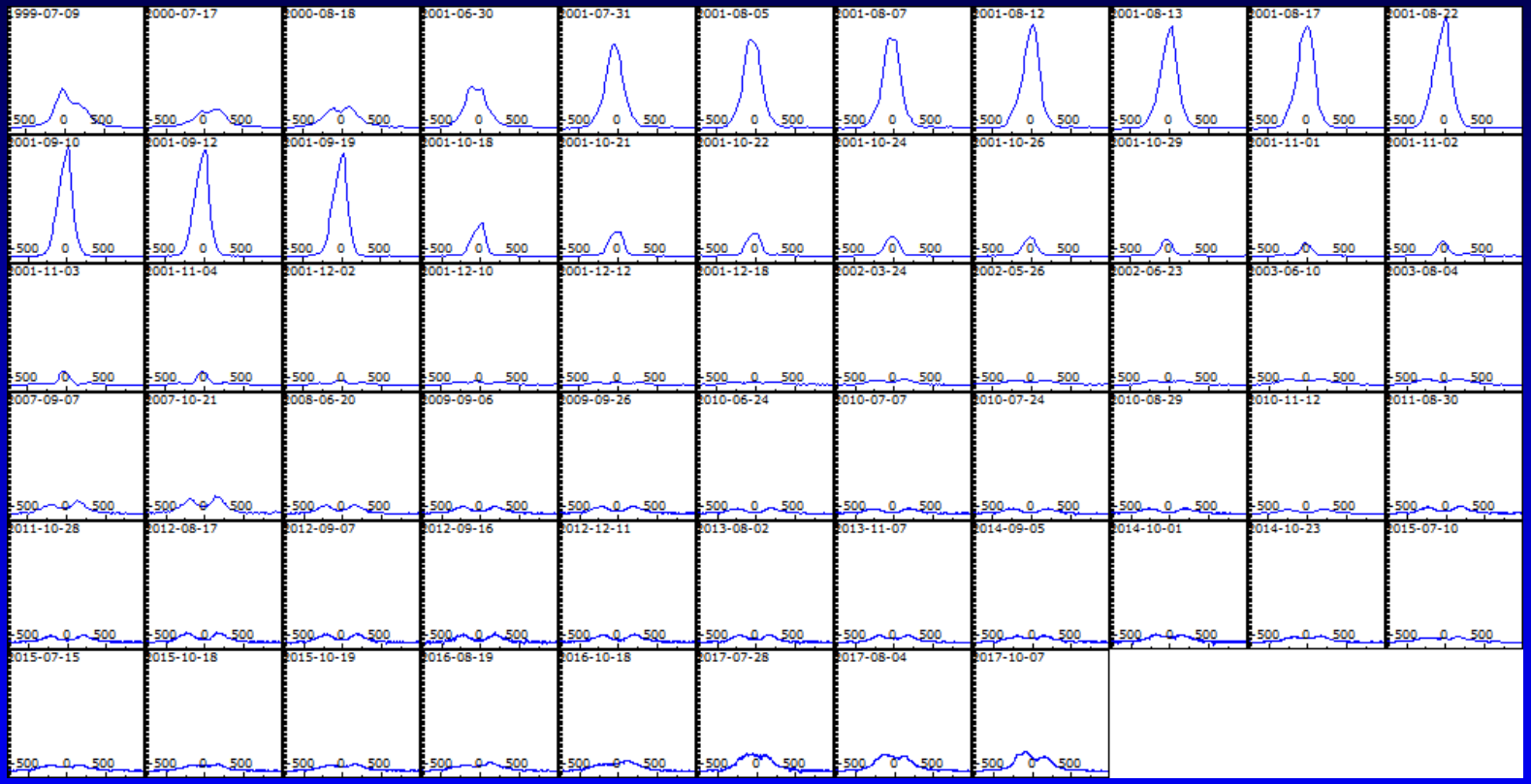




Emission event	#	Outburst	EE1	EE2
EE 2012, 2015	2		Eb/Eb	Eb/Eb

ome CMa
2 outbursts

Rapid outburst – HD 206773



Strong outburst from 30th June to 19th sept 2001

Outburst « remarquable »

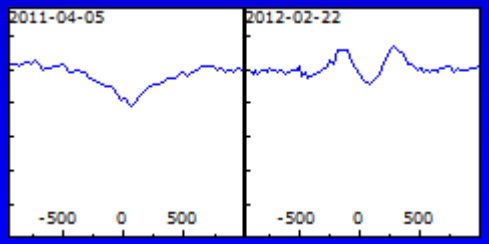
I called « Remarquable » an outburst which start from an absorption or quasi absorption to emission above continuum

They would correspond to a transition code of:

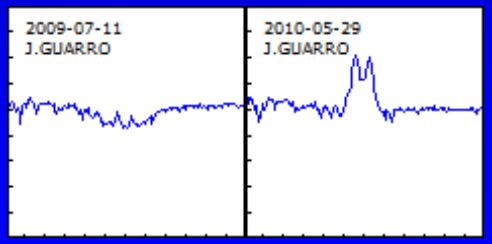
A [e] / [x] E [x]

