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CCD PHOTOMETRY OF THE ECLIPSING BINARY AR BOOTIS

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The eclipsing binary AR Bootis (= SVS 1266 = GSC 1999.0011 = FL 1630, $\alpha = 13^{\rm h}48^{\rm m}10\overset{\rm s}{.}40$, $\delta = +24°55'26\overset{''}{.}6$, J2000; $V_{max} = 13.5$ mag) is a frequently observed, rather faint variable star. It was discovered by Kurochkin (1959, 1960) in the vicinity of the globular cluster M3, but the period of $P = 0.416718$ days determined turned out to be incorrect. Houck and Pollock (1986) obtained two photographic light curves in the span of 3 days. They revised Kurochkin's data and derived the new period of 0.34470 days.

The system was also observed visually by the BBSAG and Brno observers: Locher and Diethelm obtained 9 times of minimum between 1975 and 1980, four times of minimum were observed by Borovička and Dědoch in 1987–90 (Mikulášek et al. 1992, Zejda 1995). Recently, other photometric times of minima have been given by Diethelm and Blättler. No spectroscopic observations have been published for this system.

We performed CCD photometry of AR Boo at two observatories. The system was observed in 1996–1998 at the Brno Observatory, Czech Republic, with a 40-cm Newtonian telescope and the CCD camera SBIG ST-7 without filter. Two color photoelectric photometry was done during the 12 nights from May to July 1997 at the Ondřejov Observatory, Czech Republic, with a 65-cm telescope and the CCD camera SBIG ST-6. Standard V Johnson and R Cousins filters were used. In most nights filters were changed between exposures, typically 120 seconds long. High signal-to-noise ratio enabled very good precision of the light curves, with standard error of measurements about 0.010 mag in R and 0.015 mag in V band. Altogether 183 measurements in R and 84 in V have been obtained.[1] The stars GSC 1999.0067 ($V = 12.9$ mag) and GSC 1999.0253 ($V = 12.9$ mag) – numbered 11 and 15 on the finding chart of Houck and Pollock (1986) – on the same frame as the variable served as a comparison and check stars, respectively.

Figure 1 shows the composite V, R light curves of AR Boo obtained in 1997. The light amplitude in primary minimum is $A_1 = 0.65 \pm 0.02$ mag and in secondary minimum $A_2 = 0.50 \pm 0.02$ mag in the R color. The amplitudes in V are very similar. The light curve seems to be typical of a β Lyrae type eclipsing binary. We also derived $V - R$ colour indices: 0.56, 0.59 and 0.37 mag for AR Boo in minimum, comparison and check stars, respectively.

[1] The table of observational data in ASCII format is available as the 4601-t2.txt file together with the electronic version of the Bulletin.

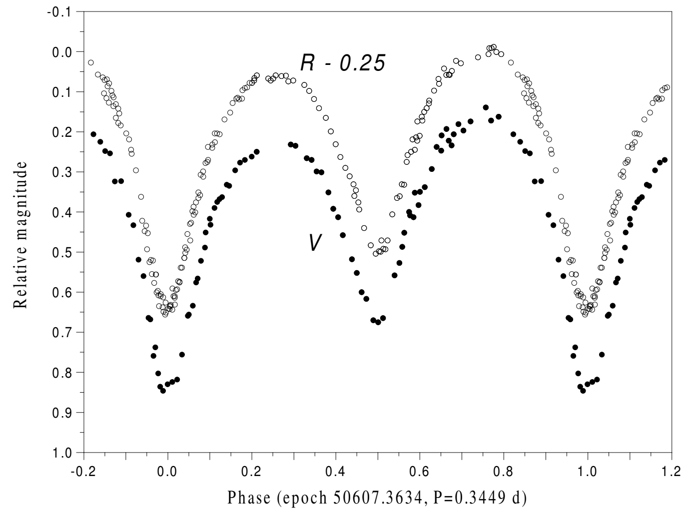

Figure 1. Composite differential V, R light curves of AR Boo computed using the new period of 0.3449 days. The R light curve is shifted by 0.25 mag

From the published photographic observations of Kurochkin (1960) we selected 12 times when the variable was fainter than 14.40 mag and defined them as plate minima. We also used the published observations of Houck and Pollock (1986) and determined three times of minimum light. Nevertheless, after a discussion with the first author, we revealed a systematic error in the published heliocentric Julian dates of -0.0661 days and corrected the times accordingly. From our measurements we derived 11 new times of minimum light and their errors using the method of Šarounová & Wolf (1996).

All available times of minimum (heliocentric Julian Date $-2\,400\,000$) are given in Table 1. The given errors apply to the last digit of the minimum time. For the ephemeris computation, the minima got a weight according to the observational method: plate minima (p) weight 1, visual (v) 5, photographic (f) 10, and CCD minima (C) 50.

A total of 44 moments of minimum covering the period 1950–1998 were incorporated in our analysis. They could not be fitted by a single period. The minima can be fitted either by a sudden period increase in about 1983 or by a continuous increase during the given period. The following light elements were calculated:

$$\text{Pri. Min.} = \text{HJD} \quad \underset{\pm 4}{24\,36661.541} + \underset{\pm 2}{0.3448669} \times E \qquad (1)$$

for JD $<$ 2445400, and

$$\text{Pri. Min.} = \text{HJD} \quad \underset{\pm 3}{24\,50182.4799} + \underset{\pm 1}{0.3448733} \times E \qquad (2)$$

for JD $>$ 2445400, or

$$\text{Pri. Min.} = \text{HJD} \quad \underset{\pm 4}{24\,36661.537} + \underset{\pm 2}{0.3448646} \times E + \underset{\pm 6}{1.17} \times 10^{-10} \times E^2 \qquad (3)$$

for the whole period.

The parabolic elements do not explain satisfactorily the photographic minima of Houck and Pollock (1986) but they fit better the CCD minima from the recent years. The $O-C$ residuals for all times of minimum with respect to the linear ephemeris (1) are shown in

Table 1: The times of minimum of AR Boo

JD_{hel}	m.	E	$O-C_{1,2}$	$O-C_3$	observer	source
34133.336	p	−7331	+0.014	−0.004	Kurochkin	(1960)
34146.430	p	−7293	+0.003	−0.015	Kurochkin	(1960)
34834.449	p	−5298	+0.012	+0.002	Kurochkin	(1960)
35593.314	p	−3097.5	−0.002	−0.006	Kurochkin	(1960)
35600.384	p	−3077	−0.002	−0.005	Kurochkin	(1960)
36658.419	p	−9	−0.019	−0.014	Kurochkin	(1960)
36661.359	p	−0.5	−0.010	−0.005	Kurochkin	(1960)
36666.357	p	14	−0.012	−0.008	Kurochkin	(1960)
36666.565	p	14.5	+0.023	+0.028	Kurochkin	(1960)
36668.433	p	20	−0.006	−0.001	Kurochkin	(1960)
36687.415	p	75	+0.009	+0.013	Kurochkin	(1960)
36695.315	p	98	−0.023	−0.018	Kurochkin	(1960)
42575.486	v	17148.5	−0.005	+0.004	Locher	BBSAG
42576.519	v	17151.5	−0.006	+0.002	Locher	BBSAG
42775.697	v	17729	+0.011	+0.019	Locher	BBSAG
42780.516	v	17743	+0.002	+0.009	Locher	BBSAG
42872.594	v	18010	+0.001	+0.007	Locher	BBSAG
43624.395	v	20190	−0.008	−0.006	Locher	BBSAG
43656.479	v	20283	+0.003	+0.005	Locher	BBSAG
43662.524	v	20300.5	+0.013	+0.015	Locher	BBSAG
44343.442	v	22275	−0.009	−0.012	Diethelm	BBSAG
46140.7391	f	27486.5	+0.0019	−0.0074	Houck & Pollock	(1986)
46140.9091	f	27487	−0.0005	−0.0099	Houck & Pollock	(1986)
46143.8416	f	27495.5	+0.0006	−0.0088	Houck & Pollock	(1986)
47669.386	v	31919	−0.002	−0.004	Borovička	BRNO 30
47946.502	v	32722.5	+0.008	+0.007	Borovička	BRNO 31
47968.561	v	32786.5	−0.005	−0.005	Borovička	BRNO 31
47968.571	v	32786.5	+0.005	+0.005	Dědoch	BRNO 31
50182.4791 ±2	C	39206	−0.0008	+0.0002	Šafář	this paper
50192.4789 ±30	C	39235	−0.0023	−0.0013	Diethelm	BBSAG 112
50200.4128 ±2	C	39258	−0.0005	+0.0005	Šafářová	this paper
50200.5850 ±5	C	39258.5	−0.0007	+0.0003	Šafářová	this paper
50547.3555 ±2	C	40264	−0.0003	+0.0000	Šafář	this paper
50551.4936 ±18	C	40276	−0.0007	−0.0003	Diethelm	BBSAG 115
50607.3635 ±4	C	40438	−0.0003	+0.0000	Šarounová	this paper
50607.5346 ±3	C	40438.5	−0.0016	−0.0014	Šarounová	this paper
50611.5025 ±5	C	40450	+0.0002	+0.0005	Šarounová	this paper
50638.4028 ±2	C	40528	+0.0004	+0.0006	Šarounová	this paper
50888.4365 ±2	C	41253	+0.0010	+0.0005	Šafář	this paper
50899.4721 ±3	C	41285	+0.0006	+0.0001	Šafář	this paper
50923.4410 ±17	C	41354.5	+0.0008	+0.0003	Diethelm	BBSAG 117
50925.5099 ±14	C	41360.5	+0.0005	−0.0001	Diethelm	BBSAG 117
50926.3730 ±6	C	41363	+0.0014	+0.0008	Blättler	BBSAG 117
50927.4073 ±3	C	41366	+0.0011	+0.0005	Šafář	this paper

Figure 2. The non-linear fit, corresponding to the calculated elements (3) is plotted as a dashed curve. Further observations are needed to decide about the character of period changes in this interesting system.

Acknowledgement. We are thankful to Prof. John C. Houck, MIT Center for Space Research, for additional analysis of their photographic measurements, and to Dr. Roger Diethelm, BBSAG, for sending his original CCD light curves.

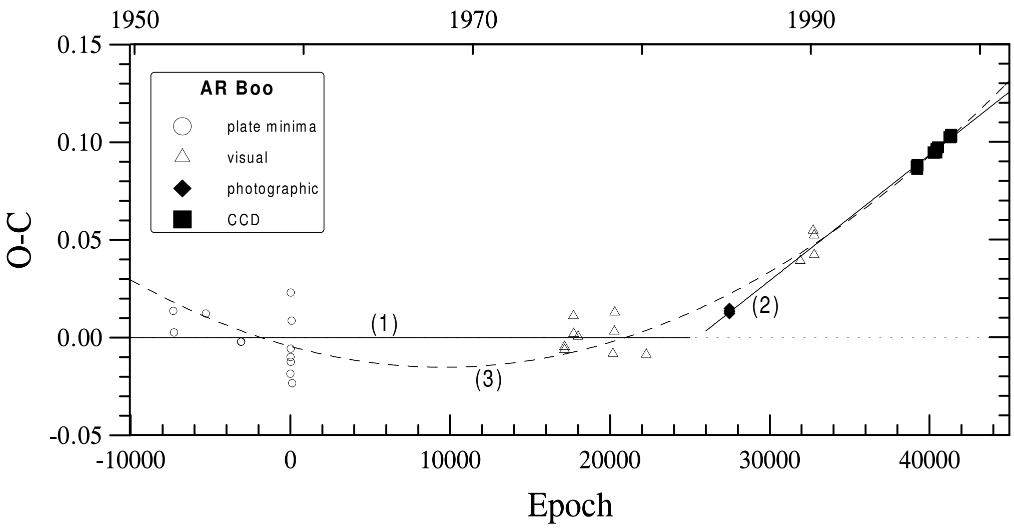

Figure 2. $O-C$ diagram for AR Boo

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OBSERVATION OF SUPERHUMPS IN SS UMi

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The dwarf nova SS UMi was discovered as an optical counterpart of Einstein IPC source E1551+718 (Mason et al. 1982). Mason et al. (1982) reported the system to be varying between $V \sim 13$ and $V \sim 17$. The object was independently detected as an ultraviolet-excess object, PG 1551+719 (Green et al. 1982). Richter (1989) examined 4180 Sonneberg plates and suggested the SS Cyg-type classification based on his finding that faint maxima often last longer than bright maxima. The insufficient detection limit of Richter (1989), however, made the result inconclusive. The dwarf nova subtype was not certain – while Andronov (1986) suggested the 127 min periodicity from photographic observations taken during quiescence, CCD photometry by Udalski (1990) suggested a longer (6.8 or 9.5 h) period – until the discovery of superhumps by Chen et al. (1991). The superhump period (101 min) obtained by Chen et al. (1991) being only based on peak separations from sparsely distributed short runs, it needs to be refined, especially in view of the comparison with the orbital period (97.6 min) obtained by radial velocity study (Thorstensen et al. 1996).

The CCD observations were done using the 1.0-m telescope at the Wise Observatory during the 1998 April superoutburst detected and communicated on April 4 by Hanson (1998). The log of observations is summarized in Table 1. Our observation started four days after the onset of the superoutburst, and continued till its end. We used a V filter; the exposure time was 240 s. We used four local comparison stars (C1 to C4 in Figure 1), whose non-variability was checked down to 0.02–0.05 mag (1-sigma error) by inter-comparison. The magnitudes of SS UMi are given relative to C1, whose magnitude we determined as V=15.71. The typical estimated error of each observation is 0.03 mag. We applied heliocentric corrections to the observed times before analysis.

Figure 2 presents the whole light curve, showing a characteristic decline from super-outburst. Superimposed superhumps are already apparent.

Table 1: Journal of observations

Year	Month	Start (UT)	End (UT)	JD−2400000*	N**
1998	April	8.736	8.989	50912.236	87
		9.794	9.990	50913.294	52
		12.764	12.998	50916.264	60
		13.752	13.989	50917.252	67

*: start of observation, **: number of observations

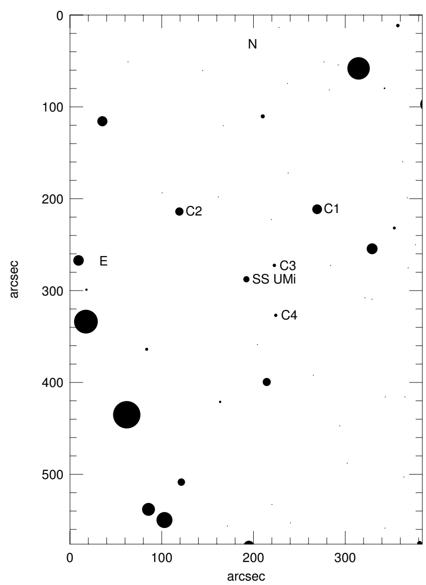

Figure 1. Comparison stars

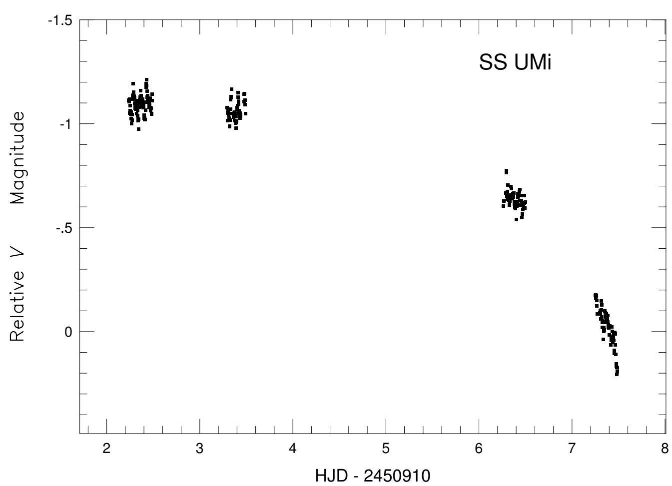

Figure 2. The entire light curve

For the the first two nights' data during the superoutburst plateau stage, we applied the Phase Dispersion Minimization (PDM) method (Stellingwerf 1978), after removing the linear trend of decline. The resultant theta diagram displayed in Figure 3. The best superhump period is 0.0699 ± 0.0003 day, which is 3.1 ± 0.4 % longer than the orbital period (Thorstensen et al. 1996).

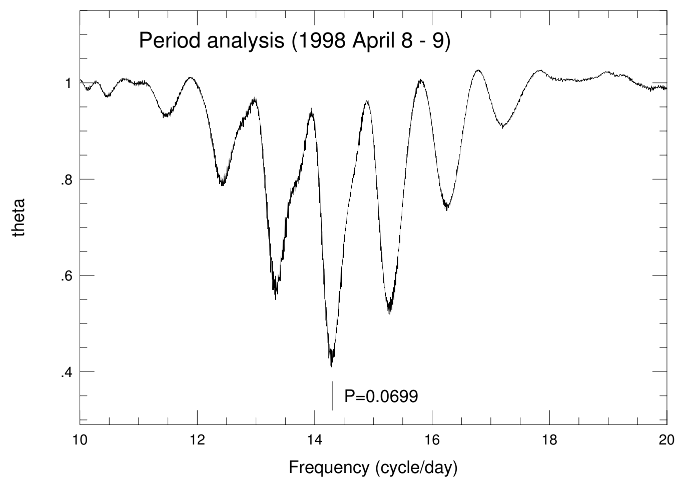

Figure 3. Period analysis for 1998 April 8 and 9

Similar analysis was applied for the latter two nights. The best obtained period from the theta diagram (Figure 4) is 0.0677 ± 0.0003 day, which exactly agrees with the orbital period within the estimated error. The result implies that orbital signals predominate rather than late superhumps at the very terminal stage of a superoutburst of this star.

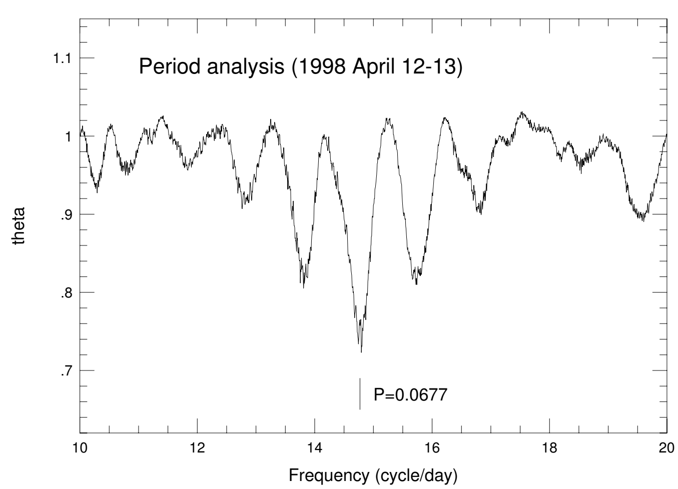

Figure 4. Period analysis for 1998 April 12 and 13

Figure 5 represents phase-averaged light curves of the first two nights (upper panel) and of the last two nights (lower panel). While the former shows a typical profile of a superhump, the latter, folded by the orbital period, shows a broader hump-like feature.

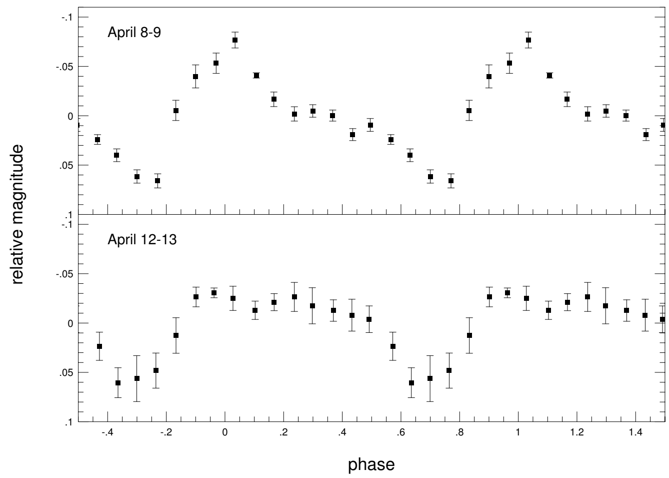

Figure 5. Averaged light curves

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PHOTOMETRY OF STARS IN THE FIELD OF HP ANDROMEDAE (AND A NEW RED VARIABLE)

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HP Andromedae ($0^h19^m09\overset{s}{.}07$ $+41°27'41''\!.9$ (2000, USNO–A1.0) is a poorly-studied dwarf nova normally about 18^m in quiescence but reaching $10\overset{m}{.}5$ during outbursts. At the request of AAVSO chartmaker Charles Scovil, I observed several stars in the field suitable as comparisons for visual observers while the star is bright. The results have been distributed via the 'VSNET' list-server (Skiff 1995a,b), but are published here as a matter of record. Large-scale charts prepared using this sequence have been made available on the Web by the AAVSO (`ftp://ftp.aavso.org/pub/charts/and/hp_and`).

I measured the stars on several nights in 1992 and 1995 using the Lowell 53cm photometric telescope. Strömgren y and b filters were used through either 19- or 29-arcsec diaphragms. Each observation consisted of at least three 10^s integrations on 'star' and two 10^s integrations on 'sky', with more integrations for stars fainter than V $\sim 9^m$. A dozen or more primary and secondary standards were observed each night for calibration to Johnson V and Strömgren $b{-}y$. Per-star residuals from the linear fits to the standards averaged $0\overset{m}{.}007$ in V and $0\overset{m}{.}005$ in $b{-}y$.

Results for the stars near HP And are shown in Table 1, sorted in order of decreasing brightness. The stars are identified by HD, BD, or GSC number; positions come from the ACT (Urban *et al.* 1997) or the GSC version 1.2 (STScI 1996). The standard deviations of the mean values in V and $b{-}y$ are given on the second line of each entry. Tycho BV photometry for the two brightest stars is given in the notes.

Misselt (1996) has also published BVR photometry for stars close to the variable. His results are particularly useful when HP And is faint. As has been noted by Henden & Honeycutt (1997), Misselt's V magnitudes have a small zero-point offset, amounting to +0.03–0.04 (Misselt too faint), similar to what is found here for the few stars in common.

A new red variable

While measuring stars in this field, I found that BD+40°51 = IRAS 00163+4120 = GSC 2790-1851 ($0^h19^m02\overset{s}{.}6$ $+41°37'41''$ [2000]) is very red, with a $b{-}y$ color corresponding to B–V $\sim$2.3. Subsequent observations show that the star is variable with a range of nearly a full magnitude. This is probably a semiregular variable with a period near three months. The IRAS identification was easy to make, but the star does not appear in the Dearborn catalogue (Lee *et al.* 1947), so no spectral type is available. My five observations are collected in Table 2.

Table 1: Photometry of Stars in the Field of HP Andromedae

Name	RA (2000)	Dec	V	$b-y$	n	Remarks
HD 1469*	0 19 03.2	+41 26 38	9.230	−0.012	2	A0
			.011	.004		
BD+40°54*	0 19 31.5	+41 37 09	10.270	0.533	3	GSC 2790-1458
			.014	.004		
BD+40°53	0 19 13.6	+41 45 28	10.831	0.711	2	GSC 2790-0356
			.011	.006		
GSC 2790-1158	0 18 42.9	+41 31 19	11.480	0.388	2	
			.004	.009		
GSC 2790-1753	0 19 06.4	+41 28 05	11.739	0.641	2	
			.005	.009		
GSC 2790-1885	0 19 17.1	+41 26 27	14.00	0.43	2	
			.05	.04		

Notes: HD 1469 Tycho V = 9.25±0.02, B−V = −0.05±0.02.
BD+40°54 Tycho V = 10.20±0.04, B−V = 1.01±0.07.

Table 2: Photometry of BD+40°51

JD 2400000+	V	$b-y$
48800.9	11.670	1.685
50004.8	10.947	1.549
50010.8	10.967	1.533
50044.8	11.228	1.571
50095.7	10.801	1.491

I would like to thank Margareta Westlund and Karl Gustav Andersson for pointing out an identification error in my original ‘VSNET’ post.

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PHOTOMETRIC AND POLARIMETRIC OBSERVATIONS OF VISUAL BINARY WDS 00550+2338 (ADS 755 = HD 5286)

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Name of the object:
ADS 755AB; HD 5286

Equatorial coordinates:	**Equinox:**
R.A.= $00^h55^m\!.0$ **DEC.=** $+23°38'$	2000.0

Observatory and telescope:
Byurakan Astrophysical Observatory, 50cm reflector AZT-14

Detector:	Photoelectric photometer (photomultiplier FEU-79)
Filter(s):	B - CC5(3mm)+CZC21(5mm); V - JC18(1.5mm)+CZC21(1.5mm)
Comparison star(s):	SAO74365 = GC1096 = BD +23°126

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

Availability of the data:
Through IBVS Web-site

Type of variability:	Unknown

Remarks:
Photometric monitoring of the visual binary suspected in variability (NSV 343, Kukarkin et al., 1982) has been carried out between November 25 and December 3, 1997 (in Table 1 photometric data are given). Mean values of apparent brightness in B (6.66) and V (5.59) bands as well as mean colour index B−V = 1.07 coincide with or are very close to those reported earlier by Argue (1966) and Lee (1970). Variation in brightness was insignificant for all observational period except that on November, 27 (JD 2450 779.33) when a sudden increase (ΔB = 0.56, ΔV = 0.28) has been registered over the course of about 2 hours being a real evidence of its light variation. This suggest that at least one of the components is demonstrating short-term variability. No significant polarimetric signal in UBVR bands was observed on any occasion. Further study of this system would be welcome in order to clarify the nature of detected variability.

Table 1: Results of photometric measurements

Date	Time (UTC)	JD 2450+	B	V	B−V
25.11.1997	17^h00^m	777.21	6.74	5.65	+1.09
	20^h00^m	777.33	6.72	5.62	+1.10
26.11.1997	16^h40^m	778.20	6.79	5.69	+1.10
	18^h50^m	778.29	6.68	5.59	+1.09
	19^h35^m	778.31	6.69	5.59	+1.10
27.11.1997	16^h00^m	779.17	6.70	5.60	+1.10
	17^h45^m	779.24	6.69	5.61	+1.08
	20^h00^m	779.33	6.13	5.33	+0.80
28.11.1997	17^h20^m	780.22	6.74	5.65	+1.09
01.12.1997	16^h00^m	783.17	6.74	5.63	+1.11
	17^h30^m	783.23	6.70	5.63	+1.07
	19^h25^m	783.31	6.75	5.60	+1.15
	20^h40^m	783.36	6.72	5.64	+1.08
02.12.1997	17^h30^m	784.23	6.75	5.64	+1.11
	21^h00^m	784.38	6.70	5.65	+1.05
03.12.1997	18^h00^m	785.25	6.74	5.69	+1.05
	22^h15^m	785.43	6.75	5.65	+1.10

References:

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CCD PHOTOMETRY OF THE ECLIPSING BINARY AU DRACONIS

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Name of the object:
AU Draconis = BV 53 = GSC 4421.2005 = FL 2241

Equatorial coordinates:	**Equinox:**
R.A.= $17^h35^m21^s.25$ **DEC.=** $+68°38'18''.6$	J2000.0

Observatory and telescope:
Ondrejov Observatory, 0.65-m reflecting telescope

Detector:	CCD camera SBIG ST-6
Filter(s):	V, R
Comparison star(s):	GSC 4421.2223
Check star(s):	GSC 4421.1750
Transformed to a standard system:	No

Availability of the data:
Through IBVS Web-site

Type of variability:	EB

Remarks:

New times of minimum light (HJD, filter, number of measurements):

47871.417	visual	16
50444.6617	R	58
50445.6922	V	47
50525.5593	R	26

New light elements:

$$\text{Pri.Min.} = \text{HJD } 24\ \underset{0.001}{50445.692} + \underset{0.0000001}{0.5152668} \times E$$

Color indices V−R: 0.24 for the comparison star, 0.35 for the check star 0.21 for the variable near maximum, with an error of about 0.05 mag.

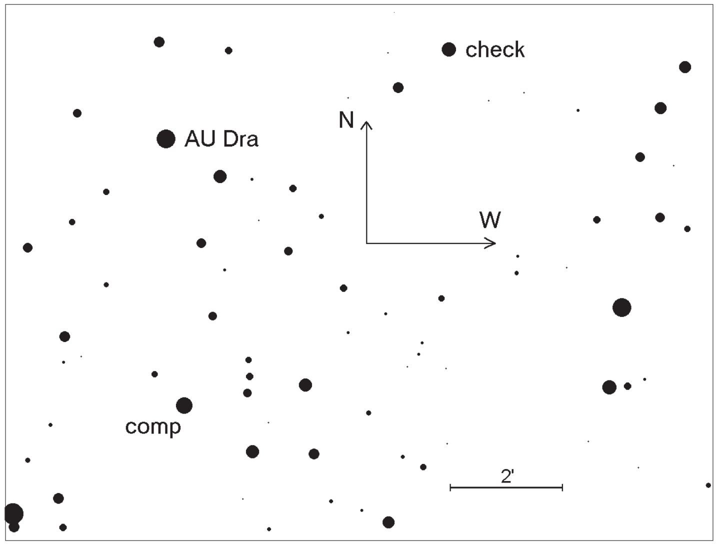

Figure 1. Identification chart of AU Dra with the size of the field $12.6' \times 9.6'$.

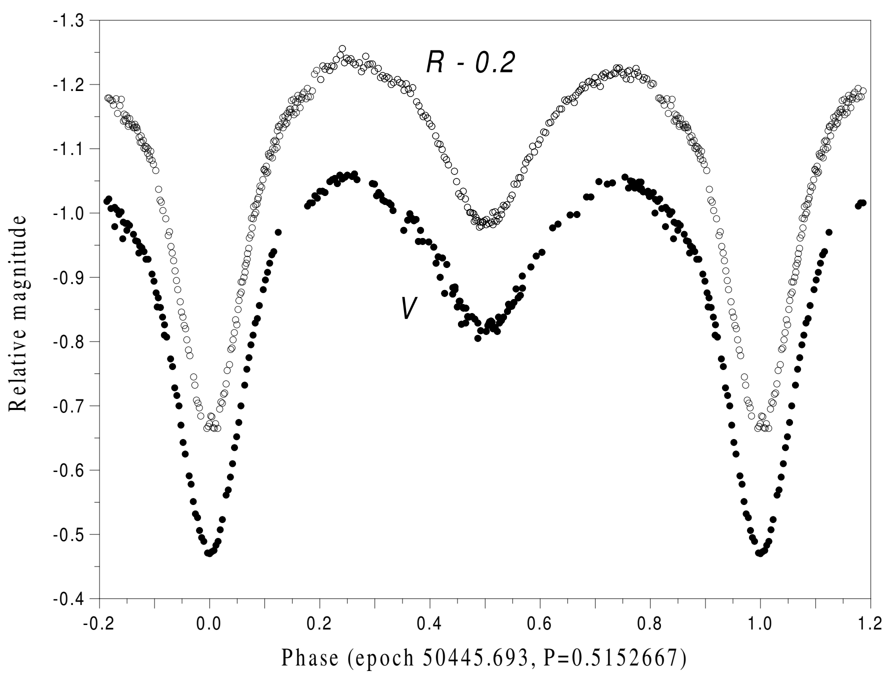

Figure 2. Composite differential lightcurve of AU Dra for the period of 0.51527 days. V and R magnitudes are relative to the comparison star. For clarity, the R light curve was shifted by 0.2 mag.

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PHOTOELECTRIC MINIMA OF SELECTED ECLIPSING BINARIES AND MAXIMA OF PULSATING STARS

(BAV Mitteilungen No. 111)

FRANZ AGERER, JOACHIM HUEBSCHER

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

In this 36th compilation of BAV results, photoelectric observations obtained in the years 1997 and 1998 are presented on 113 variable stars giving 150 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			FI	Rem
AB	And	50748.3342	.0005	HSR	−0.0121		GCVS 85	Ir	4)
ST	Aqr	50754.2783	.0004	KI	−0.0268		GCVS 85		1)
CX	Aqr	50698.4760	.0002	KI	−0.0014		GCVS 85		1)
OO	Aql	50719.3922	.0002	QU	+0.0068		GCVS 85	Ir	4)
V346	Aql	50718.3888	.0002	QU	−0.0065		GCVS 85	Ir	4)
V724	Aql	50711.3160	.0006	KI	−0.0064	s	BAVM 57		1)
VW	Boo	50584.3930	.0005	KI	−0.0223		BAVR 2)		1)
AC	Boo	50618.4434	.0003	QU	−0.0333		GCVS 85	Ir	4)
SV	Cam	50673.4498	.0014	HSR	+0.0358		GCVS 85	Ir	4)
AK	CMi	50839.4615	.0006	KI	+0.2730		GCVS 85		1)
V381	Cas	50750.4849	.0003	QU	−0.0045	s	BAVR 1)	Ir	4)
XX	Cep	50671.4158	.0035	HSR	−0.0163		GCVS 85	Ir	4)
VV	Cet	50743.4553	.0006	KI	+0.0868	s	GCVS 85		1)
		50770.3583	.0006	KI	+0.0867		GCVS 85		1)
SS	Com	50570.3924	.0003	KI	+0.0389	s	BAVR 3)		1)
CC	Com	50556.4122	.0002	KI	−0.0091		GCVS 85		1)
Y	Cyg	50672.3717	.0004	AG	−0.0997	s	GCVS 85	BV	2)
		50702.3365	.0019	AG	−0.0982	s	GCVS 85	BV	2)
CG	Cyg	50702.3863	.0004	AG	+0.0368		GCVS 85	BV	2)
GO	Cyg	50673.3822	.0016	AG	+0.0589	s	GCVS 85	BV	2)
KR	Cyg	50700.4609	.0009	FR	−0.0006	s	GCVS 85		5)
		50753.2828	.0008	FR	−0.0007		GCVS 85		5)
		50755.3856	.0013	FR	−0.0107	s	GCVS 85		5)
		50772.3013	.0005	FR	+0.0019	s	GCVS 85		5)
V382	Cyg	50671.4673	.0004	AG	+0.0500		GCVS 85	BV	2)
V488	Cyg	50686.4273	.0002	AG	+0.1071	s	GCVS 85		1)
V680	Cyg	50715.4429	.0007	QU	+0.0164		BAVR 1)	Ir	4)
V841	Cyg	50700.4466	.0040	AG	+0.0119	s	GCVS 85	BV	2)

Table 1 (cont.)

Variable		Min JD 24..	+/−	Obs	O–C			FI	Rem
V1187	Cyg	50672.4663	.0003	AG	−0.0102		BAVM 73		1)
V1191	Cyg	50672.4550	.0008	AG	+0.0005	s	GCVS 85		1)
V2021	Cyg	50680.4295	.0004	AG				BV	2)
GG	Del	50712.3204	.0003	KI	−0.0160		GCVS 85		1)
BF	Dra	50712.3895	.0010	AG	+0.0148		GCVS 85	BV	2)
CV	Dra	50713.3485	.0006	AG	−0.0005		BAVM 69	BV	2)
UX	Eri	50717.5699	.0003	KI	+0.0913		GCVS 85		1)
		50769.4442	.0004	KI	+0.0905	s	GCVS 85		1)
WX	Eri	50749.5688	.0002	KI	+0.0105		GCVS 85		1)
YY	Eri	50823.3630	.0004	KI	+0.0682		GCVS 85		1)
BL	Eri	50743.6078	.0002	KI	+0.0207	s	GCVS 85		1)
BV	Eri	50840.2387	.0004	KI	−0.0572		GCVS 85		1)
TT	Her	50602.4611	.0003	KI	+0.0276		GCVS 85		1)
FG	Hya	50840.5173	.0003	KI	−0.0498	s	GCVS 85		1)
AM	Leo	50559.3990	.0002	KI	−0.0056	s	GCVS 85		1)
V406	Lyr	50713.3506	.0004	AG	−0.0097	s	BAVM 72		1)
V496	Mon	50823.4426	.0003	KI	−0.0232		GCVS 85		1)
V456	Oph	50653.4324	.0003	KI	+0.0158		GCVS 85		1)
V508	Oph	50616.4631	.0003	KI	+0.0064		GCVS 85		1)
V566	Oph	50640.4252	.0004	KI	+0.0487		GCVS 85		1)
V839	Oph	50637.4307	.0004	KI	−0.0781	s	GCVS 85		1)
ER	Ori	50752.5825	.0002	KI	+0.0202	s	GCVS 85		1)
U	Peg	50712.4420	.0001	KI	−0.0697		GCVS 87		1)
ZZ	Peg	50753.3213	.0005	KI	+0.1358		GCVS 87		1)
AT	Peg	50716.4418	.0003	KI	+0.0032		GCVS 87		1)
AW	Peg	50720.4515	.0027	HSR	+0.0099		GCVS 87	Ir	4)
BB	Peg	50702.4698	.0006	KI	+0.0073	s	GCVS 87		1)
BN	Peg	50702.3840	.0003	KI	+0.0038		GCVS 87		1)
BO	Peg	50750.2738	.0004	KI	−0.0164		GCVS 87		1)
DI	Peg	50672.4793	.0042	HSR	−0.0153		GCVS 87	Ir	4)
		50712.3428	.0024	HSR	−0.0135		GCVS 87	Ir	4)
		50719.4618	.0007	HSR	−0.0127		GCVS 87	Ir	4)
DK	Peg	50711.523 :	.012	HSR	+0.055		GCVS 87	Ir	4)
VZ	Psc	50719.5071	.0008	KI	−0.0563	s	GCVS 87		1)
CU	Sge	50713.3218	.0003	KI	+0.0148		GCVS 87		1)
CW	Sge	50709.3253	.0006	KI	−0.0815	s	GCVS 87		1)
Y	Sex	50823.5701	.0002	KI	+0.0250		BAVR 1)		1)
CD	Tau	50839.3194	.0003	KI	+0.0042		GCVS 87		1)
X	Tri	50702.4451	.0003	QU	−0.0330		GCVS 87		4)
		50703.4166	.0003	QU	−0.0330		GCVS 87	Ir	4)
		50740.3352	.0007	HSR	−0.0327		GCVS 87	Ir	4)
		50773.3669	.0002	HSR	−0.0332		GCVS 87	Ir	4)
AW	Vir	50569.4327	.0002	KI	+0.0095		GCVS 87		1)
AZ	Vir	50571.3857	.0004	KI	−0.0131	s	GCVS 87		1)
BH	Vir	50582.4482	.0003	KI	−0.0053		GCVS 87		1)
AT	Vul	50716.3794	.0009	AG	−0.0795		GCVS 87	BV	2)

Table 2: RR Lyrae and Delta Scuti type stars

Variable		Max JD 24..	+/−	Obs	O–C		FI	Rem
XX	And	50727.46	.01	PS	−0.05	SAC 60		3)
BK	And	50740.4106	.0021	BK	+0.1070	GCVS 85		4)
GP	And	50438.4732	.0020	MAR	+0.0066	GCVS 85		7)
SW	Aqr	50699.3925	.0003	KI	−0.0032	GCVS 85		1)
SX	Aqr	50711.4236	.0021	BK	−0.0473	BAVM 75		4)
AA	Aqr	50772.2756	.0005	KI				1)
BR	Aqr	50752.3593	.0007	KI				1)

Table 2 (cont.)

Variable		Max JD 24..	+/−	Obs	O–C		FI	Rem
CY	Aqr	50683.498	.002	PS	+0.009	GCVS 85		3)
		50683.561	.002	PS	+0.011	GCVS 85		3)
		50683.621	.002	PS	+0.010	GCVS 85		3)
		50720.4871	.0007	ATB	+0.0091	GCVS 85		1)
		50749.2362	.0002	KI	+0.0091	GCVS 85		1)
		50749.2974	.0003	KI	+0.0092	GCVS 85		1)
		50749.3581	.0002	KI	+0.0089	GCVS 85		1)
FY	Aqr	50750.2861	.0042	BK				4)
		50753.3504	.0042	BK				4)
AA	Aql	50692.3804	.0004	KI	+0.0006	BAVM 78		1)
		50721.330	.005	PS	+0.007	BAVM 78		3)
V341	Aql	50713.3787	.0042	BK	+0.0195	GCVS 85		4)
		50717.4235	.0005	QU	+0.0182	GCVS 85	Ir	4)
		50742.2776	.0006	KI	+0.0174	GCVS 85		1)
X	Ari	50752.4650	.0007	KI	+0.0553	BAVR 4)		1)
RV	Ari	50825.2972	.0004	KI	+0.0070	GCVS 85		1)
RW	Ari	50749.5120	.0084	BK	−0.1289	GCVS 85		4)
CM	Boo	50600.4222	.0042	BK	−0.0433	BAVM 75		4)
CQ	Boo	50594.5152	.0010	KI				1)
		50600.4322	.0011	KI				1)
		50603.5227	.0084	BK				4)
CS	Boo	50599.4406	.0021	BK	−0.0009	IBVS 2855		4)
AH	Cam	50716.4437	.0005	QU	+0.1613	GCVS 85	Ir	4)
		50799.3768	.0007	QU	+0.1291	GCVS 85	Ir	4)
		50848.4459	.0007	QU	+0.1565	GCVS 85	Ir	4)
		50855.4172	.0004	QU	+0.1219	GCVS 85	Ir	4)
SS	Cnc	50831.3828	.0007	QU	+0.0466	GCVS 85	Ir	4)
		50849.3800	.0004	QU	+0.0442	GCVS 85	Ir	4)
		50850.4832	.0004	QU	+0.0454	GCVS 85	Ir	4)
AA	CMi	50840.4292	.0009	KI	+0.0226	GCVS 85		1)
RR	Cet	50749.4477	.0005	KI	−0.0012	GCVS 85		1)
RV	Cet	50750.5511	.0042	BK	+0.1243	GCVS 85		4)
		50772.3680	.0010	KI	+0.1221	GCVS 85		1)
RZ	Cet	50799.3557	.0011	KI	−0.0714	GCVS 85		1)
S	Com	50571.4723	.0021	BK	+0.0184	SAC 60		4)
DM	Cyg	50700.4314	.0004	QU	+0.0323	GCVS 85		4)
DX	Del	50714.434	.005	MZ				6)
		50716.3276	.0005	KI				1)
DD	Dra	50719.4997	.0020	AG	+0.0580	BAVM 49	BV	2)
BK	Eri	50770.4669	.0009	KI				1)
VX	Her	50604.4187	.0005	KI	−0.0221	BAVR 5)		1)
BD	Her	50712.3278	.0021	BK	+0.0445	GCVS 85		4)
DY	Her	50593.4602	.0003	KI	−0.0166	GCVS 85		1)
V445	Oph	50601.4440	.0005	KI	+0.0097	GCVS 85		1)
V567	Oph	50638.4789	.0006	KI	+0.0643	GCVS 85		1)
CM	Ori	50841.3259	.0011	KI	−0.0416	GCVS 85		1)
VV	Peg	50752.2609	.0004	KI	−0.0274	GCVS 87		1)
AE	Peg	50740.3450	.0004	KI				1)
		50744.3190	.0003	KI				1)
AO	Peg	50743.3484	.0005	KI				1)
AV	Peg	50741.3834	.0005	KI	+0.0555	GCVS 87		1)
		50770.2653	.0006	KI	+0.0497	GCVS 87		1)
BF	Peg	50744.4394	.0084	BK	+0.1587	GCVS 87		4)
BH	Peg	50799.2432	.0011	KI	−0.0699	GCVS 87		1)
BP	Peg	50717.4813	.0007	ATB	+0.0316	GCVS 87		1)
DY	Peg	50750.3215	.0020	MZ	−0.0012	GCVS 87		6)

Table 2 (cont.)

Variable		Max JD 24..	+/−	Obs	O–C		FI	Rem
DY	Peg	50762.2811	.0003	KI	−0.0015	GCVS 87		1)
RY	Psc	50714.4978	.0004	KI	−0.2402	GCVS 87		1)
		50740.4611	.0005	KI	−0.2327	GCVS 87		1)
NSV361	Psc	50744.4414	.0003	KI				1)
VY	Ser	50848.6679	.0002	MS	−0.0033	BAVR 6)		1)
AN	Ser	50603.4638	.0007	KI	+0.0016	GCVS 87		1)
CW	Ser	50599.4746	.0004	KI	+0.0250	GCVS 87		1)
SS	Tau	50771.5743	.0004	KI	−0.0772	GCVS 87		1)
UX	Tri	50753.4825	.0042	BK				4)
UU	Vir	50562.3948	.0005	KI				1)
		50582.3722	.0004	KI				1)
AT	Vir	50601.5011	.0042	BK	−0.1125	GCVS 87		4)
AV	Vir	50593.4495	.0042	BK	+0.0143	GCVS 87		4)

Remarks:

AG	Agerer, F.	Tiefenbach	MAR	Martignoni, M.	Busto Arsizio (I)
ATB	Achterberg, Dr. H.	Norderstedt	MS	Moschner, W.	Lennestadt
BK	Birkner, C.	Hagen	MZ	Maintz, G.	Bonn
FR	Frank, P.	Velden	PS	Paschke, A.	Rueti (CH)
HSR	Husar Dr. D.	Hamburg	QU	Quester, W.	Esslingen
KI	Kleikamp, W.	Marl			

:	=	uncertain
s	=	secondary minimum
B	=	filter: B
V	=	filter: V
Ir	=	filter: KG 5/2
1)	=	photometer CCD 375x242 uncoated - without filter
2)	=	photometer EMI 9781A - filter: V=GG495,1mm; B=BG12,1mm+GG385,2mm
3)	=	photometer Cryocam 89A - without filter
4)	=	photometer ST-7 - filter: without filter or Ir = KG 5/2
5)	=	photometer OES-LcCCD11 without filter
6)	=	photometer LC14 - without filter
7)	=	photometer starlight Xpress 510x256 - without filter
BAVM nn	=	BAV Mitteilungen No. nn
BAVM 57	=	BAV Mitteilungen No. 57 = IBVS No. 3555
BAVM 72	=	BAV Mitteilungen No. 72 = IBVS No. 4132
BAVM 73	=	BAV Mitteilungen No. 73 = IBVS No. 4133
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 38, 1 f
BAVR 5)	=	BAV Rundbrief 39, 9 ff
BAVR 6)	=	BAV Rundbrief 41, 1 ff
GCVS nn	=	Gen. Cat. of Variable Stars, 4th ed. 1985,87
SAC xx	=	Rocznik Astronomiczny Nr. xx, Krakow (SAC)

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RADIAL VELOCITY VARIABILITY OF THREE SUPERGIANTS

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One of the motivations to study supergiant stars arises from the fact that they belong to a group of stars with an unstable evolutionary stage. In this context and due to the fact that there is no conclusion concerning the nature of three specific F-type supergiants (see references in Paredes 1998), these have been selected in order to analyze their spectra and to calculate their radial velocities. In particular, HD64238 (F1Ia), HD70761 (F3Ib) and HD74180 (F3Ia) were observed with the the grid-spectrograph attached to the 1-m reflector telescope located in the Observatorio Nacional de Llano del Hato (Mérida-Venezuela). The spectrograms were obtained on photographic plates of type IIa-O covering the region: $\lambda\lambda$=3500–5000 Å. The spectral resolution and the dispersion are 0.2 Å and 73.2 Åmm^{-1}, respectively. The comparison spectra were produced with a hollow-cathode Fe lamp. The spectrograms were digitized with the Joyce-Loebl microdensitometer of the Grupo of Astrofísica Teórica of the Universidad de Los Andes (Mérida-Venezuela).

After the reduction of the spectrograms, the procedure of the identification of the spectral lines was performed using the Multiplet Table of Moore (1972). Then, using standard procedures, many elements were identified (Paredes 1998), such as FeI, FeII, CrI, CrII, among others. Furthermore, with the heliocentric correction and the Doppler effect, the radial velocity was calculated for each star. Results of the present study as well as previous ones, are given in Tables 1, 2, and 3 for each star, respectively. Analyzing the results given in these tables, we conclude that, the radial velocities of the three stars are variable.

For the completion of the work, we have collected the information from the Hipparcos Catalogue (ESA 1997) and we have noticed that there are no detectable light variations in these stars. Finally, performing a careful inspection of the shape of the spectral line profiles (see Rosenzweig et al. 1998), we concluded that P-Cygni profiles and emission lines were absent in the whole analyzed spectra. The strange behavior of the large differences in radial velocities between the Ca II H and K, Hδ, Hγ (all obtained in the present study), and the rest of the spectral lines, has been also noticed for the supergiant star HD101584 (Rosenzweig, Guzmán, and Naranjo 1997).

Note: PR is grateful to Project C-902-98-05-B C.D.C.H.T. of the U.L.A., and GP thanks the Básico Sectoriales of L.U.Z. (both Institutions in Venezuela).

Table 1: Spectral lines and radial velocities derived for HD74180

JD 2400000+	Identified Lines	Selected Lines	r.v.$\pm\sigma$ (Ref.) (km/s)	r.v. (km/s) Ca II H	r.v. (km/s) Ca II K	r.v. (km/s) Hδ	r.v. (km/s) Hγ
16436.81			29.3 (2)				
16506.63			28 (2)				
16865.68			25.4 (2)				
16912.69			25.3 (2)				
16960.58			32.0 (2)				
17216.74			30.9 (2)				
			29.4 (2)				
18754.58			27.1 (2)				
			29.7 (2)				
19062.76			18.3 (2)				
			19.9 (2)				
			18.9 (2)				
19072.72			17.8 (2)				
			18.5 (2)				
20240			21.6 (3)				
20621			20.3 (3)				
20622			23.6 (3)				
47240.553	90	61	23 ± 1 (1)	13	-44	119	41
50430.221	40	19	32 ± 2 (1)	67	-23	210	22
50430.275	80	48	31 ± 1 (1)	27	-6	210	30

(1) Present study
(2) Campbell (1928)
(3) Lunt(1918)

Table 2: Spectral lines and radial velocities derived for HD70761

JD 2400000+	Identified Lines	Selected Lines	r.v.$\pm\sigma$ (Ref.) (km/s)	r.v. (km/s) Ca II H	r.v. (km/s) Ca II K	r.v. (km/s) Hδ	r.v. (km/s) Hγ
22416.155			66.0 (4)				
22417.174			65.0 (4)				
22419.167			62.5 ± 0.2 (4)				
47213.929	101	62	56 ± 2 (1)	-97	-121	53	148

(1) Present study
(4) Abt (1970)

Table 3: Spectral lines and radial velocities derived for HD64238

JD 2400000+	Identified Lines	Selected Lines	r.v.$\pm\sigma$ (Ref.) (km/s)	r.v. (km/s) Ca II H	r.v. (km/s) Ca II K	r.v. (km/s) Hδ	r.v. (km/s) Hγ
27496.234			15.3 (2)				
33226.530			13.8 (2)				
33321.301			21.0 (2)				
47215.000	300	250	17 ± 0.4 (1)	58	-5	-219	15
50429.158	148	71	27 ± 2 (1)	63	-30	154	43

(1) Present study
(2) Abt (1970)

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NEW OBSERVATIONS AND EPHEMERIS OF RT CMa

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e-mail: `skiyota@abr.affrc.go.jp`

Name of the object:
RT CMa

Equatorial coordinates:	**Equinox:**
R.A.= $06^h13^m11\overset{s}{.}4$ **DEC.=** $-17°39'16''$	2000.0

Observatory and telescope:
0.25-m Schmidt Cassegrain (F/6.3)

Detector:	SBIG ST-6 CCD camera
Filter(s):	Johnson V
Comparison star(s):	GSC 5937:1603
Check star(s):	GSC 5937:1505
Transformed to a standard system:	No
Type of variability:	EA

Remarks:

I observed RT CMa during the period 1996–1998 and obtained the following five new moments of minima. JDhel 2450093.9812, 2450115.9749, 2450403.1885, 2450463.9899, 2450830.1223. I linked these minima and Kordylewski's observation (1963), yielding the following refined ephemeris.

$$\text{Min I JDhel} = 245\ 0093.9844(3) + 1.2937348(3) \times \text{E}.$$

Acknowledgements:

I thank Dr. Taichi Kato, Kyoto University for useful discussion and advice.

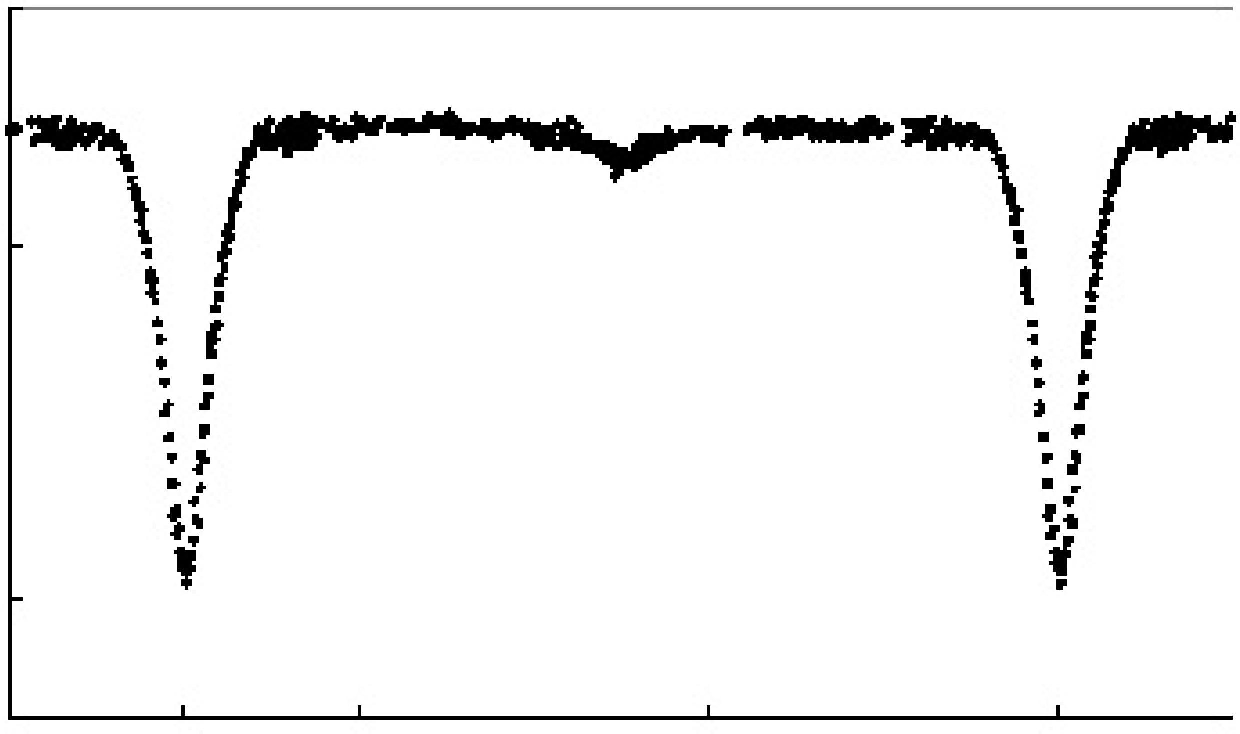

Figure 1.

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ACCURATE POSITION ESTIMATES FOR KNOWN VARIABLES

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The continued operation of the Amateur Sky Survey (Droege and Gombert 1998), Dayton, Ohio station, has resulted in accurate position estimates for a number of known variables found in the General Catalog of Variable Stars (Kholopov et al. 1985). These are observed three or more times from July 1997 to May 1998. Table 2 gives the variable name along with its position precessed to J2000 coordinates.

The data was taken with three custom-made CCD cameras using Kodak KAF-0400 chips and 135 mm camera lenses operating in drift-can (Time Delay Integration) mode. More information on the Amateur Sky Survey project can be found on the TASS Home Page maintained by Michael Richmond at the URL `http://www.tass-survey.org`. Data was reduced using a suite of astrometric/photometric programs written by Arne Henden (Henden and Kaitchuck 1982) of the United States Naval Observatory, Flagstaff station.

An analysis of Dayton TASS data was performed by Michael Richmond as a part of a poster paper presented at the Summer, 1998 AAS meeting. The paper itself can be found on the TASS Home Page under the "Meetings" section (Richmond et al. 1998). A number of stars (12,801) in the Tycho catalog were compared with corresponding entries from the Dayton TASS master photometry file (~93,000 stars). Star positions and corresponding measurement accuracy is summarized in Table 1.

Table 1

Tycho V mag	#stars	std. error of mean (arcsec)	st.dev. of mean (arcsec)
$7 < V < 9$	2075	0.97	0.85
$9 < V < 11$	9301	1.45	1.67
$11 < V < 15$	1425	1.97	2.10

Table 2

Name	RA (J2000)	DEC	Name	RA (J2000)	DEC
RY Psc	$0^h11^m41^s.3$	$-1^{\circ}44'55''.7$	AA Aql	$20^h38^m15^s.1$	$-2^{\circ}53'39''.1$
VV Cet	$0^h55^m43^s.2$	$-2^{\circ}05'38''.4$	W Aqr	$20^h46^m25^s.1$	$-4^{\circ}05'01''.1$
SZ Cet	$1^h04^m59^s.1$	$-2^{\circ}56'24''.0$	TV Aqr	$20^h53^m41^s.2$	$-1^{\circ}38'05''.9$
AS Eri	$3^h32^m25^s.2$	$-3^{\circ}18'48''.2$	VW Aqr	$21^h00^m54^s.5$	$-1^{\circ}31'11''.6$
BO Eri	$4^h36^m26^s.6$	$-2^{\circ}40'09''.5$	TW Aqr	$21^h04^m\ 5^s.6$	$-2^{\circ}02'42''.7$
FL Ori	$5^h07^m45^s.5$	$-2^{\circ}44'36''.6$	CP Aqr	$21^h10^m12^s.8$	$-1^{\circ}43'15''.9$
MV Mon	$7^h03^m38^s.1$	$-3^{\circ}11'12''.5$	RS Aqr	$21^h10^m58^s.1$	$-4^{\circ}01'40''.1$
FF Mon	$7^h06^m35^s.7$	$-3^{\circ}21'21''.2$	BL Aqr	$21^h14^m12^s.2$	$-1^{\circ}58'43''.7$
MZ Mon	$7^h16^m18^s.8$	$-2^{\circ}18'47''.9$	RR Aqr	$21^h15^m01^s.3$	$-2^{\circ}53'45''.2$
HU Mon	$7^h19^m46^s.6$	$-1^{\circ}59'36''.2$	AC Aqr	$21^h16^m21^s.8$	$-2^{\circ}13'42''.2$
TU Mon	$7^h53^m19^s.8$	$-3^{\circ}02'32''.3$	CD Aqr	$21^h19^m59^s.5$	$-4^{\circ}06'31''.7$
IL Mon	$7^h55^m35^s.6$	$-3^{\circ}35'40''.9$	DL Aqr	$21^h22^m49^s.3$	$-2^{\circ}47'35''.5$
BO Mon	$7^h59^m50^s.2$	$-3^{\circ}28'36''.5$	VZ Aqr	$21^h30^m24^s.8$	$-3^{\circ}00'47''.9$
WW Hya	$8^h57^m46^s.4$	$-3^{\circ}16'55''.9$	FF Aqr	$22^h00^m36^s.3$	$-2^{\circ}44'25''.4$
TX Hya	$9^h23^m48^s.1$	$-2^{\circ}05'28''.7$	FU Aqr	$22^h08^m12^s.2$	$-2^{\circ}10'11''.6$
CM Aql	$19^h03^m34^s.4$	$-3^{\circ}03'16''.2$	UU Aqr	$22^h09^m\ 5^s.5$	$-3^{\circ}46'28''.2$
IK Aql	$19^h05^m44^s.3$	$-2^{\circ}45'18''.7$	FX Aqr	$22^h13^m\ 1^s.3$	$-1^{\circ}43'41''.2$
AZ Aql	$19^h13^m41^s.2$	$-2^{\circ}10'08''.1$	FY Aqr	$22^h16^m34^s.9$	$-3^{\circ}48'53''.6$
IW Aql	$19^h15^m46^s.9$	$-2^{\circ}19'23''.9$	DY Aqr	$22^h19^m\ 4^s.3$	$-2^{\circ}38'30''.1$
BU Aql	$19^h32^m52^s.4$	$-2^{\circ}02'20''.4$	GM Aqr	$22^h21^m57^s.8$	$-2^{\circ}40'01''.2$
BX Aql	$19^h34^m\ 4^s.7$	$-2^{\circ}00'11''.2$	GN Aqr	$22^h22^m18^s.7$	$-4^{\circ}12'21''.9$
CD Aql	$19^h38^m15^s.1$	$-4^{\circ}19'02''.3$	GX Aqr	$22^h34^m57^s.2$	$-3^{\circ}42'33''.1$
CF Aql	$19^h40^m26^s.2$	$-1^{\circ}52'40''.1$	GY Aqr	$22^h36^m\ 7^s.5$	$-1^{\circ}37'54''.1$
CG Aql	$19^h41^m23^s.7$	$-3^{\circ}21'59''.8$	AO Psc	$22^h55^m17^s.9$	$-3^{\circ}10'36''.1$
RR Aql	$19^h57^m36^s.1$	$-1^{\circ}53'11''.8$	AF Psc	$23^h31^m44^s.9$	$-2^{\circ}44'35''.5$
QX Aql	$19^h58^m19^s.2$	$-2^{\circ}27'58''.3$			

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PHOTOMETRY OF THE W UMa SYSTEM GSC 3869_484

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The star GSC 3869_496 (Jenkner et al. 1990) was found to have Ca H&K emission in a survey by Beers et al. (1996). It was also studied by Stephenson (1986) as part of a search for nearby K and M dwarfs. He classified it as a K5 star with V=11.4. The field of that star was observed with the automated 0.5m telescope and reduced in a fashion identical to that described in Robb et al. (1997).

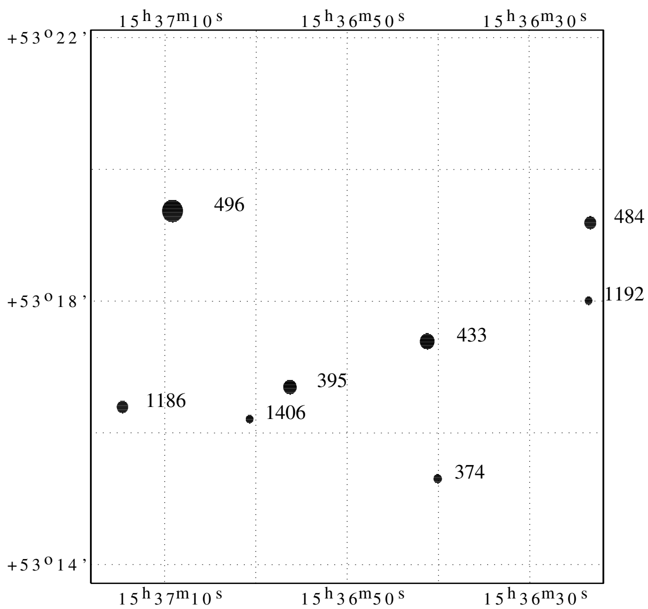

Figure 1. Finder chart labeled with the GSC numbers.

Plotted in Figure 1 is the field of stars and tabulated in Table 1 are the star's identification numbers, coordinates (J2000) and magnitudes from the Hubble Space Telescope Guide Star Catalog (GSC) (Jenkner et al. 1990). Differential ΔR magnitudes are calculated in the sense of the star minus GSC 3869_433. Brightness variations during a night were measured by the standard deviation of the differential magnitudes, which ranged from $0^{m}_{.}008$ for bright stars on a good night to $0^{m}_{.}030$ for the faint stars on poor nights. The standard deviation of the nine nightly means is a measure of the night to night variations. The run means and standard deviations were calculated and are shown as ΔR in Table 1. The high precision of these data can be seen from the standard deviation of the ΔR of GSC 3869_395 minus GSC 3869_433. The fainter stars have the expected larger standard deviation. The standard deviation of $0\overset{m}{.}013$ for GSC 3869_496 is larger than we expected but not large enough for us to be certain there are photometric variations. However the star GSC 3869_484 had obvious variations during a night and is thus a new variable star and we devote the rest of this paper to it.

Table 1: Stars observed in the field of GSC 3869_496

GSC No.	R.A. J2000	Dec. J2000	GSC Mag.	ΔR Mag.
3869_496	$15^h37^m09^s$	$+53°19'22''$	11.1	$-2.272 \pm .013$
3869_484	$15^h36^m23^s$	$+53°19'11''$	13.7	$0.133 \pm .040$
3869_1192	$15^h36^m24^s$	$+53°18'00''$	15.	$1.930 \pm .017$
3869_433	$15^h36^m41^s$	$+53°17'23''$	12.9	—
3869_395	$15^h36^m56^s$	$+53°16'42''$	13.3	$-0.001 \pm .002$
3869_1406	$15^h37^m01^s$	$+53°16'13''$	15.0	$1.876 \pm .020$
3869_1186	$15^h37^m15^s$	$+53°16'24''$	13.9	$0.664 \pm .006$

There is no ambiguity in the determination of the orbital period of GSC 3869_484 since five of the nights included more than half the light curve. Using data points within $0\overset{d}{.}04$ of the minimum, and the method of Kwee and van Woerden (1956), the heliocentric Julian Dates of minimum were found and are tabulated in Table 2.

Table 2: Times of Minimum of GSC 3869_484

Minimum	Minimum	Minimum
2450977.7701	2450977.9033	2450981.7882
2450984.8705	2450985.9425	2450986.8826
2450992.7796	2450992.9134	2450993.8528

A fit to these times gives the ephemeris:

$$\text{HJD of Minima} = 2450977\overset{d}{.}5005(7) + 0\overset{d}{.}26805(4) \times \text{E}.$$

where the uncertainties in the final digit are given in brackets and the mean square error of the fit is $0\overset{d}{.}0012$.

The differential (GSC 3869_484−GSC 3869_395) R magnitudes phased at this period are plotted in Figure 2 with different symbols for each of the nights. The asymmetry in the maxima, is indicative of star spots distributed asymmetrically over the surface of the star(s).

CCD frames of the field were obtained with B and V filters to ascertain the temperature and brightness of the variable star. The star GSC 3869_237, 10' south of GSC 3869_484, has B and V magnitudes (Urban et al. 1998) measured by the Hipparcos satellite (ESA 1997). Relative to this star, measurements of GSC 3869_484 give V=13.54 ± .05 and (B−V)=0.73 ± .12 at maximum light. From this color we estimate the spectral class of GSC 3869_484 to be approximately G6 (Cousins 1981). Its period and color are consistent with the "period-color" diagram of Rucinski (1997).

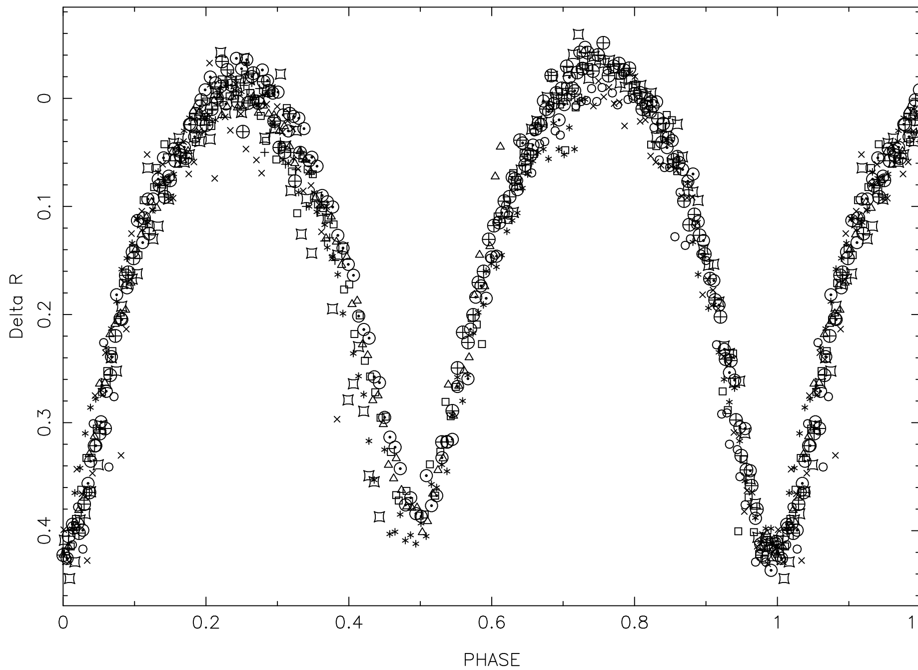

Figure 2. R band light curve of GSC 3869_484 for 1998

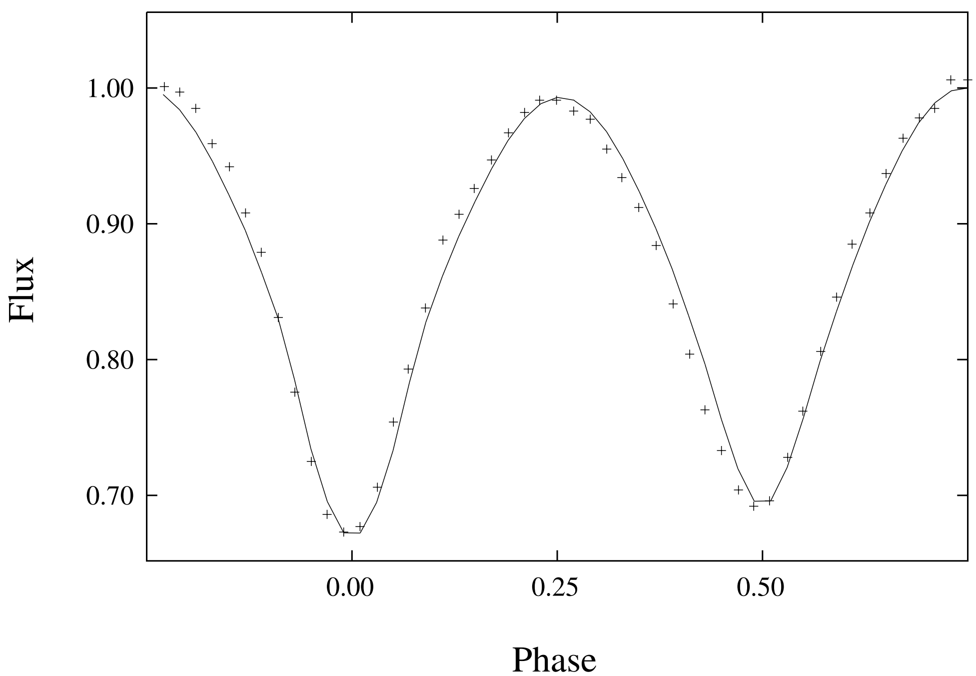

Figure 3. R band light curve (points) with example model (line) of the eclipsing system

The light curve leads us to expect this to be a contact system. Using Binmaker 2.0 (Bradstreet 1993), an example model light curve was made, assuming the temperature of the large star to be 5400K. The data are best fitted with an inclination of 69°, a mass ratio of 2, and fillout factor of 0.2. The temperature of the small star was adjusted to 5600K and a spot 12° in radius at a longitude of 270° was added to get the fit seen in Figure 3. Considering the cycle to cycle variations seen in the light curve, this is a satisfactory fit. The mass ratio and fillout factor are poorly determined but the uncertainty in the inclination is about $\pm 2°$. The difference in temperature and spot diameter are known to about $\pm 10\%$.

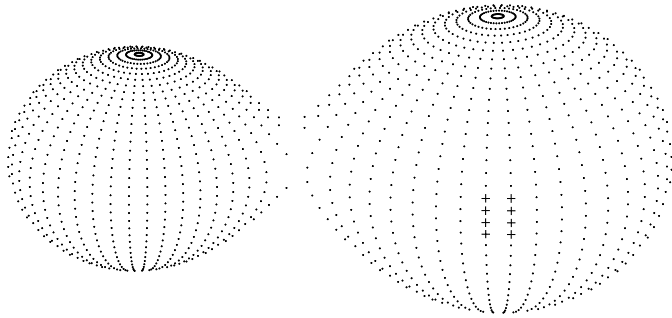

Figure 4. Three-dimensional model of the contact system at phase 0.25

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

The star GSC 3869_484 is therefore a contact eclipsing system with late type components and at least one spot. Photometric observations should be continued to monitor light curve changes due to spot migration and period changes. Spectroscopic observations have been started to determine a spectral class for the system and to measure radial velocities to determine the masses and the scale of the system.

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UBV LIGHT CURVES OF THE VERY SHORT PERIOD W UMa BINARY, GSC 03505-00677

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The star GSC 003505-00677 [RA(2000) = $16^{\rm h}31^{\rm m}54^{\rm s}.44$, DEC(2000) = $50°21'10''.5$] was discovered to be a W UMa type binary star by Robb, Greimel, and Ouellette (1997). Their paper included an R-filtered light curve, 11 timings of minimum light and a period determination of $0^{\rm d}.27897$. Its very short period and its color index of $R-I_c = 0.37$ (spectral type ~G7) qualify this system as an astrophysically important rapidly rotating solar type binary. Night to night variations and light curve asymmetries attest to this. Subsequently, the variable was selected as a target object on our recent observing run at Lowell Observatory. Our present observations were taken with the Lowell 0.79m reflecting telescope in conjunction with a thermoelectrically cooled S-13 type PMT on May 25, 26 and June 1, 1998. Standard U, B, and V filters were used. The comparison [GSC 03505-00403, RA(2000) = $16^{\rm h}32^{\rm m}24^{\rm s}.14$, DEC(2000) = $50°21'33''.4$], and check stars, [GSC 03505-00185, RA(2000) = $16^{\rm h}32^{\rm m}36^{\rm s}.88$, DEC(2000) = $50°20'52''.8$] are given C, and K in Figure 1 along with the variable, V. Some 200 observations were taken in each pass band of this 13th magnitude binary. Five mean epochs of minimum light were determined from the observations made during three primary and two secondary eclipses by DF using the Hertzsprung technique (1928). These precision epochs of minimum light are given in Table 1 along with their standard errors in parentheses. A precision linear ephemeris was calculated, using the available 16 timings of minimum light:

$$\text{J.D. Hel Min I} = 2450633^{\rm d}.9493(2) + 0.27895803(31) \times E. \qquad (1)$$

The O−C residuals for all published observations are shown graphically in Figure 2 and our timings are listed in Table 1. These light elements were also used to phase our present observations.

The UBV light curves and the B−V and U−B color curves of the variable are shown as Figure 3 as differential standard magnitudes (variable−comparison) versus phase. The probable error of a single observation was 0.9% in B, 1.3% in V and 1.9% in U. The analysis of the light curves is underway.

Table 1: Epochs of Minimum Light, GSC 03505-00677

JD Hel. 2450000+	Min	Cycles	O−C
960.8880(3)	I	1172.0	−0.0001
961.7235(4)	I	1175.0	−0.0015
961.8652(5)	II	1175.5	0.0007
966.7466(11)	I	1193.0	0.0003
966.8862(5)	II	1193.5	0.0005

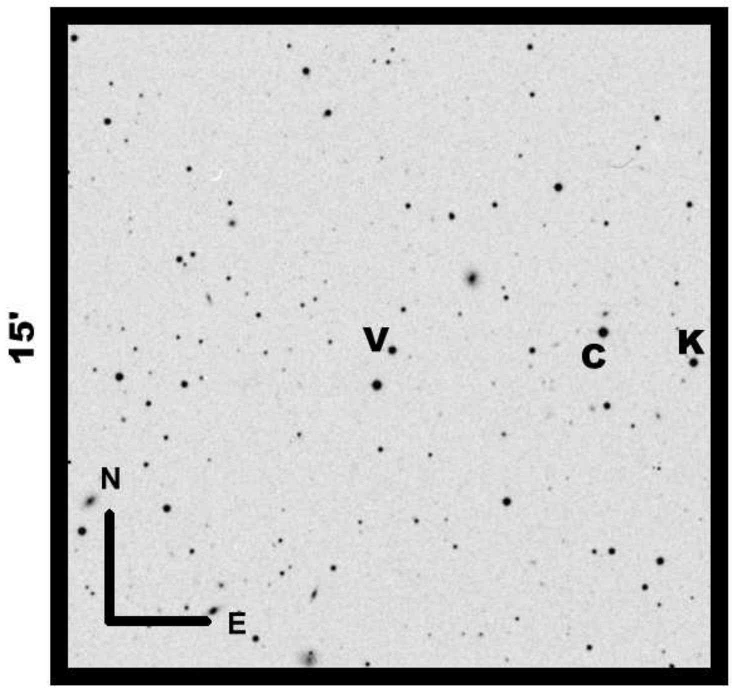

Figure 1. Finding chart (modified from the Digital Sky Survey image) of the Variable, GSC 03505-00677, V, the comparison star, C, and the check star, K.

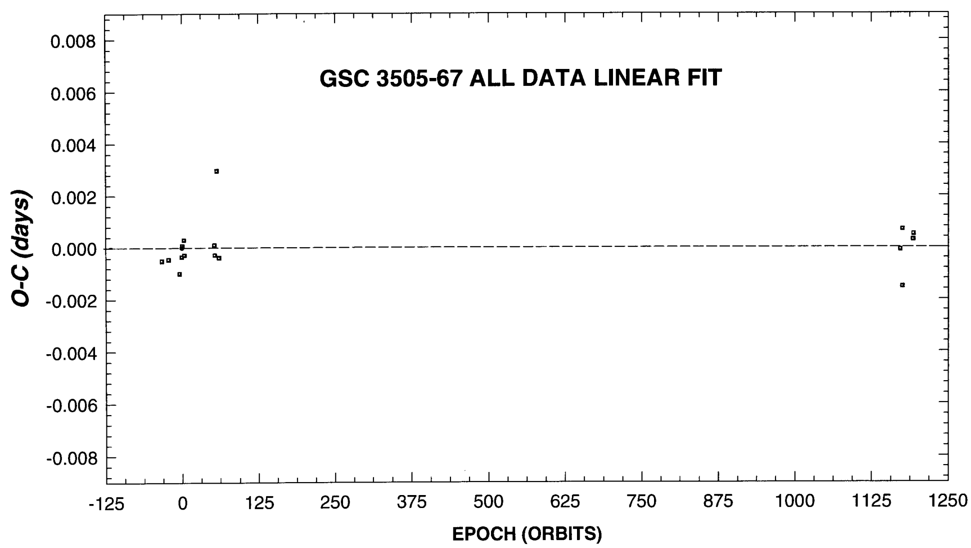

Figure 2. O−C residuals for all available timings of minimum light as calculated from the improved ephemeris.

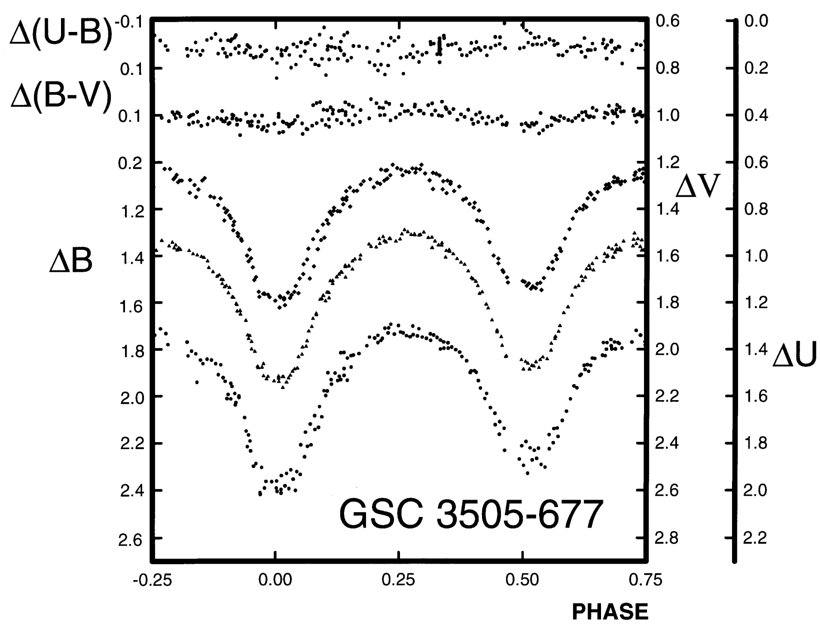

Figure 3. U, B, V light curves and U−B, B−V color curves for GSC 03505-00677 as magnitude differences, variable minus comparison star.

We are thankful for the travel support from both the University of South Carolina, Lancaster and Bob Jones University.

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SPECTRAL TYPES FOR NAMED OR SUSPECTED VARIABLE STARS IN THE IRAS POINT-SOURCE CATALOGUE

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Several years ago one of us (D.J.M.) determined spectral types for some 14,200 IRAS sources. These lay within about 7° of the southern galactic equator, and all had F(12μm) $\geq$ F(25μm). This work was done using Kodak I-N objective-prism plates taken by him some 25 years ago with the Curtis Schmidt at CTIO at a dispersion of 3400 A/mm at the A band; the spectral classifications were done with the support of the NASA Astrophysics Data Program. Although the results of this work have been sent to the sponsoring agency (NASA/JPL/IPAC), they do not appear to be generally known, so we are here presenting the classifications for those named or suspected variables for which such data are not given in the GCVS or NSV Catalogues. Some of the classifications have already been published by Kwok, Volk, and Bidelman (1997), but are repeated here. Also, classifications for fifteen of our stars have been published by Stephenson (1992), who used near-infrared objective-prism plates of approximately twice the dispersion. The agreement of the types is excellent.

The resulting spectral types for both the named and the suspected variables are listed in Table 1. Stars contained in Stephenson's (1984, 1989) catalogues of S-type and carbon stars respectively, are identified by their SS and CS numbers, and their spectral types are taken from these catalogues except for CS 2795=TU Car, which does not appear to be a carbon star. IBVS references are given for those variables named since publication of the 4th edition of the GCVS. An asterisk following the star name or number indicates that the type of variability is open to question in view of the assigned type.

It should be noted here that a large number of our southern suspected variables were discovered some 60 years ago by the late Willem J. Luyten, whose very substantial contributions to variable-star astronomy have not received much recent attention. And, finally, it is strongly suggested that the remarks concerning objective-prism classification of M-type stars given in IBVS 4230 be carefully noted by users of this list.

Table 1: Spectral Types for IRAS Stars

Name	Type	Catalogue No.	IBVS Ref.	Name	Type	Catalogue No.	IBVS Ref.
BU Aur	M7:			HY Cen	M9		
BV Aur	M8			IP Cen	M7		
FQ Aur	M6			KO Cen*	M7		
FX Aur	M6 (M7 CBS)			LY Cen	M9		
HK Aur	M3r			NS Cen	M9		
LZ Aur	M4:(M7 CBS)			NU Cen	M7:		
V392 Aur	S!	SS 199	3323	NW Cen	M8		
V399 Aur	early M?		4140	OQ Cen	M7		
V400 Aur	early M sg?		4140	OT Cen	M8		
XX CMa	MS			OY Cen	M8		
BP CMa	M10			PP Cen	M8		
BQ CMa	M8			PY Cen	M8		
BR CMa	M7			QQ Cen	M9		
BT CMa	M8			QU Cen	M7		
GT CMa	S-*3	SS 289		QW Cen	M9		
GX CMa	M8			V340 Cen	M8		
HT CMa	M4:		4140	V403 Cen	M6:		
HV CMa	C	CS 1540	4140	V409 Cen	M10		
HX CMa	C	CS 1601	4140	V410 Cen	M7		
WW CMi	M7			V411 Cen	M6		
WZ CMi	M6			V491 Cen	M6		
XY CMi	S-*3	SS 325		V592 Cen	<M		
TU Car	MS	(CS 2795)		V686 Cen*	M6		
VX Car	M6			V693 Cen	M10		
VZ Car	M8			V698 Cen	M8		
AN Car	M9			V702 Cen	M9		
AP Car	M3r			V704 Cen	M7:		
AZ Car	M9			V706 Cen	M7		
BC Car	M5r			V778 Cen	M9		
BI Car	M7			V780 Cen	M9		
BX Car	M7			V781 Cen	M8		
CE Car	M8			V784 Cen	<Mr		
CG Car	M7			V862 Cen	M6:		3840
FY Car	<Mr			V865 Cen	M8		3840
GK Car	<M			V866 Cen	mid-M?		3840
GY Car	M7			V875 Cen	IRAS C	CS 3124	4140
NP Car	M7			V893 Cen	M10		4471
V408 Car	M6:		2681	RV Cir*	M6		
V425 Car	late type		3323	RW Cir	M7:		
TY Cen*	M8:			SS Cir*	M7		
TZ Cen*	M7			TU Cir	M6		
AE Cen	M4:			TX Cir	M8		
AF Cen	M7			UZ Cir	M7		
BC Cen	M8			VV Cir	M10		
BN Cen	M4			VZ Cir*	M6		
CK Cen	M6			WW Cir	M7		
CM Cen	M9			WY Cir	M8		
CP Cen*	M4			AO Cir	M7		
CR Cen	M8			RS Cru	M7		
CS Cen	M9			RU Cru	M9		
CV Cen	M9			RV Cru	M6		
DL Cen*	MS			SS Cru	M9		
DQ Cen*	M6			SU Cru	<M?		
DX Cen	late M			AK Cru	M8		
EK Cen	M8:			AU Cru	<M		
ER Cen*	M6			AX Cru	M7		
ET Cen	M8			CG Cru	C	CS 3166	3840
EX Cen	M9			CM Cru	M9:		4140
HV Cen	M8			LS Gem	M6		

Table 1 (cont.)

Name	Type	Catalogue No.	IBVS Ref.	Name	Type	Catalogue No.	IBVS Ref.
WX Mon	M7			CT Pup	M6 (M9 CBS)		
XY Mon	M4 (M6 CBS)			CV Pup	M7		
AG Mon	M10			DG Pup	M7		
BS Mon	MS			DQ Pup	early Mr		
CI Mon	M9			DU Pup	M10		
CY Mon	M7			DW Pup	M8 (M6-9 CBS)		
DT Mon	M3			EF Pup	M7		
DZ Mon	M6 (M7 CBS)			ES Pup	MS (M6 CBS)		
EY Mon	M10			FL Pup	M4		
HW Mon	MS			FO Pup	M9		
IK Mon	M10			FW Pup	M6		
MW Mon	M6			GL Pup	M6		
MZ Mon	M6 (M7 CBS)			HR Pup	M7 (M6 CBS)		
NP Mon	M7			HQ Pup	M9		
QS Mon	M10			II Pup	M8		
V374 Mon	early Mrr			IM Pup	M4		
V375 Mon	M9			IY Pup	M9		
V378 Mon	M6(M7 CBS)			KN Pup	M9		
V381 Mon	M4			KS Pup	M8		
V385 Mon	M8			LZ Pup	M8		
V511 Mon	M8			MU Pup	C	CS 1934	
V516 Mon	<M			OY Pup	M10		
V522 Mon	M4			V346 Pup	C	CS 2101	3530
V525 Mon	M5			WY Py	S5,2	SS 533	4471
V529 Mon	M6 (M6, 7 CBS)			CG Tau	M10		
V531 Mon	M6			IX Tau	M10 (M9 CBS)		
V533 Mon	M6			IZ Tau	M10 (M9 CBS)		
V534 Mon	M9			V416 Tau	M7		
V575 Mon	M9			TZ Vel	M6:		
V631 Mon	M9:			VV Vel	M7		
V685 Mon	S! SS	338	3323	AD Vel	MS		
V686 Mon	MIO	3323		AG Vel	M7		
V694 Mon	M7	3840		BK Vel	M8		
V Mus	M6			BL Vel	M8		
W Mus	MS			CF Vel	M8		
X Mus	M7			CT Vel	M6		
Z Mus*	M9			DE Vel	M7		
RU Mus	M7			DG Vel	M6		
TY Mus	M6:			DI Vel	M8		
WW Mus	M7:			DV Vel	M6		
YZ Mus	M4r		=GH Mus	EK Vel	M8:		
AF Mus	M7 .			ER Vel	M6		
AN Mus	M8:			FL Vel	M6		
AX Mus	M6			FR Vel	M6		
BH Mus	M7			GM Vel	M6		
BM Mus	M7			MQ Vel	late M or S		4471
CC Mus	M7			NSV 2072	M6		
DF Mus	M7			NSV 2642	early M:		
DT Mus	M8:			NSV 2735	late R or N	CS 1109	
DW Mus*	M5:			NSV 2894	M6		
DY Mus	M7			NSV 2911	M7		
EG Mus	M8			NSV 3190	S	SS 251	
SY Pup	M6			NSV 3270	M8		
TV Pup	M6			NSV 3336	R:	CS 1513	
UW Pup	M9:(M9 CBS)			NSV 3388	M6		
UX Pup	M6 (M6 CBS)			NSV 3451	M7		
AO Pup	M10			NSV 3461	M8		
BO Pup	MS			NSV 3475	M7		
CD Pup	M10			NSV 3483	M6		

Table 1 (cont.)

Name	Type	Catalogue No.	IBVS Ref.	Name	Type	Catalogue No.	IBVS Ref.
NSV 3540	C	CS 1658		NSV 4989	M8		
NSV 3552	M8			NSV 5005	M6		
NSV 3627	S	SS 362		NSV 5026	M8		
NSV 3630	M3			NSV 5029	M4r or S:		
NSV 3676	N	CS 1819		NSV 5046	M7		
NSV 3743	M8			NSV 5061	MS		
NSV 3759	M6			NSV 5095	M9		
NSV 3798	M6			NSV 5131	M8		
NSV 3807	M7			NSV 5194	M6		
NSV 3818	M6			NSV 5218	M9		
NSV 3819	M7			NSV 5301	M8		
NSV 3840	M9			NSV 5330	M8		
NSV 3860*	M4			NSV 5340	M6		
NSV 3868	M6			NSV 5342	M7:		
NSV 3875	N	CS 2016		NSV 5343	M6		
NSV 3885	N	CS 2021		NSV 5361	M9		
NSV 3921	M6			NSV 5383	M3		
NSV 3928	M7			NSV 5473	M4		
NSV 3944	C	CS 2109		NSV 5616	M6		
NSV 3948	M8			NSV 5657	mid-M		
NSV 3964	M7			NSV 5670	<M		
NSV 4011	M8			NSV 5739	M8		
NSV 4075	early Mr			NSV 5779	M5		
NSV 4116	M10			NSV 5793	M8		
NSV 4129	M9			NSV 5840	M9		
NSV 4353	M9			NSV 5878	M7		
NSV 4370	M7			NSV 5892	M9		
NSV 4388	M9			NSV 5992	M9		
NSV 4403	M8			NSV 6051	M8:		
NSV 4424	M7			NSV 6066	M4		
NSV 4554	M6			NSV 6100	M7:		
NSV 4560	M4			NSV 6112*	M4r		
NSV 4592	M7			NSV 6122	M8		
NSV 4600	M7			NSV 6126	<M		
NSV 4640	M9			NSV 6132	M10		
NSV 4655	M9			NSV 6169	M4		
NSV 4663*	<Mr			NSV 6189	M7		
NSV 4729	M8			NSV 6202*	M7		
NSV 4754	M9			NSV 6237	M6		
NSV 4760	M8			NSV 6262	M6		
NSV 4769	M4			NSV 6438	M9		
NSV 4780	M7			NSV 6447	M8		
NSV 4789	M7:			NSV 6464	M9		
NSV 4805	M7			NSV 6518	M8		
NSV 4814	M8			NSV 6581	M9		
NSV 4853	M8			NSV 6641	M9:p		
NSV 4893	M7			NSV 6668	M6		
NSV 4919	M10						

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Stephenson, C.B., 1992, IBVS No. 3800

ERRATUM

[From IBVS 4750]

In the Table of IBVS No. 4612 all spectral types MS should read M5. Therefore M 5 spectral type is assigned to XX CMa, TU Car, DL Cen, BS Mon, HW Mon, W Mus, BO Pup, ES Pup, AD Vel, and NSV 5061. The original manuscript was correct. The err ors occurred when the OCR software was utilized. With our apologies

THE EDITORS

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ON THE ORBITAL PERIOD OF EG CANCRI

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The dwarf nova EG Cnc was discovered by Huruhata (1983). He reported the detection of an outburst in 1977 November and no sign of any other outburst in his photographic archives taken between 1977 and 1983. McNaught (1986) indicated that the object in quiescence was 18.6 mag (red) and 18.0 mag (blue) on the Palomar Sky Survey prints. He pointed out that characteristics of the object, which are 1) the outburst amplitude over 6 mag, 2) the decline rate of 2 mag per 20 days, and 3) its blue color, were similar to those of WZ Sge and its group.

Although there had been no confirmed outburst in EG Cnc since the 1977 outburst, the object underwent a rare outburst on 1996 November 30 (Figure 1). The object was $m_{\rm vis} \simeq 12$ at the first detection by Schmeer (1996). The outburst was a superoutburst, and it is known that the wonderful six repeated mini-outbursts appeared in the latter half of the superoutburst (Kato et al. 1998). In the first half of the superoutburst, the object showed two types of superhumps, namely 1) a double-peaked early superhump and 2) a following "common" superhump (Matsumoto et al. 1998). The early superhump showed a slightly shorter modulation period of $0\overset{d}{.}0582$ than that of the superhump of $0\overset{d}{.}06036$, later appeared. Matsumoto et al. (1998) suspected the former period is the orbital period of the binary system, by an application of the discussion in the 1996 superoutburst of AL Com (Kato et al. 1996), and also discussed the similarities between EG Cnc and the WZ Sge type dwarf novae. The WZ Sge type dwarf novae have some peculiar characteristics such as 1) very long supercycle exceeding years, 2) showing only superoutbursts without normal outbursts, and 3) large amplitudes of the superoutbursts over 6 mag. They are also known to occupy the shortest orbital-period region among all CVs. Confirmation of the orbital period of EG Cnc is crucial because it will provide an additional, independent support to the claimed universal presence of "early superhumps" in WZ Sge stars. We report here our observations of EG Cnc in quiescence to detect orbital modulations.

The CCD photometric observations were made on four nights between 1997 December 27 and 1998 January 2, using the 101-cm reflector at Bisei Astronomical Observatory and the 60-cm reflector at Ouda Station, Kyoto University. The observations at Bisei and Ouda were carried out with Johnson V-band interference filters and liquid-nitrogen cooled CCD cameras of TEK 1024T (1242×1152 pixels) and Thomson TH 7882 (576×384 pixels) at the Cassegrain foci, respectively. For more details of the instruments, see Ayani

Table 1: The log of the observations

Date	HJD−2400000	No. of frames	Error (mag)	Observatory
1997 Dec 27	50810	46	0.06	Bisei
1997 Dec 27	50810	55	0.15	Ouda
1997 Dec 28	50811	22	0.20	Ouda
1997 Dec 31	50814	67	0.20	Ouda
1998 Jan 2	50816	50	0.18	Ouda

et al. (1996) for Bisei, and Ohtani et al. (1992) for Ouda. A summary of the observations is given in Table 1.

The frames obtained at Bisei were reduced in a standard way using the IRAF (distributed by the National Optical Astronomy Observatories, U.S.A.), and the instrumental stellar magnitudes were measured with the aperture photometry routine (APPHOT) in the IRAF. The reductions of the Ouda frames were carried out with a microcomputer-based automatic PSF photometry package developed by one of the authors (T.K.). We determined the relative magnitudes of the object using a local comparison star of 12.82 mag (V) lying $\sim 4'$ west of the object.

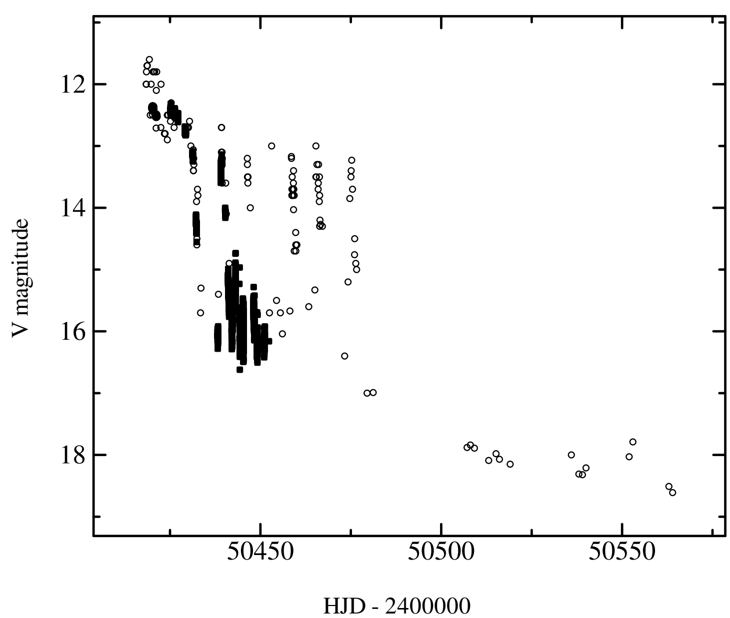

Figure 1. Overall light curve of the 1996 superoutburst of EG Cnc. The filled circles and squares respectively represent the CCD observations at Osaka Kyoiku University and Ouda station (Matsumoto et al. 1998, Kato et al. 1998). The open circles represent the reports by VSNET members.

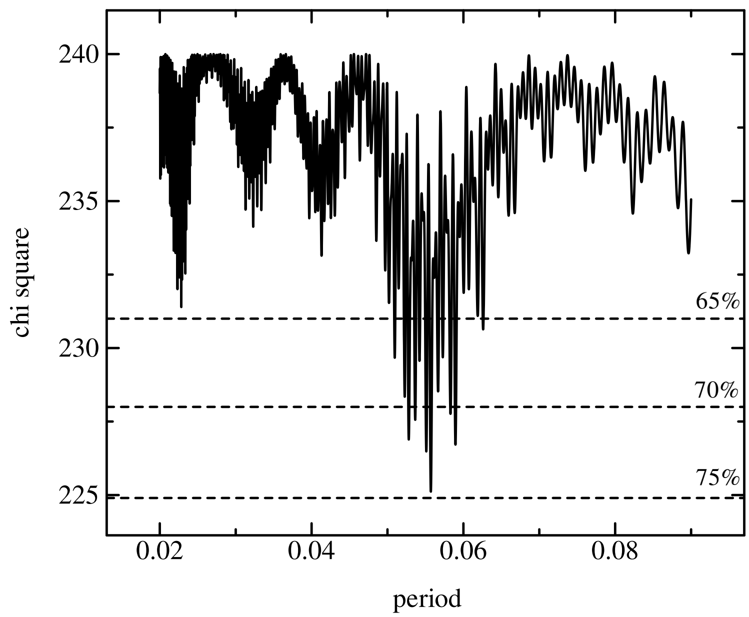

Figure 2. χ^2 tests for periods of the orbital hump

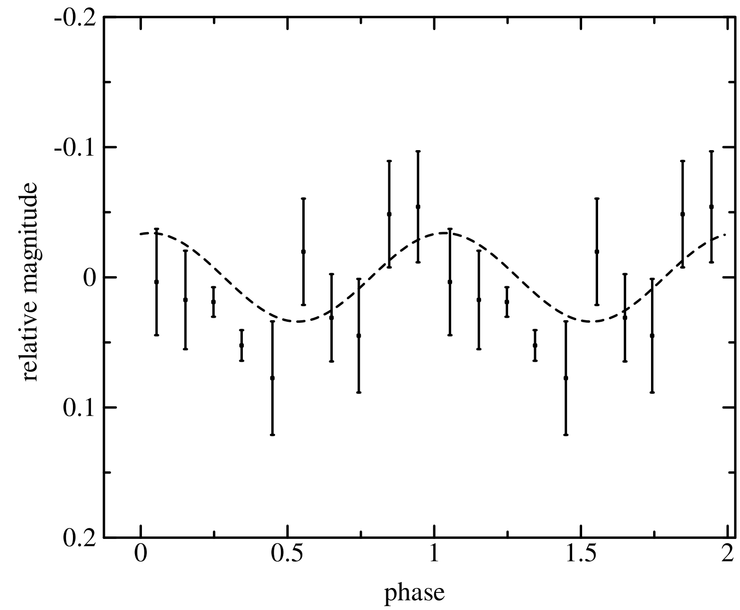

Figure 3. Folded light curve

In order to find a period of modulations in quiescence of EG Cnc, sine-curve fittings were applied to the obtained light curve with trial periods between 0.02–0.09 d. Figure 2 presents the results of χ^2 for the each trial period of the fittings. The confidence levels are represented by the dashed-lines with their value in the figure. The χ squares indicate a minimum at around 0.05–0.06 d, and there are four possible periods of 0.0528, 0.0551, 0.0557, and 0.0589 day over 70% confidence level. By knowing the superhump period of $0^{\mathrm{d}}.06036$ during the 1996 superoutburst of this object (Matsumoto et al. 1998; Patterson et al. 1998), the period of $0\overset{d}{.}0557$ corresponds to an 8.4% fractional superhump excess, $(P_{SH} - P_{orb})/P_{orb}$. This excess value is far beyond the usual relation (excess versus P_{SH}) among SU UMa-type dwarf novae (eg. see Table 1 in Nogami et al. 1997), and each period less than $0\overset{d}{.}0557$ will not be a good candidate for the orbital period. Therefore we consider that the $0\overset{d}{.}0589$ with a 2.5% fractional superhump excess is the most likely period which reflects the orbital period of the system from the present data. The present result consequently supports that the period of the early superhump in the 1996 superoutburst corresponded to the orbital period.

Figure 3 is the light curve of the all data folded by the $0\overset{d}{.}0589$ period and binned to 0.1 phases. The dashed-line in the figure represents the best-fit sine curve based on the result of the χ^2 tests. According to the fitted curve, the times of photometric maxima are expressed by the following ephemeris:

$$\mathrm{HJD\ (Maximum)} = 2450810.0912 + 0.0589 \times E, \qquad (1)$$

and the orbital modulation of EG Cnc in quiescence has an amplitude of ~ 0.06 mag.

The observation at Bisei Astronomical Observatory was made as a part of the 3rd observational program in 1997 of the observatory (K.M.).

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AAVSO PHOTOELECTRIC PHOTOMETRY OF RU Cam

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RU Cam (HD 56167) is a population II Cepheid which, in 1965-66, decreased its amplitude abruptly and drastically – from one magnitude to less than 0.1 (Demers & Fernie 1966). The amplitude fluctuated around 0.2 magnitude from 1966 to 1982; the cycle-length period varied between 17.4 and 26.6 days (Szeidl et al. 1992). Some UBVR observations have been published by Berdnikov & Voziakova (1995); although they state that the amplitude of the light curve is 0.03 magnitude, their Figure 1 shows it to be about 0.2 magnitude. The *HIPPARCOS* satellite monitored RU Cam between 1989.85 and 1993.21; the star was classified as a periodic variable, with a period of 22.24 days (ESA 1997). The American Association of Variable Star Observers has monitored RU Cam photoelectrically from 1987 to 1997. The results are described here.

A total of 109 differential V observations were made between JD 2447066 and 2450709. The comparison stars were HD 56323 (F5) and HD 57201 (F8). The V magnitude of HD 56323 has been well established, by other observers, to be 9.05. Observations were corrected for differential extinction, and transformed to the V system using the catalog values of (B−V), and transformation coefficients determined for each observer from observations of blue-red pairs. The standard error of the check star observations was 0.012 to 0.03, depending on the observer.

The power spectrum of the observations was determined using the VSTAR software developed by the AAVSO (www.aavso.org) as part of its *Hands-On Astrophysics* education project.

The range of the observations was 8.34 to 8.68. The highest peak in the power spectrum of the 1987-1997 data was at a period of 22.20 days, in excellent agreement with the period derived from the *HIPPARCOS* photometry, and with the period (22.16 days) before 1966. The phase diagram for that data and period showed an amplitude of about 0.20 mag, with relatively little scatter.

The 1997-98 data (Figure 1) is rather different; it is more typical of a double-mode pulsator, in the sense that it appears to show systematic variations in amplitude. The data of Szeidl et al. (1992) occasionally show a similar appearance. The various forms of non-periodicity in RU Cam may arise from cycle-to-cycle changes in either the phase, the amplitude, or the shape of the light curve – or even from the presence of multiple periods.

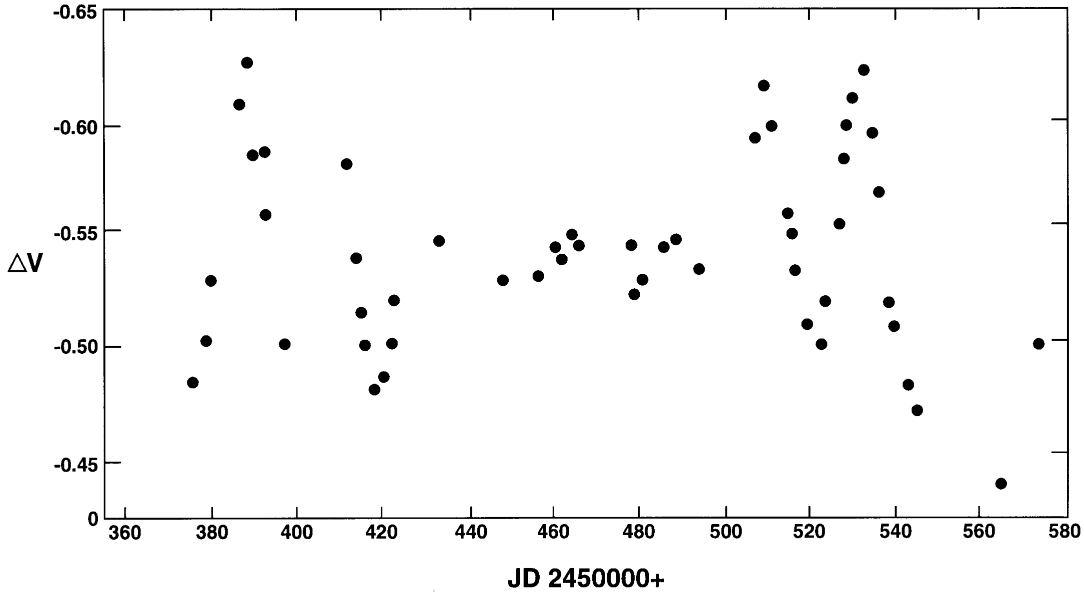

Figure 1. The AAVSO photoelectric V light curve of the peculiar Population II Cepheid RU Cam in 1997-98, relative to HD 56323 (V=9.05)

Szeidl et al. (1992) suggested that the period of RU Cam fluctuates over a wide range. An alternative interpretation is that there are random, cycle-to-cycle fluctuations in period, as in the Mira and RV Tauri stars (Percy et al. 1997); this possibility was also alluded to by Szeidl et al. (1992). A cursory application of the Eddington & Plakidis (1929) method for identifying such changes supports this proposition. The exact period found over any limited range of time would then be affected by these random changes.

The low scatter in the phase curve from 1987 to 1997 shows that the pulsation is now relatively stable, so that the 1965 decrease in amplitude was an abrupt decrease from one discrete state to another, with no significant change in period; the more complex 1997-98 data remind us that this star is still not predictable, and is well worthy of study.

Acknowledgements. We thank the many AAVSO photoelectric observers for their contribution to this project, and especially the archivist Howard J. Landis. One of us (YT) was a participant in the University of Toronto Mentorship Program, which enables outstanding senior high school students to participate in research projects at the university.

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NEW OUTBURSTS OF V1118 Ori

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Name of the object:
V1118 Ori

Equatorial coordinates:	**Equinox:**
R.A.= $05^h34^m44\overset{s}{.}2$ **DEC.=** $-05°33'40''$	2000

Observatory and telescope:
Ouda observatory in Nara with 60cm telescope

Detector:	CCD
Filter(s):	V
Comparison star(s):	GSC4774.826
Check star(s):	GSC4774.878
Transformed to a standard system:	No

Remarks:
Since 1983, when V1118 Ori became known as a new EXor (Herbig, 1990, refers to this species as EXor, after the example first recognized, EX Lupi or Subfuor, Parsamian and Gasparian, 1987) and entered into an active stage of fuor-like outburst, three 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, and 1992-93 (Parsamian et al., 1993). And now, we observed a new outburst of V1118 Ori in 1997.

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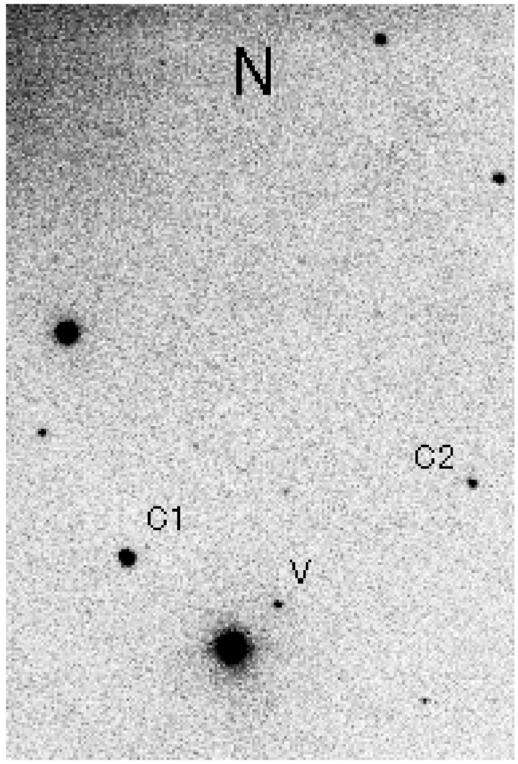

Figure 1. The field of V1118 Ori. (The size of the field is $7' \times 10'$ and north is top.)

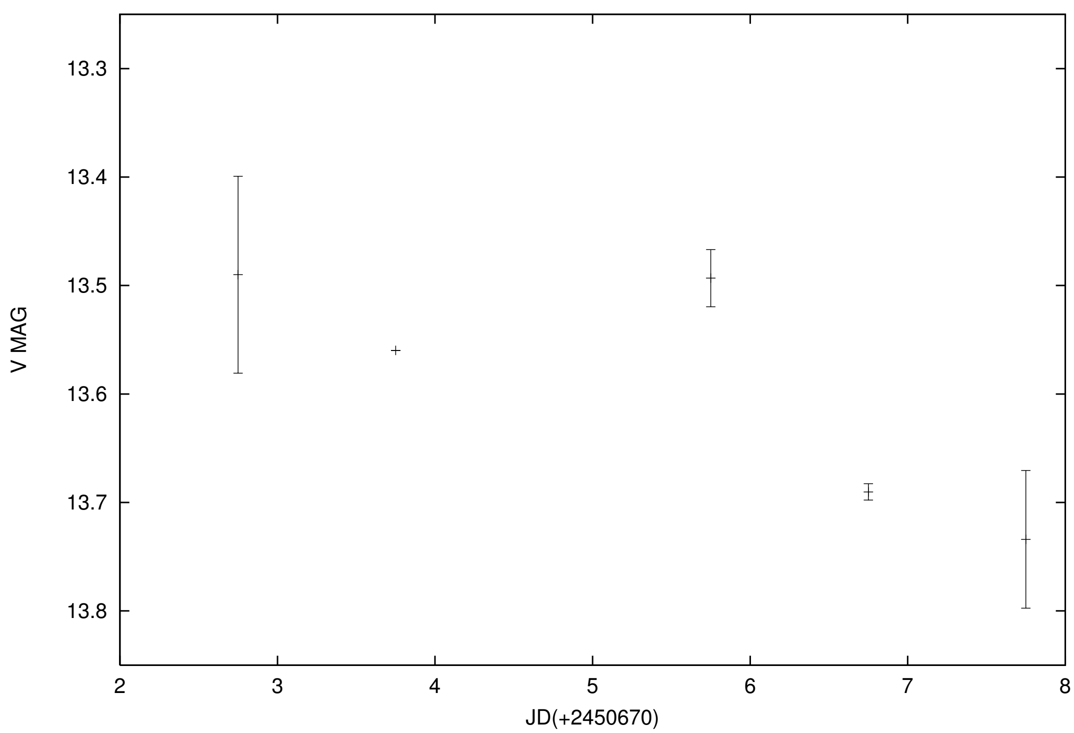

Figure 2. The light curve of V1118 Ori.

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UBV OBSERVATIONS OF THE SOLAR-TYPE NEAR CONTACT BINARY, CN ANDROMEDAE

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CN And (BD+39°59, GSC 2787-1815, PPM 42831) is one of the shortest period eclipsing binaries with an unmistakable EB-type light curve. Its eclipse depths differ by some 0.3 mags in V. It is also an active solar type binary with components of spectral type in the F5 to G5 range. Due to these factors it was included as a target object in a recent observing run at Lowell Observatory. The variable was discovered by Hoffmeister (1949). Löchel (1960) was the first to correctly determine the period, ~0.4628 days. Photoelectric observations have been made by Bozkurt et al. (1976), Seeds and Abernathy (1982), Kaluzny (1983), Michaels et al. (1984), and Evren et al. (1987). The curves are characterized by interesting asymmetries (Rafert et al. 1985) similar to V1010 Ophiuchi binaries (Shaw, 1994). Its high level of activity is attested by two flares seen by Yu-Lan and Qing-Yao (1985), as well as its X-ray luminosity of log $L_x = 30.55$ (Shaw et al. 1996).

Our present observations were taken with the Lowell 0.79m reflecting telescope in conjunction with a cooled S-13 type PMT on September 4-10, 1997. Standard U, B, and V filters were used. The comparison (HIP#1442, GSC 02786-00787, spectral type G9), and check stars, (GSC 02787-01843) are given as C, and K in Figure 1 along with the variable, V. Over 1200 observations were taken in each pass band. Three mean epochs of minimum light were determined from one primary, and two secondary eclipses using the bisection of chords method. One additional timing of minimum light, observed on November 25, 1997 was determined by DRF using the David F. Irons 0.41-m reflector of the Charlotte Amateur Astronomy Club using an SSP-5 PMT. The Hertzsprung technique (1928) was used in its determination. The precision epochs of minimum light are given in Table 1 along with their standard errors of the last digits in parentheses. Linear and quadratic ephemerides were calculated using the available 60 epochs of minimum light:

$$\text{J.D. Hel Min I} = 2450698.9591(18) + 0.46279372(13) \times E. \quad (1)$$

$$\text{J.D. Hel Min I} = 2450698.9447(14) + 0.46279092(19) \times E - 9.8(6) \times 10^{-11} \times E^2. \quad (2)$$

Equations 1 and 2 were used to calculate the O−C1 and O−C2 residuals, respectively, in Table 1. The linear and quadratic residuals are given in Figure 2 and 3, respectively.

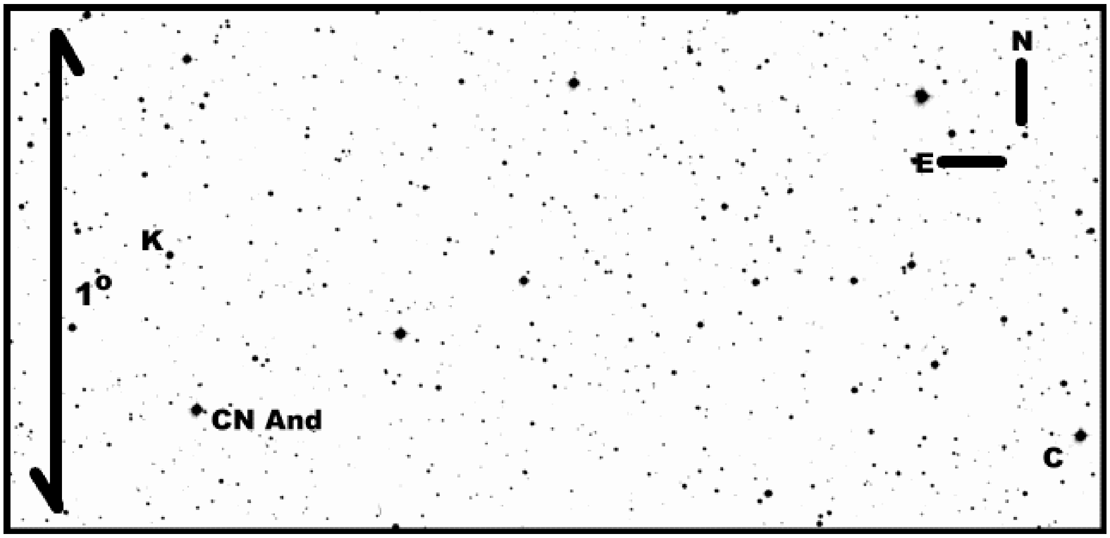

Figure 1. Finding chart made from Real Sky of the Variable, CN And, V, the comparison star, C, and the check star, K.

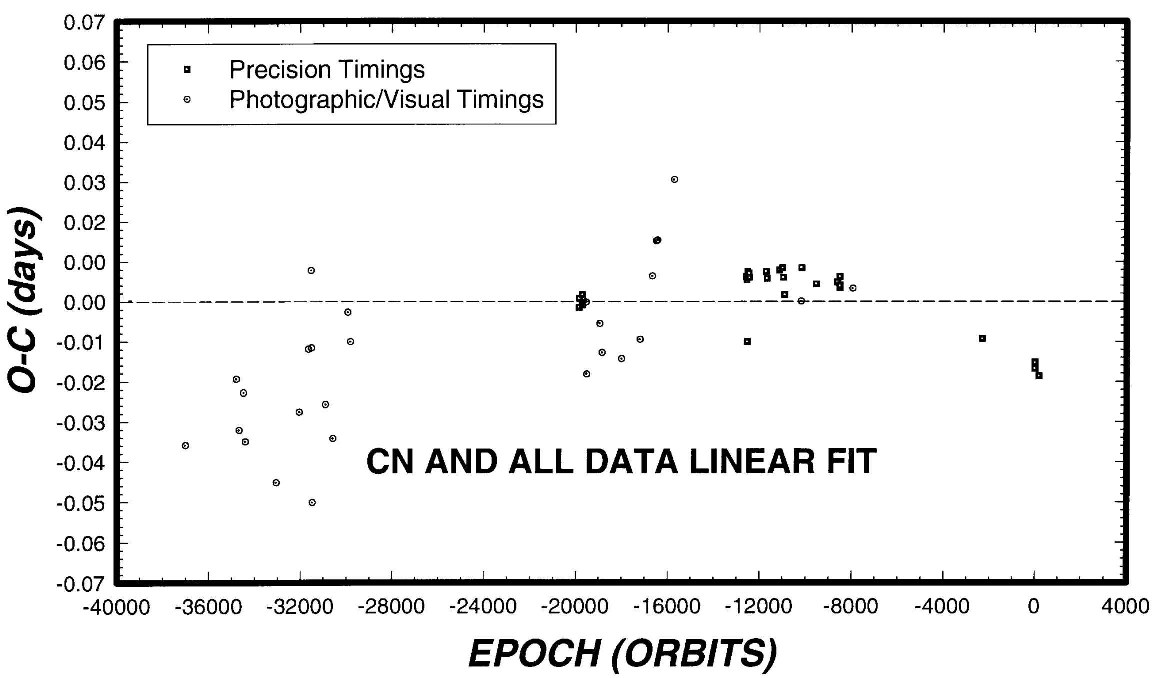

Figure 2. O–C residuals for all available timings of minimum light as calculated from equation 1.

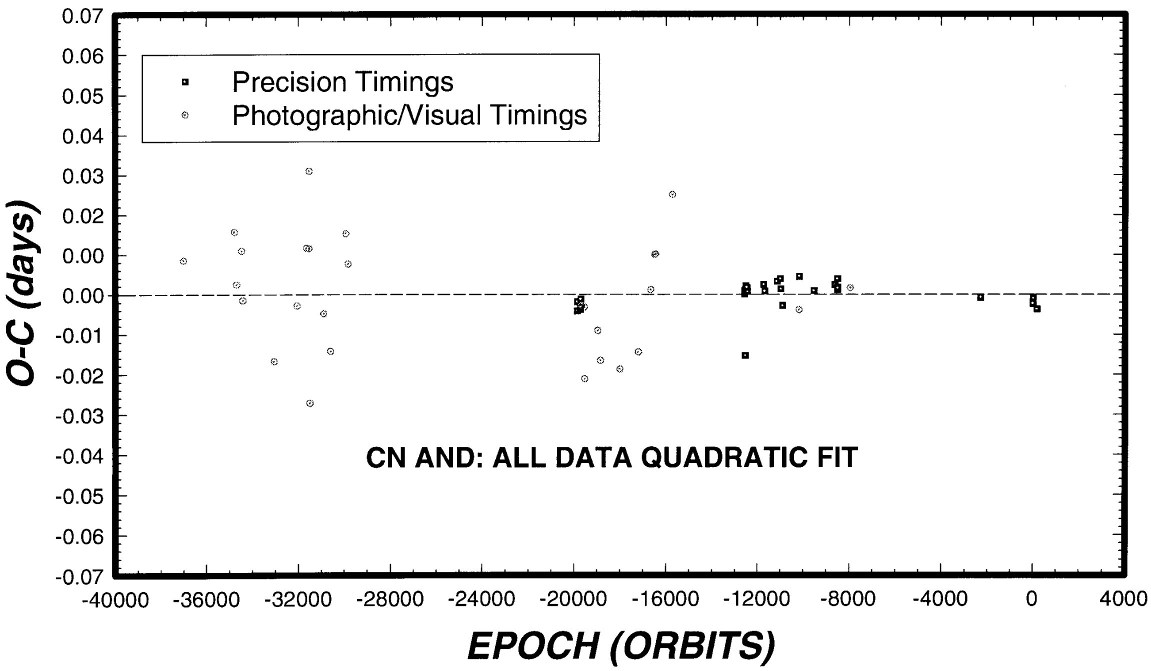

Figure 3. O–C residuals for all available timings of minimum light as calculated from equation 2.

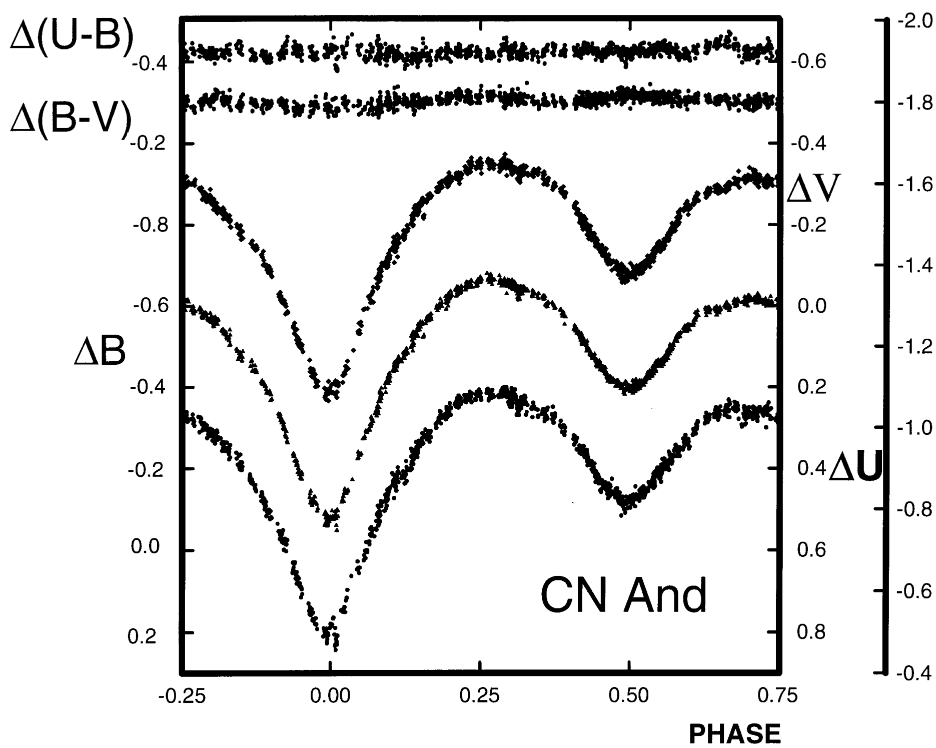

Figure 4. U, B, V light curves and U–B, B–V color curves for CN And as magnitude differences, variable minus comparison star.

Table 1: New Epochs of Minimum Light, CN And

JD Hel. 2450000+	Min	Cycles	O−C1	O−C2
698.9423(9)	I	0.0	−0.0168	−0.0024
701.9521(5)	II	6.5	−0.0151	−0.0007
702.8775(5)	II	8.5	−0.0153	−0.0010
778.5410(10)	II	172.0	−0.0186	−0.0037
Std. error of all residuals:			0.0176	0.0100

The quadratic term is statistically valid at the 16 s level. Also, the O−C residuals yield a much better fit to the timings of minimum light as evidenced by the standard errors.

This gives strong evidence that the period decrease is a real one. The period behavior may be due to mass transfer with the secondary component as the accretor and/or magnetic breaking due to the strong magnetic activity. UBV light curves and the B−V and U−B color curves of the variable are shown as Figure 4 as differential standard magnitudes (variable–comparison) versus phase. The probable error of a single observation was 0.4% in B, 0.5% in V and 1.8% in U. The analysis of these difficult light curves is underway. A spotted semi-detached light curve synthesis solution has been calculated.

We wish to thank Lowell Observatory for their allocation of observing time for the travel support from both the University of South Carolina and Bob Jones University.

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HD 6628: A NEW ACTIVE, SINGLE-LINED SPECTROSCOPIC BINARY

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The variable star HD 6628 (SAO 166806, CPD $-23°$ 130, HIP 5227, *IRAS* 01043$-$2307, RE J010649 $-$225156; listed by *Simbad* as CS Ceti) has been previously listed (SAO catalogue) as a G5 IV single star, $M_{\rm V} = 7.9$ and $d = 75$ pc. The *Hipparcos* magnitude and parallax (Schrijver 1997) are $M_{\rm V} = 7.77$ and $\pi = 0.''00756 \pm 0.''00108$ ($d = 132 \pm 22$ pc). Schrijver (1997) lists HD 6628 as a variable single star with an amplitude of variation in V of 0.10 mag. and a period of 4.50 days, and a light curve has been fitted (Grenon, 1997) to the data. That HD 6628 is chromospherically active was shown by EUV emission in both the ROSAT (Pounds *et al.*, 1991; Pounds *et al.*, 1993; Mason *et al.*, 1995; Pye *et al.*, 1995; Kreysing *et al.*, 1995) and EUVE (Bowyer *et al.*, 1994; Malina *et al*, 1994; Bowyer *et al.*, 1996) surveys, and has been confirmed by medium-resolution spectra of the H and K lines (Figure 1) obtained at the Mount John University Observatory (MJUO) at Lake Tekapo, New Zealand.

High-resolution CCD spectra of HD 6628 were obtained at MJUO between August 1993 and August 1996 using the 1 m McLellan telescope (Nankivell and Rumsey, 1986) and échelle spectrograph (Hearnshaw, 1977 and 1978). Most of the data are at Hα which shows strong and variable emission, the line often appearing entirely in emission. A Th-Ar calibration spectrum was obtained immediately after each stellar spectrum. The spectra were reduced using the ESO Munich Image Data Analysis System (*MIDAS*), the dispersion solutions being computed using standard *MIDAS* procedures in the "échelle" context. Radial velocities were measured from metal lines, principally from the λ6200, λ6219, λ6394, λ6569 and λ6750 lines of Fe I, and the λ6768 line of Ni I. The mean velocities for the individual spectra are listed in Table I. The radial velocities were analysed using the *Orbsol* program as modified and supplied to MJUO by Tsevi Mazeh of Tel Aviv University. A period of 27.3316 ± 0.0079 days was found and Figure 2 shows the radial velocities of Table 1 plotted against the periodic phase. The best-fit orbital parameters as determined by the *Orbsol* program are listed in Table 2.

The *Hipparcos* parallax and V magnitude imply an absolute magnitude for the HD 6628 system of $M_{\rm V} = 2.16 \pm 0.29$. Such a magnitude is consistent with the presence of two G5 IV stars of $M_{\rm V} = 2.91$ each, but the fact that the spectra are single-lined and not double-lined implies that one of the stars is several magnitudes fainter than the other. We therefore prefer the interpretation that the star responsible for the observed metal lines is a G5 IV star of magnitude in the range $M_{\rm V} = 2.5$ to 2.3, for example a star of greater than solar mass which is now a bright subgiant, and its companion is a main sequence star, possibly a spectral type F star.

