Introduction sur les Binaires à Eclipse

Laurent Corp

ANDROMÈDE 4A
Association Aveyronnaise d'Astronomie Amateur

Variable Star Section
BAA
British Astronomical Association

THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS
FOUNDED 1911

SOCIÉTÉ ASTRONOMIQUE DE FRANCE
COMMISSION DES ÉTOILES DOUBLES

GEOS
Groupe Européen d'Observation Stellaire

Sommaire

Généralités et rappels

Méthodologie et contributions

Ressources et questions

Etat des lieux

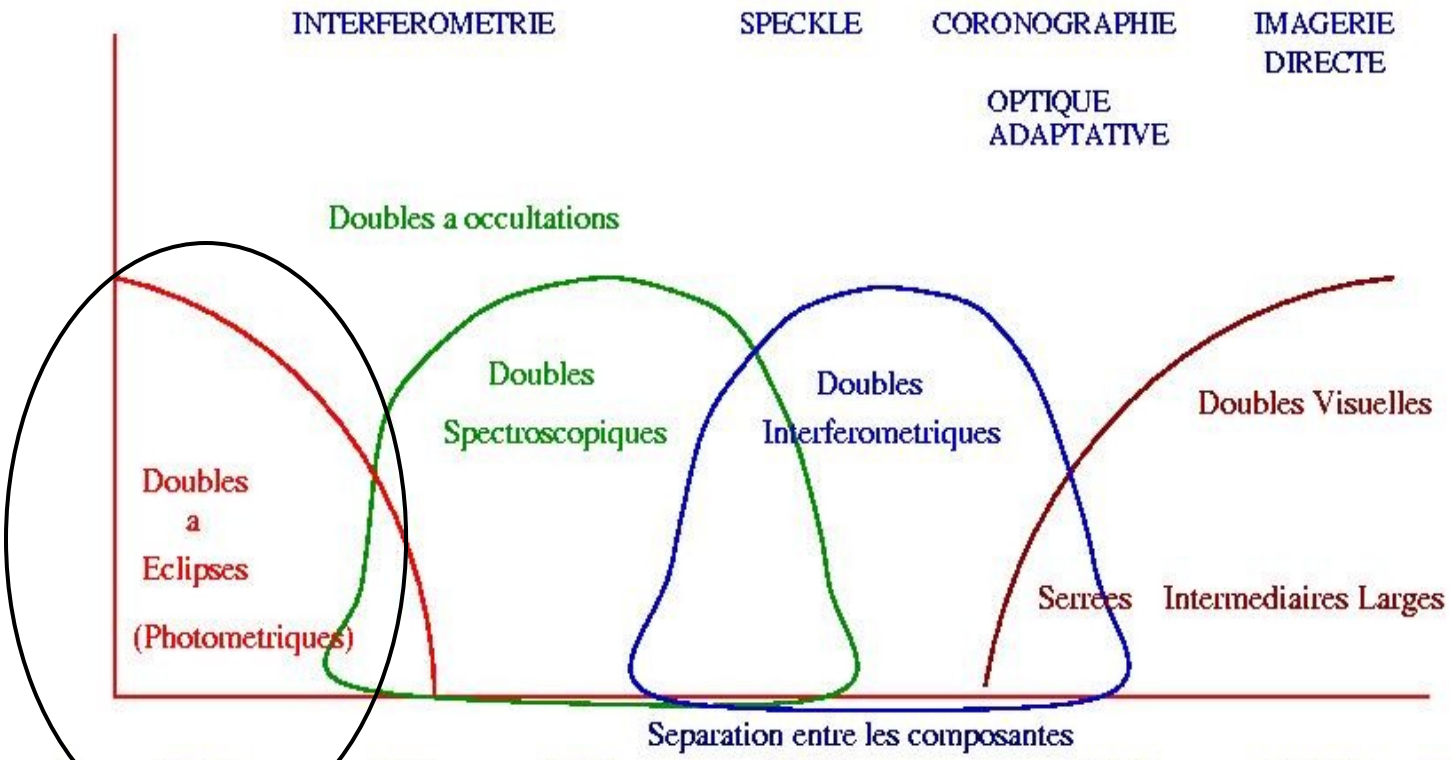
- Moins de 100 observateurs irréguliers et 8000 étoiles à surveiller
- Exoplanètes : plus de 800 observateurs pour beaucoup moins d'étoiles à mesurer (2000!)
    - 186 observateurs pour le projet WASP-148b

- Pour réussir, vous connaissez :
    - Votre instrument et « un peu – beaucoup » le ciel
    - L'acquisition « Numérique »
    - La maîtrise de vos logiciels
    - Les binaires à éclipses - *« c'est maintenant »*

Généralités et rappels

LES CATEGORIES D'ETOILES DOUBLES ET MULTIPLES

(dependent des techniques d'observation)

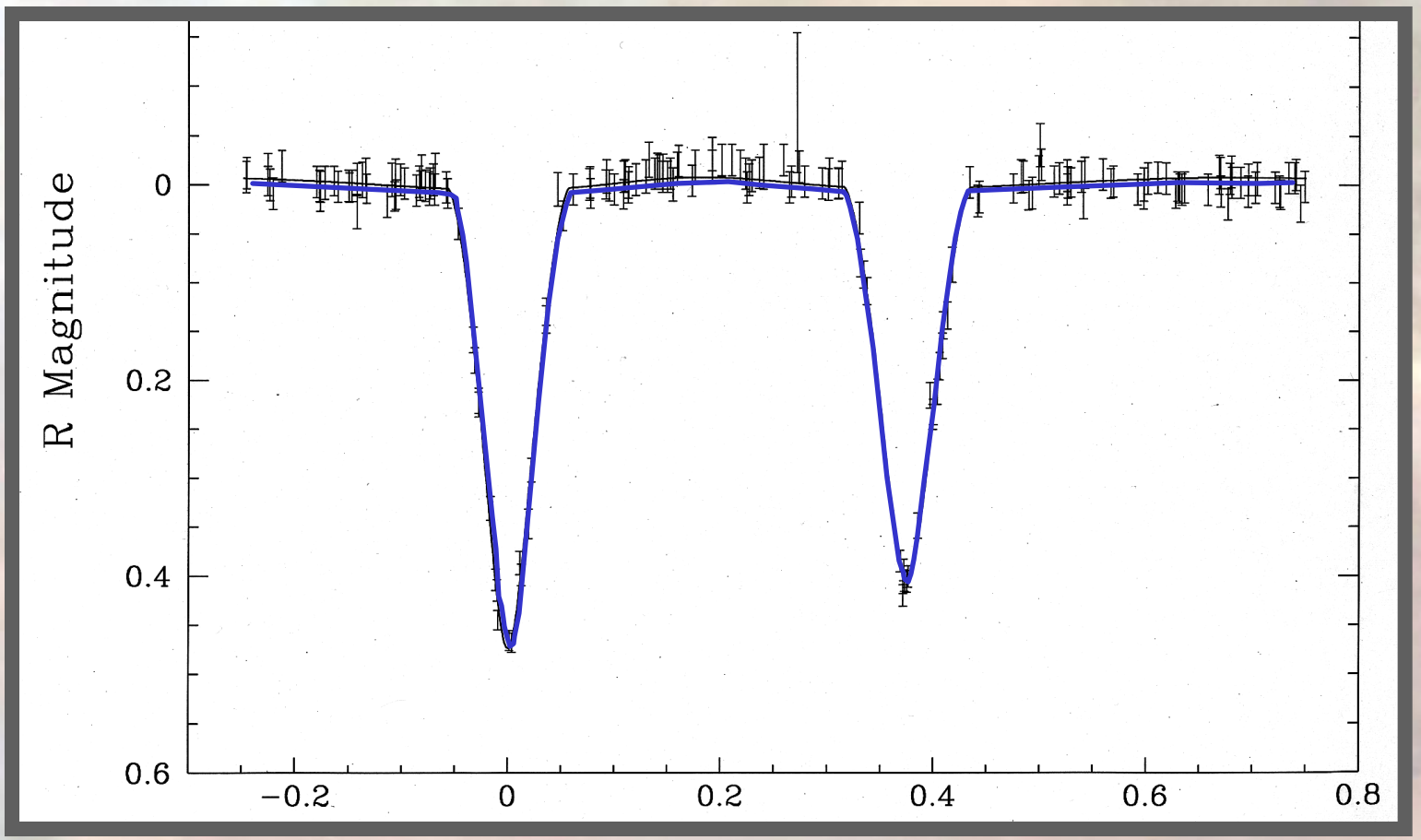


Separation intrinseque (UA)	.01 UA	< 1 UA	10 UA	50 UA	100 UA	1000 UA	10000 UA
Separation angulaire (")		< .001"	~ .01"	.02-.03"	~.1"	> 1"	

Duplicistes - Variabilistes

- La séparation des étoiles doubles conduit à des méthodes de travail différentes (process prédominant) :
  - Astrométrie
  - Photométrie (Binaires serrées)
- Catalogues différents :
  - WDS
  - GCVS (General Catalogue Variables Stars) 
- Organismes différents et Newsletters :
  - Commissions « étoiles doubles » - JDSO
  - Associations de variabilistes – JAAVSO – OEJV

Binaires à éclipses



Binaires à éclipses

Basics of periodic phenomena:

Based on the equation of a straight line:

$y = mx + b$

$T_E = PE + T_0$

$T_E = T_0 + P \times E$

E.g., GCVS elements for V398 Cam:
T = 2451615.633 + 2.0872 x E

Index (cycle) number of event

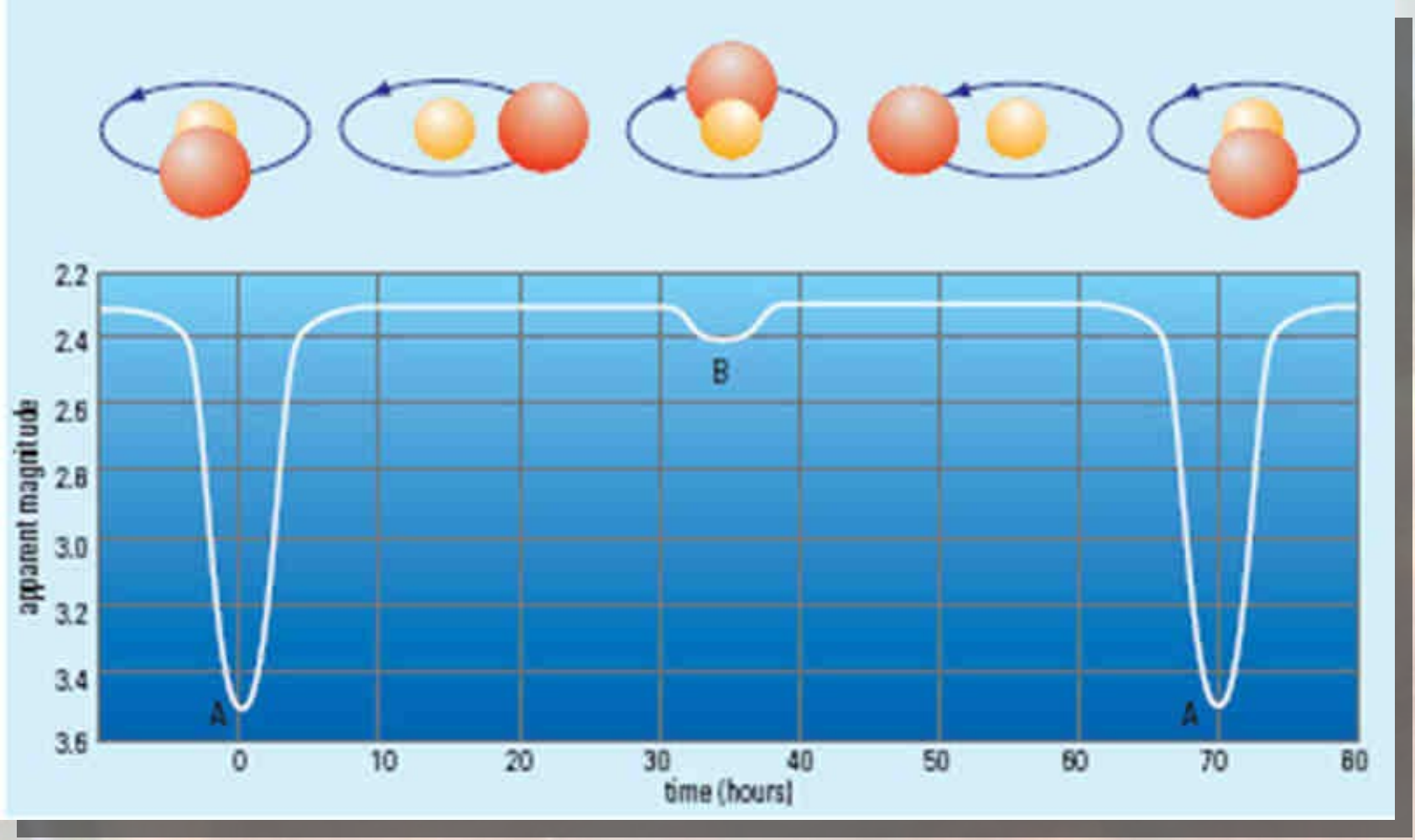
Period

Time of event 0, the "epoch"

Time of event E

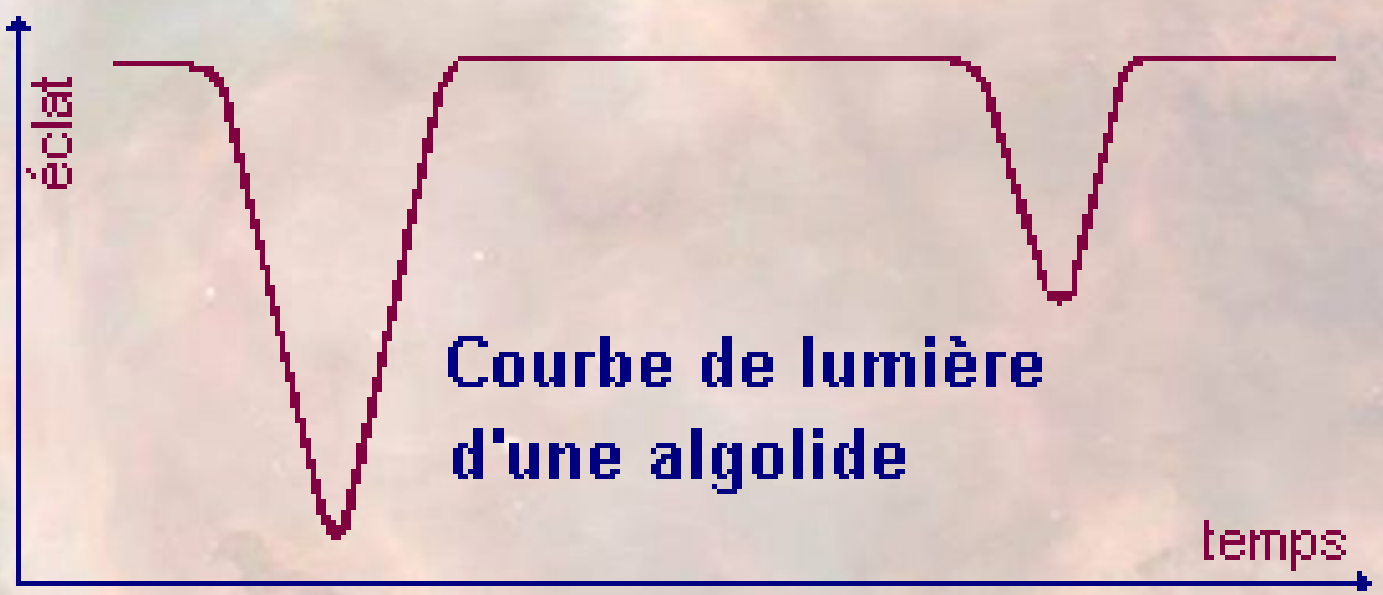
Source : AAVSO meeting – 15 Avril 2020

Binaires à éclipses

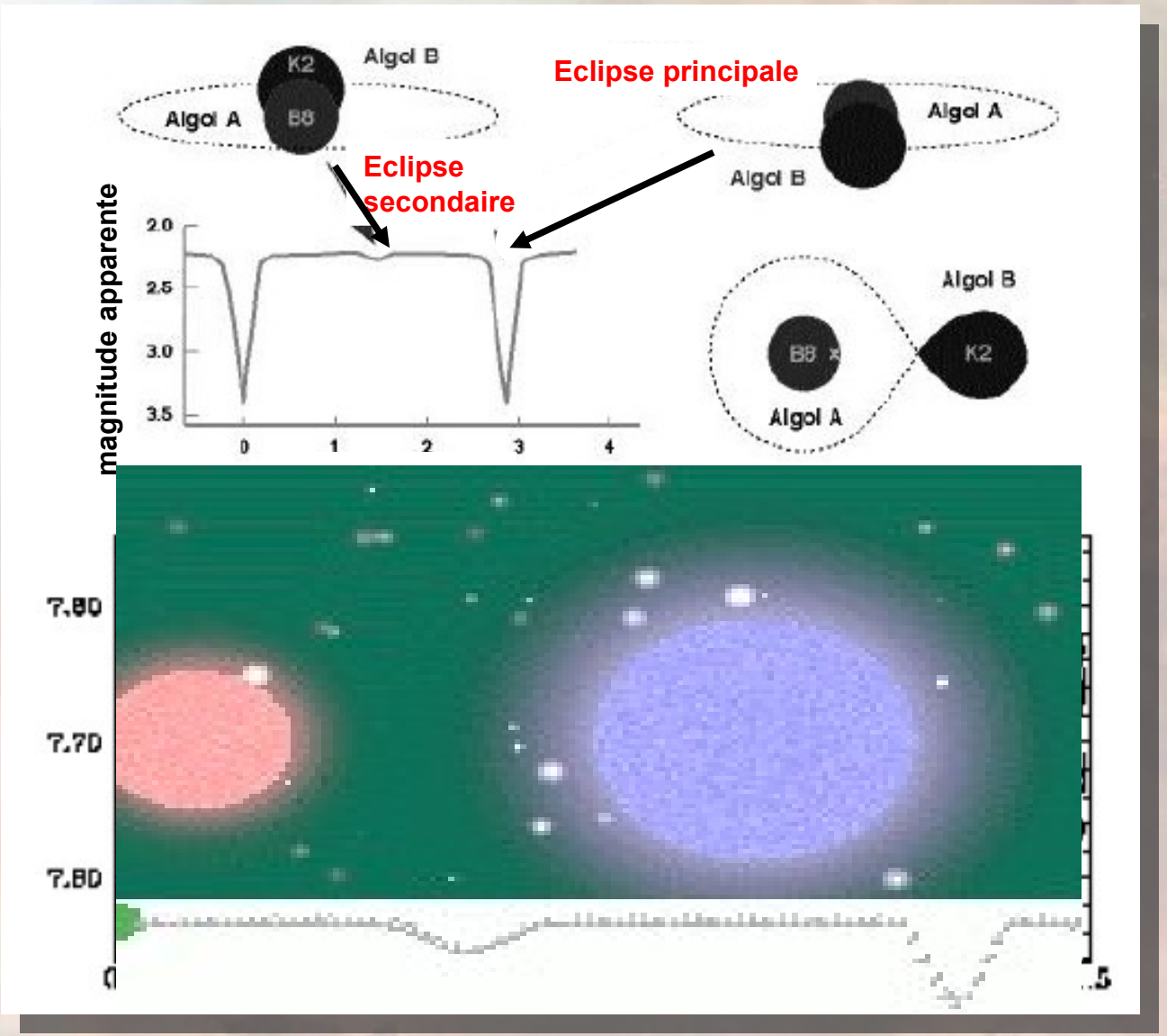


3 types de E.B.

- EA = Algolides
  - minimum principal bien marqué, minimum secondaire important ou presque indécelable



Etoiles variables périodiques binaires

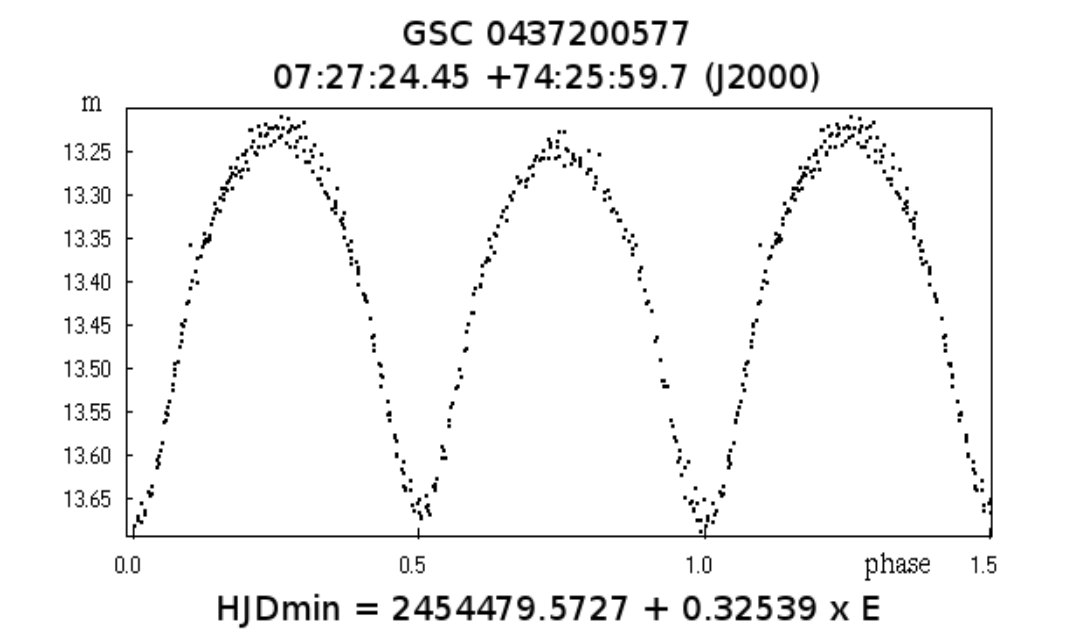


3 types de E.B.

- EB = Beta Lyrae
  - Minimum principal bien marqué
  - Courbe arrondie due à l'attraction gravitationnelle des étoiles

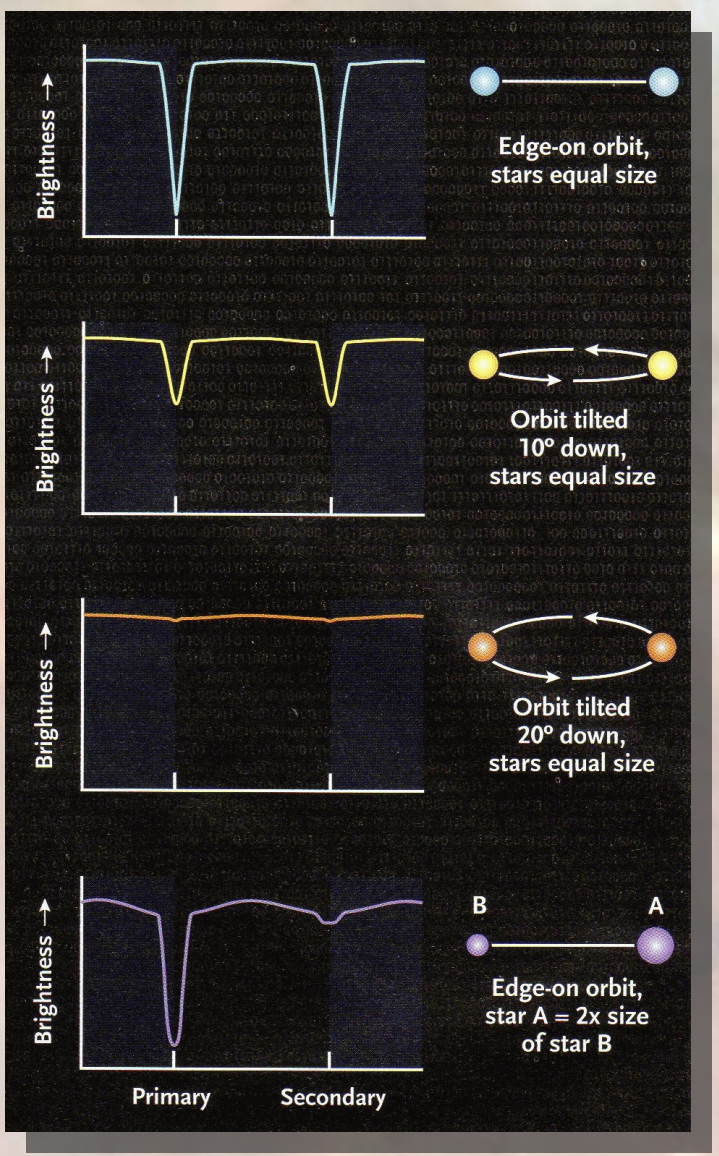
3 types de E.B.

