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ET Ori	4912
V1118	4925
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II	4992
MT	4933
51	4933
RV Per	4912
IK	4912
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Star	IBVS No.
UV Psc	4941
UY	4986
XX Pup	4936
LX	4936
UU Sge	4962
GM Sgr	4921
V4641	4921
AP Ser	4954
CC	4912
RW Tau	4912
CU	4912
X Tri	4912
TX UMa	4912
UX	4912
UY	4912
XY	4943
ZZ	4912
AA	4912
DW	4967
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V383 Vel	4994
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AH	4912
AW	4912
AZ	4912
HW	4912
Z Vul	4912
AX	4912
GP	4967
Antipin Var 70	4038
Antipin Var 71	4939
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BD +20°75	4910
BD +22°153	4935
BD +23°126	4935
BD +24°2593	4960
BD +25°2643	4960
BD +27°4648	4992
BD +28°4666	4992
BD +29°3910	4961
BD +29°3915	4961

Star	IBVS No.
BD +34°4216	4979
BD +51°2234	4988
BD +52°3383	4991
BD +62°2166	4923
BD +62°2167	4923
GSC 0128-1121	4920
GSC 0140-1831	4920
GSC 0144-1300	4920
GSC 0156-1365	4972
GSC 0156-1475	4972
GSC 0171-2059	4920
GSC 0396-1710	4920
GSC 0477-3880	4920
GSC 0490-4680	4920
GSC 0845-0121	4967
GSC 0845-0189	4967
GSC 0845-0271	4967
GSC 0923-1074	4954
GSC 0923-1281	4954
GSC 0959-1397	4920
GSC 1009-0766	4920
GSC 1010-0732	4920
GSC 1024-2911	4920
GSC 1057-1309	4920
GSC 1058-0689	4967
GSC 1060-2412	4920
GSC 1062-1819	4920
GSC 1062-2668	4920
GSC 1076-1332	4920
GSC 1076-1805	4920
GSC 1078-0852	4920
GSC 1108-0961	4920
GSC 1108-2511	4920
GSC 1123-1704	4920
GSC 1139-0011	4920
GSC 1172-1452	4920
GSC 1193-0277	4910
GSC 1193-0523	4910
GSC 1342-1261	4928
GSC 1534-0753	4998
GSC 1534-0962	4998
GSC 1534-1027	4998
GSC 1536-0928	4967
GSC 1536-1834	4967
GSC 1887-1240	4908
GSC 2109-0167	4967

Star	IBVS No.
GSC 2113-1658	4967
GSC 2151-5637	4967
GSC 2293-1021	4981
GSC 2293-1027	4981
GSC 2293-1028	4981
GSC 2293-1422	4981
GSC 2293-1456	4981
GSC 2293-1461	4981
GSC 2401-1128	4967
GSC 2581-1969	4967
GSC 2625-1563	4975
GSC 2625-1672	4975
GSC 2629-1855	4975
GSC 2636-1584	4976
GSC 2636-1675	4976
GSC 2636-1753	4976
GSC 2646-1777	4982
GSC 2646-1920	4982
GSC 2646-1938	4982
GSC 2679-0670	4997
GSC 2679-2602	4997
GSC 2753-1568	4916
GSC 2763-0878	4967
GSC 3062-0032	4902
GSC 3062-0281	4902
GSC 3099-0905	4965
GSC 3099-0933	4965
GSC 3099-1019	4965
GSC 3100-1616	4966
GSC 3100-1679	4966
GSC 3100-1797	4966
GSC 3121-1294	4995
GSC 3121-1335	4995
GSC 3121-1799	4995
GSC 3123-1116	4985
GSC 3123-1618	4985
GSC 3123-1854	4985
GSC 3131-0439	4982
GSC 3131-0476	4982
GSC 3131-0522	4982
GSC 3215-1406	4967
GSC 3358-1208	4967
GSC 3409-1129	4911
GSC 3409-1825	4911
GSC 3530-2617	4926
GSC 3530-2670	4926
GSC 3547-0216	4996
GSC 3547-1774	4996
GSC 3547-1876	4996
GSC 3551-0081	4985
GSC 3551-0085	4985
GSC 3551-0099	4985
GSC 3564-2983	4995
GSC 3564-2997	4995
GSC 3564-3059	4995
GSC 3595-0816	4967
GSC 3609-2087	4967
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GSC 3921-1531	4996
GSC 3921-1595	4996
GSC 3921-1760	4996
GSC 3947-1632	4989
GSC 3948-2105	4950
GSC 3948-2542	4950
GSC 4018-1275	4938
GSC 4031-0631	4913
GSC 4031-0953	4913
GSC 4031-1001	4913
GSC 4031-1099	4913
GSC 4068-0447	4903
GSC 4068-0472	4903
GSC 4068-1369	4903
GSC 4068-1431	4903
GSC 4282-0348	4967
GSC 4282-0778	4923
GSC 4288-0186	4967
GSC 4317-1578	4967
GSC 4383-1198	4914
GSC 4386-1592	4914
GSC 4386-1682	4914
GSC 4386-1705	4914
GSC 4386-1855	4914
GSC 4431-0386	4974
GSC 4527-1983	4967
GSC 4585-2167	4967
GSC 4585-2387	4967
GSC 4745-0397	4973

Star	IBVS No.
GSC 4745-0698	4973
GSC 4745-1227	4973
GSC 4745-1303	4973
GSC 4745-1325	4973
GSC 4745-1330	4973
GSC 4745-1360	4973
GSC 4745-1403	4973
GSC 4847-1513	4930
GSC 4847-1606	4930
GSC 4847-1694	4930
GSC 4984-0691	4955
GSC 5178-1373	4945
GSC 5178-1376	4945
GSC 5198-0636	4951
GSC 5328-1449	4937
GSC 5328-1509	4937
GSC 5328-1765	4937
GSC 5582-0545	4920
GSC 5996-0413	4936
GSC 5996-0701	4936
GSC 5996-0713	4936
GSC 9308-1513	4956
GSC 9321-1105	4956
HD 007346	4986
HD 007529	4986
HD 014210	4924
HD 026433	4934
HD 048995	4927, 4928
HD 076678	4949
HD 077191	4949
HD 094883	4952
HD 095977	4952
HD 111812	4980
HD 112299	4980
HD 162035	4990
HD 162131	4990
HD 218179	4931
HD 218915	4967
HD 236062	4967
HD 237784	4943
HD 237788	4943
HD 263542	4927, 4928

Star	IBVS No.
IRAS 18050+0622	4920
LBQS 1432-0033	4955
LD 345	4926
NGC 2506	4964
NSV 01756	4973
NSV 11766	4974
Parenago 1497	4925
Parenago 1516	4925
Parenago 1518	4925
Parenago 1588	4925
Parenago 1612	4925
RX J1450.5+6403	4940
SAO 20384	4931
SAO 20405	4931
SAO 20422	4931
SAO 23170	4924
SAO 23173	4924
SAO 31628	4983
SAO 51164	4967
SAO 62390	4952
USNO-A1.0 1575-03003814	4914
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NEW PHOTOELECTRIC MINIMA AND LIGHT ELEMENTS OF MM HERCULIS

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The variability of the RS CVn type eclipsing binary MM Herculis (BD +22°3245, HD 341475) was discovered by Tsesevich (1954). Previous observational data were well studied up to now by several authors. The last period analysis of MM Her was made by Evren (1985) and the light elements of the system were computed.

The observations in Johnson's B, V, R filters were made at the Ege University Observatory in 1998 and 1999. The new light curves obtained from these observations have been published by Taş (2000). The times of four primary minima obtained in this study are listed in Table 1.

The $O-C$ (I) residuals in Table 1 were computed from the light elements given by Evren (1985) as

$$\mathrm{HJD}_{\mathrm{min\,I}} = 2445551.4336 + 7\overset{\mathrm{d}}{.}960358 \times E.$$

The least squares solution has been computed from all photoelectric minima given by Hall and Kreiner (1980), Evren (1985) and this study, and the new light elements were derived as follows:

$$\begin{array}{c} \mathrm{HJD}_{\mathrm{min\,I}} = 2445551.4274 + 7\overset{\mathrm{d}}{.}960326 \times E. \\ \qquad\qquad\qquad \pm 7 \qquad\qquad \pm 2 \end{array}$$

The $O-C$ (II) residuals were computed using these new light elements and all of them have negative sign. These residuals were plotted against cycle values (E) and are shown in Figure 1.

As seen from Figure 1, the $O-C$ (II) residuals may be represented with a sine-like variation. Our values (filled circles in Figure 1) are seen on the descending branch of this variation. This variation can either be the result of a light-time effect or magnetic activity. Our studies concerning the third body orbit and the physical parameters of the third companion being continued and will be discussed elsewhere.

Acknowledgements: I would like to thank Drs. C. Ibanoglu and S. Evren for their guidance. This work was supported by Ege University Research Fund (Project No. 99 FEN 014).

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Hall, D.S. and Kreiner, J.M., 1980, *Acta Astron.*, **30**, 387
Taş, G., 2000, *IBVS*, No. 4883.
Tsesevich, V.P., 1954, *Odessa Izv.*, **4**, Part 2, 116

Table 1: Times of new primary minima for MM Her

JD (Hel.) (24 00000+)	E	$O-C$ (I) (day)	$O-C$ (II) (day)	Filter
50956.48586	679	−0.03082	−0.00288	V
50956.48592	679	−0.03076	−0.00282	B
50956.48615	679	−0.0305	−0.0026	R
50964.44694	680	−0.0301	−0.0021	R
50964.44701	680	−0.0300	−0.0021	V
50964.44801	680	−0.0290	−0.0011	B
51362.45861	730	−0.0363	−0.0067	V
51362.45949	730	−0.0354	−0.0059	R
51362.46187	730	−0.0331	−0.0035	B
51378.38174	732	−0.0339	−0.0043	R
51378.38212	732	−0.0335	−0.0039	B
51378.38272	732	−0.0329	−0.0033	V

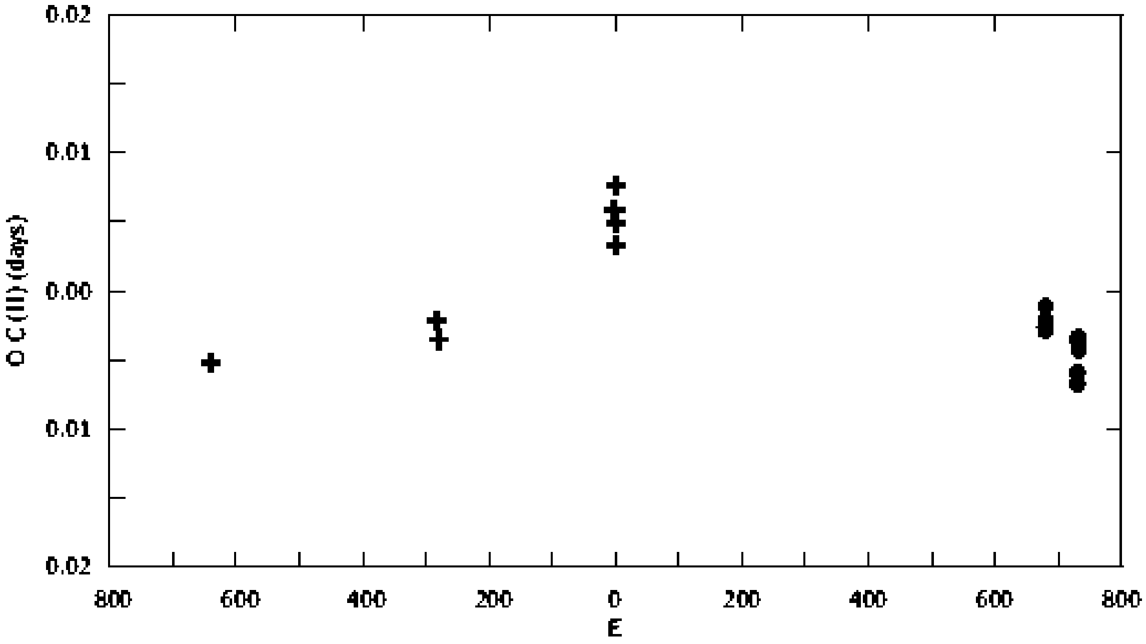

Figure 1. The $O-C$ (II) variation of MM Her. The symbols of plus and filled circle represent the data taken from literature and this study, respectively.

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CCD PHOTOMETRY OF THE 1999 SUPEROUTBURST OF V844 Her

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V844 Her was discovered as a dwarf nova (Var43) by Antipin (1996). He reported that the duration of the best-observed outburst is between 12 and 18 days, whose light curve closely resembled that of a superoutburst of an SU UMa-type dwarf nova. A systematic search for further outbursts was carried out by members of various variable star organizations, yielding the first ever detection by Scovil (1996) on 1996 Oct. 12. Time-resolved CCD photometry by Vanmunster (1996) during this outburst unambiguously detected superhumps, leading to a secure classification of an SU UMa-type dwarf nova. The determination of the superhump period was first achieved during the next superoutburst in 1997 (Vanmunster 1997; Jensen 1997), yielding a period of 0.056 ± 0.001 d, which resulted in one of the shortest superhump periods among SU UMa-type dwarf novae. A more precise superhump period of 0.05597 ± 0.00002 d is listed by Patterson (1998).

Upon the detection by McGee (1999) of a bright outburst at visual magnitude of 12.3 on 1999 September 29.824 UT, we started time-resolved CCD photometry. The observations were done using an unfiltered ST-7 camera attached to the Meade 25-cm Schmidt-Cassegrain telescope. The exposure time was 30 s. The images were dark-subtracted, flat-fielded, and analyzed using the Java$^{\rm TM}$-based aperture and PSF photometry package developed by one of the authors (TK). The flux of the variable was measured relative to GSC 3062.32 (Tycho-2 magnitudes: $V = 10.57$, $B - V = 1.25$), whose constancy was confirmed by comparing with GSC 3062.281 ($V = 12.79$, $B - V = 1.03$, Henden and Sumner(1999)). A total of 1566 observations were obtained. Heliocentric corrections were applied to all observations before the following analysis.

Figure 1 illustrates the overall light curve of the present observation. Each point represents a nightly averaged magnitude with an error bar indicating the standard error. The light curve is characteristic of an SU UMa-type superoutburst, showing the slowly fading "plateau" stage, followed by an abrupt decline, and the final fading. The superhump signal was first detected on October 1 observation (~ 1.7 d after the outburst detection), when the amplitude of the signal was 0.09 mag. Further observation on October 3 clearly showed fully grown superhumps with an amplitude of 0.3 mag (see Figure 2).

The object entered a rapid decline stage on October 13 according to observations reported to VSNET. The data during the superoutburst plateau (October 3–12) were analyzed, after subtracting the linear decline, using the Phase Dispersion Minimization (PDM) method (Stellingwerf 1978).

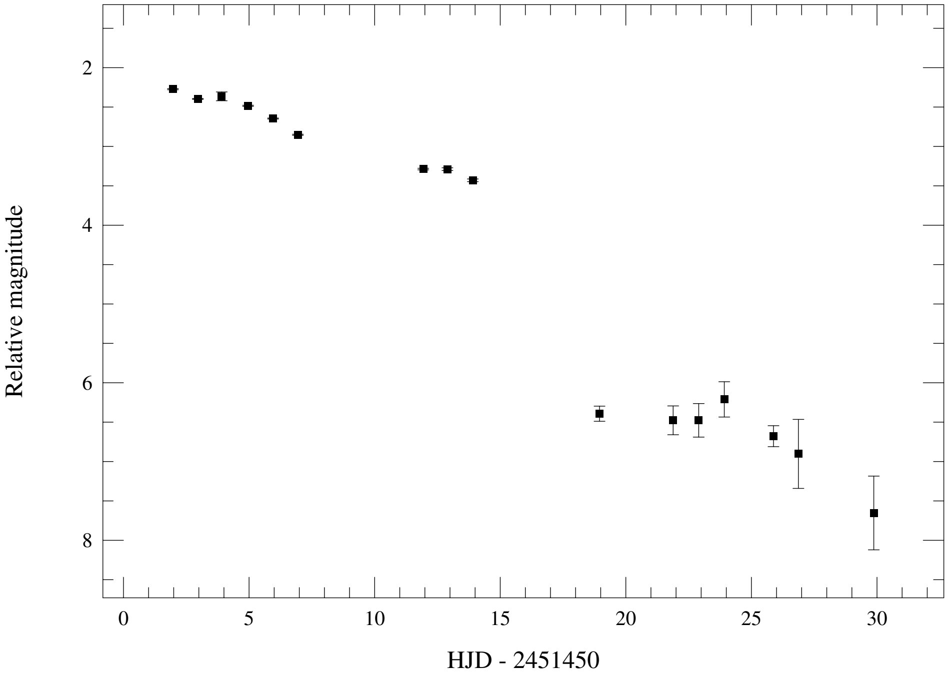

Figure 1. Overall light curve of V844 Her

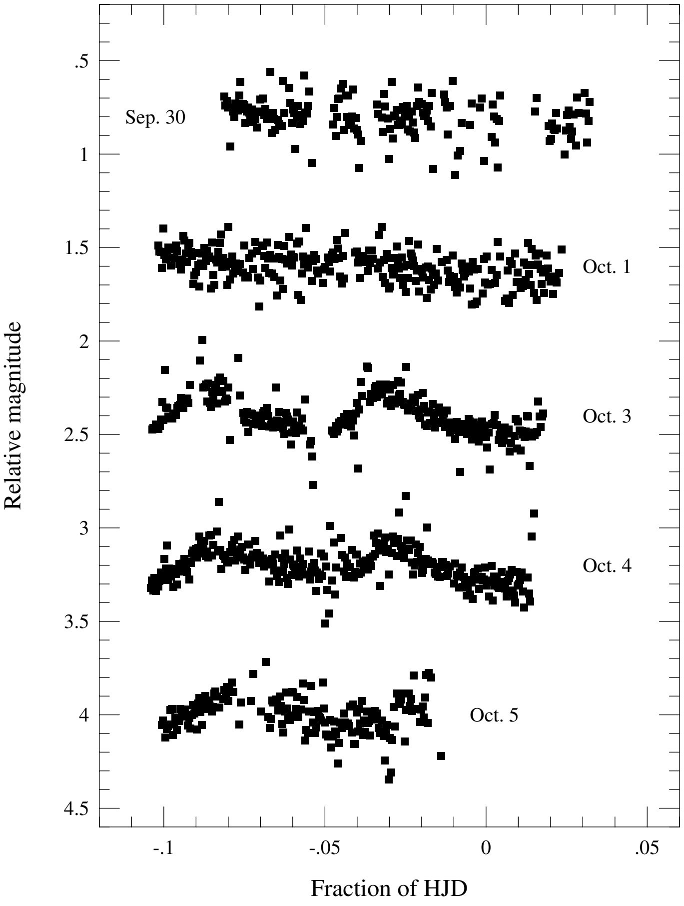

Figure 2. Period analysis of V844 Her

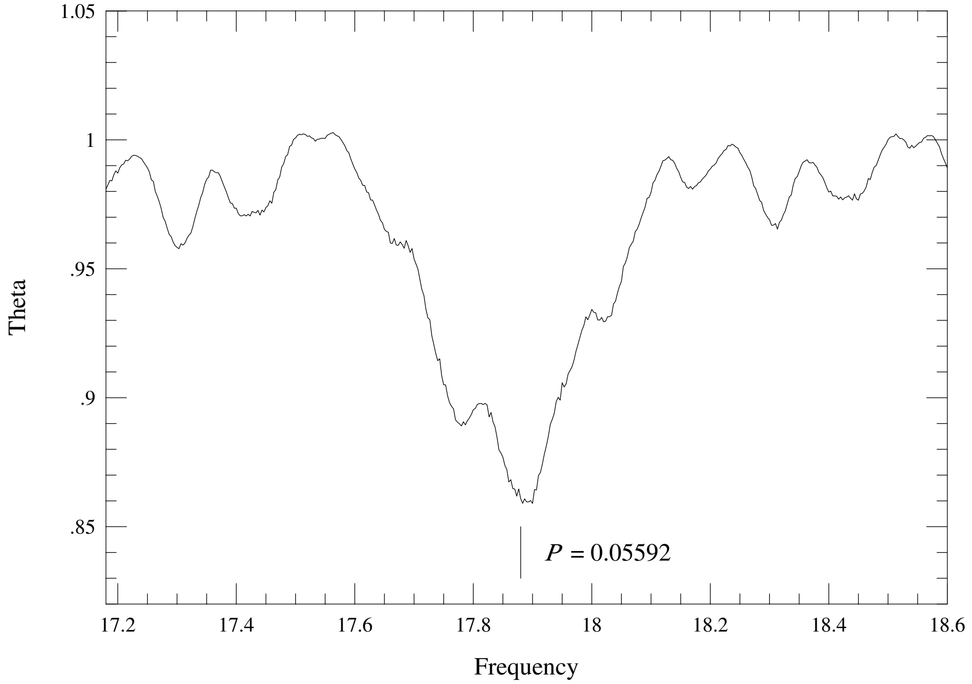

Figure 3. Development of superhumps in V844 Her

The result of period analysis is given in Figure 3. Although unavoidable one-day aliases exist, we can safely choose, with the help of previous period determinations, the correct period of 0.05592 ± 0.00002 d, corresponding to the frequency of 17.88 d^{-1}. The present best period agrees with the previously determined period (Vanmunster 1997; Patterson 1998). The analysis for the period October 1–3 yielded practically the same period (0.0559 ± 0.0001 d), which indicates the absence of a remarkable period change during the superhump growth.

Besides superhumps, we examined the post-superoutburst behavior, during which some SU UMa-type dwarf novae, especially systems with short orbital systems (Kato et al. 1998), are known to show rebrightenings. No evidence of rebrightening was observed, both in our CCD monitoring until 15 d past the steep decline, and visual monitoring reported to VSNET.

Aside from V485 Cen, almost all of SU UMa-type dwarf novae with the shortest superhump (orbital) periods belong either to what is called WZ Sge-type dwarf novae (Bailey 1979; Downes, Margon 1981; O'Donoghue et al. 1991) and ER UMa-type dwarf novae (for a review, see Kato et al. 1999). The former category contains WZ Sge, AL Com, HV Vir, EG Cnc, and related members LL And, SW UMa, WX Cet and T Leo. The latter group contains DI UMa and RZ LMi. From available photometric materials (Antipin (1996) and observations to VSNET), long and bright outbursts (presumably superoutbursts) are separated by 220–290 d, without detectable normal outbursts. Such a low frequency of normal outbursts resembles that of SW UMa, another SU UMa-type dwarf nova with a short orbital period, but the relatively regular occurrence of superoutbursts in V844 Her makes a slight difference. It may be that V844 Her occupies a previously unknown extension of WZ Sge-type dwarf novae toward the short recurrence period.

The authors are grateful to all observers who reported observations to VSNET, and especially to Hazel McGee who timely notified the outburst detection.

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THE NEW BIGHT RR Lyr NSV 01470

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Name of the object:
GSC 4068_447 = NSV 01470 = CSV 006077 = BV 0311

Equatorial coordinates:	**Equinox:**
R.A.= $04^h09^m40^s$ **DEC.=** $+62^\circ27'12''$	2000.0

Observatory and telescope:
Monegrillo Observatory, 0.4-m Newtonian telescope; Esteve Duran Observatory, 0.6-m Cassegrain telescope

Detector:	CCD

Filter(s):	V and B

Comparison star(s):	GSC 4068_1369

Check star(s):	GSC 4068_472; GSC 4068_1431

Transformed to a standard system:	No

Availability of the data:
Upon request

Type of variability:	RRab

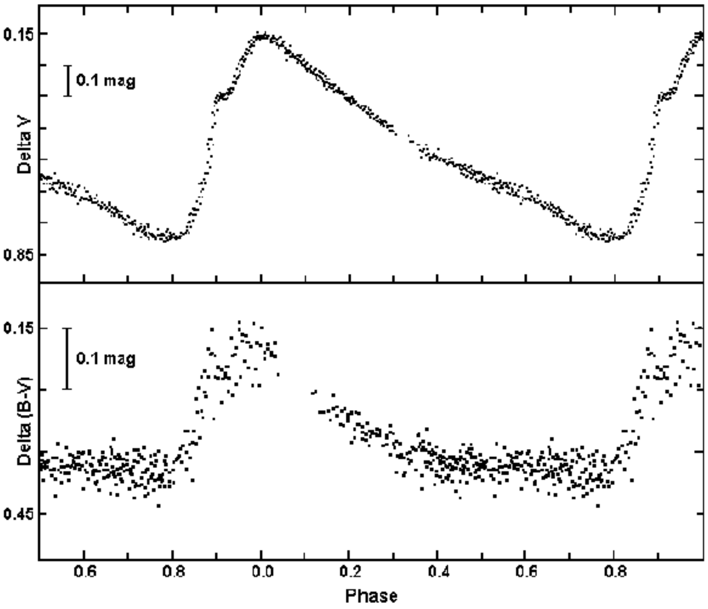

Figure 1.

Remarks:

Its variability was initially reported by Strohmeier and Knigge (1960), who indicated that this star presented rapid light changes between the photographic magnitudes of 11.8 and 12.5. This object was afterwards listed as an 'S' type variable in the NSV catalogue (Kholopov 1982). Observations performed in the *B* and *V* bands between December 1999 and March 2000 indicate that this object is an RRab Lyrae star. Although no photometric standarization was performed, previous collaborative work with the USNO Flagstaff station (Henden et al. 1999, Henden and Vidal 1997) showed that differential photometry performed at Monegrillo and Esteve Duran Observatories are virtually on the Johnson standard system, therefore we can estimate the standard amplitude in *V* and of the color index $B-V$ after using the derived Johnson *V* and $B-V$ magnitudes from the TYCHO photometric data for the comparison star. These results indicate that *V* light changes of NSV 01470 are within $11\overset{\text{m}}{.}10$ and $11\overset{\text{m}}{.}75$, and that the $B-V$ color index ranges between $0\overset{\text{m}}{.}75$ and $0\overset{\text{m}}{.}95$. The following ephemeris was computed in the *V* band:

$$\begin{array}{l} \text{Max.} = \text{HJD } 2451578.480 + 0\overset{\text{d}}{.}572092 \times E. \\ \qquad\qquad\qquad \pm 0.010 \pm 0.000100 \end{array}$$

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CI AQUILAE IN 1917

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The 1917 outburst of CI Aquilae, a possible nova, is known from a single observation (Reinmuth 1925). The maximum of the current outburst was much brighter than Reinmuth's estimate of approximately magnitude 11 ptg (blue). To obtain a more complete record of the 1917 event, I examined the Harvard College Observatory patrol plates for the year 1917. The following estimates were made using Tycho B magnitudes for nearby comparison stars.

HJD (2421000 +)	Mag. (BT)
364.749	<10.5
366.805	10.0
368.768	8.6
369.730	8.6
374.786	9.6
379.733	9.9
393.754	11.3
397.751	11.5
403.722	11.7

CI Aql was invisible, fainter than 10.5 and usually less than 11.4, for all earlier and later dates during 1917.

I am grateful to Martha Hazen, curator of astronomical photographs at HCO, for access to the patrol plates and to Kerriann Malatesta of the AAVSO technical staff for preparing this note for publication.

Reference:

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COORDINATES AND IDENTIFICATIONS FOR SONNEBERG VARIABLES ON MVS 301–308

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The list below is a continuation of a series providing accurate positions and identifications for variables appearing on the *MVS* charts (Hoffmeister 1957). The variables here were first described by Hoffmeister (1949). Details about the identification procedure and table layout are contained in the first report of our series (Kinnunen & Skiff 2000). The USNO-Flagstaff PMM pixel-server (Levine 2000) was again useful in making several identifications.

Table 1: Variables on *MVS* 301–308

Sonne.	GCVS	RA (2000)	Dec	s	GSC	IRAS
S 4256	HS Lyr	$18^\mathrm{h}14^\mathrm{m}31\overset{\mathrm{s}}{.}78$	$+41^\circ10'55\overset{''}{.}6$	A		
S 4257	HV Lyr	18 16 30.75	+31 06 17.3	A		
S 4258	HW Lyr	18 16 09.21	+40 42 43.9	A		
	TX Lyr*	18 16 25.25	+40 41 36.0	G	3107-1896	18148+4040
S 4259	HY Lyr	18 17 44.04	+31 37 43.3	G	2622-1017	
S 4260	HZ Lyr	18 18 05.11	+36 15 12.7	A		
S 4261	II Lyr	18 17 55.04	+38 33 04.2	T	3103-1468	18162+3831
S 4262	IK Lyr	18 18 51.11	+32 36 14.1	A		
S 4263	IL Lyr*	18 19 01.34	+35 26 04.8	A		
S 4264	IN Lyr*	18 18 59.42	+41 12 33.7	G	3107-0156	
S 4265	IP Lyr	18 23 24.37	+33 11 07.0	G	2627-1399	
S 4266	IQ Lyr	18 23 48.53	+32 43 22.4	A		
S 4267	IR Lyr	18 23 53.50	+39 18 57.7	A		
S 4268	IY Lyr	18 29 40.78	+31 00 00.7	G	2624-0524	
S 4269	KK Lyr	18 30 07.61	+34 18 00.9	A		
S 4270	IZ Lyr	18 29 42.18	+39 45 12.2	A		
S 4271	KQ Lyr	18 31 10.67	+31 53 17.2	G	2628-0556	
S 4272	KO Lyr	18 30 46.27	+38 20 17.0	A		
S 4273	KM Lyr*	18 30 29.72	+40 18 15.7	G	3109-2360	
S 4274	KS Lyr	18 32 11.70	+33 17 40.8	A		
S 4275	KU Lyr	18 33 03.30	+35 57 56.7	A		

Table 1: Variables on *MVS* 301–308 (cont'd.)

Sonne.	GCVS	RA (2000)	Dec	s	GSC	IRAS
S 4276	KV Lyr*	$18^{\mathrm{h}}33^{\mathrm{m}}14\overset{\mathrm{s}}{.}6$	$+35^{\circ}30'12''$	S		
S 4277	KW Lyr	18 33 39.64	+33 23 42.3	G	2628-0873	18318+3321
S 4278	KX Lyr*	18 33 15.22	+40 10 22.6	G	3109-1663	
S 4279	LN Lyr	18 36 28.31	+36 11 44.9	A		
S 4280	LO Lyr	18 37 07.29	+40 02 47.6	A		
S 4281	LQ Lyr	18 38 29.70	+39 30 04.4	G	3109-1996	
S 4282	LT Lyr	18 39 34.46	+31 45 43.5	G	2637-0230	
S 4283	LR Lyr	18 38 54.30	+40 24 50.4	G	3109-1110	
S 4284	LS Lyr	18 39 32.84	+35 03 15.2	A		
S 4285	LU Lyr	18 39 46.64	+34 33 41.5	G	2645-1153	
S 4286	LV Lyr	18 40 17.33	+34 40 13.0	G	2645-1411	
S 4287	LW Lyr	18 40 43.01	+35 09 19.5	A		
S 4288	LY Lyr	18 40 46.68	+35 35 09.0	G	2645-0607	
S 4289	LX Lyr	18 40 23.33	+41 02 23.4	G	3122-0187	
S 4290	LZ Lyr	18 41 26.23	+32 58 47.4	T	2641-1446	
S 4291	MM Lyr	18 42 37.29	+32 35 51.1	A		
S 4292	MN Lyr	18 42 38.04	+35 04 55.2	G	2645-0738	
S 4293	MO Lyr	18 42 53.41	+37 24 07.4	A		
S 4294	MR Lyr	18 43 41.38	+37 43 31.6	A		
S 4295	MP Lyr	18 43 26.02	+40 50 33.6	G	3122-1943	
S 4296	MS Lyr	18 46 50.95	+40 06 35.5	A		
S 4297	V916 Oph	18 22 49.50	+04 07 55.4	T	0441-1797	
S 4298	V883 Oph	18 22 37.82	+06 37 45.1	A		
S 4299	V884 Oph	18 22 47.43	+09 52 05.2	A		
S 4300	V885 Oph	18 23 01.02	+08 33 32.1	G	1023-1628	
S 4301	V917 Oph	18 23 22.98	+11 38 31.3	G	1031-1401	
S 4302	V886 Oph	18 24 15.07	+09 59 32.1	A		
S 4303	V887 Oph	18 24 24.31	+09 59 57.5	G	1027-1320	18220+0958
S 4304	V888 Oph	18 24 32.10	+10 51 17.8	A		
S 4305	V918 Oph	18 25 04.48	+10 33 23.8	G	1027-1683	
S 4306	V889 Oph*	18 26 25.77	+10 20 59.0	A		
S 4307	V890 Oph	18 26 29.54	+09 06 59.9	A		
S 4308	V919 Oph*	18 27 03.46	+07 27 31.4	A		
S 4309	V2040 Oph*	18 27 30.77	+10 09 21.0	A		
S 4310	V355 Her	18 27 21.01	+13 10 09.1	A		
S 4311	V891 Oph	18 27 51.90	+07 17 41.3	A		
S 4312	V920 Oph	18 28 20.23	+08 30 05.6	A		
S 4313	DM Ser	18 28 45.26	+05 14 09.1	A		
S 4314	V892 Oph	18 29 50.29	+08 56 24.8	A		
S 4315	V2041 Oph	18 30 41.44	+09 37 40.3	A		
S 4316	V893 Oph	18 31 30.37	+07 31 37.4	A		
S 4317	V921 Oph	18 31 46.12	+08 33 49.1	A		
S 4318	V922 Oph	18 32 08.57	+08 32 41.2	A		
S 4319	V923 Oph	18 32 13.87	+08 22 11.0	A		
S 4320	NSV 10993	18 32 13.00	+12 17 04.2	G	1032-1378	
S 4321	V2042 Oph	18 32 46.98	+07 58 06.1	A		
S 4322	V894 Oph	18 32 45.54	+11 43 26.3	A		18304+1141
S 4323	V2091 Oph	18 33 26.96	+06 33 46.3	A		

Table 1: Variables on *MVS* 301–308 (cont'd.)

Sonne.	GCVS	RA (2000)	Dec	s	GSC	IRAS
S 4324	V924 Oph	18$^{\rm h}$33$^{\rm m}$28$^{\rm s}$.29	+07°57′50″.8	A		
S 4325	V633 Her	18 33 22.84	+13 22 22.9	A		
S 4326	V851 Oph	18 34 51.97	+07 04 02.6	T	0458-0341	
S 4327	DN Ser	18 35 12.49	+06 15 10.0	A		
S 4328	V925 Oph	18 35 23.70	+06 27 36.1	T	0458-0515	
S 4329	V895 Oph	18 35 46.92	+11 56 47.4	G	1032-1555	
S 4330	V926 Oph	18 36 10.34	+06 52 58.5	G	0458-0764	
S 4331	V896 Oph	18 36 33.9	+06 43 28	S		18341+0640
S 4332	V897 Oph	18 37 08.14	+09 01 58.4	G	1024-0879	18347+0859
S 4333	V2094 Oph	18 38 02.75	+07 38 37.3	A		
S 4334	V927 Oph*	18 38 17.38	+06 52 17.2	G	0459-0616	
S 4335	V898 Oph	18 58 29.58	+07 05 15.8	A		
S 4336	V899 Oph	18 39 32.78	+07 47 51.7	A		
S 4337	NSV 11196	18 40 38.48	+08 53 57.8	A		
S 4338	V928 Oph	18 40 28.93	+12 04 01.4	A		
S 4339	V929 Oph	18 40 56.37	+08 17 50.7	A		18385+0814
S 4340	V900 Oph*	18 41 11.46	+07 56 00.5	A		
S 4341	V930 Oph	18 41 45.68	+12 02 11.4	G	1033-0862	
	DE Ser*	18 42 23.03	+04 37 19.1	G	0455-1330	
S 4342	V356 Her*	18 41 59.32	+13 07 54.3	A		18396+1304
S 4343	QW Her*	18 42 09.59	+13 19 59.7	A		18398+1317
S 4344	V902 Oph	18 42 52.52	+10 09 00.3	A		
S 4345	V901 Oph	18 42 49.40	+11 43 46.6	A		
S 4346	NSV 11278	18 44 13.59	+10 40 28.6	A		
S 4347	DQ Ser*	18 44 39.63	+05 02 49.4	G	0455-2618	
S 4348	V931 Oph	18 44 23.94	+10 37 24.5	A		
S 4349	NSV 11281	18 44 19.84	+11 43 39.4	A		
S 4350	V357 Her	18 44 31.80	+12 55 32.2	A		
S 4351	QX Her*	18 44 41.09	+12 13 45.2	A		
S 4352	V672 Her	18 44 53.91	+13 41 16.4	A		
S 4353	V903 Oph*	18 45 10.2	+10 37 17	S		
S 4354	V874 Aql*	18 45 41.09	+09 38 38.9	A		
S 4355	V1181 Aql	18 46 16.94	+10 31 02.6	A		
S 4356	QY Her	18 46 09.66	+12 37 50.1	G	1034-2295	
S 4357	V875 Aql	18 46 39.54	+11 57 24.5	A		
S 4358	DR Ser	18 47 21.02	+05 27 18.7	G	0456-0004	
S 4359	V795 Aql	18 47 06.88	+11 40 11.5	A		
S 4360	V358 Her	18 47 07.26	+13 06 46.2	G	1034-1727	
S 4361	V876 Aql	18 47 16.67	+10 36 48.9	A		18449+1033
S 4362	V877 Aql*	18 49 12.5	+09 44 19	S		
S 4363	V796 Aql	18 49 17.95	+11 27 40.7	A		
S 4364	V878 Aql	18 50 05.98	+07 06 20.0	T	0460-0623	
S 4365	V797 Aql	18 49 56.83	+11 27 43.3	A		18476+1124
S 4366	V879 Aql	18 49 58.57	+10 58 52.6	G	1030-3758	
S 4367	V880 Aql	18 49 59.53	+11 25 30.3	A		
S 4368	QZ Her	18 51 37.82	+12 09 50.3	A		
S 4369	NSV 11441	18 52 03.70	+11 17 25.5	G	1034-0184	
S 4370	V881 Aql	18 52 26.96	+07 58 57.8	G	1026-1475	
S 4371	V798 Aql*	18 53 01.9	+09 46 58	S		

Table 1: Variables on *MVS* 301–308 (cont'd.)

Sonne.	GCVS	RA (2000)	Dec	s	GSC	IRAS
S 4372	V335 Her	$18^{\mathrm{h}}53^{\mathrm{m}}07\overset{\mathrm{s}}{.}32$	$+13^{\circ}18'38\overset{\prime\prime}{.}9$	G	1038-0315	
S 4373	V883 Aql	18 55 51.01	+09 29 15.5	G	1043-0770	
S 4374	V884 Aql	18 55 54.01	+11 13 29.9	G	1043-0875	18535+1109
S 4375	V1183 Aql	18 55 56.49	+12 00 05.2	A		
S 4376	V800 Aql	18 56 32.40	+10 48 42.2	G	1043-2047	
S 4377	V1313 Aql	18 57 24.18	+10 42 33.6	A		
S 4378	V1184 Aql	18 59 14.32	+10 22 30.3	A		
S 4379	V887 Aql*	19 00 19.00	+13 44 39.3	G	1051-1084	
S 4380	V888 Aql	19 01 37.51	+11 38 00.2	G	1048-0362	
S 4381	V806 Aql	19 05 40.49	+08 02 56.3	G	1040-0989	19032+0758
S 4382	V1110 Aql	19 06 17.12	+03 19 08.9	G	0466-2772	
S 4383	V810 Aql	19 09 48.79	+01 12 59.5	A		
S 4384	V811 Aql*	19 12 49.17	–00 23 29.4	A		
S 4385	V846 Aql*	19 13 36.37	–01 55 00.6	A		19110–0200
S 4386	NSV 11829	19 13 58.98	+00 53 59.5	A		
S 4387	V1200 Aql*	19 15 56.57	+00 48 46.1	A		19133+0043
S 4388	V812 Aql*	19 18 54.1	+04 17 36	S		
S 4389	V1317 Aql	19 18 55.28	+08 00 11.1	A		
S 4390	V1205 Aql	19 19 20.20	+02 42 11.9	A		
S 4391	V869 Aql*	19 19 41.79	–01 26 08.6	A		
S 4392	V847 Aql	19 19 49.0	+02 01 56	S		
S 4393	V813 Aql*	19 20 07.2	+02 55 59	S		
S 4394	V814 Aql*	19 20 54.6	–01 02 13	S		19183–0107
S 4395	V817 Aql	19 23 01.28	+08 12 43.1	A		
S 4396	V850 Aql*	19 23 34.6	+00 38 00	S		
S 4397	V818 Aql*	19 23 28.26	+03 19 40.1	G	0469-1529	
S 4398	V851 Aql	19 24 00.79	+01 21 25.3	A		
S 4399	NSV 11983	19 24 12.18	+03 08 37.7	G	0469-0399	
S 4400	V1129 Aql	19 24 57.16	+05 54 43.9	A		
S 4401	V852 Aql	19 25 43.22	–00 17 18.2	G	5131-0761	
S 4402	V819 Aql*	19 26 07.6	+07 42 49	S		
S 4403	V853 Aql	19 28 07.63	+01 44 36.7	A		
S 4404	V854 Aql	19 28 27.36	+02 06 53.5	A		
S 4405	V857 Aql	19 28 41.85	+03 54 00.9	G	0473-2504	
	V820 Aql*	19 28 59.18	–01 51 33.7	A		
S 4406	V1236 Aql	19 28 40.07	+06 44 10.0	A		
S 4407	V1338 Aql*	19 29 28.6	+03 30 38	S		
S 4408	V921 Aql	19 30 19.87	–01 35 17.3	A		
S 4409	V821 Aql	19 30 15.9	+05 07 29	S		19277+0501
S 4410	V922 Aql	19 30 29.14	+01 13 05.0	A		
	V859 Aql*	19 31 01.22	+05 23 53.5	T	0486-0666	
S 4411	V978 Aql	19 31 31.63	+02 12 57.1	A		
S 4412	V1248 Aql*	19 31 36.1	+05 08 37	S		
S 4413	V860 Aql	19 33 34.2	+04 13 07	S		
S 4414	V861 Aql	19 33 58.72	+04 09 53.4	G	0486-5066	
S 4415	V823 Aql	19 34 24.33	+05 39 19.0	A		
S 4416	V824 Aql	19 35 19.59	+03 39 13.0	A		
S 4417	V990 Aql	19 35 23.64	+04 10 45.1	A		

Table 1: Variables on *MVS* 301–308 (cont'd.)

Sonne.	GCVS	RA (2000)	Dec	s	GSC	IRAS
S 4418	V862 Aql	$19^{\rm h}35^{\rm m}42\overset{\rm s}{.}69$	$-00^\circ11'58\overset{''}{.}1$	A		19331–0018
S 4419	V863 Aql	19 35 39.35	+07 55 56.9	G	1056-3367	
S 4420	V997 Aql	19 37 23.28	+05 35 55.1	G	0486-2942	
S 4421	NSV 12215	19 37 44.00	+01 49 35.8	T	0479-0823	
S 4422	V825 Aql	19 38 28.92	+04 02 57.7	G	0487-2364	19360+0356
S 4423	V826 Aql	19 38 27.85	+06 24 59.6	A		19360+0618
S 4424	V1000 Aql	19 38 27.83	+06 02 45.1	A		
	V601 Aql*	19 40 06.53	–00 20 46.1	A		
S 4425	V1018 Aql*	19 42 55.01	+00 39 47.6	A		
S 4426	V1144 Cyg	19 39 27.11	+55 31 26.7	A		
S 4427	V754 Cyg	19 42 49.75	+51 52 50.8	G	3569-0766	19415+5145
S 4428	V697 Cyg	19 49 15.74	+52 47 06.2	T	3935-2213	
S 4429	V765 Cyg	20 10 41.29	+54 03 15.9	G	3936-0705	
	V1369 Cyg*	20 11 09.92	+51 36 56.9	G	3571-2151	
S 4430	V766 Cyg	20 13 09.06	+57 45 03.5	G	3944-0074	
S 4431	V559 Cyg	20 15 53.9	+51 51 38	S		
S 4432	V768 Cyg	20 16 43.79	+55 56 03.7	A		
S 4433	V769 Cyg	20 18 45.44	+53 31 24.3	G	3937-1130	
S 4434	V560 Cyg	20 19 04.85	+59 43 22.6	A		20181+5934
S 4435	NSV 13032*	20 20 29.46	+53 51 33.1	G	3937-0770	
S 4436	V774 Cyg	20 31 01.67	+57 10 14.0	A		20298+5659
S 4437	V775 Cyg	20 31 48.47	+59 32 01.3	A		
S 4438	NSV 13255	20 42 02.78	+58 55 20.9	A		20408+5844
	DE Cep*	20 48 20.20	+59 09 55.6	G	3963-0573	
	DR Cep*	20 49 05.59	+58 53 57.2	G	3963-1024	
S 4439	NSV 13466*					
S 4440	V1320 Aql	19 44 06.17	+01 57 46.3	A		19415+0150
S 4441	V891 Aql*	19 44 10.8	+00 18 27	S		
S 4442	V892 Aql	19 44 21.99	+02 03 12.1	A		
S 4443	V1321 Aql	19 47 47.04	+04 34 42.8	G	0488-2961	19452+0427
S 4444	V893 Aql	19 49 31.86	–02 16 30.2	A		19469–0224
S 4445	V831 Aql	19 50 47.55	–03 36 58.0	A		
S 4446	V832 Aql	19 51 24.26	+04 20 05.9	A		
S 4447	V894 Aql	19 52 35.75	+04 19 04.1	A		
S 4448	V1325 Aql*	19 53 00.5	+04 25 01	S		
S 4449	V895 Aql	19 54 48.34	+04 29 46.3	G	0489-0705	
S 4450	NSV 12552*	19 55 13.48	–02 06 23.4	A		
S 4451	V833 Aql	19 55 54.20	+04 35 30.2	G	0489-2997	
S 4452	V896 Aql	19 56 57.75	+01 31 47.8	A		
S 4453	V897 Aql	19 57 40.63	–02 28 36.8	A		
S 4454	NSV 12609	19 57 53.25	+01 28 56.4	G	0481-2767	
S 4455	V898 Aql	19 59 04.38	–01 55 21.1	G	5151-0069	
S 4456	NSV 12673	20 00 36.65	–01 42 16.5	G	5160-0572	19580–0150
S 4457	V899 Aql	20 01 29.44	+04 25 36.4	G	0502-2709	19590+0417
S 4458	V900 Aql	20 03 25.00	–05 09 14.7	A		
S 4459	V901 Aql	20 05 11.87	–02 39 59.4	G	5164-1036	
S 4460	V902 Aql	20 05 30.84	+04 27 12.8	T	0502-1084	
S 4461	V903 Aql	20 08 22.09	–05 21 19.4	A		
S 4462	V834 Aql	20 09 53.84	+03 41 18.0	G	0499-2526	20073+0332

Table 1: Variables on *MVS* 301–308 (cont'd.)

Sonne.	GCVS	RA (2000)	Dec	s	GSC	IRAS
S 4463	V835 Aql	$20^{h}10^{m}15^{s}.40$	$–05^{\circ}42'59''.5$	G	5173-0870	
S 4464	V904 Aql	20 10 09.66	–00 03 09.1	A		
S 4465	V905 Aql	20 10 15.25	+01 34 18.3	A		
S 4466	V1329 Aql	20 10 45.29	+02 22 44.0	G	0499-2561	
S 4467	V836 Aql	20 12 49.94	–04 36 08.0	G	5169-1392	
S 4468	V906 Aql	20 12 56.13	+04 32 08.2	A		
S 4469	V907 Aql	20 14 42.08	+00 49 37.1	A		
S 4470	V908 Aql	20 18 32.36	+00 42 29.0	A		
S 4471	V909 Aql*	20 21 59.40	–04 41 49.4	G	5170-0660	
S 4472	V910 Aql	20 23 11.69	–01 33 57.5	G	5163-1964	
S 4473	NSV 13052	20 23 47.60	–03 51 40.9	G	5171-0505	20211–0401
S 4474	V911 Aql	20 23 47.30	+03 36 49.8	A		
S 4475	EQ Vul	19 58 23.20	+28 01 08.4	T	2149-1476	
	DG Vul*	19 58 40.17	+27 41 01.5	T	2149-1732	
S 4476	V1020 Cyg	19 59 09.05	+32 41 43.7	G	2674-3525	
S 4477	NSV 12703*	20 01 33.63	+28 14 08.8	G	2153-1109	
S 4478	V719 Cyg	20 03 38.53	+30 28 09.2	G	2670-4596	
S 4479	V486 Cyg	20 05 03.37	+34 42 49.1	A		
S 4480	V551 Cyg	20 06 06.89	+30 18 56.0	A		20041+3010
S 4481	V553 Cyg	20 06 23.04	+34 25 53.1	A		
S 4482	V725 Cyg	20 08 05.66	+30 45 02.0	G	2671-1881	
S 4483	NSV 12945	20 14 39.72	+35 39 14.8	G	2683-3724	
S 4484	NSV 12995*	20 18 49.9	+27 15 38	S		
	DT Vul*	20 25 09.00	+26 48 47.0	A		20230+2639
S 4485	V727 Cyg	20 25 49.62	+31 26 05.6	A		20238+3116
S 4486	EG Vul	20 26 59.78	+26 11 59.1	A		
S 4487	V562 Cyg*	20 27 37.14	+35 33 17.1	A		20256+3523
S 4488	EI Vul	20 28 32.60	+25 53 32.3	A		20263+2543
S 4489	DU Vul	20 30 41.79	+28 12 34.2	A		20285+2802
S 4490	V565 Cyg	20 33 12.38	+29 48 35.6	A		20311+2938
S 4491	EK Vul	20 35 25.81	+27 44 25.7	G	2165-1387	
S 4492	EL Vul	20 35 42.37	+25 29 12.2	G	2161-1307	20335+2518
	EM Vul*	20 39 35.79	+25 31 25.6	G	2174-0389	
S 4493	DW Vul	20 40 33.28	+27 04 42.2	A		
S 4494	EN Vul	20 42 21.79	+27 28 47.6	G	2178-0679	
S 4495	V571 Cyg*	20 44 43.82	+30 02 14.5	A		20426+2951
S 4496	V570 Cyg	20 44 31.47	+32 29 32.5	A		
S 4497	EW Del	20 16 31.16	+15 41 57.4	A		
S 4498	EX Del	20 16 58.35	+15 52 52.8	A		
S 4499	EY Del	20 17 30.00	+13 42 45.1	G	1085-0272	20151+1333
S 4500	EN Del*	20 18 01.67	+13 22 29.0	A		
S 4501	DF Sge*	20 17 55.6	+18 43 51	S		
S 4502	FU Del	20 19 53.99	+11 38 00.6	G	1082-0828	
S 4503	NSV 13017	20 20 15.56	+10 37 59.9	A		
S 4504	FV Del*	20 21 46.22	+14 07 49.6	G	1086-2036	
S 4505	EZ Del	20 25 22.49	+15 46 00.9	A		
S 4506	FG Del	20 28 25.40	+12 20 19.6	A		

Table 1: Variables on *MVS* 301–308 (cont'd.)

Sonne.	GCVS	RA (2000)	Dec	s	GSC	IRAS
S 4507	FH Del	$20^h28^m12^s.27$	$+19^\circ26'22''.2$	A		
S 4508	FI Del	20 29 16.34	+14 45 59.6	A		
S 4509	FK Del	20 30 19.90	+12 26 12.0	A		
S 4510	FL Del	20 31 27.97	+14 59 58.0	A		
S 4511	FM Del	20 33 44.26	+16 16 17.5	G	1633-1936	
S 4512	FN Del*	20 34 27.02	+15 05 08.6	A		
S 4513	EO Del	20 37 47.73	+18 55 31.3	A		
S 4514	EQ Del	20 39 40.44	+12 26 09.8	A		
S 4515	FY Del	20 39 58.34	+12 26 21.4	A		
	EP Del*	20 39 27.67	+19 44 51.6	G	1641-0130	20372+1934
S 4516	FO Del	20 40 47.68	+10 18 38.1	G	1092-0616	
S 4517	FP Del	20 43 10.43	+10 53 05.9	A		
S 4518	ES Del	20 43 58.30	+19 14 17.2	G	1642-0636	
S 4519	FQ Del	20 44 50.84	+18 53 37.2	A		
S 4520	FR Del	20 55 13.01	+11 37 42.0	G	1098-0472	
S 4521	FS Del	20 56 14.73	+16 40 19.4	A		
S 4522	FT Del	20 56 29.63	+16 23 46.9	A		
	EM Del*	20 57 28.65	+10 02 33.2	G	1107-0963	

Notes:

V601 Aql	SV* R 318.
V798 Aql	GCVS 4.2 (Dec 1999 version) gives position for wrong star.
V811 Aql	GCVS 4.1 position $3'.6$ in error.
V812 Aql	northeastern component of a close pair in a small trio; GSC/USNO-A2.0 positions skewed.
V813 Aql	variable on POSS-I/II red plates.
V814 Aql	companion $7''$ southwest.
V818 Aql	another similarly-bright red star $10''$ southeast.
V819 Aql	brighter companion $10''$ northeast.
V820 Aql	SV* R 314.
V846 Aql	GCVS 4.1 position $4'.2$ in error.
V850 Aql	faint on POSS-I.
V859 Aql	AN 116.1935.
V869 Aql	GCVS 4.1 position $3'.7$ in error.
V874 Aql	C* 2655.
V877 Aql	southwestern component of a close double, USNO-A2.0 position skewed; a fainter but much redder star lies at end-figures $12^s.7/11''$; possibly both stars contribute to IRAS 18468+0940.
V887 Aql	southeastern star of a close pair; variable on POSS-I/II red plates.
V891 Aql	western star of small group; crowded.
V909 Aql	GCVS 4.1 position $3'.1$ in error.
V1018 Aql	northeastern star of a pair.
V1200 Aql	eastern star of a pair.
V1248 Aql	GCVS 4.2 (Dec 1999 version) gives position for wrong star.
V1325 Aql	northwestern component of a close pair; very bright on POSS-II IV-N plate. USNO-A2.0 position is for southeastern component.
V1338 Aql	eastern star of a close pair; USNO-A2.0 position skewed due to crowding.
DE Cep	AN 987.1935.
DR Cep	AN 988.1935.

Notes (cont'd.):

V562 Cyg	IRC +40421; southeastern star of a pair.
V571 Cyg	southern star of an $8''$ pair.
V1369 Cyg	AN 720.1933.
EM Del	SVS 400.
EN Del	near to, but outside position error-ellipse of IRAS 20157+1313.
EP Del	AN 388.1933.
FN Del	eastern star of a pair.
FV Del	*MVS* chart has wrong star marked.
QW Her	GCVS 4.1 position $3\overset{'}{.}0$ in error.
QX Her	crowded.
V356 Her	eastern component of close pair.
TX Lyr	AN 18.1913.
IL Lyr	GCVS 4.1 position $3\overset{'}{.}0$ in error.
IN Lyr	GCVS 4.1 position $3\overset{'}{.}4$ in error.
KM Lyr	southwestern star of two.
KV Lyr	northern component of a pair.
KX Lyr	BD+40°3411C.
V889 Oph	northwestern star of a pair.
V900 Oph	southern star of two.
V903 Oph	variable on POSS-I/II red plates.
V919 Oph	on northeastern side of a small group.
V927 Oph	southeastern component of a close pair.
V2040 Oph	western component of a close double; *MVS* chart distorted.
DF Sge	western component of a close double; USNO-A2.0 position skewed.
DE Ser	AN 489.1934.
DQ Ser	SS 417.
DG Vul	AN 655.1936.
DT Vul	AN 726.1933.
EM Vul	AN 732.1933.
NSV 12552	near to but outside position error-ellipse of IRAS 19526–0214.
NSV 12703	see note in Skiff (1999).
NSV 12995	western component of close pair.
NSV 13032	GCVS 4.1 position $3\overset{'}{.}0$ in error.
NSV 13466	not found; there must be some gross error in the source position.

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COORDINATES AND IDENTIFICATIONS FOR SONNEBERG VARIABLES ON MVS 308–316

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The list below is a continuation of a series providing accurate positions and identifications for variables appearing on the *MVS* charts (Hoffmeister 1957). The variables here were first described by Hoffmeister (1949). Details about the identification procedure and table layout are contained in the first report of our series (Kinnunen & Skiff 2000). Some stars in this list have accurate positions already reported by Shokin & Samus (1997) and by Yoshida *et al.* (1999). The USNO-Flagstaff PMM pixel-server (Levine 2000) was again useful in making several identifications.

Table 1: Variables on *MVS* 308–316

Sonne.	GCVS	RA (2000)	Dec	s	GSC	IRAS
S 4523	V502 Cyg	$20^{\mathrm{h}}26^{\mathrm{m}}28^{\mathrm{s}}.76$	$+42^{\circ}41'45''.3$	G	3160-0462	
S 4524	V503 Cyg	20 27 17.50	+43 41 24.8	A		
	V506 Cyg*	20 30 37.82	+44 55 35.1	G	3165-0182	
S 4525	V507 Cyg	20 31 04.49	+47 22 00.4	A		
S 4526	NSV 13146*	20 33 09.96	+48 32 26.8	A		
S 4527	V511 Cyg	20 43 18.02	+45 45 18.0	A		
S 4528	V510 Cyg	20 43 09.64	+48 58 45.4	A		
S 4529	V512 Cyg	20 44 43.68	+49 35 50.9	T	3582-0560	
S 4530	V516 Cyg	20 47 09.79	+41 55 26.8	A		
S 4531	V519 Cyg	20 51 51.45	+46 32 27.1	G	3575-2497	
S 4532	V521 Cyg*	20 58 23.83	+43 53 11.2	A		
S 4533	V1225 Cyg*	21 06 16.0	+46 18 03	S		21045+4605
S 4534	NSV 13539*	21 06 17.18	+46 18 05.6	T		
S 4535	V458 Cyg	21 08 07.29	+45 39 29.9	G	3588-6507	
S 4536	V526 Cyg	21 10 17.50	+45 56 10.0	G	3588-4438	
S 4537	V1664 Cyg*	21 11 09.45	+39 33 24.2	A		
S 4538	V528 Cyg	21 11 36.77	+41 51 39.7	G	3177-2886	
S 4539	V530 Cyg	21 12 09.57	+47 38 01.7	T	3593-2868	
S 4540	V572 Cyg	21 09 00.7	+41 12 03	S		

Table 1: Variables on *MVS* 308–316 (cont'd.)

Sonne.	GCVS	RA (2000)	Dec	s	GSC	IRAS
S 4541	V576 Cyg	$21^{\rm h}09^{\rm m}38\overset{\rm s}{.}82$	$+42^{\circ}17'39\overset{''}{.}4$	G	3176-0306	
S 4542	V579 Cyg	21 10 48.37	+44 10 45.6	T	3181-5031	
S 4543	NSV 13593	21 11 08.64	+47 10 05.9	T	3592-2060	
S 4544	V583 Cyg*	21 12 35.74	+48 03 56.9	G	3593-3223	
S 4545	V584 Cyg	21 13 40.63	+44 02 08.9	A		
S 4546	V591 Cyg	21 17 24.73	+46 11 22.5	T	3589-3299	
S 4547	V593 Cyg	21 19 09.87	+42 38 18.2	A		
S 4548	V731 Cyg*	21 20 36.31	+45 14 41.2	G	3589-7386	
S 4549	V605 Cyg	21 25 44.81	+47 42 44.2	G	3594-2346	
S 4550	V732 Cyg	21 27 59.24	+43 35 20.8	A		21260+4322
S 4551	V610 Cyg	21 29 07.29	+40 40 11.3	A		
	V611 Cyg*	21 29 22.23	+41 56 16.5	T	3190-1370	
S 4552	V615 Cyg	21 30 26.08	+50 09 19.6	A		
S 4553	V616 Cyg	21 30 33.90	+50 07 32.8	A		
S 4554	V628 Cyg	21 34 04.05	+47 14 22.0	G	3595-2084	
S 4555	V537 Cyg	21 34 01.19	+49 55 59.5	T	3599-0780	
S 4556	V630 Cyg*	21 34 59.22	+40 40 18.8	A		
S 4557	V631 Cyg	21 35 08.47	+43 51 41.3	A		
S 4558	V632 Cyg*	21 36 04.22	+40 26 19.4	A		
S 4559	V645 Cyg*	21 39 58.0	+50 14 24	S	3599-1758	21381+5000
S 4560	V654 Cyg	21 43 55.90	+44 46 43.0	G	3196-1116	
S 4561	V660 Cyg*	21 48 11.45	+41 02 41.4	A		
S 4562	V663 Cyg	21 48 31.51	+42 05 32.0	G	3192-0898	
S 4563	V668 Cyg	21 49 56.77	+40 56 31.8	A		21479+4042
S 4564	V669 Cyg	21 49 59.40	+45 03 45.2	G	3604-0490	
S 4565	V670 Cyg*	21 50 19.0	+42 46 22	S		21483+4232
S 4566	V672 Cyg	21 51 21.44	+44 39 50.4	A		
S 4567	V674 Cyg	21 51 27.61	+49 44 52.2	G	3612-1129	21495+4930
S 4568	V675 Cyg	21 51 57.93	+48 43 48.3	G	3608-0393	
S 4569	DL Lac*	21 58 37.16	+41 46 24.8	G	3193-0554	
S 4570	ET Lac	21 59 06.31	+41 03 56.1	G	3189-0410	21570+4049
S 4571	IK Cep	21 52 05.51	+56 45 48.1	G	3976-1073	21503+5631
S 4572	V1429 Cyg	21 55 06.22	+53 25 22.2	A		
S 4573	V1430 Cyg	21 56 06.90	+50 17 34.6	A		
	CP Cep*	21 57 52.69	+56 09 50.1	T	3972-0139	
	GN Cep*	21 59 52.27	+57 21 48.7	G	3976-0717	
S 4574	V1414 Cyg*	22 01 20.87	+47 36 04.6	A		
S 4575	MN Cep	22 04 25.72	+54 26 18.4	A		
S 4576	DM Lac	22 04 35.65	+52 53 58.8	A		
S 4577	HX Lac	22 06 08.26	+49 31 48.8	A		
S 4578	DN Lac	22 06 28.86	+51 10 53.9	A		22045+5056
S 4579	PT Lac	22 06 48.08	+51 40 10.8	A		
S 4580	DO Lac*	22 07 37.00	+47 44 40.0	G	3610-1569	22056+4729
S 4581	NSV 14046	22 08 44.26	+48 55 23.7	A		22067+4840
S 4582	MR Cep	22 11 16.49	+55 01 12.3	A		
S 4583	DP Lac*	22 14 53.4	+55 21 17	S		
S 4584	PZ Lac	22 15 57.44	+49 34 34.4	A		22139+4919
S 4585	QQ Lac	22 16 55.45	+50 05 23.0	T	3614-1765	22149+4950
S 4586	KU Lac	22 17 01.70	+55 10 38.2	A		
S 4587	NSV 14115	22 19 12.40	+49 20 06.4	A		

Table 1: Variables on *MVS* 308–316 (cont'd.)

Sonne.	GCVS	RA (2000)	Dec	s	GSC	IRAS
S 4588	NSV 14134	$22^{h}21^{m}40^{s}.74$	$+47^{\circ}31'41''.0$	G	3611-1909	
S 4589	QV Lac*	22 26 40.96	+49 44 59.0	A		
S 4590	DQ Lac	22 26 56.68	+56 49 39.2	A		22250+5634
S 4591	NO Lac	22 28 11.96	+53 56 11.9	A		
S 4592	NSV 14189*	22 31 03.66	+47 13 41.3	A		
S 4593	ES Lac	22 32 06.31	+53 57 32.8	T	3983-0386	
S 4594	V336 Lac	22 37 55.23	+55 14 32.6	A		
S 4595	DR Lac	22 39 22.67	+51 32 35.2	A		
S 4596	GK Lac	22 41 56.21	+50 28 00.3	T	3629-0431	
S 4597	FF Lac	22 43 22.43	+48 00 52.9	G	3625-1586	
S 4598	DT Lac	22 43 45.3	+52 15 21	S		
S 4599	EE Lac*	22 48 42.23	+52 17 11.9	A		
S 4600	FL Lac	22 49 50.34	+51 15 48.6	A		
S 4601	NSV 14252	22 37 17.44	+63 57 18.7	G	4273-0701	22355+6341
S 4602	DG Cep	22 44 11.11	+61 43 42.6	T	4265-0376	
S 4603	NSV 14333*	22 50 53.19	+61 45 58.0	G	4265-0106	
S 4604	IM Cep	23 13 10.91	+62 42 05.6	G	4283-0073	
S 4605	V399 Cas	23 22 25.23	+61 07 46.9	A		
S 4606	NSV 14247*	22 36 21.95	+53 05 19.2	A		
S 4607	EY Lac	22 41 48.28	+54 24 24.4	A		
S 4608	DF Cep*	22 42 55.42	+57 37 04.3	A		22409+5721
S 4609	FI Lac	22 45 03.76	+55 32 22.2	G	3988-0039	
S 4610	DV Lac	22 45 04.26	+56 37 18.8	T	3992-2086	22430+5621
	DW Lac*	22 46 34.02	+52 51 40.8	A		
S 4611	DX Lac	22 47 04.49	+52 21 29.9	A		22449+5205
S 4612	NSV 14318	22 47 08.36	+50 06 47.6	G	3629-2399	
S 4613	DY Lac	22 47 19.26	+53 59 06.6	A		
S 4614	DZ Lac	22 48 22.60	+49 11 59.9	A		22462+4856
S 4615	FR Lac	22 48 57.90	+54 12 35.6	A		
S 4616	NSV 14332	22 50 54.52	+48 39 24.2	G	3625-1048	
S 4617	EG Lac*	22 50 38.8	+55 14 52	S		
S 4618	FN Lac	22 51 33.46	+50 46 30.9	T	3633-0017	22494+5030
S 4619	FO Lac*	22 52 01.06	+50 58 09.3	G	3633-1309	22498+5042
S 4620	FS Lac	22 53 14.44	+47 58 06.8	A		
S 4621	FT Lac	22 54 27.56	+48 25 57.9	A		
S 4622	NSV 14365*	22 55 25.39	+52 17 09.2	A		
S 4623	V342 Cas	23 01 21.16	+57 52 01.4	G	3993-0763	
S 4624	KX Cas*	23 02 36.61	+57 55 11.3	A		
S 4625	KY Cas*	23 04 53.61	+53 15 47.2	A		
S 4626	BR And	23 05 15.81	+52 10 40.0	A		
S 4627	V344 Cas	23 07 35.12	+57 23 33.9	T	4006-1750	
S 4628	KZ Cas*	23 08 13.98	+56 27 17.5	A		
S 4629	CZ And	23 09 00.88	+49 36 51.3	G	3631-1623	
S 4630	NSV 14438	23 08 52.51	+52 41 32.1	A		
S 4631	V348 Cas*	23 11 25.7	+57 45 02	S		
S 4632	BS And	23 12 46.97	+51 52 25.8	A		
S 4633	LM Cas*	23 12 59.7	+56 51 20	S		
S 4634	V352 Cas	23 17 57.57	+53 44 25.4	G	3998-0908	23156+5328
S 4635	DF And	23 18 40.26	+48 11 21.4	T	3640-0047	23163+4754

Table 1: Variables on *MVS* 308–316 (cont'd.)

Sonne.	GCVS	RA (2000)	Dec	s	GSC	IRAS
S 4636	NSV 14547*	$23^{h}24^{m}39\overset{s}{.}65$	$+49^{\circ}36'00\overset{s}{.}9$	A		
S 4637	BV And*	23 27 02.08	+50 07 13.2	A		
S 4638	NSV 14573	23 27 19.63	+48 17 28.4	A		
S 4639	DK And	23 28 45.90	+50 34 29.2	G	3645-0701	
S 4640	V369 Cas	23 29 31.29	+52 30 38.6	A		
S 4641	DL And	23 29 47.02	+48 57 18.9	G	3645-1904	23273+4840
S 4642	V370 Cas	23 30 17.88	+50 50 08.8	G	3649-2069	
S 4643	V358 Cas	23 30 27.36	+57 58 33.8	G	4007-0414	
S 4644	V371 Cas	23 33 46.34	+53 37 15.4	A		
S 4645	V359 Cas*	23 34 27.13	+56 19 17.8	T	4008-1283	
S 4646	V360 Cas	23 34 47.58	+55 54 16.4	T	4004-0771	
S 4647	BM And	23 37 38.48	+48 24 12.0	G	3642-0171	
S 4648	V361 Cas	23 41 44.28	+56 09 52.5	T	4004-0633	
S 4649	NSV 14675	23 42 03.49	+52 08 46.7	A		
S 4650	LO Cas	23 43 01.51	+52 47 15.7	A		
S 4651	PW Cas	23 25 58.46	+61 16 00.6	G	4280-1499	
	V530 Cas*	23 30 44.11	+60 15 20.7	T	4280-1989	
S 4652	DY Cep	23 32 05.44	+64 00 53.6	T	4288-1103	
S 4653	PX Cas	23 34 02.31	+56 50 28.8	A		
S 4654	PY Cas*	23 43 43.53	+61 05 52.5	T	4281-2062	23413+6049
S 4655	KK Cas	23 49 56.03	+59 56 26.6	G	4013-1095	
S 4656	QR Cas	23 51 04.24	+55 41 48.8	A		
S 4657	QT Cas*	23 53 10.01	+62 38 01.7	G	4285-0878	
S 4658	QU Cas	23 54 25.57	+56 04 21.1	A		
S 4659	LP Cas	23 57 18.79	+54 52 51.1	A		23547+5436
S 4660	QW Cas	23 57 44.21	+56 56 46.0	T	4009-1351	23552+5640
S 4661	QV Cas*	23 57 22.02	+62 10 59.2	G	4285-2442	23548+6154
S 4662	QY Cas	23 59 05.15	+54 01 00.7	A		
S 4663	QZ Cas	23 59 40.95	+56 24 13.8	G	4009-1979	
S 4664	V335 Cas	23 59 38.50	+59 45 30.3	G	4013-0847	
S 4665	V336 Cas	0 01 00.40	+60 26 45.6	G	4014-1935	
S 4666	V362 Cas	0 02 21.46	+63 28 07.2	G	4018-1972	
S 4667	LQ Cas	0 04 10.96	+61 42 07.8	A		
S 4668	MQ Cas	0 09 37.54	+58 13 11.0	G	3664-0126	00070+5756
S 4669	MR Cas	0 11 42.02	+58 04 23.9	A		
S 4670	V337 Cas*	0 13 22.33	+58 12 33.5	G	3665-1130	
S 4671	MT Cas	0 14 43.69	+54 40 14.2	A		
S 4672	MU Cas	0 15 51.56	+60 25 53.6	T	4014-1119	
S 4673	MV Cas	0 16 37.73	+62 48 48.9	A		
S 4674	MW Cas*	0 16 49.4	+55 05 01	S	3657-1399	
S 4675	MX Cas	0 19 53.44	+55 01 03.2	A		
S 4676	MY Cas	0 21 06.89	+63 54 46.3	G	4023-0337	
S 4677	NN Cas*	0 22 20.0	+57 30 02	S		
S 4678	NO Cas	0 24 04.65	+61 20 30.0	T	4015-1454	
S 4679	NP Cas	0 23 57.66	+62 57 00.6	G	4019-1669	
S 4680	NQ Cas	0 24 34.87	+54 17 38.3	T	3653-0117	
S 4681	NR Cas	0 25 27.20	+56 05 08.5	T	3657-0001	
S 4682	NS Cas	0 30 57.09	+57 18 25.3	G	3662-1990	
S 4683	NT Cas	0 32 04.64	+55 27 21.1	A		
S 4684	NU Cas	0 32 24.65	+57 01 51.6	G	3662-0956	
S 4685	NV Cas	0 36 13.04	+55 54 48.2	A		

Table 1: Variables on *MVS* 308–316 (cont'd.)

Sonne.	GCVS	RA (2000)	Dec	s	GSC	IRAS
S 4686	NW Cas	$0^{\rm h}37^{\rm m}16\overset{\rm s}{.}53$	$+58^\circ46'24\overset{''}{.}1$	G	3666-1810	
S 4687	V339 Cas*					
S 4688	KQ Cas	0 38 37.72	+58 32 42.2	A		
S 4689	NX Cas	0 38 59.46	+59 27 48.8	G	3666-0923	
S 4690	NY Cas	0 40 23.21	+58 37 06.7	G	3667-0948	
S 4691	NZ Cas	0 43 48.39	+60 12 10.1	G	4016-1611	
S 4692	OP Cas	0 46 29.91	+63 32 35.9	T	4020-0217	
S 4693	OQ Cas	0 47 25.12	+61 01 46.8	G	4016-0741	
S 4694	OR Cas	0 48 01.31	+60 51 42.1	T	4016-1866	
S 4695	DT Cas	23 34 59.63	+59 21 29.3	G	4012-1261	
S 4696	DU Cas	23 37 12.00	+57 26 22.8	G	4008-0916	23348+5709
S 4697	EI Cas	23 45 46.06	+58 06 43.0	A		
S 4698	EL Cas	23 47 38.55	+62 27 10.8	G	4285-2048	
S 4699	FH Cas	0 05 52.60	+55 02 01.8	T	3656-0368	00032+5445
S 4700	FU Cas	0 34 54.27	+55 17 15.6	G	3658-1829	
S 4701	FV Cas	0 36 36.41	+55 13 31.9	G	3658-1973	
S 4702	FX Lac	22 24 25.44	+46 08 50.9	A		
S 4703	GH Lac*	22 39 36.18	+47 17 48.7	A		
S 4704	CN And	0 20 30.54	+40 13 33.8	T	2787-1815	
S 4705	LZ Cas	0 37 23.19	+46 46 06.7	T	3249-2311	
S 4706	BZ And	0 37 37.75	+45 36 15.3	T	3249-0012	
S 4707	KR Cas	0 54 02.15	+54 31 01.1	T	3672-0269	
S 4708	KS Cas	0 57 04.06	+48 42 11.3	T	3267-0810	
S 4709	DR And*	1 05 10.70	+34 13 06.3	T	2286-0352	
S 4710	BN And	1 10 47.81	+34 07 37.1	T	2286-0416	01079+3351
S 4711	CD And	1 26 28.36	+44 21 25.0	T	2825-2245	
S 4712	CE And	1 29 33.27	+46 39 33.0	T	3265-1605	
S 4713	CI And*	1 55 08.31	+43 45 56.5	T	2828-0830	
S 4714	CP And	2 12 51.23	+45 37 51.7	T	3281-1567	
S 4715	BI And	2 25 54.34	+38 07 22.2	T	2831-1262	
S 4716	DU And	2 30 31.34	+40 50 33.3	G	2836-0362	
S 4717	CQ And	2 31 31.96	+45 56 36.6	G	3295-2141	02282+4543
S 4718	RX Tri	2 39 27.11	+35 18 50.0	T	2332-0361	02363+3505
S 4719	KL Per*	2 41 16.51	+48 56 18.8	T	3304-0048	
S 4720	IV Per	2 59 56.26	+42 37 15.1	A		02566+4225
S 4721	KN Per	3 22 35.65	+41 19 55.3	T	2869-2543	
S 4722	LY Per	3 22 41.24	+34 12 37.2	T	2349-1387	03195+3401
S 4723	IP Per	3 40 46.96	+32 31 53.7	T	2359-1011	
S 4724	IQ Per	3 59 44.68	+48 09 04.5	T	3331-1175	
S 4725	IR Per	4 20 03.17	+41 03 50.1	T	2883-1186	
S 4726	IX Aur*	5 36 08.35	+38 02 00.0	T	2910-1284	
S 4727	HL Aur	6 19 13.04	+49 42 06.9	T	3383-0696	
S 4728	GO Aur	6 26 01.98	+50 29 28.8	G	3384-0832	06221+5031
S 4729	GQ Aur	6 26 42.85	+47 14 23.1	G	3380-1273	06229+4716
S 4730	KT Aur*	6 27 43.70	+53 41 47.1	T	3765-1987	06236+5343
S 4731	KS Aur*	6 25 43.94	+36 26 19.8	T	2433-0099	06223+3628
S 4732	HR Aur*	6 31 11.02	+30 56 16.0	T	2422-0827	
S 4733	DW Gem	6 30 59.84	+27 27 07.6	T	1887-1313	
S 4734	SU Lyn	6 42 55.14	+55 28 27.2	T	3770-1789	
S 4735	GR Aur*	6 43 42.63	+38 01 53.4	A		06402+3804

Table 1: Variables on *MVS* 308–316 (cont'd.)

Sonne.	GCVS	RA (2000)	Dec	s	GSC	IRAS
S 4736	NSV 3185	$6^h44^m37\overset{s}{.}43$	$+41^\circ44'07\overset{''}{.}0$	G	2949-0574	
S 4737	GX Gem	6 46 09.14	+34 24 52.8	T	2444-0267	
S 4738	FW Gem	6 58 33.85	+31 38 26.4	A		06553+3142
S 4739	TX Lyn	7 18 08.22	+48 16 38.7	T	3396-0351	07144+4822
S 4740	TV Lyn*	7 33 31.73	+47 48 09.9	T	3409-1947	
S 4741	TW Lyn	7 45 06.29	+43 06 41.7	T	2967-0176	
S 4742	BM Lyn	7 47 20.82	+47 20 17.6	T	3407-0482	
S 4743	GW Gem	7 52 28.98	+27 09 15.6	T	1933-0692	
S 4744	SV Lyn	8 03 39.95	+36 20 41.6	T	2480-1142	
S 4745	SS Lyn	8 05 55.46	+51 41 13.6	T	3414-0470	
S 4746	SW Lyn	8 07 41.57	+41 48 01.7	T	2976-0085	
S 4747	SZ Lyn	8 09 35.75	+44 28 17.6	T	2979-1320	
S 4748	RX Lyn	8 28 08.04	+38 20 23.0	T	2975-0217	
S 4749	YY Cnc	8 34 38.90	+31 18 27.5	T	2483-0099	
S 4750	WX Cnc	8 46 50.81	+32 51 04.9	T	2487-0010	
S 4751	WY Cnc	9 01 55.45	+26 41 22.7	T	1953-0395	
S 4752	TT Lyn	9 03 07.78	+44 35 08.2	T	2989-1709	
S 4753	WW Cnc*	9 09 48.60	+30 25 36.8	T	2492-0824	
S 4754	RS LMi	9 28 33.79	+36 09 38.6	T	2500-1483	
S 4755	RZ Lyn	9 36 06.75	+41 18 31.2	T	2995-0972	
S 4756	Z LMi	9 40 15.16	+36 06 18.8	T	2507-1090	09372+3619
S 4757	YY UMa	9 44 07.87	+53 46 00.4	T	3807-0489	
S 4758	AA UMa*	9 46 59.29	+45 45 56.4	T	3433-0685	
S 4759	RT LMi	9 49 48.32	+34 27 15.4	T	2505-0412	
S 4760	YZ UMa	9 55 19.89	+44 00 29.4	T	2999-0701	09522+4414
S 4761	RV LMi*	10 23 28.98	+29 50 56.5	T	1975-0026	10206+3006
S 4762	WY UMa	10 41 53.21	+51 37 59.7	T	3448-0075	
S 4763	AB UMa	12 11 14.59	+47 49 43.8	T	3455-0362	
S 4764	TW CVn	12 59 21.18	+43 53 15.5	T	3023-1946	
S 4765	NSV 6111	13 08 55.06	+31 42 40.7	G	2532-0151	
S 4766	TV CVn	13 15 11.81	+42 15 59.5	T	3024-0852	
S 4767	NSV 6788	14 45 03.30	+36 35 51.2	G	2560-0409	
S 4768	YZ Boo	15 24 07.00	+36 52 00.5	T	2570-0167	
S 4769	YY Boo*	15 35 28.31	+43 28 49.1	T	3059-0813	
S 4770	SX CrB	16 15 23.79	+33 19 48.2	T	2583-0974	
S 4771	V449 Her*	16 42 39.15	+48 24 23.8	T	3502-0168	
S 4772	V352 Her	17 42 45.03	+30 32 54.8	T	2607-1154	17408+3034
S 4773	V337 Her	17 48 47.21	+45 41 59.4	T	3511-1324	
S 4774	V338 Her	17 53 12.74	+43 46 23.2	T	3101-1627	
S 4775	OP Her	17 56 48.53	+45 21 03.1	T	3511-2142	
S 4776	V353 Her*	18 10 05.33	+28 54 22.7	T	2104-0072	
S 4777	PW Her	18 10 24.11	+33 24 11.2	T	2626-1610	
S 4778	V342 Her	18 24 13.00	+25 04 50.7	T	2097-0407	
S 4779	OO Lyr*	18 30 09.01	+30 38 17.3	T	2624-2068	18282+3036
S 4780	V753 Cyg	19 22 47.09	+48 12 10.8	T	3547-1131	
S 4781	V687 Cyg	19 26 11.63	+29 59 12.4	T	2137-0689	
S 4782	V796 Cyg	19 33 56.11	+47 18 34.2	T	3560-0777	
S 4783	V466 Cyg	19 54 33.45	+33 00 05.4	T	2673-2051	

Table 1: Variables on *MVS* 308–316 (cont'd.)

Sonne.	GCVS	RA (2000)	Dec	s	GSC	IRAS
S 4784	V620 Cyg	$21^{\mathrm{h}}33^{\mathrm{m}}08^{\mathrm{s}}.15$	$+35^{\circ}46'18''.3$	T	2716-2777	
S 4785	ER Peg*	23 05 46.80	+33 29 07.0	T	2754-0276	
S 4786	CK And	23 13 00.97	+42 30 40.9	T	3225-1597	
S 4787	BU And*	23 23 39.90	+39 43 36.9	T	3234-0546	
S 4788	NSV 14545	23 24 28.33	+34 29 03.7	G	2773-0936	
S 4789	CM And	23 43 06.59	+35 28 45.3	T	2775-0525	23406+3512
S 4790	GM And	0 00 03.62	+35 21 46.0	G	2267-0718	

Notes:

BU And	[PCC93] 495.
BV And	Downes *et al.* (1997) identification adopted.
CI And	faint companion on southwest.
DR And	misidentified and incorrect position in SIMBAD: *not* GSC 2286-0921.
GR Aur	GCVS 4.1 position $3'.2$ in error.
HR Aur	CSV 765 = 1RXS J063112.5+305614.
IX Aur	CSV 601.
KS Aur	BD+36°1425.
KT Aur	IRC +50166.
YY Boo	BPS BS 17446-0070.
WW Cnc	fainter companion on north.
KX Cas	middle star in a line of three with two bright stars.
KY Cas	northeastern star of a pair.
KZ Cas	Downes *et al.* (1997) identification adopted; the southwestern star of a close pair, apparently confirmed by Liu *et al.* (1999).
LM Cas	hitherto slightly misidentified: the variable is the faint companion immediately northeast of the star indicated on the Downes & Shara (1993) chart. Hoffmeister's (1949) description: “nahe am Ort ein Stern 16^{m}, der Veränderliche anscheinend dicht nordöstlich davon”.
MW Cas	western component of a close double; GSC position skewed.
NN Cas	southwestern component of a close double; a third much fainter star $4''$ southwest.
PY Cas	misidentified and incorrect position in SIMBAD: *not* GSC 4281-1706.
QT Cas	western component of a close double.
QV Cas	GCVS 4.1 position $3'.3$ in error.
V337 Cas	misidentified and incorrect position in SIMBAD: *not* GSC 3664-0207. GCVS 4.1 position $3'.5$ in error.
V339 Cas	not found.
V348 Cas	western star of a pair; GSC and USNO-A2.0 positions skewed.
V359 Cas	misidentified and incorrect position in SIMBAD: *not* GSC 4008-0969.
V530 Cas	AN 406.1934.
CP Cep	SVS 683.
DF Cep	crowded.
GN Cep	AN 39.1939 = CSV 5501.
V506 Cyg	AN 729.1933; northern star of a $10''$ pair.
V521 Cyg	EM* UHA 90; in a dark region of the North America Nebula.
V583 Cyg	brighter companion $14''$ southeast (GSC 3593-3193).
V611 Cyg	AN 53.1939.
V630 Cyg	Downes *et al.* (1997) identification adopted.
V632 Cyg	Downes *et al.* (1997) identification adopted, which is a blue star in USNO-A2.0.
V645 Cyg	GSC position is for star + nebulosity. [BE83] Maser 094.60-02.00 = [BE83] IR 094.60-02.00. = GAL 094.60-01.80 = [PCC93] 443.

Notes (cont'd.):

V660 Cyg	GCVS 4.1 position 4.′7 in error.
V670 Cyg	southwestern component of a close pair.
V731 Cyg	southeastern and fainter star of a $10''$ pair.
V1225 Cyg	crowded field; mark on *MVS* chart is for NSV 13539, *cf.* V1225 Cyg is the star immediately ($13''$) southwest, which is bright on POSS-II.
V1414 Cyg	northern star of two.
V1664 Cyg	GCVS 4.1 position 3.′8 in error.
V353 Her	incorrect position in SIMBAD: *not* GSC 2104-1714 (other IDs correct).
V449 Her	HD 151056.
DL Lac	western star of two.
DO Lac	IRC +50419.
DP Lac	GCVS 4.1 position 3.′2 in error.
DW Lac	AN 72.1926.
EE Lac	fainter/northwestern component of $15''$ pair with GSC 3633-2622.
EG Lac	Downes & Shara (1993) chart has wrong star marked, but the coordinates given there and in Downes *et al.* (1997) are correct (if imprecise); lies $16''$ north of GSC 3988-1561; GCVS 4.1 position 4.′0 in error; bright on both POSS-II IV-N plates, but faint on both POSS-I/II blue and red plates, suggesting this is possibly a symbiotic star instead of dwarf nova.
FO Lac	IRC +50449.
GH Lac	GCVS 4.1 position 3.′2 in error.
QV Lac	faint companion on southwest.
RV LMi	BD+30°2004.
TV Lyn	AG+47°695.
OO Lyr	brighter star of a pair; GCVS 4.1 position 7.′1 in error.
ER Peg	GCVS 4.1 position 3.′2 in error.
KL Per	CSV 238.
AA UMa	RX J0947.0+4546.
NSV 13146	eastern star of a pair; USNO-A2.0 position probably somewhat skewed.
NSV 13539	*MVS* chart marks only this star, not S 4533 = V1225 Cyg, *cf.*
NSV 14189	GCVS 4.1 position 3.′6 in error.
NSV 14247	candidate not variable on POSS-I/II plates. *MVS* chart distorted.
NSV 14333	IRC +60372.
NSV 14365	GCVS 4.1 position 3.′1 in error.
NSV 14547	ID somewhat uncertain; blue candidate chosen.

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COMMISSIONS 27 AND 42 OF THE IAU
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S 4902 IZ CARINAE = V336 CARINAE

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The Mira variable IZ Car was originally discovered by Hoffmeister (1949, 1957) and assigned the Sonneberg designation S 4902. Its position is given in the GCVS 4.2 (December 1999 version) as: $8^h30^m58^s$; $-59°51.'9$ (1950) with an uncertainty flag. The photo-blue magnitude range is from 12 to > 14. However, attempts to identify the variable near the published position have been hitherto unsuccessful. Based on examination of UK Schmidt plates, Morel & McNaught (1985) suggested a red star a few arcminutes south ($8^h32^m10.^s57$; $-60°05'26.''2$ [2000, USNO-A2.0]) as the most likely candidate, but this star is not demonstrably variable.

I was contacted in February 2000 by Timo Kinnunen, who has been working on identifications of Sonneberg variables. He reported that S 4902 = IZ Car proved difficult to identify. After an exchange of e-mail correspondence and close scrutiny of the Sonneberg finder chart, the following conclusions have emerged:

1) The finder chart for S 4902 does not match the sky at the GCVS position, *i.e.* the coordinates are in error.

2) The finder chart is a good match for the Mira variable V336 Car, which lies exactly 3° north.

3) V336 Car = GSC 8576-0085 = IRAS 08312–5651, at $8^h32^m25.^s22$; $-57°02'13.''1$ (2000, Tycho-2).

Precessing the V336 Car position back to equinox 1875, we get $8^h29^m23.^s1$; $-56°36'40''$. We then compare Hoffmeister's position of IZ Car for 1875: $8^h29^m24^s$; $-59°36.'6$. There appears to have been a simple misprint in the Declination degrees: '59' should read '56'. As IZ Carinae has the type of variation and range consistent with that of V336 Car, we conclude that S 4902 = IZ Car = V336 Car.

I would like to acknowledge Timo Kinnunen for reacquainting me with the problem of IZ Carinae. I would also like to thank Dave Monet (USNO-Flagstaff) for providing the USNO-A2.0 catalogue on CD-ROM, which is invaluable for investigations of this kind.

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GSC 01887-01240 : A NEW ECLIPSING BINARY

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In this note, we report that GSC 01887-01240 ($\mathrm{RA}_{2000} = 06^{\mathrm{h}}26^{\mathrm{m}}23\overset{\mathrm{s}}{.}89$, $\mathrm{DEC}_{2000} = +27^\circ56'44\overset{\prime\prime}{.}2$, $V = 10\overset{\mathrm{m}}{.}75$, $B-V = 0\overset{\mathrm{m}}{.}35$) is a new eclipsing binary. The star was originally observed as a check star for one of our observing program stars, AH Aur (BD +28°1116, HD 256902). A finding chart for the newly discovered variable star is shown in Figure 1.

GSC 01887-01240 has been observed on eight nights between January and March, 2000 with a 61-cm reflector at the Sobaeksan Optical Astronomy Observatory in Korea. A PM512 CCD imaging System of Photometric Instruments cooled with liquid nitrogen and a standard *BVR* filter set were used. Two stars near GSC 01887-01240 served as comparison ($\mathrm{RA}_{2000} = 06^{\mathrm{h}}26^{\mathrm{m}}32\overset{\mathrm{s}}{.}60$, $\mathrm{DEC}_{2000} = +27^\circ56'43\overset{\prime\prime}{.}0$) and check ($\mathrm{RA}_{2000} = 06^{\mathrm{h}}27^{\mathrm{m}}21\overset{\mathrm{s}}{.}38$, $\mathrm{DEC}_{2000} = +27^\circ30'11\overset{\prime\prime}{.}5$, $V = 9\overset{\mathrm{m}}{.}92$, $B-V = 0\overset{\mathrm{m}}{.}81$) stars, respectively (see Figure 1). Our CCD observations for those stars were pre-processed according to the method given by Park (1993). Nightly extinction coefficients were computed from the comparison – star measurements and the differential magnitudes in each color in terms of Δm (variable – comparison, check – comparison) were reduced in the instrumental system. From the check – star measurements the standard errors of our observations in three colors were calculated to be $0\overset{\mathrm{m}}{.}017$ in B, $0\overset{\mathrm{m}}{.}009$ in V, and $0\overset{\mathrm{m}}{.}020$ in R, respectively.

The *BVR* light curves of GSC 01887-01240 and check stars versus Julian dates are presented in Figure 2. From the figure, one finds that the light of GSC 01887-01240 in three colors changes considerably on Jan. 26 and Mar. 24, 2000. One also finds that the pattern of the light variations indicates that the star is an eclipsing binary. From our observations two times of minimum light were obtained for the new variable in each color with the method of Kwee & van Woerden (1956) which are listed in Table 1.

Using Scargle's (1982) method we performed a period search and found a tentative ephemeris as:

$$\mathrm{Min.\ I} = \mathrm{JD\ Hel}\ 2451570.2363 + 1\overset{\mathrm{d}}{.}4280 \times E. \qquad (1)$$

The *BVR* light curves of GSC 01887-01240 constructed by using Eq. (1) are presented in Figure 3. The light curves in Figure 3 show the star to be an Algol-type eclipsing binary. The depths of primary eclipse are $0\overset{\mathrm{m}}{.}32$ in B, $0\overset{\mathrm{m}}{.}32$ in V, and $0\overset{\mathrm{m}}{.}33$ in R, respectively. It is noticed that there is a discontinuity in each light curve from $0\overset{\mathrm{p}}{.}2$ to $0\overset{\mathrm{p}}{.}3$, which is obvious especially in V-band light curve. One also finds that the light at the beginning of ingress branch of secondary eclipse is higher than following Min II. At this moment it is difficult to discern that these peculiarities are caused by the intrinsic stellar activity in the system or by incorrect determination of the period.

Future photometric as well as spectroscopic observations are urgently needed to reveal the properties of the light variability of GSC 01887-01240.

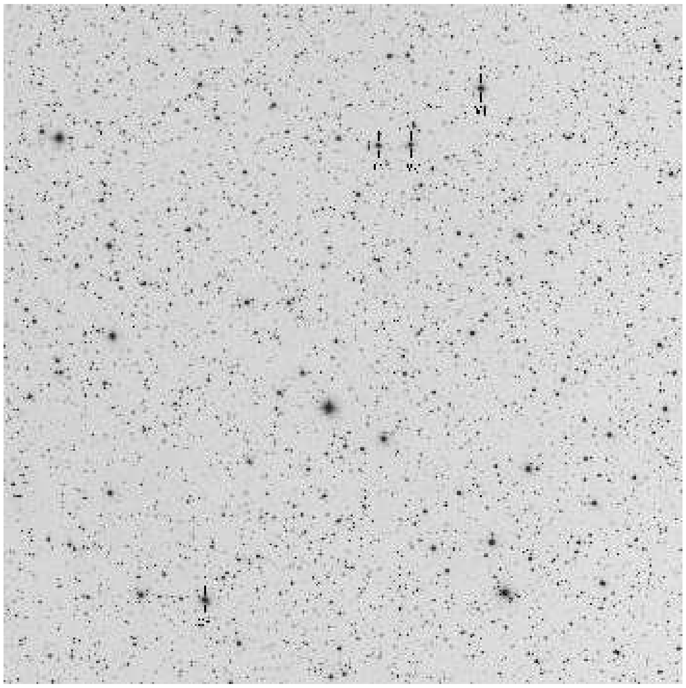

Figure 1. A finding chart for GSC 01887-01240 (V2), V1 = AH Aur, C = comparison star and Ch = check star (HD257287). The scale of the chart is $40' \times 40'$. North is up, east to the left.

Table 1: Times of minimum brightness of GSC 01887-01240.

Minimum Times	σ	Type	Filter	Weighted Mean	σ
2451570.2365	0.0013	I	B	2451570.2363	0.0011
2451570.2374	0.0011	I	V		
2451570.2351	0.0010	I	R		
2451628.0777	0.0020	II	B	2451628.0708	0.0015
2451628.0705	0.0015	II	V		
2451628.0662	0.0014	II	R		

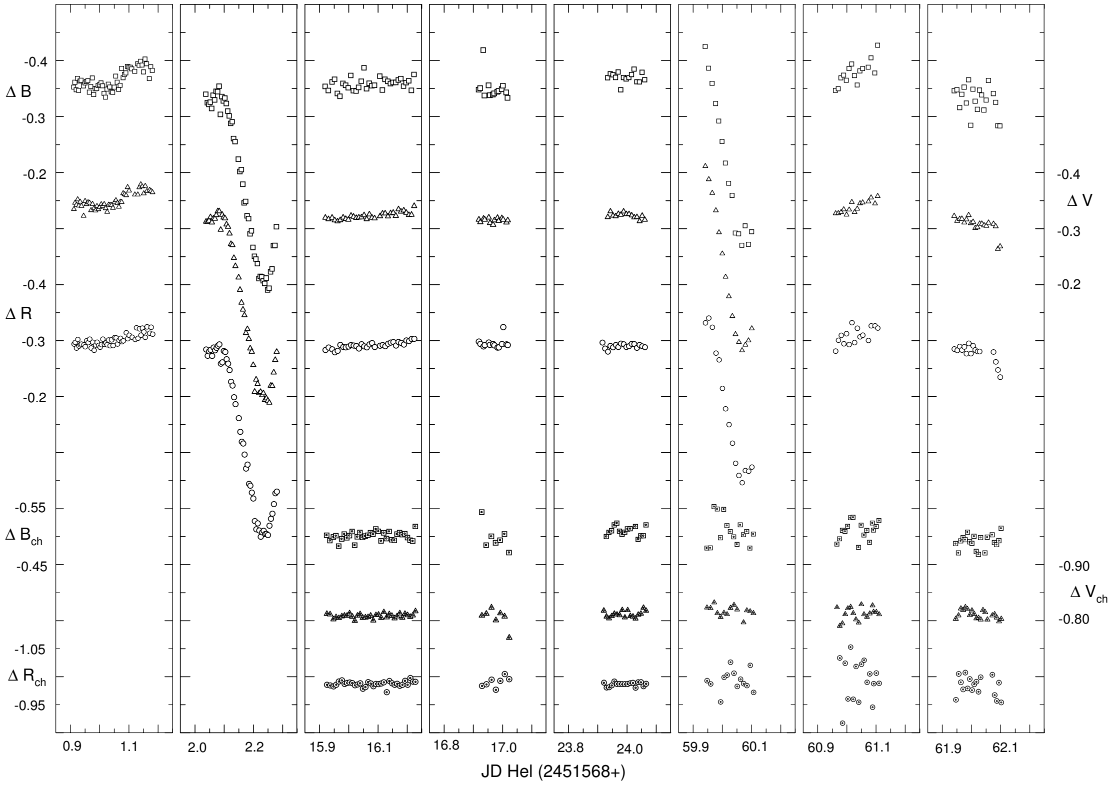

Figure 2. The *BVR* light curves of GSC 01887-01240 and the check star (HD257287).

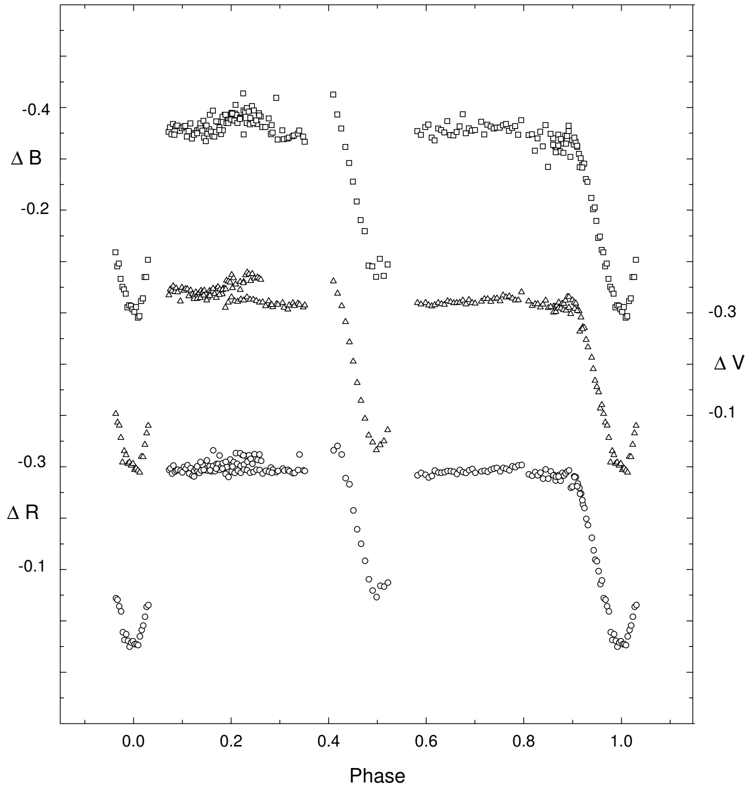

Figure 3. The *BVR* phase curves of GSC 01887-01240.

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PT ANDROMEDAE: THE RECENT OUTBURST AND EARLIER ONES

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The first report on the reappearance of PT And in 1998 came to Sternberg Astronomical Institute from Abastumani Observatory as an announcement of an outburst of a possible nova in the galaxy M31 (Samus 1998). Our late colleague A.S. Sharov (deceased 1999 Apr. 19) then immediately identified the new object with PT And. At first this star was known as the nova N15 in M31 (Grubissich & Rosino 1959). After discovery of its repeated outbursts Sharov & Alksnis (1989) suggested that N15 R15 is a foreground dwarf nova of SU UMa type, and the star was named PT And (Kazarovets & Samus 1990).

We studied the light curve of the outburst 1998 of PT And on plates taken for search and study of novae in the galaxy M31 at the Crimean Station of the Sternberg Astronomical Institute and at the Baldone Observatory of the Institute of Astronomy, University of Latvia (Sharov *et al.* 2000).

Comparison stars are identified on the finding chart (Fig. 1) and their B magnitudes are listed in Table 1. Estimates of B magnitudes for PT And are presented in Table 2 along with the times of the mid-exposure, and the light curve is shown in Fig. 2. Our observations did not catch the brightness rise, they show only that this phase of the light curve was shorter than seven days. The shape of the light decline of the 1998 outburst is very similar to those observed in 1957 (Grubissich & Rosino 1959) and in 1986 (Sharov & Alksnis 1989), at least down to $B = 18^{\mathrm{m}}$.

The values $\log(100d)$ of the rate of light decline, usually used for description of novae, in the case of PT And are very similar to each other, namely, 0.98, 0.95, and 1.05 for the outbursts of the years 1957, 1986, and 1998, respectively. Therefore, these three light declines are fitted with one combined light curve in Fig. 2, using time shifts T indicated in the upper right corner. With these rates of brightness decline, which correspond to the fast novae, and with the maximum brightness of about $B = 16\overset{\mathrm{m}}{.}3$, PT And fits well in the relationship between the magnitude at maximum and the decline rate for novae in M31, demonstrated by Sharov *et al.* (1998).