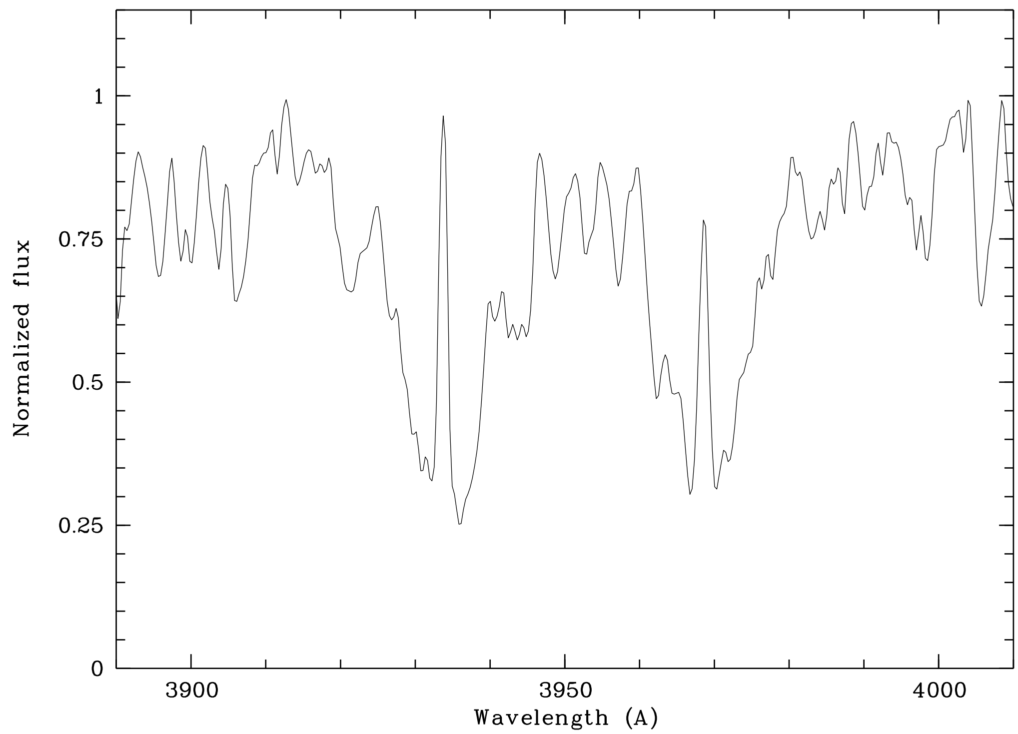

Figure 1. Medium-resolution spectrum of the H and K lines of HD 6628, obtained at MJUO, 1995 December 30.

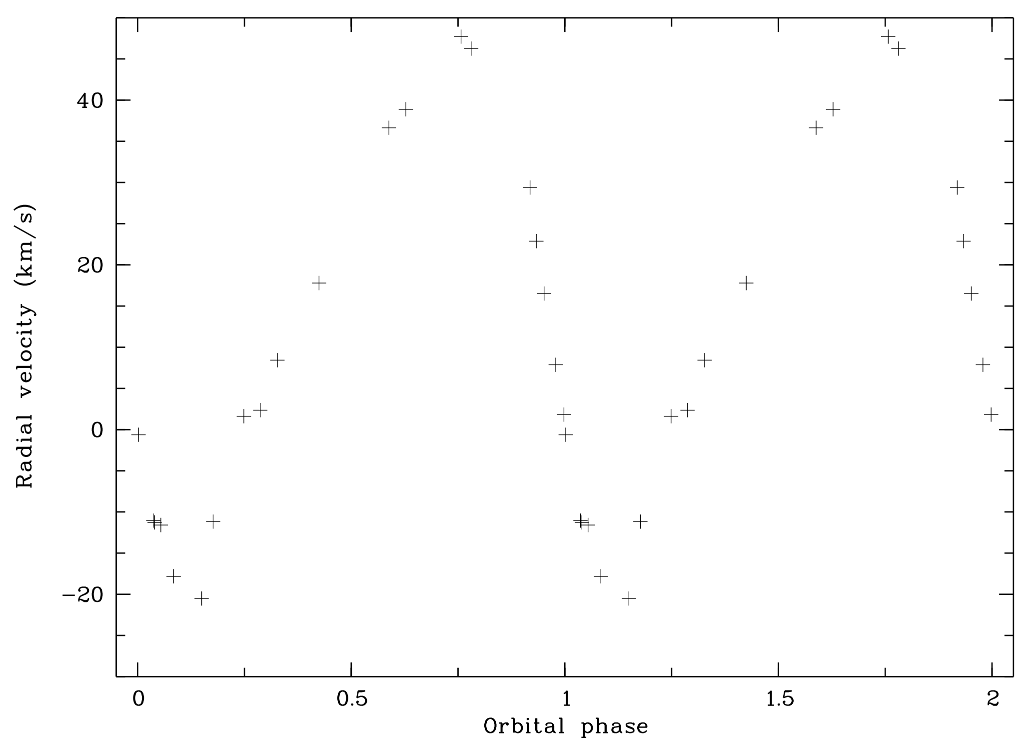

Figure 2. Phased radial velocities of HD 6628.

Table 1: Radial velocities of HD 6628, computed from high-resolution spectra obtained at MJUO.

H.J.D.	Mean velocity (km/s)	Standard deviation (km/s)
2449204.20136	−11.058	0.548
2449290.02947	−11.173	1.285
2449539.02793	+2.355	0.360
2449579.20077	+47.712	0.967
2449622.11782	+8.425	0.905
2449639.92354	+7.869	0.544
2449641.99194	−11.588	0.511
2449859.21730	−0.627	0.540
2449860.24754	−11.270	0.954
2449916.12831	−17.814	0.205
2449941.09675	+1.822	0.102
2450011.89198	+36.646	0.588
2450012.97834	+38.892	0.072
2450075.98908	+22.879	1.375
2450081.91063	−20.505	3.043
2450111.94092	+1.621	2.029
2450263.14307	+46.259	2.251
2450294.23803	+29.388	1.042
2450295.13675	+16.519	1.781
2450308.07385	+17.792	1.032

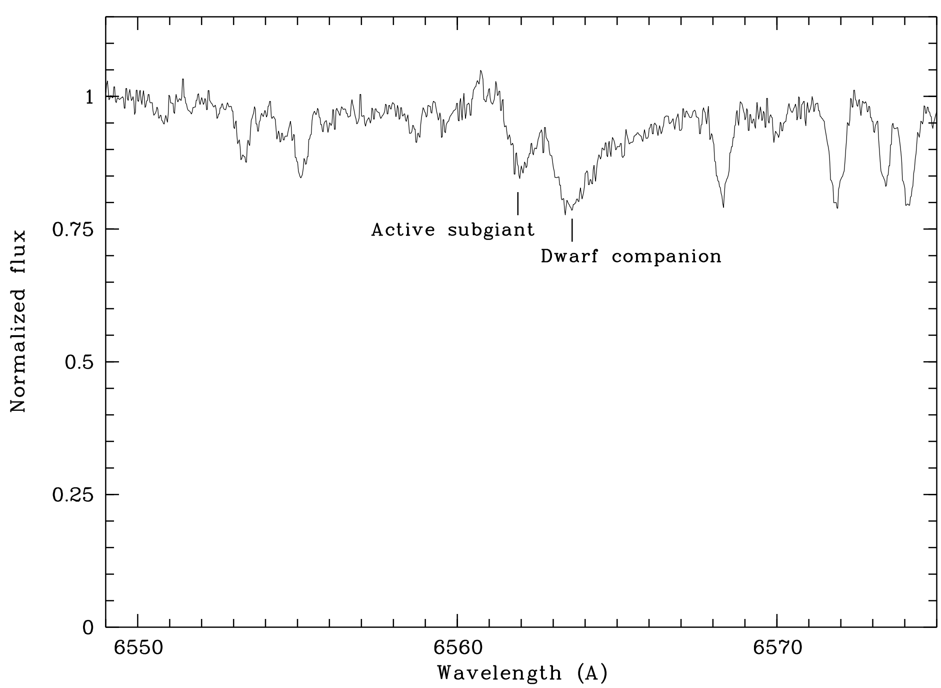

Figure 3. High-resolution spectrum of the Hα line of HD 6628, obtained at MJUO, 1995 July 17.

Table 2: Orbital parameters of HD 6628 as computed by the *Orbsol* program

Parameter	Value
P (days)	27.3316 ± 0.0079
γ (km/s)	18.38 ± 0.59
K (km/s)	13.99 ± 0.80
e	0.293 ± 0.026
Ω (°)	116.1 ± 4.0
Mass function ($M_\odot$)	0.078 ± 0.012
$a \sin i$ (Gm)	11.49 ± 0.30

A high-resolution Hα spectrum (Figure 3), obtained at orbital phase 0.08 referred to Figure 2, shows the red wing of an Hα absorption line having a radial velocity approximately 70–80 km/s greater than that of the metallic lines of the spectrum (-17.814 km/s) and, blueward of it, emission almost filling in a second absorption line. The radial velocity of the latter is measurable only very imprecisely, but it is of the same order as that of the metal-lines spectrum, and confirms that the observed metal lines and the Hα emission belong to the G5 IV subgiant. The unfilled-in red absorption wing has a profile characteristic of an F-type dwarf and is attributed to the companion star.

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PHOTOELECTRIC BVI$_C$ OBSERVATIONS AND NEW ELEMENTS FOR THE CEPHEID CU ORIONIS

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CU Ori is listed in the GCVS-IV as a classical Cepheid with a period of 2.15993 days. We included the star in our program of photoelectric observations for Cepheids because only 10 VR_c observations of the star were published previously (Schmidt *et al.* 1995). CU Ori was observed at Cerro Tololo Inter-American Observatory during September-November 1996 using the 1.0-m reflector, and at the South African Astronomical Observatory during the period December 1997 to January 1998 using the 0.5-m reflector. A total of 35 observations were obtained in BVI_c (Table 1), the accuracy of the individual data being near $\pm 0\overset{m}{.}01$ in all filters.

Table 1

JD hel 2450000+	Phase	V	$B-V$	$V-I_c$	JD hel 2450000+	Phase	V	$B-V$	$V-I_c$
355.8716	.557	13.700	1.167	1.435	393.7030	.854	13.592	1.068	1.399
358.8562	.158	13.271	1.057	1.269	394.6983	.388	13.597	1.106	1.425
361.8696	.775	13.731	1.131	1.437	808.3986	.347	13.542	-	1.392
362.8693	.312	13.533	1.063	1.385	809.3141	.838	13.661	-	1.381
363.8658	.846	13.603	1.057	1.391	810.3160	.376	13.602	-	1.391
379.7357	.361	13.563	1.103	1.369	810.4641	.455	13.688	-	1.437
380.7240	.891	13.485	1.009	1.340	811.3424	.926	13.394	-	1.285
381.7240	.427	13.647	1.168	1.430	811.5289	.026	13.309	-	1.276
382.7284	.966	13.376	1.068	1.302	812.3132	.447	13.654	-	1.410
383.7261	.502	13.735	1.093	1.469	812.4479	.519	13.724	-	1.442
384.7212	.035	13.307	0.960	1.300	813.3067	.980	13.329	-	1.253
386.7188	.107	13.269	0.956	1.289	814.4576	.598	13.773	-	1.469
387.7222	.646	13.915	1.162	1.543	815.3903	.098	13.352	-	1.289
388.7491	.197	13.403	0.990	1.337	815.4902	.152	13.318	-	1.272
389.7454	.731	13.780	1.154	1.485	816.3347	.605	13.742	-	1.435
390.7410	.265	13.484	1.066	1.370	816.4850	.685	13.795	-	1.461
391.7190	.790	13.737	1.114	1.437	817.3639	.157	13.378	-	1.311
392.7099	.322	13.532	1.044	1.400					

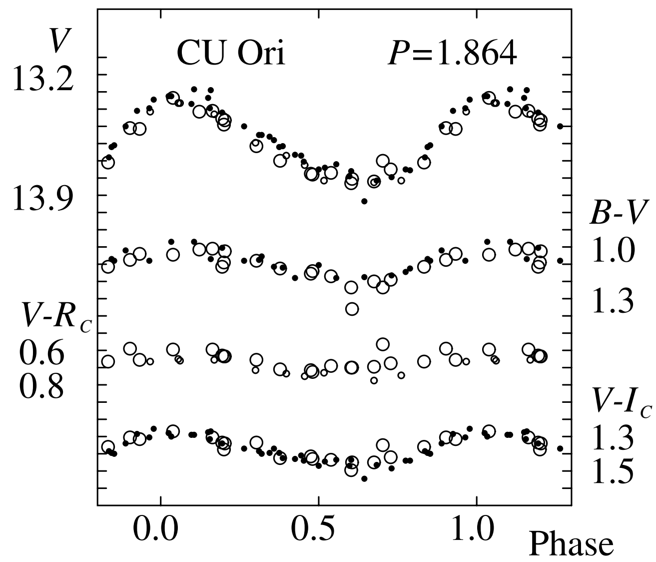

Figure 1.

After our observations of CU Ori began, Henden (1996) published $BV(RI)_c$ measurements of the Cepheid and noted that its period is 1.863832 days. We therefore analysed all existing observations by Hertzsprung's method; the derived epochs of light maximum are given in Table 2.

Table 2

Max JD hel 2400000+	Uncertainty	E	$O-C$	Number of observations	Reference
48574.9533	±0.0116	−600	−0.0006	10	Schmidt et al. (1995)
49003.6425	±0.0104	−370	0.0001	17	Henden, 1996
50381.0391	±0.0064	369	0.0020	18	This paper
50813.4517	±0.0117	601	−0.0017	15	This paper

The times of light maximum were introduced into a linear least-squares program that resulted in the following improved ephemeris:

$$\text{Max JD}_{hel} = 2449693.2717 + 1.8638630 \times \text{E}.$$
$$\pm\ 0.0009\ \pm\ 0.0000019$$

This ephemeris was used to calculate the phases in Table 1 and the $O-C$ values in Table 2, as well as for plotting the light and colour curves in Figure 1, where dots represent our observations, small circles represent observations by Schmidt *et al.* (1995), and large circles represent observations by Henden (1996).

The research described here was supported in part by the Russian Foundation of Basic Research and the State Science and Technology Program "Astronomy" to LNB and through NSERC Canada to DGT. We would also like to express our gratitude to the administrations of SAAO and CTIO for allocating a large amount of observing time.

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BV PHOTOMETRY OF ECLIPSING BINARY BLUE STRAGGLERS IN THE GLOBULAR CLUSTER NGC 5466

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Name of the object:
Blue stragglers NH 19, NH 30, NH 31 in the globular cluster NGC 5466.

Equatorial coordinates:	**Equinox:**
R.A.= $14^h03^m\!.2$ **DEC.=** $+28°46'$	1950

Observatory and telescope:
The images were obtained with the No. 1 0.9-meter telescope at Kitt Peak National Observatory.

Detector:	The 800 × 800 TI#2 CCD with a pixel scale of 0.43 arcsec (1991) and the 2048 × 2048 T2KA CCD with a pixel scale of 0.69 arcsec (1992, 1993, 1995, 1997).

Filter(s):	The Harris B and V filters were used, with an exposure times of 300 s for the V frames and 500 s for the B frames.

Comparison star(s):	Four stars in the field were selected as local magnitude standards for relative photometry, (185, 272, 276, and 281 Buonanno et al. 1984).

Transformed to a standard system:	UVB
Standard stars (field) used:	Twenty-nine standard stars selected from Landolt (1983) with a range in (B–V) from −0.186 to +2.527 mag were observed.

Availability of the data:
Electronically as 4619-t1.txt

Type of variability:	Eclipsing binary

Remarks:
We present a new photometric study of the three eclipsing blue stragglers in NGC 5466 identified by Nemec and Harris (1987). The images used in this study were obtained during May 1991, May 1992, April 1993, June 1995, and June 1997. The raw data frames were processed and reduced following standard procedures using ALLSTAR in DAOPHOTX in IRAF. Light curves based on the Mateo et al. (1990) periods were used to obtain O–C diagrams and new periods were determined from these. ALLSTAR magnitude errors were variable from frame to frame with the 1991 data having in general smaller errors. The average magnitude errors were about 0.027 for NH 19, 0.038 for NH 30, and 0.020 for NH 31. The resulting ephemerides are: NH 19 0.342146 ± 0.000001 day, epoch 2448382.886 ± 0.003 days; NH 30 0.297536 4± 0.000001 day, epoch 2448380.764 ± 0.006 day; and NH 31 0.511327 ± 0.000001 day, epoch 2448383.787 ± 0.005 day. The finding chart is published in Nemec and Harris (1987).

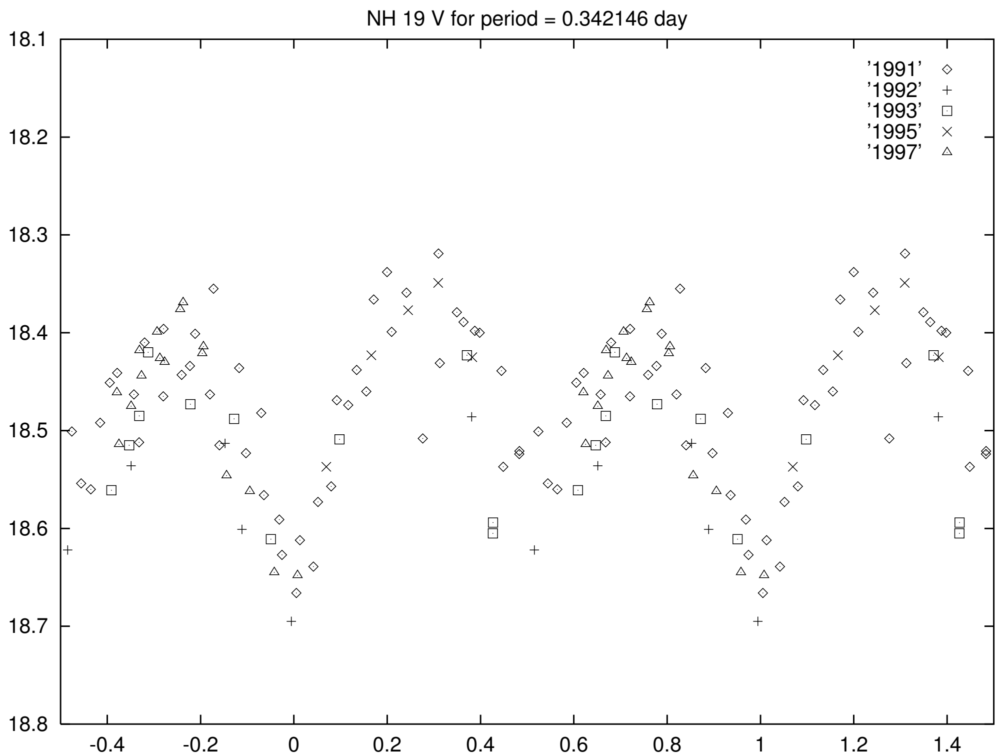

Figure 1.

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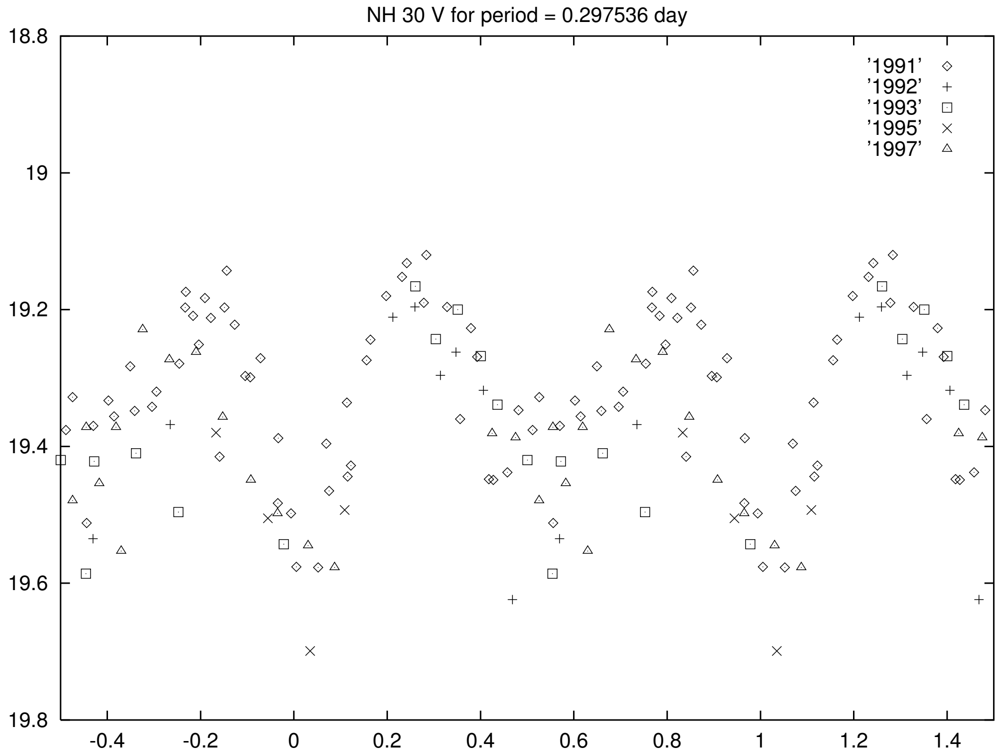

Figure 2.

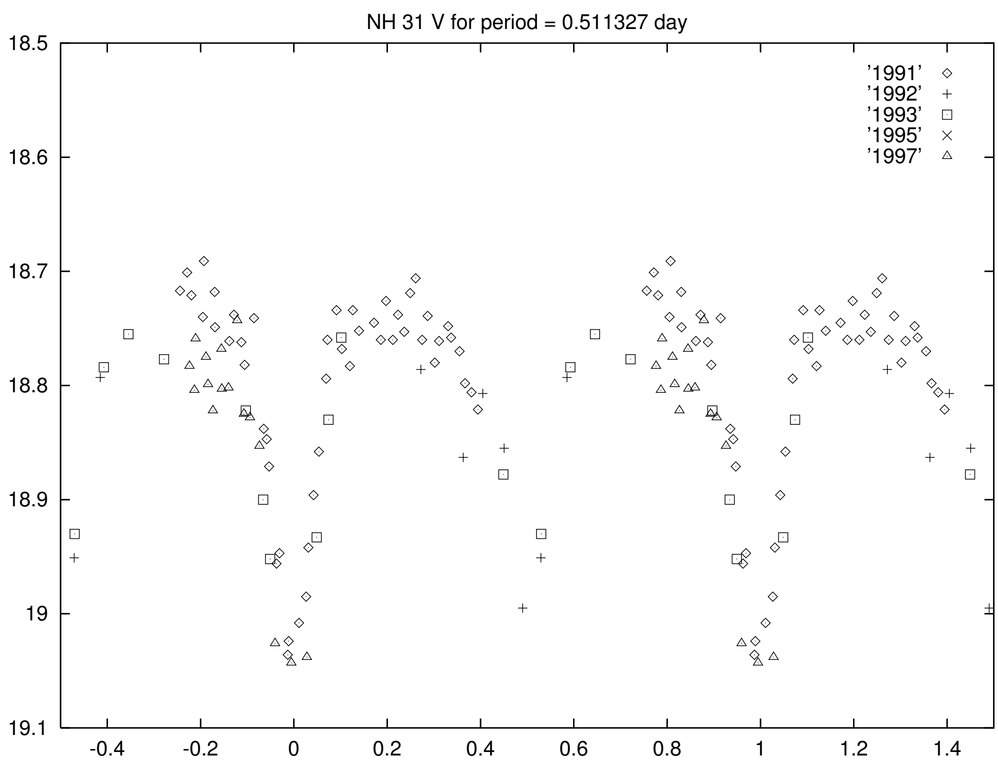

Figure 3.

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PERIOD DETERMINATIONS FOR THE RRc VARIABLE CI COMAE BERENICES

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The variability of CI Comae Berenices = S 9780 = GSC 872.326 (α_{J2000} : $12^{\rm h}14^{\rm m}11\overset{\rm s}{.}3$; δ_{J2000} : $+14°01'50''$) was discovered by Hoffmeister (1967). He found a possible RR Lyrae nature and gave two approximate moments of maximum light based on photographic plates. Splittgerber (1979), from another study employing the photographic plates secured at Sonneberg Observatory, Germany, could not determine a period of variation, but he mentioned a possible EW classification. No further source of information was found through a bibliographical search with the SIMBAD data base.

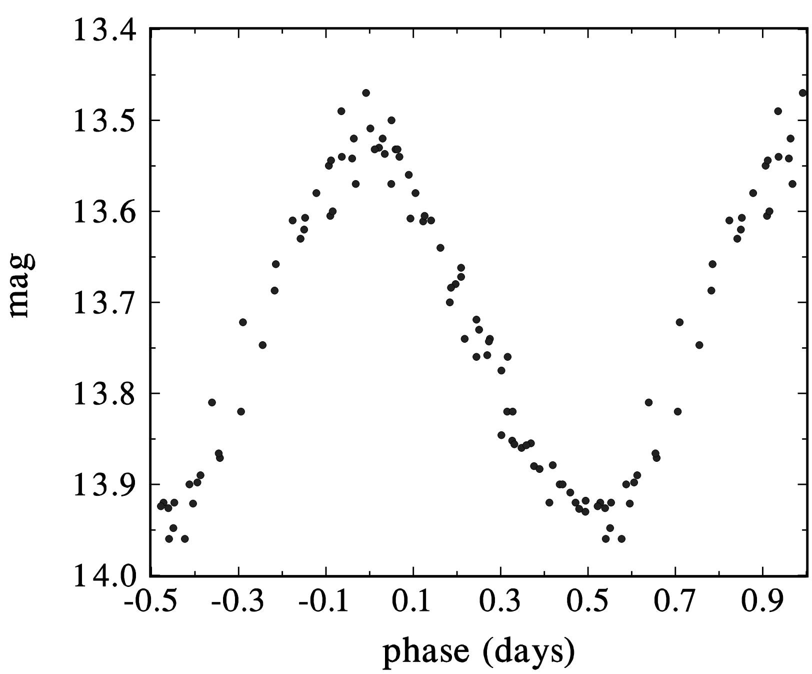

Figure 1. CCD light curve of CI Comae Berenices using the elements (1)

We have observed CI Com with a SBIG ST-6 CCD camera attached to the 0.35 m S-C-telescope of the R. Szafraniec Observatory at Metzerlen, Switzerland. GSC 872.598 (GSC magnitude: 11.29) served as comparison star, while GSC 872.499 was used as check star. Both these stars turned out to be constant at the $0.^{m}02$ level. A total of 84 CCD measurements (without using a filter) during 17 nights from JD 2450895 to JD 2450988 have been obtained. Due to the proximity of the comparison stars to the variable, no correction for differential extinction was applied to the data.

These measurements were subjected to a period search algorithm. For this purpose, we employed the program "Period98" written by Sperl (1998). With the highest peak corresponding to a frequency of $P^{-1} = 2.77799$ our measurements can be represented to within the accuracy of the photometry ($0.^{m}03$). The following elements of variation are found:

$$\mathrm{JD}(max, hel) = 2450925.467(10) + 0.359972(3) \times E \qquad (1)$$

In Figure 1, we show all our CCD data folded with the elements (1).

The slight asymmetry of the light curve as well as the range of variation ($13.^{m}51 - 13.^{m}95$) and the value for the period leads us to classify CI Com as an RRc type pulsating variable. Since no information on the colour variation is available, this conclusion is in need of confirmation.

This research has made use of the SIMBAD data base operated by the CDS, Strasbourg, France. The CCD photometry at the R. Szafraniec Observatory is supported by the "Emilia Guggenheim-Schnurr Foundation".

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PHOTOELECTRIC MINIMA OF SELECTED ECLIPSING BINARIES

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Nine new times of minima have been obtained photoelectrically for VW Cep, RZ Tau, V1073 Cyg, AG Vir and AI Dra at the Prince George Astronomical Observatory in the years from 1988 to 1998.

The AB component of the triple system VW Cephei is an eclipsing contact binary (W UMa type) that has been well studied in the last seventy-five years but requires constant monitoring because of its many period changes (Frasca et al. 1996, Jay & Guinan 1997). RZ Tau and V1073 Cyg are also contact binaries (Morris & Naftilan 1997 and Sezer 1996 resp.) whose periods may also be subject to change. AG Vir is a near contact binary (Shaw et al. 1996) and AI Dra is an Algol-type eclipsing binary (Singh et al. 1996).

Observations were made with either a 1978 vintage Celestron-8 (20 cm f/10 Schmidt-Cassegrain) or a 24″ (61 cm) classical cassegrain operating at either f/15 or f/12. (The 24″ telescope operated from 1984-88 at f/15. After the secondary mirror was stolen, the observatory in 1993 was relocated and a new secondary installed whereupon the 24″ operated at f/12. The observatory is located at 123°50′51.″5 W, 53°45′28.″9 N).

The photometer used was either an OPTEC SSP-3 or a SSP-5a; both use analogue-to-digital electronics. The former utilizes a solid-state detector; the latter an uncooled Hamamatsu R1414 side-on photometer tube with a S-5 spectral response. The UBV filters match closely the standard Johnson filters. Instrumental magnitudes only (uncorrected for differential extinction and not transformed to the standard system) were used for determining the times of minimum. For each instrument, a 1 mm pinhole was used, corresponding to 103 arc seconds for the C-8, and 22.5 and 27.6 arc seconds for the 24″ (for f/15 and f/12 respectively). In most cases, the filter was chosen that gave the greatest signal-to-noise ratio (usually B). Software written by the author (available gratis to OPTEC SSP users) records data, moves the filter slider, automatically reduces the raw data and displays a light curve on-line (with error estimates).

At all times, the object sequences sCVCs or sCVVCs (where s=sky, C=comparison and V=variable) were used.

The selection of comparison stars followed the recommendations of Henden & Kaitchuck (1982), page 208 or, in the case of RZ Tau and V1073 Cyg, previously used comparisons.

All data were plotted on a spreadsheet and a parabola fitted by least-squares. Points were rejected due to recorded errors such as the star slipping out of the pinhole, the appearance of thin cloud or aurora. Nevertheless, occasional obviously discordant points appeared due to unknown problems (such as undetected thin cloud); these were rejected.

Observations too close to advancing dawn were also found to be discordant possibly due to the fact that the linear interpolation that the software uses to calculate the sky contribution is inadequate in this situation (sky brightness rise at dawn appears to be roughly exponential).

After the least squares parabola was plotted with the data, adjustments were made to the parameters to see if the fit could be improved visually. (In this case, corrections were always less than 0.001 days.) To estimate the error, the time of minimum was adjusted until an obvious bad fit was seen; the difference in times of minimum was taken as the error.

In some cases, the method of Kwee & van Woerden (1956) was also used. Then, the actual values of the times of minimum by this method did not differ from those obtained by quadratic fitting by more than the estimated errors.

Table 1

Date (UT)	Star	Comparison	Fil.	Telesc.	Phot.	Minimum HJD$_\odot$ −2 400 000	Est'd Error (days)	Type I = Prim II = Sec.
88-07-20	VW Cep	SAO 9911	V	24″f/15	SSP-3	47 362.8616	0.001	II
90-09-26	VW Cep	SAO 9911	B	C-8	SSP-5a	48 160.7786	0.001	II
90-09-26	VW Cep	SAO 9911	V	C-8	SSP-5a	48 160.7777	0.001	II
91-05-19	VW Cep	SAO 9911	B	C-8	SSP-5a	48 395.8080	0.001	I
98-02-28	RZ Tau	GSC 1270 970	B	24″f/12	SSP-5a	50 872.8051	0.002	II
98-05-27	AG Vir	SAO 99924	V	24″f/12	SSP-5a	50 960.8170	0.003	II
98-06-04	V1073 Cyg	SAO 71340	V	24″f/12	SSP-5a	50 968.8565	0.002	I
98-07-07	V1073 Cyg	SAO 71340	V	24″f/12	SSP-5a	51 001.8627	0.0005	I
98-07-28	AI Dra	SAO 30200	B	24″f/12	SSP-5a	51 022.7949	0.0005	I

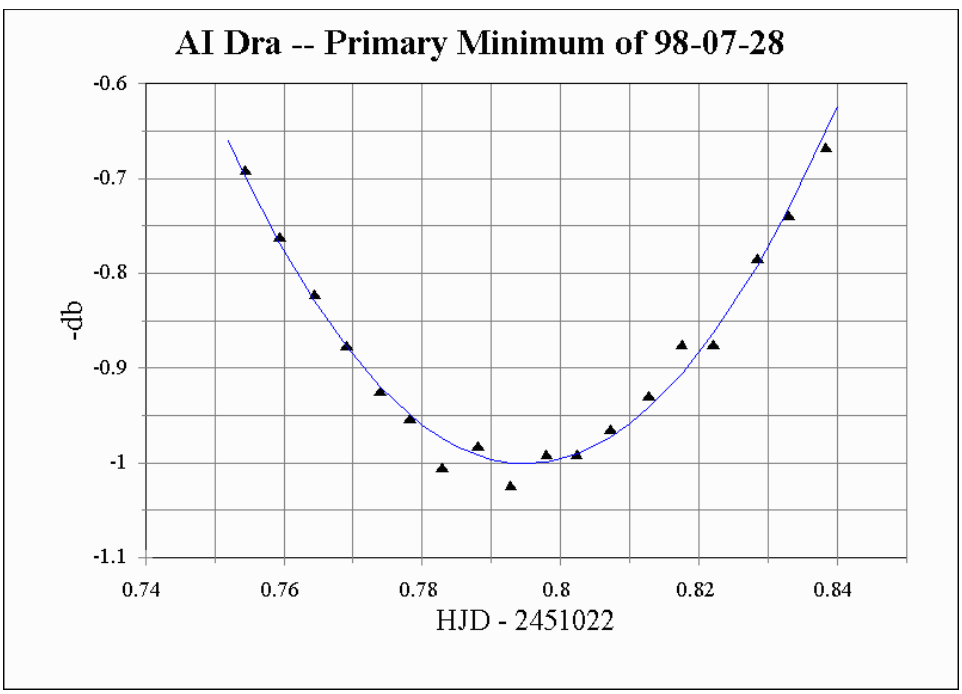

Figure 1.

The light curve for the last star (AI Dra) is shown in Figure 1.

Nine times of minimum have been successfully obtained for five stars yielding information about period changes. The described procedure is vitally dependent upon photometric skies, which are not often obtained in Prince George. A differential technique, such as the RADS system at the University of Calgary (Milone et al. 1982) or CCD photometry on fainter stars (getting both the variable and comparison in one field) would yield data on less than photometric nights (all too common at this location).

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S 10943 VULPECULAE: A NEW ROSAT SELECTED DWARF NOVA, PROBABLY OF SU URSAE MAJORIS SUBCLASS

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As part of our program of investigating the long-term optical behaviour of selected ROSAT X-ray sources we studied the X-ray source RX J1953.1+2115 in more detail. It was discovered during a 360 sec. scanning observation on Oct. 18–20, 1990 during the ROSAT all-sky survey at a mean count rate of 0.024±0.006 cts/sec. The hardness ratios HR1 = $(N_{52-201} - N_{11-41})/(N_{11-41} + N_{52-201})$ = 1.00±0.30 (where N_{a-b} denotes the number of counts in ROSAT's position sensitive proportional counter between channel a and channel b) and HR2 = $(N_{91-200} - N_{50-90})/N_{50-200}$ = –0.17±0.38, though admittedly purely constrained due to the low number of counts, suggest a moderately hard, but absorbed spectrum. Assuming a thermal bremsstrahlung spectrum with kT = 2 keV, the unabsorbed flux in the 0.1–2.4 keV band ranges between 2×10^{-13} erg/cm^2/s (for an assumed absorbing column of $N_{\rm H}=1\times10^{20}$ cm^{-2}) up to 1.5×10^{-12} erg/cm^2/s (for the maximum galactic column in this direction of $N_{\rm H}=4.9\times10^{21}$ cm^{-2}).

The best-fit X-ray position of RX J1953.1+2115 was determined as RA = $19^{\rm h}53^{\rm m}05\overset{\rm s}{.}4$, Decl. = $+21^\circ14'31''$ (equinox J2000.0) with an error radius of $30''$. The Palomar Observatory Sky Survey prints revealed 17 objects within this X-ray error radius which were tested for variability on 250 archival plates of the Sonneberg 400 mm astrograph (limiting magnitude $\sim 18^{\rm m}$) and on 190 plates of the 170 mm triplet cameras (limiting magnitude $\sim 16\overset{\rm m}{.}5$). All these 17 objects proved to be constant (or always invisible on archival plates) within the error of photometry with the exception of one ($\approx 19^{\rm m}$) slightly blue object heavily blended by a $16^{\rm m}$ object only $6''$ to the East (see Fig. 1). Due to the clear variability exhibited by this object, it is assigned the number S 10943 in the series of variable stars detected at Sonneberg Observatory.

S 10943 shows outbursts up to $15^{\rm m}$ with a rather stable recurrence time of 83.6 days. Table 1 gives a comprehensive summary of all the outbursts found on the Sonneberg photographic plates. Shorter (less than 60 days) and longer (about 100 days) intervals are occasionally found, but are rare. Because of the sporadic distribution of observations and the blending already mentioned, the duration of the outbursts is difficult to estimate, but both short (< 10 days) and long (> 20 days) outbursts seem to occur. A plate from Sep. 28, 1967 shows the object at a probable rise to a superoutburst the evolution of which could be followed on 7 plates. On Oct. 28, i.e. 30 days later, the minimum brightness was not yet reached. A series of 24 exposures, taken between 1995 May 1 and May 4, cover the early decline ($15^{\rm m}$) of a long duration outburst, which was not yet complete on May 21 (still about 1 mag above minimum light). During those 4 days periodic brightness fluctuations of small amplitude (0.2 mag) are superimposed on a steady brightness decrease of about 0.1 mag per day which may be interpreted as superhumps of an SU Ursae Majoris star. The period length was determined to be P=$0^{\rm d}\!.1196 \sim 2^{\rm h}\!.871$. Two alternative values are also possible, but with smaller probability: P=$0^{\rm d}\!.136$ and P=$0^{\rm d}\!.107$. With the superhump periods being as a rule about 2-3% longer than the orbital periods, we may expect an orbital period near $2^{\rm h}\!.8$ which is just at the upper border of the well-known period-gap of cataclysmic variables.

Table 1. Observed eruptions (r = rise, m = maximum, d = decline)

J.D.	m_{pg}		J.D.	m_{pg}		J.D.	m_{pg}	
2427710.318	16.5	d ?	2438378.251	16.0:	d	2448888.395	15.9	
9102.537	16.5:	r	9003.400	16.2		9163.470	15.8	
9107.428	15.6:	d	9347.405	17.0:	d	9504.464	15.6	r ?
9541.313	16.1		9349.405	17.0:	d	9511.554	17.1:	d
9777.455	16.8		9762.358	16.6:	r	9839.521	14.9:	d
9843.411	16.5:		9765.310	16.0	d	9839.535	15.8:	d
2430442.616	15.0:	m	9765.381	15.9	d	9839.550	15.3	d
0614.354	15.0:	m	9767.297	16.0	d	9840.505	15.6	d
0848.512	16?		9789.261	17.7:	d	9840.523	15.4	d
1020.311	16?		9789.304	17.3	d	9840.542	15.3	d
1296.418	16.2	r	9792.287	17.3:	d	9840.560	15.4	d
1296.455	16.0	r	2441917.367	15.7	d	9840.577	15.3	d
1297.417	15.8	m	1917.430	15.8	d	9841.471	15.4	d
3160.431	15.6?		2369.235	16.0		9841.493	15.3	d
6073.424	16.4		4132.340	16.9		9841.508	15.4	d
6672.573	15.8		4132.359	16.8		9841.523	15.4	d
6815.373	16.8		6683.403	16.8	r ?	9841.537	15.4:	d
7193.355	16.6:		6699.339	15.6	d	9841.552	15.4	d
7576.444	16.6:		6707.392	16.7	d	9841.567	15.6	d
8268.386	18:	r	6708.390	16.4	d	9841.581	15.5	d
8282.326	17.9:	d	7365.493	16.3	d	9842.467	15.4:	d
8282.368	17.9:	d	7379.417	17.3:	d	9842.482	15.7	d
8283.327	17:	d	7381.428	17.1	d	9842.497	15.5	d
8283.369	17.8:	d	7411.376	15.9	m	9842.511	15.7	d
8284.364	18:	d	7717.466	17.1:		9842.526	15.7	d
8367.229	17:	r	7822.323	15.7	d	9842.540	15.7	d
8370.241	15.9:	d	7823.260	15.9	d	9842.555	15.7	d
8371.224	16.3	d	8096.448	16.8:	d	9842.569	15.4	d
8371.266	16.1:	d	8097.506	17.3:	d	9859.485	17.3	d
8372.257	16.1:	d	8804.472	17.0				

TU Mensae ($P_{\rm SH}=0^{\rm d}\!.1262$; Ritter & Kolb 1998) is the only other SU Ursae Majoris star with such a long period. The absolute magnitude of TU Men during minimum brightness is $M_{\rm V}$=8.8 (Warner, 1987). Assuming a similar absolute magnitude for S 10943 and using the apparent brightness during minimum of $m_{\rm V} = m_{\rm B} = 19^{\rm m}\!.0$ we derive an apparent distance modulus of 10.2 mag. S 10943 is situated at the border between area 1 ($19^{\rm h}\!.6 <$ RA $< 19^{\rm h}\!.9$; $+15° <$ Decl. $< +25°$) and area 3 (R.A. $> 19^{\rm h}\!.9$; $+15° <$ Decl. $< +24°$) for which Richter (1968) estimated the mean value of interstellar dust extinction to be

2.0 and 1.4 magnitudes, respectively. The corresponding distance is 440 pc and 600 pc, respectively. Alternatively, we can use the relation between orbital inclination and absolute magnitude for a comparison of the absolute magnitude of TU Men and S 10943. With i = 65° for TU Men, and assuming as an extreme (conservative) case i = 0° for S 10943 (the lack of eclipses on our plates suggests i $\lesssim$ 70°), the difference of the absolute magnitude is

$$\triangle M_{\rm V}(i) = -2.5 \times \log(1 + 3/2 \times \cos i) \times \cos i$$

(see e.g. formula 4 in Warner (1987), or also Paczynski & Schwarzenberg-Czerny (1980)). This results in a distance modulus of 11.0 mag, or 580 pc and 700 pc, respectively. We therefore conclude that the most likely distance of S 10943 will be in the range of 400–700 pc. At this distance the implied X-ray flux of 6.2×10^{30}–5×10^{31} (D/500 pc)^2 erg/s is well within the range of other SU UMa systems (van Teeseling *et al.* 1996).

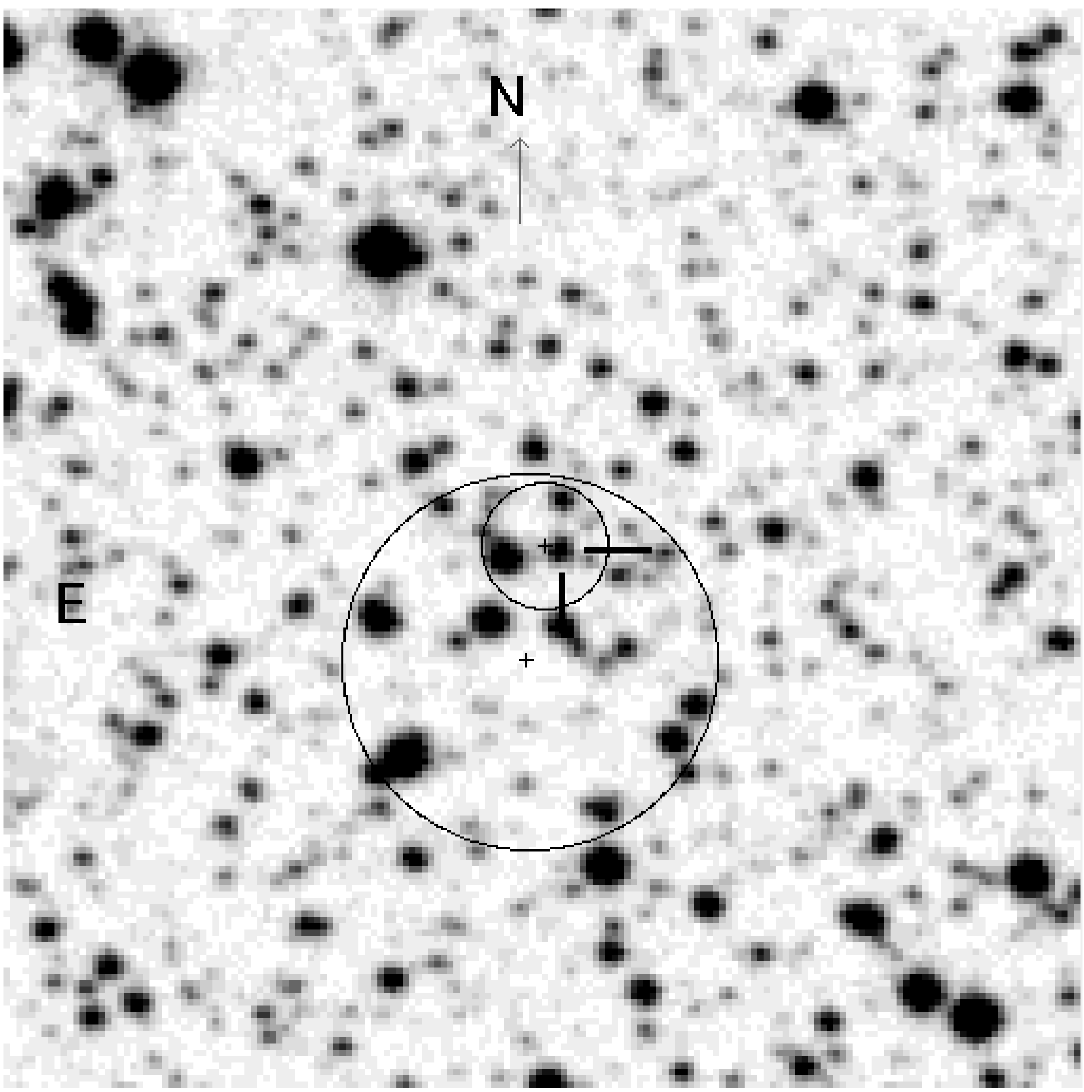

Figure 1. A 3′ by 3′ part of the digitized sky-survey image (based on the red passband plate SF04200 taken on 9 Sep 1991) with the X-ray error circles of the ROSAT all-sky survey position (large circle; 30″ radius) and the HRI pointed observation (small circle; 10″) overplotted. S 10943 Vul is marked by two heavy dashes.

The association of RX J1953.1+2115 with S 10943 Vul has been strengthened by the results of a recent ROSAT HRI observation. In the 6310 sec exposure on April 22–25, 1998 RX J1953.1+2115 was detected at a count rate of 0.0068±0.001 cts/s which is consistent with the count rate during the ROSAT all-sky survey in 1990 given the factor 3 lower sensitivity of the HRI as compared to the PSPC for X-ray sources with hard X-ray spectra. This detection allowed an improved determination of the X-ray position of RA = $19^h53^m05\overset{s}{.}2$, Decl. = $+21°14'50''$ (equinox J2000, $\pm10''$). The coordinate of S 10943 Vul as measured on the Palomar blue print is RA = $19^h53^m05\overset{s}{.}0$, Decl. = $+21°14'49''$ (equinox J2000, $\pm1''$), and thus is within $3''$ of the X-ray position. Fig. 1 shows the position of S 10943 Vul relative to the two X-ray positions.

Thus, if the orbital period is confirmed, S 10943 would then be, together with TU Men, the SU Ursae Majoris star with the second longest superhump (and orbital) period known.

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GSC 223:1761 - A NEW DELTA SCUTI VARIABLE STAR IN CANCER

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On UT 98 March 13 (JD 2450885.5), images using the 0.61 m telescope at the US Air Force Academy (USAFA) and a liquid nitrogen cooled 512x512 Photometrics CCD were taken of the asteroid 583 Klotilde to determine the asteroid's rotational period (Burtz and Wetterer 1998). Differential photometry between Klotilde and comparison stars within the same field of view revealed that one of the comparison stars (GSC 223:1761) was varying with an amplitude of $\delta R < 0.1$ magnitudes and a period of about 2 hours.

The General Catalog of Variable Stars (Kholopov et al. 1985-88) and subsequent namelists (Kholopov et al. 1985, 1987, 1989; Kazarovets and Samus 1990, 1995, 1997; Kazarovets et al. 1993) were searched and this star has not been previously identified as variable. Figure 1 is a finder chart made from a scan of the Palomar Digitized Sky Survey and identifies the variable star (GSC 223:1761) and the two comparison stars used (GSC 223:1066 and GSC 223:592). GSC 223:1761's 2000.0 coordinates are $8^h38^m09^s.7$ and $+7°13'33''$, obtained from the Hubble Space Telescope Guide Star Catalog (GSC). The GSC lists a magnitude of 11.27 ± 0.40 for this star.

Subsequent observations at USAFA were made to better define the star's type and period with the 104 HJDs (minus 2450000) and instrumental R magnitudes listed in Table 1. The data from UT 98 Mar 13 (JD 2450885.5) was continuous with three maxima and two minima and indicates a period of 0.087 ± 0.007 days, although other lower amplitude periods are likely due to the variations in minimum and maximum light from cycle to cycle. By visually inspecting composite lightcurves using periods from 0.080 to 0.0 95 days and all four nights of data, this period was refined to 0.08735 ± 0.00003 days (2.0964 ± 0.0007 hours). The observed amplitude of $\Delta R = 0.084 \pm 0.004$ corresponds to the full range of all observations. The composite lightcurve using this period is shown in Figure 2. The period, amplitude, and lightcurve characteristics are consistent with a designation as a Delta Scuti type variable star.

Acknowledgements. The Digitized Sky Surveys were produced at the Space Telescope Science Institute under U.S. Government grant NAG W-2166. The images of these surveys are based on photographic data obtained using the Oschin Schmidt Telescope on Palomar Mountain and the UK Schmidt Telescope. The plates were processed into the present compressed digital form with the permission of these institutions. The authors also wish to thank Mike Bittenbender and Joel Nelson for help with some of the observations and analysis.

Table 1: R observations of GSC 223:1761

HJD	R	HJD	R	HJD	R	HJD	R
885.61377	11.169	885.71755	11.176	897.75094	11.210	907.59767	11.229
885.61816	11.172	885.72146	11.188	897.75982	11.192	907.60191	11.233
885.62218	11.167	885.72640	11.192	897.76363	11.184	907.60601	11.223
885.62704	11.169	885.73042	11.203	897.76754	11.176	907.63865	11.152
885.63122	11.167	885.73433	11.208	897.77959	11.189	907.64282	11.164
885.63508	11.173	885.73821	11.216	897.78361	11.192	907.64698	11.173
885.63899	11.183	885.74211	11.223	897.78754	11.199	907.65115	11.185
885.64303	11.190	885.74598	11.230	897.79172	11.221	907.67580	11.223
885.64692	11.199	885.74990	11.234	897.80399	11.234	907.67997	11.224
885.65098	11.200	885.75384	11.232	897.80782	11.234	907.68414	11.219
885.65488	11.208	885.75810	11.223	897.81169	11.236	907.68831	11.222
885.65881	11.218	885.76242	11.228	897.81582	11.230	907.70810	11.202
885.66272	11.221	885.76631	11.228	897.82811	11.232	907.71354	11.195
885.66663	11.222	885.77029	11.227	897.83201	11.217	907.71832	11.185
885.67053	11.224	885.77427	11.217	904.65432	11.168	907.72253	11.175
885.67443	11.228	885.77820	11.211	904.65768	11.169	907.74788	11.204
885.67830	11.226	885.78213	11.204	904.66187	11.170	907.75203	11.210
885.68222	11.221	885.78601	11.189	904.66760	11.173	907.75625	11.212
885.68611	11.217	885.78990	11.189	904.67240	11.174	907.76051	11.232
885.68999	11.209	885.79383	11.180	904.67704	11.179	907.77761	11.207
885.69389	11.198	885.79789	11.182	904.68162	11.186	907.78258	11.225
885.69781	11.188	885.80180	11.184	904.68564	11.199	907.78681	11.216
885.70179	11.180	885.80572	11.194	904.69406	11.212	907.79103	11.204
885.70566	11.173	885.80974	11.194	904.69906	11.219	907.81355	11.196
885.70971	11.175	897.73253	11.228	904.70302	11.224	907.81812	11.186
885.71361	11.172	897.73761	11.226	907.59159	11.237	907.82248	11.189

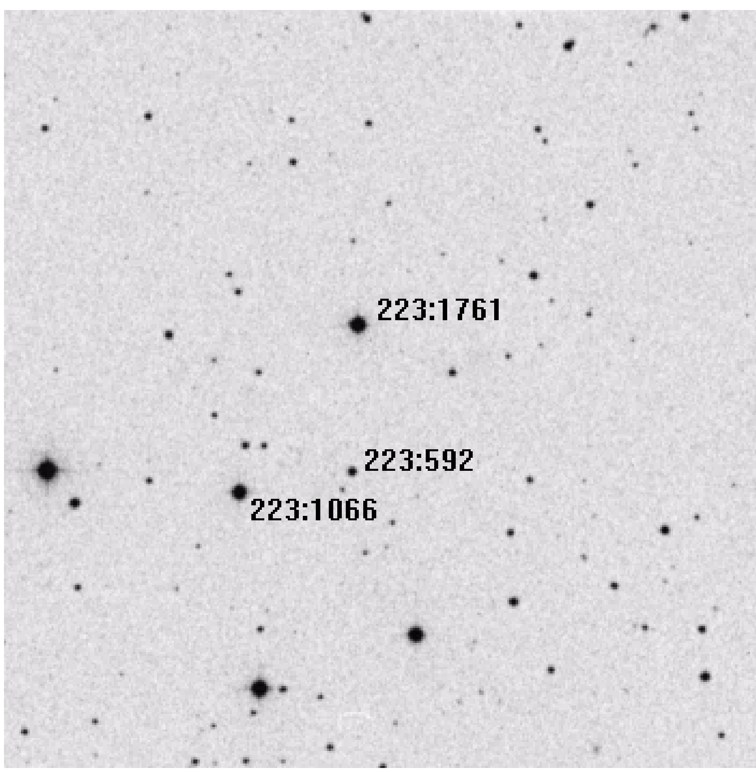

Figure 1. Finder chart for GSC 223:1761 (10′× 10′). North is up and East is to the left

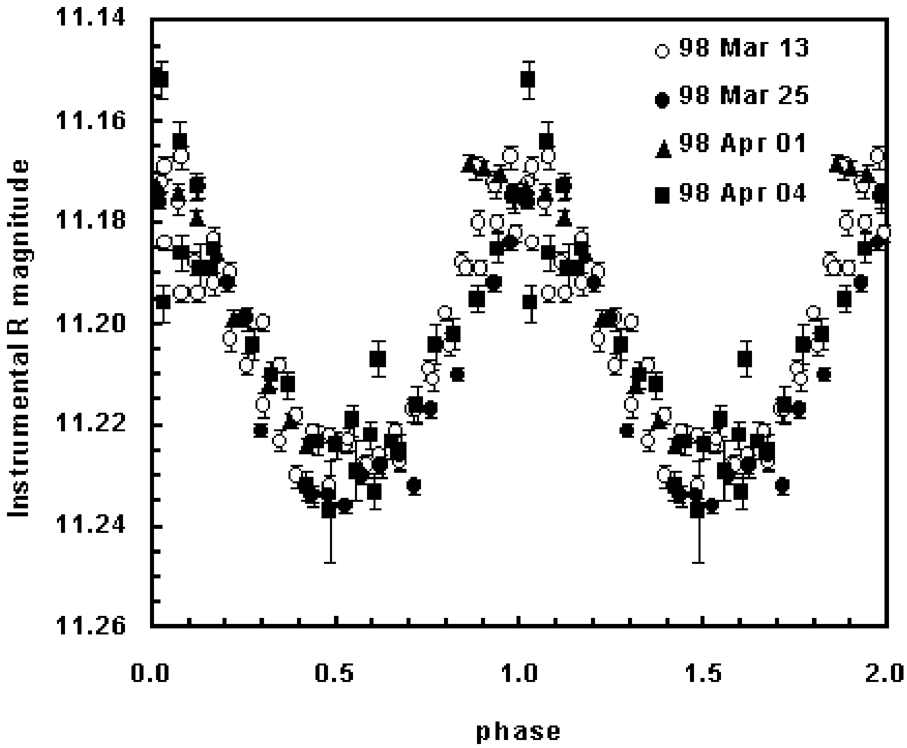

Figure 2. Lightcurve of GSC 223:1761 with 2.0964 hour period

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PERIOD CHANGE IN UV LEONIS

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UV Leo is a detached binary with two main sequence, G2 and G0, components, (Popper 1993, 1995). Period variations have been suspected by Herczeg (1962), Mallama (1980), and Rafert (1982). This prompted a study of all available earlier times of minimum by Snyder & Mattingly (1995). This study included times going back to October 1926 but because of the scatter associated with visual data only photographic and photoelectric times of minimum were used with equal weigh. The times from Oburka (1964) and Soliman, et al. (1985) were plotted but because they were misplaced from the least-squares parabolic fit a comparison was made of the sum-squares with the data deleted and the RMS residuals were improved by 15%, therefore both data were considered to be discordant and were not used in this paper. Wunder (1995) acquired two times of minimum indicating a period change and published data back to February 1949 using photoelectric data only.

Since the Snyder and Wunder papers nineteen new times of minimum have been published (Table 1). Added to this is the most recent unpublished time of 50544.7507 acquired at the MacLean Observatory. These new data have been archived with I.A.U. Comm. 27 Archive for Unpublished Observations of Variable Stars (Schmidt, 1992) and are available as file no. 299E and 338E. The data from the two papers were added to the most recent times and the linear light elements of equation (1) of Rafert (1982) were used to compute the $O-C_1$ residuals:

$$\mathrm{Hel.Min.JD} = 2438440.72525 + 0.600085011 \times E \qquad (1)$$

Figure 1 shows the residual $O-C_1$ plot with a polynomial fit which displays an abrupt increase in the orbital period around 9,000 cycles, JD 2444000. A quadratic fit over the range $-15166 < E < +9000$ compared to the range $+9000 < E < +18352$ gives the magnitude of the period increase of $\Delta P/P = +6.5 \times 10^{-7}$.

The equation for the least-squares fitting in Figure 1 was added to equation (1) to obtain the quadratic ephemeris

$$\begin{array}{l} \mathrm{Hel.Min.JD} = 2438440.72525 + 0.600085011 \times E + 3.02147 \times 10^{-11} E^2 \qquad (2) \\ \qquad\qquad\qquad \pm 0.00026 \quad \pm 0.000000026 \qquad\quad \pm 0.200 \end{array}$$

which was used to compute $O-C$ residuals, which when plotted showed a sine curve. A sinusoidal correction

$$\begin{array}{l} f(e) = (1.855 \times 10^{-3}) \sin (2.577 \times 10^{-4}\ E + 1.959) \qquad (3) \\ \qquad \pm 0.241 \qquad\qquad \pm 0.117 \qquad\qquad \pm 0.091 \end{array}$$

was added to equation (2) and resulted in decreasing the sum of the squares of the residuals by 31%, These O−C values are shown in Table 1 as $O-C_2$ and plotted in Figure 2 with a line representing a fitting of the sine function to the O−C values by least-squares.

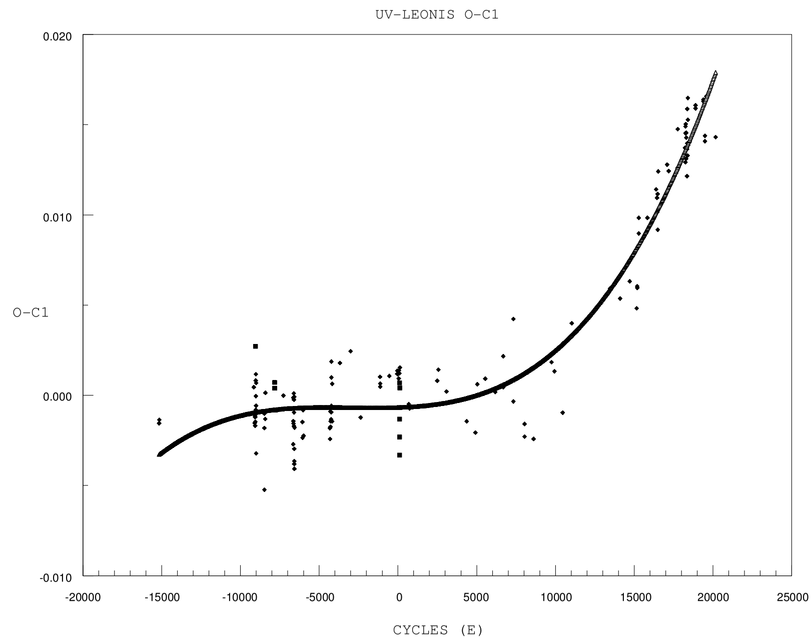

Figure 1. O−C diagram from the linear ephemeris using Equation (1). Solid line is least−squares fit. Diamond symbols = Photoelectric data; Squares = Photographic data

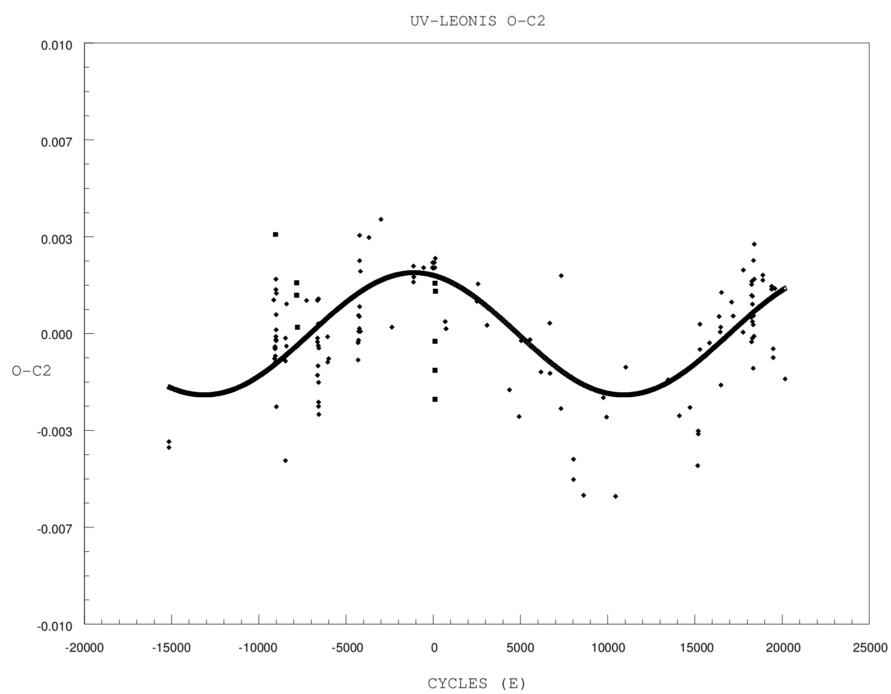

Figure 2. O−C diagram from the quadratic ephemeris with sinusoidal correction, Equation (2). Solid line representing a sine function fitting. Diamond symbols = Photoelectric data; Squares = Photographic data

Table 1

HJD	Ref	E	(O−C)$_1$	(O−C)$_2$	HJD	Ref	E	(O−C)$_1$	(O−C)$_2$
29339.8390	1	−15166.0	−0.0016	−0.0039	38495.6353	2	91.5	0.0012	0.0023
29345.5400	1	−15156.5	−0.0014	−0.0037	38504.3320	:4	106.0	−0.0033	−0.0023
32951.4513	2	−9147.5	0.0005	0.0012	38504.3330	:4	106.0	−0.0023	−0.0013
32981.4535	2	−9097.5	−0.0015	−0.0009	38504.3340	:4	106.0	−0.0013	−0.0003
32995.5559	2	−9074.0	−0.0011	−0.0004	38504.3360	:4	106.0	0.0007	0.0017
32997.3561	2	−9071.0	−0.0012	−0.0005	38512.4380	2	119.5	0.0015	0.0026
32999.4559	2	−9067.5	−0.0017	−0.0010	38513.3370	:4	121.0	0.0004	0.0015
33000.3565	2	−9066.0	−0.0012	−0.0005	38852.3840	2	686.0	−0.0005	0.0004
33006.3571	2	−9056.0	−0.0015	−0.0008	38882.3880	2	736.0	−0.0007	0.0002
33011.4620	:3	−9047.5	0.0027	0.0034	39940.3390	2	2499.0	0.0008	0.0011
33021.3615	2	−9031.0	0.0008	0.0015	39978.4450	2	2562.5	0.0014	0.0017
33024.3602	2	−9026.0	−0.0009	−0.0002	40291.3880	2	3084.0	0.0002	0.0003
33024.3603	1	−9026.0	−0.0008	−0.0001	41060.3950	2	4365.5	−0.0014	−0.0019
33027.3627	2	−9021.0	0.0012	0.0019	41390.4410	2	4915.5	−0.0021	−0.0029
33030.3610	2	−9016.0	−0.0010	−0.0002	41466.3544	2	5042.0	0.0006	−0.0002
33030.3619	2	−9016.0	−0.0001	0.0007	41766.3971	2	5542.0	0.0009	−0.0002
33033.3618	2	−9011.0	−0.0006	0.0001	42147.4502	2	6177.0	0.0002	−0.0013
33039.3600	2	−9001.0	−0.0032	−0.0025	42450.4950	5	6682.0	0.0022	0.0004
33039.3639	2	−9001.0	0.0007	0.0014	42453.4937	2	6687.0	0.0004	−0.0014
33349.3052	2	−8484.5	−0.0018	−0.0009	42838.4473	2	7328.5	−0.0003	−0.0026
33349.3060	1	−8484.5	−0.0010	−0.0001	42839.3520	5	7330.0	0.0042	0.0020
33354.4025	2	−8476.0	−0.0052	−0.0044	43266.3058	6	8041.5	−0.0023	−0.0050
33386.8110	2	−8422.0	−0.0013	−0.0004	43266.3065	2	8041.5	−0.0016	−0.0043
33390.7130	2	−8415.5	0.0001	0.0010	43608.3540	2	8611.5	−0.0024	−0.0056
33740.5630	:3	−7832.5	0.0007	0.0017	44292.4549	2	9751.5	0.0018	−0.0022
33743.5630	:3	−7827.5	0.0004	0.0013	44404.3702	2	9938.0	0.0013	−0.0029
33772.6660	:3	−7779.0	−0.0008	0.0002	44716.4120	2	10458.0	−0.0010	−0.0056
34078.4100	1	−7269.5	0.0000	0.0011	45061.4657	2	11033.0	0.0040	−0.0012
34451.3600	1	−6648.0	−0.0027	−0.0014	46521.4739	2	13466.0	0.0059	−0.0016
34454.3630	2	−6643.0	−0.0001	0.0011	46903.4273	2	14102.5	0.0054	−0.0028
34456.4620	2	−6639.5	−0.0014	−0.0002	47270.3801	2	14714.0	0.0063	−0.0025
34457.3620	2	−6638.0	−0.0016	−0.0003	47538.6165	7	15161.0	0.0048	−0.0045
34475.3660	2	−6608.0	0.0001	0.0012	47557.5204	7	15192.5	0.0060	−0.0034
34477.4640	2	−6604.5	−0.0002	−0.0011	47559.6206	7	15196.0	0.0060	−0.0035
34479.5650	2	−6601.0	−0.0017	−0.0004	47615.4315	2	15289.0	0.0090	−0.0005
34481.3660	2	−6598.0	−0.0010	0.0003	47616.3325	2	15290.5	0.0098	0.0003
34487.3640	2	−6588.0	−0.0038	−0.0025	47945.4790	2	15839.0	0.0098	−0.0003
34488.5650	2	−6586.0	−0.0030	−0.0017	48277.6275	7	16392.5	0.0114	0.0006
34489.4680	2	−6584.5	−0.0001	0.0012	48308.5314	7	16444.0	0.0109	0.0001
34493.3650	2	−6578.0	−0.0036	−0.0024	48332.5350	2	16484.0	0.0112	0.0002
34496.3650	2	−6573.0	−0.0041	−0.0028	48339.4340	7	16495.5	0.0092	−0.0018
34501.4680	2	−6564.5	−0.0018	−0.0005	48358.3399	2	16527.0	0.0124	0.0014
34803.6110	2	−6061.0	−0.0015	−0.0001	48700.3886	2	17097.0	0.0128	0.0011
34808.4108	2	−6053.0	−0.0024	−0.0010	48757.3963	2	17192.0	0.0124	0.0006
34827.3150	2	−6021.5	−0.0008	0.0005	49099.4448	7	17762.0	0.0126	0.0001
34844.4160	2	−5993.0	−0.0022	−0.0009	49103.3475	7	17768.5	0.0148	0.0022
35846.5580	2	−4323.0	−0.0018	−0.0003	49373.9847	8	18219.5	0.0137	0.0006
35850.7580	2	−4316.0	−0.0024	−0.0009	49393.7867	8	18252.5	0.0129	−0.0003
35867.5619	2	−4288.0	−0.0009	0.0006	49395.8886	8	18256.0	0.0145	0.0013
35871.4616	2	−4281.5	−0.0017	−0.0002	49398.8894	8	18261.0	0.0149	0.0017
35873.5622	2	−4278.0	−0.0014	0.0001	49407.8908	8	18276.0	0.0150	0.0018
35895.4654	2	−4241.5	−0.0013	0.0002	49420.7907	8	18297.5	0.0131	−0.0002
35897.5661	2	−4238.0	−0.0009	0.0006	49423.7917	8	18302.5	0.0137	0.0004
35901.4670	2	−4231.5	−0.0006	0.0009	49424.6927	8	18304.0	0.0146	0.0013
35904.4690	2	−4226.5	0.0010	0.0025	49425.8926	8	18306.0	0.0143	0.0010
35905.3700	2	−4225.0	0.0019	0.0034	49453.7944	9	18352.5	0.0121	−0.0012
35934.4708	2	−4176.5	−0.0014	0.0001	49453.7959	9	18352.5	0.0136	0.0003
35935.3730	2	−4175.0	0.0006	0.0021	49462.7975	9	18367.5	0.0140	0.0006
36231.5160	1	−3681.5	0.0018	0.0033	49462.7994	9	18367.5	0.0159	0.0025
36637.4740	1	−3005.0	0.0024	0.0039	49475.3986	2	18388.5	0.0133	−0.0001
37017.3240	2	−2372.0	−0.0012	0.0002	49484.7019	9	18404.0	0.0153	0.0019

Table 1 (cont.)

HJD	Ref	E	(O−C)$_1$	(O−C)$_2$	HJD	Ref	E	(O−C)$_1$	(O−C)$_2$
37758.7310	2	−1136.5	0.0010	0.0023	49484.7031	9	18404.0	0.0165	0.0031
37764.7313	2	−1126.5	0.0005	0.0018	49775.4436	2	18888.5	0.0159	0.0018
37765.6316	2	−1125.0	0.0006	0.0019	49776.3439	2	18890.0	0.0161	0.0020
38111.5809	2	−548.5	0.0011	0.0023	50080.5871	10	19397.0	0.0163	0.0015
38413.7237	1	−45.0	0.0012	0.0023	50080.5872	10	19397.0	0.0164	0.0016
38416.7243	2	−40.0	0.0014	0.0025	50139.3932	10	19495.0	0.0141	−0.0008
38440.7275	2	0.0	0.0012	0.0023	50139.3935	10	19495.0	0.0144	−0.0005
38470.7315	2	50.0	0.0009	0.0020	50190.4029	11	19580.0	0.0166	0.0016
38474.6325	2	56.5	0.0014	0.0024	50544.7507	12	20170.5	0.0143	−0.0016

:Denotes photographic observations. All others photoelectric. Both used with equal weight.

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The sinusoid would suggest a triple system interpreted that the timing residuals are caused by the light-travel time differences as the eclipsing system moves about the barycentre of the triple. The size of the triple system inferred by the light-travel time is a third body orbital period of 40.1 years and the magnitude of the binary's motion about the barycentre of the triple of 0.32 AU. There is no evidence as yet of a third body.

Rotation of the line of apsides is not plausible as a plot of the secondary minima does not show a sinusoidal variation 180 degrees out of phase with the primary and binaries of this short period have circular orbits. A mass transfer mechanism would produce a period change in one direction, increase or decrease, not both. Two other alternative explanations, a magnetic cycle and a starspot wave as explained for such binaries by Hall and Louth (1990) are possible.

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FIRST PHOTOMETRIC OBSERVATIONS AT THE TURKISH NATIONAL OBSERVATORY

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In this short paper, we give some information on the recently founded Turkish National Observatory and report the first photometric observations. After a site-testing observations carried out between 1982 and 1986 (Aslan et al., 1989) the mountain known as Bakırlıtepe near the Mediterranean coast at the latitude $+36°51'$, longitude $-30°20'$, altitude 2485 m, was selected as the National Observatory site, which is about 50 km west of the city of Antalya.

The construction of the Observatory (TUG for short) is practically complete. It is affiliated to TÜBİTAK (Scientific and Technical Research Council of Turkey). Initially TUG will have two telescopes, one of them is a small, 0.4 m Cassegrain telescope, which will be devoted to photometric observations of variable stars. The second telescope is a Ritchey–Chrétien of 1.5 m aperture, which will hopefully see the first light in September 1998. The 1.5 m telescope facility is a joint project between TÜBİTAK, IKI-RAN (Space Research Institute of the Russian Academy of Sciences), and KSU (Kazan State University).

The well-known close binary system W UMa was observed in three colours on 18 January 1997 using a SSP5A photometer attached to the 0.4 m telescope. BD +56°1399 (Hamzaoğlu et al., 1982) and BD +56°1397 were used as comparison and check stars, respectively. The B, V, and R light curves are plotted in Fig. 1. The standard error of a single differential measure does not exceed $0\overset{m}{.}005$ in any colour. The mean extinction coefficients for the night came out to be 0.207 ± 0.004, 0.118 ± 0.002, and 0.074 ± 0.004 in B, V, and R, respectively. The night of the first light turned out to be very good photometrically as can be judged from Figures 1 and 2. We do not yet have observations covering the whole year to assess the photometric quality of the site, but preliminary results suggest that the worst months are April and May. For example, the extinction coefficients obtained on 31 May 1997 are relatively high: they are 0.305, 0.174 and 0.086 in B, V, and R, respectively, and the standard error of one differential measure is 0^m03 in B and R, and 0^m02 in V.

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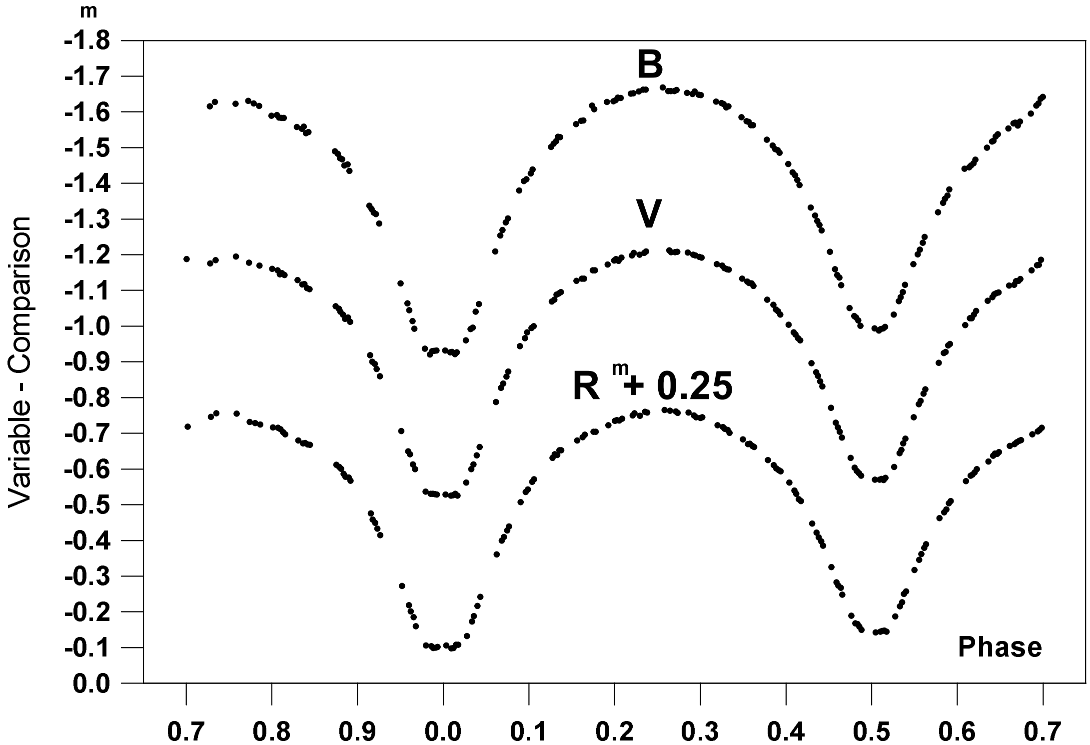

Figure 1. Observations of W UMa in B, V and R bands

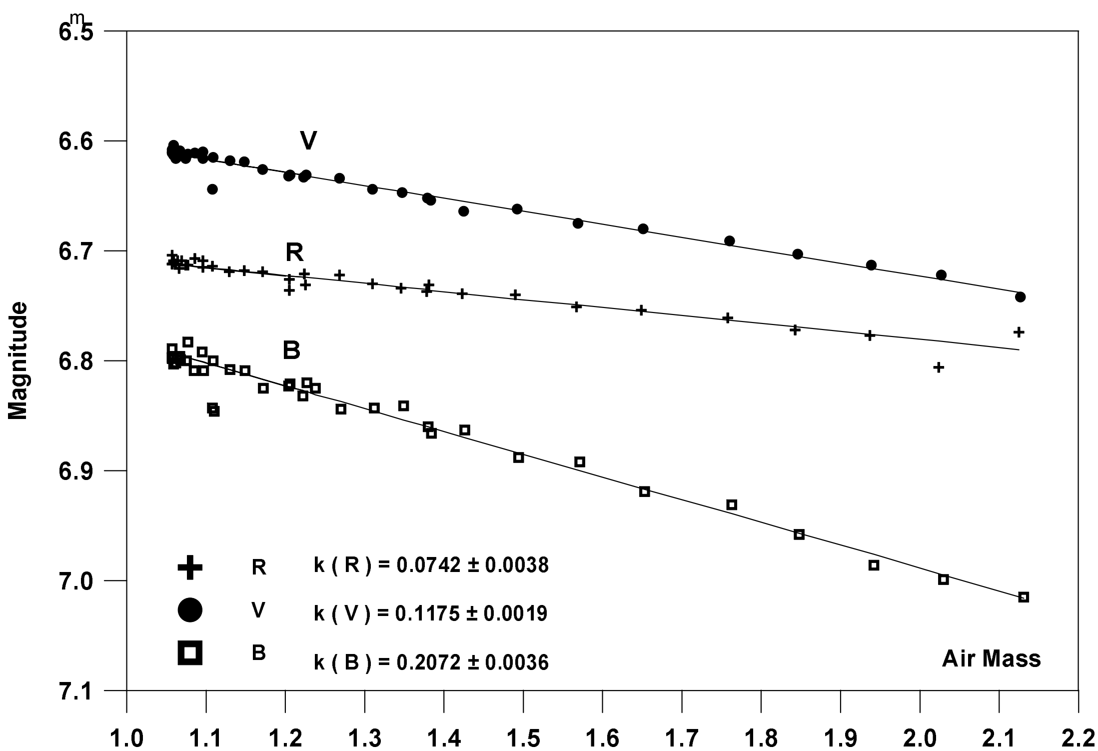

Figure 2. Atmospheric extinction curves of the comparison star

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OBSERVATIONS OF II CARINAE, A 65-DAY CLASSICAL CEPHEID IN THE SOUTHERN MILKY WAY

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Name of the object:
II Carinae

Equatorial coordinates:	**Equinox:**
R.A.= $10^h46^m50^s$ **DEC.=** $-59°47\overset{m}{.}8$	Equinox 1950

Observatory and telescope:
South African Astronomical Observatory 0.5 m reflector

Detector:	Photomultiplier Hamamatsu
Filter(s):	VI_c
Comparison star(s):	No. We conducted the "all sky photometry"
Check star(s):	No. See above.

Transformed to a standard system:	VI_c
Standard stars (field) used:	Standard stars from E-regions

Availability of the data:

JD_{hel} 2400000+	V	$V-I_c$
50808.5887	-	2.908
50809.5082	13.006	2.901
50809.5628	12.974	2.865
50810.5458	13.007	2.879
50811.5108	13.024	2.895
50812.4228	13.051	2.863
50814.5762	13.062	2.861
50815.5438	13.062	2.843
50816.4635	13.073	2.880

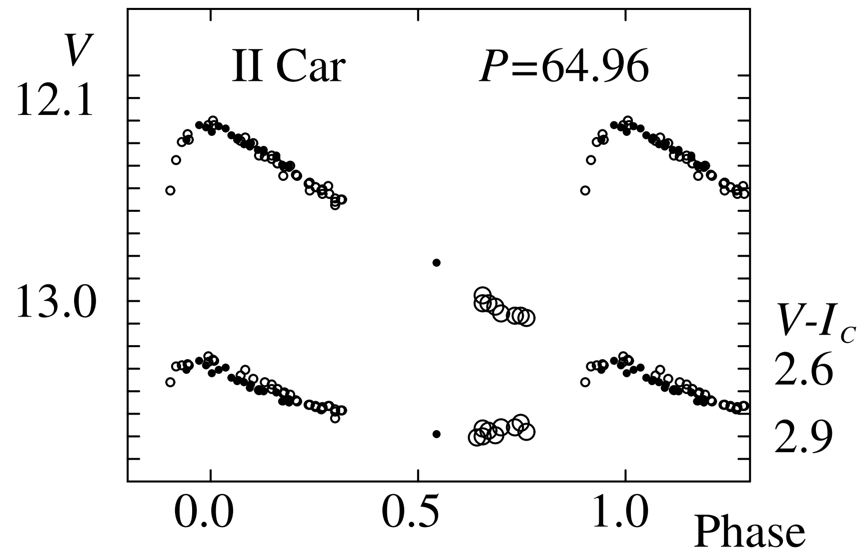

Figure 1. Dots represent data from Berdnikov & Turner (1998a), small circles represent data from Berdnikov & Turner (1998b), and large circles represent the new data

Type of variability:	DCEP

Remarks:
II Car is listed in the GCVS-IV as a classical Cepheid with a period of 64.24 days. The recent observations delineate the light curve together with the data by Berdnikov & Turner (1998a, 1998b). The accuracy of the individual observations is near $\pm0\overset{m}{.}01$ in all filters. The following revised elements have been determined: Max JD_{hel} = 2450896.8 + 64.96 × E. These elements are used in Figure 1. II Car is now the longest period classical Cepheid in the southern Milky Way to possess a photoelectric light curve. The research described here was supported in part by the Russian Foundation of Basic Research and the State Science and Technology Program "Astronomy" to LNB and through NSERC Canada to DGT. We would also like to express our gratitude to the administration of SAAO for allocating the observing time for this study.

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Budapest
4 September 1998

HU ISSN 0374 – 0676

1997 PHOTOMETRY OF CG CYGNI

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CG Cygni (= # 177 in the catalog of Strassmeier et al. 1993) is a short period eclipsing RS CVn system. Zeilik et al. (1994) model the available data from 1922 to 1993. They also review the literature on this system. Dapergolas et al. (1994 and previous work) have done considerable recent B and V photometry of this system. Heckert (1994, 1995) model 1994 and 1995 light curves of this system. This work continues with the 1997 light curves.

I observed CG Cyg on the nights of 9, 12, 13, 14, 15, and 16 August 1997 with the San Diego State University 61-cm telescope on Mt. Laguna. The photometer and observing techniques are the same as for Heckert (1994). The light curves, with 144 data points in each filter, are plotted in Figures 1 and 2 in the standard Johnson–Cousins system. The phases are computed using the ephemerides of Sowell et al. (1987). The small amplitude out-of-eclipse variations discussed by Zeilik et al. (1994) are not visible in these 1997 light curves. These variations are observed as recently as 1994 and to a lesser extent 1995 (Dapergolas et al. 1994, Heckert 1994, 1995).

Using Budding and Zeilik's (1987) Information Limit Optimization Technique (ILOT), I modeled the data. Briefly, the ILOT extracts a distortion wave from the initial binary fit. This wave is then fit for two circular 0K spots. The fits for each color are performed independently. Figures 3 and 4 show the V band fits. The latitude is the most difficult spot parameter to fit. When unable to fit the latitude of the second spot, I fixed the value where it seemed to be converging in trial fits. Such values have no reported error bars in the table below. The reported longitude, latitude and radius of each spot are in degrees. I get:

Spot Fits

	B band	V band	R band	I band
$Longitude_1$	98.6±2.5	103.7±4.5	105.4±4.8	104.0±5.7
$Latitude_1$	70.2±3.2	68.6±5.8	70.5±4.0	72.6±4.7
$Radius_1$	31.8±3.0	28.0±4.5	27.8±3.4	27.7±4.4
$Longitude_2$	221.5±7.4	213.5±15.9	216.9±11.8	211.8±11.4
$Latitude_2$	0	0	−5.9±79.4	20
$Radius_2$	8.8±0.7	7.8±1.1	8.3±1.8	8.2±1.3
χ^2	233.8	179.9	175.0	131.0

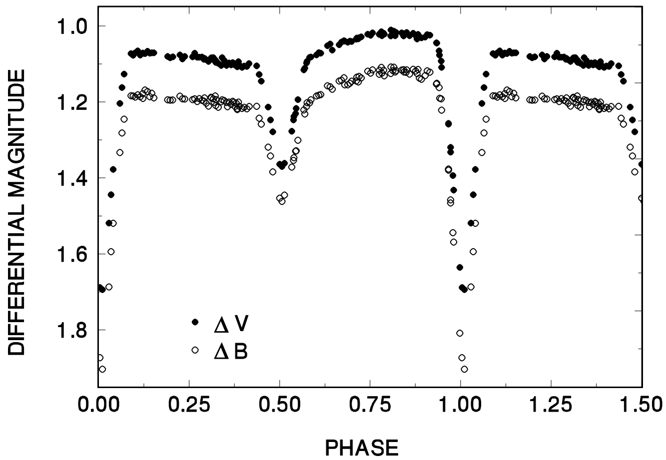

Figure 1.

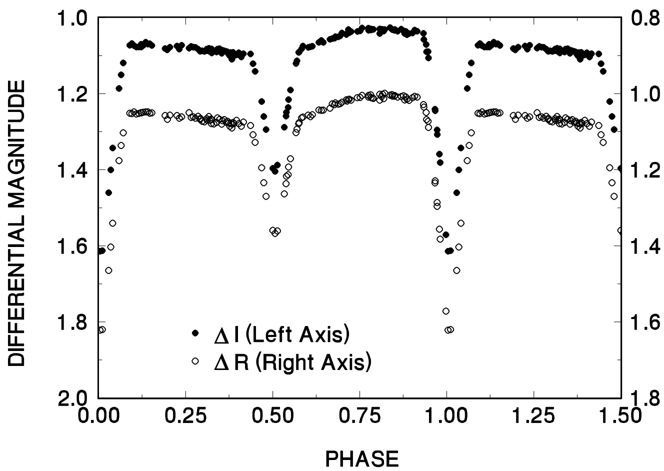

Figure 2.

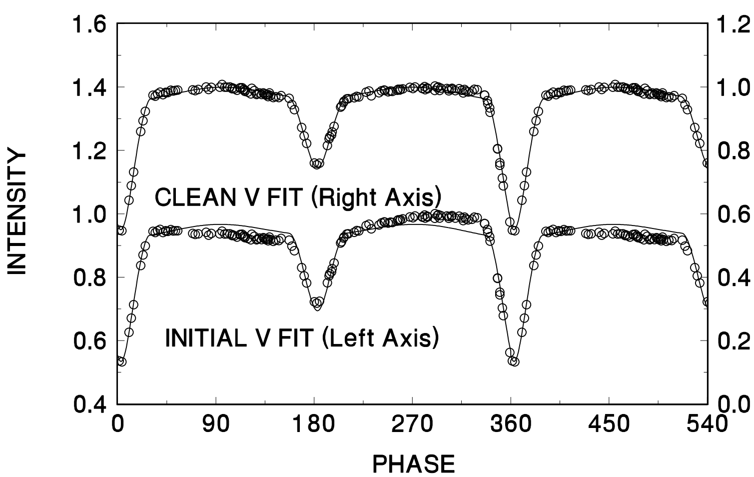

Figure 3.

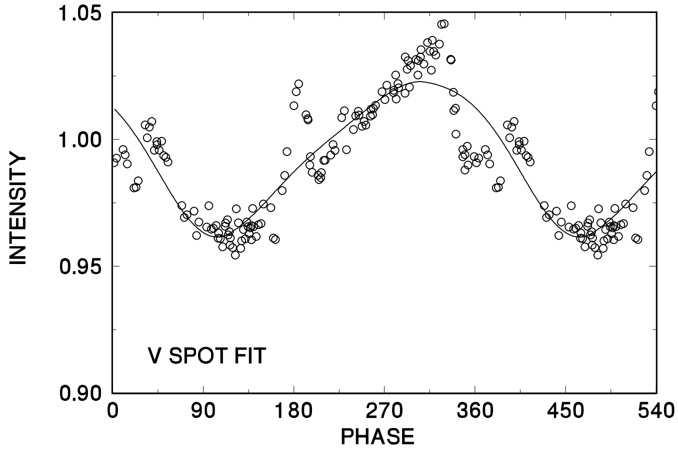

Figure 4.

During 1997 there was a spot in each Active Longitude Belt. The spot in the 90° ALB was a fairly large high latitude spot. The 270° ALB contained a smaller low latitude spot. Both of these spots are new rather than one of the spots found in the 1995 or 1994 light curves (Heckert 1994,1995). A small low latitude spot is in the 270° ALB, which had a large high latitude spot in 1995. Spots on the sun tend to disperse and reform at different latitudes rather than migrate in latitude. Hence, this spot is likely a new spot rather than a spot that changed size and migrated. The 90° ALB had a large high latitude spot in 1997 but no spot in 1995.

After performing the spot fits, I performed clean fits to the light curves with the effects of the distortion wave removed. I get:

Clean Fits

	B band	V band	R band	I band
L_1	0.747±0.010	0.716±0.013	0.718±0.012	0.724±0.059
$k(=r_2/r_1)$	0.831±0.018	0.837±0.022	0.805±0.021	0.767±0.115
$\Delta\theta_0$	−2.997±0.114	−2.968±0.122	−2.884±0.126	−2.840±0.129
r_1	0.256±0.005	0.255±0.005	0.259±0.005	0.261±0.016
i(deg)	83.3	82.8	82.8	83.1±1.6
L_2	0.236±0.011	0.266±0.014	0.270±0.013	0.269±0.061
$q(=m_2/m_1)$	0.393±0.056	0.411±0.078	0.386±0.090	0.353±0.206
χ^2	132.3	90.1	88.7	66.0

As defined by Budding and Zeilik (1987), L_1 and L_2 are the fractional luminosities of the primary and secondary star. They are normalized to sum to approximately but not exactly one. The inclination, i, is in degrees. k and q are the ratios of the radii and masses. The radius of the primary, r_1, is in units of the orbital separation. $\Delta\theta_0$ is the difference between the observed and computed times when the eclipses occur expressed in degrees. Averaging the values of $\Delta\theta_0$ for the different filters, and converting into days I find that the eclipses occurred 0.0051±0.0001 days after they are predicted to occur during this epoch. This difference is very similar to that observed in 1995 but differs from 1994 (Heckert 1994, 1995).

The mass ratio, q, is much lower than for previous work. Popper (1993, 1994) get 0.84 and 0.86, Jassur (1980) gets 0.95, Heckert (1994, 1995) get 0.53 and 0.81. Most other previous workers get 1.0 (Budding and Zeilik 1987, Zeilik et al. 1994, Naftilan and Milone 1985, and Sowell et al. 1987). The average value for the four 1997 light curves is 0.39. Mass ratios found by analysis of light curves are less reliable than those found from spectral data. However the fact that the 1997 as well as the 1994 and 1995 light curves all yield low values for the mass ratio suggests that the previously reported values lower than 1.0 are more likely to be correct than the more commonly reported values of 1.0.

I thank Ron Angione for scheduling generous amounts of observing time at Mt. Laguna. I also acknowledge support from a Cottrell College Science Award of The Research Corporation for this work.

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PHOTOELECTRIC V(RI)$_C$ OBSERVATIONS AND NEW CLASSIFICATION FOR V641 CENTAURI

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V641 Cen is listed in the GCVS-IV as a classical Cepheid with the elements:

$$\text{Max JD}_{hel} = 2441771.771 + 35.216 \times \text{E}.$$

We included the star in our program of photoelectric observations for Cepheids because only 17 UBV observations for the star (in the time interval JD 2441108–785) were published previously (Grayzeck 1978). The results of our monitoring of the star during three observing runs (JD 2449520–64, JD 2449802–27, and JD 2450568–84) were published by Berdnikov and Turner (1995a,b; 1998). An additional 49 observations of the variable in $V(RI)_c$ were obtained during March-April 1998 using the 0.5-m reflector of the South African Astronomical Observatory (Table 1). The accuracy of the individual observations is near $\pm 0\overset{m}{.}01$ in all filters. The new data, as well as all previously published observations, are plotted in Fig. 1 using the above elements. It should be clear from the nature of the seasonal variations for V641 Cen that the shape of its light curve is not stable. Therefore, V641 Cen cannot be a classical Cepheid. Based upon the long time scale and quasi-periodic nature of its light variations, as well as its spectral type of F5-G9 (GCVS-IV), V641 Cen is most likely a semiregular variable of type SRD.

The research described here was supported in part by the Russian Foundation of Basic Research and the State Science and Technology Program "Astronomy" to LNB and through NSERC Canada to DGT. We are grateful to the administration of SAAO for the allocation of observing time during which the present observations were obtained.

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Table 1

JD hel 2450000+	Phase	V	$V{-}R_c$	$V{-}I_c$	JD hel 2450000+	Phase	V	$V{-}R_c$	$V{-}I_c$
891.4787	.965	10.278	1.061	2.056	910.3930	.502	10.446	1.139	2.233
891.5744	.968	10.268	1.060	2.047	910.4635	.504	10.421	1.134	2.227
892.4770	.993	10.269	1.070	2.071	910.4874	.505	10.481	1.155	2.259
892.5933	.997	10.268	1.063	2.071	910.5743	.507	10.460	1.138	2.229
893.3859	.019	10.294	1.071	2.098	912.3303	.557	10.492	1.147	2.253
893.4888	.022	10.260	1.046	2.070	912.4080	.559	10.497	1.136	2.240
896.5103	.108	10.290	1.088	2.101	912.4885	.561	10.504	1.150	2.245
897.4188	.134	10.299	1.094	2.090	912.5774	.564	10.520	1.138	2.283
901.5472	.251	10.309	1.092	2.128	913.3299	.585	10.531	1.155	2.279
902.4304	.276	10.303	1.095	2.140	913.4003	.587	10.541	1.163	2.291
902.4912	.278	10.315	1.114	2.151	913.4749	.590	10.533	1.157	2.290
903.5502	.308	10.312	1.113	2.146	914.3251	.614	10.540	1.130	2.292
904.4052	.332	10.323	1.104	2.161	914.3910	.616	10.558	1.160	2.296
904.5036	.335	10.331	1.107	2.153	914.4760	.618	10.562	1.164	2.289
905.3541	.359	10.325	1.089	2.140	914.5517	.620	10.582	1.170	2.306
907.3752	.416	10.386	1.130	2.185	915.4139	.645	10.574	1.145	2.292
907.4295	.418	10.379	1.120	2.195	915.5008	.647	10.604	1.151	2.308
907.6029	.423	10.472	1.126	2.183	916.3198	.670	10.580	1.132	2.277
908.3709	.445	10.417	1.130	2.214	916.3919	.672	10.609	1.159	2.318
908.4285	.446	10.418	1.119	2.211	916.4724	.675	10.630	1.175	2.346
908.5164	.449	10.445	1.151	2.230	916.5561	.677	10.593	1.153	2.307
908.5804	.451	10.411	1.134	2.218	917.3412	.699	10.637	1.163	2.325
909.4854	.476	10.422	1.128	2.219	917.4078	.701	10.616	1.162	2.321
909.5804	.479	10.412	1.134	2.214	917.4792	.703	10.642	1.175	2.334
910.3165	.500	10.450	1.122	2.227					

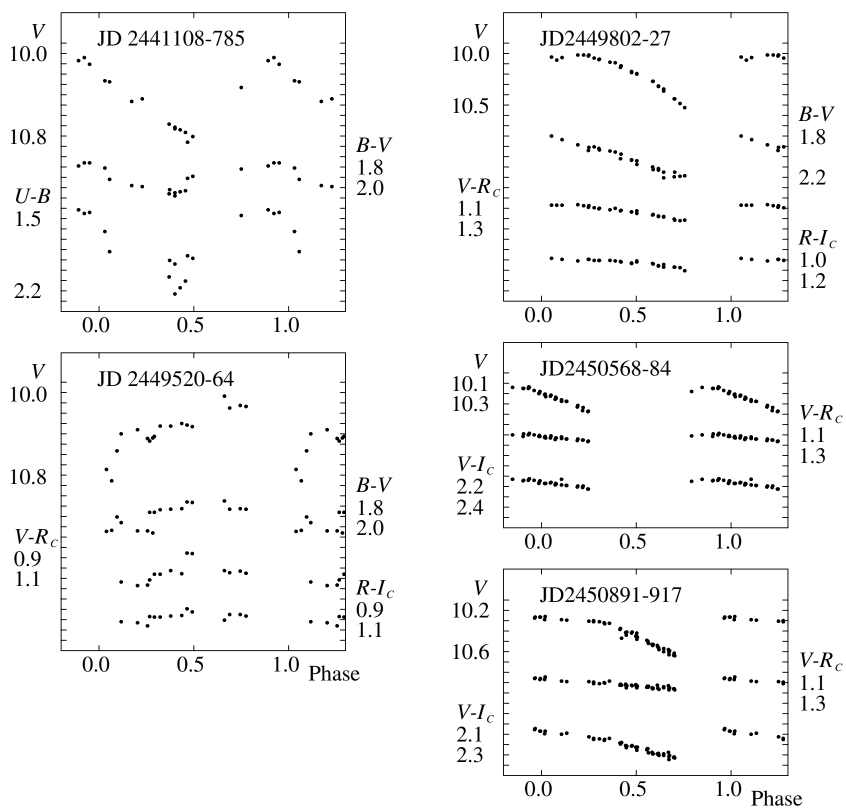

Figure 1.

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VARIATIONS OF LUMINOSITY, RADIUS, AND TEMPERATURE OF THE PULSATING RED SUPERGIANT CE TAURI

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CE Tauri (HD 36389; HR 1845; 119 Tau) is a bright semi-regular pulsating M2 Iab-Ib variable star. It is easily observable with a mean V-mag = +4.45 and B−V = +2.07. Although CE Tau may be a possible twin to the SRc M2 Iab supergiant α Orionis, it has been the target of few long-term photometric studies. Boyd et al. (1984) found the star to have a nearly sinusoidal visual light curve with an amplitude of 0.25 mag and a half-period of nearly 80 days. This estimate corresponds well with the AAVSO reported period of 165 days. Several V-band measures have also been published by Krisciunas (1986). Recent measurements by the Hipparcos satellite yield a parallax of 1.7 $\pm$ 0.8 mas, which corresponds to a distance of about 588 $\pm$ 277 pc. Morever, near-IR interferometric measurements by Quirrenbach et al. (1993) and Dyck et al. (1996), and lunar occultation measurements by Di Benedetto et al. (1993) yield an average angular diameter of 10.3 mas. This corresponds to a stellar radius of R = 654 $R_\odot$ or 3.04 AU, based on the given Hipparcos distance.

Because CE Tau is a cool M2 star, its maximum energy output is in the near-infrared and its spectrum is dominated by temperature dependent TiO molecular bands. For these reasons, and because of a lack of long-term photometric monitoring, CE Tau is an excellent candidate for Wing (1992) near-IR TiO photometry. Furthermore, using the Wing near-IR photometry presented here, and methods developed by us (see, e.g., Morgan et al. 1997; Mahler et al. 1997), it is possible to estimate the temperature, radius, and luminosity changes of CE Tau over its pulsation cycle. Hence, CE Tau was added to our program of V-band and Wing (1992) near-IR photometry of bright red giants and supergiants being carried out at the Wasatonic and Villanova observatories.

Two seasons of variability are discussed, covering 12 nights from November 1996 to March 1997 and 17 nights from November 1997 to March 1998. Differential photometry of CE Tau was carried out with a 20 cm Schmidt-Cassegrain telescope coupled to an Optec silicon PIN-photometer. The comparison star was HD 35802 and HD 35296 served as the check star. No significant light variations were found between the comparison and check stars. In addition, ϵ Tau served as a near-IR Wing standard star (Wing, 1979).

The photometry was conducted using a filter closely matched to the Johnson V-band system and the Wing near-IR three filter system, which uses near-IR intermediate-band filters centered at 719 nm, 754 nm, and 1024 nm. These filters are designated as A, B, and C by Wing (1992), respectively. TiO-indices, near-IR color indices, and IR apparent magnitudes are calculated from the observations. As defined, a numerical increase in the

TiO-index corresponds to an increase in TiO absorption at 719 nm. For M-type stars the C(1024) magnitude closely approximates the apparent bolometric magnitude (m_{bol}). Wing (1992) gives a detailed description of the three-color near-IR photometric system.

Nightly means were formed from the individual observations and plotted against Julian Day Number in Figure 1. The V-mag, TiO-index, and the near-IR C(1024)-mag are plotted. As shown in the figure, the star varies with time on a time-scale of several months. During the 1996-97 observing season CE Tau has a nearly sinusoidal light variation in which the V-mag varies from $V_{max} = +4.29$ mag to $V_{min} = +4.46$ mag. Fitting the data with a sinusoid suggests a characteristic period of about 140d for this interval. Also during the 1997/98 season the light variations are less regular and the light ranges slightly smaller. The observed V-mag amplitude of about 0.20 mag during 1996/97 is smaller than the total V-mag range of 0.40 mag found from Hipparcos photometry of CE Tau secured from 1990 to 1993.

Variations in the TiO-index are shown in the second panel of Figure 1. The TiO-index varies inversely in phase with the V-mag light variations. During 1996/97 the TiO-index reaches its minimum value of +0.54 during light maximum and reaches its maximum value of +0.64 near light minimum. These values correspond to spectral types of about M2.0 Iab to M2.4 Iab, respectively. From the TiO-index the star (at least during 1996/97) is hottest at light maximum, and coolest at light minimum. As shown in Fig.1, the mean seasonal TiO-index is more positive during 1997/98, than during 1996/97. This indicates that the mean TiO absorption is stronger during the second season, corresponding to an overall decrease in the mean temperature over the two years.

The C(1024) mag is plotted against time in the bottom panel of Figure 1. As shown, the C(1024) mag varies in a similar manner to the V-mag, but with an amplitude only $\approx$ 0.05 mag. From observations of standard stars with reliable bolometric magnitudes, the C(1024) mag was transformed to apparent bolometric magnitude (m_{bol}) by adding 1.10 to the C-mags. From prior TiO Index–temperature calibrations using near-IR standard star information supplied by Wing (1978), the T_{eff} of CE Tau was determined for each night. These effective temperatures are plotted in the top panel of Figure 2. Using these temperature and m_{bol} values, and adopting the Hipparcos distance, the luminosity ($L_\star$) and radius ($R_\star$) of the star were computed for each nightly data set. The resultant values of $L_\star/L_\odot$ and $R_\star/R_\odot$ are plotted in Figure 2. In converting from M_{bol} to $L_\star/L_\odot$, the value of $(M_{bol})_\odot = +4.75$ mag was adopted.

As shown in Fig. 2, for 1996/97 the temperature and luminosity variations of CE Tau are correlated but there appears to be no corresponding correlated changes in the stellar radius. As shown, the star is hottest at a time when it is most luminous and vice versa. However the radius of the star appears to increase systematically from $R_\star/R_\odot$ = 553 to about $R_\star/R_\odot = 570$ over the 1996/97 observing season. The apparent systematic increase in the star's radius appears to continue over the 1997/98 observing season. By the end of the 1997/98 season, the inferred stellar radius is $R_\star/R_\odot = 580$. This change is accompanied by an apparent decrease in the T_{eff} over the two years. These systematic changes in $R_\star$ and T_{eff} could be part of a long-term pulsation cycle lasting a few years. α Ori shows similar long-term behavior (Morgan et al. 1997).

It is interesting that the 140d light variation seen during 1996/97 is driven chiefly by temperature changes without the expected accompanying radius changes expected from pulsation. This suggests that the 140-160d light variation arises chiefly from the growth and decay of huge granulation cells over the star's surface rather than from primary pulsation (see Schwarzschild, 1975).

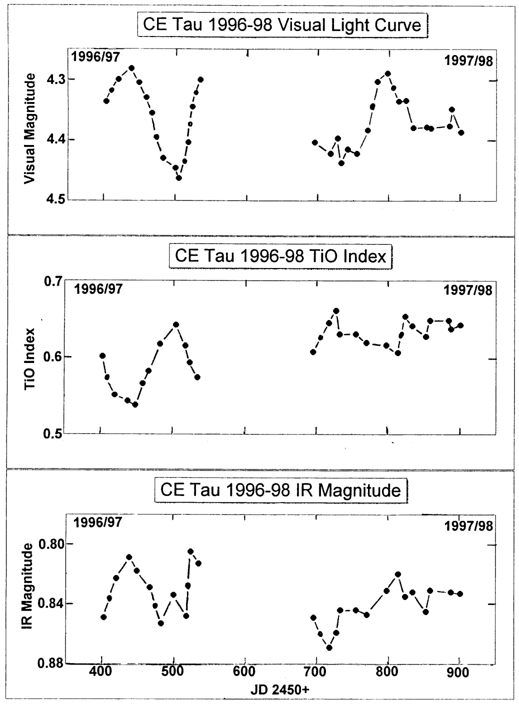

Figure 1. CE Tau visual light curve, TiO index, and IR magnitudes for the 1996/97 and 1997/98 observing seasons

Wing photometry of α Ori has also been carried out by us with the same equipment; the observed temperature, luminosity, and radius changes are slightly larger than those of CE Tau. From the TiO-indices α Ori is on average about 80 deg K warmer than CE Tau. Also α Ori appears somewhat larger and more luminous than CE Tau but the large uncertainty in CE Tau's parallax makes these comparisons less reliable. The mean photometric and physical properties of CE Tau and α Ori are listed in Table 1 for comparison. At face value, CE Tau is a close match to α Ori.

Table 1: Averaged common properties and parameters

Avg. Properties	Alpha Ori	CE Tau	Comments
Spec. Type	M2 Iab	M2 Iab - Ib	
V-Mag.	+0.50	+4.45	Data from current photometry
d(pc)	131 ± 30	588 ± 287	From Hipparcos
(B−V)	+1.85	+2.07	
E(B−V)	≈ 0.05	≈ 0.25	Using A_V = 3.2E(B−V)
A_V	≈ 0.16	≈ 0.80	
M_V	−5.24	−5.20	
TiO Index	0.73	0.60	Data from current photometry.
T_{eff}	3430K	3510K	Data from current photometry
Ang. Diameter	55.0 mas	10.3mas	
Radius	775 $R_\odot$	654 $R_\odot$	
Luminosity	69000 $L_\odot$	44500 $L_\odot$	Data from current photometry.
Period(s)	≈ 400d	≈ 140d-165d	Data from current photometry
	≈ 4.05yr	> 2 yrs.	P = 140d from 1996/97 photometry

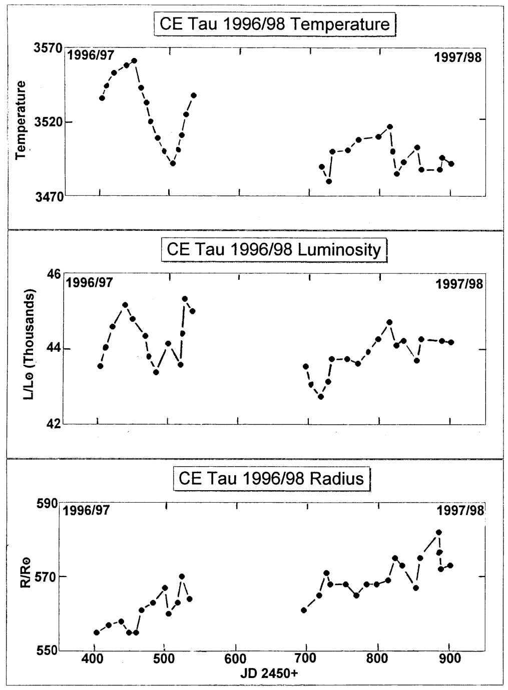

Figure 2. CE Tau derived effective temperature, luminosity, and radius variations for the 1996/97 and 1997/98 observing seasons

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MORE OBSERVATIONS NEEDED FOR V370 And, AN HIPPARCOS DISCOVERY

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350 non-Mira type stars with M-type spectra in the Hipparcos Catalogue have been analyzed by Dumm and Schild (1998) for radii and masses. Their paper lists the amplitudes of the stars as determined by Hipparcos. Among these there is one star, not included in the GCVS, NSV, or the Name Lists through No. 73 (Kazarovets and Samus 1997), that is reported to have an amplitude of 1.01 Hip, the largest amplitude of any of the tabulated stars.

It is HIP 9234, HD 11979, and has been named V370 And, at $1^{h}58^{m}44^{s}.287$ $+44^{\circ}26'07''.30$ (2000), 7.69 Hip, 7.37V, M8; HD: 7.80v, 9.15pg; Skymap: 7.7V, M4III.

The Hipparcos Catalogue contains 88 observations made on only 27 separate days spanning 1164 days (Dec. 13. 1989 - Jan. 19. 1993), as shown in Figure 1. The magnitude system is close to but somewhat different from V-magnitudes. In Figure 2 the daily means of these observations have been fitted to a period of 240 days. The type of variability assigned by Hipparcos is In, presumably because only one high maximum was observed. We believe it is more likely SR. However, the span of the scattered observations covers just over five cycles of the proposed period. As no single cycle has been observed over a sufficient fraction of the light curve, the period may be spurious, related to the true period by the distribution of the intervals between the actual observations.

These preliminary results are presented in the hope that observatories having extensive plate collections will provide photographic observations revealing the early history of this star; and that especially amateurs will provide later visual and CCD observations.

References:

Dumm, T., Schild, H., 1998, *New Astronomy*, **3**, 137
Kazarovets, E.V., Samus, N.N., 1997, *IBVS*, No. 4471

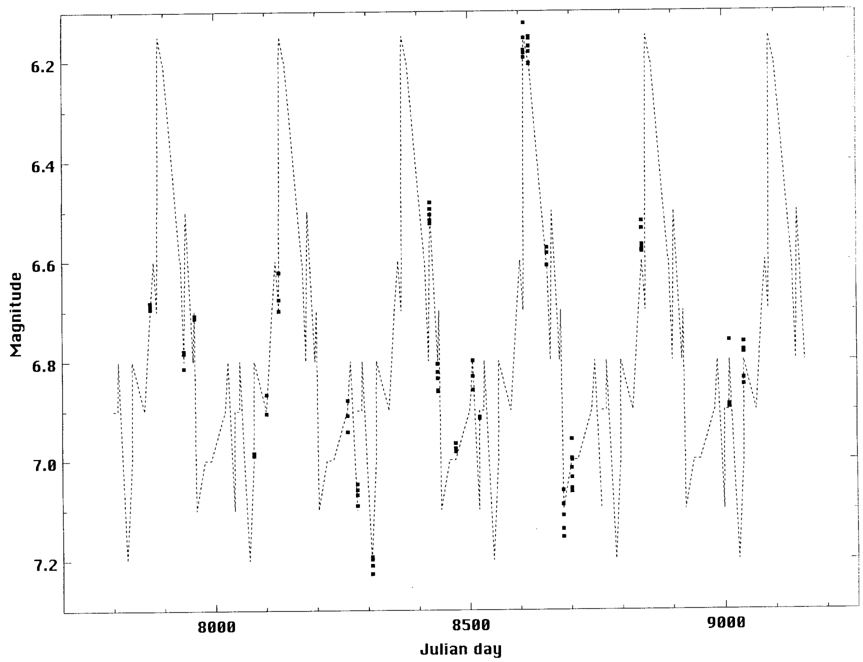

Figure 1. Hipparcos Observations of V370 And. The dots show the Hipparcos magnitudes. The dotted curve shows the light curve for the 240 day period over the original observations showing where maximum had been overlooked. The next observable maximum is expected to occur about November 1999

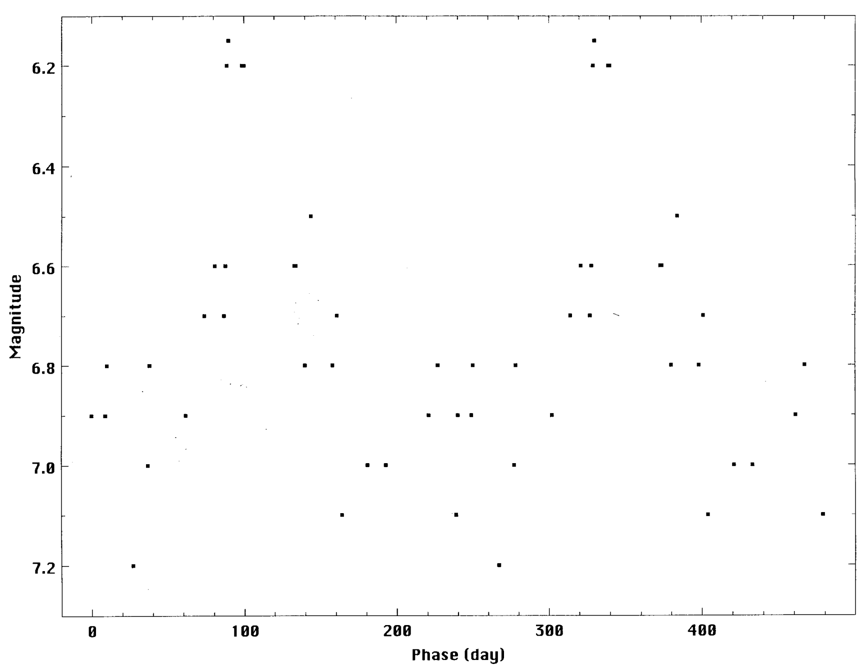

Figure 2. Mean daily observations of V370 And fitted to a period of 240 d

Erratum from IBVS 4653

The recently published No. 4630 issue of the IBVS contains two unfortunate errors. The correct declination of V370 And is $+45^\circ 26' 37.''30$ (2000) instead of $+44^\circ$ etc. Regrettably the name of John T. Lee as the co-author does not appear in the published version, for which we apologize.

The Editors

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CCD PHOTOMETRY OF UZ CrB, XX CrB AND V864 Her

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Recently Wetterer et al. 1996 (hereafter, W96) published the results of a search for RR Lyrae variable stars in the CCD/Transit Instrument (CTI) survey. Some of these stars were flagged as needing additional observations to confirm their type and/or period. This paper presents the results of observations of three of these stars using the 0.61 m telescope at the US Air Force Academy (USAFA) and a liquid nitrogen cooled 512x512 Photometrics CCD. Table 1 lists the name, star number from W96, right ascension and declination (epoch 1987.5), the number of CTI, the number of Capilla Peak (CAP), and the number of USAFA Observatory (AFA) observations through the V filter for each star. Figure 1 shows finder charts made from scans of the Palomar Digitized Sky Survey and identifies the variable stars and comparison stars.

Table 1: Variable Stars

Star	W96	α	δ	CTI	CAP	AFA
UZ CrB	27	$15^h16^m28\overset{s}{.}1$	28°00′42″	46	7	21
XX CrB	28	16 23 17.6	27 58 29	13	9	146
V864 Her	30	16 58 30.7	28 06 01	20	5	75

Table 2: Photometry results

Star	V_{Max}	V_{Min}	V_{Mean}	ΔV	B−V	m−M	Period	HJD	Type
UZ CrB	17.3	18.2	17.86	0.9	0.39	0.2	0.571895	988.6707	RRab
XX CrB	15.12	15.38	15.243	0.26	0.56	0.4	0.146620	989.7977	δ Sct
V864 Her	14.56	15.13	14.793	0.57	0.39	0.3-0.5	0.375362	983.7688	RRc (B)

Table 2 summarizes the results. After the star's name, the next five columns list the maximum, minimum, and flux averaged standard V magnitudes; the amplitude of variation in V (ΔV), and; the B−V at minimum light (from W96). W96 details the transformation from instrumental to standard magnitudes and how the flux averaged magnitude was calculated. The final four columns list the rise time as a fraction of a period (m−M); the period in days; the heliocentric Julian Date of maximum light (minus 2450000 days), and; the variability type for each star.

UZ CrB was listed in W96 as an RRab type variable with a period of 0.57190 days, although several other sidereal day aliased periods were possible. The period found combining the previous observations with the new observations (0.571895 ± 0.000006 days)

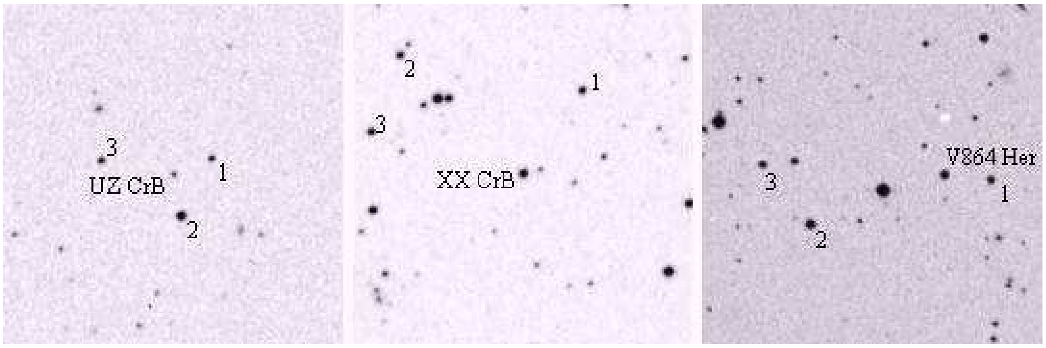

Figure 1. Finder charts (5′ x 5′) for the program stars

is very close to the originally calculated period. Due to the scatter in the data caused by UZ CrB's faintness, the sidereal day alias period at 0.363462 days can't be entirely ruled out. It is clear from the shape of UZ CrB's lightcurve (Figure 2), however, that its current designation as an RRab type variable star is appropriate and thus the 0.571895 day period is most likely correct.

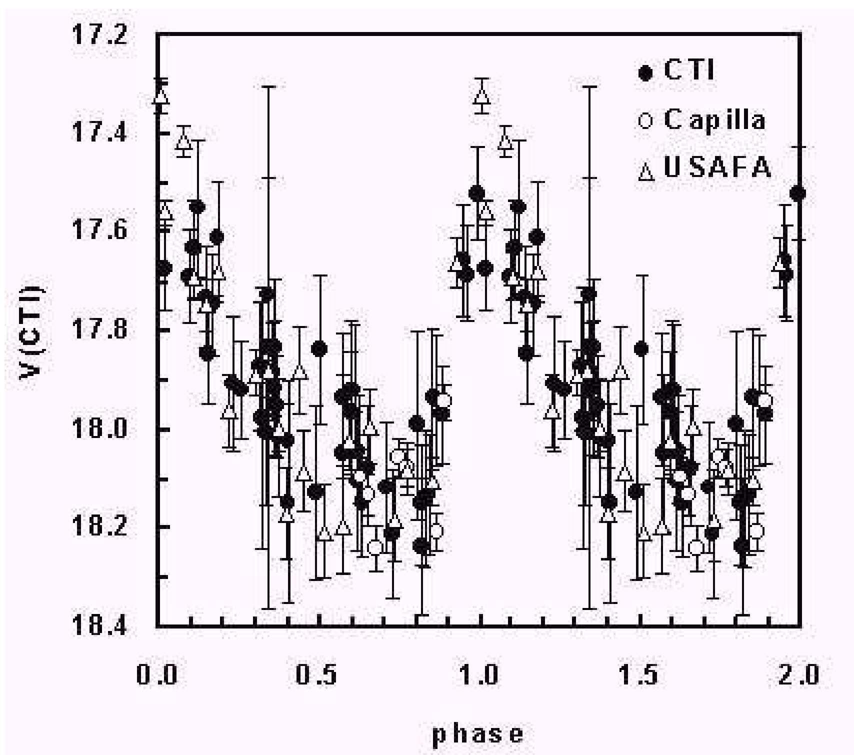

Figure 2. Lightcurve of UZ CrB. P = 0.571895 days

XX CrB was listed in W96 as a W UMa type variable with a period of 0.343670 days, although several other short periods were equally possible. Combining the previous observations with the new observations indicate that XX CrB is not an eclipsing variable and the period (0.146620 ± 0.000001 days) is a sidereal day alias of half the originally calculated period. XX CrB's period, amplitude and lightcurve (Figure 3) are now more consistent with a δ Sct type variable star and should be reclassified as such. The 0.146620 day period is undoubtedly the fundamental pulsation, although due to the variations in minimum and maximum light from cycle to cycle, other pulsational modes with lower amplitudes are likely to be present as well. The minimum and maximum magnitudes and the amplitude of $\Delta V = 0.26$ in Table 2 correspond to the full range of magnitudes observed neglecting outliers. Of the over 250 δ Sct type variable stars listed in the General Catalog of Variable Stars (Kholopov et al. 1985-88) and subsequent name-lists (Kholopov et al. 1985, 1987, 1989; Kazarovets and Samus 1990, 1995, 1997; Kazarovets et al. 1993), less than a quarter have amplitudes greater than this.

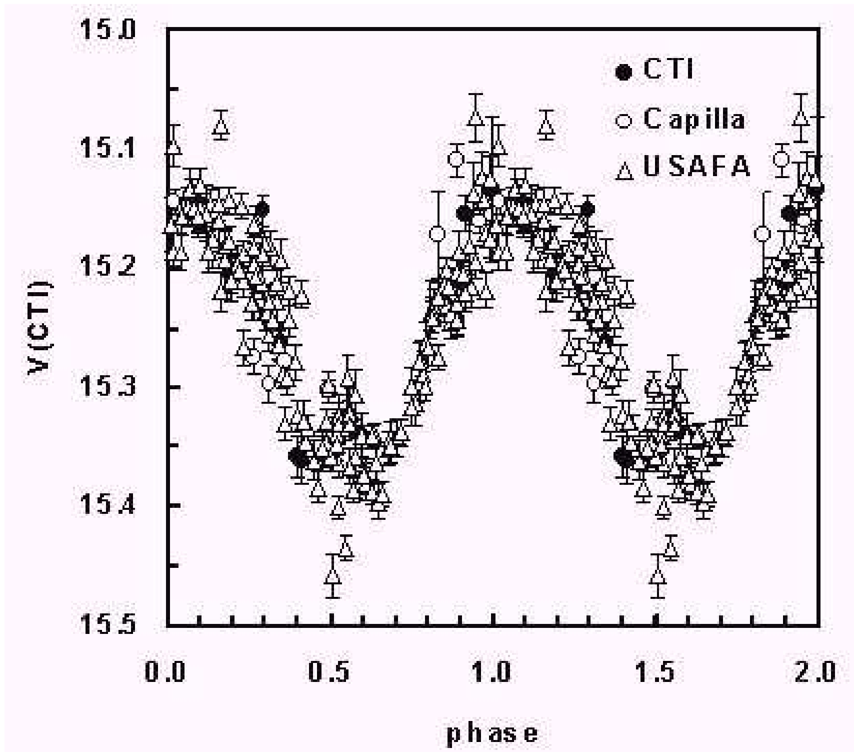

Figure 3. Lightcurve of XX CrB. P = 0.146620 days

V864 Her was listed in W96 as a possible RRc type variable star with a period of 0.272711 days, although other sidereal day aliased periods were possible. Combining the previous observations with the new observations indicate that V864 Her's period (0.375362 $\pm$ 0.000002 days) is indeed a sidereal day alias to the originally calculated period. V864 Her's period, amplitude, the asymmetry of its lightcurve (Figure 4), and the fact that the CTI observations through the B filter indicate the amplitude for this star in B is significantly greater than its amplitude in V ($\Delta B = 0.8$ from W96), are all consistent with its current designation as an RRc type variable star. Additionally, as can be seen in the lightcurve, this star displays the Blazkho effect with the ascending portion of its lightcurve changing in phase over time.

Acknowledgements. The Digitized Sky Surveys were produced at the Space Telescope Science Institute under U.S. Government grant NAG W-2166. The images of these surveys are based on photographic data obtained using the Oschin Schmidt Telescope on Palomar

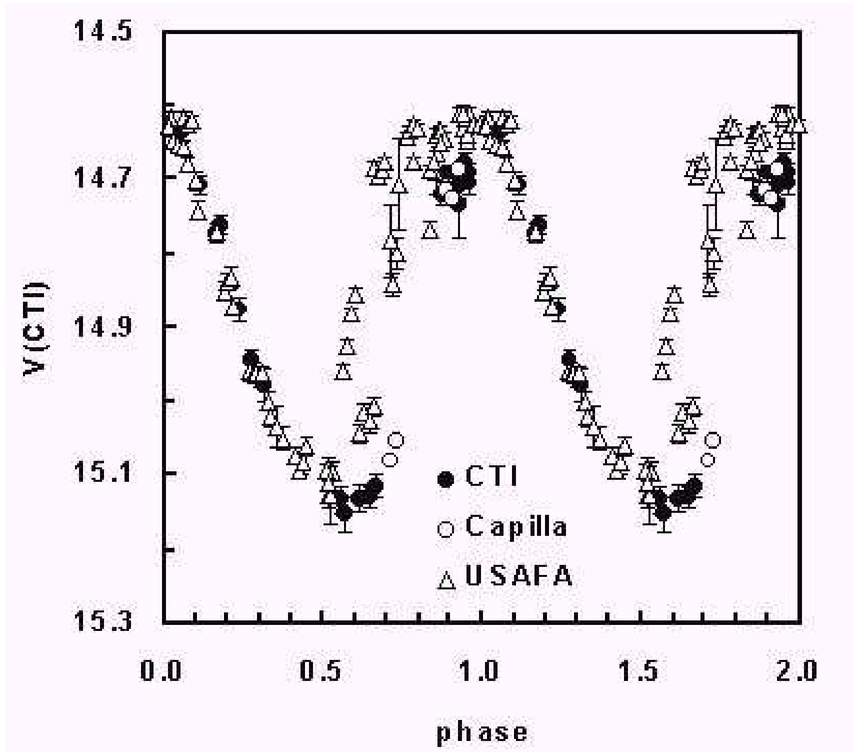

Figure 4. Lightcurve of V864 Her. P = 0.375362 days

Mountain and the UK Schmidt Telescope. The plates were processed into the present compressed digital form with the permission of these institutions. The author also wishes to thank Jim Kunkle for providing his additional Capilla Peak observations of XX CrB and Cadet Cory Naddy for help with some of the USAFA observations.