- EW = W Ursae Majoris
  - Minimum principal quasiment identique au minimum secondaire.
  - Courbe arrondie due à l'attraction gravitationnelle des étoiles
  - Etoiles naines agées en contact dont la période est inférieure à la journée



Binaires à éclipses

La courbe de lumière résultante en fonction du plan orbital de la deuxième composante



Source : « ***Sky and telescope*** » Août 2012 – page 34 : Auteur : DIRK TERRELL

Binaires à éclipses

12.7 The Effects of Changing the Mass Ratio

Fig. 12.16: All the parameters are from the original model except that the mass ratio is now 2.0. The primary and secondary minimums are deeper than the actual curve.

Fig. 12.17: The mass ratio has been set to 3.0. The theoretical curve is just a bit deeper than the actual curve.

Fig. 12.18: The mass ratio is now 5.0, making the theoretical curve shallower at both minimums.

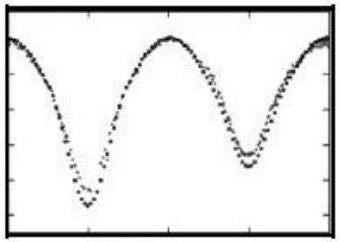


Figure 12.16

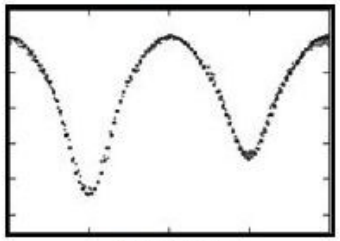


Figure 12.17

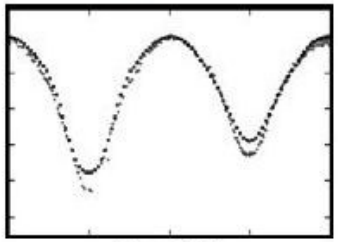
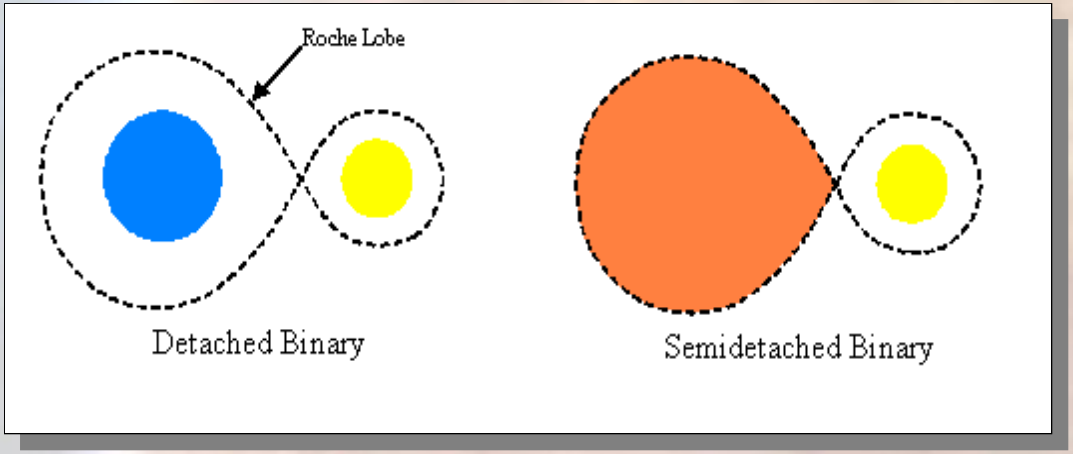
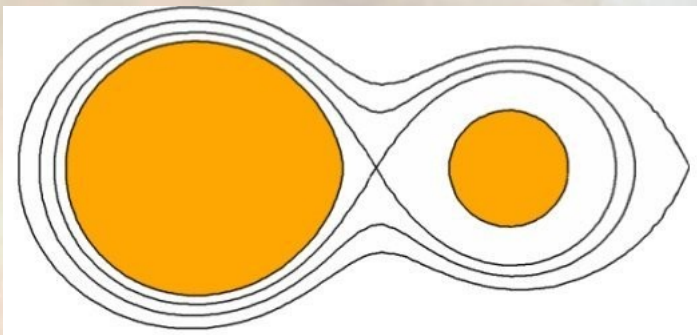


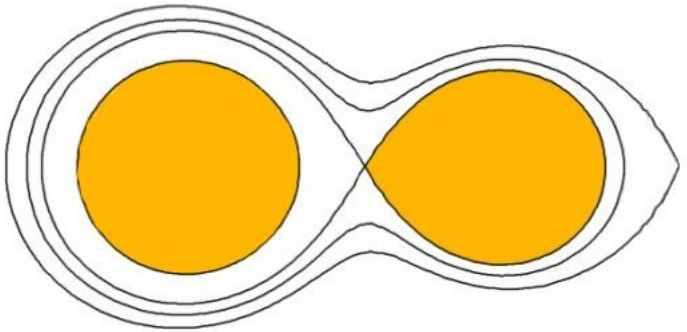
Figure 12.18

Composantes physiques

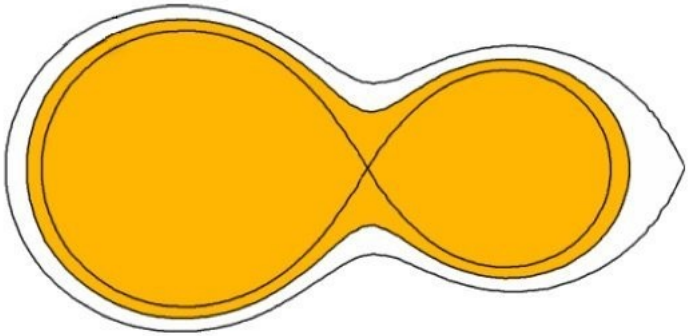




A detached system has both stars smaller than their Roche lobes.

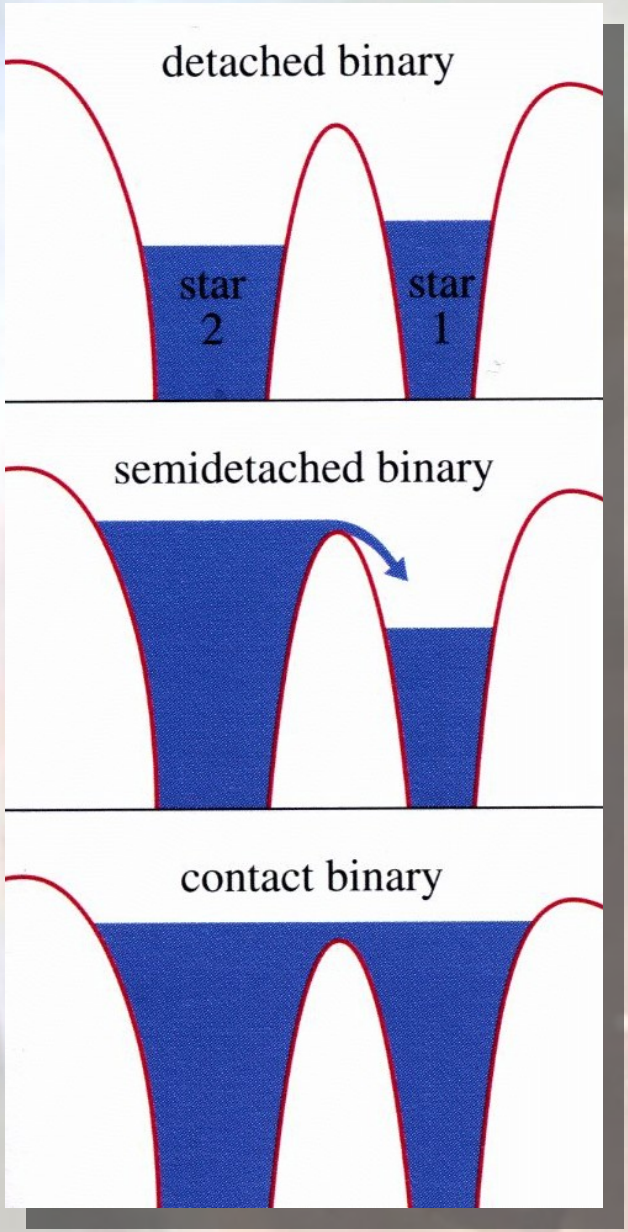


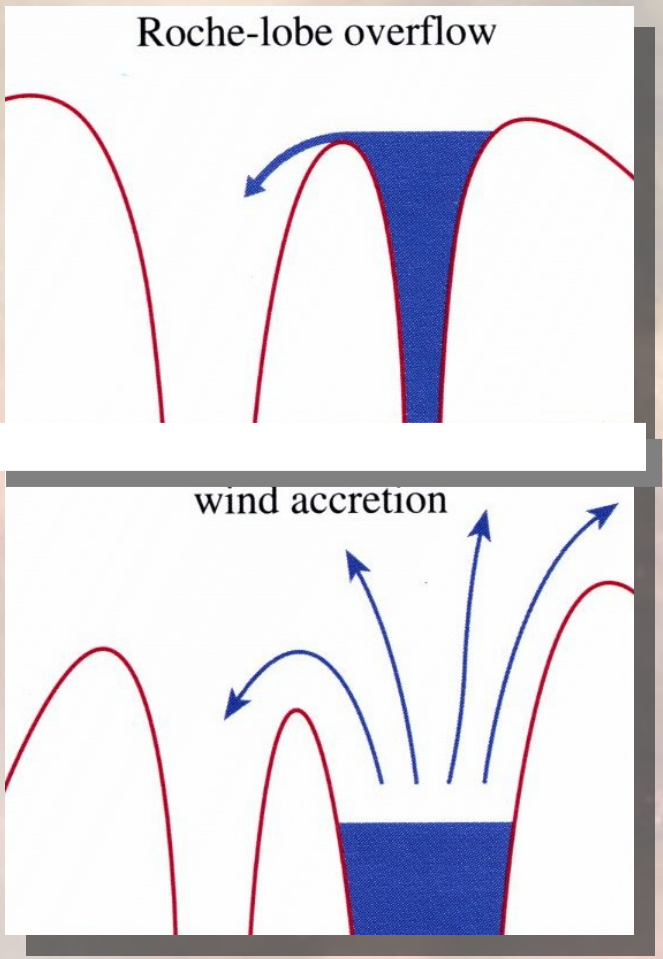
In a semidetached system, one star fills its Roche lobe while the other is smaller than the Roche lobe.



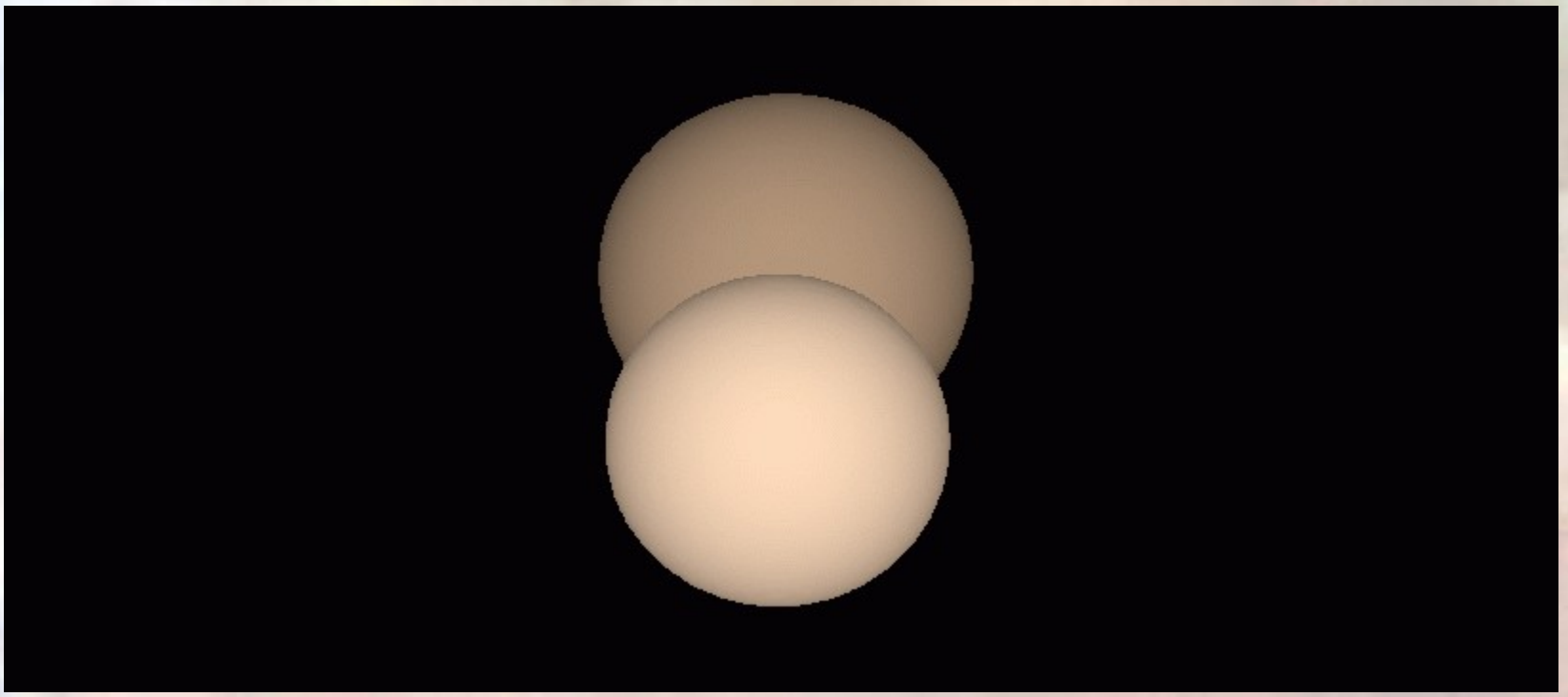
In overcontact systems both stars are contained within a common envelope of material.

Configurations et transferts de masses



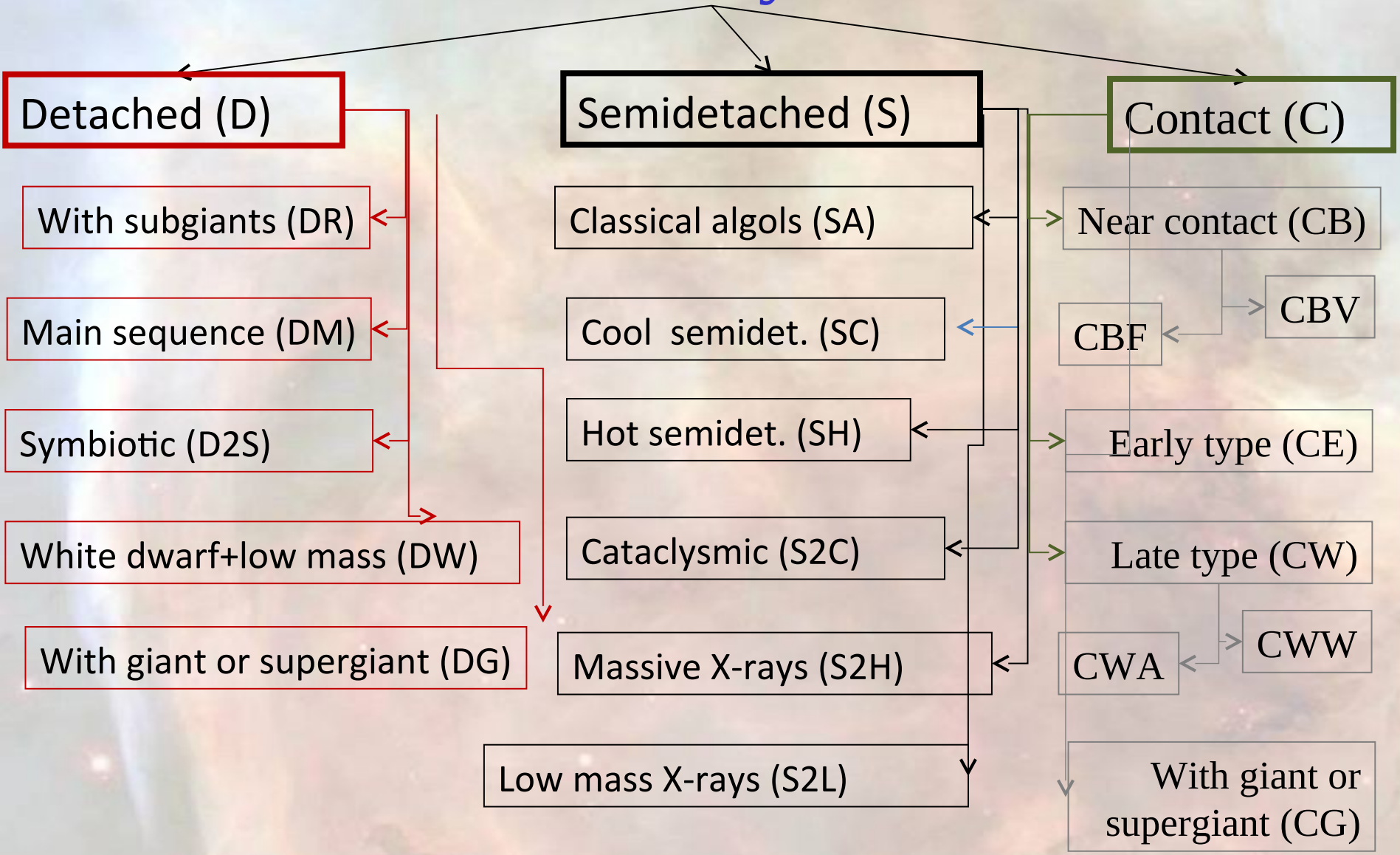


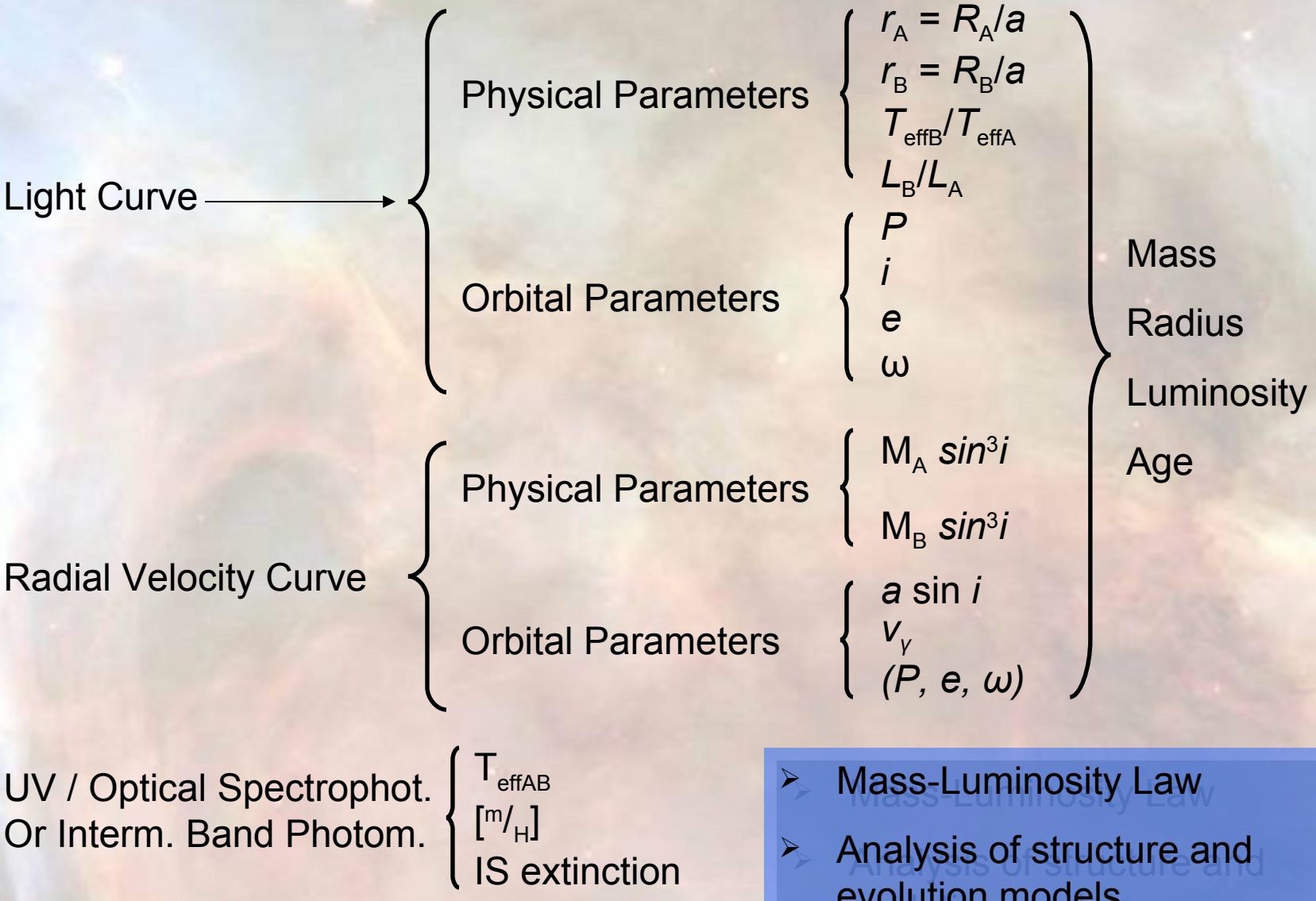
Composantes physiques



XY LEO

Evolutionary classes





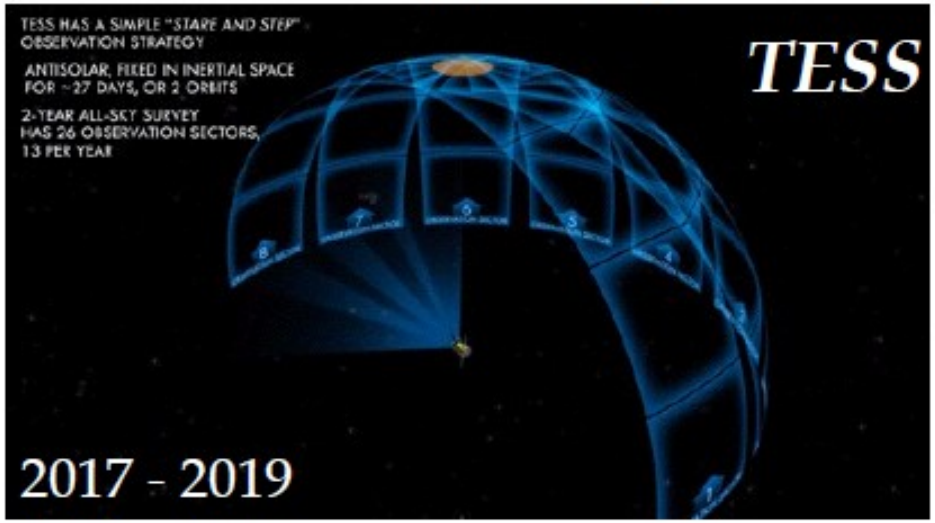
UV / Optical Spectrophot.
Or Interm. Band Photom.

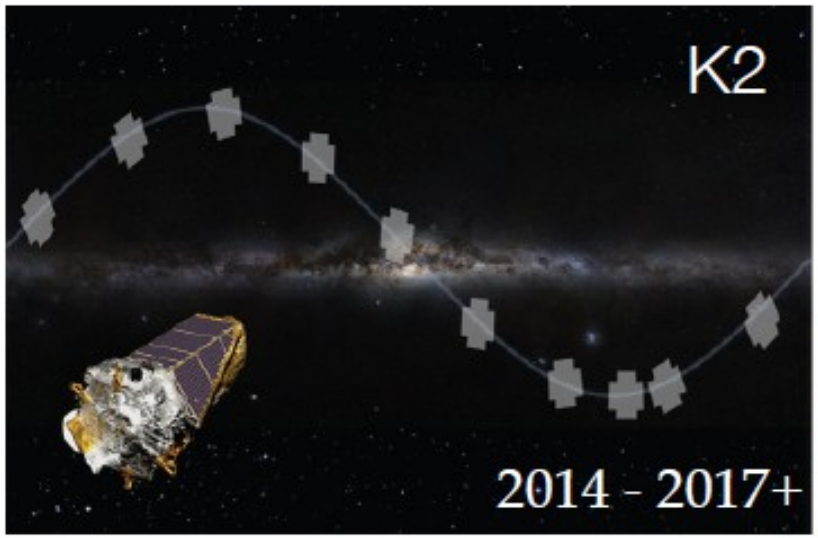
- T_{effAB}
- $[^m/_H]$
- IS extinction

- Mass-Luminosity Law
- Analysis of structure and evolution models
- Distance determination
- ...