Even scarcely observed outbursts of the years 1983 and 1988 might be fitted rather well to the combined light curve of the three well-observed outbursts. It turned out that a mistake of 30 days in Julian date (2445698 instead of the right value 2445668) for the observed maximum light ($B = 17\overset{\mathrm{m}}{.}2$) of the 1983 outburst had led to a wrong interpretation of the light curve (Sharov & Alksnis 1989). Therefore in Table 2 we repeat brightness estimates of the outburst of PT And in 1983, corrected and slightly supplemented. Further, the only two, and equal, magnitude estimates obtained during the 1988 outburst

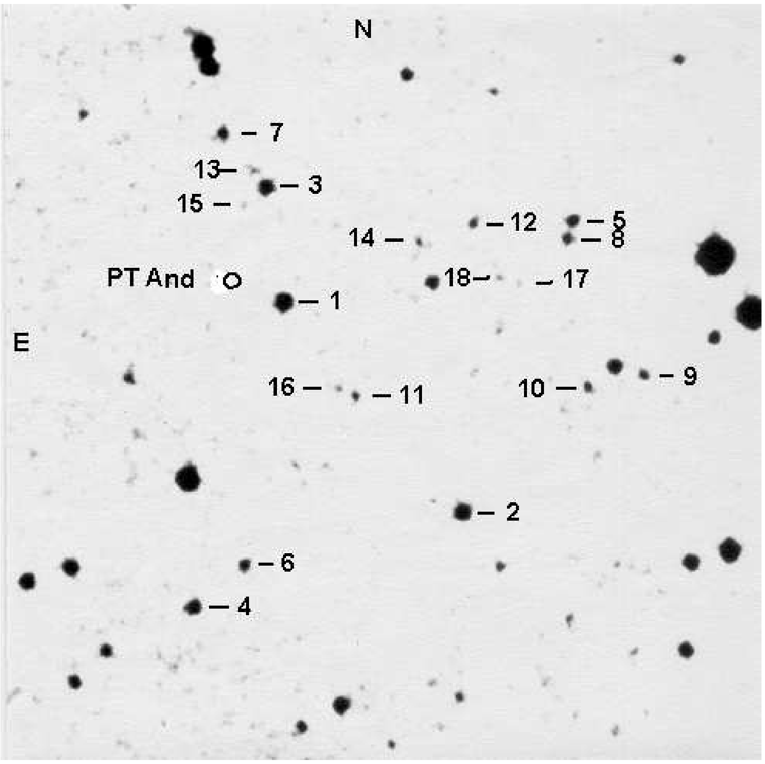

Figure 1. Finding chart for PT And and comparison stars

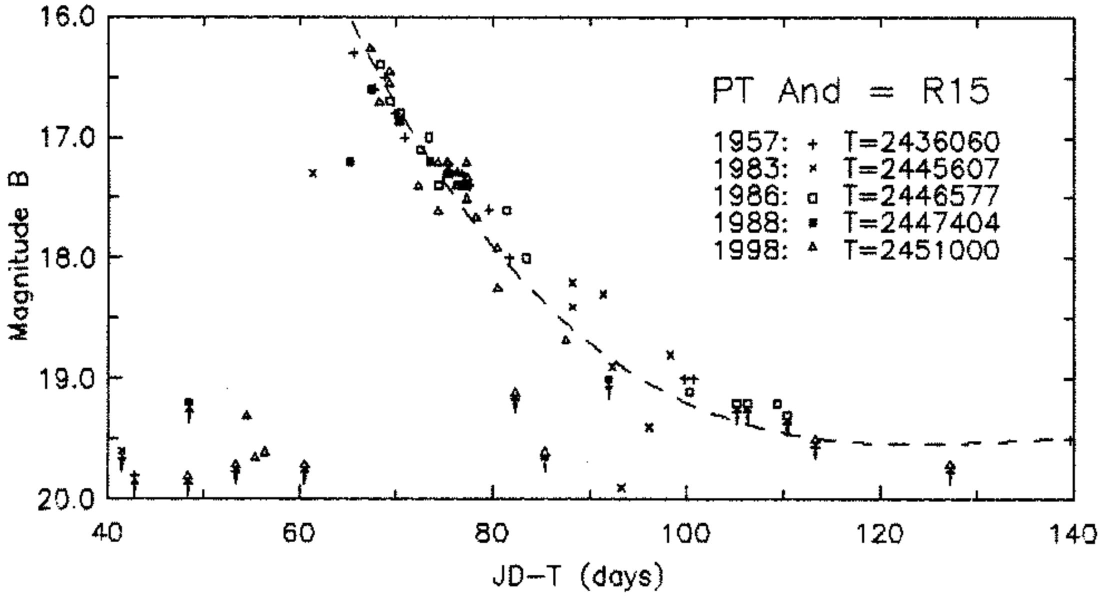

Figure 2. The light curve for five outbursts of PT And

Table 1: B magnitudes for comparison stars of PT And

Star No	B (mag)	Star No	B (mag)	Star No	B (mag)
1	16.16	7	18.5	13	19.4
2	16.44	8	18.6	14	19.4
3	17.16	9	18.7	15	19.6
4	17.44	10	18.8	16	19.7
5	17.77	11	18.9	17	19.7
6	18.0	12	19.2	18	19.7

Table 2: PT And brightness estimates for 1983 and 1998 outbursts

JD	B	JD	B	JD	B	JD	B
2400000 +	mag	2400000 +	mag	2400000 +	mag	2400000+	mag
45648.438	(19.6	51048.365	(19.8	51070.361	16.9	51076.353	17.3
45668.397	17.3	51053.375	(19.6	51072.288	17.4	51077.296	17.5
45695.185	18.4	51054.526	19.3	51074.302	17.2	51077.322	17.2
45695.235	18.2	51055.396	19.6	51074.337	17.6	51078.304	17.7
45698.396	18.2	51056.427	(19.6	51075.270	17.2	51080.478	17.9
45699.315	18.9	51060.532	(19.7	51075.313	17.3	51080.508	18.2
45700.273	19.9::	51067.289	16.2	51075.342	17.3	51082.317	(19.1
45703 181	19.4	51068.265	16.7	51075.391	17.2	51085.365	(19.6
45703.226	19.4	51069.269	16.6	51076.270	17.4	51087.507	18.7
45705.340	18.8	51069.310	16.4	51076.308	17.4	51113.293	(19.5
		51070.333	16.9	51076.311	17.3	51127.215	(19.7

might be considered as a pre-maximum observation and a post-maximum one. Thus, in Fig. 2 all brightness estimates of PT And made during the five outbursts mentioned are plotted.

According to the photometric properties discussed, PT And seems to be the best candidate for a recurrent nova in M31. The only other one candidate, although questioned by Sharov and Alksnis (1989), is the Nova R48 = R79, observed in outburst twice (Rosino 1973). Objections against the interpretation of PT And as a recurrent nova in M31 could be the two shortest (less than three years) time intervals between successive outbursts. For galactic recurrent novae they are usually tens of years and the shortest one observed has been nine years.

The decline rate (0.09 mag/d–0.11 mag/d at different outbursts) for PT And corresponds to that (0.11 mag/d) of the "plateau" phase of super-outbursts of SU UMa stars (Nogami *et al.* 1997). Contrary to the rapid decline (about 1 mag/d) phase, which typically follows the "plateau" phase of SU UMa stars, for PT And we observe reduced decline rate at later phase, as usual for novae. Neither have we detected normal outbursts, which would have been $0\overset{\mathrm{m}}{.}5$–$2^{\mathrm{m}}$ fainter than super-outbursts, and would have recurred more frequently. Thus it seems unlikely that PT And belongs to SU UMa stars or other known subtypes of dwarf novae.

At its low state, PT And is beyond detection limit of our plates, $19\overset{\mathrm{m}}{.}0$–$20\overset{\mathrm{m}}{.}0$ on average, thus the amplitude of the brightness variation exceeds 3-4 mag. In few cases, not connected to the observed outbursts, an image of the star was noticed, however, uncertainly and at the detection limit (Table 2 in Sharov & Alksnis 1989). We can add some other faint detections: JD 2442995.457 $19^{\mathrm{m}}\!.6$:, 2449978.356 20^{m}:, 2449979.384 $20^{\mathrm{m}}\!.5$:, 2449980.422 20^{m}:. These estimates may correspond either to faint outbursts or to brighter phases of the low state of the star. Remarkable is the detection of the star slightly above plate limit 12-13 days before the observed maximum in 1998. It reminds us of premaximum halt of novae.

More observations are needed to judge on the nature of this star: whether it is an unusual recurrent nova in M31 or a specimen of a variety of dwarf novae in the Galaxy.

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NSV 223: A NEW ECLIPSING BINARY

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The rapid variability of NSV 223 (BV 121 ≡ BD +20°0075 ≡ CSV 005683 ≡ GSC 1193972) was discovered by Strohmeier et al. (1956) and confirmed by Filatov (1957), who reported variations from mag. 10.9 to 11.3 (photographic plates) an a F or G spectrum.

Visual estimates carried out since 1997 by GEOS observers and mainly by J.P. Verrot allowed establishing a very probable eclipsing nature (and 13 times of mimimum light were detected), even though the case of a pulsating star could not be ruled out (Verrot 1999). Therefore, photoelectric measurements were performed at the Jungfraujoch Observatory, on the basis of a collaboration between GEOS and Geneva Observatory. Thirteen BV measurements were collected in December 1998: the practically flat behaviour of the $B-V$ colour index strongly supported the eclipsing nature. The mean value of the $(B-V)_G$ index is -0.35. The latter value can be transformed into the BV system assuming a luminosity class V. Unfortunately, the photometer of the Jungfraujoch Observatory was removed before we could complete the observation of the whole light curve.

New CCD measurements were obtained by one of us (P. Van Cauteren) at his private observatory using a 0.40-m telescope. He collected 1167 measurements in white light during 1998 using a Hisis 24 camera: these images were reduced by using a profile fitting algorithm (MIPS package; Buil et al. 1993). Moreover, he also collected 224 measurements in V light during 1999 using a ST7 camera and the MIRA Aperture Photometry software (AP software is distributed by Axiom Research Inc.). In both cases GSC 1193_523 was used as comparison star. Typically, the standard deviation for the check star (GSC 1193_277) measurements is 0.012 mag. Since NSV 223 is 1.5 mag brighter, its measurements are more precise.

From Fig. 1, it is evident that NSV 223 is a contact eclipsing binary; it ranges from 10.86 to 11.32 in V light, as determined from Geneva photoelectric measurements. The light curve has a quite regular shape and the two maxima have the same height. On the other hand, the minima are slightly different (about 0.02 mag); the noise at Min. II can be ascribed to the poor photometric conditions of one night rather than to a physical variability of the system.

An ephemeris was calculated on the basis of 15 times of minimum light supplied by GEOS visual observers (J.P. Verrot and J. Vandenbroere), of 1 photoelectric time and from the 5 CCD times:

$$\begin{array}{rl}\text{Min. I} = \text{HJD } & 2450748.896 + 0\overset{\text{d}}{.}366128 \times E. \\ & \pm\, 0.003 \quad \pm 0.000005\end{array}$$

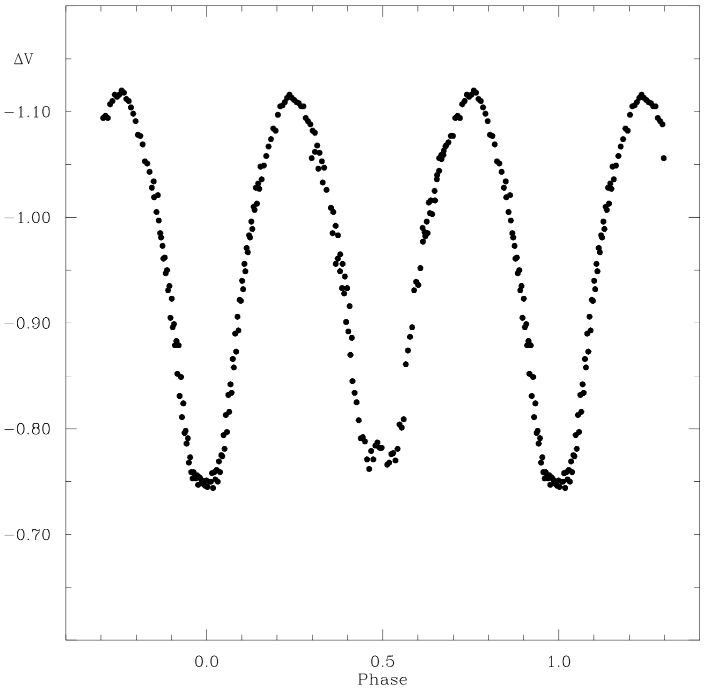

Figure 1. The 224 V CCD measurements of NSV 223 phased with the ephemeris proposed below.

A triple weight was assigned to the CCD and photoelectric minima, which are listed in Table 1 for the sake of completeness.

Table 1: Recent photoelectric and CCD times of minima of NSV 223

Type of min.	HJD	Method	Filter
II	51124.3492	CCD	white light
II	51128.3899	CCD	white light
I	51166.2751	p.e.	V light
II	51467.4273	CCD	V light
I	51468.3428	CCD	V light
I	51469.4389	CCD	V light

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THE HIPPARCOS VARIABLE CD LYNCIS

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The 9th magnitude star CD Lyn (HIP 37615, GSC 3409-2180), spectral type F2, was first detected as a variable by the Hipparcos satellite (ESA, 1997). The satellite data indicated an amplitude of 0.7 V with an uncertain period and type but probably an eclipsing binary.

Our group has observed CD Lyn to determine its period and confirm its status as an eclipsing binary. Continuous visual monitoring by Baldwin and Berg eventually detected minima, which allowed CCD observers Billings, Henden, and Nelson to observe additional minima at higher precision. The minima occurred at multiples of 2.27 days, but further CCD observations including those of Lubcke and Kaiser established that the true period is 4.55 days with the variable constant at maximum at phases 0.25 and 0.75 of this longer period.

Subsequently Williams and Hager investigated CD Lyn in the Harvard College Observatory plate collection, finding 24 times of minimum dating back to 1901. These archival plate minima and the recent CCD timings (reduced with software based on the Kwee–Van Woerden method, 1956) are listed in Table 1. A least-squares analysis with weight 1 for the photographic data and weight 100 for the CCD data resulted in the period in Equation 1, which we have combined with the best CCD timing of minimum to produce the following light elements:

$$\text{Min. I} = \text{HJD } 2451665.6526(2) + 4\overset{\text{d}}{.}5494840(4) \times E. \qquad (1)$$

Henden performed high-precision $BVRI$ photometry at maximum and during primary minimum and BV photometry during secondary minimum with the 1-meter Naval Observatory reflector (Table 2). These observations show that the primary and secondary eclipses are virtually identical in depth and color. We have chosen the nominally deeper

Table 1: Times of Minimum, CD Lyn

HJD 2400000 +	Cycle	$O-C$	Observer
15683.778	−7909.0	−0.006	Harvard plate
16584.584	−7711.0	+0.003	”
16834.709	−7656.0	−0.094	”
16891.622	−7643.5	−0.050	”
16932.578	−7634.5	−0.039	”
17321.606	−7549.0	+0.008	”
18374.695	−7317.5	−0.108	”
19384.802	−7095.5	+0.013	”
19716.880	−7022.5	−0.021	”
20485.774	−6853.5	+0.010	”
26306.847	−5574.0	+0.018	”
28192.636	−5159.5	+0.046	”
28872.792	−5010.0	+0.054	”
28904.659	−5003.0	+0.075	”
29020.583	−4977.5	−0.013	”
29657.627	−4837.5	+0.103	”
30014.732	−4759.0	+0.074	”
31122.572	−4515.5	+0.114	”
33592.832	−3972.5	+0.005	”
45348.705	−1388.5	+0.011	”
45639.846	−1324.5	−0.015	”
45696.741	−1312.0	+0.011	”
45753.579	−1299.5	−0.019	”
46408.722	−1155.5	−0.002	”
51640.6309(5)	−5.5	0.000	Henden CCD
51649.731(1)	−3.5	+0.002	Nelson CCD
51665.6526(2)	0.0	0.000	Henden CCD
51674.7526(8)	2.0	+0.001	Billings CCD

Table 2: CD Lyn Photometry

Phase	V	$B-V$	$V-R$	$R-I$
Maximum	9.80	0.36	0.25	0.23
Minimum I	10.33	0.39	0.27	0.28
Minimum II	10.32	0.39		

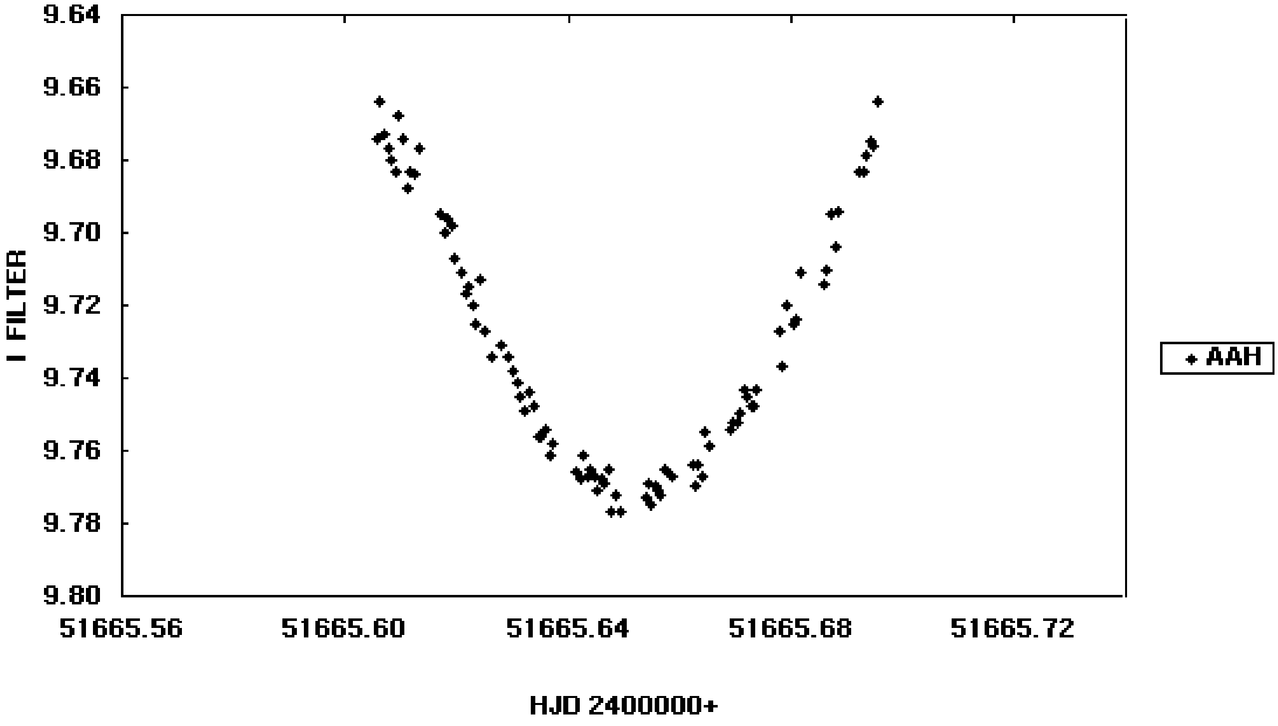

Figure 1. Primary eclipse of CD Lyn, *I* filter

Table 3: Comparison Stars

Comp Star	RA (2000)	Dec (2000)	V	$B-V$
GSC 3409−1129	$07^{\rm h}42^{\rm m}39\overset{\rm s}{.}78$	$+48°46'51\overset{''}{.}3$	9.981 ± 0.007	0.481 ± 0.011
GSC 3409−1825	$07^{\rm h}42^{\rm m}52\overset{\rm s}{.}10$	$+48°43'43\overset{''}{.}9$	12.072 ± 0.011	0.670 ± 0.011

minimum as the primary eclipse, but the difference between the two eclipses is so small that the choice may be arbitrary. The eclipses are partial and duration is about 0.15 P. Comparison stars are listed in Table 3.

In summary, CD Lyn is a detached binary system with minima of equal depth. This star is a good candidate for a high-precision radial velocity and light curve solution to determine accurate stellar masses and radii.

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PHOTOELECTRIC MINIMA OF SELECTED ECLIPSING BINARIES AND MAXIMA OF PULSATING STARS

(BAV MITTEILUNGEN NO. 128)

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In this 41st compilation of BAV results, photoelectric observations obtained in the years 1999 and 2000 are presented on 118 variable stars giving 163 minima and maxima. 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: Eclipsing binaries

Variable	Min JD 24...	±	Obs	$O-C$			Fil	Rem
OO Aql	50363.371	.002	MZ	+0.004	s	GCVS 85		6)
	50714.324	.002	MZ	+0.007		GCVS 85		6)
	50718.375	.002	MZ	+0.003		GCVS 85		6)
ZZ Aur	51262.3749	.0002	RAT RCR	+0.0125		GCVS 85		1)
AP Aur	51249.3922	.0001	RAT RCR	+0.0137	s	BAVM 67		1)
CG Aur	51256.3563	.0009	RAT RCR	+0.0080		GCVS 85		1)
HU Aur	51250.3727	.0003	RAT RCR	−0.0196		GCVS 85		1)
V404 Aur	51189.2731	.0008	MS					1)
TU Boo	51298.3696	.0006	HSR	+0.0752	s	GCVS 85		4)
TY Boo	51278.3840	.0012	MS	−0.0061	s	BAVM 68		1)
TZ Boo	51249.5757	.0003	AG	+0.0478	s	BAVM 68	BV	2)
VW Boo	51314.3832	.0004	KI	−0.0293	s	BAVR 2)	-Ir	1)
i Boo	51298.343 :	.003	AG	−0.064		GCVS 85	BV	2)
AK Cam	51197.4949	.0014	HSR	+0.0044		BAVM 69		4)
WW Cnc	51209.2896	.0009	HSR	−0.0474		BAVR 1)		4)
AD Cnc	51202.3969	.0005	RAT RCR					1)
FF Cnc	51278.3852	.0004	FR	−0.0715		BAVM 65		5)
	51278.3869	.0007	AG	−0.0699		BAVM 65	BV	2)
BI CVn	51250.4335	.0004	AG	+0.0762	s	GCVS 85	BV	2)
BO CVn	51271.363	.004	AG				BV	2)
	51295.4252	.0004	AG				BV	2)
AM CMi	51253.3921	.0013	KI	+0.1316		GCVS 85	-Ir	1)
WW Cep	51270.4395	.0005	AG	+0.0002	s	BAVM 71		1)
EF Cep	51269.3475	.0005	AG	−0.0482		GCVS 85		1)
EM Cep	51303.5652	.0050	HSR	−0.0821		GCVS 85		4)
GI Cep	51194.3465	.0003	AG					1)
SS Com	51271.3553	.0004	RAT RCR	+0.0516	s	BAVR 3)		1)
	51298.3957	.0004	KI	+0.0530		BAVR 3)	-Ir	1)

Table 1: (cont.)

Variable	Min JD 24...	±	Obs	$O-C$			Fil	Rem
CC Com	51266.4692	.0003	KI	−0.0102	s	GCVS 85	-Ir	1)
	51270.3317	.0002	RAT RCR	−0.0098		GCVS 85		1)
TW CrB	51273.4705	.0005	HSR					4)
V488 Cyg	51166.2226	.0002	FR	+0.1032	s	GCVS 85		5)
V726 Cyg	50594.4756	.0020	FR					5)
	50597.4632	.0020	FR					5)
	50599.4512	.0020	FR					5)
	50600.4481	.0020	FR					5)
V963 Cyg	51270.5765	.0004	MS	+0.0016		GCVS 85		1)
V1023 Cyg	50728.4028	.0020	FR					5)
ET Del	50720.3239	.0005	KI					1)
Z Dra	51268.3364	.0006	HSR	−0.1202		GCVS 85		4)
AR Dra	51253.3535	.0001	RAT RCR					1)
AU Dra	51287.3806	.0006	RAT RCR					1)
AX Dra	51177.6711	.0007	HSR	−0.0038		BAVR 1)		4)
BX Dra	51256.4227	.0004	AG	−0.0496	s	GCVS 85		1)
	51270.6090	.0011	HSR	+0.1069	s	GCVS 85		4)
UX Eri	51208.2748	.0004	KI	+0.0983		GCVS 85	-Ir	1)
FG Gem	51250.3034	.0005	KI	−0.0195		GCVS 85	-Ir	1)
V450 Her	51245.506	.007	HSR	+0.160	s	GCVS 85		4)
V829 Her	51294.4410	.0015	AG				BV	2)
V857 Her	51253.6416	.0011	MS					1)
	51270.4594	.0003	MS					1)
	51301.4194	.0034	MS					1)
EU Hya	51266.3619	.0006	KI	−0.0153		GCVS 85	-Ir	1)
FG Hya	51222.4387	.0005	KI	−0.0527	s	GCVS 85	-Ir	1)
SW Lac	50741.346	.002 .	MZ	−0.048		GCVS 85		6)
TW Lac	50585.5654	.0020	FR	+0.1172		GCVS 85		5)
	51308.4990	.0003	FR	+0.1455		GCVS 85		5)
UZ Leo	51262.3983	.0008	KI	+0.1126	s	GCVS 85	-Ir	1)
XY Leo	51256.4456	.0007	AG	+0.0065		GCVS 85	BV	2)
	51267.3830	.0004	KI	+0.0061	s	GCVS 85	-Ir	1)
XZ Leo	51222.5464	.0004	KI	+0.0262		GCVS 85	-Ir	1)
	51256.4434	.0005	AG	+0.0256	s	GCVS 85	BV	2)
AL Leo	51256.4103	.0006	AG	+0.0081	s	BAVM 53	BV	2)
FL Lyr	51266.5174	.0009	HSR	−0.0018		GCVS 85		4)
V404 Lyr	51299.5501	.0007	MS	−0.0714		GCVS 85		1)
V406 Lyr	51271.5636	.0005	MS	−0.0151		BAVM 72		1)
TV Mon	51197.2898	.0099	HSR	+0.0051		GCVS 85		4)
V453 Mon	51252.3399	.0002	MS	+0.1699		GCVS 87		1)
V913 Oph	51308.6063	.0006	RAT RCR					1)
ET Ori	50750.5646	.0005	KI	+0.0034		GCVS 85		1)
VW Peg	50708.5608	.0020	FR	+0.1333		GCVS 87		5)
	50756.4278		ATB	+0.0037		GCVS 87		1)
RV Per	51178.2660	.0012	HSR	−0.0052		GCVS 87		4)
IK Per	51249.3580	.0012	AG	−0.0899		GCVS 87	BV	2)
IZ Per	50540.579 :	.0020	KRW ZAU	+0.024		GCVS 87		4)
CC Ser	51262.4794	.0007	AG	−0.0682		GCVS 87	BV	2)
RW Tau	51177.436	.002	ADS BHM	−0.138		GCVS 87		4)
CU Tau	51185.3227	.0003	RAT RCR	+0.0417		GCVS 87		1)
X Tri	51149.3496	.0004	HSR	−0.0346		GCVS 87		4)
TX UMa	50141.4462	.0020	KRW	+0.1218		GCVS 87		4)
	50190.4596	.0020	KRW ZAU	+0.1234		GCVS 87		4)
	50193.5244	.0020	KRW ZAU	+0.1249		GCVS 87		4)
	50239.4733	.0020	KRW	+0.1252		GCVS 87		4)
UX UMa	51273.3666	.0007	HSR	+0.0015		GCVS 87		4)
UY UMa	51209.5455	.0047	HSR	+0.0623	s	GCVS 87		4)
	51236.4310	.0003	AG	+0.0627		GCVS 87		1)
	51236.6203	.0003	AG	+0.0640	s	GCVS 87		1)

Table 1: (cont.)

Variable	Min JD 24...	±	Obs	$O-C$			Fil	Rem
ZZ UMa	51255.3560	.0002	RAT RCR	−0.0025		GCVS 87		1)
	51278.3452	.0002	RAT RCR	−0.0059		GCVS 87		1)
AA UMa	51209.4335	.0011	HSR	+0.0135		GCVS 87		4)
AG Vir	51301.4318	.0008	AG	+0.0092	s	GCVS 87	BV	2)
AH Vir	51301.3588	.0017	AG	−0.0927	s	GCVS 87	BV	2)
AW Vir	51267.5188	.0005	KI	+0.0136		GCVS 87	-Ir	1)
	51288.3963	.0001	RAT RCR	+0.0053		GCVS 87		1)
AZ Vir	51262.4965	.0005	KI	−0.0154		GCVS 87	-Ir	1)
HW Vir	50925.3928	.0020	BRN STK					4)
	50947.4530	.0020	BRN STK					4)
	50950.4876	.0020	BRN STK					4)
	50953.4055	.0020	BRN STK					4)
	51302.3966	.0002	KI					1)
	51302.4548	.0004	KI					1)
Z Vul	50744.3374	.0007	MZ	−0.0107		GCVS 87		6)
AX Vul	50727.4255	.0020	FR	−0.0213		GCVS 87		5)

Table 2: Pulsating stars

Variable	Max JD 24...	±	Obs	$O-C$		Fil	Rem
RV Ari	51197.2529	.0004	KI	+0.0084	GCVS 85	-Ir	1)
	51222.3868	.0010	ATB	−0.0023	GCVS 85		1)
	51494.6111	.0021	ATB	+0.0081	GCVS 85		1)
TZ Aur	51156.5072	.0003	HSR	+0.0072	GCVS 85		4)
BH Aur	51158.2870	.0014	HSR				4)
RS Boo	51296.4242	.0015	ATB	+0.0229	BAVR 4)		1)
ST Boo	51295.4870	.0060	ATB				1)
TW Boo	51262.4308	.0010	QU	−0.0279	GCVS 85	V	4)
UU Boo	51251.5420	.0015	QU	+0.1129	GCVS 85	V	4)
UY Boo	51197.7229	.0050	HSR	+0.1536	SAC 68		4)
	51295.3498	.0030	HSR	+0.1495	SAC 68		4)
	51302.5016	.0024	HSR	+0.1418	SAC 68		4)
	51302.5020	.0060	ATB	+0.1421	SAC 68		1)
	51306.4111	.0030	HSR	+0.1461	SAC 68		4)
YZ Boo	51293.3993	.0021	ATB	−0.0011	GCVS 85		1)
CG Boo	51271.4341	.0019	MS				1)
CM Boo	51295.3750	.0004	QU	−0.0195	BAVM 75		4)
CS Boo	51253.5379	.0008	MS	−0.0058	IBVS 2855		1)
DD Boo	51299.3926	.0015	MS				1)
DG Boo	51295.4149	.0016	MS				1)
TT Cnc	51266.3889	.0055	ATB	+0.0697	GCVS 85		1)
VZ Cnc	51269.3546	.0008	KI	−0.0047	GCVS 85	-Ir	1)
AQ Cnc	51149.5950	.0007	HSR	−0.0572	GCVS 85		4)
	51165.5025	.0014	HSR	−0.0567	GCVS 85		4)
	51271.3630	.0011	KI	−0.0605	GCVS 85	-Ir	1)
RU CVn	51250.4577	.0025	HSR				4)
UZ CVn	51245.410 :	.007	HSR				4)
VW CVn	51271.3930	.0020	AG	+0.0809	BAVM 74		1)
X CMi	51199.350	.007	PS	+0.012	BAVR 6)		3)
RV CMi	51236.514	.007	PS	−0.236	GCVS 85		3)
AA CMi	51234.3569	.0011	KI	+0.0311	GCVS 85	-Ir	1)
AD CMi	51268.3696	.0004	MS	+0.0013	GCVS 85		1)
RR Cet	51469.4925	.0006	KI	+0.0009	GCVS 85	-Ir	1)
S Com	51279.473	.004	PS	+0.011	SAC 60		3)
SZ CrB	51252.4928	.0018	MS	−0.1797	GCVS 85		1)
XX Cyg	50674.4279	.0020	KRW ZAU	−0.0015	GCVS 85		4)
	50677.3965	.0020	KRW ZAU	+0.0000	GCVS 85		4)
	50677.5315	.0020	KRW ZAU	+0.0001	GCVS 85		4)
	51305.4641	.0007	HSR	+0.0007	GCVS 85		4)

Table 2: (cont.)

Variable	Max JD 24...	±	Obs	$O-C$		Fil	Rem
DD Dra	51273.6228	.0031	HSR	+0.0470	BAVM 49		4)
RR Gem	51165.3897	.0013	HSR	+0.1752	GCVS 85		4)
SZ Gem	50521.397	.002	MAR	−0.033	GCVS 85		2)
	51250.5464	.0017	ATB	−0.0372	GCVS 85		1)
VX Her	51298.3984	.0017	ATB	−0.0196	BAVR 5)		1)
	51349.3944	.0005	KI	−0.0245	BAVR 5)	-Ir	1)
LS Her	51326.4136	.0015	KI	−0.0368	GCVS 85	-Ir	1)
DG Hya	51270.3561	.0009	KI			-Ir	1)
RR Leo	51234.4838	.0006	KI	+0.0318	GCVS 85	-Ir	1)
	51272.4863	.0020	ATB	+0.0332	GCVS 85		1)
	51278.369	.005	PS	+0.034	GCVS 85		3)
ST Leo	51255.4286	.0010	QU	−0.0150	GCVS 85	V	4)
	51288.4104	.0014	ATB	−0.0141	GCVS 85		1)
	51300.3594	.0008	KI	−0.0147	GCVS 85	-Ir	1)
SW Leo	51202.660	.005	PS	+0.002	GCVS 85		3)
SZ Leo	51199.676	.010	PS	−0.229	GCVS 85		3)
AA Leo	51156.6410	.0023	HSR	−0.0555	GCVS 85		4)
Y LMi	51250.3280	.0020	HSR	+0.0184	GCVS 85		4)
TV Lyn	51158.3996	.0028	HSR	+0.0167	GCVS 85		4)
Y Lyr	51250.5405	.0022	HSR				4)
RZ Lyr	51245.6767	.0013	HSR	−0.0202	GCVS 85		4)

Remarks:

ADS: Andreas, F., Crimmitschau
AG : Agerer, F., Tiefenbach
ATB: Achterberg, Dr. H., Norderstedt
BHM: Böhme, H., Crimmitschau
BRN: Brauner, B., Herford
FR: Frank, P., Velden
HSR: Husar, Dr. D., Hamburg
KI: Kleikamp, W., Marl
KRW: Krawietz, A., Kurort Hartha
MAR: Martignoni, M., Magnano
MS: Moschner, W., Lennestadt
MZ: Maintz, G., Bonn
PS : Paschke, A. Rüti
QU: Quester, W., Esslingen
RAT: Rätz, M. Herges-Hallenberg
RCR: Rätz, Ch., Herges-Hallenberg
STK: Strunk, J., Leopoldshöhe
ZAU: Zaunick, H., Radebeul

: = uncertain
s = secondary minimum
1) = photometer CCD 375 × 242 uncoated, filter V/-Ir
2) = photometer EMI 9781A, filter: V = GG495,1mm; B = BG12, 1mm + GG385, 2mm
3) = photometer Cryocam 80A, without filter
4) = photometer ST-7, filter: V or -Ir
5) = photometer OES-LcCCD11, without filter
6) = photometer LC14, without filter
BAVM 53 = BAV Mitteilungen No. 53 = IBVS No. 3401
BAVM 65 = BAV Mitteilungen No. 65 = IBVS No. 3859
BAVM 67 = BAV Mitteilungen No. 67 = IBVS No. 3942
BAVM 71 = BAV Mitteilungen No. 71 = IBVS No. 4131
BAVM 72 = BAV Mitteilungen No. 72 = IBVS No. 4132
BAVM 74 = BAV Mitteilungen No. 74 = IBVS No. 4134
BAVM *nn* = BAV Mitteilungen No. *nn*
BAVR 1) = BAV Rundbrief 32, 36 ff
BAVR 2) = BAV Rundbrief 32,122 ff
BAVR 3) = BAV Rundbrief 33,152 ff
BAVR 4) = BAV Rundbrief 36,157 ff
BAVR 5) = BAV Rundbrief 39, 9 ff
BAVR 6) = BAV Rundbrief 44,162 f
GCVS *nn* = General Catalogue of Variable Stars, 4th ed. 19*nn*
IBVS *nnnn* = Information Bulletin on Variable Stars No. *nnnn*
SAC *nn* = Rocznik Astronomiczny Nr. *nn*, Krakow (SAC)

Corrections to IBVS No. 4711

RT	And	instead of	51179.3440	QU	correct is	51178.3440
V477	Cyg		50699.4784	AG		50693.4784

Correction to IBVS No. 4712

UY	UMa	instead of	50944.4471	AG	correct is	50944.4531

Correction to IBVS No. 4912 [From IBVS No. 5017]

UY	CVn	51245.410	HSR	must be deleted
DD	Dra	51273.6228	HSR	must be deleted
SY	Gem	51250.5464	ATB	must be deleted

ERRATUM FOR IBVS 4912 FROM IBVS 5296

IBVS No.4912:	UZ Cvn	51245.410	HSR	must be deleted
	SZ Gem	51250.5464	ATB	must be deleted

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A NEW β CEPHEI STAR IN THE RX J0136.7+6125 FIELD: BD +60°282

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The sky was surveyed in the X-ray region of the spectrum by the ROSAT satellite (Bade et al. 1998) and catalogs of the sources included RX J0136.7+6125 = GSC 4031_953. The star was one of the subjects of an investigation by Motch et al. (1997), who concluded from spectral observations that it was “a late type star displaying strong CaII H&K emission consistent with the measured X-ray flux”.

The automated 0.5-m. telescope, Cousins R filter and CCD camera of the Climenhaga Observatory of the University of Victoria and the usual reduction methods (Robb and Greimel, 1999) were used to make photometric observations from 17 December 1996 to 25 February 1997 UT (‘400’ series), 20 October to 21 November 1997 (‘700’ series) and from 17 to 29 January 2000 (‘1500’ series).

The field we observed is shown in Figure 1, and listed in Table 1 are the stars’ designations, coordinates (J2000) and magnitudes from the Hubble Space Telescope Guide Star Catalog (GSC) (Jenkner et al., 1990). In the table the ΔR differences in magnitude are found from our data in the sense GSC 4031_1099 minus the star. The ΔR magnitude given in the table is the mean of the eight nightly mean differential magnitudes of the ‘700’ series. The standard deviations of these then measure night to night variations and are listed as “Std Dev Between”. The standard deviation of the differential magnitudes during the best night are listed in Table 1 as the “Std Dev Within”. Since the field of view is so small extinction effects were negligible and no corrections have been made for them. No corrections have been made to transform the R_c magnitude to a standard system.

Table 1: Stars observed in the field of RX J0136.7+6125

GSC No. in Region 4031	RA J2000	Dec J2000	GSC Mag	ΔR Mag	Std Dev Between	Std Dev Within
0953	$01^h36^m43^s$	61°25′50″	10.7	0.258	0.008	0.004
0631	$01^h36^m39^s$	61°25′54″	10.2	0.433	0.007	variable
1099	$01^h37^m00^s$	61°25′04″	10.6	-	-	-
1001	$01^h36^m37^s$	61°25′06″	12.4	−1.413	0.004	0.006

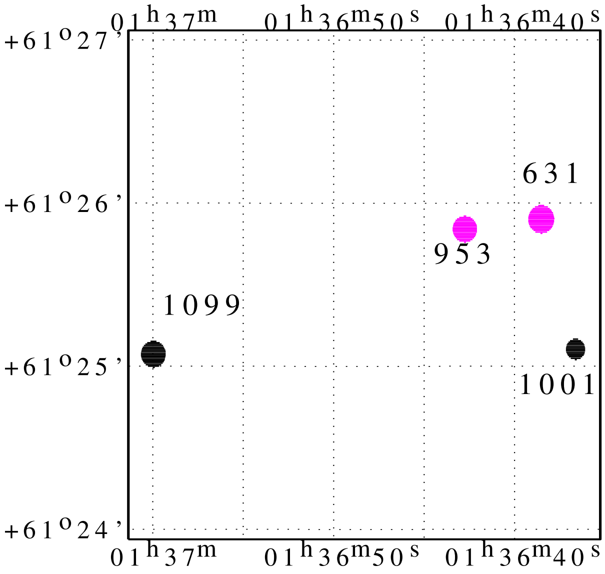

Figure 1. Finder chart labeled with the GSC numbers from region 4031.

GSC 4031_953 was monitored and found not to vary by more than approximately $0\overset{\text{m}}{.}01$ during any night. The (GSC 4031_1099 – GSC 4031_953) nightly means are given in Table 2 for all series. We believe the apparent variations in the '400' series data to be at least partly instrumental in nature. The '1500' series data are significantly different in brightness from the other years.

Brightness variations in GSC 4031_0631 were evident during a night. To increase the signal to noise GSC 4031_953 was used as the comparison star and plots of the differential R magnitudes for a few nights are shown in Figure 2. The peak to peak amplitude of the light curve was generally about 0.05, but on three of fifteen nights the amplitude approached 0.01. As can be seen from Figure 2 the light curve recovered its full amplitude between HJD 2450461 and 2450462, while on most occasions the light curve retained its full amplitude for many consecutive nights.

The Period98 (Sperl 1998) program was used to search the data for periodicities. A frequency of 4.8 cycles per day was found to be common to all three seasons, but no clearly significant common second frequency was found. In Figure 3 we plot three nights from the '1500' series data which clearly show the changing amplitude. Surprisingly the

Table 2: Individual Nights of (GSC 4031_1099 – GSC 4031_953)

HJD – 2450000	ΔR Mag	Std Dev	No. Pts	HJD – 2450000	ΔR Mag	Std Dev	No. Pts	HJD – 2450000	ΔR Mag	Std Dev	No. Pts
434	0.242	.008	187	742	0.277	.005	143	1561	0.369	.005	252
436	0.236	.010	51	764	0.259	.006	236	1567	0.368	.005	101
461	0.324	.018	176	765	0.251	.006	298	1571	0.346	.018	42
462	0.334	.010	144	766	0.258	.005	59	1572	0.338	.006	212
463	0.296	.012	118	767	0.253	.005	124				
464	0.308	.009	211	768	0.253	.005	119				
				773	0.256	.004	117				
				774	0.256	.007	56				

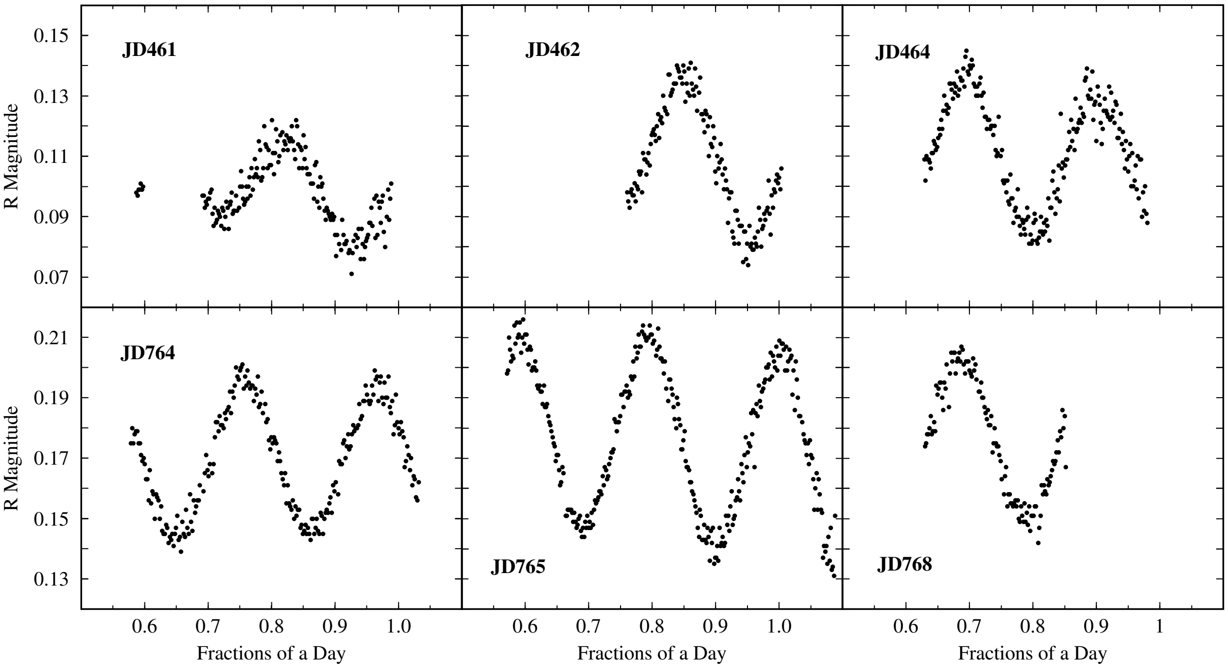

Figure 2. Sample light curves of the differential R data of (953–631) during 1997

minimum brightness levels are coincident, *not* the mean level. This behavior was also observed for the '700' series data, but for the '400' series the mean level varied from night to night due to flatfield variations.

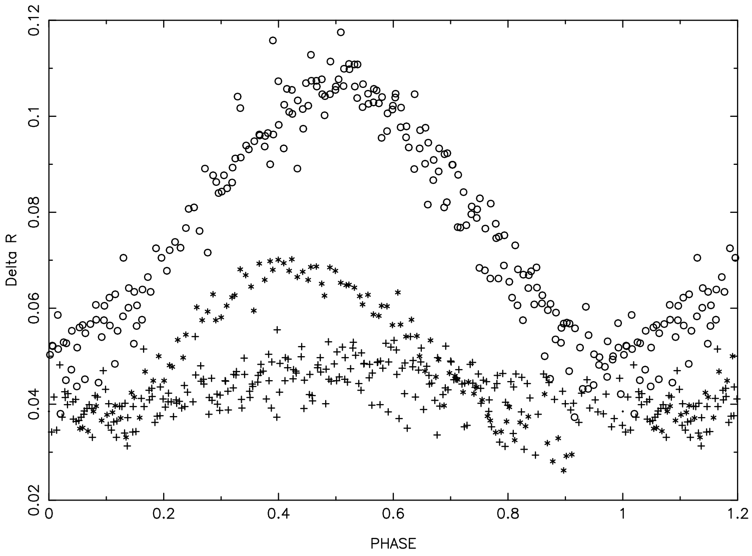

Figure 3. ΔR light curves of (953–631) for JD 1561(+), 1567($*$), and 1572($\circ$)

Times of extrema given in Table 3 with the uncertainty shown in brackets were found by the method of Kwee and Van Woerden (1956) using data within $\pm 0\overset{d}{.}05$ of the extrema. This algorithm assumes that each extremum is symmetrical, but since this is not the case, our estimates of the error are lower limits to the actual uncertainty. The periods and epochs in Table 4 were determined from the times of extrema with the uncertainty in the last significant figure given in brackets. Although the periods are statistically

Table 3: Times of Extrema (HJD – 2450000.) of GSC 4031_0631

Max	Min	Max	Min	Max	Min
461.8203(4)	434.8633(5)	742.8338(5)	742.7418(4)	1561.6952(4)	1561.7946(4)
462.8470(3)	462.9536(4)	764.7583(14)	764.6492(7)	1567.6593(4)	1572.7253(7)
463.8681(10)	464.8022(5)	764.9670(5)	764.8612(6)	1572.6249(4)	
464.6948(7)		765.7937(9)	765.6913(6)	1572.8250(7)	
464.8987(6)		765.9985(7)	765.8998(4)		
		766.6178(7)	768.7898(6)		
		767.6472(5)			
		768.6856(5)			
		773.8703(6)			

Table 4: Period and Epoch of Maxima of GSC 4031_0631

Series	Epoch	Period	RMSE
400s	$2450434\overset{\mathrm{d}}{.}7617(76)$	$0\overset{\mathrm{d}}{.}20647(12)$	$0\overset{\mathrm{d}}{.}0076$
700s	$2450765\overset{\mathrm{d}}{.}7929(14)$	$0\overset{\mathrm{d}}{.}20680(6)$	$0\overset{\mathrm{d}}{.}0051$
1500s	$2451561\overset{\mathrm{d}}{.}6907(46)$	$0\overset{\mathrm{d}}{.}20621(22)$	$0\overset{\mathrm{d}}{.}0068$

different, the root mean square errors (RMSE) are large and we contend that the period is the same for all three series.

A SIMBAD reference search for GSC 4031_0631 reveals that it is BD+60°282 and has a $V = 10.63$, $B - V = 0.42$, $U - B = -0.48$, and a spectral class of B1III (McCuskey 1974) in agreement with a spectral classification by Motch (1997) of B2II.

Since RX J0136.7+6125 = GSC 4031_953 is a late spectral type star which shows X-ray emission and yearly timescale optical variations, we expect it to be a spotted star, which exhibits solar cycle type variations. BD+60°282 = GSC 4031_631 is a reddened early spectral type, rapidly pulsating star of the β Cephei type. Its period of variation is approximately $0\overset{\mathrm{d}}{.}207$, but is complicated. Further photometric and spectroscopic observations will be valuable to confirm our conclusions as to the reason for the variability of these stars.

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A NEW ECLIPSING BINARY IN THE FIELD OF LHS 2176 AND 2178

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The nearby stars LHS 2178 = GJ 362 = GSC 4386_1592 and LHS 2176 = GJ 360 = = GSC 4386_1705 have had their properties summarized by Hünsch et al. (1999), including their visual and X-ray brightnesses, colors, spectral types, and distances. Panagi and Mathioudakis (1993) report Hα emission in LHS 2178. We observed these stars in a continuing search for photometric variations in active stars.

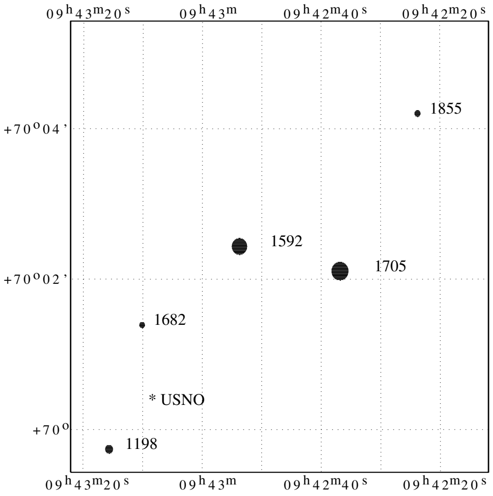

Figure 1. Finder chart labeled with the GSC numbers and an $*$ to denote USNO1575–03003814.

Figure 1 shows the field of stars observed with the automated 0.5m telescope of the Climenhaga Observatory at the University of Victoria and reduced in a fashion similar to that described in Robb and Greimel (1999). Table 1 lists the stars' identification numbers, coordinates (J2000) and magnitudes from the Hubble Space Telescope Guide

Table 1: Stars observed in the field of LHS2178

GSC No.	R.A. J2000	Dec. J2000	GSC Mag.	ΔC Mag.	Std Dev Between	Std Dev Within
4386_1592	$09^{\rm h}42^{\rm m}54^{\rm s}$	$+70^\circ02'26''$	10.8	-	-	-
4386_1705	$09^{\rm h}42^{\rm m}37^{\rm s}$	$+70^\circ02'06''$	10.2	-0.539	0.016	0.002
4383_1198	$09^{\rm h}43^{\rm m}16^{\rm s}$	$+69^\circ59'44''$	13.8	3.875	0.031	0.011
USNO1575–03003814	$09^{\rm h}43^{\rm m}09^{\rm s}$	$+70^\circ00'09''$	15.4	5.159	0.130	-
4386_1682	$09^{\rm h}43^{\rm m}10^{\rm s}$	$+70^\circ01'23''$	14.6	4.867	0.098	0.029
4386_1855	$09^{\rm h}42^{\rm m}24^{\rm s}$	$+70^\circ04'12''$	14.5	5.020	0.090	0.035

Star Catalog (GSC) (Jenkner et al. 1990). Initially observations were made in R_c and I_c, but to increase the signal to noise ratio we were forced to observe with no filter, which we designate with a "C". From standard star observations we found that our system with no filter had a very wide passband with a center wavelength close to that of Cousins R, but with 3.5 times the flux. Our differential ΔC magnitudes are calculated in the sense of the star minus LHS2178. For each star the mean of the nightly means is shown as ΔC in Table 1. The standard deviation of the nightly means is a measure of the night to night variations and is called "Std Dev Between" in Table 1. Brightness variations during a night were measured by the standard deviation of the differential magnitudes and are listed for the most photometric night in the last column as "Std Dev Within".

From the plots of individual night's data we observed no significant variations in LHS 2178 or LHS 2176. From night to night there were variations larger than we would have expected, however the comparison stars are so faint that we cannot claim to have seen photometric variations on a daily time scale.

The star USNO1575–03003814 (Monet et al. 1996) had obvious variations during a night and is a new eclipsing binary star. There is no ambiguity in the determination of its orbital period, since two of the nights contain more than one minimum. Using data points within $0\overset{\rm d}{.}04$ of the minimum, and the method of Kwee and van Woerden (1956), the heliocentric Julian Dates of minimum brightness were found and are listed in Table 2 with a letter indicating the filter used.

Table 2: Times of Minimum (HJD – 2451000) of USNO1575–03003814

Primary	643.7333R	651.8163C	652.7902I	653.7574C	671.8686C	672.8403C
Secondary	643.8984R	652.9475I	677.8507C	680.7647C		

Assuming the secondary minima are at phase 0.5, a fit to these times gives the ephemeris:

$$\text{HJD of Primary Minimum} = 2451643\overset{\rm d}{.}7333(10) + 0\overset{\rm d}{.}32340(3) \times E.$$

where the uncertainties in the final digit are given in brackets and the root mean square error of the fit is $0\overset{\rm d}{.}0021$. The 947 differential (LHS 2178 − USNO1575–03003814) unfiltered magnitudes phased at this period are plotted in Figure 2 with different symbols for each of the nights. The large scatter is attributable to the faintness of the object.

To ascertain the temperature and brightness of the variable star, CCD frames of the field were obtained with B, V, R_c and I_c filters. The stars LHS 2178 and LHS 2176 have

B, V, R$_c$ and I$_c$ magnitudes measured by Weis (1996), thus allowing us to transform our observed magnitudes to the standard Cousins system. For USNO1575–03003814 this yields values of $V = 15.43 \pm .10$ and $B-V = 1.04 \pm .10$, $V-R = 0.53 \pm .10$, $V-I = 0.86 \pm .10$ at maximum light. The reddening would be $E_{B-V} = 0.132$, $E_{V-I} = 0.182$ with an extinction of about $A_v = 0.439$ (Schlegel et al. 1998). From the dereddened colors we estimate the spectral class of USNO1575–03003814 to be approximately K0V (Cousins 1981).

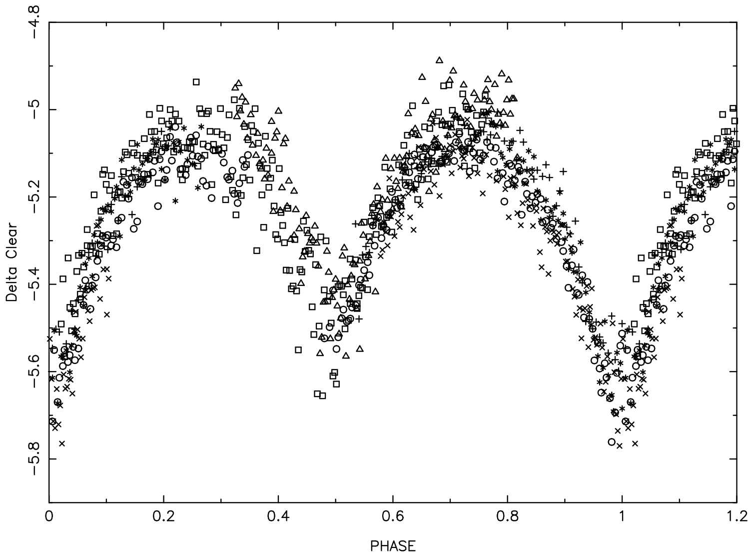

Figure 2. Unfiltered light curve of USNO1575–03003814 for spring 2000

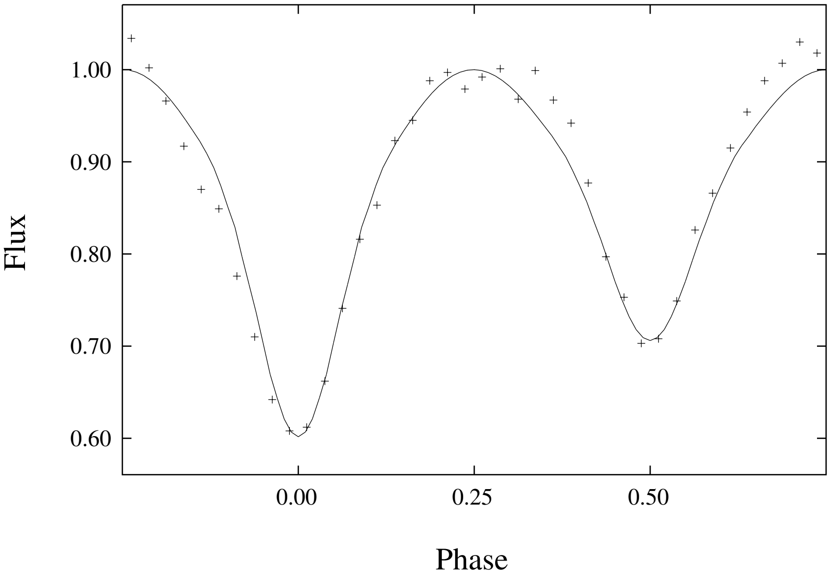

Figure 3. Unfiltered normal points with curve from an example model of the eclipsing system

While the true nature of this system cannot be determined from these data, a model can be found using reasonable parameters. The light curve leads us to expect this to be a near-contact system. Using Binmaker 2.0 (Bradstreet 1993), the model light curve as shown in Figure 3 was made. We assumed a temperature of 4900K for the primary and a mass ratio of 0.95. A satisfactory fit to the data was found with an inclination of 71.5° and a temperature of the secondary star 500K cooler than the primary star. Two main-sequence stars of this temperature difference would have a mass ratio of 0.95. The eclipses are then well fit with the stars just touching the inner critical surface of the Roche Lobe (fillout = 0.0). The uncertainty in the inclination is about ±2° and the difference in temperature is known to about ±10% both dependent on the assumed mass ratio.

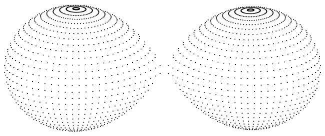

Figure 4. Three-dimensional model of the near-contact system at phase 0.25

The relative sizes and shapes of the components of the system are shown in Figure 4, again using Binmaker 2.0 (Bradstreet 1993).

The absolute magnitude can be estimated from the period and $(B-V)_0 = 0.91$ (Rucinski and Duerbeck 1997) and $(V-I)_0 = 0.68$ (Rucinski 2000) to be $M_V = 4.7 \pm .3$ giving a distance of 1140 ± 150 pc. The dependence of the absolute magnitude on the color through Rucinski's formula is nearly equal to the relationship of extinction and the reddening making the distance determination almost independent of the extinction.

The star USNO1575–03003814 is therefore a near-contact eclipsing system with late-type components. Photometric observations should be continued to monitor light curve changes due to spot migration, flares, and period changes. Spectroscopic observations will be valuable to determine a precise spectral class for the system and to measure radial velocities to determine the masses and the scale of the system.

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V803 CEN – THE SECOND "HELIUM ER UMa STAR"

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Small group of helium-rich variable stars, known as AM CVn stars, are considered as ultra-short period interacting binary white dwarfs (for a review, see Warner 1995). Among AM CVn stars, CR Boo, V803 Cen and CP Eri are known to show large-amplitude variations up to five magnitudes, on a time scale of less than a day to several months. The origin of such large-amplitude variation is still poorly understood. Warner (1995) proposed the similarity to VY Scl-type cataclysmic variables, whose "low states" are generally believed to result from reduced mass-transfer. Tsugawa and Osaki (1997) applied the dwarf nova-type thermal and tidal instability model to the helium disk systems, including CR Boo and V803 Cen. They succeeded in understanding the behavior of these systems by considering the stability of the accretion disk depending on the mass-transfer rate. Tsugawa and Osaki (1997) expected that intermediate mass-transfer systems, such as CR Boo and V803 Cen, will undergo dwarf nova-type disk instability, analogous to SU UMa-type dwarf novae in hydrogen-rich systems. They suggested higher mass-transfer systems would resemble ER UMa stars, which are a subgroup of SU UMa-type dwarf novae having extremely short supercycle length (for a review, see Kato et al. 1999). Subsequent observation indeed confirmed the presence of 46.3-d supercycle in CR Boo (Kato et al. 2000), whose behavior is extremely analogous to ER UMa stars. The application to the next candidate, V803 Cen, has been naturally sought as a part of VSNET Collaboration (http://www.kusastro.kyoto-u.ac.jp/vsnet/).

Visual observations were performed using 32-cm (R.S.), 32-cm (B.M.) and 40-cm (A.P.) reflectors. All observations were done using photoelectrically calibrated V-magnitude comparison stars. The typical error of visual estimates was less than 0.2 mag, which does not affect the following discussion. The total number of observations between 1998 November 17 and 2000 June 12 was 464.

The overall light variation is presented in Figure 1. Each filled square represents single estimates and '$\vee$' sign represents upper limits. The quasi-periodic occurrence of bright states and faint states associated with brief brightenings is clearly demonstrated. The behavior is very reminiscent of that of CR Boo (Kato et al. 2000). The light maxima are separated by $\sim$ 77 d in each observing seasons of 1998–1999 and 1999–2000. We consider this period as the representative supercycle. Individual observations are folded by this period, using the maximum epoch of JD 2451271 for the 1998–1999 season and

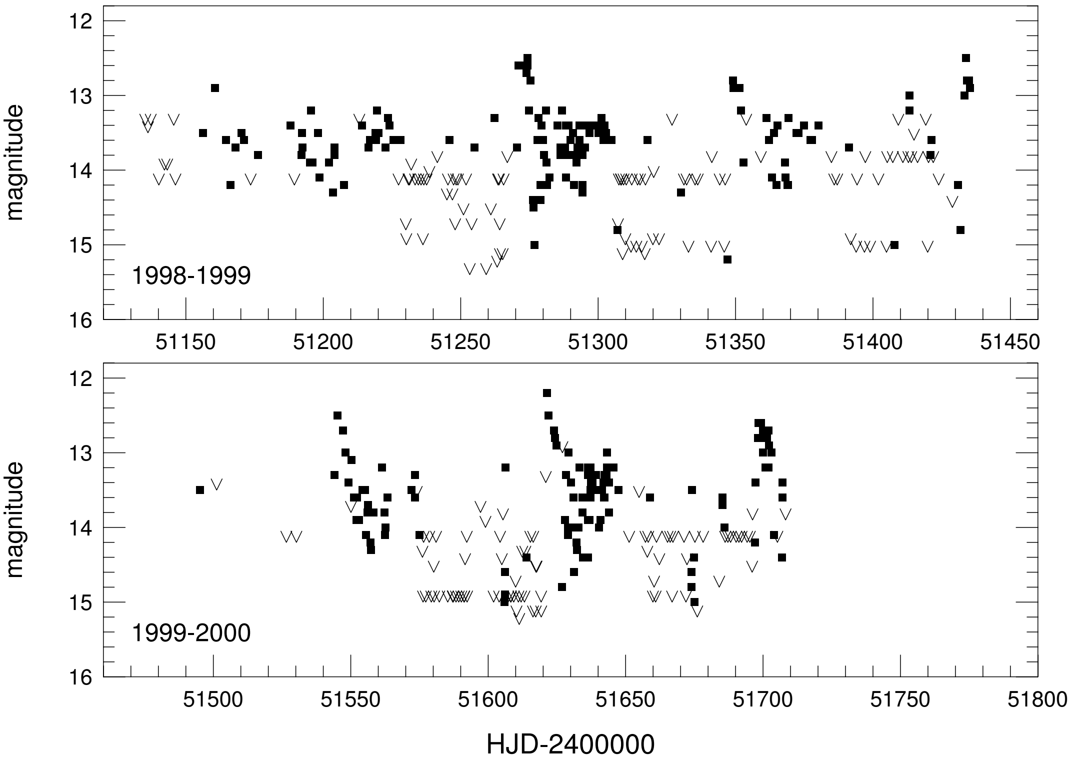

Figure 1. Overall light curve of V803 Cen

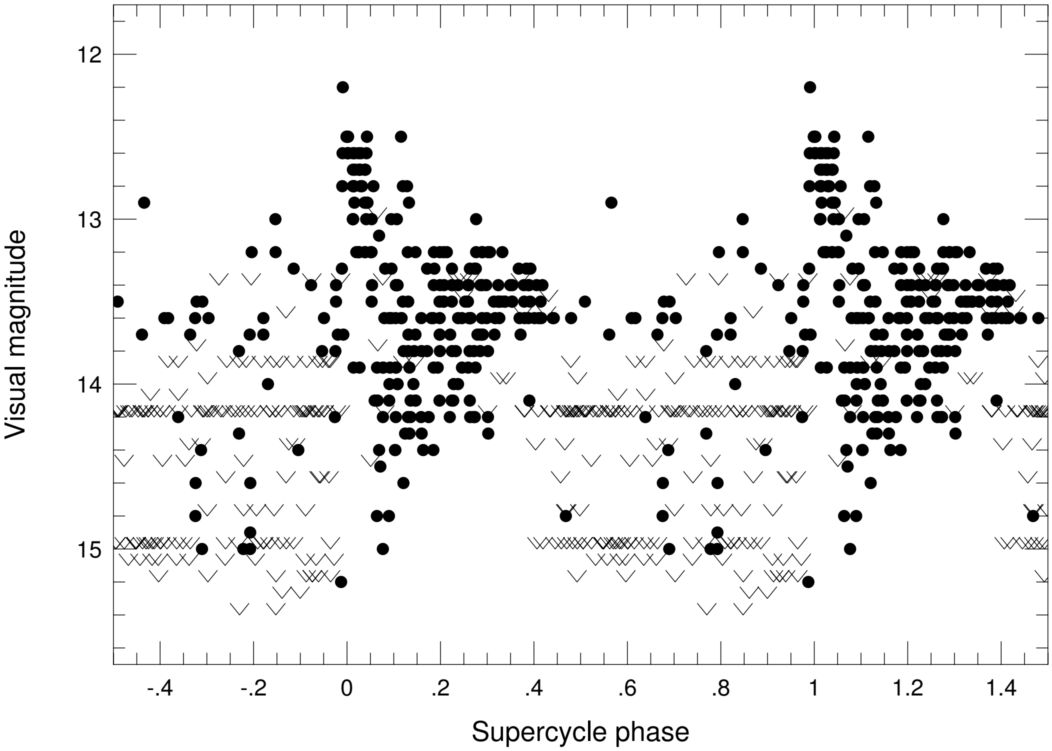

Figure 2. The 77-d supercycle of V803 Cen

Table 1: Comparison of V803 Cen and CR Boo

	V803 Cen	CR Boo
V-magnitude range	12.2–16.8	13.0–17.5
main photometric period (s)	1611	1490
supercycle length (d)	77	46.3
superoutburst duty cycle	0.4	0.5

JD 2451545 for the 1999–2000 season. The interval was 111 d between the last maximum of the 1998–1999 season and the first maximum of the 1999–2000 season. This may suggest some change occurred around the solar conjunction. However, by treating the two seasons separatedly, the quasi-periodic outburst pattern was found to be highly stable within each seasons.

Figure 2 represents the folded light curve of V803 Cen, which shows a pattern very similar to that of CR Boo, "the helium ER UMa star" (Kato et al. 2000). The bright phase (superoutburst) comprises a duty cycle of ~ 0.4 supercycle, which is close to the value ~ 0.5 in CR Boo. Large-amplitude damping oscillations were observed during the decay from the superoutburst maximum, which may correspond to short-term modulations with a time scale of a day (Patterson et al. 2000), and the feature suspected as "dips" in CR Boo (Kato et al. 2000). During the rest of supercycle phase (phase 0.6–1.0), the object is mostly faint with short brightenings, which are likely to correspond to normal outbursts in SU UMa-type dwarf novae. The overall behavior of V803 Cen can be understood as a natural extension of the CR Boo activity toward the lower mass-transfer rate, which is perfectly what is expected from its supposed orbital period (Tsugawa and Osaki 1997). The parameters of these two "twin" systems are summarized in Table 1: outburst parameters from this work and Kato et al. (2000) and main photometric period from Warner (1995).

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VW Peg: FIRST PHOTOELECTRIC OBSERVATIONS AND REVISED ELEMENTS

BAV Mitteilungen Nr. 129

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The Algol-type variable VW Pegasi (= GSC 2753.649 ($11\overset{\text{m}}{.}06$ mag); USNO-A2.0: $B = 12\overset{\text{m}}{.}0$; $R = 11\overset{\text{m}}{.}2$) was — after the photographic discovery in 1901 — first studied by Williams (1914) indicating a period of 5.26792 days. A new period of 2.642758 days resulted from some observations of Maggini (1916). As Zinner (1922) reported, he was not able to confirm any of the proposed periods. He even discussed a reclassification supposedly due to some misleading visual observations. Further observations from the Cracow observatory (observers: J. Kordylewska and K. Kordylewski), collected by Szafraniec (1962) were published; based on these observations two new suggestions on the period were made by Dworak (1976): 1.170648 days or 2.341295 days. By means of a reanalysis of the known data B.-C. Kämper suggested the period of 21.0717 days, which was only briefly communicated by Busch (1994). The variety of periods caused some confusion; many observations may have failed and in consequence even the possibility of VW Peg being constant was discussed by Dahm (1996).

In order to resolve the issue regarding the value of the period, a series of systematic CCD observations was started in 1997. These CCD observations finally indicated the occurrence of two different types of minima.

As principal comparison star we used GSC 2753.1568 ($11\overset{\text{m}}{.}44$ mag); (USNO-A2.0: $B = 12\overset{\text{m}}{.}6$; $R = 11\overset{\text{m}}{.}2$). Cracow observers used this star as well, but assuming $11\overset{\text{m}}{.}38$ mag (v). The star was observed to be constant within $\pm 0\overset{\text{m}}{.}02$.

Through several complete observation series, the primary and secondary minima were characterized in amplitude and width (cf. Figures 1 and 2).

The amplitudes Δm (measured with red sensitive, unfiltered CCD chip, the errors are estimated), and durations D of the minima are:

$$\begin{array}{ll}
\text{Min I}: & \Delta m \approx 0.71 \pm 0.03 \text{ mag};\ D = 320^{\text{m}} \pm 25^{\text{m}} \approx 0\overset{\text{d}}{.}22 \quad [D_{1/2} = 125^{\text{m}} \pm 10^{\text{m}} \approx 0\overset{\text{d}}{.}09], \\
\text{Min II}: & \Delta m \approx 0.65 \pm 0.03 \text{ mag};\ D = 430^{\text{m}} \pm 0^{\text{m}} \approx 0\overset{\text{d}}{.}30 \quad [D_{1/2} = 180^{\text{m}} \pm 12^{\text{m}} \approx 0\overset{\text{d}}{.}13].
\end{array}$$

(Definition of $D_{1/2}$: full width at half amplitude of the minima — which has been introduced as it allows to be determined more exactly than the time of eclipse D. The errors

Table 1: Observed times of primary (Min I) and secondary (Min II) minima for VW Pegasi, epochs and residuals computed according to the linear ephemeris (1) and (2), respectively.

Min I						Min II					
JD hel. − 2400000	±*	T**	E_1	$O-C_1$	Ref.	JD hel. − 2400000	±*	T**	E_2	$O-C_2$	Ref.
15729.462	.020	P	−1660	0.0043	[1]	16704.482	.020	V(x)	−1614	−0.0040	[1]
16635.541	.014	V(x)	−1617	−0.0020	[1]	17526.280	.014	V(x)	−1575	−0.0041	[1]
17478.414	.014	V(x)	−1577	0.0009	[1]	26650.354	.011	V	−1142	0.0040	[2]
17815.560	.010	V	−1561	−0.0011	[1]	50756.4271	.0035	E(x)	2	−0.0001	[3]
26307.474	.010	V	−1158	−0.0028	[2]	50756.4278	.0010	E	2	0.0006	ATB
28372.517	.014	V	−1060	0.0086	[2]	51030.3606	.0042	E(x)	15	0.0007	HSR
50708.5621	.0014	E	0	−0.0024	FR	51346.441	.010	E(x)	30	0.0049	HSR
50708.5626	.0050	E(x)	0	−0.0019	[3]	51388.5777	.0021	E_R	32	−0.0019	HSR
50982.494	.010	E(x)	13	−0.0033	HSR	51388.5785	.0014	E	32	−0.0011	HSR
51045.7134	.0035	E(x)	16	0.0008	HSR	51388.5790	.0025	E_I	32	−0.0006	HSR
51319.647	.006	E(x)	29	0.0017	HSR	51388.5813	.0011	E_V	32	0.0017	HSR
51509.2913	.0021	E	38	0.0002	FR	51578.2235	.0028	E(x)	41	−0.0018	ATB
51509.2930	.0010	E	38	0.0019	HSR	51599.297	.010	E(x)	42	0.0000	ATB

* Estimated errors of the minimum timings (reflecting errors in magnitude, as well as total number and distribution of the measured values with regard to time).

** P, V, and R denotes photographic, visual, and CCD observed minima, respectively. Observations with $V/R/I$-filters are marked as $E_V/E_R/E_I$, respectively. Those marked with (x) were extrapolated minima.

References: [1] reevaluated timings, based on data from Williams (1914); [2] reevaluated timings, based on data from Szafraniec (1962); [3] based on data from Quester (1999). Data from the observers: ATB = Achterberg / FR = Frank / HSR = Husar (this paper).

Information on the used equipment:

H. Achterberg: 20-cm SC refl. with a SBIG ST6 camera (CCD chip: TI TC241), without filter.

P. Frank: 28.8-cm flat-field-refl. with a OES-LcCCD11 camera (CCD chip: Kodak KAF400), without filter.

D. Husar: 20-cm SC refl. with a SBIG ST7 camera (CCD chip: Kodak KAF400), without filter or Bessel-type $V/R/I$-filters.

W. Quester: 20-cm MC refl. with a SBIG ST7 camera (CCD chip: Kodak KAF400), with IR-cutoff-filter KG5/2mm.

are estimated.) There may well be constant phases of $d \leq 7^{\rm m}$ during Min I and $d \leq 10^{\rm m}$ during Min II.

The observations of 11 different new minima of VW Peg with 17 independent timings are contributed by this paper and included in Table 1.

Based on the data of the almost completely observed minima, two sets of polynomials were derived by least-squares fitting procedures to describe the light curves in Min I and Min II. By matching these polynomials to the data of only partly observed minima we were able to determine the time and in most cases even the type of the aforementioned minima with considerable reliability. In Table 1 these minima are marked as extrapolated (x).

The published minima as derived from the visual observations from Williams and from the Cracow observers were reevaluated from the well documented original estimates. As given in Table 1 these minima include some small corrections compared with the earlier publications. In the original data of Williams two further (secondary) minima were found which were not published until now. Regarding one minimum he had been mislead by using a deviating magnitude for the mentioned comparison star (his star b), the other was mentioned only as discordant observation. The data from the Cracow observers J. Kordylewska and K. Kordylewski for the minimum HJD 2426307.474 due to the scatter of the data were put together for our fitting procedure in order to obtain the minimum timing with better reliability (reduced estimated error for the observation).

In Table 1 the visual observations of Maggini (1916) were excluded from the analysis as they appeared to be in contradiction to most other observations. The reported minimum at JD = 2450824.278 of the visual minima timings of Peter (as published in the BBSAG

Bulletins) disagreed for unknown reasons with a CCD observation in normal light, and caused all minima of Peter to be completely excluded from further analysis.

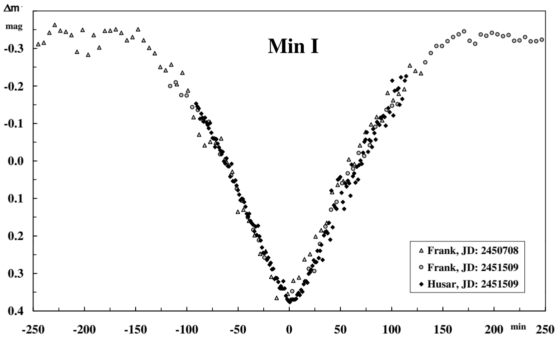

Figure 1. Light curve of Primary Minimum of VW Peg (symbols are explained in the figure).

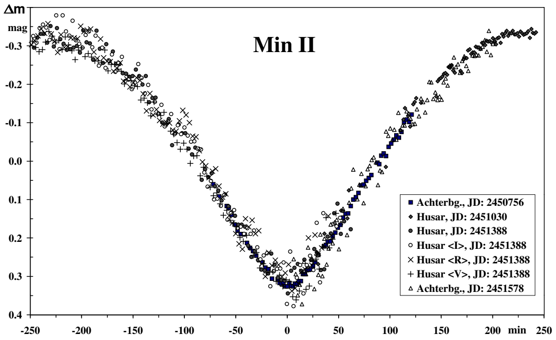

Figure 2. Light Curve of Secondary Minimum of VW Peg (symbols are explained in the figure).

Since 1997 nearly 5000 individual photoelectric observations with VW Peg apparently in normal light were made by Achterberg (18 nights), Frank (11 nights) and Husar (58 nights). These observations are listed electronically as 4916-t2.txt available through IBVS Web-site. The detailed results of these observations are available from the authors.

For the final period analysis we also used the nearly 800 visual observations during normal light from Williams (1904–1914), from the Cracow observers in the years 1930–1950 published by Szafraniec (1962), as well as the ones from 1951–1954 observed by K. Kordylewski and communicated by Kreiner (2000).

In a first run we only used the CCD observations of the minima together with our observations in normal light to check the different assumptions on the period which was realized using a computer program which searches in a wide range of period values. Later the systematic period search was extended to all observations given in Table 1 and to all observations in normal light as mentioned above. The only resulting periods (for Min I and Min II) lie very close to the value supposed by Kämper.

The primary and secondary minima from Table 1 were used separately to calculate the ephemeris for VW Peg using linear least-squares fits (weights were chosen according to the precision of the minimum timings):

$$\begin{array}{rl} \text{Min I} = \text{HJD } 2450708.5645 + 21\overset{\text{d}}{.}0717511 \times E. \\ \pm.0007 \quad\quad \pm.0000013 \end{array} \tag{1}$$

$$\begin{array}{rl} \text{Min II} = \text{HJD } 2450714.2837 + 21\overset{\text{d}}{.}0717458 \times E. \\ \pm\ .0005 \quad\quad \pm\ .0000017 \end{array} \tag{2}$$

This means that the secondary minimum is observed at phase 0.27141 ± 0.00004 (for epoch $E = 0$). As the difference of the periods in (1) and (2) is only about 2.5 times the calculated error it seems too early to make a statement on apsidal motion, but the result is seen to be encouraging for future observations.

From the phase of the secondary minimum, period, D_1 and D_2 we calculated the numerical eccentricity e of the orbit to be $e = 0.39 \pm 0.02$.

In the figures of the reduced light curves the relative magnitudes Δm of different observations are in the instrumental system and a minor part has been slightly corrected within $0\overset{\text{m}}{.}03$ to match. In Fig. 1 and Fig. 2 the time scale is in minutes, based on the given elements (1) and (2) respectively, with $t = 0$ for the times of minima.

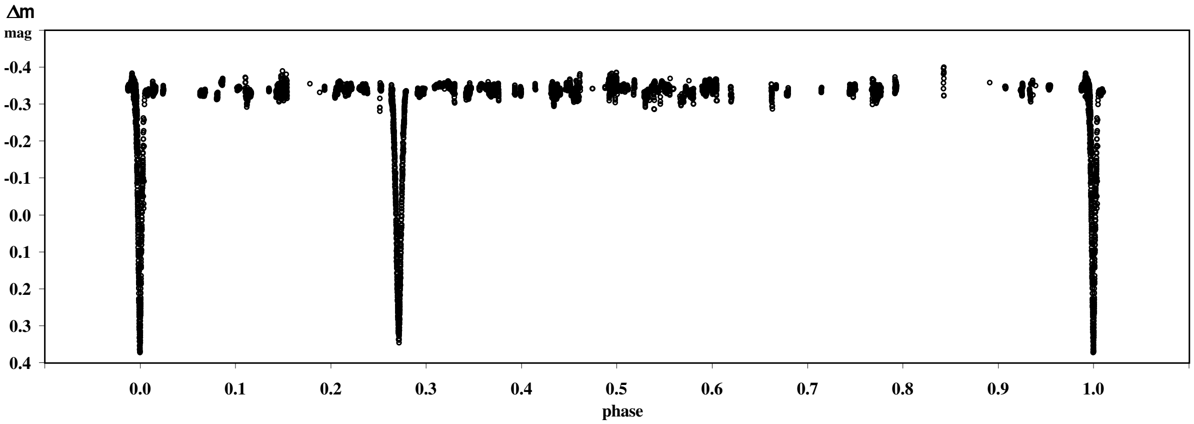

Figure 3. Complete Light Curve of VW Peg (the plotted points represent gliding 5-point mean values of the photoelectric data).

Figure 3 represents the complete phased light curve (only photoelectric data) based on elements (1). The classification of the variable as an eclipsing binary of the type EA is confirmed by the light curve.

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PHOTOELECTRIC OBSERVATIONS OF THE FLARE STAR YZ CMI IN 1999-2000

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The well-known spotted flare star YZ CMi was extensively observed during the past years and flares have been detected in the optical, radio and X-ray wavebands. YZ CMi is a spotted dM4.5e star at a distance of 5.9 pc (Gershberg et al., 1999). The rotational period, determined from spot light curves, is about 2.77 days (Chugainov, 1974; Pettersen et al., 1983).

Here we report on 7 flares detected on this star during our observing run in 1999–2000.

As a part of a flare star monitoring programme, YZ CMi was observed at the Rozhen National Astronomical Observatory with the 60-cm telescope and the *UBV* photon-counting single-channel photoelectric photometer. The monitoring was carried out in the *U*-band with an integration time of 1 s.

The log of observations is given in Table 1. I_0 is the quiet star intensity minus sky background, and σ/I_0 is the noise. During the total of 9.589 hours 7 flares were recorded and their characteristics are listed in Table 2. The flare magnitudes were computed with respect to the quiescent stellar level I_0 as

$$\Delta m\ [\mathrm{mag}] = 2.5 \log \frac{I_{0+f}}{I_0}. \tag{1}$$

The flare amplitude is:

$$\frac{I_f}{I_0} = \frac{I_{0+f} - I_0}{I_0}. \tag{2}$$

By numerical integration of the flare light curve, the equivalent duration of each flare was calculated from

$$ED = \int_{\mathrm{flare}} I_f(t)\, dt. \tag{3}$$

The flare energies (last column in Table 2) were obtained by the relation

$$\log E_f = \log ED + \log E_q^U, \tag{4}$$

where the quiescent star luminosity of YZ CMi $E_q^U = 4.11 \times 10^{28}$ ergs s^{-1} was determined using: $V = 11.15$, $B - V = 1.61$, $U - B = 0.97$, distance $r = 5.9$ pc (Gershberg et al., 1999), and the luminosity of a star with an absolute magnitude $M = 0$ in the U-band $E^U = 3.65 \times 10^{34}$ ergs s^{-1} (Moffett, 1973).

The light curves of the observed flares are plotted in Figures 1-2.

Table 1: Log of U-band flare monitoring of YZ CMi from Rozhen NAO.

Date		Monitoring intervals [UT] [h : m : s – h : m : s]	Effective monitoring time [s]	Noise σ/I_0	Flares
1999	11 Mar	19:01:54–19:12:32, 19:13:25–19:26:46	1441	0.22	no
	13 Mar	18:55:07–19:10:56, 19:11:31–19:27:06, 19:28:03–19:43:41, 19:44:49–19:46:56, 19:47:40–20:06:01, 20:06:52–20:24:25, 20:26:51–20:44:15, 20:50:17–20:09:15.	7293	0.17	2
	14 Mar	18:29:27–18:46:40, 18:50:02–19:08:06, 19:10:10–19:28:10, 19:29:00–19:46:15, 19:49:31–20:07:58, 20:08:42–20:26:11, 20:26:56–20:43:49, 20:46:30–20:03:55, 21:05:31–21:23:30, 21:24:16–21:39:39	10458	0.27	3
	15 Mar	18:26:49–18:44:04, 18:44:54–19:01:59, 19:03:26–19:20:54, 19:21:36–19:38:52, 19:40:21–19:57:42, 19:58:47–20:15:09, 20:06:03–20:33:05	7205	0.17	no
	01 Oct	02:45:16–03:05:10, 03:05:53–03:15:30	1773	0.23	no
2000	09 Mar	17:48:40–17:59:07, 18:00:44–18:16:26, 18:17:20–18:32:50, 18:33:26–18:50:30	3527	0.20	2
	12 Mar	18:09:05–18:24:22, 18:25:07–18:41:11, 18:42:15–18:57:55	2824	0.30	no
		Total time:	$34521^{\mathrm{s}} = 09^{\mathrm{h}}35^{\mathrm{m}}21^{\mathrm{s}}$		

Table 2: Characteristics of the U-band flares for YZ CMi.

No.	Date [UT]	Flare max [UT]	t_{rise} [sec]	Duration [m : s]	Noise $\frac{\sigma}{I_0}$	Amlitude $\frac{I_{0+f} - I_0}{I_0}$	Δm [mag]	$\log E_f$ [ergs]
1	13.03.1999	20:13:30	8	1:28	0.18	0.89	0.69	30.06
2	13.03.1999	20:30:06	12	0:59	0.16	1.19	0.85	29.84
3	14.03.1999	18:32:15	2	0:30	0.27	0.86	0.68	29.68
4	14.03.1999	18:52:30	58	2:26	0.26	1.31	0.91	30.14
5	14.03.1999	19:20:41	52	1:57	0.28	2.61	1.39	30.45
6	09.03.2000	17:50:20	2	0:04	0.18	5.34	2.00	29.64
7	09.03.2000	18:11:09	14	0:30	0.21	0.94	0.72	29.52

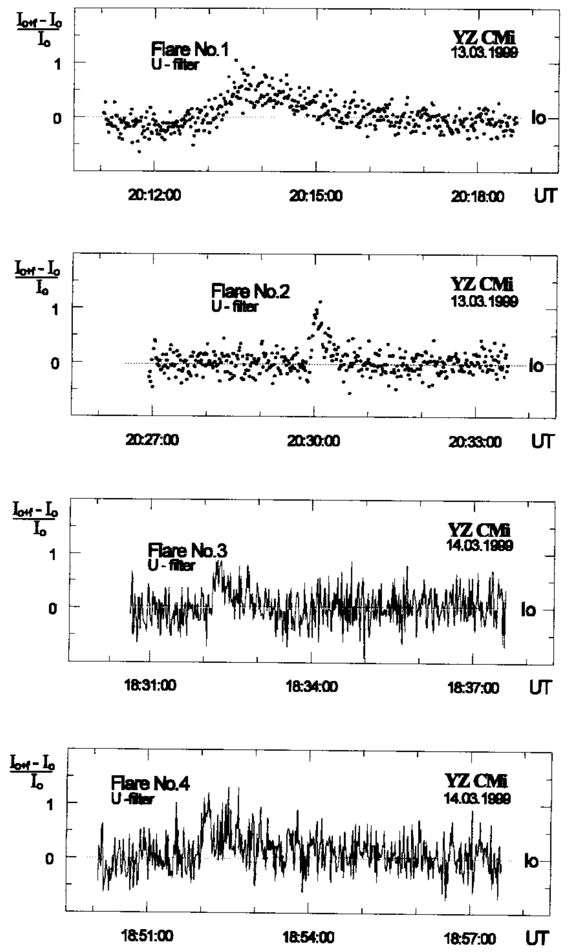

Figure 1. YZ CMi flares No. 1, 2, 3 and 4

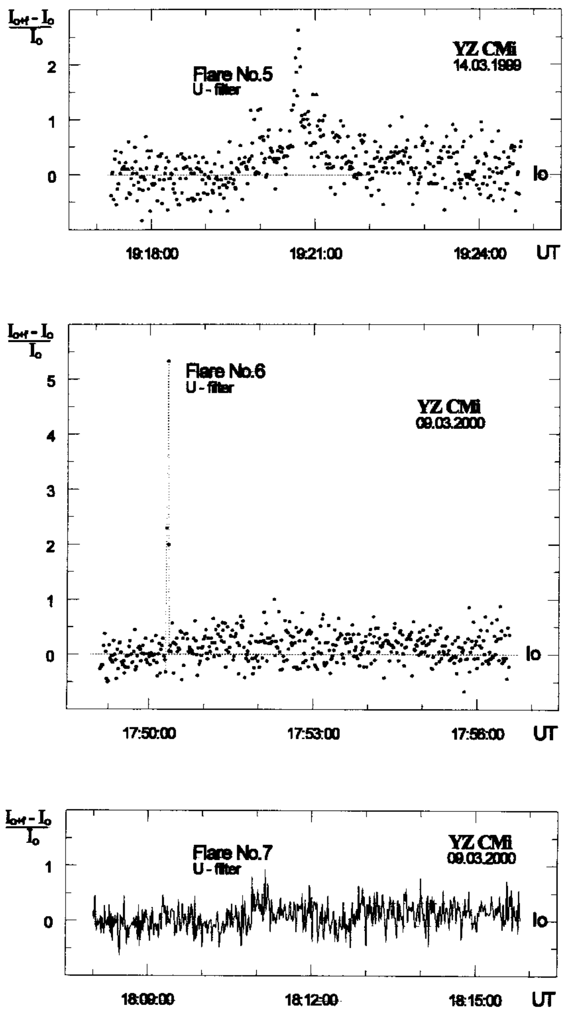

Figure 2. YZ CMi flares No. 5, 6, and 7

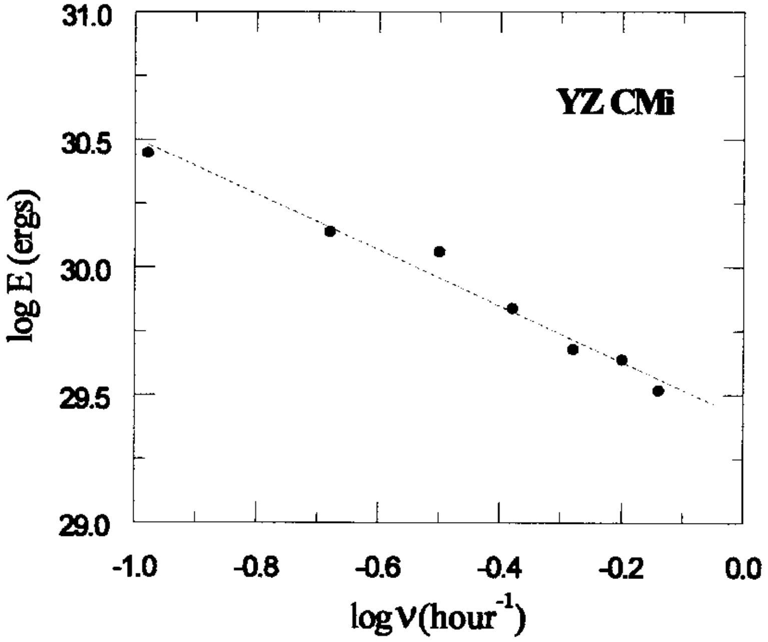

Figure 3. Flare energy $\log E$ vs. cumulative flare frequency $\log \nu$.

- Note the possible *pre-flare dip* for flare No. 7. Pre-flare dips have been heavily disputed in the past because single-channel photometers cannot control the sky during the flare record. If this pre-flare dip is real, it could be due to enhanced opacity by negative hydrogen ions H^- as a result of free-electrons production during the first stage of the flare, when the plasma is heated (Grinin, 1968).
- Another interesting flare is flare No. 6, with a total duration of 4 s and rise-time of 2 s. The flare amplitude is 5.34 ($\Delta m = 2.00$ mag). This is a typical case for *rapid spike flare.*
- Flare No. 5 shows a *pre-flare.*

According to Gershberg and Shakhovskaya (1983), the flare activity is described with the relation

$$\log \nu = a - b \log E, \tag{5}$$

where $\nu = N/T$ is the cumulative flare frequency, E is the flare energy, a and b are constants. Figure 3 shows a plot of the flare energies versus cumulative flare frequency. From our observations we get: $\log \nu = 26.2 - 0.89 \log E$.

Although the flare statistics is rather poor, the comparison with the above relationship shows remarkable agreement. Therefore we find no evidence for changes in the flare activity of YZ CMi.

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SUPERSOFT SOURCE ACTIVITY AS A POSSIBLE INTERPRETATION OF TEMPORARY FADINGS OF CH Cyg

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CH Cyg is a well-known, but enigmatic, symbiotic variable, which is known to show complex activity (e.g. Mikołajewski et al. 1990). Superimposed on the increasing symbiotic activity, sudden short-term fadings in optical and ultraviolet have been observed. In order to explain this recurrent feature, various models involving eclipses of the hot component have been proposed (e.g. Hinkle et al. 1993; Skopal et al. 1996). However, the apparent presence of fadings not strictly following the suggested ephemeris suggests the possible presence of other mechanisms. Furthermore, the asymmetry of fadings (rapid fading and slower recovery) is also difficult to explain by the eclipse model.

Particularly noteworthy is the segment of recent light curve between 1998 and 2000 (upper panel of Figure 1). This figure clearly demonstrates that fadings are not strictly periodic. Two distinct minima occurred around HJD 2451360 and 2451690, separated by 330 d, while there was no hint of a fading at around HJD 2451030. The light curve also indicates the common feature of fadings: rapid decline followed by slower brightening. Between these transient fadings, the system spends most of time at bright state. All the above features of transient fadings of CH Cyg are strikingly similar to quasi-periodic fadings (or low states) of the peculiar binary V Sge (lower panel of Figure 1), in the recurrent time of semi-periodic fadings, the relatively short duty cycle of faint states, and in the depth.

V Sge has been recently recognized as a transient supersoft X-ray source (SSXS), in which supersoft X-ray emission was only observed during its low states (Greiner et al. 1998). The phenomenon is quite similar to the Magellanic SSXS, RX J0513.9-6951 (Reinsch et al. 1996). The cause of such recurrent fading episodes and the anti-correlation between supersoft X-ray and optical light has not yet been well understood, but Hachisu and Kato (1997) presents an interpretation by considering the limit-cycle formation of optically thick wind, which can reproduce, in particular, the asymmetric profile of fadings. The striking resemblance of the CH Cyg light variation to that of V Sge raises a possibility that fadings of CH Cyg may have been caused by transient SSXS phenomenon.

The relatively common optical features of SSXSs are the presence of strong HeII emission, and the appearance of jet features (for a recent review, see Gänsicke et al. 2000). The HeII emission has been usually regarded to be absent in CH Cyg, but Leedjärv et al. (1994) detected the emergence of the HeII emission during the fading episode. Furthermore, there are evidences of accompanying X-ray emission (Leahy and Taylor 1987) and the jet ejection (Taylor et al. 1986) during the fading occurring in 1984. These pieces

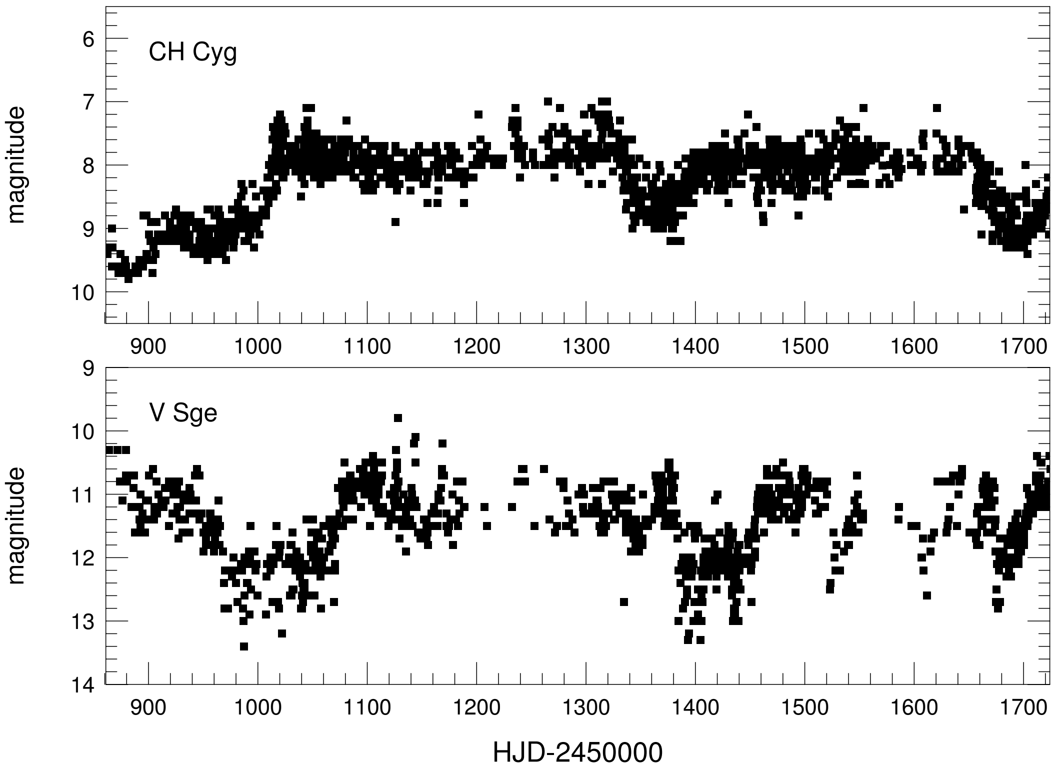

Figure 1. Light curves of CH Cyg and V Sge, drawn from visual observations reported to VSNET (http://www.kusastro.kyoto-u.ac.jp/vsnet/)

of evidence seem to strengthen the relationship to the transient SSXS phenomenon. One must note many of these signatures were recorded during the dramatic episode starting in 1984, which may be different in nature from the present milder fading episodes. However, it would be noteworthy that these high-energy events occurred during the optical low state, as in some transient SSXSs. The author has searched the public library of ROSAT observations (1WGA) in order to see the possible correlation between optical variation and the soft X-ray emission. There was only one available observation in late 1992 March, when CH Cyg was observed as a relatively hard source. CH Cyg was then in an extended low state, which is not comparable to the present high state with recurring faint states. Since V Sge is a hard X-ray source outside the transient SSXS phase (Greiner et al. 1998), it is not surprising that CH Cyg was recorded as a hard X-ray emitter at single-epoch observation. The present suggested relation between CH Cyg and SSXSs may lead to a unified understanding of various phenomena in SSXSs and symbiotic variables, particularly regarding the enigmatic high-velocity jet formation in CH Cyg-type symbiotic variables. The present interpretation is only one of possibilities, which requires further proofs from observations. Particularly crucial tests would include X-ray observations during the short fading episodes.

The author is grateful to VSNET observers who reported crucial observations of CH Cyg and V Sge.

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THE POPULATION II CEPHEID IN THE GALACTIC GLOBULAR CLUSTER PALOMAR 3

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We report a period and the first light curve for a Population II Cepheid in the outer-halo Galactic globular cluster Palomar 3. As well known, Pop. II Cepheids are usually found in clusters with well-developed blue-horizontal branch (HB) tails only (e.g., Wallerstein 1970; Smith & Wehlau 1985). Pal 3 has a completely red HB and is a scarcely populated globular cluster, so that the presence of a Pop. II Cepheid in this cluster would appear extremely unlikely. Yet, the star we studied was suspected to be a variable by Gratton & Ortolani (1984). It is listed in the latest revision of the Catalogue of Variable Stars in Globular Clusters (Clement 1997) as V4. Gratton & Ortolani obtained tentative values for the period $\approx$ 3 days and mean V magnitude $\langle V \rangle = 19.32$. No light curve has ever been published for V4. To the best of our knowledge, no follow-up observations were carried out for V4 since its discovery; in the recent HST study of the cluster by Stetson et al. (1999), V4 lies outside their observed field. Our analysis was based on approx. 20 CCD frames obtained on 6 nights: three in 18-20 January, 1997 at the 1.54-m telescope operated by the Steward Observatory, University of Arizona, one night in February 1997 at the 2-m telescope of NAO "Rozhen", (Bulgaria), one in April 1999 at the Steward Observatory and one in April, 2000 at NAO "Rozhen". The photometric reductions were carried out using the DAOPHOT/ALLSTAR package available in IRAF.

The V light curve is displayed in Fig. 1. In Table 1 are summarized the V magnitudes for V4. The first four magnitudes in the Table 1 are from Gratton & Ortolani (1984), the five one is from Ortolani & Gratton (1989)

The period we estimate from our new CCD data is slightly longer than the tentative value given in Gratton & Ortolani (1984): $P = 3\overset{\mathrm{d}}{.}402$. The derived mean V magnitude obtained by directly averaging over the pulsation cycle in intensity is $\langle V \rangle = 19.28$. The estimated amplitude in V is $0\overset{\mathrm{m}}{.}43$. The indication of a bump on the descending branch of the light curve suggests that the star may be a Pop. II Cepheid of the BL Her type (Diethelm 1983). However, a better sampled light curve is necessary to confirm this.

Table 1: Photometry in V band of V4.

JD 24...	V	σ
45350.76100	19.230	–
45351.82000	19.540	–
45352.80800	19.170	–
45353.80800	19.160	–
46449.71400	19.260	–
50466.96150	19.150	0.022
50467.89980	19.287	0.017
50468.95380	19.311	0.021
50491.47750	19.260	0.015
51288.78170	19.359	0.017
51672.37109	19.347	0.014

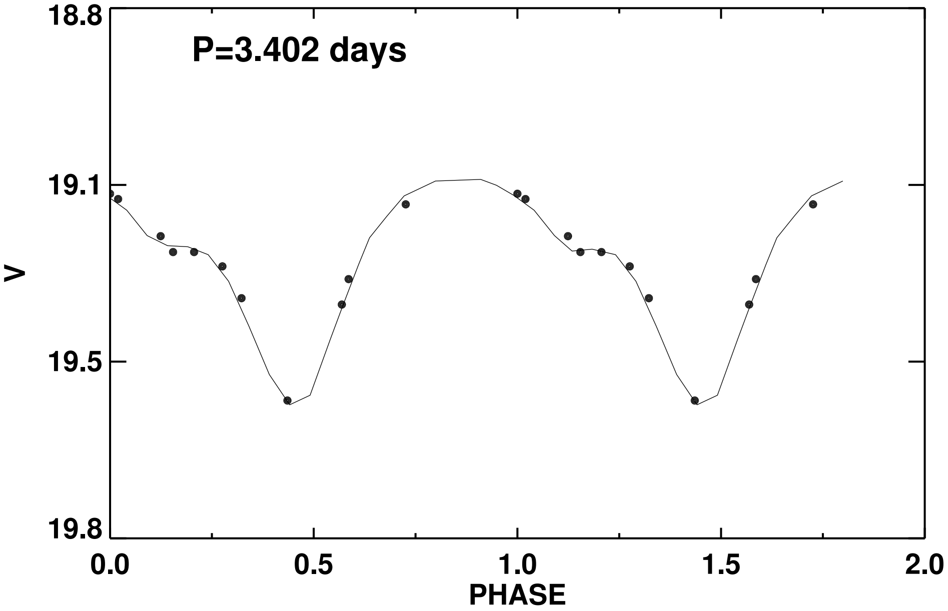

Figure 1. Light curve of the Pop. II Cepheid V4 in V band.

