COMMISSIONS 27 AND 42 OF THE I.A.U.

INFORMATION BULLETIN ON VARIABLE STARS

Nos. 4201–4300

1995 May–1996 February

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URL: http://www.konkoly.hu/IBVS/IBVS.html
HU ISSN 0374 – 0676

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

Number 4201

Konkoly Observatory
Budapest
31 May 1995

HU ISSN 0374 – 0676

PHOTOELECTRIC BV(RI)$_c$ OBSERVATIONS OF V1359 Aql [1]

V1359 Aql is classified in GCVS as a suspected s–Cepheid variable with amplitude near 0.2 mag. However, Poretti and Mantegazza (1991) noted that, according to their observations, the star's brighness did not vary more than by 0.02 mag.

To verify this conclusion, we were observing V1359 Aql during two runs in 1994 (Berdnikov and Turner, 1995; Berdnikov and Voziakova, 1995) and in March–April 1995. In the latter case the CTIO 60–cm reflector was used and 7 $BV(RI)_c$ measurements were obtained (Table 1); the accuracy of the individual data is near 0.01 mag in all filters.

The data in each individual run confirm the conclusion of Poretti and Mantegazza (1991), but there are very small variations of the mean brighness. If these variations are real, V1359 Aql may be classified as a semiregular variable.

The research described in this publication was made possible in part by grants No. NDD000 and No. NDD300 from the International Science Foundation and Russian Government as well as by grant No. 95–02–05276 from the Russian Foundation of Basic Research to LNB and by funds awarded through the Natural Sciences and Engineering Research Council of Canada (NSERC) to DGT.

Table 1

JD hel 2400000+	V	$B-V$	$(V-R)_c$	$(R-I)_c$
49809.9089	9.019	1.355	0.752	0.736
49810.9020	8.990	1.360	0.742	0.633
49811.9049	9.012	1.340	0.747	0.741
49813.8923	8.994	1.343	0.751	0.706
49814.8917	9.003	1.317	0.759	0.724
49817.9017	8.998	1.336	0.766	0.721
49818.8921	9.002	1.335	0.754	0.707

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[1]Based on observations obtained at the Cerro Tololo Inter-American Observatory

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4202

Konkoly Observatory
Budapest
31 May 1995

HU ISSN 0374 – 0676

PHOTOELECTRIC BV OBSERVATIONS OF V382 Car [1]

V382 Car is classified in GCVS–IV as a suspected Cepheid variable with amplitude near 0.2 mag. However, a number of authors (Balona, 1982; Olsen, 1983) did not reveal the variability of this star.

We were observing V382 Car at CTIO in March and April 1995. The 60–cm reflector was used and 29 BV measurements were obtained (Table 1); the accuracy of the individual data is near 0.01 mag in all filters.

Our data confirm the conclusion of above authors, i.e. V382 Car is not a variable star.

Table 1

JD hel 2400000+	V	$B-V$	JD hel 2400000+	V	$B-V$
49803.8096	3.949	1.248	49817.7928	3.944	1.258
49804.8037	3.945	1.238	49818.6913	3.927	1.240
49805.7708	3.935	1.241	49818.7721	3.944	1.262
49807.7893	3.926	1.260	49821.6845	3.940	1.239
49808.7795	3.925	1.254	49821.7651	3.932	1.258
49809.7080	3.953	1.244	49822.6762	3.934	1.243
49810.7584	3.933	1.245	49822.7720	3.932	1.249
49811.7179	3.925	1.248	49823.6725	3.939	1.250
49812.7200	3.929	1.243	49823.7720	3.934	1.263
49813.7475	3.933	1.242	49824.6626	3.921	1.241
49814.7558	3.932	1.250	49825.6583	3.926	1.244
49815.7032	3.931	1.243	49825.7524	3.934	1.249
49815.7813	3.923	1.248	49826.7082	3.931	1.248
49816.5120	3.939	1.231	49827.6597	3.927	1.257
49817.6853	3.937	1.249			

The research described in this publication was made possible in part by grants No. NDD000 and No. NDD300 from the International Science Foundation and Russian Government as well as by grant No. 95–02–05276 from the Russian Foundation of Basic Research to LNB and by funds awarded through the Natural Sciences and Engineering

[1]Based on observations obtained at the Cerro Tololo Inter-American Observatory

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4203

Konkoly Observatory
Budapest
6 June 1995

HU ISSN 0374 – 0676

UBV OBSERVATIONS OF AB Dor, 1994-5

The active, cool (early K type) dwarf AB Dor (= HD 36705, SAO 249286) has been at the focus of much attention recently (cf. Vilhu *et al.*, 1993; Collier Cameron, 1995; and references cited therein). The ephemeris of Innis *et al.* (1988), Min = 2444296.575 + 0.51479×E, is usually used (as here) for reckoning phases.

The star was observed in B and V ranges on 12 nights between Nov 3, 1994 and Jan 6, 1995 with the 20cm S-C telescope and DC photometer of the Mt Molehill Observatory (cf. Bos, 1994). Observations were also made using the automated photometer ('APT') at the Kotipu Place Observatory on four nights between 26 Oct and 14 Dec, 1994, using the UBV filters provided with the SSP 5 'Optec' photometer (cf. Hudson *et al.*, 1993). Most of this latter data come from two nights 26 Oct and 1 Nov; data from 6 and 14 Dec were prematurely terminated by an APT tracking fault.

Standard broadband differential photometric reduction procedures were followed (cf. e.g. Budding, 1993). The main comparison star was again HD 37297 (V = 5.34, $B-V$ = 1.04, $U-B$ = 0.85, sp. type K0III — cf. SIMBAD). This comparison was regularly checked against HD 37279 at Mt Molehill (Table 1), showing the stability of HD 37297 to within 0.01 mag, except on Nov 9, when poorer weather affected the data (Figure 1a, phase range 0.0 — 0.4). At Kotipu Place HD 37279 was checked against HD 35537, also a K0III star (Budding *et al.*, 1994).

Table 1. Check star HD 37279 (mean values)

Date	n	V mag	S.D.	$B-V$	S.D.
Dec 1992 - Jan 1993	14	7.429	0.007	0.258	0.006
Nov 1993 - Jan 1994	47	7.432	0.009	0.257	0.009
Nov 1994 - Jan 1995	82	7.432	0.008	0.257	0.009

Here S.D. = standard deviation, Nov 09 1994 data not included

The resulting data have been plotted up as follows: Figure 1 (a-c) the Mt Molehill V data, Figure 2 montage of the APT (preliminary) U, B, V data. Although none of these data sets are quite complete, they indicate trends in the variability towards the end of 1994 and beginning of 1995. The main characteristics of the Mt Molehill data sets are listed in Table 2. Figure 2 results from binning about 340 individual observations in each colour into about 45 'normal' points.

Table 2. Variability of AB Dor — amplitude and minimum phase

	Max.	Min.	Amplitude	Phase
Figure 1a	6.81	6.92	0.11	0.50
Figure 1b	6.82	6.92	0.10	0.42
Figure 1c	6.81	6.89	0.08	0.41

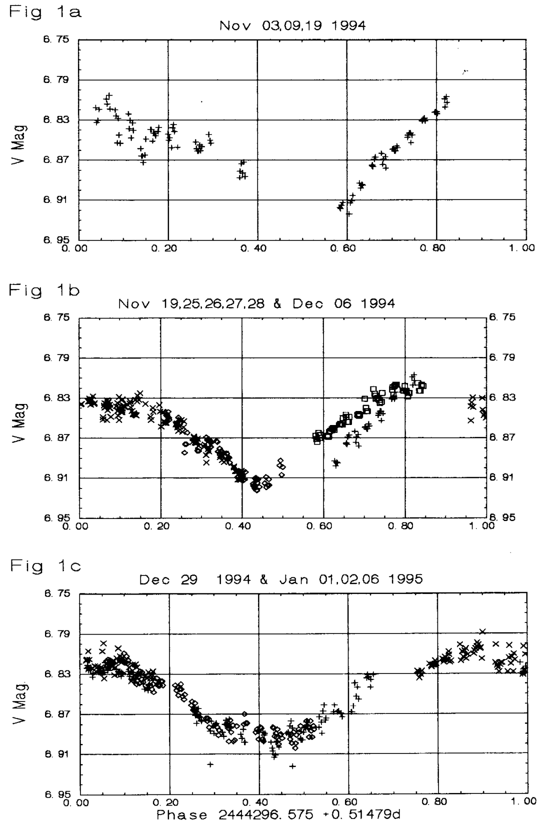

Figure 1. AB Dor: V light curves from Mt Molehill

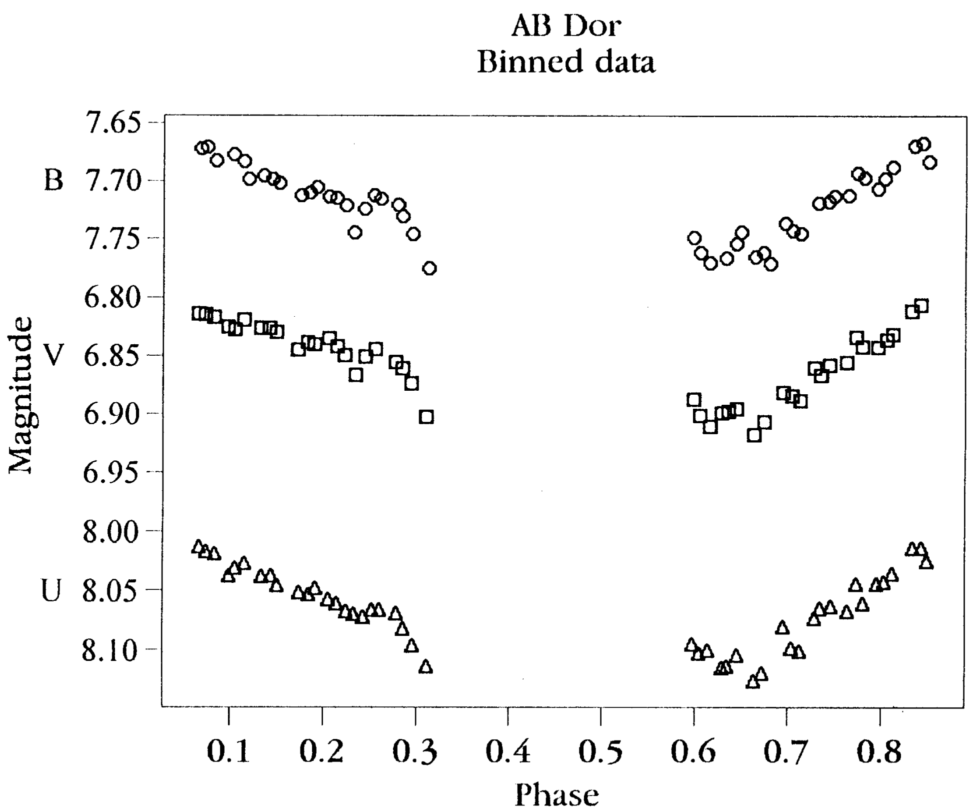

Figure 2. AB Dor: U, B, V light curves from Kotipu Place APT

The observed minima are associated with what is taken to be spot B of Innis *et al.* (1988), rather than spot A, which relates with the minima reported for the preceding year Anders (1994), Bos (1994) and Budding *et al.* (1994). What remains of spot A is perhaps the noisy maximum near phase zero in Figures 1b,c, though asymmetry is also noticeable in the shape of the main minimum.

Figure 1b shows a definite change in the slope of the rise between the observations made on November 19 and December 06 1994. The minimum of the light curve in Figure 1c is not as deep as that observed four weeks earlier (Figure 1b, Table 2). Because no clear minimum or maximum was observed in early November there is some uncertainty about the phase of minimum and the amplitude of the light curve then. It is, however, not less than 0.10 magnitudes and may have been as much as 0.12. The phase of minimum in Figure 1a must be somewhere near 0.5, though it may be closer to 0.4, as for Figures 1b,c.

AB Dor has remained at much the same brightness at maximum (6.82 V) as 12 months earlier. Both Bos (1994) and Budding *et al.* (1994) observed a small drop in $B-V$ coinciding with the minima of November 1993. There appears to be some evidence of this in the 1994/1995 data as well, but less clearly than before.

Incompleteness of the APT data-sets about the minimum is frustrating, though it supports the slight apparent deepening near phase 0.3 in December 1994, and a tendency of the curve to rise near phase 0.6 around that time (Figures 1b,c). This could be interpreted as a tendency of the minimum again to drift down in phase during the period late October 1994 to the end of the year, as suggested also for the preceding year's data (Budding *et al.*, 1994).

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

Number 4204

Konkoly Observatory
Budapest
6 June 1995

HU ISSN 0374 – 0676

A SUSPECTED K3V VARIABLE[1]

LTPV-B6001 ($\alpha_{2000} = 12^{\rm h}26^{\rm m}33^{\rm s}, \delta_{2000} = -62°51'26''$, see finder chart in Figure 1, has been used for more than 7 years as secondary comparison star for monitoring the X-ray source Wray 977 = 3U 1223–62 in the framework of the "Long-term Photometry of Variables" (LTPV) project (Sterken, 1983). Observations were carried out with the Strömgren Automatic Telescope at ESO La Silla, using a 4-channel *uvby* photometer. The mean values of 41 measurements in the so-called "system 7" (closely corresponding to the natural system, see Manfroid et al., 1992 and Sterken et al., 1993) are $V = 9.687 \pm 0.001$, b-$y = 0.892 \pm 0.001, m_1 = 0.461 \pm 0.002, c_1 = 0.278 \pm 0.006$. No other *uvby* photometry, nor Geneva colours are available from the literature. All data discussed here have been published by Manfroid et al. (1991, 1994) and Sterken et al. (1995).

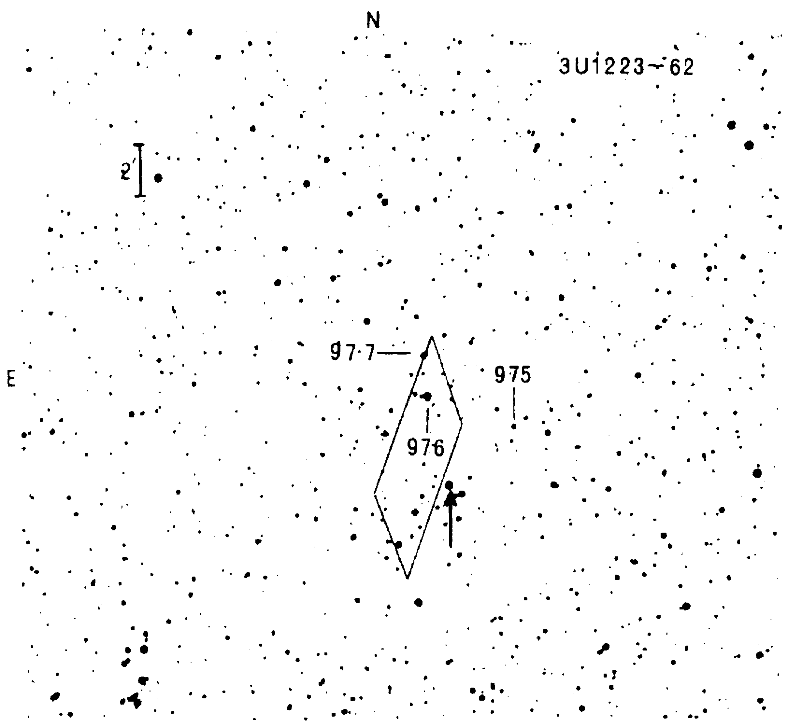

Figure 1. Finder chart for B6001, the position of Wray 977 and the error box of 3U 1223–62 is indicated (source: Vidal 1973)

[1]BASED ON OBSERVATIONS CARRIED OUT AT THE ESO LA SILLA OBSERVATORY

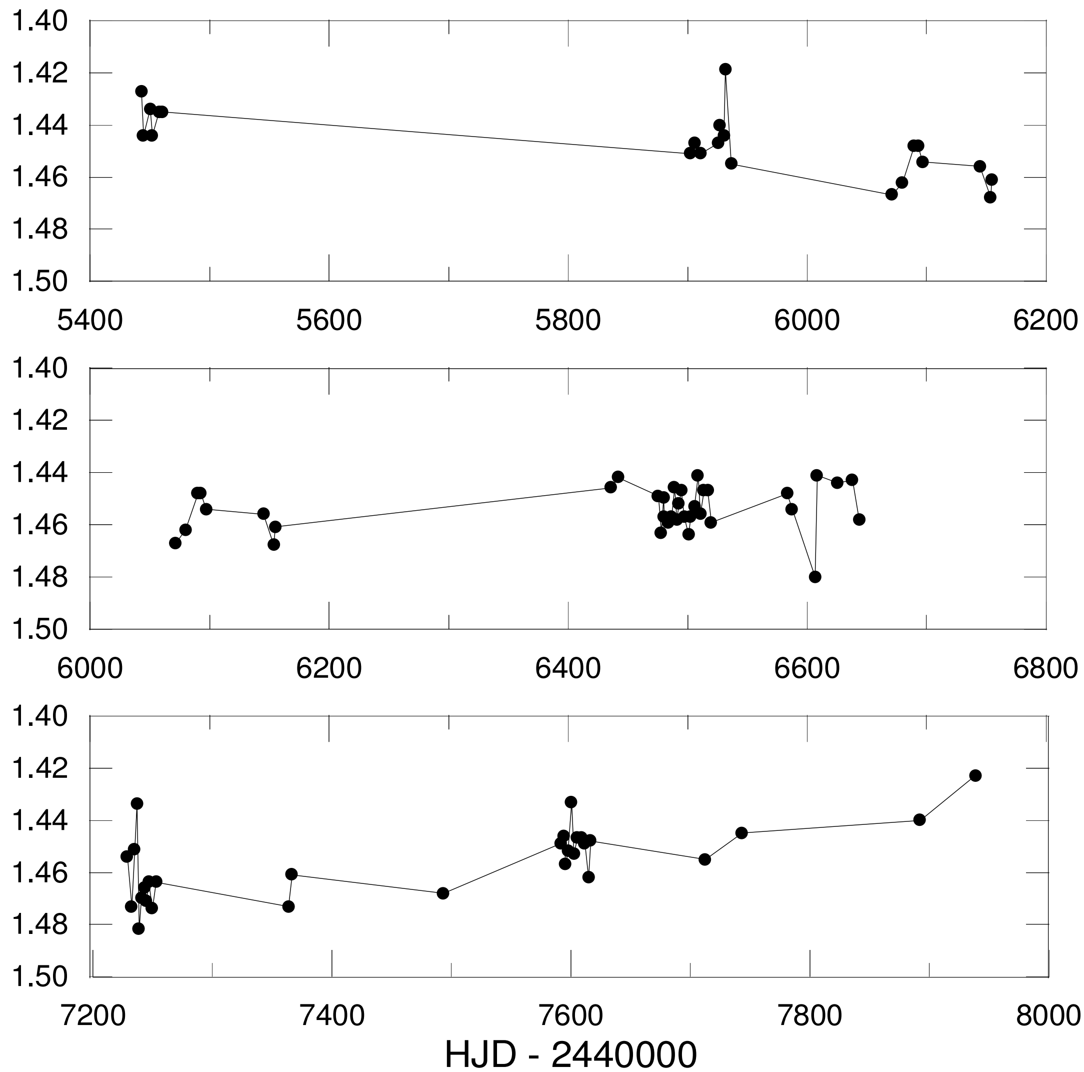

Figure 2. Differential y light curve (in the instrumental photometric system) with respect to comparison star HD 108531 ($V = 8.226, b - y = 0.056, m_1 = 0.083, c_1 = 0.712$)

Though the very small mean errors (due to the large number of measurements) may suggest that the star is a constant star, an inspection of the differential y light curve in Figure 2 shows it is not: besides some spike-like events, a long-term variation with amplitude of several hundredths of a magnitude is seen (the high-frequency noise is observational scatter). The amplitude of variation increases towards shorter wavelengths, though most of the increase in amplitude (and scatter) must be attributed to photon noise since the photon flux drops by more than a factor of 40 from y to u. Another complication that arises in the bluer bands is the magnitude of the conformity errors that may arise when combining data from non-congruent photometric instrumental configurations (note that the star is much redder than the comparison star HD 108531). This problem, however, does not affect our interpretation, since Figure 2 is constructed with non-transformed data—that is, data in the instrumental system.

The accurate mean colour indices allow estimation of the star's spectral type and luminosity class. We obtain $u-b=2.984$ and the reddening-free indices $[m_1]=0.755, [c]_1 = 0.100$. This locates B6001 on the locus of 14 *uvby* standards and 142 stars within 25 pc given in the $[c_1], [m_1]$ diagram in Fig. 6 of Olsen (1984), and at the extreme end in the $b-y, u-b$ diagram of these stars in his Fig. 7, quite close to the location of HD 95735, a star for which Olsen (1984) gives $\log T_{\rm eff} = 3.53$. B6001, according to its $[m_1]$ and $[c]_1$ indices, should have $M_{\rm V} = 6.74$ and a spectral type of about K3V or slightly later.

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4205

Konkoly Observatory
Budapest
8 June 1995

HU ISSN 0374 – 0676

A NEW ORBIT OF THE BINARY RR LYRAE STAR TU UMa

The RRab-type light variation (V=9.26-10.24 mag, A8-F8) of TU UMa (= $BD + 30^{o}2162 = SAO\,62578 = HIC56088$) was discovered by Guthnick & Prager (1929).

The period change was discussed by Szeidl et al. (1986). They fitted the O−C diagram with a negative parabola and found a 23 year-long cyclic variation superimposed on it. They concluded that this could be explained by the duplicity of the star.

Saha & White (1990) analysed the radial velocity and O−C curve of TU UMa, and determined a very eccentric orbit (P=7374.5 day, e=0.97, $a\,sin\,i$=2590 million km). Wade et al. (1992) used a special point on the rising branch to construct the O−C diagram.

The aim of our measurement was to obtain new data on the O−C diagram in order to determine the recent period variation.

We carried out photoelectric photometry (through Johnson UBV filters) of TU UMa on six nights: 1, 8, 21, 28 March and 21, 22 April 1995 with the 40 cm Cassegrain telescope and SSP-5A photometer of Szeged Observatory, Hungary. The comparison star was GSC 1984.0145 (V=9.2 mag, marked with B on chart of Quester, 1993).

The phase diagram of the light curve is plotted in Figure 1 (P=0.557702 day, T_0 =2449699.9600). The period was determined with the Phase Dispersion Method.

The moments of maxima are listed in Table 1, where the O−C residuals have been obtained from the ephemeris (Saha & White 1990):

$$Hel.JD\,max = 2425760.4364 + 0.5576581097 \times E$$

Table 1 continues the similar table in Szeidl et al. (1986). The O−C diagram can be seen in Figure 2 without the visual data with weight=0. First we fitted a parabola using only the visual normal, photographic and photoelectric data (weight=1,2,3) and derived the following formulae

$$-1.57398 \times 10^{-10} \times (HJD)^2 + 1.1334 \times 10^{-5} \times HJD - 0.1744,$$

which corresponds to a period decrease of $-3.148\;10^{-10}\;d/d = -1.755\;10^{-10}\;d/cycle = -9.9\,ms/yr$. This value is about double the reported one in Szeidl et al. (1986).

Then we calculated a light-time effect curve (only the photoelectric data were used with weight=3) supposing a cyclic period variation due to orbital motion in binary system. The parameters of the fit and their estimated errors are in Table 2. We note that the χ^2-function around the minimum is very flat, therefore a lot of parameter series give similarly good fit.

Accepting $M_1 = 0.55 \pm 0.05\,M_\odot$ mass for the pulsating component (Fernley 1993), we can calculate the semi-major axis of the orbit of the secondary and its mass with iteration (Table 3). The errors are from the uncertainty of the P and M_1. The results suggest a red or white dwarf companion which is probably not detectable in the spectrum of TU UMa

Table 1. Times of maxima

Hel.JD	weight	O−C (day)	source
46848.858	3	+0.0225	Liu and Janes (1989a)
47219.689	3	+0.0109	Barnes et al. (1992)
47255.386	0	+0.0178	BAV Mitt.50 (1988)
47255.398	0	+0.0298	BAV Mitt.50 (1988)
47265.416	0	+0.0099	BAV Mitt.50 (1988)
47265.443	0	+0.0369	BAV Mitt.50 (1988)
47270.451	0	+0.0260	BAV Mitt.50 (1988)
47275.466	0	+0.0221	BAV Mitt.50 (1988)
47294.418	0	+0.0137	BAV Mitt.50 (1988)
47609.494	0	+0.0129	BAV Mitt.52 (1989)
47613.388	0	+0.0033	BAV Mitt.52 (1989)
47613.389	0	+0.0043	BAV Mitt.52 (1989)
47618.961	3	−0.0003	Saha and White (1990)
47943.531	0	+0.0126	BAV Mitt.56 (1990)
47966.364	0	−0.0183	BAV Mitt.56 (1990)
47995.387	0	+0.0065	BAV Mitt.56 (1990)
48024.382	0	+0.0032	BAV Mitt.56 (1990)
48319.385	0	+0.0051	BAV Mitt.59 (1991)
48329.407	0	−0.0108	BAV Mitt.59 (1991)
48358.436	0	+0.0200	BAV Mitt.59 (1991)
48387.411	0	−0.0032	BAV Mitt.59 (1991)
48745.433	0	+0.0023	BAV Mitt.60 (1992)
49059.402	0	+0.0098	BAV Mitt.62 (1993)
49108.462	0	−0.0041	BAV Mitt.62 (1993)
49137.459	0	−0.0054	BAV Mitt.68 (1994)
49785.455	3	−0.0081	present paper
49798.282	3	−0.0072	present paper
49805.5315	3	−0.0073	present paper

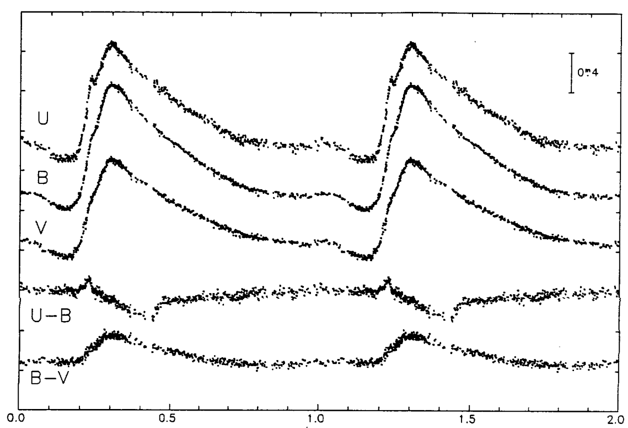

Figure 1. Phase diagram of TU UMa

Table 2. Parameters of the light-time curve

$P_{orb} = 8800 \pm 100\ day$
$a_1 sin\, i = 600 \pm 100 \times 10^6\ km$
$e = 0.9 \pm 0.05$
$\omega = 178^o \pm 3^o$
$\tau = 2447200 \pm 50$
$t_0(O-C=0) = 2447200 \pm 50$
$K = 11.4 \pm 0.5\ km/s$
$f(M_2) = 0.11 \pm 0.01\ M_\odot$
$A_{O-C} = 0.01 \pm 0.002\ day$

Table 3. Inclination, semi-major axis of the orbit and mass of the companion

$i(deg)$	$a(AU)$ ± 0.2	$M_2(M_\odot)$ ± 0.02
10	12.11	2.54
30	8.18	0.40
50	7.65	0.23
70	7.48	0.18
90	7.44	0.17

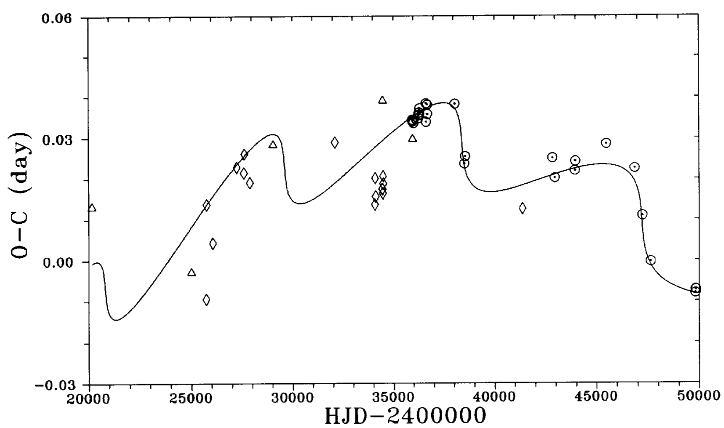

Figure 2. O−C diagram of TU UMa. The fit is the sum of the parabola and the light-time curve. Circles, triangles and diamonds represent photoelectric, photographic and visual (normal) observations respectively.

due to its low brightness. The calculated orbital radial velocity amplitude (K) of the RR Lyrae star is large enough, but the rare spectroscopic measurements for gamma-velocity cannot help to confirm the binary nature.

We can estimate the distance of TU UMa from $M_V = 0.75 \pm 0.05\, mag$ (Fernley 1994) and $< m_V >= 9.75\, mag$: $d = 630 \pm 100 pc$. If the semi-major axis is $8\, AU$ then the largest distance of the secondary component is 0.01–0.015 arcsec from TU UMa.

Liu & Janes (1989b) reported $[Fe/H] = -1.30$, E(B−V)=0.004, $< R/R_\odot >= 4.95$, $< log\, g >= 2.73$, $< T_{eff} >= 6352\ K$, d=621 pc, $< M_V >= 0.85\, mag$.

We conclude that TU UMa may have a low mass companion. Of course, the binary hypothesis can be confirmed only a few years later. Recently the binary nature is only suspected for a few RR Lyrae stars (e.g. Prosser 1989, Szatmáry 1990).

We used the SIMBAD database, operated at CDS, Strasbourg, France. This work was supported by Hungarian OTKA Grants No. T4330 and T7255. We would like to express our thanks to J. Vinkó for discussions.

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4206

Konkoly Observatory
Budapest
12 June 1995

HU ISSN 0374 – 0676

ON THE PERIODICITY OF Wa CrA/1 AND Wa CrA/2 WTTS

Walter (1986) discovered three weak-line T Tau stars (WTTS) in the CrA T-association region. The brightness of Wa CrA/1 and Wa CrA/2 is 11.24 V and 10.45 V, respectively, that of Wa CrA/3 is weaker (V = 13.72). The spectral types assigned by Walter (1986) and later by Franchini et al. (1992) are K0 to Wa CrA/1 and G5-G8 to Wa CrA/2. The rotational period of Wa CrA/2 determined by Covino et al. (1992) is P = $2^{d}.9$. Franchini et al. (1992) found a rotational velocity of Wa CrA/2 vsin i = 20 ± 5 km/s. In the course of ROTOR programme carried out in the Mt.Maidanak observatory we aimed at searching for periodicity of Wa CrA/1 and Wa CrA/2 WTTS. The observations of these WTTS were made by Yakubov in 1990 using the Mt.Maidanak 60-cm Zeiss telescope with UBVR pulse counting photometer. The periodicity of Wa CrA/1 and Wa CrA/2 light curves was analysed by CLEAN method of digital spectral analysis (Roberts et al., 1987). In this note we present the results of UBVR - photometry of Wa CrA/1 and Wa CrA/2 (see Table 1).

Table 1

JD 2448000+	V	U−B	B−V	V−R	JD 2448000+	V	U−B	B−V	V−R
Wa Cra/1					*Wa CrA/2*				
049.4071	11.40		1.22		049.4117	10.55	0.49	0.82	0.69
056.3670	11.38	0.90	1.22	0.99	056.3617	10.62	0.51	0.87	0.71
058.3847	11.35	0.78	1.22	1.08	058.3903	10.53	0.32	0.99	0.68
059.3821	11.59	0.87	1.16	1.09	059.3893	10.64	0.47	0.85	0.71
060.3663	11.42	0.76	1.13	1.16	060.3845	10.59	0.38	0.84	0.73
063.3541	11.48		1.22	1.07	063.3574	10.60		0.84	0.74
064.3383	11.55	0.63	1.14	1.05	064.3411	10.63	0.48	0.86	0.72
065.3361	11.41	0.85	1.14	1.10	065.3392	10.62	0.46	0.85	0.74
066.3330	11.59		1.17	1.07	066.3354	10.60		0.85	0.74
068.3305	11.61		1.19	1.08	068.3320	10.67		0.84	0.76
069.3423	11.38		1.12	1.07	069.3451	10.58		0.84	0.71
070.3337	11.56		1.17	1.07	070.3355	10.66		0.86	0.74
071.3309	11.45		1.19	1.05	071.3322	10.63		0.88	0.78
072.3202	11.50		1.15		072.3212	10.67		0.80	
073.3318	11.53		1.20		073.3330	10.66		0.86	
075.3426	11.57		1.16	1.05	075.3445	10.62		0.81	0.72
076.3189	11.41		1.17	1.09	076.3230	10.69		0.94	0.80
083.2883	11.43		1.17	1.09	083.2902	10.64		0.82	0.75
084.3096	11.60		1.22		084.3105	10.64		0.91	
088.2802	11.57		1.20	1.11	088.2819	10.53		0.90	0.73
089.2779	11.49		1.13	1.11	089.2842	10.60		0.85	0.74
090.2697	11.47		1.17	1.06	090.2711	10.66		0.84	0.76
091.2646	11.59		1.15	1.06	091.2659	10.64		0.87	0.78
094.2562	11.41		1.10	1.05	094.2586	10.59		0.79	0.71
095.2653	11.67		1.14	1.11	095.2675	10.65		0.86	0.72
096.2668	11.47		1.15	1.05	096.2686	10.62		0.84	0.72
097.2642	11.56		1.15	1.09	097.2655	10.59		0.83	0.78
099.2535	11.51		1.23	1.07	099.2573	10.61		0.85	0.75
100.2508	11.56		1.14	1.09	100.2528	10.56		0.86	0.73

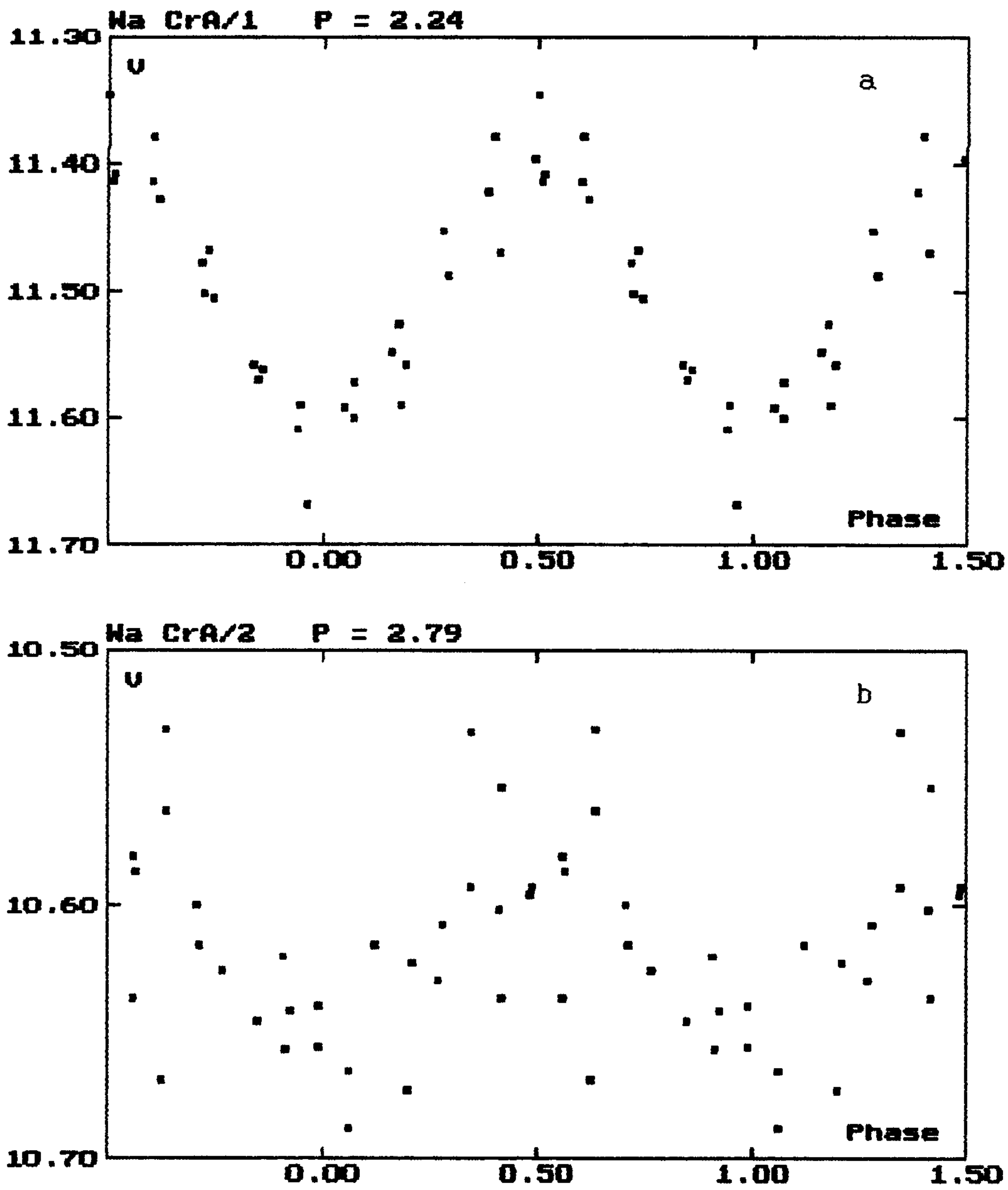

Figure 1. Folded light curves for Wa CrA/1 (a) and Wa CrA/2 (b).

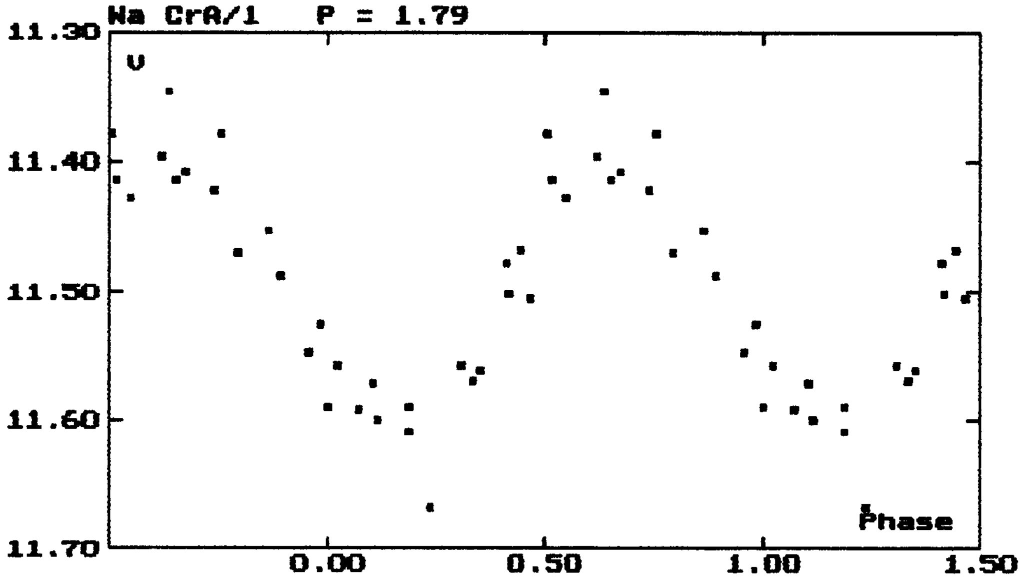

Figure 2. False periodic light curve.

The results are as follows:

Wa CrA/1: $P_0 = 2\overset{\mathrm{d}}{.}24$, Min JD = 2448048.30
Wa CrA/2: $P_0 = 2\overset{\mathrm{d}}{.}79$, Min JD = 2448048.25

Figure 1 shows the folded light curves for both stars. Besides, two false periods can be present,

Wa CrA/1: $P_f = 1\overset{\mathrm{d}}{.}79$,
Wa CrA/2: $P_f = 1\overset{\mathrm{d}}{.}55$

which produce fully equivalent folded light curves with P_0, but have somewhat larger dispersions of the points about the curves. The false period for Wa CrA/1 is shown in Figure 2. Similarity of the true and false light curves (Figures 1a and 2) is due to the southern position of the stars for Mt. Maidanak observatory latitude. Every night observation was only made close to the culmination of the stars and spacing of the temporal file is equal to one sideral day.

This work has been partially supported by ISF (MZA000) and ESO C&EE (A-02-048) grants.

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4207

Konkoly Observatory
Budapest
14 June 1995

HU ISSN 0374 – 0676

PHOTOMETRY OF SS Cyg IN 1993

SS Cyg is the brightest U Gem type dwarf nova. The average time between outbursts is about 50 days and their amplitudes are nearly 4 mag (Gaudenzi et al., 1990).

The binary nature of SS Cyg and its orbital period have been established spectrosco-!pically. Its photometric behaviour is quite irregular: although SS Cyg has been observed intensively for many decades, there is no general agreement about whether light variations with the orbital period occur in this system or not. Voloshina (1986) found regular magnitude variations with the orbital period, the shape of which was not stable over a long time but varied with the phase of the outburst cycle. This claim was supported by further observations of Bruch (1990) and Voloshina & Lyutyj (1993) but other authors (Honey et al., 1989) did not confirm it.

The photometric observations of SS Cyg in different colours may give important information about its geometric configuration and about the contribution of the different light sources (star components, disc, hot spot) to the total brightness of the system.

We observed SS Cyg mostly in R colour (Cousins system) on 8 nights in Sept/Oct 1993 with the 0.6 m telescope of Mt. Suhora Observatory equipped with a double-beam photometer (Kreiner et al., 1990) and an autoguiding (Krzesinski and Wojcik, 1990). The star HD 206330 (V=5.1 mag) was chosen as a check star. Because of the requirement of the double-beam photometer the distance between the variable and comparison star to be between 10 and 20 arcmin we used the star BD+42°4183 as a comparison. Its colours were B=12.68 and R=12.13 mag. The brightness of the comparison star was constant during our observations. The time of integration was always 10 sec. The observational data were corrected for atmospheric extinction by standard methods and phased according to the spectroscopic ephemeris (Cowley et al., 1980):

$$\mathrm{HJD} = 2444185.6881 + 0.27513 \times \mathrm{E} \qquad (1)$$

(the zero epoch corresponds to the maximum positive velocity of the absorption lines).

Some of our R light curves are presented in Figures 1-4 where Dmag is in sense variable−comparison. Analysis of the light curves allows us to draw the following conclusions:

(1) SS Cyg was in its quiescent state during almost all of our observing run because its mean magnitudes in R and B colours were respectively 11.6 and 12.5 mag.

(2) On Oct 10 the brightness began to increase slowly to 11 mag in R. This enchancement continued on the following night too (unfortunately it was mostly cloudy and there were too few observations). Probably this event is a beginning of an outburst.

(3) During the quiescent state the R light curve consists of spike-like sections. Their rising branches are very steep, nearly vertical, in contrast to the slower declining ones.

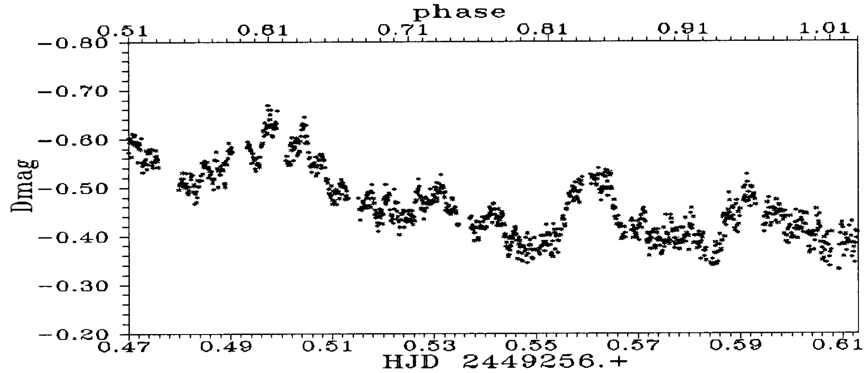

Figure 1. R light curve on Sept 26

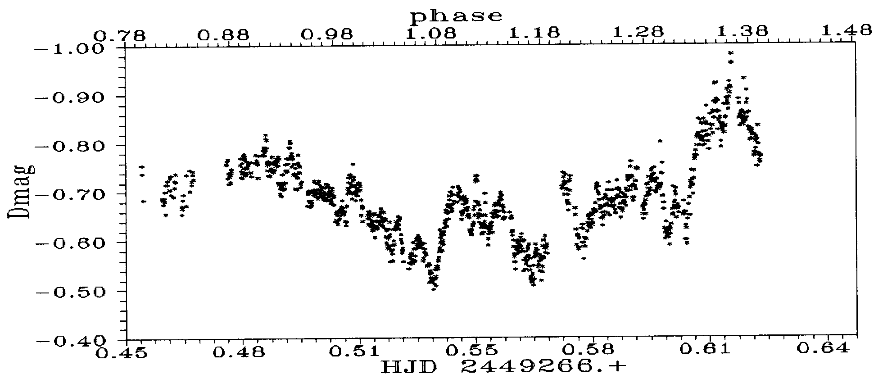

Figure 2. R light curve on Oct 5.

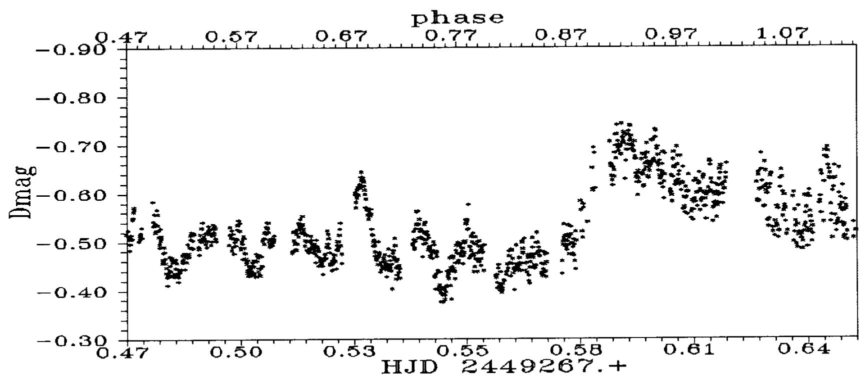

Figure 3. R light curve on Oct 6.

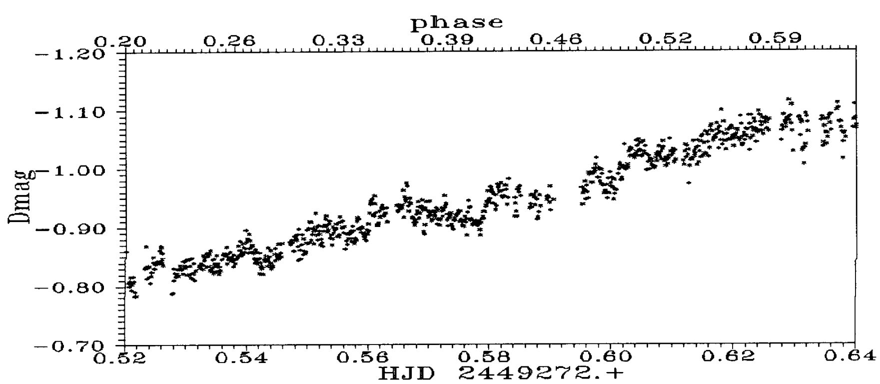

Figure 4. R light curve on Oct 11.

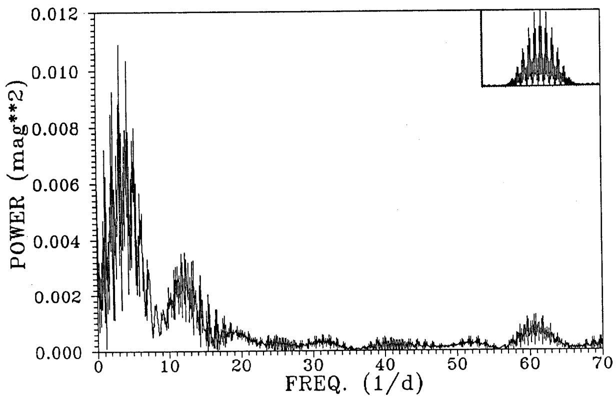

Figure 5. Fourier power spectrum of SS Cyg.

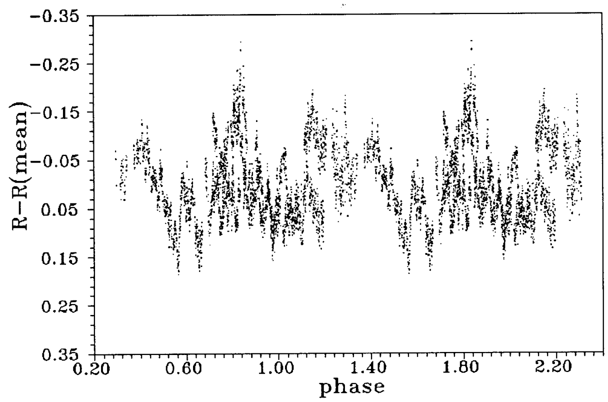

Figure 6. Folded light curve of SS Cyg.

The duration of each spike is about 20 minutes and the height is 0.13-0.15 mag. But there are also higher spikes with an amplitude of 0.2-0.3 mag (Oct 6 and 8), and they are nearly symmetric. These shapes of our light curves are quite different from the regular two-wave curves of Voloshina & Lyutyj (1993) but they are similar to those of Bruch (1990). The reason may be the observations are carried out in different phases of the outburst cycle. We suspect this fact could be due to the higher time-resolution of our observations compared to those of Voloshina & Lyutyj (1993).

(4) The increase of brightness at the beginning of the outburst is almost linear (Figure 4). Then there are smaller spikes with heights 0.05-0.07 mag.

The light curves of SS Cyg obviously exhibit strong variability on different time scales. In order to investigate periodic components of variability, all light curves (their total duration is 25 hours) were subjected to a common Fourier transform. In order to remove the long term trend the nightly means were first subtracted from each light curve. The resulting power spectrum is shown in Figure 5. It is similar to that of Bruch (1990). The highest maximum with an amplitude 0.1 is at frequency f=3.36 that corresponds to the photometric period 0.2972 days. This value differs from the spectroscopic period by 9 %. The folded light curve with our period value confirms this light variability (see Figure 6). It has two-wave shape and is similar to that of Bruch (1990). That is why we suppose the photometric period determined by us is related to the orbital one and our photometric data support the orbital nature of the long-term light variations of SS Cyg.

Acknowledgements. The authors are grateful to the Krakow Pedagogical University for the telescope time.

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

Number 4208

Konkoly Observatory
Budapest
19 June 1995

HU ISSN 0374 – 0676

CONFIRMATION OF PG 1510+234 AS A DWARF NOVA WITH A SHORT OUTBURST CYCLE LENGTH

PG 1510+234 was discovered as an ultraviolet excess object and was confirmed to be a cataclysmic variable by subsequent spectroscopy (Green et al. 1982, 1986). The identification of this object with a possible variable star NSV 06990 classified as RR: (Kukarkin et al., 1982) has been noticed by us by good positional coincidence and absence of a short-period variable star in this field (present study). The same identification was independently given by Downes and Shara (1993). However, the nature of the variability of this object remained unclear.

This object was again examined by spectroscopy by Ringwald (1993). He noticed strong broad Balmer emission lines at one time, and weaker at another time. Together with continuum variability on a time scale of days, he suggested this star to be a dwarf nova. Follow-up time-resolved photometry was undertaken by Misselt and Shafter (1995). They again reported strong nightly variation from their six-night observations. The orbital period has not been suggested from these studies.

Following these findings, we have started a long-term photometric coverage in order to reveal the nature of the strong variability. Most of the observations were done by Iida with a 16-cm reflector with an unfiltered ST−6 CCD camera. Additional V-band CCD observations were obtained by a 60-cm reflector at the Ouda Station, Kyoto University (for a detail of the instruments, see Ohtani et al., 1992). Total frames obtained by Iida and at the Ouda Station are 34 and 130, respectively, in the course of this coverage.

The frames at Ouda were first corrected for standard de-biasing and flat fielding, and were then processed by a microcomputer-based automatic-aperture photometry package developed by one of the authors (T.K.). The frames by Iida were processed following the same procedure by his microcomputer-based aperture photometry program. The magnitudes were determined relative to C_1 (Figure 1), and the estimated errors for a single measurement do not exceed 0.10 mag for Iida's observation and 0.04 mag for the Ouda data in the course of these observations. The results were combined to a single light curve after subtracting a systematic difference of 0.70 mag from Iida's data. Although this correction may introduce a small bias to the resultant light curve due to the different bandpasses, the effect is expected to be negligible in interpreting the long-term behavior of a suspected dwarf nova.

The resultant light curve is shown in Figure 2. The star showed two well-defined outbursts separated by nine days. The present photometric observations thus clearly demonstrate the dwarf nova nature of this cataclysmic variable. The recurrence time ($\sim$ 9 days) is one of the shortest known except some SU UMa-type dwarf novae. The range of variability determined from the Ouda data is $14^{m}_{.}8$ – $17^{m}_{.}9$ in the V band. In addition, the light curve implies this variable has an extremely long duty cycle (larger than 0.5), which is larger than most well-observed dwarf novae except ER UMa stars (Kato, Kunjaya 1995, Nogami et al. 1995 and references therein).