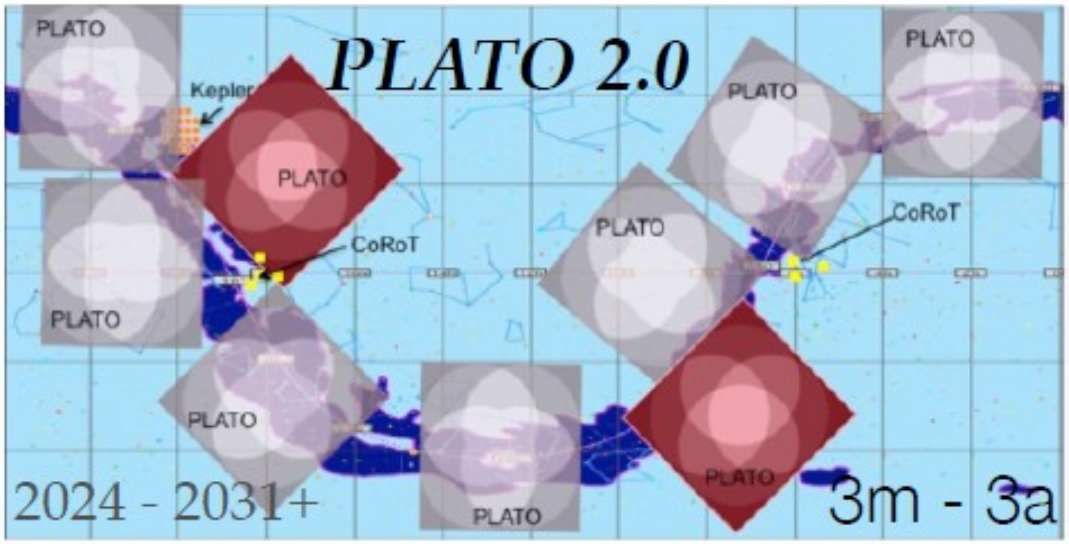
Programmes spatiaux

27j - 350j



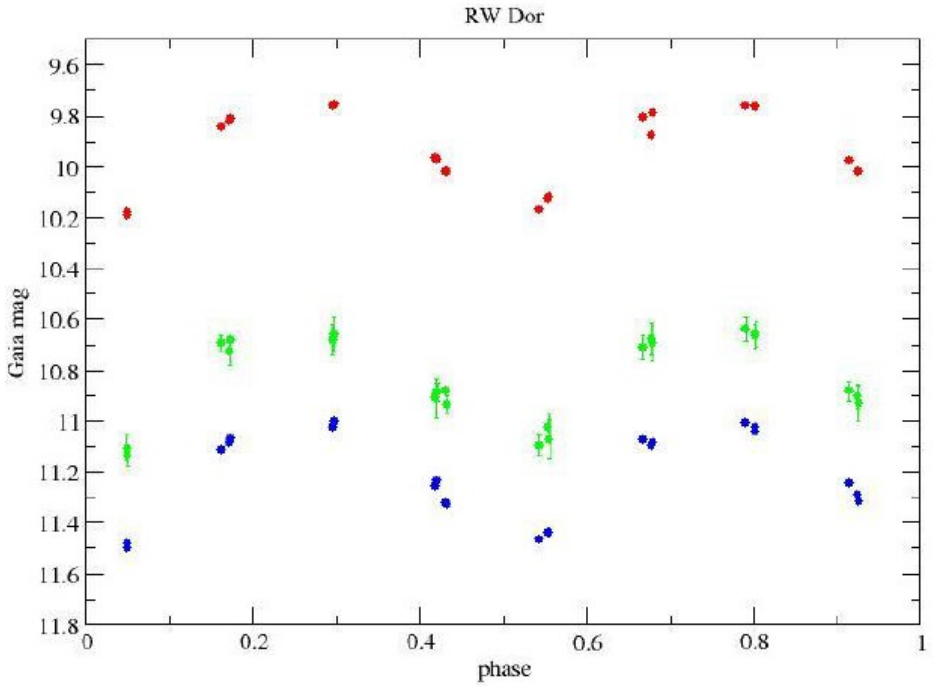


~90j

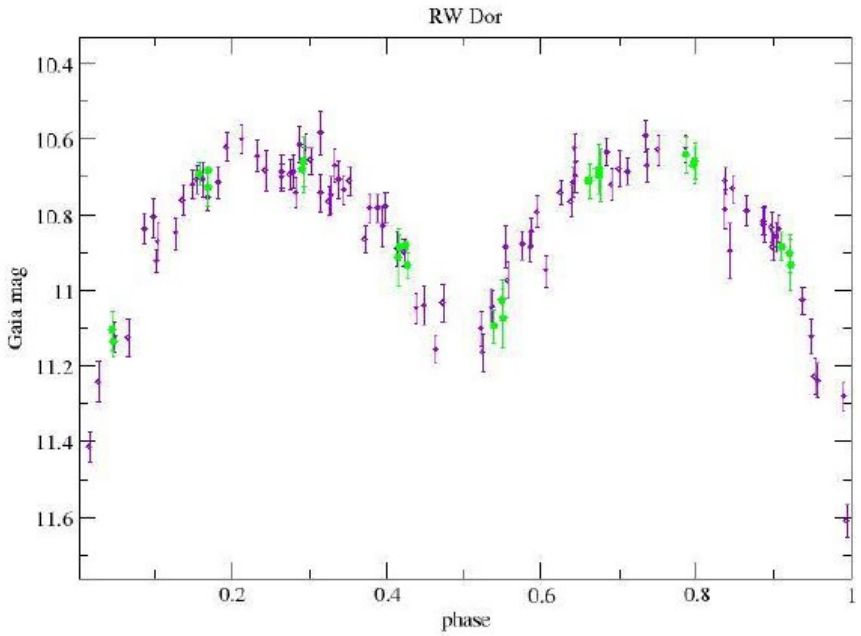


Niches pour les amateurs ?

Eclipsing binary



Early in the mission



Source : C. Jordi

University of Barcelona, Institut de Ciències del Cosmos, Institut d'Estudis Espacial de Catalunya

Ou en sommes nous ?

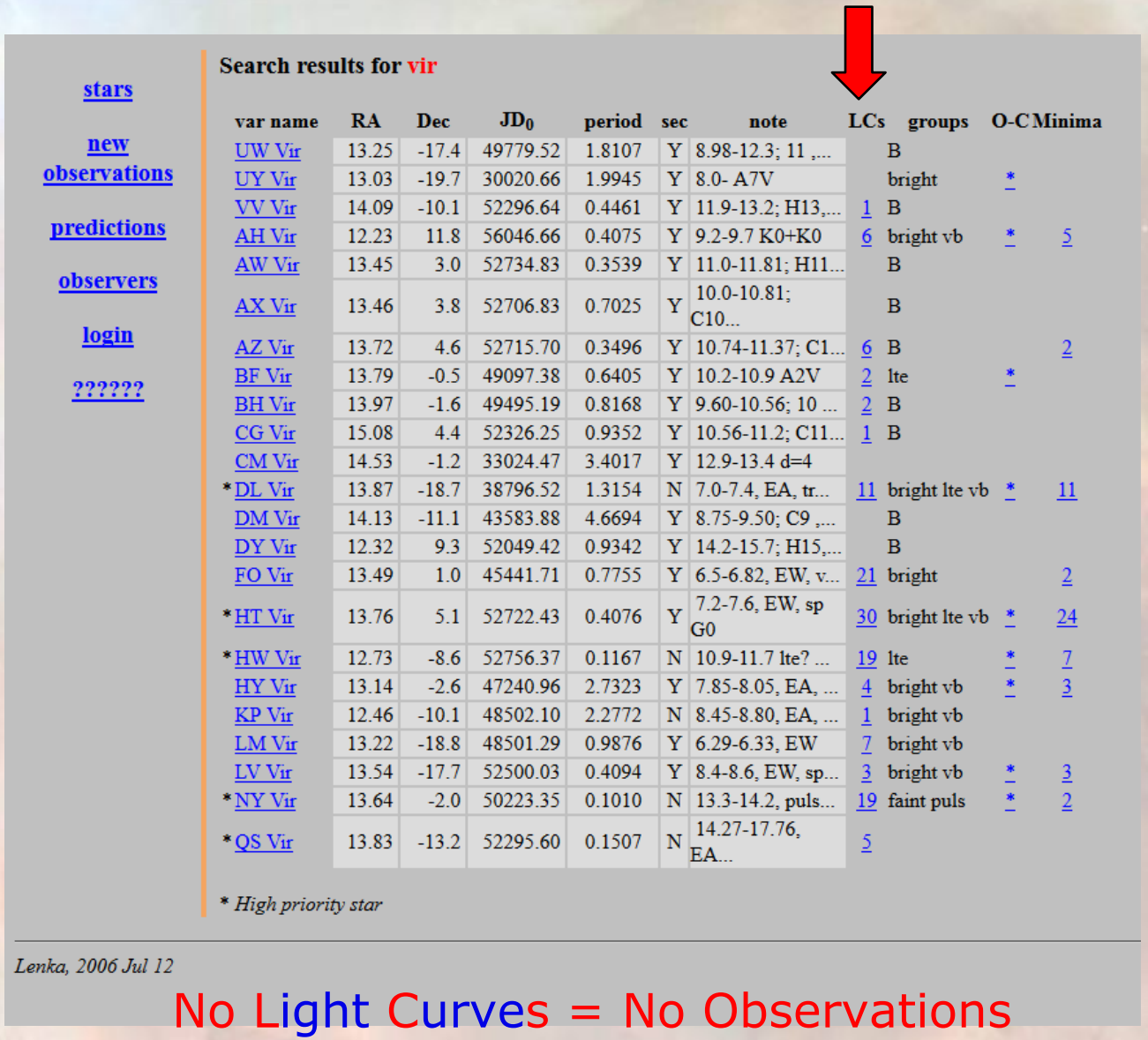
123 binaires à éclipses bien connues en 100 ans

- GCVS: 1982 binaires à éclipses (de type EA) en date du 06-10-2011
- AAVSO VSX à 5900 EA utiles pour les amateurs
- SuperWASP a probablement 50.000 courbes de lumières
- GAIA va produire 10^6 courbes, 10^5 seront sans doutes utiles
- LSST va trouver 24 millions EBs (Presa et al. 2011AJ....142...52P)
  - 6.7 million devraient être utiles !!!!

Moins de cent amateurs réparties sur la planète pour les observer…..

Source : John Southworth (STFC Advanced Fellow) Keele University, UK

Ou en sommes nous ?



stars

new observations

predictions

observers

login

??????

Search results for vir

var name	RA	Dec	JD_0	period	sec	note	LCs	groups	O-C	Minima
UW Vir	13.25	-17.4	49779.52	1.8107	Y	8.98-12.3; 11 ,...		B		
UY Vir	13.03	-19.7	30020.66	1.9945	Y	8.0- A7V		bright	*	
VV Vir	14.09	-10.1	52296.64	0.4461	Y	11.9-13.2; H13,...	1	B		
AH Vir	12.23	11.8	56046.66	0.4075	Y	9.2-9.7 K0+K0	6	bright vb	*	5
AW Vir	13.45	3.0	52734.83	0.3539	Y	11.0-11.81; H11...		B		
AX Vir	13.46	3.8	52706.83	0.7025	Y	10.0-10.81; C10...		B		
AZ Vir	13.72	4.6	52715.70	0.3496	Y	10.74-11.37; C1...	6	B		2
BF Vir	13.79	-0.5	49097.38	0.6405	Y	10.2-10.9 A2V	2	lte	*	
BH Vir	13.97	-1.6	49495.19	0.8168	Y	9.60-10.56; 10 ...	2	B		
CG Vir	15.08	4.4	52326.25	0.9352	Y	10.56-11.2; C11...	1	B		
CM Vir	14.53	-1.2	33024.47	3.4017	Y	12.9-13.4 d=4				
*DL Vir	13.87	-18.7	38796.52	1.3154	N	7.0-7.4, EA, tr...	11	bright lte vb	*	11
DM Vir	14.13	-11.1	43583.88	4.6694	Y	8.75-9.50; C9 ,...		B		
DY Vir	12.32	9.3	52049.42	0.9342	Y	14.2-15.7; H15,...		B		
FO Vir	13.49	1.0	45441.71	0.7755	Y	6.5-6.82, EW, v...	21	bright		2
*HT Vir	13.76	5.1	52722.43	0.4076	Y	7.2-7.6, EW, sp G0	30	bright lte vb	*	24
*HW Vir	12.73	-8.6	52756.37	0.1167	N	10.9-11.7 lte? ...	19	lte	*	7
HY Vir	13.14	-2.6	47240.96	2.7323	Y	7.85-8.05, EA, ...	4	bright vb	*	3
KP Vir	12.46	-10.1	48502.10	2.2772	N	8.45-8.80, EA, ...	1	bright vb		
LM Vir	13.22	-18.8	48501.29	0.9876	Y	6.29-6.33, EW	7	bright vb		
LV Vir	13.54	-17.7	52500.03	0.4094	Y	8.4-8.6, EW, sp...	3	bright vb	*	3
*NY Vir	13.64	-2.0	50223.35	0.1010	N	13.3-14.2, puls...	19	faint puls	*	2
*QS Vir	13.83	-13.2	52295.60	0.1507	N	14.27-17.76, EA...	5			

* *High priority star*

Lenka, 2006 Jul 12

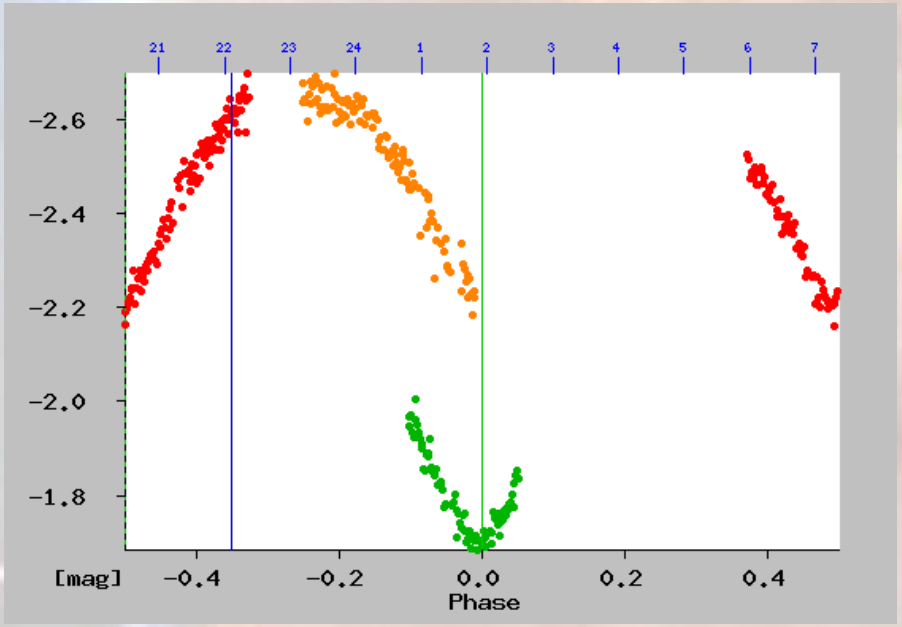
No Light Curves = No Observations

http://nyx.asu.cas.cz/dbvar/ressearch.phtml?sname=vir&obs=

Ou en sommes nous ?

502 Oph

	night	filter	exposure	box	comments	color	measur.	minima	observer	q	shift	cal.
1	B40715	V	60			●	161		laurent	1	0.00	
2	B40717V	V	60			●	114		laurent	1	0.00	
3	B40816V	V	60			●	82		laurent	1	0.00	

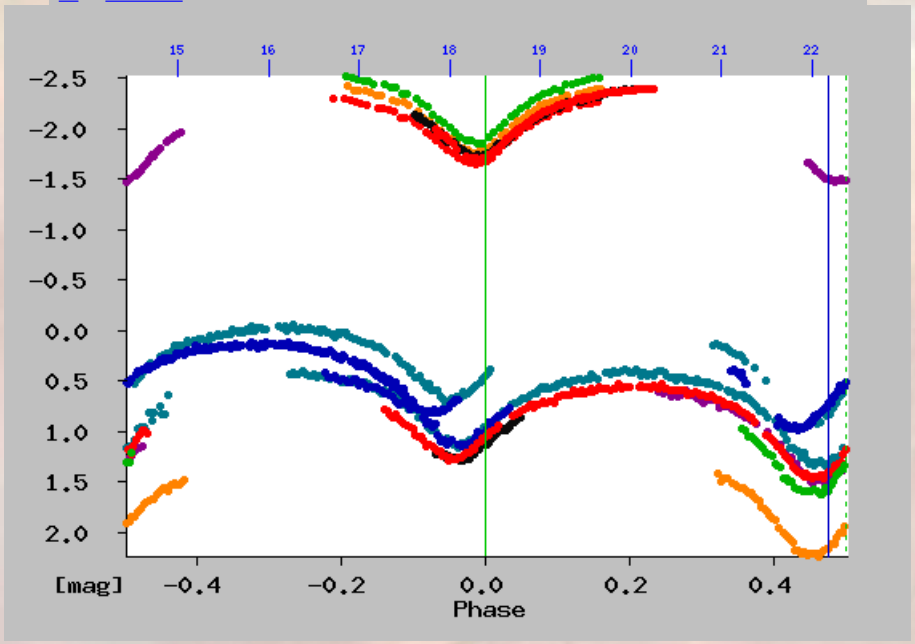


http://nyx.asu.cas.cz/dbvar/editobs.phtml?obs=&obsfilter=allobs&idvar=342&constel=&last=elem

CDL incomplète

AB And

	night	filter	exposure	box	comments	color	measur.	minima	observer	q	shift	cal.
1	A70929I	I	50	5		●	46		valmez	1	0.00	
2	A70929R	R	50	5		●	44		valmez	1	0.00	
3	A70929V	V	60	5		●	45		valmez	1	0.00	
4	B00903R	R	90			●	208		laurent	1	0.00	
5	B00919R	R	90			●	62		laurent	1	0.00	
6	B01028R	R	90			●	73		laurent	1	0.00	
7	B10819R	R	45			●	51		laurent	1	0.00	
8	B11003R	R	90		Secondaire and ...	●	167		laurent	1	0.00	
9	B11124R	R	90			●	67		laurent	1	0.00	
10	B20803R	R	90			●	40		laurent	1	0.00	
11	B20907R	R	90			●	145		laurent	1	0.00	
12	B50810V	V	60			●	257		laurent	1	0.00	
13	V060720	I	35	9		●	48		valmez	1	0.00	
14	V060926	R	45	9		●	120		valmez	1	0.00	
15	V061018	R	60	7		●	122		valmez	1	0.00	

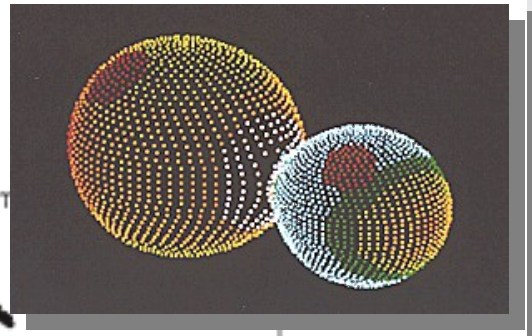


http://nyx.asu.cas.cz/dbvar/editobs.phtml?obs=&obsfilter=allobs&idvar=670&constel=&last=elem

Une foule de données

Publication AAVSO

Alton, JAAVSO Volume 34, 2006



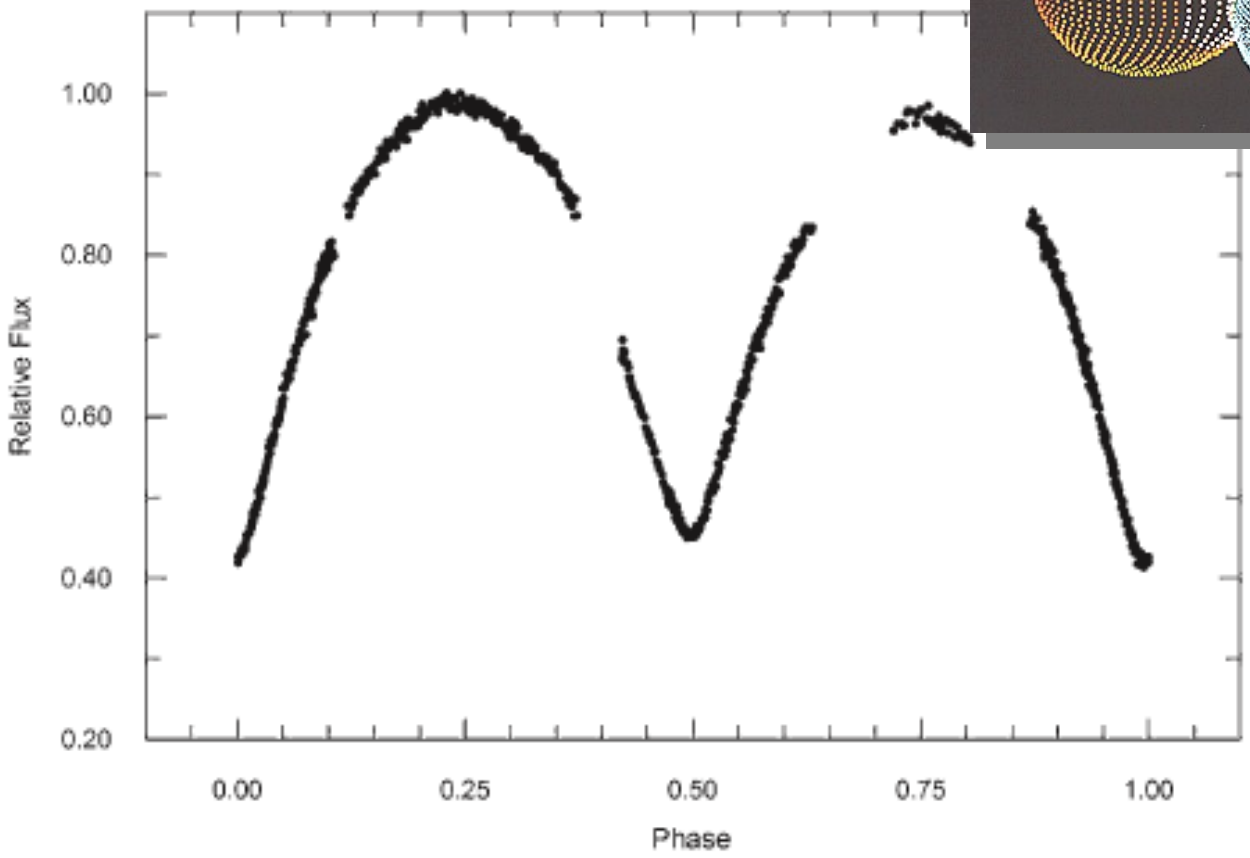
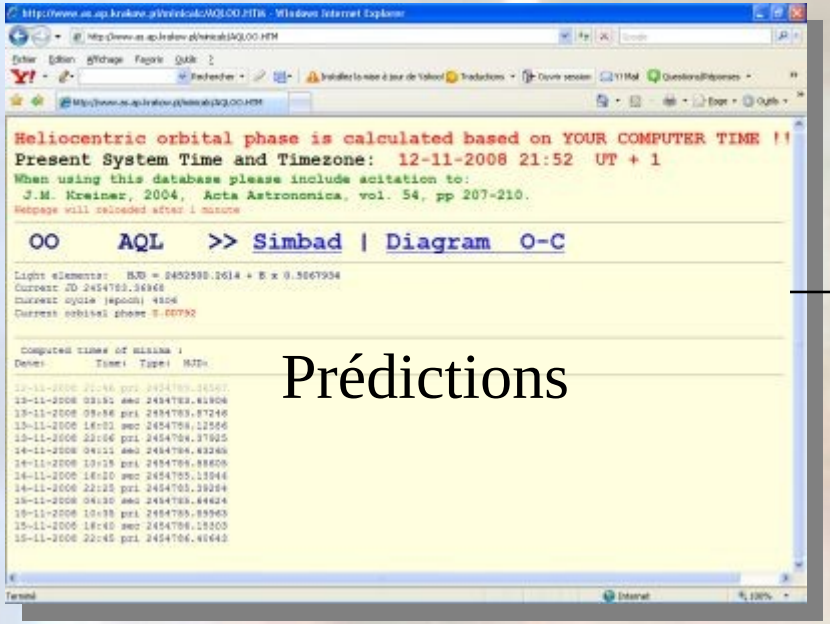


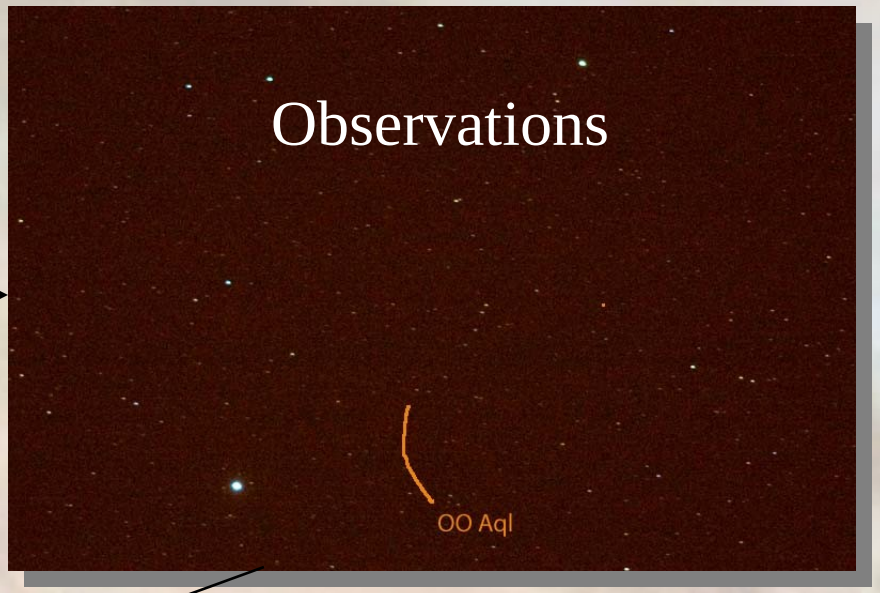
Figure 3. CCD (clear filter) light curve for OO Aql for July–September 2005. Fourier analysis derived period = 0.50681d ±0.00001d.