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ACCURATE POSITIONS FOR 45 VARIABLES IN FIVE FIELDS

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Accurate positions of 45 variable and suspected variable stars in 5 fields (each $5^\circ \times 5^\circ$) have been determined by the method described earlier (Shokin and Samus, 1997). Photographs were taken with the AFR-1 wide-field astrograph (D=23 cm, F=230 cm, $5^\circ\!.5 \times 5^\circ\!.5$ field) at Mt. Maidanak (Uzbekistan) in 1989–1992. For position determinations of some variables we used the plates taken with the 40-cm Zeiss astrograph (D=40 cm, F=159 cm) at Crimean station of Sternberg Astronomical Institute in 1960 and 1977. The rms errors in the positions of variables are 0.1–0.3 arcsec. Table 2 contains right ascensions and declinations of 45 variables stars in the HIPPARCOS coordinate system, epochs of observations, and GCS numbers (Lasker et al., 1990). Table 1 contains HIPPARCOS (ESA, 1997) and PPM (Röser and Bastian, 1991) catalog identifications for bright stars in these fields. Positions of two PPM stars, DY Aqr and TZ Cnc, have been determined for a modern epoch (see Table 2).

We are grateful to Drs. N. Samus, V. Goranskij, and N. Kurochkin for their help. This study was partially supported by by the Russian Foundation for Basic Research through grant No. 97-02-16739.

Table 1. HIPPARCOS and PPM identifications for bright variable stars

Star	HIP	PPM
KN Per	15726	
RU Per	16328	68523
IW Per	16591	68571
S Cnc	42853	125664
T Cnc	43905	
NSV 04332	44126	125983
NSV 05558	60172	158745
BK Vir	61022	158899
FW Vir	61658	159031
NSV 11898	94648	10127
BS Dra	98118	10354
NSV 14100	110023	206183
NSV 14107	110108	206201
ST Aqr		206260
DY Aqr		206217
TZ Cnc		99279

Table 2. Positions of variable stars.

Star	α_{2000}	δ_{2000}	Epoch	GSC
V431 Per	$3^h09^m34\overset{s}{.}237$	$+42^\circ19'46\overset{''}{.}16$	90.80	2855.1763
V432 Per	3 10 10.816	+42 52 09.45	90.80	2856.1647
V456 Per	3 10 11.940	+40 02 15.58	90.80	2852.1839
QW Per	3 12 42.997	+38 57 56.74	90.80	2848.1539
V433 Per	3 14 35.155	+43 14 46.80	90.80	
V373 Per	3 14 44.002	+42 22 52.86	90.80	2856.1173
QX Per	3 15 11.633	+39 34 48.65	90.80	2852.0061
V374 Per	3 17 22.503	+42 19 26.74	90.80	2856.1363
WW Per	3 18 28.246	+42 49 09.16	90.80	2856.1215
V434 Per	3 21 36.042	+40 19 22.46	90.80	2865.1811
V460 Per	3 22 31.368	+42 05 56.62	90.80	2869.1537
NSV 01112	3 22 39.141	+40 01 59.13	90.80	2865.1826
V375 Per	3 26 51.281	+40 12 59.50	90.80	2865.1164
NSV 01137	3 27 01.653	+41 53 03.13	90.80	
V463 Per	3 28 14.901	+40 22 18.63	90.80	2865.1030
NSV 04222	8 44 29.788	+19 28 03.62	92.29	1396.0142
NSV 04252	8 47 43.807	+20 01 27.43	92.29	1399.0261
NSV 04269	8 50 51.206	+19 21 26.41	92.29	1396.1497
NSV 04279	8 51 39.788	+18 53 21.36	92.29	1396.1274
NSV 04307	8 55 51.627	+18 22 57.02	92.29	1397.1175
NSV 04310	8 56 10.777	+21 33 03.47	92.29	1400.1789
VY Cnc	9 00 41.113	+18 55 23.33	92.29	1397.1380
SY Cnc	9 01 03.318	+17 53 56.01	92.29	1397.0817
TZ Cnc	9 04 01.005	+20 56 55.02	92.29	1407.0565
NSV 04361	9 04 03.844	+20 31 03.70	92.29	1407.0221
UV Vir	12 21 16.730	+00 22 03.37	89.94	282.0632
EG Vir	12 23 56.243	+00 51 31.74	68.74	
SS Vir	12 25 14.385	+00 46 10.88	89.94	282.0753
EI Vir	12 25 29.046	+01 14 20.87	68.74	
EN Vir	12 29 28.887	+01 38 03.52	68.74	
BI Vir	12 29 30.433	+00 13 28.01	89.94	282.0923
BM Vir	12 31 55.641	+00 54 30.85	89.94	289.0481
BN Vir	12 34 13.926	+02 57 16.44	89.94	289.0640
BO Vir	12 34 20.208	+00 39 25.08	89.94	289.0740
NSV 11763	19 05 23.023	+73 46 26.14	89.66	4443.1813
BI Dra	19 15 51.773	+73 45 48.39	89.66	4456.0951
NSV 12010	19 22 01.986	+74 18 30.52	89.66	4456.1501
YZ Dra	19 23 45.223	+71 41 13.50	89.66	4452.0864
NSV 12223	19 34 33.829	+74 03 05.91	89.66	4456.1244
CO Dra	19 48 24.955	+75 43 04.75	89.66	4584.2893
NSV 12535	19 51 14.443	+73 13 48.17	89.66	4457.2352
AQ Dra	20 02 50.378	+73 27 47.95	89.66	4458.1029
DY Aqr	22 19 04.280	−02 38 30.17	90.74	5228.0157
FH Aqr	22 25 02.487	−04 56 55.81	92.68	5229.1044
NSV 14201	22 33 21.072	−02 48 58.75	90.74	5236.0150

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PHOTOELECTRIC AND CCD TIMES OF MINIMA OF SEVERAL ECLIPSING BINARY SYSTEMS

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We present CCD and photoelectric photometric minima observations of 21 eclipsing binary systems. Most of them are stars with apsidal motion or at least eccentric binary systems, selected from the list of Hegedüs (1988). The other stars (mostly W UMa type) also show period changes. Some minima observations (e.g. for VW Cephei) are part of complete light curve coverages.

The only photoelectric observation was carried out at Piszkéstető Mountain Station of the Konkoly Observatory of the Hungarian Academy of Sciences with a 20 in. f/15 Cassegrain telescope. The photometer used was equipped with an unrefrigerated EMI 9058QB photomultiplier tube and Schott UG2 (for U), BG12+GG13 (for B) and GG11 (for V) filters. This system is referred to as Pi50 in Table 1. The CCD measurements (either with or without filter) were made at Baja Astronomical Observatory with an SBIG ST-7 camera, equipped with Kron-Cousins V,B,R filters, mounted on the 20 in. f/8.4 Ritchey-Chrétien telescope (Ba50 in Table 1).

The observations were made in the first eight months of 1998. The average accuracy is about 0.01 mag for the CCD data. Reduction of the photoelectric data was made by standard procedures. For the reduction of the CCD frames we used the IRAF package. Most of the minima times were computed using the parabola fitting method. In some cases (extended plateaus) we calculated the minimum by fitting lines to the descending and ascending branches. (In those cases the fifth column of the table is left empty.)

Table 1 presents the derived minima times. The content of the first two columns is self-explaining. 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 ones), while in the fifth column the number of individual data involved in the parabolic fit is given. Columns from sixth to eighth describe the filters used, the first three letters of the observers' names and the codes of the instrumentation. The last column contains the comparisons used, identified by their BD, GSC or HD numbers.

Table 1

Star	Min. HJD +2400000	error ±	Min. type	Points used	Filter	Obs.'s name	Instr.	Comp.
RT And	50964.5073	2	I	51	V	Bir	Ba50	HD 218915
AB And	50966.5525	3	II	30	V	Bir	Ba50	GSC 2763-0683
	50984.4725	4	II		V	Bir	Ba50	
	51016.5015	1	I	41	V	Bor	Ba50	
OO Aql	50950.481:	1	I	19	V	Bor	Ba50	HD 187146
	50956.5604:	2	I	61	V	Bir	Ba50	
	50967.4608	1	II	45	V	Bor	Ba50	
Y Cam	50872.4601	3	I	77	-	Bor	Ba50	GSC 4527-1983
AS Cam	50900.346	1	II	163	V	Bor	Ba50	GSC 4347-0466
RZ Cas	50871.4266	3	I	414	-	Bor	Ba50	GSC 4317-1578
TV Cas	51005.45:	1	II	190	V	Bir	Ba50	GSC 3665-0026
PV Cas	51015.5270	5	I	55	V	Bir	Ba50	GSC 4010-1432
VW Cep	50871.6230	5	I	102	-	Bor	Ba50	GSC 4585-2387
	50900.5689	3	I	54	V	Bor	Ba50	
	50941.3418	3	II	51	V,B,R	Bor	Ba50	
	50941.4834	3	I	61	V,B,R	Bor	Ba50	
	50942.4549	5	II	59	V,B,R	Bir	Ba50	
	50942.5966	5	I	28	V,B,R	Bir	Ba50	
XX Cep	51018.520:	6	II	91	V	Bor	Ba50	GSC 4288-0186
CQ Cep	50948.5421	6	I	200	V	Bir	Ba50	GSC 3991-1316
DL Cyg	51038.487	3	I	170	V,R	Bor	Ba50	GSC 3595-0816
MR Cyg	50962.4964	1	II	87	V	Bir	Ba50	GSC 3609-1220
	51014.4840	5	II	124	V	Bir	Ba50	
V477 Cyg	50974.4021	2	I	53	V	Bor	Ba50	GSC 2674-0910
AK Her	50865.6038	2	I	53	V,B	Bir	Pi50	BD+16°3123
	50866.6560	1	II	78	-	Bor	Ba50	GSC 1536-0928
	50884.5662	2	I	82	V	Bor	Ba50	
	50903.5338	3	I	78	V	Bir	Ba50	
	50971.4000	3	I	266	R	Bor	Ba50	
GU Her	50970.429	2	I	215	-	Bor	Ba50	GSC 2581-2418
	50983.4640	3	I	200	-	Bir	Ba50	
	51033.424	4	II		-	Bir	Ba50	
HS Her	50945.4690	2	I	283	V	Bir	Ba50	GSC 2113-2242
	50972.4898	3	II	343	V	Bir	Ba50	
	50981.4969	3	I	125	V	Bir	Ba50	
MM Her	50940.5600	5	I	182	V	Bir	Ba50	GSC 1565-2199
SW Lac	50961.518	1	II	49	V	Bir	Ba50	GSC 3215-0906
	50986.5360	1	II	54	V	Bir	Ba50	
	51017.4840	1	I	35	V	Bor	Ba50	
UV Leo	50899.3944	1	II	60	V	Bir	Ba50	GSC 0845-0121
GP Vul	50946.4597	8	II	65	V	Bir	Ba50	GSC 2151-2731

Remarks on some of the variables:

HS Her: We suspect the star GSC 2113-1658 in the field of HS Herculis to be variable.

PV Cas: In our last minima list (Bíró et al., 1998) we reported that 'GSC 4010-1432 showed variations of about 0.8 mag against the check star GSC 4010-1545, and some other fainter stars in the CCD frame'. On the night 21/22 July we couldn't find any variability in its brightness.

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Bíró I. B., Borkovits T., Hegedüs T., Paragi Zs., 1998, *IBVS* No. 4555

ERRATA

In IBVS Nos. 4555 and 4633 we presented CCD photometric minima observations (together with photoelectric ones) of several eclipsing binary systems. Due to an unfortunate programming bug most of the minimum times have an error in the third decimal place of JD. This erratum contains the corrected moments of minima. Table 1 shows the corrigenda to IBVS No. 4555. Table 2 should be used as a total replacement of the Table of IBVS No. 4633.

Table 1

Star	Min. HJD +2400000	Star	Min. HJD +2400000
AS Cam	50519.5238	V453 Cyg	50235.4843
PV Cas	50244.4435	V477 Cyg	50237.4480
GK Cep	50210.453	V1136 Cyg	50270.4694
	50225.4297	DI Her	50238.4929
MR Cyg	50230.4608	UV Leo	50513.5487

Table 2

Star	Min. HJD +2400000	error ±	Min. type	Points used	Filter	Obs.'s name	Instr.	Comp.
RT And	50964.5050	2	I	51	V	Bir	Ba50	HD 218915
AB And	50966.5525	3	II	30	V	Bir	Ba50	GSC 2763-0683
	50984.4721	4	II		V	Bir	Ba50	
	51016.5005	1	I	41	V	Bor	Ba50	
OO Aql	50950.486:	1	I	19	V	Bor	Ba50	HD 187146
	50956.5658:	2	I	61	V	Bir	Ba50	
	50967.4659	1	II	45	V	Bor	Ba50	
Y Cam	50872.4672	3	I	77	-	Bor	Ba50	GSC 4527-1983
AS Cam	50900.351	1	II	163	V	Bor	Ba50	GSC 4347-0466
RZ Cas	50871.4318	3	I	414	-	Bor	Ba50	GSC 4317-1578
TV Cas	51005.45:	1	II	190	V	Bir	Ba50	GSC 3665-0026
PV Cas	51015.5244	5	I	55	V	Bir	Ba50	GSC 4010-1432
VW Cep	50871.6279	5	I	102	-	Bor	Ba50	GSC 4585-2387
	50900.5736	3	I	54	V	Bor	Ba50	
	50941.3443	3	II	51	V,B,R	Bor	Ba50	
	50941.4859	3	I	61	V,B,R	Bor	Ba50	
	50942.4573	5	II	59	V,B,R	Bir	Ba50	
	50942.5990	5	I	28	V,B,R	Bir	Ba50	
XX Cep	51018.517:	6	II	91	V	Bor	Ba50	GSC 4288-0186
CQ Cep	50948.5431	6	I	200	V	Bir	Ba50	GSC 3991-1316
DL Cyg	51038.485	3	I	170	V,R	Bor	Ba50	GSC 3595-0816
MR Cyg	50962.4954	1	II	87	V	Bir	Ba50	GSC 3609-1220
	51014.4830	5	II	124	V	Bir	Ba50	
V477 Cyg	50974.4054	2	I	53	V	Bor	Ba50	GSC 2674-0910
AK Her	50865.6038	2	I	53	V,B	Bir	Pi50	BD+16°3123
	50866.6601	1	II	78	-	Bor	Ba50	GSC 1536-0928
	50884.5722	2	I	82	V	Bor	Ba50	
	50903.5413	3	I	78	V	Bir	Ba50	
	50971.4060	3	I	266	R	Bor	Ba50	

Table 2 (cont.)

Star	Min. HJD +2400000	error ±	Min. type	Points used	Filter	Obs.'s name	Instr.	Comp.
GU Her	50970.434	2	I	215	-	Bor	Ba50	GSC 2581-2418
	50983.4675	3	I	200	-	Bir	Ba50	
	51033.421	4	II		-	Bir	Ba50	
HS Her	50945.4749	2	I	283	V	Bir	Ba50	GSC 2113-2242
	50972.4946	3	II	343	V	Bir	Ba50	
	50981.5011	3	I	125	V	Bir	Ba50	
MM Her	50940.5670	5	I	182	V	Bir	Ba50	GSC 1565-2199
SW Lac	50961.518	1	II	49	V	Bir	Ba50	GSC 3215-0906
	50986.5358	1	II	54	V	Bir	Ba50	
	51017.4831	1	I	35	V	Bor	Ba50	
UV Leo	50899.4051	1	II	60	V	Bir	Ba50	GSC 0845-0121
GP Vul	50946.4643	8	II	65	V	Bir	Ba50	GSC 2151-2731

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SEARCHING THE OPEN CLUSTER NGC 6939 FOR VARIABLE STARS

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Small radial velocity variations in red giants were discovered by Walker et al. (1989) suggesting that corresponding photometric variations might be detectable. Edmonds and Gilliland (1996) discovered photometric variations in the red giant stars in the globular cluster 47 Tucanae, using the Hubble Space Telescope in the ultraviolet. We observed NGC 6939 in an attempt to observe similar variations in an open cluster in the visible part of the spectrum.

Our sixteen nights of observations were made using the 0.5 meter telescope, Cousins R filter and CCD camera of the University of Victoria (Robb and Honkanen 1992). This is an automated system, which will observe a single field all night, keeping a star on the same pixels. Each frame was bias subtracted and flat fielded using IRAF.[1] To isolate merged images the point-spread-function-fitting routines in DAOPHOT (Stetson et al. 1990) were used to find the magnitudes. An ensemble was formed from the brightnesses of the brightest stars and each star was compared with the ensemble to form a differential magnitude, ΔR in the sense of the star minus the ensemble.

The red giant stars measured in common with Mermilliod et al. (1994) are listed in Table 1 with our star identification numbers, Kustner's (1923) identification numbers, the V and B−V found by Mermilliod et al. (1994), the ΔR and the night to night standard deviation.

Table 1: Brightness, color, ΔR, and its precision for the red giants.

Id	K Id	V	B−V	ΔR	StD.	Id	K Id	V	B−V	ΔR	StD.
s1	212	12.03	1.69	2.867	0.002	s3	133	12.27	1.51	3.187	0.005
s4	121	12.53	1.54	3.448	0.003	s6	135	12.58	1.11	3.740	0.002
s8	190	12.73	1.36	3.840	0.005	s9	182	12.92	1.37	3.835	0.003
s10	053	12.86	1.30	3.894	0.004	s11	134	12.95	1.29	4.020	0.004
s12	230	12.90	1.32	4.051	0.005	s13	170	13.13	1.34	4.041	0.003
s15	145	13.05	1.31	4.086	0.002	s18	214	13.00	1.27	4.185	0.006
s19	130	13.10	1.25	4.184	0.003	s20	294	13.19	1.34	4.209	0.012
s24	58	13.32	0.89	4.568	0.002	s26	279	13.73	0.96	4.918	0.010

[1]IRAF is distributed by National Optical Astronomy Observatories, which is operated by the Association of Universities for Research in Astronomy, Inc., under contract to the National Science Foundation

Brightness variations during a night were measured by the standard deviation of the differential magnitudes of that night, which ranged from $0\overset{m}{.}004$ for bright stars on a good night to $0\overset{m}{.}100$ for the faint stars on poor nights. The standard deviation of the sixteen nightly means is a measure of the night to night variations. The high precision of these data can be seen from the standard deviation of ΔR for the bright stars. The fainter stars have the expected larger standard deviation. Plots of the standard deviation versus brightness were made and all outliers were checked for variability.

To find the variable stars the differential magnitude of each star was plotted against the time of day. For each star the sixteen nights were plotted in a four by four array with the brightness and time scales chosen to be the same for all nights. At a glance we could then see both the variations during a night and also from night to night. We checked all 215 stars in this manner and surprisingly found no ambiguity in whether or not a star was variable.

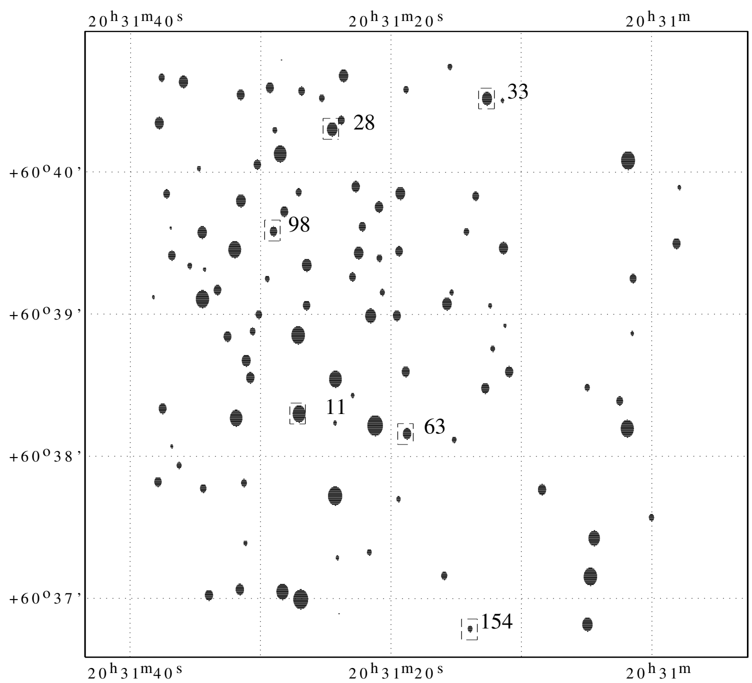

Figure 1. Finder chart labeled with our identification numbers

A finder chart based on our frames is shown in figure 1 with the variable stars marked with our id numbers. Table 2 gives our star identification numbers, Kustner's (1923) id numbers, coordinates (J2000) and magnitudes measured using the Hubble Space Telescope Guide Star Catalog (Jenkner et al., 1990), the period, the epoch with the uncertainty in the final digit in parentheses and the type of epoch.

Each variable star's differential magnitudes were fit to a sine curve of various periods and the χ^2 was used to estimate the best period. Light curves were then plotted at these periods and the aliases and multiples were checked. All the periods are very secure except that of star s11 where the period finding program also found an alias of 1.165 days that was nearly as likely.

The data were binned by JD four points to a bin. The mean magnitudes of each star are plotted against phase in Figure 2 using the period and epoch given in Table 2. The

Table 2: Variable stars discovered in the field of NGC 6939.

Id. No.	Kustner Id	R.A. J2000	Dec. J2000	Mag.	Period [days]	Epoch Helio JD	Epoch Type
s11	K134	$20^h31^m27^s$	$+60°38'18''$	13.3	7.4(6)	2450657.5(7)	max
s28	K125	$20^h31^m25^s$	$+60°40'18''$	14.2	1.30(2)	2450655.75(9)	max
s33	K80	$20^h31^m13^s$	$+60°40'31''$	14.4	10.5(20)	2450654.4(9)	max
s63	K95	$20^h31^m19^s$	$+60°38'10''$	15.1	4.954(3)	2450653.8079(5)	min
s98	K147	$20^h31^m29^s$	$+60°39'35''$	15.6	3.598(3)	2450654.0244(8)	min
s154	-	$20^h31^m14^s$	$+60°36'47''$	16.6	0.3550(6)	2450656.432(5)	min

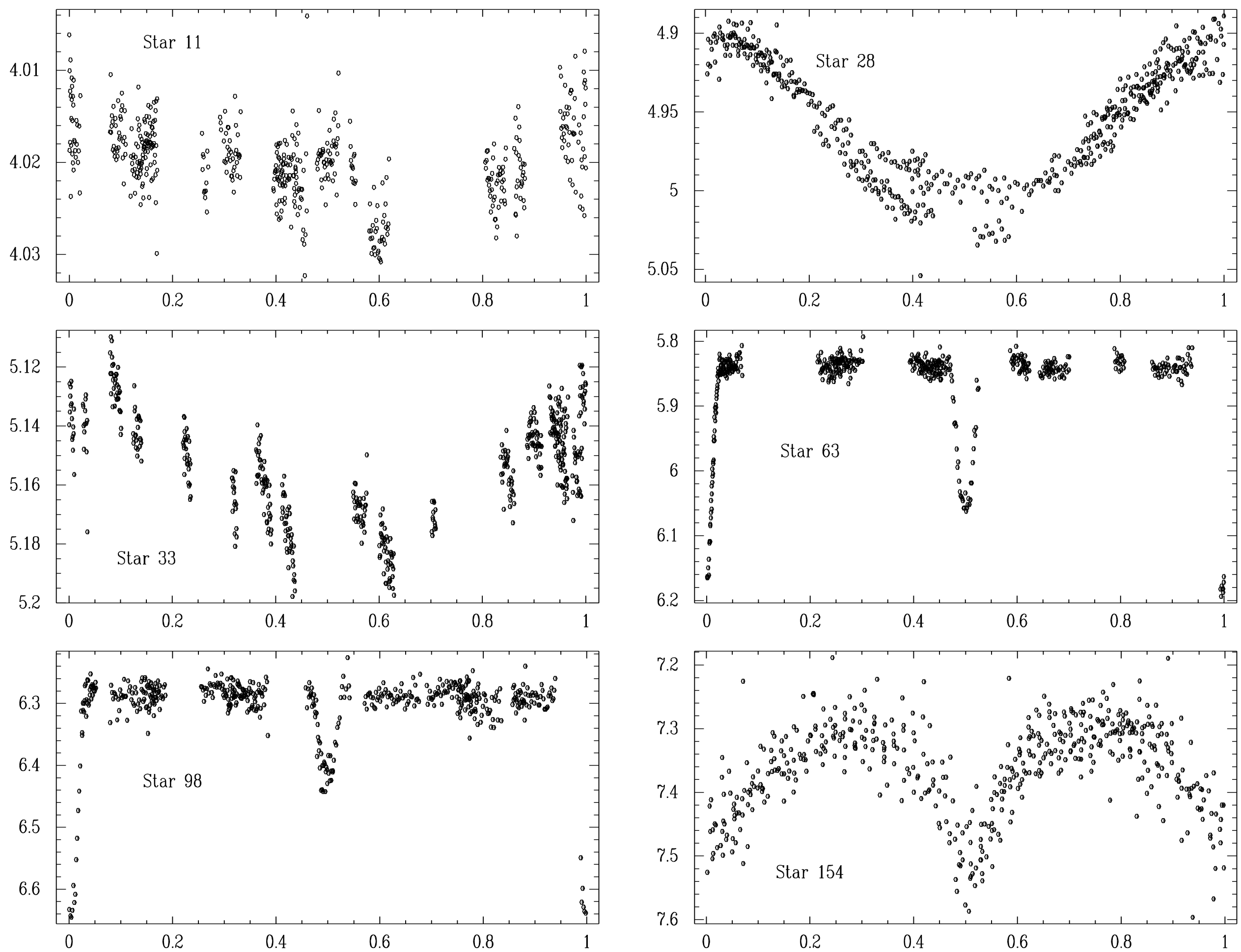

Figure 2. R band light curves of the variable stars in NGC 6939 plotted according to phase.

stars s11, s28 and s33 all lie in the red giant part of the HR diagram but s33 is probably a field star (Cannon and Lloyd 1969). Of the 16 red giants measured by Mermilliod et al. (1994) and ourselves, we find that one is variable (s11), 13 have a standard deviation of $0\overset{m}{.}005$ or less from night to night and the other two were at the extreme corner of the CCD and have a standard deviation of about $0\overset{m}{.}01$. This is in contrast to Jorissen et al. (1997), who propose that all late type stars are variable. S11 was observed for radial velocity by Milone (1994) who found it to have the largest scatter among those stars not considered variable.

Obviously from the light curves the stars s63 and s98 are eclipsing binaries. Using the method of Kwee and van Woerden (1956), heliocentric Julian times of secondary minimum were found to be 2450695.9169(5) for star s63 and 2450691.8036(8) for star s98. From the light curve of s154 we classify it as a contact binary. From our period and the relations of Rucinski (1997) and assuming a reddening of $E_{(B-V)} = 0.43$ (Mermilliod et al. 1994), this W UMa star's apparent brightness is consistent with it being a member of the cluster.

These data show that the K giant variable stars can be observed from the ground in the visible light and that not all red giant stars are variable at the level of accuracy of this work. The two eclipsing binary stars are near the turnoff point of the cluster and so are deserving of more observations especially radial velocity measurements to find the masses of the stars.

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PHOTOELECTRIC BVR$_C$ OBSERVATIONS AND CLASSIFICATION FOR V1359 AQUILAE

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Variability of V1359 Aql was discovered by Henden (1980), who reported 8 UBV measurements spanning 136 days, with the peak-to-peak amplitude being almost 0.2 mag. On the base of those data, the star was classified, in GCVS-IV, as a possible s-Cepheid. But Poretti and Mantegazza (1991) obtained 18 differential measurements in V spanning 35 days and not revealing light variations exceeding 0.02 mag.

Table 1

JD hel 2450000+	V	$B–V$	$V–R_c$	JD hel 2450000+	V	$B–V$	$V–R_c$
0628.3994	9.192	1.362	.780	0984.4104	9.329	1.398	.787
0629.3998	9.212	1.374	.779	0985.4072	9.294	1.390	.777
0632.4030	9.232	1.382	.787	0993.3919	9.226	1.367	.817
0633.3758	9.257	1.370	.789	0995.3875	9.254	1.373	.826
0634.3682	9.239	1.376	.798	0996.4012	9.185	1.373	.812
0635.3788	9.229	1.386	.793	0997.3886	9.235	1.378	.784
0636.3627	9.238	1.391	.783	0998.3714	9.205	1.356	.795
0639.3641	9.300	1.406	.803	0999.3707	9.203	1.363	.754
0644.3370	9.261	1.359	.826	1000.3652	9.175	1.358	.809
0647.2855	9.199	1.352	.769	1002.3837	9.166	1.371	.771
0648.2862	9.142	1.383	.741	1003.3593	9.181	1.346	.796
0650.3428	9.114	1.362	.726	1004.3597	9.167	1.370	.778
0651.3141	9.111	1.358	.744	1006.3510	9.165	1.383	.782
0652.3401	9.112	1.384	.815	1007.3599	9.178	1.358	.790
0653.3059	9.143	1.352	.730	1008.3431	9.186	1.340	.810
0654.3272	9.111	1.348	.813	1026.3536	9.161	1.327	.788
0657.2983	9.099	1.325	.794	1035.3607	9.077	1.360	.759
0972.4446	9.275	1.373	.813	1037.2621	9.083	1.302	.800
0973.4341	9.295	1.401	.811	1038.2504	9.073	1.309	.771
0982.4273	9.293	1.363	.793	1041.2531	9.051	1.305	.782
0983.4095	9.291	1.388	.773	1042.2206	9.060	1.305	.799

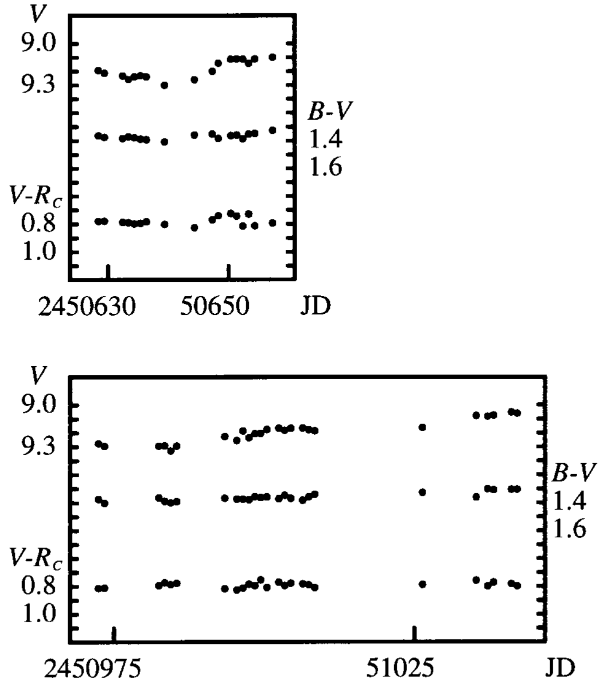

Figure 1.

To clarify the situation, Berdnikov and Turner (1995a,b) and Berdnikov and Vozyakova (1995) conducted photoelectric monitoring of V1359 Aql during three observing runs, and it was found that the data in each individual run confirm the conclusion of Poretti and Mantegazza (1991), however there exist small differences of the mean brightness between runs. As a result, Berdnikov and Turner (1995a) concluded that if these differences were real V1359 Aql might be classified as a semiregular variable.

To solve the matter, we were continuing to monitor this star with the 60-cm reflector of Mt. Maidanak Observatory (Uzbekistan). During two observing runs in 1997 and 1998, 42 BVR_c photoelectric measurements were obtained (Table 1); the accuracy of the individual data is near 0.01 mag in all filters. The light curves are presented in Figure 1 for each run separately. Trends in the brightness are distinctly seen on both graphs. Therefore, we conclude that, most likely, V1359 Aql is a semiregular variable (judging from its color, of SRD type).

The research described here was supported in part by the Russian Foundation of Basic Research and the State Science and Technology Program "Astronomy". We would also like to express our gratitude to the administration of Mt. Maidanak Observatory for allocating a large amount of observing time.

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THE HERTZSPRUNG SEQUENCE FROM RADIAL VELOCITIES

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In the 1920ies, photometric data accumulated for a large number of Cepheid made it possible to study the shape of Cepheid light curves and to establish an empirical sequence (the so-called Hertzsprung sequence) showing the dependence of the light curve shape upon the value of the period (Hertzsprung, 1926).

Somewhat later, Kukarkin and Parenago (1937), from all light curves of 102 Cepheids published by that time, established the relation between the phase of the secondary maximum (hump) of the light curve upon period: the secondary maximum appears on the descending branch of the light curve for stars with periods around 6 days and then shifts itself towards the maximum, coinciding with the latter at the period of about 10 days. For stars with periods exceeding 10 days, the hump is already observed on the ascending branch.

The secondary details can be also observed on the radial velocity curve. It is believed that the hump on the V_r curve is positioned at the same phase as that on the light curve (Fadeev, 1994). However, this statement should be carefully verified, especially because the shapes of the light curve and the velocity curve are not, generally speaking, a mirror image of each other (Sachkov et al., 1998). The first attempt to present a sequence similar to the Hertzsprung sequence but for the radial velocity curves was made by Joy (1937), but he was unable to succeed because of low accuracy of individual measurements and insufficient number of observations per Cepheid.

In 1987–1998, we acquired about 6000 individual correlation-spectrometer measurements of radial velocities for 128 Cepheids, with typical accuracy about 0.5 km/s (Gorynya et al., 1992, 1996, 1998). For further analysis, we selected radial velocity curves of 36 classical Cepheids best covered by observations. We excluded velocity curves of spectroscopic binaries, double-mode stars, and low-amplitude Cepheids. Thus, our sample contains only DCEP variables according to the classification system of the GCVS (1985), which presumably pulsate in the fundamental mode. These data permitted us, for the first time, to reveal the Hertzsprung sequence quite confidently.

To study the Hertzsprung sequence for the velocity curves, we used the so-called standard curves which fix the shape of the curve for each star. A standard curve is a set of one hundred velocity values for phases from 0 to 0.99 at steps of 0.01, constructed using the method described by Berdnikov (1992). In this process, the observations were fitted, entirely or in pieces, by an appropriate function (a Fourier series, a spline, or a polinomial of the third degree). From the standard curves, the phases of the details under consideration were determined with errors not exceeding 0.05.

Figure 1 shows the dependence of the phase of the secondary minimum (the primary minimum of the radial velocity corresponds to zero phase) upon period; Fig. 2, the dependence of the phase difference between the same detail and the velocity maximum upon period. Figure 3 presents the dependence of the velocity-curve asymmetry upon period. The asymmetry is the duration of the velocity-curve descending branch expressed as a fraction of the period. Obviously each of these plots can be derived from two others.

In these relations, similar to the case of the light-curve analysis, the stars can be readily subdivided into three groups: with periods shorter than 10 days; with periods from 10 to 20 days; and with periods exceeding 20 days. The first and the third groups show the depression on the ascending branch of the radial velocity curve, whereas the second group shows it on the descending branch, the phase of the secondary minimum being essentially constant, about -0.2.

The period grouping of the stars can probably be explained by the different nature of the secondary minimum for different period values, similar to the situation with the secondary maximum of the light curve (Fadeev, 1994).

We are going to extend our sample adding spectroscopic binary Cepheids (pulsational velocity curves). It is planned to study the behavior of the depression in more detail for long-period Cepheids, insufficiently represented in the sample used for this study. Besides that, we are going to study the phase shift between radial velocity curves and light curves; this investigation requires simultaneous sets of spectroscopic and photometric observations (preliminary analysis shows that the phases of the secondary detail are different for light curves and velocity curves; cf., for example, Figure 1 in Sachkov et al., 1996).

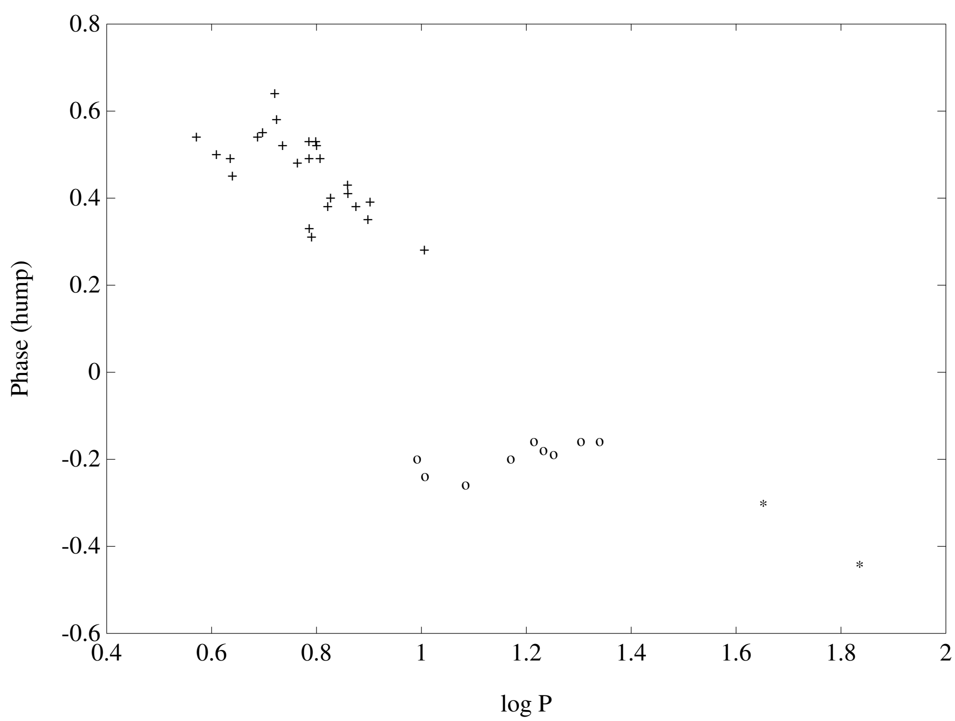

Figure 1. The (period – phase of the secondary minimum) relation. Phases are relative to the minimum of V_r (zero phase) and are expressed as fractions of the period. Crosses, Cepheids with P<10 days; open circles, Cepheids with $10< P <20$ days; asterisks, Cepheids with P>20 days

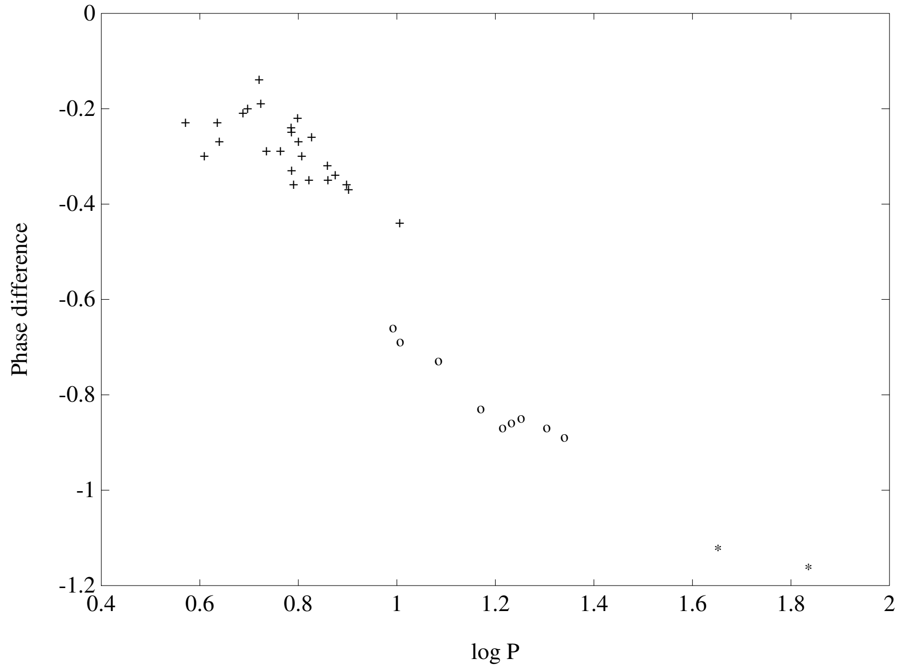

Figure 2. The (period – phase difference between the hump and the radial velocity maximum) relation. Zero phase, maximum V_r. Same notation as in Figure 1

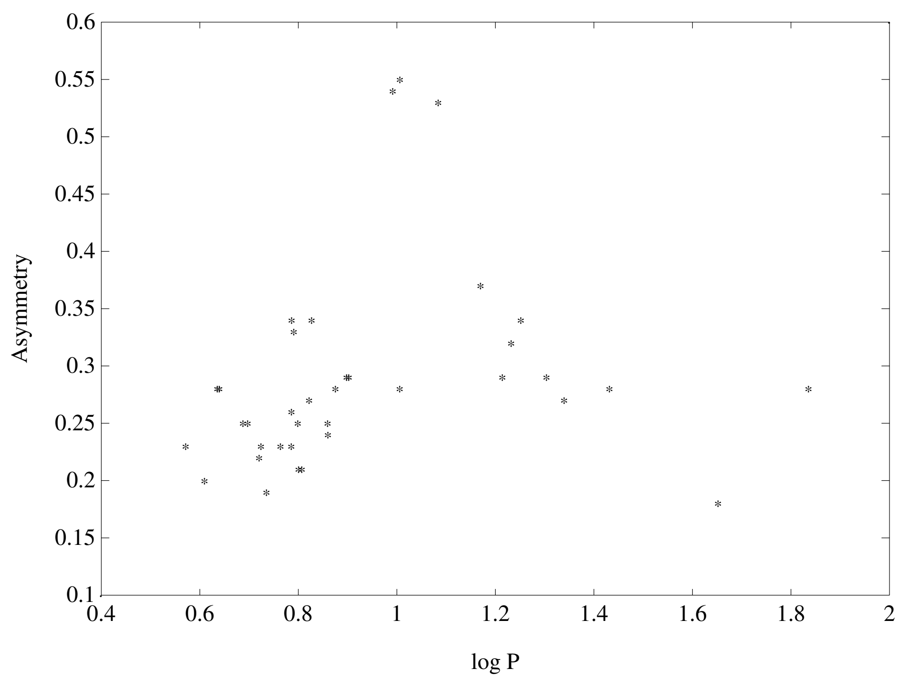

Figure 3. The (period — asymmetry) relation from standard curves. See the definition of the asymmetry in the text

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THE SUPERHUMPS IN V592 HERCULIS[†]

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The first outburst of V592 Her, recorded on Sonneberg plates of 1986, was discovered by Richter (1968). He classified the object as a nova. Later it was re-classified as dwarf nova or x-ray nova because of the shape of its light curve and the blue colour at maximum (Duerbeck 1987). A second outburst in 1986 was reported by Richter (1991). The rareness of outbursts and their large amplitude of about 10 magnitudes led Richter (1991) to re-classify it as recurrent nova or dwarf nova of long cycle time. V592 Her is a potential member of the dwarf nova subtype SU UMa (see, e.g., Warner 1995) – similar to the group of WZ Sge stars, which show rare superoutbursts, but not normal ones.

The most recent outburst started on 1998 August 26.8 (UT), was reported by T. Kinnunen (Waagen 1998), and followed by spectroscopy (R.M.) and photometry (H.D.). Here we present results of the photometric observations.

Differential CCD photometry in B and V was carried out with the 0.91 m Dutch telescope at ESO La Silla. Exposure times were 120 s for the V and 180 s for the B frames. Sky conditions were not always photometric. The position of the object in the northern evening sky permitted runs of about 90 minutes duration. This was sufficient to obtain light curves which clearly show brightness variations.

Photometric reductions were made using daophot in PC-IRAF[1]. Magnitude differences between V592 Her and the mean of the two 15^{m} comparison stars USNO-A1.0 U1050_08092747 and U1050_09092380, located north-west and south-west of the variable, were derived. Light curves, which show the presence of superhumps, are displayed in Fig. 1. Individual data will be published in a forthcoming catalogue of long-term photometry of variables (Sterken et al. 1998).

The form and strength of the superhumps are different in the three nights. Similar variations, also observed in other SU UMa type dwarf novae like HV Vir (Leibowitz et al. 1994), are likely caused by a beat phenomenon between superhump and orbital periods.

A straight line fit was subtracted from the photometric data of the three nights, and the resulting brightness variations were analyzed, using the Period98 programme (Sperl 1997). The most likely period was found to be 0.06005 day in V, and 0.06378 day in B. Other

[†]Based on observations collected at the European Southern Observatory, La Silla, Chile

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

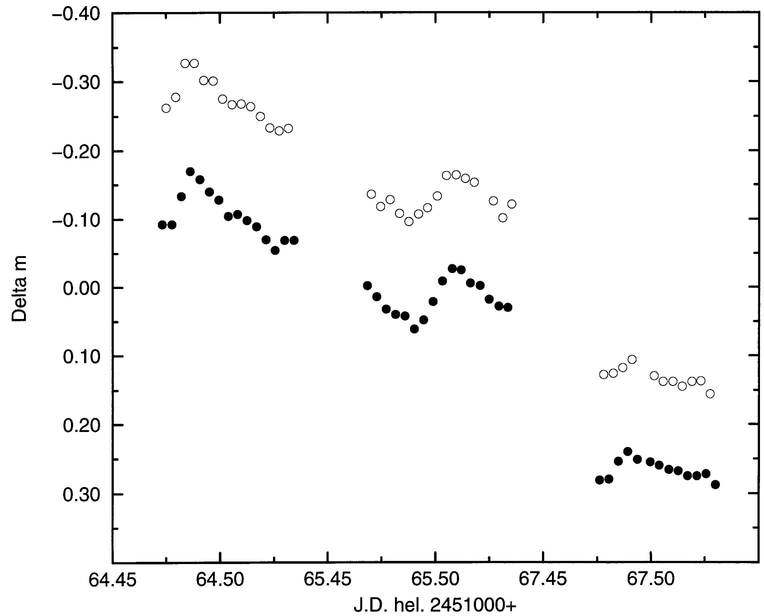

Figure 1. Light curves of V592 Her at superoutburst during the nights 1998 Sept. 7/8, 8/9 and 10/11. V magnitudes are shown as filled circles, B magnitudes as open circles, shifted by $0\overset{m}{.}4$ to fainter values. Magnitude differences are relative to the two comparison stars, as described in the text. Note the breaks in the time axis

neighbouring aliases, 0.05667 and 0.06812 days, can be rejected with high probability. The times of maximum light, averaged from the two light curves, are J.D. hel. (max) = 2 451 064.4852, 2 451 065.5074, and 2 451 067.4888. Using the first and last of these times, the improved possible superhump periods are $P = 0.06007$ and 0.06391 days, respectively, with errors of about ± 0.0002 day.

If we assume that $P = 0.06007$ day is the correct superhump period, the predicted orbital period is $P_{\rm orb} = 0.05898$ day (1.416 hrs), according to the recent calibration of the Schoembs-Stolz relation (Arenas & Mennickent 1998). The longer period predicts the orbital period 0.06239 day (1.497 hrs).

If V592 Her belongs to the WZ Sge group of SU UMa stars, whose members only show the rare superoutbursts and have orbital periods in the range 1.25 and 1.39 hours, the superhump period of 0.06007 days is favored. Additional observations of superhumps and photometry at the very faint ($23^{\rm m}$) minimum stage may give an unambiguous answer.

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CLASSIFICATION OF TY HERCULIS

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The variability of TY Her was reported by Pickering (1909), who noted that the star, whose spectrum was M0, had the photographical peak-to-peak amplitude of 0.8 mag. 53 visual observations, obtained in 1920-23 by Zakharov (1953), showed the same amplitude. But later photographic observations (Böhme, 1939; Gaposchkin, 1950; Zinner, 1952) did not reveal light variations exceeding 0.2 mag, and now this star is suspected in GCVS-IV as a constant one.

We checked the HIPPARCOS photometric data for TY Her (HIP 81291) and found that it was not constant. Figure 1 indicates that the variability is real and there are slow quasi–periodic light variations within the interval of 0.5 mag.

Both the photometric behavior of TY Her, described above, and its spectrum show that, most likely, it is a semiregular variable of type SRB.

The research described here was supported in part by the Russian Foundation of Basic Research and the State Science and Technology Program "Astronomy".

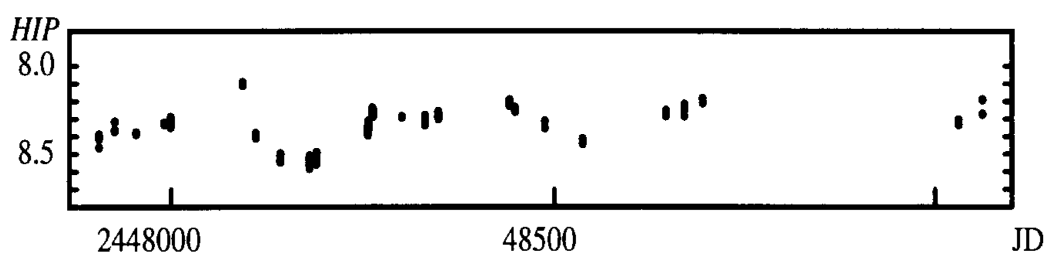

Figure 1.

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TWO LONG-NEGLECTED INTERESTING ECLIPSING BINARIES

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In the course of studying variable stars lacking finding charts or having other identification problems, we have studied two rather interesting eclipsing binaries, VX Sct and V936 Aql.

VX Sct was discovered by Cannon (1924). Oosterhoff (1943) found that it was an Algol star varying between $13\overset{m}{.}6$ and $14\overset{m}{.}2$ (photographic magnitudes) and having the following light elements:

$$\mathrm{Min} = \mathrm{JD}2427926.8 + 33\overset{d}{.}623 \times E. \qquad (1)$$

To our knowledge, no finding chart is available in the literature. Despite that, Szafraniec (1963) published a number of visual observations obtained by several observers and Kreiner (1976) published one uncertain date of minimum.

Using plates of the Maria Mitchell Observatory archive, we have rediscovered and studied the star. It is identical to GSC 5699.5176 ($18^h33^m59\overset{s}{.}64$, $-11°54'57\overset{''}{.}5$, 2000.0). Improved light elements have been determined:

$$\mathrm{Min} = \mathrm{JD}2447359.4 + 33\overset{d}{.}6208 \times E. \qquad (2)$$

Table 1 presents the list of minima from the literature and of definite fadings from our observations, with $(O - C)$ values from the elements (2).

The system is interesting because it probably has giant components and deserves further study.

V936 Aql was discovered by Harwood (1962) and never observed since. Harwood announced the star to be a short-period eclipser varying between $13\overset{m}{.}9$ and $14\overset{m}{.}8$ (photographic magnitudes). In the position shown by Harwood's finding chart, two stars are present in the US Naval Observatory A1.0 catalog: $19^h0^m17\overset{s}{.}48$, $-5°37'50\overset{''}{.}0$ ($m_{blue} = 14\overset{m}{.}5$, $m_{red} = 12\overset{m}{.}6$) and $19^h0^m17\overset{s}{.}16$, $-5°37'57\overset{''}{.}1$ ($m_{blue} = 14\overset{m}{.}4$, $m_{red} = 11\overset{m}{.}7$). The first of the two stars is identical to GSC 5140.2463 ($19^h0^m17\overset{s}{.}48$, $-5°37'49\overset{''}{.}0$, 2000.0).

We estimated V936 Aql on 1167 plates of the MMO collection (7.5-inch Cooke refractor at Nantucket) and on 249 plates of the Moscow archive (40-cm astrograph, first in Kuchino near Moscow, then at the Crimean Laboratory of the Sternberg Astronomical Institute). The plates span the JD interval from 2421871 to 2448397. The photographs show that it is the north-western (GSC) star that really varies. The red companion is almost always considerably fainter than the variable. On MMO plates, the images of the two stars merge

Table 1: Minima of VX Sct

JD 24...	$O-C$	Source	JD 24...	$O-C$	Source
23588.6	$-0\overset{d}{.}9$	Oosterhoff	33507.7	$+0\overset{d}{.}1$	Present paper
23993.6	+0.7	Oosterhoff	33541.6	+0.3	Present paper
25305.65:	+1.5:	Kreiner	33910.5	–0.6	Present paper
27926.9	+0.3	Oosterhoff	34213.7	0.0	Present paper
27960.9	+0.7	Oosterhoff	34650.5	–0.2	Present paper
29104.4	+1.1	Oosterhoff	34651.5	+0.8	Present paper
29136.4	–0.5	Oosterhoff	39761.6	+0.5	Present paper
29439.5	0.0	Oosterhoff	44434.8	+0.4	Present paper
32464.5	–0.9	Present paper	45611.5	+0.4	Present paper
32800.6	–1.0	Present paper	46619.7	0.0	Present paper
32801.6	0.0	Present paper	47358.7	–0.7	Present paper
33506.7	–0.9	Present paper	47393.7	+0.7	Present paper

Table 2: Minima of V936 Aql

JDhel 24...	$O-C$	Source	JDhel 24...	$O-C$	Source
24382.396	$+0\overset{d}{.}008$	MMO	34602.824	$+0\overset{d}{.}008$	MMO
25407.697	–0.012	MMO	35753.885	–0.004	MMO
26217.667:	+0.012:	MMO	38964.265	0.000	Moscow
26513.490	–0.004	MMO	40065.221	–0.005	Moscow
26942.745:	–0.054:	MMO	40808.196	+0.002	Moscow
27284.409	–0.003	MMO	41188.348	–0.002	Moscow
27669.396	+0.007	MMO	41219.667	–0.002	MMO
27988.831	–0.006	MMO	41521.285	–0.003	Moscow
28370.436	–0.005	MMO	42547.565	–0.001	Moscow
28716.872	0.000	MMO	42978.788:	–0.007:	MMO
29051.779:	+0.039:	MMO	43746.826:	+0.009:	MMO
29468.527	+0.011	MMO	44102.390	–0.010	MMO
29845.788	+0.004	MMO	44460.869	–0.006	MMO
32433.659:	+0.006:	MMO	44816.463	+0.006	MMO
32762.737	-0.001	MMO	45519.428	–0.005	MMO
33121.706	+0.011	MMO	46319.738	+0.002	MMO
33481.619	+0.003	MMO	47802.778	+0.002	MMO
33853.578	–0.005	MMO	48090.430	+0.007	Moscow

on many plates, thus making estimates difficult. On Moscow plates, both stars are usually distinctly visible separately.

From our observations, the star is an eclipsing variable, either of Algol type with non-spherical components or even of β Lyr type, with the period as short as $0\overset{\mathrm{d}}{.}48$, more characteristic of EW stars or cataclysmic systems. Moscow plates show variations between $14\overset{\mathrm{m}}{.}0$ and $15\overset{\mathrm{m}}{.}0B$. The secondary minimum, though not deep, is clearly present. The mean light curve from Moscow plates is shown in Figure 1. Dates of minima derived from seasonal light curves are collected in Table 2. The star definitely shows period variations, apparently not abrupt but continuous (see Figure 2). The elements

$$\begin{array}{ll}\mathrm{Min(hel)} = 2424382.388 + 0\overset{\mathrm{d}}{.}48182392 \times E - 4\overset{\mathrm{d}}{.}6 \times 10^{-11} \times E^2 \\ \qquad\qquad\quad \pm 0.003 \pm 0.00000032 \qquad\quad \pm 0.6\end{array} \quad (3)$$

represent the observations quite satisfactory; $(O-C)$ values from elements (3) are presented in the last column of Table 2.

CCD observations of V936 Aql are highly desirable.

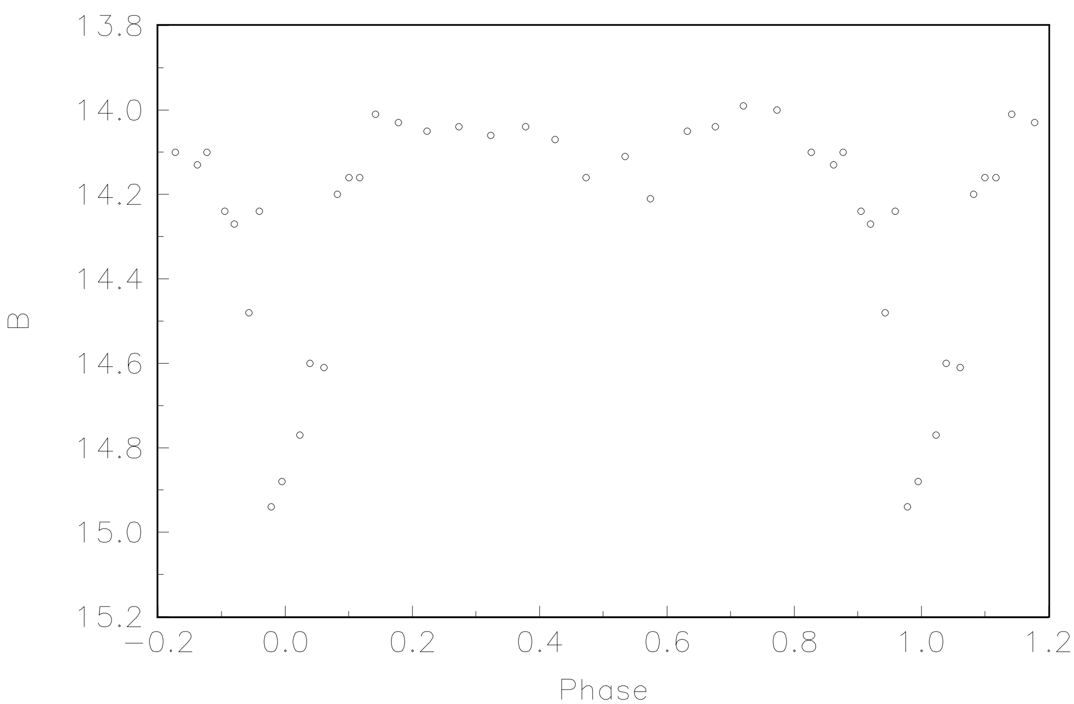

Figure 1. The mean light curve of V936 Aql from Moscow plates

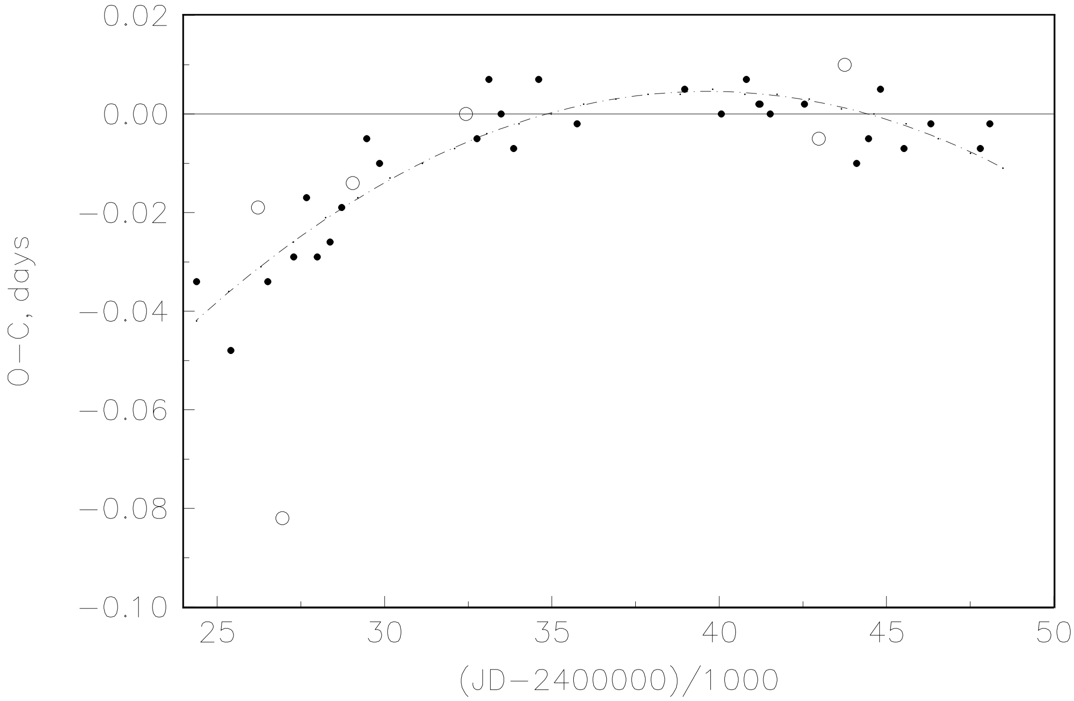

Figure 2. The $O - C$ plot for V936 Aql. The $O - C$ values are from the preliminary linear light elements Min = JD 2441521.285 + $0^{\mathrm{d}}.481821 \times E$. Open circles, uncertain values. The curve is the parabola corresponding to Eq. (3).

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XY BOOTIS – A W UMa-STAR WITH EXTREME RATE OF PERIOD CHANGE

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XY Boo (= BD+20°2874 = GSC 1466.0122 = HIP 67431 = FL 1632 = AN 21.1935 = P 3643; $\alpha = 13^{\rm h}49^{\rm m}11\overset{\rm s}{.}6$, $\delta = +20^\circ 11'24\overset{''}{.}5$, J2000; $V_{max} = 10.3$ mag; Sp. F5V) was discovered as a variable star by Hoffmeister (1935). Tsesevich (1950, 1954) observed this star visually, classified it as an eclipsing binary of W UMa-type and determined the period of 0.31264 day. This period appeared to be discordant with the first photoelectric observations of XY Boo by Hinderer (1960). Therefore Wood (1965) reanalysed Hinderer's photoelectric data and found a new period of 0.37054 day. Binnendijk (1971) published six photoelectric minima timings of XY Boo and revealed remarkable increase in the period. This led him to the calculation of the new linear ephemeris

$$\text{Pri. Min.} = \text{HJD}2440389.7321 + 0\overset{\rm d}{.}37055251 \times E \qquad (1)$$

valid after 1960. Winkler (1977) observed XY Boo photoelectrically in 1976 and derived three times of minimum light. He confirmed the long-term increase in orbital period of this binary system. He also analysed his own and Binnendijk's photoelectric data using the Wilson–Dewinney code to determine geometric parameters of XY Boo. The photometric mass ratio $q = 0.18$ calculated by Winkler was confirmed spectroscopically by McLean and Hilditch (1983) who obtained $q = 0.16$.

Awadalla and Yamasaki (1984) gave two photoelectric times of minima and confirmed the period increase reported by earlier authors. Since that time, more than twenty other photoelectric minima timings have been obtained by Zhang et al. (1991), Agerer (1993, 1994), Diethelm (1994) and Kleikamp (Agerer and Hübscher, 1996). However, no detailed period study of XY Boo has been published so far.

We performed our new CCD photometry of XY Boo during the night of May 8, 1998 at the Ondřejov Observatory, Czech Republic. A 65-cm telescope and the CCD camera SBIG ST-8 with standard R Cousins filter were used. Altogether 175 measurements in R have been obtained (Fig. 1).† The stars GSC 1466.0088 (V = 10.2 mag) and GSC 1466.0010 (V = 10.2 mag) on the same frame as the variable served as a comparison and check stars, respectively. These measurements yielded one moment of secondary minimum.

In addition, four new times of minimum light based on the Hipparcos photometric data were derived. They are included in Table 1 together with the given Hipparcos epoch and

†The table of observational data in ASCII format is available as the 4640-t2.txt file together with the electronic version of the Bulletin.

all other times of minimum of XY Boo available in the literature. A total of 43 moments of minimum spanning the interval 1944–1998 were incorporated in our analysis. Moments of minima denoted in Table 1 as Nos 14 and 15 were excluded due to large deviation. After calculating O$-$C$_1$ residuals with respect to the linear ephemeris (1) (see the fourth column in Table 1) it became evident that the period increase of XY Boo discovered by Binnendijk (1971) still continues. We found out that the description of the long-term course of O$-$C residuals by a parabola is well substantiated even if the period increase has not been strictly continual and a series of discrete period changes took place within the 54 year interval. Consequently, using the method of least squares we calculated the following light elements with a quadratic term

$$\begin{array}{l} \text{Pri. Min.} = \text{HJD}2440389.7345 + 0.3705526 \times E + 3.10 \times 10^{-10} \times E^2, \\ \qquad\qquad\qquad\qquad\quad \pm 6 \qquad\qquad\quad \pm 4 \qquad\qquad\quad \pm 8 \end{array} \quad (2)$$

which can serve also for the prediction of future times of minima. The O$-$C$_2$ residuals calculated with respect to the quadratic elements are given in the fifth column of Table 1. The O$-$C residuals for 43 times of minimum with respect to the linear ephemeris (1) are shown in Figure 2. The non-linear fit corresponding to the elements (2) is plotted as a continuous curve.

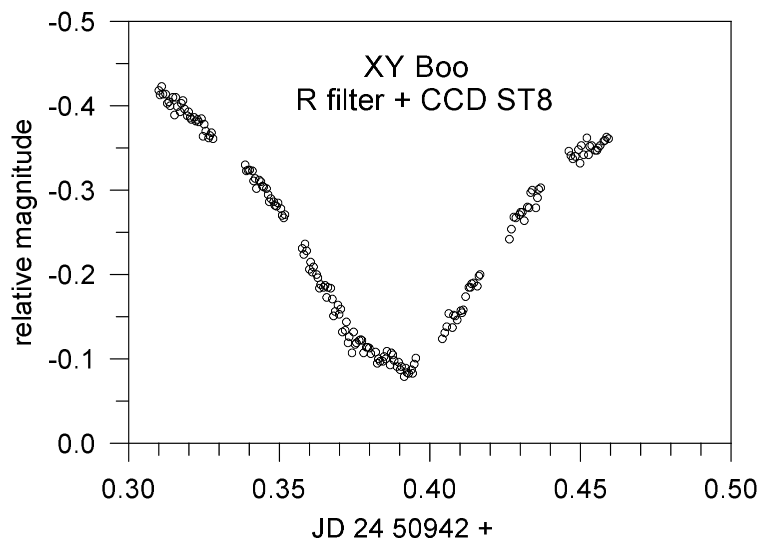

Figure 1. Differential R light curve of XY Boo obtained at JD 2450942.

The period increase by 6.2×10^{-10} day/cycle or 6.12×10^{-7} day/year or 5.3 seconds/century resulting from the elements (2) is extraordinarily large for a W UMa-star. The highest rates of similar long-term period increases in W UMa-stars previously known to us were 3.1 seconds/century in UZ Leo (see Hegedüs & Jäger 1992) and 2.7 seconds/century in V839 Oph (see Wolf et al. 1996). Because the long-term increase in orbital period is usually explained by mass transfer from the secondary to the primary component of given binary we calculated the value of this supposed mass transfer for XY Boo. Adopting the parameters given for this system by Maceroni and Van't Veer (1996) we obtained the value of 1.34×10^{-7} solar masses per year.

XY Boo, as noticed by Kaluzny (1985), has one of the shortest orbital periods for given spectral type (F5). In its position in the period-colour diagram one would expect an unevolved system with components having similar masses but XY Boo seems to be evolved

Table 1: The times of minimum of XY Boo

No.	JD hel 2400000+	Epoch	O−C$_1$ [days]	O−C$_2$ [days]	Method Filter	Reference
1	31215.386	−24759.0	0.164	−0.027	v	Tsesevich, 1957
2	35622.4578	−12865.5	0.0690	0.0165	e	Hinderer, 1960
3	35627.4596	−12852.0	0.0684	0.0159	e	Hinderer, 1960
4	39950.8121	−1184.5	−0.0006	−0.0033	e	Binnendijk, 1971
5	39951.9243	−1181.5	−0.0000	−0.0027	e	Binnendijk, 1971
6	39953.7763	−1176.5	−0.0008	−0.0035	e	Binnendijk, 1971
7	39953.9626	−1176.0	0.0003	−0.0025	e	Binnendijk, 1971
8	40298.9470	−245.0	0.0003	−0.0021	e	Binnendijk, 1971
9	40389.7319	0.0	−0.0002	−0.0026	e	Binnendijk, 1971
10	42183.400	4840.5	0.009	−0.002	e	Pohl & Kizilirmak, 1975
11	42569.7091	5883.0	0.0166	0.0029	e	Winkler, 1977
12	42577.6745	5904.5	0.0151	0.0014	e	Winkler, 1977
13	42582.6769	5918.0	0.0150	0.0013	e	Winkler, 1977
14	44691.386	11608.5	0.095	0.050	e	Diethelm, 1981a
15	44716.390	11676.0	0.087	0.041	e	Diethelm, 1981b
16	45131.3793	12796.0	0.0573	0.0030	e	Awadalla & Yamasaki, 1984
17	45132.3056	12798.5	0.0572	0.0029	e	Awadalla & Yamasaki, 1984
18	46903.4115	17578.0	0.1074	0.0076	e	Diethelm, 1987
19	47288.4252	18617.0	0.1170	0.0055	e	Diethelm, 1988
20	48132.2036	20894.0	0.1478	0.0081	e H	this paper, Hip.
21	48132.3941	20894.5	0.1525	0.0129	e H	this paper, Hip.
22	48334.3320	21439.5	0.1394	−0.0075	e V	Zhang et al., 1991
23	48334.3319	21439.5	0.1393	−0.0076	e B	Zhang et al., 1991
24	48335.2623	21442.0	0.1433	−0.0036	e V	Zhang et al., 1991
25	48335.2624	21442.0	0.1434	−0.0035	e B	Zhang et al., 1991
26	48336.3700	21445.0	0.1393	−0.0076	e V	Zhang et al., 1991
27	48336.3704	21445.0	0.1397	−0.0072	e B	Zhang et al., 1991
28	48363.2365	21517.5	0.1408	−0.0071	e V	Zhang et al., 1991
29	48363.2360	21517.5	0.1403	−0.0076	e B	Zhang et al., 1991
30	48364.1655	21520.0	0.1434	−0.0045	e V	Zhang et al., 1991
31	48364.1660	21520.0	0.1439	−0.0040	e B	Zhang et al., 1991
32	48500.1730	21887.0	0.1581	0.0052	e H	Hipparcos epoch
33	48774.3912	22627.0	0.1673	0.0041	e H	this paper, Hip.
34	48774.5807	22627.5	0.1720	0.0088	e H	this paper, Hip.
35	49130.5078	23588.0	0.1831	0.0061	e B	Agerer, 1993
36	49130.5078	23588.0	0.1831	0.0061	e V	Agerer, 1993
37	49154.4059	23652.5	0.1806	0.0026	e V	Agerer, 1994
38	49154.4091	23652.5	0.1838	0.0058	e B	Agerer, 1994
39	49166.4481	23685.0	0.1798	0.0014	e V	Agerer, 1994
40	49166.4499	23685.0	0.1816	0.0032	e B	Agerer, 1994
41	49504.4082	24597.0	0.1960	0.0038	e B	Agerer, 1994
42	49504.4096	24597.0	0.1974	0.0052	e V	Agerer, 1994
43	49511.4497	24616.0	0.1970	0.0046	e B	Diethelm, 1994
44	49859.4101	25555.0	0.2086	0.0015	CCD	Agerer & Hübscher, 1996
45	50942.3992	28477.5	0.2580	0.0016	CCD R	this paper

Note: in the 6th column “v” means visual, “e” photoelectric observation.

and the mass ratio of its components is approximately 6:1. This makes the explanation of evolution of this system difficult. Further observations are needed to decide about the true nature of period changes as well as evolutionary status of this interesting system.

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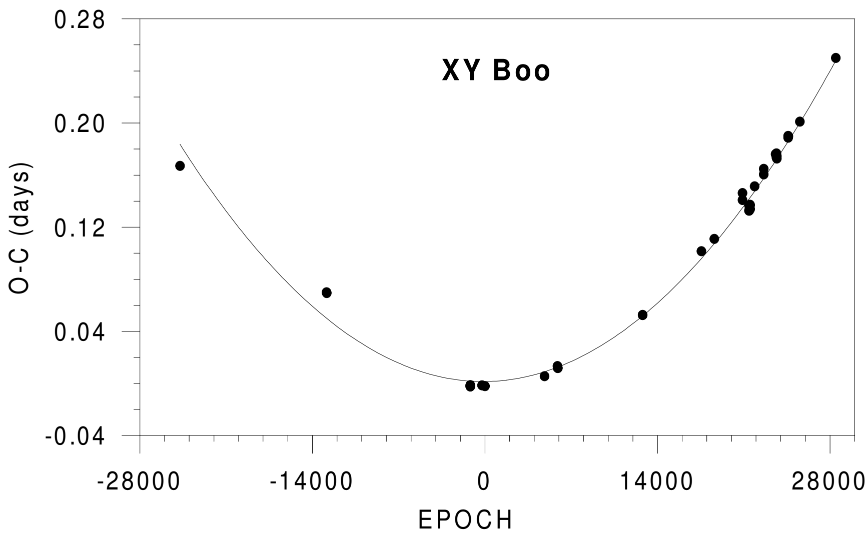

Figure 2. O–C diagram of XY Boo.

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UBV PHOTOMETRY OF P CYGNI IN 1995–1997

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P Cygni (HD 193237, Ia^+, B1), along with Eta Car and S Dor, is one of the prototypes of a group of stars now known as luminous blue variables (LBVs). In view of the current stellar models (Langer & El Eid, 1986; Maeder & Meynet, 1987; Langer et al., 1994) the LBV phase is an extremely short – about 10^4 years – but very attractive period in the evolution of the very massive stars with $120M_{\odot} > M_{init} > 50M_{\odot}$. During this phase, located close to the Humphreys–Davidson limit at the top of the HR diagram, the stars are highly unstable showing different kinds of photometric (microvariations of $\leq 0\overset{m}{.}2$, moderate variations of 1 to 2^{m}, eruptions of $\geq 3^{m}$ etc.) and spectral (temperature, line-profile) variations. Irrespective of the large number of theoretical and observational works, published in the last 15 years, the fundamental question concerning the causes of these variations is still open. It is clear, however, that the only way to come nearer to the understanding of the LBV phenomenon is to gain more and more observational data for as many stars as possible and to analyse them in detail in view of the current theoretical models. In this respect, the works of van Genderen, Sterken and de Groot (1997, 1998) and Sterken, de Groot and van Genderen (1998), devoted to the photometric variability of LBVs in the Galaxy and the Large and Small MCs, are really demonstrative.

UBV photometry of P Cygni was carried out using a single channel photoelectric photometer attached to the 0.6 m Cassegrain telescope of the National Astronomical Observatory, Bulgaria. The stars 36 Cyg (V=$5\overset{m}{.}594$, B=$5\overset{m}{.}642$, U=$5\overset{m}{.}67$) and HR7757 (V=$6\overset{m}{.}48$, B−V=$-0\overset{m}{.}090$, U−B=$-0\overset{m}{.}410$) were used as a comparison and a check star, respectively. The observations cover the period 1995–1997. Comparing the observed photometric characteristics of the check star with the adopted ones we found that the check was systematically fainter by about 0.01 to $0\overset{m}{.}02$ in V and brighter by about 0.03 to $0\overset{m}{.}05$ in U while the B values agreed in the range of $\pm 0\overset{m}{.}01$. The correction applied to the B−V and U−B observational data equals, respectively, $-0.017\pm 0\overset{m}{.}004$ and $-0.038\pm 0\overset{m}{.}007$. The corrected values are listed in Table 1. The accuracy of the given estimates is better than $0\overset{m}{.}01$ in V and B−V and about $0\overset{m}{.}02$ in U−B.

The light and colour curves of P Cygni are shown in Figure 1. According to our data the star seems to have been on average fainter and bluer than it was at the beginning of the current decade (Markova, Scuderi and de Groot, 1998). The overall average amounts to 4.836±0.027 (4.77±0.003), 0.374±0.01 (0.382±0.001) for V and B−V, respectively. The values in brackets refer to the epoch of maximum light, namely 1992 (Markova et al., 1998). The only notable event during our observational run was the rapid decrease in brightness, by about $0\overset{m}{.}145$, between JD 2450267 and JD 2450297. The amplitude of

Table 1: Photometric observations of P Cygni

JD 2440000+	n	V	B−V	U−B
9993.360	2	4.854	0.360	−0.575
9996.416	2	4.823	0.383	−0.566
10267.389	1	4.720	0.383	−0.575
10295.418	2	4.820	0.389	−0.564
10296.470	3	4.851	0.373	−0.532
10297.388	2	4.863	0.380	−0.549
10629.512	3	4.850	0.381	−0.573
10698.330	4	4.851	0.376	−0.576
10702.330	2	4.823	0.370	−0.573
10739.266	1	4.789	0.361	−0.567
10742.250	2	4.820	0.363	−0.579

this variation exceeds the corresponding standard deviation by more than four times and therefore, should be regarded as real. The colour behaviour of the variation in U−B is redder when faint whereas in B−V no significant changes were observed.

The time variations of the effective temperature, T_{eff}, the radius, R_* and the bolometric luminosity, M_{bol}, can be estimated from the photometric data. However, since the absolute values obtained from the analysis of these data are rather uncertain we determined only the relative variations of these parameters. Relative variations in the effective temperature, $\delta T/T_{eff}$, were estimated from the observed values of U−B colour index corrected for interstellar extinction E(B−V)=0.63 (Lamers et al., 1983). To calculate T_{eff} we used the compilations of the intrinsic colours $(B-V)_0$ and $(U-B)_0$ versus T_{eff} for normal supergiants of luminosity class Ia, given by Schmidt-Kaler (Schmidt-Kaler, 1982, for more information see also Scuderi et al., 1994). Relative variations in the bolometric magnitude, $\delta M_{bol}/M_{bol}$, and stellar radius, $\delta R/R_*$, were determined by calculating the corresponding parameters by means of the well known relations

$$\log \mathrm{R}_* = -0.2\mathrm{M}_{bol} - 2\log(\mathrm{T}_{eff}) + 8.46 \quad (1)$$

$$\mathrm{M}_{bol} = \mathrm{m}_v + BC + 5 - 5\lg \mathrm{d} - \mathrm{A}_v \quad (2)$$

where BC is the bolometric correction, d is the distance to the star, m_v means apparent magnitude in V band and $A_v = 1.95$. BC was calculated by means of a relationship BC vs. T_{eff} for normal supergiants (Schmidt-Kaler, 1982). We adopted d = 1.8 kpc (Lamers et al. 1983). The obtained estimates for the three parameters as a function of time are shown in Figure 2. We see that the effective temperature varies in the range of ±10 per cent while the relative variations in the R_{ast} and M_{bol} are smaller – about 6 and 3 per cent, respectively. Because the precision of the relative variations is about 6, 3 and 2 per cent, respectively, in the T_{eff}, R_* and M_{bol}, we conclude that the first two quantities show real variations while the last one seems to remain constant in the frame of error. In addition, we also found that the rapid decrease in brightness observed between JD 2450267 and JD 2450297 was accompanied by a decrease in the T_{eff} and by increasing the stellar radius.

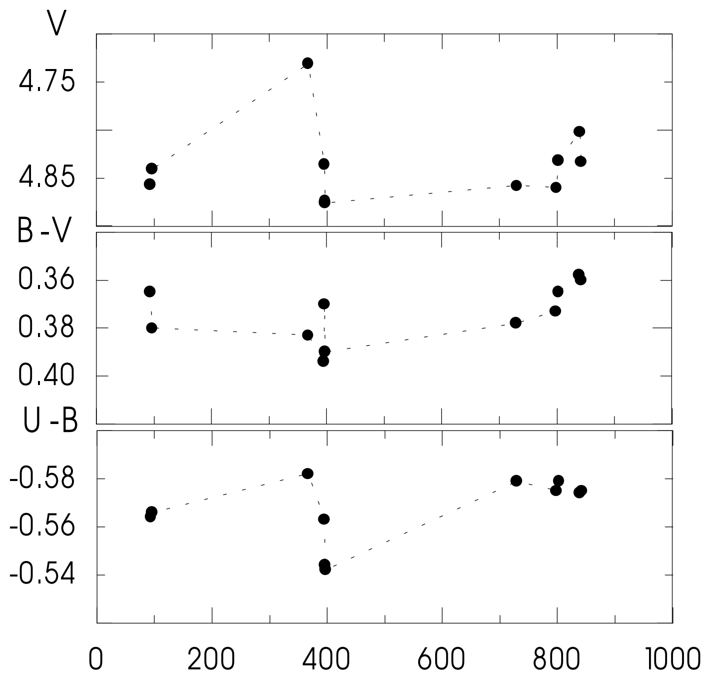

Figure 1. The light and colour curves of P Cygni as a function of time – JD 2449900.

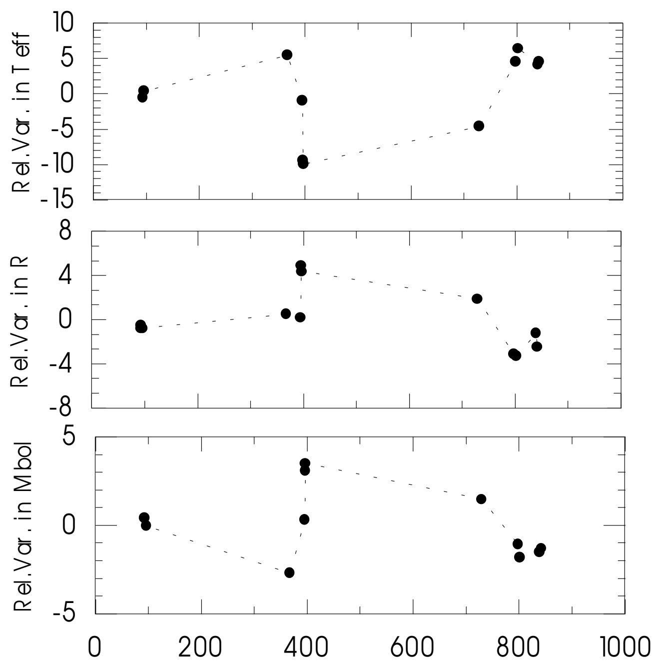

Figure 2. Relative variations in the effective temperature, radius and bolometric luminosity of P Cygni as a function of time – JD 2449900

According to van Genderen et al. (1997, 1998) and Sterken et al. (1998) LBVs show two types of S Dor phases: the very long-term (VLT-SD) and the normal SD phases (colour behaviour redder when brighter). The later are superimposed on the former. Time-scales lie between 1.4 and 25 y. During the SD cycles two types of micro-variations with an amplitude of about $0\overset{m}{.}2$ are present: one near the minima called "α Cyg-type variations" – quasi-periods of 2–6 weeks and colour curves generally blue in the maxima and red in the minima – and the other one near the maxima called "100d micro-variations" – colours generally red in the maxima and blue in the minima. Recently Markova, Scuderi and de Groot (1998) have shown that the photometric behaviour of P Cygni seems to be similar to that of other LBVs. Based on extensive UBV photometry covering the period from 1989 to 1994 the authors found evidence for a long term brightness variation with an amplitude of at least $0\overset{m}{.}1$ that lasts 4.7 years or more. The colour became redder during the brightness increase, at least in B−V, thus suggesting the star exhibited a part of a normal SD phase during that time. Superimposed on this SD phase Markova et al. (1998) observed a number of micro-variations with main characteristics – amplitude of about $0\overset{m}{.}1$ to $0\overset{m}{.}2$, peak-to-peak time scale of three to four months and mixed colour behaviour – more or less similar to that of the "100d micro-variations". In view of the above facts we suggest that during 1995–1997 P Cygni was probably at or near the minima of one SD cycle – the star was fainter and bluer than three years before, namely in 1992 (see Markova, Scuderi and de Groot, 1998). With respect to the rapid decrease in brightness observed between JD 2450267 and JD 2450297 it seems not possible to specify – based on the available data – if this was a descending branch of an "α Cyg-type" or of "100d-type" variation. Nevertheless, the colour behaviour of the variation, at least in U−B, as well as the possibility it has appeared near minimum light suggest classification as of the "α Cyg type".

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NEW VARIABLE STARS IN THE NORTHERN MILKY WAY

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This report summarizes the results of a variable-star search in the $20^\circ \times 15^\circ$ area centered at $20^{h}18^{m}$, $+60^\circ$ (1950). Five similar fields have been previously described (Dahlmark 1982, 1986, 1993, 1996, 1997). The two earliest reports describe the camera systems used for the survey.

Sixteen yellow/blue plate pairs (Kodak 103a-D + GG11 filter and 103-O unfiltered) were exposed between 1967 and 1981, and forty-seven films (Kodak TechPan 4415 + GG495 filter) taken in the years 1987 to 1998. Four exposures with a 200/210/300mm Schmidt camera taken 1995–97 on TechPan without a filter were also examined and used to prepare finding charts. Ten plate or film pairs were scanned for variables with a blink comparator and with four stereo comparators used in tandem. Magnitudes were determined in a stereomicroscope using comparison stars taken from the Guide Star Catalogue (GSC, Lasker *et al.* 1990). The yellow-light magnitudes 'm_v' shown in Table 2 are thus tied to the GSC (northern) magnitude scale and will be systematically somewhat brighter than standard Johnson V.

In this field 35 variables were found, two of which were later identified with known variables after correcting for position errors in the GCVS4. In addition, data for six designated but poorly-studied variables were analyzed. Improved coordinates and elements are provided for these. Table 1 shows positions and identifications. The coordinates were drawn from the GSC (source code G) or from the more comprehensive USNO–A1.0 catalogue (code A, Monet *et al.* 1996); for a few stars not appearing in either of these, positions were estimated ($\pm 2''$) using the Digitized Sky Survey via the Goddard SkyView facility (code S, McGlynn *et al.* 1996). An asterisk by the star name indicates a note at the bottom of the table. For the reddest stars, $b{-}r$ colors from USNO–A1.0 are shown; these are not calibrated to any standard system, but serve to indicate in a qualitative way those stars of extreme color.

The lightcurves are based on 65 magnitude estimates for each star. From these the range, approximate color-index, provisional variability type, epoch of maximum, and period have been determined. These elements are collected in Table 2.

The finder charts show a field of $15' \times 15'$ centered on the variables; north is up and east to the left.

I would like to thank Brian Skiff (Lowell Observatory) for his assistance in obtaining identifications and precise positions for the stars.

Table 1: Positions and identifications

Name	RA (2000)	Dec	s	GSC	IRAS	Remarks
LD 281	18 49 51.0	+62 17 25	G	4219-2324	18493+6213	
LD 282	19 07 56.6	+59 23 52	G	3932-0152		
LD 283	19 26 36.5	+58 52 41	G	3933-0532		
LD 284	19 30 51.5	+59 20 03	G	3933-0464	19300+5913	
LD 285	19 35 03.1	+62 19 46	A			
LD 286*	19 35 18.9	+54 39 53	A			FBS 1934+545
LD 287	19 47 53.2	+51 45 15	G	3569-1495		
LD 288	20 04 29.3	+53 21 50	G	3936-1293		
LD 289	20 05 23.6	+63 24 57	G	4236-1227		
LD 290	20 13 42.7	+65 56 28	A		20132+6547	
LD 291	20 14 32.1	+52 59 36	A			
LD 292	20 15 59.0	+63 46 32	G	4240-1183		
LD 293	20 18 45.0	+62 32 45	G	4237-1933		
LD 294*	20 20 16.9	+55 08 57	G	3941-1952	20190+5459	V770 Cyg; b–r = 4.8
LD 295*	20 21 49.5	+53 01 25	S		20204+5251	
LD 296	20 23 19.6	+65 28 18	G	4241-1345	20227+6518	
LD 297	20 29 05.8	+64 17 43	G	4241-1140		
LD 298*	20 29 11.7	+64 16 23	A		20284+6406	
LD 299	20 33 23.5	+61 52 30	A			faint companion on E
LD 300	20 35 15.0	+61 05 48	A		20342+6055	
LD 301*	20 35 13.8	+55 58 51	A			V566 Cyg
LD 302	20 36 31.9	+53 26 17	A		20351+5315	
LD 303	20 44 05.7	+54 33 52	A		20427+5422	b–r = 7.4
LD 304	20 47 16.7	+60 35 27	A		20461+6024	
LD 305	20 47 30.6	+61 38 12	A		20464+6127	
LD 306	20 48 55.9	+63 26 26	S		20480+6315	
LD 307	20 55 47.4	+58 15 18	A			b–r = 5.0
LD 308*	20 56 24.5	+52 56 58	S		20549+5245	M8
LD 309	21 00 41.7	+58 05 09	S		20593+5753	southeastern of two
LD 310	21 03 26.9	+59 58 30	A		21021+5946	b–r = 5.3
LD 311	21 06 52.0	+58 04 45	A			
LD 312	21 10 58.0	+58 01 03	G	3961-0044		b–r = 5.2
LD 313	21 17 07.5	+55 30 22	A		21156+5517	
LD 314	21 17 14.5	+54 24 42	G	3957-0169	21156+5412	
LD 315	21 31 11.1	+64 27 36	G	4257-0783	21300+6414	
HH Cep	20 18 43.6	+60 36 14	A		20177+6026	
V1198 Cyg	20 32 22.3	+52 19 42	A			b–r = 6.1
UW Cep	20 59 23.0	+58 53 33	A	3964-0838	20581+5841	b–r = 5.5
UX Cep	21 03 54.7	+55 27 51	A		21024+5515	
V339 Cep	21 11 45.4	+57 42 49	A		21103+5730	
V341 Cep	21 13 23.7	+58 02 48	A	3961-0207	21120+5750	

Notes:

LD 286 b–r = 7.0; carbon Mira according to Abrahamian & Gigoian (1993).

LD 294 GCVS4 position in error; identification verified on MVS 290.

LD 295 faint companion 5″ south.

LD 298 southwestern of two; the variable is itself a close double.

LD 301 GCVS4 position in error; identification verified on MVS 290.

LD 308 spectral type from Kwok *et al.* (1997).

Table 2: Elements of variation

Name	max min (m_v)	m_b–m_v	type	epoch JD 2400000+	period (days)
LD 281	11.1 – 14.9	2.4	M	50746	312
LD 282*	11.8 – 14.8	0	EA	49681	short
LD 283	12.8 – >16.0	1.2	M	50746	244
LD 284	10.4 – 14.5	1.0	M	50806	298
LD 285	13.5 – 14.7	0	Ia	50189	269:
LD 286	12.9 – 15.0	0.7	SRa	50715	300
LD 287	12.3 – 14.9	>0.7	SRa	50715	312
LD 288	12.3 – 14.3	1.4	Lb		
LD 289*	12.0 – 14.4	0	E		27?
LD 290	11.5 – >15.5	1.5	M	50388	269
LD 291	13.4 – 15.5	0.9	SRa	50835	318
LD 292*	13.0 – 15.8	0.6	SRb	49843	272
LD 293	11.8 – >16.2	1.7	M	50776	300
LD 294*	11.9 – 15.6	2.1	M	50835	314
LD 295	12.7 – >15.2	>0.9	M	50572	345
LD 296	11.8 – 15.8	2	M	50546	352
LD 297	13.1 – 14.4	1.0	Lb		
LD 298	11.9 – 15.4	1.2	M	50636	260
LD 299*	13.1 – 14.7	>1	SRb		
LD 300	13.4 – >16.2	>0.9	Lb		
LD 301*	12.3 – >16.2	1.0	M	50636	224
LD 302	12.1 – 14.4	1.9	SRa	50776	457
LD 303	12.8 – 14.0	>0.7	SRa	50690	375
LD 304	13.2 – >16.2	0.7	SRd	50599	297
LD 305	12.3 – >16.2	>2	M	50746	362
LD 306	12.3 – >16.0	>1.2	Lb		
LD 307	13.0 – >16.0		M?	49569	272
LD 308	13.7 – >16.0		L		
LD 309	14.2 – >16.0		SRa?	50596	351
LD 310	12.4 – 15.3	1.4	M	50018	363
LD 311	13.6 – 14.6		L		
LD 312	13.7 – 16.0	>0.7	SRa	50690	350
LD 313	12.1 – 14.6	>1.6	M	50388	491
LD 314	12.0 – 15.5	1.7	M	50249	337
LD 315	12.6 – >16.0	>1.1	M	50820	333
HH Cep	12.1 – 14.2	>1.2	SRa	50746	278
V1198 Cyg	11.7 – 15.5	1.5	M	50599	400
UW Cep	10.5 – 15.9	2.3	M	50806	472
UX Cep	12.2 – >16.0	>1	M	50746	191
V339 Cep	14.2 – 16.0		SRb	50690	340:
V341 Cep	13.7 – 16.0		SRa	50835	332

Notes:

LD 282 four dimmings observed, of which two were within one hour of normal brightness.

LD 289 period is possibly a shorter fraction of 27^d.

LD 292 period fluctuates by $\pm 20^d$.

LD 294 V770 Cyg; GCVS period (156^d) is closely one-half the present determination.

LD 299 cyclic variations in the range 400^d– 450^d.

LD 301 V566 Cyg; GCVS period ($226^d.3$) confirmed.

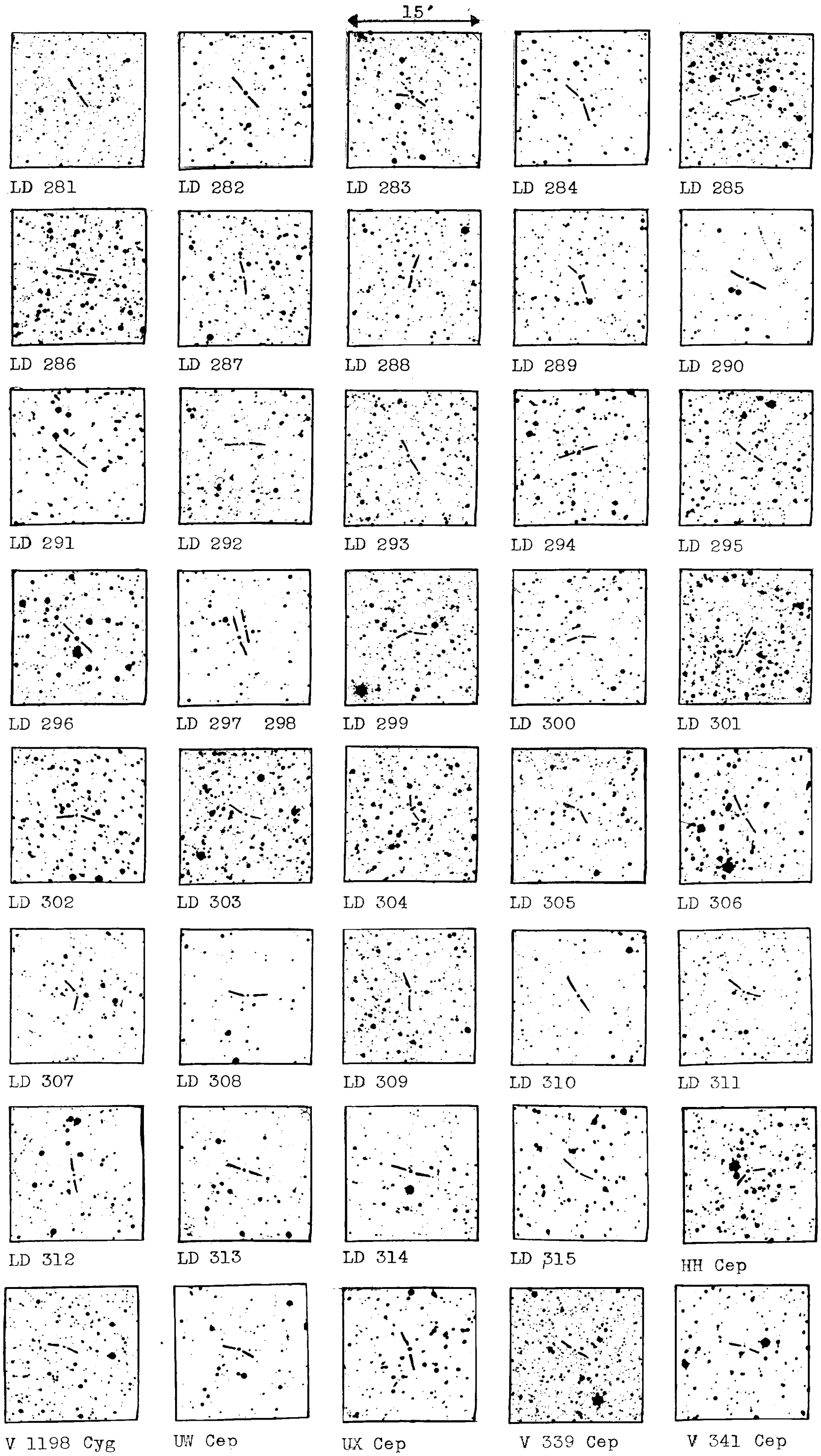
15′
LD 281
LD 282
LD 283
LD 284
LD 285
LD 286
LD 287
LD 288
LD 289
LD 290
LD 291
LD 292
LD 293
LD 294
LD 295
LD 296
LD 297 298
LD 299
LD 300
LD 301
LD 302
LD 303
LD 304
LD 305
LD 306
LD 307
LD 308
LD 309
LD 310
LD 311
LD 312
LD 313
LD 314
LD 315
HH Cep
V 1198 Cyg
UW Cep
UX Cep
V 339 Cep
V 341 Cep

Figure 1.

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Monet, D., Bird, A., Canzian, B., Harris, H., Reid, N., Rhodes, A., Sell, S., Ables, H., Dahn, C., Guetter, H., Henden, A., Leggett, S., Levison, H., Luginbuhl, C., Martini, J., Monet, A., Pier, J., Riepe, B., Stone, R., Vrba, F., Walker, R., 1996, USNO–A1.0; U.S. Naval Observatory, Washington DC; see also `http://www.usno.navy.mil/pmm`

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V842 Sco: PHOTOELECTRIC TIMES OF MINIMA AND A PERIOD STUDY

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We present here the first photoelectric determinations of minima of the eclipsing binary V842 Sco = GSC 7898:1918 = CoD −43°12132. The other minima are photographic (Kooreman 1966). The observations were made during two runs both from Cerro Tololo Inter-American Observatory[1] in Chile and with the Lowell telescope and single-channel photon counting techniques and standard UBV filters. In 1982 a refrigerated phototube EMI 2070 was used while in 1995 a refrigerated phototube RCA 31034A was utilised. GSC 7898:1728 served as the comparison and GSC 7898:1382 = HD 163046(A0V) as the check. Although the light curve is not complete, eclipses are of almost equal depth viz. $A_{V_{MinI}}$=0.20–0.66 while $A_{V_{MinII}}$=0.20–0.64 so the system displays a W UMa light curve. This can be inferred from the partial light curves displayed into Figure 1.

The resulting times of minima were determined by the polynomial line method (Guarnieri et al. 1975, Ghedini 1982) and are the last entries in Table 1. Also, included in this table are the photographically determined times of minima. The dispersion for each minimum is in brackets following the minimum itself; for the photographic minima, the dispersion was estimated from a linear solution with equal weights, we assign a dispersion of 0.015 to all these minima. The Table also contains the associated cycle number, E, and in the last column the corresponding residual, O−C. We made a least square weighted linear solution taking into account all available minima to derive an improved ephemeris and a possible period variation.

$$\begin{array}{rl}\text{Min I} = \text{HJD } 2431233.5446 + & 0\overset{\text{d}}{.}498284426 \times E \\ \pm\, 0\overset{\text{d}}{.}0031 \pm & 0\overset{\text{d}}{.}000000098 \text{ m.e.}\end{array} \qquad (1)$$

We conclude that the period has not changed significantly over the 40000 revolutions (cycles) covered by the available observations, a fact that is very scarce in systems displaying a W UMa light curve. The behaviour of the O−C residuals are depicted in Figure 2.

The author would like to thank the staff and Director of CTIO for their hospitality.

[1] Operated by AURA Inc. under cooperative agreement with the NSF

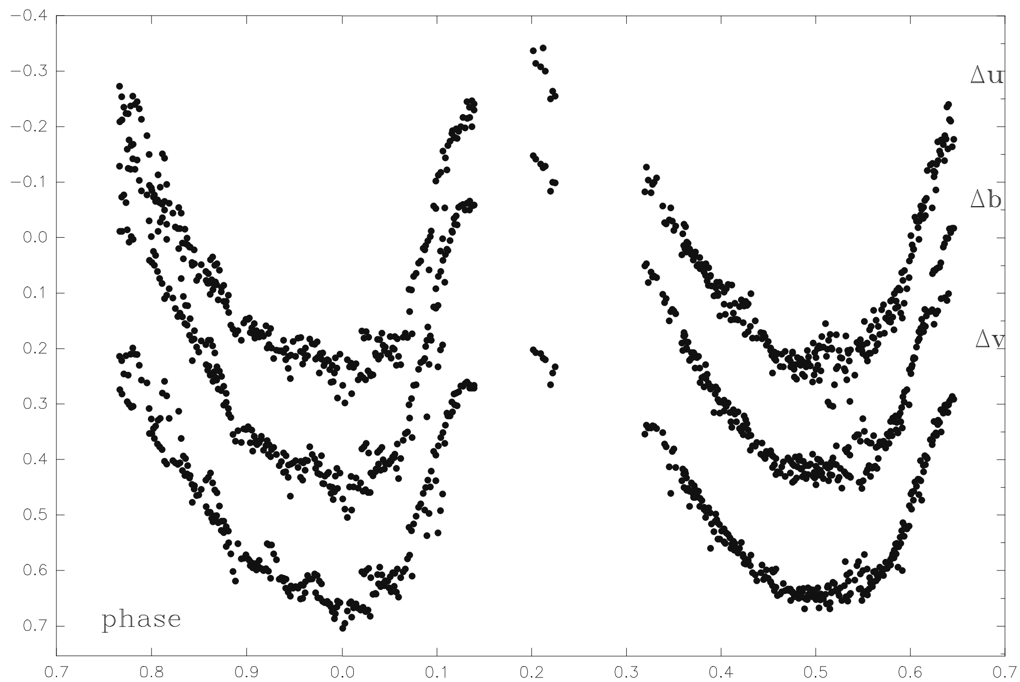

Figure 1. The partial light curves for V842 Sco. The vertical scale is for the visual differential magnitude.

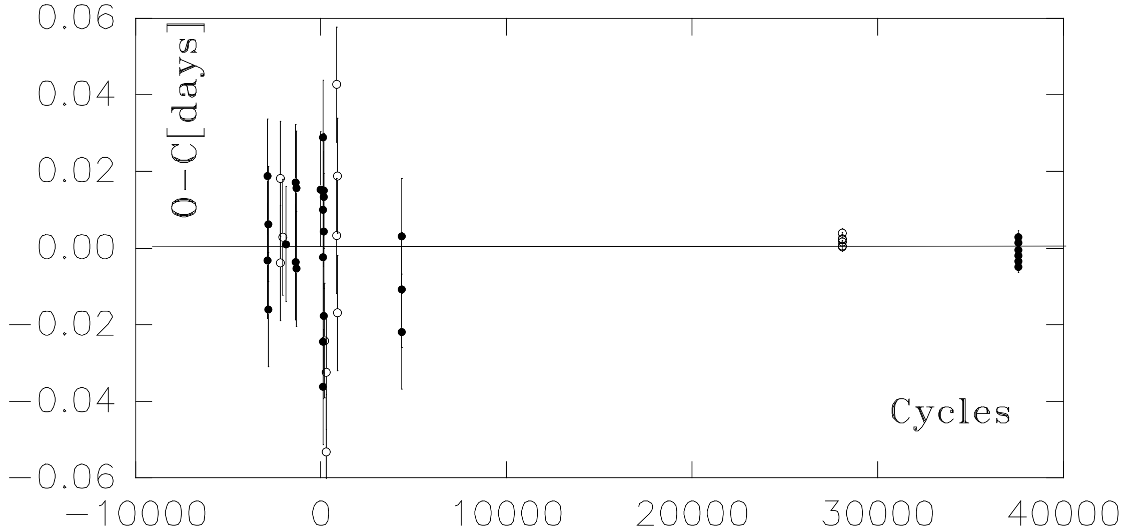

Figure 2. Behavior of the O−C residuals for V842 Sco from Eq. (1). Hollow circles stand for primary minima, vertical bars are for errors

Table 1: Times of minima and residuals for V842 Sco

Ref.	Min.	Band	HJD 2400000+ (sigma)	E	O−C
1	I	pg.	29794.4960(0.0150)	−2888.0	−0.0032
1	I	pg.	29794.5180(0.0150)	−2888.0	0.0188
1	I	pg.	29813.4180(0.0150)	−2850.0	−0.0160
1	I	pg.	29816.4300(0.0150)	−2844.0	0.0063
1	II	pg.	30149.5230(0.0150)	−2175.5	−0.0039
1	II	pg.	30149.5450(0.0150)	−2175.5	0.0181
1	II	pg.	30218.2930(0.0150)	−2037.5	0.0029
1	I	pg.	30286.3070(0.0150)	−1901.0	0.0011
1	I	pg.	30557.3690(0.0150)	−1357.0	−0.0037
1	I	pg.	30559.3830(0.0150)	−1353.0	0.0172
1	I	pg.	30574.3090(0.0150)	−1323.0	−0.0053
1	I	pg.	30574.3300(0.0150)	−1323.0	0.0157
1	I	pg.	31233.5600(0.0150)	0.0	0.0154
1	I	pg.	31287.3350(0.0150)	108.0	−0.0243
1	I	pg.	31287.3570(0.0150)	108.0	−0.0023
1	I	pg.	31288.3660(0.0150)	110.0	0.0101
1	I	pg.	31292.3060(0.0150)	118.0	−0.0362
1	I	pg.	31292.3710(0.0150)	118.0	0.0288
1	I	pg.	31312.2560(0.0150)	158.0	−0.0176
1	I	pg.	31312.2780(0.0150)	158.0	0.0044
1	I	pg.	31318.2680(0.0150)	170.0	0.0150
1	I	pg.	31321.2560(0.0150)	176.0	0.0133
1	II	pg.	31325.4540(0.0150)	184.5	−0.0241
1	II	pg.	31371.2670(0.0150)	276.5	−0.0533
1	II	pg.	31371.2880(0.0150)	276.5	−0.0323
1	II	pg.	31668.3010(0.0150)	872.5	0.0032
1	II	pg.	31669.3370(0.0150)	874.5	0.0426
1	II	pg.	31670.2740(0.0150)	876.5	−0.0169
1	II	pg.	31672.3030(0.0150)	880.5	0.0189
1	I	pg.	33411.5240(0.0150)	4371.0	−0.0219
1	I	pg.	33411.5350(0.0150)	4371.0	−0.0109
1	I	pg.	33411.5490(0.0150)	4371.0	0.0031
2	II	U	45222.6313(0.0014)	28074.5	0.0006
2	II	B	45222.6331(0.0018)	28074.5	0.0024
2	II	V	45222.6330(0.0011)	28074.5	0.0023
2	II	U	45232.5968(0.0010)	28094.5	0.0004
2	II	B	45232.6004(0.0012)	28094.5	0.0040
2	II	V	45232.5981(0.0019)	28094.5	0.0017
3	I	U	49947.6142(0.0005)	37557.0	0.0014
3	I	B	49947.6124(0.0009)	37557.0	−0.0004
3	I	V	49947.6079(0.0014)	37557.0	−0.0049
3	I	U	49949.6026(0.0007)	37561.0	−0.0033
3	I	B	49949.6088(0.0018)	37561.0	0.0029
3	I	V	49949.6040(0.0013)	37561.0	−0.0019

References: 1) Kooreman; 2) Cerruti 1982 present paper;
3) Cerruti 1995 present paper.

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Kooreman C.J. 1966, *Leiden Ann.*, **XXII**, No 5, 159.

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DETECTION OF SUPERHUMPS IN V2051 Oph

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V2051 Oph was discovered by Sanduleak (1972) and identified as a cataclysmic variable by Bond and Wagner (1977). This star was classified as novalike variable by Downes et al. (1997). The following ephemeris was reported for eclipses (Echevarria and Alvarez, 1993).

$$\mathrm{Min} = \mathrm{HJD}2444787.321141 + 0.062427860 \times E \qquad (1)$$

R. Stubbings reported an outburst on May 18, 1998 (Vsnet-obs 11960). This long outburst lasted until May 30, 1998 (Vsnet-obs 12411). One of the authors (S.K.) observed this outburst for three nights from May 21 to May 23, 1998. CCD Observations were done with a 25cm Schmidt Cassegrain (F/6.3) and a Bitran BT-20 CCD camera (Site 502A, 512 × 512 pixels). Each exposure was 60–90 seconds at interval of 120–180 seconds. GSC6815:626 ($17^{\mathrm{h}}08^{\mathrm{m}}22\overset{\mathrm{s}}{.}46$, $-25°51'49\overset{''}{.}9$) was used as a comparison and USNO0600.13191139 ($17^{\mathrm{h}}08^{\mathrm{m}}15\overset{\mathrm{s}}{.}738$ $-25°49'57\overset{''}{.}59$) was used as a check star. The constancy of the comparison star was confirmed to a level of 0.05 mag. No color correction was applied, but heliocentric corrections were applied before the following analysis, where differential magnitudes relative to the comparison star are used. The log of observations is given in Table 1.

Observations outside eclipses (phase 0.075–0.925 based on the equation 1.) were normalized using an average magnitude of each night and analyzed using Phase Dispersion Minimization (PDM) method (Stellingwerf 1978). The resultant theta diagram is displayed in Figure 1. The best superhump period is 0.06423 day. The existence of superhumps was subsequently confirmed by Patterson et al. (1998). Figure 2 is light curve folded on this period (outside eclipses). The superhump period is 2.9% longer than the orbital period (Echevarria and Alvarez, 1993) and it is a typical value for ratio of superhump to orbital period of SU UMa-type of CVs (e.g. see Table 1 in Nogami et al., 1997). The presence of a long outburst with a plateau (observation reported to Vsnet, data not shown) also agrees with this classification. Thus we concluded that V2051 Oph is a new member of SU UMa-type dwarf novae.

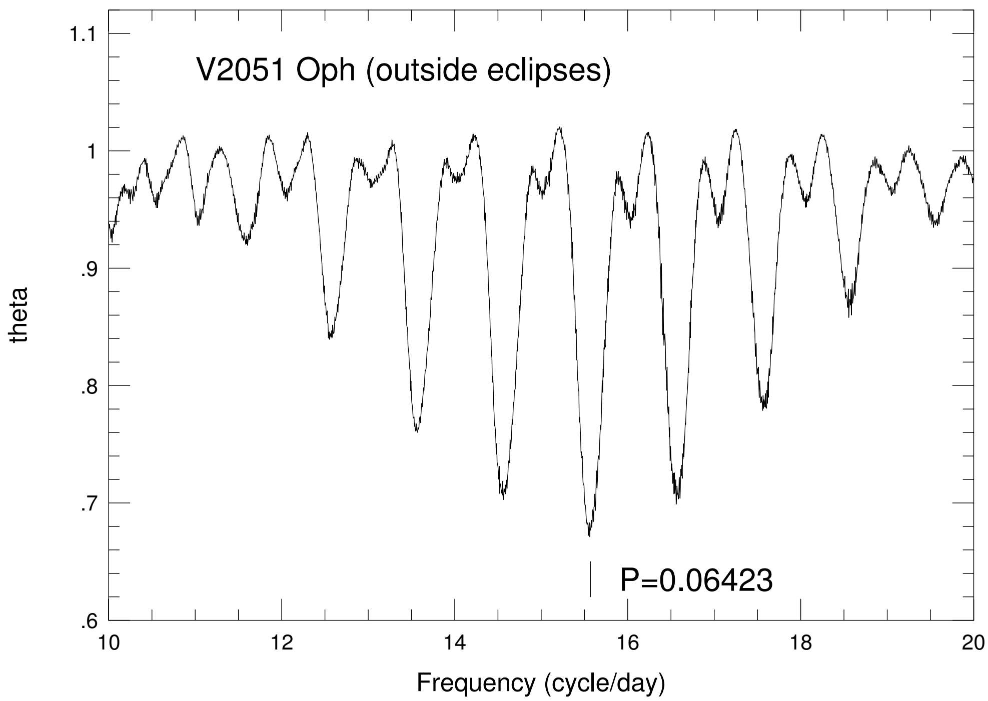

Figure 1. Theta diagram of the period analysis

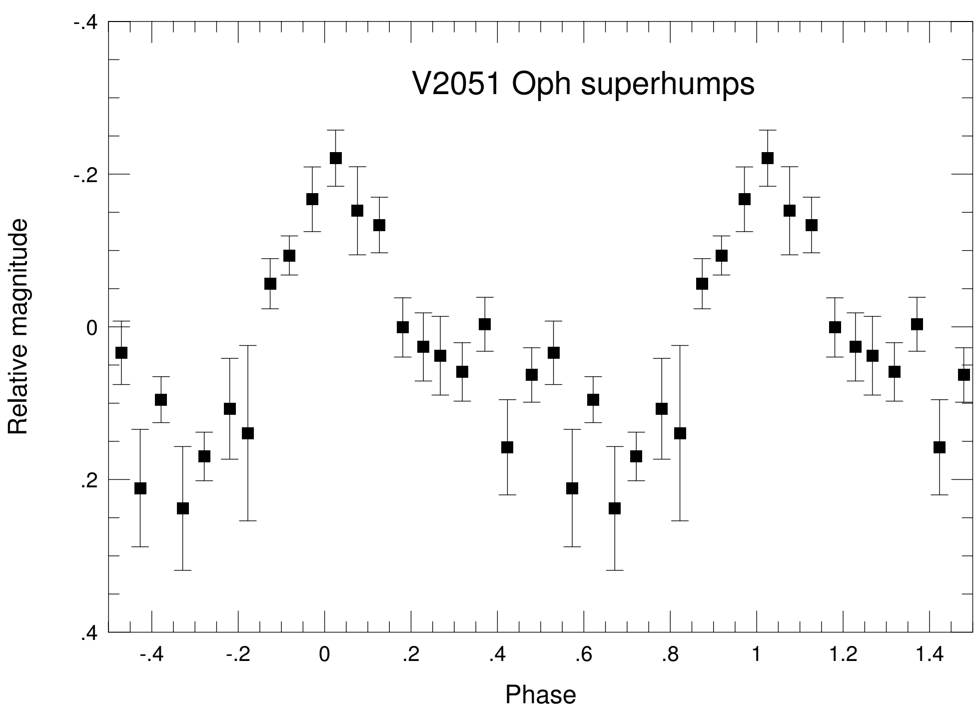

Figure 2. Folded light curve

Table 1: The log of the observations

Date in UT	No. of frames	Filter
1998 May 21.118–21.211	39	Cousins R
1998 May 22.080–22.265	96	none
1998 May 23.105–23.211	43	none

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HD 13654: PROBABLY NOT AN ECLIPSING BINARY

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Munari (1992) drew attention to HD 13654 as a possible eclipsing, spectroscopic binary on the basis of radial velocity variations and spectroscopic changes. The primary has a well determined spectral type of A3V but this was apparently replaced on one of the ten spectra by a late-type star of spectral type around G9. The interpretation of this change was that the late-type secondary had eclipsed the primary. Given the large velocity amplitude, $\sim 140\ \mathrm{km\,s^{-1}}$, and likely orbital period, a few days, this interpretation seemed appropriate. The blue spectra showed no contamination by the secondary but a red spectrum did show some absorption lines attributable to the secondary. The luminosity change during eclipse is not known but as the secondary is only weakly visible in the red the difference is likely to be at least one or two magnitudes.

In an effort to identify past eclipses in this system the Hewitt Camera Plate Archive, held by the Crayford Manor House Astronomical Society, has been searched. Details of the camera and archive are given by Howarth (1992). The brightness of HD 13654 was estimated visually, using a fixed microscope and light table, on 35 plates taken between 1964 and 1989. The plates are unfiltered and a variety of panchromatic emulsions have been used, Ilford HP3, FP4, HPS and Kodak Professional Royal Pan 4141, which give a very broad band pass. The comparison stars used were BD+58°419 (A2), BD+58°426 (B9) and occasionally BD+58°427 (A0), and are of similar colour to HD 13654. On all the plates HD 13654 was found to be slightly fainter than BD+58°419 at $V \simeq 9.8$, with no significant variation. No eclipses consistent with the spectroscopic changes were seen. It is possible that the times of the plates were unfortunately placed and real eclipses have been missed. If the eclipse occupies 0.1 in phase, then there is a probability of 0.025 that all 35 plates will miss an eclipse. While this chance is not impossibly small it is very suggestive that the system does not eclipse. Through correspondence with Dr Munari it now appears that there is some doubt over the eclipse spectrum, which may not have been of the correct star.

According to the Hipparcos and Tycho Catalogues (1997) HD 13654 is considered to be a suspected variable with a range in V_{T} of 9.5 – 10.8. However, closer inspection of the Tycho measurements reveals that the errors are very large, particularly for the faint values, and show no significant variation.

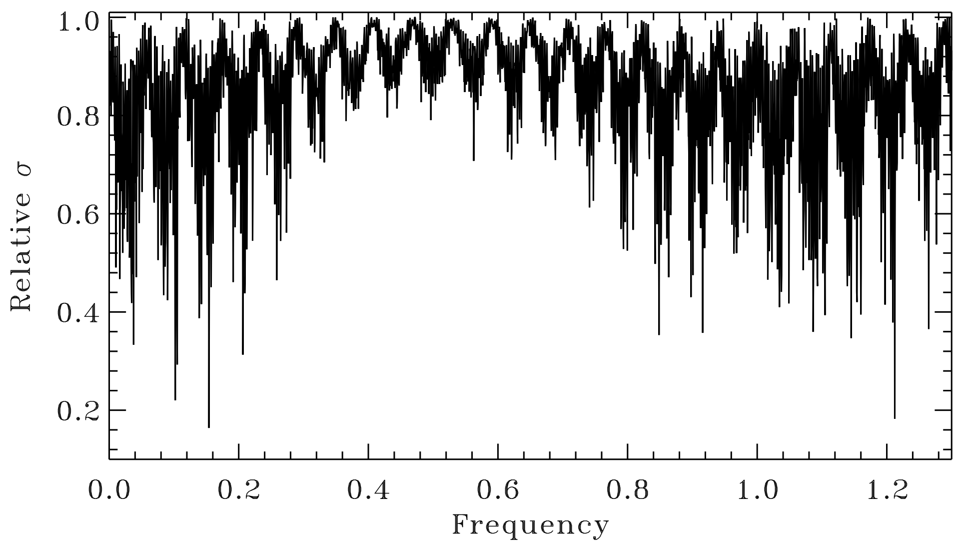

Figure 1. Least squares sine periodogram of the radial velocity measurements

The nine velocity measurements given by Munari have been subjected to a period analysis using a least squares sine periodogram. Although the number of measurements is rather small for this exercise the method is well suited to irregularly spaced, but high signal-to-noise data, much more so that the discrete Fourier methods. Given the large variation there is every expectation that this approach should reveal the correct period, the problem would lie in identifying it among the aliases. In the event aliasing is not too severe. The periodogram is given in Figure 1 and shows the relative standard error of the residuals as a function of trial frequency. Three periods are clearly identified above the rest, these are 9.8, 6.5 and 0.8 days. The periodogram was also calculated with the time of the eclipse spectrum included, using the systemic velocity, but it showed a much poorer reduction in the errors, such that no particular period could be clearly identified, suggesting that this velocity is inconsistent with the rest.

The orbital parameters of the three most likely periods are given in Table 1, together with derived values of the minimum mass of the secondary and minimum inclination of the system, assuming that the secondary in the less massive and less luminous component. The mass of the A3V star is assumed to be 2.1 $M_\odot$ (Allen 1973). It is immediately obvious that in a system with a period of 9.8 days the secondary exceeds this mass, so either the primary should be of an earlier spectral type or both stars should be visible with a similar spectral type. As only a single A-type spectrum is seen it means the 9.8 day period can be eliminated. It is also the least likely of the possible periods.

Table 1: Orbital solutions

Period (days)	K km s^{-1}	$f(m)$ $M_\odot$	σ km s^{-1}	$a_1 \sin i$ $R_\odot$	minimum mass	minimum inclination
0.82486±0.00003	69±6	0.028	7.3	1.12	0.11	22
6.4938±0.0033	85±7	0.414	6.3	10.91	2.04	67
9.8048±0.0052	86±7	0.648	7.9	16.66	2.55	90*

* Strictly undefined as the minimum mass is larger that the 2.1 $M_\odot$ assumed

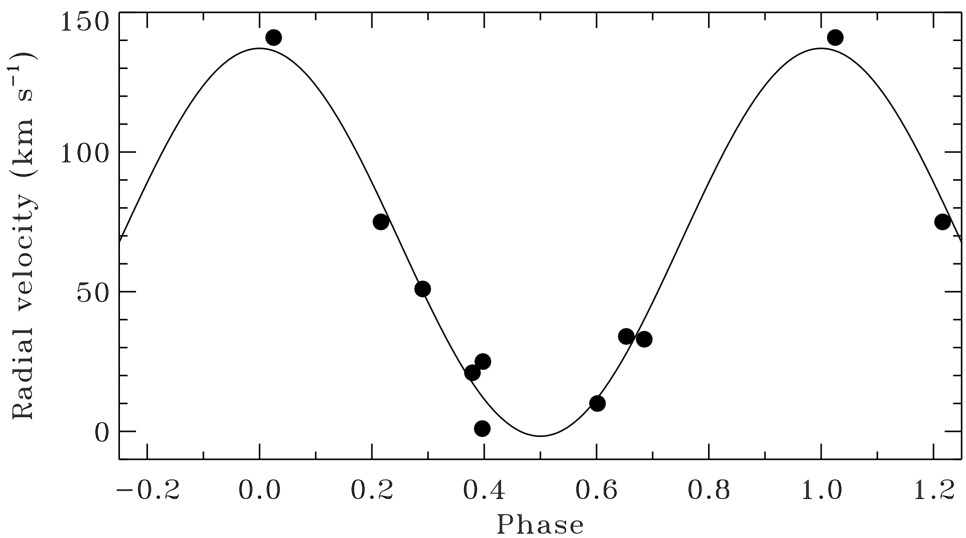

Figure 2. Radial velocity curve from the data of Munari using the 0.82486 day period.

The 6.5 day period gives the smallest residuals but the minimum mass of the secondary is only marginally less than that assumed for the primary. It therefore seems very unlikely that there would be a sufficient luminosity difference between the two for the secondary to pass unnoticed. Also, for this minimum mass, the inclination would be 90 degrees and the system would be eclipsing. If the photographic results are to be believed, the system is probably not eclipsing and avoiding this condition would increase the minimum mass, and with it, the visibility of the secondary.

For the 0.82 day period, both the minimum mass of the secondary and minimum inclination are correspondingly lower, so it is possible for the system to contain a secondary that is spectroscopically invisible. Assuming that the secondary is at least one magnitude fainter than the primary it will have a mass $m_2 < 1.5$ M$_\odot$ and the system will have an inclination, $i > 28$ degrees. However, the size of the system and radii of the components ($r_1 = 1.9, r_2 = 1.3$ R$_\odot$) means that system will be eclipsing for $i > 56$ degrees. Depending on the precise values of all the relevant parameters (for $m_2 = 0.7$ M$_\odot$, $r_2 = 0.7$ R$_\odot$ then $i > 60$ degrees will eclipse) there is still a range of inclinations, $i \sim 28 - 60$ degrees, where the system does not eclipse and stars of appropriate masses and luminosities may be accommodated. The orbital solution for this period is shown in Figure 2.

Irrespective of the periods suggested by the periodogram, dynamical arguments point to a short period; with 0.82486 days as the most likely candidate from the period analysis. Periods of less than one day are relatively common for A-type binaries and a wide range of secondaries is possible. Given the weak visibility of the secondary it is probably towards the lower end of the possible mass range, $0.7 < m_2 < 1.5$ M$_\odot$, giving an F or G star, with $28 < i < 60$ degrees.

It is a pleasure to thank Dr Munari for helpful correspondence on this system.

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IL HYDRAE: NEW ORBITAL SOLUTIONS AND BV PHOTOMETRY

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IL Hya (=HD 81410) is an active RS Canum Venaticorum binary, which shows drastic changes in the light curve within a few orbital cycles (Mekkaden & Raveendran 1998, and the references therein). Though it was suspected to be double-lined, earlier attempts to detect the spectrum of the secondary component did not succeed (Raveendran et al. 1982; Fekel et al. 1986). Recently, Donati et al. (1997) detected the secondary component on two high dispersion, high S/N ratio spectra and measured its radial velocities. Subsequently, using high resolution spectra Weber & Strassmeier (1998) measured 12 radial velocities and determined the amplitude.

The orbital parameters of the primary of IL Hya were first derived by Raveendran et al. (1982) from the eight radial velocity measurements listed by Eggen (1973), which were supplied by Wayman and Jones. Jones & Fisher (1984) have since revised three of the measurements listed by Eggen (1973). By combining his own radial velocity measurements with those of Collier Cameron (1987), Balona (1987) obtained an orbital period of 12.908 days, which is slightly longer than that obtained by Raveendran et al. (1982). Balona (1987) also derived an eccentricity of 0.05 for the orbit. Recently, Weber & Strassmeier (1998) presented the orbital parameters based on 21 new radial velocities obtained by them and the 34 velocity measurements made by Balona (1987); they assumed a circular orbit.

A total of 85 radial velocity measurements are available for IL Hya dating from 1959 till 1995, and Weber & Strassmeier (1998) used only 55 of them covering a time span of only 15 years. We have obtained fresh orbital solutions combining all the radial velocity measurements available. The solutions for both circular and elliptical orbits were obtained and these are given in Table 1. The measurements obtained by Donati et al. (1997) and Weber & Strassmeier (1998) were given weights of two while all the other observations were given unit weights.

The standard deviation reduces only marginally to 2.440 km s^{-1} from 2.444 km s^{-1} for an elliptical orbit instead of circular. Though small, the eccentricity is significantly larger than its probable error.

The observed velocities are plotted along with the computed curve corresponding to the circular orbit in Fig. 1. We have excluded 6 measurements, which show residuals larger than 5 km s^{-1}, from the solutions; these are indicated in the figure by arrows.

IL Hya was observed in *BV* bands on 9 nights during January–March 1993 with the 0.34-m telescope at Vainu Bappu Observatory, Kavalur. HD 81904 and HD 80991 were observed as comparison stars. All observations were made differentially with respect to

Table 1: Spectroscopic orbital elements of IL Hya.

Orbital elements	Circular	Elliptical
P	12.90522 ± 0.00005 $(days)$	12.90521 ± 0.00005 $(days)$
e	0.0 $(assumed)$	0.013 ± 0.005
ω	–	$23^\circ \pm 3^\circ$
K	41.5 ± 0.2 $km\ s^{-1}$	41.5 ± 0.2 $km\ s^{-1}$
γ	-7.2 ± 0.2 $km\ s^{-1}$	-7.3 ± 0.2 $km\ s^{-1}$
$T_0(JD)$	2449390.607 ± 0.016	2449390.603 ± 0.016
$T_\omega(JD)$	–	2449391.428 ± 0.07
$a \sin i$	$7.37 \pm 0.04 \times 10^6$ km	$7.37 \pm 0.10 \times 10^6$ km
$f(m)$	0.096 ± 0.002 $M_\odot$	0.096 ± 0.004 $M_\odot$
σ $(unit\ weight)$	2.44 $km\ s^{-1}$	2.44 $km\ s^{-1}$

HD 81904, and the differential magnitudes and colours were converted to V and $B-V$ using $V = 8.020$ and $B-V = 0.975$ for the comparison star (Mekkaden & Raveendran 1998). The Julian days of observation were converted to photometric phases using the ephemeris,

$$\text{Zero Phase} = \text{JD}2449400.286 + 12\overset{d}{.}90522 \times E,$$

where the initial epoch is the time of conjunction with the primary in front and the period is the orbital period given in Table 1. Both the initial epoch and period correspond to the case of circular orbit for the system. Along with the present V values the y magnitudes obtained by Sterken et al. (1995) during JD 2448957–9025 are also plotted in Fig. 2.