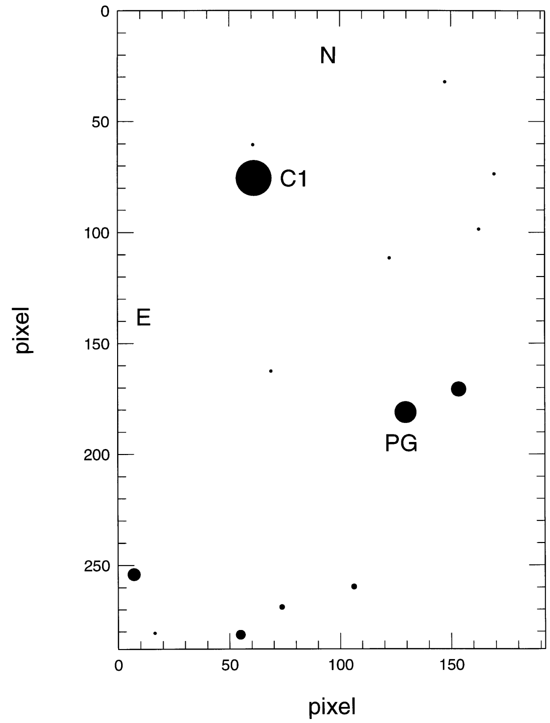

Figure 1. Field map of PG 1510+234. The field of view is about 6×9 arcmin. The variable (PG) and comparison (C_1) are marked.

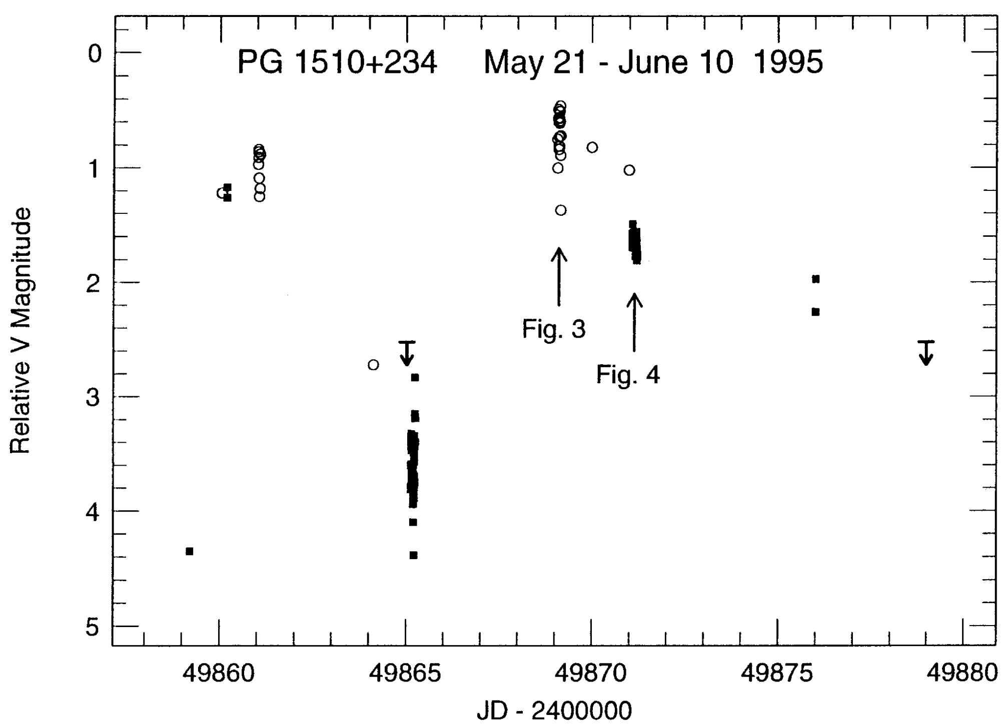

Figure 2. A general light curve constructed from all the CCD observations. Two well-defined outbursts occurred with a recurrence time of nine days. The small arrows indicate upper limits. Open circles and filled squares are points by Iida and Ouda, respectively.

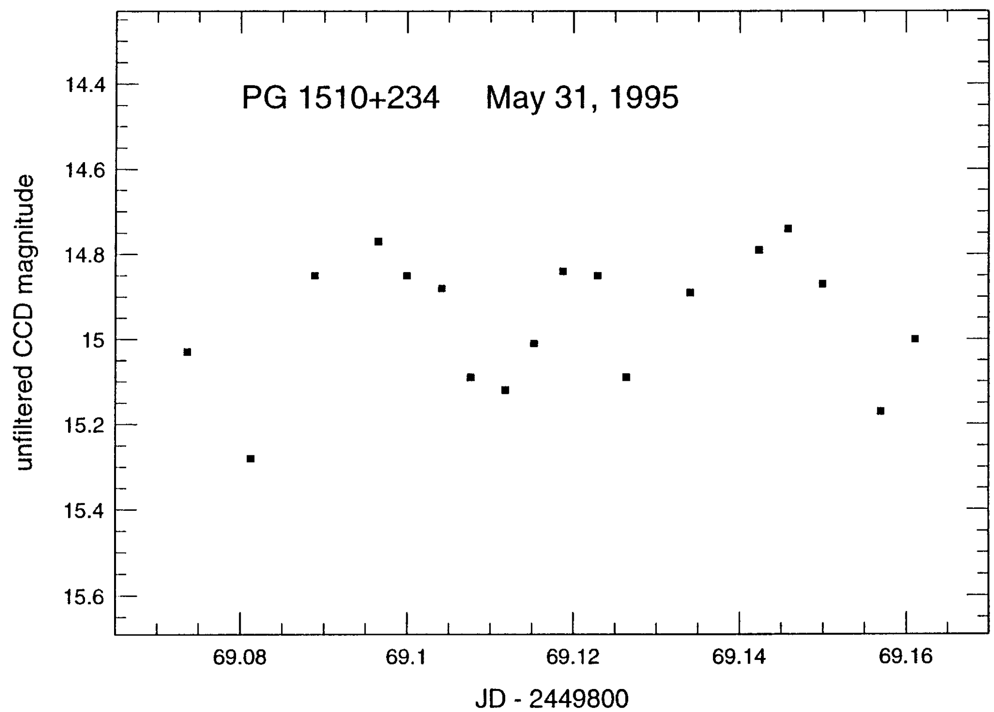

Figure 3. Time-resolved photometry by Iida on May 31. This observation at outburst maximum suggests a short-term variability with a time scale of $\sim$ 2 hours. The ordinate is the unfiltered CCD magnitude.

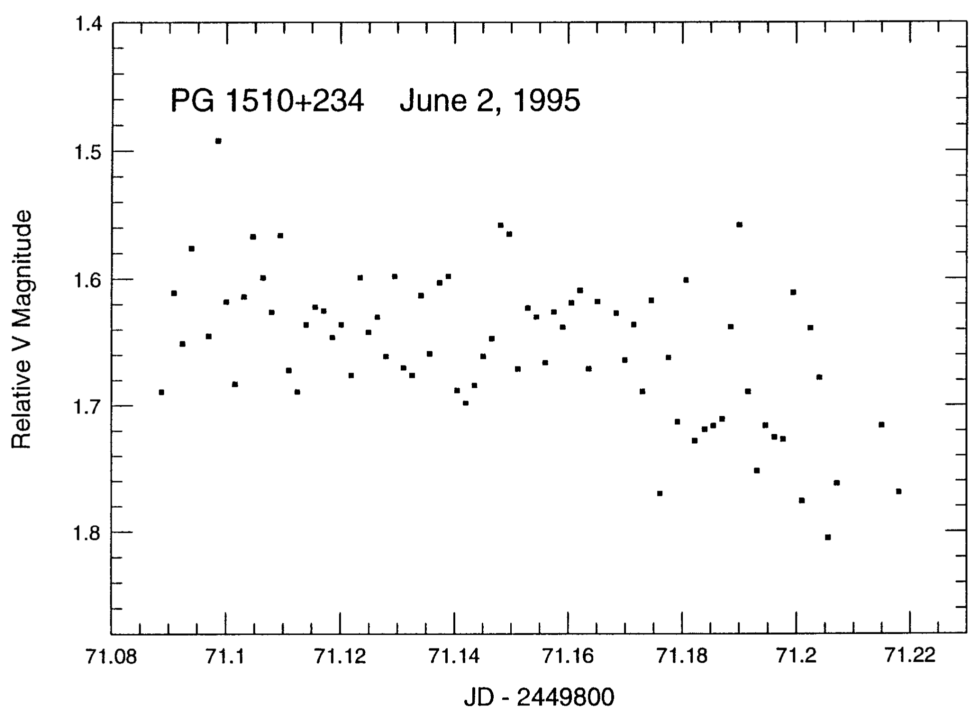

Figure 4. A short-term light curve at the Ouda Station on June 2. There is no evidence of periodic oscillations with an amplitude larger than expected error for a single measurement. Low altitude is responsible for the relatively large scatter in the last 0.04 day light curve.

Some time-resolved photometry was also undertaken during outbursts to search for any periodicity. The data by Iida taken on May 31 suggest a modulation with a time scale of ~ 2 hours (Figure 3). This finding was not confirmed by the Ouda data taken on another occasion (Figure 4). Confirmation of short-term variation observed by Iida and interpretation of such a large duty cycle should await further observations.

Part of this work is supported by a Research Fellowship of the Japan Society for the Promotion of Science for Young Scientists (T.K).

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

Number 4209

Konkoly Observatory
Budapest
20 June 1995

HU ISSN 0374 – 0676

DISCOVERY OF 10.2-MINUTE OSCILLATIONS IN THE Ap Sr (EuCr) STAR HD 185256

Using the Strömgren photometry of Martinez (1993) as a guide, we have found a new rapidly oscillating Ap (roAp) star, HD 185256, the 28th now known. Kurtz & Martinez (1993) list the first 26 members of the class, Kurtz & Martinez (1994) announced the 27th.

HD 185256 was classified by Houk (1982) as Ap Sr(CrEu). Martinez (1993) measured the Strömgren indices to be V = 9.938, $b-y = 0.277$, $m_1 = 0.185$, $c_1 = 0.615$ an $\beta = 2.738$. The calculated dereddened metallicity and luminosity indices are $[\delta m_1] = -0.054$ and $[\delta c_1] = -0.094$, both of which indicate strong metallicity and heavy line blocking in the Strömgren v band, characteristics we associate with the roAp stars. It is important when searching for roAp stars to deredden δm_1 and δc_1; reddening makes both indices appear much more normal.

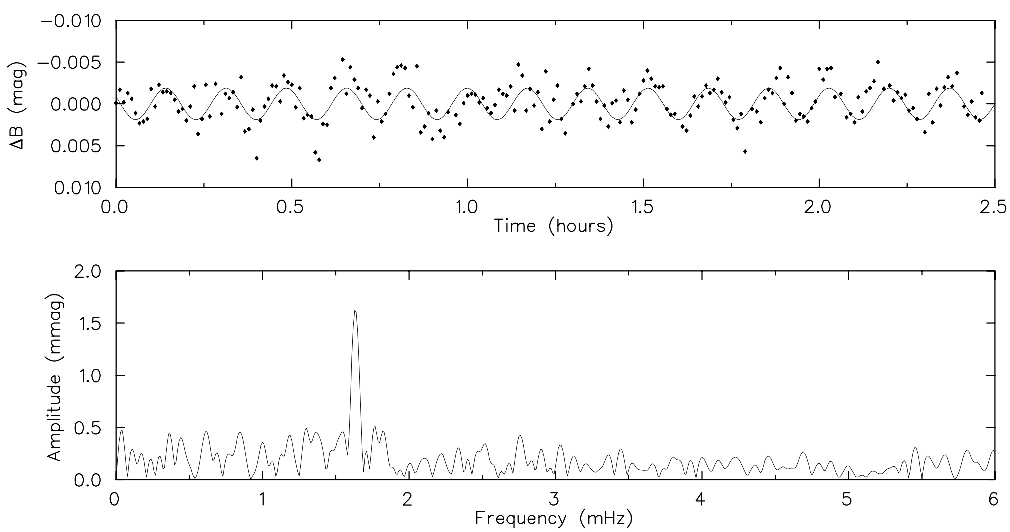

Figure 1

On the night of 1995 May 12/13 we obtained 1 hour of continuous 10-s photometric integrations on HD 185256 through a Johnson B filter using the 0.75-m telescope and University of Cape Town Photometer at the Sutherland station of the South African Astronomical Observatory. The following night we obtained 5.2 hours of observations, 2.5 hr of which are shown in the light curve in the top panel of Fig. 1. The data were corrected for coincidence losses, sky background, extinction and low frequency transparency variations and averaged to 40-s integrations. The bottom panel of Fig. 1 shows the amplitude spectrum of the full 5.2-hr light curve. The highest peak is at 1.63 mHz with a semi-amplitude of 1.61 mmag. The solid line in the top panel is a least squares fit of a sinusoid of this frequency and amplitude to the light curve.

We have an additional 6 hours of observations of this star in 1995 June which have a much lower amplitude. The pulsation amplitude is, therefore, either rotationally modulated and/or the pulsation is multiperiodic.

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

Number 4210

Konkoly Observatory
Budapest
27 June 1995

HU ISSN 0374 – 0676

YOUNG PULSATING STARS IN THE BÖHM-VITENSE DECREMENT

A half dozen variable stars with periods near one day and temperature near 7000°K have recently been reported:

Table 1

HD	ΔV	Reference
27290	0.10	Balona et al., 1994
32537	0.10	Krisciunas et al., 1993
164615	0.07	Abt et al., 1983
218396	0.08	Rodriguez and Zerbi 1995
224638	0.08	Mantegazza et al., 1994
224945	0.06	Mantegazza et al., 1994

The available Strömgren photometry is, listed in Table 2, together with log T_e and M_V derived from Eggen (1995a):

$$\log T_e = 0.53\ (\beta - 2.800) + 3.881$$
$$M_V = -12(\beta - 2.800) + 2.05 - F\Delta[c_1]$$

where

$$\Delta[c_1] = [c_1] - 2.60(\beta - 2.800) + 0.792$$
$$F = -18.5(\beta - 2.800) + 7.25$$

HD 27290 (γ Dor) is a member of the IC 2391 supercluster (Eggen, 1995b) with an age near $5\mathrm{x}10^7$y and HD 218396 (HR 8799) is a member of the Pleiades supercluster (Eggen, 1995c) with an age near 10^8y. HD 164615 (V2118 Oph) and HD 32537 (9 Aur) are young disk population stars with (U, V, W) = (+28, −13, −16) and (0, −16, −16) km/sec, respectively. HD 224638 and HD 224945 are almost certainly in the young disk because the proper motions are very small.

The periods of HD 27290 are 0.73 and 0.75 d with a beat period of 23.5 d. HD 164615 has a period of 0.81 d and HD 218396 has 0.51 d. The periods of HD 32537, HD 224638 and HD 224945 are unclear but appear to be near 1.25 d. The supercluster parallax of HD 27290 and HD 218396 give luminosities of +2.85 and +2.77 mag, respectively, agreeing well with photometric values in Table 2.

These stars are shown as open circles in the ([u−b], M_V) plane of Figure 1 where the main sequence AF stars in the Pleiades and α Persei clusters are represented by a straight line. This cluster main sequence has a pronounced gap between [u−b] = 0.97 and 1.12 mag (Eggen, 1992, 1995c, Eggen and Iben, 1988) which contains no cluster stars. The values of $[u-b] = 2[m_1] + [c_1]$ are reddening free.

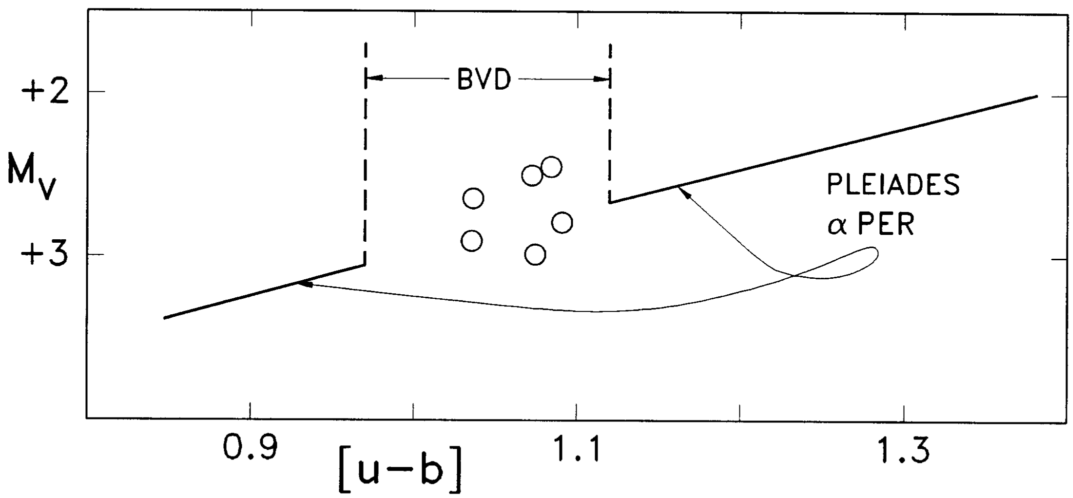

Figure 1. The Pleiades and α Persei cluster main sequence in the ([u−b], M_V) plane. The stars in Table 2 are represented by circles.

Table 2. Pulsating Variables in the Böhm-Vitense Decrement

HD	Name	V	$[M_1]$	$[c_1]$	[u−b]	$\log T_e$	M_V	Sp.T	vsini
27290	γ Dor	4.25	$0^{m}.235$	$0^{m}.620$	$1^{m}.090$	3.848	$+2^{m}.81$	F0V	50km/s
32537	9 Aur	5.00	0.217	0.599	1.033	3.840	+2.91	F1Vp*	14
164615	V2118 Oph	7.02	0.247	0.578	1.072	3.836	+3.00	F2V	60
218396	HR 8799	5.97	0.193	0.651	1.037	3.850	+2.66	F0V*	45
224638		7.45	0.205	0.681	1.085	3.850	+2.42	F0	24
224945		6.70	0.213	0.650	1.076	3.842	+2.50	F0	55

* Abt and Morrell (1995). HD 32537 has weak 4481 and HD 218396 is of type A5 from the metal lines.

Böhm-Vitense (1970) has suggested that an abrupt onset of convection in a stellar atmosphere will cause a gap in the distribution of stellar temperatures (B−V). Böhm-Vitense and Canterna (1974) found such a gap in the distribution of B−V values for field stars but failed to find it in the Pleiades and α Persei clusters. This failure is partly due to a deviant reddening in a small area of the Pleiades near Merope (23 Tau) and uncertainties in the observed values of (B−V) for the cluster stars. The gap is obvious in the ([u−b], M_V) plane and from stellar parameters for zero age main sequence stars with (X, Y) = (0.70, 0.28) (Maeder and Meynet, 1991) we find log g = 4.3, M_V = +2.9 and a mass of 1.65 $M_\odot$ for the mean temperature (7000°K) of the stars in Table 2. The mean luminosity in the table, +2.7 mag, is in close agreement. The stellar atmospheres by Lester et al. (1986) give $T_e \sim 7000$ to 7500°K for the gap of [u−b] = 0.97 to 1.12 mag. Böhm-Vitense and Canterna found that the conversion to convection in the stellar atmosphere occurs at $T_e \sim 7700$°K, in close agreement. We will therefore refer to this gap in Figure 1 as the Böhm-Vitense decrement, BVD, and the variables in Table 2, that lie in this gap, as BVDS. These are main sequence variables cooler than the red edge of the instability strip and with periods considerably longer than the USPC (δ Scuti) variables.

It should be noted that a mass of 1.65 $M_\odot$ is very close to that which divides the old disk and young disk populations (Eggen, 1995a), with the former forming Hyades-like giant sequences and the later M67-like subgiant and giant sequences. We should therefore expect the BVDS to be young disk stars. Candidates that should be monitored for light variation include the following stars in Table 3:

Table 3

HR	[u−b]	M(sub)V	Sp.T	vsini	HR	[u−b]	M(sub)V	Sp.T	vsini
571	$1^m.23$	$+2^m.95$	F0V	...	4616	$1^m.046$	$+2^m.56$	F0IV	65
1981	1.017	+2.80	F3V	...	4623	0.987	+2.79	F2V	16
3649	1.047	+2.96	F0IV	21	4971	1.076	+2.70	F0V	70
3874	1.056	+2.75	F2V	...	5817	1.086	+2.53	F0V	60
4324	0.991	+2.93	F2IV	11	6449	1.060	+2.78	F3V	18
					7877	1.040	+2.92	F2V	10

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

Number 4211

Konkoly Observatory
Budapest
28 June 1995

HU ISSN 0374 – 0676

PHOTOELECTRIC BV(RI)$_c$ OBSERVATIONS AND NEW CLASSIFICATION OF BX Cru [1]

BX Cru is classified in GCVS–IV as a classical Cepheid with the 19.537 day period. However, our photoelectric $BV(RI)_c$ observations carried out with the 0.6 m reflector of CTIO in March–April 1995 (Table 1) show that this classification is wrong: for 25 days the light of the star was constantly increasing (Fig. 1), and moreover, the variations of the color index $B-V$ were not typical of Cepheids. Most likely BX Cru is a semiregular variable.

Table 1

JD hel 2400000+	V	$B-V$	$(V-R)_c$	$(R-I)_c$
49803.8596	12.820	1.847	1.855	1.979
49804.8442	12.819	1.823	1.833	1.998
49805.8160	12.767	1.858	1.804	1.992
49807.8286	12.746	1.848	1.800	2.001
49808.8375	12.720	1.854	1.792	1.979
49809.7552	12.692	1.881	1.810	1.973
49809.8141	12.659	1.867	1.784	1.967
49810.7955	12.632	1.877	1.764	1.984
49811.7634	12.639	1.829	1.782	1.968
49813.8321	12.573	1.876	1.757	1.938
49814.7850	12.564	1.848	1.759	1.941
49815.7404	12.550	1.872	1.758	1.939
49817.7642	12.529	1.879	1.765	1.943
49817.8151	12.518	1.856	1.756	1.940
49818.7366	12.498	1.867	1.744	1.930
49818.8039	12.491	1.884	1.742	1.922
49821.7267	12.431	1.877	1.731	1.914
49821.7981	12.443	1.962	1.752	1.914
49822.7196	12.421	1.936	1.736	1.920
49823.7168	12.414	1.826	1.718	1.926
49825.7033	12.403	1.892	1.729	1.922
49826.7363	12.385	1.857	1.720	1.900
49827.6929	12.386	1.854	1.707	1.901

[1] Based on observations obtained at the Cerro Tololo Inter-American Observatory

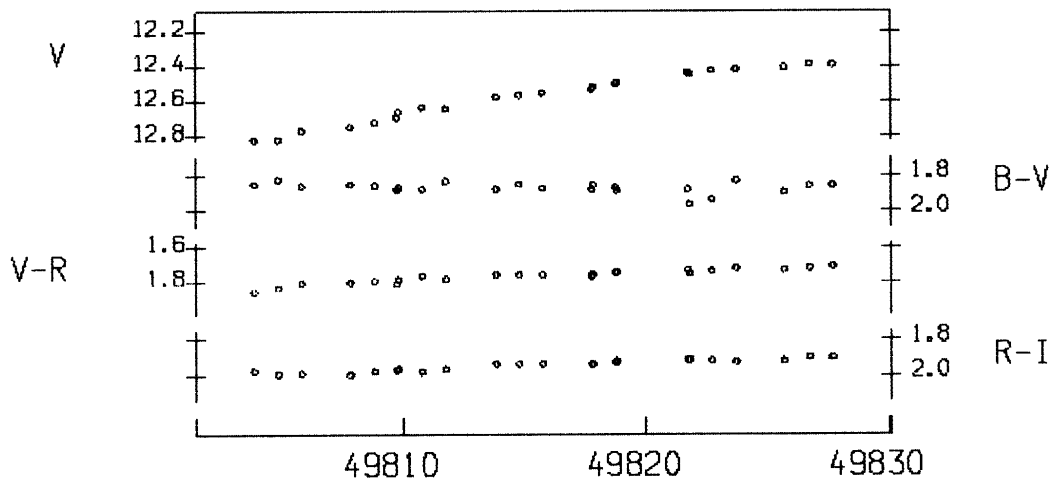

Figure 1

The research described in this publication was made possible in part by grants No. NDD000 and No. NDD300 from the International Science Foundation and Russian Government as well as by grant No. 95–02–05276 from the Russian Foundation of Basic Research to LNB and by funds awarded through the Natural Sciences and Engineering Research Council of Canada (NSERC) to DGT.

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

Number 4212

Konkoly Observatory
Budapest
28 June 1995

HU ISSN 0374 – 0676

PHOTOELECTRIC BV(RI)$_c$ OBSERVATIONS OF THE PECULIAR CEPHEID V473 Lyr [1]

V473 Lyr is classified as a Cepheid with variable amplitude in the GCVS. So for study of the pulsation behaviour of this star, it is very important to observe it as often as possible.

We observed V473 Lyr at CTIO in March and April 1995. The 60–cm reflector was used and 9 $BV(RI)_c$ measurements were obtained (Table 1); the accuracy of the individual data is near 0.01 mag in all filters. According to our data, the amplitude of the light curve (Fig.1) is near 0.12 mag in V.

The phases are calculated with the elements:

$$MaxJDhel = 2428738.767 + 1.490813 \times E.$$

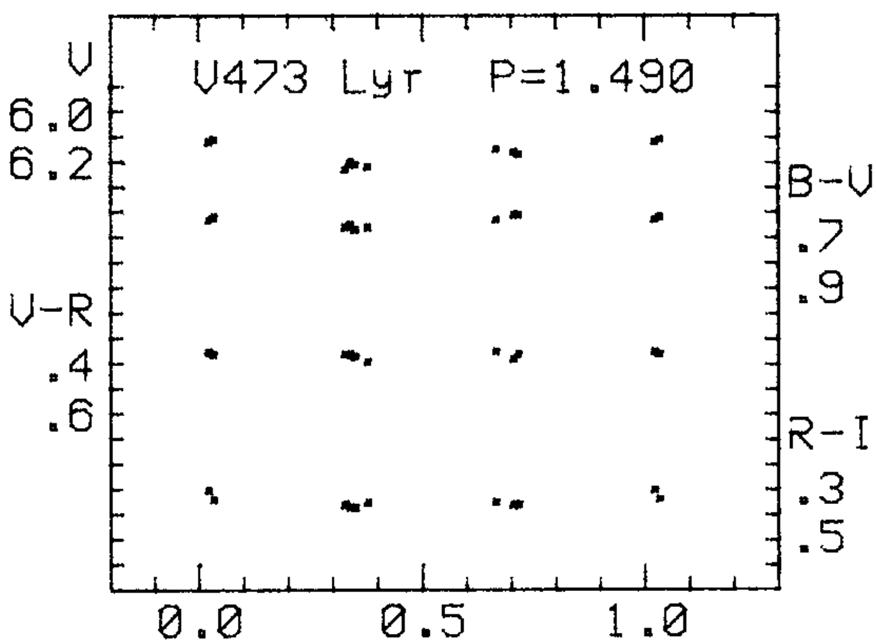

Figure 1

[1] Based on observations obtained at the Cerro Tololo Inter-American Observatory

Table 1

JD hel 2400000+	V	$B-V$	$(V-R)_c$	$(R-I)_c$
49811.9005	6.214	0.654	0.358	0.357
49813.8983	6.136	0.620	0.342	0.349
49814.8984	6.187	0.640	0.356	0.362
49817.8986	6.200	0.664	0.368	0.362
49818.8989	6.108	0.625	0.350	0.298
49821.8963	6.096	0.608	0.355	0.330
49822.9003	6.147	0.601	0.374	0.352
49823.9009	6.204	0.648	0.389	0.350
49825.9011	6.154	0.603	0.353	0.356

The research described in this publication was made possible in part by grants No. NDD000 and No. NDD300 from the International Science Foundation and Russian Government as well as by grant No. 95–02–05276 from the Russian Foundation of Basic Research to LNB and by funds awarded through the Natural Sciences and Engineering Research Council of Canada (NSERC) to DGT.

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

Number 4213

Konkoly Observatory
Budapest
28 June 1995

HU ISSN 0374 – 0676

PHOTOELECTRIC OBSERVATIONS AND NEW CLASSIFICATION OF V651 Her

V651 Her is listed in GCVS–IV as a possible classical Cepheid. Our photoelectric $UBV(RI)_c$ observations, carried out with 0.6 m reflectors of CTIO, Las Campanas and Mt. Maidanak observatories from June 1994 to March 1995, showed that this classification was wrong: V651 Her is an eclipsing variable with the elements:

$$MinJDhel = 2449827.9 + 3.1745 \times E.$$

The observations are given in Table 1 and represented graphically in Figure 1. The accuracy of the individual data is near 0.01 mag in all filters.

The research described in this publication was made possible in part by grants No. NDD000 and No. NDD300 from the International Science Foundation and Russian Government as well as by grant No. 95–02–05276 from the Russian Foundation of Basic Research to LNB and OVV, and by funds awarded through the Natural Sciences and Engineering Research Council of Canada (NSERC) to DGT.

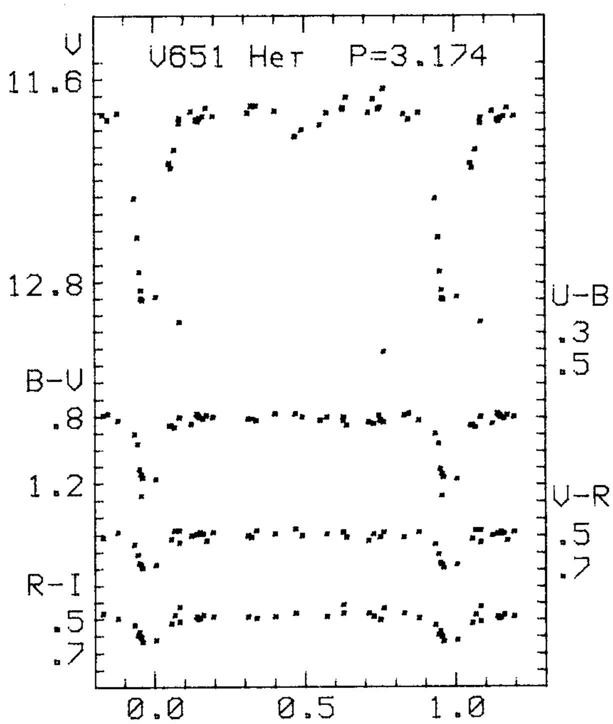

Figure 1

Table 1

JD hel 2400000+	V	$U-B$	$B-V$	$(V-R)_c$	$(R-I)_c$
49521.7227	11.852	–	0.807	–	–
49522.6649	11.816	–	0.773	–	–
49528.7389	11.640	0.403	0.821	0.466	0.422
49529.7215	12.004	–	0.854	0.456	0.470
49534.6817	11.760	–	0.813	0.475	0.408
49543.6814	11.920	–	0.775	0.453	0.456
49545.6498	11.809	0.229	0.791	0.532	0.417
49563.6060	11.757	–	0.776	–	–
49564.5920	12.080	–	0.844	–	–
49622.1201	11.752	–	0.779	0.521	–
49623.1128	11.880	–	0.788	0.490	–
49625.1259	11.767	–	0.834	0.489	–
49632.1203	11.744	–	0.802	0.505	–
49633.1169	11.685	–	0.840	0.500	–
49634.1239	12.885	–	1.265	–	–
49804.8890	11.751	–	0.813	0.497	0.498
49805.8603	12.108	–	0.840	0.513	0.517
49808.8747	12.875	–	1.160	0.657	0.611
49809.8447	11.780	–	0.795	0.491	0.474
49810.8472	11.751	–	0.794	0.475	0.459
49811.8272	12.290	–	0.892	0.544	0.528
49813.8459	11.784	–	0.788	0.483	0.473
49814.8220	11.776	–	0.807	0.469	0.484
49815.8204	11.799	–	0.793	0.474	0.471
49817.8449	11.787	–	0.779	0.500	0.453
49818.8252	11.821	–	0.774	0.478	0.477
49818.8460	11.829	–	0.780	0.481	0.481
49818.8625	11.810	–	0.791	0.470	0.484
49818.8916	11.796	–	0.798	0.483	0.461
49821.8329	11.839	–	0.785	0.463	0.507
49822.8256	11.768	–	0.775	0.479	0.480
49823.8170	11.780	–	0.818	0.517	0.457
49823.8645	11.696	–	0.827	0.477	0.475
49825.8017	11.737	–	0.815	0.461	0.483
49827.7240	12.518	–	0.951	0.600	0.581
49827.7450	12.716	–	1.103	0.647	0.570
49827.7622	12.828	–	1.130	0.664	0.596
49827.7782	12.891	–	1.152	0.677	0.629

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

Number 4214

Konkoly Observatory
Budapest
28 June 1995

HU ISSN 0374 – 0676

PHOTOELECTRIC OBSERVATIONS AND NEW ELEMENTS OF THE ECLIPSING BINARY TY Pup

We used HD 60265 as a comparison star for photoelectric observations of the Cepheid X Pup. Later it was ascertained that it was the known eclipsing variable TY Pup.

TY Pup was observed with 60–cm reflectors of Mt. Maidanak observatory (five $UBVR_c$ measurements in 1984) and CTIO (22 $BV(RI)_c$ measurements in 1995). The accuracy of the individual data is near 0.01 mag in all filters. Our observations listed in Table 1 do not satisfy the light elements published in the recent paper by Gu et al. (1993); apparently there is miscalculation in the number of epochs in the above publication. Therefore we have gathered all published observations of this star, which are photoelectric ones only (Huruhata et al., 1957; Gu et al., 1993), and analysed them as well as our CTIO measurements with Hertzsprung's method; the derived epochs of minima (in filter V) are given in Table 2. These four epochs of minima were introduced into a linear least–squares solution (with weights being inversely proportional to error squares) to obtain the following improved ephemeris formula:

$$MinJDhel = 2441955.6816 + 0.81924123 \times E$$
$$\pm .0012 \pm\ .00000023$$

This ephemeris was used in calculating the $O - C$ values in Table 2 and for plotting our observations in Figure 1.

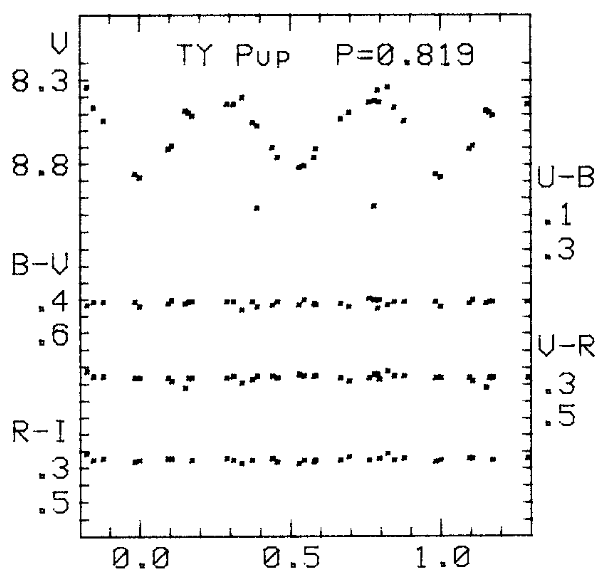

Figure 1

Table 1

JD hel 2400000+	Phase	V	$U-B$	$B-V$	$(V-R)_c$	$(R-I)_c$
45676.4960	0.781	8.417	0.045	0.393	0.239	–
45687.4492	0.151	8.480	–	0.413	0.311	–
45692.3750	0.164	8.485	–	0.401	0.254	–
45693.3828	0.394	8.569	0.053	0.438	0.248	–
45704.3593	0.792	8.352	–	0.450	0.239	–
49803.6727	0.585	8.705	–	0.429	0.246	0.247
49804.6877	0.824	8.340	–	0.424	0.218	0.215
49807.6640	0.457	8.757	–	0.403	0.254	0.263
49808.6779	0.695	8.482	–	0.437	0.273	0.228
49809.6214	0.846	8.458	–	0.409	0.246	0.249
49810.6558	0.109	8.690	–	0.397	0.279	0.245
49811.6242	0.291	8.435	–	0.408	0.255	0.237
49812.6412	0.532	8.813	–	0.426	0.234	0.268
49814.6520	0.987	8.850	–	0.401	0.258	0.257
49815.6236	0.173	8.503	–	0.401	0.252	0.246
49816.6092	0.376	8.547	–	0.406	0.265	0.255
49817.5942	0.578	8.754	–	0.412	0.242	0.264
49818.5939	0.799	8.425	–	0.399	0.269	0.237
49819.5807	0.003	8.873	–	0.433	0.253	0.253
49821.5777	0.441	8.699	–	0.429	0.249	0.243
49822.5837	0.669	8.526	–	0.411	0.257	0.254
49823.5746	0.878	8.532	–	0.402	0.249	0.237
49824.5733	0.097	8.705	–	0.412	0.253	0.244
49825.5680	0.311	8.433	–	0.404	0.244	0.254
49825.5916	0.340	8.397	–	0.457	0.287	0.274
49826.5810	0.548	8.808	–	0.397	0.248	0.246
49827.5766	0.763	8.425	–	0.384	0.259	0.247

Table 2

Min JD hel 2400000+	Error	E	$O-C$	Number of observations	Author
34092.6040	0.0009	−9598	−0.0004	279	Huruhata et al., 1957
34416.2056	0.0008	−9203	0.0010	184	Huruhata et al., 1957
46100.2230	0.0002	5059	0.0000	597	Gu et al., 1993
49817.1362	0.0013	9596	0.0157	20	This paper

Radial velocity measurements of TY Pup (Struve, 1950) satisfy the above elements: the sine fitted to Struve's data and γ–axis are intersecting near phase 0.

The research described in this publication was made possible in part by grants No. NDD000 and No. NDD300 from the International Science Foundation and Russian Government as well as by grant No. 95–02–05276 from the Russian Foundation of Basic Research to LNB and by funds awarded through the Natural Sciences and Engineering Research Council of Canada (NSERC) to DGT.

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

Number 4215

Konkoly Observatory
Budapest
30 June 1995

HU ISSN 0374 – 0676

A PECULIAR NEW VARIABLE STAR NEAR THE WIDE BINARY L266-18A/B

For several years we have conducted a spectroscopic and photometric investigation of faint common proper motion binaries which contain suspected white dwarf components (see Oswalt et al., 1991; Oswalt & Smith,1995; Smith & Oswalt, 1995). In the course of acquiring spectra of the binary L266-18A/B in Centaurus, one of us (TDO) noticed an exceedingly red object within the TV guider field which does not appear on the original survey plates.

Our initial impression was that this object might be a third component that was below the plate limit at the time Luyten conducted his survey of common proper motion binaries. Luyten (1974) reported the following data for L266-18A/B:

L266-18A: $\alpha_{1950}= 16^h18^m18^s$; $\delta_{1950}= -50°45'$ $m_{pg}= 16.4$; a-f
L266-18B: $m_{pg}= 17.5$; k-m; p.a.= 25°; sep.= 5"

A finder chart prepared from one of our V-filter CCD frames is presented in Figure 1. Since this object appears to have no prior references in the literature we have adopted the temporary designation L266-18 "C", but we do so with the caveat that it may not share motion with L266-18A/B.

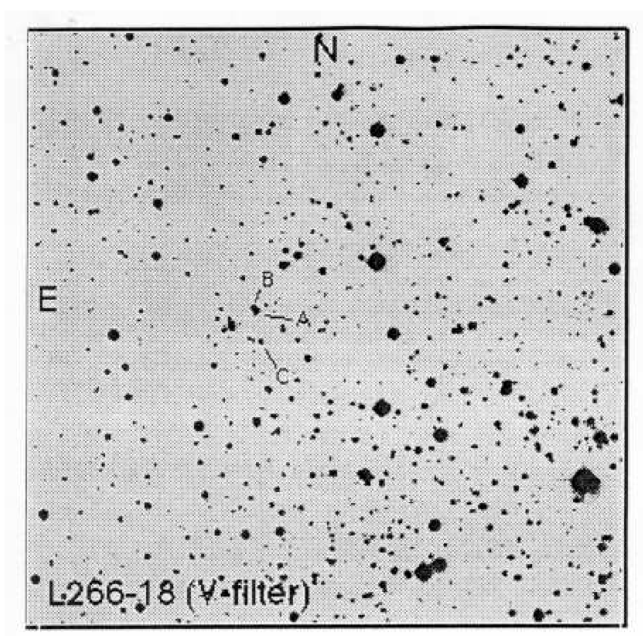

Figure 1. V-band finder chart for L266-18A/B. Suspected red variable star is labelled "C". Field is 6.'76 square, centered on $\alpha_{1950}= 16^h18^m26^s$; $\delta_{1950}= -50°43'\ 47''$. Orientation is North up, East to left.

The proper motion of the pair is listed as $\mu = 0\farcs15$/y, $\theta = 188°$. Because it is a very crowded field, the possibility that we have misidentified L266-18A/B cannot be ruled out. No objects within the field exhibit Luyten's (1974) reported proper motion, and the position angle of the most likely pair (~40°) also differs from that reported by Luyten. However, our spectra show that the selected pair consists of nearly identical DA white dwarf components—unlikely for a randomly chosen pair of stars. Both exhibit unusually red continua and a broad depression near 6700 Å, suggesting the presence of unresolved M-type component(s).

Spectrophotometry of all three stars was obtained in May 1989 at the Cerro Tololo Inter-American Observatory using the 4-m telescope equipped with the R-C spectrograph, folded Schmidt camera and 2D-FRUTTI photon-counting detector. This configuration yielded a spectral coverage of $\sim 3500 - 7200$ Å and a reciprocal resolution of ~ 7 Å. The 300 μ slit width used corresponded to $\sim 1\farcs7$ on the sky, a good match to the seeing at the time of the integrations ($\sim 1\farcs5$). During the night, the photometric standards LTT3864 and LTT7987 were observed and all spectra were bracketed by He-Ar spectra. Flux and wavelength calibrations were performed at the CTIO La Serena computer facilities using the standard IRAF reduction package.

The spectrum of L266-18 "C" presented in Figure 2 is definitely that of a late-type star. However, it is remarkably weak in blue continuum and in the depth of TiO bands. The absence of Balmer emission weakens our initial hypotheses that it is a Mira-type long period variable or a young dust- or disk-enshrouded low-mass star.

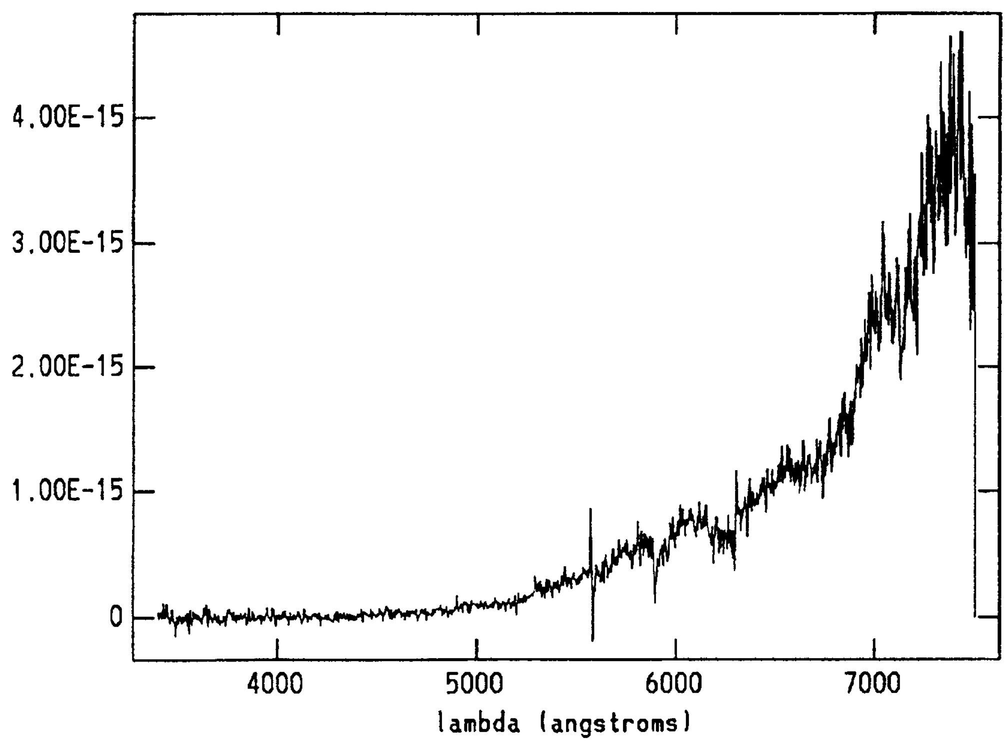

Figure 2. Optical spectrum of L266-18 "C" obtained with the CTIO 4-m telescope on 1989 May 8 UT. Flux (F_λ) is in units of ergs $cm^{-2}s^{-1}Å^{-1}$; resolution is ~ 7 Å. Discontinuities near 5600 and 6300 Å are due to incomplete night sky subtraction.

JHK photometry of the L266-18A/B field was obtained in 1990 April with the NASA IRTF 3.0-m telescope and Primo-1 aperture photometer, using a 5.″6 diaphragm and 15″ N-S chop. The detector was a single channel InSb phototube. Table 1 summarizes our *JHK* observations. Because of the relatively long integration times required, instrumental *JHK* magnitudes, rather than colors were extinction-corrected and transformed to the standard $JHK_{C.I.T.}$ system used at the IRTF. L266-18A/B is a pair of close separation and the observations were made at high air mass; as an internal check, the magnitudes of "C" also were measured differentially relative to L266-18A and B (both assumed nonvariable), and found to be consistent.

Table 1
JHK Photometry at IRTF (1990 Apr. 2 UT)

Filter	L266-18A	L266-18B	L266-18C
$J(\sigma)$	12.91 (.04)	13.40 (.04)	10.35 (.03)
$H(\sigma)$	12.52 (.03)	13.39 (.03)	9.14 (.03)
$K(\sigma)$	12.39 (.03)	13.77 (.04)	8.60 (.03)

BVRI photometry was obtained in 1992 August at CTIO with the 0.9-m telescope using the Tek 1024 CCD. These observations are summarized in Table 2. As before, magnitudes were corrected for atmospheric extinction and transformed to the standard system; differential magnitudes relative to L266-18A/B also were computed as a check. The extreme red color of "C" is evident; star "C" was near the *B*-filter frame limit, and yet its image was saturated in the *I*-filter frame (hence no *I* magnitude is reported for "C" in Table 2.

Table 2
BVRI Photometry at CTIO (1992 Aug. 24 UT)

Filter	L266-18A	L266-18B	L266-18C
$B(\sigma)$	16.85 (.02)	16.79 (.02)	21.06 (.11)
$V(\sigma)$	15.50 (.01)	15.54 (.01)	17.33 (.01)
$R(\sigma)$	14.68 (.01)	14.68 (.01)	14.94 (.01)
$I(\sigma)$	13.83 (.01)	13.85 (.01)	————

Additional *BVRI* photometry was attempted in 1993 June using the CTIO 1.5-m telescope equipped with the Tek 1024 CCD. Because the night was not photometric only differential measures could be extracted from these frames (see Table 3). Relative to both components L266-18A and B, star "C" brightened by ~ 1.20 and ~ 0.13 magnitudes in *B* and *V*, respectively, while dimming by ~ 0.10 magnitude in *R*. We conclude that "C" has become somewhat brighter and bluer in recent years. Therefore the *JHK* and *BVRI* magnitudes should not be directly compared, as they were obtained at substantially different phases in the unknown light curve of "C".

The preliminary observations reported here suggest that "C" is a variable star of unusual color and brightness amplitude. Determination of its proper motion, trigonometric parallax, spectrum variations, and especially its long-term light curve, are needed. Observers in the southern hemisphere are invited to contribute to this effort.

Table 3
Differential BVRI Photometry at CTIO (1993 June 24 UT)

Filter	L266-18 C-A	L266-18 C-B	L266-18 A-B
$\Delta B(\sigma)$	3.02 (.11)	3.02 (.12)	−0.01 (.01)
$\Delta V(\sigma)$	1.69 (.02)	1.68 (.02)	−0.01 (.01)
$\Delta R(\sigma)$	0.36 (.01)	0.36 (.01)	0.00 (.00)
$\Delta I(\sigma)$	−0.70 (.01)	−0.71 (.01)	−0.01 (.01)

Acknowledgements: Observations were conducted at Cerro Tololo Inter-American Observatory, operated by the Association of Universities for Research in Astronomy for the National Science Foundation, and at the NASA Infrared Telescope Facility at Mauna Kea Observatory. This work made use of the SIMBAD database operated by the Centre de Donnees Astronomique, Strasbourg, France and the SkyViews database operated by NASA at the Goddard Space Flight Center. We are especially grateful to S.K. Leggett for facilitating our IRTF observations. Thanks also to T. Henry, D. Kirkpatrick, J. Liebert and M. Wood for their helpful comments. This work was supported in part by NSF grant AST-9016284 (TDO) and NASA GSRP fellowship NGT-51086 (JAS).

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4216

Konkoly Observatory
Budapest
30 June 1995

HU ISSN 0374 – 0676

uvbyβ PHOTOMETRY OF STARS OF "ASTROPHYSICAL INTEREST"

In the course of several observing programs, we measured Strömgren-Crawford indices for a number of stars of "astrophysical interest", mostly suspected or proven variables, but also chemically peculiar objects (e. g. λ Bootis-type). Besides, we also report results for some comparison stars. The results of these observations will be summarized here and brief discussions of individual objects will be given.

Our observations were acquired with the 91 cm telescope at McDonald Observatory (McD) in November, 1994 as well as with the 50 cm telescope at the South African Astronomical Observatory (SAAO) in March, 1995. Integration times never were less than 50 seconds in the different filters, and at least 100 000 counts were collected for each star in each filter. The transformation matrix (similar to Sterken et al. 1993) was calculated by using 10 standard stars for the McD observations, but with 19 standards for the SAAO uvby and with 28 standards for the SAAO β measurements. The rms residual of the transformed standard star data at McD was 0.02, 0.004, 0.007 and 0.015 mag for $V, (b-y), m_1, c_1$, respectively. We obtained residuals of 0.005, 0.004, 0.007, 0.006 and 0.006 mag for $V, (b-y), m_1, c_1$ and β measured at SAAO. The larger residuals in the V and c_1 values from McD are attributed to small changes in sky transparency. These values can be taken as an estimate of the errors of the indices of the program stars, which are summarized in Table 1. We also attempted to acquire Hβ data at McD, but they are not usable due to a software problem occurring during the observations. In the following, all program stars are discussed. Unless otherwise noted, the results for variable stars must be treated with caution.

Individual objects:

HD 12389: This star was discovered to be a δ Scuti variable by Schutt (1991). However, its spectral type is A0, suggesting that it is located near the hot border of the instability strip in the HR diagram. Our colors indicate that the star is probably within the instability strip, but since it appears to be somewhat reddened, it would be important to determine its Hβ value.

HD 33957, SAO 51642: Both objects were suspected to be rapid variables by Schutt (1993). They appear to be within the instability strip, but might be reddened. A measurement of the Hβ index is necessary.

HD 81290, HD 83041, HD 109738, BD+36°4917: These are λ Bootis-type stars, and their Strömgren-indices are typical for the group. They will be further discussed by Paunzen et al. (1995). After our observations were obtained, HD 109738 was discovered to be variable with a peak-to-peak amplitude of about 0.03 mag in Strömgren v and with a period of about 45 minutes (Paunzen, private communication).

Table 1. uvbyβ photometry of the program stars

Star	Observatory	V	$b-y$	m_1	c_1	β
HD 12389	McD	8.006	0.129	0.152	1.050	
HD 33957	McD	9.525	0.149	0.083	1.156	
HD 35685	SAAO	7.278	−0.032	0.140	0.702	2.790
HD 35734	SAAO	9.098	−0.011	0.170	0.886	2.871
BD−12°1174	SAAO	9.816	0.348	0.158	0.412	2.640
SAO 176755	SAAO	10.183	0.288	0.134	0.566	2.706
HD 81290	SAAO	8.858	0.252	0.107	0.639	2.673
HD 83041	SAAO	8.798	0.230	0.104	0.725	2.705
HD 105912	SAAO	6.959	0.286	0.148	0.433	2.668
HD 106384	SAAO	6.563	0.161	0.186	0.807	2.769
HD 106952	SAAO	7.825	0.298	0.151	0.454	2.656
HD 109738	SAAO	8.283	0.165	0.129	0.864	2.778
HD 111828	SAAO					2.633
HD 111829	SAAO	9.480	0.228	0.100	1.000	2.806
HD 147491	SAAO	9.599	0.413	0.153	0.354	2.603
HD 147649	SAAO					2.855
HD 164615	SAAO					2.715
SAO 51642	McD	9.109	0.193	0.134	1.136	
HD 213258	McD	7.684	0.222	0.187	0.659	
HR 8569	McD	6.537	0.030	0.165	1.028	
BD+36°4917	McD	9.790	0.193	0.136	0.908	

HD 106384 is the multiperiodic δ Scuti star FG Vir (e. g. Breger et al., 1995). Since it varies with a dominant frequency of 12.7 cycles per day, the values reported in Table 1 represent averages of two measurements obtained in an interval of one hour, in order to compensate for the light variations of FG Vir.

HD 111828, HD 111829: The latter star is suspected (Mantegazza et al., 1991) to belong to a group of variable stars similar to γ Dor (see Krisciunas & Handler, 1995). However, it is hotter and more evolved than the confirmed γ Dor variables. More observations are necessary. HD 111828 was confused with HD 111829 in the discovery note and is much cooler.

HD 147491, HD 147649: HD 147491 was claimed to be a δ Scuti star (Yao & Tong, 1989). However, it is too cool to belong to these kind of variables, but it shows light modulation of presently unknown nature. The star is more thoroughly discussed by Handler (1995), who presents new time-series photometry using HD 147649 as a comparison star.

HD 164615 is one of the best investigated variables similar to γ Dor. However, a measurement of its Hβ index was not available so far.

HR 8569, HD 213258: The former object is a suspected δ Scuti star reported by Schutt (1991). However, it appears to be outside the hot border of the instability strip. New observations (Zima & Handler, in preparation) do not support variability of HR 8569. HD 213258 was used as comparison star for HR 8569 by Schutt (1991). We note that HD 213258 is inside the instability strip and that our Strömgren indices are consistent with Geneva photometry reported by North & Duquennoy (1991).