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NEW VARIABLES ON THE EDGE OF THE NORTHERN MILKY WAY – PAPER 1: BeV1–30

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The new variable stars reported here have been found as part of a programme to discover and classify new variables using CCD observations of selected fields on the edge of the northern milky way (eg. Bernhard et al. 1997, Bernhard 1999). In this paper the details of the first group of stars resulting from this programme are given.

The observations were made using a 20-cm Schmidt-Cassegrain telescope and an unfiltered Starlight Xpress SX CCD camera. The CCD camera uses a Sony ICX027B chip which has a very broad response, peaking near 5500 Å, giving approximate V-band magnitudes, depending on the colour of the star. The frames are processed and analysed automatically. A mean dark frame is subtracted and the images are flat fielded. The reduction method has evolved from simple aperture photometry, used initially, to a variable aperture based on the signal in each pixel, and this has led to some improvement in the photometry. Further observations of some of the stars have been made by a number of collaborators using a variety of equipment, and these are detailed in the references to individual stars given later.

The observing programme is specifically designed for the detection and classification of short-period variables, and passes through distinct survey and follow-up phases. During the survey part of the programme several series of overlapping exposures are made systematically across sections of the sky. The same areas are re-observed between 5 and 10 times over one or two months. Ideally the observations are made in short runs of two or three consecutive days, at irregular intervals, but the usual observing constraints often disrupt this pattern. The survey exposures are 20 seconds long and typically provide useful photometry down to magnitude 13.5.

Survey images are analysed automatically and software is used to compare the magnitudes and identify likely variables. Stars with a variation of 0.2 mag on at least two images are considered as variable, plus those which show an obvious drop in brightness, ~ 0.5 mag on one image. A preliminary selection of the most likely short-period variables is made from the survey observations, on the basis of range and time scale of the variation, and colour. A period analysis on even this small number of observations may point towards a likely classification or period. Follow-up observations are made of all the likely short-period variables with the apparently most tractable stars being given the highest priority. Further observations of the other variables are taken when possible. The apparently slowest variables with USNO-A2.0 (Monet et al. 1998) $b-r \sim 2$ or more are assumed to be red variables of some persuasion, and are not actively pursued.

During the follow-up phase each star is observed as continuously as possible. In general the exposure times are increased to 30 seconds to improve signal to noise, or tailored more specifically to the magnitudes of the variable and comparison stars. As these observations accumulate the likely nature of the variation becomes more clear and period analysis is performed. Once the period, or likely periods have been identified, further observations are timed to fill in the light curve or remove any ambiguities in the period.

The details of the positions and cross identifications of the Be variables are given in Table 1. The columns contain, 1; running Be number, 2; RA & Dec (2000) taken from the USNO-A2.0 catalogue, 3; the GSC number, 4; likely IRAS identification and 5; any other identification. The photometric data are given in Table 2. The columns are 1; running Be number, 2; the unfiltered CCD magnitude range based on the GSC comparison star magnitudes, 3; USNO-A2.0 r & $b-r$ magnitudes, 4; V and $B-V$ derived from Tycho-2, 5; the type of variation, 6; period, 7; reference. Additional comments, indicated by †, are given in notes to the table. All the red variables are identified as “SR”, although it is recognised that they could be almost any type late-type variable, with the magnitude range possibly grossly under estimated.

Table 1: Positions and Identifications for BeV1–30

No.	RA (2000) Dec	GSC	IRAS	Other
BeV1	19 53 40.2 +09 23 50	1062-0033		V1490 Aql
BeV2	20 11 44.6 +08 55 17			V1492 Aql/A2.0 0975.18231027
BeV3	14 51 17.1 −11 09 43	5582-0545		
BeV4	05 52 27.9 +06 20 53	0128-1121	05497+0620	CSS 170
BeV5	06 20 40.0 +06 16 08	0144-1300	06179+0617	
BeV6	18 04 57.5 +08 57 38	1008-0332	F18025+0857	V2501 Oph
BeV7	18 09 57.3 +08 50 25	1009-0766		
BeV8	19 46 25.0 +08 45 12	1057-1309		
BeV9	07 11 52.6 +04 04 05	0171-2059		
BeV10	18 32 06.9 +08 07 13	1024-2911	18297+0804	
BeV11	18 35 06.1 +08 14 28			A2.0 0975.12232581
BeV12	18 19 46.8 +08 00 24	1010-0732		
BeV13	06 18 56.2 +04 09 20	0140-1831		
BeV14	16 24 49.7 +08 04 15	0959-1397		
BeV15	16 51 29.9 +06 22 27	0396-1710		
BeV16	18 07 29.2 +06 22 36		18050+0622	A2.0 0900.11650430
BeV17	19 24 36.4 +06 31 28	0477-3880		
BeV18	19 37 11.8 +06 28 10	0490-4680		
BeV19	19 43 40.3 +10 39 07			A2.0 0975.16187403
BeV20	19 39 30.6 +10 43 14	1060-2412		
BeV21	19 54 12.7 +10 39 29	1062-2668		
BeV22	19 49 15.2 +10 35 42	1062-1819		
BeV23	20 09 36.2 +10 39 09	1076-1805		
BeV24	20 18 13.7 +10 37 55	1078-0852	F20158+1028	
BeV25	21 10 21.1 +10 36 01	1108-0961	21079+1023	
BeV26	21 04 22.4 +10 28 29	1108-2511	F21019+1016	
BeV27	20 03 00.6 +10 34 56	1076-1332		
BeV28	21 28 30.2 +10 45 23	1123-1704		
BeV29	22 01 40.7 +10 37 19	1139-0011		
BeV30	23 32 32.6 +10 33 21	1172-1452		

Table 2: Photometric data for BeV1–30

No.	Range	r	$b-r$	V	$B-V$	Type	Period (d)	Reference
BeV1	10.5–11.0	10.9	0.4	11.00	0.45	EA	1.6160	IBVS No. 4540
BeV2	12.6–13.6	13.3	2.3			SR	~ 60	vsnet-obs 17668
BeV3	11.6–11.9	11.8	0.7	11.18	0.62	EA?	1.0672 ?	vsnet-obs 15317
BeV4	11.7–12.2	11.6	2.5			SR	189†	vsnet-obs 15402
BeV5	11.6–12.1	11.8	1.8			SR		vsnet-obs 15840
BeV6	11.7–12.0	11.5	2.5			SR	~ 41	vsnet-obs 17997
BeV7	11.6–12.1	11.1	1.6	11.59	0.51	EA	2.16347†	IBVS No. 4685
BeV8	11.7–12.2	11.6	1.4	11.82	0.38	†	†	IBVS No. 4685
BeV9	11.4–11.9	11.4	0.6	12.19	-0.15	EA?		vsnet-obs 20089
BeV10	12.1–12.5	11.8	3.0			SR	> 40	vsnet-obs 21154
BeV11	12.2–12.4	11.7	3.1			SR		vsnet-obs 21220
BeV12	11.5–11.8	11.7	0.7	11.75	0.62	?		vsnet-obs 21457
BeV13	12.1–12.8	12.0	0.7			EA	1.1496	IBVS No. 4797
BeV14	12.6–13.6	12.3	0.7			RRa	0.6446	IBVS No. 4797
BeV15	12.7–13.4	12.6	0.6			RRa	0.7789	IBVS No. 4797
BeV16	12.8–13.1	12.0	3.2			SR		vsnet-obs 23743
BeV17	12.3–12.7	12.1	1.5			EW?	0.73254 ?	vsnet-obs 23759
BeV18	12.8–13.1	12.4	1.1			?		vsnet-obs 23790
BeV19	12.4–12.7	12.4	2.6			SR		vsnet-obs 23834
BeV20	12.7–13.0	12.7	1.8			SR		vsnet-obs 23842
BeV21	12.2–12.5	12.4	2.8			SR		vsnet-obs 23861
BeV22	12.1–12.4	12.4	3.0			SR		vsnet-obs 23893
BeV23	12.6–13.0	12.8	2.5			SR		vsnet-obs 23916
BeV24	11.6–11.9	11.8	3.0			SR		vsnet-obs 23936
BeV25	12.3–12.8	12.4	3.1			SR		vsnet-obs 23949
BeV26	12.1–12.6	11.7	2.7			SR		vsnet-obs 24086
BeV27	11.5–11.9	11.4	1.3			EA?	0.7789 ?	vsnet-obs 24169
BeV28	12.7–13.2	12.7	0.3			EW?	0.5579 ?	vsnet-obs 24187
BeV29	12.5–13.5	12.5	0.5			EA?		vsnet-obs 24334
BeV30	12.1–12.4	12.3	0.9			?		vsnet-obs 24340

Notes:

BeV4: $P = 189$ days Lloyd (2000) and Takamizawa (2000), S star

BeV7: Revised ephemeris $2451243.46 + 2.16347 \times E$

BeV8: Colour suggests a δ Scuti with $P = 0.1726$ or 0.2087 days, with 0.3453 and 0.4175 days less likely

The magnitude ranges of the variables are given with respect to the approximate V-band GSC magnitudes of the comparison stars. For stars of intermediate colour these values are probably close to the V magnitude, but for the red variables there is an increasingly large colour equation, and the values are probably more representative of the r magnitude.

Discrimination between the short-period and the SR variables is made principally on the time scale of the variation but with some guidance from the $b - r$ colour. The distribution of $b - r$ for this sample is shown in Figure 1, and while the two groups are easily identified there is little clear air between them. It is possible that some of the short-period variables contain late-type stars, but photometric errors and time differences between the b and r plates will conspire to reduce the separation.

The initial announcements about these stars, which contain the survey data and some preliminary analysis, were made electronically (Bernhard 1998–1999) and are available on the VSnet at `http://www.kusastro.kyoto-u.ac.jp/vsnet/Mail/` as given in Table 2. More detailed observations and analysis are available for BeV1 (Bernhard et al. 1997), BeV7 & 8 (Lloyd & Bernhard 1999) and BeV13, 14 & 15 (Lloyd et al. 1999).

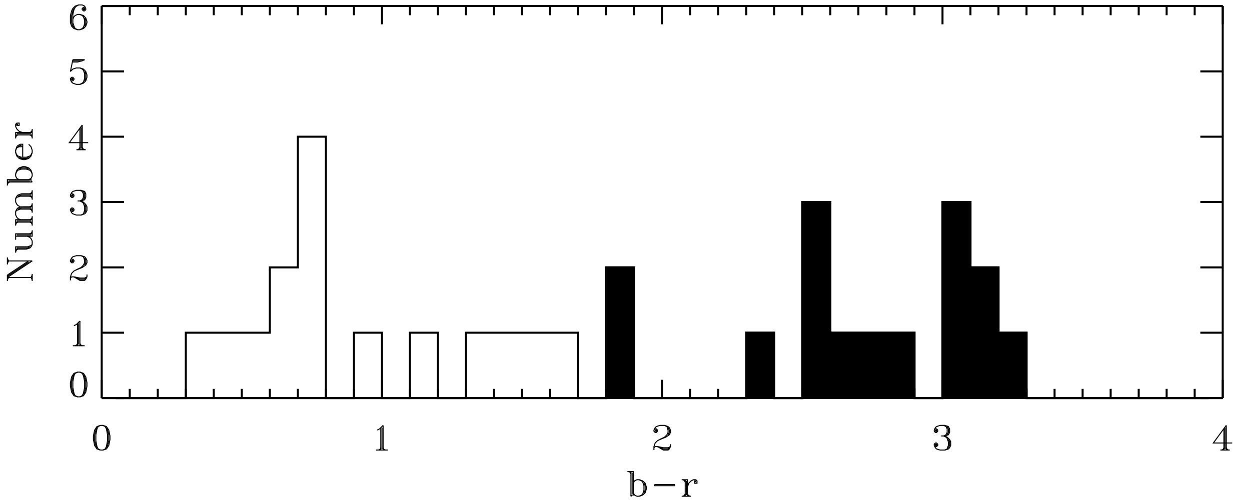

Figure 1. The distribution of $b-r$ for the stars in Table 2 with the assumed SR variables shaded.

Although the programme is aimed at the detection of short-period variables it is clear from Table 2 that many of the variables are late-type stars. Exactly half (15) of the stars in this sample are designated SR, and of the remaining stars three are confirmed eclipsing binaries with a further six possibilities, two are confirmed RR Lyrae variables, and the remaining four stars are unclassified short-period variables.

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THE OPTICAL SPECTRUM OF LUYTEN'S VARIABLE GM SAGITTARII

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I obtained several long-slit spectra of V4641 Sgr, the optical counterpart of the fast X-ray transient and superluminal radio source SAX J1819.3-2525, in mostly marginal conditions on 2000 June 2–6 using the FORS1 instrument on the first 8.2-m telescope at ESO's Paranal Observatory (ESO visitor program 65.H-0360). Most of the observations were done with the grism #600B, which covers the wavelength range 3500–5700 Å with 4 Å resolution. A few additional spectra were obtained with the grism #600R, which covers the region near Hα with similar resolution. The VLT has a good atmospheric dispersion corrector, so the slit position was left in the default north-south position.

While inspecting the first few two-dimensional spectra, I noticed a bright star about 1 arcminute south of V4641 Sgr which had narrow Balmer lines in emission and strong molecular absorption bands. The object was not exactly centered on the entrance slit of the spectrograph, so I executed a telescope offset in order to have the unusual object centered. I took a single 2 minute exposure using the blue grism #600B. See Figure 1 for the finding chart and Figure 2 for the extracted spectrum. The strong absorption bands seen at ≈ 4762, 4956, 5168, and 5450 Å (where the wavelengths refer to the deepest part of the band just redward of the steep drop) are most likely due to TiO. I crudely estimate a spectral type of M3-M5 III (Jaschek & Jaschek 1987).

It turns out that the emission line object is Luyten's variable GM Sgr (Luyten 1927), which is listed in the GCVS as an LB type star (long period, irregular) of spectral type M6. The coordinates based on the astrometric solution included in the image header agree with those given in IAUC 7277. This object also appears to be the star marked in Kato & Uemura's (1999) finding chart, although the mismatch in the filters used makes a comparison difficult.

Table 1 lists the line centers and equivalent widths of the emission lines seen in the blue spectrum. I estimate an error of $\approx 5\%$ in the equivalent widths, mainly due to uncertainties in the flux calibration. All of the Balmer lines up to H15 can be seen, with the curious exception of Hε. A weak Hα emission line is evident in the red spectrum (not shown) obtained when the slit was centered on V4641 Sgr. All of the lines listed in Table 1 are blueshifted by about 130 $\mathrm{km\,s^{-1}}$, and all are unresolved (FWHM < 4 Å).

The spectrum of GM Sgr resembles that of a Mira type variable star. The Balmer emission lines are thought to arise in the parts of the photosphere which have been heated by an outward moving shock (e.g. Fox, Wood, & Dopita 1984; Gillet 1988). The emission lines are visible over most of the pulsational cycle, and are strongest near the time of

Table 1: Wavelengths and equivalent widths of the emission lines in the GM Sgr spectrum.

Line	Central wavelength (Å)	Equivalent width (Å)
Hβ	4858.82	-6.6
Hγ	4338.63	-18.2
Hδ	4099.95	-35.0
Hε	...	...
H8	3887.21	-19.6
H9	3833.52	-16.8
H10	3796.03	-11.4
H11	3768.71	-10.8
H12	3748.28	-5.2
H13	3732.16	-4.7
H14	3721.17	-4.5
H15	3710.65	-5.9

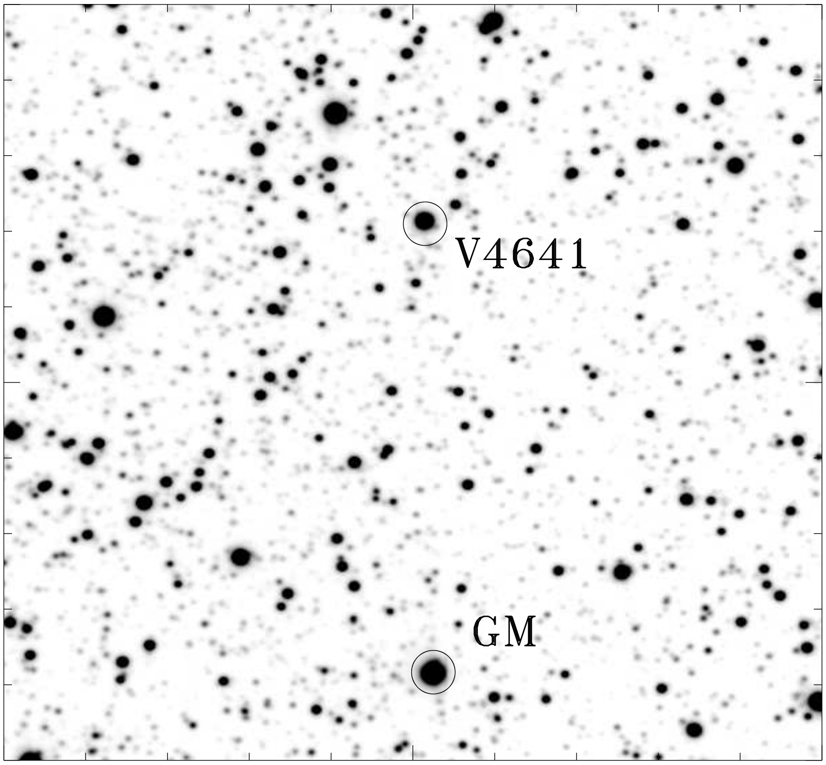

Figure 1. The finding chart for V4641 Sgr and GM Sgr. The field is $2' \times 2'$. North is up, and east is to the left. This is a section of an R band image obtained with the VLT Unit Telescope 1.

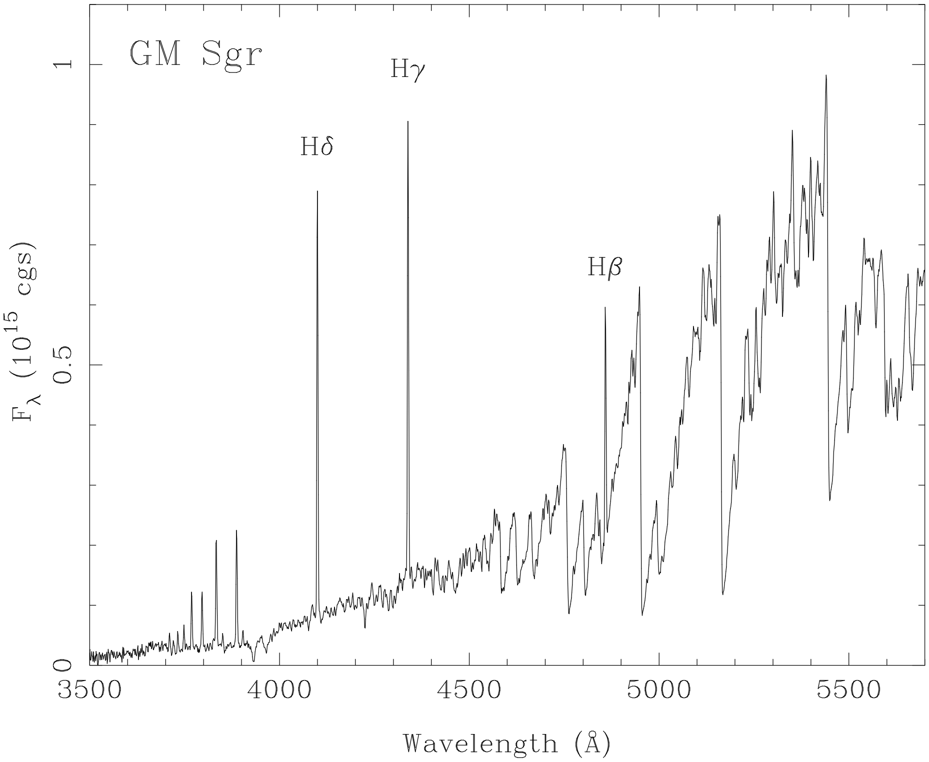

Figure 2. The flux calibrated spectrum of GM Sgr. Owing to clouds, the flux calibration is only approximate.

maximum light. The weak or absent Hε emission line is fairly typical in Mira variables near maximum light (Castelaz et al. 2000). According to Kato & Uemura (1999), a peak in the optical light curve occurred about October, 1999, although coverage subsequent to that was sparse. The pulsational period could be several hundred days, so a long-term photometric monitoring program will be needed to establish whether the variability is in fact periodic. Any CCD images of GM Sgr that also contain V4641 Sgr would of course be of extra value, since the latter source (which most likely contains a black hole—Orosz et al. 2000) seems to be prone to flaring behavior.

References:

Castelaz, M. W., Luttermoser, D. G., Caton, D. B., & Piontek, R. A., 2000, *AJ*, in press (astro-ph/0007380)
Fox, M. W., Wood, P. R., & Dopita, M. A., 1984, *ApJ*, **286**, 337
Gillet, D., 1988, *A&A*, **192**, 206
Jaschek, C., Jaschek, M., 1987, *The Classification of Stars*, Cambridge University Press
Kato, T., Uemura, M., 1999, *IBVS*, No. 4795
Luyten, W. J., 1927, *Harvard Bull.*, No. 852, 1
Orosz, J. A., et al., 2000, *IAUC*, No. 7440

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B PHOTOMETRY OF ROMANO'S STAR IN M 33

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We present the light curve of Luminous Blue Variable candidate star GR 290 (Romano's star) in M 33 (Humphreys & Davidson 1994). The observational basis of this study is a sample of photographic plates of M 33 from the collection of the Bulgarian National Astronomical Observatory — Rozhen. All plates have been taken with the 2-m RCC $f/8$ Rozhen reflector.

We used 25 B-plates, 30×30 cm (103aO, IIaO and ORWO ZU 21 emulsions, GG 385 glass filter). The plates were taken from November, 1982 to October, 1990. Julian days of observations are presented in Table 1. The plate scale is 12.8 arcsec mm^{-1} and the area covered is $1^\circ \times 1^\circ$. The whole image of M 33 fits in each plate.

The measurements have been made with a MF-4 densitometer with a constant diaphragm in the Astronomical observatory of the Sofia University. At least four estimations of sky background for each star were obtained and then averaged value was used. The calibration curves have been constructed using the photoelectric sequence of Sandage & Johnson (1974). Then they have been fitted by the least squares with the most appropriated polynomials. For each plate standard deviations of measurements are presented in Table 1.

We present also CCD B-magnitude of Romano's star. Data were obtained on Special Astrophysical Observatory — SAO (Russia) with 1024×1024 CCD camera on 0.6-m Zeiss telescope (Vlasiuk 1997). The seeing during the observations was 2–3 arcsec. The scale was 0.84 arcsec/pixel, resulting in a field size of about 8 arcmin. Photometry of the program frame was carried out by PSF-fitting using IRAF/DAOPHOT. Transformation to the standard system is based on average photographic B-magnitudes of reference stars (A–L in Fig. 1) taken from the best five Rozhen B plates. Average magnitudes and root mean squares (r.m.s.) for these stars are given in Table 2.

The results of our photometry are given in Table 1. The light curve of Romano's star is presented in Fig. 2. Open circles represent original Romano's observations transferred to the Johnson B system (Romano 1978), photographic B-magnitudes from Rozhen 2-m RCC telescope are given with open diamonds, and the CCD B-magnitude from 0.6-m telescope — with open triangle. It is seen that Romano's star presents two broad maxima within a few years around 1970 and 1990. The derived mean cycle for the whole data set (Romano's + ours), using PDM method is about 6250 days.

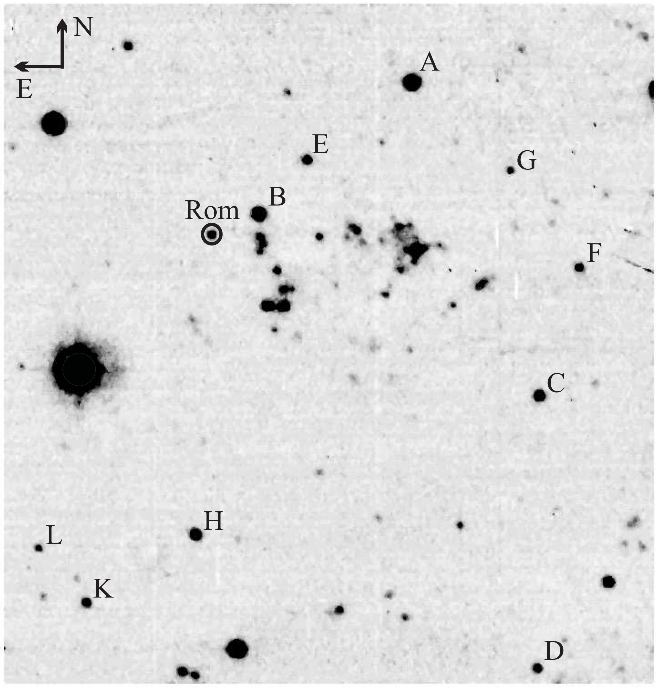

Figure 1. CCD B image of the area around the Romano's star. North is up and East is to the left. Reference stars A–L from secondary photographic sequence are shown.

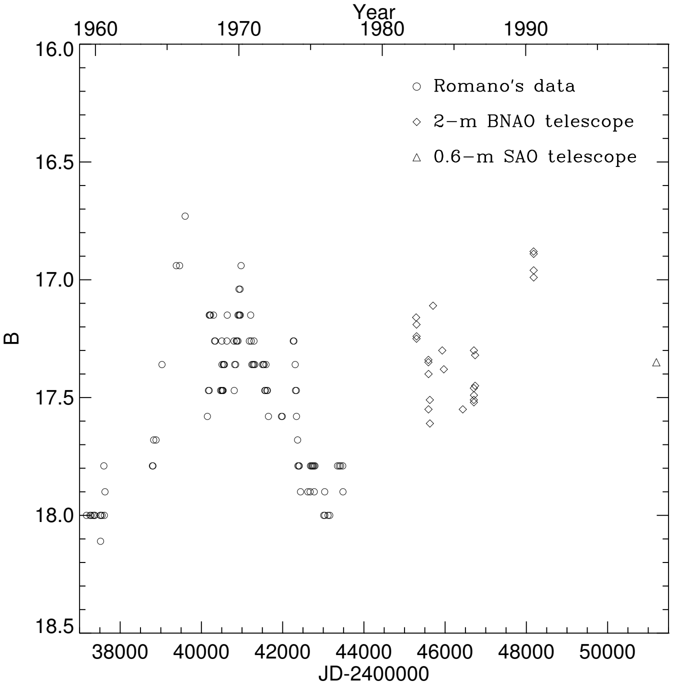

Figure 2. The long term B light curve of the Romano's star. Open circles represent original Romano's observations transferred to B-magnitudes, open diamonds — 2-m Rozhen observations, and open triangle — 0.6-m SAO observation.

Table 1: Photometry in B band of Romano's star in M 33

JD 244…	B	$\sigma(B)$	JD 244…	B	$\sigma(B)$	JD 244…	B	$\sigma(B)$	JD 244…	B	$\sigma(B)$
5286	17.16	0.15	5591	17.40	0.16	6707	17.46	0.16	8177	16.88	0.18
5295	17.25	0.15	5623	17.51	0.23	6707	17.51	0.16	8180	16.96	0.17
5296	17.19	0.23	5625	17.61	0.16	6708	17.30	0.07	8180	16.99	0.13
5297	17.24	0.25	5702	17.11	0.08	6708	17.52	0.10	8180	16.89	0.12
5588	17.35	0.23	5929	17.30	0.08	6709	17.49	0.08			
5588	17.34	0.26	5968	17.38	0.09	6738	17.45	0.11			
5590	17.55	0.20	6435	17.55	0.08	6738	17.32	0.17			

Table 2: Average B-magnitudes and r.m.s. of reference stars

St	$\langle B \rangle$	r.m.s.	St	$\langle B \rangle$	r.m.s.
A	15.49	0.18	F	17.33	0.06
B	15.79	0.07	G	17.86	0.03
C	16.48	0.13	H	16.33	0.16
D	16.35	0.10	K	17.10	0.19
E	17.22	0.13	L	17.91	0.07

Acknowledgements: It is a pleasure to thank Prof. G. Ivanov, Dr. P. Kunchev and Dr. Ts. Georgiev for letting us use their plates of M 33. This research was supported in part by the Bulgarian National Science Foundation grant under contract No. F-812/1998 with the Bulgarian Ministry of Education and Sciences. O. Sholukhova thanks for support RFBR grant No. 00-02-16588.

References:

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Romano, G., 1978, *A&A*, **67**, 291
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Vlasiuk, V., ed., 1997, Report SAO, 33

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BD +62°2167: A NEW ECLIPSING BINARY IN THE FIELD OF CW Cep

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Name of the object:
BD +62°2167 = GSC 4282_394

Equatorial coordinates:	**Equinox:**
R.A.= $23^h05^m15^s$ **DEC.**= +63°23′42″	2000.0

Observatory and telescope:
Mollet Observatory, 0.41-m Newtonian telescope

Detector:	CCD

Filter(s):	*V*

Comparison star(s):	SAO 20406 = BD +62°2166

Check star(s):	GSC 4282_778

Transformed to a standard system:	No

Availability of the data:
Upon request

Type of variability:	EA

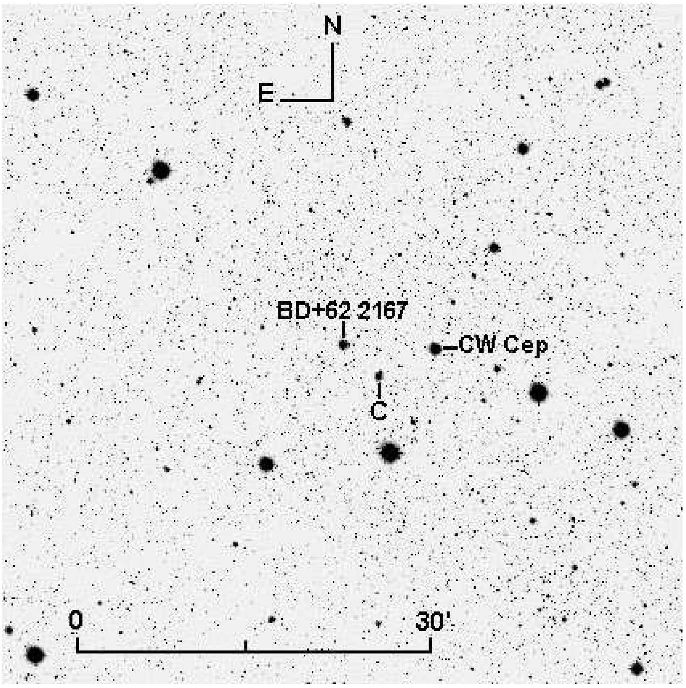

Figure 1.

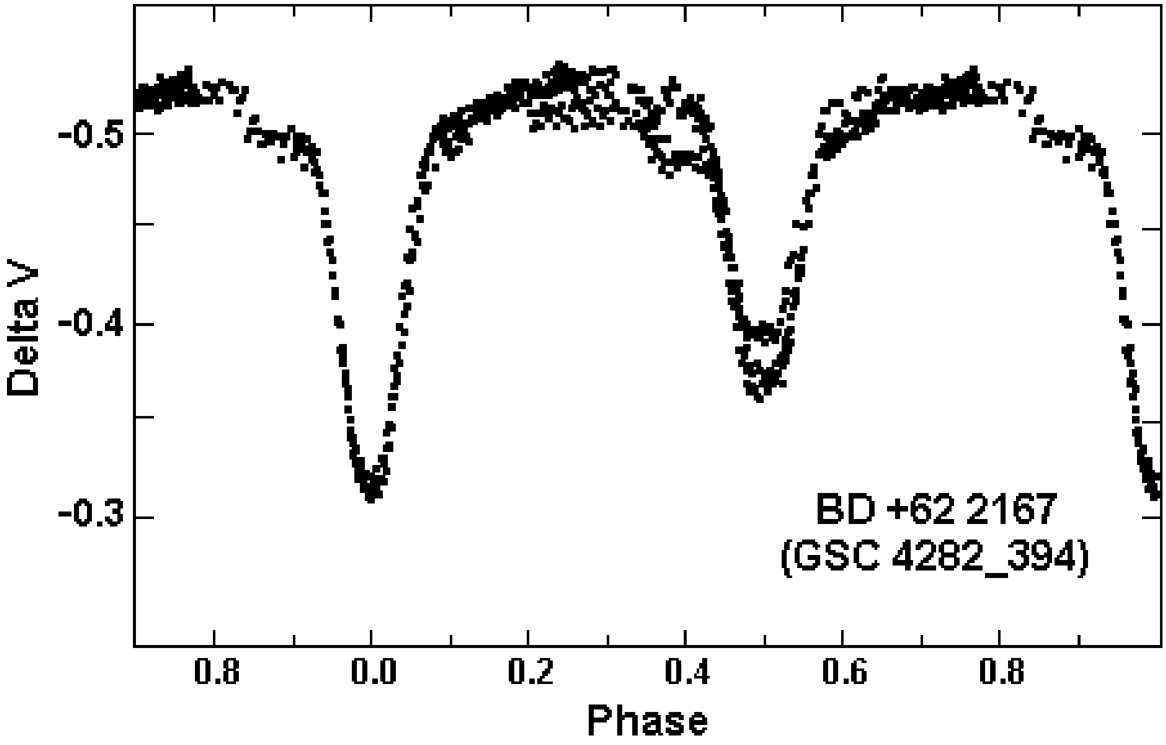

Figure 2.

Remarks:

In a photometric program for searching for new variables with an 8-cm automatic telescope at Mollet Observatory, it was found that GSC 4282_394 of $9^{\mathrm{m}}_{\cdot}4$ (Figure 1) is an Algol type eclipsing binary star with a period of $1^{\mathrm{d}}_{\cdot}3$ and an amplitude of $0^{\mathrm{m}}_{\cdot}21$ in V. The star is a visual double and both components are listed as suspected variables in the Tycho Catalogue (1997) with the 'W' flag: TYC 4282_394_1 with a variation range between 9.11 and 9.75 ($B-V=0.427$), and TYC 4281_394_2 (identified with BD +62°2167) with a brightness range from 9.49 to 10.25 ($B-V=0.394$). This flag indicates that data suggest variability, although other instrumental effects cannot be ruled out, as directly quoted from the Tycho Catalogue's notes: "variability suspected in the Tycho data; this may due to intrinsic variability since no correlation with position angle was evident. But no thorough investigation has been carried out to eliminate other reasons intrinsic to the Tycho measurements." Since the separation between the stars is about 6 arcseconds, joint photometry of both stars was performed.

The light curve suggests that the EA system is also intrinsically variable at some phases (Figure 2), probably due to activity in the system. These irregularities have an amplitude of $0^{\mathrm{m}}_{\cdot}03$, and are more important on the light-curve maxima and are permanently present in the phase intervals 0.2–0.4 and 0.8–0.9, i.e., before the beginning of both eclipses, and also during the secondary minimum affecting its shape and depth. The amplitude of minimum II was variable between $0^{\mathrm{m}}_{\cdot}154$ and $0^{\mathrm{m}}_{\cdot}180$. Since it is unlikely that independent intrinsic variations of the optical companion could match the eclipsing binary in such a selective way, real intrinsic light changes for the eclipsing binary system are highly probable.

Observations did not allow to determine which of the visual components of GSC 4282_394 is the Algol-type variable, and it was not possible to deduce it from the Tycho observations either, which do not show the detected variability but a high scatter and spurious oscillations.

The following ephemeris was computed:

$$\begin{array}{rl}\text{Min. I} = \text{HJD } 2451034.5344 & + \; 1.3045 \times E. \\ \pm\, 0.0004 & \pm\; 0.0003\end{array}$$

Also these minima timings were obtained:

HJD 2451032.5768 ± 0.0011 (II)
HJD 2451036.4918 ± 0.0005 (II)
HJD 2451038.4474 ± 0.0014 (I)
HJD 2451072.3621 ± 0.0006 (I)

Reference:

ESA, 1997, The Hipparcos and Tycho Catalogues, ESA SP-1200

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SAO 23170, A NEW BETA Cep IN THE STELLAR CLUSTER H VI 33

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Name of the object:
SAO 23170 = BD +56°508 = AGK +57°0283 = PPM 27412 = GSC 3694_2053 = NGC 869_839 = YZ 57 2080 = Oo 839

Equatorial coordinates:	**Equinox:**
R.A.= $2^h18^m48^s$ **DEC.=** +57°17′08″	2000.0

Observatory and telescope:
Mollet Observatory, Newtonian 0.41-m telescope

IBVSTdetCCD

Filter(s):	*V*

Comparison star(s):	HD 14210 = HIP 10873 = SAO 23200 = BD +56°543 = PPM 27455 = AGK +57°0289 = GSC 3694_1539

Check star(s) (two names whenever possible):

Check star(s):	1: GSC 3694_1853 2: SAO 23173 = PPM 27413 = GSC 3694_1169 3: GSC 3694_1822

Transformed to a standard system:	No

Availability of the data:
Upon request

Type of variability:	Beta CMi (Beta Cep)

Remarks:
In a photometric program searching for new variables, SAO 23170 was initially chosen as a comparison star for the suspected Tycho variable HD 14210 (= TYC 3694_1539). Photometry of SAO 23170 against check stars showed rapid light variations between 0.02 and 0.10 magnitudes in the *V* band. As a consequence, observational work was then focused on this new object. This star, with a *V* magnitude of 9.51 and B2 spectral type, was observed for 34 nights between 6 September and 23 December 1997. Data analysis using PERDET software (Breger, 1990) showed that this object is a multiperiodic Beta Cep variable. Two periods of 0.19493 and 0.24233 days (Figure 1) were identified. Observations suggest that more periodicities might be present, but photometric data did not allow to confirm it because the comparison or check stars for SAO 23170 might be slightly variable (Figure 2).

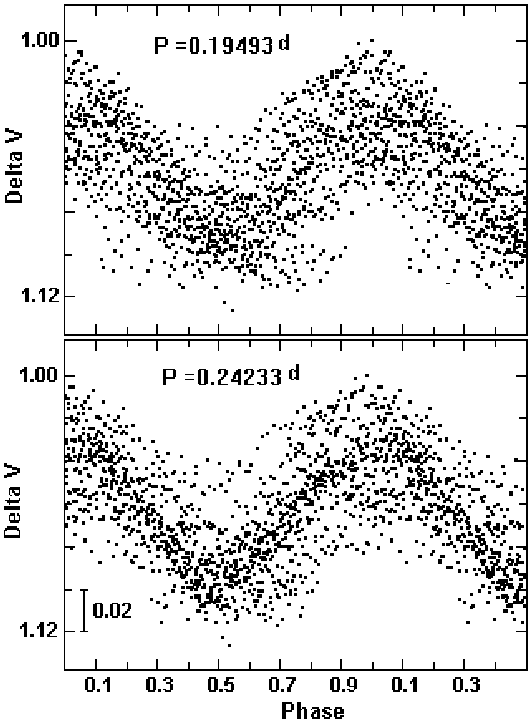

Figure 1.

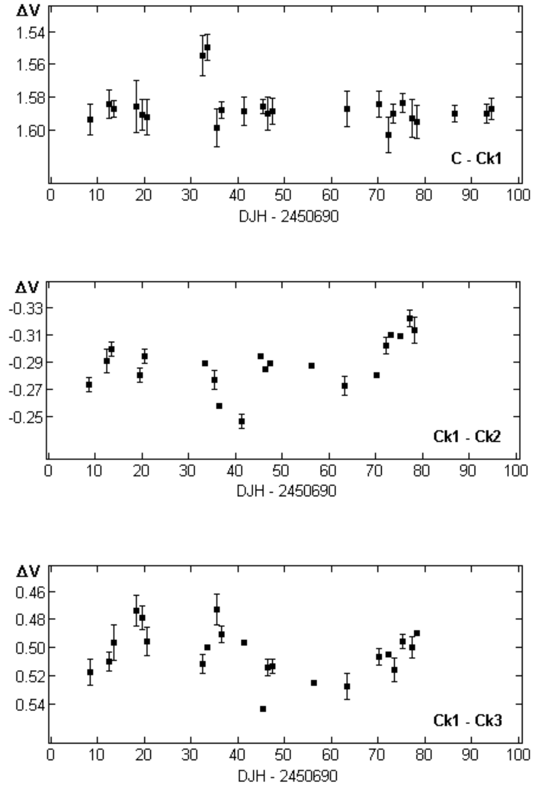

Figure 2.

References:

Breger, M., 1990, *Comm. Asteroseismology (Vienna)*, **20**, 1

ESA, 1997, The Hipparcos and Tycho Catalogues, ESA SP-1200

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NEW OUTBURST OF V1118 Ori (1997–98)

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[2] Byurakan Astrophysical Observatory, Armenia, email: eparsam@bao.sci.am

Name of the object:
V1118 Ori

Equatorial coordinates:	**Equinox:**
R.A.= $5^{\mathrm{h}}34^{\mathrm{m}}44\overset{\mathrm{s}}{.}2$ **DEC.=** $-5°33'40''$	2000

Observatory and telescope:
Private obs., Sevilla (Spain), 20-cm Schmidt–Cassegrain telescope

Detector:	CCD

Filter(s):	*V*

Comparison star(s):	Parenago 1497, 1516, 1518, 1588, 1612

Transformed to a standard system:	No

Remarks:
Since 1983, when V1118 Ori became known as a new EXor (Herbig, 1990, for reference to this species as EXors, after the example first recognized, EX Lupi or Subfuors, see Parsamian and Gasparian, 1987) and entered into an active stage of fuor-like outbursts, four outbursts have been observed. As of now we have information concerning outbursts during the period 1983–84 (Chanal, 1983, Parsamian and Gasparian, 1987), 1988–90 (Parsamian et al., 1993), 1992–94 (Garcia Garcia et al., 1995), 1997–98 (Hayakawa et al., 1998 and present paper). New observations of the star were made between November 1995 and January 2000 in *V* colour. The light curve of V1118 Ori during this period is given in Fig. 1. The amplitude of the outburst in *V* is larger than 3 mag and duration is longer than 2 years.

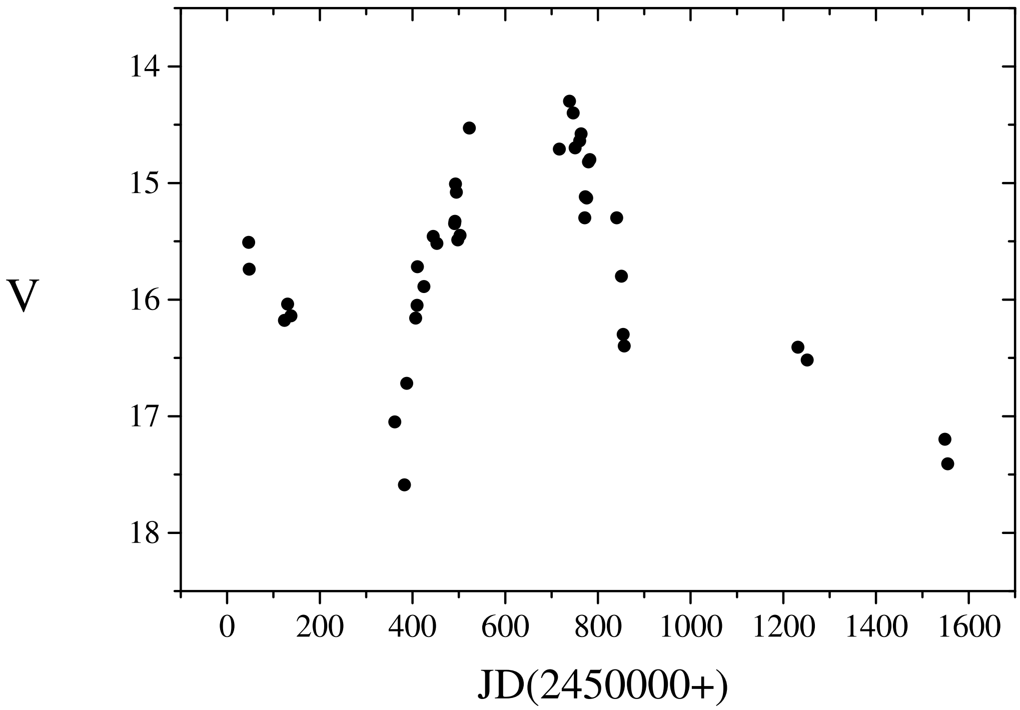

Figure 1. The light curve of the star V1118 Ori

References:

Chanal, M., 1983, *IAUC*, No. 3763

Garcia Garcia, J., Mampaso, A., and Parsamian, E. S., 1995, *IBVS*, No. 4268

Hayakawa, T., Ueda, T., Uemura, M., et al., 1998, *IBVS*, No. 4615

Herbig, G.H., 1990, Low Mass Star Formation and Pre-Main Sequence Objects, ed. Bo Reipurth, München, 223

Parsamian, E.S. and Gasparian, K.G., 1987, *Astrophysics*, **27**, 598

Parsamian, E.S.. Ibragimov, M.A., Ohanian, G.B. and Gasparian K.G., 1993, *Astrophysics*, **36**, 23

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A STUDY OF THE VARIABILITY OF LD 345

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LD 345 (GSC 3530-2757) is located at $18^{\rm h}31^{\rm m}13\overset{\rm s}{.}83$, $+46^\circ58'34\overset{''}{.}7$ (J2000). Lennart Dahlmark discovered variability during a photographic variable star search (Dahlmark, 2000a). In the discovery report LD 345 is listed as an eclipsing binary type variable of no known period. Brian Skiff of the Lowell Observatory generated interest in this star when he notified several AAVSO members of its unusual behavior. Dahlmark reported the star had appeared to enter a deep decline lasting at least two years. The long duration of the decline caused speculation as to the possibility that LD 345 may be an eclipsing binary with a very long period or belong to a more exotic class of variables such as the R Coronae Borealis or symbiotic stars.

In this paper we present the results of our investigation of the classification of LD 345. As part of our study Henden performed high precision photometry in order to determine the color indices and magnitudes of the variable and suitable comparison and check stars. We also conducted a photographic plate survey of LD 345 using the plate collections located at the Asiago Astrophysical Observatory, the Harvard College Observatory, the Sonneberg Observatory, and the Sternberg State Astronomical Institute (SAI) of the Moscow State University. In addition to these archival plate collections, the photographic observations of Dahlmark were used.

Dahlmark indicated 18 exposures were taken between 1967 and 1982, and another 48 were taken between 1995 and May 2000. On all but three plates the star remains constant at $m_v = 11.4$, $m_{pg} = 13.1$, where m_v are photovisual (yellow) magnitudes and m_{pg} are photographic (blue) magnitudes. On the three plates, exposed in July 1972, July 1973 and June 1974, the star had faded more than three magnitudes to $m_v < 14.7$.

Guilbault and Hager visited the Harvard College Observatory and examined approximately 200 patrol plates from the RH and Damon series for evidence of variability. Those plates encompassed the years 1928 to 1952, a single plate from 1962, and 1975 to 1989.

At the Sternberg State Astronomical Institute Kurochkin measured LD 345 on 172 plates taken with the 40-cm astrograph of the SAI Crimean station. He examined four plates from 1905 to 1908, one each from 1940 and 1942, and the remainder from 1978 to 1995. No additional minima were found nor could we confirm Dahlmark's observations at minimum since no exposures of the field were taken at Harvard or Moscow during the years 1972 to 1974.

Dahlmark indicated to Guilbault that the Asiago Astrophysical Observatory had taken photographic plates during the years in question (Dahlmark, 2000b). As a result, Moro was contacted at Asiago and she measured the brightness of LD 345 on 6 Schmidt plates taken between 1967 and 1970, and 10 plates from 1974 to 1976. Comparison star magnitudes were determined using the GSC–ACT (Gray, 1999) and the USNO–A2.0 catalogue (Monet et al., 1998). Subsequently, additional observations were made using the Sonneberg plate collection. Splittgerber and Kroll examined 111 photovisual plates of the Sonneberg Sky Patrol taken from 1970 to 1977. The star appears faint at maximum but just above the plate limit of $m_v = 13.0$. Between December 1971 and September 1974, however, the star is not visible on the plates. Photographic observations near or at minimum appear along with those of Dahlmark in Table 1.

Table 1. Photographic Observations of Minimum of LD345

Julian date	Date	Magnitude	Type	Observer
2440750	1970-06-12	13.3	m_{pg}	Moro
2440773	1970-07-05	13.1	m_{pg}	Dahlmark
2441153	1971-07-21	13.1	m_{pg}	Dahlmark
2441248	1972-03-15	11.8	m_v	Kroll/Splittgerber
2441391	1972-03-15	< 12.7	m_v	Kroll/Splittgerber
2441394	1972-03-18	< 12.9	m_v	Kroll/Splittgerber
2441512	1972-07-14	< 14.7	m_v	Dahlmark
2441892	1973-07-29	< 14.7	m_v	Dahlmark
2442220	1974-06-22	< 14.7	m_v	Dahlmark
2442246	1974-07-16	16.8	m_{pg}	Moro
2442248	1974-07-19	16.8	m_{pg}	Moro
2442305	1974-09-14	15.6	m_{pg}	Moro
2442307	1974-09-16	15.6	m_{pg}	Moro
2442360	1974-11-08	14.7	m_{pg}	Moro
2442551	1975-05-18	13.3	m_{pg}	Moro
2442599	1975-07-06	13.1	m_{pg}	Dahlmark

These observations confirm both the occurrence and the depth of the decline as reported by Dahlmark and allow constraints to be applied so that the duration of the minimum and the descending and ascending branches of the light curve can be reasonably determined. The duration of the minimum is $\sim$ 1000–1200 days. The recovery from the observed minimum of 16.8 m_{pg} occurs within $\sim$ 150–200 days. Assuming a symmetrical light curve with a flat bottom and minimum at $\sim 16.8 m_{pg}$, constant light lasts $\sim$ 700–800 days.

Henden used the USNO Flagstaff Station 1.0-m telescope and a SITe/Tektronix 1024 × 1024 CCD to observe LD345 in standard Johnson-Cousins UBVRI bandpasses on three photometric nights. Comparison and check stars were standardized as follows:

Star	GSC	RA (J2000)	DEC	V	$B-V$	$U-B$	$V-R$	$R-I$
comp.	3530-02670	18:31:06.40	+46:55:52.7	11.919	1.126	1.007	0.588	0.518
check	3530-02617	18:31:02.86	+46:58:15.8	12.164	0.974	0.642	0.519	0.466

with magnitude and color errors less than $0^{\rm m}_{\cdot}01$. More complete photometric information about all stars within 5 arcmin of the variable can be found in Henden (2000). Using these stars, the magnitude and colors of LD345 for the three nights were:

HJD − 2400000	V	$B-V$	$U-B$	$V-R$	$R-I$
51722.7493	11.748	1.611	...	0.924	1.162
51727.8363	11.790	1.595	1.858	0.962	1.130
51728.7805	11.783	1.610	1.866	0.957	1.137

with errors again less than 0.01mag.

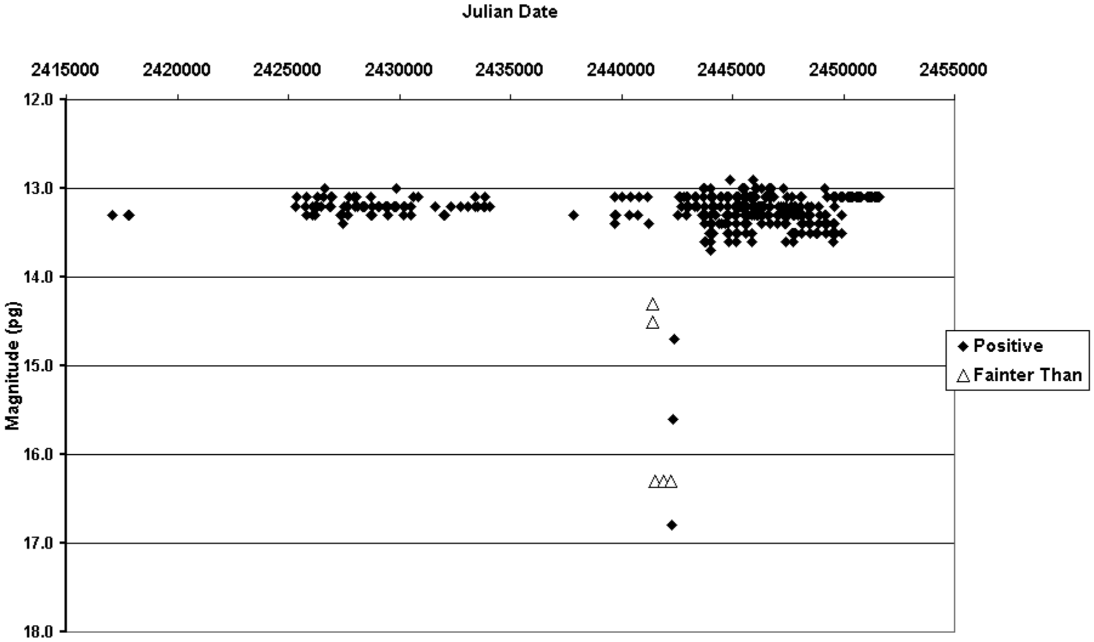

Figure 1. LD345 Photographic Light Curve

Figure 1 shows the photographic light curve from 1905 to 2000. For consistency and to improve the shape of the decline, the photovisual (yellow) magnitudes and limits were approximately converted to photographic (blue) values by adding the mean (B–V) color of the variable as given above. The data suggests the star may be variable at maximum on the order of perhaps a few tenths of a magnitude. Evident in the light curve is the absence of additional minima. If, in fact, the decline were the result of an eclipse by a companion, based upon the available photographic record the period would be very long indeed. Assuming that the minima occur at equal intervals the period cannot be shorter than 17200 days, nearly twice that of Epsilon Aurigae. Minima could have occurred during the gaps in photographic coverage, from 1908 to 1927, and 1953 to 1966, but in that case the declines would occur at irregular intervals. The photographic record does not seem to support the classification of LD 345 as an eclipsing binary, but is more characteristic of the symbiotic stars which can remain at maximum light for decades. On the other hand, the photometric colors are similar to a typical M0III star, but atypical for RCB or symbiotic stars.

In spite of the photographic and photometric observations presented in this report the classification of LD 345 remains uncertain. We hope that others will study this interesting star. AAVSO and VSnet observers have already begun visual monitoring programs. This is important if a future decline occurs. It would be valuable to search other archival plate collections for additional minima and to better define the light curve that we have presented here. Most importantly, spectroscopy is needed to reveal the properties of LD 345.

We would like to thank Lennart Dahlmark for allowing us to use his observations in this report. Guilbault and Hager would like to express their gratitude to Dr. Martha Hazen, Curator of the Harvard College Observatory Astronomical Photograph Collection, for allowing them access to this valuable resource. We also wish to thank Margareta Westlund who sent us her very recent visual observations of LD 345. We are grateful to Vitaly Goranskij of the SAI and Marvin Baldwin, Chairman of the Eclipsing Binary Committee of the AAVSO for their help in the preparation of this report.

References:

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Dahlmark, L., 2000b, Private Correspondence
Gray, W., 1999, `http://www.projectpluto.com/gsc_act.htm`
Monet et al., 1998, USNO–A2.0; U.S. Naval Observatory, Washington, DC
Henden, A., 2000, `ftp://ftp.nofs.navy.mil/pub/outgoing/aah/sequence/ld345.dat`

COMMISSIONS 27 AND 42 OF THE IAU
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THE δ SCUTI STAR QS GEMINORUM

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QS Geminorum ($\alpha_{2000} = 06^{\rm h}46^{\rm m}28\overset{\rm s}{.}6$, $\delta_{2000} = +20^\circ50'37\overset{''}{.}1$, HIP 32459, HD 263446, GSC 01342-00231) was found to be a variable star by the HIPPARCOS satellite. The Variability Annex of the HIPPARCOS Catalogue (ESA 1997) reports QS Gem to have a period of 0.134613 d with H_p magnitudes ranging between 8.874 to 8.973. The spectral type is listed as A3 and the star is classified as a δ Scuti.

As part of our ongoing δ Scuti star program, and as part of our Phscs 329 Observational Astronomy class, we selected stars from the Variability Annex of the HIPPARCOS Catalogue that showed δ Scuti type characteristics. During winter semester of both 1999 and 2000, QS Gem was observed by groups of Phscs 329 students. Observations were made with the 0.4-m David Derrick Telescope of the Orson Pratt Observatory at Brigham Young University (Hereafter DDT). Data were obtained with a Pictor 416XT CCD mounted at the newtonian focus of the telescope. This gave a plate scale of 0.93 arcsec/pixel. Observations were made through a standard Johnson V filter modeled after Bessell (1990). A total of nine nights of data were obtained between 23 February 1999 and 12 April 2000. The CCD field for the DDT is shown in Fig. 1 with QS Gem and the comparison stars labeled.

All frames were reduced using standard IRAF functions. Apparent magnitudes were determined using comparison stars 4 and 5 as shown in Fig. 1. Star 4 is identified as HD 263542 (GSC 01342-01109, $V = 9.72$) and star 5 is identified as HD 48995 (GSC 01342-00517, $V = 8.61$). From this we found an average magnitude for QS Gem of $V = 8.85$. The two other comparison stars labeled in Fig. 1 were considered too faint to use in the final analysis. However, star 3 (GSC 01342-01261) was found to be an eclipsing variable and is detailed in a separate paper (Carroll & Hintz, 2000).

From the light curves, ten times of maximum light were determined. These times are given in Table 1. Using linear regression techniques we determined an ephemeris for QS Gem as given in Eq. 1. The period determined is similar to the value found by HIPPARCOS although significantly shorter.

$$\mathrm{HJD_{max}} = 2451222.8693 + 0.131955(\pm 0.000002) \times E. \tag{1}$$

In Fig. 2 we show a light curve for QS Gem from HJD 2451444 and in Fig. 3 we show a light curve from HJD 2451626. Clearly the amplitude of QS Gem is not constant. The amplitude varies from 0.08 to 0.20. Due to this variable amplitude we chose to examine the data with the frequency search program Period98. From this analysis only f_1 and $2f_1$

were found to be reliable frequencies as shown in Table 2. The value for f_1 is in excellent agreement with the period found by linear regression. A larger data set is called for to find the true frequency spectra.

QS Gem appears to be a normal low-amplitude δ Scuti variable with a complex light curve. Since this star is relatively bright with a moderate amplitude it would be an ideal star for an international campaign or for one of the small variability satellites currently under development.

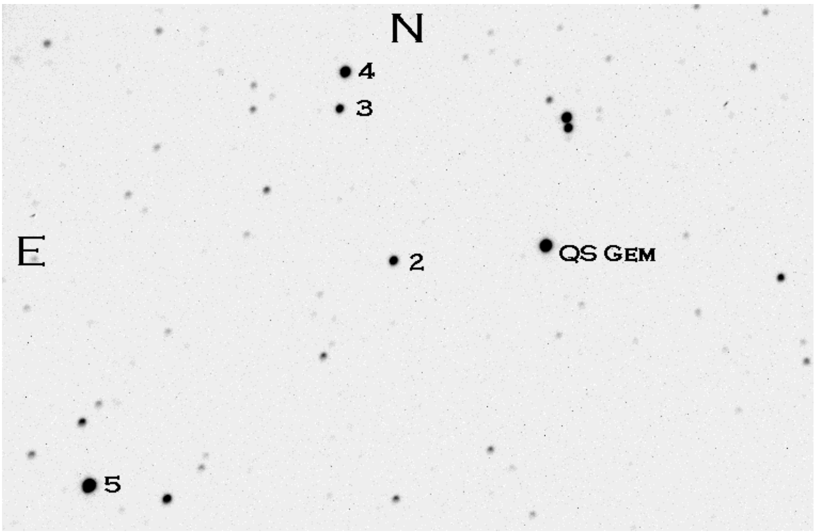

Figure 1. CCD field of QS Gem with comparison stars labeled. The field of view is 8′ × 12′.

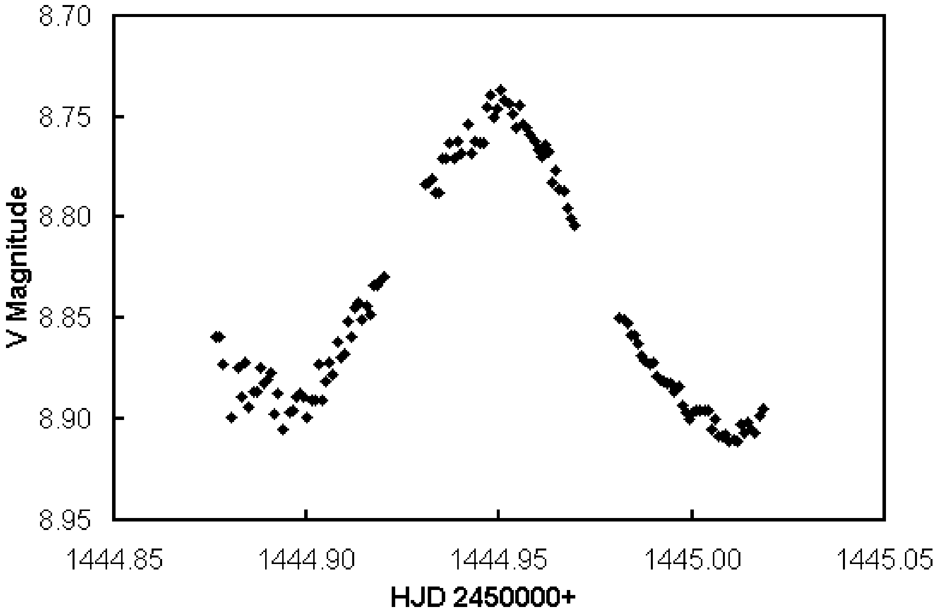

Figure 2. Light Curve of QS Geminorum from HJD 2451444

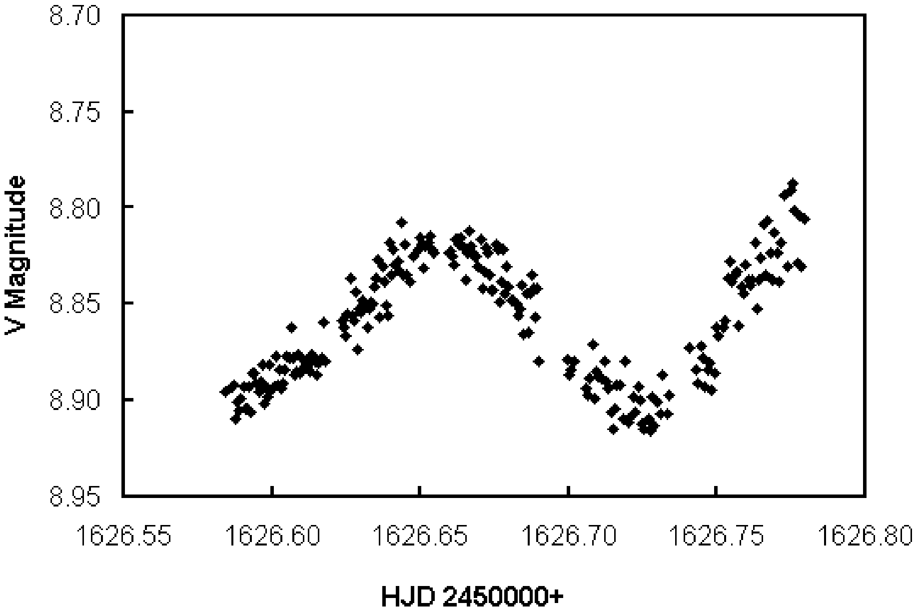

Figure 3. Light Curve of QS Geminorum from HJD 2451626

Table 1: New Times of Maximum Light for QS Geminorum

HJD 2451000.0+	Cycle	$O-C$
222.8692	0	−0.0001
444.9492	1683	−0.0004
463.9563	1827	0.0052
489.8115	2023	−0.0028
489.9398	2024	−0.0064
496.8071	2076	−0.0008
597.7505	2841	−0.0030
626.6504	3060	−0.0012
632.5904	3105	0.0008
632.7199	3106	-0.0016

Table 2: Frequencies Present in Light Curve of QS Geminorum

	Frequency (cycle/day)	Amplitude	Phase
f_1	7.5782	0.054	0.614
$2f_1$	15.1564	0.004	0.445

References:

Bessell, M. S. 1990, *PASP*, **102**, 1181
Carroll, D. D., Hintz, E. G., 2000, *IBVS*, No. 4928
ESA, 1997, The HIPPARCOS Catalogue, ESA, SP-1200

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NEW ECLIPSING VARIABLE IN THE FIELD OF QS GEMINORUM

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Name of the object:
GSC 01342-01261

Equatorial coordinates:	**Equinox:**
R.A.= $6^h46^m43^s$ **DEC.=** $+20°53'21''$	2000

Observatory and telescope:
Observations made with the 0.4-m David Derrick Telescope of the Orson Pratt Observatory on the campus of Brigham Young University.

Detector:	Pictor 416 XT CCD at the Newtonian focus which gives a plate scale of 0.93 arcsec/pixel

Filter(s):	Johnson V (Bessel, 1990)

Comparison star(s):	HD 263542 (GSC 01342-01109, $V = 9.72$) HD 48995 (GSC 01342-00517, $V = 8.61$)

Transformed to a standard system:	Johnson
Standard stars (field) used:	The two stars listed above

Availability of the data:
Upon request from the authors

Type of variability:	EA (Algol variable) — this is only a guess

Remarks:
These observations were primarily to observe the delta Scuti star QS Gem. Since the magnitude of QS Gem is 8.847 compared to the new variables 11.29 the errors are fairly large. We also note that we only saw one complete secondary minimum and only part of one primary minimum. The true nature of the star is yet to be determined. However, we estimate a period of 1.32 d, with a the secondary minimum having a drop of 0.18 mag and the primary having a drop of greater that 0.5 mag.

Reference:

Bessell, M.S., 1990, *PASP*, **102**, 1181

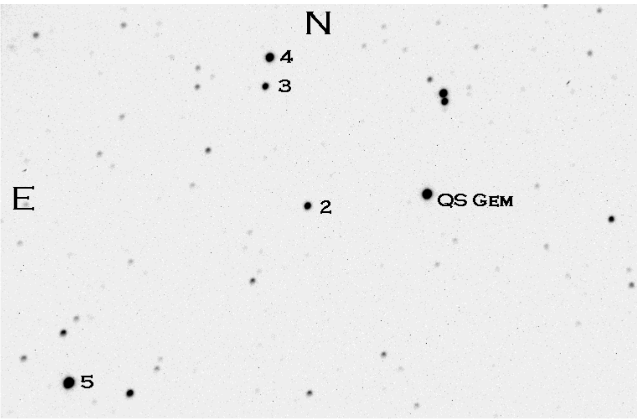

Figure 1. GSC 1342-1261 is labeled as No. 3

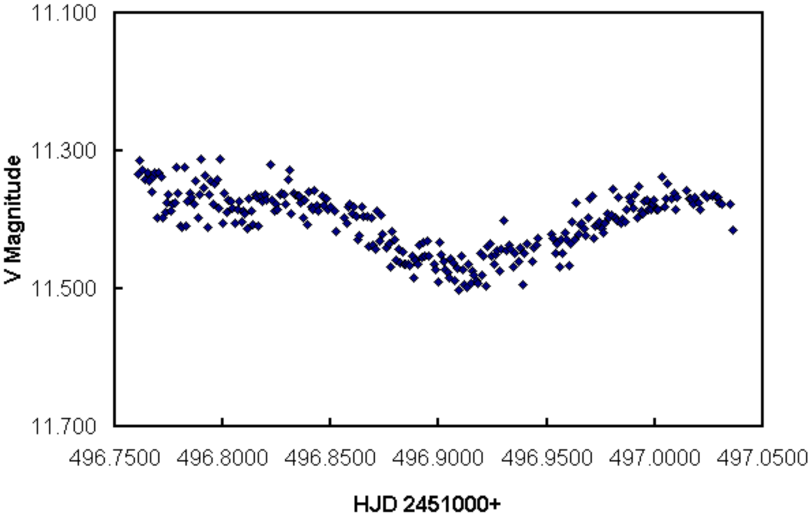

Figure 2.

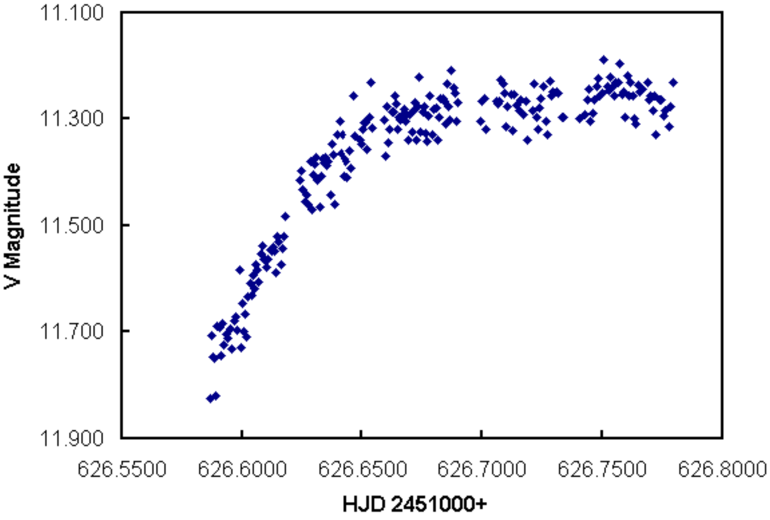

Figure 3.

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Budapest
26 July 2000

HU ISSN 0374 – 0676

GSC 03822_01056 IS A CLOSE ECLIPSING BINARY

BÍRÓ, IMRE BARNA

Baja Astronomical Observatory of Bács-Kiskun County, Szegedi út, Pf. 766, H-6500 Baja, Hungary
email: barna@electra.bajaobs.hu

Name of the object:
GSC 03822_01056

Equatorial coordinates:	**Equinox:**
R.A.= $10^{\mathrm{h}}33^{\mathrm{m}}53^{\mathrm{s}}$ **DEC.=** $+58^\circ 46' 54''$	J2000

Observatory and telescope:
Observatorio del Teide, IAC80 telescope (0.8 m, $f/11.3$, Cassegrain)

Detector:	Wright Instruments 1024 × 1024 CCD

Filter(s):	V, R

Comparison star(s):	GSC 03822_00070

Check star(s):	None

Transformed to a standard system:	Standard VR
Standard stars (field) used:	Landolt standards

Availability of the data:
Upon request at barna@electra.bajaobs.hu

Type of variability:	EB — eclipsing binary of β Lyrae type

Remarks:

Martin (2000) reported about the variability of GSC 03822_01056 in the field of the novalike eclipsing binary DW UMa, suggesting a pulsating type and a period of ~ 0.15 days from Fourier analysis. We have analysed VR photometric data of 4 consecutive nights gathered in a campaign on DW UMa during February 1997, and found that twice the quoted period is likely to hold for the new variable, which clearly exhibits two distinct minima. The folded light curve indicates an eclipsing binary nature, possibly of beta Lyrae type (EB). Analysis of the light curve gives the following preliminary ephemeris:

$$\mathrm{HJD_{min}} = 2,450,495.5222\ (\pm\ 0.0003) + 0.30995\ (\pm\ 0.0001) \times E.$$

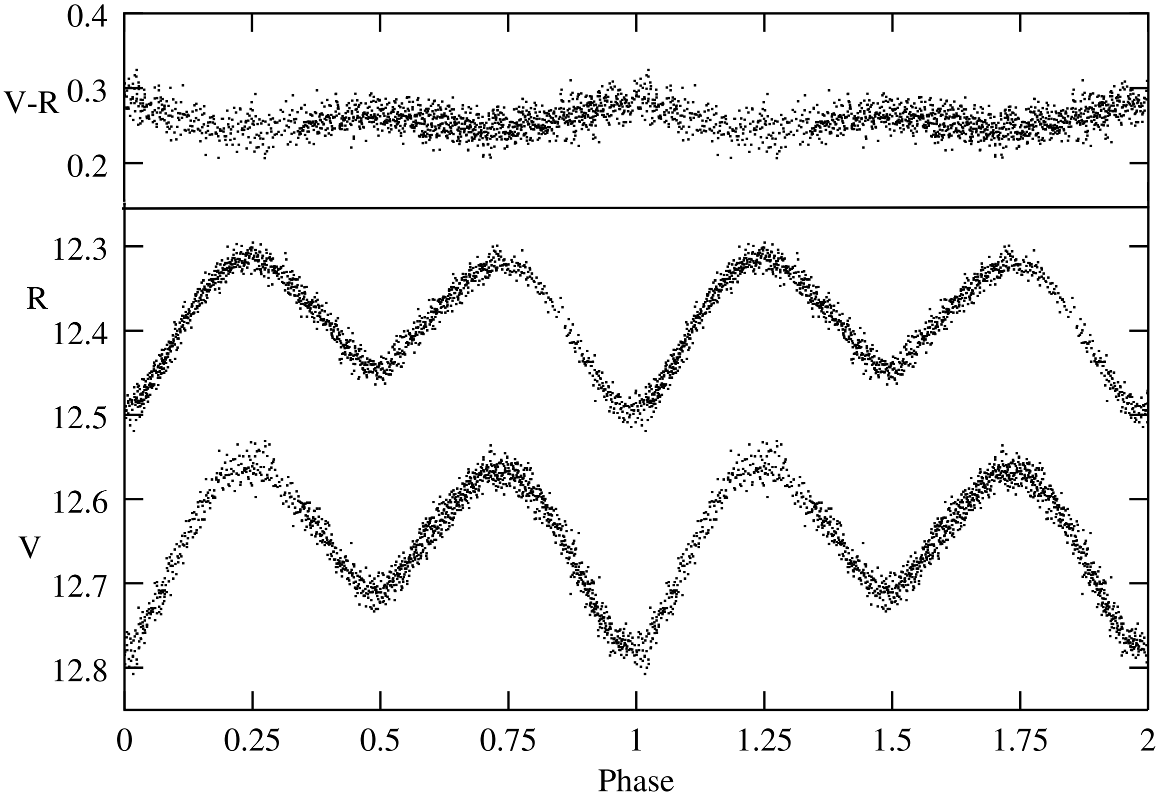

Figure 1.

Acknowledgements:

The author thanks Carlos Lazaro for his help provided during the author's visiting period at IAC.

Reference:

Martin, B.E., 2000, *IBVS*, No. 4880.

COMMISSIONS 27 AND 42 OF THE IAU
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Budapest
26 July 2000

HU ISSN 0374 – 0676

GSC 4847_1513 (FASTT 448) — A NEW ECLIPSING VARIABLE

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GSC 4847_1513 = FASTT 448 was first reported as a possible variable by Henden and Stone (1998) in their table of suspected variable stars discovered during the FASTT survey. They noted that the star had an observation 1.37 magnitudes below the mean of all observations. This suggested to the authors that the star might be an eclipsing binary and we began a program to determine the nature of the variability using photographic, visual and CCD observations.

Hager examined 230 patrol plates from the Harvard plate stacks covering the periods 1929–1951 and 1968–1989 and found five minima. Guilbault initiated random visual observations of the star using a 0.32 meter reflector to try to find the period. Those observations permitted a rough determination of the period and additional minima could be predicted and confirmed by Guilbault's observations.

CCD observations commenced in 1999 with the goal of refining the period and the shape of the lightcurve. Those observations were made with the 0.51 meter Ritchey-Chretien reflector of the Western Connecticut State University (WCSU) Observatory and an ISI Systems CCD800 CCD camera using a V filter. Additional minima were observed and the times of minimum found by all methods of observation are listed in Table 1. Both the visual and the CCD times of minimum were determined using a computer program based on the Kwee–Van Woerden (1956) method.

All minima were fitted into a least squares solution with the CCD minima weighted as 10 and the visual and photographic minima weighted as 1. From that analysis we extracted the best period and combined it with the most accurate time of minimum to derive the following elements:

$$\begin{array}{ll}\text{Min. I} = \text{HJD } 2451621.55863 + 1\overset{\text{d}}{.}0797024 \times E. \\ \qquad\qquad\qquad\quad \pm 0.00006 \;\; \pm 0.0000001\end{array}$$

The phased V lightcurve in the instrumental system is shown in Figure 1. Each point contains an error bar showing the estimated internal photometric error of each observation. The curve shows that the star fades from a maximum of $11\overset{\text{m}}{.}86 \pm 0.01$ to $13\overset{\text{m}}{.}77 \pm 0.04$ at primary minimum. A secondary eclipse with a depth of $0\overset{\text{m}}{.}14 \pm 0.01$ occurs at phase 0.50. Both eclipses are partial and their duration is about 0.2 P.

Table 1. Times of minimum, GSC 4847_1513 (FASTT 448)

HJD 2400000+	Epoch	$O-C$	Observer
25301.636	−24377	−0.017	Harvard ptg
25314.622	−25365	+0.012	Harvard ptg
25954.863	−23772	−0.010	Harvard ptg
26059.612	−23675	+0.008	Harvard ptg
27193.303	−22625	+0.011	Harvard ptg
51255.5346(4)	−339	−0.005	Guilbault vis
51490.9191(2)	−120	+0.004	Guilbault vis
51502.7906(4)	−110	−0.001	Guilbault vis
51502.7909(4)	−110	0.000	Hager ccd
51555.6977(2)	−61	+0.001	Hager ccd
51621.55863(6)	0	0.000	Hager ccd

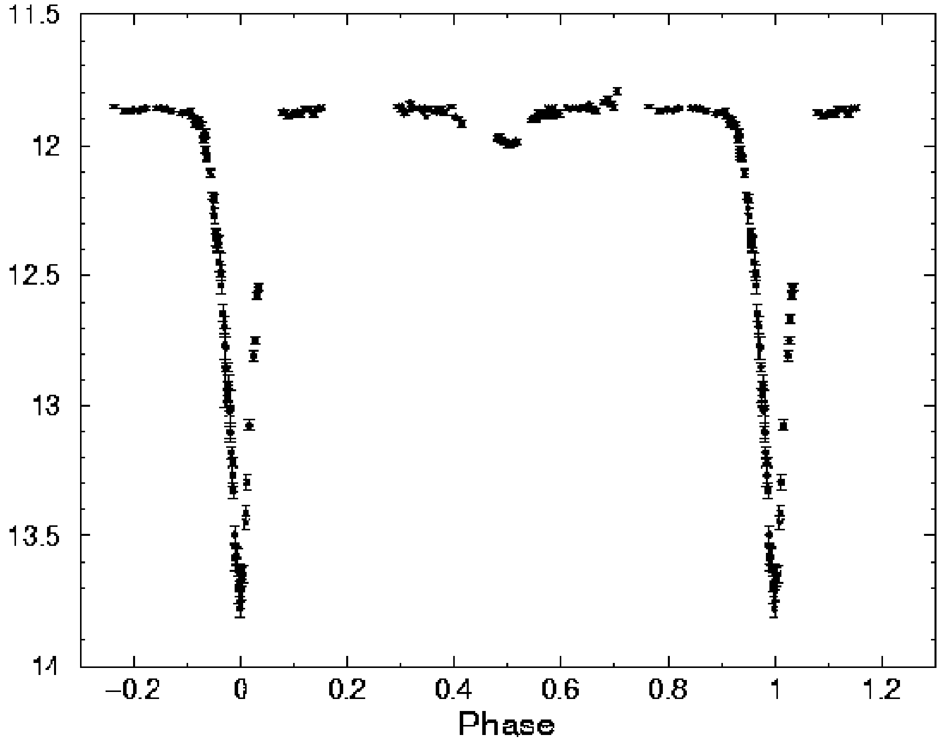

Figure 1. Phased lightcurve — V Filter

The comparison and check stars are listed in Table 2. The V magnitude and $V-I$ color index of GSC 4847_1694 was taken from the *tenxcat* catalog produced by the TASS group (Richmond *et al.* 2000). The V magnitude and color indices for GSC 4847_1605 are from the average of two nights of all sky photometry using observations of Landolt standards (Landolt, 1992) in March 1998 with the Lowell 31 inch telescope of the National Undergraduate Research Observatory (NURO) in Flagstaff, Arizona.

Table 2. Comparison Stars

	Star	V	$B-V$	$V-R$	$V-I$
Comp.	GSC 4847_1694	11.565 ± 0.065			1.331 ± 0.165
Check	GSC 4847_1605	14.182 ± 0.044	0.631 ± 0.038	0.362 ± 0.060	0.673 ± 0.060

We wish to thank Dr. Martha Hazen, curator of astronomical photographs at Harvard College Observatory, for use of the Harvard Patrol Plates. We are also grateful to Dr. Doug Welch and Dr. Chris Lloyd for their help in confirming our period. Hager's travel to NURO was made possible by a grant from Western Connecticut State University and he also wishes to thank his advisors Dr. Dennis Dawson and Dr. Phillip Lu for their valuable help.

References:

Henden, A. A., and Stone, R. C., 1998, *AJ*, **115**, 296
Kwee, K. K., and Van Woerden, H., 1956, *BAN*, **12**, No. 464, 327
Landolt, A. U., 1992, *AJ*, **104**, 340
Richmond, M. W., Droege, T. F., Gombert, G., Gutzwiller, M., Henden, A. A., Albertson, C., Beser, N., Molhant, N., Johnson, H., 2000, *PASP*, **112**, 397

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HD 218179: A NEW LONG PERIOD BRIGHT EB IN CEPHEUS

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Esteve Duran Observatory Foundation, Montseny 46 — Urb. El Montanya, 08553 Seva, Barcelona, Spain
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Name of the object:
HD 218179 = BD +63°1925 = PPM 24170 = SAO 20407 = AGK +63°1302 = GSC 4286_80

Equatorial coordinates:	**Equinox:**
R.A.= $23^h04^m47^s$ **DEC.=** $+64°05'25''$	2000.0

Observatory and telescope:
Mollet Observatory, 8-cm automatic refracting telescope

Detector:	CCD
Filter(s):	V
Comparison star(s):	SAO 20384 = PPM 24142 = HIP 113793 = HD 217872 = GSC 4282_919
Check star(s):	1: SAO 20422 = PPM 24186 = HIP 114070 = HD 218342 = GSC 4282_391 2: SAO 20405 = PPM 24168 = HIP 113947 = HD 218139 = GSC 4282_255
Transformed to a standard system:	No

Availability of the data:
Upon request

Type of variability:	EB

Remarks:

HD 218179 whose spectral type is F0, is listed in the TYCHO Catalogue with flag 'V' (strong evidence of variability in de Tycho data) with an amplitude variation between 7.47 and 7.76. The variability of this star was initially reported by Olsen (1983), who detected light changes while performing Strömgren photometry of nearly all Henry Draper stars of types A5 to G0 and brighter than $m_v = 8\overset{\text{m}}{.}3$. This star is also listed in the New Catalogue of Suspected Variable Stars Supplement with number 26012 (Kazarovets et al., 1998). In addition, in an analysis for searching sinusoidal light variations of the stars in the Tycho Catalogue, Koen and Schumann (1999) concluded that this star was variable with a 17.950 day period.

Satellite photometric data from the Tycho instrument was reanalized and the results suggested that this star might be an EB variable with a period of 35.9 days. To verify this point the star was observed for 100 nights between 9 September 1997 and 25 February 1999. This star is a visual double (MLR 7) with $8\overset{\text{m}}{.}1$ and $8\overset{\text{m}}{.}9$ components separated by 0.4 arcseconds (Olsen, 1980), so joint photometry had to be performed. Present observations confirmed the preliminary analysis, showing that HD 218179 is an EB variable with a period of 35.93 days and a 0.33 magnitude variation (from 7.41 to 7.74 in V) for minimum I. In addition, its light curve shows that the secondary minimum, $0\overset{\text{m}}{.}21$ deep, is centered at phase 0.486±0.006. In spite of Tycho data scatter, they were of great help to obtain the following ephemeris:

$$\begin{array}{rl}\text{HJD Min I} = & 2451018.846 + 35.928 \times E. \\ & \quad\quad\quad\pm 0.2 \quad \pm 0.004\end{array}$$

Also the following single secondary minimum was determined: HJD Min II = 2451036.319 ± 0.16.

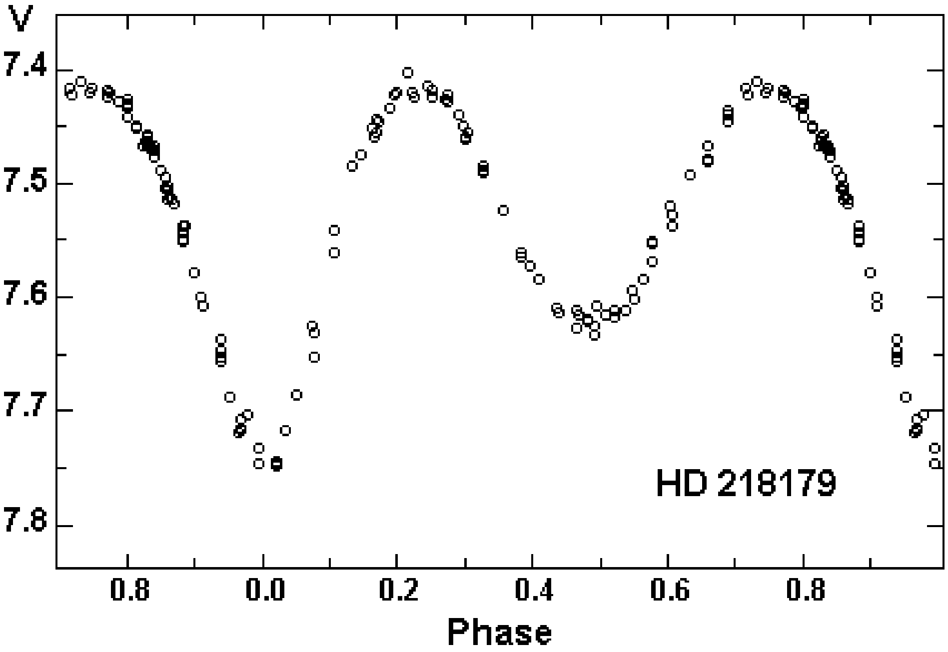

Figure 1.

Acknowledgements:

For this research the SIMBAD database, operated by CDS, Strasbourg, France, was utilized.

References:

ESA, 1997, The Hipparcos and Tycho Catalogues, ESA SP-1200
Kazarovets E.V., Durlevich O.V., Samus N.N., 1998, New Catalogue of Suspected Variable Stars. Supplement, http://www.sai.msu.su/groups/cluster/gcvs/gcvs/nsvsup/
Koen, C., Schumann, R., 1999, *MNRAS*, **310**, 618
Olsen, E.H., 1980, *Astron. Astrophys, Suppl. Ser.*, **39**, 205
Olsen, E.H., 1983, *Astron. Astrophys, Suppl. Ser.*, **54**, 55

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Budapest
1 August 2000

HU ISSN 0374 – 0676

DETECTION OF SUPERCYCLE IN SS UMi: NORMAL SU UMa-TYPE DWARF NOVA WITH THE SHORTEST SUPERCYCLE

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RESZELSKI, MACIEJ[5]; DUBOVSKY, PAVOL A.[6]

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e-mail: eddy.muyllaert@ping.be

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ER UMa stars are a small subgroup of SU UMa-type dwarf novae, which have extremely short supercycles (the interval between successive superoutbursts) of 19–50 d (for a review, see Kato et al. 1999). Only four definite members have been recognized (ER UMa, V1159 Ori, RZ LMi and DI UMa). Since the shortest known supercycles of "usual" SU UMa-type dwarf novae are in the range of 90–130 d (e.g. Table 1 in Nogami et al. 1997), several objects have been proposed as candidates for the missing link between ER UMa stars and the usual SU UMa-type dwarf novae: SX LMi (Nogami et al. 1997), HS Vir (Kato et al. 1998b), NY Ser (Nogami et al. 1998) and CI UMa (Nogami and Kato 1997). V503 Cyg (Harvey et al. 1995) also has a supercycle as short as 89 d. However, none of these objects show perfectly intermediate outburst statistics between ER UMa stars and usual SU UMa-type dwarf novae. Both HS Vir and NY Ser have short ($\sim$ 8 d) outburst recurrence times, while superoutbursts occur less frequently. In SX LMi and CI UMa, superoutbursts occur more irregularly and the frequency of normal outbursts is small. V503 Cyg shows a more regular supercycle, while the number of normal outbursts (usually two) is anomalously low compared to ER UMa stars and other SU UMa-type dwarf novae. The deviation in statistics and regularity of these systems from extremely regular ER UMa stars should require an anomalous disk viscosity or other unknown mechanisms (Nogami et al. 1997; Kato et al. 1998b).

The dwarf nova SS UMi was discovered as an optical counterpart of Einstein IPC source E1551+718 (Mason et al. 1982). The existence of superhumps during long outburst revealed its SU UMa-type nature (Chen et al. 1991; Kato et al. 1998a). Richter (1989) studied the outburst statistics based on 4180 Sonneberg plates and suggested the possible outburst interval of 30–48 d. This value has been taken by Ritter and Kolb (1998) in their sixth edition of Catalogue of Cataclysmic Variables and Low-Mass X-ray Binaries. We continued to observe SS UMi as a part of VSNET Collaboration (http://www.kusastro.kyoto-u.ac.jp/vsnet/).

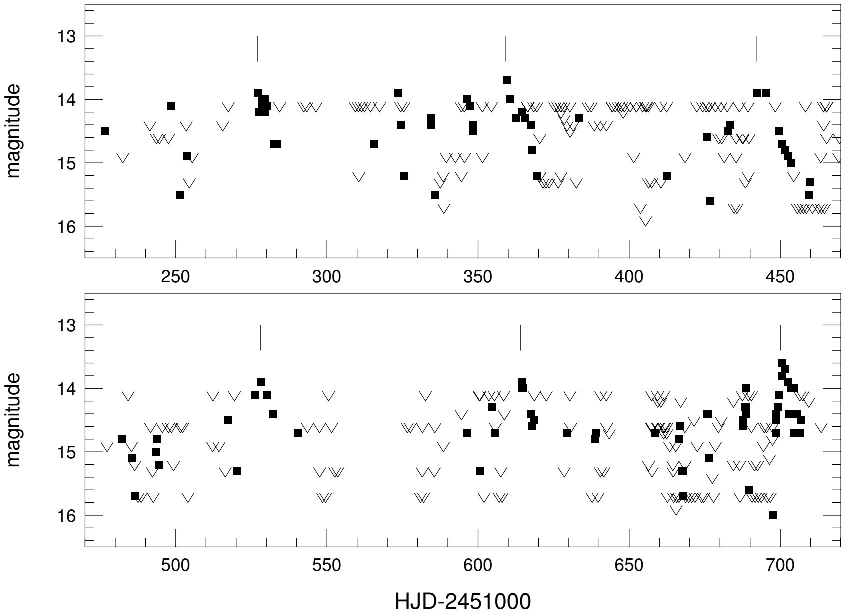

Figure 1. Overall light curve of SS UMi

Visual observations were performed using 46-cm (G.H.), 40-cm (G.P.), 20-cm (E.M.), 41-cm (M.R.) and 20-cm (P.A.D.) reflectors. All observations were done using photoelectrically calibrated V-magnitude comparison stars. The typical error of visual estimates were an order of 0.2 mag, which does not affect the following discussion. Upper limit observations were included for analysis which reached fainter than 14.0 mag. The total number of observations was 375 between 1999 February 17 and 2000 June 17, including other observations reported to VSNET.

The overall light variation is presented in Figure 1. Each filled square represents single estimates and 'V' sign represents upper limits. The observations already clearly show the presence of regular outburst cycle. Since we know that SS UMi belongs to the SU UMa-type category, we can safely choose outbursts longer than five days as superoutbursts. These outbursts are marked with vertical bars. The intervals between successive superoutbursts are in the range of 82–86 d, $84^{\mathrm{d}}.7$ in average. All observations are well expressed by this representative supercycle of $84^{\mathrm{d}}.7$. Figure 2 presents a folded light curve by this period.

We have revealed that SS UMi is an SU UMa-type dwarf nova with one of the shortest known stable supercycles. Figure 2 suggests the existence of five normal outbursts between successive superoutbursts, whose interval corresponds to $\sim$ 11 d. The combination of supercycle length of $84^{\mathrm{d}}.7$ and the outburst recurrence time of 11 d lies on the natural extension of SU UMa-type dwarf novae toward ER UMa stars (Warner 1995; Osaki 1995). Considering that many outbursts recorded by Richter (1989) were long ones, the period by Richter (1989) may be interpreted to represent the half supercycle. The present observation has thus first proven the unique location of SS UMi among "normal" SU UMa-type dwarf novae toward ER UMa stars.

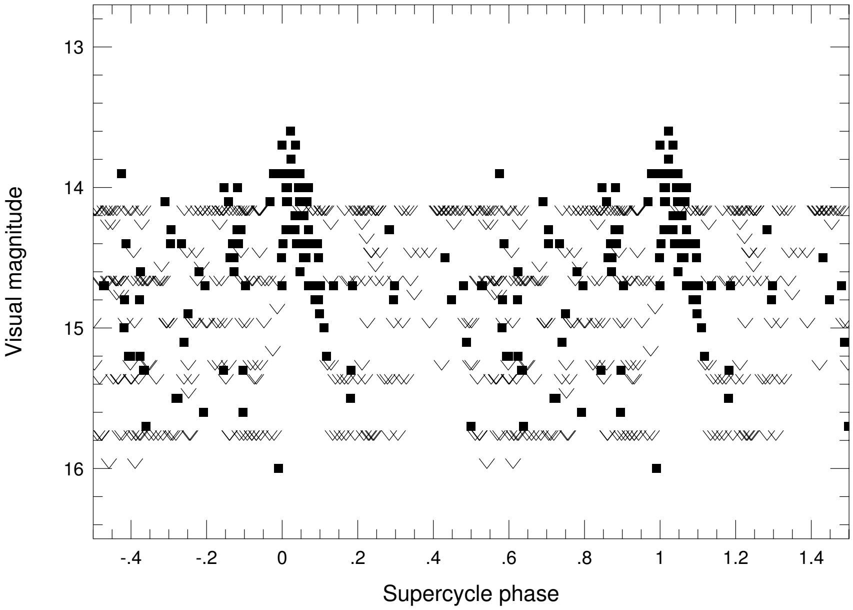

Figure 2. The 84.7-d supercycle of SS UMi

The authors are grateful to observers (H. Itoh and J. Ripero) who reported additional observations of SS UMi to VSNET.

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MT PEGASI (= HD 217813) — A YOUNG SUN WITH STARSPOTS

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Before its discovery as a variable star, MT Peg (HD 217813; G1V; $m_v = +6.65$ mag; $B-V = +0.62$) was used by us as a comparison star for multi-band photometry of 51 Peg. This photometry was carried out during the fall 1995 shortly after the announcement of a possible exosolar giant planet in orbit around 51 Peg by Mayor & Queloz (1995). The existence of this planet was subsequently confirmed by Marcy et al. (1997). The photometry was made primarily to investigate possible light variations of 51 Peg that could account for the 4.43 day, ~ 56 m/s radial velocity variations reported for this star (Mayor & Queloz 1995). After about two weeks of observations it became apparent that MT Peg was a variable star with small (~ 0.02 mag) light variations as noted by Guinan et al. (1995). Conversely, 51 Peg was found to be constant in brightness to less than a few millimags (Guinan et al. 1995), as later confirmed by Henry et al. (2000).

MT Peg has an assigned MK spectral type of G5V (Simbad). However, this spectral type is not in good agreement with the spectral class of $\sim$ G1V indicated from the *UBV* and Strömgren indices that appear in the Simbad database. The observed $B-V$ and $U-B$ values of $+0.62 \pm 0.01$ and $+0.10 \pm 0.01$ mag, respectively, and the Strömgren indices of MT Peg of $b-y = +0.39$, $m_1 = +0.202$, and $c_1 = +0.321$ indicate a G0-1 V star rather than a G5V (Simbad). In addition, the absolute visual magnitude of MT Peg of $M_v = +4.72 \pm 0.2$ mag (computed using the Hipparcos parallax of $d = 24.3$ pc and $\langle V \rangle = +6.65$ mag), is in better agreement with a near-ZAMS G1V star than a G5V star. It is possible that MT Peg has an unresolved blue companion that effects the color indices but this is unlikely. A new spectral classification of MT Peg would be useful to resolve this minor discrepancy.

UBVRI photometry was conducted with the Four College Consortium (FCC) 0.8-m Automatic Photoelectric Telescope (APT) in the Patagonia Mountains located in southern Arizona. The observations were made on 14 nights from 14 October–12 November 1995. Differential photometry was made employing the usual observing sequence sky–comparison–variable–comparison–sky. The stars were observed for about 20–25 minutes per night with integration times of 10 seconds. Standard photometric reduction methods were utilized to reduce the data. The UT times were transformed to heliocentric Julian Day (HJD) and differential atmospheric extinction corrections were applied. The observations were converted to delta-magnitudes in the sense of variable minus comparison star. In the reductions, the role of the "variable" and "comparison" star were interchanged and 51 Peg served as the comparison star for the photometry of MT Peg. Because the angular separation of 51 Peg and MT Peg is small ($< 2°$), the corrections for differential

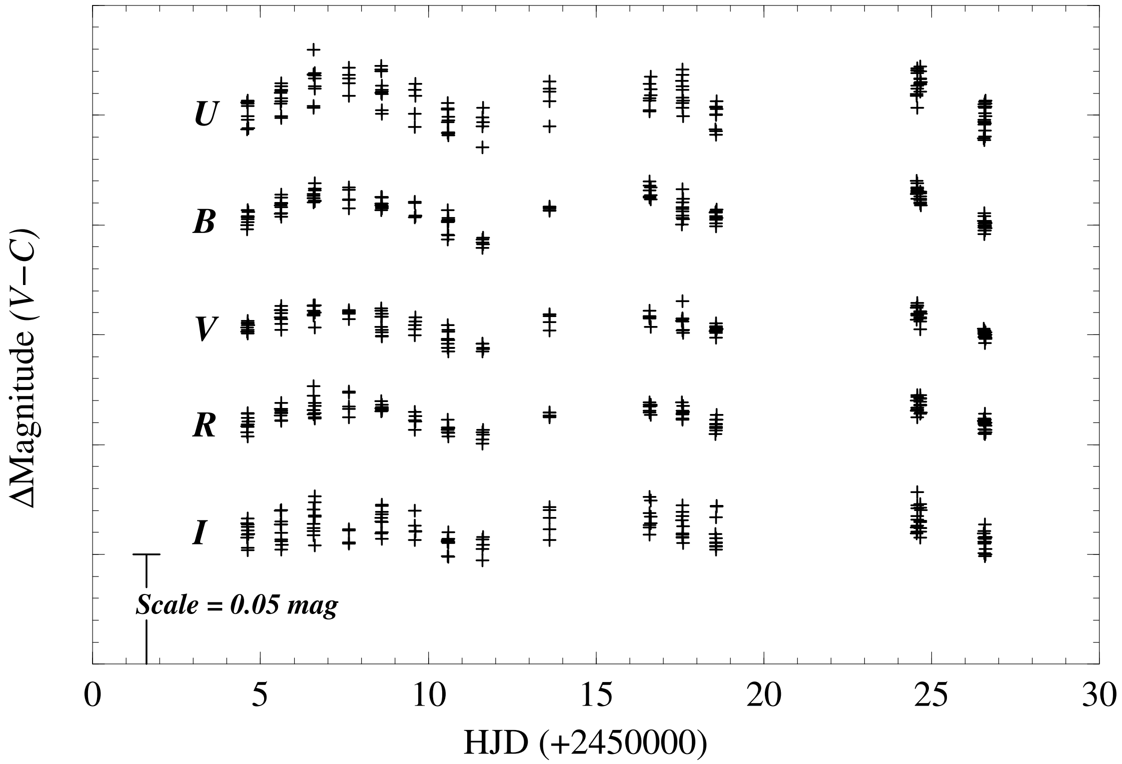

Figure 1. Light variations of MT Peg from photometry obtained during October–November 1995 are shown.

atmospheric extinction were negligible. To illustrate the light variations of MT Peg, the U, B, V, R, I observations are plotted in Figure 1 against Julian Day Number.

As shown in Fig. 1, MT Peg has periodic quasi-sinusoidal brightness variations with a period of several days. Also the light variations are wavelength dependent with the greater light amplitudes occurring at shorter wavelengths. From a power spectrum analysis (Scargle 1982), a broad, definite peak is found for a period of $P = 8.1 \pm 0.2$ days when all of the band-passes are used. Unfortunately, this observing run lasted less than a month so that the photometric period is not as well defined as it could be with additional data. The observations were combined and plotted against phase with this period. Representative light curves and a geometrical starspot model fit (discussed later) are presented in Fig. 2. As shown, the light variations are quasi-sinusoidal with light amplitudes that are small and a function of wavelength. The observed light ranges for each band-pass are: U (0.018 ± 0.003 mag), B (0.021 ± 0.002 mag), V (0.015 ± 0.003 mag), R (0.013 ± 0.002 mag), I (0.012 ± 0.003 mag).