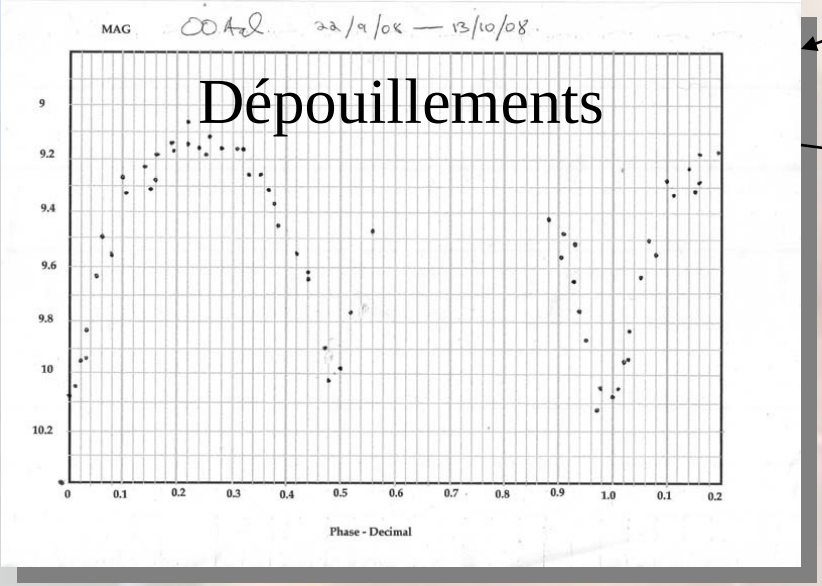
Méthodologie et contributions

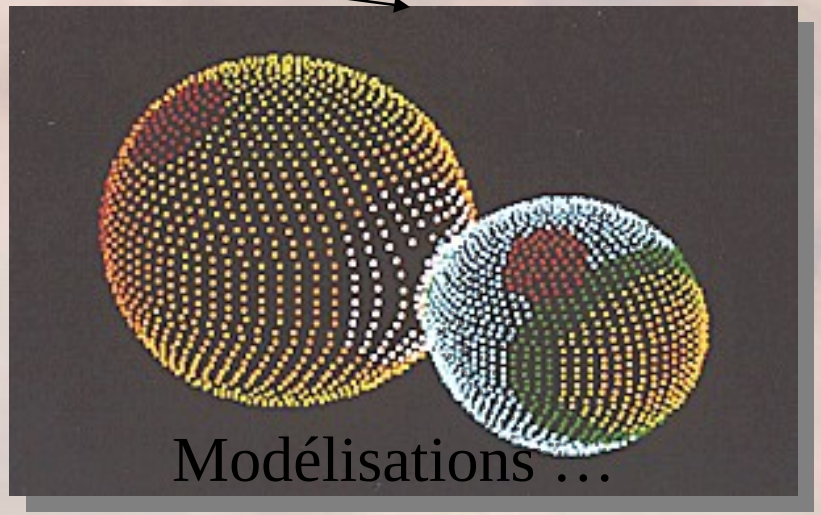
Comment mesurer les minima des B.E.

- Prédictions
- Observations
- Dépouillements
- Envoie des données
- Modélisations


Heliocentric orbital phase is calculated based on YOUR COMPUTER TIME !!
Present System Time and Timezone: 12-11-2008 21:52 UT + 1
When using this database please include acitation to:
J.M. Kreiner, 2004, Acta Astronomica, vol. 54, pp 207-210.
Webpage will reloaded after 1 minute
OO AQL >> Simbad | Diagram O-C
Prédictions


Observations
OO Aql


MAG
OO Aql 22/9/08 — 13/10/08
Dépouillements
9
9.2
9.4
9.6
9.8
10
10.2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0.1
0.2
Phase - Decimal

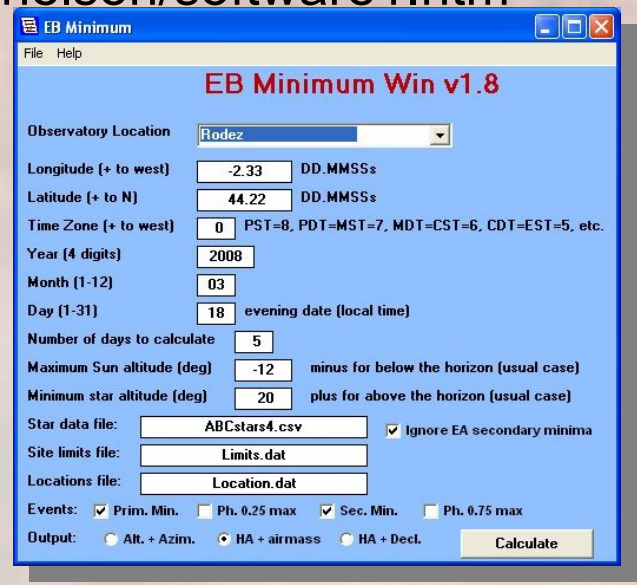

Modélisations …

Prédictions

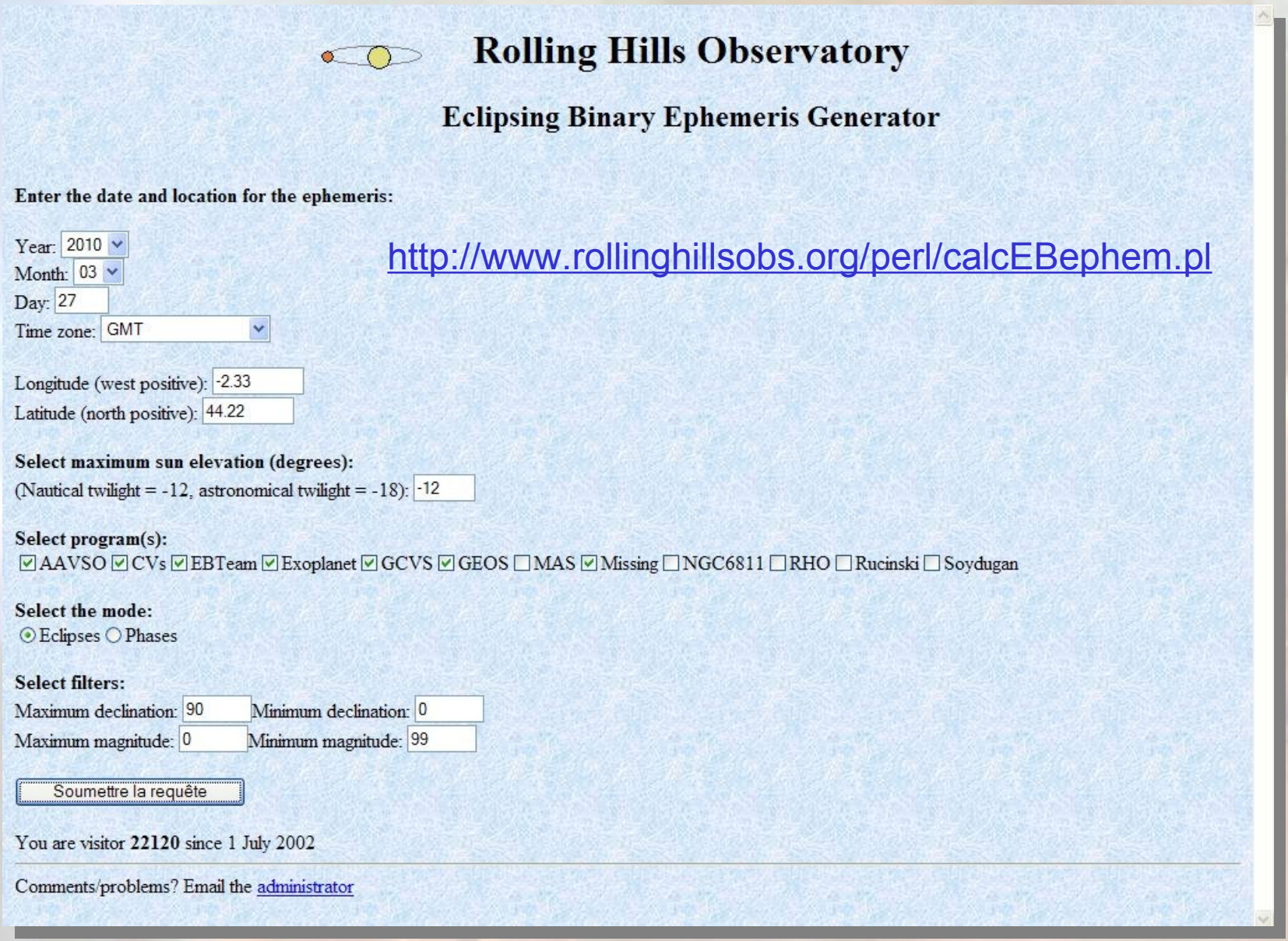
- Choisir son étoile suivant sa configuration :
  - Matérielle
    - Magnitude limite
    - Télescope en remote : indispensable d'avoir le temps d'observation total et sa maîtrise
    - Seeing
    - Pollution lumineuse
    - Temps d'observation – mise en route et le temps que vous pouvez y consacrer
    - Horizon - Heure du phénomène
  - Logicielles
- Plusieurs types de ressources pour trouver les mimima
  - Internet
  - Logiciels

Quelles variables choisir ?

- Binaires à éclipses
  - Recherches des minimums primaires et secondaires
  - Logiciels de prédictions
    - Minima 2.0 de Bob Nelson
    - http://members.shaw.ca/bob.nelson/software1.htm



Quelles variables choisir ?



Rolling Hills Observatory

Eclipsing Binary Ephemeris Generator

Enter the date and location for the ephemeris:

Year: 2010
Month: 03
Day: 27
Time zone: GMT

Longitude (west positive): -2.33
Latitude (north positive): 44.22

Select maximum sun elevation (degrees):
(Nautical twilight = -12, astronomical twilight = -18): -12

Select program(s):
☑ AAVSO ☑ CVs ☑ EBTeam ☑ Exoplanet ☑ GCVS ☑ GEOS ☐ MAS ☑ Missing ☐ NGC6811 ☐ RHO ☐ Rucinski ☐ Soydugan

Select the mode:
◉ Eclipses ○ Phases

Select filters:
Maximum declination: 90 Minimum declination: 0
Maximum magnitude: 0 Minimum magnitude: 99

Soumettre la requête

You are visitor **22120** since 1 July 2002

Comments/problems? Email the administrator

http://www.rollinghillsobs.org/perl/calcEBephem.pl

Quelles variables choisir ?

Rolling Hills Observatory

Eclipsing Binary Ephemeris Generator

Date = 2010-03-27
End of twilight = 19:15 GMT
Start of twilight = 04:39 GMT

Star	Date/Time	Altitude	Azimuth	Max Mag	Min Mag	Duration	Cycles	Date Source
V0647 Ori	2010-03-27 19:45 GMT	42	220	11.5	12.0	-	438	RHO
BW Leo	2010-03-27 19:45 GMT	41	107	14.7	15.5	-	7593	IBVS5438
V0776 Cas	2010-03-27 19:50 GMT	39	334	8.9	9.1	-	15401	RNelson
MR Aur	2010-03-27 19:50 GMT	58	259	15.1	15.5	-	24436	GCVS
BE UMa	2010-03-27 19:50 GMT	53	63	14.8	17.8	-	4488	GCVS
DV UMa	2010-03-27 19:55 GMT	75	81	14.0	19.8	-	98174	JGreaves
GM Gem	2010-03-27 19:55 GMT	52	213	13.1	14.0	-	18318	GCVS
GT Gem	2010-03-27 19:55 GMT	56	234	15.1	16.0	-	28543	GCVS
ET Leo(S)	2010-03-27 20:00 GMT	53	126	9.6	9.7	-	7378	IBVS5407
AT Cam	2010-03-27 20:00 GMT	58	330	9.8	10.6	-	1652	RHO(est)
Y Sex	2010-03-27 20:05 GMT	42	149	9.8	10.2	-	5500	RHO(est)
RZ UMi	2010-03-27 20:15 GMT	44	5	12.8	13.5	-	35843	GCVS
FR Aur	2010-03-27 20:15 GMT	53	267	12.7	14.2	-	8202	GCVS
BV Dra	2010-03-27 20:20 GMT	35	35	7.9	8.5	-	1098	RHO
W UMa	2010-03-27 20:20 GMT	76	31	7.8	8.5	3	5929	RHO
CC Mon	2010-03-27 20:30 GMT	42	229	13.7	14.4	-	21395	GCVS
V0530 Mon	2010-03-27 20:30 GMT	42	220	12.4	12.8	-	4789	RNelson
FO Aur	2010-03-27 20:35 GMT	50	270	14.3	14.9	2	3016	RHO(est)

Quelles variables choisir ?

MSO Home | An Atlas of O-C Diagrams | All-Stars in One File (txt) | allstars.cat (ascii) | SIMBAD | GCVS

Statistics of minima database | Add new minima NEW !!!

Old ephemerides

Constellations: http://www.as.up.krakow.pl/ephem/

And| Ant| Aps| Aqr| Aql| Ara| Ari| Aur| Boo| Cae| Cam| Cnc| CVn| CMa| CMi| Cap| Car| Cas| Cen| Cep| Cet| Cha| Cir| Com| Col| CrA| CrB| Crv| Crt| Cru| Cyg| Del| Dor| Dra| Equ| Eri| For| Gem| Gru| Her| Hor| Hya| Hyi| Ind| Lac| Leo| LMi| Lep| Lib| Lup| Lyn| Lyr| Men| Mic| Mon| Mus| Nor| Oct| Oph| Ori| Pav| Peg| Per| Phe| Pic| Psc| PsA| Pup| Pyx| Ret| Sge| Sgr| Sco| Scl| Sct| Ser| Sex| Tau| Tel| Tri| TrA| Tuc| UMa| UMi| Vel| Vir| Vol| Vul

UP-TO-DATE LINEAR ELEMENTS OF ECLIPSING BINARIES

prepared by J.M. Kreiner

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email: sfkreine@cyf-kr.edu.pl

When using this database please include a citation to: J.M. Kreiner, 2004, Acta Astronomica, vol. 54, pp 207-210.
Up-to-date Linear Elements of Cloes Binaries (ps)

This project was partly supported by KBN grant No 2 P03D 006 22

Current orbital phase is calculated based on YOUR COMPUTER TIME !!!!

The successive columns of tables contain:

- The name of a star in constellation order and link to times of minima calculator
- Information about minima considered in the calculation of the linear elements:
  all - primary and secondary minima were used

Quelles variables choisir ?

MSO Home | An Atlas of O-C Diagrams | Description of the Table | All-Stars in Ascii File | SIMBAD |GCVS

Statistics of minima database | Add new minima NEW !!!

UP-TO-DATE LINEAR ELEMENTS OF ECLIPSING BINARIES

Heliocentric orbital phase is calculated based on YOUR COMPUTER TIME !!!!

When using this database please include a citation to: J.M. Kreiner, 2004, Acta Astronomica, vol. 54, pp 207-210.

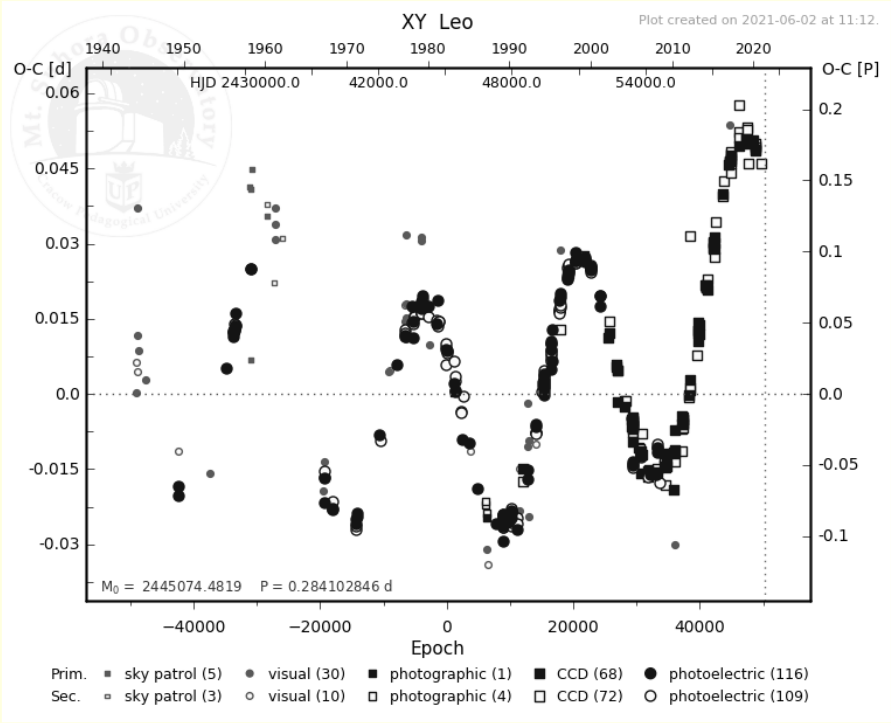
LEO

And| Ant| Aps| Aqr| Aql| Ara| Ari| Aur| Boo| Cae| Cam| Cnc| CVn| CMa| CMi| Cap| Car| Cas| Cen| Cep| Cet| Cha| Cir| Com| Col| CrA| CrB| Crv| Crt| Cru| Cyg| Del| Dor| Dra| Equ| Eri| For| Gem| Gru| Her| Hor| Hya| Hyi| Ind| Lac| Leo| LMi| Lep| Lib| Lup| Lyn| Lyr| Men| Mic| Mon| Mus| Nor| Oct| Oph| Ori| Pav| Peg| Per| Phe| Pic| Psc| PsA| Pup| Pyx| Ret| Sge| Sgr| Sco| Scl| Sct| Ser| Sex| Tau| Tel| Tri| TrA| Tuc| UMa| UMi| Vel| Vir| Vol| Vul

STAR Name	Typ	Mo HJD)	(ERR)	Period (Days)	(ERR)	NUMBER OF MINIMA all	pri	sec	e	ccd	v	pg	p	YEARS	
LEO Y	pri	2452501.2369	(5)	1.686076	(1)	16	16	0	0	13	3	0	0	2002-2006	30
LEO RT	pri	2452503.577	(7)	7.447902	(3)	23	23	0	0	2	19	1	1	1934-2006	23
LEO RW	pri	2452501.330	(2)	1.682527	(2)	10	10	0	0	6	4	0	0	1995-2006	10
LEO TX	all	2452502.4451	(*)	2.4450663	(*)	7	6	1	6	1	0	0	0	1965-1993	8
LEO UU	all	2452501.2035	(4)	1.6797667	(4)	22	20	2	0	22	0	0	0	1999-2009	10
LEO UV	all	2452500.1359	(1)	0.60008685	(7)	59	43	16	21	38	0	0	0	2000-2007	8
LEO UX	all	2452500.8480	(4)	1.0071570	(3)	18	16	2	0	18	0	0	0	1996-2007	25
LEO UZ	all	2452500.054	(2)	0.618059	(1)	12	9	3	2	10	0	0	0	2004-2007	11
LEO VZ	pri	2452500.2597	(6)	1.0898999	(6)	27	27	0	0	27	0	0	0	2001-2009	9
LEO WY	pri	2452504.53	(1)	4.985903	(6)	22	22	0	0	3	2	0	17	1953-2008	2

Quelles variables choisir ?

https://www.as.up.krakow.pl/minicalc/LEOXY.HTM



Light elements: HJD = 2452500.45 + E x 0.284101

Current JD 2459370.05455

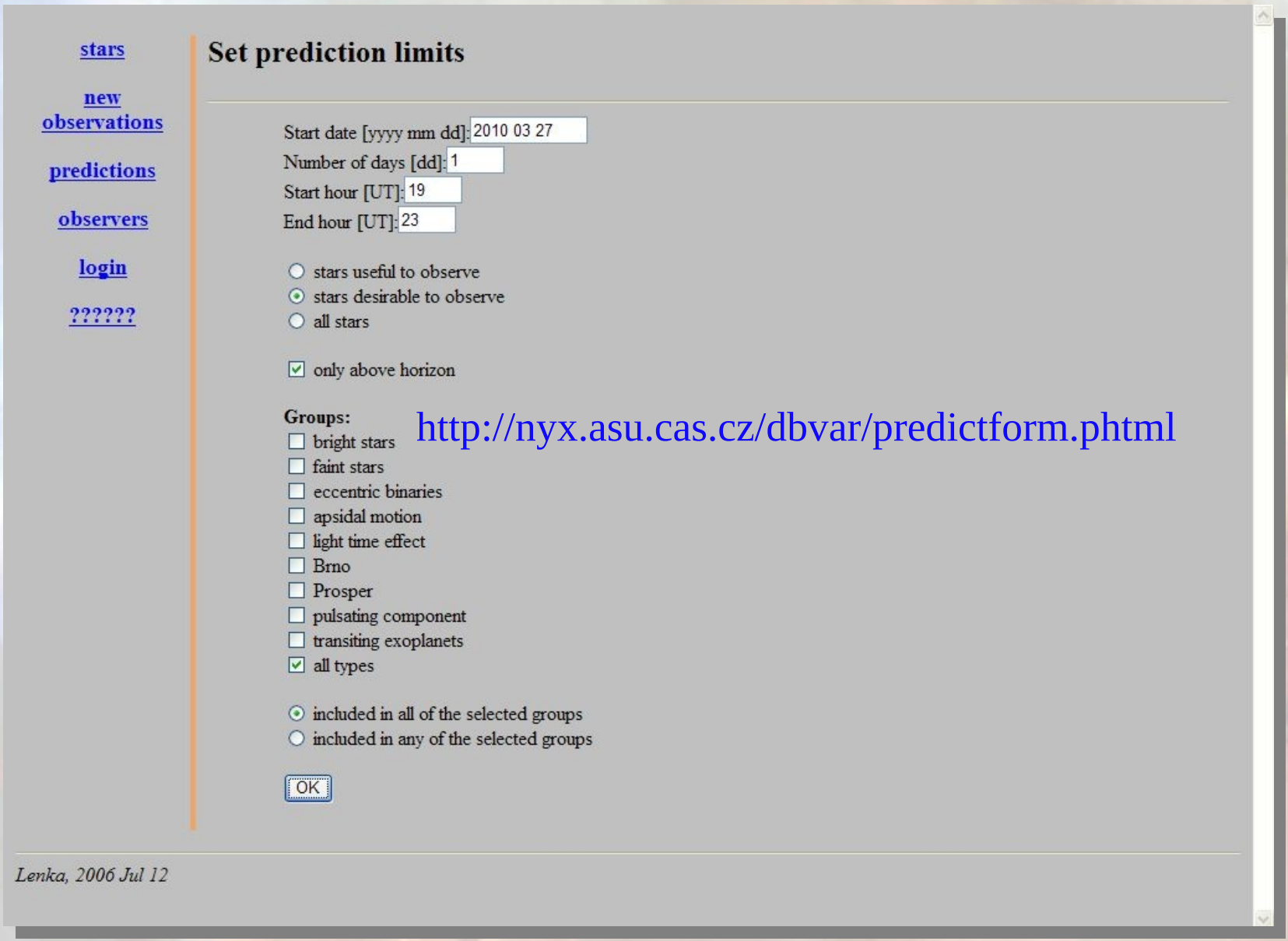
Current cycle (epoch) 24181
Current orbital phase 0.14913

