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PHOTOELECTRIC MINIMA OF SOME ECLIPSING BINARY STARS

KILIÇOĞLU, T.; BAŞTÜRK, Ö.; ŞENAVCI, H. V.; YILMAZ, M.; TANRIVERDİ, T.; ALAN, N.; SİPAHİOĞLU, S.; AYDIN, G.; ÇELİK, L.; ÇALIŞKAN, Ş.; ELMASLI, A.; GÖKAY, G.; ÇAKAN, D.; DEMİRCAN, Y; EKMEKÇİ, F.; SELAM, S. O.; YÜCE, K.; ALBAYRAK, B.

Ankara University Observatory, 06837, Ahlatlıbel, Ankara, TURKEY
e-mail: tolgahan@astro1.science.ankara.edu.tr

Observatory and telescope:
30-cm Maksutov telescope of the Ankara University Observatory

Detector:	OPTEC SSP-5A photoelectric photometer (uncooled) containing a side-on R1414 Hamamatsu photomultiplier.

Method of data reduction:
Reduction of the observations were made in the usual way (Hardie, 1962).

Method of minimum determination:
The minima times were calculated using Kwee & van Woerden's (1956) method.

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V417 Aql	54297.4312	0.0003	II	*BV*	Sbş-Çlş
	54299.4671	0.0003	I	*BV*	Ul-Er
AC Boo	54189.4124	0.0001	I	*BV*	Cv-Sy
TZ Boo	54194.4432	0.0007	I	*BV*	Çl-Çv
	54228.3272	0.0004	I	*BV*	Ps-Klç
	54235.4587	0.0010	I	*BV*	Gr-Blg
MR Cyg	54343.3918	0.0006	II	*BV*	Gk-Iş
V2150 Cyg	54278.4673	0.0008	I	*BV*	Ul-Svm
	54286.4548	0.0007	I	*BV*	Çt-Çkn
	54310.4339	0.0007	II	*BV*	Ay-Alt
	54331.4269	0.0004	I	*BV*	Bn-Ay
	54344.4355	0.0016	I	*BV*	Cv-Erd
	54366.3528	0.0005	I	*BV*	Tr-Ay

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V836 Cyg	54306.4192	0.0005	I	*BV*	Svm-Er
	54336.4772	0.0003	I	*BV*	Bş-Sv
DM Del	54289.3915	0.0004	I	*BV*	Dm-Dmr
	54316.4224	0.0004	I	*BV*	Sp-Kl
AK Her	54245.3765	0.0003	I	*BV*	Ak-Şn
	54274.4626	0.0003	I	*BV*	Bş-El
	54296.3785	0.0005	I	*BV*	Bn-Ay
	54300.3867	0.0004	II	*BV*	Çöl-Şn
TX Her	54302.4079	0.0004	II	*BV*	Cv-Kl
V842 Her	54157.4921	0.0005	I	*BV*	Çlk-Aln
	54207.3614	0.0010	I	*BV*	Klç-Blg
	54212.3870	0.0004	I	*BV*	Trn-Dmr
	54292.4257	0.0005	I	*BV*	Svm-Ul
SW Lac	54338.5017	0.0005	I	*BV*	Alt-Dm
	54346.3565	0.0002	II	*BV*	Şnv-Tn
	54346.5184	0.0001	I	*BV*	Tn-Gr
	54351.4887	0.0002	II	*BV*	Sp-Erd
	54357.4225	0.0002	I	*BV*	Çk-Ür
	54363.3555	0.0002	II	*BV*	Bş-Çk
	54363.5163	0.0001	I	*BV*	Ylm-Tn
	54364.3168	0.0002	II	*BV*	Şnv-Bğ
	54364.4785	0.0001	I	*BV*	Tn-Bğ
AM Leo	54184.4644	0.0003	II	*BV*	Ylm-Trn
	54195.4391	0.0004	II	*BV*	Şh-Çt
	54226.3504	0.0004	I	*BV*	Alt-Bn
XY Leo	54098.5661	0.0003	II	*BV*	Trn-Dv
	54198.4287	0.0003	I	*BV*	Alt-Dmr
V451 Oph	54253.3641	0.0005	I	*BV*	Ul-Erd
	54265.4574	0.0006	II	*BV*	Çkn-Bb
V566 Oph	54279.3865	0.0003	I	*BV*	Çt-Şhn
	54290.4463	0.0004	I	*BV*	Çlş-Çlk
	54305.3994	0.0003	II	*BV*	Klç-Gr
	54351.4659	0.0005	I	*BV*	Gr-Ylm
DI Peg	54335.4878	0.0002	I	*BV*	Çkn-Şa
V781 Tau	54166.3319	0.0004	I	*BV*	Çl-Ays
AH Vir	54285.3108	0.0005	I	*BV*	El-Ays
Z Vul	54284.3550	0.0003	I	*BV*	Çl-Çkr
	54322.4097	0.0007	II	*BV*	Iş-Sv

Explanation of the remarks in the table:
Observers: Ak: M. Akdamar, Aln: N. Alan, Alt: B. Altuntaş, Ay: G. Aydın, Ays: G. Aysan, Bb: B. Babaoğlu, Bğ: N. Bağıran, Blg: D. Bilgiç, Bn: A.K. Bingöl, Bş: Ö. Baştürk, Cv: E. Civelek, Çk: A. Çelik, Çkn: D. Çakan, Çkr: T.D. Çakır, Çl: T. Çolak, Çlk: L. Çelik, Çlş: Ş. Çalışkan, Çöl: E. Çöl, Çt: Y. Çetni, A.Ö. Çavuş, Dm: E. Demirci, Dmr: U. Demirhan, Dv: O. Deveci, El: A. Elmaslı, Er: G. Ergan, Erd: G. Erdoğan, Gk: G. Gökay, Gr: H. Gürsoytrak, Iş: E. Işık, Kl: C. Kılıç, Klç: T. Kılıçoğlu, Ps: Ç. Püsküllü, Sbş: B. Subaşı, Sp: S. Sipahioğlu, Sv: B. Savran, Svm: S. Sevim, Sy: S. Saydam, Şa: Ş. Şahin, Şh: Z.S. Şahin, Şhn: E. Şahiner, Şn: Y. Şendağ, Şnv: H. V. Şenavcı, Tn: T. Tanrıverdi, Tr: Z. Terzioğlu, Trn: E. Törün, Ul: N.D. Uluş, Ür: Y. Üre, Ylm: M. Yılmaz.

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PHOTOELECTRIC MINIMA OF SELECTED ECLIPSING BINARIES AND MAXIMA OF PULSATING STARS

(BAV MITTEILUNGEN NO. 186)

HÜBSCHER, JOACHIM

Bundesdeutsche Arbeitsgemeinschaft für Veränderliche Sterne e.V. (BAV), Munsterdamm 90, 12169 Berlin, Germany

In this 58th compilation of BAV results, photoelectric observations obtained in the years 2006 and 2007 are presented on 473 variable stars giving 735 minima and maxima on eclipsing binaries and pulsating stars. All moments of minima and maxima are heliocentric. The errors are tabulated in column '±'. The values in column '$O-C$' are determined without incorporation of nonlinear terms. The references are given in the section 'Remarks'. All information about photometers and filters are specified in the column 'Rem'. The observations were made at private observatories. The photoelectric measurements and all the light curves with evaluations can be obtained from the office of the BAV for inspection.

Table 1: Eclipsing binaries

Variable	M/m	HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
GK And	Min	53966.5641	.0010	RAT RCR	−0.2834		GCVS 85	-Ir	97	1)
KP And	Min	54025.5598	.0003	RAT RCR				-Ir	179	1)
CX Aqr	Min	53931.5448	.0001	RAT RCR	+0.0076		GCVS 85	-Ir	110	1)
GK Aqr	Min	53932.5567	.0001	RAT RCR				-Ir	104	1)
GS Aqr	Min	53943.488	.002	RAT RCR				-Ir	93	1)
MU Aqr	Min	53934.5075	.0002	RAT RCR				-Ir	92	1)
V346 Aql	Min	53954.4973	.0002	FLG	−0.0098		GCVS 85	o	66	12)
	Min	54307.4266	.0003	QU	−0.0103		GCVS 85	V	52	3)
V417 Aql	Min	53910.4523	.0001	RAT RCR	−0.0541	s	BAVR 33,152ff	-Ir	98	1)
XX Aur	Min	54116.3561	.0019	AG	−0.4749		GCVS 85	-Ir	37	1)
ZZ Aur	Min	54116.3480	.0006	AG	+0.0161		GCVS 85	-Ir	36	1)
	Min	54171.3625	.0017	AG	+0.0194	s	GCVS 85	-Ir	53	1)
AH Aur	Min	54148.4708	.0009	AG	+0.0610		BAVR 35,41ff	-Ir	30	1)
AP Aur	Min	53759.5025	.0002	RAT RCR	+0.0625		IBVS 3942	-Ir	155	1)
	Min	54114.5094	.0015	AG	+0.0681	s	IBVS 3942	-Ir	81	1)
BC Aur	Min	54164.444 :	.002	FR	−0.659		GCVS 85	-Ir	34	8)
CG Aur	Min	54115.2369	.0006	AG	−0.0017		GCVS 85	-Ir	45	1)
CL Aur	Min	54115.3547	.0010	AG	+0.1180		GCVS 85	-Ir	45	1)
	Min	54171.3512	.0009	SCI	+0.1181		GCVS 85	o	43	2)
EM Aur	Min	54172.3883	.0004	WN	+0.0329	s	AA 54.207	V	108	11)
GI Aur	Min	54148.2957	.0019	AG				-Ir	31	1)
HL Aur	Min	53780.4594	.0003	RAT RCR	−0.0103		GCVS 85	-Ir	51	1)
HP Aur	Min	54115.4290	.0008	AG	−0.6591		GCVS 85	-Ir	45	1)
HW Aur	Min	53990.5597	.0004	MS FR	+0.0169		IBVS 5016	o	594	5)

Table 1: (cont.)

Variable	M/m	HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
IZ Aur	Min	53999.5766	.0003	MS FR				o	328	5)
	Min	54115.2510	.0003	MS FR				o	469	5)
KU Aur	Min	53814.3799	.0001	RAT RCR	+0.0232		GCVS 85	-Ir	75	1)
MN Aur	Min	52619.6790	.0020	AG	−0.0573		GCVS 85	-Ir	130	1)
	Min	54154.4351	.0004	AG	−0.1241		GCVS 85	-Ir	234	1)
MO Aur	Min	54176.3557	.0052	AG	+0.0941		BAVM 68	-Ir	24	1)
V364 Aur	Min	54024.4794	.0002	MS FR				o	354	5)
V402 Aur	Min	54115.5200	.0060	AG				-Ir	45	1)
V404 Aur	Min	53991.5634	.0003	MS FR				o	432	5)
	Min	54116.4121	.0022	AG				-Ir	36	1)
	Min	54171.4847	.0032	AG				-Ir	53	1)
V410 Aur	Min	54115.2750	.0025	AG				-Ir	45	1)
	Min	54115.4596	.0001	AG				-Ir	45	1)
NSV 1998	Min	52688.3872	.0008	FR				o	30	8)
SU Boo	Min	54185.4972	.0006	AG	+0.0301		GCVS 85	-Ir	31	1)
TU Boo	Min	53867.5026	.0003	RAT RCR	+0.0461		GCVS 85	-Ir	117	1)
TY Boo	Min	54185.3719	.0023	AG	−0.0222	s	BAVM 68	-Ir	30	1)
	Min	54185.5302	.0039	AG	−0.0224		BAVM 68	-Ir	30	1)
	Min	54240.3966	.0001	WTR	−0.0231		BAVM 68	-Ir	70	10)
TZ Boo	Min	53818.5391	.0003	RAT RCR	−0.0566		BAVM 68	-Ir	117	1)
	Min	53862.3720	.0001	RAT RCR	−0.0543	s	BAVM 68	-Ir	81	1)
	Min	54259.5269	.0007	AG	−0.0493		BAVM 68	-Ir	42	1)
XY Boo	Min	53813.4192	.0004	RAT RCR	+0.0868	s	GCVS 85	-Ir	67	1)
	Min	54239.3957	.0002	WTR	−0.0654	s	GCVS 85	-Ir	59	10)
YY Boo	Min	54203.4437	.0009	AG	−0.1056		GCVS 85	-Ir	27	1)
AC Boo	Min	53860.4008	.0001	RAT RCR	+0.0074		AA 54.207	-Ir	63	1)
	Min	54170.5550	.0004	QU	+0.0103		AA 54.207	V	44	3)
	Min	54210.3819	.0004	QU	+0.0109		AA 54.207	Ic	46	3)
	Min	54218.4880	.0005	JU	+0.0108		AA 54.207	o	63	2)
	Min	54220.4258	.0005	FLG	+0.0102	s	AA 54.207	o	150	12)
CV Boo	Min	53863.3731	.0002	RAT RCR	−0.0109		BAVR 49,117	-Ir	52	1)
	Min	54206.4062	.0003	QU	−0.0102		BAVR 49,117	V	47	3)
ET Boo	Min	54186.4736	.0022	SCI				o	152	2)
	Min	54219.3721	.0014	JU				o	53	2)
EW Boo	Min	54200.5408	.0020	SCI				o	156	2)
	Min	54259.4568	.0010	AG				-Ir	43	1)
FI Boo	Min	54221.4135	.0058	JU				o	88	2)
GM Boo	Min	53815.4769	.0004	RAT RCR				-Ir	150	1)
	Min	54186.5265	.0009	AG				-Ir	21	1)
	Min	54201.5136	.0012	AG				-Ir	31	1)
	Min	54213.4318	.0027	AG				-Ir	21	1)
GN Boo	Min	53858.3579	.0004	RAT RCR				-Ir	68	1)
	Min	54185.4454	.0015	AG				-Ir	30	1)
	Min	54185.5960	.0021	AG				-Ir	30	1)
	Min	54201.4298	.0027	AG				-Ir	31	1)
	Min	54213.3446	.0004	AG				-Ir	21	1)
	Min	54213.4947	.0008	AG				-Ir	21	1)
GQ Boo	Min	54186.5145	.0031	AG				-Ir	22	1)
	Min	54201.5208	.0012	AG				-Ir	31	1)
	Min	54213.4402	.0022	AG				-Ir	21	1)
GR Boo	Min	54186.3574	.0044	AG				-Ir	25	1)
	Min	54186.5449	.0028	AG				-Ir	25	1)
	Min	54201.4224	.0008	AG				-Ir	31	1)
	Min	54213.4770	.0035	AG				-Ir	21	1)
GS Boo	Min	54185.4351	.0011	AG				-Ir	28	1)
i Boo	Min	54197.5025	.0035	SCI	−0.0109		GCVS 85	o	84	2)
	Min	54217.4419	.0018	JU	−0.0237	s	GCVS 85	o	68	2)
U1200-07442402	Min	54185.5216	.0038	AG				-Ir	30	1)
Y Cam	Min	53758.3911	.0002	RAT RCR	+0.2942		GCVS 85	-Ir	92	1)
SV Cam	Min	54206.3812	.0018	WN	+0.0495		GCVS 85	V	200	11)

Table 1: (cont.)

Variable	M/m	HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
SV Cam	Min	54209.3444	.0019	WN	+0.0473		GCVS 85	V	97	11)
AO Cam	Min	53809.3529	.0001	RAT RCR	+0.0044	s	GCVS 85	-Ir	65	1)
RY Cnc	Min	54150.3621	.0020	AG	+0.0574	s	GCVS 85	-Ir	16	1)
TU Cnc	Min	54202.4358	.0007	AG	+0.0325		AA 54.207	-Ir	19	1)
TX Cnc	Min	54150.2674	.0001	AG	+0.0368		GCVS 85	-Ir	16	1)
	Min	54172.4725	.0064	AG	+0.0348		GCVS 85	-Ir	34	1)
WW Cnc	Min	54175.4928	.0007	AG	−0.0689		BAVR 32,36ff	-Ir	53	1)
WY Cnc	Min	54179.4232	.0001	WN	−0.0295		GCVS 85	V	113	11)
XZ Cnc	Min	54174.3388	.0001	WTR				-Ir	100	10)
AB Cnc	Min	54202.4113	.0011	AG				-Ir	21	1)
AC Cnc	Min	54202.4573	.0003	AG				-Ir	17	1)
AD Cnc	Min	54202.3869	.0053	AG				-Ir	18	1)
EH Cnc	Min	54150.2490:	.0040	AG				-Ir	16	1)
GW Cnc	Min	54172.2949	.0044	AG				-Ir	41	1)
	Min	54172.4346	.0019	AG				-Ir	41	1)
	Min	54172.5766	.0019	AG				-Ir	41	1)
DH CVn	Min	54205.5088	.0008	AG				-Ir	46	1)
DI CVn	Min	54205.4860	.0005	AG				-Ir	47	1)
RS CMi	Min	54149.4416	.0012	AG				-Ir	25	1)
RW CMi	Min	54153.2996	.0009	AG				-Ir	18	1)
TX CMi	Min	54149.3936	.0027	AG				-Ir	22	1)
	Min	54153.2860	.0006	AG				-Ir	15	1)
	Min	54200.3820	.0002	AG				-Ir	17	1)
UZ CMi	Min	54149.3431	.0014	AG				-Ir	23	1)
	Min	54200.3433	.0002	AG				-Ir	17	1)
XZ CMi	Min	54149.3702	.0020	AG	+0.2828		GCVS 85	-Ir	22	1)
YY CMi	Min	54148.3517	.0002	WTR	+0.0143		GCVS 85	-Ir	79	10)
AK CMi	Min	54149.3824	.0022	AG	+0.2594		GCVS 85	-Ir	26	1)
AM CMi	Min	54149.4487	.0071	AG	+0.1711	s	GCVS 85	-Ir	21	1)
BF CMi	Min	54153.3309	.0033	AG				-Ir	18	1)
U0900-05269593	Min	54149.3924	.0039	AG				-Ir	22	1)
AL Cas	Min	53749.3951	.0004	RAT RCR	−0.0024	s	GCVS 85	-Ir	80	1)
CW Cas	Min	53942.5350	.0001	RAT RCR	+0.0667		GCVS 85	-Ir	73	1)
DZ Cas	Min	54019.5003	.0004	RAT RCR	−0.1672		GCVS 85	-Ir	152	1)
EG Cas	Min	54026.5209	.0003	RAT RCR	+0.1253	s	GCVS 85	-Ir	200	1)
EN Cas	Min	54192.4773	.0118	SCI	+0.2624		GCVS 85	o	145	2)
GK Cas	Min	54212.5234	.0026	SCI	+0.6839		GCVS 85	o	42	2)
GR Cas	Min	54024.3345	.0003	MS FR				o	333	5)
MR Cas	Min	54115.3740	.0019	JU				o	72	2)
	Min	54122.3382	.0009	JU				o	59	2)
	Min	54126.4695	.0040	JU				o	41	2)
	Min	54147.3599	.0028	SCI				o	31	2)
	Min	54147.3610	.0019	JU				o	75	2)
	Min	54147.5779	.0028	SCI				o	31	2)
MT Cas	Min	54205.3900	.0014	SCI				o	33	2)
OR Cas	Min	54025.3303	.0002	MS FR	−0.0204		GCVS 85	o	356	5)
V374 Cas	Min	54024.5056	.0002	RAT RCR				-Ir	171	1)
V375 Cas	Min	53992.3255	.0003	MS FR	+0.1841		BAVR 32,36ff	o	484	5)
	Min	54218.4929	.0018	AG	+0.1878	s	BAVR 32,36ff	-Ir	44	1)
V381 Cas	Min	54084.3582	.0005	QU	−0.0097		BAVR 32,36ff	V	88	3)
	Min	54091.3426	.0010	QU	−0.0091		BAVR 32,36ff	V	77	3)
V473 Cas	Min	54115.3212	.0016	AG	−0.0192	s	IBVS 4669	-Ir	45	1)
	Min	54115.5334	.0006	AG	−0.0147		IBVS 4669 115	-Ir	45	1)
V654 Cas	Min	54193.5126	.0028	SCI				o	258	2)
GSC 3675.1186	Min	54115.3661	.0013	AG				-Ir	50	1)
	Min	54115.5124	.0012	AG				-Ir	50	1)
AV Cep	Min	54223.4870:	.0030	AG				-Ir	146	1)
DK Cep	Min	54241.3903	.0003	AG	+0.0318		GCVS 85	-Ir	58	1)
EG Cep	Min	54213.3592	.0003	AG	+0.0146		GCVS 85	-Ir	56	1)
GI Cep	Min	54216.5438	.0022	AG				-Ir	33	1)

Table 1: (cont.)

Variable	M/m	HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
HI Cep	Min	54260.4249	.0030	AG				-Ir	29	1)
IO Cep	Min	54216.4172	.0037	AG	−0.6163		GCVS 85	-Ir	34	1)
IW Cep	Min	54244.4210	.0006	AG				-Ir	38	1)
LP Cep	Min	54216.3937	.0011	AG				-Ir	33	1)
NS Cep	Min	54221.5140	.0057	AG	+0.1453		GCVS 85	-Ir	43	1)
NU Cep	Min	54241.4615	.0005	AG				-Ir	58	1)
NW Cep	Min	54244.4674	.0014	AG	−0.4350		GCVS 85	-Ir	38	1)
RW Com	Min	53764.6054	.0003	RAT RCR	−0.0198	s	GCVS 85	-Ir	104	1)
	Min	53817.4154	.0001	RAT RCR	−0.0193		GCVS 85	-Ir	64	1)
	Min	54154.5647	.0011	AG	−0.0199	s	GCVS 85	-Ir	13	1)
	Min	54174.5026	.0007	AG	−0.0190	s	GCVS 85	-Ir	34	1)
	Min	54174.6226	.0026	AG	−0.0177		GCVS 85	-Ir	34	1)
	Min	54186.3700	.0004	JU	−0.0189	s	GCVS 85	o	61	2)
	Min	54216.3932	.0014	SCI	−0.0200		GCVS 85	o	88	2)
	Min	54216.3941	.0003	JU	−0.0191		GCVS 85	o	48	2)
	Min	54216.5117	.0013	SCI	−0.0201	s	GCVS 85	o	126	2)
RZ Com	Min	54174.4486	.0007	AG	+0.0405	s	GCVS 85	-Ir	35	1)
	Min	54174.6182	.0019	AG	+0.0409		GCVS 85	-Ir	35	1)
	Min	54175.4650	.0004	AG	+0.0414	s	GCVS 85	-Ir	31	1)
	Min	54175.6352	.0007	AG	+0.0423		GCVS 85	-Ir	31	1)
UX Com	Min	54176.4175	.0020	AG	−0.0955		BAVM 69	-Ir	30	1)
CC Com	Min	53765.5180	.0002	RAT RCR	−0.0129	s	GCVS 85	-Ir	102	1)
	Min	54175.4396	.0002	AG	−0.0160		GCVS 85	-Ir	31	1)
	Min	54175.5505	.0008	AG	−0.0155	s	GCVS 85	-Ir	31	1)
	Min	54202.3634	.0001	WTR	−0.0159		GCVS 85	-Ir	69	10)
	Min	54204.3531	.0010	DIE	−0.0124		GCVS 85	o	19	9)
	Min	54206.3358	.0004	DIE	−0.0159		GCVS 85	o	23	9)
	Min	54209.4245	.0009	SCI	−0.0168		GCVS 85	o	60	2)
	Min	54209.5347	.0007	SCI	−0.0169	s	GCVS 85	o	53	2)
CM Com	Min	54175.6082	.0052	AG				-Ir	31	1)
CN Com	Min	54175.5299	.0014	AG				-Ir	31	1)
	Min	54200.5349	.0010	FR				-Ir	42	8)
EK Com	Min	54174.5285	.0008	AG				-Ir	34	1)
	Min	54176.3950	.0018	AG				-Ir	31	1)
	Min	54176.5303	.0012	AG				-Ir	31	1)
	Min	54187.4637	.0005	AG				-Ir	23	1)
	Min	54187.5955	.0006	AG				-Ir	23	1)
	Min	54220.3980	.0024	SCI				o	102	2)
LL Com	Min	54176.4052	.0007	AG	−0.0287		IBVS 4386	-Ir	24	1)
	Min	54187.5945	.0006	AG	−0.0291	s	IBVS 4386	-Ir	22	1)
LO Com	Min	54154.5761	.0008	AG				-Ir	13	1)
	Min	54174.4773	.0001	AG				-Ir	34	1)
	Min	54174.6205	.0027	AG				-Ir	34	1)
LP Com	Min	54174.5358	.0007	AG				-Ir	34	1)
LT Com	Min	54187.3672	.0006	AG				-Ir	23	1)
RW CrB	Min	54221.5715	.0014	AG	−0.0053		GCVS 85	-Ir	31	1)
TW CrB	Min	54199.5934	.0014	SCI	+0.0068		SAC 70	o	105	2)
YY CrB	Min	54201.4502	.0016	SCI				o	102	2)
	Min	54201.6343	.0017	SCI				o	53	2)
	Min	54259.4387	.0009	JU				o	61	2)
AV CrB	Min	53990.3456	.0003	RAT RCR	−0.0080	s	GCVS 2007	-Ir	60	1)
VZ Cru	Min	54277.274	.003	HND				o	72	4)
XY Cru	Min	54276.453	.005	HND				o	57	4)
Y Cyg	Min	54296.4600	.0010	QU	−0.0759		GCVS 85	V	66	3)
WW Cyg	Min	53904.4980	.0001	RAT RCR	+0.0678		GCVS 85	-Ir	130	1)
	Min	54259.5020	.0002	AG	+0.0705		GCVS 85	-Ir	30	1)
WZ Cyg	Min	53920.4919	.0001	RAT RCR	+0.0584		GCVS 85	-Ir	114	1)
	Min	54003.4867	.0001	RAT RCR	+0.0591		GCVS 85	-Ir	161	1)
ZZ Cyg	Min	52862.4194	.0005	AG	−0.0434		GCVS 85	-Ir	51	1)
AE Cyg	Min	53227.4971	.0003	AG	−0.0048		GCVS 85	o	34	1)

Table 1: (cont.)

Variable	M/m	HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
BR Cyg	Min	54297.4348	.0004	QU	+0.0002		GCVS 85	V	61	3)
CV Cyg	Min	53966.4496	.0048	FLG	−0.0019	s	AA 54.207	o	123	12)
	Min	54034.3030	.0005	RAT RCR	−0.0038	s	AA 54.207	-Ir	107	1)
DL Cyg	Min	53999.5466	.0010	RAT RCR				-Ir	190	1)
V370 Cyg	Min	54252.5087	.0005	AG	−0.0225		GCVS 85	-Ir	31	1)
V443 Cyg	Min	54259.4781	.0006	AG				-Ir	30	1)
V453 Cyg	Min	54222.572 :	.005	FR				-Ir	42	8)
V454 Cyg	Min	53993.5051	.0002	RAT RCR				-Ir	130	1)
V496 Cyg	Min	54271.4984	.0007	AG				-Ir	33	1)
V498 Cyg	Min	54262.4536	.0017	AG	+0.1515		GCVS 85	-Ir	20	1)
V505 Cyg	Min	53989.4862	.0003	RAT RCR	+0.0769	s	GCVS 85	-Ir	125	1)
	Min	53991.4904	.0003	RAT RCR	+0.0781	s	GCVS 85	-Ir	168	1)
V508 Cyg	Min	52862.5056	.0016	AG				-Ir	52	1)
	Min	53607.4575	.0012	AG				-Ir	30	1)
V512 Cyg	Min	54241.5050	.0009	AG				-Ir	28	1)
V513 Cyg	Min	54262.5267	.0016	AG	−0.3294		GCVS 85	-Ir	21	1)
V525 Cyg	Min	52831.4230	.0003	AG				o	32	1)
V534 Cyg	Min	52898.5005	.0002	AG				o	22	1)
V628 Cyg	Min	53935.5048	.0003	RAT RCR	−0.0030	s	IBVS 4381	-Ir	124	1)
V726 Cyg	Min	54259.5379	.0011	AG				-Ir	30	1)
	Min	54271.4899	.0015	AG				-Ir	33	1)
V728 Cyg	Min	54260.4833	.0005	AG	+0.0546		GCVS 85	-Ir	29	1)
V749 Cyg	Min	52836.5269	.0007	AG				-Ir	19	1)
	Min	54239.4873	.0023	AG				-Ir	37	1)
V787 Cyg	Min	53985.5308	.0002	RAT RCR	+0.0041		GCVS 85	-Ir	144	1)
V828 Cyg	Min	53990.5232:	.0009	RAT RCR	+0.3250	s	GCVS 85	-Ir	105	1)
V841 Cyg	Min	54245.4324	.0011	AG	+0.0060		GCVS 85	-Ir	30	1)
V912 Cyg	Min	54252.3968	.0013	AG	−0.1060		GCVS 85	-Ir	31	1)
V963 Cyg	Min	54252.3746	.0011	AG	−0.0003		GCVS 85	-Ir	32	1)
V1004 Cyg	Min	54252.3868	.0013	AG	−0.1547		GCVS 85	-Ir	31	1)
V1019 Cyg	Min	54024.3730	.0067	FR				-Ir	29	8)
V1048 Cyg	Min	54241.4999	.0023	AG				-Ir	29	1)
V1188 Cyg	Min	54239.4283	.0020	AG				-Ir	36	1)
V1189 Cyg	Min	54241.5048	.0009	AG				-Ir	29	1)
V1191 Cyg	Min	54025.3548	.0003	RAT RCR	+0.0798	s	GCVS 85	-Ir	83	1)
V1193 Cyg	Min	54221.5631	.0013	AG				-Ir	42	1)
V1196 Cyg	Min	52836.4858	.0018	AG				-Ir	18	1)
	Min	54260.5287	.0006	AG				-Ir	29	1)
V1305 Cyg	Min	54019.2940	.0007	RAT RCR				-Ir	118	1)
V1326 Cyg	Min	54239.4193	.0006	AG				-Ir	37	1)
V1411 Cyg	Min	53940.4569	.0002	RAT RCR	−0.1767	s	GCVS 85	-Ir	135	1)
V1787 Cyg	Min	52836.5217	.0025	AG				-Ir	18	1)
	Min	54239.3648	.0003	AG				-Ir	37	1)
V2240 Cyg	Min	53993.5326	.0007	RAT RCR				-Ir	130	1)
V2277 Cyg	Min	54024.3827	.0003	RAT RCR				-Ir	143	1)
V2280 Cyg	Min	54240.4651	.0011	AG				-Ir	33	1)
V2284 Cyg	Min	54240.4994	.0010	AG				-Ir	32	1)
GSC 3776.0170	Min	52862.5033	.0008	AG				-Ir	51	1)
EX Del	Min	53932.4138	.0002	RAT RCR	−0.0601		GCVS 85	-Ir	45	1)
Z Dra	Min	53813.5121	.0004	RAT RCR	−0.1746		GCVS 85	-Ir	101	1)
RR Dra	Min	54200.5341	.0001	AG	+0.0477		GCVS 85	-Ir	90	1)
RX Dra	Min	54196.3531	.0013	AG	+0.0502		GCVS 85	-Ir	38	1)
RZ Dra	Min	53862.5110	.0003	RAT RCR	+0.0432		GCVS 85	-Ir	56	1)
	Min	54196.3404	.0007	AG	+0.0431		GCVS 85	-Ir	39	1)
	Min	54206.5343	.0017	AG	+0.0458	s	GCVS 85	-Ir	79	1)
	Min	54217.5500	.0010	AG	+0.0441	s	GCVS 85	-Ir	73	1)
SX Dra	Min	54217.4787	.0009	AG	+0.1029		GCVS 85	-Ir	74	1)
UZ Dra	Min	54204.5710	.0002	AG	+0.0025		GCVS 85	-Ir	153	1)
WW Dra	Min	54136.5301	.0026	SCI	+0.4536		GCVS 85	o	153	2)
	Min	54210.598 :	.002	SCI	+0.447		GCVS 85	o	166	2)

Table 1: (cont.)

Variable	M/m	HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
AK Dra	Min	54208.4380	.0003	AG				-Ir	42	1)
AX Dra	Min	53758.5549	.0003	RAT RCR	−0.0017	s	BAVR 32,36ff	-Ir	135	1)
	Min	53809.4038	.0001	RAT RCR	−0.0035		BAVR 32,36ff	-Ir	40	1)
	Min	53864.5162	.0001	RAT RCR	−0.0029		BAVR 32,36ff	-Ir	88	1)
	Min	53866.5060	.0004	RAT RCR	−0.0017	s	BAVR 32,36ff	-Ir	126	1)
BE Dra	Min	53993.3712	.0002	RAT RCR	+0.1293		GCVS 85	-Ir	68	1)
BS Dra	Min	54187.4820	.0003	AG	+0.0004		GCVS 85	-Ir	76	1)
BU Dra	Min	54199.3627	.0006	AG	+0.0201		MVS 12,4	-Ir	209	1)
FU Dra	Min	53809.5421	.0002	RAT RCR				-Ir	150	1)
GQ Dra	Min	54262.4470	.0023	AG				-Ir	49	1)
GV Dra	Min	54171.5447	.0028	SCI	−0.0080		IBVS 4990	o	140	2)
KK Dra	Min	54202.5301	.0005	AG				-Ir	75	1)
LZ Dra	Min	54187.4947	.0008	AG				-Ir	76	1)
MU Dra	Min	53991.3318	.0003	RAT RCR				-Ir	63	1)
RU Gem	Min	54141.5204	.0016	AG				-Ir	34	1)
RW Gem	Min	54141.4307	.0003	AG	+0.0022		GCVS 85	-Ir	52	1)
WW Gem	Min	54141.3987	.0012	AG	+0.0360	s	GCVS 85	-Ir	50	1)
AC Gem	Min	54173.4345	.0057	FR	−0.2395	s	GCVS 85	-Ir	29	8)
AF Gem	Min	54141.2971	.0007	AG	−0.0639		GCVS 85	-Ir	31	1)
AL Gem	Min	54141.5406	.0009	AG	+0.0633		GCVS 85	-Ir	31	1)
AV Gem	Min	54116.4849	.0007	AG				-Ir	22	1)
	Min	54149.4705	.0011	AG				-Ir	20	1)
AY Gem	Min	53765.3025	.0002	RAT RCR	−0.0525		GCVS 85	-Ir	68	1)
	Min	54165.3331	.0013	JU	−0.0501		GCVS 85	o	64	2)
	Min	54171.4391	.0002	FR	−0.0514		GCVS 85	-Ir	30	8)
BO Gem	Min	54136.3830	.0012	AG				-Ir	43	1)
	Min	54136.3848	.0003	FR				-Ir	37	8)
CK Gem	Min	54171.4664	.0025	FR				-Ir	29	8)
CP Gem	Min	54148.2791	.0019	FR				-Ir	32	8)
CX Gem	Min	54116.4074	.0031	FR	−0.0210	s	GCVS 85	-Ir	39	8)
DP Gem	Min	54019.535 :	.001	MS FR	−0.081	s	GCVS 85	o	250	5)
FG Gem	Min	54141.4104	.0020	AG	−0.0283	s	GCVS 85	-Ir	31	1)
FT Gem	Min	54116.4089	.0012	AG	−0.0231		GCVS 85	-Ir	22	1)
	Min	54149.3157	.0011	FR	−0.0226		GCVS 85	-Ir	37	8)
GM Gem	Min	54149.3615	.0022	AG				-Ir	20	1)
GP Gem	Min	54116.4624	.0034	AG				-Ir	22	1)
	Min	54148.3673	.0010	JU				o	89	2)
GW Gem	Min	54085.4471	.0002	RAT RCR	+0.0250		GCVS 85	-Ir	35	1)
GZ Gem	Min	54115.2717	.0010	FR				-Ir	33	8)
HR Gem	Min	54093.4396	.0006	RAT RCR				-Ir	35	1)
IM Gem	Min	54116.2781	.0016	FR				-Ir	61	8)
KQ Gem	Min	54150.3953	.0009	FR				-Ir	34	8)
KV Gem	Min	54150.2843	.0002	FR	−0.0069		BAVR 52,95ff	-Ir	46	8)
MU Gem	Min	54149.5246	.0027	FR	+0.0182		GCVS 85	-Ir	39	8)
GSC 1375.1085	Min	54147.4593	.0003	SIR				-Ir	138	7)
	Min	54148.4665	.0003	SIR				-Ir	189	7)
	Min	54173.3694	.0003	SIR				-Ir	100	7)
TU Her	Min	54217.4525	.0017	AG	−0.1717		GCVS 85	-Ir	19	1)
TX Her	Min	54268.4193	.0053	WTR	−0.0058		GCVS 85	-Ir	63	10)
BC Her	Min	53889.5219	.0002	RAT RCR	−0.3814		GCVS 85	-Ir	133	1)
CC Her	Min	54251.5038	.0001	AG	+0.1730		GCVS 85	-Ir	74	1)
DD Her	Min	54271.4623	.0023	AG	+0.3629		SAC 63	-Ir	44	1)
DK Her	Min	54239.4661	.0002	AG	−0.1180		GCVS 85	-Ir	30	1)
DP Her	Min	54239.4858	.0005	AG				-Ir	29	1)
EF Her	Min	54219.5161	.0004	AG				-Ir	19	1)
ES Her	Min	54220.5422	.0038	AG				-Ir	11	1)
GL Her	Min	54221.5864	.0015	SCI	+0.0709		GCVS 85	o	33	2)
	Min	54282.5576	.0007	AG	+0.0728		GCVS 85	-Ir	32	1)
GU Her	Min	54210.5128	.0026	AG	+0.7494		GCVS 85	-Ir	30	1)
LT Her	Min	54218.4095	.0021	SCI	−0.0231		BAVM 69	o	84	2)

Table 1: (cont.)

Variable	M/m	HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
LT Her	Min	54244.4224	.0008	AG	−0.0271		BAVM 69	-Ir	47	1)
MT Her	Min	53861.4976	.0002	RAT RCR	+0.0147		GCVS 85	-Ir	127	1)
MX Her	Min	54262.4442	.0006	AG	−0.5233		GCVS 85	-Ir	43	1)
V338 Her	Min	54245.4916	.0005	AG	+0.0778		GCVS 85	-Ir	33	1)
	Min	54296.4149	.0001	WTR	+0.0773		GCVS 85	-Ir	83	10)
V342 Her	Min	54282.4613	.0006	AG	+0.0141		GCVS 85	-Ir	32	1)
V387 Her	Min	54219.4276	.0025	AG	+0.0805		GCVS 85	-Ir	19	1)
V450 Her	Min	54205.4528	.0014	AG	+0.1266	s	GCVS 85	-Ir	36	1)
V643 Her	Min	54222.4676	.0030	AG				-Ir	19	1)
	Min	54282.3983	.0010	AG				-Ir	32	1)
V687 Her	Min	54217.4927	.0023	SCI				o	42	2)
V719 Her	Min	54240.5550	.0001	AG				-Ir	26	1)
V728 Her	Min	53116.4350	.0099	AG	+0.0459	s	IBVS 3234	o	16	1)
	Min	53858.4766	.0003	RAT RCR	+0.0464		IBVS 3234	-Ir	127	1)
	Min	54240.4604	.0011	AG	+0.0522	s	IBVS 3234	-Ir	26	1)
V731 Her	Min	54222.4375	.0035	SCI				o	84	2)
V740 Her	Min	53116.4894	.0002	AG				o	13	1)
V742 Her	Min	54212.4039	.0011	SCI				o	23	2)
V829 Her	Min	54204.4342	.0019	SCI	+0.0164	s	IBVS 5496	o	113	2)
	Min	54204.6116	.0014	SCI	+0.0147		IBVS 5496	o	102	2)
	Min	54217.5082	.0045	AG	+0.0179		IBVS 5496	-Ir	12	1)
	Min	54223.4189	.0001	AG	+0.0191	s	IBVS 5496	-Ir	27	1)
V842 Her	Min	54297.4523	.0004	JU	−0.0386		BAVR 49,180	o	55	2)
V856 Her	Min	54218.5711	.0014	SCI				o	41	2)
V857 Her	Min	54218.4067	.0020	AG				-Ir	21	1)
V1033 Her	Min	54210.4231	.0014	AG				-Ir	28	1)
	Min	54210.5730	.0002	AG				-Ir	28	1)
	Min	54217.4281	.0012	AG				-Ir	17	1)
V1034 Her	Min	54200.4918	.0009	AG				-Ir	26	1)
V1038 Her	Min	54000.3326	.0002	RAT RCR				-Ir	71	1)
	Min	54217.4252	.0013	AG				-Ir	16	1)
	Min	54217.5588	.0002	AG				-Ir	16	1)
	Min	54218.4999	.0054	AG				-Ir	20	1)
	Min	54223.4586	.0016	AG				-Ir	32	1)
V1039 Her	Min	54219.4172	.0017	AG				-Ir	19	1)
V1047 Her	Min	54217.4796	.0028	AG				-Ir	16	1)
V1054 Her	Min	54219.5206	.0029	AG				-Ir	18	1)
V1055 Her	Min	54240.4255	.0011	AG				-Ir	26	1)
V1057 Her	Min	54219.3895	.0061	AG				-Ir	17	1)
V1062 Her	Min	53116.4174	.0001	AG				o	16	1)
	Min	54245.4916	.0009	AG				-Ir	31	1)
V1067 Her	Min	54245.4315	.0009	AG				-Ir	34	1)
	Min	54245.5597	.0023	AG				-Ir	34	1)
V1073 Her	Min	53897.4145	.0001	RAT RCR				-Ir	42	1)
	Min	54220.5370	.0002	AG				-Ir	11	1)
TY Hya	Min	54171.4597	.0002	AG				-Ir	58	1)
AV Hya	Min	54136.3655	.0011	AG	−0.0891		GCVS 85	-Ir	55	1)
DF Hya	Min	54202.4026	.0036	AG	+0.0161		GCVS 85	-Ir	19	1)
DI Hya	Min	54172.3965	.0003	WTR				-Ir	116	10)
AW Lac	Min	53614.4933	.0026	AG	+0.0336	s	BAVR 35,1ff	-Ir	29	1)
	Min	54282.4964	.0010	AG	+0.0380		BAVR 35,1ff	-Ir	28	1)
CN Lac	Min	54019.2717	.0010	MS FR	−0.0201		GCVS 85	o	380	5)
FI Lac	Min	54222.5178	.0017	AG				-Ir	16	1)
IP Lac	Min	54266.4009	.0020	AG				-Ir	15	1)
LY Lac	Min	54244.4170	.0013	AG	+0.2271		GCVS 85	-Ir	36	1)
V339 Lac	Min	53966.3832	.0007	RAT RCR				-Ir	80	1)
RW Leo	Min	54207.4032	.0019	SCI	−0.1031		GCVS 85	o	28	2)
	Min	54207.4065	.0003	AG	−0.0998		GCVS 85	-Ir	48	1)
UU Leo	Min	53764.388 :	.001	RAT RCR	+0.140		GCVS 85	-Ir	60	1)
	Min	54199.4466	.0012	SCI	+0.1483		GCVS 85	o	77	2)

Table 1: (cont.)

Variable	M/m	JD H24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
UU Leo	Min	54199.4478	.0013	AG	+0.1495		GCVS 85	-Ir	26	1)
UV Leo	Min	54204.3933	.0019	WN	+0.0128		IBVS 5338	V	118	11)
	Min	54207.3828	.0016	WN	+0.0019		IBVS 5338	V	149	11)
	Min	54207.3829	.0001	SIR	+0.0020		IBVS 5338	-Ir	677	7)
	Min	54207.3842	.0008	AG	+0.0033		IBVS 5338	-Ir	49	1)
	Min	54213.3840	.0010	WN	+0.0022		IBVS 5338	V	175	11)
UZ Leo	Min	54207.4404	.0005	AG	−0.1283		GCVS 85	-Ir	50	1)
	Min	54216.4035	.0005	QU	−0.1268	s	GCVS 85	V	74	3)
VZ Leo	Min	54199.4152	.0012	AG	−0.0641		GCVS 85	-Ir	25	1)
	Min	54211.3999	.0010	SCI	−0.0684		GCVS 85	o	60	2)
XX Leo	Min	54199.3939	.0029	AG	+0.2500		GCVS 85	-Ir	25	1)
XY Leo	Min	54174.4229	.0011	AG	+0.0245		GCVS 85	-Ir	54	1)
	Min	54174.5644	.0009	AG	+0.0239	s	GCVS 85	-Ir	54	1)
	Min	54199.4233	.0045	AG	+0.0244		GCVS 85	-Ir	26	1)
XZ Leo	Min	53749.5137	.0002	RAT RCR	+0.0380		GCVS 85	-Ir	116	1)
	Min	54174.5850	.0030	AG	+0.0481	s	GCVS 85	-Ir	56	1)
	Min	54199.4564	.0011	AG	+0.0450	s	GCVS 85	-Ir	26	1)
AL Leo	Min	54174.4343	.0060	AG	+0.0104		IBVS 3401	-Ir	28	1)
AM Leo	Min	54173.3091	.0007	DIE	+0.0092		GCVS 85	o	22	9)
	Min	54192.3301	.0005	DIE	+0.0086		GCVS 85	o	22	9)
	Min	54196.3536	.0001	WTR	+0.0084		GCVS 85	-Ir	71	10)
	Min	54200.3772	.0005	JU	+0.0082		GCVS 85	o	88	2)
	Min	54202.3890	.0008	JU	+0.0081	s	GCVS 85	o	90	2)
	Min	54207.3301	.0001	DIE	+0.0109		GCVS 85	o	22	9)
	Min	54207.5131	.0011	AG	+0.0111	s	GCVS 85	-Ir	49	1)
AP Leo	Min	54173.3974	.0007	QU	−0.0369		GCVS 85	V	51	3)
BL Leo	Min	54172.3430	.0021	SCI				o	23	2)
	Min	54172.4862	.0010	SCI				o	35	2)
	Min	54172.6295	.0014	SCI				o	25	2)
ET Leo	Min	54193.3893	.0060	JU				o	52	2)
EX Leo	Min	54209.4219	.0020	JU				o	80	2)
RT LMi	Min	54199.3339	.0003	WTR	−0.0068	s	GCVS 85	-Ir	79	10)
VW LMi	Min	54185.4263	.0009	JU				o	73	2)
RZ Lyn	Min	54200.3218	.0003	WTR	−0.0995		GCVS 85	-Ir	50	10)
SW Lyn	Min	53864.3788	.0002	RAT RCR	+0.0394		GCVS 85	-Ir	56	1)
	Min	54150.3488	.0024	DIE	+0.0452		GCVS 85	o	22	9)
	Min	54173.5324	.0005	AG	+0.0425		GCVS 85	-Ir	68	1)
TY Lyn	Min	54210.4685	.0004	AG	+0.0644		GCVS 85	-Ir	191	1)
UU Lyn	Min	54175.3512	.0001	WTR	−0.0059		GCVS 85	-Ir	92	10)
CD Lyn	Min	54172.4095	.0007	AG	−0.0088		IBVS 4911	-Ir	94	1)
DU Lyr	Min	54222.5192	.0010	AG				-Ir	19	1)
LZ Lyr	Min	53899.4200	.0004	RAT RCR				-Ir	121	1)
	Min	53999.3173	.0006	RAT RCR				-Ir	78	1)
OT Lyr	Min	54222.4568	.0005	AG				-Ir	19	1)
V411 Lyr	Max	52147.475	.005	AG				o	25	1) 13)
V412 Lyr	Min	54245.5069	.0007	AG				-Ir	31	1)
V563 Lyr	Min	53898.4535	.0003	RAT RCR				-Ir	88	1)
	Min	53900.4740	.0003	RAT RCR				-Ir	96	1)
	Min	53985.3918	.0003	RAT RCR				-Ir	73	1)
V574 Lyr	Min	54295.4577	.0006	JU				o	37	2)
V580 Lyr	Min	54300.4479	.0016	JU				o	23	2)
V596 Lyr	Min	54003.3377	.0003	RAT RCR				-Ir	78	1)
CF Mon	Min	54154.3158	.0002	AG				-Ir	17	1)
GU Mon	Min	53769.3520	.0008	RAT RCR	−0.0060		GCVS 85	-Ir	64	1)
IU Mon	Min	54116.3729	.0010	AG				-Ir	22	1)
IZ Mon	Min	53768.334 :	.001	RAT RCR				-Ir	74	1)
V395 Mon	Min	54154.3438	.0017	AG				-Ir	17	1)
V396 Mon	Min	54154.3826	.0005	AG	−0.0697	s	GCVS 85	-Ir	17	1)
V442 Mon	Min	53764.269 :	.002	RAT RCR	+0.030		GCVS 85	-Ir	48	1)
	Min	54154.3628	.0011	AG	+0.0397		GCVS 85	-Ir	17	1)

Table 1: (cont.)

Variable	M/m	HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
V496 Mon	Min	54154.3478	.0024	AG	−0.0339		GCVS 85	-Ir	17	1)
V514 Mon	Min	54154.4178	.0031	AG	+0.0271		GCVS 85	-Ir	16	1)
V530 Mon	Min	54026.684 :	.001	MS FR	+0.131		GCVS 85	o	27	5)
	Min	54085.5429	.0003	MS FR	+0.1308		GCVS 85	o	291	5)
V532 Mon	Min	54096.4545	.0003	RAT RCR	+0.0120		GCVS 85	-Ir	76	1)
V536 Mon	Min	54150.3514	.0040	WTR	−0.0066		BAVR 52.165ff	-Ir	78	10)
V714 Mon	Min	54024.6114	.0002	MS FR				o	297	5)
	Min	54154.3184	.0012	AG				-Ir	17	1)
V843 Mon	Min	54116.4529	.0022	AG	−0.0706	s	BAVM 147	-Ir	22	1)
	Min	54149.3343	.0013	AG	−0.0829		BAVM 147	-Ir	20	1)
WZ Oph	Min	54244.4632	.0006	AG	+0.0040		GCVS 85	-Ir	47	1)
	Min	54288.3893	.0030	WTR	+0.0033	s	GCVS 85	-Ir	48	10)
AL Oph	Min	54219.3956	.0053	AG				-Ir	19	1)
V449 Oph	Min	53503.4349	.0015	AG	+0.0688		GCVS 85	-Ir	24	1)
V501 Oph	Min	53860.5221	.0002	RAT RCR	−0.0089		GCVS 85	-Ir	81	1)
V2553 Oph	Min	53503.4509	.0016	AG				-Ir	24	1)
	Min	54219.3874	.0001	AG				-Ir	19	1)
	Min	54239.5251	.0015	AG				-Ir	29	1)
CQ Ori	Min	54016.5780	.0028	MS FR	−0.0006		GCVS 85	o	121	5)
FZ Ori	Min	54114.4574	.0013	AG	−0.0629		GCVS 85	-Ir	36	1)
QT Ori	Min	54114.3236	.0025	AG				-Ir	39	1)
V343 Ori	Min	53744.3740	.0004	RAT RCR	+0.1850		GCVS 85	-Ir	96	1)
	Min	54096.3535	.0008	RAT RCR	+0.1947		GCVS 85	-Ir	56	1)
V392 Ori	Min	53758.2596	.0006	RAT RCR	+0.0016		GCVS 85	-Ir	56	1)
BO Peg	Min	53941.4686	.0004	RAT RCR	−0.0263		GCVS 87	-Ir	101	1)
BY Peg	Min	53250.5212	.0028	AG				o	22	1)
CE Peg	Min	53936.4783	.0003	RAT RCR				-Ir	119	1)
MQ Peg	Min	53938.5321	.0011	RAT RCR				-Ir	98	1)
BY Per	Min	53992.5824	.0005	MS FR				o	485	5)
	Min	53995.464 :	.004	MS FR				o	196	5)
	Min	54115.3481	.0058	AG				-Ir	49	1)
CC Per	Min	54115.4269	.0016	AG				-Ir	54	1)
IK Per	Min	54001.4451	.0017	MS FR	−0.1490		GCVS 87	o	611	5)
KL Per	Min	53987.4646	.0011	MS FR				o	594	5)
	Min	54085.2823	.0004	RAT RCR				-Ir	82	1)
KR Per	Min	53780.3702	.0003	RAT RCR	−0.0154		GCVS 87	-Ir	60	1)
NZ Per	Min	53751.2817	.0005	RAT RCR	+0.0357		GCVS 87	-Ir	61	1)
V432 Per	Min	54093.2740	.0003	RAT RCR	−0.0081	s	IBVS 3797	-Ir	65	1)
UZ Sge	Min	53913.4436	.0005	RAT RCR				-Ir	37	1)
AQ Ser	Min	54207.4151	.0006	FR	−0.2585		GCVS 87	-Ir	59	8)
AU Ser	Min	53817.5223	.0001	RAT RCR	+0.0097		SAC 73	-Ir	160	1)
CX Ser	Min	54207.4727	.0004	FR	−0.0757	s	GCVS 87	-Ir	59	8)
GSC 2038.0293	Min	54192.6353	.0010	FR	+0.0011		BAVM 177	-Ir	53	8)
	Min	54213.4447	.0006	FR	+0.0033		BAVM 177	-Ir	57	8)
	Min	54221.3725	.0004	FR	+0.0046		BAVM 177	-Ir	57	8)
Y Sex	Min	53769.4429	.0005	RAT RCR	+0.0010		BAVR 32,36ff	-Ir	39	1)
	Min	54173.3127	.0029	AG	+0.0015		BAVR 32,36ff	-Ir	30	1)
	Min	54173.5234	.0018	AG	+0.0023	s	BAVR 32,36ff	-Ir	30	1)
AL Tau	Min	54026.528 :	.002	MS FR				o	330	5)
AS Tau	Min	54115.3795	.0011	AG				-Ir	45	1)
CR Tau	Min	54141.3427	.0004	AG	−0.0048		IBVS 4778	-Ir	34	1)
GW Tau	Min	54136.3755	.0014	JU				o	83	2)
V471 Tau	Min	54136.3401	.0030	SCI	+0.0113		GCVS 87	o	81	2)
TW UMa	Min	54203.4304	.0009	AG	−0.2428		GCVS 87	-Ir	83	1)
	Min	54216.4301	.0002	AG	−0.2441		GCVS 87	-Ir	173	1)
TY UMa	Min	54195.3905	.0004	JU	+0.0635	s	GCVS 87	o	80	2)
UY UMa	Min	54115.6130	.0024	SCI	+0.0902		GCVS 87	o	75	2)
XY UMa	Min	54192.3796	.0008	JU	+0.0289		GCVS 87	o	74	2)
	Min	54197.4085	.0012	JU	+0.0284	s	GCVS 87	o	80	2)
AA UMa	Min	53765.4204	.0002	RAT RCR	+0.0349		GCVS 87	-Ir	55	1)

Table 1: (cont.)

Variable	M/m	HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
AA UMa	Min	54186.4986	.0003	AG	+0.0342	s	GCVS 87	-Ir	100	1)
	Min	54206.3923	.0006	JU	+0.0325		GCVS 87	o	100	2)
AW UMa	Min	54201.4057	.0030	JU	−0.0654		GCVS 87	o	100	2)
IW UMa	Min	54186.4386	.0004	AG				-Ir	89	1)
RT UMi	Min	54207.5026	.0004	AG	+0.1106		GCVS 87	-Ir	217	1)
TV UMi	Min	54222.3944	.0012	JU				o	77	2)
NSV 8499	Min	53863.4756	.0001	RAT RCR				-Ir	137	1)
AW Vir	Min	53818.4245	.0001	RAT RCR	+0.0173		GCVS 87	-Ir	32	1)
AX Vir	Min	54219.3808	.0005	FR	+0.0105		BAVR 32,36ff	-Ir	79	8)
	Min	54220.4306	.0042	FR	+0.0065	s	BAVR 32,36ff	-Ir	44	8)
BH Vir	Min	54206.4974	.0008	AG	−0.0070	s	GCVS 87	-Ir	58	1)
CM Vir	Min	54204.5302	.0006	AG				-Ir	68	1)
NY Vir	Min	54206.3214	.0015	AG				-Ir	60	1)
	Min	54206.4221	.0015	AG				-Ir	60	1)
	Min	54206.5228	.0015	AG				-Ir	60	1)
GSC 0278.0814	Min	54185.4915	.0031	FR				-Ir	50	8)
	Min	54186.5042	.0032	FR				-Ir	50	8)
	Min	54187.4817	.0054	FR				-Ir	42	8)
Z Vul	Min	54306.4498	.0004	QU	−0.0075		GCVS 87	V	70	3)
AW Vul	Min	53931.4193	.0001	RAT RCR	−0.0115		GCVS 87	-Ir	44	1)
	Min	54289.4837	.0003	SIR	−0.0115		GCVS 87	-Ir	110	7)
AZ Vul	Min	53897.5087	.0003	RAT RCR	+0.0273		GCVS 87	-Ir	100	1)
BK Vul	Min	53927.4440	.0004	RAT RCR	+0.0359	s	GCVS 87	-Ir	130	1)
BM Vul	Min	53250.5223	.0012	AG				o	21	1)
	Min	53255.4244	.0027	AG				o	29	1)
	Min	53255.6126	.0008	AG				o	29	1)
BP Vul	Min	53933.4432	.0001	RAT RCR	−0.0116		GCVS 87	-Ir	126	1)
IM Vul	Min	53921.4692	.0003	RAT RCR				-Ir	111	1)

Table 2: Pulsating stars

Variable	M/m	HJD 24...	±	Obs	$O-C$	Bibliography	Fil	n	Rem
TZ Aur	Max	54136.3723	.0010	QU	+0.0119	GCVS 85	V	66	3)
	Max	54174.3650	.0013	WN	+0.0121	GCVS 85	V	97	11)
	Max	54203.3488	.0018	WN	+0.0120	GCVS 85	V	87	11)
DN Aur	Min	53386.307	.000	AG			-Ir	38	1) 14)
	Min	53386.612	.001	AG			-Ir	38	1) 14)
	Min	53387.539	.002	AG			V	61	1) 14)
	Min	53388.470	.002	AG			V	38	1) 14)
	Min	53410.363	.001	AG			V	23	1) 14)
MV Aur	Max	54176.383	.005	AG			-Ir	25	1)
PY Aur	Max	54171.456	.003	AG			-Ir	53	1)
RS Boo	Max	54185.324	.003	AG	+0.019	BAVR 36,157ff	-Ir	30	1)
RU Boo	Max	54213.476	.003	AG			-Ir	21	1)
SZ Boo	Max	54186.418	.005	AG	+0.008	SAC 73	-Ir	21	1)
	Max	54201.579	.003	AG	+0.007	SAC 73	-Ir	31	1)
TW Boo	Max	54222.3767	.0007	QU	−0.0264	BAVR 48,189	V	51	3)
VX Boo	Max	54213.484	.003	AG			-Ir	20	1)
WZ Boo	Max	54186.493	.005	AG			-Ir	20	1)
XX Boo	Max	54185.532	.005	AG	+0.014	GCVS 85	-Ir	30	1)
	Max	54213.443	.005	AG	+0.018	GCVS 85	-Ir	21	1)
CM Boo	Max	54199.4190	.0005	QU	−0.1024	GCVS 85	V	75	3)
CQ Boo	Max	54216.4031	.0010	MZ	−0.0223	BAVR 48,189	-Ir	112	2)
U1200-07442272	Max	54185.386	.003	AG			-Ir	30	1)
AQ Cnc	Max	54222.3877	.0018	WN	−0.0707	GCVS 85	V	89	11)
CQ Cnc	Max	54172.520	.002	AG	−0.014	BAVR 49,41	-Ir	40	1)
EF Cnc	Max	54172.380	.003	AG			-Ir	41	1)
	Max	54175.3577	.0028	SCI			o	105	2)
RR CVn	Max	54205.396	.005	AG			-Ir	47	1)

Table 2: (cont.)

Variable	M/m	HJD 24...	±	Obs	$O-C$	Bibliography	Fil	n	Rem
RZ CVn	Max	54205.5304	.0019	WN	+0.1069	BAVR 48,189	V	102	11)
	Max	54221.4190	.0007	QU	+0.1083	BAVR 48,189	V	66	3)
SW CVn	Max	53080.588	.002	AG			-Ir	42	1)
	Max	54205.521	.003	AG			-Ir	46	1)
TZ CVn	Max	54176.364	.005	AG			-Ir	25	1)
AP CVn	Max	54187.439	.005	AG			-Ir	23	1)
BN CVn	Max	54208.4145	.0009	MZ	+0.0602	BAVM 75	-Ir	78	2)
AD CMi	Max	54187.298 :	.002	WN	+0.010	GCVS 85	V	62	11)
IU Car	Max	54178.470	.003	HND			o	57	4)
BI Cen	Max	54258.358	.002	HND			o	90	4)
	Max	54277.387	.002	HND			o	57	4)
KS Cen	Max	54259.306	.002	HND			o	65	4)
V480 Cen	Max	54275.454	.002	HND			o	53	4)
V595 Cen	Max	54254.425	.003	HND			o	60	4)
V753 Cen	Max	54258.447	.003	HND			o	85	4)
	Max	54259.333	.003	HND			o	75	4)
	Max	54262.431	.003	HND			o	65	4)
	Max	54263.316	.003	HND			o	82	4)
RZ Cep	Max	54219.393	.003	AG	−0.014	GCVS 85	-Ir	79	1)
GZ Cep	Max	54213.476	.003	AG			-Ir	55	1)
RT Col	Max	54145.364	.002	HND			o	87	4)
RW Col	Max	54165.448	.003	HND			o	53	4)
	Max	54170.360	.003	HND			o	20	4)
	Max	54171.455	.003	HND			o	24	4)
U Com	Max	54187.562	.005	AG	−0.002	BAVR 49,41	-Ir	23	1)
V Com	Max	54203.3503	.0020	FR	+0.0372	GCVS 85	-Ir	50	8)
AC Com	Max	54201.4222	.0020	FR			-Ir	49	8)
AE Com	Max	54201.4702	.0030	FR			-Ir	48	8)
AG Com	Max	54175.434	.005	AG			-Ir	31	1)
	Max	54202.5172	.0020	FR			-Ir	50	8)
AO Com	Max	54206.3784	.0040	FR			-Ir	46	8)
CU Com	Max	54201.4618	.0015	FR			-Ir	50	8)
CW Com	Max	54201.5021	.0030	FR			-Ir	48	8)
CY Com	Max	54202.5749	.0025	FR			-Ir	48	8)
CZ Com	Max	54202.4769	.0020	FR			-Ir	50	8)
GH Com	Max	54203.5912	.0030	FR			-Ir	46	8)
GR Com	Max	54203.4474	.0040	FR			-Ir	34	8)
HY Com	Max	54218.3918	.0030	FR			-Ir	79	8)
IQ Com	Max	54203.5835	.0045	FR			-Ir	44	8)
IS Com	Max	54176.434	.005	AG			-Ir	28	1)
RV CrB	Max	54205.465	.005	AG	−0.047	GCVS 85	-Ir	37	1)
	Max	54210.435	.005	AG	−0.051	GCVS 85	-Ir	29	1)
UY CrB	Max	54221.529	.005	AG			-Ir	30	1)
X Crt	Max	54254.375	.005	HND			o	52	4)
SW Cru	Max	54275.310	.002	HND			o	55	4)
	Max	54276.292	.002	HND			o	61	4)
XX Cyg	Max	53975.5248	.0001	FLG	+0.0020	GCVS 85	o	137	12)
DM Cyg	Max	54001.3979	.0015	FLG	−0.0004	BAVR 51,98ff	V	135	12)
V882 Cyg	Max	53935.3968	.0030	FR			-Ir	33	8)
	Max	54003.2741	.0030	FR			-Ir	33	8)
	Max	54029.4622	.0030	FR			-Ir	27	8)
	Max	54035.4604	.0030	FR			-Ir	30	8)
RT Dor	Max	54167.436	.004	HND			o	45	4)
	Max	54170.334	.002	HND			o	29	4)
VW Dor	Max	54166.437	.002	HND			o	71	4)
	Max	54170.437	.003	HND			o	89	4)
	Max	54178.423	.004	HND			o	28	4)
VX Dor	Max	54166.507	.005	HND			o	57	4)
	Max	54170.450	.003	HND			o	59	4)
XX Dor	Max	54144.397	.003	HND			o	90	4)

Table 2: (cont.)

Variable	M/m	HJD 24...	±	Obs	$O-C$	Bibliography	Fil	n	Rem
XX Dor	Max	54170.383	.005	HND			o	27	4)
	Max	54171.344	.005	HND			o	70	4)
AE Dra	Max	54201.382	.005	AG			-Ir	88	1)
DD Dra	Max	54196.500	.003	AG	−0.081	BAVR 49,6	-Ir	39	1)
	Max	54200.425	.003	AG	−0.078	BAVR 49,6	-Ir	90	1)
	Max	54202.385	.003	AG	−0.079	BAVR 49,6	-Ir	80	1)
	Max	54206.623	.005	AG	−0.089	BAVR 49,6	-Ir	80	1)
RR Gem	Max	54192.3603	.0022	WN	+0.0029	BAVR 47,67	V	159	11)
	Max	54196.3250	.0011	WN	−0.0054	BAVR 47,67	V	112	11)
	Max	54198.3154	.0009	WN	−0.0014	BAVR 47,67	V	84	11)
	Max	54209.4368	.0008	WN	−0.0042	BAVR 47,67	V	96	11)
	Max	54217.3825	.0013	WN	−0.0044	BAVR 47,67	V	122	11)
AK Gem	Max	54161.6889	.0010	HMB	−0.2285	GCVS 85	o	220	6)
	Max	54162.7277	.0010	HMB	−0.2484	GCVS 85	o	220	6)
	Max	54163.7661	.0011	HMB	+0.2606	GCVS 85	o	330	6)
	Max	54164.8046	.0010	HMB	+0.2405	GCVS 85	o	225	6)
	Max	54168.614 :	.001	HMB	−0.185	GCVS 85	o	45	6)
	Max	54169.6546	.0010	HMB	−0.2029	GCVS 85	o	178	6)
	Max	54187.6645	.0004	HMB	−0.1906	GCVS 85	o	191	6)
	Max	54188.7033	.0004	HMB	−0.2105	GCVS 85	o	225	6)
	Max	54195.6303	.0009	HMB	−0.1649	GCVS 85	o	120	6)
GI Gem	Max	54149.440	.003	AG	−0.004	BAVR 51,40ff	-Ir	20	1)
GU Gem	Max	54141.369	.003	AG			-Ir	30	1)
TW Her	Max	54220.527	.003	AG	−0.007	GCVS 85	-Ir	11	1)
AR Her	Max	54203.578	.003	AG	+0.029	BAVR 52,3ff	-Ir	27	1)
EP Her	Max	54271.427	.003	AG			-Ir	44	1)
GS Her	Max	54205.472	.005	AG			-Ir	37	1)
HM Her	Max	54210.341	.003	AG			-Ir	29	1)
IT Her	Max	54219.3947	.0026	SCI			o	65	2)
	Max	54219.5690	.0021	SCI			o	72	2)
V447 Her	Max	54203.541	.003	AG			-Ir	27	1)
V552 Her	Max	54239.380	.003	AG			-Ir	30	1)
V596 Her	Max	54210.529	.003	AG			-Ir	30	1)
UU Hya	Max	54171.364	.003	AG			-Ir	56	1)
	Max	54173.458	.003	AG			-Ir	30	1)
UV Hya	Max	54171.357	.003	AG			-Ir	59	1)
	Max	54173.475	.003	AG			-Ir	30	1)
DT Hya	Max	54259.314	.003	HND			o	62	4)
FX Hya	Max	54275.401	.002	HND			o	54	4)
GL Hya	Max	54197.3944	.0020	MZ			-Ir	53	2)
RW Hyi	Max	54144.405	.002	HND			o	96	4)
RR Leo	Max	54195.4457	.0005	QU	+0.0397	BAVR 47,67	V	67	3)
	Max	54195.4472	.0018	WN	+0.0412	BAVR 47,67	V	135	11)
	Max	54205.3991	.0013	WN	+0.0404	BAVR 47,67	V	149	11)
ST Leo	Max	54175.4301	.0004	QU	−0.0196	GCVS 85	V	61	3)
	Max	54197.4148	.0005	QU	−0.0222	GCVS 85	V	65	3)
AE Leo	Max	54187.3545	.0010	MZ	+0.2105	GCVS 85	-Ir	78	2)
DM Leo	Max	54210.4176	.0007	MZ			-Ir	125	2)
Y LMi	Max	54202.3495	.0010	MZ	+0.0141	BAVR 49,41	-Ir	104	2)
U Lep	Max	54145.450	.003	HND	+0.046	GCVS 85	o	87	4)
SZ Lyn	Max	54173.408	.001	AG	+0.026	GCVS 85	-Ir	31	1)
	Max	54180.4001	.0009	WN	+0.0273	GCVS 85	V	104	11)
	Max	54185.3401	.0012	WN	+0.0254	GCVS 85	V	96	11)
	Max	54186.4267	.0011	WN	+0.0272	GCVS 85	V	111	11)
	Max	54187.3918	.0017	WN	+0.0280	GCVS 85	V	116	11)
	Max	54188.3548	.0013	WN	+0.0267	GCVS 85	V	91	11)
	Max	54191.3688	.0010	WN	+0.0273	GCVS 85	V	235	11)
	Max	54191.4889	.0015	WN	+0.0269	GCVS 85	V	235	11)
	Max	54197.3950	.0012	WN	+0.0268	GCVS 85	V	57	11)
	Max	54202.3361	.0013	WN	+0.0260	GCVS 85	V	75	11)

Table 2: (cont.)

Variable	M/m	HJD 24...	±	Obs	$O-C$	Bibliography	Fil	n	Rem
SZ Lyn	Max	54203.4208	.0008	WN	+0.0258	GCVS 85	V	68	11)
	Max	54223.4278	.0007	WN	+0.0240	GCVS 85	V	135	11)
TV Lyn	Max	54172.555	.003	AG	+0.016	GCVS 85	-Ir	119	1)
TW Lyn	Max	53098.484	.004	AG	+0.052	GCVS 85	-Ir	51	1)
BE Lyn	Max	54221.3942	.0009	WN			V	111	11)
	Max	54222.4490	.0008	WN			V	70	11)
CR Lyr	Max	53891.8176	.0023	HMB			-Ir	38	6)
	Max	53893.7974	.0032	HMB			-Ir	37	6)
	Max	53894.7811	.0047	HMB			-Ir	24	6)
EZ Lyr	Max	53948.4515	.0006	FLG	+0.0276	BAVR 34,145ff	o	55	12)
MW Lyr	Max	53926.5133	.0022	HMB			V	13	6)
	Max	53930.4884	.0099	HMB			V	71	6)
	Max	53932.4773	.0012	HMB			V	77	6)
	Max	53934.4539	.0009	HMB			-Ir	71	6)
NR Lyr	Max	53898.7392	.0050	HMB			o	71	6)
RV Men	Max	54165.399	.004	HND			o	38	4)
	Max	54171.356	.004	HND			o	130	4)
	Max	54178.410	.003	HND			o	31	4)
GM Mon	Max	54084.8782	.0019	HMB			-Ir	226	6)
TX Mus	Max	54262.417	.003	HND			o	91	4)
	Max	54264.311	.003	HND			o	68	4)
EM Mus	Max	54277.406	.002	HND			o	96	4)
V452 Oph	Max	53503.483	.003	AG			-Ir	24	1)
V785 Oph	Max	53503.519	.005	AG	−0.007	GCVS 85	-Ir	24	1)
BT Peg	Max	53607.440	.003	AG	+0.087	BAVR 49,105	-Ir	27	1)
DY Peg	Max	53977.4504	.0005	FLG	−0.0068	GCVS 87	o	114	12)
ST Pic	Max	54167.358	.003	HND			o	40	4)
HH Pup	Max	54179.345	.003	HND			o	34	4)
	Max	54188.331	.002	HND			o	45	4)
T Sex	Max	54173.500	.003	AG	−0.074	BAVR 51,247	-Ir	30	1)
V Sex	Max	54173.409	.003	AG			-Ir	30	1)
U Tri	Max	54126.3537	.0004	MZ	−0.0148	BAVR 49,105	-Ir	100	2)
RV UMa	Max	54186.4057	.0005	QU	+0.0076	BAVR 48,189	V	74	3)
SX UMa	Max	54203.573	.003	AG	−0.152	SAC 73	-Ir	84	1)
TU UMa	Max	54152.4975	.0005	QU	−0.0265	GCVS 87	V	60	3)
	Max	54170.3439	.0007	QU	−0.0251	GCVS 87	V	65	3)
	Max	54171.4579	.0005	QU	−0.0265	GCVS 87	V	80	3)
	Max	54185.4000	.0005	QU	−0.0258	GCVS 87	V	65	3)
	Max	54195.4359	.0015	SCI	−0.0278	GCVS 87	o	162	2)
	Max	54205.4725	.0018	WN	−0.0290	GCVS 87	V	108	11)
	Max	54219.4157	.0010	FLG	−0.0273	GCVS 87	o	196	12)
AE UMa	Max	54171.4664	.0023	WN	+0.0053	BAVR 48,189	V	103	11)
	Max	54174.4816	.0002	WN	+0.0100	BAVR 48,189	V	110	11)
	Max	54175.4206	.0013	WN	+0.0027	BAVR 48,189	V	85	11)
	Max	54196.4976	.0009	WN	+0.0056	BAVR 48,189	V	58	11)
	Max	54197.359	.002	WN	+0.007	BAVR 48,189	V	62	11)
	Max	54197.4402	.0006	WN	+0.0020	BAVR 48,189	V	92	11)
	Max	54198.3850	.0009	WN	+0.0006	BAVR 48,189	V	163	11)
	Max	54198.4741	.0007	WN	+0.0037	BAVR 48,189	V	163	11)
	Max	54202.4288	.0007	WN	+0.0016	BAVR 48,189	V	52	11)
GSC 4139.0289	Max	54192.3685	.0010	MZ			-Ir	120	2)
AF Vel	Max	54258.351	.002	HND			o	64	4)
AN Vel	Max	54188.407	.002	HND			o	59	4)
ST Vir	Max	54204.574	.003	AG	+0.026	GCVS 87	-Ir	70	1)
XZ Vir	Max	54211.4539	.0010	MZ			-Ir	92	2)
BN Vul	Max	53956.4045	.0011	FLG	−0.0206	SAC 73	o	135	12)

Remarks:

AG:	Agerer, F., Tiefenbach	MZ:	Maintz, G., Bonn
DIE:	Dietrich, M., Radebeul	QU:	Quester, W., Esslingen
FLG:	Flechsig, Dr. G., Teterow	RAT:	Rätz, M., Herges-Hallenberg
FR:	Frank, P., Velden	RCR:	Rätz, C., Herges-Hallenberg
HMB:	Hambsch, Dr. F., Mol (B)	SCI:	Schmidt, U. Karlsruhe
HND:	Hund, F., Windhoek (Namibia)	SIR:	Schirmer, J., Willisau (CH)
Ju:	Jungbluth, Dr. H., Karlsruhe	WN:	Wischnewski, M. Wennigsen
MS:	Moschner, W., Lennestadt	WTR:	Walter, F., München

: = uncertain
s = secondary minimum
red = reduced results
C = CCD-camera
o = without filter
V = V-filter
-Ir = -Ir-filter
1) = ccd-camera ST-6 chip 375*242 uncoated
2) = ccd-camera ST-7
3) = ccd-camera ST-7E
4) = ccd-camera ST-8E
5) = ccd-camera ST-9 chip
6) = ccd-camera STL-11K
7) = ccd-camera Alpha Maxi chip KAF401e
8) = ccd-camera OES-LcCCD12
9) = ccd-camera pictor 1616XT
10) = ccd-camera Pictor 416XT
11) = ccd-camera Meade DSI Pro 2
12) = ccd-camera SIGMA 402 chip

Variables which possibly require a new classification

13) = GCVS-type EW:/KE: - possibly RR
14) = GCVS-type RRC - possibly EW

GCVS *yy* = General Catalogue of Variable Stars, 4th ed. 19*yy*
IBVS *nnnn* = Information Bulletin on Variable Stars No. *nnn*
MVS vv,ppp = Mitteilungen über Veränderl. Sterne; volume,pages
SAC *vv* = Rocznik Astronomiczny No. *vv*, Krakow (SAC)
BAVM *nnn* = BAV Mitteilungen No. *nnn*
BAVR *nn*, *ppp* = BAV Rundbrief No. *nn*, page *ppp*
AA *vv*, *ppp* = Acta Astronomica volume *nn*, page *ppp*
U = USNO A 2.0 Catalogue

ERRATUM FOR IBVS 5657

Corrections to BAVM 173

V699 Cyg 53258.5458 AG must be deleted

ERRATA FOR IBVS 5802

Corrections to BAVM 186

AO Cam	53809.3529	RAT RCR	correct value: 53809.3259
GK Cas	54212.5234	RAT RCR	correct value: 54211.5234

ERRATUM FOR IBVS 5802 (BAVM 186)

GSC 0137501085 SIR all results must be deleted

ERRATUM FOR IBVS 5802 (BAVM 186)

GSC 03776.00170 52862.5033 AG has to be deleted

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PHOTOMETRIC SEQUENCES AND ASTROMETRIC POSITIONS OF NOVA Sgr 2007 AND NOVA Vul 2007

HENDEN, ARNE[1]; MUNARI, ULISSE[2]

[1] AAVSO, American Association of Variable Star Observers, 49 Bay State Road, Cambridge, MA 02138, USA

[2] INF Osservatorio Astronomico di Padova, Sede di Asiago, I-36032 Asiago (VI), Italy

Nova Sgr 2007 (= V5558 Sgr) was discovered by Y. Sakurai at ∼10.3 mag on Apr 14.777 UT (cf. Nakano 2007a). It was recovered on prediscovery images by K. Haseda at mag 11.2 on Apr. 11.792 UT (cf. Yamaoka 2007). On April 20, spectroscopic confirmation was provided by Iijima (2007a), who argued that the object could be a rather peculiar nova seen in the pre-maximum phase, and by Naito et al. (2007), who concluded the object is probably not a classical nova. Later, Iijima (2007b) recapped the spectroscopic evolution until mid July and concluded the object is indeed a nova with a very peculiar behaviour. A detailed description of the first three months of photometric and spectroscopic evolution of Nova Sgr 2007 was provided by Munari et al. (2007a), that also highlighted the similarity with Nova Cas 1995 (V723 Cas) and reported about their positive detection of the nova in the X-rays with the SWIFT satellite. Further evolution in optical and infrared spectra were reported by Kiss and Sarneczky (2007a) and Lynch et al. (2007). According to Munari et al. (2007a), maximum brightness occurred around July 10.0 UT with $V = 6.53$, $B - V = +0.96$, $V - I_C = +1.22$. According to the AAVSO International Database, Nova Sgr 2007 went through five further progressively fainter maxima.

Nova Vul 2007 (= V458 Vul) was discovered on August 8.54 UT by H. Abe at 9.5 mag (cf. Nakano 2007b). Spectroscopic confirmation was obtained on the following day by Munari et al. (2007b), Buil (2007) and Fujii (2007). A description of the spectrum for August 18 was reported by Kiss and Sarneczky (2007b). According to the AAVSO International Database, Nova Vul 2007 went through three distinct maxima of similar ∼8.2 mag brightness on August 9, 13 and 19, before entering a stable decline.

In this note we present a BVR_CI_C photometric sequence around both novae. These sequences are based on the visual sequences used by the AAVSO, with a wider color range for CCD calibration. To calibrate the sequences, we obtained CCD photometry with the Sonoita Research Observatory 0.35-m robotic telescope on several distinct photometric nights, using BVR_CI_C filters and an SBIG STL-1001E CCD camera. Pixel size is $1''.25$/pix and the field of view is $20' \times 20'$. Observations on each photometric night included following an extinction star from low to high airmass, along with BVR_CI_C exposures of Landolt standard fields (Landolt 1983, 1992). The photometric sequences are presented in Figures 1 and 2.

Astrometry was performed using SLALIB (Wallace 1994) linear plate transformation routines in conjunction with the UCAC2 reference catalog. Errors in coordinates were less than 0.1 arcsec in both coordinates, referred to the mean coordinate zero point of the reference stars in each field. The coordinates we derived for Nova Sgr 2007 are $\alpha_{\rm J2000} = 18^{\rm h}10^{\rm m}18\overset{\rm s}{.}258$ ($\pm0\overset{\rm s}{.}046$), $\delta_{\rm J2000} = -18°46'51\overset{''}{.}95$ ($\pm0\overset{''}{.}047$), close to the coordinates reported by Nakano (2007a) at position end figures $18\overset{\rm s}{.}27$ and $52\overset{''}{.}1$, and by Koff (2007) at position end figures $18\overset{\rm s}{.}21$ and $51\overset{''}{.}8$. No progenitor is visible on POSS plates within a few arcsec from this position, which would set the outburst amplitude to $\Delta B \geq 13.4$ mag. 7.2 arcsec north of the nova lies field star GSC2 S9JJ000329, for which we measured psf-fit magnitudes as given in Table 1 and position (J2000) α=$18^{\rm h}10^{\rm m}17\overset{\rm s}{.}99$, δ=$-18°46'46\overset{''}{.}0$.

Table 1. Nova optical companions

companion to:	V	$(B-V)$	$(V-R_c)$	(R_c-I_c)
V5558 Sgr	12.25 ±0.05	+1.39 ±0.05	+0.77 ±0.08	+0.73 ±0.06
V458 Vul	15.96 ±0.05	+1.80 ±0.08	+1.01 ±0.05	+ 0.97 ±0.08

Our coordinates for Nova Vul 2007 are: $\alpha_{\rm J2000} = 19^{\rm h}54^{\rm m}24\overset{\rm s}{.}628$ ($\pm0\overset{\rm s}{.}061$), $\delta_{\rm J2000} = +20°52'52\overset{''}{.}02$ ($\pm0\overset{''}{.}049$), close to the coordinates reported by Nakano (2007b) at position end figures $24\overset{\rm s}{.}64$ and $51\overset{''}{.}9$. Within 0.61 arcsec from our position of the nova lies USNO-B1.0 1108-0460444, at catalog B=18.2 and R=17.8 mag. The blue color and ΔB=10.5 mag outburst amplitude make this object a viable progenitor for the nova. 7.4 arcsec south of the nova lies USNO-B1.0 1108-0460435, for which we measured psf-fit magnitudes as given in Table 1 and position (J2000) α=$19^{\rm h}54^{\rm m}24\overset{\rm s}{.}52$, δ=$+20°52'44\overset{''}{.}8$

We would like to thank J. Gross, W. Cooney and D. Terrell for their help in setting up the SRO observations and relinquishing their observing time.

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Nova Vul 2007 $\alpha_{\rm J2000} = 19\ 54\ 24.63$ $\delta_{\rm J2000} = +20\ 52\ 52.0$

	α_{J2000}	(±")	δ_{J2000}	(±")	N	V	(±)	B–V	(±)	V–$R_{\rm C}$	(±)	$R_{\rm C}$–$I_{\rm C}$	(±)	V–$I_{\rm C}$	(±)
a	298.643151	0.040	+20.927677	0.020	3	11.548	0.015	1.221	0.080	0.678	0.016	0.651	0.016	1.333	0.012
b	298.651372	0.023	+20.906116	0.041	3	12.522	0.018	0.623	0.003	0.377	0.012	0.406	0.014	0.788	0.012
c	298.636528	0.040	+20.925733	0.077	3	13.054	0.023	1.948	0.015	1.153	0.020	1.162	0.030	2.331	0.025
d	298.623639	0.040	+20.857857	0.020	3	13.148	0.022	0.431	0.012	0.251	0.025	0.282	0.033	0.536	0.023
e	298.561497	0.053	+20.878355	0.143	3	14.089	0.026	1.319	0.045	0.744	0.041	0.780	0.037	1.535	0.034
f	298.585079	0.117	+20.880976	0.088	3	14.376	0.026	0.795	0.024	0.459	0.042	0.463	0.032	0.925	0.036
g	298.648972	0.117	+20.887449	0.150	3	14.522	0.019	0.902	0.080	0.510	0.040	0.498	0.042	1.009	0.049
h	298.619093	0.185	+20.838994	0.220	3	15.310	0.016	1.706	0.069	0.919	0.037	0.976	0.040	1.912	0.024
i	298.654575	0.348	+20.831294	0.299	2	16.103	0.008	0.719	0.037						
α	298.668638	0.081	+20.950372	0.022	3	9.826	0.017	1.167	0.006	0.624	0.008	0.590	0.013	1.216	0.016
β	298.776093	0.139	+20.865219	0.065	3	10.020	0.018	1.169	0.008	0.628	0.012	0.570	0.017	1.197	0.010
γ	298.663720	0.089	+20.762015	0.027	3	10.138	0.025	0.061	0.003	0.062	0.008	0.083	0.017	0.143	0.016
δ	298.780210	0.118	+20.991291	0.052	3	10.266	0.032	0.165	0.007	0.096	0.009	0.151	0.015	0.250	0.014
ϵ	298.741060	0.104	+21.016166	0.051	3	10.804	0.028	0.982	0.011	0.542	0.011	0.504	0.009	1.045	0.005
ζ	298.513049	0.083	+20.806158	0.020	3	11.154	0.023	0.164	0.007	0.109	0.006	0.141	0.015	0.250	0.012
η	298.616811	0.051	+20.781844	0.035	3	11.444	0.019	0.510	0.005	0.304	0.009	0.318	0.011	0.624	0.010
θ	298.609665	0.043	+20.978029	0.026	3	11.959	0.020	1.363	0.014	0.756	0.008	0.698	0.015	1.455	0.015

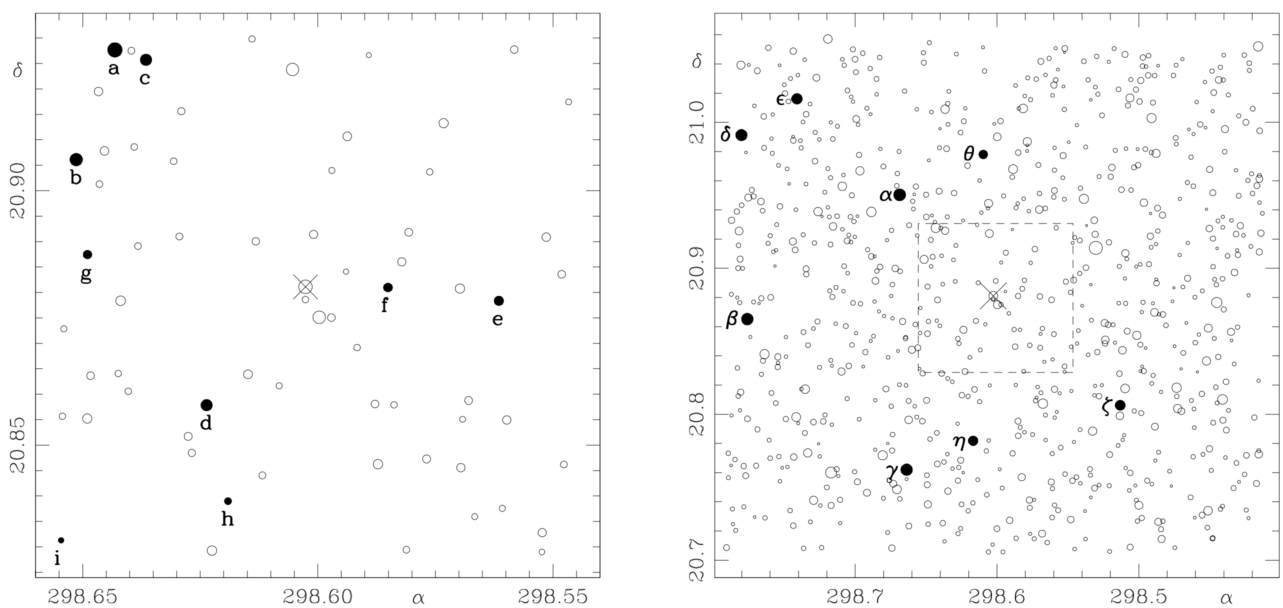

Figure 1. $BVR_{\rm C}I_{\rm C}$ photometric comparison sequence around Nova Vul 2007. The cross indicates the nova. N is the number of nights in which the given star has been measured in the given band. The error in α and δ are in arcsec. The panel on the right covers a $20' \times 20'$ area centered on the nova and shows stars down to V=16.5. The dashed $6' \times 6'$ area is zoomed in on the left panel.
α = HD 345257 (K5), β = HD 345267 (K2), γ = HD 345266 (B5), δ = HD 345268 (B8), ϵ = HD 345256 (G5) and ζ = HD 345264 (A2).

Nova Sgr 2007 $\alpha_{\rm J2000}$ = 18 10 18.26 $\delta_{\rm J2000}$ = –18 46 51.9

	α_{J2000}	(±")	δ_{J2000}	(±")	N	V	(±)	B–V	(±)	V–$R_{\rm C}$	(±)	$R_{\rm C}$–$I_{\rm C}$	(±)	V–$I_{\rm C}$	(±)
a	272.538878	0.034	–18.796609	0.057	4	11.732	0.023	1.716	0.019	0.973	0.014	0.916	0.020	1.888	0.024
b	272.611939	0.042	–18.768947	0.040	4	12.330	0.035	0.489	0.018	0.337	0.032	0.337	0.020	0.674	0.021
c	272.568396	0.037	–18.766809	0.040	4	12.790	0.030	1.554	0.015	0.854	0.023	0.751	0.014	1.597	0.027
d	272.561203	0.028	–18.791726	0.051	4	12.795	0.028	0.555	0.014	0.337	0.026	0.360	0.016	0.700	0.022
e	272.531353	0.039	–18.763034	0.055	4	13.076	0.029	0.653	0.025	0.407	0.031	0.446	0.014	0.858	0.024
f	272.627226	0.050	–18.804664	0.034	4	13.196	0.032	1.308	0.025	0.829	0.031	0.796	0.019	1.625	0.037
g	272.623339	0.044	–18.755838	0.033	4	13.471	0.029	0.785	0.024	0.491	0.033	0.455	0.016	0.943	0.030
h	272.551990	0.098	–18.765991	0.108	4	13.768	0.047	0.625	0.025	0.403	0.057	0.502	0.020	0.917	0.036
i	272.606784	0.103	–18.759362	0.079	4	14.010	0.043	0.720	0.043	0.415	0.049	0.414	0.043	0.830	0.054
j	272.524881	0.155	–18.756105	0.146	4	14.644	0.041	0.922	0.037	0.493	0.040	0.606	0.050	1.114	0.066
l	272.574081	0.246	–18.773926	0.207	4	14.993	0.048	0.831	0.094	0.510	0.087	0.569	0.029	1.087	0.076
α	272.645233	0.039	–18.700251	0.045	4	8.726	0.028	1.181	0.013	0.628	0.038	0.516	0.064	1.134	0.101
β	272.742383	0.039	–18.824034	0.035	4	9.163	0.030	0.138	0.011	0.071	0.020	0.095	0.014	0.167	0.022
γ	272.547984	0.044	–18.931866	0.067	4	9.397	0.029	1.149	0.012	0.626	0.021	0.580	0.009	1.203	0.017
δ	272.715511	0.028	–18.728065	0.037	4	9.864	0.032	0.262	0.019	0.162	0.026	0.167	0.020	0.328	0.019
ϵ	272.578128	0.046	–18.659235	0.036	4	10.079	0.033	0.209	0.012	0.138	0.030	0.164	0.012	0.304	0.021
ζ	272.699868	0.014	–18.675985	0.037	4	10.601	0.030	0.509	0.010	0.328	0.028	0.324	0.020	0.651	0.016
η	272.426442	0.046	–18.681610	0.028	4	11.127	0.024	0.554	0.016	0.350	0.033	0.393	0.020	0.748	0.017
θ	272.609916	0.028	–18.868806	0.059	4	11.180	0.025	1.678	0.012	1.005	0.020	0.947	0.010	1.951	0.018
ι	272.678816	0.020	–18.748600	0.025	4	11.392	0.034	1.561	0.026	0.848	0.037	0.755	0.012	1.596	0.024
κ	272.634969	0.031	–18.713396	0.047	4	11.718	0.030	0.369	0.008	0.200	0.021	0.243	0.014	0.447	0.013
λ	272.679044	0.048	–18.647745	0.028	4	12.026	0.036	0.535	0.009	0.335	0.030	0.328	0.020	0.662	0.025
μ	272.499717	0.048	–18.771681	0.049	4	12.602	0.027	0.402	0.020	0.214	0.023	0.287	0.033	0.509	0.036

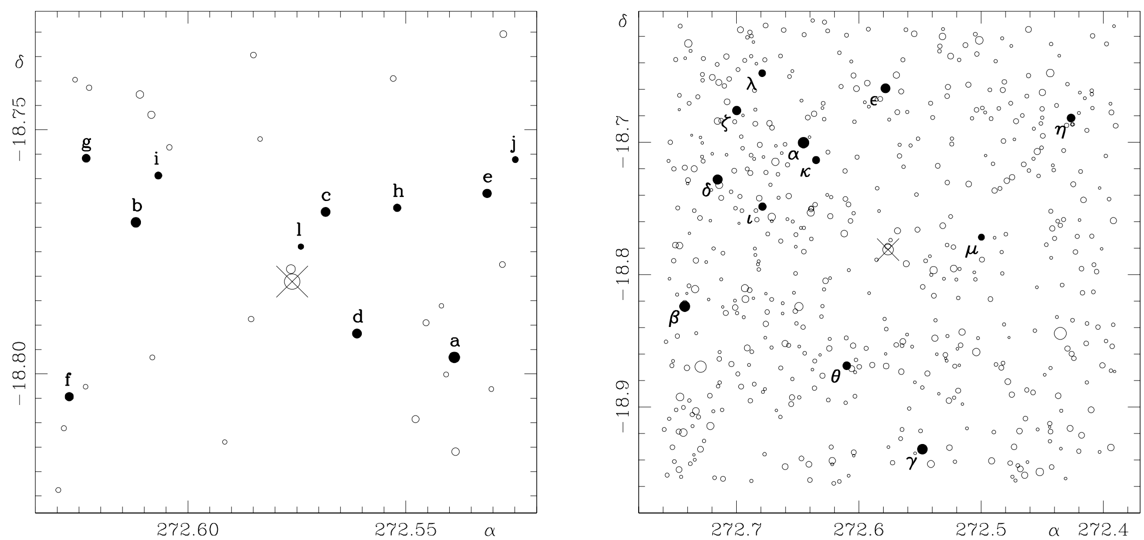

Figure 2. $BVR_{\rm C}I_{\rm C}$ photometric comparison sequence around Nova Sgr 2007. The cross indicates the nova. N is the number of nights in which the given star has been measured in the given band. The error in α and δ are in arcsec. The panel on the right covers a $20'\times20'$area centered on the nova and shows stars down to V=16.2. The dashed $6'\times6'$ area is zoomed in on the left panel.
α = HD 166240 (K0III), β = HD 166322 (B9IV), γ= HD 166145 (G5/G6III), δ = HD 312752 (A0), ϵ = HD 166189 (B9II) and ζ = HD 312750.

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ANALYSIS OF THE LIGHT CURVE OF THE RV TAURI STAR LV Del

MADERAK, RYAN M.; HONEYCUTT, R. K.

[1] Department of Astronomy, Indiana University, Bloomington, Indiana 47405-7105, USA

The RV Tauri star LV Del was observed by the Indiana University 0.41 meter automated photometric telescope (a.k.a., Roboscope) from 1990 to 2003, and was first noted by Honeycutt et al. (1992). The V magnitude light curve of LV Del is presented in Figure 1, and consists of 1263 data points acquired from JD 2448420 through JD 2452919. We have reduced the light curve using the method of ensemble photometry on an inhomogeneous data set (Honeycutt, 1992), and the error bars represent the uncertainty of the differential photometry. The zero point has an uncertainty (standard deviation of the mean) of 0.006 mag, determined using standards from the field of HR Del (Henden & Honeycutt, 1997), in which LV Del lies.

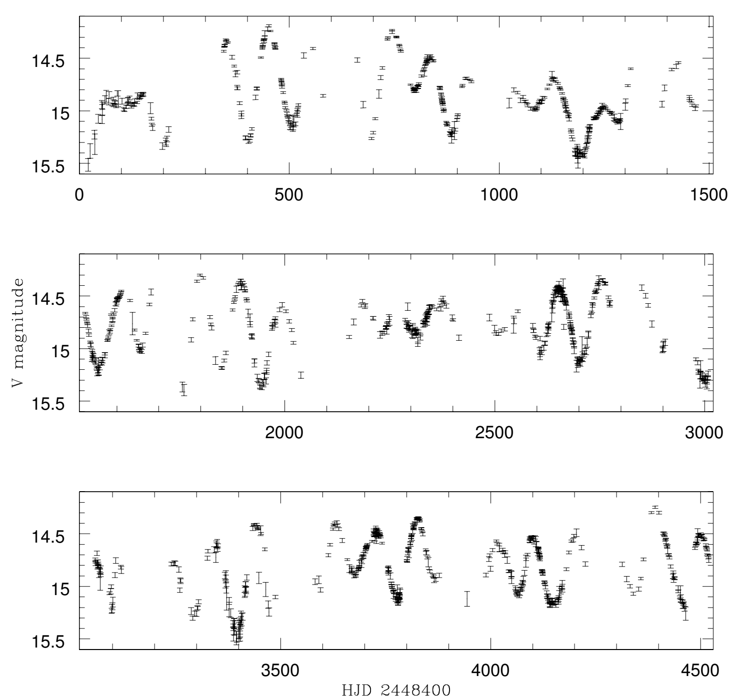

Figure 1.

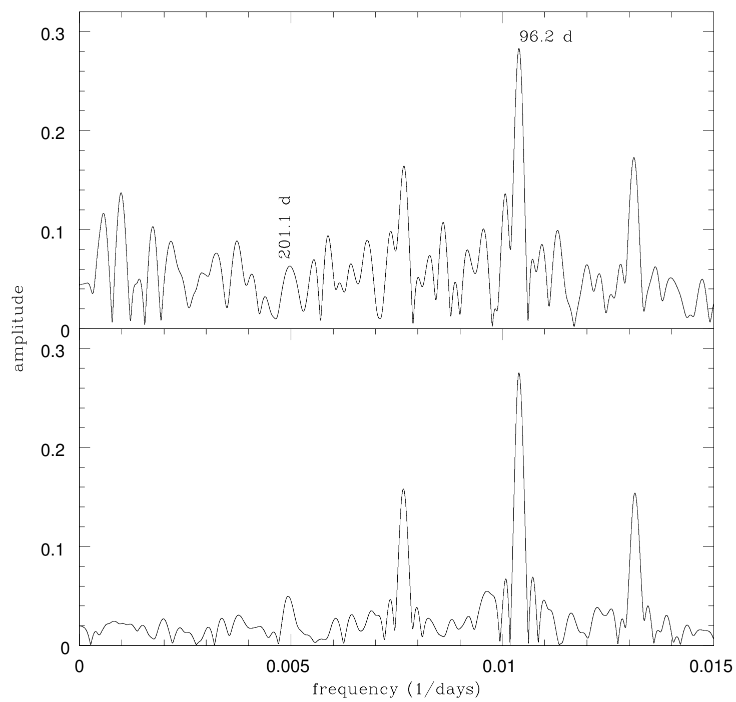

Figure 2.

A Fourier transform of the data, presented in the top panel of Figure 2, gives 96.2d as the dominate period. To demonstrate spectral leakage and aliasing, in the bottom panel we present a FT of a sine wave having the same period and amplitude; this wave has been evaluated at the same JDs as the actual light curve. Visual inspection of the light curve indicates that the 96.2d signal is not the “formal” RV Tauri period, but rather is the first harmonic, implying a value of 192.4d for the formal period. Visual inspection also suggests that the traditional RV Tauri “double hump” feature corresponding to the formal period is poorly expressed after about 1996 - 1997. The appearance of the light curve after this point is “Cepheid-like”, which is one of the typical irregularities exhibited by RV Tauri stars (Tsesevich, 1975); this apparent behavior is quantitatively supported by the dominance of the first harmonic in the FT, while no significant peak corresponding to the predicted formal period appears to present.

In order to test for any systematic changes in the period (another irregularity noted by Tsesevich, 1975), we have applied Fourier transforms to the light curve in two year overlapping windows (i.e., 12 such windows were used). A least squares fit to the resulting values of the first harmonic period versus time gives a rate of 0.10 ± 0.27 day/year, indicating no significant change in period.

Visual inspection of the light curve of LV Del suggests two other phenomena of interest: first, there appears to be a long term systematic variation of the mean brightness; second, there appears to be variation in the amplitude of the first harmonic, on a similarly long time scale. We examine the first in the top panel of Figure 3, which plots the mean brightness for one whole cycle out of each year of data (with error bars representing the standard deviation of the mean), along with a sinusoidal fit. Note that points for 1997 and 1999 have been omitted due to the data being more sparse in those years. The variations are larger than the errors, thus substantiating the presence of this signal, and identifying LV Del as a member of RVb photometric subclass (i.e., those exhibiting such long term variations; see, e.g., Tsesevich, 1975). The fitted sinusoid has a period of 1636.3d, a mean magnitude of 14.79, and an overall amplitude of 0.24 mag. Visual inspection suggests that these variations are not in fact strictly periodic, which is not uncommon for RVb stars (Tsesevich, 1975; Fokin, 1994). Two low frequency peaks, at 1762d and 1017d, also suggest the presence and irregularity of such a signal. It has been proposed (Tsesevich, 1975; Fokin 1994) that the secondary variability of the RVb class may be due to their being a member of a binary system in which they are periodically eclipsed by the ejection shell of the companion star.

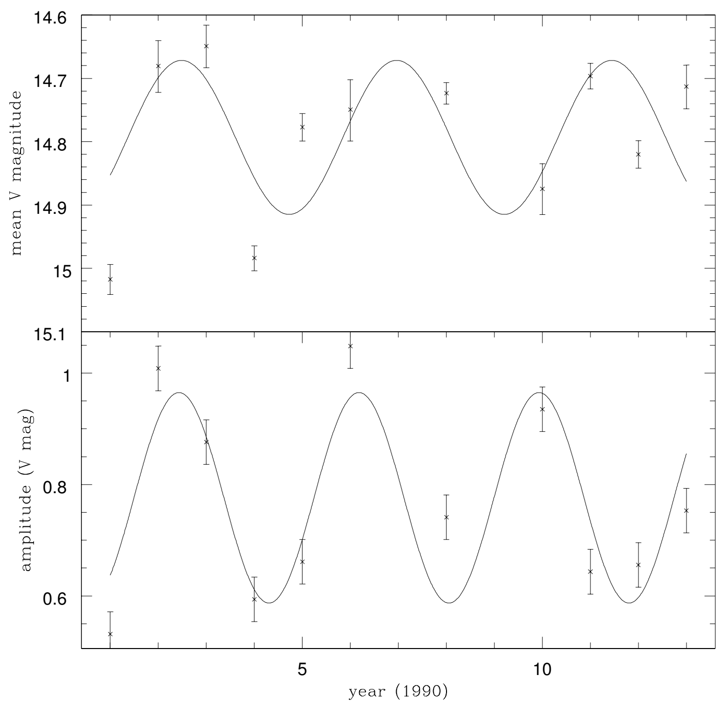

Figure 3.

To examine the apparent variation in pulsational amplitude, in the bottom panel of Figure 3 we plot the average amplitude for the same cycles as used for the top panel (in magnitudes; again, 1997 and 1999 have been omitted), with typical errors, and again with a sinusoidal fit. The errors are significantly smaller than the variations, thus verifying the presence of this variation in amplitude. The sinusoid has a period 1369.3d, where as that in top panel has a period of 1636.3d, and lags that in bottom panel by a phase of 3.7 years. For some RVb stars, these two variations are in phase (Tsesevich, 1975). In the case of LV Del, if we compare the data points in the two panels, we see that they appear to be in phase only during roughly the first half of the data set; however, the sinusoid fits indicate that, on average, the two variations are not in phase. This apparent shift in the behavior of the light curve is roughly correlated with the shift to Cepheid-like behavior mentioned above. If the star is in fact a binary, this correlation could support the idea that RVb stars are close binary systems, as proposed by Fokin (1994), which might allow a physical correlation between the pulsation and the binary nature.

The chaotic nature of the light curves of the RV Tauri stars AC Her (RVa) and R Sct (RVb) has been established (Kolláth et al., 1998; Kolláth, 1990). We have tested for chaos in the light curve of LV Del using the TISEAN non-linear time analysis package (Hegger et al., 1999). Note that this analysis was performed using a spline-smoothed light curve, with one day spacing, in order to insure uniform spacing and to maximize the available information, given that the non-linear time series analysis is very sensitive to noise. Following the procedure of Kiss & Szatmáry (2002), we used the TISEAN package to generate a phase space reconstruction of the data, and used the resulting phase space vectors to generate Broomhead-King projections of the phase space. The presence of intersections and cusps appeared to be minimized for an embedding dimension of 4, and so we may take this as a tentative indicator of the embedding dimension of the phase space (see, e.g., Kolláth et al., 1998). However, the projections were quite noisy, and no significant structure was apparent. Given the high data density of both the real and smoothed light curves, this is an indication that the data set is simply too short to obtain informative results. In this regard, we may compare to the data of Kolláth (1990), Kolláth et al. (1998), and Kiss & Szatmáry (2002) who had data sets of 32 years, 150 years, and 100 years, respectively.

A quantitative measure of the chaos present in a signal can be achieved by calculating the maximal Lyapunov exponent, which is a measure of the exponential growth of the infinitesimal perturbations which lead to chaos (Hegger et al., 1999). If chaos is present the maximal exponent should be positive (e.g., Kiss & Szatmáry, 2002). Again using the procedure laid out by Kiss & Szatmáry (2002), we have used the TISEAN package to calculate the maximal Lyapunov exponent, finding a value of 0.0238 ± 0.0031, which quantitatively indicates the presence of chaos. Again note that the spline-smoothed light curve was used.

The analysis herein has identified LV Del as an RV Tauri star of the RVb subclass. Although the formal period is poorly expressed, the irregularities exhibited by this star are typical of RV Tauri stars. The change in the behavior of the amplitude variations from being in phase to being out of phase with the long term variations in mean brightness may be correlated with the change to Cepheid-like behavior exhibited in the light curve, but we can only speculate as to the physical origin of either effect. The positive value of the maximal Lyapunov exponent indicates the presence of chaos in the light curve, but this must be taken with caution, as a longer data set would provide more certain results (see, e.g., Kiss et al., 1998). The Broomhead-King projections of the phase space trajectories suggest that the light curve is embedded in a low-dimension phase space with an embedding dimension of $\sim$4, but this is only tentative.

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A STUDY OF THE BRIGHT RR LYRAE STAR CN Cam

KINMAN, T. D.; HARMER, D. L.; SAHA, A.; WILLMARTH, D. W.

Kitt Peak National Observatory, NOAO,[1] P.O.Box 26732, Tucson, Arizona 85726, USA,
email: kinman@noao.edu

Strohmeier and Knigge (1961) discovered that CN Cam is variable and classified it as an eclipsing system. It was shown to be a type *ab* RR Lyrae star by Campos-Cucarella, Nomen-Torres, Gomez-Forrellad and Garcia-Melendo (1996); they made CCD observations of the star in B and V for 12 nights between 16 December 1995 and 12 February 1996. Their precise light curves show that CN Cam is not only one of the brighter RR*ab* ($V_{\rm max} = 9\overset{\rm m}{.}53$) but also has one of the lowest amplitudes ($0\overset{\rm m}{.}350 \pm 0.005$ and $0\overset{\rm m}{.}474 \pm 0.004$ magnitudes in V and B respectively). They gave the following ephemeris:

$$\mathrm{HJD_{max}} = 2450080.588 \pm 0.002 + 0.6214 \pm 0.0001 \times \mathrm{E} \qquad (1)$$

New photometric observations were needed, not only to improve the ephemeris but because Campos-Cucarella et al. only gave the PPM magnitude for their comparison star, SAO 001899; consequently the zero-points of their magnitudes need to be checked. We observed this comparison star on five nights and found $V = 10.201 \pm 0.003$ and $B - V = +0\overset{\rm m}{.}356 \pm 0.005$. The variable and this comparison star were observed in 1998, 1999 and 2004 (Fig. 1) and we found the following ephemeris:

$$\mathrm{HJD_{max}} = 2450080.588 \pm 0.002 + 0.621445 \pm 0.000002 \times \mathrm{E} \qquad (2)$$

The photometric observations in 1998 and 1999 were made with the Kitt Peak 0.9-m telescope using a 512 × 512 Tektronix chip under the control of the CCDPHOT program (Tody & Davis 1992, Kinman 1998). The observations in 2004 were made with the commercial robotic f/7 0.8-m Ritchey-Chretien telescope at the Tenagra Observatory in Arizona (Schwartz, 2007). The detector on this telescope was a 1024 × 1024 SITe CCD. These data were reduced with standard IRAF routines (Tody, 1993).

Our photometric observations (Table 1) give $\langle V \rangle = 9\overset{\rm m}{.}64$ and a $V_{\rm max}$ of $9\overset{\rm m}{.}42$: this is about 0.1 mag brighter than the value found by Campos-Cucarella et al. although the amplitudes that we find ($0\overset{\rm m}{.}36$ and $0\overset{\rm m}{.}49$ in V and B respectively) are close to their values. Our range in $(B-V)$ ($+0\overset{\rm m}{.}325$ to $+0\overset{\rm m}{.}454$) differs significantly from their range of $+0\overset{\rm m}{.}26$ to $+0\overset{\rm m}{.}38$.

Wils et al. (2004) used the data in the The Northern Sky Variability Survey (Woźniak et al., 2004) to give the following ephemeris for CN Cam:

$$\mathrm{HJD_{max}} = 2451628.65 + 0.62149 \times \mathrm{E} \qquad (3)$$

[1]The National Optical Astronomy Observatories are operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation

This does not agree well with our ephemeris nor the epoch of maximum given by Campos-Cucarella et al. Our examination of the Northern Sky Variability Survey shows that the best defined maximum in this data is given by the three observations at JD(hel) 2451311.6756, 2451311.6778 and 2451311.6787. If we take their epoch of maximum light to be the mean of these three epochs (JDhel 2451311.677), we find a phase of 0.010 with our ephemeris and a phase of 0.979 with the ephemeris of Wils et al. We therefore consider that there is no discrepancy between our ephemeris and the data of the Northern Sky Variability Survey, but that our ephemeris is to be preferred to that of Wils et al.

Radial velocities of CN Cam were obtained using the WIYN 3.5 m telescope and the Hydra fiber spectrograph in July, 1998. A spectral region of 510 Å centered on λ4315 was used (0.26 Å per pixel or $\sim$0.8 Å resolution). The velocity standard HD 136202 (Sp Type F8 III-IV, +54.4 km s^{-1}, Scarfe et al., 1990; Jeffery et al., 2007) was used as the template (using the whole spectrum including Hγ) to measure the radial velocities. HD 128167 (Sp Type F2 V, +0.04 km s^{-1}, Fekel, 1999) was observed as a check. The phases of the spectra were derived from our ephemeris and the γ-velocities were derived following Liu (1991). The results are given in Table 1 where T is the UT time (start), t is the integration time, JD_{hel} is the heliocentric Julian date, ϕ is the phase, V_{hel} is the heliocentric radial velocity and V_γ is the derived γ-velocity.

Table 1. Radial velocities of CN Cam and Velocity standards.

Star	Date (1998) (U.T)	T h:m	t s	JD_{hel} 2450000.+	ϕ	V_{hel} km s^{-1}	V_γ km s^{-1}
CN Cam	Jul 12	05:15	300	1006.7181	0.270	−82.7	−98.9
CN Cam	Jul 12	05:25	600	1006.7269	0.284	−81.3	−98.4
HD 136202	Jul 12	05:42	100	1006.7405	···	+54.2	···
HD 136202	Jul 12	05:49	300	1006.7467	···	+54.4	···
HD 128167	Jul 14	03:52	60	1008.6615	···	+0.9	···
HD 136202	Jul 14	03:58	90	1008.6686	···	+54.4	···
CN Cam	Jul 14	04:12	900	1008.6775	0.424	−72.9	−98.8

Jurcsik & Kovács (1996), Kovács & Walker (2001) and Sandage (2004) have shown that the metallicity [Fe/H] can be derived from the shape of the light curve and period of an RR Lyrae star. A Fourier combination ϕ_{31} of 2.467 was derived from the V light curve given by Campos-Cucarella et al. (1996); this gave [Fe/H] = −1.095 using Sandage's equation (3). A visual amplitude of $0\overset{m}{.}357$ gave [Fe/H] = −1.013 with Sandage's equation (6) while a rise-time of 0.25 gave [Fe/H] = −1.135 with Sandage's equation (7). These agree well with the approximate [Fe/H] = −1.2 that Castelli (2004) derived from our 1998 Jul 14 spectrum by comparison with spectra derived from model atmospheres. If we assume [Fe/H] =−1.1 and the absolute magnitude relation:

$$M_v = 0\overset{m}{.}214[\mathrm{Fe/H}] + 0\overset{m}{.}86 \tag{4}$$

of Clementini et al. (2003), we find $M_v = +0\overset{m}{.}62$. The extinction E$(B-V) = 0\overset{m}{.}047$ (l = 126°.4 and b = +35°.3) was taken from Schlegel et al. (1998) to give a distance of 594 pc. If we assume a 10% error in the parallax (1.684 mas), and the TYCHO proper motions $\mu_\alpha = -113.2\pm1.1$ mas, $\mu_\delta = -81.5\pm1.1$ (Hog et al., 2000), we get the following heliocentric galactic coordinates in km s^{-1}:

$$\mathbf{U} = -222 \pm 24, \quad \mathbf{V} = -338 \pm 24 \quad \text{and} \quad \mathbf{W} = +27 \pm 8$$

using the right-handed system which is positive towards the Galactic Centre, the direction of Galactic rotation and the North Galactic Pole (Johnson & Soderblom, 1987). CN Cam is therefore a halo RR Lyrae star with a significant retrograde galactic rotation and is consequently likely to belong to an *accreted* halo population (Kinman et al., 2007).

We are grateful to Francisco Campos-Cucarella for sending us their data so that the Fourier analysis could be made. We also thank Fiorella Castelli for deriving a metallicity from our spectrum of CN Cam.

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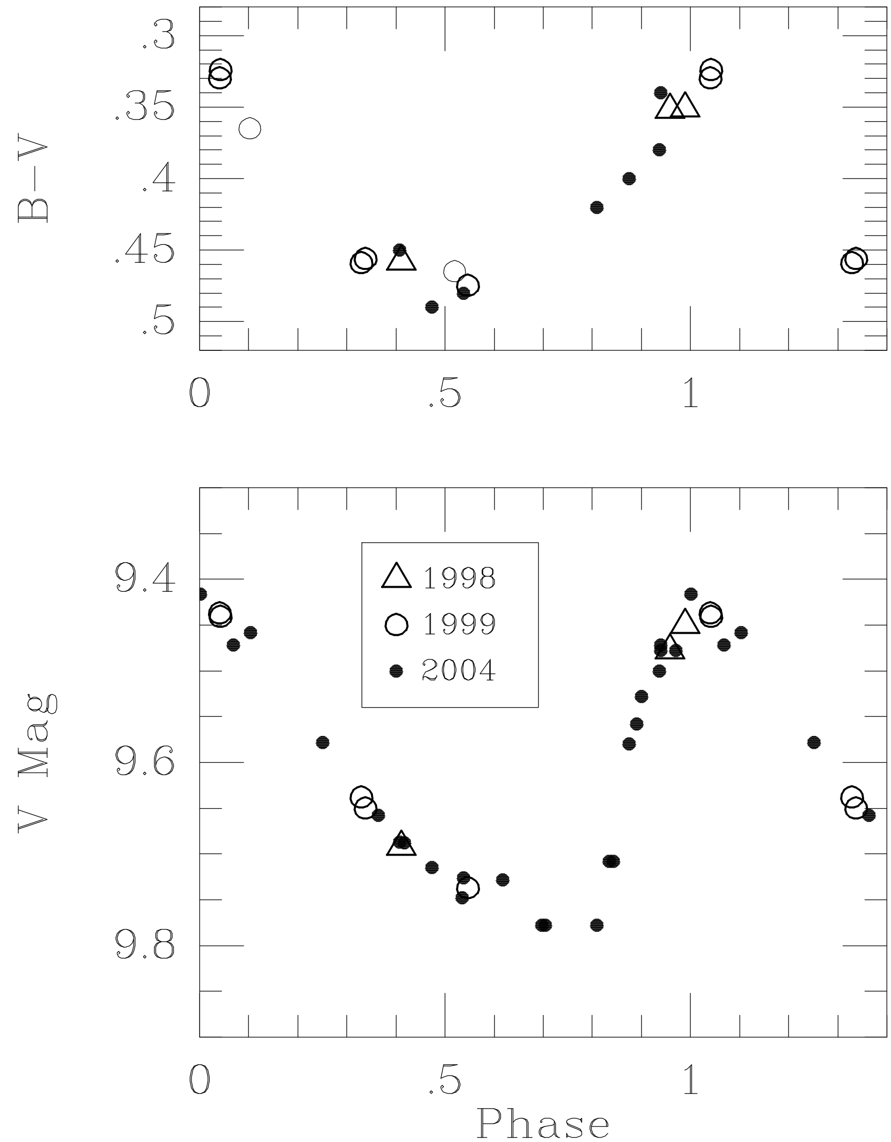

Figure 1. Fig. 1 (above) The $(B-V)$ colours and (below) the V magnitude of CN Cam as a function of phase (ϕ). 1998 observation (triangles), 1999 observations (open circles) and 2004 observations (filled circles).

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PHOTOELECTRIC MINIMA OF SOME ECLIPSING BINARY STARS

KRAJCI, TOM

PO Box 1351 Cloudcroft, New Mexico 83117; e-mail: tom_krajci@tularosa.net

Observatory and telescope:
Observations were conducted in Cloudcroft, New Mexico. 28cm Schmidt-Cassegrain, 2640 mm focal length. German equatorial mount.

Detector:	SBIG ST-7E, -25 °C, covering 8×5 arcminutes, 18 micron pixels (binned 2×2). Unfiltered.

Method of data reduction:
All CCD frames calibrated with bias, dark, and flat frames using AIP4WIN software. Differential aperture photometry performed using AIP4WIN software[†].

Method of minimum determination:
Digital tracing paper method, bisection of chords, curve fitting, and (occasionally) Kwee and van Woerden (1956).

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
HV Aqr	2454012.6534	0.0003	I	None	
V1647 Aql	2453930.6824	0.0003	II	None	
V1647 Aql	2453930.9199	0.0005	I	None	
DO Aur	2454048.8796	0.0003	I	None	
EM Aur	2454137.7738	0.0003	II	None	
S Cnc	2453876.9159	0.0010	I	None	
XZ Cnc	2454049.9853	0.0004	I	None	
BI CVn	2454137.9636	0.0002	I	None	
RR CMa	2454045.9819	0.0002	I	None	
AD CMa	2454055.9368	0.0002	I	None	
CV CMa	2454044.9377	0.0008	II	None	Apsidal motion
BQ Cap	2453994.7980	0.0015	I	None	Period 1.47409d
RZ Cas	2453989.8576	0.0003	I	None	
GK Cas	2454031.8360	0.0002	I	None	
NU Cas	2454078.6502	0.0002	I	None	
GW Cep	2453957.9704	0.0007	I	None	
GW Cep	2454137.6350	0.0002	II	None	
GW Cep	2454138.5914	0.0002	II	None	

[†]AIP4WIN software available at: `http://www.willbell.com/aip/index.htm`

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
NR Cep	2454047.8227	0.0002	II	None	
DY Cet	2453994.9419	0.0002	II	None	Period 0.440792d
EK Com	2454169.8621	0.0003	II	None	
NU Cyg	2453919.8921	0.0003	I	None	Period 0.281122d
NU Cyg	2454277.9001	0.0003	II	None	
QW Cyg	2453917.7304	0.0003	II	None	
V500 Cyg	2453977.6723	0.0001	I	None	
V704 Cyg	2453989.6342	0.0002	II	None	
V842 Cyg	2453941.8300	0.0003	I	None	
V884 Cyg	2453919.7626	0.0004	II	None	Period 0.480053d
V1189 Cyg	2453995.6313	0.0002	I	None	
V1901 Cyg	2453996.7451	0.0005	I	None	
V1902 Cyg	2453989.6812	0.0005	I	None	Period 0.450204d
V1902 Cyg	2453995.7584	0.0002	II	None	
V2150 Cyg	2453994.6667	0.0008	I	None	Period 0.591859d
V2197 Cyg	2453972.6656	0.0003	II	None	Period 0.465748d
V2197 Cyg	2453976.6248	0.0003	I	None	
V2290 Cyg	2453958.8123	0.0002	I	None	
BQ Eri	2454056.8743	0.0006	I	None	Period 0.821981d
WW Gem	2454176.6753	0.0002	I	None	
DQ Her	2454194.8589	0.0003	I	None	
V1050 Her	2453918.6933	0.0004	I	None	
V1050 Her	2453988.6435	0.0008	II	None	
V1063 Her	2453906.7337	0.0004	I	None	Period 1.65981d
RX Hya	2454109.8898	0.0001	I	None	
DI Hya	2454058.9801	0.0001	I	None	
KW Hya	2454108.7935	0.0010	II	None	
VX Lac	2453918.9449	0.0001	I	None	
CW Lib	2453929.7171	0.0003	I	None	
GI Lib	2454192.9117	0.0002	I	None	
GV Lib	2454176.9311	0.0002	I	None	
GV Lib	2454277.7088	0.0006	II	None	
Del Lib	2454138.9684	0.0006	I	None	
SW Lyn	2454169.6670	0.0002	I	None	
DF Lyr	2453933.6540	0.0002	I	None	
V429 Lyr	2453975.8341	0.0002	I	None	
EH Mon	2454179.6989	0.0006	I	None	
EW Mon	2454050.9209	0.0002	II	None	
EW Mon	2454078.8256	0.0003	I	None	
HM Mon	2454053.8793	0.0002	I	None	
V524 Mon	2454052.8766	0.0002	II	None	
V634 Mon	2454075.7686	0.0005	I	None	
V709 Oph	2453975.6722	0.0008	I	None	
V641 Ori	2454058.8514	0.0002	I	None	
V1027 Ori	2454076.7923	0.0002	II	None	

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
BQ Peg	2454012.7412	0.0002	I	None	
BY Peg	2453957.8253	0.0002	II	None	
CF Peg	2453917.8006	0.0004	I	None	Period 0.413498d
CW Peg	2454273.8879	0.0001	I	None	
DX Per	2454049.8828	0.0004	I	None	
V364 Per	2453988.9165	0.0003	II	None	
V364 Per	2454109.5937	0.0002	I	None	
BL Pup	2454138.7848	0.0002	I	None	
V1068 Sgr	2453928.7201	0.0003	II	None	
V1963 Sgr	2453918.8250	0.0002	II	None	Period 0.825080d
V1963 Sgr	2453930.7890	0.0002	I	None	
MX Ser	2453906.8760	0.0010	I	None	Period 0.30776d
MX Ser	2454169.9725	0.0003	I	None	
RW Tri	2453972.9106	0.0002	I	None	
XY UMa	2454076.9392	0.0002	I	None	
XY UMa	2454173.6989	0.0002	I	None	
DN UMa	2454166.7367	0.0005	I	None	
DV UMa	2454179.7820	0.0002	I	None	
DV UMa	2454179.8675	0.0002	I	None	
IY UMa	2453838.6023	0.0002	I	None	
IY UMa	2453838.6763	0.0002	I	None	
IY UMa	2453838.7502	0.0002	I	None	
IY UMa	2453838.8241	0.0002	I	None	
IY UMa	2453838.8981	0.0002	I	None	
CM Vir	2454173.9112	0.0003	I	None	
DM Vir	2453919.6710	0.0003	I	None	
FO Vir	2454194.7473	0.0007	I	None	
HP Vul	2454271.8414	0.0006	I	None	
NSV 13635	2453996.6262	0.0005	II	None	
NSV 13638	2454030.6114	0.0003	II	None	Period 0.427415d
GSC 0594-0324	2453958.9374	0.0003	I	None	Period 0.241202d
GSC 0594-0324	2453975.9427	0.0006	II	None	
GSC 0742-0237	2454031.9763	0.0005	I	None	
GSC 0742-0237	2454049.0089	0.0006	I	None	
GSC 2484-0592	2454057.9386	0.0009	II	None	
GSC 0742-0237	2454166.5979	0.0005	I	None	
GSC 3449-0680	2454075.9657	0.0002	I	None	
GSC 3449-0680	2454174.6384	0.0002	I	None	

Acknowledgements:

This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France (see references).

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SIMBAD astronomical database, `http://cdsweb.u-strasbg.fr/Simbad.html`

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EARLY SPECTRAL EVOLUTION OF NOVA Vul 2007=V458 Vul

TARASOVA, T. N.

Crimean Astrophysical Observatory, Nauchnyj, Crimea, 98409, Ukraine; email: taya@crao.crimea.ua

The star has been discovered as a bright nova on 2007 August 8.54 UT with the coordinates $\alpha = 19^{\rm h}54^{\rm m}24\overset{\rm s}{.}64$, $\delta = +20^\circ 52' 51\overset{''}{.}9$ J2000 and had brightness of about V = 8 mag (Abe, 2007; Nakamura et al. 2007). The nova has been given the official name V458 Vul (Samus, 2007). The light curve of V458 Vul based on AAVSO data (Henden, 2007a) is shown in Fig. 1. During the light fading the nova showed local flares up to 8th magnitude, and then declined to 11th magnitude (Nakano et al. 2007; Buil & Fujii, 2007).

We obtained five spectra on the 8th, 9th, 12th, 22nd and 24th day after the outburst (i.e. observed maximum magnitude) when the nova was at magnitude V=10.1, 10.2, 10.5, 11.2 and 11.3 respectively. The dates of our spectroscopic observations are marked on the light curve by arrows (see Fig.1).

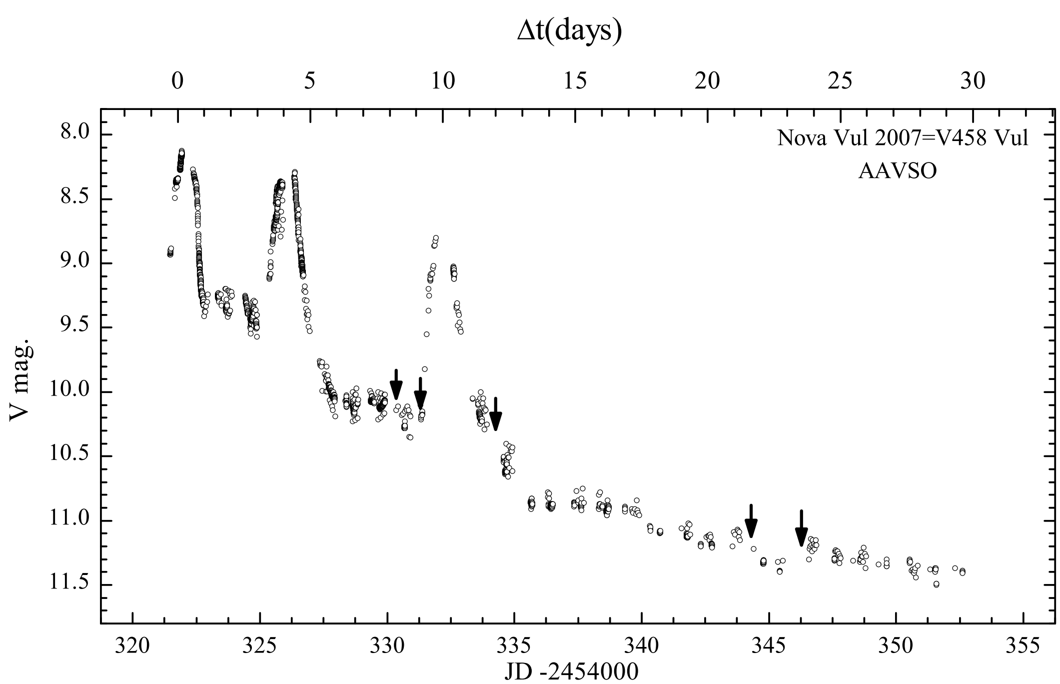

Figure 1. Light curve of V458 Vul based on AAVSO data. Arrows indicated the time of our spectral observations

The spectral observation was carried out at the Crimean Astrophysical Observatory with the 2.6m Shajn telescope. The low resolution spectra, characterized by a dispersion of 2 Å pix^{-1}, were observed in the wavelength ranges 3700-6190 Å and 5600 -7600 Å and were combined. The medium resolution spectrum, obtained on Aug 17th, has a dispersion of 0.75 Å pix^{-1} and covers the spectral range 4200 - 5300 Å. The data were processed following standard procedures for CCD frames, including bias subtraction, flat field correction, wavelength calibration. The spectrophotometric standard HR 7679 (Kharitonov et al. 1988) was used for flux calibration of the observed star. Four short time exposures of the standard star have been obtained just before and after the nova observations.

All our spectra are shown in Fig. 2. The spectra are separated vertically by a constant offset. The first two spectra were obtained before the second maximum, the third spectrum was obtained at the end of the second maximum and the last two were taken during the phase of slow decline.

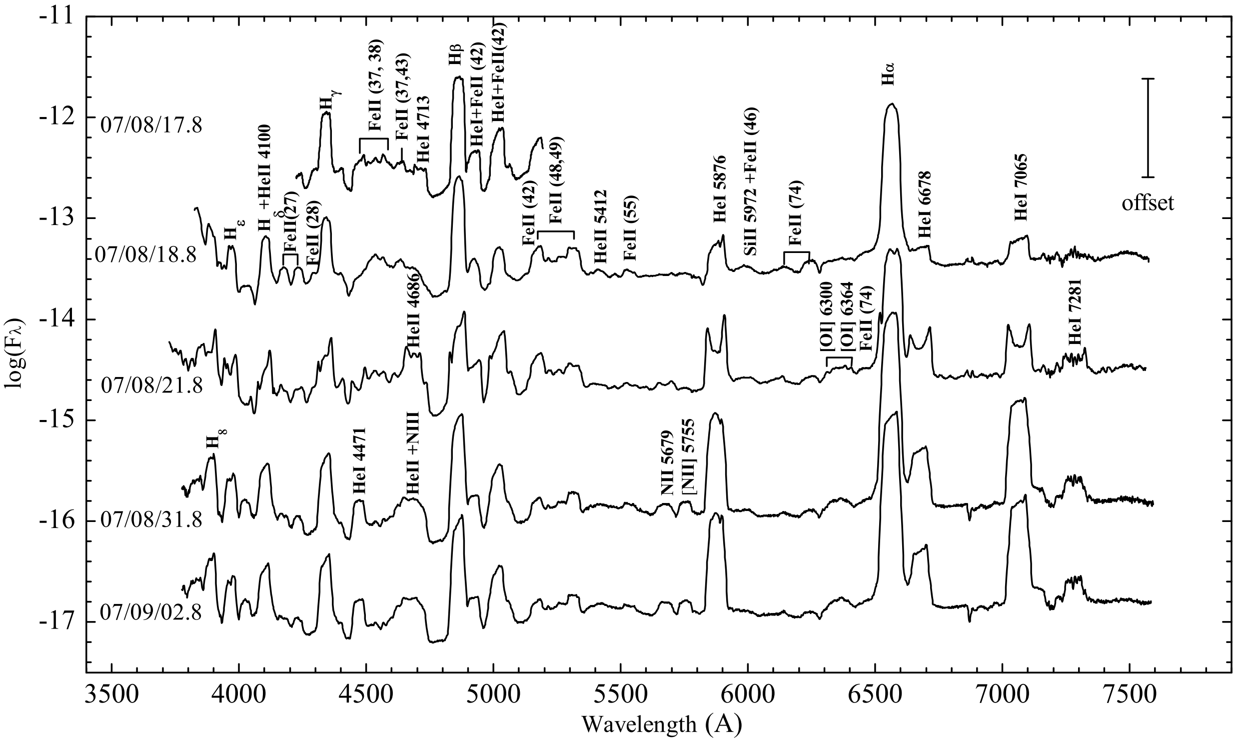

Figure 2. Spectroscopic evolution of V458 Vul. The lower four spectra are shifted downwards by one - four units respectively in log (flux). Flux F_λ is in units of $erg\,cm^{-2}s^{-1}\mathring{A}^{-1}$

Data analysis shows that the first two spectra, obtained during two consecutive nights are quite similar. The H, FeII emission lines of the 27, 28, 37, 38, 42, 49, 74 multiplets, and HeI 5876, 6678, 7065 Å dominate the spectrum of the nova. The expansion velocity (FWHM) is about 2700 $km\,s^{-1}$ for H and about 3000 $km\,s^{-1}$ for HeI lines. The line profiles of H and FeII lines have the rounded-topped form. The profiles of the HeI lines (but the HeI 4471) are different as they show "flat-top" profiles with some "jags".

On the third spectrum the strongest lines are the same as in the previous ones. But the line profiles differ noticeably from two previous and subsequent spectra. The H emission lines have a complex profile showing a clear P Cyg absorption and a multicomponent emission. While, the HeI line profile has evolved in asymmetric saddle shaped profiles. It is possible that the profile of the H emission lines is also saddle shaped and that the multicomponent appearance results from blend with HeII multiplets (2 and 3). However, we discard this hypothesis as the flux of the isolated line HeII 5412Å is lower than that of the assumed blends. The analysis of the line profiles will be realized in detail in a subsequent paper. The width of the H lines is FWHM $\approx$ 2600 $km\,s^{-1}$, the HeI lines are wider, FWHM $\approx$ 4000 $km\,s^{-1}$. The flux of the H and HeI lines has also evolved differently with time. In particular, the flux of the H lines decreased by a factor of 2, while that of the HeI lines increased by a similar factor in the time between our second and third observation.

The last two spectra were obtained within two days and are very similar to each other. However, they differ noticeably from the previous spectrum. The line profiles of the HeI lines 5876, 6678, 7065 Å evolved back to "flat-top" with "jags" as in our first and second observations. While the profile of the H lines became very similar to that of the HeI lines. The width of the H and the HeI lines are FWHM $\approx$ 2900 $km\,s^{-1}$ and FWHM $\approx$ 3000 $km\,s^{-1}$, respectively. The flux of the Hα lines became again almost same as on the first two spectra (increased by almost a factor of two). The flux of the other Balmer lines has practically not changed. The flux of the HeI 5876 and 7065 Å lines became noticeably greater than on the previous spectra while the flux of HeI 6678 Å line is almost not changed. The intensity of the metal emission lines decreased. The lines NI 5679 Å and [NII] 5755 Å , visible as weak emissions since the beginning of our observation, increased on the last spectrum. The blend of the [OI] 6300 Å and 6364 Å became appreciable on the last spectra also. The HeII 4686 Å line and the blend of the NIII 4640 Å lines became stronger and formed the broad blend centered at 4670 Å.

The nova showed several maxima near 8th magnitude, with minima near 10th magnitude between them. The spectra of the nova showed P Cyg profiles of Balmer and FeII lines when the magnitude was at maximum (see, for example, Henden, 2007b). Therefore, this star has been classified as a standard FeII-type nova in the Tololo system (Williams, 1992). However, our spectra, obtained between the 8th - 24th days after the outburst, show that the nova better fits in the He/N class. This is consistent with the observations by Skoda et al. (2007) and Kiss & Sarneczky (2007), who report broad and "flat-top" emission lines. We, thus, conclude that nova V458 Vul belongs to the hybrid nova class according to Williams' spectroscopic classification.

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THE FIRST *BVRI* LIGHT CURVES AND ANALYSIS OF THE SHORT-PERIOD ALGOL-TYPE BINARY DI Hya

MANIMANIS, V. N.; NIARCHOS, P. G.

Dept. of Astrophysics, Astronomy and Mechanics, Faculty of Physics, National & Kapodistrian University of Athens, Athens, Greece. e-mail: vmaniman@phys.uoa.gr

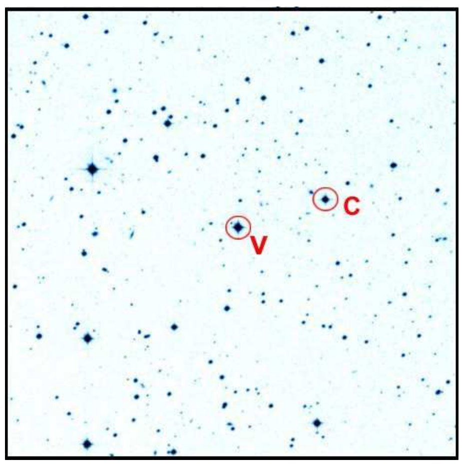

Figure 1. 14′ × 14′ finding chart with the comparison (C) star marked; DI Hya is marked with a V. North is up and east is to the left.

The eclipsing binary DI Hydrae (AN 203.1932), included by Budding et al. (2004) in their list of Algols was observed in our search for near-contact variables. The only published light curve of DI Hya before this work appears to be an unfiltered (visual) one by Brelstaff, presented by Isles (1988). The observations were made at the South African Astronomical Observatory Sutherland Station, using the 1.0 m Cassegrain telescope equipped with a CCD camera, liquid-nitrogen cooled at 180.5 K, with 1024 × 1024 imaging pixels binned to 512 × 512. The field of view was 5$'$.3 × 5$'$.3. The *BVRI* filters were used. The dates of the observations of DI Hya were 13, 21, 22 and 23 January 2006. The star 2MASS J 09065133-1231368 (USNO-B1.0 0774-0251554), located 172″ WNW of the variable, was used as a comparison star.

Approximately 350 observational points were secured in each filter, namely 351 in blue, 349 in yellow, 349 in red and 348 in the infrared. The period of the system is 0.6147132 days. The heights of the two maxima are equal within the observational error in all bands. The secondary minimum is shallow and deepens considerably at longer wavelengths; this fact indicates a large temperature difference between the components. DI Hya is known to have a spectral type of A6+[G8IV].

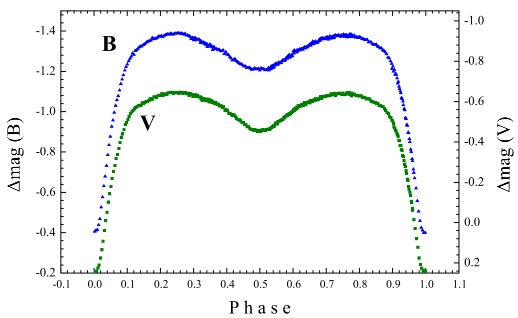

Figure 2. The complete B (upper) and V (lower) light curves of DI Hya.

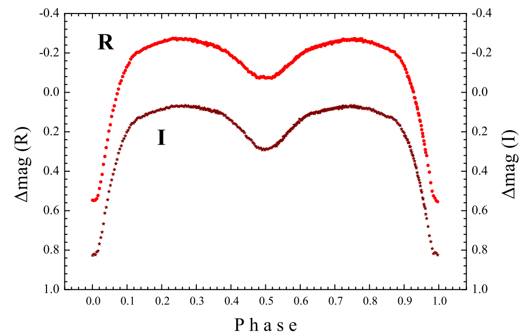

Figure 3. The complete R (upper) and I (lower) light curves of DI Hya.

Two times of minimum were extracted from our data, the secondary minimum at $HJD2453757.45928 \pm 0.0008$ and the primary at $HJD2453758.38132 \pm 0.0007$. The latter was used as a basis for the ephemeris used, combined with the above orbital period of the system.

All the observational points of all filters were used in order to analyze the light curves with Wilson-Devinney program's PHOEBE 0.28 version (Prša & Zwitter 2005) and obtain a photometric solution of the light curves. We solved the light curves assuming that there are no spots on the components of the system, since no asymmetry indicative of spots is present. Since no double-line spectroscopy was available, initial values for the mass ratio ($q = 0.42$) and for the inclination ($i = 83°$) were adopted from the tables by Budding et al. (2004). Initial values of the system's other parameters were derived from the LC part of the Wilson-Devinney programme. Also, the standard values for gravity darkening coefficients and bolometric albedos according to the spectral types of the components were used. The values of the limb darkening coefficients are automatically interpolated step-by-step by the PHOEBE program according to the Van Hamme (1993) tables. The results converged assuming semi-detached (with either star filling its Roche lobe), as well as detached configuration for the system. The minimum χ^2 rms value averaged for all filters was achieved with the mode in which the primary fills its Roche lobe (Mode 4) (these errors are reduced chi-squared values as they appear in the PHOEBE main programme). In particular, this mode gave an rms χ^2 of 0.1214, while the mode in which the secondary fills its Roche lobe gave an rms χ^2 of 0.1271 and the mode for a detached configuration 0.1232 (Mode 2). Table 1 shows the two best solutions we obtained (the Modes 4 and 2 of the original Wilson-Devinney program). The large difference between the mass ratios of the two solutions suggests a spectroscopic mass ratio is needed for a definite study of the system.

The theoretical light curves of our Mode 4 solution, along with the observed ones, are shown in Figure 4. A cross-sectional surface outline of the system is given in Figure 5 and a three-dimensional model of the system is shown in Figure 6. The relatively short distance between the two stars (the centre of mass of the system is inside the body of the primary) supports the assertion that this is a near-contact system, and therefore it was correctly included by Shaw (1994) in his second catalog of such binary systems.

Since no double-line spectroscopy is available, the only way to estimate absolute parameters is to make assumptions about the absolute magnitude or the mass of the primary and use the value of q obtained photometrically. Assuming that the primary has a mass of 2.01 solar masses, the value for a normal MS star of its spectral type, we get the following

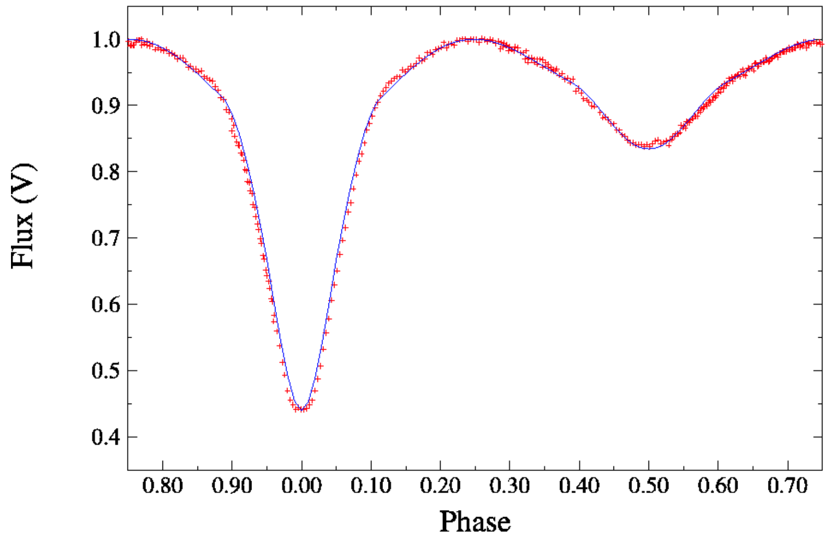

Figure 4. The observational points and the theoretical light curve fitting for our model (Mode for semi-detached systems of the W-D program) and for the V light curve of DI Hya.

absolute elements for DI Hya in solar units from our Mode 4 solution's geometrical and physical characteristics:

$$\begin{array}{rr} R_1 = 1.870 \pm 0.002 & R_2 = 1.362 \pm 0.002 \\ L_1 = 13.59 \pm 0.37 & L_2 = 1.389 \pm 0.016 \\ M_1 = 2.01 \text{ (assumed)} & M_2 = 1.42 \pm 0.070 \end{array}$$

and the bolometric absolute magnitudes:

$$M_{bol(1)} = 1.92 \quad \text{and} \quad M_{bol(2)} = 4.39$$

According to them, the primary component is located relatively close to the ZAMS line (for stars of solar metallicity) in the mass-radius diagram, indicating an only slightly evolved star, while the secondary component seems to have evolved slightly more. In the region occupied by the 16 near-contact systems studied by Niarchos & Manimanis (2002), these stars appear relatively unevolved, especially the secondary.

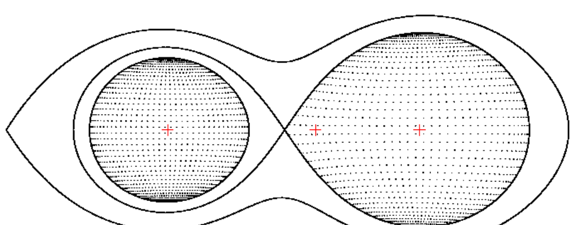

Figure 5. A cross-sectional surface outline of DI Hya at phase 0.75 (Max II) for our solution using Mode 4 of the W-D program.

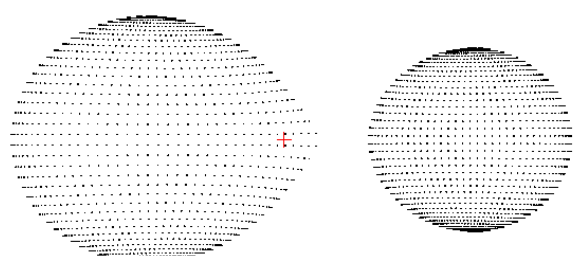

Figure 6. Three-dimensional model of the system of DI Hya as it appears at phase 0.25 (at Max I). The centre of mass of the system (red cross) is inside the body of the primary.

Table 1: Light curve solution of DI Hydrae

Parameter	Mode 4	Mode 2
i (degrees)	82.14	84.38
T_1 (K)	8100*	8100*
T_2 (K)	5328	4558
g_1, g_2	1.0*, 0.32*	1.0*, 0.32*
A_1, A_2	1.0*, 0.5*	1.0*, 0.5*
$q = M_2/M_1$	0.7066	0.5151
Ω_1	3.2550*	3.0851
Ω_2	3.5793	3.1052
$L_1/(L_1 + L_2)$ (B)	0.9552	0.9787
$L_1/(L_1 + L_2)$ (V)	0.9088	0.9629
$L_1/(L_1 + L_2)$ (R)	0.8708	0.9401
$L_1/(L_1 + L_2)$ (I)	0.8237	0.9162
r_1(back)	0.436	0.422
r_1(side)	0.407	0.402
r_1(pole)	0.385	0.384
r_1(volume)	0.408	0.402
r_2(back)	0.310	0.298
r_2(side)	0.295	0.280
r_2(pole)	0.286	0.271
r_2(volume)	0.297	0.283
χ^2	0.1214	0.1232

*assumed

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236 MINIMA TIMINGS OF ECLIPSING BINARIES OBSERVED BY INTEGRAL OMC

SOBOTKA, P.

Astronomical Institute, Academy of Sciences of the Czech Republic, 251 65 Ondřejov, Czech Republic; e-mail: sobotka@astro.cz

This study uses data provided by the Optical Monitoring Camera (OMC) onboard the ESA INTEGRAL satellite (The International Gamma-Ray Astrophysics Laboratory). There are four co-aligned instruments onboard the INTEGRAL satellite: (1) gamma-ray imager IBIS (15 keV-10 MeV, field of view 9 deg), (2) gamma-ray spectrometer SPI (12 keV-8 MeV, field of view 16 deg), (3) X-ray monitor JEM-X (3-35 keV, field of view 4.8 deg), and (4) optical monitoring camera OMC (Johnson V-filter, field of view 5 deg) (Winkler et al., 2003).

While the main goal of INTEGRAL is to provide simultaneous observations of high-energy sources in all data bands, also the OMC data alone can provide important inputs for various analyses of astrophysical objects.

During the observations, OMC is pointed to the same astrophysical object as other INTEGRAL instruments. High priority INTEGRAL objects are gamma-ray bursts and other gamma-ray and X-ray sources. Optical data of the other variable objects are by-product.

But for short periodic variables, it seems to be an advantage. INTEGRAL often watch central object for a couple of days, so continuous light curves can be obtained. It allows analysing light changes of some short periodic variable stars as are eclipsing binaries.

In this study I present 236 times of minima of eclipsing binaries. OMC observations analyzed in this paper covers time span from October 2002 to October 2006. Photometric data were obtained through Johnson V filter. All times of minima were double checked.

Observatory and telescope:
ESA INTEGRAL satellite (The International Gamma-Ray Astrophysics Laboratory) – 50 mm Optical Monitoring Camera (OMC)

Detector:	See technical details at (Mas–Hesse et al., 2003)

Method of data reduction:
Data processing was done by Off-line Scientific Analysis package (OSA 6.0) on Laboratory for Space Astrophysics and Theoretical Physics (LAEFF) near Madrid, Spain.

Method of minimum determination:
The minima times were computed using software AVE version 2.5 based on Kwee–van Woerden method (Barberá 1996)

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
XY Ant	53327.6489	0.0007	I		2
DY Aqr	52634.1942	0.0005	I		1
FK Aql	52766.1200	0.0008			2
FK Aql	52768.772	0.001			3
V342 Aql	52966.705	0.002			2
V342 Aql	53139.625	0.003			2
V917 Aql	52739.378	0.002			3
V917 Aql	53140.677	0.002			3
V964 Aql	52962.9449	0.0007			2
V1426 Aql	52709.1130	0.0004			1
V1426 Aql	53083.420	0.007			3
CV Cam	53377.1949	0.0006	I		2
CV Cam	53394.709	0.002	I		3
CV Cam	53410.779	0.001	II		2
CV Cam	53411.755	0.001	II		3
ST Car	53152.0927	0.0005			2
ST Car	53154.7996	0.0003			2
SW Car	52824.837	0.004			3
AS Car	52824.839	0.002			2
AS Car	53145.676	0.001			3
AS Car	53148.449	0.002			3
AS Car	53159.522	0.002			3
CO Car	53148.383	0.002			2
DQ Car	53145.1508	0.0009			2
DV Car	53143.478	0.002			2
EZ Car	53161.698	0.001			2
EZ Car	53152.1924	0.0008			2
EZ Car	53167.6421	0.0008			2
GL Car	53546.900	0.002			2
ZZ Cas	53346.966	0.003	II		3
ZZ Cas	53350.094	0.005	I		3
BS Cas	53552.1143	0.0006	I		2
BS Cas	53554.979	0.001	II		3
BS Cas	53557.397	0.001	I		2
KL Cas	53349.5960	0.0005			2
V459 Cas	53559.452	0.001	II		3
V646Cas	53275.117	0.001			2
V654 Cas	53348.417	0.003			3
V785 Cas	53565.452	0.001	II		2
SS Cen	53087.976	0.001			2
SV Cen	53539.884	0.001			3
BD Cen	52835.421	0.002	II		3
MN Cen	53536.441	0.008			3

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V379 Cen	53989.826	0.001			3
V380 Cen	53372.149	0.001			3
V676 Cen	53028.5526	0.0004	I		2
V676 Cen	53033.8140	0.0007	I		2
V676 Cen	53035.131	0.001	II		2
V677 Cen	52652.331	0.001	I		3
V677 Cen	52652.8237	0.0006	II		3
V685 Cen	53536.810	0.002			2
V685 Cen	53543.952	0.002			3
V700 Cen	52839.7889	0.0007			2
V700 Cen	52840.553	0.001			2
XX Cep	53352.315	0.002			2
BB Cep	53046.07	0.01			3
CM Cep	53355.420	0.003	I		3
CM Cep	53366.583	0.004	I		3
AT Cir	53373.029	0.004			2
BB Cir	53211.2621	0.0004			1
BD Cir	53397.04	0.01	I		3
RZ Com	53385.7292	0.0004	II		2
RZ Com	53386.0668	0.0003	II		2
EK Com	52670.0214	0.0003	I		3
EK Com	53381.9364	0.0007	II		2
EK Com	53382.4716	0.0006	II		2
EK Com	53382.5968	0.0006	I		2
EK Com	53509.8057	0.0006	I		3
EK Com	53511.8135	0.0005	II		3
EK Com	53513.8093	0.0006	I		3
EK Com	53514.6147	0.0007	I		2
EK Com	53531.4103	0.0006	I		3
EK Com	53531.8114	0.0005	II		3
EK Com	53531.9460	0.0007	I		2
EK Com	53532.3460	0.0004	II		2
AB Cru	53534.394	0.001			3
AB Cru	53537.819	0.002			2
AC Cru	53534.2800	0.0004	I		2
AC Cru	53534.7251	0.0004	II		2
AC Cru	53545.5768	0.0006	II		2
AN Cru	53549.8031	0.0008			3
AR Cru	53541.184	0.004			3
AY Cru	53525.734	0.001			2
AY Cru	53528.935	0.001			2
AY Cru	53540.1222	0.0009			2
AY Cru	53543.319	0.002			3
AY Cru	53549.720	0.002			2
UW Cyg	53207.3156	0.0007			1
WZ Cyg	53040.2806	0.0008			3
WZ Cyg	53202.7655	0.0005			2
WZ Cyg	53206.2728	0.0003			2
CV Cyg	52625.082	0.003	II		3

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
GG Cyg	52595.972	0.002			2
GG Cyg	52606.018	0.001			2
GG Cyg	52608.0257	0.0006			1
GG Cyg	52610.036	0.001			1
GG Cyg	52612.0474	0.0006			2
KR Cyg	52612.6234	0.0003	I		1
KR Cyg	52613.0512	0.0007	II		2
V388 Cyg	52613.0782	0.0007			2
V388 Cyg	52612.633	0.001			2
V442 Cyg	52613.0385	0.0004	II		1
V466 Cyg	52604.9663	0.0006	I		1
V466 Cyg	52606.3585	0.0004	I		1
V466 Cyg	52607.7506	0.0003	I		1
V466 Cyg	52609.1429	0.0004	I		1
V466 Cyg	52613.3164	0.0004	I		1
V466 Cyg	52616.0996	0.0003	I		1
V466 Cyg	52604.2725	0.0004	II		1
V466 Cyg	52607.0531	0.0004	II		1
V466 Cyg	52608.4450	0.0005	II		1
V466 Cyg	52609.8394	0.0004	II		1
V466 Cyg	52611.2290	0.0003	II		1
V466 Cyg	52614.0118	0.0002	II		1
V466 Cyg	52615.4033	0.0004	II		1
V466 Cyg	52616.7950	0.0004	II		1
V466 Cyg	52623.062	0.001	I		3
V466 Cyg	52624.4484	0.0005	I		2
V490 Cyg	52613.024	0.002	II		2
V689 Cyg	52606.371	0.001			3
V689 Cyg	52607.829	0.001			3
V689 Cyg	52609.2822	0.0008			2
V689 Cyg	52610.731	0.001			3
V689 Cyg	52612.1899	0.0008			3
V689 Cyg	52613.6452	0.0007			3
V689 Cyg	52615.104	0.008			3
V689 Cyg	52616.557	0.002			3
V809 Cyg	52606.055	0.001	I		3
V809 Cyg	52608.0198	0.0005	I		2
V809 Cyg	52609.9838	0.0004	I		2
V809 Cyg	52613.9121	0.0008	I		2
V809 Cyg	52615.8806	0.0008	I		2
V809 Cyg	52605.076	0.001	II		3
V809 Cyg	52607.0368	0.0008	II		3
V809 Cyg	52608.9952	0.0007	II		3
V809 Cyg	52610.9648	0.0008	II		3
V822 Cyg	52613.6636	0.0008			2
V822 Cyg	52616.1908	0.0009			2
V1011 Cyg	52607.071	0.001			1
V1011 Cyg	52610.308	0.004			2

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V1011 Cyg	52613.5486	0.0003			2
V1011 Cyg	53342.442	0.004			3
V1034 Cyg	52613.0006	0.0009	I		2
SX Gem	53112.232	0.001	II		3
SX Gem	53112.927	0.002	I		2
AF Gem	53300.0698	0.0007	II		1
AF Gem	53300.688	0.003	I		1
AF Gem	53301.302	0.002	II		1
AF Gem	53301.9357	0.0003	I		1
AF Gem	53303.1783	0.0003	I		1
V829 Her	53573.9032	0.0009			3
AS Hya	53499.568	0.001			2
EZ Hya	53496.4425	0.0004			3
FO Hya	53499.4290	0.0008			1
UW LMi	53516.4313	0.0007			1
RR Nor	53211.9276	0.0005			2
TV Nor	53242.4533	0.0005	II		1
TV Nor	53408.678	0.001	I		2
GK Nor	53399.182	0.002			3
IT Nor	53227.3334	0.0007			3
IT Nor	53430.800	0.001			2
V456 Oph	53089.7944	0.0003	I		2
V456 Oph	53091.8267	0.0004	II		1
V502 Oph	53402.5929	0.0003	I		1
V502 Oph	53405.5412	0.0008	II		1
DZ Ori	52689.9811	0.0007			2
FT Ori	52939.0726	0.0004			1
V343 Ori	52690.0619	0.0004			2
GY Pup	52676.0519	0.0003	I		1
GY Pup	52676.6707	0.0002	II		1
GY Pup	52676.8749	0.0003	I		1
GY Pup	52677.0817	0.0003	II		1
GY Pup	52677.2881	0.0003	I		1
GZ Pup	52676.0137	0.0002	II		1
GZ Pup	52676.6538	0.0003	II		1
GZ Pup	52676.8149	0.0002	I		1
GZ Pup	52676.9754	0.0002	II		1
GZ Pup	52677.1347	0.0007	I		1
GZ Pup	52677.2953	0.0003	II		1
RS Sgr	53799.627	0.001			2
V457 Sco	52699.4299	0.0008	II		2
V562 Sco	53427.360	0.005			3
V569 Sco	53058.498	0.001	I		2
V569 Sco	53060.0718	0.0006	II		2
V569 Sco	53255.9086	0.0008	II		3
V569 Sco	53257.4725	0.0002	I		2
V569 Sco	53426.081	0.001	I		2
V569 Sco	53426.6035	0.0004	II		3

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
Times of minima:					
V569 Sco	53427.6495	0.0004	II		2
V569 Sco	53429.737	0.005	II		3
CQ Ser	52888.9121	0.0007			2
Y Sex	52598.988	0.001	II		2
Y Sex	52600.036	0.001	I		1
Y Sex	52600.2478	0.0008	II		1
Y Sex	52600.4547	0.0009	I		1
Y Sex	52600.665	0.002	II		2
Y Sex	52600.8759	0.0005	I		1
Y Sex	52601.0844	0.0007	II		1
Y Sex	52601.2982	0.0004	I		2
Y Sex	52602.1320	0.0006	I		1
Y Sex	52602.3443	0.0008	II		2
Y Sex	52602.9703	0.0008	I		3
Y Sex	52603.188	0.002	II		2
Y Sex	52603.3950	0.0007	I		2
Y Sex	52603.6037	0.0006	II		2
Y Sex	52603.8143	0.0004	I		1
Y Sex	52604.0249	0.0006	II		1
RZ Tau	52867.6490	0.0004	II		1
RZ Tau	52867.8557	0.0004	I		1
RZ Tau	52868.0648	0.0003	II		1
BV Tau	52679.3175	0.0005	I		1
BV Tau	52680.2469	0.0007	I		2
BV Tau	52681.176	0.001	I		1
BV Tau	52688.6214	0.0006	I		1
BV Tau	52690.478	0.004	I		3
BV Tau	52679.7755	0.0007	II		2
BV Tau	52681.6333	0.0008	II		2
HY Tau	52687.8326	0.0009			2
EG Tra	53397.6685	0.0005			1
XY Vel	53163.714	0.001			3
AH Vir	52842.2377	0.0002	II		1
AH Vir	52842.4415	0.0003	I		1
AH Vir	52842.6460	0.0003	II		1
AH Vir	52843.4607	0.0004	II		2
AH Vir	52843.6649	0.0002	I		1
AH Vir	52843.8684	0.0004	II		2
AO Vel	52805.8838	0.0007	II		2
AO Vel	52978.607	0.002	II		3
AO Vel	52981.0223	0.0008	I		2
AT Vel	52984.26	0.01			3
AW Vel	52980.581	0.001			2
AZ Vel	52819.418	0.001			2
CK Vel	53160.734	0.003			3
DL Vel	52814.8289	0.0008			1
FU Vel	53169.7491	0.0008			2
FW Vel	53163.475	0.003			3

Remarks:
The last column represents quality of data used to determine the time of the minimum (1 - best quality, 3 - bad quality). See for example Figures 1-3.

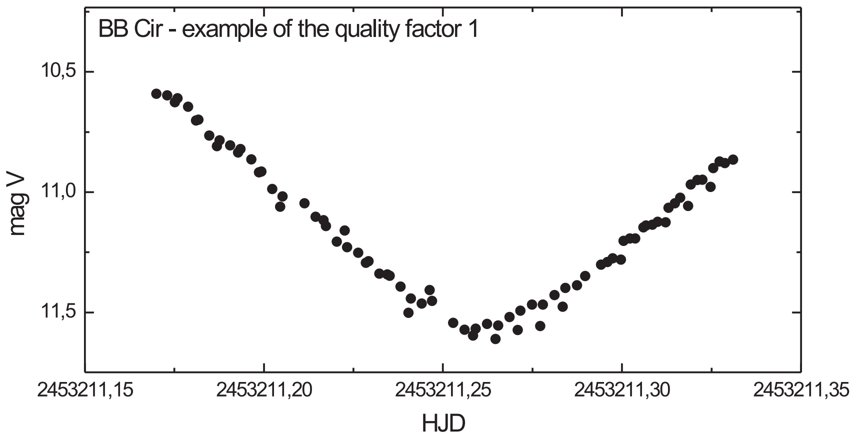

Figure 1.

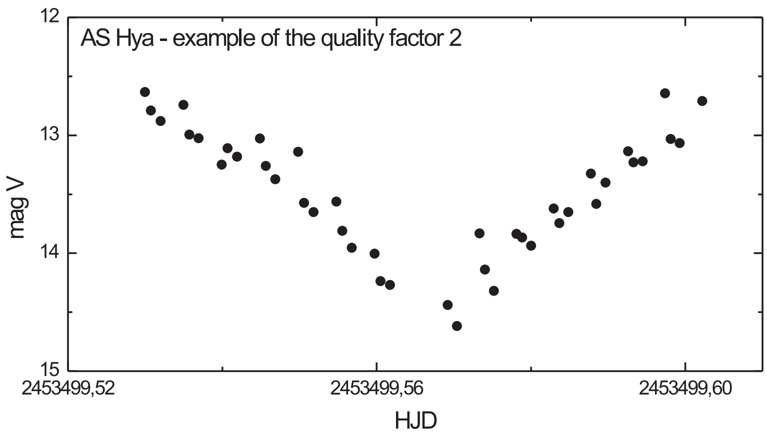

Figure 2.

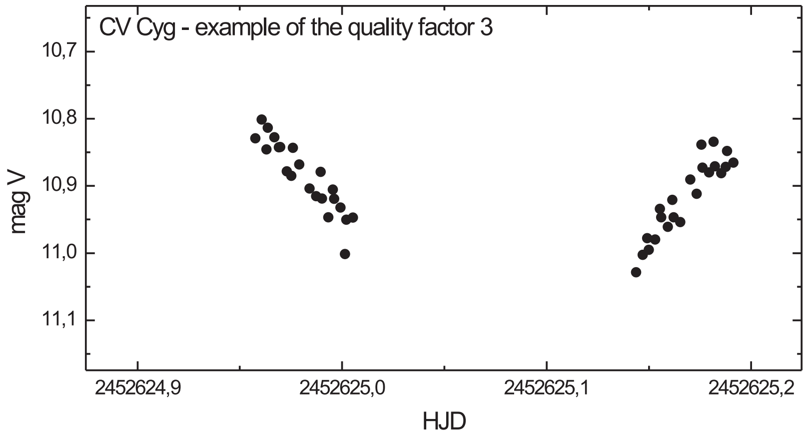

Figure 3.

Acknowledgements:

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INFORMATION BULLETIN ON VARIABLE STARS

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Konkoly Observatory
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NEW VARIABLE STAR IN THE FIELD OF THE SEYFERT GALAXY MRK 290

DOROSHENKO, V. T.[1,2]; SERGEEV, S. G.[2]; EFIMOV, YU. S.[2]; KLIMANOV, S. A.[2]; NAZAROV, S. V.[2]

[1] Crimean Laboratory of Sternberg Astronomical Institute, Nauchny, 98409, Crimea, Ukraine; e-mail: vdorosh@sai.crimea.ua; dorvalen@mail.ru

[2] Crimean Astrophysical Observatory, Nauchny, 98409, Crimea, Ukraine; e-mail: sergeev@crao.crimea.ua; efimov@crao.crimea.ua; sergdave2004@mail.ru; nazarastron2002@mail.ru

We announce the discovery of a new variable star in the field of the Seyfert galaxy Mrk 290 (star 9 in Fig. 1). The CCD monitoring was made in the BVR_cI_c bands with the 70-cm telescope of the Crimean Astrophysical Observatory over 62 nights from 20.03.2007 to 17.07.2007. We used the CCD AP7p camera with a field size of 515 $\times$ 512 pixels. The field of view of our images was $15' \times 15'$. Typically, for each observational night we obtained four images in each filter with a sampling time of about 10 min. The BVR_cI_c photometry of objects in the Mrk 290 field was made with the aperture $A = 12''$. We also observed the Seyfert galaxies NGC 3227, NGC 3516, NGC 4051, and NGC 5548 over the same nights. Some stars in the fields of these galaxies were calibrated earlier by Doroshenko et al. (2005), and we used them as secondary standards for the stars around Mrk 290.

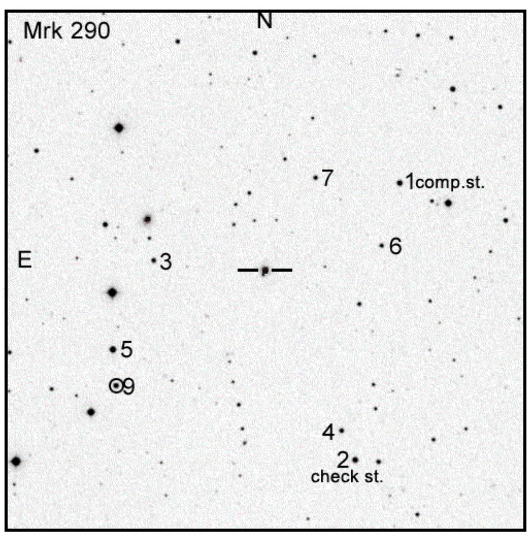

Figure 1. $14' \times 14'$ finding chart for the variable star 9 (marked by an open circle), the comparison star (No. 1), and control stars (No. 2, 3, 4, 6, 7). The Seyfert galaxy Mrk 290 is marked by two lines.

For accurate photometry it is important to search for possible variable stars among the reference star candidates. We used the χ^2 criterion to single out the variable stars.

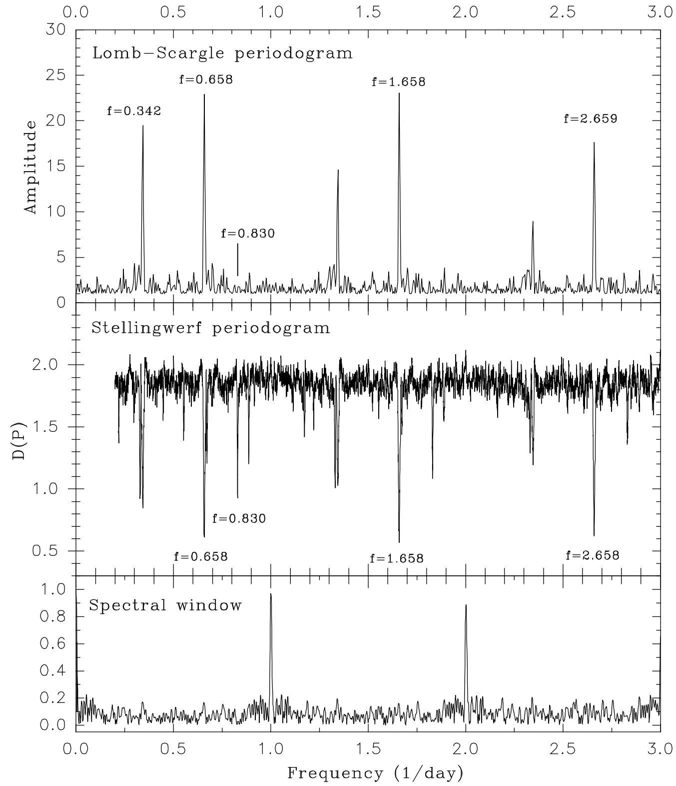

Figure 2. The Lomb-Scargle periodogram (upper panel), Stellingwerf periodogram (middle panel), and the spectral window (bottom panel) obtained from the nightly average observational data on star 9 in the B band.

We computed the light curves for each selected star and calculated the χ^2 value per one degree of freedom as well as the confidence level for the $\chi^2 \leq 1$ hypothesis. If the star under consideration is not variable, χ^2 is close to 1 in each filter. For variable stars χ^2 should be significantly greater than 1. For star 9 χ^2 per dof was equal to 11.512, 20.174, 21.389, and 9.964 in the BVR_cI_c bands, respectively. So, star 9 turns out to be a variable with high confidence level. Stars 1, 2, 3, 4, 6, and 7 are not variable stars, as $\chi^2 \leq 1$. Star 5 is a possible variable star, since for this star χ^2 was equal to 2.552, 3.147, 3.015, and 1.666 in the B, V, R_c, I_c bands, respectively. Table 1 lists the BVR_cI_c magnitudes of stars 1-7. Stars 3, 4, 6, and 7 can be used as control stars in addition to star 2 inasmuch as they are not variables. Observations, processing, and photometric uncertainties were described in more detail by Doroshenko et al. (2005).

Table 1. BVR_cI_c photometry of stars in the field of Mrk 290

Star	B	er.B	V	er.V	R_c	er.R_c	I_c	er.I_c
1	14.926	0.008	14.078	0.015	13.600	0.009	13.188	0.011
2	14.599	0.008	13.880	0.006	13.466	0.006	13.061	0.006
3	15.616	0.010	15.075	0.008	14.731	0.007	14.431	0.007
4	16.138	0.012	15.213	0.009	14.648	0.007	14.143	0.008
5	14.514	0.009	13.461	0.008	12.836	0.007	12.328	0.006
6	16.086	0.013	15.470	0.009	15.091	0.006	14.748	0.010
7	16.094	0.012	15.454	0.010	15.059	0.006	14.675	0.008

Star 9 is listed as 1478-0314015, RA=$15^h36^m22^s.56$, D=$+57°50'53''.9$ (J2000.0), b=$47°.9$ in the NOMAD1 catalog (Zacharias et al., 2004). The reddening map by Schlegel et al. (1998) implies that $E(B-V) \leq 0^m.013$. Table 2 gives the photometry of star 9 in the Johnson-Cousins BVR_cI_c system. Figure 3 shows the observed light curves of star 9 and control star 2 (two upper plots).

The Lomb-Scargle periodogram analysis of the nightly average BVR_cI_c light curves (Fig. 2) revealed high peaks at the frequencies f=0.342, 0.659, 1.659, 2.659, etc. c/d. The most significant frequency is f=1.659 c/d, although the frequency peak at f=0.659 c/d is only a little bit lower. The spectral window shows peaks at the frequencies f=1.001, 2.001, 3.001, etc. c/d. If the actual period corresponds to f=1.659 c/d, the peaks with f=0.659 and 2.659 c/d can be considered as alias peaks due to resonance f=1.659 c/d with fw=1.001 c/d. However, if the actual frequency of variability is f=0.659 c/d, the resonance frequencies should be f=0.342 and f=1.659 c/d, respectively. Almost the same periods (Fig. 2) were revealed with the use of the Stellingwerf periodogram calculated by means of the software developed by Pelt (1992). The phased light curves with P=1.518 d (f=0.659 c/d) and P=0.603 d (f=1.659 c/d) are almost sinusoidal and have much in common (Fig. 3, two bottom plots). So, the true period is very difficult to determine. It is quite possible that the variable star belongs to short-period eclipsing binaries. In this case the orbital period is P=1.205 d, the hypothetic primary and secondary minima of this system have equal depths, and they are indistinguishable from each other in BVR_cI_c bands (see Fig. 4). The phase curve with P=1.518 d does not contradict the idea of a single fast-rotating spotted star.

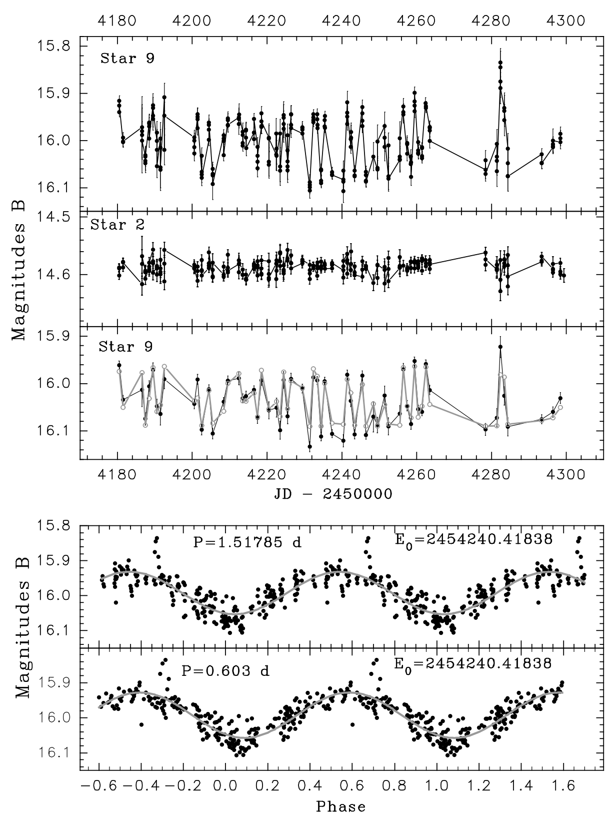

Figure 3. Observed light curves for star 9 and control star 2 as well as phase curves of star 9 in the B band with the period P=1.518 d and P=0.603 d. Nightly average light curves and the points calculated from the sinusoidal model with P=0.603 d (open circles) are shown in the middle of the figure.

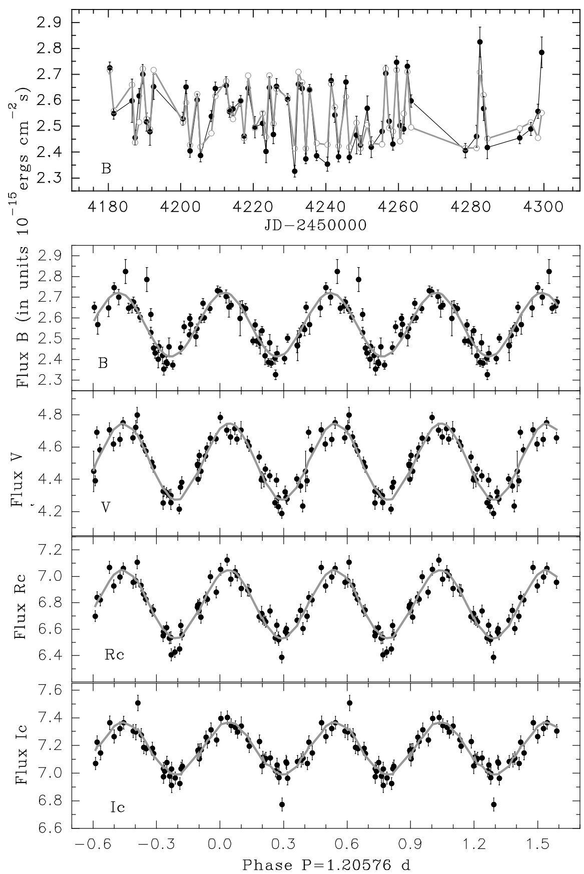

Figure 4. The nightly averaged observed light curve in B band (filled circles) and model fitting (open circles), and phase curves in the $BVRI$ bands folded with the period P=1.205 d. Fluxes is in units 10^{-15} ergs cm^{-2} s−1.

The mean V magnitude and color indices of star 9 are $V = 14\overset{m}{.}758$, $B - V = 1\overset{m}{.}245$, $V - R_c = 0\overset{m}{.}835$, and $V - I_c = 1\overset{m}{.}637$. The observed $B - V$ color index is normal to the spectral $K5 - K6$ class. The variability amplitude derived from the average phase light curves slightly decreases from B to I: $\Delta B = 0\overset{m}{.}106$, $\Delta V = 0\overset{m}{.}098$, $\Delta R_c = 0\overset{m}{.}078$, and $\Delta I_c = 0\overset{m}{.}053$. Probably we observed a small blue flare (Fig. 5) with an amplitude of about $0\overset{m}{.}1$ in B on July 30, 2007. This flare was not seen in the RI filters.

The observed dependence of the color indices on V (Fig. 6) can be comprehended in the framework of cold spots on star 9. When the brightness increases, the $(V - R_c)$ and $(V - I_c)$ color indices decrease. Such relationships were observed, in particular, in the spotted stars LQ Hya (Alekseev & Kozlova, 2002), in the star HBC 379 (Grankin 1998), and in V410 Tau (Petrov et al., 1994), and others. Such color changes are consistent with those seen in some RS CVn stars with spot activity, for example, in IN Com (Alekseev, Kozhevnikova, 2004).

The exact variability type is difficult to determine from only photometric data without reference to spectral data. Nevertheless, we found that this star belongs to the spectral class $K5 - K6$, its brightness varies with a period which is slightly greater than 1 day, the phase light curves are almost sinusoidal, and the variability amplitude is about $0\overset{m}{.}1$. These results as well as the relationships between V and color indices and the possible presence of flares indicate that star 9 probably belongs to the class of fast-rotating spotted dwarf stars or to close/contact binaries with spot activities (W UMa or RS CVn type systems).

We wish to thank Dr. Katalin Oláh, Dr. Roald Gershberg, Dr. Konstantin Grankin, and the referee for useful discussions. This study was partially supported by the Russian Foundation for Basic Research (Grant No. 06-02-16843).

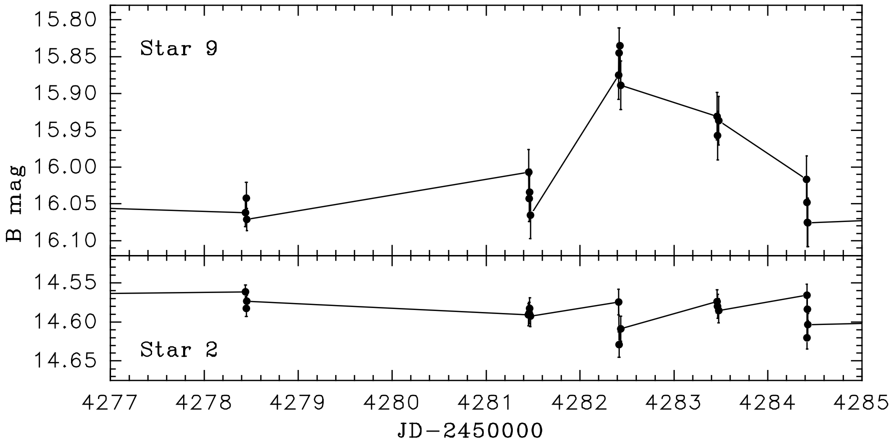

Figure 5. The flare on star 9 in B.

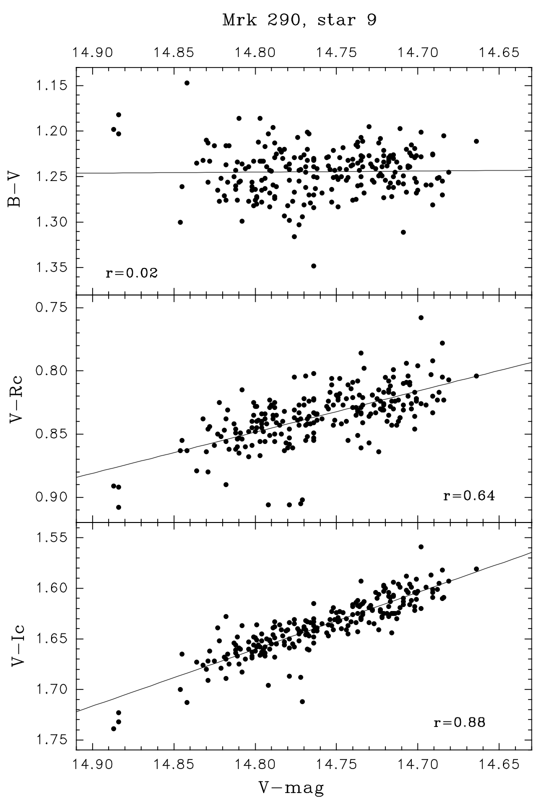

Figure 6. The relationships between the V magnitudes and color indices.

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ERRATA FOR IBVS 5438, 5543, 5713

As Dr. Samus reported, the star erroneously labelled GSC 02850-01075 is really GSC 00285-01075.

The Editors

COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 5811

Konkoly Observatory
Budapest
8 January 2008

HU ISSN 0374 – 0676

ELEMENTS FOR 10 RR LYRAE STARS

HÄUSSLER, K.[1]; BERTHOLD, T.[1,2]; KROLL, P.[2]

[1] Bruno-H.-Bürgel-Sternwarte, Töpelstr. 49, D-04746 Hartha, Germany

[2] Sternwarte Sonneberg, Sternwartestr. 32, D-96515 Sonneberg, Germany

email: sternwartehartha@lycos.de, tb@4pisysteme.de, pk@4pisysteme.de

These stars were discovered and reported to be of RR Lyrae type by Boyce & Huruhata (1942), and Morgenroth (1934). Except for V864 Oph and V2312 Oph (see details noted in the remarks below), neither further observations nor ephemeris have been published until today. Photographic plates of a field centered at alpha Oph, taken with the Sonneberg Observatory 40-cm Astrographs during three intervals spread over the years from 1964 to 1994, were used to investigate the behaviour of these objects (see Table 1).

The given elements were obtained by means of least-squares solutions. Photographic amplitudes were derived with respect to magnitudes of the comparison stars given in Table 2. An extensive list holding the times of maxima derived can be retrieved as `5811-t3.txt`, using the link in the HTML version of this paper. Individual data are available upon request.

Remarks:

V864 Oph

First elements were derived from Northern Sky Variability Survey data (NSVS 13682138, Max (hel) = J.D. 2451373.78 + $0\overset{d}{.}50969$) by Wils et al. (2006). The initial epoch given in this paper was used for our period analysis.

V2312 Oph

First elements derived by Garrigos Sanchez (1996) could be established and refined. In addition to our observations, the CCD recorded maximum timing (J.D. hel. 2450241.467) published in his paper was included in this period analysis.

This research made use of the SIMBAD data base, operated by the CDS at Strasbourg, France.

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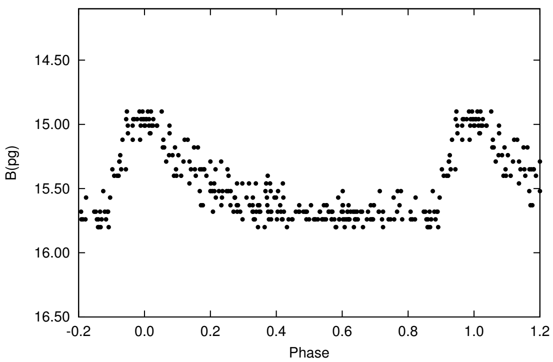

Figure 1. Light curve of V781 Oph

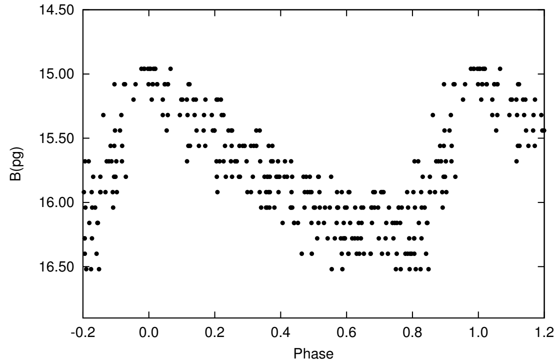

Figure 2. Light curve of V787 Oph

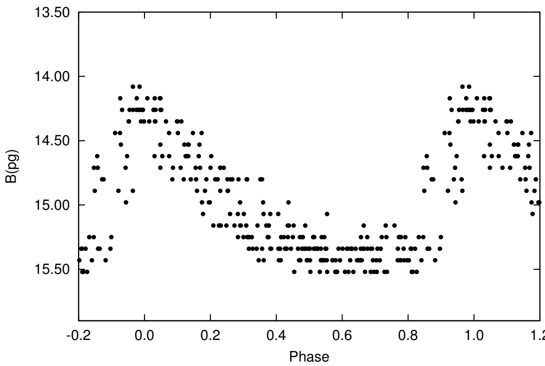

Figure 3. Light curve of V793 Oph

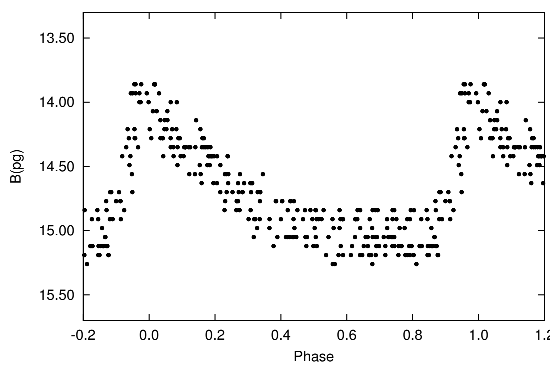

Figure 4. Light curve of V801 Oph

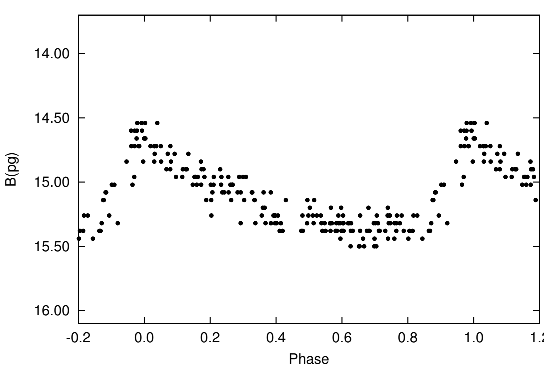

Figure 5. Light curve of V808 Oph

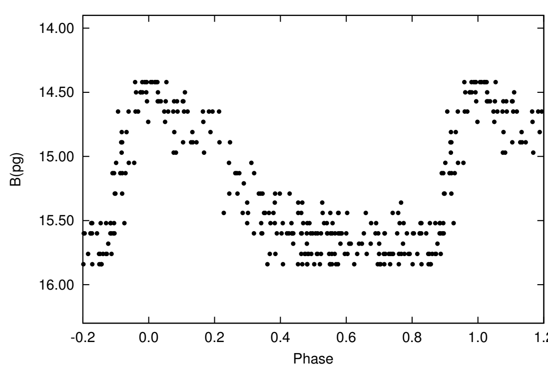

Figure 6. Light curve of V813 Oph

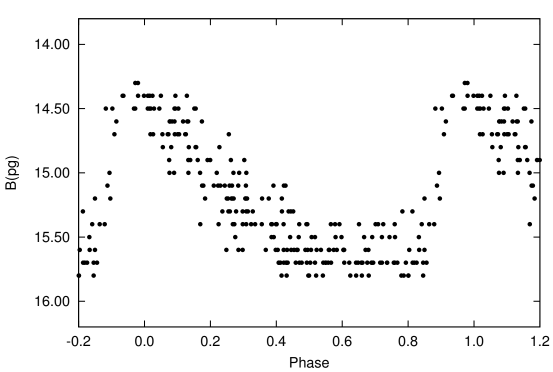

Figure 7. Light curve of V826 Oph

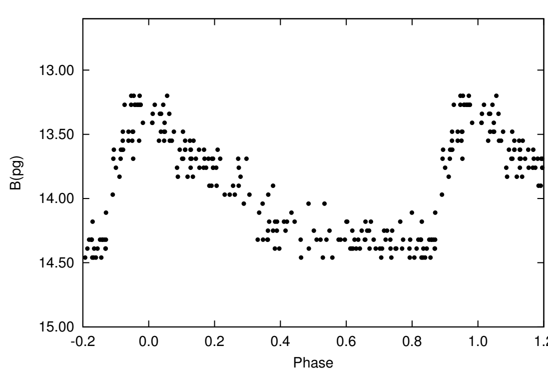

Figure 8. Light curve of V864 Oph

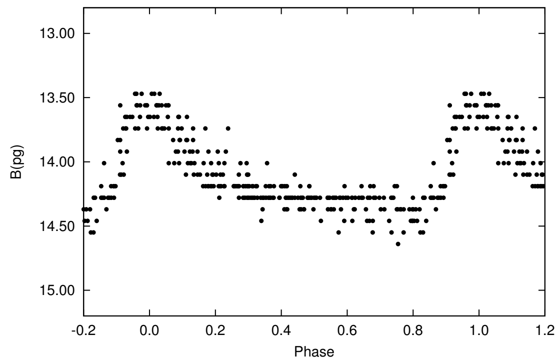

Figure 9. Light curve of V2312 Oph

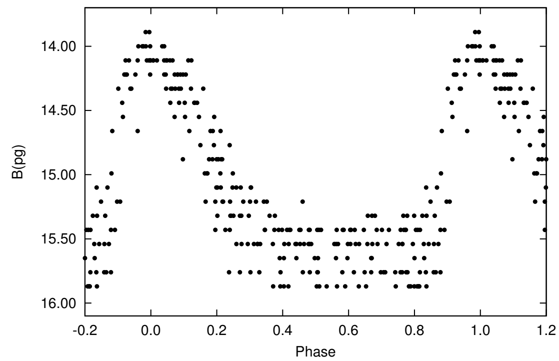

Figure 10. Light curve of NSV 9004

Table 1. Summary of this paper

Star	Type	Epoch 2400000+	Period (day)	Max.	Min.	$M-m$	No. of Plates
V781 Oph	RRab	49488.525 ±7	0.6051615 ±7	$15^{\mathrm{m}}.0$	$15^{\mathrm{m}}.7$	$0^{\mathrm{P}}.15$	261
V787 Oph	RRab	49098.518 ±13	0.5703201 ±10	$15^{\mathrm{m}}.1$	$16^{\mathrm{m}}.3$	$0^{\mathrm{P}}.25$	258
V793 Oph	RRab	49154.488 ±8	0.5508803 ±6	$14^{\mathrm{m}}.2$	$15^{\mathrm{m}}.3$	$0^{\mathrm{P}}.21$	266
V801 Oph	RRab	49154.470 ±7	0.4396193 ±6	$14^{\mathrm{m}}.0$	$15^{\mathrm{m}}.0$	$0^{\mathrm{P}}.18$	279
V808 Oph	RRab	49098.524 ±14	0.5674352 ±25	$14^{\mathrm{m}}.6$	$15^{\mathrm{m}}.3$	$0^{\mathrm{P}}.20$	190
V813 Oph	RRab	49214.384 ±6	0.4825801 ±5	$14^{\mathrm{m}}.5$	$15^{\mathrm{m}}.8$	$0^{\mathrm{P}}.23$	255
V826 Oph	RRab	49154.470 ±11	0.4987588 ±8	$14^{\mathrm{m}}.4$	$15^{\mathrm{m}}.6$	$0^{\mathrm{P}}.22$	243
V864 Oph	RRab	51373.785 ±11	0.5096870 ±9	$13^{\mathrm{m}}.3$	$14^{\mathrm{m}}.4$	$0^{\mathrm{P}}.20$	192
V2312 Oph	RRab	50241.467 ±10	0.6965889 ±9	$13^{\mathrm{m}}.6$	$14^{\mathrm{m}}.4$	$0^{\mathrm{P}}.22$	290
NSV 9004	RRab	49482.488 ±8	0.4752510 ±6	$14^{\mathrm{m}}.1$	$15^{\mathrm{m}}.7$	$0^{\mathrm{P}}.20$	256

Table 2. Comparison stars and cross references

	V781 Oph		V787 Oph	
	HV 10981		HV 10988	
	USNO 0975-09383928		USNO 0975-09419570	
Comp. No.	USNO	m^*	USNO	m^*
1	0975-09384928	$15^{\mathrm{m}}.1$	0975-09421686	$14^{\mathrm{m}}.5$
2	0975-09382102	$15^{\mathrm{m}}.5$	0975-09415442	$15^{\mathrm{m}}.5$
3	0975-09385167	$15^{\mathrm{m}}.9$	0975-09418617	$15^{\mathrm{m}}.8$
4			0975-09419077	$16^{\mathrm{m}}.7$

	V793 Oph		V801 Oph	
	HV 10995		HV 11004	
	USNO 0975-09461015		USNO 0975-09485291	
Comp. No.	USNO	m^*	USNO	m^*
1	0975-09461268	$14^{\mathrm{m}}.0$	0975-09489563	$14^{\mathrm{m}}.1$
2	0975-09461784	$14^{\mathrm{m}}.2$	0975-09484358	$14^{\mathrm{m}}.5$
3	0975-09463250	$15^{\mathrm{m}}.0$	0975-09486724	$14^{\mathrm{m}}.8$
4	0975-09461116	$15^{\mathrm{m}}.6$	0975-09484926	$15^{\mathrm{m}}.4$

	V808 Oph		V813 Oph	
	HV 11010		HV 11022	
	USNO 0975-09525734		USNO 0975-09563863	
Comp. No.	USNO	m^*	USNO	m^*
1	0975-09527020	$14^{\mathrm{m}}.3$	0975-09565058	$14^{\mathrm{m}}.1$
2	0975-09519973	$14^{\mathrm{m}}.8$	0975-09555186	$14^{\mathrm{m}}.8$
3	0975-09520205	$14^{\mathrm{m}}.9$	0975-09561877	$15^{\mathrm{m}}.5$
4	0975-09524016	$15^{\mathrm{m}}.7$	0975-09564432	$16^{\mathrm{m}}.2$

	V826 Oph		V864 Oph	
	HV 11049		AN 72.1934	
	USNO 0975-09763780		USNO 0975-09046689	
Comp. No.	USNO	m^*	USNO	m^*
1	0975-09767534	$14^{\mathrm{m}}.1$	0975-09042642	$13^{\mathrm{m}}.3$
2	0975-09766323	$14^{\mathrm{m}}.7$	0975-09043053	$13^{\mathrm{m}}.9$
3	0975-09761494	$15^{\mathrm{m}}.4$	0975-09039898	$14^{\mathrm{m}}.5$
4	0975-09763558	$16^{\mathrm{m}}.0$		

	V2312 Oph		NSV 9004	
	HV 10972		HV 10958	
	USNO 0975-09350557		USNO 0975-09298413	
Comp. No.	USNO	m^*	USNO	m^*
1	0975-09351873	$13^{\mathrm{m}}.2$	0975-09297760	$14^{\mathrm{m}}.5$
2	0975-09352592	$14^{\mathrm{m}}.0$	0975-09301834	$14^{\mathrm{m}}.8$
3	0975-09351879	$14^{\mathrm{m}}.4$	0975-09296368	$15^{\mathrm{m}}.5$
4			0975-09299654	$16^{\mathrm{m}}.4$

* Magnitudes refer to the B values of the USNO$-$A2.0 catalogue

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THE FIRST LIGHT CURVE ANALYSIS OF TWO OVERCONTACT BINARIES: EY Cas AND NO Vul

ZASCHE, P.[1]; WOLF, M.[1]; KOTKOVÁ, L.[2]

[1] Astronomical Institute, Faculty of Mathematics and Physics, Charles University Prague, CZ-180 00 Praha 8, V Holešovičkách 2, Czech Republic, e-mail: zasche@sirrah.troja.mff.cuni.cz

[2] Astronomical Institute, Academy of Sciences, CZ-251 65 Ondřejov, Czech Republic

Precise photometric observations of the two neglected and faint eclipsing binaries were carried out. All CCD measurements were obtained by the 65-cm telescope at the Ondřejov observatory, using Apogee AP-7 and Moravian Instruments† G-2 3200 ME CCD camera, only R filter was used. The observations were carried out from 2003 to 2007. New times of minima were also derived using the Kwee-van Woerden (1956) method, 4 and 3 for EY Cas and NO Vul, respectively (see Table 1.).

Table 1. New times of minima. Epochs and $O-C$ values correspond to the linear ephemeris. N denotes the number of points, from which the minimum was computed.

Star	HJD	Error (d)	Epoch	$O-C$ (d)	N
EY Cas	2453394.2190	0.0003	−0.5	0.0022	48
EY Cas	2453579.5457	0.0004	384.0	0.0030	46
EY Cas	2454000.3222	0.0001	1257.0	0.0006	77
EY Cas	2454027.5536	0.0001	1313.5	−0.0005	85
NO Vul	2453657.2381	0.0003	19718.5	0.0003	29
NO Vul	2453934.3847	0.0003	20466.0	−0.0001	41
NO Vul	2454364.2876	0.0002	21625.5	0.0007	106

EY Cas (= GSC 03660-00401, R.A.=$00^{h}03^{m}23^{s}$, Decl.=$+57°44'54''$, J2000.0, V_{max} = 13.9 mag) is a W UMa-type eclipsing binary system, with orbital period of about 0.48 days. The photometric variability of the star was discovered by C. Hoffmeister in 1936. Distance, spectral type as well as physical parameters of the components are known only with a low confidence level.

The PHOEBE programme (see e.g. Prša & Zwitter, 2005), based on the Wilson-Devinney algorithm (Wilson & Devinney, 1971), was used. The temperature of the secondary component was fixed at the value T_2 = 6700 K, according to the spectral type of F2 + F1.5 assumed by Svechnikov & Kuznetsova (1990). The results of the fit are presented in Table 2 and the light-curve with the theoretical fit is plotted in Fig. 1. The 3-D model of the system is in Fig. 2. Nevertheless, further observations are needed, spectroscopy in particular, to reveal the spectral types of the components and their respective masses.

†see http://ccd.mii.cz/

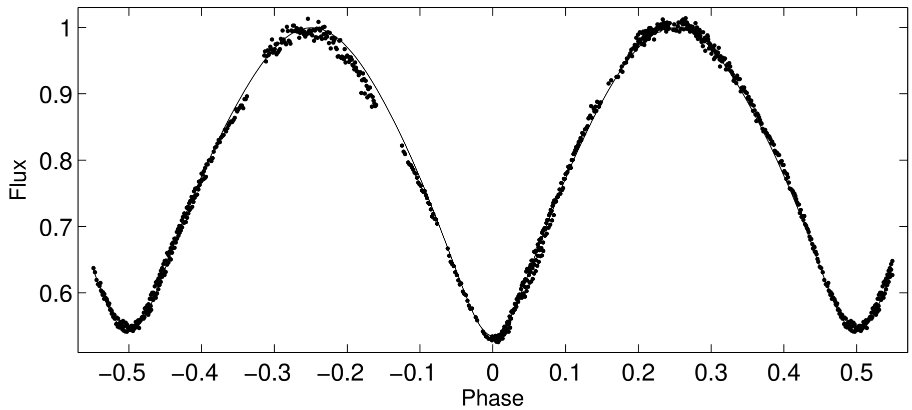

Figure 1. The R light curve of EY Cas, the solid curve stands for the model fit (with the parameters from Table 2), while the points represent the observed data.

One can see some distortion of the light curve near phase −0.15 and larger scatter near its maxima, which could be caused by the presence of spots, or by possible O'Connell effect. But these hypotheses could be confirmed only by another, more detailed analysis.

The period analysis of EY Cas was performed using 31 times of minima (listed in `5812-t1.txt`, available through the IBVS website), the first one is from 1935. Four new minima were observed, see Table 1. The linear light elements suitable for the observations are the following

$$\begin{aligned} \mathrm{HJD\ Min\,I} = 24\,53394.4578 \ &+\ 0\overset{\mathrm{d}}{.}48199184 \cdot \mathrm{E}. \\ \pm 0.0009 \ &\pm\ 0\overset{\mathrm{d}}{.}00000023 \end{aligned} \qquad (1)$$

From a numerical point of view, there is a problem with fitting the temperature. The final fit remains nearly the same for a very wide range of values (6200 K $< T_1 <$ 8300 K). In principle, the temperature could not be derived only on the basis of observations in one filter. The mass ratio q is also hardly derivable only from the photometry.

Table 2. The physical parameters of EY Cas and NO Vul.†

	EY Cas	NO Vul
Parameter	Value	
i [deg]	77.61 ± 0.35	80.90 ± 0.32
$q_{ph} = M_2/M_1$	0.79 ± 0.10	0.71 ± 0.10
r_1/r_2	1.09	1.15
T_1/T_2	1.05	1.13
L_1/L_2	1.17 ± 0.11	1.78 ± 0.16
Ω	3.11 ± 0.20	3.08 ± 0.18
f	0.655	0.429

†T_i, r_i, and L_i denote the temperature, relative radius and luminosity for primary and secondary, respectively. f stands for the fill-out factor and Ω for the modified Kopal potential. The temperatures T_2 were fixed, see the text. The "Overcontact binary" mode was used for computing and the eccentricity was set to 0 (circular orbit). The limb-darkening coefficients were interpolated from van Hamme's tables (see van Hamme, 1993). The values of gravity brightening and bolometric albedo coefficients were set at their suggested values for convective atmospheres (see Lucy, 1968), i.e. $G_1 = G_2 = 0.32$, $A_1 = A_2 = 0.5$. Also the synchronous rotation was assumed for each star ($F_1 = F_2 = 1.0$). No third light was assumed: $l_3 = 0$.

The basic physical parameters (e.g. the individual masses) of the stars could not be derived only from the photometry. Therefore, detailed spectroscopic analysis is needed. Nevertheless, the results from the light-curve fit are in agreement with other analyses of similar overcontact systems. The high degree of the overcontactness $f = 0.66$ is comparable with other similar systems, such as GR Vir ($f = 0.78$, see Qian & Yang, 2004), or IK Per ($f = 0.60$, see Zhu et al., 2005).

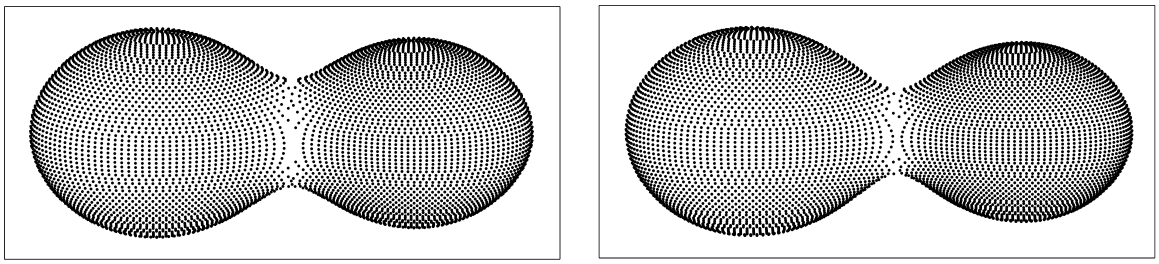

Figure 2. The 3-D plots of EY Cas (left) and NO Vul (right) at the phase 0.25, primary is on the left.

NO Vul (R.A. = $19^h34^m38^s$, Decl.=$+20°37'14''$, V_{max} = 12.83 mag) is an eclipsing binary of W UMa type. The orbital period of NO Vul is about 0.37 days and the depth of the primary minimum is about 0.7 mag in R filter. Its photometric variability was discovered by Kalv & Leis (1973). However, the basic physical parameters of the system have not been derived so far. There is only one analysis of the period variations by Qian & Ma (2001).

The light curve was also analyzed by the PHOEBE code, the same fixed values were adopted as in the case of EY Cas. The light curve with its solution is plotted in Fig. 3 and the parameters are given in Table 1. From the spectral types F8 + F8.5 derived by Svechnikov & Kuznetsova (1990), we assumed the temperature $T_2 = 6100$ K (see e.g. Harmanec, 1988).

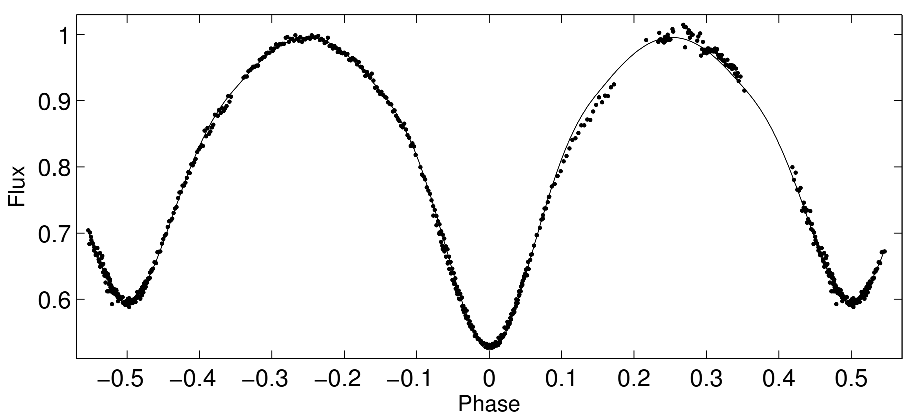

Figure 3. The R light curve of NO Vul, parameters of the fit are in Table 1.

Period analysis was done, using 108 times of minima, listed in `5812-t2.txt` (available through the IBVS website). A few new times of minima were observed given in Table 1. The $O-C$ diagram is plotted in Fig. 4, where the solid line represents the linear ephemeris, suitable for future observations,

$$\begin{array}{rl} \mathrm{HJD\ Min\,I} = 24\,46346.3049 \ + & 0\overset{d}{.}37076516 \cdot \mathrm{E}. \\ \pm\, 0.0015 \ \pm & 0\overset{d}{.}00000018 \end{array} \qquad (2)$$

The previous period analysis (Qian & Ma, 2001), indicated quadratic term in the ephemeris, which describes the times of minima since 2001 (see the dash-dotted line in Fig. 4). Nevertheless, the recent times of minima deviate from this fit. Much better explanation of the period variation could be done using a light-time effect (see e.g. Mayer, 1990), this fit is plotted as a dashed line in Fig. 4. The period of such variation is about 64 years, with the semiamplitude of about 0.016 days and an eccentricity of 0.41. A predicted third body could have a minimum mass of about 0.36 $M_{\odot}$, corresponding to spectral type about M2 (according to Harmanec, 1988), and the contribution of the third light is only about 1%, which is undetectable in the present analysis. Further minimum observations in the upcoming years could prove or reject this hypothesis.

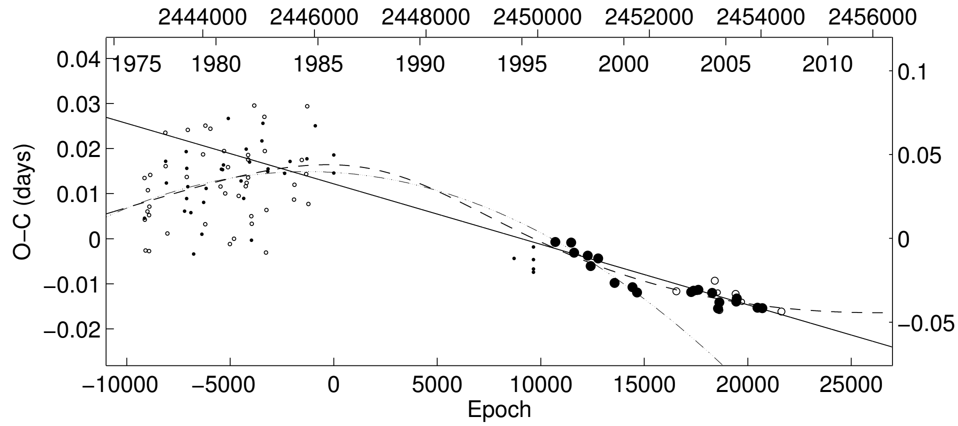

Figure 4. The $O - C$ diagram of NO Vul, the dots denote the primaries, the circles the secondaries, small ones for visual and bigger ones for the CCD and photoelectric measurements, respectively. For the explanation of the lines, see the text.

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Hα OBSERVATIONS OF ζ TAURI

POLLMANN, E.[1]; RIVINIUS, TH.[2]

[1] Emil-Nolde-Str. 12, 51375 Germany

[2] ESO-Chile, Casilla 19001, Santiago de Chile

Be stars are well known to be variable on virtually all timescales, reaching from minutes to dozens of years. For the study of the latter, long term data collections as homogeneous as possible are necessary.

The professional astronomer, however, is often hampered in the study of intermediate- to long-term time scale processes as in Be stars. The reasons are the observational practices usually employed at professional observatories, which typically are not suited for observing a bright object with execution times of a few minutes only about every other week for several seasons; as well as the funding timescales, making it hard to start the collection of a long-term database that does not promise a significant number of publications within the first few years.

On the other hand, the interpretation of time-limited observations with professional resources, such as interferometers, polarimeter, or high-resolution spectrographs, in almost all cases can profit from the knowledge of the disc state in the course of the long-term evolution.

The problems in long-term data acquisition for the professional astronomer, however, open a promising field for the dedicated amateur. Amateur spectrographs at relatively small telescopes of about 20 cm diameter, equipped with CCD-detectors meanwhile reach resolution powers well above 10 000 and and are sensitive enough to reach many of the brighter Be stars. This work describes a database worth of more than five years of observation of the Be star ζ Tau.

ζ Tau is a well known frequently observed object. Observations of the Hα emission line reach back many decades. This work amends those series by the results of Hα-observations taken between late 2000 and early 2006, i.e. six full observing seasons. All observations were made with a 20 cm Schmidt-Cassegrain telescope. From Nov. 2000 to Apr. 2003, a slitless prism-spectrograph with a dispersion of 43 Å/mm was used ($R \approx 8000$), from Sep. 2003 to Apr. 2006 a slitless grating one with a dispersion of 27 Å/mm and $R \approx 14\,000$.

The spectra were normalized by hand-selecting a number of continuum points through out the spectrum from 6500 to 6700 Å and then applying a spline fit through those points. The wavelength calibration was derived using telluric features in the region of Hα, reaching an accuracy of about 0.1Å on those features when compared to wavelengths derived with high resolution instruments (telluric wavelengths measured with UVES were kindly provided by R. Hanuschik, priv. comm.).