The nature of the light variations and the wavelength dependence are similar to those reported for chromospherically-active, cool stars (BY Dra and RS CVn variables) in which the light variations arise from the presence of starspots. The starspot hypothesis for explaining the light variability of MT Peg is strongly supported by the discovery that MT Peg is a moderately strong coronal X-ray source with an X-ray luminosity of $L_x = 1.25 \times 10^{29}$ erg s^{-1} (Gaidos 1998). Moreover, the L_x observed for MT Peg is in excellent agreement with the value expected from $L_x - P_{\rm rot}$ relationship found by Güdel et al. (1997) for G0-5 V stars, with the adopted rotation period of $P_{\rm rot} = 8.1$ d. Also, because the rotation of a single, solar-type star is dependent on age, the "rotational" age of MT Peg is about 0.7 ± 0.2 Gyr from age $- P_{\rm rot}$ relation from Dorren et al. (1994). Although this

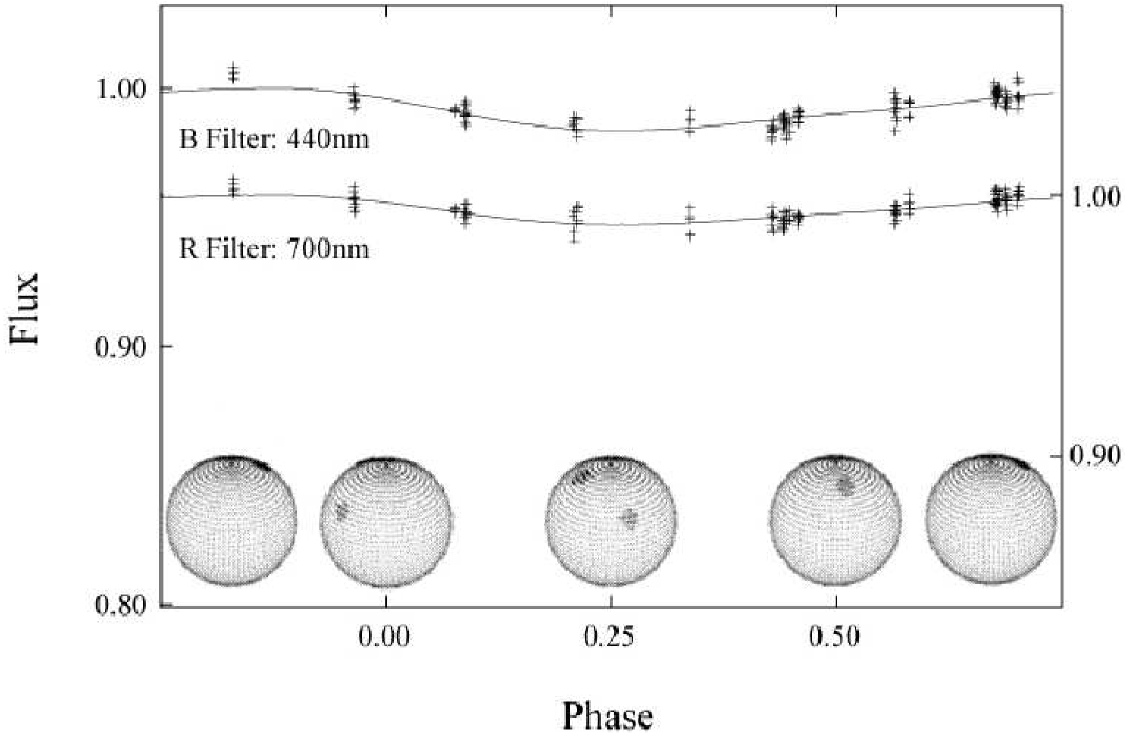

Figure 2. Starspot model fits to the B and R observations are shown in the lower part of the figure. Different rotational aspects of the star are shown. The observations are phased with a period of 8.1 days.

"spin-down" age for MT Peg is similar to the evolutionary age of Hyades stars, the (U, V, W) space motions of MT Peg of (+22.4, +11.2, +11.9) km s^{-1} are not consistent with membership in the Hyades Moving Group (−40, −18, −2) (Soderblom & Clements 1987). However, the space motions of MT Peg are similar to those of the Sirius Supercluster of (+11.1, +3.3, −8.2) km s^{-1}. A recent determination of the age of the Sirius Supercluster (which includes the Ursae Majoris Star Stream) is $\sim 0.49 \pm 0.13$ Gyr (Palouš & Hauck 1986).

The light curves were modeled using a simple starspot model included in the Binary Maker Program (Bradstreet 1993). In this case, the companion star was given a near zero mass and luminosity. The amplitudes and shapes of the light curves were fitted through manual iterations. We adopted a model with two cool, circular starspots. From the assumed spectral class of G1V, we also assumed a temperature of $T_{\mathrm{eff}} = 5800$ K for the immaculate regions of the star (Cox 2000). Because of the low amplitude light variations, there is little information contained in the light curves about the latitudes of the starspots on the star. The best fits were obtained when the spots were placed at latitudes of 30° and 60°. After about 50 iterations we obtained satisfactory fits to U, B, V, R, I light curves; the best fits were obtained with a total spot coverage (measured relative to the star's total surface area) of $\sim$ 2.2% or 4.4% if equatorial symmetry is assumed and the spots are located in both northern and southern hemispheres. From the iterative analysis, we found that the spots were separated in longitude by $\sim 90 \pm 25°$. Figure 2 shows the spot model fits to the B and R observations. The wavelength dependence of the light variations indicates a difference of temperature (photosphere − spot) of $\sim 500 \pm 150$ K. For the modeling, we assumed the rotational pole of the star is viewed at a nominal value

$i = 60°$ to our line-of-sight. When a precise value of the projected rotational velocity ($v \sin i$) is determined from spectroscopy, then the inclination of the star (i) can be found from its rotational period. Because of the small light variations and the lack of Doppler imaging, the latitudes of the star spots can not be accurately determined. However, they should be considered as representative of spot areas, distributions, and temperatures at the time of observations.

MT Peg is an important star for studying the magnetic evolution of our Sun. In particular, its estimated age of ∼ 0.5–0.7 Gyr makes it a suitable bright, nearby proxy for the Sun at an age when life was first developing on Earth some ∼ 4 Gyr ago. Additional photometry is needed to refine its period as well as to investigate possible differential rotation and a starspot activity cycle commonly found for other young solar-like stars. A modern determination of a MK spectral type would be very useful to confirm our adopted G1V spectral class. Also high dispersion spectra are needed as well to determine the star's projected rotational velocity ($v \sin i$) and to ascertain that it is a single star.

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A PROBABLE VARIATION IN THE POLARIZATION OF THE EARLY-TYPE ECLIPSING BINARY SYSTEM XZ Cep

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XZ Cep (BD +66°1512) is an eclipsing and double-lined spectroscopic binary system, consisting of late O and early B stars. The large reddening in its color (Saute & Martel, 1979) suggests the existence of a large amount of interstellar matter in the direction. A recent photometric study of this binary with the UBV photoelectric system was done by Antokhina & Kumsiashvili (1991), which yielded a semidetached configuration. Their light-curves were analyzed again by Harries et al. (1997), who also obtained a new radial-velocity curve of this system. Harries et al. confirmed that the system is a semidetached one and the cooler, less massive component is filling its critical Roche lobe.

Kreiner et al. (1990) performed a period study of the system, and derived a new photometric ephemeris as follows.

$$\mathrm{Min\ I} = \mathrm{HJD}\ 2426033.421 + 5\overset{\mathrm{d}}{.}0972531 \times E.$$

Harries et al. (1997) employed this and we also use it here.

Saute & Martel (1979) made polarimetric observations (mainly in B filter) and reported that very large and rapid changes in the polarization of XZ Cep were detected in 1970–1971. They did not mention the cause of these variations explicitly, but commented that if the variations were real, they could originate only from very violent ejection of matter. There has been no polarimetric report on XZ Cep since then.

We observed this object with a low resolution spectropolarimeter (referred to as HBS, Kawabata et al., 1999), mounted at the 36-inch reflector at Dodaira Observatory of the National Astronomical Observatory of Japan. In the observations, we used a diaphragm of 17′ ϕ, which yields a spectral resolution of about 100 Å (limited by the seeing at Dodaira). On twelve nights from November 1998 to December 1999, we observed the object at various orbital phases and got around 10 sets of data at each night. To reduce the observed data, the standard reduction software for HBS was used (Kawabata et al., 1999). The nightly mean value of the polarization is shown in Table 1.

First, to see the wavelength dependence of polarization as precisely as possible, the Stokes parameters are binned in wavelength to a constant photon noise of 0.01%. The typical resolution goes down to about 300 Å after this procedure. The polarization spectra are displayed in Fig. 1.

Table 1: The journal of polarimetric observations. The meaning of the symbols are as follows. p: polarization degree, θ: polarization angle, q, u: Stokes parameters. The subscript B means synthetic B filter of the standard Johnson system.

Date	Mid. phase	p_B (%)	θ_B (°)	q_B (%)	u_B (%)
1998 Nov. 24	0.93	4.240 ± 0.064	73.45 ± 0.43	-3.552 ± 0.065	$+2.315 \pm 0.064$
1998 Nov. 25	0.10	4.227 ± 0.043	73.20 ± 0.29	-3.521 ± 0.042	$+2.339 \pm 0.044$
1998 Dec. 29	0.77	4.143 ± 0.041	73.01 ± 0.28	-3.435 ± 0.041	$+2.316 \pm 0.040$
1998 Dec. 30	0.98	4.242 ± 0.057	73.00 ± 0.39	-3.517 ± 0.057	$+2.372 \pm 0.057$
1999 Jan. 1	0.35	4.160 ± 0.055	73.30 ± 0.38	-3.473 ± 0.055	$+2.290 \pm 0.055$
1999 Jan. 2	0.55	4.216 ± 0.054	72.78 ± 0.37	-3.477 ± 0.054	$+2.384 \pm 0.054$
1999 Nov. 13	0.36	4.175 ± 0.026	73.13 ± 0.17	-3.472 ± 0.026	$+2.319 \pm 0.025$
1999 Nov. 16	0.95	4.160 ± 0.030	72.99 ± 0.21	-3.448 ± 0.030	$+2.327 \pm 0.030$
1999 Dec. 16	0.83	4.091 ± 0.017	73.09 ± 0.12	-3.399 ± 0.017	$+2.277 \pm 0.017$
1999 Dec. 19	0.42	4.173 ± 0.046	72.87 ± 0.32	-3.450 ± 0.045	$+2.349 \pm 0.047$
1999 Dec. 20	0.62	4.125 ± 0.039	74.11 ± 0.27	-3.507 ± 0.039	$+2.172 \pm 0.038$
1999 Dec. 21	0.80	4.243 ± 0.015	74.12 ± 0.10	-3.607 ± 0.015	$+2.234 \pm 0.015$

As seen in Fig. 1, XZ Cep shows large polarization degree up to 4.4%. The value had been almost constant throughout our observations at the whole wavelength. Furthermore, the feature of polarization degree versus wavelength is quite consistent with an empirical formula of interstellar polarization derived by Serkowski et al. (1975). Therefore, the interstellar polarization must be dominant in the observed polarization of XZ Cep. In general, the polarization angle does not depend on wavelength for interstellar polarization. But in our case, the polarization angle is not constant. This slight change (or rotation) of polarization angle versus wavelength may be caused by the existence of two or more interstellar clouds with different properties which lie between XZ Cep and us.

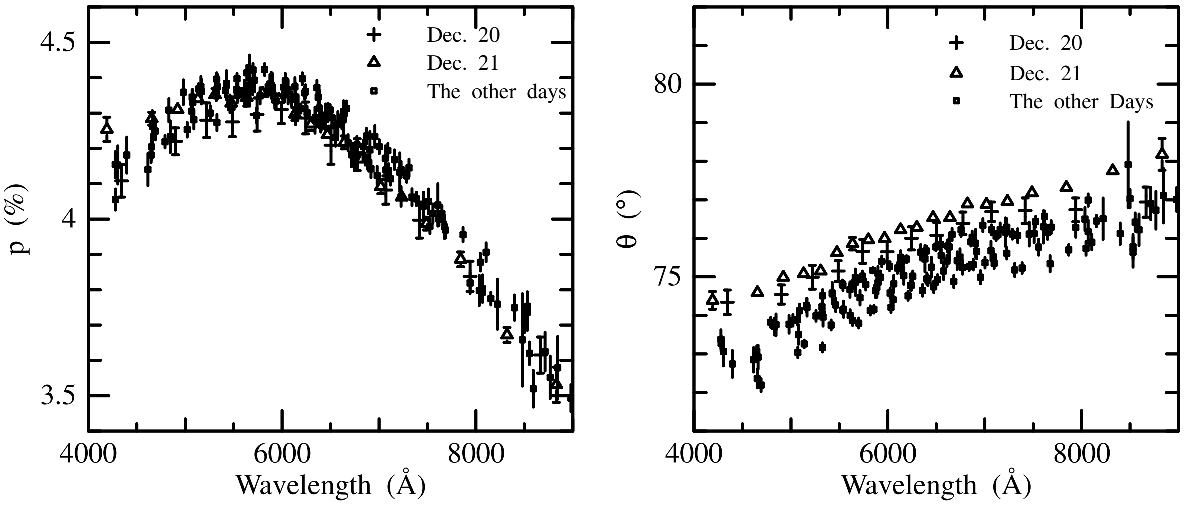

Figure 1. Dependence of the polarization on wavelength.
Left: polarization degree versus wavelength. Right: polarization angle versus wavelength.

Almost all polarization angles are between 73–76°, except those on December 20 and 21, 1999. The polarization angles shifted by $1 \sim 2°$as a whole on these two days. It is noticed that the values of polarization degrees on these two days in Fig. 1 are also changed slightly, especially in blue wavelengths on Dec. 21.

We also observed polarized standard stars for the calibration. On Dec. 21, 1999 we observed the strongly polarized standard star HD 26433 after the observation of XZ Cep. The observation of this standard star was repeated on Nov. 4, 1999. The result for HD 26433 is shown in Table 2. The difference between the data for HD 26433 on these two days is roughly within the observational error. On the other hand, the difference, e.g. between the data on Dec. 16 and 21, is ten times larger than the error (~ 0.015) for XZ Cep. It should be noticed that the data on these nights have smaller errors than those of the other days because of the fine weather conditions. Hence, we conclude that these variations of polarization of XZ Cep are not instrumental, but intrinsic. We also mention that these variations do not depend on the orbital phase, because the data on Dec. 21 and Dec. 16 are different from each other, though the orbital phase of XZ Cep on Dec. 21 is close to that on Dec. 16.

Table 2: Observed data for HD 26433, a strongly polarized standard star

Date	p_B (%)	θ_B (°)	q_B (%)	u_B (%)
1999 Nov. 4	5.083 ± 0.026	135.23 ± 0.15	$+0.041 \pm 0.026$	-5.083 ± 0.026
1999 Dec. 21	5.062 ± 0.017	135.88 ± 0.09	$+0.156 \pm 0.016$	-5.060 ± 0.017

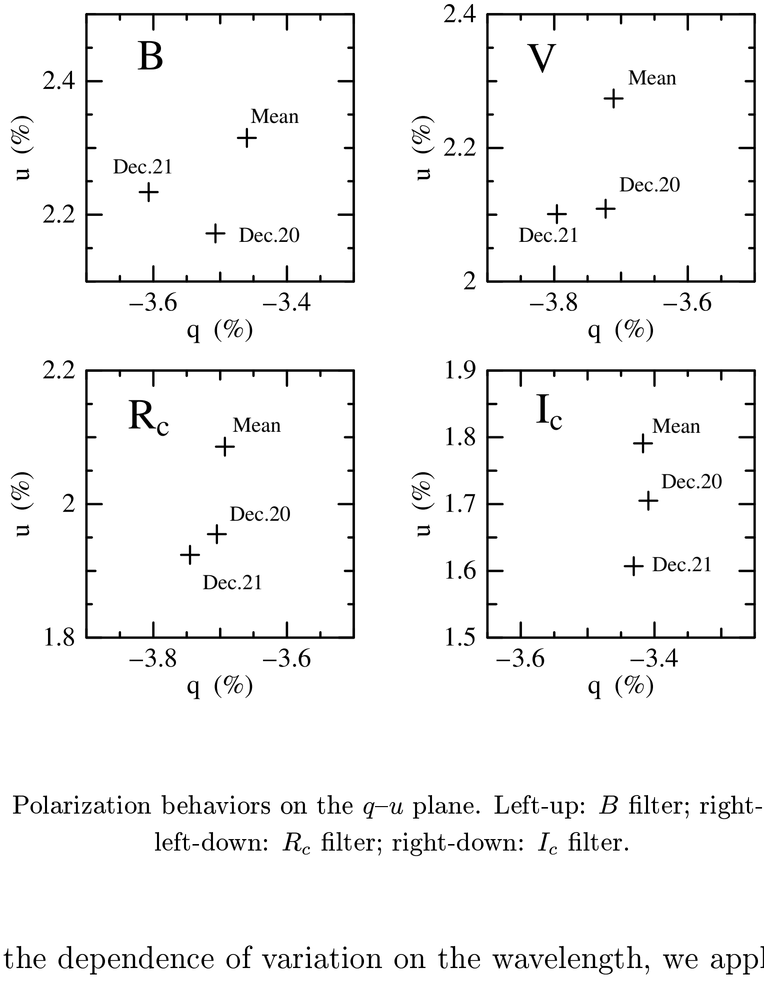

Figure 2. Polarization behaviors on the q–u plane. Left-up: B filter; right-up: V filter; left-down: R_c filter; right-down: I_c filter.

Next, to see the dependence of variation on the wavelength, we applied the synthetic standard Johnson–Cousins BVR_cI_c filters (Bessell 1990). Fig. 2 shows the values of Stokes parameter on Dec. 20 and Dec. 21 and the mean value of the other days for B, V, R_c, I_c

on the q–u plane. The Stokes parameter on Dec. 21 is different from that of Dec. 20 for each color.

The directions of the Stokes vector from the mean point to the point of Dec. 20 on the q–u plane are almost same in all filters. The Stokes vector from the point of Dec. 20 to that of Dec. 21 rotated compared to the vector from the mean point to the point of Dec. 20, except in the I_c filter. In the B filter, the vector is almost perpendicular to the one in the I_c. The angles of the rotation of the vectors are larger in shorter wavelength.

We detected a probable variation in the polarization of XZ Cep on Dec. 20 and 21, 1999, though its nature is not clear now. As the allocated telescope time to us for HBS observations ended on Dec. 21, we could not follow these variations in the whole season. We suggest here that the event happened around Dec. 20, 1999.

There are some reports on the temporal and irregular variations in the polarizations of early-type close binary systems (for example, U Cep, Piirola, 1980). Almost all variations of polarization reported so far (including the report of Saute & Martel, 1979) have short time scales (a few minutes up to a few tens of minutes). The variations reported here has a longer time scale (order of a few hours) compared with them. In the case of U Cep, a strong increase of polarization was observed in late 1975 (Piirola, 1980). Piirola suggested that this was caused by mass-transfer events which occurred in U Cep in late 1974 and 1975. And it was also reported that a period increase of U Cep occurred in late 1974 (Olson et al., 1981).

We appreciate useful discussions with K.S. Kawabata.

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BV PHOTOMETRY OF ζ And

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e-mail: ynaowugj@public.km.yn.cn

Name of the object:
ζ And = BD +23°106

Equatorial coordinates:	**Equinox:**
R.A.= $0^{\rm h}44^{\rm m}41^{\rm s}$ **DEC.=** $+23°59'.7$	1950

Observatory and telescope:
Yunnan Observatory, Academia Sinica, 35-cm Cassegrain telescope

Detector:	Unrefrigerated 1P21 photomultiplier
Filter(s):	*BV*
Comparison star(s):	BD +22°153 = HD 5516
Check star(s):	BD +23°126 = HD 5316

Transformed to a standard system:	*UVB*
Standard stars (field) used:	Standard stars from Landolt (1983)

Availability of the data:
Electronically through IBVS Web-site as 4935-t1.txt

Type of variability:	Ellipsoidal eclipsing binary

Remarks:

The binary ζ And ($P = 17.7693$ days) is of considerable interest, especially since Stebbins (1928) has found that there is a distortion wave amplitude of 0.02 magnitude in the sinusoidal light variation of system. Photoelectric observations were obtained from October 1988 to February 1990, on 29 nights. The probable error of a single observation was estimated to be ±0.017 magnitude. The phases were calculated with the light elements given by Danielkiewicz-Krosniak and Kurpinska-Winiarska (1991):

$$\text{Hel. Min. I} = \text{J.D. } 2445253.180 + 17.7693 \times E.$$

The data are given in the Table 1 (4935-t1.txt, accessible only electronically). The light curves are shown in Figure 1. It is worthy to note that the light curves in 1990 have obviously changed their shapes near 0.5 phase. Their minimum depths became shallower than those in 1988-89.

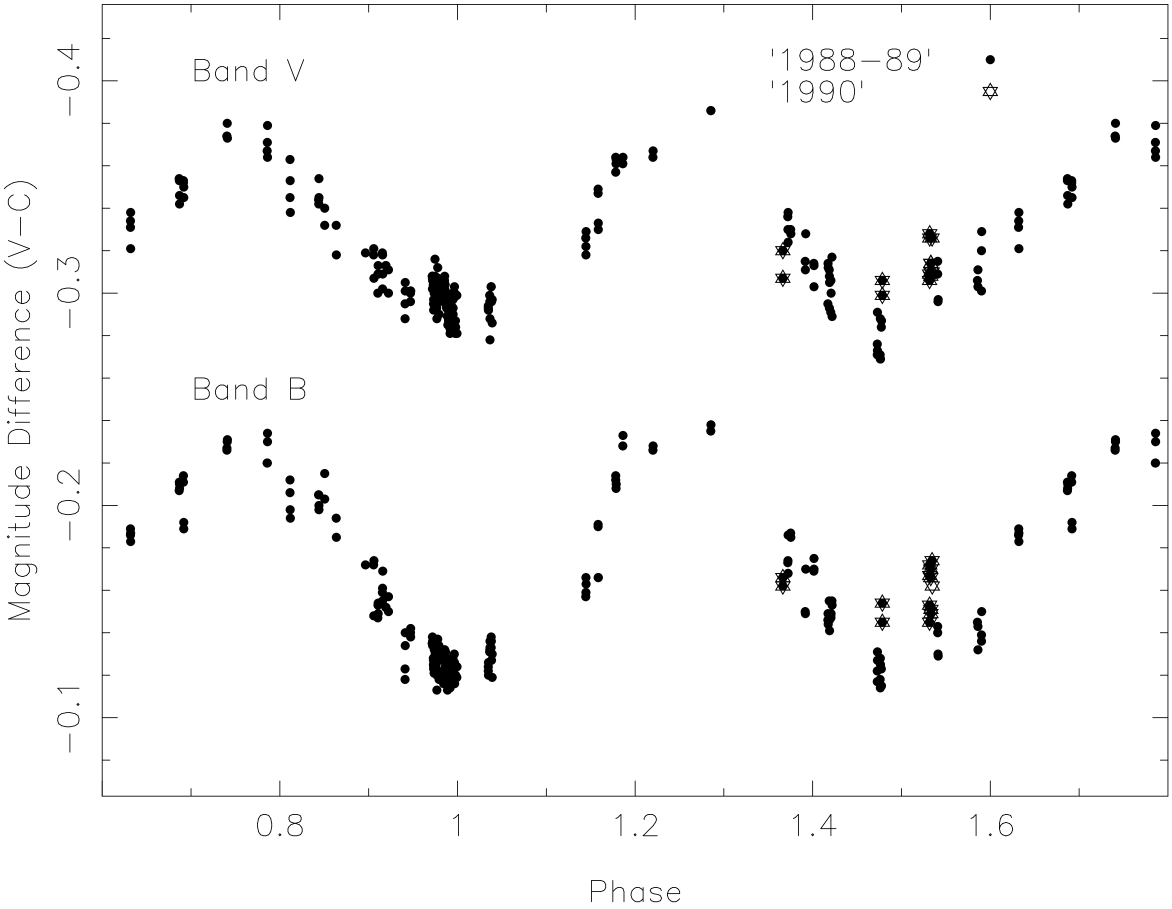

Figure 1. The photoelectric *B* and *V* light curves of the ζ And in 1988-90, relative to BD +22°153

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Stebbins, J., 1928, *Pub. Washburn Obs.*, **15**, 29

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PHOTOMETRY OF LX Pup AND XX Pup

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Strohmeier (1966) reported on a new variable, BV 677 (BD $-16°2312$) that he classified as a cepheid, brightness $\sim 9\overset{m}{.}5$, amplitude $\sim 0\overset{m}{.}5$, and with epoch and period of

$$\mathrm{Max} = \mathrm{JD}\ 2437314.25 + 13\overset{d}{.}88 \times E.$$

While Strohmeier did not give coordinates, the BD catalog identification yields coordinates of $08^{h}01^{m}47\overset{s}{.}2$, $-16°2\overset{\prime}{.}4$ (1855); these precess to $08^{h}08^{m}24\overset{s}{.}6$, $-16°27\overset{\prime}{.}5$ (J2000). No finding chart was given; the GCVS indicates either the BD catalog or the AAVSO Variable Star Atlas for identification. Because it could be a relatively nearby cepheid, LX Pup was also placed on the Hipparcos program (HIP 39840, GSC 5996–00713), but this star is noted to be incorrectly identified with LX Pup in the Hipparcos Input Catalogue. The Hipparcos coordinates are:

$$\mathrm{R.A.}\ 08^{h}08^{m}23\overset{s}{.}35, \quad \mathrm{Decl.}\ -16°28'16\overset{\prime\prime}{.}7\ (\mathrm{J2000}).$$

This star has median magnitude of $H_p = 10.797 \pm 0.006$ and so was constant at the time of the Hipparcos mission.

A few years ago, Szabados (1996) recommended this star to Henden as a southern cepheid for which no photometry was available. It was placed on the observational program at the U.S. Naval Observatory, Flagstaff Station, using the 1.0-m telescope along with a 1024 × 1024 SITe/Tektronix CCD and BVR_cI_c filters. Lund observed the field as well at South Africa, using a 0.32-m telescope along with a CB245 (TC-245) camera and a Johnson V filter. Our CCD frames, as well as the DSS, do show a bright star at the Hipparcos coordinates. However, this star is quite red:

V	$B-V$	$V-R$	$R-I$
10.666	+1.638	+0.924	+0.906

with errors under one percent. The star is constant over a two-year monitoring interval. At the same time, we notice that there is another variable located about 5 arcmin south of this position, XX Pup (GSC 5996–00727). Using USNO-A2.0, we measure its coordinates to be:

$$\mathrm{R.A.}\ 08^{h}08^{m}28\overset{s}{.}22, \quad \mathrm{Decl.}\ -16°31'59\overset{\prime\prime}{.}7\ (\mathrm{J2000})$$

with mean magnitude and colors of

V	$B-V$	$V-R$	$R-I$
10.071	+0.302	+0.214	+0.242

Other than XX Pup, there are no stars with variation that are brighter than $V = 15$ and within 5 arcmin of GSC 5996–00713.

We refined the period of XX Pup using the unequally sampled Fourier transform method of Scargle (1982). This gave us a period and epoch of

$$\text{Max} = \text{JD } 2450107.494 + 0\overset{\text{d}}{.}517195(2) \times E.$$

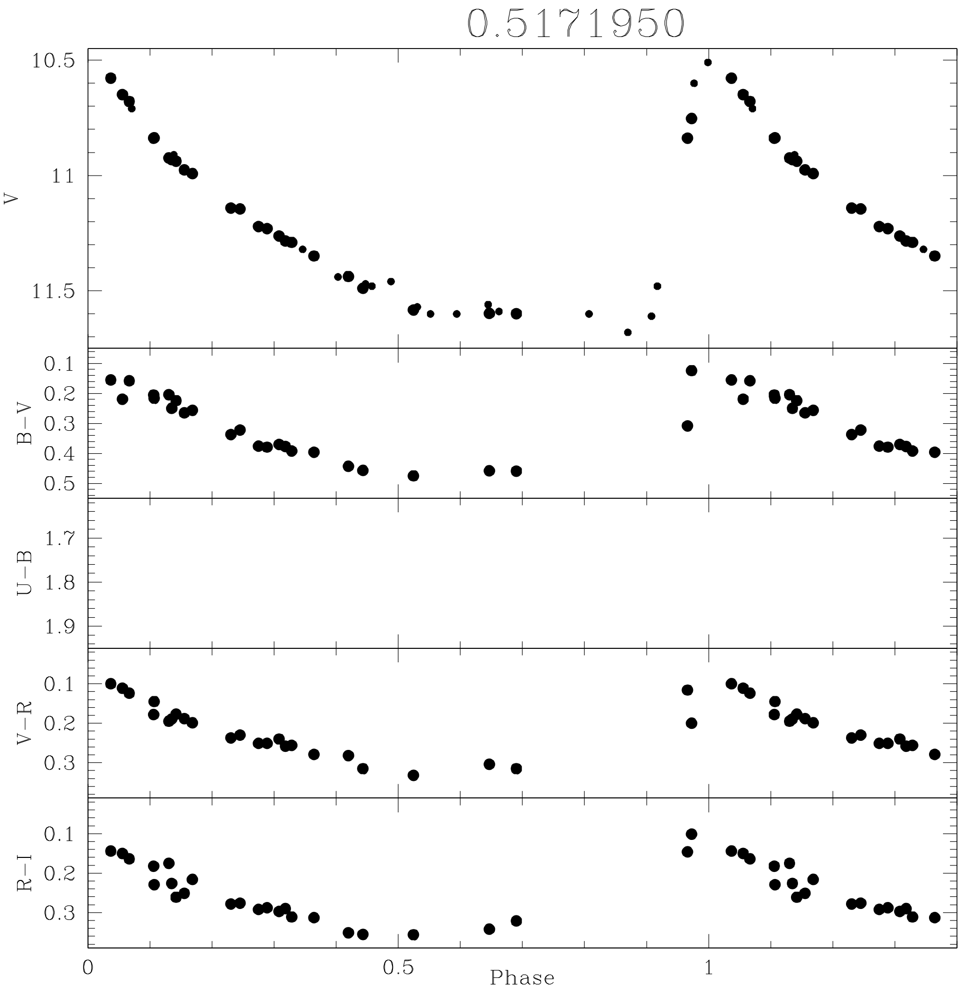

Figure 1. Light Curve for XX Pup

We present in Figure 1 the phased light curve for XX Pup where the small dots are Lund data and the large dots are Henden data. Complete photometric data for XX Pup can be found at Henden (2000a). We used as comparison and check star the following:

Star	GSC	R.A. (J2000)	Decl.	V	$B-V$	$V-R$	$R-I$
comp.	5996–00413	$08^{\text{h}}08^{\text{m}}14\overset{\text{s}}{.}40$	$-16^\circ31'18\overset{''}{.}1$	11.889	0.469	0.286	0.279
check	5996–00701	$08^{\text{h}}08^{\text{m}}11\overset{\text{s}}{.}22$	$-16^\circ29'51\overset{''}{.}6$	11.626	0.416	0.251	0.244

with mean errors under one percent. BVR_cI_c photometry for all stars in the LX Pup field can be found at Henden (2000b).

We phased Strohmeier's maxima according to this period, and found no correlation. It is unlikely that Strohmeier mistook XX Pup as a new variable. Either GSC 5996–00713 was variable during the 1960's, and is constant now, or else the identification is incorrect and some other star more than 5 arcmin from GSC 5996–00713 is the true LX Pup.

We gratefully acknowledge the assistance of Brian Skiff in finding the AAVSO Variable Star Atlas in the shelves of the Lowell Observatory and faxing the appropriate page.

References:

Henden, A., 2000a, ftp://ftp.nofs.navy.mil/pub/outgoing/aah/photom/lxpup.pht
Henden, A., 2000b, ftp://ftp.nofs.navy.mil/pub/outgoing/aah/sequence/lxpup.dat
Scargle, J. D., 1982, *Ap. J.* **263**, 835
Strohmeier, W., 1966, *IBVS*, No. 161
Szabados, L., 1996, private communication

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

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Budapest
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HU ISSN 0374 – 0676

NEW TIMES OF MINIMA AND REVISED EPHEMERIS OF BC ERIDANI

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Name of the object:
BC Eri = HIP 22234

Equatorial coordinates:	**Equinox:**
R.A.= $04^h46^m59.^s00$ **DEC.=** $-14^\circ37'23.''3$	2000.0

Observatory and telescope:
10-cm Reflector (fl = 600 mm) (KN) 25-cm Schmidt–Cassegrain (fl = 1600 mm) (SK)

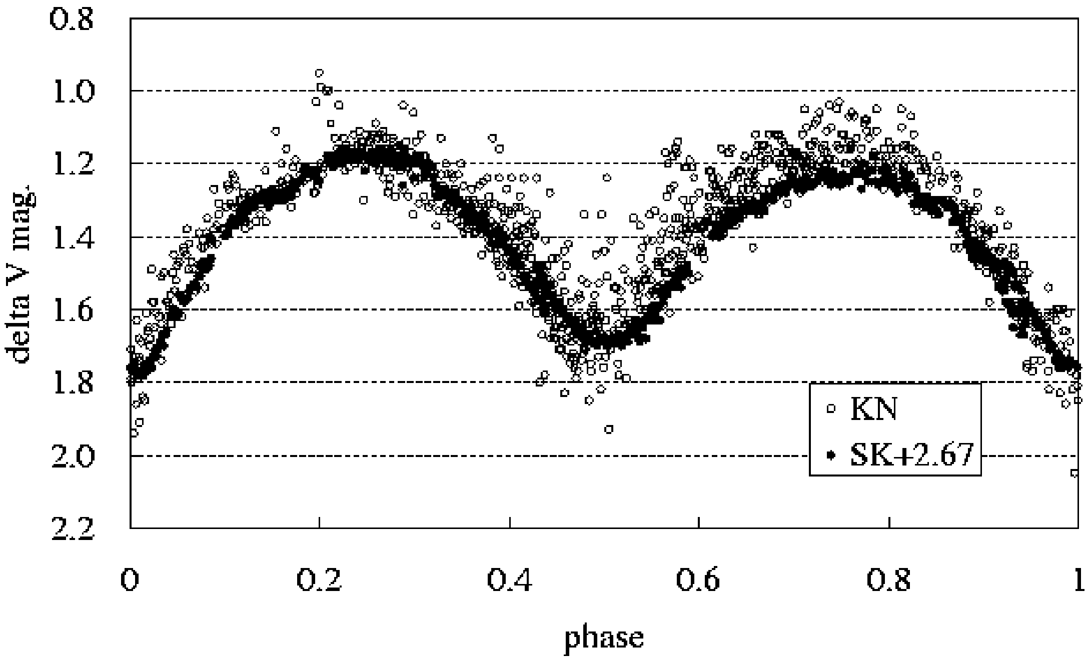

Figure 1.

Detector:	SBIG ST-5 CCD camera (KN); Apogee AP-7 CCD camera (SK)
Filter(s):	Johnson V (KN); Johnson–Cousins V and I_c (SK)
Comparison star(s):	GSC 5328:1509 = SAO 149875 (KN) GSC 5328:1449 (SK)
Check star(s):	GSC 5328:1765 (SK)
Transformed to a standard system:	No

Availability of the data:

Upon request

Type of variability:	EW

Remarks:

BC Eri was discovered by Hoffmeister (1936). Guriev (1938) assigned it as a cluster variable (Max = HJD $2428869.791 + 0\overset{\mathrm{d}}{.}26393 \times E$). Ashbrook & Gossner (1945) gave improved ephemeris (Max = HJD $2428869.791 + 0\overset{\mathrm{d}}{.}26389458 \times E$) from their observations and Harvard plates archives. Fitch (1966) assigned this star as an EW type variable with period of $0\overset{\mathrm{d}}{.}528$ from his multicolor photoelectric photometry. The fourth edition of General Catalogue of Variable Stars (Kholopov et al. 1986) listed its period as $0\overset{\mathrm{d}}{.}52778916$ with no epoch of minimum. The period in HIPPARCOS catalog (ESA 1997) is $0\overset{\mathrm{d}}{.}527242$. We observed this star from 1998 to 2000 and got the following new moments of minima.

Min (HJD)	Type of min.	Filter	Observer
2451138.10010	II	V	KN
2451176.06170	II	V	KN
2451477.11570	II	V	SK
2451493.19719	I	I_c	SK
2451501.10729	I	V	SK
2451502.15987	I	I_c	SK
2451515.08101	II	V	SK
2451525.09784	II	I_c	SK
2451526.14810	II	V	SK
2451529.05185	I	I_c	SK
2451538.01430	I	V	KN
2451548.03010	I	V	SK

We calculated the following new ephemeris from our observations.

$$\text{Min} = \text{HJD } 2451501.10674970 + 0^{\circ}5272429 \times E.$$

References:

Ashbrook, J. and Gossner, J., 1945, *Astronomical Journal*, **52**, 56
ESA, 1997, The Hipparcos & Tycho Catalogues, ESA SP-1200
Fitch, W.S., 1966, *IBVS*, No. 132
Guriev, N., 1938, *Tadjik Circ.*, No. 36
Hoffmeister, C., 1936, *Astronomische Nachrichten*, **258**, 39
Kholopov P.N. et al., 1986, General Catalog of Variable Stars 4th ed.

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HU ISSN 0374 – 0676

A NEW CLASSICAL CEPHEID IN CASSIOPEIA

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Name of the object:
Var 70 = GSC 4018.1275

Equatorial coordinates:	**Equinox:**
R.A.= $0^{\mathrm{h}}01^{\mathrm{m}}46\overset{\mathrm{s}}{.}0$ **DEC.=** $+62^{\circ}25'28''$	J2000.0

Observatory and telescope:
40-cm astrograph in Crimea

Detector:	Photoplate
Filter(s):	None
Comparison star(s):	See Fig. 1
Check star(s):	None

Transformed to a standard system:	B_{pg}
Standard stars (field) used:	B_{pg}-band standard sequence in NGC 7790 (Pedreros et al., 1984)

Availability of the data:
Upon request

Type of variability:	DCEP

Remarks:

The brightness of the star was estimated by eye on 853 plates taken for interval JD 2432853–49633. Periodic variability typical of a classical Cepheid was revealed. The light elements are the following:

$$\mathrm{JD_{max}} = 2439051.35 + 3\overset{\mathrm{d}}{.}87845 \times E.$$

The variability range is $15\overset{\mathrm{m}}{.}45$–$16\overset{\mathrm{m}}{.}35$. Max − min = $0\overset{\mathrm{P}}{.}27$. The phased light curve is given in Fig. 2.

Acknowledgements:

This study was supported in part by the Russian Foundation for Basic Research and the Council of the Program for the Support of Leading Scientific Schools through grants Nos. 99-02-16333 and 00-15-96627.

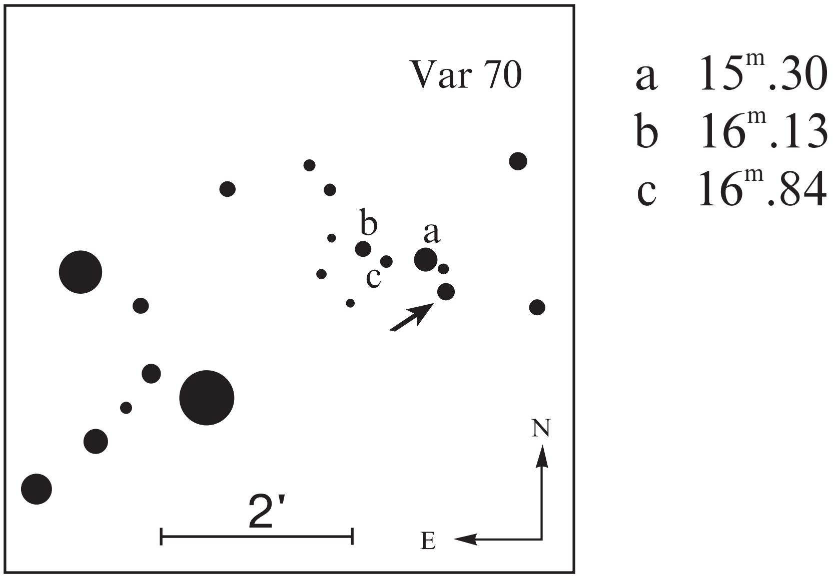

Figure 1. The finding chart and the comparison stars.

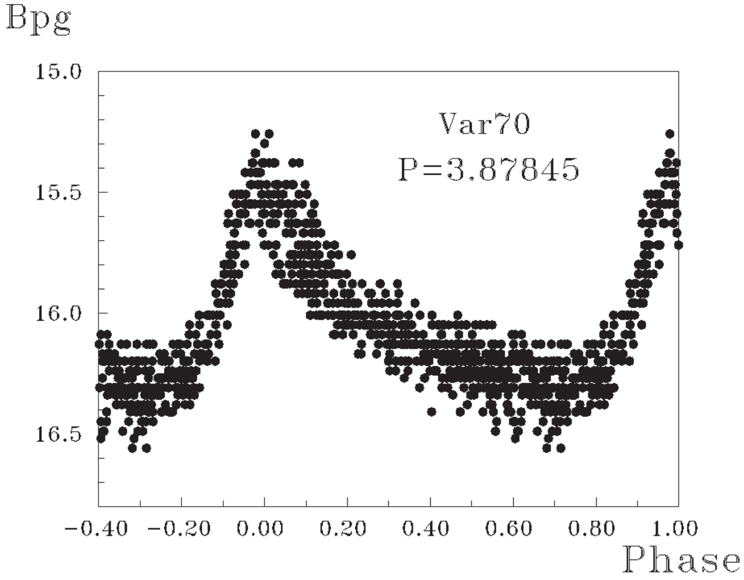

Figure 2. The phased light curve.

Reference:

Pedreros, M., Madore, B.F., Freedman, W.L., 1984, *ApJ*, **286**, 563

COMMISSIONS 27 AND 42 OF THE IAU
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Number 4939

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HU ISSN 0374 – 0676

A NEW HIGH AMPLITUDE SHORT PERIOD VARIABLE STAR IN CASSIOPEIA

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Name of the object:
Var 71

Equatorial coordinates:	**Equinox:**
R.A.= $0^{\rm h}00^{\rm m}52\overset{\rm s}{.}8$ **DEC.=** $+62^\circ25'15''$	J2000.0

Observatory and telescope:
40-cm astrograph in Crimea

Detector:	Photoplate

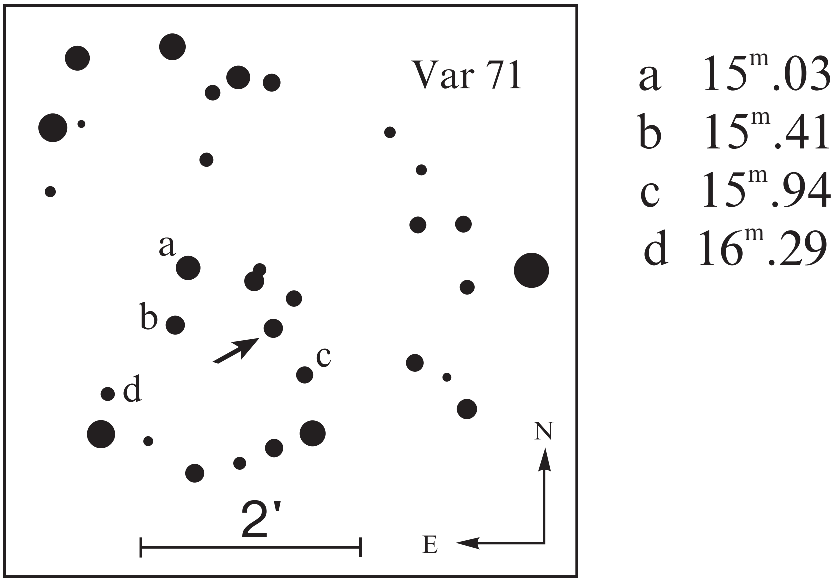

Figure 1. The finding chart and the comparison stars.

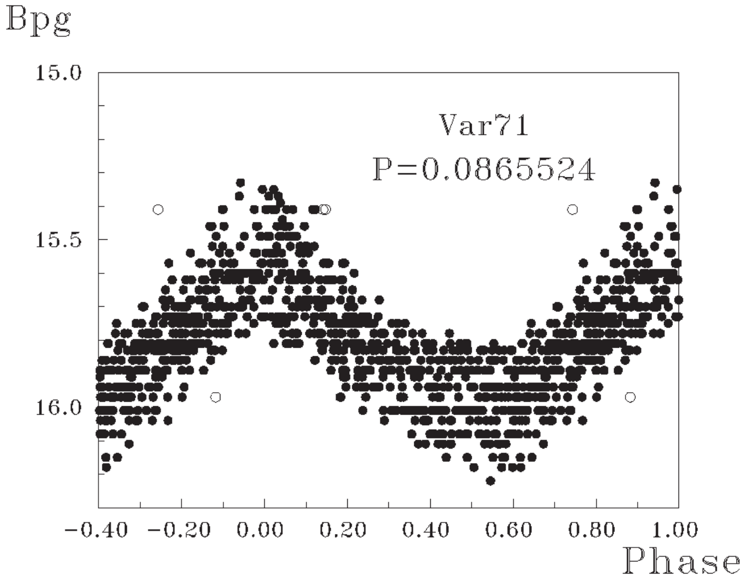

Figure 2. The phased light curve. Uncertain estimates are shown as open circles.

Filter(s):	None

Comparison star(s):	See Fig. 1

Check star(s):	None

Transformed to a standard system:	B_{pg}
Standard stars (field) used:	B_{pg}-band standard sequence in NGC 7790 (Pedreros et al., 1984)

Availability of the data:
Upon request

Type of variability:	High amplitude DSCT or SXPHE

Remarks:

The star was estimated on 856 plates taken from JD 2432853 to 2449633. Variability with a very short period, $P = 0\overset{\mathrm{d}}{.}0865524$, was found. The exposure time of most plates from Moscow collection is 45 minutes ($0\overset{\mathrm{d}}{.}03125$). So one plate accumulated the light of one third part of the period. The situation results in the following inaccuracies. Firstly, the amplitude of variability taken from the photographic phased light curve is noticeably understated. The range of variability in Figure 2 does not represent the real one. Secondly, the shape of the phased light curve is distorted, it looks more symmetric. The apparent max – min value is higher than the real one. The zero phase $\mathrm{HJD}_0 = 2441186.463$, that was used to construct Figure 2, is not the real moment of maximum brightness. The maximum happened slightly earlier than we see from the photographic observations. As to classification, the variable is a new high amplitude ($\mathrm{amp}_B > 0\overset{\mathrm{m}}{.}45$) short period pulsator of DSCT or SXPHE type. It is necessary to note that the period of the variation is stable for the investigated time interval. Further CCD observations are strongly encouraged to determine the real amplitude of variability, light curve shape and time of maximum brightness of the star.

Acknowledgements:

This study was supported in part by the Russian Foundation for Basic Research and the Council of the Program for the Support of Leading Scientific Schools through grants Nos. 99-02-16333 and 00-15-96627.

Reference:

Pedreros, M., Madore, B.F., Freedman, W.L., 1984, *ApJ*, **286**, 563

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CCD PHOTOMETRY OF THE MAY 2000 OUTBURST OF THE CATACLYSMIC VARIABLE RXJ 1450.5+6403

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RXJ 1450.5+6403 was detected as a cataclysmic variable (CV) of unknown type during the course of the ROSAT All-Sky Survey (Chisolm et al. 1999) and has a listed magnitude range of 16.3–17.1. Its USNO-A2.0 position is $\alpha = 14^{\rm h}50^{\rm m}38\overset{\rm s}{.}31$, $\delta = +64^\circ03'28\overset{''}{.}6$ (J2000.0). The object is identical to FBS 1449+642 in the First Byurakan Spectral Sky Survey of blue stellar objects (Abrahamian & Mickaelian 1994), where it is listed with a spectral type of B1.

The May 2000 outburst of RXJ 1450.5+6403 was detected by Tonny Vanmunster on 2000 May 14 (Vanmunster 2000a) and was the first-ever since the discovery of the object. It was intensively monitored as part of an international observing campaign by the Center for Backyard Astrophysics (CBA). We report differential time-series photometry related to this outburst and the detection of superhumps with a period of 0.0601 (± 0.0002) d, as well as quasi-periodic oscillations.

Upon notification of the outburst of RXJ 1450.5+6403, an international observing campaign was launched by the CBA. The CBA is a multi-longitude network of professional and amateur astronomers (Patterson 1998), who study periodic phenomena in cataclysmic variables. Since 1991, the CBA has been engaged in long-term photometric studies of CVs, primarily focusing on binary orbital periods, rotational periods, superhump periods and accretion disk precession periods. Target objects comprise SU UMa-type dwarf novae, intermediate polars (and DQ Her stars), permanent superhumpers (e.g., nova-like objects) and helium CVs, for which long, dense time-series differential photometry is performed. Target campaigns and results of the CBA are regularly reviewed on the CBA Web site (http://www.astro.bio2.edu/cba). The CBA campaign on RXJ 1450.5+6403 accumulated 92.5 hours of coverage over 12 nights and 6173 datapoints. Contributing stations are listed in Table 1.

Table 1: Log of photometry

May 2000 Date	JD Start[1]	Length (hr)	Telescope[2]	Points
14	5679.3776	5.72	1	240
15	5679.6578	6.99	2	460
15	5679.7072	3.17	3	353
15	5680.3439	6.06	5	398
15	5680.3916	5.29	1	207
16	5680.6039	5.11	3	621
18	5682.6774	4.09	2	49
19	5683.6619	7.10	2	130
19	5683.6780	5.71	4	997
21	5685.6475	7.37	2	136
21	5685.8230	3.87	4	1181
22	5687.4439	3.40	1	148
24	5688.8602	2.93	4	468
25	5689.8018	3.71	2	48
25	5689.8029	3.63	2	45
25	5689.8037	3.63	2	48
26	5690.6295	4.17	3	332
27	5691.6115	3.39	3	182
27	5691.6582	7.20	2	130

[1] 2,400,000 +

[2] (1) = CBA Belgium, 0.35-m; (2) = Braeside, 0.41-m;
(3) = CBA Maryland, 0.66-m; (4) = MDM, 1.3-m; (5) = Brno, 0.40-m

The outburst detection was made at CBA Belgium Observatory, one of the main contributing nodes in the CBA network. The observatory equipment and setup is quite characteristic for most CBA stations, and therefore is described in more detail below.

The CBA Belgium Observatory is located in Flanders, Belgium. The observatory building is a roll-off roof structure, measuring 3 m by 4 m. Its primary instrument for CCD photometry is a 0.35-m $f/6.3$ Schmidt–Cassegrain telescope, mounted on an AstroTechniek FM-98 German equatorial mount, and equipped with a SBIG ST-7 CCD camera (Kodak KAF-0400 CCD for imaging and Texas Instruments TC211 CCD for guiding). The observatory furthermore houses a laptop computer, that controls telescope and CCD operations. It is connected through a 10-Mb network connection with a desktop computer, located in the house of the observatory owner. The desktop computer allows full remote control of the telescope and CCD, and does instantaneous photometry reduction of acquired FITS images. Following software packages are used:

- Camera control, telescope guiding and unfiltered photometric imaging are all done using *MaxIm DL/CCD* (Cyanogen Productions Inc.). Images are stored as FITS files.
- All frames use 2 × 2 chip summation and are corrected for standard debiasing and flat-fielding. They are reduced using the profile fitting algorithm (PSF) of *MIPS* (Buil et al., 1993), immediately following their acquisition.
- Output files with differential magnitudes are produced by MIPS and are almost instantaneously post-processed, to allow the generation of quasi-real-time light curves. This is done using the software package *AfterMips*, written by Tonny Vanmunster.

- Sky conditions are monitored through a special software package, called *StarMon*, also written by Tonny Vanmunster. It generates an alarm sound if clouds enter the observing field.

The described set-up allows all-night long autonomous and unattended operation. The only human interaction required is for opening and closing of the observatory, and initialisation of the telescope, camera and computers.

Following the detection of a bright outburst of RXJ 1450.5+6403 at CBA Belgium Observatory on 2000 May 14/15, time-resolved and differential (variable – comparison) CCD photometry was started at this CBA node. Using the AfterMips software package, incoming observations were monitored in a quasi-real-time mode and soon revealed the development of superhumps in the system (Figure 1). This allowed the immediate classification of the object as an SU UMa-type cataclysmic variable (Vanmunster 2000b).

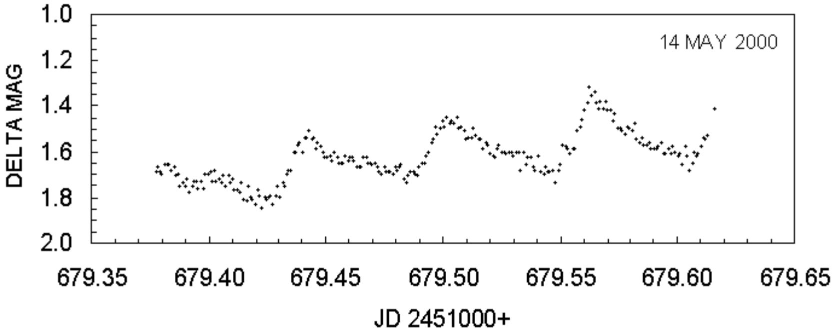

Figure 1. Light curve of RXJ 1450.5+6403 on 2000, May 14

The object was intensively monitored by additional observatories of the CBA network (see Table 1). The outburst continued till May 28th, 2000, after which the object returned to quiescence. The May 2000 light curve revealed a fairly constant superhump profile between JD 2451679.3 and 2451680.8. The superhump period slightly increased between JD 2451682.7 and 2451692.0, and showed a somewhat different profile as well. Below, we discuss these two light curve portions separately. A short, normal outburst of RXJ 1450.5+6403 was furthermore observed on June 25, 2000 (Pavlenko 2000).

Observations between JD 2451679.3 and JD 2451680.8. After removing linear trends in the light curve, we performed a period analysis using the Phase Dispersion Minimization (PDM) method (Stellingwerf 1978). The resulting theta diagram is shown in Figure 2. The best superhump period is 0.0601 (±0.0002) d. This is one of the shortest superhump periods among SU UMa-type dwarf novae. The phase-averaged superhump profile folded by this period is shown in Figure 3. The profile is that of a typical, well-developed "common superhump". The full amplitude is 0.30 mag.

These findings are consistent with radial velocity results obtained by J. Thorstensen from spectroscopic observations in April 2000 (Thorstensen 2000), when the object was at quiescence. His orbital period determination was not conclusive, but showed leading candidates at $0\overset{d}{.}0588$ and $0\overset{d}{.}0599$. Assuming the $0\overset{d}{.}0588$ value is the most accurate one, then the superhump excess value ε is 2.2 percent, where $\varepsilon = (P_{\rm sh} - P_{\rm orb})/P_{\rm orb}$, with $P_{\rm sh}$ and $P_{\rm orb}$ denoting the superhump and orbital period respectively. Thorstensen further commented that the RXJ 1450.5+6403 spectrum at minimum light appeared typical of SU UMa-type dwarf novae.

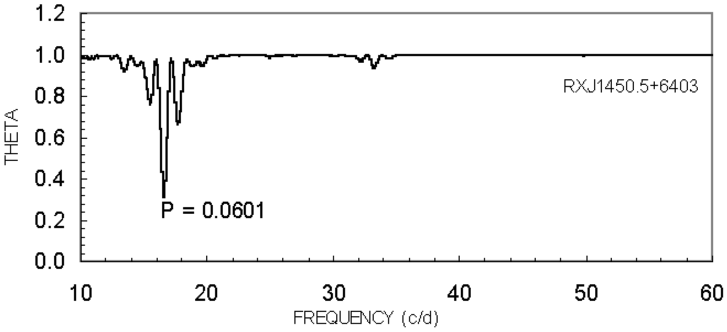

Figure 2. Period analysis of RXJ 1450.5+6403 between JD 2451679.3 and JD 2451680.8

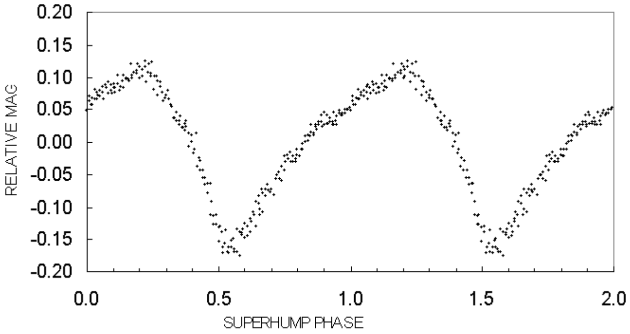

Figure 3. Common superhump profile of RXJ 1450.5+6403 between JD 2451679.3 and JD 2451680.8

Other photometric observations at quiescence were reported by D. Nogami, on behalf of the Goettingen-HS Survey Collaboration Team (Nogami 2000). Their period analysis yielded a period estimation of $0\overset{\mathrm{d}}{.}056$ with a large error due to short coverage, and a $0\overset{\mathrm{m}}{.}35$ orbital hump with a $0\overset{\mathrm{m}}{.}1$ mag secondary hump.

Observations between JD 2451682.7 and JD 2451692.0. During this stage of the outburst, we noticed a slight increase in the superhump period value. Using again the PDM method, after having removed linear trends, the resulting theta diagram of Figure 4 is characterised by a superhump period of 0.0603 (± 0.0002) d. The phase profile also changed during this stage of the outburst, with the superhump still dominating. Although most SU UMa-type dwarf novae show waveform changes, RXJ 1450.5+6403 has spent remarkably short time with its maximum light waveform, and quickly changed to a much more complex waveform. Figure 5 depicts the phase-averaged superhump profile folded by a period of $0\overset{\mathrm{d}}{.}0603$.

Quasi-periodic oscillations (QPO's) are brightness variations on a short time scale (1–30 min), with a very low amplitude, appearing as a noisy, broad band in the power spectrum, that typically is overlooked were it not for the prominence of the oscillations in the light curve (Warner 1995).

QPO's first became apparent in the RXJ 1450.5+6403 light curve on May 15th, 2000 (Figure 6), being most explicit on the descending branch of the superhumps. They were present in the light curves obtained at CBA Belgium, CBA East and Brno Observatory. Their power spectrum showed a main signal at 95 s, and a mean amplitude of $0\overset{\mathrm{m}}{.}04$. Though they continued to exist in the following night, the QPO's became more difficult to detect and finally disappeared in overall light curve noise.

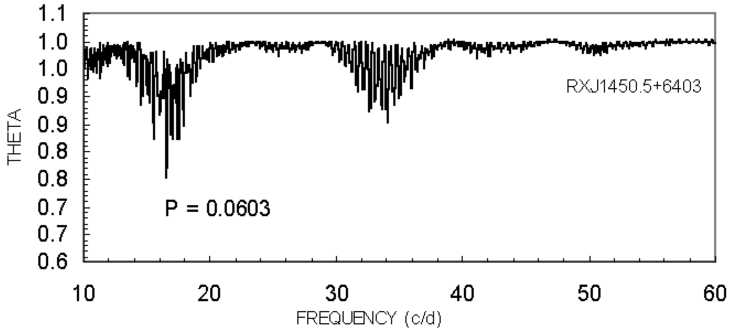

Figure 4. Period analysis of RXJ 1450.5+6403 between JD 2451682.7 and JD 2451692.0

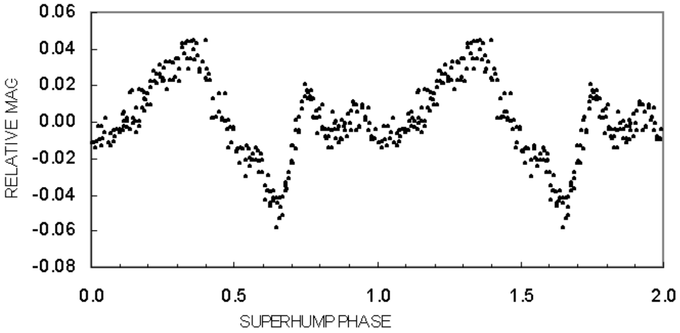

Figure 5. Common superhump profile of RXJ 1450.5+6403 between JD 2451682.7 and JD 2451692.0

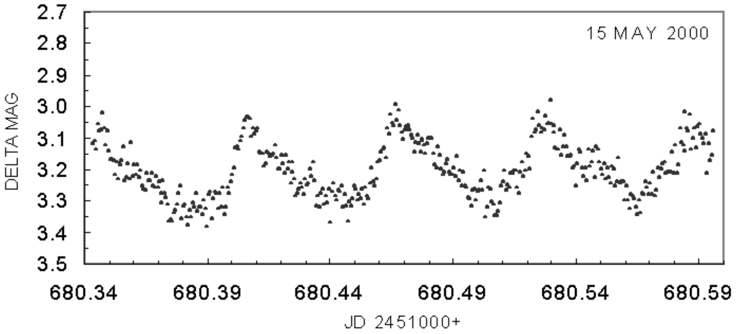

Figure 6. Light curve by Nicholas Copernicus Observatory on 2000, May 15

Acknowledgements: The first author is grateful to Jean Meeus, for assistance with implementing specific software algorithms and to the Center for Backyard Astrophysics for their continuous support in our stellar CCD photometry research work. Our final data analysis uses some special software written by the Belgian amateur astronomer Patrick Wils, who implemented routines for the PDM period determination technique.

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PHOTOELECTRIC MINIMA OF SOME ECLIPSING BINARY STARS

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We present 17 photoelectric minima of 7 eclipsing binary stars which were observed during several seasons. All observations were obtained with the 30-cm Maksutov telescope at the Ankara University Observatory. Differential observations were secured by using an EMI 9789QB photomultiplier before 29 September 1991 (HJD 2448528.5)and an OPTEC SSP-5A photometer head which contains a side on R-1414 Hamamatsu photomultiplier after that date. The filters used are in close accordance with standard ones of Johnson's system. Differential extinction and heliocentric corrections were applied to all observations. All minima times were computed using the method of Kwee and van Woerden (1956). Weighted average values of times of minima of these stars are given in Table 1, together with their mean errors, minimum types, filters and observers.

Table 1: Times of minima of observed systems

System	Min HJD 2400000 +	Mean error	Min type	Filter	Observer (*)
WY Cnc	51618.33493	0.00060	I	BV	Al
	51632.43418	0.00046	I	BV	Al
BO CVn	47673.4643	0.0022	II	BV	Gr
	47709.4180	0.0010	I	BV	Kh
	48036.4588	0.0015	I	BV	Sl
	48065.4322	0.0011	I	BV	Ör
	48071.3841	0.0017	II	BV	Ör
	48341.4974	0.0023	II	BV	Öd
	48383.4256	0.0026	II	BV	Ek
	48419.3795	0.0024	I	BV	Sl
CG Cyg	51732.41320	0.00009	I	UBV	Al
KR Cyg	50676.03710	0.00090	I	UBV	My
WZ Cyg	49917.47197	0.00044	I	UBV	My
	49938.51030	0.00028	I	UBV	My
AK Her	51728.46203	0.00017	I	UBV	Öd
UV Psc	50003.43973	0.00130	II	UBV	My
	50007.31118	0.00048	I	BV	My

(*) Al: B. Albayrak Ek: F. Ekmekçi Kh: G. Kahraman Gr: B. Gürol
My: Z. Müyesseroğlu Öd: S. Özdemir Ör: F.F. Özeren Sl: S. O. Selam

Reference:

Kwee, K. K. & van Woerden, H., 1956, *Bull. Astron. Inst. Neth.*, **12**, 327

ERRATUM FOR IBVS 4941

In IBVS 4941 a minimum time (2448383.4256) of BO CVn is wrong. The correct value is 2448383.4156.

Berahitdin ALBAYRAK

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THE FALSE NOVA 1999 IN THE NEARBY GALAXY IC 1613

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King et al. (1999) announced the discovery of a nova in the nearby galaxy IC 1613 on the basis of unfiltered images taken on October 12 and 13, 1999. According to them the object had a brightness of about $18\overset{\mathrm{m}}{.}5$ and the limiting magnitude of their frames was about 19. The analysis of their archival images showed that the object was present since August 23 with about the same brightness, but it was invisible on Aug. 18.

As we have been observing IC 1613 since 1995 to detect variable stars (Antonello et al. 1999) and the so–called nova falls in our Field B (Antonello et al. 2000), we had the opportunity to check that its coordinates are coincident within the uncertainties with those of our variable V2950B. According to our 57 measurements, taken between October 1995 and October 1998 with the 0.9-m Dutch telescope at La Silla Observatory, this is an object with an amplitude of variation in unfiltered light of about $2\overset{\mathrm{m}}{.}5$ in a period of about 645 days. Our exposures were of 30 min in duration and the limiting magnitude is about 24. According to this period the epochs of the observations by King et al. (1999) falls a few days before the maximum brightness of the star.

We got other 6 images in unfiltered light with the 1.5-m telescope at the Observatorio Astronomico Nacional of San Pedro Martir between October 12 and 19, 1999, i.e. just by chance we observed at the same dates of the detection of the presumed nova by King et al. (1999). According to our data the star brightness did not change by more than $0\overset{\mathrm{m}}{.}1$ with a mean value of $18\overset{\mathrm{m}}{.}52$ in our unfiltered light photometric system (see Antonello et al. 1999). The new data allowed us to improve the period, obtaining 631 days. Our measurements phased with this period are shown in Fig. 1, where the 1999 data are plotted as crosses and the best fitting sine wave is shown as a dashed line. The zero phase corresponds to JD 2450795.50.

We were able to find three measurements of this star in filtered light, which are listed in Table 1. The first one is by Freedman (1988), the second one was obtained from our V

Table 1: Filtered light measurements.

JD	V	$V-R$	$V-I$	$B-V$
2445973.88	21.20	1.26	3.47	2.02
2450305.90	20.16	0.95	—	—
2450725.80	22.52	—	4.36	—

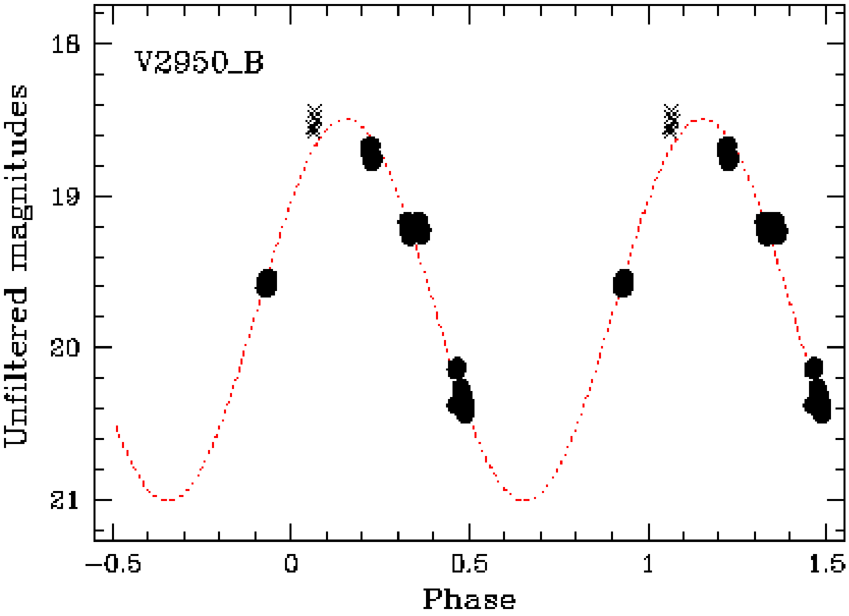

Figure 1. Unfiltered data phased with $P = 631$ d; the crosses correspond to the October 1999 observations. The dotted line is the best fitting sine wave

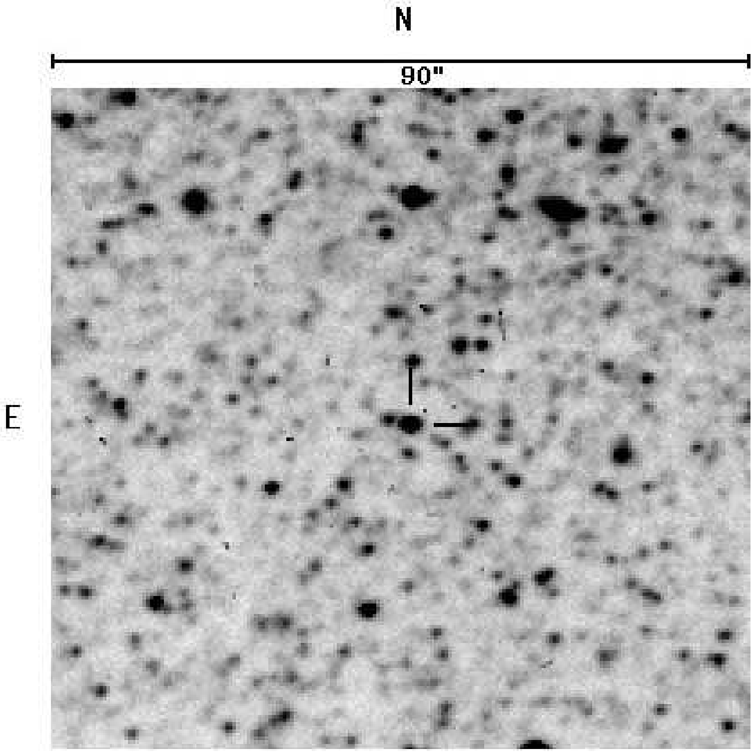

Figure 2. Unfiltered image taken on October 17, 1996: the star erroneously announced as a nova is a long period variable

and R images, and the third was measured by us on the Cole et al. (1999) frames. The star varies of at least $2\overset{m}{.}4$ in V light and its colour is very red, having $V - I$ of about 4.

Fig. 2 shows the image of V2950B in unfiltered light taken by us on October 17, 1996, i.e. three years before the announcement of the detection as a nova. At that time the star had a magnitude of 19.2.

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TIMES OF MINIMUM LIGHT FOR XY URSAE MAJORIS

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Name of the object:
XY UMa

Equatorial coordinates:	**Equinox:**
R.A.= $09^h09^m55\overset{s}{.}9$ **DEC.=** $+54^\circ29'17\overset{''}{.}7$	2000

Observatory and telescope:
0.4-m David Derrick Telescope of the Orson Pratt Observatory at Brigham Young University

Detector:	Pictor 416XT CCD mounted at the Newtonian focus of the telescope (0.93 arcsec/pixel plate scale)
Filter(s):	Standard Johnson V filter (Bessell 1990)
Comparison star(s):	1: HD 237784 ($V = 9\overset{m}{.}50$) 2: HD 237788 ($V = 9\overset{m}{.}7$)
Check star(s):	None

Transformed to a standard system:	Johnson V
Standard stars (field) used:	

Availability of the data:
Upon request

Type of variability:	RS CVn

Remarks:

Three new times of minimum light with cycle numbers determined from Chochol et al. (1998) are reported below.

HJD	Cycle
2451254.6945	33483
2451625.9173	34258
2451630.7074	34268

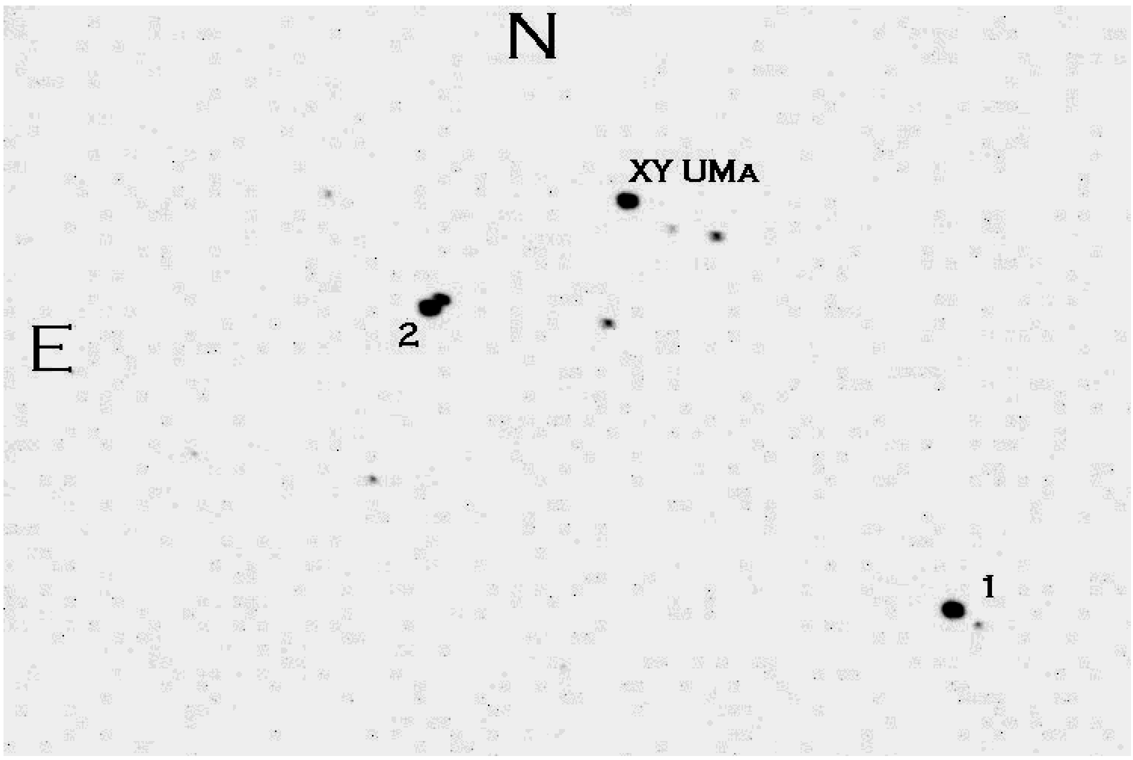

Figure 1. CCD field of XY UMa with comparison stars labeled as 1 and 2. The field of view is 8′ × 12′

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BVRI OBSERVATIONS OF V503 CYGNI IN SUPEROUTBURST

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Dwarf novae (DNe) are a subclass of cataclysmic variables characterized by the presence of sudden increases of brightness (outbursts) in the optical light curve. Normal outbursts have amplitudes in the range 2–5 mag and they occur at irregular intervals of time, typically ranging from about ten days to some months. Some dwarf novae show "superoutbursts" in the light curve, which are characterized by a larger amplitude and a longer duration than normal outbursts. Superoutbursts occur at regular, but not strictly periodic intervals of time (see, e.g., Osaki 1996).

Since the behaviour of most DNe is unpredictable, it is very difficult for astronomers to monitor these variables systematically. During DN outburst, the rise is very rapid (typically less than a day), the maximum stands for 2-3 days, and the decline has a typical duration of 4-5 days (Szkody and Mattei, 1984) but it can be as long as a month or more (Warner 1995). Therefore, for the observation of DNe during all the outburst cycle, we need a total availability of the telescope for a considerable amount of time. For this reason most of the optical observations of DNe were carried out by amateur astronomers through visual estimations or, recently, with small telescopes equipped with CCD cameras. However, the important data so collected are generally unfiltered or obtained with only one filter.

Multi-band monitoring is of special interest in order to extend the work done by amateurs, to study the spectral behavior of the optical continuum, and to explore the physics of accretion disks. For this reason in a previous paper (Spogli et al. 1998) we reported BVR_cI_c observations of a small sample of dwarf novae during the descending phase after an outburst. The most relevant conclusion was that the optical spectral distribution of DNe sometimes cannot be well described by steady-state, optically thick, accretion disk models.

V503 Cygni is a dwarf nova of the SU Ursae Majoris class, characterized by short outbursts lasting $\simeq$ 3 days and recurring with a period $\simeq$ 30 days, and superoutbursts lasting $\simeq$ 10 days and spaced by $\simeq$ 88 days (see, e.g., Harvey et al. 1995). Rises to maximum light take only $\simeq$ 1 day for both types of eruption. During quiescence a periodic signal of very large amplitude is evident, with a period of 109 minutes (Szkody et al. 1989, Szkody & Howell 1993). Superhumping is also evident during superoutbursts, with a peak-to-trough amplitude of 0.1 mag and a period of 116.7 minutes (Harvey et al. 1995).

We observed this DN at the Astronomical Observatory of Collurania-Teramo during August-September 1998. The observations were taken with the 0.72-m Ritchey–Chrétien reflector, equipped with a Tektronix 512 CCD camera and B, V (Johnson),

Table 1: BVR_cI_c magnitudes of the selected comparison stars

No.	B	V	R_c	I_c
1	15.15 ± 0.05	14.22 ± 0.04	13.72 ± 0.04	13.25 ± 0.04
3	15.82 ± 0.06	14.95 ± 0.04	14.41 ± 0.04	13.90 ± 0.04
4	11.75 ± 0.05	11.12 ± 0.04	10.78 ± 0.04	10.50 ± 0.04
5	13.98 ± 0.05	13.33 ± 0.04	12.89 ± 0.04	12.45 ± 0.04

Table 2: BVR_cI_c magnitudes of V503 Cyg

JD (2451000 +)	B	V	R_c	I_c
52.4199	13.89 ± 0.03	13.82 ± 0.02	13.66 ± 0.05	13.67 ± 0.02
53.3317	13.80 ± 0.02	13.75 ± 0.01	13.61 ± 0.05	13.64 ± 0.02
53.4180	13.76 ± 0.01	13.67 ± 0.03	13.58 ± 0.05	13.56 ± 0.06
56.2881	14.02 ± 0.04	13.94 ± 0.02	13.76 ± 0.01	13.78 ± 0.02
56.4324	14.12 ± 0.04	14.01 ± 0.01	13.94 ± 0.02	13.92 ± 0.01
57.3275	14.40 ± 0.01	14.19 ± 0.02	14.03 ± 0.01	14.16 ± 0.01
57.4824	14.39 ± 0.04	14.33 ± 0.02	14.20 ± 0.01	14.24 ± 0.03
58.2997	14.28 ± 0.03	14.28 ± 0.02	14.16 ± 0.02	14.22 ± 0.01
58.4364	14.45 ± 0.01	14.37 ± 0.02	14.23 ± 0.02	14.19 ± 0.02
59.2819	14.33 ± 0.03	14.29 ± 0.02	14.18 ± 0.02	14.19 ± 0.03
59.4048	14.49 ± 0.04	14.40 ± 0.01	14.25 ± 0.01	14.26 ± 0.01
60.3307	14.57 ± 0.05	14.61 ± 0.01	14.40 ± 0.01	14.37 ± 0.05
63.2908	14.90 ± 0.02	14.83 ± 0.01	14.64 ± 0.02	14.65 ± 0.04
67.2803	18.10 ± 0.03	17.71 ± 0.02	17.44 ± 0.01	17.64 ± 0.02

R_c, I_c (Cousins) filters. Each CCD frame was corrected using bias and dark frames obtained before and after each series of BVR_cI_c exposures. The usual flat-field correction was obtained with twilight sky flat fields.

The CCD frames were processed with MIDAS using typical photometry packages that calculate the instrumental magnitudes through synthetic aperture photometry. Although the telescope scale was relatively small (0.5 arcsec/pixel), all the magnitudes reported in this paper have been obtained using an aperture radius of 4 arcsecs for sake of homogeneity since this is the same we used in Spogli et al. (1998). This aperture size is equal to about four times the typical image FWHM and, since we used the same value for the DN and comparison standard stars, no aperture corrections were necessary.

We performed differential photometry using some comparison stars present in the field and reported by Misselt (1996). In order to check the B, V, R_c calibrations and to obtain I_c secondary standard sequences, the comparison stars were calibrated by observing, on photometric nights, several standard stars (Landolt 1992) having $B - V$ from -0.2 to 1.4, over a wide range of airmasses. The standard magnitudes of the comparison stars reported in Table 1 are the weighted means of the values obtained during at least three photometric nights. The serial numbers reported are as in Misselt (1996). Considering the standard deviation, our data are in agreement with the measurements carried out by Misselt (1996), Henden & Honeycutt (1997) and Harvey et al. (1995): the differences are always within two standard deviations. Moreover we have included the calibration for the I_c filter.

We observed V503 Cyg during the maximum and the phase of decline from a superoutburst. Probably the superoutburst started less than a day before our first observation, and the observed maximum was $V \simeq 13.7$ (JD 2451052), a value which can be considered quite typical. During the night are well evident variations probably due to superhumping. In Table 2 we report the BVR_cI_c magnitudes, while the V light curve can be found in Fig. 1.

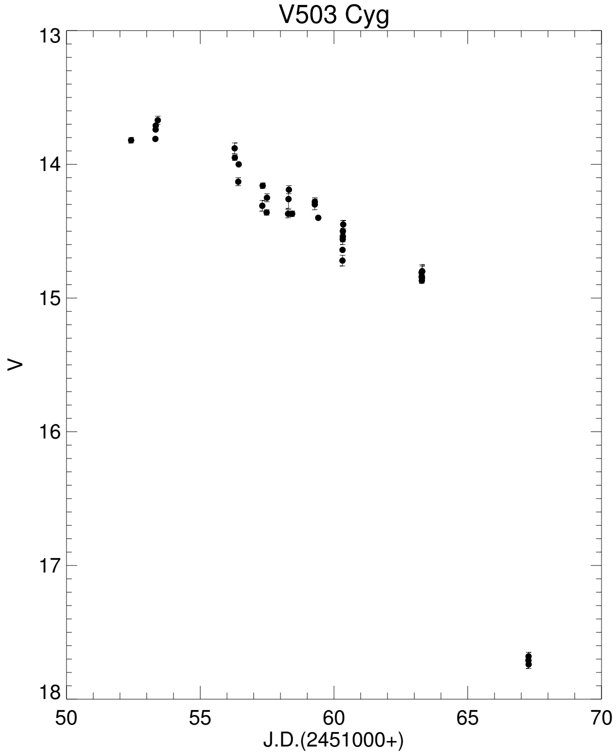

Figure 1. V light curve of V503 Cyg.

During the first week after the maximum (from JD 2451053 to 2451060) the mean colour indices were $B-V=0.1$, $V-R_c=0.1$, $V-I_c=0.1$, and the light curve showed on average a linear decay with the following rates:

$$\begin{aligned}\mathrm{d}m(B)/\mathrm{d}t &= 0.11 \pm 0.01 \text{ mag/day}\\ \mathrm{d}m(V)/\mathrm{d}t &= 0.11 \pm 0.01 \text{ mag/day}\\ \mathrm{d}m(R_c)/\mathrm{d}t &= 0.10 \pm 0.01 \text{ mag/day}\\ \mathrm{d}m(I_c)/\mathrm{d}t &= 0.10 \pm 0.01 \text{ mag/day}\end{aligned}$$

These values are quite similar to those recorded in the superoutbursts for AL Com, WZ Sge (Patterson et al. 1996), and V660 Her (Spogli et al. 1998). After this phase the decline was very rapid and in September 10th we observed the minimum ($V \simeq 17.7$).

Our current knowledge and understanding of the physical processes, that form the basis of the DN outburst mechanism, are still subject to a lot of controversy. Although disk-instability models are the most favoured models, some aspects are still unclear and more observations are required. BVR_cI_c observations of dwarf novae allow to evaluate the optical spectral behaviour and, therefore, they can be used as a test to compare theoretical models of accretion disk emission. In particular they can be used to verify the often quoted theoretical flux distribution of a stationary (infinitely) large accretion disk whose surface elements radiate as a black body spectra ($F(\nu) \propto \nu^{1/3}$, see, e.g., Warner 1995). In disk instability models the accretion disk can accumulate a certain amount of gas before it gets unstable. When instability is reached, the accretion of matter to the white dwarf increases dramatically and this explains the outburst. When the accretion disk has lost enough mass, it becomes stable again and the dwarf nova returns to minimum magnitude (see, for example, Cannizzo et al. 1986). One important feature of the disk instability picture is that the disk is never in a steady state: the quiescent disk is rarely close to steady-state, with temperature distribution usually flatter than $T(R) \propto R^{-3/4}$, where R is the radial distance from the center of the disk. Systems in eruption more closely resemble, but never achieve, the steady-state temperature distribution (Robinson et al. 1999; Kenyon 1999). If the temperature distribution is flatter, then the disk spectrum is naturally flatter and the predicted spectral slope is $\alpha \leq 0.33$.

To study the behaviour of the optical continuum of the observed DN during the outburst, we converted the BVR_cI_c magnitudes in fluxes using the conversion factors reported by Bessell (1979). For V503 Cyg we can neglect the extinction coefficient (Szkody 1985). Using the flux values so obtained we note that at the minimum the spectral distribution is dominated by the emission of the secondary star, while at the maximum the spectral distribution follows a power law ($F(\nu) \propto \nu^{\alpha}$). For V503 Cyg we obtain a spectral slope α in the range between 0.5 and 0.8 during the outburst, a value that is greater than expected.

Our data confirm that for some sources the steady-state accretion disk models do not provide a good representation of the optical continuum during the outburst (see, for example, Spogli et al. 1993, 1998). This is a clear evidence about our poor knowledge of the true radiative transfer solution in accretion disk, and more efforts must be made to obtain multi-wavelength observations of DNe.

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GSC 05178_01376: A NEW W UMa VARIABLE

DVORAK, S. W.

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Name of the object:
GSC 05178_01376

Equatorial coordinates:	**Equinox:**
R.A.= $20^h48^m13^s$ **DEC.=** $-01°29'26''$	J2000.0

Observatory and telescope:
Rolling Hills Observatory, 0.20-m Schmidt–Cassegrain telescope

Detector:	Cookbook 245 CCD (CB245)

Filter(s):	No, roughly R (CB245 camera)

Comparison star(s):	GSC 05178_01373

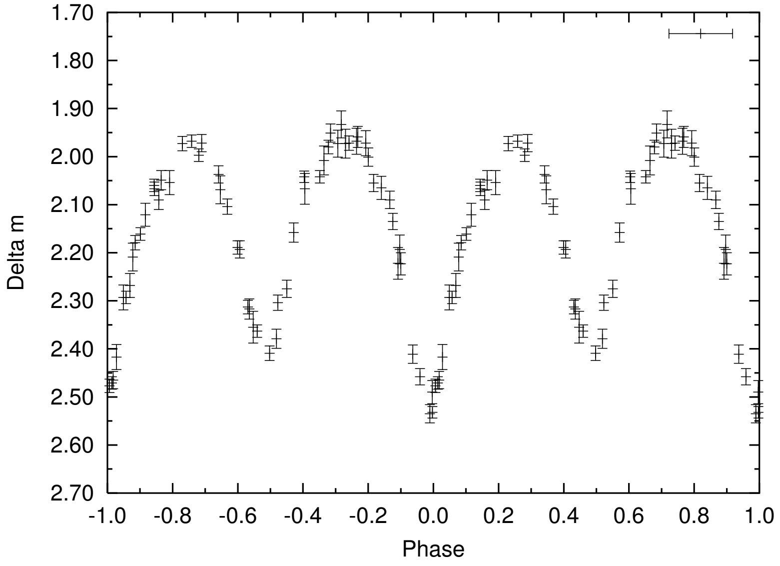

Figure 1. Phase diagram of GSC 05178_01376

Transformed to a standard system:	No

Availability of the data:

Upon request

Remarks:

The Mark III survey of The Amateur Sky Survey (TASS) has collected numerous measurements of stars along the equator using drift scan CCDs mounted behind 135-mm telephoto lenses (Richmond et al., 2000). Analysis of the data has produced a number of new variables (Gutzwiller, 1999). One of these, GSC 05178_01376, was observed by the author to verify the classification by Gutzwiller and to determine an ephemeris.

Data were obtained on five nights. Each "observation" was composed of four or five separate 10^{s} images. After dark images were subtracted and flats applied, aperture photometry using sextractor (Bertin and Arnouts, 1996) was used to generate star lists. The difference (Δm) between GSC 05178_01376 and the nearby star GSC 05178_01373 ($m_v = 9.30$) was calculated for each 10^{s} image. The data for all images comprising an "observation" were averaged and the standard deviation calculated. A heliocentric correction was applied to the data.

The TASS tenxcat database contains 59 I observations of GSC 05178_01376. The data were sorted to find the faintest measurements; these should correspond to observations that occurred at or very near a minimum. Five minima in the I-band TASS photometry were identified: TASS minima HJD − 2450000 = 740.5650; 967.8671; 1056.6230; 1059.6140; 1068.5880. Using these values in conjunction with the minima determined during the five nights of observation at Rolling Hills Observatory yields an improved ephemeris:

$$\begin{array}{rl}\text{Min. I} = \text{HJD } 2451463.5725 & + 0\overset{\mathrm{d}}{.}272218 \times E. \\ \pm 0.0004 & \pm 0\overset{\mathrm{d}}{.}000004\end{array}$$

The quoted error was estimated by assuming that each of the TASS minima had a standard error of 5 minutes. A phase diagram is shown in Figure 1. The light curve is fairly symmetric, with the primary minimum being $0\overset{\mathrm{m}}{.}10$ fainter than the secondary. The secondary eclipse occurs very close to phase 0.5.

Acknowledgements:

Michael Gutzwiller has searched through the TASS Mark III database to discover several dozen previously unknown variables. His work was instrumental in pointing the author to this new variable.

Tom Droege is the founder and main driving force behind the TASS organization. Without his efforts there would be no TASS.

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ON THE VARIABILITY OF O AND B SUPERGIANTS

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Adelman & Albayrak (1997) examined the Hipparcos photometry (ESA 1997) of the A0 to A5 supergiants in the 5th edition of the Bright Star Catalog (Hoffleit & Warren 1991) and found that these stars obey the conclusions of Maeder (1980) that for supergiants of any spectral type the amplitudes increase with luminosity. Here we examine hotter supergiants of spectral type O and B of luminosity classes Ia and Ib as well as intermediate types and also include luminosity class II stars. The results given in Table 1 are consistent with the averages of Maeder for peak to peak V amplitudes although Hipparcos photometry has a somewhat wider bandpass. He gives $0^{\rm m}_{.}072$ for B1Ia–B5Ia stars, $0^{\rm m}_{.}060$ for B6Ia–B9Ia stars, $0^{\rm m}_{.}039$ for both B1Ib–B5Ib and B6Ib–B9Ib stars, and $0^{\rm m}_{.}033$ for B1II–B5 II stars, and $0^{\rm m}_{.}021$ for B6II–B9II stars.

Table 1: The mean amplitudes of O and B supergiants

Spectral Classes	Number	Mean Amplitude [mag]
O9Ia–B2Ia	33	0.056 ± 0.017
B2.5Ia–B9Ia	26	0.076 ± 0.026
O9.5Iab–B2Iab	7	0.057 ± 0.013
B3Iab–B9Iab	11	0.054 ± 0.017
O8Ib–B2Ib	35	0.041 ± 0.024
B2.5Ib–B9Ib	22	0.040 ± 0.019
O7.5II–B2II	17	0.029 ± 0.010
B3II–B8.5II	16	0.028 ± 0.016

Table 2 (available electronically from the IBVS Web-site as 4946-t2.txt) contains the values for the stars whose averages appear in Table 1 as well as those whose luminosity types had not been divided between subclasses Ia and Ib. We eliminated known interacting binaries with gas streams, e.g., β Lyr, or those which had notes that their variability was spurious due to a companion (HR 4136). They had greater amplitudes than stars with similar normal spectral types. Still there were four stars which had amplitudes substantially greater than their spectral type peers: HD 14134 (V520 Per, B3Ia) $0^{\mathrm{m}}\!.11$, HD 100943 (B5Ia) $0^{\mathrm{m}}\!.15$, HD 183143 (HT Sge, B7Iae) $0^{\mathrm{m}}\!.15$, and HD 111934 (BU Cru, B2Ib) $0^{\mathrm{m}}\!.16$. Except for HD 183143 (Celestia 2000) these stars have known companions. V520 Per was suspected of being a photometric variable by Rufener & Bartholdi (1982) (as was HD 100943) and confirmed by Waelkens et al. (1990). Examination of Hipparcos photometry by Krzesinski et al. (1999) did not yield a period. BU Cru is a known eclipsing binary. It is close to, but not an IRAS source (Friedemann et al. 1996). Such stars should be studied further to understand their large amplitudes for their spectral types. Perhaps one or more might be interacting binaries.

Several stars had amplitudes of $0^{\mathrm{m}}\!.01$ and $0^{\mathrm{m}}\!.02$. Of particular note are HR 2618 (ε CMa, B2II), HR 2596 (ι CMa, B3 II), HR 3825 (B5II), HR 2657 (γ CMa, B8II), and HR 3571 (B8-9II) with standard errors of $0^{\mathrm{m}}\!.0005$ or less. These are among those stars with the most stable Hipparcos photometry. Although supergiants are usually considered to be stars whose atmospheres are in considerable motion, we find a few which are relatively stable. This raises the question of whether there is something special about them relative to other luminosity II class B stars, e.g., in a different stage of evolution, or whether they just in a normal quiescent stage which occurs infrequently.

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ON THE VARIABILITY OF A6 TO F9 SUPERGIANTS

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Adelman & Albayrak (1997), who examined the Hipparcos photometry (ESA 1997) of the A0 to A5 supergiants in the 5th edition of the Bright Star Catalog (Hoffleit & Warren 1991), agreed with Maeder (1980) that their amplitudes increase with luminosity. Recently Adelman, Yüce, & Engin (2000) using the same methodology studied O and B supergiants. In the process they identified some stars which deserve further study including some especially quiescent stars.

Table 1: The mean amplitudes

Spectral Classes	Number	Mean Amplitude [mag]
A0–A5Ia	13	0.069 ± 0.030
A0–A5Iab	5	0.058 ± 0.018
A0–A5Ib	8	0.035 ± 0.011
A0–A5II	17	0.036 ± 0.048
A6–A9Ia,Iab	4	0.050 ± 0.012
A6–A9Ib	3	0.017 ± 0.006
A6–A9II	9	0.029 ± 0.009
F0–F9Ia	10	0.060 ± 0.072
F0–F9Iab	7	0.033 ± 0.010
F0–F9Ib	25	0.036 ± 0.037
F0–F9II	46	0.025 ± 0.017
Cepheids	44	0.059 ± 0.028

Here we extend these studies and examine the cooler supergiants of spectral type A6 through F9 of luminosity classes Ia, Ib, and II and also for completeness A0–A5 luminosity class II stars. Celestia 2000 (ESA 1998) sometimes lists different spectral types for these stars, especially for those that are Cepheids. For example, HD 148321, which we would have included in this study, was classified by Houck & Smith-Moore (1988) as an A1m star. We also separated the known Cepheids from other F stars as they are both spectral type and photometric variables. We are particularly interested in the relatively non-variable stars, especially those in the Cepheid instability strip, as they are more easily studied spectroscopically than their variable spectral type cohorts. We tried not to include stars which are known members of interactive binary systems. Although the bandpass of Hipparcos photometry is somewhat wider, the results in Table 1 are generally consistent with the averages of Maeder who used peak to peak V amplitudes. We also include values based on Adelman & Albayrak (1997). Maeder's results (in magnitudes) are 0.052 for A0–A9Ia stars, 0.039 for A0–A9Ib stars, 0.021 for B and AII stars, 0.051 for F0–F9Ia stars, 0.047 for F0–F9Iab stars, and 0.028 for F0–F9II stars. The A6–A9Ib and F0–F9Iab and II stars are less variable than Maeder found. In part this may be a matter of statistics or bandpass. But one of these stars ι Car is among the photometrically least variable stars found by Hipparcos.

Table 2 (available electronically from the IBVS Web-site as 4947-t2.txt) contains the Name (if any), HD number, Spectral type, HIP number, number of accepted transits, mean magnitude, standard errors, and amplitude for each star which contributed to the averages in Table 1. Table 3 (available electronically from the IBVS Web-site as 4947-t3.txt), which is similar to Table 2, lists one δ Sct star: ρ Pup, one RV Tauri (RVb) star: U Mon (see, e.g. Pollard et al. 1997), and 44 Cepheids. Here we also provide the variable star designation.

Several stars had amplitudes of $0^{\rm m}_{\cdot}01$ and $0^{\rm m}_{\cdot}02$. Of particular note are those with standard errors of $0^{\rm m}_{\cdot}0005$ or less, HR 2345 (A0II), HR 3426 (A6II), HR 3452 (A5II), HR 3426 (A6II), ι Car (A8Ib), α Lep (F0Ib), HR 1242 (F0II), 22 And (F2II), HR 4114 (F2II), ν Her (F2II), π Sgr (F2II), 35 Cyg (F5Ib), 41 Cyg (F5II), HR 8718 (F5II), HR 7945 (F5II–III), δ Vol (F6II), υ^2 Cen (F6II), 45 Dra (F7Ib), γ^1 Nor (F9Ia), and HR 3643 (F9II). With many of these belonging to luminosity class II, what was seen in the B supergiants by Adelman, Yüce & Engin (2000) also occurs in the A and F supergiants.

Polaris (α UMi) is the least variable of the known Cepheids. Feast & Catchpole (1997) identified it as a first overtone pulsator. There are only two other small amplitude ($\leq 0^{\rm m}_{\cdot}10$) Cepheids in Table 2, HR 690 and HR 4110, which have standard errors greater than Polaris. The former is noted as a Cepheid and the latter as a SR variable by Celestia 2000. They and the other F supergiants which are not listed as Cepheids with amplitudes and standard errors greater than Polaris and most of their cohorts, V885 Cen (F0Iaep), HR 4912 (F3Ia), 89 Her (F2Ib), HD 161796 (F3Ib), α Car (F0II), and HR 981 (F2II-III), should be investigated in more detail. The last six stars are listed as unsolved variables by Celestia 2000 except for HR 981, whose variability is noted as spurious due to duplicity (this is also noted for HR 292), and 89 Her which is noted as a SR variable with a period of 68 days, but whose light curve suggests multiperiodicity.

Having several kinds of stars occupying similar positions in the HR diagram indicates that their structures and evolutionary histories are different. What differentiates the normal Cepheids, the first overtone pulsating Cepheids, and these other F supergiants with slight photometric variability? Further is the variability of any of these stars related to that of the hotter supergiants such as Deneb?

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THE ORBITAL PERIOD CHANGES OF YY Eri

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YY Eri ($V = 8\overset{\mathrm{m}}{.}05$–$8\overset{\mathrm{m}}{.}80$, $P = 0\overset{\mathrm{d}}{.}3125$) is a W UMa type eclipsing binary, whose orbital period variations have been argued by several authors. For example, Kim (1992) suggested that observed times of minima of YY Eri can be fitted to a non-linear ephemeris with a sinusoidal term. Maceroni and van't Veer (1994) claimed, however, that some later observations including ones of their own were deviating substantially from Kim's (1992) non-linear ephemeris. More recently, Kim et al. (1997) made an extensive study of the period variations of YY Eri, analyzing all the available photoelectric and CCD minima down to 1996 and some visual and photographic minima before 1950. They suggested that the most plausible mechanism would be a cyclic magnetic activity modulation of the primary star combined with a continuous mass transfer. They proposed two non-linear ephemerides, both of which have a periodic and a quadratic term, considering that the alternative period variations of YY Eri may be periodic ones rather than real abrupt changes.

In this study, we carried out photoelectric and CCD photometry of YY Eri with V filter from November 1992 through February 2000. Gunma University (GU) group covered three primary and four secondary minima using a 25-cm telescope plus an SBIG ST-7, while Variable Star Observers League in Japan (VSOLJ) group obtained two primary and two secondary minima using a 20-cm telescope plus a photoelectric photometer (Hamamatsu R647), a 25-cm telescope plus an SBIG ST-6, and a 6-cm/10-cm telescope plus SBIG ST-5. The times of these observed minima were determined with Kwee and van Woerden's (1956) method. VSOLJ group also covered another ten minima of YY Eri, which have been reported in *VSOLJ Var. Star Bull.*

In addition to 86 photoelectric and CCD minima listed by Kim et al. (1997), we collected another 31 photoelectric and CCD minima including those determined in this study, as shown in Table 1. The table also gives $(O-C)_1$ and $(O-C)_3$ residuals and their epochs E for these minima, which will be mentioned below. Among these data, we re-determined the three minima of *VSB 23* to four places from the original individual data using Kwee and van Woerden's (1956) method because they are given to three places of decimals in the source. We marked one (HJD 2451126.0528) of the minima of *VSB 33*

Table 1: Times of minima of YY Eri collected in this study.

HJD 2400000 +	E (cycles)	$(O-C)_1$ (days)	$(O-C)_3$ (days)	Method	Source**
46026.1049*	+38596.5	−0.0346	−0.0357	pe	AAS 136
46026.2641*	+38597	−0.0362	−0.0372	pe	AAS 136
46027.2304*	+38600	−0.0344	−0.0354	pe	AAS 136
46028.1945*	+38603	−0.0348	−0.0358	pe	AAS 136
46028.3558*	+38603.5	−0.0342	−0.0352	pe	AAS 136
48948.0655	+47685	−0.0001	+0.0002	pe	This study (VSOLJ)
50046.1407	+51100.5	+0.0023	+0.0018	CCD	This study (VSOLJ)
50049.1939*	+51110	+0.0033	+0.0007	CCD	VSB 23
50050.1586*	+51113	+0.0025	+0.0009	CCD	VSB 23
50071.0544	+51178	+0.0010	−0.0008	CCD	This study (VSOLJ)
50443.9947*	+52338	+0.0056	−0.0002	CCD	VSB 23
50481.2888	+52454	+0.0061	−0.0001	CCD	BAV-M 102
50758.4211	+53316	+0.0087	−0.0006	pe	IBVS 4670
50759.5467	+53319.5	+0.0091	−0.0003	pe	IBVS 4670
50819.9885	+53507.5	+0.0096	−0.0004	CCD	VSB 33
50823.3630	+53518	+0.0084	−0.0017	CCD	BAV-M 111
50829.9538	+53538.5	+0.0086	−0.0016	CCD	VSB 33
50834.9382	+53554	+0.0098	−0.0005	CCD	VSB 33
50843.9400	+53582	+0.0097	−0.0007	CCD	VSB 33
51126.0528:*	+54459.5	+0.0097:	−0.0039:	CCD	VSB 33
51129.1100	+54469	+0.0127	−0.0010	CCD	VSB 33
51200.9643	+54692.5	+0.0126	−0.0019	CCD	VSB 37
51496.427	+55611.5	+0.021	+0.003	CCD	BBSAG 122
51499.1572	+55620	+0.0180	−0.0000	CCD	This study (GU)
51533.0764	+55725.5	+0.0194	+0.0010	CCD	This study (GU)
51534.0411	+55728.5	+0.0196	+0.0012	CCD	This study (GU)
51535.9672	+55734.5	+0.0167	−0.0017	CCD	This study (VSOLJ)
51537.0941	+55738	+0.0184	−0.0001	CCD	This study (GU)
51538.0594	+55741	+0.0192	+0.0007	CCD	This study (GU)
51598.9842	+55930.5	+0.0205	+0.0013	CCD	This study (GU)
51599.9478	+55933.5	+0.0197	+0.0004	CCD	This study (GU)

* see text

* AAS 136: Yang & Liu (1999); BBSAG 122: *BBSAG Bull.*, **122**, 4, BAV-M 102: *BAV Mitteilungen*, Nr. 102; BAV-M 111: *BAV Mitteilungen*, Nr. 111; IBVS 4670: Selam, Gürol & Müyesseroğlu (1999); VSB 23: *VSOLJ Var. Star Bull.*, **23**, 2; VSB 33: Nagai (1999); VSB 37: Nagai (2000)

with a colon and will not use it in our discussion, because this minimum is found not free from somewhat large observational scatters in our re-examination of the original data.