HD 35685, HD 35734, BD−12°1174, SAO 176755, HD 105912, HD 106952: All these objects were used as comparison stars during multisite campaigns (Handler et al. 1995a, Méndez et al., in preparation, Handler et al. 1995b, Breger et al., 1995 and in preparation). They are outside the instability strip and thus not likely to be variable.

Acknowledgements: This research was supported by the Austrian Fonds zur Förderung der wissenschaftlichen Forschung under grant S-7309.

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

Number 4217

Konkoly Observatory
Budapest
6 July 1995

HU ISSN 0374 – 0676

SLOW APSIDAL MOTION IN V541 CYGNI

The detached eclipsing binary V541 Cyg (BD+30°3704 = GSC 2656.3703) is a less-known binary with high orbital eccentricity ($e = 0.47$) and a long period of 15.34 days. It is an important system for the study of the general-relativistic theory of the apsidal motion (Khaliullin, 1985). The theoretically expected rotational velocity of the line of apsides could be $0\overset{\circ}{.}0097$ yr^{-1}, caused by dominant relativistic contribution as well as by tidal distortion and rotational flattening of the component stars.

Our new CCD photometry of V541 Cyg was carried out on 20 June 1995 at the Ondřejov Observatory using a 65cm reflecting telescope with a CCD-camera (SBIG ST-6) at the primary focus. The measurements were done using the standard Johnson B filter with 60 s exposure time. The stars GSC 2656.1627 – listed also as star 3 by Karpowicz (1961) - on the same frame as V541 Cyg served as a comparison star. The CCD data were reduced using software developed at Ondřejov Observatory by P. Pravec and M. Velen. No correction was allowed for differential extinction, due to the proximity of the comparison star to the variable (2.8 arcmin) and the resulting small differences in the air mass. The secondary minimum and their error were determined using the Kwee-van Woerden (1956) method. The result for the moment of eclipse is:

$$\text{Sec. Min.} = \text{HJD } 24\ 49889.377 \pm 0.001$$

The apsidal motion of V541 Cyg was studied by means of an O$-$C diagram analysis. We took into consideration all photoelectric times collected in Table 1, the photographic measurements obtained by Karpowicz (1961), as well as the times of secondary minimum obtained by Kulikowski (1953). The original times of primary minimum were not used due to large scatter of the data. The epochs were calculated using the linear light elements given by Khaliullin (1985):

$$\text{Pri. Min.} = \text{HJD } 24\ 44882.2127 + 15.337873 \times \text{E}$$

Table 1. Photoelectric times of minimum of V541 Cyg.

JD Hel.$-$ 2 400 000	Epoch	Reference
44882.2127	0.0	Khaliullin (1985)
44889.2192	0.5	Khaliullin (1985)
46998.8424	138.0	Lines et al. (1989)
48839.387	258.0	Diethelm (1992)
49168.4951	279.5	Agerer (1994) ⋆
49889.377	326.5	this paper

⋆ *mean value of V and B measurements*

Table 2. Apsidal motion parameters.

T_0	=	$2\,444\,881.7920 \pm 0.0006$
P_s	=	$15^{\rm d}.3379020 \pm 0^{\rm d}.0000005$
P_a	=	$15^{\rm d}.3379111 \pm 0^{\rm d}.0000005$
e	=	0.4735 ± 0.0021
$\dot{\omega}$	=	$(0^\circ.000\,223 \pm 0^\circ.000\,045)$ cycle^{-1} =
	=	$(0^\circ.0053 \pm 0^\circ.0011)$ yr^{-1}
ω_0	=	$262^\circ.7 \pm 0^\circ.1$
U	=	1.614×10^6 P_a = $68\,000 \pm 13\,000$ yr

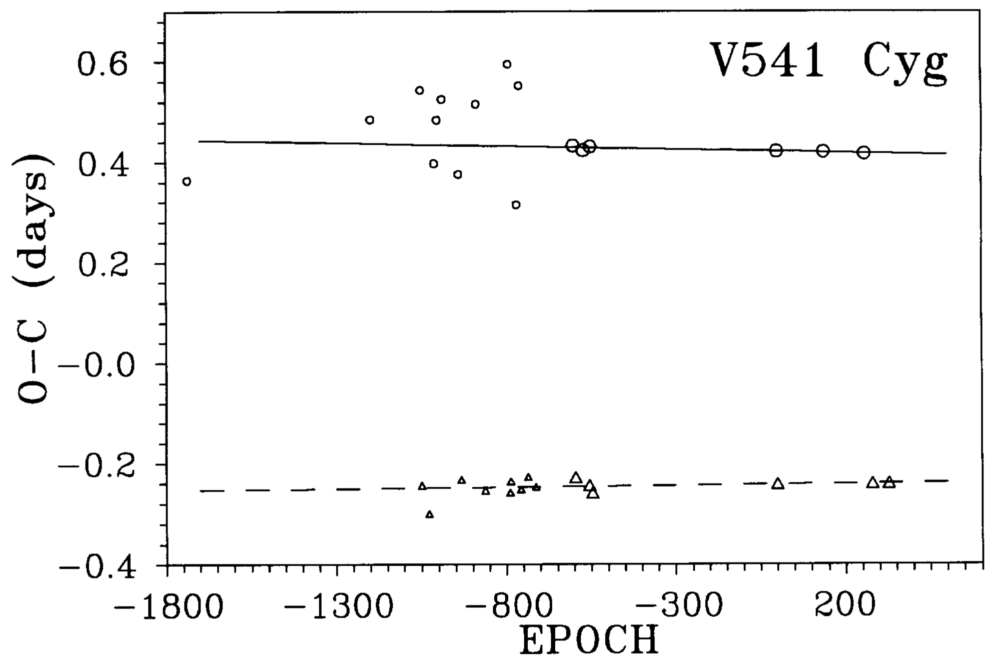

Figure 1. Residuals for the times of minimum of V541 Cyg with respect to the linear light elements. The continuous and dashed curves represent predictions for primary and secondary eclipses, respectively. The individual primary and secondary minima are denoted by circles and triangles, respectively. Larger symbols correspond to the photographic and photoelectric measurements with higher weight.

All photoelectric times of minimum were used in our computation, with a weight of 10, the photographic times obtained by Karpowicz (1961) were weighted with a weight of 5, the older photographic measurements with a weight of 1. A total 21 times of minimum light were incorporated in our analysis, with 6 primary eclipses among them.

For the apsidal motion analysis we used the method by Giménez & García-Pelayo (1983). This weighted least squares iterative procedure includes terms in the eccentricity up to the fifth order. Due to the high value of eccentricity of V541 Cyg, we used all terms in our calculation.

Adopting the orbital inclination, derived from the light curve solution, of i = 89°.86 (Khaliullin, 1985), the mean apsidal motion elements given in Table 2 can be determined. In this table P_s denotes the sidereal period, P_a anomalistic period, e represents the eccentricity, $\dot{\omega}$ the rate of apsidal motion. The zero epoch is given by T_0 and the corresponding position of the periastron is ω_0. Finally, U is the period of apsidal line rotation.

The O−C residuals for all times of minimum with respect to the linear part of the apsidal motion equation are shown in Figure 1. The original primary and secondary times of minimum obtained by Kulikowski (1953) are also plotted. The non-linear predictions, corresponding to the fitted parameters, are plotted as continuous and dashed curves for primary and secondary eclipses, respectively.

We derived the apsidal motion elements using the current data set. Our results indicate that the observed apsidal motion rate is less than expected from theory, in contradiction with previous good agreement announced by Khaliullin (1985) and Lines et al. (1989). This system could be the next member of a small group of binaries, which exhibit the discrepancy between observed and predicted rate of the apsidal motion. These anomalous cases, like DI Her (Guinan & Maloney, 1985) or AS Cam (Maloney et al., 1991) were not yet explained satisfactorily. More high-accuracy timings of this eclipsing system are necessary in the future to enlarge the time span for better analysis of the apsidal motion. Also the spectroscopic orbit of this system should be determined.

Acknowledgement. This work has been supported in part by the Grant Agency of the Czech Republic, grant No. 205-95-1498 and by the ESO C&EE Programme, grant No. A-02-069. I am grateful to Ms. Lenka Šarounová, who took part in our observations.

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

Number 4218

Konkoly Observatory
Budapest
14 July 1995

HU ISSN 0374 – 0676

REDISCOVERY OF A DWARF NOVA, V725 AQUILAE

V725 Aql is listed as a dwarf nova by Vogt and Bateson (1982), who identified a blue star on the Palomar Observatory Sky Survey plate. However, Bruch (1983) pointed out the lack of ultraviolet excess in this star.

During the course of our systematic survey of dwarf novae at the Ouda Station, Kyoto University, we found a "new" bright object in the vicinity of the cataloged position of V725 Aql on March 8, 1995, and have made photometric observations of this object on 8 nights between March 8 and March 20 and on May 6.

All of our observations at the Ouda Station were done using CCD camera (Thomson, TH7882 CDA, 576 × 384 pixels with 23 μm square pixel size) attached to the Cassegrain focus of 0.6-m reflector with Johnson V-band filter (Ohtani et al. 1992). The integration time was between 90 and 120 s depending on the brightness of the object. The mode of 2 × 2 on-chip summation was employed. We reduced the data with the personal-computer-based PSF photometry package developed by one of the authors (T.K.). This package automatically subtracts bias-frames, applies flat fielding and enables us to estimate the differential magnitudes.

The accurate position of this object calculated using our CCD image is $19^h56^m45\overset{s}{.}03$ $+10°49'32\overset{''}{.}7$ (J2000.0) (± 0.5 arcsec) using seven GSC stars. This position significantly differs from that in Vogt and Bateson (1982). However, on close examination of the discovery paper (Rohlfs 1949) and the original finding chart (Hoffmeister 1957), although the chart was small in scale, the object currently in outburst seems to be within the error of these papers. Figure 1 shows the chart based on our CCD image. At the corresponding position in the CV chart by Downes & Shara (1993), there is a very faint star.

Figure 2 shows the results of the differential photometry from March 8 to 20. The V magnitude of the comparison star is 11.9 (GSC) and the position is $19^h56^m50\overset{s}{.}88$ $+10°46'12\overset{''}{.}1$ (J2000.0). The average magnitudes on March 8 and on May 6 correspond to 13.6 and 17.3, respectively.

Rohlfs (1949) found three outbursts separated by about 1300 days. Fuhrmeister (1991) surveyed 250 Sonneberg plate and found two additional outbursts. These data seem to suggest a low outburst frequency of this object. However, no information on identification was given. Hazen (1995) tells that she has looked at 264 plates of the region in the Harvard College Observatory plate archive and has found 4 additional historical outbursts. She also tells that the position is not consistent with the chart of Vogt and Bateson (1982) but seems to be consistent with the position mentioned above.

All the facts above give good observational evidence that the object we observed is the "real" V725 Aql, only despite the range of variability (13.7–16.2) (Rohlfs 1949) which seems to be in contradiction with the new finding. The problem of the lack of ultraviolet excess claimed by Bruch (1983) seems to be solved now.

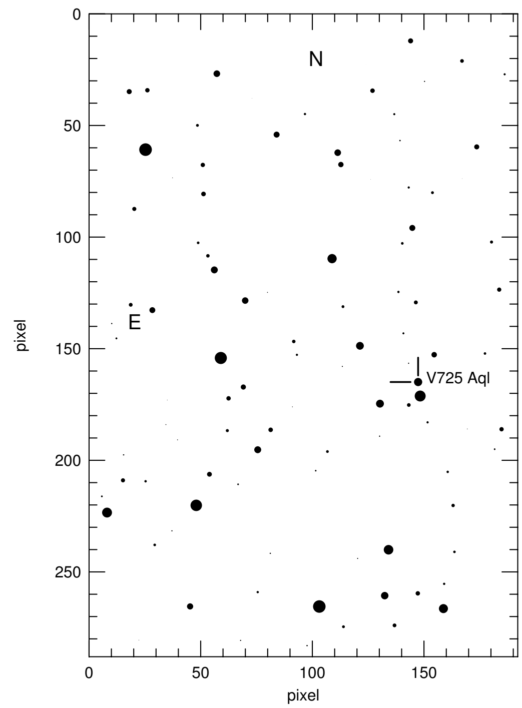

Figure 1: Chart of V725 Aql based on a CCD image

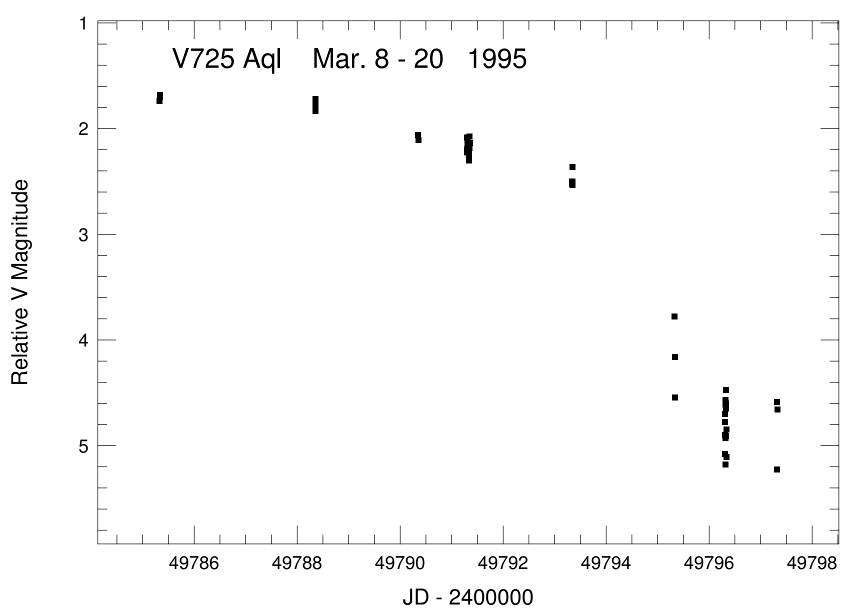

Figure 2: Outburst light curve on March 8 – 20, 1995

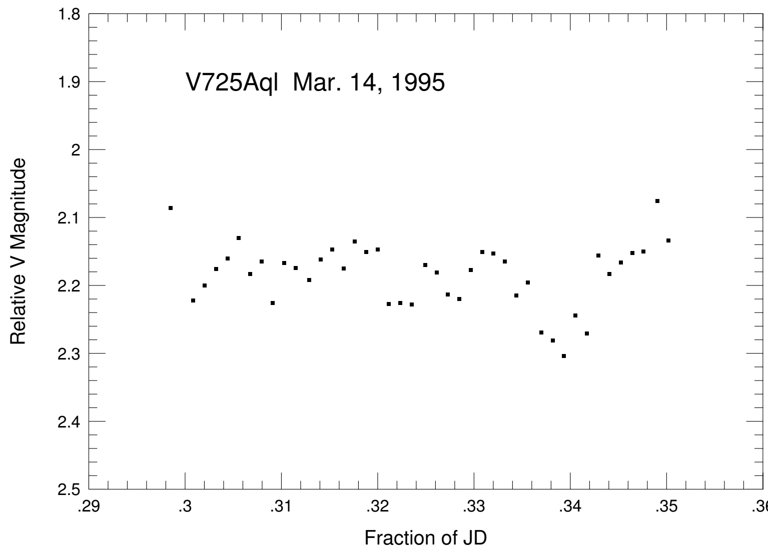

Figure 3: Short-term variation of V725 Aql

Figure 3 seems to show short-term variability during outburst. However, due to the shortness (~1 hours) of the observational time at the Ouda Station, we could not confirm any periodicity. It is left unclear what subtype of dwarf novae V725 Aql belongs to. However, a long outburst recurrence time, a rather large outburst amplitude and a rapid decline rate (~0.8 mag day^{-1}) from outburst imply that V725 Aql may be either an infrequently outbursting SS Cyg-type star or an SU UMa-type star which is currently caught during a superoutburst. The determination of the orbital period and the close monitoring for future outburst are highly encouraged.

The authors are grateful to M. Iida for calculating the position of V725 Aql. We thank B. Skiff for helping us to get original information on discovery papers. Thanks are also due to A. Nakamura and K. Hirosawa for checking against catalogued minor planets. Part of this work was supported by a Research Fellowship of the Japan Society for the Promotion of Science for Young Scientists (T.K.).

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4219

Konkoly Observatory
Budapest
17 July 1995

HU ISSN 0374 – 0676

AF Sco – A MIRA STAR, NOT A NOVA

AF Sco (= Harvard Variable 1108) is a poorly known object. It was first listed as a variable by Leavitt (1904). Swope (1932) published a finding chart, on which only the position of the star is indicated. Since it had not been seen (or rather re-observed) since the turn of the century, the 4th edition of the GCVS classified AF Sco as a nova. Some time ago, the Harvard plates were re-examined by B. Fuhrmann (Sonneberg), who put a list of positive and negative observations at my disposal. The object had brightness maxima on 1896 May 14 ($m_{\rm pg}$ = 14.0), 1897 June 4 (13.2) 1899 July 6 (12.2?), 1900 September 5 (12.9) and around 1901 September 8 (13.3). 33 plates taken between 1902 mid-April and 1929 May, sometimes reaching limiting magnitude 17, do not show the star. An image of $m_{\rm pg}$ = 17.5 is possibly visible on a plate taken on 1929 April 25.

The outburst image of the variable coincides with a quite bright star on the ESO/SERC plates, but the different times of Schmidt telescope observations make a determination of the colour impossible.

Spectroscopic observations (360 – 700 nm), made on 1995 June 25 with EFOSC1 at the ESO 3.6m telescope show that AF Sco has a spectral type M9 III, based on comparisons with spectrophotometric scans of standard stars (Turnshek et al. 1985). The large range in magnitudes on the Harvard plates ($m_{\rm pg}$ between 12.5 and 17.5) makes mira variability likely. From the brightenings observed between 1896 and 1901, a preliminary period of 388 days was derived. Making use of the fact that the star was not seen at the times when the later plates were taken, several trial runs with slightly different periods were made. The period that 'avoids' times of maximum light during observations made in later years leads to the preliminary light elements

$$t_{\rm max} = \text{J.D. } 2414858 + 385 \times E \text{ days}$$

which should be improved by present-day observations.

Previously, the object has been preliminarily identified with the IRAS source 16473–2528, and an IRAS spectrum is shown in Olnon & Raimond (1986). te Lintel Hekkert et al. (1991) have detected OH maser emission at 1612 MHz from it. The velocity separation ΔV = 10 km/s and the period of 385 days fits well into the trend in ΔV observed in mira variables of different periods and spectral types (Nguyen-Q-Rieu et al. 1979). By comparing the IRAS flux of AF Sco at 12μm with normalized fluxes of miras in the period range 370...400 days (Sivagnanam et al. 1988), we derive a distance estimate of 1300^{+600}_{-250} pc. Using period – absolute magnitude calibrations (Duerbeck & Seitter 1982), we predict a visual magnitude at maximum between $m_{\rm vis}$ = 9.1 and 10.4 (neglecting interstellar absorption, which should be less than 1 magnitude). Thus the determination of the precise period and an up-to date epoch of maximum light should be an easy task for amateur astronomers. A finding chart, based on the Digitized Sky Survey, is shown in Figure 1.

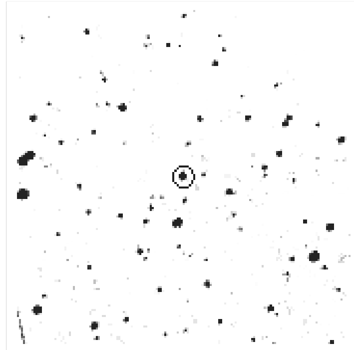

Figure 1. The field of AF Sco. Its size is $4'.5 \times 4'.5$, north is up and east to the left. The variable is marked with a circle. Its coordinates are RA = $16^h50^m25^s$, Decl. $-25°33'\,38''$, in good agreement with the IRAS position RA = $16^h50^m25^s.4$, Decl. $-25°33'\,37''$ (eq. J2000). This image is based on a 4 minute exposure through a V-filter, taken with the UK Schmidt on 1988 April 14.

Summing up, the positional coincidence of the outbursting object with the presently observed late type star confirm the IRAS identification, and the observed light variations lead to a reclassification of AF Sco as a mira star.

Acknowledgements. I am grateful to B. Fuhrmann, who put his magnitude estimates at my disposal, and to M. Naumann (ESO) for advice concerning the ESO/ST-ECF Online DSS. This research has made use of the Simbad data base, operated at CDS, Strasbourg, France. The finding chart is based on photographic data obtained using the UK Schmidt Telescope, operated by the ROE, with funding from the UK SERC until 1988 June, and thereafter by the AAO. Original plate material is © the Royal Observatory Edinburgh and the Anglo-Australian Observatory. The plates were processed into the present compressed digital form with their permission. The Digitized Sky Survey was produced at the Space Telescope Science Institute under US Government grant NAG W-2166.

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

Number 4220

Konkoly Observatory
Budapest
25 July 1995

HU ISSN 0374 – 0676

VARIABILITY OF HD 205117 IN THE OPEN CLUSTER M 39 (NGC 7092)

M 39 is one of relatively nearby open clusters (r=275 pc) which is considered to be of the II2p type. Among its 15 brightest members, Abt and Sanders (1973) discovered six true and one suspected binaries. For these binaries, we made an attempt to detect eclipsing effects by means of photoelectric B,V photometry. The observations were carried out in 1989/92 with the 60 cm telescope at Mt. Maidanak Observatory in Uzbekistan. After careful analysis of our monitoring data, light changes of small amplitude (0.051V) have been detected for HD 205117 (Sp: A0IV). The star was identified by Abt and Sanders (1973) as a probable binary. The light-curve of the star is shown in Figure 1 (the average signal-to-noise ratio is 4.48). We suggest that periodic sinusoidal variations of the star are connected with the orbital motion of its components. In this case, the real period of the binary should be 113.2 days. According to its spectrum, both components may be subgiants. The large scatter on the light curve of the binary may be interpreted as conditioned by nonstability processes in the system.

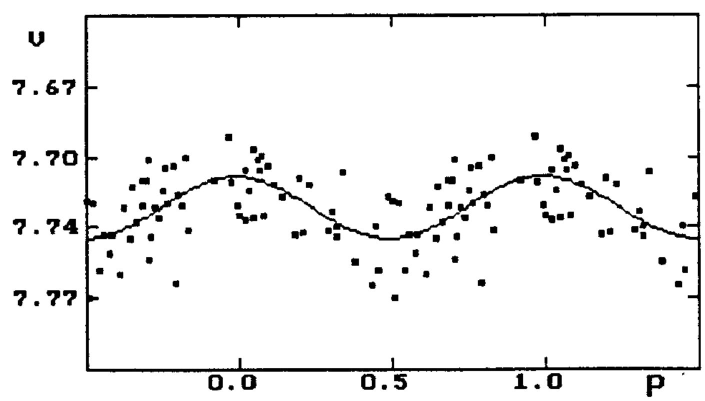

Figure 1. The light curve for HD 205117

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4221

Konkoly Observatory
Budapest
1 August 1995

HU ISSN 0374 – 0676

OPTICAL OBSERVATIONS OF THE ACTIVE STAR RE J2131+233

The sky was surveyed in the extreme ultraviolet (EUV) region of the spectrum by the EUVE satellite (Malina et al., 1994) and the ROSAT satellite (Pounds et al., 1993) and catalogs of the sources included RE J2131+233 = EUVE J2131+233 = BD +22°4409 = VVO 163. The brightness given was 9.25 in V and the spectral type was K8 (Bowyer et al., 1995). The star was the subject of an extensive investigation by Jeffries et al. (1994), however there remained a slight doubt as to the period of the photometric variations.

The automated 0.5-m. telescope, Johnson V filter and CCD camera of the Climenhaga Observatory of the University of Victoria (Robb et al. 1992) was used to make these photometric observations. The frames were bias subtracted and flat fielded in the usual manner using IRAF[1]. The magnitudes were found from aperture photometry using the PHOT package. The x y pixel coordinates of each star for photometry were found from inspection of a few frames taken at the beginning, middle and end of the night. These positions were used as starting points for the Gaussian centering option which precisely centered the 6 arc second aperture on each star for each frame.

From the Hubble Space Telescope Guide Star Catalog (Jenkner et al., 1990) the coordinates of the comparison star are RA=$21^h31^m07^s$ Dec=23°18'01" V=10.7 and check star are RA=$21^h30^m55^s$ Dec=23°22'31" V=11.5. The mean and standard deviation of all the nightly mean differential V magnitudes are -1.008 ± 0.007 ensuring the constancy of both comparison and check stars at this level. The precision of the differential variable star minus comparison star measurements are expected to be at this level. Due to the small field of view first order extinction effects were negligible and no corrections have been made for them. No corrections have been made for the colour difference between the stars to transform it to a standard system.

Photometric observations were begun 11 July 1995 UT and continued on five more nights in the next week. A "Phase Dispersion Minimization" routine modelled after that of Jurkevich (1971) reveals a minimum average sigma at a period of 0.4232 ± 0.0075 days as seen in Figure 1. A least squares fit of a single sine wave to the data also shows the deepest minimum at a period of 0.4233. Times of maximum light have been found from the method of Kwee and Van Woerden (1956) to be 2449914.8908 and 2449917.8546; and a time of minimum light to be 2449913.8295 with a formal error of about ± 0.0008 and an uncertainty due to asymmetry in the extrema of about ± 0.008. So the best ephemeris from our data is:

$$\text{HJD of Maxima} = 2449909.8059(33) + 0.4236(4) \times E$$

where the uncertainties in the final digit are given in brackets. This is in agreement with the 10.17 hour period found by Jeffries et al. (1994).

[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.

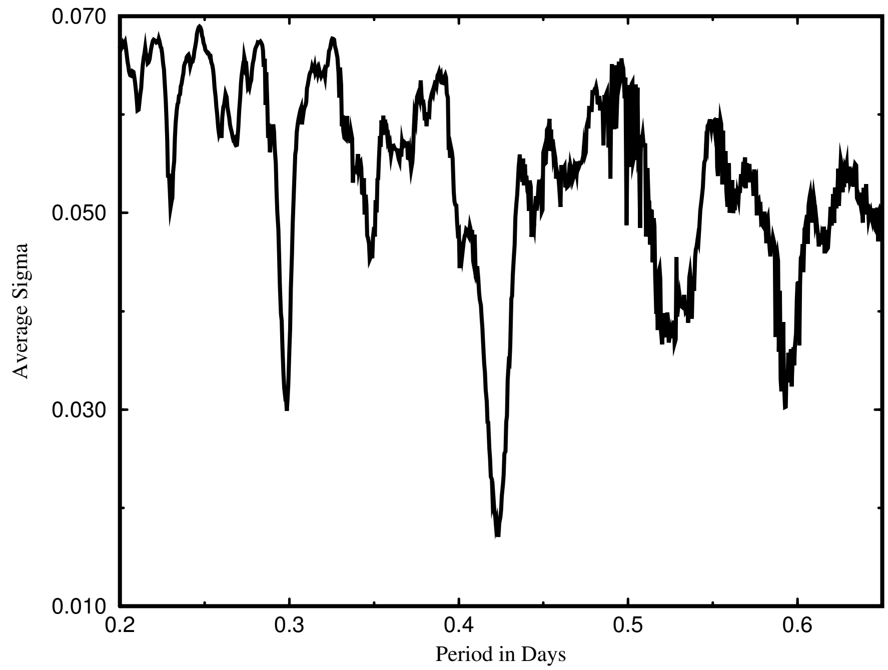

Figure 1. Average of standard deviations for various periods for RE J2131+233 for 1995

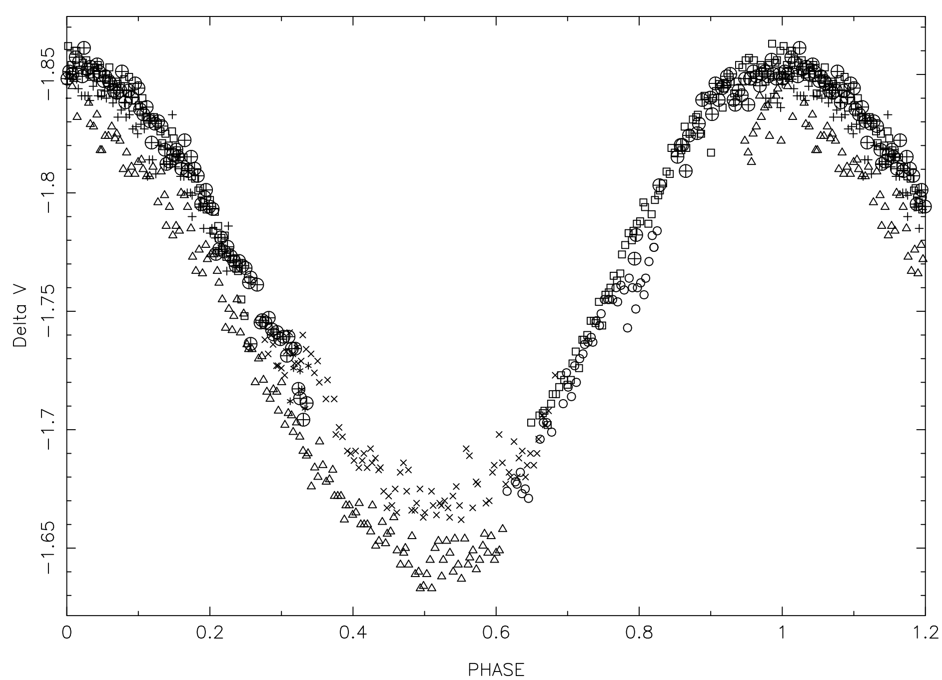

Figure 2. Light curve of 1995 V band data

A plot of the 633 differential V magnitudes for the 1995 data phased at this period is shown in Figure 2. The light curve is almost the same shape as that of Jeffries (1994), but the amplitude has increased from 0.15 to 0.20. Close inspection shows that the maxima repeat but one minimum lies 0.03 magnitudes fainter than the other observed two days later. This implies that the spots are changing in size and/or shape on a daily timescale.

Our large data sets completely eliminate the possibility of the 9.22 hour alternative period found by Jeffries et al. (1994) and confirms their 10.17 hour period. RE J2131+233 is a variable star with active regions on its surface causing brightness variations with a rotation period of 0.4236 days.

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

Number 4222

Konkoly Observatory
Budapest
4 August 1995

HU ISSN 0374 – 0676

PHOTOELECTRIC MAXIMA/MINIMA OF SELECTED VARIABLES

(BAV–Mitteilungen No. 80)

In this 28th compilation of BAV results, photoelectric observations obtained in the years 1994 and 1995 are presented on 63 variable stars giving 137 minima and maxima.

All times of minima and maxima are heliocentric. The error margins are tabulated in column '+/−'. The values in column 'O–C 1 GCVS' are determined by using the elements of the GCVS without incorporation of nonlinear terms. For the values in column 'O−C 2' 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 and the public observatory of Nürnberg. 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..	+/−	Ph	Obs	O−C 1 GCVS		O−C 2		Rem
AB	And	49587.375 :	.000	LV	AG	−0.012	85			3)
		49587.376 :	.001	LB	AG	−0.012	85			3)
BD	And	49554.4764		L	MS	+0.0072	85			2)
		49567.4378		L	MS	+0.0073	85			2)
		49578.5492		L	MS	+0.0091	85			2)
		49585.4923		L	MS	+0.0086	85			2)
BL	And	49567.5358		L	MS	−0.0010	85			2)
CN	And	49637.3010	.0005	LV	AG	−0.0494	85			3)
LO	And	49690.3217	.0004	LB	AG	−0.0437	85			3)
		49690.3240	.0013	LV	AG	−0.0414	85			3)
V417	Aql	49546.4975	.0005	LV	AG	−0.0889	85			3)
		49546.4983	.0005	LB	AG	−0.0881	85			3)
		49568.5313 /	.0004	LV	AG	−0.0778	85			3)
		49568.5314 /	.0002	LB	AG	−0.0777	85			3)
V761	Aql	49534.4824		L	MS	+0.0797	85			2)
V1353	Aql	48803.363 :/	.004	LB	AG	−0.680	85			3)
		48803.364 :/	.004	LV	AG	−0.679	85			3)
		49158.477 :	.004	LB	AG	+0.027	85			3)
		49158.482 :	.004	LV	AG	+0.032	85			3)
		49569.4812 /	.0039	LV	AG	+0.0328	85			3)
		49569.4818 /	.0009	LB	AG	+0.0334	85			3)
GX	Aur	49640.4599 /		L	MS	−0.0289	85	−0.0109	14)	2)
TZ	Boo	49511.4509	.0003	LB	AG	+0.0527	85	−0.0078	13)	3)
		49511.4511	.0004	LV	AG	+0.0529	85	−0.0076	13)	3)
		49537.4510 /	.0008	LV	AG	+0.0512	85	−0.0089	13)	3)
		49537.4530 /	.0005	LB	AG	+0.0532	85	−0.0069	13)	3)

Table 1 (cont.)

Variable		Min JD 24..	+/−	Ph	Obs	O−C 1 GCVS	O−C 2	Rem
WW	Cam	49624.5462	.0004	LV	AG	−0.0153 85		3)
		49624.5465	.0003	LB	AG	−0.0150 85		3)
FR3	Cnc	49722.4146	.0004	LB	AG		−0.0213 12)	3) 8)
		49722.4146	.0005	LV	AG		−0.0213 12)	3) 8)
CW	Cas	49594.3758	.0009	LV	AG	−0.0046 85		3)
		49594.3764	.0008	LB	AG	−0.0040 85		3)
DN	Cas	49615.5480	.0010	LB	AG	−0.0228 85		3)
		49615.5516	.0017	LV	AG	−0.0192 85		3)
DZ	Cas	49637.4835	.0009	L	AG	−0.1342 85		2)
GG	Cas	49662.4298	.0010	LV	AG	+0.0298 85		3)
OX	Cas	49636.3288	.0009	LV	AG	+0.0125 85		3)
		49636.3305	.0013	LB	AG	+0.0142 85		3)
V445	Cas	49641.3107		L	MS	+0.0463 85	+0.0028 14)	2)
V541	Cas	49625.3577 /	.0009	LB	AG	+0.0271 85		3)
		49625.3578 /	.0010	LV	AG	+0.0272 85		3)
SU	Cep	49592.4330	.0007	LV	AG	+0.0028 85		3)
		49592.4331	.0008	LB	AG	+0.0029 85		3)
VZ	Cep	49567.4219	.0004	LB	AG	−0.0036 85		3)
		49567.4223	.0004	LV	AG	−0.0032 85		3)
WW	Cep	49692.3517 /	.0003	L	AG	+0.2683 85	+0.0024 15)	2)
WX	Cep	49619.4900	.0007	LV	AG	+0.0021 85		3)
		49619.4907	.0010	LB	AG	+0.0028 85		3)
EF	Cep	49636.4979	.0003	L	AG	−0.1399 85		2)
GW	Cep	49592.5447	.0006	LB	AG	−0.0192 85		3)
		49592.5457	.0003	LV	AG	−0.0182 85		3)
NS	Cep	49630.3867	.0001	L	AG	−0.3393 85		2)
OT	Cep	49641.5254	.0003	L	AG	+0.4406 85		2)
Y	Cyg	49574.4478	.0005	LV	AG	+0.1324 85		3)
		49574.4482	.0004	LB	AG	+0.1328 85		3)
CG	Cyg	49574.5322	.0005	LB	AG	+0.0317 85		3)
		49574.5343	.0004	LV	AG	+0.0338 85		3)
DK	Cyg	49637.4436	.0003	LB	AG	+0.0360 85		3)
		49637.4441	.0003	LV	AG	+0.0365 85		3)
GO	Cyg	49555.4585	.0003	LV	AG	+0.0523 85		3)
		49555.4589	.0003	LB	AG	+0.0527 85		3)
		49556.5353 /	.0014	LV	AG	+0.0525 85		3)
		49556.5366 /	.0004	LB	AG	+0.0538 85		3)
V382	Cyg	49534.4774	.0008	LB	AG	+0.0253 85		3)
		49534.4785	.0004	LV	AG	+0.0264 85		3)
V488	Cyg	49570.4531 /	.0004	L	AG	+0.1143 85		2)
		49641.358 :	.005	L	AG	+0.114 85		2)
V500	Cyg	49503.5052		L	MS	+0.0460 85		2)
		49515.5204		L	MS	+0.0464 85		2)
		49527.5367		L	MS	+0.0479 85		2)
V505	Cyg	49637.3426	.0005	L	AG	+0.1532 85		2)
		49640.3484 /	.0002	L	AG	+0.1545 85		2)
V680	Cyg	49565.469 :	.000	LV	AG	+0.050 85		3)
		49565.471 :	.000	LB	AG	+0.052 85		3)
V700	Cyg	49518.4529	.0001	L	AG	−0.0137 85		2)
		49527.4652 /	.0006	L	AG	−0.0126 85		2)
		49535.4558		L	MS	−0.0131 85		2)
		49535.4563	.0013	L	AG	−0.0126 85		2)
		49639.3560 /		L	MS	+0.0030 85		2)

Table 1 (cont.)

Variable		Min JD 24..	+/−	Ph	Obs	O−C 1 GCVS		O−C 2		Rem
V859	Cyg	49537.4618	.0004	L	AG	−0.0509	85			2)
		49580.3946	.0002	L	AG	−0.0482	85			2)
V877	Cyg	49637.3222		L	MS	+0.0225	85			2)
V889	Cyg	49547.4506 /	.0014	LB	AG	−0.1335	85			3)
		49547.4530 /	.0015	LV	AG	−0.1311	85			3)
		49624.364 /	.003	LV	AG	−0.129	85			3)
		49624.368 /	.003	LB	AG	−0.125	85			3)
V1061	Cyg	49535.4799	.0006	LB	AG	−0.0211	85			3)
		49535.4802	.0009	LV	AG	−0.0208	85			3)
V1083	Cyg	49605.4040	.0012	LB	AG	−0.0466	85			3)
V1191	Cyg	49587.3879	.0004	L	AG	+0.0013	85			2)
		49599.4536 /	.0006	L	AG	+0.0020	85			2)
		49608.384 :	.003	L	AG	+0.001	85			2)
		49619.3527	.0003	L	AG	+0.0016	85			2)
		49619.5106 /	.0003	L	AG	+0.0028	85			2)
		49621.3904 /	.0002	L	AG	+0.0024	85			2)
RX	Dra	49639.427 /	.003	LV	AG	+0.043	85			3)
		49639.431 /	.002	LB	AG	+0.047	85			3)
EF	Dra	49465.549 :	.001	LB	AG			+0.003	11)	3)
		49465.550 :	.001	LV	AG			+0.004	11)	3)
		49580.4595	.0004	LB	AG			+0.0027	11)	3)
		49580.4606	.0006	LV	AG			+0.0038	11)	3)
MS	Her	49534.4903	.0003	L	AG	+0.0136	85			2)
		49567.4770 /	.0003	L	AG	+0.0135	85			2)
PW	Her	48830.650	.004	LB	AG	+0.310	85	+0.006	13)	3)red
		48830.654	.004	LV	AG	+0.314	85	+0.010	13)	3)red
		48882.507	.004	LB	AG	+0.310	85	−0.001	13)	3)red
		48882.510	.004	LV	AG	+0.313	85	+0.002	13)	3)red
		48908.448	.004	LB	AG	+0.322	85	+0.007	13)	3)red
		48908.449	.004	LV	AG	+0.323	85	+0.009	13)	3)red
		48934.378	.004	LB	AG	+0.323	85	+0.005	13)	3)red
		48934.380	.004	LV	AG	+0.325	85	+0.007	13)	3)red
		49127.431	.004	LB	AG	+0.350	85	+0.007	13)	3)red
		49127.433	.004	LV	AG	+0.352	85	+0.009	13)	3)red
V728	Her	49600.358 :	.002	LV	AG	−0.001	85	+0.004	9)	3)
		49600.362 :	.001	LB	AG	+0.002	85	+0.008	9)	3)
V829	Her	49545.419 :	.000	LB	AG					3)
		49545.420 :	.001	LV	AG					3)
VY	Lac	49600.5201 /	.0004	LB	AG	−0.1325	85			3)
		49600.5201 /	.0006	LV	AG	−0.1325	85			3)
TY	Lyn	48986.4931		LV	5)	+0.0649	85			1)
QU	Lyr	49565.498 :/	.003	L	AG	−0.002	85			2)
V839	Oph	49556.4335 /	.0005	LV	AG	−0.1007	85			3)
		49556.4340 /	.0003	LB	AG	−0.1002	85			3)
BP	Per	49630.5521	.0002	L	AG	−0.0092	87			2)
V432	Per	49636.5100	.0008	LV	AG	−0.0797	87	+0.0005	10)	3)
		49636.5108	.0004	LB	AG	−0.0789	87	+0.0013	10)	3)
V482	Per	49625.5029	.0025	LB	AG			+0.0058	13)	3)
		49625.5034	.0026	LV	AG			+0.0063	13)	3)
V511	Per	49640.4323	.0014	LB	AG					3)
		49640.4360	.0010	LV	AG					3)

Table 2. RR Lyrae/Delta Scuti Stars

Variable		Max JD 24..	+/-	Ph	Obs		O−C 1 GCVS		O−C 2		Rem
SW	And	48558.4105		LV	6)		−0.1114	85	−0.0150	S92	1)
RS	Boo	49479.5177		L	PS		−0.0072	85			4)
TT	Cnc	49643.6538		L	MS		+0.0688	85			2)
S	Com	47651.4388		LV	WU	WC	−0.0561	85	+0.0065	S89	1) 7)
XZ	Cyg	49549.5318		L	PS		+0.1710	85			4)
AR	Per	49625.509	.001	LB	AG		+0.037	87			3)
		49625.510	.001	LV	AG		+0.038	87			3)

Remarks :

AG	F. Agerer	Zweikirchen
GZI	M. Garzarolli	Höchstadt
HFK	M. Hofmann	Nürnberg
HFT	M. Hofmann	Nürnberg
MS	W. Moschner	Lennestadt
PS	A. Paschke	Rüti <CH>
SCG	S. Schurig	Nürnberg
WC	M. Wieck	Nürnberg
WU	E. Wunder	Rückersdorf

:	=uncertain	
/	=secondary minimum	
L	=photoelectric observation	filter: without
LB	=as above	filter: B
LV	=as above	filter: V
red	=reduced results	
Sxx	=Rocznik Astronomiczny, Krakow (SAC) xx = year of publishing	
1)	=photometer: 1P21 - filter: V = GG11 / B = BG3+GG13	
2)	=photometer: CCD 375 ⋆ 242 - uncoated - filter: without	
3)	=photometer: EMI 9781A - filter: V=GG495, 1mm / B=BG12, 1mm+GG385, 2mm	
4)	=photometer: Cryocam 89A - filter: without	
5)	=team: GZI, HFK, SCG, WU	Nürnberg observatory
6)	=team: GZI, HFK, HFT	Nürnberg observatory
7)	=team: Nürnberg observatory	
8)	=FR3 Cancri = GSC 1383.600, c.f. IBVS No. 3859	
9)	=BAV Mitteilungen No. 51 = IBVS No. 3234	
10)	=BAV Mitteilungen No. 61 = IBVS No. 3797	
11)	=BAV Mitteilungen No. 63 = IBVS No. 3811	
12)	=BAV Mitteilungen No. 65 = IBVS No. 3859	
13)	=BAV Mitteilungen No. 68	
14)	=BAV Mitteilungen No. 69	
15)	=BAV Mitteilungen No. 71 = IBVS No. 4131	

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

Number 4223

Konkoly Observatory
Budapest
10 August 1995

HU ISSN 0374 – 0676

NEW VARIABLE IN OPHIUCHUS

During the analysis of results from photometric monitoring of members of the open cluster IC 4665, a new variable star has been found near the center of the cluster. The variable's position is approximately; RA = $17^h43^m42^s.7$, DEC = +5°42' 04" (1950). The variable's mean magnitude is approximately V $\simeq$ 14.9. The accompanying finding chart (north at top, east at left) in Figure 1 is approximately 4 arcminutes on a side and identifies the variable and the nearby solar-type cluster member P100 (Prosser 1993). The bright member K64, normally defined as the center of the cluster, is also indicated. A check of the GCVS and NSV catalogs did not reveal a previously known variable at the above position.

V-band CCD photometry of the region was obtained during May 1995 with the 0.9m telescope at CTIO. 36 observations over a 14 night period (JD: 2449845-2449859) provided relative photometry between the new variable and several stars of comparable brightness. Periodogram analysis was performed on the relative photometry using a program which incorporates the method outlined by Horne & Baliunas (1986) and Scargle (1982) for unevenly sampled data. A period of approximately 12.7 days was found, with an amplitude ΔV$\simeq$0.2 mag and a maximum occuring near JD = 2449856.5.

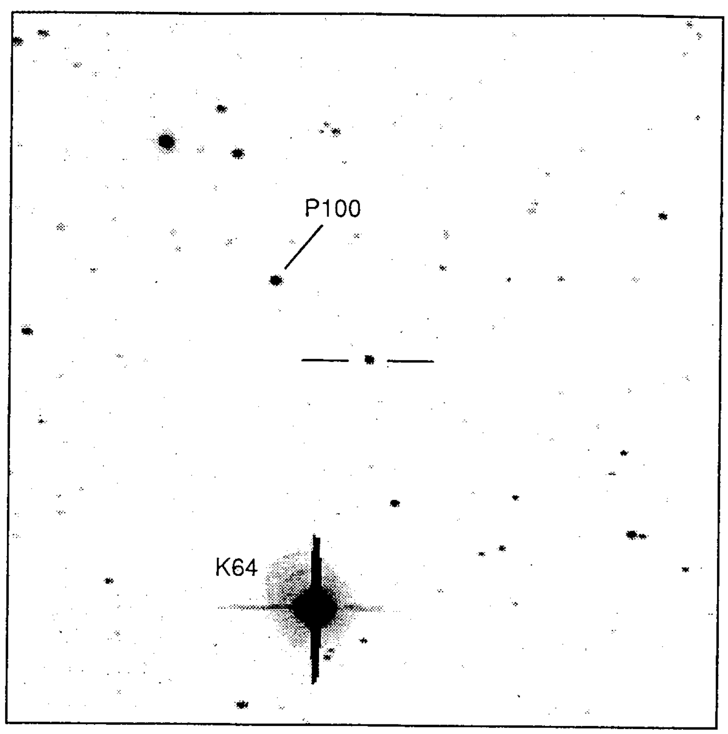

Figure 1

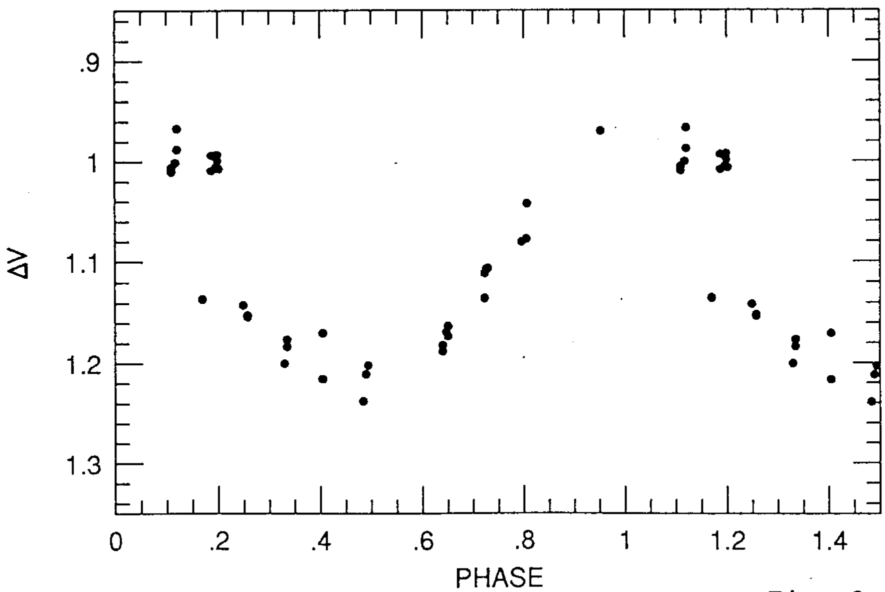

Figure 2

Figure 2 illustrates the resulting light curve for the new variable relative to an anonymous comparison star found to be constant. Further monitoring over longer time intervals should be able to refine this period estimate. It should be noted that the nearby cluster member P100 has been observed to undergo brightness variations due to rotational modulation by starspots with a period of 2.27 days and amplitude of 0.1 mag (Allain et al. 1995), making it unsuitable for use as a comparison star to the new variable. Although centrally located in the IC 4665 cluster, the variable is not a cluster member. The period is indicative of a Pop I or Pop II Cepheid at a large distance beyond the cluster; further observations are needed to conclusively determine the class, though the faint apparent magnitude together with the relatively high galactic latitude (+17°) at which it is observed would appear to suggest that it is Pop II Cepheid or W Vir type variable.

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

Number 4224

Konkoly Observatory
Budapest
10 August 1995

HU ISSN 0374 – 0676

1995 PHOTOMETRY OF RT ANDROMEDAE

RT Andromedae (=BD +52°3383A=#201 in the catalog of Strassmeier et al. 1993) is a member of the short period eclipsing group of RS CVn stars. Budding and Zeilik (1987) first modeled the spots on this star. Zeilik et al. (1989) modeled the spot structure for available data from 1920 to 1989. This work builds on previous work by modeling the spot structure during 1995.

I observed RT And on the nights of 18 January and 2, 3, 4, 6, 7, and 20 February 1995 using the San Diego State University 61-cm telescope on Mt. Laguna. The telescope is equipped with a photometer using a Hamamatsu R943-02 tube operated at −1450V and cooled to −15°C. The BVRI filters are chosen to closely match the Johnson–Cousins system. The comparison star was BD +52°3384 (=SAO 35208). In January 1994, I calibrated the magnitudes of this comparison star using Landolt standards. I got: U=10.96, B=10.25, V=10.12, R=10.05, and I=9.99. Because February is rather late in the observing season for RT And I was only able to observe it for a short time each night. The light curves therefore contain significant gaps at the beginning of the secondary eclipse and at third quadrature. The data however are sufficient to model the spots. The data, plotted in Figures 1 and 2, are differential magnitudes (star–comparison) in the standard Johnson–Cousins system.