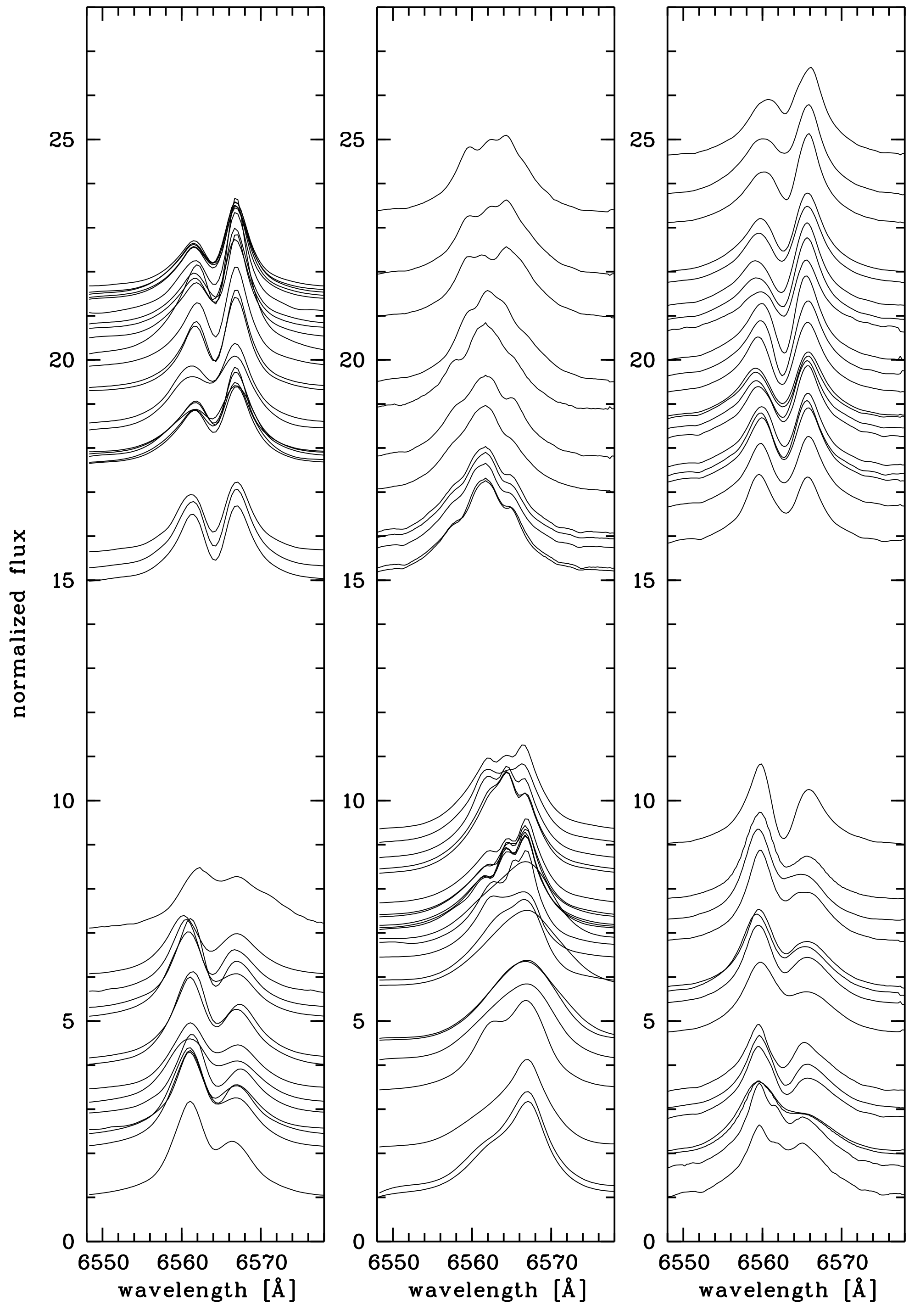

Figure 1. All Hα profiles measure from late 2000 to early 2006. The vertical offset of the profiles is proportional to time and corresponds to 25 days per continuum unit. The lowermost spectra date from Nov. 1, 2000 (left), Sep. 9, 2002 (middle) and Aug. 23, 2004 (right), respectively.

The Hα spectra obtained by EP will be published electronically together with this communication in the form of ASCII tables. (The files are available through the IBVS website as `5813-t1.txt` and `5813-t2.txt`.) The first column of each table is holding the wavelength, while the first row notes the Julian date (minus 2 400 000) at mid exposure.

Equivalent width. In the normalized and calibrated spectra, the Hα equivalent width was measured by integrating the normalized spectrum in the range from 6520 to 6600 Å. Comparison of the data presented here with quasi-simultaneous spectra taken by Rivinius et al. (2006) confirm the scientific reliability of the present data, both in terms of profile shape (see Fig. 1 vs. Rivinius et al.) and equivalent width (see Figs. 2 and 3).

In theory, the measured equivalent width should be independent from dispersion. In practice, this is typically not the case, however: spectra with lower resolution, i.e. the ones with 43Å/mm, differ systematically from higher resolution data. In our observations, this can be seen from the available quasi-simultaneous observations with professional instruments. We attempt no correction of this effect, but rather point out its existence in order not to over-interpret the data.

In general, the accuracy of amateur instruments for measuring equivalent widths currently is hardly better than about 5 %.

To check the accuracy obtained, both for the equivalent width and the peak height ratio of the emission, a series of observations of standard stars was obtained in three nights, 8h worth of observations in total. For both quantities, the RMS-error of the individual measurements in a single night was below 3 %. No correction for the contamination due to telluric vapour lines to the total EW was attempted, as the effect is, with about 1 %, well below the measuring accuracy.

Fig. 2 shows the measurements of this work combined with various published values from about 1975 to 2006 to illustrate the longest variation time scale present in ζ Tau, while Fig. 3 shows a closeup centered on the data derived in this study. The EW currently is on a slow, but steady decline, similar to the one seen before 1990.

Peak height ratio. The Hα-profile normally shows two emission peaks separated by a central absorption core. In ζ Tau, both peaks strengths vary in anti-phase respective to each other, so that the ratio of their violet to red heights, called V/R-ratio, cyclically changes from $V > R$ to $V < R$ and back. At times, however, the clear central absorption may weaken or even disappear, and the emission peaks then may have complicated appearance, split into sub-peaks and often called triple-peak profile. The origin of such triple-peak profiles is unclear. They generally appear at transitions from $V < R$ to $V > R$, but not vice versa. In the observations reported here such triple-peak structures are seen from Dec. 2003 to Sept. 2004. The temporal evolution of the Hα profile between 2000 and 2006 is shown in Fig. 1.

V/R-ratio have been measured in the spectra in which both peaks are apparent, and subjected to a formal period analysis using the time series tools introduced by Kaufer et al. (1996). Note that the following uncertainties are 1σ-errors. The first iteration reveals a V/R cycle time of 1471$\pm$15 d, i.e. about 4.0 years (Fig. 4, left). While this is shorter than the 5 to 7 years in the list by Okazaki (1997) derived from 1960 to 1993, it is consistent with the 4.25 years cycle time given by Rivinius et al. (2006) for 1991 to 2003. Given that only a little more than one cycle is covered the main purpose of this exercise is to pre-whiten the data for the analysis of shorter variations.

The second iteration on the residuals, i.e. after removing the sine wave fit derived in the first step, reveals a 69.3$\pm$0.2 d cycle (Fig. 4, right). This cycle is clearly present during

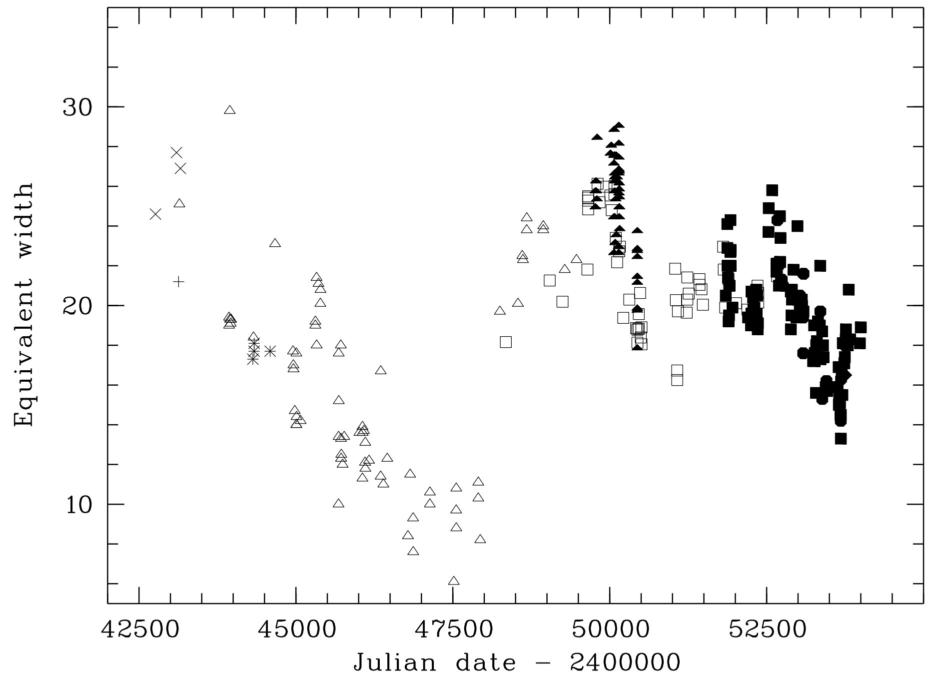

Figure 2. Hα equivalent widths of ζ Tau since 1975. Data taken from the literature are plotted as open symbols: Heros group (Rivinius et al., 2006, squares), Guo et al., 1995 (triangles), Fontaine et al., 1982 (plus), Slettebak & Reynolds, 1978 (crosses), Andrillat & Fehrenbach, 1982 (asterisks); data taken by various amateur observers as filled ones: Pollmann prism (filled triangle), Pollmann grating (filled square), Stober (filled circles), and Schanne (filled diamonds).

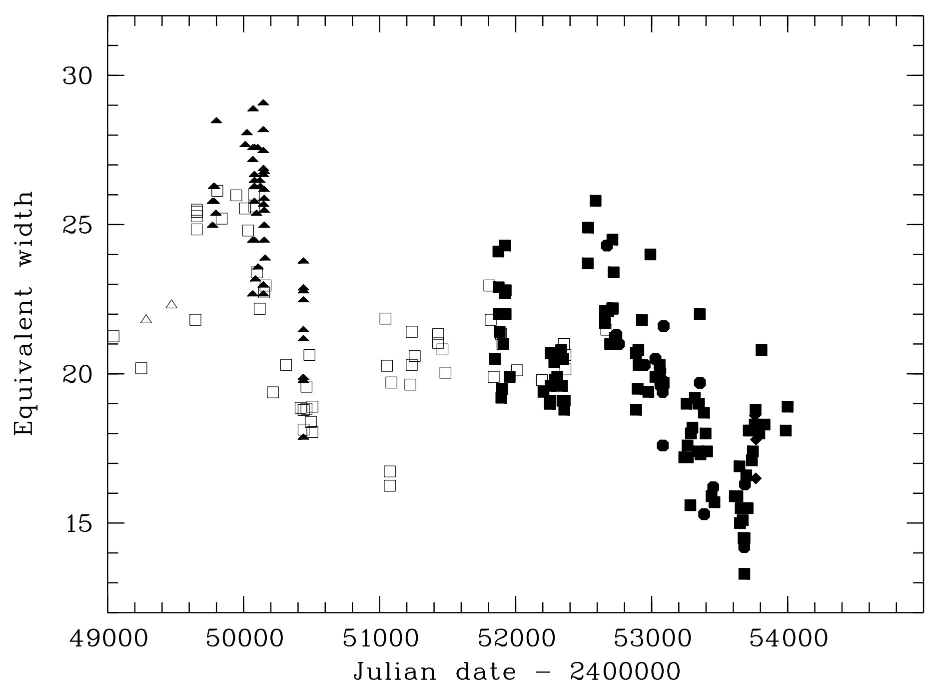

Figure 3. Enlargement of Fig. 2 (see there for symbols and data sources), showing the data presented in this work in greater detail, also for comparison between values taken with professional and amateur equipment.

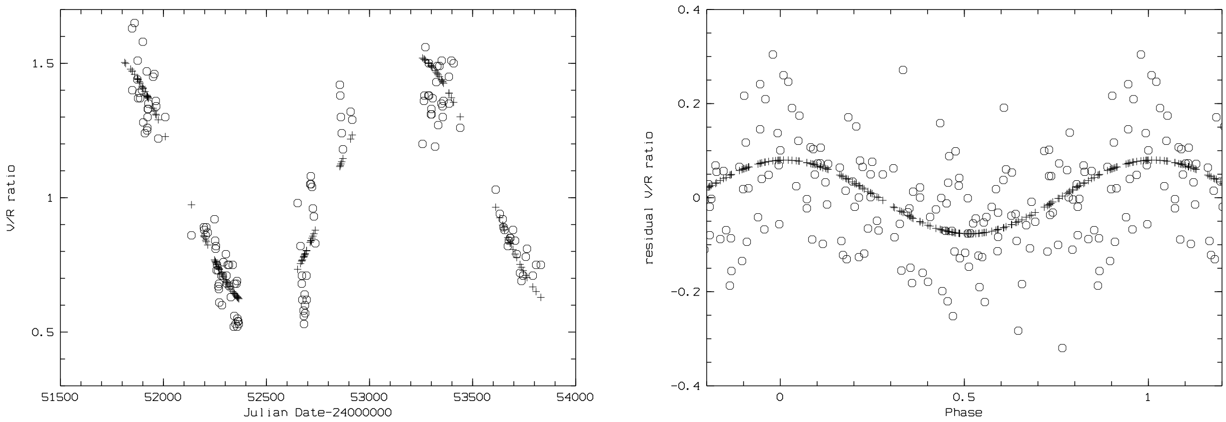

Figure 4. Hα V/R-ratio. Left: The measured values vs. Julian date (open symbols) and the sine wave with $\mathcal{P} = 1471$ d (plus signs). Right: The residuals of the left panel, folded with $\mathcal{P} = 69.3$ d and the respective sine fit. Shown are 1.4 cycles for clarification, i.e. 40 % of the points are redundant.

the central part of the dataset, but it is not of constant amplitude. The variance seen in the right panel of Fig. 4 is well above the measuring uncertainty. In fact, looking at individual seasons, the 69.3 d cycle is not seen before JD=2 452 100, hardly visible until 53000, but then becoming very strong, and finally weakening again after JD=2 453 500.

The ephemeris of the residual V/R maximum is

$$2\,452\,996 + 69.3 \times E$$

The cycle time of 69.3 days is about half of the orbital period of the system of 132.97 d (Harmanec, 1984), but a precise 1:2 ratio is well outside a 3σ uncertainty. As a check, sorting the data with the orbital period rather shows the properties of a scatter diagram than a meaningful phase curve.

Phase locking of the V/R ratio has been observed in a number of binaries. However, while Harmanec et al. (2002) attribute this to the property of the Roche lobe, e.g. for the case of 59 Cyg, Štefl et al. (2007, also Okazaki, priv. comm.) found in hydrodynamical simulations that a true phase lock will not happen for a density wave, usually thought to cause V/R variations. Rather, they attribute precise locks, as in 59 Cyg, to radiative effects (Maintz et al., 2005) which is not likely in ζ Tau, however. Instead of an exact tidal lock, the Štefl et al. mention that in eccentric binaries tidally induced disturbances may develop with a period slightly longer than the orbital one, and we may note that at least the double-wave period would qualify under this statement.

This small difference may also offer an explanation for the strongly variable amplitude: The orbital period, supposedly causing a tidal disturbance and the V/R variation cycle length as observed, would give rise to a long-term beating period in the excitation mechanism of about 9 years.

Discussion and Outlook. The data presented in this work extend the ζ Tau spectra shown by Rivinius et al., (2006, their Fig. A.4 in Appendix A). While their data cover the years 1991 to 2003, the data here cover 2000 to 2006, with the observations ongoing.

Long-term spectroscopic monitoring by dedicated amateurs can deliver important data for the professional community. For instance, one easily recognizes state of the V/R cycle due to the one-armed density wave, as well as maxima in equivalent width at 50150 and 52600, that do not coincide with the V/R cycle.

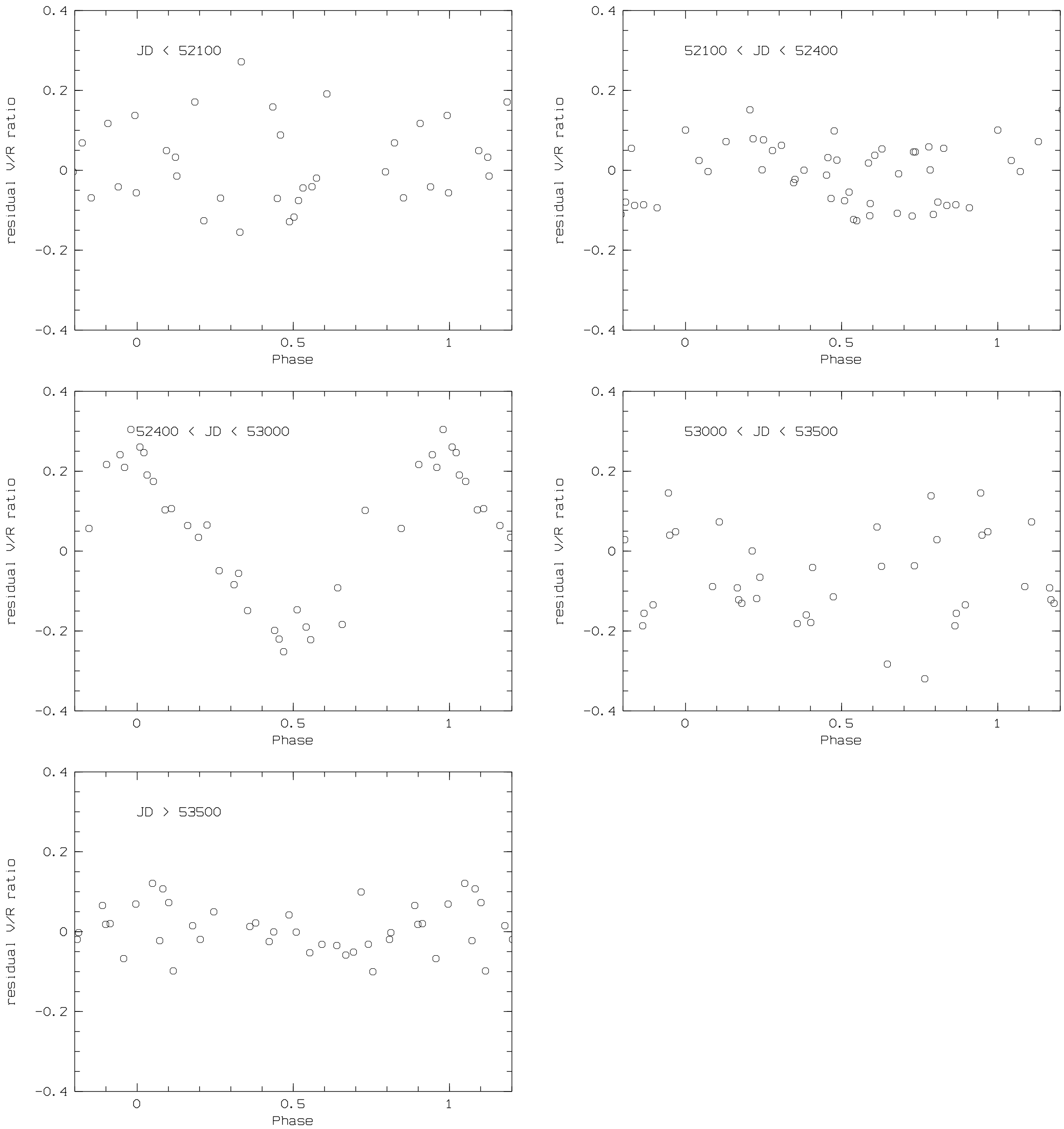

Figure 5. Strength of 69.3 d V/R-ratio cycles in individual data subsets.

The 69.3 d cycle in spectroscopy is another example of a phenomenon almost inaccessible to professional astronomers due to the observational timescales required, which on the other hand poses no problem to the dedicated amateur observer.

In the first few spectra of the 2006/2007 observing season, a sharp rise in equivalent width from about 18 to 26 Å is seen. At the same time, as the V/R ratio changes from $V < R$ to $V > R$ again, the emission has developed a triple-peak profile, entering a new cycle in its V/R variations.

Acknowledgements:

We are grateful to Petr Harmanec, the referee, who's detailed and critical comments lead to major extensions and improvements of this work.

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TIMES OF MINIMA FOR NEGLECTED ECLIPSING BINARIES 2006–2007

DVORAK, S. W.

Rolling Hills Observatory, Clermont, FL USA; e-mail: sdvorak@rollinghillsobs.org

Observatory and telescope:
25cm catadioptric telescope at Rolling Hills Observatory (RHO)

Detector:	SBIG ST-9XE, Peltier cooling, Kodak KAF-0261 chip, $18'.5 \times 18'.5$ FOV, 512×512 pixels.

Method of data reduction:
Reduction of the CCD frames was done with sextractor and custom-written applications[1] .

Method of minimum determination:
The times of minima were computed using the Kwee and van Woerden method as implemented in a custom-written C application.

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
CN And	54425.5629	0.0001	II	*V*	
DS And	54424.7131	0.0001	I	*V*	
LO And	54439.5544	0.0004	I	*V*	
AC Boo	54197.8699	0.0001	I	*V*	
FI Boo	53885.6150	0.0002	I	*V*	
AO Cam	53742.5213	0.0002	I	*V*	
TX Cnc	53776.5720	0.0001	I	*V*	
BI CVn	53883.6162	0.0002	I	*V*	
DF CVn	53882.6544	0.0001	I	*V*	
MT Cas	53767.5305	0.0001	I	*V*	
V523 Cas	54441.6632	0.0001	I	*V*	
EK Com	54138.9270	0.0001	I	*V*	
LP Com	53811.7679	0.0003	II	*V*	
	54149.7013	0.0002	II	*V*	

[1]Sextractor is written by Emmanuel Bertin and is available from `http://terapix.iap.fr`

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
GM Dra	53892.6388	0.0003	I	*V*	
AA Eri	53782.5389	0.0002	I	*V*	
BD Gem	54413.8433	0.0001	I	*V*	
QW Gem	54454.8445	0.0001	I	*V*	
V387 Her	53795.8946	0.0001	II	*V*	
EM Lac	54440.5584	0.0001	I	*V*	
PP Lac	54422.5770	0.0001	I	*V*	
AP Leo	54219.6596	0.0001	II	*V*	
DU Leo	53840.5874	0.0001	I	*V*	
RT LMi	54152.6574	0.0001	I	*V*	
UU Lyn	54166.6857	0.0002	II	*V*	
V714 Mon	53780.5293	0.0001	I	*V*	
FL Ori	54451.6986	0.0001	I	*V*	
BB Peg	54444.5506	0.0001	I	*V*	
BG Peg	54001.6770	0.0003	I	*V*	
DI Peg	54436.5670	0.0001	I	*V*	
DZ Psc	54415.6735	0.0001	I	*V*	
AS Ser	53893.7080	0.0001	I	*V*	
OU Ser	53840.8570	0.0004	I	*V*	
AH Tau	54145.5677	0.0002	II	*V*	
CT Tau	54415.8555	0.0001	I	*V*	
WY Tau	54172.6073	0.0001	I	*V*	
VZ Tri	54140.5376	0.0001	I	*V*	
V781 Tau	54409.8378	0.0001	I	*V*	
AA UMa	54159.5805	0.0001	I	*V*	
AW UMa	53868.6366	0.0001	II?	*V*	
BM UMa	53744.9418	0.0002	I	*V*	
AZ Vir	54121.8779	0.0001	II	*V*	
HN UMa	53874.6271	0.0003	I	*V*	
HW Vir	53773.9324	0.0001	I	*V*	
	53861.5886	0.0001	I	*V*	

Reference:

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OUTBURST OF A WZ Sge-TYPE DWARF NOVA, AL Com IN 2007

UEMURA, M.[1]; ARAI, A.[2]; SASADA, M.[2]; SCHMEER, P.[3]; MILLER, I.[4]; OHSUGI, T.[1,2]; YAMASHITA, T.[1]; KAWABATA, K. S.[1]; ISOGAI, M.[1]; SATO, S.[5]; KINO, M.[5]

[1] Astrophysical Science Center, Hiroshima University, Kagamiyama 1-3-1, Higashi-Hiroshima 739-8526, Japan. e-mail: uemuram@hiroshima-u.ac.jp

[2] Department of Physical Science, Hiroshima University, Kagamiyama 1-3-1, Higashi-Hiroshima 739-8526, Japan

[3] Bischmisheim, Am Probstbaum 10, 66132 Saarbrücken, Germany

[4] Furzehill House, Ilston, Swansea, South Wales, SA2 7LE, UK

[5] Department of Physics, Nagoya University, Furo-cho, Chikusa-ku, Nagoya 464-8602, Japan

AL Com is a WZ Sge-type dwarf nova, which is a subclass of dwarf novae characterized by very long recurrence times of outbursts. In the case of AL Com, outbursts were observed in 1892, 1941, 1961, 1965, 1974, 1975 (Bertola, 1964; Richter, 1992), 1976, 1995 (Howell et al., 1996; Kato et al., 1996; Patterson et al., 1996; Nogami et al., 1997), and 2001 (Ishioka et al., 2002). Superhumps were detected for the first time in 1995, and again in 2001. The 1961, 1965, and 1975 outbursts also lasted more than 30 days, which were probably superoutbursts (Richter, 1992). The light curve of its superoutbursts is characterized by a "dip" which suddenly interrupts a plateau phase of the superoutbursts (Bertola, 1964; Richter, 1992; Howell et al., 1996; Ishioka et al., 2002). After the dip, AL Com experienced a rebrightening. Several types of rebrightening phenomena have been observed in WZ Sge stars just after main superoutbursts (Richter, 1992; Kato et al., 2004; Uemura et al. 2007). The mechanism of them and the origin of their diversity are poorly understood. The rebrightening light curve of AL Com is characterized by a long plateau lasting more than 10 days.

Here, we report a new outburst of AL Com in October—November 2007. We performed optical and near-infrared photometry at 3 observatories. Details of our observational equipments are shown in Table 1. Using the standard procedure of image reduction and aperture photometry, we obtained magnitudes of AL Com and comparison stars from our images. As the optical comparison star we used a neighbor star located at $12^{\rm h}32^{\rm m}10\overset{\rm s}{.}04$, $+14^\circ20'15\overset{''}{.}3$ with the AAVSO V-band magnitude ($V = 13.509$, a star labeled as "AUID 000-BBS-916"[1]) for the images obtained at Higashi-Hiroshima and Ilston. For the infrared data obtained at Higashi-Hiroshima we used the same comparison star with J-band magnitude from the 2MASS catalog ($J = 12.032$, 2MASS 12321003+1420153 [2]). For the optical data obtained at Iowa, we used a comparison star located at $12^{\rm h}32^{\rm m}05\overset{\rm s}{.}30$ $+14^\circ23'34\overset{''}{.}0$ with the $R_{\rm c}$-band magnitude presented in Skiff (2007) ($R_{\rm c} = 13.09$, labeled as "NGC 4501 11").

[1] http://www.aavso.org/
[2] http://www.ipac.caltech.edu/2mass/

Figure 1 shows the optical light curve of the outburst. While our observations are rather sparse due to a bad seasonal condition, the feature of the light curve is reminiscent of the past superoutbursts in 1995 and 2001; a main superoutburst until JD 2454405 and a subsequent rebrightening phase until about JD 2454425. We, hence, propose that this outburst is a superoutburst. On the basis of the latest 3 superoutbursts, the supercycle of AL Com is calculated to be ~ 6 yr. This is the shortest among WZ Sge stars (Kato et al., 2004), while the stability of the cycle should be checked by a long monitoring in the future.

A noteworthy feature of the 2007 superoutburst is the behavior during the rebrightening phase. As can be seen in Figure 1, the magnitude apparently oscillates in a range of $V = 16.2$—15.2 mag between JD 2454410 and 2454421. A clear short flare was, furthermore, observed on JD 2454425, just before the final fading stage. These large amplitude variations were not seen during the past rebrightenings of AL Com, in which the object exhibited only low amplitude (~ 0.1 mag) superhumps (Nogami et al., 1997). The lower panel of Figure 1 presents the $V - J$ color variation. The color became bluer when the object was brighter. This is a typical behavior of dwarf nova outbursts, suggesting an appearance and disappearance of a hot, optically-thick accretion disk. We note that the $V - J$ color is atypically red during the rebrightening phase, compared with typical colors at the maximum of dwarf nova outbursts ($V - J \sim 0$).

In order to find possible superhumps, we performed time-series observations during the rebrightening phase. The light curves are shown in Figure 2. The figure contains 4 sets of light curves, in each the left panel includes all observations and the right panel is a phase-averaged light curve using the superhump period of 0.05722 d (Kato et al., 1995). As can be seen in these figures, we cannot find significant periodic variation having amplitudes larger than ~ 0.1 mag. The observed large oscillation is, hence, not attributed to superhumps. In conjunction with the color behavior, we conclude that the apparent oscillation is a sign of repetitive short rebrightenings with a cycle of 1—2 days, as observed in WZ Sge (Patterson et al., 2002).

As mentioned above, it is unclear what determines the rebrightening types in WZ Sge stars. In this paper, we revealed that AL Com exhibits not only long plateau type rebrightenings, but also short repetitive ones. This is the second case that different rebrightening behaviors were unambiguously observed in a WZ Sge star; WZ Sge itself exhibited no major rebrightening in the 1946 superoutburst, while short repetitive rebrightenings were observed in the 1978 and 2001 superoutbursts (Patterson et al., 1981). EG Cnc also experienced a hint of different types of rebrightenings (Kato et al., 2004). These facts indicate that the type of rebrightenings depends not directly on the physical parameters of the binaries and their components, for example, mass ratios or the strength of magnetic fields, but on the mass-accretion process of the outburst.

Table 1. Details of instruments used for our observations.

Site	Telescope	Camera	Filter	Exposure time (sec)
Higashi-Hiroshima	1.5-m (KANATA)	TRISPEC	V, J	63(V), 60(J)
Ilston	35-cm	SXVF-H16	no filter	30
Iowa	37-cm (Rigel)	FLI SITe-003	no filter	25

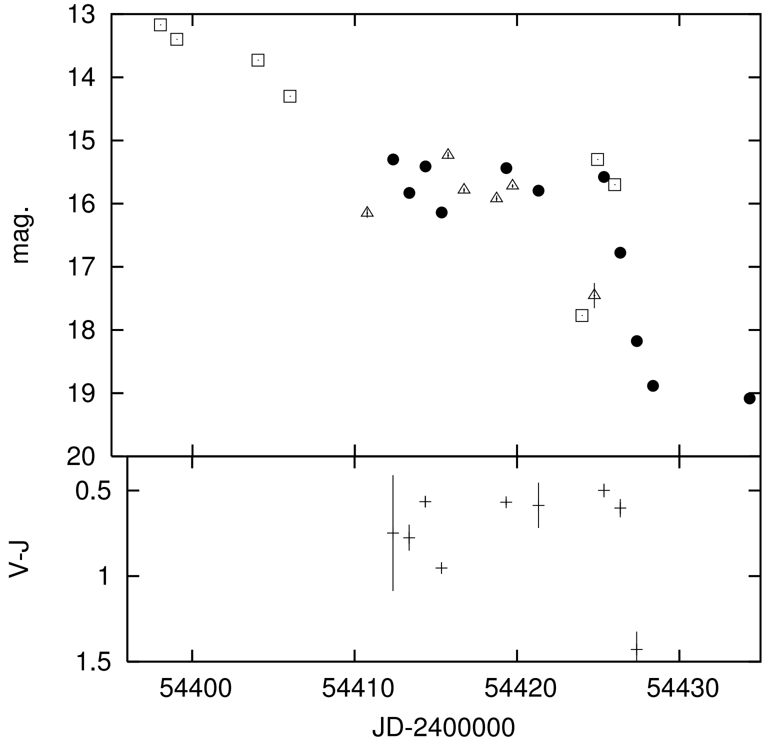

Figure 1. Upper panel: Light curve of the 2007 superoutburst of AL Com. The abscissa and ordinate denote the time in JD and the magnitude, respectively. The filled circles are V-magnitudes obtained at Higashi-Hiroshima. The open triangles and squares indicate unfiltered CCD observation at Ilston and Iowa. The magnitudes of Ilston's data were calculated by adding the V-magnitude of the comparison star ($V = 13.509$) to its differential magnitudes. Those of Iowa's data were calculated by adding the R_c-magnitude of the comparison ($R_c = 13.09$) to its differential magnitudes. Errors of the magnitudes are indicated as vertical bars, while most of errors are smaller than the symbol size. Lower panel: Color variations. The ordinate denotes $V - J$.

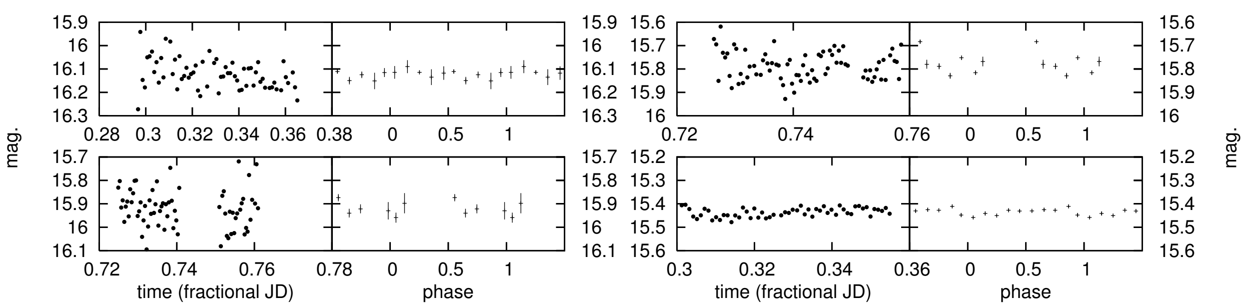

Figure 2. Time-series light curves during the rebrightening phase. Observations were performed on JD 2454415 (upper left), 2454416 (upper right), 2454418 (lower left), and 2454419 (lower right). Each panel contains two light curves; the left ones show all data points and the right ones are phase-averaged light curves folded by the superhump period of 0.05722 d (Kato, et al., 1995).

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DOES THE PERIOD OF BE LYNCIS REALLY VARY?

SZAKÁTS, R.; SZABÓ, GY. M.; SZATMÁRY, K.

[1] Dept. Experimental Physics & Astronomical Obs., Univ. of Szeged, 6720 Szeged Dóm tér 9, Hungary
e-mail: szgy@titan.physx.u-szeged.hu

The first period variation analyses (Liu et al., 1991, Tang et al., 1992, Liu & Jiang., 1994) of the HADS star BE Lyncis ($m_V \approx 8.8$ mag, $P = 0\overset{d}{.}09586954$) indicated a parabolic fit of the $O-C$. Kiss & Szatmáry (1995) suggested the presence of period variations possibly due to a companion. Derekas et al. (2003, D03) re-analysed the available data, and disproved the light-time hypothesis. They also noted that the scatter of the points in the $O-C$ diagram was slightly higher than the accuracy of individual data points, which might refer to microvariability. However, both Rodríguez et al. (1996) and D03 failed to detect additional frequency components. Later, Fu & Yiang (2005) revived the binary hypothesis again. The purpose of this paper is to test whether there is cyclic phase modulation in the light curve of BE Lyn that may refer to a light-time effect. We present 6 times of maxima from the period between 2003–2006, and re-analyse the available light curve data with phase shift analysis (e.g. Jurcsik et al., 2001) using template curve fitting.

Table 1: The log of new observations

Date	HJD (first point)	length (hour)	number of points	instrument	filter
2003.12.08	2452981.51	4.03	174	1.0 RCC	V
2004.04.22	2453119.47	2.98	281	1.0 RCC	V
2006.10.18	2454027.47	4.97	567	0.4 N	V
2006.10.19	2454028.42	5.90	668	0.4 N	V
2006.10.27	2454036.44	5.74	568	0.4 N	V
2006.10.30	2454039.42	6.47	833	0.4 N	V

We took new CCD observations of BE Lyn from two different sites. First, we used the the 1-meter RCC telescope of Konkoly Observatory, located at the Piszkéstető Mountain Station (1.0 RCC). The typical integration time was 8 s for Johnson V filter. In October, 2006 further observations were made with the 40 cm Newton telescope (0.4 N) of the University of Szeged, Dept. of Experimental Physics and Astronomical Observatory. Instrumental magnitudes were taken with Johnson V filter and with typically 10 seconds exposures. The log of observations is listed in Table 1, the light curves are shown in Fig. 1. The light curves are published electronically on the IBVS site (as `5816-t2.txt`).

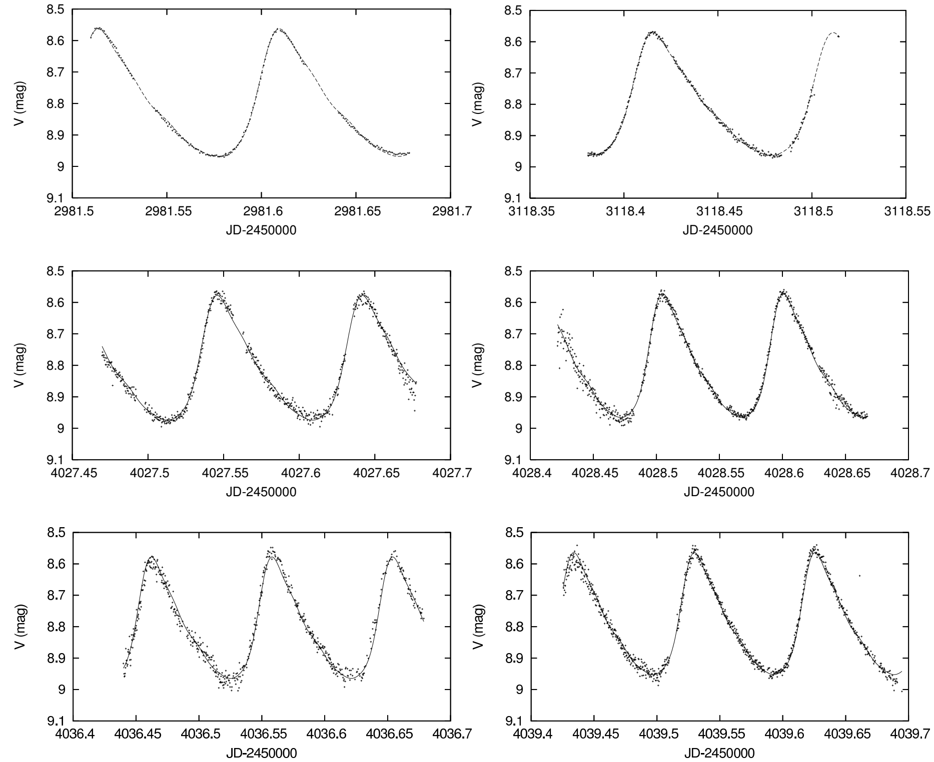

Figure 1. New light curves of BE Lyncis

In addition to the new observations, we collected light curves obtained between 1987 and 2007 from the literature. A template curve was determined by a 5-th order Fourier fit to all observations,

$$f(t) = a_0 + A\sum_{k=1}^{5}\left(a_k \sin k\phi + b_k \cos k\phi\right),$$

where A is the relative amplitude, a_0 is the mean brightness and $\phi = 2\pi t/P$. The resulted coefficients defining the template curve are: $a_0 = 8.8128$, $a_1 = 0.0740$, $b_1 = -0.1578$, $a_2 = 0.0523$, $b_2 = 0.0151$, $a_3 = 0$, $b_3 = 0.0207$, $a_4 = -0.0097$, $b_4 = 0$, $a_5 = -0.0034$, $b_5 = -0.0041$. If $A = 1$, this template curve has a total amplitude of 0.395 mag. The template curve was then fitted to the individual observing runs allowing a slight global phase shift. Because the observed light curve varied slightly, the A amplitude parameter and the a_0 mean brightness was also fitted as a free parameter. The time of maximum of the best-fit model light curve can be similarly evaluated as the $O-C$, using calculated moments of maxima as $C = 2449749.4651 + 0.09586952 \cdot E$. We determined a refined period as $P = 0\overset{\mathrm{d}}{.}09586952 \pm 0\overset{\mathrm{d}}{.}00000003$ at 3–σ confidence level.

Photometric data were available for us from Oja, 1987; Rodríguez et al., 1990, Kiss & Szatmáry, 1995; D03 and the measurements published here. We show the $O-C$ diagram of maxima for all published data in the upper panel of Fig. 2. The lower panel shows the phase shift diagram ($O-C$ of the fitted template curves) from the available photometries suitable for re-analysis (for comparison, these points are highlighted with filled circles in the upper panel). The errors were calculated from the correlation matrices of the parameters.

All new and re-determined times of maxima and amplitudes are available at the IBVS site (as `5816-t3.txt`). This table also includes the moments of maxima from the archive time series even if the data were not available for the present analysis, in this case the appropriate columns are vacant.

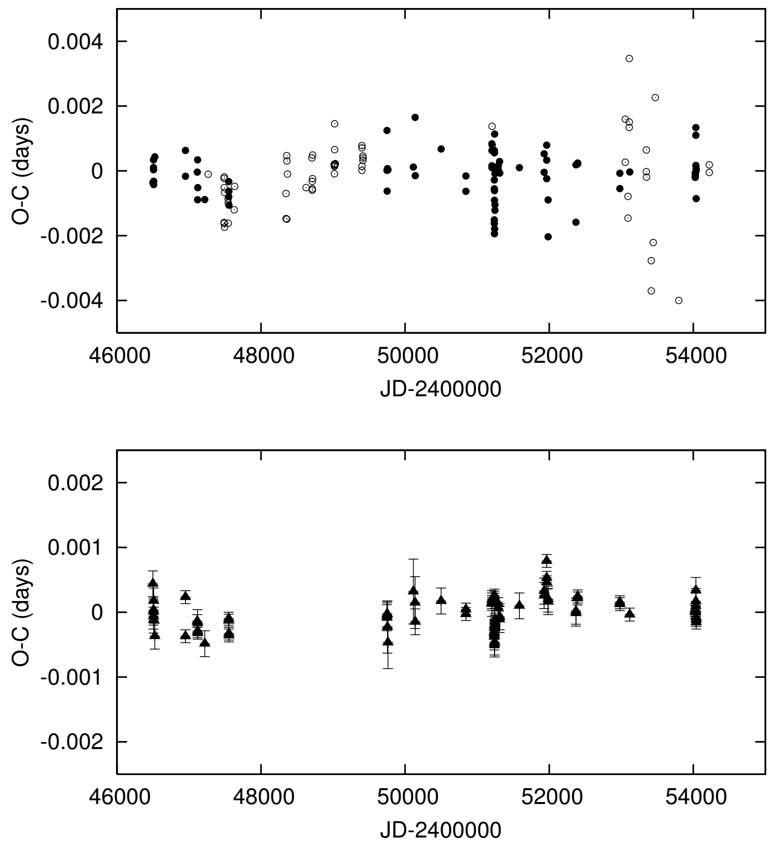

Figure 2. Upper panel: the $O-C$ of BE Lyn from times of maxima. All published data are plotted, filled circles show photometries involved into phase shift analysis. Lower panel: The phase shift diagram of BE Lyncis. Note that the $O-C$ axis has half scale as in the upper panel.

The re-determined times of maxima show only little variation, all data points are practically 0 within some 10 seconds accuracy. This strongly suggests that there is no variation in the global phase of the light curves. On the other hand, we confirm that the scatter of the classical $O-C$ diagram is too high to be a single artefact (as also noted by D03). Thus, we suggest that the phase of the maximum brightness varies slightly, leading to the observed behaviour of the $O-C$ of light maxima.

Amplitude variations are present in the data set with a range of about 0.03 mag (Fig. 3), as first noted by Rodríguez et al. (1996). We revisited the nature of the amplitude variation using Fourier-analysis, and we confirm that it is not periodic. The majority of the observed amplitudes is between 0.375 and 0.415 mag. This may be caused either by the different instrumental systems or simply by the extinction corrections, which lacks in some cases.

The correlated variation of the light curve shape and the amplitude is a known property of the Blazhko RR Lyrae stars (Jurcsik et al., 2005). The suspected variation of the amplitude and the light curve shape of BE Lyncis might suggest that they also vary in

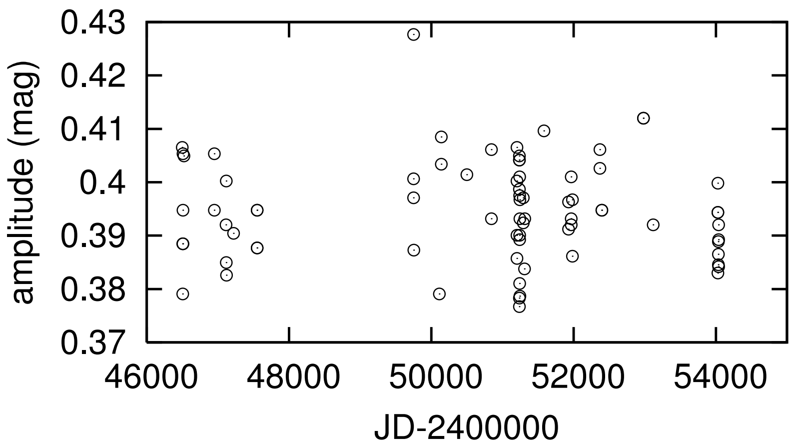

Figure 3. The variation of the total amplitude of BE Lyncis from template fitting.

a correlated way. To test this in BE Lyn, we plotted the phase of the maximum vs. the amplitude, and we found them to be uncorrelated.

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VARIABLE STAR DESIGNATIONS FOR EXTREME HELIUM STARS

JEFFERY, C. SIMON

Armagh Observatory, College Hill, Armagh BT61 9DG, N. Ireland, UK

Variability in hydrogen-deficient Bp supergiants was first established in BD+13°3224 = V652 Her and HD 160641 = V2076 Oph by Landolt (1975). Reports of variability in other hydrogen-deficient Bp supergiants followed. Amongst these was the detection of small-amplitude variations in HD 168476 = PV Tel by Walker & Hill (1985). After establishing that several such stars were variable, the GCVS identified a new class with PV Tel as the prototype and a definition: "a helium supergiant Bp star with weak hydrogen lines and enhanced lines of He and C. They pulsate with periods of approximately 0.1 to 1 days, or vary in brightness with an amplitude of 0.1 mag in V during a time interval of about a year." (Kholopov et al., 1985–88). The GCVS contains twelve confirmed PV Tel variables, three unconfirmed PV Tel variables and V652 Her, which "resembles PV Tel type stars but is a helium rich subdwarf."

The PV Tel designation is useful because it identifies A- and B-type hydrogen-deficient stars which are also variable. It presents problems because it misrepresents the types of variability observed. We propose a revision of the PV Tel designation.

Why should the designation be changed? First, observations of the helium-rich Bp supergiant PV Tel (Walker & Hill, 1985) showed evidence for light and radial velocity changes over intervals of the order of a year. There is no doubt that the star is variable. However the Walker & Hill data are also consistent with variability on shorter timescales. Subsequent observations have shown PV Tel to vary quasi-periodically with an amplitude of about 0.1 mag on a timescale of 8 – 10 days (Jones et al., 1989; Lawson et al., 1993). Hence PV Tel is not a PV Tel variable – according to the definition.

Second, the inclusion of periods of approximately 0.1 to 1 d followed the detection of variability in V652 Her (P=0.108d, Landolt, 1975), V2076 Oph 0.7 - 1.1 d (Landolt, 1975; Lynas-Gray et al., 1987) and BD+10°2179 = 0.16 d (Bartolini et al., 1982). The light curves of V652 Her and V2076 Oph are easily distinguished from one another, the former is strictly regular, the latter is either multiperiodic, quasiperiodic or irregular. Which one is not yet clear. BD+10°2179 was shown to be non-variable (Hill et al., 1984; Grauer et al., 1984). Hence, simply changing the definition of the PV Tel class (*e.g.* by extending the period range) fails to use available information. A corollary would be the need for two classes of pulsating subdwarf B star, namely EC14026=V361 Hya and PG1716=V1093 Her variables, with periods of ~ 100 s and ~ 3000 s, respectively.

Table 1: Types of light variation in hydrogen-deficient supergiants.

V*	Other	$P[d]$		Light curve
PV TEL I				
FQ Aqr	BD+1°4381	19–22		Jeffery & Malaney, 1985
NO Ser	BD−1°3438	5–8		Jeffery et al., 1985
PV Tel	HD 168476	8–10		Walker & Hill, 1985; Jones et al., 1989
V354 Nor	CPD−48°7730, =LSS 3378	10-15		Lawson et al., 1993
V2244 Oph	LS IV−1°2	10–11		Morrison, 1987; Jones et al., 1989
V4732 Sgr	LS IV−14°109	∼ 25		Lawson et al., 1993
V1920 Cyg	HD 225642, =LS II+33°5	3–4		Morrison & Willingale, 1987
	LSS 4357	?		Lawson & Kilkenny, 1998
	CoD−46°11775, =LSE 78	?		Lawson & Kilkenny, 1998
Ups Sgr	HD 181616	∼ 21	SB	Malcom & Bell, 1986
KS Per	HD 30353	∼ 30	SB	Osawa et al., 1963; Morrison & Willingale, 1987
V426 Car	CPD−58°2721, =LSS 1922	∼ 20	SB	Morrison et al., 1987
V1037 Sco	HD 320156, =LSS 4300	15–20	SB	Jones et al., 1989; Frame et al., 1995
PV TEL II				
V2076 Oph	HD 160641	0.7–1.1		Landolt, 1975; Lynas-Gray et al., 1987; Wright et al., 2005
V2205 Oph	BD−9°4395	3–9		Jeffery et al., 1985, Jeffery & Heber, 1992
V5541 Sgr	LSS 5121	?		Lawson & Kilkenny, 1998; Woolf et al., 2001
BX CIR				
V652 Her	BD+13°3224	0.1		Landolt, 1975
BX Cir	LSS 3184	0.1		Kilkenny & Koen, 1995
not pulsating				
(V821 Cen)	HD 124448	–		Jeffery & Lynas-Gray, 1990
(DN Leo)	BD+10°2179	–		Hill et al., 1984; Grauer et al., 1984
	HD 144941	–		Jeffery & Hill, 1996
MV Sgr		–	RCB	De Marco et al., 2002
DY Cen		–	RCB	De Marco et al., 2002
not known				
	LS IV+6°2			Lawson & Kilkenny, 1998
	LSS 99			
	BD+37°442			
	BD+37°1977			
	LSE 153			
	LSE 259			
	LSE 263			

Proposed variability classes. The variability types exhibited by helium-rich Bp supergiants (referring to luminosity class, since these are all low-mass stars) can be quite clearly divided into sub-types. For continuity, we propose to preserve the PV TEL moniker for two of these, simply adding the principal spectral type for each group:

PV TEL I: Hydrogen-deficient A or late-B supergiants showing low-amplitude quasi-periodic light variations on a timescale of 5 – 30 days; radial velocity variations are also seen.

Theoretically, these variations are interpreted as due to radial pulsations driven by strange-mode instability (Saio & Jeffery, 1988). The prototype FQ Aqr = BD+1°4381 (Jeffery & Malaney 1985) is the coolest EHe, other recognised members of the class include NO Ser, V354 Nor, V2244 Oph, V4732 Sgr, V1920 Cyg, up to the hottest PV Tel = HD 168476 itself. LSE 78 and LSS 4357 were reported variable by (Lawson & Kilkenny, 1998).

This proposed class definition also includes the hydrogen-deficient binaries υ Sgr, KS Per, V426 Car and V1037 Sco (Table 1). These single-lined spectroscopic binaries are easily distinguished from EHes by other means. However, all show low-amplitude light variations in the 15 – 30 days range.

PV TEL II: Hydrogen-deficient O or early-B supergiants showing low-amplitude quasi-periodic light variations on a timescale of 0.5 – 5 days; radial velocity and line-profile variations are also seen.

Theoretically, these variations are interpreted as non-radial g-mode pulsations driven by strange-mode instability (Saio & Jeffery, 1988), since "periods" are much longer than the dynamical timescales in these stars. The prototype V2076 Oph = HD 160641 (Lynas-Gray et al., 1987) is the hottest EHe, other members of the class are V5541 Sgr (Lawson & Kilkenny, 1998; Woolf et al., 2001) and V2205 Oph = BD−9°4395 (Jeffery et al., 1985).

The third sub-type is quite distinct, and its designation should reflect this:

BX CIR: Hydrogen-deficient B stars showing low-amplitude variations in light (0.1 mag in V) and radial velocity with a unique and regular period of a few hours.

Theoretically, we ascribe the variation to radial pulsations driven by the κ mechanism through Z-bump instability (Saio, 1993). The class comprises V652 Her and BX Cir. Unlike the PV TEL variables described above, the pulsations are so regular that both stars can be used as clocks (Kilkenny et al., 2005).

V652 Her was originally classified as a helium-rich subdwarf; in fact its gravity is lower than that of the main-sequence (Jeffery et al., 2001), so it is a helium-rich Bp giant, with a well-defined period (as well as $\dot{P}$ and $\ddot{P}$, Kilkenny et al., 1982, 1984, 1996) and an amplitude of 0.1 mag.

A minority of EHes are established as *not* varying on short timescales, including BD+10°2179 (=DN Leo), HD 124448 (=V821 Cen) and the metal-poor HD144941 (Grauer et al., 1984; Hill et al., 1984; Jeffery & Lynas-Gray, 1990; Jeffery & Hill, 1996). These stars lie below the instability boundary for the appropriate metallicity (Fig. 1) (Jeffery & Saio, 1999). Variability in LS IV+6°2 and LSS 99 has not been confirmed. The hot R Coronae Borealis (RCB) stars DY Cen and MV Sgr strongly resemble EHe stars LSE 78 and HD 124448 respectively (Jeffery & Heber, 1993; Jeffery et al., 1988). They showed strong RCB-like variability in the past, but are not currently known to vary on short timescales (De Marco et al., 2002).

Table 1 summarises the principal variability characteristics for all known EHe stars. Approximate timescales P are given for PV TEL variables, but the term is used loosely. Major references are given for the definition of the light curve types and the estimate of periods. The proposed classes are sensible for several reasons. They can be simply established from the timescale, light curve and amplitude of the variation and from the spectral class of the variable (which was already required for the PV TEL classification). Figure 1 shows the $log\ g - log\ T_{\rm eff}$ diagram for extreme helium stars, including the position of the Eddington limit (assuming Thomson scattering: dashed) and the loci of stars with given luminosity-to-mass ratios (solar units: dotted). Stars above the boundaries shown for metallicities $Z = 0.004, 0.01, 0.03$ (dot-dash) are predicted to be unstable to pulsations (Jeffery & Saio, 1999). Ellipses (coloured in electronic version) identify three groups of pulsating helium stars. In the electronic version, PV TEL I variables are shown in purple and red (H-def binaries), PV TEL II variables in blue, and BX CIR variables in green. Non-variables are black. The values and sources for $T_{\rm eff}$ and $log\ g$ are given in Table 2. There has to be some question about the high value of log g for NO Ser.

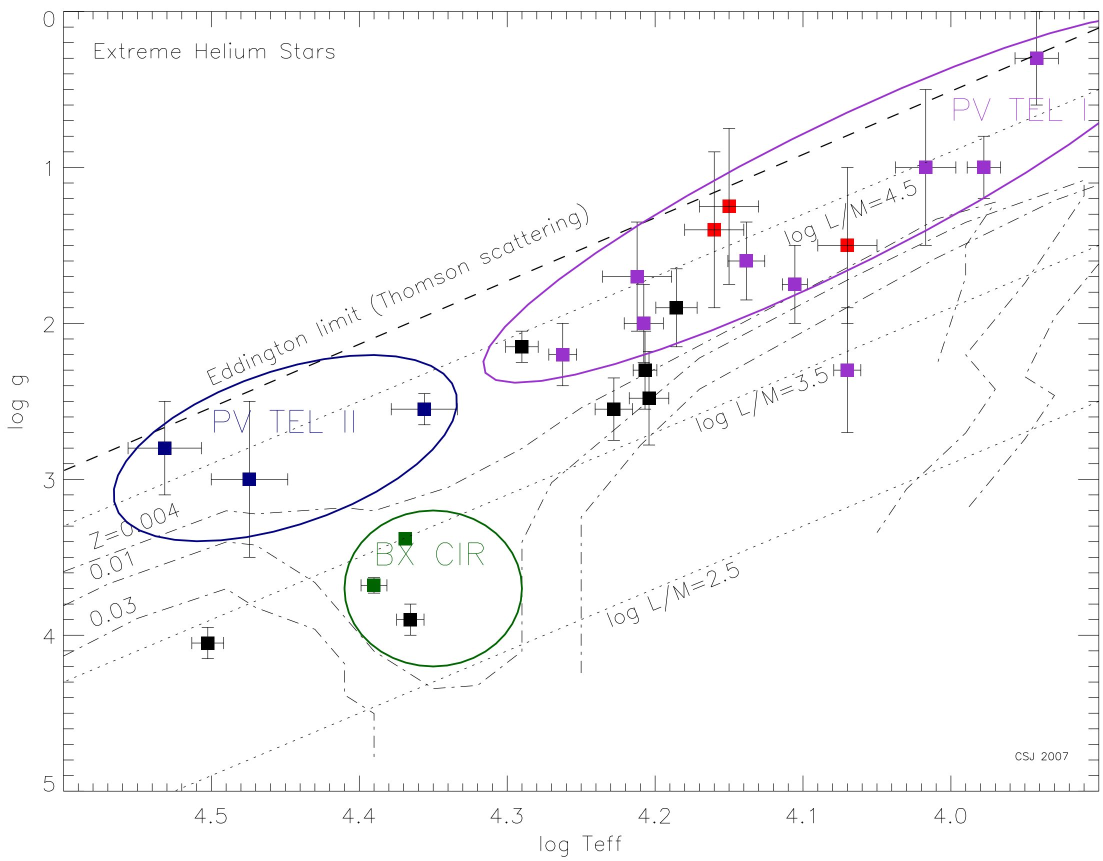

Figure 1. $log\ g - log\ T_{\rm eff}$ diagram for H-deficient variable stars

Each type of variable has a different physical mechanism, and occupies a separate region of the Hertzsprung-Russell or $log\ g - log\ T_{\rm eff}$ diagram. Since these classes have been well established for over a decade (Saio & Jeffery, 1988; Saio, 1993), a revision to the single PV TEL designation is overdue. The suggested division into classes PV TEL types I and II and BX CIR reflects current knowledge.

Table 2: Surface properties for O, B and A type extreme-helium stars

V*	Other	T_{eff}	$\log g$	Reference
PV TEL I				
FQ Aqr	BD+1°4381	8750±300	0.30±0.30	Pandey et al., 2006
V4732 Sgr	LS IV−14°109	9500±250	1.00±0.20	Pandey et al., 2006
V354 Nor	CPD−48°7730, =LSS 3378	10400±500	*1.00±0.50	Pandey & Reddy, 2006
NO Ser	BD−1°3438	11750±250	2.30±0.40	Pandey et al., 2001
V2244 Oph	LS IV−1°2	12750±250	1.75±0.25	Pandey et al., 2001
PV Tel	HD 168476	13750±400	1.60±0.25	Pandey et al., 2006
	LSS 4357	16130±500	2.00±0.25	Jeffery et al., 1998
V1920 Cyg	HD 225642, =LS II+33°5	16300±900	1.70±0.35	Pandey et al., 2006
	CoD−46°11775, =LSE 78	18300±400	2.20±0.20	Pandey et al., 2006
Ups Sgr	HD 181616	11750±750	1.5 ±0.5	Dudley, 1992
KS Per	HD 30353			
V426 Car	CPD−58°2721, =LSS 1922	14000±800	1.25±0.5	Morrison, 1987
V1037 Sco	HD 320156, =LSS 4300	14500±800	1.4 ±0.5	Schönberner & Drilling, 1984
PV TEL II				
V2205 Oph	BD−9°4395	22700±1200	2.55±0.10	Jeffery and Heber, 1992
V5541 Sgr	LSS 5121	29800±1830	*3.00±0.50	Jeffery et al., 2001
V2076 Oph	HD 160641	34000	2.80	Rauch, 1996
BX CIR				
BX Cir	LSS 3184	23390±90	3.38±0.02	Woolf and Jeffery, 2002
V652 Her	BD+13°3224	24550±500	3.68±0.05	Jeffery et al., 1999
not pulsating				
MV Sgr		16000±500	2.48±0.30	Jeffery et al., 1988
(V821 Cen)	HD 124448	16100±300	2.30±0.25	Pandey et al., 2006
(DN Leo)	BD+10°2179	16900±500	2.55±0.20	Pandey et al., 2006
DY Cen		19500±500	2.15±0.10	Jeffery & Heber, 1993
	HD 144941	23200±500	3.9 ±0.1	Harrison & Jeffery, 1997
not known				
	LSS 99	15330±500	1.90±0.25	Jeffery et al., 1998
	LS IV+6°2	31800±800	4.05±0.10	Jeffery, 1997
	BD+37°442	53000	4.0	Heber et al., 1987
	BD+37°1977	56000	4.1	Darius et al., 1979
	LSE 153	70000±2000	4.75±0.15	Husfeld et al., 1989
	LSE 259	70000±3000	4.9 ±0.25	Husfeld et al., 1989
	LSE 263	70000±7000	4.4 ±0.3	Husfeld et al., 1989

*: estimated

Cool H-deficient variables. We conclude with a remark on designations for some related variables. Theoretically speaking (Saio & Jeffery, 1988), there is a probable physical connection between PV TEL-type variations described above and the ~ 40 d pulsations observed in cool RCB variables such as RY Sgr (Alexander et al., 1980) and the late-type carbon-rich hydrogen-deficient giants such as HM Lib = HD 137613 (Kilkenny et al., 1988; Jones et al., 1989). RCB-type minima are definitive and, coupled with an appropriate spectral type, the designation needs little modification. Indeed, the RCB definition includes "cyclic pulsations with amplitudes up to several tenths of a magnitude and periods in the range 30-100 days". Of those hydrogen-deficient giants which do not show RCB-type minima, the GCVS tentatively describes HM Lib as a semi-regular variable ("SR:"). Three other variables are LV Tra = HD 148839, V4152 Sgr = HD 175893, and HD 173409 (Kilkenny et al., 1988; Jones et al., 1989). Only HD 182040 has *not* been proven to vary on these timescales (ibid.). Radial velocity variations have been observed on the same timescales (Lawson & Cottrell, 1997). While LV TrA is classified "RCB:", it is not clear that it has ever shown a deep RCB-type minimum. Meanwhile, there is increasing evidence for an evolutionary connection between all of these groups of stars (Saio & Jeffery, 2002; Pandey et al., 2006; Clayton, 2008). Perhaps the PV TEL designation should be further extended to include these cool giants:

PV TEL III: Hydrogen-deficient and carbon-rich F or G supergiants showing low-amplitude quasi-periodic light variations on a timescale of 30 – 100 days; radial velocity variations are also seen.

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IDENTIFICATION OF TWO ROTSE TRANSIENTS AS CATACLYSMIC VARIABLES IN OUTBURST

SOUTHWORTH, J.; REBASSA-MANSERGAS, A.

Department of Physics, University of Warwick, Coventry, CV4 7AL, UK, email: j.k.taylor@warwick.ac.uk

In 2007 November the ROTSE sky survey observed two optical transients, using the 0.45 m ROTSE-IIIb telescope at MacDonald Observatory (Yuan et al., 2007). The two transients were labeled ROTSE3 J031031.4+431115.0 and ROTSE3 J113709.0+513451.1 (hereafter ROTSE 0310 and ROTSE 1137, respectively). The brightness of ROTSE 0310 rose from below the detection limit to ROTSE (unfiltered) magnitude 16.4 (2007 November 8), before gradually fading over a period of one week. It had previously been observed twice at magnitude 17.0 (2007 September 7 and October 20). The brightness of ROTSE 1137 was observed to rise to magnitude 17.2 (2007 November 2) before decaying to magnitude 18.5 over the following week.

ROTSE 0310 has a counterpart in the USNO-B1.0 survey with magnitudes $B_2 = 18.32$ and $R_2 = 19.10$. ROTSE 1137 has a counterpart in the Sloan Digital Sky Survey (SDSS; York et al., 2000) with magnitudes $g = 20.64$ and $r = 20.10$. Based on the observed outbursts and the magnitudes of the counterparts in the USNO and SDSS surveys, Yuan et al. (2007) "tentatively" classified both objects as faint CVs which were observed by ROTSE-IIIb whilst in outburst.

It is becoming progressively more important to understand the characteristics of optical transients in monitoring surveys, as large-area deep variability studies become more common (e.g. OGLE, PanSTARRS and the LSST). We therefore obtained medium-resolution spectroscopy of ROTSE 0310 and ROTSE 1137 in order to determine their object types. The observations were obtained with the William Herschel Telescope and ISIS double-beam grating spectrograph, using a slit width of 1.0 arcsec and the standard 5300 Å dichroic. The blue arm was equipped with the R600B grating, giving a wavelength coverage of 3600–5100 Å and a resolution of 2 Å. In the red arm we used the R316R grating, obtaining a coverage of 6200–8800 Å with a resolution of 4 Å.

A spectrum of ROTSE 0310 was obtained on the night of 2007 December 31, with an exposure time of 900 s. Its brightness was roughly $V = 19.5$, indicating that it was in quiescence. ROTSE 1137 was observed on 2008 February 15 in poor conditions (seeing 2.5–3.5 arcsec), with a longer exposure time of 1800 s. Its brightness was consistent with its SDSS magnitudes, so it was also in quiescence. Data reduction was performed using optimal extraction (Marsh, 1989) and our usual procedures (see Southworth et al., 2007a, 2007b). Wavelength calibration was undertaken using copper-neon and copper-argon arc lamps. Flux calibration and corrections for telluric absorption was done using spectra of HD 84937).

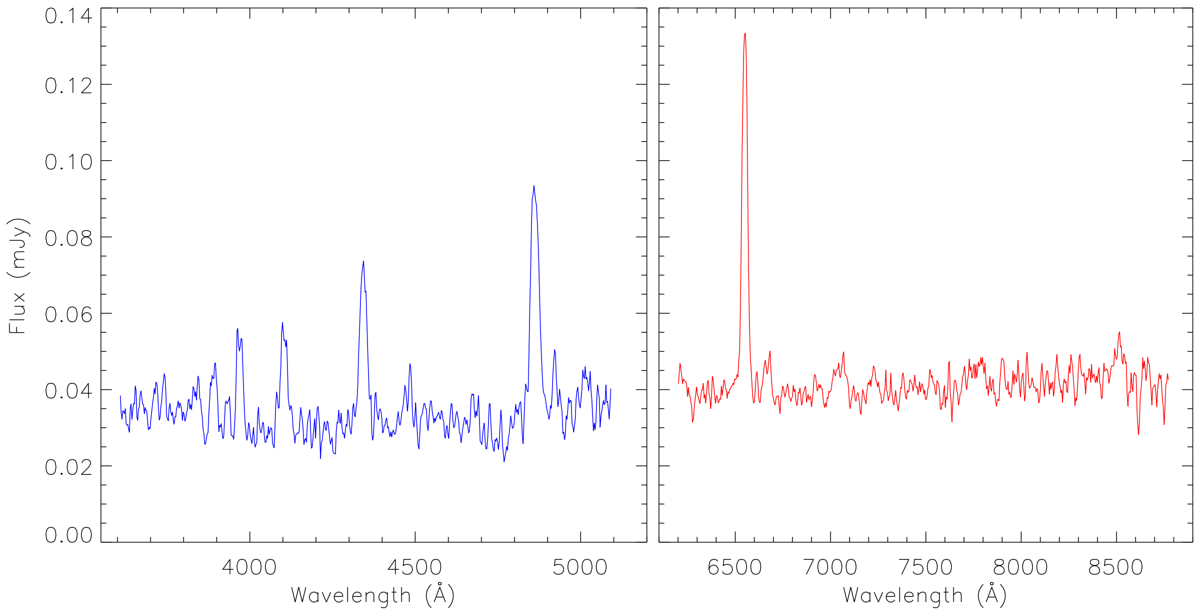

Figure 1. WHT/ISIS spectrum of ROTSE3 J031031.4+431115.0 whilst in quiescence. The spectrum from the blue arm is shown on the left and that from the red arm on the right. The data have been smoothed slightly for display purposes.

The spectrum of ROTSE 0310 is plotted in Fig. 1. Its flux calibration is only approximate as it does not take account of slit losses; the flux level is appropriate for an object at magnitude $V \sim 19.5$ at the time of observation. The spectrum shows strong single-peaked emission at the hydrogen Balmer line wavelengths. The emission is strongest at Hα and decreases to higher-order lines, which is the signature of an optically thin hydrogen-rich accretion disc (Williams, 1980). Emission is also seen at a number of He I lines, including λ4386, λ4471, λ4921, λ5015, λ6678 and λ7065. He II λ4686 emission is also detectable. The spectrum of ROTSE 0310 displays the classical signatures of a cataclysmic variable (CV) in quiescence (Warner, 1995), unambiguously confirming the tentative identification ascribed by Yuan et al. (2007). As it is known to show outbursts, ROTSE 0310 can be further categorised into the dwarf nova subclass of CVs (Warner, 1995).

Our observation of ROTSE 1137 was obtained during poor seeing conditions, and has a very low flux level. A portion of the red spectrum is shown in Fig. 2, and only Hα can clearly be identified. The rest of the spectrum is unusable as slight inaccuracies in subtraction of the sky emission lines causes changes in flux at a similar level to the puny signal detected from the target. The ISIS blue spectrum has too low a continuum flux level to extract a spectrum, so we have taken the cosmologist's approach (A. Levan, priv. comm.) of measuring the positions of emission lines directly from the CCD image. By careful application of the correct wavelength calibration, we have been able to identify four emission lines with wavelengths λ4861 (Hβ), λ4341 (Hγ) and λ4100 (Hδ). We have therefore detected emission from four Balmer lines. The Balmer emission and the light curve obtained by ROTSE point to the identification of ROTSE 1137 as a faint CV of dwarf nova type.

To summarise, ROTSE 0310 and ROTSE 1137 were both detected as transient objects by the ROTSE-III sky survey. Their magnitudes peaked at 16.4 and 17.2, respectively, before decaying to below the detection limit over roughly one week. There are faint counterparts of both objects, one in USNO-B1.0 and one in the SDSS. We have obtained

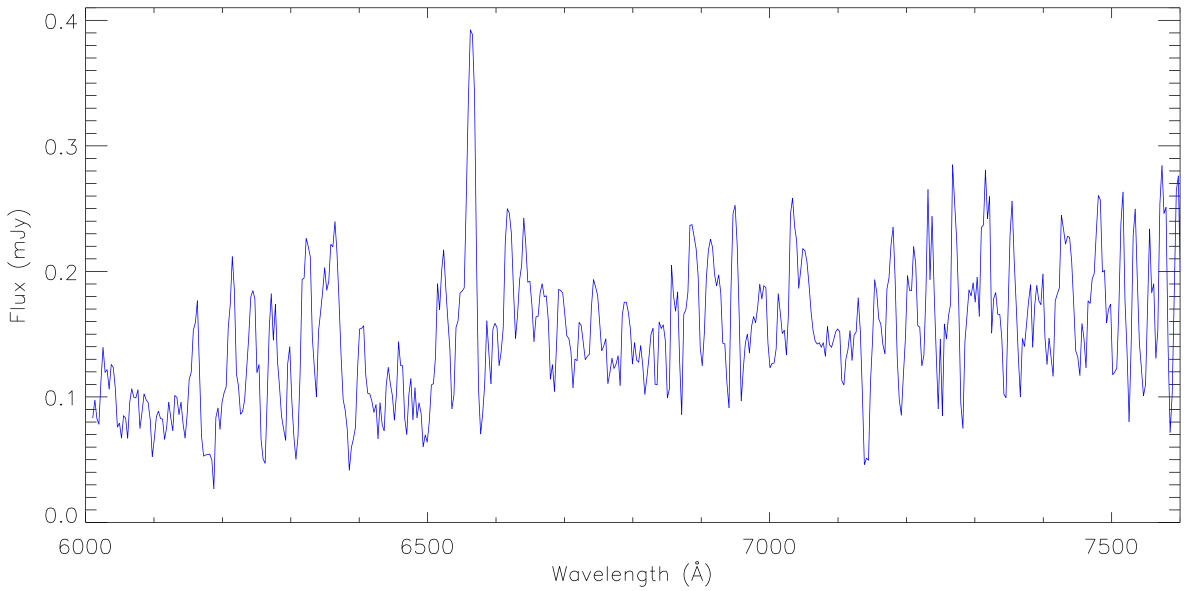

Figure 2. WHT/ISIS red spectrum of ROTSE3 J113709.0+513451.1 in quiescence. The data have been smoothed slightly for display purposes.

WHT medium-resolution spectroscopy of ROTSE 0310 and ROTSE 1137, and in both cases have detected the Balmer emission lines which are the dominant spectral characteristic of quiescent CVs. We therefore confirm the suggestion of Yuan et al. (2007) that the two objects are faint CVs which were caught in outburst by ROTSE. Neither system is mentioned in the CV catalogues of Downes et al. (2001) or Ritter & Kolb (2003; plus updates), so both are new discoveries.

This is not the first time that faint optical transients have turned out to be previously unknown CVs. Rau et al. (2007) followed up three faint optical transients and found that two of these were CVs, both of which were new discoveries. In the near future an increasing number of large-scale deep optical sky surveys will obtain observations of many thousands of transient objects. Becker (2008) discusses the various types of optical transients and predicts that the Large Synoptic Survey Telescope (LSST) may produce between 10^5 and 10^6 of these *per night*. A substantial proportion of these will be CVs, and follow-up observations similar to those presented here will likely lead to a huge increase in the known CV population.

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ERRATA FOR IBVS 5583

The following corrections were communicated to IBVS by Petr Zasche and the author, Miloslav Zejda. The times of minima for HT Vir were erroneously given in the article, and should be replaced by those given below.

Star name	Corrected time of min.
HT Vir	52751.5845
HT Vir	52751.3807
HT Vir	52765.4468
HT Vir	53068.5504

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THE EXTREME OUTBURST OF EX Lup IN 2008: OPTICAL SPECTRA AND LIGHT CURVE

KÓSPÁL, Á.[1]; NÉMETH, P.[2]; ÁBRAHÁM, P.[1]; KUN, M.[1]; HENDEN, A.[3]; JONES, A. F.[4]

[1] Konkoly Observatory, P.O.Box 67, 1525 Budapest, Hungary, e-mail: kospal@konkoly.hu

[2] Florida Institute of Technology, 150 West University Boulevard, Melbourne, FL 32901, USA

[3] American Association of Variable Star Observers, 49 Bay State Road, Cambridge, MA 02138, USA

[4] 31 Ranui Road, Stoke, Nelson 7011, New Zealand

EX Lup is the prototype of EXors, a class of pre-main sequence eruptive variables, exhibiting unpredictable brightenings lasting some months (Herbig, 1977; Herbig et al., 2001; Herbig, 2007). According to the current picture, eruptions of pre-main sequence stars are caused by enhanced accretion (Hartmann & Kenyon, 1996). In quiescent phase, EX Lup has typically $V \approx 13$ mag, while in outburst, it may brighten by 1–4 mag. The last known flare-up happened in 2002 (Herbig, 2007). As was announced by Jones (2008), EX Lup has been in outburst again since at least 2008 January 15. Based on visual estimates, the star reached a peak brightness of 8 mag, brighter than at any time before. We started an optical spectroscopic monitoring programme on 2008 January 25. In this paper we present our spectra collected until 2008 February 17, as well as the visual light curve for the same period.

Our spectroscopic observations were carried out during 13 nights in 2008 January and February with the newly installed 0.8 m f/8 Cassegrain telescope, equipped with a DFM Cassegrain Spectrograph and a 1024×1024 pixels Apogee Alta camera, at Florida Institute of Technology. Unfortunately, due to the location of the site, we were constrained to observe at extremely high airmasses (between 2.5 and 3.8). The 5″ slit and 600 l/mm grating yielded a spectral resolution of $\lambda/\Delta\lambda = 730$ in the 4250–6050 Å wavelength range at a dispersion of 1.7 Å/pixel. The S/N for our spectra is typically 5-10. The data were reduced using IRAF *ccdred* tasks and spectra were extracted by using the *twodspec* package. The spectra were traced by a 5th order Legendre function using the *apall* task, and the background was sampled over a 25 pixel range on both sides of the spectra. Wavelength calibration was done using observations of a HgAr lamp. The positions of four identified HgAr lines were fitted by a 3rd order Legendre function with rms around 0.01, to obtain the dispersion axis. The log of observations can be seen in Tab. 1.

In order to increase the signal to noise ratio, we combined all 13 spectra, by first shifting them in wavelength and then by averaging them. The resulting averaged spectrum is plotted in Fig. 1. The spectrum is dominated by emission lines, of which many can be identified as metallic lines (Fe I, Fe II, Mg I, Ti II). In addition, a prominent H_β can be observed, however, H_γ is absent from all our spectra. No absorption lines seem to be present. The identified spectral features are marked in Fig. 1. In order to be able to quantitatively compare our spectra with each other and with others published in the literature, we selected three lines and measured their equivalent widths, see Tab. 1.

Table 1: Log of spectroscopic observations, and equivalent widths of selected emission lines of EX Lup. The first two columns show the date and JD when the exposure started; the third column gives the exposure time in seconds; the fourth column shows the number of spectra taken that night; and the last three columns display the equivalent widths in Å of selected emission lines. The uncertainties of the equivalent widths are about 10% and are dominated by the uncertainties in fitting the continuum level.

Date	JD-2450000	Exp. time	Nr.	H_β	Fe II λ4921	Fe II λ5015
2008 Jan 25	4490.959	600	1	-30.0	-12.1	-11.4
2008 Jan 26	4491.956	900	1	-13.4	-6.0	-5.4
2008 Jan 28	4493.949	900	1	-12.3	-4.7	-4.6
2008 Jan 29	4494.945	900	1	-6.5	-3.2	-3.4
2008 Jan 30	4495.956	600	3	-9.0	-3.9	-3.6
2008 Jan 31	4496.945	900	2	-7.3	-3.6	-3.2
2008 Feb 1	4497.938	900	1	-8.8	-3.7	-3.8
2008 Feb 5	4501.936	900	1	-10.4	-6.3	-6.6
2008 Feb 6	4502.936	900	1	-7.4	-4.2	-4.5
2008 Feb 9	4505.967	900	1	-8.3	-4.8	-5.0
2008 Feb 11	4507.915	600	1	-13.2	-5.8	-6.5
2008 Feb 14	4510.912	900	1	-10.8	-5.7	-5.9
2008 Feb 17	4513.913	900	1	-5.1	-3.1	-3.2

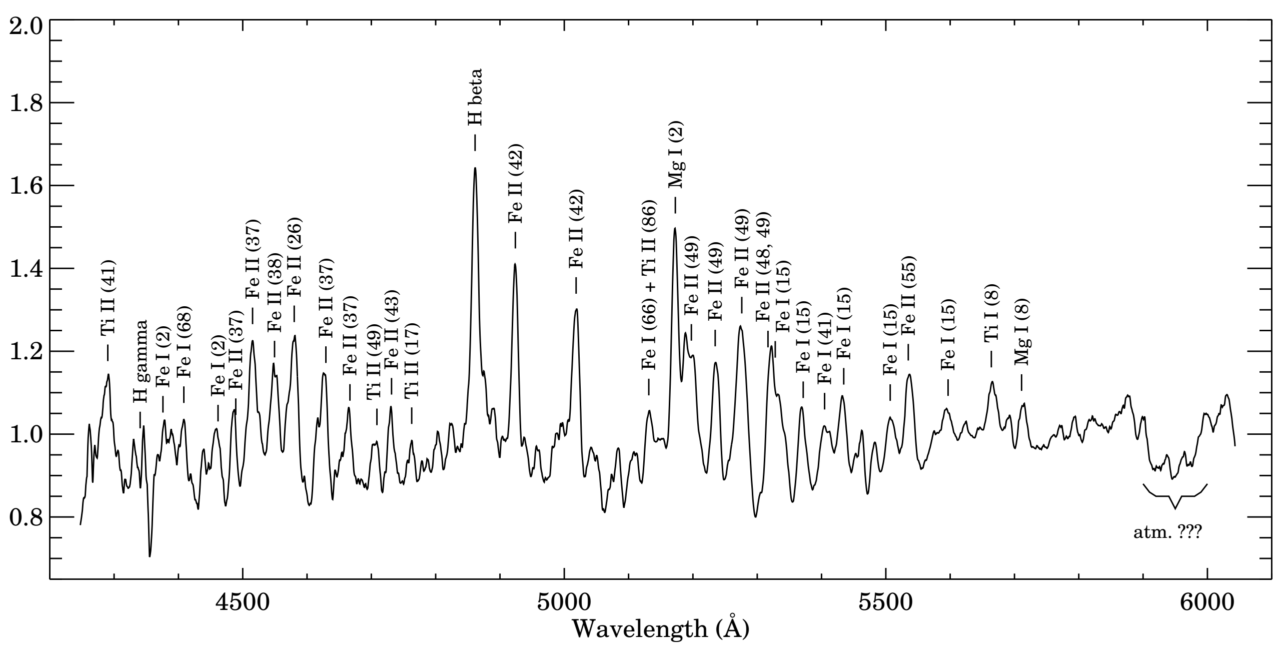

Figure 1. Average of our 13 normalised spectra of EX Lup. Identified spectral lines are marked.

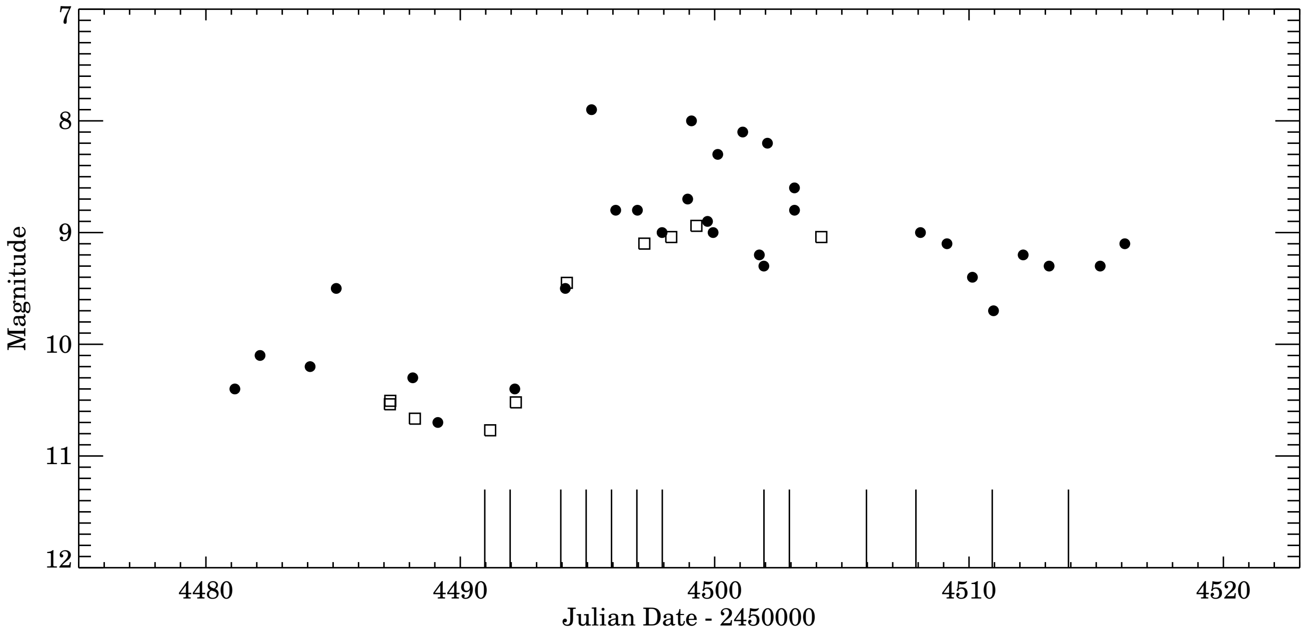

Figure 2. Light curve of EX Lup in the period 2008 January 15 – 2008 February 19. *Filled dots:* visual estimates of A.F. Jones; *open squares:* V-band magnitudes from the AAVSO International Database. The vertical lines at the bottom mark the dates when spectra were obtained.

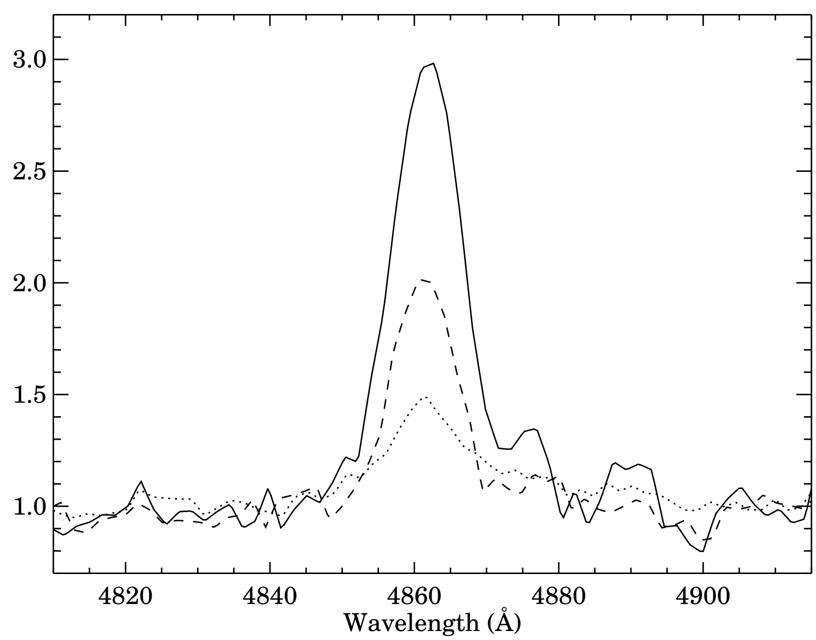

Figure 3. Profiles of the H_β line on 2006 January 25 (solid line), 26 (dashed line), and February 1 (dotted line).

Similar optical spectra were already published for EX Lup both in quiescent and in outburst phases (Appenzeller et al., 1983; Patten, 1994; Lehmann et al., 1995; Herbig et al., 2001; Herbig, 2007). All these spectra show prominent Balmer lines. H_β is clearly visible also in our spectra, and its equivalent width is similar to those published in the literature. Interestingly, H_γ is absent from all our spectra, though it was observed in all the previous studies. Weak He lines were reported in the literature. We found no He lines, but this might be due to our limited spectral resolution (some He lines might be blended with Fe lines). On the other hand, while Fe and other metallic lines were either weak or absent in previous spectra, they are very strong in ours, very likely the strongest ever observed.

Our 13 spectra cover a period of nearly one month around the peak brightness, as shown in the light curve in Fig. 2, which is a compilation of visual and V-band observations. In mid-January, the star already had a visual brightness of ≈ 10 mag, well above the usual quiescent brightness of 13 mag. It soon became even brighter, reaching a maximum of 8-9 mag, then started a slow fading. Checking the equivalent width values in Tab. 1, we found a trend: the equivalent widths were high on the first date, then became significantly reduced between 2008 January 25 and 28, and stayed more or less constant since then (see e.g. the H_β profiles in Fig. 3). The hydrogen and iron lines follow the same trend. Patten (1994) found that the equivalent widths of the Balmer lines did not appear to change much between the outburst and the quiescent phase. This is different in our results. The significant changes in our equivalent widths, however, might be due to the brightening of the object between the dates of our first and subsequent spectra. The lack of absorption features that would normally be present in an M-type dwarf suggests that the increased brightness of EX Lup is not due to variable photosphere but to the addition of a featureless continuum, probably the accretion luminosity.

In summary, our photometric and spectroscopic observations prove that EX Lup is in outburst, exhibiting the highest peak brightness ever observed. The spectra of the present outburst differ significantly from the previous ones in several aspects: the lack of the H_γ and He lines, and the extremely strong metallic features. The increased brightness of the system is probably due to increased accretion. Increased accretion, and consequently increased stellar wind, can also explain the wealth of metallic lines coming from infalling or ejected hot gas, similarly to the case of DR Tau (Beristain et al., 1998).

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CCD MINIMA FOR SELECTED ECLIPSING BINARIES IN 2007

NELSON, ROBERT H.

1393 Garvin Street, Prince George, BC, Canada, V2M 3Z1; e-mail: bob.nelson@shaw.ca

Observatory and telescope:
Sylvester Robotic Observatory (SRO): 33 cm f/4.5 Newtonian on Paramount GT-1100s mount

Detector:	SRO: SBIG ST-7XME, 1.25 pixels, $15\farcm8 \times 10\farcm5$ FOV, cooled $-10 < T < -30$ °C

Method of data reduction:
Aperture photometry using MIRA, by Axiom Research.

Method of minimum determination:
Digital tracing paper method, bisection of chords, curve fitting, and (occasionally) Kwee and van Woerden (1956).

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
WZ And	54452.6138	0.0002	II	R	
BL And	54409.6187	0.0004	I	R	
GI Aur	54412.8176	0.0002	I	R	
IZ Aur	54127.5901	0.0002	I	c	
MU Aur	54161.7816	0.0005	I	c	
V0402 Aur	54435.6811	0.0005	II	R	
V0404 Aur	54398.8961	0.0002	I	R	
V0410 Aur	54378.8722	0.0003	II	R	
TY Boo	54155.8767	0.0002	II	R	
AC Boo	54131.9628	0.0005	I	R	
GQ Boo	54161.902	0.001	I	R	
GR Boo	54181.8356	0.0002	I	R	
GT Boo	54209.8456	0.0005	II	R	
AO Cam	54134.6098	0.0001	II	R	
DN Cam	54352.887	0.001	II	B	
MT Cam	54442.6343	0.0001	I	R	
V0445 Cas	54354.954	0.003	II	R	
V0471 Cas	54356.7491	0.0002	II	c	
V0471 Cas	54357.7510	0.0002	I	R	
V0471 Cas	54358.7535	0.0002	II	R	
V0471 Cas	54381.8075	0.0002	I	R	

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V0471 Cas	54382.8096	0.0003	II	R	
V0520 Cas	54435.593	0.001	II	c	
NW Cep	54398.6343	0.0004	I	R	
EH Cnc	54441.8327	0.0003	II	R	
FF Cnc	54455.8268	0.0002	II	R	
HN Cnc	54399.0193	0.0002	I	R	
RZ Com	54181.7267	0.0002	I	R	
LQ Com	54133.9190	0.0001	I?	R	
RW CrB	54220.8444	0.0001	I	R	
BI CVn	54177.7284	0.0001	II	R	
BO CVn	54131.8950	0.0002	II	R	
DF CVn	54153.814	0.001	II	R	
DH CVn	54187.7679	0.0002	II	R	
G2533-1563 CVn	54130.9201	0.0002	II	R	
G2534-1121 CVn	54180.8174	0.0002	I	R	
G2537-0520 CVn	54217.8755	0.0003	I	R	
V0680 Cyg	54357.833	0.003	II	BVR	
V0680 Cyg	54360.8332	0.0003	I	BVR	
V0700 Cyg	54210.9659	0.0004	I	R	
V0841 Cyg	54352.7540	0.0001	I	R	
V1191 Cyg	54440.5940	0.0002	II	R	
V1918 Cyg	54220.9430	0.0002	II	R	
V2282 Cyg	54225.9364	0.0003	II	R	
BV Dra	54220.7367	0.0002	II	B	
BW Dra	54220.7163	0.0002	II	B	
FU Dra	54187.8788	0.0003	II	R	
RW Gem	54155.7573	0.0001	I	R	
AC Gem	54381.9507	0.0002	I	R	
BD Gem	54127.6834	0.0002	I	R	
V0345 Gem	54155.6440	0.0003	I	B	
V0719 Her	54233.739	0.001	II	c	
V0728 Her	54233.8613	0.0001	II	R	
V1055 Her	54229.8543	0.0002	I	R	
V1073 Her	54211.8555	0.0001	II	R	
G3092-1291 Her	54219.8302	0.0003	I	R	
V0390 Hya	54130.7676	0.0001	I	R	
V0342 Lac	54403.7319	0.0002	I	R	
SW Lyn	54378.9910	0.0001	I	V	
SW Lyn	54440.8222	0.0002	I	R	
DZ Lyn	54405.9692	0.0003	II	R	
AH Lyr	54403.6053	0.0003	I	R	
V0411 Lyr	54218.899	0.001	I	c	
V0574 Lyr	54354.7252	0.0001	II	R	
V0714 Mon	54153.6300	0.0003	II	R	
DM Peg	54355.766	0.001	I	R	
DK Per	54441.599	0.001	II	R	
IU Per	54354.8190	0.0001	I	R	

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
KR Per	54442.7613	0.0001	I	R	
KW Per	54443.673	0.001	I	R	
V0432 Per	54131.6044	0.0005	II	VRI	
V0432 Per	54131.7959	0.0002	I	VRI	
V0432 Per	54133.7124	0.0002	I	VRI	
V0432 Per	54134.7123	0.0001	II	VRI	
V0432 Per	54185.6516	0.0005	II	R	
V0432 Per	54418.7038	0.0002	II	VRI	
V0579 Per	54432.747	0.001	II	B	
RV Psc	54423.8347	0.0002	I	R	
AU Ser	54225.8558	0.0001	II	R	
OU Ser	54148.0127	0.0002	I	V	
RZ Tau	54353.9033	0.0003	I	R	
SV Tau	54455.6836	0.0004	II	R	
AH Tau	54126.6057	0.0001	II	R	
AM Tau	54440.8236	0.0002	I	R	
CR Tau	54415.7904	0.001	I	c	
CU Tau	54406.760	0.001	I	R	
EQ Tau	54355.8789	0.0002	II	R	
V0781 Tau	54382.9345	0.0005	I	R	
UX UMa	54126.8701	0.0003	I	c	
XY UMa	54442.8964	0.0001	I	R	
ZZ UMa	54455.9259	0.0001	I	R	
AA UMa	54154.8989	0.0002	I	R	
BM UMa	54419.0613	0.0002	II	c	
HH UMa	54418.9558	0.0003	I	R	
G3449-0688 UMa	54435.9180	0.0001	I	c	
BG Vul	54415.6871	0.0003	II	c	
GI Vul	54217.964	0.001	II	R	

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Thanks are due to Environment Canada for the website satellite views (see reference below) that were essential in predicting clear times for observing runs in this cloudy locale. Thanks are also due to Attila Danko for his 'Clear Sky Clock', (see below). This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France.

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Satellite Images for North America, `http://gfx.weatheroffice.ec.gc.ca/`

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DETECTION OF INCREASE IN THE OPTICAL LIGHT OF Be/X-RAY BINARY SYSTEM GRO J2058+42

KIZILOĞLU, Ü.; KIZILOĞLU, N.; BAYKAL, A.; YERLİ, S. K.; ÖZBEY, M.

[1] Physics Dept., Middle East Technical University, Ankara 06531, Turkey

[2] e-mail: umk, nil, altan, sinan, mehtap@astroa.physics.metu.edu.tr

The Be/X-ray binary GRO J2058+42 (CXOU J205847.5+414637) has an orbital period of 55.03 days (Corbet et al., 1997; Wilson et al., 2005). The optical counterpart of GRO J2058+42 was discovered by Reig et al. (2004). Its spectral type is O9.5-B0 IV-V (Wilson et al., 2005) with V=14.9 mag and R=14.2 mag. The spectra obtained by Reig et al. and Wilson et al. have shown a double peak Hα emission line which was a signature of a Be star. They have calculated a mean equivalent width (EW) of 4.5 Å. The Be star has a disk in its equatorial plane which can give rise to X-ray outburst of its companion, the neutron star. When material from the disk of the Be star accretes to the neutron star X-rays are produced. This system is in X-ray quiescent state since 2002 according to the X-ray observations of RXTE/ASM[1].

The results of our optical observations of this system between JD 2453500 and 2454000 were published in Kızıloğlu et al. (2007). A non-radial pulsation with a frequency of 2.404 d^{-1} has been found in our light curve from period analysis of the Be star. No long term variability has been observed. Therefore we expected a nearly stable disk around the Be star. We have calculated the EW of the Hα emission line as 2.31 Å.

In this study further optical photometric and spectroscopic observations of this Be/X-ray system are presented. The photometric observations were obtained by using 45 cm robotic reflecting telescope (ROTSE IIId, located at Bakırlıtepe, Turkey[2]) which operates without filters (Akerlof et al., 2003). The telescope was equipped with a 2048×2048 pixel CCD with pixel size of 3.″3. Data reduction procedures are the same as in Baykal et al. (2005) and Kızıloğlu et al. (2007). The optical spectroscopic observations were obtained using medium resolution spectrometer TFOSC (TUBİTAK Faint Object Spectrometer and Camera; installed on the RTT150, 1.5 m Russian-Turkish telescope located at Bakırlıtepe). The camera is equipped with 2048×2048, 15 micron pixel CCD. Grism G8 (5800-8300 Å) with average dispersion of 1.1 Å per pixel was used.

Figure 1 shows the differential light curve of the optical counterpart to GRO J2058+42. We adopted three nearby stars as the reference stars (Table 1) and we used their mean magnitudes in obtaining the differential magnitudes (Kızıloğlu et al., 2007). The X-ray light curve in the energy band 5-12 keV is also plotted in the same figure to see if there is any correlation with the optical light curve. However, no correlation was observed

[1] http://xte.mit.edu
[2] http://www.tug.tubitak.gov.tr

between the optical and X-ray light curves after an increase of the optical brightness. The system is in X-ray quiescent phase in spite of the presence of the Be disk. Type I X-ray outbursts which are expected to occur at every periastron passage of neutron star were not observed after 2002. If the Be disk is truncated at a resonance radius which is smaller than the Roche Lobe radius, then Type I outbursts are not seen since there is no mass transfer to the neutron star from the disk of the Be star (Okazaki and Negueruela, 2001).

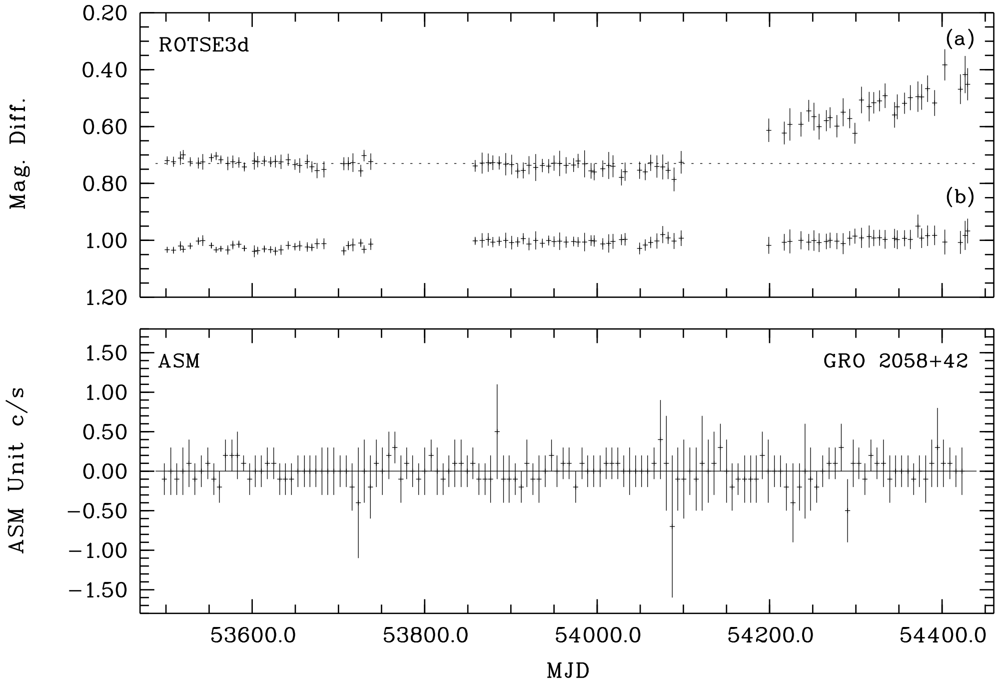

Figure 1. ROTSEIIId weekly averaged differential light curve of the Be/X-ray system GRO J2058+42 (CXOU J205847.5+414637) (top panel, a) and weekly averaged mean light curve of reference stars properly offsetted (top panel, b) for the period 2005-2007. X-ray light curve of the system obtained from RXTE/ASM observations (weekly average of 5.0-15.0 keV band light curve) is given in the lower panel. MJD = JD - 2400000.5.

No long-term variability is seen in the optical light curve up to JD 2454100. After JD 2454100 there is an increase in the light output of the system. The change is about 0.3 magnitude. Such an increase is also reflected in the EW of Hα profile, obtained on 2007, June 14. The EW is found to be as 5.4 Å. This value is greater than the previous value of 2.3 Å. We suppose an increase in the disk density after JD 2454100, since Hα EW is related with the disk density of the Be star rather than with its size (Wilson et al., 2005; Negueruela et al., 2001). There is a structural change in the disk of the Be star. The double peaked Hα line profile is shown in Figure 2. The depth of the self absorption is not as deep as in the previously obtained Hα line profiles (Kızıloğlu et al., 2007).

Table 1. CXOU J205847.5+414637 and the reference stars.

Star	$\alpha(J2000)$	$\delta(J2000)$	USNO.A2.0
J205847.5+414637	$20^h58^m47\overset{s}{.}54$	$+41°46'37\overset{''}{.}3$	14.1
Star 1	$20^h58^m53\overset{s}{.}53$	$+41°46'28\overset{''}{.}0$	13.9
Star 2	$20^h58^m45\overset{s}{.}85$	$+41°45'06\overset{''}{.}0$	13.9
Star 3	$20^h59^m05\overset{s}{.}50$	$+41°44'20\overset{''}{.}1$	14.1

After JD 2454100, there are less observational data since we intended to follow only long-term variations. Nevertheless, we performed period analysis for the increasing part of the light curve, but we did not detect any periodic behavior. Folding the same data with the known pulsation periods of 0.4162 and 0.4218 d did not reveal strong indications for the presence of the pulsations.

An increase in the disk density may enhance the optical brightness of the system. A change of 0.3 mag corresponds to a disk luminosity of about 10^{36} erg/s with T_{disk}=10000 K and R_{disk}= $4R_{star}$ assuming a cylindrical disk with a vertical height of 0.1 R_{star} for the Hα emitting region (Hanuschik et al., 1993). Rivinius et al. (2003) pointed out that enhancement in brightness is associated with mass loss from a Be star which is induced by non-radial pulsations. Such a mass loss will increase the disk density. We also know from our previous study that GRO J2058+42 has at least one non-radial pulsation mode.

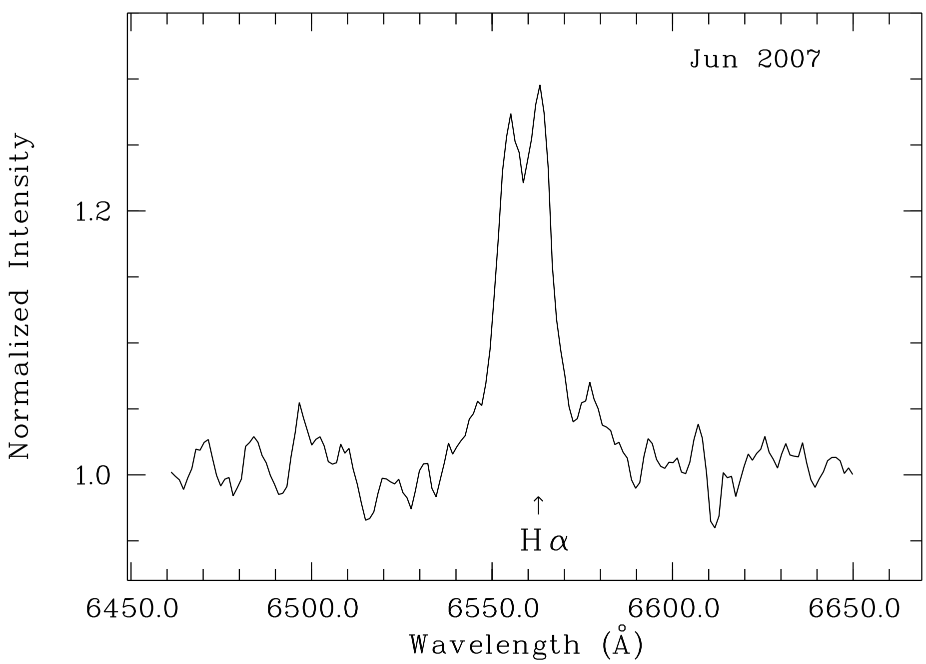

Figure 2. Hα profile observed on 2007 June 14 (JD 2454266.498).

It is also possible that the disk begins its precession with a sudden change in the structure of the Be disk. As the revealed part of the disk gets larger due to precession we get more light from the system and the Hα EW will also be larger than our previous value (Kızıloğlu et al. 2007).

Further ROTSEIIId observations are needed to explain the long term variations. Collaborations are welcomed.

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PHOTOMETRIC SEQUENCES AND ASTROMETRIC POSITIONS OF NOVA Vul 2007 N.2 AND NOVA Cyg 2008

HENDEN, ARNE[1]; MUNARI, ULISSE[2]

[1] AAVSO, American Association of Variable Star Observers, 49 Bay State Road, Cambridge, MA 02138, USA

[2] INAF Osservatorio Astronomico di Padova, Sede di Asiago, I-36032 Asiago (VI), Italy

Nova Vul 2007 N.2 (= V459 Vul) was discovered by H. Kaneda at ∼8.7 mag on Dec 25.35 UT (cf. Nakano, 2007). Spectroscopic confirmation was provided by Yamaoka (2007) and Munari et al. (2007). The latter reported a peak brightness $V = 7.58$ and $B-V = +1.10$ on Dec. 27.75 UT. At that time the spectrum was characterized by strong absorptions, with feeble emission components visible only in Hα and OI 7772 Å. A day later, the absorption spectrum weakened remarkably and a rich and strong emission line spectrum appeared, typical of novae soon after maximum.

Nova Cyg 2008 (= V2468 Cyg) was also discovered by H. Kaneda, at ∼8.2 mag on Mar 7.80 UT (cf. Nakano, 2008), and spectroscopic confirmation was provided by Nogami et al. (2008). On Mar 8.8 UT, they observed a rich emission line spectrum, with velocities and P-Cyg profiles typical of novae close to maximum brightness.

In this note we present a $BVR_\mathrm{C}I_\mathrm{C}$ photometric sequence around both novae, optimized for CCD observations and their color corrections. To calibrate the sequences, we obtained CCD photometry with the Sonoita Research Observatory 0.35-m robotic telescope on several distinct photometric nights, using $BVR_\mathrm{C}I_\mathrm{C}$ filters and an SBIG STL-1001E CCD camera. Pixel size is $1''\!.25$/pix and the field of view is $20'\times20'$. Observations on each photometric night included following an extinction star from low to high airmass, along with $BVR_\mathrm{C}I_\mathrm{C}$ exposures of Landolt standard fields (Landolt, 1983, 1992). The photometric sequences are presented in Figures 1 and 2.

Some very red stars are included in these sequences for the purpose of extending over a wide color range the determination of the transformation coefficients. When intrinsic, such red colors are generally associated to variable cool stars. However, both fields suffer from large reddenings. In fact, both novae at maximum displayed colors reddened by $E(B-V) \geq 0.6$ and in both cases blue field stars are missing. Thus, the very red stars included in the sequences are such at least in part because of the large reddenings and not necessarily because they are intrinsically very cool. Nevertheless, these stars have not been observed sufficiently often to guard against possible variability.

Astrometry was performed using SLALIB (Wallace, 1994) linear plate transformation routines in conjunction with the UCAC2 reference catalog. Errors in coordinates were less than 0.1 arcsec in both coordinates, referred to the mean coordinate zero point of the reference stars in each field.

The coordinates we derived for Nova Vul 2007 N.2 are $\alpha_{J2000} = 19^h48^m08^s\!.866$ ($\pm 0^s\!.026$), $\delta_{J2000} = +21^\circ15'26''\!.67$ ($\pm 0''\!.027$), close to the coordinates reported by Kaneda (2007) at position end figures $08^s\!.89$ and $26''\!.8$. Within 0.1 arcsec of this position there is the very faint star USNO-B1.0 1112-0430634, detected only on red POSS-II plates at $R = 20$ mag and with no counterpart in the 2MASS catalog. Its position end figures are $08^s\!.87$ and $26''\!.8$ (1 arcsec error). If this was the progenitor, the amplitude of the outburst in the B band exceeded 12.5 mag.

Our coordinates for Nova Cyg 2008 are: $\alpha_{J2000} = 19^h58^m33^s\!.36$ ($\pm 0^s\!.18$), $\delta_{J2000} = +29^\circ52'06''\!.6$ ($\pm 0''\!.31$), close to the coordinates reported by Nakano (2008) at position end figures $33^s\!.39$ and $06''\!.5$. Three arcsec away there is the very faint star USNO-B1 1198-0459968 ($R = 18$ mag) at position end figures $33^s\!.16$ and $06''\!.4$ (1 arcsec error), visible only on POSS-II red plates and not on blue ones,with no counterpart in the 2MASS catalog. If this star was the progenitor, the amplitude of the outburst was larger than 12 mag in the B band.

We would like to thank J. Gross, W. Cooney and D. Terrell for their help in setting up the SRO observations and relinquishing their observing time.

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Nova Vul 2007 N.2 $\alpha_{\rm J2000} = 19\ 48\ 08.87$ $\delta_{\rm J2000} = +21\ 15\ 26.7$

	α_{J2000}	(±")	δ_{J2000}	(±")	N	V	(±)	B–V	(±)	V–$R_{\rm C}$	(±)	$R_{\rm C}$–$I_{\rm C}$	(±)	V–$I_{\rm C}$	(±)
a	297.053417	0.019	+21.302438	0.018	3	12.963	0.015	0.700	0.009	0.411	0.020	0.436	0.018	0.849	0.007
b	297.033846	0.019	+21.283494	0.012	3	13.009	0.010	1.764	0.020	0.973	0.021	0.902	0.018	1.868	0.039
c	297.047833	0.032	+21.266738	0.021	3	13.278	0.015	1.965	0.025	1.133	0.015	1.048	0.030	2.173	0.043
d	297.022789	0.023	+21.284726	0.010	3	13.477	0.014	0.776	0.013	0.462	0.017	0.481	0.020	0.945	0.008
e	297.063279	0.019	+21.245797	0.023	3	13.898	0.015	0.532	0.008	0.297	0.020	0.362	0.020	0.665	0.005
f	297.015996	0.013	+21.279974	0.019	3	14.021	0.020	0.571	0.007	0.301	0.017	0.355	0.022	0.662	0.012
g	297.074160	0.059	+21.236478	0.016	3	14.091	0.016	1.485	0.016	0.838	0.021	0.834	0.018	1.671	0.007
h	297.039547	0.046	+21.298807	0.030	3	14.137	0.015	0.815	0.015	0.479	0.018	0.495	0.019	0.976	0.005
i	297.043746	0.078	+21.220482	0.115	3	14.573	0.017	0.912	0.021	0.514	0.022	0.492	0.017	1.003	0.006
j	297.008875	0.042	+21.236568	0.014	3	14.927	0.021	0.776	0.026	0.460	0.016	0.539	0.024	1.007	0.017
l	297.019181	0.085	+21.211302	0.047	3	15.542	0.015	1.053	0.063	0.609	0.030	0.586	0.018	1.193	0.019
α	297.168824	0.000	+21.425196	0.038	3	10.583	0.017	0.238	0.023	0.083	0.045			0.384	0.013
β	296.853879	0.035	+21.288030	0.007	3	10.715	0.044	0.166	0.045	0.115	0.028	0.283	0.033	0.407	0.030
γ	296.984049	0.037	+21.427287	0.016	3	11.096	0.018	0.994	0.011	0.391	0.061	0.406	0.032	0.799	0.032
δ	296.940301	0.028	+21.315796	0.008	3	11.490	0.015	0.357	0.016	0.177	0.045	0.239	0.040	0.422	0.011
ϵ	297.090971	0.013	+21.172636	0.020	3	11.952	0.015	0.338	0.007	0.174	0.017	0.232	0.021	0.411	0.010

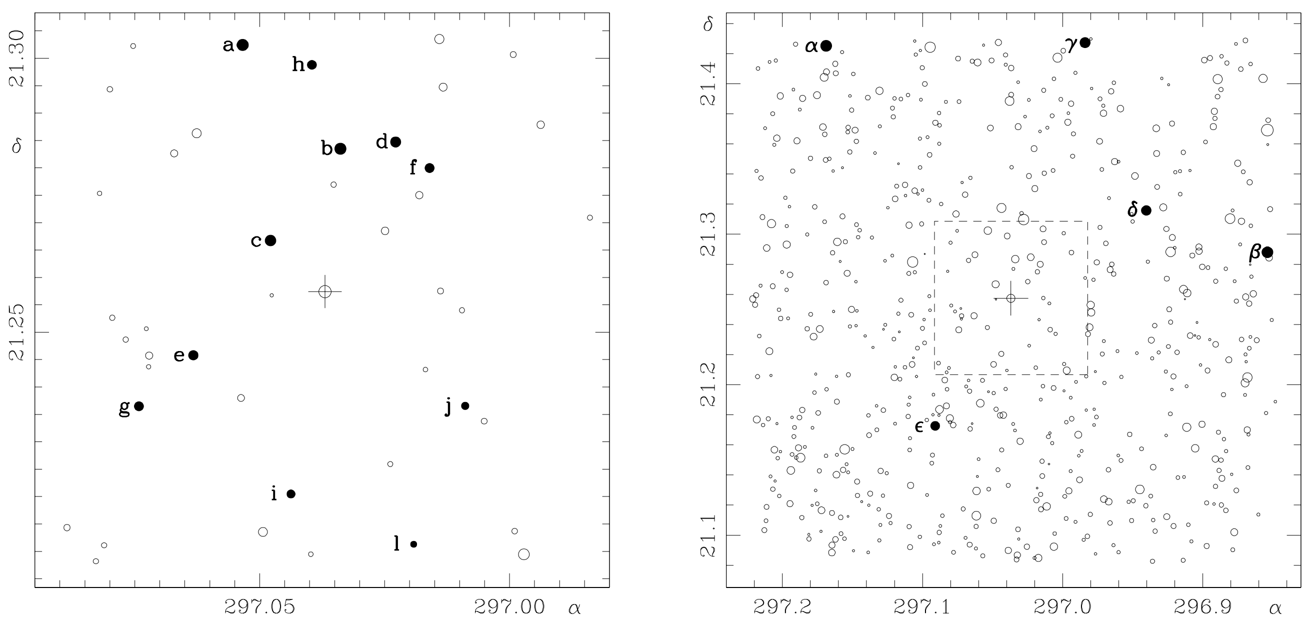

Figure 1. $BVR_{\rm C}I_{\rm C}$ photometric comparison sequence around Nova Vul 2007 N.2. The cross indicates the nova. N is the number of nights in which the given star has been measured in the given band. The error in α and δ are in arcsec. The panel on the right covers a $20'\times20'$ area centered on the nova and shows stars down to V=17.0. The dashed $6'\times6'$ area is zoomed in on the left panel.

Nova Cyg 2008	$\alpha_{\rm J2000}$ = 19 58 33.36	$\delta_{\rm J2000}$ = +29 52 06.6

	α_{J2000}	(±")	δ_{J2000}	(±")	N	V	(±)	B–V	(±)	V–$R_{\rm C}$	(±)	$R_{\rm C}$–$I_{\rm C}$	(±)	V–$I_{\rm C}$	(±)
a	299.608794	0.037	+29.838600	0.041	3	11.610	0.012	0.599	0.059	0.373	0.040	0.297	0.034	0.664	0.051
b	299.614562	0.052	+29.845833	0.015	3	11.670	0.009	0.205	0.013	0.142	0.015	0.107	0.024	0.247	0.033
c	299.678984	0.049	+29.840657	0.017	3	12.266	0.004	1.247	0.009	0.808	0.016	0.776	0.040	1.581	0.055
d	299.684122	0.069	+29.833979	0.015	3	12.620	0.010	0.931	0.016	0.548	0.016	0.407	0.022	0.942	0.029
e	299.620718	0.055	+29.870303	0.023	3	13.052	0.010	0.396	0.010	0.259	0.015	0.231	0.024	0.488	0.032
f	299.695823	0.054	+29.860969	0.014	3	13.161	0.007	0.768	0.010	0.459	0.014	0.366	0.023	0.817	0.028
g	299.595427	0.012	+29.906124	0.015	3	13.375	0.010	1.779	0.026	1.004	0.019	0.895	0.023	1.888	0.029
h	299.681125	0.052	+29.855634	0.022	3	13.884	0.013	0.448	0.018	0.280	0.018	0.241	0.027	0.517	0.038
i	299.622727	0.063	+29.865338	0.047	3	14.014	0.011	1.451	0.023	0.850	0.020	0.765	0.023	1.606	0.033
j	299.647902	0.068	+29.875127	0.023	3	14.366	0.011	0.548	0.019	0.379	0.016	0.350	0.035	0.727	0.037
l	299.590166	0.082	+29.898026	0.036	3	14.553	0.013	1.266	0.034	0.743	0.018	0.659	0.023	1.394	0.033

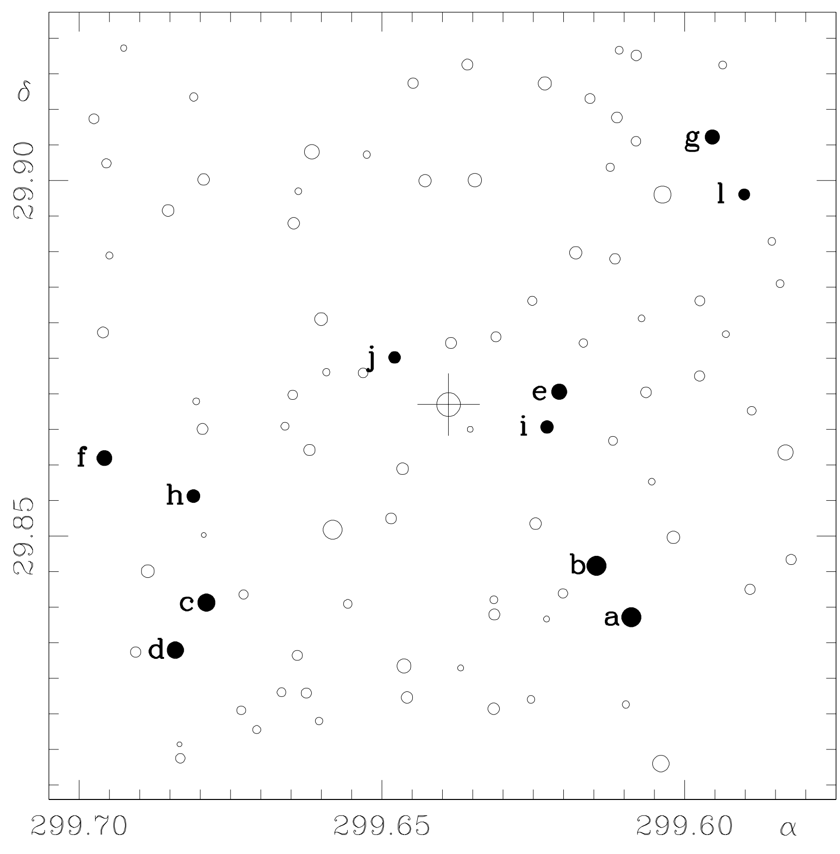

Figure 2. $BVR_{\rm C}I_{\rm C}$ photometric comparison sequence around Nova Cyg 2008. The cross indicates the nova. N is the number of nights in which the given star has been measured in the given band. The error in α and δ are in arcsec. The panel covers a $6'\times6'$ area centered on the nova and shows stars down to V=17.0. Star b is HD 33314.

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THE GEOS RR Lyr SURVEY

Eighth List of Maxima of RR Lyr Stars Observed by the Automated Telescopes TAROT

(GEOS Circular RR 33)

LE BORGNE, J. F.[1,2]; KLOTZ, A.[3]; BOËR, M.[4]

[1] GEOS (Groupe Européen d'Observations Stellaires), 23 Parc de Levesville, 28300 Bailleau l'Evêque, France

[2] LATT, Observatoire Midi-Pyrénées, Université de Toulouse, Toulouse, France

[3] CESR, Observatoire Midi-Pyrénées, Université de Toulouse, Toulouse, France

[4] Observatoire de Haute-Provence, France

We present here the eighth list of light maxima of RR Lyrae stars from the GEOS RR Lyr Survey (Le Borgne et al., 2007), a GEOS program (`http://www.upv.es/geos/`) (Boninsegna et al., 2002) of automated observations of RR Lyr stars started in January 2004.

We are using the 25-cm automatic telescopes TAROT (`http://tarot.obs-hp.fr`) (Boër et al., 2001; Bringer et al., 1999). One of the telescopes is located in the northern hemisphere in Calern Observatory (Observatoire de la Côte d'Azur, Nice University, France). A second identical telescope in the southern hemisphere is located in ESO La Silla Observatory, Chile. Images are obtained by 2048×2048 Marconi 42-40 thin back illuminated CCDs. Field of view of both telescopes is $1.86^\circ \times 1.86^\circ$. Data reduction, from bias subtraction and flatfielding to photometry using SExtractor (Bertin & Arnouts, 1996), is performed automatically. The aim of this legacy project for the study of period variations of RR Lyr stars is to monitor maxima of light of these stars in order to feed the GEOS RR Lyr web database (`http://dbRR.ast.obs-mip.fr`).

The present list contains 727 maxima observed with no filter mainly between July and December 2007 (Table 1). The maxima are determined by fitting a polynomial function on the data points. The uncertainties on individual maxima are estimated from the data sampling of each maximum. The nominal sampling (two consecutive 30-s exposures taken every 10 minutes on a time baseline of 2 hours centered around the predicted maximum time) may be altered by local events (weather or telescope operation). This results uncertainties from 0.002 to 0.010 day. For a well observed star, the mean uncertainty on maxima is about 0.003 day (4.3 minutes). The $O-C$'s are computed with the GCVS elements (Kholopov et al., 1985) and are displayed in Table 1 in column '$O-C$'. The column 'E' contains the cycle number. Note that this cycle number takes into account the shifts induced by the elements when the period of the elements is very different from the actual one, the absolute value of $O-C$ becoming greater than 1 period. When no elements are available in the GCVS, the reference of the elements, if exists, is given as a footnote of Table 1. The fifth column in Table 1 gives the abbreviation of the name of the observatory where the star was observed.

Table 1: maxima of RR Lyrae stars

Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.*	Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.*
SW And	54310.482±0.003	−0.769	81800.	C	TY Aps	54326.607±0.002	0.048	29102.	LS
SW And	54321.542±0.005	−0.766	81825.	C	TY Aps	54330.620±0.002	0.047	29110.	LS
SW And	54357.363±0.002	−0.769	81906.	C	VX Aps	54325.599±0.002	−0.005	41451.	LS
SW And	54376.380±0.002	−0.770	81949.	C	VX Aps	54339.657±0.003	0.001	41480.	LS
SW And	54390.533±0.002	−0.770	81981.	C	XZ Aps	54292.580±0.003	−0.214	43541.	LS
SW And	54413.531±0.002	−0.771	82033.	C	XZ Aps	54329.576±0.002	−0.226	43604.	LS
SW And	54433.433±0.003	−0.771	82078.	C	BS Aps	54292.505±0.003	0.003	28963.	LS
SW And	54438.297±0.002	−0.773	82089.	C	BS Aps	54317.582±0.005	0.030	29006.	LS
SW And	54449.354±0.003	−0.773	82114.	C	CK Aps	54283.571±0.002	−0.178	28217.	LS
XX And	54340.521±0.002	0.228	21104.	C	CK Aps	54284.818±0.002	−0.178	28219.	LS
XX And	54351.366±0.003	0.232	21119.	C	DD Aps	54317.550±0.003	0.082	27140.	LS
XX And	54358.589±0.003	0.228	21129.	C	DI Aps	54283.704±0.002	−0.024	35116.	LS
XX And	54366.542±0.005	0.230	21140.	C	DI Aps	54319.529±0.003	−0.027	35185.	LS
XX And	54379.550±0.005	0.229	21158.	C	EL Aps	54283.789±0.003	−0.174	45355.	LS
XX And	54385.332±0.003	0.229	21166.	C	EL Aps	54322.643±0.005	−0.161	45422.	LS
XX And	54395.451±0.003	0.230	21180.	C	EX Aps	54286.849±0.004	0.013	55857.	LS
XX And	54405.567±0.003	0.227	21194.	C	EX Aps	54341.579±0.005	0.015	55973.	LS
XX And	54408.461±0.003	0.230	21198.	C	EX Aps	54367.529±0.005	0.016	56028.	LS
XX And	54419.305±0.003	0.233	21213.	C	LU Aps	54283.863±0.005	0.196	22500.	LS
XX And	54432.310±0.002	0.228	21231.	C	SW Aqr	54316.408±0.003	0.000	63616.	C
XX And	54434.488±0.005	0.238	21234.	C	SW Aqr	54343.510±0.005	0.003	63675.	C
XX And	54437.368±0.007	0.227	21238.	C	SW Aqr	54349.480±0.004	0.002	63688.	C
AT And	54300.456±0.005	−0.006	19382.	C	SW Aqr	54355.449±0.002	0.000	63701.	C
AT And	54337.480±0.005	0.003	19442.	C	SW Aqr	54356.370±0.005	0.002	63703.	C
AT And	54366.465±0.002	−0.007	19489.	C	SW Aqr	54372.439±0.002	−0.004	63738.	C
AT And	54368.324±0.005	0.001	19492.	C	SX Aqr	54356.388±0.005	−0.114	27179.	C
AT And	54387.442±0.004	−0.005	19523.	C	SX Aqr	54359.604±0.003	−0.113	27185.	LS
AT And	54405.335±0.005	−0.003	19552.	C	SX Aqr	54371.393±0.003	−0.109	27207.	C
AT And	54406.570±0.006	−0.002	19554.	C	SX Aqr	54401.389±0.002	−0.113	27263.	C
AT And	54408.426±0.003	0.004	19557.	C	TZ Aqr	54317.470±0.005	0.019	29357.	C
AT And	54411.506±0.004	−0.001	19562.	C	TZ Aqr	54319.748±0.003	0.012	29361.	LS
AT And	54432.477±0.003	−0.005	19596.	C	TZ Aqr	54327.742±0.002	0.009	29375.	LS
AT And	54447.286±0.004	−0.002	19620.	C	TZ Aqr	54329.459±0.002	0.013	29378.	C
CI And	54337.563±0.005	0.108	38412.	C	TZ Aqr	54345.449±0.005	0.009	29406.	C
CI And	54339.502±0.002	0.108	38416.	C	TZ Aqr	54378.582±0.005	0.013	29464.	LS
CI And	54340.469±0.002	0.106	38418.	C	WZ Aqr	54289.817±0.004	0.068	67878.	LS
CI And	54342.412±0.003	0.110	38422.	C	WZ Aqr	54351.602±0.004	0.071	68003.	LS
CI And	54354.526±0.002	0.106	38447.	C	YZ Aqr	54358.666±0.002	0.053	34414.	LS
CI And	54356.464±0.003	0.105	38451.	C	AA Aqr	54325.712±0.003	−0.118	55145.	LS
CI And	54386.516±0.002	0.104	38513.	C	AA Aqr	54328.757±0.003	−0.117	55150.	LS
CI And	54407.356±0.003	0.102	38556.	C	AA Aqr	54361.636±0.004	−0.118	55204.	LS
CI And	54416.565±0.003	0.101	38575.	C	AA Aqr	54383.555±0.002	−0.119	55240.	LS
CI And	54422.3826±0.0018	0.1018	38587.	C	BN Aqr	54299.801±0.002	0.554	34977.	LS
CI And	54423.348±0.003	0.098	38589.	C	BN Aqr	54330.801±0.002	0.558	35043.	LS
CI And	54432.558±0.002	0.098	38608.	C	BN Aqr	54344.420±0.003	0.557	35072.	C
CI And	54435.466±0.002	0.098	38614.	C	BN Aqr	54347.709±0.006	0.558	35079.	LS
CI And	54438.373±0.003	0.097	38620.	C	BN Aqr	54375.420±0.002	0.560	35138.	C
DR And	54351.476±0.002	−0.019	30422.	C	BN Aqr	54380.586±0.005	0.560	35149.	LS
DR And	54368.360±0.003	−0.028	30452.	C	BO Aqr	54326.792±0.002	0.141	18307.	LS
DR And	54378.509±0.002	−0.015	30470.	C	BO Aqr	54358.716±0.003	0.141	18353.	LS
DR And	54396.535±0.002	−0.009	30502.	C	BR Aqr	54328.816±0.002	−0.156	34641.	LS
DR And	54405.540±0.003	−0.014	30518.	C	BR Aqr	54329.780±0.002	−0.156	34643.	LS
DR And	54412.290±0.003	−0.022	30530.	C	BR Aqr	54349.539±0.002	−0.154	34684.	C
DR And	54430.313±0.005	−0.018	30562.	C	BR Aqr	54350.499±0.002	−0.158	34686.	C
DR And	54431.449±0.010	−0.009	30564.	C	BR Aqr	54378.455±0.004	−0.151	34744.	C
DR And	54448.3436±0.0015	−0.0075	30594.	C	BR Aqr	54401.589±0.005	−0.147	34792.	LS
TY Aps	54298.501±0.005	0.037	29046.	LS	CP Aqr	54307.463±0.002	−0.110	35440.	C
TY Aps	54319.582±0.002	0.046	29088.	LS	CP Aqr	54326.465±0.002	−0.108	35481.	C

Table 1 (cont.): maxima of RR Lyrae stars

Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.*
CP Aqr	54327.389±0.004	−0.111	35483.	C
CP Aqr	54333.416±0.004	−0.108	35496.	C
CP Aqr	54352.413±0.002	−0.111	35537.	C
CP Aqr	54358.438±0.003	−0.110	35550.	C
CP Aqr	54371.420±0.005	−0.103	35578.	C
CP Aqr	54372.340±0.002	−0.110	35580.	C
DN Aqr	54328.752±0.003	0.045	40873.	LS
DN Aqr	54335.724±0.006	0.045	40884.	LS
FX Aqr	54320.756±0.003	0.120	15449.	LS
GP Aqr	54328.693±0.003			LS
GP Aqr	54352.580±0.010			LS
GP Aqr	54383.390±0.008			C
HH Aqr	54336.635±0.005			LS
AA Aql	54323.643±0.003	0.033	82856.	LS
AA Aql	54325.456±0.003	0.037	82861.	C
AA Aql	54362.356±0.005	0.034	82963.	C
V341 Aql	54288.447±0.003	0.031	22650.	C
V341 Aql	54292.493±0.005	0.031	22657.	C
V341 Aql	54330.639±0.002	0.027	22723.	LS
V341 Aql	54354.341±0.003	0.030	22764.	C
V341 Aql	54358.386±0.005	0.029	22771.	C
S Ara	54327.692±0.004	0.174	29156.	LS
CZ Ara	54286.700±0.005	−0.156	37518.	LS
CZ Ara	54320.545±0.003	−0.159	37565.	LS
X Ari	54386.636±0.002	0.331	25805.	C
X Ari	54394.452±0.005	0.333	25817.	C
X Ari	54396.406±0.003	0.334	25820.	C
X Ari	54407.478±0.005	0.337	25837.	C
X Ari	54411.383±0.002	0.335	25843.	C
X Ari	54416.593±0.005	0.336	25851.	C
X Ari	54431.569±0.003	0.335	25874.	C
X Ari	54435.476±0.002	0.336	25880.	C
X Ari	54450.453±0.004	0.336	25903.	C
TZ Aur	54383.520±0.002	0.013	88035.	C
TZ Aur	54408.586±0.002	0.012	88099.	C
TZ Aur	54447.362±0.002	0.012	88198.	C
BH Aur	54370.527±0.002	−0.003	25475.	C
BH Aur	54385.581±0.005	0.000	25508.	C
BH Aur	54397.436±0.002	−0.003	25534.	C
BH Aur	54408.386±0.002	0.001	25558.	C
BH Aur	54411.577±0.002	−0.001	25565.	C
BH Aur	54452.621±0.004	−0.005	25655.	C
ST Boo	54287.489±0.005	0.096	56414.	C
ST Boo	54292.467±0.002	0.096	56422.	C
U Cae	54427.653±0.002	−0.107	47912.	LS
U Cae	54432.696±0.002	−0.102	47924.	LS
U Cae	54440.6681±0.0018	−0.1056	47943.	LS
U Cae	54443.604±0.002	−0.108	47950.	LS
U Cae	54445.7019±0.0015	−0.1094	47955.	LS
U Cae	54448.6388±0.0015	−0.1110	47962.	LS
U Cae	54450.7393±0.0010	−0.1095	47967.	LS
U Cae	54453.682±0.002	−0.105	47974.	LS
U Cae	54463.758±0.003	−0.104	47998.	LS
U Cae	54464.5965±0.0016	−0.1055	48000.	LS
U Cae	54466.6925±0.0015	−0.1085	48005.	LS
AH Cam	54370.415±0.003	−0.396	42419.	C
AH Cam	54378.529±0.003	−0.394	42441.	C
AH Cam	54387.346±0.005	−0.427	42465.	C
AH Cam	54395.464±0.005	−0.421	42487.	C
AH Cam	54419.427±0.003	−0.426	42552.	C
AH Cam	54433.466±0.006	−0.399	42590.	C
AH Cam	54434.571±0.002	−0.400	42593.	C
AH Cam	54436.4042±0.0014	−0.4103	42598.	C
AH Cam	54441.565±0.005	−0.412	42612.	C
AH Cam	54453.362±0.005	−0.414	42644.	C
RW Cnc	54419.542±0.003	0.209	27162.	C
SS Cnc	54419.544±0.0014	0.051	85319.	C
SS Cnc	54448.5627±0.0010	0.0500	85398.	C
TT Cnc	54442.589±0.003	0.105	25731.	C
AN Cnc	54420.624±0.003	0.143	29439.	C
AN Cnc	54438.5495±0.0019	0.1445	29472.	C
AS Cnc	54414.595±0.005	0.349	24637.	C
AS Cnc	54417.687±0.003	0.353	24642.	C
AS Cnc	54445.473±0.005	0.351	24687.	C
AS Cnc	54453.503±0.003	0.353	24700.	C
EZ Cnc [1]	54447.534±0.003	−0.031	13364.	C
EZ Cnc [1]	54454.626±0.002	−0.034	13377.	C
AA CMi	54451.467±0.002	0.055	37527.	C
AA CMi	54465.756±0.003	0.054	37557.	LS
BB CMi	53754.541±0.010	0.112	70909.	C
BB CMi	53758.505±0.010	0.111	70919.	C
IU Car	54410.691±0.005	0.266	17249.	LS
IU Car	54432.810±0.003	0.271	17279.	LS
IU Cas	54321.558±0.002	−0.107	39381.	C
IU Cas	54377.405±0.005	−0.107	39467.	C
IU Cas	54386.500±0.003	−0.104	39481.	C
IU Cas	54397.539±0.003	−0.104	39498.	C
IU Cas	54401.435±0.003	−0.105	39504.	C
IU Cas	54412.474±0.003	−0.105	39521.	C
IU Cas	54418.319±0.007	−0.105	39530.	C
IU Cas	54429.362±0.003	−0.101	39547.	C
IU Cas	54438.449±0.003	−0.105	39561.	C
V363 Cas	54338.388±0.005	0.543	33292.	C
V363 Cas	54339.481±0.003	0.543	33294.	C
V363 Cas	54350.420±0.005	0.551	33314.	C
V363 Cas	54358.624±0.010	0.557	33329.	C
V363 Cas	54370.628±0.005	0.537	33351.	C
V363 Cas	54374.478±0.005	0.561	33358.	C
V363 Cas	54385.410±0.004	0.563	33378.	C
V363 Cas	54387.592±0.004	0.559	33382.	C
V363 Cas	54396.345±0.005	0.567	33398.	C
V363 Cas	54402.339±0.005	0.549	33409.	C
V363 Cas	54415.447±0.010	0.540	33433.	C
V363 Cas	54416.560±0.005	0.560	33435.	C
V363 Cas	54432.398±0.005	0.549	33464.	C
AQ Cep	54102.291±0.002	0.062	39871.	C
RR Cet	54011.768±0.002	0.006	37666.	LS
RR Cet	54021.722±0.002	0.006	37684.	LS
RR Cet	54026.699±0.002	0.005	37693.	LS
RR Cet	54031.677±0.002	0.006	37702.	LS
RR Cet	54036.653±0.002	0.005	37711.	LS
RR Cet	54047.715±0.002	0.006	37731.	LS
RR Cet	54051.587±0.002	0.007	37738.	LS
RR Cet	54358.518±0.002	0.007	38293.	C
RR Cet	54379.533±0.003	0.007	38331.	C
RR Cet	54381.744±0.003	0.006	38335.	LS

Table 1 (cont.): maxima of RR Lyrae stars

Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.*	Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.*
RR Cet	54412.714±0.003	0.007	38391.	LS	DM Cyg	54299.500±0.002	0.061	27907.	C
RR Cet	54419.353±0.004	0.009	38403.	C	DM Cyg	54328.469±0.002	0.060	27976.	C
RR Cet	54435.388±0.002	0.007	38432.	C	DM Cyg	54339.386±0.002	0.060	28002.	C
RR Cet	54440.364±0.003	0.005	38441.	C	DM Cyg	54344.422±0.002	0.058	28014.	C
RU Cet	54402.581±0.003	0.077	24862.	LS	DM Cyg	54365.414±0.002	0.057	28064.	C
RU Cet	54416.657±0.005	0.082	24886.	LS	DM Cyg	54394.3871±0.0015	0.0597	28133.	C
RU Cet	54419.586±0.006	0.080	24891.	LS	DM Cyg	54402.365±0.003	0.060	28152.	C
RX Cet	54351.853±0.006	0.218	24797.	LS	DM Cyg	54415.390±0.005	0.070	28183.	C
RX Cet	54374.807±0.004	0.225	24837.	LS	DU Del	53215.575±0.005	−0.273	42576.	C
RX Cet	54416.688±0.005	0.226	24910.	LS	DX Del	54296.417±0.005	0.060	31588.	C
RZ Cet	54379.680±0.010	−0.150	40095.	LS	DX Del	54330.441±0.002	0.055	31660.	C
RZ Cet	54394.495±0.004	−0.142	40124.	C	DX Del	54374.396±0.002	0.057	31753.	C
RZ Cet	54435.343±0.002	−0.143	40204.	C	DX Del	54375.341±0.005	0.057	31755.	C
RZ Cet	54436.3625±0.0016	−0.1449	40206.	C	DX Del	54400.387±0.003	0.054	31808.	C
UU Cet	54330.707±0.004	−0.129	21651.	LS	DX Del	54401.335±0.002	0.057	31810.	C
UU Cet	54375.552±0.005	−0.134	21725.	LS	VW Dor	54406.664±0.005	−0.083	28088.	LS
UU Cet	54401.621±0.010	−0.126	21768.	LS	VW Dor	54407.801±0.003	−0.087	28090.	LS
UU Cet	54415.555±0.003	−0.132	21791.	LS	RW Dra	54287.477±0.002	0.171	33663.	C
RW Col	54420.804±0.005	−0.243	50285.	LS	RW Dra	54291.454±0.002	0.162	33672.	C
RW Col	54426.803±0.004	−0.065	50296.	LS	XZ Dra	54311.474±0.002	−0.104	25988.	C
RW Col	54431.712±0.006	0.081	50305.	LS	XZ Dra	54312.423±0.002	−0.108	25990.	C
RW Col	54443.708±0.003	−0.096	50328.	LS	XZ Dra	54339.580±0.004	−0.111	26047.	C
RX Col	54402.718±0.005	−0.033	43078.	LS	XZ Dra	54342.436±0.003	−0.114	26053.	C
RX Col	54427.658±0.005	−0.043	43120.	LS	XZ Dra	54350.539±0.005	−0.112	26070.	C
RX Col	54456.765±0.006	−0.044	43169.	LS	BC Dra	53440.587±0.010	0.081	15512.	C
RX Col	54465.667±0.003	−0.053	43184.	LS	BC Dra	53525.496±0.010	0.080	15630.	C
RY Col	54379.776±0.010	−0.169	41911.	LS	BC Dra	53941.410±0.010	0.079	16208.	C
RY Col	54402.787±0.004	−0.143	41959.	LS	BC Dra	53961.557±0.010	0.078	16236.	C
RY Col	54425.763±0.003	−0.152	42007.	LS	BC Dra	54295.450±0.005	0.088	16700.	C
RY Col	54440.596±0.002	−0.164	42038.	LS	BC Dra	54344.382±0.005	0.089	16768.	C
S Com	54454.674±0.003	−0.100	23526.	C	BC Dra	54372.455±0.014	0.098	16807.	C
WW CrA	54328.607±0.004	−0.035	41184.	LS	BC Dra	54400.502±0.006	0.082	16846.	C
V413 CrA	54286.712±0.005	0.044	21696.	LS	BC Dra	54411.296±0.008	0.082	16861.	C
V592 CrA	54340.610±0.005	0.195	39311.	LS	BC Dra	54452.314±0.004	0.084	16918.	C
SW Cru	54283.510±0.005	0.069	86195.	LS	BD Dra	54328.473±0.002	0.745	21311.	C
UY Cyg	54301.439±0.005	0.056	56835.	C	BD Dra	54331.410±0.002	0.737	21316.	C
UY Cyg	54311.530±0.002	0.054	56853.	C	BD Dra	54371.451±0.005	0.722	21384.	C
UY Cyg	54329.469±0.002	0.051	56885.	C	BD Dra	54372.633±0.005	0.726	21386.	C
UY Cyg	54342.370±0.005	0.055	56908.	C	BD Dra	54378.529±0.002	0.731	21396.	C
UY Cyg	54352.461±0.002	0.054	56926.	C	BD Dra	54397.372±0.002	0.725	21428.	C
UY Cyg	54365.360±0.003	0.056	56949.	C	BD Dra	54401.493±0.002	0.722	21435.	C
UY Cyg	54366.477±0.002	0.052	56951.	C	BD Dra	54407.386±0.005	0.725	21445.	C
UY Cyg	54370.402±0.002	0.052	56958.	C	BD Dra	54423.307±0.003	0.741	21472.	C
UY Cyg	54374.327±0.003	0.052	56965.	C	BD Dra	54430.369±0.005	0.735	21484.	C
UY Cyg	54375.449±0.002	0.053	56967.	C	BD Dra	54450.401±0.003	0.739	21518.	C
UY Cyg	54383.297±0.003	0.051	56981.	C	BK Dra	54289.431±0.003	−0.154	48585.	C
UY Cyg	54397.322±0.003	0.058	57006.	C	BK Dra	54331.467±0.002	−0.155	48656.	C
UY Cyg	54416.385±0.003	0.057	57040.	C	BT Dra	54290.411±0.003	−0.014	40015.	C
XZ Cyg [2]	54285.490±0.005	0.001	12248.	C	RT Equ	54318.653±0.004	0.035	36978.	LS
XZ Cyg [2]	54286.420±0.002	−0.002	12250.	C	RT Equ	54322.654±0.003	0.033	36987.	LS
XZ Cyg [2]	54292.480±0.005	−0.008	12263.	C	RT Equ	54325.764±0.005	0.030	36994.	LS
XZ Cyg [2]	54300.409±0.003	−0.011	12280.	C	RT Equ	54326.658±0.002	0.034	36996.	LS
XZ Cyg [2]	54335.417±0.002	0.002	12355.	C	RT Equ	54329.768±0.005	0.031	37003.	LS
XZ Cyg [2]	54350.345±0.002	−0.001	12387.	C	RT Equ	54330.659±0.002	0.032	37005.	LS
XZ Cyg [2]	54357.341±0.002	−0.004	12402.	C	RX Eri	54409.718±0.003	−0.010	55713.	LS
XZ Cyg [2]	54368.541±0.004	−0.002	12426.	C	RX Eri	54416.763±0.003	−0.012	55725.	LS
DM Cyg	54289.422±0.003	0.060	27883.	C	RX Eri	54453.766±0.005	−0.005	55788.	LS
DM Cyg	54294.456±0.002	0.055	27895.	C	RX Eri	54466.686±0.003	−0.005	55810.	LS

Table 1 (cont.): maxima of RR Lyrae stars

Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.*	Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.*
SV Eri	54415.641±0.007	0.748	26426.	LS	VZ Her	54329.423±0.002	0.064	39835.	C
SV Eri	54430.634±0.010	0.752	26447.	LS	AR Her	54284.428±0.006	−1.213	27299.	C
SV Eri	54445.625±0.007	0.753	26468.	LS	AR Her	54292.416±0.005	−1.216	27316.	C
XY Eri	54432.651±0.005	−0.252	53530.	LS	BD Her	54317.432±0.005	0.143	45767.	C
XY Eri	54437.667±0.010	−0.224	53539.	LS	BD Her	54326.413±0.002	0.120	45786.	C
XY Eri	54443.785±0.004	−0.202	53550.	LS	BD Her	54327.354±0.005	0.113	45788.	C
XY Eri	54453.722±0.003	−0.242	53568.	LS	BD Her	54335.442±0.003	0.144	45805.	C
XY Eri	54463.6717±0.0015	−0.2688	53586.	LS	BD Her	54344.431±0.002	0.129	45824.	C
BB Eri	54408.780±0.003	0.227	26056.	LS	BD Her	54345.376±0.002	0.126	45826.	C
BB Eri	54452.662±0.002	0.227	26133.	LS	UU Hor	54357.799±0.002	0.146	46040.	LS
RX For	54368.804±0.005	−0.011	24338.	LS	UU Hor	54379.686±0.004	0.147	46074.	LS
RX For	54374.753±0.004	−0.035	24348.	LS	UU Hor	54406.722±0.005	0.149	46116.	LS
RX For	54410.5831±0.0016	−0.0440	24408.	LS	SZ Hya	54448.6918±0.0016	−0.1870	25630.	C
RX For	54417.752±0.003	−0.043	24420.	LS	BI Hya	54232.577±0.002	0.220	50015.	LS
RX For	54423.738±0.003	−0.030	24430.	LS	DD Hya	54445.489±0.002	−0.143	25410.	C
RX For	54429.731±0.003	−0.010	24440.	LS	DD Hya	54448.503±0.0016	−0.140	25416.	C
RX For	54432.7095±0.0016	−0.0182	24445.	LS	DD Hya	54450.517±0.003	−0.133	25420.	C
RX For	54447.610±0.005	−0.051	24470.	LS	DD Hya	54451.516±0.003	−0.137	25422.	C
SS For	54340.821±0.005	−0.130	31633.	LS	DG Hya	54466.833±0.003	0.051	40585.	LS
SS For	54401.754±0.005	−0.136	31756.	LS	ET Hya	54120.6834±0.0018	0.1390	26548.	LS
SS For	54407.699±0.003	−0.136	31768.	LS	ET Hya	54142.6166±0.0017	0.1356	26580.	LS
SS For	54413.645±0.003	−0.135	31780.	LS	ET Hya	54155.643±0.002	0.137	26599.	LS
SW For	54362.757±0.005	0.415	24907.	LS	GO Hya	54445.658±0.004	−0.078	45246.	C
SW For	54411.785±0.005	0.415	24968.	LS	V Ind	54348.681±0.005	−0.136	29672.	LS
SW For	54428.658±0.005	0.409	24989.	LS	V Ind	54372.657±0.002	−0.140	29722.	LS
SW For	54440.722±0.008	0.417	25004.	LS	CQ Lac	54328.437±0.002	0.126	31114.	C
SX For	54380.746±0.004	0.038	25147.	LS	CQ Lac	54333.395±0.003	0.124	31122.	C
SX For	54408.599±0.004	0.045	25193.	LS	CQ Lac	54339.595±0.004	0.124	31132.	C
SX For	54423.728±0.003	0.040	25218.	LS	CQ Lac	54377.422±0.006	0.128	31193.	C
SX For	54437.653±0.003	0.043	25241.	LS	CQ Lac	54385.483±0.003	0.129	31206.	C
SX For	54463.686±0.006	0.046	25284.	LS	CQ Lac	54395.402±0.002	0.127	31222.	C
RR Gem	54394.578±0.002	−0.374	32815.	C	CQ Lac	54405.3227±0.0017	0.1272	31238.	C
RR Gem	54396.563±0.002	−0.376	32820.	C	CQ Lac	54416.487±0.004	0.131	31256.	C
RR Gem	54417.621±0.003	−0.375	32873.	C	RX Leo	54453.693±0.005	0.093	27773.	C
RR Gem	54446.6187±0.0010	−0.3813	32946.	C	WW Leo	54446.567±0.003	0.035	32453.	C
RR Gem	54449.4007±0.0015	−0.3805	32953.	C	X LMi	54414.684±0.005	0.206	22233.	C
RR Gem	54454.5655±0.0010	−0.3807	32966.	C	X LMi	54438.628±0.003	0.199	22268.	C
RR Gem	54455.3608±0.0015	−0.3801	32968.	C	U Lep	54411.762±0.002	0.042	22459.	LS
GI Gem	54408.531±0.002	0.071	55536.	C	U Lep	54425.718±0.002	0.043	22483.	LS
GI Gem	54450.559±0.003	0.073	55633.	C	U Lep	54428.617±0.005	0.034	22488.	LS
GI Gem	54454.4561±0.0015	0.0703	55642.	C	U Lep	54436.769±0.002	0.046	22502.	LS
RW Gru	54345.714±0.005	−0.137	36317.	LS	U Lep	54450.722±0.003	0.043	22526.	LS
TW Her	54284.460±0.002	−0.011	81930.	C	U Lep	54453.631±0.003	0.045	22531.	LS
TW Her	54290.451±0.003	−0.014	81945.	C	VY Lib	54284.636±0.003	−0.027	24610.	LS
TW Her	54296.447±0.002	−0.012	81960.	C	TT Lyn	54416.630±0.003	−0.034	29736.	C
TW Her	54308.435±0.003	−0.012	81990.	C	TT Lyn	54440.525±0.005	−0.036	29776.	C
TW Her	54310.433±0.002	−0.012	81995.	C	TT Lyn	54447.696±0.002	−0.035	29788.	C
TW Her	54312.431±0.003	−0.012	82000.	C	TT Lyn	54455.462±0.004	−0.035	29801.	C
TW Her	54316.431±0.002	−0.008	82010.	C	TW Lyn	54395.653±0.003	0.054	19452.	C
TW Her	54324.418±0.002	−0.013	82030.	C	TW Lyn	54408.664±0.002	0.055	19479.	C
TW Her	54340.403±0.003	−0.012	82070.	C	TW Lyn	54451.550±0.002	0.056	19568.	C
TW Her	54342.400±0.003	−0.013	82075.	C	TW Lyn	54452.514±0.004	0.056	19570.	C
VX Her	54286.460±0.002	−0.411	71450.	C	TW Lyn	54453.477±0.002	0.055	19572.	C
VX Her	54291.469±0.003	−0.411	71461.	C	TW Lyn	54455.404±0.002	0.055	19576.	C
VZ Her	54288.473±0.002	0.064	39742.	C	RZ Lyr	54285.550±0.005	0.006	25628.	C
VZ Her	54299.480±0.002	0.063	39767.	C	RZ Lyr	54324.387±0.004	−0.011	25704.	C
VZ Her	54307.406±0.002	0.063	39785.	C	RZ Lyr	54325.408±0.003	−0.013	25706.	C
VZ Her	54318.415±0.005	0.064	39810.	C	RZ Lyr	54330.519±0.003	−0.014	25716.	C

Table 1 (cont.): maxima of RR Lyrae stars

Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.*
RZ Lyr	54345.352±0.003	−0.007	25745.	C
RZ Lyr	54366.314±0.002	−0.006	25786.	C
RZ Lyr	54368.361±0.002	−0.004	25790.	C
RZ Lyr	54370.407±0.002	−0.003	25794.	C
RZ Lyr	54371.431±0.005	−0.001	25796.	C
AW Lyr	53217.573±0.004	0.053	56058.	C
AW Lyr	53219.568±0.005	0.058	56062.	C
AW Lyr	53224.538±0.003	0.054	56072.	C
AW Lyr	53245.435±0.005	0.058	56114.	C
AW Lyr	54285.556±0.005	0.017	58205.	C
AW Lyr	54299.475±0.005	0.008	58233.	C
AW Lyr	54308.435±0.005	0.014	58251.	C
AW Lyr	54311.415±0.002	0.009	58257.	C
AW Lyr	54325.345±0.005	0.011	58285.	C
CN Lyr	54285.483±0.005	0.022	23820.	C
CN Lyr	54297.412±0.005	0.021	23849.	C
CN Lyr	54311.394±0.002	0.016	23883.	C
CN Lyr	54318.394±0.005	0.023	23900.	C
CN Lyr	54325.381±0.003	0.016	23917.	C
CN Lyr	54327.434±0.005	0.012	23922.	C
CN Lyr	54339.372±0.003	0.020	23951.	C
CN Lyr	54353.358±0.004	0.019	23985.	C
IO Lyr	54312.449±0.002	−0.028	25460.	C
IO Lyr	54357.461±0.003	−0.032	25538.	C
IO Lyr	54368.422±0.003	−0.036	25557.	C
Z Mic	54299.685±0.006	−0.117	21642.	LS
Z Mic	54323.753±0.010	−0.113	21683.	LS
Z Mic	54329.631±0.004	−0.104	21693.	LS
Z Mic	54373.646±0.009	−0.109	21768.	LS
EM Mus	54296.564±0.002	−0.150	33727.	LS
Y Oct	54292.628±0.003	−0.206	40076.	LS
Y Oct	54296.508±0.004	−0.205	40082.	LS
Y Oct	54327.543±0.003	−0.208	40130.	LS
RS Oct	54318.847±0.004	0.097	39277.	LS
RS Oct	54320.681±0.005	0.099	39281.	LS
RS Oct	54329.846±0.003	0.103	39301.	LS
RV Oct	54283.688±0.005	0.126	68574.	LS
RY Oct	54327.492±0.004	0.117	46746.	LS
RY Oct	54328.617±0.003	0.115	46748.	LS
RY Oct	54408.625±0.005	0.111	46890.	LS
SS Oct	54285.810±0.004	−0.063	42239.	LS
SS Oct	54317.532±0.003	−0.054	42290.	LS
SS Oct	54325.613±0.002	−0.057	42303.	LS
SS Oct	54326.855±0.002	−0.059	42305.	LS
SS Oct	54335.559±0.005	−0.060	42319.	LS
SS Oct	54341.774±0.005	−0.063	42329.	LS
SS Oct	54369.760±0.003	−0.060	42374.	LS
SS Oct	54371.627±0.005	−0.058	42377.	LS
SS Oct	54409.563±0.005	−0.053	42438.	LS
UV Oct	54330.521±0.002	−0.118	36862.	LS
UW Oct	54283.888±0.002	−0.010	44875.	LS
UW Oct	54357.670±0.003	−0.013	45041.	LS
UW Oct	54365.675±0.003	−0.009	45059.	LS
UW Oct	54372.788±0.003	−0.008	45075.	LS
UW Oct	54418.566±0.002	−0.012	45178.	LS
AR Oct	54325.808±0.002	0.000	44422.	LS
AR Oct	54328.569±0.002	0.006	44429.	LS
AR Oct	54334.874±0.005	0.013	44445.	LS
AR Oct	54338.813±0.004	0.016	44455.	LS
V445 Oph	54286.618±0.002	0.019	67359.	LS
V455 Oph	54288.451±0.005	−0.245	27440.	C
V455 Oph	54298.431±0.003	−0.251	27462.	C
V816 Oph	54299.571±0.002	−0.102	47146.	LS
V964 Ori	54415.679±0.002	−0.388	45409.	LS
V964 Ori	54416.689±0.002	−0.387	45411.	LS
V964 Ori	54423.7549±0.0015	−0.3864	45425.	LS
V964 Ori	54465.640±0.002	−0.388	45508.	LS
TX Pav	54284.595±0.002	−0.168	58978.	LS
TX Pav	54285.515±0.002	−0.168	58980.	LS
TX Pav	54330.583±0.002	−0.167	59078.	LS
TX Pav	54342.538±0.005	−0.168	59104.	LS
TY Pav	54285.718±0.002	0.275	17952.	LS
TY Pav	54325.499±0.003	0.274	18008.	LS
TY Pav	54347.523±0.005	0.275	18039.	LS
WY Pav	54285.625±0.005	0.071	46582.	LS
BH Pav	54284.827±0.002	0.202	55014.	LS
BH Pav	54319.655±0.002	0.212	55087.	LS
BH Pav	54339.674±0.003	0.198	55129.	LS
BH Pav	54340.632±0.005	0.203	55131.	LS
BN Pav	54289.755±0.002	−0.027	45759.	LS
BN Pav	54319.811±0.002	−0.031	45812.	LS
BN Pav	54348.733±0.004	−0.035	45863.	LS
BN Pav	54381.627±0.005	−0.037	45921.	LS
BP Pav	54285.551±0.002	0.025	48290.	LS
BP Pav	54319.816±0.002	−0.104	48354.	LS
BP Pav	54320.869±0.005	−0.125	48356.	LS
BP Pav	54345.649±0.005	−0.066	48402.	LS
BP Pav	54372.527±0.005	−0.058	48452.	LS
BP Pav	54373.5822±0.0014	−0.0774	48454.	LS
BP Pav	54382.545±0.003	−0.250	48471.	LS
BP Pav	54412.589±0.005	0.237	48526.	LS
DN Pav	54285.834±0.002	0.097	27970.	LS
DN Pav	54299.888±0.002	0.098	28000.	LS
DN Pav	54369.686±0.003	0.098	28149.	LS
DN Pav	54370.624±0.003	0.099	28151.	LS
VV Peg	54298.442±0.002	−0.025	30527.	C
VV Peg	54317.488±0.003	−0.026	30566.	C
VV Peg	54338.488±0.003	−0.027	30609.	C
VV Peg	54365.351±0.002	−0.025	30664.	C
VV Peg	54384.395±0.002	−0.028	30703.	C
VV Peg	54387.330±0.004	−0.023	30709.	C
VV Peg	54405.3996±0.0017	−0.0242	30746.	C
VV Peg	54431.285±0.003	−0.023	30799.	C
AV Peg	54291.503±0.003	0.108	26900.	C
AV Peg	54307.509±0.003	0.108	26941.	C
AV Peg	54309.461±0.002	0.108	26946.	C
AV Peg	54327.418±0.003	0.108	26992.	C
AV Peg	54345.377±0.002	0.110	27038.	C
AV Peg	54363.335±0.003	0.111	27084.	C
AV Peg	54400.4199±0.0017	0.1099	27179.	C
AV Peg	54402.373±0.004	0.111	27184.	C
AV Peg	54407.448±0.003	0.111	27197.	C
AV Peg	54429.309±0.003	0.111	27253.	C
BH Peg	54337.513±0.005	−0.081	23358.	C
BH Peg	54405.416±0.005	−0.124	23464.	C
BH Peg	54432.340±0.003	−0.121	23506.	C

Table 1 (cont.): maxima of RR Lyrae stars

Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.*	Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.*
BH Peg	54441.326±0.007	−0.109	23520.	C	X Ret	54363.660±0.005	0.197	30336.	LS
CG Peg	54296.487±0.002	−0.046	32526.	C	X Ret	54380.856±0.004	0.173	30371.	LS
CG Peg	54297.417±0.004	−0.050	32528.	C	X Ret	54381.849±0.005	0.182	30373.	LS
CG Peg	54310.499±0.002	−0.048	32556.	C	X Ret	54420.733±0.002	0.199	30452.	LS
CG Peg	54326.383±0.002	−0.047	32590.	C	X Ret	54425.656±0.002	0.202	30462.	LS
CG Peg	54330.585±0.002	−0.049	32599.	C	X Ret	54445.825±0.002	0.200	30503.	LS
CG Peg	54354.409±0.002	−0.049	32650.	C	X Ret	54448.777±0.003	0.200	30509.	LS
CG Peg	54376.367±0.002	−0.047	32697.	C	V675 Sgr	54285.698±0.004	0.065	40322.	LS
CG Peg	54389.446±0.002	−0.048	32725.	C	V675 Sgr	54287.625±0.005	0.065	40325.	LS
CG Peg	54411.402±0.005	−0.047	32772.	C	V756 Sgr	54299.582±0.003	0.097	47455.	LS
CG Peg	54412.336±0.002	−0.047	32774.	C	V756 Sgr	54323.684±0.005	0.097	47501.	LS
DZ Peg	54330.419±0.003	0.160	33653.	C	V1130 Sgr	54289.763±0.005	0.041	47406.	LS
DZ Peg	54350.460±0.002	0.159	33686.	C	V1176 Sgr	54322.685±0.005	0.009	92697.	LS
DZ Peg	54384.469±0.002	0.156	33742.	C	V1645 Sgr	54320.585±0.005	−0.043	36333.	LS
DZ Peg	54386.295±0.003	0.160	33745.	C	V1645 Sgr	54326.668±0.004	−0.041	36344.	LS
DZ Peg	54392.369±0.005	0.161	33755.	C	V1645 Sgr	54341.595±0.005	−0.041	36371.	LS
AR Per	54352.525±0.002	0.055	63719.	C	V494 Sco	54287.659±0.002	−0.146	30799.	LS
AR Per	54355.501±0.002	0.053	63726.	C	V690 Sco	54286.581±0.003	−0.015	25371.	LS
AR Per	54358.483±0.003	0.056	63733.	C	RU Scl	54334.832±0.004	0.403	47050.	LS
AR Per	54383.591±0.003	0.056	63792.	C	RU Scl	54336.800±0.005	0.398	47054.	LS
AR Per	54384.440±0.002	0.054	63794.	C	RU Scl	54375.779±0.002	0.403	47133.	LS
AR Per	54386.568±0.003	0.055	63799.	C	RU Scl	54418.701±0.002	0.405	47220.	LS
AR Per	54389.548±0.004	0.056	63806.	C	RU Scl	54419.686±0.004	0.403	47222.	LS
AR Per	54396.357±0.002	0.056	63822.	C	UZ Scl	54299.779±0.002	0.036	33816.	LS
AR Per	54415.504±0.002	0.053	63867.	C	UZ Scl	54352.776±0.003	0.037	33934.	LS
AR Per	54422.3139±0.0015	0.0543	63883.	C	UZ Scl	54375.679±0.002	0.035	33985.	LS
AR Per	54433.379±0.003	0.055	63909.	C	UZ Scl	54411.611±0.005	0.037	34065.	LS
AR Per	54435.5078±0.0017	0.0562	63914.	C	VW Scl	54322.779±0.003	−0.009	51894.	LS
AR Per	54448.2739±0.0016	0.0559	63944.	C	VW Scl	54323.800±0.005	−0.010	51896.	LS
RV Phe	54329.796±0.003	−0.174	20815.	LS	VW Scl	54346.787±0.004	−0.014	51941.	LS
RV Phe	54350.661±0.003	−0.183	20850.	LS	VW Scl	54363.649±0.005	−0.013	51974.	LS
RV Phe	54372.734±0.005	−0.178	20887.	LS	VW Scl	54365.693±0.005	−0.012	51978.	LS
RV Phe	54384.662±0.005	−0.178	20907.	LS	VW Scl	54407.585±0.004	−0.015	52060.	LS
TZ Phe	54320.817±0.004			LS	VX Scl	54338.800±0.003	−0.565	19966.	LS
TZ Phe	54349.746±0.005			LS	VX Scl	54345.806±0.005	−0.569	19977.	LS
TZ Phe	54365.749±0.005			LS	VX Scl	54382.755±0.003	−0.586	20035.	LS
TZ Phe	54373.757±0.006			LS	VX Scl	54419.709±0.003	−0.597	20093.	LS
TZ Phe	54376.831±0.005			LS	VX Scl	54428.626±0.003	−0.603	20107.	LS
TZ Phe	54402.690±0.006			LS	AE Scl	54339.775±0.005	0.198	23854.	LS
TZ Phe	54413.776±0.008			LS	AE Scl	54361.793±0.002	0.213	23894.	LS
U Pic	54377.817±0.002	0.059	28865.	LS	AE Scl	54381.596±0.003	0.212	23930.	LS
U Pic	54407.761±0.003	0.058	28933.	LS	AE Scl	54410.752±0.002	0.214	23983.	LS
U Pic	54444.7522±0.0013	0.0579	29017.	LS	AF Sct	54326.602±0.002	0.097	50988.	LS
U Pic	54452.682±0.003	0.061	29035.	LS	AT Ser	54284.601±0.005	0.032	16725.	LS
RY Psc	54331.586±0.005	0.514	21993.	C	RU Sex [3]	54453.616±0.007	0.040	33798.	C
RY Psc	54338.472±0.002	0.514	22006.	C	RU Sex [3]	54455.721±0.006	0.043	33804.	C
RY Psc	54356.484±0.003	0.515	22040.	C	BI Tel	54319.754±0.005	−0.159	48912.	LS
RY Psc	54366.546±0.005	0.513	22059.	C	HY Tel	54289.816±0.005	0.009	63521.	LS
RY Psc	54378.731±0.002	0.515	22082.	LS	HY Tel	54327.672±0.004	0.030	63615.	LS
RY Psc	54389.328±0.003	0.517	22102.	C	HY Tel	54352.644±0.003	0.046	63677.	LS
RY Psc	54407.351±0.003	0.530	22136.	C	RW TrA	54284.790±0.002	−0.166	34209.	LS
RY Psc	54412.648±0.003	0.530	22146.	LS	RW TrA	54292.646±0.003	−0.165	34230.	LS
RY Psc	54415.293±0.003	0.526	22151.	C	RW TrA	54365.581±0.005	−0.169	34425.	LS
RY Psc	54433.309±0.002	0.532	22185.	C	RW TrA	54368.574±0.005	−0.168	34433.	LS
XX Pup	54446.725±0.002	0.467	24504.	LS	W Tuc	54322.837±0.004	0.158	27162.	LS
HH Pup	54431.765±0.003	0.009	40772.	LS	W Tuc	54355.592±0.005	0.159	27213.	LS
HK Pup	54456.739±0.007	−0.240	24309.	LS	W Tuc	54364.583±0.004	0.159	27227.	LS
X Ret	54351.859±0.003	0.204	30312.	LS	W Tuc	54367.795±0.003	0.160	27232.	LS

Table 1 (cont.): maxima of RR Lyrae stars

Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.*	Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.*
W Tuc	54371.644±0.005	0.156	27238.	LS	BK Tuc	54318.809±0.002	−0.088	31958.	LS
W Tuc	54376.784±0.003	0.158	27246.	LS	BK Tuc	54335.860±0.003	−0.093	31989.	LS
W Tuc	54423.666±0.002	0.157	27319.	LS	TU UMa	54448.6135±0.0015	−0.0272	20832.	C
W Tuc	54425.596±0.003	0.160	27322.	LS	EX UMa	54412.564±0.006	0.028	9947.	C
YY Tuc	54327.817±0.003	0.244	19579.	LS	EX UMa	54413.658±0.007	0.037	9949.	C
YY Tuc	54334.802±0.003	0.244	19590.	LS	EX UMa	54449.477±0.005	0.029	10015.	C
YY Tuc	54341.784±0.005	0.240	19601.	LS	SV Vol	54439.777±0.003	0.188	33546.	LS
YY Tuc	54355.753±0.002	0.239	19623.	LS	BN Vul	54291.490±0.005	0.061	14746.	C
YY Tuc	54376.704±0.002	0.234	19656.	LS	BN Vul	54294.461±0.003	0.062	14751.	C
YY Tuc	54411.624±0.005	0.228	19711.	LS	BN Vul	54316.444±0.005	0.062	14788.	C
AE Tuc	54336.862±0.003	0.174	48420.	LS	BN Vul	54332.480±0.003	0.056	14815.	C
AE Tuc	54346.811±0.002	0.178	48444.	LS	BN Vul	54335.456±0.003	0.062	14820.	C
AE Tuc	54357.587±0.002	0.180	48470.	LS	BN Vul	54351.500±0.002	0.064	14847.	C
AG Tuc	54329.748±0.003	0.046	24125.	LS	BN Vul	54354.470±0.003	0.064	14852.	C
AG Tuc	54344.817±0.002	0.051	24150.	LS	BN Vul	54385.367±0.005	0.066	14904.	C
BK Tuc	54284.701±0.003	−0.083	31896.	LS					

* C = Calern, LS = La Silla
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3 Williams, 1993

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PHOTOMETRIC ANALYSIS OF A NEW W UMa SYSTEM IN VULPECULA

CAPEZZALI, DANIELE[1,2]; FIORUCCI, MASSIMO[1]; SPOGLI, CORRADO[1,2]

[1] Physics Dept. University of Perugia, Via A. Pascoli, 06123, Perugia, Italy

[2] Porziano Astronomical Observatory, Piazza S. Chiara 2, 06081, Assisi, Italy

In the last few years we have repetitively observed the variability of GSC2.3 N32O092280 (J2000.0 $\alpha = 20^{\mathrm{h}}58^{\mathrm{m}}18\overset{\mathrm{s}}{.}8$, $\delta = +25^{\circ}28'14''$) during a program to study the dwarf nova VW Vul (Capezzali et al., 2007). After our accidental discovery, we soon noted that the variability of this source has been already reported in literature by Pojmanski et al. (2005) with the All Sky Automated Survey (ASAS), but the variability type and the period were quite uncertain and needed of a deeper investigation. Intrigued by the strange behaviour of this source, we began observing intra–night variability at the Porziano Astronomical Observatory, Mt. Subasio, Assisi (Italy). We used a 0.35 m Schmidt-Cassegrain telescope equipped with an HiSIS 23 CCD camera (Kodak Kaf 401E of 762×512 pixels) and standard BVR_CI_C Johnson–Cousins broad-band filters. The intra–night observations were taken on 7, 8, 14 and 15 July 2007, with a total of 256 photometric data with the R_C filter. Moreover we observed the variable during the night of September 15th 2007 in the V and I_C broad bands, and our archive contains BVR_CI_C data of sporadic observations done during the years 2004–2007. The total number of observations is 356 (Electronic table 1).

The CCD frames were first corrected for standard de–biasing and flat–fielding, then processed for aperture photometry and differential photometry using the comparison stars already calibrated for VW Vulpeculae (Capezzali et al., 2007). Every magnitude has been obtained by comparison with at least four stars and we have verified that the typical standard deviation is of the order of 0.01–0.02 magnitudes. The time has been converted in Heliocentric Julian Days.

From a preliminary analysis we noted that the intra–night light curves show a variability of a few tenths of magnitude in all the four bands (Table 1), and minima with a typical recurrence time of $0\overset{\mathrm{d}}{.}192225$, in agreement with Pojmanski et al. (2005). However, a deeper analysis soon revealed a small difference in magnitude between two consecutive minima, and a variability feature typical of W UMa systems, i.e. continually changing light levels through all phases with primary and secondary eclipses of almost equal depths. The total eclipse has a relatively long duration (0.1 phases) and suggests an extreme mass ratio system in a state of over–contact. The secondary eclipse is slightly less deep and is total, indicating that the inclination is close to 90°. The preliminary value of the orbital period has been obtained by means of the Fourier periodogram:

$$\mathrm{P} = 0.38451 \pm 0.00002\mathrm{days}(9^{\mathrm{h}}13^{\mathrm{m}}42^{\mathrm{s}})$$

$$\Phi_0 = \mathrm{HJD}2454289.2333 \pm 0.0001$$

Table 1: Photometric parameters of the new variable system

filter	N data	max	min
B	13	13.59±0.06	14.12±0.05
V	34	12.82±0.02	13.29±0.01
R_C	276	12.41±0.01	12.86±0.01
I_C	33	12.01±0.02	12.43±0.02

To estimate the mean effective temperature of star 1 (the star eclipsed at primary minimum), we have initially noted that our BVR_CI_C data suggest a temperature of ∼5200 K, while the JHK values reported by 2MASS (Cutri et al., 2003) are consistent with an higher average temperature (∼5800 K). It is extremely probable that the star is reddened by the interstellar matter in the Vulpecula region, so we used the Galactic Extinction $E(B-V) = 0.18$ reported by Schlegel et al. (1998) to estimate $\mathrm{T}_1 = 6100$ K, a value that now allows an agreement between optical and near-infrared dereddened color indices.

We analyzed our dereddened observations with the 2003 version of the Wilson-Devinney program (Wilson & Devinney, 1971; Wilson, 1979, 1990). We used mode 3, appropriate for over–contact binaries of this type, and adjusted the parameters shown in Table 2. As explained before, we set the mean effective temperature of star 1 equal to 6100 K. Unadjusted parameters such as the gravity darkening exponents and bolometric albedos were set to their theoretically expected values for this type of star. Limb darkening coefficients were taken from the tables presented by Van Hamme (1993). Only the principal parameters were iterated: phase of the primary conjunction ϕ_0, inclination i, average temperature of the secondary star T_2, surface potential $\Omega_1 = \Omega_2$, mass ratio q, and relative monochromatic luminosity of the primary star L_1 in the V, R_C and I_C bands. Figure 1 shows the best fit to the VR_CI_C normalized flux versus phase. The geometrical representation is given in Figure 2.

It is well established in literature that the Wilson–Devinney code underestimates the errors (see e.g. Maceroni & Rucinski, 1997), and spurious values can be obtained when fits of almost the same quality have been achieved for a large range of mass ratio values (Kreiner et al., 2003). However, in the favorable case of total-annular eclipses an overcontact photometric mass-ratio is very accurate and reliable (Wilson, 1994; Terrell & Wilson, 2005), and we have effectively verified that the fit is sensibly poorer when the mass ratio is changed.

In conclusion, the average parameters reported in Table 2 give effectively the best fit to our photometric data, while the errors should be at least doubled in order to be realistic. Our solution indicates that GSC2.3 N32O092280 is an A-type W UMa contact binary: the primary minimum corresponds to a transit eclipse of the smaller secondary in front of the larger primary component. These variables usually have surface temperatures greater than 6000 K, in agreement with the estimate obtained considering the interstellar extinction. The temperature difference between the two components is relatively small (≃190 K) and this is in agreement with a good thermal contact. The primary component is over five times the mass of the secondary component ($M_2/M_1 = 0.195$).

Further photometric and spectroscopic observations could be useful since the system shows the night-to-night variability that is common for W UMa systems, and the maximum at phase 0.75 is slightly brighter than the maximum at 0.25 (O'Connell effect).

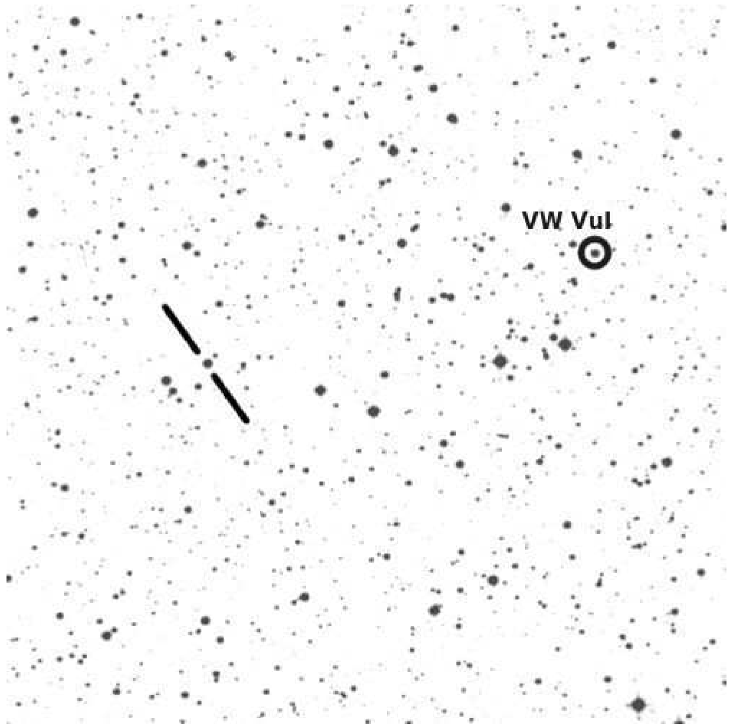

Figure 1. Finding chart of the new variable.

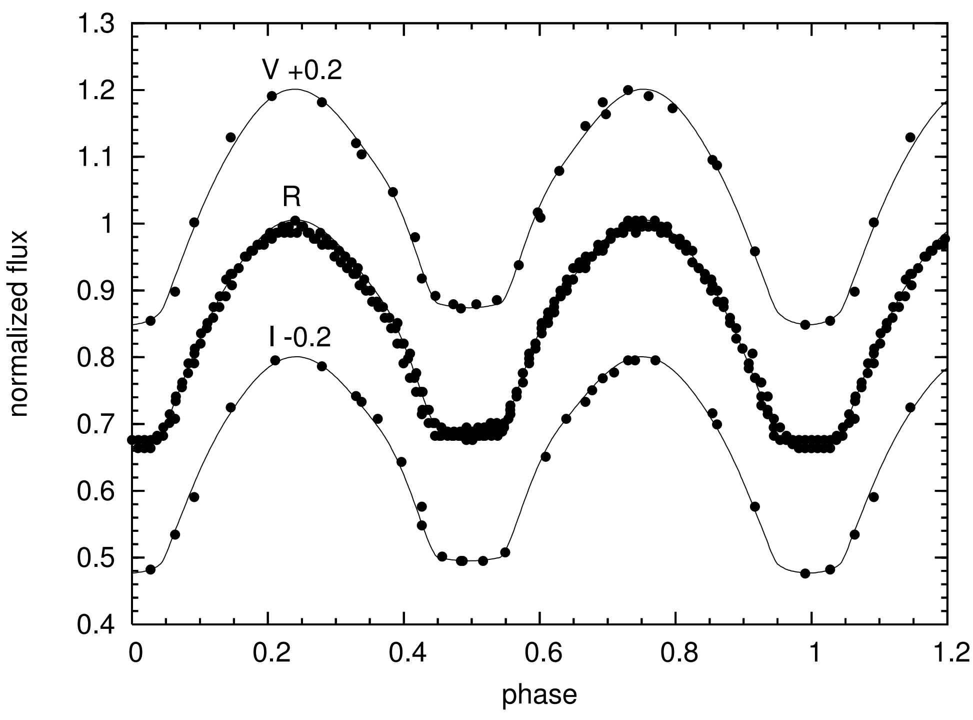

Figure 2. Comparison between theoretical (lines) and observed (circles) VR_CI_C phase diagrams of the new variable system in Vulpecula. The best fit is obtained with the Wilson-Devinney code for an A–type W UMa over–contact binary.

Table 2: Adjusted Parameters from the Wilson-Devinney code

Parameter	Value	Std. Error*
i	89°	1°
T_1	6100 K	(assumed)
T_2	5912 K	49 K
$q = M_2/M_1$	0.195	0.003
Ω_1	2.17	0.01
Ω_2	2.17	0.01
$L_1/(L_1 + L_2)V$	0.829	0.006
$L_1/(L_1 + L_2)R_C$	0.826	0.002
$L_1/(L_1 + L_2)I_C$	0.824	0.005
r_1^{pole}	0.500	0.001
r_2^{pole}	0.244	0.001
r_1^{side}	0.549	0.001
r_2^{side}	0.256	0.001
r_1^{back}	0.575	0.001
r_2^{back}	0.302	0.001

* Formal errors from the differential corrections solution.

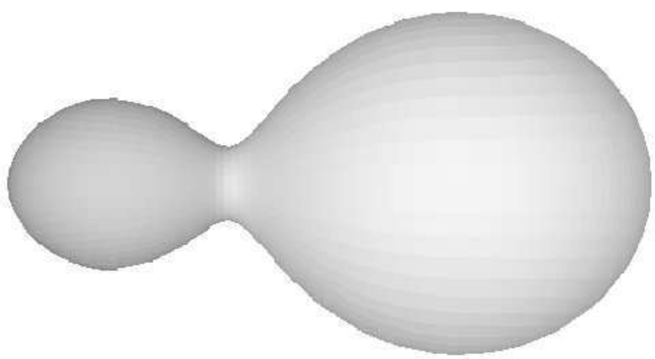

Figure 3. Geometrical representation of GSC2.3 N32O092280 during the maximum

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BN UMa AND CF Del : TWO NEW GALACTIC FIELD DOUBLE MODE RR LYRAE STARS

McCLUSKY, J. V.

Department of Chemistry, Texas Lutheran University, Seguin, TX 78155

BN UMa and CF Del have been found to be the 30th and 31st known galactic field double mode RR Lyrae variables. Analysis of the light curve of BN UMa reveals a fundamental frequency of 1.865924 ± 0.000019 and a first overtone of 2.5021805 ± 0.0000076. The deconvoluted light curves of BN UMa are shown in Figures 1 and 2. Successive prewhitening of the data (`Period04`) using both the fundamental and first overtone periods and their first three harmonics reveals several prominent combination bands, Table 1.

A similar analysis for CF Del indicates a fundamental frequency of 2.090090 ± 0.000020 and the first overtone at 2.808845 ± 0.000016. The deconvoluted light curves of CF Del are shown in Figures 3 and 4, and the combination bands are listed in Table 2.

The ratio of the first overtone period P1 to the primary period P0, P1/P0, for BN UMa is 0.74572 ± 0.00002 and for CF Del is 0.74411 ± 0.00003. These are typical values for RRd stars, Figure 5. It is interesting to note that the apparent outlier, GSC 3059-0636, is the only RRd in the galactic field known to have a much stronger fundamental mode pulsation than its overtone: A1/A0 = 0.52 (Oaster et al., 2006). In contrast to GSC 3059-0636, BN UMa and CF Del have typical amplitude ratios in which the first overtone has a larger amplitude than the fundamental: A1/A0 for BN UMa is 2.47, while that for CF Del is 1.24. Table 3 contains the characteristics of all 31 known galactic field RRd stars.

For BN UMa a total of 438 observations were obtained on 44 nights between JD 2454144 and 2454546, while for CF Del 239 observations were obtained on 34 nights between JD 2454349 and 2454576. Observations were taken approximately 20 minutes apart and were conducted with a robotic 0.45m f/4.5 Newtonian telescope located outside Seguin, Texas, USA using an unfiltered SBIG ST-10XME CCD camera. Stellar data were extracted from dark corrected and flat fielded images using Sextractor; magnitudes were derived differentially. For BN UMa GSC 3010-2100 was the comparison star and GSC 3010-2126 and GSC 3012-0837 were check stars. For CF Del USNO A2 0975-18805217 was the comparison star and USNO A2 0975-18802001, 0975-18808454, 0975-18802602 were check stars. The photometric accuracy varied by night, but was typically between 0.010 and 0.015 mag for both stars. Differential magnitudes of CF Del-comp and BN UMa-comp are available in the electronic form of this document (through the IBVS-website as `5825-t4.txt` and `5825-t5.txt`) and will also be submitted to the AAVSO database at `www.aavso.org`.

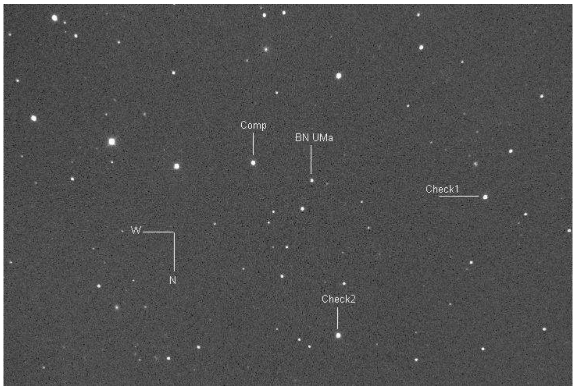

Figure 1. Finding chart for BN UMa identifying the variable, comparison and check stars. The field is $25''.0\times16''.9$. The R magnitude of the comparison star is $14^{m}.1$ according to the USNO A2 catalogue.

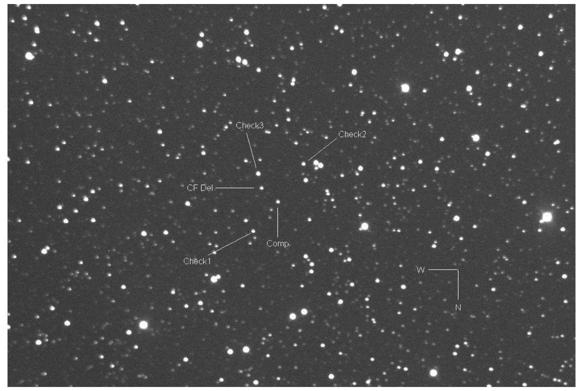

Figure 2. Finding chart for CF Del identifying the variable, comparison and check stars. The field is $25''.0\times16''.9$. The GSC 2.3 V magnitude of the comparison star GSC 3010.2100 is $12^{m}.55$.

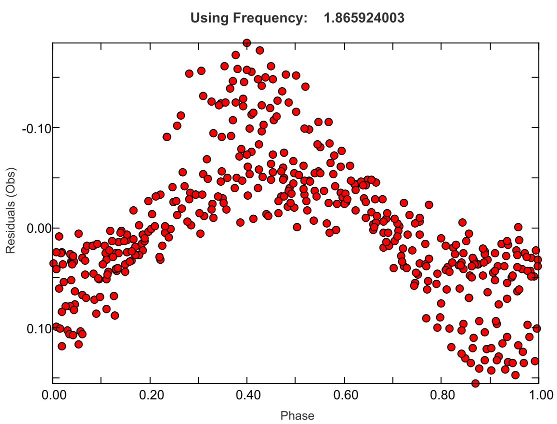

Figure 3. Fundamental mode of BN UMa after removing the first overtone and its first three harmonics.

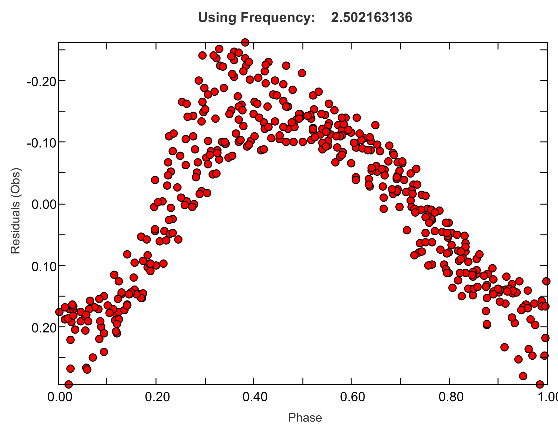

Figure 4. First overtone mode of BN UMa after removing the fundamental mode and its first three harmonics.

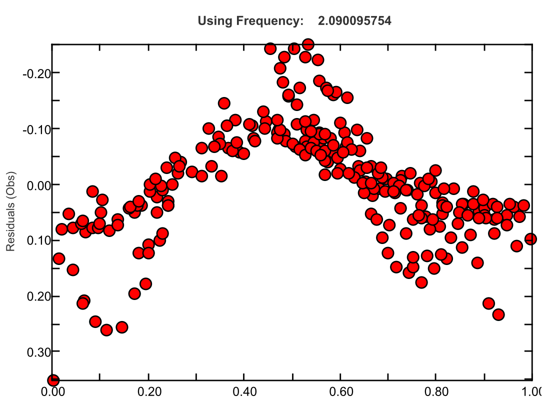

Figure 5. Fundamental mode of CF Del after removing the first overtone and its first four harmonics.

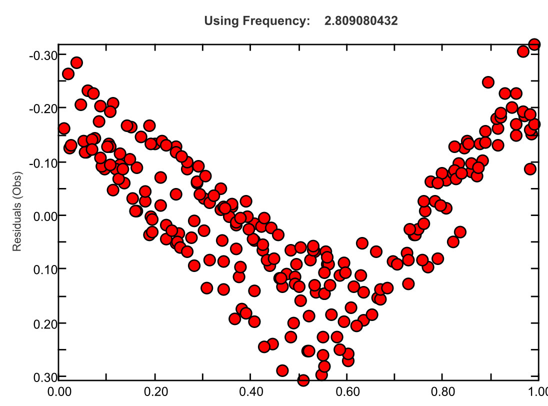

Figure 6. First overtone mode of CF Del after removing the fundamental mode and its first four harmonics.

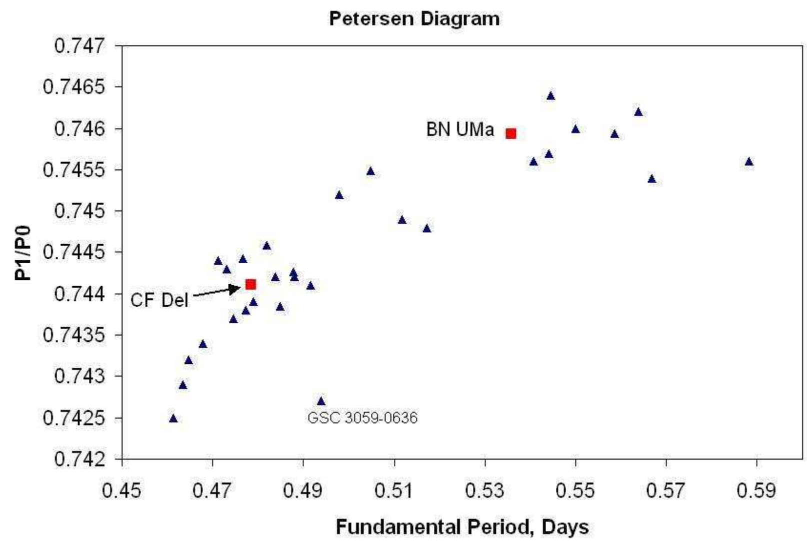

Figure 7. Petersen diagram of the 31 known RRd galactic field variables.

Table 3. All known galactic field double mode RR Lyrae stars excluding the galactic bulge

Star	Period F(d)	Period 1O(d)	Period ratio	Amplitude ratio 1O/F	ref
GSC 7411-1269	0.461255	0.342477	0.7425	0.98	Wils, 2006
V2493 Oph	0.463349	0.344234	0.7429	1.58	Wils, 2006
EM Dra	0.464727	0.345387	0.7432	1.18	Wils, 2006
GSC 8403-0647	0.467814	0.347778	0.7434	1.05	Wils, 2006
V372 Ser	0.471254	0.350791	0.7444	1.4	Wils, 2006
GSC 6368-0742	0.47302	0.35206	0.7443	1.5	Bernhard, 2006
GSC 3047-0176	0.474608	0.352983	0.7437	1.29	Wils, 2006
SW Ret	0.476624	0.354811	0.7444	2.73	Szczygiel, 2007
GSC 0526-0586	0.47722	0.35498	0.7438	1.3	Bernhard, 2006
CF Del	**0.478448**	**0.356018**	**0.7441**	**1.24**	**current work**
GSC 8758-1831	0.47907	0.35636	0.7439	1.5	Bernhard, 2006
ASAS 141539+0010.1	0.481932	0.358842	0.7446	1.57	Szczygiel, 2007
V458 Her	0.483723	0.359971	0.7442	2.17	Wils, 2006
ASAS122801-2328.4	0.48482	0.360634	0.7439	1.57	Pilecki, 2007
BS Com	0.487817	0.363066	0.7443	1.42	Dékány, 2007
Z Gru	0.487995	0.363187	0.7442	1.3	Wils, 2006
GSC 9092-1397	0.491521	0.365738	0.7441	1.17	Wils, 2006
GSC 3059-0636	0.4940	0.3669	0.7427	0.52	Oaster, 2005
GSC 7509-0299	0.49785	0.37102	0.7452	1.6	Bernhard, 2006
ASAS 211848-3430.4	0.50486	0.376366	0.7455	2.12	Szczygiel, 2007
EN Dra	0.511849	0.381272	0.7449	2.03	Wils, 2006
GSC 8936-2145	0.517197	0.385208	0.7448	1.37	Wils, 2006
BN Uma	**0.535786**	**0.39966**	**0.7459**	**2.48**	**current work**
GSC 4421-1234	0.540804	0.403193	0.7456	2.25	Wils, 2006
CU Com	0.544158	0.405762	0.7457	2.00	Wils, 2006
GSC 6108-0220	0.54452	0.40644	0.7464	6.0	Bernhard, 2006
AQ Leo	0.549995	0.410357	0.746	1.65	Wils, 2006
ASAS040054-4923.8	0.558588	0.416671	0.7459	1.61	Szczygiel, 2007
GSC 4868-0831	0.56392	0.420805	0.7462	2.45	Wils, 2006
GSC 8833-1048	0.5668	0.42249	0.7454	1.9	Bernhard, 2006
GSC 7019-0641	0.58823	0.4386	0.7456	2.2	Bernhard, 2006

Table 1. BN UMa Frequency Data

Assignment	Frequency	Amplitude (mag)
f_0	1.865924	0.0757
$2f_0$	3.731905	0.0055
$3f_0$	5.597857	0.0030
f_1	2.502180	0.1872
$2f_1$	5.004361	0.0362
$3f_1$	7.506544	0.0132
$4f_1$	10.008722	0.0045
$f_0 + f_1$	4.36809	0.0332
$f_1 - f_0$	0.63624	0.0259
$2f_1 - f_0$	3.13840	0.0106
$f_0 + 2f_1$	6.87025	0.0108
$f_0 + 3f_1$	9.37241	0.0036

Table 2. CF Del Frequency Data

Assignment	Frequency	Amplitude (mag)
f_0	2.090089	0.1424
$2f_0$	4.180179	0.0278
$3f_0$	6.270270	0.0061
$4f_0$	8.360359	0.0063
f_1	2.808845	0.1768
$2f_1$	5.617691	0.0241
$3f_1$	8.426536	0.0073
$4f_1$	11.235382	0.0044
$f_0 + f_1$	4.898935	0.0655
$f_1 - f_0$	0.718756	0.0345
$2f_0 + f_1$	6.989025	0.0165
$f_0 + 2f_1$	7.707781	0.0221
$2f_0 + 2f_1$	9.797871	0.0169
$2f_1 - 2f_0$	1.437511	0.0057
$3f_0 - 2f_1$	0.652579	0.0036

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DISCOVERY OF SHORT-PERIODIC PULSATING COMPONENT IN THE ECLIPSING BINARY Y LEONIS

TURCU, V.; POP, A.; MOLDOVAN, D.

Cluj-Napoca Astronomical Observatory, Romanian Academy, Cluj-Napoca Branch, Str.Cireşilor 19, RO-400487 Cluj-Napoca, Romania, (e-mail: vladturcu@yahoo.com)

Y Leo (HIP 47178=SAO 80927) is a less studied Algol binary system with orbital period of 1.68610 d, and deep primary eclipses of about 3.1 magnitudes. Spectral type of the primary component is A3 according with Struve (1945). Based on Struve's radial velocity determinations and the most extensive photoelectric $UBVI$ observational study of Y Leo, up to date, made by Johnson (1960), Giuricin et al. (1980) solved the system and determined mass of the primary ($M_h = 2.6M_{Sun}$).

We have observed Y Leo during winter-spring 2008 season. We present here observations made outside primary eclipse in three nights (orbital phase 0.764 … 0.922 on JD 2454517, 0.680 … 0.877 on JD 2454522, and 0.325 … 0.470 on JD 2454545). The orbital phases were determined with following new ephemeris, based on our data:

$$t_n = HJD\ 2454509.35034 + 1.68610897 \cdot n$$

The telescope used was a 16″Meade LX200 Schmidt-Cassegrain (D = 40cm, F/D =10) at Cluj-Napoca Astronomical Observatory, Feleacu Station (Long. = 23°35′37.″1 E, Lat. = 46°42′36.″3 N, Alt. = 756 m). The CCD camera were SBIG ST-8XMEI with V filter (from Custom Scientific $UBVRI$ set). Integration time was 20 seconds in analog binning mode (18μm × 18 μm, 765 × 510 binned pixels).

The calibration and photometric reductions were performed using AIP4WIN2 software (Berry & Burnell, 2005). Calibrations of CCD images were made with dark frame substraction and flat field correction. Photometric reduction was made in aperture photometry mode with 7.″27 star aperture radius, and 10.″91 to 14.″55 sky annulus radii. Seeing was less than 2″ on each night.

Table 1. Photometric parameters of observed stars from the Tycho-2 catalogue (ESA 1997) and ESO/ST-ECF GSC

ID	Name	RA (J2000)	Dec (J2000)	V_T	(B_T - V_T)
VAR	Y Leo	9^{h}36^{m}51.^{s}807	+26°13′57.″66	10.^{m}090	0.^{m}296
C1	GSC 01962 1289	9^{h}37^{m}25.^{s}353	+26°07′36.″34	10.^{m}698	0.^{m}670
C2	GSC 01962 1118	9^{h}37^{m}14.^{s}36	+26°12′58.″6	(11.^{m}53)†	–
C3	GSC 01962 1325	9^{h}37^{m}03.^{s}22	+26°11′55.″4	(13.^{m}47)†	–

†Photographic magnitudes

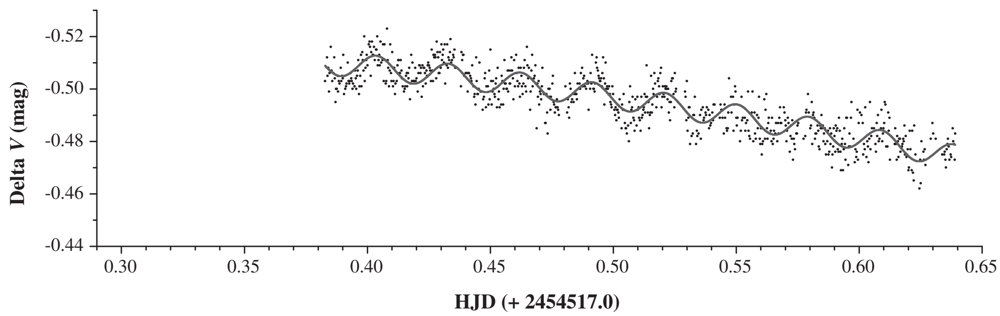

Figure 1. Light curve of Y Leo on February 20/21, 2008

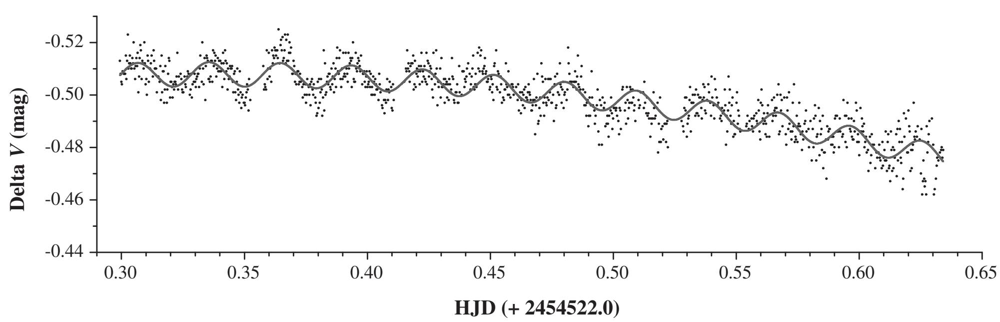

Figure 2. Light curve of Y Leo on February 25/26, 2008

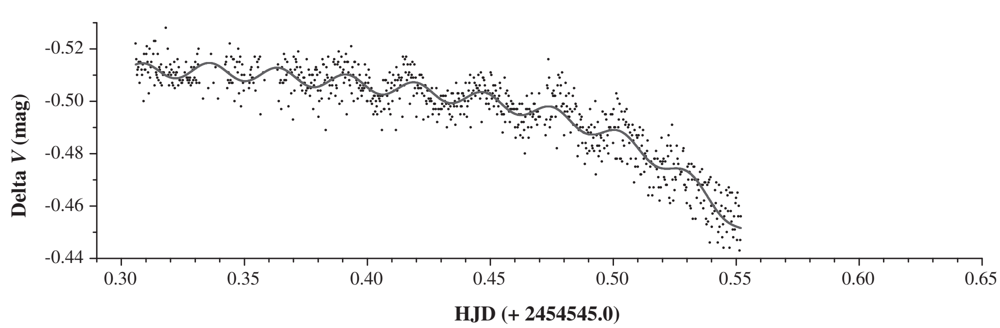

Figure 3. Light curve of Y Leo on March 19/20, 2008

The V time series in instrumental system for VAR-C1, C1- C2, and C3-C1, obtained during each night, were separately analyzed, taking into account the individual weights derived from the observational errors. Their amplitude spectra were analyzed using the methods of Kuschnig et al. (1997) and that proposed by Pop (2005), which was derived from the previous one [see also Pop (2005) and Pop & Vamoş (2007)].

The C2-C1 and C3-C1 observations performed during each of the three nights proved to be photometrically stable within the limits of the observational errors.

All the three VAR-C1 data sets (Figs. 1-3) obviously display rapid low-amplitude oscillations superposed on the eclipsing binary light curve. We analyzed the amplitude spectra of each of these data sets through the above mentioned methods after performing a preliminary detrending. For the first two nights we used second order polynomials, while for the third one, covering descending part of the shallow secondary eclipse, a fourth order polynomial was necessary.

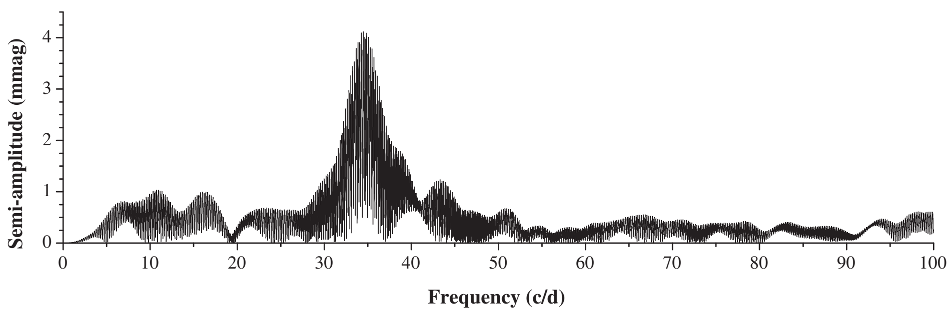

Figure 4. Amplitude spectra of detrended and merged data

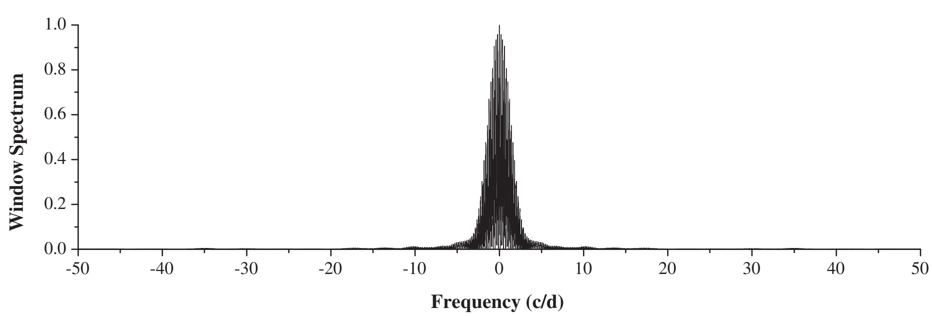

Figure 5. Power spectral window of merged data

The highest peak in three amplitude spectra appeared at about 35 c/d, i.e. a periodicity of about 41 minutes. In all cases it was found to be statistically significant at confidence levels of 100%. The application of Breger's et al. (1993) method, in the same frequency domain, supplied us the following values of the S/N ratio: 8.19, 6.61, and 3.91. These results agree with those obtained through the previously mentioned methods. In Fig. 4 we presented the amplitude spectrum of the three detrended and merged data sets, while in Fig. 5 we displayed the corresponding power spectral window.

The application of Pop's method (2005, 2007) [and also Pop & Vamoş (2007)] emphasized the presence of noise levels significantly higher than expected from the observational noise. We also note the presence of a cycle-to-cycle variability of the light curve, as well as the asymmetric shape of the highest peak in the amplitude spectrum (see the structure of window spectrum in Fig. 5). In order to clarify the actual character of the pulsations, more observations are needed and a proper decoupling of the pulsation and binarity, including frequency modulation due to the light-time effect (e.g. Pop & Turcu, 1993).

Considering the amplitude and period of its oscillations and also its spectral type and mass, this star is a δ Scuti pulsator with frequency of 34.48337($\pm$ 0.00056) c/d and semiamplitude 4.09($\pm$ 0.15) mmag. Yoon et al. (2004) found some Hα line profile variations in Y Leo, probably related to the presence of mass transfer phenomena in the system, or that of some gas streams etc. Thus, Y Leo is a new candidate for the "oEA" (oscillating EA) stars group (Mkrtichian et al., 2004).

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THE UNCONFIRMED ECLIPSING NATURE OF V348 And AND DETECTION OF VARIABILITY OF HD 1438

ZASCHE, P.,[1]; SVOBODA, P.[2]

[1] Astronomical Institute, Faculty of Mathematics and Physics, Charles University Prague, V Holesovickach 2, Praha 8, CZ-180 00 Czech Republic, e-mail: zasche@sirrah.troja.mff.cuni.cz

[2] Private observatory, Vypustky 5, Brno, CZ-614 00 Czech Republic, e-mail: tribase.net@volny.cz

Precise photometric observations in standard Johnson-Cousins BVR_c system of a neglected eclipsing binary V348 And were carried out. All the measurements were obtained with the 34-mm refractor at the Private observatory in Brno, using the SBIG ST-7XME CCD camera, and standard B, V and R_c filters by the specification by Bessell (1990). The field of view (FOV) is about $2^\circ \times 3^\circ$, see Fig. 1 left, or equivalently the angular pixel size is circa $14'' \times 14''$. The observations come from the time span from September 2007 to January 2008. The measurements were processed by the software C-MUNIPACK†, which is based on aperture photometry.

V348 And. V348 And (= HD 1082 = HIP 1233, R.A.=$00^h15^m18^s$, Decl.=$+44^\circ12'12''$, J2000.0, V_{max} = 6.76 mag, sp. B9V, according to Simbad database) is one member of an astrometric binary A 1256 (the second component is less then $1''$ distant). The observations obtained by the Hipparcos satellite (see Peryman & ESA, 1997) indicate that the system is an Algol-type eclipsing binary with its orbital period 5.5392 days (Kruszewski & Semeniuk, 1999).

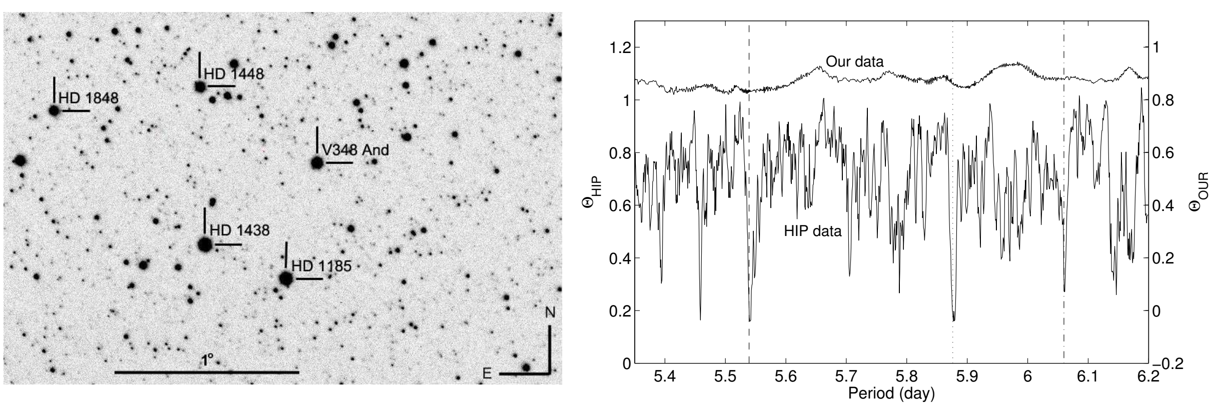

Figure 1. Left: Identification frame for the stars. Right: PDM spectrum for Hipparcos and our data. Also the different periods are plotted, the dashed one for 5.5392 days, the dash-dotted one for 6.06 days, and the dotted one for 5.876 days.

Since its discovery as an eclipsing binary, the photometric variation has not been confirmed so far. The Hipparcos observations of the two eclipses were the only ones, which were used for estimation of its light elements. Regrettably, two minima observed

†See `http://integral.sci.muni.cz/cmunipack/`

by the Hipparcos satellite were not covered by the data sufficiently, and only 8 points were used for estimation of these minima and its orbital period. According to a light curve observed by Hipparcos, a predicted depth of the primary minimum of the star should be at least 0.13 mag and its duration, D more than 10 hours.

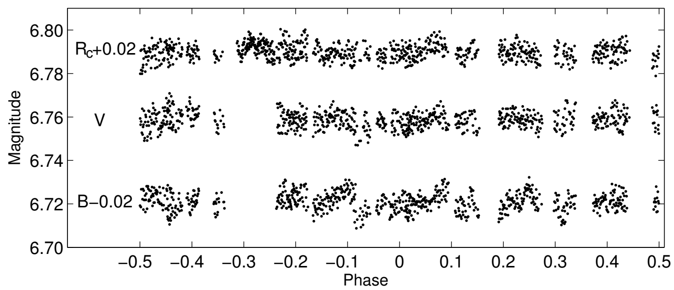

Figure 2. The B, V and R_c light curves of V348 And. The shift ± 0.02 mag was applied to R_c and B observations for the better clarity of the plot.

Since September 2007, we have tried to reproduce the observations made by Hipparcos and using B, V and R_c filters, the star has been observed each clear night, until a phase light curve of the system was covered. The data files are available through the IBVS website as `5827-t1` – `5827-t3.txt`. HD 1185 (= HIP 1302, R.A.$=00^h16^m22^s$, Decl.$=+43°35'42''$, J2000.0, $V = 6.15$ mag, sp. A2V, according to Simbad database) was used as a comparison star. As check stars to control the non-variability of this star we used the two following stars HD 1448 and HD 1848 (see Fig. 1 left). No visible variabilities between these three stars were observed. The final result is presented in Fig. 2, where the phase light curves in B, V and R_c filters are plotted (the period 5.5392 days was used). We assumed that the minimum is detectable in all filters, and the light curve is well covered at least in R_c filter. Despite the scatter in each filter is circa 0.01 mag, there has not been detected any observable photometric decrease. No minimum occurred during these 19 nights of observations (more than 100 hours of observations in total). The PDM spectrum of our observations as well as of Hipparcos data are plotted in Fig. 1 right. The result is that the orbital period of the system is different than presumed on the basis of the Hipparcos data. Using the Hipparcos photometry, the period could be also a different one, about 5.876 or 6.06 days (see the different minima in the PDM spectrum in Fig. 1 right and also the Hipparcos light curves in Fig. 3). According to our new observations only, one is not able to judge whether the orbital period is one of the suggested periods above or other one, further photometric observations are still needed.