Now, we will briefly discuss the orbital period variations of YY Eri based on all the photoelectric and CCD minima available to us. Figure 1 shows the $O-C$ diagram of YY Eri constructed with the following linear ephemeris

$$\text{Prim. Min} = \text{HJD } 2433617.51983 + 0.321496212 \times E$$

which is given by Kim et al. (1997, Eq. (1) in their paper).

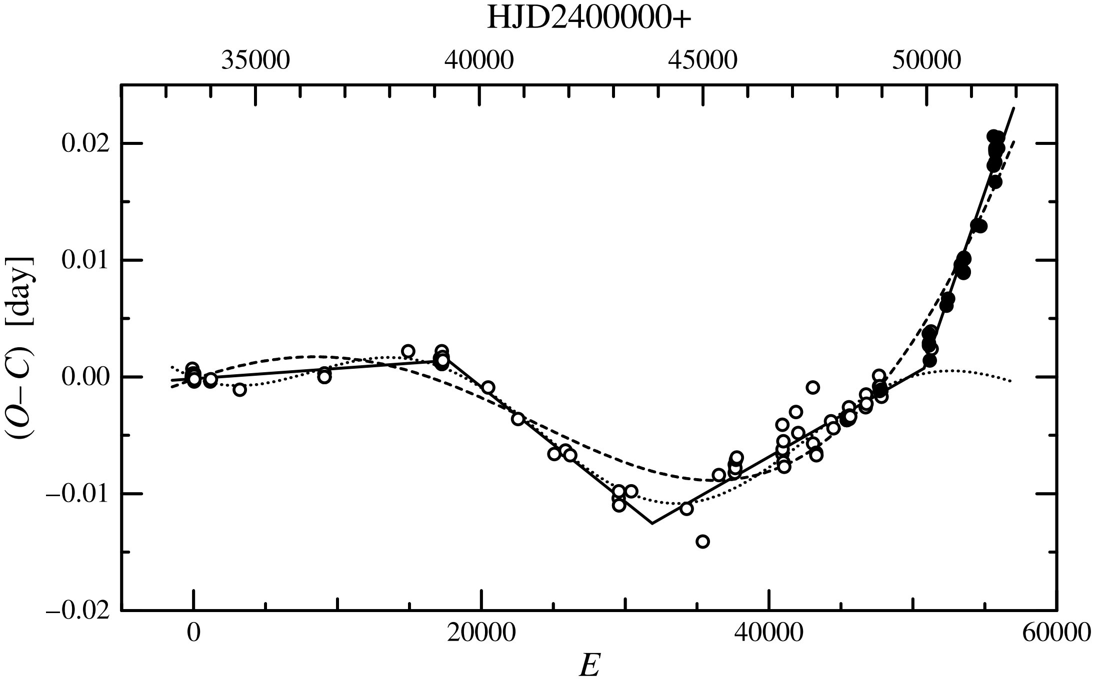

Figure 1. $O-C$ diagram of YY Eri constructed with the linear ephemeris of Kim et al. (1997, Eq. (1) in their paper). The open circles are the minima used by Kim et al. (1997) while filled circles are those collected in this study. The dotted line indicates the non-linear ephemeris of Kim et al. (1997, Eq. (2) in their paper), and the broken line represents the "best-fit" ephemeris with a sinusoidal and a quadratic term. The segments of solid straight lines show a combination of linear ephemerides listed in Table 2.

It turns out that the $O-C$ values of five minima of *AAS 136* (Yang and Liu, 1999) are systematically smaller than those of nearly same epochs by $0\overset{d}{.}03$–$0\overset{d}{.}04$. Since the discrepancy is unacceptably large, we will not take account of these minima in our discussion. It is noted, however, that the $O-C$ values became satisfactorily consistent with those of nearly the same epochs if exactly one day is added to each of these minima.

The dotted line in Figure 1 shows one of the two non-linear ephemerides proposed by Kim et al. (1997, Eq. (2) in their paper), which has a sinusoidal and a quadratic term. Figure 2a displays the $(O-C)_1$ residuals from this non-linear ephemeris. They are also listed in Table 1. This ephemeris represents the overall $O-C$ variation of YY Eri fairly well except for the last few thousand cycles, where $(O-C)_1$ residuals increase rapidly, suggesting that the ephemeris of Kim et al. (1997) can be applied no longer for these epochs. It is also found that the same is true of the case of the other non-linear ephemeris of Kim et al. (1997, Eq. 3 in their paper), although no line for the ephemeris is drawn in Figure 1.

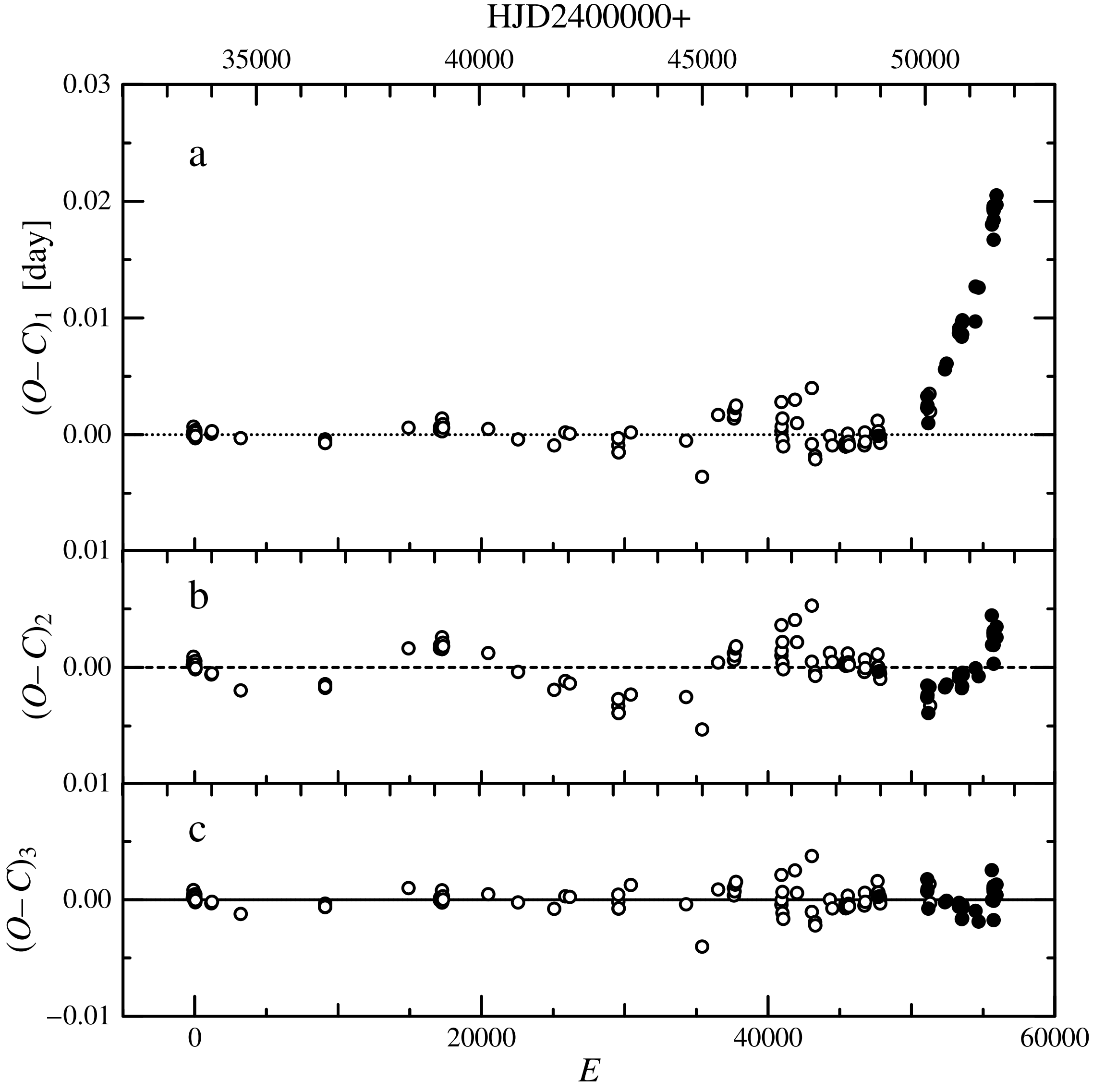

Figure 2. (a) $(O-C)_1$ residuals from Eq. (2) in the paper of Kim et al. (1997). (b) $(O-C)_2$ residuals from the non-linear ephemeris with a sinusoidal and a quadratic term fitted to all the data. (c) $(O-C)_3$ residuals from a combination of the linear ephemerides given in Table 2.

Table 2: Linear ephemeris of YY Eri for each interval

Interval Division & Duration	Linear Ephemeris Primary Min.	Period Change $\Delta P/P$
$\geq$ 5700 days	HJD $2433574.4392 + 0.32149630 \times (E + 134)$	
	$\pm\,1$ $\pm\,1$	
HJD 2439300		-3.3×10^{-6}
4600 days	HJD $2440201.1179 + 0.32149523 \times (E - 20478)$	
	$\pm\,3$ $\pm\,5$	
HJD 2443900		$+5.2\times10^{-6}$
6000 days	HJD $2444636.1486 + 0.32149692 \times (E - 34273)$	
	$\pm\,3$ $\pm\,4$	
HJD 2449900		$+8.9\times10^{-6}$
$\geq$ 1700 days	HJD $2450045.9782 + 0.32149979 \times (E - 51100)$	
	$\pm\,3$ $\pm\,9$	

Assuming that the ephemeris of YY Eri is still represented by an equation having a sinusoidal and a quadratic term over the cycles down to the latest minimum, we obtain the "best-fit" solution which is shown by the broken line in Figure 1. However, the obtained ephemeris, whose parameters are not presented here, does not represent the overall $O-C$ variation so well. In fact, as seen in Figure 2b, the $(O-C)_2$ residuals from this ephemeris show a somewhat wave-like pattern rather than a random scattering around $(O-C)_2 = 0$. It is also noticed that the deduced periodicity ($\sim$ 76 yr) of the periodic term is much longer than the time span ($\sim$ 49 yr) covered with the photoelectric and CCD minima available to us. Therefore, at the moment, no strong evidence seems to exist that the ephemeris of YY Eri should have a periodic term.

Next, we assume that YY Eri has experienced only abrupt period changes. Dividing the observationally covered span ($\sim$ 49 yr) into four constant period intervals, we computed a linear ephemeris for each interval with the least square method, which is shown in Table 2 and also in Figure 1 with a segment of straight solid line. Although Kim et al. (1997) also derived such a combination of linear ephemerides for YY Eri, we adopt different intervals from theirs. For example, we separated the span $E = -133.5 - (+47685)$ into three constant period intervals, while they divided it into five intervals. Keeping in mind that observed times of minima are more or less affected by measured errors in observations and by possible fluctuant effects due to stellar "activity", we believe that, to investigate the nature of the overall $O-C$ variation, the least divisions would be more reasonable as far as no appreciably systematic residuals are presented. It is also noticed that there exists a significant discontinuity between the two linear ephemerides of Kim et al. (1997) around $E \simeq 36000$ (see Fig. 2 in their paper), which is unacceptable unless another two period jumps are supposed to have occurred around there. The $(O-C)_3$ residuals from the linear ephemerides obtained in this study are given in Table 1 and also in Figure 2c, where we see no significant wave-like pattern as found in Figure 2b.

In conclusion, the observed orbital period variations of YY Eri are more likely to be approximated by abrupt changes than by periodic ones. Kim et al. (1997) claimed that abrupt period changes are less plausible for YY Eri because no evidence of anisotropic mass ejection had been reported. There are some binaries, however, whose abrupt period changes are considered due to a cyclic magnetic activity of the component(s) (e.g. Šimon, 1997a, 1997b). Therefore, an abrupt period change approximation does not necessarily exclude the possibility of a cyclic magnetic activity mechanism for YY Eri.

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HD 77191: ANOTHER VARIABLE SOLAR TWIN

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The University of Vienna runs two automatic photometric telescopes (APT) in the Southern Arizona desert named Wolfgang and Amadeus. A description of the telescopes and the used photometers is given by Strassmeier et al. (1997). Beside other programs the telescopes are used for monitoring the light change of long period AGB variables (Lebzelter 1999, Kerschbaum et al. 2000). The discovery of a new photometric variable G star reported here has been made in the course of a short time monitoring of a group of AGB stars for determining their current brightness. Typically one datapoint is obtained per night. The new variable has been used as a comparison star within this program.

HD 77191 has been observed together with the program star RT Cnc (M5III) and the second comparison star HD 76678 (G5). Observations have been done with Wolfgang using Johnson B and V filter. HD 77191 has been identified as variable by comparison of the light change of RT Cnc relative to both comparison stars.

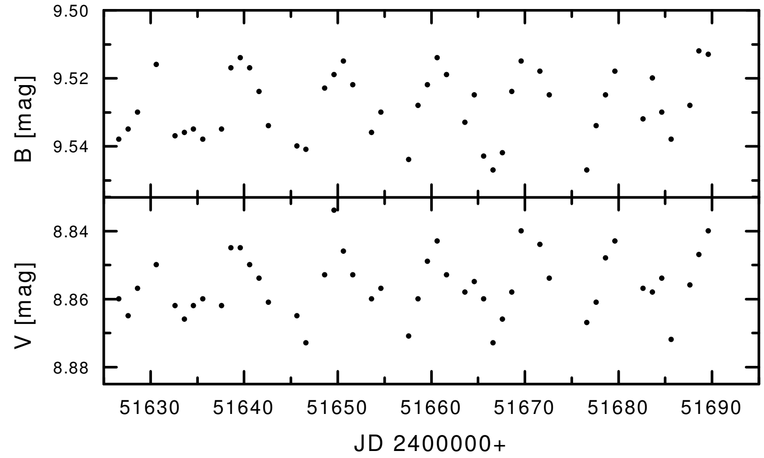

Figure 1. Light change of HD 77191

Figure 1 shows the light change of HD 77191 in both filters. Data have been derived relative to the second comparison star HD 76678 ($V = 8\overset{\text{m}}{.}39$, $B - V = 0\overset{\text{m}}{.}83$ from Tycho Catalogue, Perryman et al. 1998). Each datapoint is the mean of ten measurements. The mean scatter of these measurements is $0\overset{\text{m}}{.}004$ in B and $0\overset{\text{m}}{.}003$ in V, respectively, therefore clearly smaller than the amplitude of the variations observed. Figure 2 presents the results of a Fourier analysis of the data using Period98 (Sperl 1998). From the strongest peak (0.099988 c/d) we derive a period of 10.0 ± 0.2 days. Figure 3 gives the visual brightness versus phase.

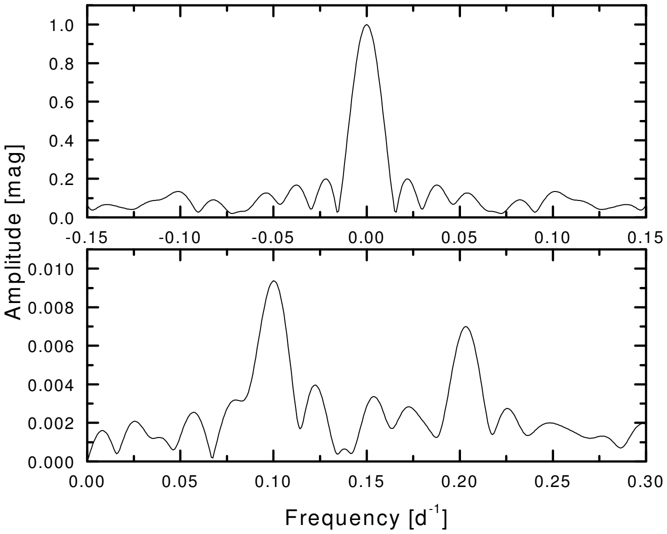

Figure 2. Result of a Fourier analysis on the data. The upper panel gives the spectral window, the lower panel the amplitude spectrum

The light curve is obviously asymmetric. Inspection of the mean light curve in Figure 3 as well as of the total light change (Fig. 1) reveals a bump on the descending branch of the light curve around phase 0.5. The light change is similar in both filters with an amplitude of about 0.04 magnitudes. The asymmetry of the light curve can also be seen as a second peak in the spectrum of the Fourier analysis (Fig. 2).

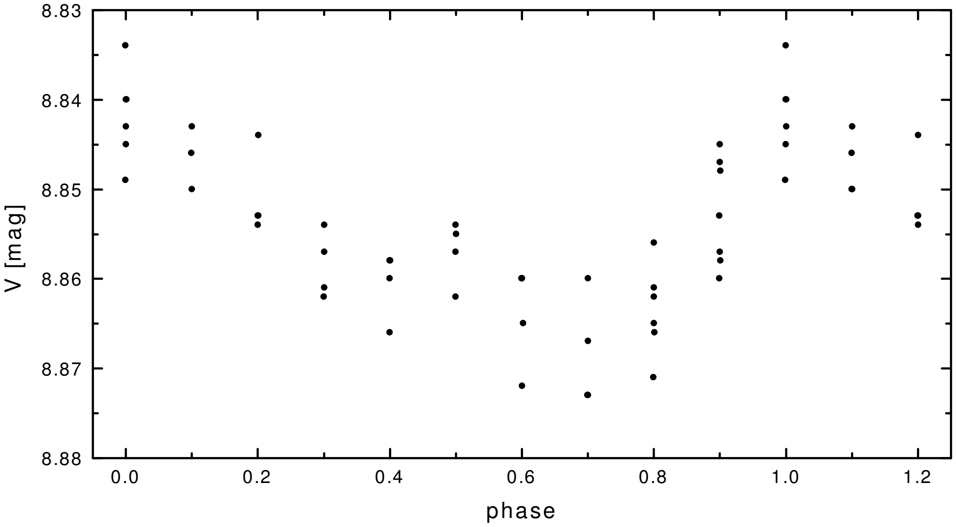

Figure 3. Phase plot of the light variations of HD 77191 using a period of 10.0 days. Data points between 1.0 and 1.2 are repeated for clarity

No investigation on this star has been reported in the literature. The Hipparcos catalogue (Perryman et al. 1998) gives a spectral type of G0 which is in agreement with the $B-V$ value of $0\overset{\text{m}}{.}67$ derived both by Hipparcos and by our APT measurements. The Hipparcos parallax for this star of 15.58 ± 1.15 milliarcseconds gives an absolute V brightness $M_V = 4.83$ (without any corrections for reddening). It is therefore probably a main sequence G0 star, similar to our Sun. The Hipparcos measurements indicate that HD 77191 is a single star.

We propose that the reason for the star's variability are star spots on its surface. Several stars similar to the Sun have been found already to show such variability (Lockwood et al. 1997, Strassmeier et al. 1999). Strassmeier & Bopp (1992) presented the results of different star spot geometries on the photometric light change. Following their parameter study the light curve of HD 77191 may be explained by the assumption of two spots of different size at different latitudes on the star's surface (compare their Fig. 10 and 11).

The variability in $B-V$ is very small (total amplitude of about $0\overset{\text{m}}{.}01$), but indicates that the star is reddest during its light minimum around phase 0.6. This is in agreement with "dark" spots on the stellar surface.

The measured period of the light change of 10 d is then the rotation period of the star at the latitude of the spot(s). This period is quite long for an active G0 dwarf (compare Fig. 1 in Hall 1991). Our data do not allow to derive any results on differential rotation of this star.

On the one hand, HD 77191 is very similar to our Sun in several aspects. On the other hand, there is an obvious difference in activity between the Sun and HD 77191. This makes this star an interesting object for further spectroscopic and photometric investigations to understand variability of main sequence stars in that part of the HRD.

Acknowledgements: This research has been supported by the Austrian Science Fund under project number S7301-AST and P14365-PHY. The author wishes to thank Klaus Strassmeier for helpful comments on the manuscript.

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PERIOD VARIATION OF XX CYGNI REVISITED

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The light variation of XX Cygni (= HIP 98737, spectral type A5–F5, $\langle V \rangle = 11^{\mathrm{m}}.7$, $P \approx 0^{\mathrm{d}}.1349$, $\Delta V = 0^{\mathrm{m}}.80$) was discovered by Ceraski (1904). While Shapley & Shapley (1915) referred to XX Cyg as "the shortest-period variable star known", McNamara & Feltz (1980) highlighted the importance of XX Cyg by noting the fact, that this star has longer period than any other high-velocity variables of this type. The single periodic nature of the star was recognized by Nijland (1923) and the follow-up studies regarding the description of the light variation concentrated on detecting small, secular changes of the light curve shape or the period. A full set of physical parameters was determined by Joner (1982). Szeidl & Mahdy (1981) published a very thorough period study concluding that the period of XX Cyg suffered a sudden change by $+87 \times 10^{-9}$ day ($\Delta P/P = 6 \times 10^{-7}$) in 1942 and was constant otherwise. Since then a few times of maxima have been published in almost every observing season, but there has been no paper dealing with the very recent behaviour of the period change. For this purpose, we made new CCD observations, collected all available epochs of maximum and analysed the resulting $O-C$ diagram.

Unfiltered CCD observations were carried out at University of Szeged on three subsequent nights (July 31–August 2, 2000). The applied instrument was the 0.28-m Schmidt–Cassegrain-type telescope located in the very center of the city of Szeged. The detector was an SBIG ST–9E CCD camera (512 × 512 pixels) giving an angular resolution of about $2''$/pixel. The exposure time was 20 seconds and the frames were obtained almost uninterruptedly enabling a very good phase coverage during every cycle.

The data were reduced with standard tasks in IRAF. We made aperture photometry with IRAF/DIGIPHOT. Two nearby stars were chosen as comparison and check stars (comp = GSC 3948-2542, $10^{\mathrm{m}}.4$, check = GSC 3948-2105, $10^{\mathrm{m}}.9$). Throughout the observations we did not find significant differential brightness variations larger than $0^{\mathrm{m}}.015$ implying a photometric accuracy of the same order. A single-night light curve is shown in Fig. 1. The whole dataset contains 826 individual data points obtained on three nights. They are available upon request from the first author. All data were phased with the finally adopted ephemeris (see later) and the corresponding phase diagram is plotted in Fig. 2.

Five new times of maxima were determined from the individual cycles by fitting low-order (3–5) polynomials to the top part of the light curves. The estimated accuracy is about 0.0003 days. To construct the updated $O-C$ diagram, we collected all available data from the literature. Szeidl & Mahdy (1981) gave a full compilation until 1980,

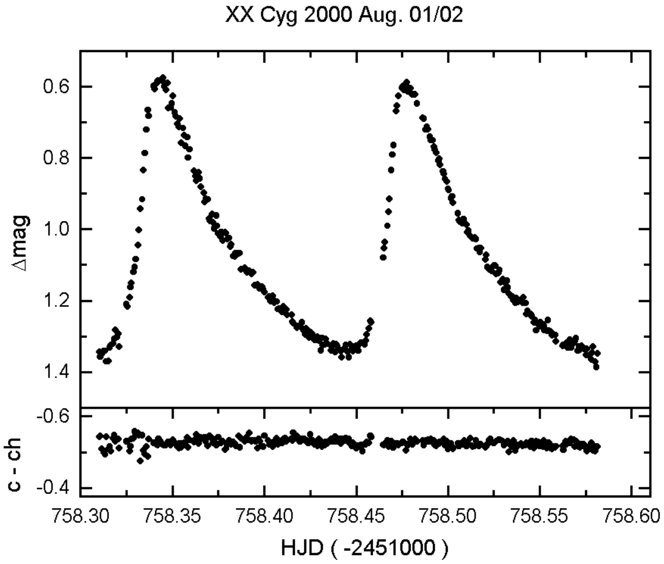

Figure 1. The unfiltered light curve of XX Cygni obtained on August 1, 2000

therefore, we had only to add new data published by Romano & Perissinotto (1982), Joner (1982), Sadun & Ressler (1986), Rodríguez et al. (1993), Kim & Joner (1994) and Agerer & Hübscher (2000). In cases when the authors listed only the photometric data, we determined the individual epochs of maximum with the same fitting procedure. We have to note that the typical light curve sampling is less dense than ours, therefore, some of the determined epochs are of lower quality.

The final sample including times of maxima from Szeidl & Mahdy (1981) contains 88 points. The $O-C$ values were calculated with the same formula as in Szeidl & Mahdy (1981): Hel. $\mathrm{JD_{max}} = 2430671.1010 + 0.134865070 \times E$. Six discordant points which were obviously bad had to be rejected. The remaining 82 points were used to form yearly means of the cycle numbers and $O-C$ values. The resulting diagram is plotted in Fig. 3.

The two well-defined linear branches give further support to the main conclusion by Szeidl & Mahdy (1981) that the period of XX Cyg suffered a sudden change in 1942 and since then it has remained constant. The amount of period change is $(+92.8 \pm 9.8) \times 10^{-9}$ days, or $\Delta P/P = 6.9 \times 10^{-7}$. This is somewhat larger than the value determined by Szeidl & Mahdy (1981) — 87×10^{-9} days — that can be attributed to our longer dataset allowing higher accuracy. Our work extends the results of Szeidl & Mahdy (1981) by a further 20-year long period of time and thanks to the relatively large number of observations, we could determine a very accurate ephemeris for XX Cyg. By a least-squares linear fit of the second branch of the $O-C$ diagram, we obtained the following formula:

$$\text{Hel. JD}_{\text{max}} = 2451757.3984 + 0.13486513(5) \times E.$$

The reason of the abrupt period change has remained essentially unknown since its detection. Recently, Breger & Pamyatnykh (1998) shortly discussed the observed period changes in SX Phe stars concluding that sudden jumps cannot be described in terms of long-term stellar evolution, but they are most likely in connection with nonlinear effects in pulsation. Similar conclusion was also reached by Rodríguez et al. (1995). Mixing events in the semiconvective zone or slight overshooting at the convective core edge predicted by

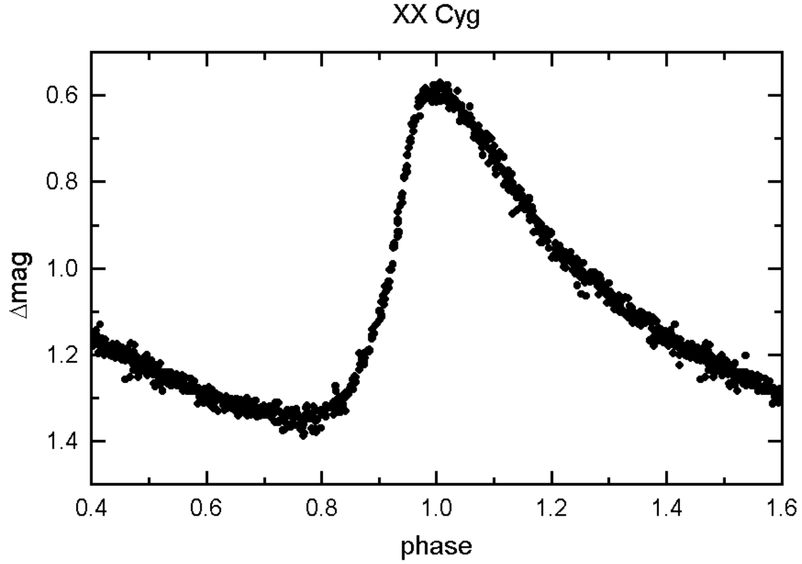

Figure 2. The phase diagram of all unfiltered observations calculated with the adopted ephemeris (E_0 = HJD 2451757.3984, $P = 0.134865123$ days)

Table 1: Times of maxima of XX Cyg (HJD – 2400000). References: (1) Romano & Perissinotto (1982), (2) Joner (1982), (3) Sadun & Ressler (1986), (4) Rodríguez et al. (1993), (5) Kim & Joner (1994), (6) Agerer & Hübscher (2000). Cycle numbers and $O-C$ values were calculated with the ephemeris of Szeidl & Mahdy (1981)

Hel. JD	E	$O-C$	Ref.	Hel. JD	E	$O-C$	Ref.
38939.4210	61308	0.0123	(1)	46631.7142	118345	0.0065	(5)
38961.3960	61471	0.0043	(1)	46951.6171	120717	0.0094	(4)
40124.3460	70094	0.0128	(1)	46999.4899	121072	0.0051	(4)
40152.2470	70301	−0.0033	(1)	46999.6249	121073	0.0053	(4)
44437.8645	102078	0.0069	(2)	47001.5153	121087	0.0076	(4)
44440.8298	102100	0.0052	(2)	47001.6508	121088	0.0082	(4)
44456.7445	102218	0.0058	(2)	47004.4814	121109	0.0066	(4)
44461.7353	102255	0.0066	(2)	47360.7955	123751	0.0072	(5)
44461.8705	102256	0.0069	(2)	47361.7374	123758	0.0051	(5)
44513.6594	102640	0.0076	(2)	50674.4279	148321	0.0049	(6)
45901.6893	112932	0.0062	(3)	50677.3965	148343	0.0064	(6)
45906.6798	112969	0.0067	(3)	50677.5315	148344	0.0066	(6)
45928.6638	113132	0.0077	(3)	51305.4641	153000	0.0074	(6)
45941.7467	113229	0.0087	(5)	51757.3984	156351	0.0088	this paper
45945.7926	113259	0.0086	(5)	51757.5342	156352	0.0098	this paper
46581.8129	117975	0.0053	(5)	51758.3432	156358	0.0096	this paper
46583.8378	117990	0.0072	(5)	51758.4773	156359	0.0088	this paper
46627.5333	118314	0.0064	(4)	51759.4214	156366	0.0089	this paper

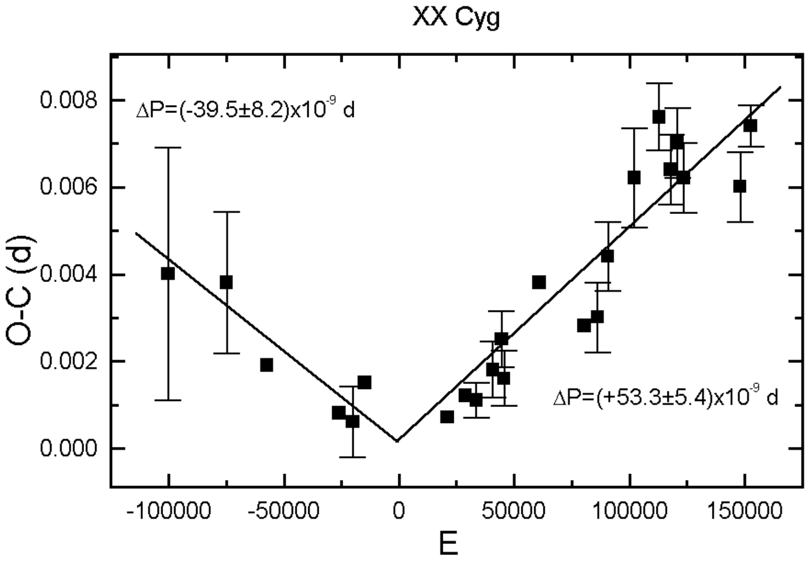

Figure 3. The mean $O - C$ diagram of XX Cyg

Sweigart & Renzini (1979) are the most widely accepted theoretical explanations. Follow-up observations are crucial to monitor the constancy of the period and to detect further possible sudden change(s).

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CCD PHOTOMETRY OF THE ECLIPSING BINARY HV AQUARII

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The W UMa type eclipsing binary HV Aquarii (BD $-3^\circ 5183$, GSC 5198.0659, PPM 205095, $\alpha_{2000} = 21^{\rm h}21^{\rm m}25\overset{\rm s}{.}3$, $\delta_{2000} = -3^\circ 9' 37''$, $V_{\rm max} = 10\overset{\rm m}{.}0$) is a relatively new variable with a short orbital period of about 9 hours. It was discovered by Hutton (1992) during a photometry of minor planets. The first photoelectric measurements were obtained independently in October 1992 by Schirmer & Geyer (1992) and Robb (1992). Schirmer & Geyer (1992) determined light elements from their high speed photometry using the secondary minima:

$$\text{Sec. Min.} = \text{HJD } 2448840.4548 + 0\overset{\rm d}{.}374460 \times E$$

and concluded that the spectral type is G5 according to the average $B - V = 0\overset{\rm m}{.}70$ They also noted, that both components show strong chromospheric activity. Robb (1992) based on his V, R CCD photometry, derived another ephemeris with longer orbital period:

$$\text{Pri. Min.} = \text{HJD } 2448835.7736 + 0\overset{\rm d}{.}374479 \times E.$$

He used the LIGHT modelling program for a determination of physical and geometrical parameters of the system. He concluded that HV Aqr is in a contact configuration with an extreme mass ratio $q = M_2/M_1 = 0.146$, inclination of 78.3 degrees and fillout factor 0.475 (solution in R filter). The temperature of both components was assumed to be 6500 K.

Our new CCD photometry of HV Aqr was carried out during two consecutive nights, 17 and 18 August 2000, at the Ondřejov Observatory, Czech Republic. A 65-cm reflecting telescope with a CCD-camera ST-8 was used. The measurements were done using the standard R filter with typically 10–15 s exposure time. The nearby stars GSC 5198.0636 ($V = 11\overset{\rm m}{.}4$) on the same frame as HV Aqr served as comparison star. Unfortunately, the star SAO 145329, used frequently as a comparison star by previous observers was over-exposed on our frames. The standard error of measurements, probably due to non-photometric conditions, varies between 0.01 and 0.03 mag. Two moments of primary and secondary minima and their errors were determined using the least squares fit to the data and by the bisecting cord method. These new times of minimum are presented in Table 1. The epochs were calculated using the new linear light elements.

Visual observations of HV Aqr were done by P. Molik in 1995 (5 August–26 October). He used a 0.2-m refractor at the Petrin Hill Observatory in Prague (Czech Republic). Visual estimates were done by the method of Nijland–Blazhko using a series of three

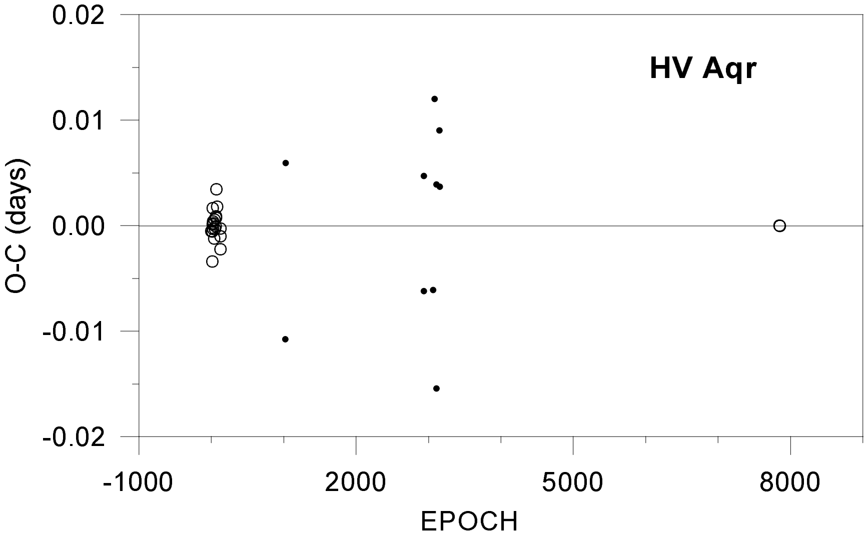

Figure 1. $O-C$ graph for the times of minimum of HV Aqr. The residuals corresponding to photoelectric and CCD data are denoted by circles, dots represents the visual timings of Martignoni and P.M.

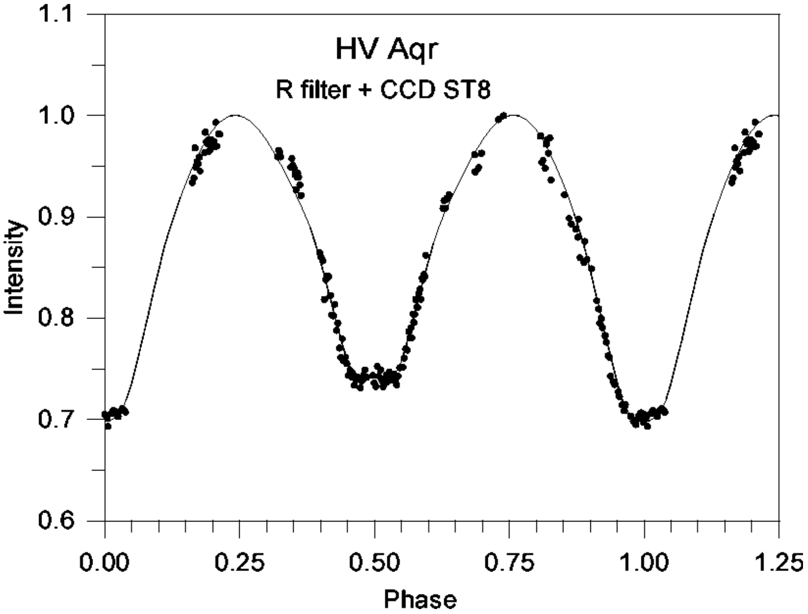

Figure 2. Composite R light curve of HV Aqr.

Table 1: Times of minimum of HV Aqr.

No.	JD Hel. – 2400000	Epoch	$O-C$ (days)	Method Filter	Source
1	48835.7737	0.0	−0.0005	pe R, V	Robb (1992)
2	48840.4544	12.5	−0.0005	pe V	Schirmer & Geyer (1992)
3	48841.5749	15.5	−0.0034	pe V	Schirmer & Geyer (1992)
4	48842.5161	18.0	0.0016	pe V	Schirmer & Geyer (1992)
5	48843.4507	20.5	0.0001	pe V	Schirmer & Geyer (1992)
6	48844.7616	24.0	0.0004	pe R, V	Robb (1992)
7	48844.9481	24.5	−0.0003	pe R, V	Robb (1992)
8	48845.8848	27.0	0.0002	pe R, V	Robb (1992)
9	48850.5641	39.5	−0.0012	pe V	Schirmer & Geyer (1992)
10	48852.8126	45.5	0.0006	pe R, V	Robb (1992)
11	48853.9351	48.5	−0.0003	pe R, V	Robb (1992)
12	48858.8033	61.5	−0.0001	pe R, V	Robb (1992)
13	48859.7404	64.0	0.0009	pe R, V	Robb (1992)
14	48859.9275	64.5	0.0008	pe R, V	Robb (1992)
15	48862.5514	71.5	0.0035	pe V	Schirmer & Geyer (1992)
16	48866.8560	83.0	0.0018	pe R, V	Robb (1992)
17	48882.3932	124.5	−0.0010	pe V	Schirmer & Geyer (1992)
18	48883.3281	127.0	−0.0022	pe V	Schirmer & Geyer (1992)
19	48883.5173	127.5	−0.0003	pe V	Schirmer & Geyer (1992)
20	49217.523	1019.5	−0.011	vis	Martignoni (1996)
21	49219.412	1024.5	0.006	vis	Martignoni (1996)
22	49934.625	2934.5	0.005	vis	this paper
23	49935.550	2937.0	−0.006	vis	this paper
24	49983.481	3065.0	−0.006	vis	this paper
25	49989.490	3081.0	0.012	vis	this paper
26	49999.386	3107.5	−0.015	vis	this paper
27	50000.341	3110.0	0.004	vis	this paper
28	50015.325	3150.0	0.009	vis	this paper
29	50017.379	3155.5	0.004	vis	this paper
30	51774.5178	7848.0	0.0000	CCD R	this paper
31	51775.45391	7850.5	0.0000	CCD R	this paper

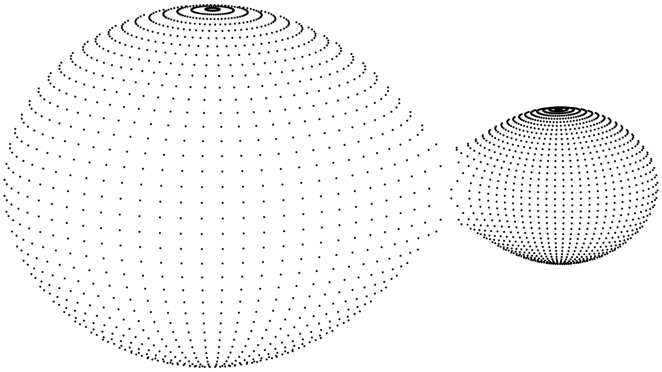

Figure 3. Geometrical representation of HV Aqr at phase 0.25.

comparison stars: GSC 5198.1260, GSC 5198.0999, and GSC 5198.0636. Total 192 estimates were obtained. The supposed mean error of a single estimate is ±0.05 mag. To avoid any prejudice about the behaviour of this low-amplitude star no prediction of times of minimum light was used.

The period of HV Aqr was studied by means of an $O-C$ diagram analysis. We took into consideration all photoelectric measurements of Schirmer & Geyer (1992) and Robb (1992) as well as results of our CCD measurements given in Table 1. A total of 21 photoelectric times of minimum light were used in our analysis, with 13 secondary eclipses among them. The new linear light elements

$$\begin{array}{rl}\text{Pri. Min.} = \text{HJD } 2448835.77422 + 0.37445764 \times E, \\ \pm 0.00033 \ \pm 0.00000014\end{array}$$

were calculated by the least squares method. Our resulting period is about 2 seconds shorter than was obtained by Robb (1992). The $O-C$ residuals for all times of minimum are shown in Figure 1. The visual estimations of Martignoni (1996) and of the present paper are also plotted as dots.

Our R light curve was used for the preliminary determination of photometric elements using the Binary Maker 2.0 reduction software (Bradstreet 1993). The initial set of parameters was the same as in Robb (1992). We arrived at the following elements: $q = 0.18$, fillout factor 0.40 and inclination of 78.3 degrees in a good agreement with the previous solution. The temperatures were adopted to be $T_1 = 5500$ K and $T_2 = 5300$ K, which seems us to be more consistent with G5 spectral type. The computed light curve based on these new elements is compared with our measurements in Figure 2, the geometrical representation of HV Aqr at phase 0.25 is displayed in Figure 3.

Acknowledgement. This work has been supported in part by the Grant Agency of the Czech Republic, grant No. 205-99-0225

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BV PHOTOMETRY OF THE BINARY STAR VW LMi

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e-mail: alex@roastro.astro.ro

Name of the object:
VW LMi = HIP 54003 = HD 95660

Equatorial coordinates:	**Equinox:**
R.A.= $11^{\mathrm{h}}02^{\mathrm{m}}51\overset{\mathrm{s}}{.}9$ **DEC.=** $30^\circ 24' 54\overset{\prime\prime}{.}5$	2000.0

Observatory and telescope:
Astronomical Institute of the Romanian Academy, 0.5-m $f/15$ Cassegrain reflector

Detector:	EMI 9502B type photomultiplier
Filter(s):	B and V
Comparison star(s):	HD 95977, SAO 62390
Check star(s):	HD 94883
Transformed to a standard system:	No

Availability of the data:
Upon request

Type of variability:	EW

Remarks:

VW LMi (HIP 54003, HD 95660) was found to be a variable star by the Hipparcos/Tycho mission. The Variability Annex of the Hipparcos Catalogue (ESA 1997) reports VW LMi to have a period of $0\overset{\mathrm{d}}{.}477547$, with Hp magnitude ranging between 8.031 to 8.446. The star was classified as a W UMa eclipsing binary type. The spectral type is listed as F3V. Up to the present, no observations can be found in literature. Nine nights of data were obtained between 15 April 1999 and 9 May 2000. The filters used are in close accordance with the UBV Johnson system. From the light curves produced, four times of minimum light (one primary and three secondaries) were determinated. These times, given in Table 1, are calculated according to the method described by Kwee and van Woerden (1956). The phased light curves were obtained using the ephemeris

$$\mathrm{Min.\ I} = \mathrm{HJD}\ 2451635.3084 + 0\overset{\mathrm{d}}{.}477547 \times E.$$

Table 1

Min HJD 2400000.0 +	Type	Epoch
51288.3670	Secondary	−726.5
51617.3998	Secondary	−37.5
51635.3084	Primary	0.
51671.3594	Secondary	75.5

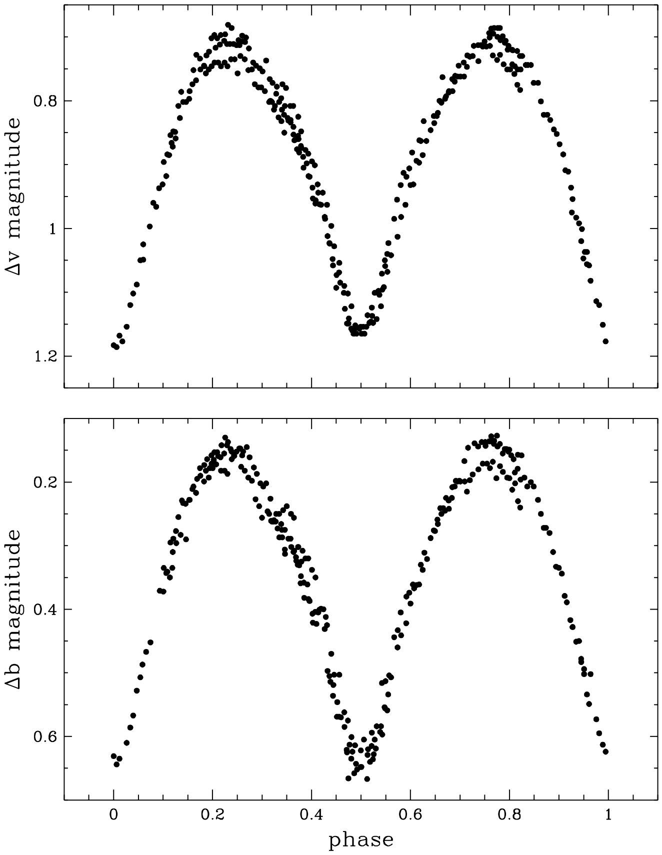

Figure 1.

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Kwee, K.K. and van Woerden, H, 1956, *BAN*, **12**, 327
ESA, 1997, The Hipparcos Catalogue, ESA SP-1200

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UBV OBSERVATIONS OF AG Dra IN THE END OF THE LATEST ACTIVE PHASE AND AFTER IT

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The photometric history of the symbiotic star AG Dra includes many active phases separated by quiescent periods, which are characterized with an U colour orbital variability whose amplitude is about one magnitude. This variability is supposed to be due to an occultation of a bright nebular region by the cool giant in the system (Mikolajewska et al. 1995, Friedjung et al. 1998). The last active phase was characterized by five rapid brightenings realized every year from 1994 to 1998 (Petrik & Hric 1994, Skopal & Chochol 1994, Montagni et al. 1996, Petrik et al. 1998, Tomova & Tomov 1998). Their amplitudes were about one magnitude in the V band and reached up to four magnitudes in the U band. In this note we present new UBV photometric data acquired during the latest eruption in 1998 and after it, when the brightness gradually reached its quiescent values.

Table 1: Photometric observations of AG Dra

JD − 2450000	n	V	B	U	JD − 2450000	n	V	B	U
828.7	2	9.790	11.176	11.566	1357.3	3	9.728	11.097	11.525
865.7	3	9.707	11.103	11.429	1401.3	3	9.702	11.094	11.460
866.6	3	9.713	11.089	11.433	1404.3	3	9.708	11.061	11.442
867.6	4	9.728	11.098	11.418	1408.3	2	9.715	11.101	11.469
877.6	3	9.725	11.089	11.402	1437.3	3	9.766	11.150	11.422
1007.5	2	9.659	10.828	10.195	1509.2	1	9.713	11.097	11.338
1015.4	3	9.621	10.680	10.023	1510.2	1	9.702	11.087	11.324
1027.3	2	9.410	10.334	9.389	1581.6	3	9.758	11.120	11.112
1087.2	2	9.643	10.764	10.181	1626.5	4	9.753	11.088	11.026
1088.2	2	9.628	10.777	10.222	1627.5	4	9.740	11.090	11.011
1226.6	3	9.747	11.148	11.402	1715.4	3	9.822	11.222	11.320
1239.6	3	9.754	11.135	11.407	1716.5	2	9.833	11.235	11.343
1293.4	3	9.818	11.219	11.513	1718.5	2	9.823	11.220	11.362
1298.4	4	9.797	11.217	11.518	1721.4	3	9.827	11.240	11.379
1332.4	3	9.794	11.190	11.527					

Three colour UBV photometry of AG Dra was obtained during January 1998–June 2000 (Table 1) with a single channel photoelectric photometer, mounted at the Cassegrain focus of the 0.6-m telescope of the National Astronomical Observatory Rozhen. The comparison stars and the accuracy of the measurements were the same like those presented in the work of Tomova & Tomov (1998). To consider our quiescent data we used the ephemeris $\mathrm{JD}(U_{\mathrm{min}}) = 2\,442\,514.4 + 552.4 \times E$ of Skopal and Chochol (1994). The zero epoch is that of the photometric minimum, when the cool giant is in front of the hot component.

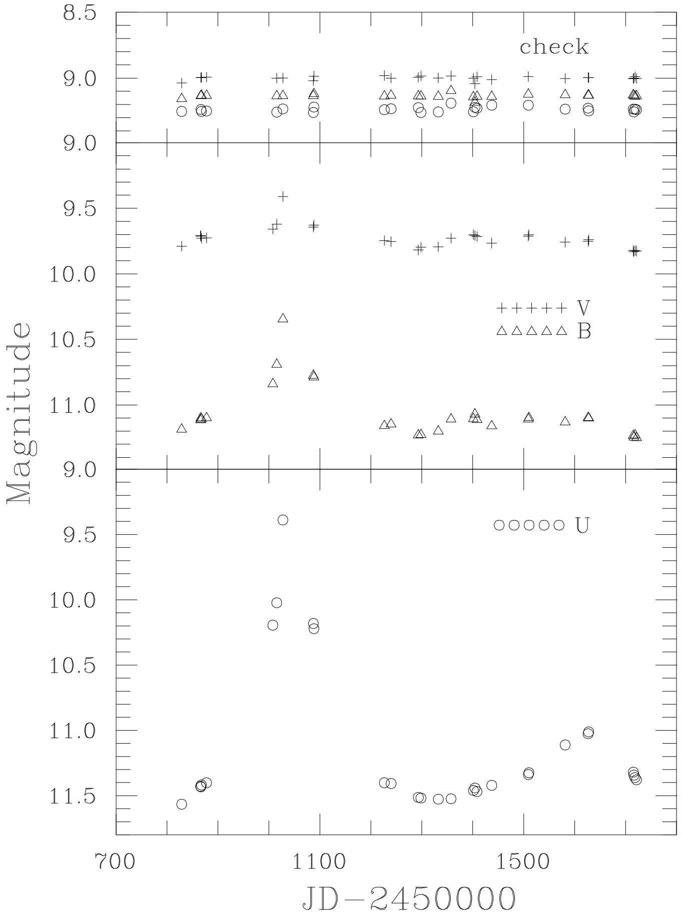

Figure 1. The UBV light curves of AG Dra

Figure 1 gives the three-colour light curve of AG Dra during the time of the observations. It is seen that the brightening of the star in 1998 is followed by a period of quiescence when the light in the B and V spectral regions reached its typical values during quiescent state. At that time the variations of the U light were probably determined by the orbital motion, since the smallest and greatest values are at the epochs of the orbital photometric minimum and maximum. Our data are not complete during the eruption, but they show that the light varied in all the colours and the amplitude of the variation was larger for the shorter wavelengths. The variation of the U magnitude indicates an increase by a factor of 4.8 of the light compared with the quiescent period before the 1994–1998 active phase. The B and V increase factors are 2.0 and 1.3.

The brightness at the time of the orbital minimum is greater than the brightness at the orbital minima during the quiescent stage before 1994 (Hric et al. 1993, Hric et al. 1994). Its increased value is determined by the greater number of the recombinating ions in the circumbinary nebula. Tomov et al. (2000) considered the U orbital variations of AG Dra during quiescence. They came to the conclusion that the whole circumbinary nebula of this system is an ionized region (except the portion occulted by the cool star) as its hot stellar component is very luminous. Consequently, the growth of the luminosity alone will not lead to an increase of the number of the recombinating ions. It can be caused by a growth of the mass-loss rate of the giant star (Friedjung et al. 1998), and because of a mass outflow by the hot component during the active phase as well. On the other hand, there are no pronounced minima on the B and V light curves at the epoch of this orbital minimum, which is due to the different pattern of variability of the light of AG Dra in the region of these photometric systems (Bastian 1998, Friedjung et al. 1998).

The authors thank their colleague Dr. R. Zamanov for his helpful modification of the processing software.

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CCD LIGHT CURVE AND REVISED PERIOD FOR THE RRc VARIABLE AP SERPENTIS

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Name of the object:
AP Ser = AN 34.1935 = GSC 920.002 = HIP 74556

Equatorial coordinates:	**Equinox:**
R.A.= $15^h14^m01^s$ **DEC.=** $+09°58'52''$	2000.0

Observatory and telescope:
Private observatory, Schlüsselacher, Wald, 0.15-m refractor

Detector:	SBIG ST-7 CCD camera

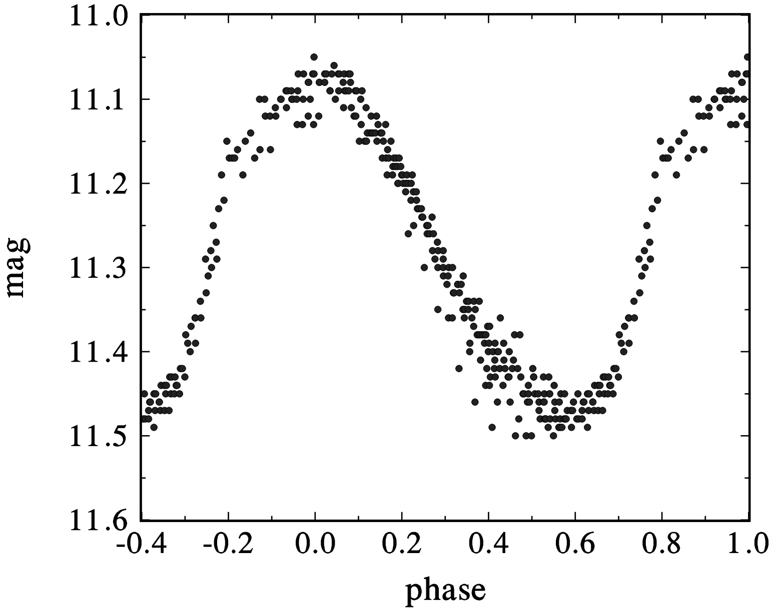

Figure 1. CCD light curve (without filter) of AP Ser

Filter(s):	None

Comparison star(s):	GSC 923.1074

Check star(s):	GSC 923.1281

Availability of the data:
Upon request from blaettler-wald@bluewin.ch

Type of variability:	RRc

Remarks:
The well known RRc variable AP Serpentis, discovered by Hoffmeister (1935), has been reobserved with our CCD equipment as mentioned above. During 8 nights between JD 2451697 and JD 2451724 a total of 312 measurements were secured. AP Ser is the brighter, north-eastern star in a close double. In our aperture photometry, both components of the pair were included in the diaphragm. In the the Digital Sky Survey, the brightness of the companion can be estimated to be about 15.0 mag (photographic). Figure 1 shows our observations folded with a period of $0\overset{d}{.}340853$, the best value for the representation of our data. This value is considerably shorter than the one given by de Bruijn and Lub (1985; $0\overset{d}{.}341320$), determined from *VBLUW* photometry secured in 1975, and slightly longer than the period derived from the Hipparcos satellite photometry (http://astro.estec.esa.nl/Hipparcos/), $0\overset{d}{.}340805$. Neither of these earlier period values yield light curves of acceptable quality from our data. We have fitted the earlier photometry of AP Serpentis (Varsavsky, 1960; Peña et al., 1990) with our period value and find both sets to be very well representable by it. Due to the rather long time gaps between the available sets of observations, it is not possible to assign cycle numbers unequivocally. A period of $0\overset{d}{.}340852$ brings the two latest sets in very good agreement, but fails to do so for the earliest set (Varsavsky, 1960). The most likely reason for this being a slight lengthening of the period value of AP Ser over the course of the last 40 years.

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1432–0033: A NEW ECLIPSING SU UMa-TYPE DWARF NOVA

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The object LBQS 1432–0033 was detected as a cataclysmic variable (CV) of unknown type by C. Berg during the course of his QSO (Quasi Stellar Objects) spectroscopic survey (Berg et al. 1992). He reported 1432–0033 at a quiescent magnitude of $B = 18\overset{m}{.}5$, and showing typical emission lines. He also was the first to point out the resemblance to the dwarf novae HT Cas and U Gem. The J2000.0 coordinates for 1432–0033 are $\alpha = 14^h35^m00\overset{s}{.}14$, $\delta = -00°46'07\overset{''}{.}0$ (Downes et al. 1997), while astrometry by Henden (2000) yields a position of $\alpha = 14^h35^m00\overset{s}{.}24$, $\delta = -00°46'05\overset{''}{.}8$ (J2000.0).

Here we report differential time-series photometry of 1432–0033 during the June 2000 outburst, by two observatories from the Center for Backyard Astrophysics. We detected superhumps with a period of $0\overset{d}{.}078 \pm 0\overset{d}{.}002$ and also found eclipses in 1432–0033, yielding an orbital period of $0\overset{d}{.}07273 \pm 0\overset{d}{.}00001$. Our observations firmly establish 1432–0033 as a genuine eclipsing SU UMa-type dwarf nova.

The first detected outburst of 1432-033 was observed visually by Stubbings (1999a) on 1999, May 10.446 UT with a reported magnitude of $m_v = 15.0$. The outburst, presumably a superoutburst, lasted at least 10 days (Stubbings 1999b). A next outburst was reported by Schmeer (2000), who found the object around $14\overset{m}{.}5$ on unfiltered CCD images taken with the Iowa Robotic Observatory (IRO 2000) telescope on 2000, April 06.378 UT. While 1432–0033 was still faint on an image taken on April 04.378 UT, it was clearly rising on April 05.376 UT. This outburst was probably a normal, faint outburst, as indicated by visual observations (Pearce 2000). 1432–0033 was again reported in outburst at a visual magnitude of $m_v = 14.9$, on 2000, June 24.419 UT (Stubbings 2000). For the first time, this outburst was monitored intensively by CCD photometry, the results of which are discussed below.

The shortest likely interval between outbursts of 1432–0033 is about 79 days. The maximum superoutburst cycle, derived from the above observations, is about 411 days, although there is a high likelihood that the true supercycle value will be smaller. More intensive monitoring of 1432–0033 will be required to further refine this value. The outburst amplitude is about 4 magnitudes.

Upon notification of the outburst of 1432–0033, a small observing campaign was launched by the Center for Backyard Astrophysics (CBA). The CBA is a multi-longitude network of professional and amateur astronomers (Patterson 1998), who study periodic

Table 1: Log of photometry

UT Date	JD Start[1]	Length (hr)	Telescope[2]	Points
26 June 2000	1722.4075	2.33	1	74
28 June 2000	1724.4007	2.09	1	47
29 June 2000	1724.9994	0.95	2	111
30 June 2000	1725.7665	5.89	2	612

[1] 2,450,000 +

[2] (1) = CBA Belgium, 0.35-m; (2) = CBA Pakuranga, 0.25-m

phenomena in cataclysmic variables. Target campaigns and results of the CBA are regularly reviewed on the CBA Web site (http://www.astro.bio2.edu/cba). The CBA campaign on 1432–0033 accumulated 11.3 hours of coverage over 4 nights and 844 datapoints. Details are listed in Table 1.

Time-resolved and differential (variable − comparison) CCD photometry of 1432–0033 was started at CBA Belgium on June 26, 2000, using a 0.35-m $f/6.3$ Schmidt–Cassegrain telescope, mounted on an AstroTechniek FM-98 German equatorial mount, and equipped with an SBIG ST-7 CCD camera (Kodak KAF-0400 CCD for imaging and Texas Instruments TC211 CCD for guiding). For a complete description of the CBA Belgium Observatory equipment and software, see Vanmunster et al. (2000). We used GSC 4984 691 ($12\overset{\mathrm{m}}{.}7$) as the comparison star, whose constancy was confirmed by other check stars. Camera control, telescope guiding and photometric imaging were all done using *MaxIm DL/CCD* (Cyanogen Productions Inc.). Images were stored as FITS files and were corrected for standard debiasing and flat fielding. Data reduction was completed using the profile fitting algorithm (PSF) of *MIPS* (Buil et al. 1993), immediately following image acquisition, allowing incoming observations of 1432–0033 to be monitored in a quasi-real-time mode. This approach revealed the real-time development of superhumps in the system and allowed the immediate classification of the object as a new SU UMa-type cataclysmic variable (Vanmunster 2000).

Further observations at CBA Belgium and CBA Pakuranga were obtained over the next nights (Table 1), allowing a more detailed analysis of the superhump period. After removing linear trends in the light curve, we performed a period analysis using the Phase Dispersion Minimization PDM method (Stellingwerf 1978). The resulting theta diagram is shown in Figure 1. The best superhump period is $0\overset{\mathrm{d}}{.}078 \pm 0\overset{\mathrm{d}}{.}002$. Given the rather limited amount of observations and the baseline of 5 nights only, we could not derive a more accurate superhump period value. The superhump full amplitude was about $0\overset{\mathrm{m}}{.}2$.

Next to the detection of superhumps, we also found eclipses in 1432–0033, as shown in Figure 2, that depicts CBA Pakuranga observations between JD 2451725.77 and JD 2451726.01. Observations at this observatory were made with a 0.25-m $f/10$ Schmidt–Cassegrain telescope and SBIG ST-6 CCD camera. There are only a very limited number of SU UMa-type cataclysmic variables exhibiting eclipses. Yet, they provide the unique opportunity to reconstruct the brightness distribution of the accretion disk from the observed light curve, and to study the evolution of the accretion disk structure over time. Eclipses in 1432–0033 had a more or less symmetric profile and an average duration of 23 minutes. The eclipses showed an average depth of 0.6–0.7 magnitudes.

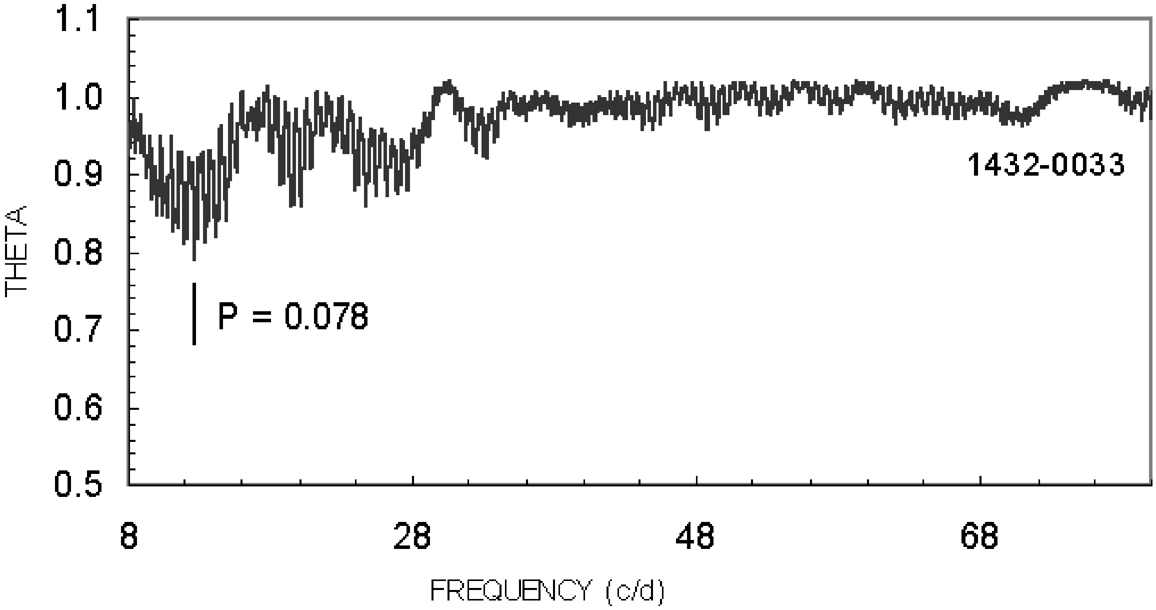

Figure 1. Period analysis of 1432–0033.

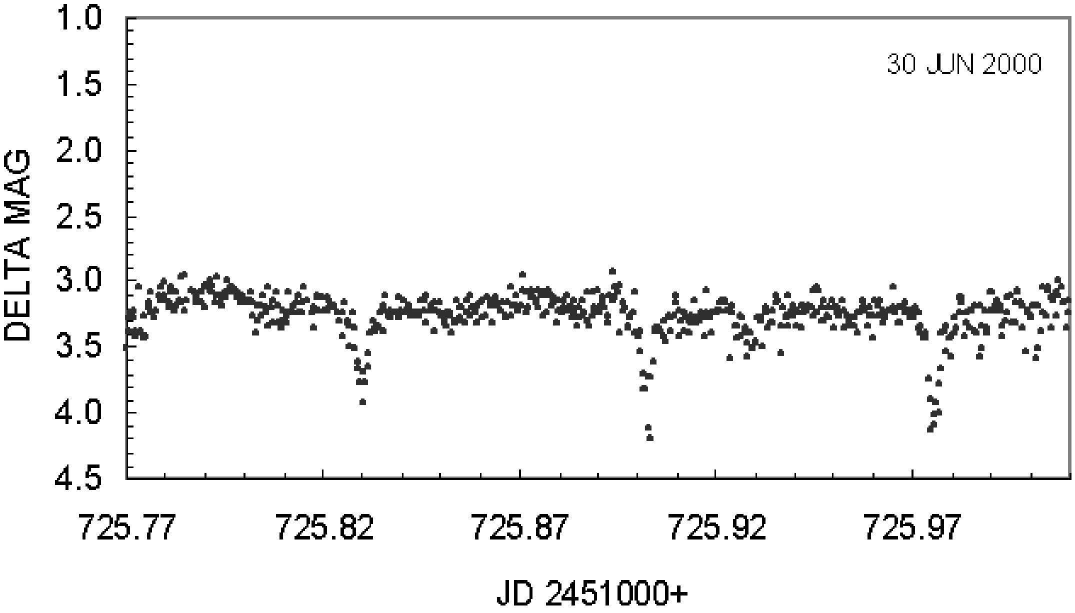

Figure 2. Eclipses in the light curve of 1432–0033.

Over the course of the outburst, we were able to make 6 useful mid-eclipse timings of 1432–0033. From these, we derived an orbital period of $0\overset{d}{.}07273 \pm 0\overset{d}{.}00001$. We also derived a heliocentric mid-eclipse ephemeris :

$$\begin{aligned} T = \mathrm{JD}\ 2451725.03349 &+ 0\overset{d}{.}072727 \times E \\ \pm 0.00053 &\pm 0.000013 \end{aligned}$$

where E is the cycle number.

The superhump excess value $\varepsilon = (P_{\rm sh} - P_{\rm orb})/P_{\rm orb}$, where $P_{\rm sh}$ and $P_{\rm orb}$ denote the superhump and orbital period, respectively, is 7.8 percent. Knowing that typical ε values are around 2 to 3 percent, the high ε value for 1432–0033 is likely to be explained by the uncertainty of the $P_{\rm sh}$ value.

A next superoutburst of 1432–0033, hopefully during a better visibility season, will probably allow a more accurate determination of the superhump period (and hence the ε), and in addition, provides a great opportunity to study the eclipses and accretion disk structure in full detail.

Acknowledgements. We are grateful to the Center for Backyard Astrophysics for their continuous support in our stellar CCD photometry research work.

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FIRST DETERMINATIONS OF PHOTOELECTRIC MINIMA, REAL PERIOD AND STUDY OF THE PERIOD OF NP Pav

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NP Pav was discovered by Hoffmeister (1949) who published a finder chart (1957). Shaw and Sievers (1970) found that it is an EA object, with a period of $1\overset{d}{.}266821$ and a deep secondary minimum. They also published a list of minima and a finder chart.

We present here the first photoelectric determinations of minima of the eclipsing binary NP Pav = S 5117 = KSP 5263 = BV 1305 = GSC 9321:1055. The observations were made during three runs, all from Cerro Tololo Inter-American Observatory[1] in Chile with the Lowell telescope and single-channel photon counting techniques and standard UBV filters. In 1982 and 1984 a refrigerated phototube EMI 2070 was used while in 1995 a refrigerated phototube RCA 31034A was utilized. GSC 9308:1513 = CPD $-69°3134$ ($9\overset{m}{.}6$) served as the comparison and GSC 9321:1105 = CPD $-69°3146$ ($6\overset{m}{.}7$) = CoD $-69°1958$ ($7\overset{m}{.}1$) = SAO 254907 = HD 198971 (B9/9.5V $6\overset{m}{.}9$) as the check.

The photoelectric light curve is completed in the three filters U, B and V. It is presented in Figure 1 together with their color index curves $u-b$ and $b-v$. The light curve shows a shallow secondary minimum of $0\overset{m}{.}225$ depth in V, therefore the period must be reduced to half of the value. The depth of the primary minimum is $1\overset{m}{.}075$ in V. The eclipse is almost complete and the portion of the light curve that is included into the eclipse is measured by the external tangent angle that is 0.12 in phase units. The $b-v$ color is somewhat redder by about $0\overset{m}{.}025$ in V around the primary minimum and bluer for the same amount around the secondary minimum. Outside the minima the light curve is not constant showing the proximity effects.

The photographic minima were scaled to the new period and a dispersion of 0.02 incorporated to all of these minima. The linear solution is Min I = HJD 2438234.4014 + $0\overset{d}{.}6334113 \times E$ with an error of $0\overset{d}{.}0042$ for the day and $0\overset{d}{.}0000027$ for the period. Two sets of photoelectric minima, one of only one minimum in 1984 and the other with six minima in 1995, were derived by the polynomial line method (Guarnieri et al. 1975, Ghedini 1982). A least square solution for the photoelectric times of minima gives:

$$\begin{aligned}\text{Min I} = \text{HJD } 2445984.7095 &+ 0\overset{d}{.}63353658 \times E \\ \pm 0.0011 &\pm 0.00000020 \text{ m.e.,}\end{aligned} \tag{1}$$

without a term of the second order, in other words, the period in the photoelectric part has remained in first approximation constant. In Table 1 are shown the photoelectric minima,

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[1] NOAO with is operated by AURA Inc. under cooperative agreement with the NSF

Table 1: Times of photoelectric minima and residuals for linear ephemeris of NP Pav

Min.	Band	HJD(sigma) 2400000 +	E	$O-C$
I	U	45984.7094(0.0010)	0.0	−0.0001
I	B	45984.7093(0.0012)	0.0	−0.0002
I	V	45984.7098(0.0014)	0.0	0.0003
II	U	49945.9004(0.0037)	6252.5	0.0035
II	B	49945.8995(0.0028)	6252.5	0.0026
II	V	49945.8995(0.0026)	6252.5	0.0026
I	U	49946.8478(0.0010)	6254.0	0.0006
I	B	49946.8476(0.0012)	6254.0	0.0004
I	V	49946.8478(0.0011)	6254.0	0.0006
II	U	49947.7943(0.0027)	6255.5	−0.0032
II	B	49947.7974(0.0011)	6255.5	−0.0001
II	V	49947.7963(0.0017)	6255.5	−0.0012
I	U	49948.7495(0.0011)	6257.0	0.0016
I	B	49948.7491(0.0014)	6257.0	0.0012
I	V	49948.7487(0.0021)	6257.0	0.0008
I	U	49951.9113(0.0038)	6262.0	−0.0042
I	B	49951.9108(0.0018)	6262.0	−0.0047
I	V	49951.9108(0.0012)	6262.0	−0.0047
II	U	49959.8388(0.0026)	6274.5	0.0041
II	B	49959.8357(0.0016)	6274.5	0.0010
II	V	49959.8354(0.0011)	6274.5	0.0007

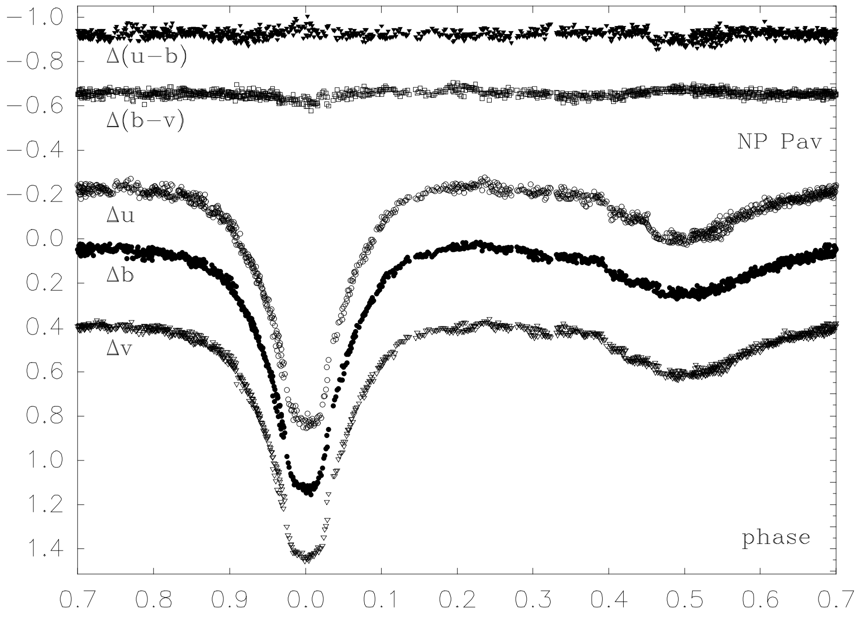

Figure 1. Complete light and color curve of NP Pav. The vertical scale corresponds to δv, the shifts are: $\delta b = -0.402$, $\delta u = -0.651$, $\delta(b-v) = -0.711$, $\delta(u-b) = -0.898$

Table 2: Times of minima and residuals for parabolic and linear ephemeris of NP Pav

Ref.	Min.	Band	HJD(sigma) 2400000 +	E	$O-C$	$(O-C)'$
1	I	pg.	38234.4080(0.0200)	−12236.0	−0.0037	0.0082
1	I	pg.	38258.4520(0.0200)	−12198.0	−0.0289	−0.0176
1	I	pg.	38260.3610(0.0200)	−12195.0	−0.0201	−0.0088
1	I	pg.	38307.2330(0.0200)	−12121.0	−0.0198	−0.0095
1	I	pg.	38314.2310(0.0200)	−12110.0	0.0108	0.0209
1	I	pg.	38555.5490(0.0200)	−11729.0	0.0029	0.0080
1	I	pg.	38562.5120(0.0200)	−11718.0	−0.0015	0.0035
1	I	pg.	38614.4370(0.0200)	−11636.0	−0.0155	−0.0115
1	I	pg.	38614.4650(0.0200)	−11636.0	0.0125	0.0165
1	I	pg.	38621.4280(0.0200)	−11625.0	0.0081	0.0120
1	I	pg.	38640.3980(0.0200)	−11595.0	−0.0239	−0.0204
1	I	pg.	38642.3110(0.0200)	−11592.0	−0.0111	−0.0077
1	I	pg.	38649.3110(0.0200)	−11581.0	0.0215	0.0248
1	I	pg.	38675.2400(0.0200)	−11540.0	−0.0190	−0.0162
1	I	pg.	38694.2500(0.0200)	−11510.0	−0.0110	−0.0086
1	I	pg.	39029.3330(0.0200)	−10981.0	0.0027	−0.0010
1	I	pg.	39373.2820(0.0200)	−10438.0	0.0148	0.0054
1	I	pg.	39378.3280(0.0200)	−10430.0	−0.0064	−0.0159
1	I	pg.	39385.3340(0.0200)	−10419.0	0.0322	0.0226
1	I	pg.	40089.0310(0.0200)	−9308.0	0.0203	0.0010
1	I	pg.	40096.0070(0.0200)	−9297.0	0.0289	0.0095
1	I	pg.	40419.0310(0.0200)	−8787.0	0.0182	−0.0048
1	I	pg.	40450.0620(0.0200)	−8738.0	0.0126	−0.0107
2	I	U	45984.7094(0.0010)	0.0	−0.0006	−0.0001
2	I	B	45984.7093(0.0012)	0.0	−0.0007	−0.0002
2	I	V	45984.7098(0.0014)	0.0	−0.0002	0.0003

References: 1 photographic minima; 2 photoelectric minimum of 1984.

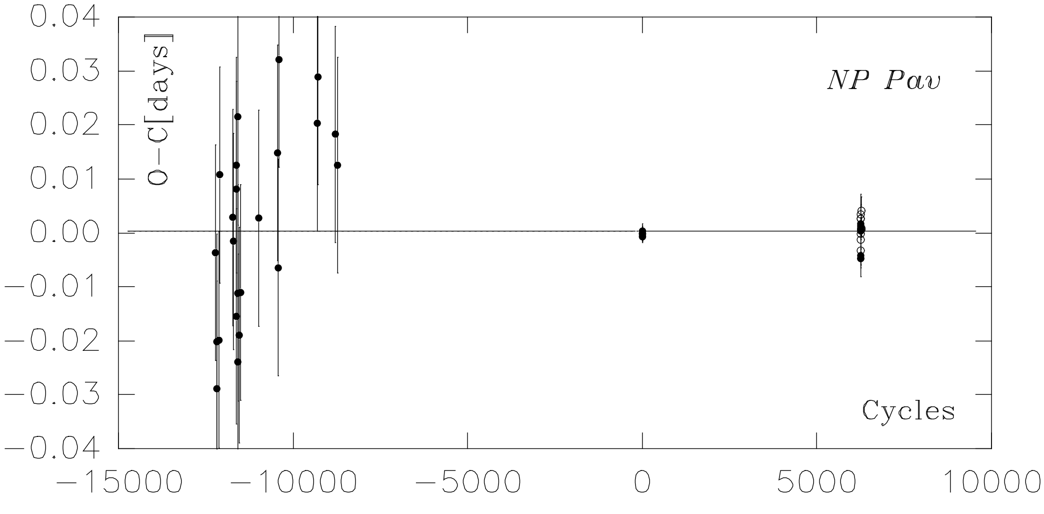

Figure 2. Behavior of the $O-C$ residuals for NP Pav from formulae (1) and (2). Hollow circles stand for primary minima, vertical bars are for errors

the dispersion associated with each minimum, the epoch numbers and the $O-C$ residuals respect to (1). It was not possible to find a common solution for both the photographic and the photoelectric minima. The photographic and the 1984 photoelectric minima gives the following formula:

$$\begin{array}{rlll} \text{Min I} = \text{HJD } 2445984.7095 & + \, 0\overset{\text{d}}{.}6333894 \times E & - \, 1\overset{\text{d}}{.}04 \times 10^{-9} \times E^2 \\ \pm \, 0.0019 & \pm \, 0.0000030 & \pm \, 0.26 \times 10^{-9} \end{array} \qquad (2)$$

which is quadratic. This is shown in Table 2 that is similar to Table 1, where the $O-C$ and $(O-C)'$ are the residuals respect to the linear and parabolic solution.

Although comparing the periods of the photographic solution ($0\overset{\text{d}}{.}6334113[27]$) with that corresponding to the photoelectric solution ($0\overset{\text{d}}{.}63353658[20]$) the period varies and the second order term in (2) is not negligible, the large errors of the $(O-C)'$ values implies, that the quadratic fit seems to be not reliable (suggested by a referee). We consider that in a first approximation the period has remained constant during all the 'history' of this system. The formula (1) that is all photoelectric is to be used for derive new times of minima. The $O-C$ diagram is displayed in Figure 2.

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NOVA CI AQUILAE IN DECLINE

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The first known outburst of CI Aquilae was discovered on Heidelberg plates recorded in June 1917 (Reinmuth 1925) and classified as a possible nova by Dürbeck (1987). The measured maximum of the outburst was $m_{\mathrm{pg}} \approx 11^{\mathrm{m}}$ and thus rather low, but obviously the real maximum has been missed. Williams (2000) found, that this nova outburst had been recorded before on Harvard College Observatory patrol plates from 1917; he measured a maximum of $8^{\mathrm{m}}.6$.

On April 28, 2000 Takamizawa et al. (2000) discovered a probable nova in Aquila with $m_{\mathrm{V}} \approx 10^{\mathrm{m}}$ which seems to be identical with the 1917 nova. It reached its peak in the beginning of May at about $8^{\mathrm{m}}.7$, which is $7^{\mathrm{m}}.5$ above the quiescent phase (Szkody 1994). If no outbursts were missed between 1917 and 2000, CI Aql has the longest period (83 years) of all recurrent novae so far known.

We obtained near infrared photometries of this object using the DENIS instrument (Epchtein et al. 1997) at the ESO 1-m telescope in La Silla in the period from May 10 (about 12 days after outburst) to July 1, 2000. The images were taken simultaneously in all three bands Gunn-I (0.82 μm), J (1.25 μm) and K_s (2.15 μm). The exposure time of each image was 9 seconds in I and 11 seconds in J and K. Each band was observed with five to seven images while moving the source around in the field of view. This was used to eliminate errors due to local flatfield effects, and to be able to obtain the sky background using the iso-airmass median sky filtering. Thus, the intrinsic noise within one set could be reduced to $0^{\mathrm{m}}.01$. The fluxes of the nova and two nearby comparison stars were measured using the SExtractor software (Bertin & Arnouts 1996). The magnitudes of the nova were calculated relative to the two comparison stars, which were then calibrated using the DENIS online zero points. The difference of the measured magnitudes of the two comparison stars indicate the overall quality of the measurements. The errors are $0^{\mathrm{m}}.013$ in I, $0^{\mathrm{m}}.031$ in J and $0^{\mathrm{m}}.023$ in K.

Fig. 1 shows the light curve of CI Aql (a) in 1917 as measured from photographic plates, (b) in 2000 from visual data and (c) in 2000 from our NIR data, all in the same scale. In each of the three cases the abscissa covers a range of 120 days. The light curve (b) contains mostly data contributed to the AAVSO database by amateur astronomers (Mattei 2000). The filled symbols are photometries obtained using CCDs, the open symbols are visual estimates and can therefore contain significant errors. Especially after the end of July (MJD 51750), when the magnitude of the nova has fallen below 13^{m}, there is a pretty large straggling of the data. The light curve shows a rather slow decline compared to

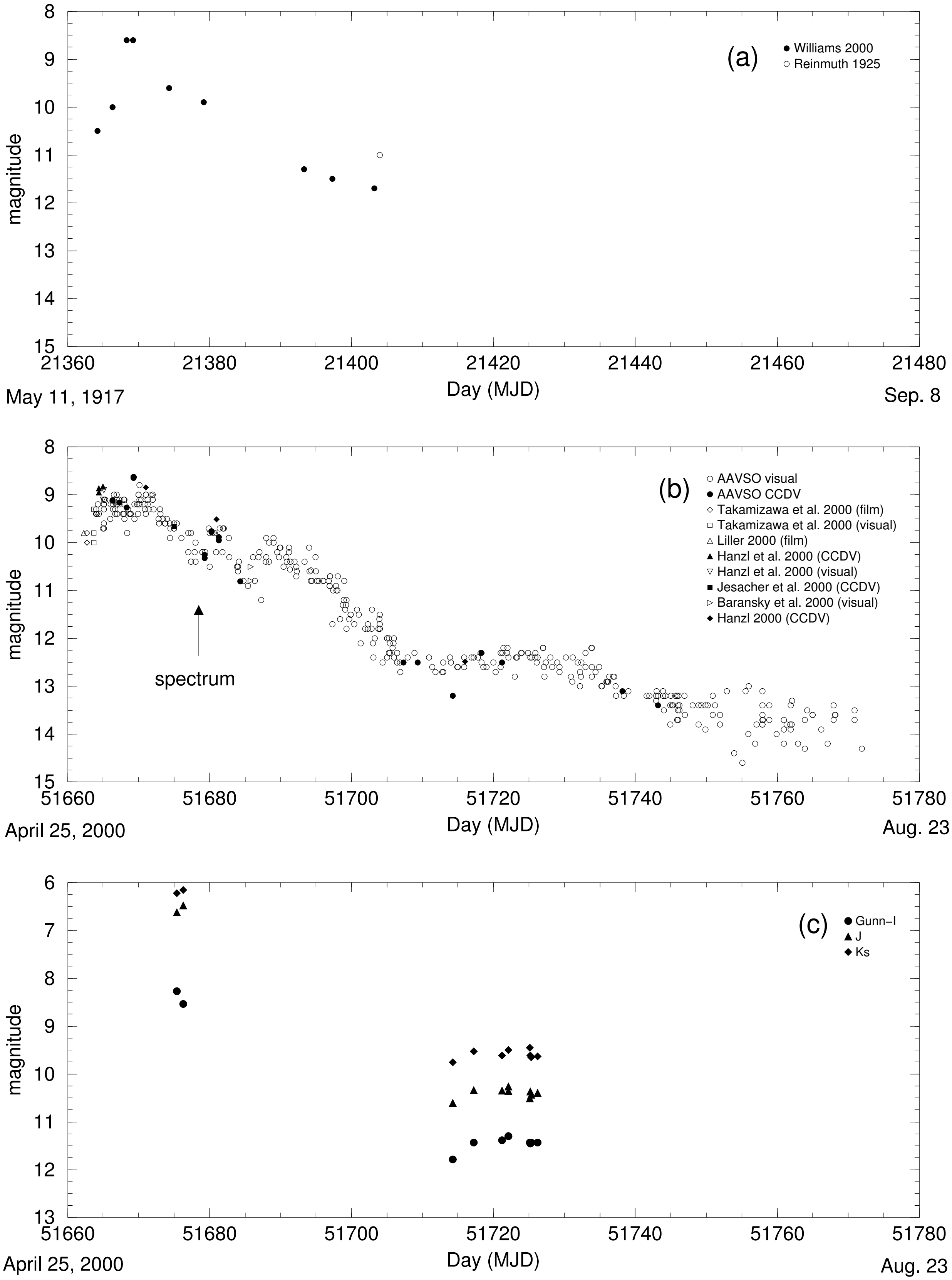

Figure 1. The light curve of CI Aql (a) in 1917, (b) 2000 in the visual, (c) 2000 in near-infrared

other recurrent novae ($t_2 \approx 25$ days). The NIR decline is of about the same order as the visual decline. On June 27 (MJD 51722) we took three sets of images in intervals of about 20 minutes, and we could not find any short-term variation with this period.

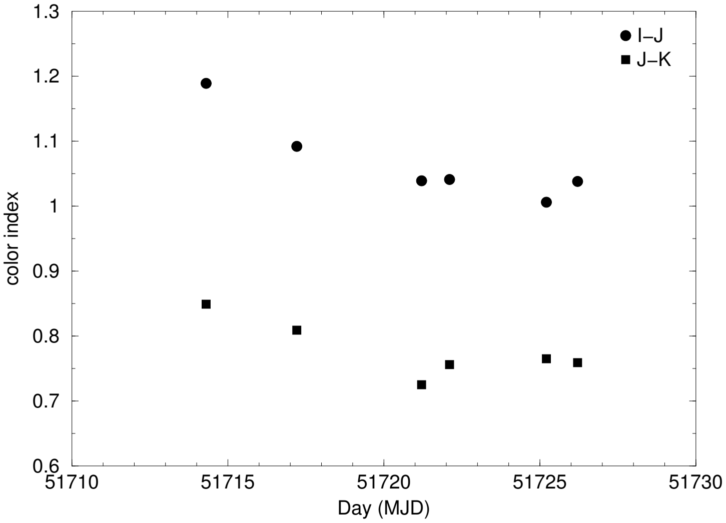

Figure 2. The color indices $I - J$ and $J - K$ of CI Aql between June 14 and July 4, 2000

While the nova gets bluer in $I - J$ (Fig. 2), the reddening in $J - K$ around June 25, 2000 (MJD 51720) may indicate the start of a dust formation episode. $J - K$ was about $0\overset{\mathrm{m}}{.}36$ on May 11/12. The decrease in $I - J$ is consistent with a recovery from the $0\overset{\mathrm{m}}{.}7$ dip in the visual (Fig. 1b) between MJD 51700 and 51720 caused by the formation of a dust shell. The increase of $J - K$ may be a sign of the onset of the formation of very hot dust particles causing the next dip in the visual light curve starting at MJD 51730. Using typical dust formation radii of 10^{11} m (Kimeswenger & Koller 2000), this gives an estimate for the velocity of the dust drift of a few hundreds of km/s.

Furthermore, we obtained a composite spectrum of CI Aql with the Innsbruck 60-cm telescope on May 14, 2000 (MJD 51679), about two weeks after the outburst of the nova (marked with an arrow in Fig. 1b). We took two or three spectra of every region with an exposure time of 1800 seconds each. The spectrograph was used with a grating of 240 lines/mm, giving a resolution of about 2.4 Å/pixel on the CCD. Different spectra of the same region show no differences, which indicates that the error is smaller than 10% of the continuum. Therefore, the various features at the emission lines are real and not caused by noise. The spectrum, shown in Fig. 3, shows a flat continuum from 4000 to 9000 Å and strong emission lines (1.5 to 9 times the continuum). The FWHM range from 3400 km/s (in case of H_α) up to 7400 km/s (in case of [NII]). The emission line profiles vary significantly between the different species: the lines with higher velocities are asymmetrical and show multiple peaks, the lines with lower velocities exhibit a single asymmetric peak.

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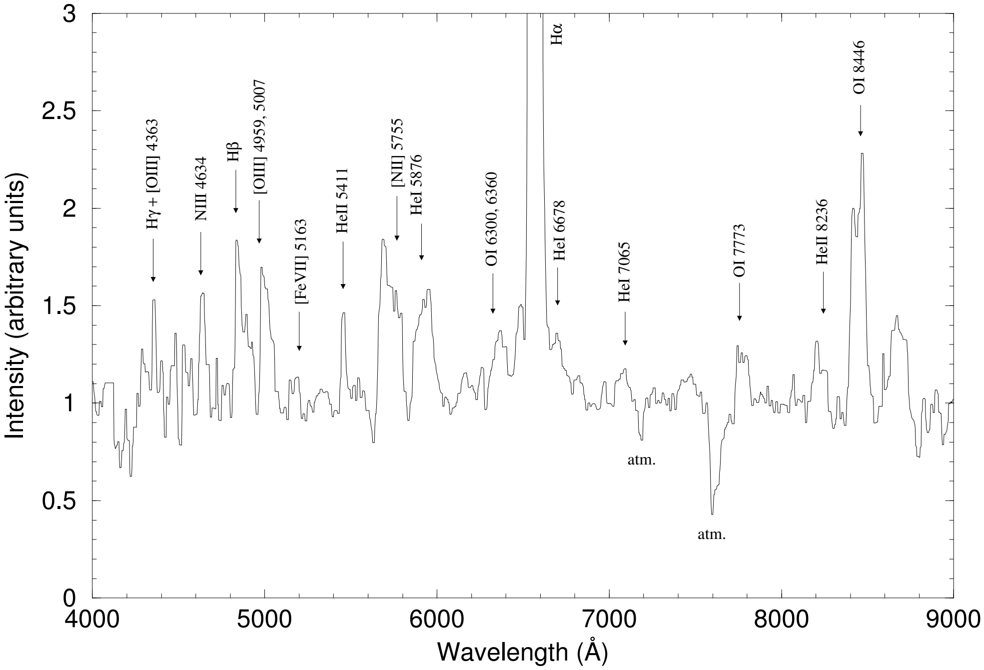

Figure 3. Composite spectrum of CI Aql taken on May 14, 2000

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ON THE VARIABILITY OF EARLY K STARS

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Adelman & Albayrak (1997), Adelman, Cay, Cay & Kocer (2000), Adelman, Yüce & Engin (2000) using the Hipparcos photometry (ESA 1997) of the O, B, A, and F supergiants in the Bright Star Catalogue, 5th edition (Hoffleit & Warren 1991) and the Supplement of the 4th edition (Hoffleit et al. 1983), confirmed that the variability of supergiants increase with luminosity (Maeder 1980) and identified some apparently quiescent stars particularly among those of luminosity class II. To more completely examine the domains of stellar variability, this study is being extended. Here I study the K0–K4 stars which include BY Draconis stars, Cepheids, Algols, β Lyrae type binaries, rotating ellipsoidal variables, FK Comae Berenices type variables, RS Canum Venaticorum stars, slow irregular variables, RV Tauri stars, and semiregular variables as well as microvariables and many stars which need additional observations to determine their variability type as well as constant stars.

Table 1 gives the mean amplitudes of various spectral types which have at least 3 class members. I excluded stars with spurious variability due to duplicity. These values are indicative of the mean variability and useful for determining the relative variability when comparing with other spectral types. For example, the luminosity class II values are similar to those for A and F II stars given by Adelman, Cay, Cay & Kocer (2000). At the top are supergiant class averages. Maeder (1980)'s peak to peak V amplitudes are $0\overset{\mathrm{m}}{.}066$ for K0–K9 Iab stars, $0\overset{\mathrm{m}}{.}028$ for K0–K9 Ib stars, and $0\overset{\mathrm{m}}{.}028$ for K0–K9 II stars, values in good agreement for the luminosity II stars with poorer agreement for the remaining stars.

Table 2 (available electronically from the IBVS Web-site as 4958-t2.txt and 4958-t2.tex) lists the values for the individual stars including those which were not used in compiling these values. It gives for each star the HR Number (if any), Names (Bayer, Flamsteed, and variable star designations), the V magnitude from the Bright Star Catalog and its Supplement, the spectral type, the Hipparcos number, the standard error (mag), the amplitude (mag), and comments (type of variable and some NSV numbers if there was not space in the second column). The Hipparcos photometry does not confirm the reported variability of some stars. In some cases this might indicate a change in the stellar behavior while in others it might reflect the quality of the previous photometry.

Table 3 contains selected stars whose amplitudes of variability are significantly larger than those of stars with the same spectral types, usually a factor of two larger than the type mean. Some are well-known variables. The K0–K4 stars are not particularly variable. There are a fair number of microvariables. Among the supergiants some are definitely variable, but most luminosity class II stars are about as variable as those of luminosity class III. The K4 Ib, II, and II–III class stars appear to be slightly more variable than the K0–K3 stars. Over time spans of longer than 3 years a larger fraction of the stars may well show variability. Still a fair percentage show amplitudes of $0\overset{\mathrm{m}}{.}01$ and $0\overset{\mathrm{m}}{.}02$ which is suggestive of constancy. The unresolved variables with amplitudes of order typically $0\overset{\mathrm{m}}{.}05$ need additional photometry to determine their type of variability.

Table 1: The mean amplitudes of various types of K0–K4 stars

Spectral Classes	Number	Mean Amplitude (mag)	Comment
K0Ib–K2Ib	12	0.129 ± 0.328	
	11	0.035 ± 0.009	without stars in Table 3
K2.5Ib–K4.5Ib	25	0.049 ± 0.031	
	22	0.039 ± 0.012	without stars in Table 3
K0Ib	3	0.590 ± 0.970	affected greatly by R Scl
K2Ib–II	4	0.035 ± 0.013	
K3Ib	11	0.040 ± 0.012	
K4Ib	3	0.057 ± 0.038	
K0II	9	0.019 ± 0.006	
K1II	10	0.024 ± 0.012	
K2II	12	0.026 ± 0.008	
K3II	16	0.027 ± 0.012	
K4II	3	0.043 ± 0.006	
K0II–III	23	0.026 ± 0.009	
K1–III	4	0.025 ± 0.010	
K2II–III	9	0.023 ± 0.009	
K3II–III	8	0.023 ± 0.005	
K4II–III	4	0.045 ± 0.913	
K0–III	11	0.018 ± 0.008	
K0III	327	0.025 ± 0.015	
K0.5III	31	0.024 ± 0.009	
K1–III	4	0.025 ± 0.010	
K1III	270	0.025 ± 0.008	
K1+III	7	0.020 ± 0.010	
K1.5III	23	0.023 ± 0.010	
K2–III	7	0.017 ± 0.005	
K2III	239	0.027 ± 0.015	
K2+III	3	0.017 ± 0.006	
K2.5III	50	0.024 ± 0.007	
K3–III	9	0.019 ± 0.006	
K3III	206	0.026 ± 0.008	
K3.5III	20	0.027 ± 0.008	
K4–III	4	0.025 ± 0.006	
K4III	152	0.029 ± 0.010	
K4.5III	15	0.031 ± 0.007	
K0III–IV	24	0.025 ± 0.007	
K1III–IV	17	0.026 ± 0.011	
K2III–IV	10	0.026 ± 0.007	
K0IV	33	0.025 ± 0.007	
K1IV	21	0.028 ± 0.014	
K0V	19	0.034 ± 0.019	
K1V	10	0.044 ± 0.021	
K2V	14	0.037 ± 0.015	
K3V	12	0.045 ± 0.050	
	11	0.031 ± 0.009	without BB Scl
K4V	4	0.040 ± 0.014	

Table 3: Some stars with amplitudes different than stars of similar spectral type

Name	HD No.	Spectral Type	HIP Number	SE (mag)	Amp. (mag)	Comments
QY Pup	63302	K1Ia–Iab	38031	0.0037	0.18	SRD
R Scl	173819	K0Ibp	92202	0.0417	1.17	RVA
BM Sco	160371	K2.5Ib	86527	0.0126	0.14	SRD
V340 Sge	185622	K4Ib	96688	0.0049	0.10	U
V809 Cas	219978	K4.5Ib	115141	0.0060	0.13	L
ζ And	4502	K1IIe	3693	0.0025	0.07	EB/GS
NSV 5068	95725	K1II	54024	0.0011	0.05	
	207119	K2.5II Ba0.2	107398	0.0019	0.05	U
NSV 6706	127753	K3II	71326	0.0020	0.05	
16 α Boo	124897	K1.5IIIFe-0.5	69673	0.0020	0.05	NSV 6603, U
	14890	K2III	11121	0.0014	0.06	U
QU Gem	49500	K2III*	32743	0.0102	0.18	U
	61026	K2III	36987	0.0012	0.05	
EE UMa	99967	K2IIICN-1	56135	0.0020	0.09	P
	128902	K2III	71568	0.0013	0.05	U
V350 Lac	213389	K2IIIe	111072	0.0047	0.13	ELL
	68763	K3III:	40160	0.0018	0.05	U
43 Leo	89962	K3III	50851	0.0019	0.05	
22 φ^3 Cet	5437	K4III	4371	0.0015	0.05	MV
	37171	K4III	26386	0.0021	0.06	U
V520 Car	93070	K4III	52468	0.0039	0.07	L
	126307	K4III	70385	0.0053	0.08	I
	161369	K4III	86713	0.0017	0.05	U
	178717	K4III:Ba4	94103	0.0017	0.05	MV
V1762 Cyg	179094	K1IV	94013	0.0037	0.08	NSV 11775, RS
V1386 Ori	41593	K0Ve	28954	0.0022	0.06	U
DX Leo	82443	K0V	46843	0.0065	0.09	BY
V762 Cas	7389	K1V	5926	0.0048	0.10	SR
DE Boo	131511	K2V	72848	0.0019	0.07	U
BB Scl	9770	K3V	7372	0.0024	0.20	EA

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ON THE VARIABILITY OF K5–M STARS

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Recently (Adelman 2000) examined the Hipparcos photometry (ESA 1997) of K0–K4 stars in the Bright Star Catalogue, 5th edition (Hoffleit & Warren 1991) and the 4th edition Supplement (Hoffleit et al. 1983). Many were not particularly variable. Here for comparison I examine the K5–M stars which include BY Draconis variables, eclipsing binaries, Algols, irregular variables, Miras, microvariables, small amplitude red variables, and semi-regular variables as well as many unsolved variables.

Table 1 presents the mean amplitudes of K5–M stars with 3 or more class members. Stars with spurious variability due to duplicity were omitted. Values are often recalculated omitting a star which significantly skews the average. Maeder (1980), who found that supergiant variability increases with luminosity, gave as mean values for V photometry $0\overset{\mathrm{m}}{.}213$ for M0–M2 Iab stars, $0\overset{\mathrm{m}}{.}028$ for K0–K9Ib stars, $0\overset{\mathrm{m}}{.}028$ for K0–K9II stars, and $0\overset{\mathrm{m}}{.}113$ for M0–M2Ib and II stars. The Hipparcos average values are $0\overset{\mathrm{m}}{.}308 \pm 0\overset{\mathrm{m}}{.}148$ for 10 M0–M3Iab stars, $0\overset{\mathrm{m}}{.}202 \pm 0\overset{\mathrm{m}}{.}200$ for 16 K5-M5Ib stars, and $0\overset{\mathrm{m}}{.}306 \pm 0\overset{\mathrm{m}}{.}512$ ($0\overset{\mathrm{m}}{.}208 \pm 0\overset{\mathrm{m}}{.}177$ without a Mira variable) for 24(23) K5–M6II stars. The discrepancies most likely reflect the choices of passbands and stars (see also Adelman 2000).

Except for the K5II, K5III, K6III, and K7III stars, the mean amplitudes are usually greater than those of K0–K4 stars whose values are typically of order $0\overset{\mathrm{m}}{.}02$ to $0\overset{\mathrm{m}}{.}03$. A few exceptionally stable stars with standard errors $\leq 0\overset{\mathrm{m}}{.}006$ and amplitudes $\leq 0\overset{\mathrm{m}}{.}02$ are the K5III stars HR 851, HR 2549, and HR 7541. The larger mean amplitudes were seen also for some K4 spectral types. Almost all M luminosity I, II, and III stars are certainly variable. Many currently unresolved variables with amplitudes of order $0\overset{\mathrm{m}}{.}05$ require further observation. For some stars, one can find evidence for longer term variability via comparison of the Hipparcos magnitudes with the Bright Star Catalog (and other published) V magnitudes. For example, VX Sgr and R Dra show large discrepancies much greater than produced by the use of different bandpasses.