[] indicates optional, x means a or A

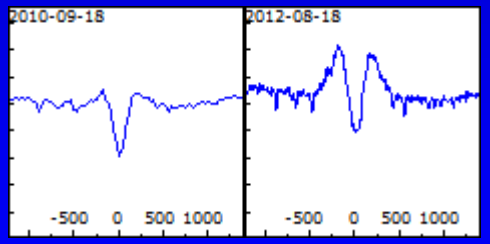
A/EA



Aea/AEa



AeA/EA



Outburst « remarquable » list

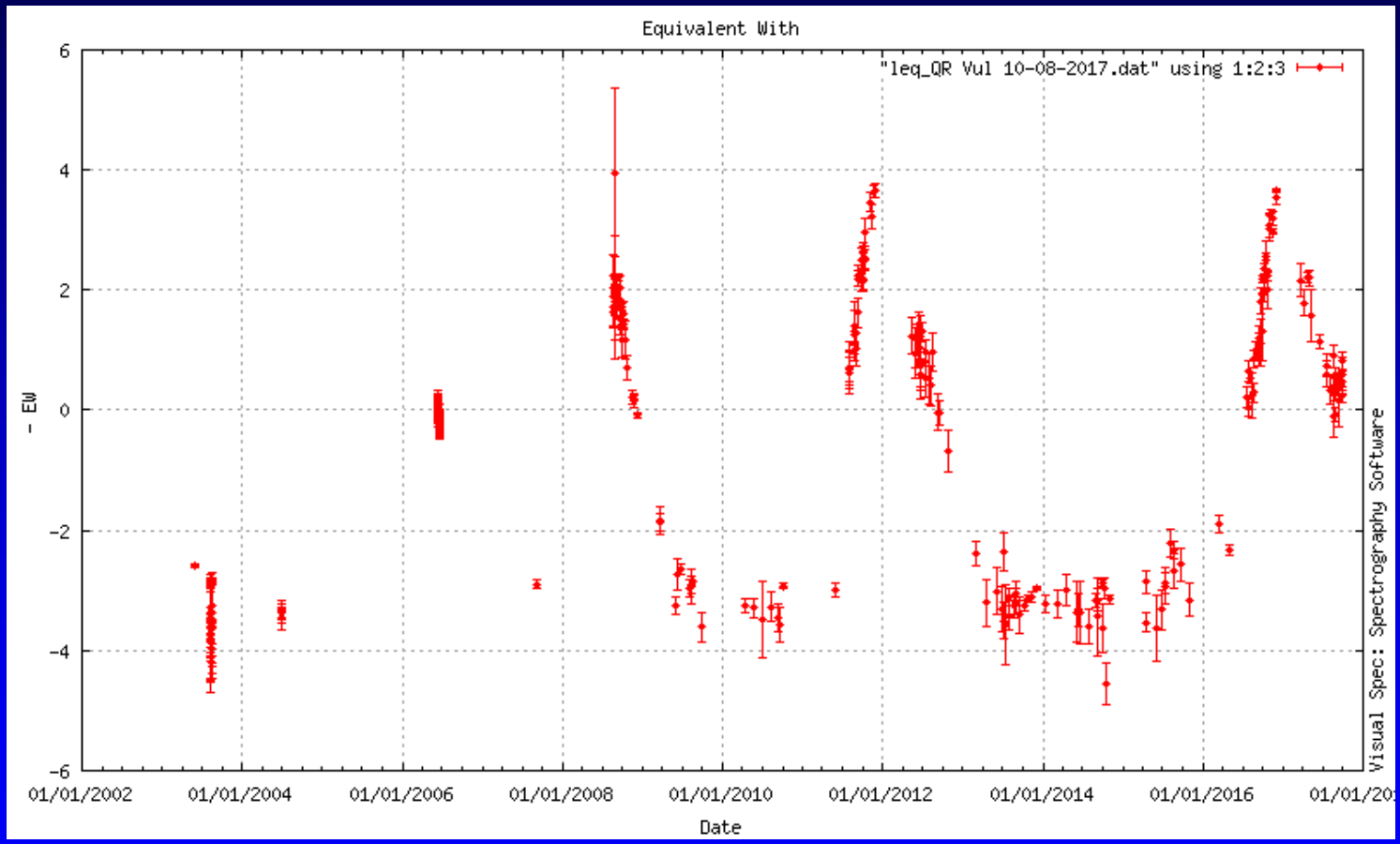
HD 2789	HD 49787	QR Vul
V442 And	V749 Mon	HD 194779
HD 20134	HD 57682	lam Cyg
HD 21362	OT Gem	V2136 Cyg
CT Cam	HD 71072	60 Cyg
HD 22780	NR Vel	V2148 Cyg
ELECTRA	zet Oph	V421 Cep
Menkhib	HD 167375	V2163 Cyg
RW Tau	NW Ser	ALFIRK
V1153 Tau	HD 168957	V2163 Cyg
V413 Aur	V532 Lyr	EM Cep
lam Eri	HD 171754	V439 Cep
V1369 Ori	HD 171780	HD 212666
V1371 Tau	HD 176630	14 Lac
HD 37149	HD 177648	V378 And
V438 Aur	iot Lyr	omi And
HD 42406	V1448 Aql	V813 Cas
69 Ori	V341 Sge	HD 224544
bet Mon A	12 Vul	HD 237056
HP CMa	V396 Vul	HD 237091
V739 Mon	HD 189689	

62 objects has exhibited a transition of type Absorption to significant Emission

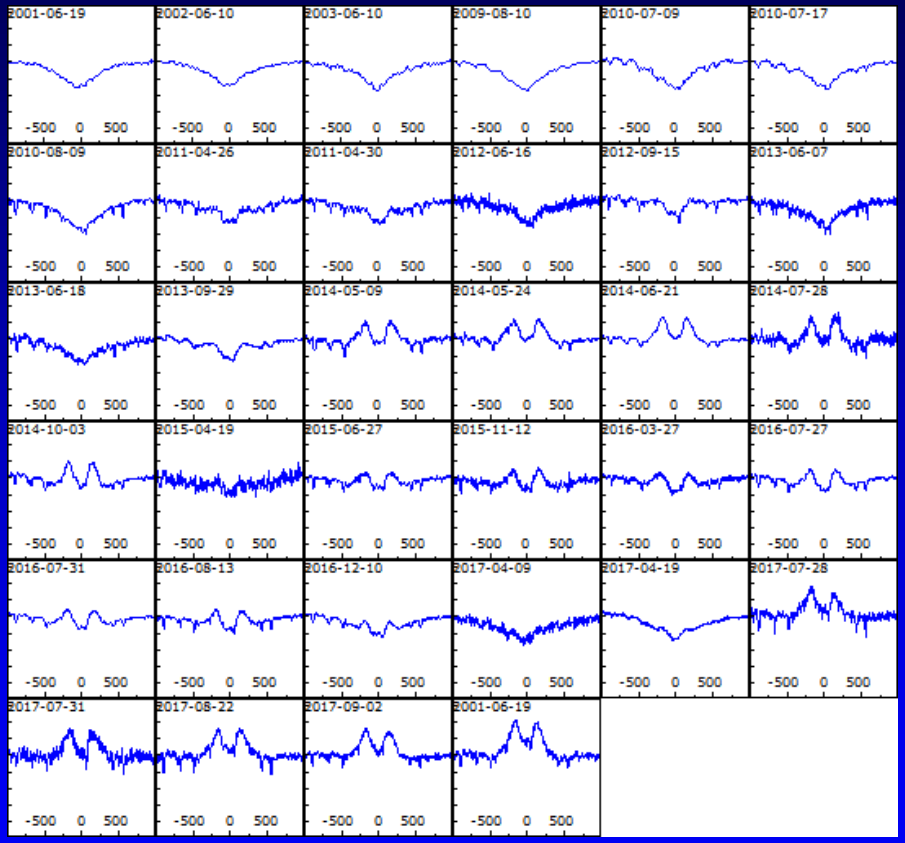
QR Vul, HD22780, V442 and, V341 Sge, known « outburst » star are correctly captured with the defined criteria