Assumed eclipse duration : D= (in period unit)

Computed times of minima :
Date: Time: Type: HJD:

04-06-2021 14:17 pri 2459370.01218
04-06-2021 17:42 sec 2459370.15423
04-06-2021 21:06 pri 2459370.29628
05-06-2021 00:31 sec 2459370.43833
05-06-2021 03:55 pri 2459370.58038
05-06-2021 07:20 sec 2459370.72243
05-06-2021 10:44 pri 2459370.86448

Quelles variables choisir ?



http://nyx.asu.cas.cz/dbvar/predictform.phtml

Quelles variables choisir ?

stars

new observations

predictions

observers

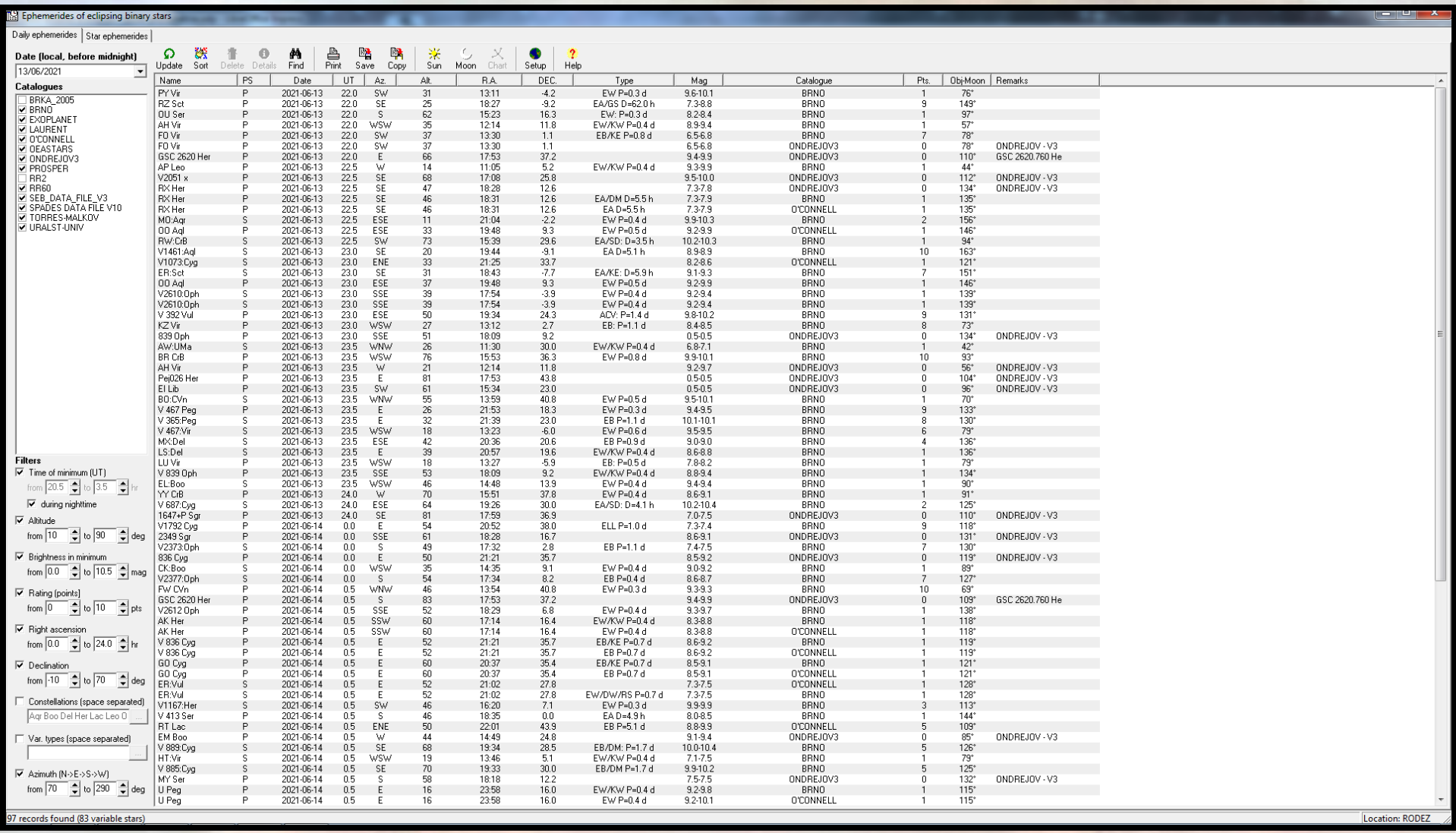
login

??????

Predictions for selected (high priority) stars
from 2010-3-27
days 1, hour 19 - 23

name	type	min [UT]	note	group	observations
HH95-79 Tau	P	3/27/19:00	13.5-14.5, GSC ...		
FO Aur	P	3/27/19:04	14.3-14.9! new ...	faint	12
Y Leo	P	3/27/19:05	10.1-13.2 lte?		4
344 Lac	S	3/27/19:10	12.2-13.0, var....		6
889*S Aql	P	3/27/19:21	8.5-8.7	bright ecc am	3
RV Lyr	P	3/27/19:36	11.0-13.3 A5	lte	1
361 Lyr	P	3/27/19:39	14.3-15.7 var lc		28
GSC2583 CrB	P	3/27/19:40	12.0-12.2, GSC ...		25
401+S Lac	P	3/27/19:40	7.9-8.0 ecc HIP	bright ecc	7
QS Aql	S	3/27/19:46	5.9-6.06 B5	bright lte	77
BL Cam	P	3/27/19:49	13.0, SX Phe pu...	lte puls	41
501*P Mon	P	3/27/19:55	12.7-13.2 A3	ecc	3
BW Dra	S	3/27/20:00	8.61-9.08, sp B...	bright	6
SW Cnc	P	3/27/20:07	11.6-12.5 D=4		2
GV Cyg	P	3/27/20:09	13.2-15.2 A5 lt...	faint lte	5
BL And	S	3/27/20:11	11.0-11.7		4
V Tri	S	3/27/20:12	11.0-11.8 A3 lte?	B	2
KR Com	S	3/27/20:14	7.25-7.33, sp F...	bright	28
HS 2231 Peg	P	3/27/20:14	14.1-14.6 GSC22...		5
456 Oph	P	3/27/20:17	10.2-10.7,EA		
EX Dra	P	3/27/20:19	14.5-15.0 ecl. ...	faint lte	17
WASP-3 Lyr	P	3/27/20:19	10.6 F7V trans....	trex	1
959+S Cyg	P	3/27/20:20	11.3-11.4, A=0....	ecc	5
NY Vir	P	3/27/20:20	13.3-14.2, puls...	puls	6
AL Cas	P	3/27/20:20	12.3-13.0 lte? new	lte	2
GSC1588+S Her	P	3/27/20:33	12.8-13.8 new e...	ecc	2
ET Boo	S	3/27/20:37	9.1,astrometr.o...	bright	9
GW Cep	P	3/27/20:38	11.4-12.1 G3 lt...	lte	15
LP Cep	P	3/27/20:40	13.7-15 lte, pe...	faint lte	31
MW Lac	P	3/27/20:41	13.1-13.6 A2		3

Quelles variables choisir ?



Name	PS	Date	UT	Az.	Alt.	R.A.	DEC.	Type	Mag	Catalogue	Pts.	Obj-Moon	Remarks
PY Vir	P	2021-06-13	22.0	SW	31	13:11	-4.2	EW P=0.3 d	9.6-10.1	BRNO	1	76°	
RZ Sct	P	2021-06-13	22.0	SE	25	18:27	-9.2	EA/GS D=62.0 h	7.3-8.8	BRNO	9	149°	
OU Ser	P	2021-06-13	22.0	S	62	15:23	16.3	EW: P=0.3 d	8.2-8.4	BRNO	1	97°	
AH Vir	P	2021-06-13	22.0	WSW	35	12:14	11.8	EW/KW P=0.4 d	8.9-9.4	BRNO	1	57°	
FO Vir	P	2021-06-13	22.0	SW	37	13:30	1.1	EB/KE P=0.8 d	6.5-6.8	BRNO	7	78°	
FO Vir	P	2021-06-13	22.0	SW	37	13:30	1.1		6.5-6.8	ONDREJOV3	0	78°	ONDREJOV - V3
GSC 2620 Her	P	2021-06-13	22.0	E	66	17:53	37.2		9.4-9.9	ONDREJOV3	0	110°	GSC 2620.760 He
AP Leo	P	2021-06-13	22.5	W	14	11:05	5.2	EW/KW P=0.4 d	9.3-9.9	BRNO	1	44°	
V2051 x	P	2021-06-13	22.5	SE	68	17:08	25.8		9.5-10.0	ONDREJOV3	0	112°	ONDREJOV - V3
RX Her	P	2021-06-13	22.5	SE	47	18:28	12.6		7.3-7.8	ONDREJOV3	0	134°	ONDREJOV - V3
RX Her	P	2021-06-13	22.5	SE	46	18:31	12.6	EA/DM D=5.5 h	7.3-7.9	BRNO	1	135°	
RX Her	P	2021-06-13	22.5	SE	46	18:31	12.6	EA D=5.5 h	7.3-7.9	O'CONNELL	1	135°	
MO:Aqr	S	2021-06-13	22.5	ESE	11	21:04	-2.2	EW P=0.4 d	9.9-10.3	BRNO	2	156°	
OO Aql	P	2021-06-13	22.5	ESE	33	19:48	9.3	EW P=0.5 d	9.2-9.9	O'CONNELL	1	146°	
RW:CrB	S	2021-06-13	22.5	SW	73	15:39	29.6	EA/SD: D=3.5 h	10.2-10.3	BRNO	1	94°	
V1461:Aql	S	2021-06-13	23.0	SE	20	19:44	-9.1	EA D=5.1 h	8.9-8.9	BRNO	10	163°	
V1073:Cyg	S	2021-06-13	23.0	ENE	33	21:25	33.7		8.2-8.6	O'CONNELL	1	121°	
ER:Sct	S	2021-06-13	23.0	SE	31	18:43	-7.7	EA/KE: D=5.9 h	9.1-9.3	BRNO	7	151°	
OO Aql	P	2021-06-13	23.0	ESE	37	19:48	9.3	EW P=0.5 d	9.2-9.9	BRNO	1	146°	
V2610:Oph	S	2021-06-13	23.0	SSE	39	17:54	-3.9	EW P=0.4 d	9.2-9.4	BRNO	1	139°	
V2610:Oph	S	2021-06-13	23.0	SSE	39	17:54	-3.9	EW P=0.4 d	9.2-9.4	BRNO	1	139°	
V 392 Vul	P	2021-06-13	23.0	ESE	50	19:34	24.3	ACV: P=1.4 d	9.8-10.2	BRNO	9	131°	
KZ Vir	P	2021-06-13	23.0	WSW	27	13:12	2.7	EB: P=1.1 d	8.4-8.5	BRNO	8	73°	
839 Oph	P	2021-06-13	23.0	SSE	51	18:09	9.2		0.5-0.5	ONDREJOV3	0	134°	ONDREJOV - V3
AW:UMa	S	2021-06-13	23.5	WNW	26	11:30	30.0	EW/KW P=0.4 d	6.8-7.1	BRNO	1	42°	
BR CrB	P	2021-06-13	23.5	WSW	76	15:53	36.3	EW P=0.8 d	9.9-10.1	BRNO	10	93°	
AH Vir	P	2021-06-13	23.5	W	21	12:14	11.8		9.2-9.7	ONDREJOV3	0	56°	ONDREJOV - V3
Pej026 Her	P	2021-06-13	23.5	E	81	17:53	43.8		0.5-0.5	ONDREJOV3	0	104°	ONDREJOV - V3
EI Lib	P	2021-06-13	23.5	SW	61	15:34	23.0		0.5-0.5	ONDREJOV3	0	96°	ONDREJOV - V3
BO:CVn	S	2021-06-13	23.5	WNW	55	13:59	40.8	EW P=0.5 d	9.5-10.1	BRNO	1	70°	
V 467 Peg	P	2021-06-13	23.5	E	26	21:53	18.3	EW P=0.3 d	9.4-9.5	BRNO	9	133°	
V 365:Peg	S	2021-06-13	23.5	E	32	21:39	23.0	EB P=1.1 d	10.1-10.1	BRNO	8	130°	
V 467:Vir	S	2021-06-13	23.5	WSW	18	13:23	-6.0	EW P=0.6 d	9.5-9.5	BRNO	6	79°	
MX:Del	S	2021-06-13	23.5	ESE	42	20:36	20.6	EB P=0.9 d	9.0-9.0	BRNO	4	136°	
LS:Del	S	2021-06-13	23.5	E	39	20:57	19.6	EW/KW P=0.4 d	8.6-8.8	BRNO	1	136°	
LU Vir	P	2021-06-13	23.5	WSW	18	13:27	-5.9	EB: P=0.5 d	7.8-8.2	BRNO	1	79°	
V 839 Oph	P	2021-06-13	23.5	SSE	53	18:09	9.2	EW/KW P=0.4 d	8.8-9.4	BRNO	1	134°	
EL:Boo	S	2021-06-13	23.5	WSW	46	14:48	13.9	EW P=0.4 d	9.4-9.4	BRNO	1	90°	
YY CrB	P	2021-06-13	24.0	W	70	15:51	37.8	EW P=0.4 d	8.6-9.1	BRNO	1	91°	
V 687:Cyg	S	2021-06-13	24.0	ESE	64	19:26	30.0	EA/SD: D=4.1 h	10.2-10.4	BRNO	2	125°	
1647+P Sgr	P	2021-06-13	24.0	SE	81	17:59	36.9		7.0-7.5	ONDREJOV3	0	110°	ONDREJOV - V3
V1792 Cyg	P	2021-06-14	0.0	E	54	20:52	38.0	ELL P=1.0 d	7.3-7.4	BRNO	9	118°	
2349 Sgr	P	2021-06-14	0.0	SSE	61	18:28	16.7		8.6-9.1	ONDREJOV3	0	131°	ONDREJOV - V3
V2373:Oph	S	2021-06-14	0.0	S	49	17:32	2.8	EB P=1.1 d	7.4-7.5	BRNO	7	130°	
836 Cyg	P	2021-06-14	0.0	E	50	21:21	35.7		8.5-9.2	ONDREJOV3	0	119°	ONDREJOV - V3
CK:Boo	S	2021-06-14	0.0	WSW	35	14:35	9.1	EW P=0.4 d	9.0-9.2	BRNO	1	89°	
V2377:Oph	S	2021-06-14	0.0	S	54	17:34	8.2	EB P=0.4 d	8.6-8.7	BRNO	7	127°	
FW CVn	P	2021-06-14	0.5	WNW	46	13:54	40.8	EW P=0.3 d	9.3-9.3	BRNO	10	69°	
GSC 2620 Her	P	2021-06-14	0.5	S	83	17:53	37.2		9.4-9.9	ONDREJOV3	0	109°	GSC 2620.760 He
V2612 Oph	P	2021-06-14	0.5	SSE	52	18:29	6.8	EW P=0.4 d	9.3-9.7	BRNO	1	138°	
AK Her	P	2021-06-14	0.5	SSW	60	17:14	16.4	EW/KW P=0.4 d	8.3-8.8	BRNO	1	118°	
AK Her	P	2021-06-14	0.5	SSW	60	17:14	16.4	EW P=0.4 d	8.3-8.8	O'CONNELL	1	118°	
V 836 Cyg	P	2021-06-14	0.5	E	52	21:21	35.7	EB/KE P=0.7 d	8.6-9.2	BRNO	1	119°	
V 836 Cyg	P	2021-06-14	0.5	E	52	21:21	35.7	EB P=0.7 d	8.6-9.2	O'CONNELL	1	119°	
GO Cyg	P	2021-06-14	0.5	E	60	20:37	35.4	EB/KE P=0.7 d	8.5-9.1	BRNO	1	121°	
GO Cyg	P	2021-06-14	0.5	E	60	20:37	35.4	EB P=0.7 d	8.5-9.1	O'CONNELL	1	121°	
ER:Vul	S	2021-06-14	0.5	E	52	21:02	27.8		7.3-7.5	O'CONNELL	1	128°	
ER:Vul	S	2021-06-14	0.5	E	52	21:02	27.8	EW/DW/RS P=0.7 d	7.3-7.5	BRNO	1	128°	
V1167:Her	S	2021-06-14	0.5	SW	46	16:20	7.1	EW P=0.3 d	9.9-9.9	BRNO	3	113°	
V 413 Ser	P	2021-06-14	0.5	S	46	18:35	0.0	EA D=4.9 h	8.0-8.5	BRNO	1	144°	
RT Lac	P	2021-06-14	0.5	ENE	50	22:01	43.9	EB P=5.1 d	8.8-9.9	O'CONNELL	5	109°	
EM Boo	P	2021-06-14	0.5	W	44	14:49	24.8		9.1-9.4	ONDREJOV3	0	85°	ONDREJOV - V3
V 889:Cyg	S	2021-06-14	0.5	SE	68	19:34	28.5	EB/DM: P=1.7 d	10.0-10.4	BRNO	5	126°	
HT Vir	S	2021-06-14	0.5	WSW	19	13:46	5.1	EW/KW P=0.4 d	7.1-7.5	BRNO	1	79°	
V 885:Cyg	S	2021-06-14	0.5	SE	70	19:33	30.0	EB/DM P=1.7 d	9.9-10.2	BRNO	5	125°	
MY Ser	P	2021-06-14	0.5	S	58	18:18	12.2		7.5-7.5	ONDREJOV3	0	132°	ONDREJOV - V3
U Peg	P	2021-06-14	0.5	E	16	23:58	16.0	EW/KW P=0.4 d	9.2-9.8	BRNO	1	115°	
U Peg	P	2021-06-14	0.5	E	16	23:58	16.0	EW P=0.4 d	9.2-10.1	O'CONNELL	1	115°	

http://www.motl.cz/dmotl/predpovedi/

Quelles variables choisir ?

- Quelques conseils :
  - Attention aux temps indiqués
    - TU
    - Locaux
    - Géocentriques
    - Héliocentriques
  - Recoupez les prévisions

Observations

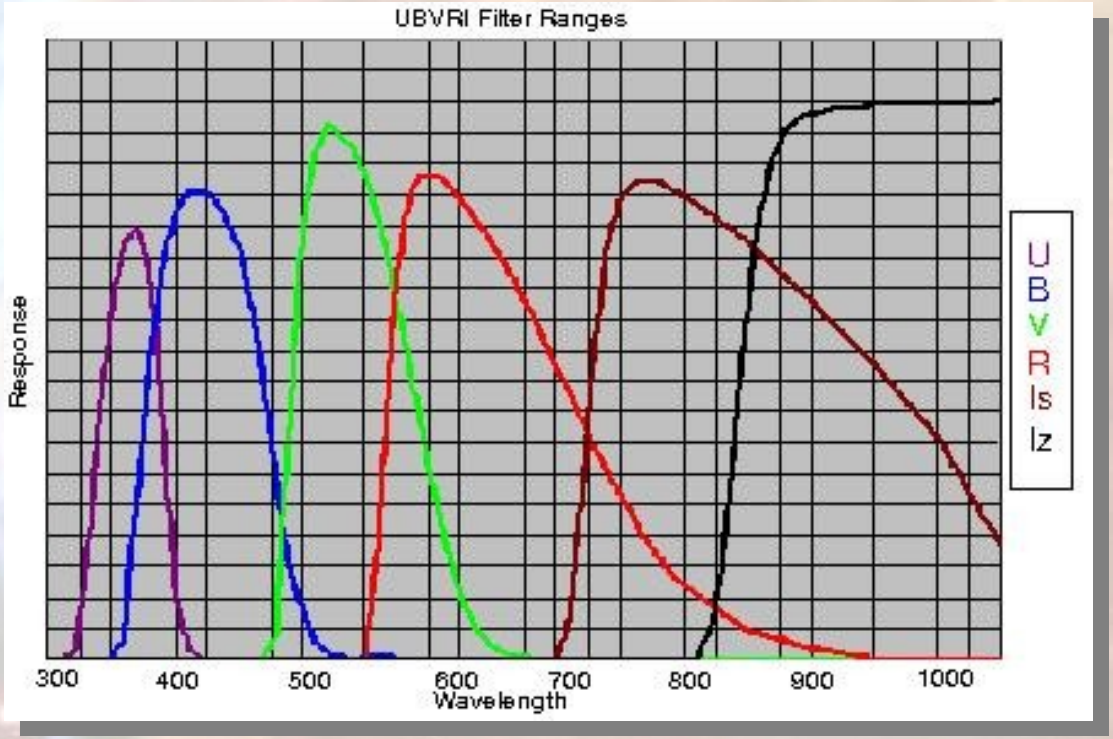
- Avoir son ordinateur à l'heure
- Observations idéales (acquisitions des images)
  - 1h30 avant le minima
  - 1h30 après le minima
- 1 à 3 étoiles (maxi) par nuit suivant la saison
- ***Faire ses images de calibrations***
- ……

La filtration

- Certains programmes sont possibles sans utiliser de filtres
- Cela dépend du type d'étoile que l'on observe
  - Exemples :
    - RR Lyrae
    - Binaires à Eclipses
    - Certaines Cataclysmiques
- Les filtres a utiliser sont de la gamme U B V R I
- Ne pas confondre avec les filtres L R G B type Astronomik

La filtration

- Filtre V (pour photométrie)
  - minimum filtre V, les caméras → réponses fréquentielles différentes. Indispensable pour avoir des mesures cohérentes.