Table 2 (available electronically from the IBVS Web-site as 4959-t2.txt and 4959-t2.tex) contains the values for the stars whose averages appear in Table 1 as well as those which were not used in compiling these values. Table 3 lists stars whose amplitudes of variability are significantly greater than those of other stars with similar spectral types; usually at least twice those of the average amplitude of the class. Although many have been classified, additional observations especially of those which are unresolved types are desirable. No Miras are included as they are usually well-known stars.

Table 1: The Mean Amplitudes of Various Types of K5 though M Stars.

Spectral Classes	Number	Mean Amplitude (mag)
K5Ib	5	0.060 ± 0.029
K5II	3	0.033 ± 0.006
M1II	3	0.083 ± 0.083
M3II	5	0.146 ± 0.111
M4II	4	0.302 ± 0.131
M5II	4	1.012 ± 1.046
	3	0.493 ± 0.156 without R Cen
M0II–III	4	0.060 ± 0.000
M2II–III	3	0.110 ± 0.096
M3II–III	4	0.170 ± 0.075
K5III	169	0.035 ± 0.026
K6III	5	0.034 ± 0.005
K7III	9	0.034 ± 0.014
K5–M0III	8	0.044 ± 0.012
M0–III	4	0.042 ± 0.032
	3	0.027 ± 0.000 without γ Phe
M0III	73	0.050 ± 0.059
	72	0.043 ± 0.021 without V341 Car
M0+III	3	0.043 ± 0.006
M0.5III	7	0.053 ± 0.014
M1III	86	0.062 ± 0.044
M1.5III	11	0.058 ± 0.031
M2III	94	0.083 ± 0.100
M2.5III	10	0.394 ± 1.000
	9	0.078 ± 0.041 without S Car
M3–III	6	0.107 ± 0.048
M3III	75	0.143 ± 0.181
	74	0.126 ± 0.097 without X Mon
M3+III	3	0.070 ± 0.000
M3.5III	11	0.130 ± 0.008
M4III	69	0.314 ± 0.718
	67	0.193 ± 0.120 without R Tri & T UMa
M4+III	3	0.140 ± 0.010
M4.5III	11	0.528 ± 0.992
	10	0.235 ± 0.206 without R Vir
M5 III	35	0.433 ± 0.661
	34	0.328 ± 0.235 without R Dra
M6III	16	1.042 ± 1.244
	13	0.478 ± 0.272 with 3 Mira variables
M6.5III	3	2.733 ± 2.207 includes 2 Mira variables
M7III	15	3.121 ± 1.411 includes 12 Mira variables
K5V	3	0.247 ± 0.375 61 Cyg A large contributor

Table 3: Some stars with amplitudes different than stars of similar spectral type

Name	HD No.	Spectral Type	HIP Number	SE (mag)	Amp. (mag)	Comments
VX Sgr	165674	M4Iae	88838	0.0643	1.31	SRC
TV Gem	42475	M0–1Iab	29416	0.0131	0.61	SRC
α^1 Her	156014	M5Ib–II	84345	0.0189	0.40	SRC
V959 Her	159968	M1II	86153	0.0083	0.18	SR
CI Boo	126009	M3II	70236	0.0064	0.34	LB
BO Mus	109372	M4II	61404	0.0125	0.43	LB
V2093 Cyg	187880	M4IIb	97651	0.0168	0.40	L
XY Lyr	172380	M4.5–M5+II	91373	0.0262	0.47	LC
T Cet	1760	M5IIe	1728	0.0334	0.66	SR
SV Crv	111499	M5II	62611	0.0288	0.47	SRB
AF Col	42682	M2II–III	29263	0.0059	0.22	U
	33872	K5III	24189	0.0017	0.07	U
	39853	K5III	27938	0.0016	0.06	U
V448 Car	49877	K5III	32531	0.0153	0.20	SR
	95314	K5III	53778	0.0014	0.06	U
QT Hya	99712	K5III:	55953	0.0048	0.09	SR
V918 Cen	102461	K5III	57512	0.0022	0.07	SR
AW CVn	120933	K5III	67665	0.0042	0.12	SR
CW CVn	121212	K5III	67803	0.0085	0.26	SR
	159881	K5III	86317	0.0019	0.08	U
γ Phe	9053	M0-IIIa	6867	0.0041	0.09	SR
CF Cet	402	M0III	696	0.0062	0.16	SR
BI Scl	9692	M0III	7330	0.0021	0.09	U
69 υ Gem	60522	M0III–IIIb	36962	0.0023	0.08	U
	62689	M0III	36982	0.0021	0.08	U
V341 Car	65750	M0III	38834	0.0292	0.52	L
	91056	M0III	51313	0.0032	0.08	L
NSV 7351	142804	M0III	78120	0.0037	0.09	I
RV Cae	28552	M1III	20856	0.0049	0.12	NSV 1615, I
SW Col	35515	M1III	25194	0.0057	0.33	LB:
SX Col	46431	M1III	31099	0.0054	0.12	L
V436 Pup	70946	M1III	41107	0.0021	0.12	NSV 4056, I
V914 Cen	101541	M1III	56970	0.0030	0.13	NSV 5289, I
DX Boo	127093	M1III	70800	0.0058	0.11	I
V854 Ara	155035	M1–2III	84105	0.0028	0.12	I
AW Phe	9184	M2III	6952	0.0089	0.21	SR
V805 Cas	21179	M2III	16319	0.0052	0.21	SR
WW Pic	35158	M2III	24943	0.0181	0.60	NSV 1946, SR
NO Aur	37536	M2IIIS	26718	0.0111	0.17	L
EM Leo	85162	M2III	48292	0.0058	0.21	I
FR Cam	104216	M2III	58545	0.0071	0.21	L
RY UMa	107397	M2IIIe	60180	0.0413	0.79	SRB
OW Ser	137570	M2III	75584	0.0104	0.15	NSV 7079, I
σ Lib	133216	M3–III	73714	0.0100	0.17	SR
V1472 Aql	190658	M2.5III	98954	0.0138	0.18	SR
47 TV Psc	2411	M3III	2219	0.0146	0.40	SR

Table 3 (cont.)

Name	HD No.	Spectral Type	HIP Number	SE (mag)	Amp. (mag)	Comments
15 Tri	16058	M3IIIa	12086	0.0091	0.57	NSV 866, L
η Gem	42995	M3III	29655	0.0053	0.23	SRA+E
X Mon	51478	M3IIIe	33441	0.0647	1.45	SRA
27 BP Cnc	71250	M3III	41400	0.0084	0.21	SR
GK Com	104207	M3III	58519	0.0049	0.20	I
V768 Cen	130328	M3III	72432	0.0195	0.25	SRB
GG Lib	138344	M3III	76075	0.0138	0.23	SR
IQ Aqr	198272	M3III	102770	0.0077	0.56	NSV 13326, SR
V414 Cep	197939	M3III	102358	0.0100	0.23	SR
92 χ Aqr	219576	M3III	114939	0.0153	0.21	L
LY Ser	139608	M3/4III	76573	0.0071	0.36	LB:
Z Eri	17491	M4III	13064	0.0100	0.46	SRB
AK Hya	73844	M4III	42502	0.0339	0.68	SRB
CG UMa	80390	M4IIIa	45915	0.0104	0.36	LB
TV UMa	102159	M4III	57362	0.0281	0.38	SRB
V335 Hya	106198	M4III	59588	0.0101	0.51	NSV 5503, I
FP Vir	118289	M4III	66345	0.0177	0.51	SRB
V3879 Sgr	172816	M4III	91781	0.0140	0.39	SRB
HD Peg	207932	M4III	107956	0.0161	0.38	LB
ST UMa	99592	M4/5III	55936	0.0176	0.60	SRB
L$_2$ Pup	56096	M5IIIe	34922	0.0356	0.86	SRB
GO Vel	73588	M5III	42315	0.0332	0.83	SR
V744 Cen	118767	M5III	66666	0.0134	0.98	SRB
FY Lib	132112	M5III	73213	0.0145	0.50	SRB
V2113 Oph	156860	M5IIIab	84780	0.0114	0.51	SR:
W Cyg	205730	M5IIIae	106642	0.0417	0.85	SRB
RX Lep	33664	M6III	24169	0.0287	0.59	SRB
S Lep	41698	M6III	28874	0.0260	0.79	SRB
RS Cnc	78712	M6IIIase	45058	0.0267	0.93	SRC
EU Del	196610	M6III	101810	0.0227	0.45	SRB
S Phe	224583	M6IIIe	118249	0.0420	1.01	SRB
61 Cyg A	201091	K5V	104214	0.0259	0.68	V1803 Cyg, BY

Acknowledgements. I wish to thank the Citadel Development Foundation for their support.

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Maeder, A., 1980, *A&A*, **90**, 311

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2000 BVR PHOTOMETRY OF FK COMAE

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Name of the object:
FK Com = BD +24°2592 = HD 117555

Equatorial coordinates:	**Equinox:**
R.A.= $13^{\rm h}30^{\rm m}46\overset{\rm s}{.}80$ **DEC.=** $24°13\overset{\prime}{.}96$	2000

Observatory and telescope:
Ege University Observatory, 48-cm Cassegrain telescope

Detector:	Hamamatsu, R4457 (PMT)
Filter(s):	B, V and R filters of Johnson $UBVR$ system
Comparison star(s):	BD +24°2593
Check star(s):	BD +25°2643

Availability of the data:
Upon request

Type of variability:	FK

Remarks:
The 2000 observations of FK Com were carried out between February 07 and June 27, 2000. 212 data points in each filter were obtained during 15 nights. The light elements are taken from Jetsu et al. (1993). The mean light and colour curves obtained in three colors (B, V, R) are shown in Figure 1. Circles and squares represent the nightly means obtained between February 7 and June 7, 2000, and between June 16 and June 27, 2000, respectively. As it can be seen from Figure 1, the minimum of the light curve obtained in V filter was shifted from phase 0.81 to phase 0.66 (about 54° in the longitude). At the same time, the amplitude of the V-light curve changed; it increased from $0\overset{\rm m}{.}11$ to $0\overset{\rm m}{.}15$ in V band. In Figure 2 the colour index variations obtained in the colour indices $B-V$ and $V-R$ are shown. The symbols are the same as in Figure 1. While the shift of the minimum of the wave-like distortion on the light curve of FK Com is obvious, it is not possible to see this behaviour on the colour index curves.

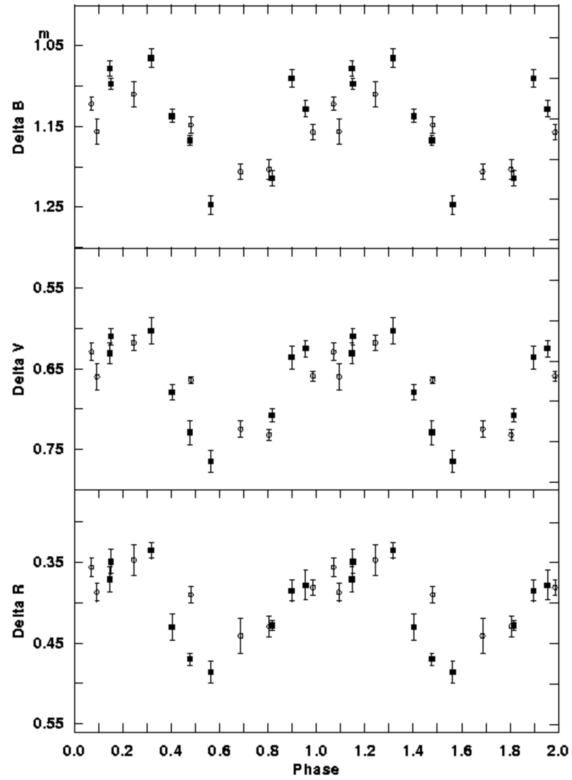

Figure 1. The B, V, R light curves obtained in 2000 of FK Com

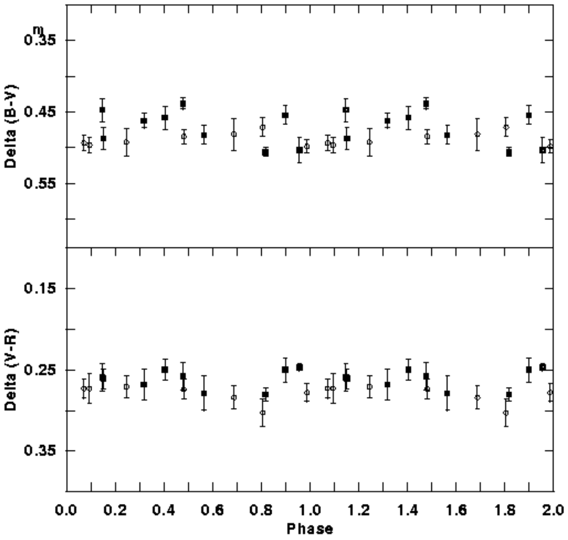

Figure 2. The $B-V$ and $V-R$ colour curves obtained in 2000 of FK Com

Reference:

Jetsu, L., Pelt, J. and Tuominen, I., 1993, *A&A*, **278**, 449

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NEW TIMES OF MINIMA AND LIGHT ELEMENTS OF KR CYGNI

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Name of the object:
KR Cyg = BD +30°3915 = HD 333645

Equatorial coordinates:	**Equinox:**
R.A.= $20^{h}09^{m}05^{s}.60$ **DEC.=** $+30^{\circ}33'01''.3$	2000

Observatory and telescope:
Ege University Observatory, 48-cm Cassegrain telescope

Detector:	Hamamatsu, R 4457 (PMT)
Filter(s):	Johnson B and V
Comparison star(s):	BD +29°3910 = HD 191398
Check star(s):	BD +29°3915 = HD 333664
Transformed to a standard system:	No

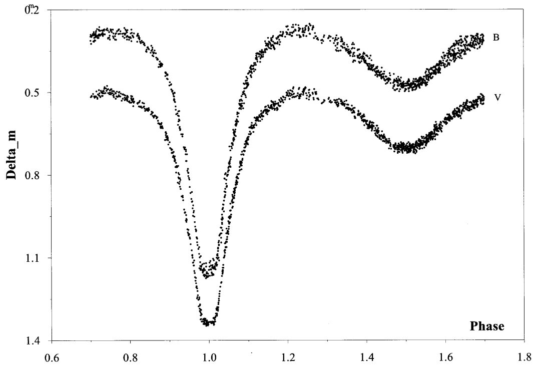

Figure 1. Differential B and V light curves of KR Cyg. The value of $0^{m}.3$ was added to V magnitudes in order to plot the curves detached

Availability of the data:

Upon request

Type of variability: EB

Remarks:

KR Cyg is an EB type eclipsing binary which was discovered by Schneller (1931). The spectral type of the system is given as A2V by Kholopov et al. (1985). Vetesnik (1965) observed the system photoelectrically and obtained its light curves in B and V filters. Wilson and Rafert (1980) modelled the light curves and obtained the geometric and physical parameters of the system. The star was observed photoelectrically at Ege University Observatory on 21 nights during the observational seasons of 1999 and 2000. During the observations four primary and four secondary minima were obtained. The times of minima calculated with the method of Kwee and van Woerden (1956) are given in Table 1, together with their minimum types, filters and observers.

Table 1

Min HJD (2400000 +)	Type	Filter	Observer(s)
51363.4866	I	BV	Es, De
51429.4095	I	BV	Es
51454.3437	II	BV	Es, De
51691.4093	I	BV	Es, De
51718.4518	I	BV	Es, Boy
51721.4147	II	BV	Es, De
51726.4804	II	BV	Es, Va, Boy
51737.4680	II	BV	Es, Va

Es: Esin Sipahi, Va: Varol Keskin,
De: Ahmet Devlen, Boy: Bülent Yaşarsoy

The new light elements are:

$$\text{Min I} = \text{JD}_{\text{Hel}}\ 2451363.4875 + 0\overset{\text{d}}{.}8451572 \times E.$$
$$\pm 4 \qquad\qquad \pm 13$$

In these light elements, the epoch was chosen as the best time of minimum obtained and the period was taken from Kholopov et al. (1985). The new light curves of KR Cygni are shown in Figure 1. The phases in Figure 1 were calculated with the new light elements. The light curves of KR Cyg show a deep primary and shallower secondary minimum. Their amplitudes are about 0.877, 0.830 at the primary, 0.196, 0.195 at the secondary minimum in B and V light, respectively. The system is redder at the primary minimum which implies that the spectral type of the secondary is later than the primary.

Acknowledgements:

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NEW CCD OBSERVATIONS OF UU SAGITTAE AND V477 LYRAE

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Eclipsing binary central stars of planetary nebulae form a rare class of variable stars which are key objects in determining absolute parameters of central compact systems through light curve modelling. There are only eight such objects listed in the latest catalogue of cataclysmic binaries, LMXBs and related objects (Ritter & Kolb 1998) and only two of them, UU Sge (central star of Abell 63) and V477 Lyr (Abell 46) have detailed analyses in the literature. Earlier photometric studies of these stars raised the possibility of period changes that can be attributed to either mass-losing processes or other kind of interaction between the components (UU Sge — Pollacco & Bell 1993, V477 Lyr — Pollacco & Bell 1994). The main aim of this note is to present new observations which reveal the recent behaviour of the orbital periods.

Unfiltered CCD photometry was carried out on 5 nights in August, 2000 at the Piszkéstető Station of the Konkoly Observatory. The main reason for doing unfiltered observations is the relative faintness of the observed stars ($V_{\rm max} = 14\overset{\rm m}{.}7$ for UU Sge, $V_{\rm max} = 15\overset{\rm m}{.}1$ for V477 Lyr). The applied instrument was the 60/90/180-cm Schmidt telescope equipped with a Photometrics AT200 CCD camera (1536 × 1024 pixels, KAF-1600 chip with UV-coating). The field of view is $29' \times 18'$ yielding an angular resolution of $1\overset{''}{.}1$/pixel. The exposure times varied from 60 sec to 180 sec depending on the actual weather conditions and target brightness. The image reduction performed with the standard tasks in IRAF included flat-fielding with a master frame formed from several individual exposures taken during the evening twilight. Differential aperture photometry was made with the IRAF/APPHOT package. In both cases we chose two nearby field stars at similar brightnesses as comparison and check stars. Their magnitude differences were used to estimate the photometric accuracy which is about ±0.01–0.03 mag, the latter value being typical during the primary minima (e.g., UU Sge was only barely detectable in the primary minimum, see below). Individual data are available upon request from the first author.

UU Sagittae

This star was observed on all of the five nights (August 3/4, 4/5, 7/8, 8/9 and 9/10) by obtaining 174 individual CCD frames. There is an optical companion ($V = 15\overset{\rm m}{.}87$) at a distance of $2\overset{''}{.}8$ toward PA 92° (Ciardullo et al. 1999) which strongly reduces the eclipse depth when including its contribution. Since our image scale ($1\overset{''}{.}1$/pixel) prevented an appropriate removing of the second light of optical companion, we applied an aperture photometry that included both stars. The reduced unfiltered eclipse depth was found to be $0\overset{\mathrm{m}}{.}9$. The light curve exhibits a strong reflection effect with an amplitude of $0\overset{\mathrm{m}}{.}3$ (Fig. 1, left panel).

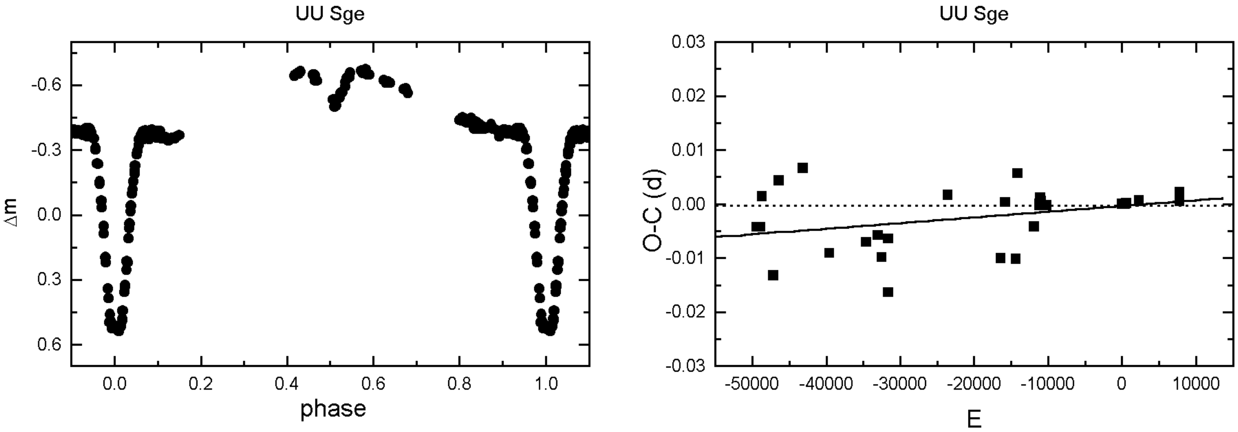

Figure 1. *Left*: the phase diagram of UU Sge with the adopted ephemeris. *Right*: The $O - C$ diagram of UU Sge. The solid line shows the linear fit, while the dotted line corresponds to the zero level.

We have tried to separate the effect of the optical companion by measuring its brightness relative to the chosen comparison stars during the primary minimum, when UU Sge has a minimal contribution. By choosing an aperture radius of 2 pixels we could exclude UU Sge's light and we calculated the unfiltered magnitude differences between the comparison stars and optical companion. This value was taken when correcting the combined differential magnitudes using larger aperture. After the second light removal we obtained a corrected light curve with an eclipse depth of 4.5 ± 0.3 mag which is close to the real value (Bell et al. 1994 reported $\Delta V = 4.05 \pm 0.06$ mag with the 4.2-m William Herschel Telescope). This correction illustrates the definite detection of UU Sge even in the primary minimum ($V_{\rm min} = 19.20 \pm 0.07$ mag, Bell et al. 1994). The scatter of the corrected light curve disabled the accurate eclipse timing. Fortunately, the primary minimum shows a quite symmetric light curve, thus the direct measurements could be used for determining epochs of minimum.

Three new times of minimum were obtained by determining the midpoints of several (2-3) chords taken a few tenth of a magnitude above the bottom part of the light curve (Table 1). The estimated timing accuracy is about 0.0005–0.0007 days (the first epoch has larger uncertainty because of the partial coverage). These times of minima were added to the published values collected by Pollacco & Bell (1993), while a further epoch was presented by Bell et al. (1994). The final sample contains 33 individual epochs which were used to calculate the $O - C$ diagram covering 76 years. The used ephemeris was the following (Pollacco & Bell 1993):

$$\mathrm{HJD(Min\ I)} = 2448133.40747 + 0.465069102 \times E.$$

Early data are photographic, thus their lower accuracy is the main reason for the considerable scatter of the first part of the diagram. The general appearance suggests a slightly larger, but most likely constant period which was determined by a least-squares linear fit of the $O - C$ values. The fitted slope is $(1.05 \pm 0.49) \times 10^{-7}$ resulting in a corrected period of 0.46506921(5) days. This is a little longer period than that of by Bell

Table 1: New times of minima (Hel. JD – 2400000). $O-C$ values were calculated with the ephemerides given in Pollaco & Bell (1993) — UU Sge, and Pollacco & Bell (1994) — V477 Lyr.

	Hel. JD	E	$O-C$
UU Sge	51760.4835:	7799	0.0021
	51761.4120	7801	0.0005
	51766.5285	7812	0.0012
V477 Lyr	51764.5163	7693	−0.0002
	51765.4605	7695	0.0005
	51766.4038	7697	0.0004

et al. (1994), however, the difference is very close to the detection limit. Therefore, we conclude, that our new ephemeris

$$\mathrm{HJD(Min\ I)} = 2451766.5285 + 0.46506921 \times E$$

is a marginally improved one allowing accurate phase predictions for the follow-up observations.

V477 Lyrae

V477 Lyrae ($V_{\rm max} = 15\overset{\rm m}{.}1$, $\Delta V = 1\overset{\rm m}{.}5$, $P = 0\overset{\rm d}{.}4717$) was observed on three subsequent nights (August 7/8, 8/9 and 9/10), thus only partial phase coverage could be obtained. Although V477 Lyr is similar to UU Sge, there are much less observations in the literature as for UU Sge. The most striking feature of the light curve is the strong reflection effect with an amplitude up to $0\overset{\rm m}{.}5$ (see left panel in Fig. 2). Pollacco & Bell (1994) presented the first full light-curve analysis for V477 Lyr concluding that Abell 46 may be an example of a 'lazy PN' (the central star is visually bright whilst the nebula itself has a low surface brightness), while the secondary component is oversized for its mass. There are 12 published epochs of minimum which were listed by Pollacco & Bell (1994). Since then there were no new observations on this star.

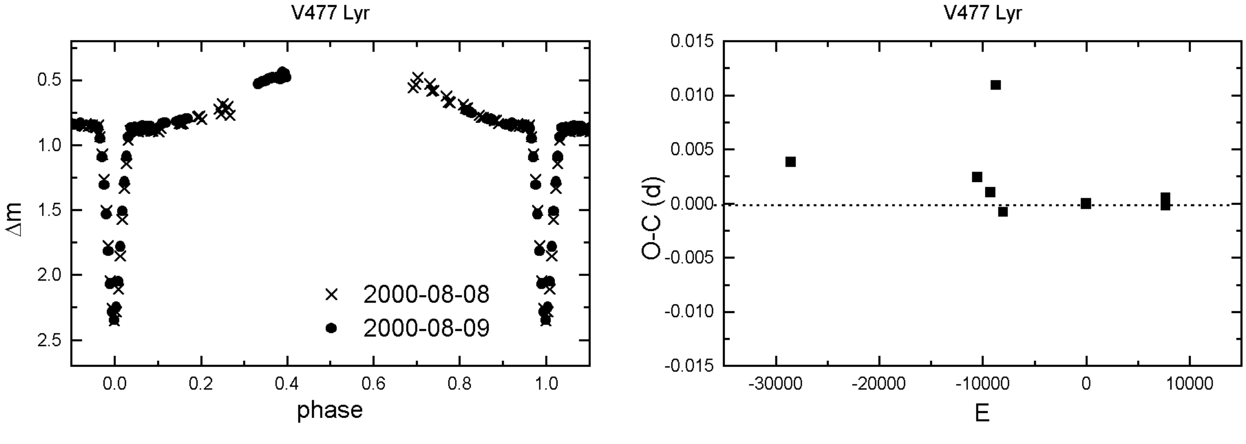

Figure 2. *Left*: the phase diagram of V477 Lyr with the adopted ephemeris. Data obtained on the first night were excluded because of larger scatter caused by the unfavorable weather conditions. *Right*: The $O-C$ diagram of V477 Lyr. Obviously inaccurate photographic data were exluded, while the dotted line corresponds to the zero level.

Our observations resulted in three new times of minima (Table 1) which were determined by fitting low-order polynomials to the lowest part of the individual light curves. Since the primary minimum is only partial, the timing is more accurate than in the case of UU Sge, with an estimated accuracy of 0.0003 days. The $O-C$ diagram was calculated with the ephemeris in Pollacco & Bell (1994):

$$\mathrm{HJD(Min\ I)} = 2448135.50446 + 0.47172909 \times E.$$

As can be seen in the right panel of Fig. 2, there is no significant variation in the $O-C$ diagram, which corresponds to a stable period over 40000 cycles (about 50 years). A formal linear fit gives a slope of $(-1.1 \pm 1.1) \times 10^{-7}$ suggesting a relative stability of the period $\Delta P/P \approx 1.1 \times 10^{-7}/0.4717 \approx 2 \times 10^{-7}$. Therefore, we conclude that no period change can be detected using the presently available data and follow-up observations can be planned with the cited ephemeris.

This research was supported by the “Bolyai János” Research Scholarship of LLK from the Hungarian Academy of Sciences, Hungarian OTKA Grant #T032258 and Szeged Observatory Foundation. The observations were acquired during the course of Summer Training Programme for students of astronomy at University of Szeged. The warm hospitality of the staff of the Konkoly Observatory and their provision of telescope time is gratefully acknowledged. The NASA ADS Abstract Service was used to access data and references. This research has made use of Simbad Database operated at CDS, Strasbourg, France.

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P CYGNI IN 1987–1993

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P Cygni is a B1 Ia$^+$ hypergiant in the Cyg OB1 association. It is one of the oldest known variable stars, in fact second only after Mira Ceti. It was discovered during an S Dor-type outburst in 1600. The star spent the following decades showing violent behaviour, but reached a quiet state by around 1700 which is still in effect today (de Groot 1986).

P Cygni has been considered to be without any appreciable variation for a long time. Consequently, it was observed unfrequently (a good listing of early observations is given by Müller & Hartwig 1920), the first systematic photoelectric observations began only in the late 1930's in Abastumani. The Abastumani observers later classified P Cygni as a W UMa-type eclipsing binary (Kharadze & Magalashvili 1967), though further observations did not confirm it (Alexander & Wallerstein 1967).

Percy was the first to start a long-term campaign of P Cygni observations (Percy & Welch 1983, Percy et al. 1988, 1996). His results showed that the star varied irregularly on time-scales from a few days to a few months, while the colour variations were smaller and apparently independent of the V light curve.

Here I present observations of the star made with the 50-cm telescope of Konkoly Observatory in Piszkéstető (1987–88) and with the 60-cm telescope in Budapest (1991–93). The observing circumstances were the same as mentioned in previous papers (Zsoldos 1993, 1995). I used 36 Cygni as comparison star ($V = 5.58$, $B - V = 0.06$, $U - B = 0.00$). The observations are given in Table 1 and Fig. 1.

The small number of observations precludes the possibility of a thorough period analysis. One can, however, confirm the conclusions of Percy et al. (1988): the time-scales vary between 20 and 200 days. The most probable cycle lengths in the given data set are $P_1 = 26\overset{d}{.}7$ and $P_2 = 218\overset{d}{.}8$. These values remain the same if we include further observations of Markova & Tomov (1998).

The colour variations are on a smaller scale than the light variation, also confirming earlier results. It seems from Fig. 1, that, at least in the case of the longer cycle, the light and colour curves are antiparallel. This is what one would expect from non-radial pulsations (supposing that the cause of the variation is pulsation). The long cycle lengths (between 20^d and 200^d) also favour non-radial pulsation (Lovy et al. 1984).

Israelian et al. (1996) discussed the possible — if any — connection between the shell ejections observed in P Cygni and the light variations. They seem to have found some indication that shell ejections were followed by an increase in visual brightness.

Table 1: Photometry of P Cygni

J.D.	V	$B-V$	$U-B$
2446925.571	4.821	0.379	−0.707
6966.475	4.787	0.394	−0.712
6983.467	4.851	0.389	−0.695
6984.465	4.842	0.382	−0.697
6985.389	4.823	0.387	−0.689
6997.452	4.793	0.393	−0.692
7016.362	4.812	0.389	−0.707
7018.445	4.825	0.390	−0.707
7019.387	4.824	0.391	−0.697
7030.385	4.818	0.399	−0.696
7032.377	4.847	0.401	−0.712
7060.316	4.827	0.391	−0.682
7062.329	4.847	0.401	−0.694
7098.241	4.875	0.375	−0.696
7335.490	4.740	0.413	−0.626
7349.454	4.789	0.405	−0.624
7372.442	4.780	0.410	−0.612
7374.397	4.801	0.417	−0.611
7406.356	4.754	0.405	−0.647
7408.365	4.774	0.403	−0.635
7433.281	4.831	0.395	−0.639
7446.299	4.872	0.402	−0.619
8410.492	4.819	0.402	−0.634
8417.528	4.844	0.394	−0.608
8433.528	4.836	0.383	−0.606
8475.518	4.782	0.406	−0.674
8477.521	4.793	0.390	−0.655
8485.441	4.800	0.396	−0.686
8534.310	4.824	0.377	−0.682
8557.281	4.876	0.371	−0.654
8573.269	4.846	0.375	−0.673
8813.504	4.838	0.382	−0.697
8853.410	4.822	0.395	−0.678
8859.349	4.857	0.380	−0.682
8897.314	4.755	0.416	−0.684
8936.242	4.829	0.388	−0.707
2449254.346	4.801	0.392	−0.686

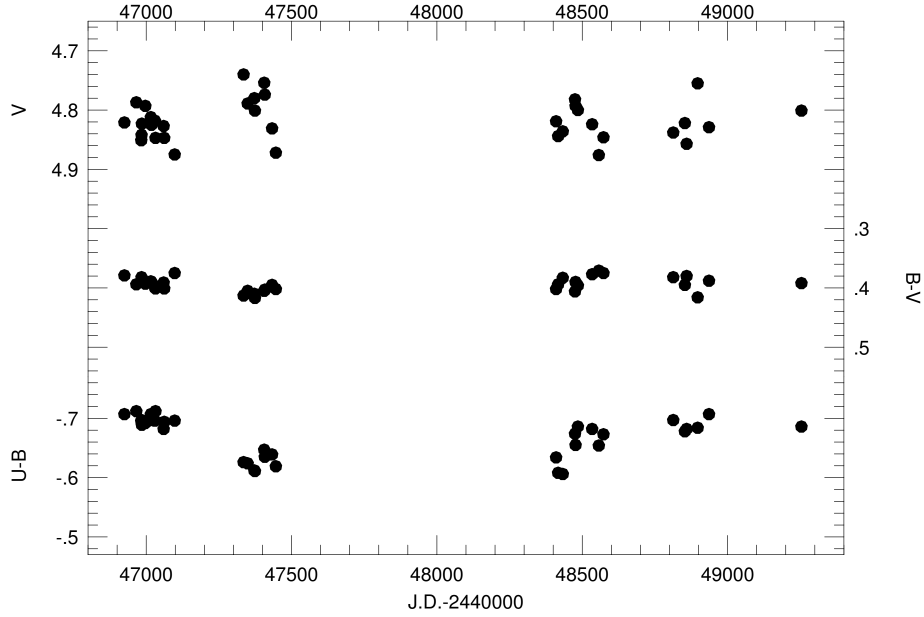

Figure 1. The light and colour curves of P Cygni.

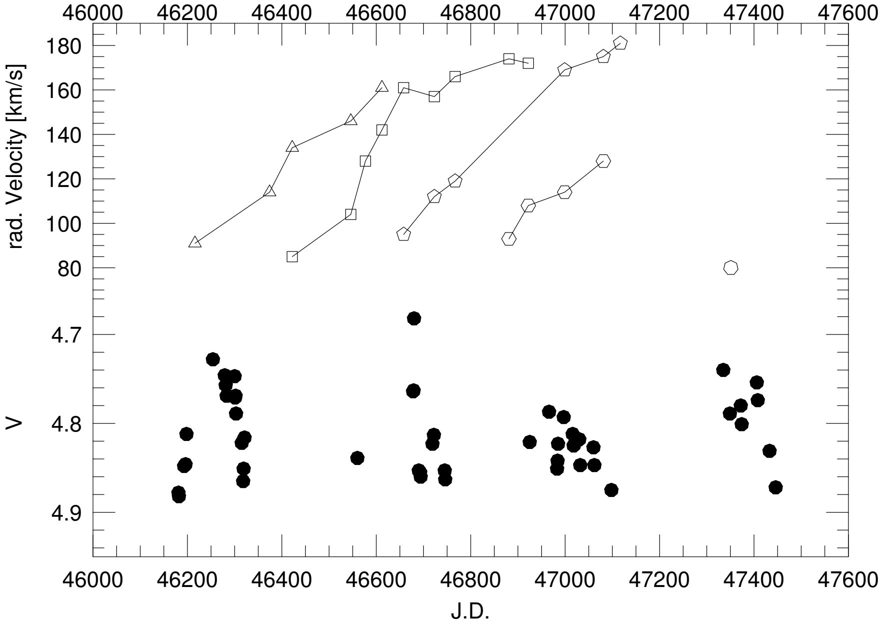

Figure 2. The connection of light curve and shell ejections. The lower part is the light curve, the upper part is the velocity variations of FeII lines.

Since my observations cover a longer time, it seems worth comparing the light curve with the radial velocities of the various shells. Figure 2 shows the light curve (my observations from Percy at al. (1988) and from Table 1 of the present paper) and the radial velocity variations of the absorption components of FeII lines from Table V of Israelian et al. (1996).

Figure 2 shows the possibility of the connection. The ejection of a shell roughly coincides with the ascending branch of a wave on the light curve. The characteristic time scales also support this connection: they are about 200 days for the ejections, 219 days for the light curve, respectively. It must be noted here, however, that Stahl et al. (1994) did not find any correlation between radial velocity and light curve.

It is clear that there is still a need for more photometry of P Cygni. A longer, continuous light curve would help to decide if the connection shown in Fig. 2 is real or coincidental.

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Correction [Wed Feb 19 11:06:50 MET 2003]
The correct reference is:
Kharadse, E. K., Magalashvili, N. L., 1967, *The Observatory*, **87**, 295

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THREE DELTA SCUTI STARS IN THE OLD OPEN CLUSTER NGC 2506

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During our observational survey to search for low-amplitude pulsating stars (e.g., δ Scuti stars and γ Dor stars) in open clusters, we discovered three new δ Scuti type variable stars in a field of the old open cluster NGC 2506. Kaluzny & Shara (1988) also monitored stars in a wider area of the cluster than our observation but found no variable stars, probably due to their limited data sets (only nine exposures for three nights).

Time-series V CCD photometry was performed for ten nights from December 11th, 1996 to March 5th, 1997. The observations were done with a SITe 1024 CCD camera attached to the 1.8-m telescope at Bohyunsan Optical Astronomy Observatory (BOAO). Field of view of a CCD image is $5'.8 \times 5'.8$ at $f/8$ Cassegrain focus of the telescope. Typical photometric seeing was less than $2''.0$. We also carried out UBVI photometry to study physical properties of variable stars in the cluster (Kim *et al.* 2000 for detailed results).

Data analyses such as CCD image process, PSF (Point Spread Function) photometry and the ensemble normalization, have been carried out by the methods described by Kim *et al.* (1999). We examined light variations of 590 stars in the observed field using 304 CCD frames and found three new pulsating stars. Finding chart of these new pulsating stars is shown in Figure 1.

Power spectra and light curves are displayed in Figures 2 and 3, respectively. Each pulsating star has a dominant frequency. Three pulsating stars are located within the δ Scuti instability strip in the color-magnitude diagram (Figure 4). It should be noted that V1, a probable cluster member deduced from the membership probability (Mermilliod 1992), is located at a bluer and brighter region than the main-sequence turn-off point of the cluster ; i.e., it might be identified as a pulsating blue straggler star.

Observational parameters of the three new δ Scuti stars are summarized in Table 1. Two B and V deep-exposured data were used to estimate the color index. Photometric errors are less than $0^{\mathrm{m}}.01$.

Table 1: Observational parameters of the new δ Scuti type variable stars

	ID[1]	RA$_{2000}$[1]	DEC$_{2000}$[1]	$\overline{V}$[2]	$\overline{B-V}$[2]	Period	Epoch[3]	ΔV	P_μ[1]
V1	5462	$7^{\mathrm{h}}59^{\mathrm{m}}58^{\mathrm{s}}.1$	$-10^\circ45'55''$	$13^{\mathrm{m}}.69$	$0^{\mathrm{m}}.21$	$0^{\mathrm{d}}.0678$	431.242	$\sim 0^{\mathrm{m}}.03$	0.71
V2	5467	$7^{\mathrm{h}}59^{\mathrm{m}}53^{\mathrm{s}}.6$	$-10^\circ45'49''$	$14^{\mathrm{m}}.50$	$0^{\mathrm{m}}.29$	$0^{\mathrm{d}}.0921$	430.209	$\sim 0^{\mathrm{m}}.17$	0.91
V3	5589	$7^{\mathrm{h}}59^{\mathrm{m}}57^{\mathrm{s}}.8$	$-10^\circ47'21''$	$14^{\mathrm{m}}.75$	$0^{\mathrm{m}}.35$	$0^{\mathrm{d}}.0815$	513.082	$\sim 0^{\mathrm{m}}.11$	0.00

[1] Identification, coordinates and membership probability (Mermilliod 1992)

[2] Photometric data from Kim *et al.* (2000)

[3] Epoch at maximum brightness (H.J.D. – 2450000.0)

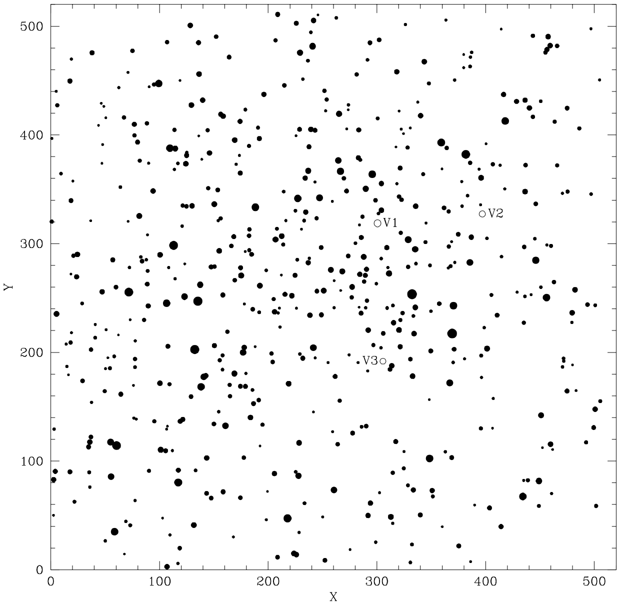

Figure 1. Observed CCD field ($5\overset{\prime}{.}8 \times 5\overset{\prime}{.}8$) of the open cluster NGC 2506. Three variable stars discovered in this study are represented by open circles. North is up and east is to the left

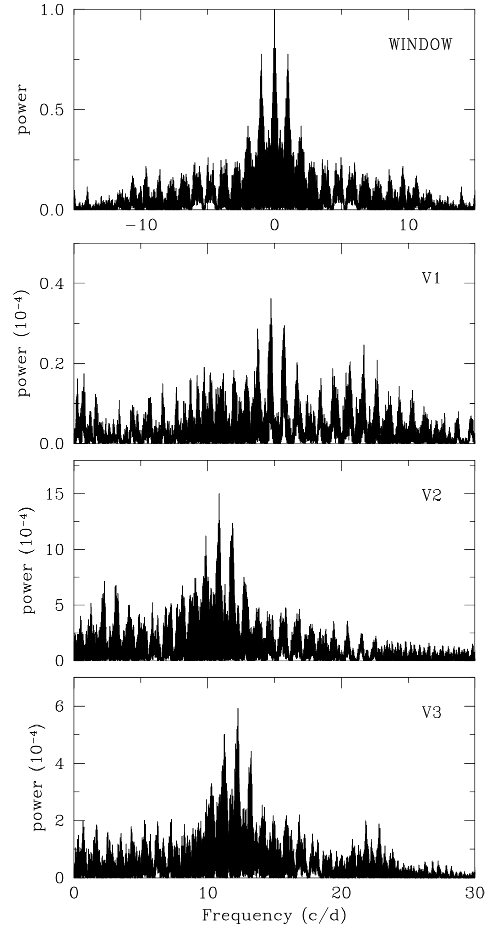

Figure 2. Power spectra of the three variable stars. The spectral window is shown in the top panel. The dominant frequency is 14.742 c/d for V1, 10.854 c/d for V2 and 12.264 c/d for V3

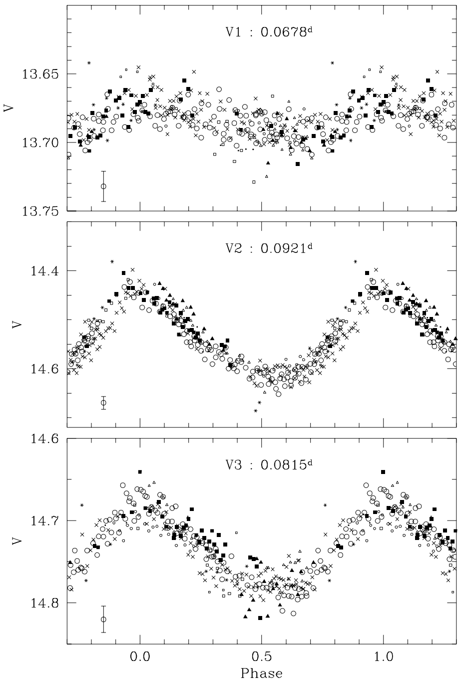

Figure 3. Light curves of the three pulsating stars. Data points are differently marked for each observing night. Typical observation errors are represented by error bars

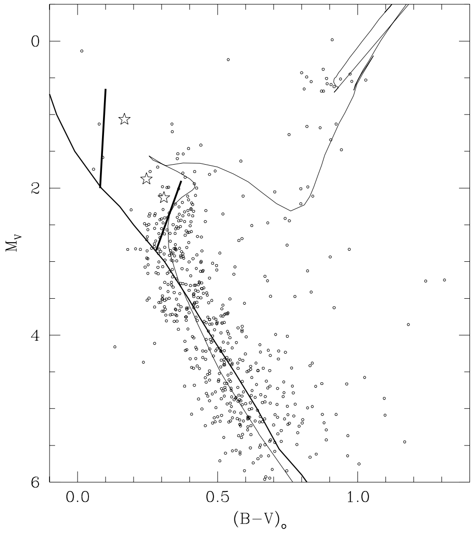

Figure 4. Positions of pulsating stars in the color–magnitude diagram of NGC 2506, using photometric data by Kim *et al.* (2000). Thick and thin lines denote an empirical ZAMS (Sung & Bessell 1999) and a theoretical isochrone (Girardi *et al.* 2000), respectively. Thick solid bars, nearly perpendicular to the ZAMS, represent δ Scuti instability strip (Breger 1979). The pulsating stars are marked by star symbols. We adopted the reddening of $E(B-V) = 0.04$, distance modulus of $(V - M_V)_\circ = 12.5$ and age of $\log t = 9.25$ (Kim *et al.* 2000)

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CCD LIGHT CURVES OF ROTSE1 VARIABLES, I: GSC 3099.905 HERCULIS

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Name of the object:
GSC 3099.905 = ROTSE1 173454.24+441152.2

Equatorial coordinates:	**Equinox:**
R.A.= $17^{h}34^{m}54.24^{s}$ **DEC.=** $+44^{\circ}11'52.2''$	2000.0

Observatory and telescope:
Private observatory Schlüsselacher, Wald, 0.15-m refractor

Detector:	SBIG ST-7 CCD camera
Filter(s):	None
Comparison star(s):	GSC 3099.933
Check star(s):	GSC 3099.1019

Availability of the data:
Upon request from diethelm@astro.unibas.ch

Type of variability:	EW

Remarks:

As a byproduct of the ROTSE1 CCD survey, a large number of new variables have been discovered (Akerlof et al., 2000). In a series of papers, we report unfiltered CCD observations for some of the close binary systems (type EW and E) in the list of Akerlof et al. (2000). GSC 3099.905 was observed with our CCD equipment as specified above during 5 nights between JD 2451746 and JD 2451781. A total of 143 CCD frames were measured and Figure 1 shows these observations folded with the elements

$$\mathrm{JD(min,hel)} = 2451746.4772(5) + 0.2514358(20) \times E.$$

These elements of variation are deduced from a linear fit to the newly determined normal minima from the ROTSE1 data (JDH 2451305.7095(2), primary; JDH 2451311.8712(4), secondary) as well as the 8 minima (5 primary, 3 secondary) published in BBSAG Bulletin 123.

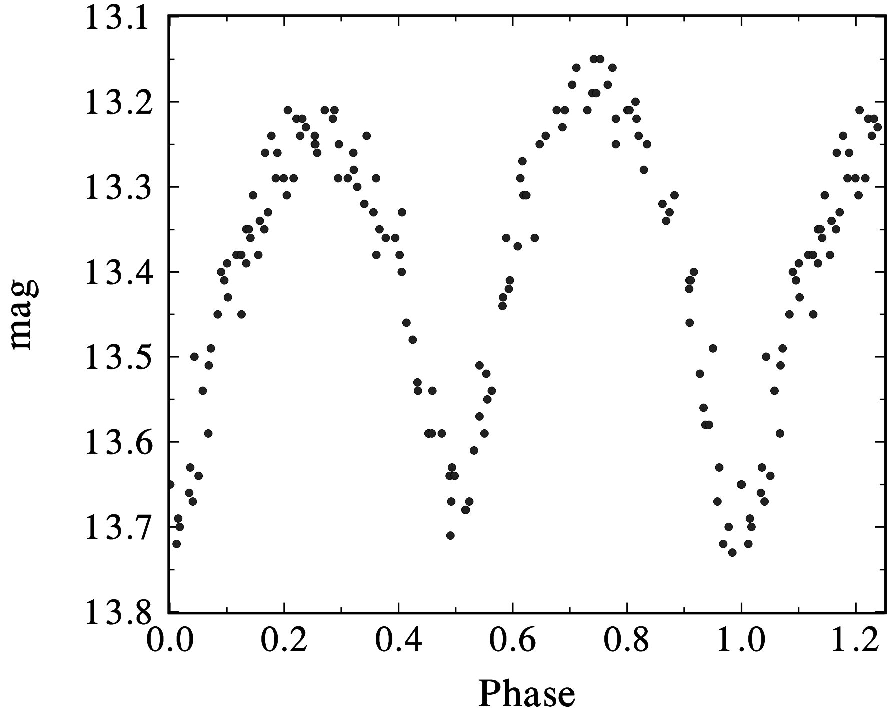

Figure 1. CCD light curve (without filter) of GSC 3099.905

Acknowledgements:

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

Reference:

Akerlof, C., Amrose, S., Balsano, R., Bloch, J., Casperson, D., Fletcher, S., Gisler, G., Hills, J., Kehoe, R., Lee, B., Marshall, S., McKay, T., Pawl, A., Schaefer, J., Szymanski, J., Wren, J., 2000, *AJ*, **119**, 1901

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CCD LIGHT CURVES OF ROTSE1 VARIABLES, II: GSC 3100.1616 HERCULIS

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Name of the object:
GSC 3100.1616 = ROTSE1 174311.02+432709.0

Equatorial coordinates:	**Equinox:**
R.A.= $17^{\mathrm{h}}43^{\mathrm{m}}11.02^{\mathrm{s}}$ **DEC.=** $+43^\circ27'09.0''$	2000.0

Observatory and telescope:
Private observatory Schlüsselacher, Wald, 0.15-m refractor

Detector:	SBIG ST-7 CCD camera
Filter(s):	None
Comparison star(s):	GSC 3100.1679
Check star(s):	GSC 3100.1797

Availability of the data:
Upon request from diethelm@astro.unibas.ch

Type of variability:	EW

Remarks:

As a byproduct of the ROTSE1 CCD survey, a large number of new variables have been discovered (Akerlof et al., 2000). In a series of papers, we report unfiltered CCD observations for some of the close binary systems (type EW and E) in the list of Akerlof et al. (2000). GSC 3100.1616 was observed with our CCD equipment as specified above during 5 nights between JD 2451746 and JD 2451781. A total of 158 CCD frames were measured and Figure 1 shows these observations folded with the elements

$$\mathrm{JD(min,hel)} = 2451746.4139(6) + 0.2581094(25) \times E.$$

These elements of variation are deduced from a linear fit to the newly determined normal minima from the ROTSE1 data (JDH 2451286.8514(2), secondary(?); JDH 2451310.7238(6), primary(?)) as well as the 8 minima (3 primary, 5 secondary) published in BBSAG Bulletin 123. Because of the uncertainty in the cycle count since the ROTSE1 data, the elements given above are in need of affirmation.

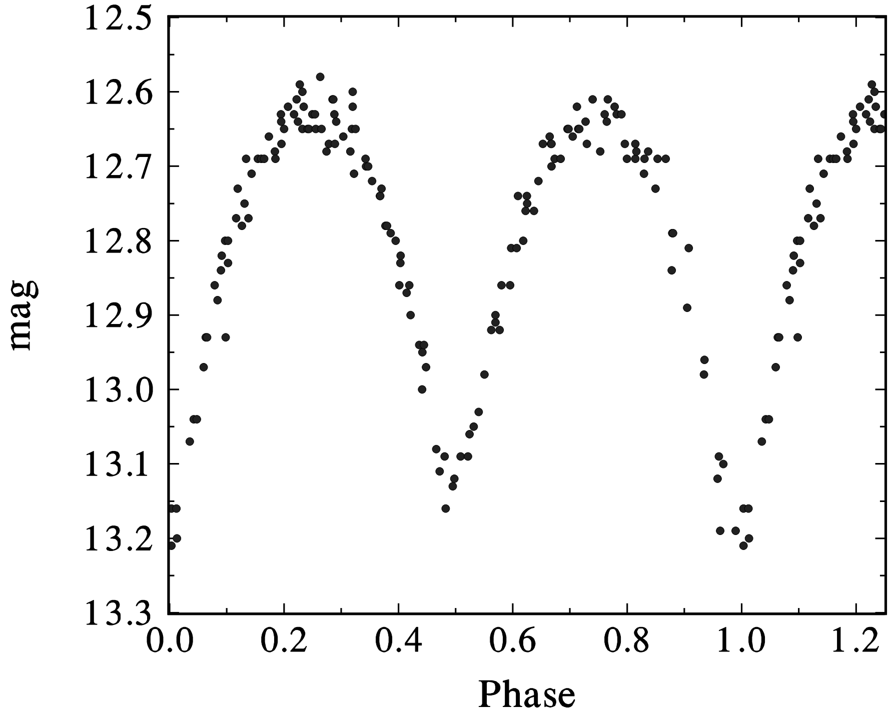

Figure 1. CCD light curve (without filter) of GSC 3100.1616

Acknowledgements:

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

Reference:

Akerlof, C., Amrose, S., Balsano, R., Bloch, J., Casperson, D., Fletcher, S., Gisler, G., Hills, J., Kehoe, R., Lee, B., Marshall, S., McKay, T., Pawl, A., Schaefer, J., Szymanski, J., Wren, J., 2000, *AJ*, **119**, 1901

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CCD TIMES OF MINIMA OF ECLIPSING BINARY SYSTEMS

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We present CCD photometric minima observations of 22 eclipsing binary systems. Most of them are possible triple systems, or binaries having eccentric orbits, selected from Borkovits & Hegedüs (1996), or from the listing of Hegedüs (1988). Some minima observations (e.g. IM Aurigae, GSC 3822 1056) are part of complete light curve coverages.

Most of the measurements were carried out at Baja Astronomical Observatory with three different CCD cameras, mounted on the 20-inch $f/8.4$ Ritchey–Chrétien telescope. These were an SBIG ST-6 (referred as ST6 in the 7th column of Table I), an SBIG ST-7 (ST7), and an Apogee AP-7 (AP7). The first minima observations of the newly discovered variable GSC 3822 1056 were carried out at Observatorio del Teide (Tenerife, Spain) using the IAC80 (0.8-m $f/11.3$ Cassegrain) telescope and a Wright Instruments (WRI) camera in 1997.

Reduction of the CCD frames was made with a customly developed IRAF[1] package. The minima times were computed with parabolic fitting, and in some cases with linearized Pogson-method.

Table 1 presents the derived minima times. The contents of the first two columns are self-explanatory. The error in the last digit appears in the third column. In the fourth column the types of minima are marked (I for primary, and II for secondary). The columns from fifth to seventh describe the filters used (if any), the first three letters of the observers' names (Bír = I.B. Bíró, Bor = T. Borkovits) and the codes of the instrumentation. The last column contains the comparisons used, identified by their HD, GSC or SAO numbers.

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[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

Star	Min. HJD 2400000 +	Error ±	Min. type	Filter	Obs.'s name	Instr.	Comp.
RT And	51021.4303	3	II	V	Bír	ST7	HD 218915
	51463.2480	1	I	-	Bor	ST6	HD 236062
	51463.5634	7	II	-	Bor	ST6	”
AB And	51716.4610	1	I	-	Bor	AP7	2763-0878
OO Aql	51380.5004	1	II	-	Bír	AP7	1058-0689
	51679.5093	3	II	-	Bor	AP7	”
HP Aur	51080.5584	1	II	R	Bír	ST7	2401-1128
	51124.6623	3	II	R	Bír	ST7	”
	51196.5140	1	I	V	Bír	ST7	”
IM Aur	51568.390	1	II	V	Bor	ST7	3358-1208
	51576.4930	3	I	R	Bor	ST7	”
	51593.331	1	II	V	Bír	ST7	”
	51593.333	1	II	B	Bír	ST7	”
	51593.333	1	II	R	Bír	ST7	”
	51596.4493	6	I	R	Bor	ST7	”
	51601.4389	2	I	R	Bor	ST7	”
	51603.3087	5	II	V	Bír	ST7	”
	51611.4166	3	I	V	Bír + Bor	ST7	”
	51611.4171	1	I	R	Bír + Bor	ST7	”
	51611.4174	8	I	B	Bír + Bor	ST7	”
	51808.4836	1	I	-	Bír	AP7	”
Y Cam	51133.6194	2	I	R	Bor	ST7	4527-1983
	51315.4352	3	I	-	Bor	AP7	”
RZ Cas	51135.5832	2	I	R	Bor	ST7	4317-1578
	51162.484	:	II	V	Bír	ST7	”
	51165.4644	1	I	V	Bír	ST7	”
	51183.3930	1	I	R	Bor	ST7	”
	51379.4136	1	I	-	Bor	AP7	”
	51783.4085	1	I	-	Bor	AP7	”
VW Cep	51284.3671	2	I	-	Bor	AP7	4585-2387
	51661.3433	7	II	V	Bor	AP7	4585-2167
	51661.4800	5	I	V	Bor	AP7	”
	51814.4129	5	II	-	Bor	AP7	”
	51814.5500	5	I	-	Bor	AP7	”
XX Cep	51454.4119	5	I	-	Bor	ST6	4288-0186
CW Cep	51449.469	1	II	-	Bor	ST6	4282-0348
DL Cyg	51113.371	5	II	V, R	Bír	ST7	3595-0816
	51381.450	2	I	-	Bor	AP7	SAO 51164
MR Cyg	51689.489	1	I	-	Bor	AP7	3609-2087
AK Her	51301.4589	2	I	-	Bor	AP7	1536-1834
	51617.6013	3	I	R	Bor	ST7	1536-0928
	51680.4087	1	I	-	Bor	AP7	1536-1834
DI Her	51707.391	1	I	-	Bor	AP7	2109-0167
GU Her	51691.416	1	I	-	Bor	AP7	2581-1969
HS Her	51302.4332	2	I	-	Bor	AP7	2113-1658
	51681.509	1	II	-	Bor	AP7	”
SW Lac	51778.3737	4	II	-	Bor	AP7	3215-1406
	51778.5325	1	I	-	Bor	AP7	”
UV Leo	51197.6475	3	II	V	Bír	ST7	0845-0121
	51207.5492	3	I	-	Bor	AP7	0845-0271
	51218.3502	2	I	-	Bor	AP7	0845-0189
	51597.3051	3	II	V	Bír	ST7	0845-0121

Table 1 (cont.)

Star	Min. HJD 2400000 +	Error ±	Min. type	Filter	Obs.'s name	Instr.	Comp.
IZ Per	51097.3945	1	I	*V*	Bír	ST7	3670-1506
DW UMa	51675.3726	2	I	-	Bor	AP7	3822-0070
	51675.5090	2	I	-	Bor	AP7	”
GP Vul	51692.4426	4	I	-	Bor	AP7	2151-5639
GSC 3822 1056	50495.5219	4	I	*R*	Bír	WRI	3822-0070
	50495.5224	6	I	*V*	Bír	WRI	”
	50495.675	1	II	*R*	Bír	WRI	”
	50495.678	1	II	*V*	Bír	WRI	”
	50496.602	2	II	*V*	Bír	WRI	”
	50496.605	1	II	*R*	Bír	WRI	”
	50496.7590	2	I	*R*	Bír	WRI	”
	50496.7592	3	I	*V*	Bír	WRI	”
	50497.6881	7	I	*V*	Bír	WRI	”
	50497.6891	8	I	*R*	Bír	WRI	”
	50498.4633	9	II	*V*	Bír	WRI	”
	50498.4671	7	II	*R*	Bír	WRI	”
	50498.6186	4	I	*V*	Bír	WRI	”
	50498.6191	2	I	*R*	Bír	WRI	”
	50499.7040	3	II	*R*	Bír	WRI	”
	50500.6327	8	II	*V*	Bír	WRI	”
	50539.530	2	I	*V*	Bír	WRI	”
	50540.4587	5	I	*V*	Bír	WRI	”
	50547.5841	8	I	I	Bír	WRI	”
	51228.4120	5	I	-	Bír	AP7	”
	51228.5678	1	II	-	Bír	AP7	”
	51236.46923	1	I	-	Bír	AP7	”
	51236.6253	3	II	-	Bír	AP7	”
	51237.3985	4	I	-	Bír	AP7	”
	51237.5547	2	II	-	Bír	AP7	”
	51238.3315	6	I	-	Bír	AP7	”
	51238.480	:	II	-	Bír	AP7	”
	51242.3566	2	I	-	Bír	AP7	”
	51242.5144	2	II	-	Bír	AP7	”
	51250.4125	5	I	-	Bír	AP7	”
	51250.566	:	II	-	Bír	AP7	”
	51262.345	1	II	-	Bír	AP7	”
	51262.499	1	I	-	Bír	AP7	”
	51263.4271	1	I	-	Bír	AP7	”
	51349.423	1	II	-	Bír	AP7	”
	51356.4002	5	I	-	Bír	AP7	”
	51675.4300	8	II	-	Bor	AP7	”
	51715.411	:	II	-	Bír	AP7	”

Remarks on some of the variables:
DW UMa: This is the only one nova-like variable in the above list. After a quiescent period in 1998-99 it returned back to its normal state.
GSC 3822 1056: The following new ephemeris was calculated:

$$\mathrm{Min_I} = \mathrm{HJD}\ 2450495.5212 + 0\overset{\mathrm{d}}{.}3098906857 \times E.$$

This work was partly supported by National Grant OTKA T030743.

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Hegedüs T., 1988, *CDS Bull.*, **35**, 15

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ON THE VARIABILITY OF LATE B III–V STARS

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This paper studies Hipparcos photometry (ESA 1997) of luminosity class III–V B6–B9 stars from the Bright Star Catalogue, 5th edition (Hoffleit & Warren 1991) and the Supplement of the 4th edition (Hoffleit et al. 1983) which for the most part were not investigated as part of Adelman (1998)'s study of HgMn and magnetic CP stars. Adelman, Yüce & Engin (2000) considered the corresponding supergiants. The stars investigated here include some mCP stars (α^2 CVn variables), β Cephei type, γ Cassiopeiae type variables (or Be stars), irregular variables, slowly pulsating B stars, and SX Arietis type variables as well as microvariables and many stars which need additional observations to determine their variability type as well as constant stars.

Table 1 lists the mean amplitudes of those spectral types with 3 or more class members. These values are indicative of the mean variability. We excluded stars with spurious variability due to duplicity. The Hipparcos photometry does not confirm the reported variability of some stars. In some cases such as the γ Cassiopeiae stars this might indicate changes in the stellar behavior as some class members have long periods of quiescence or reflect the quality of the previous photometry.

The mean amplitudes are smaller than found from most previous studies of other regions of the HR diagram using these same methods. Typically they are between $0^{\mathrm{m}}.024$ and $0^{\mathrm{m}}.030$ which are slightly greater than those found for the early K III stars (Adelman 2000). The amplitudes of the giants are slightly less than those of the comparable luminosity II stars found by Adelman, Yüce, & Engin (2000). This suggests that many are constant.

Table 2 (available electronically from the IBVS site as 4968-t2.txt) presents the values for the individual stars including those which were not used in the the mean values. For each star it gives the HR number (if any), names (Bayer, Flamsteed, or variable star designations), the V magnitude of the Bright Star Catalog and/or its Supplement, the spectral type, the Hipparcos number, the standard error (mag), the amplitude (mag), and comments which give the type of variable and the NSV number of the star when the column 'Name' is filled already with another name of the variable.

Table 3 contains selected stars whose amplitudes of variability are significantly greater than those of stars with the same spectral types, usually a factor of two greater than the type mean, or $0\overset{\mathrm{m}}{.}05$. Some are well-known variables. Those which have not been well studied should be.

There are also many stars with amplitudes of $0\overset{\mathrm{m}}{.}01$ which should be considered to be candidates for photometric standards. These are B6 III: 91 λ Cet, B7 III: HR 144, 112 β Tau, 43 Cam, HR 3898, B8 III: 64 Ori, 27 ϕ Sgr, B9III: 25 ν Cas, 73 ξ2 Cet, λ Cen, 14 γ Lyr, B9.5III: 65 θ Aql, B9III–IV: 40 υ^2 Hya, B6IV: 19 Tau, B7IV: α Col, ι Vol, HR 6708, B9IV: KK And, 6 Tau, θ Col, HR 2518, α Del, κ And, ε Tuc, B8IV–V: ϕ Eri, B9IV–V: HR 3856, 33 ι Aqr, 62 η Aqr, B6V: HR 1214, B7V: σ Ari,72 Ori, B8V: 41 Ari, HR 1172, HR 1307, HR 2415, η Cha, HR 4089, 27 β Lib, HR 6628, HR 7507, HR 8014, HR 8112, 17 ι And, B9V: ε Hyi, 13 Tau, 41 υ^4 Eri, 16 λ Aql, β^1 Sgr, 54 α Peg, HR 1723, HR 4735, 35 σ Her, 4 Sgr, 68 Aql, 27 Vul, B9.5V: 4 Ari, 72 ρ Cet, θ Men, 5 Cnc, 77 σ Leo, 7 δ Crv, ι^2 Nor, ζ CrA.

Table 1: The mean amplitudes of various types of B6 through B9 stars

Spectral classes	Number	Mean Amplitude (mag)	Comment
B6IIII	18	0.028 ± 0.013	
B7IIII	30	0.025 ± 0.012	
B8III	55	0.026 ± 0.010	
B8.5III	3	0.023 ± 0.006	
B9III	48	0.026 ± 0.023	
B9.5III	10	0.023 ± 0.007	
B7III–IV	5	0.024 ± 0.009	
B8III–IV	4	0.045 ± 0.037	
	3	0.027 ± 0.006	without V487 Car
B9III–IV	7	0.027 ± 0.016	
B9.5III–IV	3	0.020 ± 0.000	
B6IV	22	0.030 ± 0.016	
B7IV	17	0.043 ± 0.058	
	16	0.030 ± 0.023	without 31 Aqr
B8IV	11	0.028 ± 0.013	
B9IV	28	0.024 ± 0.014	
B9.5IV	4	0.028 ± 0.015	
	3	0.020 ± 0.000	without V817 Tau
B7IV–V	3	0.027 ± 0.006	
B8IV–V	7	0.026 ± 0.010	
B9IV–V	14	0.024 ± 0.009	
B6V	44	0.036 ± 0.024	
	42	0.032 ± 0.015	without IP Vel & AL Scl
B7V	47	0.035 ± 0.036	
	45	0.028 ± 0.011	without V392 Pup & GG Lup
B7/8V	3	0.023 ± 0.006	
B8V	137	0.036 ± 0.059	
	131	0.025 ± 0.013	without β Per, HU Tau, V831 Cen, V760 Sco, V822 Her, & V822 Aql
B8/9V	18	0.027 ± 0.006	
B9V	130	0.027 ± 0.019	
	12	0.025 ± 0.012	without NO Pup & HD104568
B9.5V	80	0.046 ± 0.121	
	77	0.024 ± 0.008	without AR Aur, δ Lib, & RX Her

Table 3: Some stars with amplitudes greater than stars of similar spectral type

Name	HD number	Spectral type	HIP number	SE (mag)	Amp. (mag)	Comments
3 V377 Vul	182255	B6III	95260	0.0017	0.07	SPB
12 HK CMa	49333	B7IIIn	32504	0.0019	0.05	ACV
IT Vel	70084	B7III	40662	0.0019	0.05	ELL
V761 Cen	125823	B7IIIp	70300	0.0047	0.06	SXARI
IU CMa	44953	B8IIIHewk	30426	0.0015	0.05	ACV
OX Pup	63401	B8III	37982	0.0020	0.06	ACV
5 PT Ser	140873	B8III	77227	0.0024	0.05	
V4198 Sgr	177863	B8III	93887	0.0032	0.05	NSV 11743 SPB
13 V388 And	220885	B9III	115755	0.0018	0.05	ACV
V442 Cep	209809	B9III	108938	0.0062	0.14	NSV 14018, EB
DZ Eri	28843	B9III	21192	0.0081	0.11	SXARI
54 LM Vir	114846	B9III	64520	0.0025	0.06	EW
V487 Car	84809	B8III–IV	47893	0.0065	0.10	NSV 4623, ACV
TX Lep	34797	B8/9III/IV	24827	0.0023	0.06	ACV
HR 2968	61925	B6IVe	37345	0.0013	0.06	U
IU Lib	138764	B6IV	76243	0.0036	0.06	SPB
18 ι Lyr	178475	B6IV	93903	0.0016	0.07	GCAS
ξ Oct	215573	B6IV	112781	0.0014	0.05	P
31 o Aqr	209409	B7IVe	108874	0.0248	0.25	GCAS
KQ Mus	100359	B7IV	56246	0.0043	0.08	SPB
V542 Lyr	176318	B7IV	93104	0.0014	0.09	EA
PU Pup	61429	B8IV	37173	0.0028	0.06	EB
V869 Cen	123515	B9IV	69174	0.0030	0.06	NSV 6565, SPB
	135174	B9IV	74657	0.0048	0.05	U
HR 7285	179588	B9IV	94377	0.0024	0.06	U
V817 Tau	24769	B9.5IV	18485	0.0030	0.05	ACV
TZ Men	39780	B9.5IV–V	25776	0.0007	0.14	EA/D
IP Vel	84400	B6V	47694	0.0017	0.14	EA
HR 2360	45796	B6V	30524	0.0018	0.06	U
HZ CMa	50123	B6Vnpe	32810	0.0028	0.07	P
V371 Pup	59215	B6V	36246	0.0017	0.05	SPB
HR 2948	61555	B6V	37229	0.0008	0.08	NSV 3673, U
HR 3745	81753	B6Ve	46329	0.0018	0.05	NSV 4492, U
V964 Cen	115823	B6V	65112	0.0020	0.05	NSV 6190, EB
	210628	B6V	109424	0.0014	0.05	U
4 β Psc	217891	B6Ve	113889	0.0012	0.05	NSV14410, U
AL Scl	224113	B6V	117931	0.0010	0.10	EA/DM
V576 Per	21071	B7V	15988	0.0037	0.05	SPB
HR 2226	43179	B7V	29546	0.0011	0.06	U
V392 Pup	63215	B7V	37915	0.0011	0.11	GCAS, U
GG Lup	135876	B7V	74950	0.0013	0.25	EA
V1466 Aql	187961	B7V	97787	0.0078	0.06	NSV 12496, U
HR 7721	192276	B7V	99539	0.0022	0.05	U
26 β Per	19356	B8V	14576	0.0020	0.14	EA/SD
HU Tau	29365	B8V	21604	0.0012	0.37	EA/SD
	50138	B8e	32923	0.0061	0.10	U

Table 3 (cont.)

Name	HD number	Spectral type	HIP number	SE (mag)	Amp. (mag)	Comments
V410 Pup	66079	B8V	39084	0.0019	0.06	EB
V831 Cen	114529	B8V	64425	0.0053	0.15	NSV 6133, EB
η Mus	114911	B8V	64661	0.0006	0.06	EA
V760 Sco	147683	B8V	80405	0.0037	0.41	EA/DM
V974 Her	164447	B8Vne	88172	0.0049	0.07	GCAS, U
V4407 Sgr	174632	B8V	92649	0.0037	0.09	EB
V822 Her	174853	B8Vnn	92593	0.0056	0.15	NSV 11442, EB
V822 Aql	183794	B8V	96007	0.0067	0.43	EB/DM
2173 Cyg	208727	B8V	108348	0.0026	0.06	SPB
V761 Cas	7157	B9V	5688	0.0018	0.06	ACV
2 ξ Tau	21364	B9Vn	16083	0.0006	0.09	EA,U
NO Pup	71487	B9V	41361	0.0027	0.18	EA/KE
NY Vel	74067	B9V	42540	0.0022	0.05	NSV 4193, BCEP
V402 Lac	210405	B9V:	109354	0.0010	0.07	EA
V397 Pup	63786	B9V	38167	0.0007	0.09	NSV 3756, EA
	104568	B9V	58709	0.0041	0.10	
17 AR Aur	34364	B9.5V	24740	0.0012	0.57	EA
19 δ Lib	132742	B9.5V	73473	0.0059	0.89	EA/SD
RX Her	170757	B9.5V*	90727	0.0017	0.39	EA/DM

Notes:
ACV= α^2 Canum Venaticorum type, BCEP= β Cephei type, EA = Algol type variable, EB = β Lyrae type variable, ELL = rotating ellipsoidal variable, EW = W Ursa Majoris type variable, GCAS = γ Cassiopeiae type, I = irregular, MV = microvariable, P = periodic variable, SPB = slowly pulsating B star, SV = spurious variability due to duplicity, SXARI = SX Arietis type, and U = unresolved variable.

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ON THE VARIABILITY OF A3–F0 LUMINOSITY CLASS III–V STARS

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Several previous IBVS contributions (see, e.g., Adelman 2000) studied the Hipparcos photometry (ESA 1997) of stars from various parts of the HR Diagram in the Bright Star Catalogue, 5th edition (Hoffleit & Warren 1991) and the 4th edition Supplement (Hoffleit et al. 1983). Here I examine the A3–F0 stars of luminosity classes III–V except for those magnetic and non-magnetic CP stars which were studied by Adelman (1998). These stars also include δ Scuti variables, Algol type and other eclipsing binaries, W Ursae Majoris stars, microvariables, constant stars considered as variable by some observer(s), and stars with spurious variability due to duplicity, as well as nonvariable stars.

Table 1 shows the mean amplitudes of A3–F0 luminosity class III–V stars with at least 3 class members. When one allows for known variables and statistics, the mean amplitudes appear to be smallest for the A3–A7 III and A3–F0 IV stars with almost all averages indicating that these are not very variable stars. These values are similar to those found for B6–B9 III stars by Adelman, Gentry, & Sudiana (2000) and K0–K4 III stars by Adelman (2000). It is unlikely that all the small amplitude δ Scuti stars have been found as those with amplitudes comparable to the mean values were not readily discovered using Hipparcos photometry. The averages for the luminosity class III stars are similar to those of comparable luminosity class II stars given by Adelman, Cay, Cay & Kocer (2000).

Table 2 (available electronically from the IBVS site as 4969-t2.txt) contains the values for the stars whose averages appear in Table 1 as well as those which were not used in compiling these values, especially with spurious variability due to duplicity. Table 3 lists stars whose amplitudes of variability are a factor of order 1.67 or more greater than the means (without known δ Scuti stars), usually $0\overset{m}{.}04$ or greater. No known δ Scuti stars are included in this table. Those stars which have not been classified as belonging to a known type are in need of additional photometry.

Table 2 also contains many stars with amplitudes of 0.01 which should be considered as candidates for standard stars. A few are indicated to have spurious variability due to duplicity, but may still be suitable for certain applications. In addition 37 δ Cas is an eclipsing binary star and 82 NT Peg is a δ Sct star. This indicates that it would be desirable to check the literature of these stars for any high quality photometry before using them as standards.

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Table 1: The mean amplitudes of various types of A3 through F0 stars

Spectral class	No.	Mean amplitude (mag)
A3III	15	0.023 ± 0.007 (without EA HR 7422)
A4III	11	0.020 ± 0.004
A5III	18	0.022 ± 0.008
A7III	30	0.029 ± 0.015
	26	0.025 ± 0.009 (without 4 0.05-0.07 mag. variables)
A8III	11	0.019 ± 0.005
A9III	10	0.028 ± 0.008
F0III	42	0.030 ± 0.015
	33	0.025 ± 0.009 (without known δ Scuti stars)
A7III–IV	6	0.022 ± 0.004
A9III–IV	4	0.035 ± 0.010
F0III–IV	3	0.027 ± 0.006
A3IV	29	0.022 ± 0.008
A4IV	12	0.022 ± 0.009
A5IV	15	0.022 ± 0.004
A6IV	5	0.020 ± 0.007
A7IV	18	0.024 ± 0.007
A8IV	7	0.023 ± 0.005
A9IV	10	0.026 ± 0.008 (without δ Sct V376 Per)
F0IV	50	0.023 ± 0.006 (without δ Sct stars and known photometric variable binaries)
A5IV–V	8	0.024 ± 0.007
A6IV–V	3	0.033 ± 0.006
A7IV–V	5	0.026 ± 0.005
A9IV–V	3	0.027 ± 0.006
F0IV–V	10	0.028 ± 0.006
A3V	141	0.026 ± 0.030 (without RZ Cas)
A4V	56	0.027 ± 0.015 (without V1031 Ori)
A5V	61	0.024 ± 0.010 (without V1010 Oph)
A6V	16	0.026 ± 0.011
A7V	54	0.029 ± 0.025
A8V	27	0.028 ± 0.010
A9V	22	0.029 ± 0.007 (without S Ant)
F0V	80	0.028 ± 0.015

Table 3: Some stars with amplitudes greater than stars of similar spectral type

Name	HD number	Spectral type	HIP number	SE (mag)	Amp. (mag)	Comments
28 Peg	210516	A3III	109458	0.0008	0.04	
	16769	A5III	12821	0.0009	0.04	P
	104664	A7III	58765	0.0008	0.04	
41 Vir	112097	A7III	62933	0.0016	0.04	
	141296	A9III	77574	0.0009	0.04	
	118295	A7–F0III	66294	0.0008	0.04	
	107054	A9.5III	60018	0.0008	0.04	
υ^1 Cnc	72041	F0IIIn	41816	0.0017	0.05	U
	111102	F0III	62428	0.0009	0.05	
36 Her	150379	A3IV	81634	0.0010	0.04	
	88987	A9IV	50305	0.0013	0.04	
	69682	F0IV	40878	0.0010	0.04	
	222226	F0IV	116699	0.0014	0.04	
	55595	A5IV–V	34814	0.0010	0.04	
NSV 8183	155154	F0IV–Vn	83317	0.0010	0.04	U
LR And	1826	A3V	1799	0.0025	0.04	ELL
V773 Cas	10543	A3V	8115	0.0011	0.05	EA
	23055	A3V	17223	0.0010	0.04	
42 V467 Per	23848	A3V	17886	0.0017	0.05	EB
	24805	A3V	18286	0.0009	0.04	
RR Lyn	44691	A3Vm	30651	0.0009	0.36	EA/DM
32 τ^2 Hya	82446	A3V	46776	0.0008	0.06	U
65 DN UMa	103483	A3Vn	58112	0.0012	0.08	EB
NSV 5983	111604	A3V	62641	0.0018	0.04	U
	168740	A3V	90304	0.0013	0.04	MV
	195481AB	A3V	101223	0.0010	0.04	
	14213	A4V	10814	0.0016	0.04	MV
26 Cam	38091	A4Vn	27249	0.0014	0.04	NSV 2615, U
	82380	A4V	46873	0.0011	0.04	
22 Com	109307	A4V	61295	0.0010	0.04	
	130917	A4V	72552	0.0006	0.04	
	215631	A4V	112725	0.0009	0.04	
V343 Peg	218395	A4Vn	114187	0.0015	0.12	NSV 14430, U
	51335	A5V	33385	0.0014	0.04	
π Vir	104321	A5V	58590	0.0008	0.04	MV
V342 Peg	218396	A5V	114189	0.0049	0.08	P
	73819	A6Vn	42600	0.0012	0.04	
	126859	A6V	70904	0.0014	0.05	
	199986	A5/7V	103557	0.0014	0.04	
DD Cam	24733	A7V	18585	0.0062	0.19	EB
	68457	A7Vm	40474	0.0015	0.04	U
	76512	A7V:n	43853	0.0007	0.04	
α Aql	187642	A7V	97649	0.0011	0.05	EA

Table 3: (cont.)

Name	HD number	Spectral type	HIP number	SE (mag)	Amp. (mag)	Comments
48 LMi	94480	A8V	53355	0.0026	0.07	U
92 Vir	121607	A8V	68092	0.0013	0.04	U
	103928	A9V	58369	0.0010	0.04	MV
	149989	A8/F0V	81650	0.0012	0.04	P
	154660	A9V	83738	0.0018	0.04	MV
	11100	F0V	8417	0.0015	0.06	MV
9 V398 Aur	32537	F0V	23783	0.0027	0.06	SR
V368 Pup	58634	F0V:	35960	0.0020	0.05	P
	82582	F0V	46963	0.0010	0.04	MV
30 LMi	90277	F0V	51056	0.0007	0.04	
LL Vel	96008	F0V	54060	0.0016	0.05	ELL
BW Boo	128661	F0V	71487	0.0009	0.05	EA/DM
V533 Lyr	172187	F0V	91250	0.0022	0.12	EB
	204153	F0V	105769	0.0007	0.04	MV

Notes:

EA = Algol type eclipsing binary

EB = eclipsing binary

EW = W Ursae Majoris type variable

MV = microvariable

P = periodic variable

SR = semi-regular variable

U = unresolved variable

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AN SX Phe STAR IN THE GLOBULAR CLUSTER M15

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We present observational results of a newly discovered SX Phe star, SX1 ($\mathrm{RA}_{2000} = 21^{\mathrm{h}}29^{\mathrm{m}}39\overset{\mathrm{s}}{.}4$, $\mathrm{DEC}_{2000} = 12°11'43\overset{''}{.}4$, $V = 18\overset{\mathrm{m}}{.}450$, $B - V = 0\overset{\mathrm{m}}{.}225$, from our observation), in a field located $102\overset{''}{.}4$ north and $283\overset{''}{.}5$ west from the center of the globular cluster M15 ($21^{\mathrm{h}}29^{\mathrm{m}}58\overset{\mathrm{s}}{.}3$, $+12°10'01''$, Djorgovski & Meylan 1993). We could not find this star at the recent catalogue of variable stars in globular clusters (Clement 2000).

Time-series *BV* CCD photometry was performed over four nights from August 12th to 16th, 1999. The observations were done with an SITe 2048 × 2048 CCD camera attached to the 1.8-m telescope at the Bohyunsan Optical Astronomy Observatory (BOAO). The size of the field of view of a CCD image is $11\overset{'}{.}6 \times 11\overset{'}{.}6$ at the $f/8$ Cassegrain focus of the telescope.

Using IRAF/CCDRED package, we processed images to correct overscan regions, trim sections, subtract bias frames and correct flat field images. Instrumental magnitudes were obtained using the Point Spread Function fitting photometry routine in IRAF/DAOPHOT package (Stetson 1987, Massey & Davis 1992). We applied the ensemble normalization technique (Gilliland & Brown 1988, Kim *et al.* 1999) to standardize the instrumental magnitudes of all stars in the time-series CCD frames.

A finding chart of SX1 is shown in Figure 1. Light curves of SX1 are displayed in Figure 2, which shows amplitude modulating features implying the excitation of closely-separated pulsating frequencies. We have obtained power spectra for SX1 from the multiple frequency analysis (Kim & Lee 1996), as shown in Figure 3. Table 1 lists the results

Table 1: Results of the multiple frequency analysis

	B-band				*V*-band			
	Freq. (c/d)	Amp.[1]	Phase[1]	S/N[2]	Freq. (c/d)	Amp.[1]	Phase[1]	S/N[2]
f_1	24.626	$0\overset{\mathrm{m}}{.}054$	3.67	13.7	24.626	$0\overset{\mathrm{m}}{.}049$	3.62	14.2
f_2	24.350	$0\overset{\mathrm{m}}{.}031$	−1.21	6.7	24.353	$0\overset{\mathrm{m}}{.}025$	3.63	5.9
s.d.[3]		$0\overset{\mathrm{m}}{.}023$				$0\overset{\mathrm{m}}{.}020$		

[1] B or $V = \text{constant} + \Sigma_j A_j \cos 2\pi f_j(t - t_0) + \phi_j$, $\quad t_0 = \text{HJD } 2451400$

[2] Amplitude signal to noise ratio introduced by Breger *et al.* (1993)

[3] Standard deviation after fitting synthetic curves to the data

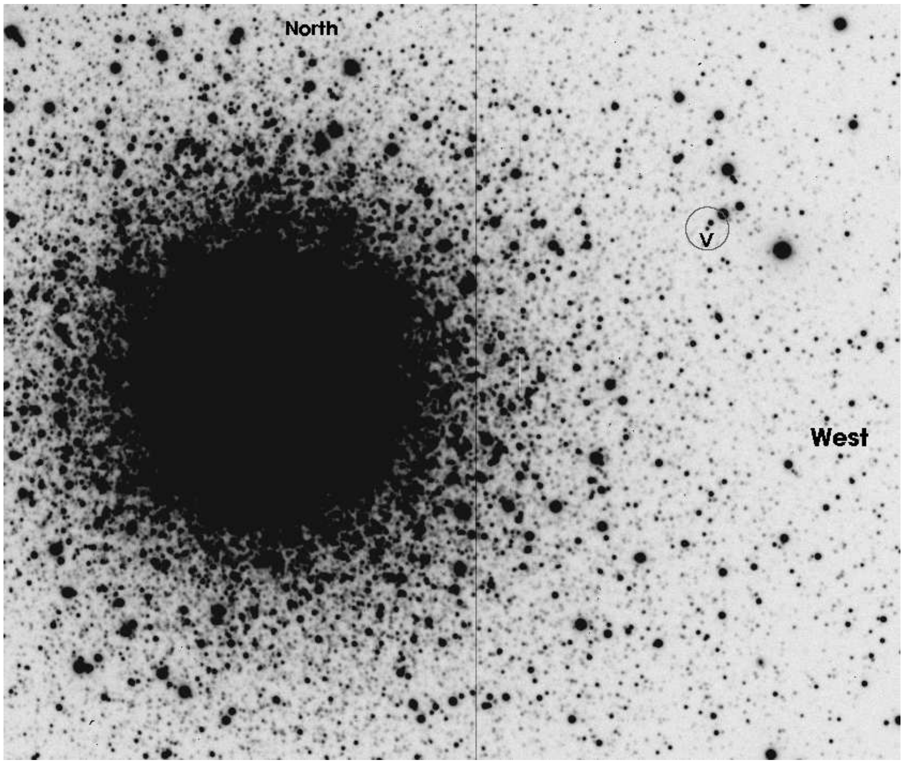

Figure 1. A greyscale map of a V-band CCD image of the globular cluster M15. The new SX Phe star SX1 is denoted by 'V' in the center of the small circle.

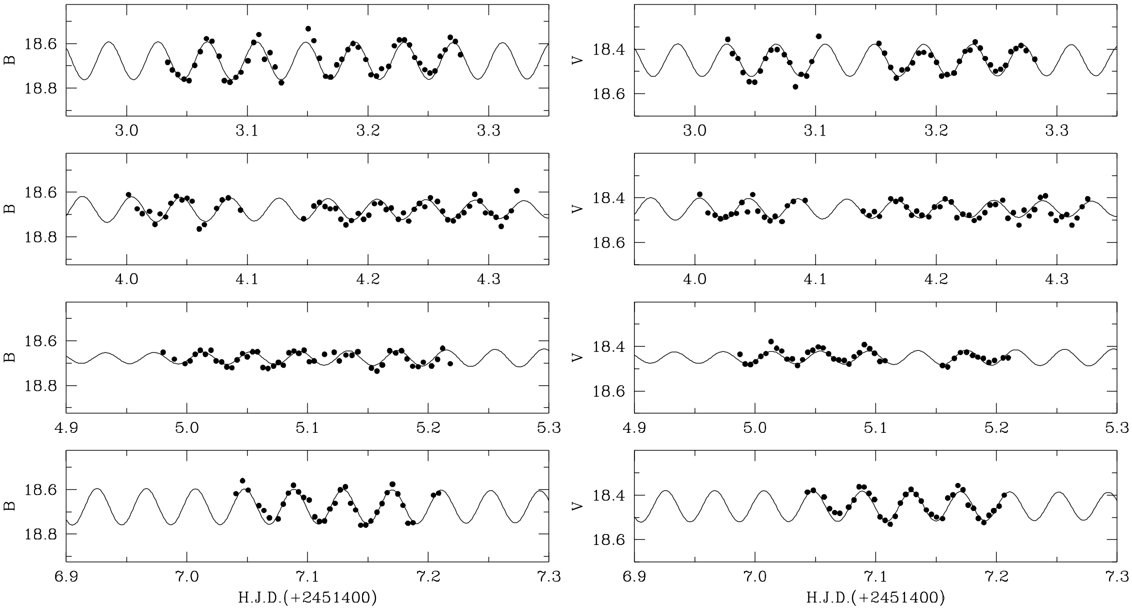

Figure 2. Light curves of SX1, B-band (left) and V-band (right). Synthetic curves obtained from the multiple frequency analysis (see Table 1) are superimposed to the data.

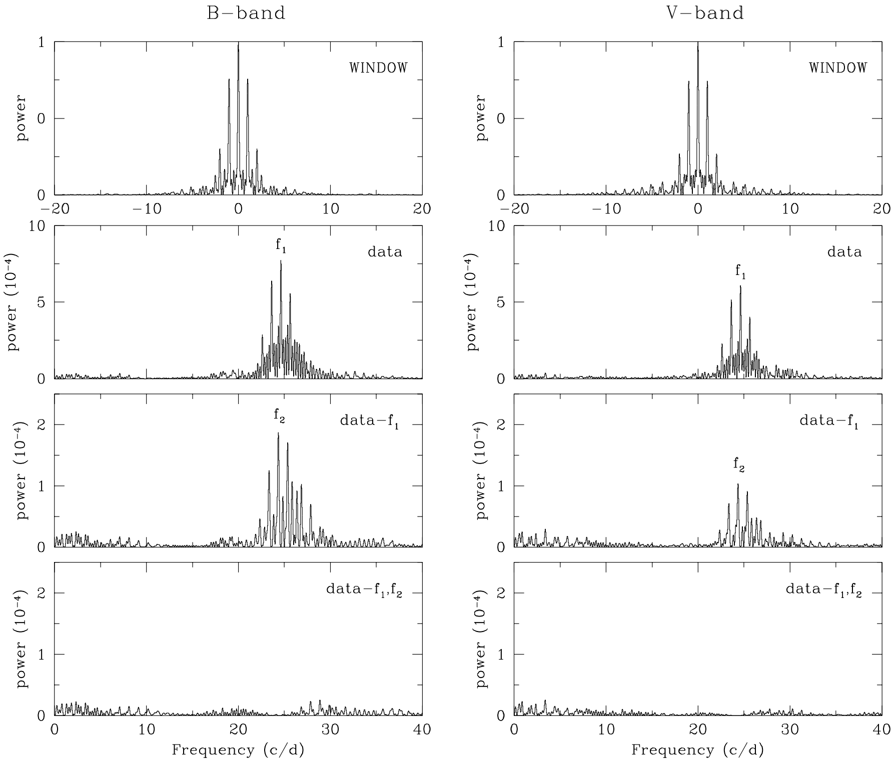

Figure 3. Power spectra of SX1 for the *B*-band (left) and *V*-band (right). Window spectra are in the top panel. Two closely-separated frequencies, f_1 and f_2, are obviously found.

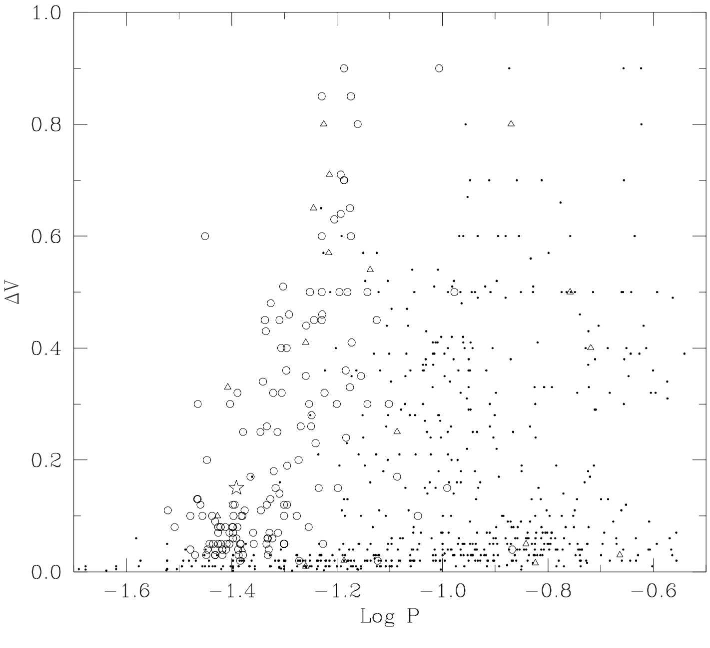

Figure 4. *V* amplitude versus period diagram: star symbol for the new SX Phe star SX1, small dots for δ Sct stars (Rodríguez *et al.* 2000), open triangles for field SX Phe stars (Rodríguez *et al.* 2000) and open circles for SX Phe stars in other globular clusters (Rodríguez & Lopez-Gonzalez 2000).

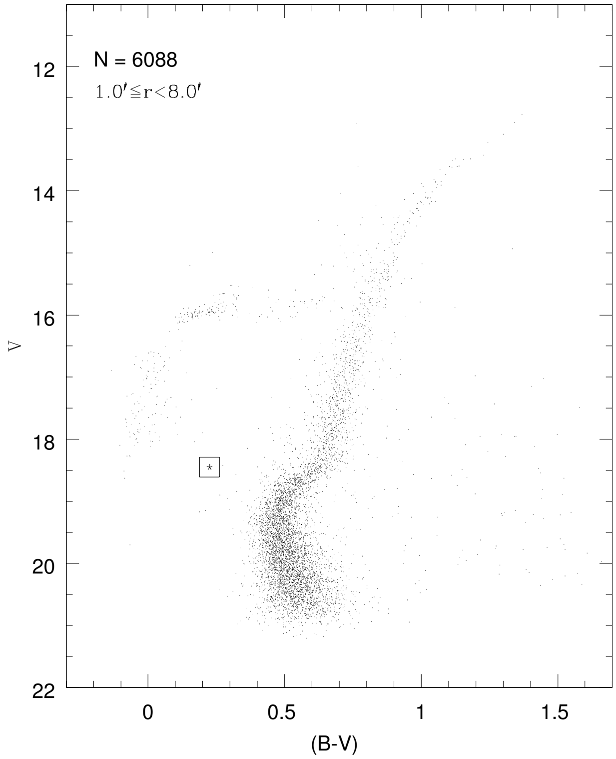

Figure 5. Position of SX1 in the color-magnitude diagram of the globular cluster M15. Note that it is located at the blue straggler region.

of the analysis. Considering the position in the period–amplitude diagram (Figure 4) and the color–magnitude diagram (Figure 5), SX1 might be identified as an SX Phe star and/or a pulsating blue straggler star in the cluster.

Detailed analysis of color variations, pulsation modes and the period–luminosity relation will be given elsewhere.

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

Number 4971

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THE ORBITAL PERIOD OF LV HERCULIS

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The variability of this star (TYC 2076-1042-1; $17^{\rm h}35^{\rm m}32\overset{\rm s}{.}4$, $+23^\circ10'31''$, J2000; Sp F9, $V = 10.9$) was announced by Hoffmeister (1935), but has received little attention since then. Zessewitsch (1944) reported a period of 2.634 days and classified it as an Algol type system, but in a later study presenting times of minimum (Zessewitsch 1954) the period is listed as being 5.2674 days, or twice as long. Further times of minimum for LV Her were given by Huth (1964), but they do not seem to fit either ephemeris.

Spectroscopic observations were reported by Popper (1996), who determined the spectral type of the nearly equal components to be G0, in good agreement with the F9 type implied by the Strömgren photometry by Hilditch & Hill (1975). Popper expressed difficulty in finding an orbital period fitting his observations, and ruled out the value of 5.2674 days. Less than half of his 29 spectra showed double lines, indicating substantial orbital eccentricity. The mass ratio was estimated to be close to unity. He concluded that an orbital period of 9.218 days fits 11 of his 13 double-lined spectra, with an eccentricity of 0.45, and also seems to agree with the times of minimum reported by Zessewitsch (1954). However, he pointed out that this period is inconsistent with two of his observations, and that a further more serious inconsistency is given by the fact that the total mass for the system implied by the 9.218-day period orbit is only about 1.0 $M_\odot$, much too small for two main-sequence stars of spectral type F9 or G0 in an eclipsing system.

LV Her was observed spectroscopically at the Harvard-Smithsonian Center for Astrophysics (CfA) in order to clarify the issue. A total of 18 observations have been obtained to date with an echelle spectrograph on the 1.5-m Tillinghast reflector at the F. L. Whipple Observatory (Mt. Hopkins, Arizona, USA). A single echelle order spanning 45 Å was recorded at a resolving power of $\lambda/\Delta\lambda = 35{,}000$, centered at a wavelength of 5187 Å. Radial velocities for both components were derived with the two-dimensional cross-correlation technique TODCOR (Zucker & Mazeh 1994), which uses two templates, one for each component. The templates for this star were selected from an extensive library of synthetic spectra based on model atmospheres by R. L. Kurucz (available at `http://cfaku5.harvard.edu`), computed by Jon Morse (Morse & Kurucz, in preparation).

An excellent fit to the velocities was found for a period of 18.13120 days, which is nearly twice the tentative period given by Popper. The observations and the double-lined orbital solution are shown graphically in Fig. 1, and the preliminary elements are given in Table 1. The orbit is indeed quite eccentric, and the mass ratio close to unity, as reported by

Popper. More importantly, the minimum masses of the components, while still relatively poorly determined because of the lack of observations near maximum velocity separation, are close to 1 $M_\odot$ for each star, in excellent agreement with the spectral type. Grids of cross-correlations against templates over a range of effective temperatures indicate that both stars are best fit with spectra having a temperature of 6000 K, corresponding to spectral type F9. This confirms Popper's classification, and leaves little doubt that the period in this well-detached system now is well established. From the measured projected rotational velocities ($v \sin i = 12$ km s^{-1} for both stars), the components appear to be synchronized with the orbital motion at periastron (pseudo-synchronized).

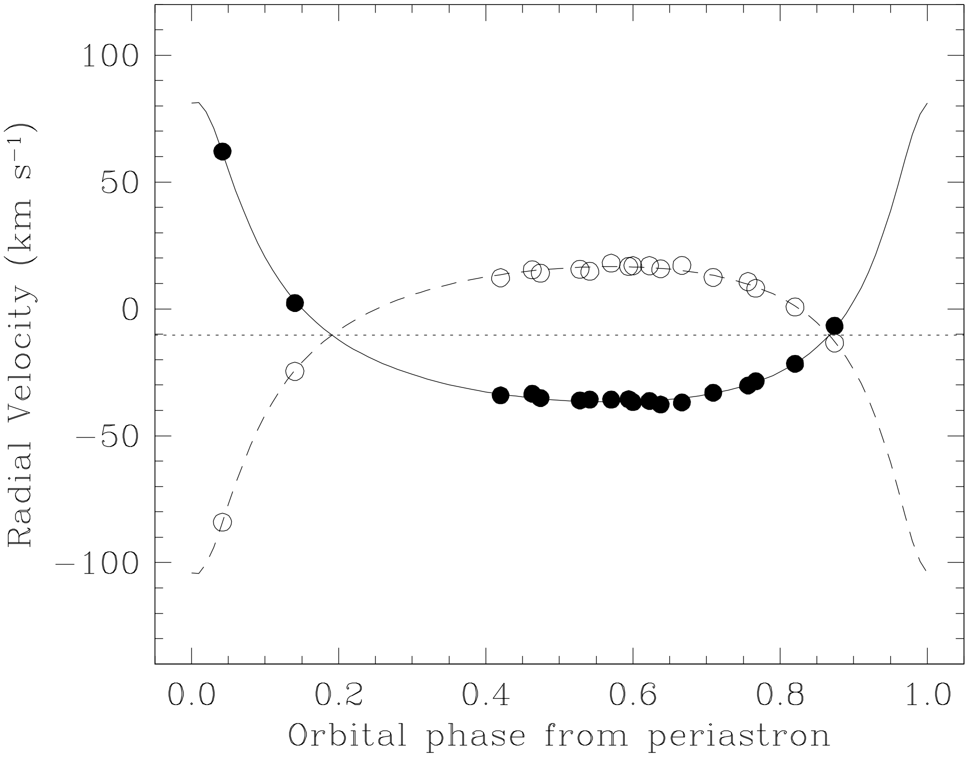

Figure 1. Spectroscopic orbital solution for LV Her

The ephemeris for eclipses that we derive for LV Her from these data is:

$$\mathrm{Min\ I} = 2,450,538.23\,(\pm\,0.20) + 18.13120\,(\pm\,0.00074) \times E,$$
$$\mathrm{Min\ II} = 2,450,535.24\,(\pm\,0.12) + 18.13120\,(\pm\,0.00074) \times E.$$

A difficulty remains, however, in that the published times of minimum do not fit this ephemeris. Apsidal motion, though certainly possible in this eccentric system, is expected to be very small due to the wide separation of the stars, and thus cannot explain the discrepancy.

Further times of minimum would be very helpful to improve our knowledge of the system, and the ephemeris presented above is intended to facilitate the observation. Complete photoelectric light curves on a standard system are also needed in order to establish the absolute dimensions of the components accurately. To this end, spectroscopic observations of LV Her will continue at the CfA until a definitive orbit is obtained.