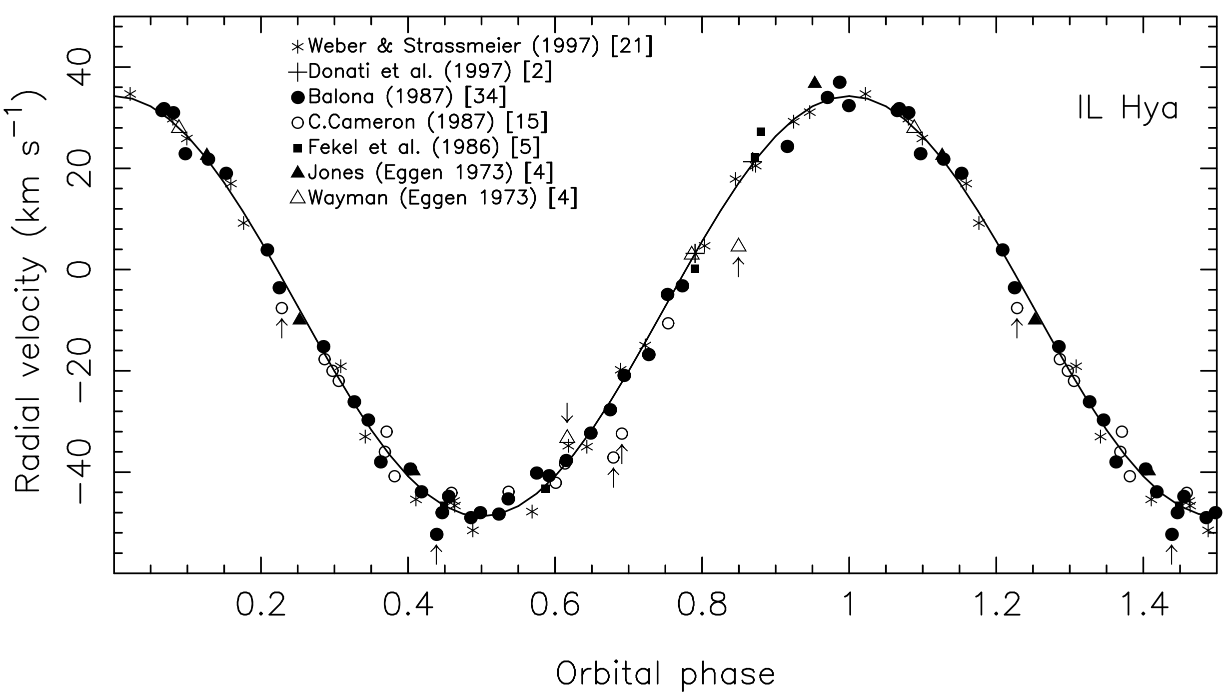

Figure 1. Radial velocity curve of IL Hya. The numbers inside the square brackets indicate the number of observations, and the arrows the observations excluded in the solutions

Table 2: *BV* photometry of IL Hya.

JD 2440000+	V	$B-V$
9012.446	7.400	
9018.339	7.320	1.024
9019.323	7.357	1.045
9020.300	7.382	1.037
9021.294	7.400	1.045
9034.290	7.389	1.047
9035.274	7.399	1.057
9036.323	7.412	1.057
9050.272	7.377	1.045

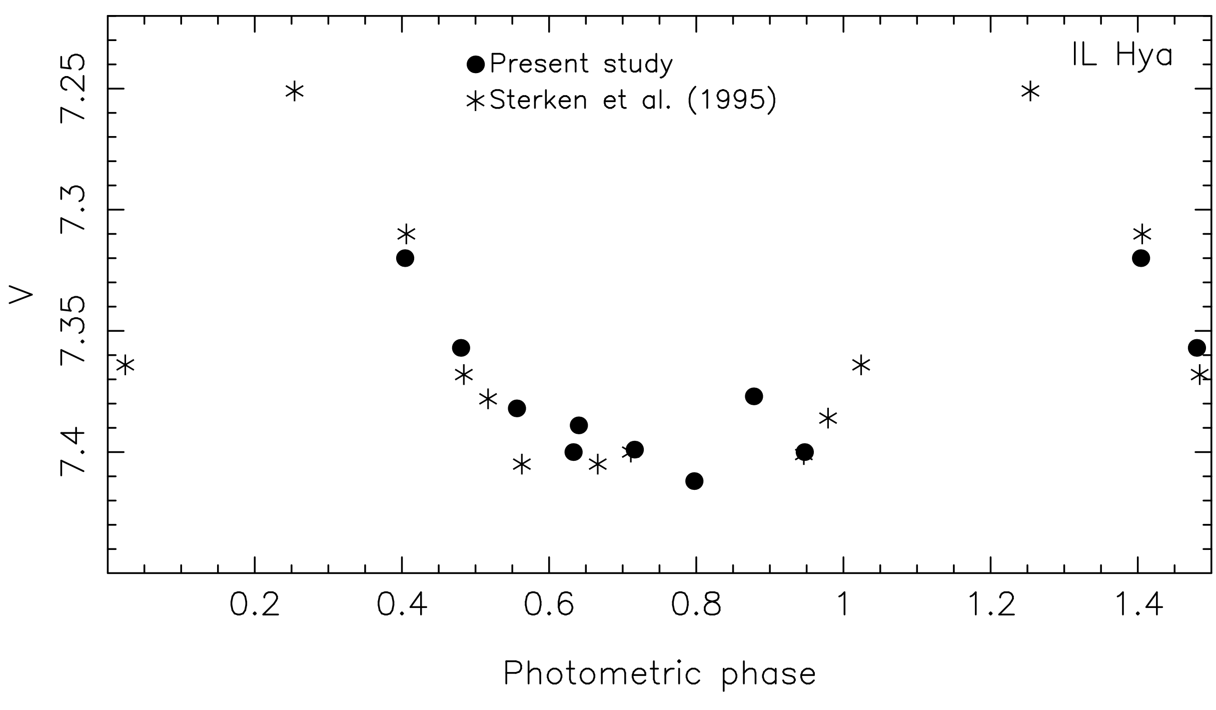

Figure 2. *V* light curve of IL Hya

The amplitude of variation in V is ~0.20 mag. The light curve is highly asymmetric; it shows a broad minimum spread over ~$0\overset{p}{.}4$, implying that the starspots had a longitudinal extent significantly larger than 180°, and hence, the spots were not completely out of view during the phases of light maximum. The brightness at light maximum is ~7.25 mag, indicating that the unspotted magnitude is appreciably brighter than 7.23 mag, the brightest so far observed (Mekkaden & Raveendran 1998).

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A PERIOD STUDY OF THE ECLIPSING BINARY SYSTEM W URSAE MINORIS

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Since the discovery by Astbury (1913) and by Davidson (Dyson 1913), W Ursae Minoris (BD +86°244), a bright eclipsing binary quite close to the celestial north pole, had attracted much interest in earlier days, particularly among the photometrists. Spectroscopic observations were performed by Joy and Dustheimer (1935) and Sahade (1945), who both gave single-lined radial velocity curves for the system. The most comprehensive study of the system was performed by Devinney et al. (1970), where two sets of photometric light curves were solved by the rectification method to yield the photometric elements. They derived the absolute dimensions and confirmed that W UMi is a semi-detached system of Algol-type. Mardirossian et al. (1980) reanalyzed five light curves of Devinney et al. with the Wood's model.

Occasional monitoring for the times of minima have been done for the system. As to the period study, the following ephemerides for Min I, e.g., have been published.

Dyson (1913):	HJD 241 9487.850 + $1\overset{d}{.}7012E$
Martin and Plummer (1918):	HJD 242 1219.685 + $1\overset{d}{.}70116E$
McLaughlin (1926):	HJD 242 2813.605 + $1\overset{d}{.}70116E$
Dugan (1930):	HJD 242 4999.604 + $1\overset{d}{.}70116E$
Himpel (1937):	HJD 242 7624.485 + $1\overset{d}{.}70116E$
Nason and Moore (1951):	HJD 243 3457.761 + $1\overset{d}{.}7011576E$
Devinney et al. (1970):	HJD 243 9758.846 + $1\overset{d}{.}7011576E$
SAC 66 (1995):	HJD 244 6614.481 + $1\overset{d}{.}7011576E$

(SAC = *Rocznik Astronomiczny Obserwatorium Krakowskiego*)

As these show, almost everybody considered that the period had been constant, and they devoted in revising the epoch and getting more precise period. The only two exceptions were Gadomski (1926) and Payne-Gaposchkin (1952), who suggested that the period was variable. However, these were not confirmed by others.

As we noticed that the primary minimum did not occur at the predicted time, we observed W UMi in order to know the possible variation of its orbital period. Photoelectric observations of the system were done with the Multichannel Polarimetric Photometer attached to the 91cm reflector at Dodaira Station of the National Astronomical Observatory of Japan and also with a photometer (PMT: 1P21) attached to the 45cm telescope

Table 1: New Photoelectric Observations

Obs. HJD (Min I)	Site	Observer	E^1	$O-C^1$	E^2	$O-C^2$
2449770.0722	Dodaira	Y. Nakamura	5885	–0.0863	4429	0.0018
2450464.131:[3]	Fk. Univ.	K. Asada	6293	–0.0998	4837	–0.0039
2450487.9460	Fk. Univ.	K. Asada	6307	–0.1010	4851	–0.0048
2450857.0866	Fk. Univ.	R. Sato	6524	–0.1116	5068	–0.0112

[1] These values are based upon the ephemeris of Devinney et al. (1970).
[2] These are based upon the new linear ephemeris (4).
[3] This observation provided rather different moments for the minimum in B and V bands. However, the mean value seems reasonable.

at Fukushima University. Their features are described in other publications (Nakamura et al. 1991a, b). The comparison and check stars were BD +86°245 and BD +86°246 for Dodaira observations and 23 and 24 UMi for Fukushima observations, respectively. The estimated times of the primary minimum are listed in Table 1. The observed data at Fukushima are the mean of B and V light curves and those at Dodaira are averaged over four channels. The new observations showed large negative $O-C$ values.

In order to study the long-term behaviour of the period variation, we have collected observed minima timings, including ours, from the literature and from B.R.N.O. (Brno Regional Network of Observers) and BAV Databases, which are all for the primary eclipse. Devinney et al. (1970) observed primary minima, whose central times are, however, not described explicitly in their paper. The mean of the two minima times observed by them is instead given, hence we employed it as useful information. A total of 160 observed times of primary minima (147 visual, 4 photographic and 9 photoelectric) were collected and are plotted in Figure 1 according to the ephemeris by Devinney et al. There is a large scatter in the observed times of minima. Despite such a large scatter, it may be concluded that the orbital period of the system had been constant before $E \sim +1000$. However, recent primary minima have occurred definitely earlier than predicted.

Because the ephemeris by Devinney et al. (1970) was derived with only the limited data up to 1970, we derived another linear ephemeris using all data. In deriving this, we omitted six data which show the large $O-C$ residuals in Figure 1, and we put weight 10 on the photoelectric estimates, 3 on photographic ones, and 1 to visual ones. If the datum is denoted to be uncertain, we set the weight to its half value. Thus, we have

$$\text{Min I} = \text{HJD } 2443392.4794(\pm 13) + 1\overset{\text{d}}{.}70115182(\pm 22)\ E. \quad (1)$$

The $O-C$ residuals based upon this ephemeris are shown in Figure 2.

We have examined two possibilities for the period change of the system: one is a constant period change (decrease) and the other a sudden period decrease. For the first possibility, the ephemeris should be quadratic. We calculated such a formula as

$$\text{Min I} = \text{HJD } 2443392.4924(\pm\ 7) + 1\overset{\text{d}}{.}70114548(\pm 18)\ E - 8\overset{\text{d}}{.}80(\pm 21) \times 10^{-10}\ E^2. \quad (2)$$

This quadratic ephemeris is shown with the dash-dot curve in Figure 2.

We next sought for the two linear ephemerides which fit for the sudden period decrease shown in the figures. The following ephemerides were found to be good for the purpose:

$$\text{Min I} = \text{HJD } 2442235.7289(\pm\ 8) + 1\overset{\text{d}}{.}70115716(\pm 22)\ E \quad (3)$$

before the sudden period decrease, and

$$\text{Min I} = \text{HJD } 2442235.7289(\pm 16) + 1\overset{\text{d}}{.}70113830(\pm 45)\ E \quad (4)$$

after the period change. The $O-C$ residuals based upon these ephemerides are shown in Figure 3. The $\Sigma(O-C)^2$ values for all the data used are 0.032616 for the eq. (2) and 0.021577 for the eqs. (3)+(4), respectively.

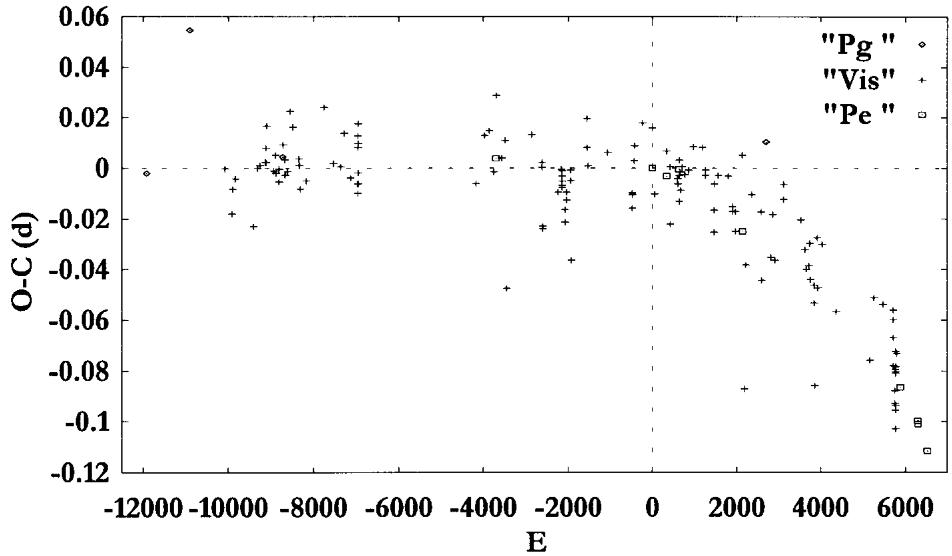

Figure 1. $O-C$ diagram for the primary minimum of W UMi. The calculation is based on the ephemeris of Devinney et al. (1970).

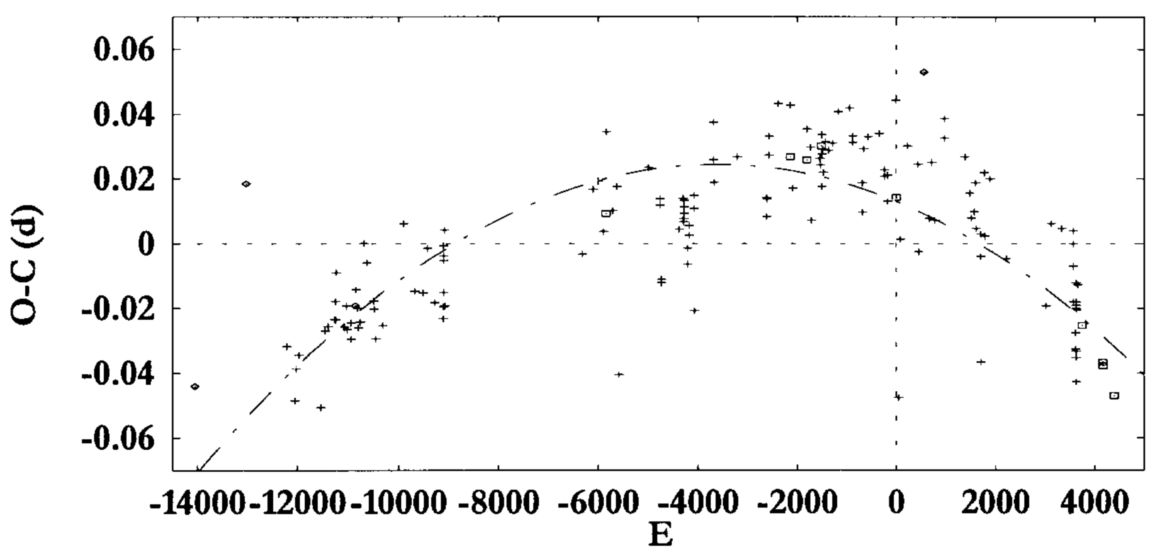

Figure 2. $O-C$ residuals based upon the new single linear ephemeris. The quadratic ephemeris is also represented with the dashed curve.

Though we derived a quadratic ephemeris for W UMi, the fitting by the parabola is worse than the two linear ephemerides, and moreover it is rather difficult to imagine a mechanism which derives constant period decrease in such a semi-detached system as

W UMi. Therefore, we prefer the interpretation of a sudden period decrease which is represented as two straight lines in Figure 3. According to this, the amount of period decrease is $\Delta P/P = -1.11 \times 10^{-5}$, and this change occurred nearly at JD2442236. We think that mass loss from the system is the most natural explanation for this phenomenon.

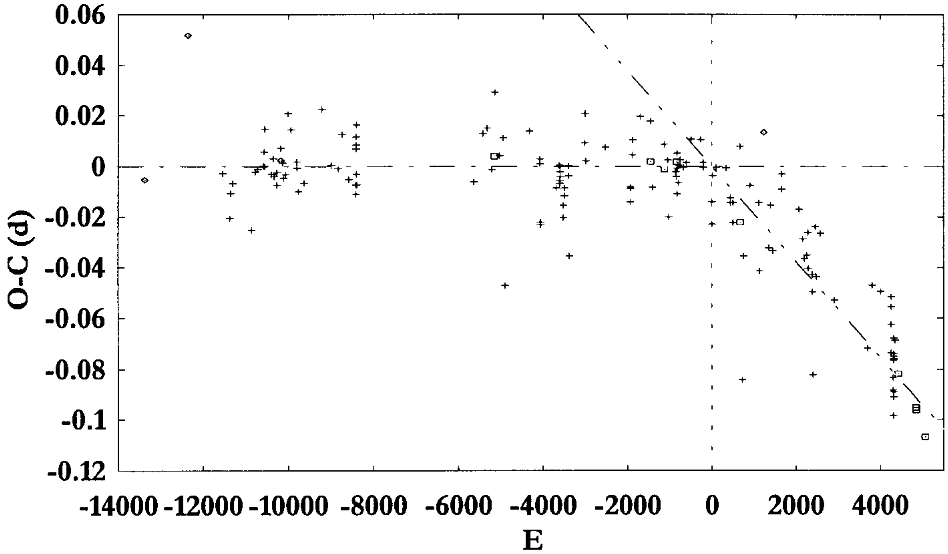

Figure 3. $O-C$ diagram for the primary minimum of W UMi. The observed data are fitted with the two linear ephemerides (3) and (4). The intersection is at JD 2442236.

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LINE PROFILE CHANGES IN X PERSEI

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X Persei is the optical counterpart of X-ray transient source 4U 0352+30. The system consists of a neutron star secondary accreting from an O9.5IIIe primary via stellar wind processes. The photometric and spectroscopic observations show that X Persei lost its circumstellar disc and it has been in "extended optical low state" during the periods 1974-1977 and 1990-1993. Engin and Yüce (1997) observed X Per in the period 1994-1996 and found that it entered a "new low state" in 1995.

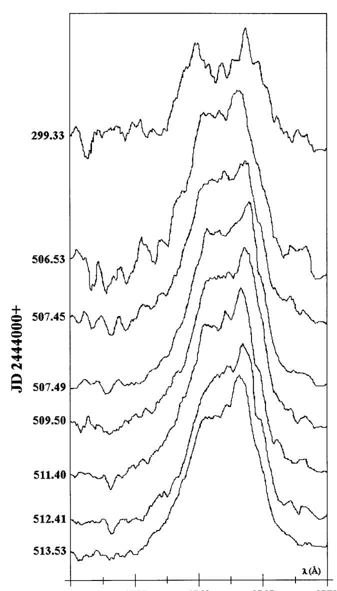

Figure 1. Hα line profile variations.

Roche et al. (1993) have examined the long-term variability of Hα emission line and they have given their Hα equivalent width measurements with those of other authors. These measurements correspond to the period from October 1981 onwards. We present here the Hα and Hβ equivalent width measurements of X Persei that are based on the observations of this system during the period February 1980 and September 1980. The

Table 1: Hα equivalent widths.

Date	JD(2440000+)	EW of Hα (Å)
29 Feb 1980	4299.33	−2.6
23 Sep 1980	4506.53	−4.7
24 Sep 1980	4507.45	−4.6
24 Sep 1980	4507.49	−5.1
26 Sep 1980	4509.50	−4.8
28 Sep 1980	4511.40	−5.0
29 Sep 1980	4512.41	−4.6
30 Sep 1980	4513.53	−4.8

spectrograms, which had been obtained with the coudé spectrograph at the 152cm telescope of Haute-Provence Observatory, have been borrowed from Trieste Observatory for this work.

Figures 1 and 2 show the profiles of Hα and Hβ. It is clearly seen that the profiles taken in February and September 1980 are different. In February 1980 the emission wings are symmetric and central absorption component is strong, but in September 1980 absorption becomes weaker and emission stronger with an asymmetric profile, with violet wing being broad.

Tables 1 and 2 list our Hα and Hβ equivalent width measurements, respectively.

Figure 3 shows the variation of Hα equivalent width with time. Our data confirm that after the disc-loss phase of 1974–1977, in February 1980 the disc began to form again and in September 1980 an expanding full disc was present.

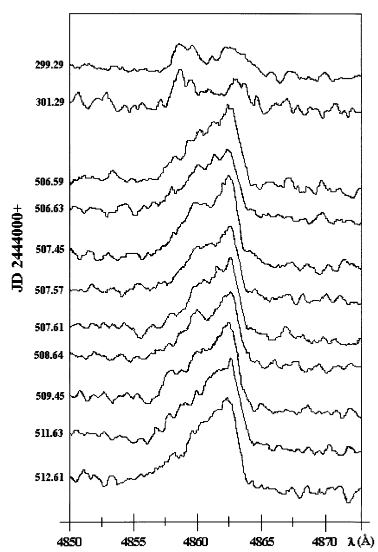

Figure 2. Hβ line profile variations.

Table 2: Hβ equivalent widths.

Date	JD(2440000+)	EW of Hβ (Å)
29 Feb 1980	4299.29	− 0.7
02 Mar 1980	4301.29	−0.8
23 Sep 1980	4506.59	−2.5
23 Sep 1980	4506.63	−2.3
24 Sep 1980	4507.45	−2.3
24 Sep 1980	4507.57	−2.4
24 Sep 1980	4507.61	−2.3
25 Sep 1980	4508.64	−2.3
26 Sep 1980	4509.45	−2.1
28 Sep 1980	4511.63	−2.5
29 Sep 1980	4512.61	−2.5

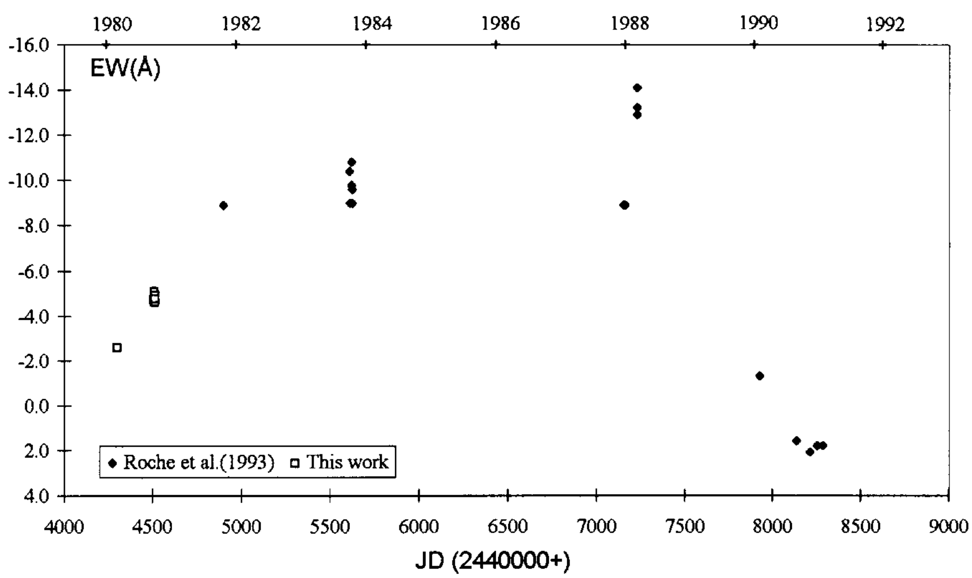

Figure 3. The variation of Hα equivalent widths with time.

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HD 82780 – A NEW ECLIPSING BINARY

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As a part of a continuing program to search for eclipses in known double-line spectroscopic binaries (Wolf and Caffey 1996), the star HD 82780 has been observed on 32 nights at the Baker Observatory of SW Missouri State University. The observations in BVR_cI_c at most spectroscopic phases of its 1.6815 day period were obtained using a Photometrics CCD photometer attached to the 0.4 meter Cassegrain telescope. The light curves showing a primary eclipse about 0.08 and a secondary eclipse about 0.05 magnitude deep are plotted in Figure 1.

Since the spectroscopic (and now eclipsing) binary HD 82780 is itself the brightest component of the visual triple ADS 7438, the B component of the visual system was chosen as the comparison star and the C component as the check star for our photometry. All CCD images have been analyzed and reduced to magnitudes using the standard procedures and packages within IRAF. Because the comparison star has almost the same colors as the variable, the B, R and I curves in Figure 1 have been arbitrarily shifted on this graph respectively by −0.2, 0.2 and 0.4 in delta magnitude for clarity. The light curves have been plotted with an ephemeris based on a time of primary minimum observed by us and with the spectroscopic period given in Batten et al. (1988). The linear light elements are

$$\text{Pri. Min.} = \text{HJD } 2450511.8460 + 1\overset{d}{.}6815 \times E.$$

To our knowledge, no complete spectroscopic study of HD 82780 has been published. However, Batten et al. (1988) presented spectroscopic elements for this star obtained from Northcott (1965). The high values listed for $m \times \sin^3 i$ indicated to us the possibility of eclipses and were instrumental in adding this star to our program list. We have combined Northcott's spectroscopic elements and our light curve data to obtain a preliminary solution for this eclipsing system using Bradstreet's (1993) Binary Maker 2.0 and then Wilson's (1979) DC light curve modeling program. An excellent fit to the light curves was possible with the values listed in Table 1.

We have dereddened the photometric indices for HD 82780 tabulated by Wolff and Simon (1997) and used the resulting values in conjunction with the temperature–gravity grids of Moon and Dworetsky (1985) to determine a temperature of 6950K for the primary star. This agrees well with the F2V spectral type listed by Batten et al. and others.

Table 1: Model parameters from Wilson DC program.

Parameter	Combined	B	V	R_c	I_c	Adjusted
T_1 (K)	6950					
T_2 (K)	6588					x
i (°)	74.76					x
Ω_1	5.883					x
Ω_2	6.245					x
q (m_2/m_1)	0.726					
$g_1 = g_2$	0.32					
$A_1 = A_2$	0.50					
$F_1 = F_2$	1.0					
r_1 (pole,side)	0.194					
r_1 (point,back)	0.196					
r_2 (pole,side)	0.142					
r_2 (point,back)	0.143					
x_1		0.71	0.59	0.51	0.43	
x_2		0.72	0.60	0.52	0.44	
$L_1/(L_1+L_2)$		0.708	0.699	0.693	0.687	x
$L_2/(L_1+L_2)$		0.292	0.301	0.307	0.313	

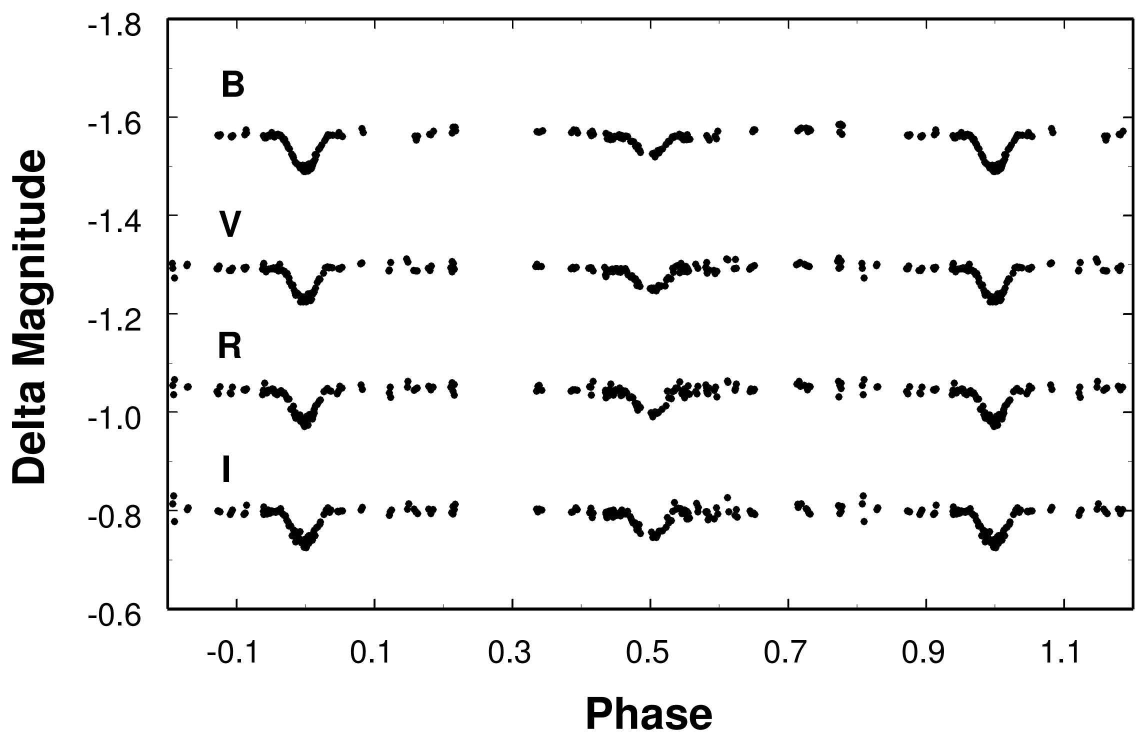

Figure 1. Observed light curves of HD 82780

Table 2: Physical Parameters

Parameter	Value
A (Separation)	5.65×10^6 km.
K_1	99.1 km/sec
K_2	136.5 km/sec
M_1	$1.47 M_\odot$
M_2	$1.07 M_\odot$
R_1	$1.57 R_\odot$
R_2	$1.15 R_\odot$

Individual solutions were computed for each light curve as well as a combined solution for all curves together. Since the results were similar for each, only those of the combined solution are given. Because the observed eclipses are shallow and partial, only the more obvious parameters have been adjusted in the solutions.

The computed orbital inclination varied by only ±0.20 degrees among the individual light curve solutions, but it appears to be somewhat sensitive to the assumed mass ratio. For example, if the mass ratio were to be increased by 0.10, the inclination would drop to 73.70 degrees; if the mass ratio were to be decreased by 0.10, the inclination would increase to 76.00 degrees. On the other hand, the T_2 parameter varied by about ±200K among the individual solutions, but was generally insensitive to these changes in mass ratio.

Using the results of the light curve modeling and Northcott's radial velocity data we have calculated preliminary absolute dimensions and masses for the eclipsing system. These values are given in Table 2. Since the accuracy of the radial velocity data is not known, it is not possible to estimate the accuracy of these values. The calculated mass of the secondary component seems low for its computed temperature. If a more definitive spectroscopic analysis of this system were to become available, HD 82780 might be marginally useful in the study of the radiative flux scale discussed by Popper (1998) since its *Hipparcos* parallax indicates a distance of less than 100 parsecs.

This research has made use of the SIMBAD database operated by the CDS, Strasbourg, France. We acknowledge the assistance of several undergraduate and high school students who assisted in the data collection and reduction. This study was supported in part by NSF Grants AST-9315061 and AST-9605822, and by NASA grant NGT-40060.

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RAPID RADIAL VELOCITY VARIATIONS IN ROAP STAR γ Equ FROM LINES OF NdIII AND PrIII

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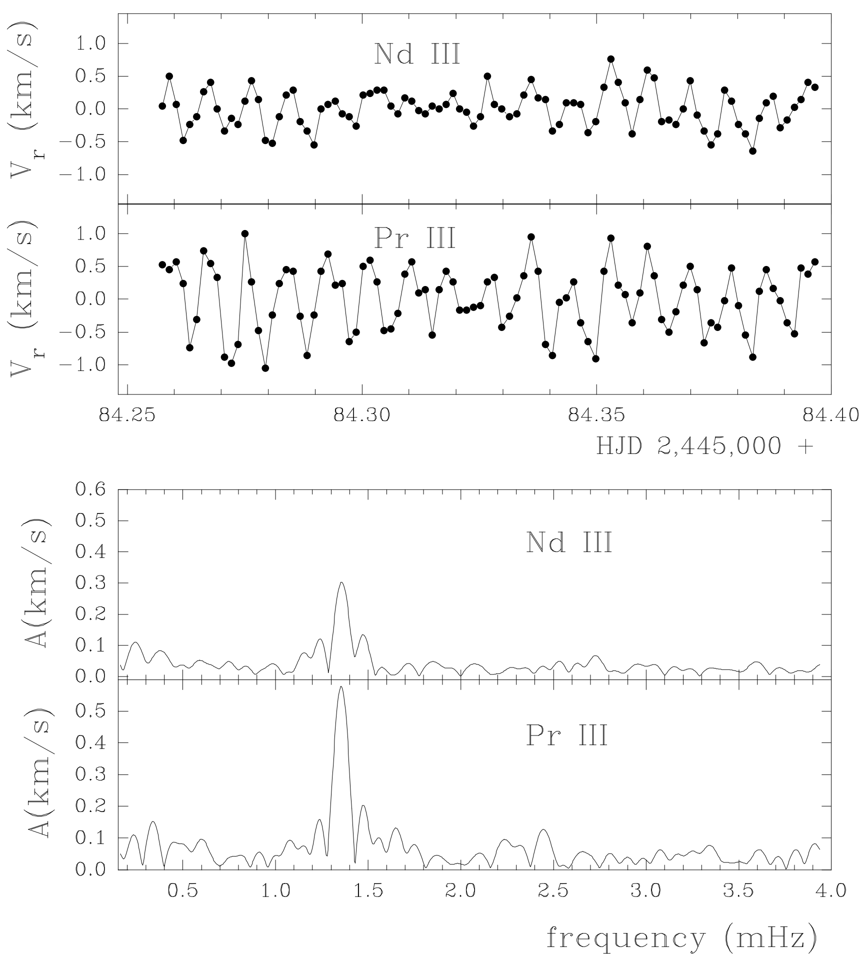

Figure 1.

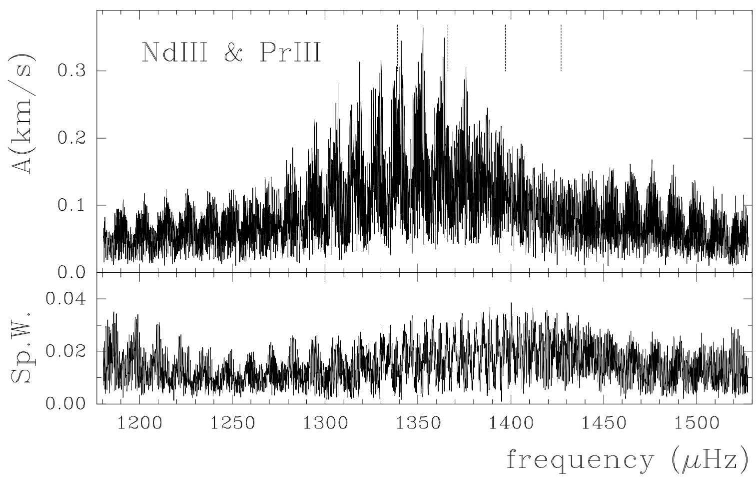

Figure 2.

Cool, magnetic, chemically peculiar stars which exhibit low-amplitude ($\Delta B \leq 16$ mmag) photometric variations with the typical periods of 6 to 16 minutes form the group of rapidly oscillating Ap (roAp) stars. Detailed description of the observed properties of roAp stars is given in a review by Martinez and Kurtz (1995).

SrCrEu star γ Equ (HD 201601) is one of the best-studied among roAp stars. The analysis of its photometric oscillations revealed the existence of at least four high-overtone pulsational modes (Martinez et al. 1996). Practically zero rotational velocity of this star (Ryabchikova et al. 1997) makes it the best candidate for the measurements of radial velocity (RV) variations due to pulsations. The first RV monitoring was made by Libbrecht (1988) who found a peak-to-peak amplitude of 42 m/s. Recently, Kanaan and Hatzes (1998) performed new observations of γ Equ with the iodine absorption cell and found peak-to-peak amplitudes of RV variations ranging from less than 100 m/s to about 1000 m/s. Kanaan and Hatzes showed that the weaker chromium and titanium lines have the largest amplitudes in comparison with the stronger lines of the same elements as well as with the iron lines.

We performed new observations of γ Equ in the red spectral region looking for high amplitude radial velocity variations with the classical technique of RV measurements.

All observations have been performed with the Photometrics CCD camera installed in the coudé spectrograph of the 2.6–meter Shajn reflector of the Crimean Astrophysical Observatory during 14 nights in August–October of 1998. The exposure time was 90 seconds. This value is a reasonable compromise that allows to obtain sufficient signal-to-noise ratio, and is still short enough to minimize phase smearing for the 12 minutes pulsation period (Martinez et al. 1996). The interval between the two consecutive exposures (including readout and data acquisition time) was equal to 128–130 seconds. Typical signal-to-noise ratios per pixel are in the range 60–120 (depending on the weather conditions and seeing). Spectral resolution is about 35000 for the observations in the second order of grating (regions $\lambda\lambda$ 6690, 6340, 6140 Å). For the region centered at λ 6530 Å (the first order of the grating) it is equal to 18000. A calibration spectrum (ThAr lamp) was obtained for each stellar spectrum. Typical set of observations consists of 20 to 90 exposures. The estimated error of the RV measurements for a single line is within 160–240 m/s.

Data reduction was done with the SPE package written by S.G. Sergeev. Continuum fitting was made with the help of synthetic spectrum calculated for each spectral region with SYNTH code (Piskunov 1992) using abundances from Ryabchikova et al. (1997).

During our preliminary analysis we try to identify the lines with the largest RV amplitudes. The Vienna Atomic Line Database (VALD, Piskunov et al. 1995) was extensively used for line identification. A few rather strong features at $\lambda\lambda$ 6145, 6160, 6327, 6690 Å, which show the largest RV variations, were identified with the lines of Nd III and Pr III. Data for the identification of the second ions of rare-earth elements were taken from Mathys and Cowley (1992), and from Cowley and Bord (1998). Fig. 1 shows the curve of the RV variations (upper panel) and its amplitude spectrum (lower panel) for Nd III λ 6145.07 Å, and for Pr III λ 6160.24 Å lines for one night – August 27, 1998 (94 spectra). The oscillations clearly seen in the RV curve, also appear in the Fourier power spectrum. The amplitude spectrum has a strong peak at a frequency of 1.35 ± 0.05 mHz, which corresponds to the pulsation period of 12.35 minutes. The RV data were analysed using the period-finding package ISDA by Pelt (1992) and the program PERDET (Breger, 1990). Combining RV measurements obtained in different nights (the data were rectified by subtracting a mean value for each night) we get the resulting periodogram in the frequency range of interest $1180 \leq \nu \leq 1530$ μHz which is shown in Fig. 2 together with the spectrum of the window function of observations. The largest amplitude is found at the frequency of 1352.6 μHz. The pulsation frequencies detected in the photometric data (Martinez et al. 1996) are indicated by dotted lines.

The analysis of the RV variations indicates a presence of the amplitude modulation, which may be caused by beating among several frequencies. Kanaan and Hatzes (1998) obtained the highest RV variations in $\lambda\lambda$ 5828–5852 Å spectral region. This region contains Nd III λ 5845.07 line. Perhaps this line rather than Cr I λ 5844.30 is responsible for high RV amplitude.

The preliminary analysis of the radial velocity data for γ Equ shows that:

- the highest amplitudes of RV pulsations are associated with the lines of Pr III and Nd III.
- the spectral lines of other species in the observed spectral regions do not show regular RV variations.
- Two out of four photometric frequencies (Martinez et al. 1996) appear in the RV periodograms.

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VARIABLE RESIDUAL ABSORPTION SPECTRA OF AB AURIGAE

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AB Aur (spectral type A0e, V = $7^{\rm m}$) is the brightest Herbig Ae star of the northern hemisphere, and is often considered as the prototype of the pre-main sequence objects of intermediate mass (2–5$M_\odot$). This type of stars shows conspicuous signs of extended chromosphere accompanied by intense activity and strong stellar winds. On VSNET mailing list Poyner (1997) reported that AB Aur suddenly faded by one magnitude in Dec. 2, 1997. One of the authors, Fujii observed AB Aur with his low-dispersion spectrograph attached to 28-cm Schmidt-Cassegrain telescope at Fujii Bisei Observatory several times before and after the sudden fading. His spectra showed that the emission lines near HeI5876Å and NaD were drastically variable. In order to investigate the spectral variation in detail, we carried out spectroscopic observations with the grating spectrograph attached to the 1.01-m telescope (F/12) of Bisei Astronomical Observatory, Okayama, Japan.

The variability of the HeI 5876Å emission line had been reported by many authors (e.g. Catala et al. 1993, Böhm et al. 1996), among which the MUSICOS 1992 campaign was the most extensive one. The four telescopes joined the campaign monitored the evolution of HeI emission line at a spectral resolution of 30000 for about 4 days. Since the HeI profiles showed rapid and remarkable variation with the period of $\sim$ 32 hours, Böhm et al. (1996) selected several profiles which appeared most frequently in their campaign, and regarded their average as "basic"-profile. The "basic"-profile is a very broad emission which has an equivalent width of -750 mÅ and a FWHM of 350 km/sec. The residual spectra which was produced by subtracting "basic"-profile from all spectra showed an almost flat, deep broad symmetric absorption or a combination of emission and absorption. They considered that the HeI emission generated from extended chromosphere of AB Aur and the variable HeI line is composed of two components, one is the "basic"-component and another is the rotationally modulated absorption component caused by azimuthal structures of stellar surface.

We observed HeI 5876Å emission line of AB Aur on ten nights between Jan. 5 and Feb. 17 in 1998. A series of HeI spectra was obtained with linear dispersion of 13 Å/mm and resolution of 10000. The detectors used were the liquid-nitrogen-cooled CCD camera Astrocam 4200 series with UV-coated 1024 $\times$ 256 pixels EEV CCD before Jan. 29 and thereafter the Electronic-cooled CCD camera ST-6 (SBIG) with TC241 375 $\times$ 242 pixels CCD. The exposure time of all observations was 10 min. Before and after each exposure we obtained comparison Fe-Ne frames for the wavelength calibration. To reduce and analyze our observations, NOAO IRAF (Image Reduction and Analysis Facility) software was used. The raw spectrum images were bias-subtracted and flat-fielded, then stellar spectra were extracted from spectrum images. All spectra were normalized by continuum flux. The radial velocity was corrected to heliocentric radial velocity. The standard deviation of radial velocities of NaD_1D_2 interstellar absorption lines is 5 km/sec.

The HeI 5876Å emission line of AB Aur is generally variable, showing complicated profile which consists of very broad single emission, blue-shifted single emission, or a combination of blue-shifted emission and red-shifted absorption. We have analyzed the profile variation with the following method. The "basic"-profile is defined as an average of profiles which not only frequently appeared but also had the smallest equivalent width (i.e. integrated intensity of HeI emission is maximum), because we assume that the variability of profiles is caused by an absorption component. Then, we select three spectra (Feb. 5 11:31UT, Feb. 5 11:57UT and Feb. 5 12:23UT) which have the smallest equivalent width in our observations, and we have regarded its average as our "basic"-profile.

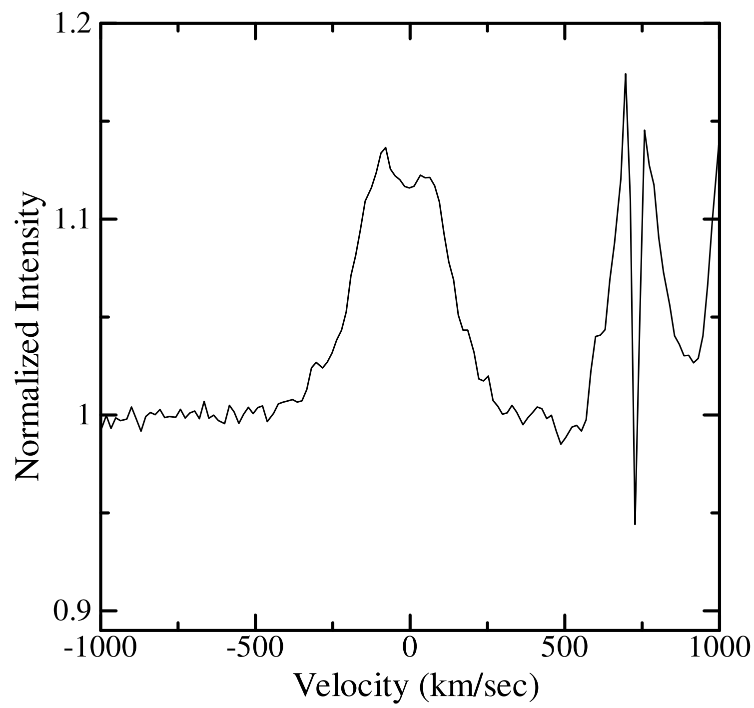

Figure 1. The "basic"-profiles of HeI which is an averaged profile of the three spectra with maximum emission feature in our observations.

Fig. 1 indicates our "basic"-profile which has a symmetric and slightly blue-shifted broad emission, i.e. the equivalent width, FWHM and the centroid-position are -925 mÅ, 330 km/sec and -7 km/sec, respectively. If we admit the heliocentric radial velocity of AB Aur is $+21 \pm 10$ km/sec (Finkenzeller, 1983), this profile suggests that the chromosphere is expanding. By the reason that the chromosphere is hotter than the photosphere, the emission line does not show the P-Cygni profile. Fig. 2 shows residual profiles which were produced by subtraction of the "basic"-profile from all spectra. It is apparent that the residual profiles appear as a sequence of single absorption component slightly redward shifted.

Fig. 3 shows the relation between the equivalent width and the central velocity of residual absorption profiles except for the almost flat spectra from Feb. 5 10:15UT to 14:05UT. The central velocity is measured by gaussian-fitting. It obviously shows that the central velocity of residual absorption widely spreads from −60 km/sec up to 100 km/sec, and the absorption intensity reveals some dependence on the central velocity, taking a maximum intensity at around 30 km/sec. This behavior may be explained by some longitude-dependent structure of cold absorbing material appeared in the outer part of the stable expanding chromosphere of AB Aur. For further investigation of the structure of absorbing material, monitoring observation of the HeI emission line with enough coverage of period is desirable.

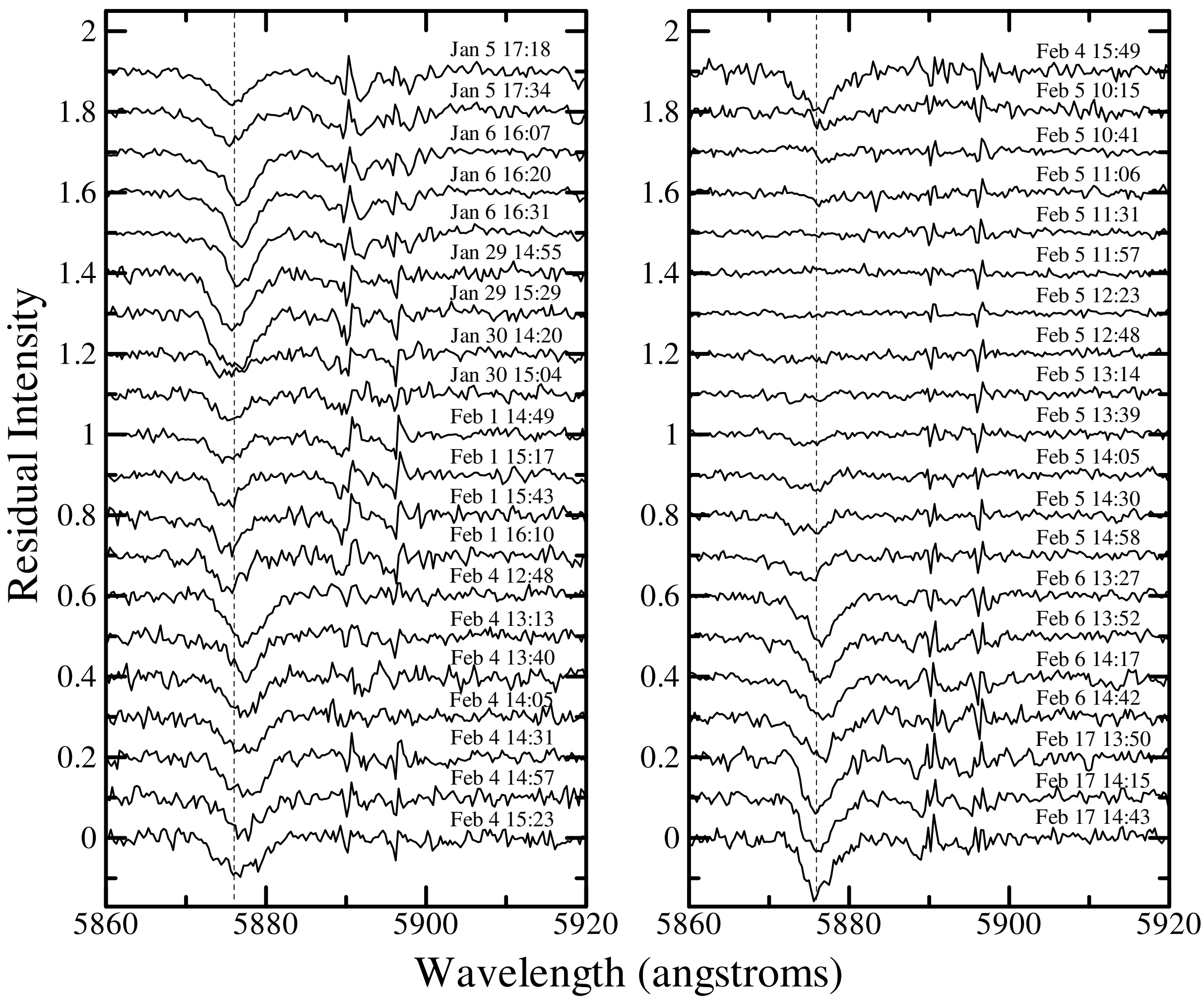

Figure 2. The residual profiles from Jan. 5 to Feb. 17 in 1998 were produced by subtracting the "basic"-profile from all spectra. The start in time of exposure is shown in UT. The vertical dash-line represents the rest wavelength.

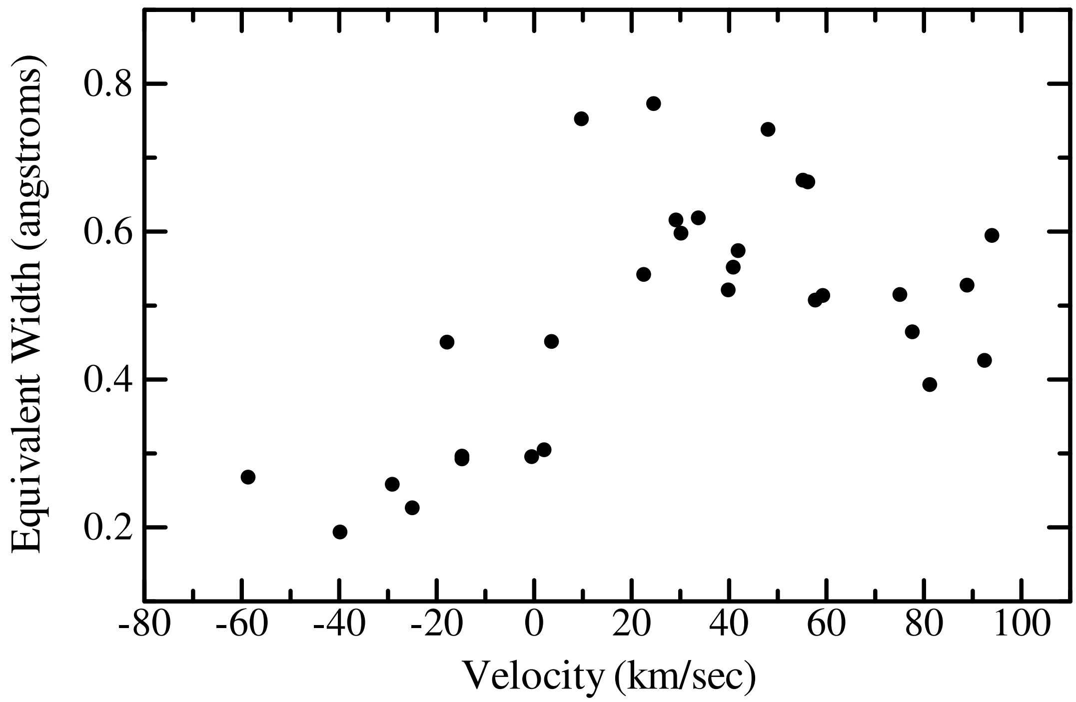

Figure 3. The relation between the equivalent width and the central velocity of residual absorption profiles is shown. The unit of equivalent width is defined by the "basic"-profile continuum level in Fig. 1.

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FLARES DISCOVERED ON 1RXS J220111+281849

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The star 1RXS J220111+281849 (Voges et al. 1997) = GSC 2215_1629 (Jenkner et al. 1990) = G 188-38 (Giclas et al. 1980) = HIP 108706 (ESA 1997) was found to have significant X-ray emission in a survey by the ROSAT satellite (Bade et al. 1998). It was classified as an M4 star by Reid (1995) with an apparent magnitude of V = 11.99 by Weis (1987), (B−V) = 1.63 (Harrington et al. 1993) and a distance of 8.96±.25 pc (ESA 1997). As part of a search for radial velocity variations of nearby K and M dwarfs, Delfosse et al. (1998) measured its $v \sin i$ to be 29.6 km sec^{-1} and observed hydrogen lines to be in emission.

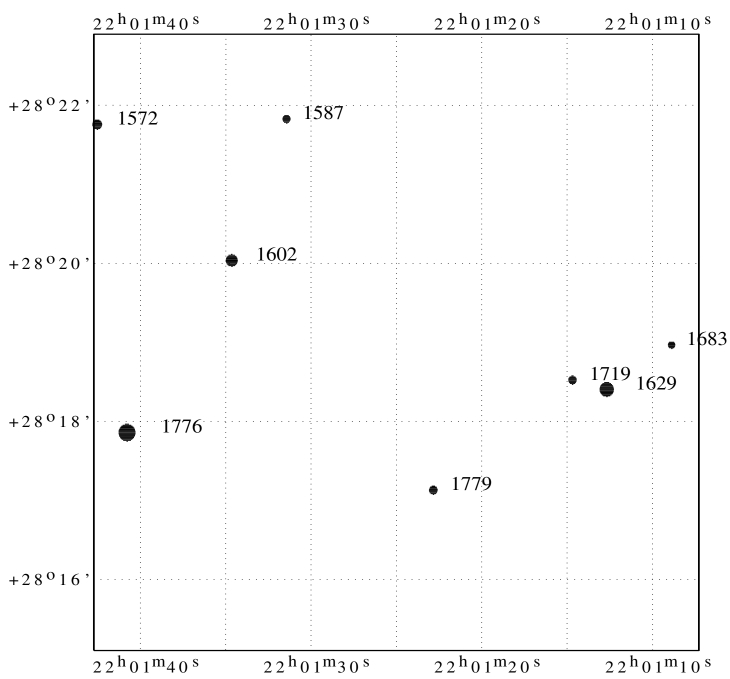

Figure 1. Finder chart labeled with the GSC numbers.

Plotted in Figure 1 is the field of stars observed with the automated 0.5-m telescope and reduced in a fashion identical to that described in Robb et al. (1997). Tabulated in Table 1 are the stars' identification numbers, coordinates (J2000) and magnitudes from the

Table 1: Stars observed in the field of GSC 2215_1629

GSC No.	R.A. J2000	Dec. J2000	GSC Mag.	ΔR Mag.
1629	$22^h01^m13^s$	$+28°18'24''$	11.6	$0.307 \pm .015$
1776	$22^h01^m41^s$	$+28°17'51''$	10.7	-
1602	$22^h01^m35^s$	$+28°20'02''$	12.5	$1.780 \pm .004$
1587	$22^h01^m31^s$	$+28°21'50''$	14.0	$3.372 \pm .007$
1779	$22^h01^m23^s$	$+28°17'08''$	13.8	$3.222 \pm .003$
1719	$22^h01^m15^s$	$+28°18'31''$	13.8	$3.145 \pm .016$
1683	$22^h01^m09^s$	$+28°18'58''$	14.2	$3.786 \pm .013$
1572	$22^h01^m43^s$	$+28°21'45''$	13.3	$2.615 \pm .005$

Hubble Space Telescope Guide Star Catalog (GSC) (Jenkner et al. 1990). Differential ΔR magnitudes are calculated in the sense of the target star minus GSC 2215_1776. Brightness variations during a night were measured by the standard deviation of the differential magnitudes, which ranged from $0\overset{m}{.}005$ for bright stars on a good night to $0\overset{m}{.}050$ for the faint stars on poor nights.

The run mean of the thirteen nightly means and their standard deviation, which is a measure of the night to night variations, are given in Table 1 as ΔR and its uncertainty. The high precision of these data can be seen from the standard deviation of the ΔR of GSC 2215_1779 minus GSC 2215_1776, which is $0\overset{m}{.}003$ and shows that these two stars are constant at this level of precision. The fainter stars have the expected larger standard deviation. The star GSC 2215_1629 had obvious flares of up to $0\overset{m}{.}3$ during four nights and also slight changes of about $0\overset{m}{.}020$ on an hourly time scale.

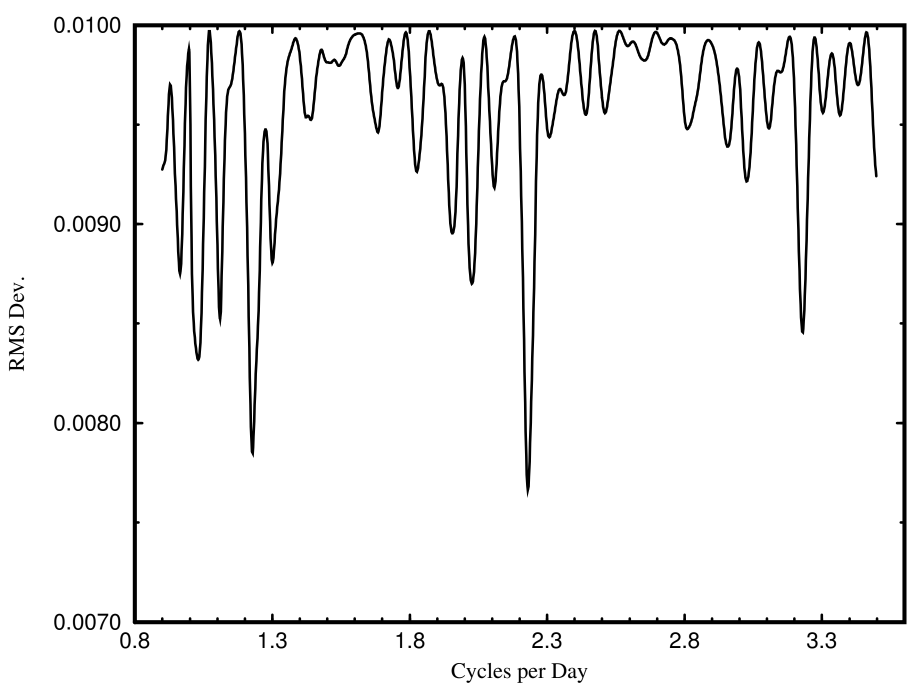

Figure 2. Periodogram for 1RXS J220111+281849 for 1998

The four nights which showed flares were excluded from the search for periodicity and the other nine nights were fit with a single sine curve of various frequencies. In Figure 2 we have plotted the RMS deviation of a point from a sine curve as a function of period.

There is little ambiguity in the determination of the photometric period of GSC 2215_1629, which gives the ephemeris:

$$\text{HJD of Maxima} = 2451053.386(50) + 0\overset{\text{d}}{.}448(5) \times E,$$

where the uncertainties in the final digits are given in brackets.

The differential (GSC 2215_1629−GSC 2215_1776) R magnitudes of the nine nights with no flares, phased at this period, are plotted in Figure 3 with different symbols for each of the nights. We suspect that this variation is due to rotation of an asymmetry in the distribution of spots into and out of our view. Since the star may rotate differentially and the spot asymmetry may change, we do not expect the rotation period of the star to be precisely this value. Combining our period with the maximum rotation period, $P/\sin i$ of Delfosse et al. (1998) gives the inclination of $58 \pm 4°$ for the axis of rotation, assuming a radius of 0.3 $R_{\odot}$, where the quoted uncertainty does not include the contribution from differential rotation.

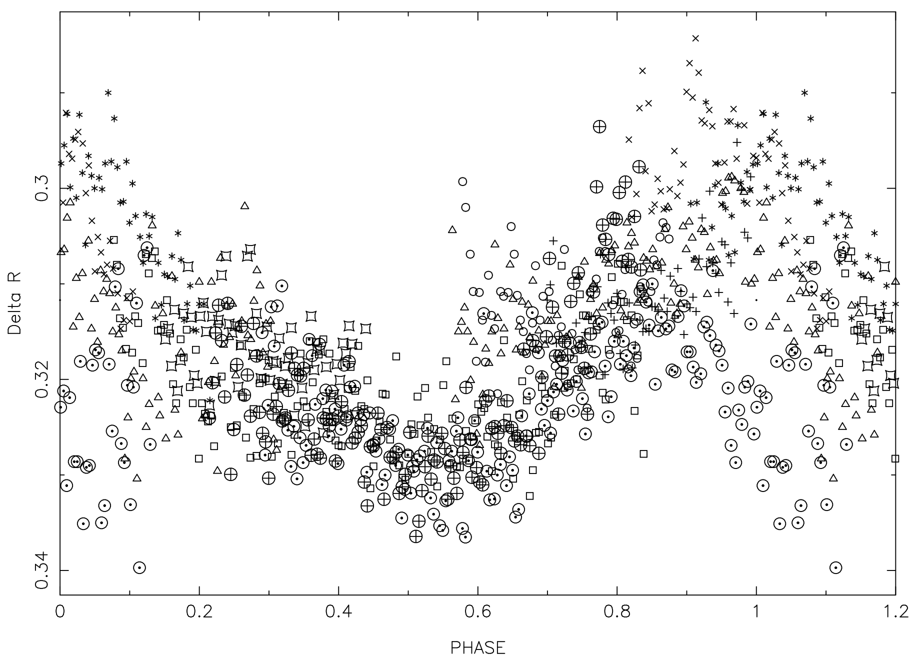

Figure 3. R band light curve of 1RXS J220111+281849 for 1998

During four nights we observed flares of large amplitude which are plotted in Figure 4. The Heliocentric Julian Dates (−2451000) of the onset of the flares, were 55.7223, 60.8024, 60.9995, 70.7525, 76.7180, and 76.9140, where the time between individual data points is about 0.0020 days. On two of the nights we see a pair of flares separated in time by 0.1960 and 0.1971 days, which are identical considering the spacing of the data.

The probability of two pairs of flares having the same spacing in time as chosen from our 1452 data points is extremely small and hints at a possible periodicity. The time spacing implies that there are either two regions on opposite sides of the star which flared or one region which flared near one limb of the star and then the other. A search for periods which superimpose the flares in phase, yields a good fit at the period of 0.4421 days, which is intriguingly close to the photometric period, but there were many other periods with residuals nearly as small. Obviously more data is needed to give any confidence in a possible periodicity of the flaring activity. We eagerly await next year to confirm or disprove this periodicity and urge observers to contribute to an international campaign by contacting the authors.

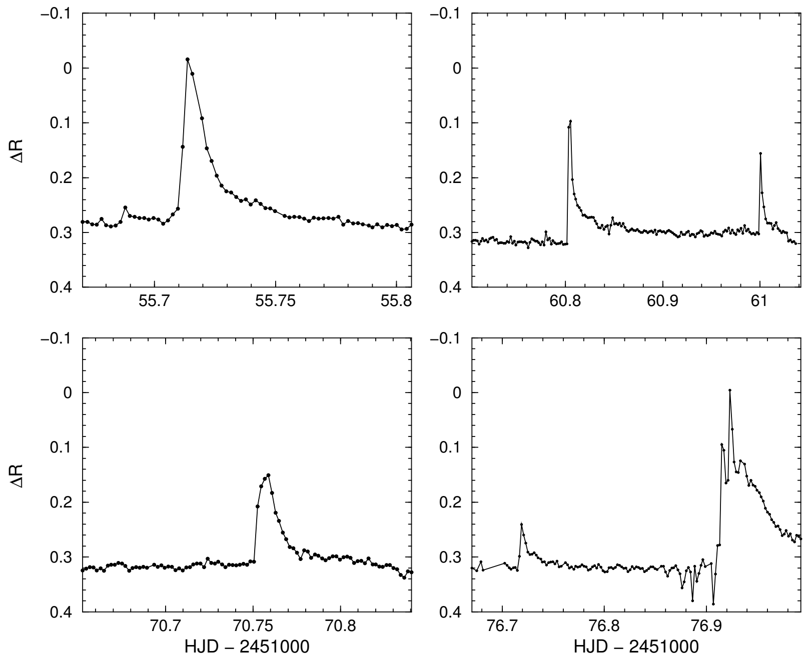

Figure 4. Differential R measurements of 1RXS J220111+281849 for the nights with flares

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

Number 4653

Konkoly Observatory
Budapest
9 December 1998

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GSC 4666:209 IS A NEW VARIABLE

GLENN GOMBERT

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Name of the object:
GSC 4666:209, IRAS Point Source Catalog: 23590:0402

Equatorial coordinates:	**Equinox:**
R.A.= $0^h01^m38\overset{s}{.}7$ **DEC.=** $-3°45'22\overset{''}{.}3$	J2000

Observatory and telescope:
TASS Mark III Camera – The data was taken with three custom-made CCD cameras each using Kodak KAF-0400 chips and 135-mm camera lenses operating in drift-scan (Time Delay Integration) mode.

Detector:	Kodak KAF-0400

Filter(s):	V and I bands of Johnson–Cousins system

Transformed to a standard system:	Johnson–Cousins Band(s)
Standard stars (field) used:	The I-band photometric magnitudes were obtained using all-sky photometry, photometric first order transformation coefficients were calculated using Landolt standard stars in the region of −4.5 to −1.5 degrees in declination. Photometric zero points were calculated using Tycho stars present in each image. An analysis of the photometric accuracy performed on a subset of the reduced data can be found in TASS Technical Note #45 (Richmond, M.W.).

Availability of the data:
Through IBVS Web-site as 4653-t1.txt

Type of variability:	Semi-regular

Remarks:

The Amateur Sky Survey (Droege and Gombert 1998), Dayton, Ohio station has discovered a new semi-regular variable (GSC 4666:209). This new variable is not included in the General Catalog of Variable Stars or New Suspected Variables (Kholopov et al., 1985). This star was observed a total of 26 times between July 30, 1997 and October 23, 1998. The V-band magnitudes were also measured for this new variable but are considered too faint to publish. The (V−I) color at maximum is +2.67.

A preliminary period estimate for this new variable (based on the collected data) is 83.3 days. A better period estimate will be published when more data has been collected. Data was reduced using a suite of astrometric/photometric programs written by Arne Henden (Henden and Kaitchuck 1982) of the United States Naval Observatory, Flagstaff station.

Acknowledgements:

I would like to thank Brian Skiff of Lowell Observatory and Michael Richmond of the Rochester Institute of Technology for their help and advice on preparing this Technical Note. The phase plot shown in Figure 1 was prepared by Michael Richmond.

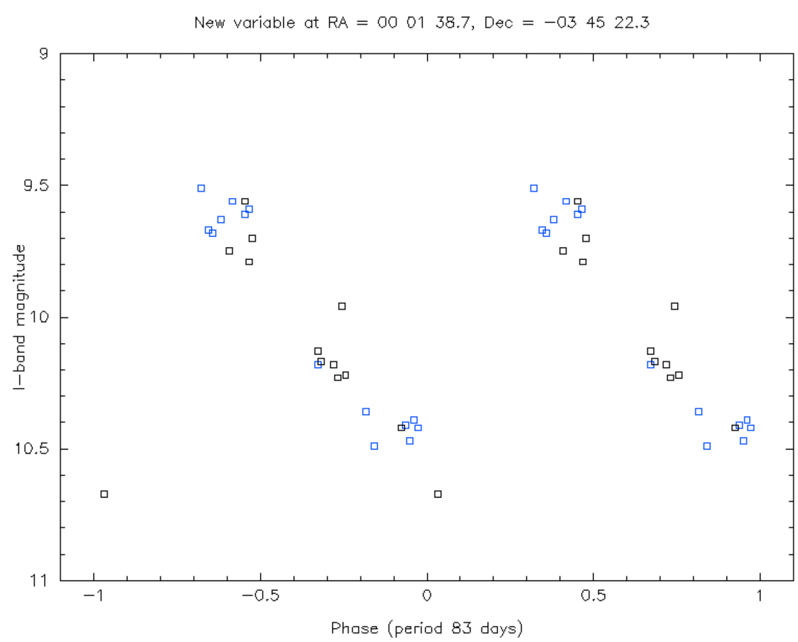

Figure 1. Phase plot of the new variable

References:

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Richmond, M.W., TASS Technical Note #45, "An Analysis of Dayton TASS Data Reduced With Flatcomp Program"
URL: http://a188-L009.rit.edu/tass/technotes/tn0045.html

ERRATA

In IBVS Nos. 4555 and 4633 we presented CCD photometric minima observations (together with photoelectric ones) of several eclipsing binary systems. Due to an unfortunate programming bug most of the minimum times have an error in the third decimal place of JD. This erratum contains the corrected moments of minima. Table 1 shows the corrigenda to IBVS No. 4555. Table 2 should be used as a total replacement of the Table of IBVS No. 4633.

Table 1

Star	Min. HJD +2400000	Star	Min. HJD +2400000
AS Cam	50519.5238	V453 Cyg	50235.4843
PV Cas	50244.4435	V477 Cyg	50237.4480
GK Cep	50210.453	V1136 Cyg	50270.4694
	50225.4297	DI Her	50238.4929
MR Cyg	50230.4608	UV Leo	50513.5487

Table 2

Star	Min. HJD +2400000	error ±	Min. type	Points used	Filter	Obs.'s name	Instr.	Comp.
RT And	50964.5050	2	I	51	V	Bir	Ba50	HD 218915
AB And	50966.5525	3	II	30	V	Bir	Ba50	GSC 2763-0683
	50984.4721	4	II		V	Bir	Ba50	
	51016.5005	1	I	41	V	Bor	Ba50	
OO Aql	50950.486:	1	I	19	V	Bor	Ba50	HD 187146
	50956.5658:	2	I	61	V	Bir	Ba50	
	50967.4659	1	II	45	V	Bor	Ba50	
Y Cam	50872.4672	3	I	77	-	Bor	Ba50	GSC 4527-1983
AS Cam	50900.351	1	II	163	V	Bor	Ba50	GSC 4347-0466
RZ Cas	50871.4318	3	I	414	-	Bor	Ba50	GSC 4317-1578
TV Cas	51005.45:	1	II	190	V	Bir	Ba50	GSC 3665-0026
PV Cas	51015.5244	5	I	55	V	Bir	Ba50	GSC 4010-1432
VW Cep	50871.6279	5	I	102	-	Bor	Ba50	GSC 4585-2387
	50900.5736	3	I	54	V	Bor	Ba50	
	50941.3443	3	II	51	V,B,R	Bor	Ba50	
	50941.4859	3	I	61	V,B,R	Bor	Ba50	
	50942.4573	5	II	59	V,B,R	Bir	Ba50	
	50942.5990	5	I	28	V,B,R	Bir	Ba50	
XX Cep	51018.517:	6	II	91	V	Bor	Ba50	GSC 4288-0186
CQ Cep	50948.5431	6	I	200	V	Bir	Ba50	GSC 3991-1316
DL Cyg	51038.485	3	I	170	V,R	Bor	Ba50	GSC 3595-0816
MR Cyg	50962.4954	1	II	87	V	Bir	Ba50	GSC 3609-1220
	51014.4830	5	II	124	V	Bir	Ba50	
V477 Cyg	50974.4054	2	I	53	V	Bor	Ba50	GSC 2674-0910
AK Her	50865.6038	2	I	53	V,B	Bir	Pi50	BD+16°3123
	50866.6601	1	II	78	-	Bor	Ba50	GSC 1536-0928
	50884.5722	2	I	82	V	Bor	Ba50	
	50903.5413	3	I	78	V	Bir	Ba50	
	50971.4060	3	I	266	R	Bor	Ba50	

Table 2 (cont.)

Star	Min. HJD +2400000	error ±	Min. type	Points used	Filter	Obs.'s name	Instr.	Comp.
GU Her	50970.434	2	I	215	-	Bor	Ba50	GSC 2581-2418
	50983.4675	3	I	200	-	Bir	Ba50	
	51033.421	4	II		-	Bir	Ba50	
HS Her	50945.4749	2	I	283	V	Bir	Ba50	GSC 2113-2242
	50972.4946	3	II	343	V	Bir	Ba50	
	50981.5011	3	I	125	V	Bir	Ba50	
MM Her	50940.5670	5	I	182	V	Bir	Ba50	GSC 1565-2199
SW Lac	50961.518	1	II	49	V	Bir	Ba50	GSC 3215-0906
	50986.5358	1	II	54	V	Bir	Ba50	
	51017.4831	1	I	35	V	Bor	Ba50	
UV Leo	50899.4051	1	II	60	V	Bir	Ba50	GSC 0845-0121
GP Vul	50946.4643	8	II	65	V	Bir	Ba50	GSC 2151-2731

T. Borkovits, I.B. Bíró

The recently published No. 4630 issue of the IBVS contains two unfortunate errors. The correct declination of V370 And is $+45°26'37''.30$ (2000) instead of $+44°$ etc. Regrettably the name of John T. Lee as the co-author does not appear in the published version, for which we apologize.

The Editors

COMMISSIONS 27 AND 42 OF THE IAU
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Number 4654

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Budapest
14 December 1998

HU ISSN 0374 – 0676

CCD PHOTOMETRIC OBSERVATIONS OF THE CATACLYSMIC STAR USNO 1425.09823278

TOMASZ KWAST AND IRENA SEMENIUK

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e-mail: is@sirius.astrouw.edu.pl, tk@sirius.astrouw.edu.pl

Name of the object:
USNO 1425.09823278

Equatorial coordinates:	**Equinox:**
R.A.= $19^h27^m11\overset{s}{.}6$ **DEC.=** $+54°17'51''$	2000.0

Observatory and telescope:
Ostrowik Station of the Warsaw University Observatory, 0.6 m Cassegrain

Detector:	CCD Camera with a Tektronix TK512 CCD
Filter(s):	R Cousins
Comparison star(s):	GSC 3921.0974
Check star(s):	GSC 3921.0860
Transformed to a standard system:	No

Availability of the data:
Through IBVS Web-site as 4654-t1.txt

Type of variability:	SU UMa type cataclysmic variable

Remarks:

The star was discovered by J.-y. Hu et al. (1997). The superhump period was determined by Vanmunster (1997) as equal to 0.0561 day. Our observations were made during a 6.2 h run on the night of September 4/5, 1997, when the R magnitude of the star was approximately 14.3. The effective exposure time was 120 s. The time of the superhump maximum representative for the whole observing run is:

$$\text{BJD Max} = 2450696.3895 \pm 0.0012.$$

It was obtained by the least squares fit to the individual pulse maximum times as visible in Fig. 2. In the fitting procedure the superhump period was fixed on the Vanmunster (1997) value.

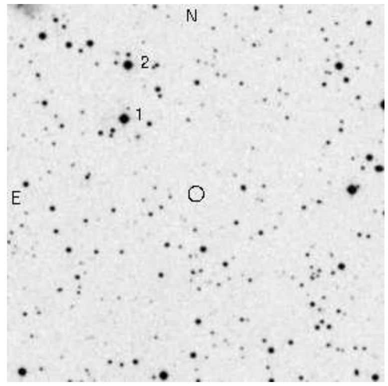

Figure 1. The Digitized Sky Survey finding chart for USNO 1425.09823278 covering a region 8 × 8 arcminutes centered on the position of the variable. The stars 1 and 2 are the comparison and check stars respectively. A rough mean R magnitude of the variable during our observations based on the USNO Catalogue magnitude of the comparison star was 14.3.

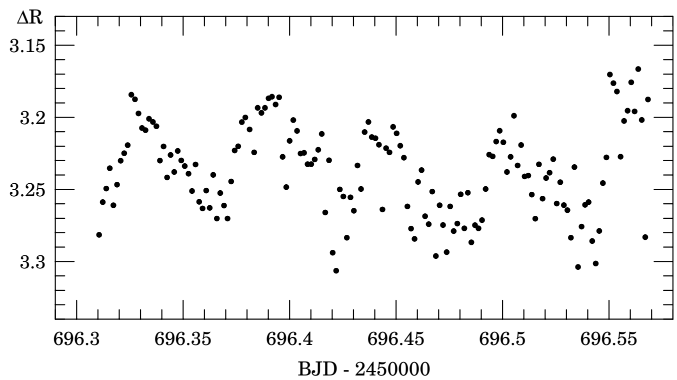

Figure 2. The light curve of USNO 1425.09823278 from 4/5 Sep 1997. ΔR denotes the difference of the magnitude of the variable and the magnitude corresponding to the sum of intensities of the comparison and check stars.

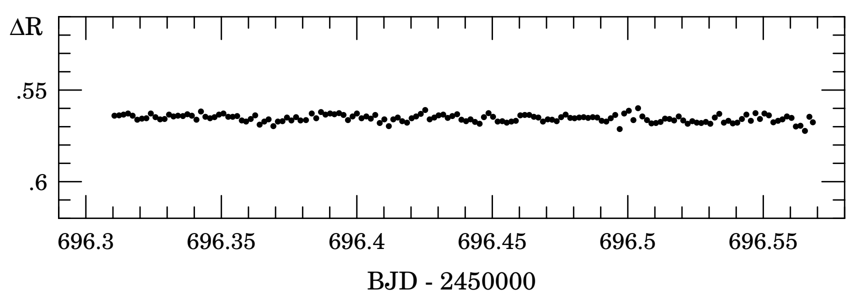

Figure 3. The behaviour of the comparison star during our observations. ΔR denotes the difference of the comparison star magnitude and the magnitude corresponding to the sum of intensities of the comparison and check stars.

References:

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Vanmunster T., 1997, IAU Circ. No. 6740.

COMMISSIONS 27 AND 42 OF THE IAU
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Number 4655

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17 December 1998

HU ISSN 0374 – 0676

NEW CATALOGUE OF SUSPECTED VARIABLE STARS. SUPPLEMENT — VERSION 1.0

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In the course of systematization and evaluation of data on photometrically unstable objects, we have compiled a preliminary catalogue of suspected variables (version 1.0) which is a natural continuation of the New Catalogue of Suspected Variable Stars (NSV Catalogue; Kukarkin et al., 1982). This Supplement to the NSV Catalogue contains information on 11206 stars suspected in variability, in most cases, within the recent 20 years. The new catalogue numbers of suspected variable stars begin with No. 15001, to avoid confusion with the NSV catalogue. In the system of the GCVS, this is the first catalogue presenting the new accuracy standard (to 1–2 arcsec) for coordinates of variability suspects in our Galaxy. It presents photometric and spectral-type data, possible variability types, additional information (on duplicity or multiplicity, large proper motion, revealed mistakes, etc.), along with identifications, whenever possible, with well-known general and special catalogues, thus reflecting specific features of objects entering corresponding catalogues and enabling us to considerably reduce the needed volume of verbal remarks. Compared to 33 tables of identifications with different catalogues available to users of the GCVS and the NSV Catalogue, the Supplement to the NSV Catalogue gives identifications of its stars with more than 50 different catalogues.

Detailed references to catalogues and lists used for identifications (with author names, complete names of catalogues, and bibliographic descriptions) and byte-by-byte descriptions of the Supplement's tables can be found in the readme file of the electronic version, NSVSUP, of the present Supplement.

The main table of the Supplement to the NSV Catalogue is a compact presentation of data resulting from the analysis of photometric and spectroscopic information contained in more than 50000 bibliographic descriptions currently constituting the Supplement's ever growing data base. We hope that this compact and formalized presentation of data for each star will facilitate users' orientation in the tremendous volume of available information. In our understanding, the catalogue's main goal is to provide necessary data on each variable star making it possible to locate it, rather easily, on the sky, to find it in other catalogues, and, whenever possible, to get an idea about the character of variability. It may serve the international community of variable star researchers as a tool for designing observing programmes: each suspected variable, after thorough investigation, can enter the General Catalogue of Variable Stars, and some of them may even become new prototypes in variability classification.

Observers need high accuracy of coordinates for variable stars. According to practical requirements of ground-based and orbital observations, to typical parameters of seeing and of automatic telescope pointing, we tried to achieve an accuracy about 1 arcsec for objects of our catalogue. Such positional accuracy will, most probably, exclude ambiguity in pointing to the majority of objects, except variable components of multiple systems needing individual approach to identification of each of the closely located companions. Such accuracy of coordinates also makes it possible to undertake automatic identifications of most variable stars with objects of numerous modern electronic catalogues.

For variables down to 9th–10th magnitudes, we accepted coordinates from SAO or PPM catalogues. The Hubble Space Telescope Guide Star Catalogue enabled us to improve coordinates for the majority of fainter stars (to 14th–15th magnitudes). We used the USNO A1.0 catalogue to find positions of still fainter stars (to the limit of Sky Surveys, $21–22^{m}$). For faint stars not contained in the latter two catalogues, we determined coordinates relative to GSC stars. For each star having a finding chart, we compared the chart with the image of the corresponding star field created using the visualization software kindly provided by A.A. Volchkov (Sternberg Astronomical Institute) for the GSC and by J. Manek (Stefanik Observatory, Czech Republik) for the USNO A1.0 catalogue. We rounded the resulting coordinates to 0.1 second of time in right ascension and to 1 arcsecond in declination. GSC numbers for the stars of the NSV Supplement are included into the table of identifications. The number of the Supplement's stars with GSC identifications is 5921 (or 53%), 160 of them having simultaneously two or more GSC numbers.

In the electronic version of the Supplement, the coordinates of suspected variables are presented for two equinoxes, B1950.0 and J2000.0. The numbering of stars in the catalogue follows increasing right ascension for the equinox B1950.0: all our variable star catalogues and the majority of special catalogues give positions for this equinox. Only recently, many catalogues began to choose the equinox J2000.0, thus making it necessary to transform the coordinates in the catalogues of variable stars (GCVS and the NSV Catalogue) to J2000.0. In the process of this transformation for the GCVS, currently under way in our group, we also find and identify each star and improve its coordinates; for the Supplement to the NSV Catalogue, we have already solved these problems during its compilation, so the transformation was straightforward.

Among the stars of the Supplement, there are 1956 stars suspected in variability in the cause of the orbital observations of the Hipparcos experiment. The manner of presentation of Hipparcos variables in our catalogue does not differ from that used for the rest of suspected variables; we have adjusted the variability types suggested in the Hipparcos catalogue according to the standard GCVS classification. The Hipparcos variables in the Supplement to the NSV Catalogue are mostly stars with information insufficient for reliable determination of their variability types, so that they could not be assigned GCVS names and included into the special, 74th Name-List of Variable Stars (to be published in the IBVS in the nearest future). A number of stars were not named because of their spectroscopic and/or photometric characteristics contradicting the existing variability types (thus, either re-reductions of data or new observations are needed, for example, to check the period of brightness variations, the luminosity class, etc.).

For each of the 118322 stars of the Hipparcos catalogue, more than 100 homogeneous brightness measurements, gathered during 4 years of orbital observations (1989–1993), in the Hipparcos system, are available on CD-ROM. So it was important to identify stars of

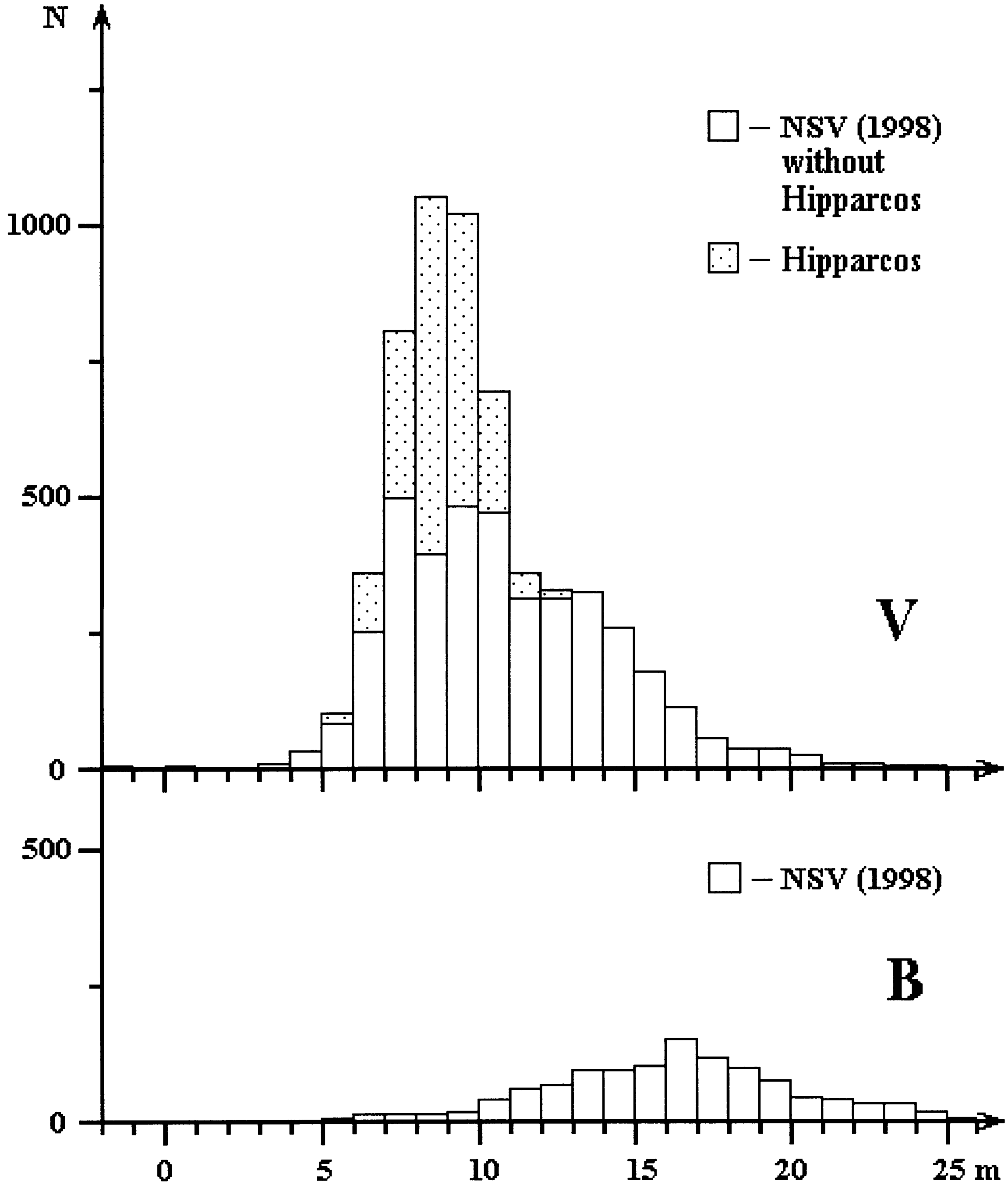

Figure 1. The brightness distribution in V and B bands for stars of the Supplement to the NSV Catalogue

our Supplement with those Hipparcos catalogue stars not recognized as variables. We got 1420 such identifications and included them into the identification table, thus enabling the users to combine data of our catalogue with Hipparcos observations and to determine, for some stars, variability types not found by the ESA scientific team.

We are planning to add cross-identification tables arranged in the order of numbers of external catalogues and making it possible to find corresponding GCVS names or NSV/NSV Supplement numbers.

Figure 1 shows the brightness distribution (V and B light) for the stars of the NSV Supplement. In the upper panel, we also demonstrate the contribution of Hipparcos discoveries of variable stars to the NSV Supplement. Among the stars of the Supplement, V magnitudes are presented for slightly more than 50% of them; B magnitudes, for about 10%; the rest of the stars have magnitudes presented in other bands. In the NSV Catalogue proper, two thirds of stars had photographic or B magnitudes.

The NSVSUP Catalogue is available by INTERNET, at the GCVS home page of the Sternberg Astronomical Institute:

ftp ftp.sai.msu.su, /pub/groups/cluster/gcvs/gcvs/nsvsup/ (anonymous)
http://www.sai.msu.su/groups/cluster/gcvs/gcvs/nsvsup/
E-mail: gcvssai.msu.su

This study was supported, in part, by the Russian Foundation for Basic Research (grant 97-02-16739), by the Federal Scientific Programme "Astronomy" (project 2.2.1.6), and by the Russian Programme of Support for Leading Scientific Schools (grant 96-15-96656).

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Kukarkin, B. V., Kholopov, P. N., Artiukhina, N. M., Fedorovich, V. P., Frolov, M. S., Goranskij, V. P., Gorynya, N. A., Karitskaya, E. A., Kireeva, N. N., Kukarkina, N. P., Kurochkin, N. E., Medvedeva, G. I., Perova, N. B., Ponomareva, G. A., Samus, N. N., and Shugarov, S. Yu., 1982, *New Catalogue of Suspected Variable Stars* (Moscow: Nauka Publishing House)

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1997 PHOTOMETRY OF RT ANDROMEDAE

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As part of an ongoing study of short period eclipsing RS CVn stars, this work reports 1997 light curves and spot models of RT And. Previous papers in this series (Heckert 1995 and Heckert et al. 1996) report 1995 and 1996 data and summarize previous similar work. Arévalo et al. (1995) report infrared observations from which they estimate the system parameters.

I observed RT And on the nights of 7, 8, 9, 10, and 11 January 1997 with the 61 cm telescope at Mt. Laguna Observatory operated by San Diego State University. I used the instrument, technique, and calibration reported in Heckert (1995). Figure 1 shows the BVRI differential magnitudes (star–comparison) in the standard Johnson-Cousins system. Phases for the 93 data points in each filter, were computed with the ephemeris given by Strassmeier et al. (1993): $\phi = 2441141.8888 + 0.62892984 \times E$.

As for the 1995 and 1996 data, I used the Information Limit Optimization Technique (ILOT) of Budding and Zeilik (1987) to model the data to find the spot structure. Figures 2 and 3 show the fits. In degrees, I get:

Table 1: Spot Fits

	B band	V band	R band	I band
Longitude	239.5 ± 4.2	237.9 ± 4.9	239.4 ± 6.3	244.2 ± 8.5
Latitude	39.0 ± 19.2	44.3 ± 26.9	45	45
Radius	11.2 ± 2.4	12.0 ± 4.1	11.0 ± 0.7	11.1 ± 0.7
χ^2	233.0	136.0	127.1	109.0

As for most previous results, the data fit well with a single spot. It is interesting to compare these results to those for the 1995 and 1996 data. Figure 4 plots the spot positions. The spot is roughly the same size and at mid latitudes for all three years. Note however that the modeled latitudes are quite uncertain and in some cases values had to be fixed at 45° because I was unable to fit this parameter. The spot migrated from the 90° Active Longitude Belt (ALB) to the 270° ALB between 1995 and 1996. In 1996 the spot was at 216° longitude, barely within the region that could be considered the 270° ALB. By 1997 the spot had migrated to 240° longitude, closer to the center of the 270° ALB. Heckert et al. (1998) notice a similar trend for WY Cnc. Spots originate near the edge of an ALB and migrate to increasing longitudes.

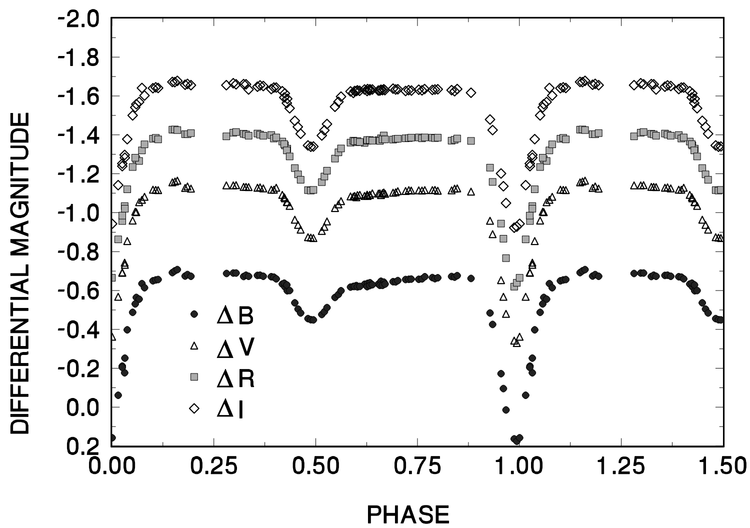

Figure 1.

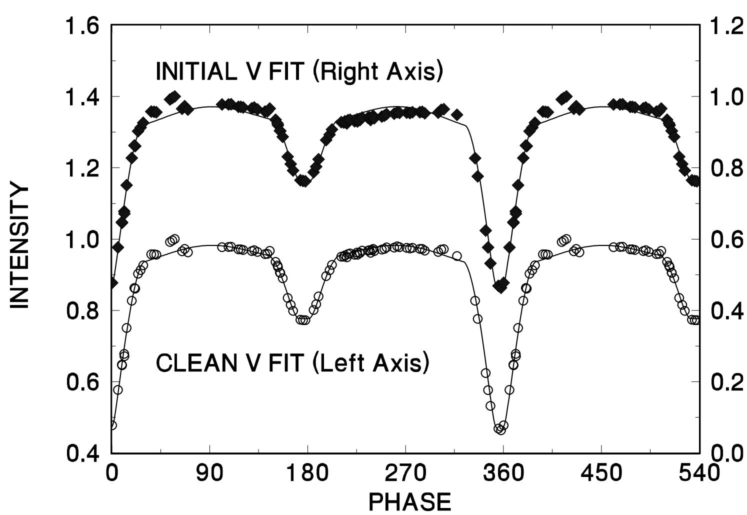

Figure 2.

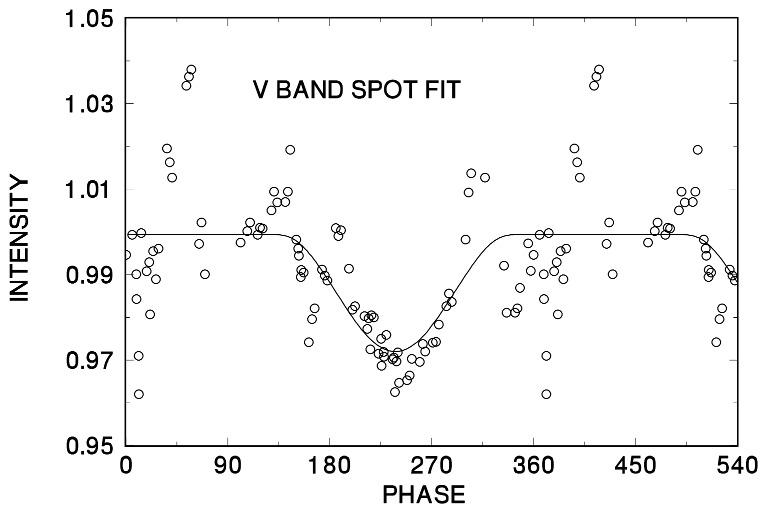

Figure 3.

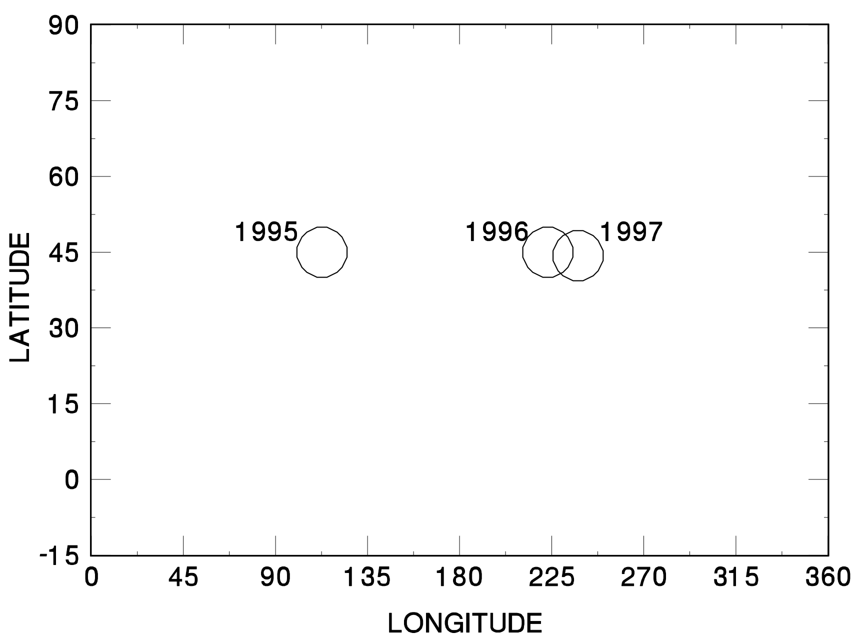

Figure 4.

Unlike the 1995 and 1996 light curves, these light curves were complete enough to perform clean fits with the effects of the spot distortion wave removed. These fits provide estimates of the system parameters. The quantities are as defined by Budding and Zeilik (1987). The result is as follows:

Table 2: Clean Fits

	B band	V band	R band	I band
L_1	0.861 ± 0.008	0.823 ± 0.008	0.807 ± 0.008	0.775 ± 0.008
$k(= r_2/r_1)$	0.718 ± 0.006	0.721 ± 0.007	0.736 ± 0.010	0.744 ± 0.007
$\Delta\theta_0$	3.660 ± 0.134	3.921 ± 0.141	3.961 ± 0.152	4.098 ± 0.150
r_1	0.319 ± 0.004	0.316 ± 0.004	0.315 ± 0.004	0.307 ± 0.003
i (deg)	90.0 ± 1.7	89.5 ± 2.3	86.9 ± 1.1	90.0 ± 1.9
e	0.024 ± 0.013	0.014 ± 0.012	0.020 ± 0.011	0.021 ± 0.012
M_0	2.929 ± 0.137	3.015 ± 0.153	2.998 ± 0.108	3.051 ± 0.080
L_2	0.111 ± 0.009	0.145 ± 0.009	0.165 ± 0.010	0.199 ± 0.010
$q(= m_2/m_1)$	0.399 ± 0.065	0.424 ± 0.083	0.54 ± 0.105	0.470 ± 0.130
χ^2	152.5	82.1	97.1	80.5

The luminosities of the primary and secondary stars, L_1 and L_2, are normalized to sum to approximately but not exactly one. $\Delta\theta_0$ is the correction in degrees that must be added to the observed times of eclipse minima to obtain the minima times computed with the ephemeris given by Strassmeier et al. (1993). The radius of the primary, r_1, is in units of the orbital separation. The averages of these values, $r_1 = 0.314 \pm 0.005$ and $k = 0.730 \pm 0.012$, compare well with the solutions of Arévalo et al. (1995) which are: $r_1 = 0.316 \pm 0.005$ and $k = 0.715 \pm 0.033$. My average value of the orbital inclination, 89.1 ± 1.5 compares to 88.4 ± 1.1 and 87 obtained by Zeilik et al. (1989) and Arévalo et al. (1995). M_0 and e are the mean anomaly and ellipticity. Zeilik et al. (1989) find that RT And has a slightly elliptical orbit rather than the circular orbit more common for these systems. They get values of 3.03 ± 0.22 and 0.026 ± 0.013 which agree with the averages of these values of 3.00 ± 0.04 and 0.020 ± 0.04. My values of the mass ratio are lower than the previous values of 0.65 used by Budding and Zeilik (1987) and the spectroscopically determined value of 0.73 (Popper 1994). However photometric mass ratios, especially when determined from a single set of light curves, are less reliable than those from spectroscopic data.

I thank Ron Angione for scheduling generous amounts of observing time at Mt. Laguna. I also acknowledge support from a Cottrell College Science Award of The Research Corporation for this work.

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ABRUPT PERIOD CHANGE IN THE δ SCUTI STAR V1162 ORIONIS[†]

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The variability of V1162 Ori ($V = 9.89, B - V = 0.38$) as a high-amplitude δ Scuti star was discovered by Lampens (1985). Poretti et al. (1990) found the light variations to be monoperiodic; they determined a period of $0\overset{d}{.}07868614$ and an amplitude of $0\overset{m}{.}2$ in the Johnson V band. From new observations, Hintz et al. (1998) found that the period had changed to $0\overset{d}{.}07869165$, and that the amplitude of the light variations had dropped to $0\overset{m}{.}12$. In addition, they also saw evidence for the presence of a secondary period.

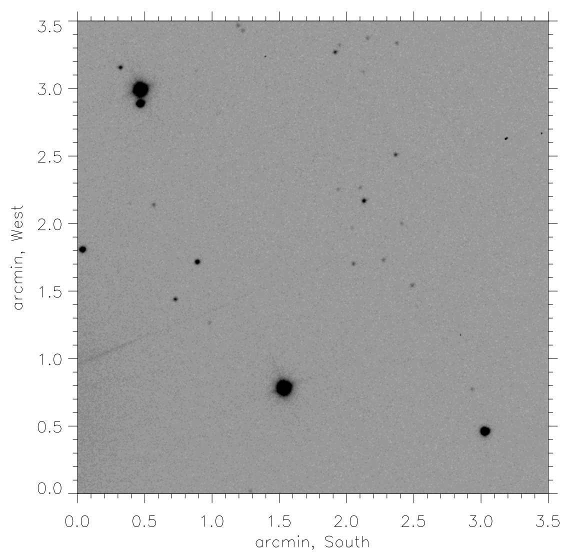

Figure 1. CCD image of the field. The brightest star in the NW corner is V1162 Ori

As a consequence of the findings by Hintz et al. (1998), we started to monitor the star using the Dutch 91 cm telescope at ESO, La Silla, Chile. The detector is a 512×512 pixel CCD (ESO CCD #33) with a field of view of $3\overset{'}{.}5 \times 3\overset{'}{.}5$ (see Fig. 1). The data were obtained in the Strömgren y and b bands. Data reduction was carried out using the software package MOMF (Kjeldsen & Frandsen 1992) that combines aspects of PSF

[†]Based on observations obtained at the European Southern Observatory at La Silla, Chile (observing proposal ESO 61-D0128)

and aperture photometry. The resulting differential magnitudes (with respect to the brightest comparison star nearby) are accurate to about 3–4 mmag, the rms scatter of the magnitude difference between the two comparison stars. Our data, typically, cover about one full pulsation cycle per night.

The light curves clearly indicate a significant increase of the amplitude towards the end of the observing season: from January to March 1998 the y-amplitude was $0^{\rm m}_{.}11$–$0^{\rm m}_{.}12$ (comparable to the Hintz et al. 1998 result) and it has increased to $0^{\rm m}_{.}14$ in April.

22 times of maximum were derived from our y data, and a period analysis revealed that a significant change has occurred somewhere in March or April 1998. A linear fit to our January, February and March 1998 times of maximum yields

$$T_{\rm max} = {\rm JD}\ 2450818.6262 + 0^{\rm d}_{.}0786987 \times E, \\ \pm 0.0004 \pm 0.0000007$$

where $E = 0$ corresponds to our first observed time of maximum. The new period is significantly longer than any value reported previously.

Figure 2 shows the resulting $O - C$ diagram. Our new data show that this star is a most interesting δ Scuti star which deserves full attention. We continue monitoring this star and encourage any one to perform multi-colour photometry in order to clarify

- whether the variability of this star is truly monoperiodic
- what is the real time scale of the period changes
- how the amplitude changes are related to the period changes

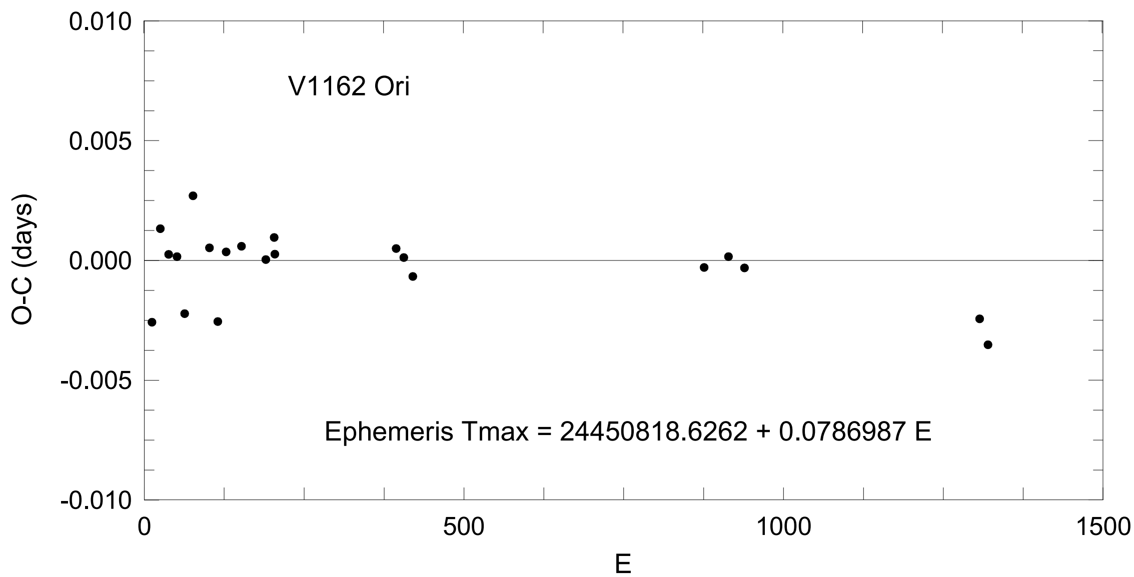

Figure 2. $O - C$ diagram for our new V1162 Ori times of maximum (y light)

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NEW ECLIPSING BINARY HII 706 IN THE PLEIADES CLUSTER

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We present observational results of a newly discovered eclipsing binary star HII 706 ($RA_{2000} = 3^h45^m35^s.7$, $DEC_{2000} = 24°30'3''$; V = $11^m.85$, B−V = $0^m.61$) in the central region of the Pleiades cluster. The light variations of HII 706 were detected accidentally during a multi-site observation campaign (Rodríguez 1998) for four γ Dor type variable star candidates in the Pleiades cluster.

Time-series CCD photometry was performed over four nights from December 5 to 11, 1998. The observations were done with a SITe 2048 CCD camera attached to the 1.8m telescope at Bohyunsan Optical Astronomy Observatory (BOAO). The field of view of the CCD image is $11'.6 \times 11'.6$ at the f/8 Cassegrain focus of the telescope.

Using the IRAF/CCDRED package, we processed CCD images to correct overscan regions, trim unreliable subsections, subtract bias frames and correct flat field images. Instrumental magnitudes for HII 706 and comparison stars were obtained via the aperture photometry routine in IRAF/DAOPHOT package (Massey & Davis 1992). Because seeing was variable and typically about 2.0 arcsec during the observing runs, the aperture size was chosen to be 18 pixels (6.12 arcsec) in diameter. We applied classical two-star differential photometry to get differential magnitudes. Brightness of two comparison stars (V = $11^m.26$, B−V = $0^m.81$ for C1 ≡ HII 746; V = $13^m.84$, B−V = $0^m.89$ for C2 ≡ HII 650, from our observation) near HII 706 was monitored to check light variations of HII 706 (see Figure 1).

We could not find any previous reports about light variations of HII 706 (Kholopov *et al.* 1985–1988, Durlevich *et al.* 1996). However, we detected obvious brightness change of the star from our data. Light curves of HII 706 are shown in Figure 2 and its differential magnitudes, $\Delta V = V_{HII\,706} - V_{HII\,746}$, are listed in Table 1. Total V amplitude is about $0^m.45$ ($11^m.85$–$12^m.30$) and the period is estimated to be about 0.574 day (epoch at primary minimum is JD 2451157.06). Because the light curves of phase from 0.0 to 0.5 and phase from 0.5 to 1.0 look nearly the same, the star could be classified as a pulsating variable star with a period of 0.287 day (a half of the above value). However, considering the short period, large amplitude and peculiar light curves (broad maximum and sharp minimum), we can rule out the possibility that it belongs to pulsating stars such as δ Sct stars, γ Dor stars and RR Lyrae stars, *etc.* The light curves are similar to that of an W UMa type eclipsing binary star (Hoffmeister *et al.* 1985).

In Figure 3, we show the position of HII 706 in color–magnitude diagram of the Pleiades cluster. Magnitudes and colors in the BDA data base (Mermilliod 1992) were used. From this, we can deduce that HII 706 may be a non-member star; it is about $1^m.5$ fainter than the main sequence stars in the cluster with the same color.

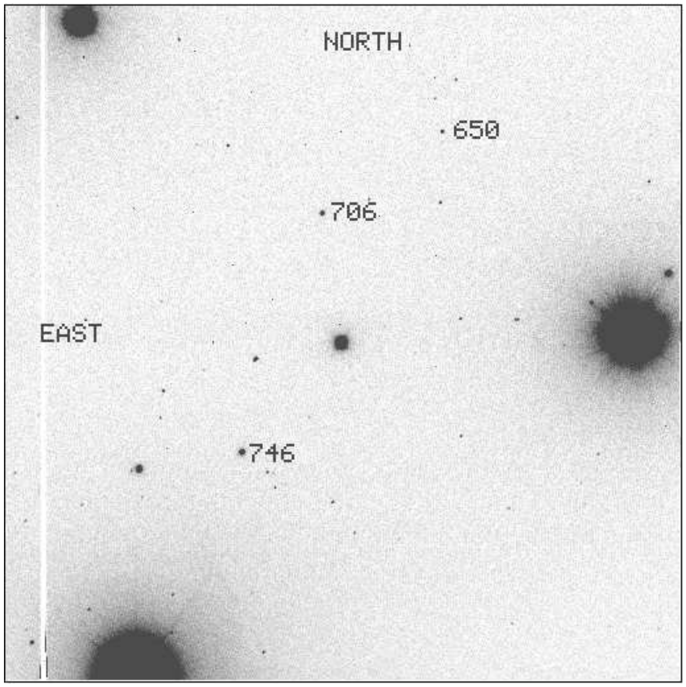

Figure 1. Observed CCD frame (11.′6 × 11.′6) of HII 706 in the central region of the Pleiades cluster. Two comparison stars (HII 746, HII 650) are denoted by their Hertzsprung (1947) number

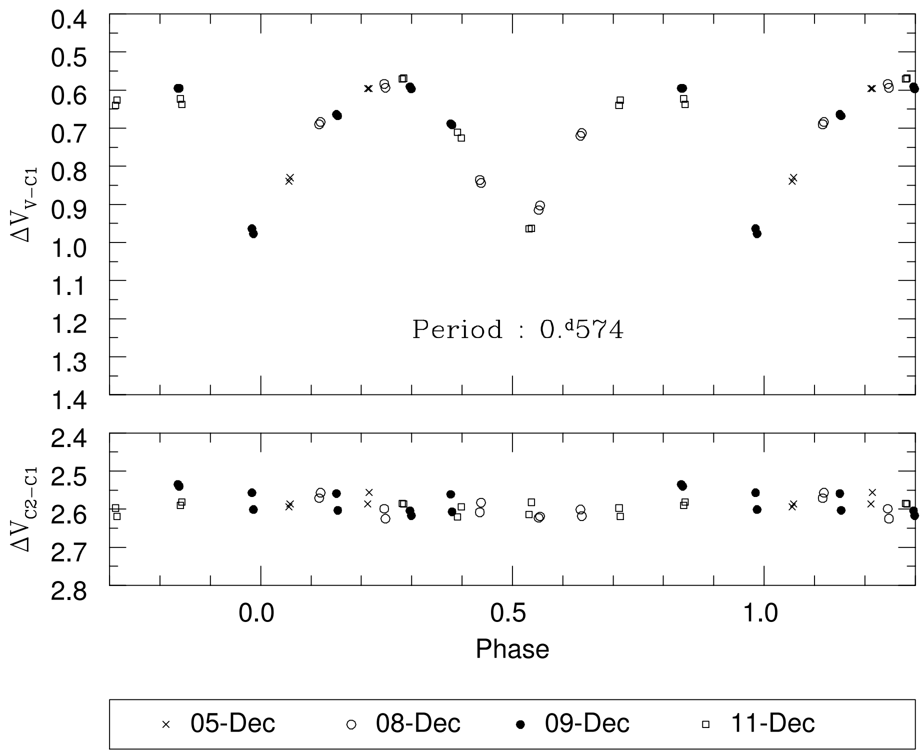

Figure 2. Light variations of HII 706. Magnitude differences between the two comparison stars are also plotted in the lower panel. Data points obtained over four nights are differently marked for each observation night

Table 1: Differential magnitudes of HII 706 ($\Delta V = V_{HII\,706} - V_{HII\,746}$)

HJD 2451000 +	ΔV	HJD 2451000 +	ΔV	HJD 2451000 +	ΔV	HJD 2451000 +	ΔV
153.07418	0.839	156.16336	0.844	157.14637	0.664	159.01099	0.726
153.07561	0.830	156.22908	0.915	157.14786	0.668	159.08791	0.964
153.16392	0.596	156.23059	0.903	157.23028	0.591	159.09087	0.963
153.16559	0.596	156.27667	0.720	157.23173	0.597	159.19068	0.640
155.97877	0.690	156.27814	0.713	157.27667	0.688	159.19222	0.626
155.98024	0.684	156.96551	0.595	157.27818	0.692	159.26448	0.623
156.05291	0.584	156.96715	0.595	158.94350	0.571	159.26600	0.638
156.05430	0.594	157.05015	0.964	158.94504	0.569		
156.16183	0.836	157.05184	0.977	159.00652	0.711		

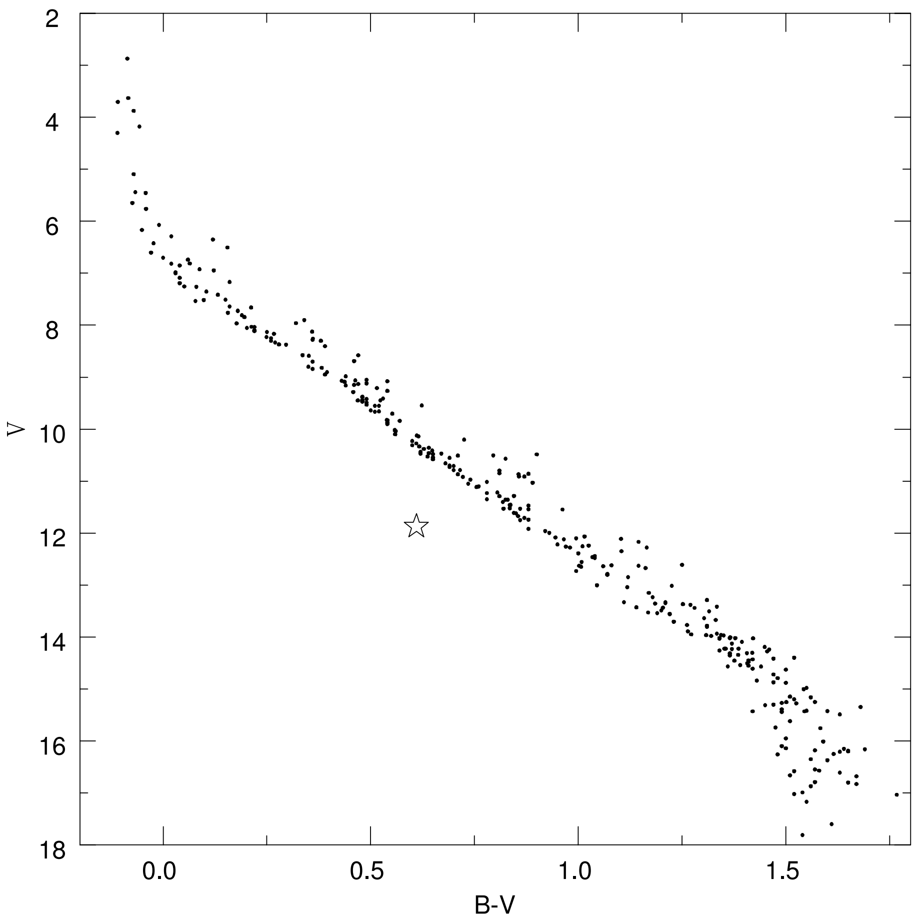

Figure 3. Position of HII 706 in the color–magnitude diagram of the Pleiades cluster. We use magnitudes and colors in the BDA data base (Mermilliod 1992). HII 706 (star symbol) is about $1^{m}_{.}5$ fainter than main sequence stars in the cluster with the same color

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THE 74TH SPECIAL NAME-LIST OF VARIABLE STARS

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This Name-list is a rather unusual one. In November, 1996, the General Catalogue of Variable Stars (GCVS) team was contacted by Dr. M. Grenon representing the compilers of the Hipparcos catalogue and suggested to give GCVS names to 5665 variable stars discovered by the Hipparcos mission, so that these stars will appear in the Hipparcos catalogue already along with their final GCVS designations. Within one month, we selected Hipparcos variables satisfying GCVS criteria and designated 3157 objects as GCVS stars (ESA, 1997). However, the preparation of the 74th Name-list, which is the largest Name-list in the history of the GCVS, took considerable time:

— We checked identifications of Hipparcos variables with the NSV catalog, revealed a number of missing identifications, and complemented Hipparcos results with information from our files for NSV stars. We also identified Hipparcos variables with our supplementary lists of suspected variables (the basis of the Supplement to the NSV Catalogue, Kazarovets et al., 1998).

— We thoroughly reconsidered classification of Hipparcos variable stars according to the GCVS criteria (Kholopov, 1985; Kholopov et al., 1987, 1989; Kazarovets and Samus, 1995). In many cases, we disagreed in classification with the Hipparcos team. In particular, we felt cautious about short (several days) periods found by Hipparcos team for many variable red giants and preferred to classify them as probable red irregulars or semiregulars. On another hand, the Hipparcos results clearly show that the existing GCVS classification system is insufficient. For example, we found difficulties in classifying variable red subgiants, a type of variable stars not clearly recognized before the Hipparcos mission. However, no new types of variable stars are introduced in the present Name-list; the revision of the classification system is a task for future research.

— We retrieved SIMBAD identifications for Hipparcos variables, checked many of them (more than 500 mistakes in the SIMBAD data base were revealed in this process; a list of suggested corrections will be published elsewhere), added identifications with the Hubble Space Telescope Guide Star Catalog (GSC). The list of Hipparcos variables was identified with existing catalogues of spectroscopic variables; as a result, several stars were reclassified from pulsating stars to ellipsoidal variables. The extreme case of V1472 Aql, reclassified from a red semiregular variable to a possible eclipser, was described by Samus (1997). Special effort was spent for components of double stars, where much confusion in identifications occurs. For stars in open clusters, we tried to retain numbers in the system of J.-P. Mermilliod's data base (BDA) from several numbers suggested by SIMBAD in some cases. This part of our work was the most time-consuming.

The printed version of the 74th Name-list consists of a single (main) table and a list of remarks. The electronic supplement to the Name-list (available via ftp from Sternberg Astronomical Institute) also presents the table of identifications.

The main table of the Name-list presents new variable stars arranged in the order of their HIP (Hipparcos catalogue) numbers, which are in the order of right ascensions for the equinox 2000.0. However, the GCVS names within each constellation are introduced in the order of right ascensions for the equinox B1950.0; we retain this equinox until a new GCVS version, with accurate 2000.0 coordinates, is ready. In the printed version, the table contains: Hipparcos catalogue numbers; new GCVS names; variability types adopted by us. An asterisk after the name of a star means that a remark for the star follows the table. In the electronic version, this table contains also truncated coordinates (equinox 1950.0; in vast majority of cases, the epoch is also 1950.0 — this may be not so only for stars lacking astrometric solution in the Hipparcos catalogue and having no published proper motions in other sources known to us); limits of variability (in the Hipparcos magnitude system, rounded to 0.01; for some stars, the range of variability adopted by us is wider than that given in the Hipparcos catalogue, in accordance with light curves; for several stars, a still wider range follows from observations published elsewhere, such magnitudes are followed by the letter V for V magnitudes or P for photographic magnitudes). A significant deviation from the format of the previous Name-lists is the absence of two columns with references to the literature; the main source of data is the Hipparcos catalog (ESA, 1997), which also contains finding charts.

The table of identifications (in the electronic version only) presents, along with Hipparcos numbers and GCVS names, designations from a number of important astronomical catalogues (Bayer designations and Flamsteed numbers; Bright Star Catalogue numbers, BS = HR; Bonner, Cordoba, and Cape Durchmusterung numbers; SAO, PPM, GSC numbers; IRC, CRL, and IRAS designations of infrared surveys; designations from catalogues of double stars, nearby stars, large-proper-motion stars, carbon stars, zirconium stars; preliminary designations of suspected variable stars, their NSV Catalogue and CSV numbers, etc.). In the readme file, a more detailed description of this table, along with the list of catalogues, is presented. We would like to warn the users that, despite our considerable effort to check identifications, this table is substantially based, in its contents and completeness, upon data from SIMBAD.

Of the 2417 stars from the Hipparcos list of new variable stars not included into the present Name-list, 91 are already contained in the GCVS; the rest of objects do not meet some of the GCVS naming criteria, they appear in the Supplement to the NSV Catalogue (Kazarovets et al., 1998) or are already present in the NSV catalogue (Kholopov, 1982).

The electronic version of the 74th Name-list of variable stars can be found at ftp://ftp.sai.msu.su/ pub/groups/cluster/gcvs/gcvs/nl74. The readme file contains, in particular, a detailed byte-by-byte description of the tables.

We gratefully acknowledge the use of the SIMBAD data base and of the BDA data base for open clusters during preparation of this Name-list. This study was partially supported by the ESA, by the Russian Foundation of Basic Research (grant 97-02-16739), by the Russian Federal Scientific Programme "Astronomy", and by the Russian Council for Support of Leading Scientific Schools (grant 96-15-96656).