To model the data, I used the Information Limit Optimization Technique (ILOT) described in detail by Budding and Zeilik (1987). To perform the initial fits, I started with the orbital parameters found by Zeilik et al. (1989), including ellipticity effects. Unlike most of the short period RS CVns, RT And has an elliptical orbit. From the initial binary star fits, I extract a distortion wave and then fit the distortion wave for the longitude and radius of circular spots at 0K. The ILOT allows fitting for the spot latitude, but in this case I was unable to fit for the latitude simultaneously with the other parameters. I therefore used a fixed latitude of 45°, the value to which the latitude seemed to converge in preliminary trial fits. The fits for each wavelength are performed independently. I get:

	B band	V band	R band	I band
Longitude	110.9±5.1	112.7±5.2	117.9±5.6	125.2±4.86
Latitude	45	45	45	45
Radius	11.5±0.7	12.0±0.7	11.3±0.8	12.0±0.7
χ^2	110.6	82.3	70.2	135.1

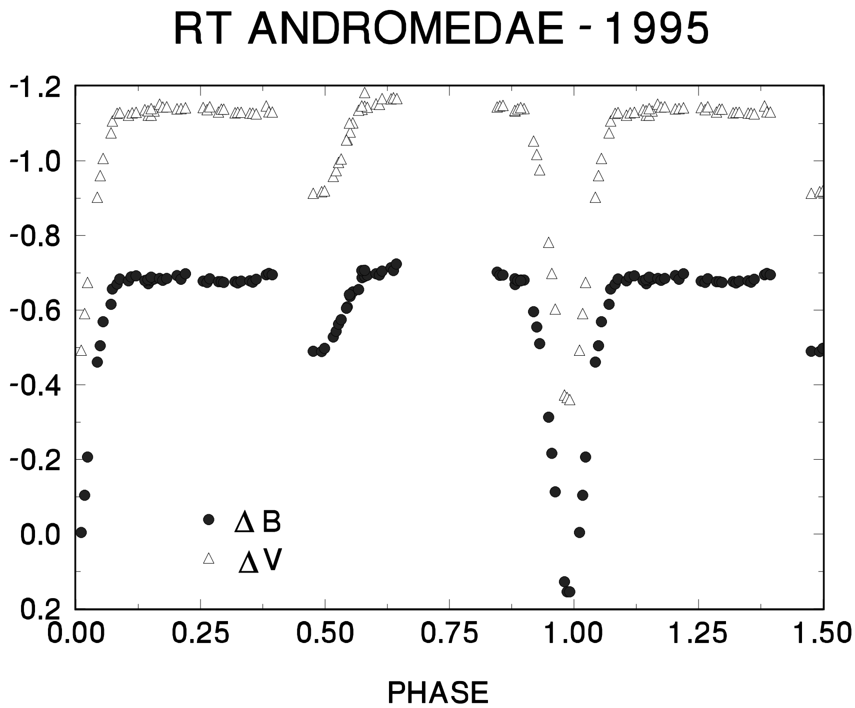

Figure 1

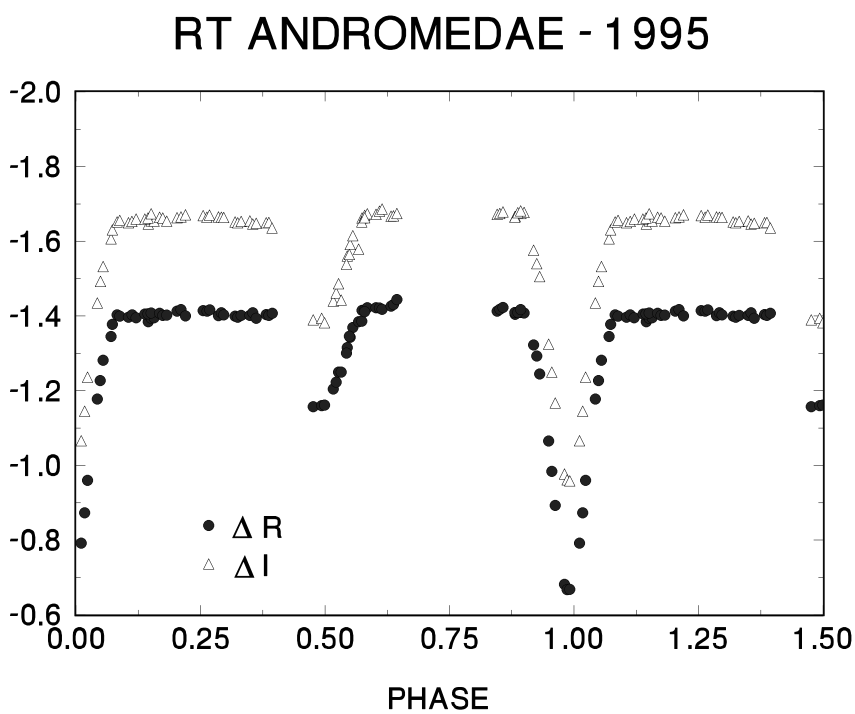

Figure 2

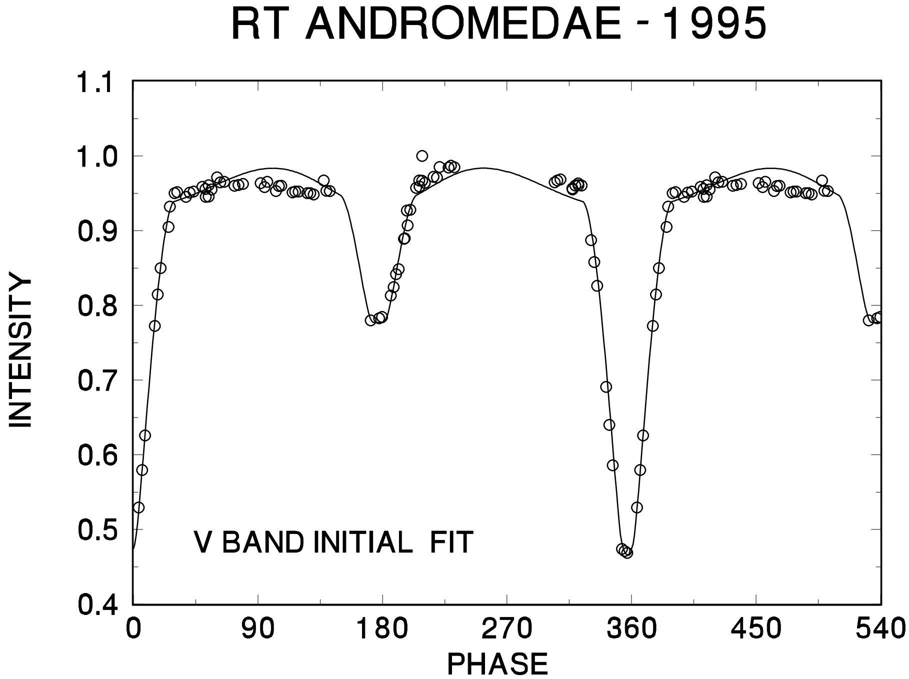

Figure 3

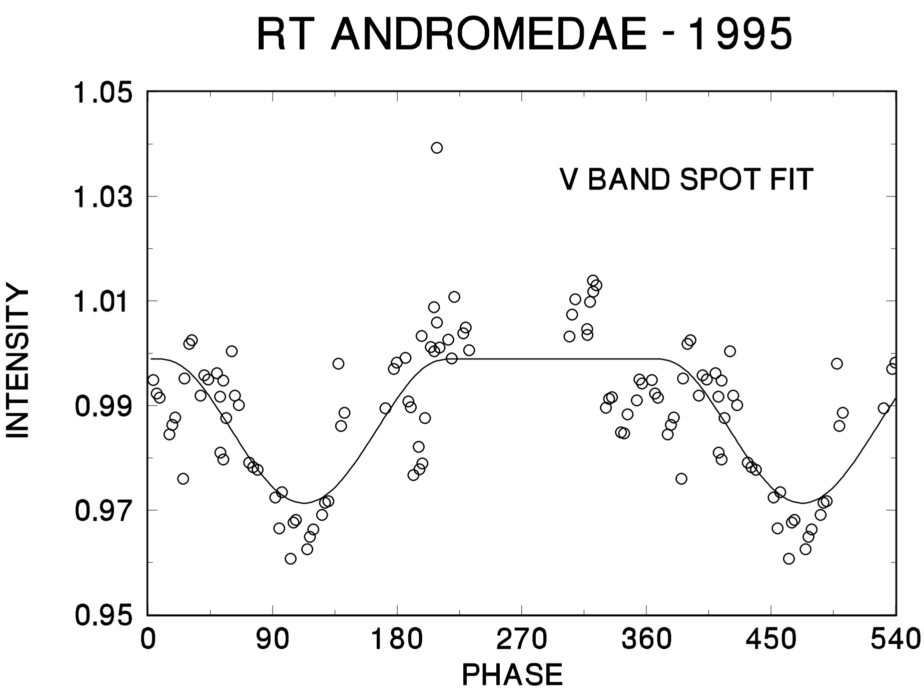

Figure 4

Figures 3 and 4 show the initial and spot fits in the V band. I made no attempt to do clean fits to remove the spot effects and find the binary star parameters because the incompleteness of the light curves would reduce the confidence in these solutions. Because there is a gap in the light curves at roughly longitude 270° it is not possible to completely rule out the possibility of a spot at this longitude. To investigate this possibility I tried to fit both a single spot and a second spot at this longitude. In neither case was I able to fit a spot, so the available data indicates that RT And has a single spot in the 90° Active Longitude Belt. This result is similar to the previous long term trends found by Zeilik et al. (1989) for a single spot in one of two Active Longitude Belts.

I thank Ron Angione for scheduling very generous amounts of observing time at Mt. Laguna. I received support from the American Astronomical Society Small Grants Program for this work. I also acknowledge both financial support and a Faculty Scholarly Development Assignment Program Leave from Western Carolina University.

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

Number 4225

Konkoly Observatory
Budapest
10 August 1995

HU ISSN 0374 – 0676

1994 PHOTOMETRY OF BH VIRGINIS

BH Virginis (#117 in the catalog of Strassmeier et al., 1993) is a member of the short period eclipsing RS CVn class of stars. Budding and Zeilik (1987) first modeled the spots on this star. Zeilik et al. (1990) modeled the spot structure for available data from 1953 to 1986. Heckert and Summers (1994) modeled 1993 light curves. In this work, we continue to observe BH Vir.

We observed BH Vir on the nights of 13, 14, 15, 16, 17, 20, and 21 May 1994 using the San Diego State University 61-cm telescope on Mt. Laguna. We used the same instrument and comparison star as for the 1993 data (Heckert and Summers 1994). Our data, plotted in Figures 1 and 2, are differential magnitudes (star–comparison) in the standard Johnson Cousins system.

To model the data, we used the Information Limit Optimization Technique (ILOT) described in detail by Budding and Zeilik (1987). From the initial binary star fits we extract a distortion wave. We then fit the distortion wave for the longitude and radius of two circular spots at 0K. Being unable to fit the latitudes, the most difficult parameter to fit, we held them constant at 45° for both spots. After fitting the spots, we remove the spot effect to find a clean fit for the binary star parameters. The fits for each wavelength are performed independently. We get:

Spot fits

	B band	V band	R band	I band
$Longitude_1$	45.2±5.3	53.3±6.8	50.5±15.2	42.6±15.3
$Latitude_1$	45	45	45	45
$Radius_1$	13.8±0.5	12.3±0.7	10.5±1.6	10.8±1.5
$Longitude_2$	133.1±4.3	142.7±6.4	138.5±11.6	145.0±10.4
$Latitude_2$	45	45	45	45
$Radius_2$	15.8±0.5	13.4±0.8	13.1±1.5	14.0±1.4
χ^2	156.3	98.4	21.2	16.9

Clean fits

	B band	V band	R band	I band
L_1	0.654±0.017	0.628±0.022	0.620±0.028	0.608±0.033
$k(=r_2/r_1)$	0.918+0.033	0.936±0.042	0.917±0.053	0.924±0.062
r_1	0.245±0.004	0.245±0.005	0.249±0.007	0.248+0.008
i(deg)	86.8±0.4	86.8±0.4	87.3±0.6	87.1±0.6
L_2	0.329±0.018	0.356±0.023	0.363±0.029	0.378±0.034
χ^2	144.8	85.4	73.2	57.8

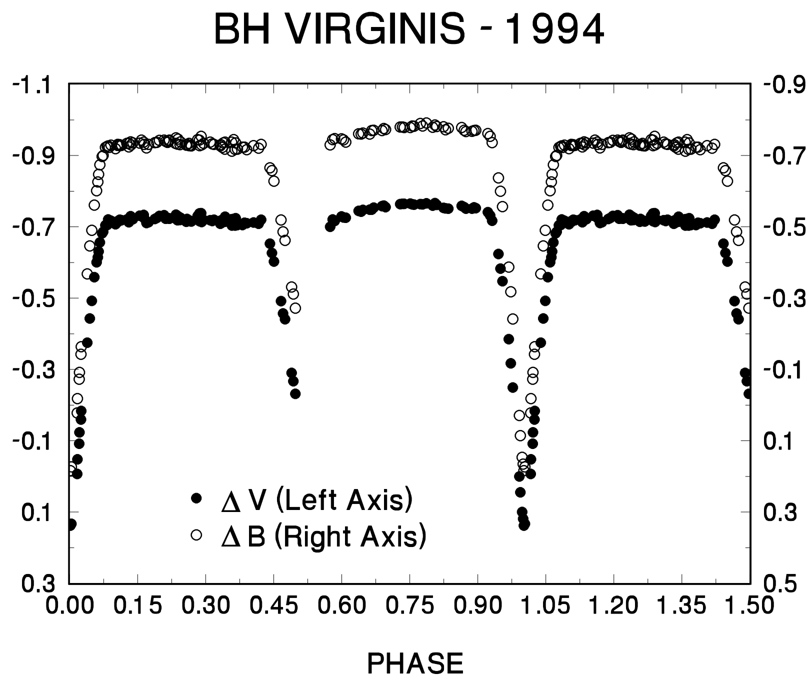

Figure 1

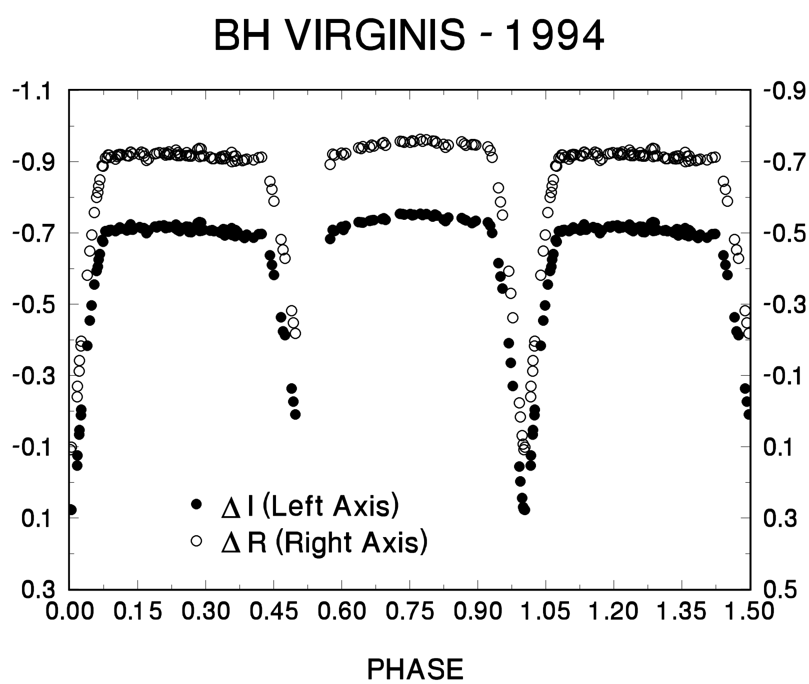

Figure 2

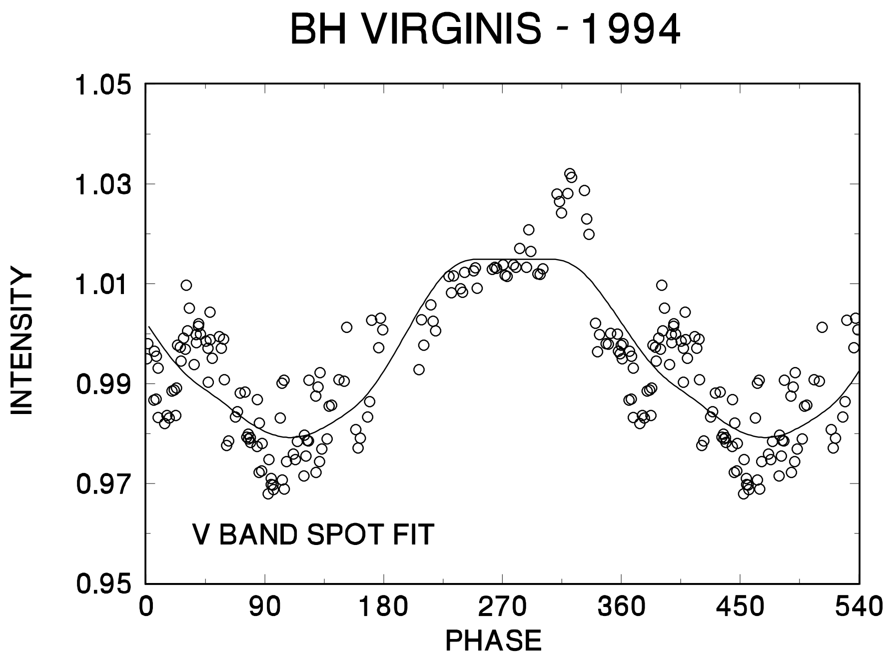

Figure 3

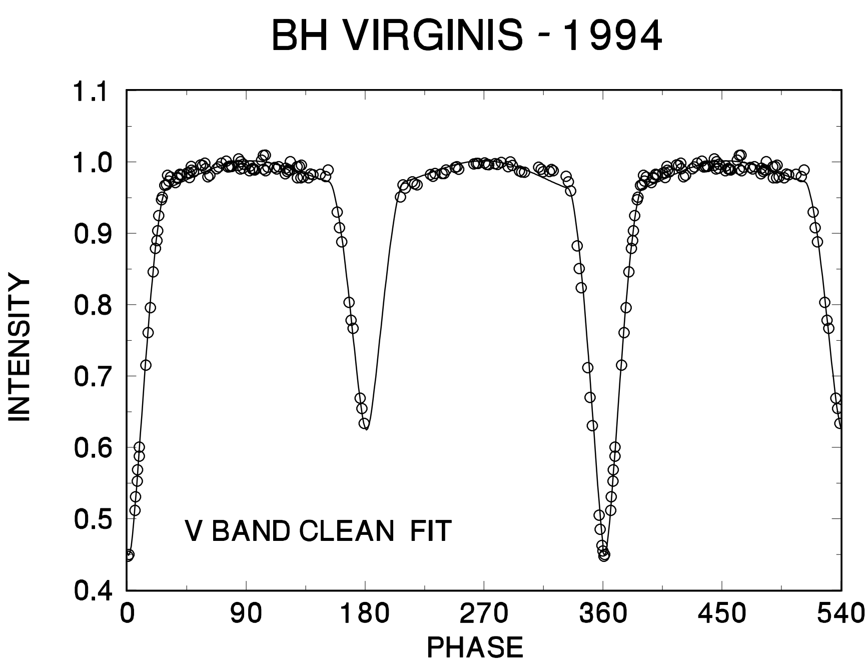

Figure 4

The clean fit parameters are as defined by Budding and Zeilik (1987). L_1 and L_2 are the fractional luminosities of the primary and secondary stars, and i is the orbital inclination. The primary and secondary radii, r_1 and r_2, are in units of the semi-major axis of the orbit. Figures 3 and 4 show our spot fit and final clean fit for the V band. Note that the models in the different bands agree well. Zeilik et al. (1990) find that the spots for BH Vir tend to cluster in Active Longitude Belts at 90°and 270°. Our models show the same phenomenon. During 1993 the spot was in the 270°ALB, but during 1994 the spots were both in the 90°ALB. Two spots in the same ALB is rather unusual for these short period RS CVns, however two spots fit the data much better than a single larger spot. The results of our clean fits agree well with those of Zeilik et al. (1990).

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

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

Number 4226

Konkoly Observatory
Budapest
10 August 1995

HU ISSN 0374 – 0676

PRECISION B,V,R,I LIGHT CURVES AND NEW DETERMINATION FOR V440 CASSIOPEIAE

V440 Cassiopeiae was discovered by Hoffmeister (1967), and classified as an Algol variable. His paper includes accurate positions, a finder chart, three times of minimum light, and maximum and minimum magnitudes. Busch and Häussler (1990) observed V440 Cas, reclassifying it as a W UMa type. They listed maximum and minimum magnitudes and calculated the ephemeris

$$\text{Min. I} = \text{J.D.}\,2447391.555 + 0^{\rm d}\!.280692 \times \text{E} \quad (1)$$

However, their light curve is either extremely noisy or improperly phased. Aside from these two papers, V440 Cas has apparently been ignored.

Our present observations were made on 27, 28, and 29 September 1994 at Kitt Peak National Observatory, Arizona, with the CCD photometer system (CCDPHOT) in conjunction with the 0.9 m Cassegrain reflector telescope. Approximate coordinates of the variable, comparison and the check star are given in Table 1 and are designated as star V, C, and K, respectively, on our CCD image (Figure 1). About 250 observations were taken in each passband, B, V, R, I.

Five mean epochs of minimum light were determined from observations made during three secondary and two primary eclipses. The bisection of chords technique was used in their determination. Our minima are given in Table 2 along with those by Hoffmeister (1967) and the epoch by Busch and Häussler (1990). Timings are accompanied by their probable errors in parentheses. These were introduced into a weighted least squares solution to obtain the following linear ephemeris:

$$\text{JD Hel Min. I} = \text{J.D.}\,\underset{\pm 3}{2449624.797} + \underset{\pm 3}{0^{\rm d}\!.3256880} \times \text{E} \quad (2)$$

In this calculation, Hoffmeister's times were given a weight of 0.1, while our minima and the epoch by Busch and Häussler were assigned weights of 1.0. On 28 September, our observations covered a complete light curve affirming our new period. Thus, the 0.28 day period given by Busch and Häussler is in error, probably due to aliasing. The major source of uncertainty in the above empheris arises from the low precision of the previous timings. If timings reported by Hoffmeister are excluded from the analysis, the following improved ephemeris is obtained:

$$\text{JD Hel Min. I} = \text{J.D.}\,\underset{\pm 8}{2449624.79708} + \underset{\pm 3}{0^{\rm d}\!.32568791} \times \text{E} \quad (3)$$

The residuals calculated from equation 2 are listed in Table 2 as $(\text{O}-\text{C})_1$, while the residuals of equation 3 are listed as $(\text{O}-\text{C})_2$.

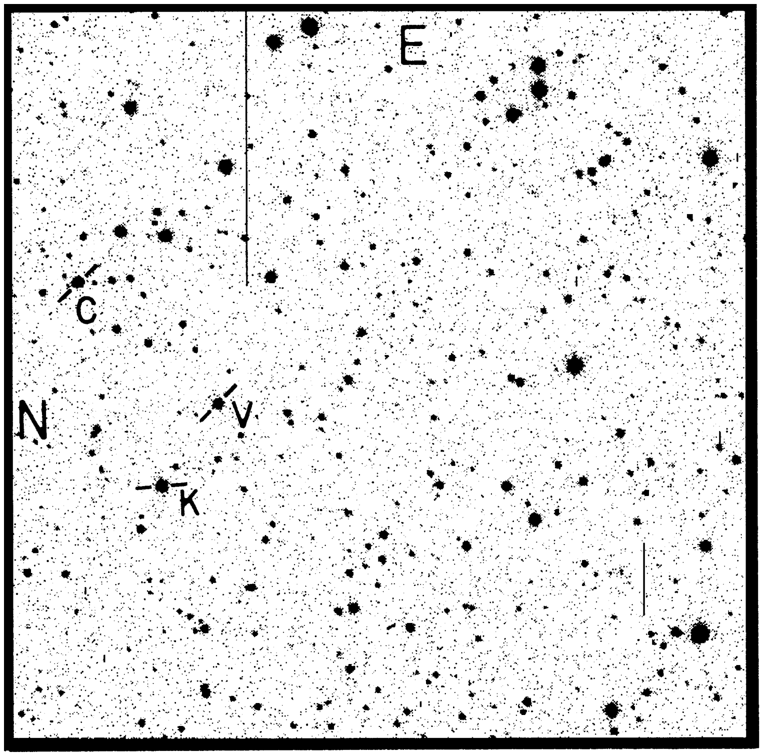

Figure 1. Finder Chart for V440 Cas. The stars marked "V", "C", and "K" are V440 Cas, the comparison star, and the check star, respectively.

Table 1

Star	R. A. (2000)	Dec. (2000)
V440 Cas	$23^h36^m40^s$	51°09' 29"
Comparison	$23^h36^m46^s$	51°10' 35"
Check	$23^h36^m36^s$	51°10' 38"

Table 2

JD Hel. 2400000+	Cycles	$(O-C)_1$	$(O-C)_2$	Source
29193.42	−62733.0	+0.0072	+0.0033	HO
30253.34	−59478.5	−0.0244	−0.0280	HO
30262.50	−59450.5	+0.0164	+0.0127	HO
47391.555	−6857.0	+0.0004	+0.0000	BH
49623.6574(8)	−3.5	+0.0001	+0.0002	PO
49623.8196(5)	−3.0	−0.0005	−0.0004	PO
49623.9828(5)	−2.5	−0.0001	−0.0001	PO
49624.6345(3)	−0.5	+0.0002	+0.0003	PO
49624.7971(1)	0.0	−0.0001	−0.0000	PO

PO=Present Observations, BH=Busch and Häussler (1990), HO=Hoffmeister (1967)

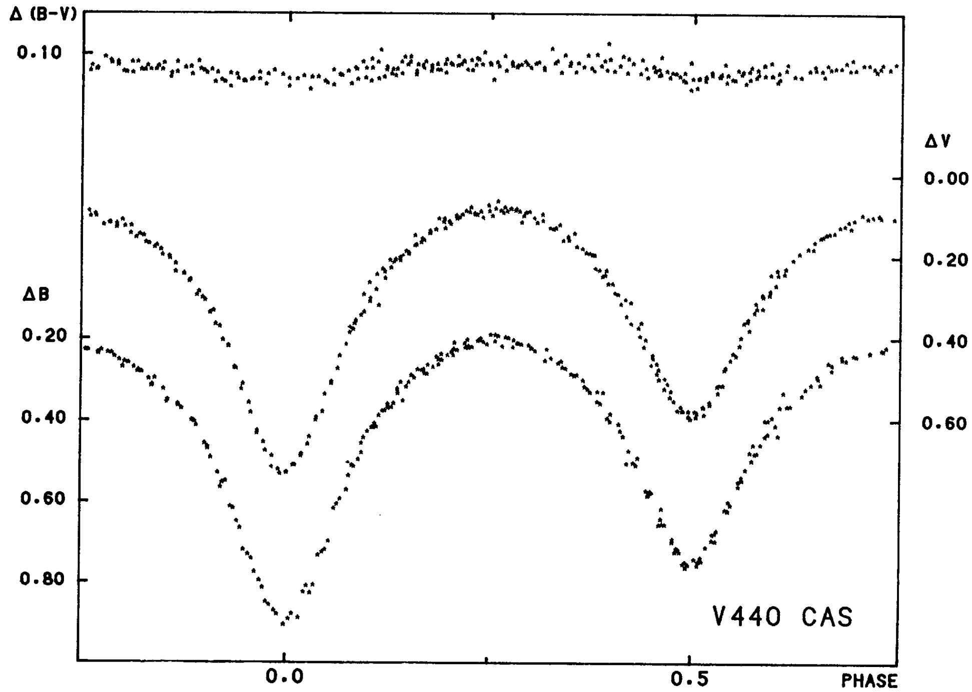

Figure 2. Photoelectric light curves in B and V of V440 Cas as defined by the individual observations.

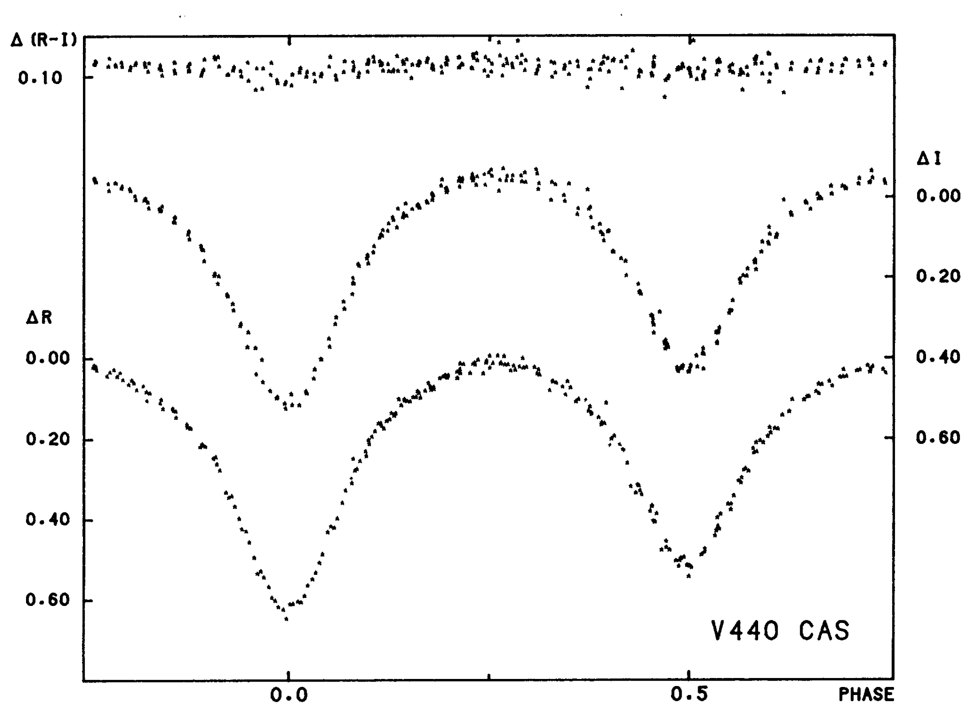

Figure 3. Photoelectric light curves in R and I of V440 Cas as defined by the individual observations.

More timings of minimum light are needed to determine the period behavior of this binary.

The B, V light curves of V440 Cas are shown in Figure 2, and the R, I light curves are shown in Figure 3. All light curves shown are as defined by individual observations and presented as differential magnitude (v−c) versus phase. Our light curves confirm Busch and Häussler's classification of V440 Cas as a W UMa variable. The analysis of the observations is underway.

Much of the present analysis was performed by JF as a part of her undergraduate summer research project, funded through the American Astronomical Society REU program.

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[1] This research was partially supported by funds from the National Science Foundation.
[2] Visiting Astronomer, Kitt Peak National observatory, National Optical Astronomical Observatories, which are operated by the Association of Universities for Research in Astronomy, Inc. under contract with the National Science Foundation.

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Busch, H., and Häussler, K., 1990, *VSS*, **10**, 4, 354

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

Number 4227

Konkoly Observatory
Budapest
14 August 1995

HU ISSN 0374 – 0676

DH AQUILAE – A NEW SU UMa-TYPE DWARF NOVA

After discovery as a variable star, DH Aql was confirmed to be a large-amplitude dwarf nova by Tsessevich (1969). He observed three outbursts from 268 Sternberg plates. These outbursts were all short-lived (lasting less than a few days), accompanied by a rapid decline up to 1.3 mag day^{-1}. He deduced from these observations the outburst cycle length of DH Aql as 268 days. The General Catalogue of Variable Stars (GCVS) adopted these outburst parameters and UGSS-type classification. Zhukov and Solovjev (1972) also reported a similar short outburst in 1972. A similar conclusion was obtained by more recent visual monitoring. Vanmunster and Howell (1995) list only three confirmed outbursts for the period 1991–1994. A photoelectric photometry (V=18.25) during quiescence (Bruch and Engel 1994) suggests a large outburst amplitude of $\sim$ 5.7 mag.

All the above facts – 1) a large outburst amplitude, 2) existence of short outbursts with a rapid decline, 3) low outburst frequency – seem to suggest SU UMa-type classification rather than SS Cyg-type suggested in GCVS, despite the fact that long outbursts suggesting superoutbursts seem to be missing at least from available literature.

Szentasko, Vanmunster and others distributed alert notices of a bright outburst of DH Aql via vsnet. The peak brightness (m_v=12.4) seemed to surpass most of the historical outbursts, so we started *V*-band CCD photometry in order to check whether this outburst is a superoutburst.

The observations were done on Sep. 23 and 25, 1994 using a CCD camera (Thomson, TH 7882CDA, 576 $\times$ 384 pixels with 23 μm square pixel size) attached to the Cassegrain focus of 0.6-m reflector (focal length=4.8m) at Ouda Station, Kyoto University (Ohtani et al., 1992). An interference filter was used which had been designed to reproduce the Johnson *V* band. The mode of 2 $\times$ 2 on-chip summation was employed. The exposure time was 60$-$90 sec and saving dead time of 13 sec throughout observations.

We reduced the data using the personal-computer-based aperture photometry package developed by one of the authors (T.K.). This package automatically subtracts bias-frames, applies flat fielding and enables us to estimate the instrumental magnitudes. The aperture size was 9$''$ in radius. The sky level was determined from pixels whose distance from the individual objects are between 24$''$ to 48$''$.

An identification chart of DH Aql based on our CCD image is drawn in Figure 1. Figure 2 shows the light curve of DH Aql on Sep. 25, 1994 with the differential magnitude of DH Aql and the star "C_1" in Figure 1. The detection of superhumps clearly seen in Figure 2 and the long duration (at least 14 days) of the present outburst (Mattei 1995) indicate that this outburst is doubtlessly a superoutburst. We analysed the Sep. 25 light curve, using phase dispersion minimization (PDM) method (Stellingwerf 1978) implemented in IRAF package (IRAF is distributed by National Optical Astronomy Observatories, U.S.A.) and obtained 0.0805 ($\pm$ 0.003) day as the best estimation of superhump period. The present observations first established DH Aql as an SU UMa-type dwarf nova.

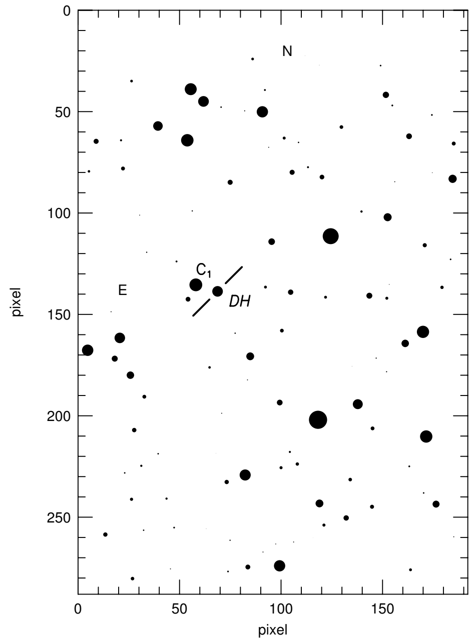

Figure. 1. Field map of DH Aql. The field of view is about 6×9 arcmin. The variable (DH) and comparison (C_1) are marked.

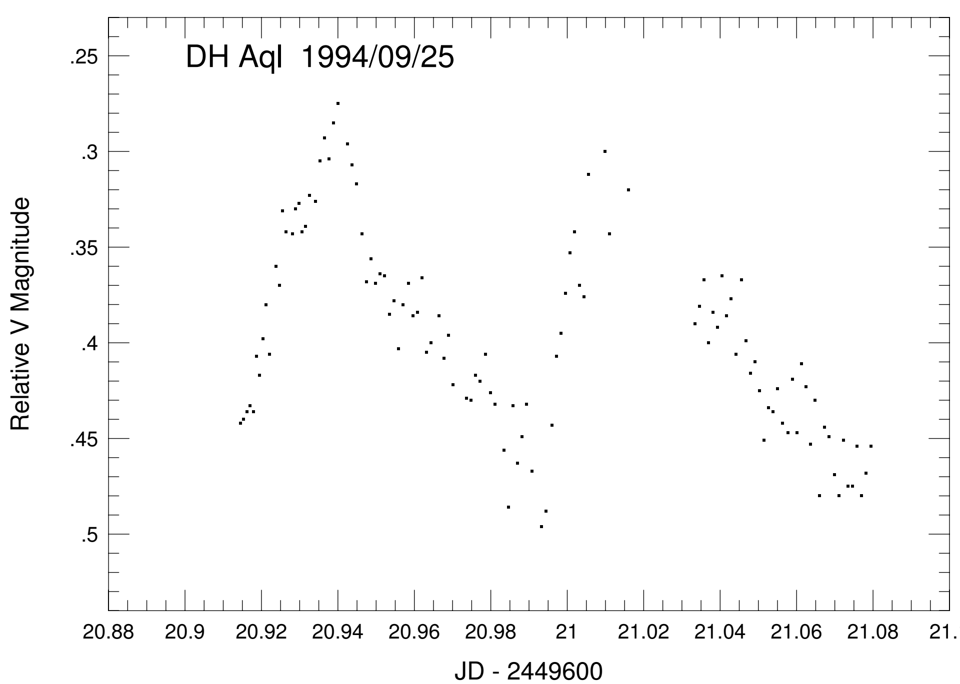

Figure. 2. Time-resolved photometry at Ouda on Sep. 25, 1994. Superhumps with a period of 0.0805 day are clearly seen.

The authors are grateful to VSNET members, especially L. Szentasko and T. Vanmunster for notifying us of the outburst, and F. Ringwald for searching the references using SIMBAD database. We are also grateful to P. Schmeer and AFOEV (Schweitzer) for supplying us with additional outburst records. Part of this work is supported by a Research Fellowship of the Japan Society for the Promotion of Science for Young Scientists (T.K).

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4228

Konkoly Observatory
Budapest
14 August 1995
HU ISSN 0374 – 0676

PECULIAR OUTBURST BEHAVIOR OF GO Com

GO Com was discovered by Kowal (1977) as an eruptive object on a Palomar plate taken on 1977 July 1.213. The variable was confirmed to coincide with a suspected variable star CSV 1959 = SVS 382 (Belyavskij, 1933). On the other hand, Usher (1981) independently discovered a very blue star of B=18.1 during the survey of the north galactic pole region. This star (US 31) was identified with GO Com. The extreme color (U−B = −1.5) suggests an extreme nature of this object. Vogt and Bateson (1982) classified this variable as a WZ Sge-type dwarf nova because of its large outburst amplitude and low outburst frequency.

The object has been visually monitored by VSOLJ members since 1986, and the short outburst observed on May 30, 1989 (m_v=13.2) has been the only record in recent years (Vanmunster and Howell 1995) until Vanmunster (1995) detected another outburst on July 16, 1995. Although only single positive visual observation has been available on this outburst, the outburst seems to have been confirmed by our CCD observation on July 25 which caught the object at V=16.6. A negative visual observation (fainter than 13.6) by M. Moriyama (private communication) 1.5 day after Vanmunster's detection seems to indicate that this outburst is also short-living just as one observed in May, 1989.

14 days after this outburst, GO Com was unpredictably caught in outburst on July 30.8, 1995 at m_v=13.3 (L. Szentasko, VSNET message). This outburst was subsequently confirmed by our CCD observation. We then started systematic time-resolved photometry to cover this outburst. The observations were carried out using a CCD camera (Thomson TH 7882, 576 × 384 pixels) attached to the Cassegrain focus of the 60 cm reflector (focal length=4.8 m) at Ouda Station, Kyoto University (Ohtani et al., 1992).

To reduce the readout noise and dead time, an on-chip summation of 2×2 pixels to one pixel was adopted. An interference filter was used which had been designed to reproduce the Johnson V band. The exposure time was between 60 and 180 s. The frames were first corrected for standard de-biasing and flat fielding, and were then processed by a microcomputer-based PSF and aperture photometry package developed by one of the authors (T.K.). The differential magnitudes of the variable were determined against a local standard star ($12^h56^m36\overset{s}{.}64$ $+26°31'42\overset{''}{.}9$ (J2000.0), V=12.8). The position and magnitude were taken from the Guide Star Catalog). The constancy of this comparison was checked against several stars in the same field.

The resultant general light curve is given in Figure 1, which clearly shows the long-living (lasting at least 7 days) nature of the present outburst. Existence of these two types (short and long) of outbursts suggests the SU UMa-type nature of GO Com, as was first suspected by the possible detection of 95 min periodicity in quiescent light curve (Howell et al., 1990). The rate of decline ($\sim$ 0.1 mag/day) also seems to support that this outburst may be a superoutburst, probably first documented one in GO Com.

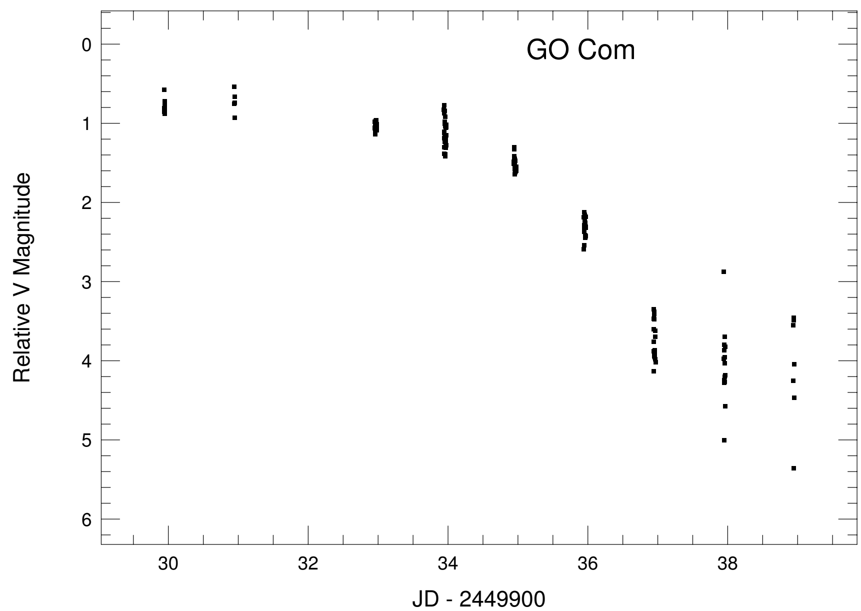

Figure 1. A general V-band light curve of GO Com constructed from all the CCD observations. The zero point corresponds to V=12.8. The outburst lasted at least 7 days showing a slow decline ($\sim$ 0.1 mag/day) followed by a rapid decline.

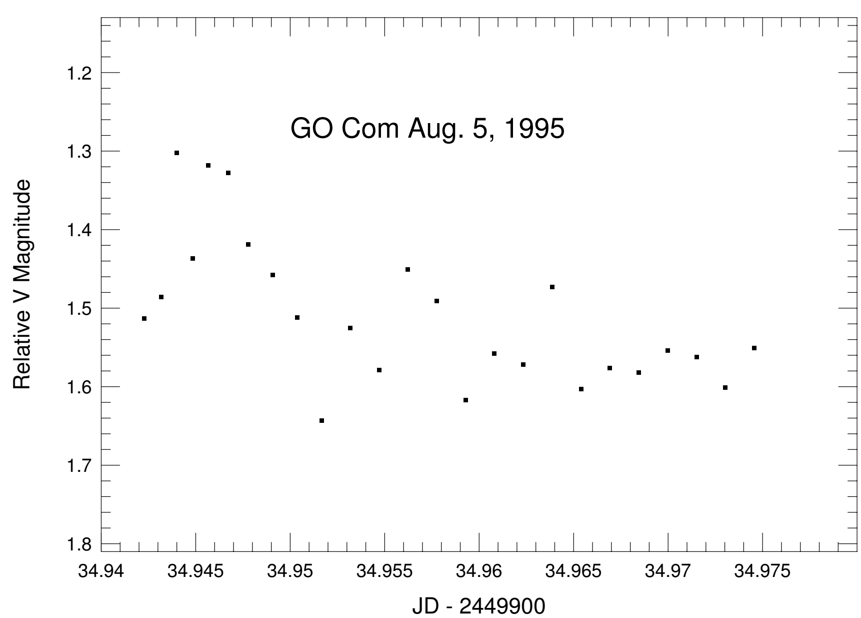

Figure 2. Time-resolved photometry of GO Com on Aug. 5. The light curve seems to indicate a hump feature with an amplitude of 0.2 mag at around Aug. 5.446 UT, which would be attributed to a superhump.

Due to unfavorable location in the sky, we can say little about existence of superhumps which are characteristics to SU UMa-type dwarf novae. The data on Aug. 5 (Figure 2) seems to indicate a hump feature with an amplitude of 0.2 mag at around Aug. 5.446 UT, which would be attributed to a superhump. The secure classification of this dwarf nova should await for further observations.

Although the classification of GO Com is still immature, we should point out the peculiar pattern of two consecutive outbursts. As stated earlier, the outbursts of GO Com have been very rare, likely one in few years. Hence the short interval (14 days) of these two outbursts is already a surprise. Although combinations of normal and super-outbursts are sometimes observed in SU UMa stars, they usually belong to either of the two patterns: (1) short outburst following a superoutburst, (2) short outburst just preceding a superoutburst. In the latter case, the interval of the short and superoutbursts are usually less than a few days. Such "precursor" type short outburst is currently understood as a trigger of a superoutburst in the scheme of thermal and tidal instabilities of the accretion disk to explain dwarf nova outbursts (Osaki 1989). Whether the current unique pattern of outbursts of GO Com can be explained in the same scheme would be an interesting problem. [Our latest observation indicates that GO Com is again in outburst on Aug. 13.44 at V=15 – 15.5. This post-outburst brightening can be fit by the pattern (1). It is again interesting that these two types of combinations of outbursts are consequently observed.]

The authors are grateful to T. Vanmunster, L. Szentasko and G. Poyner for their promptly circulating the news of this rare event through VSNET. Part of this work is supported by a Research Fellowship of the Japan Society for the Promotion of Science for Young Scientists (T.K).

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

Number 4229

Konkoly Observatory
Budapest
15 August 1995

HU ISSN 0374 – 0676

MULTICOLOR PHOTOELECTRIC PHOTOMETRY OF SN 1993J

We present $UBV(RI)_c$ photometry of supernova 1993J which erupted in the spiral galaxy M81 (NGC 3031) during late March 1993. The supernova was discovered on 28 March 1993 by Francisco Garcia during the star's initial rapid rise (Garcia *et al.*, 1993). This was the brightest supernova in the northern hemisphere in about 40 years and because of its brightness ($m_{v(max)} \simeq +10.3$) and high declination of +69°, SN 1993J has been extensively observed with ground based instruments and orbiting satellites over a wide range of wavelengths. Thus, SN 1993J has joined SN 1987A as one of the most extensively observed supernovae.

Table 1

HJD (2449000+)	U	B	V	R_c	I_c
79.6292	+11.02	+11.69	+11.42	+11.26	+10.87
80.6343	+11.42	+11.95	+11.63	+11.30	+10.99
81.6344	+11.67	+12.18	+11.82	+11.43	+11.14
82.6353	+11.79	+12.23	+11.84	+11.44	+11.17
84.6339	+11.77	+12.17	+11.69	+11.32	+11.09
86.6368	+11.71	+11.94	+11.50	+11.11	+10.96
88.6377	+11.54	+11.72	+11.28	+10.92	+10.80
93.6400	+11.33	+11.40	+10.89	+10.57	+10.53
94.6448	+11.36	+11.40	+10.86	+10.53	+10.50
96.6366	+11.48	+11.47	+10.86	+10.52	+10.46
97.6371	+11.60	+11.53	+10.89	+10.54	+10.48
101.6337	+12.41	+12.08	+11.19	+10.72	+10.56
102.6342	+12.64	+12.24	+11.28	+10.79	+10.64
103.6348	+12.76	+12.37	+11.37	+10.85	+10.67
105.6358	+13.08	+12.61	+11.54	+10.97	+10.77
106.6354	+13.33	+12.73	+11.61	+11.02	+10.80
107.6329	+13.45	+12.86	+11.68	+11.07	+10.86
109.6330	+13.47	+13.00	+11.82	+11.16	+10.93
110.6335	+13.81	+13.19	+11.91	+11.25	+10.95
111.6350	+13.61	+13.10	+11.91	+11.23	+10.97
112.6346	+13.91:	+13.15	+11.91	+11.27	+10.95
113.6352	+13.60:	+13.19	+12.00	+11.32	+11.02
114.6358	+13.86:	+13.14	+12.00	+11.29	+11.10
115.6363	+14.04:	+13.27	+12.09	+11.44	+11.17
116.6368	+13.96:	+13.31	+12.12	+11.51	+11.26
117.6375	+13.82:	+13.34	+12.15	+11.49	+11.27
118.6388	+13.95:	+13.34	+12.17	+11.49	+11.15
120.6400	+14.21:	+13.43	+12.21	+11.51	+11.12
121.6406	+14.28:	+13.37	+12.23	+11.53	+11.17

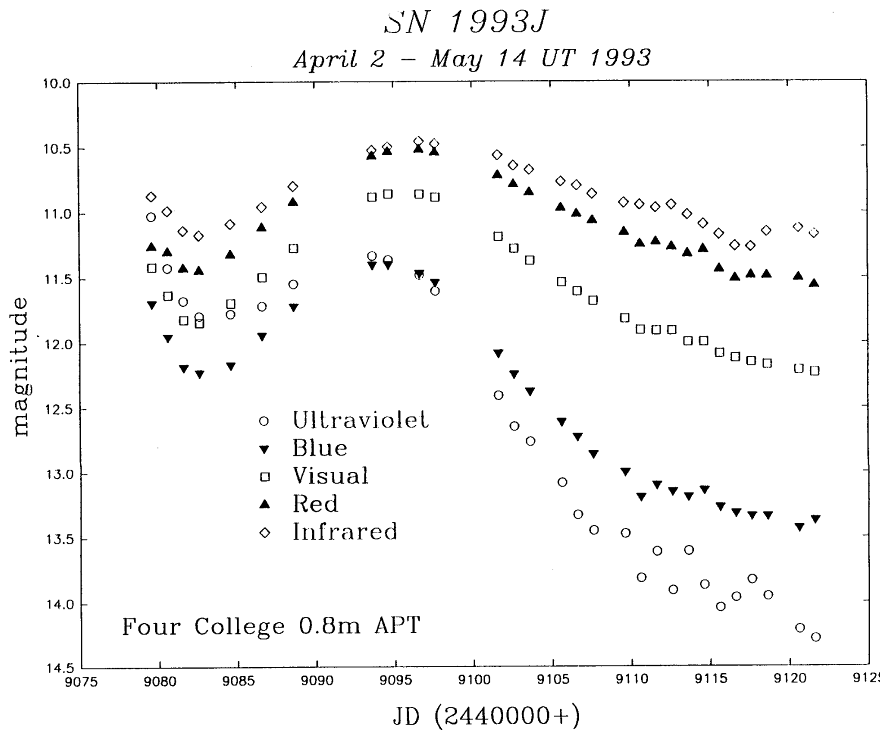

Figure 1. A plot of our data from Table 1.

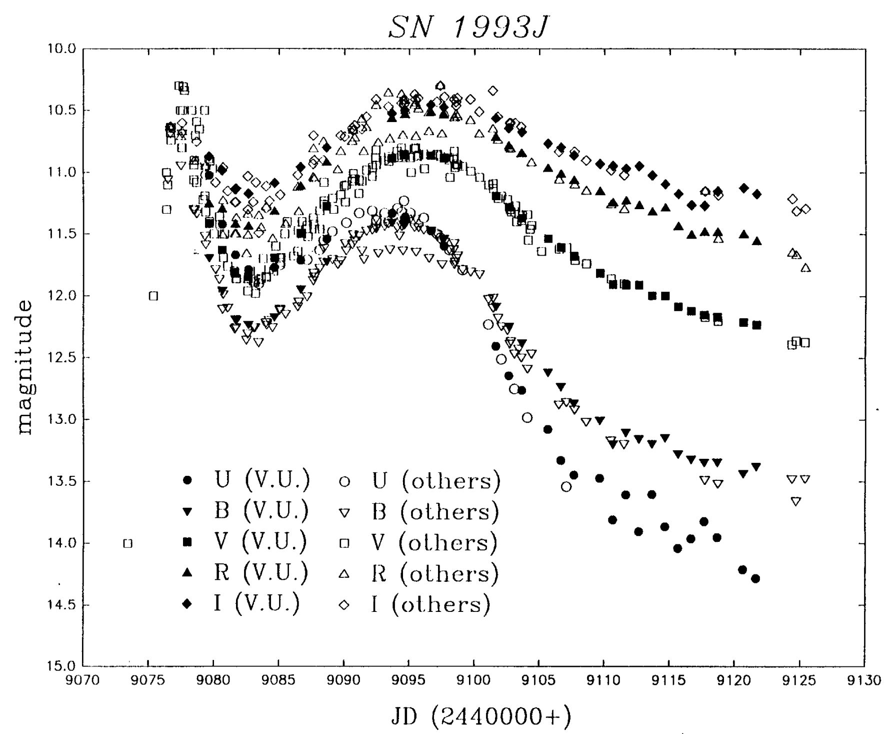

Figure 2. A plot of all the data collected from the literature, including our own observations, to create a single light curve of SN 1993J in the $UBV(RI)_c$ bandpasses.

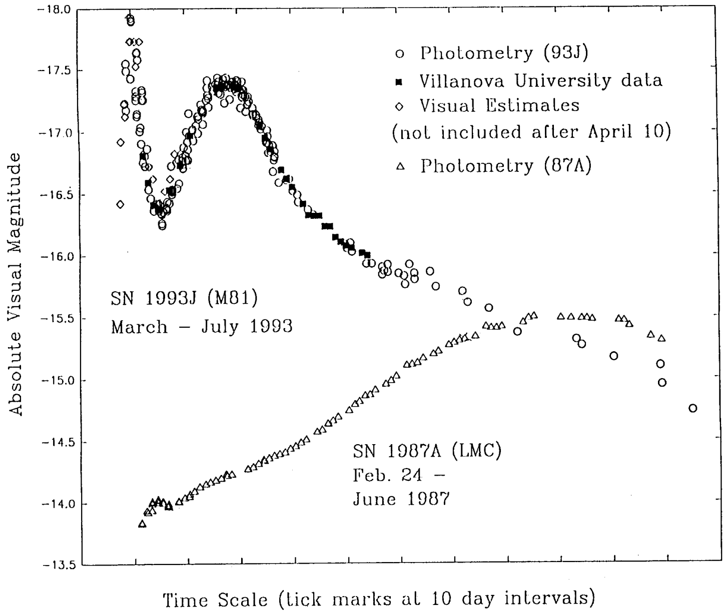

Figure 3. A plot comparing SN 1993J and SN 1987A by plotting the absolute visual magnitude vs. time using the same time scale for both objects. A distance modulus of 27.8 mag and an intermediate value for interstellar absorption, $A_v \simeq 0.5$ mag (see Richmond *et al.*, 1994) were used for calculating the absolute magnitude of SN 1993J. For SN 1987A, a distance modulus of 18.5 mag and an A_v of 0.25 mag (see Menzies *et al.*, 1987) were used. SN 1993J's light curve developed much more rapidly than SN 1987A's light curve. Also, SN 1993J was about 2 magnitudes brighter in absolute magnitude than SN 1987A at their respective peaks.

We carried out $UBV(RI)_c$ photoelectric photometry from early April through May 1993 using the Four College Consortium 0.8m Automatic Photoelectric Telescope (FCC 0.8m APT) located at Mt. Hopkins, AZ. Differential photometry was conducted through a 40 arcsec diaphragm using the following comparison stars: HD 85458 (F5, V = +8.7, B−V = +0.5), HD 86677 (F5, V = +7.876, B−V = +0.510); and HD 85828 (K0, V = +8.0, B−V = +1.0) served as a check star. Because of the faintness of the supernova, blind offsets were made to the position of the supernova. The supernova was observed using the usual pattern of *sky - comparison - check - variable - comparison - sky* with an integration time of 20 seconds. The data were reduced using software developed at Villanova University by G.P. McCook. The details of the reduction procedure have been described elsewhere by Guinan *et al.* (1987). The data were then transformed to the $UBV(RI)_c$ system and corrections were made to account for the effect of fainter stars included in the aperture with the supernova as it faded. In order to fully correct for stars included in the diaphragm with the supernova, we observed the same field one year later, after the supernova had faded below the telescope's limiting magnitude, to measure the background light directly. We computed nightly means from the individual measures of SN 1993J and these values are tabulated in Table 1 and a plot of our observations vs. Heliocentric Julian Day number is given in Figure 1. The estimated errors of the observations in the $BV(RI)_c$ are on the order of 0.01–0.02 magnitudes; the scatter in the U observations was similar until the star rapidly faded in this bandpass and the errors became large. We included these U-band measures in Table 1 with colons after the magnitude values.