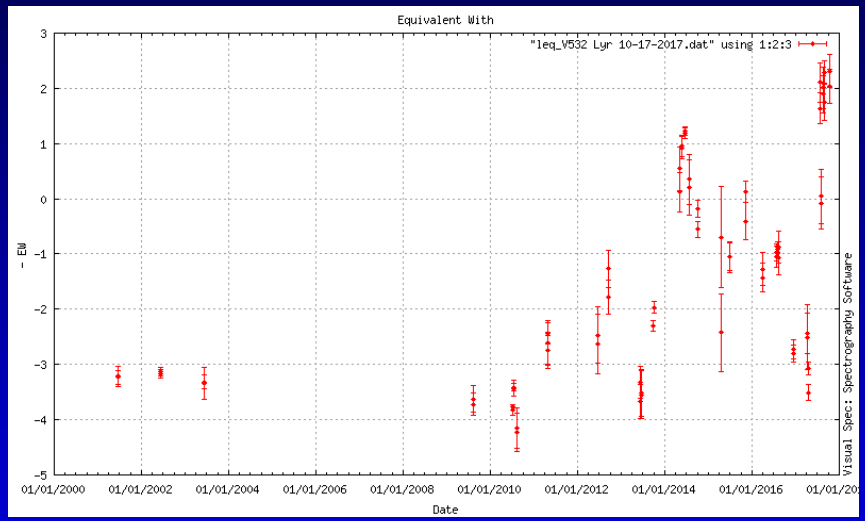
40 had more than one outburst

QR Vul - EW curve



V532 Lyr



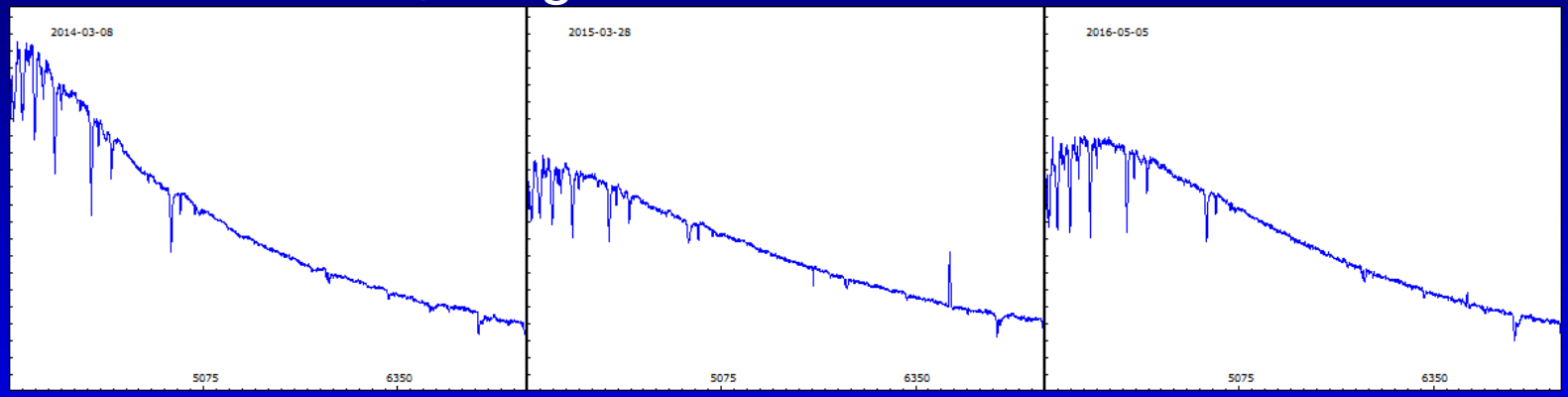


V532 Lyr - B4Ve

4 outburst: 2001, 2012, 2014, 2017

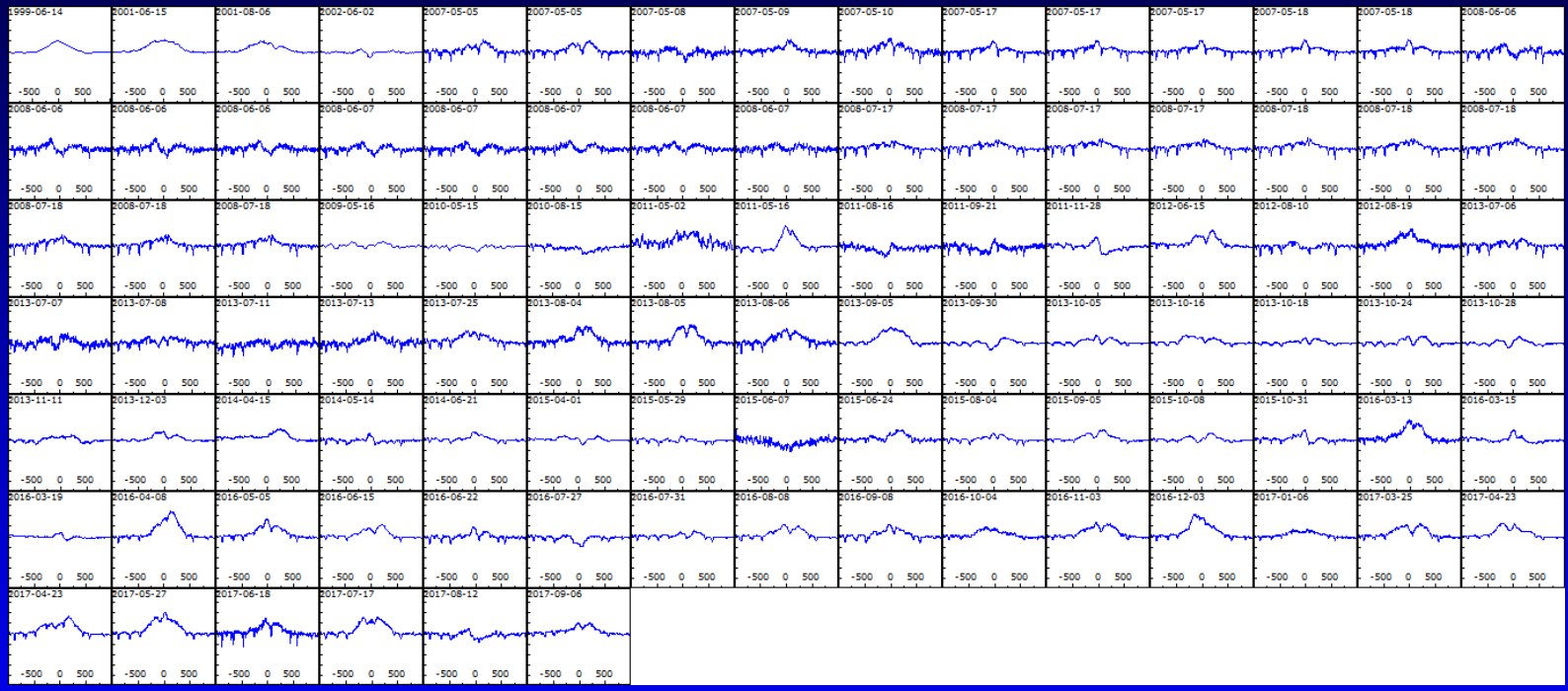