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Samus, N.N., IBVS, 1997, No. 4501

Table 1: GCVS Names for Hipparcos Variables

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
40	V463 Cep	E:	1805	V745 Cas*	EB	4304	CL Psc	LB:
76	V401 And	LB:	1808	CK Cet	EB	4316	CM Psc	SR:
109	DR Psc	DSCTC	1843	CC Psc	SRB:	4328	BV Phe	BY:
181	V822 Cas	SRB	1880	BP Phe	LB:	4406	CX Tuc	LB:
215	V396 Cep	LB:	1921	V746 Cas*	LBV	4433	CN Psc	SRB
270	V397 Cep	EA	1938	CD Psc	SRD:	4448	BW Phe	BY:
302	V398 Cep	SRB	1941	CE Psc	SRB	4451	V758 Cas	LB:
316	NN Peg	DSCTC	1993	CT Tuc	BY:	4452	CO Psc	LB:
336	V739 Cas	LB	2005	BQ Phe	SXPHE:	4513	CY Tuc	LB:
386	V399 Cep	IA	2054	V350 And	E:	4530	CP Cet	SRD
457	BH Phe	SRB:	2080	CF Psc	LBV	4586	CQ Cet	SRB
500	BI Phe	SRB:	2123	CG Psc	SRD	4593	CP Psc	EB:
520	CE Cet	SRB	2164	BC Scl*	LB:	4621	V358 And	LB:
523	CQ Tuc	BY:	2216	V351 And	LB	4658	BX Phe	SRB
590	V341 And	SRB:	2271	V747 Cas*	LB:	4726	CR Cet	SRB
610	BZ Hyi	EA	2274	CL Cet*	RRC:	4900	V359 And	BY:
632	BK Phe	LB:	2285	V352 And	LB:	4918	V759 Cas	LB:
696	CF Cet	SRB	2299	V402 Cep	DSCTC	4945	CQ Psc	SRD+EA
720	CG Cet	SRB	2340	CH Psc	SRD	5002	V360 And	SRB
723	V740 Cas	SRD:	2384	V353 And	LB:	5038	CZ Tuc	SRA
817	V342 And	EA	2462	BR Phe	LB:	5091	CR Psc	LB:
834	V741 Cas	EB	2550	BD Scl	EB	5161	V760 Cas	LBV
852	NO Peg	SRB	2596	V748 Cas	SRB	5227	CS Cet	BY:
864	NP Peg	SRA	2618	CM Cet	LB:	5268	ι Tuc	SRD:
882	V343 And	LB	2651	V354 And	LB:	5409	CS Psc	SRB
883	BL Phe	EB	2667	V749 Cas	LB:	5450	V361 And	DSCTC:
919	V344 And	BY:	2808	V750 Cas	LB:	5452	CT Cet	EW
940	V742 Cas*	BE	2813	V751 Cas	LBV	5525	CT Psc	SRB
988	V345 And	SRB:	2899	V752 Cas	LB	5662	CU Psc	BY:
989	NQ Peg	SRB	2933	CU Tuc	EA	5688	V761 Cas	ACV:
1032	CH Cet	LB	2960	BS Phe	SRB	5868	DD Tuc	SRB
1041	V400 Cep	WR	3158	CN Cet	EA:	5926	V762 Cas	BY:
1110	V347 And	SR:	3171	V753 Cas	LB	5976	V763 Cas	SRB
1112	V346 And	LB	3294	V754 Cas	SRD	6027	V764 Cas	BE
1131	V401 Cep	SRB	3367	V755 Cas	EA/GS:	6039	DE Tuc	SRB
1146	CR Tuc	LB	3414	π Cas*	ELL	6171	V765 Cas	EB
1217	CS Tuc	LB	3454	V355 And	EA	6220	CV Psc	SRB
1233	V348 And	EA	3498	V356 And	LB:	6286	CU Cet	SRB
1289	V349 And	LB	3513	V756 Cas	DSCTC:	6287	V766 Cas	EA
1325	BV Psc	SRB:	3518	CI Psc	SRB	6350	BE Scl	EW
1378	CI Cet	ACV:	3634	CV Tuc	LB:	6430	CV Cet	SRB
1429	BW Psc	SRB	3791	CW Tuc	ELL:	6453	CW Psc	SRB
1435	BX Psc	EB:	3808	CK Psc	LB:	6501	CW Cet	RR:
1497	BY Psc	SRB	3821	η Cas	RS:	6536	BF Scl	SRD
1507	BM Phe	EW	3839	V757 Cas	LBV	6584	BY Phe	SR
1555	BN Phe	SRB	3852	BT Phe	SRB	6609	BZ Phe	LB:
1609	BZ Psc	SRB:	3894	BU Phe	SRB	6852	V362 And	E:
1627	BO Phe	SRB	4106	CO Cet	SRD	6856	CC Phe	BY:
1652	V743 Cas	SRB	4129	V357 And	ELL:	6934	V767 Cas	SRB
1735	V744 Cas	EA	4266	CN Oct	LB:	6998	CX Psc	LB:

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
7021	CX Cet	E:	8968	ZZ Ari	SRA	10701	AD Ari	DSCTC
7103	V768 Cas	LBV:	8980	V777 Cas	BE	10714	AD Tri	LB:
7122	V363 And	EB	8985	FG Eri	DSCTC:	10841	ZZ For	LB:
7205	V364 And	LB:	9014	V403 Cep	SRB:	10851	AA For	SRC
7218	CY Cet	SRB:	9017	V548 Per	BE	10964	AE Ari	SRB
7289	YZ Tri	SRB	9141	DK Cet	BY:	10981	V552 Per	EB
7315	BG Scl	SRB	9150	V369 And*	LB:	11035	AF Ari	EA:
7323	BH Scl	EA	9171	AA Tri	SRB	11039	CK Hyi	LB:
7326	CC Hyi	LB	9208	XY For	LB:	11098	V553 Per	ACYG:
7330	BI Scl*	LB:	9211	V778 Cas	SRC	11272	AE Tri	SRB:
7449	BK Scl	LB:	9234	V370 And	LB:	11279	V554 Per	ACYG:
7496	CD Hyi	SRB:	9274	DL Cet	SRB	11314	DT Cet	EB:
7505	CY Psc	SRB	9355	DE Psc	SRD	11369	AG Ari	EA
7511	V365 And	DSCTC	9443	XZ For	EW	11421	AF Tri	LB
7512	V769 Cas	LBV:	9472	CH Hyi	SRB	11437	AG Tri	BY:
7682	CE Hyi	DSCTC	9487	α Psc	ACV	11455	CL Hyi	SRB:
7755	V770 Cas	LB	9494	V779 Cas	EA:	11677	AB For	LB:
7757	CZ Cet	SRB	9500	V371 And	BY:	11722	V555 Per	BE
7768	CZ Psc	LB:	9538	V780 Cas	BE	11785	V375 And	SRB
7936	V771 Cas	BE:	9599	DF Psc	BY:	11864	DU Cet	LB:
7939	V772 Cas	ACV:	9619	AA Ari	LB:	11888	V556 Per	ACYG:
7940	CD Phe	ACV:	9635	V781 Cas	SRD	11894	V788 Cas	LBV
7986	DD Cet	SRD	9701	DM Cet	LB	11921	DV Cet	LB:
8034	V366 And	LC	9717	V404 Cep	LB:	11934	WY Hor	EW
8035	CF Hyi	BY:	9740	V372 And	EA	11970	AC For	LB:
8115	V773 Cas	EA	9779	V373 And	DSCTC	11978	V789 Cas	SRB
8182	V547 Per*	LB:	9796	AB Ari	LB:	11982	AH Ari	LB:
8196	DE Cet	SRB	9812	CF Phe	SRB	11998	DW Cet	SRB
8206	BL Scl	LB:	9854	DN Cet	SRB	12009	V790 Cas	ACYG:
8297	V774 Cas	SRB	9867	V374 And*	E	12016	FH Eri	SRB
8337	DF Cet	LB:	9963	AC Ari	SRB	12017	AI Ari	LB:
8344	CE Phe	SRB	9996	DO Cet	LB:	12039	V376 And	EB
8481	VZ For	SRB	9997	V782 Cas	BE	12113	DX Cet	DSCT
8485	CG Hyi	LBV	10039	YY For	LB:	12136	V377 And	EA:
8574	DH Cet	SR	10077	AB Tri	EB:	12163	AD For	SRB
8579	DG Cet	E	10099	DP Cet	EA	12178	V791 Cas	EB
8618	V367 And	SRB	10141	V784 Cas	DSCTC	12311	DY Cet	EW
8646	DI Cet	SRD	10147	V783 Cas	BE	12317	DZ Cet	LB:
8655	DD Psc	LB:	10173	V785 Cas	EA	12373	FI Eri	DSCTC
8665	ZZ Tri	LB:	10191	YZ For	BY:	12465	AH Tri	SRD
8681	WW For	SRD	10243	V786 Cas	ACYG:	12468	AK Ari	LB:
8682	V368 And	LB	10248	CI Hyi	SRB	12478	V557 Per	ACV:
8693	V775 Cas	EA:	10319	AC Tri	LB:	12544	V558 Per	LB:
8698	WX For	LB	10463	V549 Per	BE	12565	V559 Per	ACV:
8749	WY For	E:	10486	V787 Cas	BE	12569	V560 Per	LB:
8762	FF Eri	LB:	10489	V550 Per	SRC:	12587	V561 Per	SRD
8781	WZ For	EA:	10522	DQ Cet	LB	12657	AL Ari	EA
8796	α Tri*	ELL	10579	DS Cet	EA:	12662	V562 Per	ACV:
8821	V776 Cas	EW:	10591	DR Cet	SRB	12674	CM Hyi	SRB
8953	XX For	SRB	10633	V551 Per	ACYG	12731	AM Ari	SRB:

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
12805	V405 Cep	EA:	14700	CP Oct*	DSCTC:	16941	CT Cam	BE
12833	FK Eri	EA	14703	FU Eri	EA:	17024	V1125 Tau	E
12884	CN Hyi	EW	14731	EK Cet	BY:	17040	V1126 Tau	E:
13016	V792 Cas	BCEP	14750	AG For	SRB	17042	V579 Per	RRC:
13058	V563 Per	LB	14824	V571 Per	LB	17145	FZ Eri	SRB
13074	WZ Hor	EA:	14915	EL Cet*	LB:	17167	FY Eri	ACV
13101	XX Hor	LB:	14919	FV Eri	LB:	17261	CV Cam	EB
13130	FL Eri	SRB	14932	V802 Cas	I:	17333	CU Cam	EA
13185	XY Hor	SRB	15139	V803 Cas	BE:	17361	CW Cam	IA:
13188	FM Eri	LB:	15186	ZZ Hor	LB:	17373	AM For	SRB
13189	CO Hyi	SRB	15193	V572 Per	EA	17379	V1127 Tau	SRB
13198	EF Cet	LB:	15241	V573 Per	E:	17390	GG Eri	LB:
13199	EE Cet*	EW	15316	AA Hor	LB:	17441	GH Eri	EA
13221	V793 Cas	EB	15321	CP Cam	EB	17442	GI Eri	SRB
13252	V564 Per	LB:	15324	AH For	LB:	17530	GK Eri	EA
13276	V794 Cas	EA	15361	AR Ari	DSCT	17543	CT Hyi	ACV:
13293	FN Eri	SRA	15408	V804 Cas	LB:	17590	CX Cam	SRB:
13396	FO Eri	EA	15457	κ^1 Cet	BY	17599	AN For	LB:
13446	V796 Cas	LBV	15479	AI For	SRB:	17666	V580 Per*	E:
13461	AN Ari	LB:	15627	τ^1 Ari	EB:	17873	V1129 Tau	BY:
13474	V795 Cas	E	15721	V574 Per	SRB	17878	V1128 Tau	EW
13475	FP Eri	EW	15728	EM Cet	EA:	17955	AI Men	SRB
13493	FQ Eri	LB:	15757	AB Hor	LB:	17968	UW Ret	SRB
13495	EG Cet	SRB	15770	V575 Per	LBV:	17988	V1130 Tau	EB
13575	XZ Hor	LB:	15857	V1120 Tau	LB:	17993	GL Eri	SRB
13645	AO Ari	SRB:	15858	V1121 Tau	EB:	18048	GM Eri	SRB
13756	EH Cet	SRB:	15890	CQ Cam	LC	18124	GN Eri	LB:
13785	V565 Per	BY:	15931	CQ Hyi	LB	18151	CY Cam	LBV:
13797	V797 Cas	LBV:	15939	AS Ari	SRB:	18179	AK Men	DSCT
13801	AP Ari	BY:	15988	V576 Per	LBV:	18291	GP Eri	SRB:
13829	V566 Per	ACV:	16070	AC Hor	LB:	18318	GO Eri	LB:
13999	CP Hyi	EW:	16071	AT Ari	SRD	18398	GQ Eri	LB:
14038	FR Eri	LB:	16083	ξ Tau	E:	18424	V581 Per	BE
14049	V798 Cas	ACV	16195	CR Cam	BE:	18468	V406 Cep	LB:
14055	FS Eri	LB:	16204	UU Ret	SRB	18474	V1131 Tau	DSCTC
14087	EI Cet	ACV:	16228	CS Cam	ACYG:	18517	UX Ret	EW
14210	CO Oct	LB	16247	AK For	E:	18581	V1132 Tau	LB:
14213	V567 Per	SRD	16315	FW Eri	E	18585	DD Cam	EB
14238	YY Hor	SRB	16319	V805 Cas	SRB	18593	CZ Cam*	*
14377	V799 Cas	EA	16366	AL For	LB:	18659	UY Ret	LB:
14433	AQ Ari	SRB	16563	V577 Per	BY:	18694	GR Eri	SRB:
14478	V568 Per	BY:	16592	CR Hyi	ELL:	18695	GS Eri	LB:
14526	V800 Cas	LB	16593	V1122 Tau	LB:	18957	V1133 Tau	LBV:
14568	AE For	EA	16644	V578 Per	EB	18996	V1134 Tau	LB:
14605	AF For	LB	16706	V1123 Tau	EW	19008	DE Cam	BE
14616	V569 Per	LB:	16737	V1124 Tau	SRD:	19062	GT Eri	EA
14626	V801 Cas	BE	16772	AD Hor	DSCTC	19105	DF Cam	SR:
14656	YZ Hor	ACV:	16775	CS Hyi	SRA	19137	V1135 Tau	SRB
14665	FT Eri	BY:	16807	UV Ret	LB:	19335	V582 Per*	RS:
14673	V570 Per	EB:	16864	FX Eri	EW	19380	AE Hor	EA

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
19398	GU Eri	LBV	21213	RZ Cae	EA:	23608	V411 Aur	LB:
19463	GV Eri	LB:	21233	DM Cam	LB	23699	V1154 Tau	E:
19487	V583 Per	LB	21241	HN Eri	EB	23701	V1362 Ori	LB:
19530	UZ Ret	DSCTC	21339	SS Cae	LB:	23761	VY Pic	LB:
19571	GW Eri	EA	21499	V409 Cep	LB:	23793	AP Dor	EW:
19591	V1136 Tau	RS:	21563	HO Eri	LB:	23809	V1363 Ori	EW
19647	V584 Per	BE	21575	V1148 Tau*	ELL:	23815	UZ Col	LB:
19672	V1137 Tau	ACV:	21621	V1149 Tau	EA	23842	UY Lep	LB:
19700	GX Eri	SRB:	21626	V1150 Tau	BE	23883	V1155 Tau	BE
19714	V1138 Tau	SRB	21633	V1151 Tau	LB:	23928	UZ Lep	LB:
19725	GY Eri	LBV	21648	HP Eri	SRD:	23947	V412 Aur	SRB
19764	DG Cam	LB:	21688	HQ Eri	LB:	23981	VV Col	LB
19853	V1139 Tau	LB:	21810	V1152 Tau*	SRB:	23996	V1364 Ori	LB:
19991	V586 Per	BE	21825	HR Eri	SRB	24019	V1156 Tau	E:
19992	V585 Per	SRD:	21894	HS Eri	DSCTC:	24029	V413 Aur	BE
20004	DH Cam	ACV	21913	DN Cam	EW	24064	AQ Dor	LB
20015	CU Hyi	BY:	21959	HT Eri	LB:	24103	V1157 Tau	LBV
20075	GZ Eri	LB	22050	V592 Per*	EB	24118	V414 Aur	BE
20095	V587 Per	LB:	22171	HU Eri	LB:	24186	VZ Pic*	BY:
20235	V588 Per	SRB	22229	AL Dor	EA	24221	AR Dor	E:
20262	V1140 Tau	ACV:	22272	V593 Per	EB	24238	V415 Aur	BE
20304	VV Ret	LB	22326	HV Eri*	DSCTC:	24318	VV Lep	LB:
20315	V407 Cep	DSCTC	22379	CR Oct	SRB	24326	V416 Aur	GCAS:
20436	V589 Per	LB	22383	DO Cam	SRB	24350	V417 Aur	EA
20493	V1141 Tau	LBV	22454	V1359 Ori	DSCTC	24386	V1158 Tau	SRB:
20513	V1142 Tau	LB:	22474	AM Dor	LB:	24390	DT Cam	E:
20570	V590 Per	EB:	22498	DP Cam	E:	24436	β Ori	ACYG
20657	VW Ret	EA	22513	V594 Per	LB:	24441	V1365 Ori	BY:
20665	RT Cae	EW:	22631	HW Eri	LB:	24481	V418 Aur	LB:
20670	RU Cae	SRB	22663	AN Dor	EA	24552	V1366 Ori	E:
20715	V1143 Tau	LBV	22795	DQ Cam	E:	24625	V1367 Ori	LB
20779	DK Cam	EA	22837	ST Cae	LB:	24653	DU Cam	SRB
20806	HH Eri	EA	22863	V407 Aur	SRB	24707	VW Lep	LB:
20856	RV Cae	LB	22868	UZ Pic	E:	24710	VW Col*	EA
20860	V408 Cep	GCAS:	22912	SU Cae	LC:	24713	VX Col	LB:
20896	DI Cam	EA	22928	V408 Aur	LC	24823	AS Dor	LB:
20903	HI Eri	LB:	22971	VV Pic	LB:	24836	DV Cam	EA
20930	CQ Oct	SRB	23013	V409 Aur	SRD:	24840	VX Lep	LB
20958	V1145 Tau	SRC:	23033	DR Cam	SRB	24892	V419 Aur	LB:
20961	RW Cae	SRB:	23112	UW Lep	LB:	24906	V1159 Tau	ACV
20963	V1144 Tau*	LBV	23196	VW Pic*	EW	24943	WW Pic	SRA
20992	HK Eri	LB:	23217	UX Lep	LB:	25004	V1368 Ori	SRA
20993	V591 Per	LB:	23321	SV Cae	SRB	25011	V1369 Ori	BE
21050	HL Eri	EB	23328	V1360 Ori	LBV:	25114	V420 Aur	BE
21063	RX Cae*	DSCTC	23337	V410 Aur	EW	25178	V423 Aur	LBV:
21080	HM Eri	SRB:	23374	AO Dor	LB:	25203	V421 Aur	LB
21082	V1146 Tau	LB:	23436	V1153 Tau	BE	25224	V422 Aur	BY:
21148	DL Cam	BCEP:	23440	DS Cam	LB:	25229	DX Cam	LB:
21179	V1147 Tau	BY:	23491	VX Pic	SRB	25233	DW Cam	BY:
21190	RY Cae	LB:	23496	V1361 Ori	EB	25234	VY Lep	LB:

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
25252	V424 Aur	EB	27144	V436 Aur	LB:	29096	AE Col	BY:
25284	V425 Aur	EB	27170	XY Pic	EW	29103	V356 Pup	RS:
25394	V1370 Ori	LBV	27199	EE Cam	DSCTC	29108	V449 Aur	EB
25577	V1371 Ori	EB	27221	XY Col	LB:	29186	V1387 Ori	EB
25579	WX Pic	LB:	27229	WY Lep	LB	29198	V450 Aur	SRB:
25599	V426 Aur	EB	27309	V1380 Ori*	EA	29225	PU Gem	ACYG
25610	AT Dor	LB:	27318	WZ Lep	LB	29263	AF Col	LB
25655	V1372 Ori	BE	27407	XZ Col	LB:	29321	V1388 Ori	EA
25681	V1373 Ori	SRD	27459	V438 Aur	GCAS	29352	V451 Aur	LBV
25710	VY Col	SRB	27462	YY Pic	DSCTC	29436	EK Cam	LB:
25775	VZ Col	BY:	27469	V437 Aur	EA	29455	IO CMa	EA
25779	V1160 Tau	LB:	27473	YY Col	SRD	29474	IQ CMa	EB
25801	V427 Aur	LB	27500	EF Cam	LB:	29488	IP CMa	LBV
25864	AL Men	EB	27591	V439 Aur	LB:	29509	V1389 Ori	SRB:
25877	V428 Aur	RV	27656	YZ Col	SRD	29563	V1390 Ori	BE
25896	V1374 Ori	BE	27661	V440 Aur	LB:	29564	AW Dor	LB:
25902	V1375 Ori	E:	27748	XX Lep	ACV	29589	PV Gem	DSCTC
25981	VZ Lep	SRD	27776	ZZ Col	SRB	29592	AG Col	LB
25996	V429 Aur	LB:	27850	V1167 Tau	BE	29604	IR CMa	SRB
26123	WW Col	LB:	27874	YZ Pic	SRB	29707	V1391 Ori	LB
26128	V430 Aur	SRC	27912	V1381 Ori	LB:	29757	PW Gem	EA:
26223	V1376 Ori	LB	27925	AA Col	DSCTC	29787	V1392 Ori	EB
26243	WW Lep	LBV	27941	V1382 Ori	BE:	29840	PX Gem	ACYG
26263	V1377 Ori*	LBV	28017	AB Col	SRB:	29847	V718 Mon	LBV
26282	V1161 Tau*	LB:	28023	V441 Aur	SRB:	29899	V1393 Ori	LB:
26324	AU Dor	LB:	28039	V1383 Ori	EB	29901	V452 Aur	LB
26354	V431 Aur*	BE:	28094	XY Lep	LB:	29961	V1394 Ori	LB
26401	WX Col	RS:	28134	ZZ Pic	LB	29964	AO Men	BY:
26434	V432 Aur	E:	28142	V1384 Ori	EA	30010	V1395 Ori	LB:
26442	V1378 Ori	LBV	28151	V442 Aur	SRB	30034	AB Pic	BY:
26449	V1162 Tau	BE:	28215	V717 Mon	LB	30174	IS CMa	EW
26464	V1379 Ori	LBV	28217	AA Pic	LB:	30185	V719 Mon	LB:
26517	DZ Cam	LB:	28283	V443 Aur	LB	30227	V453 Aur	SRB:
26574	V1163 Tau	BE	28368	EG Cam	BY:	30237	AC Pic	SRB
26606	V433 Aur*	LBV:	28440	AN Men*	EW	30263	IT CMa	LBV
26612	WX Lep	EB	28499	V444 Aur	ACV	30270	V454 Aur	EA
26620	WY Col	LB:	28519	V1385 Ori	EB	30319	AD Pic	LB
26679	WY Pic	SRB:	28583	EH Cam	LB:	30380	V720 Mon	LC:
26708	V1164 Tau	ELL:	28587	AM Men	LB:	30407	V721 Mon	LB
26758	DY Cam	LB:	28607	EI Cam	LB:	30409	IV CMa	SRC
26760	AV Dor	EA	28628	V445 Aur	LBV	30426	IU CMa*	ACV:
26772	WZ Pic	E:	28701	V446 Aur	LB	30452	PY Gem	BE
26845	V435 Aur	BE	28716	χ^2 Ori	ACYG	30546	V444 Car	LB:
26868	WZ Col	LBV:	28770	AC Col	SRD	30583	IW CMa	E:
26872	V434 Aur	BE	28783	V447 Aur	BE	30587	AH Col	ACV
26959	XX Col	SRB	28851	V448 Aur	LBV	30722	PZ Gem	BE:
26983	XX Pic	SRB	28852	AD Col	E:	30775	AX Dor	LB:
26998	V1165 Tau	BE:	28954	V1386 Ori	BY:	30785	EL Cam	LB:
27012	V1166 Tau	E:	28973	XZ Lep	LBV	30786	IX CMa	EB
27134	XZ Pic	BY:	28984	YY Lep	SRB:	30806	V722 Mon	E:

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
30822	V456 Aur	DSCTC	32507	VV Vol	SRB	33890	V335 Gem	EA
30840	IY CMa	E:	32531	V448 Car	SRD:	33944	V337 Gem	EA:
30875	AI Col	SRB	32570	KQ CMa	ACV	33945	V336 Gem	SRB
30878	V455 Aur	EA:	32586	V739 Mon	BE	33977	o^2 CMa	ACYG
30891	V723 Mon	SRD:	32612	QT Gem	EB	34000	V450 Car	LBV
30903	IZ CMa	SRB	32647	EP Cam	SRB	34032	V749 Mon	GCAS:
30909	V724 Mon	SRB	32653	EQ Cam	SRB	34080	LT CMa	EA
30992	V725 Mon	BE	32671	KR CMa	SRB	34116	V750 Mon*	GCAS
30993	V726 Mon	LBV	32696	KS CMa	BE	34122	V451 Car	SRB
31008	KK CMa	EB	32743	QU Gem	LB:	34126	VZ Vol	LB:
31017	KL CMa	EA	32745	V740 Mon	ACV	34161	LU CMa	LB:
31027	V457 Aur	LB:	32758	KT CMa	E:	34287	LV CMa	EB
31057	AY Dor	LB:	32776	QV Gem	LB:	34342	LW CMa	SRB:
31065	V727 Mon	EB	32815	KU CMa	BE	34343	BT Lyn	SRB
31068	AE Pic	EB:	32839	V741 Mon*	LBV:	34362	BU Lyn	SRB:
31086	KM CMa	LB	32845	QW Gem	EW	34385	V751 Mon	SRB
31113	AK Col	EA	32856	KV CMa	E:	34396	V361 Pup	EW
31116	AL Col	ACV	32923	V743 Mon	GCAS	34401	V752 Mon	DSCTC:
31174	EM Cam	LB:	32937	KW CMa	ACV	34435	BV Lyn	LB:
31180	KN CMa	SRD:	32947	V742 Mon	BE	34448	LX CMa	LB:
31199	V728 Mon	BE	32953	VW Vol	LB:	34463	BN CMi	SRB:
31236	QQ Gem	E:	33040	KX CMa	LB	34569	LY CMa	GCAS
31255	V458 Aur	LB	33042	KY CMa	LB	34575	V410 Cep	LB:
31259	EN Cam	ACV:	33063	V449 Car	SRD	34579	LZ CMa	EB:
31296	KO CMa	LB	33100	BR Lyn	SRB:	34641	ES Cam	LB
31359	BQ Lyn	SRD	33107	VX Vol	E:	34659	V362 Pup	E:
31363	V729 Mon	SRB	33115	VY Vol	LB:	34684	V753 Mon*	EB:
31371	V730 Mon	EA:	33119	KZ CMa	BE	34704	V338 Gem	LB:
31485	V459 Aur	EB	33166	QX Gem*	LBV:	34778	V463 Aur	RRAB:
31539	UZ Vol	E:	33200	LL CMa	BE	34792	V452 Car	EA:
31625	V357 Pup	LB:	33260	LM CMa	ACYG:	34798	MM CMa	LBV
31644	V445 Car	SRB	33261	V745 Mon	EA	34807	V754 Mon	ACV:
31664	V446 Car	LB:	33267	V744 Mon	BE:	34817	V363 Pup	LBV
31678	AP Men	SRB	33361	V746 Mon	BE	34836	V364 Pup*	IA:
31697	V731 Mon	ACYG:	33389	V462 Aur	EB	34986	MN CMa	BE
31701	AM Col	LB	33437	V747 Mon	BE:	35015	MO CMa*	I:
31719	V460 Aur	SRB	33443	LN CMa	LB:	35036	MP CMa	EB
31739	V732 Mon	LBV:	33487	V358 Pup	EA:	35109	MQ CMa	LB:
31894	V733 Mon	BE	33493	QY Gem	E:	35156	MR CMa	ACV
31906	V734 Mon	ACV	33549	V359 Pup	LB:	35168	MS CMa	EA
31925	V736 Mon	LB	33573	ER Cam	LB:	35200	ET Cam	LB:
31934	V735 Mon	ACV:	33583	QZ Gem	SRB	35201	MT CMa	LB:
31982	QR Gem	LB	33592	LO CMa	SRB:	35247	EU Cam	SRB
32085	EO Cam	SRB	33673	LQ CMa	BE:	35264	π Pup	SRD:
32088	V737 Mon	BE	33676	LP CMa	BE	35300	V755 Mon	LBV
32187	V738 Mon	SRB	33707	BS Lyn	LB:	35355	MU CMa	BE:
32218	V447 Car	SRB	33778	LR CMa	ACYG:	35356	MV CMa	EB
32408	KP CMa	LBV	33804	LS CMa	E:	35407	MW CMa	ACV
32459	QS Gem	DSCT	33822	V748 Mon	LB:	35415	τ CMa*	EB
32495	V461 Aur	LB:	33864	V360 Pup*	EB:	35428	V339 Gem	E:

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
35447	V365 Pup	EA	36969	V763 Mon	BE	38416	V459 Car	ACV
35461	MX CMa	EB	36971	V379 Pup	ACV	38430	V402 Pup	ACYG:
35464	WW Vol	LB	36981	V378 Pup*	EB:	38439	V403 Pup	BE:
35475	V756 Mon	LB:	36983	EZ Cam	SRB	38650	V404 Pup	LBV
35525	BW Lyn	SRB	37012	V455 Car	EA	38684	CL Lyn	EA
35549	MY CMa	LB:	37099	V380 Pup	GCAS:	38728	V768 Mon	LB:
35607	V366 Pup	EA:	37126	V764 Mon	RRC	38738	CM Lyn	LB
35626	MZ CMa	SRB	37197	V345 Gem*	DSCTC:	38787	V406 Pup	LC
35664	V340 Gem	BY:	37232	BR CMi	ACV:	38807	BS CMi	SRD:
35669	V757 Mon	BE:	37272	V382 Pup	BY:	38855	BT CMi	BE
35690	EV Cam	ACV:	37294	V765 Mon	LB:	38866	V405 Pup	EB
35769	NN CMa	GCAS	37296	V381 Pup	EB	38900	FH Cam	EW
35776	BO CMi*	*	37343	V383 Pup	SRB:	38923	V407 Pup	SRC:
35795	NO CMa*	BE:	37433	V384 Pup	LC	38945	BU CMi	EA:
35810	V758 Mon	LB	37436	V346 Gem	SRD:	38971	FI Cam	LB:
35829	NP CMa	BE	37466	V766 Mon	LB	38987	BV CMi	EA:
35831	V759 Mon	ACV:	37549	V456 Car	SXARI:	39017	V769 Mon	EB:
35898	V367 Pup	LB:	37555	V457 Car	LB:	39020	V408 Pup	BE
35904	η CMa	ACYG	37595	FG Cam	SRD	39070	V460 Car	LC
35926	NQ CMa	BE:	37615	CD Lyn	E:	39084	V410 Pup	EB
35960	V368 Pup	DSCTC	37668	V386 Pup	SXARI:	39090	V409 Pup	E:
35977	BX Lyn	LB:	37675	V387 Pup	BE	39128	V411 Pup	SRB
35979	V453 Car	EA:	37692	V385 Pup	ACV	39131	V412 Pup	LB:
36004	V760 Mon	LB	37695	WX Vol	LB	39162	V413 Pup	LBV:
36093	V761 Mon	E:	37707	CE Lyn	SRB	39225	V461 Car	EA
36110	V341 Gem	LB	37708	V347 Gem	LB:	39229	V414 Pup	ACV:
36186	NR CMa	DSCTC	37743	V388 Pup	BE	39250	CN Lyn	EA
36213	EW Cam	RRAB	37748	CF Lyn	E	39290	V415 Pup	LBV
36227	V369 Pup	ACYG:	37751	V390 Pup	EA	39297	FO Cnc	LB:
36246	V371 Pup	LBV	37758	V389 Pup	IA:	39310	V462 Car	EB
36250	V370 Pup	BE	37775	V348 Gem	E:	39365	V416 Pup	SRB:
36334	BY Lyn	SRB:	37847	CG Lyn	LB:	39452	V417 Pup	E:
36349	V372 Pup	BY:	37915	V392 Pup	E:	39521	V418 Pup	LB:
36377	σ Pup	ELL:	37925	V393 Pup*	ELL	39541	V770 Mon	SRB:
36386	V343 Gem	SRB	37927	V391 Pup	DSCTC:	39584	MX Vel	BE:
36404	V373 Pup	BE	37961	FF Cam	BE:	39611	V463 Car	BY:
36409	V374 Pup	SRB	37966	V458 Car	ACV:	39635	BW CMi	LB:
36412	V342 Gem	LB:	37973	CH Lyn	SRB	39637	V419 Pup*	LB:
36495	V762 Mon	LB:	37985	V394 Pup	SRD	39687	MY Vel	LBV
36545	BZ Lyn	SRB:	37999	CI Lyn	SRD	39755	FK Cam	SRB
36578	EX Cam	LB:	38070	o Pup*	BE:	39759	MZ Vel	LB:
36605	V375 Pup	LBV:	38110	V395 Pup	LBV	39791	WY Vol	ACV
36682	V454 Car	EB	38155	V396 Pup	SRD	39834	V420 Pup	BE
36728	V376 Pup*	EB:	38167	V397 Pup	EA	39844	V771 Mon	LB:
36746	BP CMi	SRB	38173	V398 Pup	ACYG:	39857	V772 Mon	CEP:
36802	V377 Pup	LB	38186	V399 Pup	EA	39885	V464 Car	LB:
36822	V344 Gem	DSCTC	38242	V767 Mon	LB	39896	FP Cnc	BY
36888	BQ CMi	SRA:	38257	CK Lyn	LB	39919	NN Vel	ACYG:
36945	EY Cam	SRB:	38326	V400 Pup	LB:	39927	V773 Mon	E:
36965	CC Lyn	EW	38338	V401 Pup	EA:	39944	CO Lyn	DSCTC

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
39968	V421 Pup	EB	41670	ZZ Pyx	LB:	43493	OT Vel	SRB
39997	V774 Mon	LB	41714	AA Pyx	ACV	43515	FS UMa	LB:
39998	CS Oct	LB:	41726	AB Pyx	LC	43685	CY Lyn	ELL:
40005	V422 Pup	LB:	41749	FQ Cnc	SRB	43738	FT UMa	RRC:
40025	V775 Mon	LB	41774	NS Vel	GCAS:	43746	NN Hya	LB:
40066	V423 Pup	ACV	41811	AC Pyx	EA:	43763	V473 Car	LBV
40074	V424 Pup	LB:	41889	FR Cnc	BY:	43792	OU Vel	BE
40135	CP Lyn	LB:	41906	V470 Car	EB:	43812	OV Vel	EB:
40139	V425 Pup	EB:	41978	FS Cnc	LB:	43936	OW Vel	SRD:
40144	V427 Pup	SRB:	42013	MU Hya	SRB	43963	CZ Lyn	SRB
40148	V426 Pup	BE:	42061	NT Vel	EA	43967	FY Cnc	SRB
40230	CQ Lyn	DSCT	42068	FN UMa	LB	44021	FU UMa	LB:
40264	V428 Pup	SRB	42110	AD Pyx	LB	44123	NO Hya	SRB:
40285	NO Vel	EB	42161	NU Vel	LB	44126	FZ Cnc	SRB
40409	V429 Pup	LB:	42227	NV Vel	IB:	44145	DM Cha	SRB
40459	V430 Pup	BY:	42239	FO UMa	LB	44166	OX Vel	ACV:
40504	NP Vel	LB:	42251	V471 Car	BE	44189	DN Cha	SRB
40596	V431 Pup	E	42399	NW Vel	SRD	44216	V474 Car	BY
40638	V465 Car	LB:	42433	NX Vel	E	44222	GG Cnc	LB:
40641	CS Lyn	EB	42469	AE Pyx	SRD:	44266	V475 Car	SRB
40651	CR Lyn	DSCTC	42504	NZ Vel	ELL:	44281	AL Pyx	LB
40666	V466 Car	EA	42519	OO Vel	ACV	44308	AM Pyx	LB:
40689	MQ Hya	SRD	42533	AF Pyx	E:	44337	OY Vel	ACV
40750	MR Hya	SRB	42540	NY Vel	ACV	44359	NP Hya	ACV:
40763	MS Hya	SRD	42554	CW Lyn*	EB:	44397	FV UMa	SRB
40777	V432 Pup	ACV:	42674	MV Hya	SRB	44433	OZ Vel	LB:
40805	V433 Pup	LB:	42700	MW Hya	LB	44457	FW UMa	LB:
40838	V467 Car	EA:	42744	CX Lyn	LB	44482	PP Vel	LB:
40853	V434 Pup	EA	42756	AG Pyx	LB:	44530	GH Cnc	SRB
40871	V435 Pup	LB:	42802	AH Pyx	LB	44609	NQ Hya	LB:
40892	MT Hya	SRB	42819	V472 Car	ACV	44612	PQ Vel	EA
40902	FL UMa	LB:	42826	FT Cnc	SRD	44650	V476 Car	EA:
40931	CT Lyn	SRB	42841	WZ Vol	EA	44655	PR Vel	LBV
41107	V436 Pup	LB	42921	FU Cnc	SRB:	44666	FY UMa	SRB:
41113	NQ Vel	IA:	42951	MX Hya	EA	44675	NR Hya	LB:
41118	V411 Cep	LB	43039	MY Hya	LB	44683	FX UMa	EA:
41121	V437 Pup	LB	43071	OQ Vel*	RRC:	44718	GI Cnc	SRB
41149	CU Lyn	LB	43082	OP Vel	ACYG:	44738	NS Hya	SRB
41250	V438 Pup	EA	43114	AI Pyx	IA:	44773	GK Cnc	LB:
41266	V468 Car	ACV:	43199	FV Cnc*	UG:	44800	DO Cha	ELL:
41302	CV Lyn	SRB:	43205	FQ UMa	LB:	44813	NT Hya	DSCTC
41324	V439 Pup	SRC	43207	FP UMa	LB:	44925	FZ UMa	LB
41390	V440 Pup	LB	43215	AK Pyx	LB	44943	FM Cam	SRB:
41501	NR Vel	GCAS:	43229	OR Vel	BE	44996	PS Vel	LBV
41515	XY Pyx	EB	43245	FW Cnc	LB	45009	AN Pyx	ACV:
41535	YY Pyx	SRA	43251	FX Cnc	SRB	45030	NU Hya	LB
41541	XZ Pyx	LB:	43308	MZ Hya	SRB	45079	PT Vel	EA
41581	FM UMa	ACV:	43431	FL Cam	LB	45094	V477 Car	EA
41586	YZ Pyx	BCEP:	43443	OS Vel	ACYG:	45194	GL Cnc	LB:
41644	V469 Car	ACV	43469	FR UMa	LB:	45295	GM Cnc	LB:

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
45373	AO Pyx	LB	47467	AO Ant	LB:	49960	AQ Ant	LB:
45392	PU Vel	EB	47549	V485 Car	BE	50072	EQ Leo	LB:
45467	PV Vel	ACYG:	47591	V486 Car	EB	50097	GM UMa*	EB
45483	GN Cnc	RR:	47733	EK Leo	SRB	50160	AR Ant	LB:
45509	PW Vel	LB:	47761	TU LMi	LB	50167	GO UMa	LB
45547	NV Hya	LB:	47833	FO Cam	LB:	50169	GN UMa	LB
45548	PX Vel	ACV	47892	V488 Car	LBV	50212	PU Hya	LB:
45597	GO Cnc	EA	47893	V487 Car	ACV	50256	AS Ant	LB:
45615	V478 Car	SRD	47992	V489 Car	SRB	50268	AT Ant	SRB:
45633	PY Vel	SRD:	48020	EL Leo	SRB	50272	V499 Car	ACYG:
45679	AP Pyx	LB:	48027	DP Cha	SRB	50276	V339 Vel	LB
45692	PZ Vel	LBV	48063	TV Sex	LB:	50358	TY LMi	LB
45693	GG UMa	DSCTC:	48104	V490 Car	SRB	50368	V500 Car	WR
45706	AQ Pyx	SRD	48120	QW Vel	LB	50389	GP UMa	LB:
45755	NW Hya	LB:	48155	QX Vel	EB	50463	V340 Vel	E:
45833	QQ Vel	BE	48185	QY Vel	EA	50502	TZ LMi	SRB
45846	NX Hya	EB	48292	EM Leo	LB	50550	V341 Vel	EA
45887	NY Hya	EA	48422	GL UMa	BY:	50598	V342 Vel	ACYG:
45934	QR Vel	BE	48469	QZ Vel	LBV	50626	V501 Car	SRB
45935	GH UMa	SRB	48472	EN Leo	LB	50702	V343 Vel	EA
46002	NZ Hya	EA	48494	OX Hya	SRB	50749	UU Sex	SRB
46005	FN Cam	EW	48527	V335 Vel	LBV	50750	ER Leo	DSCTC:
46063	V479 Car	BY:	48632	TW Sex	LB:	50775	V344 Vel	DSCTC
46147	V480 Car	BE	48665	V491 Car*	BY:+E:	50780	V345 Vel	EA
46241	AR Pyx	EB:	48688	TV LMi	EA:	50827	UV Sex	SRB
46295	QS Vel	ACV	48782	V492 Car	LBV	50846	V502 Car	LB:
46323	OO Hya	I:	48794	V494 Car	LB:	50951	UU LMi	SRB
46340	QT Vel	EA	48832	V493 Car*	EA	50970	V346 Vel	LB
46344	GI UMa	SRB	48913	TY Sex	E:	50979	GQ UMa	LB
46435	OP Hya	LB	48923	TX Sex	SRB	51049	V347 Vel	LB
46452	V481 Car	ACV	48943	OY Hya	BE	51063	V503 Car	BE:
46521	AL Ant	LB	49177	OZ Hya	EA	51087	V348 Vel	SRC
46570	EG Leo	LB	49209	PP Hya	ELL:	51110	GR UMa	LB
46620	V482 Car	SRB:	49220	EO Leo	LBV:	51112	AU Ant	SRB
46689	EH Leo	SRB	49271	TW LMi	SRB	51141	V505 Car	SRB
46722	OQ Hya	LB:	49300	EP Leo	SRD:	51150	V504 Car	ACYG:
46833	AM Ant	ACV	49322	PQ Hya	LB:	51175	AV Ant	LB
46845	AN Ant	EB	49375	AP Ant	ACV	51246	V506 Car	LBV:
46948	OR Hya	LB:	49393	V336 Vel	DSCTC	51265	V507 Car	BE
46959	QU Vel	LB:	49463	PR Hya	SRB	51289	PV Hya	LB
46978	V484 Car	GCAS	49613	TZ Sex	SRB	51310	V508 Car	ACYG
46985	V483 Car	LBV	49642	V495 Car	ACV	51355	V349 Vel	ACV:
46987	OS Hya	LB	49743	V337 Vel	GCAS	51361	GS UMa	DSCTC:
46988	OT Hya	SRB:	49755	PS Hya	SRB:	51412	V350 Vel	ACV
46994	EI Leo	SRB	49783	PT Hya	LB:	51424	V511 Car	LB
47074	QV Vel	ACV	49816	V496 Car	SRB	51429	V509 Car	EA
47102	OV Hya	LB:	49927	V497 Car	BE	51453	V510 Car	GCAS
47130	OU Hya	LB:	49940	V338 Vel	ACV	51496	PW Hya	BY:
47364	GK UMa	SRB:	49944	TX LMi	LB:	51585	ES Leo	SRB:
47427	OW Hya	EA	49945	V498 Car*	E:	51595	V351 Vel	E:

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
51632	DQ Cha	ACV	53470	V525 Car	LB	55140	V535 Car	LB
51677	ET Leo	EW:	53479	V526 Car	ACYG:	55146	FO Leo	EB
51683	PX Hya	E	53487	QR Hya	E	55207	V536 Car	LBV:
51810	V512 Car	SRB	53564	FG Dra	LB	55238	V537 Car	SRB
51847	AW Ant	SRD:	53653	EZ Leo	LB	55274	UV Crt	SRB
51857	V513 Car	ACYG	53676	V357 Vel	LB:	55283	V903 Cen	SRC
51876	GT UMa	EB	53708	V527 Car	DSCTC:	55294	UW Crt	LB:
51924	AX Ant	LB:	53732	FH Dra	SRB	55355	V538 Car	LB:
52043	V514 Car	LBV	53753	QS Hya	SRD	55396	V904 Cen	LB:
52046	V515 Car	SRB	53782	V358 Vel	LB	55432	FP Leo	LB:
52095	V352 Vel	LB:	53806	V359 Vel	EA	55448	V905 Cen	LB:
52215	GU UMa	LB:	53905	TW Crt	EA	55460	FQ Leo	LB:
52225	UW Sex	LB:	53932	VV LMi	SRD	55471	HO UMa	LB
52239	AY Ant	LB:	53938	V360 Vel*	ACV	55499	V906 Cen	LBV:
52265	GV UMa	LB:	53940	V361 Vel	LB	55524	V907 Cen	BE
52274	V516 Car	ACYG	53944	FF Leo	SRB	55545	FR Leo	LB:
52291	V517 Car	SRB:	54003	VW LMi	EW:	55795	UX Crt	SRB
52299	UV LMi	LB:	54021	V528 Car	LC	55910	UY Crt	LB:
52315	EU Leo	LB	54026	V529 Car	EA	55952	FS Leo	EB
52329	EV Leo	SRB	54108	FG Leo	SRB	55953	QT Hya	SRD
52340	DR Cha	E	54112	V362 Vel	EW	56012	HP UMa	LB
52370	V518 Car	GCAS:	54130	V530 Car	LC	56072	FT Leo	LB:
52405	V519 Car	BE	54165	HH UMa*	DSCT:	56100	UZ Crt	LB
52465	UW LMi	EA	54215	TX Crt	ACV	56139	VV Crt	E:/RS:
52468	V520 Car	LC:	54230	VX LMi	SRB	56144	KO Mus	SRB:
52507	V521 Car	LB	54243	HI UMa	LB:	56158	HQ UMa	DSCTC
52508	GW UMa	DSCT:	54251	HK UMa	LB:	56217	FU Leo	LB
52509	PY Hya	LB:	54268	FH Leo	NL:	56246	KQ Mus	LBV
52553	EW Leo	SRB:	54396	HL UMa	SRB	56252	KP Mus	BE
52565	PZ Hya	LB:	54431	V531 Car	LB:	56267	FV Leo	SRB
52567	AZ Ant	DSCTC	54518	HM UMa	LB	56300	QU Hya	SRB
52580	EX Leo	EW	54593	V897 Cen	LB:	56328	FP Cam	LB:
52622	V354 Vel	LB	54613	FI Leo	LB	56330	HR UMa	EA
52623	UX LMi	DSCTC	54659	V898 Cen	DCEPS:	56353	V908 Cen	SRB
52624	V353 Vel	DSCTC:	54670	V899 Cen	LB:	56379	KR Mus	E
52663	GX UMa	SRD	54708	V532 Car	SRB	56435	V909 Cen	SRB
52723	UY LMi	LB	54711	FK Leo	EA	56533	HS UMa	LB
52748	V355 Vel	LB:	54723	FL Leo*	SRD:	56556	V910 Cen	LC
52789	QQ Hya	LB:	54751	V533 Car	ACYG:	56592	V911 Cen	GCAS:
52794	GY UMa	SRB	54766	FM Leo	EA	56698	V912 Cen	LB
52816	V356 Vel	EB	54799	TY Crt	SRB	56702	V913 Cen	LB
52827	V522 Car	ACYG:	54814	V900 Cen	E	56724	IW Vir	LB
52889	UZ LMi	SRD:	54820	TZ Crt	LB	56835	VW Crt	LB
52892	GZ UMa	E:	54865	V901 Cen	EW:	56899	VX Crt	SRB:
52999	EY Leo	LB	54951	FN Leo	LC	56923	FI Dra	SRB
53078	BB Ant	LB	54974	UU Crt	SRB	56970	V914 Cen	LB
53079	FF Dra	LB	55030	HN UMa*	EW:	57037	CT Oct	BY:
53109	V523 Car	ACYG	55031	V902 Cen*	E:	57067	V915 Cen*	ACV:
53154	V524 Car	ACYG	55078	V534 Car*	IA:	57072	VY Crt	DSCTC
53325	BC Ant	LB:	55085	DS Cha	LB:	57106	V916 Cen	BE

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
57126	FW Leo	ACV:	59259	QY Hya	EB:	61507	V934 Cen	SRB
57173	VZ Crt	LBV:	59289	KK Vir	LB:	61686	IK UMa	LB:
57237	V917 Cen	SRD	59404	CU Oct	ACV	61701	KM Com	LB
57263	DT Cha	LB:	59443	QZ Hya	LB	61703	KY Mus	ACYG:
57264	IX Vir	LB:	59549	KL Vir	SRB	61751	KZ Mus	BCEP
57380	ν Vir	SRB	59588	V335 Hya	LB	61773	V935 Cen	LB
57411	WW Crt	LB	59602	IV Com	BY:	61836	V340 Hya	EA
57480	FX Leo*	SR:	59653	DK Cru	BE	61882	LL Mus	EA
57505	DU Cha	LB	59665	KU Mus*	EB:	61899	KR Vir	SRD:
57512	V918 Cen	SRD:	59678	DL Cru	ACYG	61903	KS Vir	LB
57582	HT UMa	LB:	59789	V336 Hya	LB	61908	V341 Hya	SRB
57607	V919 Cen	SRB:	59811	V926 Cen	SRB	61910	VV Crv	EA
57653	V920 Cen	LB	59889	IW Com	LB	61975	V936 Cen	SRB
57655	FY Leo	SRB	59914	UV Crv	BY:	61976	KN Com	LB:
57661	DV Cha	ACV	59921	V337 Hya	SRA	61997	DP Cru	EB
57678	QV Hya	LB:	59959	KV Mus	BE:	62062	V342 Hya	LB
57731	HU UMa*	BY:	60117	UW Crv	LB	62064	V937 Cen	LB:
57737	V921 Cen*	SRB:	60126	KM Vir	LB	62070	KT Vir	SRB
57808	V922 Cen	ACYG:	60128	DM Cru	ACYG:	62086	V938 Cen	LB:
57843	V923 Cen	LC	60213	UX Crv	LB	62097	BX CVn	LB
57923	FQ Cam	LB:	60273	V338 Hya	SRB	62168	KU Vir	LB
57928	KS Mus	LB:	60298	KN Vir	LB:	62216	KO Com	LB:
58059	V924 Cen	SRB	60333	KO Vir	LB	62247	LM Mus	SRB
58157	HV UMa	RRC	60384	BT CVn	LB:	62291	DQ Cru	BE
58295	HW UMa	LB:	60438	UY Crv	BY:	62316	V939 Cen	LB:
58328	V925 Cen	SRB	60477	BU CVn	LB	62333	DR Cru	BY:
58359	FZ Leo	BY:	60520	UZ Crv	LB	62339	LN Mus	EB
58372	IY Vir	LB:	60786	DN Cru	E:	62355	BY CVn	LB
58400	DW Cha	BY:	60812	KP Vir	EA	62403	LO Mus	BY:
58513	DD Cru	LB:	60862	KW Mus	LB:	62432	V343 Hya	SRB
58520	DX Cha	IA:	60867	IX Com	SRB	62445	V940 Cen	BY:
58545	FR Cam	LB	60934	V927 Cen	LB	62484	KP Com	SRB:
58579	TX Crv	E:	60938	KQ Vir	LB:	62494	KQ Com	LB:
58587	TY Crv*	ELL	60979	V928 Cen	SRB	62581	IL UMa	SRB
58596	TZ Crv	SRD	60984	V929 Cen	LB:	62588	LP Mus	LB:
58648	HX UMa	EB	60999	IY Com	LB	62623	V941 Cen	LB:
58719	KT Mus	LC:	61006	FK Dra	EA	62732	DS Cru	ACYG:
58748	DE Cru	LBV	61024	V339 Hya	SRB	62738	IM UMa	LB
58783	DF Cru	LBV	61040	V930 Cen	LB:	62767	V942 Cen	LB
58794	DG Cru	GCAS	61163	BV CVn	LB	62773	V943 Cen	ACV
58795	HY UMa	LB:	61180	IZ Com	LB:	62801	LQ Mus	EA
58802	QW Hya	LB	61186	BW CVn	SRB	62853	VW Crv	SRB:
58835	DH Cru	ACV	61204	KK Com	EB:	62891	BZ CVn	LB
58866	IZ Vir	SRB	61226	V931 Cen	LB:	62918	DU Cru	LC
58927	HZ UMa	LB:	61237	II UMa*	EW:	62919	DT Cru	LBV:
58946	QX Hya	SRB	61247	V932 Cen	LB	62936	IN UMa	LB:
58954	DI Cru	WR	61290	KL Com	SR:	63136	DV Cru	BY:
58997	UU Crv	LB:	61362	V933 Cen*	LB:	63154	LR Mus	LB:
59136	BS CVn	LB:	61440	KX Mus	IB:	63170	DW Cru	ACYG:
59181	IU Com	BY:	61448	DO Cru	BE	63186	V944 Cen	LB:

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
63210	V945 Cen	LBV	65324	V346 Hya	SRB:	67357	CU CVn	EW:
63313	KV Vir	LB:	65376	CL CVn	LB	67449	DM Boo	IB:
63357	V344 Hya	LB:	65398	LT Mus	EB:	67471	MN Vir	LB:
63360	CC CVn	SRB:	65517	V966 Cen	RS:	67511	IR UMa	LB
63442	CD CVn	LB:	65590	LU Vir	EB:	67531	V348 Hya	LB:
63560	KW Vir	SRB	65633	CM CVn	LB:	67604	V981 Cen	LB
63565	V946 Cen	BE	65637	V967 Cen	BE:	67616	V982 Cen	BY:
63602	FL Dra	LB	65693	LU Mus	BE	67657	DN Boo	EW:
63650	V345 Hya	LB:	65746	CN CVn	LB:	67662	CV CVn	LB:
63653	CE CVn	LB	65776	V968 Cen	ACV	67669	V983 Cen	E:
63688	LS Mus	BE	65818	V969 Cen	LBV:	67704	V984 Cen	SRB
63706	CF CVn	LB:	65841	KS Com	LB	67709	MO Vir	SRD
63752	KX Vir	SRB	65848	LV Mus	BE	67803	CW CVn	SRD
63849	V947 Cen	DSCTC:	65876	CO CVn	LB	67830	V985 Cen	LB:
63850	CG CVn	LB:	65953	CP CVn	LB:	67917	DO Boo	SRB
63979	V948 Cen	EB:	66030	V970 Cen	LB	67984	V349 Hya	SRB
64025	V949 Cen	EA	66070	V971 Cen	LB	68019	V986 Cen	LB
64130	V950 Cen	DSCTC	66078	LV Vir*	EW:	68186	V988 Cen	BY:
64210	KY Vir	SRB:	66124	CQ CVn	LB:	68218	V987 Cen	BE
64334	V951 Cen	LB:	66142	V972 Cen	WR	68221	MP Vir	LB:
64359	V952 Cen	BE	66157	V973 Cen	LB:	68284	IS UMa	SRB:
64391	V953 Cen	LB	66179	KT Com	CWB:	68298	V989 Cen	LB:
64433	KZ Vir	EB:	66266	LW Vir	LB:	68383	MQ Vir	LB
64460	LL Vir	SRB:	66273	V347 Hya	BY:	68384	CX CVn	EA
64471	V954 Cen	DSCT	66324	LX Vir	LB	68417	CY CVn	LB
64508	CH CVn	LB:	66394	V974 Cen	ELL:	68477	SV UMi	LB:
64520	LM Vir	EW:	66407	LY Vir	LB:	68500	V990 Cen	LB
64528	CI CVn	EA:	66470	CR CVn	SRB	68718	MR Vir	EB
64572	V956 Cen	SRD:	66496	DH Boo	SRB	68744	IT UMa	LB:
64578	V955 Cen	BE	66572	LW Mus	DSCT	68750	CE Cir	E:
64607	LN Vir	E:	66580	V975 Cen	E:	68757	V350 Hya	LB
64613	V957 Cen	SRB	66607	DY Cha	LBV	68788	V991 Cen	LB:
64622	V958 Cen	BE	66609	IP UMa	DSCTC:	68798	SW UMi	LB:
64636	IO UMa	EA	66631	V976 Cen	ACV:	68832	FS Cam	LB
64645	LO Vir	SRB	66682	CS CVn*	LB:	68842	V992 Cen	EB:
64653	V959 Cen	GCAS	66683	LX Mus	EA	68881	MS Vir	EW:
64712	V962 Cen	LB:	66738	IQ UMa	SRB	68904	CZ CVn	LB:
64719	V960 Cen	E	66783	LY Mus	LB	68913	DP Boo	SRB
64737	V961 Cen	ELL:	66875	LZ Vir	LB	68979	V993 Cen	ACV
64834	LP Vir	ELL:	66899	DI Boo	LB	68998	V994 Cen	SRD:
64935	LQ Vir	LB	67010	DK Boo	LB	69017	V351 Hya	LB
64941	V963 Cen	E:	67179	V977 Cen	LB:	69110	V352 Hya	LB:
64959	LR Vir	SRD	67202	V978 Cen	LB	69211	V353 Hya	EA
65035	FM Dra	SRB	67226	CD Cir	LB:	69272	V995 Cen	LB:
65069	KR Com	EB:	67238	FN Dra	LB	69348	MT Vir	LB:
65112	V964 Cen	EB	67254	MM Vir	SRB:	69403	MU Vir	E:
65122	LS Vir	SRB:	67263	CT CVn	LB	69405	DQ Boo	BY:
65225	LT Vir	SRB:	67298	V980 Cen	LB	69445	CF Cir	WR
65294	V965 Cen	ACYG:	67324	V979 Cen	EB	69451	NP Aps	LB
65296	CK CVn	LB:	67325	DL Boo	LB	69502	IU UMa	LB:

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
69539	V996 Cen	LB	71264	V1010 Cen	GCAS	73047	TU UMi	DSCTC
69557	V998 Cen	LB:	71269	FP Dra	LB:	73082	V1020 Cen	LB
69562	MV Vir	BY:	71313	CG Cir	EA	73122	NX Aps	I:
69582	V997 Cen	LBV:	71359	CH Cir	ACV	73237	FR Dra	LB:
69627	IV UMa	ELL:	71374	NT Vir	LB:	73247	CS Cir	EB
69695	DR Boo	LB	71376	SY UMi	LB:	73288	CT Cir	SRB
69712	DS Boo	LB	71390	CI Cir	LB	73346	ET Boo	EB
69828	MW Vir*	EW:	71455	NU Vir	SRD	73378	EU Boo	LB:
69847	V999 Cen	LBV:	71563	V1011 Cen	LB:	73426	V1021 Cen	SRB
69848	MX Vir	DSCTC:	71665	V1013 Cen	LB	73445	HV Lib	LB
69850	NQ Aps	SRB	71666	IS Lup	LBV	73465	HW Lib	RR:
69894	V354 Hya	E:	71668	CK Cir	BE	73474	TV UMi	EB
69956	NR Aps	LB:	71709	V1012 Cen	BE	73479	IU Lup	EA
69966	MY Vir	LB:	71712	EG Boo	LB:	73526	IV Lup	LB
69978	V1001 Cen	IA:	71727	IT Lup	ACV	73589	EV Boo	LB
69980	V1000 Cen	E	71868	NV Vir	SRB:	73595	V1022 Cen	RR:
69987	MZ Vir	LB	71900	EH Boo	LB:	73604	HX Lib	LB:
70020	NN Vir*	RRC:	71922	V1014 Cen	I:	73612	EW Boo	EA
70026	V1002 Cen	LB	71929	NT Aps	EW	73643	EY Boo	LB:
70188	NO Vir	LB	71965	EI Boo	SRD	73662	EX Boo	SRB
70198	DT Boo	ISB	71967	V1015 Cen*	CEP:	73710	HY Lib	DSCT
70240	DU Boo	EB:	72032	CL Cir	EA	73763	IW Lup	SRB
70245	SX UMi	LB:	72117	V1016 Cen	LB:	73984	HZ Lib	LB:
70248	ε Aps	GCAS:	72198	FQ Dra	ACV:	74005	II Lib	SRB
70250	V1004 Cen	LB	72208	EK Boo	SRB	74011	CU Cir	BE
70287	DV Boo	EA	72209	HT Lib	LB:	74034	TX UMi	BY:
70290	V1003 Cen	LC:	72268	NW Vir	LB:	74077	LW TrA	LB:
70370	V355 Hya	LB:	72367	CN Cir	EB	74119	IK Lib	LB:
70450	NP Vir	SRB:	72372	V1017 Cen	LB	74127	IL Lib	E
70530	IP Lup	ACV	72377	CM Cir	ACV	74147	CV Cir	BE
70547	NS Aps	LB	72391	EL Boo*	DSCT:	74152	IX Lup	LB:
70621	DW Boo	EB:	72426	EM Boo	EA	74166	IY Lup	LB:
70769	V1005 Cen	SRB	72438	CO Cir	BE	74214	EZ Boo	LB:
70772	NQ Vir	LB	72566	HU Lib	SRD	74245	IM Lib	E:
70800	DX Boo	LB	72592	CP Cir	GCAS:	74252	IZ Lup	SRB
70816	NR Vir	SRD	72616	CQ Cir	BE	74253	FF Boo	LB:
70832	V1006 Cen	SRB	72625	SZ UMi*	BY:	74337	FG Boo	LB
70840	IQ Lup	E:	72637	EN Boo	SRB	74369	KK Lup	LB
70876	DY Boo	LB	72680	EP Boo	LB:	74405	NY Aps	BY:
70902	DZ Boo	SRD	72689	EO Boo	LB:	74440	FH Boo	LB:
70932	HS Lib	LB	72710	V1018 Cen	LBV:	74451	TW UMi	LB
70999	EE Boo	LB	72757	EQ Boo	E:	74471	OP Ser	LB:
71015	FO Dra	LB:	72800	V1019 Cen	LBV	74618	OR Ser	LB:
71048	V1007 Cen	SRB:	72801	NV Aps	LB:	74633	OQ Ser	SRB
71052	NS Vir	EB	72825	NU Aps	LB:	74642	OS Ser	SRB
71077	V356 Hya	EB	72838	ER Boo	LB:	74654	CW Cir	BE
71107	EF Boo	EW	72989	CR Cir	LC:	74660	CX Cir	ACYG:
71128	IR Lup	LB:	72992	TT UMi	SRB	74673	NZ Aps	LB
71178	V1009 Cen	BY:	73034	ES Boo	LB:	74714	KL Lup	LB:
71194	V1008 Cen	BE	73041	NW Aps	EB	74807	KM Lup	LB:

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
74825	IN Lib	RR:	76822	PR Ser	LB:	78949	V2349 Oph	LB
74838	IO Lib	RS:	76828	IX Lib	LB:	78959	AD CrB	SRB:
74866	TY UMi	EA	76832	UU UMi	BY:	79038	V364 Nor	BE
74938	FS Dra	LB	76909	IY Lib	LB:	79055	V365 Nor	LB
74999	OO Aps	LB	76947	FW Dra	LB	79057	AE CrB	LB:
75035	KN Lup	BY:	76968	V359 Nor	LB	79085	V1047 Sco	I:
75054	CY Cir	LB	76970	FP Boo	EW	79101	ϕ Her*	ACV:
75187	OT Ser	BY:	76987	KV Lup	EB	79106	PW Ser	LB:
75203	FI Boo	EW:	77037	FX Dra	EB	79158	V1048 Sco	LB:
75207	KO Lup	LB:	77045	PS Ser*	E	79162	AF CrB	LB:
75224	CZ Cir	ACYG:	77199	KW Lup	BY:	79178	PX Ser	LB:
75269	OU Ser*	EW:	77227	PT Ser*	LBV	79207	V366 Nor	ACYG:
75323	γ Cir	BE:	77369	V1039 Sco	SRD:	79247	V1049 Sco	LB
75420	OP Aps	DSCTC	77445	FY Dra	LB	79253	UV UMi	LB:
75456	OV Ser	LB	77462	KX Lup	LB:	79277	PY Ser	LB
75563	IP Lib	BY:	77598	YY CrB	EW	79283	AG CrB	SRB
75584	OW Ser	LB	77605	XZ CrB	LB:	79331	V890 Her	LB:
75620	KP Lup	LB:	77645	V360 Nor	ACYG:	79347	V891 Her	LB:
75641	FK Boo	LBV	77657	KY Lup	ACV	79479	V1050 Sco	SRB
75665	LX TrA	SRD:	77691	KZ Lup	SRB	79490	V367 Nor*	LC:
75715	IQ Lib	CEP:	77841	YZ CrB	LB:	79530	V1051 Sco	SXARI
75720	FL Boo	LB:	77859	V1040 Sco	BCEP:	79543	V892 Her	SRB
75818	KQ Lup	E:	77861	IZ Lib	SRB	79712	PZ Ser	LB:
75836	IR Lib	EW:	77993	FZ Dra	LB:	79747	OR Aps	LBV:
75861	OX Ser	SRD:	78034	MM TrA	BE	79754	V368 Nor	SRB
75878	V358 Nor	LB:	78061	ZZ CrB	LB	79763	V1052 Sco	LB:
75886	TZ UMi	LB	78179	OQ Aps	LB	79880	V369 Nor	LB
75924	KR Lup	BY:	78209	AA CrB	LB:	79949	V370 Nor	LB:
75992	IS Lib	LB:	78231	MN TrA	EA	79958	V371 Nor	BY:
76036	FM Boo	LB:	78265	π Sco	EB	79992	τ Her	LBV
76042	FN Boo	BY:	78310	V361 Nor	ACYG:	80004	V1053 Sco	LB:
76044	KS Lup	LB	78491	MO TrA	SRB	80020	V893 Her	RR:
76047	FT Dra	LB	78509	V2348 Oph	LB	80060	V1054 Sco	E:
76091	OY Ser	SRB	78523	V1041 Sco	EA	80073	AH CrB	SRB
76161	IT Lib	EA:	78526	MP TrA	E:	80100	AI CrB	LB:
76243	IU Lib	LBV	78533	LL Lup	ACV:	80248	V2350 Oph	LB:
76272	FU Dra	EW	78534	V1042 Sco	LB	80302	V894 Her	SRD
76279	LY TrA	LB	78563	V1043 Sco	SRB	80395	MR TrA	ACV
76296	OZ Ser	LB	78682	MQ TrA	BE	80442	V2351 Oph	RR:
76297	γ Lup*	ELL:	78705	PU Ser	SRB	80503	UW UMi	SRB
76371	KT Lup	BE	78708	V1044 Sco	E:	80523	V895 Her	SRB
76414	XY CrB	LB:	78756	LM Lup	ACV	80531	V372 Nor	ACV:
76454	LZ TrA	LBV	78777	AB CrB	LB:	80541	V896 Her	LB:
76480	IV Lib	E:	78781	LN Lup	SRB	80545	V373 Nor	E:
76515	PP Ser	LB:	78803	V362 Nor	LC:	80557	V374 Nor*	ELL:
76538	PQ Ser	NL:	78810	V363 Nor	LB:	80580	V375 Nor	LB:
76627	FV Dra	LB	78844	AC CrB	LB:	80603	V1055 Sco	EW
76684	FO Boo	LB:	78880	V1045 Sco	LB:	80636	V1056 Sco	BY:
76694	IW Lib	RR:	78919	V1046 Sco	E	80640	V376 Nor	BE:
76762	KU Lup	ACV	78925	PV Ser	LB:	80659	V377 Nor	LC

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
80707	MS TrA	ACV:	82123	V916 Her	E:	83713	V933 Her	LB:
80714	V1057 Sco	SRB	82207	V917 Her	LB:	83714	V934 Her	SRB:
80788	V378 Nor	CEP:	82253	V918 Her	EB	83802	V851 Ara	EB
80791	V897 Her	SRD:	82335	V843 Ara	ACV	83814	V935 Her	EB
80830	V379 Nor	LB	82344	V921 Her	EB	83868	V936 Her	LB:
80876	V898 Her	BY:	82346	V919 Her	DSCTC	83891	V2365 Oph	E:
80945	V1058 Sco	ACYG	82387	V922 Her	LB:	83904	V937 Her	LB:
80961	GG Dra	EB	82390	V920 Her	E:	83943	V852 Ara	EA
80965	V380 Nor	SRB	82428	V923 Her	EB	83958	V2366 Oph	LB:
80978	MT TrA	LB:	82442	V2355 Oph	EB	83972	OW Aps	LBV
81165	V2352 Oph	BY:	82451	V1067 Sco	E:	84004	V939 Her	LB
81191	V899 Her	EW	82459	CV Oct	LB	84016	V938 Her	SRB:
81243	V901 Her	SR:	82544	V2356 Oph	LB:	84025	V853 Ara	ACV
81244	GH Dra	LB:	82650	V1068 Sco	LB	84038	V940 Her	SRD
81245	V900 Her	LB:	82720	UX UMi	LB:	84042	OX Aps	LB
81256	V1059 Sco	BE	82745	V844 Ara	LB:	84105	V854 Ara	LB
81284	GI Dra	SRD:	82769	V845 Ara	LB:	84148	V855 Ara	LB
81319	V902 Her	LB:	82776	V924 Her	SRB:	84191	V941 Her	LB:
81334	V1060 Sco	DSCTC	82819	V1069 Sco	EA:	84231	V856 Ara	LB:
81376	V840 Ara	LB	82825	V925 Her	LB:	84277	V2367 Oph	BY:
81411	V903 Her	SRB	82848	V1070 Sco	LBV	84385	V942 Her	LB
81415	V1061 Sco	LB	82868	V846 Ara	BE	84401	V1075 Sco	BE:
81420	V905 Her	LB:	82883	V927 Her	DSCT	84479	V2368 Oph	EA
81426	V904 Her	LB:	82920	V926 Her	LB:	84483	V1076 Sco	BE
81438	OS Aps	LB	82967	V2357 Oph	EW:	84504	V943 Her	LB:
81477	V1062 Sco	ACV	82982	OV Aps	ACV:	84535	λ UMi	SRB
81478	V841 Ara	BY:	82985	V847 Ara	LBV:	84595	V2369 Oph	BY:
81483	V906 Her	LB	83014	V1071 Sco	SRB	84596	V944 Her	LB
81530	OT Aps	EA	83021	V2358 Oph	LB	84642	V857 Ara	BY:
81554	MU TrA	ACV	83102	GL Dra	SRB	84650	V1077 Sco	BE
81622	V907 Her	LB:	83105	V848 Ara	BE	84686	V858 Ara	ACV
81645	V1063 Sco	GCAS	83117	V2359 Oph	LB	84726	V945 Her	LB
81694	V908 Her	BY:	83150	MX TrA	ACV	84745	V1078 Sco	BE
81700	V842 Ara	LB:	83208	V928 Her	LB:	84752	V946 Her*	LB:
81712	V1064 Sco	LB:	83209	V2360 Oph	LB:	84775	V947 Her	LB:
81743	OU Aps	ACV:	83250	V849 Ara	LC	84837	GM Dra	EW
81753	MV TrA	SRD	83255	CW Oct	ACV:	84876	V1079 Sco	LB
81842	V1065 Sco	ACV	83322	V2361 Oph	LB:	84896	GN Dra	SRB
81855	V909 Her	LB	83366	CX Oct	SRB	85022	V1080 Sco	IA:
81893	V2353 Oph	ACV	83370	V929 Her	DSCTC	85057	V948 Her	EA
81921	V1066 Sco	LB:	83416	V2362 Oph	LB:	85065	V949 Her	SRB
81938	V910 Her	LB:	83425	V930 Her	BY:	85076	GP Dra	LB
81967	V912 Her	SRD:	83457	V1072 Sco	DSCTC	85087	V2370 Oph	LB:
81968	MW TrA	LB:	83462	V931 Her	LB:	85125	GO Dra	LB
81975	V911 Her	LB:	83574	V1073 Sco	ACYG:	85189	V2371 Oph	BCEP
82029	V913 Her	LB:	83584	V932 Her	LB	85252	V950 Her	LB:
82050	V914 Her	SRD	83618	V850 Ara	LB	85277	GQ Dra	EB
82056	GK Dra	EA	83632	V2363 Oph	SRB	85344	V951 Her	LB:
82089	V2354 Oph	LB:	83638	V2364 Oph	SRB	85435	V859 Ara	LC
82103	V915 Her	LB:	83706	V1074 Sco	ACYG:	85507	V2372 Oph	LB

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
85510	V952 Her	LB:	87107	V2386 Oph	LB:	88902	V713 CrA	LB
85522	GR Dra	L	87114	V968 Her	LB	89083	GY Dra	LB
85553	V860 Ara	LB	87136	V4375 Sgr	BE	89129	V4383 Sgr	BE
85569	V1081 Sco	EA	87221	V1087 Sco	LB	89132	V985 Her	LB:
85644	V953 Her	LB:	87228	GU Dra	LB:	89142	V986 Her	LB:
85672	V954 Her	LB:	87245	V969 Her	LB:	89203	V4384 Sgr	ACYG:
85714	OY Aps	LB	87255	V1088 Sco	LB	89225	V714 CrA	ACV
85718	GS Dra	LB:	87257	V1089 Sco	ACV	89238	V4385 Sgr	ELL:
85729	V861 Ara	ACYG:	87298	V1090 Sco	E:	89243	GZ Dra	E:
85751	V862 Ara	BE:	87302	V868 Ara	BE	89271	V987 Her	LB
85812	V2373 Oph	EB	87446	V970 Her	LB:	89316	V355 Pav	LB:
85820	V863 Ara	SRB:	87474	V2387 Oph	LB	89404	V4386 Sgr	E:
85849	OZ Aps	EA	87541	GW Dra	DSCTC	89416	V356 Pav	E:
85895	V864 Ara	BE	87576	GV Dra	EA	89470	V4387 Sgr	ACV
85904	V955 Her	LB:	87580	V1091 Sco	ACV	89510	V4388 Sgr	LB:
85905	V2375 Oph	LB	87655	V2388 Oph	EB	89527	V2392 Oph	SRB:
85925	V2374 Oph	SRD	87797	V2389 Oph	SRB	89605	QV Tel	BE
85944	V2377 Oph	EB	87886	V1092 Sco	LBV	89645	V527 Lyr	LB:
85968	V865 Ara	SRB	87908	V971 Her	SRB	89662	V4389 Sgr	SRB:
85974	V2376 Oph	LB:	87933	ξ Her	SRD	89753	QR Ser	EB:
85992	V957 Her	LB	87958	V972 Her	EW	89816	QS Ser	EA:
85997	V2378 Oph	E:	87999	V2390 Oph	LB:	89862	V988 Her	EA
86000	V956 Her	LB:	88067	V973 Her*	SRB:	89955	V715 CrA	ACV:
86073	V958 Her	LB:	88073	V4376 Sgr	ELL:	89999	V989 Her	LBV
86084	V2379 Oph	E:	88118	V353 Pav	I:	90001	V4390 Sgr*	EB
86085	V2380 Oph	LB	88172	V974 Her	BE	90026	QW Tel	EB
86153	V959 Her	SRC	88181	V975 Her	LB	90043	V4391 Sgr	SRB
86163	V1082 Sco	E:	88182	V4377 Sgr	LB:	90100	V4392 Sgr	SRD:
86200	V866 Ara	ACV:	88308	V976 Her	LB:	90108	QX Tel	SRD
86253	V1083 Sco	BE	88326	QQ Ser	LB:	90113	V4393 Sgr	LB:
86294	V1084 Sco	EW:	88341	V4378 Sgr	LB	90170	V528 Lyr	SRB
86374	V2381 Oph	RR:	88394	V977 Her	LB	90254	V716 CrA	LB:
86392	V960 Her	SRD	88411	GX Dra	SRD	90259	V4394 Sgr	EB:
86395	V962 Her	SRB:	88434	V978 Her	LB	90293	V529 Lyr	ACV
86434	V1085 Sco	LB:	88491	V869 Ara	LC	90338	V990 Her	EA:
86439	V961 Her	SRB	88517	V711 CrA	EB	90409	V993 Her	LB:
86450	GT Dra	IA:	88537	V979 Her	DSCTC	90417	V991 Her	SRD:
86487	V2382 Oph	BE	88563	V980 Her	LB	90420	V992 Her	SRD
86509	V2383 Oph	BY:	88601	V2391 Oph*	BY:	90463	HH Dra	LB
86588	V963 Her	LB	88615	V4379 Sgr	BE:	90483	V994 Her*	EA
86658	V867 Ara	EW	88620	V354 Pav	LB	90646	V4395 Sgr	SRB
86672	V2384 Oph	E	88711	V712 CrA	SRC	90671	V4396 Sgr	EA
86709	V965 Her	SRC:	88722	V982 Her	LB	90723	V530 Lyr	LB:
86710	V964 Her	LB	88761	V983 Her	LB	90761	QT Ser	ISA:
86711	V966 Her	DSCTC	88769	V981 Her	LB:	90768	V448 Sct	BE
86712	PP Aps	EA	88789	V4380 Sgr	LB	90770	V995 Her	LB:
86751	V1086 Sco	LB	88823	V984 Her	LB:	90797	ν Pav	LBV
86846	V967 Her	LB:	88853	V870 Ara*	EW:	90803	V996 Her	LB:
86964	V2385 Oph	BE	88876	V4381 Sgr	ACYG:	90811	V4397 Sgr	SRB
87043	V352 Pav	DSCTC	88884	V4382 Sgr	BCEP	90815	V357 Pav	ACV:

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
90880	V531 Lyr*	E:	92510	V457 Sct	GCAS:	94588	V1447 Aql	LBV:
90907	V449 Sct	ACYG:	92513	V540 Lyr	LB	94596	V1448 Aql	BE:
90913	V450 Sct	SRD	92523	HO Dra	LB	94619	V554 Lyr	ACV:
90950	V4398 Sgr	ACYG	92537	V539 Lyr	EA	94693	V367 Pav	EB
90970	V532 Lyr	BE	92629	V363 Pav	EA	94702	V336 Tel	BY:
90971	V2393 Oph	ACV	92649	V4407 Sgr	EB	94743	V2077 Cyg	E:
90972	HI Dra	RRC	92699	V1003 Her	DSCTC:	94793	V1449 Aql	BCEP
90990	QU Ser	ACV	92700	V541 Lyr	LB	94824	V1450 Aql	EB:
91001	V451 Sct	ACV	92715	V1435 Aql	LB:	94862	V555 Lyr	LB
91020	V4399 Sgr	EA:	92776	V4408 Sgr	LBV:	94897	HT Dra	LB:
91052	HL Dra	EB	92835	HP Dra	EA	94969	V389 Vul	SRB
91061	HK Dra	LB	92836	V1436 Aql	E:	94978	HV Dra	SRD+E:
91071	V997 Her	SRB	92889	HQ Dra	LB:	95036	V4412 Sgr	LB:
91130	V4400 Sgr	BE	93082	CY Oct	LB	95049	V1451 Aql	LB
91135	V4401 Sgr	SRB	93092	V335 Tel	LB:	95063	V4414 Sgr	SRB
91140	V998 Her	E:	93104	V542 Lyr	EA	95075	V4413 Sgr	LB:
91193	V358 Pav	LB:	93145	HR Dra	LB	95082	V1452 Aql	CEP:
91206	V4402 Sgr	LB	93177	V543 Lyr	BCEP:	95160	V368 Pav	EB:
91224	QV Ser	ACV	93210	V545 Lyr	LBV:	95187	V2078 Cyg	BY:
91250	V533 Lyr	EB	93214	V544 Lyr	DSCTC	95226	V4415 Sgr	SRB
91292	V717 CrA	SRD	93215	V1437 Aql	BE	95252	V4416 Sgr	SRB
91335	HM Dra	SRD	93222	V546 Lyr	LB:	95313	V4417 Sgr*	E:
91359	V534 Lyr	ACYG:	93259	V1438 Aql	DSCTC	95320	HU Dra	SRB
91422	V999 Her	LB:	93270	V387 Vul	LB	95403	V370 Pav	LC
91477	V452 Sct	ACYG:	93272	V364 Pav	LBV:	95405	V369 Pav	LB:
91494	V718 CrA	LB:	93309	V547 Lyr	LB	95459	V556 Lyr	EB
91516	V359 Pav	LB	93349	V1439 Aql	EB:	95479	V371 Pav	LB
91578	QY Tel	EA	93359	V548 Lyr	SRB	95499	V1453 Aql	LB:
91671	V535 Lyr	LBV	93633	V549 Lyr	DSCTC:	95512	V390 Vul	ACV:
91718	V4403 Sgr	EA	93696	V4409 Sgr	BE	95537	V557 Lyr	SRD
91728	V453 Sct	LB	93724	V1440 Aql	ELL:+NL:	95543	V2079 Cyg	ACV:
91777	V719 CrA	BE	93732	V1441 Aql	EB	95547	V1454 Aql	E:
91789	V536 Lyr	LB	93773	V1442 Aql	LB:	95578	V337 Tel*	DSCT:
91813	V360 Pav	LB	93786	V365 Pav	LB:	95588	V1455 Aql	EA:
91832	QZ Tel*	EB	93808	V550 Lyr*	LBV	95592	V372 Pav	SRB
91871	V454 Sct	SRB	93893	V720 CrA	LB	95611	V2080 Cyg	EA
91970	V1000 Her	SRD	93903	ι Lyr	BE	95635	V338 Tel	LB
91983	HN Dra	RR:	93907	V551 Lyr	ELL:	95673	V558 Lyr	BE
92048	V537 Lyr	LB:	93931	V4410 Sgr	LB:	95691	V2081 Cyg	CEP:
92066	V4404 Sgr	ACV	94011	V1443 Aql	GCAS:	95716	V1456 Aql	SRB
92079	V4405 Sgr	SRB:	94169	V1444 Aql	ACV:	95748	V1457 Aql	SRB
92128	V455 Sct	GCAS	94294	V1445 Aql	LB:	95779	V4418 Sgr	LB:
92142	V4406 Sgr	SRB	94354	V552 Lyr	LB	95833	V2082 Cyg	ELL
92148	V361 Pav	LB	94361	HS Dra	LB	96011	V2083 Cyg	EA
92151	V1434 Aql	LB:	94377	V338 Sge	E:	96034	V391 Vul	LBV
92237	V1001 Her	LB	94384	V1446 Aql	BE	96065	V339 Tel	SRB
92330	V362 Pav	E	94427	V388 Vul	ACV:	96111	V4419 Sgr	SRB
92335	V538 Lyr	LB	94443	V366 Pav	LB:	96189	V2084 Cyg	DSCTC
92374	V1002 Her	EA	94474	V553 Lyr	LB	96228	V392 Vul	ACV:
92423	V456 Sct	LB	94537	V4411 Sgr	E:	96309	V1458 Aql	SRA

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
96350	HW Dra	LB	98156	V2095 Cyg	ACV:	99720	V1477 Aql	CEP:
96429	HX Dra	LB:	98267	V374 Pav	LB:	99754	V1479 Aql	LB:
96493	V393 Vul	BY:	98283	V2098 Cyg	LB	99755	V1478 Aql	LB
96533	V2085 Cyg	LB	98289	V2097 Cyg	LBV	99758	V378 Pav	SRB
96547	HY Dra	SRB	98297	IL Dra	LB:	99863	IP Dra	EB
96599	V339 Sge*	LC	98379	V2100 Cyg	LBV:	99890	V1480 Aql	LB
96682	V1459 Aql	LB:	98422	V2099 Cyg	SRB:	99920	V4434 Sgr	LB
96687	V2086 Cyg	LB:	98424	V2101 Cyg	LB	99953	V2113 Cyg	BE
96688	V340 Sge	LC:	98500	V345 Tel	LB	99983	V1481 Aql	LB
96872	V2087 Cyg	LB	98504	V397 Vul	ELL:	99995	LZ Del	GCAS
96873	V4420 Sgr	SRB:	98538	V1469 Aql	LB	100024	V4435 Sgr	LB
96875	V340 Tel	BY	98539	V4428 Sgr	EA	100051	V2114 Cyg	LB
96916	V1460 Aql	LB:	98542	V1468 Aql	LB	100107	BF Cap	EB
96966	V2088 Cyg	DSCTC:	98603	V2102 Cyg	LB	100119	V4436 Sgr	LB:
96983	V4421 Sgr	LB	98611	V2104 Cyg	IA	100140	V2115 Cyg	LB:
96984	V341 Sge	GCAS:	98635	V2103 Cyg	BE	100187	DE Oct	RRC:
96989	V2089 Cyg	SRB	98729	V2105 Cyg*	ACYG:	100234	BG Cap	SRD:
97032	V341 Tel	LB	98811	V375 Pav	BY:	100242	V2116 Cyg	SXARI:
97059	V1462 Aql	BE	98815	V346 Tel	LB:	100253	V4437 Sgr	EB
97065	V1461 Aql	EA	98826	V1470 Aql*	E	100308	V2117 Cyg	SXARI:
97117	V1463 Aql	BE	98832	DD Oct	E:	100383	MM Del	LB:
97135	V342 Sge	SRB	98893	V1471 Aql	EB:	100389	V379 Pav	LB:
97142	V2090 Cyg	LB	98902	V2106 Cyg	LB	100413	V4439 Sgr	SRB:
97159	CZ Oct	LB	98932	IM Dra	SRB	100422	V4438 Sgr	LB
97263	HZ Dra	EA	98954	V1472 Aql*	E:	100468	MN Del	SRB
97303	V4422 Sgr	LB:	99037	IN Dra	DSCTC	100548	V2118 Cyg	ACYG:
97460	V4423 Sgr	LB:	99042	V4429 Sgr*	SRD:	100550	V1482 Aql	SRB
97481	V342 Tel	LB	99176	V344 Sge	LB	100574	V2119 Cyg	BE
97500	V394 Vul	E:	99246	V2107 Cyg	EB	100576	V380 Pav	LB:
97501	V2091 Cyg	LB:	99249	BC Cap	SRB	100665	V347 Tel	LB
97583	V343 Tel	EB	99250	V1473 Aql	LBV:	100719	V399 Vul	EA:
97584	V2092 Cyg	LBV	99252	V2109 Cyg	DSCT	100732	V4441 Sgr	LB
97600	V1464 Aql	RRC:	99279	V2108 Cyg	EB	100743	V4440 Sgr	LB:
97651	V2093 Cyg	LB	99358	V376 Pav	LB	100744	V2120 Cyg	GCAS
97664	V1465 Aql	ACV:	99365	BD Cap	DSCTC	100746	V413 Cep	E:
97670	V343 Sge	E:	99370	V2110 Cyg	LBV	100802	MO Del	BY:
97678	II Dra	SRD:	99381	V412 Cep	LB	100813	V4442 Sgr	LB:
97679	V395 Vul	BE	99402	V398 Vul*	LBV:	100859	V2121 Cyg*	RRAB:
97681	V396 Vul	BE	99403	V2112 Cyg	LB	100868	V4443 Sgr	LB
97787	V1466 Aql	BE:	99408	V4430 Sgr	LB	100869	BH Cap*	EB:
97803	V373 Pav	LB:	99415	V2111 Cyg	LBV	100921	V348 Tel	LB:
97923	V4424 Sgr	RRAB	99456	V1474 Aql	LB	100926	V1483 Aql	LB:
97935	V344 Tel	LB	99457	BE Cap	BE:	100981	MP Del	EA
98021	V4425 Sgr	SXPHE:	99533	V1475 Aql	LB	101064	V381 Pav	LB
98028	V2094 Cyg	ACV	99547	V1476 Aql	LB:	101068	V2122 Cyg	ACV:
98060	V1467 Aql	LB:	99553	V4431 Sgr	SRD	101185	BK Ind	EA
98088	V4426 Sgr	SRB	99568	V4432 Sgr	LB:	101195	MQ Del	SRD
98095	IK Dra	LB:	99606	V4433 Sgr	IB:	101236	MR Del	EA
98113	V4427 Sgr	LB	99615	V377 Pav	ACV	101238	MS Del	LB
98121	V2096 Cyg	SRD	99640	IO Dra	DSCTC:	101277	BI Cap	LB:

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
101286	V382 Pav*	DSCT:	102723	BM Cap	E	105162	V2150 Cyg*	EW:
101303	V383 Pav	LB:	102770	IQ Aqr	SRB	105193	V422 Cep	LB
101316	MT Del	LB	102777	IP Aqr	LB	105230	V2151 Cyg	NL:
101366	BL Ind	LB	102827	V2136 Cyg	E:	105324	BN Cap*	IB:
101369	MU Del	BY:	102844	NO Del	LB	105337	V423 Cep	LB
101405	BK Cap	LB:	102866	V385 Pav	LB	105389	IX Aqr	LB
101411	V2123 Cyg	BE	102895	BP Ind	BY:	105404	BS Ind	EA
101412	V2124 Cyg	LB	102926	V417 Cep	GCAS:	105441	V390 Pav	BY:
101439	V2126 Cyg	EB:	102943	V418 Cep	BE	105448	V2152 Cyg	ACV:
101474	V2125 Cyg	LC	102984	DH Oct	LB:	105464	CD Mic	E:
101512	MV Del	SRB:	103013	V2137 Cyg	LB:	105468	V391 Pav	LB:
101569	V2127 Cyg	ACV:	103026	IR Aqr	LB	105565	V2153 Cyg	BE
101572	DF Oct	LB:	103083	NP Del	ELL:	105575	IY Aqr	LB
101615	MW Del	SRB:	103126	V2138 Cyg	ACV:	105581	DI Oct	SRD
101632	V2128 Cyg	LB:	103168	BY Mic	LB:	105584	V2154 Cyg	EA
101639	V1484 Aql	LB:	103185	NQ Del	LB:	105614	SY Equ	BCEP
101657	MX Del	EB	103277	V2139 Cyg	BE	105623	NT Peg	BE
101678	BS Mic	LB	103290	BQ Ind	SXPHE	105648	CE Mic	BY:
101705	V384 Pav	LB:	103312	V2140 Cyg	ACYG:	105690	V424 Cep	EA
101862	V2129 Cyg	DSCTC	103320	V386 Pav	EW	105699	V2155 Cyg	GCAS
101926	IM Aqr	LB	103417	NR Del	LB	105741	V2156 Cyg	BE
101949	V2130 Cyg	SXARI:	103447	IS Aqr	LB	105788	CF Mic	LB
101960	IQ Dra	SRB:	103476	V2141 Cyg	LB	105811	V2157 Cyg	ACYG:
101968	BU Mic	DSCTC	103553	V387 Pav	LB	105846	V2158 Cyg	LB
101977	BT Mic	EB	103586	SX Equ	LB:	105866	V2159 Cyg	ACV:
101988	IN Aqr	LB	103625	BZ Mic	LB	105934	V425 Cep	LBV
102037	V400 Vul	EA:	103645	V2142 Cyg	SRB	105949	V426 Cep	LB
102041	IO Aqr	EA	103667	V2143 Cyg	LB:	105958	NU Peg	LB:
102064	BM Ind	LB	103700	V2144 Cyg	GCAS:	105960	V427 Cep	EB:
102160	BN Ind	SRB	103769	IT Aqr	SRB	105963	V2160 Cyg	BY:
102217	BL Cap	RR:	103803	V388 Pav	DSCTC	106009	V2161 Cyg	LBV
102238	V401 Vul	BY:	103851	IU Aqr	LB	106062	NV Peg	SRB
102256	BV Mic	EA:	103873	V2145 Cyg	LB	106077	CL Gru	SRB
102330	MY Del	LB:	104043	α Oct*	EB	106079	V2162 Cyg	BE
102353	BO Ind	EW	104130	V2146 Cyg	SRA	106145	V2163 Cyg	BE
102355	BW Mic	SRD:	104135	V403 Vul	EB	106200	V428 Cep	EB
102358	V414 Cep	SRB:	104175	V404 Vul	SRD	106211	V2164 Cyg	LB:
102397	V2131 Cyg	LB	104183	V389 Pav	LB:	106232	NW Peg	SRB
102412	BX Mic	EB:	104196	V2147 Cyg	ACV:	106242	NX Peg	LB:
102427	MZ Del	EB	104279	IV Aqr	LC	106285	V429 Cep	ACYG:
102428	DG Oct	LB:	104478	NR Peg	EB:	106316	BT Ind	SRB
102445	V415 Cep	EA	104483	V2148 Cyg	EA	106360	V392 Pav	SRB
102457	V2132 Cyg	LB	104604	BR Ind	EA	106400	V430 Cep	BY:
102524	V2133 Cyg	EA	104719	V419 Cep	LC:	106476	V2165 Cyg	EA
102545	NN Del	EA	104883	V420 Cep	GCAS	106544	IZ Aqr	LB:
102558	V416 Cep	SRB:	104923	NS Peg	LB:	106579	NY Peg	SRB
102589	λ Cyg	BE	105010	V2149 Cyg	GCAS	106600	BO Cap	LB:
102622	V2134 Cyg	EB	105019	IW Aqr	LB:	106604	V431 Cep	ACV
102650	V402 Vul	EB:	105058	CC Mic	E:	106620	V2166 Cyg	BE
102700	V2135 Cyg	BE	105091	V421 Cep*	BE:	106652	CM Gru	SRB

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
106662	V2167 Cyg	LBV	108776	V393 Lac	I:	110346	PT Peg	SRB
106694	V2168 Cyg	BY:	108807	OV Peg	LB:	110364	DN Oct	SRB:
106712	V433 Cep	GCAS:	108844	KL Aqr	LB	110388	KT Aqr	LB:
106716	V432 Cep	BE	108888	V394 Lac	EB	110408	V405 Lac	LBV
106739	BP Cap	LB	108909	KM Aqr	LB:	110464	PU Peg	EB
106764	BQ Cap	EA	108911	V395 Lac	ACYG:	110500	V406 Lac	ACYG:
106812	V2169 Cyg	EB	108938	V442 Cep	EB	110528	KU Aqr	LB
106897	NZ Peg	RR:	108943	OW Peg	LB:	110569	PV Peg	LB
106929	UX PsA	LB:	108957	V443 Cep	EA	110596	PW Peg	LB:
106964	V434 Cep	E	108982	VW PsA	LB:	110617	PX Peg	LB:
107054	UY PsA	LB:	109020	V396 Lac	IA:	110622	V407 Lac	ELL:
107099	OO Peg	EA	109072	OX Peg	LB:	110662	V450 Cep	BE
107135	UZ PsA	LB	109113	V397 Lac	BE	110699	V408 Lac	GCAS
107161	V2170 Cyg	LB	109124	V444 Cep	ELL:	110703	CT Gru	LB
107202	OP Peg	LB:	109191	V445 Cep	ELL:	110707	KV Aqr*	E:
107349	BU Ind	LB:	109193	V398 Lac	EA	110842	DK Tuc	E:
107353	V435 Cep	BE	109201	KN Aqr	LB	110881	KW Aqr	LB
107473	V436 Cep	SRB	109205	V399 Lac	ACYG:	110921	V409 Lac	GCAS
107523	BV Ind	LB:	109212	OY Peg	LB	110948	V410 Lac	LB
107530	BR Cap	LB:	109238	V400 Lac	LBV:	110968	V411 Lac	DCEPS
107532	V2171 Cyg	LB	109282	VX PsA	LB:	111022	V412 Lac*	LC
107725	V437 Cep	LB:	109283	V401 Lac	EA	111071	V413 Lac*	ELL
107745	CN Gru	LB	109311	V446 Cep	EA	111119	PY Peg	LB
107823	DK Oct	LBV	109325	BY Ind	LB	111162	KX Aqr	EA
107845	BS Cap	LB	109354	V402 Lac	EA	111190	CU Gru	LB:
108022	OQ Peg	BE	109376	OZ Peg	SRB	111219	CV Gru	LB:
108061	OR Peg	LB	109382	KO Aqr	SRB	111250	V451 Cep	LB
108128	CO Gru	SRB	109395	KP Aqr	LB:	111315	KY Aqr	LB:
108133	V438 Cep	SRB	109437	PP Peg	LB	111360	V414 Lac	ACV
108192	DL Oct	LB	109476	KQ Aqr	ACV:	111365	KZ Aqr	SRB
108236	BT Cap	SRB:	109492	ζ Cep*	E:	111454	LL Aqr	EA
108274	BU Cap	LB	109505	V447 Cep*	LBV:	111523	PZ Peg	LB:
108286	OS Peg	LB:	109547	DF Tuc	LB:	111581	LM Aqr	SRB
108298	BV Cap	LB	109580	BZ Ind	LB:	111606	LN Aqr	BY:
108326	V2172 Cyg	BE	109594	CQ Gru	LB:	111610	CW Gru	SRB
108348	V2173 Cyg	LBV	109606	V448 Cep*	E:	111647	LO Aqr	IB
108476	V2174 Cyg*	ACYG:	109613	KR Aqr	LB	111718	CX Gru	ELL:
108486	CP Gru	EA	109666	CR Gru	LB	111771	CY Gru	LB
108494	BW Cap	LB	109763	DG Tuc	LB	111785	V415 Lac	BE
108524	BW Ind	SRD:	109770	DH Tuc	LB	111795	V416 Lac	LB
108546	V439 Cep	BE:	109802	V403 Lac	LB:	111809	VZ PsA	EA
108562	KK Aqr	LB	109884	VY PsA	EB	111856	CZ Gru	SRB
108576	OT Peg	BY:	109901	CS Gru	BY:	111877	V417 Lac	LB
108588	OU Peg	LB	109955	DI Tuc	LB	111907	V418 Lac	LB
108597	VV PsA	BE	110037	KS Aqr	LB:	111932	QQ Peg*	BY:
108646	V441 Cep	EA	110058	PQ Peg	LB	111957	QR Peg	LB:
108714	V440 Cep	ACYG:	110163	PR Peg	CEP:	111989	DD Gru	LB
108738	V2175 Cyg*	BE	110177	V404 Lac	BE	112047	V419 Lac	LB:
108741	BX Ind	DSCTC	110200	V449 Cep	ACYG:	112050	QS Peg	LB:
108768	DM Oct	BY:	110251	PS Peg	SRB	112058	QT Peg	EA

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
112078	LP Aqr	LB	114206	BN Scl	EA	115952	V814 Cas	LB
112088	V452 Cep	SRD	114217	DK Gru	SRB:	115991	V352 Peg	ACV:
112205	DE Gru	LB	114305	V381 And	E	116103	CG Phe*	SXPHE:
112212	QU Peg	LB	114344	V457 Cep	LBV	116105	BT Scl	LB:
112250	QV Peg	LB:	114368	V344 Peg	LB:	116108	V353 Peg	EB
112261	V420 Lac	SRD:	114384	V382 And	EB	116119	V354 Peg	ACV
112294	QW Peg	LB	114400	BO Scl	LB	116153	V389 And	E
112312	WW PsA	BY+UV	114404	V345 Peg	LB	116223	DM Psc	SRB
112339	V421 Lac	LB	114407	DL Gru	LB	116228	V390 And	SRB
112399	QX Peg	LB:	114414	BP Scl	LB:	116411	V391 And	LB
112420	LQ Aqr	LB	114426	LS Aqr	L	116435	V355 Peg	SRD
112574	QY Peg	LB	114427	DO Tuc	BY:	116507	V815 Cas	LB:
112698	V422 Lac	IA:	114451	DP Oct	LB	116622	V460 Cep	LB
112781	ξ Oct	LBV	114489	DL Psc	LB	116640	CH Phe	LB:
112830	DL Tuc	BY:	114552	V807 Cas	ELL:	116685	V392 And	E
112877	DG Psc	LB:	114580	DP Tuc	LB:	116716	V393 And	LB:
112919	QZ Peg	LB:	114608	V346 Peg	LB	116748	DS Tuc	RS:
112960	V335 Peg	E:	114698	V347 Peg	SRD	116870	V394 And	LBV
112972	V453 Cep*	EA	114716	DQ Tuc	BY:	116948	V816 Cas	LB
113065	V454 Cep*	EA:	114736	DM Gru	BY:	117099	CI Phe	SRB:
113095	DH Psc	LB:	114791	V458 Cep	WR	117111	V395 And	RRC:
113139	V336 Peg	LB	114815	V808 Cas	BE:	117161	V356 Peg	LB:
113226	V423 Lac	BE	114850	V383 And	LB:	117185	V357 Peg	EW
113263	V455 Cep	ACYG	114889	DO Oct	SRB:	117205	V817 Cas	BE
113288	V424 Lac	LC	114917	CC Ind	SRB:	117239	V358 Peg	SRB
113316	V456 Cep	ACV:	114946	DN Gru	LB:	117244	V359 Peg	SRB
113321	V337 Peg	LB	114975	V348 Peg	LB:	117276	CK Phe	LB
113330	DM Tuc	LB	114985	V349 Peg	SRB:	117311	DN Psc	LB:
113410	V338 Peg	LB:	115141	V809 Cas	LC	117413	V360 Peg	RV:
113442	DF Gru	EA	115176	BQ Scl	LB:	117431	DT Tuc	LB:
113532	WX PsA	DSCTC	115224	V810 Cas	BE	117459	DO Psc	BY:
113549	WY PsA	LB:	115244	V811 Cas	BE	117469	V461 Cep	LB:
113556	DI Psc	LB:	115262	V459 Cep	DSCTC	117514	V818 Cas	BE
113558	V339 Peg	LB:	115267	V812 Cas	ACV	117520	DU Tuc	SRB
113640	V378 And	BE	115368	V813 Cas	BE	117618	V361 Peg	LB
113667	DK Psc	LB:	115392	DO Gru	LB:	117632	V362 Peg	LB:
113683	DG Gru	BY:	115433	DR Tuc	LB	117647	V396 And	DSCTC
113687	V340 Peg	LB	115504	V384 And	LB:	117669	CL Phe	BY:
113897	V806 Cas	E:	115530	V385 And	LB	117670	V462 Cep	EB
113968	DH Gru	BY:	115541	V386 And	SRB	117691	V397 And	LB:
114022	WZ PsA	LB	115563	V350 Peg	DSCTC	117718	ϕ Peg	SRB:
114024	V341 Peg*	ELL	115565	BR Scl	LB:	117738	LV Aqr	SRB:
114094	LR Aqr	SRB	115609	DQ Oct	SRB	117744	V398 And	LB:
114100	V379 And	IA:	115627	V351 Peg	RRC	117747	LW Aqr	LB
114106	V380 And	LBV	115643	V387 And	LB	117769	V399 And	LB
114127	DI Gru	E:	115647	DP Gru	EA	117830	V819 Cas	ACYG:
114175	DN Tuc	E:	115657	LT Aqr	LB	117853	DV Tuc	ACV
114187	V343 Peg	EA:	115755	V388 And	ACV:	117871	DW Tuc	LB:
114189	V342 Peg*	ELL:	115844	LU Aqr	SRD	117986	V363 Peg	SRB
114196	BM Scl	LB:	115858	BS Scl	DSCTC	118002	LX Aqr	SRB

Table 1 (cont.)

HIP	GCVS	Type	HIP	GCVS	Type	HIP	GCVS	Type
118096	DX Tuc*	EW:	118223	V821 Cas	EA	118307	DQ Psc	SRB
118139	V820 Cas	BE	118238	V400 And	E			
118222	DP Psc	SRD	118277	BU Scl	LB:			

Remarks to Table 1

HIP 000940 = V742 Cas SB, $P_{orb} = 55\overset{d}{.}9212$.
HIP 001805 = V745 Cas Component B of the double system observed brighter than in the Hipparcos Input Catalogue.
HIP 001921 = V746 Cas SB, $P_{orb} = 27\overset{d}{.}8$.
HIP 002164 = BC Scl May be eclipsing.
HIP 002271 = V747 Cas VB. The variability may be due to the fainter component.
HIP 002274 = CL Cet Type ELL: is also possible.
HIP 003414 = π Cas SB, $P_{orb} = 1\overset{d}{.}9642$.
HIP 007330 = BI Scl Type E: is also possible.
HIP 008182 = V547 Per High proper motion (LTT 10610) not confirmed by Hipparcos data.
HIP 008796 = α Tri SB, $P_{orb} = 1\overset{d}{.}767$.
HIP 009150 = V369 And VB (0$''\!\!.$1, 128°, 1986.9).
HIP 009867 = V374 And Not identical with BD+44°422.
HIP 013199 = EE Cet The variability may be due to the fainter (B) component.
HIP 014700 = CP Oct Variability type and spectral type (F2/F3Ib/II) do not agree.
HIP 014915 = EL Cet SB2.
HIP 017666 = V580 Per The variability may be due to the fainter (B) component.
HIP 018593 = CZ Cam $P = 267\overset{d}{.}79$, semiregular behavior unusual for B5 stars.
HIP 019335 = V582 Per A single deep minimum at the bottom of the small-amplitude ($5\overset{m}{.}63$–$5\overset{m}{.}64$) wave.
HIP 020963 = V1144 Tau SB, $P_{orb} = 13\overset{d}{.}88$.
HIP 021063 = RX Cae Variability type and spectral type (F3/F5II) do not agree.
HIP 021575 = V1148 Tau Type LBV: is also possible. SB, $P_{orb} = 2\overset{d}{.}2075$.
HIP 021810 = V1152 Tau Type E: with $P = 11\overset{d}{.}080$ is also possible.
HIP 022050 = V592 Per VB (0$''\!\!.$2, 197°, 1989.7).
HIP 022326 = HV Eri Type RRC: is also possible.
HIP 023196 = VW Pic Variability may be due to component B.
HIP 024186 = VZ Pic Kapteyn's star.
HIP 024710 = VW Col Variability may be due to component B.
HIP 026263 = V1377 Ori SB?, $P_{orb} \sim 5\overset{d}{.}5$–$6\overset{d}{.}5$.
HIP 026282 = V1161 Tau Variability needs confirmation.
HIP 026354 = V431 Aur $P = 16\overset{d}{.}86$ detected in Hipparcos data.
HIP 026606 = V433 Aur SB?
HIP 027309 = V1380 Ori In a bright nebula.
HIP 028440 = AN Men Type RRC: is also possible.
HIP 030426 = IU CMa Type LBV: is also possible.
HIP 032839 = V741 Mon Type ACV: is also possible.
HIP 033166 = QX Gem Type ACV: is also possible.
HIP 033864 = V360 Pup Type ACV: is also possible.
HIP 034116 = V750 Mon In the region of the nebula IC 2177.
HIP 034684 = V753 Mon Type ACV: is also possible.

HIP 034836 = V364 Pup The preceding component of the northern star in the system of two CoD–CPD objects, CoD–36°3425 and CoD–36°3426 (CPD–36°1171 and CPD–36°1172). The cross-identifications of these CoD and CPD objects differ from one source to another; our adopted identification is based on the paper editions of the catalogues.
HIP 035015 = MO CMa The amplitude can have been overestimated (M. Grenon, private communication).
HIP 035415 = τ CMa SB, $P_{orb} = 154\overset{d}{.}90$.
HIP 035776 = BO CMi Several episodes of outburst-like activity.
HIP 035795 = NO CMa Type LBV: is also possible.
HIP 036728 = V376 Pup Type ACV: is also possible.
HIP 036981 = V378 Pup Type BE is also possible.
HIP 037197 = V345 Gem The variability may be due to the fainter (B) component.
HIP 037925 = V393 Pup SB, $P_{orb} = 2\overset{d}{.}5248$.
HIP 038070 = o Pup Type EA: is also possible.
HIP 039637 = V419 Pup Not a nearby star (despite having a Gl number).
HIP 042554 = CW Lyn Type RRC: is also possible.
HIP 043071 = OQ Vel The type is doubtful.
HIP 043199 = FV Cnc The type is doubtful.
HIP 048665 = V491 Car Mean magnitude $9\overset{m}{.}69$.
HIP 048832 = V493 Car SB, $P_{orb} = 3\overset{d}{.}368$.
HIP 049945 = V498 Car Type BE: is also possible.
HIP 050097 = GM UMa SB, discrepant $P_{orb} = 3\overset{d}{.}2424$.
HIP 053938 = V360 Vel Several close companions.
HIP 054165 = HH UMa Type EW: is also possible.
HIP 054723 = FL Leo Variability range according to *E.M. Halbedel*, IBVS No. 3502, 1990.
HIP 055030 = HN UMa Type DSCT: is also possible.
HIP 055031 = V902 Cen VB, $\rho = 12''$. Variability may be spurious.
HIP 055078 = V534 Car Flare-like activity.
HIP 057067 = V915 Cen The variability type is not quite consistent with the spectral type (B9II/III).
HIP 057480 = FX Leo Not a nearby star (despite having a Gl number).
HIP 057731 = HU UMa VB A (B = GSC 3014.0222 = L265-581, 24″, 250°, common proper motion).
HIP 057737 = V921 Cen High proper motion (LTT 4397) not confirmed by Hipparcos data.
HIP 058587 = TY Crv SB2.
HIP 059665 = KU Mus Type RV: is also possible.
HIP 061237 = II UMa Type RR: is also possible.
HIP 061362 = V933 Cen Hipparcos data contradict the luminosity class V.
HIP 062918 = DU Cru The identification with NSV 06012 (SIMBAD) is wrong.
HIP 066078 = LV Vir Type RR: is also possible.
HIP 066682 = CS CVn Hipparcos data contradict the luminosity class V.
HIP 069828 = MW Vir Type DSCTC: is also possible.
HIP 070020 = NN Vir Type EW: is also possible.
HIP 071967 = V1015 Cen Variability type and luminosity class (III) do not agree.
HIP 072391 = EL Boo Type E: is also possible.
HIP 072625 = SZ UMi Variability needs confirmation.
HIP 075269 = OU Ser SB2.

HIP 076297 = γ Lup SB, $P_{orb} = 2\overset{d}{.}8081$.
HIP 077045 = PS Ser Both components are SB systems, $P_{orb}(A) = 15\overset{d}{.}888$, $P_{orb}(B) = 13\overset{d}{.}561$.
HIP 077227 = PT Ser SB, $P_{orb} = 38\overset{d}{.}937$.
HIP 079101 = ϕ Her SB, $P_{orb} = 560\overset{d}{.}5$.
HIP 079490 = V367 Nor Maybe not a supergiant.
HIP 080557 = V374 Nor Type LBV: is also possible.
HIP 084752 = V946 Her Not Wolf 688, a large-proper-motion star, which is at $17^h19^m28\overset{s}{.}9$, $+33°05'10''$ (epoch and equinox 2000.0).
HIP 088067 = V973 Her Suspected rapid brightness variations.
HIP 088601 = V2391 Oph $P_{orb} = 88.13$ yr. Component B is a suspected variable star (NSV 24260) and may be the cause of variations.
HIP 088853 = V870 Ara Type DSCT: is also possible.
HIP 090001 = V4390 Sgr SB2 and speckle binary.
HIP 090483 = V994 Her The secondary component of the double system may also vary.
HIP 090880 = V531 Lyr Minima observed only between JD 2448600 and 2448800.
HIP 091832 = QZ Tel The variability may be due to the fainter (B) component.
HIP 093808 = V550 Lyr SB, $P_{orb} = 1\overset{d}{.}0309$.
HIP 095313 = V4417 Sgr The variability may be due to the fainter (B) component.
HIP 095578 = V337 Tel Type EW: is also possible.
HIP 096599 = V339 Sge Extremely metal-weak.
HIP 098729 = V2105 Cyg Variability type and spectral type (F8Iab:) do not agree.
HIP 098826 = V1470 Aql The variability may be due to the fainter (B) component.
HIP 098954 = V1472 Aql SB, $P_{orb} = 198^d$.
HIP 099042 = V4429 Sgr A giant, according to Hipparcos data, despite the published luminosity class (V).
HIP 099402 = V398 Vul Not identical to IRC+30416 = NSV 12861.
HIP 100859 = V2121 Cyg Strong Blazhko effect.
HIP 100869 = BH Cap Type RR: is also possible.
HIP 101286 = V382 Pav Type EW: is also possible.
HIP 104043 = α Oct SB, $P_{orb} = 9\overset{d}{.}073$.
HIP 105091 = V421 Cep SB, $P_{orb1} = 5\overset{d}{.}4136$, $P_{orb2} = 225\overset{d}{.}44$.
HIP 105162 = V2150 Cyg Type RR: is also possible.
HIP 105324 = BN Cap The variability may be due to the fainter (B) component.
HIP 108476 = V2174 Cyg SB, $P_{orb} = 225\overset{d}{.}162$.
HIP 108738 = V2175 Cyg X-ray source.
HIP 109492 = ζ Cep Radial velocity varies.
HIP 109505 = V447 Cep The variability may be due to the fainter (B) component.
HIP 109606 = V448 Cep SB, $P_{orb} = 7\overset{d}{.}7320$.
HIP 110707 = KV Aqr One deep fading overlapping a brightening trend.
HIP 111022 = V412 Lac SB, $P_{orb} = 41.95$ yr.
HIP 111071 = V413 Lac SB, $P_{orb} = 2\overset{d}{.}9833$.
HIP 111932 = QQ Peg Variability needs confirmation.
HIP 112972 = V453 Cep SB, $P_{orb} = 54\overset{d}{.}723$.
HIP 113065 = V454 Cep SB, $P_{orb} = 5\overset{d}{.}6556$.
HIP 114024 = V341 Peg SB, $P_{orb} = 2\overset{d}{.}1779$.
HIP 114189 = V342 Peg Suspected SB.
HIP 116103 = CG Phe Type RRC: is also possible.
HIP 118096 = DX Tuc Type RRC: is also possible.

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DX CETI, A HIGH-AMPLITUDE δ SCUTI STAR

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The first note on the light variation of DX Ceti (= NSV 00871 = HIP 12113 = HD 16189, $\langle V \rangle = 7.00$, $\Delta V = 0.20$, P = $0\overset{d}{.}1039$, spectral type A5) based on photoelectric observations is that of Stetson (1991) who suspected its variability but did not measure the full light curve. The monoperiodic nature was discovered by the Hipparcos satellite (ESA 1997) and the star was classified as an RRc variable.

We started a long-term observational project of Strömgren photometry and spectroscopy of the newly discovered bright Hipparcos variables (see Kiss et al. 1998 for the first results). DX Cet was chosen because its period is shorter than that of any other RR Lyrae variables and we suspected a probable misclassification. Therefore, accurate determination of the fundamental physical parameters is highly desirable.

The spectroscopic observations were carried out at the David Dunlap Observatory with the Cassegrain spectrograph attached to the 1.88m telescope on November 17/18, 1998. The detector and the spectrograph setup was the same as used by Vinkó et al. (1998). The resolving power was 11,000 and the signal-to-noise ratio reached about 50. The spectra were reduced with standard IRAF tasks, including bias removal, flat-fielding, cosmic ray elimination, order extraction (with the task *doslit*) and wavelength calibration. For the latter, two FeAr spectral lamp exposures were used, which were obtained immediately before and after every six stellar exposures. The observing sequence of FeAr-var-var-var-var-var-var-FeAr was chosen because of the short period of DX Cet. Careful linear interpolation between the two comparison spectra has been applied in order to take into account the sub-pixel shifts of the stellar exposures caused by the movement of the telescope. The exposure time was fixed as 3 minutes, which corresponds to 0.02 in phase, thus avoiding phase smearing of the radial velocity curve.

Radial velocities were determined by cross-correlating the continuum normalized spectra of DX Cet with the spectrum of the IAU standard velocity star HD 187691, using the IRAF task *fxcor*. The spectral type and radial velocity of HD 187691 are F8V and $+0.1 \pm 0.3$ km s^{-1}. The cross-correlated region was between 6550 and 6700 Å. The observed heliocentric radial velocities are presented in Table 1. The velocimetric accuracy is estimated to be about $\pm 1 - 1.5$ km s^{-1}, which is indicated by the residual scatter of the measurements around a fitted low-order Fourier polynomial.

The photometric measurements were obtained using the 0.4 m Cassegrain-type telescope of Szeged Observatory on November 18/19, 1998. The detector was a single-channel

Table 1: The observed heliocentric radial velocities (in km/s)

Hel. J.D.	$V_{\rm rad}$	Hel. J.D.	$V_{\rm rad}$	Hel. J.D.	$V_{\rm rad}$
2451135.7029	18.6	2451135.7511	34.8	2451135.7877	19.7
2451135.7065	18.3	2451135.7535	36.6	2451135.7915	17.5
2451135.7088	19.7	2451135.7558	36.1	2451135.7938	17.3
2451135.7112	18.2	2451135.7606	37.5	2451135.7962	16.1
2451135.7135	21.1	2451135.7629	37.0	2451135.7985	15.1
2451135.7158	22.9	2451135.7653	35.1	2451135.8008	16.1
2451135.7289	28.7	2451135.7676	34.5	2451135.8032	16.2
2451135.7320	28.4	2451135.7699	34.6	2451135.8074	16.0
2451135.7344	29.3	2451135.7723	30.9	2451135.8097	18.1
2451135.7367	31.0	2451135.7760	28.1	2451135.8121	18.8
2451135.7390	31.7	2451135.7783	28.7	2451135.8151	19.9
2451135.7441	35.4	2451135.7807	25.9	2451135.8175	20.2
2451135.7465	33.7	2451135.7830	23.0	2451135.8198	21.4
2451135.7488	33.7	2451135.7853	19.1		

Optec SSP-5A photoelectric photometer equipped with *uvby* filters supplied by the manufacturer. We made differential photometry relative to HD 16647 ($V = 6.25, b-y = 0.26, m_1 = 0.15, c_1 = 0.47$ mag).

Unfortunately, due to the unfavorable weather conditions the accuracy was acceptable only for the V (±0.02) and c_1 (±0.035) data. The light and radial velocity curves are presented in Fig. 1.

Our photometric observations allowed estimation of the mean Strömgren colours which can be compared to previous observations of Stetson (1991 – S91): $\langle b-y\rangle = 0.19$ mag (0.180 by S91), $\langle m_1\rangle = 0.16$ mag (0.163 by S91), $\langle c_1\rangle = 0.85$ mag (0.808 by S91). The uncertainty of the mean values is about $\pm(0.01-0.02)$ mag. These values were used in the following analysis.

We have obtained one new time of maximum (HJD(max)=2451136.4227). Using the Hipparcos ephemeris (HJD(max) = 2448500.0730, P = $0\overset{d}{.}1039530$) we calculated an O−C value of -0.002 days, which suggests a very stable period. If we assume that this small negative value is due to a slightly shorter period, then the resulting corrected period is P = $0\overset{d}{.}1039529$, very close to the Hipparcos value. We conclude that the difference does not exceed the accuracy of the period determination and suggests a stable monoperiodic pulsation in DX Cet. This result is in very good agreement with the theoretical predictions of Breger & Pamyatnykh (1998) concerning the period changes of δ Scuti stars (see below).

The geometric distance of DX Cet, as measured by the Hipparcos satellite, is only 110 ± 12 pc. Since the star is far from the Galactic plane and lies within close proximity to the Sun, the interstellar reddening can be neglected. Thus, the apparent magnitude can be easily converted to absolute magnitude. The calculated visual absolute magnitude is 1.78 ± 0.24 mag, while the bolometric absolute magnitude (BC(A5) = -0.15, Carroll & Ostlie 1996) is 1.63 ± 0.24. The corresponding luminosity is $17.8\pm4L_\odot$.

The metallicity, expressed with the [Fe/H] value, was determined by Eq. (2) of Malyuto (1994). The result is [Fe/H] = -0.05 ± 0.2, suggesting a nearly solar composition. The atmospheric parameters $T_{\rm eff}$ and $\log g$ were obtained using the recent synthetic colour grids of Kurucz (1993). An average $T_{\rm eff}-\log g$ pair was calculated with a two-dimensional linear

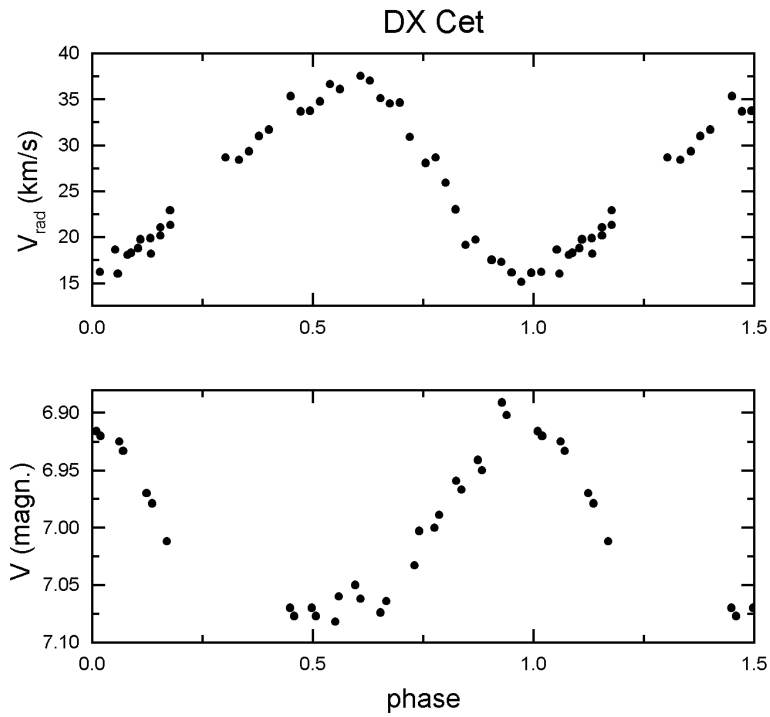

Figure 1. The radial velocity and light variations of DX Cet.

interpolation in the $(b-y)_0-(c_1)_0$ colour-colour diagram. The resulting parameters are: $\langle T_{\rm eff}\rangle = 7250 \pm 200$ K, $\langle \log\ g\rangle = 3.6 \pm 0.2$ dex.

We calculated the mean stellar radius combining the mean temperature, luminosity and solar values $T_{\rm eff} = 5770$ K and $M_{\rm bol} = 4.75$ (Allen 1976). It is $R_* = 2.7 \pm 0.5 R_\odot$. A stellar mass of $M_* = 1.5 \pm 0.6 M_\odot$ was obtained from the $\log g$ and R_* values by means of the effective gravity

$$g_{\rm eff} = G\frac{M_*}{R_*^2} + p\frac{dV_{\rm r}}{dt},$$

where $p = 1.36$ is the projection factor (Burki & Meylan 1986). In summary, therefore, we adopt

$$M_V = 1.78 \pm 0.24 \text{ mag}$$
$$M_{\rm bol} = 1.63 \pm 0.24 \text{ mag}$$
$$L = 17.8 \pm 4 L_\odot$$
$$[\mathrm{Fe/H}] = -0.05 \pm 0.2$$
$$\langle T_{eff}\rangle = 7250 \pm 200 \text{ K}$$
$$\langle \log\ g\rangle = 3.6 \pm 0.2 \text{ dex}$$
$$\langle R_*\rangle = 2.7 \pm 0.5 R_\odot$$
$$M_* = 1.5 \pm 0.6 M_\odot$$

All of the parameters discussed above suggest the probable misclassification of DX Cet. All of them lie far beyond the typical range of RR Lyrae variables, however, they are very consistent with the typical δ Scuti properties. Our conclusion based on the physical parameters is that DX Cet is a monoperiodic, high-amplitude δ Scuti star. The stability of its period is in perfect agreement with the theoretical calculations of Breger & Pamyatnykh

(1998), who predict a small rate of the period change (smaller than 10^{-7} year^{-1}, see Fig. 6 in their paper) for δ Scuti variables with similar physical parameters.

The mode of pulsation is another relevant question. The relatively large amplitudes of the light and radial velocity variations suggest radial pulsation. The "classical" pulsation constant ($Q = P(M/R^3)^{1/2}$) was calculated to be 0.029 ± 0.012. According to the theoretical pulsational models (e.g. Petersen & Jørgensen 1972, Milligan & Carson 1992), both fundamental and first overtone pulsation modes are consistent with the observed physical parameters. The position of DX Cet on the (log $T_{\rm eff}$ − log g) and (log $T_{\rm eff}$ − log $L/L_\odot$) diagrams is very close to the evolutionary tracks of $M = 1.8 - 2.0 M_\odot$ (Breger & Pamyatnykh 1998).

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THE SPECTRUM OF FG SAGITTAE IN 1998

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The interest in the variable star FG Sge has considerably increased after 1992 when it underwent dramatic photometric variations not seen before. These variations have continued up to the present time. Wallerstein (1990) and Jurcsik (1993) were the first who noted similarities between low–amplitude variations and sharp brightness declines of FG Sge and those of R CrB stars. At present, the universally accepted paradigm is that in the case of FG Sge we witness the result of a final helium shell flash after the star had departed from AGB (Iben 1984). After the discovery of another late helium flash star — Sakurai's object (Nakano, Benetti & Duerbeck 1996) the interest to both stars is higher still. For the latest reviews see Kipper (1996) and Gonzalez et al. (1998).

We have continued our routine monitoring of FG Sge and starting from 1996 also Sakurai's object trying to obtain some spectra every year in order to detect possible changes in their spectra. Two sets of spectra of FG Sge were obtained in 1998, on June, 19 and July, 11 with the prime focus echelle spectrometer of RAS 6–m telescope. The resolution of these spectra is 12,000. The spectral coverage is $\lambda\lambda 4200 \div 7700$ for the first set and $\lambda\lambda 4700 \div 8600$ for the second one. Both sets are usable redwards from $\lambda 4800$. The reduction of the spectra was performed using the image reduction system IRAF†. At the time of our observations a deep brightness drop was in an advanced stage and the star was as faint as it was during the previous deep minimum 2 years ago when Gonzalez et al. (1998) observed rich emission–line spectrum. The light–curve for dates near to our observations is depicted in Fig. 1. The data for this figure were taken from the AAVSO International Database (Mattei 1998). The moments of our observations are indicated by vertical lines.

The spectra of the first set which were observed about 60 days after the onset of brightness decline are very rich emission–line spectra with narrow lines. The rich photospheric absorption spectrum characteristic of light maxima is absent. Due to moderate resolution the lines are not fully resolved but are not wider than 29 $\mathrm{km\,s^{-1}}$. Such a spectrum is referred to as E1 by Alexander et al. (1972). In R CrB stars the E1 lines are usually blueshifted by some 10 $\mathrm{km\,s^{-1}}$ relative to stellar radial velocity. We, however, found, that these lines give the velocity $v_{\rm r} = 41 \pm 3$ $\mathrm{km\,s^{-1}}$ close to the velocity we found from absorption lines during relative light maxima $v_{\rm r} = 44.4$ $\mathrm{km\,s^{-1}}$ (Kipper & Kipper 1993). The lines correspond mostly to low excitation ($\epsilon_{\rm u} < 4$ eV) of singly ionized rare earths

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

and few lines of Fe I, K I, Na I, Mg I, Ca I and Ca II. Selected regions of the spectra are illustrated in Fig. 2 and Fig. 3.

The lines of Ti II, which are usually observed in the spectra of R CrB stars in minima, were not identified in FG Sge spectrum at this resolution. Of usually strong Sc II lines only few weak ones were found. In the second set of spectra, obtained 20 days later, the emission lines are much weaker or absent. The remaining lines were initially stronger with the tendency of lower excitation lines ($\epsilon_u < 3$ eV) being more persistent.

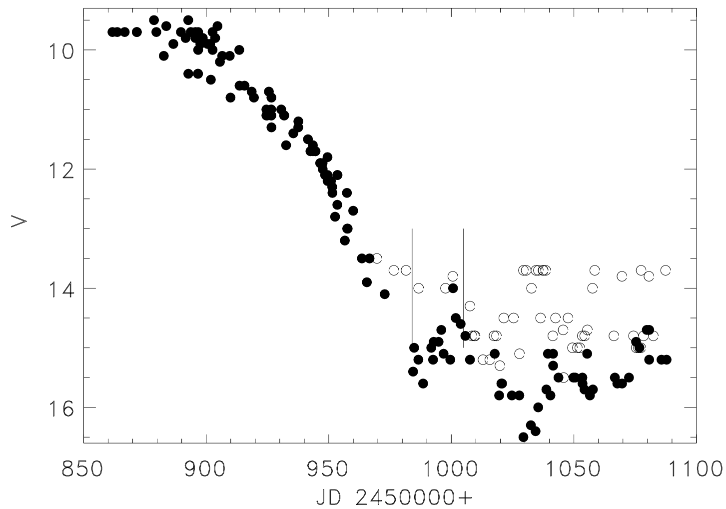

Figure 1. Light curve of FG Sge for summer 1998 (Mattei 1998). Open symbols indicate the upper limits. Vertical lines indicate the moments of spectral observations

Two of Ca II ($\epsilon_u = 3.15$ eV) IR triplet lines at $\lambda 8498$ and $\lambda 8542$, which are close to the red wavelength limit of our second set of spectra, remained quite strong with the line ratio 1:2.1 corresponding to optically thick case.

The Mg I b triplet lines at 5167.3, 5183.6 and 5183.6 Å, which usually belong to broad line category during R CrB stars minima, are narrow and weaken considerably between the two observation sets.

C_2 Swan bands of $\Delta v = 0, 1, 2$ sequences are strongly in emission in our first set of spectra. We could not, however, see the bands of CH and CN. In the case of FG Sge this phenomenon was first observed by Gonzalez et al. (1998) during the deep brightness decline in May, 1994 and then again in June, 1996. In the case of V854 Cen (R CrB star) Rao & Lambert (1993) found that C_2 bands in emission were not rotationally resolved and the bandheads were somewhat blueshifted. No such shift is observable in our spectra and some rotational structure of bands is visible. In the second set of spectra the C_2 bands are considerably weaker and the $\Delta v = 2$ sequence is no more visible.

The only broad lines in the spectra are the Na I D doublet lines and K I doublet lines at 7664.9 and 7699.0 Å. The Na I D lines are also the most prominent features in the entire visible spectrum.Their profile is depicted in Fig. 3. The interstellar absorption, which has been present in all FG Sge spectra observed so far, is indicated in the figure. Broad and sharp emission features are visible. Both broad and narrow emission components are nearly at the photospheric velocity. The half–width of the broad emission is around 180 km s^{-1}. The K I doublet shows the same behaviour with broad and narrow components.