Table 1: Preliminary spectroscopic elements for LV Her

Parameter	Value
P (days)	18.13120 ± 0.00074
γ ($\mathrm{km\,s^{-1}}$)	-10.34 ± 0.20
K_A ($\mathrm{km\,s^{-1}}$)	59.2 ± 3.6
K_B ($\mathrm{km\,s^{-1}}$)	60.7 ± 3.7
e	0.562 ± 0.027
ω (deg)	351.4 ± 1.0
$T_{\rm peri}$ (HJD)	$2{,}450{,}536.485 \pm 0.028$
$a_A \sin i$ (10^6 km)	12.22 ± 0.54
$a_B \sin i$ (10^6 km)	12.52 ± 0.55
$M_A \sin^3 i$ ($\mathrm{M}_\odot$)	0.93 ± 0.12
$M_B \sin^3 i$ ($\mathrm{M}_\odot$)	0.91 ± 0.12
$q \equiv M_B/M_A$	0.976 ± 0.016
N	18
σ_A ($\mathrm{km\,s^{-1}}$)	1.00
σ_B ($\mathrm{km\,s^{-1}}$)	1.08

References:

Hilditch, R. W., & Hill, G., 1975, *MemRAS*, **79**, 101
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Huth, H., 1964, *Mitt. Veränd. Sterne, Sonneberg*, Band 2, Heft 5, 112
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Budapest
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GSC 156_1365, A NEW EB ECLIPSING BINARY STAR IN MONOCEROS

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Name of the object:
GSC 156_1365 = PPM 151295 = AGK +05°0881

Equatorial coordinates:	**Equinox:**
R.A.= $6^h48^m43\overset{s}{.}5$ **DEC.=** $+5°02'01''$	2000.0

Observatory and telescope:
Mollet Observatory, 0.41-m Newtonian telescope US Naval Observatory, 1-m Ritchey–Chretien telescope Piera Observatory, 0.09-m Maksutov telescope

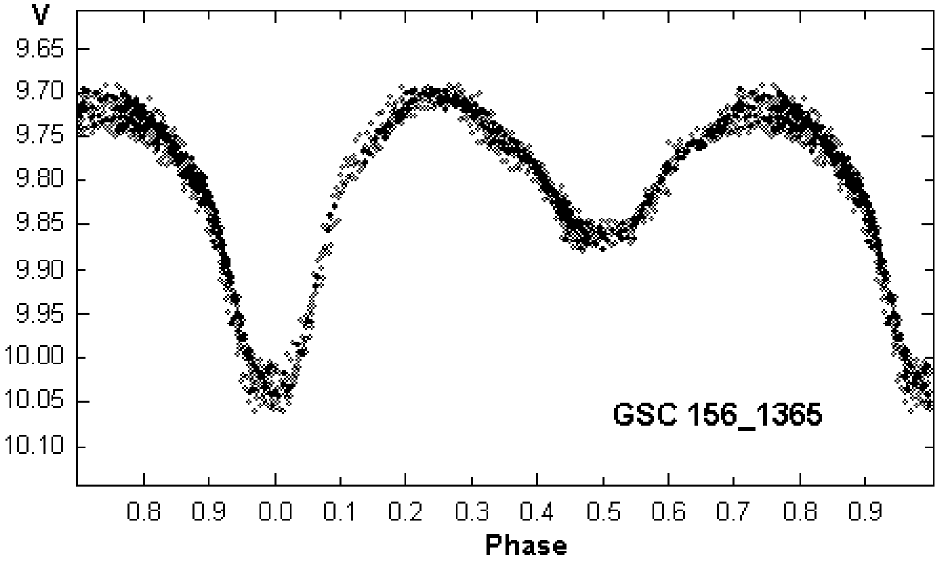

Figure 1.

Detector:	CCD

Filter(s):	*V*

Comparison star(s):	GSC 156_1475

Transformed to a standard system:	Standard Johnson
Standard stars (field) used:	Landolt standards (1992)

Availability of the data:
Upon request

Type of variability:	EB

Remarks:

The variability of GSC 156_1365, a star with a V magnitude of 9.74 and B9 spectral type ($B-V=0.130$), was discovered by chance with a 9-cm telescope at Piera Observatory while performing observations of NSV 03217. To improve photometric precision, the star was monitored for 95 nights from 29 January 1997 to 27 March 1998 with the 41-cm telescope at Mollet del Valles Observatory. The stars in the field of GSC 156_1365 were also placed in the Johnson–Cousins system in the $BVRI$ bands with the Ritchey–Chretien 1-m telescope at the US Naval Observatory Flagstaff Station.

Photometric data, with an average scatter of $0\overset{\mathrm{m}}{.}007$, indicated that GSC 156_1365 is an EB type eclipsing binary star with a period close to 1 day, with a variation in the V band from $9\overset{\mathrm{m}}{.}375$ to $10\overset{\mathrm{m}}{.}075$ for minimum I, and to $9\overset{\mathrm{m}}{.}889$ for minimum II. The light curve showed a transient O'Connell effect (O'Connell 1951) of $0\overset{\mathrm{m}}{.}025$ during the maximum preceding the primary minimum, whose shape and depth were also variable with time. These time-variable phenomena were incidentally observed after monitoring the star for 14 months, since its period close to 1 day forced to a long observational time span to complete the light curve. Thus, at the beginning of 1997 the O'Connell effect was present with a $0\overset{\mathrm{m}}{.}025$ amplitude, and the primary minimum was $0\overset{\mathrm{m}}{.}032$ shallower. By the end of 1997 and the beginning of 1998, the O'Connell effect was not detectable at all, and primary minimum was deeper.

Observations also allowed to determine the following ephemeris:

$$\begin{array}{rl}\text{Min I} = \text{HJD } & 2450869.40404 + 0\overset{\mathrm{d}}{.}989888 \times E.\\ & \pm\, 0.00043 \pm 0.000004\end{array}$$

References:

Landolt, A.U., 1992, *AJ*, **104**, 340
O'Connell, D.M.K., 1951, *Riverview Pub.*, **2**, 85

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

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26 October 2000

HU ISSN 0374 – 0676

NSV 01756: A RED VARIABLE IN ERIDANUS

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Name of the object:
BD −05°1073 = GSC 4745_1397 = HV 10413 = CSV 000454

Equatorial coordinates:	**Equinox:**
R.A.= $04^{h}53^{m}27\overset{s}{.}83$ **DEC.=** $-05°34'49\overset{''}{.}0$	2000.0

Observatory and telescope:
Mollet del Valles Observatory, 0.4-m Newton telescope US Naval Observatory Flagstaff Station, 1.0-m Ritchey–Chretien telescope

Detector:	CCD in all cases

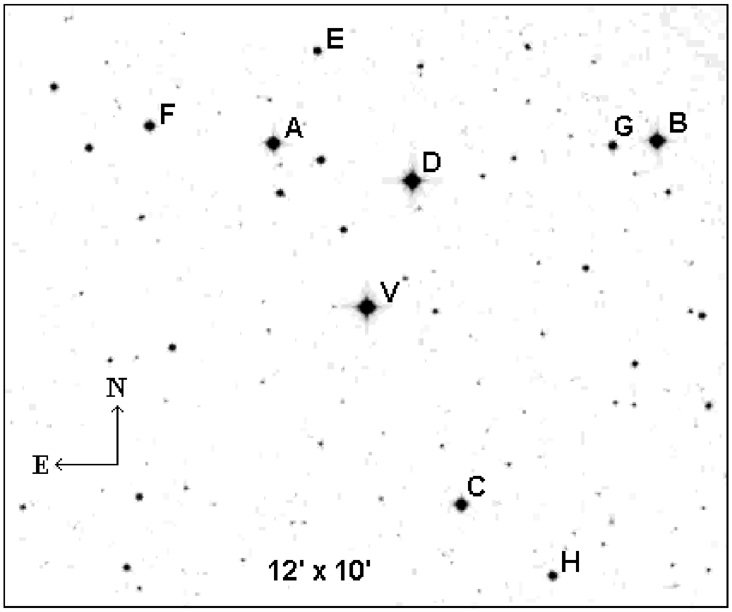

Figure 1. Field of NSV 01756 (V = variable) made from RealSky (1996), and the standardized field stars listed in Table 1

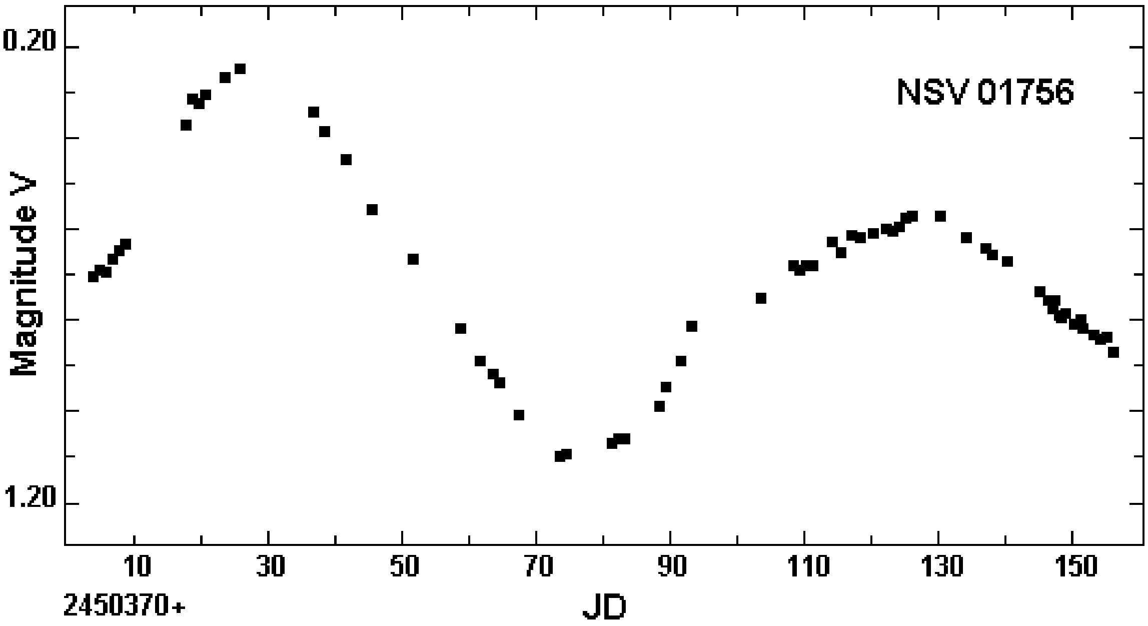

Figure 2.

Table 1

Star	GSC	V	s.d.	$B-V$	s.d.	$V-R_c$	s.d.	R_c-I_c	s.d.
A	4745_1330	11.063	0.013	0.502	0.017	0.299	0.013	0.309	0.009
B	4745_1403	10.599	0.008	0.536	0.018	0.311	0.013	0.311	0.008
C	4749_0698	11.609	0.008	0.538	0.012	0.335	0.011	0.287	0.010
D	4745_1325	10.376	0.016	1.154	0.017	0.592	0.024	0.512	0.011
E	4745_1227	13.759	0.027	0.586	0.053	0.370	0.036	0.341	0.107
F	4745_1303	13.036	0.014	1.384	0.056	0.733	0.016	0.669	0.035
G	4745_1360	13.399	0.031	0.791	0.055	0.419	0.042	0.480	0.056
H	4749_0397	13.216	0.006	0.527	0.033	0.336	0.029	0.299	0.060

Table 2

JD 2400000 +	V	s.d.	$B-V$	s.d.	$V-R_c$	s.d.	R_c-I_c	s.d.
50516.6661	10.755	0.001	1.671	0.001	1.317	0.003	1.738	0.001
50517.6592	10.755	0.002	1.655	0.002	1.323	0.005	1.730	0.001
50518.6260	10.793	0.003	1.642	0.004	1.325	0.002	1.766	0.002
50521.6297	10.819	0.002	1.647	0.004	1.321	0.003	1.756	0.003
50753.8732	10.839	0.001	1.668	0.002	1.336	0.001	1.754	0.001
50776.9077	10.714	0.002	1.651	0.003	1.335	0.003	—	—
50821.7318	10.866	0.001	1.598	0.003	1.344	0.003	1.856	0.002
50835.7631	10.703	0.003	1.590	0.005	1.312	0.002	1.829	0.002
50836.6767	10.677	0.002	1.617	0.004	1.303	0.003	1.823	0.004
50837.6255	10.660	0.002	1.615	0.002	1.293	0.002	1.802	0.003
50838.7089	10.644	0.002	1.626	0.002	1.288	0.003	1.767	0.004
50839.6702	10.643	0.001	1.622	0.001	1.289	0.002	1.802	0.005

Filter(s):	B, V, R, I

Comparison star(s):	BD –05°1072 = PPM 701872 = GSC 4745_1325

Check star(s):	GSC 4745_1330

Transformed to a standard system:	Johnson–Cousins
Standard stars (field) used:	Landolt standards (Landolt, 1992)

Availability of the data:
Tables 1 and 2

Type of variability:	SR

Remarks:
The variability of NSV 01756 was announced by Handley and Shapley (1940). They indicated that this object was an eclipsing binary star with a photographic magnitude variation from $12\overset{\mathrm{m}}{.}8$ to $13\overset{\mathrm{m}}{.}5$. Bidelman (1987) estimated an M4 spectral type. To know more about NSV 01756, the star was systematically observed in the V band for 61 nights from October 1996 to March 1997, and occasionally observed in 1995 and 1998. Some observations were obtained in B, R and I bands. Figure 1 shows the field of NSV 01756. Table 1 lists the standardized V magnitudes and color indices of comparison stars near the variable, while Table 2 lists the color indices for NSV 01756. Observations show no evidence for the star to be an eclipsing binary. The light curve suggests that probably it is a semiregular variable. The maximum detected amplitude in the V band was $0\overset{\mathrm{m}}{.}84$, from $10\overset{\mathrm{m}}{.}25$ to $11\overset{\mathrm{m}}{.}10$ (Figure 2). Data show two successive light maxima separated by a time span of 100 days, but since SR stars show period variations between successive light maxima, more observations should be performed to ascertain the long term behavior of NSV 01756.

References:

Bidelman, W.P., 1987, *IBVS*, No. 2993
Handley, C.M., Shapley, H., 1940, *HB*, No. 913
Landolt, A.U., 1992, *AJ*, **104**, 340
RealSky, 1996, The Astronomical Society of the Pacific and the Space Telescope Science Institute, San Francisco

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

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NSV 11766 IS A NEW SHORT PERIOD PULSATING VARIABLE

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Name of the object:
NSV 11766 = GSC 4431_546 = BV 0062 = CSV 008121

Equatorial coordinates:	**Equinox:**
R.A.= $19^{\mathrm{h}}06^{\mathrm{m}}26\overset{\mathrm{s}}{.}3$ **DEC.=** $+68^\circ29'2''$	2000.0

Observatory and telescope:
Esteve Duran Observatory, 0.6-m Cassegrain telescope l'Estelot Observatory, 0.3-m Newtonian telescope

Detector:	CCD in all cases

Filter(s):	B, V, R

Comparison star(s):	GSC 4431_386

Check star(s):	None

Transformed to a standard system:	No

Availability of the data:
Upon request

Type of variability:	SX Phe:

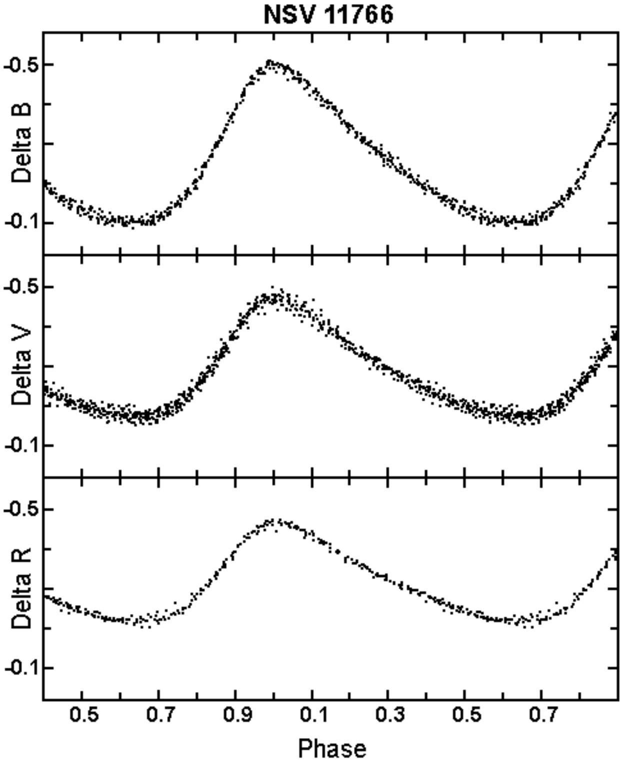

Figure 1.

Remarks:

The variability of NSV 11766 was first announced by Geyer et al. (1955), and finally listed in the NSV catalogue (Kholopov, 1982) as an unstudied variable with rapid light changes between the photographic magnitudes 11.6 and 12.0. In a program for searching new variables, the star was observed in the B, V, and R bands between May 1997 and June 2000, and also some observations where obtained in I. Photometric data show that NSV 11766 is actually a periodic rapid variable with a period close to 0.12 days and an amplitude of $0\overset{\mathrm{m}}{.}30$ in the V band (Figure 1), $0\overset{\mathrm{m}}{.}39$ in B, $0\overset{\mathrm{m}}{.}25$ in R, and $0\overset{\mathrm{m}}{.}25$ in I. Its short period and relatively large amplitude suggest that this object might be an SX Phe variable, although additional data should definitively determine its type. Photometry also indicates that the period of this object has remained stable within the given uncertainty. The following ephemeris was computed for light maxima:

$$\begin{array}{rl}\text{Max.} = \text{HJD } 2451697.6040 & + \; 0\overset{\mathrm{d}}{.}1181533 \times E. \\ \pm\, 0.0015 & \pm\, 0.0000002\end{array}$$

References:

Geyer, E., Kippenhahn, R., Strohmeier, W., 1955, *Kleine Veröffentlichungen der Universitäts-Sternwarte zu Berlin-Babelsberg*, No. 9

Kholopov, P.N., editor, 1982, New Catalogue of Suspected Variable Stars, Moscow

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

Number 4975

Konkoly Observatory
Budapest
27 October 2000

HU ISSN 0374 – 0676

CCD LIGHT CURVES OF ROTSE1 VARIABLES, III: GSC 2625.1563 HERCULIS

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Name of the object:
GSC 2625.1563 = ROTSE1 J180835.74+334205.7

Equatorial coordinates:	**Equinox:**
R.A.= $18^{h}08^{m}35.74^{s}$ **DEC.=** $+33^{\circ}42'05.7''$	2000.0

Observatory and telescope:
Private observatory, Schlüsselacher, Wald, 0.15-m refractor

Detector:	SBIG ST-7 CCD camera
Filter(s):	None
Comparison star(s):	GSC 2625.1672
Check star(s):	GSC 2629.1855

Availability of the data:
Upon request from diethelm@astro.unibas.ch

Type of variability:	EW

Remarks:

As a byproduct of the ROTSE1 CCD survey, a large number of new variables have been discovered (Akerlof et al., 2000). In a series of papers, we report unfiltered CCD observations for some of the close binary systems (type EW and E) in the list of Akerlof et al. (2000). GSC 2625.1563 was observed with our CCD equipment as mentioned above during 4 nights between JD 2451746 and JD 2451781. A total of 155 CCD frames were measured and Figure 1 shows these observations folded with the elements

$$\mathrm{JD(min,hel)} = 2451746.5126(4) + 0.2942801(12) \times E.$$

These elements of variation are deduced from a linear fit to the newly determined normal minima from the ROTSE1 data (JDH 2451258.8894(8), primary, JDH 2451277.8726(4), secondary) as well as the 6 minima (2 primary, 4 secondary) published in BBSAG Bulletin 123.

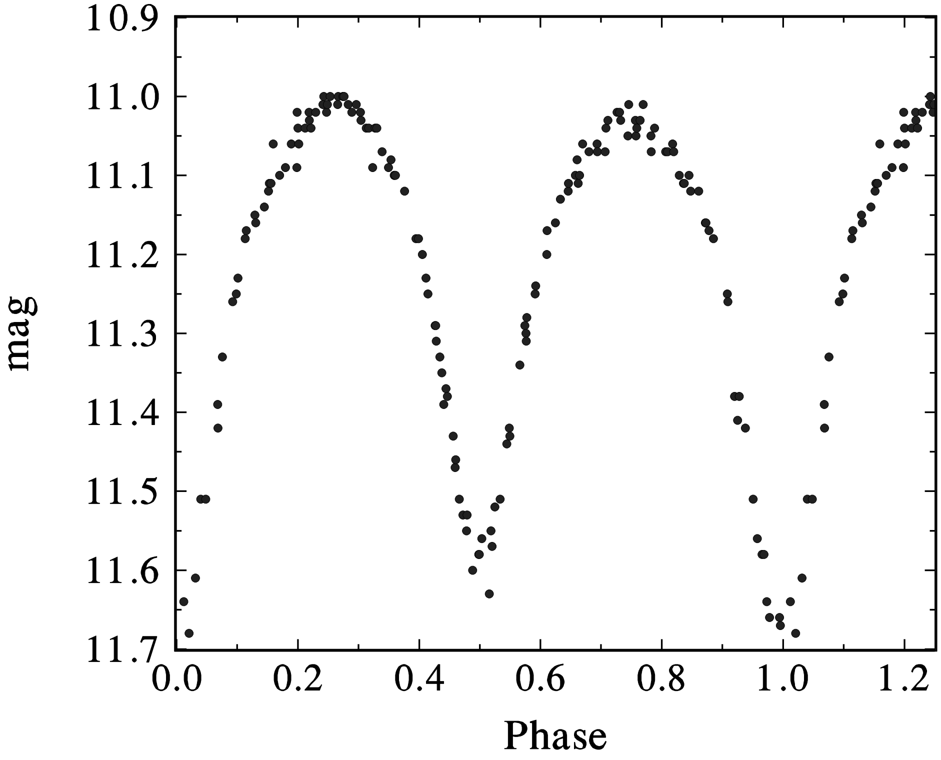

Figure 1. CCD light curve (without filter) of GSC 2625.1563

Acknowledgements:

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

References:

Akerlof, C., Amrose, S., Balsano, R., Bloch, J., Casperson, D., Fletcher, S., Gisler, G., Hills, J., Kehoe, R., Lee, B., Marshall, S., McKay, T., Pawl, A., Schaefer, J., Szymanski, J., Wren, J., 2000, *AJ*, **119**, 1901

Blättler, E., 2000, *BBSAG Bulletin*, No. 123, 6

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

Number 4976

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CCD LIGHT CURVES OF ROTSE1 VARIABLES, IV: GSC 2636.1753 LYRAE

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Name of the object:
GSC 2636.1753 = ROTSE1 J182712.15+361436.8

Equatorial coordinates:	**Equinox:**
R.A.= $18^h27^m12.15^s$ **DEC.=** $+36°14'36.8''$	2000.0

Observatory and telescope:
Private observatory Schlüsselacher, Wald, 0.15-m refractor

Detector:	SBIG ST-7 CCD camera
Filter(s):	None
Comparison star(s):	GSC 2636.1584
Check star(s):	GSC 2636.1675

Availability of the data:
Upon request from diethelm@astro.unibas.ch

Type of variability:	EW

Remarks:

As a byproduct of the ROTSE1 CCD survey, a large number of new variables have been discovered (Akerlof et al., 2000). In a series of papers, we report unfiltered CCD observations for some of the close binary systems (type EW and E) in the list of Akerlof et al. (2000). GSC 2636.1753 was observed with our CCD equipment as mentioned above during 4 nights between JD 2451757 and JD 2451781. A total of 134 CCD frames were measured and Figure 1 shows these observations folded with the elements

$$\mathrm{JD(min,hel)} = 2451757.5642(4) + 0.2731270(15) \times E.$$

These elements of variation are deduced from a linear fit to the newly determined normal minima from the ROTSE1 data (JDH 2451260.8816(14), secondary, JDH 2451288.8797(8), primary) as well as the 5 minima (3 primary, 2 secondary) published in BBSAG Bulletin 123.

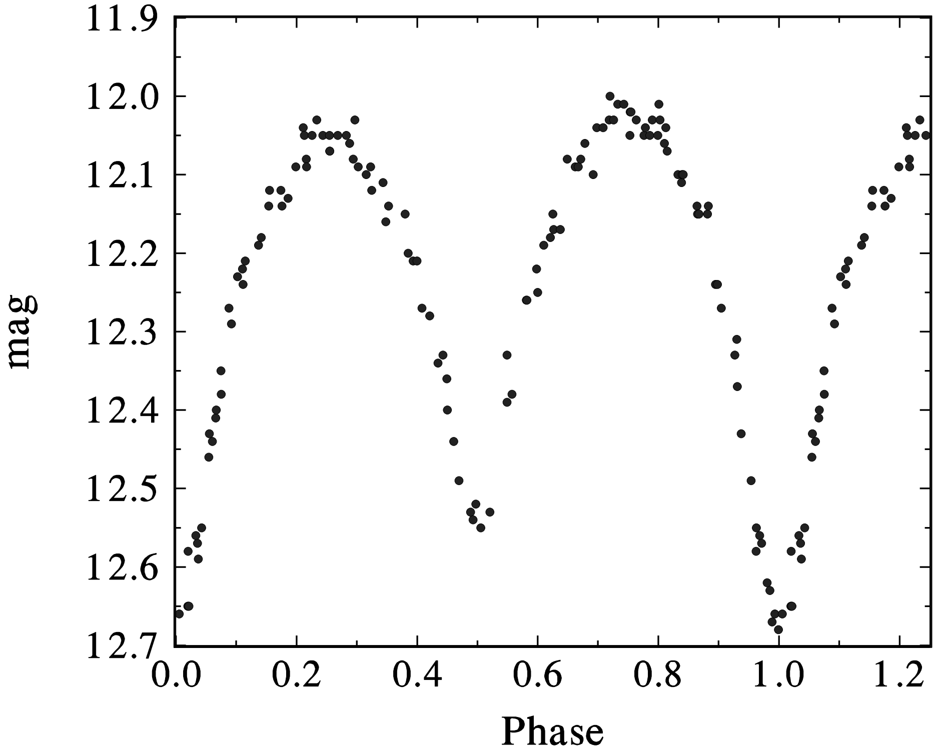

Figure 1. CCD light curve (without filter) of GSC 2636.1753

Acknowledgements:

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

References:

Akerlof, C., Amrose, S., Balsano, R., Bloch, J., Casperson, D., Fletcher, S., Gisler, G., Hills, J., Kehoe, R., Lee, B., Marshall, S., McKay, T., Pawl, A., Schaefer, J., Szymanski, J., Wren, J., 2000, *AJ*, **119**, 1901

Blättler, E., 2000, *BBSAG Bulletin*, No. 123, 6

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BVRI OBSERVATIONS OF V516 CYGNI IN OUTBURST

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V516 Cyg is a dwarf nova (DN) that varies between $m_{\rm pg} \simeq 13.8$ and $m_{\rm pg} \simeq 16.8$ (Downes & Shara 1993), but only a few photometric observations are available in the literature. We have already analysed this source in Spogli et al. (1998), but in that case we observed the source only during the descending phase after an outburst. In that period it had colour indices of $B-V=0.1$, $V-R_c=0.2$, $V-I_c=0.2$ at the apparent maximum.

We observed this DN at the Astronomical Observatory of Collurania–Teramo during August–September 1998 with the aim to better evaluate the photometric behaviour during all the outburst phase. The instruments used and the photometric techniques have been already described in Spogli et al. (2000).

We re-calibrated the comparison stars in the finding chart reported by Spogli et al. (1998). The standard magnitudes are listed in Table 1. Moreover, we measured the B magnitudes for the stars 2 and 3. Although the star 1 is double, we used it as a comparison star because the aperture size is sufficiently large to collect the light coming from both the sources. Probably one of these is the radio source WSRTGP 2045+4144 (Taylor et al. 1996).

Table 1: BVR_cI_c magnitudes of the selected comparison stars

No.	B	V	R_c	I_c
1	15.05 ± 0.06	14.20 ± 0.04	13.71 ± 0.04	13.25 ± 0.04
2	16.56 ± 0.07	15.34 ± 0.04	14.72 ± 0.04	14.15 ± 0.04
3	17.07 ± 0.08	15.57 ± 0.05	14.82 ± 0.04	13.91 ± 0.04

Two stars which are very bright in the infrared band are visible in the field of view, and were used to evaluate colour effects. One star (with $V=21.0\pm0.5$, $R_c=17.2\pm0.1$, $I_c=13.26\pm0.05$) is situated $\simeq 86'$ E and $\simeq 53'$ N with respect to V516 Cyg. The other ($V=19.2\pm0.3$, $R_c=16.9\pm0.1$, $I_c=13.95\pm0.05$) is $\simeq 3'$ W and $\simeq 26'$ N with respect to the DN. We calibrated the magnitudes also at the Astronomical Observatory of Perugia and no relevant differences are noticeable.

The comparison stars were used to find the value of the zero point of the magnitude scale for each CCD image and, then, to measure the dwarf nova standard magnitude and its error. Although for many observational runs we obtained more than one CCD image

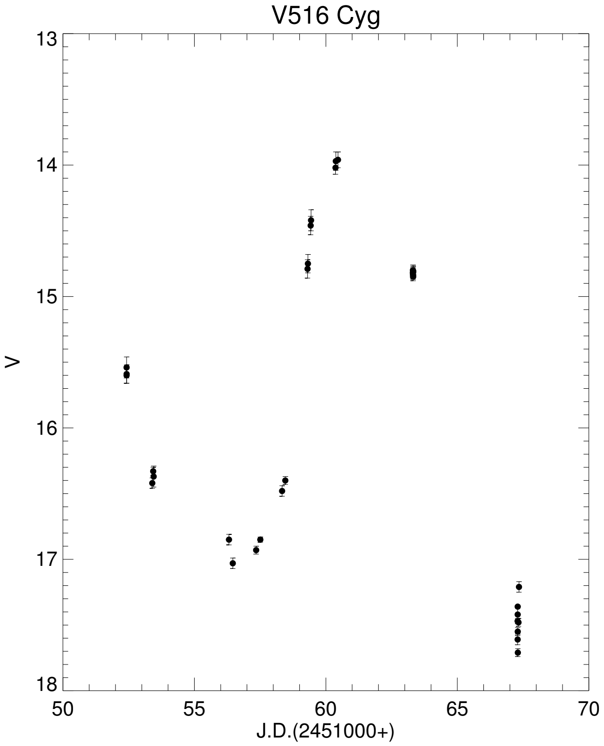

Figure 1. *V* light curve of V516 Cyg.

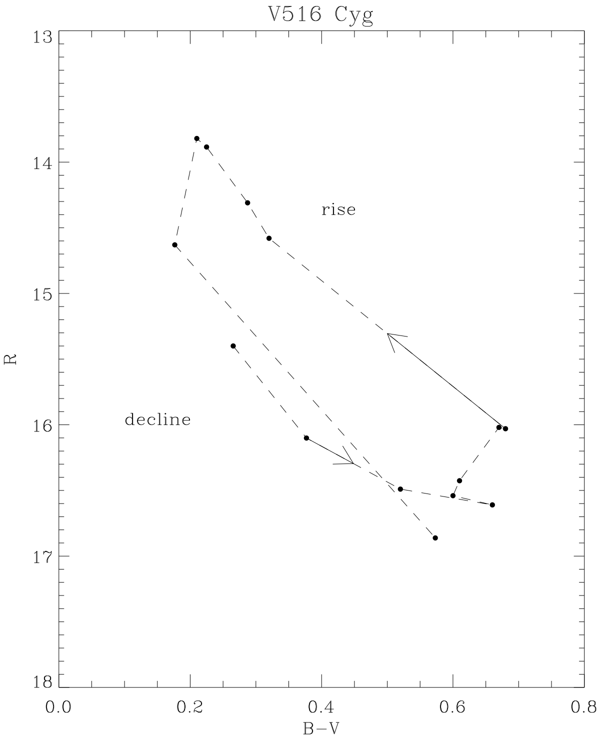

Figure 2. Colour index variations of V516 Cyg during the outburst

Table 2: BVR_cI_c magnitudes of V516 Cyg

JD (2451000 +)	B	V	R_c	I_c
52.4202	15.85 ± 0.03	15.58 ± 0.04	15.40 ± 0.02	15.11 ± 0.03
53.4277	16.74 ± 0.07	16.36 ± 0.02	16.10 ± 0.01	15.66 ± 0.01
56.3205	17.37 ± 0.03	16.85 ± 0.04	16.49 ± 0.01	15.97 ± 0.05
56.4615	17.69 ± 0.02	17.03 ± 0.04	16.61 ± 0.02	15.96 ± 0.04
57.3540	17.53 ± 0.02	16.93 ± 0.03	16.54 ± 0.02	15.92 ± 0.02
57.5042	17.46 ± 0.03	16.85 ± 0.02	16.43 ± 0.01	15.82 ± 0.03
58.3344	17.15 ± 0.04	16.48 ± 0.04	16.02 ± 0.01	15.40 ± 0.02
58.4545	17.08 ± 0.02	16.40 ± 0.03	16.03 ± 0.02	15.49 ± 0.03
59.3086	15.09 ± 0.02	14.77 ± 0.05	14.58 ± 0.01	14.37 ± 0.01
59.4285	14.73 ± 0.01	14.44 ± 0.05	14.31 ± 0.01	14.14 ± 0.02
60.3679	14.23 ± 0.01	14.00 ± 0.04	13.89 ± 0.01	13.82 ± 0.02
60.4603	14.17 ± 0.01	13.96 ± 0.06	13.82 ± 0.03	13.76 ± 0.05
63.3205	15.00 ± 0.03	14.83 ± 0.01	14.63 ± 0.01	14.47 ± 0.03
67.3155	18.00 ± 0.05	17.42 ± 0.01	16.86 ± 0.07	16.41 ± 0.02

(usually two in every filter), Table 2 reports only the average values. All photometric V measurements are shown in Figure 1.

At the beginning the dwarf nova was declining from a previous outburst and, at the end of August, it reached the minimum values of magnitude: $B = 17.7$, $V = 17.0$, $R_c = 16.6$ and $I_c = 16.0$. The new rising phase started a few days after and V516 Cyg reached the maximum in the night of September 3rd (JD 2451060), with $B = 14.2$, $V = 14.0$, $R_c = 13.9$ and $I_c = 13.8$. The star returned to minimum on September 10th (JD 2451067) with $V \simeq 17.4$, with a difference between the minimum and the maximum of $\Delta V \simeq 3.4$: our data show that sometimes V516 Cyg becomes fainter than the values listed by many catalogues. In this phase rapid oscillations are evident within a range of almost half a magnitude (see Fig. 1).

Figure 2 shows the almost entire loop of the $B - V$ colour index as a function of magnitude for V516 Cyg. At similar brightness levels, the system is bluer during decline and redder at rise.

Only very few investigations of colour changes in DNe during the full outburst cycle have been carried out up to date. The few observations reported in literature show that some sources follow a loop in the colour–magnitude diagram (see Warner 1995). This behaviour can be well explained with disk instability models. In these models, bursts which begin at a small disk radius (inside-out) produce symmetric light curves with comparable rise and decline times, while eruptions starting at a large disk radius (outside-in) generate asymmetric light curves with short rise times and protracted declines (Cannizzo & Kenyon 1987). The colour–magnitude loop can also be used to separate outside-in and inside-out outburst: in the first case the evolution of the colours is characterised by a large loop in the C–M diagram, while the colour evolution is exactly the same in the rise and decline phase for the inside-out outburst (the loop collapses to a line in the C–M diagram).

The fact that the outside-in outburst produces a reddening in colour when the instability sets in is basically equivalent to the UV delay phenomenon at the onset of outburst (for a review see Osaki 1996). In this case we obviously have a large loop in the colour–

magnitude diagram.

Our data show a large loop in the C–M diagram of V516 Cyg, which suggests that the predicted outside-in outburst of disk instability models are in agreement with the observations presented here.

In conclusion, we can say that the data presented here can be considered a substantial contribution to the poor optical database of V516 Cyg. In particular these measurements complete the preceding data reported in Spogli et al. (1998) covering for the first time the optical multicolour behavior over the outburst cycle.

Our observations are in agreement with outside-in outbursts, as described by Cannizzo & Kenyon (1987) in their disk instability models. The observed outburst probably starts in the outer part of the disk and the heating front propagates from the outside to the inside.

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BVRI OBSERVATIONS OF KT PERSEI IN OUTBURST

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[2] Teramo Astronomical Observatory, Collurania, Teramo, Italy

KT Persei is a well known dwarf nova (DN) of the Z Cam subtype, characterized by an orbital period of 0.1627 days and a typical time interval between two subsequent outbursts of 26 days (Ritter & Kolb 1998). The secondary has a spectral type of M3.3 ± 1 and an apparent brightness of $V = 17.9$ (Thorstensen & Ringwald 1997).

The observations were taken at the Astronomical Observatory of Collurania–Teramo with the 0.72-m Ritchey–Chretien reflector, equipped with a Tektronix 512 CCD camera and B, V (Johnson), R_c, I_c (Cousins) filters. The photometric techniques used have already been described by Spogli et al. (2000a and 2000b). We calibrated some of the comparison stars in the finding chart reported by Misselt (1996). The standard magnitudes are reported in Table 1. Considering the standard deviation, our data are in agreement with the measurements carried out by Misselt (1996), but show small systematic differences with respect to the data published by Henden & Honeycutt (1997). In any case differences are always within three standard deviations. Moreover we have included the calibration for the I_c filter.

Table 1: BVR_cI_c magnitudes of the selected comparison stars

No.	B	V	R_c	I_c
1	13.09 ± 0.04	12.56 ± 0.04	12.22 ± 0.04	11.86 ± 0.04
4	16.52 ± 0.06	15.16 ± 0.04	14.35 ± 0.04	13.50 ± 0.05
5	15.35 ± 0.05	14.26 ± 0.04	13.64 ± 0.04	13.06 ± 0.05
7	13.93 ± 0.04	13.27 ± 0.04	12.84 ± 0.04	12.41 ± 0.04
8	16.53 ± 0.06	15.68 ± 0.04	15.18 ± 0.05	14.64 ± 0.05

We observed KT Per in August-September 1998 during all the outburst, from the rise to the maximum to the subsequent decline. In Table 2 we report the BVR_cI_c magnitudes while the V light curve can be found in Figure 1. The observed maximum was $V \simeq 12.5$, a value which is fainter than other outbursts observed in this source, but that can be considered quite typical. This outburst follows a particular faint state ($V \simeq 15.6$ in October 27th) that confirms the evidence that sometimes KT Per becomes fainter than the minimum of $V = 15^{\rm m}_{\cdot}4$ listed by many catalogues (Thorstensen & Ringwald 1997). The differences between the minimum and the maximum are: $\Delta B \simeq 3.3$, $\Delta V \simeq 3.0$, $\Delta R_c \simeq 2.7$ and $\Delta I_c \simeq 2.0$.

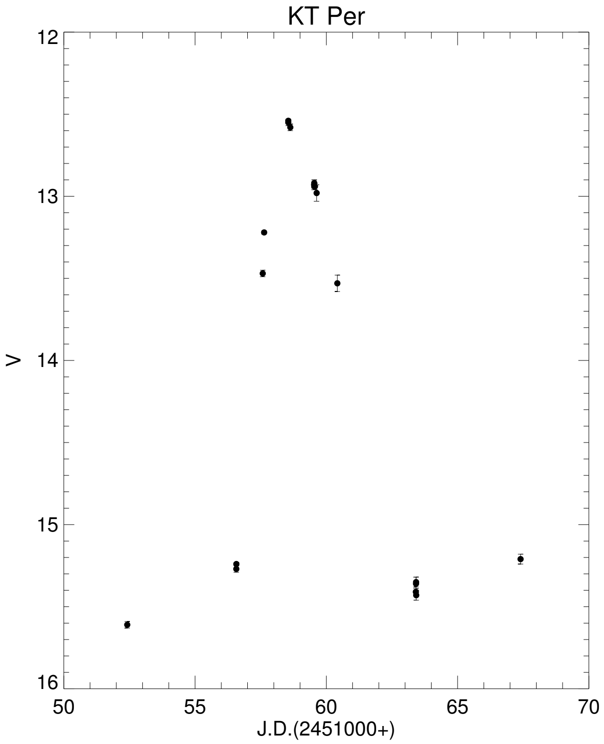

Figure 1. *V* light curve of KT Per

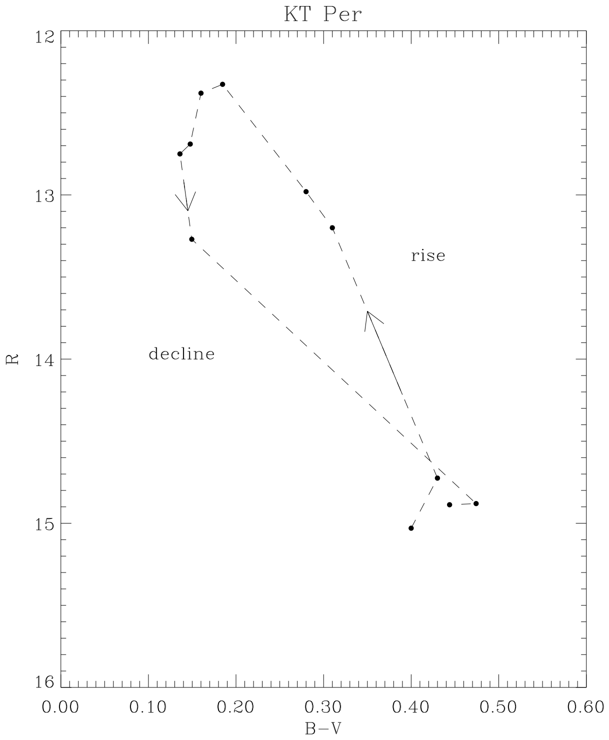

Figure 2. Colour index variations of KT Per during the outburst

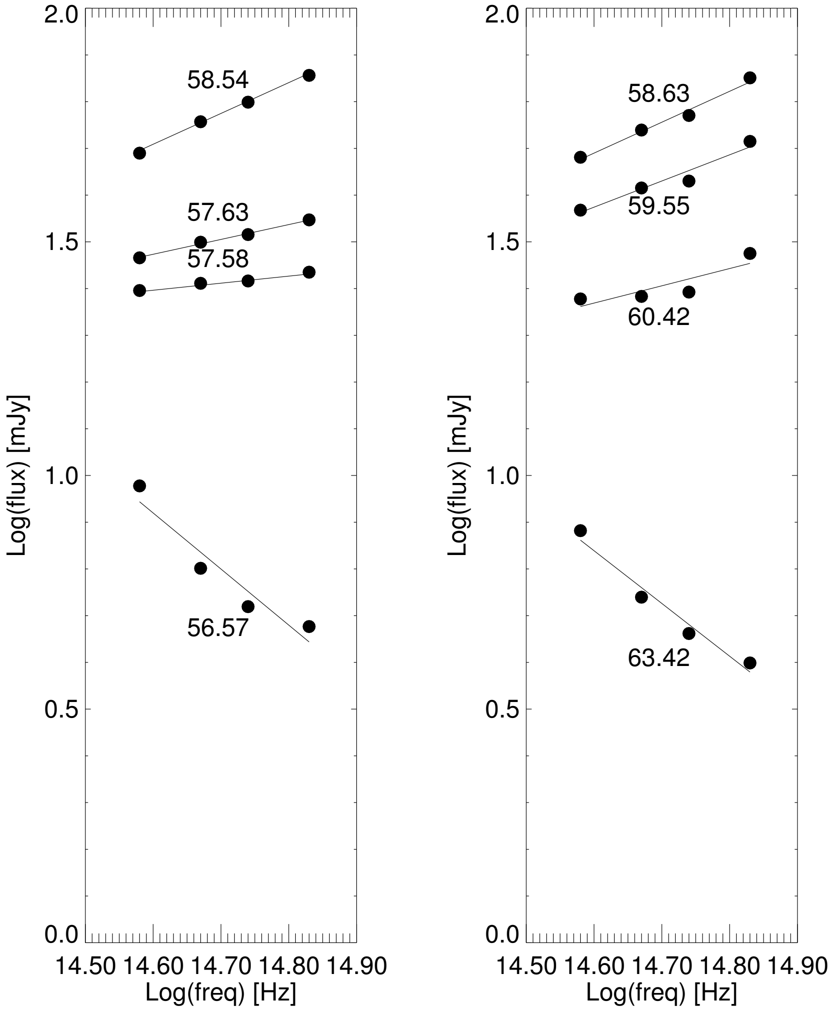

Figure 3. Spectral slope changes in KT Per during the rise (left panel) and the decline (right panel). The date (JD 2451000 +) is reported near the fluxes

Table 2: BVR_cI_c magnitudes of KT Per

JD (2451000 +)	B	V	R_c	I_c
52.4194	16.01 ± 0.05	15.61 ± 0.02	15.03 ± 0.02	14.21 ± 0.01
56.5715	15.69 ± 0.03	15.25 ± 0.01	14.72 ± 0.02	13.94 ± 0.01
57.5769	13.78 ± 0.03	13.47 ± 0.02	13.20 ± 0.02	12.90 ± 0.01
57.6315	13.50 ± 0.03	13.22 ± 0.01	12.98 ± 0.02	12.72 ± 0.01
58.5457	12.73 ± 0.02	12.54 ± 0.01	12.33 ± 0.02	12.16 ± 0.01
58.6273	12.74 ± 0.04	12.58 ± 0.02	12.38 ± 0.03	12.18 ± 0.01
59.5499	13.08 ± 0.02	12.93 ± 0.01	12.69 ± 0.02	12.47 ± 0.01
59.6311	13.12 ± 0.04	12.98 ± 0.05	12.75 ± 0.04	12.51 ± 0.01
60.4197	13.68 ± 0.03	13.53 ± 0.05	13.27 ± 0.04	12.94 ± 0.03
63.4232	15.87 ± 0.03	15.40 ± 0.01	14.88 ± 0.02	14.18 ± 0.02
67.3987	15.65 ± 0.03	15.21 ± 0.03	14.89 ± 0.02	14.20 ± 0.02

Figure 2 shows almost the entire loop of the $B-V$ colour index as a function of magnitude for KT Per. Obviously during the maximum the DN is blue ($B-V \simeq 0.2$) and during the minimum redder ($B-V \simeq 0.4$), but it is important to remark that for the first part of the decline the system remains blue or becomes bluer. This behaviour can be well explained with disk instability models as described in Spogli et al. (2000b). Our data show a large loop in the colour-magnitude diagram for KT Per, therefore constrain theoretical models and suggest that the predicted outside-in outburst of disk instability models are in agreement with the observations.

BVR_cI_c observations of dwarf novae allow to evaluate the optical spectral behaviour and, therefore, they can be used as a test to compare theoretical models of accretion disk emission. In particular they can be used to verify the often quoted theoretical flux distribution of a stationary (infinitely) large accretion disk whose surface elements radiate as black body spectra ($F(\nu) \propto \nu^{1/3}$, see, e.g., Warner 1995).

To study the behaviour of the optical continuum during the outburst, we converted the BVR_cI_c magnitudes in fluxes using the conversion factors reported by Bessell (1979). We corrected our observations for interstellar reddening adopting the value $E_{B-V} = 0.2$ reported by La Dous (1989), then we have $A_V \simeq 0.6$. For a correction of the fluxes in the B, R_c and I_c bands we used the interpolation formula of Cardelli, Clayton & Mathis (1989).

Using the flux values so obtained we noted that at minimum the spectral distribution is dominated by the emission of the secondary star, while at maximum the spectral distribution follows a power law ($F(\nu) \propto \nu^{\alpha}$) with $\alpha \simeq 0.6$. Figure 3 shows the spectral slope changes in KT Per in logarithmic scales. During the decline the high frequency flux remains strong, a behaviour that may be consistent with a strong irradiation of the hot inner part of the disk while the outer part is already cooling.

These data confirm that at least for a sample of DNe (KT Per, SY Cnc, DX And, V660 Her, AL Com, V503 Cyg, see Spogli et al. 1993, 1998, 2000a) it is not possible to approximate their emission during outburst by a sum over all contributions of surface elements of an infinitely large steady-state disk, which radiate like black bodies.

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BROAD BAND PHOTOMETRY OF CG CYGNI

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Name of the object:
CG Cyg = BD +34°4217

Equatorial coordinates:	**Equinox:**
R.A.= $20^{\mathrm{h}}58^{\mathrm{m}}13\overset{\mathrm{s}}{.}50$ **DEC.**= $35^{\circ}10\overset{\prime}{.}5$	2000

Observatory and telescope:
Ege University Observatory, 48-cm Cassegrain telescope

Detector:	Hamamatsu, R4457 (PMT)

Filter(s):	B, V and R filters of Johnson UBV system

Comparison star(s):	BD +34°4216

Availability of the data:
Upon request

Type of variability:	RS CVn

Remarks:
We obtained the wide band photometry of CG Cygni at Ege University Observatory. In Figure 1 we show the V-band light curve of the system obtained in June-July 2000.

Acknowledgements:
The authors would like to thank Dr. S. Evren, A. Devlen and G. Taş for their assistance during the observations.

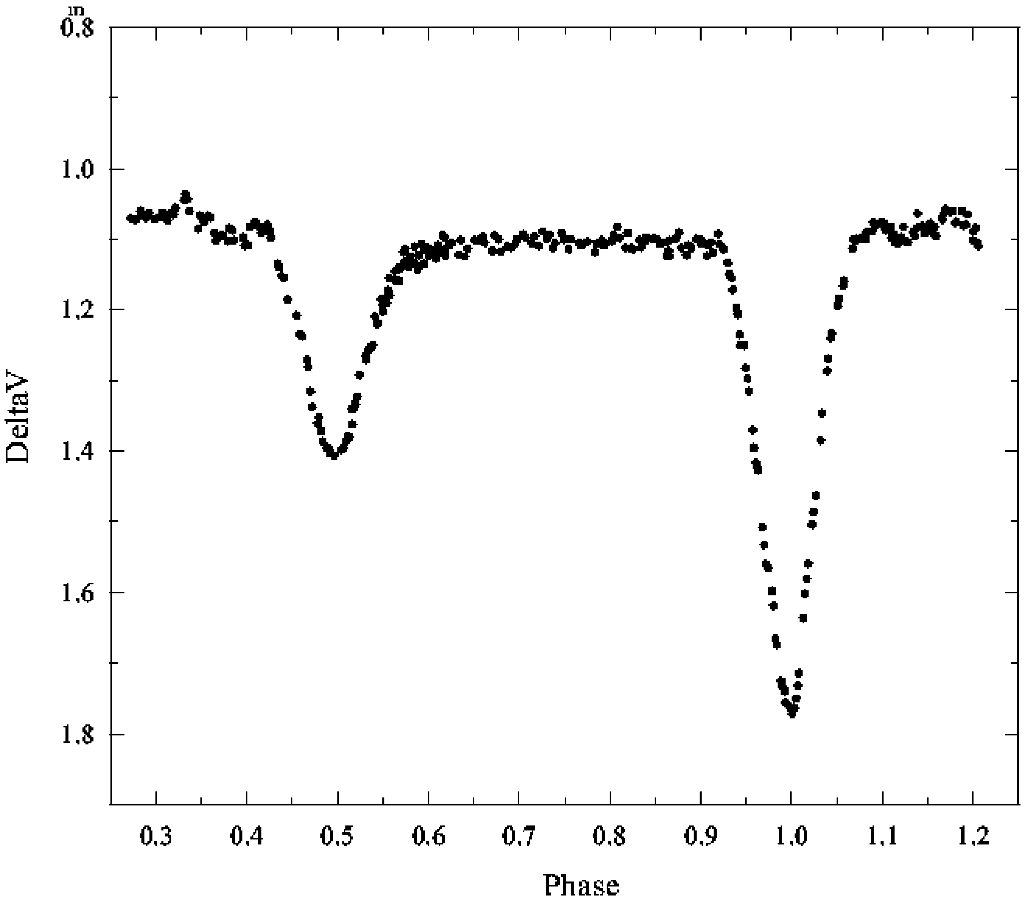

Figure 1. The V-band light curve of CG Cyg

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THREE-COLOUR PHOTOMETRY OF IN COMAE

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email: afsar@astronomy.sci.ege.edu.tr, ibanoglu@astronomy.sci.ege.edu.tr

Name of the object:
IN Com = BD +26°2405 = HD 112313

Equatorial coordinates:	**Equinox:**
R.A.= $12^{\rm h}55^{\rm m}33\overset{\rm s}{.}70$ **DEC.=** $25^\circ 53\overset{\prime}{.}5$	2000

Observatory and telescope:
Ege University Observatory, 48-cm Cassegrain telescope

Detector:	Hamamatsu, R4457 (PMT)

Filter(s):	B, V and R filters of Johnson UBV system

Comparison star(s):	HD 112299

Check star(s):	HD 111812

Availability of the data:
Upon request

Type of variability:	R:/PN

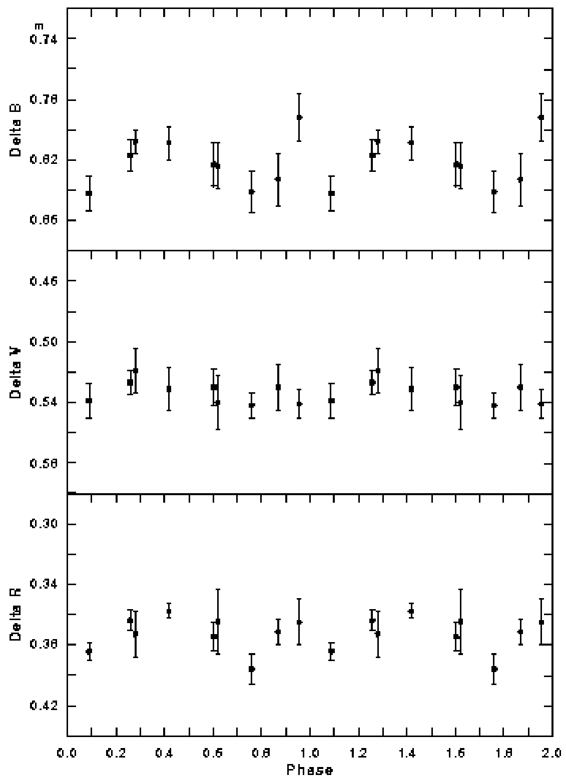

Figure 1. The B, V, R light curve obtained between March 9 and 25, 2000 of IN Com.

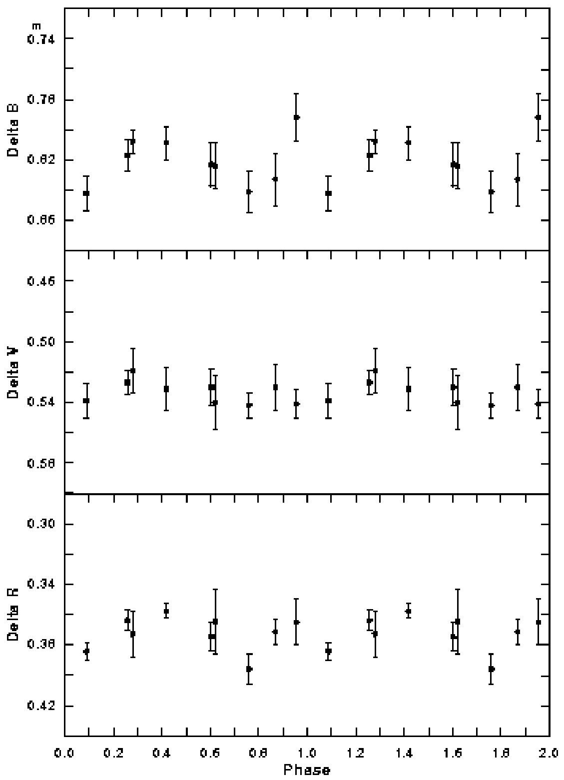

Figure 2. The B, V, R light curve obtained between May 4 and 12, 2000 of IN Com.

Remarks:

IN Comae was observed at Ege University Observatory with the 48-cm Cassegrain telescope. Two light curves in B, V, R were obtained with about two months interval. The light curves are shown in Figures 1 and 2. The points indicate nightly mean observed magnitude and the bars are their standard deviations. The phases of the observations were computed by using the following light elements (Strassmeier et al. 1997):

$$\mathrm{JD(Hel)} = 2449415.0 + 5\overset{\mathrm{d}}{.}913 \times E.$$

The standard deviations of differential magnitude is about $0\overset{\mathrm{m}}{.}007$ for the photometric system. The differences of the apparent magnitudes of comparison and check stars are almost constant during the observing season. Standard deviations of this differences do not exceed 3σ. However, the magnitude differences between IN Com and comparison change considerably at same night and are above 3σ. Therefore, the large deviations in Figures 1 and 2 originate from the IN Com itself (İbanoğlu et al. 2000). Note that the shape of the light curve of the system differs within a two-month time interval.

Acknowledgements:

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GSC 2293-1021:
A NEWLY DISCOVERED W URSAE MAJORIS VARIABLE

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The new variable star GSC 2293-1021 ($\alpha = 01^{\rm h}28^{\rm m}54\overset{\rm s}{.}54$, $\delta = 30°08'02\overset{''}{.}7$, B1950, $V = 14.1$) was chosen as one of the comparison stars during the observations of the high-amplitude δ Scuti variable UV Tri. GSC 2293-1021 was first suspected to be a variable star on November 17, 1999. Since then, it was observed until January 2000 using the red-sensitive Thomson TH 7882 CCD photometer (Wei et al. 1990) attached to the 85-cm Cassegrain telescope at the Xinglong Station of the Beijing Astronomical Observatory (BAO). The dimensions of the CCD detector are 13.25 mm × 8.83 mm, consisting of 576 × 384 pixels, which corresponds to a sky field-of-view of $12\overset{'}{.}3 \times 8\overset{'}{.}4$. The Johnson V filter and 5 comparison stars (C_1, C_2, C_3, C_4, C_5) were used. C_1 = GSC 2293-1422 ($\alpha = 01^{\rm h}29^{\rm m}15\overset{\rm s}{.}73$, $\delta = 30°06'08\overset{''}{.}4$, B1950, $V = 13.4$), C_2 = GSC 2293-1028 ($\alpha = 01^{\rm h}29^{\rm m}19\overset{\rm s}{.}64$, $\delta = 30°08'13\overset{''}{.}4$, B1950, $V = 12.9$), C_3 = GSC 2293-1027 ($\alpha = 01^{\rm h}29^{\rm m}11\overset{\rm s}{.}76$, $\delta = 30°11'53\overset{''}{.}2$, B1950, $V = 13.6$), C_4 = GSC 2293-1461 ($\alpha = 01^{\rm h}29^{\rm m}13\overset{\rm s}{.}83$, $\delta = 30°02'19\overset{''}{.}6$, B1950, $V = 14.0$), C_5 = GSC 2293-1456 ($\alpha = 01^{\rm h}29^{\rm m}03\overset{\rm s}{.}60$, $\delta = 30°05'54\overset{''}{.}8$, B1950, $V = 14.1$). The relative positions of the new variable and the comparison stars are shown in Fig. 1. Depending on the weather conditions from night to night, different exposure times (ranging from 20 to 80 seconds) were used. No variability higher than 0.01 mag was found for any of the 5 comparison stars. However, we found the magnitude difference between GSC 2293-1021 and all other comparison stars to vary as a sine-like curve. We used Hao's (1991) program and PERIOD96 (Sperl 1996) to complete the period analysis. An oscillation frequency of 7.665 cd^{-1} (period = 0.131 days) was obtained. However, we found the magnitudes of both maxima to be unequal. So, we think that this might indicate two eclipses evenly spaced with a period of 0.262 days. The light curve of two nights of observations folded with $P = 0.262$ days is shown in Fig. 2. To identify the type of the new variable star, we obtained two spectra on February 6 and March 11, 2000 using the low-dispersion Cassegrain spectrograph of the 2.16-m telescope at the Xinglong Station of BAO. The spectrum of GSC 2293-1021 obtained on March 11, 2000 is shown in Fig. 3. In addition to two O_2 telluric bands at 6870 Å and 7620 Å, some neutral metal lines, such as Na ID (5890 Å, 5896 Å), Cr I (5192 Å, 5273 Å, 7219 Å), and Ca I (5601 Å), can easily be identified the spectrum. Thus, we estimate the spectral type of GSC 2293-1021 to be between late-G and early-K. According to the spectral type and the shape of the folded light curve, we think that this may be a W Ursae Majoris type variable.

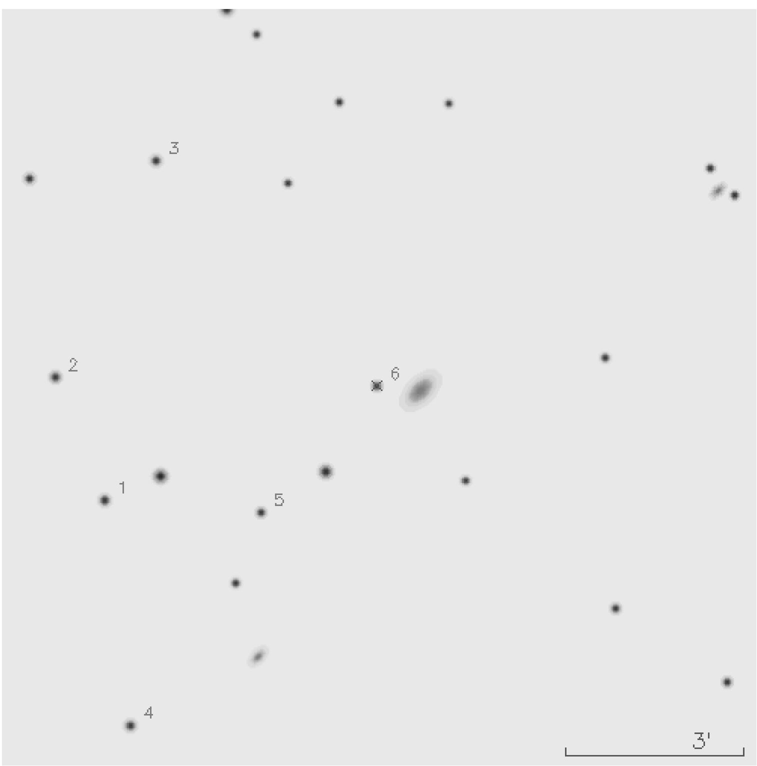

Figure 1. Identification chart of the new variable GSC 2293-1021 (labelled "6") and 5 comparison stars denoted with No. 1–5 respectively. The scale of the field is marked on the right bottom part. North is up and East is to the left

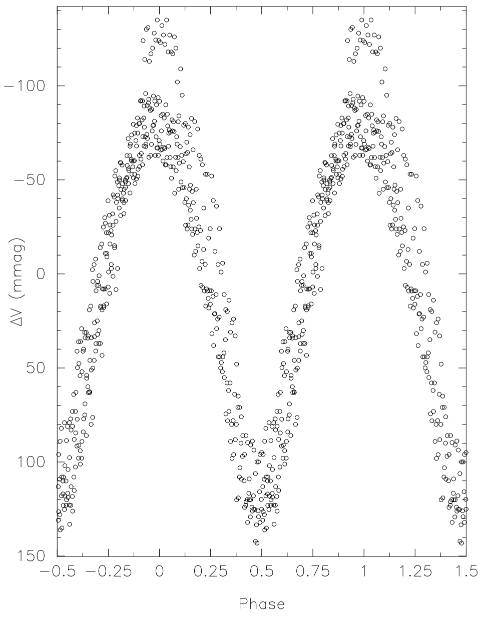

Figure 2. Folded light curve of GSC 2293-1021. The ordinate, ΔV, is the magnitude difference between the new variable star and the comparison star C_1

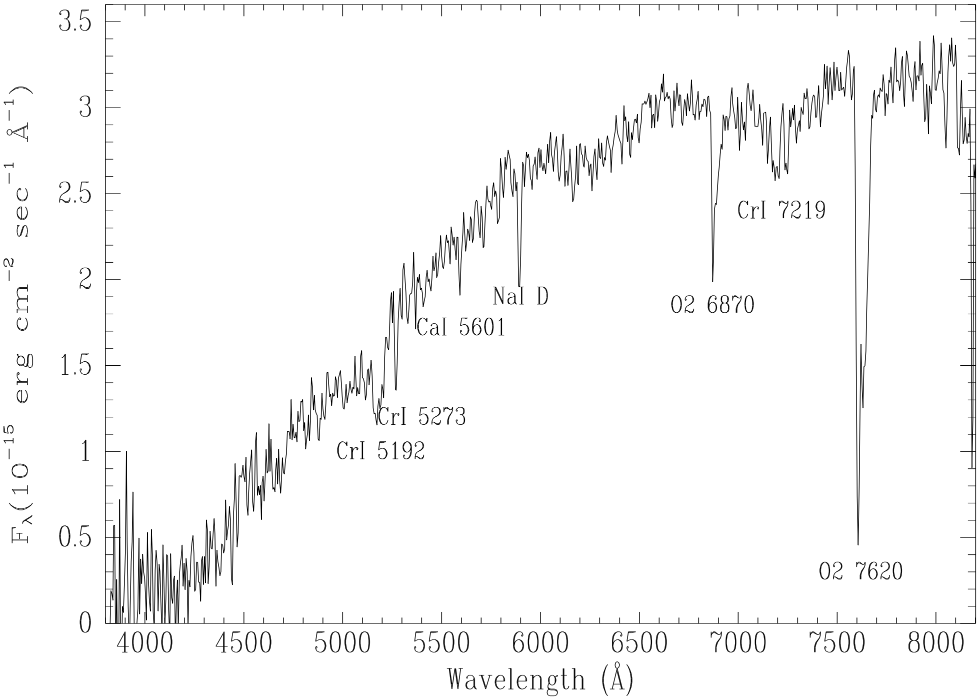

Figure 3. Spectrum of GSC 2293-1021 obtained on March 11, 2000. The ordinate is relative intensity

Acknowledgements. We acknowledge the grant from the National Natural Science Fund of China.

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COMMISSIONS 27 AND 42 OF THE IAU
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CCD LIGHT CURVES OF ROTSE1 VARIABLES, V: GSC 3131.476 LYRAE, GSC 2646.1938 LYRAE

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VAR1

Name of the object:
GSC 3131.476 = ROTSE1 J185052.26+434007.1

Equatorial coordinates:	**Equinox:**
R.A.= $18^h50^m52\overset{s}{.}26$ **DEC.=** $+43°40'07\overset{''}{.}1$	2000.0

Comparison star(s):	GSC 3131.439

Check star(s):	GSC 3131.522

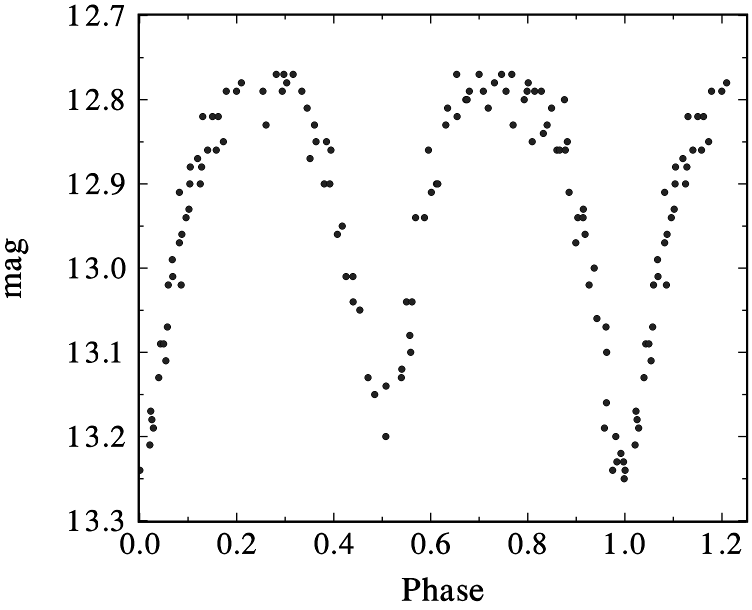

Figure 1. CCD light curve (without filter) of GSC 3131.476

VAR2

Name of the object:
GSC 2646.1938 = ROTSE1 J185110.44+353556.1

Equatorial coordinates:	**Equinox:**
R.A.= $18^h51^m10^s.44$ **DEC.=** $+35°35'56''.1$	2000.0

Comparison star(s):	GSC 2646.1777

Check star(s):	GSC 2646.1920

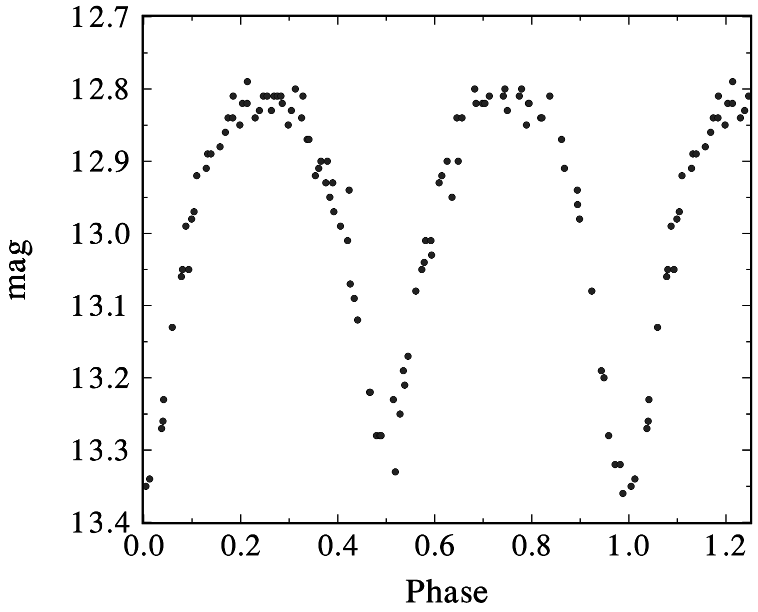

Figure 2. CCD light curve (without filter) of GSC 2646.1938

Observatory and telescope:
Private observatory, Schlüsselacher, Wald, 0.15-m refractor

Detector:	SBIG ST-7 CCD camera

Filter(s):	None

Availability of the data:
Upon request from diethelm@astro.unibas.ch

Type of variability:	EW

Remarks:

As a byproduct of the ROTSE1 CCD survey, a large number of new variables have been discovered (Akerlof et al. 2000). In a series of papers, we report unfiltered CCD observations for some of the close binary systems (type EW and E) in the list of Akerlof et al. (2000). GSC 3131.476 (VAR1 in this paper) was observed with our CCD equipment as mentioned above during 4 nights between JD 2451757 and JD 2451781, while the data on GSC 2646.1938 (here VAR2) was collected during 4 nights between JD 2451766 and JD 2451781. A total of 107 CCD frames were measured for VAR1 and 119 frames for VAR2. Figures 1 and 2 show these observations folded with the elements

$$\begin{array}{ll}\text{GSC 3131.476:} & \text{JD(min, hel)} = 2451757.4883(5) + 0.2429100(25) \times E,\\ \text{GSC 2646.1938:} & \text{JD(min, hel)} = 2451766.6097(3) + 0.2860550(12) \times E.\end{array}$$

These elements of variation are deduced from a linear fit to the newly determined normal minima from the ROTSE1 data (VAR1: JDH 2451257.8242(2), primary, JDH 2451308.7108(4), secondary; VAR2: JDH 2451295.8834(3), secondary, JDH 2451306.7233(5), primary) as well as the minima derived from our data and given in Blättler (2000).

Acknowledgements:

This research made use of the Simbad data base, operated at CDS, Strasbourg, France

References:

Akerlof, C., Amrose, S., Balsano, R., Bloch, J., Casperson, D., Fletcher, S., Gisler, G., Hills, J., Kehoe, R., Lee, B., Marshall, S., McKay, T., Pawl, A., Schaefer, J., Szymanski, J., Wren, J., 2000, *AJ*, **119**, 1901

Blättler, E., 2000, *BBSAG Bulletin*, **123**, 6

ERRATUM FOR IBVS 4982

In IBVS No. 4982 the period of GSC 2646.1938 should read $0\overset{d}{.}2890550$ instead of $0\overset{d}{.}2860550$.

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DISCOVERY OF ECLIPSING BINARY NATURE OF SAO 31628 = BD+49°2997, COMMON COMPARISON STAR FOR CH CYGNI

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On 2000 June 22 and 2000 July 3, we observed the field containing both CH Cygni and SAO 31628 with the 1-meter Nickel telescope at UCO/Lick Observatory on Mt. Hamilton, near San Jose, California. The observations consisted of repeated 10-second exposures on 2000 June 22 (843 in all), and 30-second exposures on 2000 July 3 (487 in all), plus approximately 21 and 18 seconds of dead-time between each exposure for CCD readout and processing on 22 June and 3 July, respectively. Observations were performed using a Johnson B filter and the thinned, 1024×1024 SITe CCD currently in Lick's dewar #5 (24-μm pixels). The aim of these observations was to determine the flickering state of CH Cygni during a dip in optical flux. SAO 31628 was intended to be used as a constant comparison star.

As part of our standard observing procedure, each of the comparison stars, including SAO 31628, was examined for variability with respect to the others. The optical brightness of SAO 31628 was found to vary by more than 20%, with a light-curve shape indicating an eclipse by a companion (see Figure 1). The light curves in Figure 1 were constructed by forming the ratio of counts from SAO 31628 to an ensemble average of 4 other stars in the field (see Sokoloski et al. 2000 for details of this procedure), with counts extracted using simple aperture photometry. The light curves have been normalized to unity by dividing by the mean count rate outside of eclipse. The eclipse can be seen in its entirety on 2000 June 22, and the eclipse ingress can be seen on 2000 July 3. The eclipse duration is approximately 5 hours, and the time between the 2 eclipses (between eclipse minimum on 2000 June 22 and eclipse minimum from an extrapolated eclipse profile on 2000 July 3) is 11.242 ± 0.004 days.

The similar shape of the light curves around eclipse ingress suggests that we are seeing a repeat of the same event. Thus, an integral number of orbital periods of the binary probably occurred between the two observations. In order to investigate this possibility, we searched through over 50 hours of our previous Nickel observations of SAO 31628 (spread over 3 years), looking for unexplained variations. We found such variations, with the same shape as the June and July 2000 eclipses, in a 2.9-hour observation from 1998 July 22. Using this longer baseline, the orbital period of the binary was found to be $P_{\rm orb} = 3.747833 \pm 0.000007$ days. All other possible periods are ruled out by our data, except perhaps $P_{\rm orb} = 1.873917 \pm 0.000004$ days (i.e. half the above period). We had only 1/2 hour of data with which to test the hypothesis of a 1.873917 day period, and the data

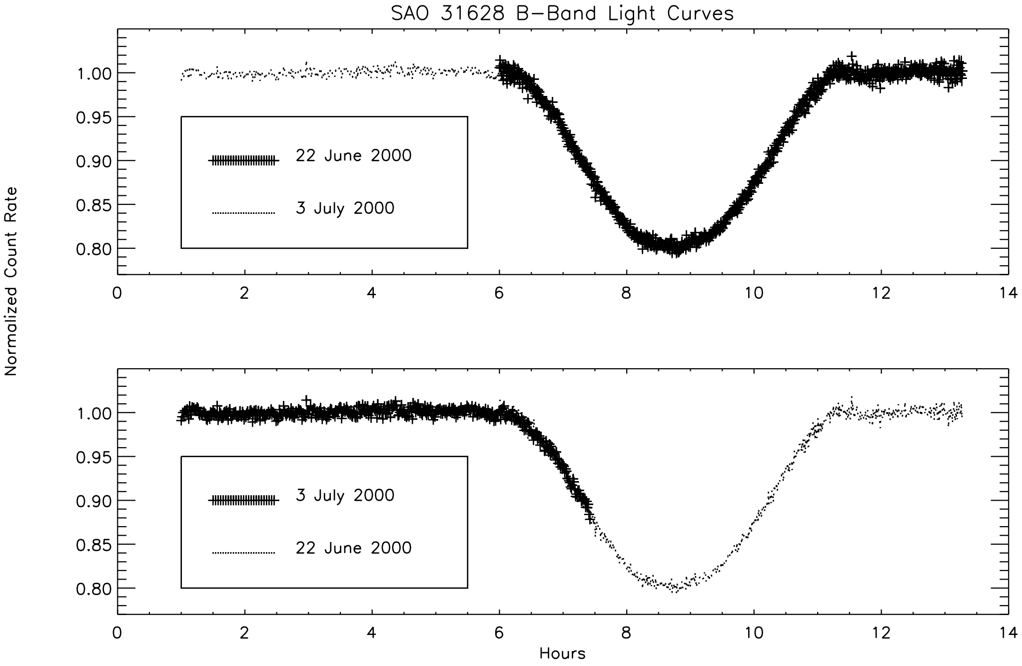

Figure 1. Differential B-band light curves for SAO 31628. The data from the 2 nights are shifted and overlaid to compare the light curve shapes. In the upper panel, the 22 June data are highlighted with larger plot symbols. In the lower panel, the data from 3 July 2000 are highlighted. The light-curve shapes appear to match quite closely in the region that overlaps

quality was poor due to high background. Because of our lack of good data at this period, we also cannot say anything about the presence, or shape, of a secondary eclipse around phase 0.5 of the 3.7 day orbital period. Finally, for completeness, we mention that there is also the possibility that the orbital period could in fact be $P_{\rm orb} = 7.49567 \pm 0.00002$ days, if one of the eclipses in 2000 is a primary and the other a secondary eclipse. Given the similarity of the eclipse shapes, however, we view this possibility as unlikely. In summary, we find that minimum in B light occurs on the ephemeris:

$$B_{\rm min} = {\rm HJD}\ 2451717.8150 \pm 0.0005 + E \times (3.747833 \pm 0.000007)\ {\rm days},$$

where E is the number of cycles since $HJD =\ 2451717.8150 \pm 0.0005$.

A search of the Hipparcos/Tycho catalog indicates that SAO 31628 (Tycho identifier TYC 3551-00642-1) was flagged both for apparent variability and suspected duplicity. Our observations confirm both the variability and duplicity. The SIMBAD database lists SAO 31628 as a star with $B = 9.62$, $V = 9.36$, and spectral type A5.

With its brightness so similar to that of the irregularly variable symbiotic star CH Cygni, and it also being less than $4'$ away, SAO 31628 has been a natural choice for a comparison star by many observers (e.g. Rodgers et al. 1997, Leedjärv & Mikolajewski 1995, Panov & Stegert 1994, and Hoard 1993 just in the past few years). However, with variations in B of up to 0.2 mag every 3.7 days (comparable to the variations in CH Cygni), and possible variations every 1.9 days, some of the published observations of CH Cygni are likely to have been affected by the SAO 31628 eclipse. SAO 31628 should therefore be used with caution, and with awareness of the time of observations with respect to the phase of the binary motion. Additional observations of SAO 31628, to confirm the orbital period and search for a secondary eclipse, would be useful.

The authors thank R. Wade for pointing them towards the Tycho catalog. This work was supported in part by NSF grant INT-9902665.

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Rodgers, B., et al., 1997, *PASP*, **109**, 1093
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ON THE VARIABILITY OF A0–A2 LUMINOSITY CLASS III–V STARS

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This paper investigates the Hipparcos photometry (ESA 1997) of luminosity class III–V A0–A2 stars from the Bright Star Catalogue, 5th edition (Hoffleit & Warren 1991) and the Supplement of the 4th edition (Hoffleit et al. 1983). These stars include δ Scuti variables, eclipsing binaries, SX Phe stars, ellipsoidal variables, and a few CP stars (although most studied by Adelman (1998) were excluded) along with microvariables and many stars which need additional observations to determine their variability type.

Table 1 lists the mean amplitudes of various spectral types which have at least 3 class members. These values indicate the mean variability. We excluded stars with spurious variability due to duplicity. A few values were calculated again when they included stars whose amplitudes were much larger than those typical of their spectral type. The mean amplitudes are smaller than those of the corresponding supergiants (Adelman & Albayrak 1997 and Adelman, Cay, Cay, & Kocer 2000) and are generally comparable with the smallest such values previously seen in similar papers among the late B III–V stars (Adelman, Gentry, & Sudiana 2000), the A3–F0 III–V stars (Adelman 2000a), and the K0–K4 III stars (Adelman 2000b).

Table 2 (available electronically from the IBVS site as 4984-t2.txt and 4984-t2.tex) contains the values for the individual A0–A2 III–V stars including those which were not used in compiling these means. It lists for each star the HR number (if any), names (Bayer, Flamsteed, or variable star designations), the V magnitude from the Bright Star Catalogue and its Supplement, the spectral type, the Hipparcos number, the standard error (mag), the amplitude (mag), and comments (type of variable using the GCVS and NSV designations). The NSV number is included in the comments field if another name is given in the names column. Hipparcos photometry does not confirm the reported variability of some stars which might indicate a change in the stellar behavior or reflect the quality of the previous photometry. Table 2 also contains stars with amplitudes of $0\overset{\mathrm{m}}{.}01$ which are candidates for use as standards.

Table 3 lists selected stars with amplitudes of variability significantly greater than those of stars with the same spectral types, usually a factor of 1.67 greater than the type mean, typically $0\overset{\mathrm{m}}{.}04$. Some are well-known variables. Many of those with amplitudes of $0\overset{\mathrm{m}}{.}04$ require further study. We doubt that α CMa (Sirius) is really variable.

Acknowledgements. SJA wishes to thank the Citadel Development Foundation for their support. RSCF has a US Marine Corps Scholarship.

Table 1: The mean amplitudes of various types of A0–A2 stars

Spectral class	Number	Mean amplitude (mag)	Comment
A0III	23	0.025 ± 0.006	
A1III	4	0.025 ± 0.006	
A2III	12	0.022 ± 0.006	
A0III–IV	3	0.027 ± 0.012	
A2III–IV	4	0.028 ± 0.005	
A0IV	22	0.030 ± 0.051	
	21	0.020 ± 0.004	without χ^2 Hya
A1IV	10	0.022 ± 0.006	
A2IV	34	0.029 ± 0.032	
	32	0.022 ± 0.006	without YZ Cas & β Aur
A2IV–V	3	0.023 ± 0.012	
A0V	238	0.025 ± 0.024	
	231	0.022 ± 0.007	without 7 stars
A0–1V	6	0.028 ± 0.008	
A1V	200	0.024 ± 0.017	
	197	0.022 ± 0.007	without TU Hor, α CMa, & 75 KS Peg
A1–2V	4	0.030 ± 0.000	
A2V	199	0.027 ± 0.043	
	196	0.023 ± 0.009	without 31 Cam, V2368 Oph, & SX Phe
A2–A3V	6	0.082 ± 0.146	
	5	0.022 ± 0.004	without ES Lib

Table 3: Some stars with amplitudes great than stars of similar spectral type

Name	HD No.	Spectral Type	HIP No.	SE (mag)	Amp. (mag)	Comments
HR 444	9484	A0III	7222	0.0010	0.04	
HR 3962	87318	A0III–IV	49294	0.0010	0.04	
χ^2 Hya	96314	A0IV	54255	0.0041	0.26	EB
21 YZ Cas	4161	A2IV	3572	0.0008	0.20	EA/DM
34 β Aur	40183	A2IV	28360	0.0006	0.07	EA
	23642	A0Vp*	17704	0.0013	0.04	
	24966	A0V	18437	0.0009	0.04	
HR 1524	30397	A0V	22136	0.0009	0.04	
IW CMa	45382	A0V	30583	0.0011	0.09	U
HR 2328	45380	A0Vn	30675	0.0141	0.04	U
	50126	A0V	32715	0.0011	0.04	
PS Pup	60168	A0V	36608	0.0022	0.10	EA
HR 3019	63112	A0V	37951	0.0008	0.04	
BU CMi	65241	A0V	38945	0.0020	0.10	NSV 3829, EA
37 OW Hya	83650	A0Vn	47427	0.0015	0.33	EA
HR 4428	99922	A0V	56078	0.0020	0.12	U
	113457	A0V	63839	0.0008	0.04	
	203112	A0V	105237	0.0009	0.04	
δ Scl	223352	A0V	117452	0.0014	0.09	
	152521	A0/1V	82792	0.0017	0.04	
BD Phe	11413	A1Vp	8593	0.0017	0.04	DSCT
HR 597	12467	A1V	10054	0.0009	0.04	
HR 875	18331	A1Vn	13717	0.0016	0.06	
TU Hor	21981	A1V	16339	0.0053	0.14	ELL
NSV 1359	24071	A1V	17797	0.0006	0.05	U
9 α CMa	48915	A1Vm	32349	0.0024	0.19	
34 Hya	83373	A1V	47249	0.0009	0.04	
HR 4805	109860	A1V	61637	0.0010	0.04	
	131637	A1V	73102	0.0008	0.04	
	133330	A1V	73635	0.0009	0.04	
75 KS Peg	222133	A1Vn	116611	0.0045	0.10	EB
V357 And	5066	A2V	4129	0.0025	0.06	P
	14172	A2V	10856	0.0009	0.04	
32 Eri	24554	A2V	18255	0.0011	0.06	U
HR 1324	26961	A2V	20070	0.0031	0.06	ELL
	35859	A2V	25298	0.0010	0.04	
31 Cam	39220	A2V	27971	0.0029	0.16	EB
HR 3335	71581	A2V	41475	0.0011	0.04	EA/DM
	102481	A2V	57556	0.0009	0.04	
HR 6169	149632	A2V	81231	0.0009	0.04	
V2368 Oph	156208	A2V	84479	0.0008	0.13	NSV 8438, EA
HR 7857	195922	A2Vnn	101473	0.0015	0.04	U
SX Phe	223065	A2V	117254	0.0216	0.59	SXPHE
VZ Psc	214484	A2Vp	111809	0.0005	0.04	EA
ES Lib	135681	A2/3V	74765	0.0188	0.38	EB/KE

References:

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CCD LIGHT CURVES OF ROTSE1 VARIABLES, VI: GSC 3123.1618 LYRAE, GSC 3551.81 CYGNI

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VAR1

Name of the object:
GSC 3123.1618 = ROTSE1 J185538.25+405859.0

Equatorial coordinates:	**Equinox:**
R.A.= $18^h55^m38\overset{s}{.}25$ **DEC.**= $+40°58'59\overset{''}{.}0$	2000.0

Comparison star(s):	GSC 3123.1854

Check star(s):	GSC 3123.1116

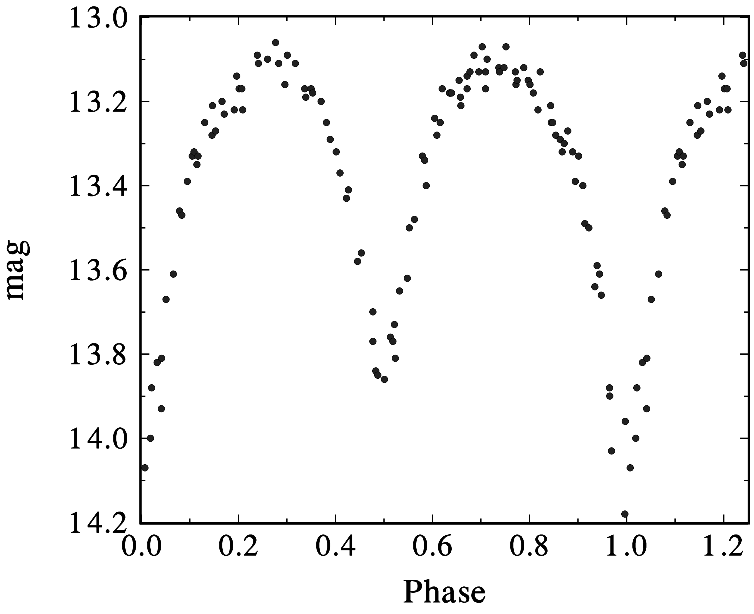

Figure 1. CCD light curve (without filter) of GSC 3123.1618

VAR2

Name of the object:
GSC 3551.81 = ROTSE1 J192954.62+485500.5

Equatorial coordinates:	**Equinox:**
R.A.= $19^{\mathrm{h}}29^{\mathrm{m}}54\overset{\mathrm{s}}{.}62$ **DEC.=** $+48^\circ55'00\overset{''}{.}5$	2000.0

Comparison star(s):	GSC 3551.85

Check star(s):	GSC 3551.99

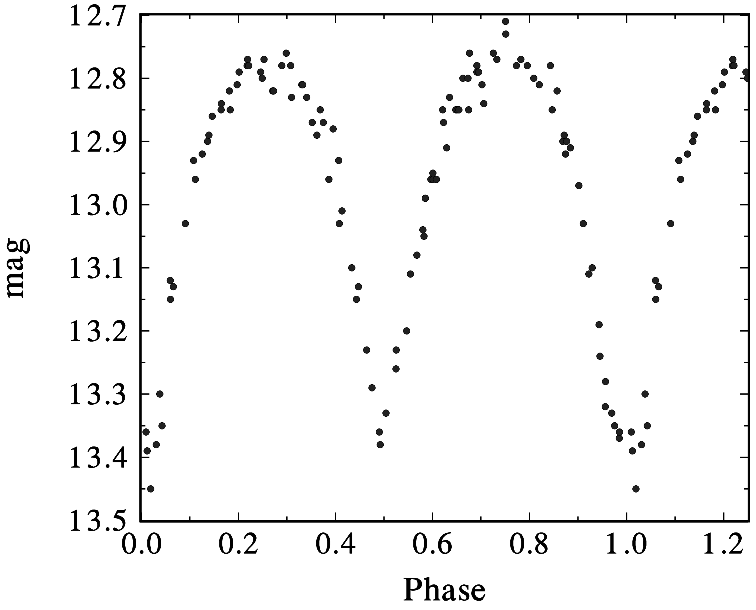

Figure 2. CCD light curve (without filter) of GSC 3551.81

Observatory and telescope:
Private observatory Schlüsselacher, Wald, 0.15-m refractor

Detector:	SBIG ST-7 CCD camera

Filter(s):	None

Availability of the data:
Upon request from diethelm@astro.unibas.ch

Type of variability:	EW

Remarks:

As a byproduct of the ROTSE1 CCD survey, a large number of new variables have been discovered (Akerlof et al. 2000). In a series of papers, we report unfiltered CCD observations for some of the close binary systems (type EW and E) in the list of Akerlof et al. (2000). GSC 3123.1618 (VAR1 in this paper) was observed with our CCD equipment as mentioned above during 4 nights between JD 2451766 and JD 2451781, while the data on GSC 3551.81 (here VAR2) was collected during 4 nights between JD 2451766 and JD 2451781. A total of 118 CCD frames were measured for VAR1 and 112 frames for VAR2. Figures 1 and 2 show these observations folded with the elements

$$\begin{array}{ll} \text{GSC 3123.1618:} & \text{JD(min, hel)} = 2451766.5843(2) + 0.2559007(10) \times E; \\ \text{GSC 3551.81:} & \text{JD(min, hel)} = 2451771.3637(2) + 0.3069917(12) \times E. \end{array}$$

These elements of variation are deduced from a linear fit to the newly determined normal minima from the ROTSE1 data (VAR1: JDH 2451295.8551(25), secondary, JDH 2451306.7304(16), primary; VAR2: JDH 2451287.8512(2), primary) as well as the minima derived from our data and given in Blättler (2000).

Acknowledgements:

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

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UY PISCIUM: 1990–1992

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The variability of UY Piscium was discovered by Strohmeier (Strohmeier et al. 1957). Huth (1959) detected 100–150 days long cycles from photographic plates. The spectral type of the star was estimated as M0 (Vyssotsky & Balz 1958) or K (Götz & Wenzel 1962). Its luminosity class is unknown. The only photoelectric photometry of the variable was published by Eggen (1973), who estimated a period of about 80 days from his observations. The star is classified as SRD in the *General Catalogue of Variable Stars*.

I observed UY Psc in 1990–1992 in Budapest with the 24-inch telescope of Konkoly Observatory. The observing circumstances were the same as mentioned in previous papers (Zsoldos 1993, 1995). I used HD 7346 as a comparison star ($V = 8.500$, $B - V = 1.093$) (Ochsenbein et al. 2000) and HD 7529 as a check. The observations are given in Table 1 and Fig. 1.

Table 1: Photometry of UY Piscium

J.D.	V	$B - V$
2448163.477	9.099	1.697
48176.428	9.098	1.719
48187.404	9.043	1.692
48190.386	9.036	1.735
48202.371	8.971	1.733
48271.245	8.990	1.803
48480.540	8.905	1.747
48485.556	8.916	1.761
48502.497	8.914	1.749
48506.508	8.944	1.780
48534.474	9.023	1.780
48536.451	9.028	1.747
48561.389	9.072	1.777
48562.371	9.077	1.765
48593.304	9.096	1.754
2448897.438	8.941	1.832

Figure 1 shows the light curve of UY Psc (including Eggen's observations, too) phased with a period of $133\overset{\mathrm{d}}{.}8$. This is longer than the estimate by Eggen but is in agreement with that of Huth. The amplitude seems to be variable, it was certainly larger when Eggen observed the star. The $B-V$ colour (not shown in Fig. 1) does not show any variation correlated with the light curve.

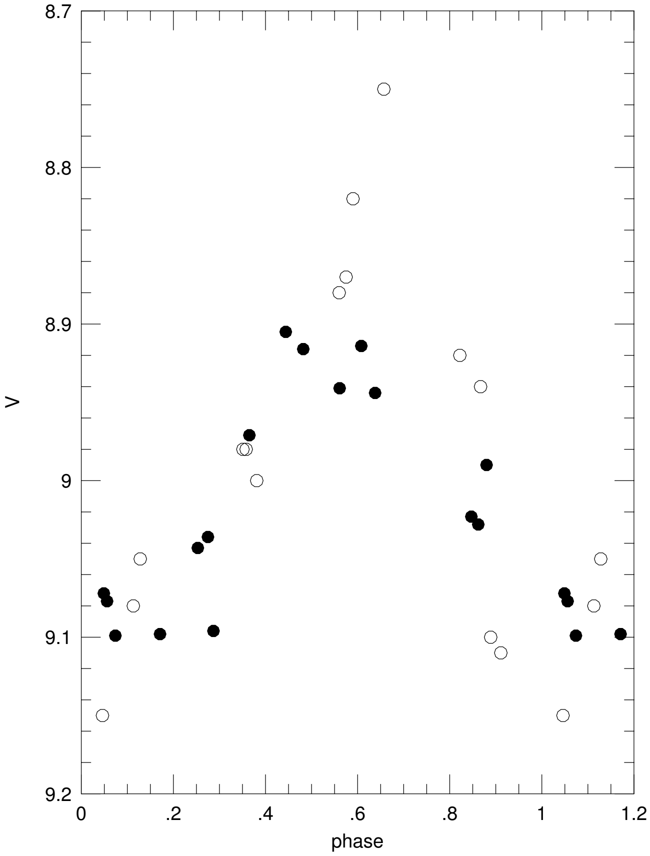

Figure 1. The light curve of UY Piscium. The dots are from Table 1, the circles are Eggen's observations.

The star does not seem to be a SRD variable. Its colour index is too red, more appropriate to an M than a K star as given in the *GCVS*. The late spectral type and the small amplitude indicates that a classification of SRA might be more appropriate.

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

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STRÖMGREN PHOTOMETRY OF THE T TAURI STAR SU AURIGAE: MULTI-TIMESCALE LIGHT VARIATIONS

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Intensive long-term photoelectric photometry of classical T Tauri stars (CTTS) can provide fundamental new information that helps to understand stars in the early stages of evolution. CTTS typically have spectral types from F to K, exhibit weak Hα and Ca II H & K emissions, have broad absorption lines (implying rapid rotation), and are located well above the main-sequence. One of the brightest archetypical CTT stars, SU Aurigae (HD 282624; G2 IIIe; $\langle V\rangle = +9\overset{\text{m}}{.}20$; $\langle B-V\rangle = +0\overset{\text{m}}{.}90$) is observed to undergo rapid and dramatic light variations. These light variations appear not to be accompanied by spectral changes (Herbst & Shevchenko, 1999). This implies possible obscuration of the star by dust with properties similar to the interstellar medium (ISM). In a previous paper by the authors (DeWarf *et al.*, 1998; hereafter Paper I), the interstellar absorption of SU Aur was determined, and when combined with the Hipparcos distance, yielded estimates of its absolute magnitude and intrinsic colors. These values placed SU Aur about 1.8 mag above the main-sequence for its respective unreddened spectral type. In Paper I, SU Aur was plotted on pre-main sequence (PMS) evolution tracks and an age of about 4 Myrs and a mass of $1.9 \pm 0.1\ M_\odot$ was ascertained. The observations presented here were made using the 0.8-m Four College Automatic Photoelectric Telescope (APT), in Arizona. This concentrated (nightly) photometry, has began in October 1993 and continuing to the present, is made in the Strömgren *uvby* system. A description of the instrumentation, observing, and reduction procedure is given in Paper I.

After analyzing the data collected since 1993, large ($\Delta V \approx \Delta y \approx 0\overset{\text{m}}{.}40$) "eclipse-like" dimming events have been observed frequently. Representative photometry from the 1998/99 observing season is shown in Fig. 1. In the figure the Strömgren b magnitudes and the corresponding Strömgren $[c_1]$ and $[m_1]$ indices (Strömgren, 1966; Crawford & Mandwewala, 1976) are plotted against Heliocentric Julian Day. As shown, the light variations of SU Aur, like many T Tauri stars, are complicated. In addition to the short-term "dips" in the light curve, the star also varies on time scales of days, months, and years. Excluding the dips, the overall light variations in b are between $b_{\text{max}} \simeq +9\overset{\text{m}}{.}75$ to $b_{\text{min}} \simeq +10\overset{\text{m}}{.}20$ over September 1998 to March 1999. As shown in the upper panel of Fig. 1, four large dimming events were observed nearly 48 days apart, lasting several days each. To understand the possible cause of such drops, the reddening-independent $[c_1]$ and $[m_1]$ indices were calculated. For data from 1993 to the present we find average values of $0\overset{\text{m}}{.}30 \pm 0\overset{\text{m}}{.}060$ and $0\overset{\text{m}}{.}50 \pm 0\overset{\text{m}}{.}087$ for $[c_1]$ and $[m_1]$ respectively. As seen in Fig. 1, these indices do not show any significant variation, though the b filter light varies by more than

$0\overset{\mathrm{m}}{.}75$. It is therefore reasonable to conclude that orbiting concentrations of dust could produce the observed dimming events, and that this dust has properties similar to that of the ISM. CTT stars are pre-main sequence objects that have extensive accretion disks and SU Aur has a large infrared excess implying a large circumstellar cloud. Hence, it is possible that these dimming events were caused by concentrations of matter orbiting in the outer regions of the disk, by clumps of material surrounding a forming planet, or from dust clouds condensing from ejected matter and, in the process, obscuring the star.

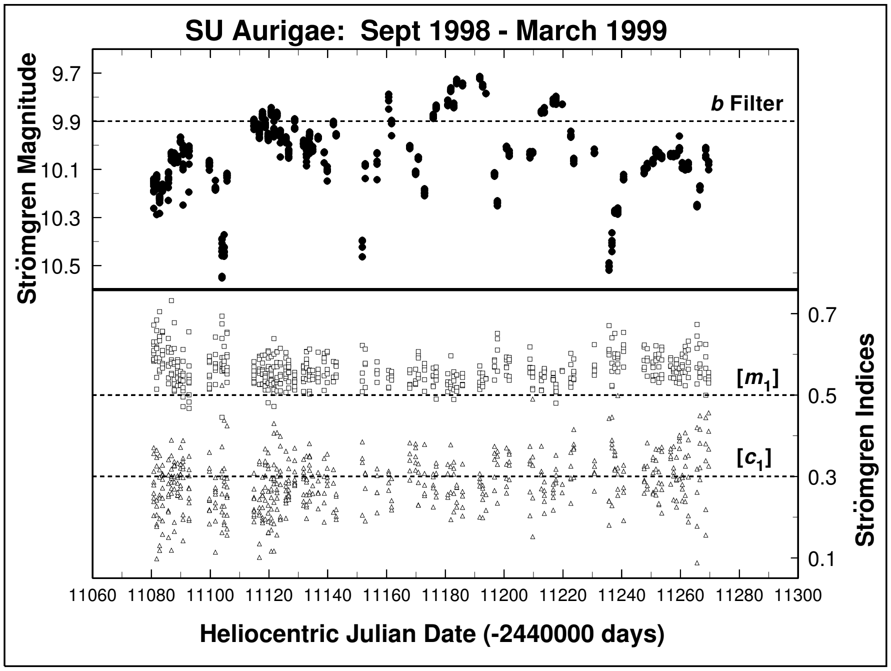

Figure 1. The 1998/99 b filter light curve for SU Aur is shown in the top panel with the Strömgren $[c_1]$ and $[m_1]$ indices in the lower panel. The reference lines in the lower panel represent the average values since 1993. Although there are dramatic drops in mean light, the indices remain relatively unaffected. This implies obscuration by dust with properties similar to ISM dust. We find average maximum light levels during this epoch to be about 12.0, 10.8, 9.9, 9.4 mag for u, v, b, and y.

The accretion disk and the possible concentrations of matter orbiting around SU Aur are likely being observed nearly edge-on. From speckle interferometry taken along a N-S position angle (DeWarf & Dyck, 1993), the star appears to have no measurable projected spatial extent beyond about 29 AU in the L' band (3.8 μm). Using the IRAS fluxes (IRAS Point Source Catalog; *Joint IRAS Science Working Group*, 1988), the spectral slope as defined by Adams *et al.* (1987)

$$\eta = \frac{d\log \nu F_\nu}{d\log \nu} \qquad \Longrightarrow \qquad \eta_{12} \approx \frac{\log \dfrac{\nu_{12}F_{12}}{\nu_{25}F_{25}}}{\log \dfrac{\nu_{12}}{\nu_{25}}}$$

is -0.65 for the spectral region between 12 and 25 μm. Examples of stars that have similarly red spectral slopes are AFGL490, Elias 29, and HL Tau. These stars have resolved infrared emitting circumstellar material projected out to about 1100, 600, and 200 AU respectively (*cf* DeWarf & Dyck, 1993). Of course, as Adams *et al.* (1988) has shown, for circumstellar disk geometry, a high inclination angle will result in significant reddening. HL Tau is an excellent potential candidate for this type of geometry (Lay *et al.*, 1997; Mundy *et al.*, 1996; Sargent & Beckwith, 1991). Therefore, it is likely that for HL Tau and SU Aur, the actual (not just projected) extent of the circumstellar material is less than the extent of the material around either AFGL490 or Elias 29. The results of the speckle interferometry and particularly red spectral slope imply that the infrared emitting region of SU Aur is confined to a disk, and that the disk is observed nearly edge-on.