Low resolution outburst detection

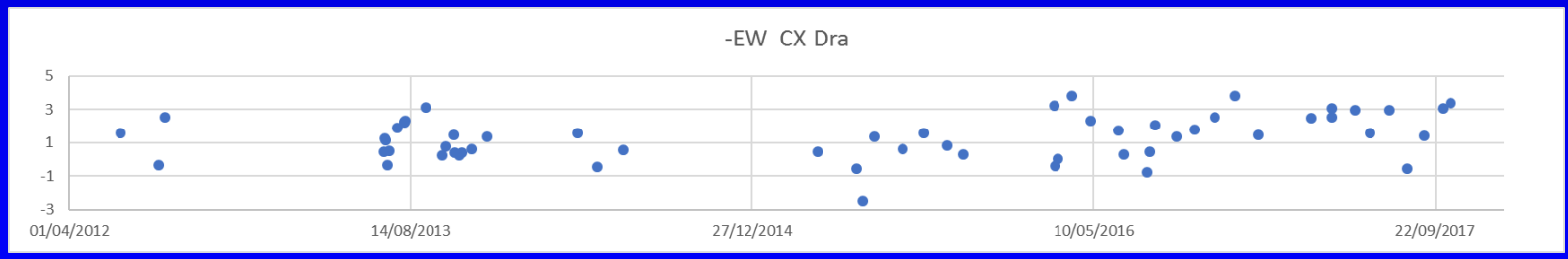
NR Vel - B2Ve, mag 7.67



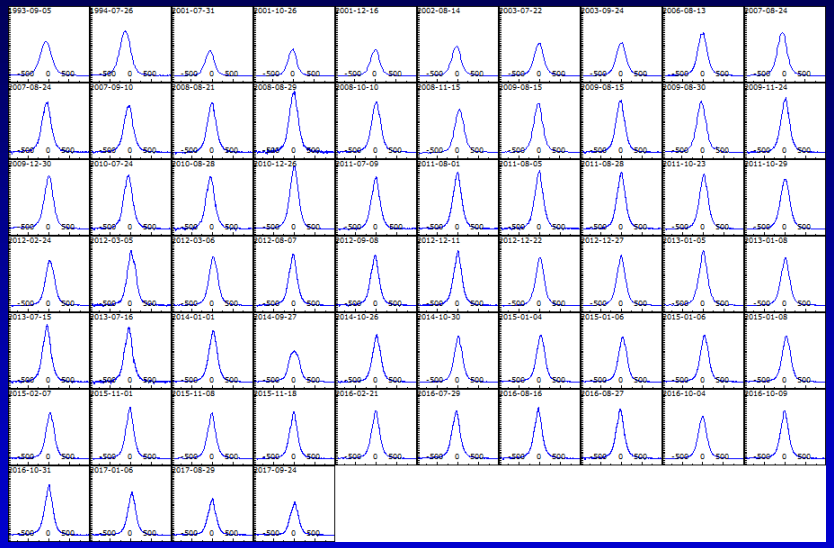
T.Bolhsen

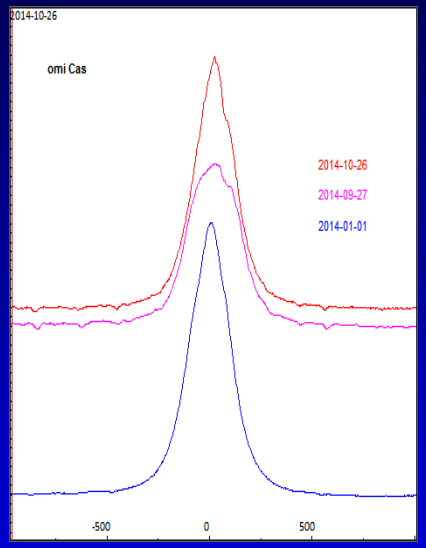
CX Dra - peculiar





How do we count outburst ?