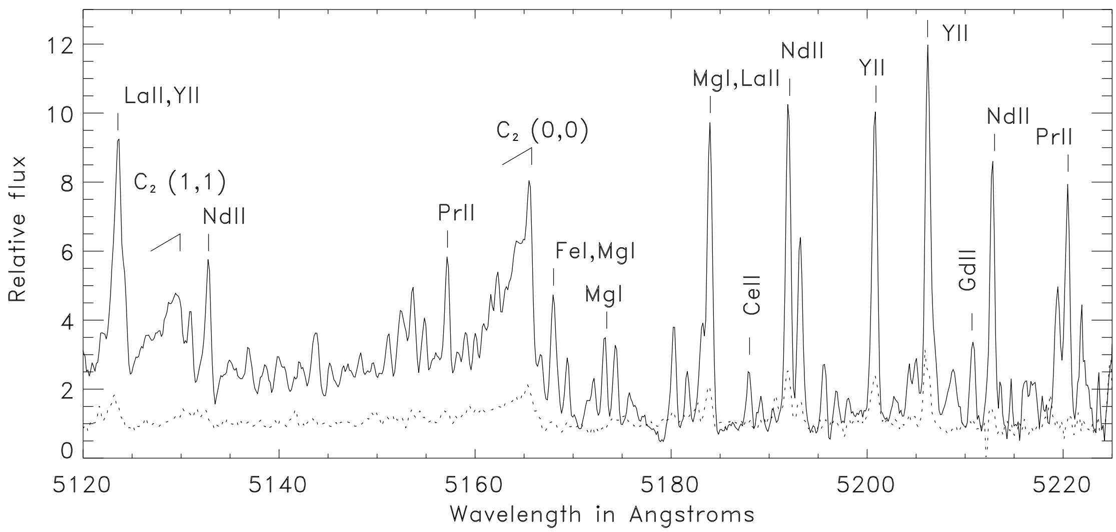

Figure 2. A part of the spectra of FG Sge on June, 19 (full line), and on July, 11, 1998 (dotted line). The relative flux is given in continuum units

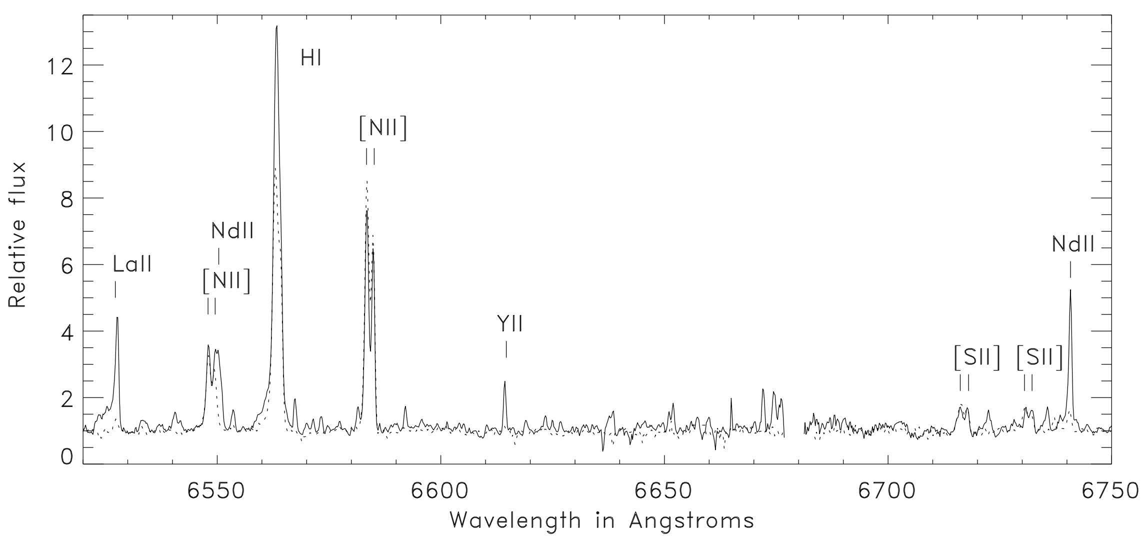

Figure 3. The same as in Fig. 2 for another wavelength interval

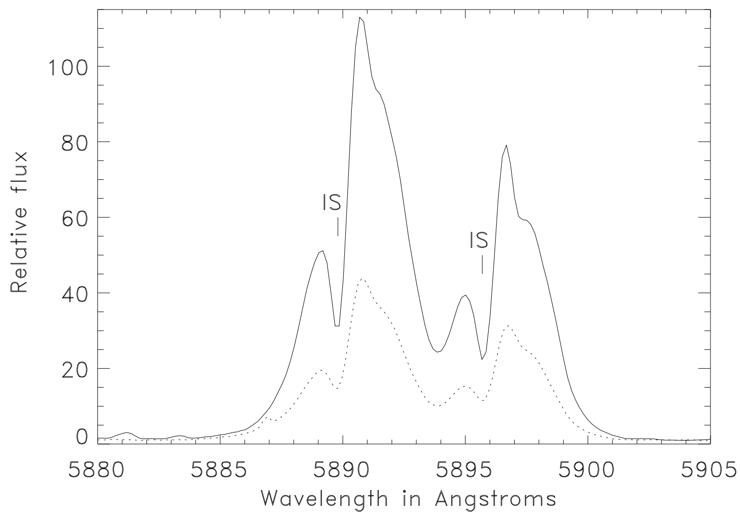

Figure 4. Na I doublet in the spectrum of FG Sge on June, 19 (full line), and on July, 11, 1998 (dotted line)

Some of the lines formed in FG Sge nebula (He 1–5) are also visible. Part of those lines (H_α, H_β, λ6548.05 [N II]) seem to be contaminated by stellar ("chromospheric") emission lines and their intensities are decreasing as the other stellar emission lines do. Several lines (λ5007.57 [O III], λ6583.45 [N II], λ6716.4 and λ6730.8 of [S II]) are quite free from stellar emission lines and their intensity does not change during our observations. All nebular lines and especially the lines with stellar contribution show two–peaked profiles with the red component weaker than the blue one. The radial velocity of the nebula inferred from these lines is 45 ± 4 km s^{-1}, in good accordance with the stellar velocity, and the expansion velocity of the nebula 33 ± 1 km s^{-1} is again close to the value of 35 ± 1 km s^{-1} found by Gonzalez et al. (1998).

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ON IDENTIFICATIONS OF NEW VARIABLE STARS ANNOUNCED BY WOITAS

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Having prepared the special (Hipparcos) 74th Name-list of variable stars (Kazarovets et al., 1999), we are now working on the next, 75th Name-list. Among candidates selected for designation as variable stars, there are several stars from the list of 43 new variables published by Woitas (1997). Our work on checking and improving coordinates of Name-list candidates and on their identification with the GSC shows that the appearance of catalogues like GSC, USNO A1.0 and A2.0, Hipparcos and Tycho greatly reduces the number of problems encountered when locating variables and measuring their coordinates. However, this applies to recent discoveries of variable stars. Old GCVS and NSV variables need a long and laborious work: they must be found using charts and identified using new positional catalogues, thus improving coordinates and switching to the equinox 2000.0 from 1950.0. In this connection, papers published by variable star researchers should not create new identification problems instead of reducing their number. Unfortunately, the cited paper (Woitas, 1997) does create new problems.

Our analysis of Table 1 in Woitas (1997) has shown the following.

1. Of the 43 announced new variables, two stars are known GCVS objects (No. 26 = V713 Ara, No. 29 = V764 Sco). Additional 27 stars have been attributed GCVS names in the Hipparcos catalogue (ESA, 1997), but surely Woitas did not yet know the final version of the Hipparcos catalogue during the preparation of his paper.

2. The heterogeneity of presentation of 2000.0 coordinates in the Table is amazing, especially for a study based upon Tycho mission, mainly an astrometric one. The coordinates published by Woitas, in many cases, considerably (up to several arcseconds) differ from 2000.0 coordinates in the Hipparcos catalogue as well as in the PPM catalogue or in the GSC. Probably the positional data used by Woitas come from SIMBAD. Below I present a table of accurate positions.

3. A number of mistakes in the information presented by Woitas and of other problems deserve special discussion.

No. 1 = TICID 3303/979. This Tycho (and GSC) number corresponds to HD 15922, not 15992. The star HD 15992 is NSV 00839 (Kholopov, 1982), and the present misidentification (due to misprint) could bring the star into the GCVS. The needed star, HD 15922, is the variable star V376 And, named on the base of Hipparcos data. But most amazing is that the right ascension given by Woitas for this star actually corresponds to the equinox 1950.0, whereas the declination is for 2000.0, as indicated in the header.

No. 4 = TICID 8535/222. Misprint in the number of the region; read 8538 instead of 8535.

No. 10 = TICID 8911/2750. The declination in IBVS No. 4444 is greatly in error. Instead of $-61°12'15''.8$, it should be $-61°52'17''.5$.

No. 40 = TICID 2772/1716. For this red star (spectrum M5), the large difference between the blue and the red magnitude resulted in the existence of two GSC numbers; besides that coinciding with the Tycho designation, there is also GSC 2772/1486.

No. 43 = TICID 8953/3540. The coordinates given by Woitas correspond to the position of CoD−59°3546, reduced from rather rough 1875.0 coordinates; but CoD−59°3546 is probably GSC 8958/3649. The Tycho mission did not observe GSC 8958/3649, and GSC (or TICID) 8953/3540 corresponds to CoD−59°3541 = CPD−59°3034, at a position differing from that published by Woitas by several minutes of arc.

I wish to thank Dr. N. Samus for his help. Thanks are due to the Russian Foundation for Basic Research and to the State Programme "Astronomy" for partial financial support of the GCVS research.

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Woitas, J., 1997, IBVS, No. 4444

Table 1: Tycho Positions for Variables Announced by Woitas

No.	$\alpha(2000.0)$	$\delta(2000.0)$	GCVS
1	$02^h35^m11\overset{s}{.}630$	$+49°51'37\overset{''}{.}25$	V376 And
2	$03^h35^m53\overset{s}{.}004$	$-69°11'34\overset{''}{.}76$	CS Hyi
3	$06^h18^m02\overset{s}{.}797$	$+35°35'51\overset{''}{.}43$	(new)
4	$06^h18^m22\overset{s}{.}271$	$-54°24'14\overset{''}{.}61$	(new)
5	$06^h34^m32\overset{s}{.}794$	$+55°21'10\overset{''}{.}93$	BQ Lyn
6	$06^h35^m37\overset{s}{.}648$	$+32°34'36\overset{''}{.}52$	V459 Aur
7	$07^h46^m52\overset{s}{.}852$	$+81°40'56\overset{''}{.}75$	FF Cam
8	$07^h32^m46\overset{s}{.}150$	$-53°33'18\overset{''}{.}87$	V454 Car
9	$07^h39^m27\overset{s}{.}232$	$-11°33'50\overset{''}{.}33$	V381 Pup
10	$07^h54^m29\overset{s}{.}379$	$-61°52'17\overset{''}{.}47$	(new)
11	$09^h47^m20\overset{s}{.}403$	$+32°46'56\overset{''}{.}24$	EL Leo
12	$09^h47^m10\overset{s}{.}378$	$-57°20'43\overset{''}{.}45$	(new)
13	$10^h24^m39\overset{s}{.}640$	$-54°19'18\overset{''}{.}94$	V346 Vel
14	$10^h44^m10\overset{s}{.}024$	$-72°03'52\overset{''}{.}13$	V521 Car
15	$11^h01^m35\overset{s}{.}756$	$-61°02'55\overset{''}{.}83$	(new)
16	$11^h18^m43\overset{s}{.}743$	$-58°11'11\overset{''}{.}10$	V537 Car
17	$11^h21^m38\overset{s}{.}963$	$-60°59'28\overset{''}{.}22$	(new)
18	$11^h37^m34\overset{s}{.}060$	$-60°54'11\overset{''}{.}66$	V913 Cen
19	$12^h17^m29\overset{s}{.}634$	$-34°30'18\overset{''}{.}30$	V337 Hya
20	$12^h38^m51\overset{s}{.}509$	$+13°48'13\overset{''}{.}50$	KM Com
21	$13^h09^m36\overset{s}{.}086$	$-07°46'51\overset{''}{.}27$	KY Vir
22	$14^h19^m37\overset{s}{.}740$	$+05°53'46\overset{''}{.}67$	NN Vir
23	$14^h22^m52\overset{s}{.}236$	$-55°57'44\overset{''}{.}36$	V1003 Cen
24	$14^h22^m17\overset{s}{.}716$	$+41°27'02\overset{''}{.}18$	DU Boo
25	$16^h05^m01\overset{s}{.}109$	$-39°13'00\overset{''}{.}28$	LN Lup
26	$17^h00^m36\overset{s}{.}618$	$-61°24'17\overset{''}{.}79$	V713 Ara
27	$17^h32^m10\overset{s}{.}485$	$-51°04'26\overset{''}{.}75$	V863 Ara
28	$17^h46^m22\overset{s}{.}666$	$-72°49'19\overset{''}{.}41$	(new)
29	$17^h56^m08\overset{s}{.}498$	$-45°09'20\overset{''}{.}67$	V764 Sco
30	$18^h34^m26\overset{s}{.}303$	$+57°48'06\overset{''}{.}56$	HL Dra
31	$20^h15^m53\overset{s}{.}568$	$+07°40'13\overset{''}{.}27$	(new)
32	$20^h46^m40\overset{s}{.}197$	$-27°13'59\overset{''}{.}86$	(new)
33	$21^h01^m53\overset{s}{.}351$	$+18°59'55\overset{''}{.}94$	(new)
34	$21^h32^m00\overset{s}{.}737$	$-58°48'54\overset{''}{.}43$	BT Ind
35	$21^h54^m22\overset{s}{.}194$	$-41°15'57\overset{''}{.}81$	CO Gru
36	$22^h14^m02\overset{s}{.}615$	$-57°13'06\overset{''}{.}33$	DH Tuc
37	$22^h25^m46\overset{s}{.}170$	$-49°49'33\overset{''}{.}24$	CT Gru
38	$22^h28^m58\overset{s}{.}321$	$+50°57'47\overset{''}{.}28$	V411 Lac
39	$23^h49^m58\overset{s}{.}211$	$-61°08'07\overset{''}{.}24$	DU Tuc
40	$23^h56^m58\overset{s}{.}052$	$+32°20'14\overset{''}{.}06$	(new)
41	$18^h03^m19\overset{s}{.}263$	$+23°49'00\overset{''}{.}54$	(new)
42	$05^h40^m58\overset{s}{.}773$	$-27°57'07\overset{''}{.}72$	(new)
43	$11^h05^m44\overset{s}{.}373$	$-60°29'15\overset{''}{.}81$	(new)

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NEW CCD-LIGHTCURVE AND IMPROVED ELEMENTS OF IT HERCULIS

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Name of the object:
IT Herculis = GSC2112.1845

Equatorial coordinates:	**Equinox:**
R.A.= $18^h45^m47^s$ **DEC.=** $+25°20'21''$	J2000.0

Observatory and telescope:
R. Szafraniec Observatory, Metzerlen, Switzerland; 35 cm RC reflector

Detector:	SBIG ST6 CCD camera
Filter(s):	None
Comparison star(s):	GSC2112.1621
Check star(s):	Anon. $0'\!.5$ NW of IT Her
Transformed to a standard system:	No
Type of variability:	EW

Remarks:

During 19 nights from JD2450925 to JD2451077, 91 observations of IT Herculis were obtained. These measurements were subjected to a PDM period search algorithm (Stellingwerf, 1978). In good agreement with the finding of Schmidt and Seth (1996), the following new elements of variation for this EW-type eclipsing binary have been found:

$$\mathrm{JD(min,hel)} = 2450946.363(3) + 0\overset{d}{.}339366(10) \times E. \qquad (1)$$

Figure 1 shows our data folded with these elements. Both minima show a time of constant brightness of $0\overset{d}{.}025$ (±0.003) day duration.

Acknowledgements:

This research made use of the SIMBAD data base operated at the CDS, Strasbourg, France. Photometry at the R. Szafraniec Observatory is supported by the “Emilia Guggenheim-Schnurr Foundation”.

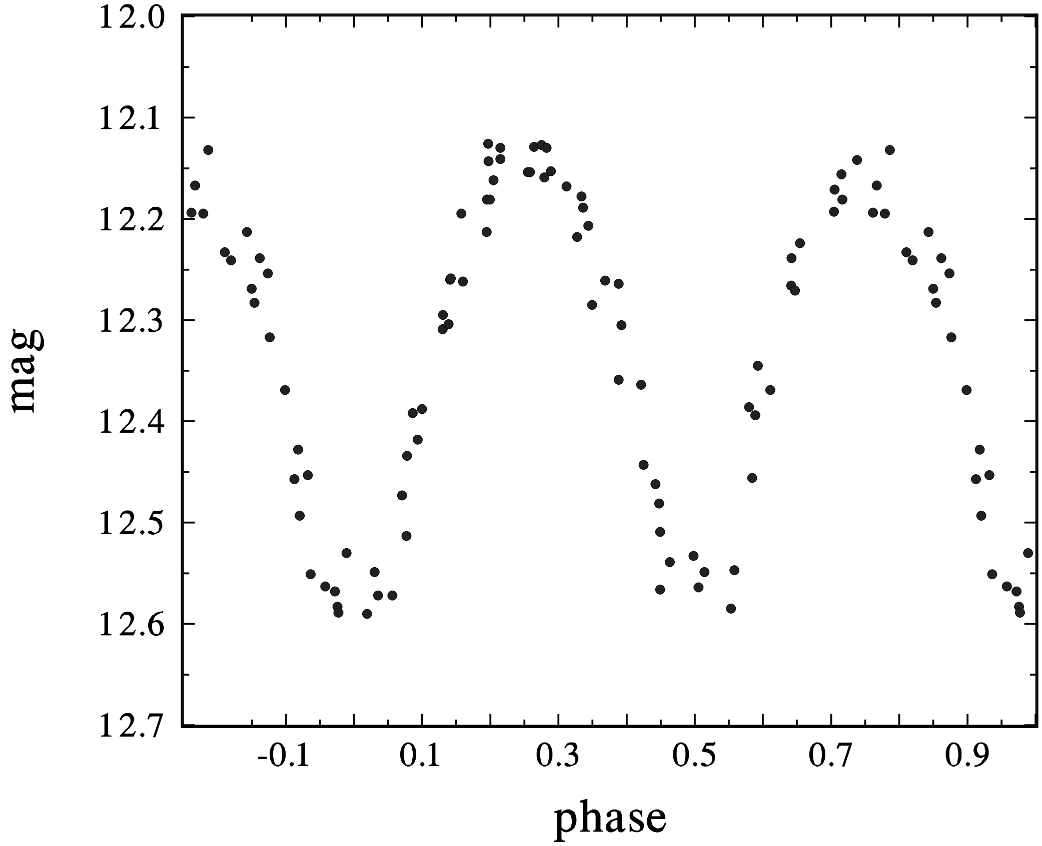

Figure 1. CCD light curve of IT Herculis using the elements (1)

References:

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Stellingwerf, R.F., 1978, *ApJ* **224**, 953

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LIGHT CURVES FOR NOVA Sgr 1998 AND NOVA Sco 1998

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In 1998 two bright novae were discovered by Liller, one in Sagittarius on Mar. 22.3 UT and one in Scorpius on Oct. 21.0 UT (Liller 1998a and b, respectively). Immediately following the discoveries, the authors began photometric observations, Jones visually and Liller with a CCD and a "minus-IR" filter. As noted elsewhere (Liller & Jones 1996), this combination of CCD and filter results in a broad band V system which extends from a wavelength of about 450 nm to 730 nm and thus includes the Hα line. As noted in the Circulars, the discovery photographs were made using Kodak Technical Pan film plus an orange filter which yields a passband extending from approximately 610 nm to 690 nm.

The light curves, shown in Figures 1 and 2, are similar in that both show a steady decline. However, they clearly differ in two other respects: N Sco was much "faster" than N Sgr; and while the visual and CCD magnitudes for Nova Sgr never depart by more than a few tenths of a magnitude, those for Nova Sco began to diverge conspicuously immediately after discovery.

Clearly, the quantity t_3, the time in days that it takes a nova to decline by three magnitudes from peak brightness, depends on the passband of the observation. This annoying fact was emphasized in the classic works of Arp (1956) and of Payne-Gaposchkin (1957). The relationship between t_3 and absolute magnitude has been calibrated among others by Arp (1956) and Rosino (1964), who used blue-sensitive photographs in their work. Consequently, Hα, nearly always the strongest emission feature in nova spectra especially shortly after peak brightness, did not contribute to their measurements.

In the blue photographic band, spectra of novae are usually dominated by numerous fainter emission lines including the higher members of the Balmer series, and by the continuum, bluish in the absence of interstellar extinction. As for the dark-adapted eye most sensitive near 500 nm, it has little sensitivity at the wavelength of Hα. As a result, values of t_3 derived from visual observations should usually agree quite well with the "classical" values.

On the other hand, both CCDs and Kodak's Technical Pan emulsion have their sensitivities very close to 656 nm, the wavelength of Hα. One would suspect, therefore, that the intensity of Hα relative to the neighboring continuum would be the root of the cause for the differing behaviors of the two novae of 1998. Indeed, low-resolution spectrograms taken with a CCD and an objective prism by Liller (1998a) showed for Nova Sgr an Hα line in emission at a level $\sim$ 1.5 times brighter than the surrounding continuum, while

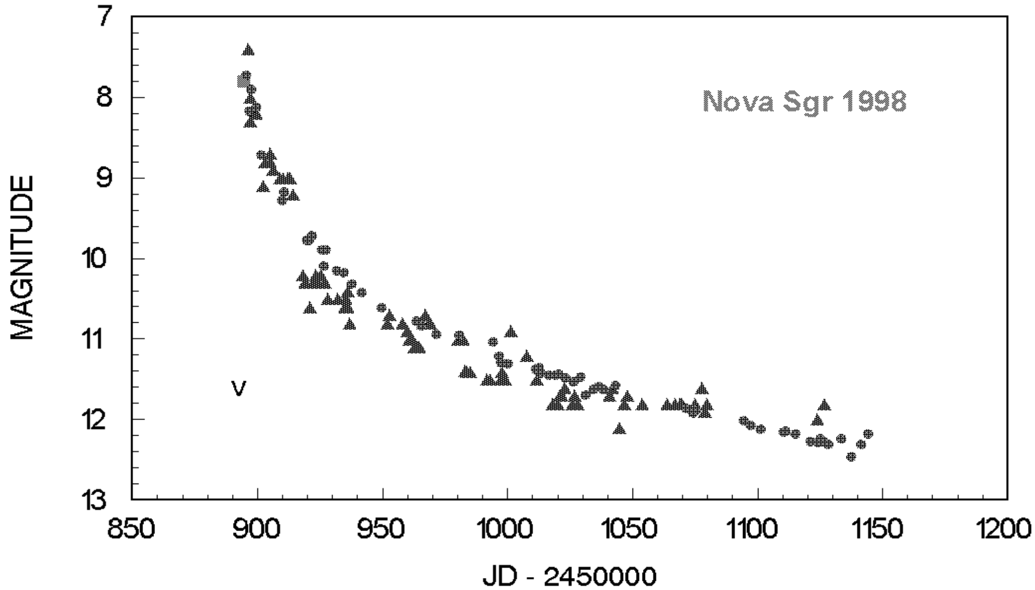

Figure 1. Light curves of Nova Sgr 1998 showing the visual magnitude estimates as triangles and the CCD broadband V observations as circles. The photographic discovery is indicated with a square; the "v" denotes a fainter-than pre-discovery observation.

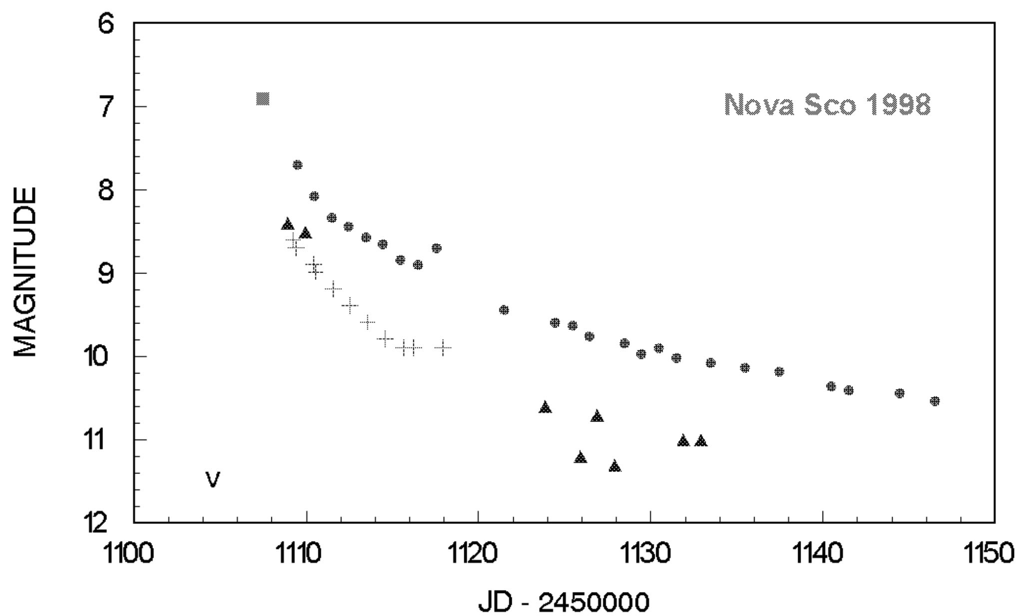

Figure 2. Light curves of Nova Sco 1998 using the same symbols as in Fig 1. Additionally, plus signs (+) indicate several estimates kindly provided by the AAVSO.

for Nova Sco, he reported a broad, intense Hα emission at a level of ~ 7.6 times brighter than the surrounding continuum (Liller 1998b).

To our knowledge there have been no reports of magnitude measurements in the R and B bands.

From our light curves we find that for Nova Sgr, $t_3 \approx 35$ and 48 from the visual and the CCD observations, respectively. For Nova Sco, we estimate $t_3 \approx 12$ and 22 days, respectively. As usual, the peak magnitudes are uncertain, but it seems probable that for Nova Sgr, discovery was made before maximum brightness. However, for Nova Sco there remains considerable uncertainty: the previously known photographs of the region were taken 4 nights before the discovery photograph, and the extrapolations of the light curves provide only a hint of what the peak magnitude might have been.

We are most indebted to Drs. Nikolai Samus and Hilmar Duerbeck for urging us to publish light curves of novae, and to Dr. Samus for reading an earlier version of this paper. It is our intention to publish more nova light curves in the near future.

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ON SEVERAL "LOST" HARVARD VARIABLES

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One of important problems connected with the catalogs of variable stars is the following. For many faint variable stars discovered decades ago, their discoverers announced only approximate coordinates, which are reproduced in the GCVS. Currently, an attempt is being made by the GCVS compilers either to identify such stars with GSC or with the USNO A1.0/A2.0 catalog or to measure their coordinates on photographs and thus to improve the positional accuracy of the GCVS to the level sufficient for straightforward positional identifications during observations. However, quite a number of variables with uncertain positions have no finding charts in the literature.

More than 13000 variable stars were discovered, mainly in the first half of the 20th century, at Harvard Observatory. Among these stars, 1087 are lacking reference to a finding chart in the GCVS, and 1570, in the NSV catalog. Many of them can be found using the Harvard plate collection, especially taking advantage of ink marks left by discoverers on discovery plates. A large fraction of the "lost" Harvard variables are stars discovered by Luyten in 1932–1937 during preparation of the Bruce Proper Motion Survey, announced in several issues of the *Astronomische Nachrichten*, and listed in his catalog (Luyten, 1938).

To estimate the amount of work needed to find or recover the majority of the "lost" Harvard variables and the chances of success, we have carried out a small pilot project. Several stars, mostly Luyten's variables in different constellations, were chosen more or less at random. Then, one of us (M.H.) found the stars on plates of the Harvard collection, and the other (N.S.) identified the stars with the GSC or with the USNO A1.0 catalog or measured the coordinates. The results for 12 stars are collected in Table 1. Its last column contains identification with the IRAS Catalog of Point Sources (Neugebauer et al., 1988). The cases of V782 Ara, NSV 08216, and V CMa are discussed in more detail below.

Table 1: The positions of Harvard variables

GCVS, NSV	HV	GSC	α(2000.0)	δ(2000.0)	Source	IRAS
V782 Ara	9018		$17^h09^m14\overset{s}{.}48$	$-52°41'02\overset{''}{.}9$	A2.0	
NSV 08216	9017	8727.1397	$17^h08^m57\overset{s}{.}65$	$-52°39'23\overset{''}{.}6$	GSC	17049–5235
DU Aqr	9727	5209.0644	$21^h43^m23\overset{s}{.}40$	$-01°06'38\overset{''}{.}9$	GSC	
V CMa	3029	7087.0114	$06^h43^m40\overset{s}{.}71$	$-31°46'56\overset{''}{.}5$	Tycho	
SY Col	8054	7613.1614	$06^h27^m49\overset{s}{.}78$	$-38°34'04\overset{''}{.}2$	GSC	06261–3832
EK Mus	8437		$12^h24^m05\overset{s}{.}60$	$-67°48'07\overset{''}{.}8$	A2.0	12212–6731
NR Pup	8104		$07^h59^m42\overset{s}{.}58$	$-50°08'34\overset{''}{.}3$	A2.0	07583–5000
UU Pyx	8153		$08^h43^m12\overset{s}{.}05$	$-33°05'45\overset{''}{.}1$	A2.0	08411–3254
V559 Sgr	9184		$18^h01^m35\overset{s}{.}3$	$-34°47'58''$	N.S.	
V429 Sco	9153		$17^h56^m39\overset{s}{.}0$	$-34°59'54''$	N.S.	
BZ Tel	9277		$18^h11^m47\overset{s}{.}05$	$-49°53'03\overset{''}{.}8$	A2.0	
GQ Vel	8268		$10^h14^m55\overset{s}{.}48$	$-41°39'23\overset{''}{.}0$	A2.0	10127–4124?

Remarks to the table:

V559 Sgr. Three faint stars are present in the Digitized Sky Survey very close to the position of the variable. The coordinates measured by N.S. refer to the position of the north-western object, better agreeing with the discovery photograph.

V429 Sco. The position of the most probable candidate measured; many stars of the neighborhood are missing in USNO A1.0/A2.0 catalogs.

V782 Ara. This variable star was discovered by Luyten (1935). In the discovery paper and in Luyten (1938), two variables at almost the same position were announced, namely HV 9017 = AN 486.1935 ($17^h01\overset{m}{.}0$, $-52°31'$, 1900.0) and HV 9018 = AN 487.1935 ($17^h01\overset{m}{.}2$, $-52°32$arcm, 1900.0). Later Hoffmeister (1963) rediscovered AN 487.1935 independently, but did not publish any details. As a large-amplitude star (16.5 to fainter than 17.5, according to Luyten), independently discovered by two authors, HV 9018 was included into the GCVS as V782 Ara; HV 9017 remains a "suspected" variable star, NSV 08216 (13.0 to 16.0, according to Luyten). However, in the absence of a finding chart, it is by no means clear which of the two stars was rediscovered by Hoffmeister.

Both variables could be found by M.H. marked on the plates near the published positions. The brighter, NSV star, associated with an IRAS point source, is strongly variable and will be included in one of the next Name-lists of variable stars. In the course of the search for these two stars, M.H. discovered a new variable approximately in one degree to the north of Luyten's position: its A2.0 (2000.0) coordinates are $17^h09^m43\overset{s}{.}562$, $-51°40'51\overset{''}{.}80$. The star is bluish ($m_{blue} = 12.4$, $m_{red} = 12.1$, color index $+0^m3$) in the USNO A2.0 catalog and very blue (negative color index) in the A1.0 catalog. However, most probably the star is a red variable with a large amplitude (at least 2 magnitudes), and its catalog color index may be due to variability on non-simultaneously-taken plates in blue and red light.

V CMa. The star was discovered by A. Cannon (Pickering, 1907) as a Mira with a 230^d period, later improved to $243\overset{d}{.}57$ by Payne-Gaposchkin (1950). Bidelman (1981) announced Me spectrum for the star, from Cerro Calan data. No finding chart was ever published. Additional confusion was introduced by the world-recognized reference source, "Geschichte und Literatur" (GuL). Thus, its first edition (Müller and Hartwig, 1918) identifies V CMa with "the southern, preceding component of a rather loose double star", whereas the second edition (Prager, 1934) says that CoD−31°3605 = CPD−31°1311 *precedes* the variable by 16″ — a rather *close* pair for the beginning of the century. The reference to magnitudes of comparison stars in the 4th volume of the GuL, 2nd edition (Schneller, 1957), is actually for V CMi, not V CMa. Harvard photographs do not show the 16″ companion of CoD$-31°3605$ (visible in the Digitized Sky Survey). The position of Cannon's variable corresponds to the description in Müller and Hartwig (1918). V CMa, identified by us with GSC 7087.0114, may also be identical to CoD$-31°3607$, but this identification is not certain due to a distortion in the CoD catalogue. Our identification of V CMa agrees with that adopted by Bidelman (1981).

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THE VARIABLE M GIANT GSC 0375-00202 ≡ V866 Her

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The variability of V866 Her (= Antipin V9 = GSC 0375-00202 = IRAS 16582+4115) has been discovered by Antipin (1994). He found a moderate amplitude and irregular variability, remarked about the star's red color on Palomar charts and reported a $12\overset{m}{.}1 \leq B_{pg} \leq 14\overset{m}{.}2$ range.

In 1995 and 1996 we obtained several spectra of V866 Her with the Padova & Asiago Astronomical Observatories' 1.82 m telescope equipped with the Boller & Chivens+CCD and Echelle+CCD spectrographs. The spectra were extracted and calibrated in a standard fashion using the IRAF† reduction package on a PC running under the Linux operating system. The journal of observations is given in Table 1.

Table 1: Journal of observations

Date	JD 2400000+	Exp. time [sec]	Resolution [Å]	Instrument
11. Mar. 1995	49787.61	20+200	18	B&C + CCD
21. Mar. 1995	49798.50	900	0.3	Echelle + CCD
22. July 1995	49921.44	240	18	B&C + CCD
15. Oct. 1995	50006.26	60+180	18	B&C + CCD
14. May 1996	50218.39	180+180	18	B&C + CCD
09. July 1996	50274.35	60+240	18	B&C + CCD

The low-resolution spectra of V866 Her, dominated by molecular absorption bands, are typical for O-rich late type giants (cf. Figure 1). A comparison with the M-giant spectra from the Silva & Cornell (1992) atlas show an excellent match to the M6III spectral type (cf. Figure 2). The continuum in the Echelle+CCD is very much the one expected from a M giant and no trace of emission lines is found (cf. Figure 3 where a comparison is made with T CrB in the Hα region).

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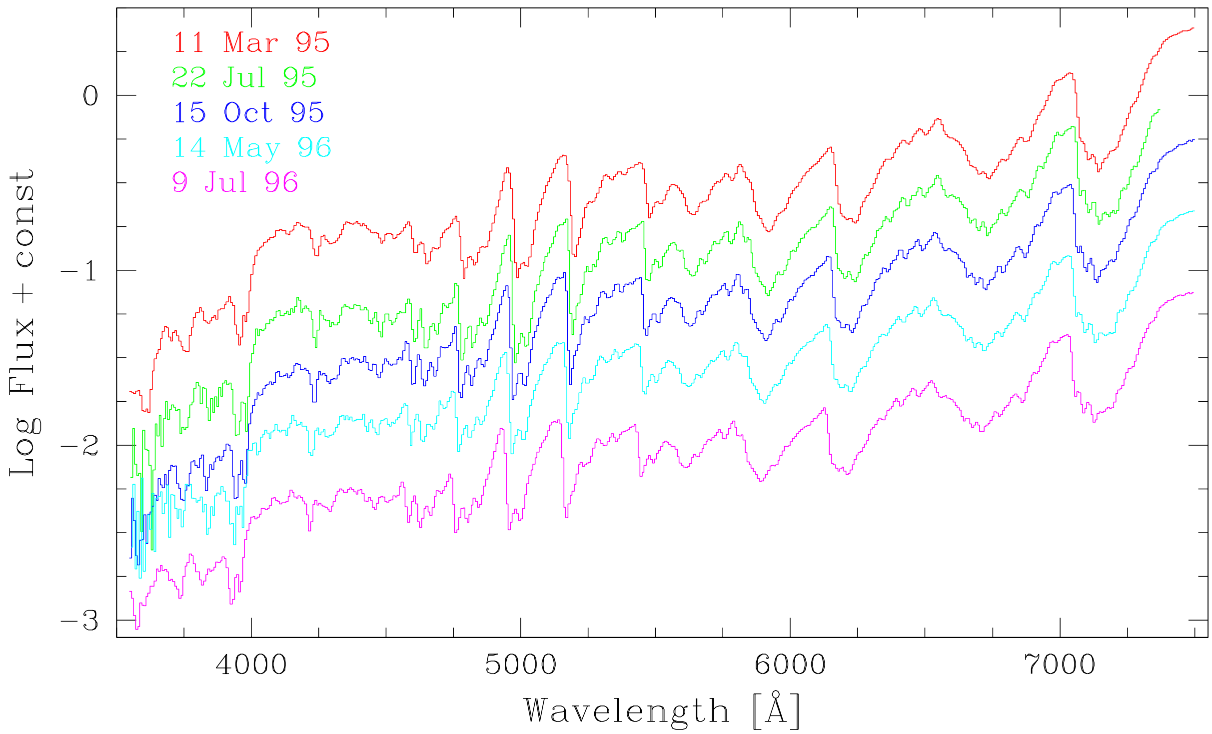

Figure 1. The low-resolution spectra of V866 Her. The dates in the up left corner are arranged from top to bottom in the same way as the spectra.

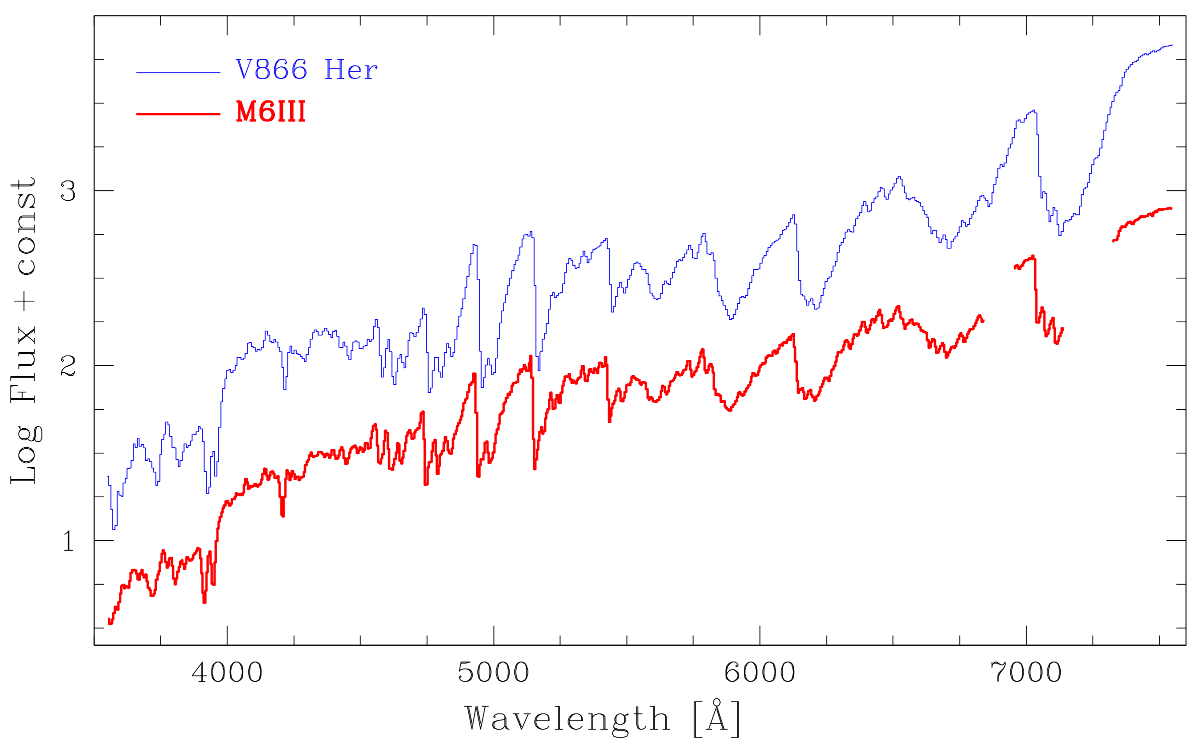

Figure 2. The spectrum of V866 Her compared to a M6III standard from Silva & Cornell (1992).

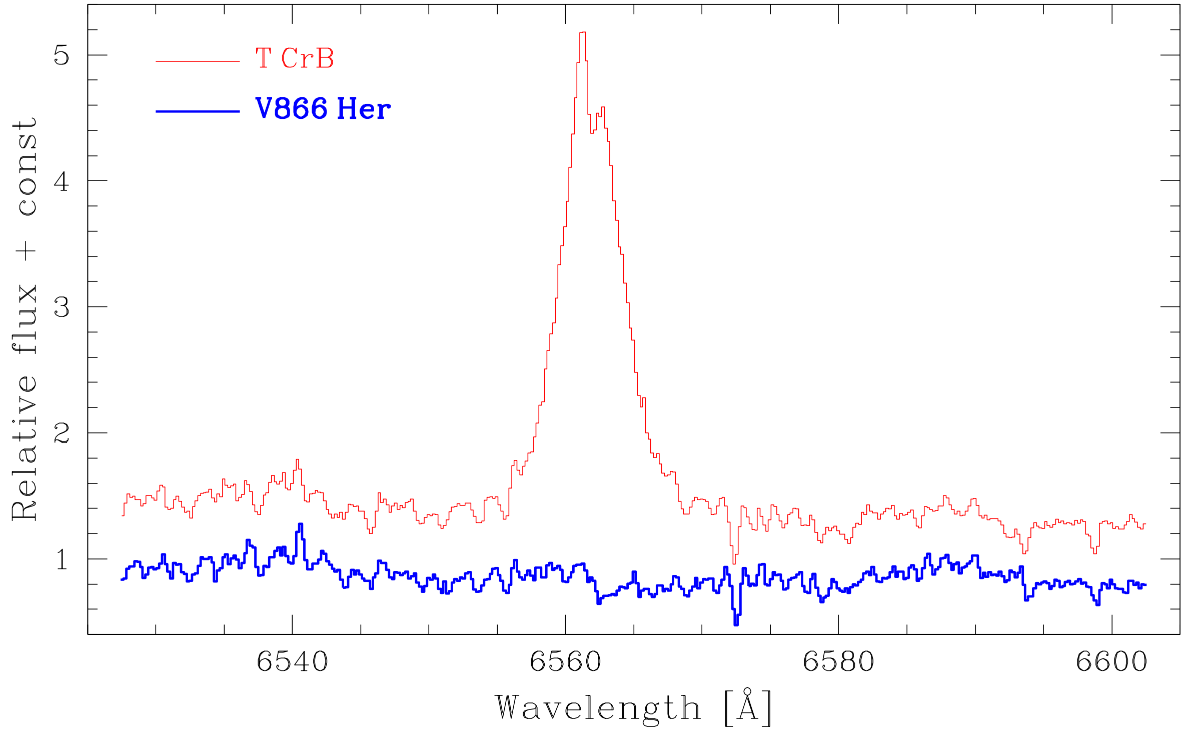

Figure 3. The Hα Echelle order for V866 Her compared to that of T CrB observed the same night. In V866 Her there is evidently no trace of even the weakest Hα in emission.

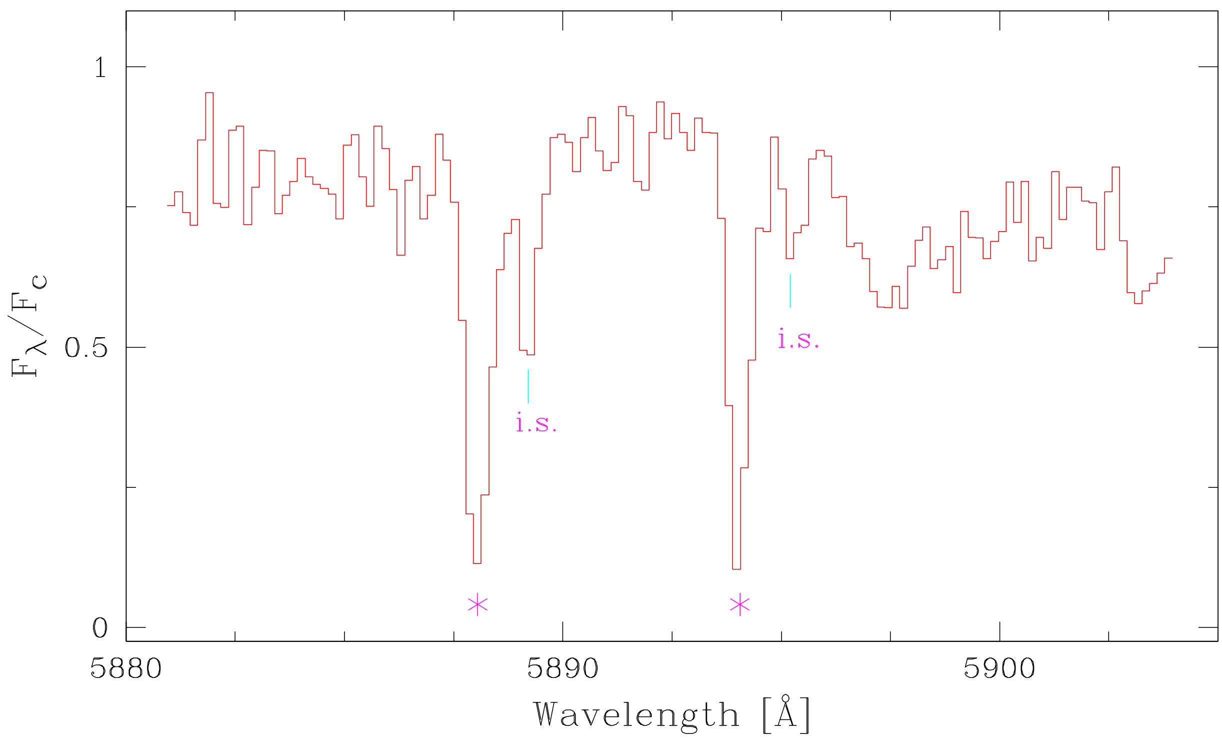

Figure 4. The NaI resonance doublet absorption lines as observed in the Echelle spectrum of V866 Her. The stellar and interstellar components are marked.

The heliocentric radial velocity of V866 Her measured on the Echelle spectrum is $RV_\odot = -84.2 \pm 0.3$ km s^{-1}, suggesting a relationship to the spheroidal galactic component. The NaI doublet shows two components (cf. Figure 4), one at $RV_\odot = -85.3 \pm 0.25$ km s^{-1} (therefore of stellar origin) and another at $V_\odot = -23.9 \pm 2.8$ km s^{-1} of a most probable interstellar origin.

The equivalent width of the interstellar NaI D absorptions in the V866 Her Echelle spectrum is 0.18 Å, which corresponds to a reddening of $E_{B-V} = 0.06$ mag according to the Munari & Zwitter (1997) calibration. It is worth to note that the Burstein & Heiles' (1982) global maps give a value $E_{B-V} = 0.0$ in the direction of V866 Her, which is evidently not the case given the presence of fairly strong interstellar NaI D lines. Combining a mean $\langle B_{pg} \rangle = 13^{\rm m}_{\cdot}0$ with a color $B-V = 1.58$ mag appropriate for a M6III and the absolute M_V magnitudes for the M giants belonging to the spheroidal galactic component ($M_V = -1.6$ mag, Frogel and Whitford 1987), a distance to V866 Her of 3.7 kpc is found. The galactic coordinates of V866 Her are $l = 65^\circ_{\cdot}54$, $b = +37^\circ_{\cdot}86$, which means a distance of $z = 2.3$ kpc from the galactic plane. The latter is typical of a galactic Halo object, in agreement with the above evidence from radial velocity. Therefore V866 Her is an old star of $M \leq 1.0 M_\odot$ mass.

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THE CARBON STAR V1965 Cyg

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V1965 Cyg is entry #2754 in the General Catalogue of Cool Carbon Stars (Stephenson, 1973), and #4347 in the Second edition of the same Catalogue (Stephenson, 1989).

Unfortunately, the star was mis-identified with the nearby Mira variable V1129 Cyg and this error propagated over many papers. Alksnis et al. (1990) and Kazarovets et al. (1990) tried to stop this confusion presenting observational evidences that V1129 Cyg and V1965 Cyg (= IRAS 19321+2757 = CGCS 4347 = RAFGL 2417 = C 2754 = NSV 12165 = IRC +30374 = CSV 4727) are indeed different objects.

V1965 Cyg has remained a poorly known object, without a devoted investigation in literature. We obtained low-resolution spectra of it in 1994, 1995 and 1997, and one Echelle spectrum in 1997. The low-resolution observations were secured with the Boller & Chivens+CCD ($R \sim 18$ Å) spectrograph of Padova & Asiago Astronomical Observatory 1.82 m telescope. The high-resolution spectrum was obtained with the Echelle+CCD ($R \sim 0.3$ Å) spectrograph at the same telescope. The spectra were extracted and calibrated in a standard fashion using the IRAF† reduction package running on a PC under Linux operating system. The journal of observations is given in Table 1.

Table 1: Journal of observations

Date	JD 2400000+	Exp. time [sec]	Resolution [Å]	Instrument
10. Dec. 1994	49697.28	45+720	18	B&C+CCD
15. Oct. 1995	50006.29	120+420	18	B&C+CCD
13. Nov. 1997	50766.26	1590	0.3	Echelle+CCD
20. Nov. 1997	50773.26	1500	18	B&C+CCD

The low-resolution spectra of V1965 Cyg are shown in Fig. 1 and the Hα order of the high-resolution one in Fig. 2. Both high- and low-resolution spectra show absorption lines and bands of a carbon star. In the Boller & Chivens spectra the strongest absorption feature is the blend of the NaI resonance doublet at 5889.953 Å and 5895.923 Å. The

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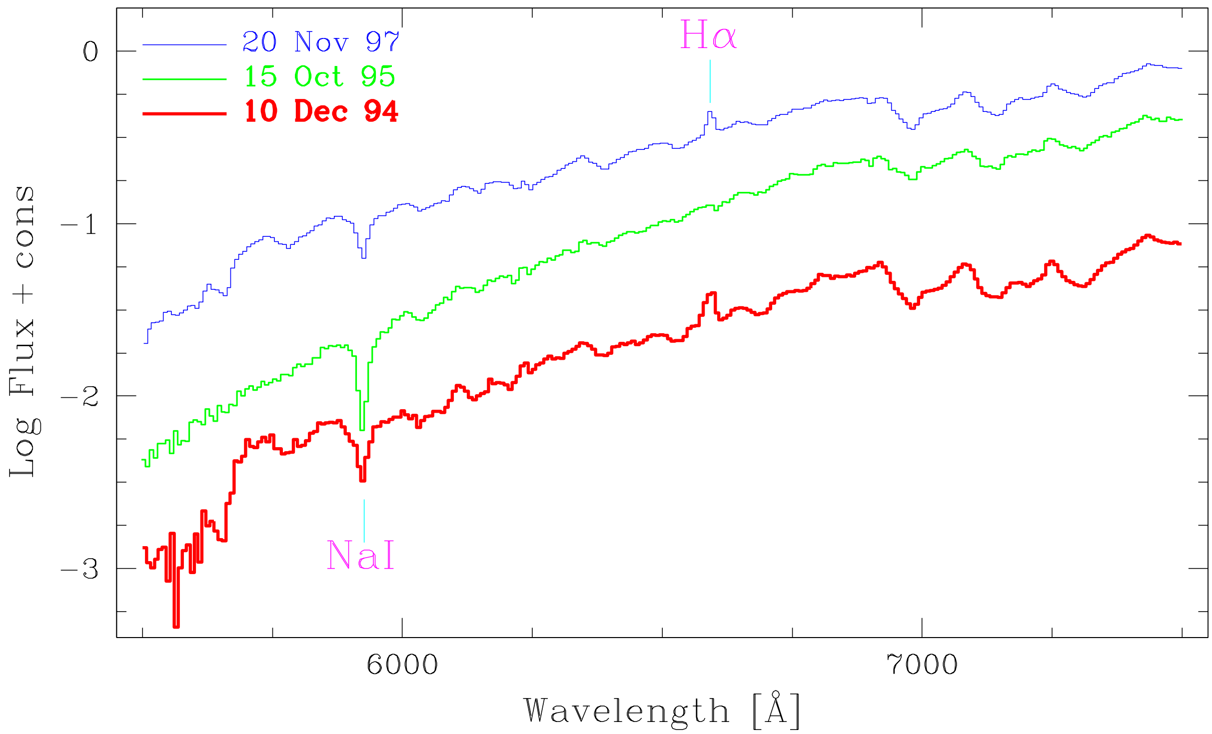

Figure 1. Flux calibrated Boller & Chivens spectra of V1965 Cyg.

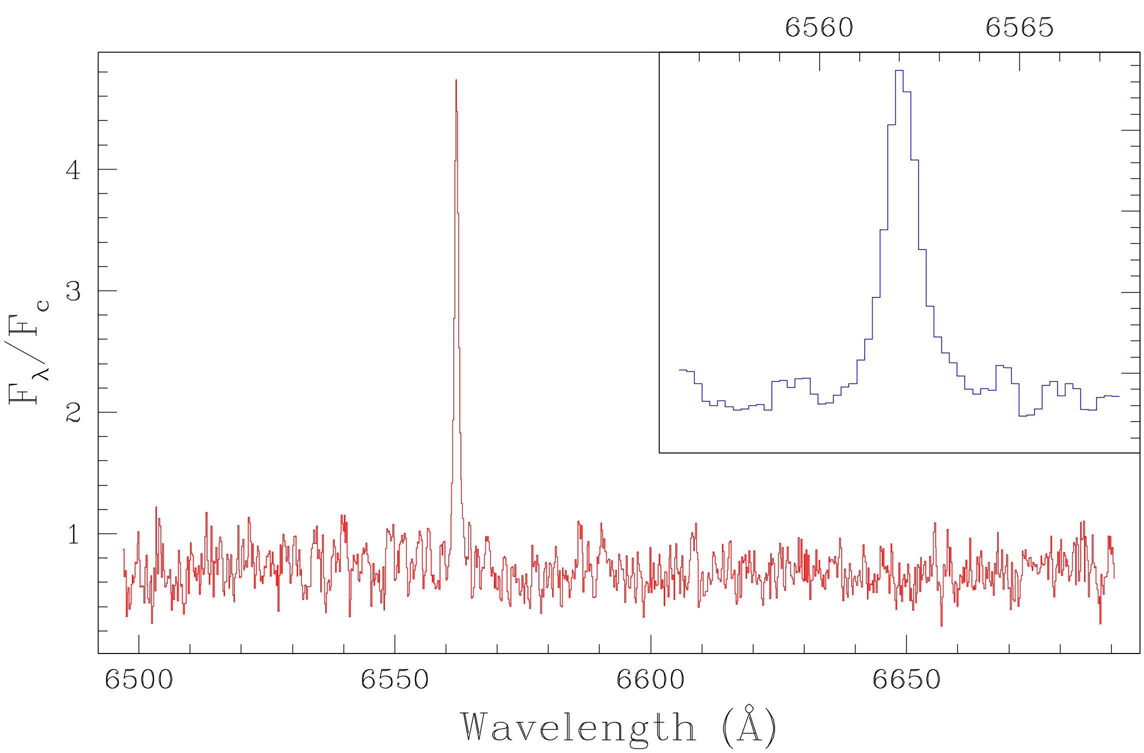

Figure 2. Hα order in the Echelle spectrum of V1965 Cyg (Nov 13, 1997).

most remarkable change in the low-resolution spectra of V1965 Cyg is the Hα that was in emission in 1994 and 1997 and absent in 1995. When the Hα was not in emission, the carbon absorption features retraced and the continuum appeared smoother. The integrated Hα flux is 1.7×10^{-13} on the Dec. 10, 1994 spectrum and 1.3×10^{-13} erg cm^{-2} s^{-1} on the Nov. 20, 1997 one.

The high-resolution spectrum of V1965 Cyg shows a sharp and moderate intensity Hα emission line with a symmetrical profile, whose FWHM is $\sim$0.9 Å (the FWHM of the instrumental PSF on night-sky lines is $\sim$0.3 Å) and the heliocentric radial velocity is -54.0 km s^{-1}.

Our observations are indeed not enough to address the issue on the nature of V1965 Cyg. They however document remarkable spectroscopic changes (affecting both the emission lines and the continuum) that could motivate a long term devoted photometric and spectroscopic monitoring. If the photometric behavior should not match that of a pulsating variable, the presence of Hα in emission and its large variability could suggest an interacting binary nature for V1965 Cyg.

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V335 Vul = AS 356: A CARBON SYMBIOTIC BINARY?

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Merrill & Burwell (1950) were the first to notice the unusual nature of V335 Vul (= IRAS 19211+2421 = GSC 2128–00676). They reported an N or S continuum with the Hα in emission (MHα 215-33). As a carbon star (Case 452) the object appeared in the Nassau & Blanco (1957) catalog and later in the Stephenson (1973) General Catalogue of Cool Carbon Stars (C 2728). Collins (1991) reported a variability in the range 10.1–12.7 mag (unfiltered TP2415 sensitivity interval), and Kazarovets et al. (1993) classified V335 Vul as a semi-regular variability. Finally, Skiff & Williams (1997) identified the variable # 120 in the list by Dahlmark (1993) as V335 Vul. Little is known about the overall properties of V335 Vul, particularly about the spectroscopic ones.

We obtained low-resolution spectra of V335 Vul in 1993 and 1997, and a high resolution one in 1998 (cf. the journal of observations in Table 1). The low-resolution observations were secured with the Boller & Chivens+CCD spectrograph mounted on the 1.82 m telescope of the Padova & Asiago Astronomical Observatories. The high-resolution spectrum was obtained with the Echelle+CCD spectrograph on the same telescope. The spectra were extracted and calibrated in a standard fashion using the IRAF† software package. All observations were performed in non-perfect photometric conditions. Therefore the slope of the B&C spectra are indeed accurate, but the zero point in Figure 1 is arbitrary. The parts of the Echelle spectrum in Figures 2 and 3 are in relative fluxes.

Our spectra confirm the presence of a carbon giant in V335 Vul, with bands of carbon molecules dominating the continuum of B&C spectra. The Echelle spectrum is quite characteristic of carbon stars too: it appears extremely "spiky" in spite of the intrinsic high S/N ratio and the NaI doublet (at 5889.953 and 5895.923 Å) is in remarkably strong and wide absorption.

The two B&C spectra in Figure 1 document spectacular spectroscopic changes. The most remarkable one is the appearance in 1997 of Balmer lines in strong emission together with a hot continuum in the blue. Balmer lines were in emission at the time of the Merrill & Burwell (1950) discovery but not when we observed V335 Vul in 1993. This behavior suggests that V335 Vul is a binary star where the carbon giant is orbited by a hot companion whose temperature and/or luminosity varies remarkably in time.

The Hα profile in the expanded plot in Figure 2 is very similar to that shown by symbiotic binaries (Oliversen & Anderson 1982, Munari 1993), with marked blue asymmetry or

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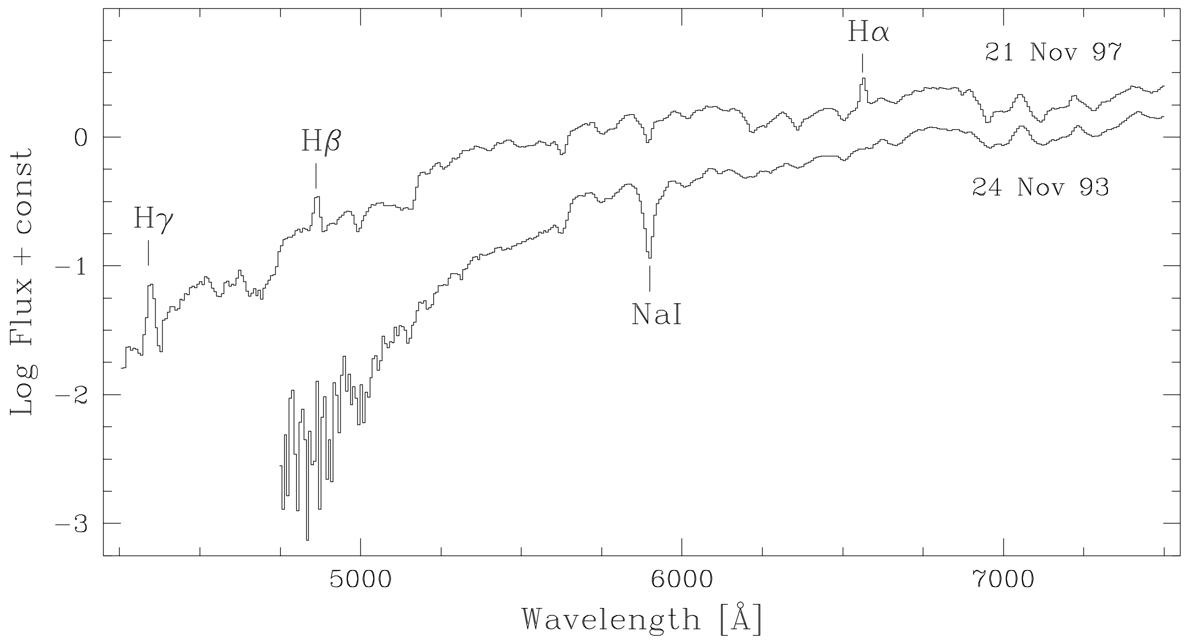

Figure 1. Boller & Chivens spectra of V335 Vul.

Table 1: Journal of observations

Date	JD 2400000+	Exp. time [sec]	Resolution [Å]	Instrument
24. Nov. 1993	49316.22	60+360	18	B&C + CCD
21. Nov. 1997	50774.22	30+300	16	B&C + CCD
08. Aug. 1998	51034.36	900	0.25	Echelle + CCD

with a blue shifted absorption component causing the Hα profile to appear double-peaked (again it is useful to remind the reader that the apparently noisy spectrum is indeed a manifestation of the carbon continuum, the S/N ratio of the continuum being around 95). It may be anticipated by analogy with symbiotic binaries that prolonged monitoring of V335 Vul should reveal changes in the emission line profiles, changes that should repeat in phase with the orbital motion (cf. Munari 1988, outburst-like activities aside).

The heliocentric radial velocities in the Echelle spectrum are -15 and -1 km s^{-1} (± 7.0 km s^{-1}) for the Hα emission and the NaI $D_{1,2}$ absorption, respectively. Given the probable binary nature of V335 Vul, such radial velocities should vary in time and trace the orbital motion. The emission line flux ratio in the 1997 B&C spectrum is $H\alpha/H\beta/H\gamma =$ 1.0/0.18/0.37. The large $H\alpha/H\beta/H\gamma$ ratio is pretty similar to what normally observed in symbiotic stars, and reinforce the link of V335 Vul with this class of interacting binaries.

V335 Vul would be a fully flagged symbiotic star (according to the generally accepted definition by Allen 1984) if He II or higher ionization emission lines would be detected in the spectra. The absence of a *true* continuum in the high resolution spectra of carbon stars and the extreme crowding of absorption lines (which overlapping eventually mimics a forest of emission lines), make detection of moderate or weak emission lines very difficult (in Figure 2 a 3-times weaker Hα could have escape detection on a cursory inspection). Therefore specifically devoted observations are necessary to detect the He II, He I and

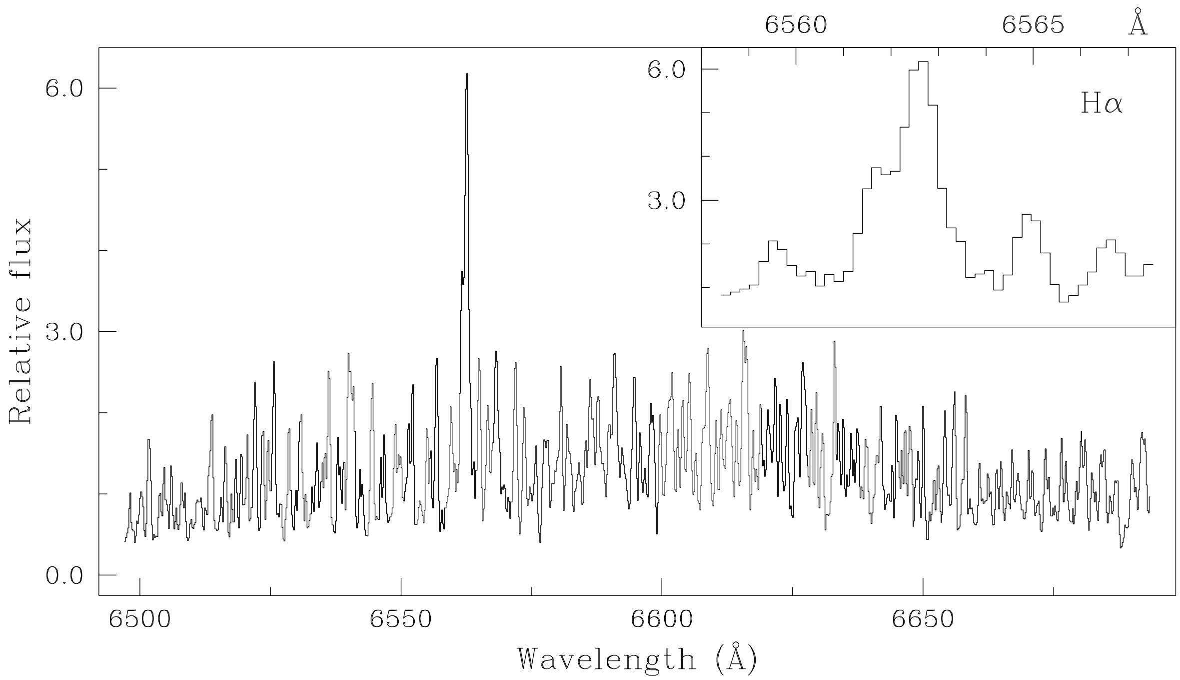

Figure 2. Hα order of the Echelle spectrum of V335 Vul. The enlarged Hα profile is shown in the inset.

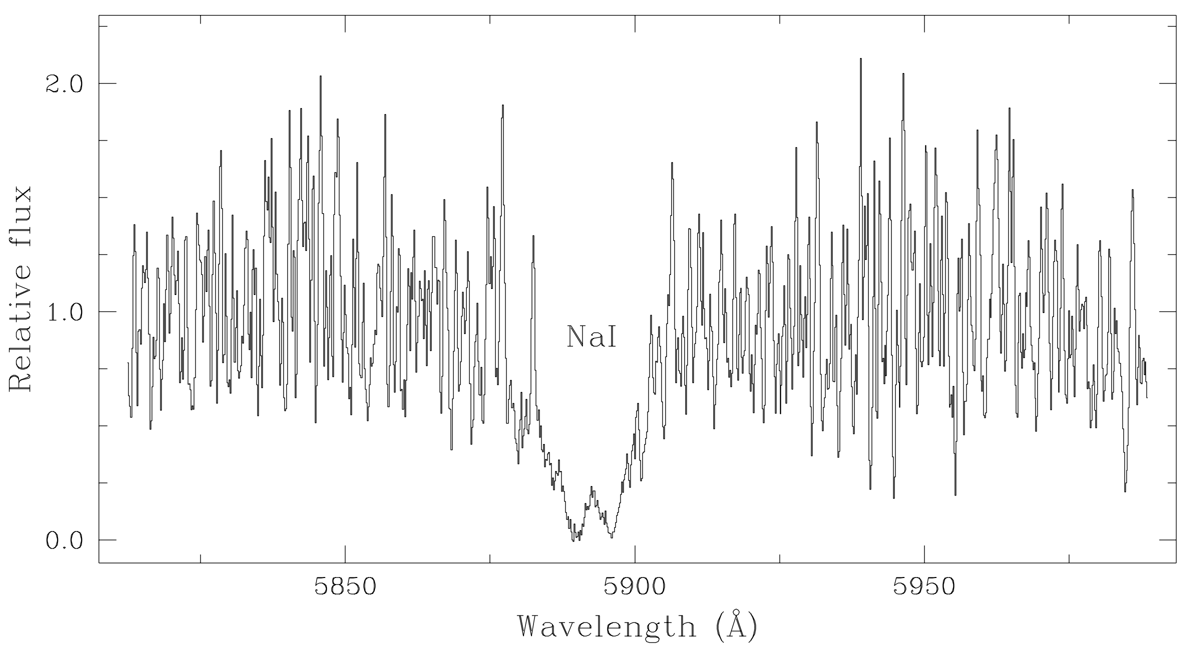

Figure 3. NaI order of the Echelle spectrum of V335 Vul.

[OIII] emission lines that are normally observed in symbiotic stars.

Devoted, repeated and high-resolution observations are clearly in order to document the binary nature, derive the orbital parameters and monitor the activity of the hot component. If V335 Vul should turn out to be a genuine symbiotic star this would be an interesting result because of the paucity of carbon symbiotic stars known in our Galaxy. In the latter only ∼1% of all known symbiotics harbor a carbon giant, whereas in the LMC, SMC and Draco satellite galaxies the vast majority of symbiotic stars are indeed carbon stars.

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V473 Cas: FIRST ELEMENTS AND LIGHTCURVE

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V473 Cas = SON 8461 = GSC 3679-1417 was discovered by Hoffmeister (1964) on photographic plates of the Sonneberg Observatory. He classified the star as a short-period variable with a photographic magnitude range of 13.5–14.0. A first follow-up investigation was performed by Gessner and Meinunger (1973). On the plates of the Sonneberg astrograph (400/1600 mm and 400/1950 mm) they found six (partly uncertain) minima in the period between JD 2438286 and JD 2438328 (42 days) which were insufficient for determining a period. Nevertheless they classified the star as an eclipsing binary and gave the photographic magnitude range as 13.4–14.0. This is the information given for V473 Cas in the fourth edition of the GCVS (Kholopov et al. 1985).

About 15 years after Gessner and Meinunger we put V473 Cas on our observing program, after a photographic minimum had accidentally been found by Peter Frank in a series of photographs aimed at V470 Cas. Our subsequent CCD observations were made with an SBIG ST6 camera without filters, attached to a 32-cm Ritchey-Chretien telescope with $f = 1740$ mm (Wolfgang Moschner), and with an OES-LcCCD 11 camera without filters, attached to a 30cm flatfield camera with $f = 576$ mm (Peter Frank). The integration times were 60 seconds at both telescopes. The CCD observations cover 3 years. GSC 3679-2081 served as the comparison star; several other stars in the same field were used to check its constancy.

V473 Cas turned out to be a β-Lyr-type eclipsing binary (see Fig. 1). In the instrumental system of the ST6 camera the amplitude of variability is 0.85 mag for the primary minima and 0.30 mag for the secondary minima. From 17 individual nightly CCD series we determined moments of primary minima, using the method of Kwee and van Woerden (1956). They are listed in Table 1.

Using the 17 CCD minima, a weighted least-squares fit led to the following elements:

$$\begin{array}{l}\text{Min. I} = \text{JDhel } 2450334.4400 + 0\overset{\text{d}}{.}41546073 \times E. \\ \qquad\qquad\qquad\qquad\qquad\pm 2 \qquad\qquad\quad \pm 4\end{array}$$

In addition to the CCD observations, one of us (Wolfgang Moschner) investigated the variable on about 320 photographic plates of the 0.4-m astrographs of the Sonneberg Observatory. Twenty additional times of minimum light could be found in this way, from

Table 1: Observed times of minima for V473 Cas

No.	Observer	Type	Weight	JD hel.	O−C	Ref.
1	W. Moschner	P	0	29086.4960	−0.0359	this paper
2	W. Moschner	P	0	29106.4170	−0.0570	this paper
3	W. Moschner	P	0	29108.5170	−0.0343	this paper
4	W. Moschner	P	0	29553.4580	−0.0517	this paper
5	W. Moschner	P	0	30259.5120	−0.0733	this paper
6	W. Moschner	P	0	36604.2810	−0.0128	this paper
7	W. Moschner	P	0	38044.2840	+0.0033	this paper
8	I. Meinunger	P	0	38286.4970	+0.0027	VSS 7
9	W. Moschner	P	0	38291.4910	+0.0112	this paper
10	I. Meinunger	P	0	38296.4670	+0.0017	VSS 7
11	I. Meinunger	P	0	38318.4830	−0.0048	VSS 7
12	I. Meinunger	P	0	38322.6190	−0.0018	VSS 7
13	I. Meinunger	P	0	38325.5390	−0.0204	VSS 7
14	W. Moschner	P	0	38327.6310	+0.0061	this paper
15	I. Meinunger	P	0	38328.4440	−0.0118	VSS 7
16	W. Moschner	P	0	38339.2360	−0.0218	this paper
17	W. Moschner	P	0	38343.4280	+0.0156	this paper
18	W. Moschner	P	0	38372.5010	+0.0063	this paper
19	W. Moschner	P	0	38640.4430	−0.0238	this paper
20	W. Moschner	P	0	39054.4780	+0.0045	this paper
21	W. Moschner	P	0	39063.3790	−0.0269	this paper
22	W. Moschner	P	0	39414.4550	−0.0152	this paper
23	W. Moschner	P	0	40127.4190	+0.0182	this paper
24	W. Moschner	P	0	45607.3480	+0.0202	this paper
25	W. Moschner	P	0	45940.5400	+0.0127	this paper
26	W. Moschner	P	0	46685.4560	+0.0076	this paper
27	P. Frank	F	5	47776.4540	+0.0057	this paper
28	P. Frank	E	5	50043.4058	−0.0040	this paper
29	P. Frank	E	5	50043.6116	−0.0059	this paper
30	W. Moschner	E	10	50330.4931	+0.0000	this paper
31	W. Moschner	E	10	50332.5719	+0.0015	this paper
32	W. Moschner	E	10	50334.4400	+0.0000	this paper
33	W. Moschner	E	10	50368.3019	+0.0019	this paper
34	W. Moschner	E	10	50369.3390	+0.0003	this paper
35	W. Moschner	E	10	50376.3968	−0.0047	this paper
36	F. Agerer	E	10	50465.3090	−0.0011	this paper
37	P. Frank	E	10	50604.4905	+0.0010	this paper
38	P. Frank	E	10	50652.4836	+0.0084	this paper
39	W. Moschner	E	10	50668.4700	−0.0004	this paper
40	P. Frank	E	10	50672.4121	−0.0052	this paper
41	P. Frank	E	10	50673.4566	+0.0006	this paper
42	W. Moschner	E	10	50685.5020	−0.0023	this paper
43	W. Moschner	E	5	51041.5544	+0.0002	this paper
44	W. Moschner	E	10	51079.3588	−0.0023	this paper

Notes to Table 1: O−C residuals were computed with respect to the elements derived in this paper. In the third column, "P" denotes minimum light on a single photographic plate, "F" a minimum time derived from a dense series of photographic plates, and "E" a minimum time from a dense series of CCD measurements. The fourth column lists the weights used in the least-squares adjustment for the elements. In the last column, "VSS 7" is an abbreviation for Gessner & Meinunger (1973). Minima nos. 38 and 40 are secondary minima, all others are primary minima.

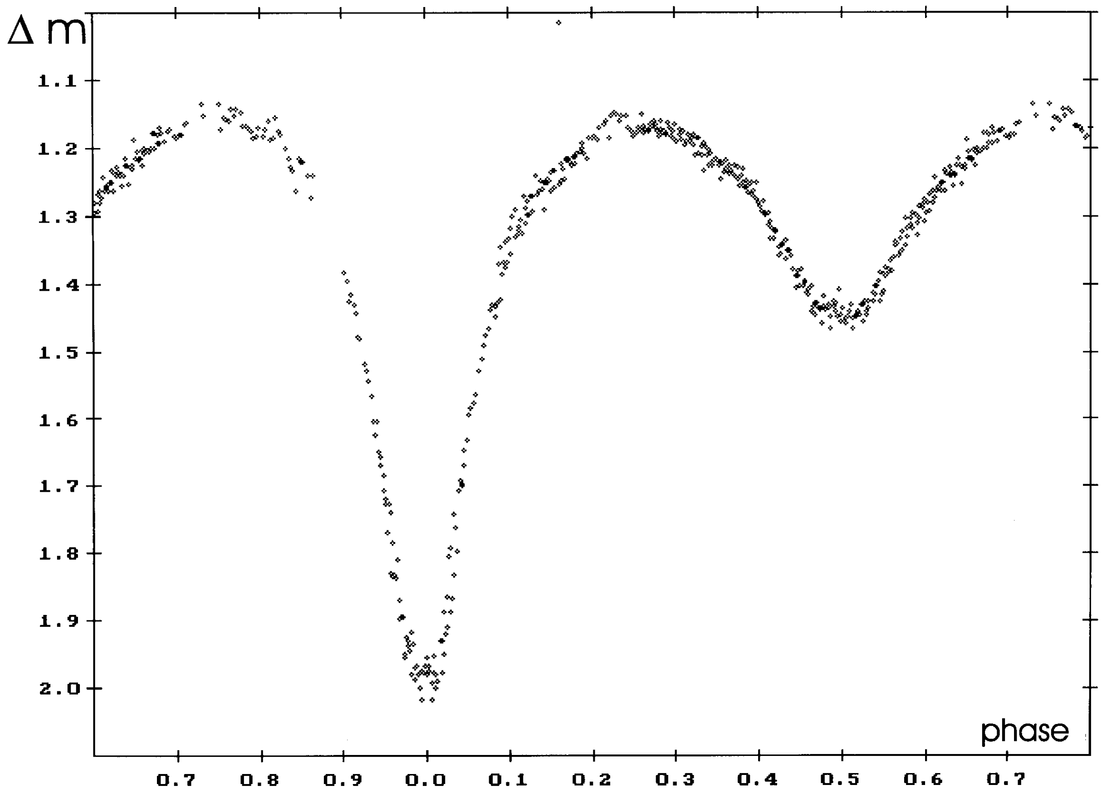

Figure 1. Folded differential lightcurve of V473 Cas.

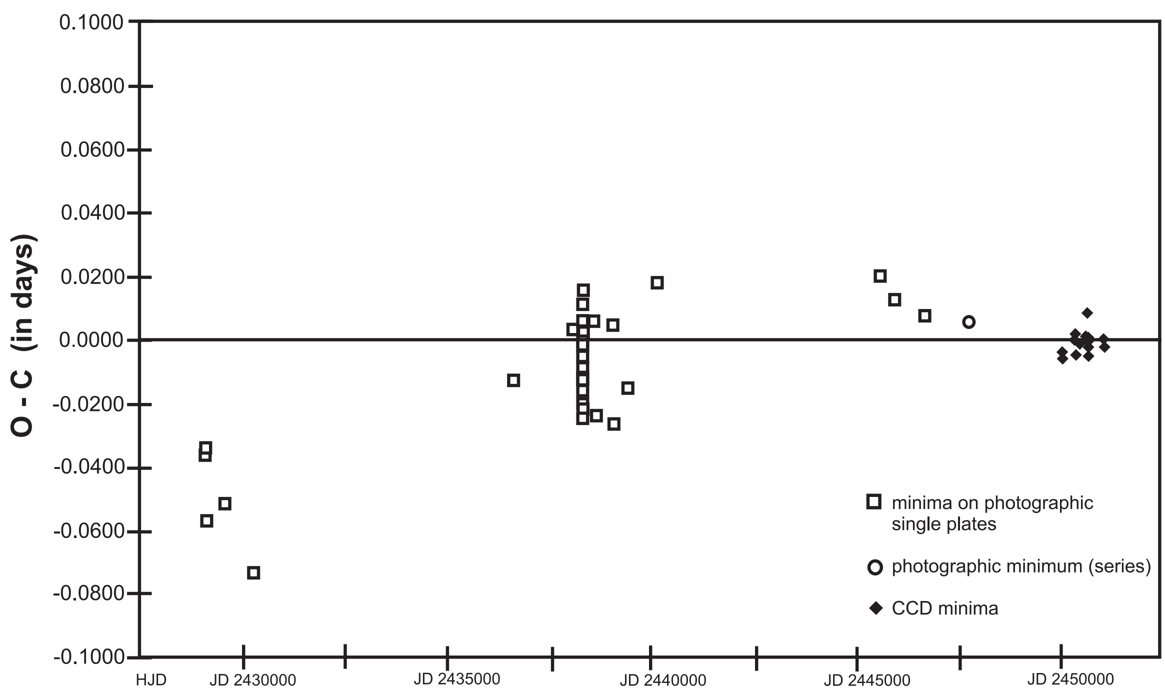

Figure 2. O–C diagram for V473 Cas using the elements derived in this paper.

plates taken between JD 2429086 and JD 2446685. They are listed in Table 1. Residuals from the least-squares fit are listed in Table 1 and displayed in the O−C diagram, Fig. 2, both for the CCD minima which were used for the fit, and for the photographic minima which were not used. A small decrease in the period around or before JD 2438000 is indicated in Fig. 2.

Acknowledgements: We thank for help and assistance by the management and staff of Sonneberg Observatory, especially by Dr. Peter Kroll in using the library and plate archive. This research made use of the SIMBAD data base, operated by the CDS at Strasbourg, France.

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Kwee, K.K., van Woerden, H., 1956, *Bull. Astron. Inst. Netherlands*, **12**, 32

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PHOTOELECTRIC TIMES OF MINIMA OF SOME ECLIPSING BINARY SYSTEMS

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We present 27 photoelectric minima observations of 11 eclipsing binary systems which was observed during several seasons and most of them are part of the complete light curve coverages. All observations were obtained with the 30 cm Maksutov telescope at the Ankara University Observatory. Differential observations were secured by using an OPTEC SSP-5A photometer head which contains a side on R-1414 Hamamatsu photomultiplier. The filters used are in close accordance with the standard Johnson's UBV and reductions of the observations have been performed in the usual way (Hardie, 1962).

The moments of minima and their standard errors for each filter were calculated by using the well known method of Kwee & van Woerden (1956). Weighted average values of times of minima of the observed systems are given in Table 1, together with their minimum types, filters and observers. Weighted averages and their mean errors for the minima times in different filters were calculated with the formula given in Gürol & Selam (1994).

This work was partially supported by TÜBİTAK-BAYG under the project no. 1369 "Photoelectric Photometry of some Interacting Binary Stars".

References:

Gürol, B. & Selam, S., 1994, *IBVS*, No. 4109

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

Table 1: Times of minima of observed systems

System	Min HJD 2400000+	Mean error	Min type	Filter	Observers (*)
V346 Aql	51040.33918	0.00025	I	BV	My
	51041.44680	0.00025	I	BV	My
SS Ari	50393.43951	0.00096	II	UBV	Gr
	50729.38661	0.00169	I	UBV	Sl
LS Del	50301.47825	0.00145	II	BV	My
	50731.34013	0.00172	I	BV	Sl
	50758.27261	0.00091	I	BV	Gr
YY Eri	50758.42113	0.00058	I	BV	Gr
	50759.54675	0.00032	II	BV	Gr
RX Her	50259.38072	0.00078	II	UBV	Gr
AK Her	50259.45353	0.00054	I	UBV	Sl
SW Lac	50647.37854	0.00032	I	UBV	My
	50649.30233	0.00057	II	BV	My
	50649.46731	0.00106	II	UBV	My
UV Psc	50715.52658	0.00114	II	BV	Sl
	50731.45062	0.00042	I	BV	Sl
W UMa	50505.53455	0.00042	II	UBV	Gr
	50511.37119	0.00024	I	UBV	Sl
AW UMa	50476.40952	0.00141	II	UBV	Sl
	50477.50777	0.00081	I	UBV	Gr
HW Vir	50155.39460	0.00005	I	BV	Gr
	50155.51190	0.00007	I	BV	Gr
	50491.43000	0.00006	I	BV	Gr
	50491.48860	0.00009	II	B	Gr
	50491.54670	0.00005	I	BV	Gr
	50511.50570	0.00004	I	BV	Sl
	50511.56360	0.00021	II	V	Sl

(*) Observers:
Gr: B. Gürol, My: Z. Müyesseroğlu, Sl: S. O. Selam

ERRATA

In IBVS No. 4380 we were presented photoelectric minima times of several eclipsing binary systems. We explore some mistakes in References and Table 1 due to the typing errors. The corrections are as follows:

- *page 1, References:* The IBVS number of the first reference should read as 4109 instead of 4027
- *page 2, Table 1:* the 3rd moment of minimum of V1073 Cyg should read as 47776.3453 instead of 47767.3453
- *page 4, Table 1:* the name of the star V456 Oph was missing in the 1st column, 2nd row of the table. This row should read as

  V456 Oph 50269.3834 0.0002 I BV My

- *page 4, Table 1:* the minimum time of TX UMa should read as 49804.4848 instead of 49804.4760

Z. Müyesseroğlu, B. Gürol, S. O. Selam

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NEW VARIABLE IN CYGNUS

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Equatorial coordinates:	**Equinox:**
R.A.= $19^h28^m57\overset{s}{.}9$ **DEC.**= $43°06'25\overset{''}{.}5$	2000

Observatory and telescope:
Crimean Astrophysical Observatory, 38-cm telescope

Detector:	CCD ST-7
Filter(s):	Close to R (Johnson)
Comparison star(s):	See Fig. 1
Transformed to a standard system:	No

Availability of the data:
Upon request

Type of variability:	Yet unknown

Remarks:
A new variable was found while making photometric observations of the cataclysmic variable V1504 Cyg during August 3–5 and September 25–26 in 1998. The exposure time was 90 s in Aug. and 100 s in Sept. A typical error of 3% in a single observations was estimated every night. The total exposure was about 21 hours. The frequency analysis yields the most significant period of light variations $P = 0.17505 \pm 0.00003$ d (Fig. 3). Mean light curve is constructed using the ephemeris and zero phase epoch $HJD_0 = 2451029.5207 + 0\overset{d}{.}17505 \times E$ (Fig. 4). The new variable can be either a W UMa type star with an orbital period of 0.3501 d, or a δ Sct type star.

Acknowledgements:
The author would like to thank Drs. I. Pustylnik, N. Samus and A. Lynas-Gray for helpful discussion and comments, V. Goransky for help in observations, and V. Rumiantsev for determination of coordinates of the new variable.

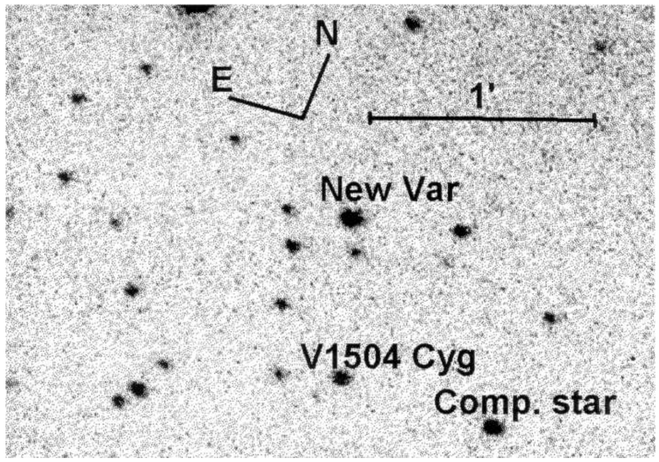

Figure 1. The finding chart for the new variable

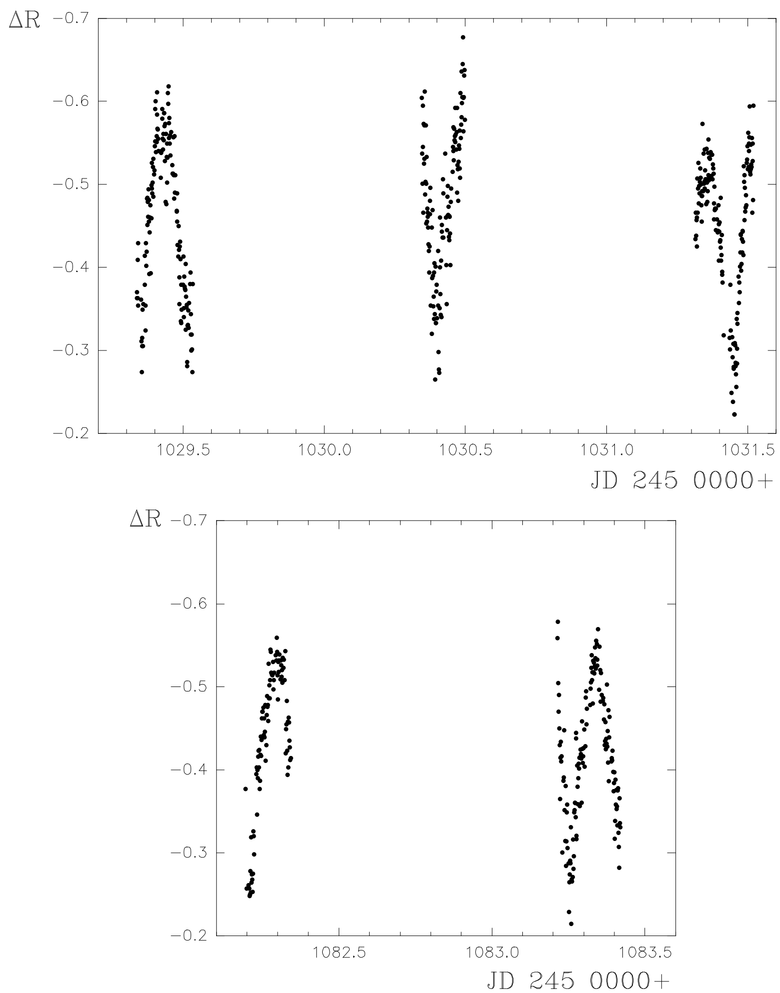

Figure 2. The original light curve for all data, obtained in August (upper panel) and September (lower panel) 1998

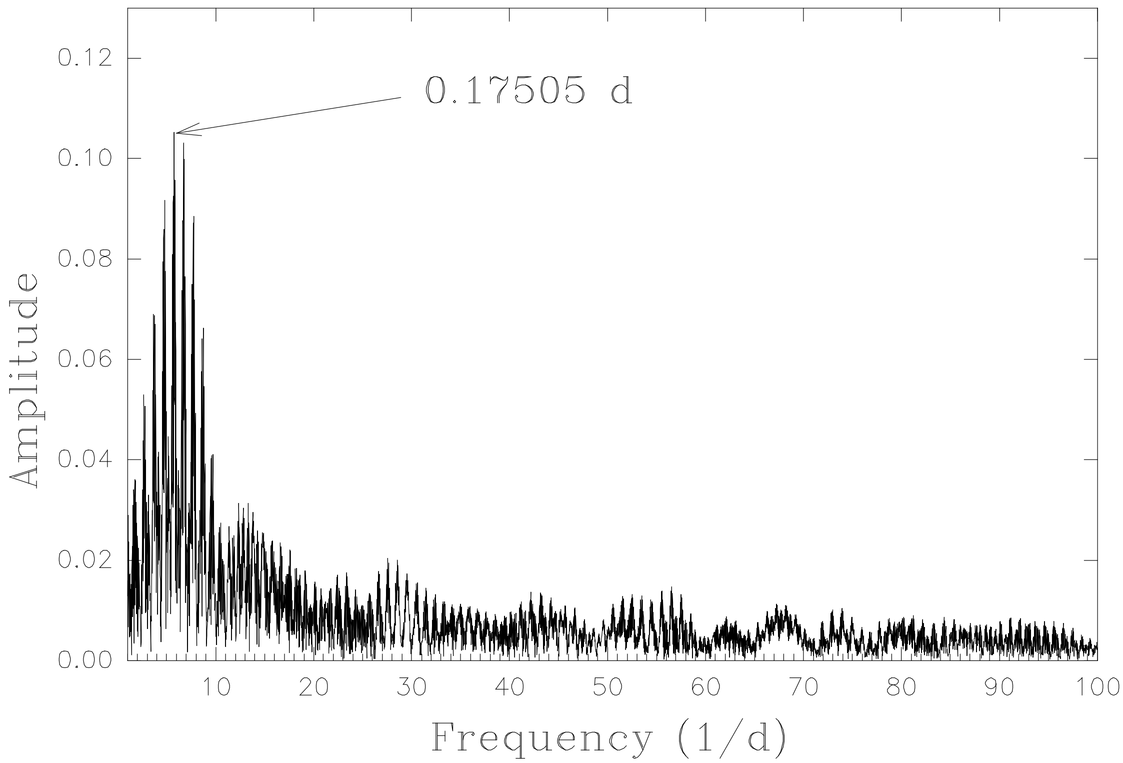

Figure 3. The periodogram of all data

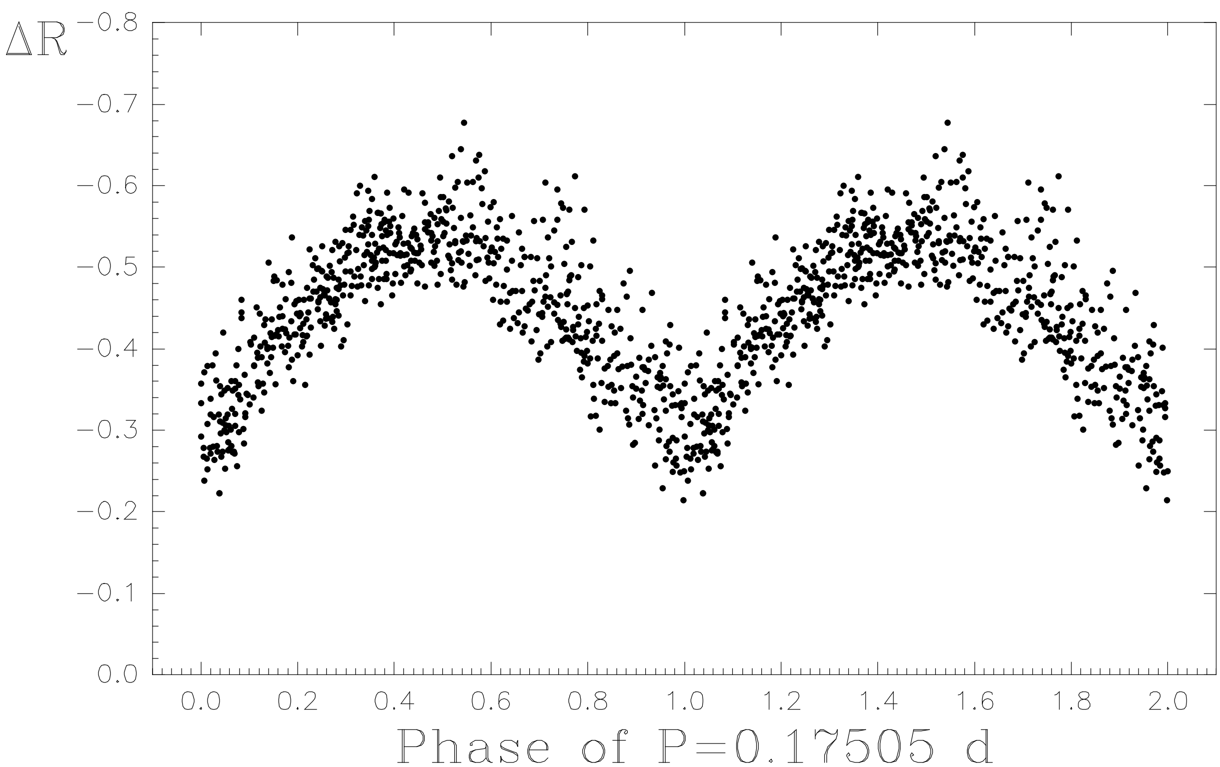

Figure 4. The mean light curve of the new variable

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"ANTI-HUMPS" IN THE DWARF NOVA RZ LEONIS

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In this article we report the discovery of "anti-humps" in the quiescence light curve of RZ Leo. This is a rather atypical phenomenon in dwarf novae, and we urge for more observations to fully clarify this new view. A complete long-term observational study of RZ Leo including the observations reported here is in preparation.

The long-cycle length dwarf nova RZ Leonis Majoris was observed in early 1998 at the 0.92 m DUTCH telescope of the ESO La Silla Observatory. 300-s integration CCD images, obtained through the V filter were reduced in the standard way using the astronomy package *IRAF*[†]. Instrumental magnitudes were extracted using the *IRAF phot* aperture photometry package. Differences between variable, comparison and check stars were calculated and then shifted to an absolute scale using the star for which $V = 14.201$ is given by Misselt (1996). This star was also used as comparison, and a fainter star, of similar brightness to RZ Leo, was used as check. In these conditions the variance of the differences of the check star provides a good estimate of the expected variance (instrumental) of the RZ Leo light curve. Observations are summarized in Table 1.

Figure 1 shows the differential light curves folded with the period $0\overset{d}{.}0756$ (Mennickent & Sterken 1999). The evolution of the hump is singular. It starts as a $0\overset{m}{.}15$ absorption feature (07/01/98), then disappears from the light curve (11/01/98 and 06/02/98) and then re-appears like a small wave (07/02/98) and fully developed symmetrical hump (18/03/98 and 19/03/98). Secondary humps are also visible, with amplitude roughly 60% of the main hump amplitude. On February 7 a secondary absorption hump is also visible, along with the main absorption feature. These "anti-humps" appear at the same phases where normal humps develop one month later. A close inspection of the data of February 7 reveals an alternative interpretation: the observed minima could define the base of the humps. We have rejected this point of view for three reasons:

1. it does not fit the ephemeris, indicating a possible shift of the hump maximum by about 0.2 cycles
2. the peak-to-peak distance between main and secondary maxima should be 0.3 cycles instead of 0.5 cycles, which is observed on the other 3 nights and
3. the amplitude of secondary maximum should be about 80% of the main peak, contrasting with a value of 60% observed on the other nights.

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

Table 1: Journal of observations. N is the number of science frames per night. HJD is the heliocentric Julian day at the start of the night, referred to the zero point 2 440 000. The variance of the differences between check and comparison star is given (in hundredths of magnitude).

Date (UT)	HJD	N	σ_{C-CH}	$\overline{V}$
07/01/98	10820.7488	25	0.02	19.08
11/01/98	10824.7719	27	0.02	19.13
06/02/98	10850.7540	30	0.01	19.06
07/02/98	10851.7520	30	0.02	18.94
18/03/98	10890.6939	36	0.02	18.71
19/03/98	10891.6219	22	0.02	18.67

Humps are believed to trace the hot spots in CVs. These hot spots are normally produced in the shock region where the gas stream hits the accretion disk. The correlation between main and secondary hump amplitudes supports the hypothesis of a single hot spot seen front and back orbiting the binary center of mass. In addition, the correlation between hump's amplitude and mean brightness could indicate a dependence of the mass transfer in the disk on the mass transfer rate from the secondary. Our observations should constrain models of gas dynamics in close binary systems, specially those considering the region of stream–disk interaction.

This work was partially supported by grant Fondecyt 1971064.

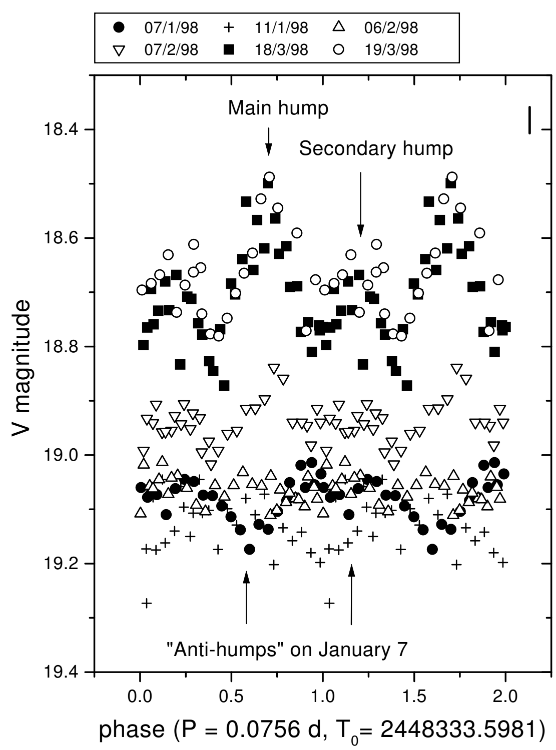

Figure 1. Light curves of RZ Leo folded with a period $0^{\mathrm{d}}.0756$.

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Misselt, K.A., 1996, PASP 108, 146.

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NEW DWARF NOVAE ON MOSCOW PLATES II

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A search for new variable stars on Moscow archive plates was continued, resulting in the discovery of four new UG-type stars (Var 63–66). The coordinates of new dwarf novae, taken from the USNO A1.0 catalogue, are listed in Table 1 and their finding charts are shown in Figure 1.

The stars were estimated by eye on plates taken with the 40-cm astrograph in Crimea. The magnitudes of comparison stars are given in Table 2. Standard sequences in NGC 1027 (Hoag et al., 1961) and in IC 5146 (Walker, 1959) were used to obtain B-band magnitudes of comparison stars for Var 64 and Var 66, respectively. Magnitudes of comparison stars for Var 63 and Var 65 are based on the B-band standard for 3C 454.3 (Angione, 1971) with the exception of comparison stars *a, b, c* and *d* for Var 63 whose B-band magnitudes were measured photoelectrically by Shugarov (private communication) at the 60-cm reflector in Crimea.

Var 63, 64 and 65 are blue on the Palomar prints. The color of Var 66 is discussed below.

Var 63 Peg. We estimated the star on 176 plates taken in JD 2437176–48893. The range of variability on our plates is $13\overset{\rm m}{.}3$–[$17\overset{\rm m}{.}7$. A total of seven outbursts have been revealed. The rather large amplitude of variability — more than $4\overset{\rm m}{.}4B$ — and long duration of the best-observed outburst (#6, see below) — more than 14 days — allow us to consider Var 63 as a UGSU-subtype dwarf nova candidate. Further observations and search for superhumps are strongly encouraged. Outbursts (JD24...):

#1	38949.461	13.43	#4	46081.234	13.29	#6	47390.407	[17.7
							47396.420	13.48
#2	44521.353	15.25	#5	47035.492	[17.15		47397.440	13.34
	44523.421	[17.7		47041.485	16.45		47398.483	13.38
				47057.391	[16.66		47407.368	15.61
#3	44901.347	[17.7					47410.457	17.70
	44904.307	15.95						
						#7	48566.216	13.48

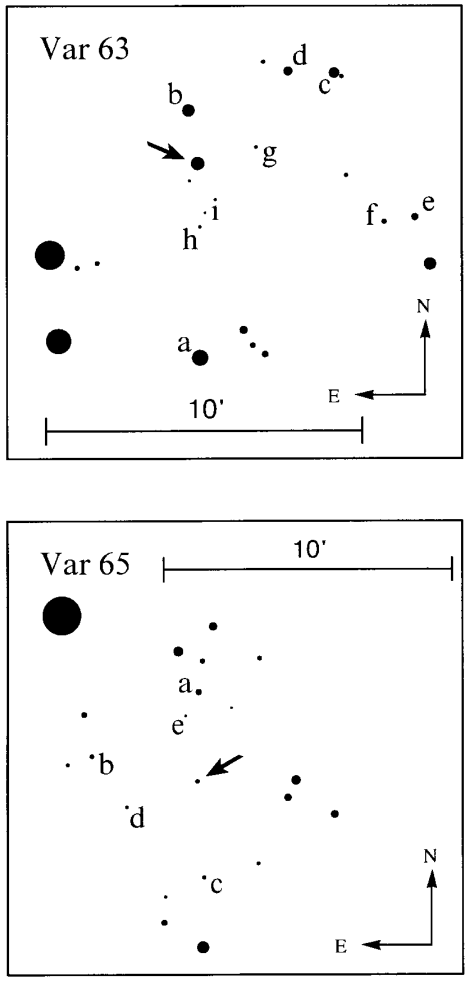

Figure 1. Finding charts

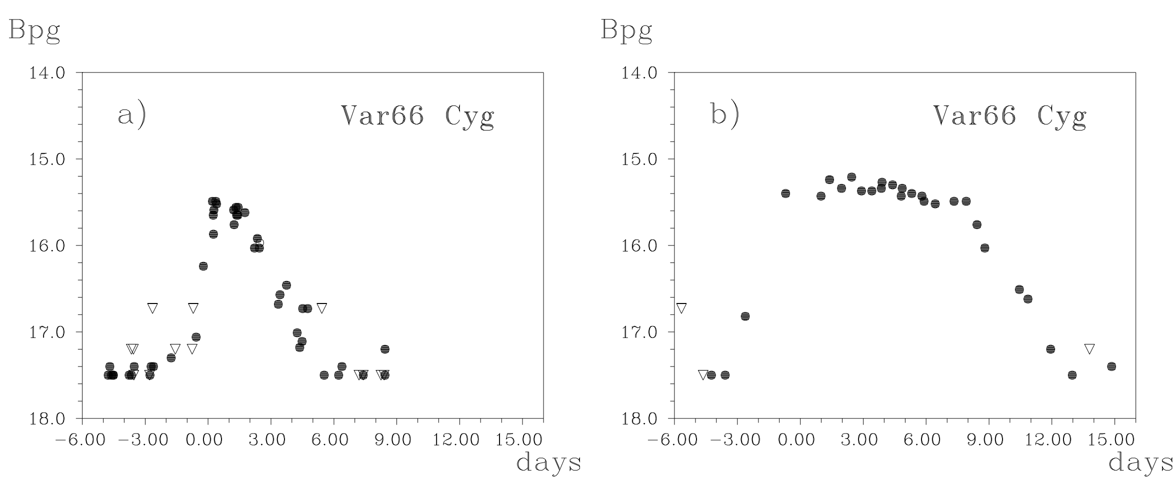

Figure 2. Var66 Cyg. Summary light curves of the short-lasting outburst (a) and the long-lasting one (b)

Table 1: Coordinates of New Variables

Var	α (J2000.0)	δ (J2000.0)
Var 63	$22^h58^m43\overset{s}{.}5$	$+11°09'13''$
Var 64	$03^h21^m14\overset{s}{.}4$	$+61°05'26''$
Var 65	$22^h45^m00\overset{s}{.}6$	$+16°55'15''$
Var 66	$21^h44^m03\overset{s}{.}7$	$+44°39'02''$

Table 2: Comparison Stars

Var	a	b	c	d	e	f	g	h	i
Var 63	12.63	13.57	14.12	14.39	15.83	16.66	17.15	17.4	17.7
Var 64	13.74	14.18	14.71	15.07	15.59	16.07	16.69	16.94	17.6
Var 65	15.53	16.22	16.80	17.4	17.6				
Var 66	15.02	15.65	16.73	17.2	17.5				

Var 64 Cam. The UG-type variability was suspected on the basis of 223 estimates (JD 2433150–48627). The *B*-band magnitude changes in the range $14\overset{m}{.}0$–[$17\overset{m}{.}6$. However, the star was in the bright state on two plates only. Confirmation was needed for the classification.

This confirmation came from Pietz (1998) who found the outburst on September 23, 1998. T. Kinnunen suspected short-term variations close to the maximum of this outburst (Kato, 1998). This is very interesting because our plate estimates show Var 64 to be definitely variable during the minimum of brightness ($16\overset{m}{.}5$–[$17\overset{m}{.}6$).

We measured the accurate position of Var 64 on our plate (in outburst, JD2442719) relative to 18 neighbouring GSC stars. Our measurements yielded coordinates $3^h21^m14\overset{s}{.}33$, $+61°05'26\overset{''}{.}0$ (J2000), which are accurate to about $\pm0\overset{''}{.}3$. The variable is thus identical to the USNO A1.0 object at $3^h21^m14\overset{s}{.}41$, $+61°05'25\overset{''}{.}7$ (J2000).

According to available data (Moscow estimates and *vsnet* observations), all observed outbursts are short-lasting. Outbursts on Moscow plates (JD24...):

#1	42719.417	14.00	#2	48240.309	[16.69
				48244.363	14.40
				48246.210	15.83

Var 65 Peg. We investigated this star on 153 plates (JD 2444076–47477) and revealed a total of seven outbursts. The range of variability on our plates is $15\overset{m}{.}8$–[$17\overset{m}{.}6$. Two best-observed outbursts are short (#1 and #3, see below). Outbursts (JD24...):

#1	44873.397	[17.6	#3	45552.391	[17.4	#6	46768.250	[16.8
	44875.366	15.81		45553.518	15.94		46769.174	16.08
	44876.355	15.94		45558.381	17.45			
	44877.356	15.77		45562.487	[17.6	#7	47410.457	16.01
	44880.383	16.65					47417.364	17.04
	44883.430	[17.4	#4	45666.233	[17.6		47421.440	[17.4
				45674.205	16.36			
#2	45199.526	16.15						
	45200.510	16.08	#5	46376.269	16.71			
	45205.469	[17.4		46382.394	16.15			

Var 66 Cyg. We estimated this star on 208 plates taken in JD2433483–49634 and found its B-band magnitude to vary from $15^{\rm m}_{\cdot}25$ to [$17^{\rm m}_{\cdot}5$. Moscow photographic observations show that the light curve of Var 66 is typical of dwarf novae. We observed two types of outbursts: the long-lasting ones with $15^{\rm m}_{\cdot}25B$ at maximum and a duration of about 15 days and the short-lasting ones with $15^{\rm m}_{\cdot}5B$ at maximum and a duration of about 6 days. We used three "long" best-observed outbursts and five "short" ones to construct the summary light curves (Figure 2). It is significant that the star spends little time in a quiescent state with the outbursts following one after another almost immediately.

The only problem is the color of the new variable. The color index (blue minus red) is $1^{\rm m}_{\cdot}3$ in the USNO A1.0 and $0^{\rm m}_{\cdot}7$ in the USNO A2.0. It is not blue enough for a UG-type variable, especially if compared to the colors of neighbouring stars. The issue remains open and all observers are welcome to resolve the uncertainty.

The author would like to thank Drs. S.Yu. Shugarov, N.N. Samus and A.K. Dambis for their help and attention to this investigation, and to express gratitude to Mr. J. Manek for the software to visualize the USNO A1.0 and A2.0 catalogues. I acknowledge the very useful *vsnet* Data Base maintained by Drs. D. Nogami, T. Kato, S. Masuda and H. Baba. 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 96-15-96656.

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Kato, T., 1998, vsnet-alert **2232**

Pietz, J., 1998, vsnet-alert **2218**

(available on http://www.kusastro.kyoto-u.ac.jp/vsnet/Mail/vsnet-alert/msg02232.html, .../msg02218.html)

Walker, M.F., 1959, *ApJ*, **130**, 57

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NEW OBSERVATIONS OF GSC 3639.1081

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[2] Sternwarte Sonneberg, D-96515 Sonneberg, Germany, pk@stw.tu-ilmenau.de

Name of the object:
GSC 3639.1081 And

Equatorial coordinates:	**Equinox:**
R.A.= $23^h53^m39^s$ **DEC.=** $+45°37'21''$	J2000.0

Observatory and telescope:
R. Szafraniec Observatory, Metzerlen, Switzerland: 35-cm R-C-reflector; Sonneberg Observatory, Sonneberg, Germany: Sky Survey

Detector:	SBIG ST6 CCD camera, photographic plates

Filter(s):	None

Comparison star(s):	GSC 3639.1061

Check star(s):	GSC 3639.2363

Transformed to a standard system:	No

Availability of the data:
Upon request from R.D.

Type of variability:	EA

Remarks:

Diethelm (1997) reported on the incidental discovery of GSC 3639.1081 as a variable star, very probably an eclipsing binary. In order to determine the elements of light variation for this star, we searched the historical Sky Survey photographic plate collection of Sonneberg Observatory, Germany. By visual inspection we found a most probable period of 0.95436 days. Armed with this information, we were able to observe two additional primary minima of GSC 3639.1081 with the CCD equipment (JD 2451032.4479 (7) and JD 2451076.3469 (5), published in the BBSAG Bulletins, Nos. 118 and 119 respectively) at R. Szafraniec Observatory, Metzerlen, Switzerland. The current elements are therefore:

$$\mathrm{JD(min, hel)} = 2451032.4479(8) + 0\overset{d}{.}954326(3) \times E.$$

The actual period value could still be $0.954326/n$ days (integer n), but the probability for $n \gg 1$ is very small.

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Reference:

Diethelm, R., 1997, IBVS No. 4525

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IDENTIFICATIONS FOR WACHMANN'S VARIABLES IN THE SOUTHERN CYGNUS STARCLOUD

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As part of general work aimed at improvement of the coordinates for variable stars and of bibliographic databases, I have identified the 310 objects studied by Wachmann (1961, 1963, 1964, 1966) in the region of the southern Cygnus starcloud. His work included both new and known variables. The few brightest stars naturally appear in traditional astrometric catalogues, but the great majority have not been hitherto identified with accurate coordinates.

I made use of Wachmann's very clear charts together with plots of the GSC or USNO–A2.0 star catalogues to identify most of the stars. This was done with a program that plots either catalogue on a computer screen in a Mongo or IDL window, allowing the user to click with a mouse cursor on a star, whose ID and coordinates are then written out to a file. Nearly all the stars were unambiguously identified this way. In a number of cases—all involving red variables—I made use of the POSS-I red- and blue-light prints to identify the reddest object at the location indicated on Wachmann's charts. For a few difficult cases, it was found that the more recent POSS-II IIIa-J (blue-light) and IV-N (far-red) film copies made identification trivial for the faint red stars, despite their having been taken at different epochs.

The variables are listed in four tables corresponding to the four parts in which Wachmann published his results. The first column shows the HBV number assigned to new variables; the second shows the GCVS name. The positions are given to $1''$ precision, mostly from the GSC v1.1 and USNO–A2.0 (Monet *et al.* 1998). A few extremely faint and/or crowded stars do not appear in any catalogue. For these I estimated positions ($\pm 2''$) using large-scale Digitized Sky Survey frames from the Goddard SkyView facility (McGlynn *et al.* 1996). For a few bright stars, Hipparcos (Perryman *et al.* 1997) or ACT (Urban *et al.* 1998) positions were available. The source of the position is coded in column 's' as follows: A = USNO–A2.0, G = GSC v1.1, H = Hipparcos, S = SkyView, T = ACT. The Remarks column shows identifications with other surveys. Longer comments are given in the Notes at the end of each table. The identifications are 'new' in the sense that they were either not present or not linked in the same entry in the SIMBAD database as of mid-February 1999. If Wachmann has given a preliminary "Kiel" name (e.g. AN 92.1906) or another for known but undesignated variables, these are also listed in the Remarks or Notes.

This work was made significantly easier thanks to a number of excellent on-line tools, including SIMBAD, the 'VizieR' catalogue-server from the CDS-Strasbourg, and the Goddard SkyView utility. The POSS-II film sets have been provided to the Lowell Observatory library by the Friends of Lowell Observatory.

Table 1: Positions and identifications – I

HBV	GCVS	RA (2000)	Dec	s	GSC	Remarks
232	PX Lyr	19 19 53.2	+29 52 29	G	2136-2174	
233	PY Lyr	19 20 26.0	+28 56 44	G	2136-3365	
234	V846 Cyg	19 24 13.7	+30 08 30	G	2654-2052	
235	V865 Cyg	19 27 24.8	+33 03 09	A		
236	V867 Cyg	19 28 37.0	+32 59 18	A		
237	V880 Cyg	19 31 25.9	+33 39 17	A		
238	V886 Cyg	19 32 45.2	+32 40 38	A		
239	V901 Cyg	19 34 19.6	+31 12 44	A		
240	V903 Cyg	19 34 44.1	+31 15 19	A		IRAS 19327+3108
241	FO Vul	19 35 03.4	+26 34 57	A		
242	FQ Vul	19 35 36.6	+26 17 02	G	2146-2906	
243	V912 Cyg	19 35 52.7	+31 31 52	G	2655-1873	
244	FR Vul	19 36 24.8	+26 45 57	T	2146-4509	HD 338614
245	FT Vul	19 36 23.5	+27 09 35	A	2146-1843	IRAS 19343+2702
246	V916 Cyg	19 37 03.7	+31 10 34	A		
247	V917 Cyg	19 37 34.6	+29 56 04	A	2150-0477	IRAS 19355+2949
248	V921 Cyg	19 37 58.7	+33 39 28	A		
249	V923 Cyg	19 38 10.8	+31 34 57	A	2655-0133	
250	FV Vul	19 38 40.8	+27 35 58	A	2146-0243	
251	V928 Cyg	19 38 55.3	+29 29 59	A		
252	V929 Cyg	19 38 49.5	+32 24 09	A		IRAS 19368+3217
253	V931 Cyg	19 39 14.1	+29 46 09	A		
254	V937 Cyg	19 39 30.7	+33 01 38	A	2660-3389	
255	V938 Cyg	19 39 42.3	+32 12 14	G	2660-1920	IRAS 19377+3205
256	V952 Cyg	19 42 50.3	+33 22 22	A		
257	V960 Cyg	19 43 52.4	+33 55 00	A		
258	V961 Cyg	19 43 58.3	+32 52 14	G	2660-3699	
259	V962 Cyg	19 44 00.0	+33 16 39	A		
260	V963 Cyg	19 44 04.9	+31 41 50	G	2656-1995	
261	V964 Cyg	19 44 01.8	+33 26 24	A		
262	V977 Cyg	19 45 47.1	+31 13 22	T	2656-1815	
263	V999 Cyg	19 49 53.3	+31 07 03	G	2669-4992	IRAS 19479+3059
264	V1001 Cyg	19 50 15.1	+29 29 39	G	2152-0227	
265	V1008 Cyg	19 50 48.3	+31 56 26	A	2673-2954	
266	HH Vul	19 52 10.1	+29 14 09	T	2152-2750	HD 332856
267	HI Vul	19 53 47.6	+28 44 17	G	2152-6136	
268	V1011 Cyg	19 55 14.9	+34 12 30	G	2677-1203	
269	V1013 Cyg	19 56 58.2	+33 46 33	G	2677-1585	
270	V1018 Cyg	19 57 59.9	+33 20 28	T	2674-3450	HD 226829
271	V1019 Cyg	19 58 37.7	+30 23 19	G	2670-1841	
272	V1021 Cyg	19 59 21.0	+33 11 01	A	2674-4054	
273	V1023 Cyg	19 59 53.2	+30 24 21	A	2670-2251	
274	V1027 Cyg	20 02 27.4	+30 04 26	G	2670-4475	
	PW Lyr	19 19 38.3	+29 06 44	A		AN 92.1906
	AV Cyg	19 20 41.1	+29 30 21	G	2136-2142	
	BF Cyg	19 23 53.5	+29 40 29	T	2137-0234	[NM51] 8
	DX Cyg	19 16 04.5	+29 22 56	A		
	EI Cyg	19 36 58.5	+32 11 58	A		IRAS 19350+3205
	EM Cyg	19 38 40.1	+30 30 28	G	2655-3329	
	EN Cyg	19 40 09.5	+29 16 23	G	2150-4264	

Table 1: Positions and identifications – I (cont'd.)

HBV	GCVS	RA (2000)	Dec	s	GSC	Remarks
	V941 Cyg	19 41 04.4	+30 50 09	G	2656-0904	AN 372.1928
	V463 Cyg	19 42 14.0	+31 18 02	G	2656-3251	
	V541 Cyg	19 42 29.5	+31 19 40	G	2656-3703	
	V805 Cyg	19 43 15.5	+33 33 42	A		AN 978.1935
	V370 Cyg	19 43 38.1	+32 47 35	G	2660-2075	
	EP Cyg	19 45 03.7	+31 19 51	G	2656-1255	
	V974 Cyg	19 45 18.6	+32 31 53	G	2660-3690	AN 425.1934
	V976 Cyg	19 45 28.2	+31 28 30	G	2656-1369	IRAS 19435+3121
	EQ Cyg	19 45 29.0	+31 26 54	A		
	SY Cyg	19 46 34.3	+32 42 18	T	2660-0978	
	IV Cyg	19 50 12.3	+34 19 27	A		
	IY Cyg	19 55 33.8	+31 45 50	A	2669-1116	
	GI Cyg	19 59 33.7	+33 44 47	A	2674-5704	

Table 2: Positions and identifications – II

HBV	GCVS	RA (2000)	Dec	s	GSC	Remarks
291	OV Lyr	19 16 13.3	+29 20 34	G	2136-1930	IRC +30365
292	OX Lyr	19 16 42.6	+29 07 10	A	2136-1441	
293	OY Lyr	19 17 01.9	+29 00 25	A	2136-1363	
294	OZ Lyr	19 17 03.2	+28 51 03	A		
295	QQ Lyr	19 21 02.0	+31 44 00	A		
296	QR Lyr	19 21 26.0	+32 59 27	G	2658-0965	
297	QS Lyr	19 22 07.4	+31 00 20	A		IRAS 19201+3054
298	V841 Cyg	19 22 18.4	+28 41 08	G	2136-0494	
299	V843 Cyg	19 22 57.1	+29 41 08	A		
300	V847 Cyg	19 24 28.6	+28 30 50	G	2137-0375	
301	V849 Cyg	19 24 56.0	+27 51 53	A	2133-0391	IRAS 19229+2745
302	V853 Cyg	19 26 37.7	+32 13 21	A		
303	V856 Cyg	19 26 53.7	+29 10 26	A		
304	V857 Cyg	19 26 53.9	+32 51 04	A		
305	V859 Cyg	19 27 12.7	+28 56 50	G	2137-0744	
306	V863 Cyg	19 27 28.9	+29 11 23	A		
307	V872 Cyg	19 29 20.7	+30 29 50	G	2654-0629	IRAS 19273+3023
308	V869 Cyg	19 29 11.8	+31 11 17	A		
309	V871 Cyg	19 29 13.2	+33 06 02	A	2658-0815	
310	V873 Cyg	19 29 20.8	+31 46 52	A		
311	FM Vul	19 31 47.0	+27 08 05	G	2133-1304	
312	V883 Cyg	19 32 05.7	+28 48 24	A		
313	V891 Cyg	19 33 38.4	+29 16 22	T	2150-3272	BD+28 3385
314	V895 Cyg	19 33 46.9	+32 43 06	G	2659-2047	BD+32 3477
315	V897 Cyg	19 33 59.5	+29 47 42	G	2150-3096	
316	FP Vul	19 35 19.9	+27 24 55	A		
317	V910 Cyg	19 35 53.3	+28 12 40	A		
318	V909 Cyg	19 35 53.2	+28 16 44	T	2150-2128	
319	V919 Cyg	19 37 55.4	+28 34 11	G	2150-4075	
320	V918 Cyg	19 37 42.0	+30 13 11	G	2655-1745	
321	V934 Cyg	19 39 29.3	+30 16 35	A		
322	V943 Cyg	19 41 23.4	+28 34 57	A	2151-3541	see note
323	V945 Cyg	19 41 51.3	+31 08 52	A		IRAS 19399+3101
324	V954 Cyg	19 43 09.1	+34 10 37	A		
325	V957 Cyg	19 43 45.6	+29 31 41	G	2151-4762	
326	V959 Cyg	19 43 54.0	+30 19 34	G	2656-3828	
327	GO Vul	19 46 35.4	+27 53 59	A	2147-0989	
328	GP Vul	19 46 56.9	+28 51 08	T	2151-2818	
329	GR Vul	19 48 06.0	+27 37 00	A		

Table 2: Positions and identifications – II (cont'd)

HBV	GCVS	RA (2000)	Dec	s	GSC	Remarks
330	V1010 Cyg	19 53 45.9	+29 34 26	A		
	PP Lyr	19 17 43.9	+28 07 30	A		AN 89.1906
	DV Cyg	19 21 44.7	+29 45 30	A	2136-0808	
	V687 Cyg	19 26 11.6	+29 59 12	T	2137-0689	
	DZ Cyg	19 27 09.0	+31 57 37	A		
	FM Cyg	19 30 07.4	+29 55 16	A	2137-0461	
	BG Cyg	19 38 57.7	+28 30 47	T	2150-4887	
	HW Cyg	19 40 18.1	+32 46 02	G	2660-2881	
	EU Cyg	19 51 17.3	+32 40 32	A		
	GY Vul	19 51 55.3	+29 03 00	G	2152-3124	see note
	IX Cyg	19 53 14.0	+32 10 44	A	2673-0624	
	AB Vul	19 53 47.0	+28 56 56	G	2152-4146	
	EW Cyg	19 53 52.4	+31 32 04	G	2669-3433	
	GG Cyg	19 54 18.7	+32 40 46	G	2673-3269	
	EX Cyg	19 54 23.4	+31 13 38	A	2669-3471	
	EY Cyg	19 54 36.7	+32 21 55	A		
	V466 Cyg	19 54 33.5	+33 00 05	T	2673-2051	
	EZ Cyg	19 57 49.0	+30 15 57	G	2670-4043	
	GH Cyg	19 59 10.8	+29 27 03	T	2153-2761	
	V1022 Cyg	19 59 47.0	+30 06 05	G	2670-4680	see note
	V483 Cyg	20 00 45.9	+31 50 03	G	2670-0004	

Notes to Table 2:

HBV 322 = V943 Cyg IRAS 19393+2827; mislabelled on Wachmann chart, variable is nearby star to east.
GY Vul AN 979.1935 = IRAS 19498+2855.
V1022 Cyg AN 981.1935 = IRAS 19577+2957.

Table 3: Positions and identifications – III

HBV	GCVS	RA (2000)	Dec	s	GSC	Remarks
336	PR Lyr	19 18 13.6	+26 43 03	A		IRAS 19162+2637
337	PS Lyr	19 18 22.7	+27 17 01	G	2132-2021	HD 338070
338	PV Lyr	19 19 02.6	+31 36 37	G	2653-2016	
339	V840 Cyg	19 22 07.0	+28 40 06	T	2136-0341	see note
340	QT Lyr	19 22 20.5	+30 39 02	A	2654-2705	
341	V842 Cyg	19 22 57.9	+27 45 59	A	2132-3422	
342	V855 Cyg	19 26 42.8	+31 46 53	A		
343	V858 Cyg	19 27 08.8	+29 50 19	A		IRAS 19251+2944
344	V874 Cyg	19 29 59.8	+28 21 55	A	2137-2491	
345	V875 Cyg	19 30 25.8	+30 14 29	S		see note
346	V876 Cyg	19 30 46.4	+30 53 48	G	2655-1737	
347	V877 Cyg	19 30 51.7	+32 12 09	G	2659-2240	
348	V879 Cyg	19 31 06.5	+32 04 39	G	2659-2171	IRAS 19291+3158
349	V885 Cyg	19 32 49.9	+30 01 17	T	2655-1877	BD+29 3637
350	V889 Cyg	19 33 32.1	+28 29 00	T	2150-4751	
351	V890 Cyg	19 33 27.3	+32 10 24	G	2659-0935	
352	FN Vul	19 33 45.7	+27 11 27	A	2146-1241	
353	V898 Cyg	19 34 00.1	+30 52 57	S		see note
354	V902 Cyg	19 34 35.5	+29 06 28	A		
355	V907 Cyg	19 35 30.4	+29 45 46	A		
356	FS Vul	19 36 23.7	+27 10 09	S		
357	V914 Cyg	19 36 38.4	+31 39 10	A		
358	V930 Cyg	19 39 06.8	+30 28 51	G	2656-4142	
359	V933 Cyg	19 39 16.7	+29 50 11	G	2150-1601	IRAS 19373+2943
360	FW Vul	19 40 51.2	+27 13 02	G	2147-1068	
361	V947 Cyg	19 42 14.0	+31 35 38	A		

Table 3: Positions and identifications – III (cont'd)

HBV	GCVS	RA (2000)	Dec	s	GSC	Remarks
362	V948 Cyg	19 42 20.7	+30 39 56	A		
363	GI Vul	19 42 37.6	+26 38 28	G	2147-2646	
364	V950 Cyg	19 42 37.8	+30 04 00	S		see note
365	V965 Cyg	19 44 09.3	+31 42 37	A		
366	V968 Cyg	19 44 34.0	+28 49 36	G	2151-2602	
367	V969 Cyg	19 44 23.4	+33 24 48	G	2660-2171	IRAS 19424+3317
368	V970 Cyg	19 44 56.4	+28 15 22	A		
369	GN Vul	19 46 24.6	+27 23 25	G	2147-1110	
370	V989 Cyg	19 48 38.5	+30 02 42	A	2669-4954	
371	GU Vul	19 48 57.1	+26 23 23	G	2148-0479	[MS98] 16-12052
372	V990 Cyg	19 49 09.4	+30 09 51	A	2669-0225	IRAS 19471+3002
373	V998 Cyg	19 49 44.4	+30 47 39	G	2669-2409	
374	V1004 Cyg	19 50 29.5	+33 08 32	G	2673-0578	
375	HP Vul	19 59 01.0	+26 42 14	A	2149-0441	
	NU Lyr	19 14 34.1	+29 12 38	G	2135-0920	IRAS 19125+2907
	AK Lyr	19 15 19.5	+27 01 00	A		
	EO Lyr	19 15 05.8	+32 32 12	G	2657-1485	
	NV Lyr	19 15 02.7	+33 50 48	G	2661-2019	
	BV Lyr	19 17 40.5	+32 58 07	G	2657-1530	
	EP Lyr	19 18 19.6	+27 51 03	T	2132-3812	
	AL Lyr	19 19 29.6	+27 33 45	G	2132-3884	
	IO Vul	19 21 01.2	+27 01 03	A	2132-1281	AN 95.1906
	V1254 Cyg	19 22 03.4	+29 19 50	A	2136-2802	AN 96.1906
	V1110 Cyg	19 22 08.8	+30 07 34	A		see note
	DW Cyg	19 23 16.8	+28 11 51	A		
	IQ Vul	19 23 29.8	+26 58 37	A		AN 101.1906
	V1114 Cyg	19 24 36.4	+28 26 11			see note
	XY Vul	19 25 59.3	+26 24 35	A		
	XZ Vul	19 29 24.3	+27 26 05	G	2133-1449	
	V401 Cyg	19 29 20.3	+30 24 29	T	2654-2502	
	IU Vul	19 29 41.2	+27 05 29	G	2133-1327	AN 106.1906
	EE Cyg	19 30 32.4	+28 32 19	A		
	V1126 Cyg	19 32 38.4	+29 35 26	A		see note
	HL Cyg	19 33 16.0	+28 11 34	A		
	V1965 Cyg	19 34 10.1	+28 04 08			see note
	TY Cyg	19 33 51.9	+28 19 44	A		IRAS 19318+2813
	FQ Cyg	19 33 48.4	+30 54 55	A		IRAS 19318+3048
	FR Cyg	19 35 01.3	+28 13 41	A		
	EH Cyg	19 36 48.8	+28 07 43	G	2150-1292	
	AG Vul	19 40 28.1	+27 36 00	A		IRAS 19384+2728
	HY Cyg	19 40 53.8	+29 02 51	A	2151-4800	
	FV Cyg	19 43 03.2	+28 42 14	A	2151-3601	
	FW Cyg	19 43 20.8	+31 30 14	G	2656-3323	IRAS 19413+3122
	NSV 12351	19 43 46.3	+28 07 44	S		see note
	YZ Vul	19 44 02.1	+27 46 06	A		IRAS 19420+2738
	AH Vul	19 45 19.5	+27 35 34	A	2147-1821	IRAS 19433+2728
	AI Vul	19 46 47.5	+28 08 34	G	2151-5679	
	ZZ Vul	19 47 49.9	+29 09 15	A	2151-1388	IRAS 19458+2901
	AA Vul	19 50 26.1	+28 11 21	S		see note
	EV Cyg	19 53 00.0	+29 38 46	G	2152-0596	IRAS 19509+2930
	V468 Cyg	19 55 38.1	+32 45 34	G	2673-4122	[PCC93] 400
	KL Cyg	19 57 53.5	+33 09 36	A	2674-4901	
	X Vul	19 57 28.6	+26 33 23	H	2149-0741	
	DG Vul	19 58 40.2	+27 41 01	G	2149-1732	

Notes to Table 3:

HBV 339 = V840 Cyg	BD+28 3304 = IRAS 19201+2834.
HBV 345 = V875 Cyg	not in USNO–A2.0; verified on POSS-I prints.
HBV 353 = V898 Cyg	verified using POSS-II J/N films; is the northern star of a close (∼2″) pair.
HBV 364 = V950 Cyg	IRAS 19406+2956, close double.
V1110 Cyg	AN 97.1906 = IRAS 19202+3001.
V1114 Cyg	AN 103.1906; position from Downes *et al.* (1997) verified on DSS and adopted position from Bruch *et al.* (1987) slightly in error.
V1126 Cyg	AN 111.1906 = IRAS 19306+2928.
V1965 Cyg	AN 112.1906; position from Alksnis *et al.* (1990) verified on DSS and adopted; variable is southeastern star of close pair.
NSV 12351	AN 215.1935, constant.
YZ Vul	SV* R 75.
AA Vul	northern star of merged pair; verified on POSS-I prints.