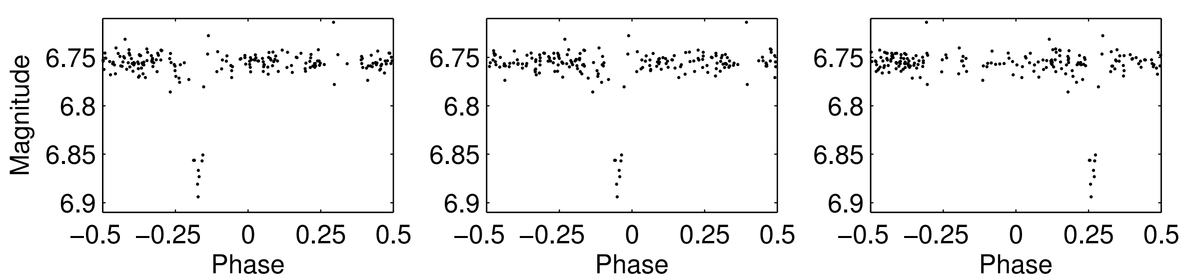

Figure 3. The light curves of V348 And according to the Hipparcos data, the periods 5.5392, 5.876, and 6.06 days were used, respectively (from left to right).

HD 1438. Another interesting result from the observing campaign of V348 And was the discovery of a photometric variability of the star HD 1438 (= 26 And A = HR 70 = HIP 1501, R.A.=$00^h18^m42^s$, Decl.=+43°47′28″, J2000.0, V = 6.11 mag, sp. B8V, according to Simbad database). This star is about 30 arc minutes distant from V348 And.

The star is a primary component of an astrometric binary ADS 254, while the secondary (NSV 119) is about 4 magnitudes fainter and circa 6.″2 distant. No changes in position angles of the two components have been detected yet, so its possible orbital period is more than a thousand years. Baize (1962) mentioned a possible long-term photometric variation of the secondary component. This variation is very slow (9.5 mag in 1845, 11.0 mag in 1913, 12.0 mag in 1934, 11.2 mag in 1959) and has not been explained so far. The spectral types were estimated as B8V+F3V (according to Lindroos, 1985 and Wyatt, 2003), while Soderblom et al. (1991) presented the spectral types B8V+dG0. Wyatt (2003) also derived a distance of the system about 212 pc, and investigated a possible presence of a dust disc around the star. The submillimeter observations of the star indicate presence of the disc with the temperature about 100 K with its total mass about 0.05 $M_\oplus$.

Our new photometric observations of the star from the same time epoch as V348 And indicate a shallow photometric variability (see Fig. 4). Such a variability has an amplitude about only 0.015 mag, but despite this fact, it is clearly visible in all B, V and R_c filters. Its period is about 1.6 days.

The nature of these variations could be explained by presence of a pulsating component in the system. Due to the small telescope used (because of the high brightness of the stars), the components A and B could not be resolved into separate stars and one is not able to judge, whether the variable component is the primary, or the secondary one.

There could be also an alternative explanation of the variability. Almost sinusoidal oscillations could be also described as ellipsoidal variations (close binary with tidally distorted stars, where the components are not eclipsing each other). This solution was presented in Fig. 4 with the theoretical fit, while the parameters of such fit are in Table 1. The final period of such variation is therefore doubled, about 3.16 days.

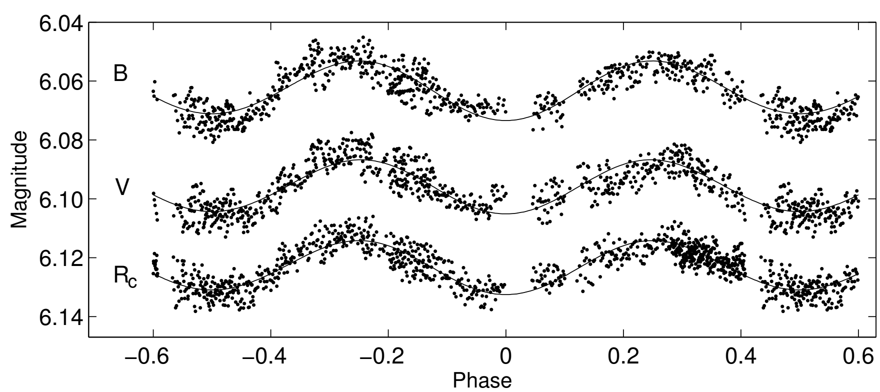

Figure 4. The B, V and R_c light curves of HD 1438.

Altogether there are 806 (B), 855 (V) and 1040 (R_c) observations, respectively. The data files are available through the IBVS website as `5827-t5` – `5827-t7.txt`. For analysis the PHOEBE programme (see e.g. Prša & Zwitter, 2005), based on the Wilson-Devinney algorithm (Wilson & Devinney, 1971), was used. The value of the mass ratio was estimated via the "q-search" method, see Fig. 5 for the sums of squares in the individual passbands as a function of the mass ratio. This value results in $q = 0.7 \pm 0.2$. The temperature of the primary was fixed at the typical value for B8V stars (11600 K, see

Harmanec, 1988). The amount of the third light was also computed, but its contribution to the total light is only very small (below 1 percent) and such a low value is comparable with its respective error. The value of the third light reveals that the variable is the primary component. Nevertheless, further observations are still needed, especially the spectroscopic ones to confirm the nature of this system.

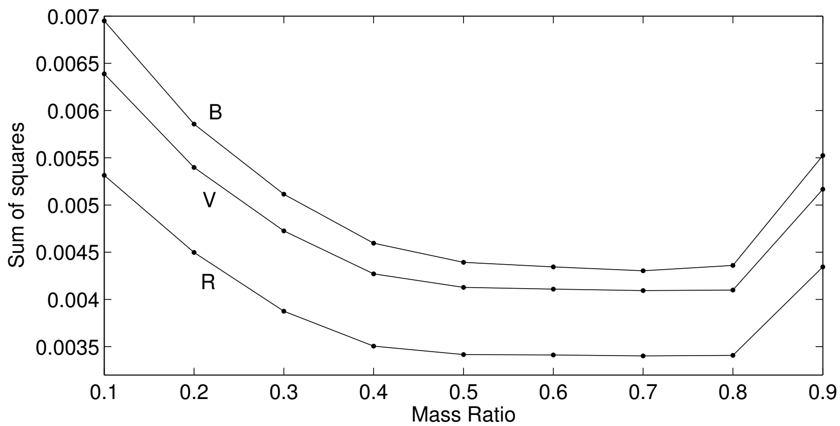

Figure 5. Sum of squares as a function of the mass ratio.

Table 1. The physical parameters of HD 1438.*

Parameter	Value	Parameter	Value
HJD_0	2454360.21 ± 0.05	T_1/T_2	> 2.68
P [day]	3.163063 ± 0.000002	r_1/r_2	0.77
i [deg]	38.8 ± 3.9	Ω^{L1}_{crit}	3.24
L_1/L_2 (B)	63 ± 3	Ω^{L2}_{crit}	2.84
L_1/L_2 (V)	343 ± 32	Ω_1	4.18 ± 0.16
L_1/L_2 (R_c)	188 ± 14	Ω_2	3.11 ± 0.24

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OPTICAL SPECTROSCOPY SN 2007gr OF TYPE Ic

TARASOVA, T. N.

Crimean Astrophysical Observatory, Crimea, Nauchnyj, Ukraine; email: taya@crao.crimea.ua

SN 2007gr was discovered on 2007 August 15.51 UT (Li et al., 2007) in NGC 1058 which is a member of a group of nearby galaxies. The distance to this galaxy is 10.6 ± 1.3 Mpc (Pilyugin et al., 2004). Chornock et al. (2007) classified SN 2007gr as Type Ib/c based on the spectrum obtained on the night after the discovery. The later spectral evolution did not confirm the presence of He, therefore SN 2007gr was classified as Type Ic. This supernova is one of the nearest stripped-envelope SNe ever observed.

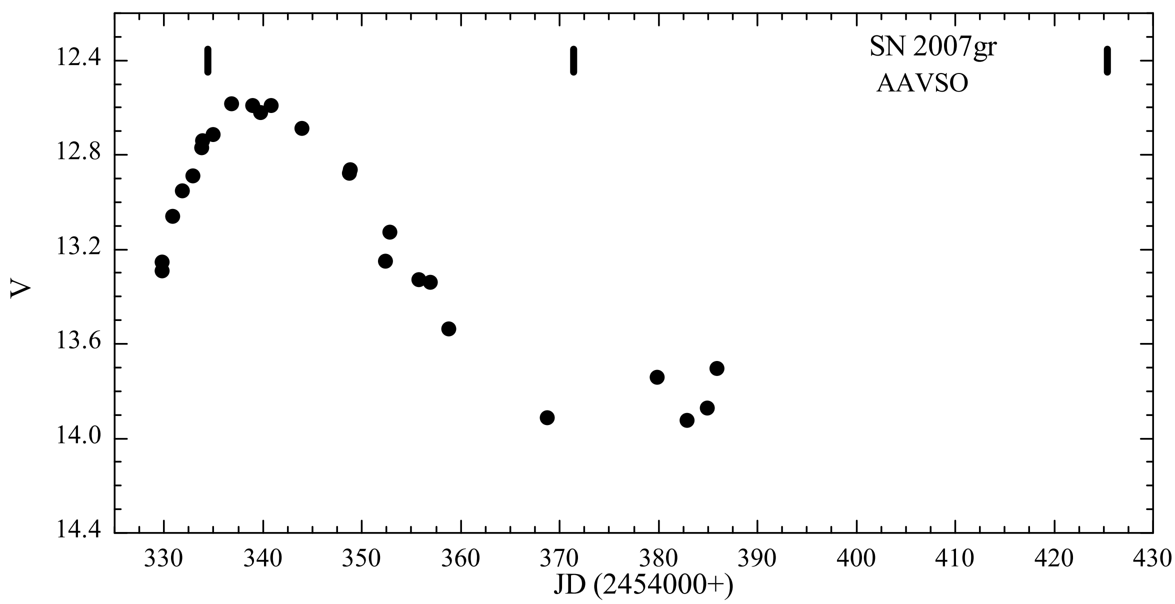

Figure 1. Light curve of SN 2007gr based on AAVSO data. Vertical bars indicate the time of our spectral observations

The spectral observations were carried out at the Crimean Astrophysical Observatory at the Nasmyth focus of the 2.6m Shajn telescope. The spectra with dispersion of 2 Å pix^{-1} were registered in two spectral regions 3700 - 6190 Å, 5600 - 7600 Å and were combined with the exception of the first spectrum. It was obtained on August 21.9 and covered the spectral region 5600 - 7600 Å. The spectral images were processed in standard fashion for CCD frames, including bias subtraction, flat-field corrections, wavelength calibration. The spectrophotometric standard HR 788 (Kharitonov et al., 1988) was used for flux calibration of the SN spectrum.

The light curve of SN 2007gr based on AAVSO data (Henden, 2007) is shown in Fig. 1. The observation span a period of $\sim$ 56 days. A preliminary analysis of the light curve gives V_{max}=12.6 in period from 24 till 28 August. The dates when spectra were taken, are labeled by vertical bars. The first spectrum was obtained before the maximum, the second and the third spectra were taken in the phase of brightness fading. All our spectra are shown in Fig. 2. The spectra are separated vertically by a constant offset.

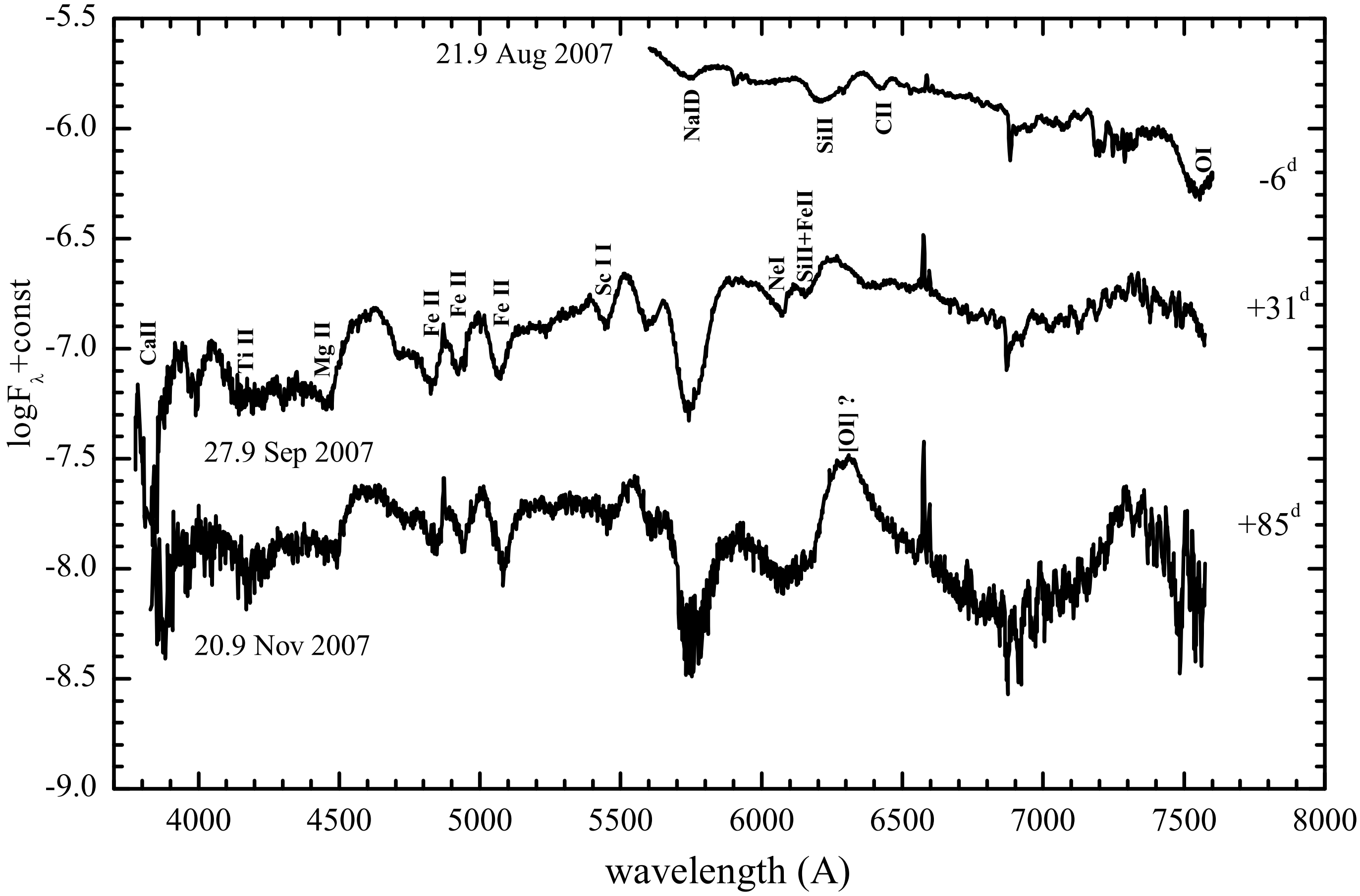

Figure 2. Spectral evolution of SN 2007gr. The lower two spectra are shifted downwards by the const in log (F_λ). Flux F_λ is given in units of $erg\, cm^{-2} s^{-1} \AA^{-1}$. Epochs (days) are given relative to maximum brightness.

The first spectrum obtained for 6 days before the maximum brightness of the supernova shows shallow absorption features. The features centered at 5750 Å and 6200 Å are identified as NaID and SiII 6355 Å, respectively. The feature centered at 6430 Å is more likely identified as CII 6580 Å and the feature centered at 7550 Å is possibly identified as OI. The feature centered at 6430 Å was first identified by Chornock et al. (2007) as HeI. The later spectral evolution did not confirm the identification of this line as HeI. Therefore SN 2007gr was classified as SN Ic. This feature was investigated in detail by Valenti et al. (2008). These authors pointed out that the more likely identification for this line is CII 6580 Å at velocities $\sim$ 11000 km/s.

The subsequent two spectra, obtained on 31st and 85th day after maximum brightness of the supernova are quite similar. The NaID line dominates in the spectra. The absorption features in these spectra are CaII H and K centered at 3810 Å, FeII 4924 Å, 5018 Å, 5169 Å centered at 4830 Å, 4920 Å, 5070 Å, respectively. Moreover, we identified the features centered at 5450 Å, 6070 Å and 6160 Å as Sc 5552 Å, NeI 6217 Å, SiII 6355 Å +FeII 6316 Å, respectively.

Some broad absorption features are also present in the spectra at 6900 Å and the "W"-shaped absorption feature centered at $\sim$ 4300 Å. However, we cannot tell whether the absorption feature centered at 6900 Å is real or it is a result of noise from the telluric bands at 6880 Å. The "W"-shaped absorption feature is observed in many Type I SNe around and after maximum. It is specified by Valenti et al. (2008) as a blend of two spectral lines TiII 4252 Å and MgII 4354 Å.

The spectral line SiII 6355 Å fades on the 31st day and apparently disappears on the 85th day after maximum brightness. It is possible that the SiII is filled by the forbidden lines of [O] 6300 Å, 6364 Å on the 85th day. Therefore we believe that the spectrum taken on the 85th day after maximum brightness of the supernova probably displays the first signs of the nebular stage.

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NEW OUTBURST OF V1118 Ori (2007-2008)

GARCIA, JOSE GARCIA[1]; PARSAMIAN, ELMA S.[2]

[1] Tamarindo, 5, 41089 Dos Hermanas, Sevilla, Spain e-mail: garciados@infonegocio.com

[2] V. Ambartsumian Byurakan Astrophysical Observatory, Armenia e-mail: elma@sci.am, eparsam@bao.sci.am

Name of the object:
V1118Ori

Equatorial coordinates:	**Equinox:**
R.A.= $5^h34^m44\overset{s}{.}2$ **DEC.=** $-5°33'40''$	2000

Observatory and telescope:
Private obs., Sevilla(Spain) with Schmidt-Cassegrain tel.

Detector:	CCD Camera

Filter(s):	V

Date(s) of the observation(s):
2007.02.09 – 2008.21.02

Comparison star(s):	Parenago 1492,1518,1540,1600,1641

Availability of the data:
Available at the IBVS website (`5829-t1.txt`)

Type of variability:	EXor

Remarks:
Since 1983, the discovery, V1118 Ori became known as an EXor or Subfuor (Parsamian and Gasparian, 1987; Herbig, 1990). We have information concerning its outbursts the periods 1983-84 (Kosai, 1983; Hurst et al., 1984; Parsamian and Gasparian, 1987), 1988-90 (Parsamian et al., 1993; Parsamian et al., 1996), 1992-94 (Garcia Garcia, Mampaso and Parsamian, 1995; Parsamian et al., 2002), 1996-98 (Hayakawa et al., 1998; Garcia Garcia and Parsamian, 2000), 2004-06 (Waagen et al., 2005; Williams et al., 2005; Garcia Garcia et al., 2006). New observations show, that V1118 Ori started brightening at 12.10.2007 until reached its maximum of V=$15\overset{m}{.}3$, then decreased. Some fluctuations of the brightness are observed. The last observation at 10.02.2008 is V=$16\overset{m}{.}11$.

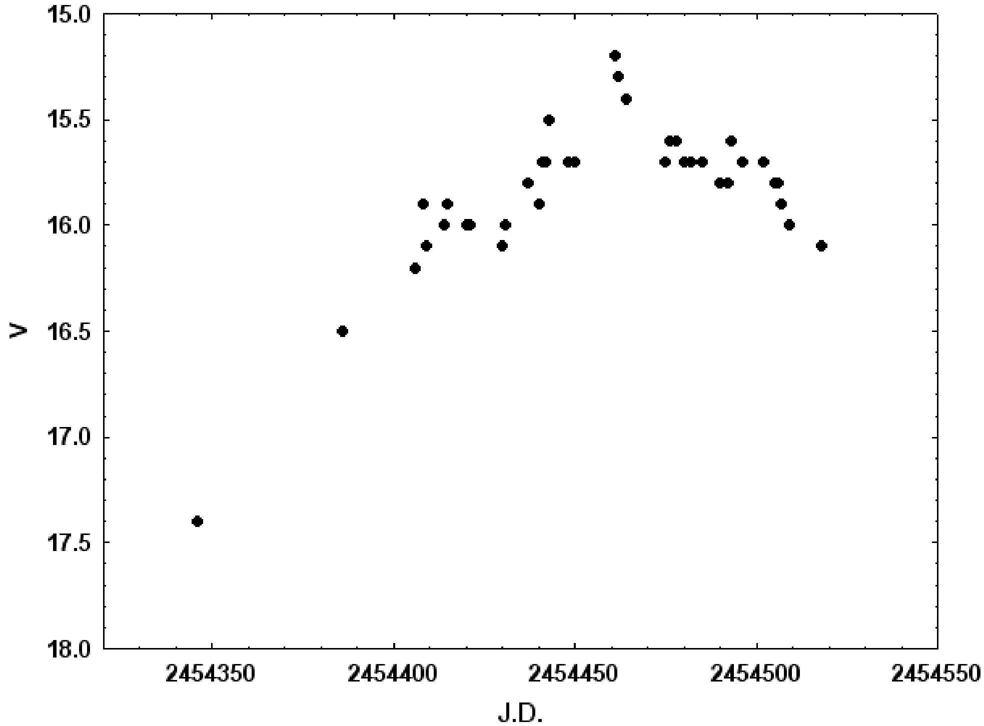

Figure 1.

Reference:

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BAV-RESULTS OF OBSERVATIONS - PHOTOELECTRIC MINIMA OF SELECTED ECLIPSING BINARIES AND MAXIMA OF PULSATING STARS

(BAV MITTEILUNGEN NO. 193)

HÜBSCHER, JOACHIM; STEINBACH, HANS-MEREYNTJE; WALTER, FRANK

Bundesdeutsche Arbeitsgemeinschaft für Veränderliche Sterne e.V. (BAV), Munsterdamm 90, 12169 Berlin, Germany

In this 60th compilation of BAV results, photoelectric observations obtained in the years 2007 are presented on 292 variable stars giving 399 minima on eclipsing binaries and maxima on pulsating stars. All moments of minima and maxima are heliocentric. The errors are tabulated in column '±'. The values in column '$O-C$' are determined without incorporation of nonlinear terms. The references are given in the section 'Remarks'. All information about photometers and filters are specified in the column 'Rem'. The observations were made at private observatories. The photoelectric measurements and all the lightcurves with evaluations can be obtained from the office of the BAV for inspection.

Table 1: Minima of Eclipsing binaries

Variable	Min HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
RT And	54304.4365	.0032	AG	-0.0038	s	GCVS 85	-Ir	23	1)
TW And	54338.5491	.0040	FR	$+2.0333$		GCVS 85	-Ir	15	7)
XZ And	54429.2461	.0002	JU	$+0.1654$		GCVS 85		93	2)
AD And	54360.4324	.0006	AG	-0.0464		GCVS 85	-Ir	37	1)
AP And	54360.5174	.0008	AG				-Ir	38	1)
BD And	54390.4269	.0016	AG	$+0.0174$		GCVS 85	-Ir	39	1)
BL And	54382.5480	.0021	AG	$+0.0139$	s	GCVS 85	-Ir	56	1)
	54390.4839	.0029	AG	$+0.0037$	s	GCVS 85	-Ir	37	1)
CU And	54390.6056	.0016	AG				-Ir	37	1)
EX And	54360.4979	.0027	AG				-Ir	37	1)
GK And	54360.3951	.0012	AG	-0.2879		GCVS 85	-Ir	39	1)
	54366.4259	.0005	AG	-0.2852		GCVS 85	-Ir	45	1)
GZ And	54433.3182	.0010	JU	-0.0069		GCVS 85		87	2)
LO And	54360.4212	.0018	AG	$+0.0486$		GCVS 85	-Ir	38	1)
	54360.6123	.0016	AG	$+0.0492$	s	GCVS 85	-Ir	38	1)
V404 And	54380.3651	.0008	JU					86	2)
	54381.3781	.0011	JU					143	2)
V412 And	54360.3313	.0022	AG				-Ir	39	1)
	54423.3193	.0005	JU					100	2)
V425 And	54360.5331	.0005	AG				-Ir	21	1)
	54390.3693	.0018	AG				-Ir	36	1)
CD Aqr	54383.3949	.0027	FR	$+0.0591$		GCVS 85	V	35	5)
CX Aqr	54410.2498	.0005	DIE	$+0.0085$		GCVS 85	o	23	8)
FK Aql	54327.4958	.0013	AG	-0.0494		GCVS 85	-Ir	27	1)

Table 1: (cont.)

Variable	Min HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
QY Aql	54312.4466	.0016	AG	−0.1623		GCVS 85	-Ir	34	1)
V346 Aql	54380.4465	.0008	WN	−0.0103		GCVS 85	V	72	10)
	54389.2972	.0005	WN	−0.0106		GCVS 85	V	101	10)
V416 Aql	54327.4767	.0004	AG				-Ir	27	1)
V417 Aql	54326.5044	.0001	AG	−0.0504		BAVR 33,152ff	-Ir	36	1)
	54327.4272	.0005	AG	−0.0534	s	BAVR 33,152ff	-Ir	27	1)
V609 Aql	54389.3821	.0022	AG	−0.0341	s	GCVS 85	-Ir	25	1)
V724 Aql	54297.4885	.0009	AG	−0.0275		IBVS 3555	-Ir	44	1)
V761 Aql	54314.4620	.0007	AG	+0.0961		GCVS 85	-Ir	28	1)
	54375.4147	.0002	AG	+0.0962		GCVS 85	-Ir	26	1)
	54389.3152	.0019	AG	+0.0953		GCVS 85	-Ir	25	1)
V803 Aql	54325.4462	.0006	AG				-Ir	50	1)
V804 Aql	54325.4229	.0011	AG				-Ir	53	1)
V829 Aql	54297.5404	.0012	AG				-Ir	44	1)
V970 Aql	54327.4718	.0013	AG				-Ir	27	1)
V1045 Aql	54312.5144	.0006	AG				-Ir	35	1)
	54389.2953	.0035	AG				-Ir	25	1)
V1075 Aql	54312.4118	.0006	AG				-Ir	35	1)
	54375.4020	.0031	AG				-Ir	26	1)
	54382.4545	.0025	AG				-Ir	24	1)
V1096 Aql	54377.3405	.0005	AG	−0.2733		GCVS 85	-Ir	20	1)
	54382.3398	.0028	AG	−0.2752	s	GCVS 85	-Ir	24	1)
V1097 Aql	54314.4436	.0017	AG				-Ir	28	1)
	54382.4512	.0030	AG				-Ir	24	1)
V1243 Aql	54296.3491	.0017	AG				-Ir	33	1)
V1299 Aql	54389.4095	.0034	AG				-Ir	47	1)
V1430 Aql	54389.3923	.0005	QU	−0.0091		AJ 119,2391	V	68	3)
V1538 Aql	54326.3882	.0008	AG	−0.0763		BAVM 140	-Ir	32	1)
	54327.4707	.0034	AG	−0.0656		BAVM 140	-Ir	27	1)
V1542 Aql	54314.4436	.0005	QU	+0.0083	s	IBVS 5161	V	85	3)
SS Ari	54389.3208	.0004	DIE	−0.0450	s	GCVS 85	o	22	8)
BC Aur	54406.355 :	.002	FR	−0.662		GCVS 85	V	122	5)
	54455.320 :	.004	FR	−0.656	s	GCVS 85	V	33	5)
FR Aur	54164.3736	.0040	FR	−0.5263		GCVS 85	-Ir	25	7)
V432 Aur	54389.670 :	.001	FR	+1.538		IBVS 5319	-Ir	74	7)
AC Boo	54313.4732	.0003	QU	−0.0498	s	GCVS 85	Ic	59	3)
AM CMi	54491.3984	.0010	QU	+0.1839		GCVS 85	V	64	3)
AX Cas	54367.4688	.0005	AG	−0.0942		GCVS 85	-Ir	61	1)
	54388.4835	.0010	AG	−0.0927		GCVS 85	-Ir	45	1)
	54390.2831	.0012	JU	−0.0942		GCVS 85		80	2)
BN Cas	54308.5023	.0004	AG				-Ir	25	1)
BS Cas	54308.3991	.0010	AG	−0.0153		IBVS 4778	-Ir	21	1)
	54319.4105	.0011	AG	−0.0157		IBVS 4778	-Ir	20	1)
BU Cas	54367.3529	.0016	AG	−0.0218		GCVS 85	-Ir	61	1)
EN Cas	54374.4475	.0032	AG	+0.2854		GCVS 85	-Ir	26	1)
GU Cas	54374.4400	.0025	AG	−0.3306		GCVS 85	-Ir	25	1)
IR Cas	54382.5845	.0013	AG	+0.0087	s	GCVS 85	-Ir	55	1)
IT Cas	54363.4056	.0005	QU	+0.0599		GCVS 85	V	76	3)
MV Cas	54374.4157	.0001	AG				-Ir	22	1)
NN Cas	54374.4781	.0006	AG				-Ir	22	1)
OR Cas	54388.4555	.0010	AG	−0.0201	s	GCVS 85	-Ir	40	1)
OX Cas	54357.4099	.0007	QU	+0.0253	s	GCVS 85	V	86	3)
	54367.3670	.0010	QU	+0.0250	s	GCVS 85	V	68	3)
	54388.4781	.0017	JU	+0.0066		GCVS 85		84	2)
	54388.4815	.0010	AG	+0.0100		GCVS 85	-Ir	40	1)
PV Cas	54327.4053	.0004	QU	−0.0338		GCVS 85	V	56	3)
	54356.3195	.0013	JU	+0.0326	s	GCVS 85	o	60	2)
	54453.4343	.0005	QU	−0.0387		GCVS 85	V	66	3)
	54454.3466	.0005	QU	+0.0334	s	GCVS 85	V	85	3)
V336 Cas	54374.4041	.0008	AG				-Ir	24	1)

Table 1: (cont.)

Variable	Min HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
V345 Cas	54382.3855	.0007	AG				-Ir	56	1)
V360 Cas	54374.3776	.0003	AG				-Ir	25	1)
V366 Cas	54388.4234	.0014	AG	−0.0651	s	IBVS 4798	-Ir	24	1)
V374 Cas	54374.5153	.0043	AG				-Ir	27	1)
V375 Cas	54378.3655	.0047	JU	+0.1988		BAVR 32,36ff		21	2)
	54462.3479	.0025	QU	+0.1986		BAVR 32,36ff	V	80	3)
V381 Cas	54317.4657	.0007	QU	+0.0144	s	BAVR 32,36ff	V	91	3)
	54366.3507	.0012	AG	+0.0130	s	BAVR 32,36ff	-Ir	47	1)
	54455.3928	.0007	QU	+0.0120	s	BAVR 32,36ff	V	95	3)
V387 Cas	54319.4450	.0012	AG	+0.0757		GCVS 85	-Ir	20	1)
	54388.6029	.0007	AG	+0.0806		GCVS 85	-Ir	45	1)
V396 Cas	54366.3791	.0022	AG				-Ir	33	1)
V427 Cas	54366.5402	.0016	AG				-Ir	34	1)
V459 Cas	54367.2818	.0009	AG	−0.0127		IBVS 4737	-Ir	77	1)
	54388.3609	.0006	AG	−0.0793	s	IBVS 4737	-Ir	46	1)
V471 Cas	54388.4234	.0015	SCI	−0.0134	s	GCVS 85	o	29	2)
	54388.6253	.0014	SCI	+0.0205		GCVS 85	o	25	2)
V523 Cas	54366.2982	.0026	AG	−0.0409		GCVS 85	-Ir	47	1)
	54366.4144	.0007	AG	−0.0416	s	GCVS 85	-Ir	47	1)
	54366.5319	.0009	AG	−0.0409		GCVS 85	-Ir	47	1)
V860 Cas	54366.4445	.0002	AG				-Ir	47	1)
SU Cep	54382.4856	.0004	FR	+0.0100		GCVS 85	-Ir	31	7)
WY Cep	54385.3619	.0010	AG	+0.0225	s	GCVS 85	-Ir	55	1)
XX Cep	54364.3851	.0017	JU	−0.0230		GCVS 85		75	2)
XY Cep	54298.4091	.0007	AG	−0.0406		GCVS 85	-Ir	74	1)
ZZ Cep	54360.3942	.0007	JU	−0.0106		GCVS 85	o	32	2)
AI Cep	54382.4797	.0012	FR	+0.1666		GCVS 85	-Ir	31	7)
BE Cep	54366.4791	.0008	AG				-Ir	34	1)
BU Cep	54385.3590	.0027	AG				-Ir	57	1)
CW Cep	54387.3616	.0016	FR	−0.0064		GCVS 85	-Ir	60	7)
	54432.3890	.0012	JU	−0.0098	s	GCVS 85		70	2)
DW Cep	54384.3026	.0010	AG	+0.4339		GCVS 85	-Ir	46	1)
EF Cep	54375.3628	.0011	AG	−0.1519		GCVS 85	-Ir	110	1)
GS Cep	54366.3923	.0017	AG	+0.0647		GCVS 85	-Ir	33	1)
IM Cep	54338.4893	.0012	AG				-Ir	38	1)
NW Cep	54357.3526	.0015	AG	−0.4231		GCVS 85	-Ir	39	1)
Y Cyg	54314.4350	.0031	WTR	−0.0789		GCVS 85	-Ir	85	9)
	54314.4370	.0003	FR	−0.0769		GCVS 85	-Ir	40	7)
	54410.320	.007	JU	−0.077		GCVS 85		48	2)
SY Cyg	54365.3278	.0006	AG				-Ir	58	1)
AE Cyg	54359.5073	.0004	AG	−0.0052		GCVS 85	-Ir	37	1)
	54363.3841	.0008	JU	−0.0052		GCVS 85		61	2)
BO Cyg	54367.3920	.0038	SCI	+0.0847		GCVS 85	o	86	2)
	54367.3984	.0002	WTR	+0.0911		GCVS 85	-Ir	142	9)
	54388.4737	.0007	QU	+0.0917		GCVS 85	V	86	3)
	54388.4742	.0008	FR	+0.0922		GCVS 85	-Ir	22	7)
CG Cyg	54338.4117	.0012	AG	+0.0589		GCVS 85	-Ir	36	1)
	54388.2699	.0006	DIE	+0.0570		GCVS 85	o	22	8)
DK Cyg	54360.3930	.0015	AG	+0.0498		BAVR 35,1ff	-Ir	35	1)
DO Cyg	54364.3655	.0003	AG				-Ir	65	1)
EN Cyg	54326.5230	.0011	AG				-Ir	21	1)
GG Cyg	54365.3636	.0012	AG	+0.1246		GCVS 85	-Ir	30	1)
	54367.3791	.0036	FR	+0.1318		GCVS 85	-Ir	12	7)
GV Cyg	54312.4833	.0006	AG				-Ir	25	1)
KR Cyg	54313.4927	.0036	FR	+0.0077	s	GCVS 85	-Ir	22	7)
	54338.4286	.0004	QU	+0.0116		GCVS 85	V	70	3)
KV Cyg	54366.4142	.0030	SCI	+0.0513		GCVS 85	o	126	2)
LO Cyg	54356.3690	.0027	SCI				o	42	2)
	54360.4501	.0038	SCI				o	72	2)
	54366.4243	.0013	JU					117	2)

Table 1: (cont.)

Variable	Min HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
LO Cyg	54367.3725	.0015	JU					85	2)
	54378.3580	.0021	SCI				o	36	2)
	54382.4737	.0047	SCI				o	85	2)
MR Cyg	54337.5270	.0013	AG	+0.0013		GCVS 85	-Ir	28	1)
NU Cyg	54380.3713	.0021	SCI				o	33	2)
V385 Cyg	54338.4560	.0011	AG	−0.1287		GCVS 85	-Ir	35	1)
V387 Cyg	54360.4336	.0017	AG	+0.0173	s	GCVS 85	-Ir	37	1)
V388 Cyg	54316.5253	.0031	SCI	−0.1368		BAVR 32,36ff	o	175	2)
V398 Cyg	54307.4549	.0028	SCI				o	18	2)
V445 Cyg	54317.4805	.0013	SCI				o	29	2)
V447 Cyg	54365.4161	.0014	AG				-Ir	29	1)
V466 Cyg	54298.5030	.0002	AG	+0.0051		GCVS 85	-Ir	29	1)
V488 Cyg	54313.4696	.0037	FR	+0.0698	s	GCVS 85	-Ir	27	7)
V493 Cyg	54240.5680	.0030	SCI	+0.1205		GCVS 85	o	55	2)
V496 Cyg	54339.3447	.0013	AG				-Ir	32	1)
V526 Cyg	54357.5429	.0013	AG	+0.0423		GCVS 85	-Ir	56	1)
V620 Cyg	54360.5110	.0010	AG				-Ir	38	1)
V628 Cyg	54357.4216	.0008	AG	−0.0033		IBVS 4381	-Ir	29	1)
V642 Cyg	54389.3947	.0030	SCI	+0.3097		GCVS 85	o	52	2)
V680 Cyg	54364.4335	.0007	AG	+0.0209		BAVR 32,36ff	-Ir	64	1)
V711 Cyg	54337.4126	.0048	AG				-Ir	28	1)
V725 Cyg	53991.5511	.0064	FR	+0.2672	s	GCVS 85	-Ir	40	7)
	54365.3803	.0004	AG	+0.2386		GCVS 85	-Ir	29	1)
V743 Cyg	54296.4533	.0005	AG				-Ir	36	1)
	54298.4947	.0014	AG				-Ir	28	1)
V873 Cyg	54360.3840	.0008	FR				V	36	5)
V909 Cyg	54339.5051	.0016	AG	−0.0163	s	BAVR 47,2f	-Ir	23	1)
V959 Cyg	54366.4486	.0008	FR	−0.0455		GCVS 85	-Ir	21	7)
V961 Cyg	54298.5115	.0008	AG	−0.0887	s	GCVS 85	-Ir	28	1)
V962 Cyg	54326.3665	.0007	AG				-Ir	18	1)
V965 Cyg	54366.5301	.0104	FR				V	40	5)
V975 Cyg	54339.5311	.0004	AG				-Ir	22	1)
V979 Cyg	54327.4578	.0003	FR	+0.0297		GCVS 85	o	52	7)
	54365.3892	.0006	FR	+0.0298	s	GCVS 85	V	93	5)
	54365.5703	.0014	FR	+0.0240		GCVS 85	V	93	5)
	54367.4442	.0004	FR	+0.0294		GCVS 85	V	53	5)
V995 Cyg	54365.4626	.0044	SCI				o	124	2)
V1004 Cyg	54339.4707	.0032	AG	−0.1547		GCVS 85	-Ir	19	1)
V1013 Cyg	54298.5203	.0035	AG				-Ir	29	1)
V1018 Cyg	54339.4272	.0015	AG	−0.0844		GCVS 85	-Ir	23	1)
	54365.4057	.0021	AG	−0.0847		GCVS 85	-Ir	31	1)
V1136 Cyg	54365.5417	.0052	AG	+0.4102	s	GCVS 85	-Ir	28	1)
V1147 Cyg	54327.5350	.0004	FR				o	49	5)
	54367.3615	.0015	FR				V	53	5)
V1171 Cyg	54298.4576	.0008	AG	−0.0490		GCVS 85	-Ir	28	1)
	54339.3941	.0023	AG	−0.0520		GCVS 85	-Ir	22	1)
V1411 Cyg	54312.5167	.0013	AG	−0.1749	s	GCVS 85	-Ir	25	1)
	54337.3742	.0009	AG	−0.1730	s	GCVS 85	-Ir	31	1)
V1414 Cyg	54312.4600	.0009	AG				-Ir	25	1)
V1508 Cyg	54367.4218	.0068	FR	+0.1776	s	GCVS 85	-Ir	21	7)
V1723 Cyg	54360.5432	.0001	AG				-Ir	38	1)
V1815 Cyg	54405.3557	.0003	WTR	+0.0034	s	BAVR 55,1ff	-Ir	124	9)
V1918 Cyg	54343.4492	.0004	QU				V	60	3)
V2181 Cyg	54296.4650	.0007	AG	+0.0097		BAVR 50,45f	-Ir	36	1)
	54312.5221	.0007	FR	+0.0093		BAVR 50,45f	-Ir	35	7)
RR Del	54308.4971	.0564	AG	+0.3272		GCVS 85	-Ir	17	1)
TY Del	54357.3902	.0001	WTR	+0.0520		GCVS 85	-Ir	113	9)
YY Del	54313.4304	.0005	AG	+0.0105		GCVS 85	-Ir	22	1)
	54375.2910	.0004	AG	+0.0099		GCVS 85	-Ir	27	1)
AL Del	54327.3837	.0018	AG				-Ir	46	1)

Table 1: (cont.)

Variable	Min HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
AL Del	54385.3184	.0023	AG				-Ir	25	1)
AV Del	54313.4899	.0003	AG	+0.0684		GCVS 85	-Ir	25	1)
BG Del	54381.4017	.0008	AG				-Ir	34	1)
BH Del	54313.3929	.0015	AG				-Ir	24	1)
BO Del	54327.4551	.0023	AG				-Ir	40	1)
BS Del	54385.3014	.0030	AG				-Ir	23	1)
BW Del	54308.5096	.0001	AG				-Ir	18	1)
	54325.4742	.0006	AG				-Ir	28	1)
BY Del	53991.3364	.0013	AG				-Ir	42	1)
	54327.5372	.0024	AG				-Ir	55	1)
CR Del	54313.4321	.0033	AG				-Ir	22	1)
DM Del	54327.3988	.0013	AG	−0.1061		GCVS 85	-Ir	40	1)
TZ Dra	54318.4417	.0004	QU	−0.0231		GCVS 85	V	66	3)
BE Dra	54389.4211	.0007	AG	+0.1309		GCVS 85	-Ir	116	1)
BF Dra	54389.5933	.0012	AG	+0.0435		GCVS 85	-Ir	116	1)
BO Gem	54433.4070	.0008	FR				V	34	5)
CW Gem	54454.3417	.0034	FR	+0.0190	s	BAVM 69	V	48	5)
IM Gem	54454.5509	.0016	FR				V	78	5)
ES Her	54368.3449	.0006	AG				-Ir	34	1)
LV Her	54297.4498	.0008	AG	−0.0146		GCVS 85	-Ir	34	1)
PW Her	54391.4184	.0050	AG	−0.2543		BAVM 68	-Ir	62	1)
V342 Her	54317.3829	.0003	WTR	+0.0147		GCVS 85	-Ir	76	9)
V381 Her	54297.4702	.0025	AG				-Ir	34	1)
V387 Her	54297.5300	.0006	AG	+0.0779	s	GCVS 85	-Ir	34	1)
V1052 Her	54297.5439	.0008	AG				-Ir	34	1)
V1073 Her	54368.2663	.0003	AG				-Ir	34	1)
AW Lac	54357.3499	.0036	AG	+0.0345	s	BAVR 35,1ff	-Ir	38	1)
CG Lac	54390.4151	.0039	AG				-Ir	37	1)
CN Lac	54312.4526	.0012	AG	−0.0314		GCVS 85	-Ir	25	1)
CO Lac	54348.4255	.0011	JU	−0.0091		GCVS 85	o	77	2)
	54389.3097	.0011	JU	+0.0066	s	GCVS 85		71	2)
CY Lac	54357.5236	.0018	AG				-Ir	39	1)
EK Lac	54337.4481	.0025	AG	−0.0050		GCVS 85	-Ir	32	1)
EM Lac	54357.4775	.0005	AG	+0.0672	s	GCVS 85	-Ir	38	1)
EO Lac	54384.1767	.0100	AG				-Ir	51	1)
EP Lac	54368.3881	.0012	AG	−0.3681		GCVS 85	-Ir	46	1)
ES Lac	54359.4243	.0032	AG				-Ir	46	1)
	54368.3363	.0017	AG				-Ir	33	1)
EY Lac	54000.5040	.0200	AG				-Ir	31	1)
	54384.3213	.0020	AG				-Ir	21	1)
FI Lac	54384.3232	.0024	AG				-Ir	19	1)
FL Lac	54390.3114	.0017	AG	−0.0615		GCVS 85	-Ir	39	1)
GX Lac	54366.4544	.0013	AG				-Ir	34	1)
IP Lac	54364.3813	.0008	AG				-Ir	65	1)
	54381.4290	.0105	AG				-Ir	27	1)
KS Lac	54384.4327	.0017	AG				-Ir	20	1)
MZ Lac	53150.4765	.0020	AG	−0.3368	s	GCVS 85	o	17	1)
	54363.4283	.0017	AG	−0.3623	s	GCVS 85	-Ir	17	1)
NW Lac	54357.3723	.0011	AG				-Ir	38	1)
	54363.4165	.0009	AG				-Ir	16	1)
PP Lac	54359.3951	.0009	AG	−0.0504	s	GCVS 85	-Ir	45	1)
	54359.5939	.0005	AG	−0.0522		GCVS 85	-Ir	45	1)
V339 Lac	54363.4373	.0014	AG				-Ir	16	1)
V345 Lac	54359.4912	.0026	AG	+0.0841		GCVS 85	-Ir	45	1)
TT Lyr	54357.4341	.0007	JU	+0.0138		GCVS 85	o	54	2)
UZ Lyr	54343.4567	.0008	JU	−0.0239		GCVS 85	o	70	2)
BV Lyr	54306.4358	.0010	JU				o	60	2)
FT Ori	54494.3957	.0007	QU	−0.1188	s	GCVS 85	V	95	3)
U Peg	54359.3910	.0016	ALH	−0.0122		BAVR 45,3	o	556	4)
ZZ Peg	54387.4392	.0022	FR	+0.1448	s	GCVS 87	V	46	5)

Table 1: (cont.)

Variable	Min HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
AT Peg	54356.4011	.0007	ALH	+0.0238		GCVS 87	o	384	4)
BB Peg	54360.3206	.0004	DIE	−0.0008		GCVS 87	o	22	8)
BY Peg	54382.3404	.0012	FR				V	41	5)
	54382.5125	.0017	FR				V	41	5)
	54440.3001	.0004	FR				V	40	5)
CC Peg	54388.4508	.0039	FR	−0.0147	s	IBVS 5017	V	42	5)
	54440.2398	.0015	FR	−0.0048		IBVS 5017	V	63	5)
CU Peg	54367.5832	.0012	AG				-Ir	35	1)
DP Peg	54367.3956	.0016	AG				-Ir	33	1)
GH Peg	54381.4274	.0007	QU	+0.0054		GCVS 87	V	86	3)
RT Per	54452.2871	.0003	JU	+0.0587		GCVS 87		80	2)
AG Per	54450.3227	.0016	JU	+0.1276		GCVS 87		87	2)
IU Per	54453.3739	.0006	JU	+0.0099		GCVS 87		99	2)
KN Per	54462.388	.008	WTR	+0.009	s	BAVR 52,93ff	-Ir	121	9)
LS Per	54390.4651	.0004	AG				-Ir	49	1)
V366 Per	54390.4871	.0047	AG				-Ir	50	1)
V449 Per	54390.4826	.0022	AG	+0.0462		GCVS 87	-Ir	48	1)
V Sge	54388.3306	.0006	AG	−0.0456		GCVS 87	-Ir	30	1)
SY Sge	54325.5419	.0035	AG	+0.1527		GCVS 87	-Ir	28	1)
UZ Sge	54314.4972	.0008	AG				-Ir	28	1)
	54365.4585	.0002	AG				-Ir	45	1)
	54375.4165	.0018	AG				-Ir	28	1)
CK Sge	54304.4361	.0015	AG				-Ir	30	1)
CW Sge	54375.3398	.0018	AG	+0.0112		GCVS 87	-Ir	27	1)
DK Sge	54304.3875	.0016	AG				-Ir	30	1)
	54388.3316	.0011	AG				-Ir	30	1)
DL Sge	54314.4553	.0009	JU				o	76	2)
FL Sge	54389.3930	.0024	AG				-Ir	25	1)
GN Sge	54365.3538	.0009	AG	+0.0010	s	GCVS 87	-Ir	44	1)
GO Sge	54365.3434	.0031	AG				-Ir	46	1)
	54382.3486	.0015	AG				-Ir	24	1)
DK Sct	54319.4127	.0017	AG	+0.0169		GCVS 87	-Ir	27	1)
EY Sct	54319.5073	.0038	AG				-Ir	26	1)
CD Tau	54432.4747	.0003	SIR	+0.0062		GCVS 87	-Ir	787	6)
CF Tau	54387.6264	.0044	SCI	−0.0030		BAVR 35,1ff	o	99	2)
V Tri	54381.5324	.0009	FR	−0.0025	s	GCVS 87	V	57	5)
RV Tri	54390.3176	.0034	AG	−0.0212	s	GCVS 87	-Ir	50	1)
RR Vul	54359.3461	.0012	AG	−0.0691		GCVS 87	-Ir	37	1)
	54364.3994	.0002	WTR	−0.0665		GCVS 87	-Ir	151	9)
AT Vul	54374.3595	.0100	AG	−0.0778		GCVS 87	-Ir	32	1)
AW Vul	54388.2726	.0018	AG	+0.3903		GCVS 87	-Ir	31	1)
AX Vul	54388.3254	.0008	AG	−0.0296		GCVS 87	-Ir	31	1)
AY Vul	54325.3609	.0004	AG	−0.0719		GCVS 87	-Ir	28	1)
BG Vul	54367.4997	.0008	AG				-Ir	35	1)
BM Vul	54367.3238	.0021	AG				-Ir	36	1)
	54367.5120	.0026	AG				-Ir	36	1)
BP Vul	54325.3939	.0021	AG	−0.0114		GCVS 87	-Ir	28	1)
	54388.4173	.0009	AG	−0.0493	s	GCVS 87	-Ir	31	1)
BS Vul	54318.3781	.0001	WTR	−0.0217		GCVS 87	-Ir	76	9)
BU Vul	54338.3608	.0024	AG	+0.0177		GCVS 87	-Ir	35	1)
	54359.4117	.0011	AG	+0.0159		GCVS 87	-Ir	36	1)
	54387.2948	.0006	DIE	+0.0184		GCVS 87	o	22	8)
CD Vul	54339.3458	.0001	WTR	−0.0004		GCVS 87	-Ir	70	9)
EU Vul	54374.3440	.0005	AG				-Ir	33	1)
FM Vul	54339.4518	.0010	AG	+0.0244		GCVS 87	-Ir	20	1)
FO Vul	54339.4561	.0039	AG				-Ir	19	1)
FR Vul	54339.4133	.0012	AG	−0.0057		GCVS 87	-Ir	17	1)
GI Vul	54339.5355	.0009	AG				-Ir	30	1)
G2038.0293	54271.4084	.0001	FR	+0.0041		BAVM 177	-Ir	49	7)
	54318.4708	.0012	FR	+0.0025		BAVM 177	-Ir	42	7)

Table 1: (cont.)

Variable	Min HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
G2038.0293	54325.4076	.0005	FR	+0.0036		BAVM 177	-Ir	28	7)
	54326.3998	.0009	FR	+0.0049		BAVM 177	-Ir	21	7)
G2656.4286	53611.4344	.0021	AG	−0.0006		IBVS 5900	-Ir	22	1)
	53612.5615	.0031	AG	+0.0007		IBVS 5900	-Ir	25	1)
	53620.4400	.0015	AG	−0.0015		IBVS 5900	-Ir	30	1)
	53637.3236	.0068	AG	−0.0051		IBVS 5900	-Ir	25	1)
	53992.5225	.0022	AG	−0.0009	s	IBVS 5900	-Ir	35	1)
G3089.1247	54252.3742	.0025	FR				-Ir	46	7)
	54252.5172	.0006	FR				-Ir	46	7)
	54337.4197	.0012	FR				-Ir	48	7)
G3679.1920	54319.4570	.0016	AG				-Ir	18	1)
U1125-18642389	54388.3455	.0026	FR				V	41	5)
	54440.3548	.0015	FR				V	31	5)
U1200-13084491	54327.5197	.0012	FR				o	35	5)
	54367.4664	.0020	FR				V	53	5)
U1275-15124020	54312.4256	.0012	AG				-Ir	26	1)
	54357.4836	.0011	AG				-Ir	30	1)
U1275-15134722	54357.3494	.0041	AG				-Ir	30	1)

Table 2: Maxima of Pulsating stars

Variable	Max HJD 24...	±	Obs	$O-C$	Bibliography	Fil	n	Rem
GP And	54450.4247	.0010	WN	+0.0059	GCVS 85	V	51	10)
V341 Aql	54380.3507	.0012	WN	+0.0105	BAVR 45,74	V	85	10)
V525 Aql	54357.3730	.0010	MZ			-Ir	77	2)
V921 Aql	54365.3608	.0010	MZ			-Ir	63	2)
RU Boo	54218.4004	.0008	MZ			-Ir	77	2)
YZ Boo	54381.2786	.0008	WN	+0.0020	GCVS 85	V	68	10)
CU Boo	54203.5081	.0004	MZ			-Ir	113	2)
	54316.3729	.0030	MZ			-Ir	79	2)
RZ Cep	54338.523	.003	AG	−0.037	GCVS 85	-Ir	40	1)
	54385.438	.003	AG	−0.042	GCVS 85	-Ir	55	1)
UY Cyg	54338.447	.003	AG	+0.057	GCVS 85	-Ir	36	1)
XX Cyg	54363.3973	.0012	WN	+0.0024	GCVS 85	V	72	10)
	54380.3901	.0013	WN	+0.0022	GCVS 85	V	41	10)
	54387.4041	.0011	WN	+0.0032	GCVS 85	V	135	10)
DM Cyg	54381.3710	.0014	WN	−0.0036	BAVR 51,98ff	V	87	10)
	54389.3471	.0013	WN	−0.0049	BAVR 51,98ff	V	55	10)
V357 Cyg	54359.598	.003	AG			-Ir	36	1)
V791 Cyg	54339.387 :	.002	FR			V	48	7)
	54360.3481	.0020	FR			V	12	5)
V835 Cyg	54359.544	.003	AG			-Ir	37	1)
V1344 Cyg	54360.399 :	.005	FR			V	15	5)
V1962 Cyg	54381.3434	.0005	MZ			-Ir	72	2)
BX Del	54325.564	.010	AG			-Ir	28	1)
CD Del	54327.535	.003	AG			-Ir	40	1)
CG Del	54381.366	.003	AG			-Ir	31	1)
DX Del	54384.3206	.0017	WN	+0.0566	GCVS 85	V	144	10)
EF Del	54385.460	.003	AG			-Ir	23	1)
EG Del	54385.347	.002	AG	+0.028	GCVS 85	-Ir	23	1)
EH Del	54385.372	.003	AG			-Ir	23	1)
VX Her	54380.2641	.0009	WN	+0.0420	GCVS 85	V	53	10)
VZ Her	54348.3575	.0010	WN	+0.0639	GCVS 85	V	133	10)
	54359.3654	.0010	WN	+0.0636	GCVS 85	V	141	10)
	54363.3277	.0009	WN	+0.0630	GCVS 85	V	90	10)
	54366.4094	.0012	WN	+0.0623	GCVS 85	V	97	10)
V633 Her	53895.3857	.0002	MZ			-Ir	72	2)
CZ Lac	54381.4477	.0012	WN	−0.0589	BAVR 53,12f	V	105	10)
	54404.3367	.0024	WN	−0.0758	BAVR 53,12f	V	154	10)

Table 2: (cont.)

Variable	Max HJD 24...	±	Obs	$O-C$	Bibliography	Fil	n	Rem
Y Lyr	54299.3904	.0020	MZ			-Ir	72	2)
RZ Lyr	54366.3140	.0015	WN	−0.0066	BAVR 48,189	V	106	10)
	54388.3038	.0015	WN	−0.0002	BAVR 48,189	V	129	10)
AQ Lyr	54324.4286	.0010	MZ			-Ir	84	2)
CN Lyr	54381.3281	.0019	WN	+0.0019	BAVR 43,57	V	62	10)
CX Lyr	54362.4056	.0004	MZ	+0.1511	BAVR 49,41	-Ir	76	2)
DI Lyr	54366.3467	.0008	MZ			-Ir	80	2)
LX Lyr	54379.3806	.0004	MZ	+0.0044	BAVR 49,105	-Ir	87	2)
VV Peg	54450.3301	.0018	WN	−0.0253	GCVS 87	V	143	10)
BH Peg	54357.3610	.0012	ALH	+0.0000	BAVR 47,67	o	408	4)
	54387.4691	.0020	WN	−0.0183	BAVR 47,67	V	136	10)
CG Peg	54339.4611	.0005	QU	−0.0278	SAC 72	V	81	3)
CV Peg	54367.327	.003	AG			-Ir	36	1)
DY Peg	54450.3777	.0010	WN	−0.0065	GCVS 87	V	43	10)
SS Psc	54433.4504	.0007	QU	+0.0068	BAVR 47,67	V	69	3)
FI Sge	54381.325	.003	AG			-Ir	36	1)
BT Ser	54318.3878	.0040	MZ			-Ir	80	2)
	54326.3679	.0060	MZ			-Ir	36	2)
XZ Vir	54223.3750	.0003	MZ			-Ir	61	2)
DR Vir	54222.4139	.0040	MZ			-Ir	133	2) red

Remarks:

AG:	Agerer, F., Tiefenbach	QU:	Quester, W., Esslingen
ALH:	Alich, K., Schaffhausen (CH)	SCI:	Schmidt, U., Karlsruhe
DIE:	Dietrich, M., Radebeul	SIR:	Schirmer, J., Willisau (CH)
FR:	Frank, P., Velden	WN:	Wischnewski, M., Wennigsen
Ju:	Jungbluth, Dr. H., Karlsruhe	WTR:	Walter, F., München
MZ:	Maintz, G., Bonn		

:	uncertain
s	secondary minimum
red	Normal minimum/maximum
C	CCD-camera
o	without filter
V	V-filter
Ic	I-filter Cousins
-Ir	-Ir-filter
Unnnn	USNO A2.0 catalogue (U as first character of starname)
Gnnnn	GSC (G as first character of starname)
1)	ccd-camera ST-6 chip 375*242 uncoated
2)	ccd-camera ST-7
3)	ccd-camera ST-7E
4)	ccd-camera ST-8E
5)	ccd-camera ST-9 chip
6)	ccd-camera AlphaMaxi
7)	ccd-camera OES-LcCCD12
8)	ccd-camera pictor 1616XT
9)	ccd-camera Pictor 416XT
10)	ccd-camera Meade DSI Pro 2
GCVS *yy*	General Catalogue of Variable Stars,4th ed. 19*yy*
IBVS *nnnn*	Information Bulletin on Variable Stars No. *nnn*
SAC *vv*	Rocznik Astronomiczny No. *vv*, Krakow (SAC)
AJ	Astronomical Journal
BAVM *nnn*	BAV Mitteilungen No. *nnn*
BAVR *vv*, *ppp*	BAV Rundbrief Vol. *vv*, page *ppp*

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BVR_CI_C PHOTOMETRIC OBSERVATIONS OF V733 Cep (PERSSON'S STAR)

SEMKOV, E. H.; PENEVA, S. P.

Institute of Astronomy, Bulgarian Academy of Sciences, 72, Tsarigradsko Shose blvd., BG-1784 Sofia, Bulgaria, e-mail: esemkov@astro.bas.bg, speneva@astro.bas.bg,

Photometric variability is a widespread characteristic of the pre-main sequence (PMS) stars. FU Orionis (FUor) outbursts are a very rare phenomenon but with an important role in stellar evolution (Herbig, 1977). An increase in optical brightness of the order of 4-5 magnitudes, an F-G supergiant spectrum with broad blue-shifted Balmer lines, strong infrared excess and connection with reflection nebulae are the main characteristics of FUors (Reipurth, 1990). According to Hartmann and Kenyon (1985) the FUor outburst is a result of a major increase of accretion from a circumstellar disk on the stellar surface. Another class of PMS objects with high amplitude variations has for a prototype the variable star UX Orionis (UXor). UXors are intermediate mass stars displaying sudden drops in brightness of up to 3 mag. probably caused by variable circumstellar extinction (Natta et al., 1997).

The PMS object V733 Cep (Persson's star) is located in the dark cloud L1216 near to Cepheus OB3 association. The variability of V733 Cep is discovered by Swedish amateur astronomer Roger Persson in 2004 (Persson, 2004). He noted the presence of the star on the red POSS-II image (1991) and its absence on the corresponding POSS-I image (1953). The star is visible also on a Palomar Quick-V plate from 1984. A R-band CCD image of V733 Cep was taken with the 88 inch telescope on Mauna Kea, Hawaii, on 2004 October 9. The magnitude, measured from this observation is about $R = 17\overset{m}{.}3$ (Reipurth et al., 2007). Comparing this value with the data from USNO-B catalog, Reipurth et al. (2007) conclude that the star has faded by $1\overset{m}{.}6$ (R) over a time period of about 13 yr. The authors suspect a possible outburst in the period 1953-1984 and find great spectral similarities to FU Ori itself.

In this paper we present BVR_cI_c photometric data of V733 Cep obtained in the period February 2007 - February 2008. Our observations were performed at two observatories with three telescopes: the 2-m Ritchey-Chretien-Coude and 50/70/172 cm Schmidt telescopes of the National Astronomical Observatory Rozhen (Bulgaria) and the 1.3-m Ritchey-Chretien telescope of the Skinakas Observatory[1] of the Institute of Astronomy, University of Crete (Greece). Five different CCD cameras were used during the period of our photometric observations. The technical parameters and chip specifications for the CCD cameras used are summarized in Table 1. All frames were taken through a standard Johnson-Cousins set of filters. Aperture photometry was performed using IDL DAOPHOT routines. All frames obtained with the 2-m RCC, the 1.3-m RC the 50/70 cm Schmidt telescope were reduced using the same aperture of about $3\overset{\prime\prime}{.}0$ radius.

[1]Skinakas Observatory is a collaborative project of the University of Crete, the Foundation for Research and Technology - Hellas, and the Max-Planck-Institut für Extraterrestrische Physik.

Table 1. CCD cameras and chip specifications

Telescope	CCD type	Size	Pixel size	Field	RON
2-m RCC	VersArray 1300B	1340×1300	20μm	$5'.6 \times 5'.6$	2.8ADU/rms
1.3-m RC	Photometrics CH360	1024×1024	24μm	$8'.5 \times 8'.5$	2.6ADU/rms
1.3-m RC	ANDOR DZ436-BV	2048×2048	13.5μm	$9'.6 \times 9'.6$	5.3ADU/rms
Schmidt	ST 8	1530×1020	9μm	$28' \times 18'.7$	6.2ADU/rms
Schmidt	ST 11000	4008×2672	9μm	$73' \times 49'$	13ADU/rms

In order to facilitate transformation from instrumental measurements to the standard system a sequence of fifteen comparison stars in the field of V733 Cep was calibrated in BVR_cI_c bands. The standard stars used for comparison are of great importance for the correct magnitude estimation. In regions of star formation like the Cepheus L1216 dark cloud a great percentage of stars can be photometric variables. Calibrations were made with the 1.3-m RC telescope during four clear nights in June and July 2007. Standard stars from Landolt (1992) were used as a reference. The finding chart (R band images obtained with the 1.3-m RC telescope) of the comparison sequence is presented in Fig. 1. The field is $8'.5 \times 8'.5$, centered on V733 Cep. North is at the top and east to the left. Table 2 (available through the IBVS website as `5831-t2.tex`) contains our photometric data for the $BVRI$ comparison sequence. The corresponding mean errors of the mean are listed, too.

Three stars from our list (C, G and N) were also measured by Pozzo et al. (2003) in BVI bands. Comparing our magnitudes with the data reported in Pozzo et al. (2003) we find a good agreement for I and V values. Only for B magnitudes there are differences at about $0^{\mathrm{m}}.2$. Three of stars primary selected for our comparison sequence appear to be photometric variables unknown to the present. The USNO-B1.0 identification number, the coordinates of the stars and the observed minimal and maximal values for I and V bands are summarized in Table 3. The stars are named Var. 1, Var. 2, and Var. 3 and they are also marked on Fig. 1. One of them Var. 1 show a very high amplitude of brightness variation ($\Delta V = 2^{\mathrm{m}}.98$) and it is probably a long period variable of Mira type. Var. 2 lie at about $4'$ south-east from V733 Cep in the same dark cloud and it is probably a PMS object.

Table 3. New variable stars in the field of V733 Cep

Star	USNO-B1	RA J 2000	DE J 2000	$I_{\max}$	$I_{\min}$	$V_{\max}$	$V_{\min}$
Var. 1	1525-0418386	22:53:46.53	62:34:58.6	13.88	16.24	16.28	19.26
Var. 2	1525-0418333	22:53:36.22	62:31:46.8	13.87	14.54	16.36	17.38
Var. 3	1525-0418196	22:53:15.69	62:35:27.9	13.06	13.33	15.26	15.61

The results from our CCD photometric observations are given in Table 4. The table contains Date, the Julian Date, the I_c, R_c, V and B magnitudes. Our photometric observations of V733 Cep in the period February 2007 - February 2008 show that the brightness of the star is almost steady. We observed only a low amplitude fluctuations of about $0^{\mathrm{m}}.1$ (I) around the middle values. Using our comparison sequence we measured the plate scans from POSS-II and Quick-V. The corresponding photometric values are: $V = 17^{\mathrm{m}}.75$ (Aug. 27, 1984), $I = 13^{\mathrm{m}}.77$ (Jul. 24, 1991), $R = 16^{\mathrm{m}}.00$ (Sep. 3, 1991) and $B = 20^{\mathrm{m}}.78$ (Aug. 9, 1991). The light curve of V733 Cep from all known observations is plotted on Fig. 4. On the figure the arrow marks the limit of the red plate from POSS-I (Oct. 31, 1953).

Our photometric data suggest that in the period Feb. 2007 - Feb. 2008 the star

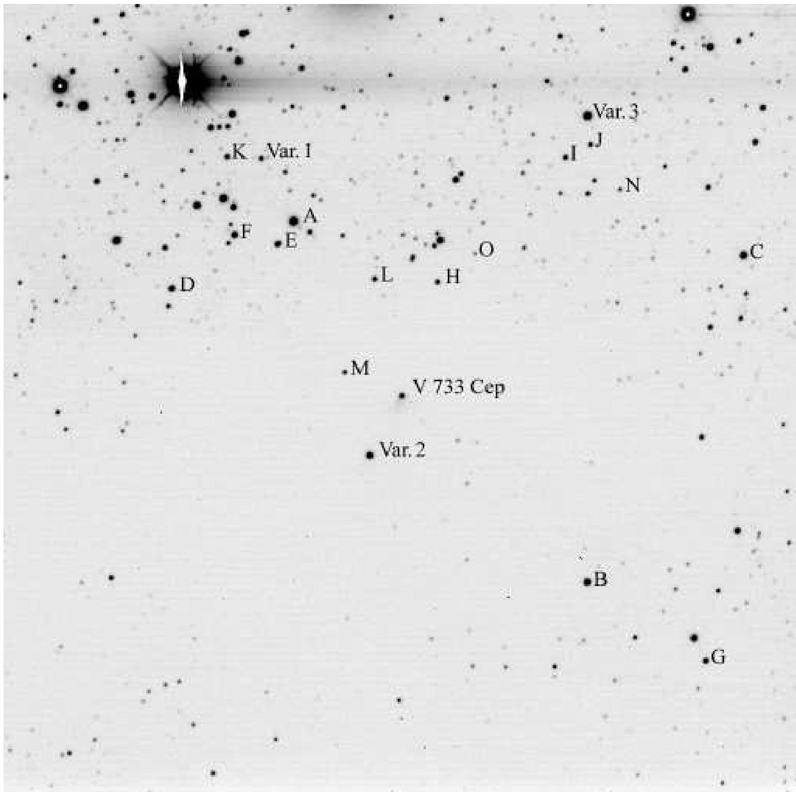

Figure 1. A finding chart of the comparison sequence in the field of V733 Cep

brightness is similar to the measured from POSS-II and Quick-V plates (Fig. 4). Thus the photometric behavior of V733 Cep appears different from the well studied FUors. A main photometric characteristic of FUors is the slow decreases in brightness after the outburst (Clarke et al., 2005). The two observed minimums (on POSS-I and on Oct. 2004) can be explained by a variable extinction from the circumstellar environment - a UXor type of variability. On the other hand the observed amplitude of V733 Cep ($\sim$ 5 mag. in red) is extremely high for this type of variability. Only a few UXors such as V1184 Tau have a similar photometric behavior (Semkov et al., 2008). The construction of the historical light curve of V733 Cep would be very important for a determination of the type of variability. The shape of the light curve will be a very strong evidence for FUor or UXor type of variability. We'll try to collect more data from the archiving photographic plates and new CCD observations to solve the problem with the exact classification of V733 Cep.

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Table 4. Photometric observations of V733 Cep in the period February 2007 - February 2008

Date	J.D.(245...)	I_c	R_c	V	B	CCD	Tel.
2007 Feb 25	4157.212	14.06	16.35	18.19	–	ST-8	Schmidt
2007 Apr 10	4200.582	14.07	16.04	18.19	–	VersArray	2m RCC
2007 Jun 27	4278.519	14.17	16.41	18.41	21.08	Photometrics	1.3m RC
2007 Jul 04	4285.525	14.11	16.33	18.34	21.08	Photometrics	1.3m RC
2007 Jul 23	4305.494	14.02	16.25	18.22	20.75	ANDOR	1.3m RC
2007 Jul 25	4306.512	14.04	16.27	18.27	20.81	ANDOR	1.3m RC
2007 Aug 14	4327.401	14.07	16.02	18.18	–	VersArray	2m RCC
2007 Aug 15	4328.402	14.09	16.04	18.22	–	VersArray	2m RCC
2007 Aug 17	4330.461	14.10	16.09	18.19	21.01	VersArray	2m RCC
2007 Nov 06	4411.217	14.17	16.12	18.24	–	VersArray	2m RCC
2008 Feb 12	4509.235	14.29	16.25	18.38	–	ST 11000	Schmidt
2008 Feb 29	4526.220	14.19	16.13	18.09	–	ST 11000	Schmidt

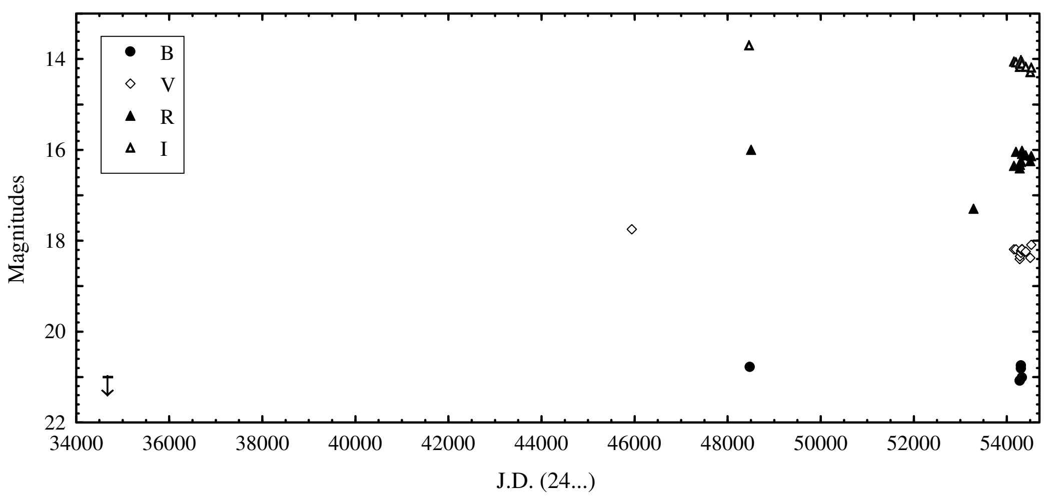

Figure 2. B, V, R_c and I_c light curves of V733 Cep

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RECENT CCD PHOTOMETRY OF AB Dor, AND A COMMENT ON THE LONG-TERM ACTIVITY CYCLE

INNIS, J. L.[1]; BUDDING, E.[2,3]; OLÁH, K.[4]; JÄRVINEN, S. P.[5,6,7]; COATES, D. W.[8]; MESSINA, S.[9]; KAYE, T. G.[10]

[1] Brightwater Observatory, 280 Brightwater Rd., Howden, TAS, 7054, Australia. Email: brightwater@iraf.net
[2] Physics Department, University of Canakkale, TR 17020, Turkey
[3] Carter Observatory, Wellington, New Zealand
[4] Konkoly Observatory, H-1525 Budapest, P.O.Box 67, Hungary
[5] Astrophysikalisches Institut Potsdam, An der Sternwarte 16, D-14482 Potsdam, Germany
[6] Tuorla Observatory, University of Turku, FI-21500 Piikkiö, Finland
[7] Astronomy Division, P.O. Box 3000, FI-90014 University of Oulu, Finland
[8] School of Physics, Building 27, Monash University, VIC, 3800, Australia
[9] INAF Catania Astrophysical Observatory, via S. Sofia 78, 95123 Catania, Italy
[10] Spectrashift, 404 Hillcrest, Prospect Heights, IL 60090, USA

AB Doradus (HD 36705) is a young, active, K–type dwarf. Recent work has shown the AB Dor system to consist of at least four stars (e.g. Guirado et al., 2006), but AB Dor itself is not a close binary. The rapid rotation and the high level of activity are a consequence of the star's relative youth. Activity signatures have been detected at radio, UV, and X-ray wavelengths.

AB Dor has been systematically observed since attention was drawn to it by Pakull (1981), who discovered the $\sim$0.5 d rotation period, although in recent seasons optical coverage has decreased. An analysis of the photometric data to 2000 by Järvinen et al. (2005) noted evidence for a possible $\sim$20–year activity cycle.

We obtained CCD B and V data at the Brightwater Observatory, Tasmania, in 2007 March 03–April 13 and 2007 December 15–2008 March 22. See Innis et al. (2007) for more details of the photometric equipment and method. The CCD field of view is $0\overset{\circ}{.}80\times0\overset{\circ}{.}55$, allowing us to observe both AB Dor and the comparison stars HD 36316 and HD 37082 simultaneously. Instrumental magnitudes were found using standard aperture photometry techniques. We corrected for extinction (including the second–order colour–dependent term in the B–band) and transformed our instrumental magnitudes to the standard Cousins system.

The mean and standard deviations for our observed V and $B-V$ differences HD 37082 $-$ HD 36316 were 1.72$\pm$0.01 and -1.30 ± 0.03 respectively, which agree reasonably well with previous work (Grothues et al., 1997, HD 37082: $V = 9.651$, $B-V = 0.169$, HD 36316: $V = 7.951$, $B-V = 1.451$; Cutispoto, 1998, HD 36316: $V = 7.95$, $B-V = 1.46$). Our final magnitudes and colours for AB Dor have been derived relative to HD 37082 (using $V = 9.651$, $B-V = 0.169$, from Grothues et al., 1997).

Just over 1800 individual exposures were obtained in each of B (exposure time 45s) and V (exposure time 30s) filters, yielding around 450 data points in each filter as we average four consecutive exposures to reduce scintillation noise (datafiles are available through the IBVS website as `5832-t1.txt`, `5832-t2.txt`). We use the period and epoch of P=0.51479 d and HJD 2444296.575 (Innis et al., 1988) for the following phase plots.

In 2007 March–April AB Dor varied in V by approximately 0.08 mag, from V ~6.98 to V ~7.06, as shown in the top left panel of Figure 1. Minimum light is very nearly at phase zero. The top right panel shows the check−comparison star magnitude differences at the same scale.

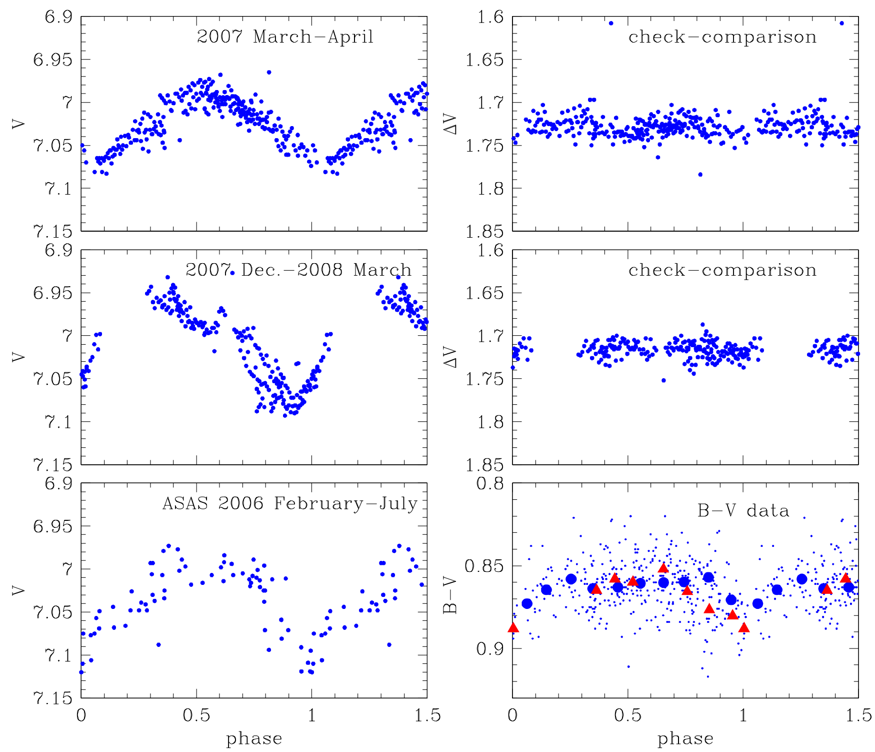

Figure 1. Photometry from the Brightwater Observatory: Top left panel AB Dor V light curve for 2007 March–April; top right panel: check− comparison star V magnitude differences 2007 March–April. Middle left panel: 2007 December–2008 March V AB Dor light curve; middle right panel: check− comparison star V magnitude differences 2007 December–2008 March. Lower left panel: V light curve for AB Dor for aperture 4 of the ASAS data set (Pojmanski and Maciejewski, 2005) for 2006 February–July. Lower right: observed (small dots) and phase–binned $B-V$ data (big dots: 2007, triangles: 2008) for the Brightwater photometry.

In 2007 December–2008 March (middle left panel of Figure 1) the light curve was less stable, with maximum light somewhat brighter, near 6.95, and with a clear shift in minimum to near phase 0.9. Minimum light at the two epochs are comparable. We show again the check−comparison star differences in the middle right panel to support the case that it is AB Dor which has changed – similar changes have of course been noted earlier.

The lower left panel of Figure 1 shows V data for AB Dor for 2006 February to July, taken in aperture 4 as part of the All Sky Automated Survey (ASAS, Pojmanski and Maciejewski, 2005). We include this to show that the amplitude of variation and the phasing of minimum light in mid 2006 was close to that seen in our 2007 March–April observations.

Our B data are somewhat more scattered than our V data, most likely due to the lower sensitivity of the CCD at shorter wavelengths. Small $B-V$ changes were noted, however these were of comparable size to the observational noise. We have binned our $B-V$ data in 0.1 phase bins to reduce noise. The lower right panel of Figure 1 shows the original and phase–binned $B-V$ data. There is an indication that the star is about 0.02-0.03 mag redder when fainter in both seasons observed at Brightwater. The mean and sample standard deviation for our determination of $B-V$ (for our entire CCD data, 2007 March–2008 March) is 0.86±0.02 mag.

For interest, we performed a spot modeling analysis on our 2007 March–April data. Adopting maximum light observed at that epoch as the unspotted flux level, we find that a single, circular midlatitude spot of radius ∼14° produces a good fit to the data. However, if we take the historical maximum (equivalent to V ∼6.74) a polar spot near 40° in radius (some 11% by area) is required to reduce the overall flux, in addition to a midlatitude spot of around 12° needed to produce the rotational modulation. Supposing T_{star}= 5000 K and T_{spot}= 3500 K we get excellent simultaneous fits both to the B and V light curves. For the modeling technique see Ribárik et al., 2003.

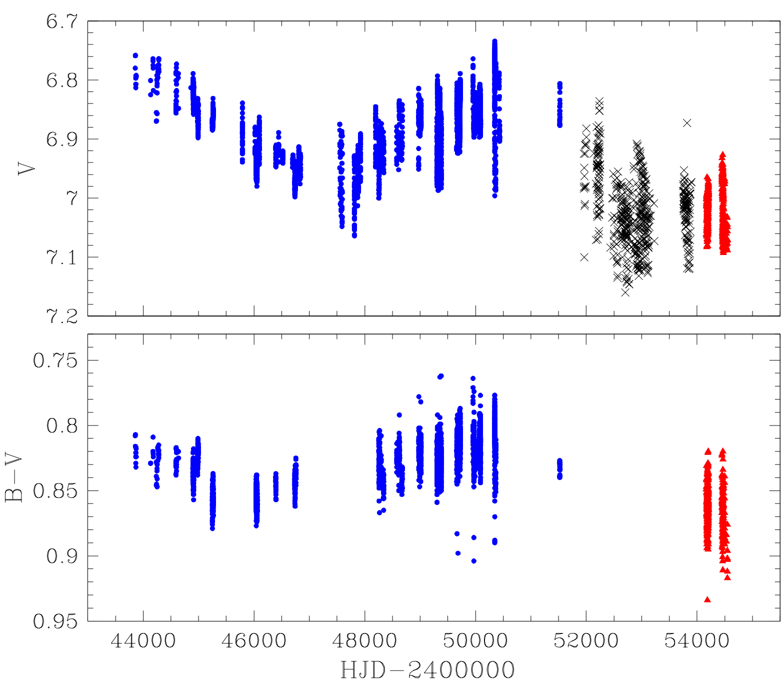

Figure 2. Top panel: V–band data for AB Dor, from the compilation of Järvinen et al. (2005) (dots), with our recent data (extreme right, triangles), and ASAS aperture 4 data (crosses).The mean value of the ASAS data may be uncertain by 0.05 mag. Our new data support the ∼ 20–year activity cycle proposed by Järvinen et al. (2005). Lower Panel: $B-V$ data for AB Dor, from the unpublished compilation of Messina (in preparation) and including our new $B-V$ data. A clear variation is seen.

In the top panel of Figure 2 we show the complete V history of AB Dor, as far as it is known, using the photometric compilation of Järvinen et al. (2005) and including our 2007–2008 data. We include all the currently available 'aperture 4' ASAS data as crosses. For bright stars like AB Dor the biggest 'aperture 4' photometry (diameter = 6 pixels, one pixel ≈15 arcsecs, see Pojmanski, 2002) gives magnitudes with the lowest noise. These data cover a recent gap in the record, but we note there are systematic differences of

$\sim$0.05 mag between the various ASAS apertures. However, the ASAS data also suggest that AB Dor was at the fainter part of its brightness range over this interval (e.g. as seen in the data in the lower panel of Fig. 1). Järvinen et al. (2005) deduced the likely presence of two different cycles, one a 'flip–flop' (spot–longitude) cycle of about 5.5 years, and another, longer-term, mean–brightness cycle of near 20 years. Our recent data, showing the star to be even fainter than at the minimum recorded some 18 years ago, appears to support the $\sim$20–year cycle proposed by Järvinen et al. (2005). Our new analysis, including the 2007–2008 data, yields a period of 19$\pm$3 y, with a false alarm probability (FAP) of 1.4×10^{-4}, as determined using the Lomb method for unevenly sampled data (Press et al., 1992).

In the lower panel of Figure 2 we plot the $B-V$ history of AB Dor, from published observations compiled by Messina (in preparation), also with our recent data. A clear, long–term, colour change is seen. Messina's analysis (in preparation) shows that the long-term $B-V$ variations are in phase with the V variations, with the same cycle period, but with a smaller variation amplitude. The new $B-V$ data seem to further support the cyclic color variation of AB Dor, with the star getting redder when it is fainter. We are continuing the analysis.

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ON THE ACCRETION STATE SWITCHING IN EX Dra

HALEVIN, A. V.[1]; HENDEN, A. A.[2]

[1] Department of Astronomy, Odessa National University, T.G.Shevchenko Park, Odessa, 65014, Ukraine

[2] American Association of Variable Star Observers, 49 Bay State Road, Cambridge, MA 02138, USA

Introduction. EX Dra is a long-period (5.04 h) dwarf nova with deep eclipses ($1\overset{m}{.}5$) and about 2^m - 3^m amplitude outbursts. It was classified as an eclipsing dwarf nova by Barwig et al. (1993). Baptista, Catalan and Costa (2000), using photometric observations, found that this system has a mass ratio $q = 0.72$ and an inclination angle $i = 85°$. They estimated the white dwarf mass to be $M_1 = 0.75$ $M_\odot$ and the red dwarf mass to be $M_2 = 0.54$ $M_\odot$. Knigge (2006) determined the spectral class of the mass donor to be M1.5±0.5. Assuming that the flux densities at mid-eclipse are indicative of the secondary star, Baptista, Catalan and Costa (2000) estimated 290 pc as the lower limit for the distance. Following Knigge (2006), another estimate of the lower limit distance using 2MASS JHK photometry and the K-band magnitude of the red dwarf gives 216 pc. However, this value contradicts our eclipse mapping data, because during quiescent states the accretion disc becomes too cold to provide outbursts. A detailed discussion can be found in Halevin et al. (2008).

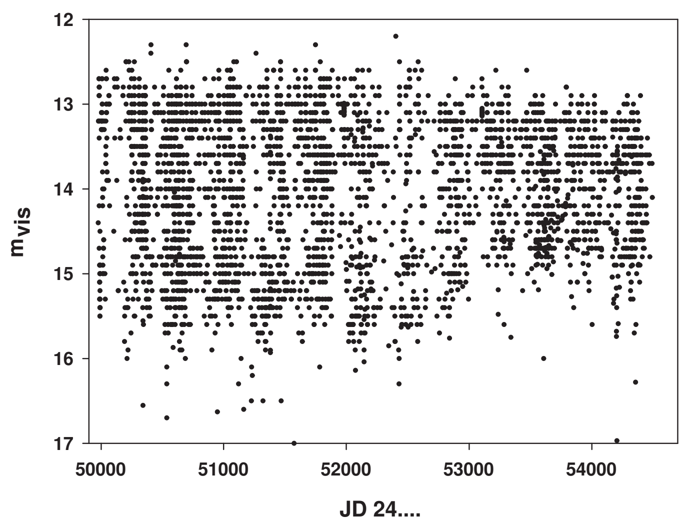

Figure 1. Long-term light curve of EX Dra for AAVSO visual and CCD observations.

Studies of eclipse timings show that the ephemeris is not described by a simple linear relationship. Baptista, Catalan and Costa (2000) found that the ephemeris must be modified by adding a sinusoidal term with a 1479^{d} period. Another estimate by Shafter and Holland (2003) gives a sinusoidal period of 1823^{d}. According to the previous investigators, EX Dra showed outbursts with a cycle of about 20 days and a duration of about 10 days.

Observations and data analysis. In our work we used 3500 visual and V band CCD observations of EX Dra, obtained by members of American Association of Variable Star Observers (AAVSO) during the time interval from 1995 to 2008.

One can see the long-term variability of EX Dra in the AAVSO light curve (Fig. 1). Visual inspection shows two different states of activity in the system: before and after JD 2452650. Significant change of the system behavior is clearly visible: before JD 2452650, EX Dra has a quiescent magnitude of about $15\overset{m}{.}5$, and after this date, the quiescent magnitude is approximately 15^{m}. At the same time, the maximum brightness becomes lower, with outburst amplitudes reduced from 3^{m} to 2^{m}.

We used Fourier techniques on our data, divided into two sets, to analyze the outburst cycle length: before the state switching and after it. Power spectra for the two segments of the EX Dra light curve can be seen in Fig. 2.

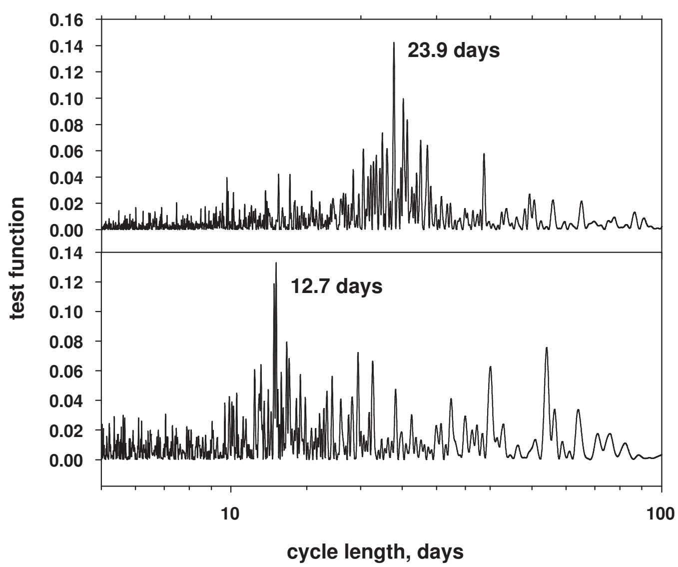

Figure 2. Power spectra for EX Dra observations before JD 2452650 (top) and after (bottom) this date.

We see here that before JD 2452650 the periodogram shows one prominent peak corresponding to the cycle length of 23.9 days. For the later state of EX Dra, the power spectrum shows two peaks near 12.6 and 12.7 days. The last one is higher and we consider it as representing the new cycle length time-scale.

The information about photometric and time-scale changes of the system behavior is summarized in the Table 1.

Detailed light curve inspection shows that the last system state is described with a very unstable outburst behavior and in principle we cannot use the 12.7 day cycle length as the only outburst variability parameter.

Table 1: Photometric parameters of the two states of EX Dra.

Parameter	$JD_{obs} < 2452650$	$JD_{obs} > 2452650$
Visual magnitude in maximum	$(12.90\pm 0.17)^m$	$(13.08\pm 0.13)^m$
Visual magnitude in minimum	$(15.41\pm 0.23)^m$	$(14.78\pm 0.18)^m$
Outburst cycle, days	23.9	12.7

To perform more detailed data analysis, we used wavelet analysis to search for possible evolution of outburst cycles. A detailed description of wavelet analysis principles can be found in Foster (1996). Here we used the code written by Foster to calculate the weighted wavelet Z-transform (WWZ) map (Fig. 3).

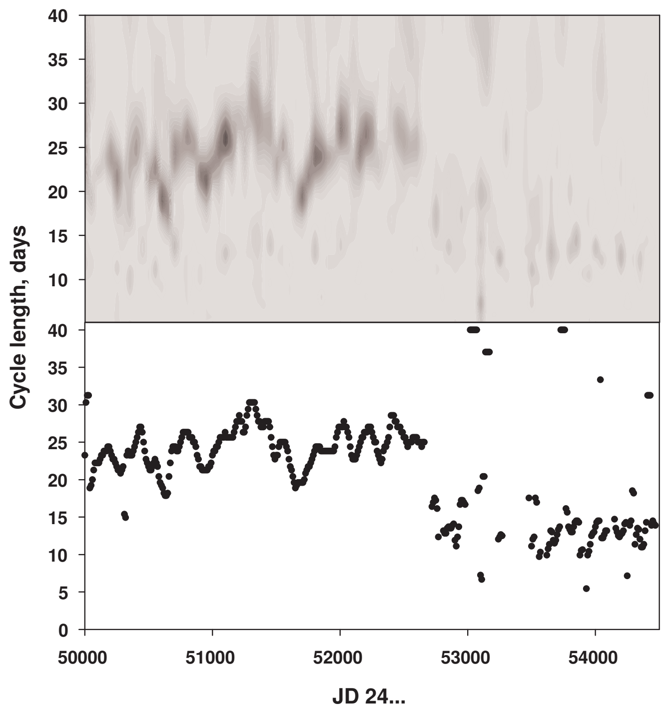

Figure 3. Weighted wavelet Z-transform map and the dominant cycle length evolution for Fig. 1 observations.

Fig. 3 shows the wavelet map for AAVSO data (top), and the curve (bottom) which represents evolution of the most prominent time-scales of the wavelet map. The wavelet map shows a dramatic switching of the outburst time-scale from the nearly regular 20-25 days cycle length before JD 2452650 to one with less prominent outbursts that have a time-scale of about 10-15 days.

The wavelet analysis also gives JD 2452665 as a more precise determination of the moment of state switching. Before this date we see smooth cycle length changes in the range from 18 to 30 days. These changes have two different timescales: a short one of about 225 days and a long one with 1280 days. The last time scale is close to the period of system ephemeris changes determined by Baptista, Catalan and Costa (2000). After the state switching the system behavior becomes more complicated. With the current shorter outburst cycle, we now need more frequent observations of this star to achieve good time resolution in order to resolve variability details of the system.

Discussion. To explain the state switching of the system we analyzed the dependence of the outburst cycle length from the other system parameters. From the standard α-disc solutions we have the formula for the viscous time-scale (Frank, King and Raine, 2002):

$$t_{visc} \sim 3 \times 10^5 \alpha^{-4/5} \dot{M}_{16}^{-3/10} M_1^{1/4} R_{10}^{5/4} s \tag{1}$$

where $\dot{M}_{16}$ is mass transfer rate in 10^{16} g s^{-1} units, M_1 is white dwarf mass in solar masses and R_{10} is accretion disc radius in 10^{10} cm units.

One can see that simply increasing the mass transfer rate by the minimum system brightness increase factor (~ 1.7) in our case cannot explain the observed decrease of the outburst cycle by more than 1.8 times. To provide an additional decrease of the viscous time-scale, we would need to decrease the accretion disc size by a factor of 1.4. The other possible explanation is to increase the α parameter value in the disc.

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PHOTOMETRIC SEQUENCES AND ASTROMETRIC POSITIONS OF NOVA Cyg 2008 N.2 AND NOVA Sgr 2008

HENDEN, ARNE[1]; MUNARI, ULISSE[2]

[1] AAVSO, American Association of Variable Star Observers, 49 Bay State Road, Cambridge, MA 02138, USA

[2] INAF Osservatorio Astronomico di Padova, Sede di Asiago, I-36032 Asiago (VI), Italy

Nova Cyg 2008 N.2 (= V2491 Cyg) was discovered by K. Nishiyama and F. Kabashima at ∼7.7 mag on Apr. 10.728 UT (cf. Nakano, 2008a). Spectroscopic confirmation was provided by Ayani and Matsumoto (2008) on Apr. 11.72 UT, that observed a FWHM of 4500 km/s for the Hα emission line. P-Cyg absorption components for Balmer lines at −4000 km/s were reported by Tomov et al (2008a) for Apr. 11.99 and 13.95 spectra, together with presence of an additional emission component at +2300 km/s and a classification as a FeII-type nova given the numerous FeII multiplets seen in emission. A classification as He/N-type nova was instead preferred by Lynch et al. (2008) on the base of their near-IR spectra of Apr. 12.56 UT that displayed a FWHM of 5500 km/s for the emission lines that included HeI, NI, NII and OI. From the intensity of OI emission lines at 0.84 and 1.13 μm on Apr. 17.6 UT, Rudy et al. (2008) estimated a reddening $E_{B-V}\sim0.43$. The FWHM of the emission lines in the near-IR spectra of Ashok et al. (2008) for Apr. 18 and 20 were ∼4100 km/s, while it ranged from 4200 to 5400 km/s depending from the given emission line in the optical spectra for Apr. 27.3 and 28.4 UT of Helton et al. (2008) who also remarked on the appearance of HeII and NIII emission lines in the spectra and the disappearance of P-Cyg absorption components from all emission lines. A detailed description of the spectral appearance on Apr 15 and 17 was presented by Tomov et al. (2008b), who revised their classification to that of a He/N-type nova.

Ibarra and Kuulkers (2008) were the first to note the positional coincidence of Nova Cyg 2008 N.2 with an X-ray source observed before outburst by Rosat, Swift and XMM-Newton satellites. A greater number of details of such pre-outburst X-ray observations were reported by Ibarra et al. (2008), that noted how the source was largely variable on time scales of ∼4 days, sometimes displaying a very soft energy distribution. The only other nova detected in X-rays *before* the outburst is Nova Oph 1998 (=V2487 Oph, Hernanz and Sala, 2002). The nova was not-detected by Swift on Apr. 11 and instead positively observed by the X-ray satellite on Apr. 15, at a much lower count rate than before the outburst (Kuulkers et al., 2008).

Finally, Balman, Pekon and Kiziloglu (2008) reported that their serendipitous monitoring on the nova field from July to November 2007 failed to reveal any source at the nova position brighter than the $R_{\rm C}$=18.2 mag limiting magnitude of their observations.

Nova Sgr 2008 (= V5579 Sgr) was also discovered by K. Nishiyama and F. Kabashima, at ∼8.4 mag on Apr 18.784 UT (cf. Nakano et al., 2008b). Spectroscopic confirmation was provided by M. Fujii on Apr. 19.82 UT (cf. Yamaoka, 2008) who noted a prominent P-Cyg profile for Hα.

In this note we present a $BVR_\mathrm{C}I_\mathrm{C}$ photometric sequence around both novae, optimized for CCD observations and their color corrections. To calibrate the sequences, we obtained CCD photometry with the Sonoita Research Observatory 0.35-m robotic telescope on several distinct photometric nights, using $BVR_\mathrm{C}I_\mathrm{C}$ filters and an SBIG STL-1001E CCD camera. Pixel size is $1\farcs25$/pix and the field of view is $20'\times20'$. Observations on each photometric night included following an extinction star from low to high airmass, along with $BVR_\mathrm{C}I_\mathrm{C}$ exposures of Landolt standard fields (Landolt, 1983, 1992). The photometric sequences are presented in Figures 1 and 2. Astrometry was performed using SLALIB (Wallace, 1994) linear plate transformation routines in conjunction with the UCAC2 reference catalog. Errors in coordinates were less than 0.1 arcsec in both coordinates, referred to the mean coordinate zero point of the reference stars in each field.

The coordinates we derived for Nova Cyg 2008 N.2 are $\alpha_\mathrm{J2000} = 19^\mathrm{h}43^\mathrm{m}01\fs980$ $(\pm0\fs030)$, $\delta_\mathrm{J2000} = +32°19'13\farcs55$ $(\pm0\farcs017)$, close to the coordinates reported by Sostero and Guido (2008) at position end figures $01\fs98$ and $13\farcs5$. Within 0.9 arcsec of this position there is the very faint star USNO-B1.0 1223-0482965 (R=15.9 mag), with no counterpart in the 2MASS catalog. Its position end figures are $02\fs04$ and $13\farcs8$ (0.4 arcsec error). If this was indeed the progenitor, the amplitude of the outburst in the R band reached 9 mag.

Our coordinates for Nova Sgr 2008 are: $\alpha_\mathrm{J2000} = 18^\mathrm{h}05^\mathrm{m}58\fs92$ $(\pm0\fs08)$, $\delta_\mathrm{J2000} = -27°13'55\farcs9$ $(\pm0\farcs25)$, close to the coordinates reported by Nakano (2008b) at position end figures $58\fs88$ and $56\farcs0$. The field is extremely crowded, with several very faint field stars laying within 4 arcsec from nova position and not listed in USNO B1 or 2MASS catalogs.

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Nova Cyg 2008 N.2	$\alpha_{\rm J2000}$ = 19 43 01.980	$\delta_{\rm J2000}$ = +32 19 13.55

	α_{J2000}	(±")	δ_{J2000}	(±")	N	V	(±)	$B–V$	(±)	$V–R_{\rm C}$	(±)	$R_{\rm C}–I_{\rm C}$	(±)	$V–I_{\rm C}$	(±)
a	295.770766	0.000	32.337710	0.012	2	10.130	0.030	0.073	0.035	0.024	0.028	0.059	0.027	0.084	0.023
b	295.715457	0.023	32.295483	0.035	2	11.430	0.011	0.647	0.003	0.364	0.042	0.344	0.047	0.703	0.017
c	295.795501	0.068	32.339573	0.083	5	12.266	0.022	1.224	0.031	0.651	0.026	0.548	0.033	1.186	0.032
d	295.730632	0.029	32.371117	0.011	5	12.588	0.024	0.928	0.037	0.532	0.022	0.448	0.029	0.969	0.033
e	295.755898	0.035	32.292282	0.026	5	12.920	0.020	0.620	0.030	0.365	0.033	0.352	0.018	0.715	0.030
f	295.714856	0.058	32.369232	0.035	5	13.447	0.027	0.405	0.029	0.240	0.035	0.249	0.017	0.489	0.029
g	295.725640	0.109	32.279405	0.065	4	13.768	0.012	1.716	0.046	1.338	0.024	1.495	0.086	2.841	0.089
h	295.730676	0.067	32.282243	0.026	4	13.825	0.023	1.150	0.049	0.590	0.062	0.533	0.034	1.113	0.032
i	295.796389	0.027	32.298523	0.044	5	13.912	0.019	0.473	0.034	0.295	0.028	0.292	0.017	0.586	0.034
j	295.767954	0.085	32.356529	0.048	5	14.065	0.031	1.388	0.041	0.796	0.040	0.720	0.013	1.505	0.043
l	295.802322	0.044	32.340871	0.075	5	14.112	0.026	0.845	0.038	0.486	0.048	0.507	0.040	0.994	0.042
m	295.709392	0.120	32.367846	0.079	4	14.183	0.011	1.713	0.079	0.983	0.037	0.871	0.034	1.837	0.025
n	295.702940	0.061	32.343425	0.051	3	14.751	0.018	1.320	0.038	0.750	0.041	0.708	0.013	1.450	0.037
p	295.706523	0.086	32.310415	0.062	3	15.308	0.017	1.425	0.027	0.841	0.037	0.808	0.013	1.642	0.031
q	295.795897	0.096	32.319984	0.055	4	15.858	0.016	0.571	0.045	0.393	0.023	0.454	0.041	0.854	0.042
r	295.797462	0.087	32.351040	0.080	3	16.203	0.022	0.842	0.049	0.520	0.023	0.481	0.037	0.996	0.051
s	295.739036	0.030	32.305966	0.146	3	16.897	0.039	0.935	0.025	0.565	0.061	0.529	0.039	1.088	0.060
t	295.761767	0.303	32.286087	0.076	3	17.680	0.034	0.815	0.116	0.639	0.028	0.566	0.053	1.194	0.061

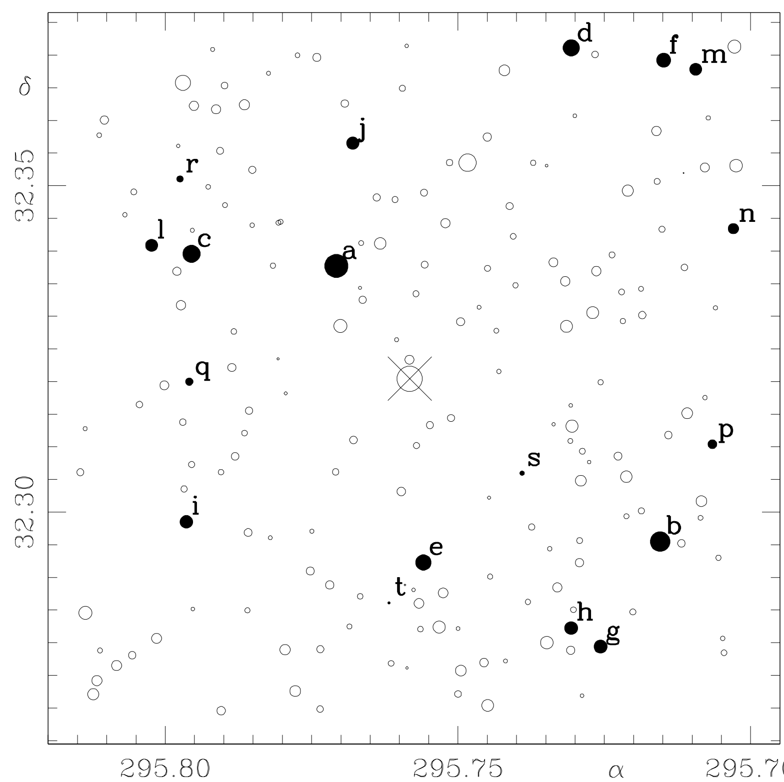

Figure 1. $BVR_{\rm C}I_{\rm C}$ photometric comparison sequence around Nova Cyg 2008 N.2. The cross indicates the nova. N is the number of nights in which the given star has been measured in the given band. The error in α and δ are in arcsec. The panel covers a $6'\times6'$ area centered on the nova and shows stars down to V=18.2. Star a is HD 331150.

Nova Sgr 2008 $\alpha_{\rm J2000} = 18\ 05\ 58.92$ $\delta_{\rm J2000} = -27\ 13\ 55.9$

	α_{J2000}	(±")	δ_{J2000}	(±")	N	V	(±)	$B-V$	(±)	$V-R_C$	(±)	R_C-I_C	(±)	$V-I_C$	(±)
a	271.498698	0.013	–27.218845	0.068	3	12.181	0.029	1.274	0.013	0.670	0.019	0.593	0.033	1.253	0.036
b	271.461207	0.022	–27.184760	0.063	3	12.358	0.025	1.695	0.030	0.906	0.054	0.803	0.049	1.694	0.046
c	271.551541	0.105	–27.210843	0.072	3	12.535	0.026	1.433	0.037	0.824	0.044	0.928	0.061	1.761	0.084
d	271.466788	0.028	–27.181444	0.076	3	12.652	0.020	0.646	0.029	0.361	0.036	0.367	0.040	0.728	0.044
e	271.457383	0.060	–27.209712	0.139	3	12.860	0.025	1.700	0.014	0.916	0.035	0.822	0.036	1.725	0.044
f	271.520404	0.088	–27.169562	0.081	3	12.991	0.025	0.354	0.030	0.246	0.031	0.278	0.047	0.528	0.057
g	271.511246	0.107	–27.204964	0.099	3	12.999	0.017	1.228	0.029	0.653	0.048	0.563	0.032	1.206	0.032
h	271.546017	0.112	–27.267344	0.101	3	13.129	0.022	0.831	0.014	0.439	0.052	0.428	0.034	0.865	0.043
i	271.463180	0.134	–27.198303	0.175	3	13.213	0.027	0.254	0.034	0.156	0.043	0.211	0.028	0.391	0.012
j	271.511217	0.170	–27.241061	0.278	3	13.463	0.026	0.667	0.035	0.402	0.039	0.409	0.049	0.814	0.060
α	271.326008	0.028	–27.135099	0.069	3	10.728	0.021	0.085	0.027	0.047	0.023	0.056	0.026	0.105	0.039
β	271.437136	0.029	–27.160220	0.032	3	11.226	0.026	1.171	0.020	0.630	0.030	0.557	0.026	1.178	0.019
γ	271.472608	0.108	–27.148808	0.109	3	11.377	0.025	1.574	0.014	0.824	0.037	0.706	0.028	1.514	0.035
δ	271.393885	0.049	–27.114685	0.060	3	11.608	0.011	1.806	0.026	1.192	0.038	1.370	0.041	2.577	0.049
ϵ	271.553356	0.022	–27.248853	0.043	3	11.872	0.023	0.679	0.011	0.379	0.032	0.369	0.026	0.747	0.035
ζ	271.503831	0.033	–27.109669	0.032	3	12.159	0.023	0.825	0.027	0.463	0.033	0.390	0.035	0.844	0.043

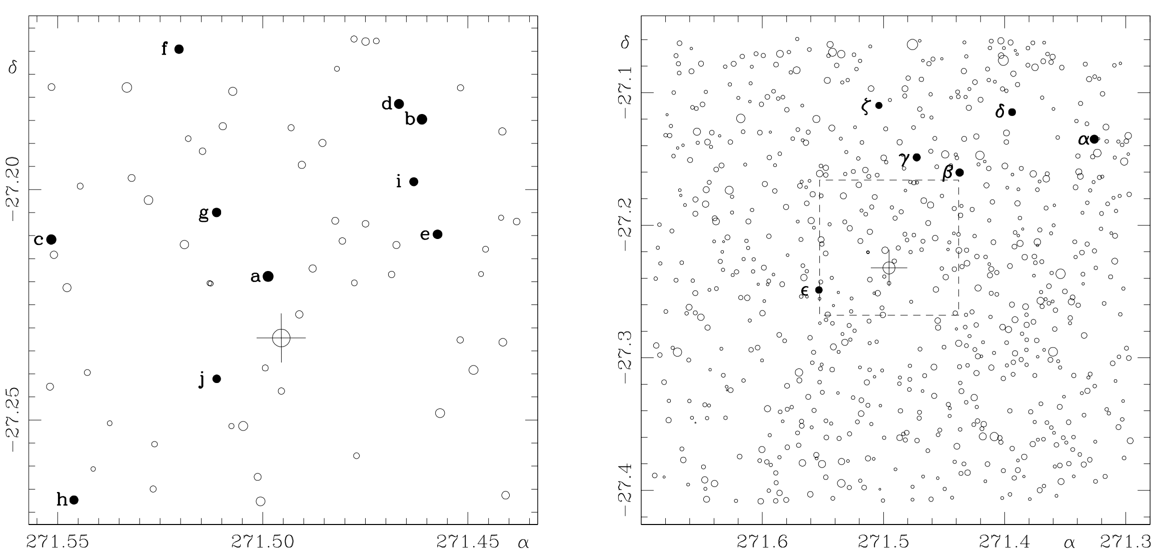

Figure 2. BVR_CI_C photometric comparison sequence around Nova Sgr 2008. The cross indicates the nova. N is the number of nights in which the given star has been measured in the given band. The error in α and δ are in arcsec. The panel on the right covers a $20'\times20'$ area centered on the nova and shows stars down to V=16.0. The dashed $6'\times6'$ area is zoomed in on the left panel.

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NEW AND ARCHIVE TIMES OF MINIMA OF ECLIPSING BINARY SYSTEMS

BORKOVITS, TAMÁS[1,10]; VAN CAUTEREN, PAUL[2]; LAMPENS, PATRICIA[3]; DUFOER, SJOERD[4]; KLEIDIS, STELIOS[5]; VAN LEENHOVE, MAARTEN[6]; CSIZMADIA, SZILÁRD[7,1,8]; REGÁLY, ZSOLT[8]; PATKÓS, LÁSZLÓ[8]; KLAGYIVIK, PÉTER[9]; BÍRÓ, IMRE BARNA[1]; HEGEDÜS, TIBOR[1]; KISS, ZOLTÁN TAMÁS[1]

[1] Baja Astronomical Observatory of Bács-Kiskun County, Baja, Szegedi út, Kt. 766, H–6500 Hungary; e-mail: borko@alcyone.bajaobs.hu

[2] Beersel Hills Observatory, Beersel, Belgium

[3] Royal Observatory of Belgium

[4] Belgium

[5] Zagori Observatory (ZPO), Epirus, Greece

[6] Willebroek Observatory, Belgium

[7] FÖMI Satellite Geodetic Observatory, Pf. 585, Budapest, H–1592 Hungary

[8] Konkoly Observatory of the Hungarian Academy of Sciences, Budapest, Pf. 67, H–1525 Hungary

[9] Department of Astronomy, Eötvös Loránd University, Budapest, Pf. 32, H–1518 Hungary

[10] Guest observer at Piszkéstető Observatory of Konkoly Observatory

Observatory and telescope:
50-cm $f/8.4$ Ritchey–Chrétien telescope (Ba50) of the Baja Astronomical Observatory (Hungary) 50-cm $f/15$ Cassegrain telescope (Pi50) of the Konkoly Observatory at Piszkéstető Mountain Station (Hungary) 13-cm refractor, 25, and 40-cm Newton telescopes (BHO13, BHO25, BHO40, respectively); Beersel Hills Observatory (Belgium) 8-cm refractor and 20-cm reflector (Duf08, Duf20) of Sjoerd Dufoer (Belgium) 20-cm reflector and 30-cm SC telescope (ZPO20, ZPO30) of Zagori Observatory (ZPO), Epirus (Greece) 28-cm SC telescope (WOB28) of Willebroek Observatory (Belgium) 40-cm f/8.9 Ritchey-Chrétien telescope (IAO40) of the Izsák Astrophysical Observatory of the Eötvös Loránd University (Hungary)

Detector:	512 × 512 Apogee AP-7 CCD camera (Ba50) cooled UBVRI Photometer (Pi50) uncooled UBV Photometer (Pi50u) 2184 × 1472 SBIG ST-10XME with filter wheel (filters Bessell specifications) (BOHxx) SBIG ST-7 with filter wheel (filters Bessell specifications) (BHOxxST7) 2184 × 1472 SBIG ST-10XME (Dufxx) SBIG ST-7XMEI with filter wheel (ZPO30) FLI CM10 CCD camera (ZPO20) 2184 × 1472 SBIG ST-10XME (WOB28) 4008 × 2672 SBIG STL-11K (IAO40)

Method of data reduction:

Reduction of Baja and IAO (Budapest) CCD frames was made with a customly developed IRAF[1] package.
BHO observations were reduced by Mira-AP (7) software.
Duf and WOB measurements by MaximDL4.
ZPO observations: AIPWIN V1.25.

Method of minimum determination:

The minima times were computed with parabolic fitting, and in some cases with linearized Pogson-method or Kwee-van Woerden method (Kwee & van Woerden, 1956). ZPO minima calculations: Minima25 (developed: R.H. Nelson)

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
AP Aur	54133.2997	2	II	V	Csz/IAO40
CL Aur	54487.4260	1	I	V	ZPO30
	54510.4465	3	II	R	Bor/Ba50
HP Aur	54172.3437	5	II	V	BHO25
	54428.4489	3	II	V	WOB28
	54487.4952	1	I	B	ZPO20
IM Aur	53762.3599	5	II	R	Bír/Ba50
	54078.5493	4	I	B, V, R	Heg/Ba50
	54516.3425	1	I	V	Kis/Ba50
IU Aur	54495.3575	2	II	B, V	ZPO30
	54496.2615	1	I	B	ZPO20
	54523.4332	4	I	V	ZPO30
44i Boo[a]	54199.3577	7	II	U, B	Reg/Pi50
	54199.3592	5	II	V, R	Reg/Pi50
	54199.4926	6	I	U, B, V, R	Reg/Pi50
	54222.5252	3	I	B, V, R	Bor/Pi50
Y Cam	52558.3989	3	I	V	BHO40ST7
	52687.3230	1	I	V	BHO40ST7
	54201.3690	3	I	V	BHO40
SV Cam	44661.4686	1	I	V, B	Pat/Pi50u
	45613.3482	1	I	V, B	Pat/Pi50u
	45766.3647	1	I	V, B	Pat/Pi50u
	46362.4016	1	I	V, B	Pat/Pi50u

[1]IRAF is distributed by the National Optical Astronomical Observatories, operated by the Association of the Universities for Research in Astronomy, inc., under cooperative agreement with the National Science Foundation

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
AS Cam	54077.4252	5	II	R	Bor/Ba50
	54525.3607	1	I	R	Bor/Ba50
IT Cas	54445.2352	3	I	V	ZPO30
OX Cas	54342.4736	4	II	V	Duf08
PV Cas	54454.3461	2	II	V	WOB28
VW Cep	54190.4896	6	I	B, V, R	Bor+Reg/Pi50
	54192.438	1	I	B, V, R	Reg/Pi50
	54557.4398	10	II	B, V, R	Bor+Reg/Pi50
GK Cep[b]	54222.3977	6	II	B	Bor/Pi50
	54222.4014	6	II	V, R	Bor/Pi50
CC Com	54192.3224	2	II	V	Csz/IAO40
	54192.4325	2	I	V	Csz/IAO40
	54207.3290	2	II	V, R	Bor/Ba50
	54207.4393	3	I	V, R	Bor/Ba50
	54207.5500	1	II	V, R	Bor/Ba50
V370 Cyg	54397.3474	4	I	V	Duf20
V453 Cyg	54366.4316	12	I	–	Duf08
V477 Cyg	54323.5483	1	I	V	Duf08
V478 Cyg	54457.3028	11	I	V	Duf20
V961 Cyg	54397.3462	3	I	V	Duf20
RX Dra	54192.5694	3	I	–	BHO13
EF Dra	54570.4248	5	I	V	Kla/IAO40
TU Her	54192.5171	4	I	V	BHO40
AK Her	54212.4950	6	I	R	Bor/Ba50
	54223.4556	9	I	V, R	Bor/Pi50
CT Her	54174.5508	54	II	V	BHO40
	54200.4662	2	I	B	BHO40
AU Lac	54366.3163	3	I	–	Duf08
RW Leo	54202.3591	2	I	–	BHO40
XY Leo	54133.3698	2	I	V	Csz/IAO40
UV Lyn	54442.5408	1	II	V	ZPO30
EF Ori	54380.5720	9	II	–	BHO40
GU Ori	54380.5621	2	II	–	BHO40
AG Per	54452.3540	2	I	V	Duf20
	54452.3542	3	I	V	WOB28
V432 Per	54389.3808	1	I	V	Csz/IAO40
AO Ser	54175.5429	3	I	V	BHO13
	54186.5371	14	II	V	BHO13
	54201.4835	7	II	V	BHO40
	54211.5959	2	I	B	BHO40
	54213.3545	1	I	B	BHO40
	54244.5717	9	II	V	BHO40
OU Ser	54234.3739	4	I	V	Csz/IAO40
	54234.5152	3	II	V	Csz/IAO40
SV Tau	54454.6025	3	I	V	Duf20
RS Tri	54397.2910	8	I	V	WOB28
W UMa	54556.5283	2	II	V	Kla/IAO40
VV UMa	54192.3861	2	I	–	BHO13
	54193.4220	11	II	–	BHO13
	54203.3849	6	I	V	BHO13ST7
	54388.6326	7	II	V	BHO40
XY UMa	54556.4186	1	I	V	Kla/IAO40
DW UMa	54176.3651	1	I	R	Bor/Ba50
	54176.5016	1	I	R	Bor/Ba50
	54176.6384	1	I	R	Bor/Ba50
	54214.3420	3	I	V, R	Bor/Ba50
	54214.4785	6	I	V, R	Bor/Ba50
	54544.3831	1	I	R	Bor/Ba50
	54544.5196	1	I	R	Bor/Ba50
	54544.6563	2	I	R	Bor/Ba50
HX UMa	54211.425	2	II	V	Csz/IAO40

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
LP UMa	54176.4566	8	I	R	Bor/Ba50
	54176.621	1	II	R	Bor/Ba50
	54214.4245	8	II	V, R	Bor/Ba50
	54214.584	1	I	V	Bor/Ba50
	54544.4768	5	II	R	Bor/Ba50
	54544.629	1	I	R	Bor/Ba50
RT UMi	54172.5058	3	I	V	BHO25
DR Vul	54312.4591	3	I	V	Duf08

Explanation of the remarks in the table:

[Observer(s)]/Instrument

[a]: 44i Boo: On the night 2454199 the discrepancy between the secondary mid-eclipse times in U, B and V, R bands is supposed to be real.

[b]: GK Cep: On the night 2454222 the discrepancy between the mid-eclipse times in B and V, R bands is supposed to be real.

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UX Ari: NEW PHOTOMETRY AND LONGITUDINAL ASYMMETRY IN SPOT ACTIVITY FIXED IN ORBITAL REFERENCE FRAME

ROSARIO, M. J.[1]; MEKKADEN, M. V.[2]; RAVEENDRAN, A. V.[2]

[1] Vainu Bappu Observatory, Indian Institute of Astrophysics, Kavalur 635701, India. e-mail: mjr@iiap.res.in

[2] Indian Institute of Astrophysics, Bangalore 560034, India. e-mail: mvm@iiap.res.in, avr@iiap.res.in

UX Ari (HD 21242) is one of the brightest member of RS CVn binaries, and has been observed photometrically almost every season since the discovery of its light variability in 1972 by Hall et al. (1975). It is a non-eclipsing, double-lined spectroscopic binary with a K0–K1 subgiant as the primary and a G5 dwarf as the secondary in a near-circular orbit (Carlos & Popper, 1971; Duemmler & Aarum, 2001).

We observed UX Ari photometrically in BV bands on 23 nights during January–March 2008 with the 34-cm telescope of Vainu Bappu Observatory, Kavalur. All the measurements were made with respect to the comparison 62 Ari. HR 999 was also observed on several nights along with the variable as the check star. Table 1 lists the results of our photometric observations. Each value given in the table is a mean of 3-4 independent measurements. The typical uncertainty in both the differential V and $(B-V)$ values is $\sim$0.01 mag.

The differential V and $(B-V)$ values given in Table 1 are plotted in Fig. 1 after converting the Julian dates of observation to orbital phases with the ephemeris: JD = 2450646.83 + $6^{\mathrm{d}}\!.4372703$E. The initial epoch corresponds to the conjunction with the more massive, cool primary in front. The orbital period and the epoch of maximum radial velocity of the active star from which the above time of conjunction is derived are from Duemmler & Aarum (2001). Figure 1 shows that the light variation during January–March 2008 was highly asymmetric with a broad minimum and a narrow maximum. The monotonic decrease in the brightness at light curve minimum observed during 2001–07 (Rosario et al., 2007) seems to be over and the light curve minimum seems to be getting brighter from this season onwards. The trend in $(B-V)$ variation over the photometric cycle is not well-defined; however, there is some indication that the star is bluer at fainter visual magnitudes as reported by several observers earlier.

Aarum Ulvås & Henry (2003), who analysed the individual light curves of UX Ari, have reported that there is no clear correlation between the orbital phase of light minimum and time, except that during 1982–90 the orbital phase seemed to decrease linearly from about $0^{\mathrm{p}}\!.75$ to $0^{\mathrm{p}}\!.40$. They also reported that the migration rate of phase of light minimum varied from -0.1157 yr^{-1} to $+0.2605$ yr^{-1}, and most of the time the rate had a negative value.

All the differential V magnitudes of UX Ari with respect to 62 Ari obtained during 1972–2008 (Aarum Ulvås & Henry, 2003; Rosario et al., 2007; Table 1) are plotted in

Table 1: BV photometry of UX Ari.

JD 2450000.0+	V	$(B-V)$	JD 2450000.0+	V	$(B-V)$
4475.1170	1.204	—	4476.1592	1.089	−0.203
4477.1181	1.098	−0.225	4478.1951	1.211	−0.239
4480.1072	1.250	−0.257	4481.1188	1.239	−0.240
4485.1243	1.241	−0.253	4486.1181	1.255	−0.241
4487.1100	1.244	−0.262	4491.1278	1.214	—
4502.1311	1.081	−0.232	4514.0905	1.182	−0.255
4515.0924	1.081	−0.211	4516.0944	1.148	−0.217
4517.0917	1.227	−0.230	4522.0912	1.103	−0.224
4525.1090	1.221	−0.244	4528.0953	1.093	−0.254
4529.0993	1.165	−0.248	4530.1026	1.245	—
4531.1078	1.237	—	4532.1035	1.222	−0.235
4534.1023	1.126	−0.211			

Fig. 2 after converting the Julian dates of observation to orbital phases with the above ephemeris. The uncertainty in the orbital period quoted by Duemmler & Aarum (2001) is only $0^{\mathrm{d}}.0000069$ and the accumulated error in orbital phase over 36 years, over which the V band observations of UX Ari span, is only $0^{\mathrm{p}}.002$. Figure 2 shows that the range in the observed differential V magnitudes of UX Ari has a clear orbital modulation, implying that the spot activity in the star has a longitudinal asymmetry that is fixed in the orbital frame of reference. The upper envelope of the ΔV values shows a maximum around $0^{\mathrm{p}}.50$. The lower boundary shows a minimum around the same phase and a maximum around $0^{\mathrm{p}}.0$ where the upper envelope shows a minimum. It is remarkable that the total spread in ΔV magnitudes at $0.^{p}0$ observed so far is only around 0.18 mag while that at $0^{\mathrm{p}}.5$ it is around 0.48 mag.

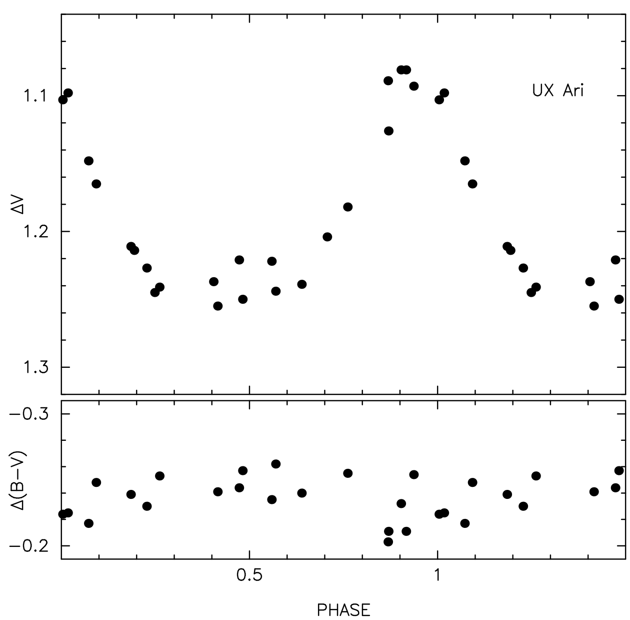

Figure 1. Plot of ΔV and $\Delta(B-V)$ values of UX Ari obtained during January–March 2008 against the corresponding orbital phase computed using the ephemeris JD = 2450646.83 + $6^{\mathrm{d}}.4372703$E.

The fainter secondary component of the binary system also shows a low level of chromospheric activity as indicated by the variation in the Ca II K core emission from it (Aarum Ulvås & Engvold, 2003). UX Ari appears bluer at fainter visual magnitudes, which is unusual for a spotted star. Rosario et al. (2007) have shown that the bluer colour of UX Ari at fainter V magnitudes results because of the increased fractional contribution to the total light in the blue spectral region by the hotter G5 companion as the cooler component becomes fainter. Hence, most of the light variation observed in UX Ari can be attributed to the intrinsic light variability of the cool primary component.

The active stars in RS CVn binaries are presumed to undergo highly enhanced solar-like activity. Starspots, which are analogues to sunspots, distributed asymmetrically across the stellar surface rotationally modulate the observed flux, thereby producing light variability observed in these objects. The variations in light curves are attributed to changes in sizes of spots or spot groups and their distribution on the stellar surface. The phases of light minimum in many of these objects are found to migrate along the orbital phases at different rates. In some of the objects the migration can be traced continuously for several years while in some it can be traced only for a few years. To account for this, in analogy with the sun, Hall (1972, 1991) proposed that there is differential rotation in the active stars and only a particular latitude co-rotates synchronously with the orbital motion, and hence spots present in different latitudes would produce light curves with slightly different periods. The existence of differential rotation in components of close binaries, especially in active stars of RS CVn systems, is not well-established observationally. Almost all information on the differential rotation of spotted stars is based on the migration of the phase of the minimum of light curves of these stars.

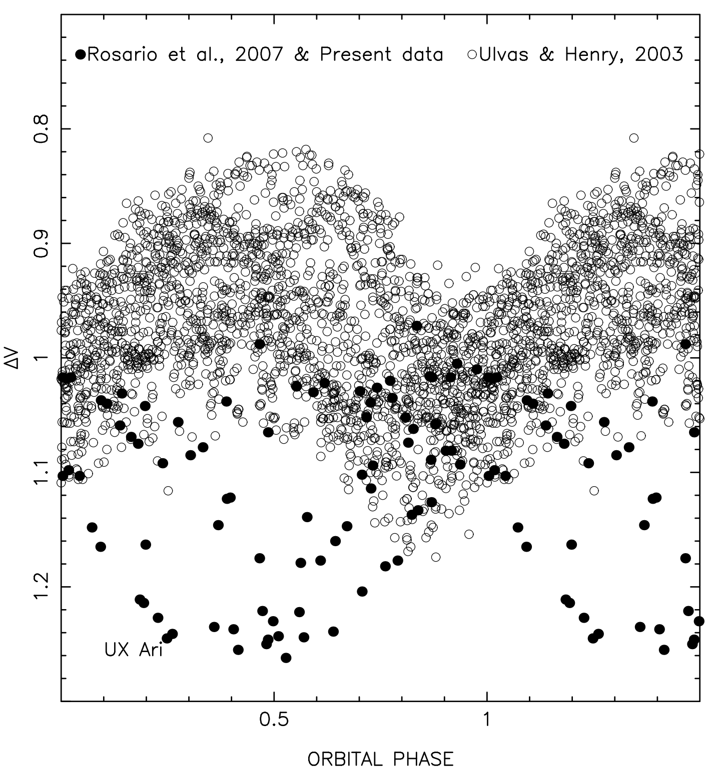

Figure 2. Plot of ΔV values of UX Ari obtained so far against the corresponding orbital phase computed using the ephemeris JD = 2450646.83 + $6\overset{d}{.}4372703$E.

Figure 2 clearly shows that there is enhanced spot activity, as indicated by a larger spread in observed magnitudes, in the hemisphere of the active star facing the hotter companion when compared to that away from it. The minimum and maximum of a light curve obtained during a particular epoch may occur over a large range of orbital phases (Aarum Ulvås & Henry, 2003). But the fainter light minima and brighter light maxima among them always occur at orbital phases close to $0^{\rm p}\!.5$. The orbital inclination of UX Ari is around 60° (Duemmler & Aarum, 2001). Hence, the existence of a significant orbital modulation in spot activity implies that the regions of enhanced spot activity are located closer to the equator rather than the poles and that these regions rotate in near-perfect synchronism with the orbit. Any slight difference in the rotational period would completely smear out the modulation when data spread over such a time interval as long as 35 years ($\sim$ 2000 photometric cycles) are combined.

The large spread of about 0.5 mag in V magnitudes close to $0^{\rm p}\!.5$ requires that the regions that produce the enhanced activity have an appreciable latitudinal extent on the surface of the active star. The rotation of a large latitudinal zone in near-perfect synchronism with the orbit would mean that differential rotation in the active star is either absent or really small.

Another implication of the existence of the longitudinal asymmetry in spot activity, which is fixed in the orbital frame of reference, is that the spots do not appear and disappear with equal probability at all longitudes on the surface of the active star in the UX Ari system; the presence of the companion significantly affects the physical processes that produce spots and modulates the surface distribution of spots on the active star.

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166. LIST OF TIMINGS OF MINIMA ECLIPSING BINARIES BY BBSAG OBSERVERS

(BBSAG Bulletin No. 134)

DIETHELM, ROGER

BBSAG, Bahnhofstrasse 3, CH–4118 Rodersdorf, Switzerland

The following Table lists timings of minima of eclipsing binaries secured by photoelectrical means by BBSAG observers, obtained between July 2007 and June 2008. The given $O-C$ values generally refer to the linear elements of the GCVS (Kholopov et al., 1985), except for the cases stated in the remarks. All times given are heliocentric UTC. This is the last installment of the BBSAG Bulletin. Since only two observer contributed to our lists in the last two years, we have decided to publish our results as personal contribution in the future.

Table 1: Eclipsing binaries

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
V1075 Aql	p	54297.4395	0.0009	−0.0265	14	RD	V
V379 Aur	p	54505.2822	0.0012		17	RD	V
V523 Aur	p	54505.3974	0.0011		9	RD	V
GSC2393-680 Aur	p	54504.3716	0.0011	+0.0038	12	RD	V; el.: IBVS No. 5695
TX Boo	p	54633.6985	0.0001	−0.8673	235	RD	V
FY Boo	s	54632.7167	0.0001	+0.0036	101	RD	V; el.: IBVS 5741
AK Cam	p	54504.3143	0.0002	+0.0251	29	RD	V; el.: BAV Mitt. 69
DH CVn	p	54564.3642	0.0004	−0.0161	19	EBl	C; el.: IBVS No. 5149
LO Com	p	54564.3606	0.0004	+0.0130	18	EBl	C; el.: IBVS No. 5052
LP Com	s	54564.3386	0.0005	−0.0199	16	EBl	C; el.: IBVS No. 5052
V385 Cyg	p	54295.4702	0.0004	−0.1214	39	RD	V
V469 Cyg	p	54925.4723	0.0003	−0.1094	40	RD	V
V809 Cyg	p	54295.4902	0.0003	+0.0374	31	RD	V
V853 Cyg	p	54295.4566	0.0005	+0.0250	37	RD	V
V961 Cyg	p	54295.4568	0.0001	+0.0017	30	RD	V; el.: IBVS No. 4278
V974 Cyg	s	54295.4685	0.0004	−0.2413	42	RD	V; non-circular orbit
V2280 Cyg	p	54407.2568	0.0004	+0.0549	28	EBl	C; el.: IBVS No. 4996
V2282 Cyg	s	54407.3458	0.0006	−0.0473	21	EBl	C; el.: IBVS No. 4996
V2284 Cyg	s	54407.3514	0.0008	+0.0035	22	EBl	C; el.: IBVS No. 4985
V2294 Cyg	s	54407.3468	0.0005	+0.0439	24	EBl	C; el.: IBVS No. 4995
MU Dra	s	54387.3245	0.0006	−0.0281	13	EBl	C; el.: IBVS No. 5232

Table 1: Eclipsing binaries (cont.)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GSC3523-505 Dra	p	54388.2980	0.0007	−0.0019	15	EBl	C; el.: IBVS No. 5699
GSC3552-321 Dra	s	54407.2234	0.0010	+0.0006	33	EBl	C; el.: IBVS No. 5699
GSC3888-464 Dra	s	54288.4095	0.0008	+0.0114	17	EBl	C; el.: IBVS No. 5505
GSC3905-60 Dra	s	54388.2489	0.0011	−0.0020	16	EBl	C; el.: IBVS No. 5699
TZ Gem	p	54505.380	0.003	+0.087	9	RD	V
AZ Gem	s	54504.3038	0.0008	+0.0846	27	RD	V
BD Gem	p	54504.3817	0.0007	−0.0279	17	RD	V
EN Gem	p	54504.3060	0.0011	−0.0429	26	RD	V
NSV3210 Gem	p	54504.3410	0.0009	−0.0031	31	RD	V; el.: IBVS No. 5630
NSV3346 Gem	p	54504.2644	0.0024	+0.0051	13	RD	V; el.: IBVS No. 5630
LT Her	p	54296.4520	0.0008	−0.0312	31	RD	V; el.: BAV Mitt. 69
LV Her	p	54297.4509	0.0004	+0.0333	31	RD	V; el.: IBVS No. 5201
V357 Her	s	54296.4322	0.0011	−0.0072	16	RD	V; el.: IBVS No. 5280
V731 Her	s	54297.4938	0.0006	+0.0005	22	RD	V; el.: IBVS No. 5592
V732 Her	p	54297.536	0.002	−0.088	21	RD	V
V733 Her	s	54297.4393	0.0004	−0.0149	19	RD	V
V742 Her	s	54296.4560	0.0008	+0.0357	24	RD	V
V1088 Her	s	54296.3768	0.0011	−0.0567	10	RD	V; el.: ROTSE1
GSC963-246 Her	p	54295.4543	0.0005	+0.0038	23	EBl	C; el.: IBVS No. 5799
	s	54318.3951	0.0002	+0.0078	22	EBl	C
GSC1518-913 Her	s	54295.4469	0.0007		19	EBl	C; el.: IBVS No. 5799; refined period: 0.32104
	p	54318.4142	0.0010		17	EBl	C
GSC1537-1557 Her	s	54288.4754	0.0007	+0.0016	13	EBl	C; el.: IBVS No. 5505
GSC1549-3991 Her	p	54288.3991	0.0009	−0.0010	12	EBl	C; el.: IBVS No. 5505
GSC2587-289 Her	p	54295.4353	0.0003	−0.0011	27	EBl	C; el.: IBVS No. 5799
	p	54318.3566	0.0002	+0.0013	23	EBl	C
GSC2587-4476 Her	p	54295.4476	0.0009		16	EBl	C; el.: IBVS No. 5799; revised period: 0.310764
GSC3097-1297 Her	s	54288.3907	0.0007	+0.0011	14	EBl	C; el.: IBVS No. 5564
GSC3101-547 Her	p	54364.3497	0.0005	+0.0026	19	EBl	C; el.: IBVS No. 5564
GSC3106-1368 Her	s	54364.2974	0.0012	+0.0049	21	EBl	C; revised el.: 53229.5392 + 0.358362×E
GSC3510-5 Her	p	54288.4186	0.0009	+0.0204	17	EBl	C; el.: IBVS No. 5564
GSC3532-553 Her	s	54388.2794	0.0005	−0.0002	21	EBl	C; el.: IBVS No. 5699
BV Lyr	p	54295.4580	0.0002	+0.0263	40	RD	V
V400 Lyr	p	54384.2906	0.0004	−0.0391	15	EBl	C; el.: IBVS No. 4995
V574 Lyr	s	54384.3601	0.0008	−0.0030	22	EBl	C; el.: IBVS No. 4976
V579 Lyr	p	54384.3040	0.0004	−0.0131	18	EBl	C; el.: IBVS No. 4982
V580 Lyr	p	54384.2715	0.0004	−0.0203	22	EBl	C; el.: IBVS No. 4982
V582 Lyr	s	54384.3610	0.0007	+0.0405	16	EBl	C; el.: IBVS No. 4985
V591 Lyr	p	54387.2562	0.0005	+0.0004	13	EBl	C; el.: IBVS No. 5232
	s	54387.4069	0.0014	+0.0010	7	EBl	C
V592 Lyr	p	54387.3600	0.0009	+0.0098	16	EBl	C; el.: IBVS No. 5232
V596 Lyr	s	54387.3162	0.0021	+0.0077	10	EBl	C; el.: IBVS No. 5232
GSC3108-57 Lyr	s	54387.3904	0.0008	−0.0036	10	EBl	C; el.: IBVS No. 5525
GSC3109-859 Lyr	s	54387.2559	0.0008	−0.0053	11	EBl	C; el.: IBVS No. 5525
GSC3526-1995 Lyr	s	54387.3850	0.0017	−0.0131	11	EBl	C; el.: IBVS No. 5525
GSC3526-2369 Lyr	s	54387.2505	0.0004	+0.0251	12	EBl	C; el.: IBVS No. 5525
	p	54387.412	0.003	+0.022	10	EBl	C

Table 1: Eclipsing binaries (cont.)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
V2332 Oph	p	54297.4253	0.0004	−0.0718	24	RD	V; el.: IBVS No. 4345
GSC995-1646 Oph	s	54364.3625	0.0013	+0.0119	22	EBl	C; el.: IBVS No. 5505
NSV8780 Oph	s	54296.415	0.003	−0.099	16	RD	V; el.: IBVS No. 5360
NSV9637 Oph	p	54296.4467	0.0005	−0.0164	29	RD	V; el.: IBVS No. 5644
GU Ori	s	54505.2898	0.0005	−0.0434	22	RD	V; el.: JAAVSO 14, 12
GSC107-596 Ori	s	54474.3452	0.0008	+0.0006	20	EBl	C; el.: IBVS No. 5799
GSC702-1892 Ori	p	54474.2846	0.0009	−0.0007	12	EBl	C; el.: IBVS No. 5493
GSC706-845 Ori	p	54474.3600	0.0019	−0.0045	22	EBl	C; el.: IBVS No. 5799
GSC1283-53 Ori	s	54474.2857	0.0008	+0.0001	26	EBl	C; el.: IBVS No. 5799

Observers:

EBl :	E. Blättler	Wald, Switzerland
RD :	R. Diethelm	Rodersdorf, Switzerland

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OBSERVATIONS OF THE ACTIVE SOUTHERN RS CVn BINARY V841 Cen IN 2007 AND 2008 – A LARGE, LONG–LIVED SPOT WAVE

INNIS, J. L.[1]; COATES, D.W.[2]

[1] Brightwater Observatory, 280 Brightwater Rd., Howden, TAS, 7054, Australia. Email: brightwater@iraf.net

[2] School of Physics, Building 27, Monash University, VIC, 3800, Australia

V841 Cen (HD 127535) is an active single–lined RS CVn binary of orbital period just under 6 d (Collier Cameron, 1987). The star is one of the more active southern RS CVn systems having been detected at microwave frequencies, both in short–term flare events and more slowly varying 'quiescent' emission (Slee et al., 1987a, 1987b). Photometric data have been presented by a number of workers – Udalski & Geyer (1984); Innis et al. (1985); Bopp et al. (1986); Collier Cameron (1987); Mekkaden & Geyer (1988); Strassmeier et al. (1994); and especially Cutispoto (1990, 1993, 1996, 1998a, & 1998b). These data show a ∼6 d spot wave of varying amplitude, usually ∼0.05 to ∼0.25 mag in V, with smaller associated colour changes. The spot wave is highly variable (op cit.), changing at times within a few weeks (e.g. Innis et al., 1998).

We observed V841 Cen at the Brightwater Observatory in 2007 and 2008. A description of the observatory and techniques is given in Innis et al. (2007). In brief, a short–focus, 70–mm telescope and cooled CCD is used to obtain a field of view near $0.^\circ 8 \times 0.^\circ 55$, allowing target and comparison stars to be observed simultaneously. The observations in B and V filters were transformed to the Cousins system. We used exposure times of 45 sec in B and 30 sec in V. We combine 4 such individual (and consecutive) exposures in each filter to form normal points. Usually 4 or more normal points in each of B and V were obtained on a given night.

We collected 38 nights of data between 2007 April–September (∼ 180 normal points in each filter), and a further 9 nights of data between 2008 April and May (∼ 130 normal points in each filter). We used HD 128227 as the comparison star and CPD -59° 5634 as the check star. For the normal points we find for these stars magnitude differences (and standard deviations) ΔV: 1.256±0.016 for 2007; 1.263±0.012 for 2008; ΔB: 0.985±0.028 for 2007; 0.998±0.042 for 2008. These results indicate no detectable variation in the comparison and check stars above observational scatter. For the comparison star HD 128277 we use V =8.33 and $B - V$ =1.07 (which are average values from the work of Bopp et al., 1986; Collier Cameron 1987; Mekkaden & Geyer, 1988; and Cutispoto, 1990,1993,1996, 1998a, 1998b – all those authors report V and $B - V$ values that closely agree).

Figure 1 shows the data for V841 Cen plotted against HJD. The top panel shows V data, the lower panel shows $B - V$. The dots represent the 2007 April–September data, and the crosses represent the 2008 April–May data. The range in V is very large, slightly over 0.4 mag.

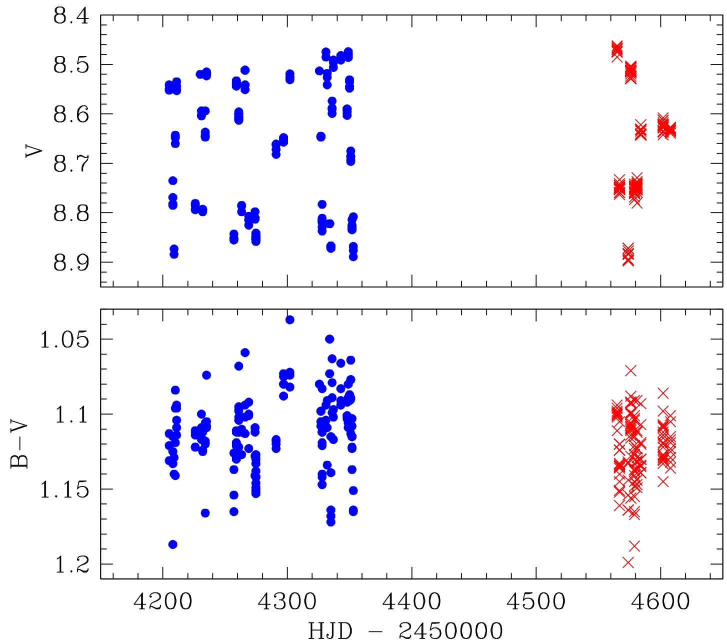

Figure 1. Brightwater Observatory V data (top) and $B-V$ (lower) data for V841 Cen. The dots represent the 2007 April–September data, and the crosses represent the 2008 April–May data.

We use the period of 5.988 d and epoch HJD 2444653.737 (Innis et al., 1998) for the phase plots shown in Figure 2. These observations show that, given the rapid changes the star has exhibited previously, the light curve has been remarkably stable over the ∼13 month extent of the dataset. The lower panel of Figure 2 shows $B-V$ versus V. A clear colour change of several hundredths of a magnitude is seen. The star appears to have been slightly redder in 2008 compared to 2007.

In Figure 3 we have collected the known V photometric range versus year for V841 Cen, obtained from the references listed above. The most recent data show that both maximum and minimum light are comparable to the historical extremes. What is unusual is that the 2007 and 2008 data show such a large range of ∼0.4 mag in V, which is significantly larger than has been seen previously for this star. It is also among the largest spot waves seen for this class of object. That the spot wave has apparently maintained this amplitude over 13 months is of further interest.

Assuming a spot or spot group that contributes effectively no flux compared to the unspotted photosphere, at minimum light approximately 45% of the visible stellar disk must be covered to produce the ∼0.4 mag spot wave. The data indicate that such a large spot or spot region remained relatively unchanged during the observing interval. An alternative hypothesis would be that the large amplitude is a consequence of a bright spot on one hemisphere, and a dark spot on the other. This would however require two spots (or spot regions) to stay relatively stable over a year. If so, by reference to the overall V variation in Figure 3, one may also need to conclude such a bright spot had been present previously to account for maximum light in the 1994 observations. The data do not allow us to determine if this was the case, but postulating a single long–lived spot or spot group requires fewer assumptions.

We intend to continue monitoring V841 Cen. We expect that, given the history of this star, the large amplitude spot wave is likely to exhibit significant changes in the near future.

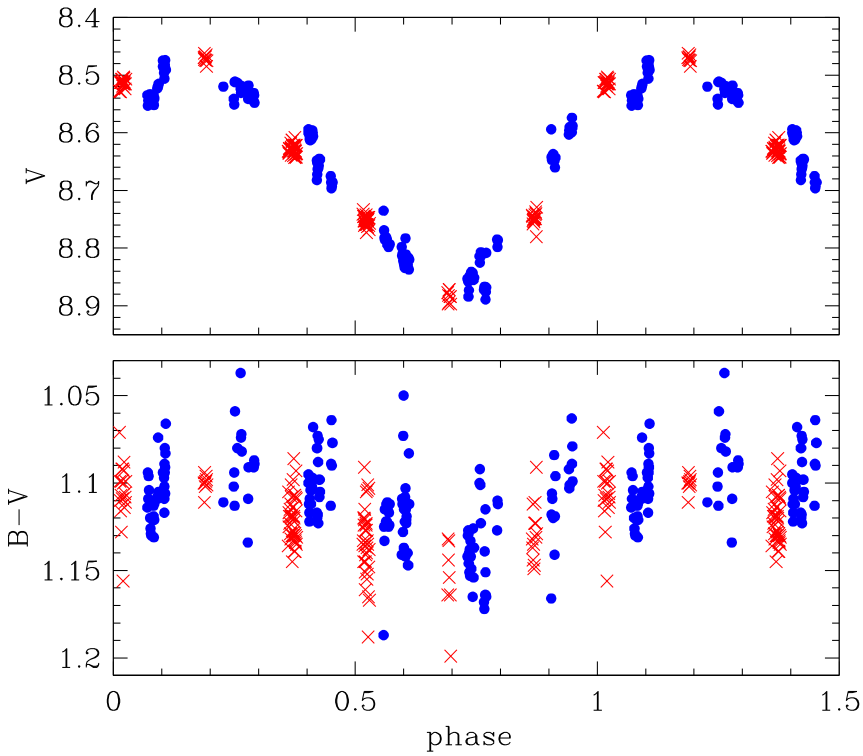

Figure 2. Top panel: V light curve for V841 Cen using the period of 5.988 d and epoch HJD 2444653.737 (Innis et al., 1998). Lower Panel: $B - V$ colour index curve of V841 Cen. In both panels the dots represent the 2007 April–September data, and the crosses represent the 2008 April–May data.

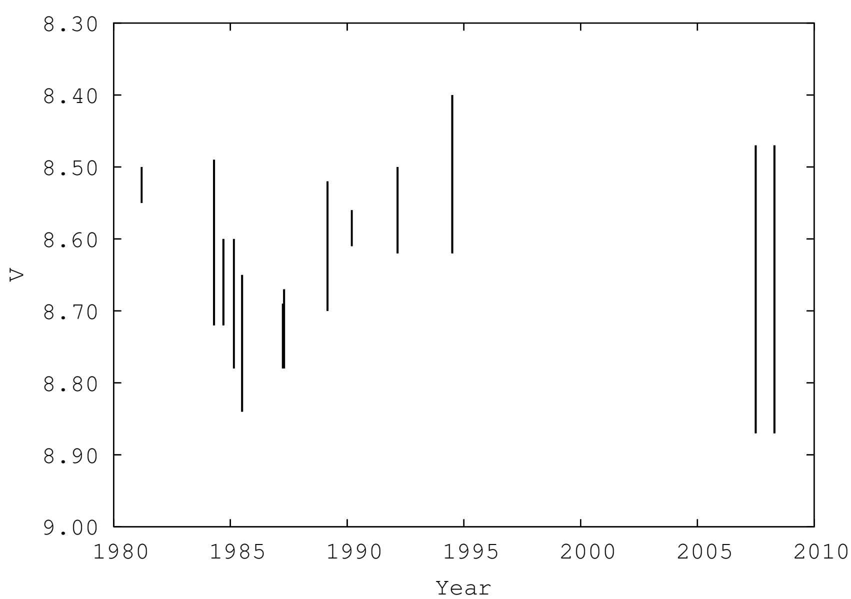

Figure 3. Range in V light for V841 Cen.

Acknowledgments: This work has made use of the SIMBAD database of the Stellar Data Centre (CDS) Strasbourg, the NASA ADS abstract database, the data–reduction packages IRAF (NOAA, USA) and Muniwin (D. Motl), and the numerical analysis program OCTAVE (J. Eaton and colleagues). D. Coates thanks the Faculty of Science, Monash University, for the provision of an Honorary Research Fellowship. We thank K. Oláh for assistance with this paper.

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ERRATUM FOR IBVS 5838

In IBVS 5838, first page, third paragraph, the comparison star of V841 Cen is mentioned with two different HD numbers. The correct name of the star is HD 128227.

The Editors

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PLATE ARCHIVE PHOTOMETRY OF THE PROGENITORS OF NOVA CYG 2008 N.2 AND NOVA SGR 2008

JURDANA-SEPIC, RAJKA[1]; MUNARI, ULISSE[2]

[1] Physics Department, University of Rijeka, Omladinska 14, HR 51000 Rijeka, Croatia

[2] INAF Osservatorio Astronomico di Padova, Sede di Asiago, I-36032 Asiago (VI), Italy

Nova Cyg 2008 N.2 (= V2491 Cyg) and Nova Sgr 2008 (= V5579 Sgr) were discovered on 10 April 10 and 18 April 2008, respectively. A summary of the discovery circumstances and early studies of these two novae has been presented by Henden and Munari (2008). To the aim of providing more information on the nature of these two novae, we have searched the archives of the Asiago Schmidt telescopes for photographic plates imaging their progenitors.

Henden and Munari (2008) found the position of Nova Cyg 2008 N.2 to be coincident with the faint star USNO-B1.0 1223-042965 (within 0.9 arcsec). We located 131 Asiago photographic plates covering the position of Nova Cyg 2008 N.2, 44 of which were later discarded for various reasons (too bright sky background, poor focus or guiding, too bright limiting magnitude, or other plate defects). A total of 87 good B and V plates (exposed between Oct 4, 1970 and Oct 10, 1986) were then retained, and the magnitude of the progenitor was eye-estimated at the microscope against the $BVR_{\mathrm{C}}I_{\mathrm{C}}$ photometric calibration sequence of Henden and Munari (2008). The results are given in Table 1 (available electronic only) and plotted for the B-band in Figure 1. During the 16 years covered by the Asiago archive plates, no outburst or large variability was detected. The progenitor remained stable around the mean values:

$$< B > \; = \; 17.88 \quad \text{(dispersion 0.20 mag)} \tag{1}$$

$$< V > \; = \; 17.06 \quad \text{(dispersion 0.22 mag)} \tag{2}$$

$$< B - V > \; = \; +0.82 \tag{3}$$

$$< V > - \, R_{\mathrm{C}}^{POSS-II} \; = \; +0.73 \tag{4}$$

The $V - R_{\mathrm{C}}$ is obtained by comparison with POSS-II plate on which the progenitor shines at $R_{\mathrm{C}}{\approx}16.33$ mag. Comparing with maximum brightness attended by the nova, the outburst amplitude has been ΔB=8.9, ΔV=8.5 mag and ΔR_{C}=8.7. Such a limited amplitude is in sharp contrast with the rapid decline of Nova Cyg 2008 N.2. A 8.7 mag amplitude would correspond to a mean decline time $t_2{\approx}200$ days (cf. Warner 1995, his Figure 5.4), a dozen times slower than the observed $t_2{\sim}17$ days (Munari et al. 2008).

A serendipitous monitoring of the field of Nova Cyg 2008 N.2 was carried out by Balman et al. (2008) from July to November 2007. They failed to reveal any source at the nova

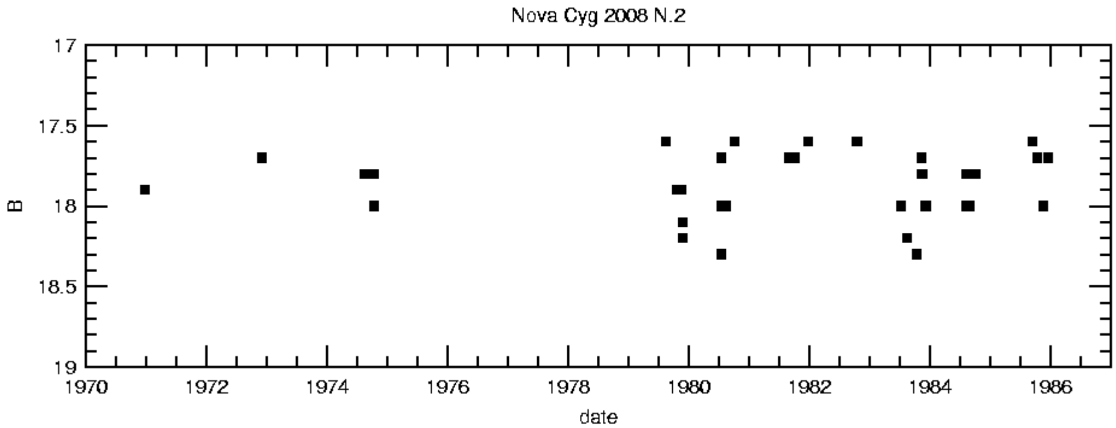

Figure 1. B band photometry of the progenitor of Nova Cyg 2008 N.2 from photographic plates of the Asiago Schmidt telescopes archives, showing its constancy in brightness over the period 1970-1986.

position brighter than the R_C=18.2 mag limiting magnitude of their observations. Balman et al. (2008) do not specify what is the astrometric position they assumed for the nova. They linked their magnitude scale to USNO-B1 R_C magnitudes of the surrounding stars. By comparing with the Henden and Munari (2008) photometric sequence, no systematic offset larger than 0.1 mag is likely to affect the USNO-B1 R_C values. This would imply that the progenitor of Nova Cyg 2008 N.2, which was photometrically stable over the period 1970-1986, should have turned fainter by $\Delta R_C \geq 2$ mag for several months right before to erupt as a nova. This behavior would be highly peculiar and has no correspondence among other novae, which instead in some cases tend to show an *increase* in their luminosities in the years before the outburst (cf. Robinson 1975). It seems therefore worthwhile that Balman et al. (2008) specify the astrometric position they assumed for the nova and possibly publish a zoomed picture of the field from their piled-up CCD R_C observations.

Similarly for Nova Cyg 2008 N.2, we searched the Asiago Schmidt plate archives also for Nova Sgr 2008, and found 106 plates covering its position. After plate inspection, 58 good B and I_C band plates were finally retained. We adopted nova position and photometric comparison sequence from Henden and Munari (2008). The 58 good plates cover the period June 16, 1961 to 24 July, 1977, with an average limiting magnitude $B{\sim}18$, $I_C{\sim}15.5$. They are listed in Table 2 (available electronic only). The progenitor was below limiting magnitude on all the plates.

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CONFIRMATION OF THE RRd NATURE OF V458 HER

HAMBSCH, FRANZ-JOSEF[1,2]; WILS, PATRICK[2]

[1] Bundesdeutsche Arbeitsgemeinschaft für Veränderliche Sterne e.V. (BAV), Germany; e-mail: hambsch@telenet.be

[2] Vereniging Voor Sterrenkunde, Belgium; e-mail: patrickwils@yahoo.com

V458 Her was discovered to be variable by Hoffmeister (1936). It was classified as an RRc type variable with a period of 0.3599801 days. From data in the Northern Sky Variability Survey (*NSVS*; Woźniak et al., 2004), Wils et. al (2006) found it to be a double-mode RR Lyrae type variable (RRd), with a fundamental period of 0.48374 days and a period ratio of 0.7442 (with the first overtone period having the largest amplitude, common among RRd stars). Szczygieł & Fabrycky (2007) cast some doubt on this classification because a significant secondary frequency couldn't be found in data from the All Sky Automated Survey (*ASAS-3*; Pojmanski & Maciejewski, 2005).

CCD observations were therefore performed with a 35-cm C14 and an SBIG ST-8 camera on 10 nights in July-August 2007 (V and R_C data) and on 14 nights in April-May 2008 (only V data) to verify the classification. The comparison stars used were GSC 1539-0959 (adopted magnitude $V = 12.45$ and $R = 12.37$ from the Tycho2 catalogue) and GSC 1539-1173. The median nightly standard deviation for the check star measurements was 0.02 mag. All data are available electronically.

The data were analysed using Period04 (Lenz & Breger, 2005). The presence of an additional frequency (the fundamental mode) and some of its combination frequencies with the first overtone mode were readily identified. Table 1 gives an overview of the frequencies identified, together with their amplitudes and phases. The values for the R_C data were calculated using the frequencies derived from the V data. The uncertainties on the values were derived from Monte Carlo simulations. The top panel of Fig. 1 presents a phase diagram of the V data, plotted with the first overtone period, the period with the largest amplitude. The bottom panel shows a phase diagram of the V data, prewhitened with the first overtone period and its harmonics (but not with the combination frequencies), and plotted with the fundamental period. The period ratio P_1/P_0 for V458 Her can then be calculated to be 0.7443, the amplitude ratio $A_1/A_0 = 3.1$.

The extended *ASAS-3* data set, including data from 2007 and 2008, now also clearly confirms the RRd nature of V458 Her. The frequencies derived from these data are $f_1 = 2.777932$ and $f_0 = 2.067709$, which again leads to $P_1/P_0 = 0.7443$, and also $A_1/A_0 = 3.7$.

This research made use of the SIMBAD and VizieR databases operated at the *Centre de Données Astronomiques (Strasbourg)* in France.

Table 1: Frequencies detected in V458 Her.

Frequency		Ampl. V	Phase V	Ampl. R_C	Phase R_C
	c/d	mmag	degrees	mmag	degrees
f_1	2.777971(6)	208±1	158.8±0.3	175±3	161±1
f_0	2.067729(20)	67±1	68.2±0.9	50±3	70±4
$2f_1$	5.555942	27±1	142.1±1.9	33±3	165±6
$f_1 + f_0$	4.845700	29±1	11.1±2.0	13±3	354±11
$f_1 - f_0$	0.710242	16±1	57.8±3.5		
$3f_1$	8.333913	13±1	137.2±3.5	11±3	135±19
$2f_1 + f_0$	7.623671	12±1	324.6±4.9		
$4f1$	11.111883	6±1	140.7±8.6		

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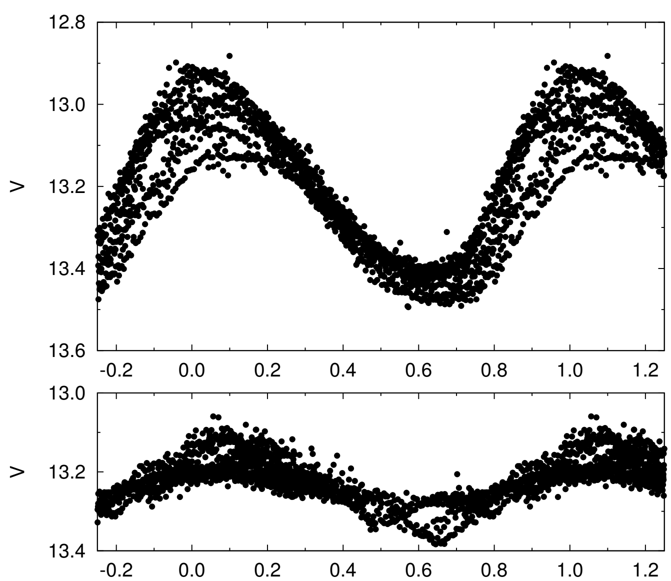

Figure 1. Top: phase diagram of the V458 Her V data, plotted with the first overtone period of 0.359975 days. Bottom: V data, prewhitened with the first overtone period, and plotted with the fundamental period.

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EVIDENCE FOR SHORT-TERM VARIATIONS IN TWO O-TYPE STARS

DE BECKER, M.[1,2]; LINDER, N.[1]; RAUW, G.[1,2]

[1] Institut d'Astrophysique et de Géophysique, Université de Liège, Allée du 6 Août, Bât B5c, 4000 Liège, Belgium, e-mail: debecker@astro.ulg.ac.be

[2] Fonds National de la Recherche Scientifique, Belgium

The study of spectral variability of O-type stars led, in a few cases, to the discovery of variations with periods of a fraction of a day (see e.g. ζ Pup, Baade 1991, and ζ Oph, Kambe et al. 1997). These variations are often considered to be the signature of non-radial pulsations. More recently, Rauw et al. (2008) investigated in detail the case of HD 93521 and reported on variations on time scales of 1.75 and 2.89 h. As only a handful of O-type stars displaying short-term variations are known, any new detection constitutes as significant improvement of the catalog of short-term varying massive stars.

In this paper, we present the results of a spectroscopic monitoring of two O-type stars. HD 13268 is an ON8V star that belongs to the Per OB1 association. HD 15137 (O9.5V) is a runaway SB1 system ($P \sim 30$ d) whose preliminary orbital parameters have been published by Boyajian et al. (2005) and McSwain et al. (2007). The former authors suggested that this star may have been ejected from the nearby cluster NGC 654 in the Perseus spiral arm. Both stars display broad absorption lines due to a rather high rotational velocity. Their projected rotational velocities are respectively estimated to be equal to 302 km s^{-1} (Penny 1996) and 178 km s^{-1} (Conti & Ebbets 1977).

Our analysis is based on data collected with the Aurélie spectrograph at the 1.52-m telescope of the Observatoire de Haute Provence (OHP, France). In the case of HD 13268, the time series is constituted of 62 spectra obtained between October 2004 and November 2007, but most of the data were obtained during 4 nights in autumn 2007 (see Table 1). We observed HD 15137 44 times during the same epoch, with 12 spectra obtained on the same night with a timespan of about 6 hours (on 2006, October 26th, see Table 2). Our spectra covered wavelengths between 4460 and 4890 Å , with a resolving power of about 8000. Exposure times were of the order of 25–45 minutes depending on the sky conditions. The signal-to-noise of our spectra – estimated in regions devoid of spectral lines – was higher than 200. The data were reduced following the procedure described by Rauw & De Becker (2004).

We applied the Time Variance Spectrum (TVS) analysis technique as described by Fullerton et al. (1996) to our spectral time series. In the case of HD 13268, we detected a significant – although weak – variability in the profile of He I λ 4471, He I $\lambda\lambda$ 4542,4686, and Hβ. This variability was present both in the complete data set, and in data sets of individual nights during which several spectra were collected. We analyzed our time series using the generalized Fourier technique of Heck et al. (1985) and revised by Gosset et al. (2001). This technique is especially adapted to the case of unequally spaced data. The power spectra are shown in Fig. 1 for He II λ 4686 and H β. Our results point to potential variability time scales of 14.5 and 6.7 h respectively for the two lines, even though significant residuals are still present after prewhitening (see middle panels of Fig. 1). Several factors are likely to contribute to these residuals: (i) the reported time scales may be incorrect (aliasing, ...), (ii) the low amplitude of the variations makes our temporal analysis very sensitive to noise, and (iii) more than one unidentified time scale may contribute to the detected variations. The studies of the other few examples of short-term varying O-type stars suggest indeed that multiperiodic variations are occurring.

Table 1. Journal of the observations of HD 13268. The heliocentric Julian date at mid-exposure is given as HJD - 2 450 000, and the date (yyyy/mm/dd) is that of the beginning of the night.

#	HJD	Date	#	HJD	Date	#	HJD	Date
1	3286.512	2004/10/07	22	4396.484	2007/10/22	43	4421.454	2007/11/16
2	3289.595	2004/10/10	23	4396.505	2007/10/22	44	4421.475	2007/11/16
3	3290.490	2004/10/11	24	4396.551	2007/10/22	45	4421.499	2007/11/16
4	3294.634	2004/10/15	25	4396.574	2007/10/22	46	4421.549	2007/11/16
5	3295.482	2004/10/16	26	4396.595	2007/10/22	47	4421.573	2007/11/16
6	3295.672	2004/10/16	27	4407.364	2007/11/02	48	4421.598	2007/11/16
7	3296.597	2004/10/17	28	4407.381	2007/11/02	49	4422.356	2007/11/17
8	3648.620	2005/10/04	29	4407.399	2007/11/02	50	4422.373	2007/11/17
9	3652.586	2005/10/08	30	4407.418	2007/11/02	51	4422.388	2007/11/17
10	3654.456	2005/10/10	31	4407.436	2007/11/02	52	4422.402	2007/11/17
11	3982.621	2006/09/03	32	4407.454	2007/11/02	53	4422.439	2007/11/17
12	3984.575	2006/09/05	33	4407.473	2007/11/02	54	4422.454	2007/11/17
13	4034.408	2006/10/25	34	4407.490	2007/11/02	55	4422.469	2007/11/17
14	4034.466	2006/10/25	35	4407.553	2007/11/02	56	4422.484	2007/11/17
15	4034.524	2006/10/25	36	4407.570	2007/11/02	57	4422.516	2007/11/17
16	4034.585	2006/10/25	37	4407.691	2007/11/02	58	4422.533	2007/11/17
17	4035.386	2006/10/26	38	4421.613	2007/11/16	59	4422.557	2007/11/17
18	4396.369	2007/10/22	39	4421.350	2007/11/16	60	4422.570	2007/11/17
19	4396.392	2007/10/22	40	4421.370	2007/11/16	61	4422.594	2007/11/17
20	4396.414	2007/10/22	41	4421.393	2007/11/16	62	4422.608	2007/11/17
21	4396.462	2007/10/22	42	4421.433	2007/11/16			

Table 2. Journal of the observations of HD 15137.

#	HJD	Date	#	HJD	Date	#	HJD	Date
1	3652.642	2005/10/08	16	4035.545	2006/10/26	31	4409.528	2007/11/04
2	3654.538	2005/10/10	17	4035.568	2006/10/26	32	4410.475	2007/11/05
3	3980.585	2006/09/01	18	4035.588	2006/10/26	33	4411.551	2007/11/06
4	3982.552	2006/09/03	19	4035.611	2006/10/26	34	4412.504	2007/11/07
5	3984.545	2006/09/05	20	4035.632	2006/10/26	35	4413.584	2007/11/08
6	4033.406	2006/10/24	21	4035.655	2006/10/26	36	4414.530	2007/11/09
7	4033.495	2006/10/24	22	4396.438	2007/10/22	37	4415.546	2007/11/10
8	4033.602	2006/10/24	23	4397.516	2007/10/23	38	4416.453	2007/11/11
9	4034.670	2006/10/25	24	4400.646	2007/10/26	39	4417.467	2007/11/12
10	4035.413	2006/10/26	25	4401.598	2007/10/27	40	4418.383	2007/11/13
11	4035.437	2006/10/26	26	4402.588	2007/10/28	41	4419.412	2007/11/14
12	4035.458	2006/10/26	27	4405.599	2007/10/31	42	4421.525	2007/11/16
13	4035.480	2006/10/26	28	4406.590	2007/11/01	43	4422.421	2007/11/17
14	4035.502	2006/10/26	29	4407.532	2007/11/02	44	4423.322	2007/11/18
15	4035.524	2006/10/26	30	4408.591	2007/11/03			

In the case of HD 15137, our sampling of high frequencies is rather poor as this star was intensively observed during only one night. However, the TVS indicates a significant line profile variability of at least He I λ 4471 and H β, i.e. the strongest absorption lines in the blue spectrum, during that particular night. The comparison of the line profiles obtained during a same night reveals indeed variations from one spectrum to the other, with time intervals of the order of 30–40 minutes between two consecutive observations. These variations can be seen in the line profiles plotted in the left part of Fig. 2. We note that it is unlikely that these variations be due to the orbital motion of the SB1 as its period is of the order of 30 d, i.e. much longer than the time scales investigated during a single night. The right part of Fig. 2 shows the power spectrum of the complete time series for H β. The wavelength position of the line profile has been corrected for the orbital motion before computing the power spectrum. The corrections were calculated on the basis of a SB1 orbital solution computed from our data and the radial velocities published by Boyajian et al. (2005) and McSwain et al. (2005), using the same method as De Becker et al. (2006). We note the presence of a family of peaks close to 2 d^{-1}. Some power is also found at higher frequencies (see for instance a low amplitude family of peaks whose presence is suggested around 10 d^{-1}). A much better sampling of high frequencies is however needed in order to clarify the situation and propose valuable values for the short variability time scale(s). We note that Boyajian et al. (2005) already suggested the occurrence of short-term variations for this star.

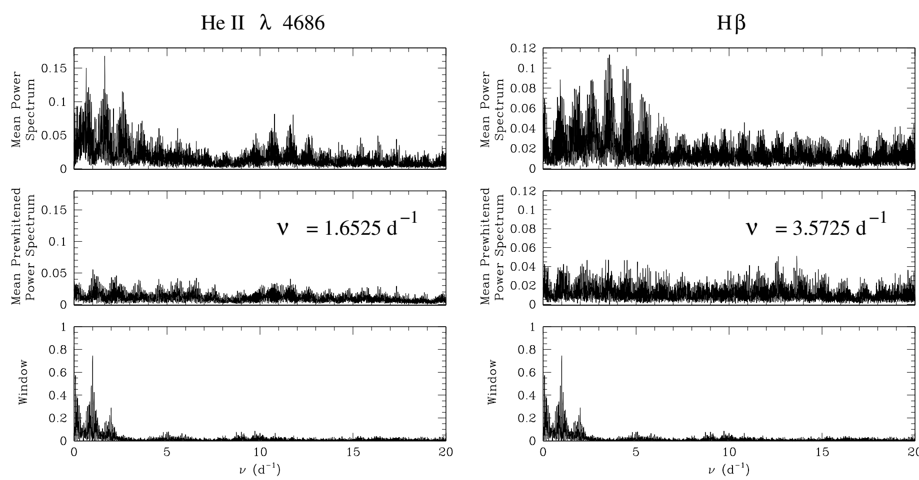

Figure 1. Fourier analysis of He II λ 4686 between 4682 and 4685 Å (*left part*) and H β between 4857 and 4860 Å (*right part*) in the case of HD 13268. *Upper panels:* mean power spectrum over the specified wavelength domain. *Middle panels:* prewhitened power spectrum using the specified frequency corresponding to the highest peak in the upper panel. Significant residual power is still present, but a much better sampling of higher frequencies is requested in order to determine accurately the variability time scales. *Lower panels:* spectral window related to the data sampling.

Considering (i) the low amplitude of the variations and (ii) their rather high frequency, intensive monitoring with large collecting area telescopes is really needed if one wants to investigate the short term behaviour of these stars. Typically, several complete nights on 4-m class telescopes, using rather high resolving power (at least 20000), should be devoted to these targets in order to characterize their short term variations in a way similar to that of HD 93521 (Rauw et al. 2008) or ζ Oph (Kambe et al. 1997).

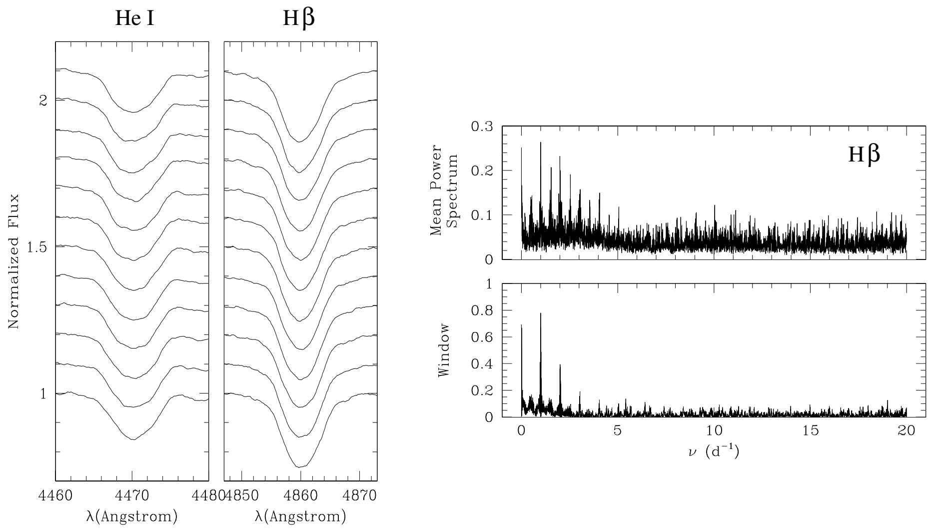

Figure 2. *Left part:* Line profiles of He I λ 4471 and H β in the case of HD 15137. The selected spectra are those obtained during a single night (number #10 to #21 in Table 2, from the top to the bottom). *Right part:* Fourier analysis of the complete time series (44 spectra) for H β after correction for the SB1 orbital motion. We note that some residual power due to the orbital motion may still be present at low frequencies. The power spectrum suggests however the presence of frequencies likely related to time scales of a fraction of a day.

In summary, we report on the detection of significant variations on time scales of a fraction of a day in the blue spectrum of two late-type main-sequence O stars: HD 13268 and HD 15137. The frequency sampling of our time series did not allow us to determine the variability time scale, but we claim that these stars should be considered as very valuable targets for future studies aiming at investigating rapid variations in O-type stars. Such variations may be the signature of non-radial pulsations, or of structures related to circumstellar rotating material. Intensive high spectral resolution spectroscopic campaigns are needed to investigate such a behaviour.

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SHORT-PERIOD OSCILLATIONS FOUND IN THE ALGOL-TYPE SYSTEM GSC 4550-1408

DIMITROV, D.; KRAICHEVA, Z.; POPOV, V.

[1] Institute of Astronomy, BAS, Tsarigradsko Shossee 72, 1784 Sofia, Bulgaria,
e-mail: dinko@astro.bas.bg; zk@astro.bas.bg; vpopov@astro.bas.bg

GSC 4550-1408 was discovered as an eclipsing binary by Biyalieva and Khruslov (2007), in their search for new variables in the NSVS database (Wozniak et al. 2004). This star is suitable for more detailed study taking into consideration its period $P = 1.23837$ days, amplitude of primary minimum $A_R \simeq 0.4$ mag, and visual magnitude $V_T = 11.26$ mag.

The CCD photometry of GSC 4550-1408 was carried out with the 60cm Cassegrain telescope at NAO Rozhen, equipped with the CCD camera FLI PL09000 (3056x3056, 12μ pixel), and Bessell (1990) standard $UBVRI$ filters. The standard IRAF procedures were used for the reduction of the photometric data.

The phased light curve is shown on Fig. 1. Light curves for several nights, acquired in the BVR passbands are shown in Fig. 3 and 4. Oscillations with a peak-to-peak amplitude up to 0.02 mag in R, and 0.04 mag in B, were detected in four of the observational runs (including secondary minimum). A preliminary analysis of the out-of-eclipse data shows a main periodicity about 37 c/d ($\sim$ 39 min.).

Spectral observations of GSC 4550-1408 were obtained with the Coudé spectrograph (resolution of 0.19 Å/pixel) with the 2m RC telescope at NAO Rozhen. The spectral domain covered three regions around H_α, H_β, and MgII 4481 lines. The data reduction of the spectra was made with the standard IRAF procedures. The corresponding radial velocities were measured with the cross-correlation technique using synthetic spectrum, calculated with the programme SPECTRUM (Gray & Corbally 1994) and a grid of LTE atmosphere models for a solar-type chemical composition (Castelli & Kurucz 2003), as a template spectrum. Comparing the synthetic and the observed spectra (Fig. 5), the parameters of the primary component were estimated (Table 4).

The preliminary orbital and physical parameters were computed using both Rozhen and NSVS data, with the PHOEBE software (Prša & Zwitter 2005). The new ephemeris is as follows:

$$HJD(\mathrm{MinI}) = 2451403.832(\pm 0.004) + 1.2383832(\pm 0.0000008)E \tag{1}$$

The amplitude of the RV curve is $A_{RV} = 15$ kms^{-1}, and the γ velocity is -52.3 kms^{-1} (Fig. 2). The physical parameters of the secondary component, computed with the PHOEBE, are shown in Table 4. The spectral types of the two components were estimated using Gray & Corbally (1994) calibration.

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Table 1. Data of the variable, comparison, and check stars used for the CCD photometry

ID	Name	RA (J2000)	DEC (J2000)	Spectral type
Var	GSC 4550-1408	$11^h\ 40^m\ 01.44^s$	$+75°\ 09'\ 21.3''$	
C1	SAO 7402	$11^h\ 38^m\ 38.42^s$	$+75°\ 10'\ 51.1''$	G5
C2	GSC 4550-1520	$11^h\ 37^m\ 15.62^s$	$+75°\ 11'\ 50.6''$	F5

Table 2. Observational runs of GSC 4550-1408

Date	HJD(start)	Length	Filter	Exp. [s]	N	Phase
12.05.2008	2454599.4533	$03^h\ 19^m$	*R*	20	485	0.479–0.590
13.05.2008	2454600.2794	$01^h\ 53^m$	*R*	20	260	0.146–0.209
16.05.2008	2454603.4463	$02^h\ 22^m$	*BVR*	120,60,20	60	0.703–0.783
03.06.2008	2454621.3795	$00^h\ 33^m$	*BVR*	120,60,20	9	0.182–0.200
29.06.2008	2454647.3367	$02^h\ 38^m$	*R*	60	136	0.145–0.233
30.06.2008	2454648.3087	$03^h\ 44^m$	*R*	60	175	0.930–0.055
01.07.2008	2454649.3814	$01^h\ 35^m$	*R*	60	100	0.796–0.855

Table 3. Rozhen spectra of GSC 4550-1408

Date	HJD(mid)	S/N	Exp. [s]	RV [kms^{-1}]		Region [Å]	Phase
13.05.2008	2454600.4071	28	1800	-73.7	±2.7	4400-4600	0.251
13.05.2008	2454600.4282	28	1800	-67.8	±6.8	4400-4600	0.268
13.05.2008	2454600.4516	33	1800	-45.6	±6.6	4800-5000	0.287
13.05.2008	2454600.4727	31	1800	-73.0	±4.4	4800-5000	0.304
13.05.2008	2454600.4953	38	1800	-71.1	±5.4	6500-6700	0.322
13.05.2008	2454600.5166	38	1800	-78.4	±6.3	6500-6700	0.340
10.06.2008	2454628.3810	29	1800	-42.8	±4.9	4400-4600	0.840
10.06.2008	2454628.4041	37	1800	-43.9	±4.3	4800-5000	0.859
10.06.2008	2454628.4268	46	1800	-49.5	±3.6	6500-6700	0.877
11.06.2008	2454629.3406	26	1800	-31.8	±4.7	4400-4600	0.615
11.06.2008	2454629.3641	33	1800	-34.2	±5.1	4800-5000	0.634
11.06 2008	2454629.3870	33	1800	-38.2	±7.4	6500-6700	0.653

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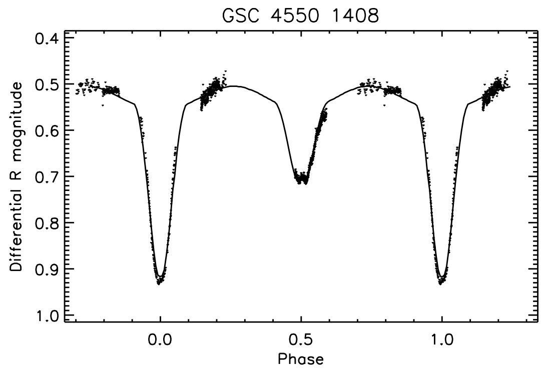

Figure 1. R band light curve of GSC 4550-1408 observed at NAO Rozhen (dots), and the synthetic light curve (solid line)

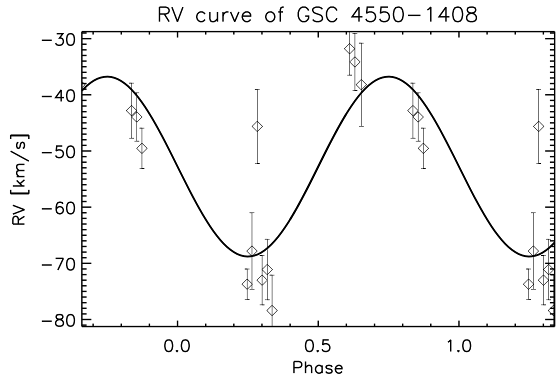

Figure 2. The Radial Velocity curve of GSC 4550-1408 (diamonds), and the best fit for the circular orbit assumption (solid line).

Table 4. Physical parameters of the primary and secondary components of GSC 4550-1408

Parameter		Primary star	Secondary star
$T_{\rm eff}$	[K]	8500	6900
$\log g$		4.0	3.6
$v \sin i$	[kms^{-1}]	~ 60	
Spectral type		A3 V-IV	F2 III

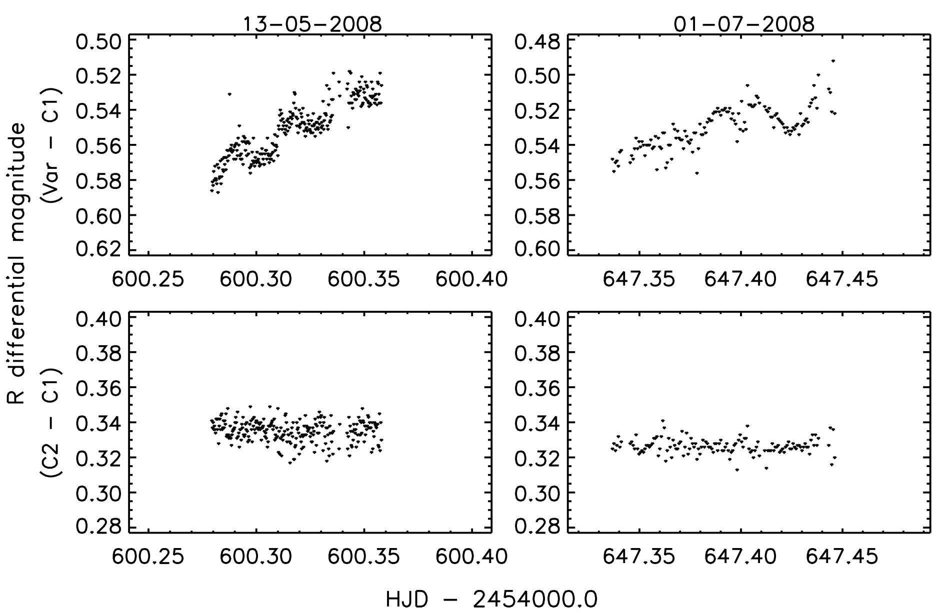

Figure 3. Nightly light curves of GSC 4550-1408: differential magnitudes between the variable and comparison stars ΔR(Var - C1), and between the check and comparison stars ΔR(C2 - C1)

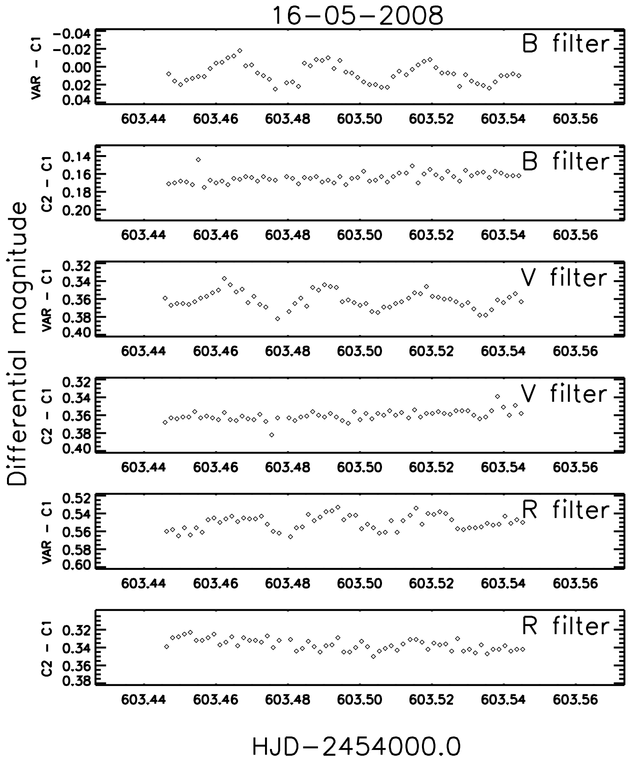

Figure 4. BVR light curves of GSC 4550-1408 and the check star observed on 16.05.2008

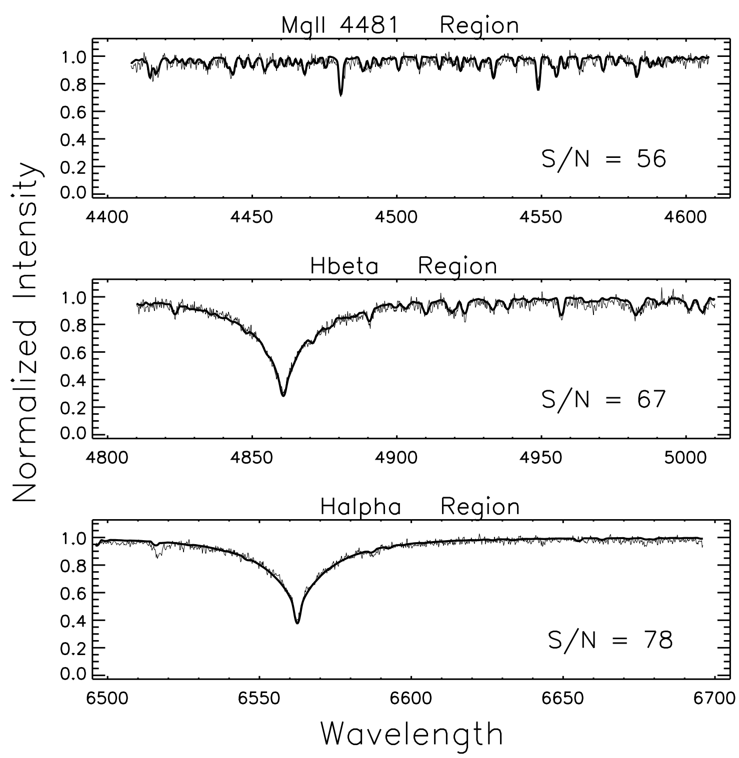

Figure 5. Rozhen combined spectra (thin line) of GSC 4550-1408 and the best synthetic spectra (thick line)

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TIMES OF MINIMA OBSERVED BY "PI OF THE SKY"

OGŁOZA, W.[1]; NIEWIADOMSKI, W.[1]; BARNACKA, A.[1]; BISKUP, M.[2]; MAŁEK, K.[3]; SOKOŁOWSKI, M.[4]

[1] Mt. Suhora Observatory, Cracow Pedagogical University, Podchorazych 2, 30-086 Krakow, Poland, ogloza@ap.krakow.pl

[2] Faculty of Mathematics, Informatics and Mechanics, University of Warsaw, Poland

[3] Center for Theoretical Physics PAS, Warsaw, Poland

[4] Soltan Institute for Nuclear Studies, Warsaw, Poland

The following table lists CCD times-of-minima of several binaries recorded by the "Pi of the Sky" (`http://grb.fuw.edu.pl/pi/`) robotic telescope during GRB patrol observations (Burd et al. 2005) in 2004-2007.

The observations, made in white light with an infrared-blocking filter, were reduced in the usual way. Times of minima, determined with the method of Kwee and van Woerden (1956), were added to the database of minima described by Kreiner (2004).

Web access to the database with individual times of minima is available at `http://www.as.ap.krakow.pl/miniauto`.

We would like to thank the staff of Las Campanas Observatory for their help in installing and maintaining the "Pi of the Sky" telescope.

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Star	HJD 2450000 +	Error	Type	Star	HJD 2450000 +	Error	Type
ST Aqr	3259.7033	0.0008	pri	AG Ari	3320.7312	0.0014	pri
ST Aqr	3281.5646	0.0013	pri	AG Ari	3321.6776	0.0018	pri
SU Aqr	3250.8167	0.0028	pri	AL Ari	3340.6998	0.0007	sec
SU Aqr	3251.8540	0.0010	pri	TU CMa	4070.6730	0.0008	pri
SU Aqr	3974.7854	0.0008	pri	VW CMa	4064.7022	0.0004	pri
CW Aqr	3974.8142	0.0021	pri	VW CMa	4069.7452	0.0007	pri
CW Aqr	3976.7327	0.0015	sec	VW CMa	4120.5647	0.0016	sec
CW Aqr	3980.7923	0.0016	pri	CX CMa	4119.5907	0.0006	pri
CW Aqr	4032.6475	0.0014	sec	FF CMa	4122.6579	0.0025	sec
CX Aqr	3251.5709	0.0002	pri	FZ CMa	4048.7534	0.0004	pri
CX Aqr	3253.7905	0.0007	pri	FZ CMa	4069.7594	0.0006	sec
CX Aqr	3258.7970	0.0005	pri	FZ CMa	4120.6744	0.0004	sec
CX Aqr	3259.6282	0.0007	sec	HY CMa	4073.6777	0.0016	pri
CX Aqr	3281.5940	0.0003	pri	IQ CMa	4074.7232	0.0003	pri
CX Aqr	3282.7088	0.0011	pri	IS CMa	4042.7249	0.0010	pri
CX Aqr	3980.7490	0.0010	sec	IS CMa	4054.7579	0.0011	sec
CX Aqr	3982.6956	0.0006	pri	IS CMa	4071.7239	0.0006	pri
DD Aqr	3260.6574	0.0011	pri	KL CMa	4072.7344	0.0012	sec
DD Aqr	3281.5667	0.0011	pri	LV CMa	4120.6850	0.0016	pri
DY Aqr	4059.5686	0.0013	pri	YY CMi	3361.7474	0.0009	pri
EE Aqr	3250.5730	0.0010	sec	YY CMi	3390.7434	0.0012	sec
EE Aqr	3250.8282	0.0003	pri	YY CMi	3401.6850	0.0015	sec
EE Aqr	3251.5880	0.0011	sec	YY CMi	3407.6955	0.0012	pri
EE Aqr	3251.8477	0.0003	pri	BU CMi	3378.6805	0.0013	pri
EE Aqr	3253.6299	0.0008	sec	RR Cen	3455.6494	0.0007	pri
EE Aqr	3980.7258	0.0011	pri	V678 Cen	3509.7239	0.0013	pri
EE Aqr	3982.7611	0.0003	pri	V700 Cen	3504.5353	0.0031	pri
EE Aqr	4032.6440	0.0002	pri	V757 Cen	3504.5693	0.0003	pri
EF Aqr	3974.7963	0.0004	pri	V757 Cen	3504.7453	0.0007	sec
EK Aqr	4005.7181	0.0027	pri	V757 Cen	3509.5445	0.0004	sec
EK Aqr	4028.7013	0.0016	pri	V757 Cen	3509.7202	0.0007	pri
EL Aqr	3260.7514	0.0012	pri	V839 Cen	3504.6512	0.0003	pri
EL Aqr	3309.6208	0.0028	sec	TT Cet	3311.6685	0.0010	pri
EL Aqr	3310.5820	0.0016	sec	TV Cet	3328.7196	0.0005	pri
EL Aqr	4004.7676	0.0009	sec	TX Cet	3287.7168	0.0015	pri
EL Aqr	4005.7290	0.0013	sec	WY Cet	3311.6391	0.0015	pri
EL Aqr	4006.6899	0.0009	sec	XY Cet	3320.6722	0.0005	sec
EL Aqr	4011.7441	0.0014	pri	XY Cet	3338.7512	0.0011	pri
EL Aqr	4028.5967	0.0008	pri	YY Cet	4040.7737	0.0002	pri
EL Aqr	4038.6943	0.0015	pri	AA Cet	4040.7756	0.0005	pri
HV Aqr	3250.6336	0.0009	pri	DY Cet	3337.7258	0.0010	sec
HV Aqr	3280.5840	0.0009	pri	DY Cet	4040.7832	0.0029	sec
HV Aqr	3986.6397	0.0014	sec	TX Cnc	3387.7552	0.0016	sec
KX Aqr	3251.7534	0.0003	pri	TX Cnc	3388.7118	0.0011	pri
KX Aqr	3253.8255	0.0009	pri	WY Cnc	3390.6964	0.0011	pri
QR Ara	3426.8540	0.0025	pri	XZ Cnc	3399.6336	0.0016	pri
RX Ari	3340.5585	0.0003	pri	FF Cnc	3388.7447	0.0011	pri
RX Ari	3341.5820	0.0014	pri	FF Cnc	3400.6475	0.0010	pri
SS Ari	3326.6583	0.0013	sec	RS Col	4057.6405	0.0007	pri
SS Ari	3338.6450	0.0009	pri	RS Col	4060.6586	0.0008	sec

Star	HJD 2450000 +	Error	Type	Star	HJD 2450000 +	Error	Type
RS Col	4067.7185	0.0012	pri	YY Eri	3306.7868	0.0002	sec
RS Col	4072.7520	0.0012	sec	YY Eri	4024.6932	0.0003	sec
eps CrA	3991.5288	0.0013	pri	YY Eri	4046.7155	0.0003	pri
RV Crv	3466.5913	0.0009	pri	YY Eri	4047.6802	0.0002	pri
RV Crv	3469.5805	0.0005	pri	YY Eri	4051.6990	0.0001	sec
RV Crv	3470.7091	0.0009	sec	YY Eri	4055.7180	0.0001	pri
RV Crv	3473.6999	0.0007	sec	YY Eri	4063.5940	0.0002	sec
RV Crv	3474.8161	0.0008	pri	YY Eri	4063.7548	0.0001	pri
RV Crv	3475.5555	0.0006	pri	YY Eri	4067.6134	0.0000	sec
RV Crv	3477.8022	0.0016	pri	YY Eri	4067.7738	0.0002	pri
RV Crv	3478.5477	0.0005	pri	AS Eri	3306.6756	0.0023	pri
RV Crv	3479.6751	0.0008	sec	BC Eri	4024.7859	0.0009	sec
RV Crv	3504.7031	0.0006	pri	BC Eri	4043.7663	0.0013	sec
RV Crv	3506.5658	0.0012	sec	BC Eri	4057.7356	0.0017	pri
SX Crv	3466.6869	0.0006	pri	BC Eri	4060.6407	0.0015	sec
SX Crv	3466.8389	0.0015	sec	BC Eri	4067.7531	0.0005	pri
SX Crv	3468.5925	0.0013	pri	BU Eri	4046.7405	0.0003	pri
SX Crv	3468.7486	0.0010	sec	BU Eri	4052.6431	0.0003	pri
SX Crv	3469.6963	0.0005	sec	BU Eri	4063.6037	0.0005	pri
SX Crv	3470.6523	0.0009	sec	BV Eri	3306.6811	0.0011	pri
SX Crv	3471.5920	0.0010	sec	BV Eri	4039.7283	0.0008	pri
SX Crv	3471.7570	0.0008	pri	BV Eri	4051.6588	0.0001	pri
SX Crv	3473.6596	0.0009	pri	BV Eri	4052.6739	0.0005	pri
SX Crv	3474.5999	0.0007	pri	BW Eri	4051.6976	0.0010	sec
SX Crv	3474.7581	0.0012	sec	BW Eri	4067.6478	0.0014	sec
SX Crv	3475.5533	0.0013	pri	BZ Eri	3306.8076	0.0007	pri
SX Crv	3477.6074	0.0008	sec	FO Eri	3305.5690	0.0017	pri
SX Crv	3477.7722	0.0013	pri	FX Eri	3304.8383	0.0016	pri
SX Crv	3478.5634	0.0006	sec	GH Eri	4023.8201	0.0005	pri
SX Crv	3478.7250	0.0004	pri	GH Eri	4042.6048	0.0010	pri
SX Crv	3480.6236	0.0009	pri	GK Eri	4047.7522	0.0006	pri
SX Crv	3480.7797	0.0005	sec	GW Eri	4067.6099	0.0011	pri
SX Crv	3504.6844	0.0011	pri	HN Eri	4024.7003	0.0006	pri
TW Crt	3466.6943	0.0005	pri	HN Eri	4047.7812	0.0011	pri
TW Crt	3468.5808	0.0009	pri	HN Eri	4063.6746	0.0005	sec
W Crv	3466.7679	0.0009	sec	HN Eri	4067.7304	0.0003	pri
W Crv	3468.7075	0.0007	sec	AE For	4039.7544	0.0003	sec
Y Crv	3473.6422	0.0038	pri	AE For	4040.6730	0.0002	sec
RW Dor	4036.5947	0.0003	pri	AE For	4052.6091	0.0002	sec
RW Dor	4036.7411	0.0008	sec	AL Gem	4106.7526	0.0009	pri
RW Dor	4037.5995	0.0014	sec	GW Gem	4127.6524	0.0003	pri
RW Dor	4037.7384	0.0004	pri	QT Gem	3378.7173	0.0026	pri
RW Dor	4041.7335	0.0007	pri	SX Hya	3471.7411	0.0017	pri
RW Dor	4049.5878	0.0007	sec	SX Hya	3474.6335	0.0009	pri
RW Dor	4059.7177	0.0006	pri	SX Hya	3497.7983	0.0039	pri
RW Dor	4107.6761	0.0007	pri	WY Hya	3389.6753	0.0006	pri
AV Dor	4065.6784	0.0008	pri	WY Hya	3390.7408	0.0012	sec
RU Eri	4046.7924	0.0016	pri	WY Hya	3409.7133	0.0010	pri
RU Eri	4047.7467	0.0015	sec	EZ Hya	4079.7577	0.0011	pri
YY Eri	3306.6253	0.0002	pri	FG Hya	3387.7496	0.0006	sec

Star	HJD 2450000 +	Error	Type	Star	HJD 2450000 +	Error	Type
FG Hya	3388.7329	0.0010	sec	AP Leo	3445.6625	0.0005	pri
FG Hya	3389.7165	0.0010	sec	AP Leo	3446.7374	0.0010	sec
FG Hya	3400.6934	0.0007	pri	AP Leo	3447.5982	0.0008	sec
FG Hya	3404.6285	0.0018	pri	AP Leo	3448.6735	0.0007	pri
FG Hya	3404.7926	0.0016	sec	AP Leo	3449.7477	0.0006	sec
FG Hya	3405.6126	0.0003	pri	AP Leo	3458.5710	0.0007	pri
FG Hya	3405.7800	0.0009	sec	AP Leo	3459.6493	0.0005	sec
FG Hya	3406.7616	0.0006	sec	AP Leo	3462.6609	0.0004	pri
FG Hya	3409.7104	0.0018	sec	AP Leo	3476.6465	0.0006	pri
HU Hya	3404.6543	0.0009	pri	AP Leo	3489.5578	0.0006	pri
HU Hya	3409.6792	0.0004	pri	DU Leo	3418.7118	0.0006	sec
QY Hya	3466.6784	0.0003	pri	V Lep	4054.7643	0.0005	pri
QY Hya	3468.7232	0.0009	sec	V Lep	4069.7462	0.0005	pri
QY Hya	3470.7666	0.0011	sec	Z Lep	4043.7843	0.0016	pri
QY Hya	3477.6326	0.0005	pri	Z Lep	4055.7062	0.0015	pri
QY Hya	3477.7847	0.0013	sec	Z Lep	4057.6982	0.0006	pri
QY Hya	3478.6645	0.0021	sec	Z Lep	4060.6805	0.0007	pri
QY Hya	3480.7094	0.0007	sec	Z Lep	4067.6379	0.0017	pri
V340 Hya	3470.6329	0.0024	pri	RR Lep	4043.6978	0.0005	pri
V356 Hya	3497.7677	0.0007	pri	RS Lep	4060.6730	0.0003	pri
V358 Hya	3404.7641	0.0020	pri	VZ Lib	3509.8297	0.0006	sec
UX Leo	3459.6740	0.0026	pri	VZ Lib	3511.6204	0.0010	sec
UZ Leo	3411.6875	0.0011	pri	VZ Lib	3511.7985	0.0021	pri
UZ Leo	3415.6998	0.0008	sec	VZ Lib	3517.7113	0.0013	sec
UZ Leo	3419.7261	0.0007	pri	ES Lib	3517.6814	0.0007	pri
UZ Leo	3432.7033	0.0008	pri	IR Lib	3511.6166	0.0021	pri
UZ Leo	3446.6112	0.0008	sec	IR Lib	3511.7580	0.0008	pri
VZ Leo	3390.7585	0.0008	sec	SX Lup	3938.6220	0.0021	sec
XY Leo	3390.7340	0.0005	pri	SX Lup	3941.6965	0.0031	pri
XZ Leo	3390.7818	0.0007	sec	FS Lup	3463.8760	0.0012	pri
AM Leo	3414.6435	0.0001	pri	FT Lup	3938.6193	0.0006	pri
AM Leo	3431.6516	0.0004	sec	TY Men	3981.7195	0.0005	pri
AM Leo	3433.6644	0.0003	pri	AN Men	4066.6222	0.0007	pri
AM Leo	3436.5909	0.0007	pri	Z Nor	3938.6828	0.0016	sec
AM Leo	3440.6124	0.0005	pri	NS Mon	3372.3718	0.0014	sec
AM Leo	3444.6382	0.0005	pri	IR Nor	3938.5794	0.0014	pri
AM Leo	3446.6496	0.0003	sec	V1010 Oph	3511.8652	0.0015	pri
AM Leo	3503.5318	0.0003	pri	V2394 Oph	3511.6615	0.0015	sec
AP Leo	3414.6745	0.0005	pri	ET Ori	3343.7634	0.0015	pri
AP Leo	3430.8136	0.0006	sec	ET Ori	3344.7142	0.0009	pri
AP Leo	3431.6711	0.0006	sec	FR Ori	3354.6536	0.0007	pri
AP Leo	3432.7515	0.0007	pri	V1388 Ori	3375.6364	0.0017	pri
AP Leo	3433.6096	0.0005	pri	U Peg	3263.7374	0.0007	sec
AP Leo	3433.8242	0.0006	sec	U Peg	3264.6730	0.0003	pri
AP Leo	3434.6886	0.0003	sec	U Peg	3265.6110	0.0003	sec
AP Leo	3436.6247	0.0007	pri	U Peg	3265.7957	0.0000	pri
AP Leo	3438.7776	0.0004	pri	U Peg	3266.7357	0.0004	sec
AP Leo	3439.6361	0.0005	pri	U Peg	3267.6703	0.0005	pri
AP Leo	3444.5849	0.0003	sec	U Peg	3272.7276	0.0006	sec
AP Leo	3444.7978	0.0013	pri	U Peg	3273.6644	0.0004	pri

Star	HJD 2450000 +	Error	Type	Star	HJD 2450000 +	Error	Type
U Peg	3282.6595	0.0003	pri	VZ Psc	4005.6224	0.0009	sec
U Peg	3283.6000	0.0003	sec	VZ Psc	4005.7542	0.0006	pri
U Peg	3294.6529	0.0006	pri	VZ Psc	4006.6691	0.0009	sec
U Peg	3295.5930	0.0008	sec	VZ Psc	4006.7950	0.0001	pri
U Peg	3296.7154	0.0005	sec	VZ Psc	4028.6134	0.0007	sec
U Peg	3298.5910	0.0006	sec	VZ Psc	4038.6641	0.0006	pri
U Peg	3300.6492	0.0005	pri	AQ Psc	3271.8084	0.0007	pri
U Peg	3301.5890	0.0007	sec	AQ Psc	3273.7106	0.0009	pri
TY Peg	3265.6978	0.0015	pri	AQ Psc	3274.6609	0.0008	pri
AT Peg	3260.7413	0.0007	pri	AQ Psc	3283.6975	0.0007	pri
BB Peg	3987.6129	0.0010	pri	AQ Psc	3286.7873	0.0007	sec
BB Peg	4008.5804	0.0013	pri	AQ Psc	3287.7417	0.0009	sec
BX Peg	3987.9119	0.0006	pri	AQ Psc	3288.6942	0.0011	sec
BX Peg	3989.6960	0.0004	pri	AQ Psc	3289.6437	0.0005	sec
DI Peg	3265.6239	0.0002	pri	AQ Psc	3302.7217	0.0011	pri
DI Peg	3267.7591	0.0005	pri	AQ Psc	3338.6295	0.0006	sec
DI Peg	3272.7415	0.0002	pri	AQ Psc	3994.7293	0.0006	pri
DI Peg	3282.7067	0.0005	pri	TY Pup	4120.6157	0.0012	pri
DK Peg	3263.6938	0.0006	pri	UZ Pup	4119.7152	0.0006	sec
DK Peg	3281.6377	0.0016	pri	EN Pup	4119.7125	0.0013	pri
DK Peg	3294.6972	0.0007	pri	EN Pup	4120.7216	0.0006	pri
DK Peg	3299.5934	0.0010	pri	MP Pup	4120.7522	0.0011	pri
OO Peg	3280.5699	0.0009	sec	UX Ret	4023.7521	0.0001	pri
V357 Peg	3266.7474	0.0007	pri	UX Ret	4037.7194	0.0002	sec
V357 Peg	3273.6884	0.0011	pri	UX Ret	4041.6420	0.0003	sec
AE Phe	3304.7990	0.0006	sec	V1055 Sco	3483.6384	0.0013	pri
AE Phe	3946.7458	0.0003	pri	V1055 Sco	3483.8200	0.0005	pri
AE Phe	4021.7574	0.0001	pri	V1055 Sco	3938.6120	0.0010	pri
AE Phe	4077.7443	0.0004	sec	V1055 Sco	3941.7053	0.0009	sec
RW PsA	4032.6553	0.0005	sec	V1084 Sco	3991.6479	0.0006	pri
Y Psc	3264.6854	0.0009	pri	V1084 Sco	3995.5929	0.0008	pri
Y Psc	4002.7795	0.0030	pri	U Sct	3950.7122	0.0012	pri
SZ Psc	3309.6047	0.0012	pri	RS Ser	3940.6797	0.0013	sec
UV Psc	3273.6972	0.0002	sec	RS Ser	3944.5653	0.0012	pri
UV Psc	3283.5936	0.0003	pri	CQ Ser	3944.6360	0.0012	pri
UV Psc	3286.6058	0.0010	sec	Y Sex	3410.7111	0.0009	pri
UV Psc	3288.7592	0.0004	pri	Y Sex	3411.7596	0.0014	sec
UV Psc	3289.6211	0.0004	pri	Y Sex	3412.8075	0.0010	pri
UV Psc	3294.7887	0.0006	pri	Y Sex	3413.6501	0.0011	pri
UV Psc	3298.6607	0.0006	sec	VY Sex	3410.7003	0.0009	sec
UV Psc	3307.7029	0.0002	pri	VY Sex	3411.8060	0.0007	pri
UV Psc	3311.5756	0.0010	sec	VY Sex	3413.7982	0.0006	sec
VZ Psc	3260.6343	0.0007	pri	VY Sex	3459.6932	0.0010	pri
VZ Psc	3260.7736	0.0010	sec	YY Sgr	3940.7137	0.0005	sec
VZ Psc	3272.6548	0.0005	pri	BN Sgr	3983.5230	0.0021	pri
VZ Psc	3272.7931	0.0009	sec	DV Sgr	3940.6809	0.0007	pri
VZ Psc	3282.5822	0.0026	pri	EG Sgr	3945.7061	0.0023	pri
VZ Psc	3282.7139	0.0008	sec	EG Sgr	3950.6682	0.0016	pri
VZ Psc	3990.5990	0.0008	pri	V1647 Sgr	3983.5713	0.0010	sec
VZ Psc	4004.7015	0.0006	pri	V4396 Sgr	3994.6141	0.0014	pri

Star	HJD 2450000 +	Error	Type	Star	HJD 2450000 +	Error	Type
RW Tau	3353.6892	0.0012	pri	VV Vir	3497.6343	0.0006	pri
RZ Tau	3327.7995	0.0005	sec	AG Vir	3432.7710	0.0005	pri
RZ Tau	3329.6726	0.0007	pri	AG Vir	3459.7610	0.0006	pri
RZ Tau	3343.6058	0.0010	sec	AG Vir	3461.6926	0.0005	pri
RZ Tau	3344.6379	0.0007	pri	AG Vir	3462.6585	0.0005	sec
RZ Tau	3345.6759	0.0007	sec	AG Vir	3463.6184	0.0010	pri
RZ Tau	3349.6264	0.0006	pri	AG Vir	3501.5363	0.0012	pri
RZ Tau	3354.6103	0.0005	pri	BF Vir	3470.6330	0.0012	pri
RZ Tau	3355.6552	0.0007	sec	BF Vir	3475.7447	0.0005	pri
RZ Tau	3356.6901	0.0004	pri	BF Vir	3477.6703	0.0009	pri
RZ Tau	3370.6135	0.0008	sec	BF Vir	3495.6033	0.0004	pri
AH Tau	3328.7072	0.0001	pri	BH Vir	3473.7648	0.0005	sec
AH Tau	3347.6456	0.0009	pri	BH Vir	3492.5531	0.0003	sec
CD Tau	3348.6890	0.0004	sec	CX Vir	3490.6421	0.0010	pri
GR Tau	3328.7476	0.0009	pri	DM Vir	3515.7677	0.0007	sec
GR Tau	3347.6615	0.0014	pri	GR Vir	3490.6846	0.0002	pri
GR Tau	3353.6777	0.0008	pri	GR Vir	3492.5940	0.0003	sec
GR Tau	3356.6796	0.0014	pri	GR Vir	3492.7665	0.0002	pri
HU Tau	3343.7646	0.0006	pri	GR Vir	3496.7582	0.0002	sec
V781 Tau	3334.7661	0.0009	pri	GR Vir	3497.6240	0.0002	pri
V781 Tau	3343.7216	0.0013	pri	GR Vir	3497.7983	0.0004	sec
V781 Tau	3344.7576	0.0010	pri	HY Vir	3470.6966	0.0009	pri
V781 Tau	3348.7250	0.0005	sec	HY Vir	3492.5545	0.0018	pri
V781 Tau	3352.6900	0.0005	pri	IM Vir	3474.6294	0.0005	pri
V781 Tau	3353.7309	0.0005	pri	LU Vir	3490.8006	0.0014	pri
V781 Tau	3356.6609	0.0005	sec	LU Vir	3492.7543	0.0007	pri
V781 Tau	3357.6920	0.0004	sec	LU Vir	3496.6907	0.0005	pri
V781 Tau	3370.6283	0.0006	pri	LU Vir	3497.6759	0.0013	pri
V1061 Tau	3327.7339	0.0015	pri	MS Vir	3490.6006	0.0008	sec
V1121 Tau	3328.6906	0.0004	pri	MS Vir	3490.7528	0.0008	pri
V1121 Tau	3347.6461	0.0005	pri	MS Vir	3492.6323	0.0007	pri
V1121 Tau	3366.6087	0.0006	pri	MS Vir	3492.7890	0.0010	sec
V1128 Tau	3305.7179	0.0010	pri	MS Vir	3496.6932	0.0012	pri
V1128 Tau	3315.6411	0.0004	sec	MS Vir	3504.6621	0.0011	sec
V1128 Tau	3315.7964	0.0005	pri	MS Vir	3509.6613	0.0006	sec
V1128 Tau	3320.6811	0.0005	pri				
V1128 Tau	3321.7496	0.0002	sec				
V1128 Tau	3326.6372	0.0002	sec				
V1128 Tau	3326.7905	0.0006	pri				
V1128 Tau	3327.7054	0.0005	pri				
V1128 Tau	3328.6207	0.0004	pri				
V1128 Tau	3328.7742	0.0004	sec				
V1128 Tau	3329.6894	0.0005	sec				
V1128 Tau	3339.6151	0.0003	pri				
V1128 Tau	3347.7071	0.0005	sec				
V1128 Tau	3366.6353	0.0003	sec				
X Tri	3320.7036	0.0007	pri				
X Tri	3321.6746	0.0003	pri				
UW Vir	3480.7279	0.0030	pri				
VV Vir	3492.7257	0.0011	pri				

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MULTICOLOUR CCD PHOTOMETRY OF THREE RRab STARS

JURCSIK, J.[1]; SÓDOR, Á.[1]; HURTA, ZS.[2,3]; KŐVÁRI, ZS.[1]; VIDA, K.[2,3]; HAJDU, G.[2]; NAGY, I.[2]; DÉKÁNY, I.[1]; POSZTOBÁNYI, K.[4]; KOPONYÁS, B.[2]; VÁRADI, M.[5]; VITYI, N.[2]

[1] Konkoly Observatory of the Hungarian Academy of Sciences, P.O. Box 67, H-1525 Budapest, Hungary; e-mail: name@konkoly.hu

[2] Eötvös Loránd University, Department of Astronomy, P.O. Box 32, H-1518 Budapest, Hungary

[3] Visiting Astronomer, Konkoly Observatory of the Hungarian Academy of Sciences

[4] AEKI, KFKI Atomic Energy Research Institute, Thermohydraulic Department, H–1525 Budapest 114, PO Box 49, Hungary

[5] Observatoire de Genéve, Universite de Genéve, CH–1290, Sauverny, Switzerland

In the present paper we publish the third set of our observations of monoperiodic fundamental mode RR Lyrae stars. The first and second sets of RRab light curves were published in Jurcsik et al. (2006) and Sódor et al. (2007), respectively. CCD observations of short period ($P < 0.5$ d), northern variables are obtained in order to determine the true incidence rate of light curve modulation occurring in these stars.