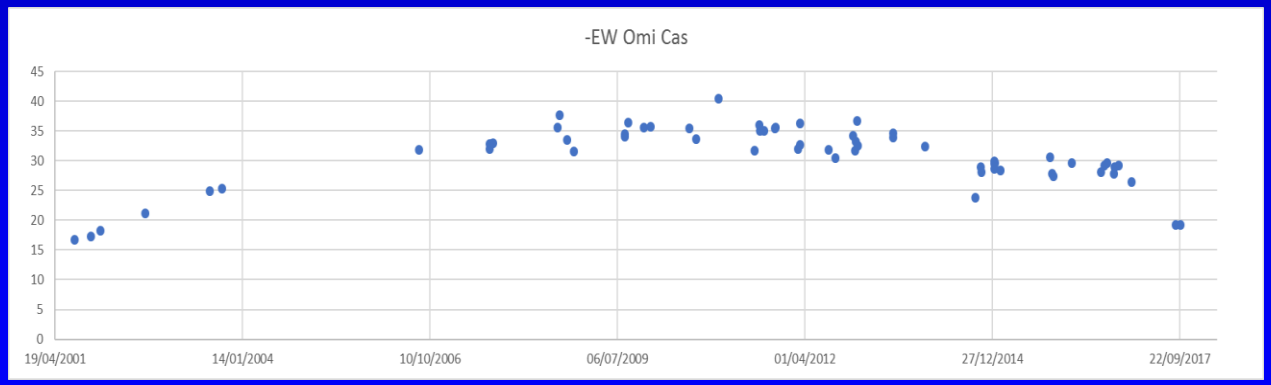




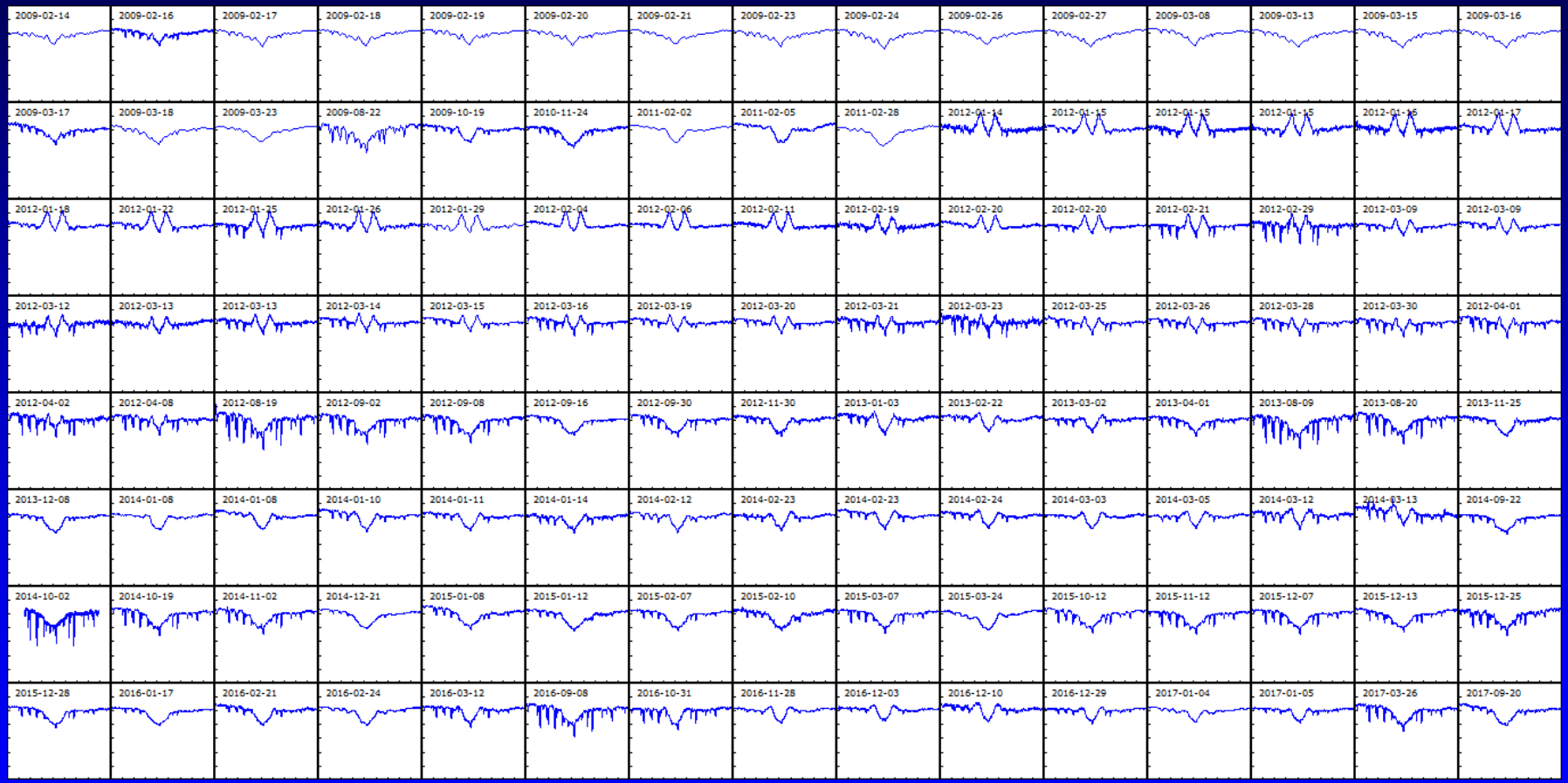
omi Cas - B5IIIe

How do we count outburst ?

Short EE ?