We also collected all the available visual and photometric measurements of SN 1993J from the *IAU Circulars*, those published in the literature, and other sources through the end of 1994. Extensive compilations of optical photometry of SN 1993J are given by Lewis *et al.* (1994) and Richmond *et al.* (1994). After removing some obviously inaccurate measures, these data are included in Figure 2 along with our own observations. A comparison of the absolute visual magnitudes of SN 1993J is made to the LMC supernova SN 1987A in Figure 3 where both stars are plotted on the same magnitude and time scales.

The rapid expansion of the progenitor star's interior and the interaction of this shock front with its envelope and photosphere caused the initial rapid rise of SN 1993J to a peak magnitude of V = +10.3. The first decline in brightness occurred in early April 1993, dropping to V = +11.9, as the thin envelope of the star lost heat from the shock wave. During mid-April there was a second increase in brightness to V = +10.5; this time the increase was powered by the energy released by the decays of radioactive cobalt into nickel and iron. As the energy from these short-lived decay products decreased, the star slowly dimmed and cooled. By December 1993, the supernova's magnitude had decreased to approximately V = +17.

The progenitor of SN 1993J has been identified as a late G or early K supergiant (Aldering, Humphreys, Richmond, 1994) with $V_{mag} \simeq +20.75$. The progenitor appears to be a member of a binary or multiple star system having fainter nearby blue components. The spectroscopic and photometric behavior of SN 1993J indicate that the progenitor star had its hydrogen envelope partially stripped away by strong winds, or more likely, by a close binary companion. Possible analogs of SN 1993J could be ζ Aurigae systems which are composed of K-supergiant components and early B-main sequence companions.

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

Number 4230

Konkoly Observatory
Budapest
16 August 1995

HU ISSN 0374 – 0676

NEW SPECTRAL CLASSIFICATIONS FOR 49 RED VARIABLE STARS

Over the years spectral classifications of a great many red variables have been published from objective-prism plates taken with CWRU's Burrell Schmidt telescope and its twin, the University of Michigan's Curtis Schmidt. These plates have variously covered the photographic, visual, and infrared parts of the spectrum.

In looking through our extensive cardfiles, we have found 49 further red variables for which we have useful, apparently unpublished, spectral data. Most of the relevant plates were taken and searched many years ago in the course of our surveys for high-luminosity early-type stars. Table 1 lists the stars for which we present new data.

Table 1

Name	Catalogue Sp. Type	New Data	Remarks
TZ Aps	—	M9:e	
TU Aql	M4-9	M2e	
EM Aql	M7	M4e	
PX Aql	M5	M2e	
V434 Aql	M6	M4e	
V630 Ara	Me	M6e	
V352 Car	Me	M5e	
UV Cen	Me	M5e	
GR CrA	Me	M4e	
KM CrA	Me	M4e	
RT Lup	Me	M8e	
ST Mon	M6.5	MSe	
AZ Mon	M9	M6e	
CH Mus	Me	M5e	
CR Mus	Me	M4e	identical with FP Mus
EK Mus	Me	M8:e	
BD Nor	Me	>M5e	
FS Nor	Me	M7e	
PP Nor	Me	>M5e	
UX Oph	M4e	M1e	
V585 Oph	M5	M6e	
BZ Pup	M5	M4:e	
FO Pup	Me	M7e	
UU Pyx	Me	M4e	
GH Sgr	Me	M4e	

Table 1 (cont.)

Name	Catalogue Sp. Type	New Data	Remarks
IM Sgr	M9e	M2e	
V361 Sgr	M3 III	M3e	
V930 Sgr	M5-6		emission noted
V931 Sgr	M7-8		emission noted
V1592 Sgr	—	Me	
V1683 Sgr	M7		emission noted
V1690 Sgr	M7		emission noted
V2512 Sgr	–	M:e	
V2543 Sgr	M8eα		error in GCVS; should be M3e
RX Sco	Me	M7:e	
V880 Sco	Me	M8e	
VW Sct	M4-7	M6e	
XY Ser	M3	M3e	
BE Ser	M5	M5e	
Y TrA	S4,1		emission noted, called M6e
RS TrA	Me	M8e	
ER TrA	Me	M8e	
GY TrA	—	Me	
HK TrA	Me	M4e	
TZ Vel	–	M7:e	
NSV 4665	–	M9e:	
NSV 6929	Me	M5e	
NSV 8952	Me	M2e	
NSV 13052	—	M3e	

Two facts should be borne in mind concerning objective-prism studies of M-type variables: (1) blue-sensitive plates are the most efficient ones for the detection of emission lines; thus red and infrared plates will generally not show such features even if they are present elsewhere, and (2) objective-prism observations, made at random, of course tend to favor the brighter parts of the variables' light curves, but can occasionally refer to phases rather far from maximum light. Thus objective-prism spectral types are usually somewhat later than the variables' types at maximum light, which are those usually tabulated.

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ERRATUM

In IBVS No. 4230, the spectral type of ST Mon was incorrectly given due to an unfortunate typographic error. The new spectral type of ST Mon is M5e.

The editors

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

Number 4231

Konkoly Observatory
Budapest
18 August 1995

HU ISSN 0374 – 0676

THE DEEP 1995 OPTICAL MINIMUM OF CH CYGNI AND A NEW EPISODE OF DUST CONDENSATION

CH Cyg (=HD 182917), formerly an MKK standard for the spectral type M6 III, has been the subject of intense study since the onset of an active phase in the 60es. At that time, emission lines and a highly variable hot blue continuum appeared in the optical spectra. CH Cyg is now recognized as a symbiotic star, composed of an M giant and a white dwarf. Reviews on the properties and nature of this binary have been presented, among others, by Kenyon (1986) and Mikolajewski *et al.* (1990, hereafter MMK90).

We have been monitoring CH Cyg in UBV and JHKLM bands since 1978. A detailed report on the measurements collected throughout 1995 has been presented by Munari *et al.* (1995, hereafter MYKT95). Their data for U and M bands are plotted in Figure 1.

The U lightcurve is dominated by the protracted active phase that started in 1977 and ended in 1987, the following minimum extending throughout 1988-1989, and the new bright phase that began in 1990. According to the numbering introduced by MMK90, the latter will be hereafter termed the *5^{th} historically recorded outburst.* In July 1995 CH Cyg returned to the same U brightness of the 1988-1989 minimum and flickering activity disappeared as well.

In Figure 2 low resolution CCD spectra of CH Cyg for November 23, 1993 (when the star was approaching maximum U brightness) and July 27, 1995 are compared. The spectra have been obtained with the Boller & Chivens + CCD spectrograph attached to the 1.82 m telescope in Asiago. The resolution is 18 Å. Data reduction has been performed in a standard way with the IRAF software package and the calibration into absolute fluxes has been achieved with observations in open slit mode of CH Cyg and some standard stars from the list of Oke & Gunn (1983). The spectra in Figure 2 show that in the summer of 1995 the blue continuum from the hot component and circumstellar ionized gas has retraced. The TiO bands of the M giant dominate throughout the whole optical range. The intensity of emission lines has greatly diminished too.

Is the 5^{th} outburst now over ?

The faint U band brightness and the optical spectra seem to support this conclusion. However, the U lightcurve of the 5^{th} outburst shows several brightness drops superimposed onto the linear increase in magnitude culminated with the 1994 maximum brightness. On the contrary, the lightcurve of the 4^{th} outburst is much smoother. Therefore, it will be necessary to wait for additional observations extending to 1996 to firmly establish if (a) the present minimum in the activity of the hot component is simply another (even if very deep) drop and an immediate recover will follow, or (b) it is really the end of the outburst began in 1990.

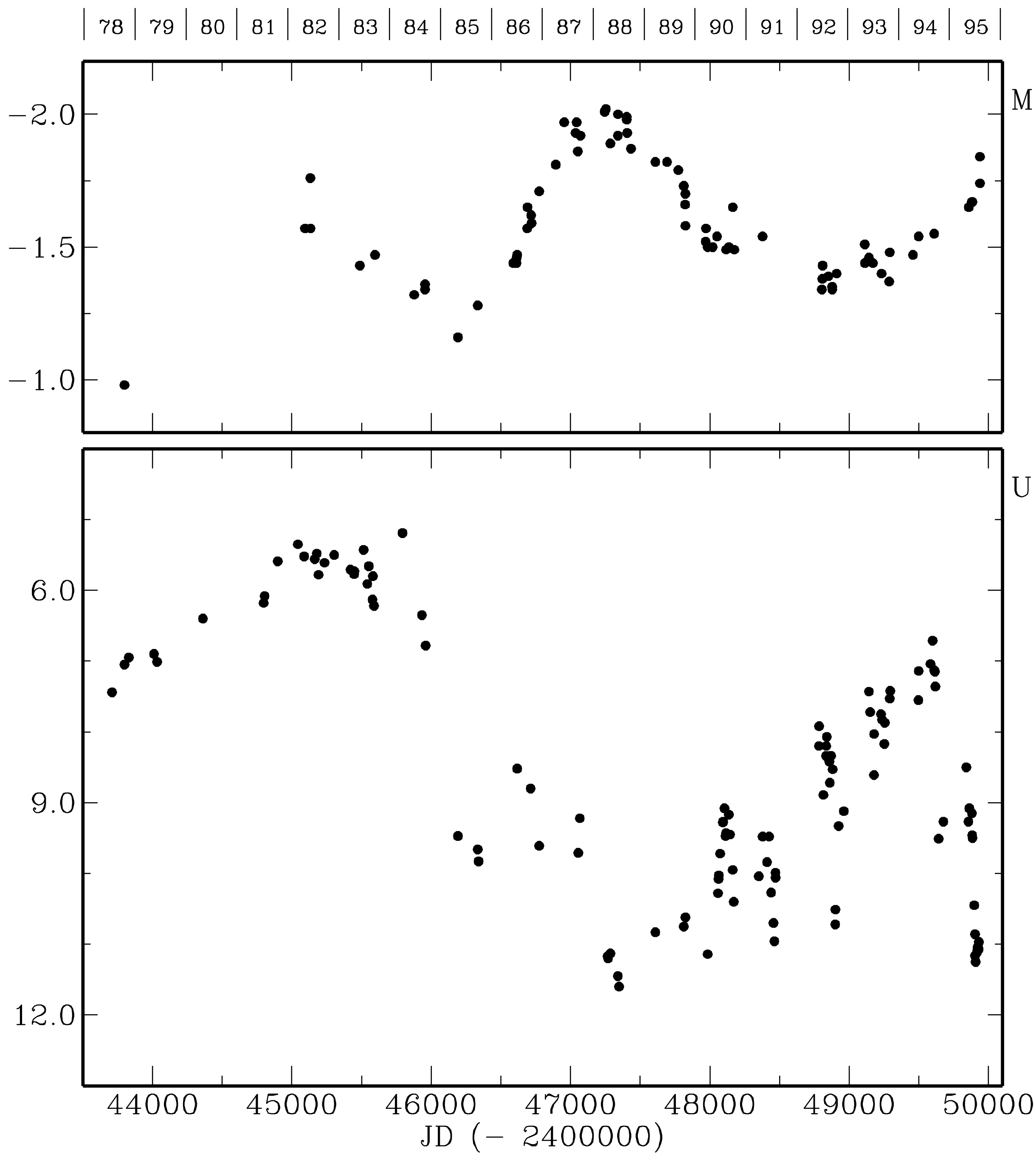

Figure 1. U and M band lightcurves of CH Cyg over years 1978 to 1995.

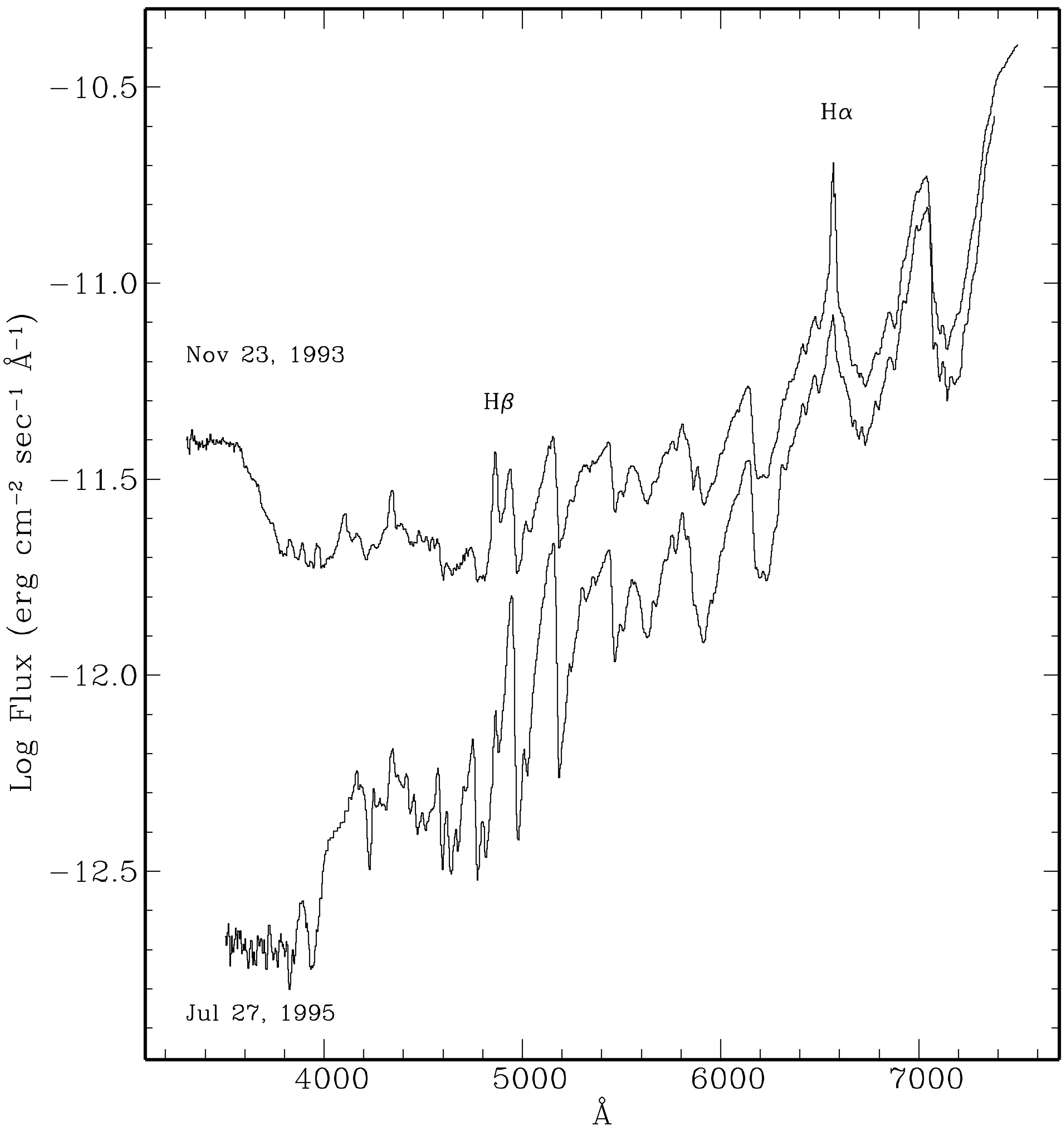

Figure 2. Absolute spectrophotometry of CH Cyg.

The M band lightcurve presented in Figure 1 traces the emission of the dust around the M giant, as demonstrated by MYKT95. A dust condensation episode took place in 1986. After the peak reached in 1988, the dust formation rate dropped far below the dilution rate in the surrounding medium and the M brightness decreased toward the 1992 minimum. A similar cycle took place in the years 1978-85. Figure 1 shows that in 1993 a new dust condensation cycle started. Dust condensation in the wind of the M giant is still in full progress at the time of writing.

The two previous dust condensation cycles lasted ∼7 years each. It is therefore important to extend the infrared observations of CH Cyg to coming years to monitor the present dust condensation event and to check if these cycles are periodic. Such a periodicity would have profound implications for the modelling of CH Cyg, its circumstellar environment and in particular for the evolutionary status of its cool giant.

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4232

Konkoly Observatory
Budapest
21 August 1995

HU ISSN 0374 – 0676

CI Aql: A NEW SHORT-PERIOD ECLIPSING BINARY

CI Aql was classified as a doubtful nova by Duerbeck (1987), mainly based on a $\sim 4^{\rm m}_{.}6$ eruption observed in 1917. The small amplitude of the outburst and the lack of subsequently recorded eruptions suggested CI Aql might be a dwarf nova with a very long recurrence time. However, a dwarf nova classsification was not supported by a recent spectrum (Szkody & Howell 1992) that did not have the Balmer lines in emission.

CI Aql was included in a program of automated long-term monitoring of cataclysmic variables conducted at Indiana University since about 1991 (Honeycutt et al., 1990; Honeycutt and Turner, 1992). Nearly 300 V differential magnitudes, spanning a time range of 4 years, have been obtained. The overall light curve does not show any significant long-term modulation, but rather several low-brightness data points homogeneously distributed. A phase dispersion minimization analysis (Stellingwerf 1978) applied over the whole data sample revealed a strong minimum in the θ window at P = $0^{\rm d}_{.}618355(9)$. On this period the light curve shows a sinusoid with an amplitude of $0^{\rm m}_{.}2$ and a period of half the orbital period, with a superimposed eclipse $0^{\rm m}_{.}6$ deep and 0.15 phase units wide. The sinusoid is probably an ellipsoidal modulation from the secondary, though it could be a secondary eclipse (Figure 1). The ephemeris of the eclipse minimum is:

$$\text{J.D.}\,2448412.167(25) + 0^{\rm d}_{.}618355(9) \times \text{E}$$

There is (to within the errors) little scatter in the light curve of Figure 1, suggesting that flickering, if present, is quite small. This conclusion is supported by an upper limit of $0^{\rm m}_{.}08$ in the star's variability during a one hour photometric run in March 1991 (Mennickent, 1992).

Two spectra of CI Aql were obtained using the 2.5 meter telescope at Las Campanas Observatory, Chile in 1991. On May 20 (UT) the Modular Spectrograph and a CRAF CCD chip with 12μ pixels was used with a grating of 600 lines/mm. This combination gave a spectral resolution of 5 Å over the range 6400-8900 Å. The exposure time was 1800 seconds and the mid UT = $9^{\rm h}_{.}14^{\rm m}3^{\rm s}_{.}$. The second spectrum was obtained on August 03, 1991. On this occasion a grating of 300 lines/mm was selected, yielding a spectral resolution of 14 Å, and a range of 4800-8800 Å. The exposure time was 900 seconds, and the mid UT = $4^{\rm h}_{.}38^{\rm m}21^{\rm s}_{.}$. Helium-Argon comparison spectra were taken before and after the scientific exposures and all spectra were reduced using IRAF standard packages. The observations were made as part of a monitoring program of the near infrared spectral region of several CV candidates. The equivalent widths of some of the prominent absorption lines in Figures 2 and 3 are tabulated in Table 1. In addition, weak TiO bands are clearly visible in both spectra (for example, around λ 6700 Å). The KI λ 7696 Å line and the OI λ 7774 Å line were visible as weak absorptions in the May spectrum.

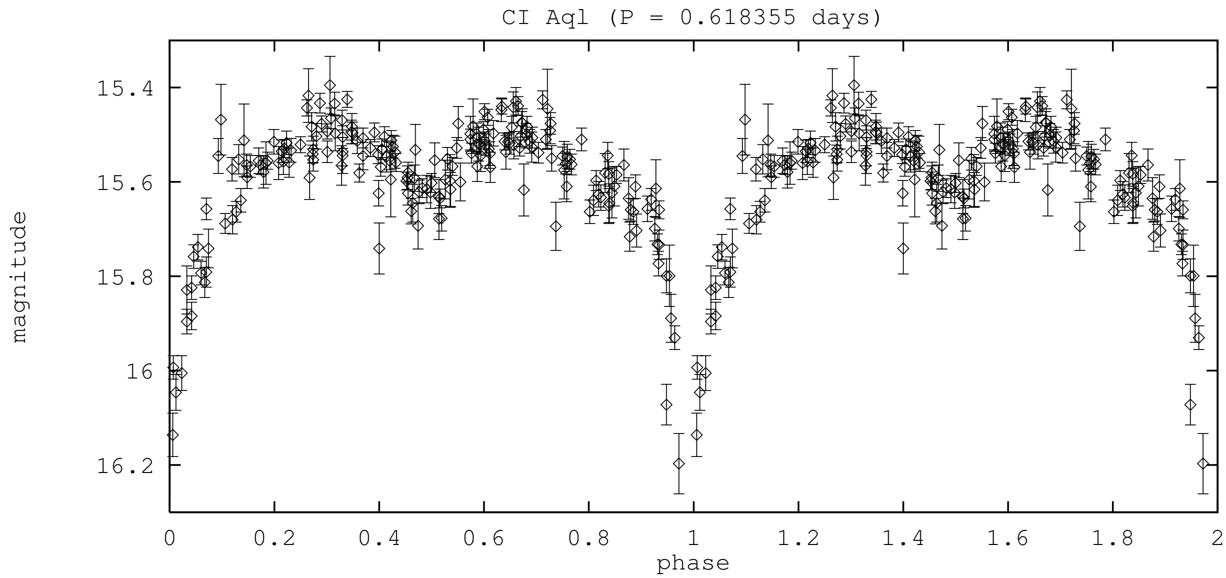

Figure 1. V-band differential magnitude of CI Aql phased with a period P = $0\overset{d}{.}618355$. The zero point of the magnitude scale is accurate to only 0.2 mag.

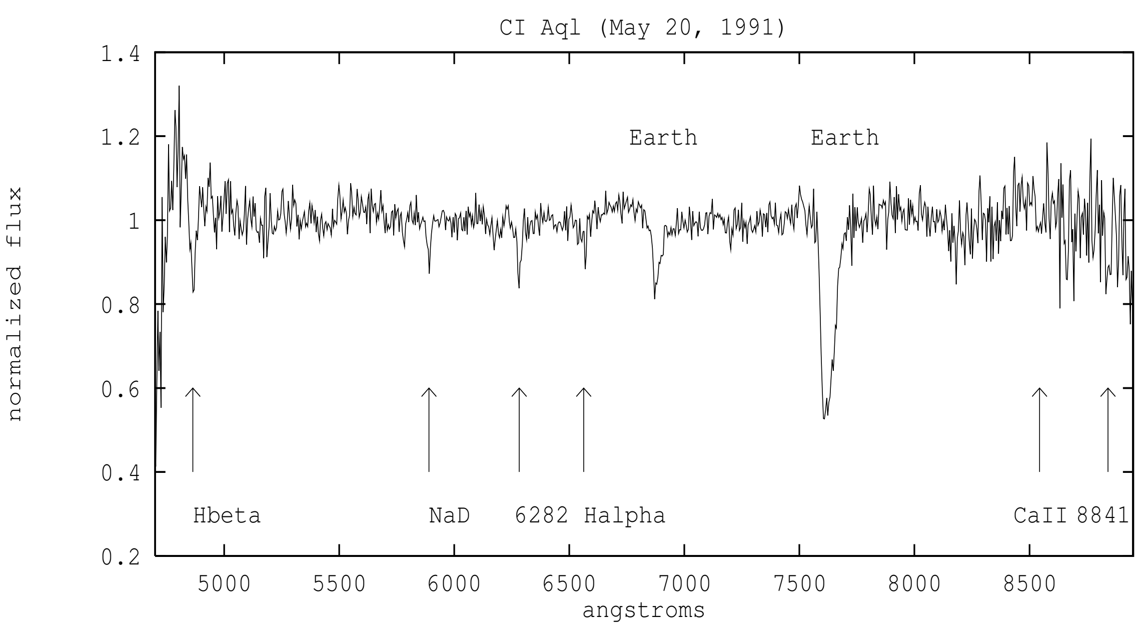

Figure 2. Spectrum of CI Aql obtained at Las Campanas in May 20, 1991.

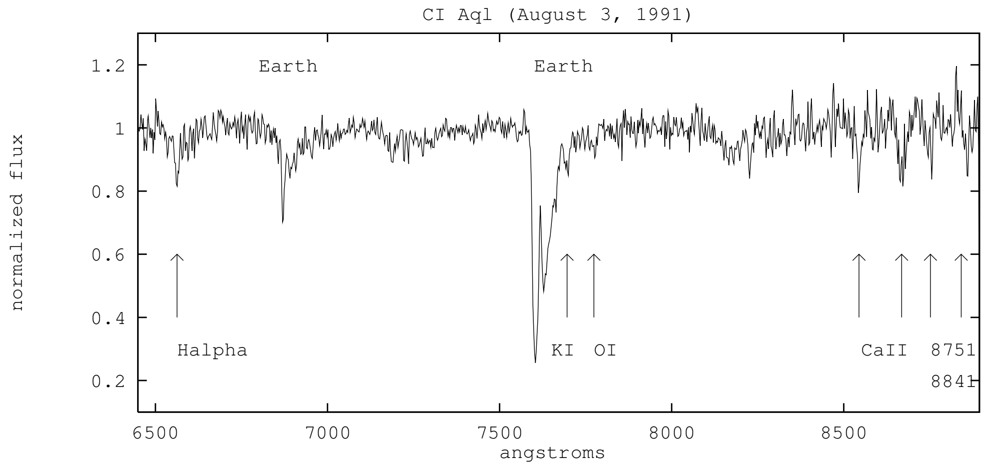

Figure 3. Spectrum of CI Aql obtained at Las Campanas in August 3, 1991.

Table 1. Equivalent width of the absorption lines observed in CI Aql

Line	W_λ (20/5/91)	W_λ (3/8/91)
Hβ	8	-
λ 5890 Å	2	-
λ 6279 Å	4	-
Hα	3	6
CaII λ 8542 Å	-	2
CaII λ 8662 Å	-	4
λ 8749 Å	-	2
λ 8863 Å	-	2

Table 2. CI Aql magnitudes and colors observed in different epochs. S94 refers to Szkody (1994), H94 to Harrison (1992) and M95 to Mennickent (1995)

Color or Mag	Epoch	Refrence	Color r Mag.	Epoch	Reference
V = 16.22	88/08/31	S94	J = 14.5	88/09/06	S94
B−V = 1.08	88/08/31	S94	K = 13.5	88/09/06	S94
V−R = 0.68	88/08/31	S94	V−J = 1.7	88/09/06	S94
V = 16.20	91/03/20	M95	J−H = 0.51	May-June 92	H92
B−V = 0.95	91/03/20	M95	H−K = 0.22	May-June 92	H92
U−B = 0.53	91/03/20	M95	K = 12.67	May-June 92	H92

A set of UBV exposures was obtained using the 1.0 m telescope at Las Campanas Observatory on March 20, 1991 (UT) as part of a monitoring campaign of poorly known CV candidates (Mennickent, 1995). The colors B−V = $0^{\rm m}_{\cdot}95 \pm 0^{\rm m}_{\cdot}06$ and U−B = $0^{\rm m}_{\cdot}53 \pm 0^{\rm m}_{\cdot}11$ are not typical of dwarf novae, being comparable, instead, to the colors observed in CVs with evolved companions (for example V1017 Sgr, T CrB and RS Oph). Our data, supported by near-infrared colors obtained by other authors (see Table 2), indicate a steeply red flux distribution.

The dominance of the spectrum of a cool star in the near-IR spectrum suggests that CI Aql has an evolved companion, perhaps similar to that of recurrent nova systems (Webbink et al., 1987). However, note that the lack of emission lines and the lack of flickering implies that CI Aql may not be interacting (at least at the present time). The Na D, K I lines and TiO bands are characteristic of a K-M type star, and the weakness of Na D, K I and Mg b imply a luminosity higher than IV (see the atlas of Turnshek et al., 1985 at similar spectral resolution). The Ca II infrared triplet is known to increase in strength with luminosity. Applying the equivalent width calibration of Ginestet et al. (1994) to the data in Table 1 implies a luminosity class of II-III. (However, the Ginestet et al. calibration is at substantially higher spectral resolution than our spectra, so this result is preliminary.) A determination of the stellar parameters of CI Aql is beyond the scope of this note but will be the subject of a future investigation.

Acknowledgements: This research was supported by the Dirección de Investigación de la Universidad de Concepción, Chile, DI # 95.11.11.1-1, and by a National Science Foundation grant to Indiana University.

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4233

Konkoly Observatory
Budapest
28 August 1995

HU ISSN 0374 – 0676

PHOTOMETRIC DETECTION OF THE ORBITAL PERIOD IN ER UMa

ER UMa (=PG0943+521) is a prototype of recently discovered small group of SU UMa-type dwarf novae (ER UMa stars or RZ LMi stars) which are characterized by extremely short (19 – 44 d) interval (supercycle) between successive superoutbursts, short (3 – 4 d) outburst interval of normal outbursts, and small ($\sim$ 3 mag) outburst amplitude (Kato, Kunjaya 1995; Misselt, Shafter 1995; Robertson et al. 1995).

The classification of ER UMa stars as SU UMa-type dwarf novae was based on the detection of periodic modulations, which have been considered to be superhumps, during the long outbursts. However, there still remains some ambiguity of the identification of superhumps since two of three well-established ER UMa stars do not have published orbital periods. The first established member, ER UMa, is not an exception. An attempt to determine its orbital period seems to have been hindered by its seemingly low-inclination binary configuration (Ringwald 1993). The identification of superhumps in these systems has been therefore largely based on unstableness of the period, or loss of coherence between outbursts. Determination of orbital periods in these systems is therefore an urgent task in order to verify these identifications and interpretation of these systems. We here report on detection of periodic modulation in ER UMa during quiescence, whose period we attribute to its orbital period.

Observations were carried out on Jan. 19, 1995, when ER UMa was in quiescence between normal outbursts. We used a CCD camera (Thomson TH 7882, 576 $\times$ 384 pixels) attached to the Cassegrain focus of the 60 cm reflector (focal length=4.8 m) at Ouda Station, Kyoto University (Ohtani et al. 1992). To reduce the readout noise and dead time, an on-chip summation of 2$\times$2 pixels to one pixel was adopted. An interference filter was used which had been designed to reproduce the Johnson V band. The exposure time was 120 seconds. The reduction technique, the comparison and check stars are the same as described in Kato, Kunjaya (1995).

The resultant light curve is shown in Figure 1. ER UMa showed a slow increase in brightness by 0.2 mag during the seven hours' run. Superimposed on this linear trend, there existed a semi-periodic modulation with a typical amplitude of 0.3 – 0.4 mag. A period analysis using the Phase Dispersion Minimization (PDM) method (Stellingwerf 1978), after removing a linear increase of brightness, has yielded a theta diagram shown in Figure 2. The best frequency determined by the bisection method is 15.75 $\pm$ 0.04 cycle/day, corresponding to a period of 0.0635 $\pm$ 0.0002 day, which is considerably shorter than the published superhump periods of 0.06549 – 0.06573 day. From the facts that the observed period is about 3 percent shorter than the superhump period, and that the modulations were observed during quiescence, we have attributed this period as the orbital period of ER UMa. This identification seems to be consistent with the result of recent high accuracy radial velocity study by Thorstensen (1995), who gave a period of 0.06366 $\pm$ 0.00004 day.

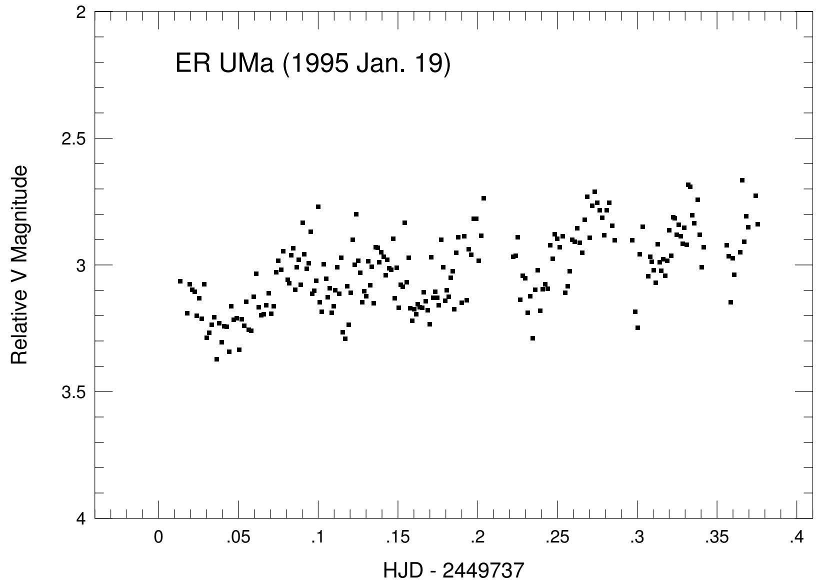

Figure. 1. *V*-band light curve of ER UMa obtained during quiescence (Jan. 19, 1995). The zero point of the magnitude scale corresponds to *V*=12.0. Superimposed on a gradual rise, semi- periodic oscillations with an amplitude of 0.3 – 0.4 mag and a period of 0.0635 day are clearly visible.

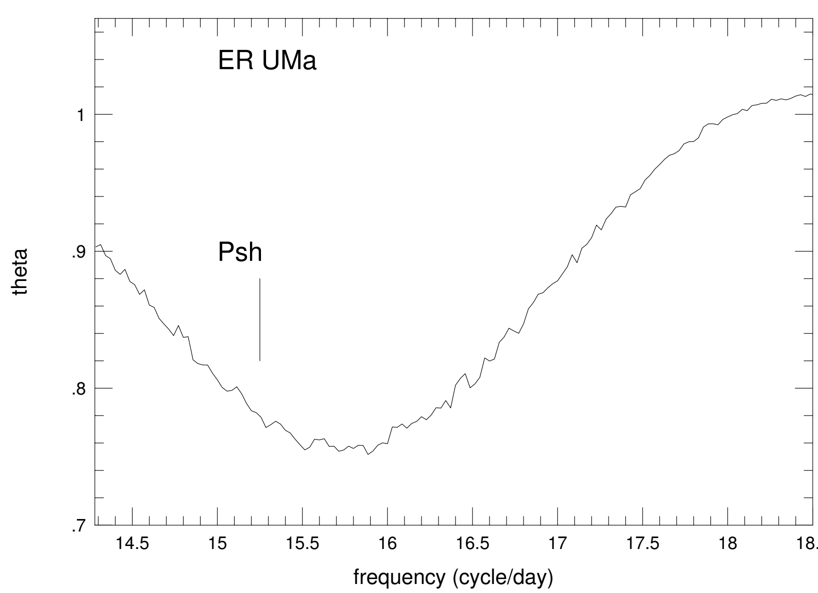

Figure. 2. Theta diagram (Stellingwerf 1978) of period analysis for the data in Figure 1. The most likely period is slightly offset to a higher frequency (shorter period) to the reported superhump period, which is marked as Psh in the figure.

Although the good agreement of the photometric and spectroscopic periods strongly supports that the periodic modulation detected here is related to the orbital motion, the low inclination configuration proposed by Ringwald (1993) poses a problem in interpreting the source of light modulation. It would be unlikely that the modulation is caused by geometric obscuration of the hot spot as in high inclination systems. Under the restriction of this configuration, we may propose a possibility of changing release of potential energy of accretion stream hitting a non-precessing eccentric accretion disk. This interpretation should be tested by future observations.

Part of this work is supported by a Research Fellowship of the Japan Society for the Promotion of Science for Young Scientists (T.K.).

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

Number 4234

Konkoly Observatory
Budapest
28 August 1995

HU ISSN 0374 – 0676

PRECISION U, B, V, R, I, LIGHT CURVES OF LP CEPHEI

In our study of the eccentric eclipsing binary (EEB) candidates of Hegedüs (1988), we obtained UBVRI photoelectric light curves of LP Cephei. LP Cep (HBV 484 = SVS 681) was discovered by Wachmann (1972). He identified it as an Algol type variable, with the secondary displaced to approximately 0.55 phase. The paper includes accurate positions, a finder chart, a linear ephemeris, and a list of photographic magnitudes.

Our present observations were made on 21 through 25 (inclusive) September, 1994 at Kitt Peak National Observatory, Arizona. The CCD photometer system (CCDPHOT) was used in conjunction with the 0.9m Cassegrain reflector telescope. Approximate coordinates of the variable, comparison, and check star are given in Table 1 and are designated as star V, C, and K, respectively, on the CCD image taken during observation (Figure 1). About 400 observations were taken in each passband.

Table 1

Star	R. A. (2000)	Dec. (2000)
LP Cep	$21^h19^m50^s$	60°42' 28"
Comparison	$21^h19^m44^s$	60°41' 20"
Check	$21^h19^m47^s$	60°40' 24"

Four mean epochs of minimum light were determined from the observations made during one secondary and three primary eclipses. The bisection of chords technique was utilized in their determination. These minima are given in Table 2 accompanied by their probable errors in parentheses. We calculated a linear ephemeris using Wachmann's data alone (equation 1) and another ephemeris using our data alone (equation 2). From Wachmann's data we obtained

$$\text{JD Hel. Min I} = \underset{\pm 8}{2430517.4649} + \underset{\pm 4}{0\overset{d}{.}6930642} \times E \qquad (1)$$

in good agreement with Wachmann's (1972) ephemeris, while our observations yielded

$$\text{JD Hel. Min I} = \underset{\pm 3}{2449621.73239} + \underset{\pm 7}{0\overset{d}{.}693180} \times E \qquad (2)$$

Table 2

JD Hel. 2400000+	Minimum	Cycle	O–C
49617.9199 (11)	II	−5.5	0.0000
49618.9597 (2)	I	−4.0	0.0000
49619.6528 (2)	I	−3.0	−0.0001
49621.7324 (5)	I	0.0	0.0000

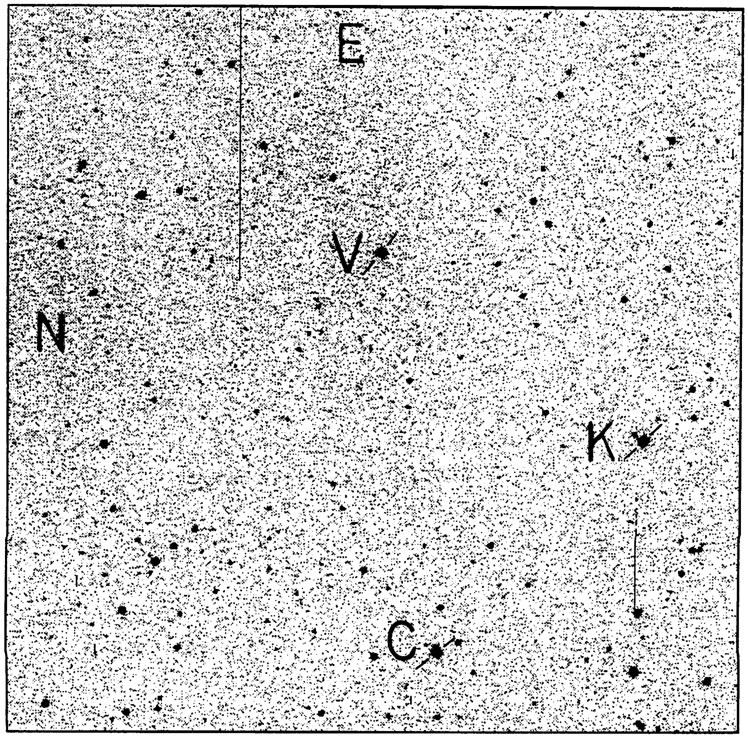

Figure 1. CCD field image, showing LP Cep (V), the comparison star (C), and the check star (K).

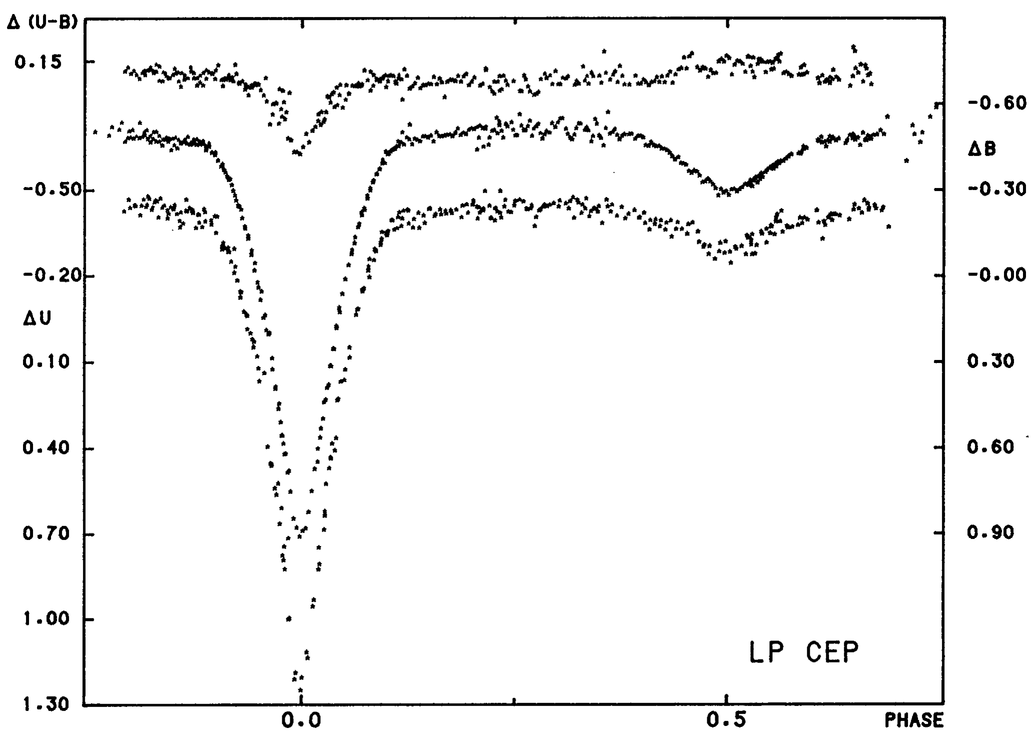

Figure 2a. U, B photoelectric light curves of LP Cep as defined by the individual observations.

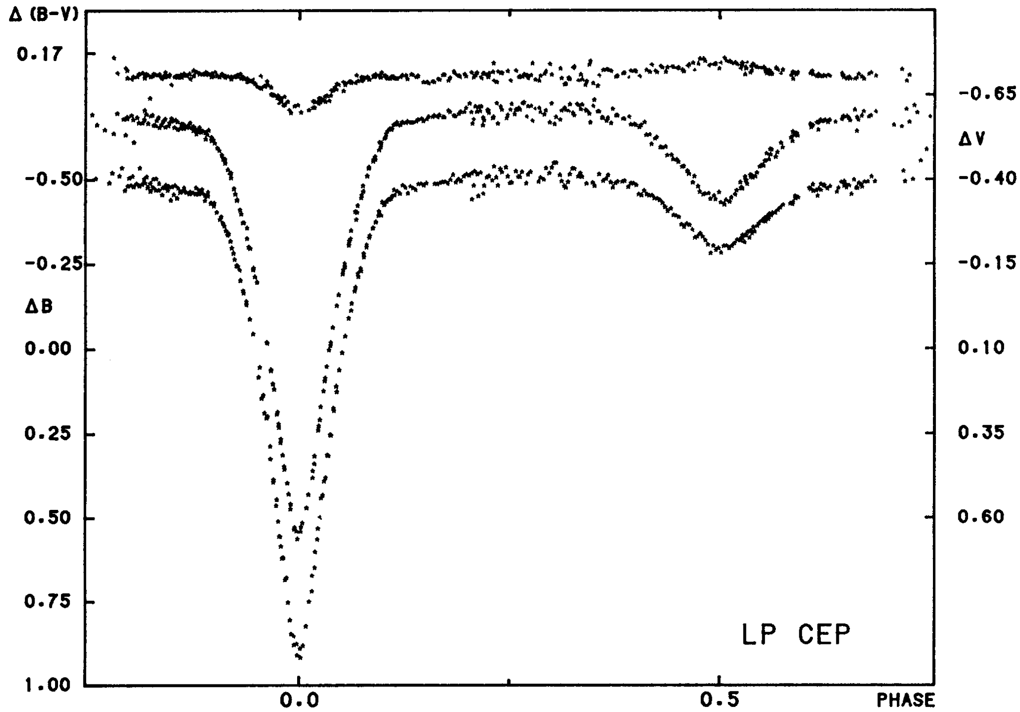

Figure 2b. B, V photoelectric light curves of LP Cep as defined by the individual observations.

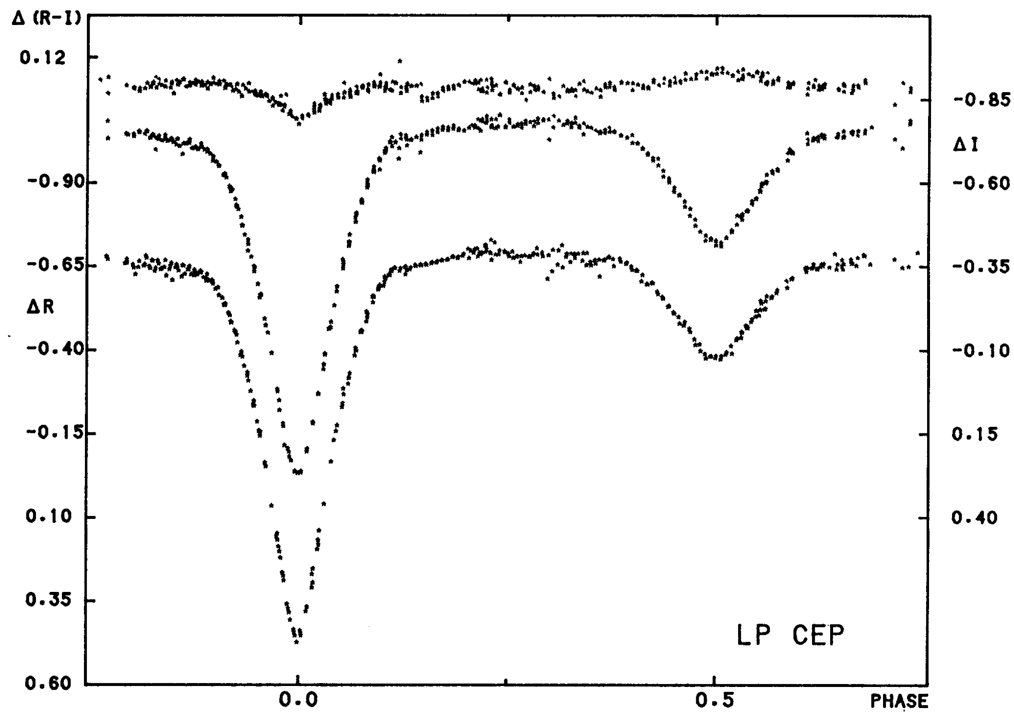

Figure 2c. R, I photoelectric light curves of LP Cep as defined by the individual observations.

The linear ephemeris determined by equation 2 was used to calculate the O−C residuals and the phases of our present observations. The calculated periods of each data set indicate a period increase of ∼10 s; however, the large gap in timings and the sparsity of the data make it unclear if this period change is real. More timings of minimum light are needed, both from photographic archives and future observations, so that the period behavior of the system can be determined.

The U, B, V, R, I light curves of LP Cep as defined by their individual observations are shown in Figure 2 as differential magnitude (variable−comparison) versus phase. We have obtained a preliminary solution, which indicates that LP Cep is a typical short-period Algol with the secondary component filling its Roche lobe and the primary component attaining a fillout of ∼80% . The temperature difference between the components is ∼2800 K. Further analysis of the observations is underway.

This work was partially supported by Millikin University Leighty Funds.

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4235

Konkoly Observatory
Budapest
28 August 1995
HU ISSN 0374 – 0676

COMPLETE PHOTOELECTRIC U,B,V LIGHT CURVES OF THE SHORT PERIOD NEAR CONTACT SYSTEM: HL AURIGAE

The eclipsing variable, HL Aurigae (S4727 Aur), was discovered by Hoffmeister (1949) in a survey of Zone +40° Sonneberg plates for new variables. He gave the variable a probable classification of an Algol-type (EA) eclipsing system which displayed a 1.0 magnitude amplitude but he gave no period. Kippenhahn (1953) reclassified HL Aurigae as a Beta Lyrae-type binary from 96 plate estimates showing the primary and secondary eclipse depths to have 1.1 and 0.35 magnitude amplitudes respectively. He also reported the first orbital elements which are given in Equation 1.

$$\text{JD Hel Min. I} = 2426365.309 + 0\overset{d}{.}6225058 \times \text{E} \quad (1)$$

Kippenhahn (1955) later published a photographic light curve and fifteen times of minimum light. Pfau (1955a, 1955b) published two lists which included fourteen new minima, a finder chart, and a photographic light curve. Since that time, HL Aurigae has been monitored by many individuals (BBSAG #21-#103) who give timings of minimum light for this system. Zhang et al. (1994) give an informative IBVS note which includes eleven epochs of minimum light, BV photoelectric light curves, and the improved ephemeris given in Equation 2.

$$\text{JD Hel Min. I} = 2447913.3470 + 0\overset{d}{.}62250590 \times \text{E} \quad (2)$$

Our present U,B,V light curves of HL Aur were obtained, as part of our survey of the eccentric eclipsing binary (EEB) candidates of Hegedüs (1988). The observations were made on 1994, December 9-15 at Lowell Observatory, Arizona. The 0.79-m National Undergraduate Research Observatory (NURO) reflector was used in conjunction with a thermoelectrically cooled S-13 type PMT.

The approximate coordinates of the comparison, check, and variable stars are given in Table 1.

Table 1

Star	RA (2000)	D (2000)
HL Aurigae	$6^h19^m08\overset{s}{.}5$	49°42'22"
Comparison	$6^h19^m16\overset{s}{.}4$	49°21'53"
Check	$6^h18^m59\overset{s}{.}4$	49°24'59"

We determined four new precise epochs of minimum light from observations made during three primary and one secondary eclipse. The Hertzprung method (Hertzsprung, 1928) was used to determine the first two primary minima while the bisection of chords technique was used to determine the last primary epoch of minimum light. The secondary minimum was determined using the bisection of chords technique as well as a hybrid of this

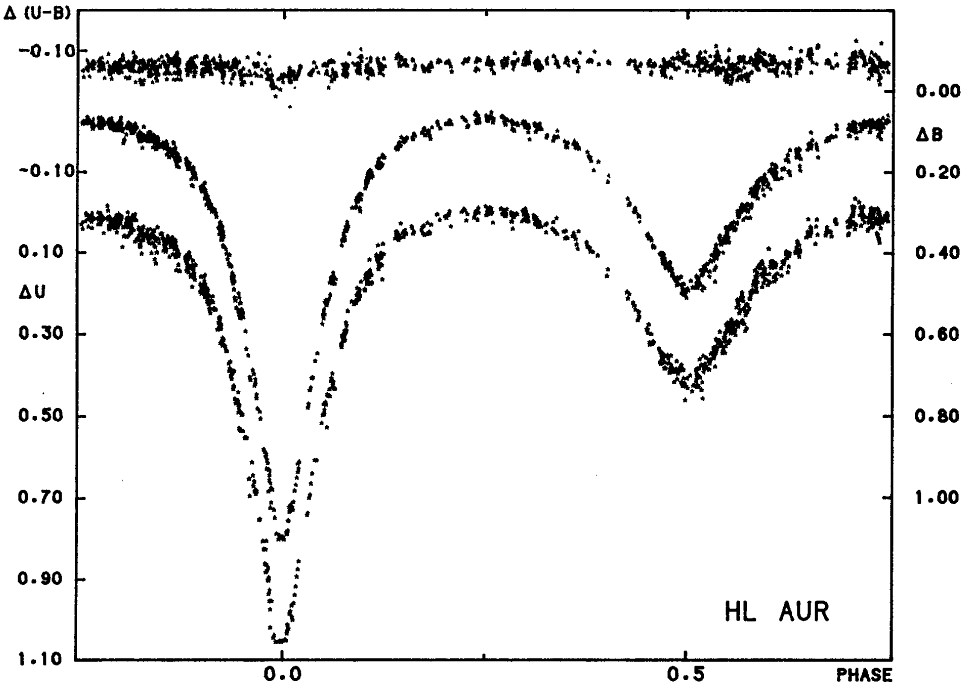

Figure 1. Photoelectric U, B light curves of HL Aurigae as defined by the individual observations.

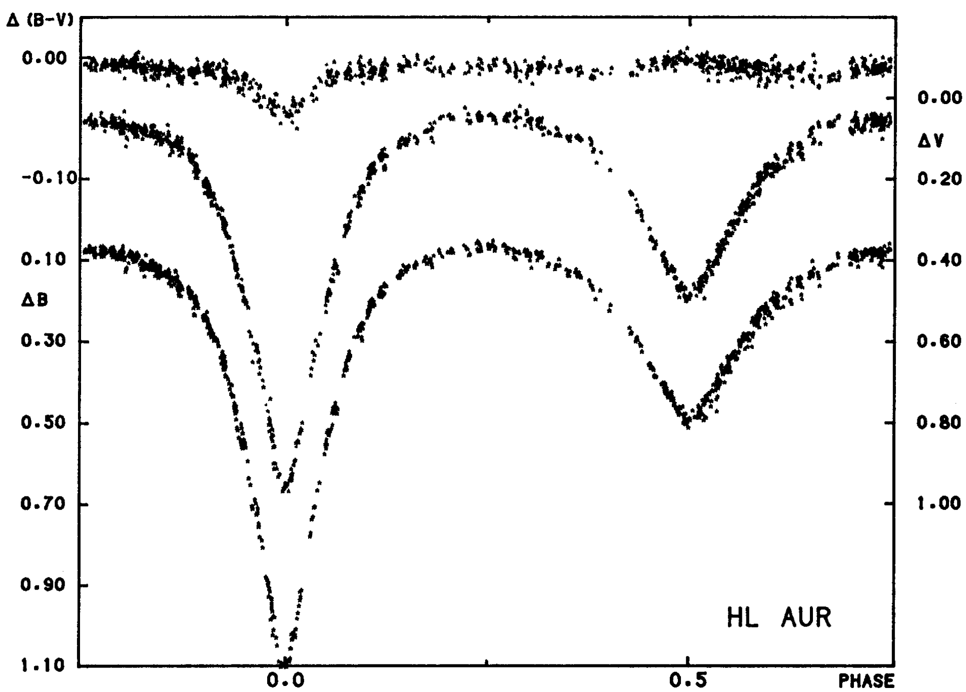

Figure 2. Photoelectric B, V light curves of HL Aurigae as defined by the individual observations.

method which allows analysis of asymmetric eclipses. These are listed in Table 2. In Table 2, values are accompanied by their probable errors in parentheses.