Now light and colour curves of BK And, UU Boo, and V387 Per are presented. The observations were made with the 60 cm automatic telescope of Konkoly Observatory, Svábhegy, Budapest, equipped with a Wright 750x1100 CCD camera using $BVR_{\rm C}I_{\rm C}$ filters. Data reduction and aperture photometry were performed using standard IRAF†packages. Second order extinction correction of the B data were taken into account, with $\kappa" = 0.02$ coefficient. Instrumental magnitudes were transformed to the $BVR_{\rm C}I_{\rm C}$ system by observing standard magnitude stars determined by A. Henden in the fields of CZ Lacertae and MW Lyrae (Jurcsik et al. 2008, and Sódor et al. in preparation). Log of observations and comparison stars' data are given in Table 1.

Light curves of BK And and V378 Per were previously published by Schmidt & Reiswig (1993) and Schmidt & Seth (1996), respectively. These observations contained, however only 10-20 V an R CCD data points, that are not enough for accurately describe the light variations of the stars. Observations of UU Boo were obtained by Sturch (1966) and Bookmeyer et al. (1977). This light curve is, however, incomplete and noisy. Our observations are the first complete, accurate, multicolour light curves of these variables. The time coverage of the data also allows us to conclude that the light curves of these stars are stable, no light curve modulation with amplitude larger than ~ 0.02 mag in maximum brightness occur.

The photometric data are available electronically from the IBVS website (5844-t5.txt – 5844-t16.txt). The Tables list the relative $BVR_{\rm C}I_{\rm C}$ magnitude and relative $B-V$, $V-R_{\rm C}$, $V-I_{\rm C}$ colour time series with respect to the comparison stars. We checked

†IRAF is distributed by the National Optical Astronomy Observatories, which are operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

the constancy of the brightness of the comparisons by measuring magnitude differences to several check stars in our respective field of views. The *r.m.s.* scatter of these data is between 0.006 and 0.012 mag in each band. This is in accordance with the *r.m.s.* scatter of the Fourier fits of the B, V, R_C, I_C light curves of BK And, UU Boo, and V378 Per, which are 0.012/0.008/0.009, 0.011/0.011/0.010/0.011, and –/0.010/0.010 mag, respectively. The V light curves and the colour curves of the three stars are plotted in Figs. 1 – 3.

Table 1. Log of observations

Star	Comparison				Observation period		No. of
	GSC 2.3.2	RA(2000)	DEC(2000)	V * [mag]	JD 2400000 +	nights	$B/V/R_C/I_C$ data
BK And	N078000076	23 35 08.29	+41 04 09.1	13.16	54413 – 54512	20	391 / 391 / 0 / 373
UU Boo	N6AZ000508	15 17 36.40	+35 05 29.5	11.90	54171 – 54567	16	338 / 330 / 328 /320
V378 Per	NCGO000977	03 55 02.99	+32 39 10.6	12.82	54413 – 54509	15	0 / 578 / 0 / 573

* V magnitudes of the comparison stars are from GSC 2.3.2

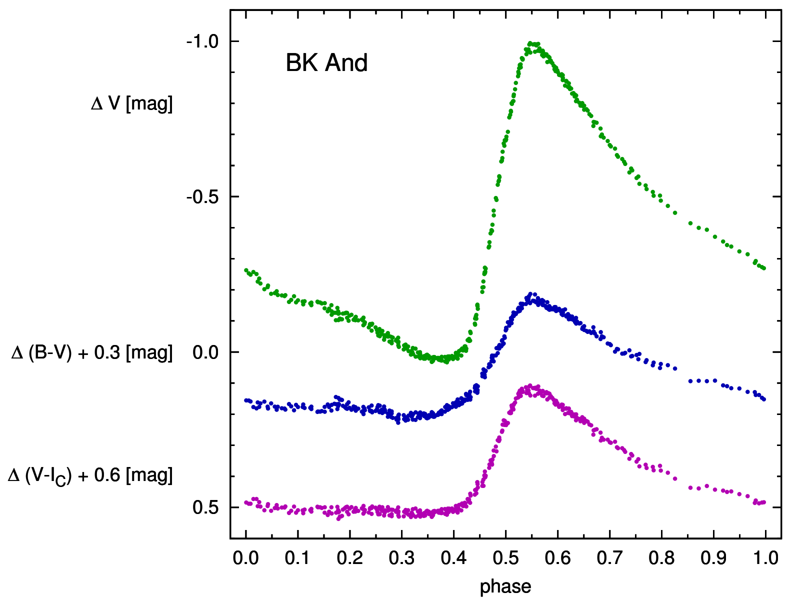

Figure 1. Differential V, $B - V$ and $V - I_C$ light and colour curves of BK And.

Table 2. Normal maximum timings of the V light curves.

Star	T_{max} - 2400000 [HJD]
BK And	54452.2082
UU Boo	54197.3875
	54491.653
V378 Per	54474.2780

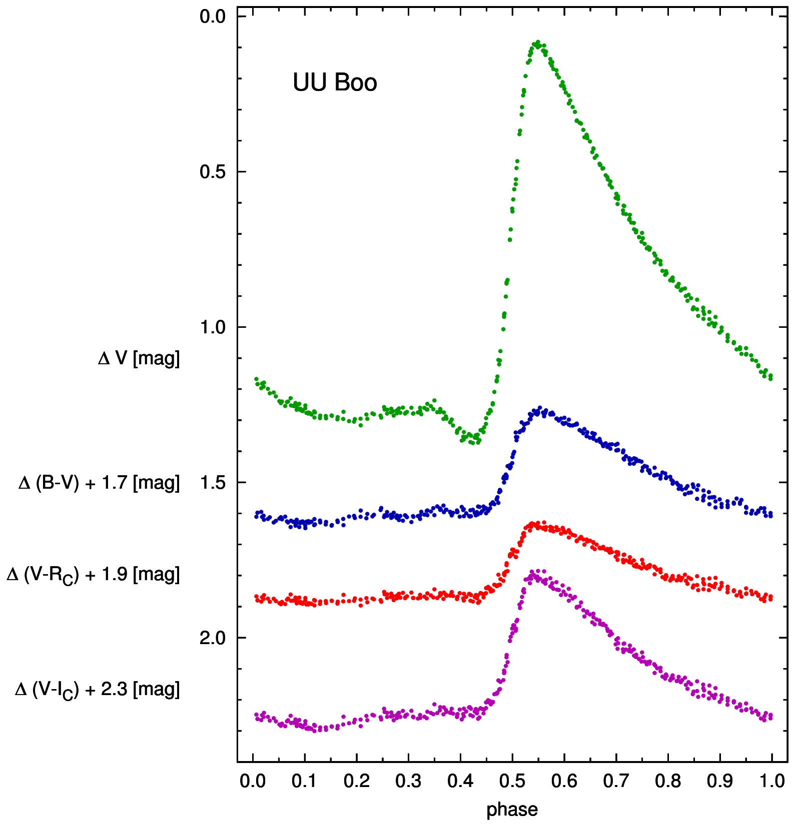

Figure 2. Differential V, $B-V$ $V-R_\mathrm{C}$ and $V-I_\mathrm{C}$ light and colour curves of UU Boo.

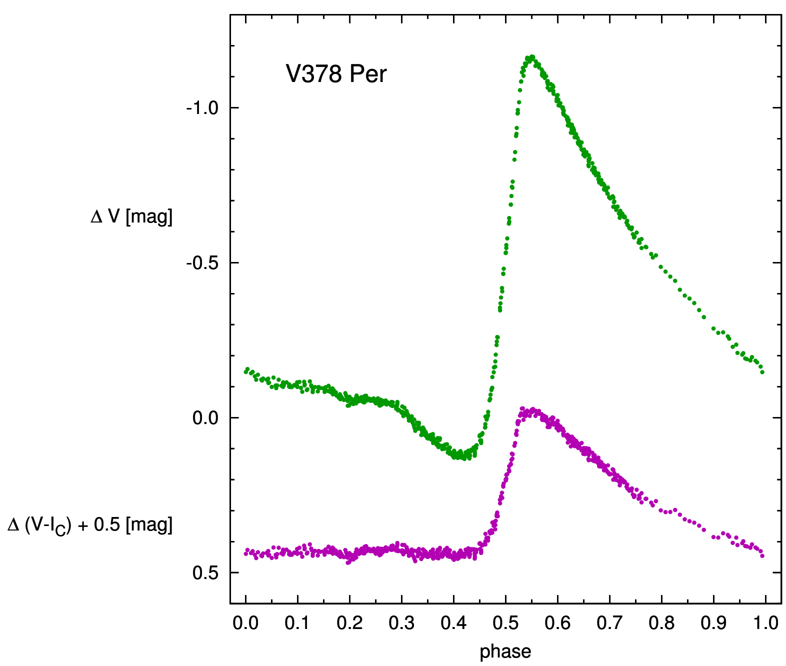

Figure 3. Differential V and $V-I_\mathrm{C}$ light and colour curves of V378 Per.

Table 3. Fourier parameters of the V light curves.

Star	P [d]	A_1 [mag]	R_{21}	R_{31}	R_{41}	R_{51}	ϕ_{21} * [rad]	ϕ_{31} * [rad]	ϕ_{41} * [rad]	ϕ_{51} * [rad]
BK And	0.4216093(8)	0.360	0.518	0.321	0.159	0.109	2.671	5.410	1.990	4.688
UU Boo	0.4569339(2)	0.454	0.458	0.341	0.228	0.161	2.244	4.707	1.037	3.687
V378 Per	0.3987208(5)	0.417	0.555	0.371	0.246	0.161	2.337	5.112	1.469	4.206

* Phase differences are given according to sine term decomposition.

Seasonal normal maximum timings and Fourier parameters of the V light curves of BK And, UU Boo, and V378 Per are listed in Table 2, and Table 3, respectively.

Table 4 compares the photometric metallicities calculated from the V light curves of the variables according to Eq. 3 of Jurcsik & Kovács (1996) to the results of spectroscopic metallicity measurements.

Table 4. Spectroscopic and photometric [Fe/H] values.

Star	$[Fe/H]_{phot}$	$[Fe/H]_{spect}$ ^{a}	ref.
BK And	−0.04	0.10	Layden (1994)
UU Boo	−1.17	−1.64	Layden (1994)
		−1.00	Kinman & Carretta (1992)
V378 Per	−0.31	–	

a: Spectroscopic metallicities are transformed to the [Fe/H] scale used for the photometric metallicities according to Eq. 3, and Eq. 2 of Jurcsik (1995) and Jurcsik & Kovács (1996).

We thank Béla Szeidl for his many helpful comments on this work. This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France. The financial support of OTKA grants T-048961, and T-068626 is acknowledged. ZsK is a grantee of the Bolyai János fellowship of the HAS.

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V965 CYGNI, AN A AND F TYPE VERY HIGH FILL-OUT BINARY WITH STRONG MAGNETIC ACTIVITY?

SAMEC, RONALD G.[1,4]; BRANNING, JEREMY[1]; JONES, STEPHANIE M.[1]; FAULKNER, DANNY R.[2,4]; HAWKINS, NATHAN C.[3,4]

[1] Astronomy program, Department of Physics, Bob Jones University, Greenville, SC 29614

[2] University of South Carolina, Lancaster

[3] University of Oklahoma

[4] Visiting Astronomer, Lowell Observatory, Flagstaff, AZ

V965 Cygni [$\alpha(2000)$=$19^{\rm h}44^{\rm m}09\overset{\rm s}{.}3$, $\delta(2000)$=$+31^\circ42'37''$] was observed as a part of our continuing study of neglected interacting eclipsing binaries. It was discovered by Wachmann (1964) and identified as a W UMa star with a period of 0.64 days or possibly as an RR Lyrae type c with ~ 1 magnitude amplitude. He reported 7 times of minimum light. We recalculated his early ephemeris using our computer program using his original minima:

$$\text{HJD Tmin I} = 2435047.295\ (\pm 0.017) + 0.640575\ (\pm 0.000009)\ \text{d} \times \text{E}. \qquad (1)$$

In addition, four other times of minimum light have been published by Zejda, (2004), Hubscher, Paschke, Walter (2007) and by Hubscher, Paschke and Walter (2006). There have been no further references.

Our U, B, V, R, I light curves were taken with the Lowell 31 inch reflector in Flagstaff with the LN cooled CCD camera with a metachrome coated TEK 512 × 512 chip and standard BVR_cI_c filters on July 19-25, 2004. Our individual observations include 83 in U, 94 in B, 112 in V, 77 in R and 92 in I. A finding chart of V965 Cyg (V), the comparison star (C) (GSC 2656 3363) [$\alpha(2000) = 19^{\rm h}44^{\rm m}03\overset{\rm s}{.}64$, $\delta(2000) = 31^\circ41'13\overset{''}{.}25$], and the check star, (K) (GSC 2656 2055) [$\alpha(2000) = 19^{\rm h}44^{\rm m}16\overset{\rm s}{.}91$, $\delta(2000) = 31^\circ41'31\overset{''}{.}64$] are given in Figure 1. Our observations, Variable (V) minus Comparison (C) delta magnitudes are given in Table 1.

Standard magnitudes were determined from two nights of observations, July 20 and 24. V965 Cyg is found to have an apparent V magnitude range of $\sim 14.0 - 14.5$. Using a standard reddening line and a plot of $U - B$ vs. $B - V$ with a calibrated $U - B$ vs. $B - V$ main sequence plot (Cox, 2000) we determined a dereddened $(B - V)_0 \sim 0.07 \pm 0.02$. This is that of an A3-type main sequence star. From this we estimate the primary component to have a temperature of about 8725 K (Cox, 2000). The check and comp star are both of 11th magnitude and are of K4-K5V type. The standard magnitudes and color indices with uncertainties are given in Table 2.

We determined two times of minimum light from our present observations,

$$\text{HJD I} = 2453211.9135 \pm 0.0005 \text{ and HJD II} = 2453207.7440 \pm 0.0036.$$

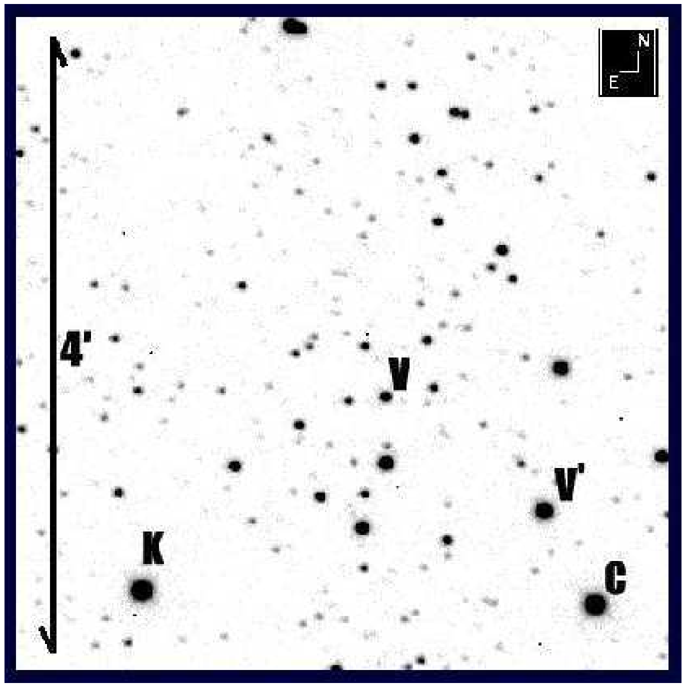

Figure 1. Finding Chart, V965 Cyg Variable (V), Comparison (C) and Check (K), V' is V963 Cyg.

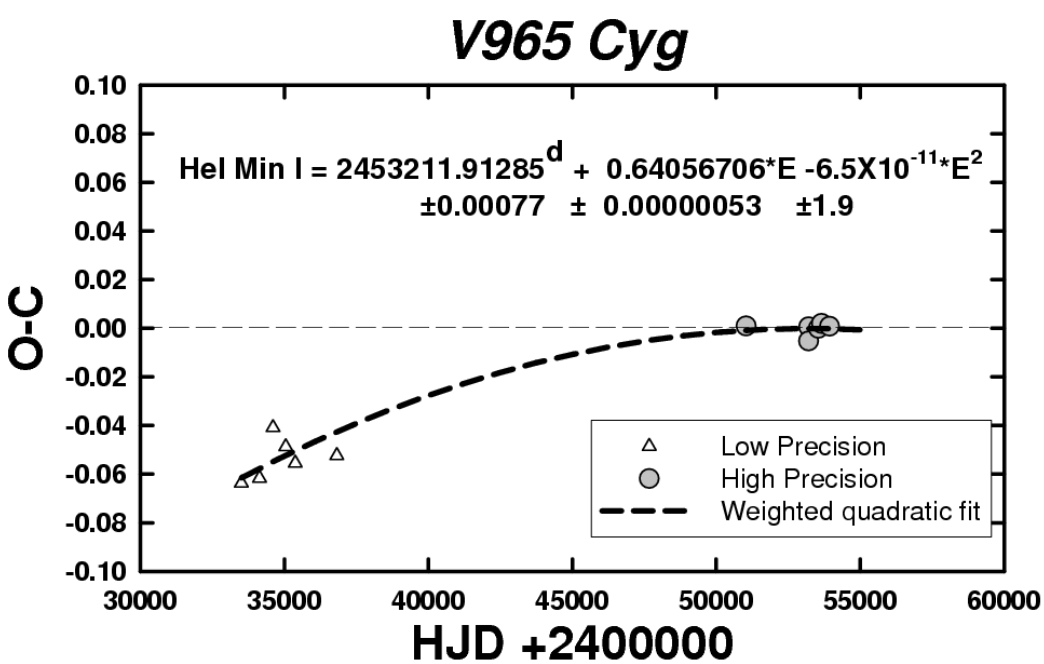

Figure 2. Quadratic fit overlying linear residuals from Equation 4.

The following ephemeris was calculated from all the available times of minimum light

$$\text{HJD Tmin I} = 2453211.9129\ (\pm 0.0009) + 0.64056889\ (\pm 0.00000010)\ \text{d} \times \text{E} \qquad (2)$$

A quadratic behavior is suggested by our timings. Our calculation gives:

$$\begin{array}{llll} \text{HJD Tmin I} & = 2453211.91285 & +0.64056706\ \text{d} \times \text{E} & -0.000000000065\ \text{d} \times \text{E}^2 \\ & \pm 0.00077 & \pm 0.00000053 & \pm 0.000000000019 \end{array} \qquad (3)$$

Since we only have twelve times of minimum light (one outlier removed), and there are only six precision points (weighted 10 times that of the earlier points), we believe the quadratic ephemeris is still tentative. However, the early points do supply a useful contribution to this determination. In fact the latest points, covering only a brief period suggest only a linear fit. Continued monitoring of this system will result in a true picture of its period behavior. All times of minimum light are shown in Table 3 along with the linear and the quadratic residuals. Figure 2 shows the quadratic residuals.

A *BVRI* synthetic light curve solution was undertaken. We first used Binary Maker 3.0 (Bradstreet, 2002) to explore the character of our light curves and determine initial fits to each of our *BVRI* light curves. Using the average starting values from these fits, we proceeded to compute a simultaneous five color light curve solution with the 2004 version of the Wilson Code (Wilson and Devinney, 1971; Wilson, 1990, 1994; Van Hamme and Wilson, 1998), which includes Kurucz atmospheres, rather than black body, and a detailed reflection treatment along with 2-D limb darkening coefficients. We explored a range of mass ratios to find the best fit.

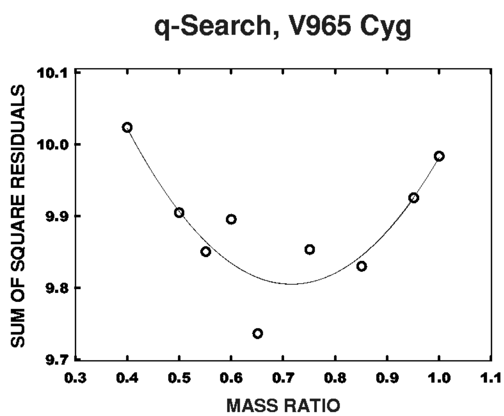

Figure 3. The q vs. sum of square residual plot of Mass Ratio Search for V965 Cyg.

Our first solution gave a contact binary with various characteristics which we will give below. The mass ratio was 0.55. Since the eclipses were partial (inclination 73 degrees), we conducted a q-search in parameter space to try to find the a better mass ratio. Our q-search is given in Figure 3. This curve is fairly shallow so the mass ratio is still not well determined. The lowest residual mass ratio was near 0.65. Taking this solution as a starting point, we determined a new solution allowing q to vary. The solution was essentially the same as that resulting from the q-search.

Our best solution and photometry reveals V965 Cyg as a hot, high fill-out contact binary (79%) (all our solutions gave high fill-outs) with a large polar spot region on the secondary (less massive) component. The spot would indicate V965 Cyg has strong magnetic activity. The high fill-out as well as its high rotation velocity would increase the convective activity. Also, with its high fill-out we would suspect that V965 Cyg will soon become unstable and coalesce into a FK Comae-type star. A decreasing period would help verify this scenario. Radial velocity curves are needed to give a solid determination of the mass ratio. The complete Wilson code solution is given in Table 4. The solution overlaying the $UBVRI$ light curves are given in Figure 4, 5 and 6. Figure 7 shows the surface potential.

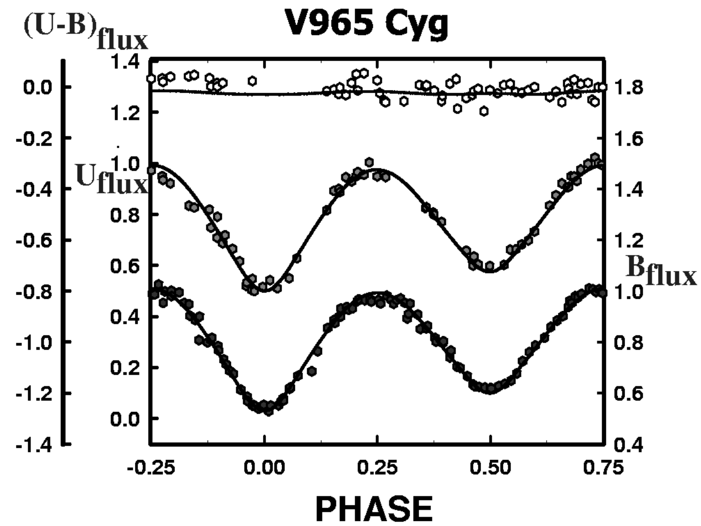

Figure 4. $UBVRI$ light curves and $U-B$ color curve overlaid on the Synthetic Light Curve Model.

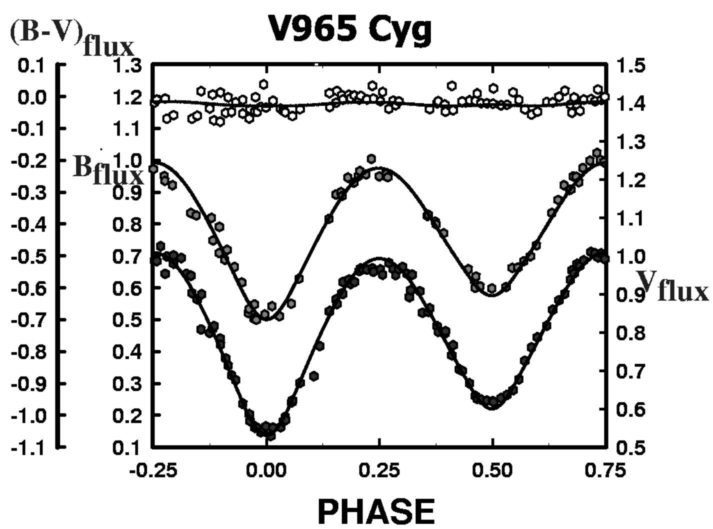

Figure 5. $UBVRI$ light curves and $B-V$ color curves overlaid on the Synthetic Light Curve Model.

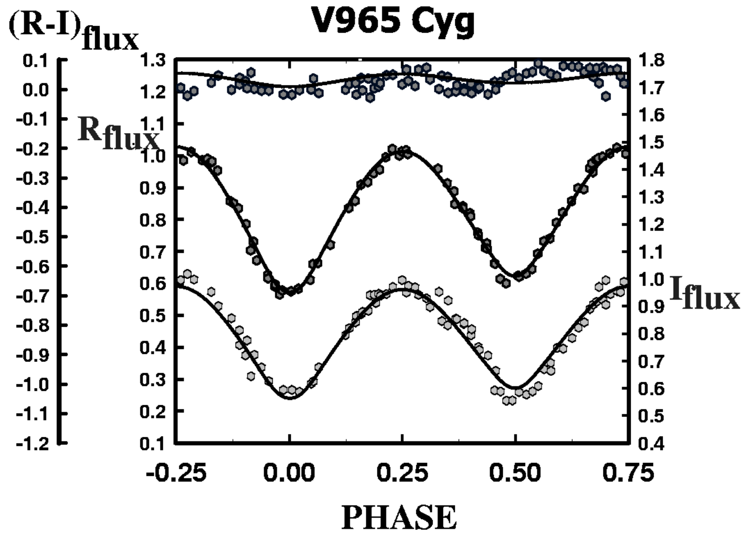

Figure 6. *UBVRI* light curves and $R-I$ color curves overlaid on the Synthetic Light Curve Model.

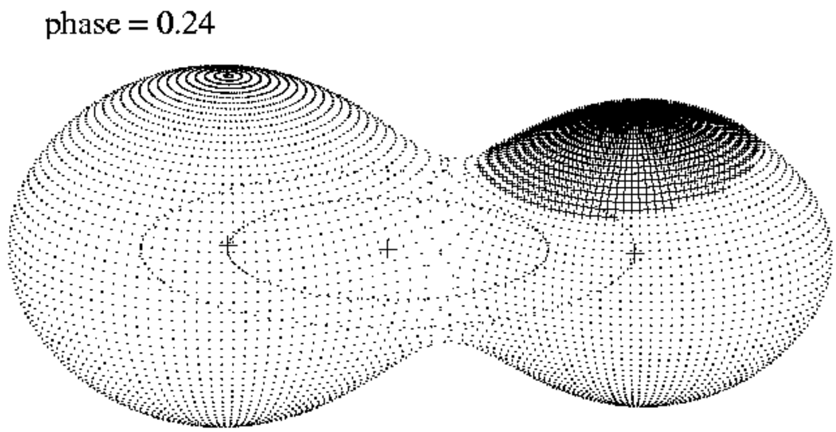

Figure 7. Stellar surface of V965 Cyg.

Table 4: Synthetic curve Parameters for V965 Cyg

Parameter	Best Fit Simultaneous solution
$\lambda_U, \lambda_B, \lambda_V, \lambda_R, \lambda_I$ (nm)	360, 440, 550, 640, 790
$x_{bol1,2}, y_{bol1,2}$	0.654, 0.654, 0.119, 0.119
$x_{1I,2I}, y_{1I,2I}$	0.446, 0.446, 0.209, 0.209
$x_{1R,2V}, y_{1V,2V}$	0.559, 0.559, 0.251, 0.251
$x_{1V,2B}, y_{1B,2B}$	0.660, 0.660, 0.281, 0.281
$x_{1B,2U}, y_{1U,2U}$	0.768, 0.768, 0.311, 0.311
g_1, g_2	1.00, 1.00
A_1, A_2	1.0, 1.0
inclination(°)	71.5±1.5
T_1, T_2 (K)	8725±300*, 7800±290**
Ω_1, Ω_2	2.867±0.022
q(m_2/m_1)	0.65±0.05
fill-out	76%
JD Zero	2453211.9149±0.0007
Period	0.64100±0.00015
$L_1/(L_1+L_2)_I$	0.64±0.05
$L_1/(L_1+L_2)_R$	0.65±0.06
$L_1/(L_1+L_2)_V$	0.67±0.06
$L_1/(L_1+L_2)_B$	0.69±0.07
$L_1/(L_1+L_2)_U$	0.69±0.07
r_1, r_2 (pole)	0.440±0.012, 0.370±0.015
r_1, r_2 (side)	0.478±0.013, 0.398±0.017
r_1, r_2 (back)	0.539±0.014, 0.484±0.026

∗ photometric + reddening estimate uncertainty.
∗∗ error calculated from Wilson code. As a photometric uncertainty, this should be about 200K.

Spot Parameters

STAR	Colatitude (°)	Longitude (°)	Spot Radius (°)	Temp. Factor
2	7.5±1.5	45.3±14.5	53±22	0.82±0.31

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MULTICOLOUR CCD PHOTOMETRY OF FOUR RRab STARS

JURCSIK, J.[1]; SÓDOR, Á.[1]; HURTA, ZS.[2,3]; KŐVÁRI, ZS.[1]; POSZTOBÁNYI, K.[4]; VIDA, K.[2,3]; HAJDU, G.[2]; NAGY, I.[2]; KOPONYÁS, B.[2]

[1] Konkoly Observatory of the Hungarian Academy of Sciences, P.O. Box 67, H-1525 Budapest, Hungary; e-mail: name@konkoly.hu

[2] Eötvös Loránd University, Department of Astronomy, P.O. Box 32, H-1518 Budapest, Hungary

[3] Visiting Astronomer, Konkoly Observatory of the Hungarian Academy of Sciences

[4] AEKI, KFKI Atomic Energy Research Institute, Thermohydraulic Department, H–1525 Budapest 114, PO Box 49, Hungary

The fourth set of CCD light curves of monoperiodic fundamental mode RR Lyrae stars based on the observations of the 60 cm automatic telescope of Konkoly Observatory, Svábhegy, Budapest is published. The equipment and data reduction procedure were the same as in Jurcsik et al. (2008).

Observations of RZ Cam, SW CVn, GI Gem and SU Leo are presented, which are the first complete, accurate, multicolour light curves of these variables. Photometric data of the stars were published previously by Bookmeyer et al. (1977), Schmidt, Chab & Reiswig (1995) and Sturch (1966). These data were, however, either too noisy or scanty to define accurate light curves. Based on the time coverage of the data we conclude that the light curves of the stars are stable, there is no light curve modulation apparent with amplitude larger than $0.02 - 0.03$ mag in the maximum brightness of any of the stars.

Table 1. Log of observations

Star	Comparison				Observation period		No. of
	GSC 2.3.2 / BD	RA(2000)	DEC(2000)	V * [mag]	JD 2400000 +	nights	$B/V/I_C$ data
RZ Cam	N7T2000280	06 34 25.02	+67 03 14.2	12.70	54510 – 54585	17	457 / 460 / 445
SW CVn	BD +37°2310	12 41 23.02	+37 01 00.3	9.99	54544 – 54602	10	400 / 387 / 377
GI Gem	N8N9000652	07 04 59.14	+13 27 03.3	12.81	54431 – 54523	22	646 / 655 / 643
SU Leo	N6WV000233	09 53 37.66	+08 01 20.0	12.83	54453 – 54576	12	0 / 321 / 317

* V magnitudes of the comparison stars are from GSC 2.3.2

The photometric data are available electronically from the IBVS website (`5846-t5.txt` – `5846-t19.txt`). The tables list the relative BVI_C magnitude and relative $B-V$, $V-I_C$ colour time series with respect to the comparison stars. The brightnesses of the comparison stars remained constant during the observations. The *r.m.s.* scatter of their relative magnitudes measured to several check stars are about 0.006 and 0.012 mag. For comparison, the *r.m.s.* scatter of the Fourier fits to the B, V, I_C light curves of RZ Cam, SW CVn, GI Gem, and SU Leo are 0.014/0.009/0.010, 0.013/0.011/0.013, 0.013/0.010/0.010, and –/0.010/0.009 mag, respectively.

The V light curves and the colour curves of the three stars are plotted in Figs. $1 - 4$.

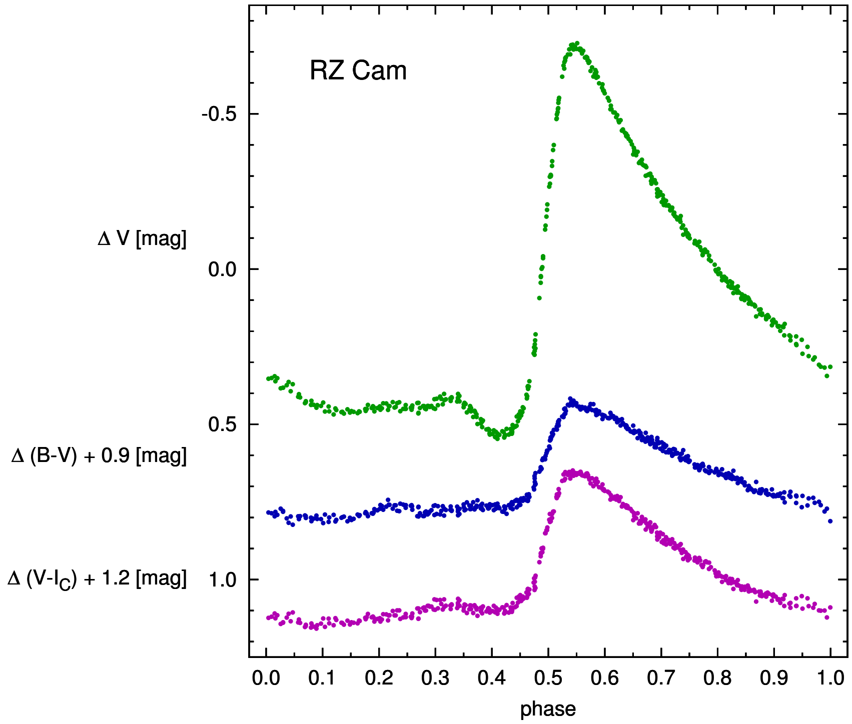

Figure 1. Differential V, $B-V$ and $V-I_C$ light and colour curves of RZ Cam.

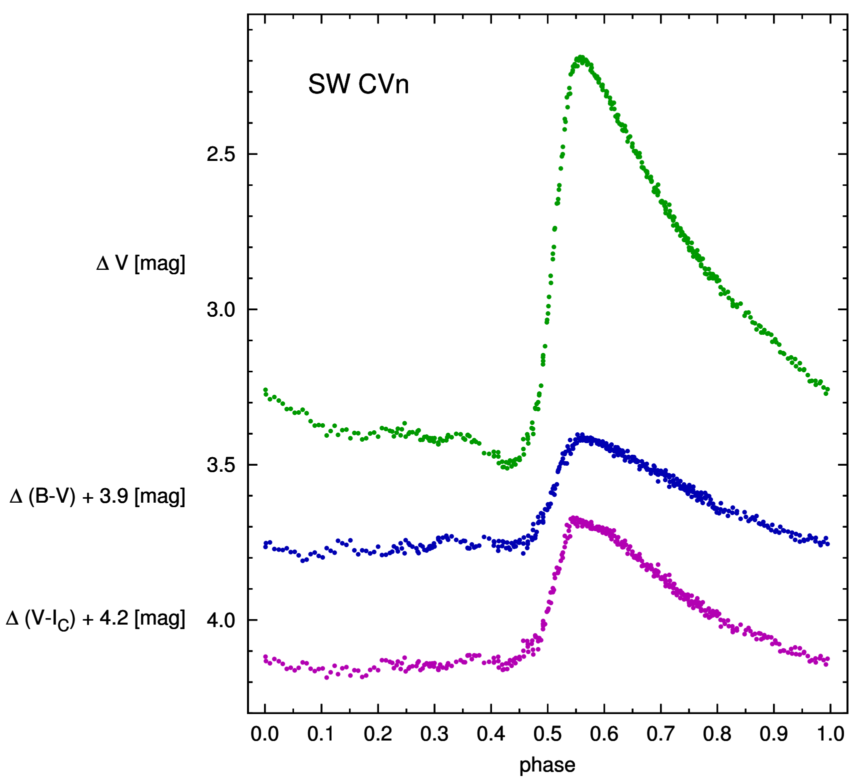

Figure 2. Differential V, $B-V$ and $V-I_C$ light and colour curves of SW CVn.

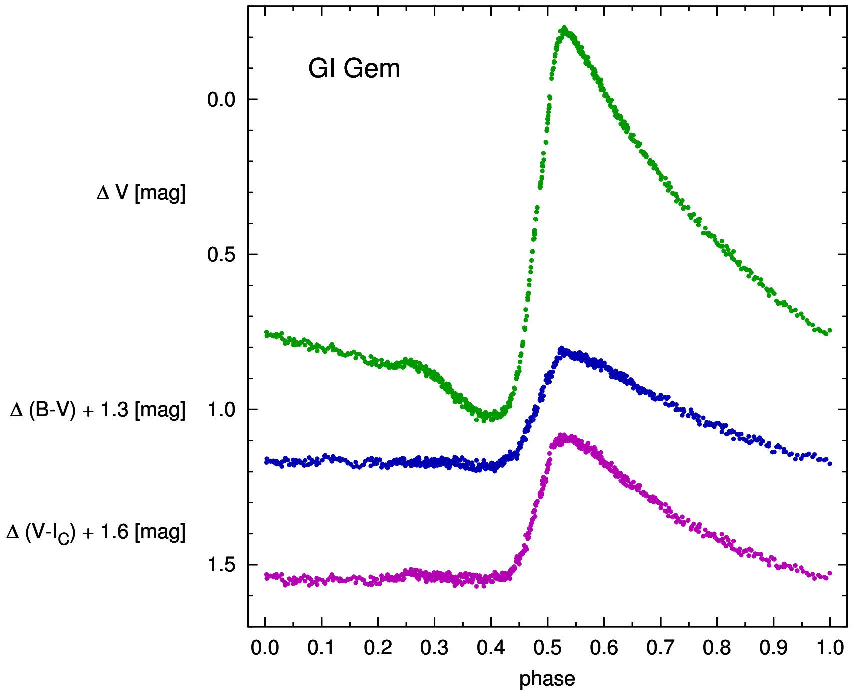

Figure 3. Differential V, $B-V$ and $V-I_C$ light and colour curves of GI Gem.

Table 2. Normal maximum timings of the V light curves.

Star	T_{max} - 2400000 [HJD]	Star	T_{max} - 2400000 [HJD]
RZ Cam	54546.4615	SW CVn	54573.4340
GI Gem	54479.5847	SU Leo	54497.5215

Table 3. Fourier parameters of the V light curves.

Star	P [d]	A_1 [mag]	R_{21}	R_{31}	R_{41}	R_{51}	ϕ_{21} * [rad]	ϕ_{31} * [rad]	ϕ_{41} * [rad]	ϕ_{51} * [rad]
RZ Cam	0.4804514(8)	0.444	0.453	0.351	0.229	0.167	2.251	4.751	1.118	3.736
SW CVn	0.441671(1)	0.461	0.480	0.342	0.223	0.152	2.264	4.807	1.135	3.744
GI Gem	0.4332664(6)	0.402	0.550	0.366	0.250	0.164	2.377	5.143	1.545	4.345
SU Leo	0.4722633(5)	0.454	0.458	0.347	0.221	0.163	2.239	4.724	1.104	3.702

* Phase differences are given according to sine term decomposition.

Seasonal normal maximum timings and Fourier parameters of the V light curves of RZ Cam, SW CVn, GI Gem, and SU Leo are listed in Table 2, and Table 3, respectively. Table 4 compares the photometric metallicities calculated from the V light curves of the variables according to Eq. 3 of Jurcsik & Kovács (1996) to the results of spectroscopic metallicity measurements.

We thank Béla Szeidl for his many helpful comments on this work. This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France. The financial support of OTKA grants T-048961, and T-068626 is acknowledged. ZsK is a grantee of the Bolyai János fellowship of the HAS.

Table 4. Spectroscopic and photometric [Fe/H] values.

Star	$[Fe/H]_{phot}$	$[Fe/H]_{spect}$ [a]	ref.
RZ Cam	−1.24	−0.77	Layden (1994)
SW CVn	−0.95	−1.26	Layden (1994)
		−1.65	Suntzeff et al.(1994)
GI Gem	−0.46	–	–
SU Leo	−1.23	−1.15	Layden (1994)

a: Spectroscopic metallicities are transformed to the [Fe/H] scale used for the photometric metallicities according to Eq. 3 and Eq. 2 of Jurcsik (1995) and Jurcsik & Kovács (1996).

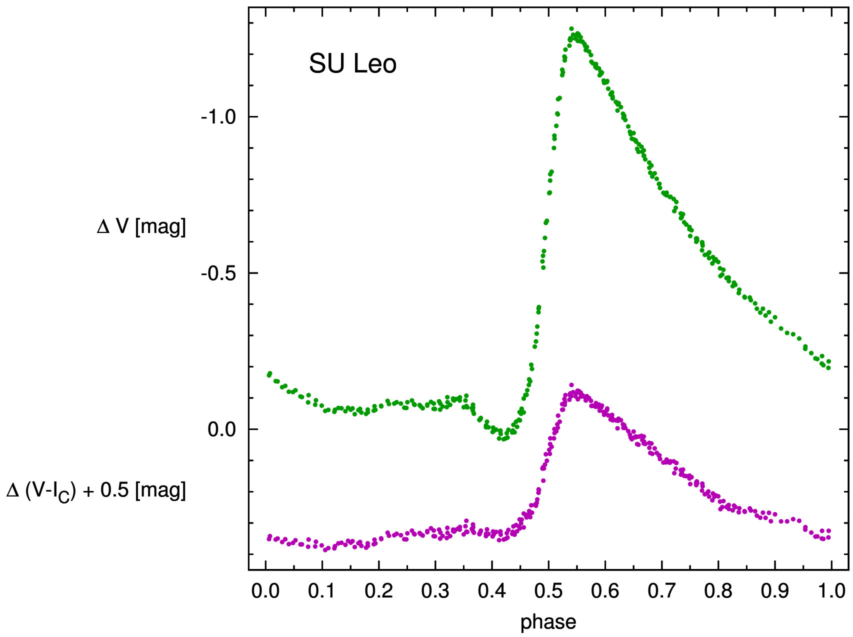

Figure 4. Differential V and $V - I_C$ light and colour curves of SU Leo.

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ELEMENTS FOR 8 ECLIPSING BINARIES

HÄUSSLER, K.[1]; BERTHOLD, T.[1,2]; KROLL, P.[2]

[1] Bruno-H.-Bürgel-Sternwarte, Töpelstr. 46, D-04746 Hartha, Germany

[2] Sternwarte Sonneberg, Sternwartestr. 32, D-96515 Sonneberg, Germany

email: sternwartehartha@lycos.de, tb@4pisysteme.de, pk@4pisysteme.de

These stars were discovered and reported to be variable by Boyce & Huruhata (1942) and Hoffmeister (1930, 1949, 1967). Photographic plates of fields centered around α Oph and 67 Oph resp., taken with the Sonneberg Observatory 40cm Astrographs during three intervals spread over the years from 1938–1994, were used to check the behaviour of these objects (see Table 1). The given elements were obtained by means of least-squares solutions. Photographic amplitudes were derived with respect to magnitudes of the comparison stars given in Table 2. An extensive list holding the times of minima derived can be retrieved as `5847-t3.txt`, using the link in the HTML version of this paper. Individual data are available upon request.

Remarks:

V415 Oph

Published times of minimum light by Hoffmeister (1930, the faintest observation only), Meinunger (1966) and Paschke (see Diethelm, 2004) were included in our analysis.

V760 Oph

First elements (now contained in the GCVS) derived from four minima observed by Mandel and published by Tsessevich (1960) have been found to be wrong. The four times of minimum light published there were included in this analysis.

V947 Oph

First elements (now contained in the GCVS) published by Götz et al. (1957) have been found to be erroneous. The ASAS database contains only 97 measurements of this star. Three very faint ones were used as times of minimum light and included in this analysis.

V968 Oph

Both type and period previously published by of Götz et al. (1957) and cited in the GCVS are erroneous. The same applies to the values given in the paper of Kraus (2007).

The period varies. Elements valid for J.D. 2429100-2447500 and J.D. 2447500-2449500 (at least, end of observations) resp.

NSV 9840

Further investigation is needed to confirm the existence as well as the duration (d=$0\overset{p}{.}04$:) of a possible phase of constant brightness in the middle of the minimum.

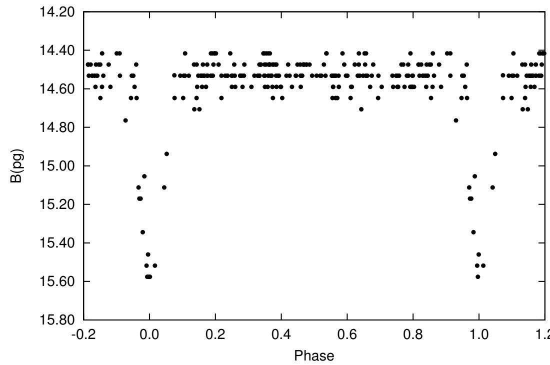

Figure 1. Light curve of V415 Oph

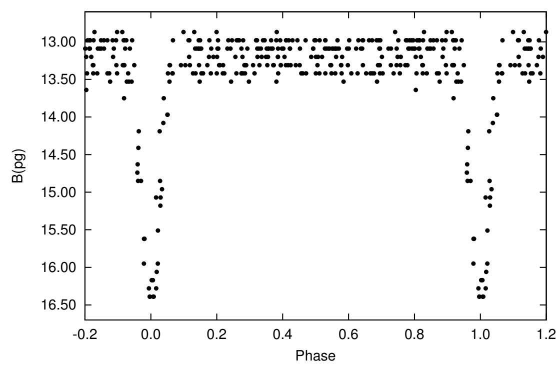

Figure 2. Light curve of V760 Oph

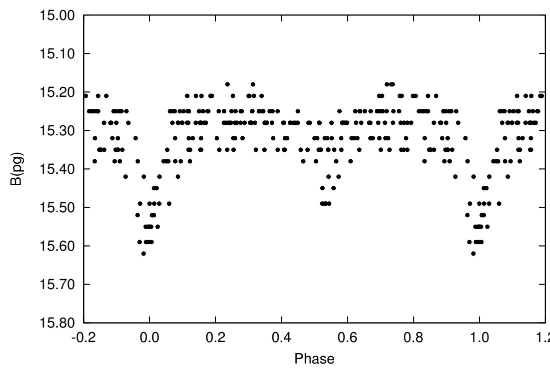

Figure 3. Light curve of V947 Oph

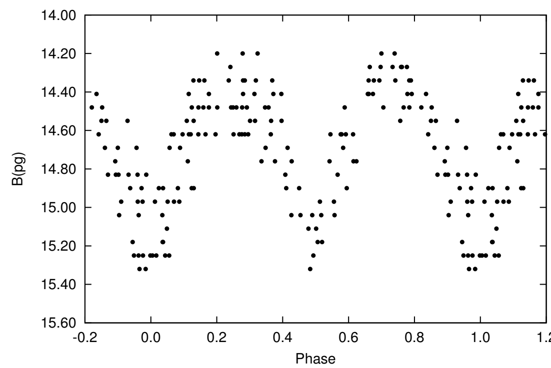

Figure 4. Composite light curve of V968 Oph

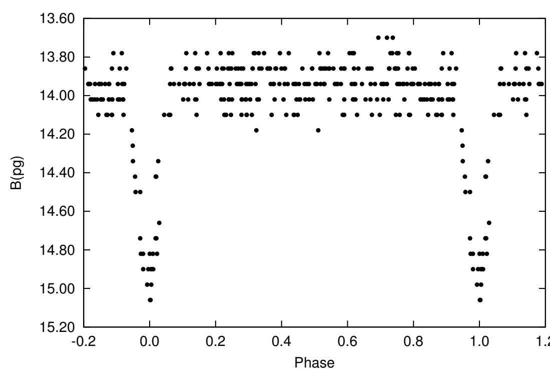

Figure 5. Light curve of NSV 8869

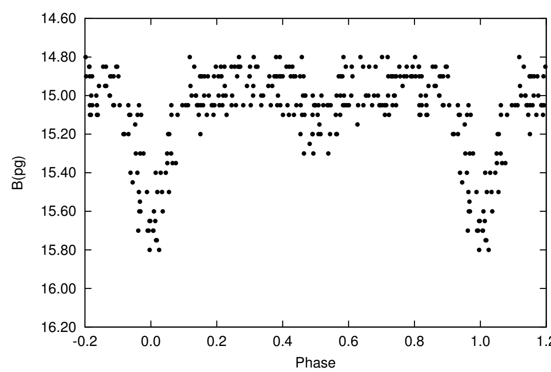

Figure 6. Light curve of NSV 8970

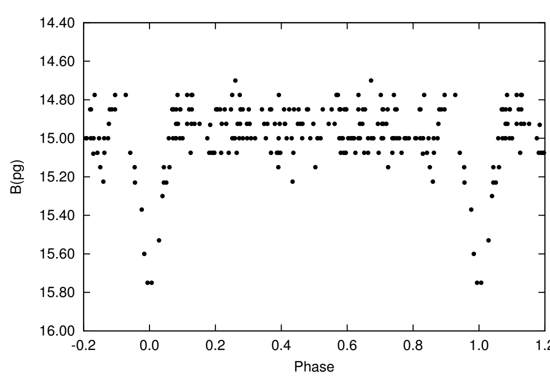

Figure 7. Light curve of NSV 9740

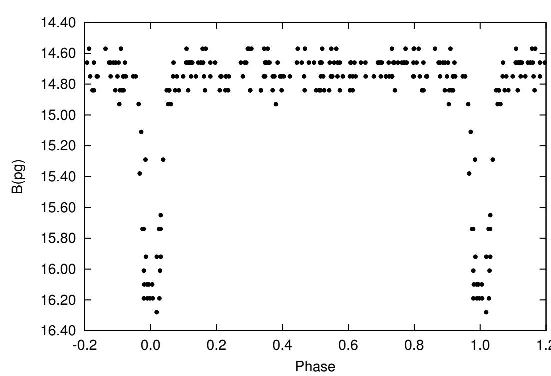

Figure 8. Light curve of NSV 9840

Table 1. Summary of this paper

Star	Type	Epoch 2400000+	Period (day)	Max.	Min.I	Min. II	D	No. of Plates
V415 Oph	EA	52825.470 ±16	2.5371464 ±28	$14^{m}_{.}5$	$15^{m}_{.}5$		$0^{P}_{.}16$	221
V760 Oph	EA	49193.468 ±10	1.5615272 ±21	$13^{m}_{.}2$	$16^{m}_{.}4$		$0^{P}_{.}13$	292
V947 Oph	E	53571.689 ±4	0.7977454 ±2	$15^{m}_{.}25$	$15^{m}_{.}60$	$15^{m}_{.}45$		263
V968 Oph (1)	E	46609.479 ±10	0.7233397 ±7	$14^{m}_{.}3$	$15^{m}_{.}2$	$15^{m}_{.}2$		125
V968 Oph (2)	E	49215.440 ±22	0.7232656 ±199					32
NSV 8869	EA	49133.418 ±8	1.4340859 ±19	$13^{m}_{.}9$	$15^{m}_{.}0$		$0^{P}_{.}17$	283
NSV 8970	EB	49213.347 ±25	2.504273 ±11	$14^{m}_{.}9$	$15^{m}_{.}7$	$15^{m}_{.}2$		268
NSV 9740	EA	47392.363 ±26	2.0421460 ±87	$14^{m}_{.}9$	$15^{m}_{.}7$	$15^{m}_{.}0$:	$0^{P}_{.}15$	202
NSV 9840	EA	49124.518 ±47	5.254049 ±48	$14^{m}_{.}7$	$16^{m}_{.}2$		$0^{P}_{.}16$	196

This research made use of the SIMBAD data base, operated by the CDS at Strasbourg, France.

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Kraus, A.L. et al., 2007, *AJ*, **134**, 1488
Meinunger, L., 1966, *Mitt. Veränd. Sterne*, **3**, 137, (H5)
The All Sky Automated Survey, `http://archive.princeton.edu/~asas`
Tsessevich, V.P., 1960, *Astron. Circ.*, **212**, 16

Table 2. Comparison stars and cross references

	V415 Oph		V760 Oph	
	176.1929		HV 10937	
	USNO 0900-11244760		USNO 0975-09180391	
Comp. No.	GSC	m*	USNO	m*
1	0900-11246767	$14\overset{\mathrm{m}}{.}2$	0975-09174322	$13\overset{\mathrm{m}}{.}2$
2	0900-11255289	$14\overset{\mathrm{m}}{.}9$	0975-09177551	$14\overset{\mathrm{m}}{.}3$
3	0900-11252628	$15\overset{\mathrm{m}}{.}2$	0975-09175192	$14\overset{\mathrm{m}}{.}9$
4	0900-11245022	$15\overset{\mathrm{m}}{.}8$	0975-09177416	$17\overset{\mathrm{m}}{.}3$

	V947 Oph		V968 Oph	
	S 4199		S 4226	
	USNO 0958-0324966		USNO 0900-12423939	
Comp. No.	USNO	m*	USNO	m*
1	0958-0324686	$15\overset{\mathrm{m}}{.}35$	0900-12425730	$14\overset{\mathrm{m}}{.}4$
2	0958-0324901	$15\overset{\mathrm{m}}{.}76$	0900-12436022	$14\overset{\mathrm{m}}{.}5$
3			0900-12436022	$15\overset{\mathrm{m}}{.}0$
4			0900-12429616	$15\overset{\mathrm{m}}{.}6$

	NSV 8869		NSV 8970	
	HV 10948		HV 10956	
	USNO 0975-09260589		USNO 0975-09289484	
Comp. No.	USNO	m*	USNO	m*
1	0975-09256163	$14\overset{\mathrm{m}}{.}2$	0975-09285269	$15\overset{\mathrm{m}}{.}0$
2	0975-09258315	$14\overset{\mathrm{m}}{.}3$	0975-09286902	$15\overset{\mathrm{m}}{.}1$
3	0975-09255998	$15\overset{\mathrm{m}}{.}2$	0975-09292729	$15\overset{\mathrm{m}}{.}5$
4			0975-09290674	$15\overset{\mathrm{m}}{.}9$

	NSV 9740		NSV 9840	
	S 9838		S 9831	
	USNO 0900-10650673		USNO 0975-09921950	
Comp. No.	USNO	m*		
1	0900-10654081	$14\overset{\mathrm{m}}{.}9$	0975-09915079	$14\overset{\mathrm{m}}{.}5$
2	0900-10655451	$15\overset{\mathrm{m}}{.}2$	0975-09916596	$14\overset{\mathrm{m}}{.}6$
3	0900-10656993	$15\overset{\mathrm{m}}{.}8$	0975-09924115	$15\overset{\mathrm{m}}{.}3$
4			0975-09923676	$16\overset{\mathrm{m}}{.}1$

* Magnitudes refer to the B values of the USNO−A2.0 catalogue except for V947 Oph. USNO−B1.0 was used for this star due to the lack of appropriate objects in the other catalogue

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V772 Cas: AN INTRINSICALLY VARIABLE BpSi STAR IN AN ECLIPSING BINARY?

GANDET, T. L.

Lizard Hollow Observatory, P.O. Box 89175, Tucson, AZ 85752-9175, USA; e-mail: tlglhobs@comcast.net

V772 Cas (HD 10260, HR 481) was discovered to be variable by the *Hipparcos* team (ESA, 1997), who determined the amplitude to be 0.039 magnitudes (*Hp*). Kazarovets *et al.* (1999) classified it as an ACV: star and assigned the *GCVS* designation of V772 Cas. Hube (1970) announced the radial velocity (RV) to be variable, based on eleven spectra. An ongoing study, by the present author, of late–B stars whose RVs have been discovered to vary (e.g. by Hube, 1970), but which lack published orbits, has so far yielded orbital periods, P_{orb}, for several of them, including V772 Cas. Combining the RVs of Hube (1970) with the *Hipparcos* photometry of V772 Cas, we find that $P_{orb} = 5.0138$ days and confirm that it is an eclipsing binary, perhaps an Algol-type. We present a preliminary spectroscopic orbit and evidence for a possible modulation of the light curve, which may arise in intrinsic variability of the primary star, perhaps of the α^2 CVn type. The purpose of this note is to alert observers to the possibility of intrinsic variability of this chemically peculiar, slowly rotating, B8IIIpSi eclipsing binary star, in order that observations may be made as early as the coming observing season (2008–2009).

Otero (2007) announced that V772 Cas is an eclipsing binary, with an eccentric orbit and a period of 10.7269 days. At the same time, he cautioned that the star 'might be a small amplitude ACV ($V = 6.68 - 6.69$) star with a period of 3.5473 d'. We attempted to resolve this uncertainty in the period and to determine the type of variability by requiring that the photometric and RV data meet, as closely as possible, these conditions: the correct period must result in the maximum coherence in the phased velocity and light curves; the least squares solution for the spectroscopic orbital elements converges to a Keplerian one; the final orbit yields the minimum standard error (S.E.) of one RV observation, and that it predicts a naive proxy time of primary minimum. It should be emphasized that *Hipparcos* did not observe any eclipse throughout its entire length, so that there is no directly observed time of minimum for V772 Cas. As a simple proxy for it, we adopted T_{min} to be the JD of the faintest magnitude observed by *Hipparcos*.

Candidate periods were initially chosen from amongst those with the strongest signals in a period search of the *Hipparcos* data using various standard periodogram techniques. The resulting power spectra differed amongst themselves. However, the strongest peaks in the spectral window, between 0.9 and 12 days, are at 5.08, 5.67, 8.23, 9.08, 10.84 days, with a very weak one at 3.55 days, and there are no peaks at aliases of one year. Phase plots of the RV and *Hipparcos* photometry data for periods corresponding to the strongest peaks in the power spectra between 0.9 days and 12 days, focusing on the interval between 3 and 12 days, were ultimately relied upon to eliminate those candidate periods that gave clearly incoherent or extremely noisy light curves.

No coherent phased light curves were found for periods between 10.1 and 12.5 days, although somewhat coherent and noisy light curves for periods of 3.461 and 10.026 days must be mentioned, as the former provides some support for the shorter period proposed by Otero (2007) and the latter is twice the period ultimately settled upon as being the correct one. The candidate period of 10.026 days yields a light curve with two clear minima separated by very nearly $0.5P$, but it was eliminated because the resulting RV curve is double-waved, inconsistent with duplicity and evidence that this candidate period is twice the true period. While the 3.461-day period light curve is very noisy, it produces a very clean RV curve, which is nonetheless neither Keplerian nor convergent in the orbit solution.

As might be expected from such a small number of observations, the periodogram search of the RVs was not very helpful. However, none of the spectral window peaks in the RV data correspond to any of the candidate periods described above, nor do any of the strongest RV power spectrum peaks yield a coherent and Keplerian RV curve.

Combining the results from the periodogram and phase-plot period searches of the *Hipparcos* and RV data, it was found that light *and* RV curves that met the requirements described above could only be obtained by periods between about 5.012 and 5.014 days. Applying those criteria, we found that $P_{orb} = 5.0138$ days produces the minimum scatter in the light curve, a spectroscopic orbit solution that both converges to a Keplerian orbit and very closely predicts a simple proxy for T_{min} (see below).

However, the orbit solution converged to $P_{orb} = 5.01253$ days when all orbital elements were allowed to vary as unknowns. Eclipses will occur, assuming $i = 90°$, at phases corresponding to $\nu + \omega = 90°$ and $270°$, where ν is the true anomaly and ω is the longitude of periastron in the orbit. $P_{orb} = 5.01253$ was rejected because T_{min}, as predicted from the orbit solution, is nearly one day different from our proxy T_{min}. Furthermore, $P_{orb} = 5.0138$ is only slightly more than 1σ longer while producing a more coherent light curve. We thus fixed the period in the orbit solution at 5.0138 days, and the resulting orbital elements are listed in Table 1, which also provides their standard errors. Orbital elements from the $P_{orb} = 5.01253$ solution differ from the one adopted here by no more than expected from the standard errors of each solution. We also emphasize that none of the other candidate periods resulted in both coherent light *and* velocity curves, and that the correctness of $P_{orb} = 5.0138$ days can be supported entirely by the photometry, without appeal to the RVs, as discussed below. Moreover, these combined results appear to exclude any period near 3.5 days, or between 10.0-12.0 days, from being the correct one. The RVs and *Hipparcos* data cover 387 and 233 cycles of the orbit, respectively.

Table 1. Spectroscopic orbital elements of V772 Cas.

Element	Value	S.E.
P	=5.0138	±(fixed) days
T	=JD 2439799.53	±0.61 days
e	=0.17	±0.10
ω	=305°	±45°
V_0	=−3.1	±2.9 km sec^{-1}
K	=38.4	±4.7 km sec^{-1}

Figure 1 shows the eleven RVs of Hube (1970), phased on $P_{orb} = 5.0138$ days and referred to the time of periastron in Table 1. The small grey dots indicate the RV curve using those orbital elements. In view of the small number of RV measures of V772 Cas, this orbit must be considered preliminary.

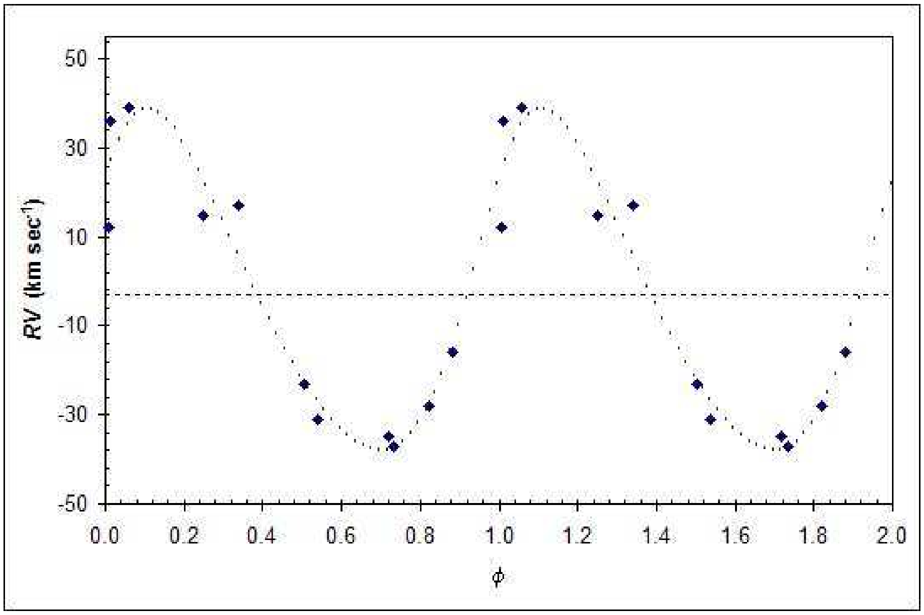

Figure 1. Radial velocity curve of V772 Cas, $P_{orb} = 5.0138$ days, observations by Hube (1970). $\phi = 0.0$ is the time of periastron passage given in Table 1. The theoretical velocity curve is that from the orbital elements in Table 1.

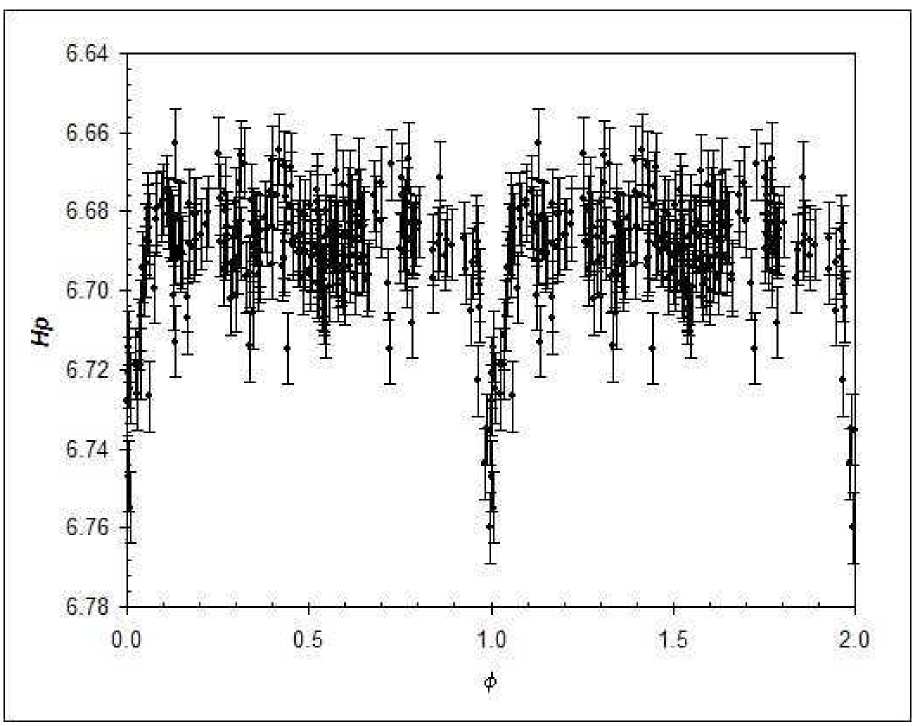

Figure 2. Light curve of V772 Cas light curve (*Hipparcos* observations). The observations are phased on $P_{orb} = 5.0138$ days and $T_{min} =$ JD 2448099.08.

Figure 2 shows the full light curve of the *Hipparcos* data, phased on P_{orb}=5.0138 days and the proxy T_{min}=JD 2448099.08; the light curves in Figures 3 and 4 also are phased this way. Largely owing to the distortion of the light curve evident in Figure 2, we do not offer an estimate of the uncertainty of T_{min}, but point out that T_{min}=JD 2448099.19 would be appropriate if the eclipse were total and the egress portion of the light curve were as short as the ingress portion. However, P_{orb} and the time of periastron passage given in Table 1 predicts T_{min} to occur only 0.002 day later than the proxy T_{min} given above. Notice that the time of periastron and time of minimum were determined by virtually independent methods, the period being fixed entirely from the photometry while the time of periastron is entirely from the orbit solution.

Figures 3 and 4 show detail from Figure 2 near primary eclipse, at ϕ=0.0, and at ϕ=0.5, respectively. The offset by ~0.06 in phase of the shallow 'secondary minimum', seen in Figure 3, is merely consistent with the poorly-determined eccentricity given in Table 1. It may, instead, be accounted for by a short-period modulation of the system's light that appears to be present throughout the entire orbit, and this putative modulation may also be responsible for the marked asymmetry of the light curve during primary eclipse ($0.10 < \phi < 0.25$), visible in Figure 3, and for the 'third' minimum at $\phi \sim 0.35$ seen in Figure 4. If it is accepted that the supposed minimum at $\phi \sim 0.56$ is real and not merely an observational artifact, then it seems difficult to dismiss the minima at $\phi \sim 0.35$ as occurring entirely by chance. It was not found possible to artificially force light minima to occur at precisely ϕ=0.0 and 0.5 and to have both a convincingly coherent light curve and a convergent orbit solution. Since v sin i is only 20 km sec^{-1} (Abt *et al.* 2002), variations owing to an ellipsoidal-shaped primary star do not seem likely.

This short-period modulation apparently persisted during the 233 orbital cycles covered by the *Hipparcos* observations, and its period must therefore be equal to an integer fraction of P_{orb} to have maintained coherence. A value for it very close to one day may be gleaned from the light curve, and we note, in passing, that $P_{orb}/5$ = 1.00276 days. (A referee, more alert than the present author, pointed out that this is very close to the length of the sidereal day in units of mean solar days. It is worth mentioning that the spectral window of the out-of-eclipse *Hipparcos* data set shows no signatures, above the noise level, between periods of 0.5-1.7 days.) An attempt to determine a more accurate value for this periodicity was made by removing from consideration all observations made during primary eclipse, construed narrowly, and then performing periodogram searches of the remaining data. None of the strongest peaks in the power spectrum of this out-of-eclipse data are very close to an integer fraction of P_{orb}, in the interval 0.5-7.0 days, and none of them produce a convincingly coherent light curve. A period of 1.609 days produces a convincing light curve, and $P_{orb}/3$=1.671. But this result is complicated by the choice of observations that are presumed to fall outside of eclipse. It is hoped that future observations will sort out this situation.

Because the modulation apparently remained coherent, it may be attributed to either intrinsic variability with a constant period, or to duplicity of one of the components. The primary star's spectral type, B8IIIpSi (Cowley 1972), and the distortion of the light curve at primary minimum suggest that intrinsic variability of the primary star is the more likely source of the modulation and that it is of the α^2 CVn type (ACV). That it is the primary star to which the variability should be assigned is indicated by the large Δm between the two components, which is inferred by the failure, so far, to detect the secondary's spectrum and by the shallow, 'secondary', minimum near $\phi \sim 0.56$.

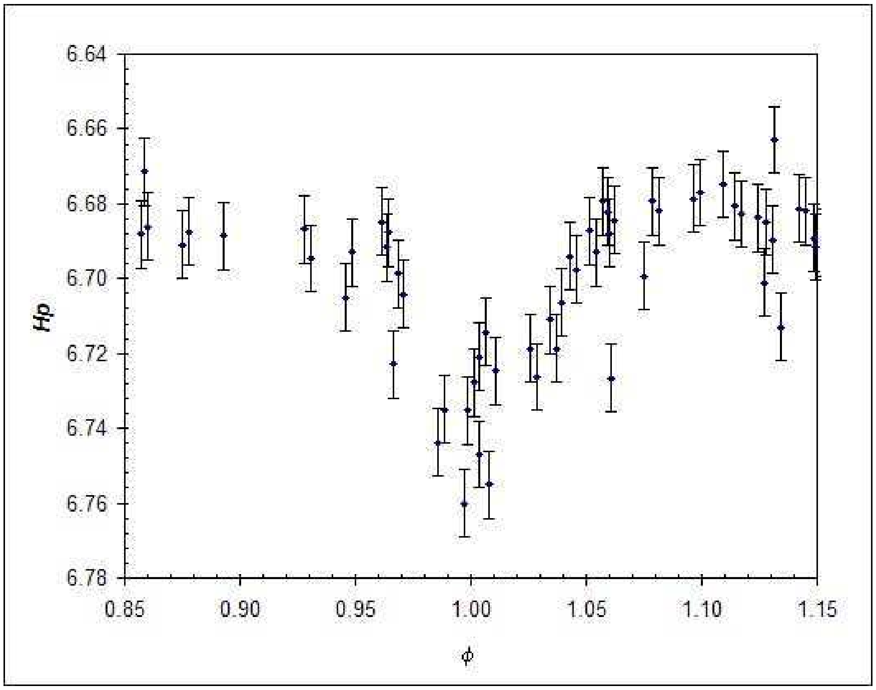

Figure 3. Light curve of V772 Cas light curve (*Hipparcos* observations) showing detail near primary eclipse. Notice the light curve asymmetry during primary eclipse. The observations are phased on P_{orb}=5.0138 days and T_{min}=JD 2448099.08.

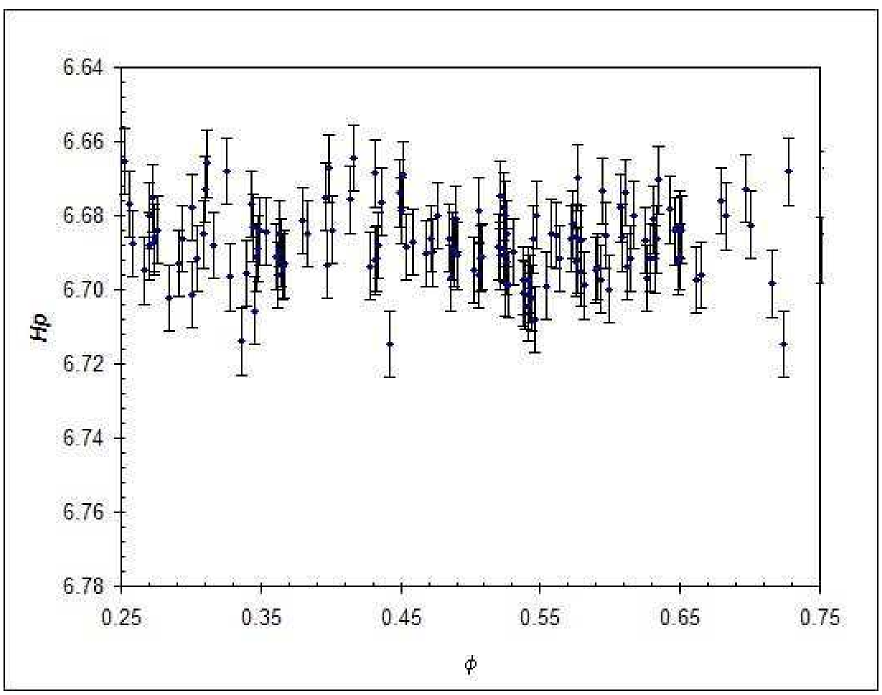

Figure 4. Light curve of V772 Cas (*Hipparcos* observations) showing detail near ϕ=0.5. A shallow minimum may occur at $\phi\sim$0.56. Another minimum, of about the same depth, is possible at $\phi\sim$0.35. The observations are phased on P_{orb}=5.0138 days and T_{min}=JD 2448099.08.

This note proposes an orbital period of 5.0138 days for V772 Cas and that the light curve may be modulated by intrinsic light variations of the primary star with a period near 1 day. High-resolution spectra and time-series photometry of V772 Cas are highly desirable to determine the character of the putative modulation, especially of its period, and to clarify the nature of the eclipsing-spectroscopic binary system. Observations at sites separated by some distance in terrestrial longitude would be valuable.

Dr. P. Etzel, of the Mt. Laguna Observatory, kindly furnished the program with which the spectroscopic orbital elements were calculated. The assistance of the anonymous referee in the preparation of this paper is very much appreciated. This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France, and of the Smithsonian Astrophysical Observatory/NASA Astrophysics Data System (ADS) hosted at CDS.

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THE COOL DWARF INTERACTING ECLIPSING BINARY, HH95-79

SAMEC, RONALD G.[1,2]; MCKENZIE, ROB[1,2]; HAWKINS, NATHAN C.[1,2]; VAN HAMME, WALTER[4]; FAULKNER, DANNY R.[2,3]

[1] Astronomy program, Department of Physics Bob Jones University, Greenville, SC 29614 USA

[2] Visiting Astronomer, SARA Observatory, Kitt Peak, AZ

[3] U of South Carolina, Lancaster, SC

[4] Florida International University, Miami, Fl

HH95-79 ([HH95] FS Aur-79) [Henden and Honeycutt, 1995; GSC 1874-399; $\alpha(2000)=$ $05^{\rm h}48^{\rm m}03\overset{\rm s}{.}82$, $\delta(2000)=28°30'48\overset{''}{.}13$] was observed as a part of our study of near-contact, solar-type binaries with possible stream impacts. Also, its rare combination of an EB-type light curve and very short period indicated that the system was made up of dwarf components, possibly harboring a brown dwarf.

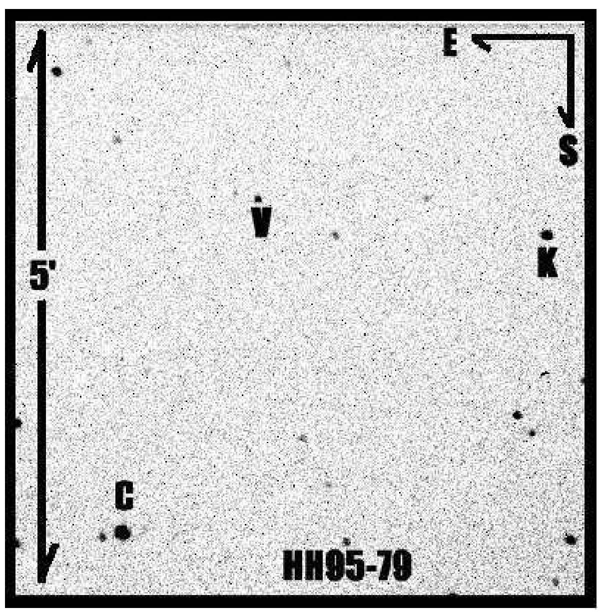

Figure 1. Finding chart, HH95-79, comparison star (C) and check star (K).

The system was discovered by Robertson et al. (2004) who gave the following ephemeris:

$$\text{HJD Tmin I} = 2452963.744(\pm 0.004) + 0.2508(\pm 0.0001)\text{d} \times \text{E}. \quad (1)$$

After the initial presentation of the present work in May 2005 (McKenzie et al., 2005), Austin et al. (2007) took observations in December 2005 in UBV and obtained single line radial velocity curves of the primary and a spectroscopic identification of the primary of spectral type dM3e ($T \sim 4100$K). A synthetic light curve solution was given indicating a mass ratio of 0.52. They found that emission features were present confirming chromospheric activity and possibly circumstellar material. However, they did no modeling of a third light as we do here. They indicated a near contact configuration. Since their absolute masses were based on single line curves, we can not regard these as definitive. The Center for Backyard Astrophysics observed 66 times of minimum light for the paper, some of which are duplicate epochs. They give an improved ephemeris:

$$\text{HJD Tmin I} = 2452963.74445 + 0.250816(\pm 0.000001)\text{d} \times \text{E}. \tag{2}$$

No changes in the period over the rather brief period (~ 2 years) are indicated, which is expected. This does not indicate, however, that the period is not changing.

Our U, B, V, R, I light curves were taken at the taken Southeastern Association for Research in Astronomy (SARA) observatory on Kitt Peak using a 0.9-m reflector with the AP7 CCD camera and standard $UBVR_cI_c$ filters. The CCD observations were taken on 7, 8 December 2004 and 21 March 2005 in remote mode by RGS and NCH. More than 100 In the B, V, R, I passbands, 97, 90, 94 and 95 images were taken, respectively as well as a 7 in the U pass band (see Figure 1.). The stars [GSC 2336-0621, $\alpha(2000) = 05^{\rm h}48^{\rm m}10\overset{\rm s}{.}29$, $\delta(2000) = 28°27'34\overset{''}{.}38$] and [GSC 1874-0609, $\alpha(2000) = 05^{\rm h}47^{\rm m}47\overset{\rm s}{.}37$, $\delta(2000) = 28°29'46\overset{''}{.}60$] were used as the comparison (C) and check (K) stars, respectively. A finding chart of HH95-79 (V), the comparison star (C), and check star (K) is given in Figure 1. The light curves are given in Figure 2, as normalized flux versus phase. Our standardized observations are given in Table 1 (available through the IBVS website as `5849-t1.txt`) as Variable-comp magnitudes.

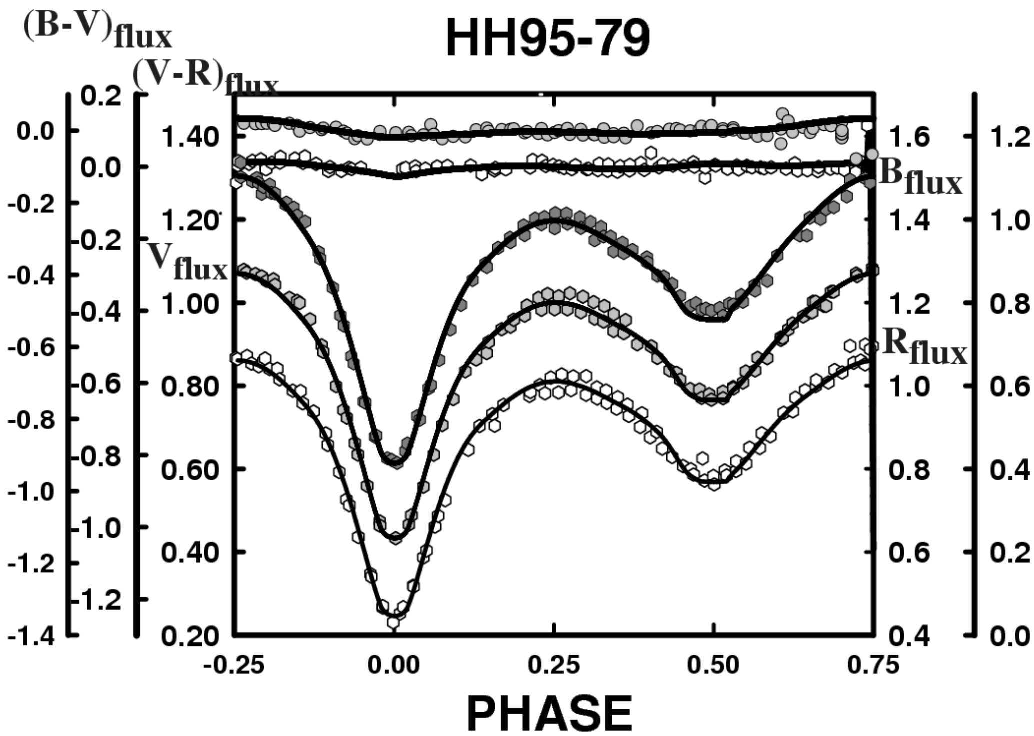

Figure 2. B,V,R normalized flux light curves for HH95-79 with synthetic light curve solution overlaid.

Six mean epochs of minimum light were determined from eclipse timings in all pass bands, using parabola fits: HJD Tmin I = 2453348.7476 ($\pm$0.0011), 2453349.0008 ($\pm$0.0028) and HJD Tmin II = 2453347.8687 ($\pm$0.0015), 2453348.8715 ($\pm$0.0013), 2453441.6739 ($\pm$0.0010), 2453450.7025 ($\pm$0.0030).

From all available observations (we used only primary eclipses and thus well determined ones from the CBA observations), we calculated the following definitive improved linear ephemeris:

$$\text{HJD TMin I} = 2453348.7473(\pm 0.0001) + 0.25081621(\pm 0.00000008)\text{d} \times \text{E} \qquad (3)$$

The times of minimum light are given in Table 2 (available through the IBVS website as `5849-t2.txt`). Further observations are needed to better characterize the period behavior of this system.

From standard star measurements taken on 7, 8 December 2004 we were able to obtain standard magnitudes at all quadratures, and of C and K. The results are given in Table 3 (available through the IBVS website as `5849-t3.txt`). The photometrically determined spectral types for the variable ranged from K7 to K9 while the comparison was K7$\pm$1 and check, G9$\pm$5. The apparent magnitude range of the variable was $V = 13.75 - 14.47$ mags while the comparison was 10.05$\pm$0.01 and check, 13.83 $\pm$0.02 mags in V.

Our light curves were premodeled with Binary Maker 2.0 (Bradstreet, 1992) and fits were obtained in B and V using semi-detached and contact configurations. The hand model parameters gave starting values for a simultaneous BVR synthetic light curve solution using the 2004 version of the Wilson Code (Wilson and Devinney, 1971; Wilson, 1990, 1994; Van Hamme and Wilson, 1998) which includes Kurucz atmospheres, and a detailed reflection treatment along with 2-D limb darkening coefficients and iterative spot modeling. We removed the I-curve since it was discrepant. We suppose this was due to local atmospheric effects, probably variable humidity.

Our BVR simultaneous solution yielded a mass ratio of 0.53$\pm$0.01, equal to that of Austin et al. (2007), within the errors. We list the parameters of that solution as Table 4, and display the light curve solution overlaying our data in Figure 2. The errors accompanying the corrected parameters in Table 4 are from the full set calculation, rather that subsets. Our displayed solution uses two hot spots two fit asymmetries. Our solutions show a hot spot with a temperature factor near 1.25 on the secondary component. Its location is that of a stream impact spot arising from a coming into contact binary. We believe the mass transfer is not vigorous at this time. The other spot is presumably magnetic in nature, arising from white light faculae. These may dominate the surfaces of short period, chromospherically active binaries (Guinan, 1990). Austin et al. (2007) used cool star spots, only, in their solution. Our Roche lobe model is given as Figure 3 and 4. All indications are that the secondary component is not a brown dwarf, but an early M-type main sequence star.

We wish to thank SARA for their allocation of observing time, and the American Astronomical Society for a small research grant which supported our observing runs.

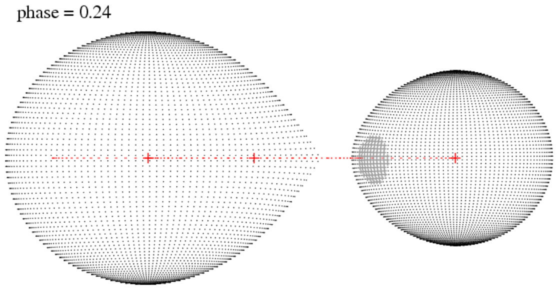

Figure 3. Geometrical representation of HH95-79 at phase 0.24 with stream spot shown on component 2.

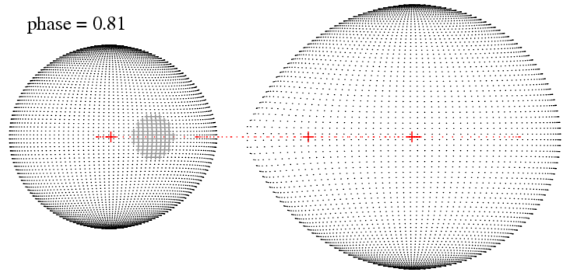

Figure 4. Geometrical representation of HH95-79 at phase 0.81 with second spot region shown on component 2.

Table 4: Synthetic Curve Parameters for HH95-79

Parameter	Simultaneous solution
$\lambda_B, \lambda_V, \lambda_R$ (nm)	440, 550, 640
$x_{\rm bol1,2}, y_{\rm bol1,2}$	0.540, 0.464, 0.276, 0.290
$x_{\rm 1R,2R}, y_{\rm 1R,2R}$	0.724, 0.778, 0.219, 0.336
$x_{\rm 1V,2V}, y_{\rm 1V,2V}$	0.778, 0.824, 0.289, 0.362
$x_{\rm 1B,2B}, y_{\rm 1B,2B}$	0.822, 0.857, 0.213, 0.341
g_1, g_2	0.32, 0.32
A_1, A_2	0.5, 0.5
inclination(°)	86±1
T_1, T_2 (K)	4100, 3257±25
Ω_1, Ω_2	2.927±0.018, 3.045±0.038
$q(m_2/m_1)$	0.53±0.01
JD Zero	53448.74716±0.00017
Period	0.25081±0.00009
$L_1/(L_1+L_2)_R$	0.917±0.004
$L_1/(L_1+L_2)_V$	0.932±0.004
$L_1/(L_1+L_2)_B$	0.947±0.004
r_1, r_2 (pole)	0.410±0.002, 0.285±0.006
r_1, r_2 (point)	0.565±0.005, 0.342±0.017
r_1, r_2 (side)	0.434±0.002, 0.296±0.007
r_1, r_2 (back)	0.463±0.002, 0.319±0.010

Spot Parameters

STAR	Colatitude (°)	Longitude (°)	Spot Radius (°)	Temp. Factor
2	88±9	276±7	14±2	1.47±0.04
2	91±15	35±6	15±6	1.25±0.07

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EARLY SPECTROSCOPY AND PHOTOMETRY OF THE NEW OUTBURST OF V1647 Ori

KUN, M.

Konkoly Observatory, H-1525 Budapest, P.O.Box 67, Hungary, e-mail: kun@konkoly.hu

V1647 Ori is a young eruptive variable star, illuminating a variable reflection nebula (McNeil's Nebula). The previous outburst of the star between 2004 January and 2005 October has been extensively documented in the literature (e.g. Briceño et al. 2004, Ojha et al. 2006, Acosta-Pulido et al. 2007, Fedele et al. 2007). Optical, near-, and mid-infrared observations of the star during the quiescent period following the outburst (Aspin et al. 2008) suggested a spectral type of M0$\pm$0.2, mass 0.8$\pm$0.2 $M_\odot$, and age <0.5 Myr for V1647 Ori. The observed properties of the outburst of V1647 Ori are different in several respects from both the EXor and FUor type outbursts, and suggest that this star probably represents a new type of eruptive young stars, younger and more deeply embedded than EXors, and exhibiting variations on shorter time scales than FUors.

A new outburst of the star was announced on 27th August 2008. Itagaki et al. (2008) detected the apparent brightening of V1647 Ori on 26 August. The flux-calibrated optical spectrum of the star, obtained by Aspin (2008) on Aug 30, showed strong Hα emission line with P Cygni profile, the CaII triplet lines in emission, and suggested a Johnson R magnitude of 17.3, corresponding to a brightening of some 6 mag in the R-band with respect to the quiescent phase.

In order to compare the present brightness and emission line strengths of the star with those observed at the beginning of the outburst in 2004 I observed V1647 Ori between 28 August and 1 September 2008, using the CAFOS instrument on the 2.2-m telescope of Calar Alto Observatory (Spain). Spectra covering the wavelength region of 4800–7800 Å were obtained on Aug 29 and 31, using the grism G–100 whose dispersion is 2.12 Å/pix. Grism R–100, having a dispersion of 2.04 Å/pix, was used for observing the spectral region 5800–9000 Å on Aug 28, 30, and Sep 1. The exposure time was 1800 s for each spectrum. The spectrum of a He–Hg–Rb lamp was observed for wavelength calibration. Direct images, each with an exposure time of 60 s, were taken immediately after the spectroscopic observations, utilizing the central 1024$\times$1024 pixel region of the SITe 2048$\times$2048 chip. The image scale was 0.53″/pix. The 9-arcmin field of view included seven secondary standard stars published by Semkov (2004). Two I_C-band images were obtained on both August 28 and 29, and two images both in the I_C and R_C bands were taken on the remaining three nights. Data reduction and analysis were performed in IRAF. One-dimensional spectra were extracted from the spectroscopic images using the 'apextract' package of IRAF. The spectrum of the nebula was also extracted from the images obtained through grism G–100. The resulting spectra were wavelength-calibrated and analysed in the ‘onedspec’ package of IRAF. The direct images, obtained through the same filter on each night, were coadded after bias subtraction and flatfield correction, using dome flat field images. The instrumental magnitudes of V1647 Ori and the comparison stars were determined on the coadded images by PSF-photometry using the ‘daophot’ package in IRAF. The preliminary aperture photometry, used for scaling the PSF magnitudes was obtained using 1.5 arcsec apertures in each image. The instrumental magnitudes were transformed into the standard photometric system as described by Acosta-Pulido et al. (2007).

The upper panel of Fig. 1 shows the spectrum of the star (thick line) and the nebula (thin line) in the green spectral region, normalized to the continuum. The most conspicuous feature of this spectral region, is the strong Hα emission with P Cygni type absorption. Both spectra indicate a weak Hβ and NaI D absorption. The lower panel shows the red spectral region with strong Hα and CaII triplet emissions. In addition to the strong atmospheric absorption bands around 6860, 7600, and 8280 Å the OI line at 7773 Å is clearly seen in absorption in each red spectrum. The left panel of Fig. 2 shows an I-band image, centred on V1647 Ori, obtained on 1 September. The right panel shows the Hα line observed on three different nights.

The $R_{\rm C}$ and $I_{\rm C}$ magnitudes, as well as the equivalent widths of the Hα, CaII, and OI lines are listed in Table 1. Values for both the emission and absorption components of the Hα line are shown. The UT, given in Column 2, refers to the start of the spectroscopic exposure. The photometric uncertainties were computed as the quadratic sum of the formal errors of the instrumental magnitudes provided by IRAF and the uncertainties of the standard transformation. The uncertainties of the equivalent widths are around 6%, estimated from repeated measurements.

Table 1. Results of the observations

Date	UT	$R_{\rm C}$	$I_{\rm C}$	W(Hα)		W$_\lambda$(CaII)			OI
				em.	abs.	(8498)	(8542)	(8662)	
		(mag)	(mag)	(Å)	(Å)	(Å)	(Å)	(Å)	(Å)
2008 Aug 28	04:17	···	14.64 (0.06)	−31.5	1.6	−7.46	−7.84	−6.24	1.6
2008 Aug 29	03:39	···	14.80 (0.07)	−41.5	3.4	···	···	···	
2008 Aug 30	03:48	17.02 (0.07)	14.64 (0.05)	−41.3	5.0	−8.45	−8.50	−6.79	2.2
2008 Aug 31	03:32	16.81 (0.07)	14.66 (0.07)	−41.5	6.0	···	···	···	
2008 Sep 01	03:51	17.11 (0.05)	14.69 (0.04)	−43.6	3.6	−7.97	−8.52	−6.36	2.0

Comparison of the image of McNeil’s Nebula, the main apparent features of the spectrum of V1647 Ori, and the data listed in Table 1 with similar data obtained in February–March 2004 suggests that the initial conditions of the present outburst are largely the same as were in 2004. Walter et al. (2004) and Ojha et al. (2006) measured similar Hα and CaII equivalent widths in February–March 2004, McGehee et al. (2004), Ojha et al. (2006), and Acosta-Pulido et al. (2007) report similar $R_{\rm C}$ and $I_{\rm C}$ magnitudes for the same period. The optical spectra obtained in February–March 2004 by Fedele et al. (2007) show P Cygni-type profile of the Hβ line with strong absorption and weak emission component, indicating that the source of the line is a strong stellar wind. Only the absorption component of the Hβ can be identified in the low S/N part of our spectra. The

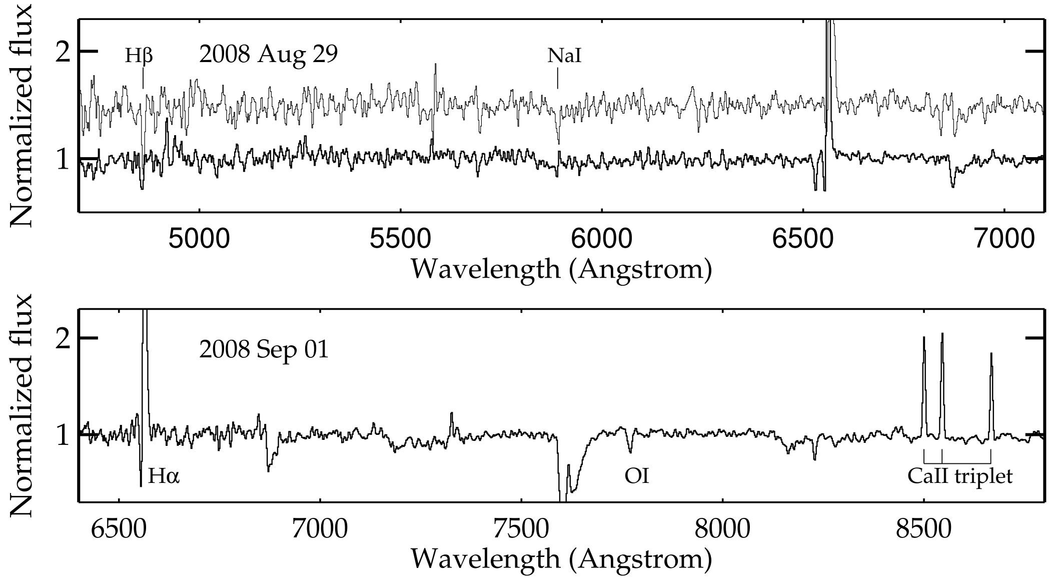
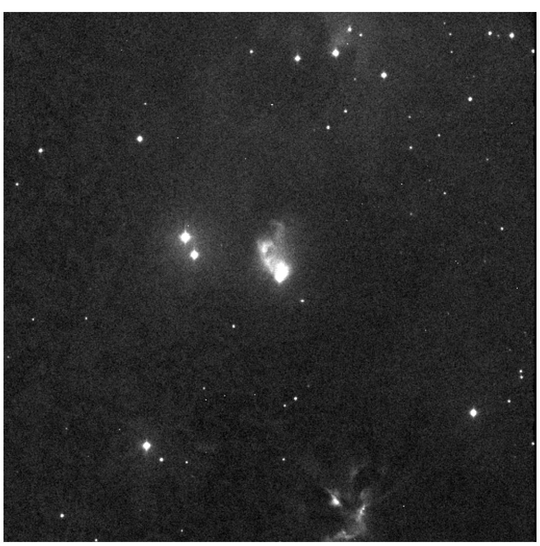


Figure 1. Upper panel: The spectrum of V1647 Ori (thick line) and McNeil's Nebula (thin line), on the wavelength interval 4700–7100 Å, obtained on Aug 29. Lower panel: The 6400–8800 Å region of the spectrum of V1647 Ori obtained on Sep 01 2008.



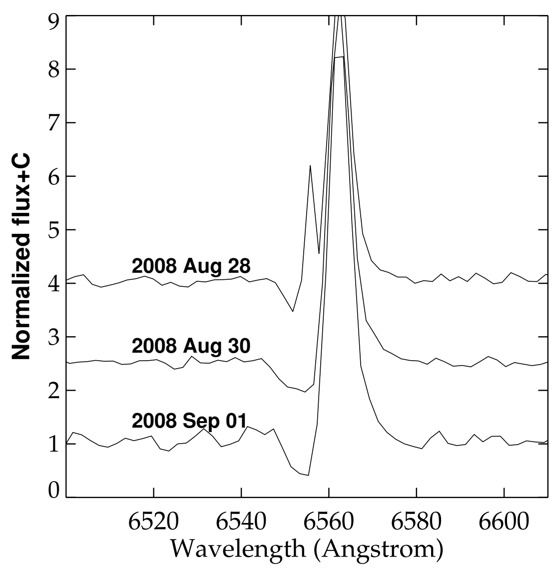


Figure 2. Left: I-band image of the field centered on V1647 Ori, observed on September 1. Right: Hα line profiles on three different nights.

OI λ 7773 Å absorption was also detected by Ojha et al. (2006) in the spectra obtained at the early phases of the outburst in 2004. The CaII line ratios $W_\lambda(8498)/W_\lambda(8542)$ and $W_\lambda(8662)/W_\lambda(8542)$ are useful tracers of the physical conditions at the origin of the emission (e.g. Hamann & Persson 1992). Our measured ratios, averaged for the three nights, are 0.95 and 0.78, whereas the same ratios obtained by Walter et al. (2004) in March–April 2004 are 1.10 and 0.63, respectively. Both measurements show that the λ 8662 Å line was the weakest component of the triplet. Ojha et al. (2006) reported on nearly equal equivalent widths of the triplet components in later phases of the outburst. The ratios measured in the quiescent phase by Aspin et al. (2008), 0.86 and 0.97, show a similar situation.

The simultaneous spectroscopic and photometric observations allow us to calculate line fluxes. The average observed fluxes of the Hα, CaII(λ8498), CaII(λ8542), and CaII(λ8662) emission lines are F(Hα)=1.4×10^{-17} Wm^{-2}, $F_\lambda(8498)=1.2\times10^{-17}$ Wm^{-2}, $F_\lambda(8542)=1.3\times10^{-17}$ Wm^{-2}, and $F_\lambda(8662)=1.0\times10^{-17}$ Wm^{-2}, respectively. These numbers indicate a 14-fold increment of the Hα flux with respect to the flux measured in 2007 February (Aspin et al. 2008). The observed emission line fluxes are affected by the increased accretion rate from the disk onto the star, the strong wind accompanying the enhanced accretion, and the decreasing circumstellar extinction associated with the outburst (Aspin et al. 2008). The contribution of these processes to the fluxes of various emission lines may be strongly different.

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THE LONGITUDINAL MAGNETIC FIELD OF THE ROAP STAR HD 99563

ELKIN, V.G.[1]; FREYHAMMER L.M.[1]; KUDRYAVTSEV D.O.[2]; ROMANYUK, I.I.[2]

[1] Centre for Astrophysics, University of Central Lancashire, Preston PR1 2HE, United Kingdom

[2] Special Astrophysical Observatory, Nizhniy Arkhyz, KChR, Russia

The chemically peculiar star HD 99563 is an important member of the class of rapidly oscillating Ap (roAp) stars and its monoperiodic rapid oscillation shows the highest known radial velocity amplitude among these (Elkin et al. 2005). The rapid pulsation was discovered photometrically by Dorokhova & Dorokhov (1998) and was comprehensively studied by Handler et al. (2006) in a multisite photometric campaign. The longitudinal magnetic field in HD 99563 was first detected by Hubrig et al. (2004) and later confirmed by Hubrig et al. (2006).

The roAp stars as a class are in general well-described by the oblique pulsator model, which assumes a dipole magnetic field axis that is aligned with the stellar pulsation axis. It is important to observe the longitudinal magnetic field over the stellar rotation period for HD 99563 to provide a geometrical model of the magnetic field structure.

We obtained observations of the magnetic field with the 6-m telescope BTA (Big Telescope Alt-azimuthal) of the Special Astrophysical Observatory in Russia. The observations and the data reduction were performed similarly to the procedures described by Kudryavtsev et al. (2006). The results of our magnetic field measurements together with those obtained by Hubrig et al. (2004, 2006) are given in Table 1.

Table 1: The longitudinal magnetic field measurements for HD 99563. The columns give: HJD of the middle of the exposure, rotational phase using the ephemeris of Handler et al. (2006), the longitudinal magnetic field B_l, the standard deviation of B_l and the observing place. The first three measurements were taken from Hubrig et al. (2004, 2006) who used ESO VLT and the other six are our observations with 6-m BTA.

HJD (2450000+)	Phase	B_l [G]	σ [G]	Telescope
2494.483	0.0728	-688	145	VLT
3012.749	0.0617	-235	73	VLT
3015.727	0.0845	-670	84	VLT
3395.550	0.5273	+580	100	BTA
3718.580	0.4660	+680	100	BTA
3719.553	0.8002	-320	280	BTA
3784.569	0.1289	-110	120	BTA
3786.526	0.8010	-750	160	BTA
3812.523	0.7290	+270	120	BTA

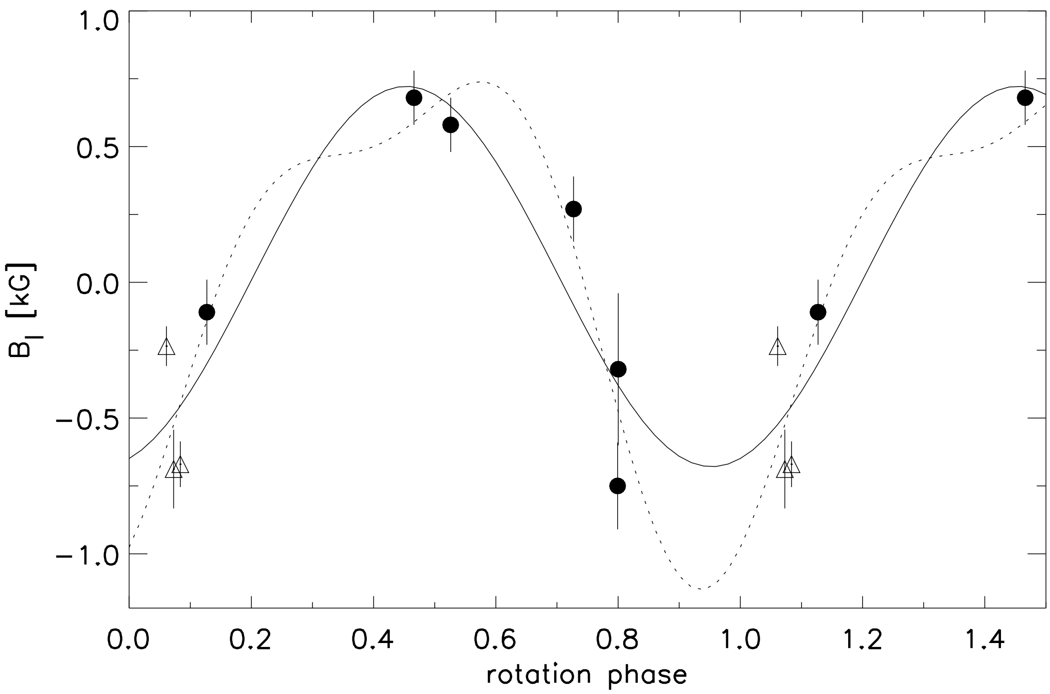

Figure 1. Variation of the longitudinal magnetic field in HD 99563 (filled circles - new observations from the 6-m telescope, triangles - results by Hubrig et al. 2004, 2006). A best-fit sine curve is shown with the full line, while the dotted line is for a sine curve including the first harmonic. Both curves fit the observations well, but several measurements with similar phases do show a scatter. The differences in the two points at the phase near 0.8 may be explained by relatively large errors. Although the differences in the measurements from VLT, obtained at nearly equal rotational phases, are still not clear.

We have a total of nine points spread over the rotation period. Fig. 1 shows the variation of the longitudinal field with the stellar rotation period according to the ephemeris given by Handler et al. (2006):

$$\mathrm{HJD} = 2452031.29627 + 2.91179E.$$

This rotation period is quite reliable and additionally supported by Doppler imaging and line profile variations (Freyhammer et al 2008). The number of magnetic field measurements is not sufficient to determine the rotation period independently. Least-squares sine fitting was performed with the program Period04 (Lenz & Breger 2004), which for a pure sine curve uses:

$$B_l = B_0 + B_1 \sin(2\pi(\omega_1 t + \phi_1)).$$

The observations are illustrated in Fig. 1 with the fitted curve shown as a solid line for the determined parameters: mean magnetic field $B_0 = 21 \pm 58$ G and amplitude $B_1 = 701 \pm 114$ G. Alternatively, for a least-squares sine fit that also includes the first harmonic, i.e.,

$$B_l = B_0 + B_1 \sin(2\pi(\omega_1 t + \phi_1)) + B_2 \sin(2\pi(2\omega_1 t + \phi_2)),$$

we get the curve shown with a dotted line in the figure. This fit has the magnetic field parameters: $B_0 = 6 \pm 77$ G, $\mathrm{B}_1 = 846 \pm 149$ G, $\mathrm{B}_2 = 311 \pm 186$ G. The harmonic amplitude is significant only at the 1.7σ level, indicating that a purely sinusoidal fit is sufficient for the present observations.

The photometry by Handler et al. (2006) shows a double wave light variation with the rotation period, and maximum brightness in the U and B filters at phases 0.25 and 0.75 and minimum brightness at phases 0.0 and 0.50. The variations in the V, R, I filters are in antiphase to U and B and have lower amplitudes. This behaviour is typical for a dipole rotator where two opposing spots come into view over the rotation period.

The minima of the U and B filters thus coincide with the times when one of the magnetic poles is closest to the line-of-sight, i.e., the times of magnetic maxima and minima in Fig. 1. The fit to the magnetic measurements possibly suggests a minor phase offset of $\Delta\varphi_{\mathrm{rot}} = -0.046 \pm 0.027$ (units of fractional phase) as the magnetic minimum in Fig. 1 occurs near phase 0.95, while the positive extremum coincides with phase 0.45. This phase difference has, however, only a 1.7σ significance, and considering the uncertainties in the magnetic curve, more observations are needed at a higher precision.

Handler et al. (2006) calculated the radius of HD 99563 to be $2.38\,\mathrm{R}_{\odot}$. Taking into account the longitudinal field variations and the projected rotation velocity of $v \sin i = 28.5 \pm 1.1\,\mathrm{km\,s^{-1}}$ (Elkin et al. 2005), the geometrical parameters for an oblique rotator model are: inclination angle between rotation axis and line of sight $i = 43.^{\circ}5$ and magnetic obliquity (angle between rotation axis and the magnetic dipole axis) $\beta = 88.^{\circ}4$. These are similar to those determined by Handler et al. (2006).

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THE NEW CONTACT BINARY GSC 2414-0797

ROBB, R.M.[1,2]; VINCENT, J.[2]; HENDERSON, H.[2]; GREIMEL, R.[3]; DREW, J.E.[4]; GONZALEZ-SOLARES, E.A.[5]

[1] Guest Observer, Dominion Astrophysical Observatory, and Guest User, Canadian Astronomy Data Centre, which are operated by the Herzberg Institute of Astrophysics, National Research Council of Canada

[2] Dept. of Physics and Astronomy, University of Victoria, Victoria, BC, Canada, V8W 3P6, e-mail: robb@uvic.ca

[3] Institut für Physik, Karl-Franzens Universität Graz, Universitätsplatz 5, 8010 Graz, Austria

[4] Centre for Astrophysics Research, STRI, Univ. of Hertfordshire, College Lane Campus, Hatfield AL10 9AB

[5] Physics Department, Imperial College London, Exhibition Road, London SW7 2AZ

Contact binary stars are of great interest since it is not obvious how they came to be or what they will evolve to become. Because many of these interesting stars are bright enough to be observed with small telescopes from bright locations, they make an ideal project for amateur-professional collaboration. The star GSC 2414-0797 was suspected of variability in brightness from the IPHAS survey (Drew et al., 2005) data. GSC 2414-0797 can be found in the NOMAD catalog (Zacharias et al., 2004) which lists $B = 13.96$ mag, $V = 13.41$ mag, $R = 12.58$ mag and 2MASS measurements reveal that $J = 11.77$ mag, $H = 11.33$ mag and $K = 11.18$ mag with an uncertainty of approximately ± 0.15 due to brightness variations of the star.

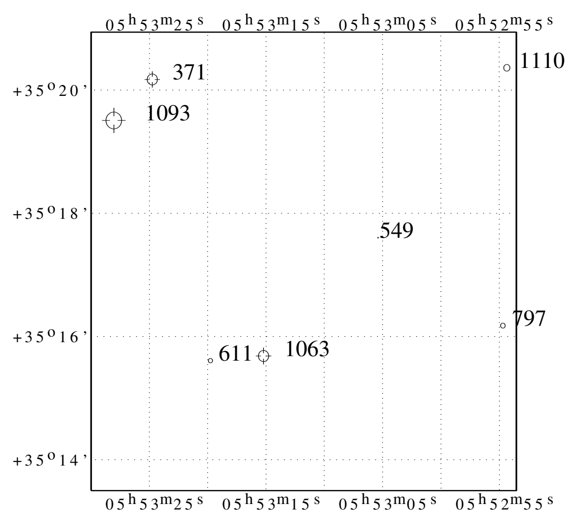

Figure 1. Finder chart labelled with the GSC identification numbers from region 2414.

The University of Victoria (UVic) observations were made with our automated 0.5 m telescope, Star I CCD and reduced in a fashion similar to that described in Robb and

Table 1: Stars observed in the field of GSC 2414-0797

GSC Id	R.A. J2000	Dec. J2000	GSC Mag.	ΔR Mag	σ Nights	σ Hours	ΔI Mag.	σ Nights	σ Hours
0797	$05^h52^m55^s$	$35°16'11''$	13.7	2.390	0.016	0.131	2.153	0.017	0.122
1093	$05^h53^m28^s$	$35°19'30''$	10.7	-	-	-	-	-	-
0371	$05^h53^m25^s$	$35°20'10''$	12.2	0.983	0.002	0.008	0.551	0.002	0.007
0611	$05^h53^m20^s$	$35°15'37''$	13.8	2.622	0.007	0.027	2.593	0.003	0.026
1063	$05^h53^m15^s$	$35°15'41''$	12.2	1.274	0.012	0.013	1.285	0.010	0.013
0549	$05^h53^m05^s$	$35°17'36''$	14.8	3.022	0.010	0.046	2.811	0.024	0.030
1110	$05^h52^m54^s$	$35°20'22''$	13.3	1.618	0.014	0.013	0.949	0.002	0.007

Greimel (1999). All UVic observations were made using 120 second exposures and Cousins R and I filters. The field of stars, seen in Figure 1, was observed during the years 2005, 2006 and 2008 and Julian Dates of observation (-2450000) were 3385, 3409, 3411, 3416, 3776, 3777, 3780, 4487-4489, and 4514. Table 1 lists the stars' identification numbers and magnitudes from the Hubble Space Telescope Guide Star Catalogue (GSC) (Jenkner et al., 1990).

Our differential magnitudes are calculated in the sense of the star minus GSC 2414-1093. For each star the mean of the nightly means is shown as ΔR and ΔI in Table 1. Brightness variations on an hourly timescale were measured by the standard deviation of the differential magnitudes and are listed for the most photometric night in the column labelled "σ Hours". A "σ Hours" one night of 0.007 sets an upper limit on variations of an hourly timescale. The standard deviation of the means of each night is a measure of the night to night variations and is called "σ Nights" in Table 1. The smallest "σ Nights" is 0.002 magnitudes. This excellent photometry shows that night to night variations in GSC 2414-1093 and GSC 2414-0371 must be less than a few millimagnitudes. Only the 2008 data are included in the table since the mean values for the other years were different by a few hundredths of a magnitude due to slight differences in the flat fields. If we assume the flat fields are perfect the standard deviation of the ΔR nightly means for all 11 nights would be 0.011 magnitudes for the stars GSC 2414-1093 and GSC 2414-0371, so these stars remained constant at that level on the nights we observed them.

The star GSC 2414-0797 showed brightness variations during a night typical of a contact binary star. During the night 2454487 more than one orbit was observed allowing an unambiguous estimate of the period to be 0.340 ± 0.002 days. Times of minimum brightness listed in Table 2 were found using the method of Kwee and van Woerden (1956) on the data within 0.04 days of the minimum. The 2008 times of minima are the average of the times of minima determined from the R and I filtered data.

Table 2: Times of Minimum Light HJD-2450000

Year	HJD	(O-C)	Type	HJD	(O-C)	Type
2005	3385.7698(06)	-0.0010	II	3411.6583(06)	+0.0006	II
	3416.7659(04)	-0.0011	II			
2006	3777.6528(16)	+0.0014	I	3777.8226(03)	+0.0009	II
2008	4487.6677(07)	-0.0012	II	4487.8400(08)	+0.0008	I
	4488.0071(23)	-0.0024	II	4488.6905(11)	-0.0003	II
	4489.7126(16)	+0.0000	II	4489.8852(12)	+0.0023	I

From these times of minima our best estimate of the ephemeris is:

$$\text{HJD of Primary Minimum} = 2453385^{\rm d}.6005(7) + 0^{\rm d}.3406176(6) \times \text{E}.$$

where the uncertainty in each final digit is given in brackets and the RMS deviation was 0.0014 days. There is no evidence for a changing orbital period.

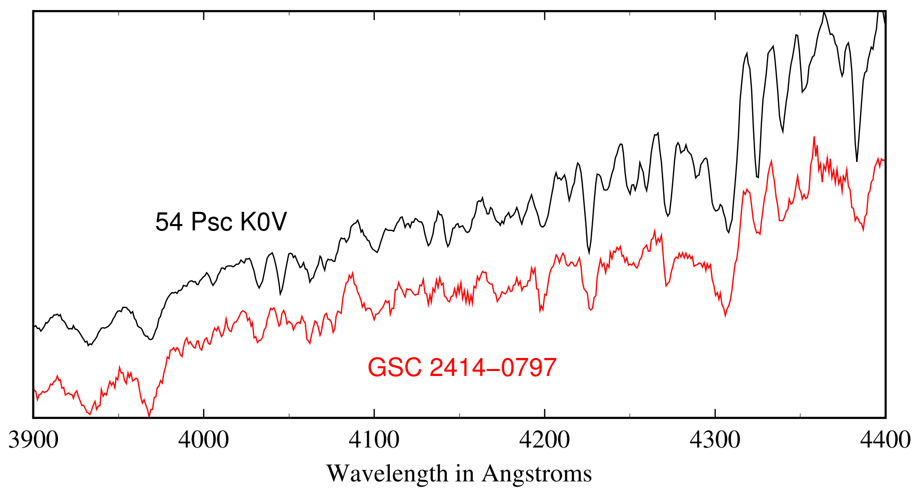

Figure 2. Spectra of GSC 2414-0797 and the MK K0V spectral class standard star 54 Piscium

Spectra of GSC2414-0797 and 54 Piscium observed with the Dominion Astrophysical Observatory's 1.8 m telescope at 60 Å/mm are shown in Figure 2. The time of observation was 4:22 UT 18 Feb 2006, which corresponds to a phase of approximately 0.16. The strength of the G band, Calcium H&K lines and the Calcium I 4227 Å line are typical of a late G or early K spectrum and the H γ 4340 Å and Fe I 4326 Å lines indicate a K0V±1 spectral classification. All the catalog colour measurements listed in the first paragraph are consistent with a spectral class of K0V±3, if the V measurement is assumed to be too faint by 0.3 magnitudes, so henceforth we will assume that at maximum brightness $V = 13.1$ mag.

Comparison of plots of the individual years' data reveal no systematic offsets as might be expected from flat fielding errors or changes in active regions. Therefore the 1152 individual ΔR observations were averaged into 100 normal points and plotted in Figure 3. Using the Light Curve Synthesis software Binary Maker 3.0 (Bradstreet 2004) various models were fit to the data. Because there are no known radial velocity data and the eclipses seem to be partial, the mass ratio / inclination / fillout factor degeneracy cannot be broken (Terrell and Wilson 2005). We can however put limits on the inclination, mass ratio and fillout factor and show that the system can be described by astronomically reasonable parameters. The (mass ratio, inclination, fillout factors) limits were (0.22, 75°, 0.20) to $(0.90, 66°, 0.05)$. Plotted in Figure 3 is the best fit found using a mass ratio of 0.3, an inclination of 71.3°, a fillout factor of 0.17, temperatures of 5150 and 5052 Kelvin. To model the difference in maxima a spot 90% of the photospheric temperature on the more massive star at colatitude of 55° and longitude of 275° and a radius of 13.5° was assumed. This fit gave mean residuals of 0.004. The 2008 data taken with both the I and R band filters were used to calculate 50 normal points and the differences are plotted in Figure 3 shifted by an arbitrary amount. As expected the color and thus temperature did not change as a function of phase.

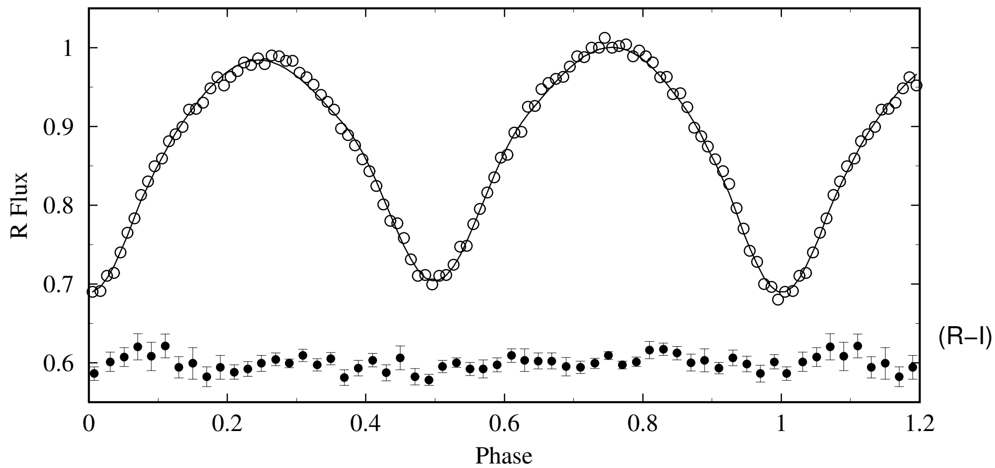

Figure 3. Model of GSC 2414-0797 with the parameters given in the text

Assuming a K0 star, the PLC relation by Rucinski (2004) implies an absolute magnitude of about $M_V = 4.75 \pm 0.25$, so with an apparent magnitude of $V = 13.1 \pm 0.1$ an estimate of the distance is 470 ± 100 parsecs. Since the star seems to have a dark spot it might be expected to be an X-ray source but it is not included in the ROSAT Bright Source catalog (Voges, et al. 1999). GSC 2414-0797 seems to be a rapidly rotating late type contact binary star with active regions covering a significant part of its surface.

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THE GEOS RR Lyr SURVEY

Ninth list of maxima of RR Lyr stars observed by the automated telescopes TAROT

(GEOS Circular RR 35)

LE BORGNE, J. F.[1,2]; KLOTZ, A.[3,4]; BOËR, M.[3]

[1] GEOS (Groupe Européen d'Observations Stellaires), 23 Parc de Levesville, 28300 Bailleau l'Evêque, France

[2] LATT, Université de Toulouse, CNRS, Toulouse, France

[3] Observatoire de Haute-Provence, Saint Michel l'Observatoire, France

[4] CESR, Université de Toulouse, CNRS, Toulouse, France

We present here the ninth list of light maxima of RR Lyrae stars from the GEOS RR Lyr Survey (Le Borgne et al. 2007), a GEOS program (`http://www.upv.es/geos/`, Boninsegna et al., 2002) of observations of RR Lyr stars using the automatic telescopes TAROT (`http://tarot.obs-hp.fr`, Boër et al., 2001, Bringer et al., 1999). The present list contains 328 maxima observed mainly between January and June 2008 (Table 1).
A description of the present list may be found in the former lists (for example Le Borgne et al. 2008). The data are also available in the GEOS RR Lyr web database (`http://dbRR.ast.obs-mip.fr`). The $O-C$'s are computed with the GCVS elements (Kholopov et al., 1985) when available. Otherwise, the reference of the elements, if exists, is given as a footnote of Table 1.

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Table 1: maxima of RR Lyrae stars

Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.
CI And	54472.309±0.002	0.102	38690.	C	AL CMi	54479.695±0.003	0.448	32483.	LS
WY Ant	54523.648±0.003	0.212	24164.	LS	RV Cap	54617.842±0.004	0.003	46309.	LS
TY Aps	54519.750±0.005	0.039	29487.	LS	BI Cen	54471.797±0.006	0.032	39237.	LS
TY Aps	54626.609±0.004	0.037	29700.	LS	BI Cen	54519.844±0.002	0.041	39343.	LS
XZ Aps	54525.723±0.003	-0.282	43938.	LS	BI Cen	54526.637±0.002	0.036	39358.	LS
V341 Aql	54624.856±0.003	0.032	23232.	LS	BI Cen	54608.667±0.002	0.040	39539.	LS
S Ara	54641.706±0.003	-0.322	29852.	LS	V499 Cen	54589.654±0.003	0.030	25831.	LS
S Ara	54642.607±0.003	-0.325	29854.	LS	V499 Cen	54615.715±0.002	0.031	25881.	LS
MS Ara	54590.659±0.003	0.377	50676.	LS	V499 Cen	54624.576±0.003	0.031	25898.	LS
MS Ara	54641.582±0.002	0.379	50773.	LS	S Com	54527.411±0.002	-0.100	23650.	C
TZ Aur	54474.387±0.002	0.011	88267.	C	S Com	54541.491±0.003	-0.098	23674.	C
TZ Aur	54478.304±0.002	0.012	88277.	C	S Com	54581.379±0.004	-0.098	23742.	C
TZ Aur	54548.417±0.006	0.015	88456.	C	S Com	54605.427±0.003	-0.101	23783.	C
TZ Aur	54557.424±0.003	0.013	88479.	C	ST Com	54503.505±0.005	-0.025	18832.	C
BH Aur	54474.518±0.003	0.000	25703.	C	ST Com	54512.487±0.005	-0.027	18847.	C
RS Boo	54499.643±0.002	0.001	33734.	C	ST Com	54551.417±0.005	-0.027	18912.	C
RS Boo	54539.645±0.003	0.005	33840.	C	ST Com	54582.565±0.004	-0.024	18964.	C
RS Boo	54569.453±0.002	0.003	33919.	C	V413 CrA	54590.819±0.008	0.052	22212.	LS
RS Boo	54600.397±0.003	0.005	34001.	C	V413 CrA	54623.814±0.004	0.044	22268.	LS
RS Boo	54609.454±0.002	0.006	34025.	C	TV CrB	54539.544±0.002	0.026	39207.	C
RS Boo	54629.450±0.003	0.003	34078.	C	TV CrB	54542.466±0.003	0.025	39212.	C
RS Boo	54632.467±0.002	0.001	34086.	C	TV CrB	54635.419±0.002	0.025	39371.	C
ST Boo	53165.502±0.010	0.099	54611.	C	TV CrB	54642.432±0.003	0.022	39383.	C
ST Boo	54504.649±0.002	0.077	56763.	C	W Crt	54526.646±0.002	-0.022	36121.	LS
ST Boo	54519.594±0.003	0.087	56787.	C	W Crt	54592.568±0.002	-0.022	36281.	LS
TW Boo	54521.514±0.002	-0.053	51910.	C	W Crt	54606.578±0.004	-0.021	36315.	LS
TW Boo	54544.405±0.004	-0.050	51953.	C	X Crt	54588.546±0.004	0.068	17453.	LS
TW Boo	54578.465±0.005	-0.055	52017.	C	UY Cyg	54638.425±0.002	0.058	57436.	C
UY Boo	54503.707±0.005	0.782	19463.	C	XZ Cyg [2]	54578.509±0.003	-0.004	12876.	C
UY Boo	54554.495±0.005	0.805	19541.	C	XZ Cyg [2]	54635.436±0.002	-0.002	12998.	C
UY Boo	54582.499±0.004	0.823	19584.	C	XZ Cyg [2]	54641.501±0.002	-0.003	13011.	C
CM Boo	54540.503±0.002	-0.103	30602.	C	XZ Cyg [2]	54642.432±0.002	-0.005	13013.	C
AH Cam	54472.522±0.002	-0.429	42696.	C	V939 Cyg [3]	54642.448±0.005	0.019	12525.	LS
AH Cam	54473.258±0.002	-0.429	42698.	C	RW Dra	54538.615±0.002	0.175	34230.	C
AH Cam	54475.499±0.003	-0.401	42704.	C	RW Dra	54546.565±0.005	0.153	34248.	C
AH Cam	54499.464±0.002	-0.404	42769.	C	RW Dra	54571.410±0.002	0.194	34304.	C
TT Cnc	54551.334±0.002	0.105	25924.	C	RW Dra	54586.436±0.003	0.161	34338.	C
AN Cnc	54475.478±0.006	0.138	29540.	C	RW Dra	54598.426±0.003	0.192	34365.	C
AS Cnc	54474.498±0.002	0.352	24734.	C	SU Dra	54512.406±0.003	0.051	16066.	C
EZ Cnc [1]	54472.639±0.002	-0.032	13410.	C	SU Dra	54518.356±0.004	0.058	16075.	C
W CVn	54520.542±0.006	-0.132	60023.	C	SU Dra	54527.597±0.004	0.053	16089.	C
W CVn	54540.407±0.004	-0.131	60059.	C	SU Dra	54539.483±0.003	0.051	16107.	C
W CVn	54542.613±0.005	-0.132	60063.	C	SU Dra	54551.371±0.002	0.052	16125.	C
W CVn	54572.407±0.003	-0.133	60117.	C	SU Dra	54584.392±0.003	0.052	16175.	C
W CVn	54573.510±0.003	-0.133	60119.	C	SW Dra	54502.495±0.003	0.062	49639.	C
Z CVn	54553.427±0.003	0.359	23893.	C	SW Dra	54518.439±0.002	0.055	49667.	C
Z CVn	54570.425±0.005	0.357	23919.	C	SW Dra	54519.581±0.002	0.058	49669.	C
RU CVn	54502.537±0.003	0.212	34922.	C	SW Dra	54547.493±0.003	0.056	49718.	C
RZ CVn	54550.528±0.004	-0.160	25038.	C	XZ Dra	54584.500±0.003	-0.111	26561.	C
RZ CVn	54570.376±0.002	-0.171	25073.	C	BC Dra	54538.662±0.006	0.083	17038.	C
SS CVn	54521.613±0.005	0.157	31135.	C	BC Dra	54539.387±0.005	0.089	17039.	C
SS CVn	54568.515±0.005	0.164	31233.	C	BC Dra	54572.485±0.009	0.086	17085.	C
SS CVn	54570.424±0.002	0.158	31237.	C	BC Dra	54587.598±0.005	0.088	17106.	C
SS CVn	54572.336±0.002	0.156	31241.	C	BC Dra	54639.407±0.005	0.087	17178.	C
UZ CVn	54538.509±0.004	0.246	40286.	C	BC Dra	54644.442±0.005	0.085	17185.	C
AA CMi	54504.342±0.003	0.058	37638.	C	BD Dra	54517.536±0.005	0.722	21632.	C

Table 1 (cont.): maxima of RR Lyrae stars

Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.
BD Dra	54537.525±0.005	0.683	21666.	C	ST Leo	54541.565±0.002	-0.021	55689.	C
BD Dra	54540.494±0.003	0.707	21671.	C	ST Leo	54586.496±0.002	-0.020	55783.	C
BD Dra	54570.551±0.004	0.722	21722.	C	SZ Leo	54473.595±0.002	0.429	16863.	C
BD Dra	54573.498±0.002	0.724	21727.	C	SZ Leo	54523.784±0.002	0.416	16957.	LS
BD Dra	54576.440±0.004	0.721	21732.	C	AX Leo	54472.606±0.005	-0.031	40213.	C
BD Dra	54609.381±0.005	0.675	21788.	C	AX Leo	54512.575±0.005	-0.038	40268.	C
BK Dra	54630.468±0.002	-0.156	49161.	C	AX Leo	54550.375±0.005	-0.033	40320.	C
BK Dra	54646.453±0.002	-0.157	49188.	C	AX Leo	54558.362±0.003	-0.041	40331.	C
BT Dra	54510.580±0.005	-0.009	40389.	C	V LMi	54548.406±0.003	0.035	64381.	C
BT Dra	54569.440±0.002	-0.017	40489.	C	V LMi	54579.405±0.002	0.031	64438.	C
BT Dra	54573.560±0.004	-0.017	40496.	C	U Lep	54471.656±0.003	0.044	22562.	LS
RR Gem	54503.434±0.002	-0.382	33089.	C	VY Lib	54593.784±0.002	-0.031	25189.	LS
SZ Gem	54502.403±0.003	-0.055	54493.	C	TT Lyn	54499.672±0.005	-0.035	29875.	C
SZ Gem	54521.446±0.002	-0.055	54531.	C	TT Lyn	54528.347±0.004	-0.037	29923.	C
SZ Gem	54527.458±0.002	-0.057	54543.	C	TT Lyn	54547.466±0.003	-0.036	29955.	C
GI Gem	54499.514±0.002	0.069	55746.	C	TT Lyn	54550.452±0.003	-0.037	29960.	C
GI Gem	54529.410±0.002	0.069	55815.	C	TW Lyn	54502.626±0.003	0.054	19674.	C
VX Her	54555.579±0.004	-0.417	72041.	C	TW Lyn	54520.453±0.002	0.052	19711.	C
VX Her	54556.490±0.005	-0.417	72043.	C	TW Lyn	54547.443±0.004	0.058	19767.	C
VX Her	54638.453±0.002	-0.421	72223.	C	RZ Lyr	54579.494±0.002	-0.014	26203.	C
VZ Her	54542.543±0.002	0.065	40319.	C	RZ Lyr	54582.564±0.004	-0.011	26209.	C
VZ Her	54576.450±0.002	0.067	40396.	C	RZ Lyr	54600.459±0.002	-0.010	26244.	C
VZ Her	54579.532±0.002	0.066	40403.	C	RZ Lyr	54644.439±0.002	0.003	26330.	C
VZ Her	54598.466±0.003	0.066	40446.	C	AW Lyr	54584.514±0.005	0.010	58806.	C
VZ Her	54613.437±0.002	0.066	40480.	C	CN Lyr	54608.417±0.004	0.021	24605.	C
VZ Her	54646.461±0.003	0.065	40555.	C	CN Lyr	54638.445±0.007	0.018	24678.	C
AR Her	54541.512±0.003	-1.235	27846.	C	CN Lyr	54645.441±0.003	0.021	24695.	C
AR Her	54644.427±0.003	-1.256	28065.	C	IO Lyr	54586.579±0.004	-0.032	25935.	C
BD Her	54642.454±0.003	0.065	46453.	C	IO Lyr	54600.433±0.003	-0.029	25959.	C
DL Her	54586.503±0.004	0.041	27683.	C	IO Lyr	54608.508±0.005	-0.033	25973.	C
V542 Her	54555.546±0.006	0.128	24715.	C	IO Lyr	54630.440±0.003	-0.032	26011.	C
V593 Her	54638.463±0.005	-0.114	29935.	C	IO Lyr	54645.444±0.002	-0.033	26037.	C
V650 Her	54638.469±0.003	0.025	29283.	C	MW Lyr	53909.422±0.002	0.132	44911.	C
SV Hya	54626.563±0.003	0.102	31989.	LS	MW Lyr	53911.401±0.002	0.122	44916.	C
SZ Hya	54503.485±0.003	-0.192	25732.	C	MW Lyr	53922.512±0.002	0.093	44944.	C
UU Hya	54473.645±0.002	0.026	28623.	C	MW Lyr	53926.512±0.002	0.115	44954.	C
UU Hya	54507.690±0.002	0.019	28688.	LS	MW Lyr	53932.480±0.005	0.115	44969.	C
WZ Hya	54509.700±0.002	-0.001	27677.	LS	MW Lyr	53936.440±0.003	0.096	44979.	C
BI Hya	54512.663±0.002	0.227	50547.	LS	MW Lyr	53942.421±0.002	0.110	44994.	C
DD Hya	54472.574±0.003	-0.154	25464.	C	MW Lyr	53944.410±0.002	0.109	44999.	C
DD Hya	54501.683±0.002	-0.148	25522.	LS	MW Lyr	53985.356±0.005	0.077	45102.	C
DD Hya	54506.695±0.002	-0.154	25532.	LS	V340 Lyr	54582.612±0.005	-0.030	42221.	C
IK Hya	54506.744±0.005	-0.016	24685.	LS	RV Oct	54588.691±0.004	0.128	69108.	LS
IK Hya	54618.562±0.005	0.002	24857.	LS	RV Oct	54608.678±0.002	0.124	69143.	LS
GO Hya	54499.756±0.005	-0.077	45331.	LS	RV Oct	54627.530±0.003	0.128	69176.	LS
GO Hya	54521.393±0.005	-0.079	45365.	C	SS Oct	54627.831±0.003	-0.046	42789.	LS
V Ind	54616.776±0.004	0.347	30230.	LS	SS Oct	54642.750±0.002	-0.051	42813.	LS
V Ind	54626.850±0.003	0.350	30251.	LS	UV Oct	54588.783±0.005	-0.145	37338.	LS
RR Leo	54576.370±0.002	0.089	24936.	C	UV Oct	54589.869±0.003	-0.145	37340.	LS
RX Leo	54529.487±0.007	0.091	27889.	C	UV Oct	54627.859±0.003	-0.138	37410.	LS
SS Leo	54501.779±0.004	-0.052	20309.	LS	UV Oct	54630.571±0.004	-0.139	37415.	LS
SS Leo	54523.695±0.003	-0.058	20344.	LS	V445 Oph	54586.776±0.003	0.028	68115.	LS
SS Leo	54554.388±0.003	-0.056	20393.	C	V445 Oph	54594.711±0.003	0.022	68135.	LS
SS Leo	54569.419±0.002	-0.057	20417.	C	V445 Oph	54611.787±0.004	0.026	68178.	LS
SS Leo	54579.441±0.003	-0.057	20433.	C	V445 Oph	54641.558±0.002	0.021	68253.	LS
ST Leo	54474.654±0.005	-0.014	55549.	C	V445 Oph	54643.542±0.003	0.020	68258.	LS

Table 1 (cont.): maxima of RR Lyrae stars

Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.
V452 Oph	54643.438±0.002	0.007	32281.	C	RV UMa	54558.520±0.002	0.113	20260.	C
V455 Oph	54613.442±0.004	-0.254	28156.	C	RV UMa	54573.499±0.002	0.114	20292.	C
V455 Oph	54642.483±0.003	-0.263	28220.	C	RV UMa	54640.433±0.002	0.116	20435.	C
WY Pav	54585.794±0.006	0.065	47092.	LS	TU UMa	54539.510±0.002	-0.029	20995.	C
WY Pav	54595.798±0.003	0.063	47109.	LS	TU UMa	54553.456±0.003	-0.025	21020.	C
WY Pav	54598.744±0.005	0.066	47114.	LS	TU UMa	54558.472±0.002	-0.028	21029.	C
WY Pav	54624.646±0.005	0.070	47158.	LS	AB UMa	54473.493±0.016	0.125	30431.	C
WY Pav	54641.710±0.003	0.066	47187.	LS	AB UMa	54512.464±0.011	0.124	30496.	C
BN Pav	54594.864±0.003	-0.057	46297.	LS	AB UMa	54548.428±0.011	0.113	30556.	C
BN Pav	54598.834±0.002	-0.058	46304.	LS	AB UMa	54578.413±0.006	0.119	30606.	C
BN Pav	54640.801±0.002	-0.061	46378.	LS	AB UMa	54581.401±0.004	0.109	30611.	C
XX Pup	54478.790±0.003	0.467	24566.	LS	EX UMa	54473.364±0.006	0.031	10059.	C
XX Pup	54503.616±0.003	0.468	24614.	LS	EX UMa	54518.413±0.005	0.025	10142.	C
BB Pup	54472.778±0.002	0.112	32592.	LS	EX UMa	54557.502±0.004	0.030	10214.	C
BB Pup	54476.624±0.002	0.114	32600.	LS	AF Vel	54599.595±0.003	0.300	24966.	LS
HH Pup	54480.610±0.003	0.011	40897.	LS	FS Vel	54597.606±0.002	-0.143	31609.	LS
HH Pup	54514.607±0.003	0.013	40984.	LS	FS Vel	54606.648±0.004	-0.140	31628.	LS
HH Pup	54521.638±0.003	0.010	41002.	LS	ST Vir	54554.586±0.002	0.012	33635.	C
HH Pup	54523.592±0.002	0.011	41007.	LS	ST Vir	54571.426±0.002	0.008	33676.	C
V440 Sgr	54605.828±0.004	0.094	27428.	LS	ST Vir	54582.523±0.002	0.013	33703.	C
V440 Sgr	54625.876±0.003	0.088	27470.	LS	ST Vir	54588.687±0.002	0.014	33718.	LS
V675 Sgr	54588.865±0.005	0.071	40794.	LS	ST Vir	54595.666±0.002	0.009	33735.	LS
V675 Sgr	54597.854±0.005	0.068	40808.	LS	ST Vir	54609.640±0.002	0.015	33769.	LS
V675 Sgr	54599.788±0.005	0.075	40811.	LS	ST Vir	54625.652±0.003	0.005	33808.	LS
V675 Sgr	54626.759±0.003	0.070	40853.	LS	UU Vir	54512.794±0.003	-0.007	26735.	LS
V675 Sgr	54642.817±0.003	0.071	40878.	LS	UU Vir	54529.439±0.002	-0.007	26770.	C
V1645 Sgr	54599.788±0.002	-0.024	36838.	LS	UU Vir	54557.503±0.003	-0.005	26829.	C
V1645 Sgr	54625.773±0.003	-0.022	36885.	LS	UU Vir	54568.442±0.004	-0.005	26852.	C
V494 Sco	54595.725±0.005	-0.187	31520.	LS	UU Vir	54595.554±0.005	-0.003	26909.	LS
V494 Sco	54618.793±0.004	-0.195	31574.	LS	UV Vir	54499.549±0.005	0.023	24710.	C
V494 Sco	54621.790±0.003	-0.189	31581.	LS	UV Vir	54507.748±0.003	0.003	24724.	LS
V690 Sco	54586.854±0.002	-0.018	25981.	LS	UV Vir	54527.717±0.005	0.011	24758.	LS
V690 Sco	54587.840±0.003	-0.016	25983.	LS	UV Vir	54586.432±0.003	0.018	24858.	C
V690 Sco	54589.809±0.003	-0.016	25987.	LS	UV Vir	54597.582±0.003	0.013	24877.	LS
V690 Sco	54617.865±0.002	-0.019	26044.	LS	UV Vir	54617.537±0.005	0.007	24911.	LS
VY Ser	54555.550±0.005	0.049	32671.	C	AF Vir	54585.704±0.003	-0.120	29461.	LS
VY Ser	54592.689±0.009	0.055	32723.	LS	AF Vir	54609.403±0.003	-0.126	29510.	C
VY Ser	54612.678±0.015	0.050	32751.	LS	AF Vir	54616.659±0.003	-0.126	29525.	LS
AN Ser	54637.511±0.003	0.001	76481.	C	AF Vir	54617.625±0.003	-0.128	29527.	LS
AT Ser	54640.711±0.003	0.039	17202.	LS	AS Vir	54585.614±0.002	0.133	27882.	LS
AV Ser	54572.597±0.003	0.137	53797.	C	AS Vir	54611.607±0.003	0.115	27929.	LS
AV Ser	54587.717±0.005	0.142	53828.	LS	AT Vir	54538.479±0.003	-0.273	28263.	C
AV Ser	54602.822±0.002	0.133	53859.	LS	AT Vir	54567.397±0.004	-0.274	28318.	C
RU Sex [4]	54510.711±0.009	0.047	33961.	LS	AT Vir	54611.558±0.004	-0.280	28402.	LS
RU Sex [4]	54522.623±0.005	0.051	33995.	LS	AV Vir	54512.577±0.009	0.023	19854.	C
RV Sex	54498.707±0.005	0.056	49379.	LS	AV Vir	54541.478±0.006	0.020	19898.	C
RW TrA	54588.884±0.003	-0.170	35022.	LS	AV Vir	54568.415±0.008	0.023	19939.	C
RW TrA	54620.681±0.005	-0.167	35107.	LS	AV Vir	54594.689±0.005	0.021	19979.	LS
RW TrA	54628.534±0.002	-0.169	35128.	LS	AV Vir	54625.564±0.003	0.021	20026.	LS
RV UMa	54504.693±0.005	0.113	20145.	C	BB Vir	54569.465±0.002	0.260	31746.	C
RV UMa	54542.608±0.006	0.115	20226.	C	BB Vir	54598.673±0.003	0.260	31808.	LS
RV UMa	54553.373±0.004	0.115	20249.	C	BN Vul	54641.439±0.002	0.068	15335.	C

* C = Calern, LS = La Silla
1 Boninsegna (1990)
2 Baldwin, M.E., Samolyk, G. (2003)
3 Agerer, F., Moschner, W. (1996)
4 Williams, D.B. (1993)

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MAXIMA OF RR LYR STARS FROM AAVSO INTERNATIONAL DATABASE

LE BORGNE, J. F.[1,2]; VANDENBROERE, J.[1]; HENDEN, A. A.[3]; BUTTERWORTH[3], N.; DVORAK, S.[3]

[1] GEOS (Groupe Européen d'Observations Stellaires), 23 Parc de Levesville, 28300 Bailleau l'Evêque, France

[2] LATT, Université de Toulouse, CNRS, Toulouse, France

[3] AAVSO (American Association of Variable Star Observers), 49 Bay State Rd., Cambridge, MA 02138, USA

We present here a list of light maxima of RR Lyrae stars of ab and c types extracted from AAVSO International Database (`http://www.aavso.org/`, Henden, 2007). We have extracted the measurements of RR Lyrae stars made with CCDs and selected the time series which allow the determination of maximum times with an accuracy better than 0.005 day and which have not been used and published for such a purpose yet. These unpublished times of maximum were determined in order to supply the GEOS RR Lyr database (`http://dbrr.ast.obs-mip.fr`, Le Borgne et al., 2007).

The selected data were obtained by 20 observers (Table 1) who use telescopes of diameter from 20 to 40 cm. The time series contain from about 30 to 300 measurements obtained during a time interval from 2 to 6 hours. The present list contains 479 maxima observed with V, B, R or I filters between JD 2452654 and 2454452 (Table 2). Most of the measurements have been done through V filter. In Table 2, the filter is indicated in the last column when different from V. Some maxima have been obtained with more than 1 filter: the times of maximum were computed separately for each filter but the mean value is given since the differences are within errors in all cases. Only 3 maxima were obtained with no filter. The columns in Table 2 are self explanatory. The observers are identified by their AAVSO acronyms which identifies them in Table 1. The times of maximum are determined by fitting a polynomial function on the data points. $O-C$s are computed with GCVS elements (Kholopov et al., 1985), when available. Note that the cycle number 'E' takes into account the shifts induced by the elements when the period of the elements is very different from the actual one, the absolute value of $O-C$ becoming then greater than 1 period. The uncertainty on the times of maximum depends on individual measurement uncertainties, the time sampling and the shape of the light curve; the sharp maximum of an RRab star is determined with a better accuracy than the flat one of an RRc though the period of an RRc is shorter. The typical uncertainty is about 0.002 day (~3 min). As noted above, the maxima of RRc stars are usually flat and may be even double. In this last case, we have measured the first occurring maximum. When relevant, this is noted as remarks in the last column of Table 2.

Acknowledgments

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Table 1: Observers

Observer	Number of maxima		Observer	Number of maxima	
M. Banfi	5	BVN	M. A. Nicholas	1	NMI
N. Butterworth	142	BIW	R. Papini	4	PCC
G. Di Scala	11	DSI	V. Petriew	8	PVA
S. Dvorak	291	DKS	H. Pulley	1	PHA
G. Hagen	1	HGH	W. Rauscher	1	RWA
R. Huziak	5	HUZ	C. W. Robertson	10	RCW
G. Klingenberg	2	KGE	D. R. Starkey	1	SDB
A. Marchini	2	MXI	D. Trowbridge	1	TDW
M. P. Nicholson	1	NMR	J. Waller	4	WAJ

Table 2: maxima of RR Lyrae stars

Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.	
XX And	54126.579±0.003	0.219	20808	DKS	
ZZ And	53709.568±0.003	0.022	52082	DKS	
AC And	54023.423±0.014	-0.220	7766	PCC	
AC And	54024.561±0.008	0.207	7767	PCC	
AC And	54056.576±0.004	0.216	7812	DKS	
AC And	54058.700±0.007	0.206	7815	DKS	
AC And	54295.495±0.004	0.158	8148	PCC	
AC And	54308.537±0.009	-0.313	8167	BVN	
AC And	54308.540±0.008	-0.310	8167	MXI	
AC And	54316.490±0.013	-0.184	8178	MXI	
AT And	53338.683±0.003	-0.009	17823	DKS	
AT And	54029.634±0.004	-0.003	18943	DKS	
AT And	54063.561±0.004	-0.006	18998	DKS	
AT And	54278.865±0.006	-0.005	19347	DKS	
CI And	53731.648±0.003	0.091	37162	DKS	
CI And	54008.917±0.002	0.101	37734	DKS	
CI And	54033.635±0.003	0.098	37785	DKS	
CI And	54044.781±0.003	0.096	37808	DKS	
CI And	54078.710±0.002	0.094	37878	DKS	
CI And	54129.610±0.003	0.099	37983	DKS	
DR And	53697.708±0.002	-0.007	29261	DKS	
DR And	53745.571±0.003	-0.009	29346	DKS	
DR And	53754.583±0.002	-0.007	29362	DKS	
DR And	53763.592±0.003	-0.008	29378	DKS	
DR And	54006.843±0.004	-0.024	29810	DKS	
DR And	54028.811±0.002	-0.018	29849	DKS	
DR And	54066.532±0.004	-0.025	29916	DKS	
DR And	54075.533±0.004	-0.034	29932	DKS	
SW Aqr	52893.026±0.002	-0.002	60517	BIW	
SW Aqr	53265.981±0.003	-0.001	61329	BIW	
SW Aqr	53672.004±0.002	-0.002	62213	BIW	
SW Aqr	54360.041±0.002	-0.001	63711	BIW	
SX Aqr	53668.541±0.002	-0.104	25895	DKS	
TZ Aqr	52898.040±0.003	0.007	26872	BIW	
TZ Aqr	53640.029±0.004	0.014	28171	BIW	
TZ Aqr	54037.577±0.003	0.011	28867	DKS	
YZ Aqr	52896.037±0.003	0.043	31764	BIW	
YZ Aqr	53245.960±0.004	0.041	32398	BIW	
AA Aqr	52903.972±0.003	-0.099	52810	BIW	
AA Aqr	53261.992±0.005	-0.107	53398	BIW	
AA Aqr	53687.605±0.002	-0.107	54097	DKS	
BO Aqr	52895.002±0.005	0.112	16244	BIW	
BO Aqr	53267.001±0.003	0.117	16780	BIW	
BO Aqr	54018.643±0.003	0.137	17863	DKS	
BR Aqr	52915.967±0.003	-0.137	31709	BIW	
BR Aqr	53273.034±0.002	-0.142	32450	BIW	
BR Aqr	53646.002±0.001	-0.148	33224	BIW	
BR Aqr	53697.563±0.002	-0.149	33331	DKS	
BR Aqr	54388.567±0.002	-0.158	34765	DKS	
BR Aqr	54390.976±0.002	-0.158	34770	BIW	
BR Aqr	54415.552±0.002	-0.158	34821	DKS	
DN Aqr	52911.022±0.003	0.022	38636	BIW	
DN Aqr	53277.965±0.005	0.022	39215	BIW	
AA Aql	53661.571±0.002	0.031	81026	DKS	
S Ara	53184.979±0.003	-0.179	26628	BIW	
S Ara	53625.983±0.003	-0.212	27604	BIW	
TZ Aur	53687.904±0.002	0.011	86259	DKS	
IN Ara	53176.070±0.003	0.141	41059	BIW	
IN Ara	54338.018±0.003	0.146	42899	BIW	
MS Ara	53198.925±0.003	-0.218	48026	BIW	
BH Aur	52660.648±0.003	-0.001	21726	DKS	
BH Aur	53380.812±0.003	-0.003	23305	DKS	
BH Aur	53396.774±0.002	-0.004	23340	DKS	
BH Aur	53698.707±0.003	-0.002	24002	DKS	
BH Aur	53762.560±0.002	-0.002	24142	DKS	
BH Aur	54124.695±0.003	-0.002	24936	NMI	
RS Boo	53755.903±0.003	-0.004	31763	DKS	
RS Boo	53803.825±0.002	-0.005	31890	DKS	
RS Boo	54152.868±0.002	-0.000	32815	DKS	
RS Boo	54222.671±0.002	-0.004	33000	DKS	
RS Boo	54292.855±0.002	-0.006	33186	TDW	
ST Boo	53467.927±0.005	0.091	55097	NMR	
SW Boo	53006.910±0.003	0.232	20322	DKS	
SW Boo	53041.832±0.003	0.234	20390	DKS	
SW Boo	53474.755±0.002	0.253	21233	DKS	
SW Boo	53479.889±0.003	0.252	21243	DKS	
SW Boo	53511.729±0.003	0.253	21305	DKS	
SW Boo	53530.732±0.002	0.255	21342	DKS	
SZ Boo	53167.960±0.003	0.007	48827	BIW	
SZ Boo	53474.856±0.002	0.008	49414	DKS	
TV Boo	52654.895±0.002	0.054	89728	DKS	
TV Boo	53396.919±0.003	0.062	92102	DKS	
TV Boo	53482.875±0.003	0.064	92377	RCW	
TV Boo	53500.705±0.004	0.078	92434	RCW	
TV Boo	53510.706±0.004	0.077	92466	RCW	
TV Boo	53523.822±0.004	0.066	92508	RCW	
TV Boo	53540.706±0.004	0.072	92562	RCW	
TV Boo	53544.763±0.003	0.065	92575	RCW	[1]
TV Boo	53545.704±0.003	0.069	92578	RCW	[1]
TV Boo	54139.906±0.006	0.095	94479	DKS	[2]
TV Boo	54185.825±0.003	0.068	94626	DKS	
TV Boo	54228.680±0.002	0.102	94763	DKS	
TV Boo	54243.646±0.003	0.066	94811	DKS	
TW Boo	52817.718±0.005	-0.043	48709	WAJ	*R*
TW Boo	53073.742±0.002	-0.043	49190	DKS	
TW Boo	53469.750±0.002	-0.046	49934	DKS	
UU Boo	52658.891±0.002	0.147	36274	DKS	
UU Boo	53051.853±0.002	0.157	37134	DKS	
UU Boo	53133.645±0.002	0.160	37313	DKS	
UU Boo	53504.674±0.002	0.170	38125	DKS	
UU Boo	53810.821±0.002	0.180	38795	DKS	
UU Boo	54241.709±0.002	0.192	39738	DKS	
UY Boo	53485.664±0.006	-0.003	17900	DKS	
UY Boo	53539.697±0.003	0.010	17983	DKS	
UY Boo	54240.742±0.003	0.104	19060	DKS	
XX Boo	54172.738±0.003	0.011	42666	DKS	
AE Boo	54164.854±0.002	0.093	75507	DKS	
AE Boo	54242.637±0.008	0.098	75754	DKS	
AE Boo	54248.614±0.008	0.092	75773	DKS	
U Cae	53701.006±0.004	-0.091	46181	BIW	*BVRI*
U Cae	53740.046±0.002	-0.092	46274	BIW	
U Cae	54446.962±0.002	-0.109	47958	BIW	*VI*
U Cae	54452.001±0.002	-0.107	47970	BIW	*VI*
UY Cam	53808.421±0.010	-0.082	68316	KGE	
AH Cam	53669.839±0.005	-0.376	40519	DKS	
AH Cam	53670.936±0.001	-0.386	40522	DKS	
AH Cam	53680.895±0.002	-0.382	40549	DKS	
AH Cam	53697.881±0.002	-0.358	40595	DKS	
AH Cam	53717.780±0.006	-0.371	40649	DKS	
AH Cam	53731.792±0.003	-0.371	40687	DKS	
AH Cam	53734.727±0.002	-0.385	40695	DKS	
AH Cam	53744.693±0.002	-0.375	40722	DKS	
AH Cam	53764.605±0.002	-0.375	40776	DKS	
AH Cam	53785.631±0.004	-0.367	40833	DKS	

Table 2 (cont.): maxima of RR Lyrae stars

Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.		Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.	
AH Cam	54002.806±0.005	-0.377	41422	DKS		AN Cap	52849.050±0.005	0.112	6035	BIW	
RW Cnc	52695.839±0.003	0.183	24012	DKS		AN Cap	52854.043±0.005	0.116	6047	BIW	
RW Cnc	53102.959±0.003	0.187	24756	BIW		AN Cap	52883.991±0.004	0.127	6119	BIW	
RW Cnc	53442.772±0.003	0.189	25377	DKS		AN Cap	53226.999±0.005	0.108	6944	BIW	
RW Cnc	53450.985±0.005	0.194	25392	BIW		AN Cap	53632.045±0.005	0.175	7918	BIW	
RW Cnc	53726.794±0.003	0.215	25896	DKS		IU Car	53105.945±0.006	0.272	15479	BIW	
RW Cnc	53739.916±0.005	0.204	25920	DKS		BI Cen	53163.886±0.002	0.007	36351	BIW	
RW Cnc	53745.925±0.003	0.194	25931	DKS		V499 Cen	53161.011±0.002	0.024	23090	BIW	
RW Cnc	53761.811±0.003	0.211	25960	DKS		V674 Cen	53115.014±0.002	-0.062	37825	BIW	
RW Cnc	53767.830±0.003	0.211	25971	DKS		RR Cet	53718.661±0.002	0.004	37136	DKS	
RW Cnc	53788.615±0.004	0.202	26009	DKS		RU Cet	52931.010±0.005	0.068	22352	BIW	
RW Cnc	53802.910±0.004	0.270	26035	DKS		RU Cet	53273.996±0.005	0.081	22937	BIW	
RW Cnc	53829.662±0.004	0.209	26084	DKS		RV Cet	52968.037±0.004	0.166	22224	BIW	
RW Cnc	54075.892±0.003	0.200	26534	DKS		RV Cet	53401.947±0.005	0.187	22920	BIW	
RW Cnc	54081.920±0.003	0.209	26545	DKS		RV Cet	53673.741±0.005	0.178	23356	DKS	
RW Cnc	54087.940±0.003	0.209	26556	DKS		RX Cet	52933.028±0.006	0.133	22324	BIW	
RW Cnc	54126.797±0.003	0.215	26627	DKS		RX Cet	53286.973±0.002	0.110	22941	BIW	
SS Cnc	54100.692±0.002	0.048	84451	DKS		RZ Cet	52969.921±0.003	-0.112	37334	BIW	
SS Cnc	54150.649±0.002	0.047	84587	DKS		RZ Cet	53380.959±0.003	-0.116	38139	BIW	
TT Cnc	53000.700±0.003	0.084	23172	DKS		RZ Cet	54041.674±0.002	-0.131	39433	DKS	
TT Cnc	53455.978±0.003	0.094	23980	BIW		UU Cet	52930.064±0.004	-0.119	19340	BIW	
TT Cnc	53479.646±0.002	0.098	24022	DKS		UU Cet	53264.011±0.004	-0.122	19891	BIW	
TT Cnc	53698.813±0.003	0.083	24411	DKS		RY Col	53097.960±0.003	-0.084	39234	BIW	
TT Cnc	53707.835±0.002	0.090	24427	DKS		RY Com	54151.821±0.002	-0.007	31033	DKS	
TT Cnc	53734.897±0.003	0.106	24475	DKS		WW CrA	53193.962±0.003	-0.065	39156	BIW	
TT Cnc	53742.782±0.002	0.102	24489	DKS		RV CrB	54177.917±0.003	-0.099	67768	DKS	1
TT Cnc	53755.735±0.002	0.096	24512	DKS		RV CrB	54188.859±0.002	-0.101	67801	DKS	1
TT Cnc	53764.739±0.003	0.085	24528	DKS		RV CrB	54246.892±0.003	-0.100	67976	DKS	
TT Cnc	53772.620±0.002	0.078	24542	DKS		TV CrB	53486.656±0.004	0.029	37406	DKS	
TT Cnc	53772.621±0.002	0.079	24542	DKS		SW Cru	53091.035±0.004	0.057	82557	BIW	
TT Cnc	53794.604±0.003	0.087	24581	DKS		SW Cru	53835.098±0.002	0.060	84827	DSI	
TT Cnc	53803.624±0.003	0.092	24597	DKS		SW Cru	54171.074±0.002	0.061	85852	DSI	*BVRI*
TT Cnc	54049.842±0.003	0.083	25034	DKS		SW Cru	54175.007±0.002	0.061	85864	DSI	*BVRI*
TT Cnc	54054.918±0.007	0.088	25043	DKS		SW Cru	54214.012±0.003	0.060	85983	BIW	
TT Cnc	54058.865±0.003	0.091	25050	DKS		RW Dra	52786.882±0.003	0.179	30275	DKS	
TT Cnc	54167.615±0.003	0.095	25243	DKS		RW Dra	53504.822±0.002	0.150	31896	DKS	
TT Cnc	54198.607±0.000	0.097	25298	DKS		RW Dra	53513.682±0.003	0.152	31916	DKS	
AS Cnc	54129.910±0.002	0.340	24176	DKS		RW Dra	53535.861±0.002	0.185	31966	DKS	
W CVn	54155.831±0.003	-0.131	59362	DKS		RW Dra	53822.879±0.002	0.193	32614	DKS	
W CVn	54176.797±0.003	-0.131	59400	DKS		RW Dra	53970.776±0.005	0.156	32948	PHA	
Z CVn	53519.626±0.003	0.245	22312	DKS		XZ Dra	52753.847±0.004	-0.062	22719	DKS	
Z CVn	53726.904±0.002	0.263	22629	DKS		RX Eri	53007.963±0.002	-0.008	53326	BIW	
Z CVn	53743.892±0.005	0.252	22655	DKS		RX Eri	53359.722±0.003	-0.009	53925	DKS	
Z CVn	53762.853±0.004	0.252	22684	DKS		RX Eri	53409.054±0.004	-0.006	54009	BIW	
Z CVn	53794.897±0.003	0.259	22733	DKS		RX Eri	53739.670±0.002	-0.010	54572	DKS	
Z CVn	53813.858±0.004	0.259	22762	DKS		BB Eri	53056.949±0.003	0.194	23684	DKS	
Z CVn	53830.864±0.004	0.266	22788	DKS		BB Eri	53396.618±0.003	0.204	24280	DKS	
Z CVn	54197.687±0.003	0.296	23349	DKS		BB Eri	53415.995±0.004	0.204	24314	BIW	
RX CVn	54208.795±0.003	-0.040	27115	DKS		RX For	53032.606±0.003	-0.018	22101	DKS	
SS CVn	53043.949±0.002	0.166	28047	DKS		RX For	53373.064±0.003	-0.029	22671	BIW	
AA CMi	54116.612±0.003	0.055	36824	DKS		SS For	52964.991±0.003	-0.146	28856	BIW	
AL CMi	54141.678±0.002	0.437	31869	DKS		SS For	53391.563±0.002	-0.141	29717	DKS	
RV Cap	52868.974±0.003	0.023	42403	BIW		SS For	53398.995±0.003	-0.140	29732	BIW	
RV Cap	53228.961±0.003	0.024	43207	BIW		SS For	53400.975±0.002	-0.142	29736	BIW	
RV Cap	53596.970±0.003	-0.013	44029	BIW		SX For	53680.974±0.005	0.038	23991	BIW	
RV Cap	53613.981±0.002	-0.016	44067	BIW		SX For	53683.998±0.005	0.036	23996	BIW	
RV Cap	54003.536±0.003	0.001	44937	DKS		RR Gem	52659.608±0.002	-0.289	28448	WAJ	
VW Cap	52860.003±0.005	0.106	87349	BIW	1	RR Gem	52669.545±0.004	-0.285	28473	WAJ	
VW Cap	53239.960±0.005	0.123	88558	BIW	1	RR Gem	52674.706±0.003	-0.289	28486	DKS	
VW Cap	53596.033±0.005	0.139	89691	BIW	1	RR Gem	52682.652±0.002	-0.289	28506	DKS	
YZ Cap	53221.990±0.005	0.034	34712	BIW	1	RR Gem	52707.685±0.003	-0.287	28569	WAJ	
YZ Cap	53639.013±0.005	0.036	36237	BIW	1	RR Gem	52742.645±0.003	-0.290	28657	WAJ	

Table 2 (cont.): maxima of RR Lyrae stars

Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.	
RR Gem	53073.588±0.002	-0.306	29490	DKS	
RR Gem	53323.878±0.001	-0.322	30120	DKS	
RR Gem	53352.879±0.001	-0.325	30193	DKS	
RR Gem	53429.957±0.002	-0.325	30387	BIW	
RR Gem	53467.697±0.002	-0.330	30482	PVA	3
RR Gem	53482.396±0.002	-0.331	30519	HGH	
RR Gem	53687.800±0.002	-0.337	31036	DKS	
RR Gem	53730.706±0.002	-0.341	31144	DKS	
RR Gem	54138.719±0.001	-0.365	32171	DKS	
RR Gem	54169.710±0.002	-0.364	32249	DKS	
RR Gem	54175.667±0.002	-0.367	32264	DKS	
SZ Gem	54138.579±0.002	-0.054	53767	DKS	
GI Gem	53705.773±0.002	0.070	53914	DKS	
GI Gem	54089.646±0.002	0.069	54800	DKS	
GI Gem	54148.570±0.002	0.070	54936	DKS	
RR GRU	53609.065±0.003			BIW	
RR GRU	54351.022±0.003			BIW	
SS Gru	53631.019±0.003	0.163	51661	BIW	
TW Her	52732.814±0.002	-0.009	78047	DKS	
TW Her	53120.826±0.001	-0.009	79018	DKS	
TW Her	53203.942±0.002	-0.010	79226	BIW	
TW Her	54275.667±0.002	-0.012	81908	DKS	
VX Her	52757.819±0.001	-0.365	68093	DKS	
VX Her	53174.928±0.002	-0.378	69009	BIW	
VX Her	53509.619±0.002	-0.386	69744	DKS	
VX Her	54249.577±0.002	-0.409	71369	DKS	
AR Her	52744.715±0.005	-1.585	24024	DKS	
AR Her	53489.693±0.005	-1.601	25609	DKS	
AR Her	53497.668±0.002	-1.617	25626	DKS	
AR Her	53505.635±0.005	-1.640	25643	DKS	
AR Her	53510.783±0.005	-1.192	25653	DKS	
AR Her	53519.764±0.003	-1.612	25673	DKS	
AR Her	53536.653±0.004	-1.644	25709	DKS	
AR Her	53817.728±0.002	-1.176	26306	PVA	
AR Her	54245.378±0.004	-1.251	27216	BVN	
AR Her	54260.462±0.003	-1.208	27248	BVN	
AR Her	54276.394±0.006	-1.257	27282	BVN	
AR Her	54276.396±0.003	-1.255	27282	PCC	
AR Her	54300.392±0.002	-1.230	27333	BVN	
DL Her	52871.942±0.006	0.017	24785	BIW	
DL Her	53223.970±0.006	0.027	25380	BIW	
DL Her	53954.049±0.005	0.037	26614	BIW	
DL Her	54191.875±0.005	0.029	27016	DKS	
DL Her	54249.847±0.004	0.021	27114	DKS	
DL Her	54274.714±0.003	0.040	27156	DKS	
SZ Hya	52673.698±0.010	-0.139	22326	DKS	
SZ Hya	52720.949±0.005	-0.165	22414	BIW	
SZ Hya	52729.044±0.003	-0.129	22429	BIW	
SZ Hya	52736.035±0.002	-0.122	22442	BIW	
SZ Hya	52741.941±0.003	-0.126	22453	BIW	
SZ Hya	52755.908±0.003	-0.127	22479	BIW	
SZ Hya	52756.986±0.003	-0.123	22481	BIW	
SZ Hya	52758.060±0.003	-0.124	22483	BIW	
SZ Hya	52763.971±0.003	-0.123	22494	BIW	
SZ Hya	52777.884±0.004	-0.178	22520	BIW	
SZ Hya	52784.919±0.002	-0.127	22533	BIW	
SZ Hya	53055.683±0.002	-0.132	23037	DKS	
SZ Hya	53382.822±0.005	-0.172	23646	DKS	
SZ Hya	53389.839±0.002	-0.140	23659	DKS	
SZ Hya	53410.784±0.005	-0.147	23698	DKS	
SZ Hya	53427.967±0.005	-0.155	23730	BIW	
SZ Hya	53431.686±0.002	-0.197	23737	DKS	
SZ Hya	53465.043±0.002	-0.149	23799	BIW	
SZ Hya	53708.950±0.002	-0.149	24253	DKS	
SZ Hya	53784.697±0.003	-0.152	24394	DKS	
SZ Hya	54145.710±0.005	-0.165	25066	DKS	
SZ Hya	54173.646±0.002	-0.166	25118	DKS	
UU Hya	53065.993±0.003	0.008	25936	BIW	
UU Hya	53112.629±0.001	0.019	26025	DKS	
UU Hya	53421.701±0.003	0.010	26615	DKS	
UU Hya	53459.946±0.004	0.012	26688	BIW	
UU Hya	53464.658±0.002	0.009	26697	DKS	
DG Hya	53058.665±0.010	0.044	37310	DKS	
DG Hya	53069.973±0.005	0.173	37336	BIW	
DG Hya	53419.941±0.003	0.143	38150	BIW	
DH Hya	53043.806±0.003	0.051	44719	DKS	
DH Hya	53056.031±0.003	0.052	44744	BIW	
DH Hya	53377.795±0.003	0.055	45402	DKS	
DH Hya	53413.001±0.002	0.053	45474	BIW	
DH Hya	53705.916±0.001	0.057	46073	DKS	
V Ind	53647.023±0.002	-0.153	28209	BIW	
V Ind	54364.983±0.002	-0.140	29706	BIW	
RR Leo	52787.572±0.002	0.054	20982	DKS	
RR Leo	53092.942±0.002	0.059	21657	DKS	
RR Leo	53463.007±0.002	0.065	22475	BIW	
RR Leo	53735.806±0.002	0.071	23078	DKS	
SS Leo	53478.968±0.003	-0.043	18676	BIW	
ST Leo	53490.001±0.002	-0.019	53489	BIW	
SZ Leo	53440.687±0.004	-0.138	14930	DKS	
SZ Leo	53441.753±0.003	-0.141	14932	DKS	
SZ Leo	54078.893±0.002	-0.136	16125	DKS	
SZ Leo	54116.828±0.001	-0.119	16196	DKS	
SZ Leo	54148.876±0.002	-0.115	16256	DKS	
SZ Leo	54168.625±0.003	-0.126	16293	DKS	
TV Leo	52727.696±0.004	0.093	23313	DKS	
TV Leo	52737.114±0.003	0.091	23327	BIW	
TV Leo	53087.004±0.003	0.098	23847	BIW	
TV Leo	53477.932±0.003	0.099	24428	BIW	
WW Leo	53135.973±0.003	0.027	30279	BIW	
WW Leo	53366.864±0.002	0.028	30662	DKS	
WW Leo	53428.959±0.003	0.030	30765	BIW	
WW Leo	53744.852±0.003	0.032	31289	DKS	
WW Leo	53822.619±0.003	0.032	31418	DKS	
AA Leo	52764.619±0.003	-0.067	21996	DKS	
AA Leo	53503.955±0.002	-0.070	23231	BIW	
AA Leo	53718.873±0.003	-0.070	23590	DKS	
AA Leo	54154.690±0.003	-0.074	24318	DKS	
Y LMi	53784.905±0.004	-0.173	34757	DKS	
Y LMi	54165.641±0.002	-0.203	35483	DKS	
Y LMi	54185.569±0.003	-0.205	35521	DKS	
U Lep	52994.704±0.002	0.042	20022	DKS	
U Lep	53042.966±0.002	0.041	20105	BIW	
U Lep	53399.994±0.002	0.043	20719	BIW	
TT Lyn	54155.552±0.003	-0.033	29299	DKS	
TV Lyn	53806.531±0.003	0.022	53420	KGE	3
TV Lyn	54110.714±0.002	0.022	54684	DKS	
TV Lyn	54127.561±0.002	0.024	54754	DKS	1
TV Lyn	54177.617±0.002	0.024	54962	DKS	1
TW Lyn	54088.705±0.002	0.051	18815	DKS	
RR Lyr	53956.872±0.003	-0.045	19465	RCW	*VI*
RR Lyr	53984.684±0.007	-0.008	19514	RCW	*I*
RZ Lyr	53073.901±0.002	0.002	23258	DKS	
RZ Lyr	53538.623±0.002	0.004	24167	DKS	
RZ Lyr	53671.546±0.002	0.004	24427	DKS	

Table 2 (cont.): maxima of RR Lyrae stars

Variable	Maximum HJD 24...	$O-C$ (days)	E	Obs.	
RZ Lyr	53821.842±0.003	-0.005	24721	DKS	
RZ Lyr	54014.587±0.002	0.002	25098	DKS	
RZ Lyr	54269.698±0.002	0.003	25597	DKS	
RZ Lyr	54275.835±0.002	0.005	25609	DKS	
CN Lyr	53559.804±0.006	0.022	22056	DKS	
EZ Lyr	53557.654±0.002	-0.118	37397	DKS	
KS Lyr	54002.587±0.002			DKS	
Z Mic	54358.966±0.002	-0.116	21743	BIW	
CM Ori	54140.633±0.003	-0.022	43972	DKS	
V964 Ori	53668.819±0.002	-0.357	43929	DKS	
V964 Ori	53707.676±0.002	-0.358	44006	DKS	
BN Pav	54368.017±0.003	-0.035	45897	BIW	
AO Peg	54269.790±0.003	0.038	52546	DKS	
AV Peg	52909.943±0.002	0.083	23361	BIW	
AV Peg	53267.923±0.002	0.090	24278	BIW	
AV Peg	53315.549±0.001	0.090	24400	RWA	3
AV Peg	53645.031±0.002	0.096	25244	BIW	
AV Peg	53680.556±0.001	0.097	25335	DKS	
AV Peg	54020.579±0.002	0.104	26206	DKS	
AV Peg	54261.836±0.002	0.109	26824	DKS	
BH Peg	53538.832±0.004	-0.085	22112	DKS	
BH Peg	53678.553±0.004	-0.101	22330	DKS	
BH Peg	54001.622±0.004	-0.092	22834	DKS	
BH Peg	54015.710±0.003	-0.106	22856	DKS	
BH Peg	54044.542±0.003	-0.119	22901	DKS	
BT Peg	53677.588±0.003	0.079	30929	DKS	
BT Peg	54059.535±0.004	0.082	31615	DKS	
CG Peg	54023.681±0.005	-0.043	31942	DKS	
CG Peg	54248.838±0.002	-0.047	32424	DKS	
DZ Peg	53728.537±0.002	0.156	32662	DKS	
ET Peg	54034.524±0.002	-0.046	30681	DKS	
GY Peg	54054.710±0.002	-0.246	25499	DKS	
GY Peg	54100.536±0.003	-0.234	25590	DKS	
TU Per	54011.769±0.002	-0.222	25103	DKS	
TU Per	54031.806±0.002	-0.219	25136	DKS	
TU Per	54115.574±0.002	-0.227	25274	DKS	
AR Per	53661.855±0.002	0.051	62096	DKS	
AR Per	53678.876±0.003	0.050	62136	DKS	
AR Per	54089.533±0.002	0.052	63101	DKS	
ET Per	53731.558±0.002	0.064	64841	DKS	
ET Per	54014.837±0.002	0.048	65560	DKS	
FM Per	53705.655±0.006	0.007	40760	DKS	1
FM Per	53727.682±0.003	0.020	40805	DKS	
U Pic	53715.051±0.003	0.051	27360	BIW	*B*
U Pic	53715.051±0.002	0.051	27360	BIW	
U Pic	53715.931±0.003	0.051	27362	BIW	*B*
U Pic	53715.932±0.002	0.051	27362	BIW	
RU Psc	54019.652±0.006	0.014	35545	DKS	
RU Psc	54028.626±0.005	0.010	35568	DKS	
RU Psc	54064.526±0.006	-0.006	35660	DKS	
HH Pup	53737.017±0.002	0.008	38994	BIW	
V796 Sgr	53202.988±0.004	-0.059	30316	BIW	
V494 Sco	53195.939±0.002	-0.031	28244	BIW	
RU Scl	52931.728±0.003	0.355	44206	DKS	
RU Scl	53284.970±0.002	0.366	44922	BIW	
RU Scl	54016.124±0.004	0.392	46404	DSI	
RU Scl	54021.056±0.002	0.391	46414	DSI	
CS Ser	53165.956±0.002	0.012	41742	BIW	
CS Ser	53561.048±0.002	0.007	42492	BIW	
CS Ser	53567.893±0.003	0.003	42505	BIW	
CS Ser	53568.947±0.003	0.004	42507	BIW	
CS Ser	53570.001±0.003	0.004	42509	BIW	
SS Tau	53671.721±0.002	0.489	42471	DKS	
SS Tau	53734.607±0.002	0.489	42641	DKS	
SS Tau	54009.822±0.002	0.485	43385	DKS	
SS Tau	54013.891±0.003	0.484	43396	DKS	
SS Tau	54020.917±0.002	0.482	43415	DKS	
SS Tau	54023.878±0.002	0.483	43423	DKS	
SS Tau	54088.594±0.002	0.464	43598	DKS	
BI Tel	53201.144±0.007	-0.051	46834	BIW	
HH Tel	53627.980±0.002	-0.187	52389	BIW	
HH Tel	54381.007±0.002	-0.170	53951	BIW	
U Tri	54034.672±0.002	-0.040	78109	DKS	
U Tri	54050.773±0.003	-0.040	78145	DKS	
U Tri	54063.743±0.002	-0.041	78174	DKS	
UX Tri	53662.854±0.006	0.036	3061	DKS	
UX Tri	53672.641±0.003	0.018	3082	DKS	
UX Tri	53700.636±0.004	-0.001	3142	DKS	
UX Tri	53735.645±0.004	-0.010	3217	DKS	
UX Tri	54032.627±0.002	0.021	3853	DKS	
UX Tri	54038.683±0.002	0.007	3866	DKS	
YY Tuc	53644.015±0.003	-0.276	18503	BIW	
YY Tuc	54424.960±0.002	0.229	19732	BIW	
RV UMa	53223.593±0.002	0.094	17408	DKS	
RV UMa	53506.770±0.003	0.094	18013	DKS	
RV UMa	53507.705±0.005	0.093	18015	SDB	*B*
RV UMa	53762.807±0.002	0.102	18560	PVA	
RV UMa	53827.867±0.003	0.102	18699	DKS	
RV UMa	54127.899±0.002	0.108	19340	DKS	
RV UMa	54255.676±0.003	0.104	19613	DKS	
SX UMa	53480.861±0.002	0.111	27258	PVA	1 3
SX UMa	53483.932±0.002	0.111	27268	PVA	1 3
SX UMa	53492.840±0.002	0.112	27297	PVA	1 3
SX UMa	53780.935±0.002	0.131	28235	PVA	1
SX UMa	54061.040±0.002	0.145	29147	PVA	1
TU UMa	54165.880±0.001	-0.028	20325	DKS	
AB UMa	54191.679±0.004	0.113	29961	DKS	
AB UMa	54236.643±0.006	0.108	30036	DKS	
AX UMa	54140.874±0.004	0.234	16373	DKS	
AF Vel	53114.922±0.003	0.253	22151	BIW	
AN Vel	53093.959±0.002	-0.127	68769	BIW	
CD Vel	53090.911±0.002	-0.183	42494	BIW	
AE Vir	53151.980±0.003	0.086	39235	BIW	
AE Vir	53518.990±0.005	0.093	39814	BIW	
BB Vir	54256.648±0.002	-0.221	31083	DKS	
BC Vir	53499.721±0.002	0.099	59480	DKS	
FK Vul	53698.560±0.003	0.023	40599	DKS	

[1] RRc, double maximum
[2] RRc, flat maximum
[3] No filter

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LONG TERM BVR$_C$I$_C$ PHOTOMETRY OF CARBON AND SYMBIOTIC STARS IN THE DRACO DWARF GALAXY

MUNARI, U.[1]; SIVIERO, A.[1]; OCHNER, P.[2]; TOMASONI, S.[2]; MOSCHINI, F.[2]; FRIGO, A.[2]; MORETTI, S.[2]; TOMASELLI, S.[2]; BALDINELLI, L.[2]; MAITAN, A.[2]; VAGNOZZI, A.[2]; BACCI, S.[2]

[1] INAF Osservatorio Astronomico di Padova, Sede di Asiago, I-36032 Asiago (VI), Italy

[2] ANS Collaboration, c/o Osservatorio Astronomico, I-36032 Asiago (VI), Italy

The Draco dwarf galaxy (Ddg) is a satellite of the Milky Way Galaxy, characterized by low reddening ($E_{B-V} = 0.03$), low metallicity ([Fe/H] ≈ -2), high velocity dispersion ($\sigma_V = 10.5\,\mathrm{km\,sec^{-1}}$), a tidal radius of 40 arcmin (≈ 0.83 kpc), a total mass within the tidal radius of $3.5 \times 10^7 M_\odot$, and a distance modulus of $m - M = 19.3$ mag. The overall light-to-mass ratio is $M/L = 146 \pm 42$ (in solar units), indicating a strongly dark-matter dominated, bound stellar system (Odenkirchen et al. 2001).

The first three carbon stars (named C1, C2, C3) were discovered in Ddg by Aaronson et al. (1982). Since then, other three were found (cf. Kinemuchi et al. 2008, and references therein). One of the carbon stars, C1, is a symbiotic binary (Belczynski et al. 2000). It displays a rich and high ionization emission line spectrum (Aaronson et al. 1982, Munari and Buson 1994) and it is a super-soft X-ray source (Bickert et al. 1996).

An extensive search for variable stars in Ddg was carried out by Baade and Swope (1961), during which they found 260 variables. They did not notice any of the carbon stars as a variable star, in spite the mean brightness of the variables they discovered and characterized (mainly RR Lyr) was three whole magnitudes fainter than the carbon stars themselves. Should any of the carbon stars have varied by more than 0.2 mag, Baade and Swope's survey would have detected them. The issue if any of the carbon stars in Ddg is indeed variable, of very low amplitude, is still an open issue given the contradicting results reported in the literature (see Kinemuchi et al. 2008 for a partial summary).

Over the last three years we have carried out a surveillance monitoring of C1, looking for active phases of this highly interacting and energetic binary.

Our BVR_CI_C CCD photometric surveillance extended from 2006.30 to 2008.68. Together with C1, in the same field of view our CCD observations, we recorded also C2 and C3. We observed with several telescopes, all located in Italy: the 0.5 m of Museo Civico di Rovereto (Trento), the 0.5 m of Osservatorio Astronomico S. Lucia di Stroncone (Terni), the 0.4 m of Associazione Ravennate Astrofili Rheyta in Bastia (Ravenna), the 0.4 m of Osservatorio Astronomico Pizzinato (Bologna), and a 0.3 m located in Folgaria (Trento). All instruments were equipped with either Schuler, Optec, Custom Scientific or Omega standard BVR_CI_C filters. All observations were reduced and corrected for color equations using the same photometric comparison sequence calibrated around C1 by Henden and

Table 1: Median values (and errors) of our BVR_CI_C photometry of Draco C1, C2 and C3 covering the period from 2006.30 to 2008.68. Median values (and errors) from Skopal et al. (2007, coded b) and mean values (and errors) from Kinemuchi et al. (2008, coded a) are given for comparison.

	$<V>$		$<I_C>$		$<B-V>$		$<V-I_C>$		$<R_C-I_C>$		
C1	17.17	0.08	15.68	0.05	1.49	0.14	1.49	0.06	0.63	0.06	
C2	17.36	0.06	16.03	0.05	1.59	0.25	1.31	0.07	0.63	0.05	
C3	17.53	0.09	16.23	0.08	1.47	0.29	1.31	0.10	0.59	0.06	
C1	17.15	0.08	15.66	0.04			1.49	0.09			a
C2	17.30	0.05	15.99	0.04			1.31	0.06			a
C1	17.19	0.05	15.82	0.07	1.45	0.03	1.41	0.05	0.65	0.02	b

Munari (2000). A total 121 VR_CI_C runs were collected in separate nights, 33 of which included also observations in the B band.

Even if no outburst or bright phase of C1 has been recorded, the collected data allow to put constraints on the variability of C1, C2 and C3. Table 1 lists the median values of our observations, and for comparison the median values obtained by Skopal et al. (2007), who monitored C1 from 2003.9 to 2007.2, and by Kinemuchi et al. (2008), who monitored C1 and C2 from 1993 to 1996. The values in Table 1 agree well within the errors, indicating the absence of any long term trend affecting C1 and C2 over the last 15 years.

The program stars were faint, our telescopes of limited diameter and the observations were carried out in surveillance, short-exposure mode. Therefore, the error affecting the single photometric point is significant. To obtain meaningful light-curves is necessary to bin the data. A bi-monthly binning proved to be the most convenient in term of noise suppression and preservation of light-curve details. Such a bi-monthly binning provides the following results for the three program stars.

C3 is not variable, at least not with an amplitude larger than 0.05 mag.

C2 is a border-line case. The amplitude of any actual variability should not exceed 0.1 mag. Shetrone et al. (2001) listed C2 as a definite photometric variable, but they did not provide supporting details. An amplitude around 0.2 mag is listed for C2 by Kinemuchi et al. (2008), again with not details.

C1 is more confidently a true variable, as illustrated by Figure 1 which could also support feeble hints of an anti-correlation of brightness and color (C1 redder when fainter, bluer when brighter), as observed in pulsating stars. The amplitude is ≈ 0.2 mag, with a possible periodicity of the order of one year. Amplitude and period would be appropriate for either a reflection effect or an ellipsoidal distortion of the carbon star. It is worth noticing that Shetrone et al. (2001) asserted C1 to be not variable, while it is definitively a variable according to Kinemuchi et al. (2008).

The reflection effect is quite common in symbiotic binaries and it is caused by the very hot and luminous white dwarf illuminating the facing side of the cool giant companion. In this case the period of the reflection effect is also the orbital period. The ellipsoidal distortion of the mass donor cool giant is also frequently observed in symbiotic binaries, where the high mass transfer rate necessary to sustain the stable H-burning conditions on the white dwarf, requires Roche lobe filling conditions. In this case, the orbital period is twice longer than the period of photometric variability. Given its super-soft X-ray nature, both a reflection effect and the Roche lobe filling are highly probable to occur in C1, and the light-curve in Figure 1 could result from the combination of the two. The high-resolution spectroscopic observations by Munari (1991) proved C1 to be variable in both radial velocity and emission line profiles. Clearly, C1 is worth further observations, which we plan to carry out.

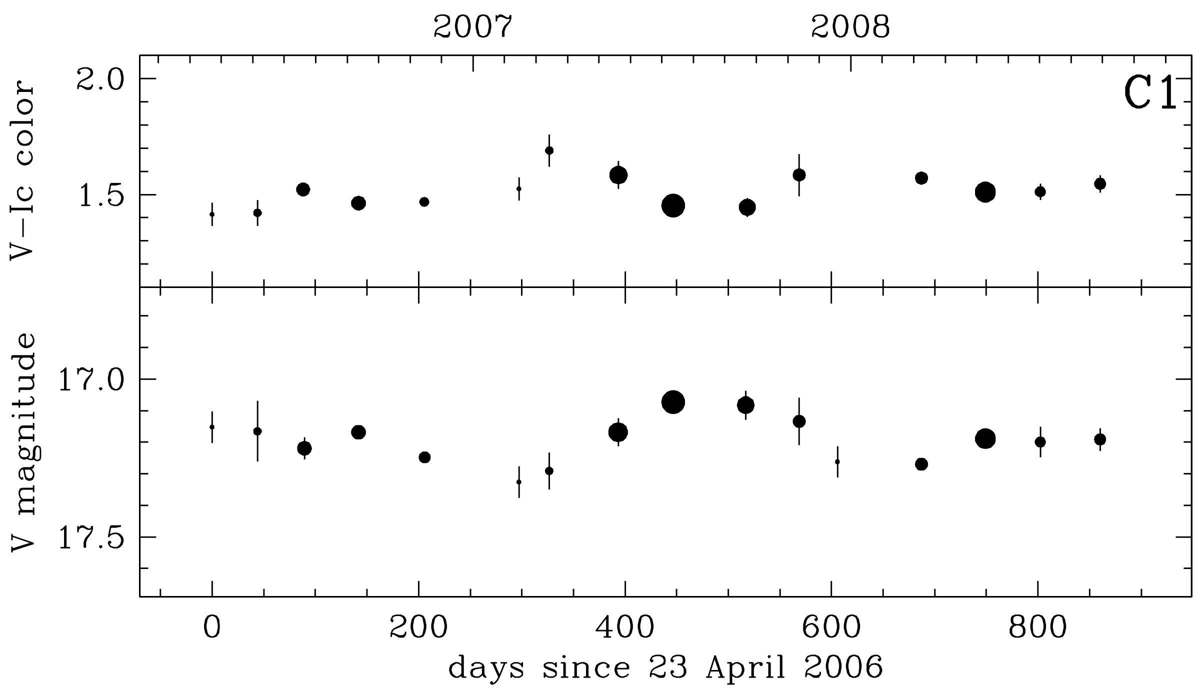

Figure 1. V, $V - I_C$ light-curve of carbon symbiotic binary C1 from our observations, binned into bi-monthly means. The size of the dots is proportional to the number of observations in that bin. The error bars are the errors of the mean.

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SHORT-PERIOD OSCILLATIONS IN THE ALGOL-TYPE SYSTEMS II: NEWLY DISCOVERED VARIABLE GSC 3889-0202

DIMITROV, D.; KRAICHEVA, Z.; POPOV, V.

Institute of Astronomy, BAS, Tsarigradsko Shossee 72, 1784 Sofia, Bulgaria,
e-mail: dinko@astro.bas.bg; zk@astro.bas.bg; vpopov@astro.bas.bg

GSC 3889-0202 was discovered as a new eclipsing binary in our search for new variables in the NSVS database (Wozniak et al. 2004). According to the NSVS data the star was classified as Algol-type binary with period $P \simeq 2.71$ days, amplitude of primary minimum $A_R > 0.35$ mag, and the magnitude in maximum R'max $\simeq 10.6$ mag.

The CCD photometry (in BVR bands) of GSC 3889-0202 was carried out with the 60cm Cassegrain telescope at NAO Rozhen, equipped with the CCD camera FLI PL09000 (3056x3056, 12μ pixel), and Bessell (1990) standard $UBVRI$ filters. The standard IRAF procedures were used for the reduction of the photometric data. There are no suitable standards in the field (Fig. 1) and we apply the photometry method of Everett and Howell (2001). An ensemble standard star (COMP) was created using four stars (Table 1) with $\sigma < 0.013$ mag in all R band observations.

The phased light curves, based on the NSVS data and Rozhen observations, are shown on Fig. 2. The light curves for several nights, acquired in the BVR passbands are shown in Fig. 4 and Fig. 5. Short-period oscillations with a peak-to-peak amplitude of up to 0.045 mag in R (Table 2), 0.05 mag in V, and 0.07 mag in B (also present at the primary and the secondary minima) were detected. A preliminary periodogram analysis (Fig. 6) of the data shows a main periodicity of about 22.69 c/d ($\sim$ 63.47 minutes).

Spectral observations of GSC 3889-0202 were obtained with the Coudé spectrograph (resolution of 0.19 Å/pixel) of the 2m RC telescope at NAO Rozhen (Table 3). The spectral domain covered three regions around H_α, H_β, and MgII 4481 lines (Fig. 3). The data reduction of the spectra was made with the standard IRAF procedures. The corresponding radial velocities were measured by the cross-correlation technique using synthetic spectrum, calculated with the programme SPECTRUM (Gray & Corbally 1994) and a grid of LTE atmosphere models for a solar-type chemical composition (Castelli & Kurucz 2003), as a template spectrum. The physical parameters of the primary component were estimated by comparing the synthetic and the observed spectra. The parameters of the secondary were computed with the PHOEBE software (Prša & Zwitter 2005). The spectral types of the two components were determined using Gray & Corbally (1994) calibration (Table 4). The amplitude of the RV curve was estimated to be $A_{RV} \geq 60$ kms^{-1}, and the γ velocity is -16.2 kms^{-1} (Fig. 2).

The new ephemeris were computed using both Rozhen and NSVS data:

$$HJD(\mathrm{MinI}) = 2454620.151(\pm 0.004) + 2.71066(\pm 0.00008)E \quad (1)$$

Acknowledgements This study made use of the SIMBAD, ADS, and VSX databases, and GCVS catalogue.

Table 1. Data for the variable, comparison, and check stars used in the CCD photometry

ID	Name	RA (J2000)	DEC (J2000)	$B_T - V_T$
VAR	GSC 3889-0202	$17^h\ 46^m\ 30.43^s$	$+53°\ 11'\ 57.8''$	0.244
C1	GSC 3902-0709	$17^h\ 46^m\ 50.63^s$	$+53°\ 12'\ 32.8''$	1.158
C2	GSC 3889-0120	$17^h\ 46^m\ 24.77^s$	$+53°\ 12'\ 07.7''$	
C3	GSC 3889-0906	$17^h\ 46^m\ 38.61^s$	$+53°\ 12'\ 27.6''$	
C4	GSC 3889-0216	$17^h\ 46^m\ 28.79^s$	$+53°\ 09'\ 16.5''$	

Table 2. Observational runs of GSC 3889-0202

Date	HJD(start)	Length	Filter	Exp. [s]	N	Phase	$A_R$max(osc.)
05.06.2008	2454623.50080	$01^h\ 44^m$	R	60	83	0.24-0.27	0.02
27.06.2008	2454645.48054	$02^h\ 18^m$	BVR	120,60,30	35	0.35-0.38	-
29.06.2008	2454647.45583	$01^h\ 45^m$	R	60	99	0.08-0.10	0.045
30.06.2008	2454648.47006	$02^h\ 38^m$	R	60	135	0.45-0.49	0.03
01.07.2008	2454649.45747	$01^h\ 45^m$	R	60	98	0.81-0.84	0.02
03.07.2008	2454651.46105	$02^h\ 10^m$	R	60	119	0.55-0.59	0.03
06.07.2008	2454654.40236	$02^h\ 21^m$	R	30	239	0.64-0.67	0.015
17.07.2008	2454665.48791	$01^h\ 33^m$	R	60	79	0.73-0.75	0.015
18.07.2008	2454666.44853	$01^h\ 46^m$	R	60	99	0.08-0.11	0.035
25.07.2008	2454673.32356	$00^h\ 20^m$	R	60	19	0.61-0.62	-
02.08.2008	2454681.40295	$03^h\ 18^m$	BVR	120,60,30	49	0.60-0.65	0.02
03.08.2008	2454682.52403	$00^h\ 54^m$	BVR	120,60,30	14	0.01-0.03	-
04.08.2008	2454683.51846	$01^h\ 19^m$	BVR	120,60,30	19	0.38-0.40	0.03
05.08.2008	2454684.51287	$01^h\ 15^m$	BVR	120,60,30	19	0.75-0.77	0.04
06.08.2008	2454685.26067	$05^h\ 31^m$	R	60	252	0.02-0.11	0.02
07.08.2008	2454686.31423	$05^h\ 42^m$	BVR	120,60,30	89	0.41-0.50	0.025
11.08.2008	2454690.29035	$07^h\ 42^m$	BVR	120,50,20	127	0.88-1.00	0.035
06.09.2008	2454716.28481	$04^h\ 31^m$	BVR	120,60,30	57	0.47-0.54	0.04

Table 3. Rozhen spectra of GSC 3889-0202

Date	HJD(mid)	S/N	Exp. [s]	RV [kms^{-1}]		Region [Å]	Phase
10.06.2008	2454628.5088	39	1800	-40.8	±1.7	4400-4600	0.094
10.06.2008	2454628.4841	51	1800	-35.4	±6.5	4800-5000	0.084
10.06.2008	2454628.4612	63	1800	-36.0	±4.3	6500-6700	0.076
11.06.2008	2454629.4740	38	1800	-32.7	±1.6	4400-4600	0.450
11.06.2008	2454629.4968	52	1800	-25.9	±6.8	4800-5000	0.458
11.06 2008	2454629.5197	63	1800	-24.3	±2.3	6500-6700	0.467
12.06.2008	2454630.5328	35	1800	+17.2	±1.8	4400-4600	0.840
12.06.2008	2454630.5096	48	1800	+22.4	±5.7	4800-5000	0.832
12.06 2008	2454630.4864	58	1800	+24.6	±2.6	6500-6700	0.823

Table 4. Physical parameters of the primary and secondary components of GSC 3889-0202

Parameter		Primary star	Secondary star
T_{eff}	[K]	7750	4500
$\log g$		3.9	3.2
$v \sin i$	[kms^{-1}]	~ 60	
Spectral type		A7 V-IV	K III

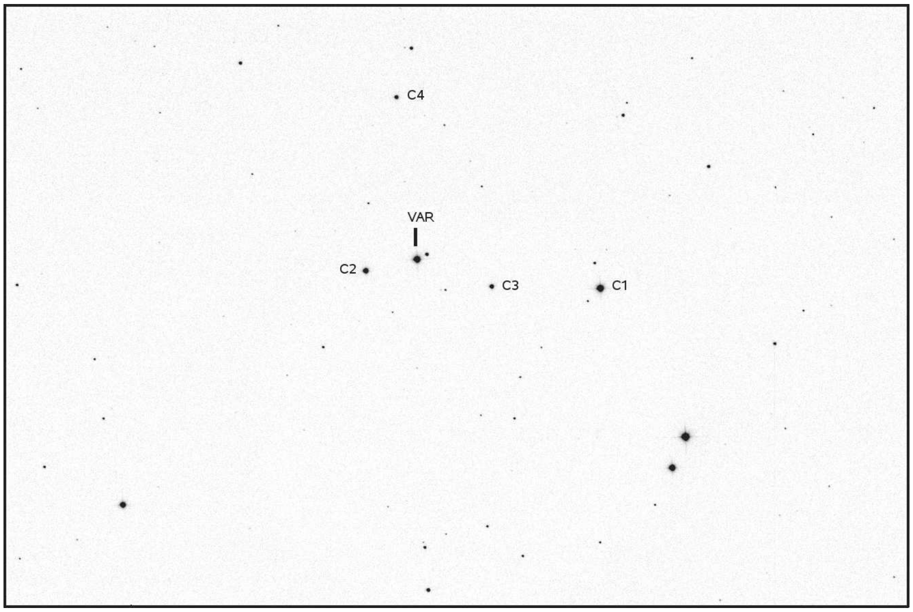

Figure 1. Field of the eclipsing binary GSC 3889-0202 (size $15' \times 10'$). North is down and East is to the right.

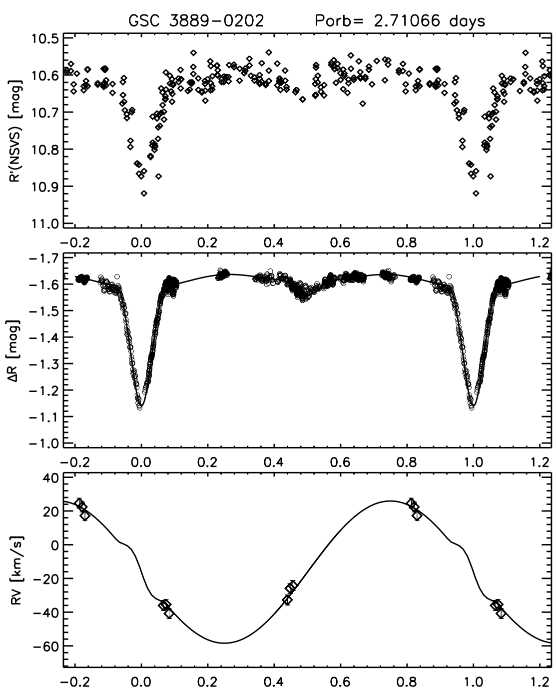

Figure 2. Light and radial velocity curves of GSC 3889-0202. Upper panel - NSVS data, midlie panel - Rozhen R data (dots) and model (solid line), and lower panel - Rozhen RV data (diamonds) and model (solid line).

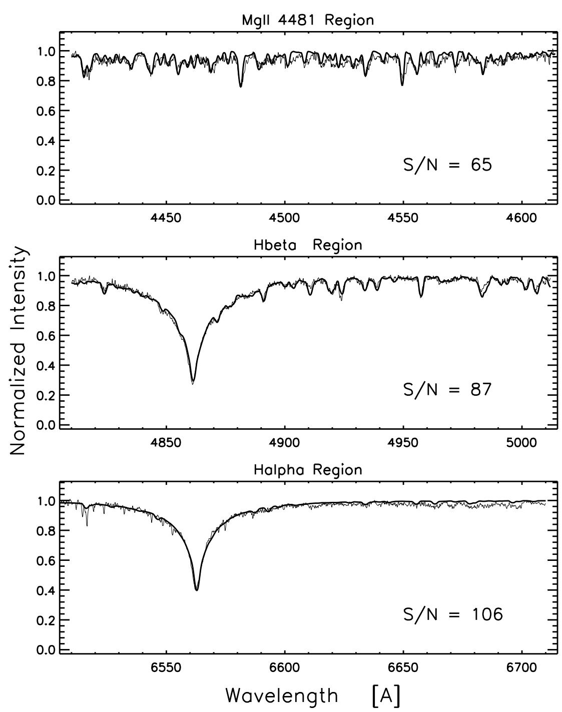

Figure 3. Rozhen combined spectra (thin line) of GSC 3889-0202 and the best synthetic spectra (thick line).

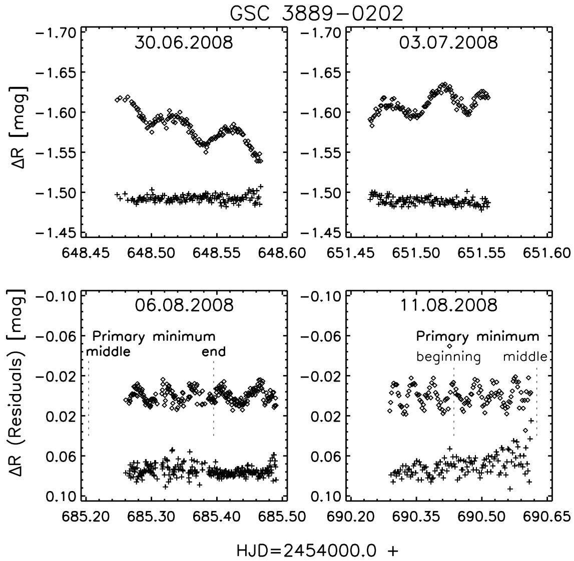

Figure 4. Sample ΔR light curves of GSC 3889-0202 (VAR–COMP, diamonds) and properly shifted C3 star (C3–COMP, crosses). Residuals between observations and the model near the primary minimum are presented on the lower panel. Dashed vertical lines indicate the beginning, middle, and the end of the eclipse.

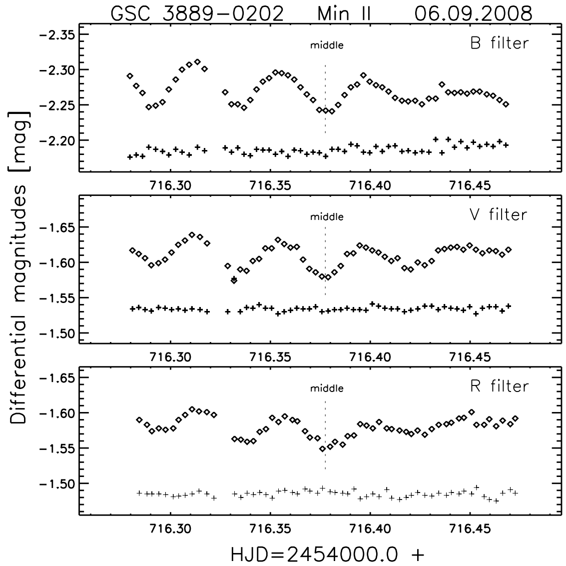

Figure 5. Differential BVR light curves of GSC 3889-0202 (VAR–COMP, diamonds) around secondary minimum and shifted C3 star (C3–COMP, crosses). Dashed vertical lines indicate the middle of the secondary eclipse.

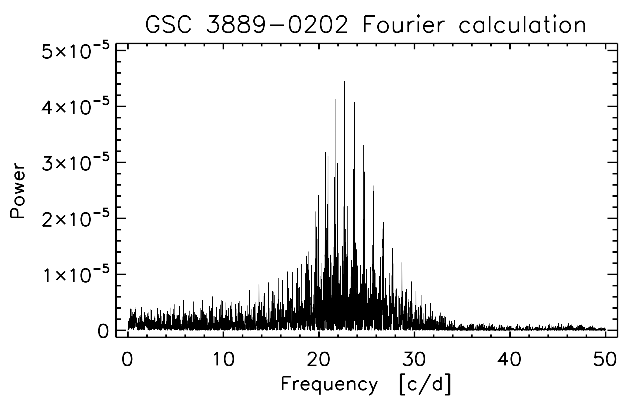

Figure 6. Power spectrum of GSC 3889-0202 Rozhen data after subtracting the synthetic light curve from the data.

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VARIABLE STARS IN THE FIELD OF THE OPEN CLUSTER KING 7

BUKOWIECKI, ŁUKASZ; MACIEJEWSKI, GRACJAN

Centrum Astronomii, Uniwersytet Mikołaja Kopernika, Pl-87100 Toruń, Poland;
e-mail: gm@astri.uni.torun.pl

King 7 (C 0355+516) was discovered by King (1949) who described the cluster as a moderately rich group of stars fainter than 16 mag and spread in the area of 8' × 4'. Durgapal et al. (1996) collected $UBVRI$ CCD photometry for the central ($6' \times 6'$) part of the cluster and obtained fundamental parameters such as the age of 600 Myr, the interstellar extinction $E(B-V) = 1.37$ mag, and the distance of 1.9 kpc. These authors also studied the mass function of the cluster. Durgapal et al. (1997) redetermined cluster's parameters and obtained the age of $600-800$ Myr, the interstellar extinction $E(B-V) = 1.25$ mag, and the distance of 2.20 ± 0.34 kpc. Durgapal & Pandey (2001) reported the limiting radius of the cluster $r_{\rm lim} = 3'$. Sandhu et al. (2003) estimated the photometric binary content in the cluster for about 20%. In this report we present results of a dedicated CCD search for variable stars in the field of King 7.

The observations were gathered in B and V bands between January and April, 2008 with the 90/180 cm Schmidt-Cassegrain Telescope of the Nicolaus Copernicus University Astronomical Observatory in Piwnice near Toruń, Poland. The telescope was used in the imaging mode with a 60 cm correction plate and a field-flattening lens mounted near the focal plane. SBIG STL-11000 CCD camera (4008 × 2672 pixels × 9 μm) was used as a detector. The field of view was 72 arcmin in declination and 48 arcmin in right ascension with the scale of 1.08 arcsec per pixel. The 2×2 binning was used to increase the signal-to-noise ratio. The exposure time was set to 20 s and 600 s. The typical seeing (FWHM) was 5–6". During about 31 hours of observations in total 277 images in V and 90 in B were obtained. About 5700 stars brighter than 18.5 mag in V were monitored. The collected observations were reduced with the software pipeline developed for the Semi-Automatic Variability Search sky survey (Niedzielski et al. 2003, Maciejewski & Niedzielski 2005). The BV magnitudes were obtained for the crowded cluster's core ($r < 8'$) with the DAOPHOT package using the profile-fitting photometry. The calibration coefficients that transform instrumental magnitudes into standard ones were determined using 270 stars located in the field of the cluster for which photometry was taken from Durgapal et al. (1997). The $(B-V)$ coverage was in range between 0.85 and 2.45 mag. The comparison of the observed $(B-V)$ with the literature one is presented in Fig. 1. The instrumental coordinates of stars were transformed into equatorial ones based on positions of stars brighter than 16 mag and extracted from the Guide Star Catalog. The candidates for new variable stars were selected from the V-band database using the analysis of variance method (ANOVA, Schwarzenberg-Czerny 1996).

The collected BV photometry allowed us to redetermine cluster's basic parameters. The procedure described in Maciejewski & Niedzielski (2007) in detail was applied. As a result the following parameters were derived: the central coordinates $RA = 03^{\rm h}59^{\rm m}09^{\rm s}$, $DEC = 51°47'48''$, the limiting radius of 11.6 ± 0.7 arcmin, $\log(age) = 9.00 \pm 0.05$, $E(B-V) = 1.07 \pm 0.05$ mag, the apparent distance modulus of 14.7 ± 0.1 mag, and the distance of 1.90 ± 0.25 kpc. The radial density profile with the best-fit King's formula (King 1966) is plotted in Fig. 2. The central density $f_0 = 9.27 \pm 0.22$, the core radius $r_{\rm core} = 1.39 \pm 0.05$, and the density of the background stellar field $f_{\rm bg} = 1.08 \pm 0.04$ were derived. The cleaned colour-magnitude diagram (CMD) was constructed for the central part ($r < 3r_{\rm core}$) of King 7 and was plotted with the best-fit isochrone of solar metallicity in Fig. 3.

As a result of our survey 16 variable stars were detected in the field of King 7. They are listed in Table 1 and their light curves are presented in Fig. 4. V13 is known as V721 Per – a semi-regular pulsating star. The remaining 15 stars are previously unknown variables. Only 5 variables – V1, V2, V3, V4, and V5 – are located within or near to the limiting radius of the cluster and their membership can be discussed considering their location in the cluster's CMD. The remaining stars are treated as variables of the Galactic background.

V1 was classified as a pulsating variable of δ Cephei type. The star is situated near to the isochrone (Fig. 1). Assuming it belongs to the cluster, its absolute magnitude is $M_{\rm V} = +1.8$ mag and dereddened $(B-V)_0 = 0.30$. That locates the star in δ Scuti or γ Doradus area in the Hertzsprung-Russell diagram. However, the relatively long period of variance and the large amplitude in V are in disagreement with characteristics of both types. Therefore the membership of V1 is unlikely and the star seems to be a background Cepheid. V2 is a faint eclipsing system of EA type. The collected data did not allow to determine the period of variability because only one incomplete eclipse was observed. Its location in the CMD clearly indicates that it is a Galactic background star. V3 is a faint variable revealing long-time changes in the light curve. It was not detected in exposures in B filter that indicates the star is very red with $(B-V)$ greater than 2.0 mag. Its location in the CMD clearly shows that the star is not a member of King 7. V4 was classified as a short-period EB system with unequal brightness in both maxima ($\Delta V_{\rm max} = 0.05$ mag). The system is situated far from cluster's isochrone and is located in the outskirts of the cluster. That makes its membership unlikely. V5 is another variable star belonging to cluster's halo and it is situated just beyond the limiting radius. It was classified as a pulsating star of RR Lyrae type. The location of the variable in the CMD makes its membership unlikely.