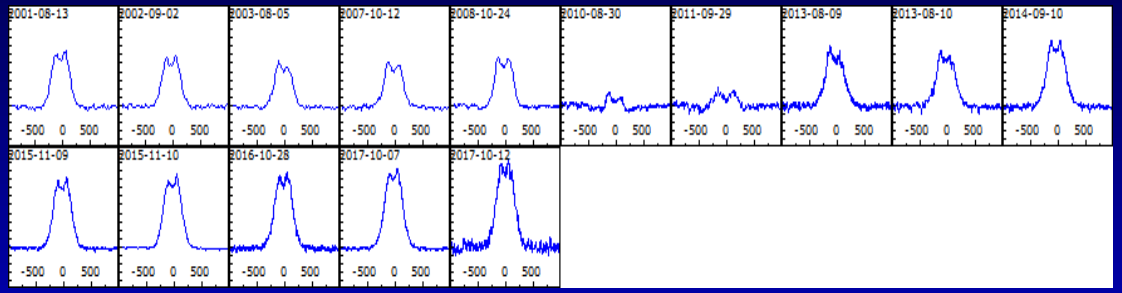


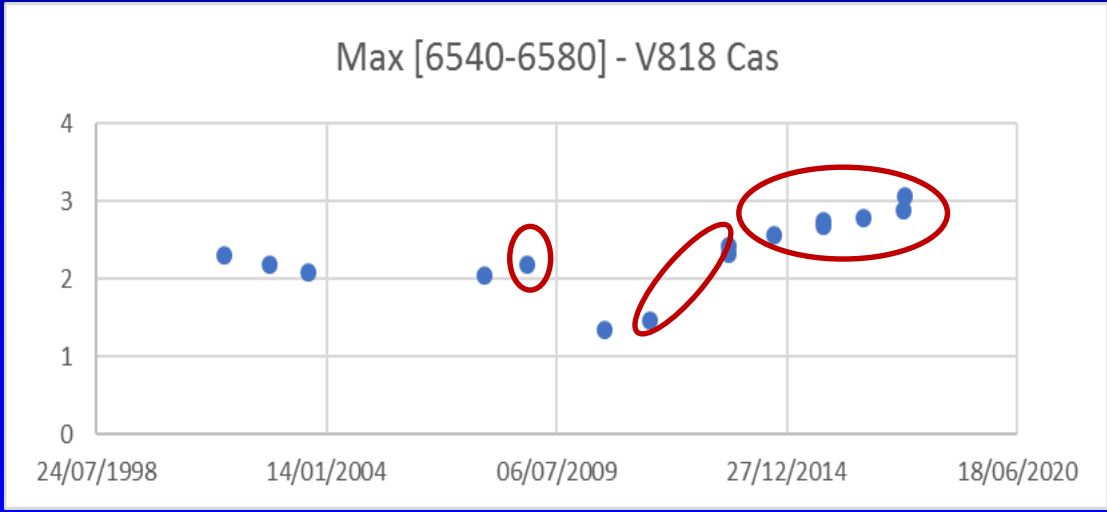
Lam Eri



How many outburst do we have here ? seven ?

Counting Outburst by star





For 130 E/E stars…

Compute Imax/Ic [6540-6580] ang for each scaled profile

Store in .dat file

Detect maximum and start of growth

Threshold set at 3%

Record all EE with date in texte file

Max Algorithm can work only on E/E outburst

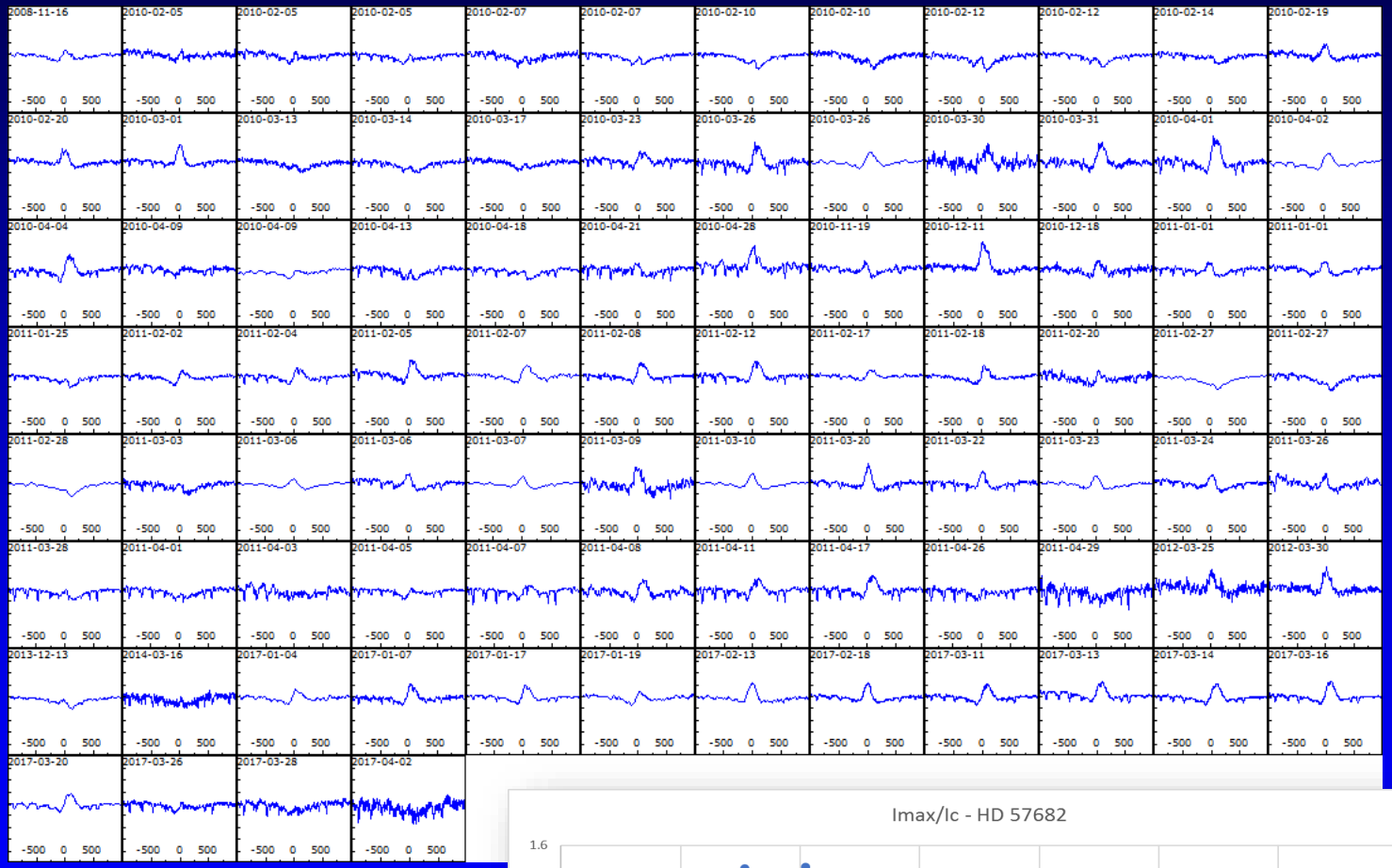
"V818 Cas" EE:**24-10-2008** EE:**29-9-2011/9-8-2013** EE:**10-9-2014/12-10-2017**