Table 4: Positions and identifications – IV

HBV	GCVS	RA (2000)	Dec	s	GSC	Remarks
407	V371 Lyr	19 16 59.1	+26 58 03	G	2132-1424	
408	V377 Lyr	19 20 51.2	+33 32 40	G	2657-0676	
409	V378 Lyr	19 21 52.5	+31 21 31	G	2654-2377	see note
410	V379 Lyr	19 22 28.6	+31 18 24	G	2654-1515	
411	IR Vul	19 23 38.2	+26 39 37	G	2132-0569	
413	V1117 Cyg	19 25 55.6	+29 11 49	G	2137-2301	
414	IS Vul	19 27 45.7	+26 19 51	G	2133-2610	
415	IV Vul	19 30 29.2	+27 45 30	G	2133-1361	
416	V1124 Cyg	19 31 39.8	+30 09 34	A		
417	V1125 Cyg	19 31 48.4	+31 52 03	T	2655-2300	
418	V1128 Cyg	19 33 28.6	+30 29 56	A		see note
419	IW Vul	19 35 33.5	+26 38 58	G	2146-2566	
420	V1135 Cyg	19 36 29.8	+29 53 54	G	2150-0025	
421	V1136 Cyg	19 37 50.0	+28 50 36	G	2150-3565	
422	IX Vul	19 38 56.0	+26 24 51	G	2146-4148	
423	IY Vul	19 40 10.6	+26 01 51	G	2142-1402	
424	V1142 Cyg	19 39 58.0	+33 55 30	G	2664-0032	
425	V1145 Cyg	19 42 27.4	+28 14 29	G	2151-4731	
426	V1147 Cyg	19 45 52.5	+32 15 40	G	2660-2608	
427	IZ Vul	19 47 16.5	+27 19 57	G	2147-1126	see note
428	KK Vul	19 47 21.1	+28 28 42	G	2151-1105	not IRAS 19453+2821
429	V1151 Cyg	19 47 51.1	+29 51 35	G	2151-0598	
430	V1156 Cyg	19 50 37.1	+29 21 17	G	2152-2405	
431	V1157 Cyg	19 51 09.8	+31 20 13	G	2669-2695	
432	V1158 Cyg	19 51 30.7	+31 06 35	A		
433	KN Vul	19 55 34.6	+27 42 21	G	2148-3403	
434	V1171 Cyg	19 57 57.4	+33 53 02	G	2678-1498	** Couteau 1805
435	V1172 Cyg	19 58 12.5	+33 12 30	G	2674-3816	
	EL Lyr	19 13 20.8	+32 03 18	G	2657-1946	
	EM Lyr	19 14 06.3	+29 04 55	A		
	AI Lyr	19 14 35.6	+27 49 46	A		SV* R 60
	NSV 11870	19 16 35.8	+26 53 43	G	2132-1974	CSV 4592, constant
	RV Lyr	19 16 18.0	+32 25 15	A		
	CSV 4593	19 25 19.5	+32 32 56	G	2658-1433	constant
	MU Lyr	19 16 31.1	+30 39 20	A		
	NSV 11882	19 17 33.3	+30 08 00	G	2653-2297	CSV 4600, constant
	FO Lyr	19 18 02.6	+27 01 14	A		
	V458 Lyr	19 19 28.3	+27 15 13	S		CSV 4616, see note
	AM Lyr	19 19 26.4	+32 25 48	A		IRAS 19175+3220

Table 4: Positions and identifications – IV (cont'd)

HBV	GCVS	RA (2000)	Dec	s	GSC	Remarks
	BW Lyr	19 20 35.0	+26 25 52	G	2132-2244	
	V1105 Cyg	19 20 43.1	+29 32 32	S		CSV 4628, see note
	BX Lyr	19 20 34.0	+32 43 55	A		IRAS 19186+3237
	AN Lyr	19 21 50.1	+32 00 32	A	2658-1662	
	ES Lyr	19 22 16.7	+33 24 38	G	2658-0571	
	IP Vul	19 22 53.2	+26 58 00	A		CSV 4650
	BY Lyr	19 23 58.7	+30 22 01	A		
	BZ Lyr	19 23 57.0	+31 01 09	A		
	FH Cyg	19 24 10.9	+29 54 44	G	2137-0377	IRAS 19222+2948
	FI Cyg	19 25 38.3	+29 26 50	A		IRAS 19236+2920
	NSV 12024	19 26 06.4	+27 41 28	G	2133-0527	CSV 4667, constant
	DY Cyg	19 26 39.2	+28 32 38	A		
	FK Cyg	19 26 56.7	+29 21 42	G	2137-1602	
	FL Cyg	19 26 54.2	+34 07 11	G	2662-0162	
	IT Vul	19 28 35.8	+27 07 04	A		CSV 4687
	HH Cyg	19 28 39.3	+32 53 18	A		
	NSV 12096	19 30 04.6	+30 05 36	A	2655-1064	CSV 4699
	HI Cyg	19 30 20.6	+30 54 08	S		see note
	FN Cyg	19 30 45.9	+30 06 17	A		
	FO Cyg	19 31 10.9	+30 58 46	A	2655-2459	
	HN Cyg	19 33 39.9	+28 56 14	A		see note
	EF Cyg	19 33 54.3	+30 08 26	G	2655-0668	IRAS 19319+3001
	HR Cyg	19 34 26.8	+30 39 42	A		
	EG Cyg	19 35 01.1	+30 07 33	A	2655-1532	IRAS 19330+3001
	AR Vul	19 35 43.7	+26 33 35	A	2146-3358	IRAS 19336+2626
	AF Vul	19 35 48.1	+27 39 36	A		
	NSV 12197	19 35 51.1	+30 09 01	G	2655-0770	CSV 4745, constant
	FS Cyg	19 36 15.1	+34 23 50	A		
	FT Cyg	19 36 23.6	+32 41 56	G	2659-1109	
	V368 Cyg	19 37 20.3	+29 05 58	A		constant
	NSV 12228	19 37 39.9	+30 45 28	G	2655-1875	see note
	EK Cyg	19 37 49.0	+31 50 23	A	2655-0115	
	EL Cyg	19 38 06.0	+28 36 23	A		see note
	V1485 Cyg	19 38 08.1	+29 40 43	A		see note
	NSV 12250	19 38 28.2	+30 55 55	G	2655-3043	CSV 4763, constant
	HT Cyg	19 38 39.0	+31 44 13	A		IRAS 19367+3137
	HV Cyg	19 40 15.2	+31 46 17	A	2656-2991	IRAS 19383+3139
	HX Cyg	19 40 29.7	+34 04 02	G	2664-0225	IRAS 19386+3356
	II Cyg	19 41 00.5	+30 54 36	G	2656-4951	IRAS 19390+3047
	FU Cyg	19 41 16.1	+31 56 30	A		
	EO Cyg	19 41 41.0	+32 49 04	G	2660-3135	IRAS 19397+3241
	IK Cyg	19 42 40.2	+30 07 57	G	2656-3924	IRAS 19406+3000
	IO Cyg	19 44 34.5	+32 29 09	A	2660-3916	
	SU Cyg	19 44 48.7	+29 15 53	H	2151-5896	
	FY Cyg	19 45 10.7	+32 03 10	G	2660-3350	IRAS 19432+3155
	S Vul	19 48 23.8	+27 17 10	H	2147-0133	
	IT Cyg	19 48 13.2	+33 40 06	G	2673-0013	
	ER Cyg	19 49 12.4	+30 24 43	G	2669-3670	
	V1508 Cyg	19 49 57.5	+31 51 16	G	2669-0180	CSV 4838
	ES Cyg	19 50 05.5	+31 32 02	G	2669-2939	IRAS 19481+3124
	IU Cyg	19 50 08.2	+34 09 57	A		IRAS 19482+3402
	χ Cyg	19 50 33.9	+32 54 51	H	2673-4643	
	SV Vul	19 51 30.9	+27 27 37	H	2148-4057	
	ET Cyg	19 51 19.5	+31 18 13	A		IRAS 19493+3110

Table 4: Positions and identifications – IV (cont'd)

HBV	GCVS	RA (2000)	Dec	s	GSC	Remarks
	V449 Cyg	19 53 21.0	+33 57 01	H	2677-0291	
	V467 Cyg	19 55 37.5	+32 30 01	A	2673-4489	IRAS 19536+3221
	EQ Vul	19 58 23.2	+28 01 09	G	2149-1476	HD 333188
	V482 Cyg	19 59 42.6	+33 59 28	G	2678-1186	IRAS 19577+3351
	V717 Cyg	20 01 05.0	+30 49 52	G	2670-3884	
	NSV 12703	20 01 33.6	+28 14 09	G	2153-1109	CSV 4980, see note
	V485 Cyg	20 01 15.1	+33 55 43	H	2678-0393	AN 71.1939
	V1583 Cyg	20 02 31.8	+30 46 40	G	2670-0147	CSV 4995
	V718 Cyg	20 03 05.1	+30 20 13	G	2670-3287	
	V719 Cyg	20 03 38.5	+30 28 09	G	2670-4596	
	V720 Cyg	20 04 06.0	+29 57 38	G	2153-0502	IRAS 20020+2949
	CD Cyg	20 04 26.6	+34 06 44	H	2678-0210	
	V550 Cyg	20 05 04.9	+32 21 24	A		southeastern of pair

Notes to Table 4:

HBV 409 = V378 Lyr near to but not same as CGCS 4248 = IRAS 19199+3114.

HBV 418 = V1128 Cyg IRAS 19315+3023; mislabelled on Wachmann chart: the variable is the star immediately west.

HBV 427 = IZ Vul verified from description in Walker (1963) and Humason (1938).

V458 Lyr IRAS 19174+2709; ID uncertain, but very close to IRAS position.

V1105 Cyg IRAS 19187+2926, verified on POSS-II J/N films.

HI Cyg verified on POSS-II J/N films.

HN Cyg red variable, not dwarf nova.

NSV 12228 CSV 101871 = IRAS 19356+3038; evidently not an eclipsing variable as per Wachmann.

EL Cyg IRAS 19361+2829, close to edge of IRAS error ellipse.

V1485 Cyg CSV 4759 = NSV 12238, double star.

NSV 12703 1RXS J200134.0+281411; USNO–A2.0 and GSC positions differ by about $3\farcs5$ suggesting, together with the x-ray detection, that this is an active late-type dwarf star with modest proper motion.

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IDENTIFICATIONS FOR WACHMANN'S VARIABLES IN SA 98

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This report contains accurate coordinates and identifications for some 160 new and known variables studied by Wachmann (1964a, 1964b, 1966, 1968) in a broad region near the low-galactic-latitude Selected Area 98 along the celestial Equator. The brightest stars naturally appear in traditional astrometric catalogues, but the majority of the fainter ones have not been hitherto identified with accurate coordinates.

The methods used to obtain the coordinates were the same as those used for a group of variables in the Cygnus starcloud also observed by Wachmann (Skiff 1999). Since the present list lacks extremely faint stars, no heroic efforts were needed to identify them.

The stars are shown in two tables. The first gives results from the first three brief papers of the series, while the last gives a longer list of known variables that Wachmann summarized in the final paper. In Table 1, the first column shows the HBV number assigned to new variables; the second shows the GCVS name. The positions are mostly from the GSC v1.1 and USNO–A2.0 (Monet *et al.* 1998) given to 1″ precision, entirely adequate for these mostly bright stars. I have adopted high-accuracy coordinates from the 'FASTT' transit circle for several of the variables published by Henden & Stone (1998). For additional bright stars, Hipparcos (Perryman *et al.* 1997) or ACT (Urban *et al.* 1998b) positions were readily available. The source of the position is coded in column 's' as follows: A = USNO–A2.0, F = FASTT, G = GSC v1.1, H = Hipparcos, T = ACT. The Remarks column shows identifications with other lists. Longer comments are given in the Notes at the end of the table. The identifications are 'new' in the sense that they were either not present or not linked in the same entry in the SIMBAD database as of mid-February 1999. If Wachmann has given a preliminary name (e.g. CSV 841) for known but undesignated variables, these are also listed in the Remarks. Table 2 is arranged similarly, but without the HBV column.

This work was made significantly easier thanks to a number of excellent on-line tools, including SIMBAD, the 'VizieR' catalogue-server from the CDS-Strasbourg, and the Goddard SkyView utility.

Table 1: Positions and identifications – I

HBV	GCVS	RA (2000)	Dec	s	GSC	Remarks
376	V393 Mon	6 35 10.1	−0 49 11	A		
377	V394 Mon	6 36 49.1	−3 52 19	G	4806-3060	
378	V395 Mon	6 37 05.5	+2 21 13	G	0150-1888	
379	V396 Mon	6 38 36.5	+3 36 18	G	0151-0244	
380	V397 Mon	6 38 30.7	−4 21 50	G	4807-1059	LS VI −04°4
381	V404 Mon	6 39 29.0	−0 44 32	G	4799-2035	
382	V442 Mon	6 42 19.5	+3 48 23	G	0155-1743	HD 262416
383	V445 Mon	6 43 08.3	−1 46 44	G	4799-1408	HD 292242
384	V448 Mon	6 47 45.0	+1 22 17	G	0148-2301	HD 289110
385	V450 Mon	6 49 19.3	+0 19 50	G	0148-2346	
386	V451 Mon	6 49 38.6	+1 16 03	G	0148-0058	middle of three
387	V452 Mon	6 49 55.9	−4 10 20	G	4808-0714	
388	V453 Mon	6 50 39.0	−2 22 07	G	4804-1104	
389	V454 Mon	6 53 56.1	+1 35 09	G	0149-0307	LS VI +01°17
390	V455 Mon	6 55 00.9	+0 07 19	A		
391	V456 Mon	6 56 04.7	+1 22 21	G	0149-2430	
392	V457 Mon	6 56 55.3	−1 54 51	G	4805-3495	CCDM J06569-0155A
393	V458 Mon	6 57 49.3	+2 11 53	G	0153-1004	LF 11 57
394	V459 Mon	6 58 20.0	+1 19 00	A		
395	V460 Mon	7 00 16.6	+2 02 12	G	0166-0353	HD 289471
396	V461 Mon	7 03 10.6	+2 33 17	A		
397	V462 Mon	7 04 30.2	+3 23 39	A		
398	V463 Mon	7 05 32.7	+2 56 08	G	0166-0536	
399	V464 Mon	7 05 43.7	−3 09 32	G	4818-1667	
400	AN CMi	7 09 09.2	+1 42 11	G	0163-2532	
401	AO CMi	7 10 04.3	+1 58 29	G	0167-1770	
402	V484 Mon	6 31 05.4	−2 08 49	A	4802-1327	
	CU Mon	6 32 46.8	+0 02 35	A	0146-1103	
	CV Mon	6 37 04.8	+3 03 50	H	0150-0121	
	V446 Mon	6 43 17.4	+1 09 39	A		CSV 841
403	V508 Mon	6 47 09.4	+3 58 02	G	0156-0044	
	TX Mon	6 50 52.2	−1 25 46	G	4800-1874	
	SZ Mon	6 51 27.8	−1 22 16	C	4800-1700	see note
	XX Mon	6 52 12.1	−2 48 25	G	4804-1167	
	EK Mon	6 52 46.1	−2 27 30	G	4805-0467	
	TY Mon	6 56 39.7	+0 11 23	G	0149-3097	
	TZ Mon	6 58 00.9	−0 22 35	G	4801-2693	
	AA Mon	6 57 23.7	−3 50 36	G	4809-0644	
404	V465 Mon	7 08 09.3	−0 03 57	F	4815-2284	see note
	V376 Mon	6 48 48.0	−3 36 17	A	4804-2990	CSV 879
	TW Mon	6 50 32.3	+0 00 24	G	0148-0483	
405	V518 Mon	6 51 09.0	+0 37 28	A		
	HL Mon	7 02 52.0	−1 44 26	A		
	UV Mon	7 02 59.9	+0 37 18	G	0162-3042	
	UW Mon	7 03 39.7	−0 11 31	F	4814-1567	FASTT 268
406	V535 Mon	7 10 48.7	+1 16 56	G	0163-1482	HD 289713

Table 1: Positions and identifications – I (cont'd.)

HBV	GCVS	RA (2000)	Dec	s	GSC	Remarks
437	V485 Mon	6 31 45.3	+1 20 18	G	0146-0767	IRC +00114
438	V492 Mon	6 34 29.9	+0 12 14	G	0146-0924	HD 291794, see note
439	V494 Mon	6 36 44.2	−2 51 44	G	4802-1534	
440	V495 Mon	6 37 03.3	−2 49 27	G	4802-1622	
441	V496 Mon	6 37 44.7	+3 18 02	G	0151-1066	
442	V498 Mon	6 39 44.2	+1 57 45	G	0151-2262	see note
443	V499 Mon	6 40 05.1	+3 41 07	G	0151-0101	
444	V501 Mon	6 40 41.7	−1 06 41	G	4799-1943	
445	V502 Mon	6 43 26.1	−2 29 49	G	4803-0463	
446	V504 Mon	6 44 43.9	−3 57 09	G	4807-0671	
447	V505 Mon	6 45 50.0	+2 29 57	H	0152-0591	
448	V506 Mon	6 46 36.5	−3 50 12	G	4808-2439	
449	V507 Mon	6 46 58.8	+1 19 34	G	0148-0804	[HLL97] 328
450	V509 Mon	6 47 10.7	−1 02 15	A		
451	V510 Mon	6 47 26.9	+2 31 01	G	0152-0220	
452	V511 Mon	6 47 34.5	+1 55 13	G	0152-1309	IRAS 06449+0158
453	V513 Mon	6 47 45.9	+1 06 40	A		
454	V377 Mon	6 49 02.0	−1 39 37	G	4800-2535	IRAS 06465-0136
455	V514 Mon	6 49 18.5	−0 03 33	G	4800-0856	
456	V515 Mon	6 49 21.1	−2 06 49	G	4804-2031	
457	V517 Mon	6 50 52.4	−0 04 24	G	4800-0457	
458	V516 Mon	6 50 41.5	+1 51 54	G	0148-0358	IRAS 06480+0155
459	V519 Mon	6 51 28.8	−0 01 58	G	4800-0313	
460	V520 Mon	6 55 12.4	−1 28 54	G	4801-3720	
461	V521 Mon	6 55 53.5	−0 14 25	G	4801-2799	
462	V522 Mon	6 56 40.8	−2 43 56	G	4805-2172	
463	V524 Mon	6 59 01.2	+2 12 51	G	0153-1410	
464	V525 Mon	6 59 20.5	+1 20 42	G	0149-1508	
465	V526 Mon	7 01 53.6	−1 07 53	G	4814-3228	
466	V527 Mon	7 02 05.6	−1 54 24	G	4818-4231	
467	V529 Mon	7 02 59.4	+1 09 54	F	0162-1092	see note
468	V528 Mon	7 02 36.3	+1 59 58	G	0166-1467	
469	V530 Mon	7 03 15.8	+3 14 54	G	0166-2648	
470	V531 Mon	7 03 13.8	+1 58 15	G	0166-1856	IRAS 07006+0202
471	V532 Mon	7 04 30.6	−0 21 06	F	4814-1849	FASTT 269
472	V533 Mon	7 06 38.7	+2 00 28	G	0166-1773	
473	V534 Mon	7 07 12.7	+1 52 38	A		IRAS 07046+0157
474	V536 Mon	7 13 55.5	−2 54 29	G	4819-0262	

Notes to Table 1:

SZ Mon	the infrared source IRAS 06489-0118 probably applies to the fainter companion a few arcsec east of the variable.
HBV 404 = V465 Mon	HD 293336 = FASTT 274.
HBV 438 = V492 Mon	IRAS 06319+0014 = IRC +00116.
HBV 442 = V498 Mon	HD 288904 = CSI+02-06371.
HBV 467 = V529 Mon	IRAS 07004+0114 = FASTT 166.

Table 2: Positions and identifications – II

GCVS	RA (2000)	Dec	s	GSC	Remarks
CW Mon	6 36 54.5	+0 02 18	A		see note
SY Mon	6 37 31.3	−1 23 44	G	4799-0384	
CY Mon	6 38 31.8	−1 36 39	G	4799-0105	IRAS 06359-0133
CD Mon	6 40 30.4	−1 04 45	G	4799-1815	IRAS 06379-0101
GT Mon	6 42 44.6	−1 43 32	G	4799-1482	IRAS 06402-0140
BT Mon	6 43 47.2	−2 01 13	A		
GU Mon	6 44 46.8	+0 13 17	G	0147-1822	
DT Mon	6 45 20.3	−1 42 47	A		IRAS 06428-0139
DD Mon	6 45 57.8	−0 17 32	G	4800-0372	
V560 Mon	6 46 28.8	−0 15 36	G	4800-0738	CSV 855
CE Mon	6 46 57.4	+3 03 26	A	0152-2294	
FY Mon	6 47 08.7	+3 15 34	G	0152-2179	
MR Mon	6 47 11.5	+1 31 46	H	0148-1053	
DF Mon	6 47 38.9	+0 41 28	G	0148-1664	constant
V449 Mon	6 47 56.4	+2 47 56	A		CSV 869
DW Mon	6 47 51.3	−2 41 19	G	4804-2214	
DX Mon	6 47 57.5	−2 07 25	G	4804-1809	see note
DG Mon	6 48 05.1	+0 32 17	G	0148-1457	IRAS 06455+0035
PZ Mon	6 48 21.1	+1 13 08	H	0148-0872	
CSV 869	6 48 33.5	+1 00 16	A		constant
CF Mon	6 49 22.0	−0 23 47	A		
DI Mon	6 49 36.3	+3 10 19	T	0152-2191	see note
GV Mon	6 49 41.6	+0 28 11	A		
BU Mon	6 50 33.6	+3 44 16	G	0152-1957	IRAS 06479+0347
V378 Mon	6 50 36.2	−1 29 01	A		CSV 888, see note
DK Mon	6 50 39.2	+1 43 49	G	0148-0382	
V379 Mon	6 51 27.1	−2 45 48	A		
CI Mon	6 52 19.9	+1 44 49	A		IRAS 06497+0148
V380 Mon	6 52 09.2	−1 37 23	G	4800-2481	
EG Mon	6 52 06.2	−4 01 53	G	4808-0814	IRAS 06496-0358
XY Mon	6 52 20.4	−3 28 41	G	4804-0066	IRAS 06498-0324
MS Mon	6 52 58.6	−0 06 11	A		
XZ Mon	6 53 36.4	−4 13 21	G	4809-2633	
DM Mon	6 53 51.9	+1 53 43	G	0153-0327	
QR Mon	6 54 06.3	+0 47 36	T	0149-0625	
AU Mon	6 54 54.7	−1 22 33	H	4801-1012	
HI Mon	6 55 49.1	−4 02 36	T	4809-0245	IRAS 06533-0358
MT Mon	6 55 58.3	−3 20 59	A	4805-2387	
CN Mon	6 56 35.4	−0 31 13	A		IRAS 06540-0027
AZ Mon	6 57 45.2	+3 18 09	G	0153-2310	RAFGL 1043
UU Mon	6 59 45.0	+2 12 28	G	0153-1382	
DO Mon	7 00 00.4	+2 56 06	G	0166-0280	IRAS 06573+0300
CP Mon	7 00 11.8	+4 08 25	G	0170-1144	
AE Mon	7 01 25.0	−2 20 20	G	4818-3711	
V566 Mon	7 01 41.1	+4 04 24	G	0170-2595	CSV 943
BK Mon	7 02 50.7	+3 09 24	G	0166-3084	IRAS 07002+0313
GG Mon	7 02 55.3	−1 16 14	G	4814-0250	
HM Mon	7 03 02.9	+0 13 49	F	0162-0265	FASTT 224
CSV 948	7 03 13.6	−0 33 38	A		constant
MV Mon	7 03 38.1	−3 11 11	G	4818-3022	
V383 Mon	7 04 37.9	−1 55 46	A		CSV 957

Table 2: Positions and identifications – II (cont'd.)

GCVS	RA (2000)	Dec	s	GSC	Remarks
GH Mon	7 04 41.4	−2 28 19	G	4818-2919	
CSV 905	7 05 22.8	−0 49 33	G	4814-1905	constant
FF Mon	7 06 35.5	−3 21 20	G	4818-2450	IRAS 07040-0316
V384 Mon	7 06 51.5	−0 41 02	F	4814-0367	FASTT 305
BR Mon	7 07 22.4	−1 19 25	G	4814-0434	
BM Mon	7 08 45.3	+0 41 46	F	0163-2281	FASTT 203
FH Mon	7 08 49.4	−2 32 01	G	4819-1608	
AG Mon	7 09 13.7	−2 21 32	G	4819-1532	IRAS 07067-0216
HO Mon	7 10 16.9	+0 25 28	G	0163-1337	HD 293322
WW CMi	7 11 05.9	+4 04 36	G	0171-3567	
BW Mon	7 11 22.2	−1 29 40	G	4815-1732	IRAS 07088-0124
HQ Mon	7 11 33.7	+0 52 07	F	0163-0679	FASTT 179
MW Mon	7 12 23.5	−1 24 52	F	4815-0892	see note
AH Mon	7 12 26.7	−1 52 00	G	4815-1450	IRAS 07099-0146
HR Mon	7 12 32.3	−1 10 31	G	4815-3425	
V386 Mon	7 12 31.7	−3 43 44	A		CSV 987
MX Mon	7 12 33.0	−4 27 14	T	4823-0688	
XX CMi	7 12 57.9	+2 37 32	G	0167-0213	
AK Mon	7 12 49.9	−3 03 29	A		
AI Mon	7 12 50.8	−4 28 39	A		

Notes to Table 2:

CW Mon	Downes *et al.* (1997) position differs slightly in Dec. USNO–A2.0 end figures $54^{\rm s}.55/17''.7$ (epoch 1955.9, in quiescence); AC2000 (Urban *et al.* 1998a): $54^{\rm s}.47/17''.4$ (epoch 1909.083, mp=12.0, in outburst).
DX Mon	IRAS 06454-0204 = [FT96] 214.5-1.8D.
DI Mon	IRAS 06469+0313 = IRC +00130.
V378 Mon	IRAS 06480-0125.
MW Mon	IRAS 07098-0119 = FASTT 344.

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DISCOVERY OF 29-MIN PULSATIONS IN THE CHEMICALLY PECULIAR STAR HD 13038

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The star HD 13038, which is classified as A3 in the Henry Draper catalogue, has Strömgren colours $b - y = 0.102$, $m_1 = 0.213$, $c_1 = 0.866$ and $\beta = 2.860$. The Hβ index is consistent with an early A type, and the metallicity ($\delta m_1 = -0.022$) and luminosity ($\delta c_1 = -0.055$) indices are indicative of strong line blanketing in the Am and Ap stars.

On night JD2451146, HD 13038 was observed photometrically as part of a survey for rapidly oscillating Ap stars in the northern hemisphere being conducted from the Uttar Pradesh State Observatory in Naini Tal. The observations were acquired using the ISRO high-speed photometer attached to the 1-m Sampurnanand telescope of the UPSO. The observations comprise continuous 10-s integrations in Johnson B light. A 30-arcsec aperture was used to minimize the effects of seeing fluctuations and tracking drifts. As we were searching for oscillations in the 6–16 minute range, no comparison stars were observed. The observations were interrupted for occasional measurements of the sky background.

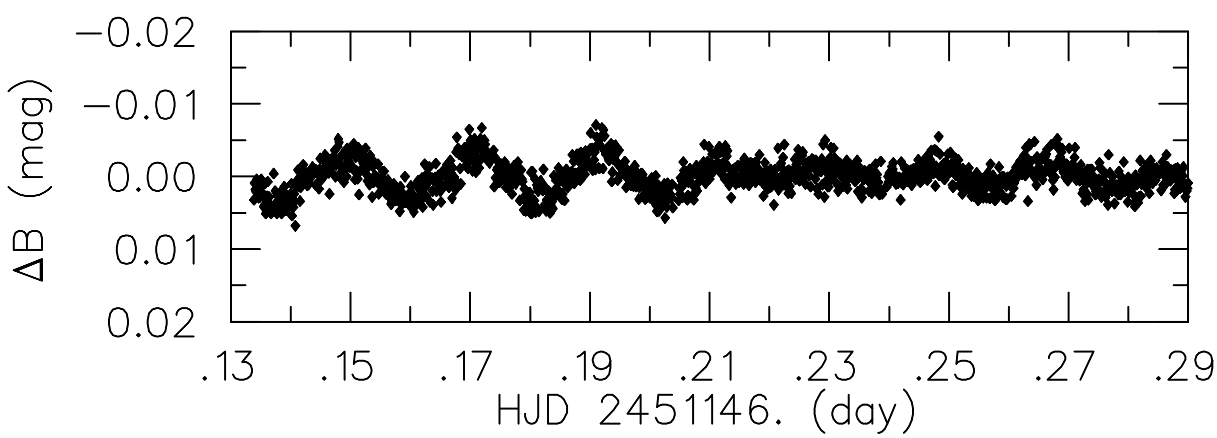

Figure 1. The discovery light curve showing beating.

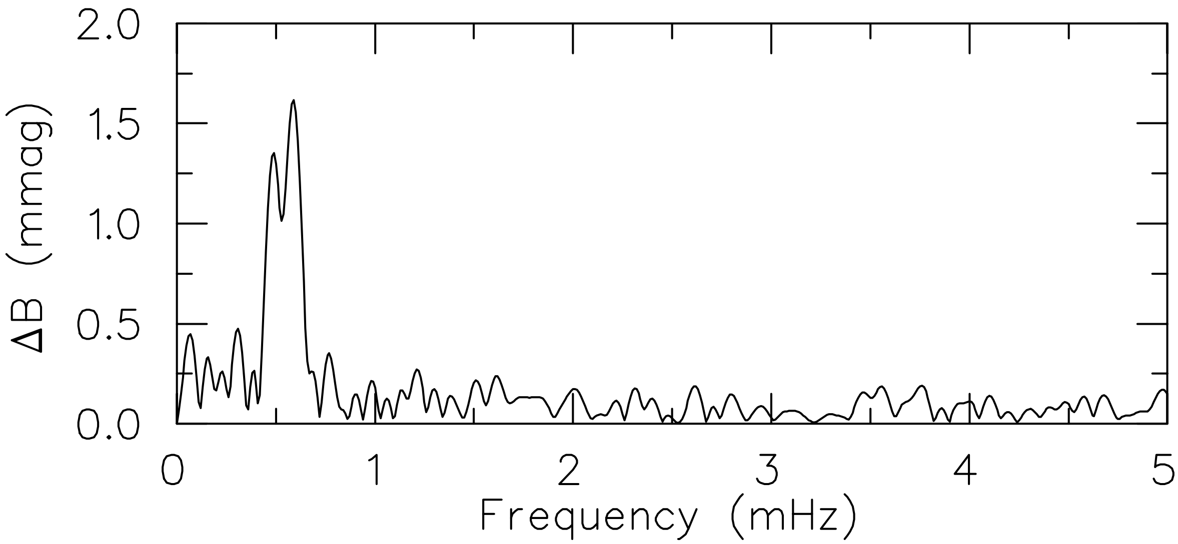

Figure 2. Fourier transform of the discovery light curve.

The data were corrected for coincidence counting ('dead time') losses, sky background and a mean extinction of $\kappa_B = 0\overset{m}{.}26$/airmass, respectively. Since these were single-channel measurements, some sky transparency variations are to be expected in such data. Figure 1 shows the discovery light curve. Notice the change in amplitude, indicative of beating of two or more frequencies.

Figure 2 shows the Fourier transform of the light curve. The Figure shows only frequencies up to 5 mHz, but we have examined all frequencies up to the Nyquist frequency and find no further periodicities. The sky transparency variations (as evidenced by the noise for $\nu \leq 0.5$ mHz) were negligible in this 3.8-hr light curve. The noise at those low frequencies is comparable to the scintillation noise. Such remarkably stable sky transparency is relatively rare, but this Figure demonstrates the photometric quality attainable at Naini Tal on an excellent night.

The bimodal nature of the dominant peak in the Fourier transform indicates that the oscillations are multiperiodic. The frequencies and amplitudes of the two components of this peak are 0.59 mHz/1.61 mmag and 0.49 mHz/1.33 mmag. This corresponds to a beat period of 2.78 hr. We have confirmed the presence of these oscillations and their multiperiodic character on three subsequent nights.

The nature of HD 13038 is unclear. The pulsation periods (28 and 34 min) are much longer than those of the roAp stars (which span 6–16 min) and rather short for δ Scuti stars ($P \geq 1/2$ hr). Moreover, there are no confirmed Ap stars known to exhibit δ Scuti pulsation, although a few ρ Pup stars (evolved marginal Am stars) do, as does the classical Am star HD 1097. To clarify the nature of HD 13038, spectroscopic observations are being acquired. These will be presented together with a detailed frequency analysis in a future publication.

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IDENTIFICATIONS FOR THE HARO-CHAVIRA "INFRARED STARS"

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The first seven extremely-red Haro-Chavira stars were published by Johnson *et al.* (1965), which includes BVRIJHKLMN photometry for them. The positions listed for these stars are consistently nearly a full degree in error, as a consequence of which they seem to have been overlooked in later literature. The offsets are parallel to the direction of precession, and the error evidently arises from the application of 100 years of precession motion with the wrong sign. These stars were unambiguously identified using the published charts, which are copied from the POSS-I prints of the region.

In a follow-up work, Chavira (1967) published a more extensive list of stars based on far-red objective-prism and direct plates. The main difficulty in the identifications was the poor positions, some in error by $10'$. The finder charts were thus indispensable for positive identification on the sky. Two stars (HC 56 and HC 62) defeated my attempts to locate them.

The table shows the HC numbers from the combined list followed by equinox 2000 coordinates. Note that HC 5 was omitted in Johnson *et al.* (1965). An asterisk by the star name indicates a note at the bottom of the table. Column 's' shows the source of the position, coded as follows: A = USNO–2.0, F = FASTT (Henden & Stone 1998), I = IRAS, S = SkyView. After the IRAS names come USNO–A2.0 blue magnitudes and 'b–r' colors (neither are on a standard system), and Johnson I magnitudes (from photoelectric measurements for HC 1-8, and Chavira's eye-estimates from plates for the remainder). The spectral types are mostly from Chavira, but others from the literature are given as available and specified in the Notes. Some new identifications based on the corrected positions are given in the Remarks. A few stars are known or suspected variables, but all certainly are to some degree.

This work was greatly facilitated by the use of SIMBAD, the VizieR catalogue-server from the CDS-Strasbourg, and (*sine qua non*) the Goddard SkyView utility. My thanks to their creators and maintainers for providing them to the astronomical community.

Table 1: Positions and identifications

Name	RA (2000)	Dec	s	IRAS	mb	b−r	I	spec	Remarks
HC 1*	20 34 01.5	+42 25 27	A	20322+4215	19.9	6.7	6.4	M4:	
HC 2*	20 33 01.1	+40 45 41	A	20312+4035	18.0	6.1	5.8	M0	
HC 3*	20 25 30.1	+40 44 37	A	20236+4034	19.4	4.2	8.4		
HC 4*	20 26 55.7	+39 51 04	S				9.0		
HC 6*	20 41 11.2	+41 06 26	S				8.5	M3:	IRC +40440
HC 7*	20 42 24.8	+40 24 48	S	20405+4013			9.3		
HC 8*	20 44 09.6	+40 56 20	A		18.9	6.0	8.2		
HC 9	17 56 34.8	−19 51 01	A	17536−1950	18.2	6.0	8.8	M8	
HC 10	18 03 43.1	−18 41 01	A		18.6	3.8	7.9	M8?	
HC 11	18 04 40.9	−19 17 43	A	18017−1917	18.8	4.6	7.5	M8:	
HC 12	18 05 37.2	−18 27 05	A	18026−1827	20.3	4.3	9.2	M8	
HC 13	18 06 10.4	−17 29 16	A	18032−1729	20.0	2.2	9.3	M8	
HC 14	18 11 24.1	−19 45 53	A	18084−1946	20.6	5.1	8.1		
HC 15*	18 29 32.3	−4 15 34	I	18268−0417			8.9	M7	
HC 16	18 30 46.3	−5 34 29	S	18281−0536			9.3	M7	
HC 17	18 33 57.0	−3 04 37	A		16.3	3.1	9.3		
HC 18*	18 34 37.4	−2 51 22	I	18320−0253			9	M6?	
HC 19	18 37 36.7	−5 54 27	S	18349−0557			9	M7	
HC 20	18 39 40.6	−0 01 25	S	18370−0004			9.4	M6	
HC 21	18 40 21.4	−0 06 52	S	18377−0009			8.9	M8	
HC 22	18 40 30.1	+0 46 09	A	18379+0043	19.7	4.1	9.5	M6	
HC 23	18 40 52.7	+0 45 45	S	18383+0042			9.4	M7	
HC 24	18 40 46.3	+1 09 58	S	18382+0107			9.5	M6	
HC 25	18 41 18.9	−0 31 12	S	18387−0034			8.9	M9	
HC 26	18 42 30.6	+0 07 07	S	18399+0004			8.9	M7	
HC 27*	18 42 34.1	−0 47 26	S				9.6		
HC 28	18 43 13.3	−0 13 38	S	18406−0016			9.4	M7	
HC 29	18 44 22.0	+2 07 41	A	18418+0204	19.8	5.0	9.4	M8	
HC 30*	18 45 19.4	+0 56 19	S				9.5	M7	
HC 31	18 45 56.1	−0 51 57	S	18433−0055			8.4		
HC 32	18 45 57.8	−1 14 17	S	18433−0117			9.5	M7	
HC 33	18 47 00.1	−1 22 39	S	18443−0126			9.5	M6	
HC 34	18 47 02.4	+0 46 52	S	18444+0043			9.5		
HC 35	18 49 25.4	+4 22 35	A	18469+0419	14.3	5.9	7.7	M7	
HC 36	18 49 42.8	+1 41 03	S	18471+0137			8.3		
HC 37	18 49 58.0	−0 24 53	A		18.9	3.6	9.3	M6	crowded
HC 38	18 51 15.3	+3 46 56	S	18487+0343			9.3		
HC 39*	18 50 36.1	−0 29 04	S				9.1		
HC 40	18 50 48.7	+1 25 58	S	18482+0122			8.8		
HC 41	18 51 43.8	+1 05 43	S				9.5	M6	
HC 42	18 52 39.7	+0 11 41	S				9.5	M	variable
HC 43	18 55 01.0	+4 52 34	S				9	M6?	
HC 44	18 54 47.4	+0 25 28	S	18522+0021			7.2	M7?	NSV 11511
HC 45	18 59 51.3	+8 16 48	S	18574+0812			9.4	M9:	EIC 728
HC 46*	19 01 16.3	+9 21 41	S	18588+0917			9.4		
HC 47	19 02 09.9	+4 53 22	S	18596+0448			9	M7	
HC 48	19 02 25.0	+4 49 59	S	18599+0445			8.2		EIC 734
HC 49	19 03 19.0	+5 35 23	S				9.1	M7	
HC 50	19 03 05.0	+8 44 21	S	19006+0839			8.6	M7	
HC 51	19 03 51.8	+8 25 48	S	19014+0821			9.4		
HC 52	19 04 55.8	+8 38 01	S	19025+0833			9.3		
HC 53	19 09 49.9	+7 45 13	S	19074+0740			8.6	M7:	
HC 54	19 11 36.1	+10 05 59	S	19092+1000			8.7	M6	
HC 55	19 12 41.1	+8 32 17	S	19102+0827			8.9		
HC 56*	19 12.7	+9 48					9.4		

Table 1: Positions and identifications (cont'd.)

Name	RA (2000)	Dec	s	IRAS	mb	b−r	I	spec	Remarks
HC 57	19 14 13.3	+11 09 26	S				9.4	M6?	NSV 11835
HC 58	19 14 30.4	+10 50 47	S	19121+1045			9.1	M8:	not PN
HC 59	19 20 04.7	+19 53 23	S	19178+1947			8	M8	OO Sge
HC 60	19 27 53.3	+24 06 27	S	19257+2400			7.5		
HC 61*	19 37 00.4	+21 43 42	S	19348+2136			7.9	M8	NSV 12208
HC 62*	17 56.9	–19 17					7.3	M7	
HC 63	17 58 26.6	–16 32 41	A	17555–1632	18.9	3.5	8.2	M6	
HC 64	18 01 02.5	–20 08 40	S				8		
HC 65	18 03 11.7	–20 05 11	A	18002–2005	17.2	4.5	7	M7:	
HC 66	18 03 36.3	–16 51 08	A	18007–1651	16.6	3.7	7	M7	
HC 67	18 05 27.6	–19 33 13	A	18024–1933	18.5	4.1	8.1	M7	
HC 68*	18 06 14.9	–18 58 55	A	18032–1859	16.8	1.3	8.0	M6	
HC 69*	18 11 56.9	–19 52 22	A	18089–1953	18.4	3.3	8.1	C/S:	CGCS 3964
HC 70	18 31 34.9	−4 44 11	A	18289–0446	19.2	5.3	7.9	M6.5e?	
HC 71	18 32 08.1	−3 58 41	A	18294–0400	19.7	5.3	8.5	M6.5	
HC 72	18 33 06.7	−4 12 41	A	18304–0415	19.7	4.3	9	M6	
HC 73	18 33 43.8	−6 01 30	A	18310–0603	19.3	5.3	8.3	M6?	
HC 74	18 33 45.0	−3 13 30	A	18311–0315	18.9	4.6	8.1	M7	
HC 75	18 36 34.6	−4 22 20	S	18339–0424			8		
HC 76	18 36 35.3	−5 44 49	A	18338–0547	18.3	4.0	7.9	M8	
HC 77	18 37 39.2	−3 53 03	A	18350–0355	18.3	4.3	8.7	M7:	
HC 78	18 42 07.8	−1 05 01	A	18395–0108	19.5	4.7	8.9	M7:	
HC 79	18 42 37.5	−1 23 33	A	18400–0126	19.1	4.5	9	M6	
HC 80	18 44 47.9	+0 22 31	F	18422+0019	19.3	5.7	7.5	M6	FASTT 1187
HC 81	18 45 04.3	−0 46 47	F		19.3	4.6	9	M7:	FASTT 1270
HC 82*	18 46 05.1	−0 03 12	A		19.4	4.8	8.6	M6	
HC 83	18 47 02.4	+1 14 17	A	18444+0110	19.7	4.9	8.7	M6	
HC 84	18 48 10.6	+1 46 39	A	18456+0143	18.7	5.4	7.9	M6	
HC 85	18 48 27.8	+0 21 56	S				8.6	M6	
HC 86	18 49 34.3	+5 57 19	A		17.9	4.6	7.2	M7	
HC 87*	18 49 47.8	+6 00 27	A		17.8	5.1	7	M7	
HC 88	18 50 26.0	+4 36 05	A	18479+0432	19.7	5.9	7	M8:	
HC 89	18 51 42.6	+3 46 37	S	18492+0342			9	M7:	
HC 90	18 51 10.2	+1 35 13	A	18486+0131	19.5	5.0	8	M6	
HC 91	18 52 10.6	+5 51 40	A	18497+0547	19.1	5.1	8.3	M7	
HC 92	18 52 27.4	+5 15 11	A	18499+0511	19.8	4.0	9.4		
HC 93	18 51 38.1	+2 22 28	A		19.2	4.4	8.6		
HC 94	18 52 24.5	+5 34 51	S				9.3	M6.5	
HC 95	18 54 09.1	+6 25 58	A	18517+0622	19.1	4.7	7.2	M7:	
HC 96*	18 54 41.8	+6 24 12	S	18522+0620			9.2	M7:	
HC 97	18 54 02.4	+0 15 35	F	18514+0011	17.7	4.4	7.9	M6	FASTT 1211
HC 98	18 56 23.8	+4 45 14	A		19.4	4.9	7.2	M8	
HC 99	19 00 18.0	+10 11 18	A	18579+1006	18.5	4.2	8	M7	
HC 100	19 00 50.3	+9 12 24	S	18584+0908			9.3		
HC 101	19 02 05.8	+9 23 14	A	18597+0918	19.2	3.9	8.6	M6	
HC 102	19 02 13.1	+9 11 28	A	18598+0907	19.5	4.3	8.5	M6	
HC 103	19 03 26.4	+3 43 06	A	19008+0338	17.0	3.1	9	M7:	
HC 104	19 08 28.3	+14 58 55	A	19061+1454	18.4	3.9	7.9		
HC 105	19 10 39.1	+10 13 06	S	19082+1008			8.8	M7:	
HC 106	19 11 15.0	+11 12 21	A	19088+1107	18.4	4.3	8.5	M6	
HC 107	19 13 10.0	+9 46 13	A	19107+0941	19.1	5.3	8.4	M6	
HC 108	19 13 53.0	+8 44 12	A		18.3	3.8	8.7	M6.5	
HC 109	19 14 14.5	+7 45 26	A	19118+0740	19.7	4.8	8.8	M6	
HC 110	19 16 13.1	+12 18 18	A	19138+1212	19.0	5.3	7.5	M7	

Table 1: Positions and identifications (cont'd.)

Name	RA (2000)	Dec	s	IRAS	mb	b−r	I	spec	Remarks
HC 111	19 16 55.9	+13 09 04	A	19146+1303	19.1	4.2	7.8	M6	
HC 112	19 18 10.7	+13 45 19	A	19158+1339	18.1	4.4	7.4	M7:	
HC 113	19 19 38.5	+14 05 57	S	19173+1400			7.8	M6.5	
HC 114	19 19 55.8	+12 54 36	S	19176+1248			6.6		
HC 115	19 21 55.7	+20 12 11	A	19197+2006	19.1	4.6	8.8	M8	
HC 116	19 22 01.3	+19 44 40	A	19198+1938	19.1	4.4	8.8	M7	
HC 117	19 23 27.3	+18 38 05	A		19.4	4.2	8.9	M7:	
HC 118	19 24 16.7	+17 23 51	A	19220+1717	20.2	4.9	9	M7	
HC 119	19 24 48.4	+19 48 18	A		19.8	4.4	8.6	M6	
HC 120	19 25 15.6	+18 55 26	A	19230+1849	19.6	4.9	8.9	M6?	
HC 121	19 26 19.1	+16 40 32	A	19240+1634	18.5	3.8	7.8	M8	NSV 12022
HC 122	19 26 17.0	+18 12 16	A	19240+1806	20.2	4.8	6.7	M9:	PV Sge
HC 123	19 28 04.9	+23 48 38	A	19259+2342	18.2	4.2	8.3	M7	
HC 124	19 28 57.8	+20 54 24	A	19267+2048	18.3	4.5	8.6	M7:	
HC 125	19 29 27.5	+18 39 40	A		19.3	4.9	8.9		
HC 126	19 29 41.2	+18 42 08	A	19274+1835	19.9	6.2	8	M8	

Notes:

HC 1 SIMBAD position slightly in error, spectral type from Pesch (1967).
HC 2 GSC 3157-0317; SIMBAD position somewhat in error, spectral type from Kwok *et al.* (1997).
HC 3 eastern of two stars.
HC 4 eastern star of merged pair.
HC 6 also StRS 381, spectral type from Pesch (1967); M0I in Imanishi *et al.* (1996), and M3/4III in Goto *et al.* (1997).
HC 7 western star of merged pair.
HC 8 northwestern star of merged pair.
HC 15 extremely faint on DSS, IRAS coordinates roughly confirmed.
HC 18 not visible on DSS, IRAS coordinates roughly confirmed on POSS-II IIIa-F film.
HC 27 northeastern star of pair; just outside error ellipse of IRAS 18399–0050.
HC 30 if chart ID is correct, this is *not* IRAS 18427+0053 = FASTT 1171.
HC 39 outside error ellipse of IRAS 18480–0032.
HC 46 near edge of IRAS error ellipse.
HC 56 not found; nominal Chavira coordinates shown.
HC 61 just outside IRAS error ellipse.
HC 62 not found; nominal Chavira coordinates shown.
HC 68 very faint on DSS.
HC 69 spectral type from Kwok *et al.* (1997).
HC 82 eastern star of merged pair.
HC 87 near but outside error ellipse of IRAS 18472+0556.
HC 96 Chavira chart has south up, east right.

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THE SUDDEN PERIOD CHANGE OF VV CEPHEI

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VV Cep (HD 208816, HR 8383) is known as a massive eclipsing binary consisting of an M supergiant and a Be companion showing strong Balmer and [FeII] emission lines (Cowley 1969). The orbital period, based on photometric data, is 7430^{d} (Gaposchkin 1937, Saitō et al. 1980) and the eclipses are apparently total. Wright (1977) has found the spectroscopic orbits of both components from the radial velocity measurements of some neutral atomic lines of the M component and the Hα emissions from an envelope of the hot companion. Assuming the inclination 77° he calculated the masses and sizes of both components concluding that M supergiant does not fill up its Roche lobe. However, quite large eccentricity ($e = 0.346$) indicates that some mass transfer events may exist near the periastron passage, when temporary Roche-lobe overflow drives a stream which forms an accretion disk around the Be companion (Wright 1977, Stencel et al. 1993).

The nature of the hot companion has attracted much attention over the last years. In particular the spectral type and temperature of the B star remain very uncertain. Estimates range from early B or even O (Hutchings & Wright 1971, Stencel et al. 1993) to as late as A0 (Hack et al. 1989).

We have observed VV Cep as a part of a project of UBVRI photometric monitoring of long period binaries. We used one-channel photometer with the 60-cm Cassegrain telescope at the Piwnice Observatory. The UBV realization was very close to the original Johnson's response curves, while R and I bands were centered at *shorter* effective wavelengths of 638 nm and 740 nm, respectively. As the comparison star 20 Cep has been used.

Figure 1 presents our light curves of VV Cep in the UBV bands, covering the period from 1991 to the end of 1998. The large scatter of the observed magnitudes is due to intrinsic variability of both components: semiregular pulsations of the M supergiant (visible in B and V light curves) and random fluctuations of the hot component (seen mainly in U light curve). The amplitudes of the variations were about $0\overset{m}{.}3$ in the UBV bands and about $0\overset{m}{.}2$ in the I and R bands. The eclipse is very well seen in ultraviolet and blue light. In the V light the eclipse is difficult to detect because the amplitude of the M supergiant's pulsations is over three times larger than the depth of the minimum. The period of the semiregular pulsation over the whole eclipse is about 114 d and corresponds very well to the previously reported periods which range from 110 to 118 d (Saitō et al. 1980).

We have analyzed the U−B, B−V, V−R colour curves. This allows us to remove much of the intrinsic variations of the supergiant, in particular its pulsations.

The eclipse duration was calculated using U−B, B−V curves where the eclipse is clearly visible. The eclipse began just after JD 2450541 and ended just before JD 2451177 in both colours. The totality phase seems not to be longer than 450 d in U−B and 477 d in B−V colour. This indicates that the 1997/98 eclipse was similar to the 1957/58 one (Larsson-Leander 1957, 1959) in the duration of totality phase and partial phases (Fig. 2). The previous 1977/78 eclipse (Fig. 3) seems to be different in some aspects: it was asymmetric, with shorter totality phase and longer total duration (Saitō et al. 1980).

The most surprising feature of the eclipse is the disagreement between the observed time of mid-eclipse and the predicted time based on the Gaposchkin's (1937) ephemeris (Fig. 4). The ephemeris gives JD 2450790 for the mid-eclipse time, while the observations (Fig. 2, 3) clearly show that it occurred at around JD 2450855. This means that the mid-eclipse occurred 65 d *later* than expected from the ephemeris. There are two probable reasons for such event: (i) inappropriate Gaposchkin's elements; (ii) the secular or even sudden change of period in VV Cep. We inspected diagram O−C (Fig. 4) for the past five eclipses observed since 1890 and recalculated the times of minima, but we did not find any systematic deviation from the Gaposchkin's elements (see e.g. Saitō et al. 1980). This means that a sudden increase of about 1% in the orbital period occurred between the two last eclipses!

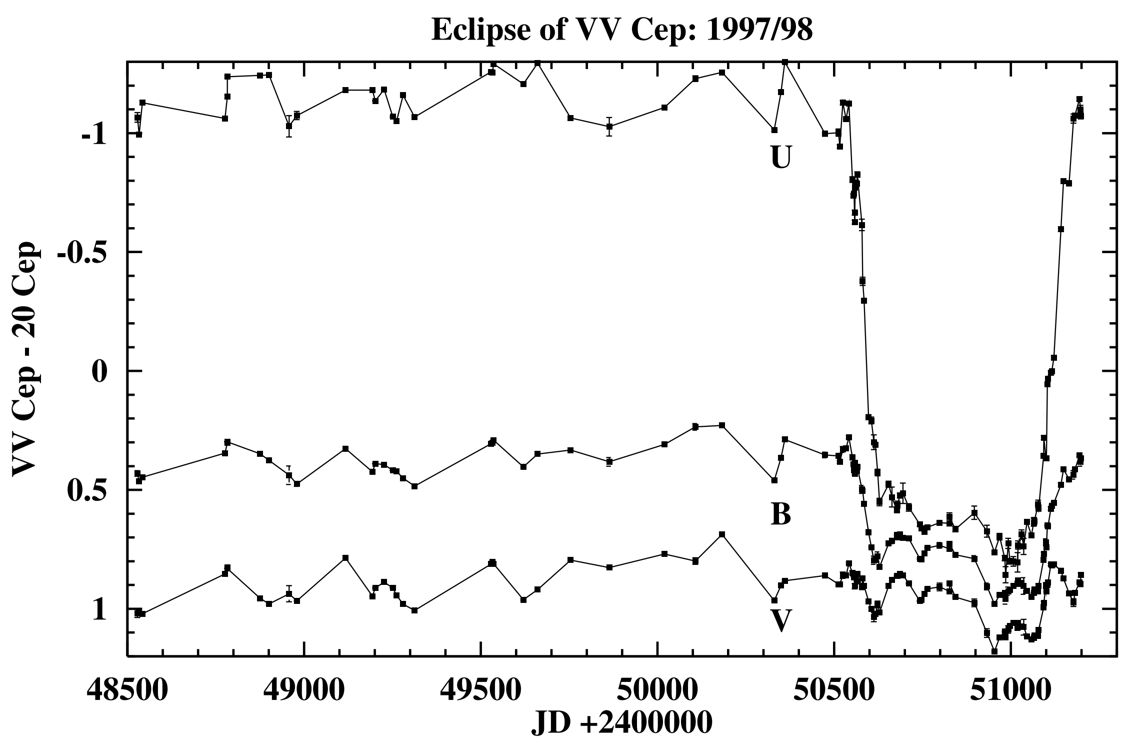

Figure 1. The latest part of the UBV light curves of VV Cep including the 1997/98 eclipse. The comparison star was 20 Cep and its variability was smaller than reported by Saitō (1978). The B and V light curves are shifted by +0.2 mag. and +1.0 mag. respectively. The errors of individual observations are drawn with bars and for most of the nights are smaller than 0.006 for B, V and 0.010 for U band.

The well-known reasons for the period change in binaries are: 1) mass transfer between components, 2) ejection of some amount of mass from a system, or 3) presence of a third body. The sudden increase of the period suggests the first possibility (that is the mass transfer between less massive donor to more massive gainer) or the second one.

Assuming, that the change in the period is caused entirely by a rapid mass-loss event from the M star (the second scenario) we can calculate the total mass ejected during the period of last 20 years. There are two dynamical solutions conceivable in the case of VV Cep system. The first one is the result of the Wright's spectroscopic orbit of the hot component. It is a massive system ($40M_\odot$) with the mass ratio $q = M_{\rm M}/M_{\rm B}$ very close to unity. In this case we obtained the value of the total ejected mass of the order of 0.1 solar mass! This gives the lower limit of the mass loss rate of $\dot{M} = 5 \times 10^{-3} M_\odot\,{\rm yr}^{-1}$. We propose the second possibility: the *medium mass model* with mass ratio $0.2 \leq q \leq 0.3$. In such a case, rejecting questionable spectroscopic solution for the hot component and using well-defined mass function for the M star $f(m) = 4.68 \pm 0.44$, we get the mass of a B star of about $8M_\odot$ (typical for early B main-sequence star) and the mass of M star about $2.5M_\odot$ (it corresponds to early AGB phase rather than to supergiants). This gives the total mass ejection of about $0.008M_\odot$ and mass loss rate of $\dot{M} = 4 \times 10^{-4} M_\odot\,{\rm yr}^{-1}$ which is consistent with the estimates of the upper limits of mass loss rate from the M-component in VV Cep (Stencel et al. 1993, Kawabata & Saitō 1997). Assuming that the change of period is caused by a mass transfer (the first scenario) we get the mass transfer rate of $5 \times 10^{-2} M_\odot\,{\rm yr}^{-1}$ for $q = 1$ and $5 \times 10^{-4} M_\odot\,{\rm yr}^{-1}$ for $q = 0.3$. These calculations also advocate the low mass model of the VV Cep system.

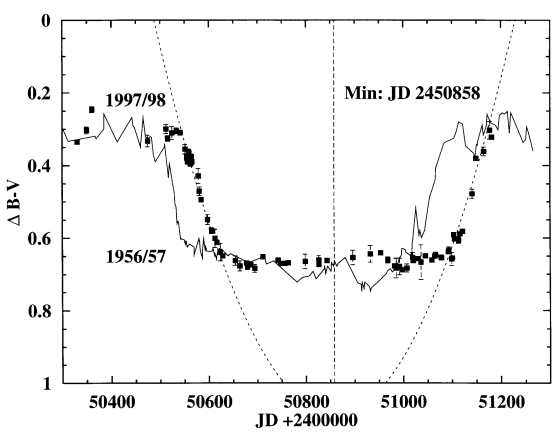

Figure 2. The 1997/98 eclipse in B−V (points) and the 1956/57 eclipse in similar P−V (solid line, Larsson-Leander 1957, 1959) shifted according to Gaposchkin's ephemeris by $+2 \times 7430^{\rm d}$. The dashed line is a simple parabolic fit to the shoulders of the eclipse setting the time of mid-eclipse at JD 2450858. Note that both eclipses are symmetric and of similarity in the depth and shape.

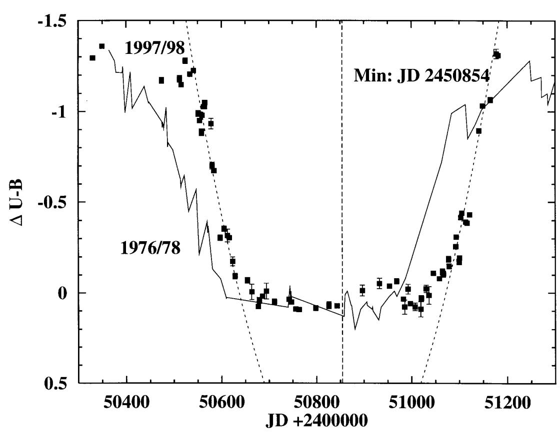

Figure 3. The 1997/98 eclipse in U−B (points) and 1976/78 eclipse in 3500 Å–4170 Å colour (solid line, Saitō et al. 1980) shifted by $+7430^{\rm d}$. The dashed line is a parabolic fit to observed shoulders and the time of mid-eclipse is JD +2450854. The minima are slightly different in the shape and the duration of the totality.

Table 1 reports colours and V magnitudes of VV Cep and 20 Cep. The depth of the eclipse does not differ significantly from the last one in 1977 (Saitō et al. 1980). The colours of the B component corresponds to B1 V main sequence star with $E({\rm B}-{\rm V}) = 0.63$. However, this reddening seems to be overestimated in the case of M component.

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Table 1: Colours and V magnitudes for the both components of VV Cep and the comparison star 20 Cep. The colours of VV Cep during totality were adopted for the M component. The UBVR magnitudes of 20 Cep were transformed to Johnson system from Argue (1966, 1967).

Star	U−B	B−V	V−R	V
VV Cep, outside eclipse	0.43	1.73	1.45	5.14
VV Cep, M component	1.82	2.07	1.52	5.25
VV Cep, B component	−0.52	0.36	∼0.4	7.68
20 Cep	1.78	1.41	1.10	5.27

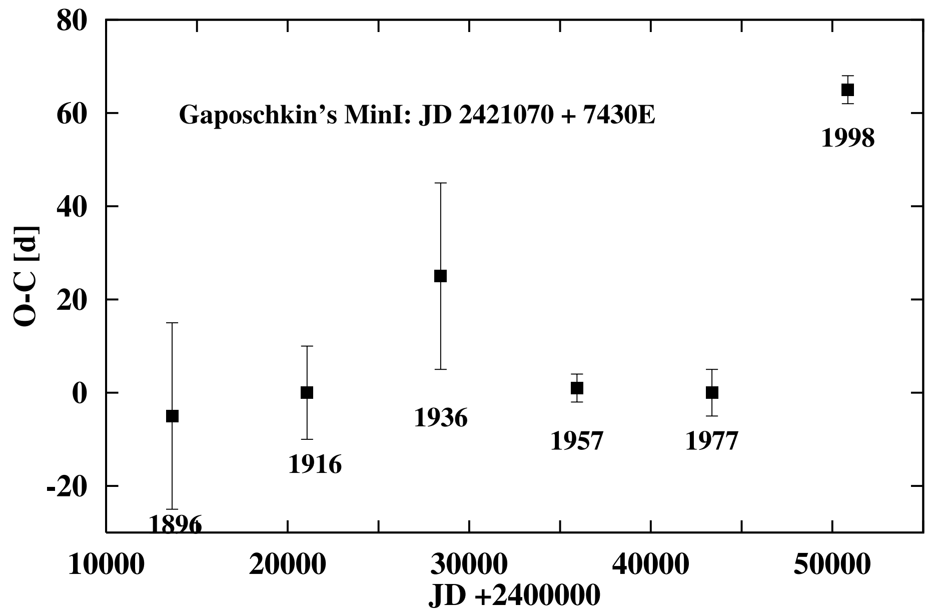

Figure 4. The O−C diagram for the orbital period of the VV Cep system. The times and errors of the first three eclipses were estimated graphically using published photographic light curves by Gaposchkin (1937). The O−C of 1997/1998 eclipse obviously indicates a sudden large change in the orbital period between the last two minima.

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THE REVISION OF APSIDAL MOTION IN V541 Cyg: NO DISCREPANCY WITH THEORY

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The eclipsing binary V541 Cyg (GSC 2656.3703, $V_{\rm max} = 10^{\rm m}_{.}35$, $P = 15^{\rm d}_{.}34$) was discovered by Kulikowski (1953). It is a detached pair of nearly equal stars (B9.5 V + B9.5 V) with a highly eccentric orbit (e = 0.48). The light curve has two deep minima: Min I = $0^{\rm m}_{.}728$, Min II = $0^{\rm m}_{.}713$ V, the primary one being three times longer than the secondary one (DI = $0^{\rm P}_{.}0480$, DII = $0^{\rm P}_{.}0165$). The relativistic term should dominate in the apsidal advance of the orbit: $\dot\omega_{\rm rel}/\dot\omega_{\rm class} = 5.7$ – the highest rate among such systems.

Khaliullin (1985) was the first to obtain a photoelectric light curve and to calculate a photometric orbit of V541 Cyg. Using the photographic light curve published 20 years earlier by Karpowicz (1961), he also found the apsidal motion in the system not to be in conflict with the theory, though in wide error limits. Wolf (1995), Guinan et al. (1996) concluded from more numerous eclipse times that the observed rate of apsidal advance was significantly slower than that expected by theory. Lacy (1998) provided the first spectroscopic orbit and calculated, for the first time, the absolute properties of the system. His data yielded the theoretical rate of apsidal advance to be as:

$$\dot\omega_{\rm theor} = \dot\omega_{\rm rel} + \dot\omega_{\rm class} = 0^\circ_{.}74 + 0^\circ_{.}15 = 0^\circ_{.}89 \pm 0^\circ_{.}03/100\,{\rm yr}.$$

At the same time, Lacy calculated, from 8 photoelectric times of minima, the observed rate of the periastron advance to be: $\dot\omega_{\rm obs} = 0^\circ_{.}60 \pm 0^\circ_{.}1/100\,{\rm yr}$ – 67% of the predicted value. Having in mind the short (only 15 years) history of photoelectric observations of minima and their small number, one could not expect this value to be final. So we have continued observations of the star and reanalysed all timings of light minima available from literature in order to get a more accurate value of $\dot\omega_{\rm obs}$.

We observed the star in September–November 1998 at the Moscow (70-cm reflector) and at the Crimean (60-cm reflector) observatories of Moscow University with the help of UBV photometer (EMI 9789) constructed by I. M. Volkov. We used GSC 2656.4241 ($10^{\rm m}_{.}0$ V, A2V) as the comparison star and GSC 2656.1627 ($9^{\rm m}_{.}6$ V, F0V) as the check one. During one night we observed a secondary minimum and combining the observations of three nights we have reconstructed one primary minimum. All observations were obtained in V band, close to the standard Johnson's V system. We have got 589 individual points during 5 nights. The resulting light curve is represented in Figure 1. Every point in this plot represents the mean value of 2 or 3 individual points. Observations by Khaliullin (1985) were analysed along with our new data according to common procedure, and the

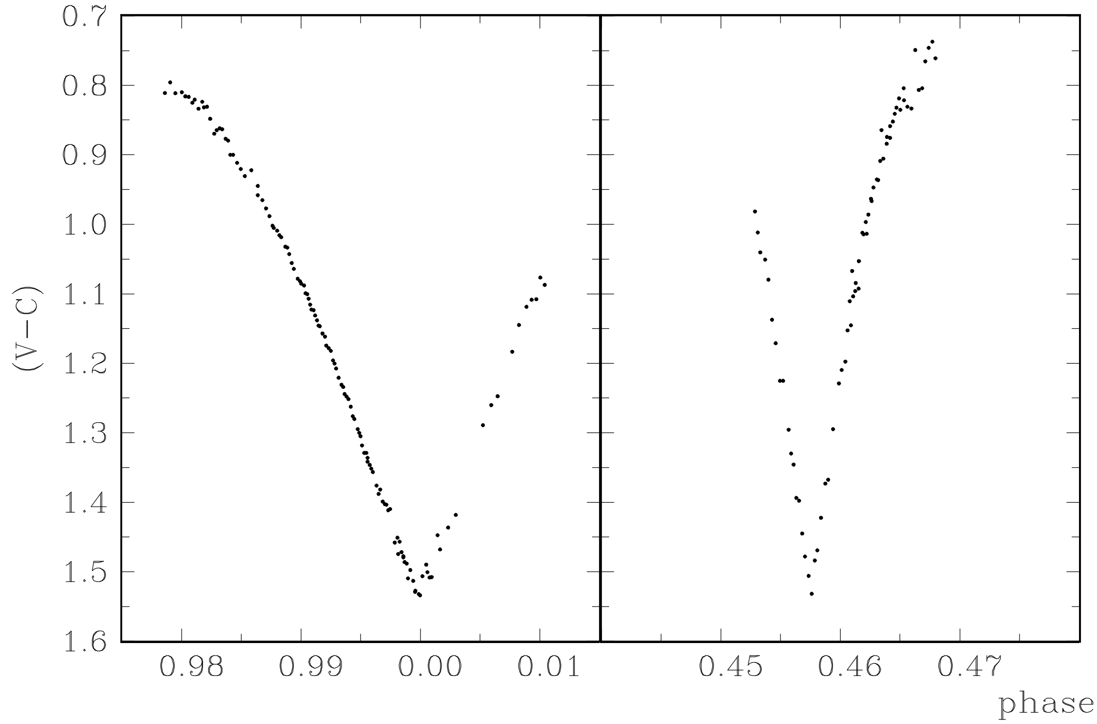

Figure 1. A plot of the V–band light curve.

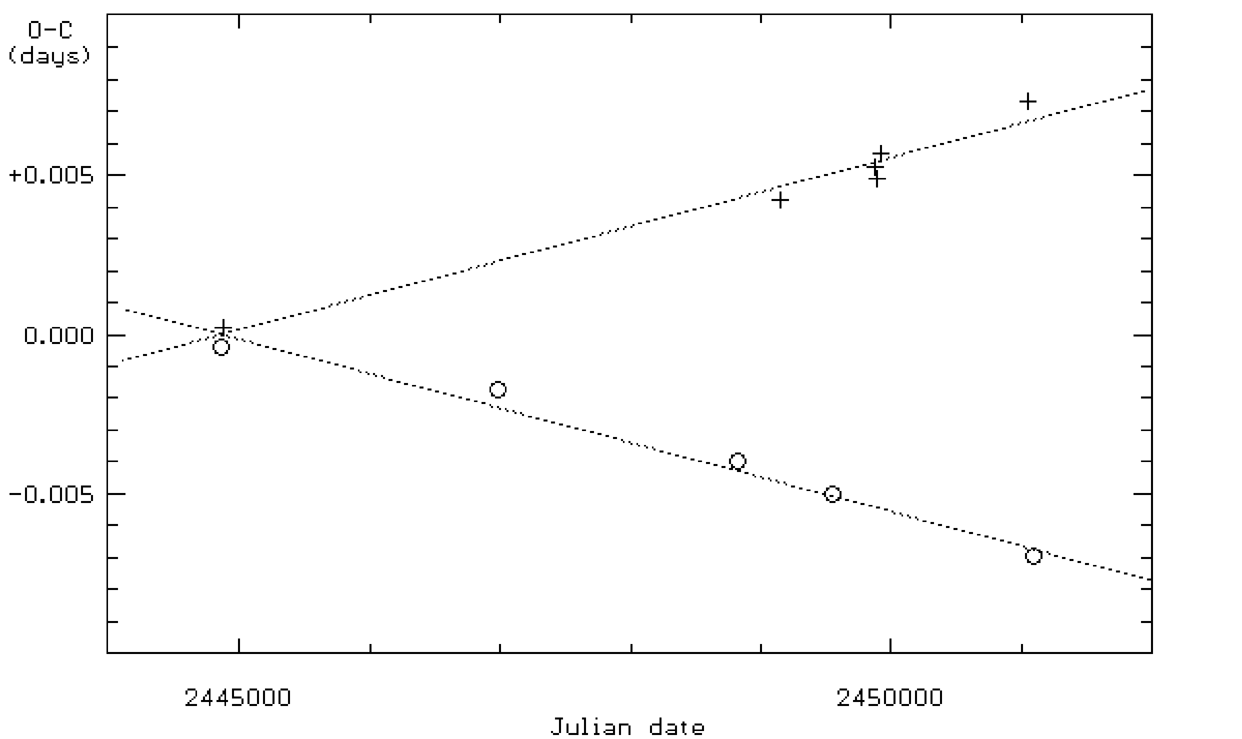

Figure 2. The residuals for the times of minima of V541 Cyg showing the difference of periods. The individual primary and secondary minima are denoted by circles and crosses respectively.

Table 1: Timings of light minima for V541 Cyg

MinI$_\odot$ 24...	(O−C), d	Source
44882.2148	−0.00044	Khaliullin (1985)
44889.2196	+0.00021	Khaliullin (1985)
46998.8424	+0.00054	Lines et al. (1989)
49168.4951	−0.00040	Agerer (1994)
48839.3870	+0.00025	Diethelm (1992)
49560.2668	−0.00003	Lacy et al. (1995)
49889.3770	−0.00015	Wolf (1995)
49904.7145	−0.00055	Guinan et al. (1996)
49935.3911	+0.00023	Lacy et al. (1998)
51070.3967	+0.00065	present paper
51109.3918	−0.00032	present paper

resulting times of light minima are collected in Table 1. We put photoelectric timings by other authors in this Table too. We have checked all available data including old photographic and visual observations, but they happened to be of no use despite of great time gap between their epoch and the modern one. Moreover, we had to exclude some photoelectric timings with errors exceeding 5σ limit. We did not use observations by Diethelm (1995) – 11 CCD points in secondary minimum and Diethelm (1996) – 24 CCD points in primary minimum. Maybe the small number of observations resulted in the poor accuracy of these timings. So 5 primary and 6 secondary minima make up the resulting Table. Mean errors of individual moments are $\pm0\overset{d}{.}00040$ for primary minima and $\pm0\overset{d}{.}00045$ for secondary ones. Analysing these data with the least–squares method one can obtain the following ephemeris:

$$\mathrm{MinI}_\odot = \underset{\pm 2}{2444882.2152} + \underset{\pm 10}{15\overset{d}{.}3378740} \times E,$$

$$\mathrm{MinII}_\odot = \underset{\pm 2}{2444889.2194} + \underset{\pm 11}{15\overset{d}{.}3379072} \times E.$$

The difference of the two periods is illustrated by the graph in Figure 2, where circles designate primary minima and crosses, a secondary minima. This diagram is plotted with the mean period. The two periods differ by:

$$\Delta\mathrm{P} = \mathrm{PII} - \mathrm{PI} = \underset{\pm 20}{0\overset{d}{.}0000332} = \underset{\pm 17}{2\overset{s}{.}87}.$$

Using the traditional procedure and absolute parameters of V541 Cyg from Lacy (1998), we obtain: $\dot\omega_{\rm obs} = 0\overset{\circ}{.}86 \pm 0\overset{\circ}{.}05/100\,\mathrm{yr}$, or the period of apsidal rotation: U = 41675 ± 2500 years. Comparing this result with the theory, we see that there is no discrepancy between theory and observations within error limits:

$$\dot\omega_{\rm theor} = \underset{\pm 3}{0\overset{\circ}{.}89} \simeq \underset{\pm 5}{0\overset{\circ}{.}86} = \dot\omega_{\rm obs}.$$

We suggest, for subsequent investigations of the system, to use moments for Khaliullin (1985) data from our present paper, as here they were recalculated with better accuracy. We are ready to provide all our data including Khaliullin's old points via e-mail.

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NEW TIMES OF MINIMA AND UPDATED EPHEMERIDES OF SELECTED CONTACT BINARIES

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The period variation of contact binary systems of the W UMa-type is a controversial issue of binary star astrophysics. It is known that W UMa-stars show a wide variety of period change (Kreiner, 1977), but the cause of the long- as well as short-term variations is still a mystery (see e.g. Kalimeris *et al.*, 1994 for a discussion of possible physical mechanisms). There are pieces of evidence that the observed period variations of contact binaries are basically random phenomena (van't Veer, 1991; Rucinski, 1993), besides the occasional light-time effect caused by a third component. On the other hand, it was pointed out very recently by Kaszás *et al.* (1998) that the period variation of VW Cep seems to be also affected by the magnetic activity cycle.

The aim of this paper is twofold: first, to present new times of minima of bright W UMa-systems in order to contribute to the period variation studies, and second, to provide up-to-date accurate ephemerides of a sample of W UMas that can be used to predict orbital phases in the present and the next few observing seasons. Such ephemerides are essential to perform high-resolution spectroscopic studies, where the accurate phase of the system that can be assigned to the observed spectrum must be precisely known.

We obtained Johnson BV photometric measurements of the W UMa-stars listed in the first column of Table 1, with the 40 cm Cassegrain telescope at Szeged Observatory between 1995 and 1998. A sample light- and colour curve of SW Lac illustrating the photometric accuracy is plotted in Fig. 1 as a function of phase. The times of minima calculated by low-order polynomial fitting to the data points close to the particular minimum are collected in the second column of Table 1. The typical uncertainty of these moments is ± 0.0005 day.

We have also collected recently published times of minima for a sample of bright W UMa-stars that were selected for targets of our spectroscopic observing program. The spectroscopic results will be published elsewhere. Here we present the updated ephemerides of these program stars that can be used for calculating phases accurate to ± 0.01 during the next observing season (provided the systems do not exhibit sudden and violent period changes in the meantime).

W UMa-stars usually change their period slowly but continuously over time, and it can seldom be described as a linear period variation. Since the purpose of our study was to find approximate periods for a limited duration, we restricted the time base of our study only to the past five years. $O-C$ diagrams were computed for all program stars

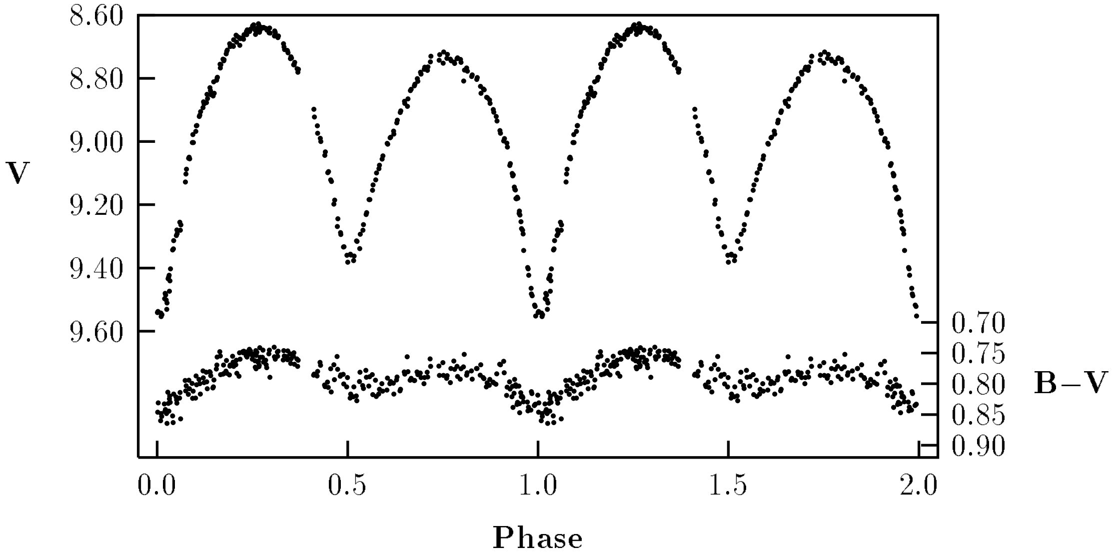

Figure 1. Light- and colour curve of SW Lac

Table 1: New times of minima of W UMa systems

Star	Min (Hel.JD) 2 400 000+	type	Star	Min (Hel.JD) 2 400 000+	type
44i Boo	49828.5515	II	U Peg	50728.3701	II
	49830.5611	I		50728.5567	I
	49841.4052	II		50750.2953	I
	49841.5414	I			
	50180.4658	II	VW Cep	50707.2843	II
	50182.4747	I		50707.4248	I
	50941.3394	II			
	50942.4089	II	XY Leo	49828.3876	II
	50942.5450	I		50195.3114	I
				50196.3080	II
AB And	50702.3634	II		50508.3982	I
	50702.5283	I		50513.3698	II
				50519.3377	II
SW Lac	50694.3642	II		50547.3229	I
	50700.2965	I		50862.3933	I
	51035.4430	I		50862.5359	II

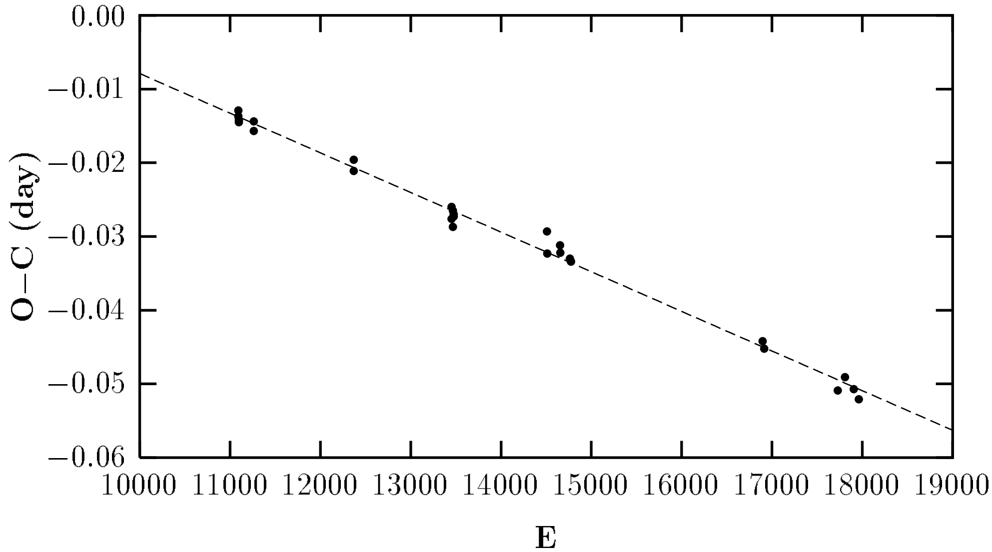

Figure 2. The $O-C$ diagram of SW Lac as a function of the cycle number E

Table 2: New ephemerides of selected W UMa-stars.

Star	T Min I (HJD 2 400 000+)	Period (days)	ΔP (10^{-6} day)	$\Delta P/\Delta T$ (10^{-10})
AB And	51000.2368	0.33189103	−1.11784	−0.752
OO Aql	51000.1473	0.50678964	+1.16731	+0.936
VW Cep	51000.2054	0.27830821	−6.38711	−9.339
DK Cyg	51000.0999	0.47069290	+2.35766	+1.808
V1073 Cyg	51000.2912	0.78585079	−8.90802	−7.228
LS Del	51000.2257	0.36384021	+3.41065	+5.826
SW Lac	51000.1656	0.32071552	−5.37688	−9.398
U Peg	51000.2713	0.37477746	−3.97695	−2.740

using the data published recently in *IBVS* and the ephemerides in *GCVS*. In all cases the $O-C$ diagrams could be well approximated with a straight line, and linear least-squares fit provided the correction of the period and the epoch as the fitted slope and the zero-point, respectively. An example of the computed $O-C$ diagrams and the fitted line is plotted in Fig 2 in order to illustrate the validity of the linear approximation of the $O-C$ diagram over the studied time interval. The list of individual moments of minima and their references for all stars can be requested from the first author of this paper via e-mail.

Table 2 presents the newly inferred ephemerides together with the ΔP differences (in 10^{-6} day) between the periods presented in this paper and those listed in *GCVS*, and the approximate rate of the period change $\Delta P/\Delta T$ (in 10^{-10} day/day) where ΔT is the difference between the current epochs and those in *GCVS*. ΔP may give some hints about usefulness of older periods in calculating orbital phases, while the other parameter is a rough measure of the stability of the period over a few thousand days, although this is obviously not a proper representation of the actual period variation, which would require much longer samples and correct treatment of non-linear terms in the fitting.

It is apparent from Table 2 that both the increase and the decrease of the period can be observed among the W UMa-stars analyzed here. This is a well-known property of contact binaries and it can be confirmed by larger statistical samples (e.g. Kreiner, 1977). If one assumes that these systems remain in stable contact configuration and the total mass of the system is constant then the increase of the period corresponds to a mass transfer from the less massive to the more massive component (thus, decreasing the mass ratio), while in the case of period decrease the direction of the mass transfer is reversed (i.e. the mass ratio is increasing). The thermal-relaxation oscillation theory of contact binaries (Lucy & Wilson, 1979) proposes such kind of mass transfers as the system is oscillating around the marginal contact state being temporarily in contact and non-contact phases. In this picture the systems with increasing period (OO Aql, DK Cyg, LS Del) are before the broken-contact phase, while the systems with decreasing period (AB And, VW Cep, U Peg, SW Lac, V1073 Cyg) are after that.

Concerning the speed of the observed period variations, it can be seen in Table 2 that the period variation rates are about the same order of magnitude, 10^{-9}–10^{-10} day/day for all systems studied in this paper. Model calculations by Mochnacki (1981) give about $\tau \approx 10^9$ years as the lifetime of contact binaries due to magnetic braking. A rough estimate of the theoretical period variation rate of the contact binary is $1/\tau$ day/day, therefore, the period variation rates in Table 2 are at least an order of magnitude higher than the prediction by the magnetic braking mechanism. However, more precise treatment of much more extensive observational data are necessary to address these questions in a satisfactory and more detailed way.

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A STUDY OF THE MICROVARIABLE STAR V1674 CYGNI

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V1674 Cyg (BD +34°3816) was discovered as a microvariable star by Walker and Quintanilla (1978) (WQ) during their study of the X-ray binary Cyg X-1 (V1357 Cyg), which is located 53″ South. The star had shown both long time non-periodic variations (in the range of $10^{\rm m}.555$–$10^{\rm m}.570$ B), and periodic variations with the components $P_1 = 1^{\rm d}.3608$ ($A_1 = 0^{\rm m}.0037$) and $P_2 = 0^{\rm d}.8055$ ($A_2 = 0^{\rm m}.0032$). Karitskaya and Goranskij (1996) confirm the variability in the range of $10^{\rm m}.012$–$10^{\rm m}.035$ V with one of two possible periods, $P_1 = 4^{\rm d}.223$ or $P_2 = 1^{\rm d}.3009$. Lyuty (1972), Rössiger and Luthardt (1989) considered this star to be constant, and selected it as a comparison star for their photometry of Cyg X-1. Some observers use this star for comparison purposes due to its colour close to that of Cyg X-1, or due to lack of other available stars in small CCD fields. So the knowledge of photometric behaviour of V1674 Cyg will be useful to treat the earlier observations of Cyg X-1.

We monitored V1674 Cyg in the course of our photometric study of Cyg X-1 during four seasons in 1995–1998 (JD 2450009–51040). The observations were carried out with the 100 cm reflector of Tien-Shan observatory (Kazakhstan) using the four-channel WBVR photometer with dichroic beam-splitters (Kornilov, 1998), and with the 48 cm reflector of Mt. Maidanak observatory (Uzbekistan) using a single-channel UBVR photometer. The comparison and check stars were BD +34°3812 (A2) and BD +35°3895 (A0). A total of 581 BVR observations were taken in 89 nights. Additionally we have U and instrumental ultraviolet (w) band measurements. A small systematic difference between the two data sets was found in the mean magnitudes, and eliminated. The observations have the accuracy equal to 3–5 mmag in each of B, V and R bands (three nights with lower accuracy were averaged and also used in the calculations). The frequency analysis in B, V and R bands shows, in general, similar results, because the colour changes are almost within detection limits. So here we show only 'smoothed B band measurements' calculated with the formula $B_s = (B + V + R + \langle B - V\rangle + \langle B - R\rangle)/3$, to decrease the noise in the set.

Figure 1a shows the amplitude spectrum of V1674 Cyg which covers the range of periods between $0^{\rm d}.1$ and $1000^{\rm d}$. The spectrum resembles that calculated by WQ after eliminating the non-periodic variations in WQ data. Both spectra have double peaks,

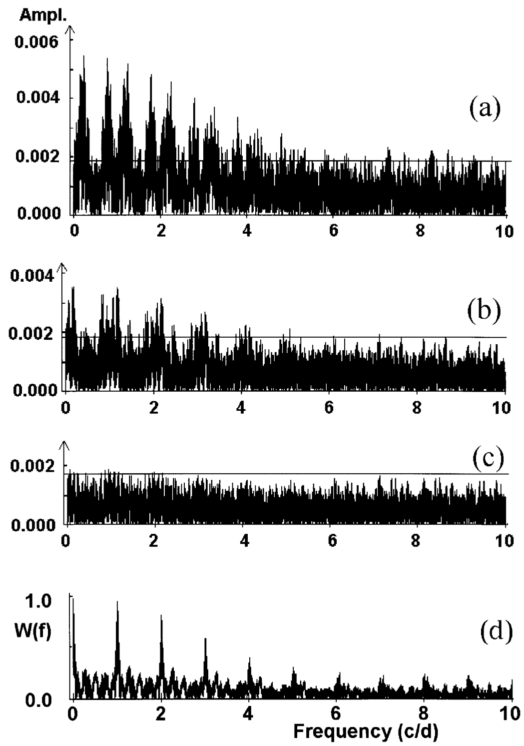

Figure 1. The amplitude spectra of the initial set (a); of the residual set after prewhitening for P_1 (b); of the residual set after prewhitening for P_1 and P_4 (c); spectral window (d).

their height being 30 per cent larger in our spectrum. Undoubtedly, the star is a periodic variable. We made a digital experiment described by Terebizh (1992) to estimate the statistical significance of the peaks in the spectrum. For each time of an observational data point, we chose an accidential magnitude from the list of observations. So we mixed the list of star magnitudes for the given list of times of observations. The mixed chaotic set preserves the distributions of magnitudes and times of the initial set. The horizontal line marks the highest amplitude level of 1.8 mmag for the chaotic set's spectrum achieved in 10^5 realizations of light curves with the trial periods, so the probability of accidental appearance of peak with this amplitude is less than 10^{-5}. The largest peaks of the real set have the amplitude of 5.4 mmag. So they are reliable with a probability more than 99.999 per cent.

The periods of the three predominating peaks are the following: $P_1 = 4\overset{d}{.}272 \pm 0\overset{d}{.}002$, $P_2 = 1\overset{d}{.}3007 \pm 0\overset{d}{.}0001$, and $P_3 = 0\overset{d}{.}80513 \pm 0\overset{d}{.}00005$. The last one was noted by WQ. These three periods are aliases interconnected with a window feature of 1 c/day (Fig. 1d). The periodicities belong to V1674 Cyg – the power spectrum of the check star does not show any details.

Figure 1b shows the amplitude spectrum of the residual set after prewhitening the initial set for $P_1 = 4\overset{d}{.}272$. The probability level of 10^{-5} has also been calculated. The peaks of the residual spectrum are highly reliable: $P_4 = 5\overset{d}{.}267 \pm 0\overset{d}{.}002$; $P_5 = 6\overset{d}{.}676 \pm 0\overset{d}{.}002$; $P_6 = 1\overset{d}{.}2300 \pm 0\overset{d}{.}0001$; $P_7 = 0\overset{d}{.}83839 \pm 0\overset{d}{.}00005$, the highest peak being 3.6 mmag.

Repetition of the prewhitening procedure for the larger amplitude wave with P_4 leads to a residual set with a flat amplitude spectrum (Fig. 1c). This test shows that the periods P_4 – P_7 are interdependent, and reflect only one wave in the light curve. So, our analysis

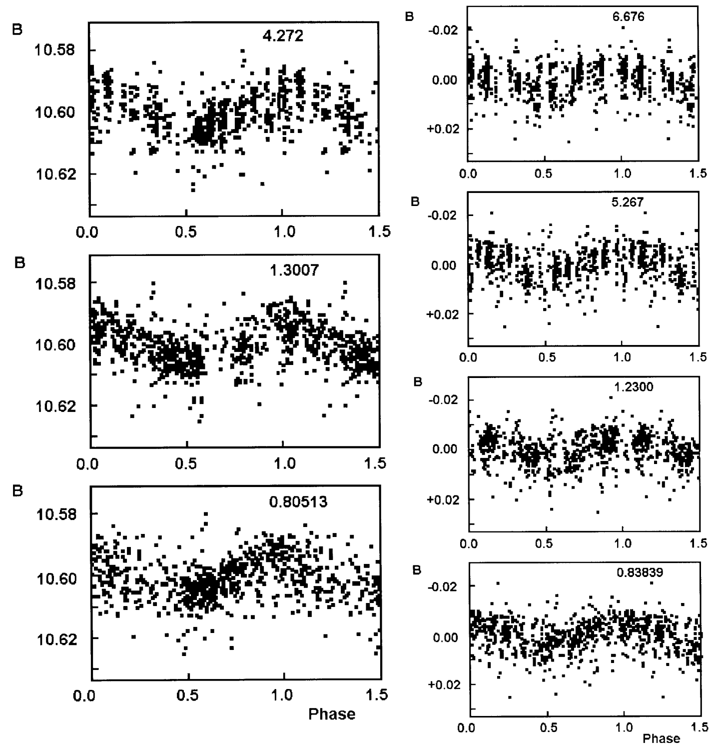

Figure 2. Left: the light curves of the three predominant periods P_1–P_3 (the secondary wave with P_4 is eliminated). Right: the light curves of secondary periods (the primary wave with P_1 eliminated).

detects only two independent waves in V1674 Cyg, with the full amplitudes of 10.8 and 7.2 mmag. Periods $P_1 = 4\overset{\mathrm{d}}{.}272$ and $P_4 = 5\overset{\mathrm{d}}{.}267$ may be preferable only because of their higher peak amplitudes, but their aliases and double values are also possible.

The flat spectrum of the residual set and the absence of low-frequency noise in our data suggest that the trends in our observations are small relative to those found by WQ in B band. We find marginal evidence of a trend with the amplitude of $0\overset{\mathrm{m}}{.}012$ in the second season of our observations in JD 2450360–50399. We have also analysed the influence of possible season-to-season trends on our results and found it to be insignificant. Analysing HIPPARCOS photometry of η Cyg (NSV 12586, Sp. K0III), a comparison star used by WQ, we reject the assumption that this star may be the source of any trends or periodicities.

The principal results in the individual photometric bands are given in Table 1 (the number of observations, the total range of variability, the mean magnitude, the dispersion, and the full amplitudes of harmonic component are given).

V1674 Cyg is a double star. Our CCD astrometry and photometry for the faint companion gives: $\rho = 5\overset{\prime\prime}{.}9$; $\theta = 170°$; B = $14\overset{\mathrm{m}}{.}0 \pm 0.2$; V = $13\overset{\mathrm{m}}{.}0 \pm 0.1$; R = $12\overset{\mathrm{m}}{.}0 \pm 0.1$ (JD 2451199.15). For the bright component: B = $10\overset{\mathrm{m}}{.}65$; V = $10\overset{\mathrm{m}}{.}07$; R = $9\overset{\mathrm{m}}{.}57$. (The summary brightnesses are presented in the Table). The colours agree with the primary's F8III spectrum (Bregman et al., 1973).

In spite of the periodic nature of the light curve, we cannot yet find a unique type for V1674 Cyg. One can suggest that the bright component is a pulsating variable [the ratio $P_1/P_4 = 0.81$ is close to that between the 2nd and the 1st overtones of mixed mode pulsators like CO Aur or GSC 4018.1807 (Antipin, 1997)]. The star may be also a spotted,

Table 1

Band	N (obs.)	Total range (mag)	Mean (mag)	Dispersion (mmag)	Ampl. P_1 (mmag)	Ampl. P_4 (mmag)
U	75	10.71 – 10.79	10.741	17.2	—	—
B	596	10.58 – 10.64	10.601	8.9	12.2	7.0
V	598	9.98 – 10.03	10.001	8.4	12.8	8.2
R	589	9.43 – 9.49	9.456	8.9	11.2	7.0

or an ellipsoidal variable. Spectroscopic study may help to choose a real type for V1674 Cyg. Besides, the variability may also be due to the faint companion. Then its amplitude may be about $0\overset{m}{.}19$ V, with EW type.

Taking into account recent results of the OGLE project (see, e.g., Udalski et al., 1994), we can conclude that the low-amplitude periodic variable stars with the periods of few days are not unique, but widely spread. They are found in so-called 'miscellaneous' group. So the classification of OGLE variables will face us with the same problem as that of V1674 Cyg. GCVS has many types for poorly studied irregular variables (i.e. I, IA, IB, L, LB, S:), but unfortunately it does not have any type for poorly studied regular, or periodic, or multiperiodic ones. Without the special type definition, V1674 Cyg should stay in the GCVS as an unique variable with the symbol (*) in the column "Type".

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CL AURIGAE: A NEW PHOTOMETRIC TRIPLE STAR

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The detached eclipsing binary CL Aurigae (= BD +33°0975 = GSC 2393.1455 = HV 6886 = FL 439; $\alpha_{2000} = 5^{\rm h}12^{\rm m}54\overset{\rm s}{.}2$, $\delta_{2000} = +33°30'28''$, Sp. = A0, $V_{\rm max} = 11\overset{\rm m}{.}7$) is a photoelectrically neglected variable with a short orbital period of about 1.24 days. This system was selected as a possible candidate for the study of the apsidal motion (Hegedüs 1988) and thus it was also included to our observational project of eclipsing binaries with eccentric orbit (e.g. Wolf & Šarounová 1995).

CL Aur was discovered to be a variable star photographically by Hoffleit (1935). The first photographic light curve was obtained by Kurochkin (1951), who also determined the first light elements:

$$\text{Min. I} = \text{HJD } 2\,432\,967.262 + 1\overset{\rm d}{.}244\,366\,6 \times E.$$

Next visual observations were made by Szafraniec (1960), the spectral type was determined by Götz & Wenzel (1968). The photographic plates of the GAIS (Nos. 39052–40649 and Moscow observatories (Nos. 16869–35540) were examined by Fadeyev (1973). Due to the relatively deep primary minimum this variable was often observed visually, mostly by BBSAG observers (K. Locher, H. Peter, R. Diethelm). To our knowledge this star has not been measured photoelectrically since discovery.

Our new CCD photometry of CL Aur was carried out during eight nights between November 1995 and December 1998 at the Ondřejov Observatory, Czech Republic. Primarily, a 65-cm reflecting telescope with a CCD-camera (SBIG ST-6 or ST-8) was used. The measurements were done using the standard Cousins R filter with 60 or 90 s exposure time. Two additional measurements were done using 18-cm Maksutov-Cassegrain (Ondřejov) and 25-cm Newtonian (Hradec Králové) telescopes without filter. The nearby stars GSC 2393.1532 ($V = 11.4$ mag) — listed also as star b by Kurochkin (1951) — and GSC 2393.1435 ($V = 11.9$ mag) on the same frame as CL Aur served as a comparison and check stars, respectively. Flat fields for the reduction of the CCD frames were routinely obtained from exposures of regions of the sky taken at dusk or dawn. Standard error of measurements varies from 0.01 mag to 0.02 mag. The new moments of primary and secondary minimum and their errors were determined using the least squares fit to the data, by the bisecting chord method or by the Kwee–van Woerden algorithm. These seven times of minimum are presented in Table 1. In this table, N stands for the number of

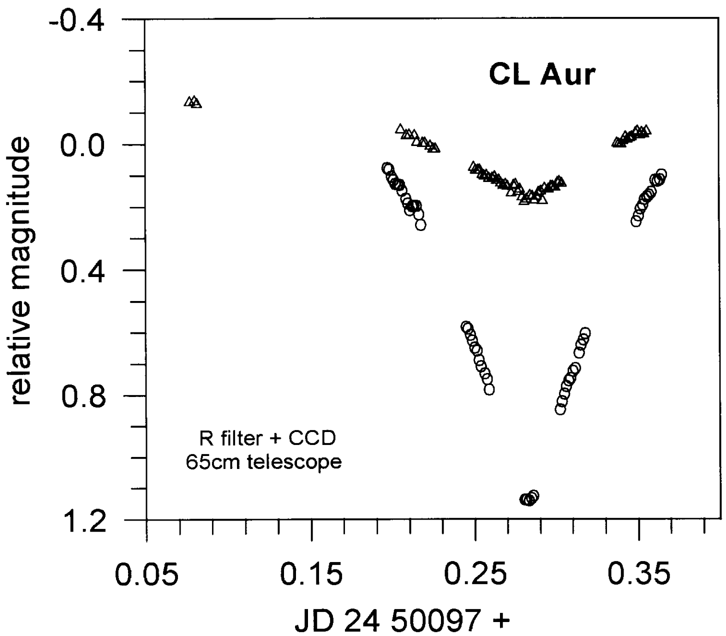

Figure 1. A plot of differential R magnitudes obtained during primary eclipse of CL Aur on 14 January 1996 (circles). The measurements of secondary minimum obtained on 22 November 1995 were shifted in time by +42.5 periods and are plotted as triangles together with primary minimum.

observations used in the calculation of the minimum time. The epochs were calculated according to the light elements of Kurochkin (1951).

Figure 1 shows the differential R magnitudes during the primary minimum observed at JD 2450097 (circles). Our measurements of secondary minimum (triangles) were shifted exactly by 42.5 periods (+52.8858 d) and are also plotted. The light amplitude in R colour for primary minimum according to our measurement is $A_1 = 1.28$ mag, for secondary minimum we found $A_2 = 0.32$ mag. The duration of both minima seems to be almost identical, $D_1 \simeq D_2 \simeq 0.22$ days $= 0.176$ phase.

The change of period and possible apsidal motion of CL Aur were studied by means of an $O-C$ diagram analysis. We took into consideration all visual and photographic measurements found in the literature as well as the CCD times given in Table 1. The $O-C$ graph for all moments of minimum are shown in Figure 2. The photographic

Table 1: New precise times of minimum of CL Aur

JD Hel. 24 00000+	Epoch	Error (days)	N	Instrument Filter
50044.3958	13723.5	0.0007	63	65-cm, ST6, R
50097.2826	13766.0	0.0002	56	65-cm, ST6, R
50714.4888	14262.0	0.0006	52	18-cm, ST6, -
50831.4589	14356.0	0.0001	39	65-cm, ST8, R
50884.3431	14398.5	0.0003	68	65-cm, ST8, R
51157.4815	14618.0	0.0006	24	25-cm, ST5, -
51177.3914	14634.0	0.0001	51	65-cm, ST8, R

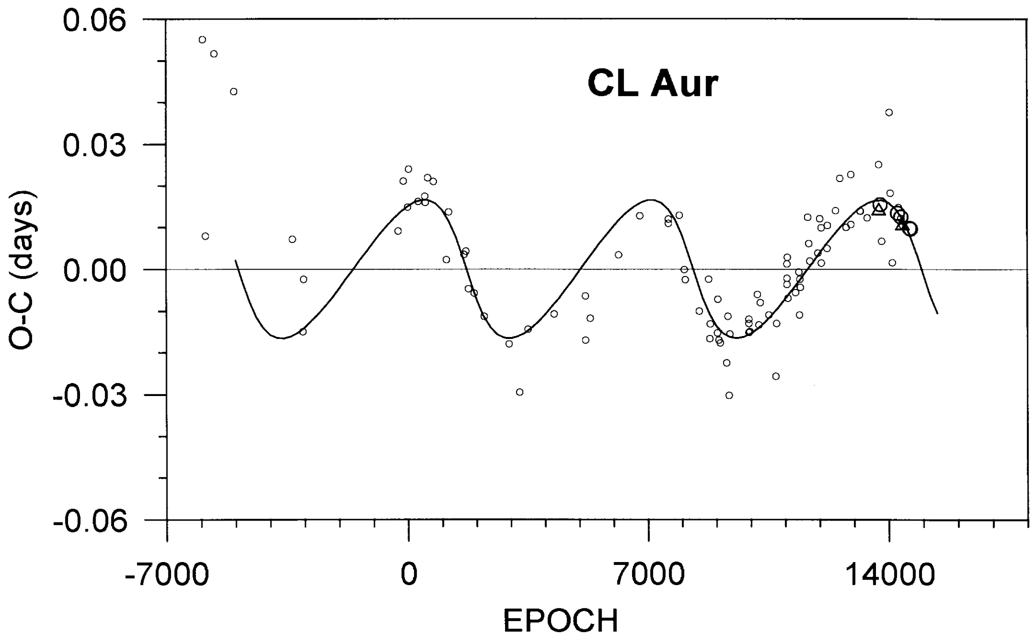

Figure 2. $O - C$ diagram of CL Aur. The individual times of primary and secondary minimum are denoted by circles and triangles, respectively. Larger symbols are our CCD measurements. The curve corresponds to a third body orbit.

times or visual estimations obtained by Kurochkin (1951) and BBSAG observers are also plotted.

We analysed the $O - C$ diagram and the light curve using the current observations. Our results indicate that this binary has no significant eccentric orbit. According to our timings, the secondary minimum occurs at the phase $\Phi_{II} = 0.5000 \pm 0.0001$ and the duration of primary and secondary eclipses is practically identical. This system could be excluded from the list of possible candidates for apsidal motion study.

Secondly, quasi-sinusoidal deviations of the $O - C$ values are remarkable after zero epoch and could be caused by a light-time effect. Preliminary analysis of the third body period gives the following parameters:

$$\begin{aligned} P_3 \text{ (period)} &= 8240 \pm 70 \text{ days} = 22.5 \text{ years} \\ T_0 \text{ (time of periastron)} &= \text{J.D. } 2\,443\,315 \pm 35 \\ A \text{ (semiamplitude)} &= 0.0166 \pm 0.0012 \text{ day} \\ e &= 0.405 \pm 0.025 \\ \omega &= 179^\circ \pm 2^\circ \end{aligned}$$

These values were obtained together with the new linear ephemeris

$$\begin{aligned} \text{Min. I} = \text{HJD } 2\,432\,967.2472 &+ 1\overset{\text{d}}{.}244\,371\,63 \times E, \\ \pm 0.0006 \quad &\pm 0.000\,000\,17 \end{aligned}$$

by the least squares method. Assuming a coplanar orbit ($i_3 = 90^\circ$) and a total mass of the eclipsing pair $M_1 + M_2 \simeq 3M_\odot$ (Harmanec 1988) we can obtain a lower limit for the mass of the third component $M_{3,\min}$. The present explanation is supported by the quite reasonable value of the mass function $f(M_3) = 0.0614 M_\odot$, from which the minimum mass of the third body is $1 M_\odot$.

New high-accuracy timings of this interesting eclipsing system are necessary in the future in order to confirm and/or improve the light-time effect parameters given above. For the current use we propose the following linear light elements:

$$\text{Min. I} = \text{HJD } 2\,451\,177.3914 + 1\overset{\text{d}}{.}244\,365 \times E.$$

Acknowledgement. This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France.

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ERRATUM FOR IBVS 4683

CL Aur is not BD +33°0975.

The Editors

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HD 74425: A NEW ELLIPSOIDAL VARIABLE STAR

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We find the SB2 star HD 74425 ($V = 7.8$, F8) to be a new ellipsoidal variable star, based on one year of photometric observations with a 0.4 m automatic photoelectric telescope (APT). The observations also suggest additional small-amplitude variations that may be due to star spots. The star was on our observing program as a photometric comparison star.

Nordström et al. (1997) found HD 74425 to be a double-lined spectroscopic binary with a period of 1.585232 ± 0.000008 days and a mass ratio of 1.17. They did not determine spectral types for the individual components due to their limited spectral coverage; the combined HD spectral type of F8 remains the only classification. The star is listed as a photometrically constant, single star in the *HIPPARCOS* catalogue (Perryman et al. 1997) with $V = 7.82$, $B - V = 0.47$, and $\pi = 9.26$ mas. The *HIPPARCOS* results and the mass ratio are consistent with both components being main-sequence F stars.

From 23 September 1997 through 1 June 1998, the 0.4 m APT acquired nearly 400 measurements of HD 74425 in the Johnson B and V bands. The observations were reduced differentially with respect to the constant comparison star HD 70312 ($V = 7.7$, F5), corrected for extinction with nightly extinction coefficients, and transformed to the Johnson system with long-term mean transformation coefficients. Further details of the observing and data reduction procedures can be found in Henry (1995).

Our periodogram analysis finds the strongest periodicity at $0\overset{d}{.}79267 \pm 0\overset{d}{.}00006$ and $0\overset{d}{.}79266 \pm 0\overset{d}{.}00005$ in the V and B observations, respectively (Figure 1). This period is exactly half of the orbital period found by Nordström et al. (1997) to within the formal 1-σ errors, which suggests that variability is due to tidal distortion in one or both stars. Therefore, we present our V-band observations in Figure 2 phased with the orbital ephemeris

$$\mathrm{JD_{conj}} = 2\,447\,799.138 + 1\overset{d}{.}585232 \times E, \tag{1}$$

where the time of conjunction corresponds to the less massive star in front (Andersen 1999) and the period is the orbital period from Nordström et al. (1997). The fact that the minima in the phase curve occur at the spectroscopic times of conjunction confirms that photometric variability is due to the ellipticity effect.

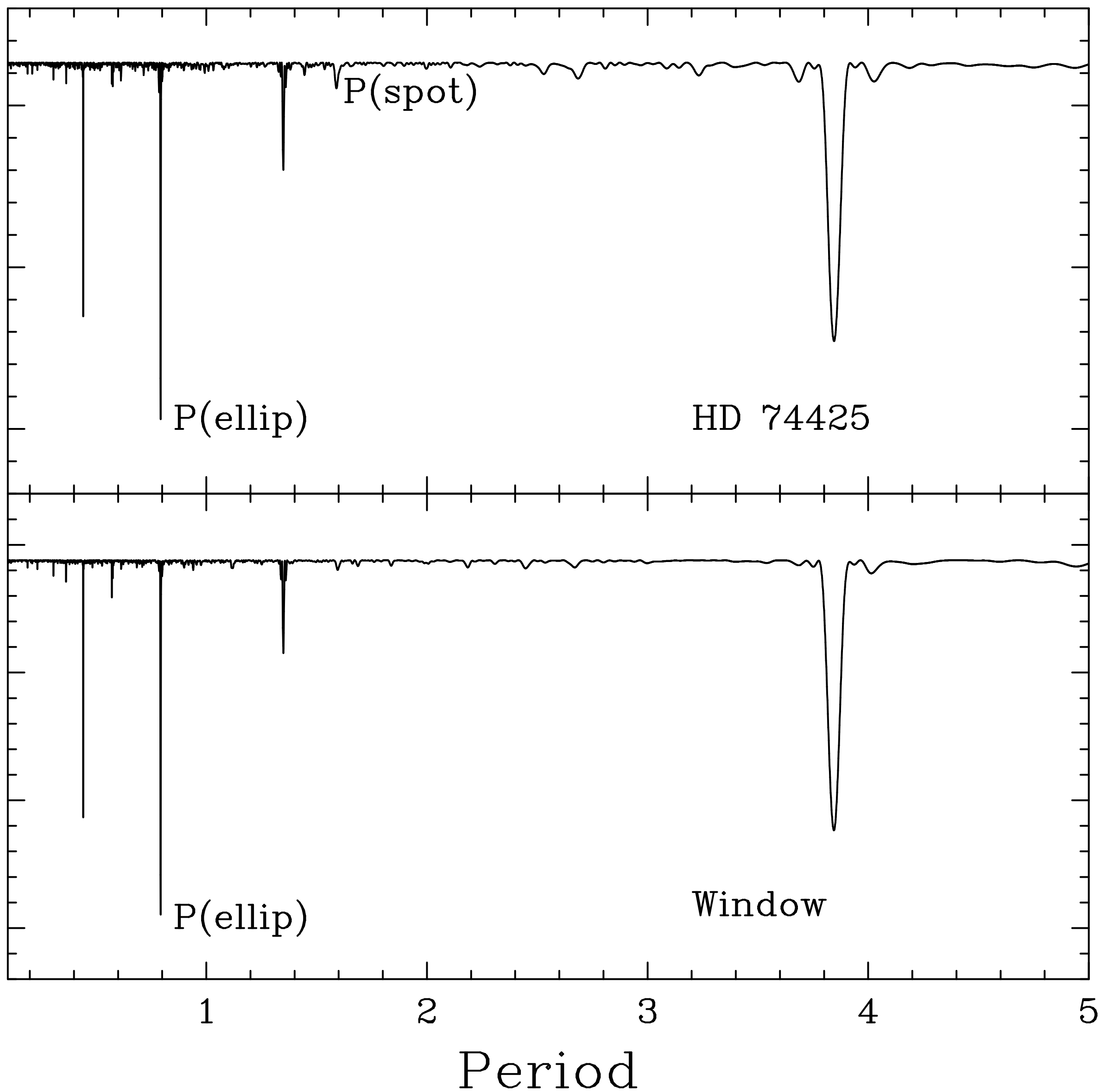

Figure 1. Periodogram analysis of HD 74425. The upper panel shows the periodogram of the *V* data with labels for the $0^{\rm d}.79267$ ellipticity period and a much weaker $1^{\rm d}.590$ period, probably arising from spot modulation. All other significant dips are aliases of the $0^{\rm d}.79267$ period, as shown by the window function on that period in the lower panel.

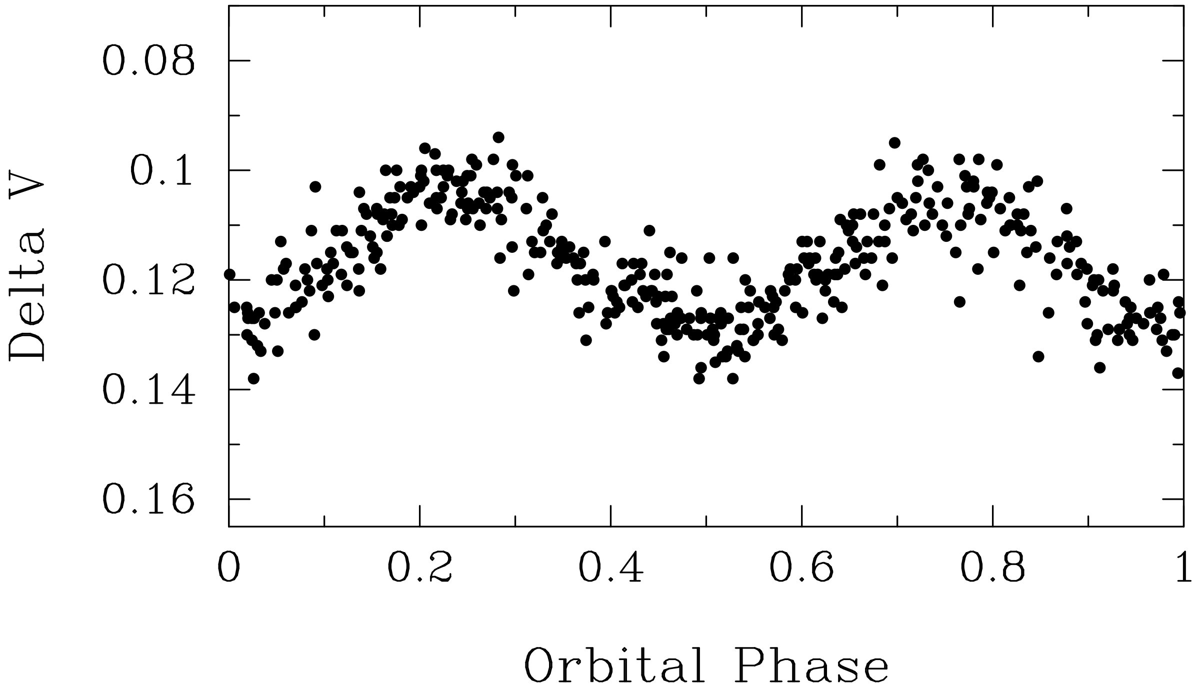

Figure 2. V-band observations of HD 74425 phased with the orbital ephemeris in equation 1. The minima occur at the times of conjunction, confirming that the majority of the variability is due to the ellipticity effect. There is no evidence for eclipses.

We used least squares to fit the truncated Fourier series

$$m = A_1 \cos(\theta) + B_1 \sin(\theta) + A_2 \cos(2\theta) + m_0 \tag{2}$$

to the phased V and B data sets. The $\cos(2\theta)$ term gives the amplitude of the ellipticity effect, while the $\cos(\theta)$ and $\sin(\theta)$ terms give the amplitude and phase of any light variation on the orbital period. The results of this analysis are given in Table 1. Column 1 gives the photometric band, column 2 the date range, and column 3 the number of observations. Column 4 lists the peak-to-peak amplitude of the ellipticity effect. Columns 5 and 6 show that slight photometric variability does exist on the orbital period. This is probably due to small star spots on the cooler secondary star, which would be expected to rotate synchronously with the orbital period. The spot amplitudes and phases in Columns 5 and 6 agree within their respective errors. The spot-rotation period is also evident in our V and B periodograms at a period of $1\overset{d}{.}590 \pm 0\overset{d}{.}002$ (see Figure 1), which suggests nearly perfect synchronization.

Table 1: Photometric Analysis of HD 74425

Filter	Date Range $HJD - 2400000$	n	Ellipticity Amp (mag)	Spot Amp (mag)	Spot Phase
V	50718–50963	398	0.0233 ± 0.0008	0.0027 ± 0.0008	0.66 ± 0.05
B	50714–50959	387	0.0277 ± 0.0008	0.0025 ± 0.0008	0.59 ± 0.05

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DISCOVERY OF THE VARIABILITY OF GSC 1009.766 AND GSC 1057.1309

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CCD observations of selected fields on the edge of the northern Milky Way have been made as part of a programme to discover and classify new variables (eg. Bernhard et al. 1997, Bernhard 1999). In this paper the observations of two new variables resulting from this programme are reported. GSC 1009.766 is an EA binary with a period of 2.16252 days and GSC 1057.1309 is a short-period variable, possibly a β Cephei, δ Scuti or W UMa variable. Following the practice in previous reports of discoveries from this programme these stars are also referred to as BeV7 and BeV8 respectively. The observations were made using a 20-cm Schmidt-Cassegrain telescope and a Starlight Xpress SX CCD camera without filter. In each observing run typically 300 images are taken of several survey fields. The CCD camera uses a Sony ICX027B chip which has a very broad response, peaking near 5500 Å, giving approximate V-band magnitudes. The frames are processed automatically; de-biased using a mean dark frame and flat fielded. The magnitudes are derived using a simple aperture photometry procedure with a 5×5 pixel square for the star+sky and 7×7 pixel square window frame for the sky.

GSC 1009.766

GSC 1009.766 is classified as non stellar in the Guide Star Catalog and this is attributable to a faint companion, which is clearly seen on the CCD images, but is not completely resolved from the brighter, variable component. The separation between the two components is estimated to be about 2 pixels, or ~5 arcsec on the sky. All the magnitude estimates of GSC 1009.766 completely include the faint companion. Examination of the images suggests that the faint companion is *slightly* fainter than the variable at minimum light, although this estimate is rather subjective. The comparison stars used were GSC 1009.1116 (GSC 11.0) and GSC 1009.842 (12.2), and showed a constant magnitude difference consistent with the GSC magnitudes. The magnitude scale used assumes that GSC 1009.1116 has V = 11.0.

GSC 1009.766 was observed 113 times during the second half 1998. Initially, during the survey phase the observations are relatively sparse but following the discovery of variations the star was observed more intensively. The observations show GSC 1009.766 to be an Algol-type eclipsing binary with primary and secondary eclipses of ~ 0.5 and 0.1 mag respectively. The ephemeris of primary minimum is

$$\mathrm{Min.\ I} = \mathrm{JD}\,2\,451\,072.55(\pm0.02) + 2\overset{\mathrm{d}}{.}16252(\pm0.00023) \times E.$$

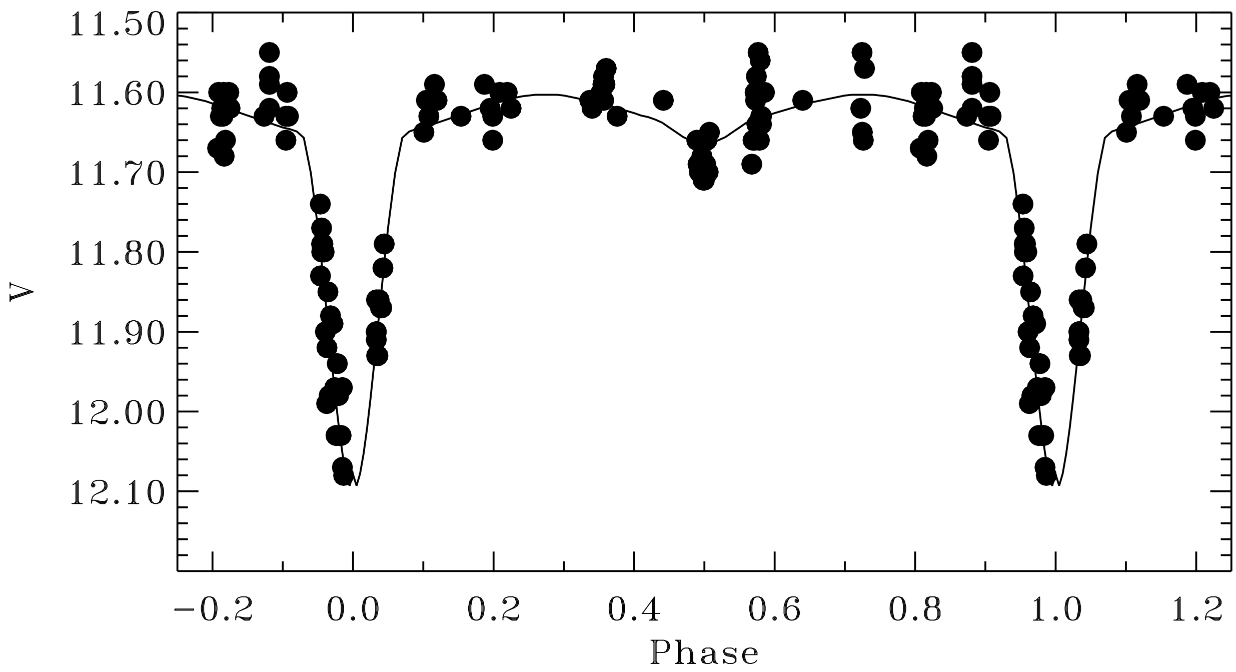

Figure 1. The observed light curve of GSC 1009.766 with a photometric solution, assuming no contribution from the faint companion

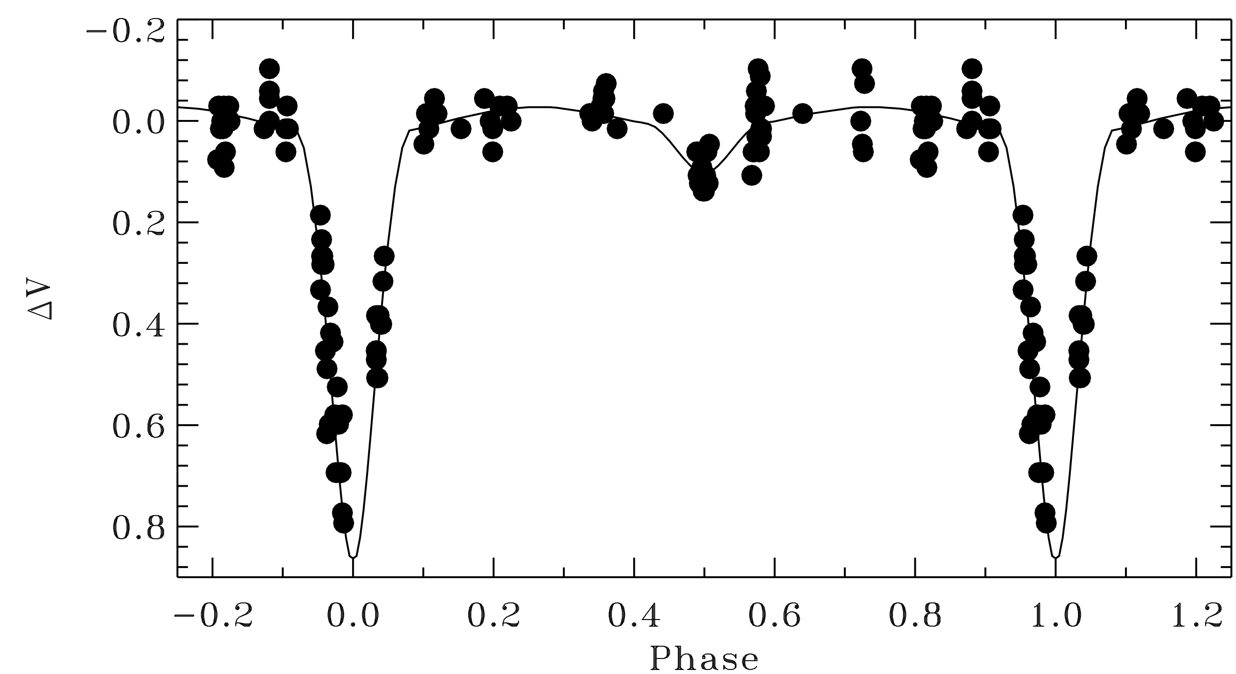

Figure 2. The relative light curve of GSC 1009.766 corrected for the contribution from the faint companion, with a solution over plotted.

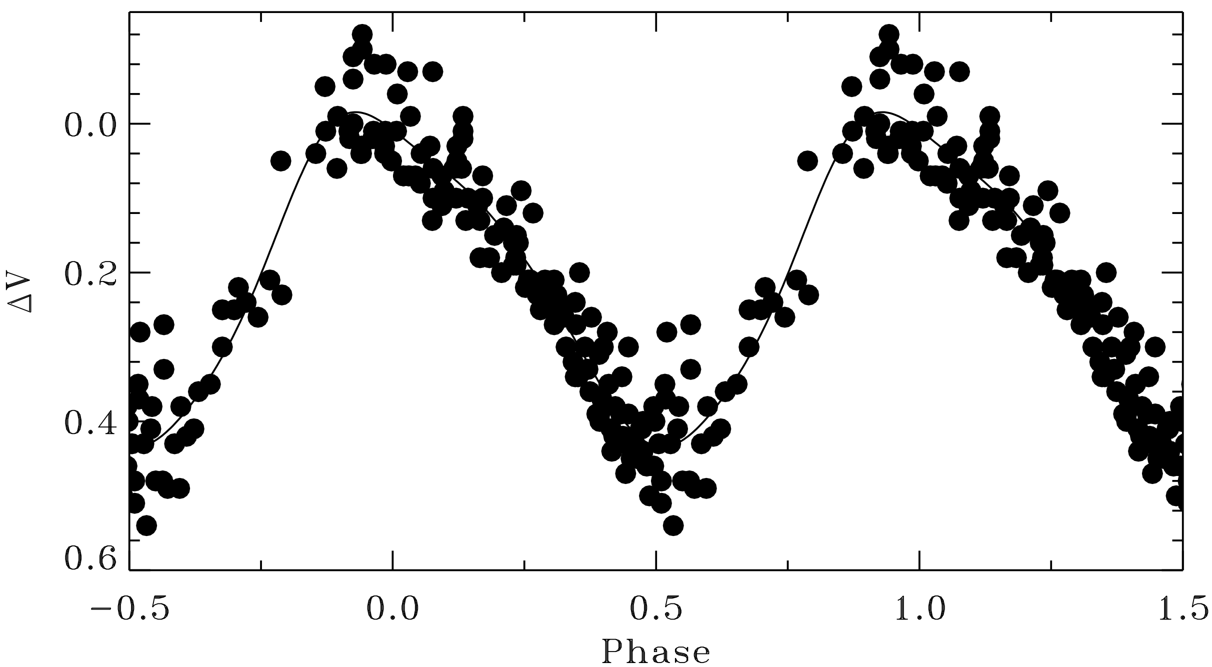

Figure 3. The light curve of GSC 1057.1309 folded with a period of 0.172675 days.