To summarize, none of 5 variables detected in the field of King 7 can be treated as a likely cluster's member. This observation can be justified considering a relatively small number of stars that constitute the cluster. We estimate that only 150 the brightest stars of the cluster were monitored in our survey.

The original photometric data are available in electronic form on survey's web site[1] and will be also available at WEBDA[2].

[1]http://www.astri.uni.torun.pl/~gm/OCS
[2]http://www.univie.ac.at/webda/

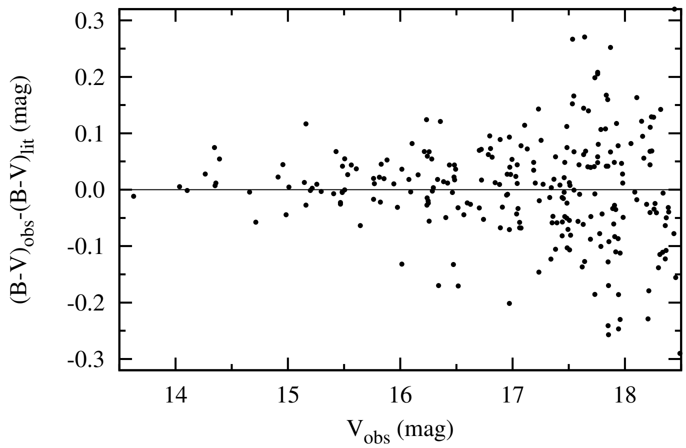

Figure 1. The comparison of the observed photometry with the literature one.

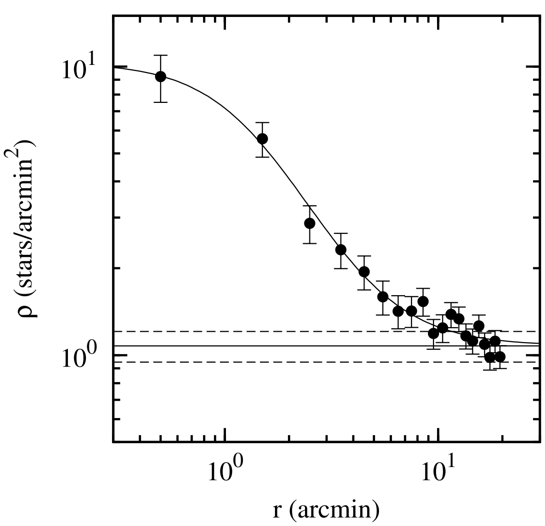

Figure 2. The radial density profile with the best-fit King's formula. The horizontal continuous line marks the background-star-density level and the dashed ones – 3-sigma error.

Table 1. The list of variable stars detected in the field of King 7. d denotes the distance from the cluster center, $V_{\max}$ – the maximal brightness in V band, ΔV – the amplitude of variation in V, $(B-V)$ – the color index at the maximum of brightness, P – the period of variation, T_0 – the epoch of minimum brightness for eclipsing systems or maximum for pulsating stars, types of variability: EA – a detached binary, EB – a semidetached binary, EW – a contact system, RR – a pulsating star of RR Lyrae type, DCEP – a pulsating star of δ Cephei type, MISC – a miscellaneous variable of unresolved type.

ID	Coordinates J2000.0	d (arcmin)	$V_{\max}$ (mag)	ΔV (mag)	$(B-V)$ (mag)	P (days)	T_0 HJD–2450000	Type
V1	035848+514259	5.8	16.54	0.35	1.37	4.3253	505.4001	DCEP
V2	035931+515446	7.7	17.39	0.58	1.26	–	–	EA
V3	035957+515700	11.8	17.46	0.32	>2	–	–	MISC
V4	035857+513540	12.3	15.76	0.14	1.02	0.28785	499.8975	EB
V5	040006+513902	12.5	17.52	0.47	1.10	0.57644	501.1083	RR:
V6	035939+513337	14.9	15.18	0.16	1.32	–	–	MISC
V7	035911+520433	16.8	11.49	0.08	1.88	–	–	MISC
V8	040041+515659	16.9	17.93	1.33	>2	–	–	MISC
V9	035700+514409	20.3	13.92	0.17	1.11	1.8667	503.1155	DCEP
V10	035652+514850	21.2	15.68	0.58	1.54	–	–	MISC
V11	035652+515156	21.5	12.63	0.18	0.84	3.9231	502.6295	EA
V12	035751+520550	21.6	16.20	1.18	2.26	–	–	MISC
V13	040039+512101	30.2	14.62	2.62	2.26	–	–	MISC
V14	040105+512140	31.8	16.05	0.14	1.18	0.36105	499.6698	EW
V15	035920+511424	33.4	14.91	0.80	0.93	0.57001	500.1683	EB
V16	040048+511144	39.3	16.53	0.26	1.18	0.28910	500.1716	EW

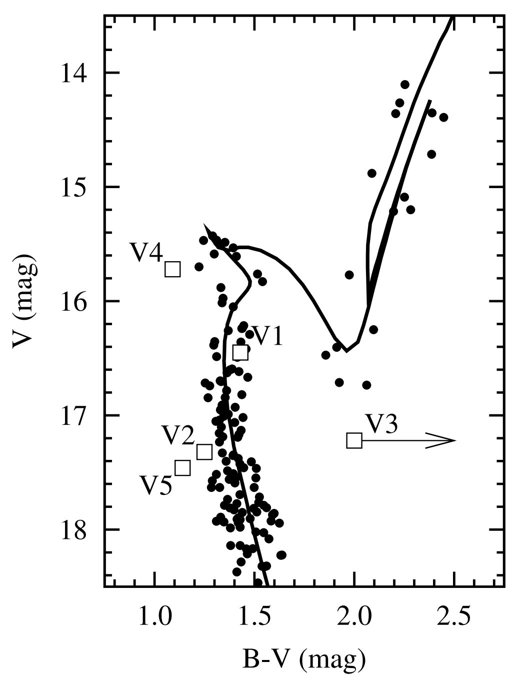

Figure 3. The colour-magnitude diagram for King 7 with best-fit isochrone of solar metallicity. The open symbols denote variables stars located within the cluster's limiting radius. See text for discussion.

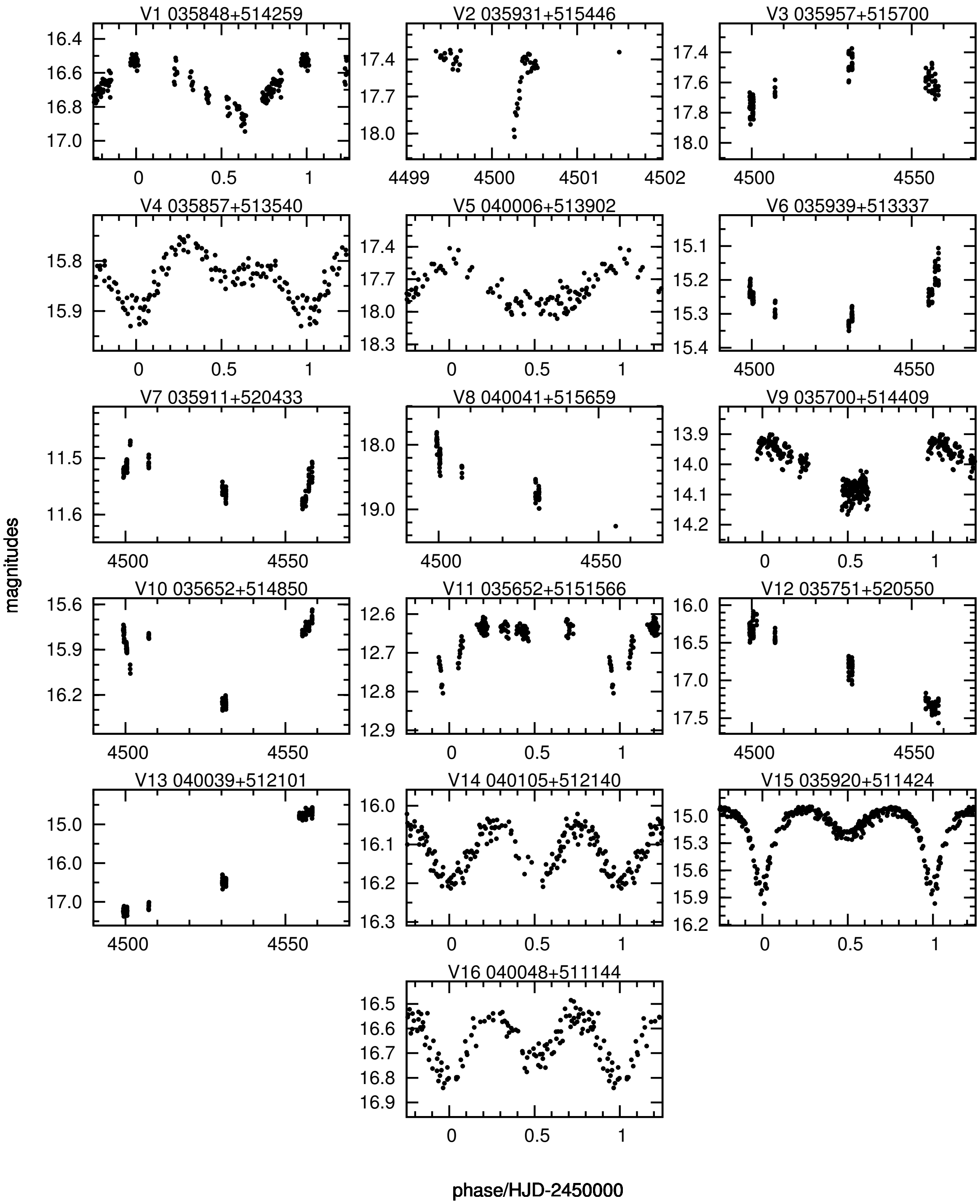

Figure 4. V-band light curves of variable stars discovered in the field of King 7.

Acknowledgements: We are indebted to the anonymous referee for helpful suggestions that have significantly improved this report. This research is supported by UMK grant 411-A and has made use of the WEBDA and SIMBAD data bases.

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COMMISSIONS 27 AND 42 OF THE IAU
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ELEMENTS FOR 10 RR LYRAE STARS

HÄUSSLER, K.[1]; BERTHOLD, T.[1,2]; KROLL, P.[2]

[1] Bruno-H.-Bürgel-Sternwarte, Töpelstr. 46, D-04746 Hartha, Germany

[2] Sternwarte Sonneberg, Sternwartestr. 32, D-96515 Sonneberg, Germany

email: info@sternwarte-hartha.de, tb@4pisysteme.de, pk@4pisysteme.de

These stars were discovered and reported to be of RR Lyrae type by Boyce & Huruhata (1942) and Hoffmeister (1966, 1967, 1968).

Except some remarks concerning the type of variability no further observations or ephemeris have been published until today.

Photographic plates of a field centered at α Oph, taken with the Sonneberg Observatory 40-cm Astrographs during three intervals spread over the years from 1964 to 1994, were used to investigate the behaviour of these objects (see Table 1).

The given elements were obtained by means of least-squares solutions. Photographic amplitudes were derived with respect to magnitudes of the comparison stars given in Table 2. An extensive list holding the times of maxima derived can be retrieved as `5858-t3.txt`, using the link in the HTML version of this paper. Individual data are available upon request.

Remarks:

V1064 Oph, V1074 Oph, V2028 Oph
Brightness in minimum light beyond the plate limit.

This research made use of the SIMBAD data base, operated by the CDS at Strasbourg, France.

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Hoffmeister, C., 1966, *Astron. Nachr.*, **289**, 1
Hoffmeister, C., 1967, *Astron. Nachr.*, **290**, 43
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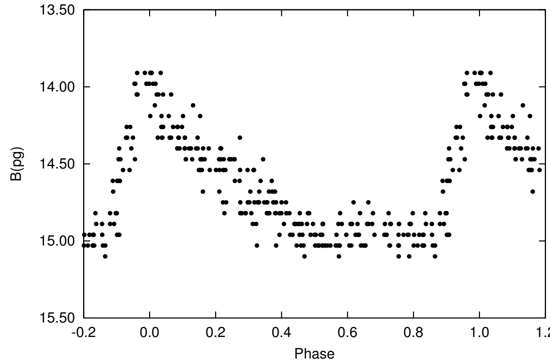

Figure 1. Light curve of V821 Oph

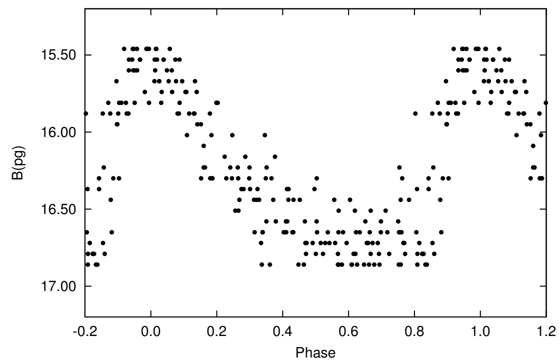

Figure 2. Light curve of V1062 Oph

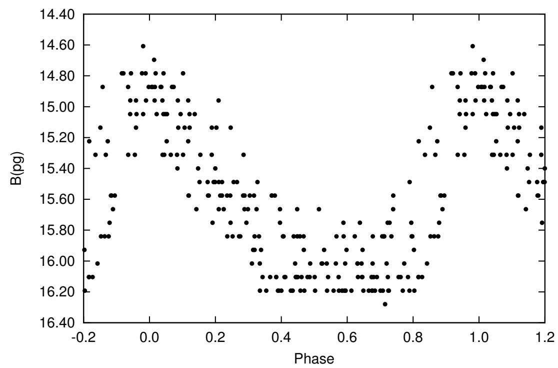

Figure 3. Light curve of V1064 Oph

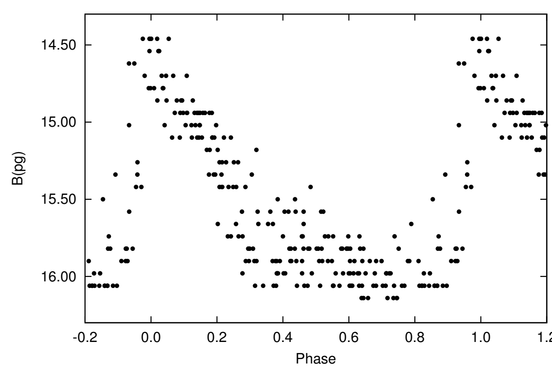

Figure 4. Light curve of V1074 Oph

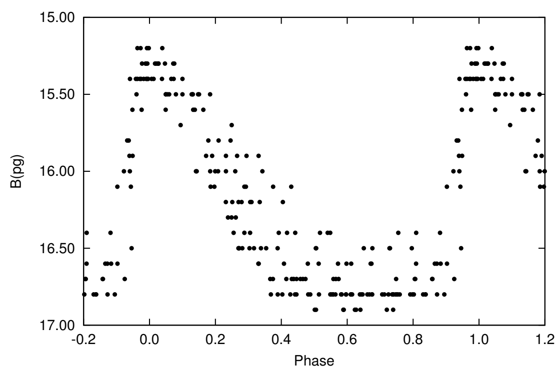

Figure 5. Light curve of V2023 Oph

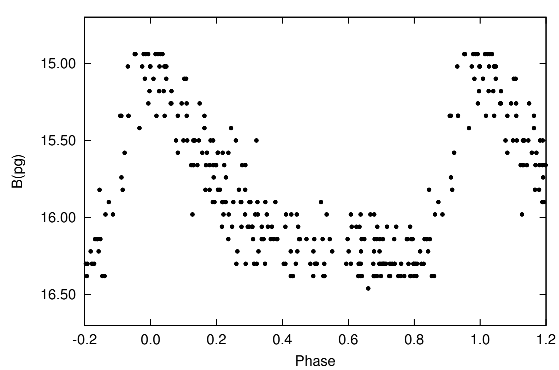

Figure 6. Light curve of V2026 Oph

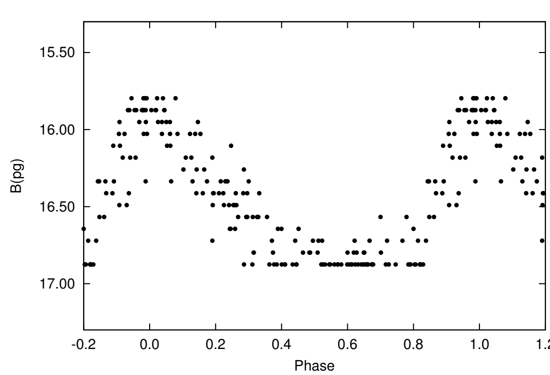

Figure 7. Light curve of V2028 Oph

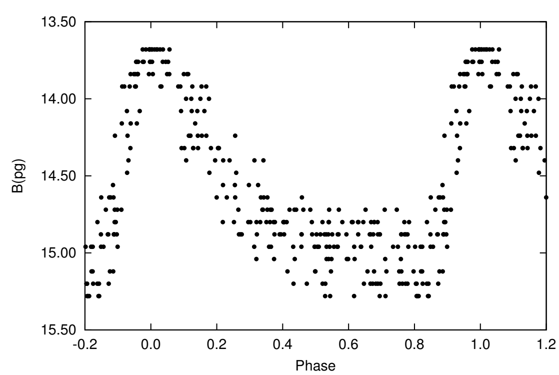

Figure 8. Light curve of NSV 9576

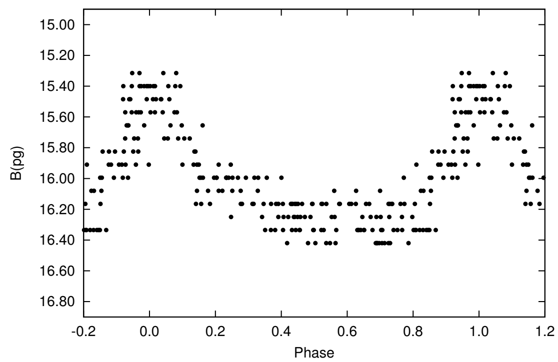

Figure 9. Light curve of NSV 9592

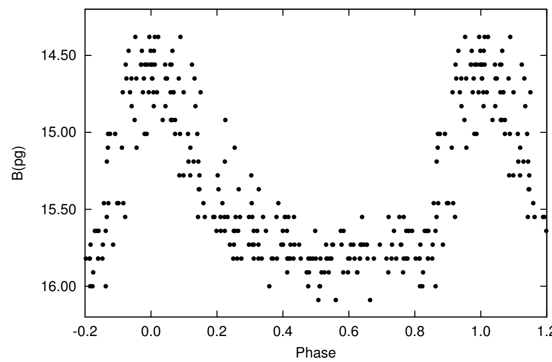

Figure 10. Light curve of NSV 9642

Table 1. Summary of this paper

Star	Type	Epoch 2400000+	Period (day)	Max.	Min.	$M-m$	No. of Plates
V821 Oph	RRab	49124.460 ±6	0.4678199 ±4	$14\overset{\mathrm{m}}{.}0$	$15\overset{\mathrm{m}}{.}0$	$0\overset{\mathrm{p}}{.}15$	268
V1062 Oph	RRab	49488.510 ±10	0.5265861 ±8	$15\overset{\mathrm{m}}{.}6$	$16\overset{\mathrm{m}}{.}8$	$0\overset{\mathrm{p}}{.}22$	212
V1064 Oph	RRab	49484.515 ±13	0.4173550 ±8	$14\overset{\mathrm{m}}{.}8$	$>16\overset{\mathrm{m}}{.}2$	$0\overset{\mathrm{p}}{.}20$	225
V1074 Oph	RRab	46991.385 ±5	0.3451787 ±4	$14\overset{\mathrm{m}}{.}6$	$>16\overset{\mathrm{m}}{.}1$	$0\overset{\mathrm{p}}{.}14$	240
V2023 Oph	RRab	49482.471 ±6	0.4559190 ±4	$15\overset{\mathrm{m}}{.}2$	$16\overset{\mathrm{m}}{.}8$	$0\overset{\mathrm{p}}{.}12$	212
V2026 Oph	RRab	49124.437 ±8	0.6650988 ±8	$15\overset{\mathrm{m}}{.}1$	$16\overset{\mathrm{m}}{.}3$	$0\overset{\mathrm{p}}{.}18$	247
V2028 Oph	RRab	49193.401 ±8	0.4702531 ±6	$15\overset{\mathrm{m}}{.}9$	$>16\overset{\mathrm{m}}{.}8$	$0\overset{\mathrm{p}}{.}20$	178
NSV 9576	RRab	49475.471 ±6	0.5404488 ±5	$13\overset{\mathrm{m}}{.}7$	$15\overset{\mathrm{m}}{.}1$	$0\overset{\mathrm{p}}{.}18$	283
NSV 9592	RRab	49482.446 ±12	0.5848983 ±11	$15\overset{\mathrm{m}}{.}4$	$16\overset{\mathrm{m}}{.}2$	$0\overset{\mathrm{p}}{.}18$	217
NSV 9642	RRab	48839.403 ±7	0.4677834 ±5	$14\overset{\mathrm{m}}{.}5$	$15\overset{\mathrm{m}}{.}9$	$0\overset{\mathrm{p}}{.}18$	238

Table 2. Comparison stars and cross references

	V821 Oph		V1062 Oph	
	HV 11039		S 8618	
	USNO 0975-09664766		USNO 0975-09287755	
Comp. No.	USNO	m^*	USNO	m^*
1	0975-09671874	$13\overset{\mathrm{m}}{.}8$	0975-09287344	$15\overset{\mathrm{m}}{.}3$
2	0975-09670349	$14\overset{\mathrm{m}}{.}0$	0975-09284917	$16\overset{\mathrm{m}}{.}1$
3	0975-09663688	$14\overset{\mathrm{m}}{.}8$	0975-09285925	$16\overset{\mathrm{m}}{.}5$
4	0975-09666335	$15\overset{\mathrm{m}}{.}6$	0975-09284030	$16\overset{\mathrm{m}}{.}9$

	V1064 Oph		V1074 Oph	
	S 8621		S 9829	
	USNO 0975-09393539		USNO 0975-09803952	
Comp. No.	USNO	m^*	USNO	m^*
1	0975-09393991	$14\overset{\mathrm{m}}{.}8$	0975-09309205	$13\overset{\mathrm{m}}{.}7$
2	0975-09393013	$15\overset{\mathrm{m}}{.}3$	0975-09309459	$14\overset{\mathrm{m}}{.}1$
3	0975-09390228	$15\overset{\mathrm{m}}{.}8$	0975-09304972	$14\overset{\mathrm{m}}{.}8$
4	0975-09393505	$16\overset{\mathrm{m}}{.}4$	0975-09307002	$15\overset{\mathrm{m}}{.}2$

	V2023 Oph		V2026 Oph	
	S 10339		S 10343	
	USNO 0975-09537477		USNO 0975-09650550	
Comp. No.	USNO	m^*	USNO	m^*
1	0975-09542893	$15\overset{\mathrm{m}}{.}1$	0975-09649513	$14\overset{\mathrm{m}}{.}8$
2	0975-09535757	$15\overset{\mathrm{m}}{.}5$	0975-09656802	$15\overset{\mathrm{m}}{.}5$
3	0975-09537864	$16\overset{\mathrm{m}}{.}2$	0975-09649101	$16\overset{\mathrm{m}}{.}0$
4	0975-09536233	$16\overset{\mathrm{m}}{.}9$	0975-09648330	$16\overset{\mathrm{m}}{.}8$

	V2028 Oph		NSV 9576	
	S 10346		S 8625	
	USNO 0975-09754043		USNO 0975-09598276	
Comp. No.	USNO	m^*	USNO	m^*
1	0975-09748201	$15\overset{\mathrm{m}}{.}8$	0975-09606051	$13\overset{\mathrm{m}}{.}2$
2	0975-09750824	$16\overset{\mathrm{m}}{.}2$	0975-09605746	$14\overset{\mathrm{m}}{.}1$
3	0975-09754904	$17\overset{\mathrm{m}}{.}0$	0975-09596234	$15\overset{\mathrm{m}}{.}0$
4			0975-09599125	$15\overset{\mathrm{m}}{.}6$

	NSV 9592		NSV 9642	
	S 9818		HV 11040	
	USNO 0975-09612849		USNO 0975-09668186	
Comp. No.	USNO	m^*	USNO	m^*
1	0975-09617524	$15\overset{\mathrm{m}}{.}1$	0975-09670412	$14\overset{\mathrm{m}}{.}0$
2	0975-09616192	$15\overset{\mathrm{m}}{.}5$	0975-09667180	$15\overset{\mathrm{m}}{.}1$
3	0975-09614978	$16\overset{\mathrm{m}}{.}2$	0975-09664470	$15\overset{\mathrm{m}}{.}8$

* Magnitudes refer to the B values of the USNO−A2.0 catalogue

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Budapest
7 November 2008

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MULTICOLOUR CCD PHOTOMETRY OF THREE RRab STARS

KUN, E.[1]; SÓDOR, Á.[2]; JURCSIK, J.[2]; HURTA, ZS.[3,4]; NAGY, I.[3]; KŐVÁRI, ZS.[2]; POSZTOBÁNYI, K.[5]; KOVÁCS, G.[3]; VIDA, K.[3,4]; BELUCZ, B.[3]

[1] University of Szeged, Dept. of Exp. Physics and Astron. Obs., H-6720 Szeged, Dóm tér 9, Hungary

[2] Konkoly Observatory of the Hungarian Academy of Sciences, P.O. Box 67, H-1525 Budapest, Hungary; e-mail: name@konkoly.hu

[3] Eötvös Loránd University, Department of Astronomy, P.O. Box 32, H-1518 Budapest, Hungary

[4] Visiting Astronomer, Konkoly Observatory of the Hungarian Academy of Sciences

[5] AEKI, KFKI Atomic Energy Research Institute, Thermohydraulic Department, H–1525 Budapest 114, PO Box 49, Hungary

The fifth set of CCD light curves of monoperiodic fundamental mode RR Lyrae stars based on the observations of the 60 cm automatic telescope of Konkoly Observatory, Svábhegy, Budapest is published. The equipment and data reduction procedure were the same as described in Jurcsik et al. (2008).

Observations of CN Lyr, CG Peg and FH Vul are presented here. Photometric data on these three variables were published previously by Oosterhoff (1960), Sturch (1966), Stepien (1972), Penston (1973), Schmidt & Reiswig (1993), and Castellani et al. (1998). The light curve of FH Vul was considered as a stable one and was used as a calibrator object for deriving the [Fe/H] – Fourier parameter relation by Jurcsik & Kovács (1996). Though no indication of light curve variation of any of these variables was evident, small amplitude Blazhko-modulation (e.g. found in Jurcsik et al. 2005, 2006) could not be excluded from the earlier observations.

Based on the accuracy and time coverage of our data we conclude that the light curves of these 3 stars are stable, indeed. There is no apparent light curve modulation with amplitude larger than $0.01 - 0.02$ mag in the maximum brightness of any of the stars.

Table 1. Log of observations

Star	Comparison				Observation period	No. of	
	GSC 2.3.2	RA(2000)	DEC(2000)	V [mag]*	JD 2400000 +	nights	$B/V/I_C$ data
CN Lyr	N24S000237	18 41 42.87	+28 44 57.1	11.90	54642 – 54701	8	267 / 271 / 242
CG Peg	N2MC000574	24 41 01.91	+24 44 16.6	13.16	54656 – 54751	11	333 / 292 / 295
FH Vul	N2P8000417	20 40 29.43	+22 12 24.3	12.82	54633 – 54741	8	218 / 234 / 227

* V magnitudes of the comparison stars are from GSC 2.3.2

The photometric data are available electronically from the IBVS website (5859-t5.txt – 5859-t16.txt). The tables list the relative BVI_C magnitude and relative $B-V$, $V-I_C$ colour time series with respect to the comparison stars listed in Table 1. The brightnesses of the comparison stars remained constant during the observations. The *r.m.s.* scatter of their relative magnitudes measured to several check stars are between 0.005 and 0.015 mag.

For comparison, the $r.m.s.$ scatter of the Fourier fits to the B, V, I_C light curves of CN Lyr, CG Peg, and FH Vul are 0.007/0.006/0.005, 0.010/0.007/0.006, and 0.016/0.009/0.009 mag, respectively.

The V light curves and the colour curves of the three stars are plotted in Figs. 1 − 3.

Normal maximum timings and Fourier parameters of the V light curves of CN Lyr, CG Peg, and FH Vul are listed in Table 2, and Table 3, respectively. Table 4 compares the photometric metallicities calculated from the V light curves of the variables according to Eq. 3 of Jurcsik & Kovács (1996) to the results of spectroscopic metallicity measurements.

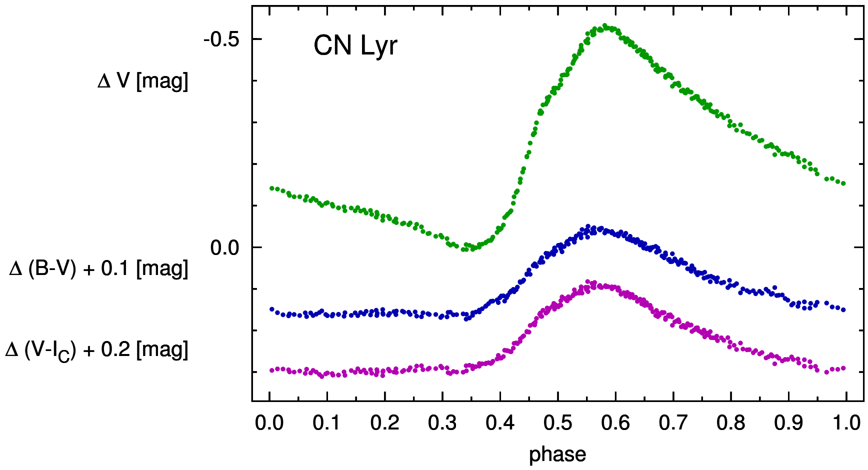

Figure 1. Differential V, $B-V$ and $V-I_{\rm C}$ light and colour curves of CN Lyr.

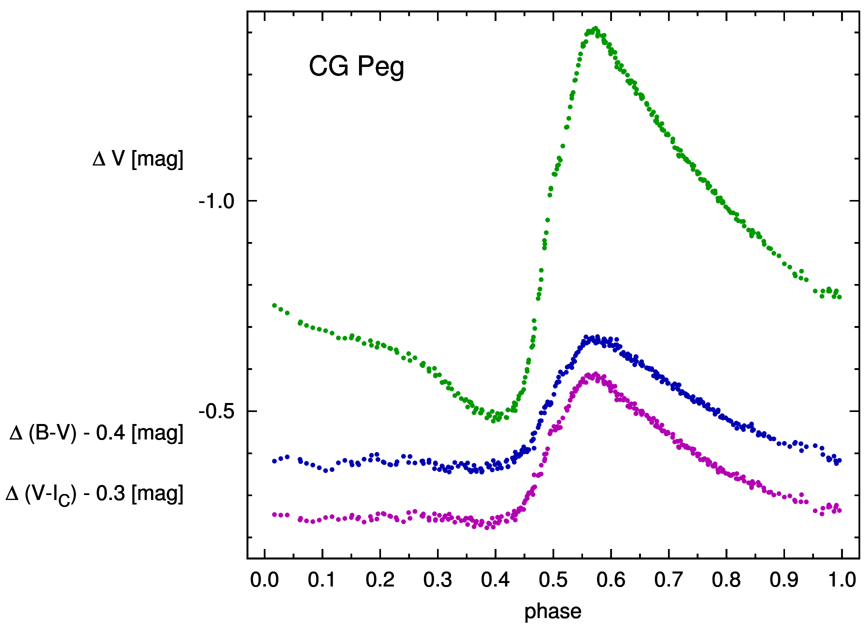

Figure 2. Differential V, $B-V$ and $V-I_{\rm C}$ light and colour curves of CG Peg.

Table 2. Normal maximum timings of the V light curves.

Star	$T_{\rm max} - 2400000$ [HJD]	Star	$T_{\rm max} - 2400000$ [HJD]
CN Lyr	54671.3549	FH Vul	54640.5113
CG Peg	54703.8288	FH Vul	54717.5400

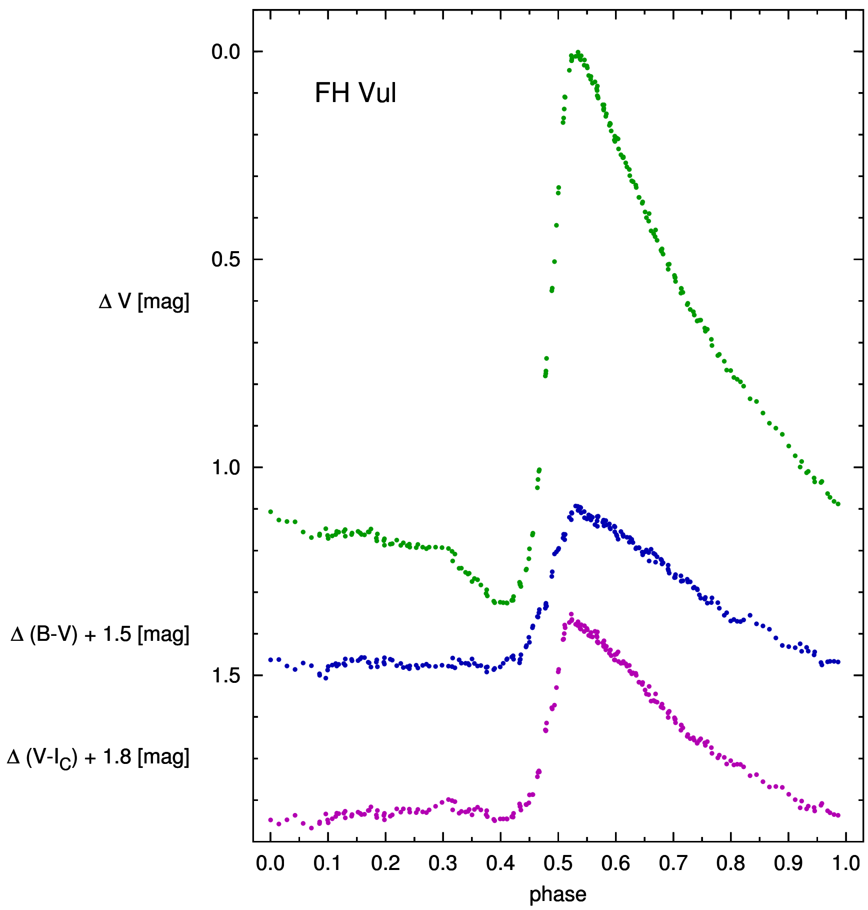

Figure 3. Differential V, $B-V$ and $V-I_{\rm C}$ light and colour curves of FH Vul.

Table 3. Fourier parameters of the V light curves.

Star	P [d]	A_1 [mag]	R_{21}	R_{31}	R_{41}	R_{51}	ϕ_{21} * [rad]	ϕ_{31} * [rad]	ϕ_{41} * [rad]	ϕ_{51} * [rad]
CN Lyr	0.41138232**	0.205	0.439	0.224	0.073	0.024	2.616	5.523	2.274	5.679
CG Peg	0.46713820**	0.312	0.542	0.327	0.186	0.099	2.574	5.435	2.035	4.742
FH Vul	0.405413(4)	0.440	0.516	0.373	0.239	0.170	2.256	4.930	1.227	3.927

* Phase differences are given according to sine term decomposition.

** GCVS period.

Table 4. Spectroscopic and photometric [Fe/H] values.

Star	$[Fe/H]_{phot}$	$[Fe/H]_{spect}$ [a]	ref.
CN Lyr	+0.17	−0.05	Layden (1994)
CG Peg	−0.25	−0.26	Layden (1994)
FH Vul	−0.59	−0.61	Layden (1994)

a: Spectroscopic metallicities are transformed to the [Fe/H] scale used for the photometric metallicities according to Eq. 3 and Eq. 2 of Jurcsik (1995) and Jurcsik & Kovács (1996), respectively.

We thank Béla Szeidl for his many helpful comments on this work. This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France. The financial support of OTKA grants T-048961, and T-068626 is acknowledged. ZsK is a grantee of the Bolyai János scholarship of the HAS.

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Layden, A. 1994, *AJ*, **108**, 1016
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Schmidt, E. G., Reiswig, D. E. 1993, *AJ*, **106**, 2429
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ERRATUM FOR IBVS 5793

In IBVS 5793 Table 3 the 2nd line on the maximum timings of BK Cas gives erroneous T_{max} value. This line should correctly be: "BK Cas **54321.1434** normal".

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BVR_CI_C PHOTOMETRY OF THE ECCENTRIC ECLIPSING BINARY HD 350731

KLEIDIS, STELIOS[1,2]; ROBERTSON, C. W.[3]; WILS, PATRICK[4]

[1] Zagori Observatory, Epirus, Greece, e-mail: steliosklidis@gmail.com

[2] Helliniki Astronomiki Enosi, Athens, Greece

[3] SETEC Observatory, Goddard, KS, USA, e-mail: cwr@pixius.net

[4] Vereniging voor Sterrenkunde, Belgium, e-mail: patrickwils@yahoo.com

The star HD 350731 = GSC 1624-0493 at position $\alpha_{2000} = 19^h53^m45\overset{s}{.}26$, $\delta_{2000} = +20°30'33\overset{''}{.}2$ (UCAC2; Zacharias et al., 2004a), was found to be an eccentric eclipsing binary by Otero et al. (2004). It is an early type binary: Nesterov et al. (1995) give a spectral type B9, the AGK3 catalogue (Heckmann, 1975) lists A0.

CCD observations of the object were done on 7 nights in 2007 at SETEC Observatory (30-cm SCT, V only) and on 16 nights in 2008 at Zagori Observatory (30-cm LX200, BVR_cI_c). The images were reduced with AIP4Win (Berry & Burnell, 2000). HD 350730, with a similar spectral type of A0 (Heckmann, 1975), was used as comparison star. Its magnitude $V = 10.04$ and colour $B - V = 0.073$ were taken from the Tycho catalogue (ESA, 1997), the $R = 9.980$ value from NOMAD (Zacharias et al., 2004b) and the $I_c = 9.974$ magnitude from TASS (Richmond, 2007). The data are available in the electronic edition of IBVS (5860-t3.txt – 5860-t7.txt).

The times of minima derived from our data are listed in Table 1. The following ephemeris was calculated using data from ASAS (Pojmanski, 2002), NSVS (Wozniak et al., 2004), and the minima from Zejda et al. (2006), Brát et al. (2007) and Table 1.

$$HJD\ Min\ I = 2454651.4603(14) + 1.635135(3)E \quad (1)$$

$$HJD\ Min\ II = 2454650.7235(20) + 1.635135(3)E \quad (2)$$

A phase plot of the data is given in Fig. 1. Note that Otero et al. (2004) reversed the primary and secondary eclipses. There is indeed only a small difference in the depth of the two eclipses, suggesting that both stars have a similar temperature. This is also supported by the $B - V$, $V - R_C$ and $V - I_C$ colour curves plotted in Fig. 2, showing only small variation.

The Phoebe program (Prša & Zwitter, 2005) was used to determine the orbital parameters of HD 350731. Calculations were done for a detached system. As is usual when radial velocity curves are absent, it is very difficult to obtain a precise value for the mass ratio q. Values in the range of 0.7 to 1.1 all give very good fits. We further took linear limb darkening coefficients from van Hamme (1993) and assumed periastron-synchronized rotation, albedo and gravity brightening values equal to 1 and a primary temperature of

Table 1: List of minima of HD 350731. $O-C$ values are derived from Eqs. 1 and 2.

Epoch HJD-2400000	Min	Uncertainty [days]	$O-C$ [days]	Observer	Filter
54299.9065	I	0.0002	0.0002	CWR	V
54340.7838	I	0.0002	-0.0009	CWR	V
54345.6896	I	0.0001	-0.0005	CWR	V
54628.5684	I	0.0002	0.0000	SK	BVR_CI_C
54642.5482	II	0.0002	0.0004	SK	BVR_CI_C
54651.4605	I	0.0004	0.0002	SK	BVR_CI_C
54665.4390	II	0.0002	-0.0007	SK	BVR_CI_C

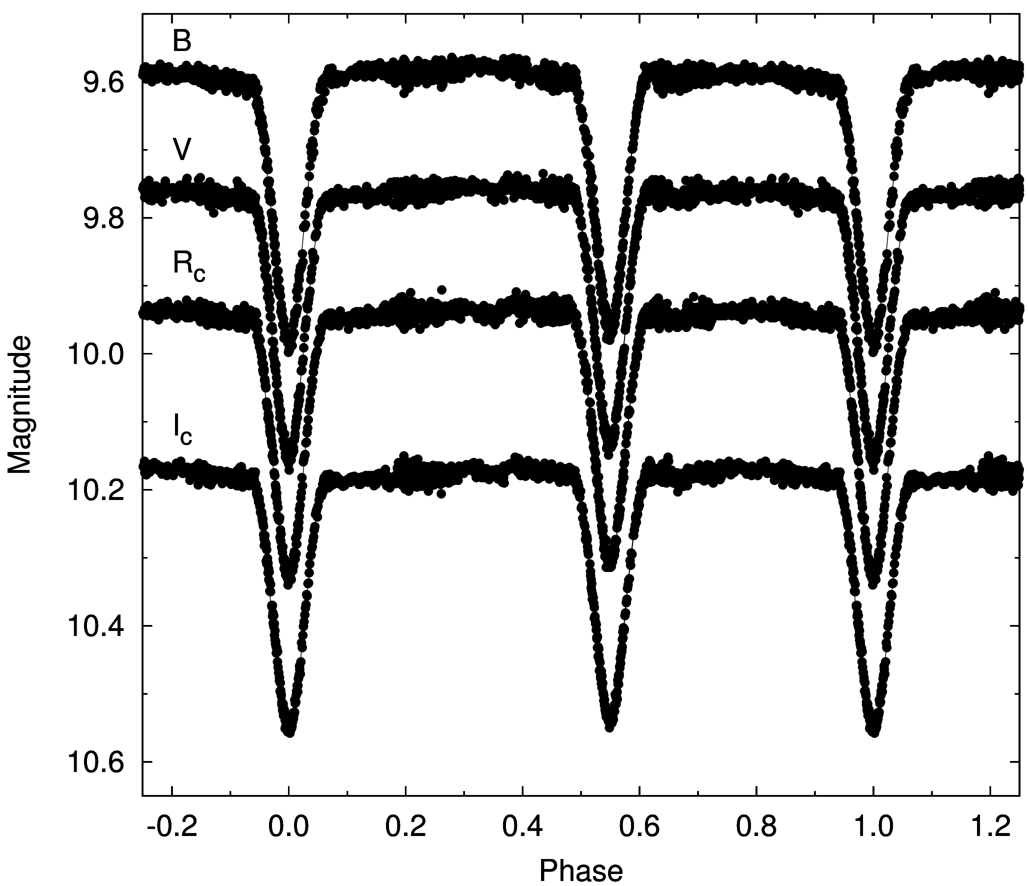

Figure 1. Phase plot of the HD 350731 data. The V, R_C and I_C data have been shifted in magnitude by resp. 0.25, 0.50 and 0.75 mag. for clarity.

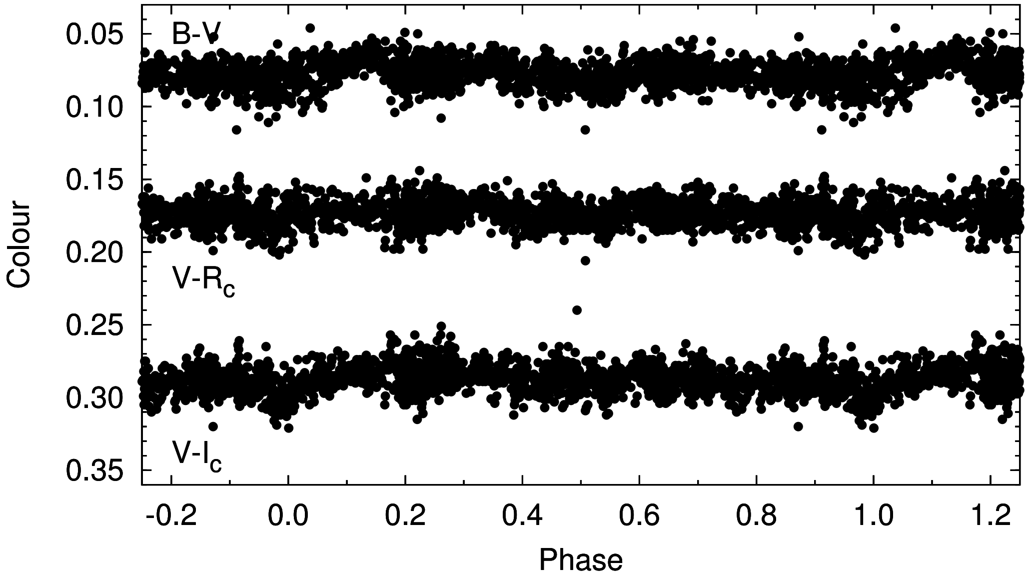

Figure 2. Phase plot of the $B-V$, $V-R_C$ and $V-I_C$ colours of HD 350731. The latter two colours have been shifted for clarity by 0.1 and 0.2 mag. respectively.

Table 2: Calculated system parameters for HD 350731.

q	0.9	$\pm$	0.2
i	82.3°	$\pm$	0.4°
e	0.078	$\pm$	0.001
ω	348°	$\pm$	3°
Ω_1/Ω_2	1.14	$\pm$	0.08
$T_1 - T_2$	320K	$\pm$	60K

T_1 = 10500K, based on the spectral type (Cox, 2000). Uncertainties on the calculated parameters were then derived by varying q in the range given above. The results obtained are presented in Table 2.

HD 350731 shows some scatter outside of eclipse, but no periodicity was found. Mainly because of the fairly short period of this eccentric eclipsing binary, apsidal motion will be dominated by general relativistic effects. With an estimate of 3 $M_\odot$ for the mass of a main sequence primary (Cox, 2000), general relativity predicts an apsidal motion of $28 \pm 6°$ per century (Gimenez, 1985), while classical effects are only responsible for less than one tenth of that amount (Claret & Gimenez, 1993). Because the argument of periastron ω is close to the ascending node, variations in the phase of the secondary minimum will however be almost negligible in the near future.

Acknowledgements: This study made use of NASA's Astrophysics Data System, and the SIMBAD and VizieR databases operated at the Centre de Données Astronomiques (Strasbourg) in France.

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ECLIPSE MAPPING OF RW Tri IN THE LOW LUMINOSITY STATE

HALEVIN, A. V.[1]; HENDEN, A. A.[2]

[1] Department of Astronomy, Odessa National University, T.G. Shevchenko Park, Odessa, 65014, Ukraine

[2] American Association of Variable Star Observers, 49 Bay State Road, Cambridge, MA 02138, USA

RW Tri is a bright well known eclipsing nova-like system. It was discovered in 1937 (Protitch, 1937). Walker (1963) determined the orbital period to be 5.57 h. Africano et al. (1978) found that eclipse timings demand that the ephemeris has a cyclic term with a period of 2777 or 4980 days. Different authors give different values of the system inclination angle i: 80° (Longmore et al. 1981), 82° (Frank & King 1981), 70.5° (Smak 1995). Frank & King (1981) found that the disc size is about $0.4a$ where a is the orbital separation.

Horne & Stiening (1985) performed the first eclipse mapping of the system. They found that the temperature of the inner part of accretion disc is about 40000 K. Also using the eclipse mapping technique, Rutten et al. (1992) determined the mass accretion rate to be $3{\cdot}10^{-8}$ $M_\odot$ year^{-1}.

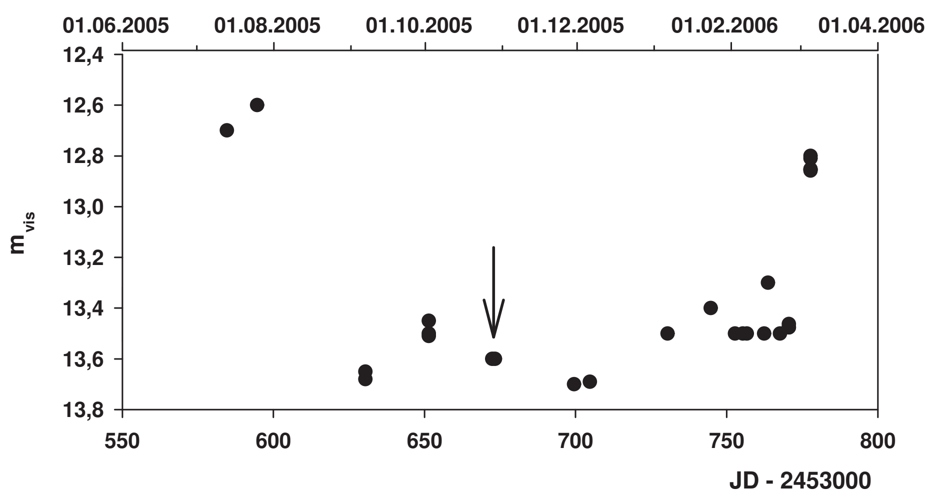

Figure 1. Fragment of the AAVSO visual light curve of RW Tri. Eclipse observations are marked with an arrow.

Poole et al. (2003) estimated the range for the primary and secondary stellar masses as 0.4 - 0.7 and 0.3 - 0.4 $M_\odot$ respectively. Groot et al. (2004) using spectral eclipse mapping found that the mass accretion rate is about 10^{-8} $M_\odot$ year^{-1}.

In our paper we used AAVSO observations of RW Tri, obtained by Keith Graham with a Meade LX200 f/10 12" telescope and SBIG ST-9E CCD camera in V band. The exposure duration is 70 sec and the read time for this CCD is less than 1 sec. Observations were obtained during the low luminosity state (Fig. 1) on October 10, 2005 (JD 2453672). The star out-of-eclipse brightness dropped from $12^{\rm m}_{.}6$ to $13^{\rm m}_{.}7$ visual magnitudes for about 150 days. There are no outbursts observed during this state although the time interval between AAVSO visual measurements was sometimes longer than 25 days. This shows that the accretion disc temperature is high enough even in low state to hold the hydrogen in the ionized state and to prevent the appearance of the outbursts (this situation is typical for nova-like stars).

The eclipse light curve is shown in Fig. 2. For our observations, the out-of-eclipse brightness of the system was $13^{\rm m}_{.}74 \pm 0^{\rm m}_{.}06$ and in the mid-eclipse the magnitude was $15^{\rm m}_{.}83 \pm 0^{\rm m}_{.}04$. There is a small effect of the hotspot presence on the post eclipse light curve (0.05 - 0.1 phase interval). The light curve before the eclipse does not show the typical hump usually associated with a bright spot. This feature appears in cataclysmic variables due to anisotropic radiation of the hot spot in the place where the accretion flow shocks the accretion disc. Apparently the outer part of accretion disc is optically thin and we can see the hotspot structure from most directions.

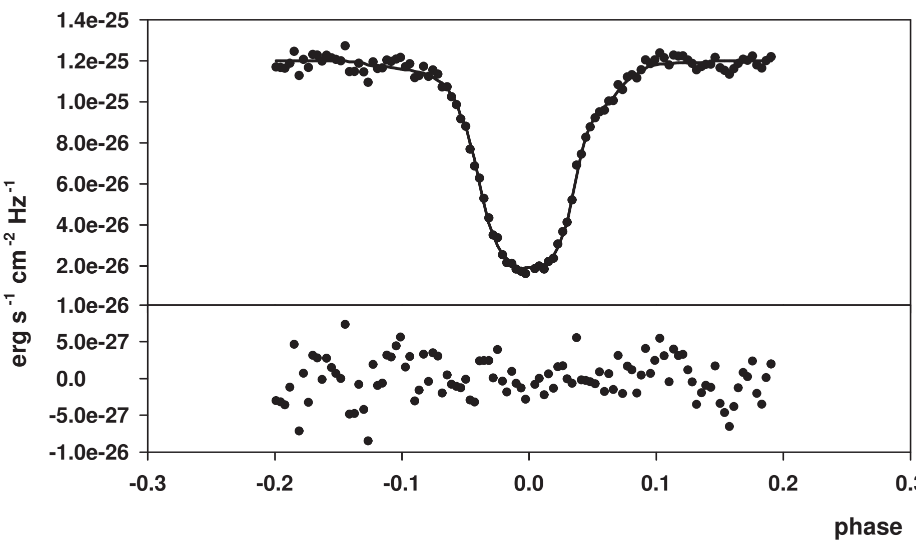

Figure 2. Top: normalized light curve of RW Tri and the model fit. Fluxes were calculated using zero magnitude absolute fluxes, determined by Bessel et al. (1998). Below: residuals for the fit. One can see that large amplitude residuals correspond to the flickering on out-of-eclipse parts of the light curve.

In this paper we used zero magnitude absolute fluxes, determined by Bessel et al. (1998) to prepare our observations for the eclipse mapping procedures.

We applied a genetic algorithm eclipse mapping technique (see Halevin, 2007 for detailed description) to calculate the eclipse map of the RW Tri accretion disc. In our modification the accretion disc brightness is modeled with a distribution of radiating points in the orbital plane inside the Roche lobe of the primary star. Our technique looks for an optimal spatial distribution of the points to fit the observed eclipse light curve. The system flux is reconstructed here by summing of the brightness of points visible at different phases.

To remove smooth orbital brightness variations we used a second-order polynomial approximation for the out-of-eclipse parts of the light curve. After that we divided the eclipse light curve by the approximation values and scaled the result with the polynomial value at zero phase.

In our models we used system parameters taken from Groot et al. (2004) ($M_{wd} = 0.7M_\odot$, $M_{rd} = 0.6M_\odot$, i=75°). Eclipse models for other system parameters estimates show either shifted or highly asymmetric accretion disc eclipse maps (Halevin & Henden, 2008).

One can see the normalized phase light curve of the eclipse with the fit and residuals in Fig. 2. To estimate the errors of our observations we calculated the scattering of the residuals in the eclipse time range where the flickering is not significant. The error value was obtained is σ_{me}=1.2·10^{-27} erg s^{-1} cm^{-2} Hz^{-1}. So in the mid-eclipse the signal-to-noise rate is about 15. Because the mid-eclipse and out-of-eclipse flux are f_{me}=2·10^{-26} and f_{oe}=1.2·10^{-25} erg s^{-1} cm^{-2} Hz^{-1} respectively, the error for the out-of-eclipse flux is $\sigma_{me}\sqrt{f_{oe}/f_{me}} \approx 2.94\cdot10^{-27}$ erg s^{-1} cm^{-2} Hz^{-1} and therefore has a signal to noise of ≈40.

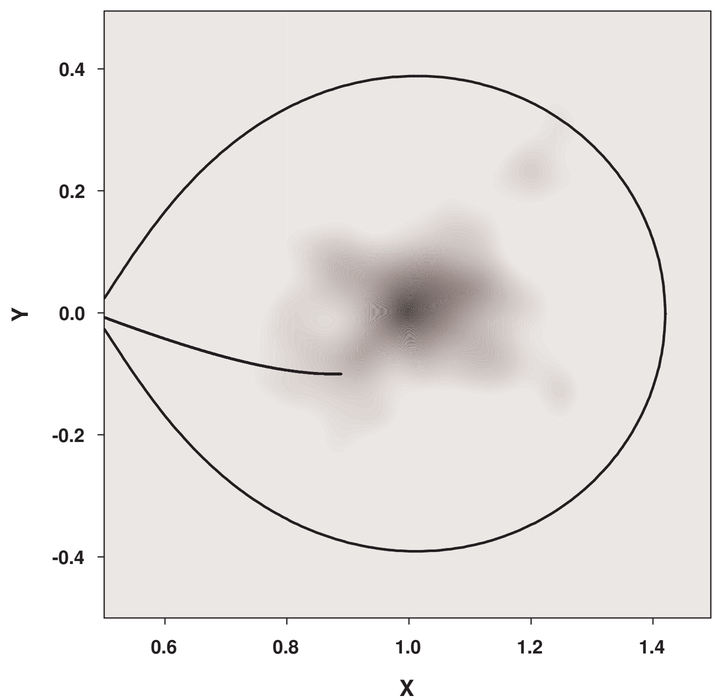

Figure 3. Eclipse map for the JD 2453672 light curve of RW Tri calculated for the system parameters $q = 0.86$ and $i = 75°$. The solid line is the ballistic trajectory of the accretion stream. Spatial coordinates are in orbital separation units.

To build the map of accretion disc we used a model with 300 radiating points. The corresponding smoothed map for the brightness distribution in the accretion disc is in Fig. 3. The solid line inside the Roche lobe shows a ballistic stream trajectory.

One can see that the brightest part of accretion disc is about $0.1a$ in radius and the hotspot distance is about $0.17a$. We consider this value as the real size of accretion disc.

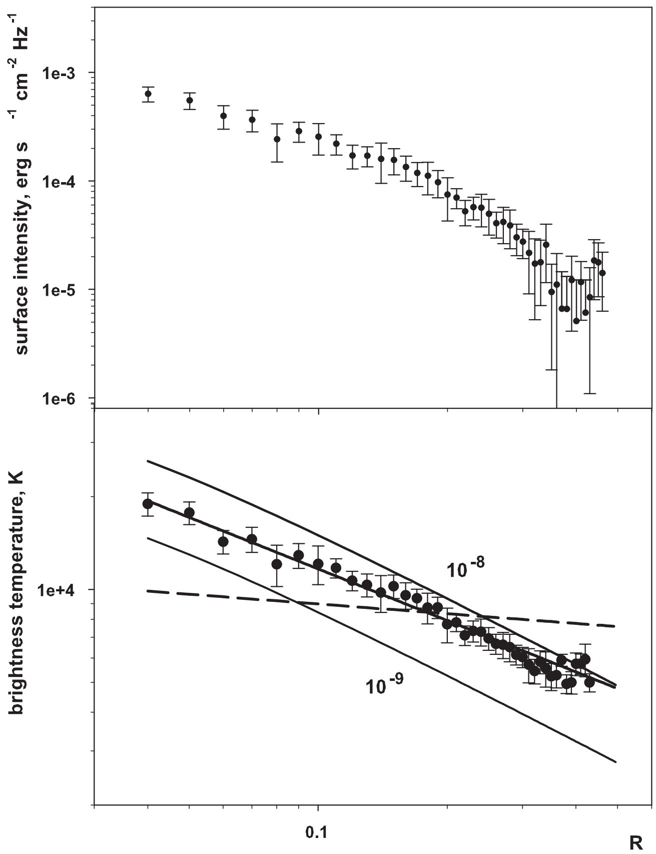

Figure 4. Azimuthally averaged radial intensity distribution in accretion disc for Fig. 3 eclipse map (top). Radial brightness temperature distribution in accretion disc. Solid lines are theoretical temperature distribution for steady state disc in the case of 10^{-8} and 10^{-9} $M_{\odot}$ year^{-1} mass accretion rate (bottom). Dashed line shows critical temperature above which gas is in steady accretion regime Warner (1995).

Trigonometric parallax determination with the Hubble Space Telescope gave a distance of 341 pc to RW Tri (McArthur et al. 1999). Using this distance estimate and the interstellar extinction A_V=$7\overset{m}{.}8{\cdot}10^{-4}$ pc^{-1} was taken using the value for the nearest object from Neckel et al. (1980), we calculated the radial brightness temperature distribution in the disc and compared it with predictions of accretion disc models. In the case of the A_V=0 one would obtain the temperature becomes about 13 percent lower. It shows the importance of the interstellar extinction accounting in our case.

In Fig. 4 the radial brightness temperature plot is shown. Here we compare the observed distribution with that predicted for steady state solutions for accretion rates of 10^{-8} and 10^{-9} solar masses per year. Our fit of the temperature distribution with that predicted from the steady state disc model gives the value $\dot{M} = (3.9{\pm}0.2){\cdot}10^{-9}$ $M_{\odot}$ year^{-1}. This result is close to that obtained from eclipse mapping by Rutten et al. (1992) value $\dot{M} = 3{\cdot}10^{-9}$ $M_{\odot}$ year^{-1} (during the low luminosity state).

We fitted the observed temperature distribution with the function $T = T_0 R^{-b}$ and found $b = 0.56(\pm 0.01)$. Our estimate of parameter b is far from that predicted in the steady state model 3/4 value. From Fig. 4 one can see that the temperature distribution consists of two different parts: for R less than $0.14a$ and for R greater than this radius. If we fit these parts separately, we obtain values $b = 0.52 \pm 0.04$ for $R < 0.14a$ and $b = 0.74 \pm 0.03$ for $R > 0.14a$. This difference is typical for SW Sex type stars.

Our mass accretion rate estimate is less than that determined by the Horne & Stiening (1985) value of $\dot{M} = 10^{-7.9}$ $M_\odot$ year^{-1}, but during their observations the system was in the high luminosity state (V $\approx 12^{\rm m}_{.}5$) and the authors used lower distance value to be 300 pc. According to their data the temperature in the disc does not drop below the critical value, above which gas remains in the steady state accretion regime, typical for classical nova-like systems.

The dashed curve in Fig. 4. shows the critical temperature level Warner (1995), calculated for the RW Tri system parameters. One can see that the temperature drops below critical value immediately after the hotspot distance and, hence, the most probable accretion disc radius. It is enough for the accretion disc to remain in the steady state.

Using eclipse mapping techniques we calculated the radial brightness temperature distribution. For inner parts of accretion disc the slope of this distribution is close to the $R^{-1/2}$ law. For outer parts the temperature distribution corresponds to a steady state $R^{-3/4}$ law. We estimated the mass accretion rate in the system as $\dot{M} = (3.9 \pm 0.2) \cdot 10^{-9}$ $M_\odot$ year^{-1}. Our results show that even during the low luminosity phase, disc remains in the hot steady state.

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DWARF NOVA TRIANGULI 2008 AS A WZ SGE-TYPE OBJECT

SHUGAROV, S. YU.[1,2]; VOLKOV, I. M.[1,2]; CHOCHOL, D.[2]

[1] Sternberg Astronomical Institute, Moscow University, Universitetsky Ave., 13, Moscow 119992, Russia; e-mail: shugarov@ta3.sk; imv@sai.msu.ru

[2] Astronomical Institute of the Slovak Academy of Sciences, 059 60 Tatranská Lomnica, Slovak Republic; e-mail: chochol@ta3.sk

On Oct. 26, 2008, Maehara (2008) reported outburst of the dwarf nova in Triangulum at the coordinates $\alpha = 02^{\rm h}38^{\rm m}39\overset{\rm s}{.}11$, $\delta = +35°56'48\overset{''}{.}3$ J2000. The brightness of the nova at the time of discovery was $14\overset{\rm m}{.}12$, measured with unfiltered CCD. A faint counterpart with $J = 21.74$ was found in GSC2.3. It indicates large amplitude super-outburst $\sim 8^m$, typical for WZ Sge-type dwarf novae. These objects are characterized by the "outburst orbital humps" or "early superhumps", which appear in the early phase of outburst with the binary orbital period. Nakajima (see Kato, 2008a) did not detect any clear superhumps larger than $0\overset{\rm m}{.}1$ during the 7.5 hour observations of this dwarf nova before Oct. 28, 2008.

Our $UBV(RI)_{\rm C}$ observations of the superoutburst of the dwarf Nova Tri 2008 were obtained with the 0.5 m telescope of the Astronomical Institute of the Slovak Academy of Sciences at Stará Lesná Observatory from October 26, 2008 till November 7, 2008. The SBIG ST10-MXE CCD camera (2184x1472) was used. The part of our CCD frame with the object and comparison stars is presented in Fig. 1.

In this paper we analyse only our V observations. We used GSC 2336 2105 ($V = 9\overset{\rm m}{.}95$ according to Hipparcos and Tycho Catalogues (ESA, 1997) and our own measurements) as a comparison star. (No. 1 in the finding chart shown in Fig. 1.) Its constancy was checked against a number of check stars in the field. (No. 2 – 4 in Fig. 1.)

The light curve of the outburst in V passband is presented in Fig. 2. The higher resolution of observational runs **A** (early superhumps) and **B** (ordinary superhumps) are shown in Fig. 3.

Fourier period analysis of our CCD observations taken from Oct. 26 till Nov. 1, 2008 (during the first 8 nights of the superoutburst), after trend removal, revealed the presence of small amplitude early superhumps (double-humped variations) with the period 76.46 ± 0.5 minutes ($0\overset{\rm d}{.}0531$). This period was used to construct the phase diagram of the residuals. Their mean values with errors are given in Fig. 4. The observations taken from Nov. 2 till Nov. 7, 2008 revealed the presence of 77.33 ± 0.2 minutes ($0\overset{\rm d}{.}0537$) superhumps. Their phase diagram is presented in Fig. 5. It is remarkable, that the superhump period of dwarf Nova Tri 2008 is the shortest one among WZ Sge-type objects.

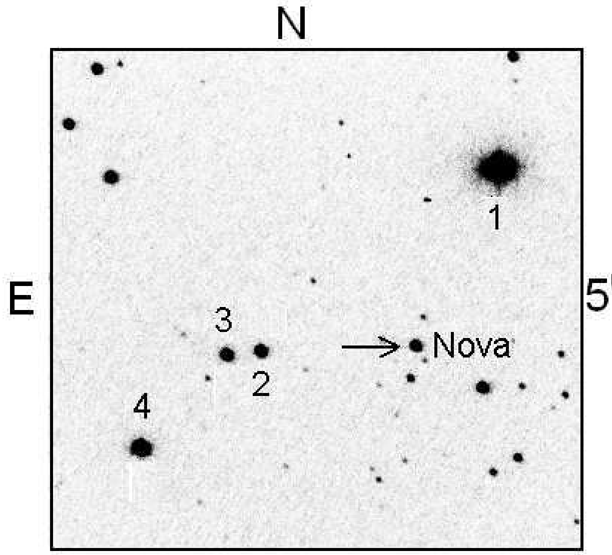

Figure 1. $UBV(RI)_C$ photometric comparison sequence around dwarf Nova Tri 2008.

Similar period values were obtained just recently by Maehara and Ohshima (see Kato, 2008b).

This research made use of the SIMBAD data base, operated by the CDS at Strasbourg, France.

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ERRATUM FOR IBVS 5862

In IBVS 5862, the discovery of the CV was incorrectly attributed to Maehara (2008). The variable was discovered by the Catalina Real Time Transient Survey and designated as CSS081026:023839+355648.

Reference:

Cataclysmic Variables detected by CSS, http://nesssi.cacr.caltech.edu/catalina/BrightCV.html

The Editors

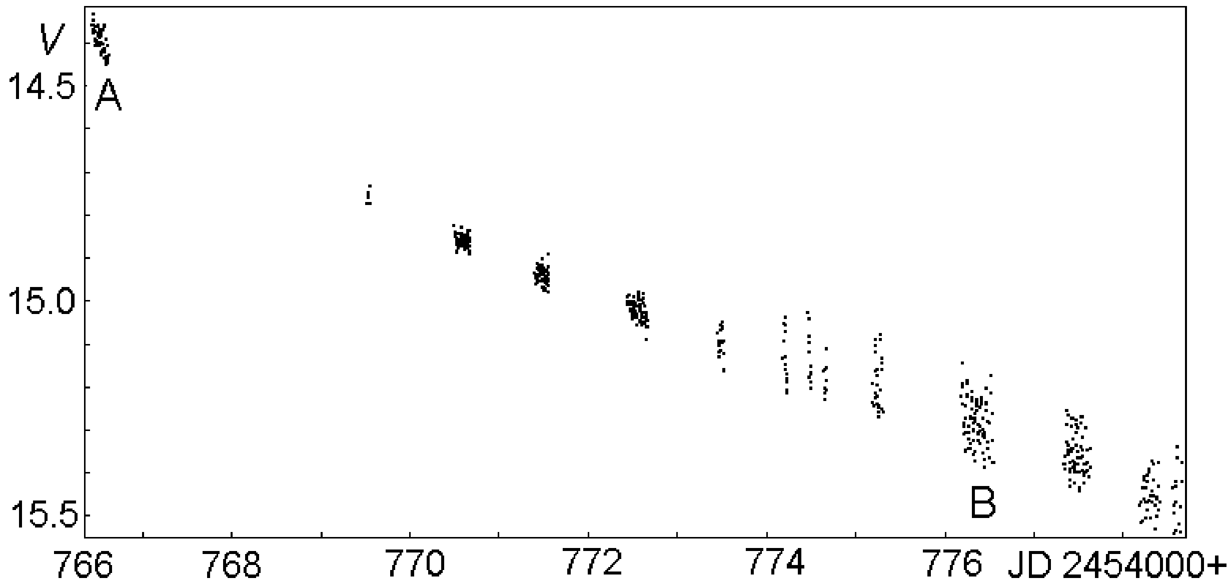

Figure 2. The light curve of dwarf Nova Tri 2008. The higher resolution of observational runs **A** and **B** are shown in Fig. 3.

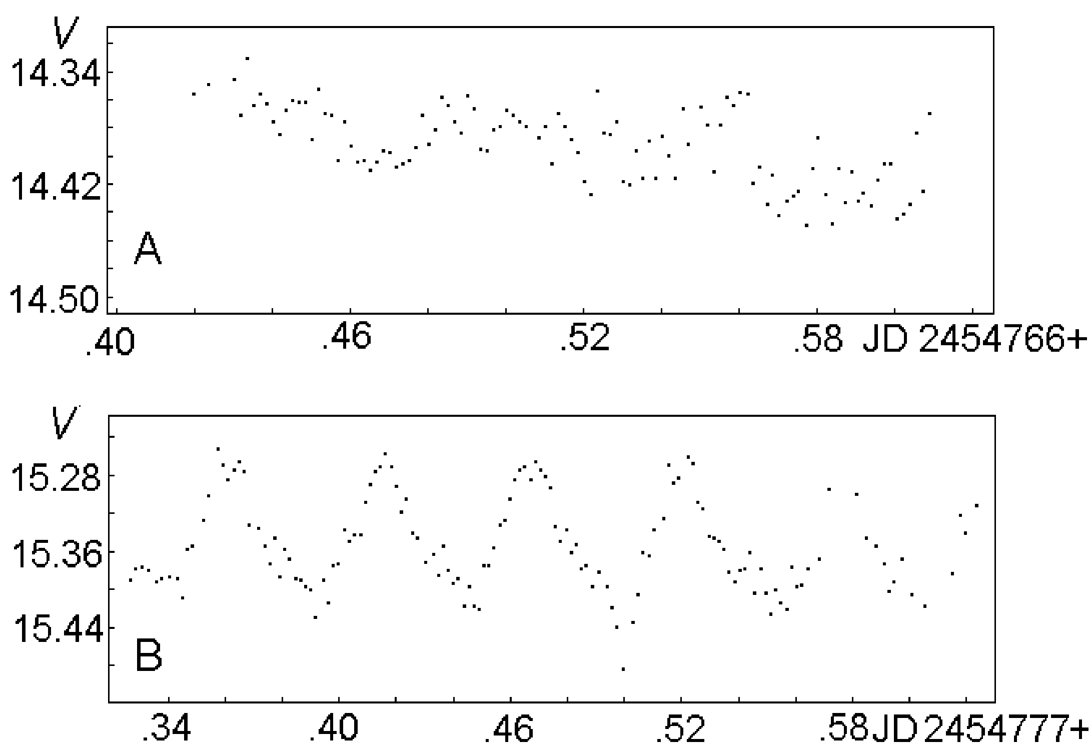

Figure 3. The early superhumps (**A**) and ordinary superhumps (**B**).

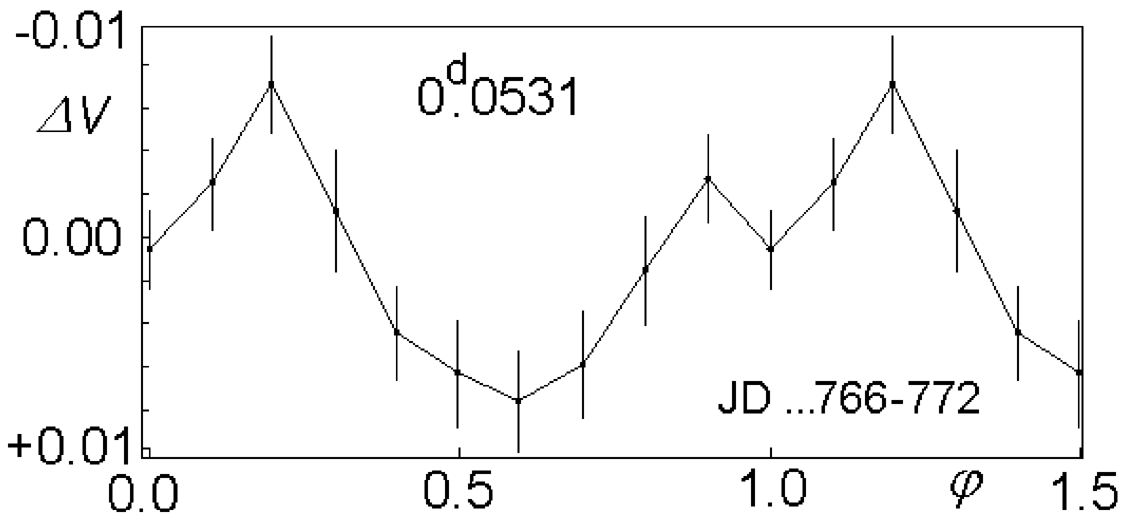

Figure 4. The phase diagram of early superhumps (mean values).

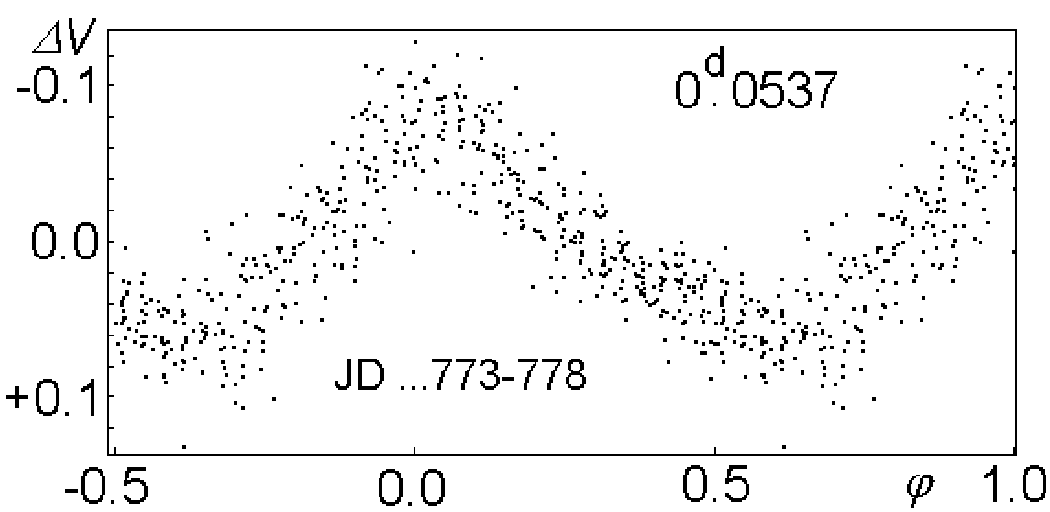

Figure 5. The phase diagram of ordinary superhumps.

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THE 79TH NAME-LIST OF VARIABLE STARS

KAZAROVETS, E.V.[1]; SAMUS, N.N.[1,2]; DURLEVICH, O.V.[2]; KIREEVA, N.N.[1]; PASTUKHOVA, E.N.[1]

[1] Institute of Astronomy, Russian Academy of Sciences, 48, Pyatnitskaya Str., Moscow 119017, Russia [elena_k@sai.msu.ru, kireeva@sai.msu.ru, pastukhova@sai.msu.ru, samus@sai.msu.ru]

[2] Sternberg Astronomical Institute, University of Moscow, 13, University Ave., Moscow 119992, Russia [gcvs@sai.msu.ru]

The present 79th Name-List of Variable Stars contains data necessary for identifications of new variables finally designated in 2008. This list is special because it contains almost only stars earlier included into the NSV catalogue (Kholopov, 1982) or its Supplement (Kazarovets et al., 1998). Exceptions are several Novae and unusual variables named upon requests of the IAU Bureau of Astronomical Telegrams. With the 1270 stars of the current Name-List, the total number of named variable stars, not counting designated non-existing stars or stars subsequently identified with earlier-named variables, is now 41 483.

In order to keep the volume of this publication reasonable, we decided to separate the catalogue of newly designated variables (to be published elsewhere in the nearest future) from the Name-List proper. In accordance to this, Table 1 of the current Name-List, dealing with stars that were already catalogued, contains the NSV number, new GCVS name, equatorial coordinates (rounded to an accuracy sufficient for identification), and variability type for each star. The order of stars in Table 1 corresponds to the order of stars in the GCVS. The electronic version of the Name-List at http://www.sai.msu.su/gcvs/gcvs/nl79 additionally presents variability ranges, identifications with astronomical catalogues, and bibliographic references for the newly named variable stars. The remarks concerning the two unusual variables, V1710 Aql (type *) and V1129 Cen (type EB+*) follow Table 1.

The stars in Table 1 were selected in the course of our large-scale systematic revision of the NSV catalogue. For a part of them, studies by different authors have been published during the recent decades. For many other stars, we were able to properly study and classify them using publicly available data of modern automatic sky surveys, first of all, of the ASAS-3 survey (Pojmanski, 2002).

As usual, we continued naming Novae and other variables of astrophysical importance upon requests from the IAU Bureau of Astronomical Telegrams. Such stars, named since the 78th Name-List (Kazarovets et al., 2006), are listed in Table 2. It contains, for each star, its GCVS name, equatorial coordinates (rounded to an accuracy sufficient for identification), variability type, range of variation with the photometric system indicated (an asterisk means an instrumental CCD system), epoch of maximum brightness (for Novae), and two references. The first reference is to the discovery announcement and the second one, to the finding chart. "2MASS" instead of the second reference means that the star can be found using its coordinates in the 2MASS catalogue (Cutri et al., 2003).

This study was supported in part by Russian Foundation for Basic Research through grant 08-02-00375, by the Programme "Origin and Evolution of Stars and Galaxies" of the Presidium of Russian Academy of Sciences, and by the Support Programme for Leading Scientific Schools of Russia (grant NSh 433.2008.2). Our research has made extensive use of the excellent ASAS-3 data base. Effective software for period determination was kindly provided by Dr. V.P. Goranskij. Thanks are due to Dr. B. Reipurth for valuable suggestions.

References:

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ERRATUM FOR IBVS 5721

In IBVS No. 5721 ("The 78th Name-List of Variable Stars"), erroneous coordinates of V2609 Oph were given. The coordinates of this variable should correctly be $17^{\rm h}53^{\rm m}34\overset{\rm s}{.}1$ $+05^\circ24'58''$(2000.0).

Table 1

NSV	Name		R.A., 2000.0 h m s	Decl., 2000.0 o ’ "	Type	NSV	Name		R.A., 2000.0 h m s	Decl., 2000.0 o ’ "	Type
00098	V0456	And	00 13 52.6	+45 26 34	SR	24897	V1717	Aql	19 49 01.5	+00 29 12	M
00288	V0457	And	00 45 42.2	+46 11 58	M:	12461	V1718	Aql	19 50 34.0	+00 54 38	SRB
00608	V0458	And	01 44 02.1	+48 02 43	EA	24909	V1719	Aql	19 50 44.2	+01 45 50	EA
00854	V0459	And	02 33 57.9	+45 59 56	M	12510	V1720	Aql	19 52 54.1	+06 40 54	LB
00855	V0460	And	02 34 14.3	+42 14 28	DSCT	24910	alpha	Aql	19 50 47.0	+08 52 06	DSCT
14453	V0461	And	23 11 59.0	+49 39 37	LB	20721	V0882	Ara	16 39 56.4	-61 09 28	EA
14500	V0462	And	23 19 32.6	+45 55 32	EA	07991	V0883	Ara	16 51 45.1	-50 17 47	EA
14514	V0463	And	23 20 13.9	+37 08 40	EB	08110	V0884	Ara	17 02 41.0	-58 54 20	EA
26077	V0464	And	23 24 01.8	+46 52 12	SRB	08125	V0885	Ara	17 03 59.7	-63 24 36	EB
14742	V0465	And	23 53 15.9	+46 53 06	LB	21540	V0886	Ara	17 21 56.2	-51 25 26	SRB
04537	BG	Ant	09 34 23.7	-25 33 13	EB	08629	V0887	Ara	17 27 10.1	-57 11 44	EB:
04565	BH	Ant	09 39 14.5	-24 40 37	SRB	08808	V0888	Ara	17 30 30.6	-61 46 25	EW
04593	BI	Ant	09 42 53.8	-40 12 54	SRA	09348	V0889	Ara	17 39 42.0	-52 38 03	EA
04604	BK	Ant	09 44 14.8	-39 39 41	RRAB	09472	V0890	Ara	17 41 34.5	-48 54 36	CWA
04649	BL	Ant	09 50 53.5	-27 07 18	EW	09482	V0891	Ara	17 41 50.2	-51 53 36	EB
04652	BM	Ant	09 51 08.6	-29 08 51	EW	09542	V0892	Ara	17 43 27.5	-52 21 43	EA
04681	BN	Ant	09 57 06.0	-39 17 26	RRAB	09650	V0893	Ara	17 47 03.3	-46 33 49	EA
04749	BO	Ant	10 07 53.8	-32 35 52	EB	09677	V0894	Ara	17 48 30.3	-51 13 36	EA
04766	BP	Ant	10 10 31.4	-36 32 13	M	10164	V0895	Ara	18 06 01.7	-47 31 27	RVA
04792	BQ	Ant	10 14 16.6	-33 43 22	SRB	10161	V0896	Ara	18 06 16.7	-56 02 13	EA
04801	BR	Ant	10 15 55.5	-30 57 52	LB	00930	BD	Ari	02 48 12.4	+16 16 28	SRB
04817	BS	Ant	10 17 53.4	-37 50 12	SRB	01707	V0556	Aur	04 45 18.8	+35 58 15	SR
04885	BT	Ant	10 32 02.6	-30 10 37	RR	01732	V0557	Aur	04 50 46.7	+42 40 32	SR:
04925	BU	Ant	10 39 10.2	-39 39 28	LB	01753	V0558	Aur	04 53 40.1	+37 18 44	SR:
05056	BV	Ant	11 01 25.5	-37 10 18	EA	01766	V0559	Aur	04 55 45.0	+41 52 27	SR:
06592	PT	Aps	14 15 33.0	-72 17 40	EA	16199	V0560	Aur	04 56 42.8	+39 17 24	EA
06722	PU	Aps	14 37 53.2	-74 21 57	EA	01813	V0561	Aur	05 03 54.2	+29 49 04	LB
06956	PV	Aps	15 11 28.5	-73 25 34	EA	01916	V0562	Aur	05 18 55.3	+29 38 21	EW
07039	PW	Aps	15 25 28.4	-78 26 55	SRB	01943	V0563	Aur	05 22 00.6	+32 53 53	LB
07907	PX	Aps	16 45 29.9	-76 48 19	EB:	02072	V0564	Aur	05 32 05.0	+30 06 55	SRB
08251	PY	Aps	17 13 40.1	-73 53 43	SRB	02432	V0565	Aur	05 37 42.4	+39 15 30	EA
08564	PZ	Aps	17 24 47.0	-69 08 48	EA	02565	V0566	Aur	05 42 03.0	+41 03 48	SR
10349	QQ	Aps	18 17 01.8	-78 10 33	EA	02591	V0567	Aur	05 43 37.0	+33 54 14	EW
13281	NZ	Aqr	20 46 05.1	-04 31 07	LB	02590	V0568	Aur	05 43 55.5	+44 51 40	SRB
13331	OO	Aqr	20 49 43.2	-13 07 36	EW	02621	V0569	Aur	05 46 34.2	+44 26 52	EB
13435	OP	Aqr	20 58 10.4	-03 07 31	LB	02645	V0570	Aur	05 49 27.8	+44 39 24	SRB
13526	OQ	Aqr	21 06 09.1	-08 11 12	SRB	02651	V0571	Aur	05 49 41.9	+39 54 40	LB
25517	OR	Aqr	21 13 13.7	-04 16 00	EA	02735	V0572	Aur	05 56 51.0	+30 06 57	LB
13694	OS	Aqr	21 25 39.2	-13 32 19	EB	02739	V0573	Aur	05 58 04.3	+46 48 11	LB
25913	OT	Aqr	22 29 13.3	-09 02 54	SRB	02763	V0574	Aur	06 01 48.7	+51 45 03	RRAB
14437	OU	Aqr	23 08 48.0	-12 20 40	LB	02828	V0575	Aur	06 07 30.9	+51 06 53	RRAB
26081	OV	Aqr	23 26 08.6	-19 22 24	EA	02850	V0576	Aur	06 10 11.3	+30 01 44	EA
14603	OW	Aqr	23 32 18.0	-17 23 51	RRAB	16791	V0577	Aur	06 10 18.1	+32 03 11	SR:
14744	OX	Aqr	23 54 01.3	-07 40 39	RRAB	02939	V0578	Aur	06 22 50.0	+30 19 52	LB
11441	V1707	Aql	18 52 03.7	+11 17 26	EA	02951	V0579	Aur	06 25 46.5	+46 19 58	EA
11493	V1708	Aql	18 53 57.5	+01 36 41	SR:	03008	V0580	Aur	06 32 14.1	+31 09 54	EA
24627	V1709	Aql	18 54 54.4	+01 07 18	GDOR	06461	HQ	Boo	13 49 52.2	+12 22 29	RRAB
24661	V1710	Aql	19 02 00.3	+02 09 11	*	06813	HR	Boo	14 48 33.0	+21 44 01	EW
24712	V1711	Aql	19 13 15.2	+01 34 38	LB	06881	HS	Boo	15 00 06.3	+21 47 43	RRAB
12008	V1712	Aql	19 25 28.5	+11 23 39	EW	06940	HT	Boo	15 06 46.1	+21 26 17	RRAB
12215	V1713	Aql	19 37 44.0	+01 49 36	EW	06948	HU	Boo	15 07 31.5	+25 03 07	RRC
12263	V1714	Aql	19 39 39.5	+09 34 10	EA	06969	HV	Boo	15 09 49.8	+26 51 15	RRAB
12374	V1715	Aql	19 45 39.2	-05 19 18	M	01698	SW	Cae	04 41 41.9	-33 14 53	SRB
12433	V1716	Aql	19 48 58.7	+12 34 06	SRB	01708	SX	Cae	04 43 56.5	-43 05 19	EA

Table 1 (continued)

NSV	Name	R.A., Decl., 2000.0 h m s ° ' "	Type	NSV	Name	R.A., Decl., 2000.0 h m s ° ' "	Type
01403	MX Cam	03 56 24.5 +69 02 28	EA	03475	V0395 CMa	07 14 20.3 -19 40 22	SRB
15852	MY Cam	03 59 18.3 +57 14 14	ELL	03482	V0396 CMa	07 14 42.1 -17 25 41	LB
01444	MZ Cam	04 05 15.9 +54 36 11	DCEPS	03489	V0397 CMa	07 15 18.3 -16 16 12	EA
01485	NN Cam	04 12 38.2 +69 29 09	UG	17456	V0398 CMa	07 23 34.7 -31 18 00	EA
01495	NO Cam	04 14 51.6 +75 20 41	EW	03434	DF CMi	07 10 23.2 +06 29 12	SRB
02748	NP Cam	06 02 05.2 +72 51 05	SRD:	03521	DG CMi	07 18 33.4 +09 29 40	EA
03715	NQ Cam	07 48 12.8 +72 29 17	EW	03522	DH CMi	07 18 44.8 +10 21 53	SRB
03754	NR Cam	07 54 30.6 +78 06 45	EW	03594	DI CMi	07 27 00.3 +03 58 27	LB
03771	NS Cam	07 55 39.7 +74 15 11	EB	03637	DK CMi	07 33 14.2 +02 44 16	EA
04019	NT Cam	08 24 17.4 +74 30 25	DSCT	03710	DL CMi	07 44 36.4 +07 16 52	EA
04638	NU Cam	09 54 47.4 +83 21 01	EB	17647	DM CMi	07 53 59.9 +03 45 00	EA
04069	IR Cnc	08 26 18.4 +23 15 13	EB	03927	DN CMi	08 09 52.9 +05 03 37	SRB
04150	IS Cnc	08 36 47.4 +06 59 22	LB	13698	CP Cap	21 25 59.3 -15 03 05	RRC:
04207	IT Cnc	08 42 42.6 +21 24 57	EW:	13702	CQ Cap	21 26 32.7 -17 52 42	EB
04347	IU Cnc	09 00 59.1 +12 58 52	EW	13710	CR Cap	21 27 21.2 -19 07 59	RR(B)
06154	EK CVn	13 14 32.5 +34 20 56	LB:	13967	CS Cap	21 56 54.3 -12 12 50	SRB
19773	EL CVn	13 23 57.0 +43 35 55	EA	17246	V0603 Car	06 55 10.1 -62 07 47	RRAB
06227	EM CVn	13 24 22.8 +48 04 38	SR	03497	V0604 Car	07 14 50.6 -59 16 04	EW
06303	EN CVn	13 32 05.3 +46 00 07	EA	03687	V0605 Car	07 39 50.2 -53 38 28	EB
02888	V0360 CMa	06 15 07.6 -14 55 04	RRAB	03725	V0606 Car	07 44 38.7 -56 42 32	EA
02956	V0361 CMa	06 25 01.2 -23 28 26	SRB	17677	V0607 Car	07 56 22.7 -61 17 02	ACV
02969	V0362 CMa	06 26 50.3 -23 15 06	EB	03920	V0608 Car	08 07 34.0 -55 19 37	EW
02985	V0363 CMa	06 29 41.3 -20 21 46	SRB	04408	V0609 Car	09 10 25.5 -57 30 22	EA
03015	V0364 CMa	06 31 47.7 -14 54 51	SRB	04476	V0610 Car	09 22 59.8 -59 44 56	EA
03037	V0365 CMa	06 35 17.9 -15 22 50	SRA	04528	V0611 Car	09 31 35.2 -65 51 05	EA
03044	V0366 CMa	06 35 41.1 -29 12 46	SRA	04535	V0612 Car	09 33 14.2 -64 21 07	M
03042	V0367 CMa	06 35 46.9 -13 05 02	SR:	04546	V0613 Car	09 35 16.6 -60 27 28	EA
03046	V0368 CMa	06 36 39.5 -16 59 34	SRB	04559	V0614 Car	09 36 57.8 -65 50 07	SRB
03051	V0369 CMa	06 37 16.5 -29 50 02	SRB	04560	V0615 Car	09 37 35.8 -58 30 38	SRB
03084	V0370 CMa	06 40 05.5 -13 55 31	SRB	04591	V0616 Car	09 41 07.2 -72 53 19	LB
03169	V0371 CMa	06 41 08.1 -20 09 05	SRB	04589	V0617 Car	09 41 33.9 -61 39 03	M
03184	V0372 CMa	06 43 14.2 -15 56 12	SRB	04592	V0618 Car	09 42 11.8 -59 02 18	SRA
03209	V0373 CMa	06 46 33.0 -19 19 18	SRB	04610	V0619 Car	09 43 13.0 -72 06 38	LB
03242	V0374 CMa	06 51 23.2 -16 14 56	SRB	04603	V0620 Car	09 43 16.3 -66 03 52	LB
03251	V0375 CMa	06 52 05.7 -13 29 57	EA	04606	V0621 Car	09 43 41.4 -61 32 15	M
03267	V0376 CMa	06 54 04.7 -19 29 54	LB	04611	V0622 Car	09 43 47.1 -66 04 54	SRB
17233	V0377 CMa	06 55 16.1 -17 12 55	EA	04625	V0623 Car	09 45 33.8 -73 58 00	EA
03308	V0378 CMa	06 57 14.1 -31 24 58	EB	04626	V0624 Car	09 45 58.0 -72 12 38	SRB
03327	V0379 CMa	06 59 55.8 -15 55 47	LB	04657	V0625 Car	09 50 47.8 -67 23 15	EW
03336	V0380 CMa	07 01 04.0 -18 51 36	LB	04659	V0626 Car	09 50 48.0 -69 06 03	LB
17283	V0381 CMa	07 01 32.1 -27 51 34	EB	04655	V0627 Car	09 51 08.6 -57 08 45	SRA:
03348	V0382 CMa	07 02 29.7 -15 39 20	SRB	04666	V0628 Car	09 51 33.2 -73 36 11	SRB
03357	V0383 CMa	07 03 11.0 -24 51 06	SRB	04670	V0629 Car	09 53 04.6 -65 48 10	EW
03362	V0384 CMa	07 03 55.1 -17 52 48	DCEP	04679	V0630 Car	09 54 59.7 -61 57 40	M:
03361	V0385 CMa	07 04 04.7 -16 06 22	SRB	04687	V0631 Car	09 57 18.3 -67 10 09	SRB
03366	V0386 CMa	07 04 32.3 -19 37 46	LB	04686	V0632 Car	09 57 50.3 -58 15 33	EA
03384	V0387 CMa	07 05 36.1 -25 06 33	SRB	04700	V0633 Car	09 58 22.5 -72 29 37	EA
17336	V0388 CMa	07 06 07.4 -12 57 08	EA	04708	V0634 Car	10 00 19.4 -69 13 40	SRA:
03391	V0389 CMa	07 06 17.2 -24 36 58	LB:	04711	V0635 Car	10 00 30.0 -69 58 21	EB
03393	V0390 CMa	07 06 38.0 -15 48 07	DCEP	04714	V0636 Car	10 01 03.4 -68 54 19	M
03433	V0391 CMa	07 09 46.2 -20 05 35	EA	04716	V0637 Car	10 01 23.7 -71 17 01	RRC
03439	V0392 CMa	07 10 16.4 -16 15 49	SRB	04718	V0638 Car	10 02 08.6 -70 06 35	SRA
03466	V0393 CMa	07 13 18.2 -14 34 47	SRB	04722	V0639 Car	10 02 34.7 -75 00 37	RRC
03471	V0394 CMa	07 14 01.7 -14 36 01	LB	04727	V0640 Car	10 04 30.3 -58 39 52	INA

Table 1 (continued)

NSV	Name	R.A., Decl., 2000.0 h m s ° ' "	Type	NSV	Name	R.A., Decl., 2000.0 h m s ° ' "	Type
04728	V0641 Car	10 04 57.7 -60 04 56	M	14606	V1020 Cas	23 32 39.0 +63 04 09	DCEP
04735	V0642 Car	10 05 27.8 -67 36 59	M:	14638	V1021 Cas	23 35 24.0 +61 50 12	EA
04737	V0643 Car	10 06 09.0 -60 10 37	M	14773	V1022 Cas	23 57 08.5 +55 42 21	EA
04751	V0644 Car	10 06 47.5 -71 50 43	SR	18645	V1066 Cen	11 06 38.2 -49 18 00	SR
04754	V0645 Car	10 07 34.1 -63 09 49	M	05092	V1067 Cen	11 07 14.9 -44 11 34	M
04760	V0646 Car	10 09 14.3 -62 42 23	M	05095	V1068 Cen	11 07 25.4 -52 48 00	M
04769	V0647 Car	10 10 35.6 -61 51 48	SRB	05094	V1069 Cen	11 07 25.7 -42 46 31	M
04775	V0648 Car	10 11 02.9 -57 48 14	ZAND:	05130	V1070 Cen	11 11 39.7 -54 11 25	SRA:
04783	V0649 Car	10 12 46.3 -57 49 51	M	05128	V1071 Cen	11 12 07.6 -37 34 37	EA
04795	V0650 Car	10 14 12.1 -66 08 19	M	05131	V1072 Cen	11 12 13.3 -55 17 00	M
04830	V0651 Car	10 21 23.9 -68 50 23	M	05135	V1073 Cen	11 12 32.6 -47 33 41	M
04853	V0652 Car	10 24 54.1 -63 52 14	SRA:	05136	V1074 Cen	11 12 37.1 -56 20 16	EA
04858	V0653 Car	10 25 39.6 -68 14 56	M	05141	V1075 Cen	11 13 39.4 -47 27 23	M
18424	V0654 Car	10 29 24.6 -60 05 16	EA	05145	V1076 Cen	11 14 22.4 -42 40 20	M
04881	V0655 Car	10 30 08.8 -66 59 05	EA	05148	V1077 Cen	11 14 59.9 -42 28 27	M
04910	V0656 Car	10 36 27.1 -62 11 33	DCEP	05156	V1078 Cen	11 16 41.6 -42 38 10	EA
04919	V0657 Car	10 38 27.3 -57 19 38	M	05164	V1079 Cen	11 17 35.4 -51 37 40	M
18470	V0658 Car	10 38 47.3 -58 43 32	EA	05167	V1080 Cen	11 18 06.6 -46 08 51	M
04944	V0659 Car	10 41 13.2 -71 33 15	M	05176	V1081 Cen	11 21 58.3 -49 28 55	M
18486	V0660 Car	10 43 39.6 -60 10 22	M:	05177	V1082 Cen	11 22 05.5 -47 17 33	EA
18497	V0661 Car	10 44 00.4 -59 52 28	EA	05194	V1083 Cen	11 25 08.3 -60 31 28	LB
18518	V0662 Car	10 45 36.3 -59 48 23	EB	05201	V1084 Cen	11 26 12.2 -51 21 38	SRB
04984	V0663 Car	10 48 46.4 -69 17 50	M	05207	V1085 Cen	11 26 46.2 -50 47 14	M
04991	V0664 Car	10 50 30.7 -72 44 36	M	05215	V1086 Cen	11 28 18.5 -49 15 00	M
04996	V0665 Car	10 51 52.0 -66 20 07	EA	18773	V1087 Cen	11 28 52.0 -62 55 52	EA
05001	V0666 Car	10 52 08.2 -73 36 39	SRB	05218	V1088 Cen	11 28 55.8 -53 43 00	SRB
05002	V0667 Car	10 52 44.3 -58 10 39	SRB	18786	V1089 Cen	11 31 48.7 -60 41 36	EA
05009	V0668 Car	10 52 55.3 -69 39 08	M	05239	V1090 Cen	11 32 02.0 -44 23 02	M
05010	V0669 Car	10 53 23.8 -59 35 12	SRA:	05250	V1091 Cen	11 33 29.1 -53 37 13	M
05027	V0670 Car	10 56 36.5 -71 32 27	M	05265	V1092 Cen	11 36 26.2 -61 19 10	LC
05039	V0671 Car	10 58 09.3 -72 14 46	M	05264	V1093 Cen	11 36 26.7 -59 30 57	EA
05046	V0672 Car	10 59 25.4 -58 12 18	M	05266	V1094 Cen	11 36 33.8 -46 30 07	EB
05084	V0673 Car	11 05 38.6 -73 15 48	M	05297	V1095 Cen	11 41 48.8 -51 52 29	M:
18655	V0674 Car	11 06 50.2 -59 50 48	EA	05302	V1096 Cen	11 42 48.4 -51 46 09	SRB
05098	V0675 Car	11 07 42.1 -71 35 41	SRA:	18909	V1097 Cen	11 46 59.8 -62 28 29	EB
05112	V0676 Car	11 09 19.6 -71 48 11	SRB	05330	V1098 Cen	11 47 04.3 -62 28 55	SR:
05142	V0677 Car	11 13 28.9 -67 35 29	M	05335	V1099 Cen	11 47 20.2 -61 54 58	EB
05166	V0678 Car	11 17 29.0 -74 03 09	SRB	05340	V1100 Cen	11 47 53.8 -63 44 59	M
00042	V1004 Cas	00 07 19.1 +64 17 00	EA	05352	V1101 Cen	11 49 14.5 -46 13 23	EA
15024	V1005 Cas	00 07 25.3 +63 20 57	EA	05354	V1102 Cen	11 49 30.1 -35 46 54	SRB
15025	V1006 Cas	00 07 37.5 +53 31 36	GDOR	05363	V1103 Cen	11 51 13.6 -38 03 14	SRB
00049	V1007 Cas	00 08 03.3 +51 08 03	EW	05369	V1104 Cen	11 51 42.7 -62 53 11	EB
00135	V1008 Cas	00 21 16.2 +48 11 06	LB	05381	V1105 Cen	11 54 08.7 -54 10 17	SRB
00320	V1009 Cas	00 51 09.9 +56 04 59	EB	05386	V1106 Cen	11 55 12.9 -56 52 21	EB
00353	V1010 Cas	00 57 57.0 +60 06 15	EA	05405	V1107 Cen	11 59 03.5 -52 35 06	SRA
00381	V1011 Cas	01 04 15.0 +62 32 16	EB	05411	V1108 Cen	12 00 12.7 -42 12 04	SRA
15255	V1012 Cas	01 12 53.9 +51 36 08	GDOR	05418	V1109 Cen	12 00 46.1 -40 21 17	EA
00481	V1013 Cas	01 21 42.4 +61 46 07	DCEP	05440	V1110 Cen	12 03 47.8 -53 16 48	M
00517	V1014 Cas	01 28 36.5 +52 37 32	EB	05451	V1111 Cen	12 05 40.0 -35 45 17	SRB
00587	V1015 Cas	01 42 06.4 +70 43 39	EA	05459	V1112 Cen	12 06 37.7 -42 43 19	EW
15367	V1016 Cas	01 43 16.8 +59 59 51	DCEP	05460	V1113 Cen	12 06 46.9 -50 19 26	M
00752	V1017 Cas	02 14 24.8 +65 35 58	DCEP	05471	V1114 Cen	12 08 21.7 -43 04 01	RRC
01009	V1018 Cas	03 01 19.4 +60 34 20	EA	05480	V1115 Cen	12 10 06.8 -53 25 40	M
14486	V1019 Cas	23 17 51.6 +62 08 05	DCEPS	05487	V1116 Cen	12 11 03.2 -50 40 23	EA

Table 1 (continued)

NSV	Name	R.A., Decl., 2000.0 h m s ° ' "	Type	NSV	Name	R.A., Decl., 2000.0 h m s ° ' "	Type
05497	V1117 Cen	12 11 57.6 -50 50 42	EA	06187	V1171 Cen	13 20 35.5 -63 24 43	BE
19345	V1118 Cen	12 16 43.0 -45 52 03	EA	06200	V1172 Cen	13 21 37.6 -61 34 15	LB
05525	V1119 Cen	12 16 56.8 -45 12 07	EA	06202	V1173 Cen	13 21 42.9 -60 49 47	SRB
05541	V1120 Cen	12 18 37.0 -53 08 12	M	06203	V1174 Cen	13 21 49.9 -61 57 03	BE
05584	V1121 Cen	12 23 38.7 -34 24 13	EA	06208	V1175 Cen	13 22 28.7 -45 53 30	EA
05590	V1122 Cen	12 24 03.0 -41 49 08	SRB	19754	V1176 Cen	13 23 01.8 -62 26 32	EA
05601	V1123 Cen	12 24 53.5 -47 09 08	SRD	06218	V1177 Cen	13 24 18.2 -37 17 01	EA
05620	V1124 Cen	12 26 36.6 -52 25 25	M	06226	V1178 Cen	13 24 53.5 -39 44 03	EA
05642	V1125 Cen	12 29 01.2 -47 57 39	SRB	06234	V1179 Cen	13 25 56.5 -40 18 19	RRC
05700	V1126 Cen	12 32 54.5 -54 38 54	LB	06237	V1180 Cen	13 26 29.2 -64 29 51	M
05723	V1127 Cen	12 33 52.8 -34 49 58	SRB	06255	V1181 Cen	13 27 45.4 -37 46 59	RRAB
05743	V1128 Cen	12 35 14.7 -35 36 50	LB	06256	V1182 Cen	13 28 10.1 -48 02 29	EA
19448	V1129 Cen	12 39 07.9 -45 33 44	EB+*	06263	V1183 Cen	13 28 51.5 -32 00 09	LB
05849	V1130 Cen	12 40 46.4 -34 51 35	RRC	06268	V1184 Cen	13 29 07.0 -35 52 41	RRC
05861	V1131 Cen	12 41 56.6 -50 16 12	M	06266	V1185 Cen	13 29 13.0 -64 06 41	LB:
05868	V1132 Cen	12 42 09.6 -43 55 03	M:	06262	V1186 Cen	13 29 14.0 -59 27 33	LB
05891	V1133 Cen	12 43 15.0 -33 41 02	EA	06269	V1187 Cen	13 29 14.4 -44 14 02	SRB
05922	V1134 Cen	12 44 54.1 -40 17 18	RRAB	06294	V1188 Cen	13 32 04.2 -38 36 32	RRAB
05946	V1135 Cen	12 48 00.5 -44 01 20	M	06318	V1189 Cen	13 34 59.4 -35 52 16	RRAB
05964	V1136 Cen	12 49 33.0 -55 23 40	M	06279	V1190 Cen	13 35 14.8 -43 50 22	SRB
05989	V1137 Cen	12 50 56.1 -31 19 19	LB:	06338	V1191 Cen	13 36 19.2 -34 25 12	RRAB
06001	V1138 Cen	12 52 03.8 -31 02 53	RRC	06344	V1192 Cen	13 37 36.8 -38 11 45	M
06003	V1139 Cen	12 52 23.8 -31 03 27	EW	06346	V1193 Cen	13 38 07.8 -39 29 53	SRA
06010	V1140 Cen	12 53 16.4 -37 21 02	EW	06354	V1194 Cen	13 38 34.6 -49 42 59	EB
06032	V1141 Cen	12 57 00.3 -33 30 07	LB	06358	V1195 Cen	13 39 39.4 -40 49 27	LB
06036	V1142 Cen	12 58 14.9 -62 58 08	EA	06360	V1196 Cen	13 40 02.1 -44 04 55	M
06045	V1143 Cen	12 59 08.5 -31 41 55	LB	19910	V1197 Cen	13 40 38.0 -63 22 30	DCEP
06047	V1144 Cen	12 59 14.9 -31 56 42	EA	19913	V1198 Cen	13 40 51.6 -62 52 47	EA
06048	V1145 Cen	12 59 47.8 -50 15 47	RRAB	06422	V1199 Cen	13 45 22.9 -35 56 16	SRA:
19569	V1146 Cen	13 00 50.2 -64 37 51	SRA	19977	V1200 Cen	13 52 17.5 -38 37 17	EA
06052	V1147 Cen	13 00 57.6 -49 12 12	UGSS:	06494	V1201 Cen	13 55 58.2 -30 29 36	SRB
06059	V1148 Cen	13 01 44.9 -50 42 17	M	20009	V1202 Cen	13 59 20.1 -62 27 37	EA
06061	V1149 Cen	13 01 54.9 -50 40 45	EA	20056	V1203 Cen	14 11 48.0 -62 01 35	EB
06065	V1150 Cen	13 02 38.4 -47 07 16	SRA	06584	V1204 Cen	14 13 48.4 -64 00 30	EA
06070	V1151 Cen	13 03 14.8 -48 30 29	M	06605	V1205 Cen	14 16 40.7 -36 56 18	SRA
06075	V1152 Cen	13 03 51.0 -64 06 00	LB	06624	V1206 Cen	14 19 29.1 -34 23 50	EA
06078	V1153 Cen	13 04 36.0 -61 40 17	EA	06635	V1207 Cen	14 21 03.2 -32 53 13	EA
06084	V1154 Cen	13 05 30.8 -52 06 56	SRS	06692	V1208 Cen	14 32 05.6 -63 31 39	M
19593	V1155 Cen	13 06 17.9 -48 27 46	BY	06714	V1209 Cen	14 36 03.1 -58 28 25	EA
06091	V1156 Cen	13 06 26.5 -38 23 17	EA	06728	V1210 Cen	14 36 55.6 -58 15 41	CEP(B)
06093	V1157 Cen	13 06 33.9 -42 32 33	M	06746	V1211 Cen	14 39 29.4 -42 27 08	EB:
06118	V1158 Cen	13 10 31.7 -45 19 47	SRB	00043	V0734 Cep	00 07 38.6 +76 08 28	EA
06121	V1159 Cen	13 10 44.1 -47 17 19	M	13492	V0735 Cep	21 02 23.9 +60 04 42	EA
19643	V1160 Cen	13 11 06.7 -54 10 00	EA	13635	V0736 Cep	21 16 29.1 +55 23 10	EW
06134	V1161 Cen	13 12 09.1 -39 54 44	SRA	13695	V0737 Cep	21 23 48.3 +63 33 28	EW
06132	V1162 Cen	13 12 24.0 -57 06 44	M	25632	V0738 Cep	21 29 55.1 +58 56 16	EA
06135	V1163 Cen	13 12 25.6 -57 00 01	SRB	13796	V0739 Cep	21 34 54.6 +55 56 32	DCEP
06139	V1164 Cen	13 13 00.4 -48 30 50	LB	14038	V0740 Cep	22 04 32.9 +80 11 15	RRAB
06151	V1165 Cen	13 14 46.4 -55 58 53	SRB	25862	V0741 Cep	22 13 48.1 +67 10 26	EA
06157	V1166 Cen	13 15 51.3 -63 53 03	EA	14111	V0742 Cep	22 17 24.3 +70 53 42	RRAB
06159	V1167 Cen	13 15 53.0 -36 03 48	RRAB	14110	V0743 Cep	22 18 06.2 +55 54 16	EA
06167	V1168 Cen	13 17 17.7 -33 47 21	RRAB	14149	V0744 Cep	22 24 05.0 +68 44 59	EB
19703	V1169 Cen	13 18 30.8 -62 39 45	EA	14280	V0745 Cep	22 37 51.8 +85 06 15	EA
06178	V1170 Cen	13 19 02.6 -47 07 21	M	14288	V0746 Cep	22 42 20.5 +65 54 43	EA

Table 1 (continued)

NSV	Name		R.A., 2000.0 (h m s)	Decl., 2000.0 (o ’ ")	Type	NSV	Name		R.A., 2000.0 (h m s)	Decl., 2000.0 (o ’ ")	Type
00201	FV	Cet	00 33 57.8	-13 31 19	RRAB	05749	WX	Crv	12 35 17.4	-20 33 45	SRB
00252	FW	Cet	00 40 24.6	-21 34 34	RRAB	05901	WY	Crv	12 43 42.7	-13 51 13	RRAB
00285	FX	Cet	00 45 06.1	-18 54 15	RRAB	05914	WZ	Crv	12 44 15.2	-21 25 35	EA
15337	FY	Cet	01 35 47.9	-11 22 29	SRB	05042	AC	Crt	10 59 21.8	-12 28 40	EW
00601	FZ	Cet	01 42 25.2	-22 15 57	UGSU	05159	AD	Crt	11 17 14.9	-23 36 06	SRB
00646	GG	Cet	01 53 01.0	-08 04 22	RRAB	05327	AE	Crt	11 46 47.1	-15 20 02	SRB
00675	GH	Cet	01 56 49.9	-21 11 44	EA	05359	AF	Crt	11 49 48.0	-08 17 20	SRB
15628	GI	Cet	03 03 13.1	+00 54 20	SR	05435	EK	Cru	12 02 58.5	-62 40 19	EB
04451	EW	Cha	09 14 02.6	-82 13 12	EA	19280	EL	Cru	12 11 11.7	-62 45 34	EA
04547	EX	Cha	09 33 25.7	-78 52 55	M	05594	EM	Cru	12 24 39.8	-62 45 50	M
04911	EY	Cha	10 35 25.0	-77 59 09	SRA:	05616	EN	Cru	12 26 06.2	-59 37 22	SRB
04933	EZ	Cha	10 39 09.0	-77 57 22	LB	05640	EO	Cru	12 29 00.8	-61 15 58	EA
04980	FF	Cha	10 46 44.9	-80 26 14	LB	05783	EP	Cru	12 37 16.8	-56 47 17	EA
05004	FG	Cha	10 51 28.6	-80 46 40	SRA	19453	EQ	Cru	12 40 24.3	-59 49 11	EA
05055	FH	Cha	11 00 14.1	-76 44 16	IT:	05870	ER	Cru	12 42 21.3	-58 28 07	SRB
18674	FI	Cha	11 07 43.7	-77 39 41	INT	05930	ES	Cru	12 46 13.2	-61 50 09	SRB
18675	FK	Cha	11 07 58.0	-77 38 44	INT	05978	ET	Cru	12 50 28.0	-60 39 49	EA
18679	FL	Cha	11 08 39.0	-77 16 04	INT	11822	V2469	Cyg	19 12 16.1	+49 42 24	EA
05116	FM	Cha	11 09 53.4	-76 34 26	INT	11924	V2470	Cyg	19 19 58.0	+46 53 21	RRAB
18686	FN	Cha	11 10 04.7	-76 35 45	INT	12777	V2471	Cyg	20 04 31.5	+53 03 44	EW
05124	FO	Cha	11 10 49.6	-77 17 52	INT	24999	V2472	Cyg	20 05 02.6	+41 59 44	LB
05191	FP	Cha	11 24 05.9	-75 54 49	SRA	12860	V2473	Cyg	20 09 45.8	+48 52 07	EA
05228	FQ	Cha	11 30 11.0	-78 07 03	SRB	12870	V2474	Cyg	20 10 46.2	+33 48 05	EB:
05260	FR	Cha	11 35 22.8	-81 50 50	SRB	12928	V2475	Cyg	20 13 56.2	+35 19 41	DCEP
05366	FS	Cha	11 51 38.7	-78 11 54	M	12945	V2476	Cyg	20 14 39.7	+35 39 14	EB
05371	FT	Cha	11 51 53.9	-76 44 07	SRA	13016	V2477	Cyg	20 18 58.9	+56 36 19	EW
05423	FU	Cha	12 00 59.3	-79 46 00	SRB	25285	V2478	Cyg	20 42 24.6	+42 18 05	EW
05694	FV	Cha	12 33 33.9	-82 26 28	SRB	25325	V2479	Cyg	20 45 10.8	+36 48 42	LB
05918	FW	Cha	12 45 56.9	-81 00 08	M	13506	V2480	Cyg	21 04 05.9	+39 33 00	EA
05965	FX	Cha	12 50 57.1	-81 19 24	SRB	25452	V2481	Cyg	21 04 17.1	+37 51 07	M:
06057	FY	Cha	13 02 10.3	-76 03 04	LB:	25482	V2482	Cyg	21 07 39.5	+40 40 02	M:
06069	FZ	Cha	13 04 23.1	-79 27 38	LB	25486	V2483	Cyg	21 08 09.4	+36 28 19	EB
06192	GG	Cha	13 21 57.3	-78 10 43	LB	25535	V2484	Cyg	21 15 22.9	+38 04 04	LB
06252	GH	Cha	13 29 27.8	-79 07 04	SRB	13625	V2485	Cyg	21 15 37.2	+38 02 28	EB
06312	GI	Cha	13 36 25.5	-79 33 27	SRB	13637	V2486	Cyg	21 16 59.4	+40 19 57	EA
06334	GK	Cha	13 37 53.4	-75 50 22	M	25545	V2487	Cyg	21 18 50.7	+39 54 12	LB:
06421	GL	Cha	13 47 35.3	-76 07 15	M	25674	V2488	Cyg	21 33 32.7	+36 31 19	SRB
06392	DH	Cir	13 42 55.1	-65 22 42	SRB	25697	V2489	Cyg	21 36 21.7	+38 23 24	SR
06518	DI	Cir	14 01 49.5	-64 49 17	EA	13853	V2490	Cyg	21 42 26.0	+28 49 47	EB
06792	DK	Cir	14 47 12.7	-57 40 38	EA	13112	OS	Del	20 29 56.5	+09 35 44	RRAB
06800	DL	Cir	14 48 08.1	-60 34 09	EA	13121	OT	Del	20 31 31.9	+06 46 32	EA
07044	DM	Cir	15 24 08.5	-56 50 15	EW	13149	OU	Del	20 34 14.3	+06 34 06	LB:
02740	AV	Col	05 56 50.6	-27 40 02	RRAB	13271	OV	Del	20 45 00.3	+16 48 05	LB
02826	AW	Col	06 05 11.3	-32 43 51	EA	13304	OW	Del	20 48 14.3	+04 36 54	EA
03034	AX	Col	06 34 04.9	-41 32 32	SRA	25346	OX	Del	20 49 00.6	+16 13 48	EA
19199	MS	Com	12 06 00.8	+23 12 17	GDOR	01687	BD	Dor	04 38 19.1	-57 12 14	EA
19553	MT	Com	12 55 10.6	+26 42 27	NL+ZZ	04629	MW	Dra	09 50 17.1	+74 58 16	EA
06277	MU	Com	13 29 53.1	+25 39 04	SRB	05499	MX	Dra	12 12 15.1	+68 53 00	RS
10915	V0731	CrA	18 30 51.8	-37 16 49	EB	05631	MY	Dra	12 27 43.1	+67 58 06	EA
11217	V0732	CrA	18 42 51.2	-43 11 21	EA	05644	MZ	Dra	12 28 24.7	+74 14 07	EA
11335	V0733	CrA	18 47 37.7	-41 03 44	EA	06080	NN	Dra	13 04 03.0	+65 15 24	EW
11391	V0734	CrA	18 51 08.7	-43 11 06	EA	20276	NO	Dra	15 11 44.4	+63 37 19	EA
11767	V0735	CrA	19 10 12.9	-44 31 17	M	22984	NP	Dra	17 35 16.3	+55 00 12	EA
05526	WW	Crv	12 17 02.5	-24 18 50	LB	11317	NQ	Dra	18 44 13.2	+57 41 01	RRAB

Table 1 (continued)

NSV	Name		R.A., Decl., 2000.0	Type	NSV	Name		R.A., Decl., 2000.0	Type
			h m s o ’ "					h m s o ’ "	
12492	NR	Dra	19 49 53.9 +68 10 20	RRAB	10870	V1134	Her	18 28 14.5 +12 19 51	EB
13510	TW	Equ	21 05 02.4 +08 26 51	SRB	10993	V1135	Her	18 32 13.0 +12 17 04	EB
13663	TX	Equ	21 20 42.1 +05 41 43	EA	24495	V1136	Her	18 32 47.9 +24 40 45	GDOR
00728	IY	Eri	02 07 28.2 -57 52 10	EW:	01043	AG	Hor	03 05 21.3 -52 18 05	SRB
15578	IZ	Eri	02 46 29.1 -13 57 03	RRAB	15830	AH	Hor	03 52 14.4 -49 04 18	SRB
15648	KK	Eri	03 11 57.8 -03 48 29	RRAB	03966	V0424	Hya	08 15 52.4 -01 50 49	M
01284	KL	Eri	03 45 25.4 -08 47 34	RRAB	04017	V0425	Hya	08 20 51.8 +06 28 24	RRAB
01564	KM	Eri	04 20 33.1 -15 54 50	SRB	04095	V0426	Hya	08 28 35.2 -13 51 14	EA
01652	KN	Eri	04 34 17.9 -04 56 46	EW	04178	V0427	Hya	08 39 38.9 -05 58 52	SRA
01660	KO	Eri	04 35 38.9 -04 05 54	SRB	17960	V0428	Hya	08 41 46.1 +02 11 20	M
16154	KP	Eri	04 43 07.2 -07 24 42	EA	04312	V0429	Hya	08 55 43.8 -19 13 28	SRB
01780	KQ	Eri	04 56 16.1 -08 58 14	LB	04369	V0430	Hya	09 04 48.6 +05 30 08	RRAB
01781	KR	Eri	04 56 51.9 -06 32 09	SRB	04412	V0431	Hya	09 11 39.4 -12 09 35	LB
16254	KS	Eri	05 09 02.9 -07 44 12	EB	18149	V0432	Hya	09 12 18.6 -11 04 44	EA
00763	AU	For	02 15 02.4 -33 51 05	EA	04647	V0433	Hya	09 50 16.5 -22 40 32	LB:
15483	AV	For	02 18 33.7 -29 40 16	EA	04653	V0434	Hya	09 51 16.1 -26 36 34	EA
01068	AW	For	03 11 00.2 -35 20 44	RRAB	04677	V0435	Hya	09 55 36.1 -19 41 27	EA
02837	V0378	Gem	06 08 17.5 +22 42 29	SR	04732	V0436	Hya	10 05 35.1 -12 35 15	SRB
02840	V0379	Gem	06 08 45.0 +25 51 18	SRB	04800	V0437	Hya	10 15 53.3 -26 29 06	LB
02889	V0380	Gem	06 16 12.8 +25 39 56	EW	04915	V0438	Hya	10 37 58.3 -20 11 09	LB
03029	V0381	Gem	06 34 00.0 +15 17 03	SR	04952	V0439	Hya	10 44 07.4 -27 26 42	M
03186	V0382	Gem	06 44 14.5 +16 24 04	EA	05033	V0440	Hya	10 58 28.5 -32 46 48	SRB
03210	V0383	Gem	06 47 42.1 +23 56 12	EA	05115	V0441	Hya	11 10 38.0 -28 54 02	EB
03230	V0384	Gem	06 50 56.7 +29 01 56	M	05122	V0442	Hya	11 11 30.7 -33 57 54	EW
03322	V0385	Gem	06 59 37.6 +16 40 39	SRB	05154	V0443	Hya	11 16 26.1 -33 17 13	EA
03346	V0386	Gem	07 02 49.6 +17 20 27	EA	05170	V0444	Hya	11 18 50.1 -30 28 25	SRB
03449	V0387	Gem	07 12 05.7 +17 22 48	RRAB	05187	V0445	Hya	11 23 58.2 -33 08 23	EA
03450	V0388	Gem	07 12 14.8 +18 23 50	EB	05223	V0446	Hya	11 29 58.7 -29 36 19	EW
17436	V0389	Gem	07 21 03.3 +25 40 08	EA	05288	V0447	Hya	11 40 14.8 -30 15 49	SRB
03728	V0390	Gem	07 47 03.1 +14 53 23	EA	05312	V0448	Hya	11 44 20.8 -28 29 04	SRA
13717	DT	Gru	21 28 18.1 -44 09 17	EA	05373	V0449	Hya	11 52 31.9 -25 46 55	LB
14003	DU	Gru	22 03 01.0 -39 21 23	EB	05406	V0450	Hya	11 59 19.1 -27 09 03	M
25852	DV	Gru	22 12 38.5 -54 17 27	EA	05414	V0451	Hya	12 00 12.1 -33 53 27	SRB
14193	DW	Gru	22 32 38.0 -47 42 47	EA	05421	V0452	Hya	12 01 02.6 -30 48 34	EW
14195	DX	Gru	22 32 59.2 -44 48 45	SRB	05488	V0453	Hya	12 11 06.7 -34 30 27	EA
14532	DY	Gru	23 23 14.3 -37 30 56	EW	05504	V0454	Hya	12 13 27.8 -32 39 25	EA
07777	V1116	Her	16 30 16.4 +16 55 06	DSCT	05741	V0455	Hya	12 35 04.3 -28 46 40	SRB
07883	V1117	Her	16 39 06.4 +09 47 55	IS	05754	V0456	Hya	12 35 33.6 -31 40 00	SRB
07891	V1118	Her	16 39 45.4 +09 16 37	SRA	05789	V0457	Hya	12 37 22.6 -28 02 40	SRB
07901	V1119	Her	16 40 22.4 +06 07 30	EB	05830	V0458	Hya	12 39 27.5 -33 17 26	LB
07913	V1120	Her	16 41 19.3 +08 28 02	SRB	05943	V0459	Hya	12 47 35.5 -27 35 14	LB
07928	V1121	Her	16 42 46.1 +09 53 29	SRB	06006	V0460	Hya	12 52 44.3 -26 00 13	SRB
07967	V1122	Her	16 46 37.8 +39 03 25	LB	06013	V0461	Hya	12 53 28.7 -28 42 02	EB:
07989	V1123	Her	16 50 13.1 +08 59 11	SR	06068	V0462	Hya	13 02 45.5 -23 58 13	SXPHE
08170	V1124	Her	17 04 32.9 +14 26 33	RRAB	06249	V0463	Hya	13 27 17.4 -25 02 15	M
08179	V1125	Her	17 05 26.6 +14 13 59	LB	06595	V0464	Hya	14 14 21.0 -26 53 17	EW
08208	V1126	Her	17 06 41.0 +15 40 32	RRAB	06806	V0465	Hya	14 48 24.0 -27 15 54	M
08224	V1127	Her	17 07 11.9 +36 18 10	SR	00166	CZ	Hyi	00 26 56.6 -79 32 55	SR
09195	V1128	Her	17 34 59.1 +17 21 08	LB	00350	DD	Hyi	00 55 23.6 -79 41 33	SRB
09631	V1129	Her	17 44 43.4 +15 01 55	RRAB	00502	DE	Hyi	01 23 41.2 -78 23 10	SRB
09676	V1130	Her	17 46 44.1 +15 42 02	LB	00593	DF	Hyi	01 40 49.2 -67 29 42	CWB
09697	V1131	Her	17 47 05.2 +38 33 30	RRAB	00620	DG	Hyi	01 44 38.1 -77 22 13	SRB
09696	V1132	Her	17 47 31.6 +16 49 49	RRAB	15394	DH	Hyi	01 49 13.3 -63 31 00	EA
09853	V1133	Her	17 54 43.9 +15 53 17	EA	15526	DI	Hyi	02 27 34.9 -67 47 12	M

Table 1 (continued)

NSV	Name		R.A., Decl., 2000.0		Type	NSV	Name		R.A., Decl., 2000.0		Type
			h m s	o ’ "					h m s	o ’ "	
01071	DK	Hyi	03 08 41.8	-75 47 24	SRB	06952	OV	Lup	15 08 47.6	-41 59 49	SRA
01120	DL	Hyi	03 20 09.5	-71 36 10	SRB	06959	OW	Lup	15 09 33.6	-33 48 30	EW
13263	CN	Ind	20 45 39.2	-51 02 43	EW	06968	OX	Lup	15 10 54.5	-42 35 46	EA
13404	CO	Ind	20 56 29.6	-47 50 43	EB	20263	OY	Lup	15 11 40.0	-42 11 26	EA
13527	CP	Ind	21 07 05.6	-54 04 53	EA	07070	OZ	Lup	15 26 14.3	-41 28 35	SRB
13749	CQ	Ind	21 31 03.3	-50 50 49	EA	20433	PP	Lup	15 55 24.2	-41 55 30	EA
13766	CR	Ind	21 33 45.1	-67 33 49	EW	07330	PQ	Lup	15 55 53.2	-40 41 44	RRAB
13983	CS	Ind	21 59 54.6	-68 50 37	UG	03878	EK	Lyn	08 04 17.1	+38 46 38	EA
14163	CT	Ind	22 29 46.2	-71 31 09	EA	17878	EL	Lyn	08 25 22.7	+40 34 55	EA
14241	CU	Ind	22 37 17.6	-69 29 09	EW	17902	EM	Lyn	08 30 41.7	+40 24 25	RRAB
14263	CV	Ind	22 40 39.7	-68 14 17	M	18027	EN	Lyn	08 46 07.0	+38 02 53	RRAB
14384	CW	Ind	23 00 56.6	-69 16 42	RV:	11363	V0636	Lyr	18 47 52.8	+38 42 18	LB
25841	V0454	Lac	22 09 05.0	+45 30 29	LB	01196	AR	Men	03 31 24.5	-75 27 20	SRA
14062	V0455	Lac	22 10 50.5	+50 19 37	EA	01675	AS	Men	04 32 56.8	-78 07 41	SRB
25859	V0456	Lac	22 13 50.0	+43 54 39	EA	01770	AT	Men	04 52 06.9	-70 43 52	EA
25928	V0457	Lac	22 36 23.0	+38 06 18	EA	02750	AU	Men	05 55 00.7	-72 41 36	EW
14327	V0458	Lac	22 48 55.9	+45 45 08	EA	02947	AV	Men	06 19 07.9	-78 35 09	RRAB
14332	V0459	Lac	22 50 54.5	+48 39 24	EA	03443	AW	Men	07 06 16.3	-76 50 21	EA
18241	HM	Leo	09 38 37.0	+07 14 55	UG	03534	AX	Men	07 12 01.6	-82 00 24	SRB
18312	HN	Leo	09 58 26.0	+27 45 32	GDOR	17537	AY	Men	07 34 58.5	-76 57 47	SRB
04745	HO	Leo	10 08 13.9	+26 22 33	RRAB	13190	DF	Mic	20 39 11.6	-37 55 48	SRB
05019	HP	Leo	10 56 20.7	+14 29 31	RRAB	13605	DG	Mic	21 14 19.3	-42 47 55	EA
05043	HQ	Leo	10 59 40.4	+06 37 31	RRAB	02941	V0872	Mon	06 23 09.1	-10 05 31	M
18601	HR	Leo	11 04 42.3	-02 58 20	EB	02962	V0873	Mon	06 26 10.1	+02 05 58	EA
05168	HS	Leo	11 18 42.7	+27 31 50	EW	03014	V0874	Mon	06 32 07.9	+03 08 40	EA
01830	AL	Lep	05 06 17.7	-20 07 53	EW	16906	V0875	Mon	06 33 00.1	+09 32 30	LB
16262	AM	Lep	05 12 17.6	-11 51 58	BY	03057	V0876	Mon	06 38 24.6	-01 39 03	SRB
01875	AN	Lep	05 13 44.3	-20 03 15	SRB	03180	V0877	Mon	06 43 01.5	-09 43 48	EA
01965	AO	Lep	05 24 14.6	-14 06 03	RRAB	17227	V0878	Mon	06 54 48.9	-01 16 57	EB
01986	AP	Lep	05 26 19.5	-15 27 30	EA	03282	V0879	Mon	06 55 34.0	-10 13 12	EA
02490	AQ	Lep	05 37 50.1	-15 48 12	M	17236	V0880	Mon	06 55 37.7	-09 29 23	EW
02571	AR	Lep	05 40 50.1	-23 35 07	EA	03300	V0881	Mon	06 57 33.6	+05 06 42	EA
02575	AS	Lep	05 41 11.8	-16 52 32	SRB	03305	V0882	Mon	06 57 39.5	-05 27 15	EA
02652	AT	Lep	05 48 17.1	-25 02 31	EA	17258	V0883	Mon	06 58 11.9	-05 04 29	EA
02781	AU	Lep	06 01 04.4	-12 12 21	M	03371	V0884	Mon	07 05 11.8	-11 06 02	EA
02795	AV	Lep	06 01 50.8	-21 06 18	SRB	17388	V0885	Mon	071402.926	+00 03 25	SRB
16768	AW	Lep	06 04 35.1	-14 01 57	GDOR:	03532	V0886	Mon	071917.227	-10 54 31	LB
20158	LL	Lib	14 41 43.2	-20 50 26	RRAB	17440	V0887	Mon	072129.363	-10 20 20	EB
20245	LM	Lib	15 07 52.9	-27 29 08	EA:	03645	V0888	Mon	073348.394	-09 40 53	EA
20247	LN	Lib	15 08 06.3	-29 12 09	EA	03647	V0889	Mon	073423.061	-01 27 23	LB
20262	LO	Lib	15 10 38.0	-09 30 14	RRAB	03654	V0890	Mon	073540.460	-08 44 50	EA
06989	LP	Lib	15 13 38.5	-20 26 32	EA	17552	V0891	Mon	074118.576	-01 32 30	EA
07072	LQ	Lib	15 26 01.1	-15 32 46	RRAB	03692	V0892	Mon	074155.692	-01 16 35	SRB
07164	LR	Lib	15 37 43.7	-26 35 50	EA	03719	V0893	Mon	074527.244	-05 13 12	SRB
20387	LS	Lib	15 44 14.3	-22 55 32	SR	03730	V0894	Mon	074651.481	-07 52 26	LB
07222	LT	Lib	15 44 34.6	-11 53 02	EA	03757	V0895	Mon	075021.429	-01 14 31	RRAB
07283	LU	Lib	15 50 09.7	-17 23 50	EW	03844	V0896	Mon	075941.552	-07 50 13	EA
20174	OO	Lup	14 45 46.2	-46 48 12	EA	03850	V0897	Mon	080007.789	-08 57 26	SRB
06799	OP	Lup	14 47 34.8	-49 19 13	SRB	03866	V0898	Mon	080159.718	-06 46 46	RRAB
06842	OQ	Lup	14 53 45.0	-54 38 14	EA	05175	MU	Mus	112123.336	-72 33 51	M
20235	OR	Lup	15 04 50.4	-53 21 36	EA	05180	MV	Mus	112300.113	-72 48 10	M
06917	OS	Lup	15 04 52.2	-37 57 39	EW	05186	MW	Mus	112331.986	-71 36 12	M
06921	OT	Lup	15 06 08.2	-42 55 27	EA	05216	MX	Mus	112821.449	-70 24 06	M
06933	OU	Lup	15 06 48.3	-35 04 57	EA	05233	MY	Mus	113047.189	-72 58 39	EA

Table 1 (continued)

NSV	Name		R.A., Decl., 2000.0	Type	NSV	Name		R.A., Decl., 2000.0	Type
			h m s o ' "					h m s o ' "	
05236	MZ	Mus	113057.040 -69 34 44	SRA	07763	V0400	Nor	16 30 48.2 -46 06 20	EA:
05247	NN	Mus	11 32 36.8 -70 07 52	SRB	00244	DW	Oct	00 37 52.9 -82 37 14	SRB
05275	NO	Mus	11 37 38.9 -72 11 10	M	01067	DX	Oct	02 50 25.3 -87 30 22	NL
05296	NP	Mus	11 40 47.6 -70 03 28	M	03694	DY	Oct	07 31 12.5 -84 32 18	RRAB
05300	NQ	Mus	11 42 29.2 -74 58 47	LB	04350	DZ	Oct	08 54 48.3 -83 16 57	RRAB
05301	NR	Mus	11 42 33.4 -67 52 09	M	04992	EE	Oct	10 47 26.9 -84 08 23	RRAB
05333	NS	Mus	11 47 05.9 -75 12 35	SRB	05065	EF	Oct	11 00 54.5 -84 05 27	M
05331	NT	Mus	11 47 08.6 -70 13 52	M	05267	EG	Oct	11 35 37.7 -84 21 36	SRB
05343	NU	Mus	11 48 19.1 -68 38 51	SRB	05292	EH	Oct	11 39 25.2 -87 09 26	M
05342	NV	Mus	11 48 24.1 -67 53 47	M	05654	EI	Oct	12 32 42.9 -87 26 23	EW
05372	NW	Mus	11 52 47.0 -75 12 26	SRB	05959	EK	Oct	12 53 52.2 -87 27 21	LB
05377	NX	Mus	11 53 24.0 -72 24 43	M	06034	EL	Oct	12 59 56.0 -83 12 07	M
05409	NY	Mus	11 59 57.9 -74 12 39	SRB	06158	EM	Oct	13 20 30.8 -85 52 23	SRB
05412	NZ	Mus	12 00 04.5 -75 13 50	SRB	06150	EN	Oct	14 50 18.0 -89 46 58	EW
05439	OO	Mus	12 03 37.9 -74 28 35	SRB	06749	EO	Oct	14 54 21.3 -87 21 05	SRB
05442	OP	Mus	12 03 48.4 -73 53 08	SRB	07038	EP	Oct	15 30 53.7 -84 48 29	EW
05443	OQ	Mus	12 03 52.0 -69 30 55	SRA	08042	EQ	Oct	17 10 29.0 -86 23 00	SRA
05466	OR	Mus	12 07 54.0 -67 53 01	EA:	12460	ER	Oct	19 54 17.2 -74 43 10	SRB
05473	OS	Mus	12 08 46.3 -65 45 29	LB	13608	ES	Oct	21 17 51.8 -79 24 22	EB
05512	OT	Mus	12 15 38.0 -68 08 10	M	13979	ET	Oct	22 02 40.5 -84 15 54	EA
05533	OU	Mus	12 18 22.4 -70 57 05	SR:	14315	EU	Oct	22 48 41.0 -78 48 31	EA
05577	OV	Mus	12 22 44.0 -70 28 27	SRB	07722	V2616	Oph	16 26 35.1 -05 58 03	SRB
05648	OW	Mus	12 29 36.7 -75 04 32	EA	07730	V2617	Oph	16 27 07.2 -08 51 00	EB
05657	OX	Mus	12 30 19.7 -66 57 08	M:	07750	V2618	Oph	16 28 32.9 -01 04 29	SR
05756	OY	Mus	12 36 03.6 -73 32 28	EA	07931	V2619	Oph	16 43 27.4 -12 10 47	EW
05769	OZ	Mus	12 37 02.4 -72 38 38	M	07999	V2620	Oph	16 51 06.0 +06 57 48	RRAB:
05779	PP	Mus	12 37 13.3 -67 16 22	SRB	07996	V2621	Oph	16 51 25.0 -20 21 05	RRAB
05892	PQ	Mus	12 43 38.2 -64 48 58	M:	08003	V2622	Oph	16 51 42.8 +07 13 07	RRAB
05919	PR	Mus	12 44 57.7 -67 04 22	SRB	08131	V2623	Oph	17 01 58.8 +06 55 28	SRB
06021	PS	Mus	12 55 10.2 -68 54 24	LC	20892	V2624	Oph	17 03 53.7 -24 50 42	SRB
06033	PT	Mus	12 57 43.4 -67 35 09	SRB	08154	V2625	Oph	17 03 55.2 +12 33 21	LB
06051	PU	Mus	13 01 01.2 -69 19 34	M	20913	V2626	Oph	17 05 32.0 +10 32 47	EA
06073	PV	Mus	13 04 15.3 -75 10 36	EA	08188	V2627	Oph	17 06 03.8 +01 43 21	SRB
06105	PW	Mus	13 08 46.7 -67 12 19	M:	08195	V2628	Oph	17 06 55.5 -23 33 05	CEP:
06126	PX	Mus	13 11 57.5 -68 03 35	RVB:	08219	V2629	Oph	17 07 23.7 +10 52 41	EA:
06138	PY	Mus	13 13 10.9 -66 17 35	M:	21011	V2630	Oph	17 09 05.5 +11 27 43	LB
06189	PZ	Mus	13 20 57.9 -66 13 41	M	08256	V2631	Oph	17 10 22.1 -04 03 36	CWA
06222	QQ	Mus	13 25 32.3 -73 04 14	M	08269	V2632	Oph	17 11 52.0 -23 54 35	EA
06221	QR	Mus	13 25 43.7 -75 17 04	M	08286	V2633	Oph	17 11 56.5 +09 47 03	SR
06241	QS	Mus	13 26 17.5 -67 09 13	M	08339	V2634	Oph	17 13 07.2 +09 45 31	SRB
06240	QT	Mus	13 27 03.1 -70 12 15	M	08441	V2635	Oph	17 16 29.8 -00 29 16	EW
06233	QU	Mus	13 27 19.4 -74 31 08	M	08472	V2636	Oph	17 18 10.0 -17 15 47	EA
06251	QV	Mus	13 28 51.5 -75 37 19	SR	08493	V2637	Oph	17 18 29.6 +05 16 31	EW
06285	QW	Mus	13 32 45.4 -74 59 46	M	08486	V2638	Oph	17 18 44.6 -18 56 15	EA
06420	QX	Mus	13 47 19.3 -75 34 41	M	08569	V2639	Oph	17 22 07.1 +03 09 35	RRAB
20323	V0391	Nor	15 31 52.6 -59 14 59	DCEPS	08780	V2640	Oph	17 28 01.5 +05 07 15	EW
07118	V0392	Nor	15 32 29.0 -52 52 11	EA	09159	V2641	Oph	17 33 57.2 -20 30 24	CEP
07274	V0393	Nor	15 50 26.8 -46 42 29	EB	09234	V2642	Oph	17 35 57.1 +11 50 41	EA
07355	V0394	Nor	15 58 14.7 -54 20 31	EB	09200	V2643	Oph	17 36 00.3 -20 31 25	M
07377	V0395	Nor	16 00 16.8 -45 07 36	EW	09226	V2644	Oph	17 36 44.9 -29 14 27	EA
07400	V0396	Nor	16 04 05.6 -60 12 59	EA	09504	V2645	Oph	17 40 38.6 +01 36 26	RRAB
07563	V0397	Nor	16 15 55.5 -51 07 15	DCEP	09517	V2646	Oph	17 40 54.9 +04 41 28	RRAB
07642	V0398	Nor	16 21 57.0 -49 09 24	EA	09550	V2647	Oph	17 42 20.3 +10 20 04	EA
20599	V0399	Nor	16 22 35.9 -50 32 38	EB	09569	V2648	Oph	17 43 02.9 +00 05 50	SRA:

Table 1 (continued)

NSV	Name	R.A., Decl., 2000.0		Type	NSV	Name	R.A., Decl., 2000.0		Type
		h m s	o ’ "				h m s	o ’ "	
09596	V2649 Oph	17 43 38.5	+13 55 18	LB	12268	V0408 Pav	19 42 07.9	-64 04 38	EA
09637	V2650 Oph	17 45 20.7	+08 10 39	EB	12440	V0409 Pav	19 53 08.9	-74 08 09	SRB
09727	V2651 Oph	17 49 10.6	+08 44 59	SRB:	25617	V0412 Peg	21 29 28.2	+07 15 45	SRB
09748	V2652 Oph	17 49 58.8	+07 10 24	RRC	13868	V0413 Peg	21 45 10.5	+26 43 19	EB:
24021	V2653 Oph	17 52 47.3	+03 47 39	EA	25881	V0414 Peg	22 21 18.5	+05 43 42	EA
09851	V2654 Oph	17 55 01.6	+03 21 20	LB	25943	V0415 Peg	22 41 58.8	+15 13 16	EA
09866	V2655 Oph	17 55 56.4	+01 51 43	LB	25992	V0416 Peg	23 01 05.9	+26 46 53	EA:
09872	V2656 Oph	17 55 56.7	+12 02 01	RRAB	14520	V0417 Peg	23 21 14.1	+09 26 07	SRB
09905	V2657 Oph	17 57 42.7	+02 31 20	EA	26110	V0418 Peg	23 35 37.5	+14 35 37	GDOR
09902	V2658 Oph	17 57 45.8	+01 57 09	RRAB	14723	V0419 Peg	23 50 05.0	+17 53 44	RRAB
09919	V2659 Oph	17 58 13.7	+03 00 14	EA	00651	V0723 Per	01 53 59.7	+53 28 05	EB
09995	V2660 Oph	18 01 24.0	+00 00 08	EA	00709	V0724 Per	02 03 25.7	+51 47 39	SRB
10019	V2661 Oph	18 01 50.8	+04 11 00	RRAB	00733	V0725 Per	02 10 27.0	+48 46 40	EA
10061	V2662 Oph	18 02 29.7	+06 22 19	RRAB	00877	V0726 Per	02 38 10.8	+52 51 13	LB
10072	V2663 Oph	18 02 47.7	+07 54 01	EA	00880	V0727 Per	02 39 25.9	+52 43 52	SRB
10140	V2664 Oph	18 04 12.7	+01 51 58	RRAB	00901	V0728 Per	02 43 52.2	+46 03 44	EA
10202	V2665 Oph	18 06 05.4	+06 47 22	SRB	00953	V0729 Per	02 50 30.0	+45 54 56	LB
10287	V2666 Oph	18 09 33.9	+03 59 36	GDOR	00994	V0730 Per	02 58 35.5	+46 32 05	SRB
10439	V2667 Oph	18 15 14.0	+04 30 50	SR	01085	V0731 Per	03 15 48.2	+44 03 57	EA
10478	V2668 Oph	18 16 24.4	+01 32 47	RRAB	01114	V0732 Per	03 23 19.2	+51 23 29	EA
10595	V2669 Oph	18 18 48.8	+06 41 54	SR	01180	V0733 Per	03 31 48.5	+36 12 45	EA
01719	V1799 Ori	04 47 18.2	+06 40 56	EW	01210	V0734 Per	03 38 19.1	+32 03 13	SR:
01760	V1800 Ori	04 54 18.7	+11 10 44	M	01211	V0735 Per	03 38 29.5	+34 40 14	SR:
16225	V1801 Ori	05 01 38.0	+02 54 25	EA/RS	15730	V0736 Per	03 39 41.4	+37 47 32	EA
01809	V1802 Ori	05 02 21.2	+05 29 19	M	01217	V0737 Per	03 40 20.2	+33 04 07	EW
01850	V1803 Ori	05 09 13.7	+01 21 31	SR	01371	V0738 Per	03 50 56.3	+47 14 35	SR
16296	V1804 Ori	05 23 05.5	+01 03 25	EA	15857	V0739 Per	03 59 46.4	+34 40 57	LB
01956	V1805 Ori	05 23 48.7	+12 54 23	SRB	01447	V0740 Per	04 04 49.3	+33 57 25	EW
01978	V1806 Ori	05 25 45.8	-04 05 47	EA	01448	V0741 Per	04 05 22.8	+49 11 57	SRB
01985	V1807 Ori	05 26 39.2	+01 37 23	SR	15903	V0742 Per	04 07 57.6	+42 13 19	SR:
01990	V1808 Ori	05 26 49.7	-09 13 39	SR	01473	V0743 Per	04 08 48.0	+31 30 54	LB
02001	V1809 Ori	05 27 53.9	+11 37 01	SRB	01481	V0744 Per	04 10 40.7	+44 26 50	LB
02064	V1810 Ori	05 31 15.8	+09 41 20	SRB	01528	V0745 Per	04 15 34.9	+33 49 46	M:
16352	V1811 Ori	05 34 12.4	+00 24 50	EA	01595	V0746 Per	04 26 18.9	+50 12 33	LB
02306	V1812 Ori	05 35 17.7	-05 58 27	INT(YY)	01646	V0747 Per	04 34 12.8	+47 15 36	M
02403	V1813 Ori	05 36 27.7	+14 03 59	EA	01686	V0748 Per	04 40 30.2	+43 11 52	LB
02456	V1814 Ori	05 37 09.5	-06 06 16	INT	01704	V0749 Per	04 44 47.0	+43 35 02	SR
02470	V1815 Ori	05 37 51.7	+08 51 32	EA	01714	V0750 Per	04 47 15.3	+42 50 01	LB
02597	V1816 Ori	05 43 26.3	+10 04 24	SRB	00329	CW Phe	00 51 51.5	-55 50 24	LB
02603	V1817 Ori	05 44 17.0	+10 01 42	SRB	00470	CX Phe	01 19 31.1	-48 17 41	EA
16725	V1818 Ori	05 53 42.6	-10 24 01	IN	00605	CY Phe	01 42 24.0	-46 40 52	SRB
02715	V1819 Ori	05 54 28.8	+12 31 56	DCEP	14764	CZ Phe	23 56 21.8	-53 29 22	RR(B)
02724	V1820 Ori	05 54 37.1	+04 54 11	RRAB	14769	DD Phe	23 57 04.6	-52 13 19	LB
02769	V1821 Ori	06 00 31.6	+20 51 50	SRB	14780	DE Phe	23 57 55.3	-41 55 43	EA
02894	V1822 Ori	06 17 07.9	+15 06 38	LB	01700	AL Pic	04 41 30.8	-52 16 37	RRAB
02895	V1823 Ori	06 17 17.4	+15 42 28	EA	01887	AM Pic	05 13 44.6	-49 32 48	SRA
02940	V1824 Ori	06 22 59.9	+16 39 03	EA	02813	AN Pic	06 03 03.2	-43 01 38	SRB
09948	V0401 Pav	18 01 56.3	-66 01 49	EW	16801	AO Pic	06 11 08.5	-58 17 16	EA
10425	V0402 Pav	18 17 28.5	-68 16 29	EA	03043	AP Pic	06 33 56.8	-62 49 44	SRB
10827	V0403 Pav	18 29 36.4	-64 54 40	M	03075	AQ Pic	06 38 16.5	-58 17 34	M
10858	V0404 Pav	18 30 47.4	-67 08 19	EA	00233	ES Psc	00 38 02.4	+03 41 04	EB
24452	V0405 Pav	18 31 10.9	-64 07 31	EA	15208	ET Psc	00 56 35.9	+10 40 25	EW
11686	V0406 Pav	19 04 36.5	-57 25 42	SRB	15375	EU Psc	01 44 53.5	+19 51 25	EA
11803	V0407 Pav	19 14 38.2	-61 15 40	RV	14745	EV Psc	23 54 08.1	+00 57 49	RRC

Table 1 (continued)

NSV	Name	R.A., 2000.0 (h m s)	Decl., 2000.0 (° ' ")	Type	NSV	Name	R.A., 2000.0 (h m s)	Decl., 2000.0 (° ' ")	Type
13711	YY PsA	21 27 37.5	-33 45 18	EA	04245	DM Pyx	08 46 05.8	-35 58 21	EA
13844	YZ PsA	21 42 06.2	-25 28 29	RRC	18183	DN Pyx	09 22 10.2	-31 47 53	EA
13890	ZZ PsA	21 50 35.2	-27 48 35	EW	01162	VY Ret	03 27 16.8	-61 15 33	EA
14176	AA PsA	22 30 07.5	-28 10 12	RRAB	01175	VZ Ret	03 28 36.8	-66 55 13	EA/RS
14301	AB PsA	22 44 41.5	-31 58 08	RRAB	01171	WW Ret	03 28 45.8	-60 41 26	SRB
03053	V0599 Pup	06 36 58.8	-45 10 13	SRB	01214	WX Ret	03 37 44.6	-55 23 47	SRA
03252	V0600 Pup	06 51 11.4	-48 21 56	SRB	11888	V0366 Sge	19 18 13.8	+17 39 14	EB
03294	V0601 Pup	06 55 46.0	-47 35 03	SRB	11913	V0367 Sge	19 19 53.2	+17 14 26	DCEP
03358	V0602 Pup	07 03 18.8	-44 29 39	SRA	12514	V0368 Sge	19 53 02.2	+18 25 35	EW
03380	V0603 Pup	07 05 07.5	-37 17 30	SRB	12699	V0369 Sge	20 01 29.2	+18 37 56	EW
17426	V0604 Pup	07 18 38.2	-37 13 30	EB	12772	V0370 Sge	20 04 59.9	+20 13 28	EA
03598	V0605 Pup	07 26 44.1	-44 33 39	EA	12845	V0371 Sge	20 09 35.5	+17 34 45	EB
03612	V0606 Pup	07 28 44.8	-44 28 17	CEP	25022	V0372 Sge	20 09 39.6	+21 04 44	BCEP
17520	V0607 Pup	07 36 19.1	-14 35 32	EA	12971	V0373 Sge	20 16 54.0	+16 55 26	RRC
03682	V0608 Pup	07 39 37.2	-36 30 12	EA	12978	V0374 Sge	20 17 27.9	+16 53 04	EW
17570	V0609 Pup	07 42 53.2	-28 13 05	SRB	09816	V5559 Sgr	17 54 06.3	-28 39 10	EA
03702	V0610 Pup	07 43 00.6	-20 56 11	EA	09863	V5560 Sgr	17 56 21.5	-27 37 56	CEP:
17578	V0611 Pup	07 44 06.1	-16 55 58	EA	09957	V5561 Sgr	18 00 16.1	-24 02 06	SRC
03714	V0612 Pup	07 44 27.6	-24 17 19	DCEPS:	24084	V5562 Sgr	18 02 47.5	-29 21 59	EA
03736	V0613 Pup	07 47 18.8	-19 24 04	LB	24229	V5563 Sgr	18 04 34.2	-24 22 01	EW:
03759	V0614 Pup	07 50 21.4	-23 25 20	SRA	10368	V5564 Sgr	18 13 17.2	-26 32 14	SRB
17646	V0615 Pup	07 52 45.7	-48 01 52	EA	10456	V5565 Sgr	18 16 41.6	-35 38 10	EA
03802	V0616 Pup	07 53 57.6	-28 22 03	DCEP	10624	V5566 Sgr	18 19 57.8	-22 07 15	EA
03812	V0617 Pup	07 54 48.3	-33 03 04	EA	10660	V5567 Sgr	18 21 05.5	-18 27 20	DCEP
03822	V0618 Pup	07 55 43.2	-44 46 25	EA	10761	V5568 Sgr	18 25 24.6	-22 11 16	EA
03820	V0619 Pup	07 56 21.1	-13 54 39	LB	24607	V5569 Sgr	18 50 03.6	-26 24 15	EA
03832	V0620 Pup	07 57 49.9	-29 23 03	DCEP	11781	V5570 Sgr	19 10 56.8	-25 54 40	EA
03836	V0621 Pup	07 58 09.1	-46 48 30	EB	11807	V5571 Sgr	19 13 09.7	-32 16 01	EA
03842	V0622 Pup	07 59 12.2	-26 41 56	DCEP	12107	V5572 Sgr	19 32 03.1	-28 12 45	EA
03849	V0623 Pup	07 59 42.1	-20 53 27	EA	12236	V5573 Sgr	19 39 06.6	-20 49 14	CWA
17705	V0624 Pup	08 00 41.4	-32 50 25	SRC	12369	V5574 Sgr	19 45 44.6	-31 12 37	RRAB
03870	V0625 Pup	08 01 50.5	-40 29 20	EW	24926	V5575 Sgr	19 54 19.4	-29 54 40	EB
17723	V0626 Pup	08 03 10.4	-38 11 48	EA	12710	V5576 Sgr	20 02 22.5	-12 03 19	EA
03877	V0627 Pup	08 03 11.1	-17 56 33	EA	24979	V5577 Sgr	20 03 11.1	-22 07 39	SRB
03893	V0628 Pup	08 04 53.1	-20 15 58	SRB	12854	V5578 Sgr	20 11 23.5	-43 13 48	SRB
03895	V0629 Pup	08 04 58.8	-28 51 39	DCEP	07445	V1282 Sco	16 07 04.9	-29 16 48	EA
03898	V0630 Pup	08 05 32.8	-21 11 47	LB	20517	V1283 Sco	16 08 17.0	-17 08 05	EB
03913	V0631 Pup	08 07 40.2	-25 19 51	LB	20546	V1284 Sco	16 13 38.8	-41 20 51	EA
03921	V0632 Pup	08 08 37.9	-21 20 57	SRB	07638	V1285 Sco	16 21 02.6	-30 56 49	EA
03929	V0633 Pup	08 10 06.9	-20 18 29	SRB	07746	V1286 Sco	16 28 59.7	-32 07 34	EA
03975	V0634 Pup	08 15 48.8	-31 52 41	EA	20709	V1287 Sco	16 36 52.9	-28 05 34	CWB:
03994	V0635 Pup	08 18 00.8	-19 22 14	M	07847	V1288 Sco	16 37 00.0	-45 19 07	EA
04005	V0636 Pup	08 19 30.6	-20 05 08	SRB	07960	V1289 Sco	16 47 34.7	-29 36 12	CWA
04014	V0637 Pup	08 19 50.5	-39 28 54	EA	20782	V1290 Sco	16 50 01.4	-41 37 16	EA
04028	V0638 Pup	08 21 19.5	-22 24 37	SRB	08010	V1291 Sco	16 53 11.4	-36 38 07	EA
04036	V0639 Pup	08 22 02.8	-22 25 55	SRB	08017	V1292 Sco	16 53 55.6	-41 52 51	EA
04050	V0640 Pup	08 23 28.4	-21 09 16	EA	20802	V1293 Sco	16 53 57.6	-41 38 42	EA
04054	V0641 Pup	08 23 34.9	-21 57 49	SRB	08020	V1294 Sco	16 54 00.0	-41 42 53	EA
04057	V0642 Pup	08 23 38.1	-23 20 40	EA	20827	V1295 Sco	16 54 35.8	-41 25 23	EA
04059	V0643 Pup	08 24 09.6	-21 58 06	SRB	08029	V1296 Sco	16 54 44.6	-43 16 53	EA
04067	V0644 Pup	08 25 23.8	-26 05 04	EA	20859	V1297 Sco	16 56 05.2	-40 20 58	EA
04072	V0645 Pup	08 25 40.0	-23 39 25	LB	08099	V1298 Sco	17 01 02.3	-40 20 25	SRB
17921	DK Pyx	08 33 24.1	-34 38 55	EA	08145	V1299 Sco	17 04 26.0	-39 16 04	EA
04237	DL Pyx	08 45 17.5	-33 58 21	EA	20894	V1300 Sco	17 04 58.4	-38 37 06	EA

Table 1 (continued)

NSV	Name		R.A., Decl., 2000.0 h m s ° ' "	Type	NSV	Name		R.A., Decl., 2000.0 h m s ° ' "	Type
08163	V1301	Sco	17 05 18.7 -34 56 00	EA	11359	V0360	Tel	18 49 38.0 -47 47 39	EA
08194	V1302	Sco	17 07 17.5 -37 36 23	EA	11425	V0361	Tel	18 52 52.6 -52 10 56	EA
08299	V1303	Sco	17 13 05.3 -34 45 10	EA	24620	V0362	Tel	18 54 04.9 -51 30 58	EA
08720	V1304	Sco	17 28 21.8 -38 41 48	EA	11764	V0363	Tel	19 10 12.7 -47 42 19	EA
22125	V1305	Sco	17 28 40.0 -33 34 58	EB:	12222	V0364	Tel	19 39 22.5 -52 37 48	EA
09018	V1306	Sco	17 31 34.2 -38 51 40	EA	12283	V0365	Tel	19 42 17.1 -45 46 22	LB
09245	V1307	Sco	17 37 41.7 -42 31 05	DSCT	12326	V0366	Tel	19 44 07.4 -54 38 28	EA
09708	V1308	Sco	17 49 16.4 -38 11 35	EA	12438	V0367	Tel	19 50 44.9 -51 20 43	LB
15234	CI	Scl	01 03 43.8 -30 23 55	EA	12502	V0368	Tel	19 53 49.9 -50 03 29	EW
00443	CK	Scl	01 13 39.4 -26 17 09	SRB	12974	V0369	Tel	20 18 28.0 -49 42 56	SRB
00501	CL	Scl	01 24 59.8 -34 38 58	RRAB	00573	AT	Tri	01 38 06.3 +33 00 36	RRAB
26112	CM	Scl	23 36 03.6 -32 37 24	EA	00583	AU	Tri	01 40 24.4 +33 00 53	EA
14664	CN	Scl	23 40 22.9 -38 18 58	RRAB	00726	AV	Tri	02 08 06.5 +35 23 53	EB:
10697	V0492	Sct	18 21 59.3 -05 38 46	RRAB	06925	NS	TrA	15 07 29.8 -65 34 14	EA
10862	V0493	Sct	18 28 36.7 -12 59 51	EA	07178	NT	TrA	15 40 51.2 -61 43 43	EA
10982	V0494	Sct	18 32 18.9 -11 17 24	EA	07855	NU	TrA	16 39 09.3 -69 24 25	EA
11381	V0495	Sct	18 50 00.4 -11 09 55	EA	07871	NV	TrA	16 40 05.6 -62 55 56	EA
08638	V0405	Ser	17 26 07.7 -14 16 59	M	00326	EH	Tuc	00 51 23.8 -59 37 46	SRB
09124	V0406	Ser	17 32 47.9 -14 37 33	M:	14164	EI	Tuc	22 29 12.5 -56 52 12	EA
09248	V0407	Ser	17 37 01.3 -15 06 34	M:	14254	EK	Tuc	22 38 51.8 -60 39 09	EB
09457	V0408	Ser	17 40 21.9 -12 06 45	SR:	04034	NS	UMa	08 24 24.8 +65 43 03	RRAB
09938	V0409	Ser	17 59 00.8 -11 33 23	M	04029	NT	UMa	08 24 39.0 +72 45 27	EA
10095	V0410	Ser	18 03 21.7 -00 25 52	LB	18546	NU	UMa	10 53 01.1 +57 42 08	EA
24327	V0411	Ser	18 12 24.7 -10 43 53	EA	05040	NV	UMa	10 59 41.4 +56 17 14	EA
10400	V0412	Ser	18 14 15.8 -09 20 21	DCEP	05155	NW	UMa	11 16 55.3 +28 33 34	RRAB:
24512	V0413	Ser	18 35 08.2 +00 02 35	EA	05171	NX	UMa	11 19 27.8 +58 18 53	RRAB
04902	YZ	Sex	10 35 43.9 -09 16 25	M	18787	NY	UMa	11 32 12.9 +38 55 33	GDOR
01226	V1242	Tau	03 41 26.7 +30 04 09	EA	19235	NZ	UMa	12 08 26.1 +48 58 07	GDOR
15791	V1243	Tau	03 48 51.6 +11 42 32	GDOR	05746	OO	UMa	12 34 54.0 +53 37 59	RRAB
01343	V1244	Tau	03 49 06.3 +25 35 24	SRB	05787	OP	UMa	12 36 53.6 +57 58 08	LB
01387	V1245	Tau	03 51 47.4 +25 12 07	UV	20007	OQ	UMa	13 57 22.4 +56 26 07	EW
01383	V1246	Tau	03 51 52.5 +30 25 25	SR	19698	VV	UMi	12 57 34.6 +88 57 27	EA
01497	V1247	Tau	04 11 42.4 +26 27 18	SRB	07446	VW	UMi	15 54 46.8 +85 40 06	EW
16072	V1248	Tau	04 32 48.1 +22 39 53	SR:	08183	VX	UMi	17 01 40.1 +75 17 51	GDOR
01668	V1249	Tau	04 36 48.2 +06 57 06	EA	08499	VY	UMi	17 14 14.0 +76 42 14	EW
01677	V1250	Tau	04 38 25.8 +23 53 42	EA	03926	V0401	Vel	08 08 25.0 -48 36 45	SRB
01697	V1251	Tau	04 41 57.7 +05 36 34	EA/RS	17954	V0402	Vel	08 39 21.8 -46 33 43	LB
01845	V1252	Tau	05 09 07.4 +26 08 19	LB	04250	V0403	Vel	08 46 29.0 -40 49 28	EA
01885	V1253	Tau	05 15 07.6 +18 22 29	SR	18104	V0404	Vel	08 59 14.9 -48 49 49	EA
16275	V1254	Tau	05 17 08.6 +27 41 40	SR	18132	V0405	Vel	09 04 38.4 -41 03 53	EA
01976	V1255	Tau	05 26 10.6 +19 08 16	SRB	04387	V0406	Vel	09 07 23.3 -52 29 57	EA
01987	V1256	Tau	05 27 06.5 +16 56 11	CEP	04484	V0407	Vel	09 25 02.3 -55 29 20	EB
02181	V1257	Tau	05 34 41.2 +17 53 19	LB	04554	V0408	Vel	09 37 18.5 -43 22 05	SRB
02249	V1258	Tau	05 35 33.8 +23 53 18	M	04572	V0409	Vel	09 39 22.9 -54 24 55	EA
02442	V1259	Tau	05 37 26.7 +22 20 31	M	04639	V0410	Vel	09 49 11.2 -40 41 36	M
02503	V1260	Tau	05 39 03.9 +25 36 10	EA	04665	V0411	Vel	09 52 47.9 -43 59 31	M
02520	V1261	Tau	05 39 34.9 +18 52 38	SRB	04667	V0412	Vel	09 53 06.4 -44 20 17	SRB
02617	V1262	Tau	05 45 20.5 +19 07 53	LB	04707	V0413	Vel	10 01 25.5 -45 27 26	M
10789	V0354	Tel	18 27 18.7 -48 32 59	EA	04719	V0414	Vel	10 03 09.5 -47 24 03	EA
10845	V0355	Tel	18 29 11.9 -50 58 19	EA	04721	V0415	Vel	10 03 29.9 -46 49 14	SRA
11075	V0356	Tel	18 37 18.6 -51 54 33	EA	04724	V0416	Vel	10 04 20.3 -55 12 16	EA
11114	V0357	Tel	18 38 36.2 -48 48 26	EA	04746	V0417	Vel	10 07 08.8 -55 02 16	EA
11107	V0358	Tel	18 38 36.4 -53 52 28	EA	04756	V0418	Vel	10 08 27.1 -47 00 52	M
24564	V0359	Tel	18 44 23.7 -46 57 27	EA	04780	V0419	Vel	10 11 50.9 -48 51 19	M

Table 1 (continued)

NSV	Name	R.A., Decl., 2000.0	Type	NSV	Name	R.A., Decl., 2000.0	Type
		h m s o ’ "				h m s o ’ "	
04781	V0420 Vel	10 12 14.7 -46 10 11	RRAB	06127	V0338 Vir	13 11 17.4 -11 06 21	EA
04789	V0421 Vel	10 13 34.7 -49 36 30	M:	06128	V0339 Vir	13 11 20.8 -10 30 51	SRB
04794	V0422 Vel	10 14 46.9 -41 56 36	M	06144	V0340 Vir	13 13 24.2 -13 57 57	EW
04798	V0423 Vel	10 15 22.4 -47 54 49	M	06223	V0341 Vir	13 24 31.2 -15 53 31	RRAB
04805	V0424 Vel	10 16 16.1 -51 29 25	M	06250	V0342 Vir	13 27 10.2 -04 10 21	EA
04807	V0425 Vel	10 16 20.6 -55 35 51	ZAND:	06287	V0343 Vir	13 30 57.9 +10 13 32	LB
04815	V0426 Vel	10 17 11.9 -48 47 27	M	06396	V0344 Vir	13 42 24.6 -19 23 50	SRB
04855	V0427 Vel	10 25 21.7 -46 40 37	SRB	06411	V0345 Vir	13 44 06.5 -13 22 57	LB
04871	V0428 Vel	10 28 31.6 -49 28 12	EA:	06478	V0346 Vir	13 52 51.5 -13 50 37	RRAB
04900	V0429 Vel	10 35 03.9 -44 25 32	M	06488	V0347 Vir	13 54 41.8 -22 04 52	EA
04932	V0430 Vel	10 40 13.8 -44 19 45	M	06606	V0348 Vir	14 16 25.7 -17 05 29	RRAB
04941	V0431 Vel	10 41 40.8 -51 38 43	EA	20106	V0349 Vir	14 26 03.1 -00 41 30	EA
18480	V0432 Vel	10 42 06.5 -42 52 41	EA	17353	YZ Vol	07 05 21.5 -69 09 40	EA
04931	V0433 Vel	10 43 11.6 -47 36 37	LB	03613	ZZ Vol	07 27 01.1 -69 30 55	EW
04972	V0434 Vel	10 47 12.6 -43 55 07	SRA	03790	AA Vol	07 51 05.5 -67 34 37	SRB
04974	V0435 Vel	10 47 46.6 -46 10 00	SRA	03951	AB Vol	08 10 43.5 -72 32 45	EA
04989	V0436 Vel	10 50 36.3 -52 30 40	M	04205	AC Vol	08 40 16.9 -65 47 58	EA
04993	V0437 Vel	10 51 05.6 -55 47 35	M	04249	AD Vol	08 44 39.8 -71 07 41	M
04997	V0438 Vel	10 52 09.2 -56 55 27	SRB	04253	AE Vol	08 45 39.4 -64 59 28	EW
05016	V0439 Vel	10 54 24.1 -56 15 27	LB	04309	AF Vol	08 53 34.9 -70 28 08	EW
18553	V0440 Vel	10 54 43.6 -45 36 10	EA	04341	AG Vol	08 57 43.9 -73 05 45	EA
05021	V0441 Vel	10 55 36.8 -56 10 31	M:	24837	V0460 Vul	19 39 18.1 +20 11 01	LB
05026	V0442 Vel	10 57 00.1 -53 45 58	SRA:	12428	V0461 Vul	19 48 51.6 +23 08 12	SRB
05029	V0443 Vel	10 57 19.2 -55 35 25	M	24986	V0462 Vul	20 03 08.2 +25 17 26	M:
05052	V0444 Vel	11 00 55.4 -48 00 56	M	12886	V0463 Vul	20 11 42.7 +21 51 06	SR:
05061	V0445 Vel	11 01 48.0 -56 10 31	M	13070	V0464 Vul	20 24 50.1 +28 01 16	LB
05467	V0335 Vir	12 07 52.2 -05 59 55	RRAB	13502	V0465 Vul	21 04 08.9 +26 47 50	LB
05617	V0336 Vir	12 26 08.7 +10 15 01	LB	13519	V0466 Vul	21 05 22.9 +28 17 49	RRAB
05987	V0337 Vir	12 50 35.0 +00 57 01	EW	13638	V0467 Vul	21 17 23.9 +21 53 34	EB

Remarks for unusual variable stars (type *).

V1710 Aql. Continuous brightness variations of a B8 star with a period of $68\overset{d}{.}132$.

V1129 Cen. EB-type variations ($9\overset{m}{.}55$–$9\overset{m}{.}85$ V) with brightenings to $9\overset{m}{.}1$ V, lasting for 40 days, each 357 days. HeII emission in the spectrum.

Table 2

Name		h	m	s	o	'	"	Type	Max	Min		Epoch JD 24...		References	
V0455	And	23	34	01.4	+39	21	41	UG	8.7	16.6	V			01	02
V0466	And	02	00	25.4	+44	10	19	UGSU	12.8	<19.	V			03	
V1721	Aql	19	06	28.6	+07	06	44	N	14.0	<20.	*	54732:	(2008)	04	2MASS
V1065	Cen	11	43	10.2	-58	04	04	NA	8.5	<17.0	V	54126	(2007)	05	
V1212	Cen	14	35	02.5	-64	06	20	NA	8.38	<19.	V	54708	(2008)	06	
V0733	Cep	22	53	33.3	+62	32	24	FU:	15.7	<20.	R			07	2MASS
V2467	Cyg	20	28	12.5	+41	48	36	NA	7.3	<18.	V	54176	(2007)	08	09
V2468	Cyg	19	58	33.4	+29	52	06	NA	7.6	<18.	V	54535	(2008)	10	
V2491	Cyg	19	43	02.0	+32	19	14	NA:	7.4	<16.	V	54568	(2008)	11	12
QY	Mus	13	16	36.5	-67	36	48	N:	8.7:	<17.	V	54749:	(2008)	13	
V0390	Nor	16	32	11.5	-45	09	13	NA	9.8	<20.	V	54271	(2007)	14	
V2615	Oph	17	42	44.0	-23	40	35	NA	8.6	<20.	V	54182	(2007)	15	09
V2670	Oph	17	39	50.9	-23	50	01	NA	10.0	<19.	V	54614	(2008)	16	17
V2671	Oph	17	33	29.6	-27	01	14	NA	11.1	<19.	*	54618:	(2008)	18	17
V0597	Pup	08	16	18.0	-34	15	25	NA	7.0	<19.	V	54419	(2007)	19	
V0598	Pup	07	05	42.5	-38	14	39	XN	4.1	16.	V	54257:	(2007)	20	
V5558	Sgr	18	10	18.3	-18	46	52	NB	6.53	<20.	V	54292	(2007)	21	22
V5579	Sgr	18	05	58.9	-27	13	56	NA	6.7	<19.	V	54580	(2008)	23	24
V1280	Sco	16	57	41.2	-32	20	36	NA	3.8	<20.	V	54148	(2007)	25	26
V1281	Sco	16	56	59.4	-35	21	50	NA	9.0:	<20.	V	54154:	(2007)	27	26
V1309	Sco	17	57	32.9	-30	43	10	NA	7.9	<18.	V	54716	(2008)	28	
NR	TrA	16	18	48.2	-60	27	49	NA	8.5	<19.	V	54570		29	
V0458	Vul	19	54	24.6	+20	52	52	NA	8.1	18.	V	54322	(2007)	30	22
V0459	Vul	19	48	08.9	+21	15	27	NA	7.2	20.:	V	54462	(2007)	31	

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VARIABLE STARS IN THE FIELD OF THE OPEN CLUSTER NGC 457

MACIEJEWSKI, G.[1]; BUKOWIECKI, Ł.[1]; BROŻEK, T.[1]; GEORGIEV, TS.[2]; BOEVA, S.[2]; KACHAROV, N.[3]; MIHOV, B.[2]; LATEV, G.[3]; OVCHAROV, E.[3]; VALCHEVA, A.[3]

[1] Centrum Astronomii Uniwersytetu Mikołaja Kopernika, Gagarina 11, Pl-87100 Toruń, Poland; e-mail: gm@astri.uni.torun.pl

[2] Institute of Astronomy, Bulgarian Academy of Sciences, 72 Tsarigradsko Chausse Blvd., 1784 Sofia, Bulgaria; e-mail: tsgeorg@astro.bas.bg

[3] Department of Astronomy, University of Sofia, 5 James Baurchier Str., 1164 Sofia, Bulgaria

According to the WEBDA[1] data base (Mermilliod 1996), the open cluster NGC 457 is known as a relatively young stellar system of $\log(age) = 7.324$, the reddening $E(B-V) = 0.472$ mag, and the distance of 2.43 kpc. Its apparent diameter was estimated to be 20' (Dias et al. 2002). No search for variable stars in the cluster has been performed to date.

The field of NGC 457 was searched for variable stars in B and V bands with two Schmidt telescopes. The first campaign was performed between 2007 November and 2008 April with the 90/180 cm Schmidt-Cassegrain Telescope (TSC90) of the Nicolaus Copernicus University Astronomical Observatory in Piwnice near Toruń, Poland (see Bukowiecki & Maciejewski 2008 for details). In total 478 images in V and 142 in B were obtained during about 56 hours of observations. The second campaign was performed between 2007 December and 2008 March with the 70/172 cm Schmidt Telescope (ST70) of the National Astronomical Observatory (NAO) at Rozhen (Bulgaria), operated by the Institute of Astronomy of the Bulgarian Academy of Sciences (see Maciejewski et al. 2008 for details). During almost 19 hours of monitoring 218 images in V were acquired. About 14900 stars brighter than 19.0 mag in V band were monitored in total.

One of the detected bright variables (V3 = V765 Cas) was also observed with the TSC90 in the Cassegrain mode with the Richardson spectrograph and Wright CCD camera. We obtained spectra between 3500 and 5500 Å with 2 Å/pix reciprocal dispersion with 600 gr/mm grating for spectral classification.

Both data sets were reduced and analysed in the way described in Bukowiecki & Maciejewski (2008). The transformation of instrumental magnitudes into standard ones based on over 800 cluster stars which photometry was taken from Phelps & Janes (1994). The $(B-V)$ coverage was in range between 0.25 and 2.0 mag. The residuals in observed and literature $(B-V)$ are shown in Fig. 1.

As a result of the analysis the following parameters were derived: the central coordinates $RA = 01^{\rm h}19^{\rm m}38^{\rm s}$, $DEC = 58^\circ16'48''$, the limiting radius of 14.7 ± 1.3 arcmin, $\log(age) = 7.40 \pm 0.05$, $E(B-V) = 0.48 \pm 0.05$ mag, the apparent distance modulus $m - M = 13.55 \pm 0.10$ mag, and the distance of 2.6 ± 0.3 kpc. The radial density

[1] http://www.univie.ac.at/webda/

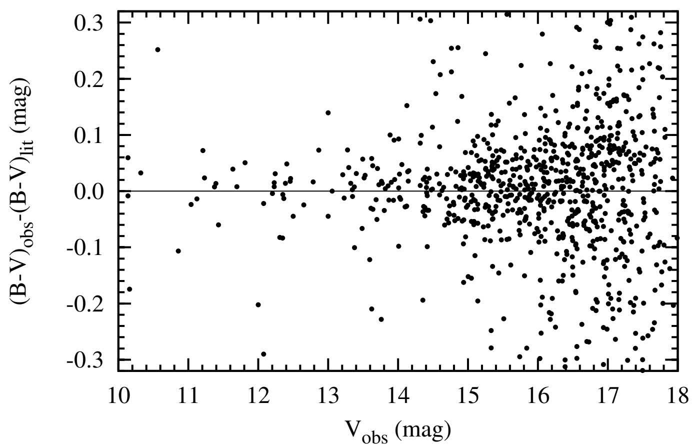

Figure 1. The comparison of the observed photometry with the literature one.

profile, plotted in Fig. 2, can be approximated with the King's formula (King 1966) with the following best-fit parameters: the central density $f_0 = 5.34 \pm 0.17$ stars/arcmin^2, the core radius $r_{\rm core} = 2.43 \pm 0.13$ arcmin, and the density of the background stellar field $f_{\rm bg} = 1.87 \pm 0.05$ stars/arcmin^2. The colour-magnitude diagram (CMD) constructed for NGC 457 with the best-fit isochrone of solar metallicity is presented in Fig. 3.

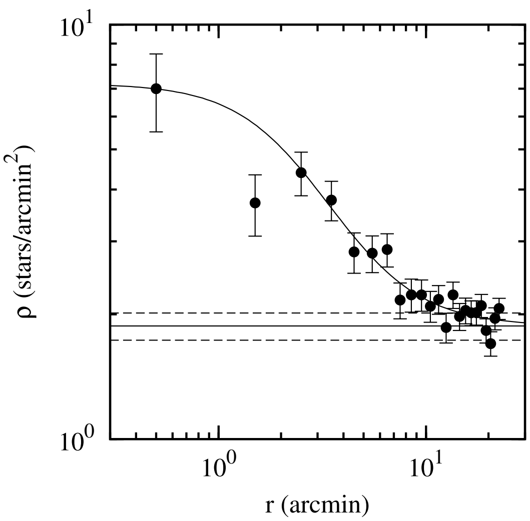

Figure 2. The radial density profile with the best-fit King's formula. The horizontal continuous line marks the background-star-density level and the dashed ones its 3-sigma error.

As a result of our survey 29 new and 2 known variable stars were detected in the field of NGC 457. They are listed in Table 1 and their light curves are presented in Figs. 4 and 5. Twelve variables (V1–V12) are located within the cluster limiting radius. They were marked with open symbols in cluster's CMD to discuss their membership. It is clear that 4 of them, i.e. V6, V7, V9, and V10 cannot belong to the cluster for sure because they are located far from the isochrone.

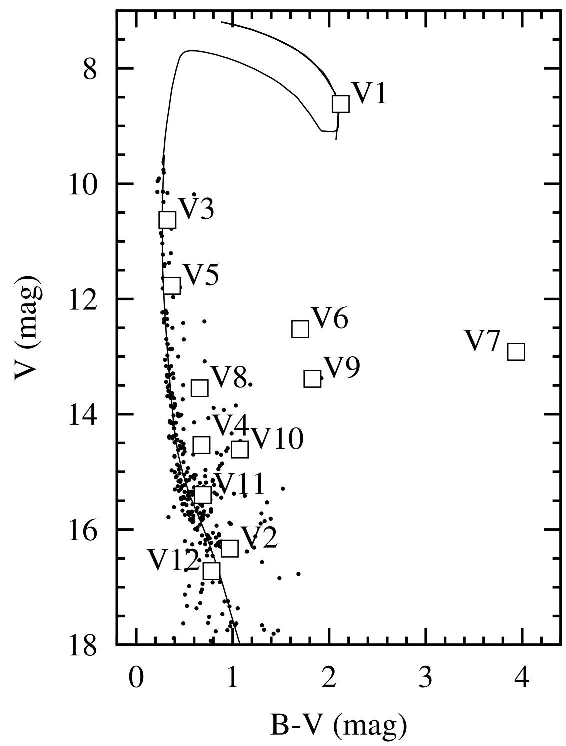

Figure 3. The colour-magnitude diagram for NGC 457 with best-fit isochrone of solar metallicity. The open symbols denote variable stars located within the cluster's limiting radius. See text for discussion.

V1 is a red and bright evolved star known as V466 Cas – an irregular pulsating variable. The star was found to be saturated in our short V band exposures, however its light curve was recorded in the B band database and plotted in Fig. 4. Its V magnitude and the $(B-V)$ colour index were taken from the SIMBAD database. The star and NGC 457 share the common proper motions (Perryman et al. 1997, Loktin & Beshenov 2003) what allows to conclude that V1 (V466 Cas) is cluster's member.

V2 is a faint contact system located near the isochrone. Assuming it belongs to the cluster, its absolute magnitude is $M_{\rm V} = 2.7$ mag. The same quantity calculated from the empirical formula of Ruciński & Duerbeck (1997) is 3.8 mag. Therefore, we conclude that V2 is a background star.

V3 is known as V765 Cas – an eclipsing system of EB type of spectral type B5. Our photometry clearly indicates that the variable is de facto a short period Algol-type system with a typical shape of minima and unequal brightness near the maxima. The variable is situated near the isochrone thus it can be treated as cluster's member. Additionally, the star was observed spectroscopically with the TSC90 in the Cassegrain mode to redetermine its spectral type. The spectrum is plotted in Fig. 6 where spectral lines that were used for classification are marked with arrows. The ratios of HeI[λ4026]/HI[λ4340] and HeI[λ4471]/HI[λ4340] were considered. As a result the spectral type of V3 (V765 Cas) was found to be slightly earlier, i.e. B2.5.

The light-curve variability of V4 indicates that it is a contact system. Assuming it belongs to the cluster, its absolute magnitude is $M_{\rm V} = 0.9$ mag. The same quantity calculated from the empirical formula of Ruciński & Duerbeck (1997) is much greater, i.e., 1.7 mag. Therefore, we conclude that the membership of V4 is unlikely.

Table 1. The list of variable stars detected in the field of NGC 457. r_d denotes the distance from the cluster center, V_max – the maximal brightness in V band, ΔV – the amplitude of variation in V, $(B-V)$ – the color index at the maximum of brightness, P – the period of variation, T_0 – the epoch of minimum brightness for eclipsing systems or maximum for pulsating stars in HJD, types of variability, and cluster membership.

ID	Coordinates J2000.0	r_d (')	V_max (mag)	ΔV (mag)	$B-V$ (mag)	P (day)	T_0 2454400+	Type	Member.
V1	011953+581830	2.7	–	–	–	–	–	MISC	Yes
V2	011929+581340	3.4	16.33	0.21	0.97	0.297507	15.7227	EW	No
V3	011909+581725	3.9	10.63	0.41	0.32	1.716280	15.6925	EA	Yes
V4	012014+581435	5.2	14.54	0.29	0.68	0.554334	15.8838	EW	No
V5	011902+581920	5.4	11.77	0.17	0.37	–	–	MISC	Likely
V6	011901+581009	8.3	12.52	0.21	1.70	–	–	MISC	No
V7	011852+580930	9.5	12.92	0.15	3.94	–	–	MISC	No
V8	011849+582353	9.6	13.55	0.44	0.66	1.720430	39.2008	EA	Likely
V9	011841+580756	11.6	13.39	0.23	1.83	–	–	MISC	No
V10	011908+580418	13.1	14.61	0.26	1.07	1.824432	18.6319	DCEP	No
V11	011751+581523	14.1	15.40	0.07	0.69	0.048419	15.3794	DSCT	Likely
V12	012043+582821	14.3	16.72	0.17	0.78	1.58797	18.0380	EA	Likely
V13	011848+583138	16.2	13.97	0.16	0.85	4.078303	28.0865	DCEP	–
V14	011749+582430	16.2	14.73	0.85	1.09	0.260823	16.0161	EW	–
V15	012048+583112	17.1	15.27	0.20	1.27	14.44783	42.7258	DCEP:	–
V16	011757+582749	17.2	15.83	0.16	0.98	0.283611	15.8081	EB	–
V17	011811+583200	19.0	16.71	0.36	1.06	0.374246	16.0459	EW	–
V18	011733+580922	19.2	15.68	0.29	0.84	0.381185	16.0145	EW	–
V19	012038+583438	19.5	14.95	0.72	0.88	0.552955	16.8896	EB	–
V20	012023+575726	20.3	15.15	0.62	0.72	0.602602	16.7453	RRAB	–
V21	012155+580611	21.0	13.79	0.14	0.64	1.168862	39.5650	CWB	–
V22	011805+575752	22.6	14.10	0.48	0.68	2.571928	19.8162	EA	–
V23	011708+582827	22.8	16.54	0.13	0.66	0.171418	15.6109	DSCT	–
V24	012223+582408	22.8	14.76	0.07	0.67	0.063837	15.4797	DSCT	–
V25	012145+580121	22.8	16.21	0.44	0.91	0.320205	15.8258	EW	–
V26	011952+584457	28.2	15.34	0.11	0.68	0.888248	17.4587	RR:	–
V27	012204+583811	28.6	13.86	0.52	0.83	3.953425:	18.7548	EA	–
V28	012038+574911	28.8	13.54	0.26	1.80	–	–	MISC	–
V29	011702+575631	29.0	15.71	0.12	1.09	7.845039	42.1188	DCEP:	–
V30	011917+574559	30.9	15.70	0.13	0.77	0.194762	15.6996	DSCT	–
V31	011712+584958	38.2	13.57	0.25	1.15	–	–	MISC	–
Remarks: V1 = V466 Cas, V3 = V765 Cas									

V5 was found to be a blue pulsating variable of unresolved type, revealing brightness changes on long-time scale. It is situated in the bright part of cluster's CMD in the area of SPB variables, thus its membership is likely.

V8 is a detached eclipsing system. Its location in the CMD suggests that it can belong to the cluster.

V11 is a short-period pulsating variable of δ Scuti type. Assuming it belongs to the cluster, its absolute magnitude is $M_\mathrm{V} = 1.8$ mag – a typical value for variables of that type. This suggests that membership of V11 is likely.

V12 was classified as a faint detached eclipsing system. It is located near the isochrone, thus the variable can be treated as cluster's member.

Concluding, 6 variables detected in the field of NGC 457 are unquestionable or likely cluster members. The cluster is found to be rich in eclipsing systems represented by 3 detached binaries. More interestingly, brightness of the systems decreases with distance from the cluster centre. Assuming an eclipsing binary belonging to the cluster, its maximum brightness can be interpreted as a rough approximation of its total mass. As a result of the mass segregation, more massive (i.e. brighter) systems are expected to occupy the central part of a cluster while the less massive (i.e. fainter) ones – the outer region (e.g. Lamers et al. 2006 and references therein).

The original photometric data are available on the survey's web site: `http://www.astri.uni.torun.pl/~gm/OCS`.

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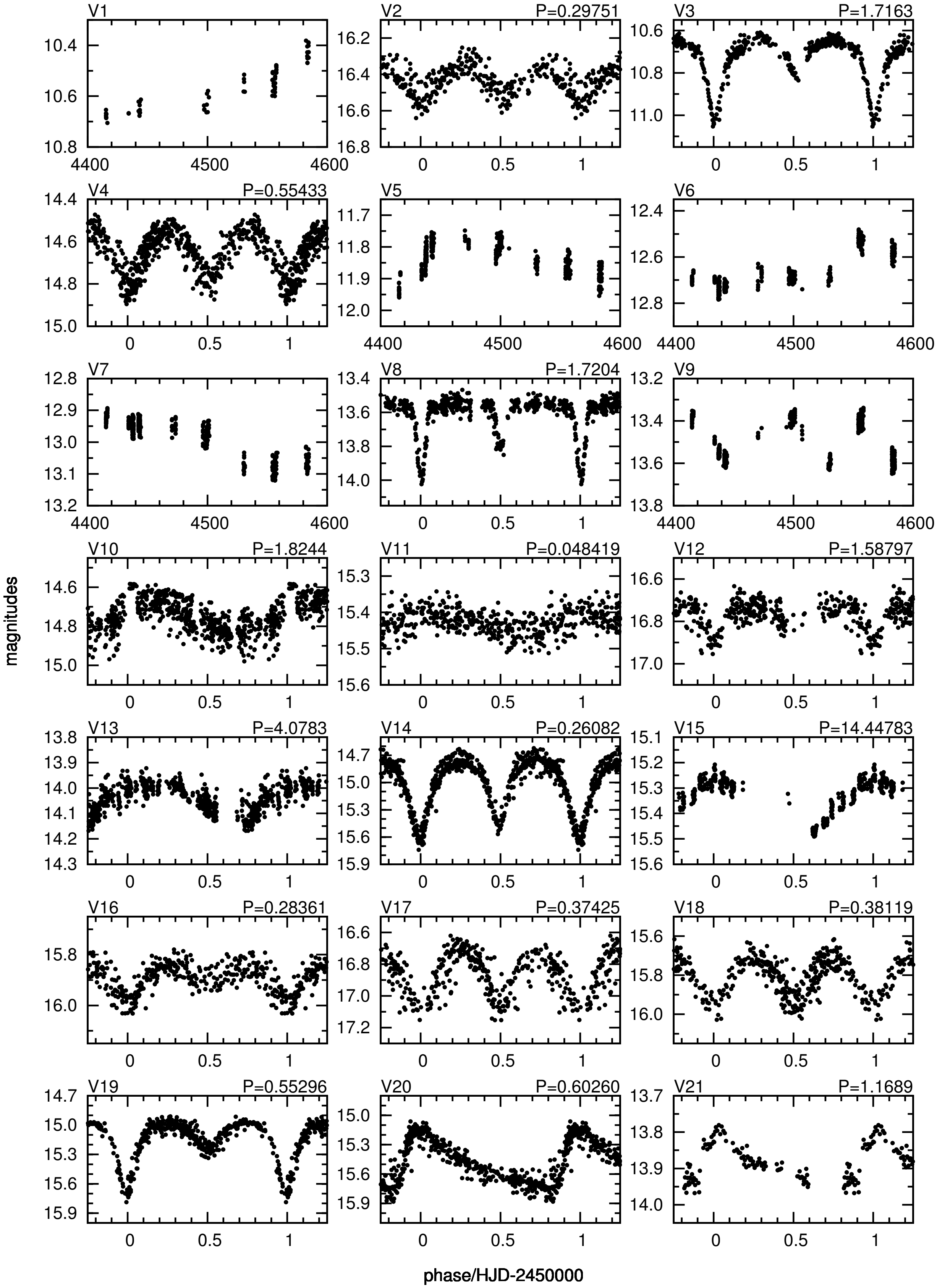

Figure 4. Light curves of variable stars discovered in the field of NGC 457.

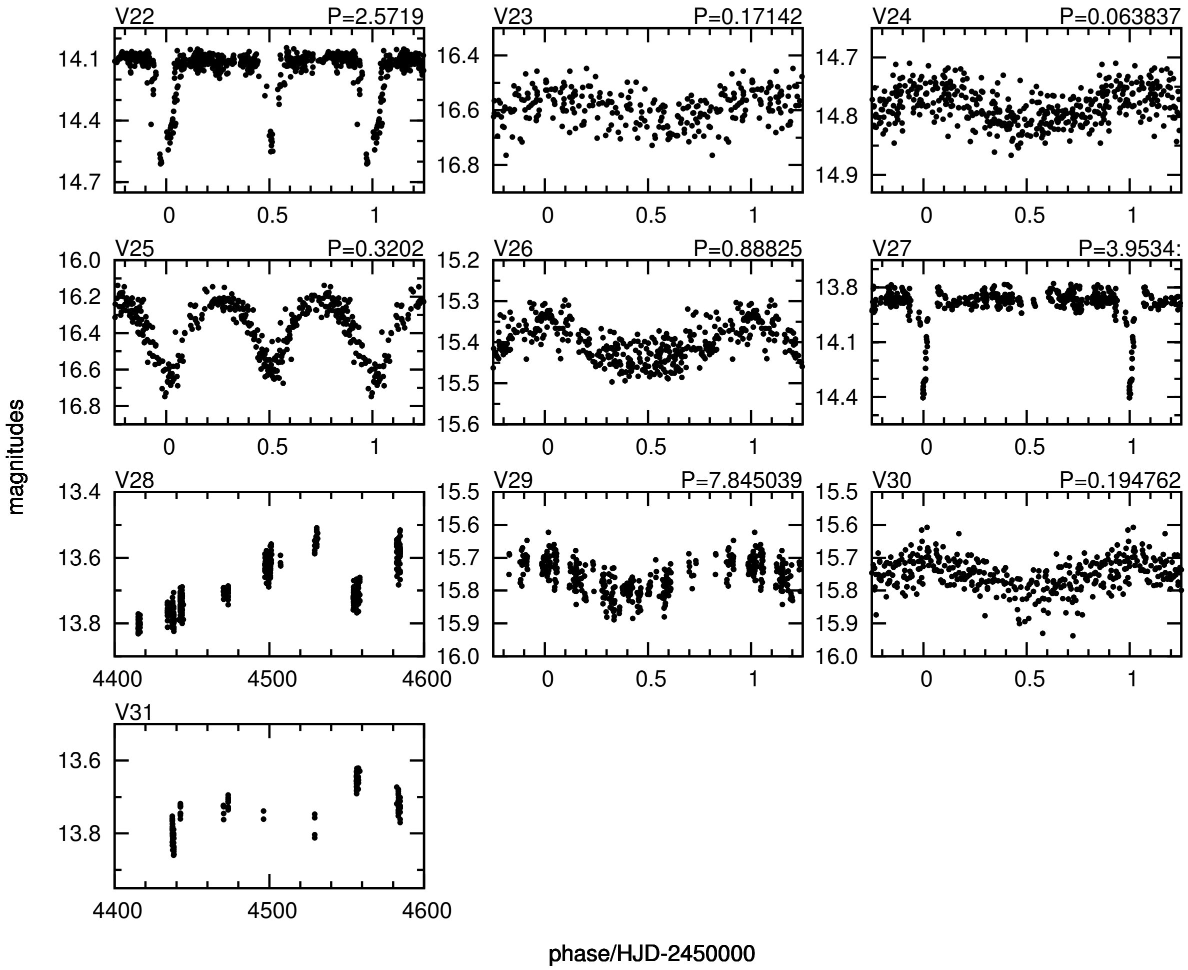

Figure 5. Light curves of variable stars discovered in the field of NGC 457.

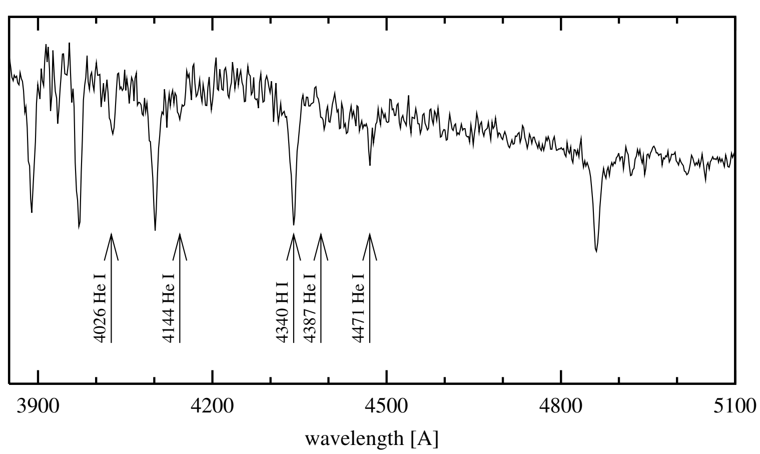

Figure 6. The optical spectrum obtained for V3 (V765 Cas) in the blue. Spectral lines that were used for classification are marked with arrows.

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LONG-TERM OPTICAL OBSERVATIONS OF THE BE/X-RAY BINARY SYSTEM V0332+53

KIZILOĞLU, Ü.; KIZILOĞLU, N.; BAYKAL, A.; YERLİ S. K.; ÖZBEY, M.

[1] Physics Dept., Middle East Technical University, Ankara 06531, Turkey
e-mail: umk, nil, altan, sinan, mehtap@astroa.physics.metu.edu.tr

The Be/X-ray binary V0332+53 has an orbital period of 34.25 d with an eccentricity of 0.31 (Stella et al. 1985). The optical counterpart of this system, BQ Cam, is an O8-9Ve star at a distance of about 7 kpc, showing Hα line emission (Negueruela et al. 1999). This emission is related to the circumstellar disk around the optical star.

Three optical brightening of BQ Cam have been detected. Two of them were reported by Goranskij (2001), one was in 1983 and the other was in 1989. The third one was reported by Goranskij and Barsukova (2004) in the beginning of 2004. About 300 days later, Swank et al. (2004) informed the first All Sky Monitor detection (on the Rossi X-Ray Timing Explorer (RXTE)) of the November 2004 X-ray outburst. The previous two optical brightenings were also accompanied by X-ray outbursts.

Recently, Krimm et al. (2008) reported a new X-ray activity starting at MJD 54 756 detected by Swift/BAT[1] hard X-ray transient monitor. Hsiao et al. (2008) obtained an optical spectrum at MJD 54 761 in which the Hα emission line showed P-Cygni profile with FWHM ∼12 Å.

We have been monitoring the binary system V0332+53 since 2004 using the 45 cm ROTSEIIId telescope (Robotic Optical Transient Experiment)[2] and RTT150 (Russian-Turkish 1.5 m Telescope)[3] located at Bakırlıtepe, Antalya, Turkey. ROTSEIII telescopes which operate without filters were described in detail by Akerlof et al. (2003). Details on the reduction of the data were described in Baykal et al. (2005) and Kızıloğlu et al. (2005). The reference stars for differential photometry were listed in a previous study of Baykal et al. (2005).

In our previous study (Baykal et al. 2005), we presented part of the optical light curve during the giant 2004 X-ray outburst. In this study we report on the long-term variability of the Be/X-ray binary system V0332+53 up to the present date. The differential optical light curve and X-ray light curve of Be/X-ray binary system V0332+53 are shown in Fig. 1. X-ray light curve was obtained from RXTE/ASM web site[4].

A fading of 0.2 mag occurs in the light of BQ Cam after MJD 53 400. On the onset of the fading trend, the Type II X-ray outburst comes to an end. The X-ray activity ends accompanied by the fading of magnitudes. The fading in the light curve of BQ Cam

[1] http://swift.gsfc.nasa.gov/docs/swift/results/
[2] http://www.rotse.net
[3] http://www.tug.tubitak.gov.tr
[4] http://xte.mit.edu

could be due to a decrease in the density or in the size of the circumstellar disk. After MJD 53 600 the system brightened again but did not reach its previous value observed before the giant 2004 X-ray activity until about MJD 54 700.

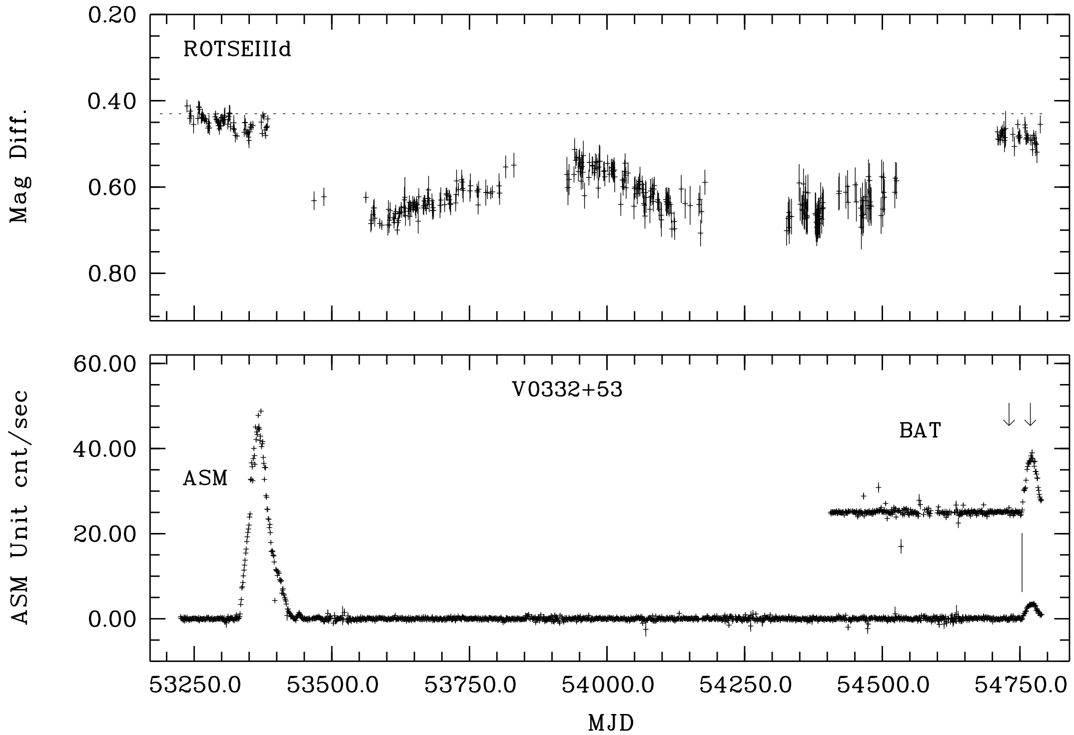

Figure 1. ROTSEIIId daily averaged differential light curve (upper panel) and X-ray light curve (lower panel) of the Be/X-ray system V0332+53 (MJD = JD − 2400000.5). Daily averages of RXTE/ASM 5.0-15.0 keV band light curve and 15-50 keV SWIFT/BAT light curve (properly scaled and shifted) are shown. Vertical line represents PAP and arrows denote spectroscopic observation times.

We presented optical spectroscopic observations obtained before (at MJD 54 730) and during (at MJD 54 768) the new X-ray activity reported by Krimm et al. (2008). The spectroscopic observations were performed with the RTT150 telescope using the medium resolution spectrometer TFOSC (TÜBİTAK Faint Object Spectrometer and Camera). The camera is equipped with a 2048 × 2048, 15μ pixel Fairchild 447BI CCD. We used grism G8 (spectral range 5800-8300 Å) with average dispersion of ~1.1 Å pixel^{-1}. The reduction and analysis of spectra were made by using MIDAS[5] and its packages: Longslit context and ALICE.

The observed Hα line profiles (Fig. 2) were single-peaked and almost symmetric. Measurements of Hα emission lines were made by fitting a Gaussian profile. For each spectrum the measured value of the equivalent width (EW) and full width at half maximum (FWHM) are given in Table 1. The EW and FWHM values for the present two Hα emission profiles are almost the same. The calculated EW value of $\sim$ 4.4 Åfor both profiles is less than the measured value of 10 Åwhich was obtained by Masetti et al. (2005) at MJD 53 377. It should be noted that the Be disk was denser at that time. According to

[5] http://www.eso.org/projects/esomidas/

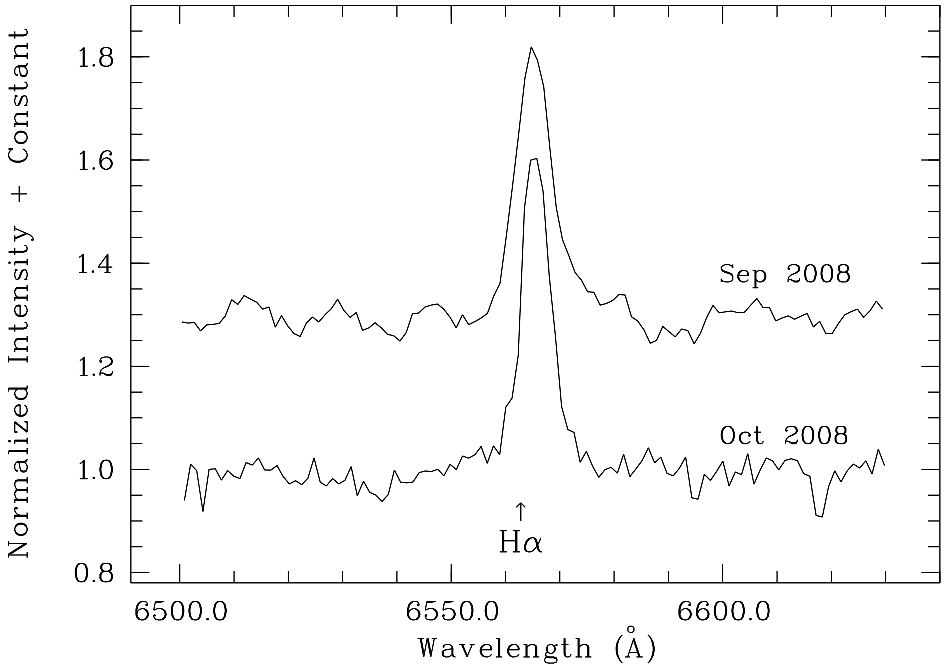

Figure 2. Hα profiles observed on Sep 21 and Oct 29, 2008, before and during the X-ray activity.

the present data, the disk is less dense and the system has almost reached the previous brightness observed before the giant X-ray flare.

The present EW values are found to be similar to the ones observed during the fading of infrared magnitudes of Negueruela et al. (1999). We did not confirm the result of Hsiao et al. (2008) since our detection showed single peaked Hα emission line (obtained 7 days later than their observations). In addition to this, the present FWHM was weaker by a factor of 2.

The Hα emission lines were found to be red-shifted by $\sim$140 km/s which were larger than that of Corbet et al. (1986), who found a blue-shift of $\sim$65 km/s in Hα line and related this to V/R variability seen in Be type stars. In the present study, quite symmetric Hα line profiles do not represent a perturbation in the disk. Because of the low inclination of this system, it is also possible that no variability is seen.

Okazaki and Negueruela (2001) pointed out the possibility of disc truncation by the neutron star which was not close to the mean critical Roche Lobe radius at periastron for the binary system V0332+53 since this system showed no Type I X-ray outburst for a long period of time. According to them, to have a temporary Type I X-ray outbursts, Be disk should be strongly disturbed. But, the Hα emission line profile obtained during the 2008 Type I X-ray outburst does not show any variability which would indicate a disturbed disk. The line is quite symmetric.

We suggest that brightening of the disk after MJD 54 700 may be due to the precession

Table 1. Hα line profiles.

Date	MJD	EW (Å)	FWHM (Å)
Sep 21, 2008	54730.0796	4.44 ± 0.13	7.89 ± 2.05
Oct 29, 2008	54768.8644	4.37 ± 0.15	6.57 ± 1.52

of the disk. When the disk is toward the periastron the material in the outer part of the disk falls on to the neutron star giving rise to the observed 2008 X-ray outburst. The new 2008 X-ray outburst coincides with the periastron passage (PAP) time of the neutron star (Type I outburst). We used the orbital period of 34.67 days and PAP time of 53367 given by Zhang et al. (2005).

We continue monitoring the system.

Acknowledgments: This project utilizes data obtained by the Robotic Optical Transient Search Experiment. ROTSE is a collaboration of Lawrence Livermore National Lab, Los Alamos National Lab and the University of Michigan (http://www.rotse.net). We thank the Turkish National Observatory of TÜBİTAK for running the optical facilities. This study was supported by TUG (Turkish National Observatory), TÜBİTAK (Turkish Scientific and Technological Research Council), through project 106T040.

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THE 2008/2009 ECLIPSE OF EE CEP WILL SOON BEGIN

GALAN, C.[1]; MIKOLAJEWSKI, M.[1]; TOMOV, T.[1]; CIKALA, M.[1,2]

[1] Uniwersytet Mikolaja Kopernika, Centrum Astronomii, ul. Gagarina 11, Pl-87-100 Toruń, Poland; e-mail: cgalan@astri.uni.torun.pl (CG); mamiko@astri.uni.torun.pl (MM); tomtom@astri.uni.torun.pl (TT)

[2] Obserwatorium Astronomiczne im. T. Banachiewicza, Węglówka, PL-32-412 Wiśniowa, Poland; e-mail: cikala@astri.uni.torun.pl (MC)

EE Cep is a very long period (5.6 yr) eclipsing binary star, as bright as about 11 magnitude in the B and V passbands. The nature of the system still remains unclear. During different eclipses very large changes of the duration and the depth of particular minima are observed (Fig. 1). This variability indicates that the secondary is probably a complex object. The most attractive explanation of these observational facts seems to be the hypothesis that the secondary consists of a dark, opaque, relatively thick disc around a low luminosity central object: a low-mass single star or a close binary (Mikolajewski & Graczyk 1999, Graczyk et al. 2003).

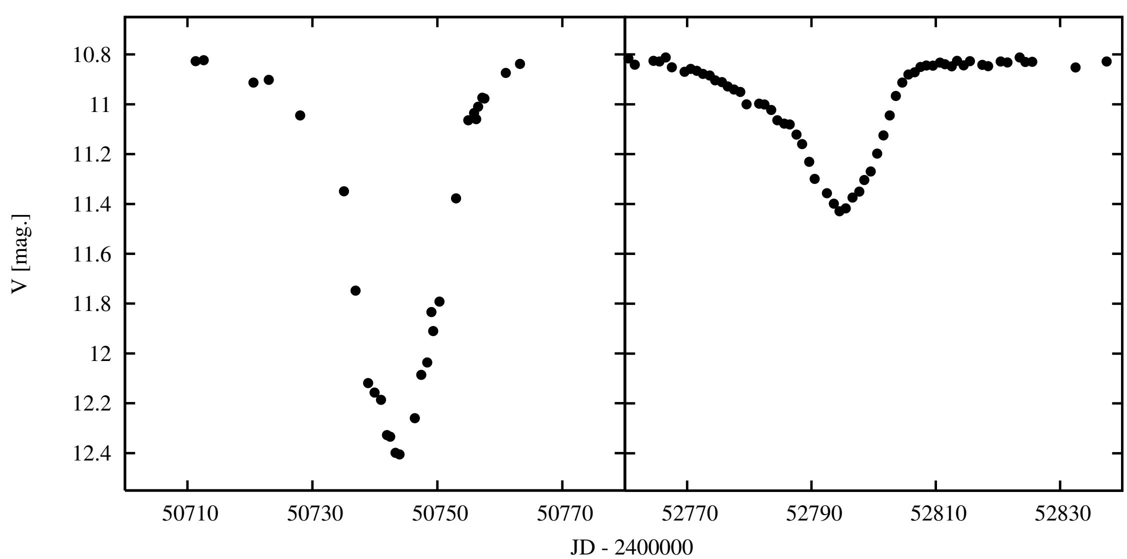

Figure 1. Light curves in V passband of two last minima: left - 1997 eclipse (Mikolajewski & Graczyk 1999, + Cook's CCD data (Halbach 1999)), right - 2003 eclipse (Mikolajewski et al., 2005a).

Differences in the shape of the particular eclipses could be explained by precession, which changes both the inclination of the disc to the line of sight, and the tilt of its cross-section to the direction of motion. The majority of the eclipses have an asymmetrical shape, in which it is possible to distinguish five repeatable phases: atmospheric and real ingress, sloped-bottom transit and real and atmospheric egress. The unique eclipse with flat bottom observed in 1969 can be explained by a nearly edge-on and non-tilted projection of the disc.

Over five years have passed, since the last eclipse in the EE Cep system took place. The observational campaign, which has been organized during the last eclipse (Mikolajewski et al. 2003), brought the best multicolour photometric and spectroscopic data so far, in respect of the time coverage as well as the quality. Ten instruments from four countries took part in photometric measurements and seven instruments from six countries in spectroscopic observations. Results of that campaign was described by Mikolajewski et al., (2005ab) in two papers signed by forty four coauthors representing fifteen institutions.