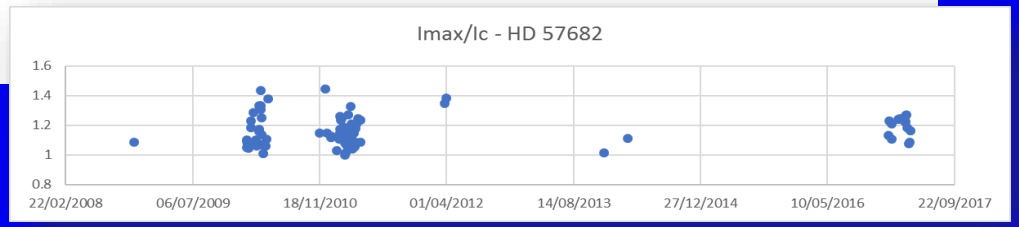
Counting outburst by star

25 Peg	7	EE:19-9-2006/23-8-2007	EE:13-10-2007/19-10-2007	EE:4-7-2008/2-8-2011	EE:30-6-2012/26-7-2012	EE:27-9-2012/5-10-2012
25 Vul	10	EE:1-6-2002/28-5-2004	EE:24-6-2009	EE:18-7-2010	EE:14-6-2011	EE:28-5-2012/28-6-2012
27 CMa	1	EE:18-11-2007/16-2-2009				
28 Cyg	23	EE:5-6-2001/31-5-2002	EE:19-10-2007	EE:9-8-2008/13-6-2009	EE:6-6-2010/13-8-2010	EE:3-8-2011
31 Peg	20	EE:16-6-1997/22-12-2001	EE:3-12-2005	EE:3-12-2005/3-12-2005	EE:3-12-2005/3-12-2005	EE:12-10-2007/5-8-2008
48 Lib	21	EE:11-2-2002/24-3-2002	EE:19-4-2003/7-7-2003	EE:2-3-2004/9-4-2007	EE:27-2-2010	EE:14-4-2010/25-4-2010
6 Cep	10	EE:23-6-2002/19-8-2003	EE:19-8-2003/19-8-2003	EE:19-8-2003	EE:26-8-2007/12-9-2007	EE:17-8-2009
8 Lac A	8	EE:21-12-2001/8-7-2002	EE:9-8-2006/21-7-2008	EE:12-10-2009	EE:13-9-2010	EE:29-8-2011
AX Mon	6	EE:17-3-2009	EE:21-2-2012	EE:29-11-2013	EE:13-3-2014/17-3-2014	EE:18-2-2015/19-2-2016
bet Psc	23	EE:25-7-1995/2-9-1996	EE:20-12-2001	EE:30-11-2002/2-12-2002	EE:30-11-2004	EE:25-8-2007
BN Gem	5	EE:15-1-2009	EE:28-4-2010	EE:17-3-2012/2-4-2013	EE:12-3-2015/10-4-2016	EE:18-2-2017/27-3-2017
chi Oph	18	EE:22-5-2003/13-3-2007	EE:14-7-2007	EE:12-5-2008/5-6-2008	EE:3-7-2008	EE:23-6-2010/4-7-2010
CW Cep	4	EE:12-8-2007/9-9-2009	EE:20-9-2012	EE:10-8-2015	EE:11-10-2016	
eps Cap	6	EE:8-7-2002	EE:18-7-2008/30-8-2008	EE:30-7-2011/27-8-2011	EE:14-7-2013	EE:29-10-2014/4-8-2015
eps Cap	6	EE:8-7-2002	EE:18-7-2008/30-8-2008	EE:30-7-2011/27-8-2011	EE:14-7-2013	EE:29-10-2014/4-8-2015
FR CMa	4	EE:27-2-2009	EE:27-2-2012/11-2-2013	EE:27-9-2014	EE:6-1-2017/20-1-2017	
FS CMa	15	EE:30-10-2009/24-1-2011	EE:6-1-2012/24-2-2012	EE:28-11-2013/2-12-2013	EE:9-12-2013/15-12-2013	EE:29-12-2013/2-1-2014

File extract – only partial data are shown

HD57682


2008-11-16
2010-02-05
2010-02-05
2010-02-05
2010-02-07
2010-02-07
2010-02-10
2010-02-10
2010-02-12
2010-02-12
2010-02-14
2010-02-19
2010-02-20
2010-03-01
2010-03-13
2010-03-14
2010-03-17
2010-03-23
2010-03-26
2010-03-26
2010-03-30
2010-03-31
2010-04-01
2010-04-02
2010-04-04
2010-04-09
2010-04-09
2010-04-13
2010-04-18
2010-04-21
2010-04-28
2010-11-19
2010-12-11
2010-12-18
2011-01-01
2011-01-01
2011-01-25
2011-02-02
2011-02-04
2011-02-05
2011-02-07
2011-02-08
2011-02-12
2011-02-17
2011-02-18
2011-02-20
2011-02-27
2011-02-27
2011-02-28
2011-03-03
2011-03-06
2011-03-06
2011-03-07
2011-03-09
2011-03-10
2011-03-20
2011-03-22
2011-03-23
2011-03-24
2011-03-26
2011-03-28
2011-04-01
2011-04-03
2011-04-05
2011-04-07
2011-04-08
2011-04-11
2011-04-17
2011-04-26
2011-04-29
2012-03-25
2012-03-30
2013-12-13
2014-03-16
2017-01-04
2017-01-07
2017-01-17
2017-01-19
2017-02-13
2017-02-18
2017-03-11
2017-03-13
2017-03-14
2017-03-16
2017-03-20
2017-03-26
2017-03-28
2017-04-02
-500 0 500


Imax/Ic - HD 57682
1.6
1.4
1.2
1
0.8
22/02/2008
06/07/2009
18/11/2010
01/04/2012
14/08/2013
27/12/2014
10/05/2016
22/09/2017

Distribution per spectral type

For these 130 E/E stars…

# outburst/Be	A0	A1	A2	Ap	B0	B1	B2	B3	B4	B5	B6	B7	B8	B9	Be	Bp	O8	O9	Oe	Total
1	1				6	6	12	5	1	4	3	2	3	1	2				1	47
2				1		3	4	3		2	3			2	1					19
3	1	1	1			2	4	1	1	1			3	1				1		17
4						3	2	2		1		1	1	1						11
5						2	3			2		1				1	1			10
6			1				1	2	1					1						6
7					1	1						1				1				4
8							2	1												3
10								1					1							2
11						1														1
12					1															1
14													1							1
15											1					1				2
18							1													1
20							1													1
21													1							1
23							2				1									3
	2	**1**	**2**	**1**	**8**	**18**	**32**	**15**	**3**	**10**	**8**	**5**	**10**	**6**	**3**	**3**	**1**	**1**	**1**	**130**