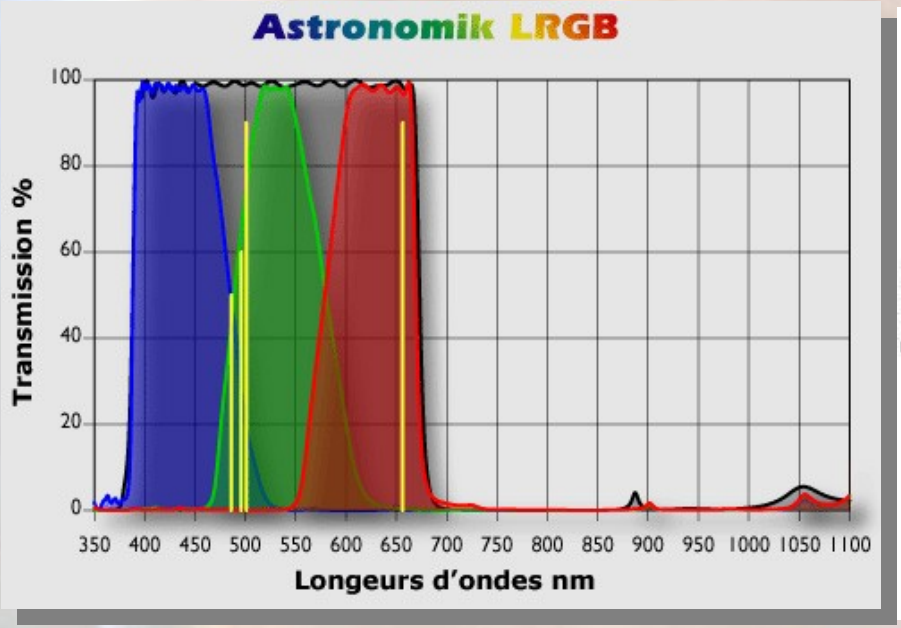


Approximate
Band Centers
U band ~ 0.350 um
B band ~ 0.450 um
V band ~ 0.550 um
R band ~ 0.600 um
I band ~ 0.800 um

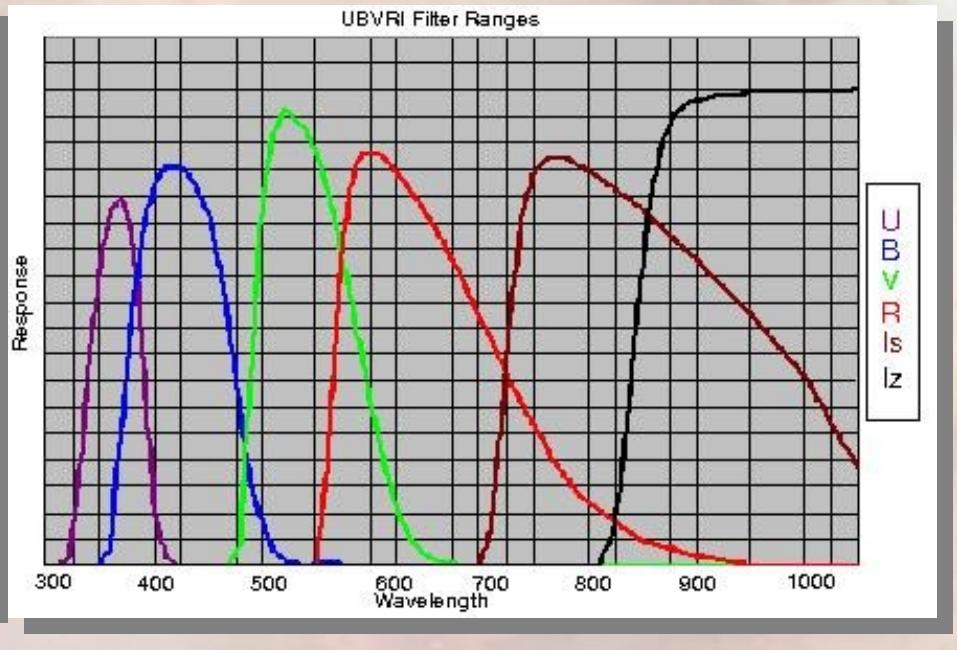
The Johnson-Cousins Filter Standard System

La filtration

Comparaisons des filtres « RGB » et « UBVRI »

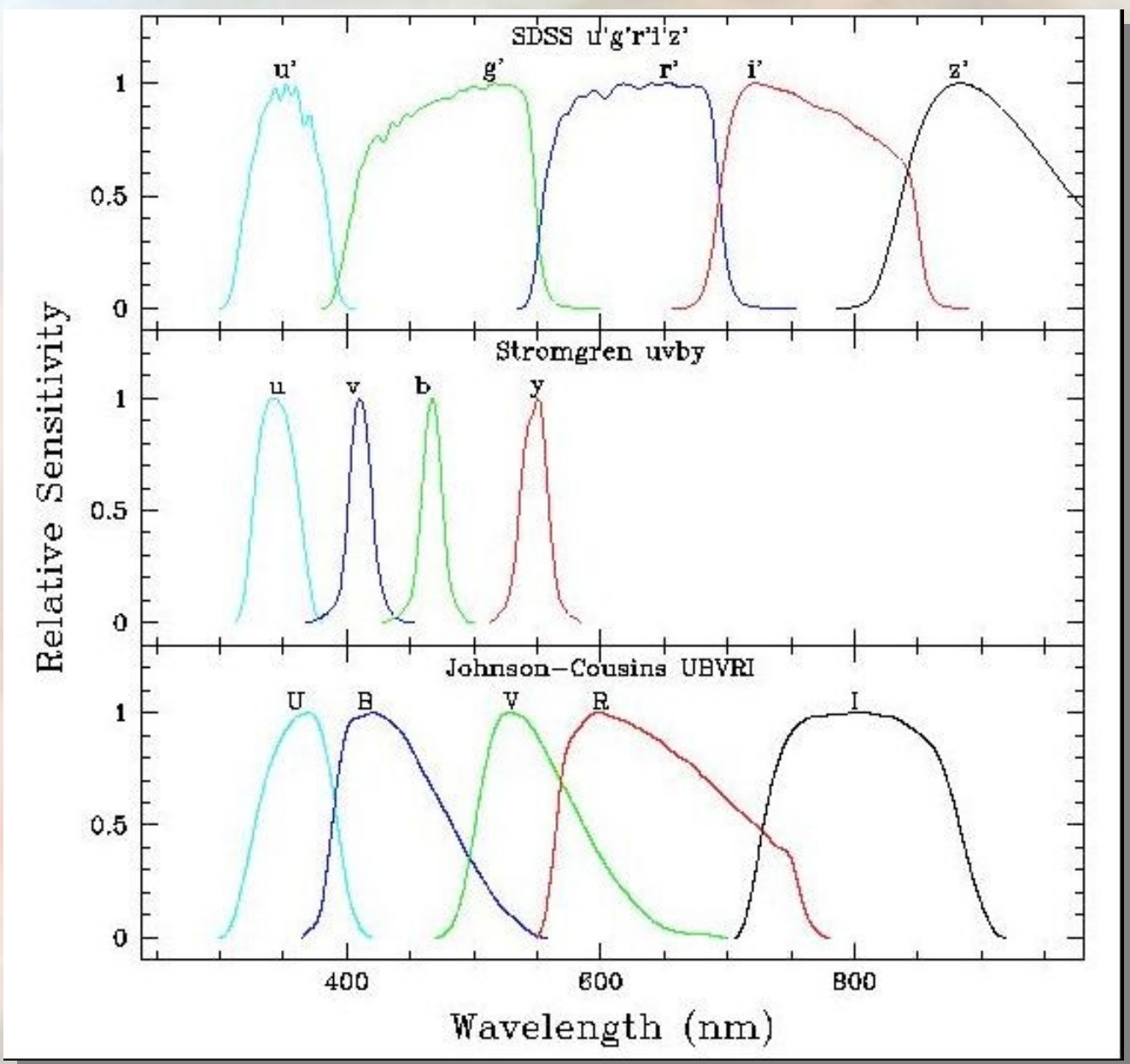


Astronomik LRGB



The Johnson-Cousins Filter Standard System

La filtration



La modélisation

- Pas si simple...
- Prérequis :
  - Courbes complètes multi-filtres
  - Faire une pré-lecture pour connaître le type de binaires à éclipses
- Logiciels de simulation :
  - Plusieurs types (adapté au data ou non)

L’envoi des données

- A des référents exclusifs
- Attention à vos propres calculs de Minima, sources d’erreurs :
  - Choix de l’époque et de la période
  - Méthodes de calculs

Les différentes contributions

- La recherche du 3ème et 4ème corps
- Les points chauds
- oEA stars
- BOT0.33
- Autres listes

Les différentes contributions

La recherche du 3ème et 4ème corps

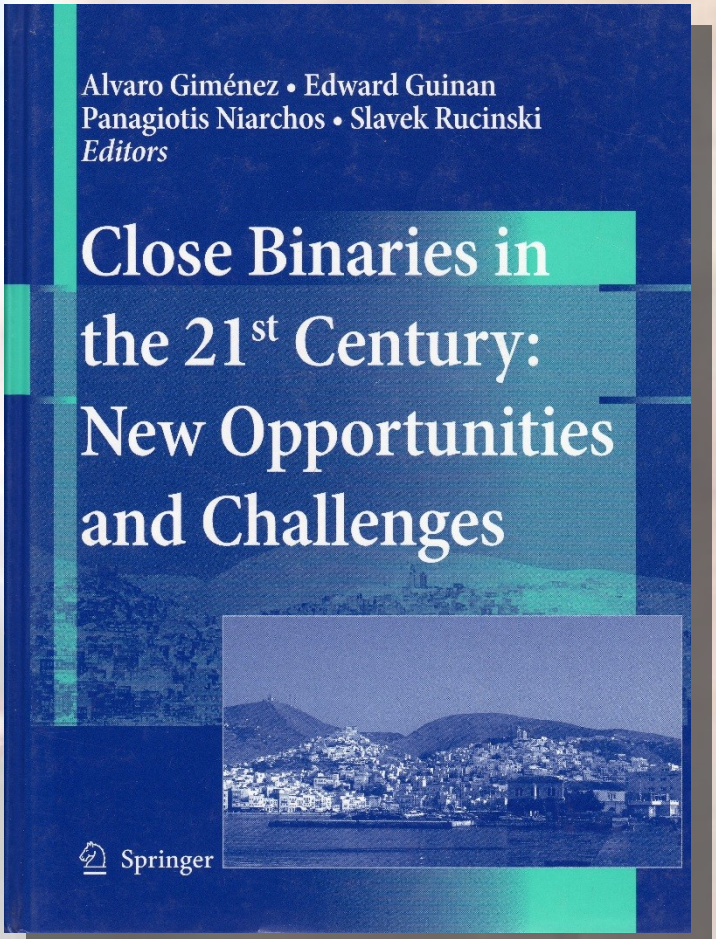
La recherche des 3ème et 4ème corps

OO AQL (9.2 – 10.8 EW/DW)

Trois études bien distinctes montrent que en fait nous ne voyons pas une étoile double mais en fait une étoile double avec deux corps qui orbitent autour.

Les études :

Eclipsing Binaries with Possible Light Time Effect (Petr Zasche – Miloslav Zejda – Lubos Brat) : ref : Astrophys Space Sci (2006) 304:175-177 décrit l'existence de plusieurs corps sans en préciser la période.



OO Aql and T LMi, another variation was found, so there is a possibility of a presence of the fourth body in the system, or magnetic activity in them. But we have not enough data to make a final decision. So the consequence is, that for the confirmation of the presence of LITE in these systems, we need detailed photometric, spectroscopic or astrometric data of these binaries.

Acknowledgements This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France, and of NASA's Astrophysics Data System Bibliographic Services. This investigation was supported by the Czech-Greek project of collaboration RC-3-18 of Ministry of Education, Youth and Sport and by the Grant Agency of the Czech Republic, grant No. 205/04/2063

References

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Mayer, P.: BAICz **41**, 231 (1990)
Naimiy, H.M.K., Al-Masharfeh, T.H.S.: ApSS **273**, 83 (2000)
Yang, Y., Liu, Q.: AJ **122**, 425 (2001)

OO AQL (9.2 – 10.8 EW/DW)

Deuxième étude :

The low-mass interacting binary system OO Aql revisited: a new quadruple system
(T. ˙ I¸cli1, D. Ko¸cak1, G. C¸ . Boz1 and K. Yakut) http://arxiv.org:1302.6686

Les auteurs indiquent une période de 52 ans pour le quatrième corps et 20 ans pour le troisième corps.

The low-mass interacting binary system OO Aql revisited: a new quadruple system

T. İçli[1], D. Koçak[1], G. Ç. Boz[1] and K. Yakut[1,2]
Department of Astronomy and Space Sciences, University of Ege, 35100, Bornova–İzmir, Turkey
Institute of Astronomy, University of Cambridge, Madingley Road, Cambridge CB3 0HA, UK

Table 2: Orbital elements of the quadruple system OO Aql. The standard errors 1σ, in the last digit are given in parentheses.

Parameter	Unit	Value
Binary system – Star AB		
Initial epoch, $T_\circ$	HJD	24 38239.696(2)
Period, $P_{\rm bin}$	day	0.50679020(8)
Period change ratio $\frac{\dot{P}}{P}$	yr	$4(1) \times 10^{7}$
Mass transfer ratio, $\frac{\dot{M}}{M}$	$M_\odot yr^{-1}$	$5(1) \times 10^{-8}$
Seperation between stars, a	$R_\odot$	3.34(2)
Parallax, π	mas	7.35
Star C		
Initial epoch, $T_\circ(C)$	HJD	24 54392
Orbital period, P_C	yr	20(1)
Amplitude, A_C	day	0.0041(2)
Eccentricity, e		0.44(7)
Longitude of the periastron, ω'_C	$^\circ$	164
Mass function, $f(m_C)$ l	$M_\odot$	0.0011
Minimum mass, $M_{C(\rm min)}$	$M_\odot$	0.19
Mass, $M_{C,i'=60^\circ}$	$M_\odot$	0.23
Mass, $M_{C,i'=30^\circ}$	$M_\odot$	0.47
Angular distance, a''_C	mas	76
Star D		
Initial epoch, $T_\circ(D)$	HJD	24 55622
Orbital period, P_D	yr	52(2)
Amplitude, A_D	day	0.019(1)
Eccentricity, e		0.220(20)
Longitude of the periastron, ω'_D	$^\circ$	20
Mass function, $f(m_D)$	$M_\odot$	0.0130
Minimum mass, $M_{D(\rm min)}$	$M_\odot$	0.42
Mass, $M_{D,i'=60^\circ}$	$M_\odot$	0.49
Mass, $M_{D,i'=30^\circ}$	$M_\odot$	0.95
Angular distance, a''_D	mas	138

OO AQL (9.2 – 10.8 EW/DW)

Troisième étude :

Eclipsing Binaries with Possible Tertiary components (LeRoy F. Snyder), voir http://www.socastrosci.org/images/SAS_2013_Proceedings.pdf pour télécharger l'article.

l'auteur fait l'interprétation de la courbe O-C et trouve une période de 19.77 ans pour le troisième corps

Eclipsing Binaries with Possible Tertiary Components

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King Canyon Observatory
357 Coventry Drive Carson City, NV 89703
snyderlf@att.net

Abstract

Many eclipsing binary star systems (EBS) show long-term variations in their orbital periods which are evident in their O-C (observed minus calculated period) diagrams. This research carried out an analysis of 324 eclipsing binary systems taken from the systems analyzed in the Bob Nelson's O-C Files database. Of these 18 systems displayed evidence of periodic variations of the arrival times of the eclipses. These rates of period changes are sinusoidal variations. The sinusoidal character of these variations is suggestive of Keplerian motion caused by an orbiting companion. The reason for these changes is unknown, but mass loss, apsidal motion, magnetic activity and the presence of a third body have been proposed. This paper has assumed light time effect as the cause of the sinusoidal variations caused by the gravitational pull of a tertiary companion orbiting around the eclipsing binary systems. An observed minus calculated (O-C) diagram of the 324 systems was plotted using a quadratic ephemeris to determine if the system displayed a sinusoidal trend in theO-C residuals. After analysis of the 18 systems, seven systems, AW UMa, BB PEG, OO Aql, V508 Oph, VW Cep, WCrv and YY ERI met the benchmark of the criteria of a possible orbiting companion. The other 11 systems displayed a sinusoidal variation in the O-C residuals of the primary eclipses but these systems in the Bob Nelson's O-C Files did not contain times of minimum (T_{min}) of the secondary eclipses and therefore not conclusive in determining the presents of the effects of a tertiary companion. An analysis of the residuals of the seven systems yields a light-time semi-amplitude, orbital period, eccentricity and mass of the tertiary companion as the amplitude of the variation is proportional to the mass, period and inclination of the 3rd orbiting body. Knowing the low mass of the tertiary body in the seven cases the possibility of five of these tertiary companions being brown dwarfs is discussed.

4.3 OO AQL

OO Aql is a W UMa binary with a combined mass $M_{1\text{-}2}$ of 1.5 $M_\odot$ and a period of 0.51 days. The O-C diagram, Figure 5, covers 37 years with 1035 data points. The quadratic equation

$$\int(e) = 38613.22334 (\pm 8.7^{-4}) + 0.5068 (\pm 1.5^{-7})E + 1.31150^{-11} (\pm 5.54^{-12}) E^2 \quad (3)$$

produced only a 4% improvement over the parabolic fit. The third body period is 19.77 years and requires a minimum mass of 0.155 $M_\odot$ since the mass function is

$$\int(M) = 0.0245\ M_\odot.$$

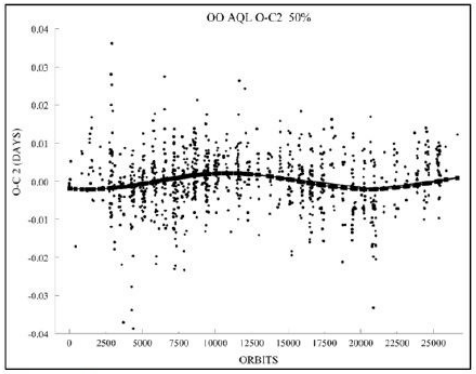
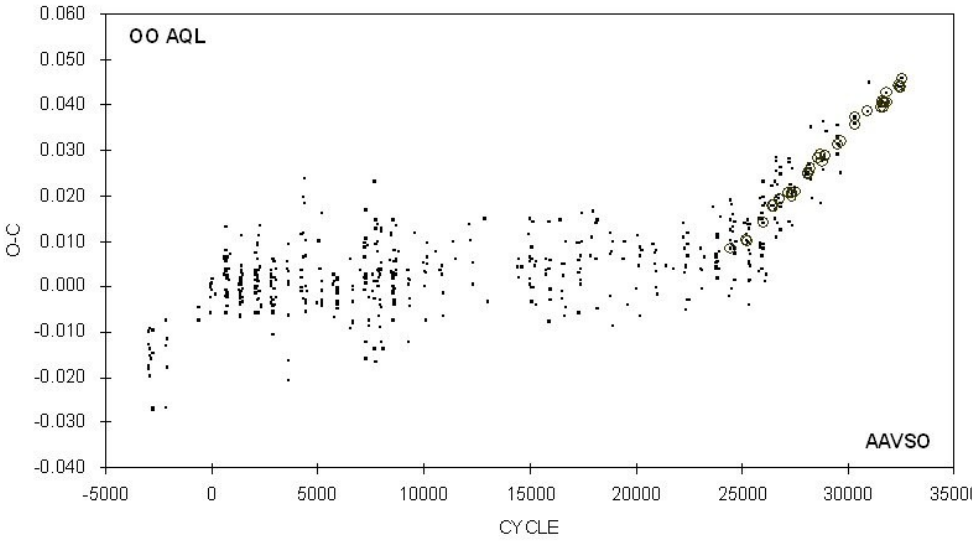
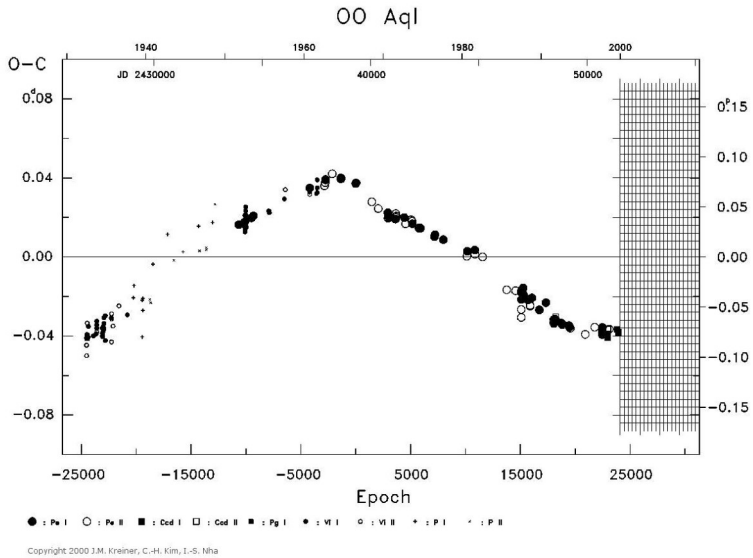


Figure 5. OO AQL.

OO AQL (9.2 – 10.8 EW/DW)





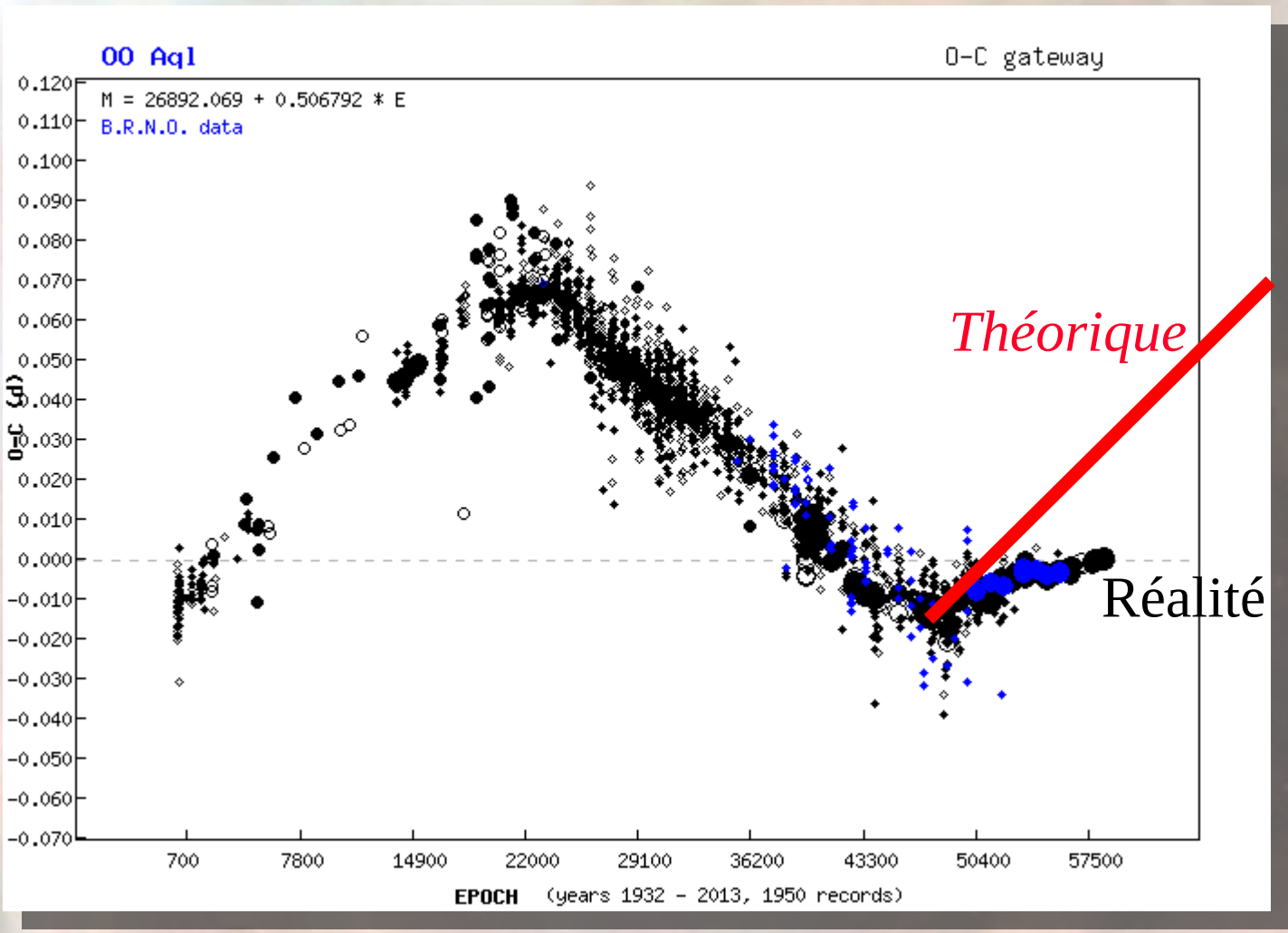
Construction de la courbe O-C sur une durée de 60 ans

Si on reprend sur une courbe tout les instants des minima, nous obtenons la courbe des O-C (Observations-Calculés), en abscisse l'instant de la mesure et en ordonné l'écart de la mesure.