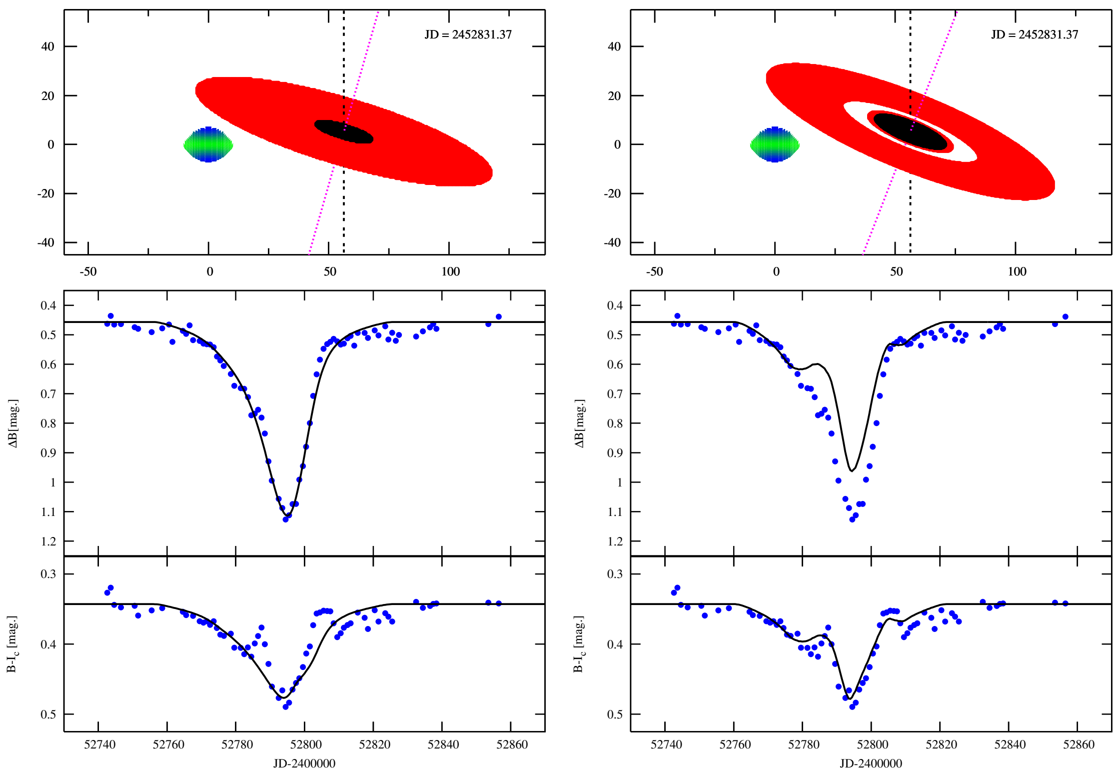

Figure 2. Two models of the eclipse of the fast rotating Be star in EE Cep by a solid disc (left) and by a disc with a gap (right). A flat and circular disc with r^{-2} density distribution has been assumed. *Top*: projection of the system in the sky plane. Polar (hot) and equatorial (cool) areas of the star are shown by dark (blue) and light (green) shades respectively. Inner (opaque) and exterior (semitransparent) areas of the disc are shown by dark and light shades (black and red colours) respectively. *Middle*: B light curve (points) from Mikolajewski et al. (2005a) with corresponding synthetic curves (lines). *Bottom*: $B - I_C$ colour index from the last 2003 eclipse (points) together with synthetic fits (lines).

The next eclipse is approaching and we hope to gather participants for the new observational campaign. The mid-eclipse moment should take place on about 14 January 2009 ($JD_{mid-eclipse} = 2454846$). The longest eclipse observed in 1969, lasted for about 60 days, so the photometric campaign should begin at least 5 weeks before (7 Dec 2008) and finish

5 weeks after (22 Feb 2009) the mid-eclipse. The most important should be the period between 2 and 27 Jan 2009 because of an interesting colour evolution noticed in 2003. The colour indices from the last eclipse show two blue maxima about 9 days before and after the mid-eclipse moment. These maxima can be understood if *(i)* the eclipsed B star is rotationally darkened at the equator and brightened at the poles and *(ii)* the eclipsing disc is divided into two parts by a transparent gap (Fig. 2). Indeed, the spectroscopic observations during the last campaign showed that the eclipsed component is a rapidly rotating Be star (Mikolajewski et al., 2005b). The best fit to its Balmer absorptions (Fig. 3) gives $v \sin i \approx 350$ km/s. This velocity leads to a difference about 5-6 $\cdot\, 10^3 K$ between the polar and equatorial temperatures. The motion of the gapped disc on the background of this star could explain both blue maxima (at $JD = 2452788, 2452805$), when the star's pole is visible in the gap. A solid disc can give quite a good fit to the light curve but does not explain the colour changes (Fig. 2 – left). A disc with a circular gap gives a quite good fit to the colours, but a poor fit to the light curve (Fig. 2 – right). Most probably it is caused by different opacities in different parts of the disc.

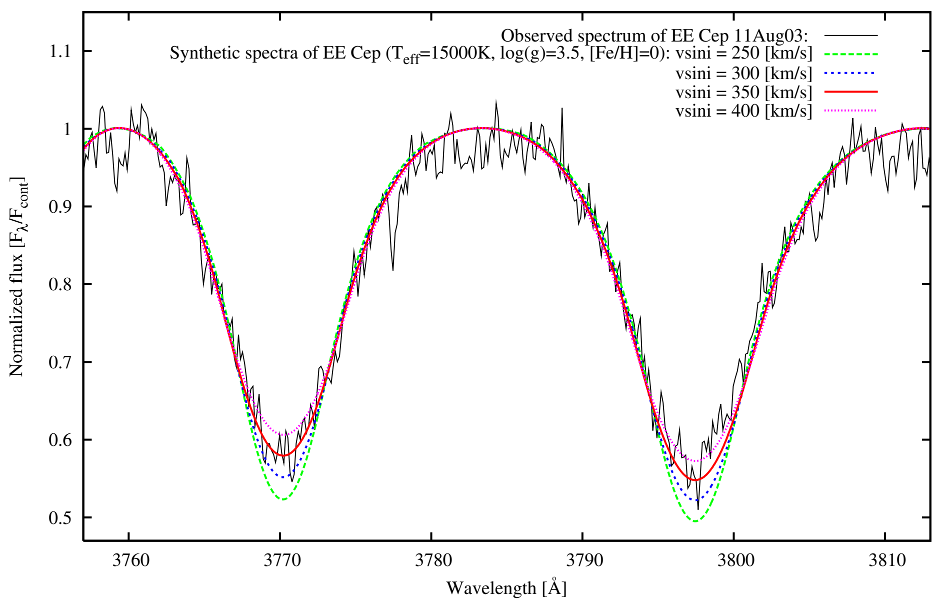

Figure 3. Synthetic and observed profiles of the H10, H11 lines.

During the 2008/2009 eclipse, we recommend photometric observations in the standard Johnson-Cousins $UBV(RI)_{\rm C}$ systems. At least one measurement per night is needed, with accuracy near to about $0\overset{\rm m}{.}01$. Some multicolour observations far from the eclipse should be made in order to calibrate systematic differences between observatories. We propose to use the same sequence of comparison stars as during the previous campaign, given by Mikolajewski et al. (2003), together with a finding chart.

Any infrared, photometric (at least JHK) and spectroscopic observations before, during and after the eclipse would be very useful. They could make it possible to detect the secondary companion of EE Cep (disc and/or central star/stars). During the last decade we observed variations in the I passband before and after the eclipses of about $0\overset{\rm m}{.}2$ (Fig. 4), which indicate a significant contribution of a dark body in this band. The variations can be connected with changes of the spatial orientation of the disc. In the

JHK passbands, the cool component can dominate the observed fluxes.

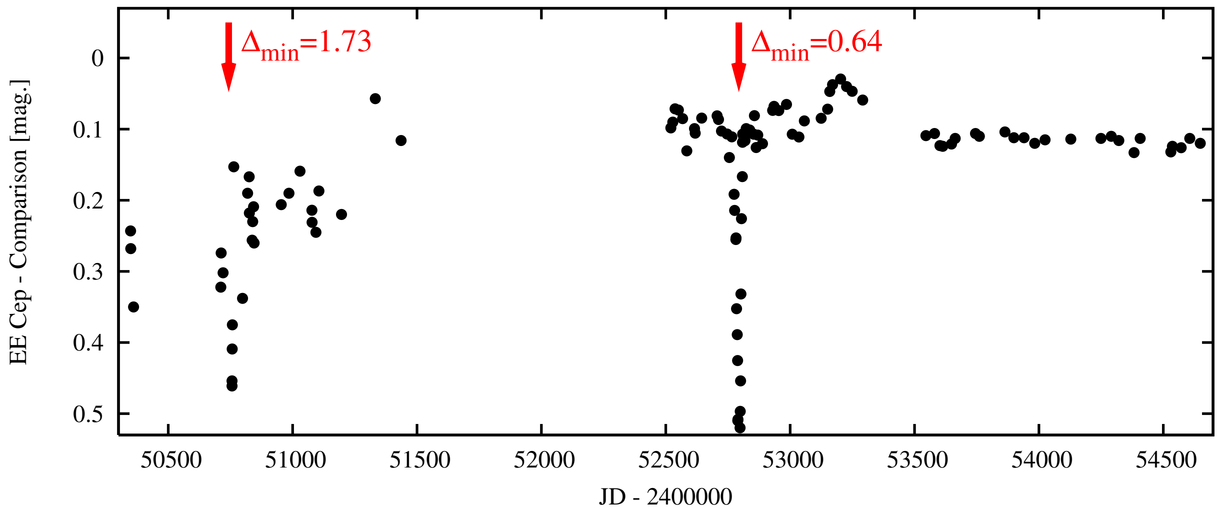

Figure 4. Differential I magnitudes of EE Cep observed in Toruń observatory during last eleven years. The depths of eclipses in 1997 and 2003 exceed the scale: both are denoted by arrows with numerical values of its amplitude. The three series of observations have been made with two photomultipliers and a CCD camera, respectively. Nevertheless, the evident non-eclipsing changes are clearly visible.

As was shown during the 2003 eclipse, the shell lines of circumstellar matter were visible about 3-2.5 months before and after the mid-eclipse, so it is advisable to begin spectroscopic observations immediately and to continue until April 2009. Of course, significant changes in the profiles of absorption and emission lines during the photometric eclipse (between 14 Dec 2008 and 14 Feb 2009) can be expected from night to night. Low and high resolution spectra and spectral distributions would be very useful.

We invite all interested observers to participate in the current campaign. Please contact us: *cgalan@astri.uni.torun.pl* or *mamiko@astri.uni.torun.pl*.

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A MULTICOLOR PHOTOMETRIC STUDY OF CN ORIONIS

SPOGLI, CORRADO[1,2]; FIORUCCI, MASSIMO[1,3]; CAPEZZALI, DANIELE[1,2]; NUCCIARELLI, GIULIANO[1]; MANCINELLI, VANNIO[2]; BRUNOZZI, PAOLO[2]; FAGOTTI, PAOLO[2]

[1] Physics Dept. and Astronomical Observatory, University of Perugia, Via A. Pascoli, 06123 Perugia, Italy

[2] Porziano Astronomical Observatory, Via Santa Chiara 2, 06081 Assisi, PG, Italy

[3] INAF Osservatorio Astronomico di Padova, Via dell'Osservatorio 8, 36012 Asiago, VI, Italy

CN Ori is one of the brightest and most active dwarf novae (DNe), with a very short recurrence time between two consecutive outbursts ($\simeq 18$ days), and one of the few DNe with an orbital period above the 3-hour upper boundary of the period gap ($P = 0\overset{\mathrm{d}}{.}163199$). The maximum reported brightness is $V = 11.9$. The minimum is extremely variable and ranges between $V = 14.2$ and $V = 16.3$, with a quasi–sinusoidal component of variability due to a partial eclipse (Mumford 1967), and other components superimposed that probably are the signature of an accretion disk out of the steady state (Mantel et al. 1988). Many photometric observations of CN Ori are reported in the literature, with time scales ranging from a few seconds to many days (see e.g., Petit 1960, Shoembs 1982). However, these data have been generally obtained in a single photometric band, and only sporadic multi–band observations are available (for example, Echevarria 1984).

We have observed this dwarf nova at the Perugia Astronomical Observatory since 2002. The instruments used and the photometric techniques applied was already described in Spogli et al. (1998). Other observations have been collected at the Porziano Astronomical Observatory, Mt. Subasio, Assisi (Italy), with a 0.35 m Schmidt–Cassegrain telescope equipped with an HiSIS 23 CCD Camera (Kodak Kaf 401E of 762×512 pixel) and standard BVR_CI_C Johnson–Cousins broad band filters. There is no evaluable difference between the reduced data obtained with the two telescopes.

The photometric data have been obtained in differential photometry using the calibration stars reported by Bailey & Howarth (1979) and Misselt (1996). With the principal aim to give the I_C magnitudes, we selected and re–calibrated a new sequence by observing, on three photometric nights, several standard stars (Landolt 1992) having $B - V$ from -0.2 to 1.5 mag. Table 1 reports the weighted averages and the standard deviations for the selected comparison stars. Fig. 1 shows the finding chart. The BVR_C magnitudes are in general agreement with the results of Misselt (1996), while they are in average fainter by 0.07 mag compared with the B and V photoelectric estimates of Bailey & Howarth (1979), with an r.m.s. scatter of 0.08 mag around the offset. The I_C values are original results.

Table 2 gives the BVR_CI_C magnitudes of CN Ori. An important sample of our data has been obtained during the partial eclipse of the binary system, considering the orbital ephemeris reported by Barrera & Vogt (1989). Neglecting eclipse points, our data confirm

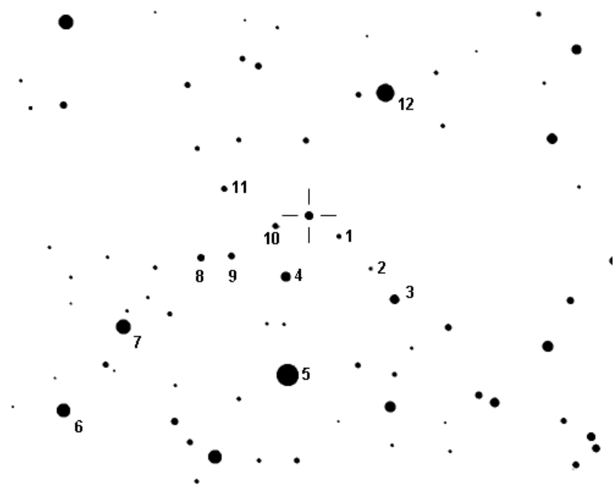

Figure 1. Finding chart of CN Ori, with the selected sequence.

the very short recurrence time between two consecutive outbursts (Fourier periodogram gives $P \simeq 18.76$ days), with a symmetric shape of the outburst profile characterized by a relatively fast rise and decline. Many variability patterns are superimposed on the outburst cycle, but our data–sampling is not applicable for an accurate investigation. Fig. 2 shows that the outburst amplitude changes at different filters. Fig. 3 shows the color-index versus magnitude diagram for CN Ori.

Table 1: BVR_CI_C magnitudes for the selected comparison stars

name(s)	RA	DEC	B	V	R_C	I_C
C1, M1$^{(1)}$, L$^{(2)}$	5:52:04.0	-5:25:40	15.95±0.06	14.65±0.05	13.88±0.03	13.15±0.03
C2, M$^{(2)}$	5:52:00.0	-5:26:42	16.08±0.07	15.10±0.04	14.52±0.04	14.01±0.05
C3	5:51:57.0	-5:27:40	14.19±0.08	12.94±0.04	12.26±0.02	11.58±0.03
C4, M3$^{(1)}$	5:52:10.7	-5:26:56	12.93±0.03	12.48±0.03	12.19±0.03	11.97±0.03
C5	5:52:10.5	-5:30:03	10.32±0.05	9.81±0.03	9.50±0.05	9.24±0.03
C6, C$^{(2)}$	5:52:38.8	-5:31:09	13.15±0.10	11.93±0.03	11.12±0.04	10.34±0.03
C7, B$^{(2)}$	5:52:31.3	-5:28:32	11.78±0.07	11.34±0.04	10.98±0.03	10.76±0.04
C8, G$^{(2)}$	5:52:21.4	-5:26:20	14.90±0.05	13.68±0.04	12.92±0.02	12.19±0.03
C9, M5$^{(1)}$, H$^{(2)}$	5:52:17.6	-5:26:18	15.36±0.05	13.93±0.03	13.14±0.03	12.38±0.03
C10, M4$^{(1)}$, K$^{(2)}$	5:52:12.1	-5:25:21	15.45±0.05	14.21±0.04	13.48±0.03	12.74±0.03
C11	5:52:18.5	-5:24:10	14.88±0.09	13.92±0.04	13.33±0.04	12.85±0.04
C12, A$^{(2)}$	5:51:58.1	-5:21:08	11.76±0.03	10.61±0.02	9.94±0.03	9.29±0.03

(1) Misselt (1986)
(2) Bailey & Howarth (1979)

During the rise to the outburst, and the subsequent decline, the emission is progressively dominated by the accretion disk and the color index follows the typical path well represented by a line. During quiescence the emission is generally dominated by the secondary, but our data show a large variation in the color–magnitude diagram, with a change in slope and curvature, and the color index is far from the expected color of an M4-5 star (Ritter & Kolb 1998). So we can conclude that the accretion disk remains relatively bright during the quiescence of CN Ori, and the large color variations are increased by the partial eclipse of the binary system.

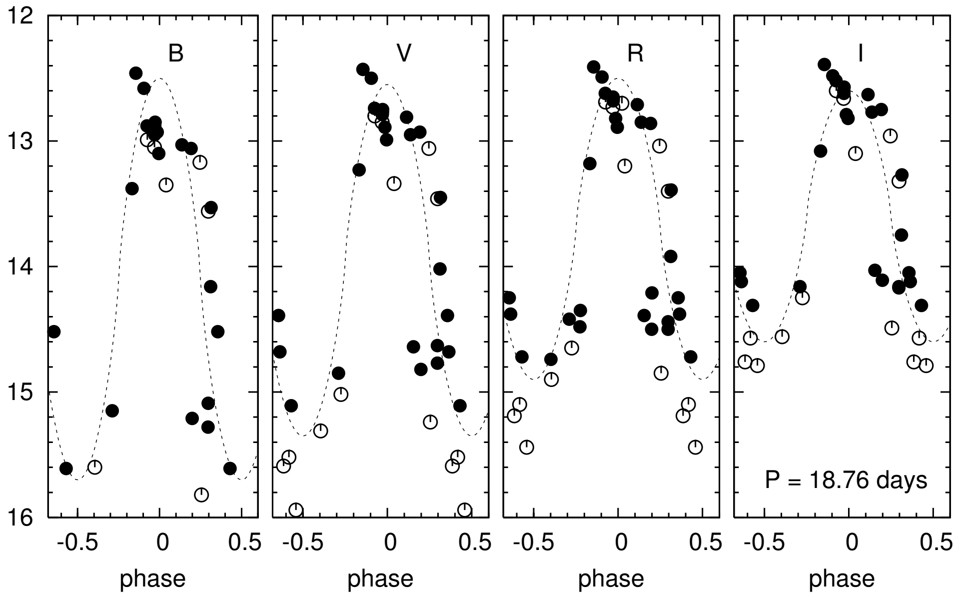

Figure 2. The phase diagram of CN Ori shows a relatively stable outburst-cycle, with a quasi-sinusoidal trend (dashed line), and the outburst amplitude that changes at different wavelengths. Empty circles represent the data obtained during the partial eclipse of the binary system.

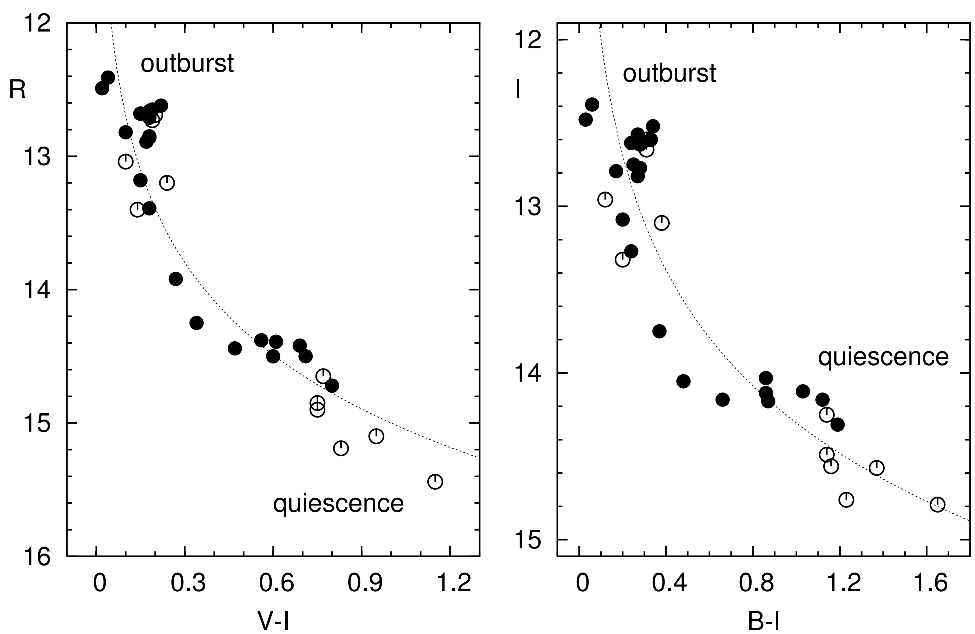

Figure 3. During the outburst the emission is dominated by the accretion disk and the color index is bluer; the emission of the secondary is progressively more important during quiescence and the color index is redder, with a complex behaviour like a curvature (dotted line).

Table 2: BVR_CI_C data of CN Ori

UT DATE	JD (245+)	B	V	R_C	I_C
11/02/2002	2317.327	12.78±0.06	12.77±0.05	12.68±0.04	12.62±0.04
22/02/2002	2328.339	15.60±0.07	15.31±0.05	14.90±0.05	14.56±0.05
24/02/2002	2330.332	15.15±0.07	14.85±0.05	14.42±0.05	14.16±0.04
04/03/2002	2338.326	13.03±0.07	12.95±0.05	12.85±0.04	12.77±0.04
10/03/2002	2344.361		15.94±0.08	15.44±0.05	14.79±0.05
19/12/2002	2628.458			14.74±0.04	
10/01/2003	2650.443			14.48±0.05	
10/01/2003	2650.485			14.35±0.04	
18/01/2003	2658.434			14.21±0.05	
12/03/2003	2711.385			12.70±0.03	
05/12/2003	2979.499	13.53±0.06	13.45±0.04	13.39±0.04	13.27±0.04
20/12/2003	2994.488		12.81±0.05	12.71±0.05	12.63±0.05
26/12/2003	3000.428	15.61±0.08	15.11±0.03	14.72±0.04	14.31±0.03
23/01/2004	3028.444	12.88±0.07	12.74±0.04	12.62±0.04	12.52±0.03
23/01/2004	3028.478	12.99±0.07	12.80±0.05	12.69±0.04	12.60±0.04
24/01/2004	3029.298	13.05±0.06	12.85±0.04	12.73±0.04	12.66±0.04
24/01/2004	3029.317	12.95±0.06	12.79±0.04	12.65±0.04	12.60±0.04
24/01/2004	3029.335	12.88±0.06	12.77±0.04	12.68±0.04	12.62±0.04
24/01/2004	3029.358	12.85±0.06	12.75±0.04	12.66±0.04	12.57±0.04
30/01/2004	3035.431	15.28±0.08	14.77±0.05	14.50±0.04	14.17±0.04
30/01/2004	3035.442	15.09±0.06	14.63±0.04	14.44±0.04	14.16±0.03
12/02/2004	3048.362	12.93±0.06	12.89±0.04	12.82±0.04	12.79±0.03
13/02/2004	3049.384	13.35±0.04	13.34±0.03	13.20±0.04	13.10±0.03
16/02/2004	3052.365	15.21±0.07	14.82±0.05	14.50±0.05	14.11±0.04
17/02/2004	3053.426	15.82±0.08	15.24±0.05	14.85±0.05	14.49±0.05
02/03/2004	3067.313	13.10±0.06	12.99±0.04	12.89±0.03	12.82±0.03
05/03/2004	3070.298		14.64±0.05	14.39±0.04	14.03±0.05
27/11/2005	3702.525	12.46±0.06	12.43±0.04	12.41±0.04	12.39±0.04
28/11/2005	3703.457	12.58±0.05	12.50±0.05	12.49±0.05	12.48±0.04
07/12/2005	3712.458		15.59±0.07	15.19±0.05	14.76±0.05
10/01/2006	3746.375	13.06±0.06	12.93±0.05	12.86±0.05	12.75±0.05
11/01/2006	3747.376	13.17±0.06	13.06±0.05	13.04±0.05	12.96±0.05
12/01/2006	3748.332	13.56±0.06	13.46±0.05	13.40±0.05	13.32±0.05
13/01/2006	3749.429	14.52±0.06	14.39±0.06	14.25±0.05	14.05±0.05
20/01/2006	3756.357		15.02±0.05	14.65±0.05	14.25±0.05
22/01/2006	3758.374	13.38±0.07	13.23±0.05	13.18±0.05	13.08±0.05
31/01/2006	3767.361	14.16±0.07	14.02±0.05	13.92±0.05	13.75±0.05
01/02/2006	3768.343		14.68±0.06	14.38±0.05	14.12±0.05
02/02/2006	3769.388		15.52±0.06	15.10±0.06	14.57±0.05

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TWO PAIRS OF INTERACTING EBS TOWARDS THE LMC IN THE OGLE DATABASE

OFIR, A.[1]

[1] School of Physics and Astronomy, Raymond and Beverly Sackler Faculty of Exact Sciences, Tel Aviv University, Tel Aviv, Israel

Manual browsing through the online OGLE LMC database[1] (Wyrzykowski *et al.* 2003) revealed that eclipsing binary OGLE 051343.14-691837.1 ($P_1 = 3.57798\,\mathrm{d}$) is significantly more noisy than other stars with similar brightness, and indeed another EB was subsequently found in it's residuals ($P_2 = 5.36655\,\mathrm{d}$). This second EB has a period of almost exactly 1.5 times the period of the first EB. To better disentangle the two signals we simultaneously fitted a truncated Fourier series with N terms ($N = 22$) for each period, plus a zero-point term, for a total of 45 fitted coefficients. We then rejected outliers and repeated untill convergence. This allowed us to better visualize both EBs (see Fig. 1) and it is easy to see that the two signals are not different harmonics of the same system but rather two distinct EBs. Since OGLE's telescope PSF is rather small, and because of the apparent resonance between the two binaries, we believe it is highly unlikely that this is chance alignment, and that the more probable explanation is of a rather compact hierarchical system of two pairs of EBs in 3:2 resonance. Interestingly, it seems that all 4 stars are rather massive as both EBs show very significant ellipsoidal variation. With this scenario in mind, the fact that both pairs of stars are EBs means that some degree of co-planarity also exist - further supporting the interacting-pairs hypothesis.

Reference:

Wyrzykowski, L. et al. 2003, Acta Astron., 53, 1

[1] http://ogle.astrouw.edu.pl/

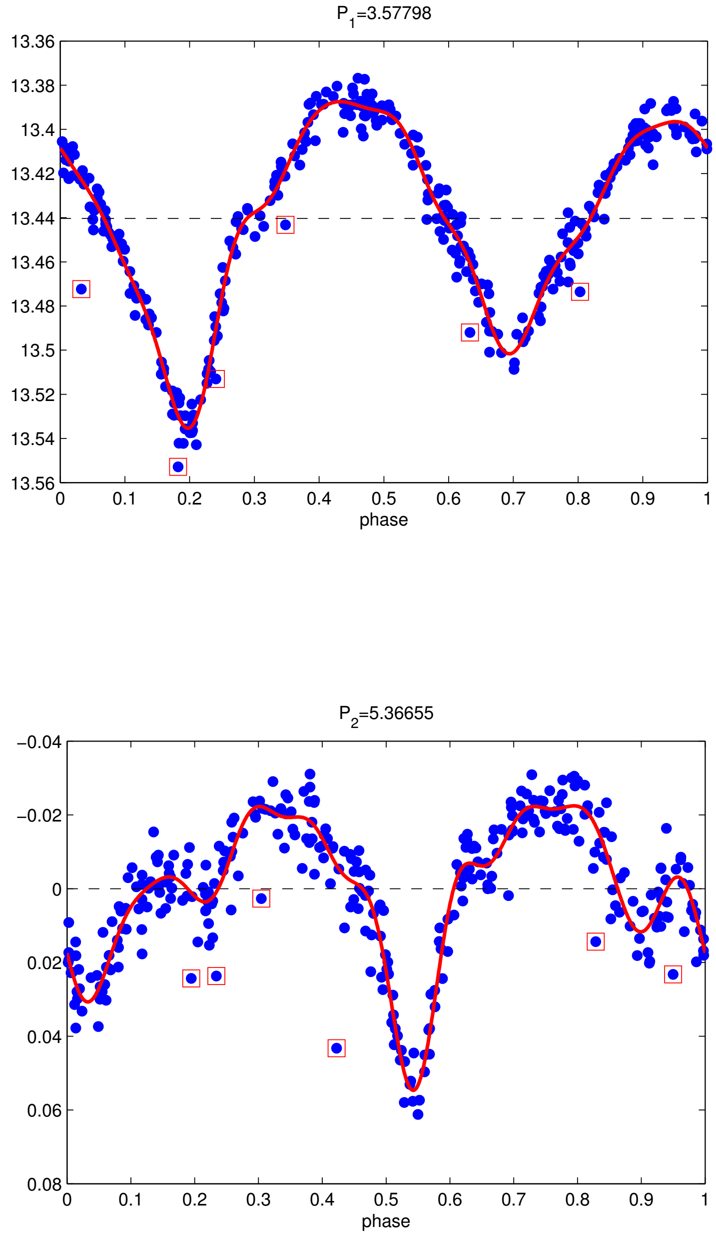

Figure 1. The red solid lines are smoothed light curves using a truncated Fourier series - see text for details (for each EB the other EB signal is removed). Outliers are marked in red boxes.

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ROTSE-III OBSERVATIONS OF NOVA M31 2008-08D (ROTSE3 J004548.3+430222)

YUAN, F.[1]; QUIMBY, R. M.[2]; CHAMARRO, D. C.[1]; UECKER, A.[3]; SISSON, M. D.[1]; AKERLOF, C. W.[1]; SCHAEFER, B. E.[4]; WHEELER, J. C.[5] ON BEHALF OF THE ROTSE COLLABORATION

[1] University of Michigan, Ann Arbor, MI 48109, USA, e-mail: yuanfang@umich.edu

[2] California Institute of Technology, Pasadena, CA 91125, USA

[3] Indiana University of Pennsylvania, Indiana, PA 15705, USA

[4] Louisiana State University, Baton Rouge, LA 70803, USA

[5] University of Texas, Austin, TX 78712, USA

Nova M31 2008-08d (ROTSE3 J004548.3+430222), with a projected distance of ∼25 kpc from the center of M31, was discovered in unfiltered CCD images taken with the 0.45-m ROTSE-IIIb telescope at McDonald Observatory on August 25.23 UT, 2008. It was initially reported by Yuan et al. (2008) as an optical transient with unknown nature because of the multi-peaked early lightcurve atypical of a nova and its ambiguous correlation with an INT[1] V-band archive source. Spectroscopic observation by Chornock et al. (2008) identifies it as a classical nova of Fe II type with a radial velocity consistent with a location in M31.

We report in Table 1 the complete photometric observations of this nova by ROTSE-IIIb and ROTSE-IIId at the TUBITAK National Observatory in Turkey. The ROTSE-III images were bias-subtracted and flat-fielded by the automated pipeline. Initial object detections were performed by SExtractor. The images were then processed with our custom RPHOT photometry program based on the DAOPHOT PSF-fitting photometry package (Quimby et al. 2006). The response peak of ROTSE-III CCDs covers a similar range to R-band. The magnitude zero point for each image was estimated from median offset of the fiducial reference stars to the USNO-B1.0 R-band measurements.

The ROTSE-III detections are plotted in Figure 1 together with upper limits constraining the rise and decay of the transient. The overall decaying lightcurve shows significant amount of oscillation before dropping below our detection threshold at the end of October. It is not uncommon for nova lightcurves to show variations due to dust formation (Shafter 2008), but usually on longer time-scales than observed for this object.

[1]The INT data were obtained from the Isaac Newton Group Archive which is maintained as part of the CASU Astronomical Data Centre at the Institute of Astronomy, Cambridge.

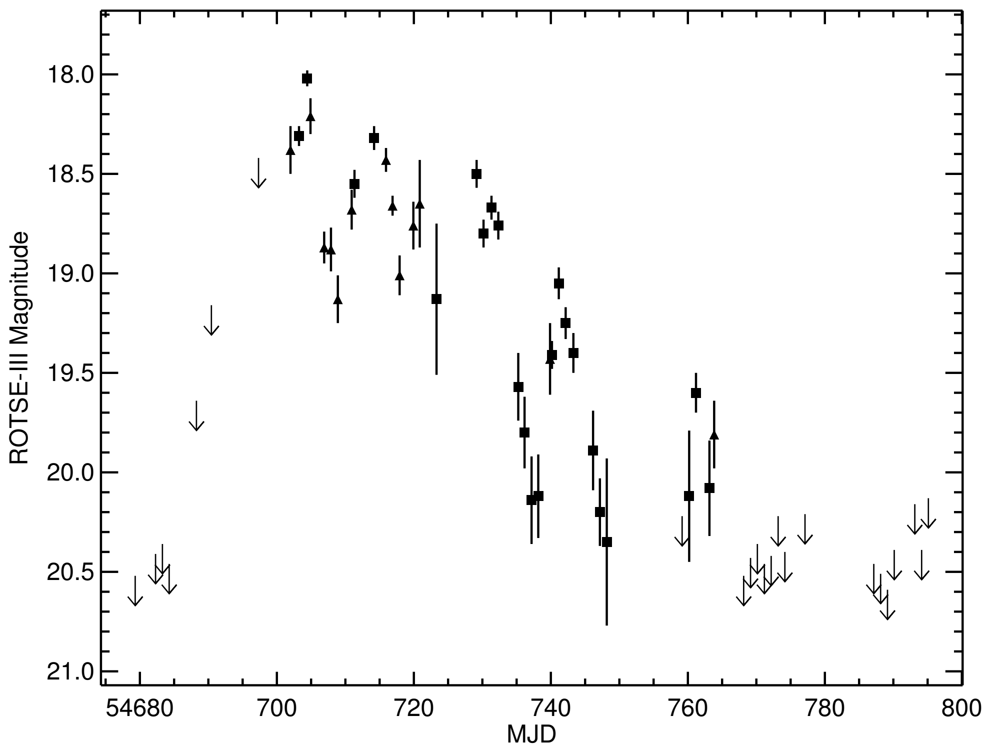

Figure 1. ROTSE-III lightcurve of Nova M31 2008-08d (ROTSE3 J004548.3+430222). The filled squares are detections from ROTSE-IIIb and the filled triangles are detections from ROTSE-IIId. All the upper limits (downward arrows) are from ROTSE-IIIb.

References:

Yuan, F., et al. 2008, *The Astronomer's Telegram*, **1702**
Chornock, R., Silverman, J. M., George, M. R., and Filippenko, A. V. 2008, *The Astronomer's Telegram*, **1708**
Quimby, R. M., et al. 2006, *ApJ*, **636**, 400
Shafter, A. W. 2008, Private Communication

Table 1. Log of ROTSE-III observations

MJD	Magnitude	Error	Upper Limit	ROTSE Telescope
54679.32			20.52	IIIb
54682.29			20.41	IIIb
54683.29			20.36	IIIb
54684.28			20.46	IIIb
54688.26			19.64	IIIb
54690.44			19.16	IIIb
54697.32			18.42	IIIb
54701.99	18.38	0.12		IIId
54703.23	18.31	0.05		IIIb
54704.43	18.02	0.04		IIIb
54704.91	18.21	0.09		IIId
54706.91	18.87	0.08		IIId
54707.90	18.88	0.11		IIId
54708.90	19.13	0.12		IIId
54710.92	18.68	0.10		IIId
54711.33	18.55	0.07		IIIb
54714.19	18.32	0.06		IIIb
54715.93	18.43	0.06		IIId
54716.89	18.66	0.05		IIId
54717.92	19.01	0.10		IIId
54719.93	18.76	0.12		IIId
54720.86	18.65	0.22		IIId
54723.31	19.13	0.38		IIIb
54729.16	18.50	0.07		IIIb
54730.17	18.80	0.07		IIIb
54731.33	18.67	0.06		IIIb
54732.33	18.76	0.07		IIIb
54735.24	19.57	0.17		IIIb
54736.16	19.80	0.18		IIIb
54737.18	20.14	0.22		IIIb
54738.16	20.12	0.21		IIIb
54739.88	19.43	0.18		IIId
54740.16	19.41	0.07		IIIb
54741.16	19.05	0.08		IIIb
54742.16	19.25	0.08		IIIb
54743.29	19.40	0.10		IIIb
54746.16	19.89	0.20		IIIb
54747.16	20.20	0.17		IIIb
54748.16	20.35	0.42		IIIb
54759.16			20.22	IIIb
54760.19	20.12	0.33		IIIb
54761.19	19.60	0.10		IIIb
54763.15	20.08	0.24		IIIb
54763.84	19.81	0.17		IIId
54768.15			20.52	IIIb
54769.15			20.43	IIIb
54770.15			20.36	IIIb
54771.17			20.46	IIIb
54772.16			20.42	IIIb
54773.18			20.22	IIIb
54774.16			20.40	IIIb
54777.10			20.21	IIIb
54787.14			20.46	IIIb
54788.14			20.51	IIIb
54789.14			20.59	IIIb
54790.13			20.39	IIIb
54793.13			20.16	IIIb
54794.13			20.39	IIIb
54795.11			20.13	IIIb

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PHOTOELECTRIC MINIMA OF SELECTED ECLIPSING BINARIES IN 2008

DVORAK, S.W.

Rolling Hills Observatory, Clermont, FL USA; e-mail: sdvorak@rollinghillsobs.org

Observatory and telescope:
25cm catadioptric telescope at Rolling Hills Observatory (RHO)

Detector:	SBIG ST-9XE, Peltier cooling, Kodak KAF-0261 chip, $18.5' \times 18.5'$ FOV, 512×512 pixels.

Method of data reduction:
Reduction of the CCD frames was done with sextractor and custom-written applications[1].

Method of minimum determination:
The times of minima were computed using the Kwee and van Woerden method (Kwee & van Woerden, 1956) as implemented in a custom-written C application.

Reference:

Kwee, K. K. & van Woerden, H., 1956, *BAN*, **12**, 327

[1]sextractor is written by Emmanuel Bertin and is available from http://terapix.iap.fr/

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
CG Aur	54794.8180	0.0001	I	*V*	
EP Aur	54514.6610	0.0001	I	*V*	
TY Boo	54595.6023	0.0001	I	*V*	
DF CVn	54503.7561	0.0002	I	*V*	
XZ CMi	54501.5743	0.0001	I	*V*	
V0364 Cas	54759.6380	0.0000	II	*V*	
	54766.5818	0.0001	I	*V*	
	54741.8930	0.0001	I	*V*	
V0384 Cas	54797.6465	0.0001	I	*V*	
V0821 Cas	54825.5334	0.0002	I	*B*	
CC Com	54596.6184	0.0001	II	*V*	
V Crt	54570.6878	0.0002	II	*V*	
V0456 Cyg	54637.8682	0.0002	I	*V*	
V0466 Cyg	54624.8263	0.0001	II	*V*	
TZ Dra	54570.8839	0.0003	II	*V*	
	54573.9200	0.0003	I	*V*	
	54583.8782	0.0003	II	*V*	
AZ Gem	54474.6207	0.0001	I	*V*	
	54498.7697	0.0001	I	*V*	
V0899 Her	54632.800	0.001	I	*V*	
FG Hya	54529.5808	0.0001	I	*V*	
UV Leo	54553.6343	0.0001	I	*V*	
VZ Leo	54528.5656	0.0002	I	*V*	
WY Leo	54568.667	0.002	I	*V*	
VW LMi	54574.6311	0.0001	I	*V*	
UV Lyn	54544.6278	0.0001	II	*V*	
TZ Lyr	54578.8170	0.0001	I	*V*	
V0396 Mon	54494.6405	0.0001	I	*V*	
V0714 Mon	54493.6578	0.0001	I	*V*	
V0508 Oph	54588.7907	0.0001	I	*V*	
FK Ori	54511.5714	0.0003	II	*V*	
FT Ori	54755.8755	0.0001	II	*V*	
BO Peg	54788.6056	0.0001	II	*V*	
	54793.5362	0.0001	I	*V*	
IQ Per	54791.873	0.0001	I	*B*	
AH Tau	54475.7472	0.0001	I	*V*	
	54475.5807	0.0001	II	*V*	
	54736.8952	0.0001	I	*V*	
CU Tau	54475.6496	0.0002	I	*V*	
RS Tri	54787.6679	0.0002	II	*V*	
	54790.5261	0.0002	I	*V*	
HW Vir	54498.8769	0.0001	I	*V*	
	54498.9353	0.0001	II	*V*	
ASAS 085128+2527.9	54477.7306	0.0001	?	*V*	

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TIMINGS OF MINIMA OF ECLIPSING BINARIES

DIETHELM, ROGER

Bahnhofstrasse 3, CH–4118 Rodersdorf, Switzerland

The following Table lists timings of minima of eclipsing binaries secured by CCD photometry, obtained between July 2008 and December 2008. The given O-C values generally refer to the linear elements of the GCVS (Kholopov et al., 1985, 2008 edition) except for the cases stated in the remarks. All times given are heliocentric UTC.

Table 1: Eclipsing binaries

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
AD And	p	54774.6223	0.0004	−0.0587	23	RD	V
AS And	p	54787.6587	0.0004	+0.0075	35	RD	V; el.: 2452548.5944 + 2.420602 * E
CN And	s	54784.6882	0.0009	−0.0061	19	RD	V
DK And	p	54784.6604	0.0009	+0.0085	25	RD	V
DO And	p	54777.6750	0.0003	+0.0215	42	RD	V
DS And	p	54802.6448	0.0004	−0.0005	32	RD	V
EP And	p	54802.6338	0.0009	−0.0047	15	RD	V; el.: IBVS No. 5184
FL And	p	54784.6643	0.0005	+0.0108	26	RD	V
HR And	p	54769.649	0.005	−0.093	10	RD	V
LO And	s	54784.6166	0.0006	−0.0021	15	RD	V
MO And	p	54821.6514	0.0005	−0.0012	32	RD	V
NZ And	p	54800.6788	0.0004	−0.0218	15	RD	V
QR And	p	54792.711	0.003	−0.014	19	RD	V; el.: IBVS No. 5777; additional pulsations
QW And	s	54800.7044	0.0007	+0.0051	16	RD	V
V372 And	p	54762.8347	0.0011	+0.0515	28	RD	V
V404 And	s	54783.6195	0.0002	+0.0034	20	RD	V
V412 And	p	54769.7531	0.0006	+0.0477	32	RD	V
V440 And	s	54774.6632	0.0005	+0.0057	15	RD	V; el.: 2452900.1019 + 1.5825712 * E
V441 And	s	54768.7252	0.0004	−0.0146	31	RD	V
V444 And	p	54800.6573	0.0007	−0.0800	24	RD	V; el.: IBVS No. 5600
V449 And	s	54821.7120	0.0001	+0.0294	22	RD	V
EL Aqr	s	54769.726	0.003	+0.003	17	RD	V
SS Ari	p	54821.6936	0.0003	−0.0027	27	RD	V
AW Ari	p	54802.6809	0.0005	−0.0123	21	RD	V; el.: IBVS No. 5219
AH Aur	s	54802.9070	0.0002	+0.1038	36	RD	V
AP Aur	s	54821.9716	0.0003	+0.0856	17	RD	V
CL Aur	p	54774.8862	0.0008	+0.1364	27	RD	V
HS Aur	p	54811.8855	0.0006	+0.0028	32	RD	V; d=0.04 days
HU Aur	s	54831.6360	0.0012	−0.0144	25	RD	V; el.: IBVS No. 3666
IZ Aur	p	54800.8208	0.0010	−0.0120	10	RD	V; IBVS No. 4586
KO Aur	p	54802.8680	0.0002	−0.0156	36	RD	V; el.: IBVS No. 3410
V404 Aur	p	54794.9111	0.0004	+0.0237	40	RD	V; el.: IBVS No. 4245
V410 Aur	s	54783.8838	0.0006	−0.0043	29	RD	V; el.: IBVS No. 5668
V523 Aur	s	54821.8769	0.0007	+0.0070	12	RD	V; el.: 2451518.32 + 0.3304376 * E
V555 Aur	s	54777.8994	0.0006	+0.0137	37	RD	V; formerly ES Tau

Table 1: Eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GSC 2393-680	p	54777.8594	0.0008	+0.0053	16	RD	V; el.: IBVS No. 5699
GSC 3751-178	p	54802.9093	0.0003	−0.0131	29	RD	V
UU Cam	p	54811.7390	0.0006	−0.0710	10	RD	V
WW Cam	s	54774.8304	0.0005	−0.0352	20	RD	V
AO Cam	s	54830.7036	0.0004	−0.0390	22	RD	V; el.: PASP 97, 648
AV Cam	p	54802.9006	0.0004	−0.0693	37	RD	V
AY Cam	p	54829.8685	0.0003	−0.0155	43	RD	V; el.: IBVS No. 3005
MP Cam	p	54787.8734	0.0004	−0.0694	36	RD	V
MT Cam	p	54831.6560	0.0003	+0.0005	25	RD	V; el.: 2452975.3307 + 0.366139 * E
GSC 3715-1039	s	54811.7157	0.0012	−0.0099	16	RD	V; el. IBVS No. 5700
	p	54831.7102	0.0004	−0.0142	19	RD	V
TU Cnc	p	54830.8810	0.0007	−0.6781	31	RD	V
TX Cnc	p	54829.8835	0.0005	+0.0382	28	RD	V
XZ Cnc	p	54831.8424	0.0007	+0.0657	21	RD	V; el.: IBVS No. 5592
YY Cnc	p	54832.8249	0.0012	−0.0075	25	RD	V; el.: IBVS No. 5591
AB Cnc	p	54830.8560	0.0004	+0.0479	27	RD	V; el.: IBVS No. 5337
AD Cnc	p	54831.8929	0.0006	−0.0223	22	RD	V
AH Cnc	s	54831.8360	0.0004	+0.0833	19	RD	V
EH Cnc	s	54831.8571	0.0003	−0.0531	28	RD	V; el.: ASAS
GW Cnc	p	54831.9258	0.0004	−0.0191	24	RD	V; el.: ASAS
IL Cnc	s	54831.9068	0.0009	+0.0498	21	RD	V; el.: IBVS No. 5248
IR Cnc	p	54830.8627	0.0003	+0.0015	33	RD	V; el.: 2452623.01 + 0.717767 * E; d=0.04 days
GSC 1927-862	s	54821.8864	0.0008	+0.0059	43	RD	V; el.: 2452707.522 + 0.536435 * E
NSV 4158	s	54831.8239	0.0003	−0.0001	16	RD	V; el.: 2452623.38 + 0.378385 * E
NSV 4188	s	54830.9446	0.0005	+0.0032	21	RD	V; el.: 2452623.165 + 0.308026 * E; d=0.018 days
DF CVn	s	54682.4056	0.0004	+0.0015	13	EBl	C; el.: IBVS No. 5021
DQ CVn	p	54682.393	0.002	−0.005	11	EBl	C; el.: IBVS No. 5541
GSC 2537-520	p	54682.4151	0.0011	−0.0059	10	EBl	C; el.: IBVS No. 5541
GSC 2544-1007	s	54682.3999	0.0011	+0.0097	13	EBl	C; el.: IBVS No. 5541
BB CMi	p	54821.9225	0.0007	+0.0857	30	RD	V; el.: AJ 109, 1239
CW CMi	s	54821.8874	0.0002	+0.0051	32	RD	V; el.: 2452750.587 + 0.313192 * E
ZZ Cas	p	54777.6503	0.0002	−0.0115	34	RD	V
AT Cas	p	54762.8238	0.0004	−0.0816	47	RD	V
BH Cas	p	54783.6764	0.0006	+0.0212	35	RD	V; el.: IBVS No. 4482
BS Cas	p	54783.6667	0.0004	+0.0050	34	RD	V; el.: IBVS No. 5668
BU Cas	p	54768.7793	0.0006	−0.0207	13	RD	V
BZ Cas	p	54761.7271	0.0005	+0.0660	39	RD	V
CV Cas	p	54756.7480	0.0003	+0.6312	36	RD	B
CW Cas	s	54756.7440	0.0002	−0.0468	38	RD	B; el.: JAAVSO 21, 34
DZ Cas	p	54777.6978	0.0002	−0.1749	35	RD	V
EY Cas	s	54787.6413	0.0003	+0.0308	27	RD	V
HQ Cas	p	54762.7914	0.0003	−0.5365	55	RD	V
IL Cas	p	54800.5942	0.0011	+0.0019	11	RD	V; BAV Mitt. 51.1
IT Cas	s	54774.7030	0.0005	+0.2004	29	RD	V; el.: AJ 114, 1206; non-circular orbit
KL Cas	p	54761.7626	0.0001	−0.0097	52	RD	V
KR Cas	p	54762.7341	0.0008	−0.1467	22	RD	V
LX Cas	p	54830.6537	0.0003	+0.0481	35	RD	V
LY Cas	p	54830.6737	0.0005	+0.1124	32	RD	V
MM Cas	p	54774.6676	0.0003	+0.0908	35	RD	V
MN Cas	s	54783.6377	0.0007	+0.0174	24	RD	V
MR Cas	s	54769.7288	0.0002	−0.0500	30	RD	V; el.: IBVS No. 5690
MT Cas	p	54792.6557	0.0004	+0.0122	21	RD	V
MY Cas	p	54792.6163	0.0010	+0.0264	15	RD	V
NN Cas	s	54768.7611	0.0006	+0.1260	18	RD	V
	p	54800.638	0.002	+0.126	19	RD	V
NT Cas	p	54762.7376	0.0005	+0.0212	37	RD	V
NV Cas	p	54783.6831	0.0003	−0.1118	23	RD	V

Table 1: Eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
OR Cas	p	54787.7009	0.0006	−0.0253	25	RD	V
OX Cas	p	54811.6737	0.0007	+0.0139	27	RD	V
QQ Cas	p	54769.7426	0.0007	+0.1074	29	RD	V; el.: BAV Rdb. 35,1
V337 Cas	p	54802.6931	0.0003	−0.0653	31	RD	V; d = 0.04 days
V361 Cas	p	54774.7186	0.0008	−0.1979	18	RD	V
V366 Cas	s	54768.7520	0.0006	+0.0637	17	RD	V; el.: IBVS No. 4798
V374 Cas	p	54774.6777	0.0003	+0.0164	39	RD	V
V375 Cas	p	54777.6631	0.0005	+0.1382	38	RD	V
V381 Cas	s	54783.6287	0.0003	−0.0197	23	RD	V
V384 Cas	p	54777.6983	0.0005	−0.1411	35	RD	V
V385 Cas	p	54762.7344	0.0010	−0.8836	16	RD	V
V387 Cas	p	54761.7116	0.0008	+0.0851	33	RD	V
V445 Cas	s	54761.7645	0.0008	−0.0118	48	RD	V; el.; BAV Mitt. 69
V448 Cas	s	54761.8494	0.0004	+0.2090	36	RD	V
V471 Cas	p	54794.5718	0.0003	+0.0814	9	RD	V
V473 Cas	p	54802.7007	0.0005	−0.0195	27	RD	V; el.: IBVS No. 4669
V520 Cas	p	54783.6144	0.0006	+0.0544	15	RD	V; el.: BBSAG Bull. 117, 9
V541 Cas	p	54829.6901	0.0008	+0.0168	26	RD	V; el.: Chin AA 11, 237
V608 Cas	s	54812.7353	0.0005		15	RD	V
V952 Cas	s	54821.6584	0.0010	−0.0121	35	RD	V; el.: IBVS No. 5171
V1007 Cas	s	54756.6563	0.0003	−0.0042	17	RD	B; el.:2451415.83+0.332008 * E
V1009 Cas	p	54769.6745	0.0006	+0.0013	16	RD	V; el.: 2451486.57 + 0.784493 * E
V1014 Cas	s	54769.7237	0.0008	+0.0016	25	RD	V; el. 2451497.062 + 0.855262 * E
NR Cep	p	54774.6995	0.0004	−0.0488	27	RD	V
OT Cep	s	54756.7775	0.0007	+0.0053	23	RD	B; el.: IBVS No. 5212
V734 Cep	p	54762.8104	0.0004	+0.0645	45		V; el.: IBVS No. 5630
	s	54783.6376	0.0005	+0.1793	27	RD	V; non-circular orbit
GSC 4502-138	p	54794.6717	0.0004	+0.0301	29	RD	V; el.: IBVS No. 5700
RW Cet	p	54802.6401	0.0007	−0.0134	23	RD	V
TV Cet	p	54821.6607	0.0016	+0.0056	30	RD	V; non-circular orbit
YY Cet	p	54812.6640	0.0009	+0.1133	34	RD	V; el.: MN 218, 159
EV Cet	s	54794.6069	0.0009	−0.0529	19	RD	V; el. IBVS No. 5455
NSV 388		54787.7388	0.0003	+0.0011	14	RD	V; el.: 245169.04 + 0.321354 * E
AR CrB	p	54684.4454	0.0006	−0.0053	17	EBl	C; el.: IBVS No. 5295
AS CrB	s	54684.4528	0.0007	+0.0036	18	EBl	C; el.: IBVS No. 5295
AV CrB	s	54684.3909	0.0003	−0.0133	21	EBl	C; el.: IBVS No. 5295
UX Eri	s	54812.6442	0.0005	+0.1534	30	RD	V
ZZ Eri	p	54756.9746	0.0009	−0.0077	20	RD	B
AM Eri	p	54783.9093	0.0004	−0.0835	18	RD	V
BL Eri	p	54830.6743	0.0005	+0.0570	30	RD	V; el.: IBVS No. 4104
BZ Eri	p	54783.9268	0.0004	+0.0049	22	RD	V
GSC 4734-713	s	54832.7370	0.0009	+0.0603	10	RD	V; el.: ASAS
GSC 5305-396	p	54829.6129	0.0004	−0.0056	23	RD	V; el.: 2453047.57 + 1.721786 * E
GSC 5305-1309	p	54787.8890	0.0005	+0.0071	35	RD	V; el.: 2454350.890 + 3.413999 * E
NSV 1864	s	54787.8658	0.0005	+0.00282	31	RD	V: el.: ASAS; d=0.06 days
BT Gem	p	54802.8376	0.0002	−0.0088	25	RD	V
DP Gem	p	54800.8123	0.0004	+0.0689	12	RD	V; el.: ASAS
FG Gem	p	54811.8692	0.0005	−0.0266	28	RD	V
FT Gem	s	54811.8431	0.0006	−0.0277	22	RD	V
MU Gem	s	54812.9117	0.0009	+0.0216	28	RD	V
GSC 1356-2826	s	54811.8639	0.0013	−0.0154	20	RD	V; el. ASAS
GSC 1368-1411	s	54821.8662	0.0003	+0.0028	33	RD	V; el.: 2452639.717 + 1.292358 * E
V1033 Her	p	54697.4439	0.0011	−0.0096	12	EBl	C; el.: IBVS No. 5146
V1036 Her	s	54697.4127	0.0007	+0.0033	11	EBl	C; el.: IBVS No. 5146
V1038 Her	p	54697.463	0.002	+0.003	13	EBl	C; el.: IBVS No. 5146
V1039 Her	s	54697.473	0.002	+0.002	12	EBl	C; el.: BBSAG Bull. 128, 10
V1044 Her	p	54697.390	0.005	−0.001	7	EBl	C; el.: IBVS No. 5192
V1047 Her	s	54697.4642	0.0006	−0.0097	13	EBl	C; el.: IBVS No. 5192
V1053 Her	p	54697.501	0.002	+0.006	10	EBl	C; el.: BBSAG Bull. 128, 10
V1055 Her	s	54697.457	0.002	+0.010	10	EBl	C; el.: IBVS No. 5192

Table 1: Eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
WY Hya	s	54829.9123	0.0004	+0.0253	33	RD	V
DF Hya	s	54832.8694	0.0002	−0.0125	29	RD	V; el.: JAAVSO 21, 111
DI Hya	p	54832.8990	0.0002	−0.0281	55	RD	V
EU Hya	p	54832.8736	0.0009	−0.0332	27	RD	V
FG Hya	s	54829.8831	0.0008	−0.0575	18	RD	V; el.: IBVS No. 2811
GN Hya	s	54830.8744	0.0004	−0.1069	36	RD	V
GSC 196-894	s	54829.8333	0.0003	−0.173	29	RD	V; el.: IBVS No. 5700
GSC 4855-1725	p	54832.8708	0.0001	+0.0026	42	RD	V; el.: 2453416.634 + 0.931733 * E
GSC 5428-504	p	54830.8739	0.0003	−0.0127	36	RD	V; el.: 2454413.846 + 1.774641 * E
RR Lep	p	54777.8607	0.0007	−0.0347	30	RD	V
GSC 5358-917	p	54794.9341	0.0008	−0.0031	33	RD	V; el.: 2454421.738 + 0.932998 * E
TY Lyn	p	54829.8921	0.0006	+0.0614	56	RD	V
DE Lyn	s	54829.8635	0.0004	+0.145	28	RD	V; el.: 2452368.560 + 0.408818 * E
UV Mon	p	54812.8163	0.0005	+0.1531	13	RD	V
V383 Mon	p	54812.8700	0.0004	+0.0284	27	RD	V
V392 Mon	p	54792.9036	0.0011	+0.0235	30	RD	V; el.: 2453655.862 + 6.767965; d = 0.12 days
V458 Mon	p	54811.8479	0.0002	+0.0663	25	RD	V
V460 Mon	p	54812.8610	0.0006	+0.2058	28	RD	V
V498 Mon	p	54802.8234	0.0010	−0.1311	18	RD	V
V514 Mon	s	54811.8535	0.0005	+0.0423	24	RD	V
V532 Mon	p	54812.793	0.002	−0.004	7	RD	V
V881 Mon	s	54812.8467	0.0002	+0.0004	24	RD	V; el.: 2453045.632 + 1.698428 * E
GSC 4826-411	p	54811.8827	0.0004	+0.0014	15	RD	V; el.: 2452561.824 + 0.337593 * E
	p	54812.8933	0.0007	−0.0008	12	RD	V
GSC 4850-1736	p	54831.8851	0.0005	−0.0009	19	RD	V; el.: 2453882.475 + 0.300399 * E
UW Ori	p	54792.8746	0.0002	+0.0414	33	RD	V; el.: Ch. AA 14, 298
EF Ori	p	54800.8159	0.0015	0.0000	11	RD	V; el.: AAVSO
ER Ori	s	54777.8866	0.0003	+0.0729	42	RD	V
FL Ori	p	54792.9083	0.0004	+0.0309	30	RD	V
FO Ori	p	54794.8899	0.0002	−0.0459	52	RD	V
FZ Ori	p	54794.8384	0.0010	+0.0189	22	RD	V; IBVS No. 5554
GU Ori	s	54800.8748	0.0004	+0.0010	32	RD	V; el.: ASAS
V517 Ori	p	54787.8805	0.0005	−0.0095	33	RD	V; el.: 2454423.746 + 1.416903 * E
V641 Ori	s	54800.8919	0.0002	+0.0639	29	RD	V; el.: ASAS
V647 Ori	p	54800.9211	0.0011	+0.0139	27	RD	V; el.: 2451985.543 + 0.977557 * E
V667 Ori	p	54800.8202	0.0003	+0.0570	14	RD	V
V1353 Ori	s	54792.8620	0.0006	−0.0074	29	RD	V; el. IBVS No. 5313
V1824 Ori	p	54802.9251	0.0003	+0.0152	28	RD	V; el.: 2453399.565 + 1.5929 * E
GSC 104-1999	p	54783.8666	0.0006	−0.0019	20	RD	V; el.: 2453044.595 + 0.829015 * E
GSC 107-596	s	54783.8437	0.0005	+0.0008	25	RD	V; el.: IBVS No. 5799
	p	54783.9709	0.0006	−0.0051	13	RD	V
GSC 702-1892	p	54777.8156	0.0003	−0.0014	16	RD	V; el.: IBVS No. 5493
	s	54777.9540	0.0005	−0.0015	17	RD	V
GSC 706-845	p	54794.8506	0.0005	−0.0048	18	RD	V; el.: IBVS No. 5799
GSC 1296-975	p	54794.8906	0.0003	+0.0312	51	RD	V; el.: 2453059.568 + 0.717359 * E
GSC 4753-984	p	54794.8331	0.0002	+0.0040	27	RD	V; el.: 2453469.502 + 1.818007 * E
NSV 1955	p	54792.9131	0.0006	+0.0067	18	RD	V; el.: 2452621.94 + 0.343453 * E
DI Peg	p	54774.6840	0.0006	−0.0109	25	RD	V
V357 Peg	s	54777.662	0.003	+0.022	31	RD	V; el.: IBVS No. 4855
RV Per	p	54783.8318	0.0008	−0.0105	22	RD	V
CH Per	p	54811.6310	0.0011	−0.0781	22	RD	V
DV Per	p	54811.6855	0.0010	+0.0856	24	RD	V
DZ Per	p	54821.7083	0.0009	+0.0277	25	RD	V
EQ Per	p	54829.6688	0.0003	+0.5350	35	RD	V
HK Per	p	54774.8653	0.0002	+0.0874	15	RD	V
HW Per	p	54787.9009	0.0004	+0.0033	34	RD	V; el.: IBVS No. 4516
II Per	p	54787.8539	0.0008	−0.0036	29	RD	V; el.: IBVS No. 5741
IK Per	p	54774.808	0.005	−0.172	15	RD	V

Table 1: Eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
KN Per	p	54830.6476	0.0018	+0.2522	26	RD	V
KR Per	s	54787.9052	0.0006	−0.0142	30	RD	V
KW Per	s	54802.6575	0.0011	0.0110	28	RD	V
NZ Per	p	54832.7045	0.0012	+0.0381	19	RD	V
QW Per	p	54832.6689	0.0002	+0.0170	23	RD	V
V366 Per	s	54832.7306	0.0025	+0.1340	13	RD	V
V432 Per	p	54831.7196	0.0006	+0.0005	20	RD	V; el.: BAV Rb 43, 104
V434 Per	p	54831.7322	0.0005	+0.1840	17	RD	V
GSC 3708-1325	s	54812.6321	0.0002		30	RD	V; non-circular orbit
SX Psc	p	54769.7494	0.0003	−0.0008	35	RD	V
UW Psc	p	54761.7402	0.0007	+0.2644	36	RD	V
CP Psc	p	54768.7235	0.0010	−0.0464	14	RD	V; el.: Hipparchos
DS Psc	p	54761.6990	0.0004	+0.0605	27	RD	V; el.: IBVS No. 4424
	s	54761.8685	0.0003	+0.0588	25	RD	V
DV Psc	s	54792.720	0.002	+0.021	10	RD	V; el.: IBVS No. 5668; prob. pulsator
DZ Psc	p	54787.6653	0.0006	+0.0113	22	RD	V; el.: IBVS No. 4910
EM Psc	s	54794.7402	0.0004	−0.0935	12	RD	V; el.: IBVS No. 5437
GSC 24-63	p	54794.6348	0.0006	−0.0030	27	RD	V; el.: 2452943.685 + 1.462048 * E
KW Pup	p	54821.8279	0.0003	+0.0280	22	RD	V
NSV 4033	p	54830.9470	0.0014	0.0000	21	RD	V; el.: 2451869.85 + 3.084476 * E
V384 Ser	s	54684.4597	0.0006	+0.0053	17	EBl	C; el.: IBVS No. 5295
RZ Tau	s	54756.9028	0.0007	+0.0546	25	RD	B
TY Tau	p	54774.890	0.002	+0.247	11	RD	V
AN Tau	p	54831.6283	0.0003	+0.0002	29	RD	V; el.: IAU Symp. 151, 321
CC Tau	p	54831.6525	0.0003	−0.0036	36	RD	V; el.: ASAS
CR Tau	p	54800.8368	0.0004	+0.1349	19	RD	V
CU Tau	p	54831.6577	0.0005	+0.0102	33	RD	V; el.: AJ 130, 224
	s	54832.6906	0.0004	+0.0095	25	RD	V
EQ Tau	s	54829.6739	0.0005	−0.0223	22	RD	V
GR Tau	s	54756.9362	0.0007	−0.0214	33	RD	B
IV Tau	p	54756.9339	0.0008	−0.0102	32	RD	B
V781 Tau	s	54792.8637	0.0003	−0.0449	26	RD	V
V1022 Tau	s	54756.9987	0.0008	−0.0604	11	RD	B; el.: PASP 101, 177
	s	54832.6849	0.0009	−0.0585	20	RD	V
V1112 Tau	s	54756.9081	0.0007	+0.0181	24	RD	B; el.: 2451946.95 + 0.423854 * E
	p	54774.919	0.003	+0.015	10	RD	V
V1188 Tau	s	54830.6561	0.0012	−0.0217	31	RD	V; el.: ASAS
V1220 Tau	s	54812.6708	0.0011	−0.0375	37	RD	V; el. IBVS No. 5455
V1222 Tau	s	54829.7029	0.0008	+0.0031	18	RD	V; el.: 2452265.857 + 0.291727 * E; d=0.03 days
V1234 Tau	s	54787.8075	0.0014	+0.1213	12	RD	V; el.: IBVS No. 5260
V1237 Tau	s	54792.8416	0.0017	+0.0019	15	RD	V; el.: IBVS No. 5271
GSC 1273-661	s	54756.9568	0.0009	+0.1417	20	RD	B; el.: ASAS
GSC 1830-1732	s	54783.8941	0.0009	+0.0057	26	RD	V; el.: IBVS No. 5699; likely RRc
NSV 1719	p	54756.9226	0.0011	+0.0062	11	RD	B; el.: 2451946.793 + 0.290302 * E
V Tri	p	54792.6348	0.0008	−0.0071	19	RD	V
WW Tri	p	54821.6616	0.0002	−0.0093	35	RD	V; el.: 2451497.856 + 1.748456 * E

Observers:

EBl :	E. Blättler	Wald, Switzerland
RD :	R. Diethelm	Rodersdorf, Switzerland;
		R. Szafraniec Obs. operated at Astrokolkhoz Obs., Cloudcroft, N.M., USA

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CCD PHOTOMETRY OF NEW VARIABLE STARS AND BX DRA

KIM, DONGHYEON[1]; JEON, YOUNG-BEOM[2]; LEE, UIRYEOL[1]; JANG, HYE-EUN[1]; CHO, SUNGYOON[1]; PARK, YOON-HO[2]

[1] Korea Science Academy, Busan, Korea. e-mail: dhkim9206@hanmail.net

[2] Korea Astronomy & Space Science Institute, Daejeon, Korea. e-mail: ybjeon@kasi.re.kr

Observatory and telescope:
A 155mm Refracting Telescope (f=1050mm) of the Bohyunsan Optical Astronomy Observatory (BOAO)

Detector:	2k × 3k CCD Camera, AP9E, FOV= $60' \times 90'$

Filter(s):	Johnson B, V

Method of data reduction:
Aperture photometry using the IRAF/DAOPHOT package (Massey & Davis 1992).

Remarks:
We obtained time-series BV CCD images of BX Dra for 17 nights between April and August 2008 using a small refracting telescope (ϕ =155mm, f =1050mm) in Bohyunsan Optical Astronomy Observatory (BOAO). Most observation was carried out by remote-control system. We examined light variations of 760 stars in the observing field by eyes. As a result, we discovered five new field variable stars including two suspected variable stars around an eclipsing binary star BX Dra. They are two eclipsing binary stars, a long-term variable star and two RR Lyrae stars. One of the RR Lyrae stars, V1, shows Blazhko effect. We marked the variable stars in Figure 1. Light curves of the new variable stars and BX Dra are shown in Figure 2 and Figure 3. We were normalized the mean differential V magnitudes of the variable stars to 0.0. For B magnitudes, we added 1.5 mag for V1 and V3, 0.5 mag for V2 and BX Dra and 0.2 mag for V4 and V5, respectively. Photometric properties of the variable stars are listed in Table 1. We re-calculated the period of BX Dra using minima of Agerer & Dahm (1995; Eq. (2))

Acknowledgements:
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Table 1: Coordinates and physical properties of new variable stars and BX-Dra

Name	R.A.+DEC (J2000.0; 2MASS)	NOMAD1 B	NOMAD1 V	Period (day)	V Amp (mag)	Type
V1	16082123+6229545	14.070	13.620	0.5344(5)[1]	0.75	RRab[2]
V2	16092751+6251085	14.900	14.370	0.4221(7)	0.22	EW
V3	16061479+6240149	15.380	15.210	0.5637(4)	0.63	RRab
V4	16104413+6226097	12.428	10.982	–	–	LB
V5	16074242+6249357	12.284	12.016	–	–	EA
BX Dra	16061736+6245460	10.978	10.626	0.5790278	0.54	EW

[1] It is difficult to define period because of Blazhko effect.
[2] Blazhko effect

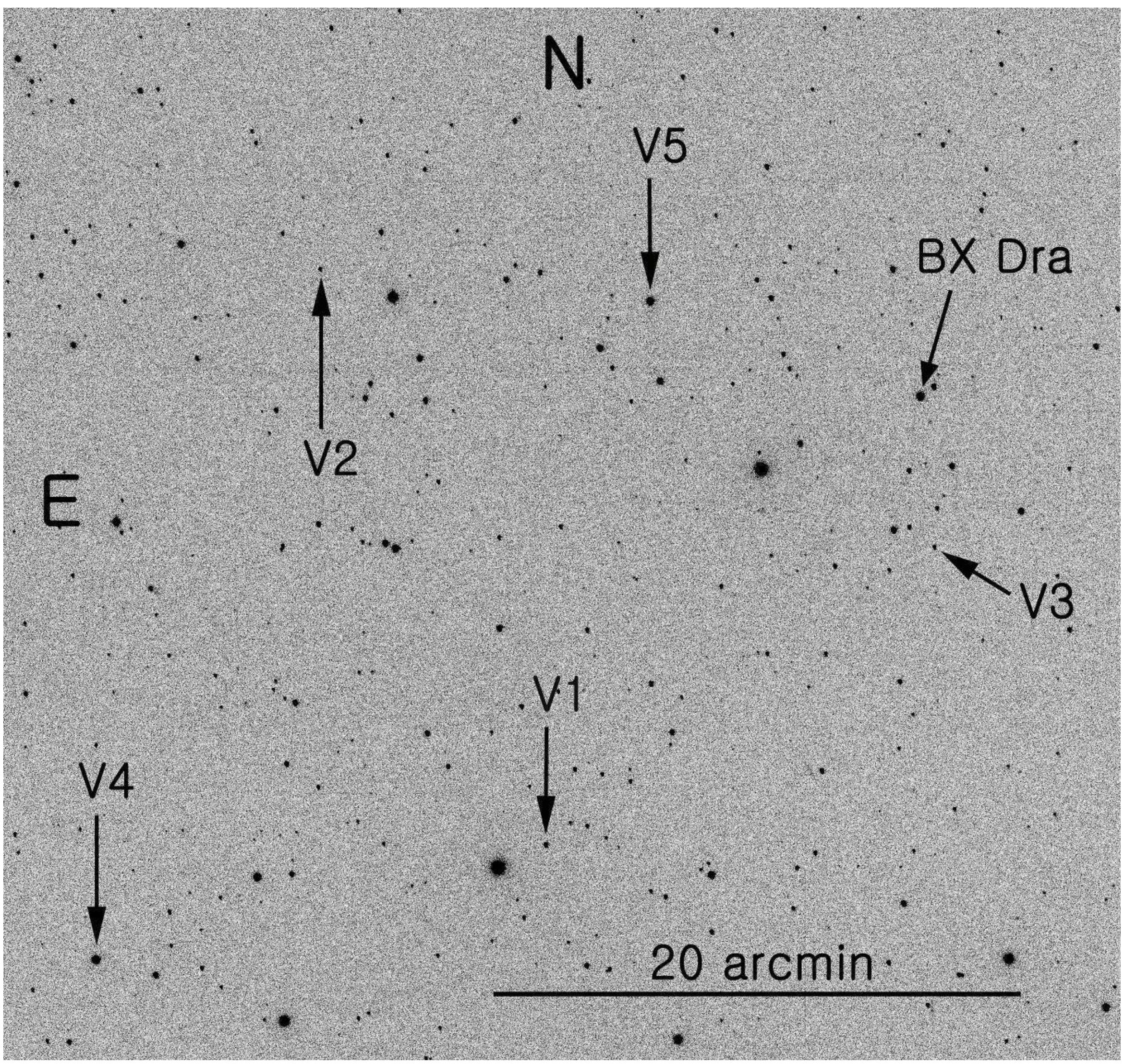

Figure 1. Finding map of new variable stars and BX Dra

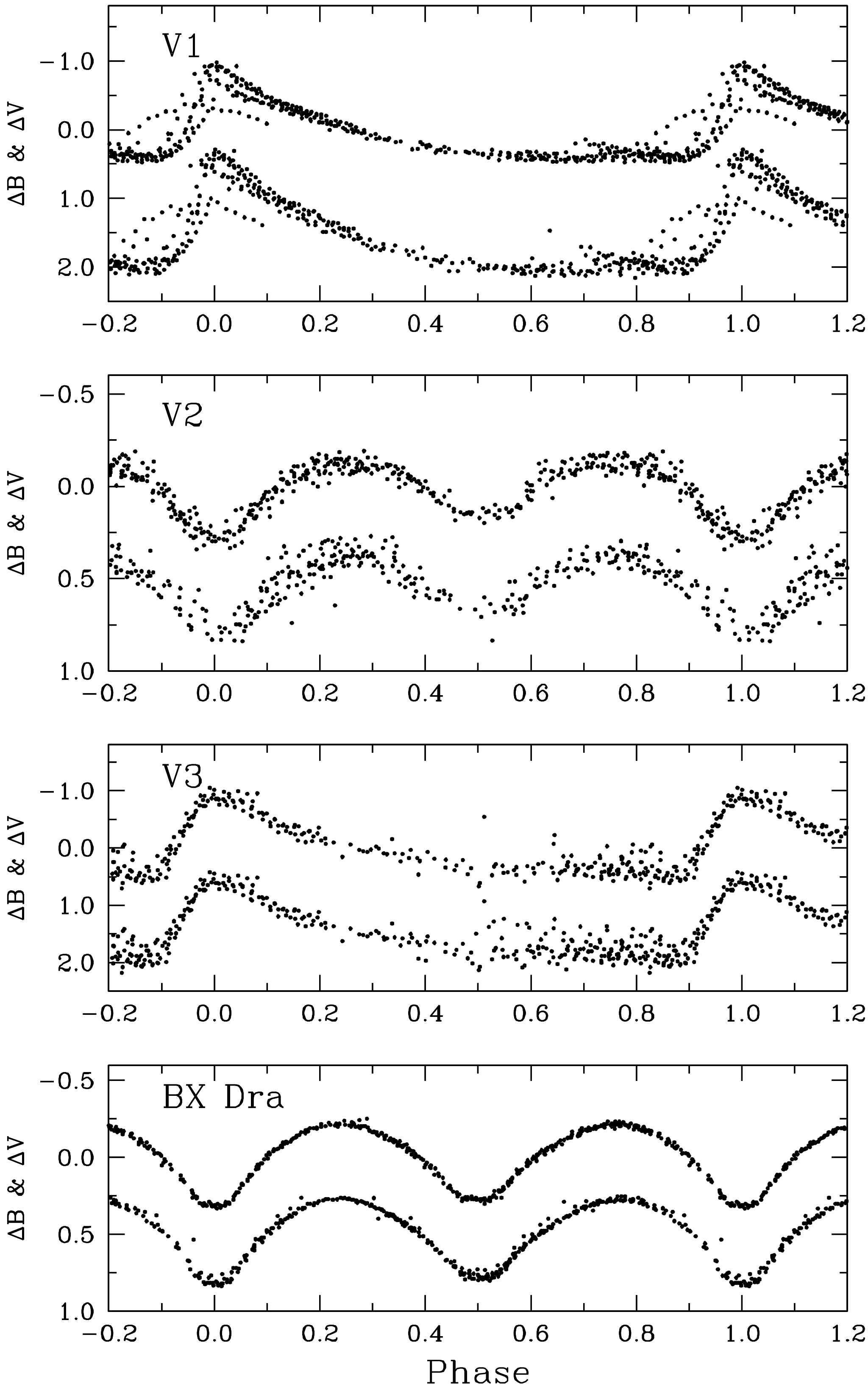

Figure 2. Light curves of three new variable stars and BX Dra

References:

Massey, P., Davis, L.E. 1992, *A User's Guide to Stellar CCD photometry with IRAF*
Agerer, F., Dahm, M. 1995, *IBVS*, **4266**

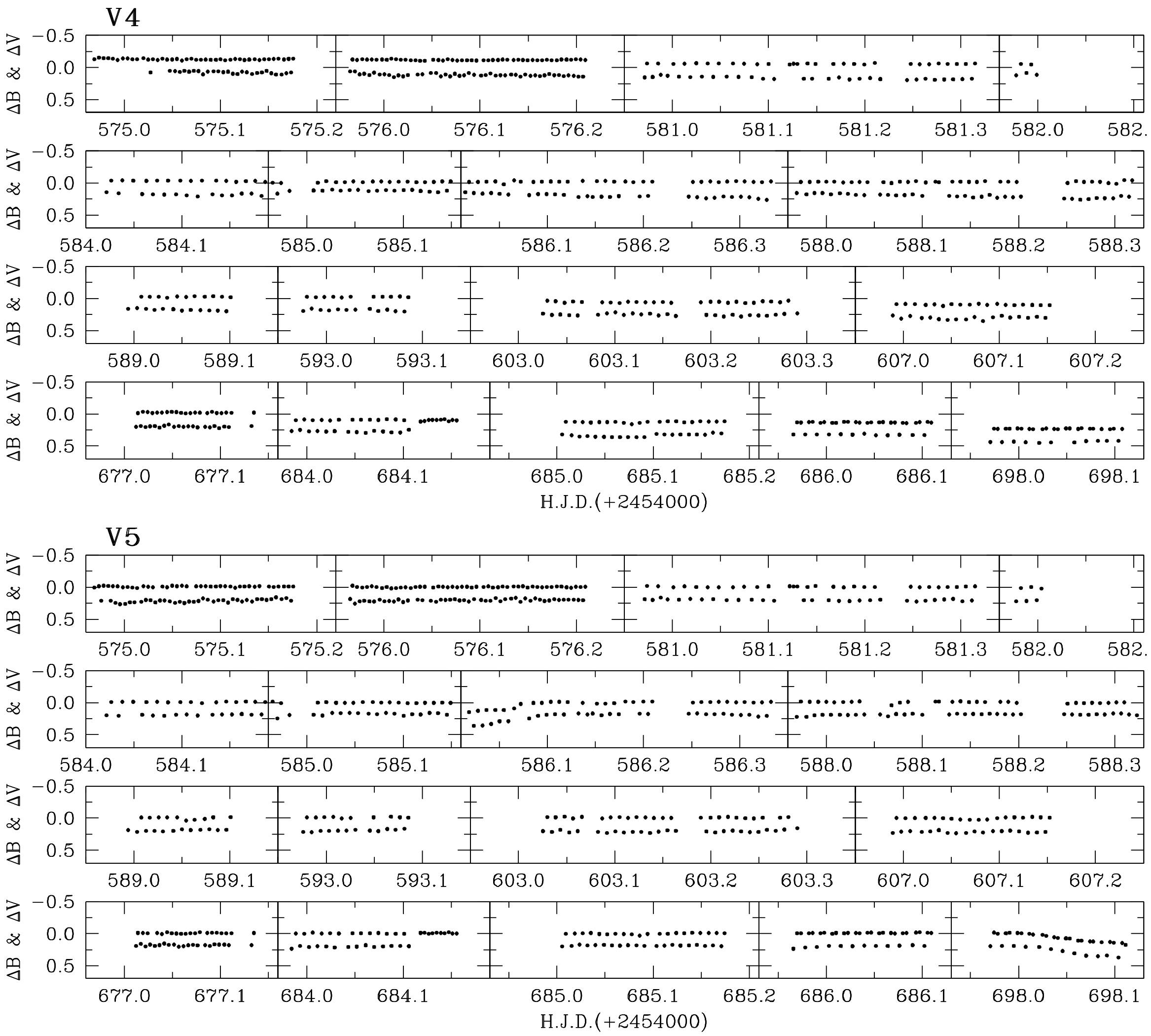

Figure 3. Light curves of two suspected variable stars

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DOUBLE-MODE RR LYRAE STARS IN SDSS STRIPE 82

WILS, PATRICK

Vereniging Voor Sterrenkunde, Belgium; e-mail: patrickwils@yahoo.com

The Sloan Digital Sky Survey (SDSS) obtained multiple images in its five colours of a region along the celestial equator in the South Galactic Cap, Stripe 82, lying between 20 and 4h right ascension and between -1.266 and 1.266 degrees declination. It contains more than 1 million sources with brightness between magnitude 14 and 22 r', measured between 62 and 134 times during the years 1998 to 2005 for the SDSS-I calibration (Ivezić et al., 2007) and the SDSS-II Supernova Survey (Frieman et al., 2008). Sesar et al. (2007) identified 634 RR Lyrae candidates in the data, based on the colour and magnitude distribution characteristics of the objects. To determine their classification, a period analysis of these stars has been performed on the SDSS data. This showed that the candidate list contains 245 RRab, 98 RRc, 12 RRd and 87 SX Phe stars. The remaining objects are eclipsing binaries, long period variables or not variable.

As double-mode pulsators are astrophysically important objects, details of the 12 RRd stars will be given in this paper. Table 1 contains the identification of the objects, their magnitude range (r'), average colours, dominant period of variation (in days), and a running number used as identification in Table 2. The latter table contains details about the detected frequencies and amplitude ratio of the first overtone mode to the fundamental mode. All these have been derived from the r' data. Uncertainties on the quantities, calculated by Monte Carlo simulations in Period04 (Lenz & Breger, 2005), are provided between parenthesis, in units of the last significant decimal. Because of the specific observing window of the data set, with the common 1-day alias ambiguities, there are strong yearly aliases. This is illustrated in a close-up view in Fig. 1 of the spectral window for SDSS J224200.05-004222.0, the star which has the largest uncertainty for the frequencies found (due to its faintness). Therefore it is sometimes difficult to pick the right 1-year alias, and the actual frequency may differ by $1/year$ from the listed frequencies. Fourier spectra for SDSS J224200.05-004222.0 are given in Fig. 2.

In all RRd stars found, the first overtone mode has the highest amplitude, as is usual for this type of variables. Note that the second star in this list, SDSS J015058.14-005051.3, has been classified as RRab by Ivezić et al. (2000) before. It has received the designation FG Cet. For illustration purposes, phase plots of the fundamental and first overtone mode, after prewhitening by the other frequency, are given in Fig. 3 and 4 for FG Cet.

The incidence rate of RRd stars among the first overtone RR Lyrae stars in Stripe 82 is therefore 11%. This is much lower than e.g. in the Sculptor galaxy (20%; Kovács, 2001) and the LMC (14%; Alcock et al., 2000), but comparable to the incidence rate in the Sagittarius dwarf galaxy (9%; Cseresnjes, 2001).

Table 1: Double-mode RR Lyrae stars in SDSS Stripe 82.

Star	r'	$u'-g'$	$g'-r'$	$r'-i'$	$i'-z'$	Period	Seq.
SDSS J014305.32+010549.2	16.8-17.3	1.17	0.10	0.04	0.01	0.353721	1
SDSS J015058.14-005051.3	17.4-18.2	1.14	0.15	0.03	-0.01	0.363189	2
SDSS J020314.89+011220.6	16.4-17.1	1.06	0.21	0.02	0.00	0.351255	3
SDSS J031333.11+004254.7	18.0-18.6	1.22	0.14	0.12	0.02	0.354149	4
SDSS J210309.24-011210.5	16.2-16.9	1.18	0.20	0.04	-0.04	0.361126	5
SDSS J212046.86+001236.4	16.0-16.7	1.16	0.09	0.05	0.02	0.358634	6
SDSS J212629.38-002054.2	19.7-20.2	1.15	0.14	-0.01	0.06	0.439661	7
SDSS J215623.95+005630.2	18.3-18.9	1.12	0.12	0.05	0.04	0.413474	8
SDSS J220654.28-010515.6	17.7-18.2	1.28	0.19	0.05	0.05	0.356722	9
SDSS J222214.29+010059.9	17.1-17.6	1.15	0.23	0.07	0.07	0.395471	10
SDSS J224200.05-004222.0	20.0-20.6	1.14	0.11	0.05	0.00	0.3640	11
SDSS J232147.14+001408.6	19.8-20.6	1.10	0.12	0.01	0.09	0.348600	12

Table 2: Light curve parameters and detected frequencies of the double-mode RR Lyrae stars in SDSS Stripe 82.

Seq.	f_0 c/d	f_1 c/d	Freq. ratio	Ampl. ratio	f_0+f_1	f_0-f_1	$2f_0$	$2f_1$
1	2.102805(8)	2.827085(7)	0.7438	1.4(1)	✓	-	✓	✓
2	2.04983(2)	2.75339(1)	0.7445	1.2(1)	✓	-	-	-
3	2.11387(3)	2.84693(2)	0.7425	1.2(2)	✓	-	-	-
4	2.09919(5)	2.82367(3)	0.7434	1.2(3)	✓	-	-	-
5	2.05805(2)	2.76912(2)	0.7432	1.2(1)	✓	-	-	-
6	2.07540(2)	2.788361(8)	0.7443	1.4(1)	✓	✓	-	✓
7	1.6936(1)	2.27448(2)	0.7446	2.1(5)	-	-	-	-
8	1.80320(2)	2.41853(2)	0.7456	1.5(2)	-	-	-	-
9	2.08647(1)	2.80330(1)	0.7443	1.3(1)	✓	✓	-	-
10	1.88608(3)	2.52863(2)	0.7459	1.9(2)	✓	-	-	-
11	2.041(2)	2.747(3)	0.7429	1.7(7)	-	-	-	-
12	2.13248(2)	2.86862(2)	0.7434	1.3(2)	✓	-	✓	-

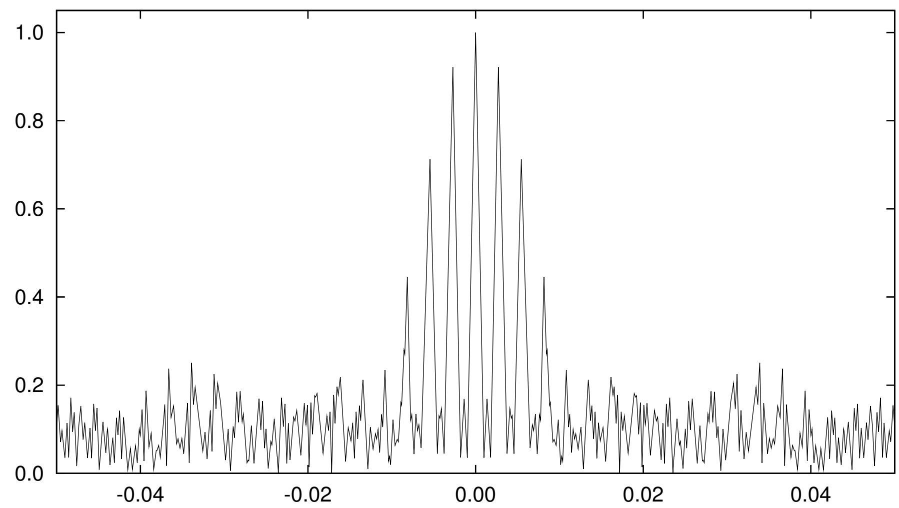

Figure 1. Spectral window for SDSS J224200.05-004222.0 showing strong 1-year aliasing.

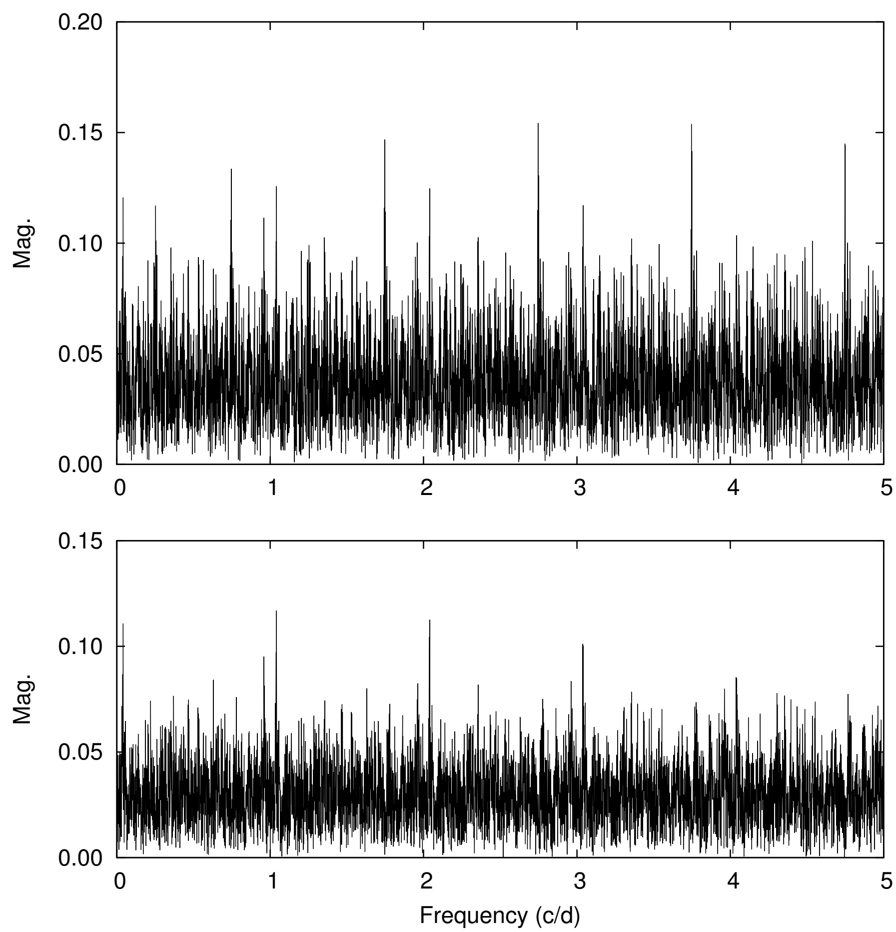

Figure 2. Fourier spectrum for star SDSS J224200.05-004222.0 before (top panel) and after (bottom) prewhitening for the dominant frequency.

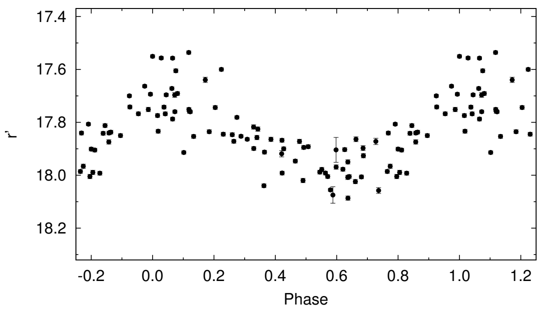

Figure 3. Phased light curve for the fundamental period of FG Cet.

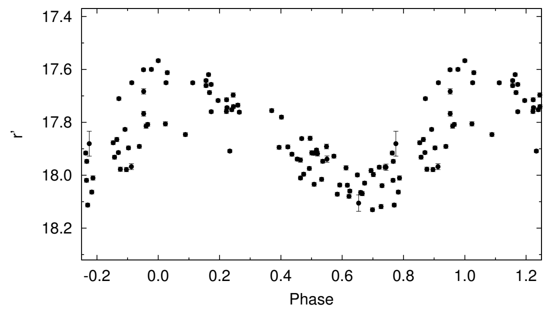

Figure 4. Phased light curve for the first overtone period of FG Cet.

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BAV-RESULTS OF OBSERVATIONS - PHOTOELECTRIC MINIMA OF SELECTED ECLIPSING BINARIES AND MAXIMA OF PULSATING STARS

(BAV MITTEILUNGEN NO. 201)

HÜBSCHER, JOACHIM; STEINBACH, HANS-MEREYNTJE; WALTER, FRANK

Bundesdeutsche Arbeitsgemeinschaft für Veränderliche Sterne e.V. (BAV), Munsterdamm 90, 12169 Berlin, Germany

In this 61th compilation of BAV results, photoelectric observations obtained in the year 2008 are presented on 299 variable stars giving 655 minima on eclipsing binaries and maxima on pulsating stars. All moments of minima and maxima are heliocentric. The errors are tabulated in column '±'. The values in column '$O-C$' are determined without incorporation of nonlinear terms.The references are given in the section 'Remarks'. All information about photometers and filters are specified in the column 'Rem'. The observations were made at private observatories. The photoelectric measurements and all the lightcurves with evaluations can be obtained from the office of the BAV for inspection.

Table 1: Times of minima of eclipsing binaries

Variable	HJD 245...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
BD And	54295.5302	.0002	RAT RCR	+0.0156		GCVS 1985	o	82	5)
DK And	54384.4751	.0003	RAT RCR	+0.0023		BAVR 55,106	o	200	5)
DS And	54479.2812	.0012	DIE	+0.0025		GCVS 1985	o	22	11)
GK And	54388.5312	.0002	RAT RCR	−0.2829		GCVS 1985	o	200	5)
LO And	54296.5097	.0002	RAT RCR	−0.0702	s	GCVS 1985	o	79	5)
SS Ari	54524.3112	.0013	WN	−0.0475		GCVS 1985	V	132	14)
ZZ Aur	54456.6376	.0001	RAT RCR	+0.0178		GCVS 1985	o	142	5)
EM Aur	54499.4277	.0005	QU	−0.1848		GCVS 1985	V	98	7)
	54500.3380	.0010	QU	−0.1855	s	GCVS 1985	V	72	7)
EP Aur	54509.3380	.0002	JU	+0.0093		GCVS 1985	o	54	6)
	54509.3407	.0015	SCI	+0.0120		GCVS 1985	o	140	6)
EQ Aur	54491.4593	.0010	AG				-Ir	99	5)
HL Aur	54186.3306	.0002	RAT RCR	−0.0129		GCVS 1985	-Ir	75	5)
HP Aur	54167.3622	.0001	RAT RCR	+0.0528		GCVS 1985	-Ir	89	5)
IM Aur	54531.3103	.0006	DIE	−0.1014		GCVS 1985	o	25	11)
IY Aur	54499.3610	.0002	WTR	−0.1200		GCVS 1985	-Ir	127	12)
KU Aur	54202.3359	.0002	RAT RCR	+0.0236		GCVS 1985	-Ir	64	5)
	54455.6959	.0003	AG	+0.0248		GCVS 1985	o	70	5)
V364 Aur	54187.3524	.0002	RAT RCR				-Ir	74	5)
V404 Aur	54115.2722	.0002	RAT RCR				-Ir	67	5)
	54164.3026	.0004	RAT RCR				-Ir	48	5)
	54176.3707	.0009	RAT RCR				-Ir	60	5)
V410 Aur	54168.3972	.0002	RAT RCR				-Ir	74	5)
	54175.3569	.0006	RAT RCR				-Ir	92	5)

Table 1: (cont.)

Variable	HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
SS Boo	54596.5176	.0020	AG	−3.7800		GCVS 1985	-Ir	92	18)
SU Boo	54149.5887	.0005	RAT RCR	+0.0303		GCVS 1985	-Ir	118	5)
TU Boo	54224.3744	.0001	RAT RCR	+0.0403	s	GCVS 1985	-Ir	47	5)
TY Boo	54586.4047	.0002	SIR	−0.0265		BAVM 68	V	57	10)
TZ Boo	54596.5061	.0002	AG	−0.0457		BAVM 68	-Ir	88	18)
XY Boo	54555.4948	.0008	AG	−0.0425	s	GCVS 1985	-Ir	41	5)
	54598.4802	.0004	AG	−0.0405	s	GCVS 1985	-Ir	90	18)
AC Boo	54213.3783	.0001	RAT RCR	−0.0548	s	GCVS 1985	-Ir	60	5)
AD Boo	54185.5396	.0008	RAT RCR	+0.0255		GCVS 1985	-Ir	140	5)
AR Boo	54555.5023	.0014	AG				-Ir	42	5)
	54598.4399	.0006	AG				-Ir	88	18)
CV Boo	54596.4478	.0002	AG	−0.0091	s	BAVR 49,117	-Ir	88	18)
EF Boo	54596.4967	.0005	JU				o	83	6)
FY Boo	54555.4241	.0007	AG				-Ir	42	5)
	54555.5455	.0011	AG				-Ir	42	5)
	54598.3529	.0010	AG				-Ir	88	18)
	54598.4727	.0003	AG				-Ir	88	18)
	54598.5871	.0002	AG				-Ir	88	18)
GL Boo	54570.5040	.0057	AG				-Ir	35	5)
GM Boo	54570.3954	.0010	AG				-Ir	35	5)
	54570.5776	.0019	AG				-Ir	35	5)
GN Boo	54570.4367	.0022	AG				-Ir	34	5)
	54570.5876	.0008	AG				-Ir	34	5)
GQ Boo	54570.3868	.0011	AG				-Ir	34	5)
	54570.5796	.0017	AG				-Ir	34	5)
GR Boo	54570.3716	.0010	AG				-Ir	34	5)
	54570.5591	.0009	AG				-Ir	34	5)
GT Boo	54596.4277	.0004	AG				-Ir	92	18)
HH Boo	54148.6406	.0008	RAT RCR	+0.0544		GCVS 2007	-Ir	108	5)
AL Cam	54516.3682	.0007	JU	−0.0318		GCVS 1985	o	80	6)
AO Cam	54472.2644	.0003	JU	−0.0523		GCVS 1985	o	80	6)
	54510.3667	.0010	JU	−0.0554	s	GCVS 1985	o	84	6)
AV Cam	54476.3512	.0030	JU	−0.0675		GCVS 1985	o	79	6)
S Cnc	54474.4415	.0004	FR	−0.1007		GCVS 1985	V	101	9)
	54531.3466	.0003	FR	−0.1029		GCVS 1985	-Ir	325	18) 2)
RY Cnc	54509.3965	.0013	AG	+0.0600		GCVS 1985	-Ir	41	5)
TU Cnc	54508.3158	.0006	AG	−0.0688		GCVS 1985	-Ir	39	5)
TX Cnc	54509.4073	.0016	AG	+0.0339		GCVS 1985	-Ir	41	5)
	54509.6023	.0020	AG	+0.0374	s	GCVS 1985	-Ir	41	5)
	54531.4267	.0004	FR	+0.0376	s	GCVS 1985	-Ir	101	18)
	54531.6141	.0008	FR	+0.0335		GCVS 1985	-Ir	101	18)
WW Cnc	54126.3907	.0001	RAT RCR	−0.0687		BAVR 32,36	-Ir	59	5)
	54175.4917	.0001	RAT RCR	−0.0700		BAVR 32,36	-Ir	134	5)
	54535.3947	.0022	AG	−0.0644	s	BAVR 32,36	-Ir	23	5)
WX Cnc	54535.3796	.0010	AG	+0.0119		GCVS 1985	-Ir	26	5)
XZ Cnc	54513.4504	.0003	FR				-Ir	57	18)
AC Cnc	54508.3439	.0014	AG				-Ir	28	5)
	54508.4900	.0017	AG				-Ir	26	5)
AD Cnc	54508.4460	.0016	AG				-Ir	26	5)
AO Cnc	54508.3843	.0007	AG	−0.0784		GCVS 2007	-Ir	29	5)
EH Cnc	54509.3443	.0006	AG				-Ir	41	5)
	54509.5535	.0006	AG				-Ir	41	5)
FF Cnc	54509.4119	.0016	AG	−0.1698		IBVS 3859=BAVM 65	-Ir	39	5)
	54513.3820	.0002	FR	−0.1692		IBVS 3859=BAVM 65	V	56	9)
	54544.4744	.0007	FR	−0.1707	s	IBVS 3859=BAVM 65	-Ir	43	18) 2)
DH CVn	54172.4041	.0004	RAT RCR				-Ir	63	5)
DR CVn	54221.5759	.0003	RAT RCR	+0.0366		GCVS 2007	-Ir	115	5)
R CMa	54500.4132	.0004	FR	+0.0830		GCVS 1985	-Ir	48	18)
	54504.3895	.0009	FR	+0.0836	s	GCVS 1985	-Ir	28	18)
RS CMi	54516.4524	.0013	AG				-Ir	28	5)

Table 1: (cont.)

Variable	HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
RY CMi	54516.3391	.0007	AG	−0.2675		BAVM 127	-Ir	28	5)
SX CMi	54516.3937	.0020	AG				-Ir	28	5)
AK CMi	54507.3201	.0009	DIE	−0.0160		GCVS 1985	o	23	11)
	54516.3736	.0007	AG	−0.0169		GCVS 1985	-Ir	28	5)
TX Cas	54479.3795	.0028	JU	−0.0033		BAVR 32,36	o	100	6)
IS Cas	54509.6233	.0025	SCI	+0.0660		GCVS 1985	o	96	6)
IV Cas	54366.5668	.0001	RAT RCR	−0.0637		GCVS 1985	o	119	5)
KR Cas	54473.3795	.0030	JU	−0.1489		GCVS 1985	o	84	6)
MS Cas	54454.4414	.0021	AG				-Ir	103	5)
MT Cas	54432.3199	.0003	AG				-Ir	113	5)
	54432.4779	.0002	AG				-Ir	113	5)
V336 Cas	54454.4354	.0010	AG				-Ir	101	5)
V345 Cas	54440.2419	.0011	AG				-Ir	62	5)
V355 Cas	54389.5328	.0003	RAT RCR	−0.1239		GCVS 2007	o	198	5)
WW Cep	54387.5148	.0001	RAT RCR	+0.0028		IBVS 4131=BAVM 71	o	132	5)
WY Cep	54385.3619	.0010	AG	+0.0225	s	GCVS 1985	-Ir	55	5)
EF Cep	54171.4079	.0002	RAT RCR	+0.1394		GCVS 1985	-Ir	70	5)
SS Cet	54433.4874	.0006	AG	+0.0091		GCVS 1985	-Ir	82	5)
TU Cet	54033.5735	.0008	AG	+0.4623		GCVS 1985	-Ir	159	5)
RW Com	54207.3754	.0001	RAT RCR	−0.0186		GCVS 1985	-Ir	59	5)
	54593.4173	.0002	JU	−0.0198	s	GCVS 1985	o	64	6)
RZ Com	54531.4044	.0005	AG	+0.0417		GCVS 1985	o	15	18)
	54583.3655	.0001	WTR	+0.0421	s	GCVS 1985	-Ir	249	12)
	54597.4137	.0001	SIR	+0.0424		GCVS 1985	-Ir	127	10)
SS Com	54544.4118	.0013	AG	−0.0568	s	BAVR 33,152	-Ir	10	5)
VY Com	54555.4716	.0036	FR	+0.0338		GCVS 2007	V	57	9)
CC Com	54203.3558	.0003	RAT RCR	−0.0166	s	GCVS 1985	-Ir	56	5)
	54593.4190	.0001	SIR	−0.0164		GCVS 1985	-Ir	185	10)
	54595.4049	.0001	SIR	−0.0167		GCVS 1985	-Ir	171	10)
DG Com	54531.4020	.0010	AG	−0.0482		GCVS 2007	o	15	18)
LO Com	54185.3597	.0005	RAT RCR				-Ir	53	5)
	54594.4268	.0006	JU				o	68	6)
MR Com	54148.4794	.0010	RAT RCR	−0.0244		GCVS 2007	-Ir	42	5)
AV CrB	54207.4657	.0001	RAT RCR	−0.0098		GCVS 2007	-Ir	141	5)
WZ Cyg	54455.2815	.0001	RAT RCR	+0.0617		GCVS 1985	o	84	5)
ZZ Cyg	54663.3963	.0003	QU	−0.0526		GCVS 1985	Ic	35	7)
CV Cyg	54319.4895	.0007	RAT RCR	+0.2470		GCVS 1985	o	119	5)
	54388.3298	.0005	RAT RCR	+0.2471		GCVS 1985	o	98	5)
V345 Cyg	54405.3553	.0007	RAT RCR	+0.0318		IBVS 5016=BAVM 132	o	56	5)
V385 Cyg	54349.5114	.0002	RAT RCR	−0.1258		GCVS 1985	o	150	5)
V401 Cyg	54382.3010	.0002	RAT RCR	+0.0652	s	GCVS 1985	o	85	5)
V466 Cyg	54390.3470	.0019	SCI	+0.0057		GCVS 1985	o	92	6)
V474 Cyg	54619.74 :	.02	AG				B;V	38	18) 20)
V504 Cyg	54299.4360	.0003	RAT RCR				o	74	5)
V728 Cyg	54365.5524	.0002	RAT RCR	+0.0562		GCVS 1985	o	137	5)
V841 Cyg	54600.5061	.0014	AG	+0.0097	s	GCVS 1985	-Ir	52	18)
V859 Cyg	54631.4231	.0004	AG	+0.0063	s	GCVS 1985	-Ir	33	18)
V874 Cyg	54631.5245	.0011	AG				-Ir	32	18)
V884 Cyg	54631.4395	.0010	AG				-Ir	33	18)
V995 Cyg	54390.3598	.0003	RAT RCR				o	125	5)
V1083 Cyg	54367.5066	.0002	RAT RCR	−0.0586		GCVS 1985	o	166	5)
V1256 Cyg	54631.4323	.0008	AG				-Ir	33	18)
V1787 Cyg	54307.3980	.0004	RAT RCR				o	43	5)
V1918 Cyg	54389.3122	.0001	RAT RCR				o	106	5)
V2282 Cyg	54619.5005	.0009	AG				B	35	18)
	54619.5006	.0004	AG				V	36	18)
V2284 Cyg	54619.4825	.0006	AG				V	34	18)
FZ Del	54297.4821	.0001	RAT RCR	−0.0389		GCVS 1985	o	95	5)
RX Dra	54601.5019	.0002	AG	+0.0554		GCVS 1985	-Ir	59	18)

Table 1: (cont.)

Variable	HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
RZ Dra	54601.5129	.0005	AG	+0.0479	s	GCVS 1985	-Ir	59	18)
TW Dra	54597.4498	.0002	AG	+0.0360		GCVS 1985	-Ir	57	18)
AK Dra	54594.4256	.0003	SCI	+0.2231		GCVS 2007	o	126	6)
BV Dra	54597.3891	.0011	AG				-Ir	57	18)
	54597.5663	.0008	AG				-Ir	57	18)
BW Dra	54597.4793	.0001	AG				-Ir	57	18)
BX Dra	54597.4133	.0001	AG	+0.0169		IBVS 4266=BAVM 82	-Ir	55	18)
FU Dra	54597.4968	.0004	AG				-Ir	57	18)
GQ Dra	54599.4421	.0004	JU				o	80	6)
KK Dra	54601.5336	.0001	AG				-Ir	59	18)
U Gem	54147.5389	.0010	SIR				o	186	10) 4)
	54148.4226	.0005	SIR				o	200	10) 4)
	54173.3668	.0005	SIR				o	100	10) 4)
	54504.3584	.0005	SIR				-Ir	61	10) 4)
	54504.5353	.0005	SIR				-Ir	59	10) 4)
	54505.4198	.0005	SIR				-Ir	70	10) 4)
	54506.3043	.0005	SIR				-Ir	82	10) 4)
	54506.4809	.0005	SIR				-Ir	78	10) 4)
	54507.3654	.0005	SIR				-Ir	82	10) 4)
	54509.4887	.0005	SIR				-Ir	81	10) 4)
	54510.3732	.0005	SIR				-Ir	81	10) 4)
	54510.5502	.0005	SIR				-Ir	76	10) 4)
	54511.4346	.0005	SIR				-Ir	81	10) 4)
	54532.3113	.0005	SIR				-Ir	70	10) 4)
TZ Gem	54505.3745	.0013	SCI				o	21	6)
	54505.3777	.0006	AG				-Ir	42	5)
WW Gem	54508.4058	.0004	AG	+0.0321		GCVS 1985	-Ir	72	5)
	54508.4060	.0001	WN	+0.0323		GCVS 1985	V	206	14)
YY Gem	54500.3369	.0010	ALH	−0.0066		GCVS 1985	B	307	8)
	54510.5151	.0010	ALH	−0.0069	s	GCVS 1985	I	629	8)
AC Gem	54507.4215	.0066	AG	−0.2792	s	GCVS 1985	-Ir	31	5)
	54532.3370	.0032	FR	−0.2911	s	GCVS 1985	-Ir	38	18)
AY Gem	54507.3393	.0005	AG	−0.0526		GCVS 1985	-Ir	41	5)
AZ Gem	54476.6352	.0012	AG	+0.0861		GCVS 1985	-Ir	52	5)
BT Gem	54508.4478	.0005	AG				-Ir	74	5)
EF Gem	54507.3620	.0023	AG				-Ir	42	5)
EL Gem	54505.4241	.0004	AG	−0.2195	s	GCVS 1985	-Ir	41	5)
EN Gem	54507.3307	.0039	AG	−0.0373	s	GCVS 1985	-Ir	40	5)
EY Gem	54505.2343	.0007	AG	−0.2308		GCVS 1985	o	45	5) 2)
FG Gem	54505.5123	.0002	AG	−0.0293		GCVS 1985	-Ir	42	5)
GW Gem	54126.3321	.0001	RAT RCR	+0.0248		GCVS 1985	-Ir	49	5)
	54505.5137	.0013	WN	+0.0261		GCVS 1985	V	161	14)
GZ Gem	54532.3889	.0007	FR				V	44	9)
KV Gem	54454.3086	.0004	AG	−0.0110		BAVR 52,95	o	191	18)
	54454.4897	.0006	AG	−0.0091	s	BAVR 52,95	o	191	18)
	54505.3990	.0004	QU	−0.0103	s	BAVR 52,95	V	76	7)
	54507.3696	.0003	QU	−0.0115		BAVR 52,95	V	84	7)
	54509.3437	.0005	QU	−0.0093	s	BAVR 52,95	V	96	7)
	54509.5203	.0010	QU	−0.0120		BAVR 52,95	V	96	7)
	54515.4374	.0005	QU	−0.0105	s	BAVR 52,95	V	75	7)
	54516.3333	.0005	QU	−0.0109		BAVR 52,95	V	90	7)
	54516.5128	.0007	QU	−0.0107	s	BAVR 52,95	V	90	7)
	54520.4566	.0007	QU	−0.0107	s	BAVR 52,95	V	75	7)
	54531.3915	.0005	QU	−0.0107		BAVR 52,95	V	70	7)
QW Gem	54506.4138	.0001	WN				V	145	14)
SZ Her	54335.3753	.0001	RAT RCR	−0.0201		GCVS 1985	o	50	5)
TT Her	54638.4031	.0001	WTR	+0.0357		GCVS 1985	-Ir	77	12)
TU Her	54217.450 :	.001	RAT RCR	−0.174		GCVS 1985	-Ir	149	5) 3)
	54369.3390	.0004	RAT RCR	−0.1743		GCVS 1985	o	91	5)
CC Her	54616.5261	.0025	AG	+0.1871	s	GCVS 1985	-Ir	33	18)

Table 1: (cont.)

Variable	HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
DH Her	54600.4570	.0007	AG	+0.0009		GCVS 2007	-Ir	52	18)
FN Her	54616.4527	.0003	AG	+0.0922		GCVS 1985	-Ir	134	18)
GU Her	54601.4088	.0007	AG	+0.7826		GCVS 1985	-Ir	79	18)
MS Her	54586.4870	.0038	SCI	−0.1166		GCVS 1985	o	105	6)
MT Her	54260.4522	.0001	RAT RCR	+0.0162		GCVS 1985	-Ir	105	5)
MX Her	54356.3497	.0003	RAT RCR	−0.5240		GCVS 1985	o	64	5)
V359 Her	54204.5004	.0007	RAT RCR	+0.1699		GCVS 1985	-Ir	106	5)
V366 Her	54597.4114	.0006	AG	−0.1220		GCVS 2007	-Ir	51	18)
V450 Her	54591.5342	.0042	SCI	−0.3328		GCVS 1985	o	135	6)
V719 Her	54211.4893	.0003	RAT RCR				-Ir	136	5)
	54213.4940	.0003	RAT RCR				-Ir	128	5)
	54329.3611	.0003	RAT RCR				o	50	5)
V733 Her	54593.4434	.0021	SCI				o	44	6)
V829 Her	54597.5158	.0050	AG	+0.0281		IBVS 5496	-Ir	49	18)
V842 Her	54610.4707	.0007	PGL	−0.0436		BAVR 49,180	o	362	16)
V861 Her	54596.3771	.0019	SCI				o	36	6)
	54596.5511	.0024	SCI				o	47	6)
V1032 Her	54601.5495	.0010	AG				-Ir	64	18)
V1033 Her	54212.5116	.0002	RAT RCR				-Ir	124	5)
	54597.4445	.0004	AG				-Ir	52	18)
	54597.5951	.0015	AG				-Ir	52	18)
V1038 Her	54205.4890	.0002	RAT RCR				-Ir	144	5)
	54205.6254	.0002	RAT RCR				-Ir	144	5)
	54597.4349	.0009	AG				-Ir	51	18)
	54597.5680	.0003	AG				-Ir	51	18)
V1042 Her	54210.4956	.0001	RAT RCR				-Ir	125	5)
V1044 Her	54317.4143	.0001	RAT RCR				o	52	5)
	54367.3480	.0002	RAT RCR				o	97	5)
	54631.4518	.0002	AG				-Ir	70	18)
	54631.5705	.0010	AG				-Ir	70	18)
V1045 Her	54238.4499	.0004	RAT RCR				-Ir	124	5)
V1047 Her	54597.3955	.0006	AG				-Ir	47	18)
	54597.5552	.0004	AG				-Ir	47	18)
V1050 Her	54631.4330	.0009	AG				-Ir	67	18)
V1053 Her	54631.4514	.0002	AG				-Ir	66	18)
V1055 Her	54316.4412	.0003	RAT RCR				o	52	5)
	54337.4075	.0005	RAT RCR				o	92	5)
V1067 Her	54331.3826	.0002	RAT RCR				o	72	5)
V1073 Her	54319.4160	.0001	RAT RCR				o	47	5)
	54324.4182	.0004	RAT RCR				o	40	5)
V1103 Her	54349.3634	.0001	RAT RCR	−0.0027		GCVS 2007	o	49	5)
AV Hya	54506.4243	.0017	AG	−0.0948	s	GCVS 1985	-Ir	59	5)
DI Hya	54535.3799	.0001	WTR				-Ir	96	12)
V409 Hya	54148.3945	.0003	RAT RCR	+0.0181	s	GCVS 2007	-Ir	83	5)
TW Lac	54382.5153	.0002	RAT RCR	+0.2958		GCVS 1985	o	143	5)
CN Lac	53254.4569	.0030	PGL	+0.0144		GCVS 1985	-Ir	143	17)
	53263.3674	.0035	PGL	+0.0017		GCVS 1985	-Ir	97	17)
EM Lac	54307.4743	.0002	RAT RCR	+0.0677		GCVS 1985	o	102	5)
EO Lac	54384.1767	.0100	AG	+0.2457		GCVS 2007	-Ir	51	5)
V344 Lac	54453.3229	.0003	RAT RCR				o	130	5)
UV Leo	54507.4277	.0006	PGL	+0.0036		IBVS 5338	o	278	16)
	54579.4375	.0001	FLG	+0.0030		IBVS 5338	V	149	15)
XX Leo	54531.5233	.0020	AG	−0.1675	s	GCVS 1985	-Ir	46	5)
XY Leo	54531.3978	.0022	AG	+0.0316	s	GCVS 1985	-Ir	47	5)
	54531.5404	.0016	AG	+0.0322		GCVS 1985	-Ir	47	5)
XZ Leo	54149.4622	.0002	RAT RCR	+0.0437		GCVS 1985	-Ir	57	5)
	54531.3591	.0010	AG	+0.0440		GCVS 1985	-Ir	47	5)
	54531.6054	.0014	AG	+0.0464	s	GCVS 1985	-Ir	47	5)
AG Leo	54507.5424	.0037	SCI	+0.1063		GCVS 1985	o	189	6)
AM Leo	54580.4417	.0001	FLG	+0.0093		GCVS 1985	V	55	15)

Table 1: (cont.)

Variable	HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
BL Leo	54564.3745	.0002	AG				o	160	18)
	54564.5143	.0002	AG				o	160	18)
CE Leo	54205.3667	.0001	RAT RCR				-Ir	59	5)
	54564.4740	.0001	AG				o	160	18)
	54564.6262	.0002	AG				o	160	18)
FM Leo	54514.4020	.0004	FR	+0.0071		IBVS 5480	-Ir	70	18)
T LMi	54221.3764	.0004	RAT RCR	−0.0956		GCVS 1985	-Ir	66	5)
	54532.4217	.0002	AG	−0.0984		GCVS 1985	-Ir	74	5)
RT LMi	54532.4483	.0002	AG	−0.0070		GCVS 1985	-Ir	71	5)
	54532.6362	.0004	AG	−0.0066	s	GCVS 1985	-Ir	71	5)
XY LMi	54115.5254	.0005	RAT RCR	−0.0096	s	GCVS 2007	-Ir	140	5)
	54195.4731	.0005	RAT RCR	−0.0127	s	GCVS 2007	-Ir	43	5)
RY Lyn	54222.3658	.0002	RAT RCR	−0.0474		GCVS 1985	-Ir	77	5)
	54516.5312	.0030	SCI	−0.0546		GCVS 1985	o	67	6)
SW Lyn	54521.3320	.0006	DIE	+0.0478		GCVS 1985	o	24	11)
SX Lyn	54532.4576	.0003	AG	+0.0017		GCVS 1985	o	170	18)
UU Lyn	54187.5311	.0006	RAT RCR	−0.0059		GCVS 1985	-Ir	129	5)
	54219.3876	.0002	RAT RCR	−0.0047		GCVS 1985	-Ir	105	5)
	54535.3647	.0019	AG	−0.0040	s	GCVS 1985	o	103	18)
	54535.5979	.0006	AG	−0.0050		GCVS 1985	o	103	18)
DE Lyn	54532.4466	.0002	AG				o	167	18)
	54532.6498	.0005	AG				o	167	18)
UZ Lyr	54381.2804	.0001	RAT RCR	−0.0257		GCVS 1985	o	54	5)
AH Lyr	54600.4703	.0002	AG				-Ir	52	18)
BV Lyr	54639.4314	.0004	AG				-Ir	41	18)
DF Lyr	54600.5257	.0005	AG	+0.0356	s	GCVS 2007	-Ir	52	18)
IP Lyr	54596.4694	.0004	AG				-Ir	55	18)
MN Lyr	54596.4385	.0007	AG	+0.0492		GCVS 2007	-Ir	46	18)
NV Lyr	54325.4946	.0002	RAT RCR				o	121	5)
PY Lyr	54600.4288	.0008	AG				-Ir	52	18)
	54631.4826	.0007	AG				-Ir	33	18)
QU Lyr	54387.3226	.0003	RAT RCR	+0.0014		GCVS 1985	o	141	5)
V574 Lyr	54350.3550	.0002	RAT RCR				o	71	5)
	54596.4425	.0002	AG				-Ir	55	18)
	54596.5790	.0034	AG				-Ir	55	18)
V580 Lyr	54596.4377	.0012	AG				-Ir	43	18)
	54596.5812	.0005	AG				-Ir	43	18)
V596 Lyr	54363.3487	.0003	RAT RCR	+0.0108	s	GCVS 2007	o	74	5)
RW Mon	54507.3193	.0003	WTR	−0.0662	s	GCVS 1985	-Ir	130	12)
TU Mon	54506.5200	.0005	FR	−0.0728		GCVS 1985	V	251	9)
UV Mon	54512.2790	.0024	SCI				o	36	6)
AO Mon	54507.2988	.0027	AG	−0.0141		BAVR 51,38	-Ir	25	5)
AT Mon	54500.4466	.0001	FR	+0.0087		GCVS 1985	V	54	9)
EP Mon	54507.3202	.0010	AG	+0.0344		GCVS 1985	-Ir	25	5)
FS Mon	54514.4190	.0008	AG	−0.0116		GCVS 2007	-Ir	45	5)
IL Mon	54514.3763	.0006	AG	−0.0482		GCVS 1985	-Ir	67	5)
IX Mon	54513.3292	.0010	AG				-Ir	32	5)
IZ Mon	54513.4324	.0023	AG				-Ir	32	5)
MX Mon	54507.4964	.0013	AG	−0.1068	s	GCVS 2007	-Ir	26	5)
V448 Mon	54506.2967	.0005	FR	+0.0573		GCVS 1985	-Ir	76	18)
	54507.4142	.0002	WN	+0.0563		GCVS 1985	V	175	14)
V527 Mon	54507.4373	.0013	AG	−0.0262		GCVS 1985	-Ir	24	5)
V532 Mon	54115.3677	.0003	RAT RCR	+0.0123	s	GCVS 1985	-Ir	79	5)
V843 Mon	54513.4085	.0009	AG	+0.0549	s	BAVM 147	-Ir	33	5)
V508 Oph	54218.4864	.0001	RAT RCR	−0.0136		GCVS 1985	-Ir	139	5)
	54223.4870	.0001	RAT RCR	−0.0125	s	GCVS 1985	-Ir	135	5)
Z Ori	54516.4311	.0006	AG	+0.0840		BAVR 52,144	-Ir	60	5)
UW Ori	54500.4003	.0012	AG	+0.0213	s	GCVS 1985	-Ir	109	5)

Table 1: (cont.)

Variable	HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
CQ Ori	54504.3269	.0037	SCI	−0.0002		GCVS 1985	o	60	6)
EF Ori	54500.4154	.0023	AG				-Ir	53	5)
EG Ori	54516.3986	.0013	AG	−0.0838		GCVS 1985	-Ir	60	5)
EW Ori	54524.4188	.0001	WN	+0.0163	s	GCVS 1985	V	125	14)
FF Ori	54500.3287	.0001	WTR	+0.0323		GCVS 1985	-Ir	104	12)
FI Ori	54476.5067	.0028	AG	+0.2270		GCVS 1985	-Ir	51	5)
FR Ori	54513.3712	.0001	WTR	+0.0274		GCVS 1985	-Ir	102	12)
FT Ori	54494.3950	.0030	ALH	+0.1195	s	GCVS 1985	V	145	8)
GU Ori	54476.3446	.0019	AG				-Ir	49	5)
	54476.5794	.0010	AG				-Ir	49	5)
	54500.3478	.0005	AG				-Ir	53	5)
V392 Ori	54476.5515	.0033	AG	+0.0036	s	GCVS 1985	-Ir	52	5)
V519 Ori	54500.3408	.0011	AG				-Ir	47	5)
V645 Ori	54516.2986	.0012	AG				-Ir	60	5)
V1031 Ori	54516.3894	.0004	FR	−0.4799		GCVS 1985	-Ir	24	18)
RW Per	54506.4270	.0013	AG	+0.0201		GCVS 1987	-Ir	44	5)
RY Per	54504.3855	.0006	AG	+0.0030		GCVS 1987	-Ir	101	5)
HV Per	54509.3180	.0004	AG	−0.2757		GCVS 2007	-Ir	60	5)
II Per	54506.4258	.0004	AG				-Ir	43	5)
IK Per	54506.4352	.0010	AG	−0.1585		GCVS 1987	-Ir	42	5)
KL Per	54454.3145	.0017	JU				o	100	6)
KN Per	54033.4905	.0018	AG	+0.0111	s	BAVR 52,93	-Ir	55	5)
KR Per	54506.5109	.0008	AG	−0.0162		GCVS 1987	-Ir	42	5)
KW Per	54514.4327	.0002	AG	+0.0107		GCVS 1987	-Ir	38	5)
NP Per	54476.4860	.0004	AG				-Ir	56	5)
NZ Per	54173.3530	.0003	RAT RCR	+0.0435		GCVS 1987	-Ir	94	5)
V482 Per	54515.3736	.0006	JU	+0.2455		BAVM 68	o	88	6)
RV Psc	54455.4130	.0001	RAT RCR	−0.0469		GCVS 1987	o	122	5)
CW Sge	54296.4223	.0005	RAT RCR	+0.0053	s	GCVS 1987	o	54	5)
AU Ser	54206.5304	.0001	RAT RCR				-Ir	146	5)
BI Ser	54203.4780	.0002	RAT RCR	+0.0965		GCVS 1987	-Ir	140	5)
V384 Ser	54570.3803	.0003	FR	+0.0014		GCVS 2007	V	42	9)
	54583.4154	.0003	FR	+0.0031	s	GCVS 2007	-Ir	88	18)
	54583.5492	.0003	FR	+0.0025		GCVS 2007	-Ir	88	18)
TY Tau	54474.3084	.0002	JU	+0.2473		GCVS 1987	o	71	6)
AH Tau	54455.4535	.0016	AG				-Ir	33	5)
	54505.3542	.0013	WN				V	93	14)
AN Tau	54455.4741	.0010	AG	−0.1917	s	GCVS 1987	-Ir	29	5)
	54476.4621	.0017	AG	−0.1941	s	GCVS 1987	-Ir	62	5)
AP Tau	54390.6080	.0025	SCI	+0.0131		GCVS 2007	o	29	6)
BN Tau	54455.4936	.0012	AG				-Ir	28	5)
CD Tau	54494.3059	.0027	SCI	+0.0049		GCVS 1987	o	112	6)
CU Tau	54455.4389	.0016	AG	+0.0166		GCVS 1987	-Ir	33	5)
	54476.2706	.0006	WTR	+0.0312	s	GCVS 1987	-Ir	88	12)
	54477.3018	.0006	WTR	+0.0318		GCVS 1987	-Ir	134	12)
	54505.3520	.0001	WN	+0.0511		GCVS 1987	V	93	14)
ET Tau	54507.3004	.0017	SCI	−0.0892		GCVS 1987	o	96	6)
	54513.3027	.0042	SCI	−0.0838		GCVS 1987	o	166	6)
GW Tau	54492.2996	.0053	SCI				o	104	6)
V1128 Tau	54500.3313	.0012	SCI				o	166	6)
X Tri	54457.3921	.0001	WN	−0.0695		GCVS 1987	V	237	14)
TY UMa	54206.3818	.0001	RAT RCR	+0.0641	s	GCVS 1987	-Ir	50	5)
	54222.5143	.0002	RAT RCR	+0.0651		GCVS 1987	-Ir	63	5)
	54514.4867	.0017	SCI	+0.0749	s	GCVS 1987	o	104	6)
	54597.4527	.0004	JU	+0.0789	s	GCVS 1987	o	78	6)
UX UMa	54570.3643	.0002	AG	+0.0019		GCVS 1987	o	175	18)
	54570.5610	.0004	AG	+0.0019		GCVS 1987	o	175	18)
UY UMa	54570.4193	.0003	AG	−0.0829		GCVS 1987	o	173	18)
	54570.6066	.0003	AG	−0.0836	s	GCVS 1987	o	173	18)
	54592.4164	.0007	JU	−0.0827	s	GCVS 1987	o	74	6)

Table 1: (cont.)

Variable	HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
VV UMa	54513.3936	.0003	JU	−0.0494		GCVS 1987	o	90	6)
XZ UMa	54174.5332	.0001	RAT RCR	−0.0888		GCVS 1987	-Ir	157	5)
	54514.3335	.0002	JU	−0.0935		GCVS 1987	o	100	6)
ZZ UMa	54168.5188	.0003	RAT RCR	−0.0022		GCVS 1987	-Ir	111	5)
	54191.5114	.0002	RAT RCR	−0.0022		GCVS 1987	-Ir	123	5)
AA UMa	54167.5372	.0002	RAT RCR	+0.0318		GCVS 1987	-Ir	123	5)
	54521.4433	.0003	JU	+0.0350		GCVS 1987	o	76	6)
AW UMa	54535.5013	.0114	FR	−0.0627	s	GCVS 1987	-Ir	43	18)
BH UMa	54216.3235	.0056	SCI	−0.0830	s	GCVS 2007	o	71	6)
	54220.5156	.0067	SCI	−0.0830	s	GCVS 2007	o	130	6)
DW UMa	54595.4735	.0004	JU				o	80	6)
	54598.4812	.0001	AG				-Ir	55	18)
ES UMa	54223.3736	.0003	RAT RCR				-Ir	49	5)
IW UMa	54186.4391	.0004	RAT RCR				-Ir	169	5)
	54535.4534	.0010	AG				o	62	18)
KM UMa	54126.5015	.0001	RAT RCR				-Ir	97	5)
LP UMa	54173.5223	.0015	RAT RCR				-Ir	96	5)
	54595.4554	.0011	JU				o	80	6)
MQ UMa	54192.5885	.0008	RAT RCR	+0.0624		GCVS 2007	-Ir	163	5)
RZ UMi	54598.3988	.0004	JU				o	44	6)
AG Vir	54555.4764	.0008	FR	−0.0082		GCVS 1987	-Ir	68	18)
	54593.3845	.0019	WN	−0.0165		GCVS 1987	V	187	14)
AW Vir	54217.3800	.0001	RAT RCR	+0.0182		GCVS 1987	-Ir	50	5)
AX Vir	54592.4239	.0001	SIR	+0.0121		BAVR 32,36	-Ir	328	10)
	54597.3418	.0001	WTR	+0.0124		BAVR 32,36	-Ir	94	12)
	54598.3946	.0003	WTR	+0.0114	s	BAVR 32,36	-Ir	94	12)
AZ Vir	54218.3870	.0006	RAT RCR	−0.0189	s	GCVS 1987	-Ir	81	5)
	54600.3959	.0001	WN	−0.0191		GCVS 1987	V	75	14)
CG Vir	54172.4880	.0005	RAT RCR	+0.1682	s	GCVS 1987	-Ir	127	5)
VV Vul	54410.3899	.0017	AG	+0.3861		GCVS 2007	-Ir	61	5)
XZ Vul	54639.4201	.0008	AG	+0.2899		GCVS 1987	-Ir	41	18)
AX Vul	54313.4070	.0002	RAT RCR	−0.0289		GCVS 1987	o	42	5)
BU Vul	54410.3456	.0050	AG	−0.2596		GCVS 1987	-Ir	67	5)
EV Vul	54671.4732	.0030	ALH	+0.4562		GCVS 1987	V	170	8)
GP Vul	54631.4487	.0004	AG	−0.0405	s	GCVS 1987	-Ir	31	18)
GR Vul	54639.4619	.0006	AG				-Ir	41	18)
HI Vul	54631.4745	.0006	AG	−0.0548		GCVS 1987	-Ir	33	18)
GSC 0133000287	54454.4391	.0004	AG	+0.0010	s	BAVR 54.105	o	208	18)
	54505.3493	.0005	QU	+0.0003	s	BAVR 54.105	V	76	7)
	54507.4419	.0007	QU	+0.0007	s	BAVR 54.105	V	84	7)
	54509.3602	.0010	QU	+0.0011		BAVR 54.105	V	96	7)
	54509.5339	.0010	QU	+0.0004	s	BAVR 54.105	V	96	7)
	54515.288 :	.004	QU	+0.001		BAVR 54.105	V	75	7)
	54515.4626	.0004	QU	+0.0012	s	BAVR 54.105	V	75	7)
	54516.3342	.0005	QU	+0.0010		BAVR 54.105	V	90	7)
	54516.5090	.0005	QU	+0.0014	s	BAVR 54.105	V	90	7)
	54520.3448	.0007	QU	+0.0015	s	BAVR 54.105	V	75	7)
	54531.3273	.0005	QU	−0.0002		BAVR 54.105	V	70	7)
	54531.503 :	.004	QU	+0.001	s	BAVR 54.105	V	70	7)
GSC 0137501085	54504.3247	.0006	SIR				-Ir	80	10)
	54504.4944	.0004	SIR				-Ir	80	10)
	54505.3355	.0005	SIR				-Ir	91	10)
	54505.5044	.0005	SIR				-Ir	71	10)
	54506.3418	.0007	SIR				-Ir	103	10)
	54506.5127	.0002	SIR				-Ir	128	10)
	54507.3483	.0004	SIR				-Ir	107	10)
	54507.5214	.0006	SIR				-Ir	113	10)
	54510.3834	.0004	SIR				-Ir	102	10)
	54544.3698	.0004	SIR				-Ir	102	10)
GSC 0162900788	54304.4128	.0009	AG				-Ir	31	5)

Table 1: (cont.)

Variable	HJD 24...	±	Obs	$O-C$		Bibliography	Fil	n	Rem
GSC 0203800293	54516.6382	.0003	FR	+0.0059		BAVM 177	-Ir	60	18)
	54570.3858	.0009	FR	+0.0015	s	BAVM 177	-Ir	115	18)
	54570.6366	.0004	FR	+0.0046		BAVM 177	-Ir	115	18)
	54583.5195	.0002	FR	+0.0069		BAVM 177	-Ir	90	18)
	54594.4188	.0010	FR	+0.0071		BAVM 177	-Ir	64	18)
	54596.4004	.0004	FR	+0.0071		BAVM 177	-Ir	66	18)
	54597.393	.001	FR	+0.009		BAVM 177	-Ir	56	18)
GSC 0236102410	54055.3620	.0006	AG				-Ir	49	5)
	54055.5214	.0015	AG				-Ir	49	5)
	54055.6819	.0060	AG				-Ir	49	5)
	54084.3232	.0006	AG				-Ir	53	5)
	54084.4819	.0012	AG				-Ir	53	5)
	54084.6411	.0004	AG				-Ir	53	5)
	54364.5419	.0007	AG				-Ir	34	5)
	54364.5419	.0007	AG				-Ir	34	5)
	54455.3989	.0041	AG				-Ir	29	5)
	54476.4061	.0008	AG				-Ir	57	5)
	54476.5640	.0005	AG				-Ir	57	5)
GSC 0265604286	54631.4159	.0013	AG	−0.0075		IBVS 5900	-Ir	33	18)
GSC 0403002020	54092.2753	.0004	AG				-Ir	37	5)
	54092.4111	.0004	AG				-Ir	37	5)
	54092.5478	.0002	AG				-Ir	37	5)
	54092.6810	.0012	AG				-Ir	37	5)
	54308.4086	.0013	AG				-Ir	21	5)
	54308.4086	.0013	AG				-Ir	21	5)
	54367.3284	.0005	AG				-Ir	61	5)
	54367.3284	.0005	AG				-Ir	61	5)
	54367.4657	.0005	AG				-Ir	61	5)
	54367.4657	.0005	AG				-Ir	61	5)
	54367.6015	.0005	AG				-Ir	61	5)
	54367.6015	.0005	AG				-Ir	61	5)
	54388.3799	.0012	AG				-Ir	45	5)
	54388.3799	.0012	AG				-Ir	45	5)
	54388.5175	.0009	AG				-Ir	45	5)
	54388.5175	.0009	AG				-Ir	45	5)
	54388.6539	.0011	AG				-Ir	45	5)
	54388.6539	.0011	AG				-Ir	45	5)
U-A2 1200-12680286	54631.5195	.0009	AG				-Ir	33	18)
U-A2 1500-01208912	54092.2723	.0004	AG				-Ir	37	5)
	54092.4269	.0013	AG				-Ir	37	5)
	54092.5782	.0003	AG				-Ir	37	5)
	54096.3584	.0024	AG				-Ir	26	5)
	54096.5023	.0011	AG				-Ir	26	5)
	54308.3828	.0001	AG				-Ir	19	5)
	54308.3828	.0001	AG				-Ir	19	5)
	54367.3132	.0012	AG				-Ir	61	5)
	54367.3132	.0012	AG				-Ir	61	5)
	54367.4639	.0013	AG				-Ir	61	5)
	54367.4639	.0013	AG				-Ir	61	5)
	54367.6141	.0010	AG				-Ir	61	5)
	54367.6141	.0010	AG				-Ir	61	5)
	54388.3207	.0009	AG				-Ir	46	5)
	54388.3207	.0009	AG				-Ir	46	5)
	54388.4678	.0004	AG				-Ir	46	5)
	54388.4678	.0004	AG				-Ir	46	5)
	54388.6192	.0012	AG				-Ir	46	5)
	54388.6192	.0012	AG				-Ir	46	5)
U-A2 1508-0029126	53660.3008	.0014	AG				-Ir	43	5)
	53660.4576	.0021	AG				-Ir	43	5)
	53660.6172	.0013	AG				-Ir	43	5)

Table 1: (cont.)

Variable	HJD 24...	±	Obs	$O-C$	Bibliography	Fil	n	Rem
U-A2 1508-0029126	54002.4749	.0090	AG			-Ir	34	5)
	54002.6316	.0008	AG			-Ir	34	5)
	54020.4391	.0013	AG			-Ir	32	5)
	54020.6004	.0028	AG			-Ir	30	5)
	54092.3076	.0001	AG			-Ir	36	5)
	54092.4678	.0013	AG			-Ir	36	5)
	54092.6209	.0002	AG			-Ir	36	5)
	54388.3693	.0022	AG			-Ir	40	5)
	54388.3693	.0022	AG			-Ir	40	5)
	54388.5289	.0032	AG			-Ir	40	5)
	54388.5289	.0032	AG			-Ir	40	5)
U-B1 1500-0005759	53653.3460	.0020	AG			-Ir	33	5)
	53717.3230	.0024	AG			-Ir	46	5)
	53990.6117	.0014	AG			-Ir	75	5)
	54002.5100	.0018	AG			-Ir	35	5)
	54003.4707	.0020	AG			-Ir	60	5)
	54020.5166	.0108	AG			-Ir	31	5)
	54035.2984	.0025	AG			-Ir	44	5)
	54085.4625	.0015	AG			-Ir	30	5)
	54454.5489	.0011	AG			-Ir	98	5)

Table 2: Times of maxima of pulsating stars

Variable	HJD 24...	±	Obs	$O-C$	Bibliography	Fil	n	Rem
SW And	54472.3508	.0011	WN	−0.0012	A&A 476.307 2007	V	109	14)
	54507.2910	.0015	WN	+0.0003	A&A 476.307 2007	V	167	14)
XX And	54479.2945	.0019	WN	+0.0213	BAVR 48,189	V	101	14)
	54513.2616	.0013	WN	+0.0190	BAVR 48,189	V	79	14)
XY And	54388.3216	.0005	MZ			-Ir	74	6)
	54433.3794	.0020	MZ			-Ir	74	6)
	54453.3186	.0090	MZ			-Ir	74	6)
ZZ And	54338.4181	.0060	MZ			V	14	13)
BK And	54337.5375	.0002	MZ	+0.0034	BAVR 49,41	V	11	13)
	54342.6056	.0002	MZ	+0.0123	BAVR 49,41	V	15	13)
CC And	54472.4346	.0014	WN	+0.0167	GCVS 1985	V	97	14)
	54475.4358	.0026	WN	+0.0201	GCVS 1985	V	120	14)
	54510.2896	.0009	WN	+0.0246	GCVS 1985	V	104	14)
DM And	54451.3274	.0009	MZ	−0.0039	GCVS 2007	-Ir	80	6)
DU And	54428.4662	.0010	MZ	+0.1953	GCVS 1985	-Ir	59	6)
GM And	54338.4720	.0005	MZ	+0.0399	GCVS 2007	V	55	6) 2)
	54338.4727	.0003	MZ	+0.0406	GCVS 2007	B	46	6) 2)
GP And	54466.2393	.0006	WN	+0.0053	GCVS 1985	V	65	14)
	54472.2976	.0007	WN	+0.0050	GCVS 1985	V	50	14)
	54475.3674	.0006	WN	+0.0062	GCVS 1985	V	80	14)
	54479.2213	.0008	WN	+0.0046	GCVS 1985	V	53	14)
	54479.3796	.0007	WN	+0.0056	GCVS 1985	V	88	14)
	54482.2902	.0008	WN	+0.0049	GCVS 1985	V	50	14)
OV And	54457.2781	.0019	WN	−0.0215	MVS 11,133	V	75	14)
	54463.3955	.0013	WN	−0.0216	MVS 11,133	V	136	14)
	54464.3365	.0016	WN	−0.0218	MVS 11,133	V	101	14)
SX Aqr	54349.4251	.0004	FLG	+0.0192	BAVR 48,57	V	100	15)
CY Aqr	54381.4464	.0002	MZ	+0.0115	GCVS 1985	-Ir	60	6)
X Ari	54512.3137	.0018	WN	+0.0533	BAVR 48,189	V	116	14)
SY Ari	54479.3686	.0080	MZ			-Ir	76	6)
TZ Aur	54479.4802	.0011	WN	+0.0128	GCVS 1985	V	134	14)
	54512.3803	.0013	WN	+0.0122	GCVS 1985	V	78	14)
NU Aur	54456.3178	.0004	MZ	+0.2642	GCVS 2007	-Ir	109	6)
UU Boo	54512.6731	.0018	SCI	+0.2024	GCVS 1985	o	71	6)
	54583.4985	.0017	SCI	+0.2051	GCVS 1985	o	46	6)

Table 2: (cont.)

Variable	HJD 24...	±	Obs	$O-C$	Bibliography	Fil	n	Rem
VY Boo	54587.5019	.0055	MZ			-Ir	121	6) 2)
CQ Boo	54583.3865	.0030	ALH	−0.0513	BAVR 48,189	o	223	8) 1)
	54583.4224	.0030	ALH	−0.0153	BAVR 48,189	o	223	8) 1)
	54639.4803	.0030	ALH	−0.0523	BAVR 48,189	o	289	8) 1)
	54639.5139	.0030	ALH	−0.0187	BAVR 48,189	o	289	8) 1)
UY Cam	54544.388	.004	AG	+0.067	BAVR 49,41	o	22	18)
TT Cnc	54513.5727	.0010	FR	−0.0098	A&A 476.307 2007	-Ir	56	18)
AP Cnc	54508.379	.001	AG	−0.040	GCVS 2007	-Ir	28	5)
AQ Cnc	54506.5188	.0017	WN	−0.0727	GCVS 1985	V	116	14)
	54521.3263	.0010	MZ	−0.0752	GCVS 1985	-Ir	59	6)
EF Cnc	54509.293	.002	AG			-Ir	40	5)
	54509.588	.002	AG			-Ir	40	5)
RZ CVn	54608.3985	.0015	WN	+0.1213	BAVR 48,189	V	82	14)
AD CMi	54479.3627	.0004	FLG	+0.0091	GCVS 1985	V	145	15)
	54479.4861	.0005	FLG	+0.0095	GCVS 1985	V	145	15)
HU Cas	54512.3576	.0010	MZ			-Ir	95	6)
IU Cas	54516.3760	.0015	MZ			-Ir	66	6)
NS Cyg	54396.3512	.0005	MZ			-Ir	86	6)
V939 Cyg	54356.4670	.0010	RAT RCR	+0.0381	BAVM 92	o	400	5)
VZ Dra	54652.5013	.0030	ALH	+0.1291	GCVS 1985	V	99	8)
RR Gem	54474.4319	.0030	ALH	−0.0031	BAVR 47,67	o	290	8)
	54479.5956	.0010	WN	−0.0042	BAVR 47,67	V	69	14)
	54505.4171	.0013	WN	−0.0067	BAVR 47,67	V	75	14)
	54509.4359	.0014	PGL	+0.0391	BAVR 47,67	o	547	16)
SZ Gem	54506.4102	.0016	SB	+0.0080	BAVR 48,65	-Ir	137	15)
	54508.4151	.0030	ALH	+0.0084	BAVR 48,65	V	290	8)
GQ Gem	54513.4732	.0020	SB	−0.1958	GCVS 2007	-Ir	117	15)
IV Gem	54454.3947	.0060	MZ			-Ir	79	6)
TW Her	54646.4964	.0020	ALH	−0.0118	GCVS 1985	V	148	8)
VX Her	54593.3738	.0010	QU	+0.0372	GCVS 1985	V	42	7)
	54608.4007	.0007	PGL	+0.0368	GCVS 1985	o	287	16)
	54618.4211	.0020	ALH	+0.0390	GCVS 1985	o	252	8)
VZ Her	54598.4653	.0013	PGL	+0.0655	GCVS 1985	o	218	16)
	54631.492	.002	AG	+0.068	GCVS 1985	-Ir	68	18)
IT Her	54597.4840	.0024	SCI			o	108	6)
	54598.4990	.0023	SCI			o	73	6)
V633 Her	54387.3324	.0010	MZ			-Ir	76	6)
SZ Hya	54509.3611	.0048	FLG	−0.2259	GCVS 1985	V	135	15)
UU Hya	54506.641	.003	AG			-Ir	70	5)
UV Hya	54506.603	.002	AG			-Ir	70	5)
RR Leo	54512.5796	.0013	WN	+0.0016	A&A 476.307 2007	V	116	14)
	54594.4667	.0005	QU	+0.0041	A&A 476.307 2007	V	66	7)
ST Leo	54555.4284	.0020	ALH	−0.0188	GCVS 1985	V;B	168	8)
BP Leo	54564.529	.001	AG	−0.201	GCVS 2007	o	160	18)
BT Leo	54507.4528	.0006	MZ			-Ir	94	6)
DI Leo	54531.388	.002	AG	+0.250	GCVS 2007	-Ir	47	5)
SZ Lyn	54479.5591	.0008	WN	+0.0186	GCVS 1985	V	59	14)
	54512.4658	.0009	WN	+0.0193	GCVS 1985	V	91	14)
Y Lyr	54380.3212	.0003	MZ			-Ir	58	6)
RR Lyr	52503.587	.004	ALH	+0.042	AC 1205.4 1982	o	999	19)
EN Lyr	54389.2908	.0080	MZ			-Ir	29	6)
EX Lyr	54364.4539	.0080	MZ	−0.1341	GCVS 1985	-Ir	105	6)
KM Lyr	54295.4626	.0060	MZ	+0.1183	GCVS 2007	-Ir	62	6)
	54297.4701	.0060	MZ	+0.1251	GCVS 2007	-Ir	53	6)
NQ Lyr	54390.3737	.0013	MZ	−0.0047	GCVS 1985	-Ir	68	6)
AI Mon	54507.605	.010	AG	−0.162	GCVS 2007	o	26	5)
EZ Mon	54513.3708	.0016	MZ	+0.0291	GCVS 2007	-Ir	191	6) 2)
CM Ori	54505.3254	.0002	MZ	+0.0267	BAVR 49,105	-Ir	70	6)
AV Peg	54456.2446	.0018	WN	+0.0057	A&A 476.307 2007	V	109	14)

Table 2: (cont.)

Variable	HJD 24...	±	Obs	$O-C$	Bibliography	Fil	n	Rem
AV Peg	54463.2717	.0018	WN	+0.0060	A&A 476.307 2007	V	101	14)
BH Peg	54466.3455:	.0050	WN	+0.0166	BAVR 47,67	V	166	14)
CD Peg	54457.2074	.0016	MZ	−0.2412	GCVS 2007	-Ir	123	6) 2)
CV Peg	54452.3141	.0040	MZ			-Ir	49	6)
DH Peg	54464.2750	.0031	WN	+0.0269	GCVS 1987	V	145	14)
DY Peg	53224.417	.001	PGL	−0.004	GCVS 1987	-Ir	174	17)
	53232.4379	.0003	PGL	−0.0042	GCVS 1987	-Ir	122	17)
	53256.3567	.0003	PGL	−0.0052	GCVS 1987	o	132	17)
	53350.4763	.0020	PGL	−0.0335	GCVS 1987	o	38	17)
	54080.3708	.0014	PGL	+0.0146	GCVS 1987	-Ir	77	17)
	54463.2118	.0005	WN	−0.0074	GCVS 1987	V	39	14)
	54479.3269	.0007	WN	−0.0090	GCVS 1987	V	39	14)
	54482.2454	.0005	WN	−0.0076	GCVS 1987	V	85	14)
GY Peg	54380.4512	.0025	MZ	−0.2392	GCVS 2007	-Ir	40	6)
AR Per	54387.4161	.0005	MZ	+0.0516	GCVS 1987	-Ir	53	6)
	54463.5937	.0022	WN	+0.0559	GCVS 1987	V	190	14)
	54464.4453	.0015	WN	+0.0564	GCVS 1987	V	173	14)
	54476.3590	.0030	ALH	+0.0547	GCVS 1987	o	460	8)
	54505.2957	.0011	WN	+0.0541	GCVS 1987	V	104	14)
	54508.2740	.0009	WN	+0.0536	GCVS 1987	V	112	14)
	54513.3825	.0011	WN	+0.0555	GCVS 1987	V	155	14)
ET Per	54455.3410	.0003	MZ	−0.0258	BAVR 49,41	-Ir	80	6) 2)
V375 Per	54509.281	.002	AG			-Ir	60	5)
V378 Per	54505.378	.002	AG			-Ir	92	5)
BO Tau	54452.4306	.0008	MZ			-Ir	80	6)
BR Tau	54457.4132	.0001	MZ			-Ir	62	6)
RV UMa	54531.371	.001	NIC	+0.009	BAVR 48,189	V	178	7)
TU UMa	54535.6079	.0015	FR	−0.0276	GCVS 1987	-Ir	52	18)
	54591.3733	.0017	WN	−0.0281	GCVS 1987	V	91	14)
	54591.3747	.0005	QU	−0.0267	GCVS 1987	V	54	7)
	54596.3934	.0007	QU	−0.0269	GCVS 1987	V	59	7)
UZ UMa	54544.416	.004	AG			o	22	18)
AE UMa	54506.5887	.0006	WN	+0.0052	BAVR 48,189	V	67	14)
	54512.5199	.0002	WN	+0.0012	BAVR 48,189	V	50	14)
	54513.4650	.0009	WN	+0.0002	BAVR 48,189	V	182	14)
	54513.5559	.0009	WN	+0.0050	BAVR 48,189	V	182	14)
	54524.4815	.0008	WN	+0.0065	BAVR 48,189	V	64	14)
U-A2 1425-00752967	54432.296	.001	AG			-Ir	113	5)

Remarks:

AG: Agerer, F., Tiefenbach
ALH: Alich, K., Schaffhausen (CH)
DIE: Dietrich, M., Radebeul
FLG: Flechsig, Dr. G., Teterow
FR: Frank, P., Velden
JU: Jungbluth, Dr. H., Karlsruhe
MZ: Maintz, Dr. G., Bonn
NIC: Nickel, O., Mainz
PGL: Pagel, Dr. L., Klockenhagen
QU: Quester, W., Esslingen
RAT: Rätz, M., Herges-Hallenberg
RCR: Rätz, M., Herges-Hallenberg
SB: Steinbach, Dr. H., Neu-Anspach
SCI: Schmidt, U., Karlsruhe
SIR: Schirmer, J., Willisau (CH)
WN: Wischnewski, M., Wennigsen
WTR: Walter, F., München

Remarks (cont.):

:	= uncertain
s	= secondary minimum
C	= CCD-camera
o	= without filter
V	= V-filter
B	= B-filter
I	= I-filter
Ic	= I-filter cousins
-Ir	= -Ir-filter
GSC	= The HST Guide Star Catalogue 1.2
U-A2	= The USNO A2.0 Catalogue
U-B1	= The USNO B1.0 Catalog
1)	= double maximum
2)	= assembled from the observations of two nights
3)	= not much descend
4)	= eclipse of the hot spot
5)	= ccd-camera ST-6 chip 375*242 uncoated
6)	= ccd-camera ST-7
7)	= ccd-camera ST-7E
8)	= ccd-camera ST-8E
9)	= ccd-camera ST-9
10)	= ccd-camera Alpha Maxi chip KAF401e
11)	= ccd-camera pictor 1616XT
12)	= ccd-camera Pictor 416XT
13)	= ccd-camera holicam
14)	= ccd-camera Meade DSI Pro 2
15)	= ccd-camera SIGMA 402
16)	= ccd-camera Artemis 4021
17)	= ccd-camera Canon EOS 300D
18)	= ccd-camera Sigma 1603
19)	= photodiode S5972
20)	= this star has not been observed since 1959; reduced by adding half time of
	= expected total duration (0.014p) to time of second contact
A&A	= Astronomy & Astrophysics
AC	= Astronomical Circular
BAVM nnn	= BAV Mitteilungen No. nnn
BAVR vv,ppp	= BAV Rundbrief Vol. vv, page ppp
GCVS yy	= General Catalogue of Variable Stars, 4th edition,
IBVS nnnn	= Information Bulletin on Variable Stars No. nnnn
MVS vv,ppp	= Mitteilungen über Veränderliche Sterne; volume,pages

ERRATUM FOR IBVS 5657 (BAVM 173)

AO Cam 53360.4840 RAT RCR correct value: 53360.4940

ERRATUM FOR IBVS 5761 (BAVM 183)

AE Cas 54000.4498 SCI correct value: 54017.4498

ERRATA FOR IBVS 5802 (BAVM 186)

AO Cam 53809.3529 RAT RCR correct value: 53809.3259
GK Cas 54212.5234 RAT RCR correct value: 54211.5234

ERRATUM FOR IBVS 5874 (BAVM 201)

GSC 0137501085 SIR all results must be deleted

COMMISSIONS 27 AND 42 OF THE IAU
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Budapest
2 February 2009

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CCD MINIMA FOR SELECTED ECLIPSING BINARIES IN 2008

NELSON, ROBERT H.

1393 Garvin Street, Prince George, BC, Canada, V2M 3Z1 e-mail: bob . nelson @ shaw . ca

Observatory and telescope:
Sylvester Robotic Observatory (SyRO): 33 cm f/4.5 Newtonian on Paramount ME mount

Detector:	SyRO: SBIG ST-7XME, 1.25" pixels, 15.8' x 10.5' FOV, cooled $-10 > T > -30$ deg C

Method of data reduction:
Aperture photometry using MIRA, by Mirametrics, Inc.

Method of minimum determination:
Digital tracing paper method, bisection of chords, curve fitting, and (occasionally) Kwee and van Woerden (1956)

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
CN And	54802.7371	0.0002	II	R	
EP And	54723.8280	0.0001	I	R	
V0441 And	54722.6977	0.0005	II	c	
V0444 And	54739.7129	0.0003	I	R	
RX Ari	54803.6572	0.0001	I	R	
AH Aur	54789.8208	0.0004	II	R	
AP Aur	54739.9813	0.0002	I	R	
BC Aur	54803.7684	0.0005	I	R	
EP Aur	54725.9431	0.0005	II	R	
GX Aur	54522.7930	0.0003	II	c	
HL Aur	54515.6406	0.0001	I	R	
HL Aur	54803.8545	0.0002	I	c	
V0410 Aur	54726.9173	0.0003	II	R	
GSC 2915-0212	54820.898	0.001	I	R	
GSC 3751-0178	54823.7385	0.0002	II	R	

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
XY Boo	54544.932	0.001	I	R	
AR Boo	54540.8442	0.0002	II	c	
GN Boo	54532.8879	0.0002	I	R	
GR Boo	54541.9320	0.0001	I	R	
GS Boo	54590.7593	0.0003	II	R	
GT Boo	54515.9263	0.0003	II	R	
GSC 2013-0288	54619.8025	0.0002	II	R	
GQ Boo	54520.9612	0.0003	II	c	
DN Cam	54729.8559	0.0001	I	V	
GSC 3715-1039	54737.8706	0.0005	I	c	
GSC 4369-1506	54820.7111	0.0003	II	R	
AX Cas	54704.8719	0.0001	I	c	
BH Cas	54722.7907	0.0005	I	R	
CW Cas	54725.8155	0.0001	II	R	
DZ Cas	54726.6808	0.0005	I	c	
EG Cas	54725.7052	0.0005	II	c	
KL Cas	54685.8913	0.0002	I	c	
V0366 Cas	54684.8838	0.0002	II	c	
V0375 Cas	54726.8282	0.0003	II	R	
V0396 Cas	54729.7403	0.0003	I	R	
V0541 Cas	54820.5954	0.0001	I	R	
V0776 Cas	54819.6290	0.0002		R	
GSC 4030-2020	54704.8561	0.0002	II	c	
BB CMi	54517.8698	0.0005	I	R	
TX Cnc	54516.6823	0.0002	I	R	
TX Cnc	54802.8896	0.0003	II	R	
WW Cnc	54823.8582	0.0001	I	R	
YY Cnc	54811.876	0.001	I	R	
HN Cnc	54821.8240	0.0003	I	R	
RW Com	54556.7480	0.0001	I	c	
RW Com	54802.9951	0.0002	II	R	
RW Com	54803.1139	0.0002	I	R	
SS Com	54550.8092	0.0002	II	R	
CC Com	54535.8200	0.0001	I	R	
CC Com	54818.9608	0.0001	I	c	
CC Com	54819.0707	0.0001	II	c	
LP Com	54512.8055	0.0002	I	c	
MM Com	54804.023	0.001	II	c	
AM CrB	54547.8649	0.0002	I	c	
BO CVn	54557.7673	0.0001	II	R	
DH CVn	54555.7694	0.0001	II	c	
DI CVn	54539.7536	0.0003	I	c	
DQ CVn	54516.7940	0.0003	I	R	
DR CVn	54516.8980	0.0002	II	R	
DR CVn	54551.7773	0.0005	II	c	
DR CVn	54821.1112	0.0002		R	
DX CVn	54558.9649	0.0002	I	c	
EE CVn	54549.7320	0.0004	II	c	
EF CVn	54553.8428	0.0002	II	c	
EG CVn	54538.8661	0.0002	II	c	
EI CVn	54554.8178	0.0001	II	c	
EI CVn	54817.0176	0.0002	I	R	

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
GSC 2537-0520	54520.8277	0.0002	II	c	
GSC 2534-1121	54541.8388	0.0002	II	c	
GSC 2544-1007	54544.7391	0.0002	I	R	
GSC 3034-0299	54547.7692	0.0001	II	R	
V0456 Cyg	54588.8528	0.0001	I	BVR	
V0628 Cyg	54814.6202	0.0003	I	c	
V0726 Cyg	54590.9341	0.0001	I	R	
V0885 Cyg	54557.0042	0.0007	I	R	
V1036 Cyg	54802.5994	0.0002	II	R	
V1901 Cyg	54728.8039	0.0002	I	c	
V2364 Cyg	54551.0034	0.0003	II	R	
V2364 Cyg	54617.9145	0.0003	II	R	
BV Dra	54545.9288	0.0001	II	V	
BW Dra	54545.9127	0.0001	I	V	
BX Dra	54527.9296	0.0001	I	R	
FU Dra	54588.7561	0.0002	II	R	
GSC2.2 N311122119912	54683.9331	0.0003	II?	c	RHN-12
WW Gem	54796.8135	0.0003	I	R	
AC Gem	54814.8452	0.001	II	c	
AL Gem	54515.8113	0.0002	I	R	
AY Gem	54818.8104	0.0001	I	c	
GSC 1331-0726	54819.9195	0.0003	II	R	
GW Gem	54824.0252	0.0001	I	R	
QW Gem	54821.7408	0.0002	II	R	
TT Her	54602.8324	0.0002	I	VRI	
TT Her	54603.7442	0.0005	I	VRI	
TT Her	54618.7928	0.0002	II	VRI	
V0719 Her	54516.9943	0.0004	I	c	
V0728 Her	54539.026	0.001	I	R	
V0742 Her	54517.9826	0.0002	I	c	
V1003 Her	54555.945	0.004	II	BVR	
V1024 Her	54555.8497	0.0001	II	c	
V1036 Her	54547.9875	0.0002	I	R	
V1038 Her	54521.9409	0.0002	II	c	
V1042 Her	54550.9219	0.0001	II	c	
V1043 Her	54546.0269	0.0002	II	c	
V1047 Her	54540.9468	0.0002	I	c	
V1047 Her	54582.8019	0.0002	I	c	
V1055 Her	54553.9412	0.0002	II	R	
V1065 Her	54565.8912	0.0001	II	c	
V1073 Her	54551.898	0.001	I	c	
V1097 Her	54591.8665	0.0001	II	c	
GSC 2056-0117	54556.9209	0.0001	I	c	
GSC 3510-1283	54557.8942	0.0001	I	c	
GSC 3097-1297	54595.7930	0.0001	II	c	
GSC 2615-1821	54613.8121	0.0001	II	R	

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
FG Hya	54499.7477	0.0002	I	R	
XZ Leo	54527.7025	0.0003	II	c	
AM Leo	54816.0161	0.0001	I	R	
GV Leo	54814.9668	0.0002	I	c	
RT LMi	54556.8184	0.0001	I	c	
RZ Lyn	54538.657	0.001	I	R	
BG Lyn	54543.7764	0.0002	I	R	
BG Lyn	54796.9430	0.0001	I	R	
DZ Lyn	54811.7608	0.0005	I	c	
GSC 2495-1146	54559.7242	0.0005	I	c	
TZ Lyr	54519.0594	0.0001	I	R	
AH Lyr	54614.8980	0.0003	I	c	
DF Lyr	54533.0031	0.0004	II	c	
QU Lyr	54609.9126	0.0003	I	c	
V0400 Lyr	54522.0273	0.0001	II	c	
V0396 Mon	54512.6751	0.0002	II	c	
GSC 0143-1718	54797.8283	0.0005	I	R	
GSC 2751-1007	54723.7050	0.0002	I	c	
KW Per	54823.6113	0.0001	I	R	
V0432 Per	54819.8346	0.0001		R	
V0462 Per	54724.8549	0.0002	II	c	
V0579 Per	54816.644	0.001	I	R	
V0680 Per	54793.8643	0.0002	II	c	
GSC 2366-3002	54821.5909	0.0002	II	R	
WY Tau	54530.7646	0.0002	I	R	
CT Tau	54723.9291	0.0001	I	R	
GQ Tau	54793.7349	0.0003	I	c	
V0471 Tau	54797.7205	0.001	I	V	
GSC 1830-1432	54739.8574	0.0005	II	c	
XZ UMa	54521.6668	0.0001	I	R	
AA UMa	54498.7387	0.0002	II	R	
AA UMa	54816.8320	0.0003	I	R	
BM UMa	54527.8214	0.0001	II	c	
HN UMa	54521.8065	0.0004	II	R	
MQ UMa	54518.9277	0.0005	I	c	
GSC 3449-0688	54499.8744	0.0002	II	c	
GSC 3449-0688	54815.8735	0.0002	I	c	
RU UMi	54512.9199	0.0003	II	R	
HW Vir	54554.9022	0.0005	I	BVR	
GSC 2140-1485	54619.9165	0.0004	II	R	

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UPDATED SPIN EPHEMERIS FOR THE CATACLYSMIC VARIABLE EX HYDRAE

MAUCHE, C.W.[1]; BRICKHOUSE, N.S.[2]; HOOGERWERF, R.[3]; LUNA, G.J.M.[2]; MUKAI, K.[4]; STERKEN, C.[5]

[1] Lawrence Livermore National Laboratory, L-473, 7000 East Avenue, Livermore, CA 94550, USA, e-mail: mauche@cygnus.llnl.gov

[2] Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, MS-15, Cambridge, MA 02138, USA, e-mail: nbrickhouse@cfa.harvard.edu, gluna@cfa.harvard.edu

[3] Interactive Supercomputing, Inc., 135 Beaver Street, Waltam, MA 02452, USA, e-mail: hoogerw@pobox.com

[4] NASA GSFC, Code 662, Greenbelt, MD 20771, USA, e-mail: mukai@milkyway.gsfc.nasa.gov

[5] Vrije Universiteit Brussel, Pleinlaan 2, B-1050 Brussels, Belgium, e-mail: csterken@vub.ac.be

Recent satellite observations demonstrate that the phase of maximum flux of the 67 min spin modulation of the white dwarf in the cataclysmic variable EX Hya is drifting away from the optical quadratic ephemeris of Hellier & Sproats (1992, hereafter HS92). Relative to that ephemeris, the peak of the spin-phase extreme ultraviolet (EUV) flux modulation measured with the *Extreme Ultraviolet Explorer* (*EUVE*) was $\phi_{67} = 0.040 \pm 0.002$ in 1994 May (Mauche 1999) and $\phi_{67} = 0.115 \pm 0.001$ in 2000 May (Belle et al. 2002). Similarly, the peak of the spin-phase X-ray flux modulation measured with the *Chandra X-ray Observatory* was $\phi_{67} \approx 0.1$ in 2000 May (Hoogerwerf, Brickhouse, & Mauche 2004) and $\phi_{67} \approx 0.2$ in 2007 May (Luna, Brickhouse, & Mauche 2008). Because the discrepancy between the observed O and calculated C phases of the spin-phase flux modulation of EX Hya is now approaching a significant fraction of a spin cycle, we have undertaken the task of updating the ephemeris.

Toward that end, we have have combined the optical data of Vogt, Krzeminski, & Sterken (1980, hereafter VKS80), Gilliland (1982), Sterken et al. (1983), Hill & Watson (1984), Jablonski & Busko (1985), Bond & Freeth (1988), HS92, Walker & Allen (2000), and Belle et al. (2005) with the optical, EUV, and X-ray data listed in Table 1. The first set of optical data in Table 1 was obtained by CS at the European Southern Observatory, La Silla, Chile using the Danish 1.5-m telescope and the DFOSC CCD camera. Differential V-band magnitudes were obtained by aperture photometry extracted from flat-fielded and bias-corrected CCD frames. The second set of optical data in Table 1 was obtained by Beuermann & Reinsch (2008, hereafter BR08) and is included here to clear up an ambiguity in the units of the timings in their Table 3, which are labeled as HJD, described as BJD, and treated as BJD(TT), whereas they are in fact BJD(UT); this change affects all the $O - C$ values in their table. Other than the *EXOSAT*, *Ginga*, and BR08 data, which have been taken from the given references, all other times of spin maximum in the table have been derived by us from the various datasets. In the processes, we have corrected an error in the (spin *and* orbit) phases of the *ASCA* data published by Ishida, Mukai, & Osborne (1994) and the *RXTE* data published by Mukai et al. (1998). We note that our result for the second *EUVE* observation agrees within the errors with the result derived independently by Belle et al. (2002). Table 1 lists the observed times of spin maximum in Barycentric Julian Date, the corresponding cycle number E derived from the HS92 quadratic ephemeris, and the $O - C$ residuals in days relative to the VKS80 linear ephemeris, the HS92 quadratic ephemeris, and our cubic ephemeris (eqn. 1). Table 1. is available electronically at the IBVS website as `5876-t1.txt`.

The task of combining optical, EUV, and X-ray data into a single ephemeris presents a number of challenges. First, the published times of optical flux maximum typically do not include error estimates. Second, the times of flux maximum are typically determined in different manners in the optical and higher-energy wavebands. In the optical, the *times* of the flux maxima are typically estimated directly from the light curves, whereas in the EUV and X-ray wavebands, where the event rates are often fairly low, the events are typically phase-folded to produce a mean light curve, from which the *phase offset* relative to the assumed ephemeris is calculated from an analytic (typically, sine) fit to the mean light curve. From this, the effective time of flux maximum is derived, typically referenced to the start or mid-point of the observation. This approach is capable of producing very high signal-to-noise ratio light curves and hence error values on the fit parameters, particularly the times of flux maxima, that are formally very small.

Table 2. Spin ephemeris constants: $T_{\max} = \sum C_n E^n$.

Data Included	$C_0 - 2400000$	C_1	C_2	C_3
Optical	37699.89157	+0.046546478	-6.25×10^{-13}	...
	±0.00054	±0.000000007	$\pm 0.22 \times 10^{-13}$	
EUV & X-ray	37699.88930	+0.046546477	-6.19×10^{-13}	...
	±0.00165	±0.000000011	$\pm 0.17 \times 10^{-13}$	
All	37699.89300	+0.046546454	-5.85×10^{-13}	...
	±0.00041	±0.000000003	$\pm 0.05 \times 10^{-13}$	
All	37699.89165	+0.046546484	-7.34×10^{-13}	$+2.16 \times 10^{-19}$
	±0.00056	±0.000000009	$\pm 0.42 \times 10^{-13}$	$\pm 0.61 \times 10^{-19}$

Given these complications, we have taken a multi-step approach to calculate a revised spin ephemeris for EX Hya. First, we fit the optical data to a quadratic ephemeris without weights, producing the ephemeris constants listed in the first entry of Table 2. The standard deviation of this fit is 0.00360 days or 0.077 cycles (which, if used as a uniform error on the data, produces the same fit with a reduced $\chi^2 = 1$). Second, we fit the EUV and X-ray data to a quadratic ephemeris accounting for the errors listed in Table 1, producing the ephemeris constants listed in the second entry of Table 2. The two results, optical on one hand and EUV and X-ray on the other, are consistent within the errors and are as well close to (but different from) the optical quadratic ephemeris constants of HS92. Next, we fit the combined data sets, using 0.00360 days for the error on the optical data and the errors listed in Table 1 for the errors on the EUV and X-ray data, producing the ephemeris constants listed in the third entry of Table 2. The ephemeris constants are now significantly different from those of the previous fits, although it is apparent that the fit is not ideal (χ^2 per degree of freedom (dof) $= 651.2/431 = 1.51$), in part because the ephemeris rolls over too rapidly at early times. To remedy this deficiency, we fit the combined data sets to a cubic ephemeris, producing the ephemeris constants listed in the fourth entry of Table 2. The fit is now somewhat improved ($\chi^2/\mathrm{dof} = 638.5/430 = 1.48$), the fit parameters are closer to those of the earlier quadratic fits, the ephemeris is close to that of HS92 through 1991 January (230,000 cycles; Fig. 1*a*), and it reproduces well all of the available EUV and X-ray data (Fig. 1*c*). Finally, by setting a lower limit of 0.02 cycles or 0.00093 days on the size of the timing errors on the EUV and X-ray data, the reduced χ^2 of the fit is reduced to a very reasonable $\chi^2/\mathrm{dof} = 471.0/430 = 1.10$. Based on these results, we recommend that the following cubic ephemeris be used for recent past and future timings of the flux maxima of the spin modulation of the white dwarf in EX Hya:

$$T_{\rm max} = 2437699.8917(6) + 0.046546484(9)\,E - 7.3(4)\times 10^{-13}\,E^2 + 2.2(6)\times 10^{-19}\,E^3. \quad (1)$$

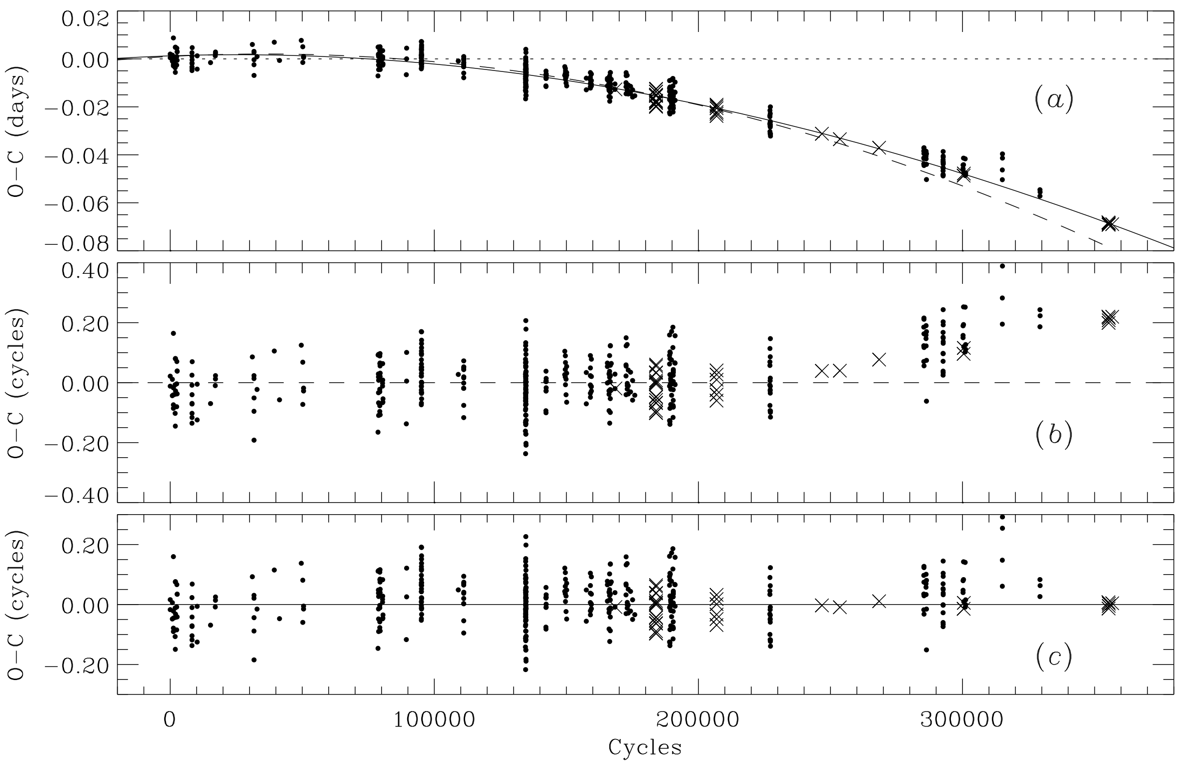

Figure 1. $O-C$ residuals for the optical (*filled circles*) and EUV and X-ray (*X*s) spin maxima of EX Hya relative to (*a*) the VKS80 linear spin ephemeris, (*b*) the HS92 quadratic spin ephemeris, and (*c*) the cubic spin ephemeris of equation 1. In the top panel, the HS92 quadratic and equation 1 cubic spin ephemerides are shown relative to the VKS80 linear spin ephemeris by the dashed and solid curves, respectively.

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THE GEOS RR Lyr SURVEY

Tenth list of maxima of RR Lyr stars observed by the automated telescopes TAROT

(GEOS Circular RR 37)

LE BORGNE, J. F.[1,2]; KLOTZ, A.[3,4]; BOËR, M.[3]

[1] GEOS (Groupe Européen d'Observations Stellaires), 23 Parc de Levesville, 28300 Bailleau l'Evêque, France

[2] LATT, Université de Toulouse, CNRS, Toulouse, France

[3] Observatoire de Haute-Provence, Saint Michel l'Observatoire, France

[4] CESR, Université de Toulouse, CNRS, Toulouse, France

We present here the tenth list of light maxima of RR Lyrae stars from the GEOS RR Lyr Survey (Le Borgne et al. 2007), a GEOS program (`http://www.upv.es/geos/`, Boninsegna et al., 2002) of observations of RR Lyr stars using the automatic telescopes TAROT (`http://tarot.obs-hp.fr`, Boër et al., 2001, Bringer et al., 1999). The present list contains 453 maxima observed mainly between July and December 2008 (Table 1). A description of the present list may be found in the former lists (for example Le Borgne et al. 2008). The data are also available in the GEOS RR Lyr web database (`http://dbRR.ast.obs-mip.fr`). The $O-C$'s are computed with the GCVS elements (Kholopov et al., 1985) when available. Otherwise, the reference of the elements, if exists, is given as a footnote of Table 1.

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Table 1: maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
SW And	54708.518±0.002	-0.784	82700.	C	TZ Aqr	54702.446±0.003	0.010	30031.	C
SW And	54712.499±0.003	-0.784	82709.	C	TZ Aqr	54706.446±0.003	0.012	30038.	C
SW And	54736.380±0.001	-0.786	82763.	C	TZ Aqr	54718.444±0.004	0.015	30059.	C
SW And	54750.534±0.002	-0.785	82795.	C	TZ Aqr	54734.435±0.003	0.012	30087.	C
SW And	54766.457±0.002	-0.784	82831.	C	BN Aqr	54708.421±0.004	0.581	35847.	C
SW And	54802.279±0.004	-0.787	82912.	C	BR Aqr	54708.532±0.002	-0.160	35429.	C
XX And	54679.495±0.003	0.234	21573.	C	BR Aqr	54709.497±0.003	-0.159	35431.	C
XX And	54692.504±0.002	0.233	21591.	C	BR Aqr	54710.460±0.002	-0.160	35433.	C
XX And	54705.513±0.003	0.233	21609.	C	BR Aqr	54736.483±0.002	-0.158	35487.	C
XX And	54739.479±0.002	0.230	21656.	C	BR Aqr	54739.372±0.003	-0.161	35493.	C
XX And	54744.544±0.004	0.236	21663.	C	BR Aqr	54765.389±0.002	-0.165	35547.	C
XX And	54750.329±0.003	0.239	21671.	C	BR Aqr	54767.320±0.004	-0.162	35551.	C
XX And	54786.465±0.004	0.237	21721.	C	CP Aqr	54674.479±0.002	-0.112	36232.	C
XX And	54791.520±0.002	0.233	21728.	C	CP Aqr	54681.429±0.002	-0.114	36247.	C
XX And	54797.306±0.003	0.237	21736.	C	CP Aqr	54688.381±0.003	-0.113	36262.	C
XX And	54802.363±0.002	0.235	21743.	C	CP Aqr	54699.502±0.003	-0.113	36286.	C
XX And	54823.324±0.002	0.236	21772.	C	CP Aqr	54712.480±0.004	-0.111	36314.	C
XX And	54828.381±0.003	0.234	21779.	C	AA Aql	54672.407±0.002	0.034	83820.	C
ZZ And	54750.428±0.002	0.024	53959.	C	AA Aql	54677.472±0.004	0.034	83834.	C
AT And	54677.396±0.005	-0.001	19993.	C	AA Aql	54681.453±0.002	0.035	83845.	C
AT And	54709.470±0.003	-0.007	20045.	C	AA Aql	54702.436±0.001	0.035	83903.	C
AT And	54722.426±0.007	-0.006	20066.	C	V341 Aql	54681.501±0.002	0.031	23330.	C
AT And	54767.464±0.008	-0.003	20139.	C	V341 Aql	54688.438±0.003	0.032	23342.	C
AT And	54790.286±0.004	-0.006	20176.	C	V341 Aql	54699.422±0.002	0.033	23361.	C
AT And	54793.373±0.005	-0.004	20181.	C	V341 Aql	54703.467±0.003	0.032	23368.	C
AT And	54796.458±0.003	-0.004	20186.	C	V341 Aql	54736.412±0.002	0.030	23425.	C
CI And	54704.499±0.002	0.112	39169.	C	X Ari	54752.598±0.005	0.351	26367.	C
CI And	54705.469±0.003	0.113	39171.	C	X Ari	54765.621±0.002	0.351	26387.	C
CI And	54706.437±0.003	0.111	39173.	C	X Ari	54788.410±0.002	0.350	26422.	C
CI And	54722.431±0.003	0.109	39206.	C	X Ari	54807.294±0.004	0.351	26451.	C
CI And	54751.513±0.002	0.108	39266.	C	SY Ari	54751.377±0.003	-0.057	32904.	C
CI And	54786.406±0.002	0.102	39338.	C	TZ Aur	54755.611±0.002	0.013	88985.	C
CI And	54787.376±0.002	0.102	39340.	C	TZ Aur	54818.670±0.003	0.012	89146.	C
CI And	54806.279±0.002	0.101	39379.	C	TZ Aur	54819.453±0.002	0.012	89148.	C
DM And	54744.469±0.005	0.007	30183.	C	TZ Aur	54825.328±0.002	0.012	89163.	C
DM And	54749.506±0.004	0.001	30191.	C	BH Aur	54743.613±0.002	0.002	26293.	C
DR And	54787.336±0.002	-0.012	31196.	C	BH Aur	54749.541±0.003	0.001	26306.	C
DR And	54828.412±0.004	-0.044	31269.	C	BH Aur	54754.558±0.003	0.001	26317.	C
NX And[1]	54791.516±0.004	0.007	24921.	C	BH Aur	54766.418±0.002	0.002	26343.	C
NX And[1]	54797.350±0.005	0.008	24930.	C	BH Aur	54802.448±0.002	0.001	26422.	C
NX And[1]	54828.463±0.005	0.015	24978.	C	BH Aur	54808.376±0.003	0.000	26435.	C
EX Aps	54650.608±0.002	0.015	56628.	LS	U Cae	54804.622±0.002	-0.113	48810.	LS
SW Aqr	54677.421±0.002	0.001	64402.	C	U Cae	54809.652±0.002	-0.121	48822.	LS
SW Aqr	54682.471±0.003	-0.002	64413.	C	AH Cam	54752.389±0.005	-0.431	43455.	C
SW Aqr	54699.468±0.002	0.001	64450.	C	AH Cam	54788.514±0.005	-0.442	43553.	C
SW Aqr	54700.385±0.002	-0.001	64452.	C	AH Cam	54807.319±0.005	-0.442	43604.	C
SW Aqr	54705.437±0.001	-0.001	64463.	C	AH Cam	54822.463±0.003	-0.417	43645.	C
SW Aqr	54727.484±0.003	-0.001	64511.	C	RW Cnc	54785.623±0.003	0.214	27831.	C
SX Aqr	54672.457±0.002	-0.117	27769.	C	RW Cnc	54796.568±0.003	0.215	27851.	C
SX Aqr	54679.423±0.003	-0.115	27782.	C	RW Cnc	54807.515±0.003	0.218	27871.	C
SX Aqr	54686.386±0.004	-0.116	27795.	C	SS Cnc	54807.455±0.003	0.053	86375.	C
SX Aqr	54708.353±0.005	-0.113	27836.	C	SS Cnc	54819.575±0.002	0.051	86408.	C
SX Aqr	54739.420±0.002	-0.118	27894.	C	SS Cnc	54825.451±0.002	0.050	86424.	C
SX Aqr	54746.386±0.001	-0.116	27907.	C	TT Cnc	54820.662±0.002	0.104	26402.	C
TZ Aqr	54678.460±0.005	0.014	29989.	C	TT Cnc	54828.547±0.004	0.101	26416.	C
TZ Aqr	54682.456±0.005	0.012	29996.	C	AN Cnc	54785.631±0.002	0.148	30111.	C

Table 1 (cont.): maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
AN Cnc	54803.556±0.005	0.149	30144.	C	RX Col	54801.694±0.004	-0.254	43750.	LS
AN Cnc	54828.539±0.002	0.146	30190.	C	RX Col	54804.658±0.005	-0.260	43755.	LS
AS Cnc	54827.731±0.003	0.364	25306.	C	RX Col	54810.599±0.005	-0.260	43765.	LS
EZ Cnc[2]	54823.575±0.002	-0.036	14053.	C	RY Col	54776.731±0.005	-0.186	42740.	LS
EZ Cnc[2]	54824.669±0.002	-0.034	14055.	C	RY Col	54777.691±0.005	-0.184	42742.	LS
Z CVn	54832.647±0.005	0.398	24320.	C	RY Col	54778.646±0.004	-0.187	42744.	LS
UZ CVn	54824.601±0.002	0.248	40696.	C	RY Col	54789.657±0.007	-0.190	42767.	LS
AA CMi	54791.567±0.002	0.060	38241.	C	RY Col	54790.616±0.003	-0.188	42769.	LS
AA CMi	54799.668±0.002	0.064	38258.	C	RY Col	54801.644±0.002	-0.174	42792.	LS
AA CMi	54802.527±0.004	0.065	38264.	C	RY Col	54802.604±0.002	-0.172	42794.	LS
AA CMi	54803.477±0.002	0.062	38266.	C	AV Col	54810.627±0.003			LS
AA CMi	54821.579±0.003	0.064	38304.	C	S Com	54823.642±0.003	-0.097	24155.	C
AA CMi	54827.769±0.002	0.062	38317.	LS	UY Cyg	54661.409±0.002	0.053	57477.	C
AL CMi	54799.546±0.005	0.458	33064.	C	UY Cyg	54684.403±0.003	0.058	57518.	C
EE Car	54823.818±0.005	0.017	44600.	LS	UY Cyg	54704.586±0.003	0.056	57554.	C
IU Car	54777.828±0.005	0.303	17747.	LS	XZ Cyg[3]	54655.501±0.003	-0.001	13041.	C
IU Car	54791.837±0.004	0.307	17766.	LS	XZ Cyg[3]	54656.434±0.002	-0.001	13043.	C
IU Car	54808.790±0.003	0.305	17789.	LS	XZ Cyg[3]	54726.433±0.003	0.008	13193.	C
IU Cas	54745.627±0.003	-0.086	40034.	C	XZ Cyg[3]	54727.369±0.003	0.011	13195.	C
IU Cas	54751.474±0.003	-0.084	40043.	C	DM Cyg	54674.435±0.004	0.061	28800.	C
IU Cas	54803.422±0.002	-0.086	40123.	C	DM Cyg	54700.468±0.002	0.063	28862.	C
V363 Cas	54696.408±0.006	0.582	33947.	C	DM Cyg	54703.406±0.002	0.062	28869.	C
V363 Cas	54702.412±0.008	0.574	33958.	C	DM Cyg	54718.522±0.003	0.063	28905.	C
V363 Cas	54720.455±0.010	0.582	33991.	C	DM Cyg	54721.464±0.003	0.066	28912.	C
V363 Cas	54749.425±0.005	0.585	34044.	C	DM Cyg	54727.337±0.002	0.061	28926.	C
V363 Cas	54790.404±0.005	0.574	34119.	C	V939 Cyg[4]	54656.399±0.006	0.018	12561.	C
V363 Cas	54791.512±0.005	0.589	34121.	C	V939 Cyg[4]	54718.409±0.003	0.023	12721.	C
AQ Cep	54750.480±0.002	0.062	40866.	C	ZZ Del	54745.334±0.002	0.011	32786.	C
RR Cet	54718.538±0.002	0.006	38944.	C	ZZ Del	54758.336±0.006	0.008	32811.	C
RR Cet	54749.506±0.002	0.005	39000.	C	BV Del	54765.322±0.002	0.021	69047.	C
RR Cet	54776.603±0.002	0.003	39049.	LS	DX Del	54676.399±0.003	0.058	32392.	C
RR Cet	54785.455±0.002	0.007	39065.	C	DX Del	54684.435±0.002	0.059	32409.	C
RR Cet	54787.665±0.002	0.005	39069.	LS	DX Del	54700.504±0.004	0.059	32443.	C
RR Cet	54790.434±0.002	0.008	39074.	C	DX Del	54717.515±0.002	0.056	32479.	C
RR Cet	54792.644±0.003	0.006	39078.	LS	DX Del	54726.499±0.003	0.061	32498.	C
RR Cet	54794.305±0.003	0.008	39081.	C	DX Del	54729.334±0.003	0.060	32504.	C
RR Cet	54820.295±0.002	0.006	39128.	C	DX Del	54745.402±0.002	0.059	32538.	C
RR Cet	54825.274±0.002	0.008	39137.	C	DX Del	54754.382±0.002	0.059	32557.	C
RR Cet	54826.376±0.005	0.004	39139.	C	VW Dor	54778.670±0.003	-0.114	28740.	LS
RV Cet	54789.649±0.006	0.194	25146.	LS	VW Dor	54782.668±0.002	-0.111	28747.	LS
RV Cet	54794.634±0.003	0.192	25154.	LS	VW Dor	54794.660±0.002	-0.101	28768.	LS
RV Cet	54804.625±0.006	0.208	25170.	LS	VW Dor	54802.638±0.002	-0.112	28782.	LS
RZ Cet	54787.657±0.005	-0.151	40894.	LS	XZ Dra	54696.480±0.002	-0.108	26796.	C
RZ Cet	54788.683±0.005	-0.146	40896.	LS	BC Dra	54703.448±0.005	0.086	17267.	C
RZ Cet	54797.363±0.002	-0.146	40913.	C	BC Dra	54705.606±0.006	0.085	17270.	C
RZ Cet	54819.325±0.005	-0.140	40956.	C	BC Dra	54752.386±0.008	0.093	17335.	C
RZ Cet	54820.339±0.002	-0.148	40958.	C	BC Dra	54788.359±0.005	0.087	17385.	C
RT Col	54809.651±0.005	-0.265	50374.	LS	BD Dra	54672.454±0.002	0.719	21895.	C
RT Col	54825.748±0.002	-0.266	50404.	LS	BD Dra	54692.483±0.003	0.721	21929.	C
RW Col	54778.724±0.006	-0.085	50961.	LS	BD Dra	54718.399±0.003	0.718	21973.	C
RW Col	54790.726±0.004	-0.255	50984.	LS	BD Dra	54722.512±0.006	0.708	21980.	C
RW Col	54801.633±0.003	0.067	51004.	LS	BD Dra	54752.516±0.010	0.670	22031.	C
RW Col	54807.631±0.002	0.243	51015.	LS	BD Dra	54787.305±0.002	0.705	22090.	C
RW Col	54825.641±0.003	0.260	51049.	LS	BD Dra	54788.482±0.002	0.704	22092.	C
RX Col	54782.707±0.005	-0.232	43718.	LS	BK Dra	54659.481±0.003	-0.155	49210.	C
RX Col	54788.634±0.004	-0.245	43728.	LS	BK Dra	54662.443±0.002	-0.153	49215.	C

Table 1 (cont.): maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
BK Dra	54694.412±0.002	-0.156	49269.	C	BD Her	54661.409±0.003	0.064	46493.	C
BK Dra	54704.477±0.002	-0.157	49286.	C	BD Her	54679.405±0.006	0.051	46531.	C
RX Eri	54776.743±0.004	-0.014	56338.	LS	UU Hor	54778.778±0.004	0.157	46694.	LS
RX Eri	54779.683±0.004	-0.010	56343.	LS	UU Hor	54780.706±0.004	0.154	46697.	LS
RX Eri	54793.780±0.003	-0.007	56367.	LS	UU Hor	54787.790±0.004	0.158	46708.	LS
SV Eri	54779.705±0.010	0.776	26936.	LS	UU Hor	54791.652±0.002	0.157	46714.	LS
SV Eri	54794.689±0.008	0.770	26957.	LS	UU Hor	54809.677±0.005	0.159	46742.	LS
SV Eri	54804.686±0.010	0.774	26971.	LS	SZ Hya	54822.559±0.003	-0.239	26326.	C
BB Eri	54778.652±0.002	0.235	26705.	LS	SZ Hya	54829.588±0.002	-0.194	26339.	C
BB Eri	54779.794±0.004	0.237	26707.	LS	UU Hya	54802.643±0.005	0.034	29251.	C
BB Eri	54787.768±0.003	0.233	26721.	LS	UU Hya	54813.630±0.005	0.020	29272.	C
BB Eri	54791.759±0.002	0.234	26728.	LS	UU Hya	54824.618±0.003	0.007	29293.	C
BB Eri	54794.605±0.003	0.231	26733.	LS	FY Hya	54650.617±0.003	0.003	21301.	LS
BB Eri	54803.730±0.004	0.237	26749.	LS	TW Hyi	54802.718±0.002	0.008	22709.	LS
BB Eri	54827.663±0.002	0.235	26791.	LS	TW Hyi	54806.774±0.004	0.011	22715.	LS
RX For	54776.768±0.004	-0.013	25021.	LS	TW Hyi	54823.657±0.003	0.010	22740.	LS
RX For	54779.755±0.003	-0.012	25026.	LS	CQ Lac	54656.450±0.003	0.138	31643.	C
RX For	54803.620±0.002	-0.040	25066.	LS	CQ Lac	54674.429±0.003	0.136	31672.	C
RX For	54806.623±0.003	-0.023	25071.	LS	CQ Lac	54746.352±0.001	0.135	31788.	C
SS For	54775.808±0.006	-0.133	32511.	LS	CQ Lac	54790.377±0.002	0.137	31859.	C
SS For	54776.796±0.003	-0.136	32513.	LS	PW Lac	54765.419±0.002	0.161	33661.	C
SS For	54787.693±0.003	-0.138	32535.	LS	RR Leo	54796.690±0.002	0.093	25423.	C
SS For	54790.669±0.002	-0.135	32541.	LS	RR Leo	54821.573±0.002	0.094	25478.	C
SS For	54792.654±0.005	-0.131	32545.	LS	RX Leo	54823.526±0.004	0.095	28339.	C
SS For	54793.643±0.004	-0.133	32547.	LS	RX Leo	54832.671±0.003	0.092	28353.	C
SS For	54794.636±0.002	-0.131	32549.	LS	ST Leo	54832.658±0.002	-0.020	56298.	C
SW For	54776.684±0.005	0.416	25422.	LS	WW Leo	54824.555±0.003	0.039	33080.	C
SW For	54780.704±0.004	0.417	25427.	LS	AX Leo	54823.663±0.005	-0.032	40696.	C
SW For	54792.764±0.006	0.421	25442.	LS	V LMi	54822.536±0.002	0.030	64885.	C
SW For	54805.622±0.006	0.419	25458.	LS	X LMi	54796.542±0.003	0.214	22791.	C
SX For	54776.645±0.004	0.044	25801.	LS	X LMi	54813.642±0.005	0.206	22816.	C
SX For	54779.673±0.004	0.046	25806.	LS	U Lep	54775.768±0.003	0.044	23085.	LS
SX For	54788.750±0.005	0.043	25821.	LS	U Lep	54778.673±0.004	0.042	23090.	LS
SX For	54791.780±0.006	0.046	25826.	LS	U Lep	54789.727±0.005	0.047	23109.	LS
SX For	54825.678±0.004	0.045	25882.	LS	U Lep	54792.629±0.004	0.042	23114.	LS
RR Gem	54808.549±0.002	-0.401	33857.	C	U Lep	54803.680±0.002	0.045	23133.	LS
RR Gem	54820.470±0.002	-0.399	33887.	C	U Lep	54824.612±0.003	0.044	23169.	LS
RR Gem	54822.455±0.001	-0.401	33892.	C	AZ Lib	54650.580±0.002	0.177	40938.	LS
RR Gem	54826.431±0.002	-0.398	33902.	C	TT Lyn	54820.493±0.003	-0.037	30412.	C
SZ Gem	54807.593±0.001	-0.057	55102.	C	TT Lyn	54821.687±0.002	-0.037	30414.	C
SZ Gem	54819.620±0.002	-0.058	55126.	C	TT Lyn	54823.483±0.003	-0.034	30417.	C
SZ Gem	54825.633±0.002	-0.058	55138.	C	TW Lyn	54756.569±0.002	0.057	20201.	C
SZ Gem	54829.642±0.002	-0.058	55146.	C	TW Lyn	54829.327±0.002	0.054	20352.	C
GI Gem	54765.539±0.002	0.069	56360.	C	RZ Lyr	54688.384±0.002	-0.019	26416.	C
GI Gem	54824.464±0.002	0.069	56496.	C	RZ Lyr	54694.520±0.002	-0.018	26428.	C
TW Her	54664.477±0.002	-0.013	82881.	C	AW Lyr	54703.390±0.005	-0.004	59045.	C
TW Her	54678.465±0.005	-0.011	82916.	C	AW Lyr	54696.426±0.004	-0.004	59031.	C
TW Her	54682.460±0.003	-0.012	82926.	C	CN Lyr	54659.425±0.003	0.018	24729.	C
TW Her	54684.457±0.004	-0.013	82931.	C	CN Lyr	54682.463±0.005	0.018	24785.	C
TW Her	54704.439±0.003	-0.011	82981.	C	CN Lyr	54696.454±0.003	0.022	24819.	C
VZ Her	54661.433±0.002	0.066	40589.	C	CN Lyr	54703.448±0.003	0.023	24836.	C
VZ Her	54672.442±0.004	0.067	40614.	C	CN Lyr	54717.429±0.003	0.017	24870.	C
VZ Her	54687.413±0.002	0.067	40648.	C	CN Lyr	54722.365±0.004	0.016	24882.	C
VZ Her	54694.458±0.002	0.067	40664.	C	CN Lyr	54729.360±0.003	0.018	24899.	C
AR Her	54683.436±0.002	-1.259	28148.	C	CN Lyr	54736.353±0.003	0.017	24916.	C
AR Her	54684.375±0.002	-1.260	28150.	C	IO Lyr	54664.489±0.002	-0.033	26070.	C

Table 1 (cont.): maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
IO Lyr	54686.420±0.002	-0.033	26108.	C	ET Peg	54744.292±0.002	-0.047	32130.	C
IO Lyr	54694.498±0.003	-0.035	26122.	C	ET Peg	54758.494±0.002	-0.051	32159.	C
IO Lyr	54697.383±0.002	-0.035	26127.	C	AR Per	54743.604±0.002	0.055	64638.	C
IO Lyr	54712.389±0.004	-0.035	26153.	C	AR Per	54752.545±0.005	0.059	64659.	C
IO Lyr	54727.391±0.002	-0.038	26179.	C	AR Per	54788.289±0.002	0.057	64743.	C
NR Lyr	54669.423±0.004	-0.024	27257.	C	AR Per	54797.649±0.003	0.055	64765.	C
NR Lyr	54742.398±0.003	-0.026	27364.	C	AR Per	54808.288±0.003	0.056	64790.	C
V340 Lyr	54688.388±0.004	-0.040	42402.	C	AR Per	54828.290±0.003	0.057	64837.	C
V340 Lyr	54709.426±0.003	-0.043	42438.	C	TZ Phe	54775.750±0.010			LS
AV Men	54810.632±0.004			LS	TZ Phe	54780.674±0.010			LS
DV Mon	54823.676±0.002	0.075	71547.	LS	TZ Phe	54788.674±0.006			LS
DY Oct	54808.728±0.003			LS	U Pic	54777.677±0.002	0.062	29773.	LS
DY Oct	54809.841±0.002			LS	U Pic	54781.640±0.001	0.061	29782.	LS
DY Oct	54823.795±0.003			LS	U Pic	54788.687±0.004	0.063	29798.	LS
DZ Oct	54810.797±0.004			LS	U Pic	54802.777±0.002	0.061	29830.	LS
DZ Oct	54824.646±0.003			LS	U Pic	54803.660±0.002	0.063	29832.	LS
DZ Oct	54825.601±0.003			LS	XX Pup	54823.766±0.004	0.483	25233.	LS
V455 Oph	54657.461±0.004	-0.264	28253.	C	CR Pup	54807.677±0.006	-0.321	38222.	LS
V455 Oph	54682.424±0.003	-0.266	28308.	C	HH Pup	54787.736±0.003	0.010	41683.	LS
CM Ori	54807.708±0.006	-0.020	44989.	LS	HH Pup	54807.664±0.002	0.010	41734.	LS
CM Ori	54824.764±0.002	-0.018	45015.	LS	HH Pup	54823.686±0.002	0.012	41775.	LS
V964 Ori	54790.626±0.002	-0.401	46152.	LS	X Ret	54783.827±0.002	0.206	31190.	LS
V964 Ori	54791.635±0.003	-0.401	46154.	LS	X Ret	54787.765±0.003	0.208	31198.	LS
V964 Ori	54792.644±0.004	-0.401	46156.	LS	X Ret	54788.751±0.003	0.210	31200.	LS
V964 Ori	54801.728±0.002	-0.401	46174.	LS	X Ret	54790.716±0.003	0.207	31204.	LS
V964 Ori	54802.739±0.003	-0.399	46176.	LS	X Ret	54823.672±0.002	0.200	31271.	LS
TY Pav	54650.846±0.005	0.257	18466.	LS	V756 Sgr	54650.642±0.002	0.098	48125.	LS
VV Peg	54676.453±0.003	-0.026	31301.	C	VW Scl	54781.574±0.002	-0.016	52792.	LS
VV Peg	54717.478±0.001	-0.025	31385.	C	VW Scl	54783.618±0.002	-0.015	52796.	LS
VV Peg	54739.457±0.002	-0.024	31430.	C	VX Scl	54793.675±0.003	-0.746	20680.	LS
VV Peg	54767.296±0.002	-0.023	31487.	C	AE Scl	54777.673±0.005	0.225	24650.	LS
VV Peg	54787.318±0.001	-0.024	31528.	C	AE Scl	54782.626±0.003	0.227	24659.	LS
AV Peg	54676.420±0.003	0.115	27886.	C	AE Scl	54788.677±0.003	0.227	24670.	LS
AV Peg	54683.448±0.002	0.116	27904.	C	AE Scl	54793.625±0.002	0.224	24679.	LS
AV Peg	54692.425±0.002	0.115	27927.	C	SS Tau	54804.728±0.005	0.416	42634.	LS
AV Peg	54702.579±0.003	0.119	27953.	C	W Tuc	54775.613±0.003	0.162	27867.	LS
AV Peg	54720.535±0.004	0.118	27999.	C	W Tuc	54780.757±0.005	0.168	27875.	LS
AV Peg	54754.497±0.002	0.117	28086.	C	W Tuc	54782.682±0.003	0.166	27878.	LS
AV Peg	54787.289±0.002	0.118	28170.	C	W Tuc	54784.606±0.002	0.164	27881.	LS
AV Peg	54794.317±0.003	0.119	28188.	C	W Tuc	54807.724±0.003	0.161	27917.	LS
BF Peg	54745.471±0.003	-0.056	23767.	C	YY Tuc	54778.604±0.002	0.166	20289.	LS
BH Peg	54678.519±0.008	-0.084	23890.	C	AE Tuc	54776.676±0.005	-0.066	49482.	LS
BH Peg	54791.310±0.005	-0.108	24066.	C	AE Tuc	54779.578±0.001	-0.065	49489.	LS
CG Peg	54687.479±0.004	-0.049	33363.	C	AE Tuc	54781.650±0.001	-0.065	49494.	LS
CG Peg	54702.427±0.002	-0.049	33395.	C	AE Tuc	54790.770±0.002	-0.060	49516.	LS
CG Peg	54717.377±0.002	-0.048	33427.	C	AE Tuc	54791.598±0.001	-0.061	49518.	LS
CG Peg	54744.476±0.004	-0.043	33485.	C	AE Tuc	54793.671±0.002	-0.060	49523.	LS
CG Peg	54758.483±0.002	-0.050	33515.	C	AB UMa	54820.657±0.010	0.134	31010.	C
CG Peg	54788.379±0.003	-0.051	33579.	C	AB UMa	54829.639±0.005	0.123	31025.	C
CV Peg	54796.244±0.003	-0.056	53389.	C	EX UMa	54791.467±0.005	0.035	10645.	C
DZ Peg	54681.465±0.002	0.161	34231.	C	EX UMa	54818.597±0.004	0.023	10695.	C
DZ Peg	54729.457±0.005	0.173	34310.	C	KT UMa	54819.548±0.004	0.042	9172.	C
DZ Peg	54746.447±0.002	0.157	34338.	C	SV Vol	54791.692±0.003	0.098	34476.	LS
DZ Peg	54766.490±0.002	0.158	34371.	C	SV Vol	54794.741±0.003	0.119	34484.	LS
DZ Peg	54788.357±0.003	0.161	34407.	C	SV Vol	54802.669±0.002	0.099	34505.	LS
ET Peg	54665.432±0.004	-0.044	31969.	C	SV Vol	54805.723±0.003	0.124	34513.	LS

Table 1 (cont.): maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
SV Vol	54808.772±0.003	0.145	34521.	LS	BN Vul	54729.366±0.002	0.064	15483.	C
SV Vol	54824.635±0.002	0.112	34563.	LS	BN Vul	54751.349±0.002	0.064	15520.	C
BN Vul	54679.458±0.005	0.063	15399.	C					

* C = Calern, LS = La Silla
1 Meinunger, 1984
2 Boninsegna, 1990
3 Baldwin and Samolyk, 2003
4 Agerer and Moschner, 1996

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PHOTOMETRIC OBSERVATIONS OF HIGH-AMPLITUDE DELTA SCUTI STARS

WILS, PATRICK[1]; KLEIDIS, STELIOS[2,3]; HAMBSCH, FRANZ-JOSEF[1,4]; VIDAL-SÁINZ, JOAQUIN[5]; VANLEENHOVE, MAARTEN[1]; LAMPENS, PATRICIA[6,7]; VAN CAUTEREN, PAUL[1,7]; ROBERTSON, C.W.[8]; STAELS, BART[1,9]; PICKARD, ROGER D.[10]; ROZAKIS, IOANNIS [2,3]; DUFOER, SJOERD[1]; GROENENDAELS, ROGER; GÓMEZ-FORRELLAD, JOSEP M.[5]; GARCÍA-MELENDO, ENRIQUE[11]; HAUTECLER, HUBERT[1]; VAN DER LOOY, JOHAN[1]

[1] Vereniging Voor Sterrenkunde, Belgium; e-mail: `patrickwils@yahoo.com`

[2] Zagori Observatory, Epirus, Greece

[3] Helliniki Astronomiki Enosi, Athens, Greece

[4] Bundesdeutsche Arbeitsgemeinschaft für Veränderliche Sterne e.V. Germany

[5] Grup d'Estudis Astronòmics, Spain

[6] Royal Observatory of Belgium, Brussels, Belgium

[7] Beersel Hills Observatory, Beersel, Belgium

[8] SETEC Observatory, Goddard, Kansas, USA

[9] Center for Backyard Astrophysics

[10] British Astronomical Association, UK

[11] Esteve Duran Observatory, Seva, Spain

The period evolution of High-Amplitude Delta Scuti Stars (HADS) is not well understood. Stellar evolution theory predicts an increasing period (Breger & Pamyatnykh, 1998), but also decreasing periods are possible during short times, and have been observed. Breger & Pamyatnykh (1998) suggest that most period changes in δ Scuti stars are caused by non-linear effects in pulsation and not to evolution. Furthermore it is not clear whether changes in period occur monotonously or in contrast abruptly with constant periods in between changes. The observational records are often too fragmented to decide between the two scenarios. Also detecting light time effects due to companions is of interest to better determine the pulsator's mass and understand its evolution. It is therefore important to regularly obtain accurate data to monitor the period behaviour of HADS.

In most cases times of maximum light are used for period studies. These are calculated from the observations using a variety of methods (often with polynomial fitting). The calculated times are usually based on data points close to maximum, while data from the rest of the cycle are ignored. Depending on the calculation method used (e.g. the degree of the fitted polynomial) and the selected data points, this often leads to a fairly large spread in the calculated times, larger than the quoted uncertainties. Higher accuracy can however be obtained when all the available observations are used, especially data from the ascending and descending branches of the light curve, as there the variation is largest per time unit.

Table 1: Details on the observed HADS without GCVS designation.

Star	Position (2000)		Mag. NSVS	Epoch HJD	Period (d)
GSC 4519-1078	04:57:20.99	+79:20:58.7	11.8-12.2	2454823.415	0.140316(2)
GSC 3755-0845	06:05:01.84	+55:09:51.9	10.4-10.7	2454201.293	0.07609773(1)
GSC 2977-0238	08:19:17.58	+41:59:00.5	10.6-11.0	2454204.343	0.07593393(5)
GSC 4552-1498	11:24:25.47	+77:42:15.3	12.9-13.4	2453321.535	0.05581096(1)
GSC 3832-0152	11:48:42.04	+54:43:07.1	11.7-12.1	2453489.290	0.09134218(2)
GSC 4556-1113	12:03:17.41	+80:33:42.4	11.5-11.9	2453813.332	0.086337(3)
GSC 3863-0740	14:41:38.23	+56:26:17.3	11.4-11.7	2453795.423	0.197702(2)
GSC 2566-1398	15:22:21.52	+32:58:45.6	11.9-12.3	2453896.456	0.0907090(1)
GSC 3074-0114	16:41:06.83	+40:42:26.3	13.8-14.5	2454138.969	0.05130(1)
GSC 3934-1904	19:39:55.94	+52:35:09.8	10.9-11.2	2453924.403	0.1092685(1)

The times of maximum light presented in this study are therefore calculated as follows. First an average light curve profile (Fourier series) for each star has been created using Period04 (Lenz & Breger, 2005), independently for each filter. As all the stars in the present study are single-mode radial pulsators, without noticeable changes in the light curve from cycle to cycle, these average light curve profiles can then be used to fit the observations of individual cycles, by shifting them in time (and magnitude if another comparison star has been chosen). Using this method a highly accurate and consistent determination of the time of maximum is possible, as data from at least half a cycle, and in the majority of cases a full cycle, are used in the fitting process.

The average profiles of the stars covered in this paper are available electronically. The uncertainty on the timings is measured by the average squared difference in time between the data points and the fitted light curve profile. This gives a measure of the width of the observed light curve. Changing the time of maximum by the quoted uncertainty makes the observations deviate clearly from the average profile, so that this uncertainty gives a realistic indication of the precision of the timing.

Some of the HADS for which observations are reported in this paper were found during a search for RR Lyrae stars (Wils, Lloyd & Bernhard, 2006) in the data of the Northern Sky Variability Survey (NSVS; Woźniak et al., 2004). Details of these stars are listed in Table 1. Uncertainties on the period are given between parentheses in units of the last decimal. It is impossible to distinguish between Population I and Population II (SX Phe) stars based on photometric data alone, so this distinction has not been made here. GSC 3074-0114 and GSC 4519-1078 were found independently by Khruslov (2006a,b), classifying the latter as an SX Phe star. GSC 4556-1113 was also found by Gregor Srdoc (AAVSO VSX). Phased light curves for the stars from Table 1 are shown in Fig. 1. GSC 3755-0845 has a fairly unusual light curve for a HADS with humps on both the ascending and the descending branch. GSC 3074-0114 has a peculiar bump near minimum.

The observers and their instruments are given in Table 2. The 271 times of maximum obtained for 19 HADS are listed in Table 3. When more than one filter was used, the times calculated per filter were averaged to get a single timing. One of the stars, GSC 2977-0238, seems to show a highly variable period. Its O-C curve is given in Fig. 3.