Etoile	Nb out	Type
25 Vul	10	B8IIIne
28 Cyg	23	B2.5Ve
31 Peg	20	B2IVe
48 Lib	21	B8IIe
6 Cep	10	B3IVe
bet Psc	23	B6Ve
chi Oph	18	B2Vne
FS CMa	15	Bpshe
FY CMa	11	B1IIe
HD 206773	12	B0Vpe
ome Ori	23	B2IIIe
V923 Aql	15	B6she
zet Crv	14	B8Ve

Star above 10 outburst… check threshold and quality, impact of resolution…

Distribution outburst All type

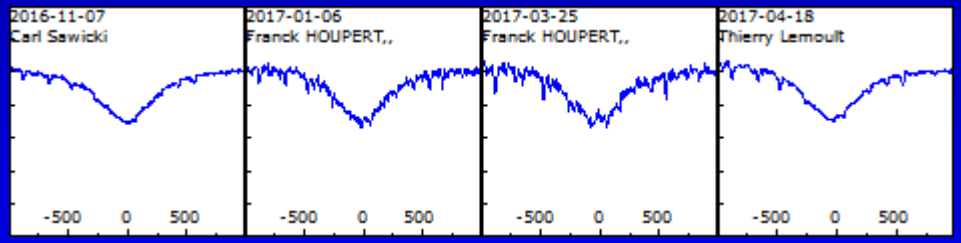
If we include the outburst visually counted from Ax/AEx

# outburst/Be	A0	A1	A2	Ap	B0	B1	B2	B3	B4	B5	B6	B7	B8	B9	Be	Bp	O6	O7	O8	O9	Oe	Total
1	2	1			11	11	25	13	5	7	6	6	4	5	2		1	1		1	1	102
2				1	2	9	13	8		3	7	1	4	4	1							53
3	1	1	1		1	4	7	3	2	2	1		3	1						1		28
4						5	6	3		3		1	1	1								20
5						3	5	2	2	2		1				1			1			17
6			1				2	3	1	1				1						1		10
7					2	1					1	1				1						6
8							2	2														4
9							1															1
10								1					1									2
11						1																1
12					1																	1
14													1									1
15											1					1						2
18							1															1
20							1															1
21													1									1
23							2				1											3
	3	**2**	**2**	**1**	**17**	**34**	**65**	**35**	**10**	**18**	**17**	**10**	**15**	**12**	**3**	**3**	**1**	**1**	**1**	**3**	**1**	**254**

This is preliminary

So how to count outburst ?

Transition Ax to xEx are clear, visual today
E/E can be detected from Imax/Ic curve
For low emission in absorption, is EW reliable ?



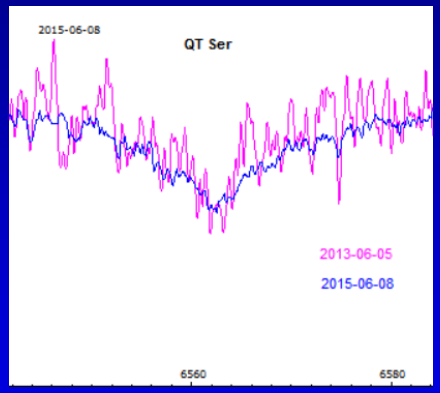
Of course, outburst can be missed if not observed…

Stability among Be stars

All the Be star up to mag 9 has been « encoded »

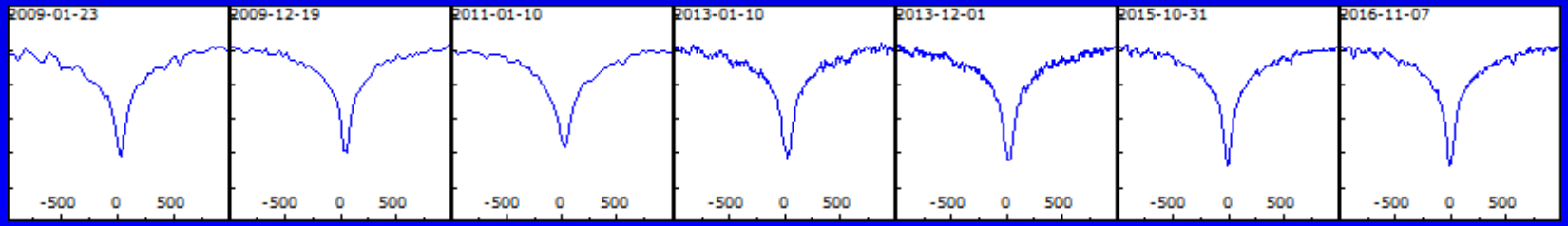
List of Be Stars in absorption with no apparent detected variations

Etoile	RA	DEC	Mag	TySp	Vsini	Nb Sp	Code
BD+36 4145	20 36 18.21	37 25 02.82	8.96	O9Ve		3	A
HD 193516	20 19 07.50	37 46 09.83	8.6	B2IIIe		4	A
HD 19993	03 14 01.36	37 40 26.04	8.26	A7.5IIe		10	A
HD 216044	22 48 43.28	55 07 33.76	8.52	B0IIe		6	A
HD 232590	02 03 48.89	55 07 14.50	8.62	B1.5IIIe		8	A
HD 339483	20 04 00.75	26 16 16.76	8.98	B1IIIe		2	A
HD 4931	00 52 15.45	60 05 23.81	8.72	B8Ve		9	A
HD 7720	01 18 27.09	61 53 34.49	8.86	B5IIe		9	A
QT Ser	18 31 04.45	04 37 37.04	7.73	B5e	295	6	A
V1443 Aql	19 08 25.17	09 08 00.77	8.93	B3Ve	99	5	A
V3508 Sgr	18 31 24.21	-19 09 31.03	7.95	B5IIIe		5	A
V372 Sge	20 09 39.59	21 04 43.62	8.34	B0.5IIIe		4	A



Noise or real change ?

HD 19993



How to improve the follow up?

ArasBeAM is the call for action tool for amateur

- Increase the coverage of stars with 0 or 1 spectrum
- Focus on stars up to mag 7, 9…
- Adjust the period to focus on some class of stars
- Add an indicator of ouburst « approaching » based on EW, Min/max – or « had outburst »

Summary of discussion

Notes taken after presentation delivery on 24th Oct 2017

- Early type star shall have more outburst and shorter outburst than late type star… if pulstations mechanism is the root cause, so needed to test the theory
- Need to compute the outburst frequency
- But, then too many stars with not enought spectra

Continue !

BeSS

L'imagination en action ©