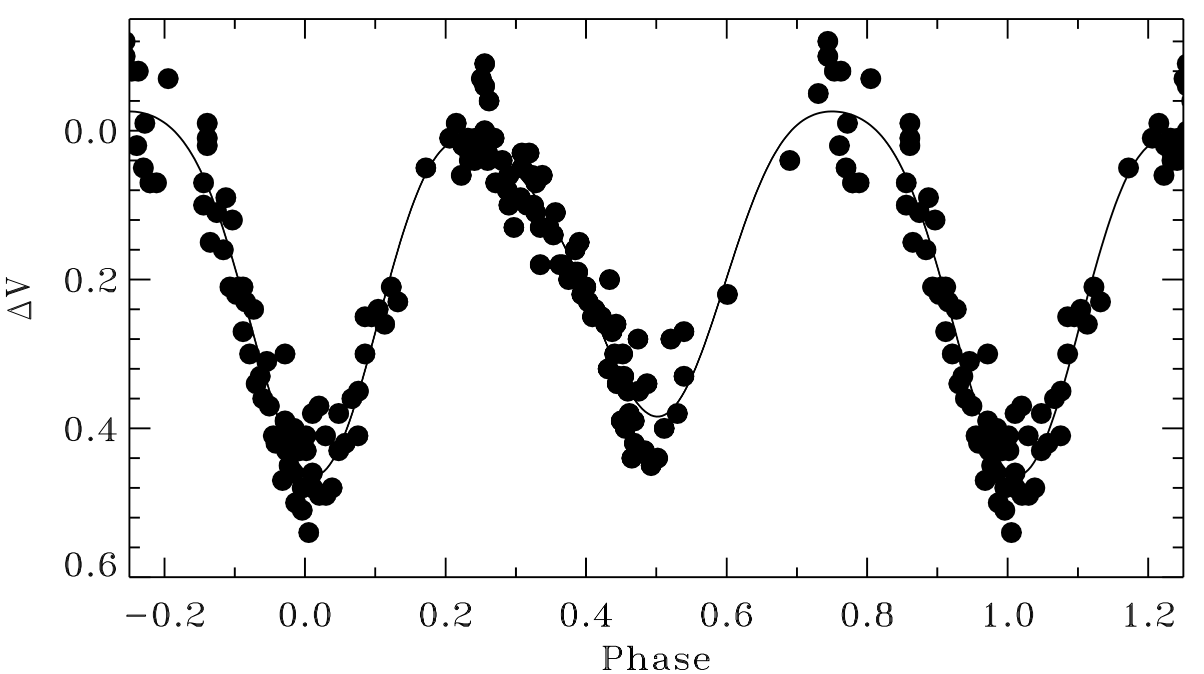

Figure 4. The light curve GSC 1057.1309 folded with a period of 0.417570 days.

Attempts to produce viable light curves with alias periods have failed, so insofar as it is possible to determine, this period is unambiguous.

An attempt has been made to model the system using the LIGHT2 code of Hill et al. (1989). In the first instance it has been assumed that the faint companion makes no contribution to the light curve. The solution plotted over the observed light curve is shown in Figure 1. For the second solution the faint companion was assumed to contribute a constant luminosity equivalent to the variable at minimum light (which is probably too large) and the light curve had this constant component removed. The corrected relative light curve and solution are shown in Figure 2.

Without any other photometric or spectroscopic information about this system the photometric solutions are poorly constrained. A wide range of system parameters give very similar light curves. The ratio of stellar temperatures is ~ 1.5–2, although the temperatures themselves are largely unconstrained. The radii of the two stars are broadly similar but secondaries both larger and smaller than the primary are possible depending on the mass ratio. The solutions in which the secondary is constrained to fill its Roche lobe are equally consistent with the light curve. For the solution plotted in Figure 1 the secondary fills its Roche lobe and the other parameters are; $T_1 = 10000$ K (fixed), $T_2 = 5200 \pm 400$ K, $R_1/a = 0.22 \pm 0.02$, $R_2/a = 0.30$ (fixed), $i = 71 \pm 1$, $q = 0.5$ (fixed). A similar solution is shown in Figure 2 for the corrected light curve. The true variation of GSC 1009.766 will lie between these two extremes (with ΔV between 0.5 and 0.8 mag) and the evidence suggests it is a classical Algol binary.

GSC 1057.1309

GSC 1057.1309 was observed 163 times between July and November 1998 with several runs of approximately 20 observations. The magnitudes are given relative to GSC 1057.1973 (11.8) and the second comparison star used was GSC 1057.1527 (12.7). From a period analysis of the observations GSC 1057.1309 appears to be a short period variable although it is not possible to derive the period unambiguously. Four possible periods emerge, two with single maxima and minima, characteristic of a β Cephei or δ Scuti variable, and double these periods, giving two maxima and minima, characteristic of a W UMa variable. Arguably the most likely period is 0.172675 ± 0.000006 days, which is shown in Figure 3, although there is some suggestion of secondary variations superimposed. For a β Cephei or δ Scuti variable other periods may be present which would easily account for this additional variation. The other single maximum period is 0.208791 ± 0.000007 days which shows a very similar variation and evidence of possible secondary periods.

The two other periods, 0.345346 ± 0.000010 and 0.417570 ± 0.000015 days, show W UMa-like light curves, but there are asymmetries in slope and differences in both the maxima and minima which are not typical of classical W UMa stars. These light curves also show scatter that would have to be interpreted as cycle to cycle variation. The light curve of the 0.417570 days period is shown in Figure 4.

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HD 130484: A NEW δ SCT VARIABLE IN VIRGO

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During an observational program on the δ Sct-type pulsating star IP Vir, HD 129727 (V = $9\overset{m}{.}5$) was used as main comparison star and HD 130484 (V = $8\overset{m}{.}8$) as a check star. These two comparison stars have not been reported as variable before in any catalogue, however our observations showed that while HD 129727 kept a constant brightness HD 130484 presents a slight δ Sct-type photometric variability every night with a luminosity amplitude of about $0\overset{m}{.}01$ and a period of about 3 hours. Figure 1 shows the light curves in the v filter corresponding to six nights of observations as magnitude differences HD 130484−HD 129727 versus the Heliocentric Julian Day.

The observations were collected through the springs of 1995 and 1996 at the observatories of San Pedro Mártir, México (1.5 m telescope) and Sierra Nevada, Spain (0.9 m telescope). These observations consisted of simultaneous $uvby$ data into the Strömgren photometric system. Additionally, some Hβ data were collected in order to derive the physical parameters of these stars. Both telescopes are equipped with identical six-channel $uvby\beta$ spectrograph photometers for simultaneous measurements in $uvby$ or in the narrow and wide Hβ channels, respectively, using uncooled EMI 9789 QA photomultipliers. To transform our data into the standard system we have used the same procedure described in Rodríguez et al. (1997). This way, we have derived for HD 130484 the following values: V = $8\overset{m}{.}786$, $b-y = 0\overset{m}{.}188$, $m_1 = 0\overset{m}{.}172$, $c_1 = 0\overset{m}{.}946$ and $\beta = 2\overset{m}{.}771$.

An analysis of frequencies was carried out on our data using the method described in Rodríguez et al. (1998) where single-frequency and multiple-frequency techniques are combined using both Fourier and multiple least squares algorithms. The analysis was made on all the four $uvby$ filters and the results show that there is a main peak at ν = 7.804 cd^{-1}, that is, a period of P = $0\overset{d}{.}1281$. After prewhitening for this frequency, the resulting periodograms suggest that other periodicities may be present in the light curves of this star, however the noise level is too high and the possible secondary frequencies cannot be confirmed. The multiperiodicity is also suggested from the light curves shown in Figure 1. The corresponding amplitudes (as determined by means of the Fourier analysis, i.e., semiamplitudes) obtained for the main frequency ν = 7.804 cd^{-1} are of $0\overset{m}{.}0045$ (±0.0008), $0\overset{m}{.}0040$ (±0.0003), $0\overset{m}{.}0037$ (±0.0003) and $0\overset{m}{.}0031$ (±0.0004) for u, v, b and y, respectively, which agree well with a δ Sct type pulsation. Figure 2 shows the power spectra in the filter b before and after prewhitening the frequency ν.

[†] Deceased

In order to derive the physical parameters of this star, the photometric Strömgren indices obtained before were used. Intrinsic indices were derived using the reference lines of Philip & Egret (1980) with the appropriate corrections for gravity and metallicity (Crawford 1975a,b; Philip et al. 1976). Thus, colour excess of $0\overset{m}{.}036$, $0\overset{m}{.}012$ and $0\overset{m}{.}007$ were found for $b-y$, m_1 and c_1, respectively. Then, deviations from the ZAMS's values of $\delta m_1 = 0\overset{m}{.}009$ and $\delta c_1 = 0\overset{m}{.}217$ are obtained. This means this star is a normal δ Sct star with nearly solar abundance. In fact, a value of [Me/H] $= -0.01$ is obtained using the Smalley's (1993) calibration for metal abundance. In addition, using the relations by Crawford (1975b) for luminosity, Code et al. (1976) for bolometric correction and the grids by Lester et al. (1986) with [Me/H] $= 0.0$ for temperature and gravity, we obtain the following values for $M_{bol} = 1\overset{m}{.}07$, $T_e = 7560$ K and $\log g = 3.62$. These results place HD 130484 in the middle part of the instability strip corresponding to the δ Sct region as can be seen in Figure 3. This figure shows the sample of δ Sct stars and the observational edges of the instability strip in the δ Sct region from Rodríguez et al. (1994). Finally, using the relation by Petersen & Jørgensen (1972), a value of $Q = 0\overset{d}{.}028$ (± 0.005) is found for the pulsation constant. This suggests that HD 130484 is pulsating in the fundamental mode or first overtone radial order.

Acknowledgements. This research was supported by the Junta de Andalucía and the Dirección General de Enseñanza Superior (DGES) under project PB96-0840.

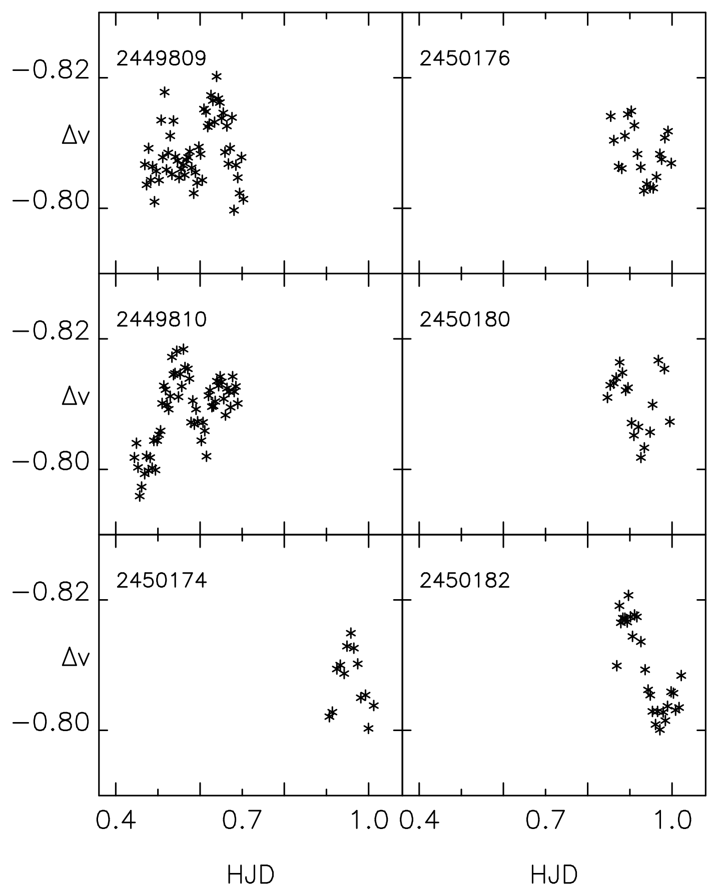

Figure 1. Differential light curves HD 130484−HD 129727 in the v filter versus Heliocentric Julian Day

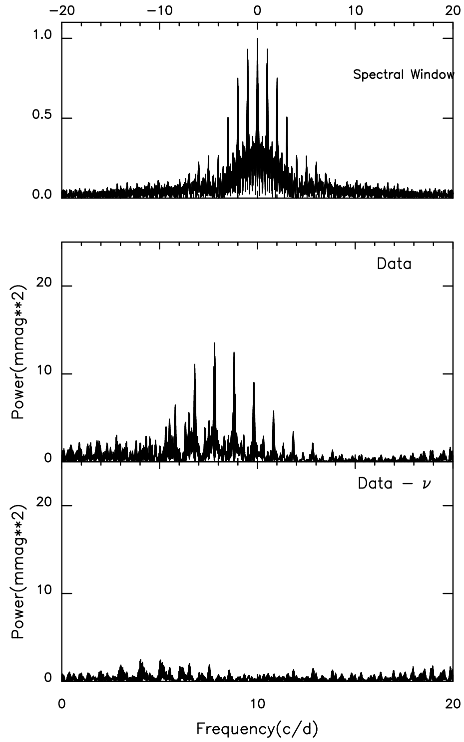

Figure 2. Power spectra of HD 130484 in the filter b before and after prewhitening the frequency $\nu = 7.804\ \mathrm{cd}^{-1}$ to our data

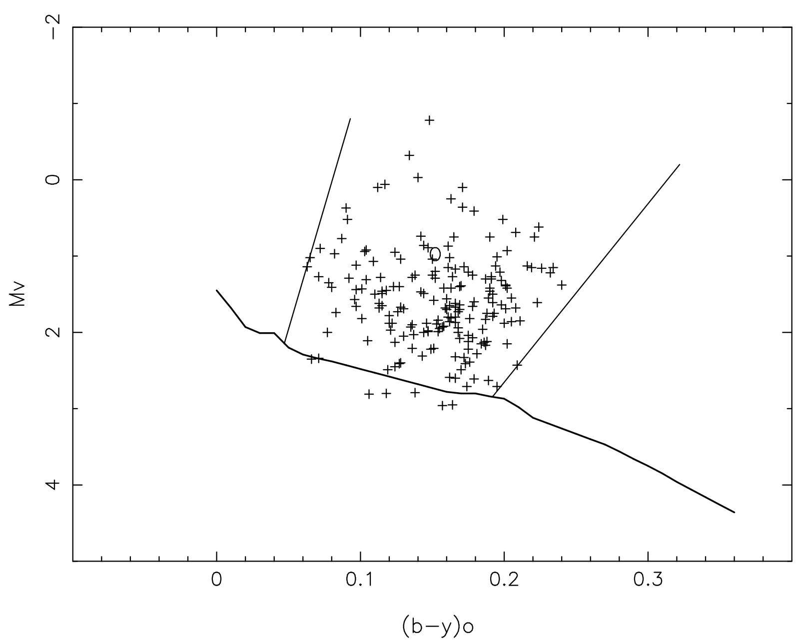

Figure 3. Position of the δ Sct stars in the H–R diagram. HD 130484 is shown with the symbol O

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Budapest
19 March 1999

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NEW PHOTOELECTRIC PHOTOMETRY OF MM HERCULIS

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Name of the object:
MM Her = BD +22°3245

Equatorial coordinates:	**Equinox:**
R.A.= $17^h58^m31\overset{s}{.}11$ **DEC.**= $22°08\overset{\prime}{.}50$	1997

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

Detector:	Hamamatsu, R 4457 (PMT)
Filter(s):	B, V and R filters of Johnson UBV system
Comparison star(s):	BD +21°3274 = HD 341480
Check star(s):	BD +22°3250 = HD 164306

Transformed to a standard system:	UBV
Standard stars (field) used:	Pleiades stars

Availability of the data:
Upon request

Type of variability:	EA

Remarks:
MM Herculis is a member of RS CVn type eclipsing binaries showing wave-like light variation in their light curves out of eclipses. Its light variations were investigated by Sowell et al. (1983) and Evren (1985; 1987a,b) in detail. The present observations of MM Her were obtained on 22 nights in 1997, and on 42 nights in 1998. The light curve obtained in 1997 of the system shows clearly the sine-like distortion. The amplitude of the variation is approximately 0.1 mag. B−V colour curve has its maximum at the phase of minimum brightness. The shape of the light curve obtained in 1998 differs from that in 1997. The wave-like distortion is asymmetric in shape rather than being sinusoidal. If the distorting effects were due only to the cool spots the colour would get reddened at the phase of minimum brightness. But this reddening is only seen in the V−R curve obtained in 1997. The reason of the blueing in B−V should not be related with the cool spots. This phenomenon can be understood by assuming existence of a facular network or a facular structure, which surrounds the spots, hotter than the photosphere.

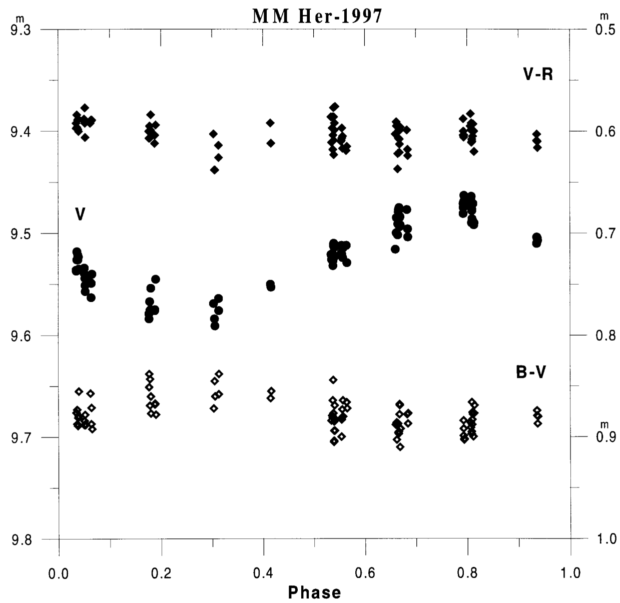

Figure 1. The light and colour curves of MM Her obtained in 1997

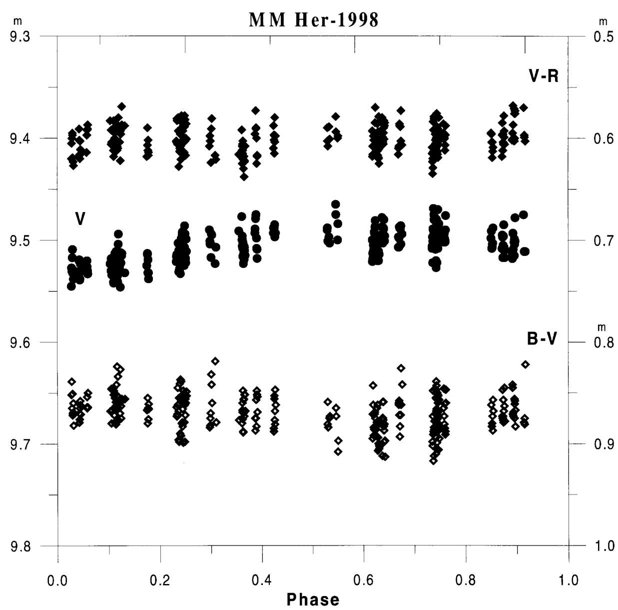

Figure 2. The light and colour curves of MM Her obtained in 1998

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Budapest
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HU ISSN 0374 – 0676

τ^1 HYDRAE: NOT A γ DORADUS VARIABLE

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The F6 V star τ^1 Hydrae (= 31 Hya = HR 3759 = HD 81997 A) is listed as a candidate γ Doradus variable by Krisciunas & Handler (1995) and Handler & Krisciunas (1997). The γ Dor stars have spectral types near F0 and low-amplitude photometric variability with periods between about 0.5 and 3 days. The inclusion of τ^1 Hya in the candidate list was based on photometric variability reported by Lockwood, Skiff, & Thompson (1993). A more complete analysis of its photometric variability is given by Lockwood, Skiff, & Radick (1997, hereafter LSR). They reported τ^1 Hya to be slightly variable from night to night (at greater than 95% significance) within five of their twelve observing seasons but did not have sufficient observations to search for periodicity. The average night-to-night rms variation for their twelve seasons was 0.0021 mag in the combined Strömgren $(b+y)/2$ wavelength band. They also noted significant long-term variability of 0.01 mag.

Duquennoy & Mayor (1991) discovered τ^1 Hya to be a single-lined spectroscopic binary with a period of 7.7 yr. No photometric variability was detected by Perryman et al. (1997) in the *HIPPARCOS* catalogue, which gives $V = 4.59$, $B-V = 0.411$, and $\pi = 58.48$ mas. However, the *HIPPARCOS* color index is probably in error and should be 0.461; the catalogue cites ground-based photometry as the source of the color index, and the General Catalogue of Photometric Data lists 11 determinations of $B-V$ with a mean of 0.461 (Mermilliod, Hauck, & Mermilliod 1997). Thus, the apparent magnitude, color index, and parallax are consistent with a spectral classification of F6 V.

We have observed τ^1 Hya for six seasons with a 0.75 m automatic photoelectric telescope (APT). Our Strömgren b and y observations were made differentially with respect to the comparison star HD 81342 ($V = 6.88$, F5), the same one used by LSR. HD 81997 B, located 66 arcseconds from τ^1 Hya, was excluded from the diaphragm during our measurements. Each differential magnitude was corrected for extinction and transformed to the Strömgren system. We also combined our b and y observations into a single $(b+y)/2$ band to increase precision. Further details on the reductions can be found in Henry (1995).

The analysis of our APT photometry is summarized in Table 1. Column 1 gives the year, column 2 the Julian Date range, column 3 the number of observations, and column 4 the seasonal-mean differential magnitudes in the Strömgren $(b+y)/2$ band. Column 5 lists the night-to-night variability ($\sigma_{\rm short}$) for each observing season, computed as the standard deviation of a single observation from the seasonal mean. The final column

Table 1: Photometric Analysis of τ^1 Hya

Year	Date Range HJD − 2400000	n	Seasonal Mean (mag)	$\sigma_{\rm short}$ (mag)	$\sigma_{\rm mean}$ (mag)
1993	49094–49121	8	−2.3170	0.0013	0.0005
1994	49295–49482	78	−2.3162	0.0011	0.0001
1995	49662–49840	74	−2.3163	0.0015	0.0002
1996	50030–50213	46	−2.3157	0.0013	0.0002
1997	50405–50552	30	−2.3154	0.0014	0.0002
1998	50761–50944	47	−2.3144	0.0018	0.0003

gives the uncertainty in the seasonal means ($\sigma_{\rm mean}$), computed as the standard deviation from Column 5 divided by the square root of the number of observations from Column 3.

Our observations overlap those of LSR for the 1993–1995 seasons and are considerably more numerous; within these three seasons, LSR reported variability in 1995. The mean of our six seasons of night-to-night variability is only 0.0014 mag. This level of variation is just what we observe for the most constant stars and so represents the precision limit of this telescope (Henry 1995). Furthermore, periodogram analysis of our six seasons of observations, taken separately and also combined into a single data set, show no significant periodicities in the range 0.1 to 10 days. Thus, we can find no evidence at all for short-term photometric variability in τ^1 Hya. This precludes its classification as a γ Dor star.

Our seasonal means, however, *do* confirm the long-term variability observed by LSR, although the shorter time span of our observations gives a smaller range of only 0.002 or 0.003 mag. Given the location of the star in the HR diagram, these slow variations are probably the result of a magnetic-activity cycle (see, e.g., Baliunas et al. 1998).

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THE SPECTRUM OF SAKURAI'S OBJECT IN 1998

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The evolution of the born–again giant Sakurai's object (V4334 Sgr) has been extraordinarily rapid (Asplund et al. 1999). The object was discovered by Y. Sakurai in February 1996 (Nakano et al. 1996) and is believed to be a star which recently experienced a final He–shell flash.

We have started monitoring of Sakurai's object starting shortly after its discovery trying to detect changes in its spectrum (Kipper & Klochkova 1997). In 1998 we have obtained four sets of spectra (on March, 06 and 08, July, 09 and 15) with the prime focus echelle spectrometer of RAS 6–m telescope. The first three spectra are of low resolution around $R = 12\ 500$ covering $\lambda\lambda 4700 \div 7750$ and the last one has somewhat higher resolution of $R = 25\ 000$ but covering only $\lambda\lambda 5000 \div 5900$. The reduction of the spectra was performed using the image reduction system IRAF[†].

In 1998 Sakurai's object underwent a deep brightness drop similarly to the weakenings suffered by the another final He–flash object FG Sge (Kipper & Klochkova 1999). The light–curve for summer and autumn 1998 is depicted in Fig. 1. The data for this figure was taken from the AAVSO International Database. Our latest spectra were obtained just before the dimming started. The inspection of the spectra shows that there are no great changes compared with the spectra obtained in 1997. As the year before, the most prominent features are the bands of carbon containing molecules. This very much hinders the analysis of low resolution spectra. Only few features changed during 1998. So in the March spectra the weak emission components of NaI D lines were visible which disappeared in July. In March the [S I] $\lambda 7725$ double peaked nebular emission line was visible giving the nebular expansion velocity of about 23 $\mathrm{km\,s^{-1}}$.

We tried to derive the temperatures for Sakurai's object comparing few published photometric colour data with colours computed using H–deficient model atmospheres. A small set of models for this analysis was computed with a improved version of MARCS program (Gustafsson et al. 1975) with updated opacities. Opacities from continuum sources, molecules CO, CN and C_2, and atomic lines were taken into account. The line opacities were treated in the opacity sampling approximation (Jørgensen et al. 1992). The structure of these models fits well with the analogous models by Asplund et al. (1997). The input abundances including C/He = 0.1 and N/He = 0.01 for the model calculations were those found for Sakurai's object in 1996 (Asplund et al. 1999). For comparisons

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

the colours $(V-R)$ and $(V-I)$ were used together with the interstellar reddening $E(B-V) = 0.53$ (Duerbeck & Benetti 1996). With the reddening $E(B-V) = 0.7$ (N.K. Rao, private communication) the temperatures would be $300 \div 500$ K higher. The results are depicted in Fig. 2 together with our earlier results and results collected from the literature. As could be seen from this figure the derived temperatures are quite consistent until March 1997. The later results diverge noticeably. Therefore we shortly describe those determinations. Pavlenko & Yakovina (1999) estimated the temperature $T_{\rm eff} = 5400$ K from the fit of very low resolution observed and synthetic spectra. Kamath & Ashok (1999) used the near–IR photometry and reddening $E(B-V) = 0.71$ to get color temperature around 5500 K. Jacoby et al. (1998) compared the strength of C_2 bands the in spectrum of Sakurai's object with the ones in the spectrum of another HdC star HD 182040 and found that $T_{\rm eff} = 5600 \pm 500$ K.

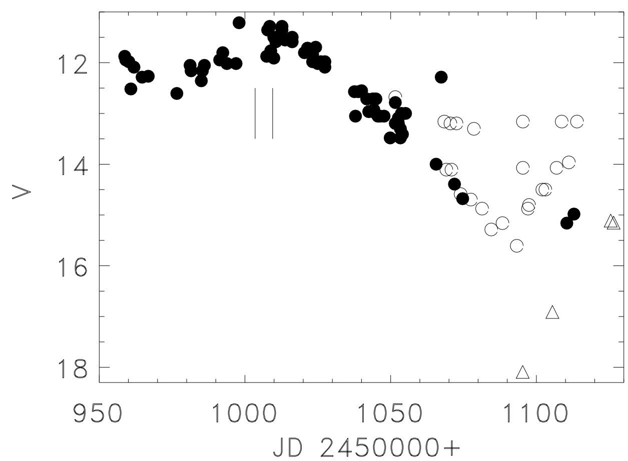

Figure 1. Light curve of Sakurai's object for summer and autumn 1998 (AAVSO). Open symbols indicate the upper limits. Triangles indicate the data added from IAUC, 7048 and 7065. Two vertical lines indicate the moments of our latest spectral observations

The low temperatures found from the colours are in sharp contrast with the intensities of C_2 Swan bands which have not changed from summer 1997. This could only be explained by increased circumstellar reddening and radiation from hot dust clouds. Indeed, Kamath & Ashok (1999) estimated the temperature of dust shell around 1800 K.

The relatively low resolution spectra offer little possibilities of determining stellar parameters. If we assume that the temperature of Sakurai's object has decreased between 1998 and 1998, the constancy of C_2 Swan band intensities could be explained by decreasing surface gravity. We succeeded in getting the best fit of the C_2 bands in the higher resolution July spectra taking $T_{\rm eff} = 5750$ K and $\log g = 0.0$ or $\log g = 0.5$ for CN lines in $\lambda\lambda 5658 \div 5696$ region. As noted, C and N abundances by number for spectrum synthesis were fixed at C/He = 0.1 and N/He = 0.01. Adopted dissociation energy of CN is $D_0(\mathrm{CN}) = 7.75$ eV. The microturbulent velocity of $\xi_{\rm t} = 5$ km s^{-1} was assumed (Asplund et al. 1999). With the lower input carbon abundance C/He = 0.03 the lower temperature $T_{\rm eff} = 5500$ K would give the best fit. The found temperature $T_{\rm eff} = 5750 \pm 200$ K is also plotted in Fig. 2. If one accepts $M = 0.8 M_\odot$ for Sakurai's object (Asplund et al. 1999) and the mean surface gravity $\log g = 0.3$ the luminosity will be $\log L/L_\odot = 4.03$.

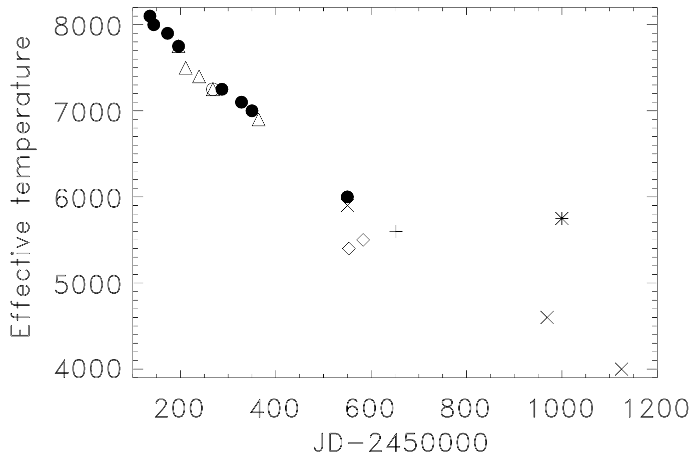

Figure 2. The effective temperature values of Sakurai's object from discovery to autumn 1998. Filled circles – Duerbeck et al. (1997), open circle – Kipper & Klochkova (1997), triangles – Asplund et al. (1999), open diamonds – Pavlenko & Jakovina (1999) and Kamath & Ashok (1999), cross – Jacoby et al. (1998), slanted crosses – temperatures found in this note using the colours, and asterisk – using C_2 Swan bands

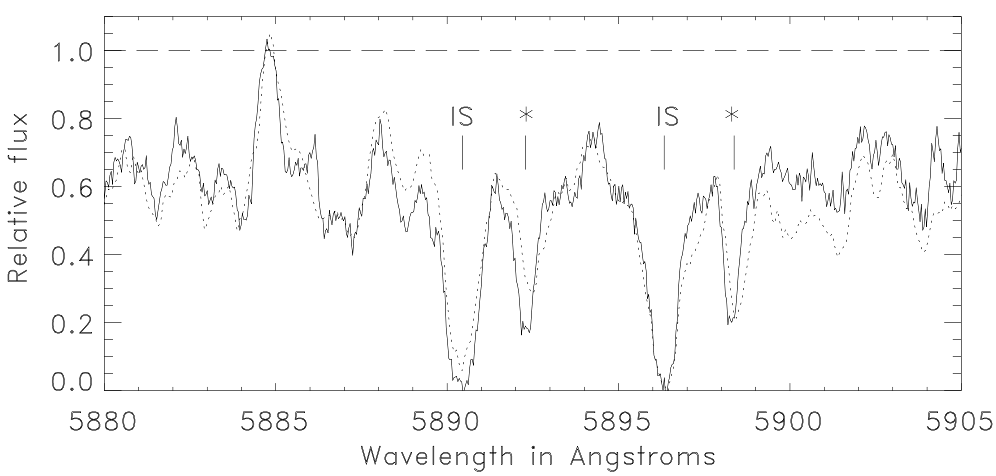

Figure 3. The spectra of Sakurai's object in 1998 (full line) and 1997 (dotted line). The positions of Na I D doublet interstellar and stellar components are indicated. Note that in 1997 the Na I D doublet intensities were reversed probably due to slight emission. Also, the stellar Na I D lines in 1997 were redshifted relative to other lines by 14 $km\,s^{-1}$. All other lines belong to C_2 and CN

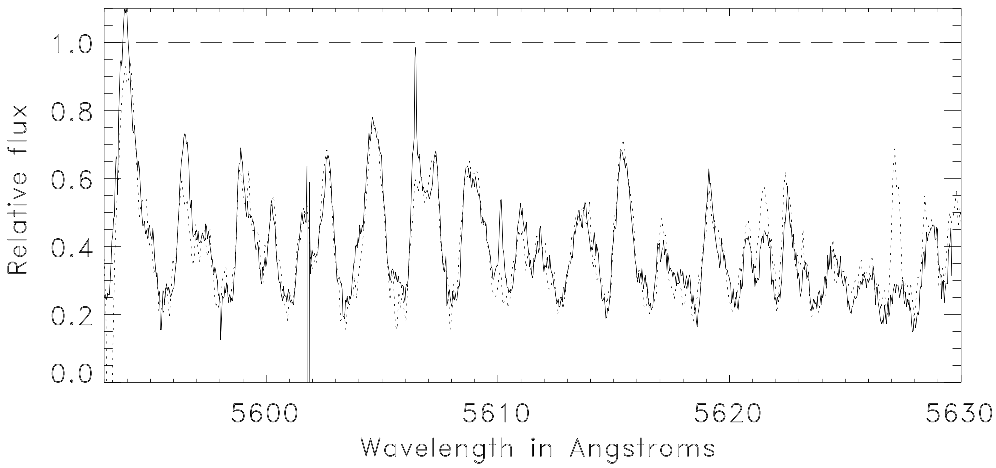

Figure 4. The same as in Fig. 3 but for C_2 (0,1) band region

This corresponds to an evolution at nearly constant luminosity as found by Asplund et al. (1999) or to slight luminosity increase if $\log g = 0.0$ were taken.

Few atomic lines in the July 19 spectra could be fitted. In that way the logarithmic abundances by number for Fe, Ca, Sc and La were found to be 6.5, 5.5, 3.5 and 1.8 correspondingly (normalized to $\log(\Sigma\mu_i\varepsilon_i) = 12.15$ and $\log\varepsilon(\mathrm{He}) = 11.54$). These abundances are close to the ones found for 1996 by Asplund et al. (1999). Sc abundance which seemed to drop in 1997 has returned to its high level.

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THE THIRD BODY IN THE ECLIPSING BINARY AS CAMELOPARDALIS

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The eclipsing binary AS Cam (HD 35111 = BD+69°325 = SAO 1357 = BV 268, $V_{\max} = 8\overset{m}{.}6$; Sp.: B8 + B9.5 V) is a well-known system having an eccentric orbit ($e = 0.17$) and an orbital period of $P_{\rm orb} = 3.43$ days. The AS Cam system was discovered photographically by Strohmeier (1963). Hilditch (1969) obtained spectra and reanalyzed the photographic data, supplemented by photoelectrically determined times of minima, to show that AS Cam consists of a pair of B9 V stars. Hilditch (1972a) estimated the masses of the components to be $M_1 = 3.3\,M_\odot$ and $M_2 = 2.5\,M_\odot$. He obtained a two-year long photometric dataset extending from 1968 to 1970.

In 1981 we began the photoelectric observations of the star with a 50-cm Cassegrain reflector of the Tien-Shan observatory of the Sternberg Astronomical Institute. Observations of the primary and secondary minima were carried out on November 28 and 30, 1981, respectively, and the corresponding light curves can be found in the paper by Khaliullin and Kozyreva (1983). Our observations provide complete and accurate coverage of all parts of the light curve minima except for a small interval at the beginning of the descending branch of the primary minimum. On the average, the standard error of individual observation is $\sim 0\overset{m}{.}004$ in V. We also determined the orbital elements and physical parameters of the components (Khaliullin and Kozyreva, 1983).

On the base of comparison with the observations of Hilditch we discovered AS Cam to be the system with a large disagreement between the observed apsidal motion rate (Khaliullin and Kozyreva, 1983) ($\dot\omega_{\rm obs} = 16°/100$ years) and its theoretical value ($\dot\omega_{\rm obs} = 44°/100$ years) This discrepancy was confirmed by others (Maloney *et al.*, 1989). A similar surprising result concerning another close binary with relativistic apsidal motion was obtained by Martynov and Khaliullin (1980): for DI Her, the theoretically expected apsidal motion caused by relativistic contribution is larger than the classical component by a factor of two. The observed apsidal motion in this system is smaller than that theoretically expected by a factor of three and, moreover, $\dot\omega_{\rm obs}$ is even smaller than $\dot\omega_{\rm cl}$. Both these results require adequate theoretical explanation.

Such disagreements were investigated by Maloney *et al.* (1989) but they did not find acceptable explanations for the conflict between theory and observations in the framework of the classical theory of gravitation.

A successful explanation has been suggested for the discrepancy between theory and observations for DI Her by Khaliullin, Khodykin and Zakharov (1991). They developed a model of a hierarchical triple system with non-coplanar orbits and found no conflict between theoretically calculated and observed apsidal motion parameters for the given longitude of periastron. The above authors give a detailed description of the domain of acceptable positions of the third body and its mass. The computations are based on observational data. This model assumes that the orbital plane of the third body is almost perpendicular to the line of sight.

Khodykin and Vedeneev (1996) showed that a third body in AS Cam can resolve the discrepancy between the theoretical and observed apsidal motion rates provided that its mass is at least 1.1–1.45 $M_{\odot}$. To reveal the effects due to the third body required accumulation of extensive and homogeneous observational datasets.

We performed our photoelectric observations in 1991–1996 at the Tien-Shan observatory. Most of the observations were obtained with the same telescope as the one used for 1981 photometry. As a light receiver we used a four-channel *WBVR* photometer with dichroic filters (Kornilov and Krylov, 1993). We have obtained light curves of 7 primary and 12 secondary minima. The most accurate light curves are those in the V-band because atmospheric extinction in this filter is the lowest. The standard error of photometry for the minima of 1991–1996 was equal to $0\overset{m}{.}01$ and the error was as small as $\sim 0\overset{m}{.}006$ on the best nights. We performed the observations using differential method with HD 34463 as a comparison star and HD 34886, as a check star. We found the rms scatter in the V-magnitude difference between AS Cam and HD 34463 outside the minima to be $0\overset{m}{.}025$, whereas the corresponding scatter for the magnitude difference between the comparison and check stars did not exceed $0\overset{m}{.}005$. Gülmen *et al.* (1976), who earlier observed this star, also pointed out a possible $\sim 0\overset{m}{.}03$ variability in the V-band outside of the eclipses. Physical variability of AS Cam really exists and contributes to the errors in the elements inferred from light curve analysis. It is therefore very desirable to understand the nature of this variability. To do this we have to secure and analyze sufficiently long datasets obtained outside eclipse.

Various methods are used to determine the times of minima for eclipsing variables. They usually involve finding the symmetry axis of the light curve. One of the most widely used method consists in fitting a parabola to a light curve minimum. However, the shape of the light curve differs from a parabola and therefore the times of minima thus obtained depend on the configuration of the binary and on the time interval during which the light curve is observed, resulting in a systematic error of the method.

We determined the times corresponding to the minimum projected distances between stars. To this end, we used a model consisting of two spherical stars with a linear limb darkening, moving in an elliptical orbit. Adopting a particular model allows homogeneous determination of the times of minima during eclipses. The timings of minima were calculated simultaneously with the photometric elements. Note that some of the latter could be fixed corresponding to the solution of a best light curve (Khaliullin and Kozyreva, 1983).

Table 1 gives the times of minima for AS Cam derived using the adopted model. Besides our minima, the timings of minima were used that we inferred from the published light curves of Hilditch (1972b) (JD 2440132, 2440147, 2440185, 2440204, 2440545, 2440590) and Lines *et al.* (1989) (JD 2447443 and 2447465) and from those kindly provided by E.F. Guinan and M. Wolf, in the framework of our model. Besides, we used some timings of minima taken from the original papers.

Table 1: Photoelectric timings of minima of AS Cam obtained at Tien-Shan observatory.

$JD_{\odot}$ 2400000+	O−C	Min	$JD_{\odot}$ 2400000+	O−C	Min
44939.2457	$0^{d}.0005$	I	48869.2220	$0^{d}.0032$	II
48538.3247	−0.0016	I	48982.4411	0.0003	II
48881.4241	0.0014	I	49003.0268	0.0001	II
48998.0740	−0.0014	I	49236.3317	−0.0010	II
49238.2405	−0.0024	I	49332.3975	−0.0024	II
49341.1695	−0.0023	I	49339.2600	−0.0018	II
49557.3235	0.0010	I	49610.3109	0.0023	II
49622.5124	0.0016	I	49634.3272	0.0018	II
49773.4737	0.0005	I	49778.4265	0.0003	II
50418.4975	0.0031	I	50056.3322	−0.0027	II
50425.3566	0.0002	I	50063.1937	−0.0031	II
44937.3262	0.0005	II	50423.4506	0.0018	II
48536.4094	−0.0052	II			

The period of the apsidal motion is much larger than the whole interval covered with observations, therefore the O−C for Min I as well as for Min II could be reproduced with linear function of time.

$$C_{I} = JD_{\odot}\ 2444939.24524 + 3^{d}.4309638 \times E, \qquad \pm 54 \qquad \pm 4$$

$$C_{II} = JD_{\odot}\ 2444937.32567 + 3^{d}.4309713 \times E. \qquad \pm 63 \qquad \pm 5$$

The O−C residuals for Min I and Min II, after subtraction of linear trend due to apsidal motion, are shown in Fig. 1. Zero point corresponds to year 1981.

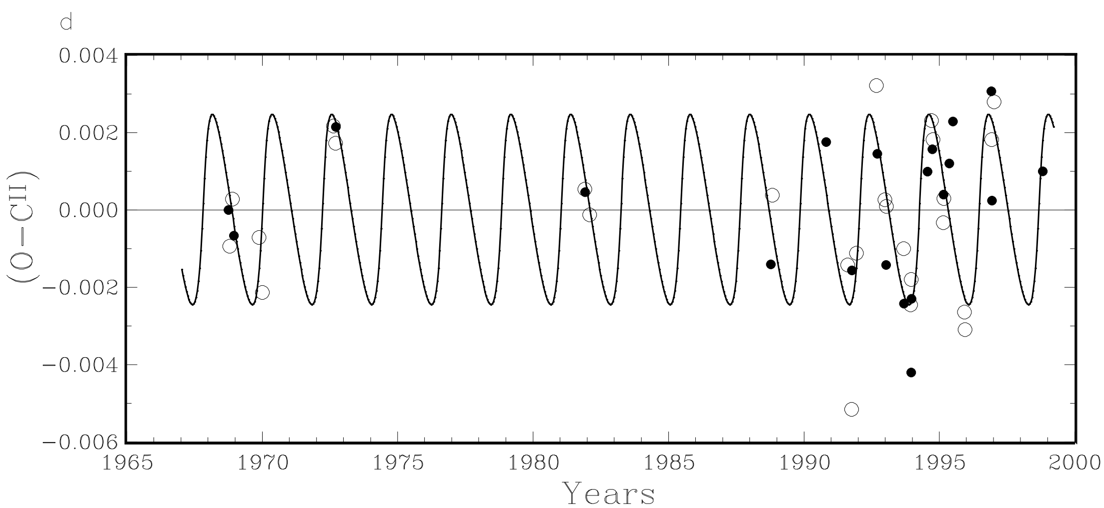

Figure 1. O−C diagram for photoelectric minima with linear trend subtracted. Individual primary (•) and secondary (∘) minima are shown. Zero O−C corresponds to JD 2444939 (year of 1981). The O−C residuals can be fitted by a theoretical calculated curve (solid line).

We see that the O−C residuals are subject to variations with a period of ≈ 2.2 years for both eclipses. This can be considered as evidence for a third body in the system. The amplitude of variations, period and eccentricity are calculated by the least square method. They are equal to

$$\frac{a' \sin i'}{c} = 4.18 \text{ min}, \qquad e' = 0.5, \qquad P' = 805^{\mathrm{d}}.$$

Our investigations concerning the mass of the third body will be described elsewhere. Here we only publish that the mass of the third component is approximately 1.1–1.7 $M_{\odot}$.

Acknowledgements. We are thankful to A.B. Kusakin, E.F Guinan and M. Wolf for their observations of AS Cam kindly presented to us.

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NEW OBSERVATIONS OF THE FUOR V1057 Cyg

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Name of the object:
V1057 Cyg

Equatorial coordinates:	**Equinox:**
R.A.= $20^h57^m06\overset{s}{.}24$ **DEC.=** $+44°03'46\overset{''}{.}4$	1950.0

Observatory and telescope:
Mt. Maidanak High Altitude Observatory, 0.6-m Zeiss reflector

Detector:	Single-channel pulse-counting photometer
Filter(s):	Johnson's UBVR
Comparison star(s):	BD +43°3781
Check star(s):	BD +40°4147

Transformed to a standard system:	Johnson system
Standard stars (field) used:	Selected Areas Nos. 104–112 by Landolt (1983)

Availability of the data:
Upon request

Type of variability:	FU (= FU Orionis type variable)

Remarks:
Figure 1 shows that the star is still fading. There is no clear trend to recover the normal brightness so far. Color-magnitude diagrams of the star during decline in 1995–98 (Table 1) show that the smooth reddening of optical colors have been changed towards becoming bluer in last two years. Evolution of the U−B color differs from that of two other colors and proceeds slower (Fig. 1). The recent blueing of the colors of V1057 Cyg provides additional support for the dust condensation hypothesis.

Acknowledgements:
This work is partly supported by CRDF grant ZP1-341.

Table 1: Yearly averaged brightness and color variations of V1057 Cyg during the recent decline

Year	JDH 24...	V	B−V	U−B	V−R	N_V	N_{BV}	N_{UB}	N_{VR}
1995	49882–50045	12.231	+2.030	+1.595	+1.868	56	56	36	56
		71	45	243	32				
1996	50209–50415	12.200	+2.091	+1.655	+1.885	72	72	23	71
		144	101	338	48				
1997	50596–50764	12.463	+2.053	+1.929	+1.868	74	73	17	73
		106	58	453	41				
1998	50995–51168	12.696	+1.983	+1.695	+1.786	68	68	21	68
		96	58	343	32				

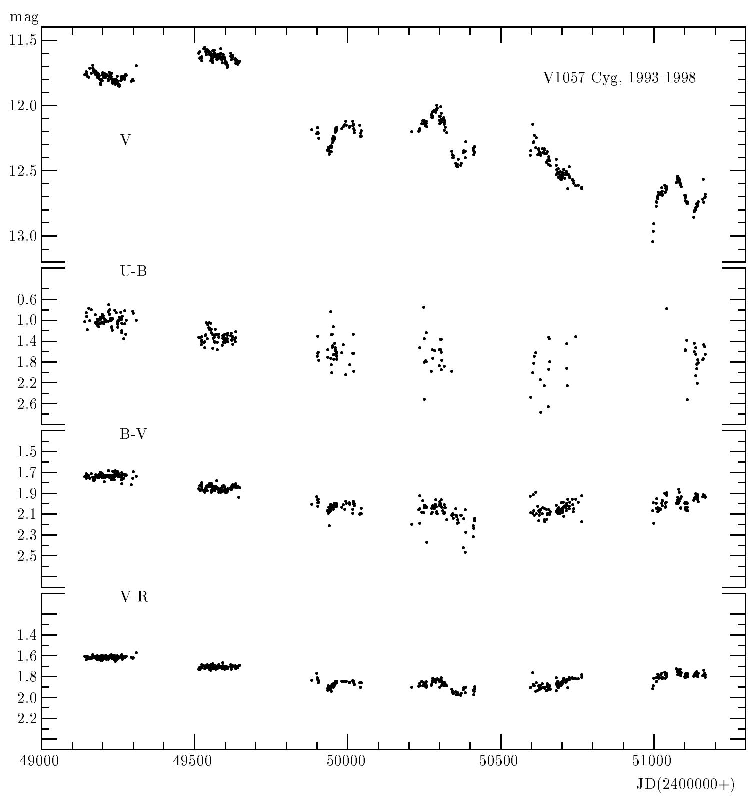

Figure 1. Brightness and color variations of V1057 Cyg in 1993–98.

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A TRANSIT OF THE PLANET 51 Peg B?

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"We see it [a probable new planet] as Columbus saw America from the shores of Spain. Its movements have been felt, trembling along the far-reaching line of our analysis, with a certainty hardly inferior to that of ocular demonstration." – John Herschel, in a speech to the British [Astronomical] Association, 10 September 1846.†

Mayor & Queloz (1995) first announced that the solar-type star 51 Peg has a Jovian-mass planet with a 4.23 day orbital period. Their observations were confirmed by Marcy et al. (1997). Since this exciting discovery many people naturally have wondered if transits of the planet could be observed across the disk of the parent star. Guinan (1995) and, later, Henry et al. (1997) reported null events. They could not find evidence of transits. However, Henry et al. show only one, possibly two, averages-of-three data points in the transit window. Under the assumption that the planet has a zero-eccentricity orbit, has a size equal to 0.8 times that of Jupiter, and assuming that the star has a size 1.3 times that of the Sun and a mass of 1.0 $M_\odot$, we would expect a full transit to be 4.3 mmag deep, last for 4 hours, and be centered at phase 0.25 (see Henry et al. 1997). Any *reflection effect* at other phases, or an eclipse at phase 0.75, would change the light of the system less than 0.1 mmag (Charbonneau, Jha, & Noyes 1998). Incidentally, if the planet is 0.8 times the size of Jupiter, there will be full transits if the orbital inclination is within 6.3 degrees of $i = 90°$.

Guillot et al. (1996) modelled Jupiter-like planets and suggest that because 51 Peg A is 8.5 Gyr old (Edvardsson et al. 1993), 51 Peg B may actually be as large as 1.3 times that of Jupiter. In that case a transit of the planet could produce a dip in the light curve as deep as 11 mmag. This, of course, assumes that a Jovian planet so close to its parent star (0.051 AU) still has its thick atmosphere.

Zerbi and 16 coauthors (1999), of which I am one, recently published the results of a multi-longitude photometric campaign on the γ Dor-type star BS 8799. The principal comparison star was HD 217715. The recommended check star was HD 218261. For reasons that I cannot quite recall, I decided to use a different check star, 51 Peg. This was two months *before* Mayor & Queloz announced the existence of the planet 51 Peg B. From 1210 Johnson V-band and Strömgren v-band measures of HD 218261 vs. HD 217715 over the course of 40 days Zerbi et al. conclude that both stars are constant. This allows us to investigate whether the 51 Peg vs. HD 217715 data show evidence of transits of 51 Peg B across its parent star.

†Quoted by Spencer Jones (1956). Of course, Herschel was referring to Neptune, which in fact was first seen by J. G. Galle and H. L. d'Arrest in Berlin 13 days later.

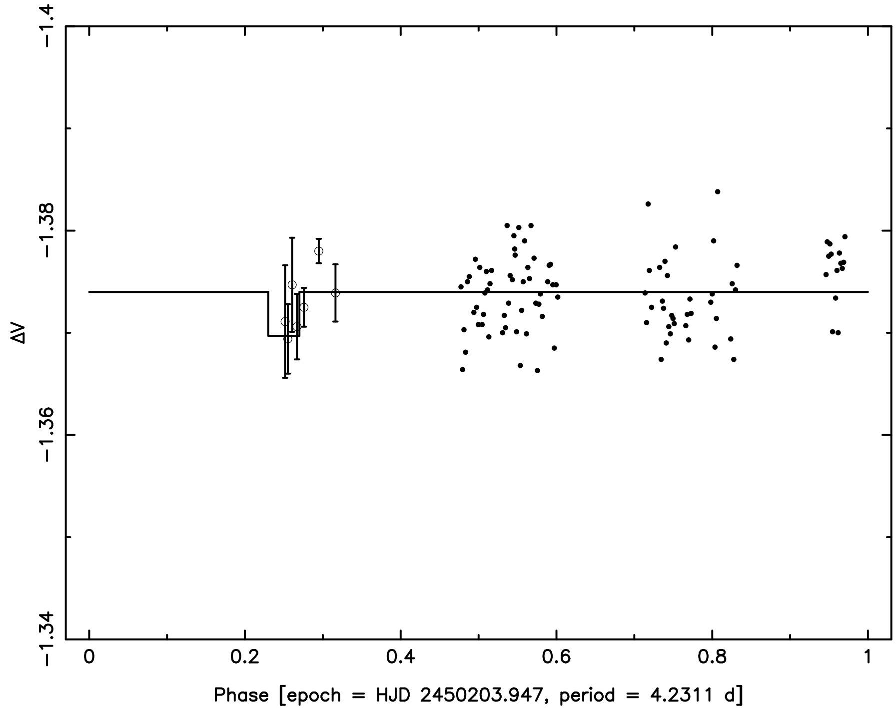

Figure 1. Differential measures of 51 Peg vs. HD 217715, obtained at Mauna Kea from 31 August to 6 September 1995 UT. The data are folded according the ephemeris of Marcy et al. (1997). Points without error bars are individual differential measures. Points with error bars are averages of 3 or 4 measures. A dip of 4.3 mmag is shown, corresponding to a full transit of a planet with $R = 0.8\,R_{\rm Jup}$.

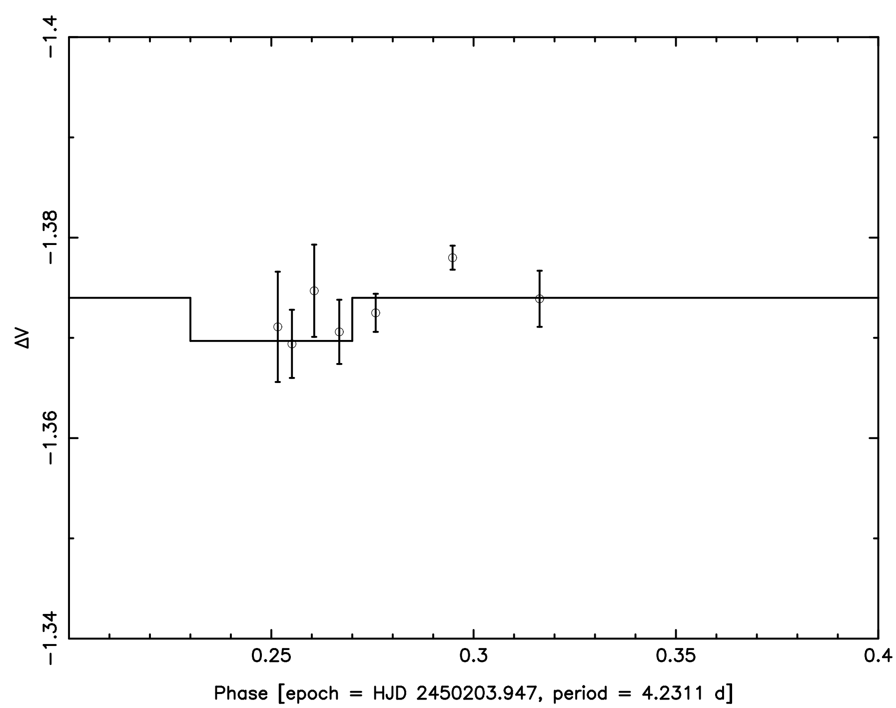

Figure 2. Data from Fig. 1, but only near the time of "inferior conjunction" of 51 Peg B.

Our observations were made with the University of Hawaii 0.6-m telescope at Mauna Kea from 31 August to 6 September 1995 UT, using an Optec SSP-5 photometer. The only night we observed near orbital phase 0.25 was 3 September 1995. From data on 6 of 7 nights we obtained 123 differential measurements under clear sky conditions with no tracking problems. Each "measurement" of a star was the result of two 30 second integrations. Each measurement of 51 Peg was bracketed by measurements of HD 217715. We linearly interpolated the comparison star counts by time for the calculation of the differential magnitude of 51 Peg, and made what we believe were appropriate differential extinction corrections. We added $\varepsilon_v \times \Delta(\mathrm{B}-\mathrm{V}) = -0.0253 \times 0.67 = -0.0170$ to all the data points to place them on the UBV system. Any systematic error in this color term has no bearing on the conclusions of this paper.

In Figure 1 we show the data folded according to the ephemeris of Marcy et al. (1997). We also show the predicted dip of 4.3 mmag centered at orbital phase 0.25 and lasting 4 hours. The dots in Fig. 1 are individual differential measures, and the points with error bars are averages of 3 or 4 differential measures. From 111 differential measures outside the transit window (phase 0.23 to 0.27) we find a mean differential magnitude of $\Delta\mathrm{V} = -1.3740 \pm 0.0004$. The internal error of a typical individual differential value is $\pm$ 3.8 mmag. Thus, an average of three measures should typically be accurate to $\pm$ 2.2 mmag.

In Figure 2 we show only the data near phase 0.25, when transits of the planet should occur, if in fact transits *do* occur. The first five points plotted are averages of three individual differential measures, and the last two points plotted are averages-of-four. Clearly, there is no 11 mmag dip. Thus, if Guillot et al. (1996) are correct, that 51 Peg B has $\mathrm{R} = 1.3\,\mathrm{R_{Jup}}$, full transits do not occur. If we average the 12 individual measures that occur in the transit window, we get $\Delta\mathrm{V} = -1.3714 \pm 0.0019$. Our data, taken at face value, indicate a dip of 2.6 ± 1.9 mmag. The probability of observing a 1.37-σ *dip* at just the right phase corresponds to the area under *one* tail of the unit-area Gaussian distribution. A random sample of points, with errors distributed in a Gaussian manner, would show this dip with a probability of 0.085.

Our data are consistent with there being no transit, but the data are not inconsistent with a 4.3 mmag transit of a $0.8\,\mathrm{R_{Jup}}$ planet having been observed. Clearly more data are warranted. We should be encouraged that ground-based or satellite observations will sooner or later reveal transits of extra-solar planets.

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ON THE PERIOD OF GU CANIS MAJORIS

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Variability of GU CMa has been discovered by Claria (1974a) who reported a photoelectric peak-to-peak amplitude of $\Delta V = 0.23$ mag. Spectral type of GU CMa is B2 Vne (Claria, 1974b) and the star was classified as a γ Cas-type variable in the General Catalog of Variable Stars (GCVS-IV). GU CMa is a visual binary (ADS 5713, Δm = 0.7, $\rho = 0.6''$). Finally, a $1\overset{d}{.}610137$ period was found from HIPPARCOS photometry (ESA, 1997).

We observed GU CMa in 1987–1998 at Mt. Maydanak within the framework of "ROTOR" programme (Shevchenko, 1989) using the UBVR pulse counting photometer attached to a 0.48-m reflector. BD $-10°1734$ (V = 7.875, U$-$B = -0.511, B$-$V = -0.053, V$-R_c$ = -0.021) was used as a comparison star. We obtained a total of 320 individual UBVR measurements during 12 observing seasons; the accuracy of the individual data is about 0.01 mag in all filters. We usually did not observe the star more than once per night, however, we monitored it four times during several hours in 1998 and detected no short-term variability.

We have derived two periods with equal probability from our data: 1.610158 (Fig. 1) and 0.80508 (Fig. 2) days.

The light curve shown in Fig. 1 is typical for binary systems consisting of two stars with nearly equal radii and effective temperatures. However, a preliminary analysis of 0.7 Å resolution spectra of GU CMa taken in 1991 with the 6-m SAO RAS telescope revealed no traces of the secondary. Thus radial velocities of He I lines, which are clearly discernible in all spectrograms, should exhibit variations with an amplitude of ±300–400 km/s, however, according to our spectroscopic data the actual amplitude does not exceed ±30 km/s, i.e., 10–15 times smaller than expected for a binary consisting of two components of equal mass $\sim 5 \div 10\,M_\odot$.

The above upper limit implies that the mass of the secondary is at least 5 times smaller than that of the primary, and therefore the short period should be preferred (see Fig. 2). Thus the new light elements are:

$$\text{Min JD}_{\text{hel}} = 2447078.115 + 0\overset{d}{.}80508 \times E.$$

The scatter of data points on the light curve is too high to be accounted for by observational errors. It may be due to irregular variability of the secondary.

I thank the CRDF Foundation for support of this work.

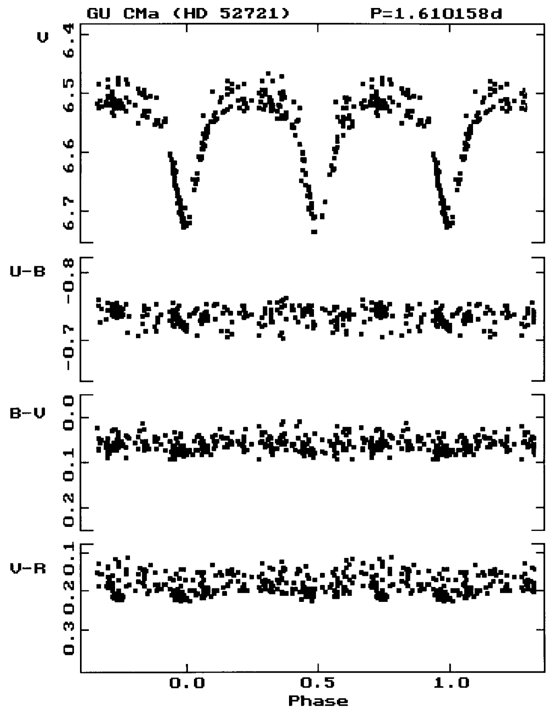

Figure 1.

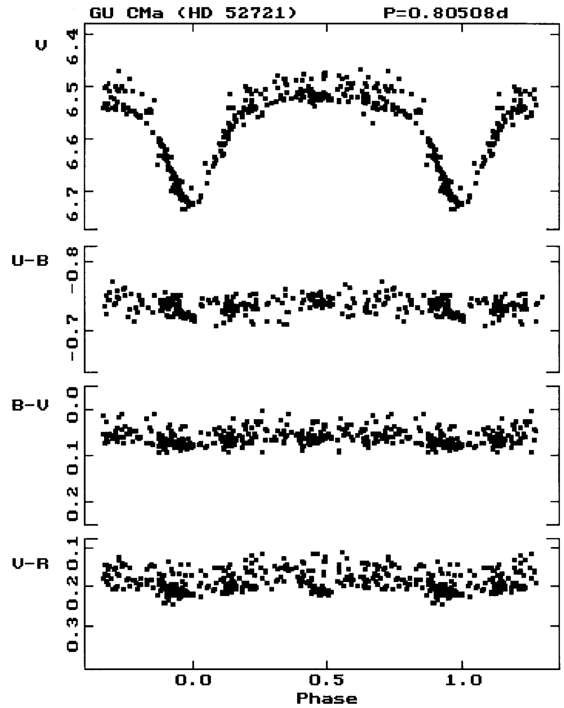

Figure 2.

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HD 129231: A NEW SHORT-PERIOD δ Sct VARIABLE

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During an observational program on δ Sct variables, HD 129727 (SAO 140102, V = $9^{\mathrm{m}}\!.5$, F0) was used as comparison star and HD 129231 (SAO 140074, V = $7^{\mathrm{m}}\!.8$, A2) as check star. The observing run was carried out through the years 1995 and 1996 at the observatories of San Pedro Mártir, México (1.5-m telescope) and Sierra Nevada, Spain (0.9-m telescope) by using similar simultaneous $uvby\beta$ Strömgren photometers attached to each telescope. The observations showed that while HD 129727 kept a constant brightness, HD 129231 presented a slight photometric variability. This latter star has not been reported as variable before in any catalogue, hence it has to be considered as a new variable star. This star was observed by the Hipparcos satellite (ESA, 1997) but it was considered as a constant star in the final results.

Figure 1 shows the light curves obtained for this star in the v filter during three nights 17, 22 and 27 of February, 1996. In this figure magnitude differences HD 129231 – HD 129727 versus Heliocentric Julian Day have been plotted. From this it can be seen that the period is about 0.032 days and the amplitude of luminosity variation is of about $0^{\mathrm{m}}\!.01$ (from peak to peak). Multiperiodicity is also suggested from the light curves shown in the figure. We tried to make use of the data collected by the Hipparcos satellite (HIP 71820, ESA, 1997) in order to gain some insight on the frequency content of this new variable. Unfortunately, this data set contains very few points (70 points) on this star, randomly distributed in time with a time span of 3.1 years. Moreover, the error of each measurement is too large (about $0^{\mathrm{m}}\!.011$). Therefore, it is not possible to reveal any reliable variability in the data. On the other hand, the geometric distance of HD 129231, as measured by the Hipparcos satellite, is of only 123($\pm$15) pc. Since the star is far from the Galactic plane and lies within close proximity to the Sun, the interstellar reddening can be neglected. This way, a visual absolute magnitude of $M_v = 2^{\mathrm{m}}\!.38(\pm 0.26)$ is obtained (assuming V = $7^{\mathrm{m}}\!.83$ from the same catalogue). Hence, due to the characteristics shown, we can conclude that this star is a new δ Sct-type variable located near to the main sequence and blue edge of the instability strip.

Acknowledgements. This research was supported by the Junta de Andalucía and the Dirección General de Enseñanza Superior (DGES) under project PB96-0840 and CONACYT.

† Deceased

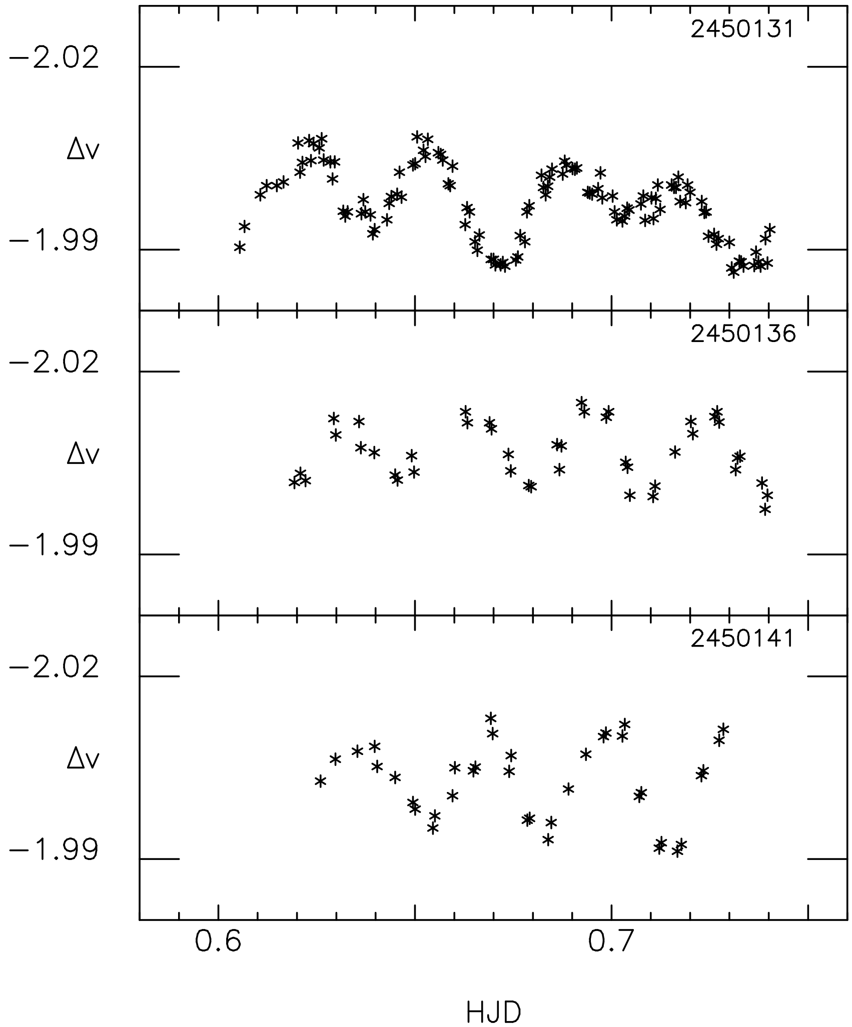

Figure 1. Differential light curves HD 129231 – HD 129727 in the *v* filter versus Heliocentric Julian Day

Reference:

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

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NEW VARIABLES IN THE FIELD OF EUVE J2114+503

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We monitored the field of the unidentified extreme-UV source, J2114+503 (Bowyer et al. 1996), for optically variable stars, using the 1-m telescope at the Wise observatory, with Tektronix 1024×1024 CCD. A total of 42 frames of 600 sec. each, from June 17, 1998 to January 21, 1999 with the Kron R filter were taken. The images were reduced in the standard way, using the IRAF package. The DAOPHOT task (Stetson 1987) was run on each image to automatically select and measure the magnitudes of all stars. Two iterations were used in selecting the PSF stars and two subtraction iterations were performed on each image (for details see Massey & Davis 1992). 577 stars were measured in at least 21 frames. We list here 5 certain variables in this field.

Table 1 lists the variables with their USNO-A2.0 name, if available, coordinates (equinox J2000.0), number of measurements, mean calibrated R magnitude and its error, B−R color index and its error, variability standard deviation and remarks. The astrometric reduction was done relative to the USNO SA1.0 catalog (Monet et al. 1996).

The magnitudes were calibrated using standard stars from Landolt (1992). The stars in the field selected as standards are listed in Table 2 with their USNO-A2.0 name, J2000.0 coordinates for epoch J1998.916, R magnitude, B magnitude and their standard deviation in the 42 frames.

Table 1: New variables in the field of EUVE J2114+503.

No.	USNO-A2 Name	R.A. J2000.0 Dec.	#	⟨R⟩	B−R	StD	Remarks
1	1350-13710453	21:14:37.28 +50:15:28.6	42	15.405	2.590	0.04	
				±0.012	±0.025		
2		21:14:24.61 +50:13:51.6	36	17.047	3.006	0.11	
				±0.021	±0.078		
3	1350-13708542	21:14:33.68 +50:23:50.3	37	15.110	2.775	0.07	$P = 0\overset{d}{.}23973$
				±0.015	±0.020		
4	1350-13713133	21:14:42.46 +50:23:33.5	39	17.779	1.842	0.12	Flares?
				±0.022	±0.100		
5	1350-13695867	21:14:09.50 +50:14:07.4	24	16.235		0.08	
				±0.019			

Table 2: List of standard stars in the field of EUVE J2114+503.

No.	USNO-A2 Name	R.A. J2000.0 Dec.	R	B	StD
s1	1350-13707363	21:14:31.28 +50:21:08.0	14.970 ±0.016	17.189 ±0.012	0.011
s2	1350-13710066	21:14:36.61 +50:19:31.6	15.029 ±0.015	17.476 ±0.010	0.007
s3	1350-13709893	21:14:36.19 +50:19:11.0	15.128 ±0.017	19.166 ±0.031	0.008
s4	1350-13709080	21:14:34.68 +50:18:19.3	15.184 ±0.017	19.141 ±0.026	0.009
s5	1350-13706971	21:14:30.53 +50:21:23.3	15.233 ±0.016	17.553 ±0.011	0.007
s6	1350-13708650	21:14:33.86 +50:18:59.5	15.312 ±0.017	17.876 ±0.016	0.008
s7	1350-13708934	21:14:34.51 +50:20:28.1	15.481 ±0.015	17.978 ±0.013	0.005
s8	1350-13708113	21:14:32.79 +50:20:33.4	15.790 ±0.016	18.557 ±0.023	0.009
s9	1350-13711663	21:14:39.58 +50:21:53.4	15.822 ±0.015	18.220 ±0.019	0.008
s10	1350-13710422	21:14:37.24 +50:22:01.3	15.967 ±0.015	18.868 ±0.022	0.007
s11	1350-13711044	21:14:38.50 +50:23:42.0	16.077 ±0.010		0.009
s12	1350-13711902	21:14:40.03 +50:23:36.6	16.193 ±0.015	18.915 ±0.024	0.008
s13	1350-13714467	21:14:45.07 +50:23:14.2	16.594 ±0.017	18.989 ±0.025	0.008

The third star in Table 1 (USNO-A2.0 #1350-13708542) shows periodic variation with a period of about 6 hours and a peak to peak amplitude of 0.160 ± 0.047 magnitude in R. The folded light curve of this star is given in Figure 1.

Finding chart for the new variables and standard stars is displayed in Figure 2. The variables are designated with circles while the standard stars are designated with boxes.

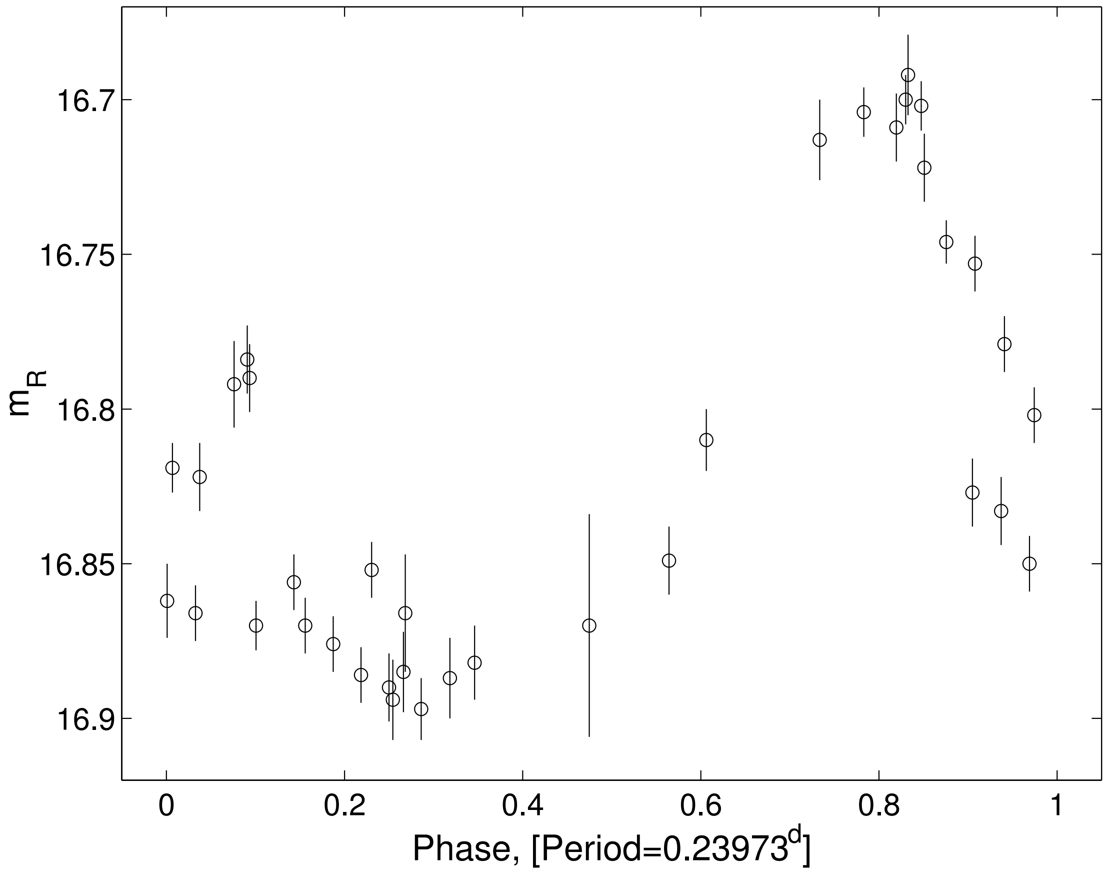

Figure 1. Folded light curve of USNO-A2.0 #1350-13708542

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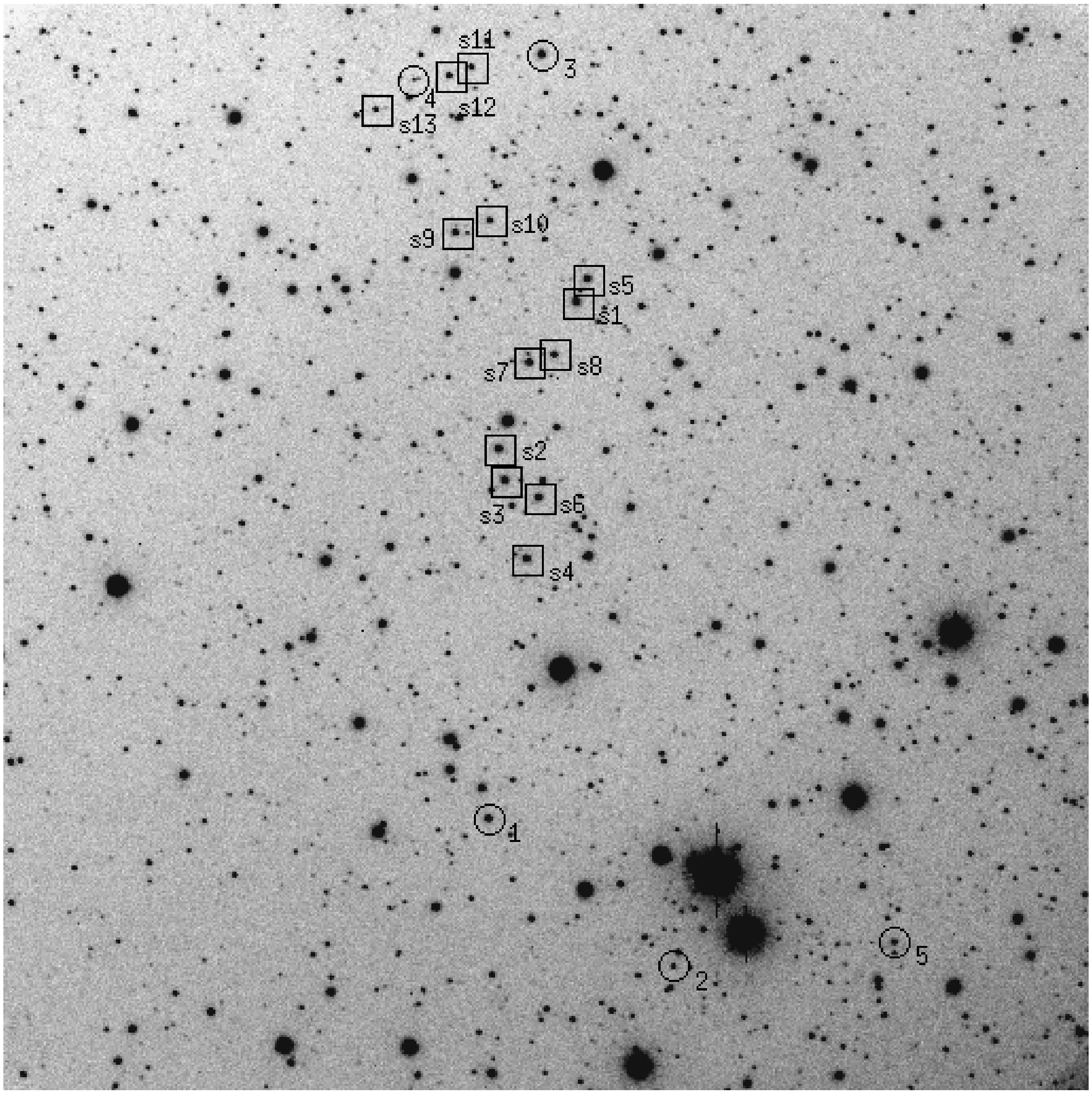

Figure 2. Finding chart of the EUVE J2114+503 field

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B AND V PHOTOELECTRIC LIGHT CURVES AND FIRST EPHEMERIS OF NSV 11321, A NEW W UMa SYSTEM

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New photoelectric observations were carried out on NSV 11321, a short period suspected variable in the constellation Lyra (Hoffmeister 1965, Kholopov *et al.* 1982). The variability was detected on the basis of 2478 visual estimates obtained from 1995 to 1997 by several GEOS members. Subsequently observations were carried out using the 76-cm reflector of the Jungfraujoch in the Swiss Alps, operated by the Geneva Observatory. We collected 322 Geneva BV photoelectric measurements on NSV 11321, using the All Sky method, concentrated in 5 nights over a 2 year interval.

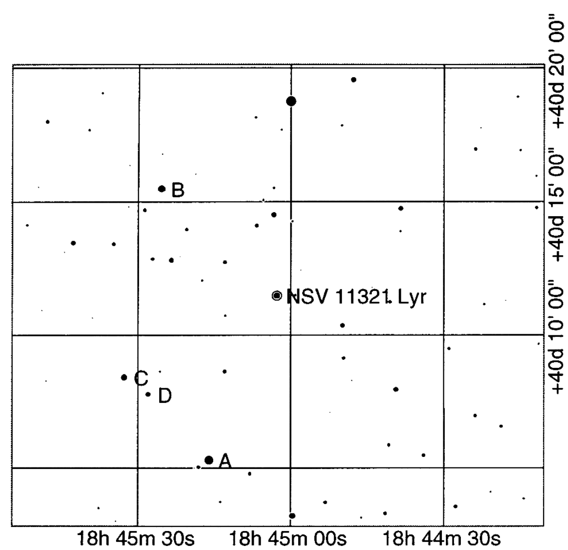

Figure 1. Finder chart of NSV 11321. Labeled stars were chosen to perform visual estimates, but they can be used for differential photometry too.

Plotted in Figure 1 is the star field used for identifying NSV 11321. Listed in Table 1 are the star's identification numbers, coordinates (J2000) and magnitudes from the Hubble Space Telescope Guide Star Catalogue (GSC, Jenkner *et al.* 1990).

Table 1: Comparison stars in the field of NSV 11321

Label	GSC No.	R.A. (J2000)	Dec. (J2000)	GSC Mag
A	3122:298	$18^h45^m19\overset{s}{.}8$s	$+40°05'01''$	9.8
B	3122:2732	$18^h45^m29\overset{s}{.}1$s	$+40°15'12''$	10.6
C	3122:809	$18^h45^m36\overset{s}{.}4$s	$+40°08'06''$	10.9
D	3122:2341	$18^h45^m31\overset{s}{.}7$s	$+40°07'29''$	11.4

There was no ambiguity in the determination of the period of NSV 11321, since two of the nights covered more than one third of the light curve. Using the method of Kwee and Van Woerden (1956), the heliocentric Julian Dates of three photoelectric minima were found and are tabulated in Table 2.

Table 2: Times of Photoelectric Minima of NSV 11321

HJD	Error
2450700.3444	± 0.0011
2451041.4344	± 0.0006
2451051.5484	± 0.0009

The Phase Dispersion Minimization method (PDM, Stellingwerf, 1978) for period finding and O−C diagrams were applied to the photoelectric data to obtain an improved ephemeris:

$$\text{Min I or II} = \text{HJD}\,2450700.3444(11) + 0\overset{d}{.}577639(4) \times E.$$

The uncertainties in the final digits, using the mean square error, are given in brackets. The period found is very close to that coming from visual estimates based on 44 observed minima, which is $0\overset{d}{.}577642$ (Beltraminelli and Dalmazio, 1999; a copy can be requested from the GEOS).

The V magnitudes and the B−V color index folded on this period are plotted in Figure 2 with different symbols for each night. The V light curve and the B−V behavior leads us to expect this to be a contact system belonging to the W UMa type rather than to be a pulsating star for the following reasons. First, the light curve shows sharp minima and well rounded maxima, as expected for an eclipsing binary. Second, the B−V amplitude is not larger than 0.04 mag, a very small value for a pulsating star. The faint reddening at both minima is probably due to the eclipse of the neck of contact binaries, which has normally an increased temperature. Third, when plotted on the $0\overset{d}{.}289$ period, the measurements show a wider scatter.

The variation ranges in V from 11.47 ± .01 for both minima to 10.96 ± .01 for the maxima. Uncertainties of the measurements do not allow us to discriminate which is the primary minimum.

The slight asymmetry in the maxima, is probably indicative of star spots distributed asymmetrically over the surface(s) of the star(s).

The average B−V color index is −0.451 ± .004 at maximum light. Using the conversion formula described by Meylan and Hauck (1981), the resulting B−V color index, considering NSV 11321 as a system belonging to the luminosity class V, is equal to 0.417. Applying the conversion table published by Cousins (1981), NSV 11321 Lyr belongs approximately to the spectral class F5. This evaluation is in agreement with Rucinski's

(1997) "period-color" diagram, in which it is shown that the evolution leads to longer periods and redder colors for more evolved contact systems .

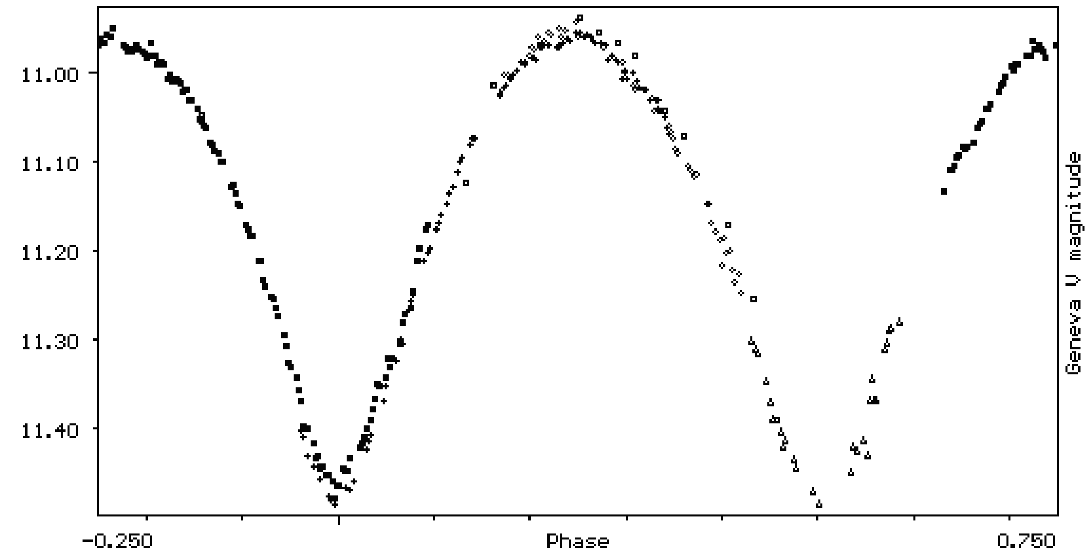

Figure 2. V band light curve of NSV 11321

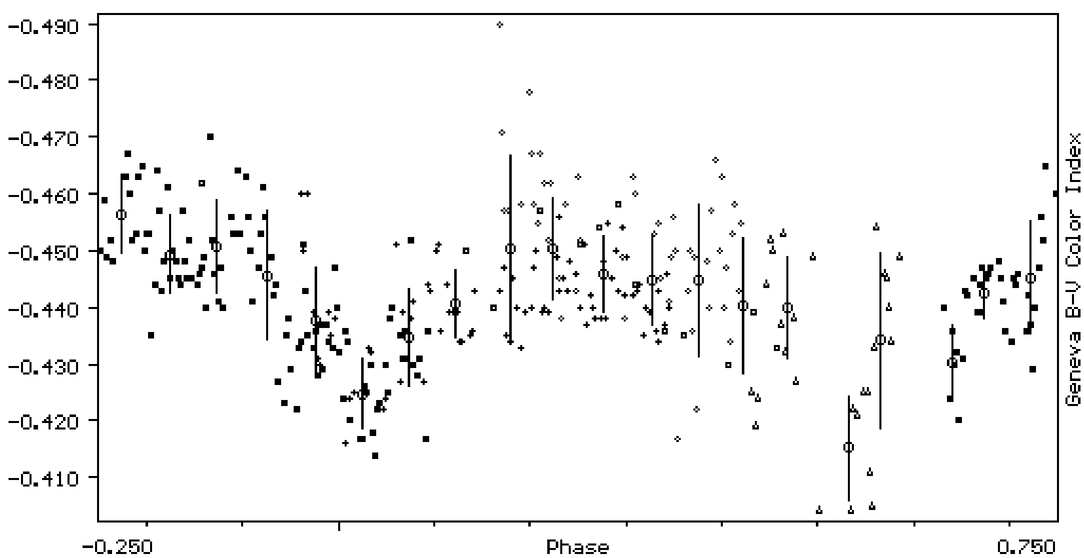

Figure 3. B−V color index. Open circles represent mean values every 0.05 phase, and error bars represent the mean square error

In conclusion we have shown that NSV11321 is an eclipsing binary of the W UMa type and spectral class F5, and have proposed a first ephemeris.

We acknowledge Paolo Bernasconi for critical reading, Julie Guignard and Gilles Allenbach for their contribution to photoelectric measurements.

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57 Tau = HD 27397 – A SPECTROSCOPIC BINARY

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In a recent paper, Paparó et al. (1999) suggest that the low-frequency variations observed in the bright F0 star 57 Tauri (= HD 27397 = HR 1351) may be due to either duplicity effects, g-mode pulsations (similar to those found in γ Doradus stars, see, e.g., Kaye et al. 1999), or a combination of the two. Their multi-site photometry, although sufficient for finding the frequencies associated with these phenomena, was not able to distinguish between them.

To this end, 139 high signal-to-noise ratio spectra were obtained over fourteen nights at the Kitt Peak National Observatory during December 1998. The signal-to-noise ratio (SNR) is estimated to be over 350. Each spectrum covers the wavelength region 5840 to 6160 ångströms and were obtained using grating A, camera 5, and the long collimator. An OG550 filter was used to block both higher and lower orders. Data were recorded on the F3KB CCD; these spectra have a reciprocal dispersion of 0.105 ångströms per pixel, resulting in a resolving power of approximately 35,400. The slit width was fixed at 250 μm, which corresponds to 1.81 seconds of arc. The projected slit image was 0.024 mm and covered 1.60 pixels.

Subsequent analysis based on the time series of first moments of the Fe I λ6122.226 photospheric line indicates that 57 Tauri is a spectroscopic binary. Table 1 presents the preliminary orbital elements of the system; the solution is plotted as a phased radial-velocity curve in Figure 1. The standard deviation of the orbital fit (noted as σ in Table 1) is higher than expected due to the ongoing pulsations present in 57 Tauri (see Paparó et al. 1999).

Additionally, since this binary has such a short period, at least some of the low-frequency variations observed by Paparó et al. (1999) are probably due to duplicity (i.e., geometric and proximity) effects.

Acknowledgments:

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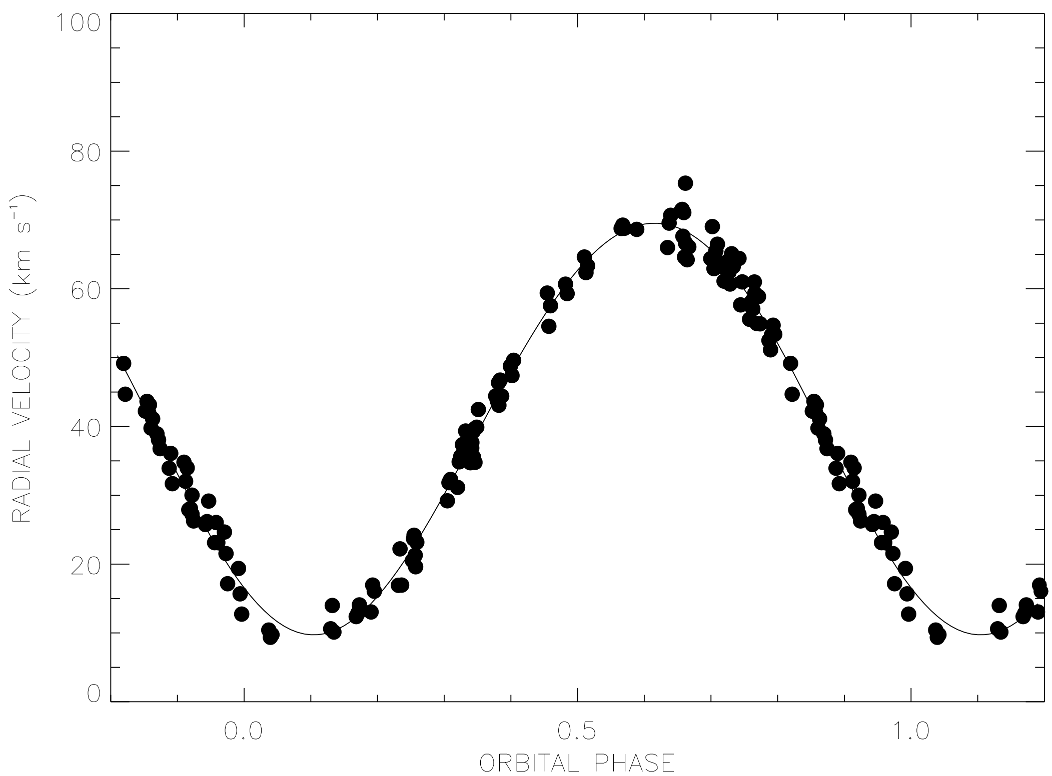

Figure 1. A phased radial-velocity curve of the primary star (57 Tauri) based on the first moments of the Fe I λ6122.226 line.

Table 1: Preliminary Orbital Elements of 57 Tauri = HD 27397

Orbital Element	Value
γ	40.268 ± 0.203 km s^{-1}
K_1	29.906 ± 0.316 km s^{-1}
e	0.028 ± 0.010
Ω	$140\overset{\circ}{.}5 \pm 20\overset{\circ}{.}4$
HJD of $T_{\rm periastron} - 2451100$	64.968 ± 0.144 days
P	2.4860 ± 0.0017 days
Mass Function	$0.0069 \pm 0.0002\ M_\odot$
$a \sin i$	6831.0 ± 72.4 AU
σ	2.12 km s^{-1}

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Paparó, M., et al., 1999, A&A, submitted

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ON THE MONOPERIODICITY OF THE SUSPECTED δ SCUTI STAR IOTA BOOTIS

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The light variation of ι Bootis (= 21 Boo = HR 5350 = HD 125161 = HIP 69713, spectral type A9V) was discussed earlier by Albert (1980), Szatmáry (1988), Gál et al. (1994) and Kiss (1995). The principal period of light variation around 38–40 min was unambiguously revealed. Handler & Paunzen (1995) have not found convincing evidence for variability, but they have not given any further detail. Rodríguez et al. (1994) listed the main parameters of the star, such as the period, amplitude (0.027 days and 0.03 mag – values given by Albert 1980), and various photometric indices ($B-V = 0.20$, $U-B = 0.06$, $b-y = 0.128$, $m_1 = 0.198$, $c_1 = 0.834$ mag). Unfortunately, the earlier measurements had very short time-spans and consequently, the stability and possible multiperiodicity could not be studied. The main aim of this note is to present new observations and a reanalyis of earlier data together with the new measurements.

Photoelectric BV observations were carried out at Szeged Observatory (Hungary) on May 5, 1998. The data was obtained using a single-channel Optec SSP–5A photometer attached to the 0.4-m Cassegrain telescope. We carried out differential photometry relative to HR 5360 ($V = 6.19$, $B-V = 0.07$ mag). The achieved accuracy in V was about $\pm0\overset{m}{.}01$. Further observations were obtained at Sierra Nevada Observatory (Spain), on 4 nights in June, 1998 (19th, 20th, 23th and 24th), using the 0.9-m telescope equipped with a four-channel *uvby* photometer. Here we made all-sky photometry monitoring the extinction curves by following two Strömgren standards (HR 6577 and HD 185734). The accuracy in y was ±0.002–0.007, depending on the weather conditions. We analysed the y measurements combined with the V data. The colour-dependent standard transformations could be neglected, as the $b-y$ index does not change more than 0.002 mag, implying y data to be only slightly shifted relative to the Johnson V. The observational data are available upon request from the first author.

The new observations alone revealed the well-known periodicity of 38 min bearing an amplitude (ΔV) somewhat smaller than 0.01 mag. We put together all new data (V and y) with earlier measurements by Kiss (1995) after subtracting the mean values. This step can be questioned, as similar subtraction can significantly change the determined frequency content. However, two observational facts were considered before doing this. First, the

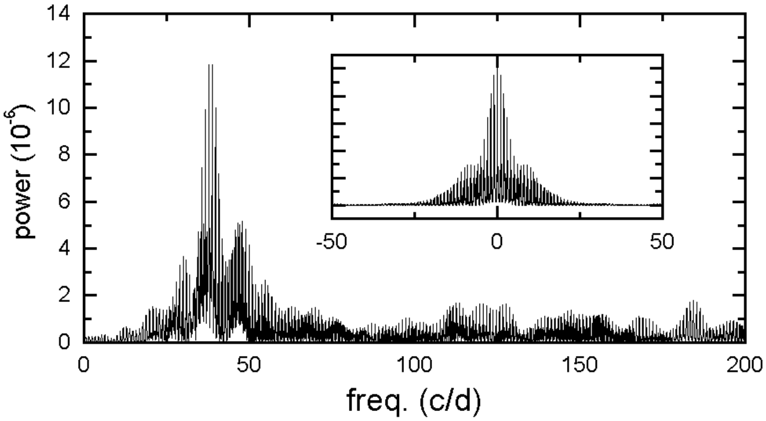

Figure 1. The power spectrum of the whole dataset. The inset shows the window function.

10 main cycles observed by Kiss (1995) suggested the lack of long-term variation of the mean brightness. Second, photometric observations of lower accuracy by the Hipparcos satellite (ESA 1997) did not confirm the period value listed by Rodríguez et al. (1994), nor any other significant light variation with higher amplitude.

We calculated the Discrete Fourier Transform (DFT) of the whole dataset using Period98 (Sperl 1998). We plotted the power spectrum with the window function in Fig. 1. The spectrum contains one principal peak at $f = 37.750 \pm 0.001$ c/d (which corresponds to a period of 38.145 ± 0.001 min) with a semi-amplitude of 0.0035 mag. The quoted very small uncertainty of the frequency is due to the very stable light variation. A lower limit for the relative stability of the period ($\Delta P/P$) is $2.62 \cdot 10^{-5}$. This is well illustrated by the phase diagram based on all observations between 1995–1998. Although they span more than 40000 cycles, the combined phase diagram (Fig. 2) has quite small scatter, not exceeding the usual observational errors.

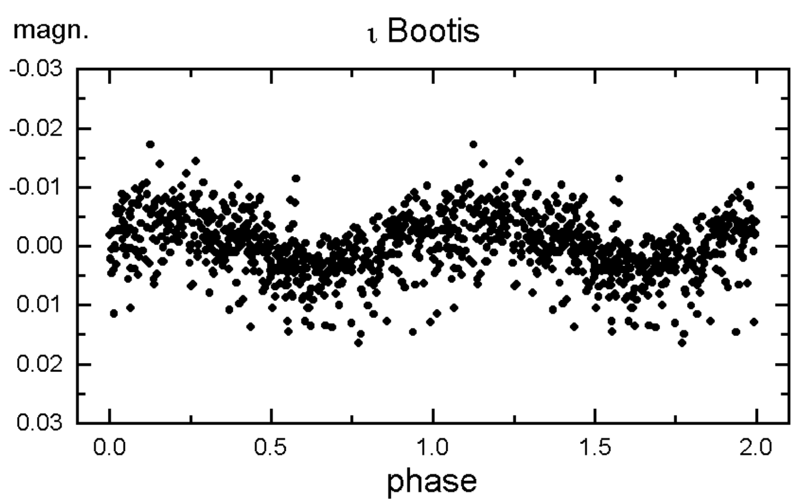

Figure 2. The combined phase diagram of all data.

After pre-whitening with the principal frequency, the remaining amplitude spectrum does not contain any peak higher than 0.001 mag. Thus, we conclude that ι Bootis has a highly monoperiodic light curve, which can be fitted quite well with a one-component sine function. This can be seen in Fig. 3, where the new data are plotted with the fitted function ($A = 0.0035$ mag, $f = 37.750$ c/d, $\phi = 0.117$).

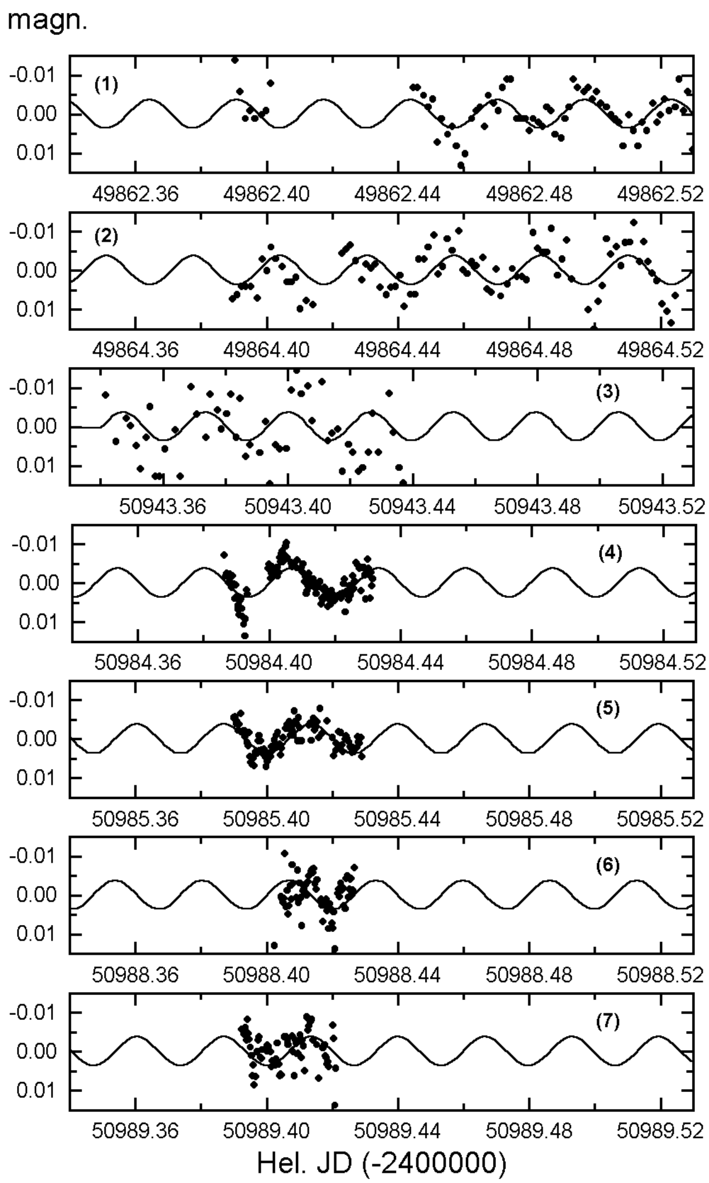

Figure 3. The V light curves of ι Bootis. The solid lines represent the one-component fit. Data in panels (1)–(3) were obtained in Szeged, (4)–(7) in Sierra Nevada.

This relatively long term stability of the period raises the question whether the light variation can be associated with pulsation. Such rapid variations with periods of 30–50 min were also observed in other δ Scuti candidates (e.g. Rodríguez et al. 1999). While ι Bootis is a fast rotating star ($v \sin i = 130$ km s^{-1}, Abt & Morrell 1995), the presence of high-order non-radial oscillations is very possible (see, e.g., Mantegazza 1997). Unfortunately, this issue can be studied only with the help of high resolution spectroscopy in order to detect line profile variations. Therefore, further spectroscopic observations are desirable to answer two questions: *i*) Is the observed variation due to pulsation?; *ii*) If yes, which mode is excited?

Another important problem is the determination of fundamental physical properties. To our knowledge, the only publication listing accurate parameters is that of Malagnini & Morossi (1990), who derived luminosities, effective temperatures, radii, masses and surface gravities for a selected sample of field stars with help of spectrophotometric observations and trigonometric parallaxes. Their calculation strongly depends on the stellar parallax available that time (48.1 mas, 25% error). However, the new parallax measurement of the Hipparcos satellite is 33.54 mas (s.e. 0.56 mas), being more than 30% smaller, corresponding to a distance of 29.8 pc. Thus, we repeated the calculations with replacing the parallax, and using the recent synthetic colour grids of Kurucz (1993). The assumption of solar metallicity, $b-y = 0.128$ and $c_1 = 0.834$ infer an effective temperature of 8000 K and $\log g = 4.3$. The estimated uncertainties are about ± 200 K and ± 0.1 dex, where the effect of fast rotation exceeds the photometric errors (Michel et al. 1998). For $V = 4.75$ mag and $d = 29.8$ pc, we get a visual absolute magnitude of $M_{\rm V} = 2.38$ mag. The bolometric correction for an A9V star is $BC = -0.09$ mag, resulting in $M_{\rm bol} = 2.29$ mag. $M_{\rm bol}$ and $T_{\rm eff} = 8000$ K give a radius of $R_* = 1.6 \pm 0.1$ R$_\odot$, while $\log g$ and radius infer a stellar mass of $M_* = 1.9 \pm 0.4$ M$_\odot$. These values strongly suggest that ι Bootis lies on the main sequence (see, e.g., Appendix E in Carroll & Ostlie 1996).

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NEW CEPHEIDS IN AQUILA

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We have continued our search for new variable stars at low galactic latitudes. As announced in the previous paper (Antipin, 1998), the main goal of this work is discovery of new classical Cepheids or related objects. Our study is based on Moscow archive plates taken with the 40-cm astrograph in Crimea.

Tables 1 and 2 contain data on two new variable stars discovered in the course of this research. The tables present for each star: GSC identifications, equatorial (J2000) and galactic coordinates, number and interval (JD) of observations, maximum and minimum brightness in B band, and light-curve asymmetry ($M - m$). Finding charts are shown in Figure 1. Magnitudes of comparison stars (Table 3) were obtained on the base of the B-band standard sequence in NGC 6755 (Hoag et al., 1961).

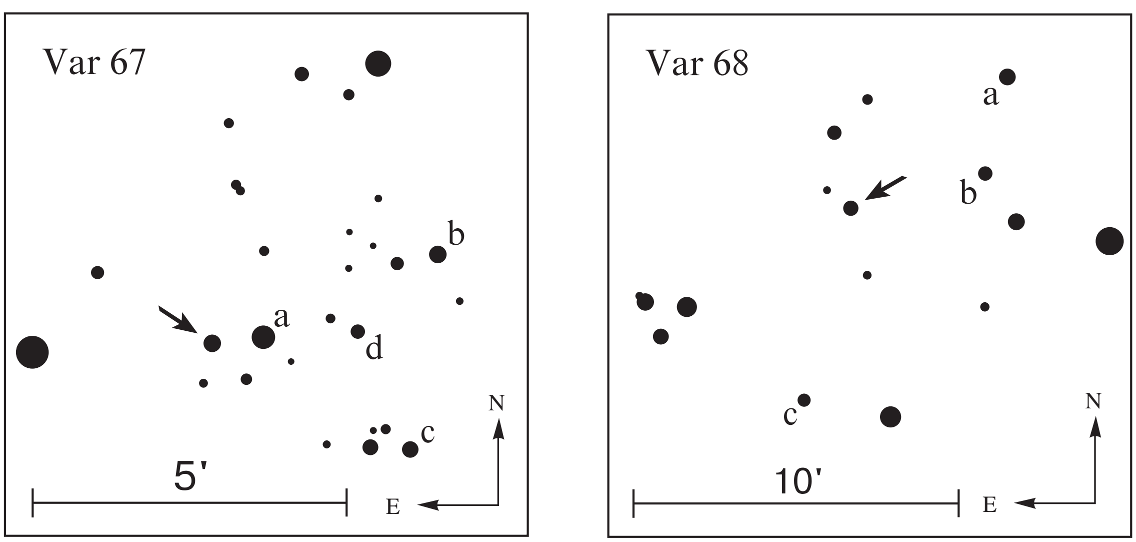

Figure 1. Finding charts

Table 1: Coordinates and Identifications of New Variables

Var	GSC	α (J2000.0)	δ (J2000.0)	l	b
Var 67	5115.0919	$18^h53^m17\overset{s}{.}8$	$-0°06'27''$	33°.05	−0°.46
Var 68	5115.1270	$18^h54^m59\overset{s}{.}5$	$-0°04'37''$	33°.27	−0°.83

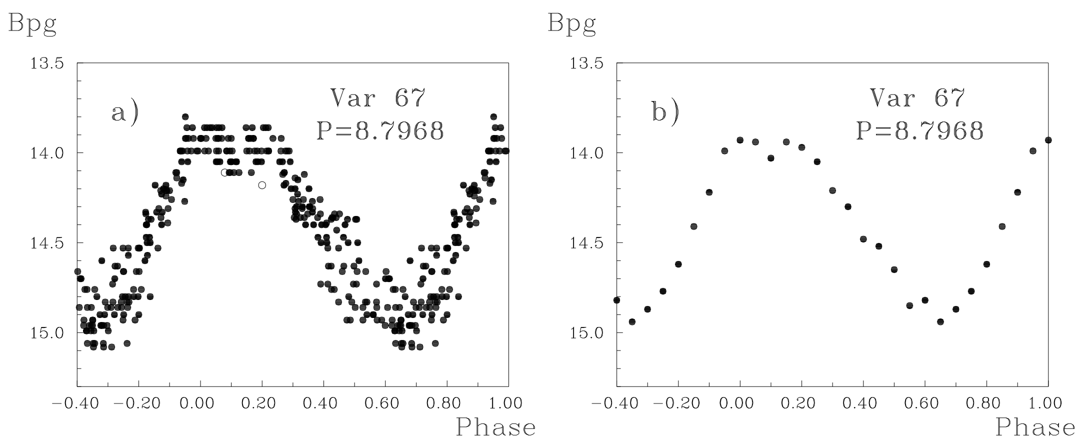

Figure 2. Var 67. Phased light curve (a) and mean phased light curve (b). Uncertain estimates are shown as open circles

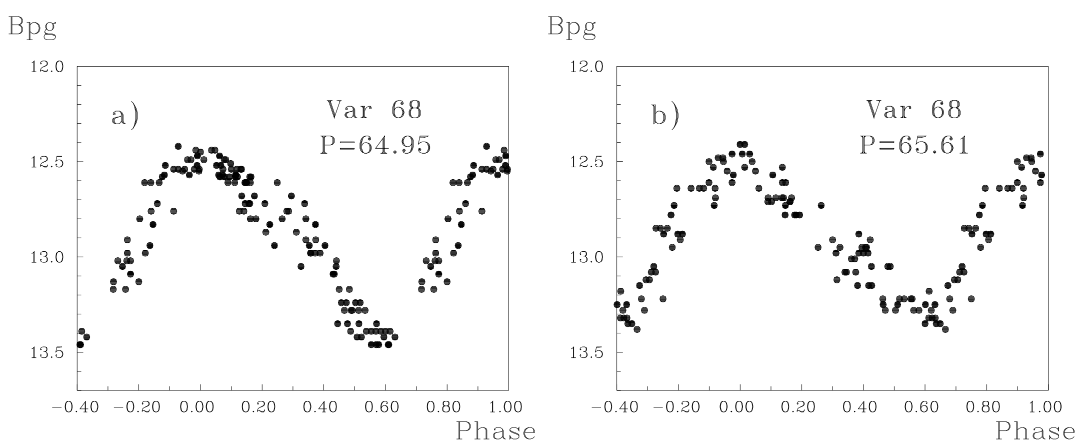

Figure 3. Var 68. Phased light curves for two intervals of observations: a) JD 2436000–2438700 and b) JD 2443700–2448200. Strong period changes are clearly seen

Table 2: Data on New Variable Stars

Var	N	JD 24...	Max	Min	$M-m$
Var 67	292	32740–49931	$13\overset{m}{.}95$	$14\overset{m}{.}95$	0.35
Var 68	299	32740–49931	$12\overset{m}{.}5$	$13\overset{m}{.}4$	0.41

Table 3: Comparison Stars

Var	a	b	c	d
Var 67	12.87	14.11	14.40	15.06
Var 68	12.32	12.61	13.45	

Var 67. The results of frequency analysis enable us to classify the variable as a new classical Cepheid with light elements:

$$\mathrm{JD}_{\max} = 2442990.34 + 8\overset{d}{.}7968 \times E.$$

The phased light curve (Figure 2a) shows a two-humped shape, in agreement with the Hertzsprung progression for this value of period. The secondary maximum (hump) at the phase ~ 0.15 is almost equal in magnitude to the primary one. The mean phased light curve is given in Figure 2b.

Var 68. The variable is identical to the Tycho object TYC 5115 1270 1 (ESA, 1998). Our photographic observations show periodic light variations typical of a Cepheid with $P \sim 65^{\mathrm{d}}$. Strong period changes have been found. The following light elements are good only for comparatively short time intervals:

$$\mathrm{JD}_{\max} = 2438167.44 + 64\overset{d}{.}95 \times E, \quad \mathrm{JD}\, 2436000 - 2438700;$$

$$\mathrm{JD}_{\max} = 2444456.39 + 65\overset{d}{.}61 \times E, \quad \mathrm{JD}\, 2443700 - 2448200.$$

The corresponding phased light curves are presented in Figure 3ab.

Having plate estimates only, it is very difficult to determine the star's type of variability for certain. Two possible classifications – RVA and DCEP – could be suggested. The colour index of the star from Tycho catalogue ($B-V = 1.869$, $\sigma = 0.314$) does not contradict any of these two classifications. But the shape of the light curve looks stable during all observations. Moreover, the changes in period caused by fast evolution of a massive star through the instability strip are characteristic of long-period Cepheids (Berdnikov, 1994). So, attributing the new variable to classical Cepheids seems preferable. In this case, Var 68 would belong to the group of Galactic classical Cepheids with the longest periods.

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NEW VARIABLE STARS IN NGC 7762

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In order to check variability of stars in open clusters we observed NGC 7762 in the framework of STACC (Small Telescope Arrays with CCD Cameras) (Frandsen & Arentoft, 1998). The main goal of this collaboration is to observe stars exhibiting complex pulsational spectrum. Observing open clusters is a reasonable solution, because 4-6 main-sequence pulsating variables can be studied on one CCD-frame. Provided that the main characteristics (age, distance, chemical composition, etc.) of the cluster-members are very similar, these stars can be used for comparative asteroseismological investigations: to help the identification of excited modes and to compare seismological information with theoretical models.

The first step toward this goal is to find adequate open clusters and variables. Frandsen & Arentoft compiled a list of potential target clusters considering the age and distance (i.e. apparent size) for small telescopes and CCD-cameras (Frandsen & Arentoft, 1996).

We have chosen NGC 7762, because there has been no previous systematic search. Frandsen & Arentoft found the following parameters for this cluster in the literature: 1.02 kpc distance, 800 Myr age and $0\overset{m}{.}98$ reddening. Later Patat & Carraro found that NGC 7762 is much older, namely 1.8 Gyr (Patat & Carraro 1995).

Time series observations of NGC 7762 in V band were carried out on three consecutive nights in September, 1997 with the 1-meter RCC telescope at Konkoly Observatory (Piszkéstető, Hungary). Table 1 gives the summary of observations.

Table 1: Log of observations

Date	HJD	$t_{\rm exp}$ (s)	filter	$N_{\rm frames}$	$t_{\rm eff}$ (h)	seeing	$V - v_{\rm intsr} = a$
1997 Sep 15/16	2450707	180	V	55	3	$2\overset{''}{.}3$	$13\overset{m}{.}08 \pm 0\overset{m}{.}02$
1997 Sep 16/17	2450708	180–190	V	50	3	$2\overset{''}{.}1$	$12\overset{m}{.}61 \pm 0\overset{m}{.}04$
1997 Sep 17/18	2450709	150–180	V	103	5	$1\overset{''}{.}5$	$12\overset{m}{.}93 \pm 0\overset{m}{.}01$

A Wright Instrument's camera with EEV CCD05-20 UV-coated chip (800×1200 pixels, 22.5 μm^2 each) was used in the Cassegrain-focus. Its full well capacity was 10^5 e^- and the readout noise was 10 electrons. There were neither bad nor hot pixels on the chip. The image scale was $0\overset{''}{.}39$ per pixel, resulting in a $4' \times 6'$ field of view. Effective observing times are shown in Table 1, and we note in passing that in general observing conditions were poor.

The relatively small field of view did not allow us to cover the whole cluster, therefore one of the most populated subfields was selected. This area contains fainter stars; the brightest members of the cluster are out of our interest, because these objects are thought to be red giants.

The frames were corrected for nonlinearity before any other reduction with the following transformation: $N_{\rm corr} = N/(1 + 3 \cdot 10^{-6}N)$, where N is the original pixel value, and $N_{\rm corr}$ stands for the nonlinearity corrected pixel value. The basic steps of reduction of the CCD frames (cosmic ray elimination, bias subtraction and flat-fielding) were performed by IRAF packages. MOMF 3.0 (Multi Object Multi Frame) software package (Kjeldsen & Frandsen, 1992) adapted to our software environment was used to determine instrumental magnitudes.

The instrumental magnitudes were transformed to Johnson's V system based on the BV CCD-photometry of Patat & Carraro (1995). The covered range of $B-V$ color indices was small, so the color terms in the transformation were omitted. The applied formula was $V - v_{\rm instr} = a$, where the corresponding a values can be found in Table 1.

Table 2 shows the internal scatters of constant stars, indicating the quality of each night. It clearly shows that the second night was the worst, and the last night offered the best conditions.

MOMF 3.0 determines a d parameter (for details see Kjeldsen & Frandsen 1992), which quantity was found to be very useful to select potential variable stars from a large sample. We used this parameter determined on the third night to identify possible variable stars after establishing the empirical $d > 1.4$ criteria for variability. Table 2 also contains typical d values for constant stars.

Table 2: Internal scatter ($\sigma_{\rm int}$) and d parameter of constant stars

HJD	$V = 11 - 13^{\rm m}$		$V = 13 - 15^{\rm m}$		$V = 15 - 17^{\rm m}$	
	$\sigma_{\rm int}$	d	$\sigma_{\rm int}$	d	$\sigma_{\rm int}$	d
2450707	$0^{\rm m}_{.}003$	1.12–1.23	$0^{\rm m}_{.}005$	1.12–1.17	$0^{\rm m}_{.}040$	1.11–1.28
2450708	$0^{\rm m}_{.}004$	1.06–1.19	$0^{\rm m}_{.}007$	1.01–1.24	$0^{\rm m}_{.}070$	0.98–1.28
2450709	$0^{\rm m}_{.}002$	1.00–1.12	$0^{\rm m}_{.}005$	0.95–1.11	$0^{\rm m}_{.}030$	0.96–1.24

After checking the light-curve and d value of each star on the frames, we found that stars numbered as #4, #33 and #47 ($d = 1.93$, 1.44, 1.68 on 17/18 September, HJD = 2450709) show significant variations (see Figures 1, 3 and 4). We used the identification numbers of Patat & Carraro (1995). Table 3 contains coordinates and GSC identification numbers. These stars are not affected by close visible companions, and are not situated at the edge of the frames (two effects that may cause problems during photometry), therefore these changes can be regarded as intrinsic light variations.

Table 3: Identification of the variable star candidates

P. & C. ID	GSC number	R.A. (J2000)	Dec. (J2000)
#4	GSC 4479_941	$23^{\rm h}50^{\rm m}05^{\rm s}_{.}19$	$+68^\circ02'04''_{.}4$
#33	—	$23^{\rm h}50^{\rm m}19^{\rm s}_{.}17$	$+68^\circ02'08''_{.}6$
#47	GSC 4479_1434	$23^{\rm h}49^{\rm m}42^{\rm s}_{.}23$	$+68^\circ03'44''_{.}4$

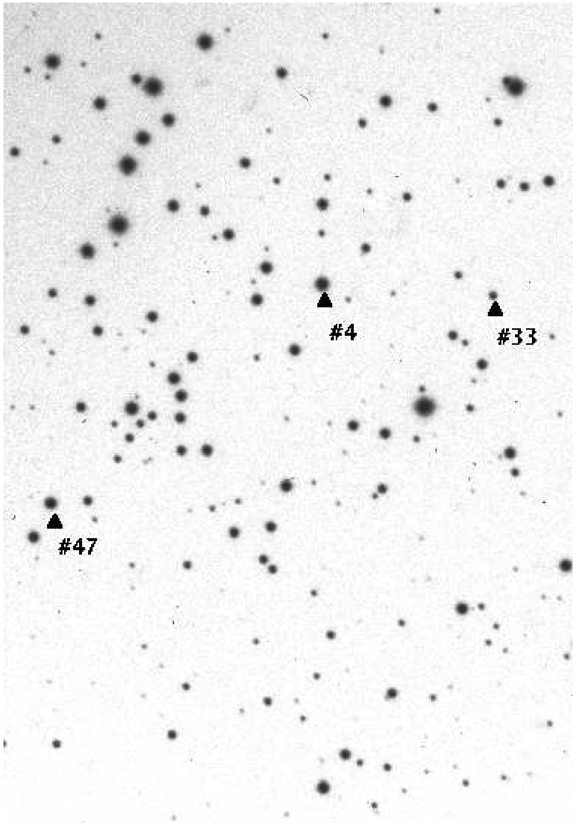

Figure 1. 10 combined CCD V-frames of the studied field of NGC 7762. The detected variable stars are also indicated. North is to the bottom, west is to the left. The field of view is $4' \times 6'$. Identification numbers are from Patat & Carraro (1995)

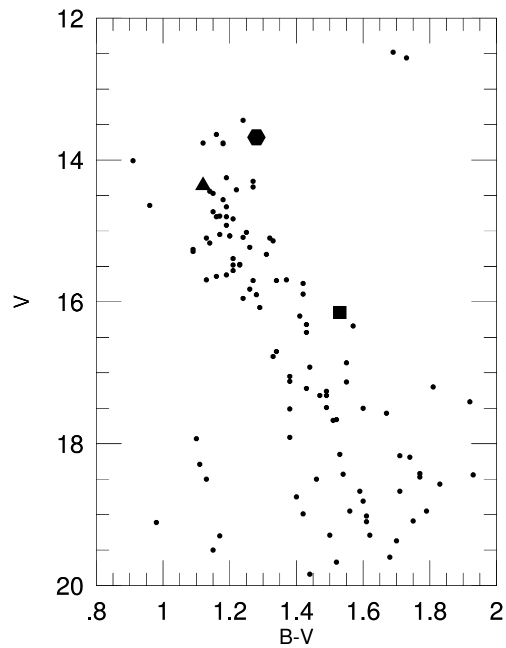

Figure 2. Color–magnitude diagram of NGC 7762. Filled hexagon: star #4, filled triangle: star #47, filled square: star #33

Star #4 brightened by $0^{\mathrm{m}}.04$ in V on the first and third nights. On the second night the sky conditions were quite bad as mentioned above, therefore the scatter is much higher, so we left out this dataset of star #4 from further investigations. The total amplitude can be $0^{\mathrm{m}}.01$–$0^{\mathrm{m}}.02$ and a preliminary period-estimation yields approximately 1 or 2 days, considering that the star was almost in the same phase on the two nights (Fig. 3). Its color index is $(B-V) = 1.28$ according to Patat & Carraro (1995), and after correcting for the interstellar reddening of the cluster we get $(B-V)_0 = 0.30$. This value along with the luminosity (apparent magnitude) shows that star #4 is an early F-type main-sequence star (Figure 2). According to the amplitude, the possible period and the position on the HR diagram this star can be a γ Doradus type variable (Krisciunas & Crowe 1997).

Star #33 showed a symmetric minimum of $0^{\mathrm{m}}.1$ on the third night (Fig. 3). Light curves obtained on previous nights neither confirm nor preclude variation. It can be stated that no obvious fading or brightening occurred during the first two nights of observations. The color-magnitude diagram of Patat & Carraro (1995) reveals that this star is slightly above the main sequence ($V = 16^{\mathrm{m}}.15$, $(B-V) = 1.53$, $(B-V)_0 = 0.55$). The shape of the light variation and the position of this star on the $V-(B-V)$ plane (see Figure 2) indicates an eclipsing binary nature.

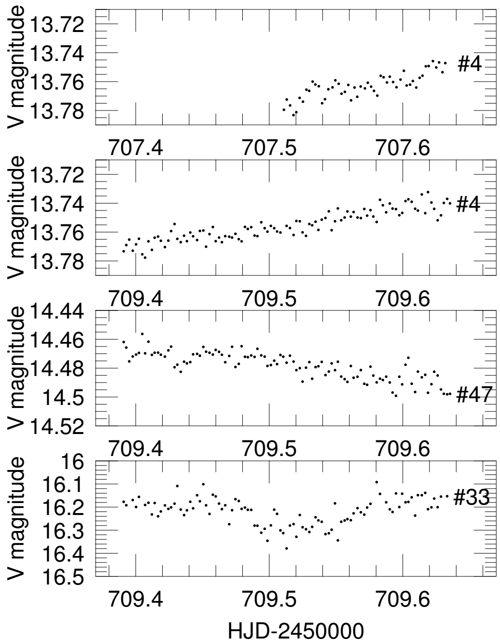

Figure 3. V light curves of the three variable stars...

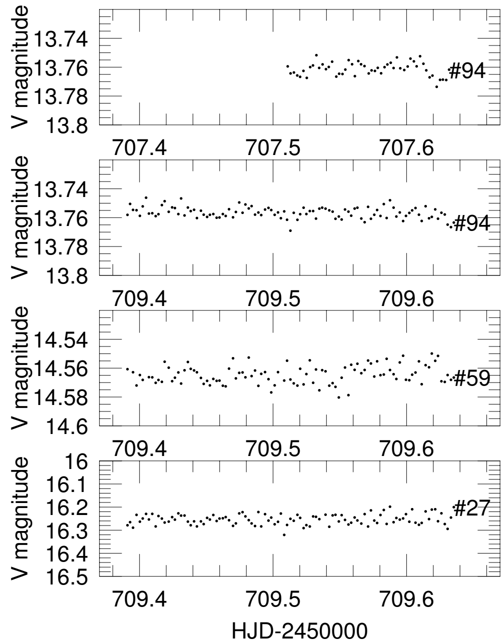

Figure 4. ...and corresponding V light curves of constant stars of the same brightness. Identification numbers are from Patat & Carraro (1995)

Star #47 faded by $0^{\rm m}\!.03$ on the last night. Unfortunately light curves obtained on previous nights are of poor quality, and unable to confirm this small variation. Its color index is $(B-V)_0 = 0.14$. Star #47 is also a variable star candidate with a light variation resembling that of #4.

More multicolor photometry is needed for these stars to classify them without doubt and to determine their properties.

The fact that we did not find δ Scuti variables to the amplitude-limit presented in Table 2 in this region of the cluster

- confirms that NGC 7762 is older than 800 Myr,
- shows that this cluster is not an ideal target for further STACC-investigations.

I would like to thank my former supervisor, J. Nuspl, for introducing me to CCD photometry and his support during my work. I also thank Sz. Csizmadia for his assistance during observations.

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