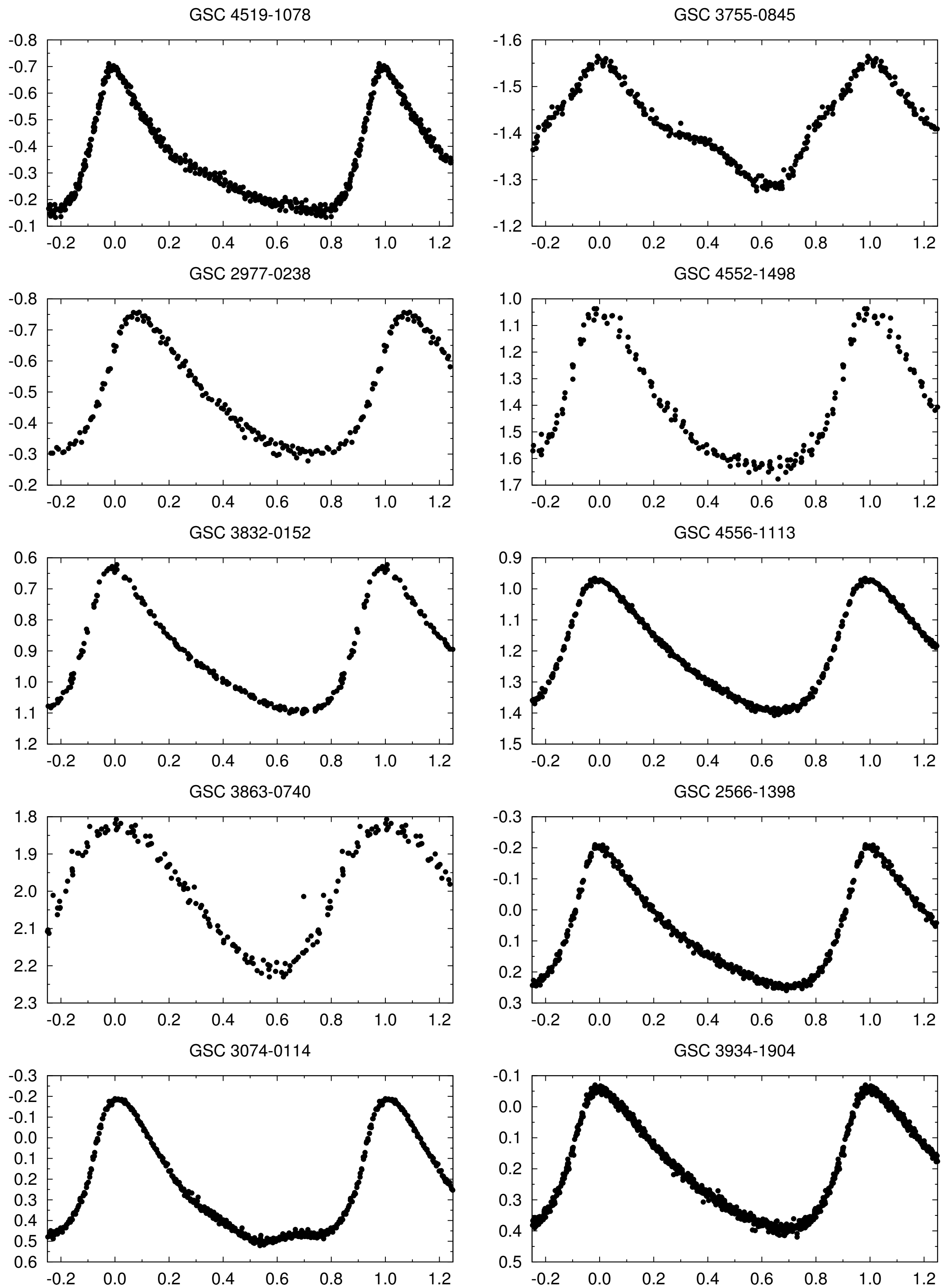

Figure 1. Phased V light curves for nine the stars from Table 1 and an unfiltered light curve of GSC 3074-0114. On the y axis differential magnitudes with respect to a comparison star are shown.

Table 2: List of instruments used for the observations.

Initials	Telescope type	Aperture	Observatory	CCD
SK	Catadioptric	30 cm	Zagori Observatory	SBIG ST-7XMEI
HMB	Cassegrain	35 cm	Mol, Belgium	SBIG ST-8
HMB2	Ritchey-Chrétien	50 cm	New Mexico, USA	STL11000XM
JVS	Newton	41 cm	Monegrillo Observatory	SX Starlight
MVL	Catadioptric	26 cm	Willebroek Observatory	SBIG ST-10XME
PL&PVC (HO)	Refractor	13 cm	R.O.B.-Humain	SBIG ST-10XME
PL&PVC (BHO)	Newton	40 cm	Beersel Hills Observatory	SBIG ST-10XME
PL&PVC (BHO2)	Refractor	18 cm	Beersel Hills Observatory	SBIG ST-10XME
CWR	Catadioptric	30 cm	SETEC Observatory	SBIG ST-8
SBL	Cassegrain	28 & 23.5 cm	Alan Guth Observatory	Starlight XPress MX-716
RP	Catadioptric	30 cm	Shobdon, UK	Starlight XPress MX7
IR	Catadioptric	35 cm	Zagori Observatory	SBIG ST-7XMEI
SD	Refractor	8 cm	Oostkamp, Belgium	SBIG ST-10XME
RG	Catadioptric	30 cm	Dworp, Belgium	Hisis24

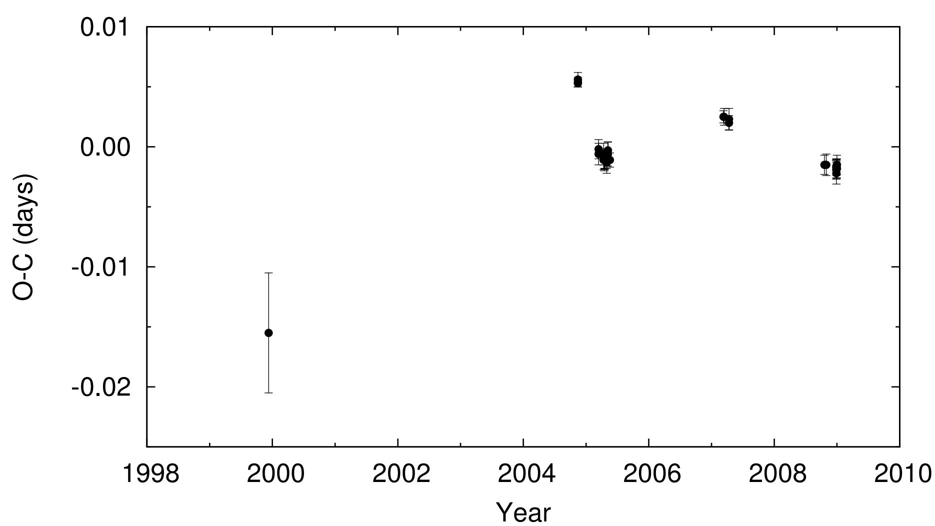

Figure 2. O-C curve of GSC 2977-0238 with respect to the elements given in Table 3. The first point was derived from NSVS data (Woźniak et al., 2004).

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Table 3: Observed times of maximum (Epoch = HJD - 2400000).

Star*	Epoch	Unc.	Obs.	Filter	Star	Epoch	Unc.	Obs.	Filter
GP And	54713.4600	0.0007	HMB	V	G 2566-1398	53913.4191	0.0007	SK	V,I_C
GP And	54827.2354	0.0006	MVL	V	G 2566-1398	53916.3220	0.0008	SK	V,I_C
GP And	54827.3142	0.0006	MVL	V	G 2566-1398	53916.4127	0.0009	SK	V,I_C
GP And	54827.3929	0.0006	MVL	V	G 2566-1398	53916.5029	0.0009	SK	V
GP And	54827.4716	0.0006	MVL	V	G 2566-1398	54170.4883	0.0007	HMB	V
V460 And	54135.3080	0.0006	RP	V	G 2566-1398	54170.5788	0.0006	HMB	V
V460 And	54135.3831	0.0006	RP	V	G 2566-1398	54170.6697	0.0006	HMB	V
V460 And	54355.5266	0.0007	SK	V	G 2566-1398	54171.4865	0.0007	HMB	V,I_C
V460 And	54355.6013	0.0007	SK	V	G 2566-1398	54171.5767	0.0008	HMB	V,I_C
V460 And	54391.4424	0.0008	SK	V	G 2566-1398	54171.6673	0.0006	HMB	V
V460 And	54391.5180	0.0008	SK	V	G 2566-1398	54172.4840	0.0007	HMB	V,I_C
V460 And	54391.5923	0.0008	SK	V	G 2566-1398	54172.5748	0.0007	HMB	V,I_C
XX Cyg	54649.4459	0.0008	SBL	V	G 2566-1398	54172.6650	0.0007	HMB	V
XX Cyg	54649.5806	0.0008	SBL	V	G 2977-0238	53321.5406	0.0003	BHO	V
XX Cyg	54728.3420	0.0008	MVL	V	G 2977-0238	53321.6166	0.0004	BHO	V
XX Cyg	54728.4768	0.0007	MVL	V	G 2977-0238	53321.6927	0.0006	BHO	V
XX Cyg	54729.4208	0.0008	MVL	V	G 2977-0238	53444.1680	0.0009	SK	V
XX Cyg	54729.5558	0.0008	MVL	V	G 2977-0238	53444.2443	0.0008	SK	V
V2455 Cyg	54357.5561	0.0001	SK	B	G 2977-0238	53473.2502	0.0008	SK	V
V2455 Cyg	54642.4354	0.0003	HO	B	G 2977-0238	53473.3266	0.0009	SK	V
V2455 Cyg	54642.5296	0.0003	HO	B	G 2977-0238	53476.2117	0.0008	SK	V
V2455 Cyg	54646.4860	0.0006	SD	V	G 2977-0238	53476.2875	0.0009	SK	V
V2455 Cyg	54652.5157	0.0007	SBL	V	G 2977-0238	53481.2232	0.0008	SK	V
V2455 Cyg	54694.4383	0.0006	SD	V	G 2977-0238	53481.2992	0.0007	SK	V
V2455 Cyg	54694.5327	0.0006	SD	V	G 2977-0238	53492.2336	0.0007	SK	V
V2455 Cyg	54702.4879	0.0022	SBL	V	G 2977-0238	53492.3094	0.0009	SK	V
V2455 Cyg	54730.3298	0.0003	MVL	V	G 2977-0238	53499.2204	0.0007	SK	V
V2455 Cyg	54730.4239	0.0004	MVL	V	G 2977-0238	53499.2960	0.0010	SK	V
V2455 Cyg	54730.5182	0.0005	MVL	V	G 2977-0238	53508.2557	0.0006	SK	V
V2455 Cyg	54730.6126	0.0005	MVL	V	G 2977-0238	54172.4534	0.0005	RP	V
V2455 Cyg	54758.4031	0.0009	MVL	V	G 2977-0238	54172.5293	0.0007	RP	V
V2455 Cyg	54758.4973	0.0009	MVL	V	G 2977-0238	54204.2692	0.0006	SK	V
V2455 Cyg	54759.3447	0.0008	MVL	V	G 2977-0238	54204.3455	0.0009	SK	V
V2455 Cyg	54759.4389	0.0009	MVL	V	G 2977-0238	54759.5706	0.0008	BHO2	V
V2455 Cyg	54759.5332	0.0007	MVL	V	G 2977-0238	54768.6067	0.0009	BHO2	V
LW Dra	54369.4051	0.0007	SK	V	G 2977-0238	54827.3794	0.0007	HMB	V
DY Her	54648.5619	0.0008	MVL	V	G 2977-0238	54827.4551	0.0008	HMB	V
DY Her	54672.4912	0.0008	MVL	V	G 2977-0238	54827.5310	0.0008	MVL	V
KZ Lac	52145.5531	0.0008	RG	-	G 2977-0238	54827.5313	0.0006	HMB	V
KZ Lac	52205.3842	0.0006	RG	-	G 2977-0238	54827.6067	0.0009	MVL	V
KZ Lac	52224.4928	0.0008	RG	-	G 2977-0238	54827.6070	0.0007	HMB	V
V593 Lyr	54339.3819	0.0007	HMB	V,R	G 2977-0238	54827.6831	0.0006	HMB	V
V593 Lyr	54339.4840	0.0008	HMB	V,R	G 2977-0238	54831.5556	0.0008	MVL	V
V593 Lyr	54339.5861	0.0005	HMB	V,R	G 2977-0238	54831.6319	0.0008	MVL	V
DY Peg	54728.4433	0.0007	HO	V	G 3074-0114	54138.9693	0.0005	HMB2	-
DY Peg	54729.3912	0.0006	BHO2	V	G 3074-0114	54139.9952	0.0005	HMB2	-
DY Peg	54729.4644	0.0004	BHO2	V	G 3074-0114	54140.9699	0.0005	HMB2	-
DY Peg	54739.3530	0.0007	SBL	V	G 3755-0845	53365.3601	0.0011	SK	V
DY Peg	54739.4258	0.0007	SBL	V	G 3755-0845	53365.4353	0.0008	SK	V
DY Peg	54808.2977	0.0007	MVL	V	G 3755-0845	53389.4068	0.0008	SK	V
DY Peg	54808.3708	0.0009	MVL	V	G 3755-0845	53389.4825	0.0008	SK	V
G 2566-1398	53896.4564	0.0009	SK	V,I_C	G 3755-0845	53389.5588	0.0008	SK	V
G 2566-1398	53896.5470	0.0011	SK	V,I_C	G 3755-0845	53405.6915	0.0007	CWR	V
G 2566-1398	53903.3501	0.0008	SK	V,I_C	G 3755-0845	53419.6952	0.0016	CWR	V
G 2566-1398	53903.4409	0.0007	SK	V,I_C	G 3755-0845	53419.7698	0.0009	CWR	V
G 2566-1398	53903.5316	0.0007	SK	V	G 3755-0845	53419.8451	0.0008	CWR	V
G 2566-1398	53907.3409	0.0009	SK	V	G 3755-0845	53426.3140	0.0008	SK	V
G 2566-1398	53909.3376	0.0009	SK	V,I_C	G 3755-0845	53426.3902	0.0009	SK	V
G 2566-1398	53909.4277	0.0007	SK	V,I_C	G 3755-0845	53426.6189	0.0007	CWR	V
G 2566-1398	53909.5187	0.0009	SK	V	G 3755-0845	53426.7704	0.0007	CWR	V

* G xxxx-xxxx denotes GSC identifiers.

Table 3: Observed times of maximum (continued).

Star*	Epoch	Unc.	Obs.	Filter	Star	Epoch	Unc.	Obs.	Filter
G 3755-0845	53426.8469	0.0011	CWR	V	G 3832-0152	53510.4814	0.0007	JVS	R
G 3755-0845	53430.6517	0.0006	CWR	V	G 3832-0152	53513.3129	0.0008	SK	V
G 3755-0845	53430.7276	0.0007	CWR	V	G 3832-0152	53518.4282	0.0007	JVS	R
G 3755-0845	53430.8037	0.0006	CWR	V	G 3832-0152	53526.3747	0.0007	SK	V
G 3755-0845	53433.6193	0.0004	CWR	V	G 3832-0152	53528.3843	0.0008	IR	V
G 3755-0845	53433.6972	0.0014	CWR	V	G 3832-0152	53529.3890	0.0007	JVS	R
G 3755-0845	53433.7732	0.0015	CWR	V	G 3832-0152	53529.4805	0.0008	JVS	R
G 3755-0845	53441.3060	0.0008	SK	V	G 3832-0152	53530.3938	0.0008	JVS	R
G 3755-0845	53441.3812	0.0008	SK	V	G 3832-0152	53530.4851	0.0007	JVS	R
G 3755-0845	53468.6244	0.0004	CWR	V	G 3832-0152	53531.3071	0.0008	SK	V
G 3755-0845	54137.2956	0.0012	RP	V	G 3832-0152	53531.3983	0.0006	SK	V
G 3755-0845	54137.3714	0.0009	RP	V	G 3832-0152	53531.3986	0.0008	JVS	R
G 3755-0845	54201.2933	0.0007	SK	B,V	G 3832-0152	53531.4898	0.0006	JVS	R
G 3755-0845	54728.5743	0.0009	HO	V	G 3832-0152	53536.4221	0.0006	JVS	B
G 3755-0845	54827.2735	0.0009	HMB	V	G 3832-0152	53539.4368	0.0008	JVS	B
G 3755-0845	54827.3498	0.0008	HMB	V	G 3832-0152	53540.4411	0.0007	JVS	B
G 3755-0845	54827.3504	0.0008	SBL	V	G 3832-0152	53541.3550	0.0005	SK	V
G 3755-0845	54827.4265	0.0008	SBL	V	G 3832-0152	53541.4462	0.0006	SK	V
G 3755-0845	54827.5022	0.0009	HMB	V	G 3832-0152	53545.2820	0.0007	SK	V
G 3755-0845	54827.5025	0.0008	SBL	V	G 3832-0152	53545.3743	0.0006	SK	V
G 3755-0845	54827.5778	0.0009	HMB	V	G 3832-0152	53553.4116	0.0009	JVS	I
G 3755-0845	54827.6537	0.0008	HMB	V	G 3832-0152	53554.4173	0.0008	JVS	I
G 3755-0845	54828.2629	0.0009	HMB	V	G 3832-0152	54174.4476	0.0008	RP	V
G 3755-0845	54828.3381	0.0010	HMB	V	G 3832-0152	54174.5388	0.0006	RP	V
G 3755-0845	54828.4146	0.0008	HMB	V	G 3832-0152	54203.3114	0.0008	SK	V
G 3755-0845	54828.4910	0.0008	HMB	V	G 3863-0740	53795.4228	0.0007	SK	BV,I_C
G 3755-0845	54828.5671	0.0008	HMB	V	G 3863-0740	53795.6202	0.0006	SK	B,V,I_C
G 3755-0845	54828.6425	0.0008	HMB	V	G 3863-0740	53799.5740	0.0005	SK	B,V,I_C
G 3755-0845	54828.7190	0.0008	HMB	V	G 3863-0740	53815.3908	0.0006	SK	B,I_C
G 3755-0845	54830.2411	0.0008	HMB	V	G 3863-0740	53815.5884	0.0006	SK	B,V,I_C
G 3755-0845	54830.3169	0.0008	HMB	V	G 3863-0740	53821.5215	0.0006	SK	B,V,I_C
G 3755-0845	54830.6219	0.0009	HMB	V	G 3863-0740	53826.4626	0.0006	SK	B,V,I_C
G 3755-0845	54830.6976	0.0009	HMB	V	G 3863-0740	53835.7536	0.0007	CWR	V
G 3755-0845	54831.2302	0.0010	HMB	V	G 3863-0740	53838.7197	0.0006	CWR	V
G 3755-0845	54831.3064	0.0008	HMB	V	G 3863-0740	53842.6732	0.0008	CWR	V
G 3755-0845	54831.3827	0.0008	HMB	V	G 3863-0740	53842.8700	0.0006	CWR	V
G 3755-0845	54838.3074	0.0008	MVL	V	G 3863-0740	53843.6649	0.0006	CWR	V
G 3755-0845	54838.3834	0.0008	MVL	V	G 3863-0740	53843.8599	0.0006	CWR	V
G 3832-0152	53474.4005	0.0005	JVS	V	G 3863-0740	53845.6379	0.0008	CWR	V
G 3832-0152	53479.4247	0.0007	JVS	V	G 3863-0740	53845.8361	0.0007	CWR	V
G 3832-0152	53487.3715	0.0006	JVS	V	G 3934-1904	53924.4033	0.0008	SK	B,V,I_C
G 3832-0152	53487.4630	0.0009	JVS	V	G 3934-1904	53924.5124	0.0008	SK	B,V,I_C
G 3832-0152	53488.3764	0.0007	JVS	V	G 3934-1904	53931.3966	0.0007	SK	B,V,I_C
G 3832-0152	53488.4679	0.0008	JVS	V	G 3934-1904	53931.5057	0.0008	SK	B,V,I_C
G 3832-0152	53488.5586	0.0008	JVS	V	G 3934-1904	53935.3304	0.0008	SK	B,V,I_C
G 3832-0152	53489.2894	0.0006	SK	V	G 3934-1904	53935.4395	0.0009	SK	B,V,I_C
G 3832-0152	53489.3807	0.0007	SK	V	G 3934-1904	53941.3401	0.0008	SK	B,V,I_C
G 3832-0152	53489.3810	0.0008	JVS	I	G 3934-1904	53941.4491	0.0007	SK	B,V,I_C
G 3832-0152	53489.4720	0.0007	SK	V	G 3934-1904	53941.5586	0.0008	SK	B,I_C
G 3832-0152	53489.4723	0.0009	JVS	I	G 3934-1904	53944.3994	0.0008	SK	B,V,I_C
G 3832-0152	53489.5639	0.0006	JVS	I	G 3934-1904	53944.5084	0.0009	SK	B,V,I_C
G 3832-0152	53489.5640	0.0006	SK	V	G 3934-1904	53944.6177	0.0005	SK	V
G 3832-0152	53496.4141	0.0009	JVS	I	G 3934-1904	54368.6888	0.0009	HMB2	-
G 3832-0152	53496.5057	0.0008	JVS	I	G 3934-1904	54370.6557	0.0008	HMB2	-
G 3832-0152	53496.5973	0.0008	JVS	I	G 3934-1904	54376.6654	0.0008	HMB2	-
G 3832-0152	53497.4195	0.0008	JVS	I	G 3934-1904	54377.6487	0.0008	HMB2	-
G 3832-0152	53497.5107	0.0008	JVS	I	G 3934-1904	54379.6158	0.0007	HMB2	-
G 3832-0152	53497.6026	0.0007	JVS	I	G 3934-1904	54380.5989	0.0008	HMB2	-
G 3832-0152	53500.3420	0.0008	SK	V	G 3934-1904	54380.7083	0.0007	HMB2	-
G 3832-0152	53510.3902	0.0007	JVS	R	G 3934-1904	54649.5086	0.0008	HMB	V

* G xxxx-xxxx denotes GSC identifiers.

Table 3: Observed times of maximum (continued).

Star*	Epoch	Unc.	Obs.	Filter
G 3934-1904	54708.4470	0.0007	SBL	V
G 4519-1078	54823.4146	0.0010	HMB	V
G 4519-1078	54827.3435	0.0007	HMB	V
G 4519-1078	54828.3257	0.0008	HMB	V
G 4519-1078	54828.4660	0.0008	HMB	V
G 4519-1078	54830.4304	0.0007	HMB	V
G 4519-1078	54830.5709	0.0006	HMB	V
G 4519-1078	54830.7109	0.0009	HMB	V
G 4552-1498	53321.5354	0.0007	BHO	V
G 4552-1498	53321.5912	0.0006	BHO	V
G 4552-1498	53321.6474	0.0007	BHO	V
G 4552-1498	53321.7025	0.0007	BHO	V
G 4552-1498	53534.3983	0.0006	IR	V
G 4552-1498	53534.4543	0.0008	IR	V
G 4552-1498	53792.3008	0.0010	BHO	V
G 4552-1498	53792.3566	0.0013	BHO	V
G 4552-1498	53810.3273	0.0005	BHO	V
G 4552-1498	53810.3832	0.0006	BHO	V
G 4552-1498	53810.4388	0.0005	BHO	V
G 4552-1498	54172.3734	0.0006	HMB	V,R
G 4552-1498	54172.4290	0.0006	HMB	V,R
G 4552-1498	54172.4855	0.0007	HMB	V,R
G 4552-1498	54172.5407	0.0007	HMB	V,R
G 4552-1498	54172.5965	0.0007	HMB	V,R
G 4552-1498	54172.6521	0.0007	HMB	V,R
G 4552-1498	54209.3203	0.0009	IR	V
G 4552-1498	54209.3764	0.0008	IR	V
G 4556-1113	53813.3316	0.0006	BHO	V
G 4556-1113	53813.4178	0.0007	BHO	V
G 4556-1113	53814.3676	0.0006	BHO	V
G 4556-1113	53814.4539	0.0008	BHO	V

* G xxxx-xxxx denotes GSC identifiers.

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NEW PHOTOMETRY OF BLUE STRAGGLERS IN FOUR GALACTIC OPEN CLUSTERS

TAŞ, GÜNAY; EVREN, SERDAR; ÖZDARCAN, ORKUN; DAL, HASAN A.; SİPAHİ, ESİN

Ege University Observatory, 35100 Bornova - İzmir - TURKEY

Blue straggler stars are very interesting subjects according to the stellar evolution theory. The appearance of the stars is not expected on the main-sequence and on the bluer side of the cluster turn-off point according to the standard evolution theory. Although there are some scenarios that have tried to clarify their locations on the H-R diagram, their origins are still considered as uncertain. In this context, the variation mechanisms of blue stragglers can provide a clue to explain their existence and to derive their physical parameters. Hrivnak (1977), Lapasset and Ahumada (1996), Mateo (1993), Maitzen et al. (1981) can be given as example studies to such attempts. The locations of stars in color-magnitude and color-color diagrams are significant to determine the photometrical cluster membership probability of the stars but a more accurate photometry is needed. Hence, we initiated an observation program for blue straggler stars of four galactic open clusters. The observations were carried out with a 48-cm Cassegrain telescope equipped with a three-channel photometer, using broad-band Johnson UBV filters, at Ege University Observatory during the 2006-2007 observing season. The blue straggler stars, which catalogued in WEBDA database for four open clusters, namely IC 4725, Melotte 111, NGC 1342 and NGC 6871, were observed with the comparison stars chosen from same clusters. The observations were reduced from the effects of atmospheric extinction; and then heliocentric corrections to the observing times were applied. The standard stars with appropriate color and brightness, taken from the lists of Landolt (1992) and Harmanec et al. (1994), were used for transformation to the standard system. The galactic and equatorial coordinates (from SIMBAD) and $E(B-V)$ color excesses (from WEBDA) of the four open clusters can be seen in Table 1.

Table 1. Coordinates and $B-V$ color excesses of the four open clusters.

	Galactic coordinates		Equatorial coordinates		
Cluster	l (°)	b (°)	RA (2000) (h m)	DEC (2000) (° ′)	$E(B-V)$ (mag)
IC 4725	13.69	−04.42	18 32	−19 07	0.476
Melotte 111	222.51	+83.40	12 22	+25 50	0.013
NGC 1342	155.19	−15.12	03 33	+37 25	0.319
NGC 6871	72.65	+02.05	20 06	+35 47	0.443

We determined the interstellar reddening in the line of sight by the color-color diagram. The estimations of color excesses in $U-B$ and $B-V$ were made by using the sliding fit method and adopting the slope of the reddening line as 0.72. The results for both blue stragglers and the comparison stars are listed in Table 2. 'BS' in the fourth column (Star type) denotes blue straggler candidates listed in the WEBDA database.

Table 2. New photoelectric photometry of blue stragglers and comparison stars in four galactic open clusters.

Cluster	WEBDA No.	HD/BD No.	Star type	V (mag)	$B-V$ (mag)	$U-B$ (mag)	$E(B-V)$ (mag)	$E(U-B)$ (mag)
NGC1342	1	21773		8.490 (6)	0.416 (10)	-0.133 (13)	0.59	0.43
NGC1342	2	21728	BS	8.815 (5)	0.235 (10)	-0.142 (13)	0.35	0.26
NGC1342	3	21785	BS	9.273 (5)	0.247 (8)	0.141 (10)	0.27	0.20
NGC1342	4	275501		9.362 (6)	1.214 (11)	1.108 (16)	0.34	0.25
NGC1342	6	275509		9.652 (8)	1.109 (12)	0.895 (20)	0.28	0.20
NGC1342	7	275507		10.160 (6)	1.123 (11)	0.824 (19)	0.34	0.24
NGC1342	8	275510		10.356 (5)	0.324 (10)	0.203 (17)	0.35	0.26
NGC1342	10	275502		10.719 (7)	0.430 (11)	0.331 (17)	0.29	0.21
NGC1342	11	275508		10.669 (7)	0.390 (9)	0.224 (11)	0.20	0.14
NGC1342		275495		9.364 (5)	0.446 (9)	-0.070 (10)	0.60	0.44
NGC 6871	4	190864	BS	7.764 (4)	0.155 (9)	-0.809 (10)	0.48	0.34
NGC 6871	5	227634	BS	7.923 (9)	0.203 (14)	-0.676 (11)	0.49	0.35
NGC 6871	7	227586	BS	8.803 (6)	0.158 (11)	-0.694 (14)	0.45	0.32
NGC 6871	8	+35° 3956	BS	8.833 (6)	0.165 (15)	-0.627 (18)	0.43	0.31
NGC 6871	1163	227767		8.871 (3)	0.016 (8)	-0.816 (11)	0.31	0.22
NGC 6871	1866	191201		7.257 (4)	0.110 (9)	-0.808 (10)	0.43	0.31
Melotte 111	89	107655		6.243 (6)	0.009 (10)	-0.010 (11)	0.04	0.03
Melotte 111	136	108449		8.271 (7)	0.263 (11)	0.043 (16)	0.34	0.24
Melotte 111	139	108486		6.684 (3)	0.170 (9)	0.101 (12)	0.20	0.14
Melotte 111	146	108662	BS	5.311 (3)	-0.020 (8)	-0.150 (10)	0.05	0.03
IC 4725	6	-19° 5032		9.553 (7)	0.192 (11)	-0.140 (12)	0.31	0.22
IC 4725	50	170682	BS	7.907 (8)	0.290 (19)	-0.071 (23)	0.41	0.29
IC 4725	91	170719	BS	8.060 (12)	0.254 (20)	-0.056 (22)	0.36	0.26
IC 4725	97	-19° 5044	BS	8.724 (15)	0.320 (22)	-0.056 (21)	0.44	0.32
IC 4725	163	170835	BS	8.765 (11)	0.200 (16)	-0.480 (18)	0.43	0.31
IC 4725	167	170836	BS	8.952 (12)	0.267 (19)	-0.120 (24)	0.40	0.29
IC 4725	233	170763		8.948 (5)	0.261 (8)	-0.028 (10)	0.36	0.26

Ahumada and Lapasset (2007) suggested new criteria to select the blue straggler stars in published data in WEBDA database; and accordingly, they excluded the stars NGC 1342 1 and 10. Both stars are also listed in Table 2 to present their new photometry. On the other hand, NGC 1342 4 (HD 275501) is tabulated by its photometric values, using Ahumada and Lapasset (2007)'s study, as $V = 9\overset{m}{.}21$, $B-V = 0\overset{m}{.}24$, $U-B = 0\overset{m}{.}17$. The literature related to this star (Hoag et al. 1961, Jennens and Helfer 1975, Francic 1989, Svolopoulos 1961, Bersier 1996, Pena et al. 1994) and our observations showed that HD 275501 is a late type star. It is thought that there is a misprint; and the values mentioned above for this star were similar to those of NGC 1342 3. NGC 1342 3 is believed to be wrongly labeled as NGC 1342 4 in the catalogue of Ahumada and Lapasset (2007) since its location on the H-R diagram was more appropriate to be a blue straggler candidate. Thus, NGC 1342 3 was labeled as blue straggler star in Table 2. The means of the color excesses listed in Table 2 were calculated for each cluster and then adopted as cluster's color excess. NGC 1342 1, on the other hand, was excluded since its color excesses have a very different value than other blue stragglers in the same cluster. This can be a photometric evidence for NGC 1342 1 that it may not be a member of the cluster. Consequently, we determined $E(B-V)$ reddenings of 0.40, 0.33, 0.46, and 0.05 mag for the clusters IC 4725, NGC 1342, NGC 6871, and Melotte 111, respectively.

The photometry of stars listed in Table 2 were checked for variability. As for the long-term observations of the blue stragglers included in this study; we detected that one of them, namely HD 21728, showed light variations.

Although HD 21728 has been classified as a chemically peculiar star (e.g. Svolopoulos 1961, Young and Martin 1973, Abt 1985, Renson 1992), its photometric variation was not identified up to now. We found a light variation with a period of 5.340 days, using the Phase Dispersion Minimization Technique of PERANSO period analysis program, for the star. The amplitude of the variation was 0.04 and 0.05 mag in B and V filters, respectively. We calculated the phases of the light and color curves presented in Figure 1 using the following light elements:

$$\mathrm{HJD} = 2\,454\,048.2562 + 5\overset{\mathrm{d}}{.}340(28) \times\ \mathrm{E},$$

where T_0 is the time of first observation point and P is the period determined from period analysis of V data. The star's light curve has asymmetric shape, while its color curve does not establish a clear variation as can be seen from Figure 1. It is known that the light curve shapes of the chemically peculiar stars can change in different filters (e.g. Maitzen 1989, Adelman 1997). The determination of physical parameters of blue stragglers is significant to test their formation scenarios and to comprehend their origin. Consequently, their photometric or spectral variability is a fairly useful tool. The magnetic peculiar stars, which are member of cluster, are also very valuable objects to study their evolution (North et al. 2008). In this context, additional multicolor broad and intermediate band photometry of HD 21728 is considered as necessary for future studies.

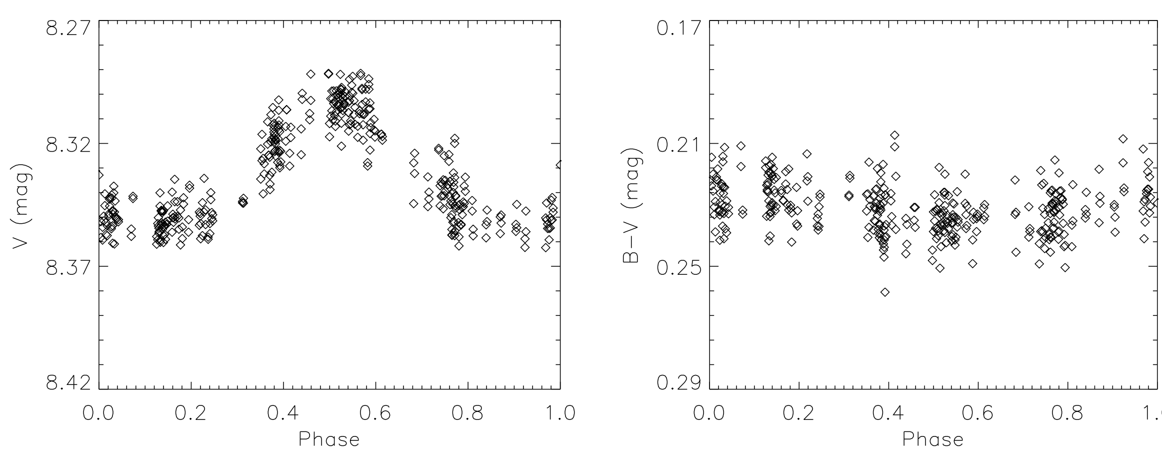

Figure 1. The first light and color curves of HD 21728.

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MW UMA, A DETACHED BINARY: OBSERVATIONS AND ANALYSIS

NELSON, ROBERT H.[1,2]

[1] 1393 Garvin Street, Prince George, BC, Canada, V2M 3Z1 e-mail: b-o-b.nelson@shaw.ca [remove dashes]

[2] Guest investigator, Dominion Astrophysical Observatory, Herzberg Institute of Astrophysics, National Research Council of Canada

While studying the optical variability of ROSAT X-ray sources, Robb et al. (2002) found MW UMa (= GSC 4153-0634 = RXJ 114302+603435) to be a detached eclipsing binary of period 1.2347 days. They presented eight CCD times of minima, photometry, a light curve in R_C (Cousins), and a classification spectrum. The spectrum and the photometry yielded approximate spectral types of F6V +F9V. The full light curves in V, R_C, and I_C were kindly forwarded to the author.

During April of 2006, the author took five high resolution (10 Å/mm reciprocal dispersion) spectra at the Dominion Astrophysical Observatory (DAO) in Victoria, British Columbia, Canada; he then used the Rucinski broadening functions (Rucinski, 2004) to obtain radial velocity (RV) curves (see Nelson, et al., 2006a for details). The spectral range was 5004-5267 Å and the reciprocal dispersion, 10 Å/mm. A log of DAO observations and RV results is presented in Table 1.

Table 1:

DAO Image #	Mid Time (HJD-2400000)	Exposure (sec)	Phase at Mid-exp	V_1 (km/s)	V_2 (km/s)
3697	53847.9490	1422	0.778	122.2	-138.4
3720	53848.9623	3600	0.599	71.5	-84.5
3729	53849.7431	3600	0.231	-124.1	134.5
3731	53849.7853	3600	0.266	-122.9	138.0
3736	53849.8639	3600	0.329	-107.4	123.1

The following elements were used for phasing throughout (see Nelson, 2006b for the O-C relation):

$$\mathrm{JD\,Hel\,Min\,I} = 52402.3277(1) + 1.23475(80)\mathrm{E}$$

The author used the 2004 version of the Wilson-Devinney (WD) light curve and radial velocity analysis program with the Kurucz atmospheres (Wilson and Devinney, 1971, Wilson, 1990, Kallrath, et al., 1998) as implemented in the Windows software WDwint (Nelson, 2005) to analyze the data. To get started, a spectral type F6V mentioned above and a temperature $T_1 = 6514 \pm 240\,\mathrm{K}$ were used; interpolated tables from Cox (2000) which gave $\log g = 4.368$ were used; an interpolation program by Terrell (1994) gave the (van Hamme, 1993) limb darkening values; and finally, a logarithmic (LD = 2) law for the extinction coefficients was selected, appropriate for cooler stars (Bessell, 1979). Convective envelopes were chosen for both stars. (Radiative envelopes were later tried as a check but gave a poorer fit.)

Mode 2 (for detached stars) was chosen based on the general appearance of the light curves. Mindful that, for detached systems, stellar size is not well constrained by the light curves (Terrell, 2009), the author determined the flux ratio based on the areas under the (well-defined) peaks in the Rucinski broadening function (see Fig. 1). This is justified (Rucinski, 2008) because the Rucinski broadening functions (Rucinski, 2004) are linear. Values were taken for all the spectra; a mean value of $\mathrm{Flux}_2/\mathrm{Flux}_1 = 0.690 \pm 0.003$ (sd of mean) was obtained. (Note that this was for a wavelength band centred at 5136 Angstroms; it was taken to represent the V band, the closest available band.)

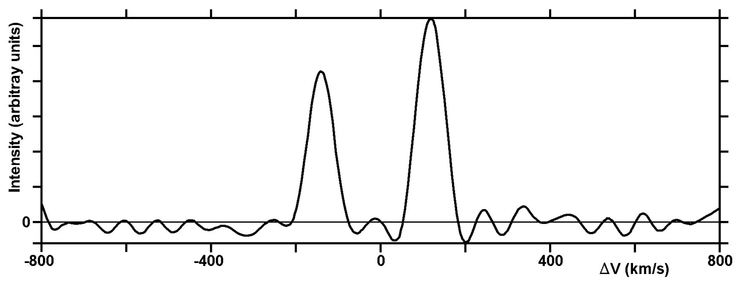

Figure 1. A Rucinski broadening function for MW UMa, image #3697.

During modelling, convergence was attained through the method of adjusting sets of uncorrelated parameters (fixed parameters are given in Table 2). In particular, the mass ratio $q = M_2/M_1$ was held fixed because this value (0.886 ± 0.003) was well determined from the RV curves; in contrast, it is not well constrained from the photometric data. Various starting values of Ω_1 were used and the DC procedure followed through to a best solution. The resultant flux ratios $= L_2/L_1$ were then found and compared to the required value of 0.690. In this way, the optimal value for Ω_1 was found and a consistent solution found.

To investigate the situation further, the author made use of a contour-plotting routine in WDwint in which the best model served as the starting point, after which the program varied two parameters – in this case, Ω_1 and Ω_2 (the surface potentials of stars 1 and 2, resp.) – over a matrix of 100 preset values. For each value of these two parameters, it searched for a best fit varying other selected parameters (in this case, L_1, T_2, and inclination i) over two iterations or loops (each loop varying one parameter, making the correction, then on to the next parameter, then on to the third). Mass ratio, q, was kept fixed, as mentioned above. A long 'rift valley' in Ω_1–Ω_2 space resulted, in which low values of the sum of residuals ($\Sigma\omega^2_{\mathrm{res}}$) nearly equaled that of the best solution all the way along the trough. (See Fig. 2.) This result underscored the need for independent flux ratio determinations obtained from the spectra, else the solution would be truly indeterminate. The lines of constant flux ratio (not shown) are lines of positive slope; the one for the required value neatly intersected the imaginary line along the trough for the best (spotted) solution (marked by a cross).

The author then ran a set of runs using the square root law (LD = 3), interacting with the above contour plot to get Ω_2 as a function of Ω_1. The best solution yielded a sum of the residues indistinguishable from the solution with LD = 2; further, there was no significant change in any of the output values.

Runs with non-zero eccentricity were attempted, but with the formal errors close to the final value of 0.001, circular orbits were adopted. Two separate runs were made: Model 0: no spots, and Model 1: spots of star 1. The final results for both models are given in Table 4. It may be seen that Model 1 (spots on star 1) gives a significantly lower residual than the unspotted model and a much better fit visually; hence it is adopted (but the unspotted results given for comparison). Note that the quoted errors are formal errors produced by the WD program; actual errors may be larger. Also the quoted error in T_2 is relative to T_1 – that is, it is the error in $(T_2 - T_1)$. The absolute error in T_1 is much larger, corresponding to half one spectral sub-class (so obviously, the absolute error in T_2 will be of the same order). Third light was tested for, but no significant differences from zero were found.

The fundamental parameters, using the results from Model 1 are given in Table 3. Also, the interstellar coefficient, $A_V = 0.19 \pm 0.09$ was taken from Robb, et al. (2002) to yield an estimate of the distance.

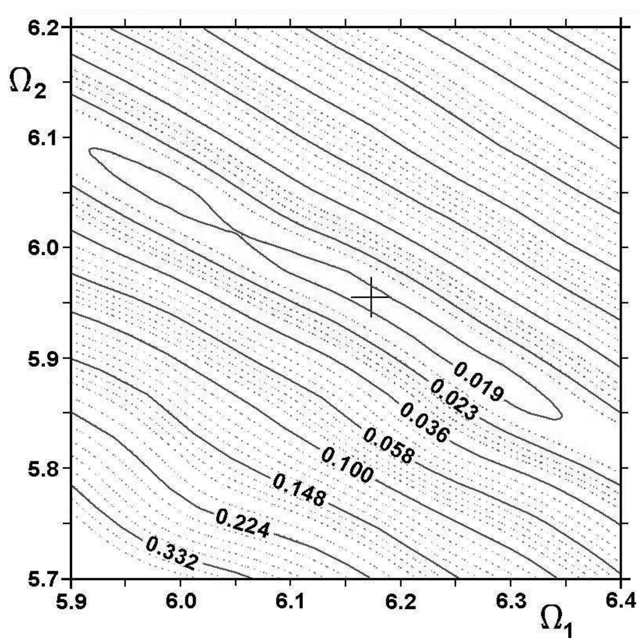

Figure 2. A contour plot of $\Sigma\omega^2_{\mathrm{res}}$ plotting Ω_1 versus Ω_1.

Table 2:

Quantity	Value Star 1	Value Star 2	Error
g	0.320	0.320	[fixed]
A	0.500	0.500	[fixed]
x (bol)	0.639	0.644	[fixed]
y (bol)	0.241	0.225	[fixed]
x (V)	0.710	0.741	[fixed]
y (V)	0.275	0.257	[fixed]
x (R_C)	0.637	0.669	[fixed]
y (R_C)	0.285	0.271	[fixed]
x (I_C)	0.553	0.585	[fixed]
y (I_C)	0.276	0.264	[fixed]

Table 3:

Fundamental Quantity	Star 1 Tabular	Star 1 WD	Star 1 error	Star 2 Tabular	Star 2 WD	Star 2 Error
Sp. Type	F6 V	–	–	F9 V	–	–
Mass (M_0)	1.32	1.28	0.10	1.11	1.14	0.09
Radius (R_0)	1.26	1.23	0.01	1.14	1.18	0.01
$\log g$ (cgs)	4.36	4.36	0.004	4.37	4.35	0.004
Luminosity (L_0)	2.56	2.47	0.36	1.60	1.75	0.25
Distance (pc)	–	159	11	–	–	–

Table 4:

Quantity.	Model 0	Model 1	Error	Quantity.	Model 0	Model 1	Error
–	(no spot)	(spot on 2)	–	–	(no spot)	(spot on 2)	–
T_1 (K)	6514	6514	130	L_2/L_1 (V)	0.670	0.690	-
T_2 (K)	6026	6112	22	a (solar radii)	6.48	6.49	0.008
Ω_1	6.27	6.17	0.02	V_γ (km/s)	-0.7	-0.7	0.3
Ω_1	5.89	5.95	0.02	r_1 (pole)	0.185	0.189	0.001
$q = M2/M1$	0.886	0.886	0.005	r_1 (point)	0.188	0.192	0.001
i (deg)	82.90	82.78	0.05	r_1 (side)	0.186	0.190	0.001
Spot Lat (deg)	na	90	30	r_1 (back)	0.188	0.191	0.001
Spot Lng (deg)	na	185	2	r_2 (pole)	0.183	0.180	0.001
Spot Rad. (deg)	na	74	5	r_2 (point)	0.186	0.184	0.001
Spot Temp fac	na	0.992	0.004	r_2 (side)	0.186	0.182	0.001
$L_1/(L_1+L_2)$ (V)	0.592	0.592	0.002	r_2 (back)	0.186	0.183	0.001
$L_1/(L_1+L_2)$ (R)	0.578	0.581	0.002	$\Sigma\omega^2_{\rm res}$	0.02140	0.01832	–
$L_1/(L_1+L_2)$ (I)	0.567	0.571	0.002				

The resultant V light curves are displayed in Figs. 3 and 4 together with the residuals, and the radial velocity curves, in Fig. 5. A 3-dimensional representation from Binary Maker 3 (Bradstreet, 1993) is displayed in Fig. 6. Fits for all colours are found in the on-line version in Figs. 7-8.

The validity of spots resulting from WD analysis is, in the opinion of the author, tenuous. Spots are added because they yield significant improvements to the fit (as happened here). One needs to use care, however, as the unrestrained addition of spots can, in principle, fit anything!

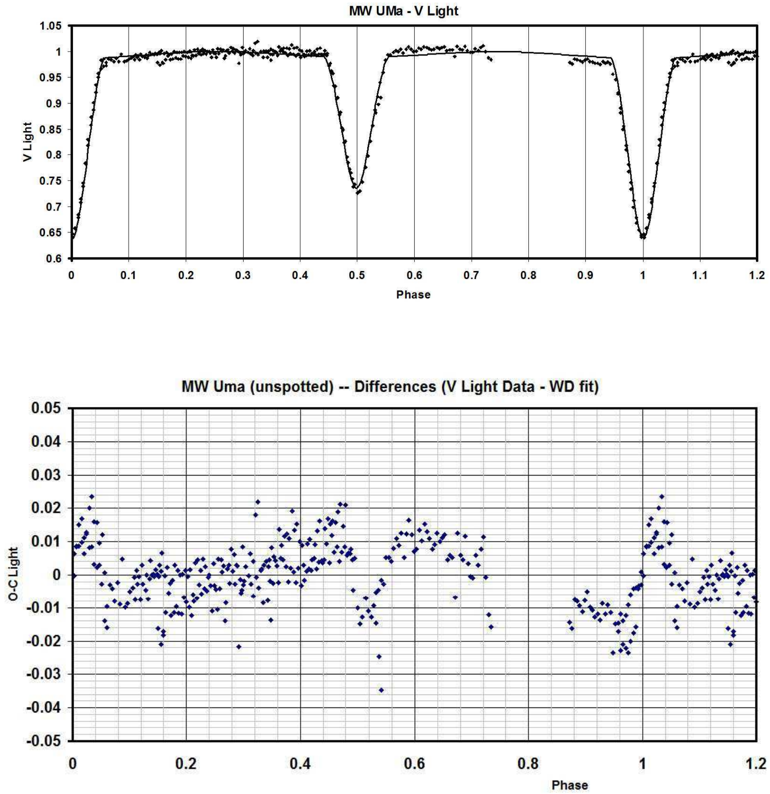

Figure 3. Photometric Data and WD Output (V, top panel), residual (bottom panel) – Model 0 (no spot)

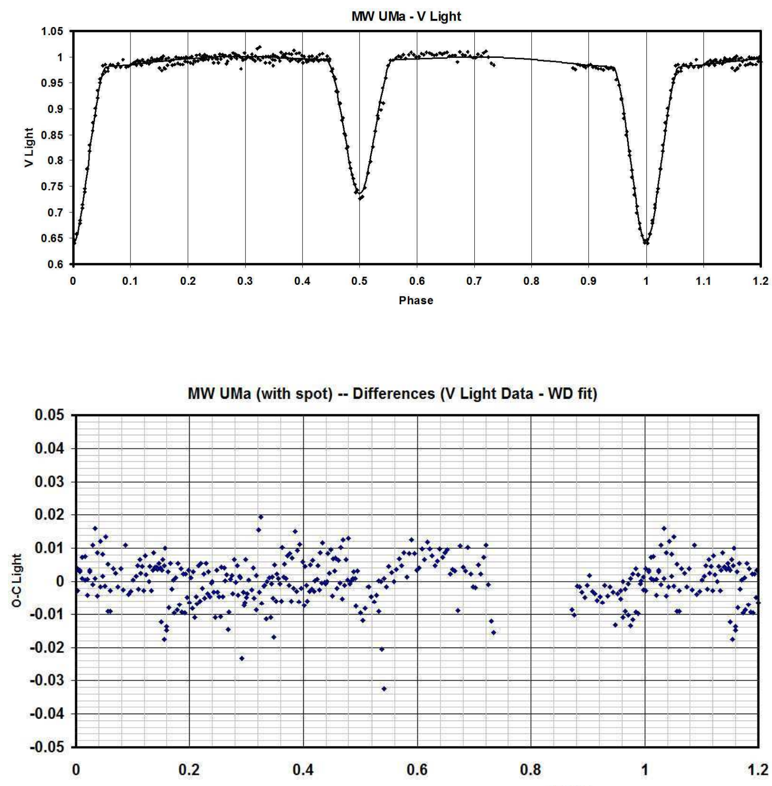

Figure 4. Photometric Data and WD Output (V, top panel), residual (bottom panel) – Model 1 (with spot)

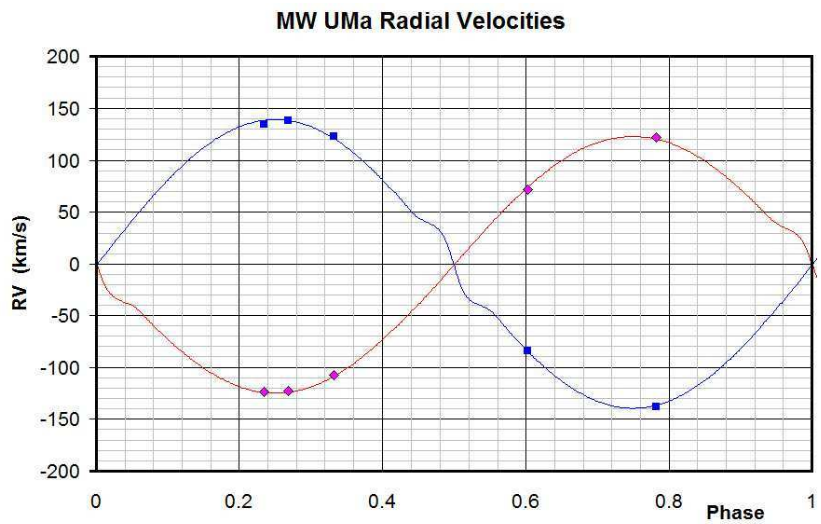

Figure 5. Radial Velocity Data and WD Output

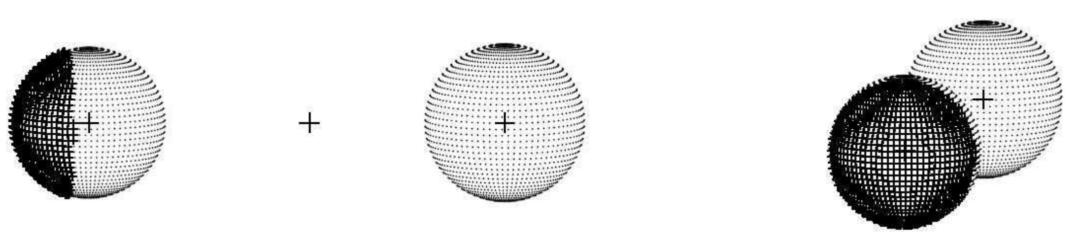

Figure 6. Binary Maker depiction of the system at phases 0.75 and 0.97 respectively

In conclusion, MW UMa is a detached binary with temperatures of about 6500 and 6100 K, and luminosities of about 2.6 and 2.5 solar units respectively. Reference to the evolutionary tracks of Schaller et al. (1992) for Y = 0.300 and z = 0.020 reveals that both stars are unevolved from the main sequence.

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HD 190336 A NEW β Cep STAR

JURCSIK, J.[1]; SÓDOR, Á.[1]; HAJDU, G.[2]

[1] Konkoly Observatory of the Hungarian Academy of Sciences, P.O. Box 67, H-1525 Budapest, Hungary; e-mail: name@konkoly.hu

[2] Eötvös Loránd University, Department of Astronomy, P.O. Box 32, H-1518 Budapest, Hungary

HD 190336 ($m_V \approx 8\overset{\mathrm{m}}{.}6, \alpha_{2000.0} = 20^{\mathrm{h}}03^{\mathrm{m}}18\overset{\mathrm{s}}{.}68, \delta_{2000.0} = +33^\circ26'59\overset{\prime\prime}{.}7$) was found to be an unsolved new variable with $f = 4.45732\,\mathrm{cd}^{-1}$ frequency and 0.0247 mag amplitude by Koen and Eyer (2002) during the revision of the epoch photometry data of the Hipparcos catalogue. This star lies in the field that was observed by the HAT-5 telescope in June and July 2003 (Hartman et al. 2004). Based on these data the HATNET variability survey classified HD 190336 as a pulsating variable with $P = 0.2244\,\mathrm{d}$ period ($f = 4.45633\,\mathrm{cd}^{-1}$). Although the HAT-5 light curve of HD 190336 shows it definitely that the star is not monoperiodic (Fig. 1), no detailed analysis of the available photometric data of HD 190336 has been performed previously. Photometric time series of HD 190336 was also observed with the Optical Monitoring Camera (OMC, Mas-Hesse et al., 2003) on board the Integral satellite (Winkler et al., 2003). The FITS format OMC data were converted into ASCII tables using the OMC2ASCII program as described in Sokolovsky (2007).

Table 1 summarises the log of the photometric data available for HD 190336.

Table 1. Photometric observations of HD 190336

Source	Observation period [JD]	number of data*	filter
Hipparcos	2 447 894–2 449 046	138	Hip
OMC	2 452 595–2 453 961	296	V
HAT-5	2 452 800–2 452 830	756	I_C

The most deviant data points are omitted

The spectral type of HD 190336 was classified to be B0.7 II-III (Walborn, 1971), its empirical temperature calibrations gave $\log T_{\mathrm{eff}} = 4.37$ (Gulati et al., 1989). Based on its period, amplitude, shape and variability of the light curve, the star can be classified as a new β Cep variable. Although all these data were available previously, HD 190336 was not listed as a candidate β Cep star in the recent catalogue of galactic β Cep stars (Stankov & Handler, 2005).

The Fourier spectrum of the HAT-5 data shows 6 distinct frequencies in the 4–5 cd^{-1} frequency range, forming two equidistant triplets with $\Delta f = 0.135\,\mathrm{cd}^{-1}$ spacing. Three combination frequency components can also be detected. Cleaned spectra of the HAT-5 observations of HD 190336 are shown in Fig. 2. (See Roberts et al., 1987, on the application of the Clean algorithm on Fourier amplitude spectra of variable star time series.) The positions of the equidistant triplets and their linear combination frequencies are marked in Fig. 2. The detected frequencies and their Fourier amplitudes and phases are listed in Table 2. Frequency triplets and doublets with the same frequency spacing were detected in other β Cep variables also (see e.g. Handler, 2005). A trivial explanation of equidistant triplets is rotational splitting, however e.g., Handler et al. (2006) interpreted the equidistant spacing of the triplet frequencies detected in the spectrum of 12 Lac as accidental because the components were found to belong to different order l modes.

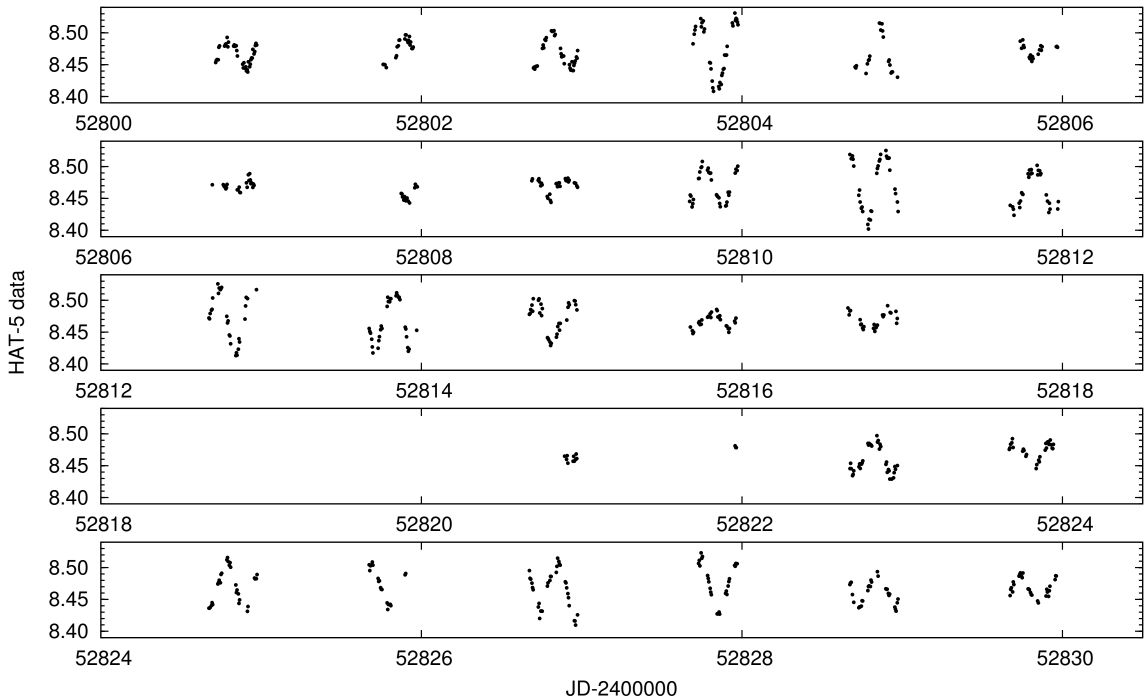

Figure 1. HAT-5 light curve of HD 190336.

Table 2. Frequencies detected in the HAT-5 data of HD 190336

	frequency cd^{-1}	amplitude / error mag		phase* / error rad	
$f_1 \approx f_2 - \Delta f$	4.1894	0.0083	0.0003	4.04	0.08
f_2	4.3269	0.0134	0.0003	0.93	0.05
$f_3 \approx f_2 + \Delta f$	4.4576	0.0245	0.0003	3.94	0.03
$f_4 \approx f_5 - \Delta f$	4.5347	0.0064	0.0003	3.89	0.10
f_5	4.6665	0.0125	0.0003	4.37	0.05
$f_6 \approx f_5 + \Delta f$	4.8074	0.0054	0.0003	6.17	0.12
$f_7 \approx f_1 + f_6 = f_2 + f_5 = f_3 + f_4$	8.9908	0.0028	0.0004	3.50	0.24
$f_8 \approx f_3 + f_5 = f_2 + f_6$	9.1361	0.0017	0.0004	3.37	0.39
$f_9 \approx f_4 + f_5$	9.2040	0.0018	0.0004	3.44	0.36

* Initial epoch $T_0 = 2\,452\,800.0$

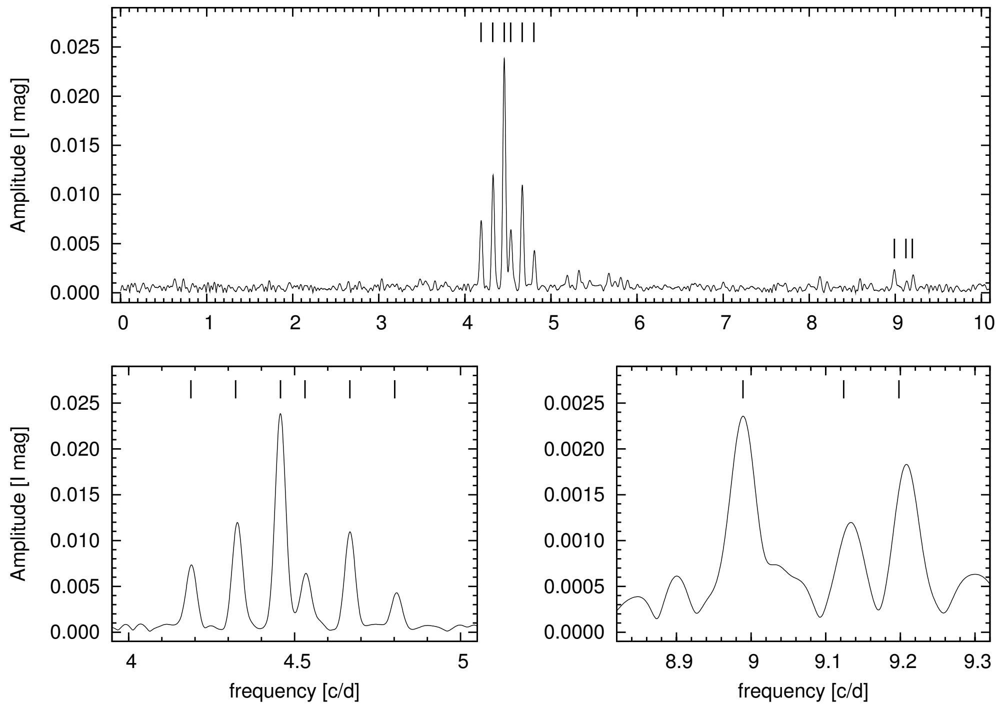

Figure 2. Clean spectra of the HAT-5 observations of HD 190336. Marks show the positions of equidistant triplets with $0.135\,\mathrm{cd}^{-1}$ spacing, and the exact positions of the linear combination frequencies.

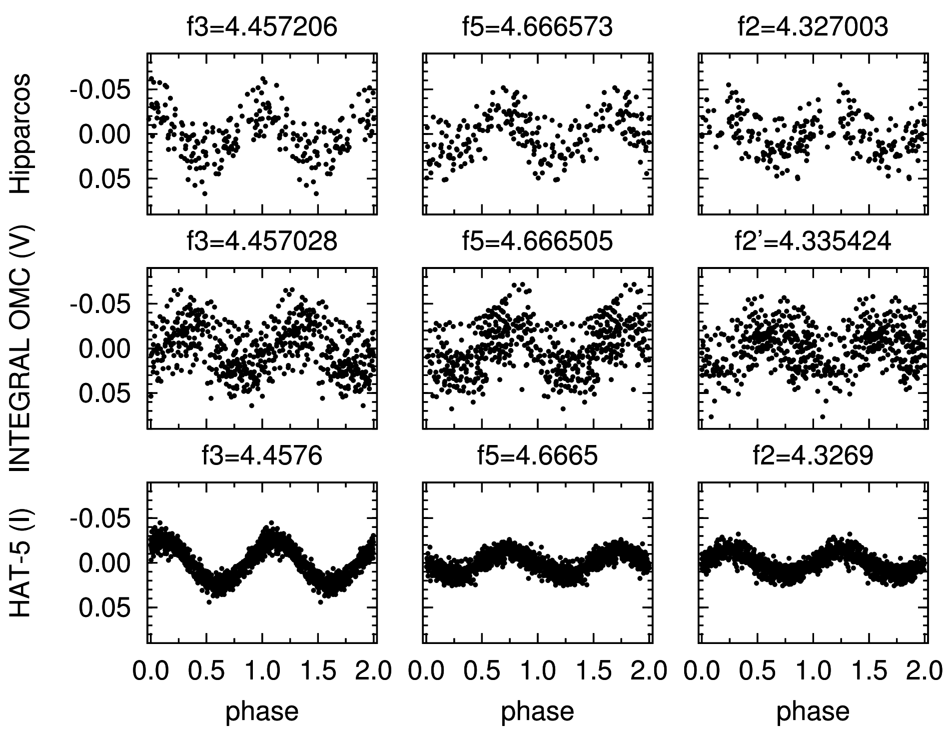

Figure 3. Hipparcos, Integral OMC and HAT-5 light curves of HD 190336 folded with the three main frequencies found in the data. In each plot the the signals belonging to the other frequencies has been removed.

The Hipparcos and OMC data of HD 190336 make it also possible to investigate the stability of the detected frequencies on longer time scale. Pigulski & Pojmanski (2008) detected both period and amplitude changes of the frequencies of multiperiodic β Cep variables using ASAS-3 observations spanning over 6 years.

Hipparcos, OMC and HAT-5 light curves of HD 190336 folded with the three main frequencies found in the data are plotted in Fig. 3. In each panel of this figure, the the signals belonging to the other frequencies has been removed.

In the Hipparcos data the three largest amplitude signals, f_3, f_5 and f_2 also appear. Their amplitudes are 0.026, 0.022 and 0.019 mag, respectively, indicating either that the amplitudes of these frequencies are changing, or that there are significant differences between their amplitude ratios in different bands. The frequencies of the three signals found in the Hipparcos data agree within the error ranges with the frequencies of the three largest amplitude frequencies detected in the HAT-5 data.

The OMC V band data span over four years, overlapping with the 30 days interval of the HAT-5 observations. Although both systematic and random noise are the largest in this data set, f_3 and f_5 can be detected in the OMC data too. Their amplitudes are close the same; 0.021 mag. For comparison, the amplitudes of these frequencies are 0.025 and 0.013 mag in the HAT-5 data (I band). Removing f_3 and f_5 from the Integral data, the residual shows a frequency at $4.3354\,\mathrm{cd}^{-1}$, close to the frequency of f_2 detected in the HAT-5 and Hipparcos data. The difference between the position of this frequency and f_2 is, however, much larger than it could be explained by the uncertainties of the frequencies. Therefore, most probably it is a different frequency.

The available photometric observations of HD 190336 do not allow to perform a more detailed asteroseismic study of the star and mode identification of the detected frequencies. They show, however, that HD 190336 is an ideal, interesting asteroseismic target which definitely deserves further attention. Both observational and theoretical efforts are needed in order to interpret its frequencies and their spacings.

Acknowledgements This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France. The financial support of OTKA grant T-068626 is acknowledged. The Clean algorithm, as implemented by J. Lehár, has been used. These results are partially based on data from the OMC Archive at LAEFF, pre-processed by ISDC.

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THREE NEW GALACTIC DOUBLE-MODE PULSATING STARS

HAJDU, G.[1]; JURCSIK, J.[2]; SÓDOR, Á.[2]

[1] Eötvös Loránd University, Department of Astronomy, P.O. Box 32, H-1518 Budapest, Hungary; e-mail: name@konkoly.hu

[2] Konkoly Observatory of the Hungarian Academy of Sciences, P.O. Box 67, H-1525 Budapest, Hungary; e-mail: name@konkoly.hu

We report the discovery of the double-mode nature of three pulsating variable stars; V2157 Sgr, V767 Sgr and V363 Cas, observed with the Optical Monitoring Camera (Mas-Hesse et al., 2003) on board the Integral satellite (Winkler et al., 2003). The observations are available via the OMC Data Server (Gutierrez et al., 2004). We have used this database to analyse light curves of RR Lyrae variables observed by OMC for any sign of light curve variability (eg. Blazhko-effect or double-mode nature). The light curves are available as FITS tables which were converted into ASCII tables using the OMC2ASCII program as described by Sokolovsky (2007). We have analysed the light curves of all the variables down to $V \sim 17$ which were classified as RR Lyrae by the OMC Input Catalogue and which have more than 200 data points using the 630 second sampling of OMC observations. The result of our analysis is the identification of double-mode nature in three of the variables. Based on their period ratios, periods, and light curves' shape, two of the stars are pulsating simultaneously in the first and second overtones (FO/SO) and are in fact short period Cepheid stars, not RR Lyrae variables. The OMC observes through a Johnson V filter, allowing us to combine the observations of OMC with ASAS (Pojmansky, 2002) V lightcurves, when they are available. When combining the lightcurves, offsets of the zero-points were taken into account. During the analysis, some outlier points were removed manually. The log of observations of the three new double mode variables is shown in Table 1.

Table 1. Log of observations

Star	Dataset	JD 2400000 +	No. of datapoints*	mean V mag
V2157 Sgr	OMC	53110 – 54051	541	14.483
V2157 Sgr	ASAS	51875 – 53894	271	14.121
V767 Sgr	OMC	52729 – 54763	640	12.532
V767 Sgr	ASAS	51940 – 53294	540	12.463
V363 Cas	OMC	52654 – 53956	1120	10.569

* After the rejection of outlying points.

V2157 Sgr ($\alpha_{2000.0} = 19^{\rm h}40^{\rm m}15^{\rm s}, \delta_{2000.0} = -39^\circ21'42''$): The combined OMC and ASAS data revealed that this variable is a double-mode RR Lyrae. As it is common in RRd stars, the dominant mode is the first overtone, however, the fundamental mode has commensurable amplitude to that of the first overtone mode. In the Fourier spectrum of the light-curve, apart from the fundamental mode and the first overtone and their harmonics, linear combination terms of f_1 and f_0 also appear. The folded light curves, the Fourier-spectra and the spectral window of the observations are plotted in Fig. 1.

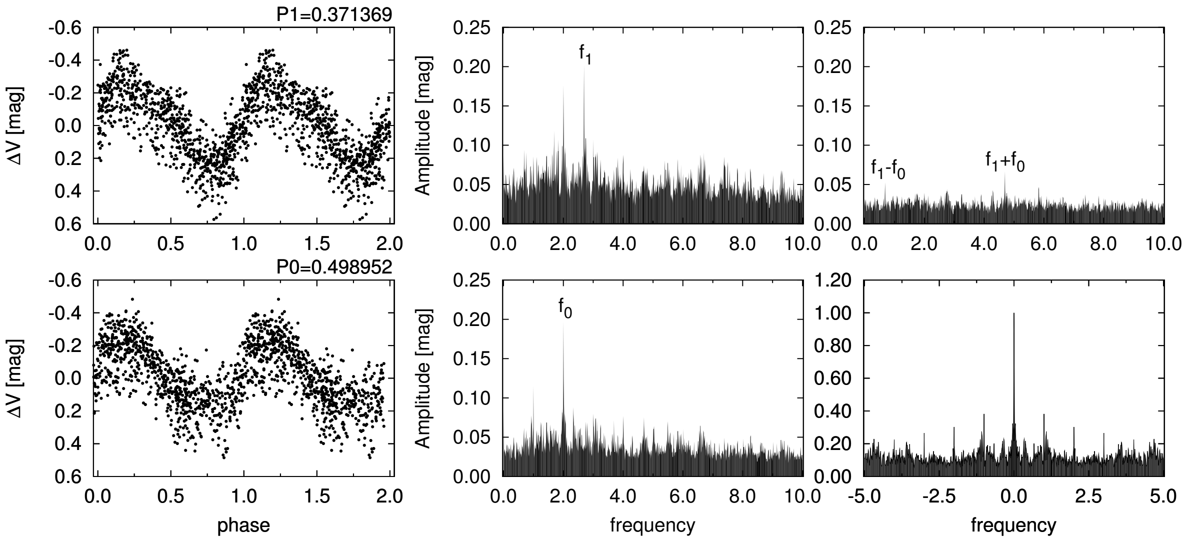

Figure 1. Light curves, Fourier spectra and the spectral window of V2157 Sgr. The light curves folded with the primary (top-left panel) and secondary (bottom-left panel) periods are prewhitened for the signals belonging to the other detected frequencies. The top and bottom panels in the middle show the Fourier spectrum of the original data and the data prewhitened for the primary period and its harmonics, respectively. In the top-right panel the spectrum after prewhitening for both the primary and the secondary frequencies and their harmonics are shown. In this residual spectrum the linear combinations of the two main pulsation components appear. The spectral window is shown in the bottom-right panel.

Table 2. Fourier parameters of the frequencies detected in the spectrum of V2157 Sgr.

V2157 Sgr	P_1=0.371369	P_0=0.498952		P_1/P_0=0.7443	
	frequency cycle/day	amplitude / error magnitude		phase*/error radian	
f_1	2.692739	0.2248	0.0063	2.15	0.06
$2f_1$	5.385478	0.0646	0.0061	1.54	0.13
$3f_1$	8.078217	0.0135	0.0062	4.83	0.45
f_0	2.004201	0.1942	0.0062	2.85	0.08
$2f_0$	4.008403	0.0376	0.0062	1.69	0.25
$3f_0$	6.012604	0.0287	0.0061	2.20	0.33
$4f_0$	8.016805	0.0204	0.0062	1.81	0.42
$f_1 + f_0$	4.696940	0.0659	0.0061	1.24	0.13
$f_1 - f_0$	0.688538	0.0527	0.0065	5.07	0.13
	r.m.s	0.117 mag			

* According to sine term decomposition. Initial epoch is 2 452 027.

V767 Sgr ($\alpha_{2000.0} = 19^{\rm h}52^{\rm m}28^{\rm s}, \delta_{2000.0} = -26^\circ42'12''$): The main period of this star is 0.67 d ($f_1 = 1.49$ c/d), that would correspond to the period of a fundamental mode RR Lyr variable. However, its secondary frequency is at $f_2 = 1.86$ c/d with a period ratio of 0.8, indicating that the star is pulsating simultaneously in the first and second radial mode overtones. Based on the period values of these modes the star is more probably a short period Cepheid than an RR Lyrae.

After prewhitening the light curve with the frequencies of the two radial modes and their linear combination term, a signal appears in the residual spectrum near the primary period, indicating period change during the observations (the observations are spanning almost eight years). The folded light curves, the Fourier-spectra and the spectral window of the observations are plotted in Fig. 2. Table 3 lists the Fourier parameters of the detected frequencies.

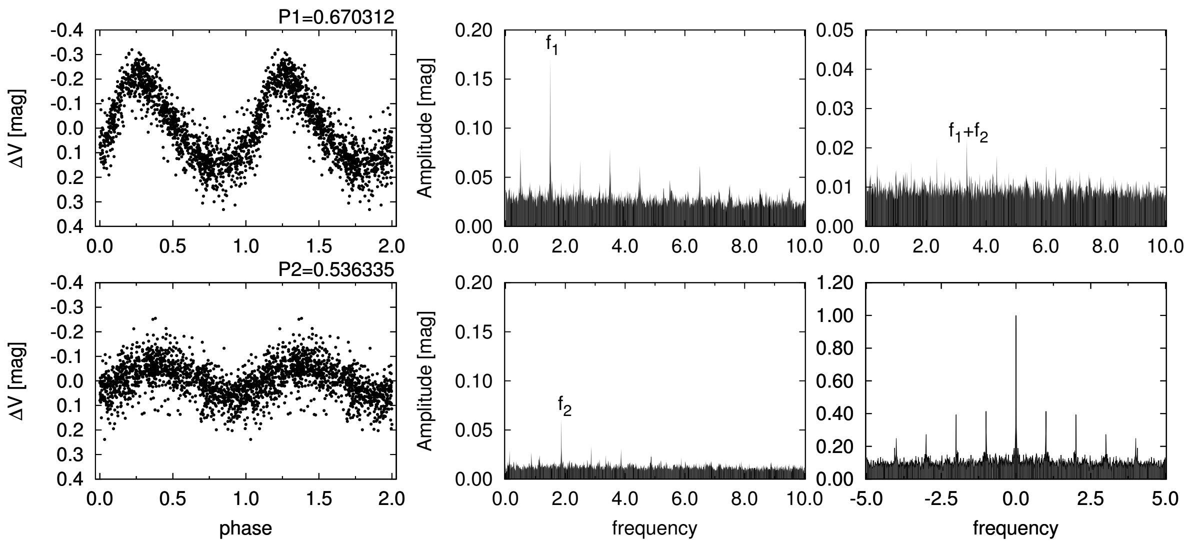

Figure 2. Same as Fig. 1, but for V767 Sgr. Note the different scales on the Y axes of the residual spectra.

Table 3. Fourier parameters of the frequencies detected in the spectrum of V767 Sgr.

V767 Sgr	P_1=0.670312	P_2=0.536335		P_2/P_1=0.8001	
	frequency cycle/day	amplitude / error magnitude		phase* /error radian	
f_1	1.491842	0.1760	0.0024	3.97	0.02
$2f_1$	2.983684	0.0338	0.0023	3.87	0.08
$3f_1$	4.475526	0.0129	0.0024	3.93	0.50
f_2	1.864508	0.0624	0.0024	4.05	0.08
$f_1 + f_2$	3.356350	0.0233	0.0024	4.05	0.12
	r.m.s	0.057 mag			

* According to sine term decomposition. Initial epoch is 2 451 940.

V363 Cas ($m_V \approx 10\overset{\mathrm{m}}{.}61, \alpha_{2000.0} = 00^{\mathrm{h}}15^{\mathrm{m}}14\overset{\mathrm{s}}{.}333, \delta_{2000.0} = +60°20'11\overset{''}{.}99$): This star is classified by the GCVS as type of RRab. Schmidt & Seth (1996) suggested to revise the type to RRc:, while Fernley et al. (1998) noted that this star is probably an Anomalous Cepheid. Despite being a moderately bright star, the double-mode nature of V363 Cas was not discovered by earlier studies due to the very small, 0.02 mag amplitude of its secondary mode. The analysis of the OMC data revealed that V363 pulsates in two radial modes with 0.802 period ratio corresponding to the first and second overtone periods. The periods of the identified modes support that instead of being an RR Lyrae, V363 Cas is also a short period Cepheid.

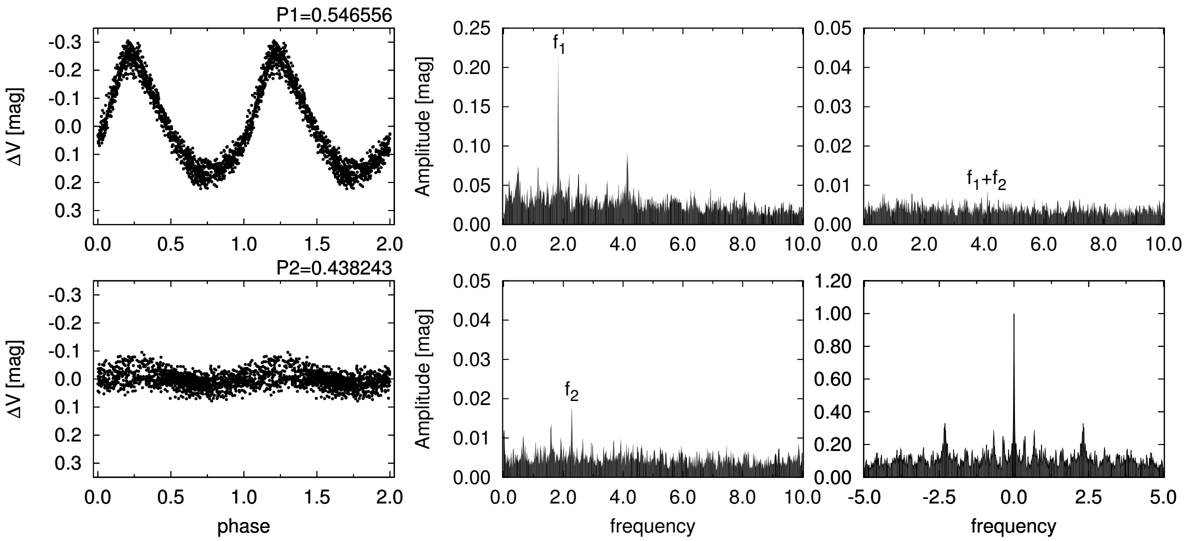

Figure 3. Same as Figs. 1 & 2, but for V363 Cas. Note the different scales on the y axes of the residual spectra.

Table 4. Fourier parameters of the frequencies detected in the spectrum of V363 Cas.

V363 Cas	P_1=0.546556	P_2=0.438243		P_2/P_1=0.8018	
	frequency cycle/day	amplitude / error magnitude		phase* /error radian	
f_1	1.829638	0.1980	0.0011	5.77	0.02
$2f_1$	3.659276	0.0392	0.0011	0.85	0.04
$3f_1$	5.488915	0.0165	0.0011	2.60	0.08
f_2	2.281842	0.0196	0.0012	4.08	0.16
$f_1 + f_2$	4.111480	0.0080	0.0012	5.55	0.19
	r.m.s	0.026 mag			

* According to sine term decomposition. Initial epoch is 2 452 654.

Acknowledgements We thank Béla Szeidl for his many helpful comments on this work. The financial support of OTKA grant T-068626 is acknowledged. This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France. This research is partially based on data from the OMC Archive at LAEFF, pre-processed by ISDC.

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ERRATUM FOR IBVS 5882

The correct coordinates of two variables discussed in this issue of the IBVS are as follows:

V767 Sgr: $\alpha_{2000.0} = 17^{\rm h}52^{\rm m}28\overset{\rm s}{.}4$, $\delta_{2000.0} = -26^\circ42'12\overset{\prime\prime}{.}5$

V363 Cas: $\alpha_{2000.0} = 00^{\rm h}15^{\rm m}14\overset{\rm s}{.}3$, $\delta_{2000.0} = +60^\circ20'25\overset{\prime\prime}{.}7$

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SHORT-PERIOD OSCILLATIONS IN THE ALGOL-TYPE SYSTEMS III: NEWLY DISCOVERED VARIABLE GSC 4588-0883

DIMITROV, D.; KRAICHEVA, Z.; POPOV, V.

Institute of Astronomy, BAS, Tsarigradsko Shossee 72, 1784 Sofia, Bulgaria,
e-mail: dinko@astro.bas.bg; zk@astro.bas.bg; vpopov@astro.bas.bg

GSC 4588-0883 was discovered as a new eclipsing binary in our search for new variables in the NSVS database (Wozniak et al., 2004). According to the NSVS data the star was classified as Algol-type binary with period $P \simeq 3.2582$ days, amplitude of primary minimum $A_R > 0.65$ mag, and the magnitude in maximum $R'_{\rm max} \simeq 11.67$ mag. The astrometric and photometric data for the star (Table 1) are taken from NOMAD catalogue (Zacharias et al., 2004).

The CCD photometry (in BVR bands) of GSC 4588-0883 was carried out with the 60cm Cassegrain telescope at NAO Rozhen, equipped with the CCD camera FLI PL09000 (3056×3056, 12μ pixel), and Bessell (1990) standard $UBVRI$ filters. The standard IRAF procedures were used for the reduction of the photometric data. Using the method of Everett and Howell (2001) six stars with $\sigma < 0.005$ mag in all R band observations (Table 1) were selected to create an ensemble standard star.

The NSVS and Rozhen's light curves of GSC 4588-0883 are shown on Fig. 2. The light curves for 6 nights, obtained in R band are shown in Fig. 4 and Fig. 5. Short-period oscillations with a peak-to-peak amplitude of up to 0.015 mag in R (Table 2) were detected. The oscillations are smaller than in the previous discovered stars GSC 4550-1408 and GSC 3889-0202 (Dimitrov et al., 2008a,b). The oscillations are present at the primary and the secondary minima also. A preliminary periodogram analysis (Fig. 6) of the data shows a main periodicity in the interval $71 \div 78$ minutes.

Spectral observations of GSC 4588-0883 were obtained with the Coudé spectrograph (resolution of 0.19 Å/pixel) of the 2m RC telescope at NAO Rozhen (Table 3). The spectral domain covered three regions around H_α, H_β, and MgII 4481 lines (Fig. 3). The data reduction of the spectra was made with the standard IRAF procedures. The radial velocities were measured by the cross-correlation technique using synthetic spectrum, calculated with the programme SPECTRUM (Gray & Corbally, 1994) and a grid of LTE atmosphere models for a solar-type chemical composition (Castelli & Kurucz, 2003), as a template spectrum. The physical parameters of the primary component were estimated by comparing the synthetic and the observed spectra. The parameters of the secondary were computed with the PHOEBE software (Prśa & Zwitter, 2005). The spectral types of the components were determined using Straižys & Kuriliene (1981) calibration (Table 4).

The new ephemeris were computed using both Rozhen and NSVS data:

$$HJD(\mathrm{MinI}) = 2451274.021(\pm0.005) + 3.25855(\pm0.00009)E \quad (1)$$

Acknowledgements This study made use of the SIMBAD, ADS, and VSX databases, and GCVS catalogue.

Table 1. Data for the variable, and standard stars used in the CCD photometry

ID	Name	RA (J2000)	DEC (J2000)	V	$B-V$	$V-R$
VAR	GSC 4588-0883	$19^h27^m53^s.70$	$+77°17'41''.8$	11.32	0.50	0.34
C1	GSC 4588-0579	$19^h25^m59^s.69$	$+77°25'47''.9$	11.38	0.46	0.31
C2	GSC 4588-2368	$19^h26^m12^s.00$	$+77°27'25''.9$	12.26	1.02	0.97
C3	GSC 4588-0521	$19^h28^m07^s.31$	$+77°20'51''.4$	12.35	0.92	0.88
C4	GSC 4588-0164	$19^h30^m24^s.86$	$+77°17'21''.8$	12.20	1.01	0.63
C5	GSC 4588-0781	$19^h27^m30^s.51$	$+77°26'49''.5$	13.15	0.41	0.31
C6	GSC 4588-1313	$19^h26^m32^s.13$	$+77°25'42''.9$	13.02	0.54	0.32

Table 2. Observational runs of GSC 4588-0883

Date	HJD(start)	Length	Filter	Exp. [s]	N	Phase	$A_R$max(osc.)
02.09.2008	2454712.24749	04^h40^m	R	120	120	0.14 - 0.20	0.015
03.09.2008	2454713.42091	03^h57^m	R	120	131	0.50 - 0.55	0.010
04.09.2008	2454714.40448	05^h24^m	R	120	128	0.80 - 0.87	0.015
05.09.2008	2454715.53156	01^h51^m	R	120	45	0.15 - 0.17	0.012
08.09.2008	2454718.25881	08^h33^m	R	120	202	0.98 - 0.09	0.015
03.10.2008	2454743.45837	04^h18^m	BVR	3×120	38,38,38	0.72 - 0.77	0.012
31.10.2008	2454771.18693	00^h42^m	R	120	20	0.23 - 0.24	
01.11.2008	2454772.35613	03^h18^m	R	120	89	0.59 - 0.63	0.015
02.11.2008	2454773.39219	01^h25^m	R	120	38	0.59 - 0.63	
04.11.2008	2454775.20502	03^h05^m	BVR	3×120	26,23,23	0.46 - 0.50	< 0.01

Table 3. Rozhen spectra of GSC 4588-0883

Date	HJD(mid)	S/N	Exp. [s]	RV [kms^{-1}]	Region [Å]	Phase
15.10.2008	2454755.4238	36	1800	-64.18 ± 1.39	4400 - 4600	0.390
15.10.2008	2454755.4468	47	1800	-61.35 ± 2.58	4800 - 5000	0.397
15.10.2008	2454755.4696	56	1800	-49.87 ± 2.18	6500 - 6700	0.404
16.10.2008	2454756.2574	44	1800	-17.52 ± 1.50	4400 - 4600	0.646
16.10.2008	2454756.2785	41	1800	-16.71 ± 1.12	4400 - 4600	0.652
16.10.2008	2454756.3016	50	1800	-12.89 ± 3.01	4800 - 5000	0.660
16.10.2008	2454756.3227	54	1800	-12.61 ± 2.03	4800 - 5000	0.666
16.10.2008	2454756.3454	60	1800	-11.10 ± 2.55	6500 - 6700	0.673
16.10.2008	2454756.3665	61	1800	-13.14 ± 2.05	6500 - 6700	0.679

Table 4. Preliminary physical parameters of GSC 4588-0883 binary system

Parameter		Primary star	Secondary star
T_{eff}	[K]	7650	4100
$\log g$		3.9	3.2
Spectral type		A9 IV	K4 III
$M_{\mathrm{S}}/\mathrm{M_P}$		0.16	
K_{P}	[kms^{-1}]	63.0	
γ	[kms^{-1}]	-42.0	
i	[deg]	78.5	
$v \sin i$	[kms^{-1}]	~ 60	

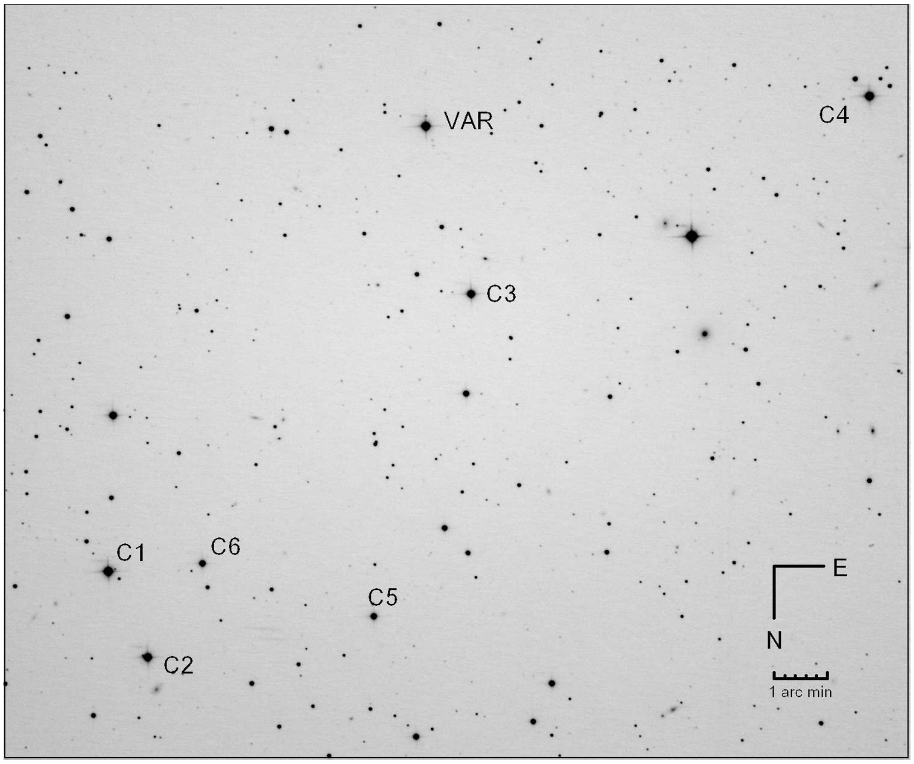

Figure 1. Field of the eclipsing binary GSC 4588-0883.

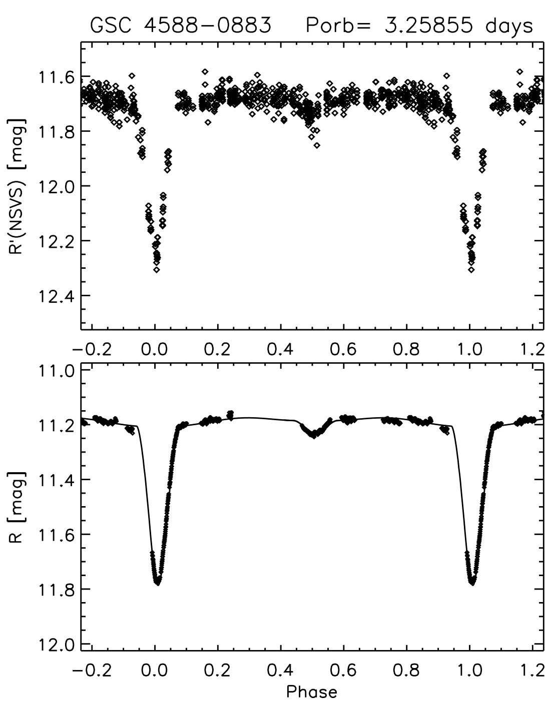

Figure 2. Light curves of GSC 4588-0883. Upper panel - NSVS data, lower panel - Rozhen R data (dots) and model (solid line).

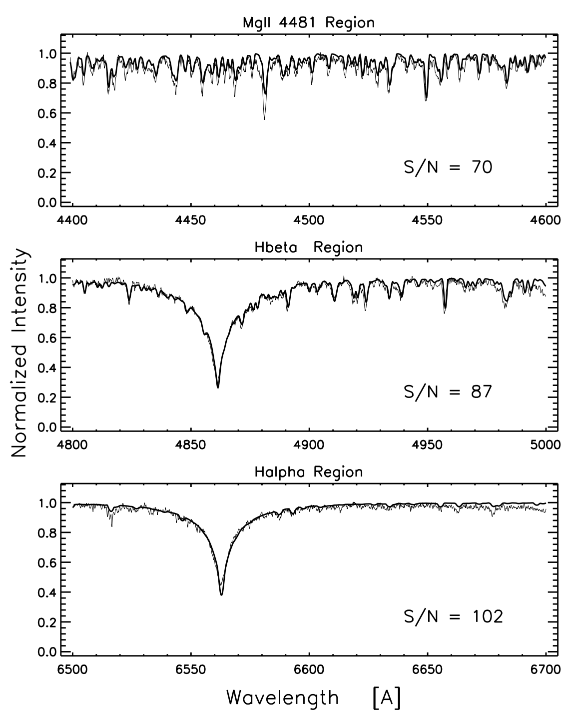

Figure 3. Rozhen combined spectra (thin line) of GSC 4588-0883 and the best synthetic spectra (thick line).

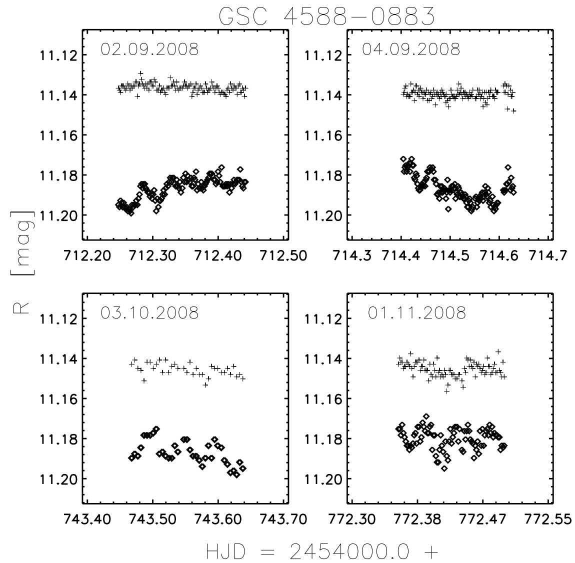

Figure 4. R light curves of GSC 4588-0883 (diamonds) and C1 standard star (crosses).

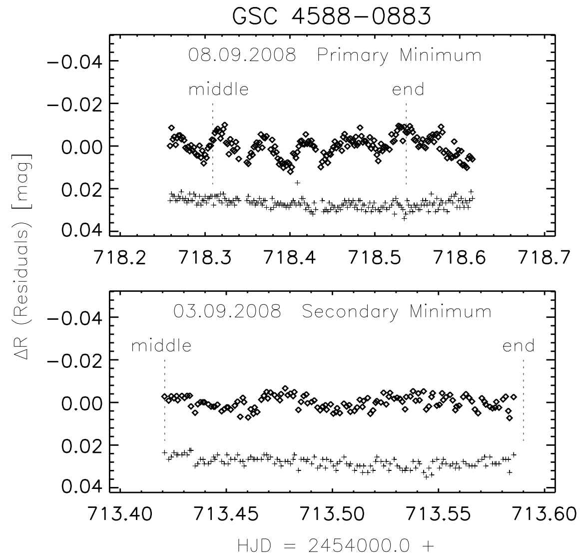

Figure 5. Residuals between observations and the model near the primary and secondary minima (diamonds) and shifted C1 standard (crosses). Dashed vertical lines indicate the middle and the end of the eclipses.

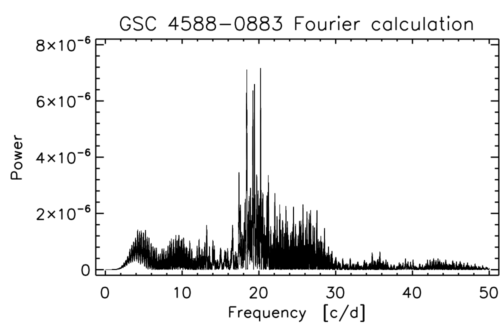

Figure 6. Power spectrum of GSC 4588-0883 Rozhen data after subtracting the synthetic light curve.

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V364 CAS – AN EVOLVED DETACHED ECLIPSING BINARY

NELSON, ROBERT H.[1,2]

[1] 1393 Garvin Street, Prince George, BC, Canada, V2M 3Z1 email: b-o-b.nelson@shaw.ca [remove dashes]

[2] Guest investigator, DAO, Herzberg Institute of Astrophysics, National Research Council of Canada

V364 Cas (= TYC 3270-1606-1 = BD 49 226, RA = $00^h52^m43^s.009$, Dec = $+50°28'10''.16$ (2000)) seems to have been discovered by Kippenhahn (1953 - earliest SIMBAD reference) but no further details are available. Perova (1957) discusses three variable stars – presumably with elements and light curves for V364 Cas, but again, no further details are available. Hilditch & Hill (1975) did Stromgren observations of V364 Cas, along with those of many other eclipsing systems. Chaubey (1984), using photoelectric observations in U, B and V did a set of two analyses – one based on the Russell and Merrill (Russell & Merrill, 1952) method, the other based on Kopal's method (Kopal, 1981). Clearly, an up-to-date analysis using a modern physical model is overdue.

During September of 2006 (and 2007), the author took nine high resolution (10 Å/mm reciprocal dispersion) spectra at the Dominion Astrophysical Observatory (DAO) in Victoria, British Columbia, Canada; he then used the Rucinski broadening functions (Rucinski, 2004) to obtain radial velocity (RV) curves (see Nelson et al., 2006a for details). The spectral range was 5004–5267 Å and the reciprocal dispersion, 10 Å/mm.

Table 1. A log of DAO observations and RV results

DAO Image #	Mid Time (HJD-2400000)	Exposure (sec)	Phase at Mid-exp	V1 (km/s)	V2 (km/s)
13087	53989.9690	3600	0.708	147.38	−120.22
13099	53990.7688	3600	0.227	−132.29	137.20
13101	53990.8146	3600	0.256	−134.71	137.94
13103	53990.8632	3600	0.288	−131.77	132.04
13114	53990.9920	3600	0.371	−101.29	105.34
13127	53991.7376	3600	0.854	114.33	−98.50
13142	53992.9787	2730	0.659	124.22	−97.79
13154	53994.8602	3600	0.878	105.39	−84.35
11257 (Taken in 2007)	54369.8310	3600	0.882	98.25	−84.63

On 10 nights October of 2006, the author took a total of 350 CCD images of the field in V, 349 in R_C and 344 in I_C (both Cousins) at his private observatory in Prince George, British Columbia, Canada. The telescope was a 33 cm f/4.5 Newtonian on a Paramount ME mount; the detector was a SBIG ST-7XME CCD cooled to −20°C. Reduction software was `MIRA` by Mirametrics, Inc., and sky flats were used.

Table 2. A list of the Variable, Comparison and Check stars

Type	TYC 3270-	R.A. J2000	Dec. J2000	V Mags	$B-V$ Mags
Variable	1606	$0^h52^m43^s.021$	$50°28'10''.099$	11.2–11.9	A7
Comparison	612	$0^h52^m39^s.557$	$50°29'39''.557$	11.36	1.33
Check	96	$0^h52^m50^s.855$	$50°28'32''.936$	12.38	0.14

The following elements were used for phasing throughout (see Nelson, 2008 for the $O-C$ relation):

$$\text{JD Hel Min I} = 53732.727(4) + 1.5430670(2)\text{E}$$

There was some initial confusion as to which was the primary eclipse (since the eclipse depths are very close). However, modeling revealed that the star initially considered to be the secondary was in fact the hotter of the two. Therefore, even though it is smaller and has the lesser mass, it must be considered the primary star as, when eclipsed, it gives the deeper eclipse that is considered to be phase 0 (by photometric tradition). The above elements reflect that designation. The primary eclipse, then, is an occultation and is flat-bottomed as a result (see electronic Fig. 4); the other eclipse is a transit (see the V light curve in Fig. 1 and VRI light curves as electronic Fig. 5).

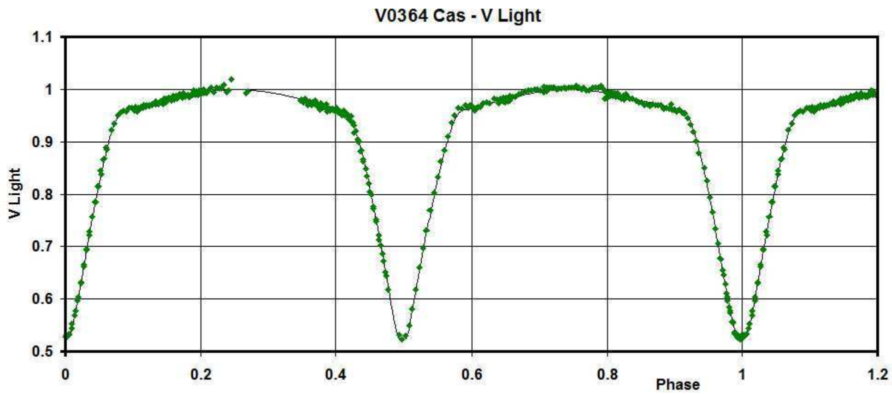

Figure 1. V364 Cas: V Light Curve – Data and WD Fit

The author used the 2004 version of the Wilson-Devinney (WD) light curve and radial velocity analysis program with the Kurucz atmospheres (Wilson and Devinney, 1971; Wilson, 1990; Kallrath et al., 1998) as implemented in the Windows software `WDwint` (Nelson, 2009a) to analyze the data. To get started, a spectral type A7 V (Brancewicz & Dworak, 1980) and a temperature $T_1 = 7816 \pm 240$ K were used; interpolated tables from Cox (2000) which gave $\log g = 4.282$ were used; an interpolation program by Terrell (1994) gave the (van Hamme, 1993) limb darkening values; and finally, a square root ($LD = 3$) law for the extinction coefficients was selected, appropriate for hotter stars (Bessell, 1979). Radiative envelopes were chosen for both stars, again appropriate for hotter stars. The parameters are listed in Table 3.

Mode 2 (for detached stars) was chosen, based on the general appearance of the light curves. Convergence by the method of multiple subsets was reached in a small number of iterations. In particular, the mass ratio $q = M_2/M_1$ was held fixed because this value (1.080 ± 0.002) was well determined from the RV curves; in contrast, it is not well constrained from the photometric data.

The solution was very robust in that when one started with significantly different initial values for the important parameters (inclination, T_2, and potentials 1 and 2), the iterations zeroed in on the same solution. Correlations between parameters were, except for one parameter, all less than 0.5. Therefore, varying almost all the parameters at once yielded rapid convergence.

Third light was tested for and found to be insignificant. Next, non-zero eccentricity was tested for; a value of 0.0006 ± 0.0003 resulted. This is a very low value and is worth ignoring.

A plot of the V light curve and WD fit are shown in Fig. 1; the RVs are shown in Fig. 2. A three dimensional representation from Binary Maker 3 (Bradstreet, 1993) is shown in Fig. 3. The reader will note that the shapes are tidally distorted. This accounts for the fact that the light curves between eclipses are not flat and, as a result, are easy to model with no ambiguities in the potentials, as occurred with MW UMa (Nelson, 2009b).

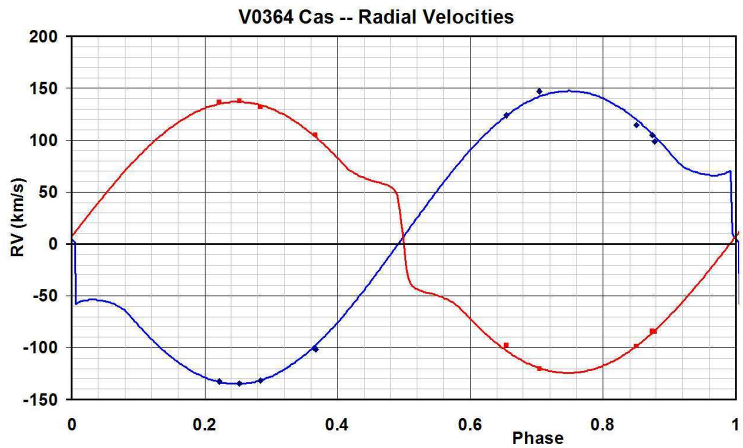

Figure 2. V364 Cas: Radial Velocity Curves – Data and WD Fit.

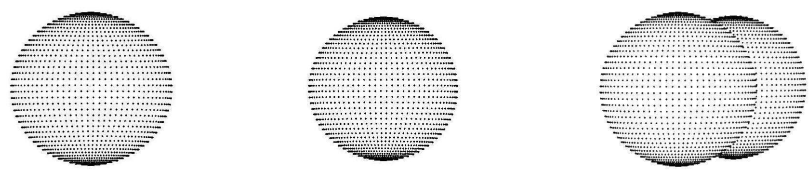

Figure 3. Binary Maker 3 representation of the system – at phases 0.75 and 0.97.

Table 3. Final WD output parameters

Quantity	Value		Error	Quantity	Value	Error	Quantity	Value	Error
	Star 1	Star 2							
g	0.320	0.320	[fixed]	T_1 (K)	7816	86	a (solar radii)	8.32	0.01
A	0.500	0.500	[fixed]	T_2 (K)	7780	86	V_γ (km/s)	6.2	0.1
x (bol)	0.194	0.330	[fixed]	Ω_1	5.349	0.006	r_1 (pole)	0.233	0.001
y (bol)	0.545	0.388	[fixed]	Ω_2	4.882	0.006	r_1 (point)	0.242	0.001
x (V)	0.076	0.202	[fixed]	$q = M_2/M_1$	1.080	[fixed]	r_1 (side)	0.236	0.001
y (V)	0.730	0.590	[fixed]	i (deg)	89.6	0.1	r_1 (back)	0.240	0.001
x (R_c)	0.039	0.105	[fixed]	$L_1/(L_1+L_2)$ (V)	0.424	0.0005	r_2 (pole)	0.273	0.001
y (R_c)	0.662	0.587	[fixed]	$L_1/(L_1+L_2)$ (R)	0.422	0.0005	r_2 (point)	0.291	0.001
y (R_c)	0.662	0.587	[fixed]	$L_1/(L_1+L_2)$ (I)	0.421	0.0005	r_2 (side)	0.279	0.001
y (I_c)	0.572	0.536	[fixed]	$\Sigma\omega_{res}^2$	0.00971	—	r_2 (back)	0.286	0.001

The WD output fundamental parameters are listed in Table 4 along with those from the properties of zero age main sequence stars (ZAMS; Cox, 2000). In estimating the distance, galactic extinction was allowed for using the formula $A_V = 3E(B-V) = 3((B-V)_{\rm data} - (B-V)_{\rm tables})$. This method is relatively crude in that neither star is on the main sequence (throwing in question the tabular value for $(B-V)$). Also, the value 3 is an approximation – it varies from place to place and many authors favour the value 3.1. This last uncertainty accounts for an error of only 4 pc and is therefore well within the error estimate of 45 pc.

As one will note from the table, both stars are over-luminous for the (solar abundant) ZAMS (Cox, 2000) by factors of about 1.5 and 2 (respectively).

Performing 2-dimensional interpolations (using the adopted temperatures and WD masses) in the under-abundant (Z = 0.004, Y = 0.252) evolutionary tracks of Charbonnel et al. (1993) yields close agreement for the luminosities of both stars (see Table 5).

Table 4.

Fundamental Quantity	Star 1			Star 2		
	Tabular	WD	error	Tabular	WD	Error
Sp. Type	A7 V			A7 V		
Mass ($M_\odot$)	1.80	1.57	0.10	1.80	1.69	0.11
Radius ($R_\odot$)	1.60	1.97	0.01	1.60	2.33	0.01
M bol	2.12	2.00	0.17	2.12	1.66	0.17
Log g (cgs)	4.28	4.04	0.004	4.28	3.93	0.004
Luminosity (Lo)	8.80	13	2	8.80	18	3
Distance (pc)	—	670	44	—	—	—

The lesser-abundant (Z = 0.001) tracks of Schaller (1992), the greater-abundant (Z=0.008) tracks of Shaerer (1993), plus the solar-abundant (Z = 0.02) tracks of Schaller (1992) are added for comparison. Note that all the papers are by the same Swiss group and represent a homogeneous set of calculations.

Table 5. Luminosities (solar units)

Abundance	Z = 0.001 Schaller 1992	Z = 0.004 Charbonnel 1993	WD Result	Z = 0.008 Schaerer 1993	Z = 0.02 Schaller 1992
Star 1 Luminosity	30	14	13	9.1	4.7
Star 2 Luminosity	38	20	18	15	8.4

In conclusion, V364 Cas is detached binary with both stars evolved off the ZAMS; they also appear to be have sub-solar abundances. Reference to the data tables of Charbonnel (1993) reveals an apparent age of around 1.3×10^9 years (from the ZAMS). An abundance study for this system would be useful in order to test the evolutionary tracks for Z = 0.004.

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COMMISSIONS 27 AND 42 OF THE IAU
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Budapest
4 May 2009

HU ISSN 0374 – 0676

PLATE ARCHIVE PHOTOMETRY OF CANDIDATE VARIABLE STARS IN CEPHEUS OB3 ASSOCIATION

MUNARI, ULISSE

INAF Osservatorio Astronomico di Padova, Sede di Asiago, I-36032 Asiago (VI), Italy

Name of the object:
USNO-B1.0 1525-0418386, USNO-B1.0 1525-0418333, USNO-B1.0 1525-0418196

Equatorial coordinates:	**Equinox:**
R.A.= $22^{\mathrm{h}}53^{\mathrm{m}}$ **DEC.=** $+62\overset{\circ}{.}5$	2000

Observatory and telescope:
Asiago 67/92 cm Schmidt Telescope

Detector:	plates

Filter(s):	BVR_CI_C

Date(s) of the observation(s):
From August 16, 1971 to November 1, 1978

Comparison star(s):	surrounding BVR_CI_C photometric comparison sequence calibrated by Semkov and Peneva (2008)

Availability of the data:
Available at the IBVS website as `5885-t1.txt`

Remarks:
While they were obtaining CCD photometry of the pre-main sequence object V733 Cephei, Semkov and Peneva (2008, hereafter SP08) noticed the possible variability of three nearby stars, USNO-B1.0 1525-0418386, USNO-B1.0 1525-0418333, and USNO-B1.0 1525-0418196 (for short Var.1, Var.2, and Var.3 hereafter). Their amplitudes of variability were reported by SP08 as $\Delta V = 2.98$ (19.26−16.28) and $\Delta I_C = 2.36$ (16.24−13.88) for Var. 1, $\Delta V = 1.02$ (17.38−16.36) and $\Delta I_C = 0.67$ (14.54−13.87) for Var. 2, and $\Delta V = 0.35$ (15.61−15.26) and $\Delta I_C = 0.27$ (13.33−13.06) for Var. 3. They observed the candidate variable stars on 12 dates distributed over the period February 2007 to February 2008, and suggested that Var. 1 could be a Mira and Var. 2 a pre-main sequence object.

Remarks:

To help shed light on the matter, we estimated the brightness of the three possible new variables on 40 plates that we found in the plate archive of the Asiago 67/92cm Schmidt telescope. The plates were exposed on Cep OB3 from August 16, 1971 to November 1, 1978. The filter + emulsion combinations corresponds to the B, V, R_C and I_C photometric bands. The magnitude of the three possible new variable stars was estimated at the microscope against the local BVR_CI_C photometric sequence calibrated by SP08. The measurements were repeated in an unbiased manner for all plates on different days. All measurements were found to repeat within 0.1 mag. The resulting magnitudes and observing details are given in Table 1 (Fig. 1).

<u>Var.1</u> (USNO-B1.0 1525-0418386). The mean values (and dispersion) we measured on the 1971-1978 Asiago plates are: $< B >= 18.8$ ($\sigma = 0.9$), $< V >= 16.93$ ($\sigma = 0.05$), $< I_C >= 14.49$ ($\sigma = 0.15$). They are within the range of variability reported by SP08. The star is confirmed, beyond doubt, to vary on the B band plates we examined, while the variability at Ic is far less pronounced (much less than listed by SP08). SP08 suggested Var.1 to be a Mira variable. To lie within the Galaxy in that direction (9 kpc) and to shine at $< V >= 16.9$, Var.1 must be extincted by $A_V \geq 1.1$ for an absolute magnitude $M_V = -1$, typical for Miras. It would correspond to $E_{V-I} \geq 0.5$ for a standard reddening law, and thus to an intrinsic $(V - I_C)_\circ \leq 2.5$ for the range of $V - I_C$ measured by SP08. Comparing with intrinsic colors by Bessell (1990) the corresponding spectral type would equal or earlier than M3III. Such an early spectral type would corresponds to a Mira with a short pulsation period and low amplitude, in agreement with our data. The $\Delta I_C = 2.36$ reported by SP08 (and not confirmed by our data) would be far too large for such a Mira.

<u>Var.2</u> (USNO-B1.0 1525-0418333). The star does not vary on the 1971-1978 plates we examined. The mean values (and dispersion) are: $< B >= 17.68$ (σ=0.04), $< V >= 16.40$ (σ=0.00), $< I_C >= 13.83$ (σ=0.11).

<u>Var.3</u> (USNO-B1.0 1525-0418196). This star too does not vary on the 1971-1978 plates we examined. The mean values (and dispersion) are: $< B >= 16.95$ (σ=0.05), $< V >= 15.03$ (σ=0.12), $< I_C >= 13.01$ (σ=0.12).

Our values for both Var.2 and Var.3 correspond to the the bright end of the range of variability reported by SP08. If they are indeed variable stars, their variability appears confined to rare episodes of drop in brightness from a protracted and stable bright state.

References:

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N.	HJD	*date*	*<UT>*	*plate + filter*			*Var.1*	*Var.2*	*Var.3*
4577	2441180.42001	1971 08 16	22:03	103a-O	GG13	B	>19.5	17.6	17.0
4669	2441216.50252	1971 09 21	24:00	0a-O	GG13	B	19.5	17.7	17.0
4709	2441240.35147	1971 10 15	20:22	0a-O	GG13	B	>17.7	17.7	17.0
4810	2441246.33759	1971 10 21	20:02	103a-O	GG13	B	19.0	17.6	16.9
4989	2441251.51882	1971 10 26	24:23	103a-O	GG13	B	17.8	17.7	16.9
5012	2441293.23595	1971 12 07	17:37	Ia-O	GG13	B	17.7	17.6	17.0
5065	2441298.24062	1971 12 12	17:44	Ia-O	GG13	B	>17.7	17.7	16.9
5097	2441301.25091	1971 12 15	17:59	Ia-O	GG13	B	17.8	17.6	16.9
5656	2441596.45764	1972 10 05	22:55	103a-O	GG13	B	19.3	17.7	16.9
5749	2441624.37154	1972 11 02	20:51	103a-O	GG13	B	>19.5	17.7	16.9
5809	2441628.35829	1972 11 06	20:32	103a-O	GG13	B	18.8	17.7	16.9
5935	2441651.24176	1972 11 29	17:45	103a-O	GG13	B	18.6	17.7	16.9
9284	2443455.43327	1977 11 07	22:20	103a-O	GG13	B	–	–	17.0
9348	2443480.38055	1977 12 02	21:05	103a-O	GG13	B	17.8	17.7	16.9
9374	2443492.35648	1977 12 14	20:31	103a-O	GG13	B	17.6	17.7	17.0
9713	2443814.34655	1978 11 01	20:15	103a-O	GG13	B	>19.5	17.7	17.0
9796	2443837.37734	1978 11 24	21:00	104a-O	GG13	B	>17.7	17.7	17.0
4579	2441180.47349	1971 08 16	23:20	IN	RG5	Ic	14.3	13.6	13.1
4670	2441216.53030	1971 09 21	24:40	IN	RG5	Ic	14.6	13.7	13.2
4710	2441240.38202	1971 10 15	21:06	IN	RG5	Ic	14.7	13.9	12.9
4811	2441246.36606	1971 10 21	20:43	IN	RG5	Ic	14.6	13.6	13.1
5011	2441293.21165	1971 12 07	17:02	IN	RG5	Ic	14.6	13.9	12.9
5064	2441298.21354	1971 12 12	17:05	IN	RG5	Ic	>14.3	13.8	12.9
5096	2441301.22383	1971 12 15	17:20	IN	RG5	Ic	14.6	13.9	13.1
5657	2441596.47987	1972 10 05	23:27	IN	RG5	Ic	14.7	13.8	13.1
5748	2441624.35140	1972 11 02	20:22	IN	RG5	Ic	14.6	13.8	12.9
5808	2441628.33815	1972 11 06	20:03	IN	RG5	Ic	14.5	13.8	12.7
5934	2441651.22023	1972 11 29	17:14	IN	RG5	Ic	14.3	13.8	13.1
5980	2441663.31632	1972 12 11	19:33	IN	RG5	Ic	14.6	14.0	12.9
6025	2441676.21091	1972 12 24	17:02	IN	RG5	Ic	14.3	13.9	12.9
9285	2443455.45758	1977 11 07	22:55	IN	RG5	Ic	14.5	13.9	13.1
9296	2443458.34850	1977 11 10	20:18	IN	RG5	Ic	14.3	13.8	13.1
9325	2443464.37893	1977 11 16	21:02	IN	RG5	Ic	14.5	13.9	13.2
9349	2443480.40625	1977 12 02	21:42	IN	RG5	Ic	14.3	13.9	12.9
9373	2443492.33010	1977 12 14	19:53	IN	RG5	Ic	14.3	14.0	13.2
9714	2443814.37363	1978 11 01	20:54	IN	RG5	Ic	14.5	13.8	12.9
4578	2441180.44710	1971 08 16	22:42	103a-E	RG1	Rc	15.7	14.9	14.2
5982	2441663.38854	1972 12 11	21:17	103a-D	GG14	V	16.9	16.4	14.9
6026	2441676.23104	1972 12 24	17:31	103a-D	GG14	V	16.9	16.4	15.0
9795	2443837.35998	1978 11 24	20:35	103a-D	GG14	V	17.0	16.4	15.2

Figure 1. (Table 1) BVR_CI_C photometry of the suspected variables on 1971-1978 plates from the archive of the Asiago 67/92 Schmidt telescope.

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ASAS J071829-0336.7: SHORT-PERIOD END FOR CONTACT BINARIES REDEFINED

PRIBULLA, T.[1,2]; VAŇKO, M.[1,2]; HAMBÁLEK, L.[2]

[1] Astrophysikalisches Institut und Universitäts-Sternwarte, Schillergässchen 2-3, D-07740 Jena, Germany, e-mail: pribulla@ta3.sk; vanko@astro.uni-jena.de

[2] Astronomical Institute of the Slovak Academy of Sciences, 05960 Tatranská Lomnica, The Slovak Republic, e-mail: lhambalek@ta3.sk

It is well known that classical W UMa-type binaries have spectral types A-K and we do not observe a single system with components of M spectral type. The spectral types and colors correlate with orbital periods due to the main-sequence state of the components, which results in sharp cut-off in the number of systems at short orbital periods. The physical reasons for the observed period cut-off are still not clear (see Rucinski, 1992).

The statistical data on the contact binaries have significantly been improved by the The All Sky Automated Survey (ASAS) (Pojmanski 1997, 2004; Paczynski et al., 2006) by discovery of several hundred new systems in the magnitude range 8-13 magnitudes. Analysis of their period distribution (Rucinski, 2007) showed that the maximum in the contact-binary numbers occurs at about $P = 0.27$ days with definite short-period cut-off at about 0.215-0.22 days. Rucinski (2007) indicated seven contact-binary candidates with $P < 0.22$ days in the ASAS sample and selected GSC 1387-475 as the best candidate. The photometric and spectroscopic investigation of Rucinski & Pribulla (2008) confirmed that GSC 1387-475 is genuine contact binary; at present being record holder for field systems with $P = 0.2178$ days. The only known contact binary having shorter period is V34 in globular cluster 47 Tuc with $P = 0.2155$ days (Weldrake et al., 2004).

In our investigation we focused on two other ASAS candidates listed in Table 3 of Rucinski (2007) observable from northern mid-latitudes: J071829-0336.7 ($P_{ASAS} = 0.211249$ days, $V_{max} = 13.75$), and J113031-0101.9 ($P_{ASAS} = 0.213135$ days, $V_{max} = 13.36$). Both stars are fainter than $V = 13$ in the maximum, therefore useful spectroscopic observations leading to sound analysis would require 8-10m class telescope because of very short orbital periods. While 2MASS infrared color of J071829-0336.7, $(J - K) = 0.81$ (K7V) is consistent with extremely short orbital period, J113031-0101.9 is too blue, $(J - K) = 0.40$ (G4-5V), to be contact binary with the orbital period given in the ASAS database.

Both targets were observed at the Stará Lesná Observatory of the Astronomical Institute of Slovak Academy of Sciences using 50cm Newton telescope equipped with SBIG ST10MXE CCD camera (see Pribulla & Chochol, 2003). Expecting both objects to be mid K-type binaries the observations were performed in the R_C and I_C filters only. The instrumental magnitudes of the targets have been obtained by the aperture photometry using the photometrically calibrated frames (dark frame subtraction and flat field division). The differential magnitudes have been left in the instrumental photometric system, very close to the Johnson-Cousins system. The part of typical CCD frames in the I_C passband for either of the targets showing the variable, comparison and check stars are shown in Figs. 1-2. The times of minimum light for both systems determined using Kwee & van Woerden's method are listed in Table 1. The preliminary light-curve (LC) analysis has been performed using code *ROCHE* (see Pribulla, 2004).

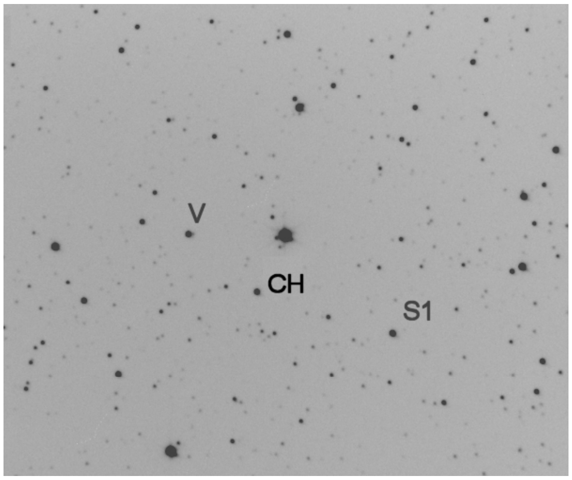

Figure 1. Field of the eclipsing binary ASAS J071829-0336.7. The size of the field is $11.'20 \times 8.'33$.

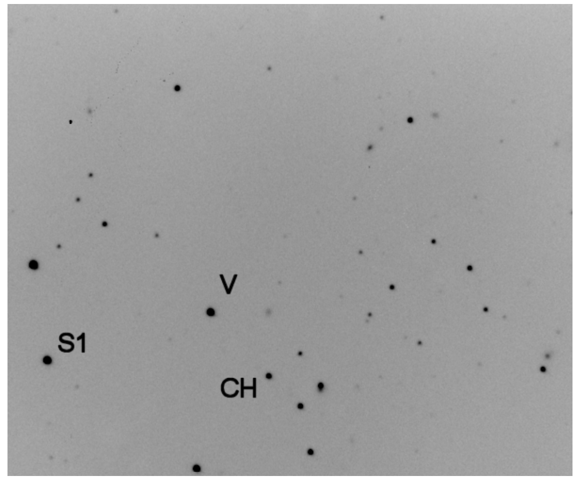

Figure 2. Field of the eclipsing binary ASAS J113031-0101.9. The size of the field is $11.'20 \times 8.'33$.

Table 1. Times of primary (I) and secondary (II) minima for both eclipsing binaries. Weighted averages from individual filters are given.

Star	HJD	Error	Filters	Type
J071829-0336.7	2454845.4267	0.0002	$(RI)_C$	I
	2454865.3905	0.0001	$(RI)_C$	II
	2454916.3039	0.0001	$(RI)_C$	II
J113031-0101.9	2454905.4210	0.0005	R_C	I
	2454917.4807	0.0002	$(RI)_C$	I

J071829-0336.7 Although this target has been observed during three nights (Jan 13/14, Feb 2/3 and Mar 25/26, 2009) only, thanks to the extremely short orbital period, full phase coverage has been achieved. The differential LC of J071829-0336.7 has been obtained with respect to USNO-A 0825.04506649 having similar color. The stability of this comparison has been checked using USNO-A 0825.04514810. Our new photometry (Fig. 3) definitely shows that the system is a close binary and not a pulsating variable. Very short orbital period given in the ASAS catalogue has been checked by fitting trigonometric polynomials of the 12th degree to the phase diagrams of our I_C data for test periods between 0.205 and 0.215 days. The best period was later optimized by non-linear least squares fitting of even trigonometric polynomials resulting in the following ephemeris for the primary minimum:

$$\mathrm{HJD\ (MinI)} = 2\,454\,874.7916(3) + 0.2112594(6)E, \tag{1}$$

compatible with the ASAS result. When scrutinizing the CCD frames of the system a faint companion has been noticed west of the system which could not be separated during the aperture photometry, but which adds unknown amount of third light. The minima of the system are partial, therefore geometric parameters cannot reliably be determined without spectroscopic mass ratio. The observed LC could be solved successfully for a large range of mass ratios between 0.55 and 0.85 (limited by rather large photometric amplitude, about 0.55 mag). Assumption of the W-type classification (less massive component slightly hotter) always resulted in better χ^2. For the case of q=0.65, convective envelope, temperature of the hotter component 4020 K (K7V), marginal contact (fill-out = 0) the orbital inclination is $i = 76\overset{\circ}{.}8$. The system sets the new short-period limit for contact binaries.

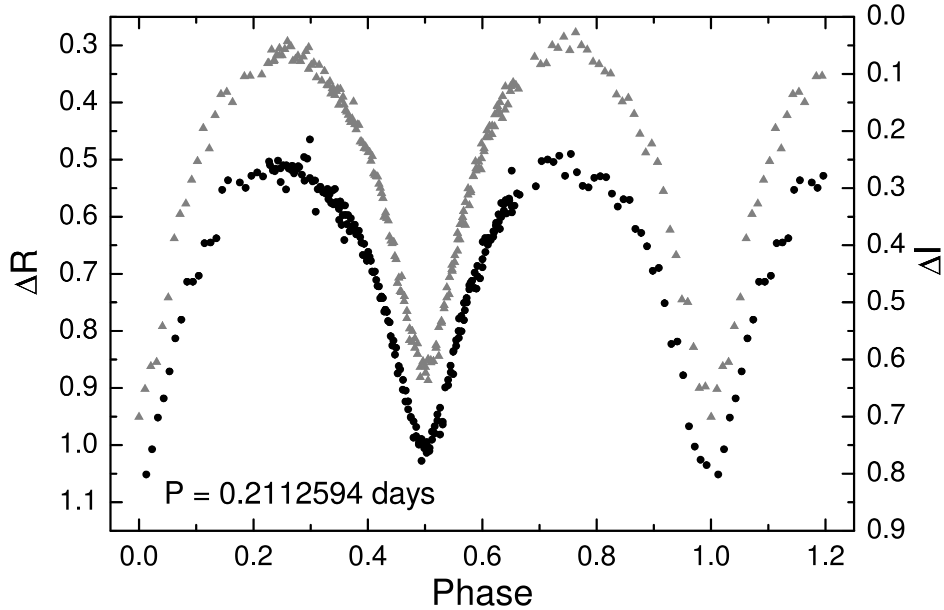

Figure 3. R_C (gray triangles) and I_C (black circles) LCs of J071829-0336.7.

J113031-0101.9 The LC of the variable (Fig. 4) has been obtained by aperture photometry with respect to GSC 4930-00167. The stability of the comparison has been checked using USNO-A 0825.07480282. The CCD photometry (Jan 25/26, Feb 2/3, Feb 29/Mar 1, Mar 14/15, 25/26, 26/27, 2009) showed that the orbital period given in the ASAS catalogue, P_{ASAS} = 0.213135 days, is spurious. This became evident from the observing run on March 14/15 which covered both minima and indicated orbital period substantially longer, being about 0.270 days. Unfortunately, ASAS photometry is too noisy to reliably determine/improve the orbital period. Therefore, the orbital period has been searched by fitting trigonometric polynomials of the 12th degree to the phase diagrams of our I_C data for test periods between 0.25 and 0.29 days. The best period was later optimized by non-linear least squares fitting of even trigonometric polynomials resulting in the following ephemeris for the minimum:

$$\mathrm{HJD(MinI)} = 2\,454\,905.2867(3) + 0.270969(4)E. \quad (2)$$

The Stará Lesná data (Fig. 4) show that the system is totally eclipsing, but otherwise rather usual contact binary. Thanks to the total eclipses the geometric parameters, $q = 0.15$, $i = 88°$, and fill-out $f = 0.5$ are rather reliable (unless there was third light). The system, however, requires photometric observations from at least 1m telescope.

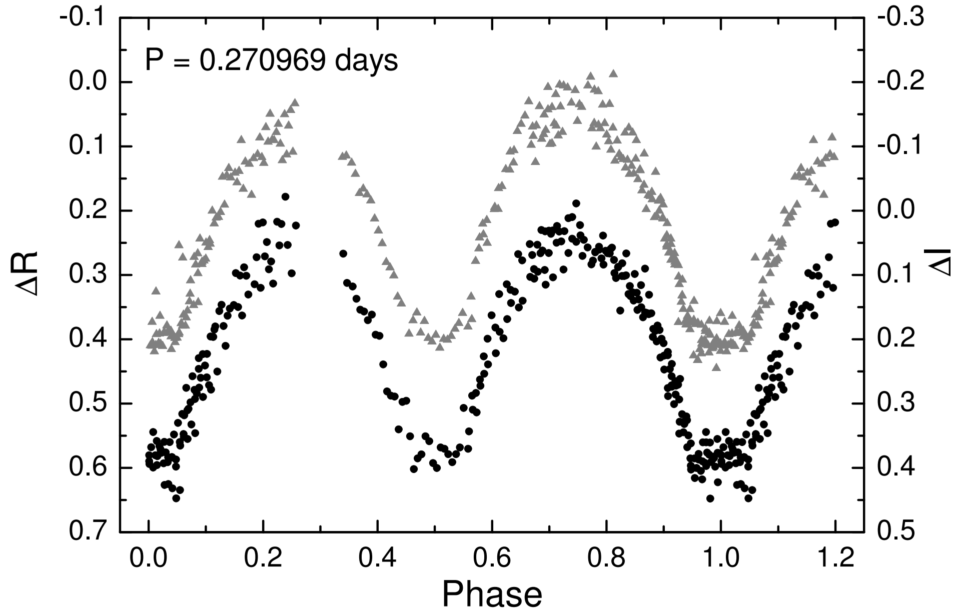

Figure 4. $(RI)_C$ light curves of J113031-0101.9. The centered symbols as in Fig. 3.

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NEW TIMES OF MINIMA OF SOME ECLIPSING BINARY STARS AND MAXIMA OF PULSATING STARS

YILMAZ, M.; BAŞTÜRK, Ö.; ALAN, N.; ŞENAVCI, H. V.; TANRIVERDİ, T.; KILIÇOĞLU, T.; ÇALIŞKAN, Ş.; ÇELİK, L.; AYDIN, G.; ÇAKAN, D.; BİLGİÇ, D.; ULUŞ, N. D.; ELMASLI, A.; SELAM, S. O.; ALBAYRAK, B.; EKMEKÇİ, F.

Ankara University Observatory, 06837, Ahlatlıbel, Ankara, TURKEY
e-mail: mesut@astro1.science.ankara.edu.tr

Observatory and telescope:
30-cm Maksutov-Cassegrain and 40-cm Schmidt-Cassegrain telescope of the Ankara University Observatory

Detector:	- OPTEC SSP-5A photoelectric photometer (uncooled) containing a side-on R1414 Hamamatsu photomultiplier. - Apogee ALTA U47+ CCD camera, 1024 × 1024 pixels.

Method of data reduction:
Reduction of the photoelectric observations was made in the usual way (Hardie, 1962) and reduction of the CCD frames was made with IRAF[1] package.

Method of minimum determination:
The minima and maxima times were calculated using Kwee & van Woerden's (1956) method.

Table 1: Minima Times of Eclipsing binaries

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Method	Obs.
V372 And	54733.4251	0.0002	I	BVR	ccd	DÇA-YÇE
	54758.4248	0.0001	II	BVR	ccd	LÇE-SKÖ
	54780.4826	0.0001	I	BVR	ccd	ÖBA-ŞHA
HS Aqr	54666.4121	0.0002	II	BVR	ccd	ZAV-SSA
	54667.4758	0.0001	I	BVR	ccd	ŞÇA-LKA
	54687.3616	0.0001	I	BVR	ccd	OBİ-GER
	54720.3846	0.0003	II	BVR	ccd	ZTE-EİM
AP Aur	54401.4788	0.0006	I	BV	pe	ETÖ-CTE
	54491.4441	0.0006	I	BV	pe	ECİ-TKI
	54500.2695	0.0006	II	BV	pe	TTA-HAS
	54527.3127	0.0004	I	BV	pe	GÖA-KYİ
	54762.4656	0.0006	I	BV	pe	MYI-BSİ

[1]IRAF is distributed by the National Optical Astronomical Observatories, operated by the Association of the Universities for Research in Astronomy, inc., under cooperative agreement with the National Science Foundation

Table 1: (cont.)

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Method	Obs.
AR Aur	54438.4782	0.0003	II	BV	pe	TKI-POR
	54777.5236	0.0005	II	BVR	ccd	ÖBA-AKA
IU Aur	54062.4016	0.0007	II	BV	pe	TTA-ZŞA
TZ Boo	54521.4731	0.0005	II	BV	pe	SSİ-HDU
	54600.3682	0.0004	I	BV	pe	NUL-HBO
	54614.3323	0.0003	I	BV	pe	TTA-YÇE
	54614.4828	0.0003	II	BV	pe	ZŞA-YÇE
	54621.4701	0.0005	I	BV	pe	BSİ-KTO
	54663.3708	0.0006	I	BV	pe	HBO-DÇA
	54666.3404	0.0005	I	BV	pe	SSA-GYA
AC Boo	54491.6398	0.0003	II	BV	pe	EGÜ-GİA
	54643.3642	0.0004	I	BV	pe	HKA-KTO
	54671.3810	0.0005	II	BV	pe	MYI-ŞŞA
CK Boo	54489.5903	0.0005	II	BV	pe	HŞE-DSA
	54648.3426	0.0005	II	BV	pe	AEL-SAY
DU Boo	54227.4733	0.0002	I	BVR	ccd	NAL-SSU
	54235.4138	0.0002	II	BVR	ccd	GGÖ-ADE
ET Boo	54207.4357	0.0001	II	BVR	ccd	TÇA-HGÜ
	54226.4654	0.0001	I	BVR	ccd	GÖA-ETÖ
TX Cnc	54466.5192	0.0005	I	BV	pe	BSA-GKA
	54501.3684	0.0004	I	BV	pe	MŞE-SER
WY Cnc	54456.4350	0.0006	I	BV	pe	EES-GYA
	54505.3680	0.0002	I	BV	pe	ŞÇA-ZAV
	54507.4389	0.0007	II	BV	pe	MÖZ-ABİ
	54519.4635	0.0003	I	BV	pe	GİA-EGÜ
BO CVn	54656.3429	0.0002	I	BVR	ccd	MYI-MSE
	54665.4026	0.0004	II	BVR	ccd	DÖZ-İTÜ
	54671.3491	0.0002	I	BV	ccd	ÖTA-SAK
	54678.3377	0.0002	II	BV	ccd	ÖTA-TKA
	54699.2940	0.0002	I	BVR	ccd	ZAY-GVA
V776 Cas	54788.3554	0.0002	I	BVR	ccd	KEY-TÇA
EG Cep	54668.3976	0.0002	II	BVR	ccd	NAL-LÇE
	54672.4814	0.0001	I	BVR	ccd	TYI-ÖBA
	54676.5650	0.0003	II	BVR	ccd	GER-BSA
RW Com	54854.4996	0.0001	II	VRI	ccd	DBİ-DÖZ
	54854.6188	0.0001	I	VRI	ccd	DBİ-DÖZ
	54865.5361	0.0001	I	BVR	ccd	ADE-MŞE
	54865.6541	0.0001	II	BVR	ccd	GGÖ-TÇA
	54911.5823	0.0001	I	BVR	ccd	ZAV-EES
	54914.5486	0.0001	II	BVR	ccd	HGÜ-POR
	54930.3325	0.0001	I	BVR	ccd	HŞE-TKA
	54930.4503	0.0002	II	BVR	ccd	HŞE-ZAY
YY CrB	54604.3614	0.0001	I	BV	pe	GÖA-CKI
	54605.4910	0.0002	I	BV	pe	LÇE-DÇA
	54688.3345	0.0003	I	BV	pe	ŞÇA-EÖZ
ZZ Cyg	54673.4536	0.0001	I	BVR	ccd	TKI-AEL
	54674.3964	0.0003	II	BVR	ccd	GÖA-EÖZ
	54717.4570	0.0001	I	BVR	ccd	MPI-SSU
GO Cyg	54634.3658	0.0004	I	BV	pe	GKA-SER
	54640.4689	0.0004	II	BV	pe	LÇE-MPI
	54653.3903	0.0005	II	BV	pe	ABİ-CKI
	54667.3843	0.0003	I	BV	pe	LKA-ZTE
	54677.4322	0.0003	I	BV	pe	ŞŞA-YÇE
	54692.5060	0.0003	I	BV	pe	HKA-ÖTA

Table 1: (cont.)

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Method	Obs.
GO Cyg	54700.4003	0.0004	I	BV	pe	ÖBA-CTE
	54705.4257	0.0003	I	BV	pe	MYI-HBO
	54710.4500	0.0002	I	BV	pe	NAL-MYA
MR Cyg	54374.4208	0.0003	I	BV	pe	MYA-SKÖ
	54390.3593	0.0007	II	BV	pe	KEY-ŞHA
	54696.4114	0.0002	I	BV	pe	MÖZ-HAS
V477 Cyg	54654.4723	0.0002	I	BV	pe	HDU-SSİ
V836 Cyg	54376.3361	0.0002	I	BV	pe	İTÜ-ADE
	54393.3258	0.0003	I	BV	pe	AEL-GİA
	54429.2639	0.0004	I	BV	pe	ETÖ-GÖA
	54649.4630	0.0004	I	BV	pe	TTA-MSE
	54752.3759	0.0007	II	BV	pe	EÇÖ-BSİ
	54373.3945	0.0004	II	BV	pe	DBİ-BSA
V1073 Cyg	54697.3165	0.0002	II	BVRI	ccd	TKI-SER
	54698.4943	0.0002	I	BVRI	ccd	MYI-ZŞA
	54720.5010	0.0004	I	BVRI	ccd	HŞE-EES
V1191 Cyg	54653.3860	0.0001	II	BV	ccd	EİM-CTE
	54654.4816	0.0001	I	BVR	ccd	SKÖ-HAS
	54654.3264	0.0001	II	BVR	ccd	SKÖ-SSU
	54656.5204	0.0001	II	BVR	ccd	ŞŞA-EÇÖ
	54662.4744	0.0002	II	BVR	ccd	GER-GKA
V2150 Cyg	54414.2966	0.0005	I	BV	pe	ÖBA-ZAV
	54674.4056	0.0004	II	BV	pe	LKA-CKI
	54679.4498	0.0006	I	BV	pe	DSA-İTÜ
	54693.3594	0.0008	II	BV	pe	ÖBA-TYI
	54759.3441	0.0005	I	BV	pe	EÇÖ-NUL
DM Del	54404.2733	0.0010	I	BV	pe	AKA-ŞHA
	54760.2868	0.0009	II	BV	pe	TKI-BSA
LS Del	52562.3993	0.0003	II	BV	pe	GER-BSA
	53293.3382	0.0003	II	BV	pe	HŞE-NBA
	53558.3901	0.0005	I	BV	pe	NUL-MYI
	53560.4026	0.0004	II	BV	pe	TTA-ECİ
	53589.3258	0.0006	I	BV	pe	ETÖ-NBA
	53589.5074	0.0009	II	BV	pe	TTA-GÖA
	53606.4239	0.0008	I	BV	pe	NAL-DBİ
YY Eri	54373.3945	0.0004	II	BV	pe	GÖA-KYİ
	54404.5444	0.0002	I	BV	pe	DÇA-KEY
	54465.3069	0.0002	I	BV	pe	LÇE-MPI
	54467.3951	0.0003	II	BV	pe	ADE-ŞÇA
V345 Gem	54844.3680	0.0002	I	BVR	ccd	GGÖ-POR
	54844.5029	0.0001	II	BVR	ccd	SAY-TÇA
	54845.4695	0.0001	I	VR	ccd	MYI-MSE
	54845.6031	0.0002	II	VR	ccd	ŞŞA-BSİ
	54851.5120	0.0002	I	BVR	ccd	BSA-HGÜ
	54851.6488	0.0002	II	BVR	ccd	DBİ-MŞE
AK Her	54610.4137	0.0004	I	BV	pe	ÖBA-EES
	54616.3136	0.0004	I	BV	pe	EES-CTE
	54620.3239	0.0006	II	BV	pe	TKI-SAY
	54630.4391	0.0004	II	BV	pe	DÖZ-KTO
	54640.3419	0.0003	I	BV	pe	MPI-HDU
HS Her	54685.3698	0.0003	I	BV	pe	HŞE-HKA
V829 Her	54587.4809	0.0005	I	BV	pe	DÇA-GVA
	54616.4969	0.0003	I	BV	pe	AEL-TYI
	54662.5167	0.0008	II	BV	pe	TKI-GKA
	54647.4809	0.0006	II	BV	pe	SER-HGÜ
V842 Her	54593.4986	0.0005	II	BV	pe	NAL-AKA
	54670.3877	0.0003	I	BV	pe	TTA-ŞŞA

Table 1: (cont.)

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Method	Obs.
V878 Her	54669.4497	0.0001	I	BVR	ccd	GİA-GER
	54683.4818	0.0002	II	BVR	ccd	TÇA-POR
	54701.4879	0.0003	II	BVR	ccd	ECİ-ZAY
SW Lac	54385.4827	0.0003	II	BV	pe	AEL-SAK
	54660.5022	0.0001	I	BV	pe	ABİ-EÖZ
	54661.4639	0.0001	I	BV	pe	MÖZ-MYA
	54665.4721	0.0010	II	BV	pe	GYA-SSA
	54673.4919	0.0002	II	BV	pe	ZAV-EES
	54675.4145	0.0002	II	BV	pe	SKÖ-SSİ
	54681.3486	0.0002	I	BV	pe	CKI-LKA
	54681.5097	0.0002	II	BV	pe	LKA-ŞÇA
	54686.3210	0.0004	II	BV	pe	GGÖ-DSA
	54698.5039	0.0005	II	BV	pe	MYI-YÇE
	54703.4790	0.0001	I	BV	pe	DÇA-LÇE
	54716.4679	0.0001	II	BV	pe	ZTE-EİM
	54719.5151	0.0024	I	BV	pe	ZŞA-HBO
	54756.3974	0.0003	I	BV	pe	ÖBA-HGÜ
	54757.3583	0.0003	I	BV	pe	AEL-GYA
XY Leo	54098.5661	0.0003	II	BV	pe	SSA-GİA
	54498.5833	0.0005	II	BV	pe	EGÜ-ECİ
	54502.4188	0.0003	I	BV	pe	TKA-SAK
	54523.4478	0.0002	I	BV	pe	KYİ-GVA
	54523.3058	0.0005	II	BV	pe	BSA-ADE
	54530.5494	0.0004	I	BV	pe	HGÜ-MŞE
	54530.4089	0.0003	II	BV	pe	TYI-GGÖ
	54582.3292	0.0006	II	BV	pe	ÖBA-ZAV
	54621.3142	0.0002	II	BV	pe	KEY-ŞHA
XZ Leo	54499.4135	0.0003	II	BV	pe	EÖZ-EİM
AP Leo	54501.5440	0.0009	II	BV	pe	TKI-DBİ
UV Leo	54465.4213	0.0003	I	BV	pe	SSİ-SKÖ
	54523.3299	0.0002	II	BV	pe	ŞHA-İYÜ
	54553.3349	0.0002	II	BV	pe	EES-CTE
CN Lyn	54518.3333	0.0008	I	BV	pe	NBA-ÖTA
V456 Oph	54649.3582	0.0004	I	BV	pe	NAL-ADE
V502 Oph	54577.5419	0.0006	II	BV	pe	LÇE-MÖZ
	54641.4712	0.0006	II	BV	pe	GER-GKA
V508 Oph	54655.3364	0.0003	I	BV	pe	TÇA-TKA
	54656.3689	0.0009	I	BV	pe	SAY-EGÜ
V566 Oph	54641.3192	0.0005	II	BV	pe	AKA-HDU
	54642.3433	0.0004	I	BV	pe	TTA-YÇE
	54646.4391	0.0001	I	BV	pe	ŞÇA-NBA
	54702.3565	0.0004	II	BV	pe	EİM-KYİ
V839 Oph	54576.5661	0.0004	I	BV	pe	ZTE-LKA
	54625.4398	0.0002	II	BV	pe	LKA-ŞÇA
	54628.5035	0.0003	I	BV	pe	HBO-BSİ
	54655.5025	0.0004	I	BV	pe	GGÖ-HGÜ
U Peg	54434.3465	0.0002	I	BV	pe	HŞE-NBA
V351 Peg	54689.4655	0.0004	II	BV	pe	SKÖ-MÖZ
V357 Peg	54702.4649	0.0001	I	BVR	ccd	ŞÇA-EÖZ
	54714.3240	0.0001	II	BVR	ccd	HŞE-TYI
	54723.2892	0.0002	I	BVR	ccd	CKI-ŞÇA
	54728.4946	0.0001	I	BVR	ccd	ÖBA-DÖZ
	54748.4518	0.0001	II	BVR	ccd	DSA-EÇÖ
V407 Peg	54703.5236	0.0002	II	BVR	ccd	LÇE-DÇA
	54716.5690	0.0002	I	BVR	ccd	ŞÇA-NBA
	54718.4808	0.0003	I	BVR	ccd	GİA-DBİ
	54721.3570	0.0002	II	BVR	ccd	BSA-İTÜ

Table 1: (cont.)

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Method	Obs.
V407 Peg	54746.5075	0.0003	I	BVR	ccd	GYA-MŞE
	54752.2351	0.0003	I	BVR	ccd	SSU-MPI
IQ Per	54421.2998	0.0006	II	BV	pe	TKI-GYA
	54733.4028	0.0005	II	BV	pe	MYI-ŞŞA
ST Per	54428.3647	0.0006	I	BV	pe	EES-CTE
V482 Per	54400.3747	0.0006	I	BV	pe	CTE-NUL
	54433.4101	0.0006	II	BV	pe	MYI-YÇE
AQ Psc	54417.3032	0.0005	II	BV	pe	TTA-ECİ
	54763.3041	0.0006	I	BV	pe	CTE-DÖZ
	54764.4984	0.0007	II	BV	pe	ZAV-SSA
RZ Tau	54769.5842	0.0002	I	BVR	ccd	HŞE-GVA
	54770.4130	0.0001	I	BVR	ccd	EGÜ-DSA
	54778.3108	0.0001	I	BVR	ccd	TKI-AEL
	54778.5188	0.0001	II	BVR	ccd	POR-TYI
GR Tau	54371.5594	0.0006	I	BV	pe	CTE-GER
	54376.5064	0.0006	II	BV	pe	NAL-ŞHA
	54422.5039	0.0004	II	BV	pe	GÖA-ETÖ
	54520.2942	0.0002	I	BV	pe	SSİ-ABİ
V471 Tau	54718.4881	0.0005	I	BV	pe	SAY-BSA
V781 Tau	54436.5708	0.0003	II	BV	pe	TTA-ZTE
	54520.3817	0.0005	II	BV	pe	ŞÇA-LKA
	54756.4728	0.0005	I	BV	pe	HŞE-EES
	54757.5060	0.0003	I	BV	pe	GİA-SSA
V781 Tau	54760.6118	0.0001	I	BVR	ccd	DBİ-GKA
	54760.4426	0.0001	II	BVR	ccd	DBİ-POR
	54775.4442	0.0001	I	BVR	ccd	MYI-ŞŞA
	54775.6177	0.0001	II	BVR	ccd	HBO-EÇÖ
V1123 Tau	54719.5734	0.0001	I	BVR	ccd	ZŞA-BSİ
	54722.5754	0.0002	II	BVR	ccd	TKI-GYA
	54725.5735	0.0001	I	BVR	ccd	GGÖ-SER
	54726.5752	0.0002	II	BVR	ccd	YÇE-ŞŞA
	54740.5726	0.0001	II	BVR	ccd	ŞŞA-MSE
	54747.5707	0.0001	I	BVR	ccd	EÇÖ-KTO
	54753.5706	0.0001	I	BVR	ccd	AEL-SAY
	54753.3699	0.0002	II	BVR	ccd	TÇA-MŞE
V1128 Tau	54785.3952	0.0001	II	BVR	ccd	TKI-ZAV
	54813.4891	0.0001	II	BVR	ccd	POR-EES
	54842.3464	0.0001	I	BVR	ccd	CKI-EES
	54842.1940	0.0001	II	BVR	ccd	ŞÇA-ZTE
V1130 Tau	54771.4260	0.0001	I	BVR	ccd	EGÜ-GYA
	54779.4153	0.0003	I	BVR	ccd	KYİ-NBA
HH UMa	54833.4998	0.0002	I	BVR	ccd	DÖZ-ÖBA
	54843.4501	0.0002	I	BVR	ccd	NAL-SSU
	54818.9856	0.0002	II	BVR	ccd	MPI-HAS
	54852.4627	0.0003	II	BVR	ccd	ZŞA-GVA
	54932.4452	0.0002	I	BVR	ccd	ÖBA-HGÜ
ZZ UMa	54920.3747	0.0001	I	BVR	ccd	LÇE-HAS
GR Vir	54647.3362	0.0003	I	BV	pe	MYA-HDU
DR Vul	54617.5044	0.0004	II	BV	pe	HKA-SAK
	54680.5335	0.0003	II	BV	pe	ZAY-HKA

Table 2: Maxima Times of Pulsating Stars

Star name	Time of max. HJD 2400000+	Error	Filter	Method	Obs.
OV And	54048.3431	0.0005	BV	pe	AEL-MYI
	54048.3431	0.0005	BV	pe	AEL-MYI
	54056.3448	0.0003	BV	pe	NUL-DÇA
	54057.2851	0.0004	BV	pe	NUL-TTA
	54064.3459	0.0004	BV	pe	NUL-TTA
	54065.2917	0.0009	BV	pe	NUL-GÖA
	54088.3418	0.0005	BV	pe	NUL-AEL
	54098.2293	0.0003	BV	pe	NUL-DÇA
	54700.5654	0.0001	BVR	ccd	NUL-ÖBA
RS Boo	53480.4586	0.0001	BV	pe	NUL-NAL
	53485.3602	0.0003	BV	pe	NUL-LÇE
	53505.3659	0.0004	BV	pe	NUL-ETÖ
ST Boo	54216.5301	0.0001	BVR	ccd	LÇE-GÖA
	54231.4734	0.0002	BVR	ccd	LÇE-DÇA
	54244.4847	0.0005	BV	pe	LÇE-GÖA
	54284.3805	0.0001	BVR	ccd	LÇE-ETÖ
	54287.4903	0.0001	BVR	ccd	LÇE-HŞE
	54297.4482	0.0001	BVR	ccd	LÇE-DÇA
	54307.4037	0.0001	BVR	ccd	LÇE-GÖA
	54330.4271	0.0001	BVR	ccd	LÇE-HŞE
	54335.4003	0.0001	BVR	ccd	LÇE-ETÖ
	54350.3315	0.0001	BVR	ccd	LÇE-DÇA
TV Boo	54228.3646	0.0002	BVR	ccd	NUL-DÇA
	54233.3312	0.0002	BVR	ccd	NUL-ETÖ
	54247.4039	0.0003	BVR	ccd	NUL-ETÖ
	54271.4659	0.0002	BVR	ccd	NUL-NAL
	54283.3396	0.0002	BVR	ccd	NUL-GÖA
4 CVn	53452.4425	0.0004	BV	pe	NUL-AEL
	53466.5304	0.0013	BV	pe	NUL-MYI
	53466.5304	0.0013	BV	pe	NUL-MYI
	53829.4387	0.0007	BV	pe	NUL-DÇA
XZ Cyg	53985.4794	0.0005	BV	pe	NUL-MYI
	53992.4743	0.0005	BV	pe	NUL-MYI
	53993.3983	0.0002	BV	pe	NUL-AEL
	54306.4815	0.0001	BVR	ccd	NUL-DÇA
	54321.4217	0.0002	BVR	ccd	NUL-MYI
	54328.4160	0.0004	BVR	ccd	NUL-MYI
	54336.3504	0.0002	BVR	ccd	NUL-ÖBA
	54742.2881	0.0001	BVR	ccd	NUL-ÖBA
RR Leo	54181.4301	0.0003	BVR	ccd	LÇE-HŞE
	54200.4271	0.0005	BV	pe	LÇE-ETÖ
	54211.2878	0.0004	BV	pe	LÇE-GÖA
	54215.3591	0.0002	BVR	ccd	LÇE-HŞE
	54234.3555	0.0002	BVR	ccd	LÇE-HŞE
	54244.3088	0.0002	BVR	ccd	LÇE-ETÖ
RR Lyr	53927.3812	0.0003	BV	pe	NUL-AEL
	53948.3911	0.0004	BV	pe	NUL-AEL
	53956.3073	0.0004	BV	pe	NUL-NAL
	53957.4458	0.0004	BV	pe	NUL-MYI
	53961.4032	0.0004	BV	pe	NUL-GÖA
	53969.3322	0.0003	BV	pe	NUL-AEL
	54258.4703	0.0002	BVR	ccd	NUL-MYI
	54291.3617	0.0002	BVR	ccd	NUL-DÇA
	54304.3763	0.0005	BVR	ccd	NUL-LÇE
	54308.3323	0.0003	BVR	ccd	NUL-ÖBA
	54334.4387	0.0003	BVR	ccd	NUL-ETÖ

Table 2: (cont.)

Star name	Time of max. HJD 2400000+	Error	Filter	Method	Obs.
T Sex	54167.3472	0.0002	BV	pe	LÇE-GÖA
	54168.2831	0.0002	BV	pe	LÇE-GÖA
	54169.2815	0.0002	BV	pe	LÇE-ETÖ
	54203.3771	0.0002	BV	pe	LÇE-HŞE

Observers:			
ADE:	A. Demirtop	KEY:	K. Eyidoğan
AKA:	A. Karafil	LÇE:	L. Çelik
ABİ:	A. Bingöl	LKA:	L. Kalkan
AEL:	A. Elmaslı	MÖZ:	M. Öztürk
BSİ:	B. Sivrilikaya	MSE:	M. Seki
BSA:	B. Savran	MYA:	M. Yazıcı
CKI:	C. Kılıç	MYI:	M. Yılmaz
CTE:	C. Tezcan	MŞE:	M. Şemuni
DBİ:	D. Bilgiç	MPI:	M. Pınarer
DÖZ:	D. Öztürk	NBA:	N. Bağıran
DÇA:	D. Çakan	NAL:	N. Alan
DSA:	D. Sabuncu	NUL:	N. Deniz Uluş
EÖZ:	E. Özel	ÖBA:	Ö. Baştürk
EİM:	E. İmdat	ÖTA:	Ö. Taşpınar
EES:	E. Esmer	POR:	P. Oruç
EÇÖ:	E. Çöl	SAK:	S. Aktaş
EGÜ:	E. Güneş	SAY:	S. Aydın
ECİ:	E. Civelek	SSA:	S. Saydam
ETÖ:	E. Törün	SKÖ:	S. Kösemen
GVA:	G. Varol	SSİ:	S. Sipahioğlu
GİA:	G. Aysan	SER:	S. Eryılmaz
GGÖ:	G. Gökay	SSU:	S. Suri
GKA:	G. Karagöz	ŞŞA:	Ş. Şahin
GÖA:	G. Aydın	ŞÇA:	Ş. Çalışkan
GYA:	G. Yazıcı	ŞHA:	Ş. Halıcı
GER:	G. Erdoğan	TTA:	T. Tanrıverdi
HŞE:	H. V. Şenavcı	TKA:	T. Karacaoğlu
HGÜ:	H. Gürsoytrak	TÇA:	T. Çakır
HBO:	H. Bozyel	TKI:	T. Kılıçoğlu
HAS:	H. Aslan	TYI:	T. Yılmaz
HDU:	H. Durmuş	ZTE:	Z. Terzioğlu
HKA:	H. Karaca	ZAV:	Z. Avcı
İTÜ:	İ. Türk	ZŞA:	Z. Şahin
KTO:	K. Topbaş	ZAY:	Z. Ay
KYİ:	K. Yiğit	YÇE:	Y. Çetni

Acknowledgements:

We would like to thank all observers at the Ankara University Observatory.

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ELEMENTS FOR 10 RR LYRAE STARS

HÄUSSLER, K.[1]; BERTHOLD, T.[1,2]; KROLL, P.[2]

[1] Bruno-H.-Bürgel-Sternwarte, Töpelstr. 46, D-04746 Hartha, Germany

[2] Sternwarte Sonneberg, Sternwartestr. 32, D-96515 Sonneberg, Germany

email: info@sternwarte-hartha.de, tb@4pisysteme.de, pk@4pisysteme.de

These stars were discovered and reported to be of RR Lyrae type by Boyce & Huruhata (1942), Hoffmeister (1966, 1967) and Nielsen (1932). Except some remarks concerning the type of variability (see details below), no further observations or ephemeris have been published until today. Photographic plates of a field centered at α Oph, taken with the Sonneberg Observatory 40-cm Astrographs during three intervals spread over the years from 1964 to 1994, were used to investigate the behaviour of these objects (see Table 1).

The given elements were obtained by means of least-squares solutions. Photographic amplitudes were derived with respect to magnitudes of the comparison stars given in Table 2. An extensive list holding the times of maxima derived can be retrieved as `5888-t3.txt`, using the link in the HTML version of this paper. Individual data are available upon request.

Remarks:

NSV 9097

Type of variability (eclipsing) described by Boyce and Huruhata (1942) is erroneous.

NSV 9320

Right ascension coordinate given in the paper of Boyce & Huruhata (1942) is erroneous. The object is placed approximately 2 minutes westwards.

NSV 9539

Nielsen (1932) reported the star to be short periodic.

This research made use of the SIMBAD data base, operated by the CDS at Strasbourg, France.

References:

Boyce, E.H., Huruhata, M., 1942, *Harvard Annals*, **109**, 19
Hoffmeister, C., 1966, *Astron. Nachr.*, **289**, 1
Hoffmeister, C., 1967, *Astron. Nachr.*, **290**, 43
Nielsen, A.V., 1932, *Astron. Nachr.*, **244**, 255

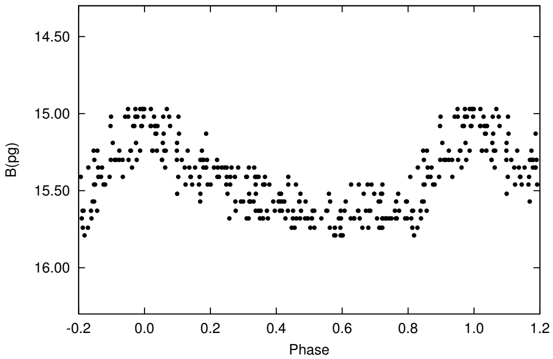

Figure 1. Light curve of NSV 8671

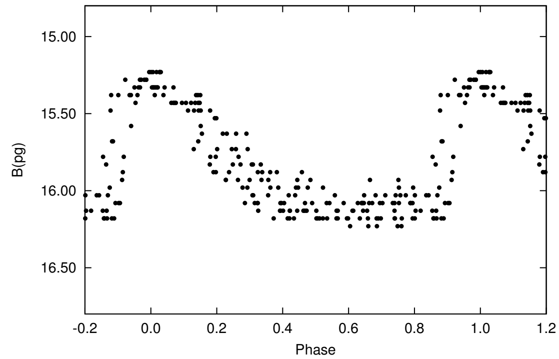

Figure 2. Light curve of NSV 8744

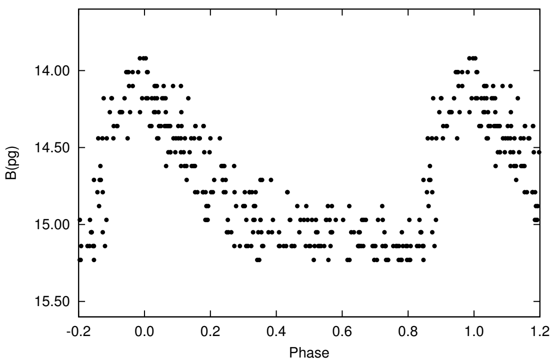

Figure 3. Light curve of NSV 8887

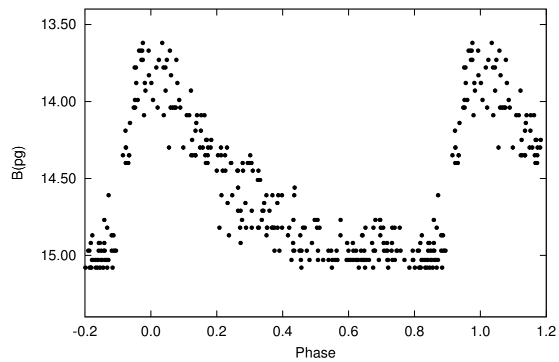

Figure 4. Light curve of NSV 9027

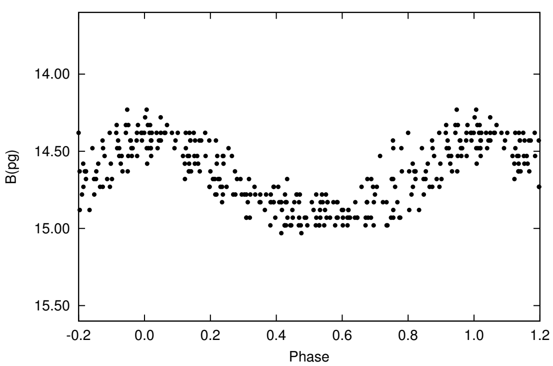

Figure 5. Light curve of NSV 9097

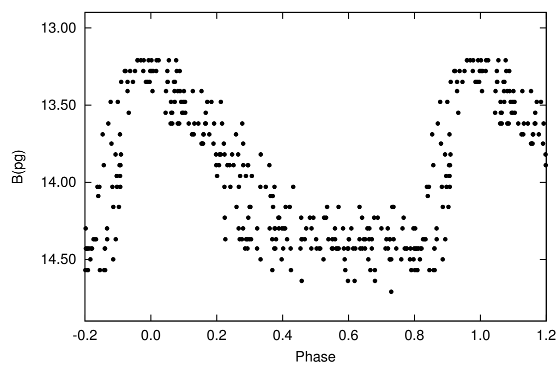

Figure 6. Light curve of NSV 9298

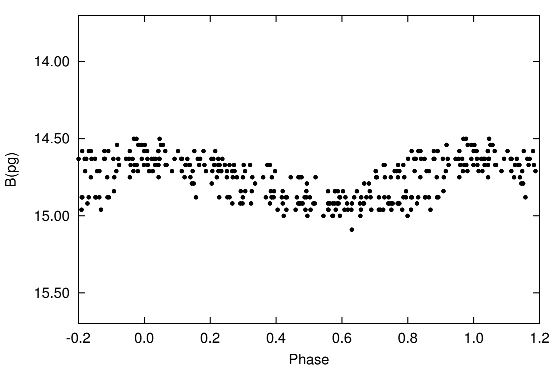

Figure 7. Light curve of NSV 9320

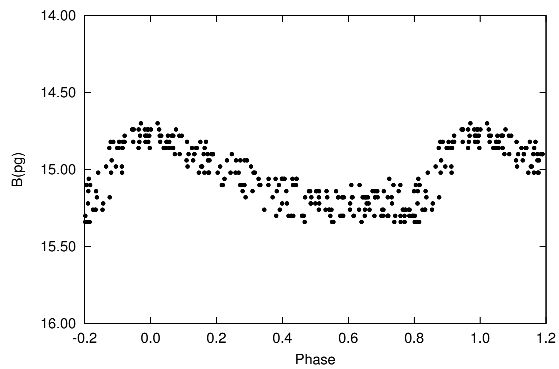

Figure 8. Light curve of NSV 9480

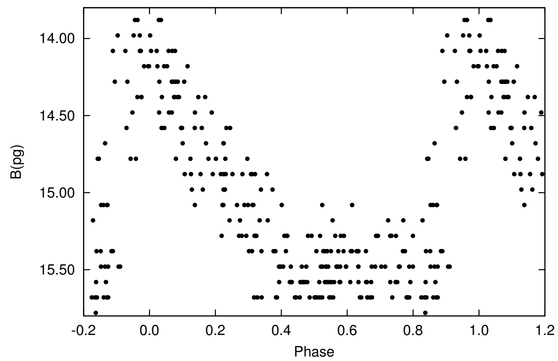

Figure 9. Light curve of NSV 9539

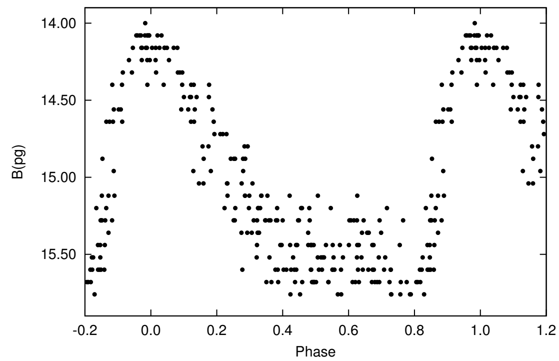

Figure 10. Light curve of NSV 9545

Table 1. Summary of this paper

Star	Type	Epoch 2400000+	Period (day)	Max.	Min.	$M-m$	No. of Plates
NSV 8671	RRab	49484.497 ±8	0.5440685 ±7	15$^{\mathrm{m}}_{.}$0	15$^{\mathrm{m}}_{.}$7	0$^{\mathrm{P}}_{.}$21	262
NSV 8744	RRab	48804.460 ±7	0.5780904 ±7	15$^{\mathrm{m}}_{.}$3	16$^{\mathrm{m}}_{.}$1	0$^{\mathrm{P}}_{.}$19	214
NSV 8887	RRab	49486.504 ±8	0.5155322 ±7	14$^{\mathrm{m}}_{.}$0	15$^{\mathrm{m}}_{.}$0	0$^{\mathrm{P}}_{.}$20	271
NSV 9027	RRab	49193.454 ±10	0.5373109 ±8	13$^{\mathrm{m}}_{.}$7	15$^{\mathrm{m}}_{.}$1	0$^{\mathrm{P}}_{.}$18	275
NSV 9097	RRc	49219.347 ±15	0.4688085 ±11	14$^{\mathrm{m}}_{.}$4	14$^{\mathrm{m}}_{.}$9		264
NSV 9298	RRab	49213.325 ±8	0.4780908 ±6	13$^{\mathrm{m}}_{.}$3	14$^{\mathrm{m}}_{.}$5	0$^{\mathrm{P}}_{.}$18	286
NSV 9320	RRc	49133.467 ±10	0.3888318 ±5	14$^{\mathrm{m}}_{.}$6	14$^{\mathrm{m}}_{.}$9		255
NSV 9480	RRab	49133.456 ±10	0.5901416 ±10	14$^{\mathrm{m}}_{.}$8	15$^{\mathrm{m}}_{.}$3	0$^{\mathrm{P}}_{.}$25	254
NSV 9539	RRab	49482.464 ±6	0.4783094 ±5	13$^{\mathrm{m}}_{.}$9	15$^{\mathrm{m}}_{.}$6	0$^{\mathrm{P}}_{.}$22	266
NSV 9545	RRab	49482.408 ±6	0.4767289 ±4	14$^{\mathrm{m}}_{.}$1	15$^{\mathrm{m}}_{.}$6	0$^{\mathrm{P}}_{.}$22	264

Table 2. Comparison stars and cross references

	NSV 8671		NSV 8744	
	S 8615		S 8616	
	USNO 0975-09209323		USNO 0975-09230699	
Comp. No.	USNO	m^*	USNO	m^*
1	0975-09208744	$14^{m}.8$	0975-09236057	$15^{m}.0$
2	0975-09204518	$14^{m}.9$	0975-09230081	$15^{m}.7$
3	0975-09208491	$15^{m}.5$	0975-09233260	$15^{m}.9$
4	0975-09209389	$15^{m}.7$		

	NSV 8887		NSV 9027	
	HV 10950		HV 10959	
	USNO 0975-09268884		USNO 0975-09304132	
Comp. No.	USNO	m^*	USNO	m^*
1	0975-09269261	$13^{m}.8$	0975-09309205	$13^{m}.7$
2	0975-09265427	$14^{m}.6$	0975-09309459	$14^{m}.1$
3	0975-09267386	$15^{m}.0$	0975-09304972	$14^{m}.8$
4	0975-09270705	$15^{m}.5$	0975-09307002	$15^{m}.2$

	NSV 9097		NSV 9298	
	HV 10962		S 9815	
	USNO 0975-09326486		USNO 0975-09458804	
Comp. No.	USNO	m^*	USNO	m^*
1	0975-09324780	$14^{m}.2$	0975-09459171	$13^{m}.2$
2	0975-09325882	$14^{m}.6$	0975-09451418	$13^{m}.6$
3	0975-09325117	$14^{m}.8$	0975-09457655	$14^{m}.1$
4			0975-09453484	$14^{m}.4$

	NSV 9320		NSV 9480	
	HV 10997		HV 11013	
	USNO 0975-09467795		USNO 0975-09528437	
Comp. No.	USNO	m^*	USNO	m^*
1	0975-09474144	$14^{m}.5$	0975-09530343	$14^{m}.7$
2	0975-09469966	$15^{m}.0$	0975-09530465	$15^{m}.0$
3			0975-09530506	$15^{m}.5$

	NSV 9539		NSV 9545	
	384.1931		S 8624	
	USNO 0975-09567576		USNO 0975-09574756	
Comp. No.	USNO	m^*	USNO	m^*
1	0975-09567070	$13^{m}.8$	0975-09575791	$14^{m}.4$
2	0975-09569476	$14^{m}.5$	0975-09568785	$14^{m}.6$
3	0975-09570224	$15^{m}.1$	0975-09577141	$15^{m}.2$
4	0975-09568033	$15^{m}.8$	0975-09578372	$15^{m}.8$

* Magnitudes refer to the B values of the USNO−A2.0 catalogue

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BAV-RESULTS OF OBSERVATIONS - PHOTOELECTRIC MINIMA OF SELECTED ECLIPSING BINARIES AND MAXIMA OF PULSATING STARS

(BAV MITTEILUNGEN NO. 203)

HÜBSCHER, JOACHIM; STEINBACH, HANS-MEREYNTJE; WALTER, FRANK

Bundesdeutsche Arbeitsgemeinschaft für Veränderliche Sterne e.V. (BAV), Munsterdamm 90, 12169 Berlin, Germany

In this 63rd compilation of BAV results, photoelectric observations obtained in the year 2008 are presented on 380 variable stars giving 591 minima on eclipsing binaries and maxima on pulsating stars. All moments of minima and maxima are heliocentric. The errors are tabulated in column '±'. The values in column '$O-C$' are determined without incorporation of nonlinear terms. The references are given in the section 'Remarks'. All information about photometers and filters are specified in the column 'Rem'. The observations were made at private observatories. The photoelectric measurements and all the light curves with evaluations can be obtained from the office of the BAV for inspection.

Table 1: Times of minima of eclipsing binaries

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
RT And	54738.3976	.0010	QU	−0.0041	s	GCVS 1985	V	85	5)
	54798.4570	.0041	AG	−0.0075		GCVS 1985	-Ir	33	18)
WZ And	54758.3592	.0003	JU	+0.0478		GCVS 1985	o	78	4)
	54765.3148	.0012	SCI	+0.0469		GCVS 1985	o	166	4)
XZ And	54779.4277	.0025	ALH	+0.1693		GCVS 1985	V	146	6)
	54824.2181	.0003	JU	+0.1695		GCVS 1985	o	27	4)
AB And	54697.3431	.0002	SG	−0.0220	s	GCVS 1985	m	50	4)
AD And	54784.4832	.0020	SCI	−0.0598		GCVS 1985	o	121	4)
	54798.2939	.0012	JU	−0.0558		GCVS 1985	o	85	4)
BD And	54379.3165	.0001	MS FR	+0.0166		GCVS 1985	o	300	8)
	54798.2421	.0026	AG	+0.0156		GCVS 1985	-Ir	33	18)
BL And	54798.2575	.0014	AG	−0.0040		GCVS 1985	-Ir	33	18)
DK And	54765.3314	.0040	WTR	−0.0021	s	BAVR 55,106	-Ir	99	13)
KN And	54800.627	.000	FR	+0.086		BAVR 39,19	-Ir	170	18)
QX And	54817.2538	.0008	AG	+0.0120	s	GCVS 2008	-Ir	30	18)
V376 And	54757.5422	.0045	SCI	+0.0031		GCVS 2008	o	183	4)
V404 And	54831.2785	.0008	JU	+0.0020		GCVS 2008	o	60	4)
V412 And	54757.3436	.0038	SCI	+0.0448	s	GCVS 2008	o	71	4)
CX Aqr	54748.2884	.0009	DIE	+0.0074		GCVS 1985	o	22	22)
KO Aql	54675.5401	.0010	AG	+0.0621		GCVS 1985	-Ir	67	18)
LT Aql	54706.4311	.0003	AG	+0.0784		GCVS 1985	-Ir	50	18)
OO Aql	54684.5386	.0003	AG	+0.0401		GCVS 1985	-Ir	51	18)
V416 Aql	54707.4818	.0100	AG	−0.0499		GCVS 2007	-Ir	36	18)
V417 Aql	54706.4446	.0002	AG	−0.0530		BAVR 33,152	-Ir	49	18)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
V417 Aql	54707.3698	.0003	AG	−0.0536	s	BAVR 33,152	-Ir	33	18)
V420 Aql	54707.4260	.0018	AG	+0.2765		GCVS 2007	-Ir	38	18)
V602 Aql	54719.3597	.0009	AG	+0.2662		GCVS 1985	-Ir	38	18)
V609 Aql	54663.3901	.0033	AG	−0.0445	s	GCVS 1985	-Ir	42	18)
V694 Aql	54684.3820	.0050	AG	+0.0183	s	IBVS 4481=BAVM 97	-Ir	52	18)
	54706.5408	.0012	AG	+0.0215	s	IBVS 4481=BAVM 97	-Ir	93	18)
V699 Aql	54684.5145	.0005	AG	+0.0213		GCVS 1985	-Ir	51	18)
	54706.4370	.0003	AG	+0.0215		GCVS 1985	-Ir	55	18)
V887 Aql	54675.4656	.0011	AG				-Ir	67	18)
V962 Aql	54675.4789	.0001	AG	+0.1019		GCVS 2007	-Ir	68	18)
V1045 Aql	54719.4572	.0013	AG	−0.0092	s	GCVS 2007	-Ir	35	18)
V1075 Aql	54719.4250	.0006	AG	−0.0309		GCVS 2007	-Ir	38	18)
V1096 Aql	54663.5278	.0012	AG	−0.2694	s	GCVS 1985	-Ir	42	18)
V1097 Aql	54703.4624	.0007	AG	−0.0659		GCVS 2008	-Ir	40	18)
V1168 Aql	54706.5534	.0010	AG	+0.0029		GCVS 1985	-Ir	50	18)
V1184 Aql	54675.4214	.0007	AG	−0.0090		GCVS 2007	-Ir	68	18)
V1197 Aql	54707.3784	.0006	AG	−0.0125		GCVS 2007	-Ir	29	18)
V1299 Aql	54663.5426	.0019	AG	−0.0450	s	GCVS 2007	-Ir	42	18)
V1353 Aql	54001.3550	.0014	MON	+0.0153		BAVR 44,62	V	93	3)
	54675.5133	.0007	AG	+0.0212	s	BAVR 44,62	-Ir	67	18)
	54697.4388	.0002	FR	+0.0172		BAVR 44,62	-Ir	54	18)
V1542 Aql	54718.4090	.0007	QU	+0.0076		IBVS 5161=BAVM 138	V	80	5)
RS Ari	54831.4846	.0007	FR	−0.0859		GCVS 1985	-Ir	38	11)
SS Ari	54085.2421	.0006	MON	−0.0345	s	GCVS 1985	V	104	3)
	54512.3344	.0020	ATB	−0.0475	s	GCVS 1985	o	60	3)
	54823.3145	.0021	PGL	−0.0585	s	GCVS 1985	o	318	17)
	54843.2074	.0007	PGL	−0.0593	s	GCVS 1985	o	170	17)
AL Ari	54800.3020	.0005	FR	−0.0081		A&A 374,980	-Ir	38	11)
	54845.2724	.0005	SIR	−0.0073		A&A 374,980	-Ir	194	10)
CQ Aur	54861.4447	.0031	SCI	+1.2485		GCVS 1985	o	144	4)
EM Aur	54099.5170	.0015	MON	−0.1702	s	GCVS 1985	V	120	3)
	54365.5149	.0004	MS FR	−0.1819	s	GCVS 1985	o	663	8)
	54827.3788	.0004	SIR	−0.1907		GCVS 1985	-Ir	155	10)
	54837.3948	.0014	PGL	−0.1957	s	GCVS 1985	o	299	17)
IY Aur	54513.3254	.0028	MON	−0.1226		GCVS 1985	V	310	3)
KU Aur	54834.4147	.0007	PGL	+0.0250		GCVS 1985	o	237	17)
V364 Aur	54452.2829	.0002	MS FR				o	231	8)
V379 Aur	54455.2871	.0003	MS FR				o	418	8)
UW Boo	54454.6987	.0032	MS FR	−0.0133	s	GCVS 1985	o	451	8)
AC Boo	54204.3908	.0006	MON	−0.0553		GCVS 1985	V	145	3)
	54595.4321	.0007	QU	−0.0345	s	GCVS 1985	Ic	70	5)
	54597.5459	.0007	QU	−0.0352	s	GCVS 1985	Ic	85	5)
	54598.4267	.0004	QU	−0.0355		GCVS 1985	B	55	5)
	54600.5411	.0004	QU	−0.0357		GCVS 1985	Ic	80	5)
	54637.5482	.0004	QU	−0.0337		GCVS 1985	B	61	5)
	54639.4887	.0003	QU	−0.0315	s	GCVS 1985	B	65	5)
	54648.4743	.0004	QU	−0.0329		GCVS 1985	Ic	65	5)
	54672.4404	.0005	QU	−0.0320		GCVS 1985	V	44	5)
GN Boo	54172.4756	.0001	MS FR				o	232	8)
GR Boo	54174.4911	.0004	MS FR				o	270	8)
SV Cam	54760.3081	.0003	SG	+0.0490		GCVS 1985	-Ir	53	5)
	54843.3387	.0042	PGL	+0.0498		GCVS 1985	o	564	17)
AO Cam	54842.4143	.0001	WN	−0.0692		GCVS 1985	V	134	15)
	54843.4044	.0001	WN	−0.0689		GCVS 1985	V	179	15)
S Cnc	54199.3914	.0013	PRK	−0.0988		GCVS 1985	o	52	8)
WW Cnc	54569.4236	.0014	ATB	−0.0723		BAVR 32,36	o	53	3)
WY Cnc	54223.3794	.0003	MON	−0.0299		GCVS 1985	V	89	3)
AD Cnc	54862.4326	.0015	SCI	−0.0183		GCVS 2008	o	29	4)
ZZ Cas	54776.4062	.0005	AG	−0.0121		GCVS 1985	-Ir	48	18)
AL Cas	54798.3155	.0014	SCI	+0.0033		GCVS 1985	o	96	4)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
AL Cas	54798.5712	.0010	SCI	+0.0087	s	GCVS 1985	o	66	4)
AX Cas	54405.2919	.0001	MS FR	−0.0948		GCVS 1985	o	396	8)
	54752.3007	.0034	SCI	−0.1033		GCVS 1985	o	42	4)
	54776.3195	.0005	AG	−0.0996		GCVS 1985	-Ir	48	18)
BN Cas	54776.4237	.0023	AG	+0.5141	s	GCVS 2007	-Ir	48	18)
BS Cas	54673.5492	.0004	AG	−0.0148		IBVS 4778=BAVM 123	-Ir	30	18)
	54736.5336	.0017	SCI	−0.0176		IBVS 4778=BAVM 123	o	93	4)
	54760.3206	.0003	JU	−0.0159		IBVS 4778=BAVM 123	o	112	4)
EY Cas	54827.4083	.0023	SCI	+0.0347		GCVS 1985	o	89	4)
	54829.3338	.0021	SCI	+0.0323		GCVS 1985	o	53	4)
	54829.5663	.0021	SCI	+0.0238	s	GCVS 1985	o	40	4)
GG Cas	54815.5474	.0033	AG	−0.0564		GCVS 1985	-Ir	60	18)
GR Cas	54453.3005	.0001	MS FR	−0.0406		GCVS 2008	o	477	8)
	54751.4811	.0025	SCI	−0.0446		GCVS 2008	o	27	4)
IL Cas	54776.4278	.0010	AG	−0.0023		BAVR 51,1	-Ir	48	18)
IR Cas	54776.3621	.0001	FR	+0.0098		GCVS 1985	-Ir	57	18)
IS Cas	54684.5654	.0004	AG	+0.0644		GCVS 1985	-Ir	60	18)
IT Cas	54737.4846	.0007	JU	+0.0617		GCVS 1985	o	63	4)
	54751.3216	.0011	JU	+0.0539	s	GCVS 1985	o	80	4)
KL Cas	54776.4451	.0017	AG	−0.0117		GCVS 1985	-Ir	37	18)
MN Cas	54815.2684	.0017	AG	+0.0188		GCVS 1985	-Ir	60	18)
OR Cas	54776.4924	.0003	AG	−0.0224		GCVS 1985	-Ir	48	18)
OX Cas	54433.2879	.0004	MON	+0.0082		GCVS 1985	V	101	3)
	54673.5519	.0015	AG	+0.0208	s	GCVS 1985	-Ir	30	18)
	54744.4601	.0009	JU	+0.0126		GCVS 1985	o	89	4)
	54764.3787	.0020	QU	+0.0164		GCVS 1985	V	106	5)
	54830.3823	.0031	JU	+0.0226	s	GCVS 1985	o	62	4)
PV Cas	54706.4139	.0005	QU	−0.2819	s	GCVS 1985	V	80	5)
QQ Cas	54718.3299	.0020	AG	+0.1038		BAVR 35,1	-Ir	63	18)
	54779.3806	.0002	WTR	+0.1062	s	BAVR 35,1	-Ir	100	13)
V336 Cas	54718.4344	.0006	AG	−0.0164	s	GCVS 2008	-Ir	63	18)
V345 Cas	54798.3995	.0015	AG	−0.0186	s	GCVS 2008	-Ir	33	18)
V357 Cas	54396.3116	.0060	MS FR	−0.1497	s	GCVS 1985	o	351	8)
V361 Cas	54317.5419	.0002	MS FR	−0.1922		GCVS 1985	o	418	8)
V381 Cas	54827.2768	.0012	JU	+0.0101	s	BAVR 32,36	o	105	4)
V449 Cas	54776.4247	.0015	AG				-Ir	37	18)
V459 Cas	54071.2432	.0006	MON	−0.0110		IBVS 4737	V	183	3)
V473 Cas	54815.3785	.0014	AG	−0.0132	s	IBVS 4669=BAVM 115	-Ir	60	18)
	54815.5824	.0003	AG	−0.0170		IBVS 4669=BAVM 115	-Ir	60	18)
V523 Cas	54779.3502	.0003	JU	−0.0372	s	GCVS 1985	o	80	4)
	54779.4666	.0002	JU	−0.0376		GCVS 1985	o	44	4)
V651 Cas	54684.3981	.0013	AG	+0.0019	s	IBVS 3554=BAVM 55	-Ir	63	18)
SU Cep	54798.4788	.0009	AG	+0.0066	s	GCVS 1985	V	73	18)
VW Cep	54676.414	.002	MOO	−0.038	s	GCVS 1985	o	14	20)
WW Cep	54700.3713	.0003	AG	+0.0018		IBVS 4131=BAVM 71	-Ir	29	18)
XX Cep	54752.3836	.0007	JU	−0.0207		GCVS 1985	o	76	4)
ZZ Cep	54738.4258	.0018	AG	−0.0067	s	GCVS 1985	-Ir	133	18)
BR Cep	54738.6018	.0003	AG	+0.0106		GCVS 2007	-Ir	133	18)
CW Cep	54750.3458	.0015	JU	+0.0022		GCVS 1985	o	79	4)
	54765.3332	.0008	JU	+0.0394	s	GCVS 1985	o	90	4)
DN Cep	54798.3753	.0017	AG	−0.0367		GCVS 1985	-Ir	74	18)
IW Cep	54738.5147	.0003	AG	+0.0298		GCVS 2008	-Ir	66	18)
KP Cep	54798.2321	.0013	AG	+0.0424		GCVS 2008	-Ir	74	18)
TT Cet	54809.3839	.0006	AG	−0.0572		GCVS 1985	-Ir	84	18)
DD Com	54455.5926	.0005	MS FR	−0.0585		GCVS 2008	o	450	8)
RW CrB	53834.3922	.0002	PRK	−0.0073		GCVS 1985	o	211	8)
YY CrB	54648.4194	.0010	JU				o	38	4)
VV Cyg	54737.3508	.0004	AG	+0.0094		GCVS 1985	-Ir	20	18)
WW Cyg	54697.4530	.0001	AG	+0.0760		GCVS 1985	-Ir	62	18)
WZ Cyg	54798.3641	.0001	FR	+0.0628		GCVS 1985	-Ir	71	18)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
BR Cyg	54465.3367	.0005	BKN	−0.0010		GCVS 1985	V	63	15) 2)
CG Cyg	54684.5900	.0012	FR	+0.0564	s	GCVS 1985	-Ir	39	11)
	54706.3689	.0002	DIE	+0.0609		GCVS 1985	o	22	12)
	54737.2942	.0003	DIE	+0.0603		GCVS 1985	o	22	12)
CV Cyg	53934.4858	.0025	MON	−0.2353		GCVS 1985	V	206	3)
DO Cyg	54718.3362	.0006	AG	−0.0252		GCVS 2008	-Ir	74	18)
	54800.4181	.0004	AG	−0.0238		GCVS 2008	-Ir	67	18)
LO Cyg	54737.3485	.0012	AG	+0.0155	s	GCVS 2008	-Ir	19	18)
	54760.3172	.0052	SCI	+0.0172		GCVS 2008	o	64	4)
MR Cyg	54706.4743	.0008	AG	+0.0012		GCVS 1985	-Ir	35	18)
QU Cyg	54663.4731	.0026	SCI	−0.0721		GCVS 2008	o	21	4)
V370 Cyg	54685.4783	.0004	AG	−0.0229		GCVS 1985	-Ir	29	18)
V387 Cyg	54688.4208	.0021	AG	+0.0192	s	GCVS 1985	-Ir	91	18)
V388 Cyg	54719.4104	.0007	FR	+0.0787		GCVS 1985	-Ir	43	11)
V393 Cyg	54697.4009	.0010	AG	+0.0218		GCVS 1985	-Ir	62	18)
V443 Cyg	54707.4437	.0015	AG	+0.0317		GCVS 2008	-Ir	19	18)
V444 Cyg	54707.4494	.0062	AG	+0.1742		GCVS 2008	-Ir	20	18)
	54709.5629	.0015	FR	+0.1815	s	GCVS 2008	-Ir	64	11)
V453 Cyg	54757.4007	.0018	FR	+0.0289	s	GCVS 2008	-Ir	45	18)
V456 Cyg	54707.3832	.0024	AG	+0.0455		GCVS 1985	-Ir	19	18)
	54709.6020	.0017	FR	−0.0203	s	GCVS 1985	-Ir	64	11)
V463 Cyg	53896.4503	.0015	MON	+0.0424		GCVS 1985	V	151	3)
V478 Cyg	54709.4075	.0009	FR	+0.0317	s	GCVS 1985	-Ir	110	11)
V483 Cyg	54685.4798	.0015	AG	+0.0232		GCVS 2008	-Ir	29	18)
V490 Cyg	54685.4130	.0046	AG	+0.2060	s	GCVS 2008	-Ir	28	18)
V493 Cyg	54685.5691	.0013	AG	+0.1177		GCVS 1985	-Ir	29	18)
V496 Cyg	54757.4771	.0014	FR	+0.0032	s	GCVS 2008	-Ir	53	11)
V502 Cyg	54697.5555	.0004	AG	+0.1203		GCVS 2008	-Ir	60	18)
V505 Cyg	54697.5413	.0012	AG	+0.0658		GCVS 1985	-Ir	37	18)
V513 Cyg	54317.4456	.0002	MS FR	+0.1954	s	GCVS 1985	o	520	8)
V628 Cyg	54704.4282	.0008	AG	−0.0029		IBVS 4381=BAVM 89	-Ir	44	18)
V635 Cyg	54658.5052	.0002	AG	−0.0475		GCVS 2008	-Ir	47	18)
	54704.5014	.0029	AG	−0.0531	s	GCVS 2008	-Ir	46	18)
	54706.4081	.0032	AG	−0.0473		GCVS 2008	-Ir	33	18)
V642 Cyg	54282.6785	.0010	AG	+0.3087		GCVS 1985	-Ir	74	3)
	54798.4741	.0007	AG	+0.3142		GCVS 1985	-Ir	75	18)
V680 Cyg	54798.5264	.0018	AG	+0.0248		BAVR 32,36	V	78	18)
V687 Cyg	54685.4605	.0005	AG	−0.0072		GCVS 1985	-Ir	40	18)
V700 Cyg	54707.5050	.0007	AG	−0.0651		GCVS 1985	-Ir	18	18)
V704 Cyg	54648.5139	.0004	AG	+0.0332		GCVS 1985	-Ir	45	18)
V711 Cyg	54704.4735	.0007	AG	−0.0066	s	GCVS 2008	-Ir	45	18)
	54706.5420	.0021	AG	−0.0050		GCVS 2008	-Ir	34	18)
V725 Cyg	54697.5295	.0007	AG	+0.2323		GCVS 1985	-Ir	38	18)
V726 Cyg	54697.5001	.0002	AG	+0.0426		GCVS 1985	-Ir	62	18)
	54707.4602	.0012	AG	+0.0433		GCVS 1985	-Ir	18	18)
V841 Cyg	54720.3755	.0019	SCI	+0.0002		GCVS 1985	o	120	4)
V859 Cyg	54685.4919	.0005	AG	+0.0074		GCVS 1985	-Ir	41	18)
V874 Cyg	54708.4230	.0015	SCI	+0.0327		GCVS 2008	o	41	4)
V889 Cyg	54685.4651	.0010	AG	−0.1769		GCVS 1985	-Ir	41	18)
V957 Cyg	54685.5189	.0008	AG	+0.1448	s	GCVS 1985	-Ir	40	18)
V1011 Cyg	54649.4842	.0005	FR	+0.0384	s	GCVS 2007	-Ir	53	18)
	54696.4608	.0026	AG	+0.0441		GCVS 2007	-Ir	94	18)
V1018 Cyg	54649.5479	.0007	FR	−0.0856		GCVS 1985	-Ir	54	18)
	54697.4463	.0008	AG	−0.0856	s	GCVS 1985	-Ir	39	18)
V1023 Cyg	54697.4204	.0013	AG	−0.0492		GCVS 1985	-Ir	38	18)
V1034 Cyg	54649.4340	.0008	FR	+0.0146	s	GCVS 1985	-Ir	88	11)
V1036 Cyg	54720.555	.002	SCI	−0.005		BAVM 141	o	38	4)
V1083 Cyg	54658.5306	.0011	AG	−0.0618		GCVS 1985	-Ir	46	18)
	54706.4948	.0025	AG	−0.0602	s	GCVS 1985	-Ir	34	18)
V1136 Cyg	54685.5173	.0003	AG	+0.0799		GCVS 1985	-Ir	40	18)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
V1171 Cyg	54763.4116	.0003	FR	−0.0504		GCVS 1985	-Ir	148	18)
V1188 Cyg	54736.3859	.0022	SCI	−0.0075		GCVS 2008	o	12	4)
V1321 Cyg	54707.4904	.0042	AG	+0.0790		GCVS 2008	-Ir	18	18)
V1326 Cyg	54715.3539	.0007	AG	+0.5055	s	GCVS 2007	-Ir	30	18)
V1356 Cyg	54649.5438	.0010	FR	+0.1526		GCVS 1985	-Ir	45	11)
V1401 Cyg	54675.5118	.0010	AG	+0.2301		GCVS 2008	-Ir	46	18)
V1411 Cyg	54737.3998	.0004	AG	−0.1680	s	GCVS 1985	-Ir	21	18)
V1414 Cyg	54658.3999	.0017	AG	+0.0461		GCVS 2008	-Ir	47	18)
V1417 Cyg	54658.5123	.0087	AG	+0.1743		GCVS 2008	-Ir	47	18)
	54682.4918	.0037	AG	+0.1703		GCVS 2008	-Ir	22	18)
	54737.3548	.0005	AG	+0.1619	s	GCVS 2008	-Ir	21	18)
	54798.4027	.0007	AG	+0.1608	s	GCVS 2008	-Ir	74	18)
V1877 Cyg	54663.5469	.0013	FR				-Ir	58	18)
	54682.5143	.0004	FR				-Ir	83	18)
V2021 Cyg	54663.4503	.0003	FR				-Ir	50	18)
	54682.4706	.0001	FR				-Ir	78	18)
V2422 Cyg	54096.2548	.0013	SCI	−0.0921	s	GCVS 2007	o	47	4)
	54338.4519	.0033	SCI	−0.1069		GCVS 2007	o	138	4)
	54673.5350	.0026	SCI	+0.1315	s	GCVS 2007	o	68	4)
	54707.4521	.0031	SCI	−0.1192		GCVS 2007	o	32	4)
XX Del	54663.5118	.0003	AG	−0.4116		GCVS 2007	-Ir	43	18)
BW Del	54703.4903	.0009	AG	+0.3503		GCVS 2007	-Ir	40	18)
CR Del	54705.3779	.0017	AG	−0.1767	s	GCVS 2007	-Ir	34	18)
EX Del	54703.4503	.0004	AG	−0.0932		GCVS 1985	-Ir	40	18)
GG Del	54719.3887	.0010	AG	−0.0226	s	GCVS 1985	-Ir	38	18)
UZ Dra	54204.5708	.0005	MON	+0.0023		GCVS 1985	V	117	3)
	54703.5518	.0010	AG	+0.0040		GCVS 1985	-Ir	57	18)
AI Dra	54758.3120	.0013	SG	+0.0233		GCVS 1985	-Ir	45	5)
BE Dra	54703.4445	.0004	AG	−0.1241	s	GCVS 1985	-Ir	41	18)
S Equ	54396.3663	.0002	BKN	+0.0660		GCVS 1985	V	85	15)
WW Gem	54508.4067	.0008	MON	+0.0330		GCVS 1985	V	252	3)
	54831.4714	.0002	WN	+0.0291		GCVS 1985	V	186	15)
YY Gem	54491.3801	.0002	MON	−0.0063		GCVS 1985	V	320	3)
AE Gem	54831.5321	.0032	SCI	+0.1617		GCVS 1985	o	128	4)
AH Gem	53446.3874	.0004	PRK	+0.0622		GCVS 2008	o	120	4)
AI Gem	53446.4036	.0006	PRK	+0.0311	s	GCVS 2008	o	120	4)
AY Gem	54809.6496	.0004	AG	−0.0537		GCVS 1985	-Ir	54	18)
AZ Gem	54809.6801	.0006	AG	+0.0844		GCVS 1985	-Ir	54	18)
EL Gem	54809.6543	.0005	AG	−0.2233	s	GCVS 1985	-Ir	54	18)
	54857.5046	.0029	SCI	−0.2220		GCVS 1985	o	58	4)
KV Gem	54809.6021	.0004	AG	−0.0148		BAVR 52,95	-Ir	52	18)
Z Her	54655.4222	.0011	FR	−0.0333		GCVS 1985	-Ir	47	18)
SZ Her	54663.4328	.0003	JU	−0.0200		GCVS 1985	o	47	4)
TX Her	54647.428	.001	JU	−0.002		GCVS 1985	o	26	4)
UX Her	54671.4921	.0084	MOO	+0.0705		GCVS 1985	o	25	20)
DH Her	54600.4544	.0029	SCI	−0.0017		GCVS 2007	o	88	4)
V829 Her	54673.4412	.0015	JU	+0.0257		IBVS 5496	o	57	4)
V856 Her	54672.4221	.0015	JU				o	52	4)
V857 Her	54599.4919	.0031	SCI				o	159	4)
V1039 Her	54709.4056	.0004	AG				-Ir	73	18)
VX Lac	54760.2852	.0003	DIE	+0.0670		GCVS 1985	o	22	12)
AG Lac	54712.5732	.0014	AG	−0.0003		GCVS 2008	-Ir	37	18)
	54737.3941	.0011	AG	−0.0013		GCVS 2008	-Ir	44	18)
AU Lac	54675.4379	.0003	AG	−0.0253		GCVS 2008	-Ir	49	18)
	54682.3993	.0008	AG	−0.0261		GCVS 2008	-Ir	19	18)
	54709.5510	.0060	AG	−0.0270	s	GCVS 2008	-Ir	40	18)
BB Lac	54709.3562	.0004	AG	−0.5518		GCVS 2007	-Ir	122	18)
CF Lac	54663.5205	.0046	AG	+0.0077		GCVS 2007	-Ir	22	18)
CN Lac	54704.4268	.0003	AG	−0.0424		GCVS 1985	-Ir	39	18)
	54709.5265	.0002	AG	−0.0417		GCVS 1985	-Ir	122	18)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
CO Lac	54199.6189	.0006	MON	+0.0073	s	GCVS 1985	V	121	3)
	54223.5046	.0004	MON	−0.0112		GCVS 1985	V	95	3)
DG Lac	54798.2347	.0004	AG	−0.2203		GCVS 1985	-Ir	49	3) 18)
EK Lac	54706.4054	.0008	AG	−0.0035		GCVS 1985	-Ir	35	18)
EP Lac	54738.4277	.0007	AG	−0.3771		GCVS 1985	-Ir	66	18)
ER Lac	54712.4537	.0085	AG	−0.4991		GCVS 2007	-Ir	33	18)
ES Lac	54738.4747	.0010	AG	+0.6610	s	GCVS 2008	-Ir	66	18)
EU Lac	54738.4215	.0004	AG	+0.1963		GCVS 2007	-Ir	68	18)
EX Lac	54712.4638	.0023	AG	+0.2246	s	GCVS 2008	-Ir	36	18)
EY Lac	54737.4082	.0008	AG	−0.4206	s	GCVS 2007	-Ir	45	18)
FL Lac	54712.5465	.0004	AG	−0.0574		GCVS 1985	-Ir	39	18)
	54738.5492	.0028	AG	−0.0768	s	GCVS 1985	-Ir	64	18)
	54798.3385	.0050	AG	−0.0829	s	GCVS 1985	-Ir	33	18)
HR Lac	54658.4963	.0011	AG	+0.1008	s	GCVS 2008	-Ir	46	18)
	54682.5212	.0021	AG	+0.0977	s	GCVS 2008	-Ir	18	18)
	54798.3772	.0006	AG	+0.1042	s	GCVS 2008	-Ir	74	18)
	54798.5884	.0019	AG	+0.1009		GCVS 2008	-Ir	74	18)
IP Lac	54798.4829	.0005	AG	+0.0779	s	GCVS 2008	-Ir	74	18)
IZ Lac	54738.4644	.0022	AG	+0.0055		GCVS 2008	-Ir	67	18)
	54798.3731	.0013	AG	−0.0016		GCVS 2008	-Ir	75	18)
MZ Lac	54737.5916	.0024	AG	+0.1566		GCVS 1985	-Ir	45	18)
NR Lac	54663.5327	.0036	AG	+0.0665	s	GCVS 2008	-Ir	32	18)
	54712.5249	.0009	AG	+0.0696	s	GCVS 2008	-Ir	38	18)
OS Lac	54737.4108	.0010	AG	+0.3241	s	GCVS 2008	-Ir	45	18)
PP Lac	54737.4900	.0004	AG	−0.0516		GCVS 1985	-Ir	45	18)
	54798.2678	.0004	AG	−0.0500	s	GCVS 1985	-Ir	33	18)
	54798.4681	.0031	AG	−0.0503		GCVS 1985	-Ir	33	18)
V339 Lac	54738.3704	.0006	AG	+0.1308		GCVS 2008	-Ir	67	18)
V342 Lac	54738.6121	.0009	AG	−0.1047		GCVS 2008	-Ir	67	18)
	54798.5132	.0009	AG	−0.1030	s	GCVS 2008	-Ir	75	18)
VZ Leo	54174.3427	.0003	MS FR	−0.0688		GCVS 1985	o	285	8)
AG Leo	54212.3794	.0019	MON	+0.0906		GCVS 1985	V	93	3)
BL Leo	54452.7290	.0030	MS FR	−0.0226	s	GCVS 2008	o	170	8)
TY Lyn	54457.3667	.0005	MS FR	+0.0583		GCVS 1985	o	351	8)
	54509.3472	.0023	MON	+0.0589		GCVS 1985	V	271	3)
AH Lyn	54455.4200	.0001	MS FR				o	585	8)
FL Lyr	54466.2261	.0003	BKN	−0.0019		GCVS 1985	V	76	15)
IW Lyr	54172.6324	.0002	MS FR	−0.0727	s	GCVS 1985	o	396	8)
V579 Lyr	54671.4189	.0010	JU				o	52	4)
V580 Lyr	54738.3613	.0006	JU				o	69	4)
TV Mon	54457.4942	.0002	MS FR	+0.0108		GCVS 1985	o	468	8)
UU Mon	54815.5163	.0006	AG	+0.0142		GCVS 2008	-Ir	38	18)
AQ Mon	54148.4030	.0007	MON	−0.0095		BAVR 52,144	V	138	3)
	54512.4166	.0009	MON	−0.0098		BAVR 52,144	V	159	3)
BM Mon	54815.5465	.0006	AG	+0.0450		GCVS 1985	-Ir	37	18)
DD Mon	54815.4187	.0007	AG	−0.1288	s	GCVS 1985	-Ir	37	18)
IL Mon	54510.348	.005	NIC	−0.050		GCVS 1985	o	128	5)
V448 Mon	54506.297	.003	NIC	+0.058		GCVS 1985	o	119	5)
	54815.5569	.0014	AG	+0.0614	s	GCVS 1985	-Ir	38	18)
V507 Mon	54815.5177	.0031	AG	−0.0372		GCVS 2007	-Ir	38	18)
V514 Mon	54453.4562	.0002	MS FR	+0.0353	s	GCVS 1985	o	429	8)
	54815.4800	.0006	AG	+0.0459		GCVS 1985	-Ir	37	18)
V515 Mon	54815.5093	.0007	AG	−0.0376		GCVS 1985	-Ir	37	18)
AL Oph	54709.4350	.0100	AG				-Ir	24	18)
V573 Oph	54655.4555	.0005	AG	+0.0241		GCVS 2007	-Ir	65	18)
V735 Oph	54709.3402	.0008	AG	+0.0698		GCVS 2008	-Ir	79	18)
CP Ori	54507.341	.001	BKN	+0.001		BAVR 57.153	V	395	15) 2)
ES Ori	54858.3197	.0023	SCI	+0.1477		GCVS 2007	o	76	4)
EW Ori	54857.3868	.0010	SIR	+0.1840	s	GCVS 1985	-Ir	166	10)
GG Ori	54492.3415	.0019	MON	+0.0835		GCVS 1985	V	129	3)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
V648 Ori	54452.4304	.0002	MS FR	+0.0627		GCVS 1985	o	315	8)
U Peg	54709.4307	.0005	QU	−0.0147		BAVR 45,3	V	65	5)
	54843.2249	.0001	WN	−0.0162		BAVR 45,3	V	100	15)
BX Peg	54757.3391	.0003	JU	+0.0528	s	GCVS 1987	o	80	4)
DK Peg	54466.356	.002	BKN	+0.089		GCVS 1987	V	71	15)
	54763.3539	.0003	AG	+0.0973		GCVS 1987	V	108	18)
V396 Peg	53621.4940:	.0005	PRK	−0.0007		BAVM 139	o	180	8)
	54704.4853	.0005	AG	−0.0039		BAVM 139	-Ir	68	18)
	54763.3610	.0012	AG	−0.0015		BAVM 139	V	104	18)
RT Per	54784.4052	.0004	JU	+0.0612		GCVS 1987	o	80	4)
XZ Per	54830.2903	.0003	JU	−0.0538		GCVS 1987	o	55	4)
	54830.2909	.0014	SCI	−0.0532		GCVS 1987	o	67	4)
BY Per	54815.5647	.0003	AG	+0.0235		GCVS 2008	-Ir	59	18)
HS Per	54815.3007	.0007	AG				-Ir	59	18)
IQ Per	53991.5750	.0009	MON	+0.0049		GCVS 1987	V	290	3)
	54433.5046	.0022	MON	−0.0606	s	GCVS 1987	V	345	3)
	54760.4886	.0002	FR	+0.0040		GCVS 1987	-Ir	84	18)
KL Per	54765.5457	.0028	SCI	+0.1287		GCVS 2008	o	150	4)
KN Per	54504.4080	.0007	QU	+0.0049		BAVR 52,93	V	85	5)
	54507.4502	.0031	ATB	+0.0145	s	BAVR 52,93	o	110	3)
V482 Per	54816.3222	.0008	JU	+0.2561		BAVM 68	o	69	4)
Y Psc	54763.4585	.0001	AG	−0.0017		GCVS 1987	V	108	18)
VZ Psc	54763.2733	.0006	AG	+0.0205	s	GCVS 1987	V	103	18)
	54763.4013	.0007	AG	+0.0179		GCVS 1987	V	103	18)
ER Psc	54704.4263	.0002	AG	+0.1922		GCVS 2007	-Ir	68	18)
V Sge	54658.5291	.0017	FR	−0.0565	s	GCVS 1987	-Ir	23	18)
SY Sge	54718.3946	.0026	PRK	+0.1508		GCVS 1987	V	34	8)
BR Sge	54712.4193	.0006	AG	−0.5432		GCVS 2007	-Ir	68	18)
CU Sge	54697.4295	.0003	FR	+0.0185	s	GCVS 1987	-Ir	62	18)
CW Sge	54712.4563	.0005	AG	+0.0201	s	GCVS 1987	-Ir	64	18)
	54719.3907	.0013	AG	+0.0208		GCVS 1987	-Ir	37	18)
DK Sge	54658.5186	.0006	AG	+0.1524	s	GCVS 2008	-Ir	42	18)
FL Sge	54388.3450	.0100	AG	+0.1062	s	GCVS 2007	-Ir	23	3)
	54663.5610	.0010	AG	+0.1058		GCVS 2007	-Ir	43	18)
GN Sge	54712.5393	.0010	AG	+0.0061		GCVS 1987	-Ir	69	18)
V384 Ser	54516.6359	.0005	FR	+0.0028		GCVS 2007	-Ir	54	18)
	54594.4335	.0002	FR	+0.0033	s	GCVS 2007	-Ir	78	18)
	54594.5664	.0002	FR	+0.0018		GCVS 2007	-Ir	78	18)
	54596.4472	.0002	FR	+0.0015		GCVS 2007	-Ir	81	18)
	54596.5811	.0005	FR	+0.0011	s	GCVS 2007	-Ir	81	18)
	54597.3894	.0002	FR	+0.0032	s	GCVS 2007	-Ir	84	18)
	54597.5232	.0002	FR	+0.0026		GCVS 2007	-Ir	84	18)
	54610.4225	.0002	FR	+0.0029		GCVS 2007	-Ir	70	18)
	54610.5568	.0004	FR	+0.0029	s	GCVS 2007	-Ir	70	18)
	54636.4897	.0002	FR	+0.0034		GCVS 2007	-Ir	63	18)
	54703.4042	.0002	FR	+0.0044		GCVS 2007	-Ir	50	18)
SV Tau	54815.3885	.0026	FR	−0.0210	s	GCVS 1987	-Ir	71	11)
AH Tau	54781.3074	.0002	AG	+0.0413		GCVS 2008	-Ir	42	18)
AN Tau	54820.3277	.0019	SCI	−0.1983	s	GCVS 1987	o	52	4)
	54862.2986	.0019	SCI	−0.2081	s	GCVS 1987	o	128	4)
CU Tau	54781.3292	.0003	AG	+0.0470	s	GCVS 1987	-Ir	42	18)
EN Tau	54844.3060	.0010	SIR	−0.0015		BAVR 52,49	-Ir	207	10)
IV Tau	54830.4196	.0016	SCI	−0.0103		GCVS 2007	o	18	4)
V781 Tau	54815.2793	.0005	FR	−0.0474	s	GCVS 1987	-Ir	218	11)
	54815.4504	.0003	FR	−0.0488		GCVS 1987	-Ir	218	11)
V1112 Tau	54814.3401	.0024	SCI				o	92	4)
RV Tri	54817.2603	.0004	AG	−0.0305		GCVS 1987	-Ir	30	18)
DY Vir	54861.5840	.0018	SCI	−0.1322		GCVS 2007	o	28	4)
AW Vul	54719.3218	.0007	DIE	−0.0121		GCVS 1987	o	30	22)
	54723.3544	.0016	DIE	−0.0117		GCVS 1987	o	29	12)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
AW Vul	54723.3545	.0007	DIE	−0.0116		GCVS 1987	o	30	22)
AX Vul	54648.5160	.0019	AG	−0.0307	s	GCVS 1987	-Ir	39	18)
	54648.5212	.0019	FR	−0.0255	s	GCVS 1987	-Ir	36	18)
AY Vul	54682.4003	.0004	AG	−0.0746		GCVS 1987	-Ir	46	18)
AZ Vul	54648.5460	.0003	AG	+0.0282		GCVS 1987	-Ir	39	18)
	54648.5461	.0004	FR	+0.0283		GCVS 1987	-Ir	54	18)
BE Vul	54697.5555	.0009	AG	+0.0650		GCVS 1987	-Ir	37	18)
BP Vul	54648.4241	.0009	AG	+0.9209		GCVS 1987	-Ir	40	18)
	54682.4184	.0001	AG	+0.9591	s	GCVS 1987	-Ir	46	18)
BS Vul	54658.4630	.0008	AG	−0.0185	s	GCVS 1987	-Ir	41	18)
	54684.3989	.0001	WTR	−0.0230		GCVS 1987	-Ir	84	13)
	54712.4825	.0002	AG	−0.0217		GCVS 1987	-Ir	65	18)
BT Vul	54697.5933	.0013	AG	+0.0037		GCVS 1987	-Ir	39	18)
BU Vul	54709.3415	.0003	DIE	+0.0150		GCVS 1987	o	22	12)
CD Vul	54648.3957	.0005	AG	−0.0032		GCVS 1987	-Ir	49	18)
ER Vul	54682.3921	.0008	FR	+0.0177		GCVS 2008	-Ir	53	11)
EV Vul	53991.3406	.0015	MON	+0.4256		GCVS 1987	V	119	3)
	54685.5816	.0016	AG	+0.4546		GCVS 1987	-Ir	39	18)
	54712.3953	.0016	AG	+0.4593	s	GCVS 1987	-Ir	69	18)
	54719.4475	.0004	PRK	+0.4565		GCVS 1987	V	205	8)
FF Vul	54682.3963	.0016	AG	−0.0611		GCVS 2008	-Ir	46	18)
FM Vul	54685.4793	.0004	AG	+0.0253		GCVS 1987	-Ir	41	18)
FQ Vul	54685.4865	.0009	AG	+0.2500		GCVS 2008	-Ir	41	18)
HI Vul	54697.4526	.0006	AG	−0.0567		GCVS 1987	-Ir	38	18)
HS Vul	54658.5216	.0004	AG	−0.0304		GCVS 2008	-Ir	42	18)
	54712.4845	.0007	AG	−0.0284	s	GCVS 2008	-Ir	67	18)
IW Vul	54685.5125	.0006	AG	−0.0488	s	GCVS 2008	-Ir	41	18)
KN Vul	54697.4554	.0005	AG	+0.0254		GCVS 1987	-Ir	37	18)
GSC 0137501089	54147.4707	.0003	SIR				-Ir	138	10)
	54148.4792	.0030	SIR				-Ir	189	10)
	54173.3791	.0030	SIR				-Ir	100	10)
	54504.3247	.0006	SIR				-Ir	80	10)
	54504.4944	.0004	SIR				-Ir	80	10)
	54505.3355	.0005	SIR				-Ir	91	10)
	54505.5044	.0005	SIR				-Ir	71	10)
	54506.3418	.0007	SIR				-Ir	103	10)
	54506.5127	.0002	SIR				-Ir	128	10)
	54507.3483	.0004	SIR				-Ir	107	10)
	54507.5214	.0006	SIR				-Ir	113	10)
	54510.3834	.0004	SIR				-Ir	102	10)
	54544.3698	.0004	SIR				-Ir	102	10)

Table 2: Times of maxima of pulsating stars

Variable	HJD 24.....	±	Obs	$O-C$	Bibliography	Fil	n	Rem
SW And	54507.2892	.0024	ATB	−0.0015	A&A 476.307 2007	o	70	3)
	54751.4179	.0015	ALH	−0.0013	A&A 476.307 2007	V	428	9)
	54840.3153	.0025	WN	+0.0014	A&A 476.307 2007	V	268	15)
XX And	54765.4996	.0032	ALH	+0.0163	BAVR 48,189	V	208	9)
	54828.3850:	.0026	WN	+0.0221	BAVR 48,189	V	129	15)
CC And	54718.3734	.0002	SG	+0.0120	GCVS 1985	m	69	5)
CI And	53375.3689	.0002	MZ	−0.0048	BAVR 53,87	Sy	100	19)
GM And	53379.3981	.0002	MZ	+0.0373	GCVS 2007	Sy	86	19)
GP And	53985.4871	.0012	MON	+0.0044	GCVS 1985	V	80	3)
	53992.5691	.0011	MON	+0.0049	GCVS 1985	V	106	3)
	53992.6476	.0011	MON	+0.0048	GCVS 1985	V	106	3)
	54829.2037	.0003	DIE	+0.0064	GCVS 1985	o	85	22)
	54829.2814	.0003	DIE	+0.0054	GCVS 1985	o	85	22)
	54830.2255	.0003	DIE	+0.0053	GCVS 1985	o	86	22)

Table 2: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$	Bibliography	Fil	n	Rem
GP And	54830.3055	.0002	DIE	+0.0066	GCVS 1985	o	86	22)
	54842.2631	.0011	WN	+0.0044	GCVS 1985	V	244	15)
	54842.3435	.0025	WN	+0.0061	GCVS 1985	V	244	15)
OV And	53376.3556	.0003	MZ	−0.0194	MVS 11,133	Sy	90	19)
	54464.3370	.0032	ATB	−0.0213	MVS 11,133	o	48	3)
	54712.3348	.0002	SG	−0.0197	MVS 11,133	m	58	5)
CY Aqr	53569.5167	.0005	PRK	+0.0136	GCVS 1985	o	185	4)
	53612.3657	.0006	PRK	+0.0137	GCVS 1985	o	266	4)
	53612.4269	.0004	PRK	+0.0139	GCVS 1985	o	266	4)
	53612.4878	.0005	PRK	+0.0137	GCVS 1985	o	266	4)
	53612.5483	.0004	PRK	+0.0132	GCVS 1985	o	266	4)
AA Aql	53985.3724	.0016	MON	+0.0033	BAVM 78	V	75	3)
	54706.4146	.0004	FLG WTH	+0.0031	BAVM 78	V	151	21)
V766 Aql	54684.414	.003	AG	+0.047	GCVS 2007	-Ir	53	18)
V1538 Aql	53899.523	.004	AG			-Ir	28	3)
	54326.512	.003	AG			-Ir	46	3) 2)
	54706.553	.003	AG			-Ir	46	18) 2)
X Ari	54831.3852	.0016	WN	+0.0564	BAVR 48,189	V	107	15)
SY Ari	53375.4782	.0001	MZ	−0.0025	GCVS 2008	Sy	155	19) 2)
TY Ari	54831.3410	.0030	SB	+0.0168	GCVS 2008	-Ir	247	16)
	54840.2330	.0040	SB	+0.0052	GCVS 2008	-Ir	265	16)
TZ Aur	53376.5212	.0003	MZ	+0.0095	GCVS 1985	Sy	98	19)
	54834.3374	.0014	PGL	+0.0127	GCVS 1985	o	251	17)
BH Aur	53721.5081	.0010	MZ	+0.0000	SAC Vol.73	Sy	116	19)
TW Boo	54197.3619	.0019	MON	−0.0045	A&A 476.307 2007	V	86	3)
YZ Boo	53846.3533	.0018	MON	+0.0033	GCVS 1985	V	45	3)
	54148.5309	.0015	MON	+0.0031	GCVS 1985	V	162	3)
	54148.6350	.0015	MON	+0.0031	GCVS 1985	V	162	3)
	54592.3777	.0018	MON	+0.0035	GCVS 1985	V	90	3)
	54592.4813	.0018	MON	+0.0030	GCVS 1985	V	90	3)
	54594.3550	.0018	MON	+0.0030	GCVS 1985	V	61	3)
	54595.3961	.0018	MON	+0.0032	GCVS 1985	V	50	3)
CG Boo	54459.6542	.0035	MS FR			o	602	8)
CM Boo	54221.3484	.0018	MON	−0.0998	GCVS 1985	V	31	3)
CQ Boo	54596.3911	.0008	MZ	−0.0133	BAVR 48,189	-Ir	80	4)
CS Boo	54202.5347	.0026	MON	−0.0030	IBVS 2855	V	33	3)
RW Cnc	54512.5691	.0052	ATB	+0.2120	GCVS 1985	o	69	3)
TT Cnc	54552.4565	.0024	ATB	−0.0045	A&A 476.307 2007	o	82	3)
	54578.3569	.0042	ATB	−0.0231	A&A 476.307 2007	o	90	3)
AS Cnc	53377.7489	.0010	MZ	−0.2987	GCVS 2008	Sy	56	19)
	53379.6029	.0010	MZ	−0.2974	GCVS 2008	Sy	109	19) 2)
RZ CVn	54196.4507	.0019	MON	+0.1056	BAVR 48,189	V	102	3)
	54508.5342	.0019	MON	+0.1194	BAVR 48,189	V	52	3)
AA CMi	53722.6809	.0010	MZ	+0.0169	BAVR 49,41	Sy	85	19) 2)
AD CMi	54515.2739	.0008	MON	+0.0117	GCVS 1985	V	216	3)
PS Cas	54815.302	.003	AG	−0.197	GCVS 2008	-Ir	60	18)
V470 Cas	54815.399	.005	AG	+0.207	IBVS 4332=BAVM 87	-Ir	60	18)
RZ Cep	54706.4175	.0020	ALH	−0.0951	GCVS 1985	V	320	9)
	54706.4481	.0020	ALH	−0.0646	GCVS 1985	V	320	9)
	54738.539	.001	AG	−0.077	GCVS 1985	-Ir	133	18)
RV CrB	54170.645	.001	MS FR	−0.053	GCVS 1985	o	395	8)
UY Cyg	53941.4643	.0012	MON	+0.0536	GCVS 1985	V	200	3)
	54671.4974	.0024	SCI	+0.0491	GCVS 1985	o	150	4)
XX Cyg	54763.2723	.0001	WN	+0.0024	GCVS 1985	V	97	15)
	54778.2414	.0001	WN	+0.0014	GCVS 1985	V	51	15)
DM Cyg	53943.4558	.0019	MON	−0.0006	A&A 476.307 2007	V	135	3)
	54700.4687	.0020	ALH	−0.0019	A&A 476.307 2007	V	164	9)
V789 Cyg	54709.4569	.0037	SCI	−0.0815	GCVS 2007	o	71	4)
V838 Cyg	54737.4040	.0010	MZ	+0.0352	GCVS 2007	-Ir	117	4)
	54762.3762	.0008	MZ	+0.0330	GCVS 2007	-Ir	155	4)

Table 2: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$	Bibliography	Fil	n	Rem
V1962 Cyg	54720.4285	.0010	MZ			-Ir	62	4)
BV Del	54709.4290	.0010	SB	+0.0234	GCVS 1985	-Ir	224	16)
DX Del	54737.3661	.0014	WN	+0.0575	GCVS 1985	V	131	15)
RW Dra	54594.4254	.0040	MZ	+0.1779	GCVS 1985	-Ir	63	4)
AV Dra	54597.4970	.0040	MZ	+0.1594	GCVS 2007	-Ir	77	4)
BK Dra	54202.3928	.0016	MON	+0.0579	BAVR 46,1	V	93	3)
	54512.6458	.0012	MON	+0.0651	BAVR 46,1	V	192	3)
CY Dra	54592.3995	.0028	MZ			-Ir	76	4)
	54593.4687	.0050	MZ			-Ir	86	4)
	54600.4311	.0030	MZ			-Ir	68	4)
DD Dra	53150.5278	.0018	MON	+0.0121	BAVR 49,6	V	132	3)
	53832.5714	.0015	MON	+0.0379	BAVR 49,6	V	133	3)
RR Gem	53376.7189	.0010	MZ	+0.0028	BAVR 47,67	Sy	139	19) 2)
SZ Gem	53721.6288	.0003	MZ	−0.0005	BAVR 48,65	Sy	127	19) 2)
GI Gem	53378.6543	.0001	MZ	−0.0086	BAVR 51,40	Sy	36	19)
TW Her	54218.5253	.0015	MON	−0.0112	GCVS 1985	V	81	3)
	54672.489	.002	MOO	+0.007	GCVS 1985	o	20	20)
VX Her	54172.6207	.0012	MON	+0.0486	GCVS 1985	V	180	3)
	54737.2675	.0019	WN	+0.0331	GCVS 1985	V	63	15)
VZ Her	54173.5464	.0016	MON	+0.0630	GCVS 1985	V	142	3)
AR Her	54674.5216	.0003	PGL	+0.0479	BAVR 52,3	o	240	17)
	54675.4577	.0005	PGL	+0.0440	BAVR 52,3	o	314	17)
	54676.4063	.0030	PGL	+0.0527	BAVR 52,3	o	251	17)
	54708.3564	.0015	PGL	+0.0438	BAVR 52,3	o	494	17)
	54746.4167	.0014	PGL	+0.0354	BAVR 52,3	o	405	17)
DY Her	54593.4195	.0018	MON	−0.0037	BAVR 48,189	V	59	3)
	54709.3506	.0008	WN	−0.0050	BAVR 48,189	V	93	15)
HN Her	54685.3812	.0002	SHT	−0.1427	GCVS 2008	-Ir	23	4)
LW Her	54680.4828	.0040	MZ	+0.1474	GCVS 2007	-Ir	79	4)
CH Lac	54663.434	.002	AG	+0.012	GCVS 2008	-Ir	25	18)
CZ Lac	54737.5001	.0020	WN	−0.1262	BAVR 53,12	V	213	15)
	54763.4393	.0019	WN	−0.1180	BAVR 53,12	V	212	15)
	54831.3006	.0019	WN	−0.1096	BAVR 53,12	V	209	15)
	54837.3309	.0014	WN	−0.1299	BAVR 53,12	V	206	15)
RR Leo	54589.4878	.0014	ATB	+0.0016	A&A 476.307 2007	o	84	3)
GP Leo	54172.370	.001	MS FR	−0.289	IBVS 5114=BAVM 136	o	315	8)
Y LMi	54591.4508	.0042	ATB	−0.0138	BAVR 49,41	o	90	3)
EH Lib	54509.6094	.0010	MON	+0.0031	GCVS 1985	V	185	3)
	54509.6984	.0010	MON	+0.0037	GCVS 1985	V	185	3)
	54513.5887	.0010	MON	+0.0038	GCVS 1985	V	170	3)
	54513.6767	.0010	MON	+0.0034	GCVS 1985	V	170	3)
	54598.3765	.0010	MON	+0.0033	GCVS 1985	V	65	3)
SZ Lyn	54858.5254	.0010	SCI	+0.0231	GCVS 1985	o	92	4)
	54858.6439	.0011	SCI	+0.0211	GCVS 1985	o	163	4)
TV Lyn	54494.3143	.0015	MON	+0.0246	GCVS 1985	V	166	3)
TW Lyn	53378.4380	.0010	MZ	+0.0457	GCVS 1985	Sy	121	19) 2)
BE Lyn	54433.6507	.0008	MON			V	171	3)
	54837.3550	.0014	PGL			o	160	17)
RZ Lyr	54731.3370	.0010	MZ	−0.0107	BAVR 48,189	-Ir	90	4)
CG Lyr	54760.3489	.0004	MZ	+0.1103	GCVS 2008	-Ir	98	4)
CN Lyr	53846.5394	.0019	MON	+0.0052	A&A 476.307 2007	V	100	3)
	54196.6143	.0010	MON	−0.0067	A&A 476.307 2007	V	142	3)
EX Lyr	54685.4431	.0060	MZ	−0.1209	GCVS 1985	-Ir	66	4)
EZ Lyr	53917.4620	.0015	MON	+0.0286	BAVR 34,145	V	79	3)
	54729.515	.003	MOO	+0.024	BAVR 34,145	o	22	20)
IO Lyr	54193.5610	.0015	MON	−0.0292	GCVS 1985	V	52	3)
KM Lyr	54678.4141	.0040	MZ	−0.0780	GCVS 2007	-Ir	33	4)
AI Mon	54815.439	.003	AG	−0.184	GCVS 2007	-Ir	37	18)
VV Peg	54720.4107	.0020	ALH	−0.0228	GCVS 1987	V	97	9)
	54759.4812	.0024	ALH	−0.0233	GCVS 1987	V	161	9)

Table 2: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$	Bibliography	Fil	n	Rem
AO Peg	54409.3366	.0028	ATB	−0.0123	BAVR 49,41	o	84	3)
AV Peg	54765.4291	.0010	QU	+0.0086	A&A 476.307 2007	V	80	5)
	54815.3999	.0004	MOO	+0.0106	A&A 476.307 2007	o	21	20)
CG Peg	54709.4349	.0012	FLG	−0.0275	SAC Vol.72	V	294	16)
DH Peg	54718.4819	.0020	ALH	+0.0010	GCVS 1987	V	580	9) 1)
	54718.5104	.0020	ALH	+0.0295	GCVS 1987	V	580	9) 1)
DY Peg	53984.3798	.0012	MON	−0.0053	GCVS 1987	V	224	3)
	53984.4519	.0012	MON	−0.0062	GCVS 1987	V	224	3)
	53984.5241	.0012	MON	−0.0069	GCVS 1987	V	224	3)
	54000.2764	.0012	MON	−0.0067	GCVS 1987	V	109	3)
	54000.3496	.0012	MON	−0.0064	GCVS 1987	V	109	3)
	54359.4377	.0012	MON	−0.0074	GCVS 1987	V	165	3)
	54359.5111	.0012	MON	−0.0069	GCVS 1987	V	165	3)
	54359.5840	.0012	MON	−0.0069	GCVS 1987	V	165	3)
	54709.4830	.0014	PGL	−0.0083	GCVS 1987	o	155	17)
	54719.4733	.0014	PGL	−0.0089	GCVS 1987	o	170	17)
	54735.4440	.0007	PGL	−0.0091	GCVS 1987	o	141	17)
	54760.3851	.0014	PGL	−0.0087	GCVS 1987	o	388	17)
	54820.3296	.0007	PGL	−0.0096	GCVS 1987	o	161	17)
	54828.2802	.0004	WN	−0.0081	GCVS 1987	V	50	15)
AR Per	54067.4003	.0016	MZ	+0.0485	GCVS 1987	Sy	41	19)
	54834.2477	.0014	PGL	+0.0568	GCVS 1987	o	239	17)
	54839.3539	.0021	PGL	+0.0564	GCVS 1987	o	381	17)
FM Per	54760.5504	.0020	FR	+0.1841	GCVS 2007	-Ir	146	18)
V375 Per	54817.253	.003	AG	−0.250	GCVS 2008	-Ir	30	18)
SS Psc	54839.232	.007	PGL	+0.007	BAVR 47,67	o	417	17)
BR Tau	54723.4862	.0010	MZ	+0.0886	GCVS 2008	Sy	45	19)
UX Tri	54464.5464	.0035	ATB	+0.0535	BAV ATB unpb.2006	o	26	3)
	54479.4616	.0031	ATB	+0.0278	BAV ATB unpb.2006	o	101	3)
RV UMa	54173.2988	.0013	MON	+0.0065	BAVR 48,189	V	117	3)
	54661.499	.003	MOO	+0.015	BAVR 48,189	o	14	20)
BN Vul	53931.4481	.0012	MON	−0.0233	SAC Vol.73	V	201	3)

Remarks:

AG:	Agerer, F., Tiefenbach	PGL:	Pagel, Dr. L., Klockenhagen
ALH:	Alich, K., Schaffhausen (CH)	PRK:	Proksch, W., Winhöring
ATB:	Achterberg, Dr. H., Norderstedt	QU:	Quester, W., Esslingen
BKN:	Bakan, Dr. S., Wedel	RAT:	Rätz, M., Herges-Hallenberg
DIE:	Dietrich, M., Radebeul	RCR:	Rätz, M., Herges-Hallenberg
FLG:	Flechsig, Dr. G., Teterow	SB:	Steinbach, Dr. H., Neu-Anspach
FR:	Frank, P., Velden	SCI:	Schmidt, U., Karlsruhe
JU:	Jungbluth, Dr. H., Karlsruhe	SG:	Sterzinger, Dr. P., Wien (A)
MON:	Monninger, Dr. G., Gemmingen	SHT:	Scharnhorst, D., Erfurt
MOO:	Moos, C., Netphen	SIR:	Schirmer, J., Willisau (CH)
MS:	Moschner, W., Lennestadt	WN:	Wischnewski, M., Wennigsen
MZ:	Maintz, Dr. G., Bonn	WTH:	Westerhoff, T., Kirchheim
NIC:	Nickel, Dr. O., Mainz	WTR:	Walter, F., München

Remarks (cont.):

:	= uncertain
s	= secondary minimum
C	= CCD-camera
B	= B-filter
Ic	= I-filter cousins
m	= multiple filter
o	= without filter
Sy	= Stroemgren y (Calar Alto) is equivalent to V-filter
V	= V-filter
-Ir	= -Ir-filter
1)	= double maxima, determination of time is difficult
2)	= normal result
3)	= ccd-camera ST-6 chip 375*242 uncoated
4)	= ccd-camera ST-7
5)	= ccd-camera ST-7E
6)	= ccd-camera ST-8E chip KAF1602E
7)	= ccd-camera ST-9 chip
8)	= ccd-camera ST-9E
9)	= ccd-camera ST-8 XMEI chip KAF1603e
10)	= ccd-camera Alpha Maxi chip KAF401e
11)	= ccd-camera OES-LcCCD12
12)	= ccd-camera pictor 1616XT
13)	= ccd-camera Pictor 416XT
14)	= ccd-camera holicam
15)	= ccd-camera Meade DSI Pro 2
16)	= ccd-camera SIGMA 402 chip
17)	= ccd-camera Artemis 4021
18)	= ccd-camera Sigma 1603
19)	= ccd-camera Busca
20)	= ccd-camera Canon EOS 350D
21)	= ccd-camera STL-6303E
22)	= ccd-camera Canon EOS D60
A&A	= Astronomy & Astrophysics
BAVM nnn	= BAV Mitteilungen No.nnn
BAVR vv, ppp	= BAV Rundbrief Vol. vv, page ppp
BAV unp	= unpublished
GCVS yyyy	= General Catalogue of Variable Stars, yyyy
GSC	= The HST Guide Star Catalogue 1.2
IBVS nnnn	= Information Bulletin on Variable Stars No. nnnn
MVS vv,ppp	= Mitteilungen über Veränderliche Sterne; volume,pages
SAC vv	= Rocznik Astronomiczny No. vv, Krakow (SAC)
U-A2	= The USNO A2.0 Catalogue

ERRATA FOR IBVS 5731 (BAVM 178)

V463 Cyg	54660.307 FR	must be deleted
GSC 0192700862	53721.4698 QU	correct value: 52721.4698

ERRATUM FOR IBVS 5802 (BAVM 186)

GSC 0137501085	SIR	all results must be deleted

ERRATUM FOR IBVS 5874 (BAVM 201)

GSC 0137501085	SIR	all results must be deleted

ERRATA FOR IBVS 5889 (BAVM 203)

SV Cam	54760.3081 SG	correct value: 54760.3068
AI Dra	54758.3120 SG	correct value: 54758.3134

ERRATUM FOR IBVS 5889 (BAVM 203)

BR Tau	54723.4862 MZ	has to be deleted

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NSV 11154 - A POSSIBLE NEW R CrB STAR

HÄUSSLER, K.[1]; BERTHOLD, T.[1,2]; KROLL, P.[2]

[1] Bruno-H.-Bürgel-Sternwarte, Töpelstr. 46, D-04746 Hartha, Germany

[2] Sternwarte Sonneberg, Sternwartestr. 32, D-96515 Sonneberg, Germany

email: info@sternwarte-hartha.de, tb@4pisysteme.de, pk@4pisysteme.de

NSV 11154 = USNO–A2.0 1350–09802429 = S9323 Lyr = ROTSE1 J183751.21+472324.5 has been discovered and reported to be a short periodic variable by Hoffmeister (1966).