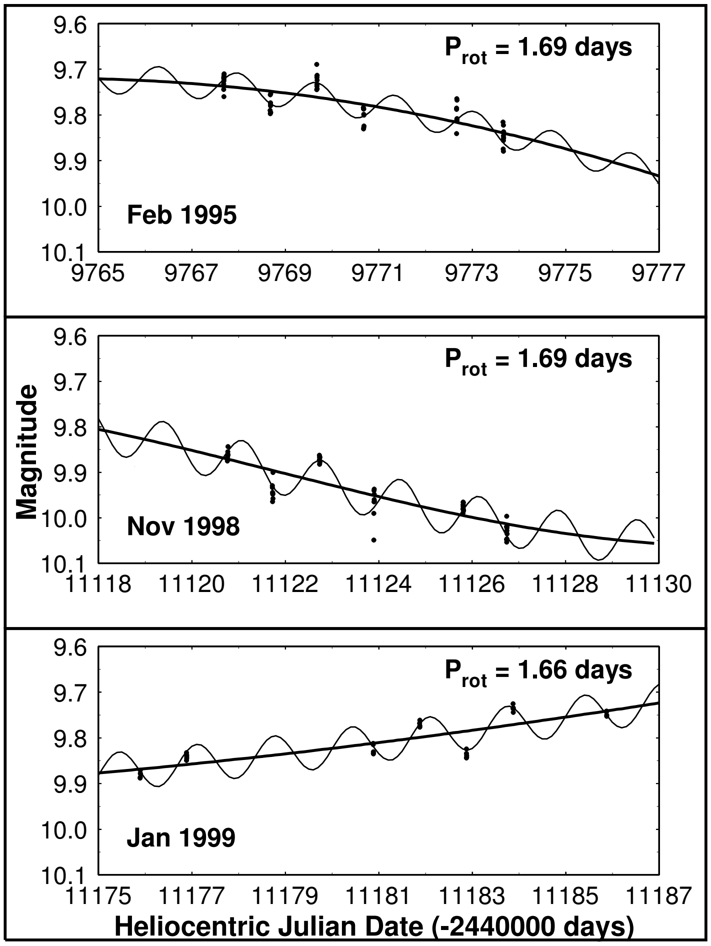

Figure 2. Three relatively constant sections of the SU Aurigae light curve. The rotational modulation of light due to starspots can be modelled by applying a direct (grid search) parameter optimization procedure. In all three cases a period of about 1.7 days was determined.

To find the rotation period of SU Aur from photometric data, appropriate sections of the light curve needed to be isolated. The rotation period is determined from the short-term, low amplitude, sinusoidal-like modulations in brightness due to the rotational effects of starspots. Many studies have established the rotation periods of T Tauri stars in this manner (see, for example, Bertout, 2000; Strassmeier *et al.*, 1999). Suitable portions of the light curve would each need to be ∼ 10 days long — long enough to contain sufficient observations, but short enough to minimize the effects of possible spot creation, destruction, or migration. The sections selected also need to be relatively constant to avoid any rapid or significant drop in flux levels due to obscuration. Examination of our observations revealed three such regions, shown in Fig. 2. Using a straightforward sinusoidal model, we applied a direct parameter optimization procedure to find the period of rotation. This method is analogous to an iterative grid search in which each of the independent parameters are varied separately until the minimum in the sum of the deviations is achieved. A period of approximately 1.7 days was found for each of these sections. For the b observations, we find the full range of the light modulations to be $0\overset{\mathrm{m}}{.}064$, $0\overset{\mathrm{m}}{.}098$, and $0\overset{\mathrm{m}}{.}084$ for the 1995, 1998, and 1999 sections shown in Fig. 2. Hartmann *et al.* (1986) report a projected rotational velocity ($v \sin i$) of 66.2 ± 4.6 km/sec. From this high rotational velocity and the speckle interferometry results, we can assume that the inclination (i) is close to 90°. Therefore, the radius of the star can be determined,

$$R_{\mathrm{rot}} \sin i = P_{\mathrm{rot}} v(\sin i)/2\pi \simeq 2.2\ R_{\odot}.$$

Given that $L = 5.1\ L_{\odot}$ and $T_{\mathrm{eff}} = 5550$ K (Paper I), the above value can be compared to the photometrically determined radius,

$$R_{\mathrm{phot}} = \sqrt{L/(4\pi\sigma T_{\mathrm{eff}}^4)} \simeq 2.5\ R_{\odot}.$$

Since the visible light emissions come from the star and reprocessed light from the extended circumstellar material, the photometrically determined overall luminosity should be larger than the actual stellar luminosity. Also, the enshrouding dust would redden, and therefore possibly lower, the photometrically determined effective temperature. Hence, the photometrically determined radius should be expected to be larger than the actual radius of the star.

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FIRST PHOTOELECTRIC OBSERVATIONS OF GQ DRACONIS

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Name of the object:
GQ Dra = HIP 85277 = HD 158260

Equatorial coordinates:	**Equinox:**
R.A.= $17^h25^m29\overset{s}{.}44$ **DEC.=** $+51^\circ29'35''.3$	2000

Observatory and telescope:
TUBITAK† National Observatory (TUG), 40-cm Cassegrain telescope

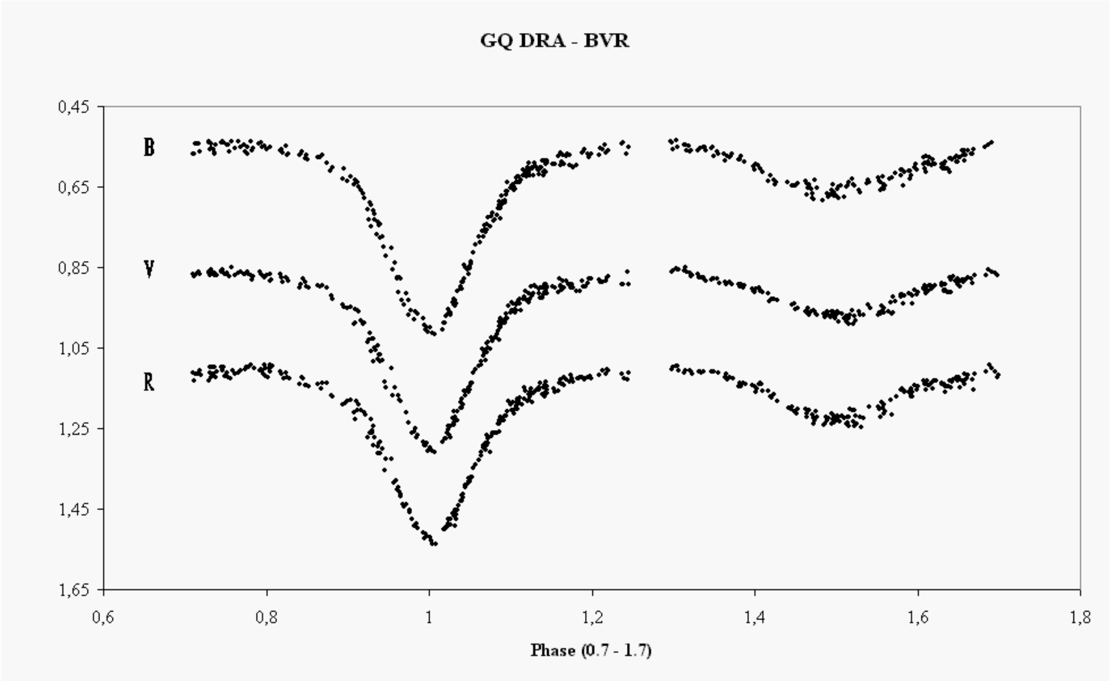

Figure 1. All nights observations in three filter. $B - 0\overset{m}{.}2$, V and $R + 0\overset{m}{.}2$ plotted respectively

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† TUBITAK: The Scientific and Technical Research Council of Turkey

Detector:	OPTEC, Inc. SSP-5A Photometer

Filter(s):	Johnson B, V and R

Comparison star(s):	BD +51°2234 = HIP 86191

Transformed to a standard system:	No

Availability of the data:
Upon request

Type of variability:	EB

Remarks:

GQ Dra is a double star and the brighter companion is an EB type eclipsing variable. Its variability was discovered by Hipparcos (ESA, 1997). We carried out photoelectric photometry of that variable. Mean V band magnitude derived from Tycho photometry is $8\overset{\mathrm{m}}{.}94$. The system has a $0\overset{\mathrm{d}}{.}765899$ orbital period and a Hipparcos epoch is given as JD 2448500.5641 (ESA, 1997). GQ Dra was observed in 21, 22, 23, 24, 26, 29, 30 September and 1 October 2000 from TUBITAK National Observatory by the authors Alis and Atay. HIP 86191 was used as a comparison star which is defined constant by Hipparcos (ESA, 1997). We made two times 10-second integrations in each filter. Each observation set contains six variable and two comparison star measurements. Differential atmospheric corrections were made in the usual way. The comparison star has the same spectral type as the variable, therefore we did not use the second-order extinction coefficients. GQ Dra shows a Beta Lyrae type light curve. The folded light curve is displayed on Figure 1 in three filters. During this observing session we observed one primary and one secondary minimum. Times of minima were determined by the Kwee and van Woerden (1956) method. The minimum times for V band are given below in Heliocentric Julian Date:

$$\begin{gathered}\text{Min I} = \text{HJD } 2451812.31325 \pm 0.00038 \\ O-C\ (\text{Min I}) = 0.0024 \\ \text{Min II} = \text{HJD } 2451817.28809 \pm 0.00109 \\ O-C\ (\text{Min II}) = 0.0009\end{gathered}$$

Acknowledgements:

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NEW FIELD VARIABLE STARS III[†]

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[4] Guest Observer at the Konkoly Observatory

We have continued the search for new short period variable stars on the CCD frames made for photometry and astrometry of minor planets (see Csák et al. 2000ab, Paper 1, Paper 2). In this note we report the discovery of thirteen new variable stars found between April and July, 2000.

The observations in Hungary leading to the discovery of V18 were carried out with the 60/90/180 cm Schmidt telescope of the Piszkéstető Mountain Station of the Konkoly Observatory. The detector was a Photometrics AT200 CCD camera (1536×1024 pixels) giving a $29' \times 18'$ field of view (FOV). The majority of the presented new variable stars was discovered with the 1.23-m telescope of the German–Spanish Astronomical Center at Calar Alto, Spain. The applied instruments was a SITe#2b CCD camera (2048×2048 pixels) yielding to a $17' \times 17'$ FOV. The observations were made through Cousins R_C filter at both places. The exposure time was chosen between 1–5 minutes, depending on the brightness of the target asteroids (Szabó et al., in preparation).

The data reduction and analysing methods were the same that described in Paper 1. The candidate new variables were checked in the SIMBAD Database. We have to note that although two fields (those of V24 and V25) were also observed by the FASTT instrument (Henden & Stone 1998, Stone et al. 1999) down to a limiting magnitude of 17.8 (R), both stars escaped the detection as variable stars. The only possible hint for variation is the larger photometric error of V25 in Stone et al. (1999). V27 was identified with GSC 03947-01632 using Guide CD-ROM Star Chart (1997). The light curves of 13 new variables are plotted in Figures 1–3. The individual measurements are available upon request from the first author.

The basic data of these stars (celestial coordinates, USNO-A2.0 blue and red magnitudes and suspected types) are summarized in Table 1. The type of variability is exclusively based on the light curve shape, thus it is likely to be quite uncertain in some cases. Follow-up observations are desirable to provide more reliable classification for most of the stars.

[†] Based on observations taken at the German–Spanish Astronomical Centre, Calar Alto, operated by the Max-Planck-Institute for Astronomy, Heidelberg, jointly with the Spanish National Commission for Astronomy

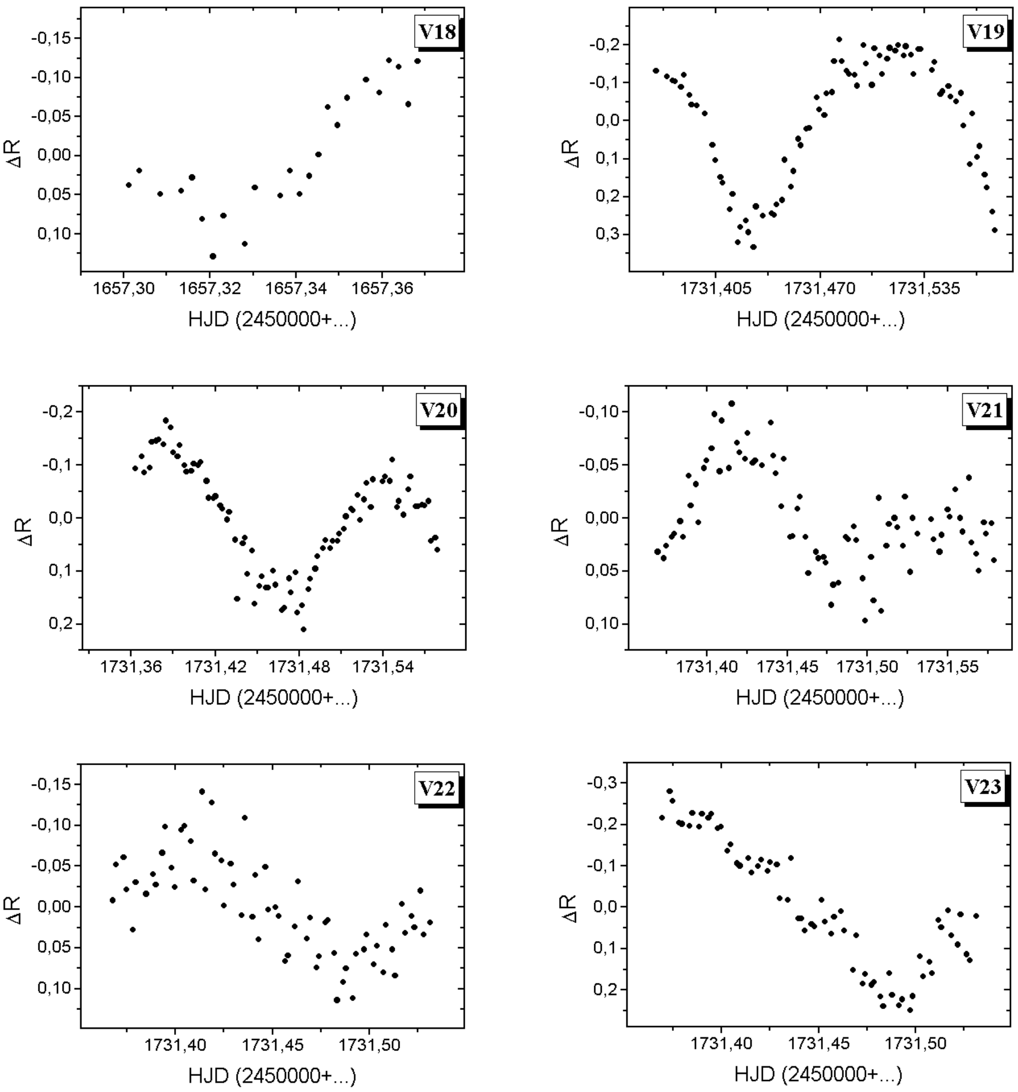

Figure 1. Light curves of 6 new variable stars

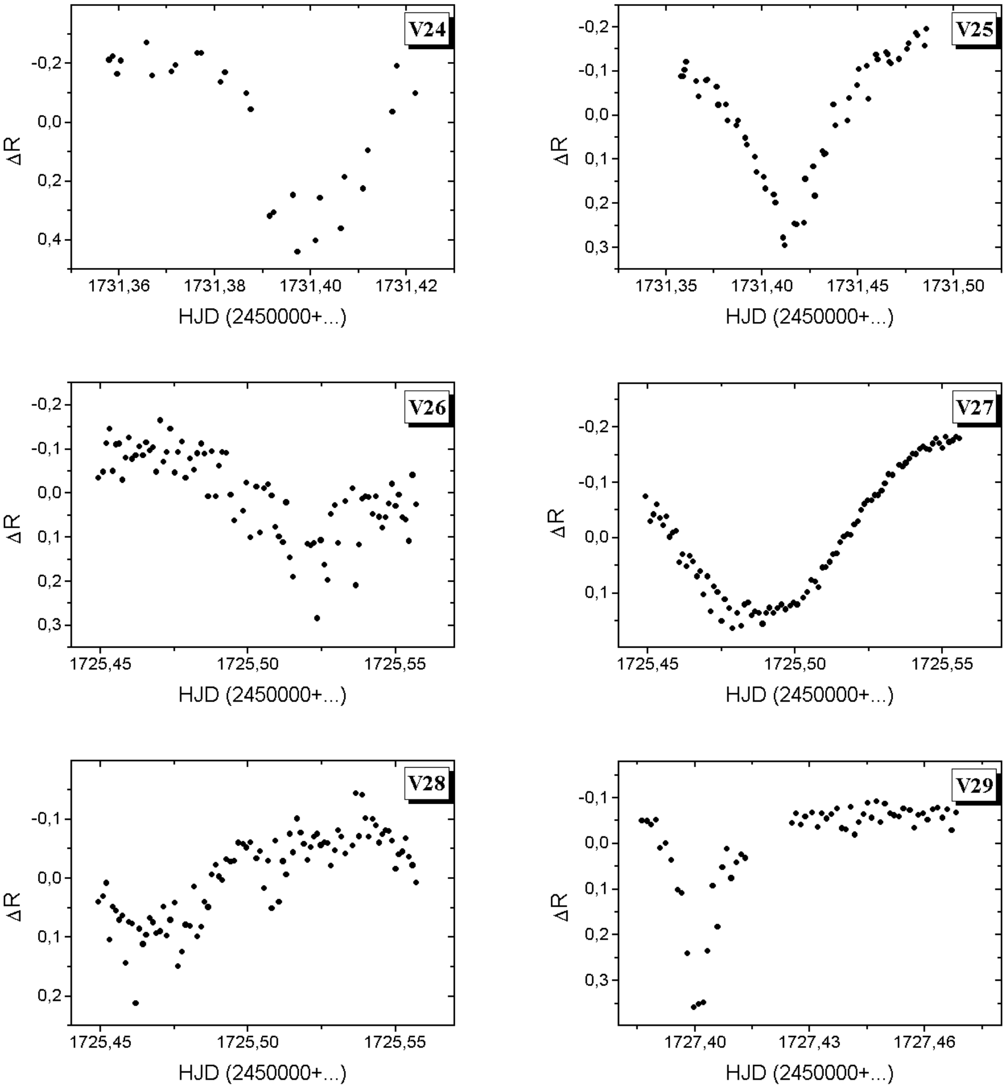

Figure 2. Light curves of 6 new variable stars

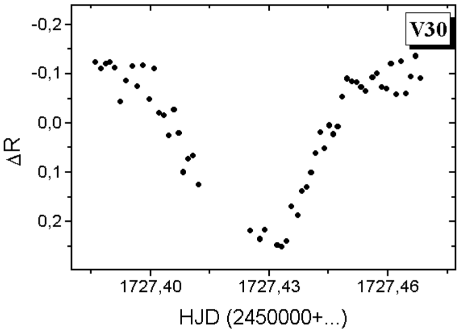

Figure 3. Light curve of the new variable star V30

Table 1: Basic data of the new variables. The coordinates, red and blue magnitudes were taken from USNO-A2.0. The coordinates for V24 and V25 are the improved values from Stone et al. (1999). The given types are based on the light curve shapes, thus they should be considered as approximative ones.

Variable	R.A. (2000)	Dec. (2000)	Red mag.	Blue mag.	Type
V18	$08^{\rm h}26^{\rm m}32\overset{\rm s}{.}5$	$+09^\circ43'18''.2$	17.1	19.7	–
V19	$17^{\rm h}33^{\rm m}08\overset{\rm s}{.}2$	$+10^\circ43'16''.5$	18.3	19.2	eclipsing
V20	$17^{\rm h}33^{\rm m}20\overset{\rm s}{.}2$	$+10^\circ46'09''.4$	17.5	19.1	pulsating
V21	$17^{\rm h}33^{\rm m}24\overset{\rm s}{.}3$	$+10^\circ47'03''.0$	17.8	19.3	pulsating
V22	$17^{\rm h}33^{\rm m}39\overset{\rm s}{.}0$	$+10^\circ47'02''.9$	18.6	19.5	–
V23	$17^{\rm h}33^{\rm m}53\overset{\rm s}{.}5$	$+10^\circ49'25''.6$	18.4	20.3	–
V24	$18^{\rm h}03^{\rm m}58\overset{\rm s}{.}7$	$+00^\circ59'53''.9$	16.9	18.4	–
V25	$18^{\rm h}04^{\rm m}16\overset{\rm s}{.}8$	$+01^\circ02'52''.0$	15.2	17.5	eclipsing
V26	$19^{\rm h}55^{\rm m}21\overset{\rm s}{.}5$	$+58^\circ33'30''.9$	16.9	18.2	–
V27	$19^{\rm h}56^{\rm m}18\overset{\rm s}{.}9$	$+58^\circ35'17''.3$	14.0	14.1	eclipsing
			13.4[a]		
V28	$19^{\rm h}56^{\rm m}23\overset{\rm s}{.}9$	$+58^\circ43'07''.2$	17.7	19.3	–
V29	$20^{\rm h}18^{\rm m}31\overset{\rm s}{.}4$	$+60^\circ41'18''.8$	17.6	18.5	eclipsing
V30	$20^{\rm h}18^{\rm m}36\overset{\rm s}{.}2$	$+60^\circ37'03''.0$	18.1	20.0	–

[a] V27 = GSC 03947-01632

Acknowledgements: This work has been supported by OTKA Grant #T032258, Pro Renovanda Cultura Hungariae Foundation Grant DT 2000 máj./43, máj./44, máj./48, and "Bolyai János" Research Scholarship of LLK from the Hungarian Academy of Sciences. The warm hospitality of the staff of the Konkoly Observatory and Calar Alto Observatory is gratefully acknowledged. We used the SIMBAD database, operated at CDS, Strasbourg, France.

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BV-PHOTOMETRY AND THE FIRST EPHEMERIS OF THE ECLIPSING BINARY SYSTEM GV Dra

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GV Dra (HIP 87576, $V_{\max} = 8\overset{m}{.}53$, $B - V = 0\overset{m}{.}42$, F2) was between the stars with accurately known position even before the Hipparcos mission so it was included in the extension of the Fifth Fundamental Catalogue (Oja 1985; Fricke et al. 1991). Hipparcos satellite discovered that GV Dra is an eclipsing binary and it is listed in the Hipparcos catalogue (ESA, 1997) as an unsolved EA variable.

Here we present the results of regular photometric monitoring in B and V bands that spanned 122 nights between March 1998 and September 2000. We observed from a private observatory near Cembra, Italy. The instrument was a 28-cm Schmidt–Cassegrain Celestron telescope equipped with Optec SSP5 photometer and standard B and V filters. The diaphragm had the size of 77 arcsec, and usual exposure time was 10 seconds. HD 162131 (HIP 86982, $V = 7\overset{m}{.}60$, $B - V = 0\overset{m}{.}16$, A2) was chosen as a comparison and HD 162035 (HIP 86955, $V = 8\overset{m}{.}27$, $B - V = 0\overset{m}{.}03$, A0) as a check star.

All the observations were corrected for atmospheric extinction and colour corrections and the instrumental differential magnitudes were transformed into standard UBV system. The variable, comparison and check stars are very close to each other so the atmospheric corrections were rather small. Altogether we obtained 228 observations in the B and 371 in the V band. Typical error of the B and V magnitudes is $0\overset{m}{.}01$. The light curves of GV Dra in each band as well as the $B - V$ colour variations are shown in Fig. 1. Expanded plots around primary and secondary eclipse are shown in Fig. 2.

The ephemeris for GV Dra, estimated on the base of our B and V photometric observations is:

$$\text{Min. I} = \text{HJD } \underset{\pm 5}{2451738.411} + \underset{\pm 3}{23\overset{d}{.}85433} \times E.$$

The B and V light curves show that the depths of the eclipses are remarkably different. The estimated values are $0\overset{m}{.}58$ and $0\overset{m}{.}28$ for the primary and the secondary minima respectively. The duration of the primary eclipse is about 11.5 hours. The secondary one lasts significantly longer, about 19 hours. The system is detached with both components well inside their Roche lobes. The position of the secondary minimum at phase 0.736 indicates a considerable eccentricity of the orbit ($e > 0.38$).

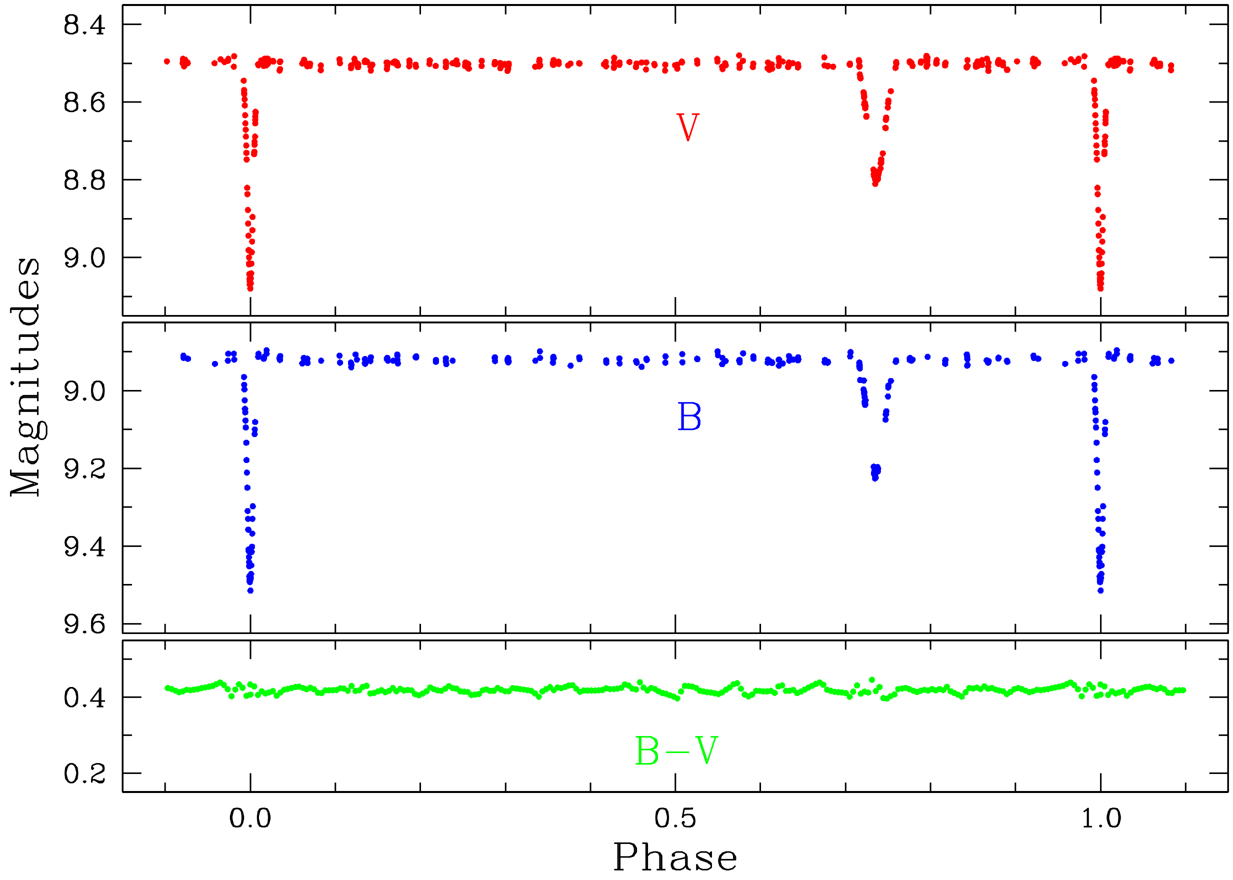

Figure 1. Light curves of GV Dra in B and V filters for the estimated period of $23^{\rm d}.85433$. The bottom panel gives the $B-V$ colour variations.

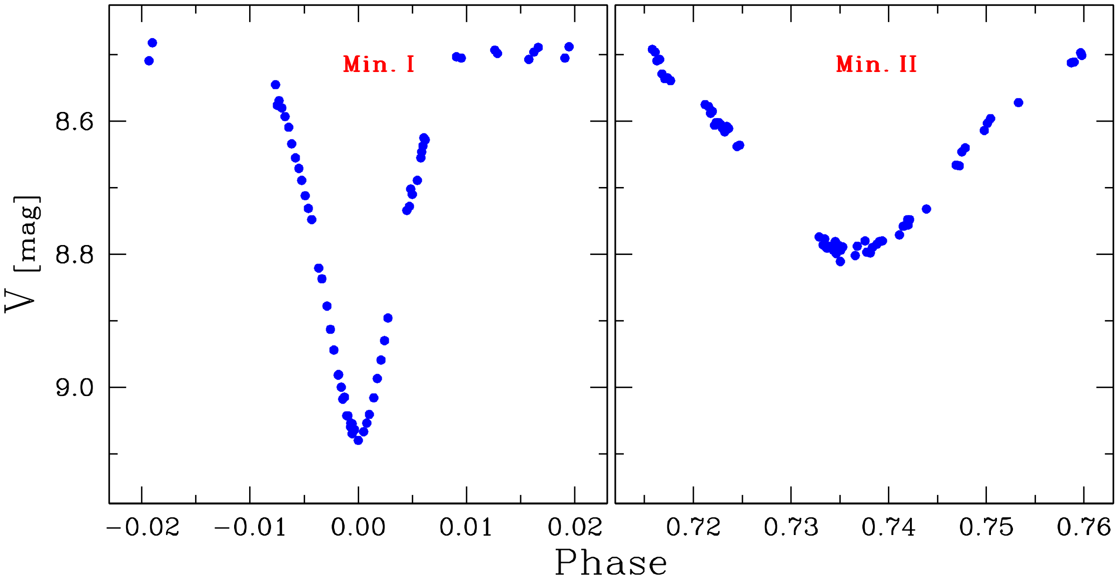

Figure 2. Expanded view around the primary and secondary eclipses in the V band.

The high orbital eccentricity makes GV Dra an interesting target for further spectral and photometric observations in order to determine the physical parameters of this eclipsing system.

The data are available upon request from dallas@inwind.it.

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4991

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1 December 2000

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BVR PHOTOMETRY OF RS CVn TYPE BINARY RT ANDROMEDAE

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Name of the object:
RT And = BD +52°3383A = HIP 114484

Equatorial coordinates:	**Equinox:**
R.A.= $23^{\rm h}11^{\rm m}10^{\rm s}\!.11$ **DEC.=** $53°01'\!.5$	2000

Observatory and telescope:
Ege University Observatory, 48-cm Cassegrain telescope

Detector:	Hamamatsu, R4457 (PMT)
Filter(s):	B, V and R filters of Johnson system
Comparison star(s):	BD +52°3383 = HIP 114482

Availability of the data:
Upon request

Type of variability:	RS CVn

Remarks:

As part of our ongoing study on short period eclipsing RS CVn system RT And is reported here. The star was observed photoelectrically with the 48-cm Cassegrain telescope from 8 Aug. to 12 Oct. 2000. The comparison and check stars are BD +52°3383 and BD +52°3384, respectively. The phases of the observations were calculated using the following light elements:

$$\mathrm{HJD\ Min.\ I} = 2451142.4938 + 0\overset{\rm d}{.}62892979 \times E.$$

Table 1 lists the dates of observations and the phases covered. The derived light curves for B, V, R colours are illustrated in Figure 1.

Acknowledgements:

This work was supported by Ege University Research Fund
(Project No. 99/FEN/016).

Table 1

Date	Phase
08 Aug.	0.61–0.68
02 Sep.	0.98–0.48
04 Sep.	0.19–0.58
06 Sep.	0.32–0.73
27 Sep.	0.94–0.15
12 Oct.	0.63–0.04

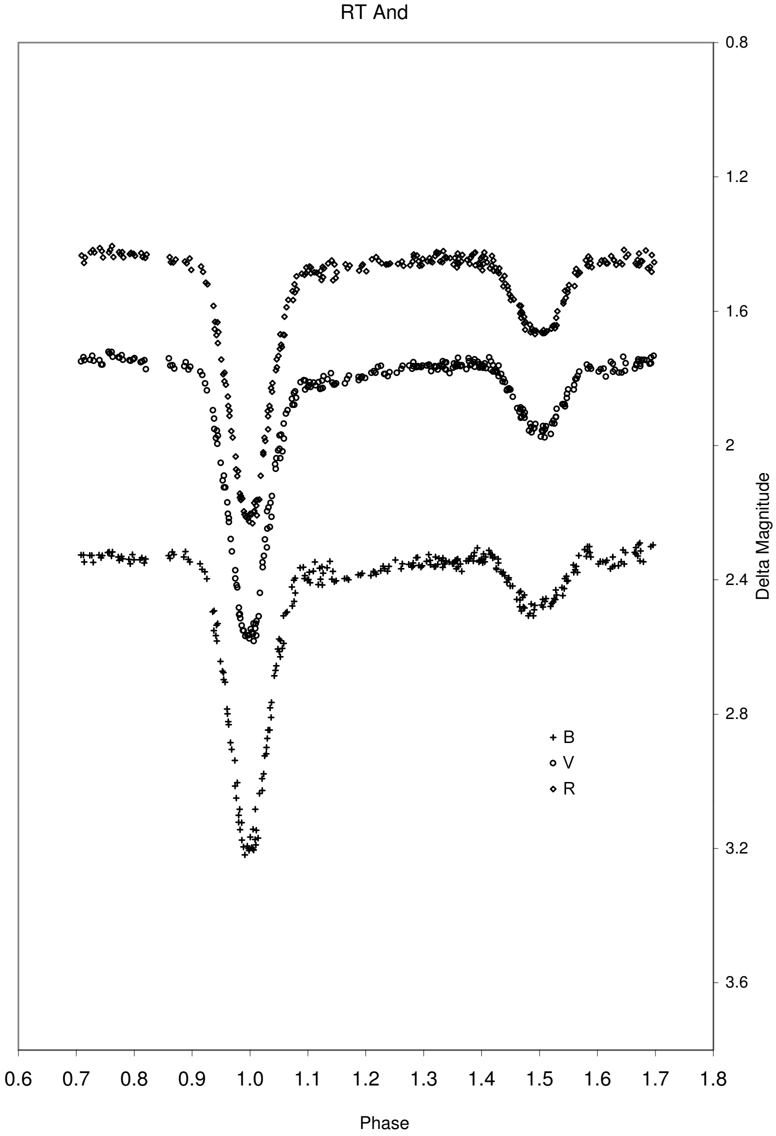

Figure 1. The light curves of RT And

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II PEGASI REACHED THE LARGEST AMPLITUDE UP TO NOW

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Name of the object:
II Peg = BD $+27°4642$ = HD 224085

Equatorial coordinates:	**Equinox:**
R.A.= $23^h55^m04\overset{s}{.}05$ **DEC.**= $28°38\overset{\prime}{.}02$	2000

Observatory and telescope:
Ege University Observatory, 48-cm Cassegrain telescope

Detector:	Hamamatsu, R4457 (PMT)
Filter(s):	U, B, V and R filters of Johnson system
Comparison star(s):	BD +28°4666 = SAO 91574
Check star(s):	BD +27°4648 = SAO 91593

Availability of the data:
Upon request

Type of variability:	RS CVn

Remarks:
II Pegasi is known as one of the most active RS CVn stars, which shows significant photometric variability due to rotational modulation of cool spots. The present observations of II Peg were obtained on 23 nights in 2000. We obtained 257 data points for each colour between July 3 and November 17, 2000. Johnson V-band light curve for II Peg obtained in this year is shown in Figure 1. Phasing is from HJD 2449582.9268 with $6\overset{d}{.}724333$ period (Berdyugina *et al.* 1998). The brightness of the system reaches its maximum value at about phase 0.84 and its minimum value at about phase 0.42. Our broad-band photometry shows V-band variations up to 0.63 mag. This value is the largest amplitude value observed up to now. The system has diminished until 8.04 mag in V-band at the first time. The smallest amplitude of 0.05 mag in V was observed on II Peg in 1983 by Evren (1988). The largest amplitudes of 0.50 mag in V were observed previously in late 1986 by Doyle *et al.* (1988) and in early 1989 by Casas *et al.* (1989).

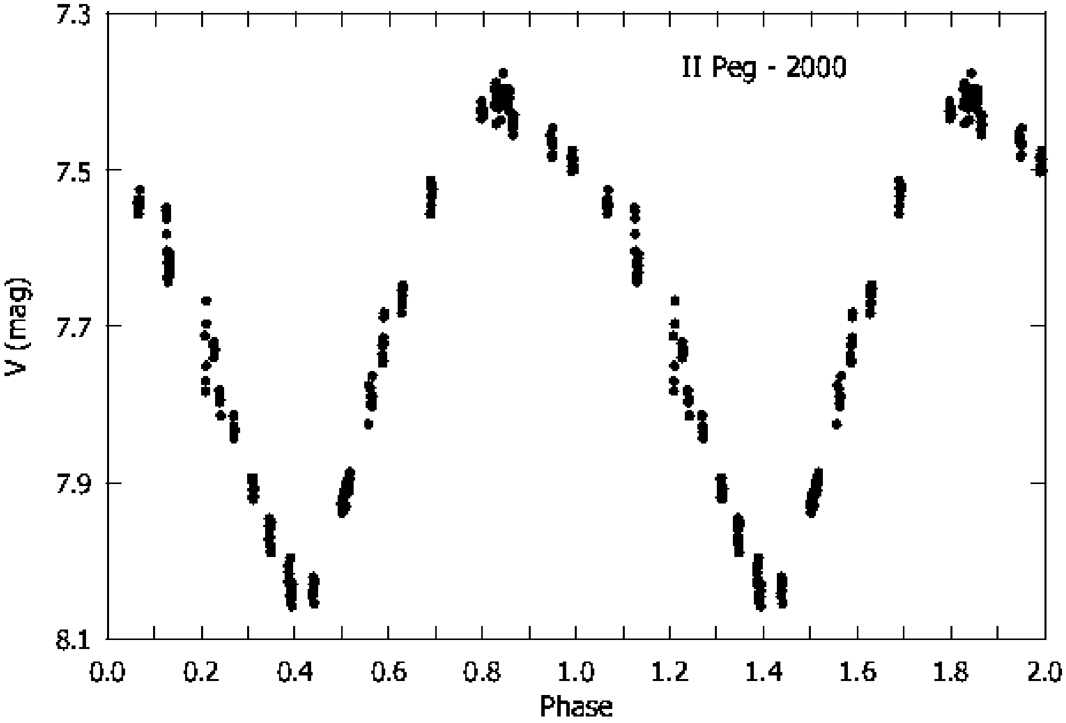

Figure 1.

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ON THE VARIABILITY OF G0–G9 STARS

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This paper examines the Hipparcos photometry (ESA 1997) of the G0-G9 stars in the Bright Star Catalogue, 5th edition (Hoffleit & Warren 1991) and the Supplement of the 4th edition (Hoffleit et al. 1983). The stars investigated include Cepheids, Algol type variables, BY Draconis stars, FK Com variables, irregular and slow irregular variables, R CrB stars, semi-regular variables, microvariables, stars which need additional observations to determine their variability type, and constant stars. Hipparcos photometry does not confirm the reported variability of some stars which might indicate a change in the stellar behavior or reflect the quality of previous photometry.

The mean amplitudes of various spectral types with at least 3 class members given in Table 1 are indicative of variability. Stars with spurious variability due to duplicity are excluded. When one allows for known variables and statistics and compares these values with those found for other spectral types, these values indicate that the G stars are not particularly variable. Their means are similar to those found for B6–B9 III stars (Adelman, Gentry, & Sudiana 2000), for A0–A2 III–V stars (Adelman, Flores, & Patel (2000), A3–A7 III and A3–F0 IV stars (Adelman 2000a), and K0–K4 III stars (Adelman 2000b). Even the supergiants are not particularly variable which continues the trend seen among the A and F supergiants (Adelman, Cay, Cay, & Kocer 2000). Our values are slightly smaller than those of Maeder (1980) whose mean V amplitudes are $0\overset{m}{.}030$ for G0–G9 Ib stars and $0\overset{m}{.}025$ for G0–G9 II stars. As Hipparcos obtained data for a period of 3 years, longer period variability such as solar cycles have only been partially sampled and the total variability may be greater.

Table 2 (available electronically from the IBVS site as 4993-t2.txt and 4993-t2.tex) contains the values for individual stars including those which were not used in compiling these means. It shows for each star the HR number (if any), names (Bayer, Flamsteed, and/or variable star designations), the V magnitude from the Bright Star Catalog and its Supplement, the spectral type, the Hipparcos number, the standard error (mag), the amplitude (mag), and comments (type of variable and some NSV numbers if there was not space in the Names column).

Table 3 lists stars with amplitudes of variability of $0\overset{m}{.}04$ and greater which are more variable than the other G stars. Some are well-known variables while others particularly those with amplitudes of order $0\overset{m}{.}04$ require additional observations.

Acknowledgements. SJA wishes to thank the Citadel Development Foundation for their support.

Table 1: The mean amplitudes of various types of G0 through G9 stars

Spectral class	Number	Mean amplitude (mag)	Comment
G0Ib	5	0.024 ± 0.009	
G0Ib–II	3	0.020 ± 0.000	
G2Ib	5	0.024 ± 0.005	
G2Ib–II	4	0.022 ± 0.010	
G3Ib	5	0.020 ± 0.007	
G5Ib	5	0.172 ± 0.334	0.022 ± 0.005 without S Sge
G8Ib	6	0.030 ± 0.006	
G5II	11	0.023 ± 0.006	
G6II	4	0.015 ± 0.006	
G8II	16	0.023 ± 0.004	
G7II–III	3	0.023 ± 0.006	
G8II–III	16	0.023 ± 0.008	
G9II–III	3	0.020 ± 0.000	
G0III	6	0.023 ± 0.008	
G2III	4	0.022 ± 0.005	
G3III	5	0.028 ± 0.008	
G4III	6	0.020 ± 0.000	
G5III	37	0.025 ± 0.010	
G6III	21	0.024 ± 0.007	
G7III	28	0.023 ± 0.007	
G7+III	3	0.020 ± 0.000	
G7.5III	4	0.020 ± 0.008	
G8III	218	0.024 ± 0.014	
G8+III	5	0.020 ± 0.012	
G8.5III	15	0.018 ± 0.007	
G8–K0III	27	0.024 ± 0.007	
G9–III	3	0.017 ± 0.006	
G9III	76	0.022 ± 0.007	
G9.5III	9	0.020 ± 0.007	
G5III–IV	3	0.020 ± 0.010	
G8III–IV	18	0.034 ± 0.044	0.024 ± 0.005 without λ And
G9III-IV	7	0.021 ± 0.004	
G0IV	6	0.032 ± 0.026	0.022 ± 0.011 without HR 6105
G1IV	3	0.020 ± 0.010	
G2IV	6	0.023 ± 0.019	0.016 ± 0.005 without ϕ Vir
G2.5IV	3	0.020 ± 0.000	
G3IV	5	0.020 ± 0.007	
G5IV	17	0.028 ± 0.010	0.026 ± 0.006 without HR 7639
G6IV	3	0.020 ± 0.000	
G8IV	18	0.030 ± 0.019	0.024 ± 0.006 without HR 878 & HR 1362
G8–K0IV	4	0.030 ± 0.000	
G9IV	4	0.025 ± 0.006	

Table 1 (cont.)

Spectral class	Number	Mean amplitude (mag)	Comment
G0IV–V	3	0.037 ± 0.006	
G0V	40	0.029 ± 0.024	0.025 ± 0.008 without σ CrB
G1V	16	0.024 ± 0.006	
G1.5Vb	3	0.023 ± 0.015	
G2V	14	0.026 ± 0.008	
G2.5V	3	0.027 ± 0.006	
G3V	14	0.024 ± 0.006	
G4V	13	0.028 ± 0.009	
G5V	18	0.029 ± 0.012	
G6V	6	0.030 ± 0.021	0.022 ± 0.008 without HR 2162
G7V	3	0.030 ± 0.010	
G8V	12	0.034 ± 0.034	0.025 ± 0.005 without HR 4550
G9V	6	0.040 ± 0.025	0.030 ± 0.007 without V711 Tau

Table 3: Stars with amplitudes greater than $0\overset{\text{m}}{.}03$

Name	HD No.	Spectral Type	HIP No.	SE (mag)	Amp. (mag)	Comments
U Sgr	170764	G1.5Ib	90836	0.0683	0.72	DCEP
10 S Sge	188727	G5Ib	98085	0.0616	0.77	DCEP
56 Peg	218356	G8Ib	114155	0.0011	0.04	U
R CrB	141527	G0Iep	77442	0.0075	0.56	RCB
RY Sgr	180093	G0Ipe(C1,0)	94730	0.1050	1.74	RCB
HR 2641	52703	G8II–III	33774	0.0012	0.04	MV
HR 3043	63660	G0III	38146	0.0006	0.04	U
HR 4006	88639	G3IIIFe-1	50109	0.0006	0.04	U
ι Tuc	6793	G5III	5268	0.0028	0.06	U
HR 3922	85945	G5III	48802	0.0014	0.04	U
ϵ UMi	153751	G5III	82080	0.0012	0.05	EA
HR 3636	78668	G6III	44936	0.0007	0.04	MV
χ Eri	11937	G8IIIbCNIV	9007	0.0025	0.04	U
GZ Eri	27362	G8III	20075	0.0043	0.16	L
V403 Aur	39743	G8III	28162	0.0057	0.13	I
NSV 3072	47973	G8III	31765	0.0047	0.08	U
72τ Cnc	78235	G8III	44818	0.0013	0.04	MV
HR 5896	141853	G8III	77689	0.0009	0.04	
NSV 7785	148897	G8IIICN-2CH-1	80843	0.0010	0.04	P
HR 7010	172424	G8III	91523	0.0009	0.04	
ξ Her	163993	G8+III	87933	0.0012	0.04	SR
HR 3907	85505	G9III	48413	0.0015	0.04	
47 o Dra	175306	G9IIIFe-0.5	92512	0.0009	0.04	RS
HR 7325	181122	G9III	94916	0.0009	0.04	
24 DK UMa	82210	G4III–IV	46977	0.0013	0.05	RS
16 λ And	222107	G8III–IV	116584	0.0142	0.21	RS
HR 780	16589	G0IV	12300	0.0010	0.04	U
HR 6105	147722	G0IV	80399	0.0008	0.08	U

Table 3 (cont.)

Name	HD No.	Spectral Type	HIP No.	SE (mag)	Amp. (mag)	Comments
105 ϕ Vir	126868	G2IV	70755	0.0028	0.06	U
HR 1936	37501	G5IV	26190	0.0013	0.04	
HR 7683	190771	G5IV	98921	0.0017	0.06	U
HR 978	20277	G8IV	15241	0.0030	0.08	U
HR 1362	27536	G8IV:	20263	0.0045	0.08	U
HR 913	18894	G0IV–V	14124	0.0009	0.04	
HR 5740	137510	G0IV–V	75535	0.0008	0.04	
18 Cet	4307	G0V	3559	0.0008	0.04	
HR 4980	114630	G0V	64478	0.0008	0.04	U
39 Ser	142267	G0VFe-0.5	77801	0.0014	0.04	
17σ CrB	146361	G0VCaIIe	79607	0.0028	0.17	RS
HR 8635	214953	G0V	112117	0.0007	0.04	
π^1 UMa	72905	G1.5Vb	42438	0.0010	0.04	MV
9 BE Cet	1835	G2V	1803	0.0016	0.04	BY
HR 2290	44594	G3V	30104	0.0008	0.04	
HR 2882	59967	G4V	36515	0.0020	0.05	U
96 κ^1 Cet	20630	G5V	15457	0.0022	0.04	P
39 Tau	25680	G5V	19076	0.0013	0.06	U
HR 6748	165185	G5V	88694	0.0013	0.04	U
HR 7330	181321	G5V	95149	0.0019	0.04	
HR 8148	202940	G5V	105312	0.0011	0.04	
HR 2162	41824	G6V	28796	0.0022	0.07	U
HR 4864	111395	G7V	62523	0.0011	0.04	
HR 4550	103095	G8Vp	57939	0.0009	0.14	U
V711 Tau	22468	G9V	16846	0.0035	0.09	RS

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V383 VELORUM, A NEW DWARF NOVA

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Luyten (1938) first reported variability of the star NSV 4834 (HV 8280), which he estimated at 12.5 and 15.5 $m_{\rm pg}$ on two plates of the Bruce Proper Motion Survey. My investigation of this star on 316 Harvard photographic plates reveals that it is a previously unrecognized dwarf nova, ranging 12.5-17 $m_{\rm pg}$. The improved position is RA $10^{\rm h}19^{\rm m}40\overset{\rm s}{.}6$, Dec $-49^\circ34'15''$ (1950). The new coordinates were determined by interpolating the position of the variable among surrounding stars from the Guide Star Catalog. A finding chart appears in Figure 1. To permit all future observations to be identified with the same name, the official designation V383 Velorum has been assigned by N. N. Samus, editor in chief of the General Catalogue of Variable Stars (personal communication).

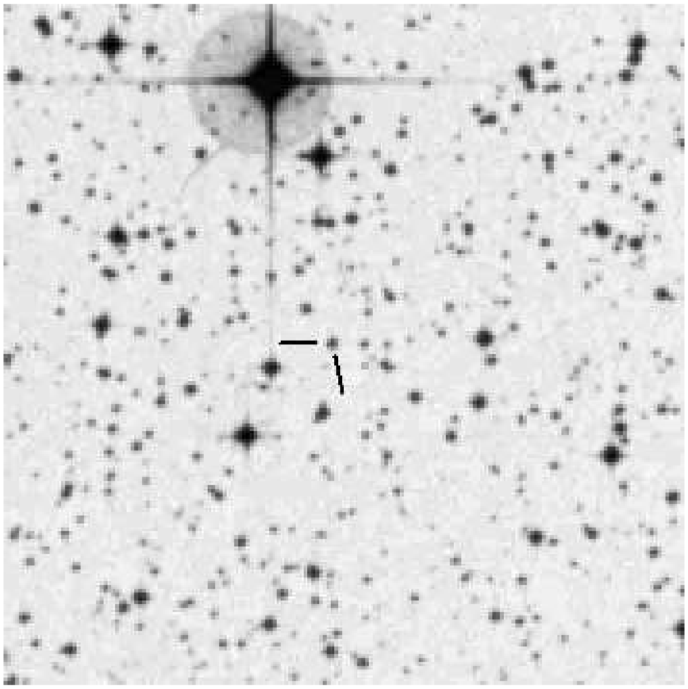

Figure 1. Finding chart for V383 Vel from the DSS (STScI). North up, field 5 arcmin wide. Bright star at top is SAO 221986 = HD 89954, 9.0 *V*

Observations during 30 maxima are listed in Table 1. The variable was estimated on 14 plates of the 60-cm Bruce astrograph (1899, 1926–35) and 107 plates of the 25-cm MF

Table 1: Maxima of V383 Vel on Harvard plates

JD 2400000 +	m_{pg}	JD 2400000 +	m_{pg}
14393.7*	12.6	29039.3*	13.5
24668.6*	13.6	29749.3	13.8
24672.6	16.5	29751.3*	12.9
26046.4*	12.8	29756.3	15.5
26055.4	14.8	30056.3*	12.5
26414.4	(14.6	30061.4	12.8
26417.4*	12.6	30063.3	13.3
26469.3*	13.4	30491.3*	12.9
26470.3	13.4	31591.3*	13.0
26471.3	14.0	31963.3*	13.1
26472.3	14.6	33039.3*	12.5
26738.6*	13.9	33418.3*	13.8:
26796.3	13.2	43695.5*	13.0
26797.3*	13.1	45703.0	13.2:
26803.4	16.2	45711.0*	13.0
26889.4*	12.8	45872.9*	14.0:
27044.6*	13.8	46110.0*	13.0
27050.5	15.8	46170.9*	12.9
27125.4	13.1	46224.9*	12.8
27193.2	13.8	46837.2*	12.8
27194.4*	12.9	46918.0*	13.2
27590.3*	13.5	47327.9*	13.1
29000.4*	13.5		

camera (1930–35). The best of these plates reach a faint limit of about 17.0 B. (These observations are listed electronically as 4994-t2.txt, available through the IBVS Web site.) In addition, estimates of the variable during outbursts were collected from the RB patrol plates (1930–52, faint limit 15.5 B) and the DSB patrol plates (1978–88, faint limit 14.5 B). Magnitudes of local comparison stars were estimated by comparison with nearby photoelectric B sequences from the Guide Star Photometric Catalogue (Lasker, Sturch, et al. 1988). The brightest observation near each maximum is labeled with an asterisk (*), though in each case the true maximum may have been brighter and earlier or later than the given JD. When available, fainter observations within a few days of labeled maxima are included in the table to indicate the rate of rise and decline.

In several instances, the maxima occur at intervals of 52–60 days, which is probably the characteristic cycle for this DN. In one instance, JD 2429000 and 2429039, the interval is shorter, but probably neither observation at 13.5 represents a full maximum.

V383 Vel is one of 1,764 new variables found by Luyten during the Bruce Survey. Most remain unstudied. For a brief review of these discoveries, see Williams (2000).

I would like to thank Martha Hazen, curator of astronomical photographs, for access to the Harvard College Observatory plate collection and Timothy Hager for assistance in preparing this report for publication.

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CCD LIGHT CURVES OF ROTSE1 VARIABLES, VII: GSC 3564.3059 CYGNI, GSC 3121.1799 LYRAE

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Var 1

Name of the object:
GSC 3564.3059 = ROTSE1 J194028.86+502554.7

Equatorial coordinates:	**Equinox:**
R.A.= $19^h40^m28.86^s$ **DEC.=** $+50°25'54.7''$	2000.0

Comparison star(s):	GSC 3564.2983

Check star(s):	GSC 3564.2997

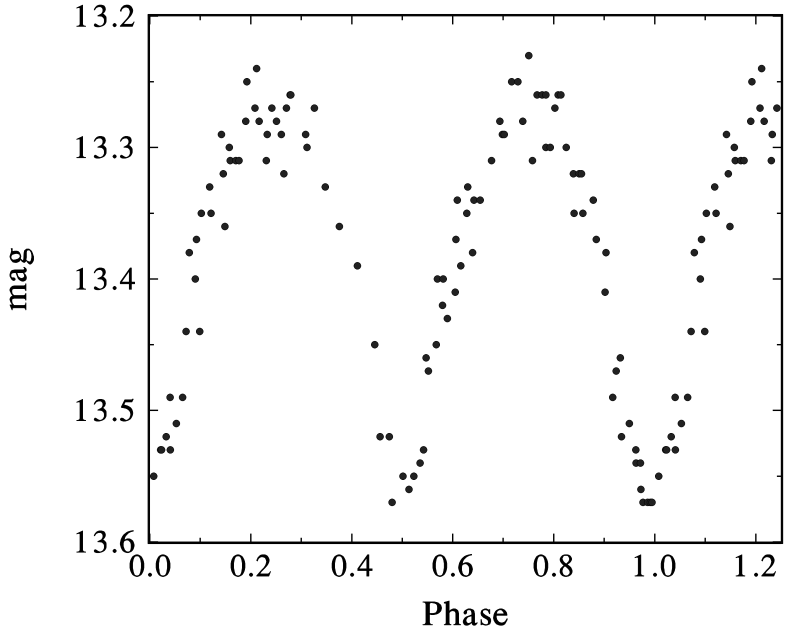

Figure 1. CCD light curve (without filter) of GSC 3564.3059

Var 2

Name of the object:
GSC 3121.1799 = ROTSE1 J191352.55+380653.3

Equatorial coordinates:	**Equinox:**
R.A.= $19^h13^m52.55^s$ **DEC.=** $+38°06'53.3''$	2000.0

Comparison star(s):	GSC 3121.1335

Check star(s):	GSC 3121.1294

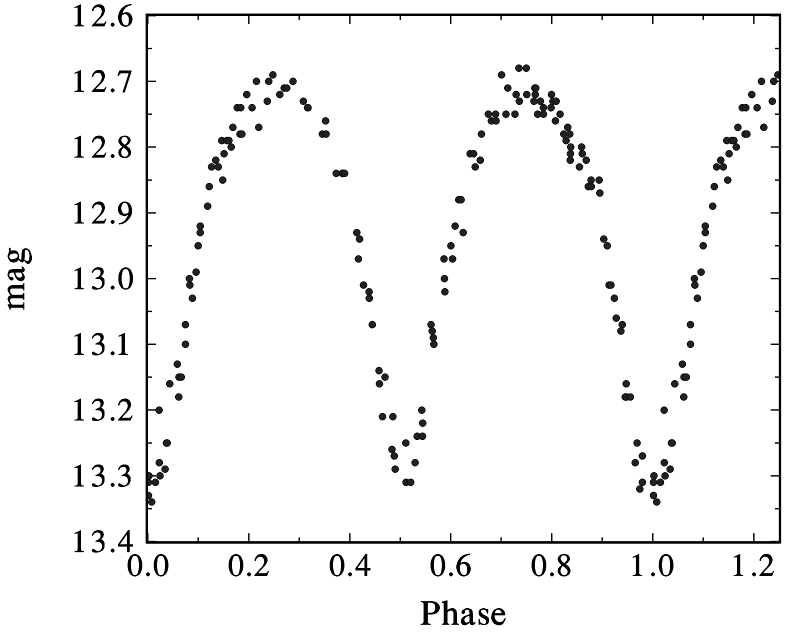

Figure 2. CCD light curve (without filter) of GSC 3121.1799

Observatory and telescope:
Private observatory, Schlüsselacher, Wald, 0.15-m refractor

Detector:	SBIG ST-7 CCD camera

Filter(s):	None

Availability of the data:
Upon request from diethelm@astro.unibas.ch

Type of variability:	EW

Remarks:

As a byproduct of the ROTSE1 CCD survey, a large number of new variables have been discovered (Akerlof et al., 2000). In a series of papers, we report unfiltered CCD observations for some of the close binary systems (type EW and E) in the list of Akerlof et al. (2000). GSC 3564.3059 (VAR1 in this paper) was observed with our CCD equipment as mentioned above during 4 nights between JD 2451766 and JD 2451781, while the data on GSC 3121.1799 (here VAR2) was collected during 6 nights between JD 2451801 and JD 2451850. A total of 108 CCD frames were measured for VAR1 and 163 frames for VAR2. A long observing run on GSC 3564.3059 during one night showed that the period given in Akerlof et al. (2000) was spurious and a corrected value had to be determined from the available CCD data. This new period is in need of confirmation, since the exact number of cycles between the two sets of observations could not be established unambiguously. Figures 1 and 2 show our observations folded with the elements

$$\begin{array}{ll}\text{GSC 3564.3059:} & \text{JD(min, hel)} = 2451781.4048(12) + 0.35436(4) \times E;\\ \text{GSC 3121.1799:} & \text{JD(min, hel)} = 2451801.3651(3) + 0.2534306(8) \times E.\end{array}$$

These elements of variation are deduced from a linear fit to the newly determined normal minima from the ROTSE1 data (VAR1: JDH 2451311.8785(4), primary (?); VAR2: JDH 2451274.8682(2), secondary; JDH 2451321.8727(6), primary) as well as the minima derived from our data and given in Blättler (2000, 2001).

VAR2 = GSC 3121.1799 turned out to be identical with V400 Lyr, which is certainly misclassified in the Fourth Edition of the GCVS. (The Editors)

Acknowledgements:

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

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Akerlof, C., Amrose, S., Balsano, R., Bloch, J., Casperson, D., Fletcher, S., Gisler, G., Hills, J., Kehoe, R., Lee, B., Marshall, S., McKay, T., Pawl, A., Schaefer, J., Szymanski, J., Wren, J., 2000, *AJ*, **119**, 1901

Blättler, E., 2000, *BBSAG Bulletin*, **123**, 6

Blättler, E., 2001, *BBSAG Bulletin*, **124**, in preparation

COMMISSIONS 27 AND 42 OF THE IAU
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CCD LIGHT CURVES OF ROTSE1 VARIABLES, VIII: GSC 3920.882 CYGNI, GSC 3547.216 CYGNI, GSC 3921.1531 CYGNI

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VAR1

Name of the object:
GSC 3920.882 = ROTSE1 J191635.07+524853.6

Equatorial coordinates:	**Equinox:**
R.A.= $19^h16^m35.07^s$ **DEC.=** $+52°48'53.6''$	2000.0

Comparison star(s):	GSC 3920.760

Check star(s):	GSC 3920.1408

VAR2

Name of the object:
GSC 3547.216 = ROTSE1 J192143.82+480356.3

Equatorial coordinates:	**Equinox:**
R.A.= $19^h21^m43.82^s$ **DEC.=** $+48°03'56.3''$	2000.0

Comparison star(s):	GSC 3547.1774

Check star(s):	GSC 3547.1876

VAR3

Name of the object:
GSC 3921.1531 = ROTSE1 J192537.72+532520.0

Equatorial coordinates:	**Equinox:**
R.A.= $19^h25^m37.72^s$ **DEC.=** $+53°25'20.0''$	2000.0

Comparison star(s):	GSC 3921.1760

Check star(s):	GSC 3921.1595

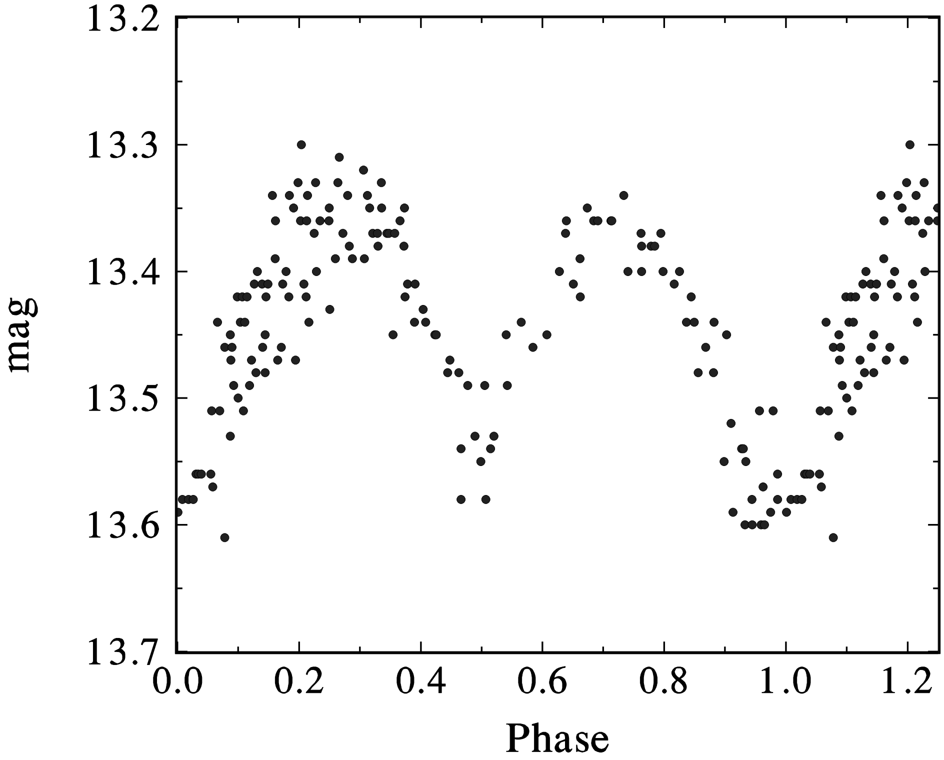

Figure 1. CCD light curve (without filter) of GSC 3920.882

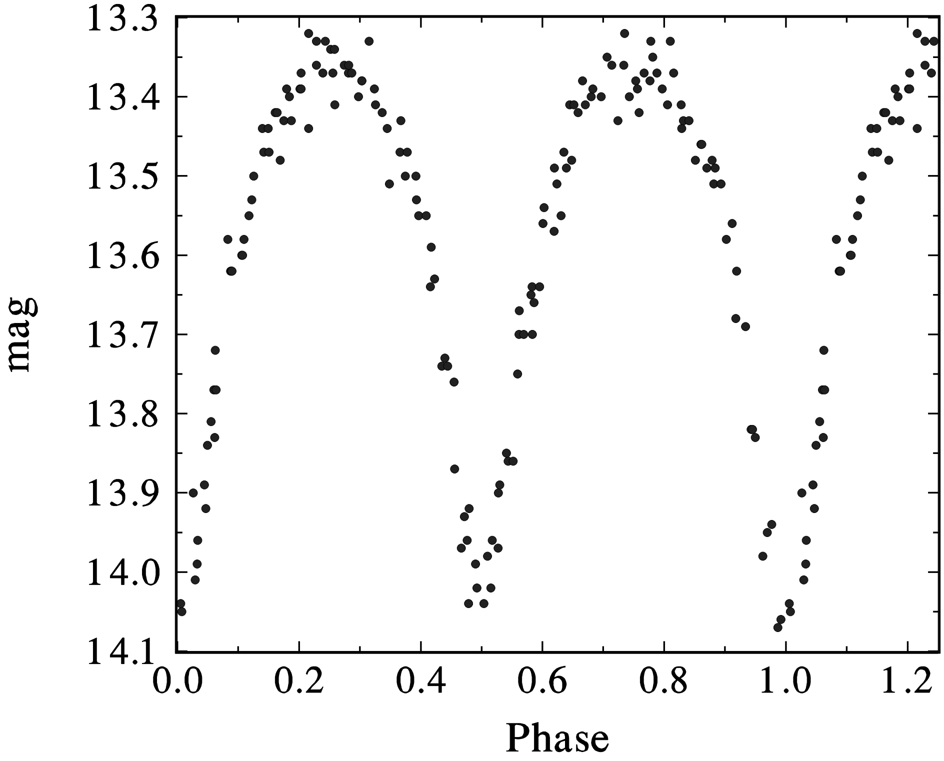

Figure 2. CCD light curve (without filter) of GSC 3547.216

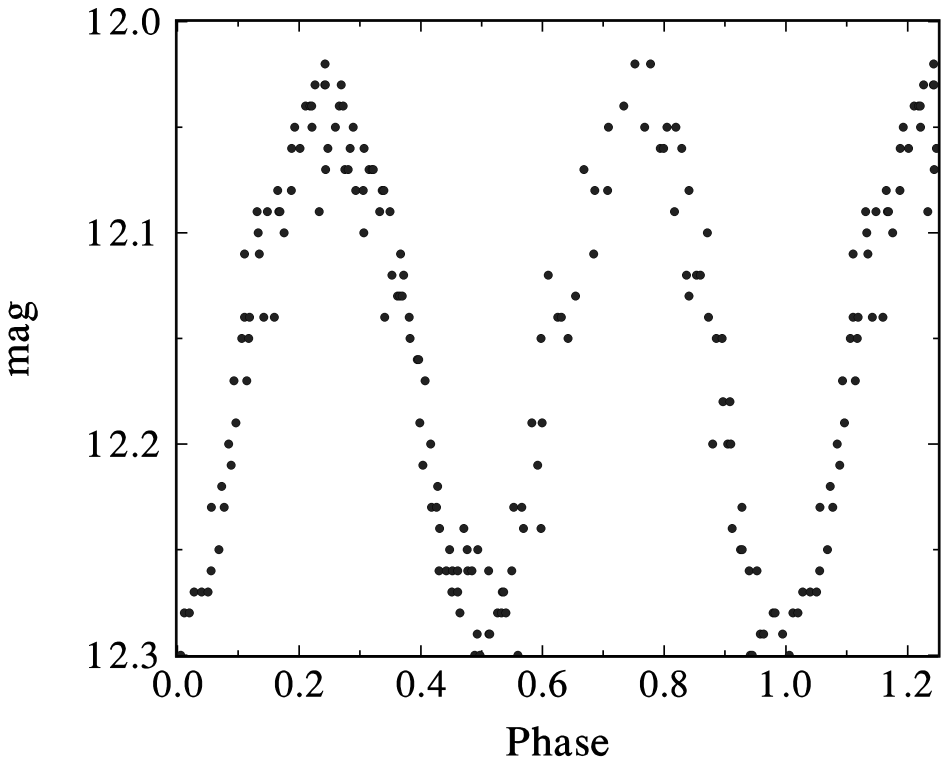

Figure 3. CCD light curve (without filter) of GSC 3921.1531

Observatory and telescope:
Private observatory, Schlüsselacher, Wald, 0.15-m refractor

Detector:	SBIG ST-7 CCD camera

Filter(s):	None

Availability of the data:
Upon request from diethelm@astro.unibas.ch

Type of variability:	EW (possibly δ Sct [VAR3])

Remarks:

As a byproduct of the ROTSE1 CCD survey, a large number of new variables have been discovered (Akerlof et al., 2000). In a series of papers, we report unfiltered CCD observations for some of the close binary systems (type EW and E) in the list of Akerlof et al. (2000). GSC 3920.882 (VAR1 in this paper) was observed with our CCD equipment as mentioned above during 5 nights between JD 2451806 and JD 2451850, while the data on GSC 3547.216 (here VAR2) was collected during 4 nights between JD 2451809 and JD 2451850. In the case of GSC 3921.1531 (VAR3), we obtained the data in 6 nights between JD 2451801 and JD 2451850. A total of 158 CCD frames were measured for VAR1, 164 frames for VAR2 and 166 frames for VAR3. Figures 1, 2 and 3 show our observations folded with the elements

GSC 3920.882: $\mathrm{JD(min, hel)} = 2451806.4044(44) + 0.361812(20) \times E$;
GSC 3547.216: $\mathrm{JD(min, hel)} = 2451806.4870(9) + 0.353358(6) \times E$;
GSC 3921.1531: $\mathrm{JD(min, hel)} = 2451811.3124(9) + 0.3359535(12) \times E$
(see note in the text).

These elements of variation are deduced from a linear fit to the newly determined normal minima from the ROTSE1 data (VAR1: JDH 2451312.7120(4), secondary; VAR2: JDH 2451259.8407(1), primary, JDH 2451291.8229(15), secondary; VAR3: JDH 2451258.8357(6), secondary (?), JDH 2451308.7271(5), primary (?)) as well as the minima derived from our data and given in Blättler (2001).

The light curve of GSC 3920.882 (VAR1) shows much more scatter than could be expected from the accuracy of the photometry. This might be due to intrinsic variability or erroneous classification, because variability of the comparison star can be ruled out.

GSC 3921.1531 (VAR3) shows a small amplitude and minima as well as maxima of equal brightness. Therefore, it might well be that this star is a pulsating variable of the δ Scuti type and half the period value stated in the elements above. Since we have no colour information, a definitive conclusion is not possible at the moment.

Acknowledgements:

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

References:

Akerlof, C., Amrose, S., Balsano, R., Bloch, J., Casperson, D., Fletcher, S., Gisler, G., Hills, J., Kehoe, R., Lee, B., Marshall, S., McKay, T., Pawl, A., Schaefer, J., Szymanski, J., Wren, J., 2000, *AJ*, **119**, 1901

Blättler, E., 2001, *BBSAG Bulletin*, **124**, in preparation

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CCD LIGHT CURVE AND NEW ELEMENTS OF V1823 Cyg

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Name of the object:
V1823 Cyg = GSC 2679.1740 = S3854 = CSV 5076 = NSV 12892

Equatorial coordinates:	**Equinox:**
R.A.= $20^h12^m6^s\!.40$ **DEC.=** $+3^\circ38'33''\!.6$	2000.0

Observatory and telescope:
Private station in Busto Arsizio, 0.21-m Newton ($F/5.0$)

Detector:	DTA Seti 245C CCD Camera

Filter(s):	None

Comparison star(s):	GSC 2679.0670 ($10^m\!.83$)

Check star(s):	GSC 2679.2602 ($11^m\!.5$)

Transformed to a standard system:	No

Availability of the data:
Through IBVS Web-site

Type of variability:	EW

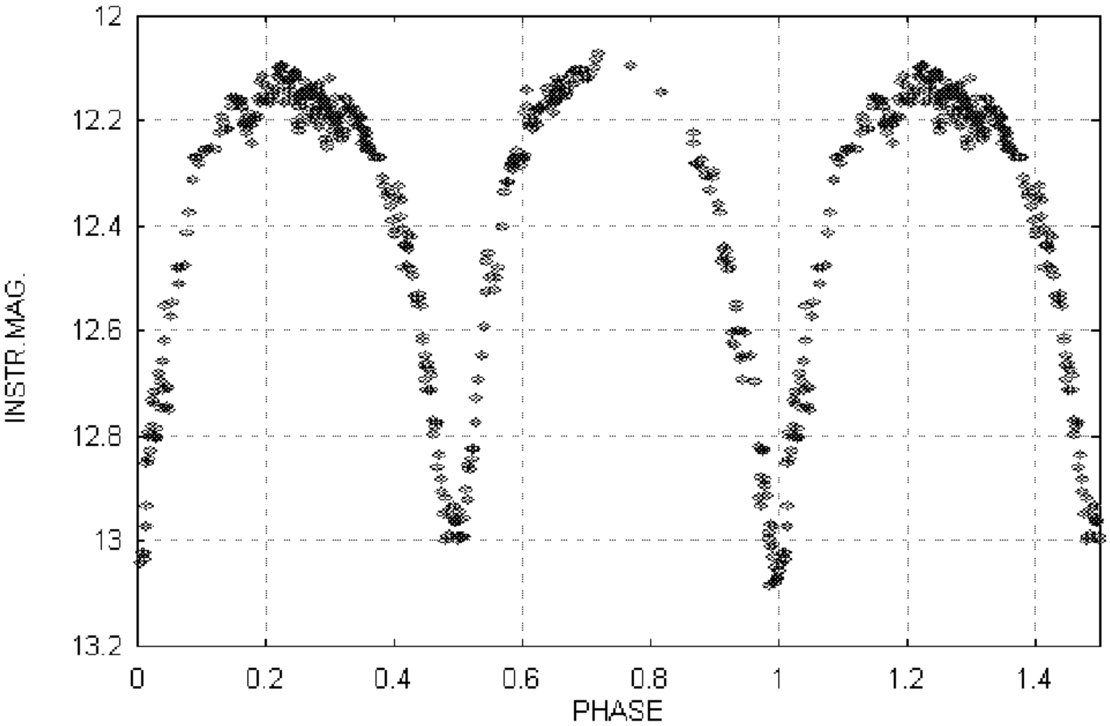

Figure 1. CCD light curve of V1823 Cyg folded with the elements given in (1)

Remarks:

V1823 Cyg was discovered as variable star by Hoffmeister (1949) and first observed by Ahnert-Rohlfs et al. (1954) who suspected an EW or RRc type of variation. It was monitored visually by some members of the G.E.O.S. (Wils, 1984): they found a probable RR Lyrae nature and gave also an approximate periodicity. We observed V1823 Cyg during 1999 and 2000 seasons: on the basis of the 409 measures obtained on 12 nights from JD 2451374 to JD 2451841 we were able to determine new type of variability (EW) and derived the following new elements of variation:

$$\mathrm{Min(I)} = \mathrm{HJD}\ 2451841.3487 + 0\overset{\mathrm{d}}{.}84627 \times E. \qquad (1)$$

Five times of minimum light are reported below:

HJD	E (1)	$O-C$ (1)
2451400.4444	−521.0	+0.0024
2451458.4092	−452.5	−0.0023
2451810.4607	−36.5	+0.0009
2451813.4187	−33.0	−0.0031
2451841.3487	0.0	0.0000

References:

Ahnert-Rohlfs, E., et al., 1954, Veröffentl. der Sternwarte in Sonneberg, Band 2, Heft 2
Hoffmeister, C., 1949, *Astronomische Abhandlungen, Ergänzungshefte zu den Astronomische Nachrichten*, Band 12, Nr. 1

Wils, P., 1984, *Note Circulaire GEOS NC*, 427

ERRATUM FOR IBVS 4997

The declination of V1823 Cyg is, of course, $+34^{\circ}38'33\overset{\prime\prime}{.}6$ instead of the +3°... printed in the paper.

The Editors

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LIGHT ELEMENTS AND A PRELIMINARY SOLUTION FOR THE LIGHT CURVE OF THE ECLIPSING BINARY GSC 1534.0753

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The ROTSE1 CCD survey (Akerlof et al., 2000) has discovered many new variables, a large number of which are eclipsing binary stars. A group of AAVSO members using CCD, visual and photographic observations have observed GSC 1534.0753 = ROTSE1 J170250.47. In this note we report the results of our investigation which include precision light elements and a light curve, as well as standard $UBVRI$ magnitudes for the variable and comparison stars. We also present a preliminary solution for the light curve using the Wilson–Devinney program.

Baldwin began a program of intensive visual monitoring of the star. A total of 69 observations were made over 24 nights. The star was seen in eclipse on five nights and from these observations preliminary light elements were determined. At the same time, Guilbault and Hager examined 211 photographic plates at the Harvard College Observatory. These photographic data enabled the elements to be further refined so that CCD observations could commence.

Lubcke observed the system with a 0.28-m Schmidt–Cassegrain telescope (SCT) equipped with an ST9E CCD camera from his private observatory. Billings used a 0.35-m SCT with a AP-7 CCD to observe the star at secondary minimum. The star was observed from JD 2451748 to JD 2451777 in the V passband. A total of 517 CCD observations were made and from these data five times of primary minimum and three times of secondary minimum were extracted. The times of primary minimum from all sources appear in Table 1.

From the Harvard minima listed above a period of $0\overset{d}{.}5111552$ was determined. The exposure time of the plates was generally one hour and the mid-point of the exposure is the time of minimum. The CCD minima were determined with the computer program *AVE* (Barbera, 2000) which uses the Kwee–van Woerden (1956) method. In order to refine the period further, a least squares solution was applied to all minima shown in

Table 1: Times of primary minimum, GSC 1534.0753

HJD 2400000 +	Error ±	Epoch	$O-C$	Observer	Type
43335.669	-	−16494	−0.002	Harvard	ptg
43659.740	-	−15860	−0.004	Harvard	ptg
43960.833	-	−15271	+0.018	Harvard	ptg
44045.671	-	−15105	+0.004	Harvard	ptg
44540.474	-	−14137	+0.009	Harvard	ptg
45170.699	-	−12904	−0.021	Harvard	ptg
45556.633	-	−12149	−0.010	Harvard	ptg
45618.490	-	−12028	−0.003	Harvard	ptg
45963.513	-	−11353	−0.010	Harvard	ptg
46028.456	-	−11226	+0.016	Harvard	ptg
46590.729	-	−10126	+0.018	Harvard	ptg
46612.652	-	−10083	−0.039	Harvard	ptg
46674.543	-	−9962	+0.002	Harvard	ptg
46937.806	-	−9447	+0.020	Harvard	ptg
46999.649	-	−9326	+0.013	Harvard	ptg
47084.489	-	−9160	+0.001	Harvard	ptg
47085.496	-	−9158	−0.014	Harvard	ptg
51748.7831	0.0009	−35	−0.001	Lubcke	CCD, V filter
51763.6073	0.0009	−6	−0.000	Lubcke	CCD, V filter
51764.6315	0.0015	−4	+0.002	Lubcke	CCD, V filter
51766.6744	0.0002	+0	−0.000	Lubcke	CCD, V filter
51767.6961	0.0002	+2	−0.001	Lubcke	CCD, V filter

Table 1. The CCD minima were weighted as 100 and the photographic minima were weighted as 1. From that analysis we extracted the best period and combined with the most accurate time of minimum to yield the following light elements:

$$\begin{array}{l} \text{Min. I} = \text{HJD } 2451766.6744 + 0\overset{\text{d}}{.}51115576 \times E. \\ \qquad\qquad\qquad\qquad\ \pm 0.0001 \quad \pm 0.00000005 \end{array}$$

The CCD observations in the V passband were folded using the elements above and the phased and normalized V light curve is shown in Figure 1. For the purpose of illustration the brightness of the variable is expressed in light units rather than magnitudes. The light curve varies continuously between eclipses and indicates that GSC 1534.0753 is a Beta Lyrae (EB) type eclipsing binary with one or both of the components being highly ellipsoidal.

In the instrumental system our V-filtered observations indicate that the star fades from a maximum of $11\overset{\text{m}}{.}94 \pm 0.01$ to $13\overset{\text{m}}{.}09 \pm 0.01$ at primary minimum. A secondary eclipse with a depth of $0\overset{\text{m}}{.}50 \pm 0.01$ occurs at phase 0.50.

From the US Naval Observatory's Flagstaff Station, Henden used the 1.0-m telescope and an SITe/Tektronix 1024 × 1024 CCD to observe the field of GSC 1534.0753. On four photometric nights observations were made in the $UBVRI$ bandpasses with magnitude and color errors less than $0\overset{\text{m}}{.}01$. The comparison (GSC 1534.1027) and check (GSC 1534.0962) stars were standardized as follows:

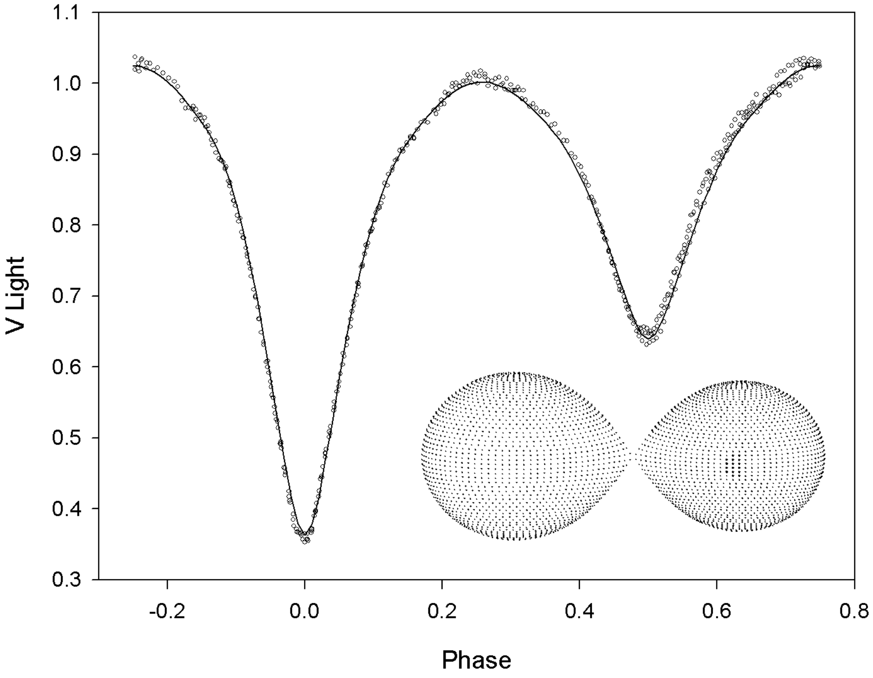

Figure 1. Phased and normalized V light curve and star figures based on the preliminary solution

Table 2: Comparison stars

Star	RA (J2000)	DEC	V	$B-V$	$U-B$	$V-R$	$R-I$
Comp.	17:02:54.93	+21:36:36.5	12.451	0.609	0.081	0.354	0.336
Check	17:02:29.25	+21:44:40.8	12.607	0.589	0.281	0.378	0.348

Extensive photometric information about all stars within 5 arcmin of the variable is available in Henden (2000). Using these stars, and again with errors less than $0\overset{\mathrm{m}}{.}01$, the magnitude and color indices of GSC 1534.0753 at four different epochs were determined as:

HJD 2400000 +	Phase	V	$B-V$	$U-B$	$V-R$	$R-I$
51754.6881	0.4494	12.324	0.723	0.247	0.405	0.358
51757.6891	0.5784	12.256	0.765	0.319	0.445	0.399
51761.7423	0.6489	12.084	0.765	0.315	0.446	0.388
51791.6953	0.9497	12.656	0.861	0.571	0.500	0.451

The colors suggest that the primary star is approximately spectral type G8 with a temperature of 5300 K using the Flower (1996) tables.

Terrell used the latest version of the Wilson–Devinney program (Wilson and Devinney, 1971; Wilson, 1979) to arrive at a preliminary solution for the system parameters. Inspection of Figure 1 shows that the system has a noticeable O'Connell effect (Davidge and Milone, 1984). To model this asymmetry in the maxima, two spots were used on the hotter component. While the available data are insufficient to reliably determine the properties of any spots in the system, the solution illustrates the nature of the asymmetries. Table 3 shows the parameters of the best-fit solution which should be regarded as provisional until further data, in particular radial velocities, can be obtained. As seen in Figure 1, the solution shows the system to be in marginal contact with the less-massive star eclipsed at primary minimum. The poor thermal contact suggests that the system may be a B-type W UMa system (Lucy and Wilson, 1979).

Table 3: Solution parameters

Parameter	Value	Std. deviation
i	$82\overset{\circ}{.}6$	$0\overset{\circ}{.}12$
T_1	5300 K	
T_2	4483 K	5 K
Ω	4.190	0.017
M_2/M_1	1.28	0.01
$(L_1/L_2)_V$	1.96	

Table 4: Spot parameters

Star	Co-Latitude (rad)	Longitude (rad)	Radius (rad)	Temperature factor
1	1.57	1.0	0.10	1.20
1	1.57	6.0	0.15	0.88

We wish to thank Dr. Martha Hazen, Curator of the Astronomical Photographic Collection at the Harvard College Observatory, for allowing us to use the plates for this and other projects. We are grateful to Dan Kaiser of the AAVSO for his valuable help in the preparation of this report. GWB acknowledges the use of software (KAPPA, PHOTOM) provided by the Starlink Project which is run by CCLRC on behalf of PPARC.

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DELTA VELORUM IS AN ECLIPSING BINARY

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Delta Velorum (HR 3485, HD 74956, HIP 42913) has been known as a quadruple system for many years as IDS 08419–5420 (Jeffers et al., 1963). The system contains two common proper motion (CPM) pairs, AB ($2''$) and CD ($6''$), separated by $\sim 69''$. The brighter pair, δ Vel (A1V, $V = 1.96$, $B - V = +0.04$, according to Simbad) comprises a bright A-type star and a companion of unknown spectral type, three magnitudes fainter. The primary component was itself resolved as a double star by speckle interferometry ($0\farcs6$) in 1978 (Tango et al., 1979) and then by the Hipparcos satellite ($0\farcs736$, $\Delta H_\mathrm{p} = 3.58$, Perryman et al., 1997), although this knowledge has not made its way to all the catalogues. The CCDM (Dommanget & Nys, 1994) and the MSC (Tokovinin, 1997) only mention the four well known components. The WDSC (Worley & Douglass, 1996), the Third Catalogue of Interferometric Measurements of Binary Stars (Hartkopf et al., 2000) and the GCPD (Mermilliod et al., 1997) do include the sub-arcsecond component.

On July 1, 1997, a drop of $\sim 0\fm3$ in δ Vel's brightness was observed visually by Otero (2000a), who went on to observe three more fadings during 1998 and 1999. Independently, Fieseler (2000) reported a fading in the engineering data of the Galileo star scanner observations of δ Vel, on June 19, 2000. Examination of the only other set of Galileo observations of δ Vel, which was made in 1989, shows a particularly well observed eclipse (see Figure 1). Hipparcos also observed δ Vel but apart from one observation of poor

Table 1: Times of minima

JD	Cycle	$O-C$	Min	Mag.	Comment
2447851.692	0	0.00	II	2.2	UB Galileo
2450631.5	62	0.10	I	2.2	vis Otero
2450831.7	66	0.10	II	2.2	vis Otero
2451147.8	73	0.15	II	2.1	vis Otero
2451308.65	77	0.00	I	2.3	vis Otero
2451715.1	86	0.10	I	> 2.1	UB Galileo
2451850.45	89	0.00	I	2.4	vis Jansen
2451869.8	89	-0.24	II	2.1	vis various

reliability the 110 observations, made fairly evenly over ~ 1200 days, show that δ Vel was constant to within ~ $0^{\rm m}_{\cdot}01$ at these times.

From an analysis of all the observations available, Lloyd (2000) and Otero (2000b) independently were able to fit an eccentric orbit with a period of approximately 45.16 days, which was consistent with both the eclipses and the out-of-eclipse observations, principally from Hipparcos. An international observing campaign across the southern hemisphere using this ephemeris resulted in the visual detection of eclipses on November 1st and 21st, 2000, near the predicted times. The times of minima from all the eclipses are gathered in Table 1 and were used to derive the improved ephemeris,

$$\mathrm{JD_I} = 2447832.10\,(\pm\,0.05) + 45.150\,(\pm\,0.001) \times E,$$
$$\mathrm{JD_{II}} = 2447851.692\,(\pm\,0.003) + 45.150\,(\pm\,0.001) \times E.$$

The best observed eclipse is that seen by Galileo in 1989 and this is shown in Figure 1 together with α Leonis for comparison. The Galileo star scanner is used for spacecraft orientation, and not for science, so the data are not calibrated. The star scanner uses an unfiltered photomultiplier tube with a response covering the Johnson U and B bands, peaking at ~ 4300 Å. The light curve shows an almost complete eclipse, with a full width of 1.0 days, and a depth of $0^{\rm m}_{\cdot}30$.

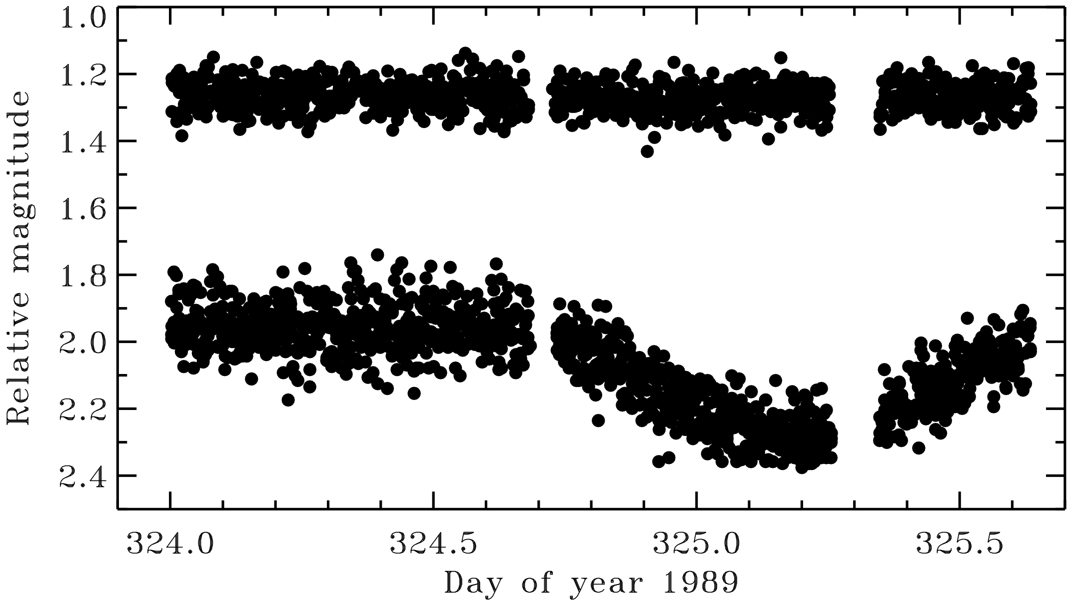

Figure 1. The light curve around secondary eclipse observed by the Galileo star tracker. The magnitudes are in the natural system of the detector normalised to the V magnitude of δ Vel. Observations of α Leonis are shown for comparison

The 2000 Galileo observations have poorer coverage than the 1989 data as Galileo's telemetry rates were lower, because the spacecraft was further from the Earth. Also software was introduced to suppress discordant measurements, which means that observations below ~ $2^{\rm m}_{\cdot}15$ are not reported by the spacecraft. Unfortunately this makes it very difficult to compare the two eclipses and assess the relative depths. The other eclipses observed visually do show a marginal but systematic difference. The three secondary eclipses typically reach 2.1 or 2.2, which is consistent with the 1989 Galileo observations, while the three primary eclipses observed were all deeper than 2.2, probably reaching 2.3.

There is also some suggestion in the visual observations that the primary eclipse is shorter than the secondary. As the orbit is eccentric, secondary eclipse occurs at $\phi = 0.43$, and the period quite long, it is possible that the system is elliptical enough to show differences in the width of the eclipses.

Given that there are three resolved components of δ Vel it may be considered that there is a possible uncertainty in the identification of the star responsible for the variations. However, the variable is unambiguously the brightest component, A. The close companions Aa and B each contribute $\sim 0\overset{\mathrm{m}}{.}05$ to the total light of the system so they cannot be responsible for the observed level of variation.

In the absence of any other information it would appear that both stars in the eclipsing binary are relatively similar. Any substantial difference would reveal itself in the eclipses, and this appears to be small. Without an accurate description of the primary eclipse, an orbital solution and detailed modelling, it is impossible to draw any definitive conclusion. However, if the difference between the eclipses is only $\sim 0\overset{\mathrm{m}}{.}1$ then this points to only a small difference in temperature and radius between the two components. The spectral type, given variously as A0V or A1V, is probably composite, and the system is probably a double-lined spectroscopic binary, with $K > 50$ km s^{-1}. The Bright Star Catalogue notes that the velocity is possibly variable, and quotes two rather different values of the $v \sin i$, 0 and 80 km s^{-1}.

We conclude that δ Velorum A is an eclipsing binary star probably containing two early main-sequence A-type stars. The δ Vel system now contains six components. The spectroscopic binary in an eccentric orbit, the close companions Aa and B, and the more distant CPM pair CD.

Further photometric and spectroscopic observations that will help in modelling the system are encouraged.

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THE DRAMA OF η CARINAE[†]

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S Doradus variables — commonly aliased as Luminous Blue Variables — are evolved massive stars which display two major types of photometric variability: 'microvariations' (such as the small-amplitude α Cyg variations covering fractions of a magnitude on time scales of 2–3 months) and 'S Doradus phases' (large-amplitude long-term variability in light and colour ranging over magnitudes on time scales of years) which are associated with wanderings over significant areas in the HR diagram. For a very detailed discussion of these types of variabilities, we refer to van Genderen (2000).

η Car has a historical record of visual-magnitude estimates and photoelectric measurements. Especially since its *'Great Eruption'* in the 1840s and the following years, η Car has been the subject of several photometric investigations which, unfortunately, leave an appreciable margin of doubt on the exact quantification of η Carinae's magnitude and colour. This is because the internal level of precision of the acquired data is quite often correctly described, though at the same time a proper assessment of the external accuracy of the data falls short, specifically for datasets spanning years or decades.

Very recently, η Car has been the focus of attention since it underwent a rapid rise in visual magnitude that started in the beginning of 1999 with a brightness gradient amounting to $-0.15\ \mathrm{mag\,y^{-1}}$ in the visual passband. The steady increase in visual light output somewhat slowed down earlier this year, and a preliminary analysis of CCD data obtained on November 12, 2000 with the Danish 1.54 m telescope at ESO La Silla reveals that η Car is now over its recent peak brightness, and could be in regress from its rightward and redward excursion in the HR diagram — its farthest excursion since about a century (see Figure 1).

It is exactly these substantial excursions in the HR diagram, together with the many peculiarities present in the spectra of these stars, that render invalid the photometric transformations to a standard system. From the perspective of the photometrist, η Car — if not the most famous amongst the S Doradus variables — certainly is the most troublesome S Dor star: it simply is the photometrist's ultimate nightmare. In previous papers (Sterken et al. 1999a, 2001a) we have given an elaborate outline of the major problems which photometrists face when performing long-term monitoring of a composite object like η Car. By its appearance as an extended object and by its anomalous spectral nature, this star is the single most difficult stellar object to measure or to monitor over a long time interval. The problems belong to several levels:

[†] Based on observations obtained at the Danish 1.54 m telescope at ESO La Silla, Chile

- the extreme brightness of η Car as a naked-eye star
- light curves that are interrupted by seasonal gaps
- the annual recurrence of high air masses that induces significant colour errors in broad-band photometry
- non-availability of a versatile photometric setup, viz. a modest-size telescope, suitable photometric instrumentation, and an appropriate photometric system
- incompatible photometric filter systems
- presence of variable and strong emission lines in the spectrum
- PMT and CCD photometry with diaphragms and apertures of different sizes

The photometric transformation problems are only relatively undisturbing in the visual passbands, but they do render any comparison of isolated photometric magnitudes and colour indices very difficult: the combination of non-overlapping data taken with different detectors, different diaphragm sizes and different filter systems (even seemingly-close UBV systems) is, to say the least, hazardous. From our previous experience, we estimate that such systematic effects may easily reach 0.1–0.2 mag. As such, when comparing isolated V magnitudes of η Car, great care must be taken because the unavoidable differences between photometric systems may result in very severe discrepancies, rendering the morphological shape of the light curve piecewise dependent on the instrumental setup.

But even more disturbing than the problems to bring magnitudes and colours to a conform scale are the long intervals during which η Car was not observed. After 1902 there is a gap of almost half a century during which there are virtually no recordings of the star's visual magnitude that could qualify as a light curve. Then, Albert Jones started observing in 1952 and carried on for almost 15 years estimating the brightness from his home observatory in Nelson, New Zealand. Systematic photoelectric measurements only started in the 1980s under impetus of Arnout van Genderen in the framework of the Long-Term Photometry of Variables project (LTPV, Sterken 1983).

The case of η Car vividly illustrates the loss of fundamental calibrated light- and colour information that is so crucial for supporting high-resolution ground-based and space-borne observations, a situation most detrimental for the correct understanding of the physics of this unique object. We, therefore, **urge observers in the southern hemisphere to turn their telescopes to η Car in order to quantitatively document the forthcoming phase of decline**. We underline that any useful photometric monitoring of this most enigmatic star must satisfy the conditions of

1. including at least one colour index in the magnitudes time series
2. delivering a vast amount of data — that is, sparse and isolated data sets in mutually incompatible filter systems are inadequate to understand the brightness evolution
3. yielding data that overlap in time in order to assure contiguous and homogeneous blending of adjacent light-curve sections
4. dissemination of data through publication, preferably after pooling, homogenization and quality control

That multi-colour photometry is carried out in an established standard system is not an absolutely necessary condition, as long as the internal homogeneity of the data on the natural photometric system is guaranteed.

We are aware that — though measuring this object takes less than five minutes per night — the future of long-term monitoring of η Car looks grim, since so many useful telescopes at major observatories have been decommissioned. Large telescopes do not

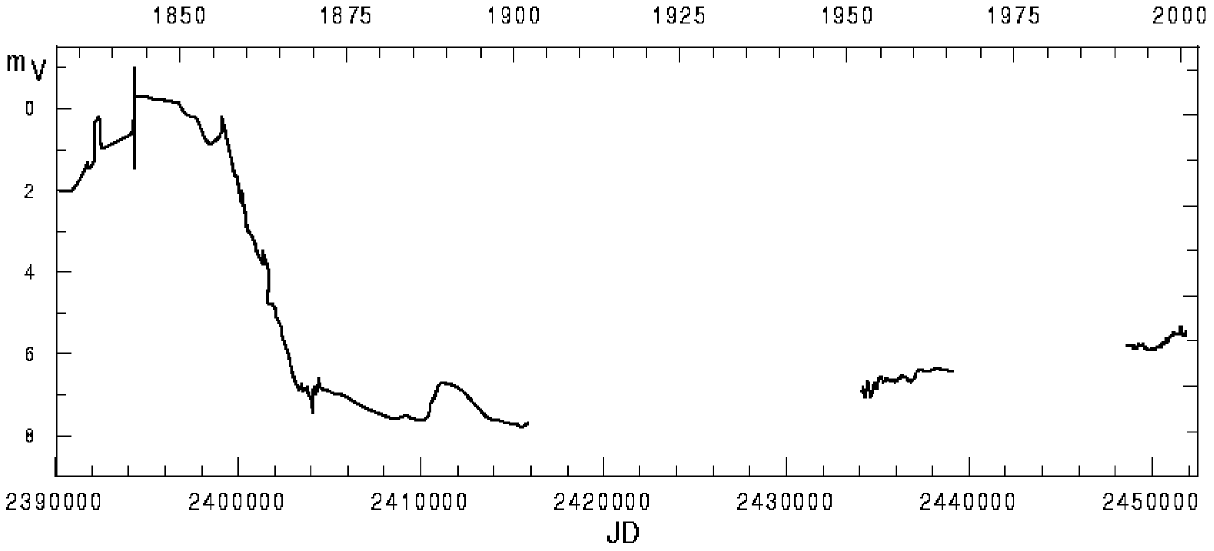

Figure 1. Schematic visual-band light curve of η Car 1830–2000. Based on data from Innes (1903), Jones and Sterken (1997, moving average), van Genderen et al. (1999), Sterken et al. (1999b, 2001b), this paper

serve the purpose because they enforce too short integration times. The present situation seems an apparently unavoidable consequence of the last decade's deployment of large and very large telescopes.

Van Helden (1994) argues that scientific instruments serve different purposes: in the first place instruments confer authority — though he shows that frequently a scientist will claim more authority than the instrument reasonably provides. In astronomy, authority comes by the size of the primary mirror: data from big telescopes are identified with *Big Science* — the happy term coined by Derek John de Solla Price to describe the shining and all-powerful large-scale character of modern science (Price 1963). Capshew and Rader (1992) even accentuate that *Little Science* is usually defined as *lacking one or another characteristic of Big Science.* Our everyday experience, though, shows that *characteristics of Little Science that are lacking in Big Science* are never discussed.

Big Science is an inevitable stage in the development of science. But η Carinae's temporary move to a maximum in the S Dor phase — a fact that we know and partially understand through the efforts of Little Science — more than ever supports the need for a systematic long-term watch of η Car and some other most eminent massive stars. The available data — perhaps even more the gaps without data — vividly support Alvin Weinberg's statement

> *"We must make Big Science flourish without, at the same time, allowing it to trample Little Science — that is, we must nurture small-scale excellence as carefully as we lavish gifts on large-scale spectaculars."* (Weinberg 1961)

Epilogue

The drive for larger size is not confined to mirror size alone. It is equally reflected in other aspects of our scientific activities, not in the least when assessing the value and impact of scientific journals. No one today will deny that IBVS, a Little Journal, over three decades has grown to a journal of Big Stature. Not just by natural growth, but through most dedicated fostering by its scientific and technical Editors. Often at the cost of their own scientific time and for no other return than rendering a very useful tool for Little Science.

I dedicate this paper to Dr. László Szabados who retires as Editor at the very moment that this 5000th Bulletin appears in press.

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