Table 2

JD Hel. 2400000+	Eclipse Type	Cycles	O−C
49695.8909(3)	II	−1.5	−0.0005
49695.8924(3)	II*	−1.5	0.0010
49696.8232(1)	I	0.0	−0.0019
49698.6900(7)	I	3.0	−0.0027
49701.8021(5)	I	8.0	−0.0031

* indicates minima determined with hybrid method

All available epochs of minima were introduced into a least squares solution to obtain a new ephemeris which best represents the present observations:

$$\text{JD Hel Min.} = \underset{\pm 12}{2449696.8251} + \underset{\pm 4}{0^{\mathrm{d}}.6225049} \times E \qquad (3)$$

The O−C residuals calculated from Equation 3 are listed as O−C in Table 2.

The U, B, V light curves of HL Aurigae as defined by their individual observations are shown in Figures 1 and 2 as differential magnitudes (variable−comparison) versus phase. This system does not show a displaced secondary in either the present precision observations or those of Zhang et al. (1994). This casts doubt on the validity of this variable being classified as an EEB. A thorough analysis of the observations is in progress and will be reported on elsewhere.

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4236

Konkoly Observatory
Budapest
29 August 1995

HU ISSN 0374 – 0676

OBSERVATIONS OF SUPERHUMPS IN CY UMa

CY UMa was discovered as a dwarf nova by Goranskij (1977). Little attention had been paid until regular visual monitoring by VSOLJ members detected a long outburst in Jan. 1988 (Kato et al., 1988). From the analysis of visual and photographic light curve during this outburst, they detected a possible superhump period of 0.0593 day, and concluded that CY UMa belongs to SU UMa-type dwarf novae. Since this detection of superhumps was suspected to be severely affected by limits of accuracy of visual and photographic observations, the author has been trying to confirm superhumps of CY UMa by CCD photometry. The observations reported here were done during two long outbursts in Dec. 1991 – Jan. 1992 and in Mar. 1993.

The observations were carried out using a CCD camera (Thomson TH 7882, 576 $\times$ 384 pixels) attached to the Cassegrain focus of the 60 cm reflector (focal length=4.8 m) at Ouda Station, Kyoto University (Ohtani et al., 1992). To reduce the readout noise and dead time, an on-chip summation of 3$\times$3 pixels to one pixel was adopted. An interference filter was used which had been designed to reproduce the Johnson V band. The exposure time was between 20 and 120 s depending on the observing condition. The frames were first corrected for standard de-biasing and flat fielding, and were then processed by a personal-computer-based aperture photometry package developed by the author. The differential magnitudes of the variable were determined against a local standard star GSC 3446.344 ($10^h57^m05\overset{s}{.}38$ $+49°37'30\overset{''}{.}4$ (J2000.0), V=12.9. The position and magnitude were taken from the Guide Star Catalog). The constancy of this comparison was checked against several stars in the same field.

The first outburst was covered from the terminal stage to its return to near quiescence (Figure 1). The Dec. 30 light curve (Figure 2) clearly shows superhumps with an amplitude of 0.18 mag. A period analysis of observations on Dec. 29–30 using the Phase Dispersion Minimization (PDM) method (Stellingwerf 1978), after heliocentric correction and removing a linear trend of decline, has yielded a superhump period of 0.0714 $\pm$ 0.0005 day. This observation clearly confirmed the SU UMa-type nature of CY UMa. Additional observations were performed on four nights from Jan. 1 through Jan. 4 just after the star returned to near quiescent brightness. A period analysis gives a theta diagram (Figure 3), which suggests persistence of the superhump period near P=0.0723 day and possible periodicity near 0.0678 day. Although irregular variation and relatively low signal-to-noise ratio have made these periods less confident, one may attribute the variability of the first period to late superhumps and the second possible orbital humps [however, one should note that the latter period may be affected by the one-day alias of the first period].

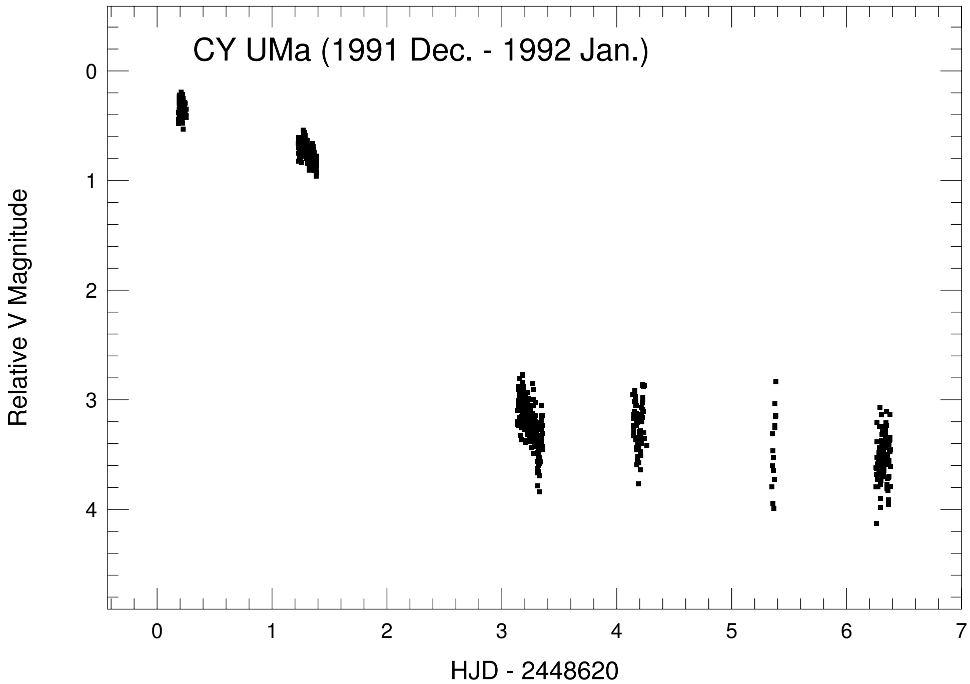

Figure 1. *V*-band light curve of CY UMa during a superoutburst in Dec. 1991–Jan. 1992. The zero point of the magnitude scale corresponds to *V*=12.9.

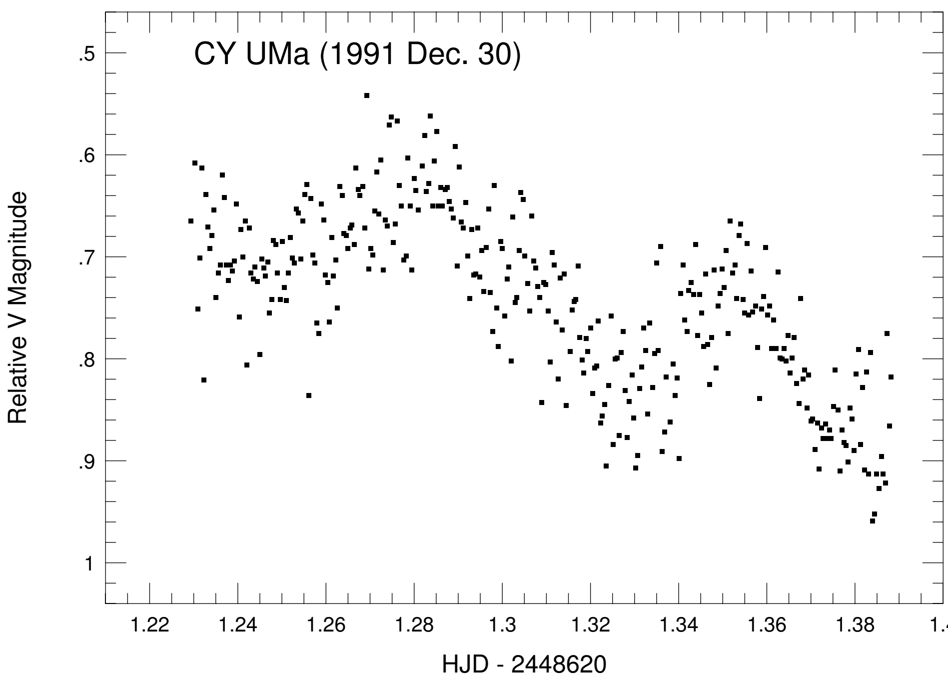

Figure 2. The light curve on Dec. 30, 1991. Superimposed on a slow decline, superhumps with an amplitude of 0.18 mag are clearly seen.

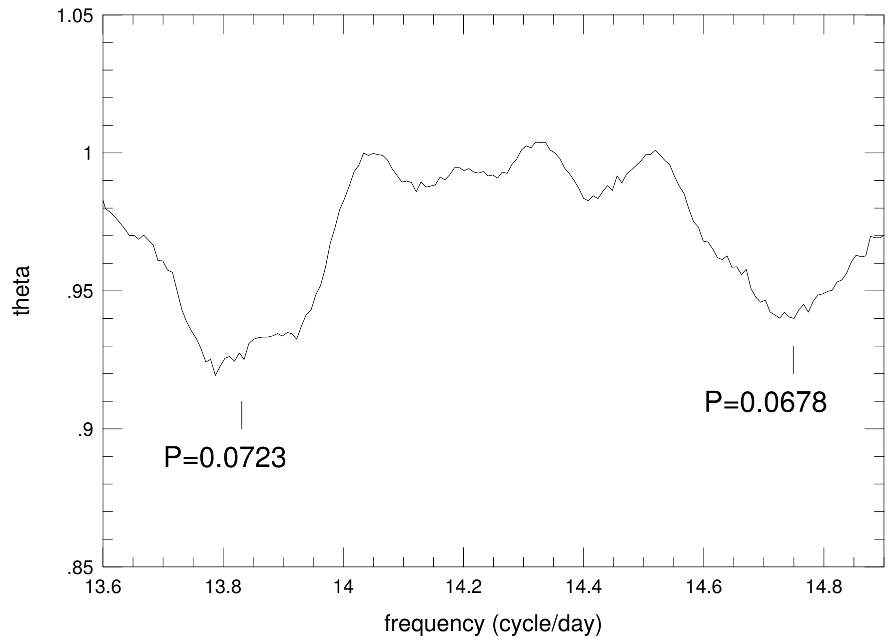

Figure 3. Theta diagram (Stellingwerf 1978) of period analysis for the post-outburst period Jan. 1–Jan. 4, 1991. Two minima in the theta diagram represent the periods of 0.0723 and 0.0678 day (see the text for interpretation).

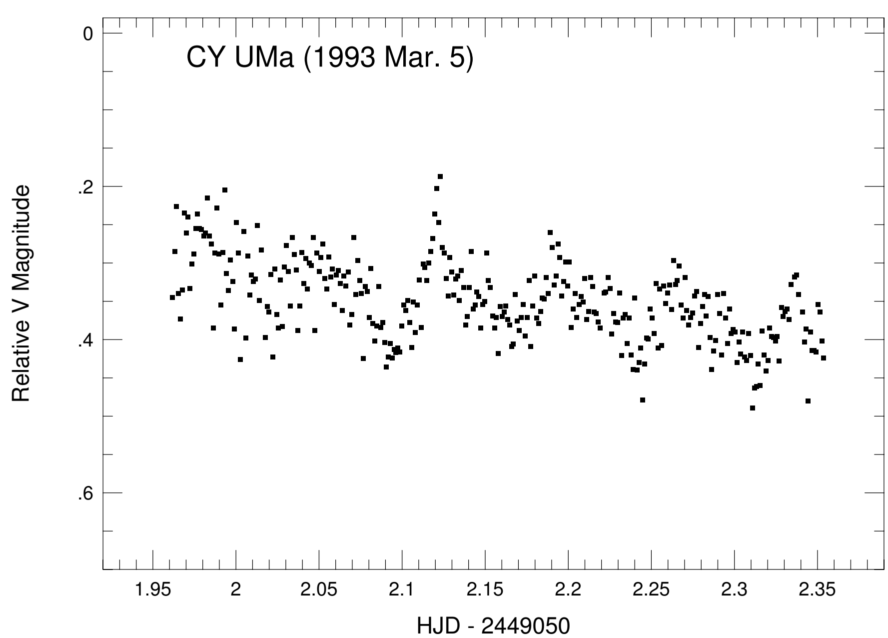

Figure 4. The light curve on Mar. 5, 1993 (second outburst). Doubly humped superhumps with a period of 0.0721 day are clearly seen.

The second outburst was followed on one night, Mar. 5, 1993. Doubly humped superhumps were clearly detected (Figure 4). A period analysis with the same procedure as in the first outburst has yielded a superhump period of 0.0721 ± 0.0003 day. A small difference of superhump periods obtained during two different superoutbursts may reflect intrinsic period variation of superhumps. From these observations we may safely conclude that the superhump period of CY UMa is 0.0719 ± 0.0005 day, which was later independently confirmed during the 1995 superoutburst by Harvey, Patterson (1995), who gave a period of 0.0724 ± 0.0005 day. The star was recently investigated by two groups based on radial velocity study; Martínez-Pais, Casares (1995) gave an orbital period of 0.06795 ± 0.00008 day, and Thorstensen (1995) 0.06957 ± 0.00004 day. The value of fractional superhump excess ($(P_{\rm SH} - P_{\rm orb})/P_{\rm orb}$) obtained by our superhump period seems to support the latter period, but near coincidence of the former period with one observed after the first outburst would require additional confirmation of the true orbital period.

The author is grateful to P. Schmeer for notifying him of the outbursts, and J. R. Thorstensen and J. Patterson for providing their preprints. Part of this work is supported by a Research Fellowship of the Japan Society for the Promotion of Science for Young Scientists.

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

Number 4237

Konkoly Observatory
Budapest
30 August 1995

HU ISSN 0374 – 0676

BV PHOTOMETRY OF THE DELTA SCUTI STAR IOTA BOOTIS

The light variation of Iota Bootis (= 21 Boo = NSV 06610 = HR 5350) was discovered by Albert (1980). Based on his data he concluded that Iota Bootis may be a Delta Scuti-type variable with a very short period (about 40 minutes). Szatmáry (1988) had similar result, which was confirmed by Gál et al. (1994). Unfortunately these measurements had very limited accuracy therefore only the existence of the variation with a period close to 40 min. was demonstrated.

We carried out photoelectric photometry (through B and V filters) on two nights, 24 and 26 May, 1995 with the 40 cm Cassegrain type telescope of Szeged Observatory using an SSP-5A photometer. The comparison star was HR 5360. The main aim of our measurements was to determine the exact period of variation and its amplitude in B and V. On these two nights we collected 155 points in two colors which cover about 10 cycles of the light curve (the individual observations are available through e-mail – see below).

In order to determine the exact period of variation we calculated the Fourier-transform (DFT) of B and V light curves separately and the phase dispersion spectra (PDM) too. The results in the different colors and with different methods are in agreement with each other (the variance is about 0.0002-0.0003 day). The correct value of the period is 0.0276 day (39.7 min) with an estimated error of ± 0.0003 day (0.4 min).

We plotted the averaged Fourier spectrum of B light curves in Figure 1. The period can be better determined with this averaging because the amplitude of noise decreases relatively to the highest peak (Gál et al., 1994). The phase diagram can be seen in Figure 2.

The Fourier amplitudes of the light variation are 0.007 and 0.005 magnitude in B and V, respectively. We fitted a sine function to the light curves in B (because of their regularity and higher S/N ratio) which are plotted in Figure 3.

The fitted function is

$$\Delta B = -1.291 + 0.007 \sin(2\pi \cdot 36.231884 \cdot T + 2.7),$$

where the frequency is in c/d, the phase is in radian and T means HJD−2440000.

We can conclude that the photometric period of Iota Bootis is 0.0276 ± 0.0003 day (=39.7 ± 0.4 min) which value confirms the results of previous studies. The full amplitudes are 0.015 and 0.010 magnitude in B and V, respectively, which show that this variation is very close to our limited accuracy. Therefore more accurate (0.001 magn. precision) photoelectric measurements are recommended.

The mode identification is difficult. In the case of double star Tau Cygni (Mkritichian et al., 1995) which has very similar light variation, the density determined from the orbital period gave a possibility to calculate the pulsational constant and comparing with the theory the excited mode could be estimated.

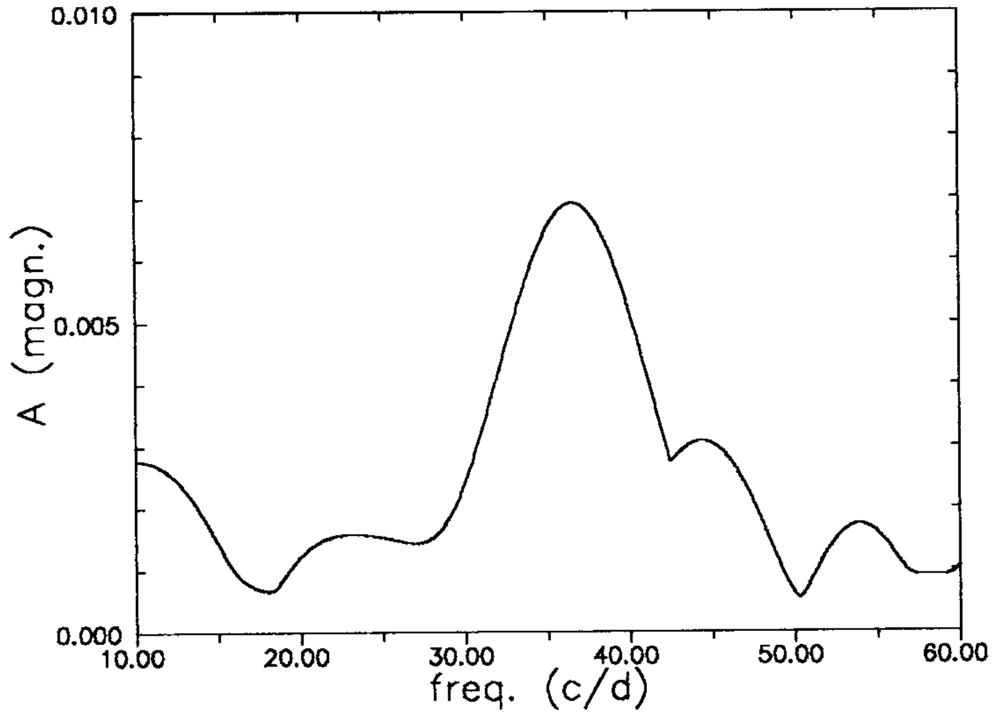

Figure 1. The mean Fourier spectrum of the B light curves

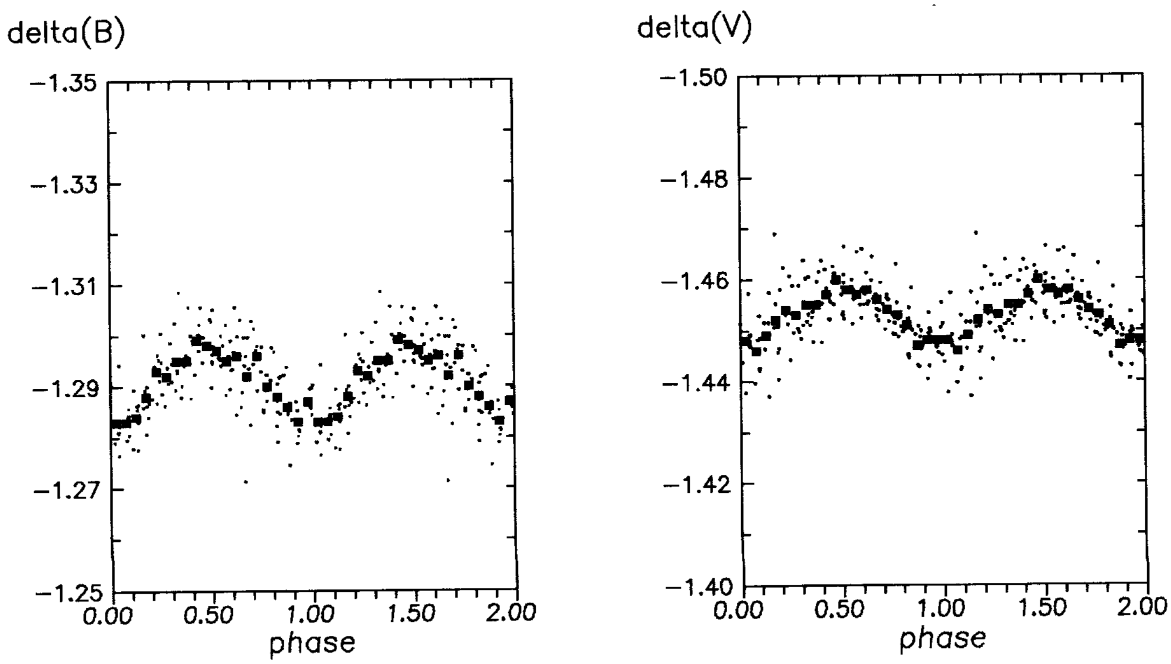

Figure 2. The phase diagram of Iota Bootis (P=0.0276 day, T_0= HJD 2449800.01)

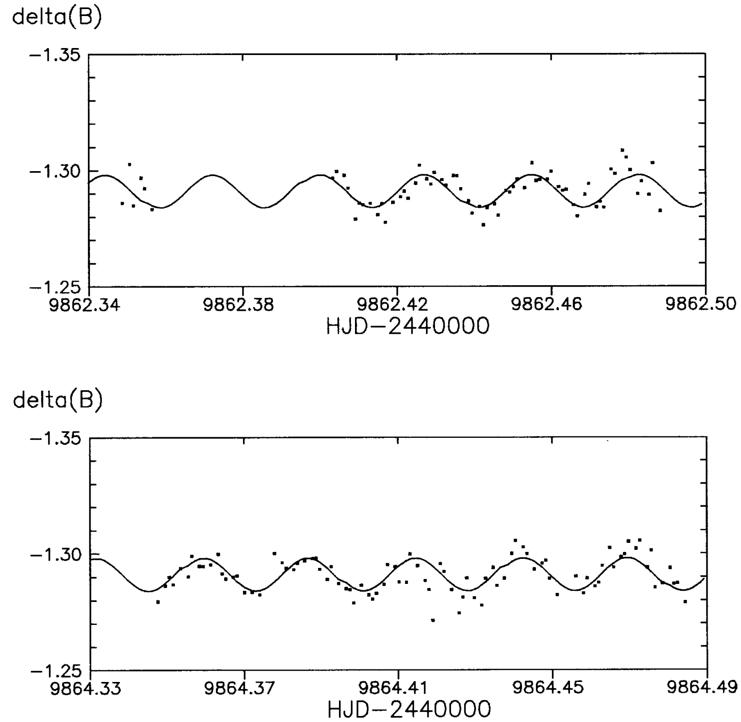

Figure 3. The 24 May (upper panel) and 26 May (lower panel) light curve with the fitted sine curve

The author wishes to express his thanks to Drs K. Szatmáry and J. Vinkó for their useful suggestions and advice. This work has been supported by Hungarian OTKA Grants No.4330 and No. 7522, Foundation of Pro Renovanda Cultura Hungariae, 'Diákok a tudományért' Grant Dt. 1995/30 and Szeged Observatory Foundation.

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

Number 4238

Konkoly Observatory
Budapest
4 September 1995

HU ISSN 0374 – 0676

POSITIONS OF VARIABLES IN SOUTHERN CLUSTERS

This note reports positions and GSC identifications for 37 new variables in southern star clusters, originally announced several years ago in two issues of IBVS (Lapasset and Claria 1985; Lapasset, Claria and Minniti 1991).

All stars have been searched for in the Guide Star Catalog, and DM catalogues. The identifications are listed in Table 1A (for stars in the 1985 paper) and Table 1B (1991 paper). Stars are grouped with their respective clusters, and in the same order as in the discovery papers. GSC numbers and magnitudes are given to enable correct identification. Coordinates are taken directly from the GSC, except for a few non-GSC entries which have been measured relative to nearby stars.

In one instance, NGC 2539-5 & 6, the IBVS finder chart does not separate this pair cleanly, and I have found the digitized NASA Skyview image gives much better resolution.

Table 1A: New variables in open clusters (according to IBVS No. 2749). Identifications and coordinates.

Clust.-member	GSC No.	GSC Mag.	RA (J2000)	Decl. (J2000)	Notes
NGC 2323-58	5381.00144	12.60	$07^h02^m48\overset{s}{.}1$	−08°13'40"	
NGC 2323-100	5381.01376	13.31	07 02 44.1	−08 22 53	
NGC 2323-160	5381.01692	12.21	07 02 47.2	−08 30 25	
NGC 2567-19	7122.01262	13.40	08 18 34.5	−30 38 01	
NGC 2567-35	7122.01299	13.52	08 18 49.3	−30 35 41	
NGC 2567-40	....	.....	08 18 48.0	−30 38 13	Note 4.
NGC 2567-58	7122.01338	12.72	08 18 23.5	−30 40 12	
IC 2395-169	8155.03642	11.63	08 44 07.7	−48 04 03	Note 1.
IC 2395-220	8155.06178	12.81	08 41 37.0	−48 24 59	
NGC 5460-330	8268.02472	13.43	14 08 01.4	−48 07 19	
NGC 5460-337	8268.01848	13.16	14 08 26.9	−48 21 38	
NGC 5460-366	8268.01682	13.23	14 06 50.8	−48 15 07	
NGC 5460-375	8268.03365	13.40	14 08 43.3	−48 26 26	
NGC 5662-17	8687.01183	11.70	14 36 14.4	−56 40 33	
NGC 5662-166	8687.01606	13.07	14 36 37.1	−56 27 23	

Table 1B: New variables in open clusters (according to IBVS No. 3594). Identifications and coordinates.

Clust.-member	GSC No.	GSC Mag.	RA (J2000)	Decl. (J2000)	Notes
NGC 2437-174	5422.00717	11.31	$07^h41^m51\overset{s}{.}5$	−14°54'29"	Note 2.
NGC 2453-50	6548.00790	11.00	07 47 33.1	−27 11 35	Note 3.
NGC 2539-1	5434.02555	12.13	08 10 55.8	−12 47 14	
NGC 2539-2	5434.03158	13.35	08 11 00.5	−12 50 43	
NGC 2539-3	5434.03081	11.54	08 10 38.1	−12 50 42	
NGC 2539-4	5434.03488	13.35	08 10 34.6	−12 49 36	
NGC 2539-5	....	.....	08 10 18.9	−12 47 33	Note 4.
NGC 2539-6	5434.00867	11.29	08 10 18.4	−12 47 39	
NGC 2539-7	5434.03191	13.55	08 10 57.7	−12 46 45	
NGC 2539-8	5434.02488	13.49	08 11 24.9	−12 45 01	
NGC 2539-9	5434.03140	14.23	08 10 17.5	−12 42 36	
NGC 2539-10	5434.02816	12.89	08 10 42.9	−13 00 42	
NGC 2539-11	5434.02863	14.42	08 10 20.7	−12 53 40	
NGC 5749-40	8684.01484	13.40	14 48 03.9	−54 36 16	
NGC 5749-64	8684.00908	12.98	14 48 33.3	−54 28 44	
NGC 5749-82	....	.....	14 49 45.1	−54 29 10	Note 4.
Cr223-10	8613.01333	12.45	10 29 53.6	−59 55 11	
Cr223-41	8956.01910	11.95	10 29 24.8	−60 05 15	
Cr223-42	8956.02557	12.15	10 29 55.5	−60 00 31	
Cr223-105	8956.01289	11.39	10 30 18.8	−60 02 06	
Cr223-109	....	.....	10 30 21.3	−60 00 10	Note 4.

Note 1. IC 2395-169 = CoD−47°4299 (10), CPD−47°2641 (10.2).
Note 2. NGC 2437-174 = BD−14°2136 (10).
Note 3. NGC 2453-50 = CoD−26°4987 (9.7).
Note 4. Not in GSC.

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Lapasset, E. and Claria, J.J. and Minniti, D., 1991, *IBVS*, No. 3594

CORRECTED POSITION FOR EV Aqr

I have reported (Morel, 1994) the position of EV Aqr as being that of a GSC star. The finder chart I used was the one of Tsesevich and Kazanasmas (1971). However, the recent atlas of cataclysmic variables by Downes and Shara (1993) indicates the correct position is slightly to the south of the GSC star (GSC 0526.01562). They give the following position:

$$(\mathrm{J2000})\ 21^{h}6^{m}19^{s}\quad +0°51'53''$$

which corresponds to the faint candidate in their atlas.

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4239

Konkoly Observatory
Budapest
5 September 1995

HU ISSN 0374 – 0676

OBSERVATIONS OF KV ANDROMEDAE DURING THE 1994 SUPEROUTBURST

KV And is a faint dwarf nova discovered by Kurochkin (1977). The object was photometrically studied by Kato et al. (1994), who discovered superhumps during its long outburst in November, 1993. Their observations established KV And as a new member of SU UMa-type dwarf novae, esp. as a good candidate for a TOAD (Tremendous Amplitude Dwarf Nova; Howell 1993, Howell et al. 1995). They gave two candidate values for the superhump period (P_{sh}) of this dwarf nova: 0.07520 ($\pm$0.00003) day or its alias 0.07427 ($\pm$0.00003) day. Due to a long gap in their observations, discrimination of these two periods should await further observations.

KV And was again caught in outburst on August 10, 1994 by Vanmunster (VSNET message). The authors started a series of time-resolved photometry to determine the true superhump period. The observations were done on six nights between August 11–18, 1994. The journal of observations is summarized in Table 1. Observations were carried out using a CCD camera (Thomson TH7882, 576 $\times$ 384 pixels) attached to the Cassegrain focus of the 60cm reflector (focal length=4.8m) at Ouda Station, Kyoto University (Ohtani et al. 1992). To reduce the readout dead time, an on-chip summation of 2$\times$2 pixels to one pixel was adopted. An interference filter was used which had been designed to reproduce the Johnson V band. The exposure time was between 90–100 sec depending on the brightness of the object.

These frames were first corrected for standard de-biasing and flat fielding, and were then processed by a microcomputer-based automatic-aperture photometry package developed by the author. The differential magnitudes of the variables were determined using a local standard star (C_1: $02^h17^m19\overset{s}{.}93$ $+40°39'50\overset{''}{.}9$ (J2000.0), V=12.6, C_1 in Figure 1). For details of the comparison and the check stars, see Kato et al. (1994).

Overall light curve constructed from all the data is shown in Figure 2. The light curve shows, as in 1993 superoutburst, a linear decline with an averaged rate of 0.12 mag day^{-1}, which is characteristic to a superoutburst of an SU UMa-type dwarf nova. Fig. 3 shows a representative light curve obtained on August 13. A clear superhump feature confirmed that the present outburst is unmistakably a superoutburst.

A period analysis of observations for the whole data set using the Phase Dispersion Minimization (PDM) method (Stellingwerf, 1978), after heliocentric correction and removal of a linear trend of decline, has yielded the best superhump period (P_{sh}) of 0.07434 ($\pm$0.0003) day. Owing to a good continuous coverage, we can now safely reject other aliasing periods in Kato et al. (1994). The new superhump period corresponds to the shorter value of the two most likely periods by Kato et al. (1994). The present period is very slightly (0.1 %) longer than the previously reported one, but the difference is within the errors of each estimate.

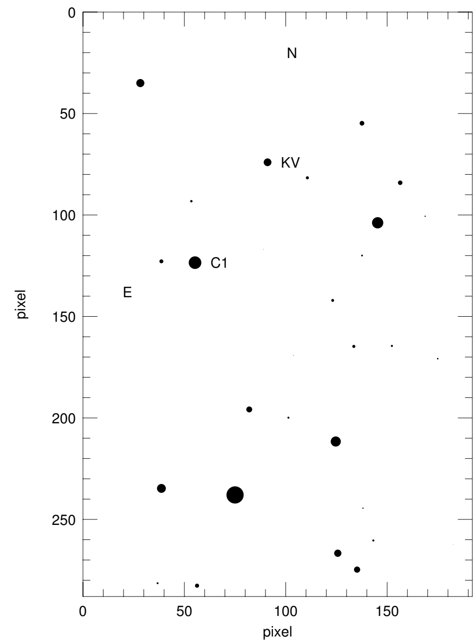

Figure 1. Finding chart of KV And drawn from a CCD image. North is up, and the field of view is about 10×7 arcmin. The primary comparison star (C_1), and KV And (KV) are marked.

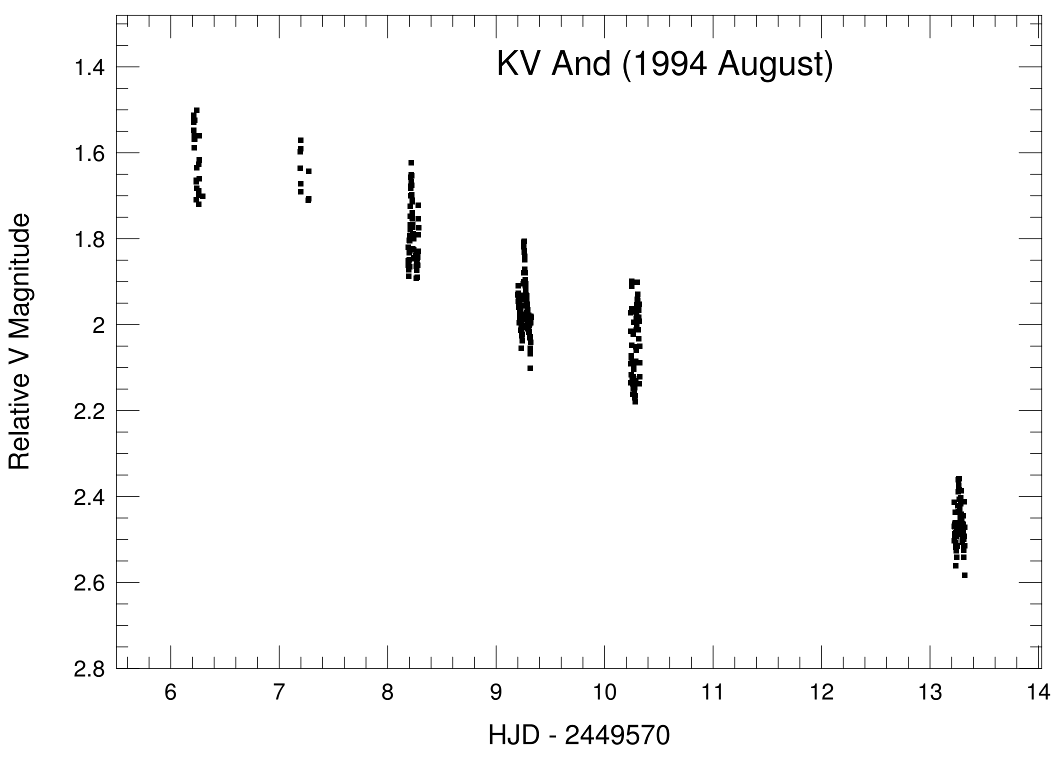

Figure 2. V-band light curve of KV And during a superoutburst in Aug. 1994. The zero point of the relative magnitudes corresponds to V=12.6.

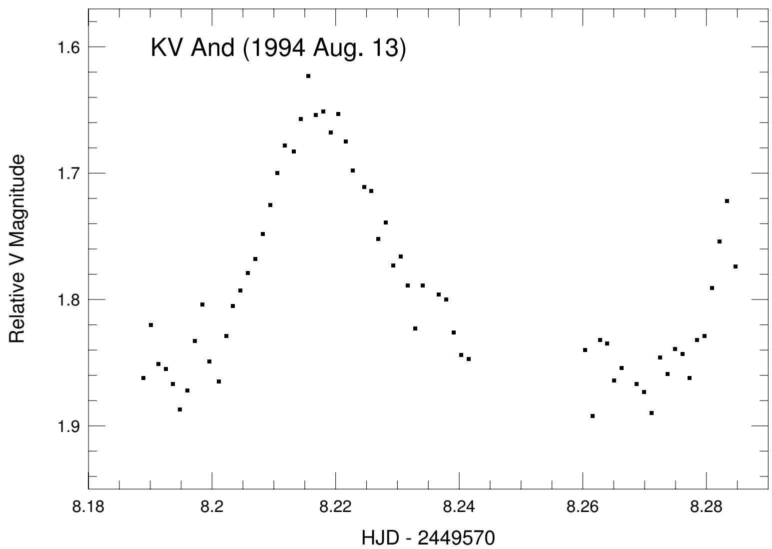

Figure 3. Enlarged light curve on August 13, 1994. A superhump is clearly seen.

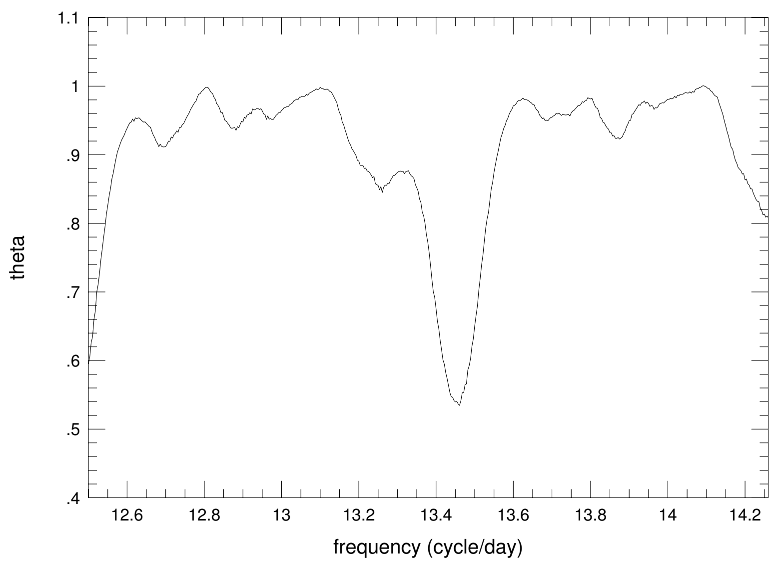

Figure 4. Theta-diagram for all the data obtained by the phase dispersion minimization (PDM) method (Stellingwerf 1978). The minima represent likely periods. The lowest minimum at frequency 13.451 day^{-1} corresponding to 0.07434 day clearly represents the best superhump period of KV And.

Table 1. Journal of observations of KV And

Date	Start (UT)	End (UT)	T*	N†
1994 August 11	17^h00^m	18^h59^m	90^s	25
12	16 37	18 29	90	9
13	16 29	18 47	90	63
14	16 46	19 40	90	100
15	17 41	19 42	90	71
18	17 16	19 40	100	71

* Exposure time.

† Number of useful object frames.

The present observations thus firmly established the superhump period of a suspected TOAD, KV And. From the interval of two recent superoutbursts, we can determine the cycle length of superoutburst (supercycle) as $\sim$ 270 days. The cycle length of normal outbursts can be guessed from recent visual observations, which gave the two shortest observed intervals as 18 days and 55 days (Vanmunster, Howell 1995). We cannot yet firmly say the typical cycle length of normal outbursts in this dwarf nova system, but the recent data seem to give shorter values than can be derived from discovery observations (Kurochkin 1977). Concerning the TOAD classification, the cycle lengths of 18 – 55 days (normal outburst) and $\sim$ 270 days (superoutbursts) seem to be too short for a dwarf nova with an outburst amplitude of 7.9: mag (cf. Table 2 in Howell et al. 1995). Clearly more precise determination of the quiescent magnitude would be a next step in understanding KV And.

The author is grateful to Tonny Vanmunster for notifying us of the outburst. This work is supported by a Research Fellowship of the Japan Society for the Promotion of Science for Young Scientists.

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Ohtani, H., Uesugi, A., Tomita, Y., Yoshida, M., Kosugi, G., Noumaru, J., Araya, S., Ohta, K. et al., 1992, *Memoirs of the Faculty of Science, Kyoto University, Series A of Physics, Astrophysics, Geophysics and Chemistry*, **38**, 167

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Vanmunster, T., Howell, S. B., 1995, in "Outburst Activity Data on Selected Cataclysmic Variables"

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

Number 4240

Konkoly Observatory
Budapest
6 September 1995

HU ISSN 0374 – 0676

PHOTOELECTRIC PHOTOMETRY OF UV LYNCIS IN 1994

UV Lyn (=BD +38°1992) was discovered to be an eclipsing binary by Kippenhahn (Geyer, Kippenhahn and Strohmeier, 1955). Kuklin (1961) gave several times of minima. Strohmeier, Knigge and Ott (1964) found that the star is of the EB type with a period of about 1.2 days. Strohmeier (1968, see Bossen, 1973) suspected the period to be incorrect and Bossen (1973) found that the star is a W UMa type binary with a period of 0.415 days but the two maxima present unequal brightness. He gave a total of 70 times of minima. Markworth and Michaels (1982) indicated that UV Lyn is an over-contact system, and they suggested that it may be an excellent object in studying mass exchange in contact systems.

Since the additional times of minima were given by Lichtenknecker (1979, 1981, 1982, 1983), Braune (1982), Hübscher (1982), Zimmermann (1982, 1983), Grzelczyk (1983), Vielmetter (1983), Quester (1985) and Pietz (1989) from visual or photographic observations. Fernandes (1983) and Agerer (1990, 1991, 1993) published some photoelectric minima.

In 1994 we observed UV Lyn with the 60-cm reflector at the Xinglong Station of Beijing Observatory. On December 12, 13 and 14, the observations were carried out in B and V with a single channel photon counting photometer. BD +38°1990 was adopted as a comparison star.

A total of 176 photometric observational points in each B and V obtained, covering a complete orbital cycle. The measurements have been corrected for differential atmospheric extinction and transferred into the UBV standard system.

By using the K-W method, two new times of minima were determined as listed in Table 1.

Table 1. New times of minima of UV Lyn

JD(hel) 2440000+	filter	m. e	Min.
9699.2752	V	±0.0004	II
9699.2751	B	.0004	II
9700.3088	V	.0003	I
9700.3088	B	.0003	I

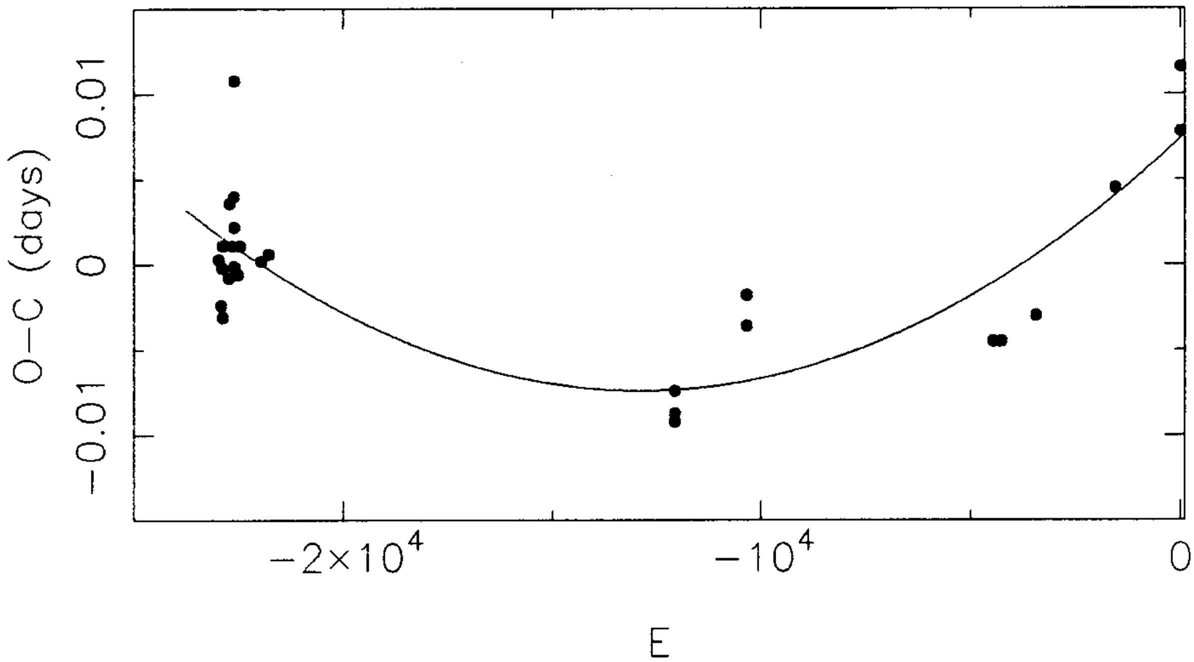

Figure 1. The O−C diagram of the minimum times of UV Lyn.

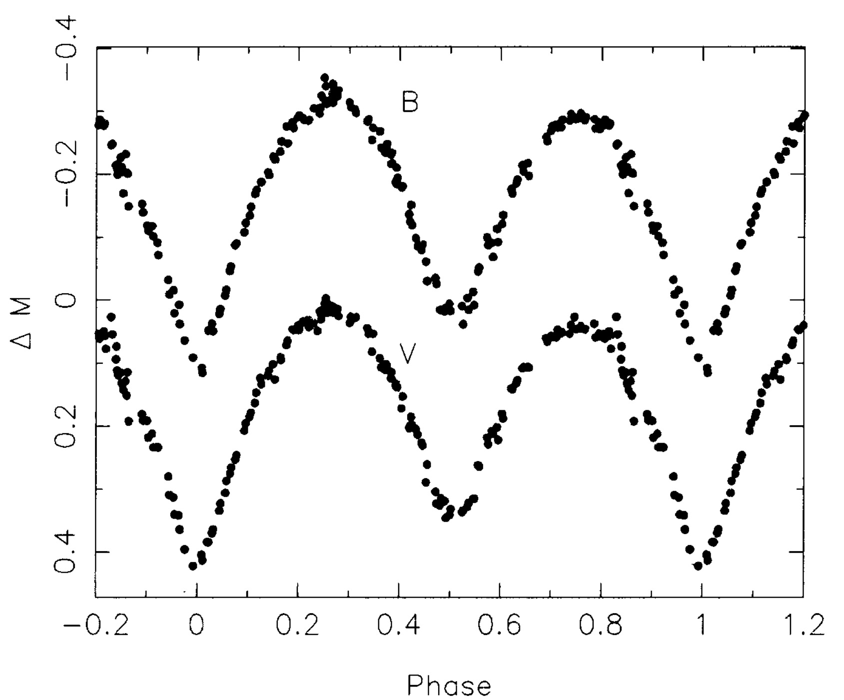

Figure 2. The light curves of UV Lyn in 1994.

Table 2. Photoelectric times of minima of UV Lyn

T_0 JD(hel) 2440000+	E	O−C	Source
165.6815	−22976.0	.0003	Bossen (1973)
187.4654	−22923.5	−.0024	Bossen (1973)
199.7095	−22894.0	−.0002	Bossen (1973)
203.6531	−22884.5	.0011	Bossen (1973)
205.7238	−22879.5	−.0031	Bossen (1973)
265.4835	−22735.5	−.0008	Bossen (1973)
271.5051	−22721.0	.0036	Bossen (1973)
303.4562	−22644.0	.0011	Bossen (1973)
314.4562	−22617.5	.0040	Bossen (1973)
318.4053	−22608.0	.0108	Bossen (1973)
319.4341	−22605.5	.0022	Bossen (1973)
320.4693	−22603.0	−.0001	Bossen (1973)
357.4022	−22514.0	−.0006	Bossen (1973)
377.3230	−22466.0	.0011	Bossen (1973)
586.6804	−21961.5	.0002	Bossen (1973)
657.4351	−21791.0	.0006	Bossen (1973)
4693.7449	−12064.5	−.0092	Markworth, Michaels (1982)
4694.7842	−12062.0	−.0074	Markworth, Michaels (1982)
4696.6503	−12057.5	−.0087	Markworth, Michaels (1982)
5406.4816	−10347.0	−.0036	Fernandes (1983)
5407.3134	−10345.0	−.0018	Fernandes (1983)
7849.4781	−4460.0	−.0045	Agerer (1990, 1991, 1993)
7929.5706	−4267.0	−.0045	Agerer (1990, 1991, 1993)
8272.3459	−3441.0	−.0030	Agerer (1990, 1991, 1993)
9055.4239	−1554.0	.0045	Agerer (1990, 1991, 1993)
9699.2751	−2.5	.0116	This paper
9700.3088	0.0	.0078	This paper

Because of the relatively low accuracy of the times of minima from visual and photographic observations, we use only the photoelectric minima published (see Table 2) and derived a new linear and quadratic ephemeris by the least squares method as follows:

$$\text{Min I.=JD (hel) } \underset{\pm 14}{2449700.3010} + \underset{8}{0^{\text{d}}.41498171} \times E$$

and

$$\text{Min I.=JD (hel) } \underset{\pm 12}{2449700.3084} + \underset{25}{0^{\text{d}}.41498401} \times E + \underset{97}{8.94} \times 10^{-11} \times E^2.$$

The O−C diagram of the minimum times is shown in Figure 1, from which it seems that the period of UV Lyn is increasing distinctly but slowly. This is different from the result given by Bossen.

By using the linear ephemeris, the observations were combined into complete light curves as given in Figure 2. The light curves show obvious asymmetry with Max I brighter than Max II by about 0.03 mag in V and 0.05 mag in B, respectively. In view of the period changes in UV Lyn, it is suggested that a mass transfer from the secondary to the primary may exist in UV Lyn, and the asymmetry of light curves could be caused by the mass stream between the two components.

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

Number 4241

Konkoly Observatory
Budapest
6 September 1995

HU ISSN 0374 – 0676

NSV 4219 UMa: AN RR Lyr VARIABLE

The variability of NSV 4219 UMa (= CSV 6652 = BV 28) was discovered by Strohmeier (Geyer et al., 1955) when he compared photographic plates taken at the Bamberg Observatory in 1929 and 1930. The magnitude changes were noted to be rapid and ranging between 11.1 and 11.9 (p).

NSV 4219 is a visual double star. Its companion is of magnitude 12.61 (V) with a B−V of 0.53.

The first photoelectric measurements of NSV 4219 UMa were obtained during a GEOS mission at the Jungfraujoch station, at the end of 1992. Others were obtained subsequently and I have now 47 measurements at my disposal made with the photometer attached to the Jungfraujoch Observatory 76-cm telescope equipped with the B and V filters of the Geneva photometric system. It covers most of the star's cycle with an instant of maximum.

To date, I have one photoelectric maximum and 21 maxima determined from visual estimates at my disposal (Vandenbroere, 1995).

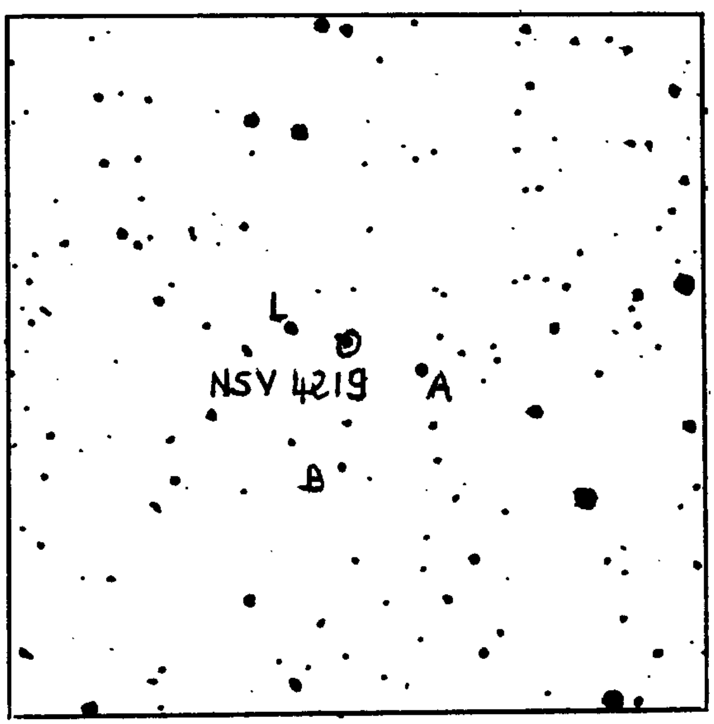

Figure 1. Identification chart of NSV 4219 UMa and its comparison stars.

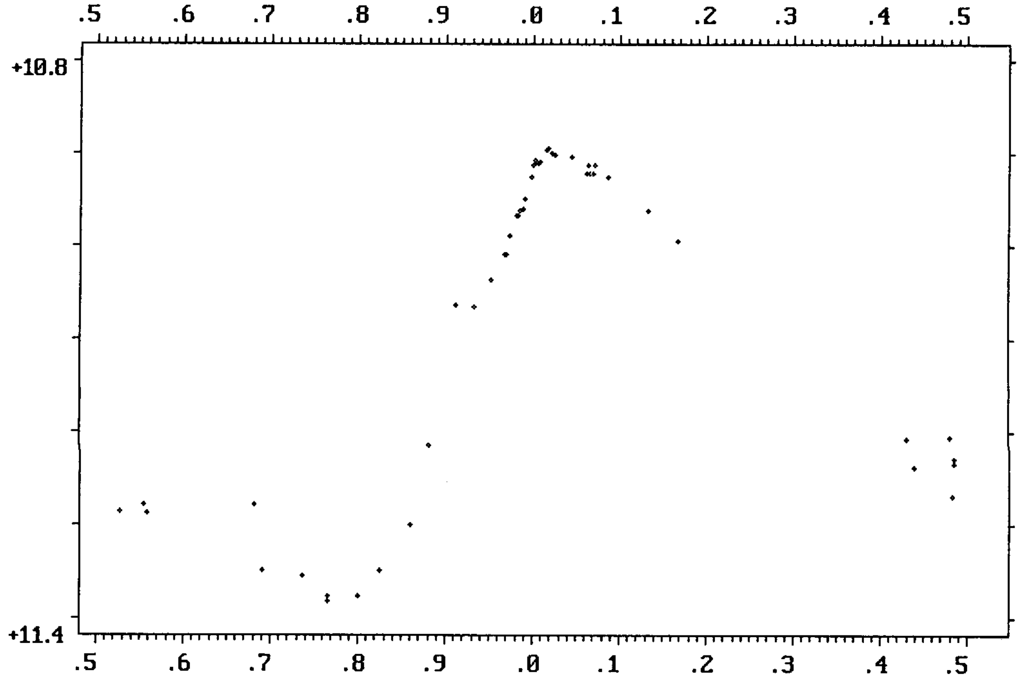

Figure 2. Composite light curve of the photoelectric measurements in V of NSV 4219 UMa using ephemeris (1).