Photographic plates (n=562) of a field centered around R Lyr, taken with the Sonneberg Observatory 40cm Astrograph between 1964-1996, were used to re-examine the behaviour of this star. Comparison stars are listed in Table 1.

The object is neither a short periodic variable nor a long periodic variable as surmised by Akerlof et al. (2000) according to the ROTSE1 data. Irregular variations with some conspicuous minima were found. The overall brightness varies between $13\overset{m}{.}0$ and $17\overset{m}{.}2$ (Fig. 1). The observed minima are variable in depth, with a mean duration of the order of 500^d.

Individual data can be retrieved as `5890-t2.txt`, using the link in the HTML version of this paper.

Table 1. Comparison stars

Comp. No.	USNO	m*
1	1350-09796351	$13\overset{m}{.}2$
2	1350-09805484	$14\overset{m}{.}8$
3	1350-09803396	$15\overset{m}{.}7$
4	1350-09804973	$17\overset{m}{.}5$

* Magnitudes refer to the B values of the USNO−A2.0 catalogue

This research made use of the SIMBAD data base, operated by the CDS at Strasbourg, France.

References:

Akerlof, C. et al., 2000, *Astron. Journal*, **119**, 1901
Hoffmeister, C., 1966, *Astron. Nachr.*, **289**, 139, (H3)

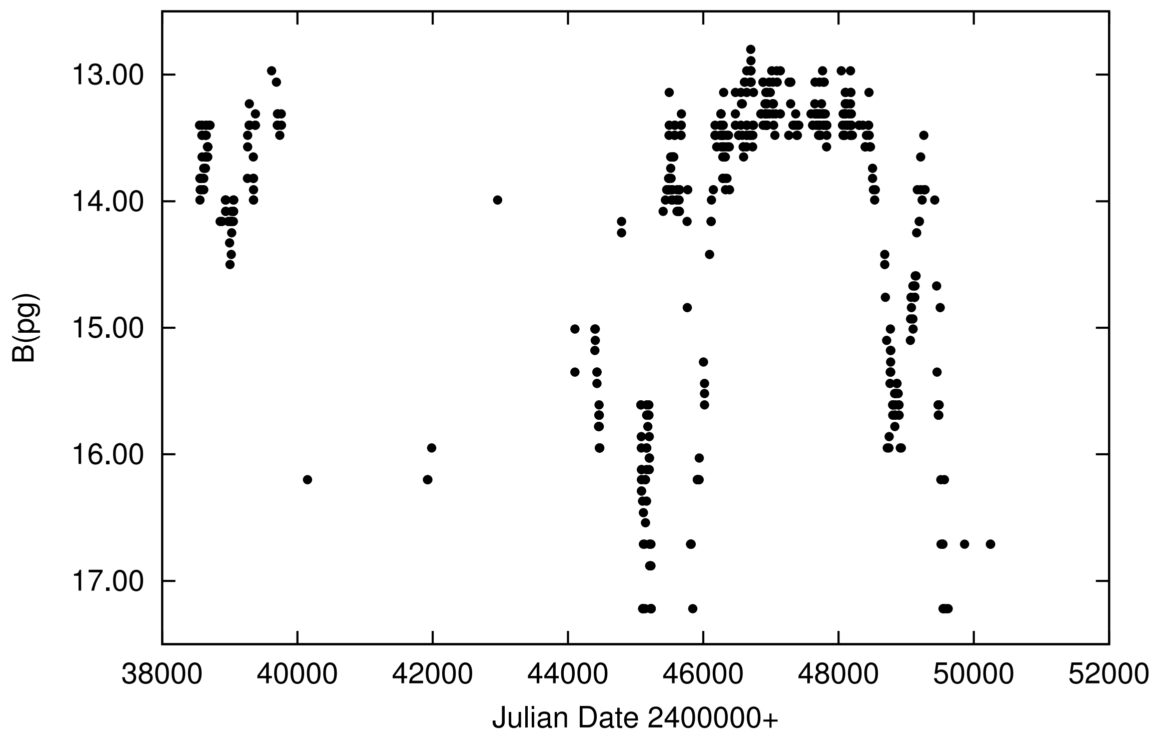

Figure 1. Photographic light curve of NSV 11154

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A PERIOD ANALYSIS OF THE δ SCUTI VARIABLE GSC 03973-01698

HINTZ, E. G.[1]; BUGNO, J. L.[1]; JONER, M. D.[1]

[1] Brigham Young University, Dept. of Physics and Astronomy, Provo, UT 84602, USA

e-mail: doctor@tardis.byu.edu; batgirl3220@aim.com; jonerm@forty-two.byu.edu

As part of an undergraduate summer research program, we examined the High Mass X-ray Binary system (HMXB) 4U 2206+543. On a finder chart for this system provided by the American Association of Variable Star Observers (AAVSO), they identify one of the comparison stars, GSC 3973-1698, as a δ Scuti variable with a period of 0.06 d. GSC 3973-1698 was present in our field of view on all nights of observations during our campaign; therefore we present an analysis of its light curves.

Our data consists of 20 nights of photometric observations on the field near 4U 2206+543. A finder chart is given in Fig. 1 which includes the δ Scuti, 4U 2206+543, and the five comparison stars. A total of 19 nights were obtained with the 0.41-m David Derrick Telescope of the Orson Pratt Observatory (OPO), which is located in the center of the BYU campus. Observations were made with an unbinned ST-10XME CCD. Six nights of data were obtained with the 0.31-m telescope of the BYU West Mountain Observatory (WMO) using another ST-10XME CCD which was binned 2×2. These six nights overlapped with six of the nights secured on the OPO system. Finally we obtained two nights of data with the 0.51-m telescope at the BYU West Mountain Observatory using a SBIG STL-1001 CCD. One of these nights was in common with the OPO data, while the other provided our 20th night of data. All observations were made with a standard V filter (Bessell, 1990) and yielded an error per observation on the order of 0.004 mag. The observational dara are available on the IBVS website as `5891-t3.txt`.

Differential magnitudes were determined relative to an ensemble of four comparison stars (Star 2 was not used since it is an eclipsing binary system). Apparent magnitudes were determined using GSC 3973-1066 (Star 3, $V = 11.946 \pm 0.013$) and GSC 3973-1906 (Star 4, $V = 11.837 \pm 0.008$). The magnitudes given were taken from the calibration of the field obtained by A. Henden[†]. In Fig. 2 we show simultaneous light curves from data taken at both observatory facilities. The light curves for all nights are presented in Fig. 3. The denser portions of the light curves indicate when simultaneous data were obtained.

Both a Fourier analysis using the `Period04` (Lenz & Breger, 2005) program and a traditional time of maximum light argument were utilized to determine a period for GSC 3973-1698. We note that a time of maximum light analysis is not always reliable for low amplitude, multiperiodic stars. In Table 1 we present the 19 times of maximum light found for GSC 3973-1698. From this we find an ephemeris of

$$\mathrm{HJD} = 2454630.942(\pm 0.003) + 0.06501(\pm 0.00001)\mathrm{E}. \tag{1}$$

[†] `http://homepage.usask.ca/~ges125/Astronomy/LPH128_aavso.pdf ftp://ftp.aavso.org/public/calib/3a2206.dat`

From the Fourier analysis we find four frequencies that have detection signal-to-noise values higher than four (Breger et al., 1993, 2007). The four main frequencies are reported in Table 2 and the power spectrum is shown in Fig. 4. Overlaid in Fig. 3 we show the four-frequency model generated from our Fourier solution. From the final panel in Fig. 4, and the fit in Fig. 3, it is clear that additional frequencies exist in GSC 3973-1698, but their detection level is too low from this data set. Our primary frequency of 15.3843 cycles/day corresponds to a period of 0.06500 days and is consistent with the value and errors found in Equation 1.

GSC 3973-1698 is a typical low amplitude δ Scuti variable with a complex frequency content. The thing that makes this star so interesting is that it is in the field of 4U 2206+543, which means that a great deal of data will be obtained in many filters as observations are taken of the HMXB.

Acknowledgements We would like to acknowledge the Brigham Young University Department of Physics and Astronomy for their continued support. We acknowledge a grant for the Theodore Dunham, Jr. Grant for Research in Astronomy. We finally acknowledge NSF grant PHY-0552795.

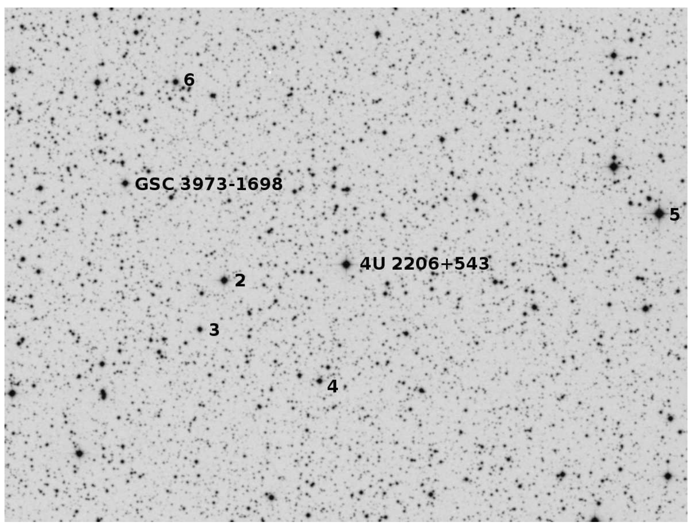

Figure 1. Finder chart for GSC 3973-1698 with 4U 2206+543 and comparison stars marked. The field is 20' wide and 15' high with North being up and East to the left.

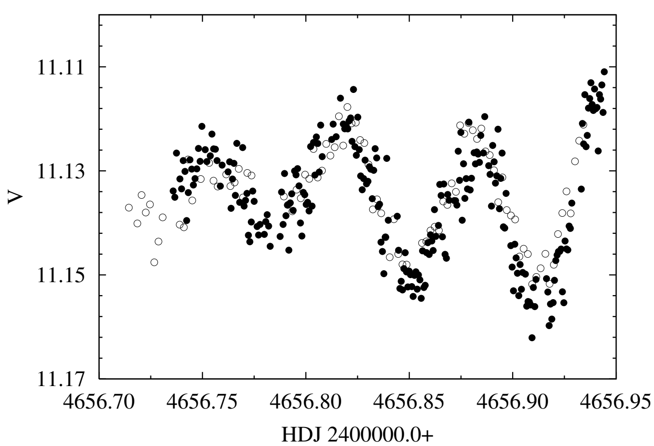

Figure 2. Simultaneous light curves from the OPO (solid) and WMO (open) facilities.

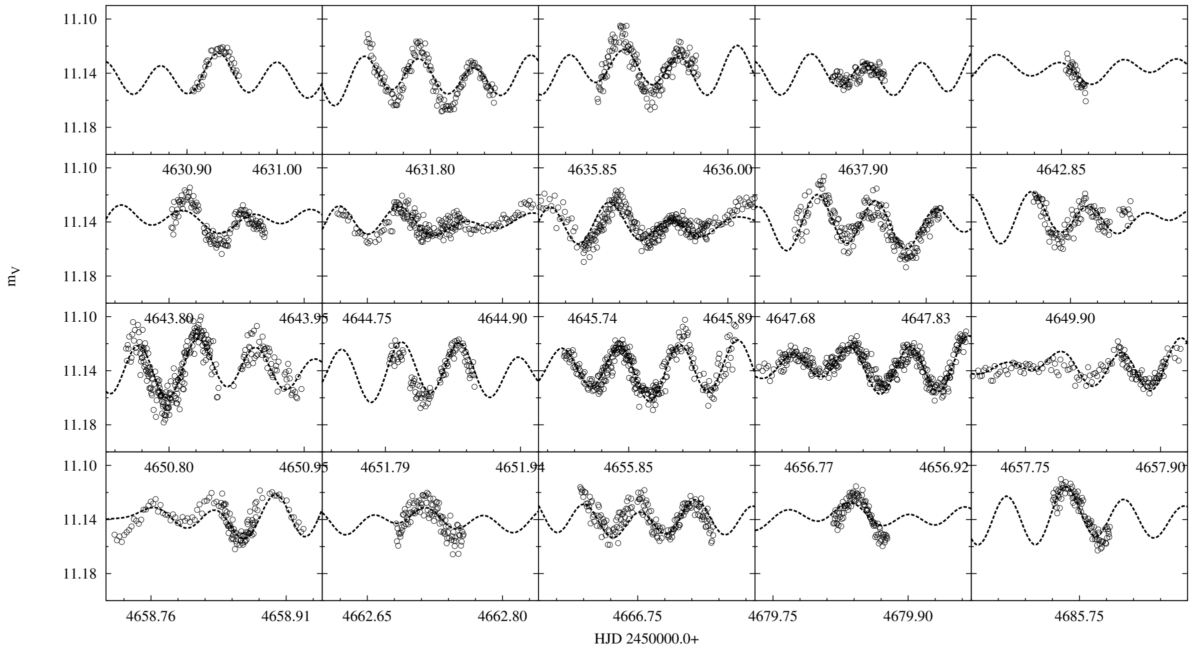

Figure 3. All 20 nights of V photometry are presented on the same magnitude and time scales. The data from WMO and OPO are plotted together.

Table 1. Times of Maximum Light for GSC 3973-1698

Cycle	HJD	Cycle	HJD	Cycle	HJD
0	2454630.9375	228	2454645.7687	398	2454656.8164
13	2454631.7871	229	2454645.8370	399	2454656.8795
14	2454631.8481	258	2454647.7103	551	2454666.7485
76	2454635.8808	259	2454647.7693	552	2454666.8103
77	2454635.9492	306	2454650.8319	752	2454679.8403
198	2454643.8204	322	2454651.8699		
199	2454643.8853	383	2454655.8394		

Table 2. Frequency Content of GSC 3973-1698

ID	Frequency (cycles/day)	Amplitude (mag)	Detection S/N
f_1	15.3843	0.010	12.5
f_2	16.3310	0.006	7.3
f_3	13.4091	0.005	6.2
f_4	6.0763	0.004	5.0

References:

Bessell, M., S., 1990, *PASP*, **102**, 1181
Breger, M et al., 1993, *A&A*, **271**, 482
Breger, M., Rucinski, S. M. & Reegen, P., 2007, *AJ*, **134**, 1994
Lenz, P. & Breger, M., 2005, *Commun. Asteroseismol.*, **146**, 53

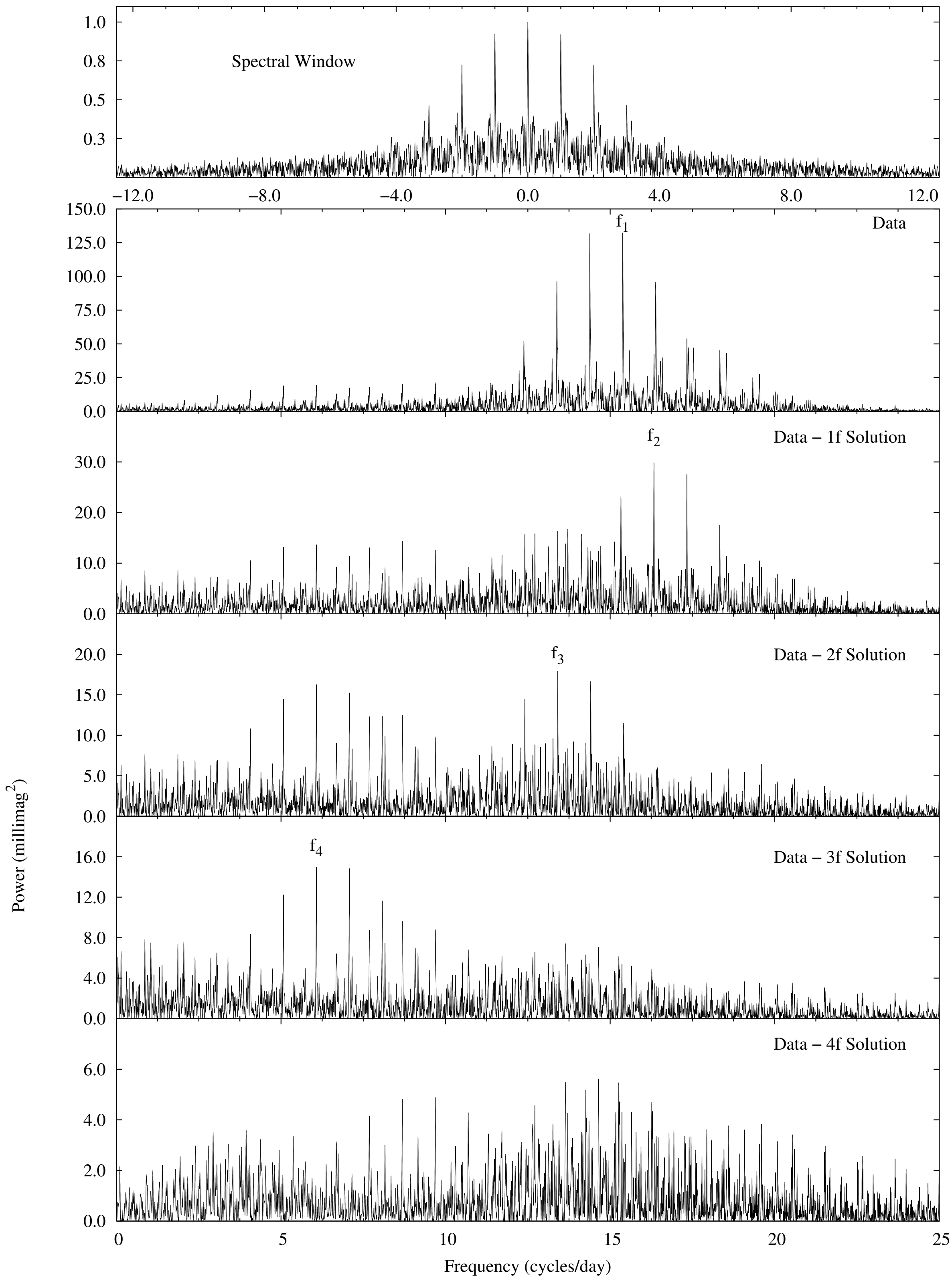

Figure 4. Power spectra of GSC 3973-1698. The spectral window in the top panel is scaled to the same frequency range as the individual power spectra.

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SHORT-PERIOD OSCILLATIONS IN THE ALGOL-TYPE SYSTEMS IV: NEWLY DISCOVERED VARIABLE GSC 4293-0432

DIMITROV, D.; KRAICHEVA, Z.; POPOV, V.

Institute of Astronomy, BAS, Tsarigradsko Shossee 72, 1784 Sofia, Bulgaria,
e-mail: dinko@astro.bas.bg; zk@astro.bas.bg; vpopov@astro.bas.bg

A new Algol-type system GSC 4293-0432 was extracted during our data-mining variability search in the NSVS database (Wozniak et al., 2004). The parameters of the system are as follows: period $P \simeq 4.3844$ days, amplitude of the primary minimum $A_R > 0.25$ mag, and magnitude in the maximum $R'_{\rm max} \simeq 10.72$ mag. $R'_{\rm max}$ stands for the maximum in the light curve in the instrumental system of NSVS, which is similar, but not identical to the R color (hence, R'). The astrometric and photometric data for the stars (Table 1) are taken from NOMAD catalogue (Zacharias et al., 2004).

The CCD photometry of GSC 4293-0432 in BVR bands was carried out with the 60cm Cassegrain telescope at Rozhen NAO, equipped with the CCD camera FLI PL09000 (3056×3056, 12μ pixel), and Bessell (1990) standard $UBVRI$ filters. The standard IDL procedures were used for the reduction of the photometric data. Five stars from the field (Fig. 1) with $\sigma < 0.005$ mag in V band observations were selected to create an ensemble standard star (Everett & Howell, 2001).

The NSVS and Rozhen light curves of GSC 4293-0432 are shown in Fig. 2. The six V light curves of the star are shown in Fig. 4. During the campaign short-period oscillations (also present at the secondary minimum) with a peak-to-peak amplitude of up to 0.04 mag in B, 0.04 mag in V, and 0.035 mag in R (Table 2) were detected. The frequency analysis of the residual light curve, performed with the `PERIOD-04` software based on the classical Fourier analysis (Lenz & Breger, 2005), revealed multi-periodic pulsation of the primary star. The main peaks in the power spectrum were observed at about 8 c/d and 22 c/d in V band (Fig. 5).

Spectral observations of GSC 4293-0432 were obtained with the Coudé spectrograph (resolution of 0.19 Å/pixel) of the 2m RC telescope at NAO Rozhen (Table 3). The spectral domain covered two regions around H_β, and MgII 4481 lines (Fig. 3). The data reduction of the spectra was made with standard IRAF procedures. The corresponding radial velocities (Table 3) were measured by the cross-correlation technique using synthetic spectrum, calculated with the programme `SPECTRUM` (Gray & Corbally, 1994) and a grid of LTE atmosphere models for a solar-type chemical composition (Castelli & Kurucz, 2003), as a template spectrum. The physical parameters of the primary component were estimated by comparing the synthetic and the observed spectra. The parameters of the secondary were computed with the `PHOEBE` software (Prša & Zwitter, 2005). The spectral types of the two components were determined using Straižys & Kuriliene (1981) calibration (Table 4).

The new ephemeris were computed using both Rozhen and NSVS data:

$$HJD\ (\mathrm{MinI}) = 2451271.7302(\pm 0.0013) + 4.38440(\pm 0.00019)E \quad (1)$$

Acknowledgements This study made use of the SIMBAD, ADS, and VSX databases, and GCVS catalogue.

Table 1. Data for the variable and comparison stars used in the CCD photometry from NOMAD

ID	Name	RA (J2000)	DEC (J2000)	V	$B-V$	$V-R$	Sp. type
V1	GSC 4293-0432	$23^h45^m41\overset{s}{.}82$	$+66°05'06\overset{''}{.}5$	10.567	0.334	0.217	A2
C1	GSC 4293-0050	$23^h45^m46\overset{s}{.}11$	$+65°59'45\overset{''}{.}7$	10.067	0.336	0.217	A0
C2	GSC 4293-0424	$23^h46^m15\overset{s}{.}22$	$+66°09'30\overset{''}{.}8$	10.442	0.251	0.162	
C3	GSC 4293-0603	$23^h45^m11\overset{s}{.}23$	$+65°59'00\overset{''}{.}4$	11.798	0.608	0.408	
C4	GSC 4293-0424	$23^h46^m15\overset{s}{.}22$	$+66°09'30\overset{''}{.}8$	11.862	0.630	0.442	
C5	GSC 4293-0105	$23^h46^m16\overset{s}{.}47$	$+66°05'27\overset{''}{.}5$	12.148	0.584	0.338	

Table 2. Observational runs of GSC 4293-0432

Date	HJD(start)	Length	Filter	Exp.[s]	N	Phase	A_{osc}(max)
06.11.2008	2454777.20962	07^h06^m	V	30	429	0.54-0.60	0.025
12.11.2008	2454783.26564	07^h32^m	V	60	360	0.92-0.99	0.020
13.11.2008	2454784.32173	05^h42^m	V	60	300	0.16-0.21	0.040
01.12.2008	2454802.21245	07^h23^m	BVR	120,60,30	100	0.24-0.31	0.04,0.03,0.025
05.12.2008	2454806.29740	04^h19^m	BVR	120,60,60	50	0.17-0.21	0.03,0.03,0.035
07.12.2008	2454808.43581	01^h30^m	BVR	120,60,60	20	0.66-0.67	~0.02
09.12.2008	2454810.27001	05^h34^m	BVR	120,60,60	70	0.08-0.13	0.035,0.035,0.03

Table 3. Rozhen spectra of GSC 4293-0432

Date	HJD(mid)	S/N	Exp. [s]	RV [kms^{-1}]		Region [Å]	Phase
08.05.2009	2454960.55950	56	1800	−18.0	±1.4	4400-4600	0.353
08.05.2009	2454960.58215	77	1800	−11.9	±1.4	4800-4965	0.358
10.05.2009	2454962.56910	58	1200	18.9	±1.5	4800-4965	0.812
10.05.2009	2454962.58534	61	1200	18.8	±1.4	4400-4600	0.815

Table 4. Preliminary physical parameters of the GSC 4293-0432 components

Parameter		Primary star	Secondary star
T_{eff}	[K]	7750	4300
$v \sin i$	[kms^{-1}]	40	
Spectral type		A7	K3

References:

Bessell, M., S., 1990, *PASP*, **102**, 1181
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Straižys, V., Kuriliene, G., 1981, *ApSS*, **80**, 353
Wozniak, P., Vestrand, W., Akerlof, C. et al., 2004, *AJ*, **127**, 2436
Zacharias, N., Monet, D., Levine, S. et al., 2004, *AAS*, **205**, 4815

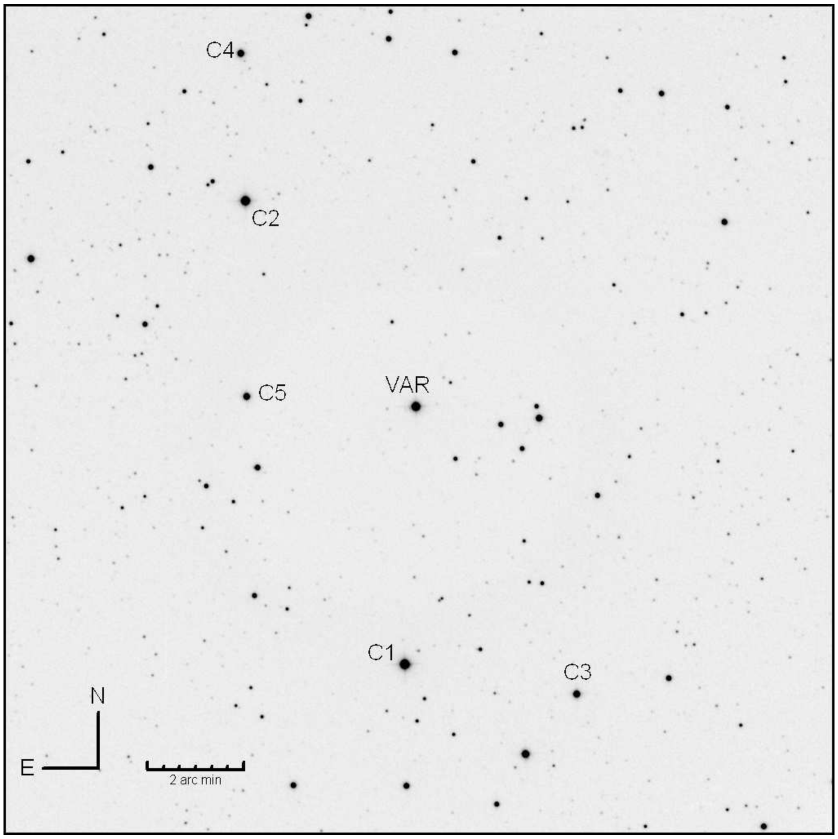

Figure 1. Field of the eclipsing binary GSC 4293-0432.

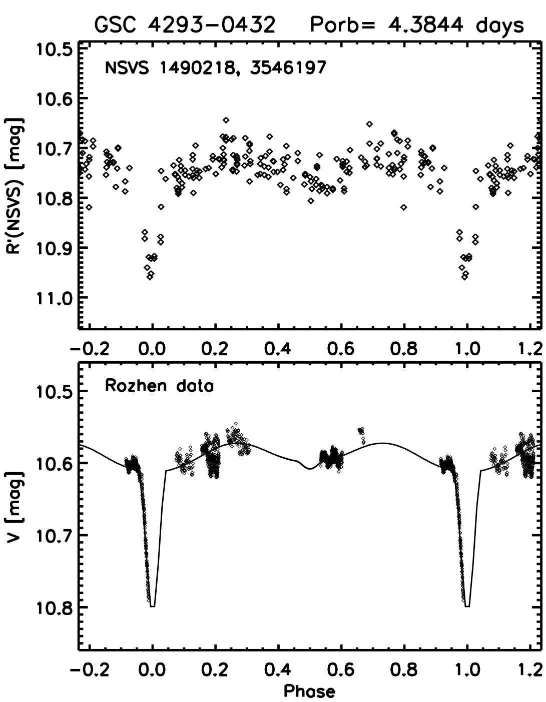

Figure 2. Light curves of GSC 4293-0432. Upper panel - NSVS data, lower panel - Rozhen V data (dots) and model (solid line).

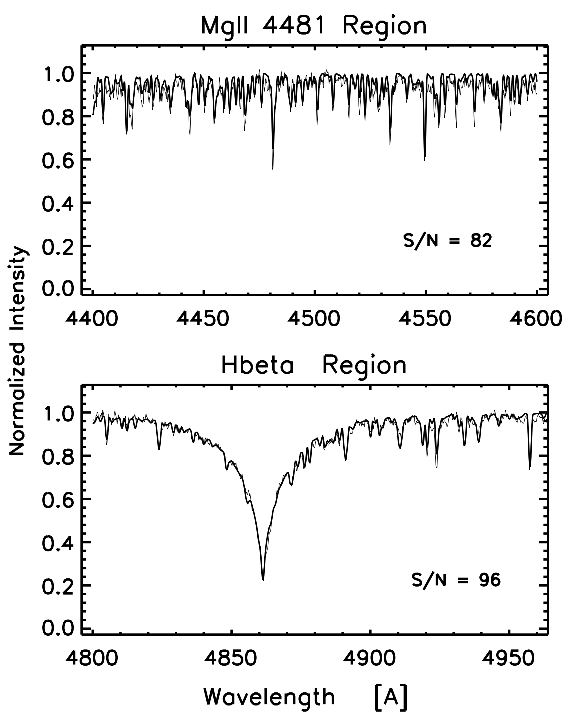

Figure 3. Rozhen combined spectra (thin line) of GSC 4293-0432 and the best synthetic spectra (thick line).

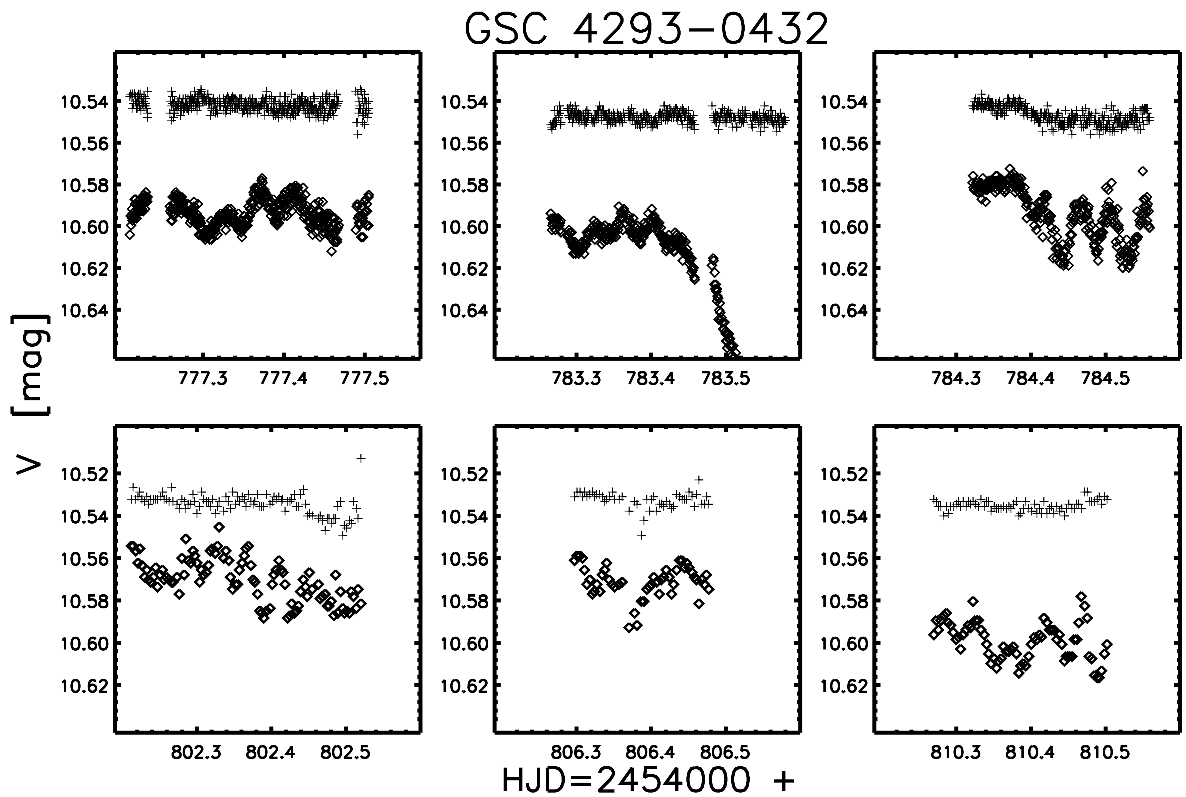

Figure 4. Sample V light curves of GSC 4293-0432 (diamonds), and shifted comparison star C2 (crosses).

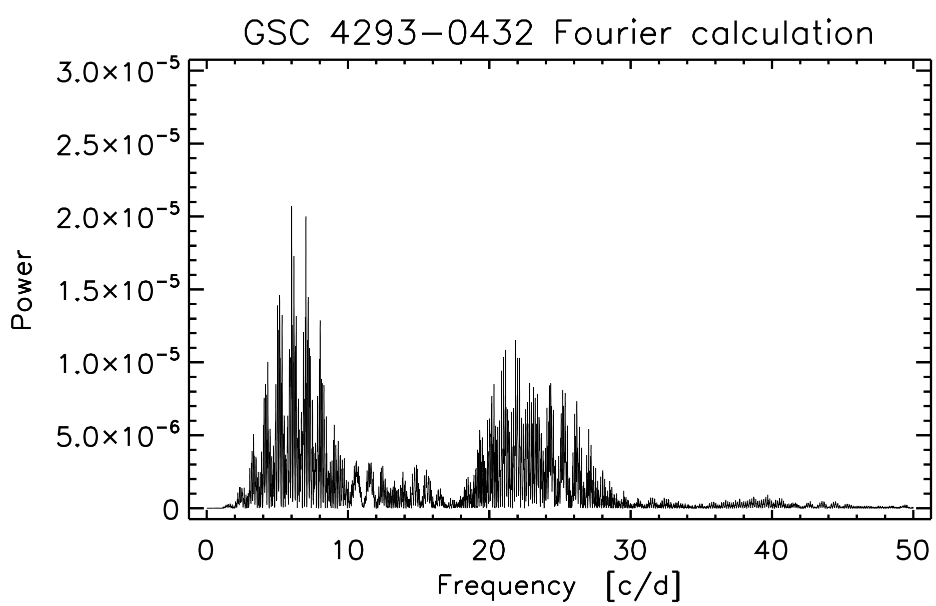

Figure 5. Power spectrum of GSC 4293-0432 Rozhen data after subtracting the synthetic light curve from the data.

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NEW TIMES OF MINIMA OF SOME ECLIPSING BINARY STARS

DOĞRU, S. S.; ERDEM, A.; DÖNMEZ, A.; BULUT, A.; AKIN, T.; DOĞRU, D.; ÇİÇEK, C.; SOYDUGAN, F

Department of Physics, Faculty of Arts and Sciences,Çanakkale Onsekiz Mart University and Çanakkale Onsekiz Mart University Observatory, Terzioğlu Campus, TR-17020, Çanakkale, Turkey; e-mail: dogru@comu.edu.tr

Observatory and telescope:
Two 30-cm Cassegrain-Schmidt telescopes of the Çanakkale University Observatory

Detector:	-ST237 camera, Peltier cooling, TC237 chip, $11' \times 8'$ FOV, 640×480 pixels, (ÇUG301). -ST10XME camera, Peltier cooling, KAF 3200ME chip, $17' \times 12'$ FOV, 2184×1472 pixels, (ÇUG302). -STL1001E camera, Peltier cooling, KAF-1001E chip, $28' \times 28'$ FOV, 1024×1024 pixels, (ÇUG303). -ALTA U47 camera, Peltier cooling, E2V CCD47-10 chip, $15' \times 15'$ FOV, 1024×1024 pixels, (ÇUG304).

Method of data reduction:
Reduction of the CCD frames was made with C-MUNIPACK[1] software.

Method of minimum determination:
Kwee – van Woerden method (Kwee & van Woerden, 1956).

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
KO Aql	54993.4578	0.0004	I	V	ÇUG304
V602 Aql	54255.4377	0.0005	I	V	ÇUG302
Y Cam	54201.3678	0.0002	I	C	ÇUG301
	54224.5087	0.0003	I	V	ÇUG302
	54925.3356	0.0001	I	C	ÇUG301
	54991.4519	0.0002	I	C	ÇUG303
AB Cas	54930.3131	0.0001	I	C	ÇUG301
OX Cas	54362.3890	0.0004	II	BVR_c	ÇUG302
	54367.3655	0.0002	II	BVR_c	ÇUG302
	54428.3118	0.0004	I	BVR_c	ÇUG302
CW Cep	54331.4020	0.0001	II	BVR_c	ÇUG302
	54357.3533	0.0003	I	BVR_c	ÇUG302
GI Cep	54086.3182	0.0003	I	C	ÇUG301
AK Cmi	54932.3067	0.0001	I	C	ÇUG301
TW Crb	54930.3888	0.0001	I	C	ÇUG301
V370 Cyg	54932.5566	0.0002	I	C	ÇUG301
V909 Cyg	54966.3708	0.0001	II	C	ÇUG301
WW Cyg	54989.4204	0.0002	I	C	ÇUG301

[1]Motl, D., 2004, C-MUNIPACK, `http://integral.sci.muni.cz/munipack/`

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
RZ Dra	54966.4644	0.0001	I	C	ÇUG301
TZ Eri	54084.4897	0.0003	I	C	ÇUG301
BC Her	54275.4998	0.0002	I	V	ÇUG302
CT Her	54961.4629	0.0002	I	V	ÇUG304
GL Her	54261.4514	0.0004	I	V	ÇUG302
SZ Her	54955.4927	0.0001	I	V	ÇUG304
TU Her	54225.3930	0.0005	II	I_c	ÇUG303
	54931.5389	0.0001	I	C	ÇUG301
TX Her	54925.4998	0.0005	I	C	ÇUG301
V338 Her	54941.4599	0.0001	I	V	ÇUG304
	54954.5176	0.0001	I	V	ÇUG304
CO Lac	54298.3185	0.0002	II	BVR_c	ÇUG302
	54338.4150	0.0003	II	BVR_c	ÇUG302
VX Lac	54111.2814	0.0001	I	C	ÇUG301
	54861.2885	0.0003	I	C	ÇUG301
RW Leo	54138.4234	0.0002	I	C	ÇUG301
	54939.3062	0.0002	I	V	ÇUG304
UU Leo	54844.4787	0.0002	I	V	ÇUG303
UX Leo	54138.4862	0.0002	I	C	ÇUG301
	54961.3398	0.0007	I	C	ÇUG301
	54966.3708	0.0001	I	V	ÇUG304
VZ Leo	54067.5363	0.0003	I	C	ÇUG301
	54962.3451	0.0003	I	C	ÇUG301
XZ Leo	54086.5432	0.0002	I	C	ÇUG301
Y Leo	54111.4376	0.0001	I	C	ÇUG301
	54869.3226	0.0007	II	I_c	ÇUG303
	54906.4333	0.0005	II	R_c	ÇUG304
	54955.3296	0.0001	II	R_c	ÇUG304
T LMi	54085.4845	0.0002	I	C	ÇUG301
	54218.3594	0.0002	I	V	ÇUG303
SX Lyn	54166.3883	0.0002	I	C	ÇUG301
EW Lyr	54224.4142	0.0001	I	V	ÇUG303
TZ Lyr	54930.4869	0.0002	I	C	ÇUG301
BO Mon	54117.3837	0.0001	I	C	ÇUG301
RW Mon	54117.5293	0.0001	I	C	ÇUG301
V839 Oph	54993.3433	0.0001	I	V	ÇUG304
EQ Ori	54116.5019	0.0003	I	C	ÇUG301
	54867.3056	0.0004	I	C	ÇUG301
FH Ori	54166.2980	0.0001	I	C	ÇUG301
RT Per	54085.3438	0.0002	I	C	ÇUG301
XZ Per	54116.2733	0.0001	I	C	ÇUG301
	54868.2952	0.0001	I	C	ÇUG301
AO Ser	54926.5017	0.0002	I	C	ÇUG301
AM Tau	54138.3095	0.0001	I	C	ÇUG301
	54841.4208	0.0003	I	V	ÇUG303
RV Tri	54110.3271	0.0002	I	C	ÇUG301
	54138.2132	0.0001	I	C	ÇUG301
V Tri	54117.3124	0.0001	I	C	ÇUG301
VV UMa	54117.4620	0.0002	I	C	ÇUG301
	54966.3794	0.0003	I	C	ÇUG301
XZ UMa	54129.3080	0.0001	I	C	ÇUG301
	54844.3556	0.0001	I	V	ÇUG303
	54954.3627	0.0004	I	V	ÇUG304
	54998.3666	0.0002	I	C	ÇUG302

Remarks:
We present 72 minima times of 46 eclipsing binaries. In the Remarks column of Times of Minima table, telescopes and detectors used in the observations are given.

Acknowledgements:
This study was supported by the Turkish *TUBITAK* under the grant no. 108T714, and it was also partly supported by the Research Found of Çanakkale Onsekiz Mart University.

Reference:

Kwee, K. K., & van Woerden, H., 1956, *Bull. Astron. Inst. Neth.*, **12**, 327.

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TIMINGS OF MINIMA OF ECLIPSING BINARIES

DIETHELM, ROGER

Bahnhofstrasse 3, CH–4118 Rodersdorf, Switzerland

The following Table lists timings of minima of eclipsing binaries secured by CCD photometry, obtained between January and June 2009. The given $O-C$ values generally refer to the linear elements of the 2008 electronic version of the GCVS (Kholopov et al., 1985, 2008 edition), except for the cases stated in the remarks, where the determination of current elements made use of the up-to-date ASAS data (`http://www.astrouw.edu.pl/asas/`) and the Lafler-Kinman algorithm of the PERANSO software (`http://www.peranso.com/`). All times given are heliocentric UTC.

Table 1: Minima of eclipsing binaries

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
ZZ Aur	p	54860.6524	0.0001	+0.0156	29	RD	V
CG Aur	p	54860.6527	0.0012	+0.0090	29	RD	V
DO Aur	p	54844.6296	0.0006	+0.0752	27	RD	V
EI Aur	s	54848.6089	0.0004	−0.1587	21	RD	V
EM Aur	p	54845.5981	0.0009	−0.1913	22	RD	V
EP Aur	p	54881.6784	0.0004	+0.0249	28	RD	V; IBVS 4099
EU Aur	p	54842.7516	0.0016	+0.5942	9	RD	V; d=0.02days
FP Aur	p	54862.6756	0.0003	−0.0713	33	RD	V
FR Aur	p	54852.579	0.005	−0.595	13	RD	V
FW Aur	p	54860.6947	0.0001	−0.0402	31	RD	V
HP Aur	p	54844.6199	0.0003	+0.0515	20	RD	V
HW Aur	p	54860.6777	0.0004	+0.0239	39	RD	V; el.: IBVS 5016
II Aur	p	54862.6516	0.0004	+0.0145	31	RD	V
V364 Aur	p	54848.6302	0.0003	−0.0189	26	RD	V; el.: 2438849.342 + 0.699026 * E
V576 Aur	p	54865.7028	0.0011	−0.2078	30	RD	V; el.: `www.astrouw.pl/asas/`
GSC 2393-680	p	54862.6909	0.0004	+0.0055	27	RD	V; el.: IBVS 5699
SY Boo	p	54961.7850	0.0002	−0.0324	47	RD	V; el.: 2451273.62 + 0.71449 * E; d=0.038days
TU Boo	p	54961.7925	0.0003	+0.0064	33	RD	V; el.: A&AS 117, 105
AC Boo	p	54958.8099	0.0011	+0.1647	11	RD	V
AQ Boo	p	54948.7748	0.0006	−0.0201	15	RD	V; el.: IBVS 4871
	s	54948.9395	0.0007	−0.0221	12	RD	V
AR Boo	s	54891.9286	0.0016	+0.0313	11	RD	V; el.: IBVS 4601
CK Boo	s	54961.7578	0.0003	+0.1106	22	RD	V; el.: IBVS 3727
CV Boo	s	54965.7394	0.0006	+0.0026	25	RD	V; el.: IBVS 5535
EF Boo	p	54958.771	0.002	−0.181	9	RD	V; el.: IBVS 4811
EW Boo	p	54961.8778	0.0003	+0.3595	25	RD	V
FY Boo	p	54957.6806	0.0002	+0.0060	12	RD	V; el.: IBVS 5741
GK Boo	s	54958.8085	0.0007	−0.0628	14	RD	V; el.: IBVS 5060
GL Boo	p	54963.8410	0.0019	+0.0453	37	RD	V; el.: 2453425.805 + 3.197524 * E
GM Boo		54961.8511	0.0005	+0.0518	26	RD	V; el.: IBVS 5125
GQ Boo	p	54965.7952	0.0006	−0.0050	29	RD	V; el.: IBVS 5125

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GU Boo	p	54965.7845	0.0005	+0.0402	14	RD	V; el.: 2451555.917 + 0.488724 * E
HH Boo	s	54958.6887	0.0009	+0.0162	10	RD	V
	p	54958.849	0.003	+0.017	13	RD	V
HR Boo	s	54963.7534	0.0005	+0.0020	15	RD	V; el.: www.astrouw.pl/asas/
	p	54963.9144	0.0008	+0.0050	10	RD	V
	s	54965.6514	0.0017	+0.0042	10	RD	V
	p	54965.8097	0.0005	+0.0046	20	RD	V
GSC 912-792	p	54958.778	0.002	−0.002	6	RD	V; el.: 2453447.874 + 0.286482 * E
	s	54958.920	0.002	−0.003	6	RD	V
GSC 921-412	s	54958.663	0.003	+0.023	5	RD	V; el.: 2453859.742 + 0.356727 * E
	p	54958.8403	0.0006	+0.0224	9	RD	V
GSC 1478-669	p	54965.7839	0.0004	−0.0221	36	RD	V; el.: 2454204.822 + 0.428000 * E
GSC 1484-525	p	54958.7985	0.0018	+0.0002	10	RD	V; el.: 2453093.610 + 0.33215 * E
WW Cam	p	54839.6640	0.0004	−0.0211	41	RD	V
AQ Cam	p	54849.6809	0.0003	+0.0257	29	RD	V
AZ Cam	p	54839.8226	0.0012	+0.0254	13	RD	V
HW Cam	p	54833.9055	0.0004	+0.0712	23	RD	V; el.: IBVS 4526
LR Cam	p	54852.6506	0.0007	−0.0482	33	RD	V; el.: IBVS 5132
MP Cam	p	54842.6658	0.0004	−0.0702	36	RD	V
NO Cam	s	54833.6883	0.0004	+0.0037	30	RD	V; el.: 2451497.718 + 0.430753 * E
NR Cam	p	54891.7028	0.0009	+0.0058	15	RD	V; el.: 2451589.757 + 0.255885 * E
GSC 4370-206	s	54862.6395	0.0003	−0.0469	29	RD	V; el.: 2453062.17715 + 0.442114 * E
NSV 3715	p	54889.6861	0.0007	+0.0008	23	RD	V; el.: 2451489.223 + 0.362098 * E
NSV 4638	s	54849.8138	0.0014	−0.0470	16	RD	V; el.: 2451434.388 + 0.39005 * E
WW Cnc	p	54842.8313	0.0005	−0.5178	21	RD	V
WX Cnc	p	54848.8760	0.0006	+0.0135	26	RD	V
WY Cnc	p	54842.9174	0.0005	−0.0323	19	RD	V
AO Cnc	p	54848.9371	0.0006	−0.0787	20	RD	V
GQ Cnc	p	54839.8837	0.0011	+0.0558	19	RD	V; el.: IBVS 4393
	p	54842.8436	0.0005	+0.0596	24	RD	V
IN Cnc	p	54889.623	0.002	−0.002	10	RD	V; el.: IBVS 5428
IO Cnc	s	54848.8582	0.0006	−0.0099	21	RD	V; el.: IBVS 5428
	s	54849.9018	0.0004	−0.0097	22	RD	V
IU Cnc	p	54833.9050	0.0004	−0.0081	36	RD	V; d=0.03days
	p	54839.8092	0.0002	−0.0070	12	RD	V
GSC 1407-222	p	54849.9153	0.0003	−0.0179	23	RD	V; el.: www.astrouw.pl/asas/
NSV 4322	s	54839.8659	0.0010	−0.0102	30	RD	V; el.: www.astrouw.pl/asas/
RV CVn	p	54950.7203	0.0010	+0.0252	11	RD	V
	s	54950.8540	0.0006	+0.0241	16	RD	V
VV CVn	p	54950.8926	0.0004	+0.0360	20	RD	V; el.: 2452308.695 + 0.5331238 * E
VW CVn	p	54887.8205	0.0010	−0.0432	8	RD	V
BI CVn	s	54888.9012	0.0004	+0.0441	29	RD	V; el.: IBVS 4554
	s	54957.6763	0.0007	+0.0463	21	RD	V
CI CVn	p	54950.8216	0.0011	−0.0200	26	RD	V; el.: Hipparcos
DF CVn	p	54887.8543	0.0010	−0.0037	16	RD	V; el.: 2450571.199 + 0.3268958 * E
	p	54888.8382	0.0005	−0.0005	8	RD	V
	p	54996.3841	0.0007	−0.0033	22	EBl	C
	s	54996.5516	0.0008	+0.0007	18	EBl	C
DH CVn	p	54881.8834	0.0007	−0.0182	24	RD	V; el.: IBVS 5149
	p	54996.3814	0.0006	−0.0181	12	EBl	C
DI CVn	s	54882.8984	0.0009	−0.0036	17	RD	V; el.: IBVS 5224
	s	54955.7171		−0.0050	19	RD	V
DQ CVn	p	54882.9012	0.0009	+0.0034	18	RD	V; el.: IBVS 5541
DR CVn	p	54884.9475	0.0008	+0.0376	15	RD	V
	p	54957.6656	0.0006	+0.0349	19	RD	V
DU CVn	s	54889.8378	0.0012	−0.0026	9	RD	V; el.: 2451341.744 + 0.307261 * E
DX CVn	p	54888.8299	0.0008	+0.0038	6	RD	V; el.: IBVS 5403
	p	54972.4565	0.0008	+0.0030	21	EBl	C

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
DY CVn	s	54888.8673	0.0002	−0.0058	19	RD	V; el.: IBVS 5403
	p	54888.9895	0.0015	−0.0066	7	RD	V
	s	54972.4908	0.0004	−0.0051	13	EBl	C
EE CVn	p	54891.8782	0.0003	−0.0053	19	RD	V; el.: IBVS 5403
	s	54996.3831	0.0017	−0.0102	12	EBl	C
	p	54996.5261	0.0006	−0.0075	18	EBl	C
EF CVn	p	54891.8628	0.0013	−0.0057	8	RD	V; el.: IBVS 5269
	p	54957.6975	0.0005	−0.0069	20	RD	V
	p	55000.4110	0.0007	−0.0051	20	EBl	C
EG CVn	s	54889.8873	0.0008	+0.0340	16	RD	V; el.: IBVS 5269
	p	55000.4356	0.0006	+0.0380	23	EBl	C
EH CVn	p	54891.8740	0.0009	−0.0422	17	RD	V
EI CVn	p	54972.4364	0.0008	−0.0125	17	EBl	C; el.: IBVS 5403
GSC 2537-520	p	55000.3955	0.0009	−0.0059	14	EBl	C; el.: IBVS 5541
GSC 2544-1007	p	55000.4444	0.0003	+0.0065	18	EBl	C; el.: IBVS 5541
TT CMi	p	54889.6617	0.0006	−0.2924	18	RD	V
TX CMi	p	54888.7173	0.0005	+0.0069	23	RD	V; el. BBSAG Bull. 106, 7
UZ CMi	p	54891.7538	0.0002	+0.0150	25	RD	V; el.: 2451925.4166 + 0.551361 * E
XZ CMi	p	54891.6902	0.0006	−0.0098	31	RD	V
CX CMi	p	54888.6757	0.0007	+0.0007	30	RD	V; el.: IBVS 5366
CZ CMi	p	54888.7927	0.0002	+0.0464	10	RD	V; el.: IBVS 5366
DL CMi	s	54889.6786	0.0006	+0.0002	26	RD	V; el.: 2451629.654 + 4.017282 * E
	p	54891.6847	0.0011	−0.0023	20	RD	V
V1018 Cas	p	54833.7032	0.0018	−0.0002	27	RD	V; el.: 2451601.625 + 4.127814 * E; non-circular orbit
EF Cep	s	54839.6440	0.0009	+0.1811	33	RD	V
RW Com	s	54874.9082	0.0008	−0.0212	14	RD	V
	p	54955.7293	0.0002	−0.0163	19	RD	V
RZ Com	p	54887.8522	0.0009	+0.0427	15	RD	V
SS Com	p	54882.9253	0.0004	+0.1594	21	RD	V; el.: BAV Rb. 1984-4, 152
	p	54952.6911	0.0007	−0.1605	22	RD	V
AQ Com	s	54881.8582	0.0004	−0.0098	15	RD	V; el.: IBVS 5684
	p	54957.6775	0.0011	−0.0094	23	RD	V
CC Com	s	54865.8558	0.0006	−0.0168	20	RD	V
	p	54865.9656	0.0005	−0.0174	11	RD	V
	s	54891.898	0.003	−0.015	11	RD	V
CM Com	s	54874.845	0.002	−0.012	10	RD	V; el.: 2452639.33 + 0.554515 * E
CN Com	p	54888.9114	0.0007	+0.0638	18	RD	V
DD Com	p	54881.8785	0.0005	+0.0742	16	RD	V
DG Com	p	54952.6863	0.0005	−0.0485	18	RD	V
EK Com	p	54882.8419	0.0007	−0.0505	21	RD	V; el.: IBVS 4167
	s	54882.9757	0.0007	−0.0499	12	RD	V
EQ Com	s	54889.9151	0.0004	+0.1719	10	RD	V
LL Com	s	54887.8972	0.0007	+0.0032	17	RD	V; el.: IBVS 4386
	p	54957.6853	0.0004	+0.0084	21	RD	V
LO Com	p	54865.8945	0.0005	+0.0097	16	RD	V; el.: IBVS 5052
	s	54955.6663	0.0011	+0.0076	13	RD	V
	p	54996.4771	0.0007	+0.0120	22	EBl	C
LP Com	s	54874.908	0.002	−0.013	15	RD	V: el.: IBVS 5052
	s	54955.6682	0.0006	−0.0191	11	RD	V
	p	54996.3853	0.0006	−0.0232	15	EBl	C
LR Com	p	54884.9132	0.0006	−0.0207	25	RD	V; el.: 2449687.296 + 0.896299 * E
MM Com	s	54888.8842	0.0007	−0.0103	17	RD	V; el.: IBVS 5224
MR Com	p	55000.387	0.003	−0.031	10	EBl	C; el.: IBVS 5269
GSC 881-218	s	54955.6990	0.0009	−0.0014	19	RD	V; el.: 2452525.822 + 0.324438 * E
GSC 883-1116	p	54955.6898	0.0003	+0.0011	17	RD	V; el.: 2454622.622 + 0.363610 * E
GSC 1445-866	p	54952.6808	0.0010	−0.0330	20	RD	V; el.: 2453439.709 + 0.373020 * E
GSC 1446-1499	s	54955.7329	0.0011	+0.0100	10	RD	V; el.: 2454868.821 + 0.266162 * E
GSC 1446-2377	p	54952.7405	0.0005	+0.0024	17	RD	V; el.: 2453439.709 + 0.297899 * E

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GSC 1994-935	s	54950.7439	0.0006	+0.0075	21	RD	V; el.: 2453818.687 + 0.347309 * E
	p	54950.9209	0.0013	+0.0066	8	RD	V
RT CrB	p	54984.7950	0.0007	−0.0180	49	RD	V
RW CrB	p	54961.7884	0.0003	−0.0016	31	RD	V
YY CrB	s	54983.7393	0.0006	−0.0979	30	RD	V; el.: IBVS 5152
AR CrB	s	54952.8582	0.0003	−0.0037	21	RD	V; el.: IBVS 5295
AS CrB	s	54955.8638	0.0004	+0.0054	26	RD	V; el.: IBVS 5295; d=0.04days
GSC 880-55	s	54874.9167	0.0017	−0.0009	14	RD	V: el.: 2452763.558 + 0.582846 * E
	s	54957.6772	0.0009	−0.0045	23	RD	V
W Crv	p	54874.9106	0.0010	+0.0171	10	RD	V
AC Crt	s	54852.8566	0.0006	+0.0021	27	RD	V; el.: www.astrouw.pl/asas/
AR Dra	p	54881.9380	0.0009	+0.0150	17	RD	V
AX Dra	p	54884.9375	0.0003	−0.0573	20	RD	V
BX Dra	p	54955.8323	0.0012	+0.0192	18	RD	V; el.: IBVS 4266
FU Dra	s	54952.8318	0.0003	−0.0112	20	RD	V; el.: Hipparcos
IV Dra	s	54952.8335	0.0003	+0.0061	17	RD	V; el.: 2450977.5005 + 0.268105 * E
RU Eri	p	54844.6313	0.0007	−0.0224	29	RD	V
TZ Eri	p	54863.7252	0.0007	+0.2883	19	RD	V
WW Eri	p	54844.6712	0.0009	+0.0597	17	RD	V
	p	54845.6007	0.0005	+0.0627	24	RD	V
BC Eri	s	54844.6561	0.0004	+0.0385	20	RD	V; el.: IBVS 4937
	s	54845.7137	0.0007	+0.0416	24	RD	V
GS C5297-974		54839.6730	0.0013	+0.0043	33	RD	V: el.: 2454535.507 + 3.417547 * E
SX Gem	p	54881.6613	0.0006	−0.0587	32	RD	V
AI Gem	s	54884.6749	0.0004	−0.0078	26	RD	V
AZ Gem	p	54887.6615	0.0005	+0.0867	27	RD	V
BD Gem	p	54882.6908	0.0003	−0.0329	28	RD	V
DP Gem	s	54849.6698	0.0003	+0.0641	32	RD	V; el.: www.astrouw.pl/asas/; d=0.05days
EL Gem	p	54874.6458	0.0003	+0.0352	24	RD	V
EY Gem	p	54881.6998	0.0006	−0.2225	28	RD	V
	p	54882.6358	0.0005	−0.2276	26	RD	V
FT Gem	s	54884.7055	0.0003	−0.0292	28	RD	V
GX Gem	p	54882.6810	0.0002	−0.0325	34	RD	V; el.: 2451563.5046 + 4.037967 * E
IV Gem	s	54852.6091	0.0013		19	RD	V
KQ Gem	p	54887.6328	0.0003	−0.0826	16	RD	V
KV Gem	s	54884.7087	0.0007	+0.0211	15	RD	V; el.: 2451876.534 + 0.358519 * E
V380 Gem	p	54862.7215	0.0007	+0.0001	21	RD	V; el.: www.astrouw.pl/asas/
NSV 3744	s	54891.7252	0.0009	+0.0273	28	RD	V; el.: www.astrouw.pl/asas/
IK Her	p	54994.8446	0.0004	+0.2440	32	RD	V
V381 Her	p	54957.8089	0.0015	+0.1821	8	RD	V
V651 Her	p	54983.7809	0.0003	−0.0784	60	RD	V; el.: IBVS 5350; GSC 962-2150
V663 Her	s	55003.910	0.003	−0.262	25	RD	V; el.: ROTSE1
V681 Her	p	54984.8087	0.0008	+0.1195	16	RD	V; el.: ROTSE1
V687 Her	s	54955.8694	0.0002	−0.1526	28	RD	V
V718 Her	p	54957.9124	0.0008	+0.2873	15	RD	V
V728 Her	s	54998.7765	0.0003	+0.0952	43	RD	V; el.: IBVS 3234
V742 Her	p	55003.7911	0.0009	+0.0384	14	RD	V
V789 Her	p	54994.7506	0.0006	+0.0117	20	RD	V; el.: IBVS 5741
V861 Her	p	54990.643	0.008	−0.031	5	RD	V; el.: IBVS 4360
	s	54990.8089	0.0005	−0.0370	14	RD	V
V1005 Her	s	54990.7759	0.0004	−0.0794	15	RD	V; el.: IBVS 4611
V1024 Her	s	54955.8300	0.0009	+0.0501	14	RD	V; el.: 2452699.47 + 0.530834 * E
V1025 Her	p	54984.7367	0.0007	−0.0211	14	RD	V; el.: 2453503.687 + 0.563359 * E
V1031 Her	p	54994.8383	0.0006	+0.0047	25	RD	V; el.: 2454599.727 + 1.436751 * E
V1036 Her	s	54990.7772	0.0009	+0.0024	19	RD	V; el.: IBVS 5146
V1041 Her	p	54994.7978	0.0004	+0.0216	39	RD	V; el.: 2451332.69 + 1.114112 * E
V1042 Her	p	54957.799	0.003	+0.021	5	RD	V; el.: IBVS 4998
V1044 Her	p	54998.6701	0.0002	−0.0036	15	RD	V; el.: IBVS 5192
	s	54998.7923	0.0007	−0.0017	14	RD	V
	p	54998.9089	0.0005	−0.0053	9	RD	V

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
V1049 Her	p	54998.8413	0.0005	+0.0028	42	RD	V; el.: 2453529.638 + 0.727327 * E
V1097 Her	p	55003.7746	0.0002	+0.0049	15	RD	V; el.: IBVS 5306
V1119 Her	p	54955.8292	0.0010	−0.0289	13	RD	V; el.: IBVS 5699; d=0.034days
V1133 Her	p	55003.7302	0.0004	−0.0427	27	RD	V; el.: 2453229.608 + 2.467545 * E; non-circular orbit
GSC 950-560	p	54983.8172	0.0003	−0.0053	34	RD	V; el.: 2454351.551 + 1.232498 * E
GSC 965-581	p	54994.8254	0.0002	+0.0010	38	RD	V; el.: 2454546.848 + 0.443541 * E
GSC 973-1212	p	54990.7758	0.0005	−0.0006	19	RD	V; el.: 2454722.504 + 0.267470 * E
GSC 985-533	s	54994.8138	0.0007	+0.0146	27	RD	V; el.: 2454179.873 + 0.389451 * E
GSC 990-480	p	54998.8064	0.0005	−0.0004	20	RD	V; el.: 2453872.797 + 0.332942 * E
GSC 1528-936	p	54984.7582	0.0003	−0.0077	26	RD	V; el.: 2454190.832 + 1.301531 * E
GSC 1539-326	p	54998.8197	0.0007	+0.0070	24	RD	V; el.: 2453833.639 + 0.387745 * E
GSC 2043-227	p	54990.6598	0.0007	+0.0077	11	RD	V; el.: 2454938.867 + 0.313849 * E
	s	54990.8157	0.0009	+0.0067	14	RD	V
UW Hya	p	54889.6548	0.0004	+0.0260	20	RD	V; el.: MVS 12, 48
VW Hya	p	54833.8695	0.0001	+0.2304	34	RD	V
VZ Hya	p	54848.9718	0.0003	+0.0046	12	RD	V
AV Hya	p	54849.8342	0.0004	−0.0940	17	RD	V; el.: Ap&SS 76, 173
CQ Hya	p	54833.9200	0.0003	+0.1760	32	RD	V
EZ Hya	p	54848.8496	0.0004	−0.1054	25	RD	V; d=0.04days
FG Hya	p	54889.7014	0.0003	−0.0690	23	RD	V; el.: IBVS 2811
V404 Hya	p	54833.8411	0.0005	+0.0121	22	RD	V
V409 Hya	p	54842.8787	0.0005	+0.0278	31	RD	V; d=0.04days
V410 Hya	p	54849.981	0.005	−0.009	7	RD	V; el.: 2452732.712 + 3.150711 * E
GSC 230-1627	p	54839.8780	0.0007	+0.0135	29	RD	V; el.: 2453894.473 + 1.059856 * E
GSC 235-461	p	54839.9429	0.0010	+0.0361	19	RD	V; el.: 2453363.83 + 1.173352 * E
GSC 4875-1418	p	54848.9076	0.0007	−0.0064	20	RD	V; el.: 2453102.627 + 0.569937 * E
GSC 5447-940	s	54842.8526	0.0003	+0.0110	28	RD	V; el.: 2453856.589 + 1.05538 * E; d=0.04days
GSC 5463-753	s	54842.8492	0.0009	−0.0013	26	RD	V; el.: 2453796.762 + 1.04244 * E
GSC 5467-1483	p	54849.9109	0.0007	−0.0032	26	RD	V; el.: 2454256.517 + 2.952224* E; d=0.02days
UU Leo	p	54852.8748	0.0007	+0.1573	20	RD	V
UX Leo	p	54890.5368	0.0006	+0.0498	30	RD	V; el.: BAV Mitt. 68, 21
UZ Leo	p	54862.8941	0.0014	+0.2000	39	RD	V
XX Leo	s	54887.924	0.002	−0.001	14	RD	V; el.: JAAVSO 28, 25
	s	54890.8383	0.0006	+0.0006	40	RD	V; d = 0.066 days
XY Leo	s	54852.8629	0.0012	+0.1832	21	RD	V
XZ Leo	s	54860.8268	0.0004	+0.0467	20	RD	V
AM Leo	s	54865.9488	0.0017	+0.0115	14	RD	V
AP Leo	s	54863.9100	0.0007	−0.0331	19	RD	V
BL Leo	s	54884.9255	0.0002	−0.0257	21	RD	V
BW Leo	s	54865.9660	0.0009	−0.1197	13	RD	V
CE Leo	s	54865.9361	0.0008	−0.0037	18	RD	V
DU Leo	p	54860.9186	0.0002	0.0000	34	RD	V; el.: IBVS 3999
GU Leo	p	54852.8794	0.0004	+0.0617	27	RD	V; el.: IBVS 5329
GV Leo	p	54863.9128	0.0002	−0.0859	18	RD	V; el.: IBVS 5697
HI Leo	p	54862.9147	0.0006	+0.0039	22	RD	V; el.: IBVS 5455; d=0.025days
HS Leo	p	54852.8914	0.0006	+0.0501	27	RD	V; el.: Per. Zv. 25, 2
GSC 262-948	p	54881.9447	0.0005	+0.0381	16	RD	V; el.: 2453444.694 + 1.371386 * E
GSC 263-585	p	54863.8283	0.0004	−0.0028	17	RD	V; el.: 2452706.698 + 1.297914 * E
GSC 270-9	s	54952.6647	0.0015	+0.0811	17	RD	V; el.: 2454299.594 + 0.581728 * E
GSC 824-1304	p	54862.8851	0.0001	+0.0095	33	RD	V; el.: 2453492.56 + 0.885789 * E
GSC 870-349	p	54952.6886	0.0006	−0.0063	27	RD	V; el.: 2453444.679 + 0.343277 * E
RT LMi	p	54860.8769	0.0003	−0.0066	24	RD	V
XY LMi	s	54860.8561	0.0009	−0.0127	27	RD	V; el.: IBVS 5411
Z Lep	p	54844.714	0.005	+0.058	5	RD	V; el.: JAAVSO 21, 111
	p	54845.7086	0.0002	+0.0591	29	RD	V
GSC 5337-1744	p	54849.7166	0.0002	−0.0019	17	RD	V; el.: 2453009.567 + 1.092078 * E
GSC 5361-545	p	54881.6873	0.0003	+0.0056	20	RD	V; el.: 2454421.804 + 0.797015 * E

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
NSV 1864	s	54852.6590	0.0003	+0.0274	37	RD	V; el.: www.astrouw.pl/asas/; d=0.045days
NSV 2698	p	54863.7504	0.0001	−0.0003	10	RD	V; el.: 2453399.588 + 0.806257 * E
NSV 7292 Lib	p	54957.8065	0.0019	−0.0136	9	RD	V; el.: www.astrouw.pl/asas/
NSV 7481	s	54952.8774	0.0001	+0.0121	26	RD	V; el.: 2451926.215 + 0.293408 * E
RV Lyn	p	54882.6328	0.0002	+0.8943	24	RD	V
RZ Lyn	p	54852.9053	0.0003	−0.1124	40	RD	V
UU Lyn	p	54842.9080	0.0006	−0.0048	21	RD	V
BG Lyn	p	54891.7339	0.0006	−0.0014	29	RD	V; el.: AJ 87, 314
DY Lyn	p	54889.609	0.002	+0.001	7	RD	V; el.: 2452704.488 + 1.313173 * E
V573 Lyr	p	55014.7582	0.0006	+0.0003	26	RD	V; el.: 2451288.851 + 0.870539 * E
UU Mon	p	54882.7018	0.0004	+0.0115	26	RD	V
BO Mon	p	54891.7542	0.0002	−0.0647	25	RD	V
CF Mon	p	54882.6455	0.0002	+0.0023	27	RD	V
EI Mon	p	54884.6382	0.0004	−0.0144	15	RD	V
EW Mon	s	54884.6191	0.0004	−0.1408	10	RD	V
GU Mon	s	54881.6418	0.0003	−0.0491	25	RD	V
KR Mon	p	54889.6774	0.0008	+0.0066	23	RD	V; el.: 2453427.651 + 1.150959 * E
V396 Mon	p	54874.7337	0.0002	−0.0756	20	RD	V
V448 Mon	p	54887.7006	0.0015	+0.0641	30	RD	V; pulsator?
V453 Mon	p	54887.6042	0.0010	−0.3037	12	RD	V
V457 Mon	p	54882.6826	0.0004	−0.0098	30	RD	V
V458 Mon	p	54882.7011	0.0003	+0.1040	25	RD	V
V463 Mon	p	54887.7028	0.0006	−0.0907	28	RD	V
V494 Mon	p	54887.6592	0.0005	+0.1278	23	RD	V
V514 Mon	s	54887.6627	0.0005	+0.0489	25	RD	V
V524 Mon	s	54884.7231	0.0008	+0.1209	20	RD	V
V714 Mon	s	54874.6818	0.0004	−0.0246	29	RD	V; el.: IBVS 4468
V864 Mon	s	54888.7382	0.0004	−0.0283	23	RD	V; el.: IBVS 5425
GSC 4829-2025	s	54888.6401	0.0012	−0.0161	18	RD	V; el.: 2453810.652 + 1.496189 * E
GSC 4839-280	s	54888.6658	0.0008	+0.0047	16	RD	V; el.: 2453356.736 + 1.130155 * E
GSC 5397-1850	p	54888.6528	0.0005	−0.0155	21	RD	V; el.: 2453793.698 + 1.862163 * E
GSC 5399-2407	s	54889.6789	0.0004	−0.0001	22	RD	V; el.: 2454162.622 + 1.444006 * E
SX Oph	p	54983.7785	0.0003	+0.0005	62	RD	V
V947 Oph	p	55014.7857	0.0003	−0.0247	15	RD	V; el.: IBVS 5847
V954 Oph		55014.807	0.002		5	RD	V
V1016 Oph	p	54984.8212	0.0004	−0.1233	28	RD	V; el.: BBSAG Bull. 99, 9
V1022 Oph	s	54984.6958	0.0006	−0.1232	14	RD	V: el.: IBVS 5690
	p	54984.8139	0.0003	−0.1249	14	RD	V
V1120 Oph	s	54957.8228	0.0007	+0.0014	12	RD	V
GSC 398-1236	s	54998.7764	0.0002	+0.0048	35	RD	V; el.: 2453793.876 + 0.314471 * E
GSC 403-1109	p	54994.7652	0.0006	−0.0028	22	RD	V; el.: 2454299.598 + 0.341104 * E
GSC 418-2020	p	55003.7668	0.0005	−0.0019	22	RD	V; el.: 2454228.802 + 1.205236 * E
GSC 978-1292	s	54998.8493	0.0006	+0.0089	37	RD	V; el.: 2454542.871 + 0.896695 * E
GSC 979-1273	p	54994.8242	0.0008	+0.0098	28	RD	V; el.: 2453560.616 + 0.389199 * E
NSV 9699	p	55003.8371	0.0008	+0.0014	35	RD	V; el.: 2454358.506 + 0.706050 * E
NSV 24049	p	55014.7245	0.0005	−0.0003	23	RD	V; el.: 2452161.3 + 3.96309 * E
EG Ori	p	54874.6484	0.0003	−0.0891	31	RD	V
EW Ori	p	54860.6486	0.0010	−0.0230	29	RD	V; non-circular orbit
FF Ori	p	54860.6230	0.0003	+0.0323	25	RD	V
FK Ori	s	54842.6844	0.0015	+0.0222	32	RD	V
FZ Ori	p	54865.6328	0.0009	+0.0161	20	RD	V
GG Ori	p	54863.6952	0.0002	+1.4269	27	RD	V; non-circular orbit
V392 Ori	p	54881.6829	0.0004	+0.0320	27	RD	V; el.: BAS India 19
V530 Ori	s	54874.6947	0.0013	−0.1879	27	RD	V
V640 Ori	p	54863.7145	0.0001	−0.1355	24	RD	V
V648 Ori	p	54860.6744	0.0002	+0.0633	35	RD	V
V1202 Ori	p	54852.6582	0.0001	−0.0304	31	RD	V; el.: IBVS 3544
V1626 Ori	p	54874.6374	0.0004	−0.0027	25	RD	V; el.: IBVS 5339
V1642 Ori	p	54863.6399	0.0005	+0.0062	30	RD	V; el.: 2453809.575 + 3.037633 * E

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GSC 127-719	p	54849.7013	0.0002	+0.0149	22	RD	V; el.: 2453059.638 + 2.13101 * E
	s	54865.6315	0.0006	−0.0374	23	RD	V
GSC 702-1892	s	54862.6967	0.0004	−0.0040	17	RD	V; el.: IBVS 5493
GSC 1283-53	p	54848.6710	0.0006	−0.0010	27	RD	V; el.: IBVS 5799
NSV 1955	p	54863.6595	0.0005	+0.0018	25	RD	V; el.: IBVS 5871
XZ Per	p	54848.7164	0.0003	−0.0538	19	RD	V
FW Per	p	54842.6686	0.0007	−0.0537	24	RD	V
IM Per	s	54833.6742	0.0007	+0.0892	39	RD	V
KR Per	s	54845.6758	0.0003	−0.0161	33	RD	V
LS Per	p	54833.6262	0.0004	−0.4882	29	RD	V
NP Per	s	54848.6540	0.0003	−0.0545	32	RD	V
V482 Per	p	54845.6826	0.0003	+0.2267	38	RD	V; el.: BAV Mit. 68, 21; d=0.02days
V737 Per	p	54833.7329	0.0007	−0.0004	17	RD	V; el.: 2451536.724 + 0.366538 * E
GSC 5404-4206	p	54888.6740	0.0003	−0.0020	24	RD	V; el.: 2453765.63 + 0.610683 * E
AO Ser	p	54952.8851	0.0004	−0.0092	27	RD	V
AU Ser	s	54952.8579	0.0001	−0.1011	25	RD	V
BI Ser	p	54963.7459	0.0005	+0.0839	36	RD	V
V384 Ser	p	54961.6506	0.0005	+0.0022	9	RD	V; el.: 2452365.4575 + 0.268729 * E
	s	54961.7836	0.0001	+0.0009	12	RD	V
	p	54961.9198	0.0010	+0.0027	10	RD	V
V385 Ser	p	54952.9146	0.0005	+0.0392	16	RD	V; el.: IBVS 5455; d=0.024days
GSC 357-162	s	54955.8611	0.0004	+0.0011	25	RD	V; el.: 2454641.656 + 0.375169 * E
GSC 370-665	s	54983.8308	0.0002	+0.0293	27	RD	V; el.: 2454227.748 + 0.421552 * E
GSC 378-1212	s	54955.8514	0.0009	+0.0001	23	RD	V; el.: 2453455.804 + 0.328202 * E
GSC 930-267	p	54983.7647	0.0004	+0.0115	35	RD	V; el.: 2453601.532 + 0.352248 * E
GSC 949-1089	p	54984.8233	0.0016	+0.0040	13	RD	V; el.: 2454606.708 + 0.350103 * E
GSC 1499-834	s	54983.7507	0.0006	+0.0086	29	RD	V; el.: 2454273.672 + 0.321226 * E
	p	54983..9096	0.0008	+0.0069	14	RD	V
GSC 2034-1670	s	54955.8499	0.0004	+0.0006	21	RD	V; el.: 2454272.556 + 0.300944 * E; d=0.01days
GSC 2038-293	p	54983.8090	0.0008	+0.0051	50	RD	V; el.: IBVS 5719
GSC 5017-129	p	54965.7720	0.0003	−0.0061	24	RD	V; el.: 2454627.626 + 0.751449 * E
GSC 5037-866	p	54984.7803	0.0003	−0.0026	15	RD	V; el.: 2454203.796 + 0.406976 * E
Y Sex	p	54862.8687	0.0003	−0.2114	29	RD	V
WX Sex	s	54862.9108	0.0006	−0.0072	20	RD	V; el.: IBVS 5455
WZ Sex	p	54890.8727	0.0024	−0.0275	24	RD	V; el.: 2454852.77 + 1.059171 * E
GSC 4908-1303	p	54860.8603	0.0003	+0.0061	32	RD	V; el.: 2453490.637 + 1.537842 * E
GSC 4911-1235	p	54865.8134	0.0008	+0.0045	11	RD	V; el.: 2453140.597 + 0.424302 * E
GSC 4916-292	p	54863.8559	0.0002	−0.0061	29	RD	V; el.: 2453773.724 + 1.919257 * E
GSC 4918-1155	p	54849.7980	0.0013	−0.0133	11	RD	V; el.: 2453115.642 + 4.699646 * E;
	p	54863.9020	0.0002	−0.0083	38	RD	V; d=0days
RZ Tau	p	54852.7188	0.0006	+0.0575	20	RD	V
TY Tau	s	54848.6948	0.0007	+0.2527	13	RD	V
WY Tau	s	54863.6341	0.0003	+0.0542	30	RD	V
AH Tau	p	54833.7012	0.0006	+0.0116	22	RD	V; el.: IBVS 5554
BN Tau	p	54842.6242	0.0005	−0.0789	30	RD	V
BV Tau	p	54862.6214	0.0020	−0.0163	20	RD	V; el.: `www.astrouw.pl/asas/`
CR Tau	p	54852.7208	0.0003	−0.0038	20	RD	V; el.: IBVS 4778
GQ Tau	p	54862.6678	0.0004	+0.1983	38	RD	V
GW Tau	p	54845.6732	0.0004	−0.0757	42	RD	V
V407 Tau	p	54849.6919	0.0007	+0.5515	24	RD	V
V1249 Tau	s	54844.705	0.003	−0.009	7	RD	V; el.: 2451609.717 + 1.188245 * E; non-circular orbit
GSC 1841-879	p	54842.5950	0.0008	−0.1047	18	RD	V
GSC 1848-1264	s	54849.7205	0.0005	+0.0055	15	RD	V; el.: IBVS 5699
TW UMa	p	54948.7739	0.0004	−0.2869	62	RD	V
TY UMa	p	54890.6670	0.0006	−0.0579	25	RD	V: el.: MNRAS 317, 111
	s	54890.8422	0.0007	−0.0601	18	RD	V
UX UMa	p	54948.7582	0.0010	+0.0003	7	RD	V
	p	54948.956	0.002	0.002	5	RD	V

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
UY UMa	s	54957.7182	0.0005	+0.1075	24	RD	V
VV UMa	p	54890.7983	0.0005	−0.0464	29	RD	V
XY UMa	p	54842.8569	0.0003	+0.0316	19	RD	V
XZ UMa	p	54852.9131	0.0005	−0.0965	29	RD	V
ZZ UMa	p	54862.8951	0.0005	−0.0024	37	RD	V
AA UMa	p	54845.857	0.002	+0.038	8	RD	V
AC UMa	p	54839.8146	0.0003	−0.1184	60	RD	V; d=0.063days
BM UMa	p	54845.8280	0.0004	+0.0090	13	RD	V
BS UMa	s	54862.8610	0.0012	+0.0005	9	RD	V; el.: 2453134.7083 + 0.349510 * E
	p	54890.6479	0.0002	+0.0014	14	RD	V
	s	54890.8199	0.0004	−0.0014	11	RD	V
DW UMa	p	54863.906	0.001	0.000	7	RD	V; el.: AA 364, 573
ES UMa		54863.8117	0.0006		16	RD	V
IW UMa	p	54848.8248	0.0006	+0.0150	17	RD	V; el.: IBVS 4402
LO UMa	p	54860.8250	0.0008	+0.0179	19	RD	V; el.: IBVS 5084
MS UMa	p	54865.9317	0.0003	+0.0318	21	RD	V
RU UMi	s	54891.9122	0.0012	−0.0171	23	RD	V
AG Vir	p	54874.8688	0.0012	−0.0133	20	RD	V
AW Vir	p	54888.9170	0.0003	+0.0230	27	RD	V
AZ Vir	s	54891.8386	0.0008	−0.0223	8	RD	V
BF Vir	s	54948.7691	0.0010	+0.1052	27	RD	V
IR Vir	p	54882.8770	0.0007	+0.0048	17	RD	V; el.: 2453913.627 + 0.369377 * E
PS Vir	p	54863.8671	0.0002	−0.0083	20	RD	V
QX Vir	p	54963.6849	0.0008	+0.0038	17	RD	V; el.: 2452025.629 + 0.242074 * E
	s	54963.8074	0.0011	+0.0052	13	RD	V
	p	54963.930	0.002	+0.006	6	RD	V
V337 Vir	s	54889.8436	0.0010	−0.0400	9	RD	V; el.: 5630
GSC 286-631	s	54952.7330	0.0018	+0.0051	16	RD	V; el.: 2453866.584 + 0.315327 * E
GSC 296-9	p	54955.6932	0.0005	+0.0002	18	RD	V: el.: 2454649.516 + 0.417704 * E
GSC 303-36	p	54888.8999	0.0003	−0.0062	28	RD	V; el.: 2454259.639 + 1.310973 * E
GSC 303-65	p	54948.6339	0.0014	+0.0041	8	RD	V; el.: 2453186.769 + 0.372329 * E
	s	54948.8211	0.0004	+0.0051	20	RD	V
GSC 303-735	p	54950.7032	0.0005	+0.0026	21	RD	V; el.: 2453079.772 + 0.288412 * E
	s	54950.8487	0.0010	+0.0038	16	RD	V
GSC 314-388	p	54948.6773	0.0006	+0.0024	22	RD	V; el.: 2454506.847 + 0.347896 * E
	s	54948.8499	0.0001	+0.0011	30	RD	V
GSC 316-99	p	54963.8060	0.0005	−0.0006	17	RD	V; el.: 2454643.620 + 0.404276 * E
GSC 318-1169	p	54963.6780	0.0011	−0.0012	11	RD	V; el.: 2453821.748 + 0.239499 * E
	s	54963.7985	0.0016	−0.0005	13	RD	V
	p	54963.9173	0.0011	−0.0014	9	RD	V
GSC 329-256	p	54963.7416	0.0014	−0.0460	17	RD	V; el.: 2452788.307 + 0.259883 * E
	s	54963.8806	0.0011	−0.0370	15	RD	V
GSC 329-639	s	54963.7500	0.0005	−0.0375	24	RD	V; el.: 2452766.289 + 0.350954 * E
GSC 330-1394	p	54965.8311	0.0007	+0.0134	38	RD	V; el.: 2453848.736 + 0.436872 * E; d=0.03days
GSC 878-260	p	54884.9351	0.0006	+0.0101	19	RD	V; el.: 2454620.606 + 0.964668 * E
GSC 892-892	p	54948.7758	0.0003	−0.0018	23	RD	V; el.: 2453459.753 + 0.305943 * E
	s	54948.9276	0.0004	−0.0029	18	RD	V
GSC 897-470	p	54889.9065	0.0003	+0.0061	28	RD	V; el.: 2454575.685 + 1.441355 * E
GSC 898-3	p	54882.8642	0.0007	−0.0027	12	RD	V; el.: 2454538.782 + 0.516644 * E
	s	54891.9068	0.0012	−0.0013	14	RD	V
GSC 4955-767	p	54887.8552	0.0005	+0.0012	13	RD	V; el.: 2453871.595 + 0.683889 * E
GSC 4958-415	p	54950.8142	0.0005	−0.0008	19	RD	V; el.: 2453106.737 + 0.868210 * E

Observers:

EBl :	E. Blättler	Wald, Switzerland
RD :	R. Diethelm	Rodersdorf, Switzerland; R. Szafraniec Obs. operated at Astrokolkhoz Obs., Cloudcroft, N.M., USA

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THE GEOS RR Lyr SURVEY

Eleventh list of maxima of RR Lyr stars observed by the automated telescopes TAROT

(GEOS Circular RR 39)

LE BORGNE, J. F.[1,2]; KLOTZ, A.[3,4]; BOËR, M.[3]

[1] GEOS (Groupe Européen d'Observations Stellaires), 23 Parc de Levesville, 28300 Bailleau l'Evêque, France

[2] LATT, Université de Toulouse, CNRS, Toulouse, France

[3] Observatoire de Haute-Provence, Saint Michel l'Observatoire, France

[4] CESR, Université de Toulouse, CNRS, Toulouse, France

We present here the eleventh list of light maxima of RR Lyrae stars from the GEOS RR Lyr Survey (Le Borgne et al. 2007), a GEOS program (`http://geos.webs.upv.es/`, Boninsegna et al., 2002) of observations of RR Lyr stars using the automatic telescopes TAROT (`http://tarot.obs-hp.fr`, Klotz et al., 2009). The present list contains 685 maxima observed mainly between January and June 2009 (Table 1).
A description of the present list may be found in the former lists (for example Le Borgne et al. 2008). The data are also available in the GEOS RR Lyr web database (`http://dbRR.ast.obs-mip.fr`). The $O-C$'s are computed with the GCVS elements (Kholopov et al., 1985) when available. Otherwise, the reference of the elements, if exists, is given as a footnote of Table 1.

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Table 1: maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
XX And	54833.443±0.003	0.237	21786.	C	RS Boo	54975.461±0.003	-0.006	34995.	C
CI And	54834.402±0.002	0.111	39437.	C	RS Boo	54989.422±0.002	-0.006	35032.	C
WY Ant	54859.641±0.004	0.221	24749.	LS	RS Boo	54992.442±0.002	-0.005	35040.	C
WY Ant	54879.745±0.005	0.224	24784.	LS	ST Boo	54939.633±0.002	0.080	57462.	C
WY Ant	54913.627±0.003	0.220	24843.	LS	ST Boo	54974.471±0.005	0.069	57518.	C
BK Ant	54864.635±0.010			LS	ST Boo	54979.452±0.004	0.072	57526.	C
BK Ant	54896.661±0.004			LS	ST Boo	54992.520±0.003	0.072	57547.	C
BK Ant	54912.673±0.005			LS	TW Boo	54852.583±0.002	-0.058	52532.	C
BN Ant	54904.729±0.004			LS	TW Boo	54861.633±0.002	-0.057	52549.	C
BT Ant	54853.780±0.010			LS	TW Boo	54900.494±0.004	-0.052	52622.	C
BT Ant	54861.716±0.010			LS	TW Boo	54901.554±0.002	-0.056	52624.	C
TY Aps	54914.586±0.003	0.042	30274.	LS	TW Boo	54916.455±0.002	-0.059	52652.	C
TY Aps	54915.591±0.004	0.044	30276.	LS	TW Boo	54956.376±0.001	-0.059	52727.	C
TY Aps	54919.603±0.004	0.042	30284.	LS	TW Boo	54958.506±0.002	-0.058	52731.	C
TY Aps	54923.616±0.003	0.041	30292.	LS	TW Boo	54965.426±0.004	-0.057	52744.	C
TY Aps	54929.633±0.004	0.038	30304.	LS	TW Boo	54982.458±0.003	-0.058	52776.	C
TY Aps	54986.846±0.006	0.058	30418.	LS	CM Boo	54853.568±0.002	-0.105	31116.	C
VX Aps	54904.793±0.004	0.119	42646.	LS	CM Boo	54884.628±0.002	-0.108	31167.	C
XZ Aps	54885.719±0.005	0.204	44550.	LS	CM Boo	54917.518±0.003	-0.109	31221.	C
XZ Aps	54902.748±0.002	0.198	44579.	LS	CM Boo	54928.481±0.003	-0.109	31239.	C
XZ Aps	54995.535±0.005	0.170	44737.	LS	CM Boo	54953.452±0.002	-0.110	31280.	C
BS Aps	54900.699±0.003	0.009	30007.	LS	CM Boo	54978.425±0.002	-0.110	31321.	C
BS Aps	54904.775±0.005	0.007	30014.	LS	U Cae	54848.697±0.002	-0.117	48915.	LS
BS Aps	54921.698±0.006	0.036	30043.	LS	AH Cam	54843.479±0.005	-0.418	43702.	C
BS Aps	54992.743±0.002	0.009	30165.	LS	AH Cam	54847.525±0.003	-0.429	43713.	C
EX Aps	54933.691±0.004	0.019	57228.	LS	AH Cam	54852.300±0.003	-0.447	43726.	C
EX Aps	54938.877±0.002	0.015	57239.	LS	TT Cnc	54836.423±0.002	0.088	26430.	C
EX Aps	54972.848±0.002	0.016	57311.	LS	TT Cnc	54849.382±0.005	0.088	26453.	C
EX Aps	55005.874±0.004	0.016	57381.	LS	TT Cnc	54862.346±0.004	0.093	26476.	C
SX Aqr	55000.851±0.004	-0.115	28382.	LS	TT Cnc	54875.311±0.005	0.098	26499.	C
TZ Aqr	55013.761±0.005	0.024	30576.	LS	TT Cnc	54907.434±0.002	0.105	26556.	C
BN Aqr	55004.782±0.003	0.595	36478.	LS	TT Cnc	54915.319±0.002	0.101	26570.	C
BO Aqr	55011.803±0.004	0.156	19294.	LS	W CVn	54841.664±0.004	-0.134	60605.	C
CP Aqr	55005.812±0.004	-0.115	36947.	LS	W CVn	54861.528±0.002	-0.134	60641.	C
CP Aqr	55006.737±0.003	-0.117	36949.	LS	W CVn	54877.530±0.002	-0.133	60670.	C
DN Aqr	55006.853±0.005	0.029	41943.	LS	W CVn	54898.493±0.003	-0.137	60708.	C
DN Aqr	55013.829±0.005	0.034	41954.	LS	W CVn	54915.596±0.002	-0.138	60739.	C
AA Aql	54990.782±0.002	0.037	84700.	LS	W CVn	54918.359±0.002	-0.134	60744.	C
V341 Aql	55013.868±0.002	0.036	23905.	LS	W CVn	54925.531±0.003	-0.135	60757.	C
S Ara	55006.799±0.003	-0.351	30660.	LS	W CVn	54929.394±0.005	-0.134	60764.	C
MS Ara	54950.799±0.004	0.396	51362.	LS	W CVn	54956.426±0.003	-0.138	60813.	C
MS Ara	55008.545±0.004	0.397	51472.	LS	W CVn	54973.529±0.003	-0.140	60844.	C
MS Ara	55013.792±0.005	0.394	51482.	LS	Z CVn	54836.571±0.003	0.399	24326.	C
X Ari	54844.408±0.002	0.350	26508.	C	Z CVn	54893.456±0.004	0.402	24413.	C
X Ari	54846.363±0.002	0.352	26511.	C	Z CVn	54910.464±0.005	0.410	24439.	C
X Ari	54848.316±0.003	0.351	26514.	C	RU CVn	54909.547±0.002	0.218	35632.	C
TZ Aur	54850.395±0.004	0.012	89227.	C	RU CVn	54912.414±0.002	0.218	35637.	C
TZ Aur	54875.462±0.002	0.012	89291.	C	RU CVn	54951.393±0.003	0.217	35705.	C
TZ Aur	54879.381±0.001	0.014	89301.	C	RU CVn	54963.431±0.003	0.217	35726.	C
TZ Aur	54908.365±0.002	0.014	89375.	C	RU CVn	54971.456±0.002	0.216	35740.	C
RS Boo	54845.658±0.003	-0.004	34651.	C	RU CVn	54975.468±0.002	0.216	35747.	C
RS Boo	54859.619±0.002	-0.005	34688.	C	RZ CVn	54870.547±0.003	-0.160	25602.	C
RS Boo	54884.523±0.002	-0.005	34754.	C	RZ CVn	54907.427±0.002	-0.162	25667.	C
RS Boo	54898.483±0.002	-0.007	34791.	C	RZ CVn	54962.463±0.002	-0.165	25764.	C
RS Boo	54926.408±0.003	-0.005	34865.	C	RZ CVn	54970.413±0.002	-0.159	25778.	C
RS Boo	54929.427±0.002	-0.005	34873.	C	RZ CVn	54979.496±0.003	-0.154	25794.	C

Table 1 (cont.): maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
SS CVn	54844.615±0.002	0.157	31810.	C	ST Com	54885.618±0.002	-0.029	19470.	C
SS CVn	54845.575±0.004	0.160	31812.	C	ST Com	54917.359±0.003	-0.031	19523.	C
SS CVn	54889.577±0.010	0.138	31904.	C	ST Com	54939.521±0.005	-0.029	19560.	C
SS CVn	54890.534±0.004	0.138	31906.	C	WW CrA	54941.804±0.003	-0.023	42280.	LS
SS CVn	54902.519±0.002	0.160	31931.	C	TV CrB	54902.591±0.002	0.028	39828.	C
SS CVn	54928.362±0.002	0.163	31985.	C	TV CrB	54963.394±0.002	0.031	39932.	C
SS CVn	54959.445±0.006	0.142	32050.	C	TV CrB	54998.474±0.005	0.034	39992.	C
SS CVn	54961.358±0.005	0.141	32054.	C	W Crt	54853.787±0.003	-0.021	36915.	LS
SS CVn	54970.427±0.003	0.118	32073.	C	W Crt	54860.788±0.002	-0.024	36932.	LS
UZ CVn	54859.496±0.004	0.253	40746.	C	W Crt	54867.794±0.002	-0.022	36949.	LS
UZ CVn	54887.398±0.002	0.244	40786.	C	W Crt	54917.648±0.002	-0.022	37070.	LS
UZ CVn	54970.437±0.002	0.247	40905.	C	W Crt	54933.714±0.002	-0.024	37109.	LS
AA CMi	54834.438±0.002	0.062	38331.	C	X Crt	54908.794±0.007	0.068	17890.	LS
AA CMi	54874.450±0.002	0.063	38415.	C	X Crt	54917.587±0.006	0.067	17902.	LS
AA CMi	54875.403±0.002	0.063	38417.	C	X Crt	54950.584±0.007	0.087	17947.	LS
AA CMi	54880.645±0.003	0.066	38428.	LS	SW Cru	54855.819±0.004	0.074	87941.	LS
AA CMi	54887.312±0.002	0.064	38442.	C	SW Cru	54864.666±0.005	0.071	87968.	LS
AL CMi	54855.699±0.003	0.460	33166.	LS	SW Cru	54886.631±0.006	0.075	88035.	LS
AL CMi	54865.610±0.004	0.462	33184.	LS	SW Cru	54901.702±0.005	0.068	88081.	LS
RV Cap	55011.831±0.003	-0.023	47189.	LS	SW Cru	54906.614±0.003	0.063	88096.	LS
TX Car	54848.793±0.004	0.125	50375.	LS	SW Cru	54910.555±0.003	0.071	88108.	LS
EE Car	54855.716±0.004	0.016	44647.	LS	SW Cru	54929.562±0.006	0.066	88166.	LS
EE Car	54885.574±0.004	0.011	44691.	LS	SW Cru	54935.796±0.005	0.073	88185.	LS
IU Car	54842.702±0.004	0.308	17835.	LS	UY Cyg	54999.516±0.002	0.055	58080.	C
IU Car	54848.596±0.005	0.305	17843.	LS	UY Cyg	55008.489±0.003	0.057	58096.	C
IU Car	54862.604±0.003	0.307	17862.	LS	XZ Cyg [1]	54942.464±0.004	0.003	13656.	C
IU Car	54901.671±0.005	0.306	17915.	LS	XZ Cyg [1]	54956.464±0.003	0.005	13686.	C
IU Car	54904.612±0.005	0.298	17919.	LS	XZ Cyg [1]	54976.522±0.002	-0.000	13729.	C
IU Car	54907.565±0.002	0.302	17923.	LS	XZ Cyg [1]	54977.455±0.005	-0.001	13731.	C
BI Cen	54858.823±0.003	0.039	40091.	LS	XZ Cyg [1]	54990.512±0.002	-0.008	13759.	C
BI Cen	54906.881±0.004	0.060	40197.	LS	XZ Cyg [1]	55012.454±0.003	0.004	13806.	C
BI Cen	54911.861±0.005	0.055	40208.	LS	DX Del	55012.435±0.005	0.063	33103.	C
BI Cen	54992.534±0.005	0.061	40386.	LS	RT Dor	54843.845±0.003	-0.094	49865.	LS
V499 Cen	54886.744±0.002	0.031	26401.	LS	VW Dor	54859.698±0.004	-0.113	28882.	LS
V499 Cen	54937.824±0.002	0.032	26499.	LS	VW Dor	54879.670±0.005	-0.112	28917.	LS
V499 Cen	54945.644±0.002	0.034	26514.	LS	RW Dra	54916.413±0.003	0.165	35083.	C
V499 Cen	55004.539±0.005	0.032	26627.	LS	RW Dra	54958.495±0.003	0.170	35178.	C
V671 Cen	54915.732±0.010	-0.107	46876.	LS	RW Dra	54959.381±0.003	0.170	35180.	C
V671 Cen	54919.645±0.005	-0.133	46885.	LS	RW Dra	54982.456±0.003	0.213	35232.	C
V671 Cen	54940.674±0.010	-0.112	46933.	LS	RW Dra	54997.471±0.002	0.169	35266.	C
RT Col	54853.651±0.002	-0.266	50456.	LS	RW Dra	55013.442±0.002	0.195	35302.	C
RW Col	54855.647±0.002	0.099	51106.	LS	SU Dra	54842.616±0.003	0.051	16566.	C
RW Col	54861.652±0.003	-0.247	51118.	LS	SU Dra	54844.597±0.002	0.051	16569.	C
RX Col	54842.680±0.008	-0.257	43819.	LS	SU Dra	54854.504±0.004	0.052	16584.	C
RX Col	54848.615±0.005	-0.263	43829.	LS	SU Dra	54858.469±0.005	0.054	16590.	C
RX Col	54880.680±0.004	-0.276	43883.	LS	SU Dra	54872.336±0.004	0.053	16611.	C
AV Col	54847.661±0.004			LS	SU Dra	54874.314±0.003	0.049	16614.	C
AV Col	54855.629±0.005			LS	SU Dra	54897.435±0.004	0.056	16649.	C
AV Col	54862.659±0.001			LS	SU Dra	54899.416±0.002	0.055	16652.	C
S Com	54843.586±0.005	-0.097	24189.	C	SU Dra	54901.392±0.002	0.050	16655.	C
S Com	54856.486±0.004	-0.102	24211.	C	SU Dra	54928.473±0.003	0.054	16696.	C
S Com	54893.446±0.004	-0.098	24274.	C	SW Dra	54861.381±0.002	0.056	50269.	C
S Com	54897.549±0.003	-0.101	24281.	C	SW Dra	54871.638±0.002	0.059	50287.	C
S Com	54934.505±0.003	-0.100	24344.	C	SW Dra	54874.000±0.004	0.142	50291.	C
S Com	54961.497±0.004	-0.091	24390.	C	SW Dra	54886.452±0.004	0.061	50313.	C
ST Com	54879.629±0.004	-0.028	19460.	C	SW Dra	54890.437±0.003	0.059	50320.	C

Table 1 (cont.): maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
SW Dra	54898.422±0.005	0.068	50334.	C	TW Her	55008.535±0.002	-0.010	83742.	C
SW Dra	54907.527±0.002	0.058	50350.	C	TW Her	55010.532±0.002	-0.012	83747.	C
XZ Dra	54950.434±0.002	-0.127	27329.	C	VX Her	54928.518±0.002	-0.428	72860.	C
XZ Dra	54960.445±0.005	-0.122	27350.	C	VX Her	54954.473±0.001	-0.430	72917.	C
XZ Dra	54971.392±0.001	-0.134	27373.	C	VX Her	54965.402±0.003	-0.430	72941.	C
XZ Dra	54990.470±0.002	-0.116	27413.	C	VX Her	54985.438±0.002	-0.430	72985.	C
XZ Dra	55001.429±0.003	-0.117	27436.	C	VX Her	54995.455±0.002	-0.431	73007.	C
XZ Dra	55010.474±0.003	-0.125	27455.	C	VZ Her	54952.492±0.002	0.068	41250.	C
BC Dra	54849.526±0.005	0.090	17470.	C	VZ Her	54960.418±0.002	0.069	41268.	C
BC Dra	54880.472±0.006	0.095	17513.	C	VZ Her	54971.426±0.001	0.068	41293.	C
BC Dra	54898.456±0.007	0.089	17538.	C	VZ Her	54974.510±0.002	0.070	41300.	C
BC Dra	54929.387±0.005	0.078	17581.	C	VZ Her	54982.434±0.002	0.068	41318.	C
BC Dra	54934.440±0.005	0.094	17588.	C	VZ Her	54985.515±0.002	0.067	41325.	C
BC Dra	54952.434±0.005	0.099	17613.	C	VZ Her	54989.479±0.002	0.068	41334.	C
BC Dra	54980.482±0.003	0.083	17652.	C	VZ Her	54993.442±0.001	0.068	41343.	C
BC Dra	54990.558±0.005	0.085	17666.	C	VZ Her	54996.526±0.002	0.070	41350.	C
BC Dra	54993.438±0.005	0.087	17670.	C	AR Her	54876.604±0.004	-1.273	28559.	C
BD Dra	54842.679±0.005	0.708	22184.	C	AR Her	54885.499±0.002	-1.308	28578.	C
BD Dra	54845.598±0.005	0.682	22189.	C	AR Her	54942.403±0.005	-1.278	28699.	C
BD Dra	54871.502±0.005	0.668	22233.	C	AR Her	54958.395±0.002	-1.267	28733.	C
BD Dra	54898.594±0.003	0.663	22279.	C	AR Her	54995.521±0.002	-1.273	28812.	C
BD Dra	54927.487±0.005	0.693	22328.	C	AR Her	54996.461±0.002	-1.273	28814.	C
BD Dra	54950.448±0.002	0.681	22367.	C	DL Her	54954.488±0.003	0.033	28305.	C
BD Dra	54953.409±0.002	0.697	22372.	C	DL Her	54993.544±0.005	0.042	28371.	C
BD Dra	54960.474±0.002	0.693	22384.	C	DL Her	54996.503±0.002	0.043	28376.	C
BD Dra	54980.495±0.003	0.686	22418.	C	V542 Her	54918.516±0.005	0.127	25301.	C
BD Dra	54990.485±0.002	0.662	22435.	C	V542 Her	54954.444±0.005	0.130	25359.	C
BD Dra	54993.422±0.005	0.654	22440.	C	V542 Her	54985.403±0.005	0.118	25409.	C
BD Dra	55010.533±0.002	0.683	22469.	C	V591 Her	54939.507±0.006	0.295	22901.	C
BD Dra	55013.469±0.004	0.673	22474.	C	V650 Her	54928.519±0.003	0.028	29842.	C
BK Dra	54958.480±0.002	-0.157	49715.	C	V650 Her	54954.464±0.002	0.030	29892.	C
BK Dra	55006.436±0.002	-0.159	49796.	C	V650 Her	54995.453±0.002	0.028	29971.	C
BT Dra	54878.501±0.004	-0.009	41014.	C	SV Hya	54866.801±0.002	0.111	32491.	LS
BT Dra	54901.455±0.003	-0.014	41053.	C	SV Hya	54912.748±0.004	0.117	32587.	LS
BT Dra	54994.470±0.002	-0.009	41211.	C	SV Hya	54913.712±0.003	0.124	32589.	LS
BT Dra	54997.407±0.002	-0.016	41216.	C	SV Hya	54935.711±0.004	0.110	32635.	LS
BB Eri	54847.609±0.003	0.234	26826.	LS	SV Hya	54993.616±0.003	0.111	32756.	LS
RR Gem	54846.292±0.002	-0.402	33952.	C	SZ Hya	54836.575±0.001	-0.192	26352.	C
RR Gem	54847.488±0.001	-0.399	33955.	C	SZ Hya	54852.688±0.010	-0.195	26382.	LS
RR Gem	54849.472±0.001	-0.401	33960.	C	SZ Hya	54853.764±0.005	-0.194	26384.	LS
RR Gem	54873.306±0.002	-0.406	34020.	C	SZ Hya	54878.455±0.005	-0.216	26430.	C
RR Gem	54874.500±0.002	-0.404	34023.	C	SZ Hya	54880.625±0.004	-0.195	26434.	LS
SZ Gem	54907.318±0.001	-0.059	55301.	C	SZ Hya	54885.461±0.002	-0.194	26443.	C
SZ Gem	54909.322±0.001	-0.059	55305.	C	UU Hya	54848.745±0.005	0.036	29339.	LS
SZ Gem	54910.324±0.002	-0.059	55307.	C	UU Hya	54859.720±0.005	0.010	29360.	LS
SZ Gem	54911.328±0.002	-0.058	55309.	C	UU Hya	54868.629±0.003	0.013	29377.	LS
SZ Gem	54913.331±0.001	-0.059	55313.	C	UU Hya	54911.590±0.002	0.017	29459.	LS
SZ Gem	54916.339±0.002	-0.058	55319.	C	UU Hya	54912.636±0.002	0.015	29461.	LS
GI Gem	54833.563±0.002	0.070	56517.	C	UU Hya	54922.610±0.005	0.036	29480.	LS
GI Gem	54836.595±0.001	0.070	56524.	C	WZ Hya	54859.753±0.004	-0.001	28328.	LS
GI Gem	54846.560±0.002	0.069	56547.	C	WZ Hya	54907.610±0.002	-0.000	28417.	LS
GI Gem	54860.424±0.002	0.069	56579.	C	WZ Hya	54908.685±0.005	-0.001	28419.	LS
GI Gem	54861.291±0.002	0.069	56581.	C	WZ Hya	54914.595±0.002	-0.005	28430.	LS
GI Gem	54876.456±0.002	0.070	56616.	C	WZ Hya	54921.583±0.003	-0.008	28443.	LS
GI Gem	54883.389±0.003	0.071	56632.	C	WZ Hya	54935.568±0.004	-0.003	28469.	LS
GI Gem	54902.453±0.002	0.071	56676.	C	WZ Hya	54942.559±0.002	-0.003	28482.	LS

Table 1 (cont.): maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
XX Hya	54841.674±0.003	0.065	29560.	LS	SS Leo	54914.527±0.002	-0.065	20968.	C
XX Hya	54848.779±0.002	0.062	29574.	LS	SS Leo	54934.571±0.005	-0.064	21000.	LS
XX Hya	54906.662±0.003	0.059	29688.	LS	ST Leo	54842.696±0.003	-0.020	56319.	C
XX Hya	54935.605±0.002	0.059	29745.	LS	ST Leo	54856.560±0.004	-0.017	56348.	C
BI Hya	54861.715±0.005	0.234	51210.	LS	ST Leo	54879.502±0.002	-0.019	56396.	C
BI Hya	54899.618±0.002	0.231	51282.	LS	ST Leo	54880.458±0.002	-0.019	56398.	C
BI Hya	54919.624±0.003	0.232	51320.	LS	ST Leo	54889.542±0.003	-0.016	56417.	C
BI Hya	54938.578±0.002	0.232	51356.	LS	ST Leo	54911.527±0.002	-0.019	56463.	C
BI Hya	54939.631±0.003	0.233	51358.	LS	ST Leo	54934.469±0.002	-0.020	56511.	C
DD Hya	54847.399±0.002	-0.156	26211.	C	ST Leo	54935.425±0.002	-0.020	56513.	C
DD Hya	54848.402±0.002	-0.156	26213.	C	SZ Leo	54905.614±0.007	0.393	17672.	LS
DD Hya	54874.507±0.002	-0.144	26265.	C	SZ Leo	54906.682±0.007	0.392	17674.	LS
DD Hya	54875.504±0.002	-0.150	26267.	C	SZ Leo	54913.641±0.010	0.409	17687.	LS
DG Hya	54853.761±0.003	0.003	41485.	LS	TV Leo	54868.735±0.004	0.115	26495.	LS
DG Hya	54859.796±0.005	0.018	41499.	LS	TV Leo	54905.741±0.005	0.114	26550.	LS
DG Hya	54915.611±0.003	-0.063	41629.	LS	TV Leo	54924.581±0.002	0.115	26578.	LS
DG Hya	54921.643±0.002	-0.051	41643.	LS	TV Leo	54934.674±0.004	0.115	26593.	LS
DH Hya	54917.666±0.004	0.070	48551.	LS	WW Leo	54854.694±0.004	0.036	33130.	LS
DH Hya	54919.620±0.002	0.068	48555.	LS	WW Leo	54886.644±0.003	0.035	33183.	LS
ET Hya	54863.794±0.004	0.147	27632.	LS	WW Leo	54912.566±0.002	0.035	33226.	LS
ET Hya	54905.612±0.003	0.148	27693.	LS	WW Leo	54918.597±0.003	0.038	33236.	LS
FX Hya	54947.736±0.003	-0.005	49611.	LS	AX Leo	54834.561±0.004	-0.037	40711.	C
FY Hya	54937.751±0.003	0.007	21752.	LS	AX Leo	54842.555±0.009	-0.038	40722.	C
FY Hya	54944.751±0.004	0.004	21763.	LS	AX Leo	54906.519±0.005	-0.035	40810.	C
GO Hya	54848.521±0.005	-0.079	45879.	C	AX Leo	54917.418±0.005	-0.038	40825.	C
GO Hya	54876.522±0.004	-0.081	45923.	C	V LMi	54841.573±0.003	0.030	64920.	C
GO Hya	54879.709±0.005	-0.077	45928.	LS	V LMi	54876.385±0.002	0.031	64984.	C
GO Hya	54886.713±0.005	-0.073	45939.	LS	V LMi	54877.474±0.002	0.032	64986.	C
GO Hya	54890.526±0.004	-0.079	45945.	C	V LMi	54879.648±0.002	0.031	64990.	C
GO Hya	54902.624±0.006	-0.073	45964.	LS	V LMi	54914.460±0.002	0.031	65054.	C
GO Hya	54906.436±0.005	-0.080	45970.	C	U Lep	54842.641±0.004	0.047	23200.	LS
IK Hya	54908.631±0.005	0.171	25303.	LS	AO Lep	54848.661±0.005			LS
IK Hya	54913.848±0.006	0.188	25311.	LS	AO Lep	54853.704±0.004			LS
IK Hya	54973.658±0.006	0.198	25403.	LS	TV Lib	54921.745±0.002	-0.005	129456.	LS
IK Hya	54990.605±0.010	0.245	25429.	LS	TV Lib	54929.834±0.002	-0.005	129486.	LS
RR Leo	54860.479±0.001	0.094	25564.	C	VY Lib	54924.829±0.003	-0.029	25809.	LS
RR Leo	54877.670±0.002	0.095	25602.	C	XX Lib	54900.839±0.005	0.056	38580.	LS
RR Leo	54878.575±0.002	0.095	25604.	C	XX Lib	54914.807±0.009	0.055	38600.	LS
RR Leo	54885.361±0.002	0.095	25619.	C	XX Lib	54937.853±0.004	0.053	38633.	LS
RR Leo	54903.457±0.002	0.095	25659.	C	XX Lib	55005.599±0.006	0.051	38730.	LS
RR Leo	54913.410±0.001	0.096	25681.	C	AZ Lib	54913.744±0.004	0.185	41342.	LS
RR Leo	54917.481±0.002	0.096	25690.	C	AZ Lib	54924.817±0.003	0.185	41359.	LS
RX Leo	54834.638±0.004	0.099	28356.	C	TT Lyn	54859.328±0.004	-0.035	30477.	C
RX Leo	54861.423±0.003	0.094	28397.	C	TT Lyn	54860.519±0.004	-0.039	30479.	C
RX Leo	54878.416±0.006	0.098	28423.	C	TT Lyn	54876.653±0.004	-0.035	30506.	C
RX Leo	54887.559±0.003	0.093	28437.	C	TT Lyn	54890.391±0.002	-0.038	30529.	C
RX Leo	54904.555±0.005	0.101	28463.	C	TT Lyn	54918.471±0.002	-0.038	30576.	C
RX Leo	54908.469±0.003	0.094	28469.	C	TW Lyn	54848.603±0.003	0.056	20392.	C
RX Leo	54914.354±0.004	0.098	28478.	C	TW Lyn	54880.405±0.002	0.055	20458.	C
RX Leo	54944.408±0.004	0.095	28524.	C	TW Lyn	54904.499±0.004	0.056	20508.	C
SS Leo	54862.544±0.002	-0.062	20885.	C	RZ Lyr	54986.451±0.002	-0.006	26999.	C
SS Leo	54868.804±0.004	-0.065	20895.	LS	RZ Lyr	54988.497±0.003	-0.005	27003.	C
SS Leo	54879.456±0.004	-0.061	20912.	C	AW Lyr	54979.461±0.004	-0.016	59600.	C
SS Leo	54884.465±0.002	-0.063	20920.	C	AW Lyr	54986.427±0.002	-0.014	59614.	C
SS Leo	54905.757±0.005	-0.066	20954.	LS	CN Lyr	54951.511±0.003	0.022	25439.	C
SS Leo	54911.397±0.002	-0.063	20963.	C	CN Lyr	54986.478±0.002	0.022	25524.	C

Table 1 (cont.): maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
CN Lyr	54995.527±0.002	0.020	25546.	C	DY Oct	54852.813±0.002			LS
CN Lyr	55007.456±0.002	0.019	25575.	C	DY Oct	54855.606±0.002			LS
IO Lyr	54952.473±0.002	-0.034	26569.	C	DY Oct	54860.627±0.003			LS
IO Lyr	54978.445±0.002	-0.032	26614.	C	DY Oct	54879.602±0.002			LS
IO Lyr	54986.524±0.002	-0.033	26628.	C	DZ Oct	54879.608±0.003			LS
IO Lyr	55008.454±0.003	-0.034	26666.	C	ST Oph	54994.731±0.003	-0.022	58994.	LS
IO Lyr	55012.494±0.002	-0.033	26673.	C	ST Oph	55008.693±0.003	-0.022	59025.	LS
V340 Lyr	54986.458±0.002	-0.043	42912.	C	V455 Oph	54977.463±0.005	-0.269	28958.	C
AV Men	54841.705±0.004			LS	V455 Oph	54997.432±0.003	-0.272	29002.	C
DV Mon	54852.608±0.002	0.070	71617.	LS	V455 Oph	55002.429±0.004	-0.268	29013.	C
TX Mus	54847.801±0.005	0.101	64636.	LS	TY Pav	54920.785±0.004	0.244	18846.	LS
TX Mus	54868.620±0.005	0.098	64680.	LS	TY Pav	54972.638±0.004	0.238	18919.	LS
TX Mus	54899.851±0.003	0.096	64746.	LS	TY Pav	54974.771±0.007	0.240	18922.	LS
TX Mus	54900.797±0.003	0.096	64748.	LS	TY Pav	54986.843±0.004	0.235	18939.	LS
TX Mus	54902.689±0.003	0.095	64752.	LS	WY Pav	54973.675±0.003	0.071	47751.	LS
TX Mus	54913.576±0.005	0.098	64775.	LS	BN Pav	54995.820±0.004	-0.093	47004.	LS
TX Mus	54917.830±0.002	0.093	64784.	LS	BN Pav	55004.889±0.003	-0.098	47020.	LS
TX Mus	54929.668±0.004	0.100	64809.	LS	BP Pav	54971.877±0.004	0.091	49567.	LS
TX Mus	54939.599±0.002	0.093	64830.	LS	BP Pav	54989.805±0.005	-0.252	49601.	LS
TX Mus	54991.658±0.005	0.098	64940.	LS	CG Peg	55013.542±0.002	-0.048	34061.	C
TX Mus	54994.493±0.005	0.093	64946.	LS	AR Per	54833.396±0.002	0.056	64849.	C
EM Mus	54864.787±0.005	-0.160	34943.	LS	AR Per	54836.375±0.002	0.056	64856.	C
EM Mus	54885.809±0.003	-0.166	34988.	LS	AR Per	54844.461±0.002	0.057	64875.	C
EM Mus	54896.557±0.002	-0.166	35011.	LS	AR Per	54858.509±0.004	0.062	64908.	C
EM Mus	54901.699±0.005	-0.165	35022.	LS	AR Per	54859.355±0.002	0.056	64910.	C
EM Mus	54910.576±0.003	-0.166	35041.	LS	AR Per	54870.419±0.002	0.056	64936.	C
EM Mus	54924.595±0.002	-0.166	35071.	LS	XX Pup	54864.624±0.004	0.484	25312.	LS
EM Mus	54925.528±0.002	-0.168	35073.	LS	XX Pup	54910.651±0.002	0.481	25401.	LS
EM Mus	54934.874±0.003	-0.168	35093.	LS	BB Pup	54855.776±0.002	0.116	33389.	LS
EM Mus	54994.690±0.005	-0.166	35221.	LS	BB Pup	54859.624±0.004	0.120	33397.	LS
VY Nor	54915.837±0.005	-0.164	78285.	LS	BB Pup	54921.612±0.002	0.118	33526.	LS
Y Oct	54989.646±0.005	-0.250	41154.	LS	BB Pup	54922.573±0.004	0.118	33528.	LS
Y Oct	54991.588±0.005	-0.248	41157.	LS	CR Pup	54847.575±0.010	-0.306	38279.	LS
Y Oct	54993.517±0.003	-0.259	41160.	LS	CR Pup	54861.583±0.006	-0.292	38299.	LS
RV Oct	54901.692±0.003	0.132	69656.	LS	HH Pup	54853.775±0.004	0.013	41852.	LS
RV Oct	54920.544±0.005	0.136	69689.	LS	HH Pup	54900.663±0.002	0.012	41972.	LS
RV Oct	54924.538±0.002	0.131	69696.	LS	HH Pup	54904.573±0.002	0.014	41982.	LS
RV Oct	54934.822±0.004	0.134	69714.	LS	HK Pup	54879.639±0.005	-0.262	24885.	LS
RV Oct	54936.528±0.004	0.127	69717.	LS	V675 Sgr	55009.571±0.006	0.078	41449.	LS
RV Oct	54938.818±0.005	0.132	69721.	LS	V756 Sgr	54971.840±0.005	0.103	48738.	LS
RV Oct	54948.526±0.002	0.131	69738.	LS	V1176 Sgr	54942.817±0.005	-0.075	94445.	LS
RV Oct	54988.507±0.005	0.130	69808.	LS	V1646 Sgr	55012.854±0.005	0.173	37999.	LS
RV Oct	54993.651±0.004	0.134	69817.	LS	V494 Sco	54941.842±0.005	-0.209	32330.	LS
RV Oct	55012.499±0.002	0.133	69850.	LS	V494 Sco	54950.799±0.004	-0.226	32351.	LS
RY Oct	54991.791±0.002	0.086	47925.	LS	V494 Sco	55013.615±0.005	-0.228	32498.	LS
RY Oct	54992.916±0.002	0.085	47927.	LS	V690 Sco	54940.790±0.005	-0.013	26700.	LS
RY Oct	55012.619±0.002	0.066	47962.	LS	V765 Sco	54950.637±0.004	0.146	54230.	LS
SS Oct	54987.879±0.002	-0.035	43368.	LS	V765 Sco	54993.756±0.004	0.145	54323.	LS
UV Oct	54901.858±0.005	-0.165	37915.	LS	V765 Sco	54995.609±0.004	0.143	54327.	LS
UV Oct	54906.749±0.005	-0.157	37924.	LS	UZ Scl	55009.839±0.005	0.039	35397.	LS
UV Oct	54907.829±0.003	-0.163	37926.	LS	VY Ser	54919.719±0.010	0.030	33181.	LS
UV Oct	54918.682±0.005	-0.162	37946.	LS	VY Ser	54970.432±0.004	0.043	33252.	C
UV Oct	54988.675±0.003	-0.168	38075.	LS	VY Ser	54975.433±0.006	0.045	33259.	C
UW Oct	54989.738±0.002	-0.010	46463.	LS	VY Ser	54980.429±0.005	0.042	33266.	C
UW Oct	54992.845±0.003	-0.014	46470.	LS	AN Ser	54944.493±0.002	0.005	77069.	C
DY Oct	54847.792±0.002			LS	AN Ser	54954.411±0.002	0.004	77088.	C

Table 1 (cont.): maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
AN Ser	54978.426±0.002	0.004	77134.	C	AF Vel	54861.710±0.005	-0.230	25464.	LS
AN Ser	54992.522±0.002	0.004	77161.	C	AF Vel	54900.744±0.004	-0.223	25538.	LS
AN Ser	55002.443±0.004	0.005	77180.	C	AF Vel	54901.800±0.005	-0.222	25540.	LS
AT Ser	54937.849±0.005	0.052	17600.	LS	AF Vel	54907.593±0.003	-0.231	25551.	LS
AT Ser	54994.592±0.006	0.057	17676.	LS	AF Vel	54937.674±0.004	-0.211	25608.	LS
AV Ser	54938.763±0.003	0.147	54548.	LS	AF Vel	54974.569±0.002	-0.234	25678.	LS
CS Ser	54940.739±0.004	0.019	45111.	LS	FS Vel	54858.804±0.002	-0.123	32158.	LS
CS Ser	54950.748±0.002	0.019	45130.	LS	FS Vel	54860.706±0.002	-0.123	32162.	LS
RV Sex	54880.797±0.003	0.056	50138.	LS	FS Vel	54941.584±0.002	-0.120	32332.	LS
RV Sex	54919.558±0.003	0.054	50215.	LS	ST Vir	54888.582±0.004	0.005	34448.	C
RV Sex	54920.564±0.003	0.053	50217.	LS	ST Vir	54910.759±0.004	-0.003	34502.	LS
RV Sex	54921.567±0.002	0.050	50219.	LS	ST Vir	54913.638±0.002	0.001	34509.	C
RW TrA	54903.820±0.002	-0.179	35864.	LS	ST Vir	54917.748±0.003	0.002	34519.	LS
RW TrA	54912.805±0.004	-0.171	35888.	LS	ST Vir	54950.609±0.003	-0.003	34599.	LS
RW TrA	54974.894±0.003	-0.173	36054.	LS	ST Vir	54965.403±0.002	0.001	34635.	C
RW TrA	54987.614±0.003	-0.171	36088.	LS	UU Vir	54889.476±0.003	-0.006	27527.	C
YY Tuc	54993.839±0.003	0.129	20628.	LS	UU Vir	54909.452±0.002	-0.005	27569.	C
RV UMa	54849.657±0.002	0.117	20882.	C	UU Vir	54914.686±0.004	-0.003	27580.	LS
RV UMa	54858.552±0.003	0.119	20901.	C	UU Vir	54935.611±0.005	-0.005	27624.	LS
RV UMa	54859.485±0.003	0.116	20903.	C	UU Vir	54939.417±0.003	-0.003	27632.	C
RV UMa	54871.655±0.003	0.116	20929.	C	UU Vir	54946.546±0.002	-0.008	27647.	LS
RV UMa	54908.631±0.003	0.116	21008.	C	UV Vir	54853.558±0.005	0.021	25313.	C
RV UMa	54927.359±0.003	0.121	21048.	C	UV Vir	54870.569±0.005	0.007	25342.	C
RV UMa	54934.376±0.002	0.117	21063.	C	UV Vir	54880.560±0.003	0.017	25359.	C
RV UMa	54976.501±0.002	0.117	21153.	C	UV Vir	54908.742±0.005	0.019	25407.	LS
RV UMa	54977.436±0.003	0.116	21155.	C	UV Vir	54913.434±0.002	0.015	25415.	C
TU UMa	54853.474±0.002	-0.027	21558.	C	UV Vir	54938.678±0.005	0.014	25458.	LS
TU UMa	54887.488±0.002	-0.030	21619.	C	UV Vir	54944.551±0.002	0.016	25468.	LS
TU UMa	54897.525±0.002	-0.031	21637.	C	UV Vir	54948.660±0.002	0.016	25475.	LS
TU UMa	54935.448±0.002	-0.029	21705.	C	UV Vir	54950.418±0.002	0.013	25478.	C
AB UMa	54841.643±0.010	0.135	31045.	C	AF Vir	54870.621±0.005	-0.138	30050.	C
AB UMa	54870.409±0.009	0.121	31093.	C	AF Vir	54871.587±0.005	-0.140	30052.	C
AB UMa	54871.595±0.005	0.108	31095.	C	AF Vir	54911.739±0.005	-0.140	30135.	LS
AB UMa	54880.593±0.006	0.113	31110.	C	AF Vir	54915.608±0.005	-0.141	30143.	C
AB UMa	54889.586±0.010	0.112	31125.	C	AF Vir	54916.582±0.003	-0.134	30145.	C
AB UMa	54909.379±0.006	0.119	31158.	C	AF Vir	54951.401±0.003	-0.146	30217.	C
AB UMa	54918.376±0.007	0.122	31173.	C	AF Vir	54965.434±0.004	-0.142	30246.	C
AB UMa	54952.546±0.009	0.116	31230.	C	AF Vir	54972.687±0.002	-0.145	30261.	LS
EX UMa	54834.344±0.004	0.028	10724.	C	AF Vir	54974.620±0.002	-0.147	30265.	LS
EX UMa	54847.374±0.005	0.030	10748.	C	AF Vir	54980.419±0.002	-0.154	30277.	C
EX UMa	54853.345±0.003	0.030	10759.	C	AF Vir	54990.587±0.005	-0.144	30298.	LS
EX UMa	54860.400±0.002	0.028	10772.	C	AS Vir	54937.571±0.004	0.112	28518.	LS
EX UMa	54873.434±0.005	0.034	10796.	C	AT Vir	54886.543±0.002	-0.284	28925.	C
EX UMa	54885.375±0.005	0.033	10818.	C	AT Vir	54915.459±0.003	-0.287	28980.	C
EX UMa	54886.455±0.003	0.027	10820.	C	AT Vir	54916.511±0.002	-0.287	28982.	C
EX UMa	54893.516±0.005	0.032	10833.	C	AT Vir	54925.450±0.002	-0.286	28999.	C
KT UMa	54841.504±0.006	0.043	9207.	C	AT Vir	54941.749±0.004	-0.287	29030.	LS
KT UMa	54846.522±0.006	0.042	9215.	C	AT Vir	54944.378±0.002	-0.287	29035.	C
KT UMa	54848.399±0.007	0.038	9218.	C	AT Vir	54989.591±0.002	-0.292	29121.	LS
KT UMa	54875.380±0.005	0.045	9261.	C	AV Vir	54862.699±0.006	0.012	20387.	C
KT UMa	54876.634±0.007	0.044	9263.	C	AV Vir	54910.660±0.004	0.019	20460.	C
KT UMa	54910.518±0.007	0.054	9317.	C	AV Vir	54939.564±0.004	0.019	20504.	C
KT UMa	54912.391±0.004	0.045	9320.	C	BB Vir	54910.548±0.002	0.269	32470.	C
AF Vel	54843.784±0.002	-0.224	25430.	LS	BB Vir	54911.489±0.002	0.267	32472.	C
AF Vel	54852.741±0.002	-0.233	25447.	LS	BB Vir	54944.466±0.002	0.268	32542.	C
AF Vel	54860.654±0.003	-0.231	25462.	LS	BB Vir	54951.533±0.002	0.268	32557.	C

Table 1 (cont.): maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
BC Vir	54950.586±0.003	0.161	62050.	LS	SV Vol	54861.828±0.002	-0.167	34662.	LS
DO Vir	54913.833±0.003	0.214	53171.	LS	SV Vol	54880.738±0.003	-0.182	34712.	LS
DO Vir	54919.695±0.003	0.216	53182.	LS	SV Vol	54902.699±0.003	-0.174	34770.	LS
DO Vir	54920.759±0.004	0.215	53184.	LS	SV Vol	54929.533±0.003	0.165	34840.	LS
DO Vir	54991.609±0.003	0.213	53317.	LS	BN Vul	54998.512±0.003	0.069	15936.	C
DO Vir	55006.533±0.004	0.221	53345.	LS	BN Vul	55007.422±0.002	0.067	15951.	C
SV Vol	54841.710±0.004	0.154	34608.	LS					

* C = Calern, LS = La Silla
1 Baldwin and Samolyk, 2003

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IRAS 19015+1625: A MULTI-PERIODIC, HIGHLY REDDENED M6III SR VARIABLE

MUNARI, U.[1]; SIVIERO, A.[1]; DALLAPORTA, S.[2]; MORETTI, S.[2]; FRIGO, A.[2]

[1] INAF Osservatorio Astronomico di Padova, Sede di Asiago, I-36032 Asiago (VI), Italy

[2] ANS Collaboration, c/o Osservatorio Astronomico, I-36032 Asiago (VI), Italy

Henden and Munari (2000, 2001, 2006) established accurate $UBVR_cI_c$ photometric sequences around more than 80 symbiotic stars. Inclusion of stars in the comparison sequences was based on several criteria, including among others (*i*) covering a wide brightness range (for estimation of brightness on archival photographic plates), (*ii*) extending over the larger possible color range (for calibration of color corrections in CCD and photoelectric photometry), and (*iii*) photometric stability over three, well separated in time, re-observations. The latter requirement intended to avoid the most obvious variables from entering the photometric sequences. However, Henden and Munari were well aware that three observations were not enough to prevent from some contamination to leak in, and it would have been only the protracted use of the sequences that would have ultimately pruned them.

The ANS (Asiago Novae and Symbiotic stars) Collaboration is monitoring intensively all symbiotic stars for which Henden and Munari calibrated the photometric sequences. While observing the symbiotic star AS 338 = V1413 Aql, we have noted that one of the reddest comparison stars, at RA:285.941467 and DEC:+16.497797, is indeed variable. This star is IRAS 19015+1625, and at the time Henden and Munari worked out their sequences, the coincidence with the suspected variable NSV 24674 was not noted, otherwise the star would not have been used.

Our BVR_cI_c photometry of IRAS 19015+1625 is presented in Table 1 (available electronic version only through the IBVS website as `5896-t1.txt`) and in Figure 1. It was obtained with (*a*) the 0.42-m ARAR telescope in Bastia (Ravenna, Italy; identified as R120 in Table 1), equipped with an Apogee Alta 260e CCD camera, 512×512 array, 20 μm pixels $\equiv 1''\!.83$/pix, field of view of $16'\times16'$ and Schuler $UBVR_CI_C$ filters; and (*b*) the AAVC 0.30-m telescope in Cembra (Trento, Italy; identified as R030 in Table 1). The CCD is an SBIG ST-9, 512×512 array, 20 μm pixels $\equiv 1''\!.72$/pix, with a field of view of $13'\times13'$. The B filter is from Omega and the VR_CI_C filters from Custom Scientific. IRAS 19015+1625 has been observed for a total of 78 nights: 49 in 2005 and other 49 in 2009.

IRAS 19015+1625 is a quite red star, as illustrated by the following mean values of the data in Table 1: $< V >= 12.64$ (dispersion 0.20 mag), $< B-V >= +1.86$ (0.11), $< V-R_c >= +2.13$ (0.10), and $< V-I_c >= +4.61$ (0.08). The corresponding mean values measured by Henden and Munari (2000) are: $< V >= 12.26(\pm0.06)$,

$< B - V >= +1.92(\pm 0.01)$, $< V - R_c >= +1.85(\pm 0.03)$ and $< V - I_c >= +3.90(\pm 0.10)$, from three distinct observations collected on 1999 Oct 2, 6 and 13.

A low resolution, absolutely fluxed spectrum of IRAS 19015+1625 was obtained on 2009 July 28.99 UT, with the AFOSC imager+spectrograph of the Asiago 1.82m telescope. The spectrum is presented in Figure 2, that illustrates its perfect match with the M6III template spectrum taken from the reference atlas of Fluks et al. (1994), reddened by $E_{B-V} = 0.9$.

The amount of reddening affecting IRAS 19015+1625 seems contradictory defined. The fit to the observed spectrum requires precisely $E_{B-V} = 0.90$, while the match with the observed $V - I_c$ (see below) indicate $E_{B-V} = 1.05$. Conversely, the $< B - V >= +1.86$ color when compared with intrinsic colors of M giants (Lee, 1970) corresponds to $E_{B-V} = 0.28$. Similarly, the 2MASS colors of IRAS 19015+1625 ($Ks = 4.01$, $J - K = +1.463$, $H - Ks = +0.453$), when compared with the intrinsic colors of M6III stars in the 2MASS system ($J - Ks = 1.25$; Straižys and Lazauskaite, 2009, with extrapolation scaled according to Lee, 1970) results in $E_{B-V} = 0.37$ (following Fiorucci and Munari, 2003 for a standard $R_V = 3.1$ reddening law).

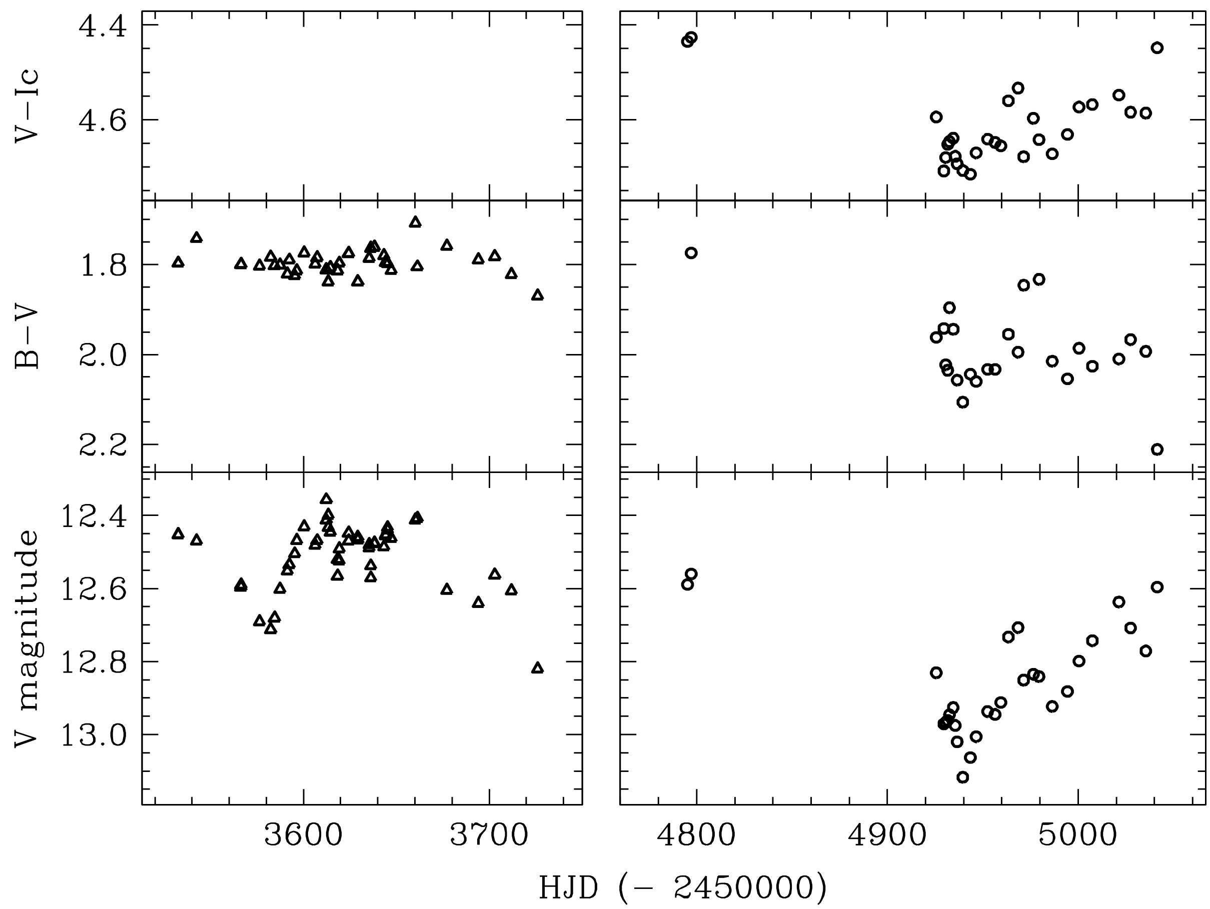

Figure 1. The light curve of IRAS 19015+1625 from our 2005 (left panels) and 2009 (right panels) observations. Formal errors (Poissonian noise + uncertainty in the slope of the instantaneous color correction from local to Henden-Munari systems) do not exceed the size of the symbols.

The light-curve of IRAS 19015+1625 in Figure 1 is characterized by a limited amplitude and color variation, with a pattern highly reminiscent of multi-periodic SR variables, similar to IRC-10443 that we have recently investigated (Munari et al., 2008). A Fourier analysis shows that a shorter, about 50-day periodicity is clearly present in IRAS 19015+1625 superimposed with a longer one, unconstrained with the present set of data, possibly of the order of 250 days.

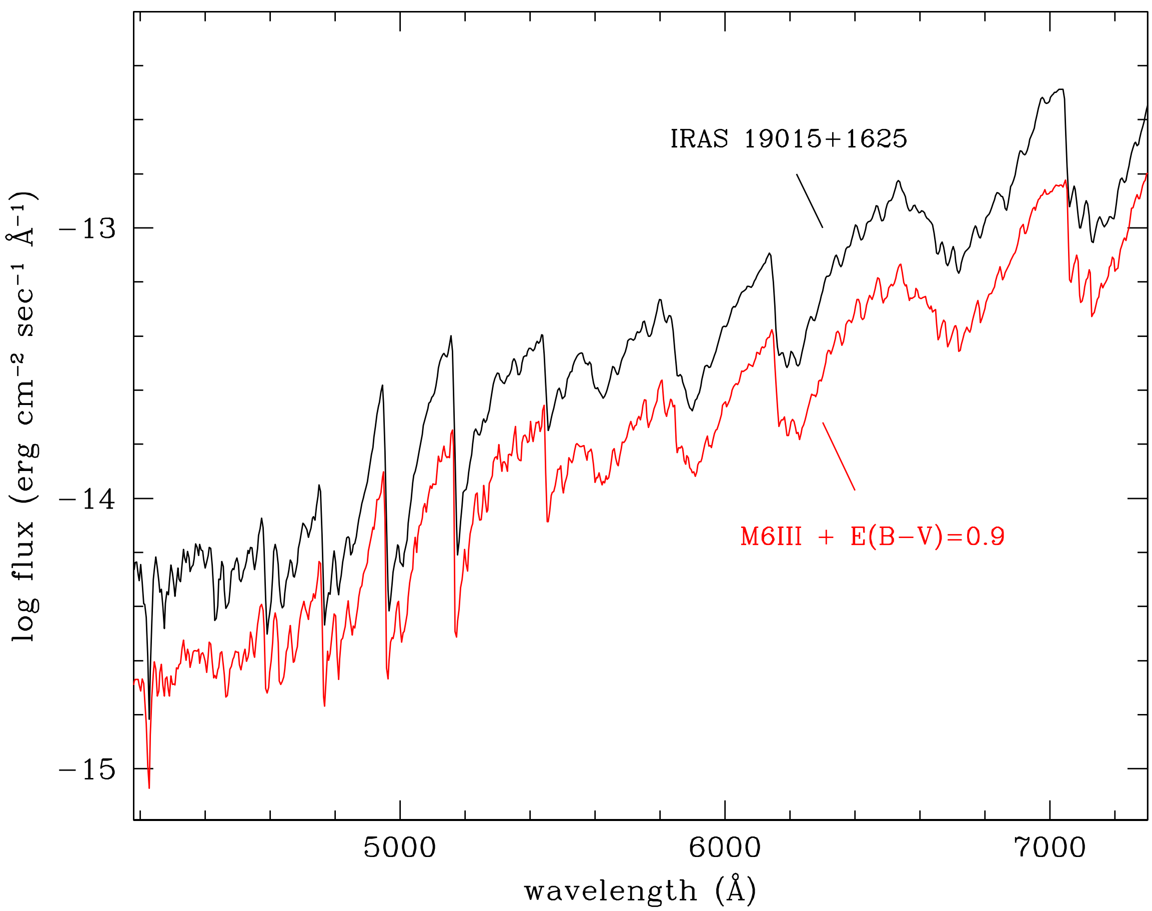

Figure 2. The absolutely fluxed spectrum of IRAS 19015+1625 for 2009 July 28.99 UT. The spectrum of a M6III star from the atlas of Fluks et al. (1994), reddened by $E_{B-V} = 0.90$, is plotted for comparison. The match is essentially perfect.

A pulsating nature of the observed variability is supported by Figure 3, that shows how the variability in the V band is strictly correlated with the $V - I_c$ color. When IRAS 19015+1625 is brightest, the color is the bluest, and when the star is faintest, the color is the redder, which is the behaviour of a black-body that expands and contracts at constant luminosity. The continuous line in Figure 3 represent the locus of MIII giants (with the actual excursion given of the right-hand ordinate axis) reddened by $E_{B-V} = 1.05$ (for a standard $R_V = 3.1$ reddening law) and scaled to the mean observed brightness for IRAS 19015+1625.

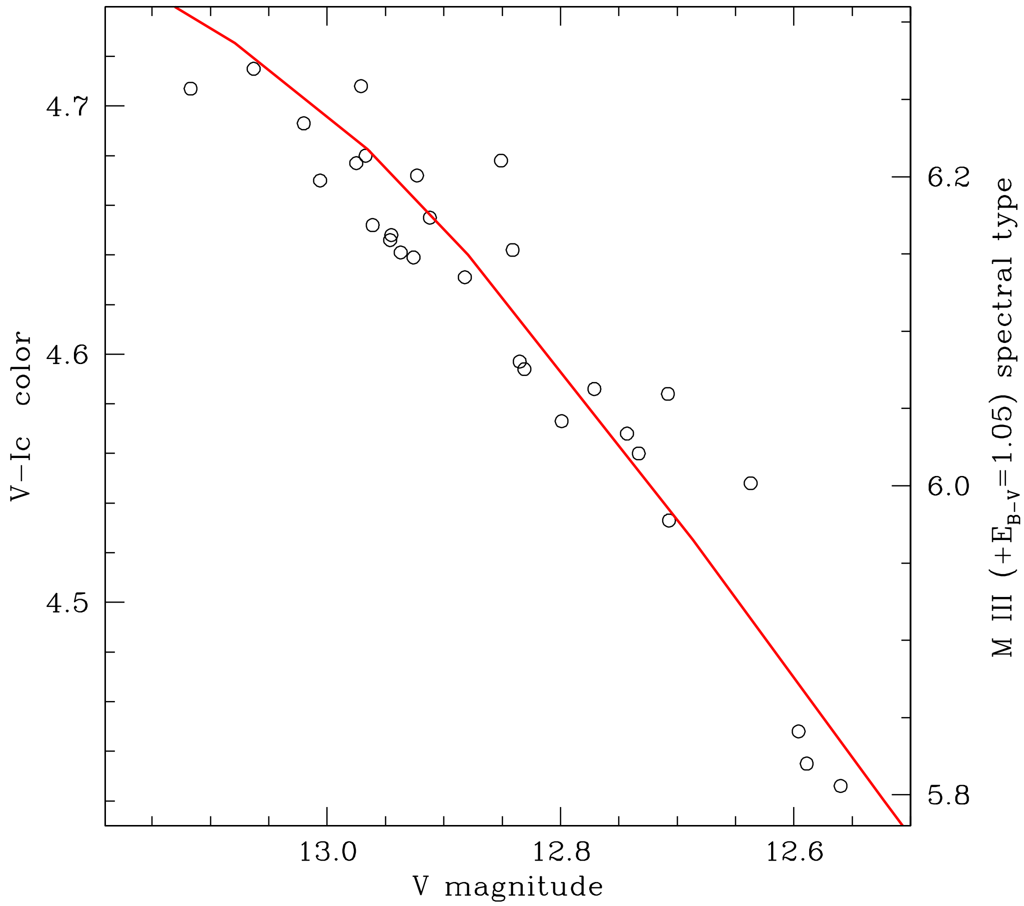

Figure 3. Variability of IRAS 19015+1625 on the $V/V-I_c$ plane from our observations. The line represents the locus of Fluks et al. (1994) spectra of class III M giants (see spectral scale at right), reddened by $E_{B-V}=1.05$.

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148 CCD TIMES OF MINIMA OF 47 ECLIPSING BINARIES

LIAKOS, A.; NIARCHOS, P.

Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University of Athens, GR 157 84 Zografos, Athens, Greece; e-mail: alliakos@phys.uoa.gr, pniarcho@phys.uoa.gr

Observatory and telescope:
16″ Cassegrain telescope at the University of Athens Observatory

Detector:	ST-8XMEI CCD camera, Peltier cooling, KAF-1603ME chip, $15' \times 10'$ and $23' \times 15'$ (using a focal reducer) FOV, 1530×1020 pixels, Bessell $BVRI$ filters

Method of data reduction:
The reduction of the CCD frames was made using the software Muniwin v.1.1.23 (Hroch, 1998).

Method of minimum determination:
The minima times were computed using the Kwee & van Woerden (1956) method.

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
AD And	54711.5097	0.0002	I	$BVRI$	
TT And	54298.4326	0.0001	I	V	
	54309.4931	0.0001	I	V	
RY Aqr	54297.4658	0.0001	I	VR	
	54361.3731	0.0003	II	VR	
	54362.3626	0.0001	I	VR	
AH Aur	54178.3628	0.0001	I	VRI	
	54203.3144	0.0001	II	VRI	
AC Boo	54572.3454	0.0002	I	$BVRI$	
	54572.5224	0.0002	II	$BVRI$	
TZ Boo	54099.6529	0.0001	I	R	
	54102.6259	0.0001	II	R	
	54605.4207	0.0002	I	$BVRI$	
	54608.3921	0.0002	I	$BVRI$	
	54608.5435	0.0003	II	$BVRI$	
	54624.4384	0.0002	II	$BVRI$	
UW Boo	54592.3568	0.0002	II	B	
AL Cam	54516.3669	0.0001	I	BV	
	54526.3292	0.0004	II	BV	

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
SV Cam	54352.5745	0.0003	II	*VRI*	
	54359.3914	0.0002	I	*VRI*	
	54361.4719	0.0001	II	*VR*	
AV CMi	54107.4977	0.0002	I	*R*	
	54475.5015	0.0009	II	*VRI*	
	54492.4357	0.0003	I	*VRI*	
	54772.6025	0.0004	I	*I*	
YY CMi	54114.4364	0.0001	I	*R*	
RW Cap	54303.5221	0.0001	I	*V*	
TY Cap	54296.4612	0.0001	I	*R*	
	54363.3648	0.0001	I	*R*	
	54373.3282	0.0001	I	*R*	
	54716.3804	0.0004	I	*BVRI*	
WY Cet	54766.4518	0.0002	I	*BVRI*	
RZ Com	54566.2706	0.0001	I	*VRI*	
	54573.3789	0.0001	I	*BVRI*	
	54573.5489	0.0002	II	*BVRI*	
KR Cyg	54696.3480	0.0001	II	*B*	
RZ Dra	54201.5765	0.0001	II	*R*	
	54229.3945	0.0001	II	*RI*	
	54232.4247	0.0002	II	*RI*	
TZ Dra	54204.5621	0.0002	II	*BI*	
	54214.5197	0.0001	I	*BI*	
	54658.3585	0.0004	II	*BV*	
	54661.3878	0.0001	I	*BV*	
TZ Eri	54475.4092	0.0002	I	*R*	
	54479.3194	0.0003	II	*BV*	
	54496.2583	0.0001	II	*B*	
UX Eri	54109.3134	0.0001	I	*R*	
AL Gem	54491.4655	0.0003	II	*VR*	
	54544.3340	0.0003	II	*VR*	
	54887.3015	0.0001	I	*BVRI*	
	54919.3026	0.0001	I	*V*	
	54935.3010	0.0011	II	*BVRI*	
GSC 3101-0683	54609.3997	0.0002	I	*B*	
	54610.3475	0.0001	I	*B*	
	54610.5055	0.0002	II	*B*	
	54611.4540	0.0002	II	*B*	
	54699.3835	0.0003	II	*BVRI*	
	54700.3326	0.0003	II	*BVRI*	
	54701.2817	0.0004	II	*BVRI*	
	54701.4384	0.0004	I	*BVRI*	
	54703.3363	0.0003	I	*BVRI*	
	54704.4433	0.0006	II	*BVRI*	
	54706.3421	0.0003	II	*BVRI*	
	54707.4480	0.0004	I	*BVRI*	

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
GSC 4589-2999	54290.4167	0.0003	II	RI	
	54306.4601	0.0007	I	$BVRI$	
	54312.3603	0.0005	II	BV	
	54377.3822	0.0001	I	R	
	54399.3355	0.0001	I	R	
	54637.4327	0.0003	I	$BVRI$	
	54642.4998	0.0001	I	V	
	54691.4703	0.0002	I	V	
GSC 4833-1209	54437.6234	0.0002	I	R	
	54791.6365	0.0008	I	VR	
	54797.5610	0.0006	II	VR	
	54798.6051	0.0004	I	VR	
	54824.3893	0.0009	I	VR	
	54883.2778	0.0017	II	VR	
	54886.4134	0.0006	I	VR	
	54906.2730	0.0015	II	VR	
CC Her	54935.5805	0.0010	II	I	
	54988.4685	0.0001	I	$BVRI$	
SZ Her	54367.2809	0.0001	I	R	
	54376.2798	0.0001	I	R	
	54392.2324	0.0002	II	VR	
V338 Her	54610.4418	0.0002	II	B	
	54706.4237	0.0002	I	$BVRI$	
UU Leo	54200.2862	0.0003	II	R	
	54520.2829	0.0001	I	R	
	54891.5123	0.0002	I	$BVRI$	
	54907.4703	0.0024	I	RI	
LZ Lyr	54595.4741	0.0001	II	R	
DD Mon	54551.2890	0.0001	I	R	
	54555.2650	0.0001	I	R	
IL Mon	54410.3509	0.0003	I	VR	
KR Mon	54108.4508	0.0001	I	R	
	54116.5072	0.0002	I	R	
	54165.4234	0.0003	II	R	
	54437.6262	0.0001	I	R	
	54486.5401	0.0004	II	R	
	54791.5462	0.0003	II	VR	
	54825.4988	0.0015	I	VR	
V839 Oph	54262.4460	0.0001	I	$BVRI$	
	54263.4695	0.0001	II	$BVRI$	
	54268.3780	0.0002	I	$BVRI$	
	54269.3989	0.0001	II	$BVRI$	
	54287.3945	0.0001	I	$BVRI$	
	54288.4192	0.0001	II	$BVRI$	
	54299.4619	0.0002	II	$BVRI$	
	54300.4837	0.0002	I	$BVRI$	
	54315.4129	0.0001	II	$BVRI$	
	54316.4355	0.0002	I	$BVRI$	

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
	54654.4801	0.0001	II	*BVRI*	
	54655.5019	0.0001	I	*BVRI*	
	54666.3412	0.0001	II	*BVRI*	
	54667.3625	0.0001	I	*BVRI*	
	54685.3586	0.0001	I	*BVRI*	
	54985.3669	0.0002	II	*BVRI*	
	54997.4323	0.0001	I	*BVRI*	
	54686.3825	0.0001	II	*BVRI*	
	54998.4554	0.0001	II	*BVRI*	
FT Ori	54457.5738	0.0001	II	*VR*	
BB Peg	54086.3022	0.0001	I	*R*	
KP Peg	54344.3843	0.0002	II	*BVRI*	
	54345.4728	0.0002	I	*BVRI*	
IU Per	54436.2332	0.0001	I	*B*	
	54800.4713	0.0001	I	*B*	
V432 Per	54117.2300	0.0001	I	*R*	
CR Sct	54305.3571	0.0002	I	*R*	
UZ Sge	54662.3688	0.0002	I	*VR*	
	55021.3218	0.0007	I	*BR*	
	55022.4293	0.0008	II	*R*	
	55023.5389	0.0002	I	*B*	
V505 Sgr	54267.5471	0.0002	I	*VI*	
YY Sgr	54236.5696	0.0001	I	*R*	
	54332.3573	0.0001	II	*R*	
EQ Tau	54108.2304	0.0001	I	*R*	
RV Tri	54348.4846	0.0001	I	*R*	
	54354.5141	0.0001	I	*R*	
	54368.4613	0.0001	II	*R*	
X Tri	54764.3948	0.0001	I	*BVRI*	
AZ Vir	54204.3995	0.0001	II	*R*	
	54217.3370	0.0001	II	*R*	
	54235.3448	0.0001	I	*R*	
DR Vul	54267.4424	0.0001	I	*R*	
	54275.3696	0.0001	II	*R*	

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MINIMA TIMES OF SELECTED ECLIPSING BINARIES

PARIMUCHA, Š.[1]; DUBOVSKÝ, P.[2]; BALUĎANSKÝ, D.[3]; PRIBULLA, T.[4,5]; HAMBÁLEK, Ľ.[4]; VAŇKO, M.[4,5]; OGLOZA, W.[6]

[1] Institute of Physics, Faculty of Natural Sciences, University of P.J. Šafárik, Košice, The Slovak Republic; e-mail: stefan.parimucha@upjs.sk

[2] Kolonica Observatory, The Slovak Republic; e-mail: var@kozmos.sk

[3] Roztoky Observatory, The Slovak Republic; e-mail: bdaniel@pobox.sk

[4] Astronomical Institute of the Slovak Academy of Sciences, Tatranská Lomnica, Stará Lesná, The Slovak Republic; e-mail: (pribulla, lhambalek)@ta3.sk

[5] Astrophysikalisches Institut und Universitäts-Sternwarte, Jena, Germany; e-mail: vanko@astro.uni-jena.de

[6] Mt. Suhora Observatory of the Pedagogical University Cracow, Poland; e-mail: sfogloza@cyf-kr.edu.pl

Observatory and telescope:
Kolonica Observatory: K1 - 2.8/180 mm photolense, K2 - 5.6/400 mm photolense, K3 - 256/1360 mm Newton, K4 - 280/1500 mm Newton, K5 - 1000/9000 mm RC, K6 - 300/2400 mm Cassegrain Roztoky Observatory: R1 - photolense 2/200 mm, R2 - refractor 70/700 mm, R3 - 400/4000 mm Cassegrain Astronomical Institute of the SAS: G1 - 500/2500 mm Newton, G2 - 600/6000 mm Cassegrain David Dunlap Observatory, University of Toronto: DDO - 150 mm refractor University Observatory Jena: GSH - 250/2250 mm Cassegrain

Detector:	K1, K2, K3, K4, R1, R2 - Meade DSI Pro, K4, K6 - SBIG ST-9XE and FLI PL1001E, K5 - two channel photoelectric photometer, G1 - SBIG ST-10XME, G2 - photoelectric photometer, DDO - SBIG ST-402 and ST-6, GSH - back-illuminated SITe TK1024

Method of data reduction:
The part of Kolonica observations and Roztoky data were reduced using C-Munipack package (`http://integral.physics.muni.cz/cmunipack/`), G1 and DDO data were analysed by scripts written under the MIDAS reduction package (`http://www.eso.org/projects/esomidas/`) by (TP). The rest of Kolonica and Jena data were reduced by scripts using Sextrator code (Bertin & Arnouts, 1996) written by (SP).

Method of minimum determination:
The minima times were computed by Kwee & van Woerden (1956) method.

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
RT And	54659.4634	0.0001	I		K1
AB And	54385.5325	0.0001	I		K1
	54680.4160	0.0002	II	*V*	K2
	54701.4912	0.0004	I	*V*	K2
CN And	54308.4784	0.0004	II		K1
	54385.3007	0.0001	II		K1
	54675.4675	0.0002	II	*V*	K2
	54709.4821	0.0003	I	*V*	K2
	54714.3435	0.0009	II		R1
EP And	54799.3940	0.0005	I	*V*	K3
	55042.4743	0.0002	II	*V*	K3
GZ And	54779.2034	0.0005	I		R1
	54779.3566	0.0002	II		R1
	55038.4709	0.0002	I	*V*	K3
LO And	54300.5035	0.0002	I	*V*	K3
	54434.4167	0.0002	I	*V*	K3
	54679.4224	0.0002	I		K1
	54719.3703	0.0001	I		R1
	55037.4174	0.0002	I	*V*	K3
V376 And	54752.3656	0.0002	II	*V*	K2
	54774.3113	0.0002	I	*V*	K2
OO Aql	53606.5916	0.0002	I		DDO
AH Aur	54433.5652	0.0003	I		K3
AR Aur	54469.4879	0.0002	I	*V*	K2
	54494.2967	0.0003	I		K2
	54715.4986	0.0002	II	*V*	K2
	54715.5004	0.0001	II		K2
	54748.5780	0.0001	II	*V*	K2
	54773.3864	0.0002	II	*V*	K2
	54775.4536	0.0001	I	*V*	K2
	54831.2728	0.0001	II	*V*	K2
V402 Aur	54749.5030	0.0003	II	*V*	K2
TY Boo	54507.5943	0.0004	II		K2
	54615.4260	0.0001	II	*V*	K3
	54912.5914	0.0005	II	*V*	K3
	54927.3378	0.0002	I	*V*	K3
TZ Boo	53868.7610	0.0003	II		DDO
	53874.7041	0.0003	II		DDO
	54173.4984	0.0002	I		K3
	54189.3978	0.0001	II	*BVRI*	K4
	54190.4375	0.0001	I	*BVRI*	K4
	54192.3696	0.0002	II	*VRI*	K4
	54192.5175	0.0001	I	*VRI*	K4
	54222.3822	0.0002	II	*BVRI*	K4
	54222.5230	0.0001	I	*BVRI*	K4

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
TZ Boo	54223.4218	0.0002	I	*BVRI*	K4
	54223.5730	0.0003	II	*RI*	K4
	54336.3451	0.0010	I		K1
	54469.6196	0.0001	II	*V*	K4
	54613.4445	0.0001	II	*V*	K4
	54883.5652	0.0002	II	*V*	K4
	54929.3273	0.0002	II	*V*	K3
	54938.5403	0.0002	II	*V*	K3
XY Boo	54964.4156	0.0002	I	*V*	K4
AC Boo	54192.4074	0.0001	I	*V*	K3
	54531.6382	0.0003	II		K2
	54533.4012	0.0003	II		R2
	54942.4166	0.0001	I	*V*	K3
FI Boo	54305.4473	0.0003	II		K1
	54581.3785	0.0003	I	*V*	K2
	54581.5654	0.0007	II	*V*	K2
	54616.4727	0.0003	I		K2
	54657.4272	0.0001	I		K1
SV Cam	54597.5162	0.0003	II		K1
	54752.5978	0.0002	I	*V*	K2
AO Cam	54544.3486	0.0001	II		R2
	54556.3903	0.0001	I		R2
	54706.4967	0.0003	I	*V*	K2
	54803.4862	0.0003	I		K1
CD Cam	54189.4308	0.0005	I	*V*	K3
	54190.5802	0.0005	II	*V*	K3
	54892.4839	0.0002	I	*V*	K3
	54941.3923	0.0001	I	*V*	K3
DN Cam	54753.2766	0.0002	I	*V*	K2
FN Cam	54500.5055	0.0004	I		K2
TX Cnc	54507.3114	0.0004	II		K2
	54782.5980	0.0002	II	*V*	K2
EH Cnc	54167.3931	0.0002	I	*R*	K4
	54167.3931	0.0003	I	*V*	K4
	54892.2636	0.0002	I	*V*	K3
BI CVn	54922.3271	0.0001	II	*V*	K4
	54937.5033	0.0002	I	*V*	K4
RZ Cas	54765.5744	0.0001	I	*V*	K2
	54782.3076	0.0001	I	*V*	K2
BS Cas	54677.5122	0.0001	I		K3
	54689.4053	0.0001	I		K3
	55042.4412	0.0001	II	*V*	K4
CW Cas	54213.4051	0.0002	II	*R*	R3
	54263.3048	0.0002	I	*R*	R3
	54264.4219	0.0002	II	*R*	R3

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
CW Cas	54271.4381	0.0004	II	*R*	R3
	54279.4098	0.0003	II	*R*	R3
	54315.4410	0.0001	II	*V*	K3
	54691.5374	0.0002	I		K3
V459 Cas	54773.2794	0.0004	I	*V*	K4
V523 Cas	54314.5347	0.0004	I	*V*	K3
	54509.3177	0.0001	II		R2
	54676.4082	0.0002	II		K1
	55017.4829	0.0002	I	*V*	K3
	55030.4532	0.0001	II	*V*	K3
V651 Cas	54335.5124	0.0002	II		K1
V651 Cas	54716.2946	0.0007	II	*V*	K2
V776 Cas	54700.4962	0.0004	II	*V*	K2
VW Cep	54307.3801	0.0002	I		K1
	54384.4771	0.0001	I		K1
	54384.3291	0.0001	II		K1
	54677.3896	0.0002	II		K1
	54677.5289	0.0002	I		K1
WZ Cep	54433.3598	0.0008	II		K3
	55029.4650	0.0002	II	*V*	K3
GK Cep	53617.6425	0.0002	II		DDO
GW Cep	54500.3078	0.0003	I		K2
	54964.5261	0.0001	I	*V*	K3
RW Com	52311.4482	0.0001	I	*BV*	G2
	52338.5060	0.0004	I	*BV*	G2
	52338.6212	0.0001	II	*BV*	G2
	52339.4524	0.0001	I	*RI*	R3
	52339.5700	0.0001	II	*VRI*	R3
	52345.5055	0.0001	II	*VRI*	R3
	54149.5808	0.0002	II	*V*	K3
	54187.4373	0.0004	I	*R*	R3
	54187.5576	0.0007	II	*R*	R3
	54189.3367	0.0005	I	*R*	R3
	54189.4556	0.0006	II	*R*	R3
	54203.3413	0.0002	I	*R*	R3
	54203.4593	0.0007	II	*R*	R3
	54203.5762	0.0004	I	*R*	R3
	54209.6300	0.0002	II		DDO
	54209.7488	0.0002	I		DDO
	54211.5289	0.0008	II	*R*	R3
	54235.3797	0.0001	I	*R*	R3
	54235.4995	0.0002	II	*R*	R3
	54513.5513	0.0001	I	*V*	K4
	54523.5205	0.0007	I		R2
	54883.4563	0.0001	II	*V*	K4

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
RW Com	54891.4076	0.0001	I	V	K4
RZ Com	54582.3507	0.0001	II		R1
SS Com	54500.6509	0.0002	I	V	K4
	54556.5894	0.0001	II		R2
CC Com	54162.4189	0.0007	I	V	K3
	54162.5294	0.0003	II	V	K3
CC Com	54887.3738	0.0002	I	V	K4
	54964.3937	0.0001	I	V	K3
YY CrB	54224.4154	0.0002	I		K1
	54298.4116	0.0002	II		K2
	54300.4821	0.0010	I		K2
	54308.3892	0.0002	I		K1
	54500.6202	0.0003	II		K2
	54504.5744	0.0008	I		K2
	54513.6124	0.0006	I		K2
	54628.4650	0.0002	I		K2
	54632.4137	0.0003	II		K2
	54648.4184	0.0030	I		K2
	55017.4401	0.0003	I		K1
CG Cyg	54260.4664	0.0002	II		K1
	54657.4548	0.0002	II	V	K2
	54658.4020	0.0004	I	V	K2
	54675.4442	0.0001	I		K1
KR Cyg	54198.5565	0.0002	II	$BVRI$	K4
V401 Cyg	54677.4440	0.0004	I	V	K2
	54679.4954	0.0002	II	V	K2
	54684.4377	0.0002	I	V	K2
	54947.5336	0.0004	II	V	K3
	54954.5275	0.0002	II	V	K3
	54973.4656	0.0001	I	V	K3
V1191 Cyg	53879.7805	0.0002	I		DDO
	53893.7283	0.0002	II		DDO
	54258.3604	0.0005	I	R	R3
	54335.4533	0.0003	I	R	R3
	54620.4785	0.0001	II	V	K3
	54941.5475	0.0002	I	V	K3
	54946.5605	0.0002	I	V	K3
V1918 Cyg	54620.4841	0.0001	II		R1
	54680.3929	0.0003	II		K1
	54942.5533	0.0001	I	V	K3
	54969.4097	0.0002	I	V	K3
LS Del	54650.4699	0.0005	II	V	K2
CM Dra	53997.4177	0.0005	I		K3
	54020.2491	0.0001	I	V	K3
	54191.4819	0.0001	I	V	K3

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
CM Dra	54309.4420	0.0002	I	*V*	K3
	54621.4660	0.0001	I	*V*	K3
FU Dra	54509.4701	0.0004	I		R2
	54509.6229	0.0005	II		K2
	54597.3436	0.0002	II		K1
	54613.4462	0.0001	I	*V*	K3
	54893.4794	0.0001	I	*V*	K3
	54977.3681	0.0002	II	*V*	K3
HL Dra	53168.6961	0.0005	I		DDO
	54660.4646	0.0002	II		K1
AK Her	54309.4458	0.0003	I		K1
	54335.3687	0.0003	II		K1
	54346.3304	0.0001	II	*V*	K5
	54365.2989	0.0001	II	*V*	K5
	54595.4526	0.0002	II	*BV*	K6
	54615.4727	0.0003	I		K2
	54699.3556	0.0001	I	*R*	K6
	54706.3122	0.0003	II		K2
	54926.5551	0.0003	I	*BVRI*	K6
	54929.5064	0.0001	I	*B*	K6
V624 Her	54621.4195	0.0005	II		K2
	54697.3858	0.0002	I	*V*	K2
V728 Her	54936.5598	0.0002	II	*V*	K3
	54938.4453	0.0002	II	*V*	K3
	54959.4181	0.0001	I	*V*	K3
V829 Her	54195.4842	0.0003	II	*V*	K3
	54500.6311	0.0002	II	*V*	K3
	54912.5088	0.0002	II	*V*	K3
	54929.5190	0.0002	I	*V*	K3
	54959.4292	0.0002	II	*V*	K4
V857 Her	52049.4447	0.0003	II	*BV*	G2
	52119.3930	0.0003	II	*BV*	G2
	52320.6342	0.0004	I	*BV*	G2
	52348.5389	0.0004	I	*BV*	G2
	52387.5201	0.0002	I	*RI*	R3
	52401.4672	0.0002	II	*VRI*	R3
	52402.4296	0.0002	I	*VRI*	R3
	52387.5203	0.0001	I	*V*	R3
	54709.3811	0.0003	II	*V*	K2
	54710.3397	0.0004	I	*V*	K2
	54977.5181	0.0002	I	*V*	K3
SW Lac	54749.3417	0.0001	I	*V*	K2
PP Lac	54299.4201	0.0002	I	*V*	K3
	55000.4517	0.0002	II	*V*	K3
	55001.4536	0.0002	I	*V*	K3

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V344 Lac	54615.5126	0.0002	II	V	K3
	54627.4759	0.0001	I	V	K3
	54691.4146	0.0004	I	V	K3
	54978.5359	0.0005	I	V	K3
V398 Lac	54783.2979	0.0002	I	V	K2
UV Leo	54494.5256	0.0002	II		K2
AM Leo	54149.5323	0.0002	I	V	K2
	54513.5000	0.0003	I		K2
CE Leo	54449.6271	0.0004	II		K3
	54538.5313	0.0003	II		R2
	54947.4012	0.0001	I	V	K3
EX Leo	54506.4816	0.0004	I		K2
RT LMi	54410.5999	0.0001	II		K3
	54525.3253	0.0001	II		R2
	54525.5127	0.0001	I		R2
	54530.3866	0.0002	I		R2
	54828.6332	0.0002	II	V	K3
	54893.3065	0.0001	I	V	K3
VW LMi	54938.5253	0.0002	I	V	K1
V714 Mon	54424.5840	0.0001	I	V	K4
RV Oph	55002.3858	0.0002	I	R	K1
V508 Oph	54513.6267	0.0001	I	V	K4
	54969.4403	0.0001	I	V	K4
V2610 Oph	54618.5275	0.0003	I	$V(R)_C$	G1
	54620.4424	0.0003	II		K2
	54627.4764	0.0002	I		K2
	54667.3591	0.0002	II	$BV(R)_C$	G1
V2612 Oph	54597.5346	0.0002	II	V	K2
FZ Ori	54506.2466	0.0001	II	$V(RI)_C$	G1
	54507.2462	0.0001	I	$BV(R)_C$	G1
V1363 Ori	52618.63160	0.0004	II		DDO
V1387 Ori	54480.3920	0.0012	II		K2
	54506.3058	0.0003	I		K2
	54533.3164	0.0012	I		K2
U Peg	54737.3508	0.0002	II	V	K2
AT Peg	54686.4720	0.0002	I	V	K2
BB Peg	54298.5034	0.0001	I	V	K3
	55033.4355	0.0001	I	V	K3
BX Peg	53928.4221	0.0002	I	V	K3
	54297.4537	0.0002	I	V	K3
	54678.4008	0.0002	II		K1
	54690.4604	0.0002	II		R2
DI Peg	54309.5089	0.0002	II		K1
	54738.3787	0.0002	I	V	K2
KW Peg	53928.4864	0.0007	II	V	K3

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
KW Peg	54297.5015	0.0002	II	V	K3
V351 Peg	53972.4606	0.0010	I		K2
	54328.4409	0.0002	I	V	K1
	54710.5267	0.0004	I	V	K2
V357 Peg	53607.7475	0.0002	II		DDO
	53616.7127	0.0002	I		DDO
	54329.3641	0.0002	I	V	K1
	54676.4345	0.0005	I	V	K2
	54680.4845	0.0003	I		K1
V432 Per	54434.2272	0.0001	I		K3
	54480.4152	0.0005	II		R3
	54489.4239	0.0003	I		R3
DV Psc	53666.3867	0.0002	I	$BV(RI)_C$	G1
	53667.4640	0.0001	II	$BV(RI)_C$	G1
	53668.3987	0.0001	II	$BV(RI)_C$	G1
	54404.4076	0.0004	I		K3
	54410.2698	0.0002	I		K3
	54410.4260	0.0002	II		K3
	54433.2610	0.0002	II	$BV(RI)_C$	G1
	54715.4127	0.0001	I	$BV(RI)_C$	G1
	54715.5771	0.0002	II	$BV(RI)_C$	G1
	54716.4977	0.0002	II	$BV(RI)_C$	G1
	54737.3162	0.0002	I	I	R3
	54737.4691	0.0003	II	I	R3
	54739.3226	0.0002	II	R	R3
	54748.4252	0.0002	I	R	R3
GSC 8-901	54410.3290	0.0001	I		K3
	54433.1982	0.0002	II	$BV(RI)_C$	G1
	54433.3434	0.0003	I	$BV(RI)_C$	G1
	54715.4478	0.0005	II	$BV(RI)_C$	G1
	54715.5896	0.0005	I	$BV(RI)_C$	G1
	54716.4581	0.0004	I	$BV(RI)_C$	G1
AO Ser	54491.6646	0.0003	II	VRI	G1
AU Ser	54507.6122	0.0001	II	V	K4
	54508.5803	0.0001	I	V	K4
	54955.3711	0.0001	I	V	K3
OU Ser	54554.5940	0.0001	I		K2
	54594.4996	0.0001	II	V	K2
BD +7 3142	54211.7133	0.0001	II		DDO
	54211.8532	0.0001	I		DDO
Y Sex	54213.4053	0.0002	I	$BVRI$	K4
	54507.4968	0.0004	II		K2
CW Sge	54988.4833	0.0003	II	V	K4
	55027.4461	0.0003	II	V	K3
	55028.4405	0.0002	I	V	K3

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
AH Tau	52195.4372	0.0001	II	UBV	G2
	52195.6032	0.0001	I	UBV	G2
	52203.4208	0.0001	II	BV	G2
	52278.2731	0.0001	II	BV	G2
	52278.4389	0.0001	I	BV	G2
	54434.4958	0.0001	I		K3
	54720.5937	0.0002	I		R1
EQ Tau	54508.2903	0.0004	I		K2
	54803.3890	0.0004	II		K1
V781 Tau	54751.4730	0.0002	II	V	K2
UX UMa	54433.6781	0.0003	I	$BV(RI)_C$	G1
	54508.6094	0.0001	I	$BV(RI)_C$	G1
	54509.5928	0.0001	I	$BV(RI)_C$	G1
	54521.5899	0.0001	I	$BV(RI)_C$	G1
	54651.3927	0.0001	I	BV	G1
XY UMa	54594.5000	0.0001	II		K1
AA UMa	54469.4804	0.0001	II	V	K4
	54937.3747	0.0002	I	V	K4
AW UMa	54887.5735	0.0001	I	$BVRI$	K6
HH UMa	54424.5872	0.0002	I		K3
	54532.3577	0.0002	I		R2
	54532.5416	0.0003	II		R2
	54912.3530	0.0002	I	V	K3
	54922.3052	0.0002	II	V	K3
TV UMi	53897.4349	0.0002	I		K3
	54173.3534	0.0003	I	V	K2
	54190.3975	0.0005	I	V	K2
	54506.6337	0.0003	I		K2
	54508.5070	0.0003	II		K2
AG Vir	54479.6439	0.0003	I		K2
AH Vir	54595.4420	0.0001	I		K1
AZ Vir	54943.4170	0.0001	I	V	K3
	54946.3894	0.0002	II	V	K3
HW Vir	54925.4281	0.0003	II	VR	GSH
	54925.4870	0.0005	I	VR	GSH
	54947.4298	0.0002	I	R	GSH
PY Vir	54202.4175	0.0003	I	$BVRI$	K4
	54228.4062	0.0004	II	$BVRI$	K4
	54505.5802	0.0003	I		K2

Explanation of the remarks in the table:
Observatory ID's are given

Remarks:

Times of minima are weighted averages from all filters used. The minimum types are calculated according to Kreiner's (2004) up to date linear elements of eclipsing binaries (`http://www.as.up.krakow.pl/ephem/`). The elements for HL Del are taken from Pribulla et al. (2006), for V398 Lac from Cakirli et al. (2007), for V1387 Ori from Pribulla et al. (2009), for BD+7 3142 from Rucinski et al. (2008) and for GSC 8-901 from Parimucha et al. (2008).

Acknowledgements:

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ERRATUM FOR IBVS 5715

The orbital inclination of XZ UMa had been omitted from IBVS 5715. It should be $83.9^\circ \pm 0.1^\circ$.

Bob Nelson

*This version of the paper contains corrections, and differs from the one appeared on-line originally. Date of last modification: 9 October 2009

COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 5899

Konkoly Observatory
Budapest
24 August 2009

HU ISSN 0374 – 0676

OBSERVATIONS OF VARIABLES

The last but one issue of the volume publishes new observations, and results on known variable stars. Figures and data files are available electronically.

Previous reports can be found in IBVS No. 5799.

The Editors

Date: 28 May 2008
Reported by: Udovichenko, S.N. - Astronomical Observatory of Odessa National University, udovich@farlep.net

Name of the object:
DM Cyg, V341 Aql, AV Peg, X Ari
Remarks:
For four RR Lyr type star: DM Cyg, V341 Aql, AV Peg and X Ari 11 new times of maxima were determined.

Date: 28 May 2008
Reported by: Liakos, A. - National and Kapodistrian Univ. of Athens, Dept. of Astrophysics, Astronomy and Mechanics, alliakos@phys.uoa.gr Niarchos, P. - National and Kapodistrian Univ. of Athens, Dept. of Astrophysics, Astronomy and Mechanics, pniarcho@phys.uoa.gr

Name of the object:
GSC 3101-0683
Remarks:
Detected in the FOV of V338 Her. Its variability was discovered by ROTSE1 experiment (Akerlof 2000), but no accurate period was given there. Pejcha (2005, 2006) published observations of the system. We report a new period. Min.I = 2454610.3476169 + 0.3162897d*E

Date: 30 December 2008

Reported by:
Liakos, A. - National and Kapodistrian Univ. of Athens, Dept. of Astrophysics, Astronomy and Mechanics, alliakos@phys.uoa.gr Niarchos, P. - National and Kapodistrian Univ. of Athens, Dept. of Astrophysics, Astronomy and Mechanics, pniarcho@phys.uoa.gr

Name of the object:
GSC 4833-1209

Remarks:
Variability discovered by Henden and Stone (1998). In the field of KR Mon. Type: EA/EB , Ephemeris : Min. I = HJD 2454437.62373 + 0.6968758d * E

Date: 20 January 2009

Reported by:
Kinman, T.D. - NOAO, U.S.A., kinman@noao.edu

Name of the object:
V391 Mon

Remarks:
The GCVS describes V391 Mon as an RRab (phot. amp. 0.4 mag; period 0.4643 days) and identifies it with GSC 4824-01986. Simbad identifies V391 Mon with GSC 4824-00646. Photoelectric observations between 1988 and 1999 showed GSC 4824-01986 to be constant but with a colour ($(B-V) = 0.376$) appropriate for an RRab, while GSC 4824-00646 was slightly variable ($12.70 < B < 12.84$) but too red ($<(B-V)> = 0.70$). The correction for reddening is uncertain, however, so the interpretation of these colours is currently ambiguous. Forty six CCD observations on 11 nights in 2008 of GSC 4824-00646 gave $11.99 < V < 12.12$. The star is probably a short period EW. There is no indication of the 0.4643 d periodicity in the data.

References:

Akerlof, C. et al., 2000, AJ, 119, 1901
Anonymous, 2006, IBVS, 5699, (report No. 75. by Pejcha, O.)
Henden, A.A., Stone, R.C., 1998, AJ, 115, 296
Pejcha, O., 2005, IBVS, 5645

COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 5900

Konkoly Observatory
Budapest
24 August 2009

HU ISSN 0374 – 0676

REPORTS ON NEW DISCOVERIES

The last issue of the volume publishes a list of newly discovered variables. Figures (finding charts and light curves) and data files are available electronically. Previous reports can be found in IBVS 5700.

The Editors

Date: 24 October 2007

Observer(s) and affiliation(s):
Tiwari, S.K. - Aryabhatta Research Institute of Observational Sciences, Manora Peak, Nainital - 263129, India
Chaubey, U.S. - Aryabhatta Research Institute of Observational Sciences, Manora Peak, Nainital - 263129, India
Pandey, C.P. - Aryabhatta Research Institute of Observational Sciences, Manora Peak, Nainital - 263129, India

HD 103498 is an A1 type magnetic star having surface magnetic field of about 2.5 kG and shows the lines of Sr, Eu and Cr in its spectrum (Cramer & Maeder, 1980). The Strömgren indices of HD 103498 are b-y = 0.003, m_1 = 0.196, c_1 = 1.010 and β = 2.858, (Hauck & Mermilliod, 1998). We observed this star on four nights between March and April 2007 with 104-cm telescope of ARIES Nainital, equipped with high-speed fast photometer and discovered 15-min oscillations. The observational and data reduction procedures are available in Tiwari, Chaubey & Pandey (2007).

The nightly observed mean amplitude of the oscillations are different from each other. The amplitude modulation may be due to either excitation of different modes or rotation of the star or both.

Acknowledgements: Dr. B.J. Medhi; DST Govt. of India, Grant No. SR/S2/HEP-20/2003.

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
11 55 11.33	+46 28 11.21	DSCT	7.026

Period	**Epoch**
15.2 m	-

Cross-identification(s):
HD 103498 = BD +47 1914

Date: 12 November 2007

Observer(s) and affiliation(s):
Liakos, A. - Dept. of Astrophysics, Astronomy and Mechanics, Faculty of Physics, National & Kapodistrian University of Athens, Athens, Greece, alliakos@phys.uoa.gr
Niarchos, P. - Dept. of Astrophysics, Astronomy and Mechanics, Faculty of Physics, National & Kapodistrian University of Athens, Athens, Greece, pniarcho@phys.uoa.gr

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
20 15 00.22	+76 54 18.28	EA	10.59 V (GSC)

Period	**Epoch**
1.688778389d	2454377.38222

Cross-identification(s):
GSC 4589-2999

Date: 12 November 2007

Observer(s) and affiliation(s):
Zhang, X.B. - National Astronomical Observatories, Chinese Academy of Sciences, Beijing, 100012, China, xzhang@bao.ac.cn
Luo, C.Q. - Dept. of Physics, China West Normal University, Sichuan, 637002, China
Luo, Y.P. - Dept. of Physics, China West Normal University, Sichuan, 637002, China
Deng, L.C. - National Astronomical Observatories, Chinese Academy of Sciences, Beijing, 100012, China, licai@bao.ac.cn

The new variable is a certain member of the intermediate age open cluster NGC752 (Platais, 1991).

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
01 57 17.29	+37 40 51.6	E	13.10 (V)

Period	**Epoch**
-	-

Cross-identification(s):
NGC 752 170 = Cl* NGC 752 Stock 239 = Cl* NGC 752 PLA 758

Date: 13 December 2007

Observer(s) and affiliation(s):
Agerer, F. - Bundesdeutsche Arbeitsgemeinschaft für veräderliche Sterne e.V., Munsterdamm 90, D-12169 Berlin, Germany, agerer.zweik@t-online.de

Remark: In the field of V941 Cyg

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
19 41 29.36	+30 51 19.6	EA	12.93 (r USNO-B-1.0)

Period	**Epoch**
1.125815 d	2453611.435

Cross-identification(s):
GSC 2656-4286 = USNO-B-1.0 1208-0386457

Date: 9 January 2008
Observer(s) and affiliation(s): Agerer, F. - Bundesdeutsche Arbeitsgemeinschaft für veränderliche Sterne e.V. (BAV), Munsterdamm 90, D-12169 Berlin, Germany, agerer.zweik@t-online.de

Remark: South-east of OR Cas (very close).

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
00 48 03.78	60 51 28.5	EW	13.64 (USNO-B1.0 R2mag)

Period	**Epoch**
0.318004 d	2454002.631 (Min I)

Cross-identification(s):
USNO-B1.0 1508-0029126

Remark: In the field of V459 Cas. Already published by Brat (2006), but no period was given there.

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
01 11 08.89	61 07 45.1	EW	14.45 (USNO-B1.0 R1mag)

Period	**Epoch**
0.302240	2454092.275 (Min I)

Cross-identification(s):
USNO-B1.0 1511-0041416 = 2MASS J01110892+6107448 = LBvar010 Cas

Date: 14 January 2008
Observer(s) and affiliation(s): Violat-Bordonau, Francisco - Caceres Astronomical Observatory, E10080, Caceres, Spain, fviolat@yahoo.es Arranz-Heras, Teofilo - "Las Pegueras" Observatotory, Navas de Oro, Segovia, Spain

Remark: BD +36 3317 is an A5 type star (Anthony-Twarog, 1984) located in the open cluster Stephenson 1, near the Delta2 Lyrae variable.

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
18 54 22.23	36 51 07.4	EA	8.77 V (SIMBAD)

Period	**Epoch**
4.30216 d	2454437.25921 (Min I)

Cross-identification(s):
BD +36 3317 = SAO 67556 = TYC 2651-802-1

Date: 15 January 2008

Observer(s) and affiliation(s):
Schuster, W.J. - Institute of Astronomy/Observatorio Astronómico Nacional, Universidad Nacional Autónoma de México, P.O. Box 439027, San Diego, CA, 92143-9027, U.S.A., schuster@astrosen.unam.mx
Ochoa, J. - Institute of Astronomy/Observatorio Astronómico Nacional, UNAM, chico@astrosen.unam.mx
Zurita, C. - Institute of Astronomy/Observatorio Astronómico Nacional, UNAM, czurita@astrosen.unam.mx
Fox Machado, L. - Institute of Astronomy/Observatorio Astronómico Nacional, UNAM, lfox@astrosen.unam.mx

Remark: On the night of 26 September 2007 UT differential *uvby* photometry of two AO-type stars was carried out at the 1.5m telescope of the San Pedro Mártir Observatory, and HD 207331 proved to be variable (see 5900-f18). Confirming CCD observations were carried out on the night of 30 September 2007 UT at the 84cm telescope of the same observatory, and the light curve suggests strongly that this variable star is of the δ Scuti type with a period of about 1.17 hour (see 5900-f19). The position of this star in the M_v,$(B-V)$ diagram also confirms this classification (see 5900-f21).

The staff of the San Pedro Mártir Observatory, Baja Californ ia, México, is gratefully thanked.

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
21 47 02.32	43 19 18.6	DSCT	8.51 (B)

Period	**Epoch**
0.04875 d	-

Cross-identification(s):
HD 207331 = BD+ 42 4207 = HIP 107557

Date: 26 February 2008

Observer(s) and affiliation(s):
DeGennaro, S. - University of Texas at Austin
Williams, K. - University of Texas at Austin
Montgomery, M. - University of Texas at Austin

Remark: This object may represent a new class of variable star: the pulsating carbon atmosphere white dwarf, or DQV. The object found to pulsate with a single mode at 417.76 +/- 0.35 s with an amplitude of 1.7

The object was observed for 5 and 3 hours on two consecutive nights using the Argos high-speed photometer on the 2.1m Otto Struve reflector at McDonald Observatory. The period and amplitude were found to be stable between the two observations.

The figures show the light curves obtained for the two nights, smoothed by a Gaussian with a sigma of 1.25 observations (37.5 s), and the combined Fourier transform of the two data sets.

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
14 26 25.7	+57 52 18.4	DQV(?)	19.16 (g)

Period	**Epoch**
417.76 s	-

Cross-identification(s):
SDSS J142625.71+575218.3

Date: 11 March 2008

Observer(s) and affiliation(s):
Cook, S.P. - 332 Weed Road, Weed, NM 88354-0499, USA

Remark: This early-type, high luminosity emission line star (15' NE of Cepheid BM Persei) is an eclipsing binary (beta Lyr type?). Minima times were determined by Kwee and van Woerden (1956) method, and the period was determined by weighted least squares fitting of three best observed minima (Belserene, 1988a) and using DFT (Belserene, 1988b) on NSVS data (Wozniak et al., 2004).

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
04 28 39.623	48 35 55.03	EB?	9.72 V (GSC)

Period	**Epoch**
21.65 d	2454516.1

Cross-identification(s):
BD +48 1098 = GSC 3333-1755 = PPM 47103 = ALS 7963 = NSVS 4287647 = NSVS 4265168

Date: 9 September 2008

Observer(s) and affiliation(s):
Liakos, A. - National and Kapodistrian Univ. of Athens, Dept. of Astrophysics, Astronomy and Mechanics, alliakos@phys.uoa.gr Niarchos, P. - National and Kapodistrian Univ. of Athens, Dept. of Astrophysics, Astronomy and Mechanics, pniarcho@phys.uoa.gr

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
23 35 50	48 43 43	DSCT	11.3 (GSC V)

Period	**Epoch**
0.112625 d	-

Cross-identification(s):
GSC 3641-0359 = 2MASS 23355022+4843428

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
19 54 39.5	32 56 02.7	DSCT	10.8 (GSC V)

Period	**Epoch**
0.0997415 d	-

Cross-identification(s):
GSC 2673-1583 = 2MASS 19543947+3256027

Date: 29 January 2009

Observer(s) and affiliation(s):
Monninger, G. - Bundesdeutsche Arbeitsgemeinschaft für veränderliche Sterne e.V. (BAV), Munsterdamm 90, DE-12169 Berlin, Germany, gerold.monninger@online.de

Remark: In the field of GSC 3377-0296, an RS CVn variable (Lloyd et al., 2007).

RA(J2000)	Dec(J2000)	type	Mag.
06 39 48.8	46 57 15.1	DSCT	14.18 (R1mag - USNO B1.0)

Period	Epoch
0.104430 d	2454840.4195

Cross-identification(s):
USNO-B1.0 1369-0180384

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ERRATUM FOR IBVS 5700

The epoch reported in IBVS 5700 for GSC 3355-0394 should be 2451537.61909 .