Pour en savoir plus, vous pouvez consulter ce lien :

http://vs-compas.belastro.net/bulletin/issue/3/p8

OO AQL (9.2 – 10.8 EW/DW)



Chaque point représente un minima (mesures amateurs)

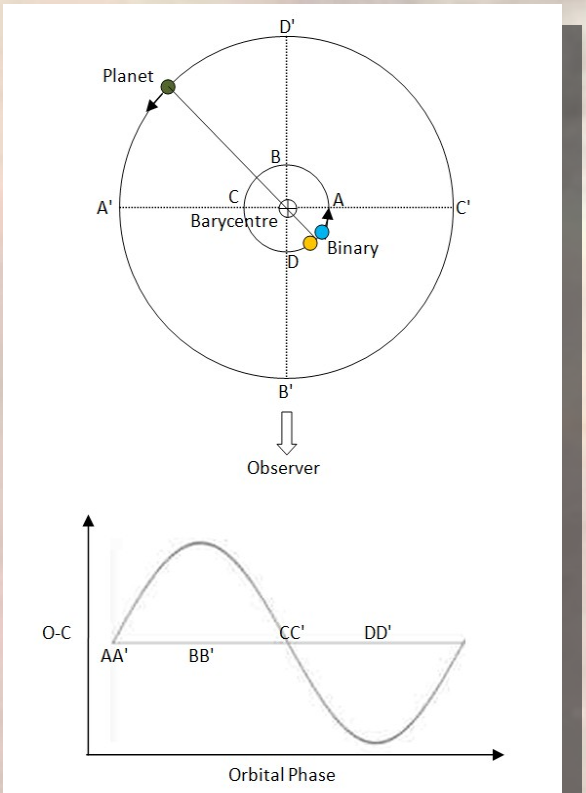
http://var.astro.cz/ocgate/ocgate.php?star=OO%20Aql

La recherche du troisième corps

SPADES

Search for Planets Around Detached Eclipsing Systems

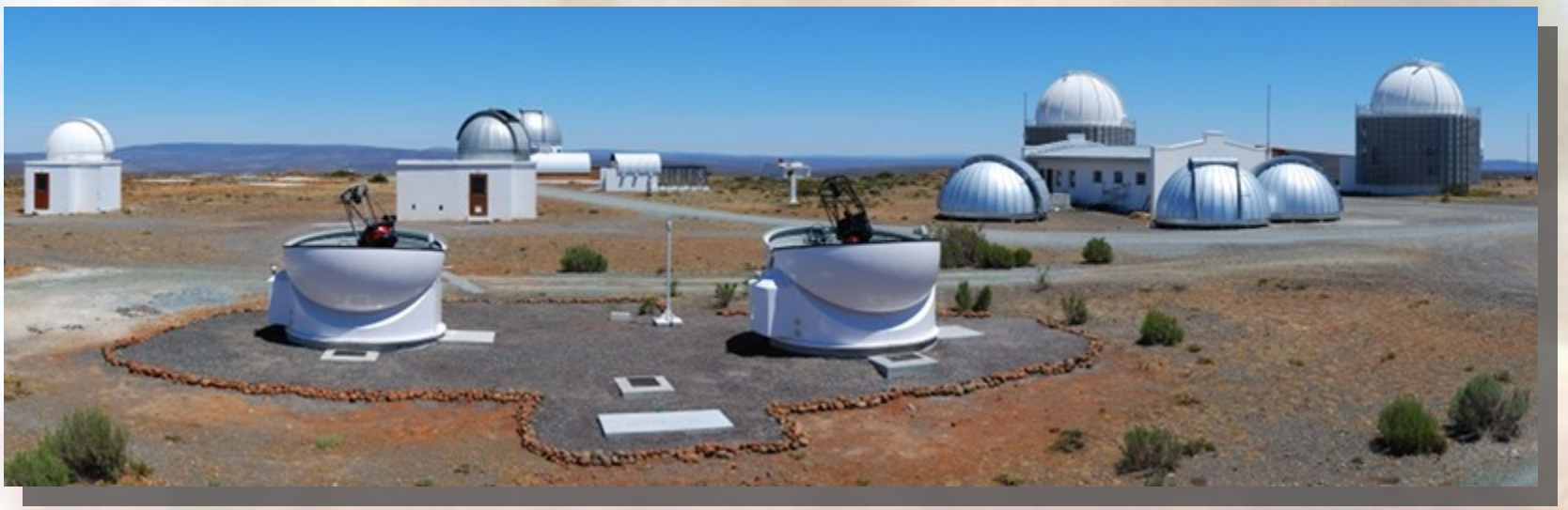
- Pour les photométristes CCD - BVR
  - Chefs de projet :
    - Dr Simon O'Toole (AAO) – Pro.
    - Dr Tom Richards (VSS) – Am.
  - Détection d'exoplanètes autour des EB
  - Listes par Constellations et RA
  - Coordinations et supports
  - Fichiers de données pour le logiciel
    « Ephemerides »
  - Http://www.varstarssouth.org



Source : **http://www.varstarssouth.org**

La recherche du troisième corps

SOLARIS – version pro de SPADES



- Réseau de 4 télescopes de 500 mm F/15 Ritchey Chretien – CCD ANDOR iKon-L 2k x 2k
- Australie - Afrique – Amérique du Sud
- 350 binaires à éclipses à mesurer (photométrie + spectro)

Source : **http://www.projectsolaris.eu/**

Les différentes contributions

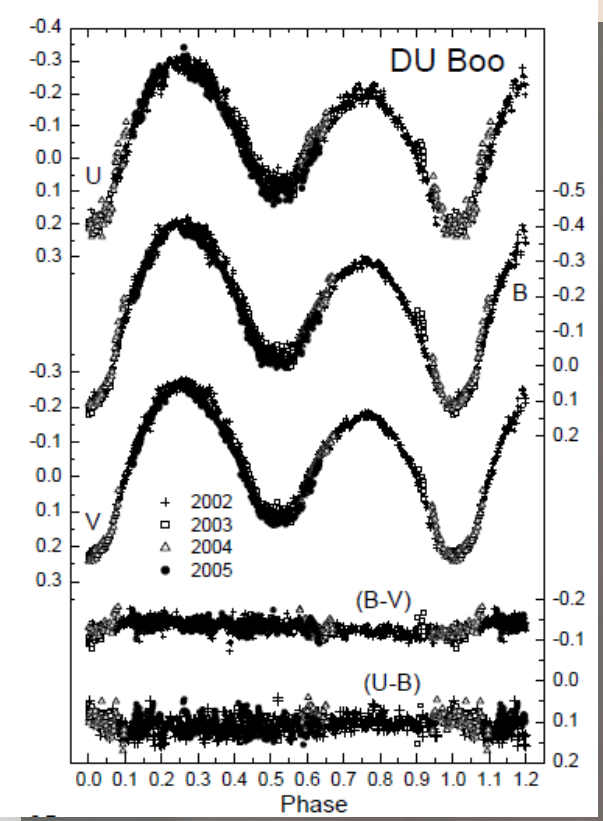
Les points chauds

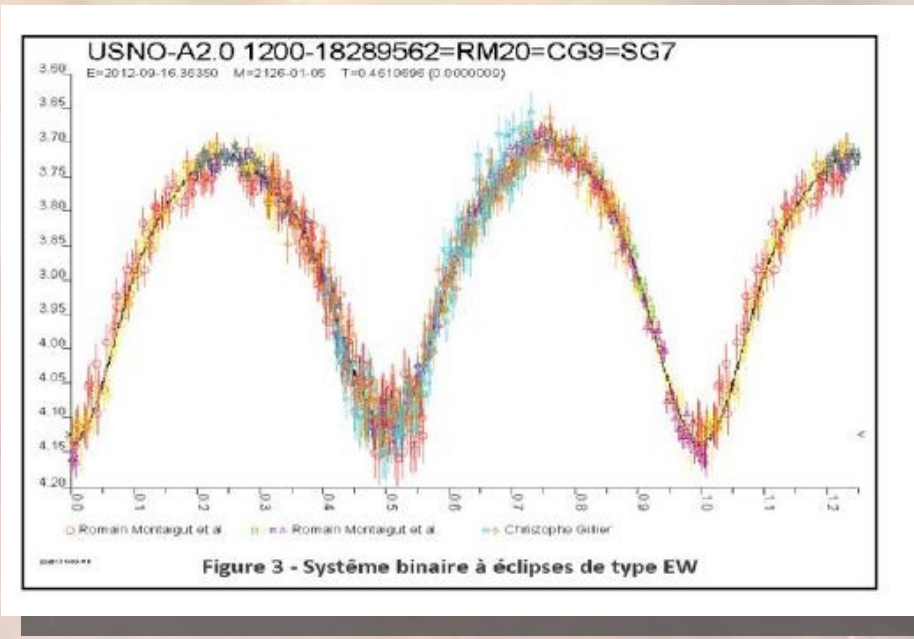
Effet O'Connell

Astron. Nachr. / AN **332**, No. 6, 607 – 615 (2011) / **DOI** 10.1002/asna.201111569

O'Connell effect in early-type contact binaries

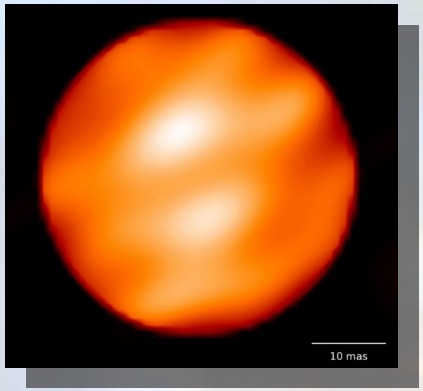
DU Boo and AG Vir T. Pribulla et al.





RM20 – Source NGC69 – N°102 – Romain Montaigut

Cause possible : Hot spot sur l'étoile secondaire



La recherche des « points chauds » sur l'une des étoiles

Mon. Not. R. Astron. Soc. **000**, 000–000 (0000) Printed 21 November 2014 (MN LATEX style file v2.2)

Doppler images of the eclipsing binary ER Vulpeculae

Yue Xiang,[123⋆] Shenghong Gu,[12] A. Collier Cameron[4] and J. R. Barnes[5]
[1] *Yunnan Observatories, Chinese Academy of Sciences, Kunming 650011, China*
[2] *Key Laboratory for the Structure and Evolution of Celestial Objects, Chinese Academy of Sciences, Kunming 650011, China*
[3] *University of Chinese Academy of Sciences, Beijing 100049, China*
[4] *School of Physics and Astronomy, University of St Andrews, Fife KY16 9SS, UK*
[5] *Center for Astrophysics Research, University of Hertfordshire, College Lane, Hatfield, Hertfordshire AL10 9AB, UK*

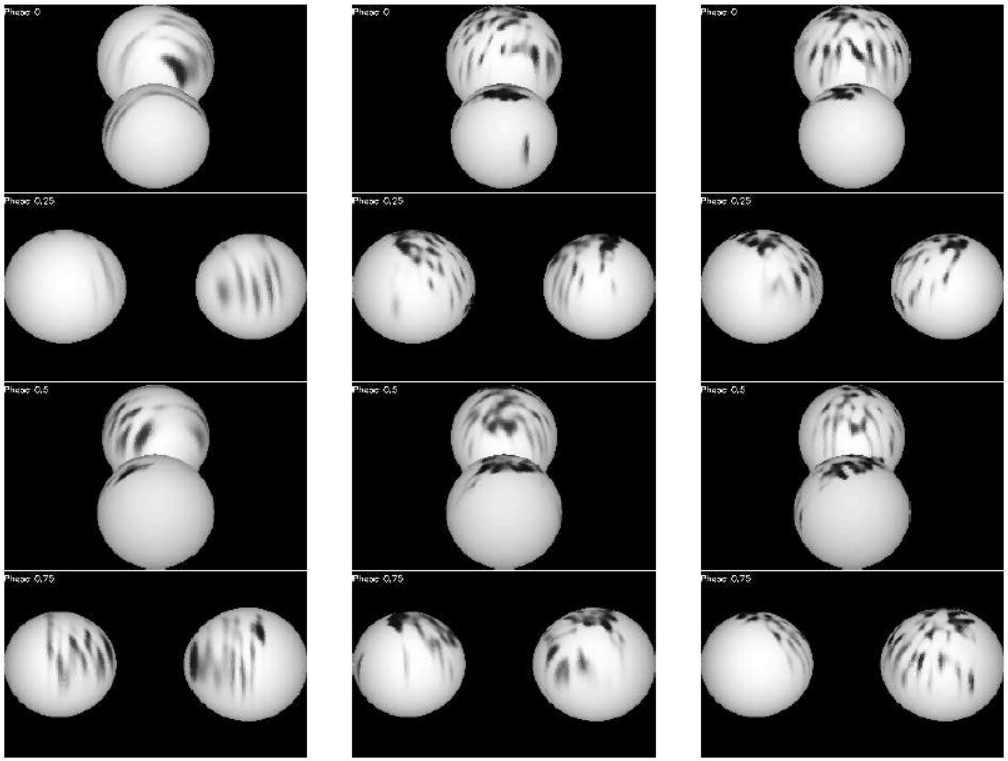


Figure 6. The images of the binary system ER Vul at orbital phases 0, 0.25, 0.5 and 0.75 for (a) 2004 November, (b) 2006 September and (c) 2008 November.

Une liste d'étoiles à suivre

https://www.aavso.org/oconnell-effect-target-list
https://www.aavso.org/sites/default/files/O'Connell_Effect_Target_List.csv

- 250 cibles
- Magnitudes < 13
- Périodes < 10 jours

CATALOG SEARCH PAPERS CHARTER HELP LOGIN

KIC 12602985

KIC 12602985 has the following values in the Kepler Input Catalog:

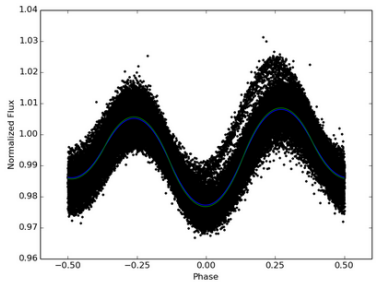
Teff	kmag	RA	DEC	GLon	GLat	KOI	MAST
4878.0000	15.1520	290.8604	51.6791	83.1553	16.3159		data target

1 ephemeris in the catalog:

InCat	period	period error	bjd_0	bjd_0 error	pdepth	sdepth	pwidth	swidth	sep	morph	LC data	SC data	LC Figs	SC Figs	ETV	Flags
True	0.2508689	0.0000002	55002.090625	0.014561	0.0318	0.0229	0.2569	0.2431	0.5153	0.88	data pf freq etv		all raw dtr pf freq etv		short	UNC

and the following additional information:

Notes:



Les différentes contributions

oEA stars

Oscillating Algol-type stars (oEA)

- Modèles de Roche pour surfaces déformées par effets de marées (config. semi-détachée, type Algol)
- Evolution avancée: fin du transfert de masse rapide entre les composantes
- Composante de type spectral A ou F, étoile pulsante de la classe 'étoiles δ Scuti'
- Période(s) de pulsation courte(s) (~0.5 - 3 h)
- Amplitude(s) faible(s) (mmag)
- Qqs. douzaines détectées (Terre) → centaines identifiées (espace)

Source : Patricia LAMPENS – Observatoire Royal - Bruxelles

Les différentes contributions

BOT0.33

BOT0.33

http://www.astrosurf.com/jfcoliac/3%20projet%20BOT0.33/bot0.33.html

Liste établie par Jean-François COLIAC

« Le projet BOT0.33 est simple : réaliser un suivi photométrique de binaires dont la période est de 0,.33 jours ou moins. »

- 35 cibles (catalogue GCVS)
- Magnitudes < 14.7

Les différentes contributions

Les étoiles « oubliées »

Les étoiles « oubliées »

https://www.aavso.org/new-otero-ebs

La liste de Sébastien Otero and all
https://www.aavso.org/sites/default/files/images/Otero%2Bv02.xls

- 1126 cibles (172 du catalogue GCVS)
- Magnitudes < 15.5
- Périodes : de 0.2 à 509 jours

Comment débuter ?

Comment débuter ?

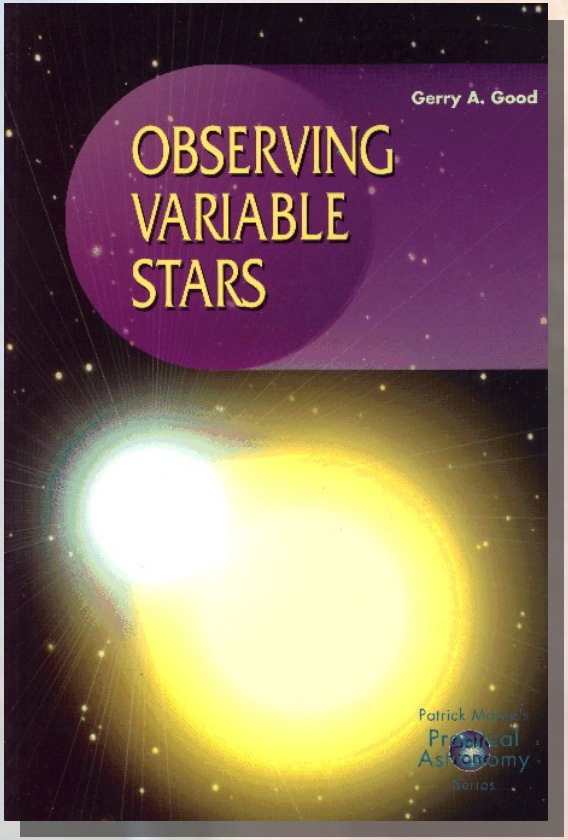
Bien préparer les éphémérides

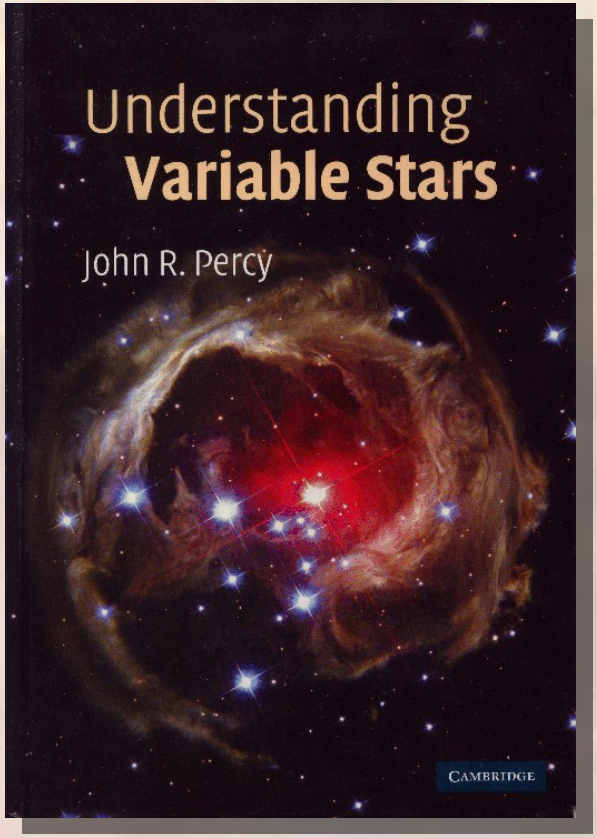
- Choisir une cible déjà bien observée

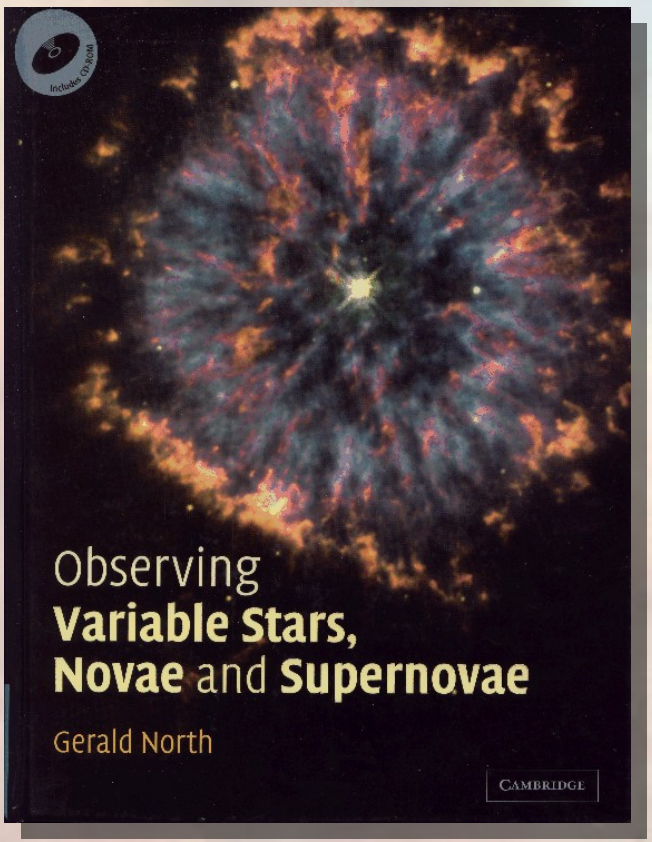
- Prendre le temps d'observer (durée 4 heures)
- Soigner les images et les images de calibrations
- Prétraiter… bien sûr
- Réduire
- Envoyer les données… vous serez publié(e)
-
-
- …..
- Etablir son propre programme et se faire plaisir