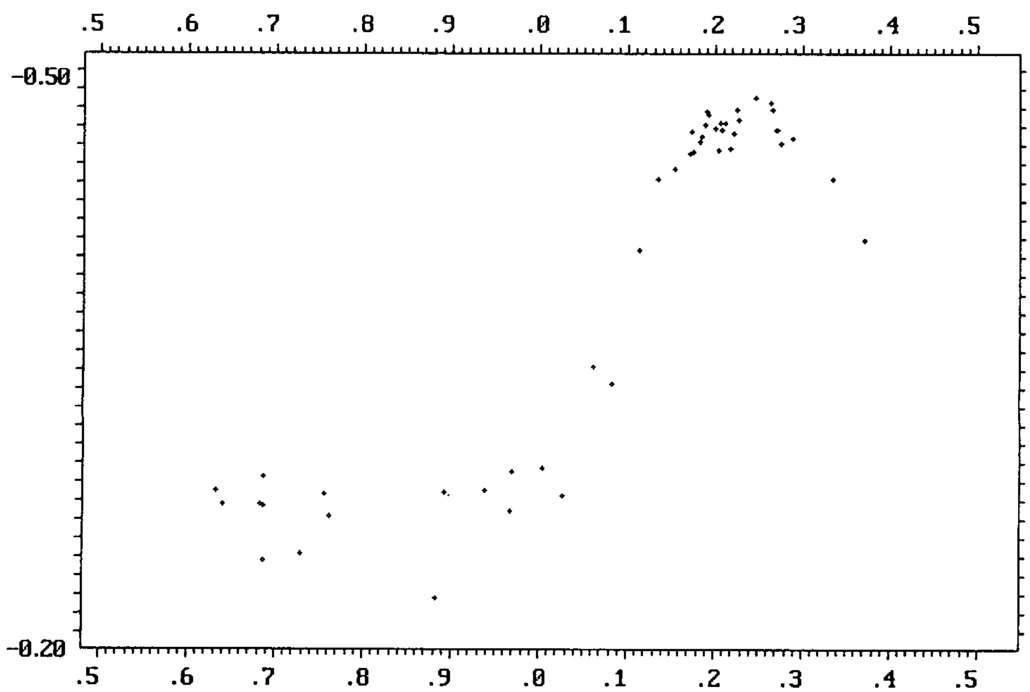

Figure 3. Phase curve of the photoelectric indices (B−V)G of NSV 4219 UMa using ephemeris (1).

Giving a triple weight to the photoelectric moment, I used the 22 instants to calculate the elements of the period of NSV 4219 UMa by linear regression and obtained the following ephemeris:

$$\text{Max=JD hel } 2449012.9896 + 0\overset{d}{.}5428316 \times \text{E} \qquad (1)$$
$$\pm 0.0048 \ \pm 0.0000093 \qquad \text{(confidence 95\%)}$$

The measurements shown in Figure 2 were obtained with the Jungfraujoch telescope during the following nights: JD 48983 (4 measurements), 48984 (2 measurements), 49097 (2 measurements), 49721 (3 measurements), and 49722 (36 measurements).

Except when in the vicinity of the minimum, all the measurements between phase 0.7 and phase 0.2 were obtained during the same cycle of the variable. The accuracy is ±0.03 magnitude in V and the non-alignment of the point at phase 0.91 not necessarily an actual change in the rate of light. The fluctuations at the end of the decreasing phase are probably real because they are typical of the light curve of RR Lyr stars with periods very close to that of NSV 4219 UMa (Lub, 1977).

The ascending phase (M−m) is 0.24 period, which indicates an RRab type star.

The (B−V)G indices of NSV 4219 UMa range from −0.49 to −0.22 (or from 0.39 to 0.61 in the Johnson and Morgan system). They are in agreement with the F spectrum of the New Catalogue of Suspected Variable Stars (1982). The shape of the colour index curve clearly shows that NSV 4219 UMa is a classical pulsating star of the RR Lyr type.

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

Number 4242

Konkoly Observatory
Budapest
12 September 1995

HU ISSN 0374 – 0676

OBSERVATIONS OF SUPERHUMPS IN FO ANDROMEDAE

FO And was discovered as a dwarf nova by Hoffmeister (1967). Subsequent survey of Sonneberg plates revealed a short outburst cycle length of 15–23 days, together with long outbursts which were suspected to be superoutbursts (Meinunger, 1984). This dwarf nova has since been monitored as a good candidate of an SU UMa-type dwarf nova.

The first detection of superhumps with a period of ~105 min was reported by Grauer and Bond (cf. Szkody et al., 1989), but the precise value of the period has not yet been published. We here report the results of CCD photometry obtained during a superoutburst in Aug. 1994.

The observations were carried out using a CCD camera (Thomson TH 7882, 576 × 384 pixels) attached to the Cassegrain focus of the 60 cm reflector (focal length=4.8 m) at Ouda Station, Kyoto University (Ohtani et al., 1992). To reduce the readout noise and dead time, an on-chip summation of 2×2 pixels to one pixel was adopted. An interference filter was used which had been designed to reproduce the Johnson *V* band. The exposure time was between 90 and 120 s depending on the brightness of the object. The frames were first corrected for standard de-biasing and flat fielding, and were then processed by a personal-computer-based aperture photometry package developed by the author. The differential magnitudes of the variable were determined against a local standard star marked as C1 (V=13.06; Thorstensen et al., 1995) in Figure 1. The constancy of this comparison was checked against several stars in the same field. Total number of useful frames was 319.

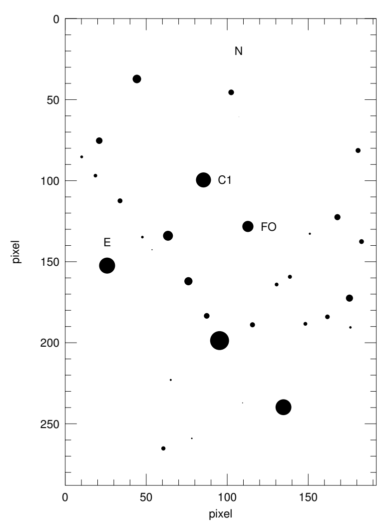

Figure 1. Finding chart of FO And drawn from a CCD image. North is up, and the field of view is about 10×7 arcmin. The primary comparison star (C1), and FO And (FO) are marked.

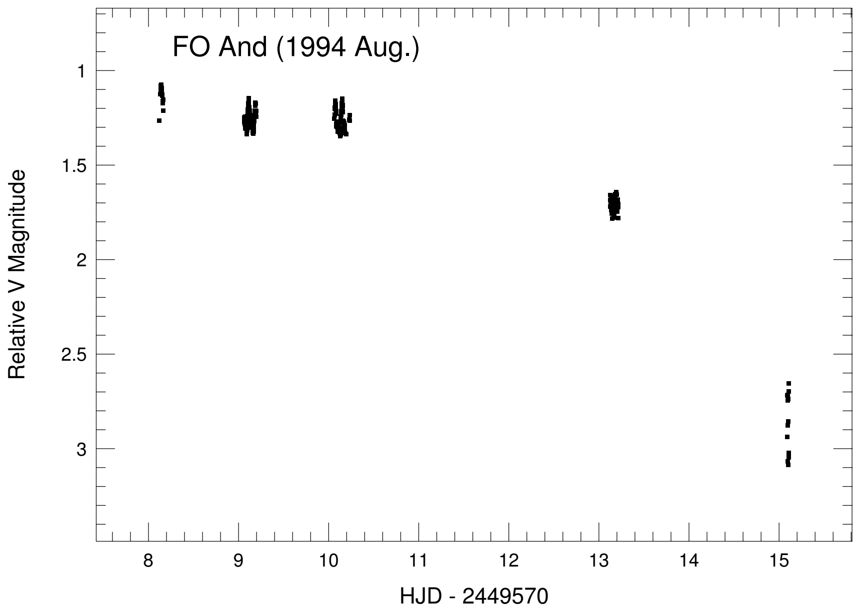

Figure 2. V-band light curve of FO And during a superoutburst in Aug. 1994. The zero point of the magnitude scale corresponds to V=13.06.

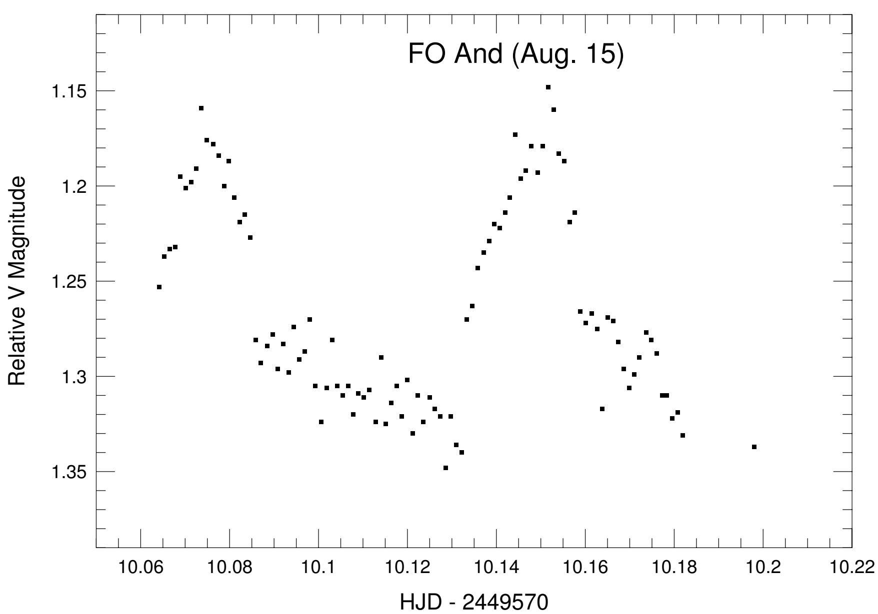

Figure 3. Enlarged light curve based on the Aug. 15 observation. Superhumps with an amplitude of 0.17 mag are clearly seen.

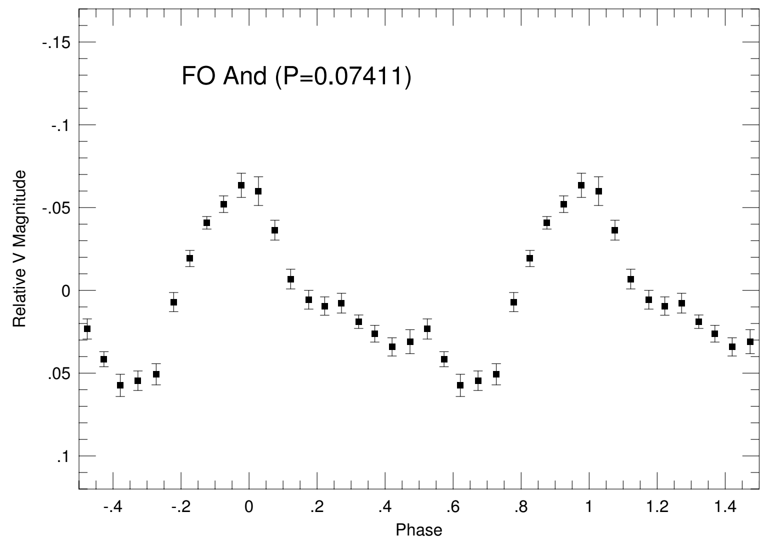

Figure 4. Folded superhump light curve of FO And. Each point represents 0.05 phase bin, and the vertical bar represents the standard error.

Figure 2 shows the overall light curve of FO And by our CCD photometry during the Aug. 1994 superoutburst. Since FO And was reported to be already in outburst on Aug. 10 (VSNET messages), we may conclude that the present outburst lasted at least 10 days. A representative light curve obtained on Aug. 15 (Figure 3) clearly shows superhumps with an amplitude of 0.17 mag. After heliocentric correction and removal of a linear trend of decline (0.097 mag was added to Aug. 15 data to correct a systematic deviation from the linear trend), a period analysis was applied to observations for the period of Aug. 13–18 using the Phase Dispersion Minimization (PDM) method (Stellingwerf, 1978). The resultant superhump period was 0.07411 $\pm$ 0.00005 day, which is about 1.5 % longer than that obtained by Grauer and Bond. A folded light curve (Figure 4) by this period clearly shows a profile of full-grown superhumps. FO And has thus become a member of SU UMa-type dwarf novae with well-determined superhump period.

Quite recently Thorstensen et al. (1995) report the orbital period of FO And as 0.07161 $\pm$ 0.00018 based on radial velocity study. By comparison with this period, we obtain the fractional superhump excess ($(P_{\rm SH} - P_{\rm orb})/P_{\rm orb}$) as 3.5 $\pm$ 0.3 %, which places FO And within usual distribution of fractional superhump excesses of SU UMa-type dwarf novae with similar orbital periods.

The author is grateful to VSNET and VSOLJ members for continuously providing him with the outburst information, and J. R. Thorstensen for providing his preprint. Part of this work is supported by a Research Fellowship of the Japan Society for the Promotion of Science for Young Scientists.

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

Number 4243

Konkoly Observatory
Budapest
18 September 1995

HU ISSN 0374 – 0676

OBSERVATIONS OF 1993 SUPEROUTBURST OF TT Boo

Although first suspected to be a Z Cam-type dwarf nova in the third edition of GCVS, TT Boo has been a good candidate of SU UMa-type dwarf novae since discovery of possible superhumps with a period of 97 min by Thorstensen and Brownsberger in 1986 (cf. Howell and Szkody, 1988). Possible detection of 111-min modulation during quiescence was reported by Howell and Szkody (1988). This period was attributed to the possible orbital period, but apparent discordance with the reported superhump period should await further observations. Confirmatory observation of superhumps was further reported by Udalski (1991), but the period was not published. Despite its brightness at maximum ($m_v \sim 12^{m}.7$) and rather frequent outbursts, the system parameters of TT Boo remained poorly studied since. The author therefore undertook a series of CCD photometry during an apparent superoutburst in April 1993, in order to confirm the classification and to determine the accurate superhump period.

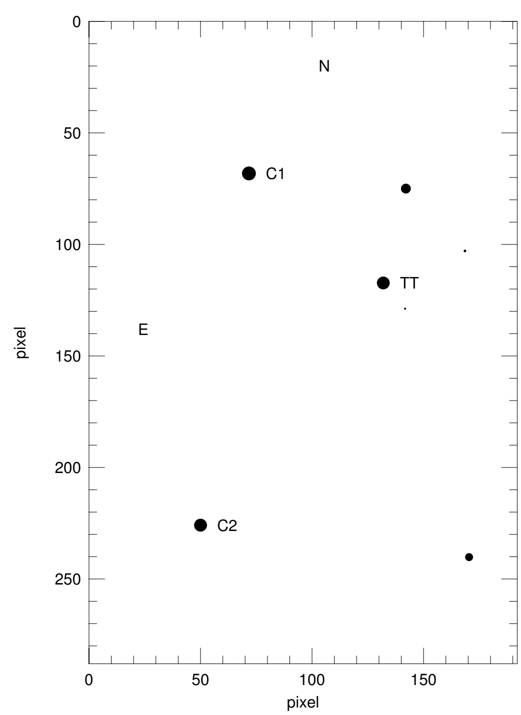

Figure 1. Finding chart of TT Boo drawn from a CCD image. North is up, and the field of view is about 10×7 arcmin. The primary comparison star (C1), check star (C2) and TT Boo (TT) are marked.

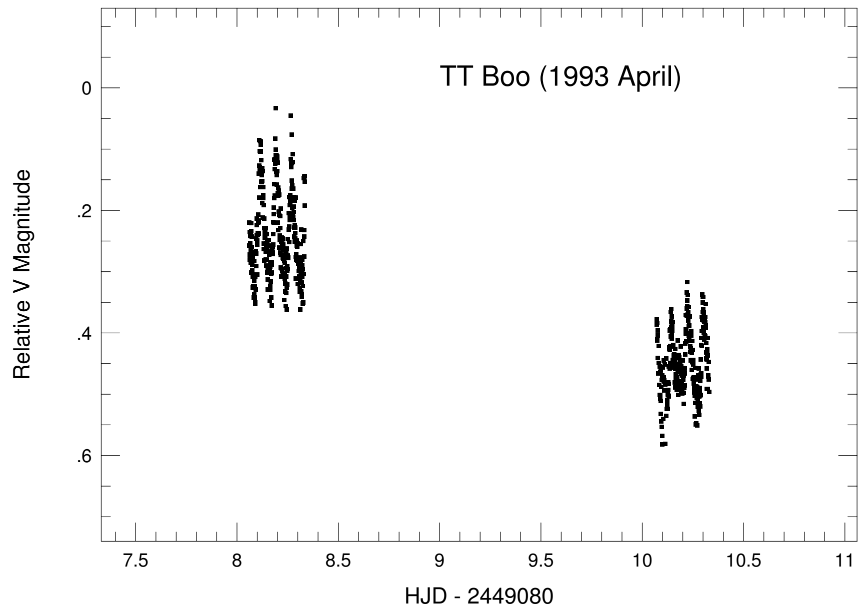

Figure 2. *V*-band light curve of TT Boo during a superoutburst in April 1993. The zero point of the magnitude scale corresponds to V=12.8.

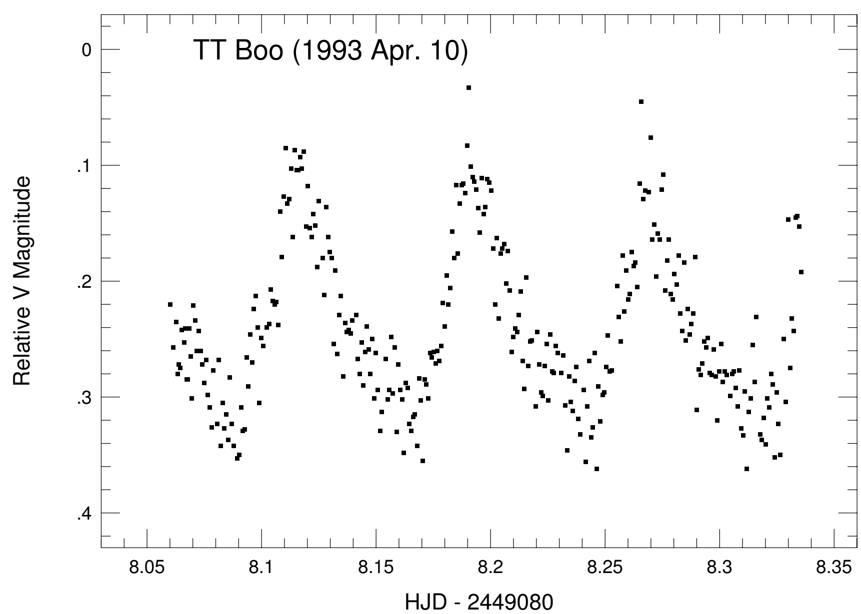

Figure 3. Enlarged light curve on April 10. Superhumps with an amplitude of 0.20 mag are clearly seen.

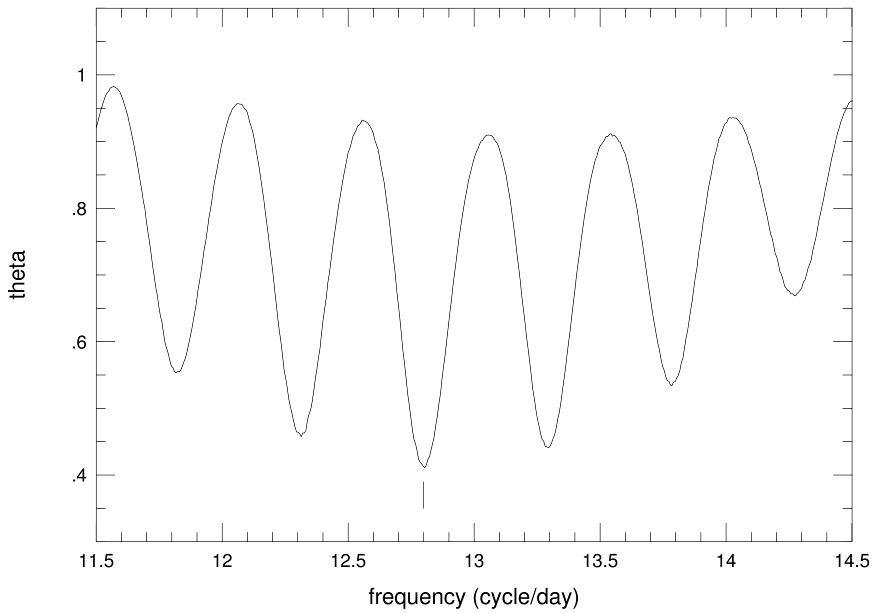

Figure 4. Theta diagram (Stellingwerf 1978) of period analysis for the whole data. A minimum at frequency 12.80 corresponds to the best superhump period of 0.07811 ± 0.00005 day.

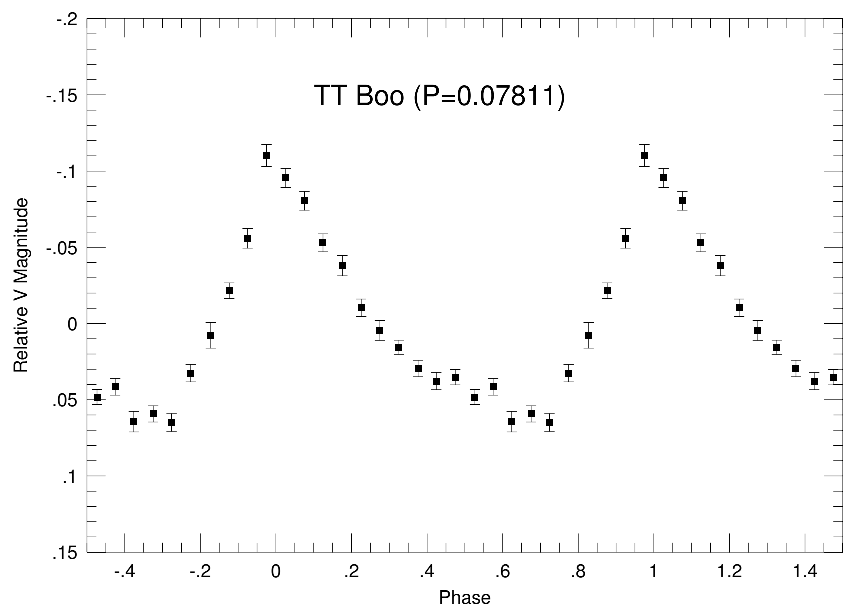

Figure 5. Folded superhump light curve of TT Boo. Each point represents 0.05 phase bin, and the vertical bar represents the standard error.

The observations were carried out using a CCD camera (Thomson TH 7882, 576 × 384 pixels) attached to the Cassegrain focus of the 60 cm reflector (focal length=4.8 m) at Ouda Station, Kyoto University (Ohtani et al., 1992). To reduce the readout noise and dead time, an on-chip summation of 3×3 pixels to one pixel was adopted. An interference filter was used which had been designed to reproduce the Johnson V band. The exposure time of 60 s was adopted; the dead time between exposures was 9 s. The frames were first corrected for standard de-biasing and flat fielding, and were then processed by a personal-computer-based aperture photometry package developed by the author. The differential magnitudes of the variable were determined against a local standard star marked as C1 (V=12.8; Mattei, private communication) in Figure 1. A comparison of the local standard star with a check star (C2 in Figure 1) in the same field has confirmed the constancy of the standard during a run, and gives the expected standard error in the differential magnitudes for the variable as 0.02 mag for a single frame. Total number of useful frames was 621.

The overall light curve is shown in Fig. 2. A slow decline with an averaged rate of 0.11 mag day^{-1} is characteristic of a superoutburst. A representative light curve obtained on Apr. 10 (Figure 3) clearly shows superhumps with an amplitude of 0.20 mag. After heliocentric correction and removal of a linear trend of decline, a period analysis was applied to the whole data set using the Phase Dispersion Minimization (PDM) method (Stellingwerf 1978). A theta diagram is shown in Figure 4. The resultant superhump period is 0.07811 ± 0.00005 day. A folded light curve (Figure 5) by this period clearly shows a profile of full-grown superhumps. TT Boo has thus become a member of SU UMa-type dwarf novae with well-determined superhump period.

The empirical relation of the orbital period and the superhump period in SU UMa-type dwarf novae (Howell and Hurst, 1994) expects the orbital period of this system as ~0.0748 day, which is significantly shorter than the photometric period obtained during quiescence. Accurate determination of the orbital period is therefore desired.

The author is grateful to J. Mattei for providing a photoelectric AAVSO sequence of TT Boo. Part of this work is supported by a Research Fellowship of the Japan Society for the Promotion of Science for Young Scientists.

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

Number 4244

Konkoly Observatory
Budapest
19 September 1995

HU ISSN 0374 – 0676

PHOTOMETRIC VARIATIONS OF THE CENTRAL STAR OF M 1-77 AND SUSPECTED VARIABILITY OF THE CENTRAL STAR OF VV 3-5

In recent years, more and more "cool" central stars of planetary nebulae were discovered to show irregular or, at best, semi-regular photometric variations. Currently, 10 such objects were reported in the literature, namely the central stars of NGC 40, NGC 6543, NGC 6826, IC 418, IC 2149, IC 3568, IC 4593, Hu 2-1, He 2-131 and He 2-138 (Bond & Ciardullo, 1991, Hutton & Méndez, 1993). Most of these objects do not appear to be binaries, and their variability is attributed to either wind variations or pulsations by the different authors.

In order to examine the reason for the variability of these stars, we have started a photometric search for related objects enabling us to learn more about possible group properties. Here we report the discovery of light variations in the central star of M 1-77 and suspected variability of the central star of VV 3-5.

Our observations were carried out in August 1995, with the Texas two-channel photometer attached to the 0.9 m telescope at McDonald Observatory, employing only channel 1 to acquire differential photometry. All our target stars have small nebulae, allowing us to include the whole nebula in the aperture. This prevents variable influence of the nebular background.

We chose two comparison stars (C1 and C2) for each object, measuring them together with the planetary nebula (PN) in the order: C1–PN–C2–C1–PN–C2–... The comparison stars, typically of 9–10 mag, were integrated for about 60 seconds, the planetary nebula about 120–180 seconds, depending on its magnitude. A Johnson V filter was mainly used, in order to minimize the nebular contribution to the data without losing too many photons from the central star.

All data were corrected for sky background and for extinction. No dead-time correction was applied, since the count rates were lower than 15 000 counts per second. The relative zeropoints of the measurements of the different stars were calculated for the first night and subtracted from the data except for a small offset for plotting purposes. These relative zeropoints were applied for all other nights of observation. The resulting light curves were analysed for variability.

Let us first describe our findings for M 1-77 in detail; its light curve can be found in Figure 1. M 1-77 appeared to be variable already in the first night we observed it. However, since the light modulation was very well correlated with air mass, we first suspected that we could be confronted with an artifact caused by strong nebular emission, i.e. we could be measuring the central star at an effective wavelength different from that of the comparison stars.

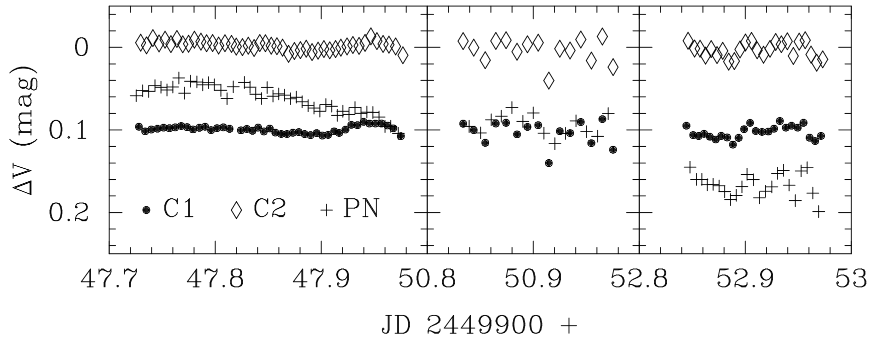

Figure 1: Differential time-series photometry of M 1-77 (PN), SAO 50704 (C1) and SAO 50708 (C2). M 1-77 is clearly variable.

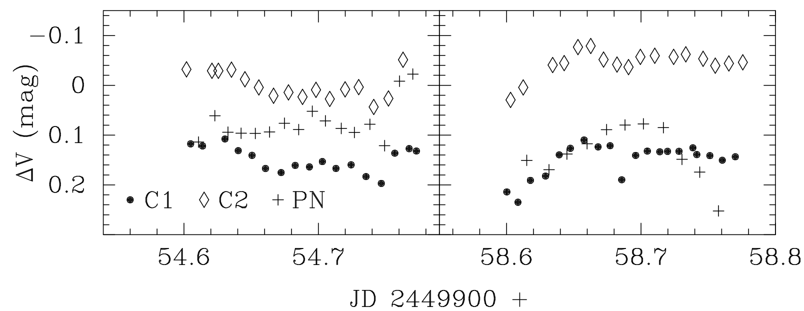

Figure 2: Differential time-series photometry of VV 3-5 (PN), SAO 161649 (C1) and SAO 187052 (C2). We suspect that VV 3-5 is variable.

Therefore, we re-observed the star with both the V and the y filter three nights later. The y filter is almost a continuum filter for planetary nebulae, and since M 1-77 is bright, we did not have to increase the integration time too much. In this night, the star did not appear to be variable (middle panel of Figure 1) on time scales of hours. However, it was constant in *both* filters, convincing us that the variations in the first night were intrinsic. Note that the mean magnitude of the star has changed from the first night to the second night. We again observed the star two nights later, finding that it was even dimmer than on the second night. Thus, we consider its variability to be well established. Moreover, M 1-77 behaves very similarly to the best investigated "cool" variable central star, HD 35914, the central star of IC 418 (Méndez et al., 1986).

Our observations of VV 3-5 are somewhat harder to interpret. First, we note that the star has a companion about 1.5 magnitudes brighter in approximately 20 arcseconds distance. This companion was always carefully excluded from the aperture. Since telescope tracking was excellent, VV 3-5 or the companion did not move towards the edge of the aperture during the integration. However, the photometric quality of the nights during which VV 3-5 was observed was not as good as those we spent on M 1-77. Our light curves are displayed in Figure 2.

In both nights, the light curves of VV 3-5 did not follow those of the comparison stars closely. Moreover, the zeropoints were also not the same in the different nights. On the other hand, the magnitude difference of the comparison stars also changed slightly. This can be attributed to bad photometric quality or to intrinsic variability of at least one of the comparison stars. The latter would be somewhat surprising, since both comparison stars have spectral types of B8.

Consequently, we can only suspect that VV 3-5 is intrinsically variable. We strongly suggest further observations of this star, preferably with CCDs because of the companion mentioned above.

The first part of our survey for photometric variations among "cool" central stars of planetary nebulae increased the number of variables to 11, maybe 12. The relatively large number of variables suggests that light modulation might be a rather common phenomenon for these stars. Therefore, the discovery of further related objects is rather of statistical interest, but should not be considered as a great surprise.

Acknowledgements: This research was partially supported by the Austrian Fonds zur Förderung der wissenschaftlichen Forschung under grant S-7309.

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

Number 4245

Konkoly Observatory
Budapest
22 September 1995

HU ISSN 0374 – 0676

NSV 02733, AN ECLIPSING VARIABLE STAR IN AURIGA

NSV 02733 (WR 123, CSV 006411), was catalogued as a suspected variable star (Kholopov, 1982) after the observations made by Weber (1963). It was originally recorded as a probable cepheid without any reference to spectral type and photometric elements. Just a photographic range from $12^m_.3$ to $13^m_.3$ was given. NSV 02733 can unambiguously be identified with star GSC 2924.1750.

During nearly two and a half month period, from February 5 to April 16, 1995, photometry of this star was performed in the V band using LYNXX-2, Starlight Xpress and ST-4 CCD cameras attached to the respectively four 0.4-m telescopes at Observatorio de Piera, Observatorio de Hostalets de Pierola, Observatorio de Monegrillo and the 0.3-m telescope at Observatorio de Sant Quinti de Mediona (Spain). GSC 2924.1971 was used as comparison star, and GSC 2924.2126 and GSC 2924.1868 as check stars (see Figure 1).

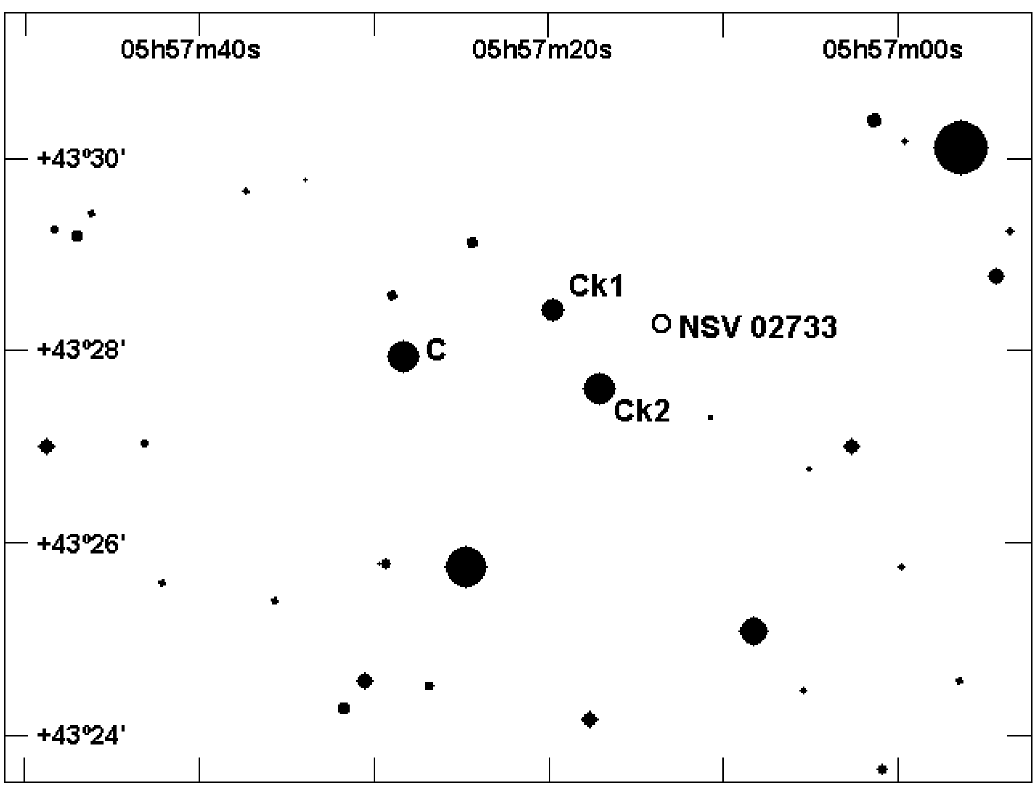

Figure 1. C = Comparison star, Ck1 and Ck2 = Check stars.

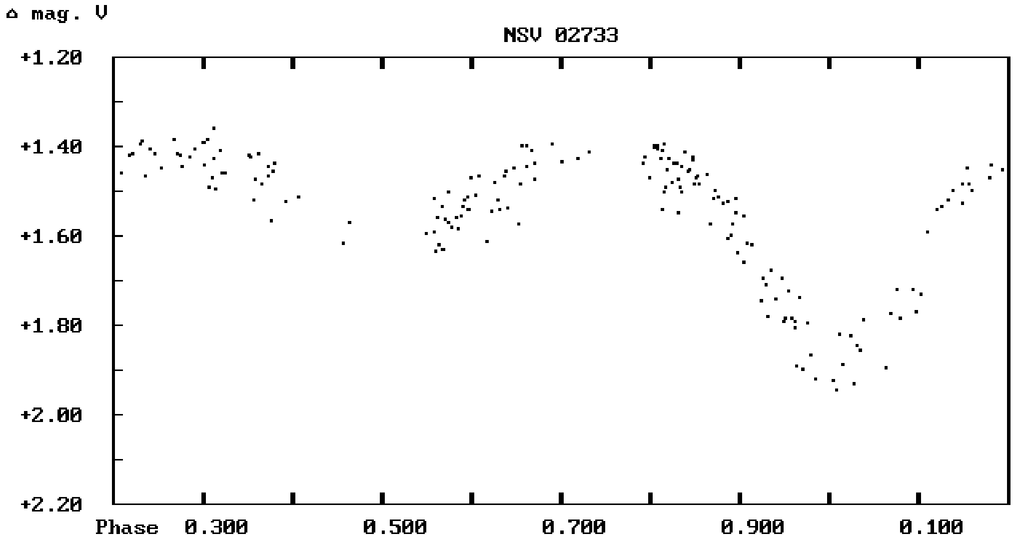

Figure 2

Observations show (Figure 2), that NSV 02733 is not a cepheid but an eclipsing binary star with a Beta Lyr type light curve. Due to light curve dispersion and incompleteness, it is not possible to derive exact information about the physical parameters of the system, but we can give the following preliminary ephemeris for the primary minimum:

$$\text{Min. I} = \text{HJD}\,2449825.476 + 0^{\text{d}}.7544 \times \text{E}$$
$$\pm 1 \qquad\qquad \pm 2$$

The star fades 0.45 magnitudes at primary minimum. The secondary is incomplete, but the light curve suggests that it may be about 0.2 magnitude deep.

More photometric and spectroscopic observations are needed in order to determine the physical parameters of this star.

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Weber, R., 1963, *IBVS*, No. 21

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

Number 4246

Konkoly Observatory
Budapest
22 September 1995

HU ISSN 0374 – 0676

THE ECLIPSING BINARY NSV 02980

NSV 02980 (Kholopov, 1982) was photographically observed by Hoffmeister (1949) who found variability in this star. NSV 02980 (CSV 00076) can unambiguously be identified with the field star GSC 0141.0638. From his observations Hoffmeister deduced that NSV 02980 was an RR Lyr or W UMa type star with a photographic magnitude variation range from 12.0 to 12.5. No photometric elements or even spectral class have been given.

From February 4 to April 12, 1995, one color photometry in the V band was performed using LYNXX-2 and ST-4 CCD cameras, at the three 0.4-m telescopes at Observatorio de Piera, Observatorio de Mollet, and Observatorio de Monegrillo (Spain). The observations collected during this observational period show that NSV 02980 is in fact an overcontact binary star. GSC 0141.0390 and GSC 0141.0666 were used as comparison and check stars respectively (see Figure 1).

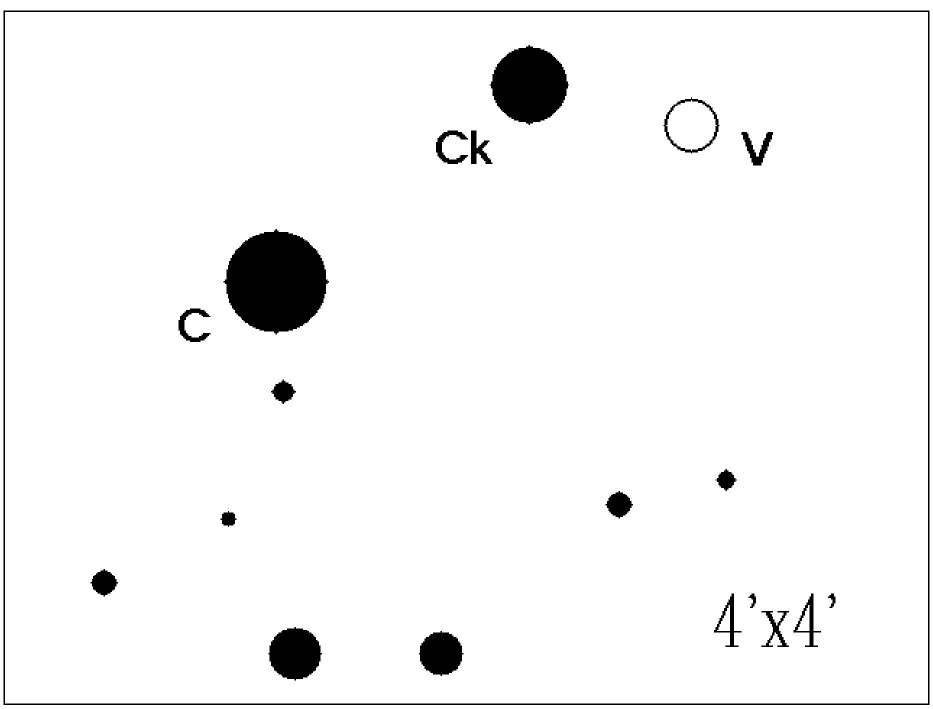

Figure 1. C = Comparison star, Ck = Check star, V = NSV 02980. North is on top.

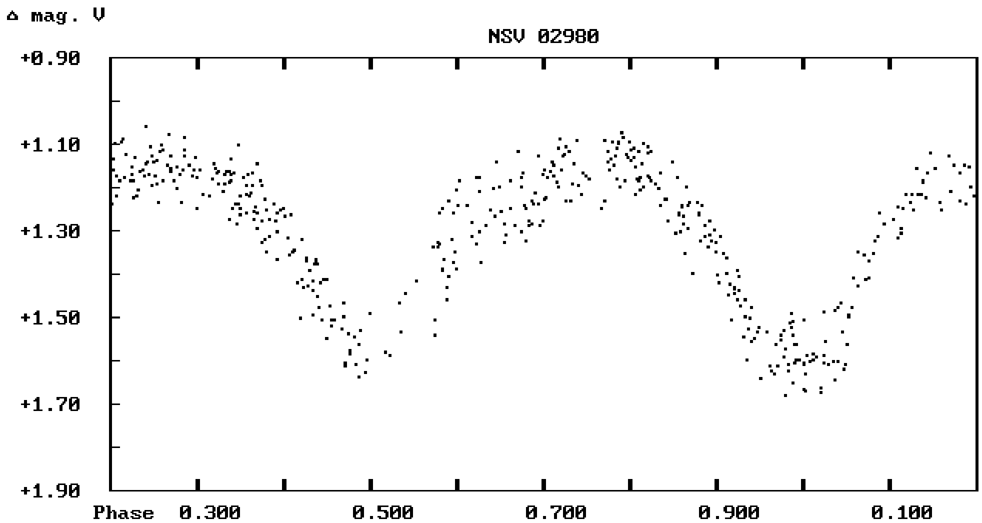

Figure 2

Figure 2 shows the obtained light curve. Light curve dispersion does not allow us to accurately determine the actual shape and depth of primary and secondary minima, but it seems that the primary minimum is a transit with a 0.45 magnitude depth and the secondary minimum is an occultation with a 0.43 magnitude depth.

Photometric elements derived from the light curve, for the primary minimum, are the following:

$$\text{Min. I} = \text{HJD}\,2449800.429 \underset{\pm 2}{} + 0\overset{d}{.}41630 \times \text{E}$$
$$\pm 2 \qquad\qquad \pm 10$$

To derive the exact nature of the binary system, we plan to obtain more accurate observations.

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

Number 4247

Konkoly Observatory
Budapest
22 September 1995

HU ISSN 0374 – 0676

OBSERVATIONS OF NSV 06836

The variability of NSV 06836 (HV 10431, GSC 2016.0004, CSV 002213) was announced by Hanley and Shapley (1940) based on the plates of the MF series taken with the 10-inch Metcalf triplet in South Africa. They indicated that the object might be an RR Lyr star with a variation range from 12.2 to 12.8 magnitudes (12.8 to 13.3 according to NSV, Kholopov, 1982).

From May 1 to July 1, 1995, the star was observed during 17 nights with a LYNXX-2 and a Starlight Xpress CCD camera in the V band using the 0.4-m telescope at Observatorio de Mollet (Spain). GSC 2016.0787 was used as comparison star and GSC 2016.0872 as check star (see Figure 1).

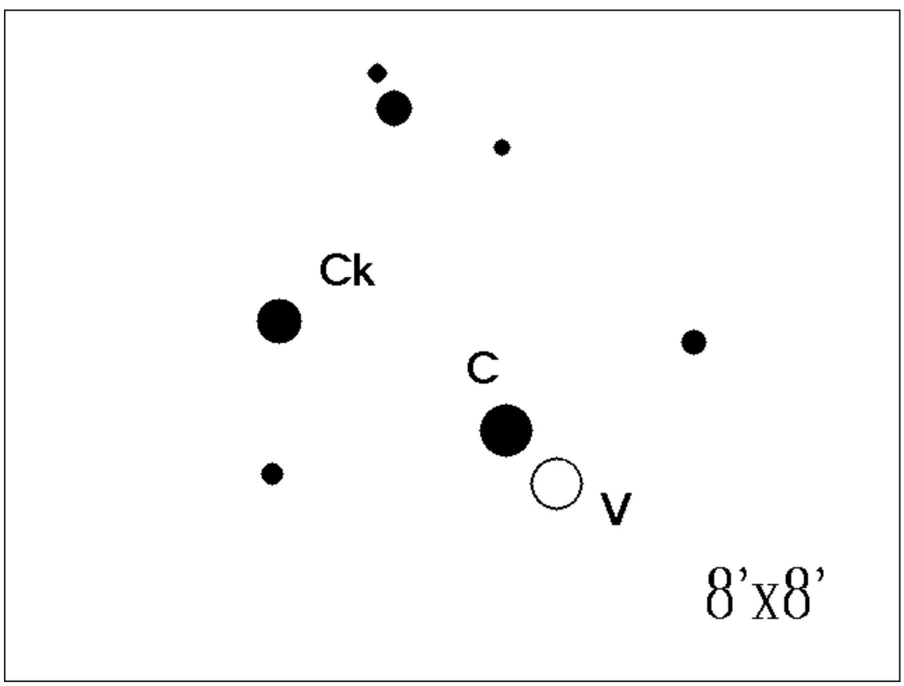

Figure 1. C = Comparison star, Ck = Check star, V = NSV 06836.
North is on the top.

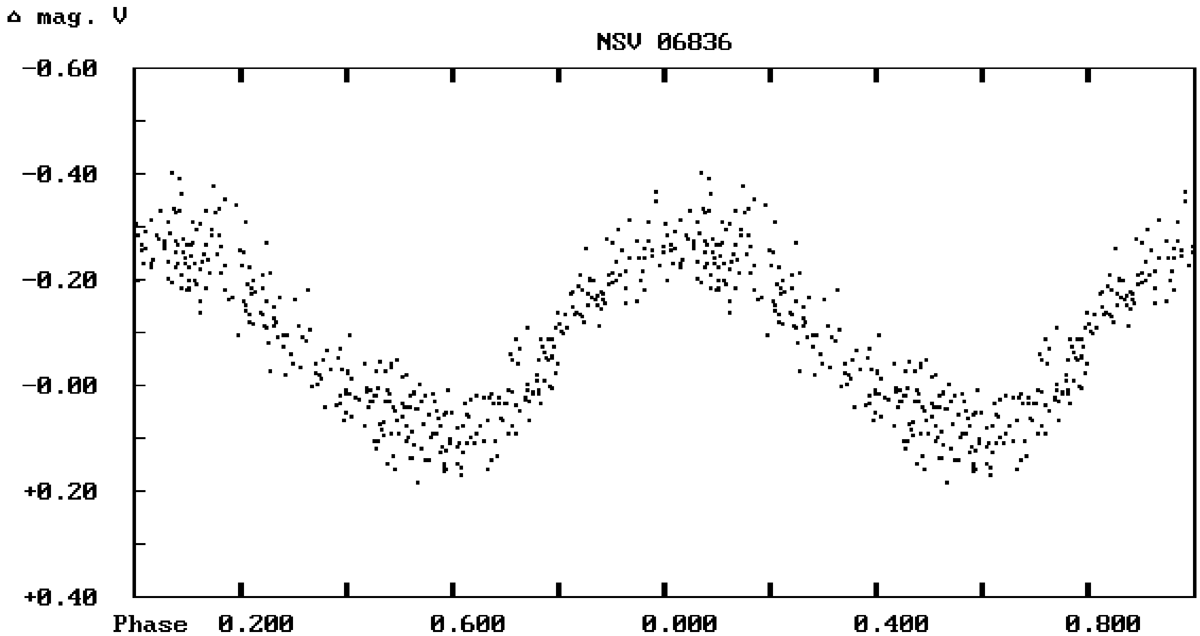

Figure 2

Observations show that NSV 06836 is an RR Lyr star with almost symmetric light curve ($\varepsilon = 0.4$), with a 0.38 magnitude variation in the V band. It has a period close to 8^h8^m(Figure 2). We determined the following ephemeris for the maximum:

$$\text{Max.} = \text{HJD}\,2449851.448 \underset{\pm 2}{} + 0\overset{d}{.}33924 \underset{\pm 1}{} \times \text{E}$$

Observations also suggest that the light variation might be modulated by a possible Blazhko effect.

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

Number 4248

Konkoly Observatory
Budapest
22 September 1995

HU ISSN 0374 – 0676

OBSERVATIONS OF NSV 13191

According to the New Catalogue of Suspected Variable Stars (Kholopov, 1982), NSV 13191 (SVS 651, CSV 007899, S 07409, GSC 1088.0993) is an RR Lyrae variable star with a photographic magnitude variation range between 12.4 and 13.6.

From July 24 to July 29, 1995, the star was observed for 6 nights in the V band, using a Starlight Xpress CCD camera attached to the Newton focus of the 0.41-m telescope at Observatorio de Mollet (Spain). GSC 1088.1164 was used as the comparison star, and GSC 1088.0612 and GSC 1088.0072 as check stars (see Figure 1).

These observations show that NSV 13191 is in fact an RR Lyrae star with an asymmetric light curve ((M − m) / P = 0.1), an amplitude in the V band of 1.0 magnitudes, and a period close to 14 hours (Figure 2). We derive the following ephemeris for the maximum:

$$\text{Max.} = \text{HJD}\,2449924.5455 + 0^{\rm d}.5818 \times \text{E}$$
$$\pm 15 \qquad\qquad \pm 5$$

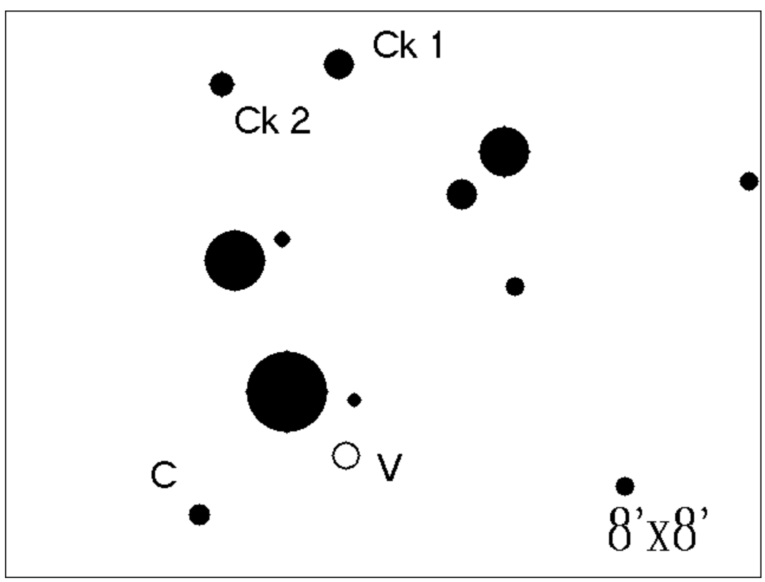

Figure 1. C=Comparison star, Ck1 and Ck2=Check stars, V=NSV 13191.
North is on top.