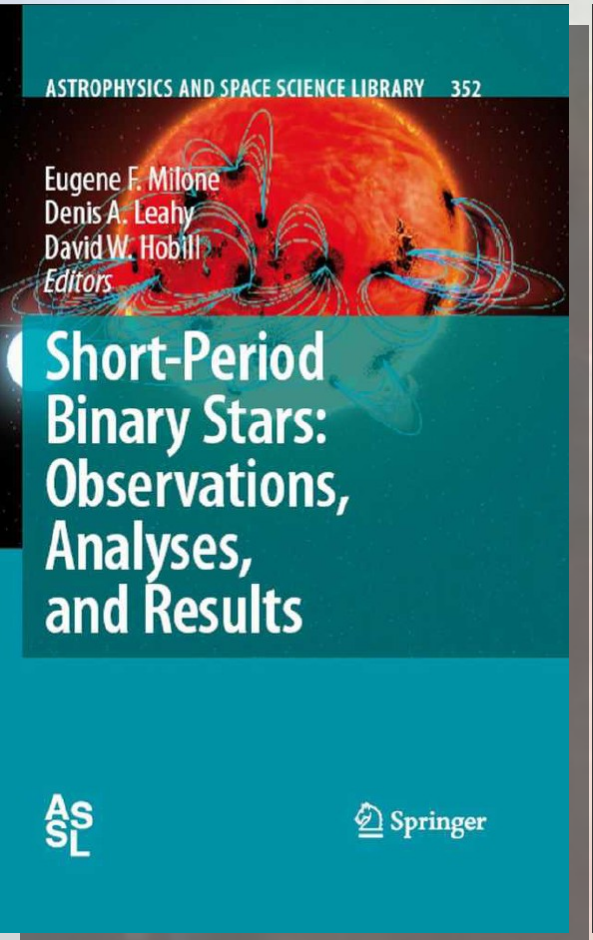
Ressources et questions

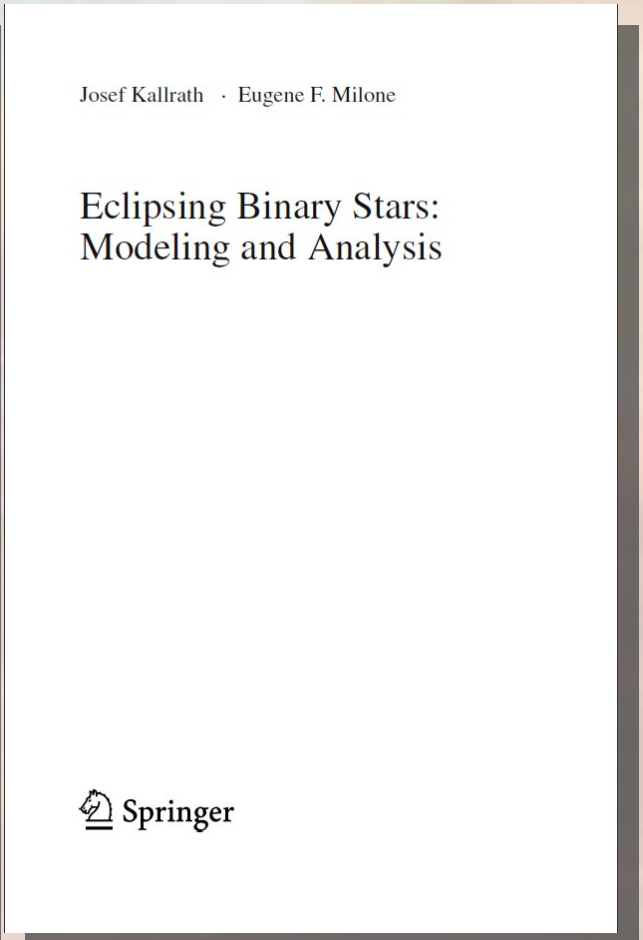
Littérature

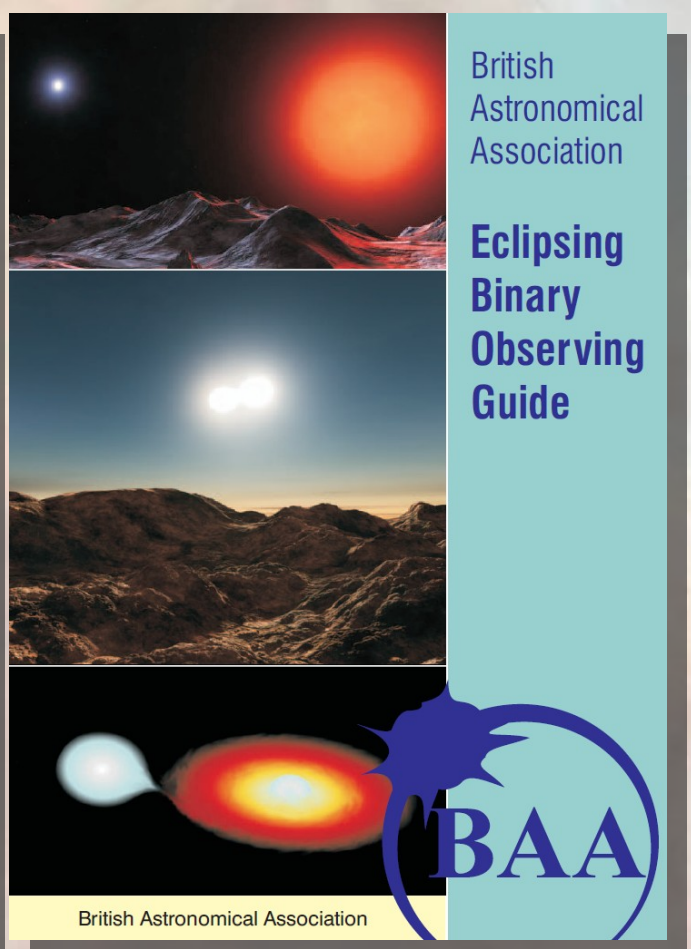




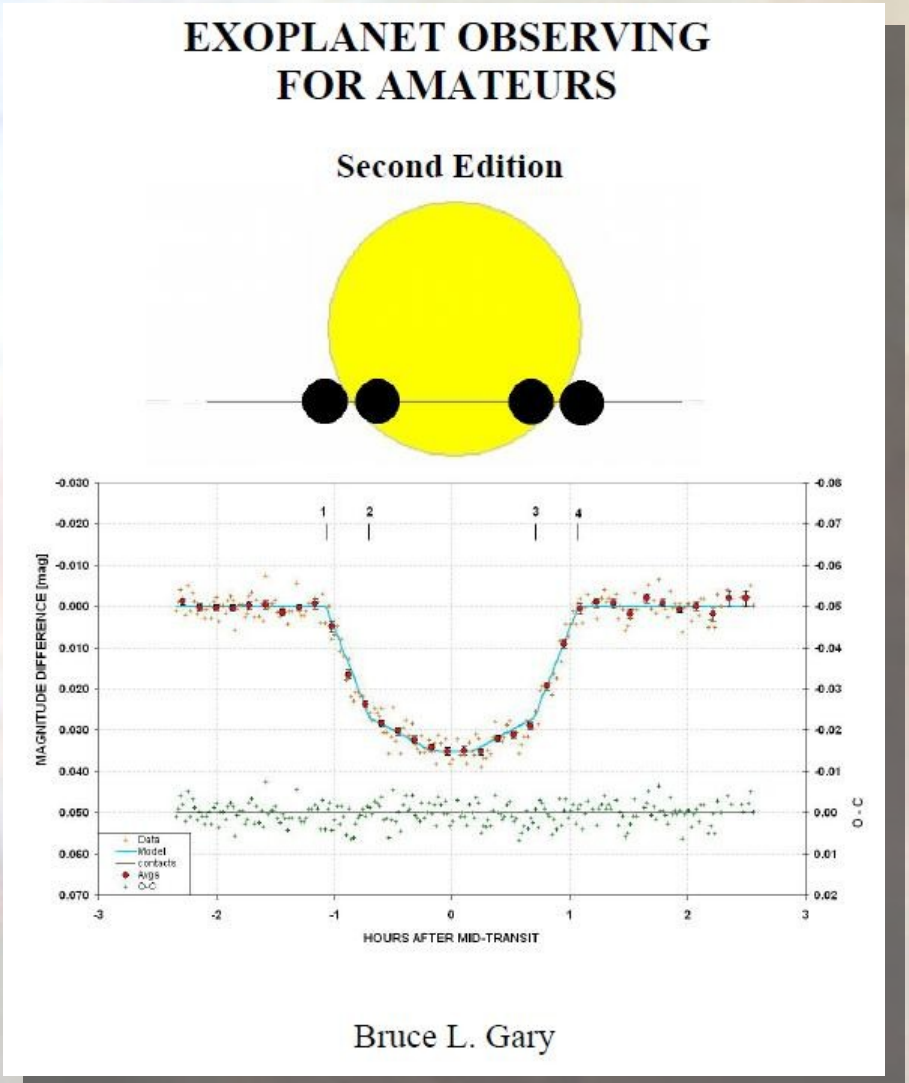


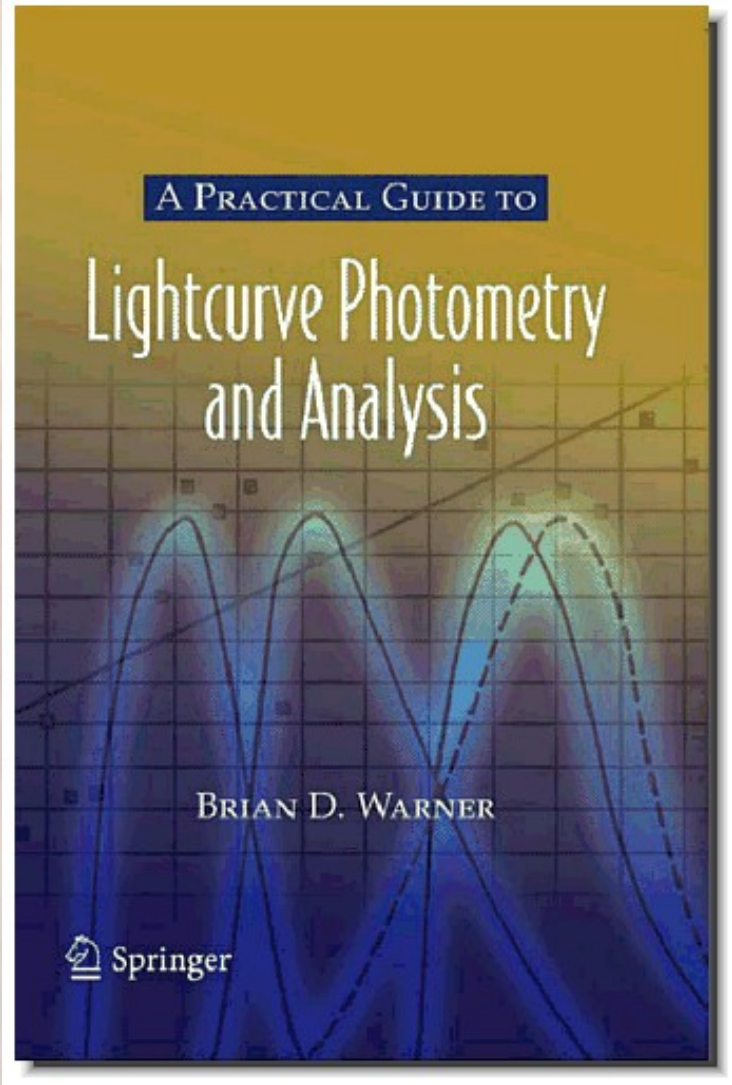

ASTROPHYSICS AND SPACE SCIENCE LIBRARY 352
Eugene F. Milone
Denis A. Leahy
David W. Hobill
Editors
Short-Period Binary Stars: Observations, Analyses, and Results
ASSL
Springer


Josef Kallrath · Eugene F. Milone
Eclipsing Binary Stars: Modeling and Analysis
Springer


British Astronomical Association
Eclipsing Binary Observing Guide
BAA
British Astronomical Association

Littérature





Littérature

- *An Introduction to Astronomical Photometry Using CCDs*
  by W. Romanishin Universitiy of Oklahoma
  Livre de 175 pages reprenant un cours universitaire de niveau accessible sans trop de mathématiques, agréable à lire.
  http://observatory.ou.edu/wrccd22oct06.pdf

- http://www.astrosurf.com/luxorion/Documents/evolstar-bmauclaire.pdf en Français – 43 pages tout sur la vie des étoiles

- *Limites et lobes de Roche (SAF – collectif)*

Liens importants

- AAVSO American Association of Variable Star Observers
  site complet (base de données des « light curves », cartes, conseils, groupes de discussion, etc...). A mon avis le meilleur site! http://www.aavso.org

  Manuel pour l'observation visuelle des étoiles variables
  http://www.aavso.org/publications/manual/

  CCD Observing Manual
  http://www.aavso.org/observing/programs/ccd/manual/

- CVnet Cataclysmic Variable network
  Site donnant les dernières informations sur les CV, interviews de professionnels, bonne introduction aux CV. Compilation des données fournies au AAVSO.
  http://home.mindspring.com/~mikesimonsen/cvnet/index.html

- CBA Center for Backyard Astrophysics
  site spécialisé pour les Cataclysmiques, reprend entre autres le programme suggéré pour le mois avenir, groupe de discussion, alert notice par email.
  http://cba.phys.columbia.edu/

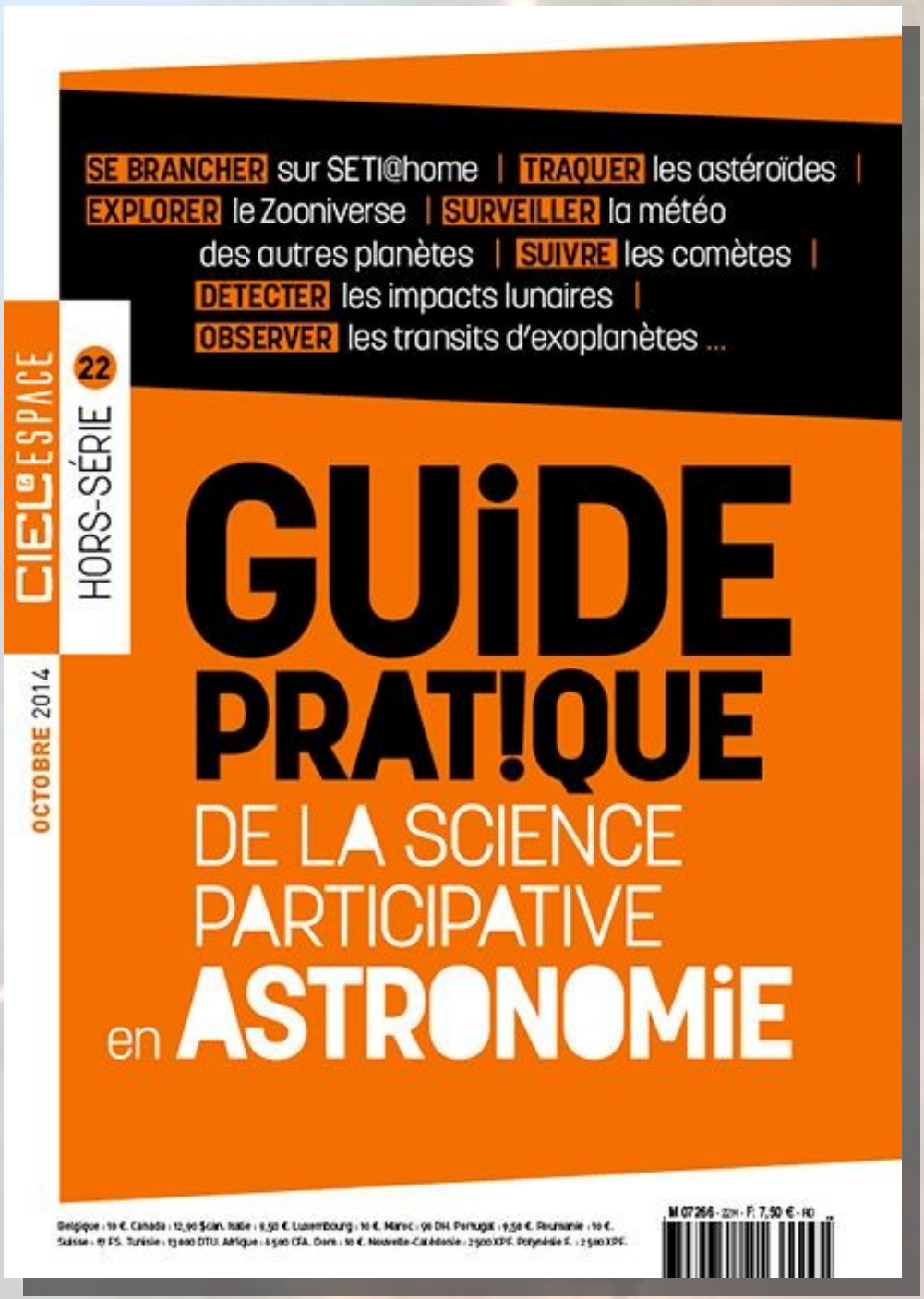
Liens importants

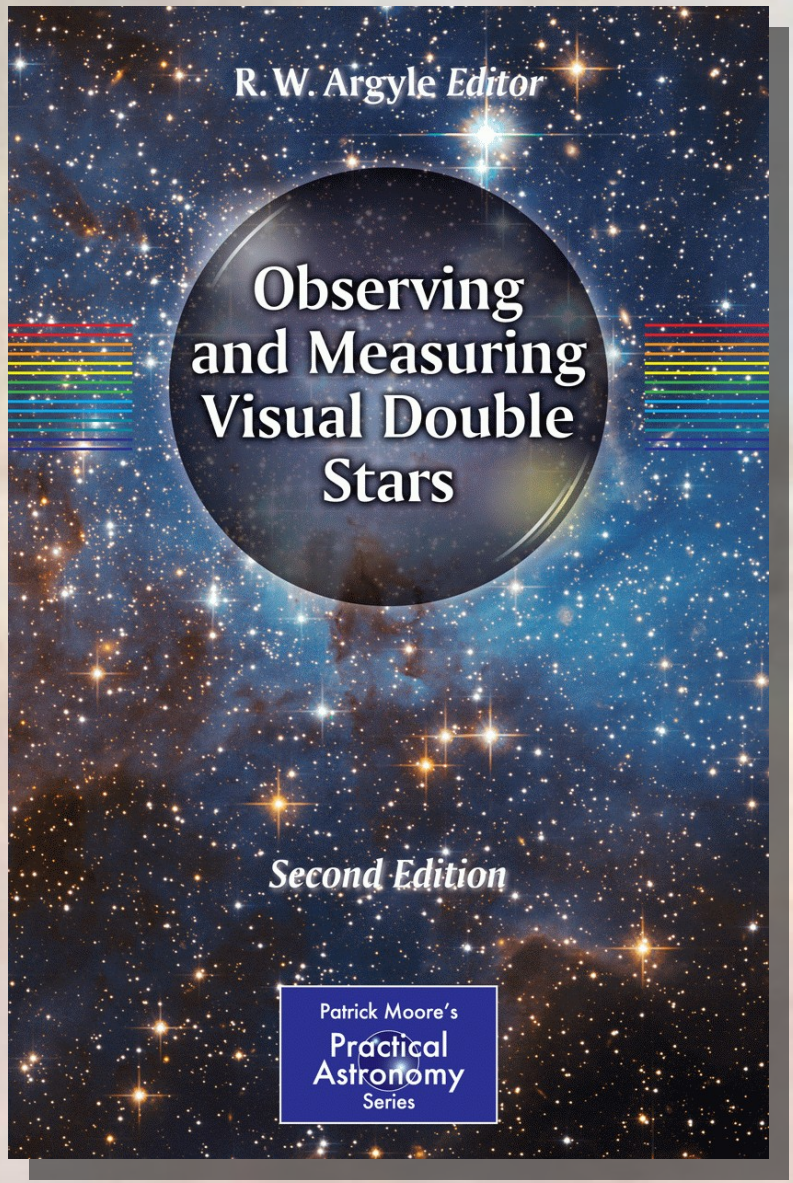
- IBVS

  http://www.konkoly.hu/IBVS/IBVS.html

- Jean Marc Breard
  - Etoilesvariables.fr
- Exercices de photométrie
  - http://gtn.sonoma.edu/members/photometry_exercise.php

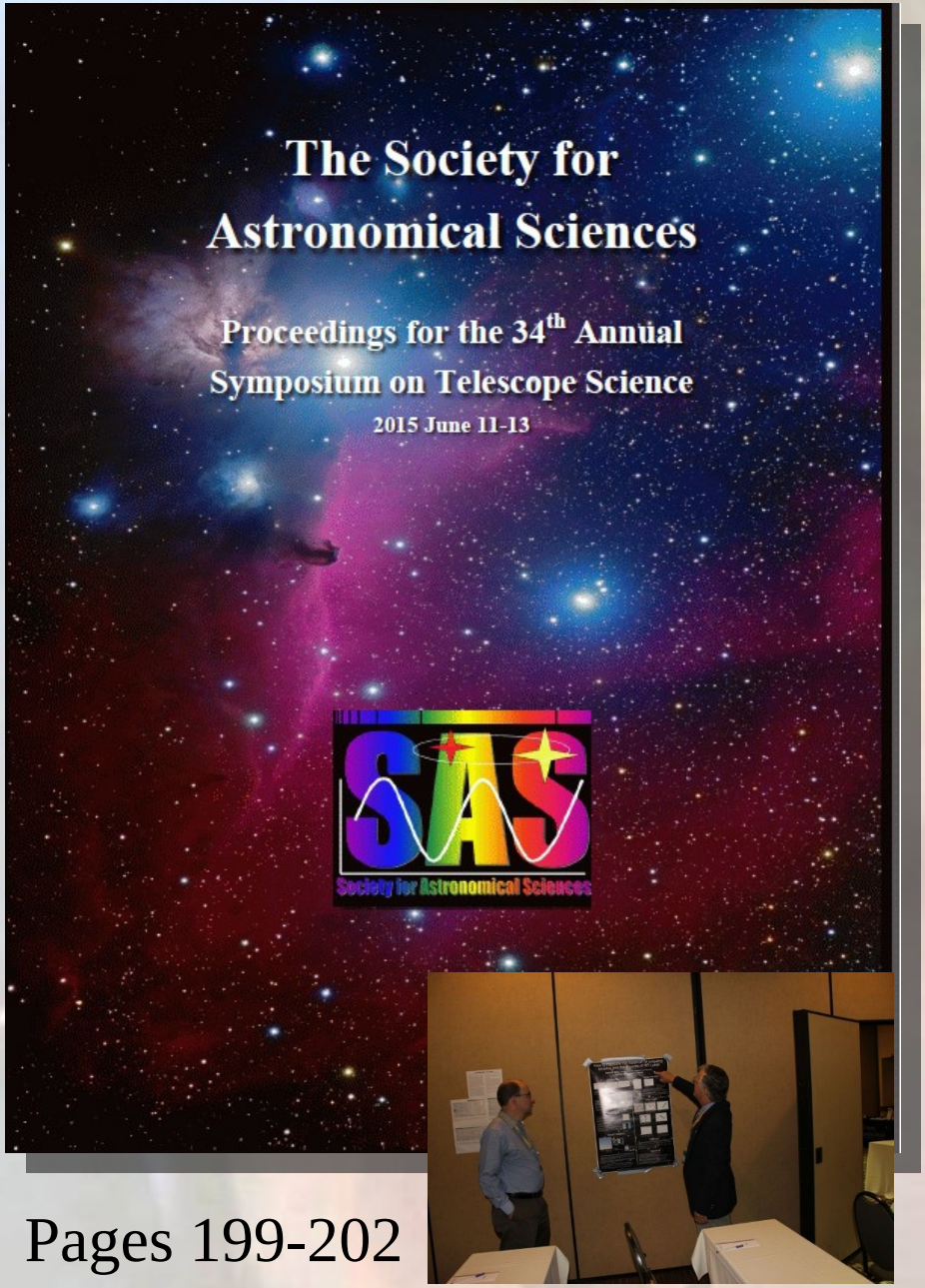
Mes publications (extrait)





16 auteurs – 423 pages – voir chapitre 20

http://www.springer.com



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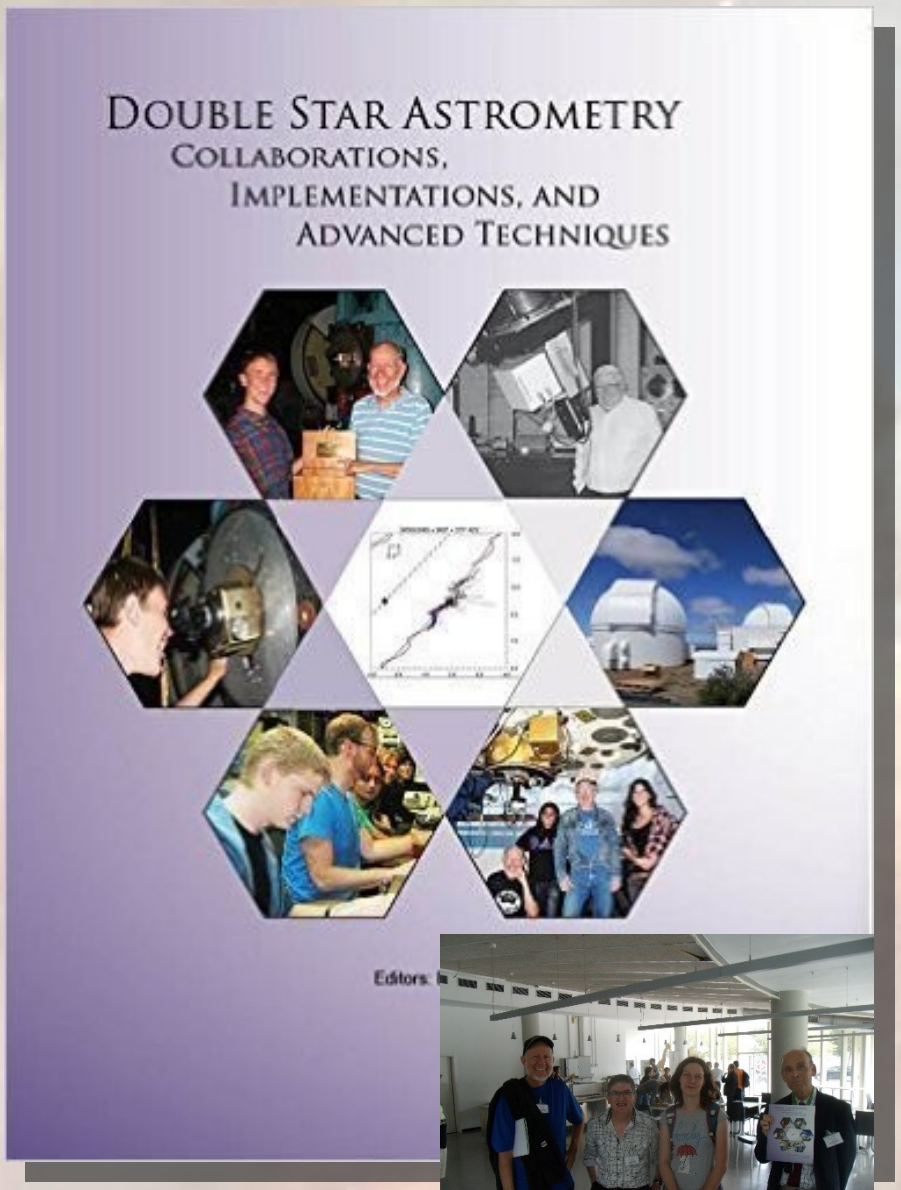

Pages 139-141

Quelques infos sont disponibles sur mon site

http://astrosurf.com/lcorp

MERCI de votre attention

des questions ?