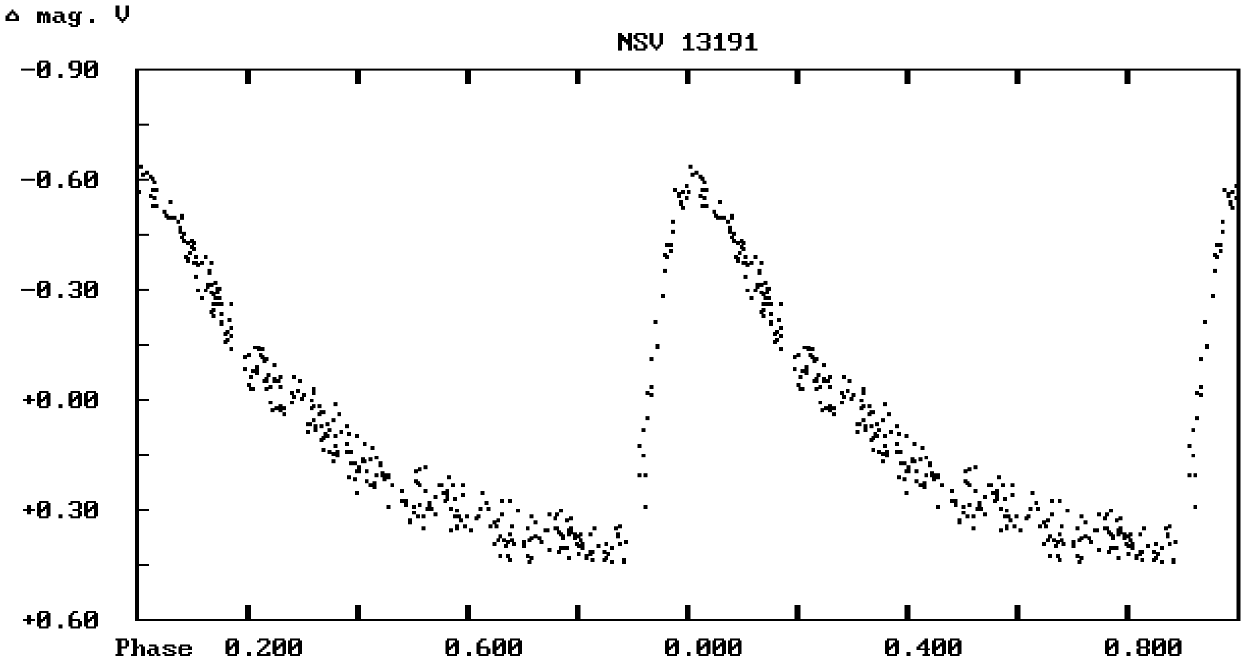

Figure 2

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

Number 4249

Konkoly Observatory
Budapest
22 September 1995

HU ISSN 0374 – 0676

AN IMPROVED EPHEMERIS FOR Z CAMELOPARDALIS

Z Cam is the prototype of a class of dwarf novae that show standstills in their light curves. Kraft et al. (1969; henceforth KKM) first established its ephemeris. They combined radial-velocity information with observations of periodic features in the light curve to derive a period of $0.289840 \pm 1 \times 10^{-6}$ d. Two studies by Robinson (1973a and 1973b), one photometric and the other using Hα emission velocities, did not yet show any significant error in the KKM ephemeris as of the early 1970s. Szkody & Wade (1981) obtained a cycle of emission-line velocities in early 1979, when Z Cam was in standstill: they also found no difference from the KKM ephemeris. Even so, the formal error in the KKM ephemeris has now accumulated to greater than 0.1 cycle, so we re-established the phase.

We obtained spectra of Z Cam using the Michigan-Dartmouth-MIT Observatory 1.3-m McGraw-Hill telescope. We used the Mark III transmission-grating spectrometer and a TI 4849 CCD chip (Luppino 1989); our 300 line/mm grating gave 10 Å FWHM resolution from 6400 to 9000 Å. On 1991 October 17 UT we obtained thirteen 15-minute exposures covering three hours; the next night we obtained three exposures, and the night after this we obtained a single spectrum. Reduction followed the procedures described in Thorstensen et al. (1991) and the references therein. The emission lines within our spectral range were strong; Hα had an equivalent width of 37 Å in the sum of our spectra, and at its center stood about twice as high as the adjacent continuum. The FWHM of Hα was 30 Å. Our first night was photometric, and we reduced our spectra to absolute flux using an observation of the white dwarf G191B2B; with a modest extrapolation to shorter wavelengths, we derive for Z Cam $V = 13.5 \pm 0.3$ (estimated error). This is close to the mean minimum magnitude (Szkody & Mattei 1984). Thus the magnitude and spectrum both show that Z Cam was not in outburst or standstill. There were no evident changes in the spectrum or flux during our brief observations.

Unfortunately, the red-star features were not measurable in our spectra, unsurprising given its rather early spectral type (G1: KKM). We therefore measured the strong Hα emission line using a double-Gaussian convolution technique (Shafter 1983). The Gaussians in the template were separated by 34 Å (full width), equivalent to 1500 km s^{-1}. In effect, this measured the steep sides of the line profile. Table 1 lists the resulting velocity time series. We fit to our emission-line velocities a least-square sinusoid of the form

$$v(t) = \gamma + K \sin[2\pi(t - T_0)/P],$$

with the period P fixed at the KKM value. With this convention, T_0 is the epoch of apparent inferior conjunction of the line source. This gave $\gamma = -36 \pm 3$ km s^{-1}, $K = 138 \pm 4$ km s^{-1}, and $T_0 =$ HJD 2448547.0174 $\pm$ 0.0014, where the uncertainties are 1-σ. The choice of T_0 is arbitrary *modulo* the period; the epoch given here corresponds to the night of our most extensive observations. The 1-σ error of a single measurement, derived from the goodness of fit, was only 11 km s^{-1}. We also re-fit the Hα velocities from Robinson (1973b); this gave $\gamma = -44 \pm 6$ km s^{-1}, $K = 135 \pm 9$ km s^{-1}, and T_0 = HJD 2441355.7828± 0.0028; the goodness-of-fit implies $\sigma = 25$ km s^{-1}. The good agreement between the K and γ velocities in the two studies gives us confidence that our phases may be compared directly. We are further emboldened since we are measuring the same line (Hα emission) in the same state (quiescence) and using a broadly similar centering, which emphasizes the outer parts of the line profile.

The two values of T_0 above are 7191.2346 days apart. This is 24811.05 cycles of the KKM period. There is no ambiguity in the cycle count; KKM's quoted error does not allow it, and the adequacy of the KKM ephemeris for the intervening epochs of Robinson (1973a and 1973b) and Szkody & Wade (1981) makes a cycle-count error even more unlikely. Adopting 24811 cycles for the interval gives a refined period $P = 0.2898406(2)$ d, where the quoted uncertainty is inflated a bit from the formal 1-σ value (1.2×10^{-7} d) and is in units of the last quoted digit. In Figure 1 we show the data of Robinson (1973b), folded together with ours on this best period. Extending this analysis back to the original KKM radial-velocity data does not improve the accuracy much, since their velocities show much more scatter than ours or Robinson's, and the extension of the time base is modest; in any case, the epoch of emission-line conjunction given in KKM's Table 2 agrees with our phase to within 0.01 cycle. Given how well our period agrees with the KKM ephemeris, which was adequate through the 1970s, there is no evidence yet of any period change.

The KKM study did, however, define a phase tied to the red star in the system; this red-star phase should have a more direct physical interpretation than the emission-line phase. KKM noted that the emission lines are not precisely 180 degrees out of phase with the absorption (presumed to represent the red star), but rather lag by an additional 0.017 d (some 20 degrees of phase). The ephemeris quoted in KKM's equation (1) is for the inferior conjunction of the red star; if we assume that the 0.017 d offset still holds, we find for an updated red-star ephemeris

$$\text{Red star inferior conjunction} = \text{JD}_{\odot}2448546.855 + 0.2898406(2)E,$$

where E is the integer cycle count. For completeness we give here

$$\text{Emission-line inferior conjunction} = \text{JD}_{\odot}2448547.0174 + 0.2898406(2)E.$$

Table 1: Hα Emission Velocities in Z Cam

HJD[a]	V (km s^{-1})	HJD[a]	V (km s^{-1})	HJD[a]	V (km s^{-1})	HJD[a]	V (km s^{-1})
8546.881	−52	8546.936	−171	8546.981	−124	8547.943	79
8546.891	−84	8546.948	−190	8546.993	−109	8547.954	106
8546.903	−124	8546.959	−171	8547.004	−60	8547.965	99
8546.914	−132	8546.971	−148	8547.016	−42	8548.958	−186
8546.926	−159						

[a] Heliocentric Julian Date of mid-integration, minus 2 440 000.

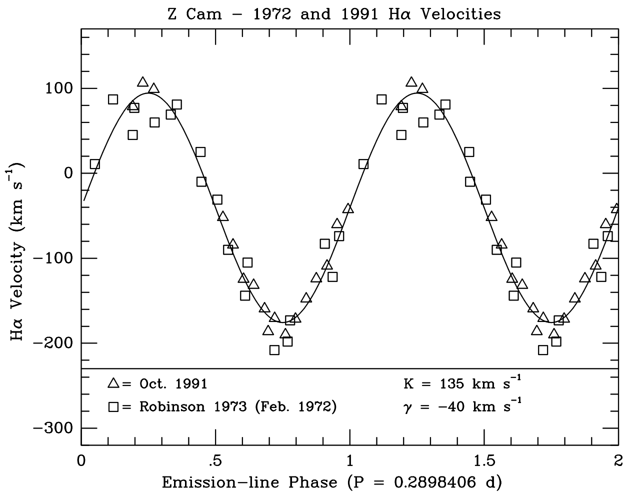

Figure 1. Hα radial velocities from Robinson (1973b; squares) and this work (triangles) folded on the refined period. All data are plotted twice for continuity. The curve shown is the least-squares best fit, and its parameters are given in the figure. For the horizontal axis, phase zero is apparent inferior conjunction of the emission line source; inferior conjunction of the red star should be at phase 0.44 in this convention (KKM).

The emission-line epoch has rather better internal precision than the absorption-line epoch. Since the emission lines form in or above the accretion disk, it seems surprising that the ephemerides from such widely separated epochs can be phased together, and that there is no obvious phase change between quiescence and standstill.

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

Number 4250

Konkoly Observatory
Budapest
25 September 1995

HU ISSN 0374 – 0676

A NEW VARIABLE IN THE FIELD OF V778 CYGNI

Observations of the V778 field in Cygnus indicate a possible new variable star. The coordinates of this from the Guide Star Catalog are $\alpha_{2000} = 20^h36^m34^s, \delta_{2000} = 60°06'45''$. The star is not listed as a variable in the General Catalog of Variable Stars (Kholopov *et al.*, 1985), the New Catalog of Suspected Variable Stars (Kholopov *et al.*, 1982), the 72nd Name-List of Variable Stars (Kazarovets and Samus, 1995) or SIMBAD; nor has a reference to it appeared in the IBVS bulletins during 1994-1995. Thus, we conclude the star has not previously been noted as a variable. The V magnitude of the star is about 12.9 from the Guide Star Catalog, and the star appears to be redder than V778 Cygni.

In 1993, observers at Wellesley College began observations of V778 Cygni to determine its photometric behavior, using a 0.6 meter telescope with a Photometrics CCD camera. One of the comparison stars used in this analysis exhibits larger variations in its magnitude than other comparisons.

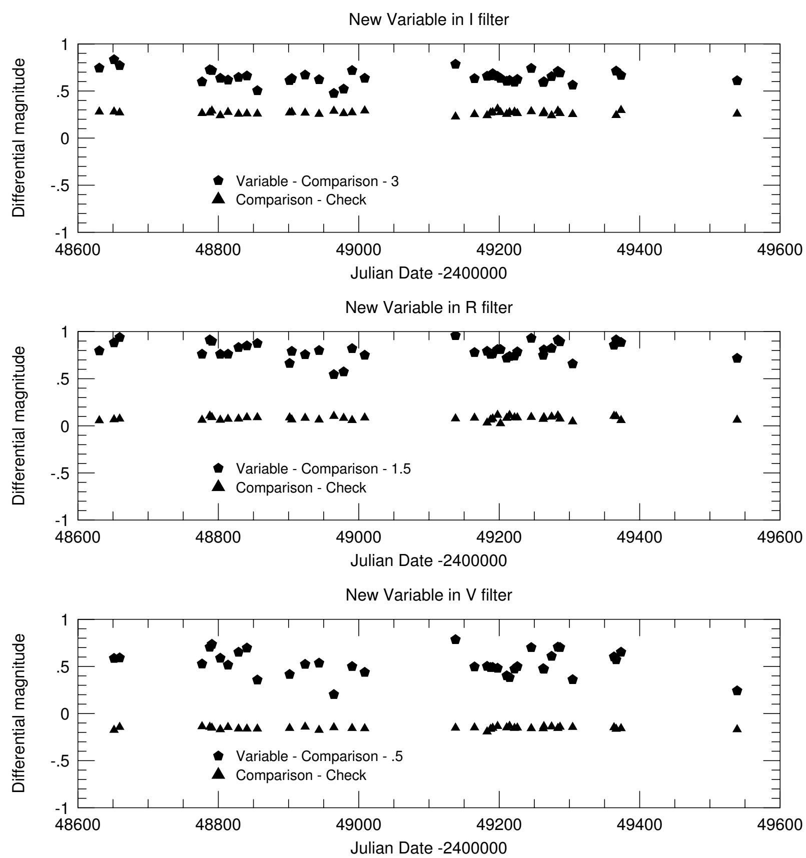

Figure 1: Light curves of a new variable in the V778 Cyg field

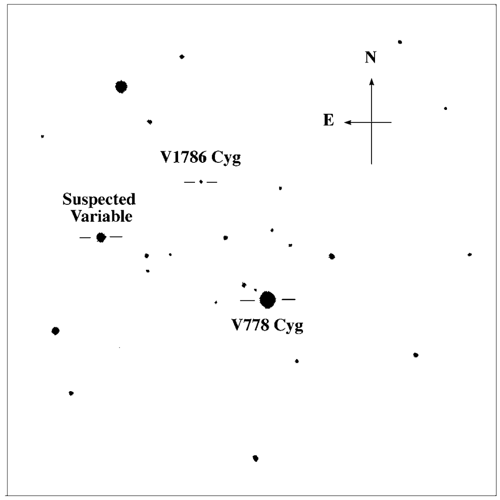

Figure 2: A finder chart for the new suspected variable star. North is up and East is left. The field shown is approximately nine arcminutes per side.

As shown in Figure 1, the amplitude of the variation of the new variable with respect to a comparison is approximately 0.6 magnitudes in V and R and 0.3 magnitudes in I. In contrast, the amplitude of the differential magnitude of the two comparisons in V, R, and I is 0.04 magnitudes, 0.16 magnitudes, and 0.13 magnitudes respectively. Figure 2 identifies the new variable.

Upon discovery of the new variable, we examined the star for periodicity. No significant periodicity for periods between 0.001 and 1000 days was found using a Fourier transform period fitting program written by Charles Prosser at Harvard Center for Astrophysics. Subsequent observations of the star indicate that it does not change in magnitude significantly during one night's observing.

Acknowledgements: We thank the W. M. Keck Foundation for a summer internship (ER) and support of astronomy at Wellesley College through the Keck Northeast Astronomy Consortium. This research was also partially supported by funds from the National Science Foundation (through AAS/REU and AST9417359), the Dudley Observatory, and a Bunting Science Fellowship funded through the Office of Naval Research. This research has made use of the Simbad database operated at CDS, Strasbourg, France.

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

Number 4251

Konkoly Observatory
Budapest
26 September 1995

HU ISSN 0374 – 0676

PU Vul DURING THE BRIGHTNESS WEAKENING OF 1993-1994

We recently (Andrillat and Houziaux, 1994, hereafter referred as AH94) reviewed spectral features of the symbiotic nova PU Vulpeculae during its nebular phase between 1989 June and 1992 October. Observations of this object have been resumed in 1993 July, 1994 June and 1995 June with the same instrumentation as in AH94. We report here on these spectra.

Monochromatic magnitudes at wavelengths where the continuum may be easily located between 375 and 900 nm show a significant drop (about 1.2 mag.) from the violet limit up to 700 nm between 1993 July and 1994 June. Figure 1 shows the composite aspect of the continuum corrected for an E(B−V)=0.4 interstellar extinction. Above 700 nm the continuum is due to the M6 III component, deeply cut by strong TiO bands, while at shorter wavelengths the photon flux originates in a hotter source, presumably the hot wind ejected from the compact object. The drop in the blue continuum can be explained by the eclipse already mentioned by Nussbaumer and Vogel (1994) from the IUE observations and confirmed by Garnavich (1994), who also notes in early 1994 April that the increase in equivalent width of Hβ may be due to a drop in the continuum around 480 nm.

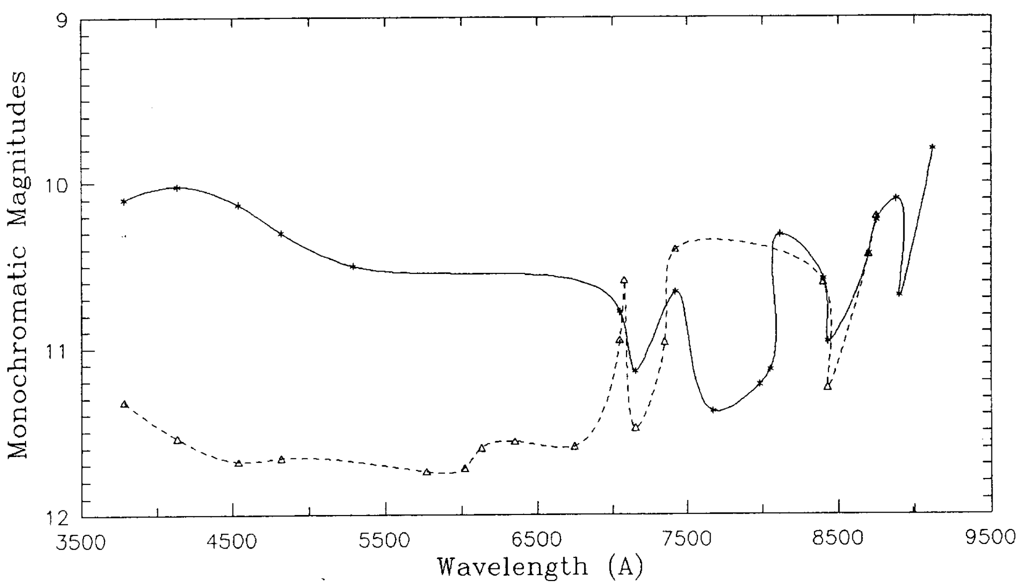

Figure 1. Continuous spectrum in 1993 July (solid line) and during the eclipse in 1994 June (dashes)

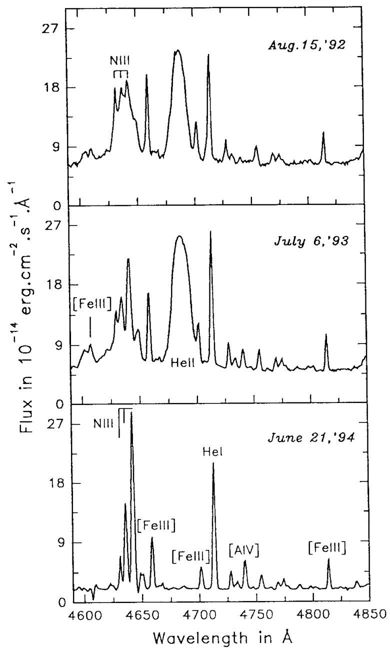

Figure 2. Variations of the absolute fluxes around 4700Å from August 15, 1992 to June 2, 1994. Note the collapse of HeII during the eclipse and the stability of the HeI line in spite of the drop of the continuum at the time of the eclipse.

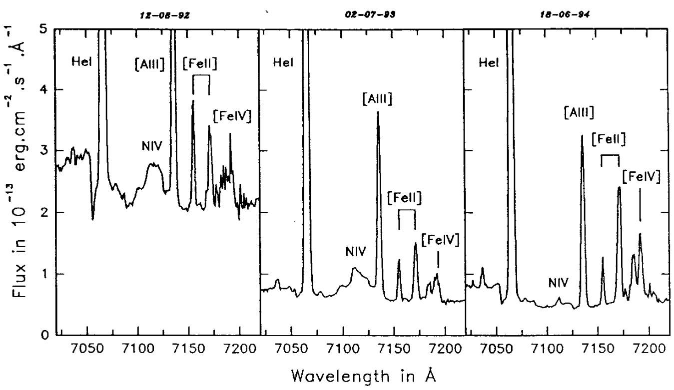

Figure 3. Variations of the absolute fluxes in the 7000Å region between August 12, 1992, and July 2, 1993 and during the eclipse phase on June 18, 1994. The continuum level drops by a factor of about 3 between August 1992 and July 1993 but remains unaltered by the eclipse. Remark that the drop of NIV at 7120Å is similar to the behavior of the HeII line in Figure 2.

The nebular spectrum has been observed between 375 and 900 nm. As in 1992, (see AH94), a large proportion of the lines belong to the Fe^{+} and Fe^{++} ions. Fluxes determined in 1994 June are in good agreement with the values given by Kolotikov et al. (1995). Discordances are observed mostly in the cases of blends, as our resolution permits to separate components unresolved on the low resolution Asiago B&C + CCD spectra. In general, [Fe III] lines slowly drop in intensity, while the [AIV] line at 474 nm increases, as it is apparent in Figure 2. On the spectrum secured during the brightness drop of 1993-1994, we observe the disappearence of the wind features, as already mentioned by Garnavich and Trummel (1994).

Table 1

Date	flux in HeII 468.6 in 10^{-12} erg.s^{-1}	FWHM in km, s^{-1}
91 Oct 25	1.09	820
92 Aug 15	2.52	833
92 Sept 9	2.71	953
93 July 6	3.30	1150
93 July 24	4.18	1200
94 June 17	< 0.1	–
95 June 17	7.33	1535

These "WR" features which have disappeared include He II at 454.2 and 468.6 nm, C II at 711.7 nm, C IV at 580.1-581.2 and 722.6 nm, N III at 420.0, 451.5, 452.3, 464.0 and 489.7 nm, and finally N IV lines at 405.0, 579.4, 638.3, 710.9-712.3 nm. Let us remark that during the 1992-1995 interval the He I 471.4 and 706.5 nm remain quite stable in flux. On the contrary, the [A IV] line at 474.0 nm, absent in 1992 (Figure 2), is stronger than the [Fe II] neighbouring lines. On the other side, we note that, except for the 1993-1994 luminosity drop, the He II λ 468.6 nm line increases both in flux and in FWHM, as reported in Table 1.

The parabolic shape of the He II line remains all trough the observed period of time, however its red wing is altered by the [Fe III] line at 470.1 nm: well separated on the 1991 October spectrum, this line is just visible as a shoulder on the 1995 June spectrum. Morever, it seems that between 1994 June and 1995 June, a narrow "spike" has developed on top of the wind component. Such a feature was observed, although ill-defined on a 1992 September 11 spectrum, although it could not be seen on August 15, 1992 (see Figure 2). This spike shows in 1995 June a -150 km.s^{-1} shift with respect to the wind component. A similar behavior is also observed in the N III line at 464 nm. In 1991 October, a strong and wide complex (2.12 10^{-12} ergs s^{-1}) is dominated by a wide 464nm line. In 1992 August, its intensity has increased to 2.75 10^{-12} ergs s^{-1} but three narrow spikes develop on top of the broad emission, corresponding to the $3^2P°$- $3^2D°$multiplet components. During the eclipse phase, the broad feature drops (as it is the case for the N IV line at 712 nm, see Figure 3), while the narrow components increase in strength (Figure 2). In 1995 June, when the broad line moderately reappears, the strongest N III components reach over 7 times the local continuum.

It is clear that the "hot" nebular spectrum of PU Vul has not yet reached its full development, while the wind features steadily reinforce their strength, indicating an increase of the wind density. The development of nebular components in the N III 464.0 nm and in the He II 468.6 nm lines shows that the nebular temperature is also increasing between 1992 and 1995.

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4252

Konkoly Observatory
Budapest
27 September 1995

HU ISSN 0374 – 0676

ON NEW VARIABLES IN THE SCULPTOR GALAXY

Recently Kaluzny et al. (1995; KKSUKM) reported their discovery of 231 variable stars, mostly RR Lyraes, in the Sculptor dwarf galaxy. They found it impossible to cross-identify the bulk of their variables with those discovered by van Agt (1978; vA) because of large errors in coordinates published by van Agt. Moreover, Kaluzny et al. claim that five randomly selected stars from the van Agt list — V4, V103, V195, V458, and V475 — turn out to be non-variable according to the newly acquired CCD photometry.

We have made an attempt to cross-identify the KKSUKM and vA lists using the equatorial coordinates from the 5th volume of the General Catalogue of Variable Stars (Samus, 1995) published earlier this year and presently being sent to users. First, we note that the KKSUKM list contains five pairs of stars with completely identical coordinates. Namely, ID 406 = ID 1926, ID 1439 = ID 3345, ID 2058 = ID 2558, ID 2059 = ID 2559, ID 2423 = ID 4233. So we reduce their list to 226 objects. Of these, we are able to identify, by coordinates, 161 stars with the vA list. The identifications are presented in Table 1. The columns contain: KKSUKM number; GCVS number (coinciding with vA number); positional difference between KKSUKM and GCVS, in seconds of arc. One can see from the last column of the table that the difference between two published positions exceeds $2''$ only in exceptional cases.

Table 2 presents data on variable stars for which the GCVS contains period values (mostly from vA). The columns contain: KKSUKM number; KKSUKM type (BLBoo for anomalous Cepheids); KKSUKS period; GCVS type; GCVS period (mostly from vA). Asterisks denote 5 cases of disagreement in periods. For V101, the two periods are one-day aliases. In our opinion, Table 2 confirms the reliability of our identifications.

Note that the star V4 from the vA list was actually rediscovered by KKSUKS, contrary to their claim (p. 409). It is also interesting to note that, of the five above-mentioned pairs of identical stars in KKSUKS, the period values presented by them for ID 2423 and ID 4233 do not agree but are one-day aliases. The light curve gives the impression that one should prefer the RRc type and the period value $0^{\rm d}.35852$.

Thanks are due to Dr. V.P. Goranskij for permission to use software developed by him. This work was partially supported by the Russian Foundation for Basic Research through grant 95-02-05189-a.

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Table 1. Cross-Identifications of Variables

ID	Var		ID	Var		ID	Var		ID	Var	
33	V112	0.″8	1823	V293	1.″0	3004	V188	0.″0	4785	V68	0.″5
37	V110	0.4	1830	V8	1.5	3016	V449	1.3	4786	V61	0.4
38	V523	0.9	1838	V183	0.5	3024	V102	0.7	4793	V64	0.3
321	V552	1.0	1873	V95	0.4	3026	V233	0.8	4812	V66	0.7
356	V17	0.4	1874	V454	0.4	3039	V3	1.1	5000	V44	1.5
357	V111	1.2	1877	V96	0.7	3043	V16	1.1	5011	V24	1.2
361	V387	1.1	1890	V384	1.0	3104	V576	1.2	5032	V342	0.7
366	V518	0.0	1899	V94	0.7	3113	V93	1.0	5049	V146	1.3
368	V508	0.2	1910	V79	0.6	3125	V77	0.5	5065	V153	0.2
377	V191	0.7	1914	V82	0.7	3126	V180	1.5	5068	V468	0.2
385	V116	1.2	1930	V368	1.0	3143	V462	2.2	5105	V148	0.5
406	V99	1.4	1932	V6	0.1	3302	V26	0.2	5141	V225	0.7
411	V234	0.2	1940	V229	1.1	3319	V55	3.2	5155	V51	1.3
416	V203	3.4	1941	V85	1.0	3346	V365	0.6	5330	V154	0.3
439	V104	1.2	1943	V108	0.8	3365	V385	0.1	5343	V41	0.8
462	V549	0.7	2004	V78	0.2	3397	V351	1.2	5344	V235	0.2
463	V113	0.8	2012	V179	0.4	3410	V63	0.5	5359	V159	0.8
734	V119	0.5	2048	V427	0.5	3413	V223	0.9	5375	V574	0.9
737	V115	0.1	2058	V75	0.9	3468	V69	1.5	5376	V312	0.2
753	V105	0.8	2059	V87	0.5	3760	V72	0.9	5382	V42	1.2
786	V4	0.3	2410	V83	0.7	3761	V166	0.3	5384	V467	1.1
803	V199	0.6	2421	V453	0.3	3801	V20	0.5	5390	V53	0.8
811	V197	1.0	2422	V5	0.3	3810	V70	0.6	5397	V43	1.0
853	V206	0.7	2423	V406	0.8	3827	V21	1.1	5492	V147	1.1
860	V388	1.6	2424	V190	1.0	3862	V59	1.1	5496	V408	1.5
1142	V15	1.1	2450	V91	0.7	3888	V163	0.5	5714	V157	1.5
1168	V597	1.6	2458	V383	0.9	3907	V171	0.3	5721	V409	0.7
1256	V118	2.0	2470	V236	0.6	3916	V381	1.0	5723	V56	1.2
1411	V90	0.3	2502	V101	0.9	3931	V346	0.2	5747	V224	0.4
1424	V176	1.5	2528	V446	0.3	3934	V71	0.3	5773	V156	0.4
1446	V366	1.1	2545	V241	0.7	3938	V62	0.8	5778	V46	0.9
1457	V84	0.5	2552	V231	0.6	4235	V602	1.2	5802	V160	0.4
1462	V11	0.4	2555	V92	0.8	4263	V7	1.4	5828	V49	1.3
1470	V10	0.4	2566	V498	3.7	4272	V170	0.8	5845	V106	0.9
1491	V367	0.3	2575	V189	0.6	4277	V107	0.8	6032	V396	0.4
1519	V386	0.8	2606	V507	0.7	4291	V169	3.4	6048	V380	0.5
1546	V86	2.5	2627	V100	0.8	4308	V447	0.3	6050	V58	1.0
1553	V268	0.7	2639	V18	0.7	4309	V466	1.8	6085	V545	0.6
1555	V89	0.7	2689	V88	0.7	4385	V74	1.4			
1558	V98	1.0	2699	V186	1.2	4689	V19	0.6			
1566	V9	1.1	2991	V237	0.5	4747	V60	0.6			

Table 2. Classifications and Periods of Variables

ID	Type(KKSUKS)	P(KKSUKS), d	Var	Type(GCVS)	P(GCVS), d	
411	RRc	0.22499	V234	RRab	0.642	⋆
734	BLBoo	1.15776	V119	BLBoo	1.15	
803	RRab	0.57363	V199	RRab	0.573	
1462	RRab	0.56113	V11	RR	0.561	
1470	RRab	0.50565	V10	RRab	0.515	⋆
1914	RRab	0.57051	V82	RRab	0.570	
2004	RRab	0.58735	V78	RRab	0.587	
2012	RRab	0.71475	V179	RRab	0.715	
2058	RRab	0.50350	V75	RRab	0.504:	
2410	RRab	0.53183	V83	RRab	0.531	
2422	RRab	0.48446	V5	RRab	0.484	
2450	RRab	0.61802	V91	RRab	0.618	
2502	RRc	0.32769	V101	RRab	0.487	⋆
2555	RRab	0.50272	V92	RRab	0.503	
2639	RRc:	0.28961	V18	RRc	0.289	
2689	RRab	0.51136	V88	RRab	0.836	⋆
3125	RRab	0.53310	V77	RRab	0.533	
3302	BLBoo	1.34607	V26	BLBoo	1.346	
3410	RRab	0.54146	V63	RRab	0.542	
3760	RRab	0.54851	V72	RRab	0.548	
3810	RRab	0.66197	V70	RRab	0.663	
3827	RRab	0.58776	V21	RRab	0.588	
3934	RRab	0.51980	V71	RRab	0.519	
4263	RRc	0.28478	V7	RRc	0.285:	
4277	RRc	0.30630	V107	RRc	0.307	
4385	RRab	0.48740	V74	RRab	0.488	
4689	RRab	0.63920	V19	RRab	0.639	
4747	RRab	0.59194	V60	RRab	0.593	
4785	RRab	0.50611	V68	RRab	0.506	
4812	RRab	0.48232	V66	RRab	0.482	
5343	RRab	0.54694	V41	RRab	0.547	
5344	RRab	0.64249	V235	RRc	0.379	⋆
5359	RRab	0.67099	V159	RRab	0.672	
5382	RRab	0.59593	V42	RRab	0.596	
5390	RRab	0.65970	V53	RRab	0.660	
5397	RRab	0.61731	V43	RRab	0.617	
5714	RRc	0.29291	V157	RRc	0.293	
5723	RRab	0.56602	V56	RRab	0.567	
5773	RRab	0.50878	V156	RRab	0.509	
5802	RRab	0.51458	V160	RRab	0.515	

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

Number 4253

Konkoly Observatory
Budapest
28 September 1995

HU ISSN 0374 – 0676

SN 1994W: UNPRECEDENTED BRIGHTNESS DECLINE AT LATE STAGE

Supernova (SN) 1994W in NGC 4041 was discovered by Cortini and Villi (1994) on July 29, 1994. Precise position was measured by Pollas (1994): $\alpha = 11^{\rm h}59^{\rm m}37\overset{\rm s}{.}67$, $\delta = +62°25'14\overset{''}{.}6$ (1950.0); the corresponding offset from the center of the galaxy is $7\overset{''}{.}8$ west and $17\overset{''}{.}5$ north.

The spectroscopic observations obtained in the period July 31 – August 13 were reported by Bragaglia *et al.* (1994), Filippenko and Barth (1994), Cumming *et al.* (1994). They showed that SN 1994W was a peculiar type II supernova. Relatively narrow (FWHM = 1200 km/s) hydrogen Balmer emission lines were superimposed on much broader bases (FWZI = 7500 km/s); broad (FWHM about 5000 km/s) He I 587.6-nm emission was also visible, with no narrow component. The Balmer lines did not show broad P–Cyg absorption. However, they did exhibit narrow (FWHM = 300 km/s) P–Cyg absorption components with minima displaced by 700 km/s from the emission-line cores. The broad (FWHM 2000 km/s) emission in He I at 447.1 and 706.5 nm, and narrow P–Cyg lines of Mg II, Si II, and O I were also identified. The constancy of the H I profiles and the presence of narrow P–Cyg absorption allowed to suggest that the supernova was exciting a massive, dense circumstellar shell, rather than a radiatively accelerated stellar wind. The similarity of these spectra with the spectra of SN 1984E was noted by Gaskell (1994).

CCD photometry of SN 1994W was reported by Bragaglia *et al.* (1994) and Mikuz (1994). Richmond *et al.* (1994) reported CCD observations in the R band obtained in July with respect to our comparison star 3. From our data we estimated R magnitude for this star ≈ 13.8 and calculated corresponding magnitudes for supernova. Visual brightness estimates were reported by Cortini and Villi (1994), Spratt (1994), Vanmunster (1994), Hasubick (1994) and Szentasko (1994).

We started photographic observations of SN 1994W on September 8 using 70-cm reflector in Moscow and 50-cm meniscus telescope at Crimea. The star was quite bright in September and October but quickly faded below the limit of our plates early in November. The comparison sequence used for the reduction of plates is shown in Figure 1, and the magnitudes of comparison stars are presented in Table 1. The observations of supernova are reported in Table 2, the light curve is shown in Figure 2.

The data presented in Figure 2 show that supernova was brightening until about August 2–6 (JD 2449566–570). Unfortunately, in August only visual brightness estimates were obtained, and their comparison with CCD data and the intrinsic scatter show that they have large systematic and random errors. So it is difficult to determine the date and magnitude at maximum light, but it is most probable that in August SN 1994W remained at nearly constant brightness $V \sim 13.6 - 13.8$. In September and October the brightness declined linearly at a rate 0.034 mag/day in the B band and 0.029 mag/day in the V.

The $B-V$ color was quite blue and increased very slowly from about 0.2 to 0.4. After October 29 the decline rate in B increased greatly up to about 0.3 mag/day. The decline in V also steepened in similar way some days later. The observed decline rate is about twice the fastest rate for type Ia and Ib supernovae. For type II the fastest decline in B at the rate 0.37 mag/day was observed for SN 1993J immediately after the first maximum light. No known supernovae have such high rate of decline at phase $\sim$ 80 days past maximum. Similar shape of the light curve was observed for SN 1987B (Tsvetkov, 1989), but with much slower decline after the linear part of the curve. So the light curve of SN 1994W appears to be unique.

If we assume the distance 22.7 Mpc to NGC 4041 from Tully (1988), then at maximum SN 1994W reached the absolute magnitude about -18, quite normal for type II supernovae. The fast brightness decline started at $M_B \approx -16$, and the upper limit on November 8 corresponds to $M_B = -13.3$. SN 1994W could have the exponential tail starting at about the same luminosity as for type II supernovae 1980K and 1987A. Observations of SN 1994W at very late stage are needed to reveal the nature of this unique object.

Table 1
Magnitudes of comparison stars

Star	B	V
1	14.05	13.18
2	14.58	14.01
3	14.84	14.27
4	15.42	14.67
5	15.77	15.10
6	16.60	15.50
7	17.35	16.35
8	17.64	

Table 2
Observations of SN 1994W

Date		JD 2449000+	B	V
Sep	8.83	604.33	14.21	14.00
	16.81	612.31	14.49	14.18
Oct	6.76	632.26	15.12	
	28.91	654.41	15.90	
Nov	1.95	658.45	17.28	15.53
	6.99	663.49		[16.5
	8.97	665.47	[18.5	

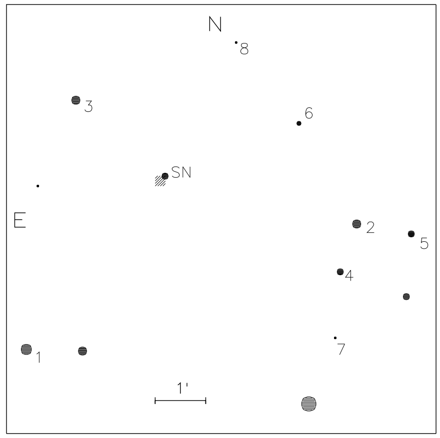

Figure 1. Comparison stars for SN 1994W

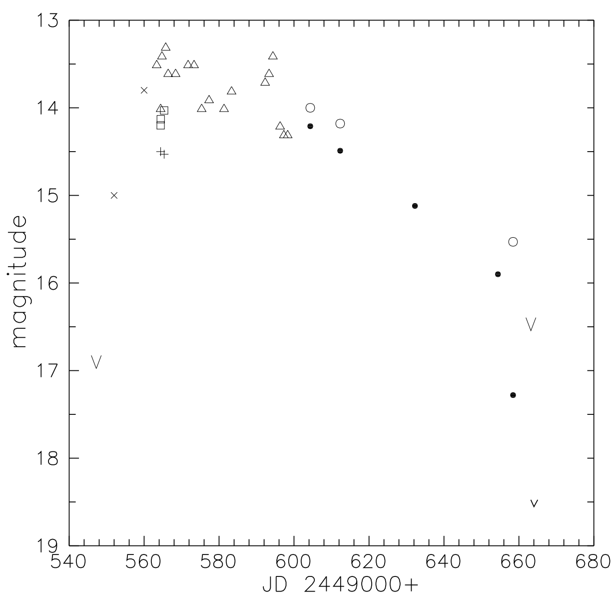

Figure 2. Light curve of SN 1994W. Dots and circles – our B and V magnitudes, pluses and squares – B and V CCD observations, triangles – visual estimates, crosses – R magnitudes based on data by Richmond *et al.* Upper limits are shown for our B and V plates and for R-band observations by Richmond *et al.*

The work was partly supported by Russian Foundation for Fundamental Research grants No. 93-02-17108, 93-02-17114, by grants No. MPP000 and MPP300 from the International Science Foundation and the Russian Government.

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

Number 4254

Konkoly Observatory
Budapest
28 September 1995

HU ISSN 0374 – 0676

ON THE NEW VARIABLE λ BOOTIS STAR HD 109738

We present new spectroscopic and photometric observations for the λ Bootis star HD 109738. Photometric observations were made during the night of 03/04 May 1995 at CTIO, Chile with the Lowell-telescope. The integration time was 30 seconds in Strömgren *b* and *v*. HD 111480 (V=8.3, A3V) was used as a comparison star and proved to be constant within an upper limit of 3 mmag in Strömgren *b*.

λ Bootis stars are a group of metal poor, Population I, A-type stars. Their evolutionary status is not well known (Paunzen et al. 1995b). HD 109738 was found by Hauck (1986) as a photometric λ Bootis star candidate in the Geneva system. Recent spectroscopic observations with the 1.6 meter telescope at Itajuba, Brazil, confirm the membership of the λ Bootis group.

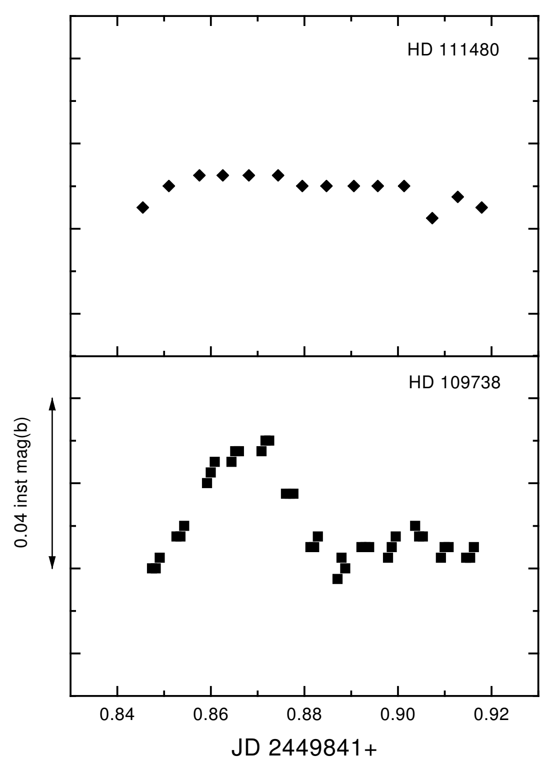

Figure 1. The lightcurve for HD 109738 and HD 111480 in instrumental Strömgren *b*

The photometric observations were made during a survey to detect variability in a sample of λ Bootis stars (Paunzen et al., 1995a). The aim of this survey is to establish pulsation in these stars. For HD 109738 we found a period of about 47 minutes with an amplitude of 18 mmag in Strömgren b. Since the dataset covers only about 3 hours, the given values are preliminary. From hitherto 25 photometrically investigated λ Bootis stars, 13 proved to be variable (Paunzen et al., 1995b). The observed periods range from 30 minutes to 4 hours.

Acknowledgements: This research was done within the working group *Asteroseismology-AMS*. Computing resources and financial support for this international collaboration were provided by the Fonds zur Förderung der wissenschaftlichen Forschung (project *P 8776 -PHY*) and the Hochschuljubiläumsstiftung der Stadt Wien (λ Bootis Sterne). We acknowledge receipt of telescope time at CTIO and Itajuba. This research has made use of the Simbad database, operated at CDS, Strasbourg, France.

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

Number 4255

Konkoly Observatory
Budapest
28 September 1995

HU ISSN 0374 – 0676

HD 168740: A NEW VARIABLE λ BOOTIS STAR

We report the discovery of pulsation in the λ Bootis star HD 168740. Observations were made in the nights of 21/22 April and 23/24 April 1995 at CTIO, Chile with the Lowell-telescope. The integration time was 10 seconds in Strömgren b and v. HD 167425 (V=6.2, F9V) was used as a comparison star in both nights.

λ Bootis stars are a group of metal poor, Population I, A-type stars. Their evolutionary status is not well known (Paunzen et al., 1995). HD 168740 was found by Hauck (1986) as a photometric λ Bootis star candidate in the Geneva system. Recent spectroscopic observations with the 24-inch Helen-Sawyer-Hogg telescope located at Las Campanas, Chile confirm the membership to the λ Bootis group.

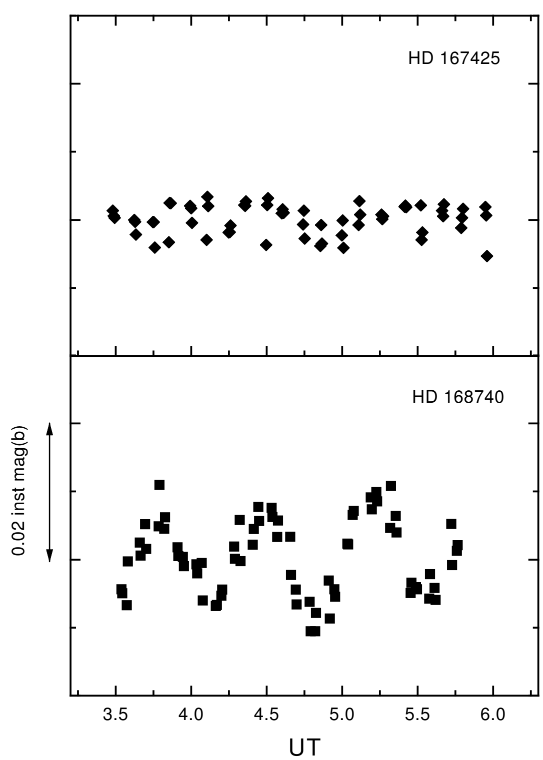

Figure 1. The lightcurve for HD 168740 and HD 167425 for the second night in instrumental Strömgren b.

The photometric observations were made during a multisite campaign for HD 111786 (Kuschnig et al., 1994). Therefore the dataset is rather short but sufficient to establish variability. We found a period of about 52 minutes with an amplitude of 16 mmag in Strömgren b. Amplitude variations are evident (Figure 1), therefore the values for the period and amplitude are preliminary. From hitherto 25 photometrically investigated λ Bootis stars, 13 proved to be variable (Paunzen et al., 1995). The observed periods range from 30 minutes to 4 hours.

Acknowledgements: This research was done within the working group *Asteroseismology-AMS*. Computing resources and financial support for this international collaboration were provided by the Fonds zur Förderung der wissenschaftlichen Forschung (project *P 8776-PHY*) and the Hochschuljubiläumsstiftung der Stadt Wien (λ Bootis Sterne). We acknowledge receipt of telescope time at CTIO and UTSO. This research has made use of the Simbad database, operated at CDS, Strasbourg, France.

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

Number 4256

Konkoly Observatory
Budapest
3 October 1995

HU ISSN 0374 – 0676

OBSERVATIONS OF 1991 SUPEROUTBURST OF WX Cet

Since its discovery as a possible nova (Strohmeier, 1964) and discovery of four outbursts of large amplitudes (Gaposchkin, 1976), WX Cet has been suggested to be closely related to an enigmatic dwarf nova WZ Sge (Bailey, 1979; Downes and Margon, 1981). This suggestion was confirmed by discovery of superhumps with a period of $\sim$80 min during the 1989 June superoutburst (O'Donoghue et al., 1991). In addition, this discovery has lead to an idea that WZ Sge-type stars are extreme SU UMa-type dwarf novae, rather than constituting a new class of dwarf novae. Although the classification of WX Cet based on superhump observation seems to be established, its seemingly unusual outburst behavior among SU UMa-type dwarf novae has not been well studied. The author undertook time-resolved CCD photometry during a faint outburst in 1991 July.

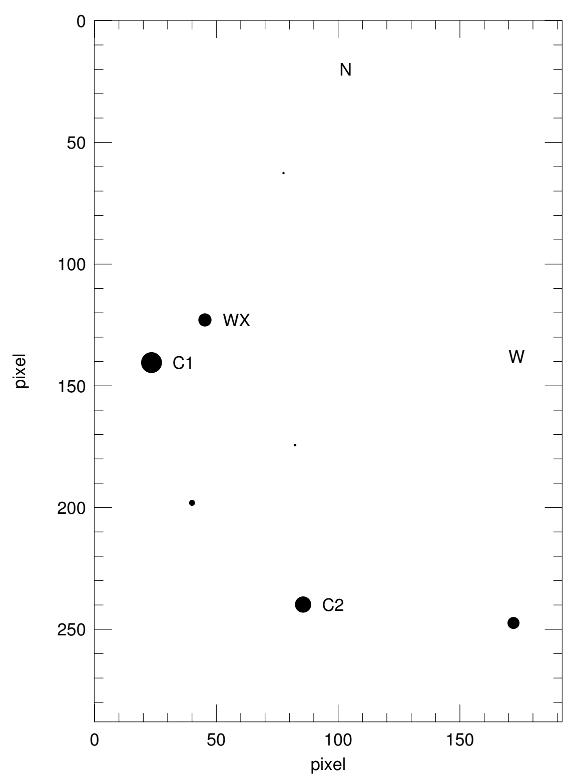

Figure 1. Finding chart of WX Cet drawn from a CCD image. North is up, and the field of view is about 10×7 arcmin. The primary comparison star (C1), check star (C2) and WX Cet (WX) are marked.

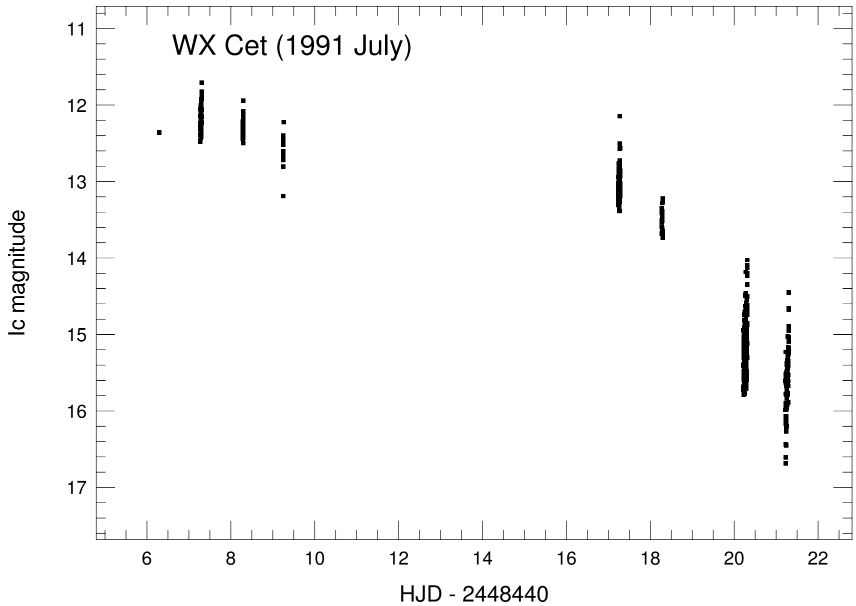

Figure 2. *I*-band light curve of WX Cet during a superoutburst in July 1991. The outburst lasted at least 12 days, followed by a more rapid decline whose rate anomalously slowed down far before reaching quiescence.

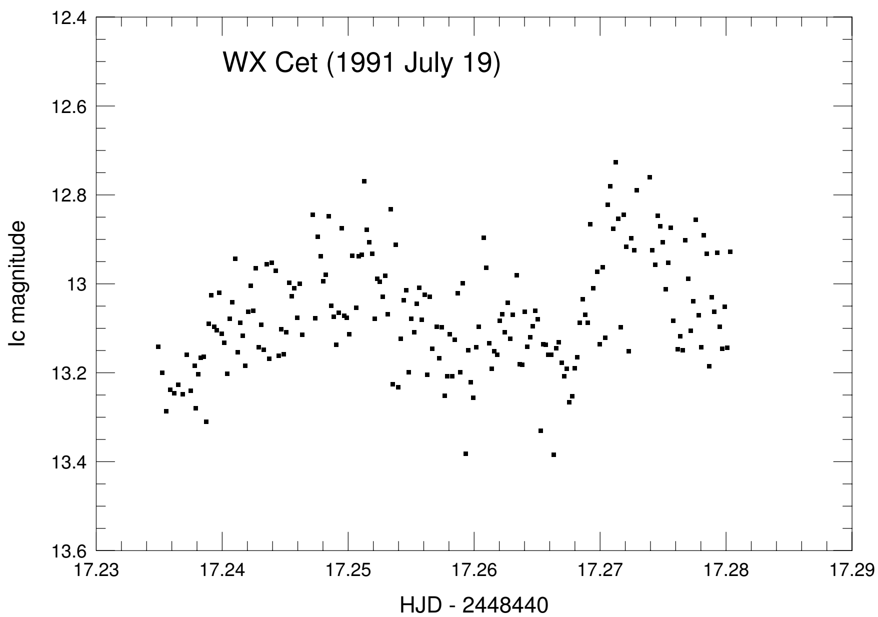

Figure 3. Enlarged light curve on July 19. Superhumps with a first broader and second sharp maxima were detected.

The 1991 July outburst was discovered by Jones and Bateson (1991) at m_v=12.2. The outburst was independently detected by the author. Due to the faintness, it became a focus of this research to test whether this outburst was a short-living one as in 1989 December which reached m_v=12.5 (cf. O'Donoghue et al. 1991). The observations were carried out using a CCD camera (Thomson TH 7882, 576 $\times$ 384 pixels) attached to the Cassegrain focus of the 60 cm reflector (focal length=4.8 m) at Ouda Station, Kyoto University (Ohtani et al., 1992). To reduce the readout noise and dead time, an on-chip summation of 3$\times$3 pixels to one pixel was adopted. An interference filter was used which had been designed to reproduce the Kron-Cousins *I* band. The exposure time of 10–60 s was adopted depending on the brightness of the object; the dead time between exposures was 8–10 s. The frames were first corrected for standard de-biasing and flat fielding, and were then processed by a personal-computer-based aperture photometry package developed by the author. The differential magnitudes of the variable were determined against a local standard star marked as C1 in Figure 1. A comparison of the local standard star with a check star (C2 in Figure 1) in the same field has confirmed the constancy of the standard to 0.01 mag. The magnitude of C1 was determined as I_c=9.92 using equatorial standard stars (Landolt, 1983). One should, however, remember that this absolute value may contain a relatively large error due to large ($\sim$2) air mass. The Ic-band magnitudes of WX Cet were determined using this local standard star.

The overall light curve is shown in Figure 2. The outburst lasted at least 12 days, with an average decline rate of 0.09 mag day^{-1} before starting a rapid decline. A time-resolved light curve obtained on July 19 (Figure 3) shows superhumps with a first broader and second sharp maxima. Although the shortness of the observing window did not allow us to improve the superhump period discovered by O'Donoghue et al. (1991), the present faint outburst is thus confirmed to be an unmistakable superoutburst.

The brightest (presumable) superoutburst of WX Cet reached m_{pg}=9.3 (Gaposchkin, 1976). The range of peak brightness of superoutbursts of WX Cet therefore reaches at least 2.9 mag, which exceeds most of ranges observed in SU UMa-type dwarf novae. Comparable cases can be found in SW UMa, VY Aqr and BC UMa, all of which are known to show 2–2.5 mag variation in the peak brightness of superoutbursts. This feature seems to be one of common characteristics of SU UMa-type dwarf novae bridging WZ Sge-like stars and classical SU UMa-type dwarf novae.

Another peculiar feature of WX Cet can be found during its terminal decline from a superoutburst. In contrast to most SU UMa-type dwarf novae, the rate of decline slowed down far before reaching quiescence. [Averaged decline rates of 0.80 mag day^{-1} and 0.41 mag day^{-1} were obtained for the intervals of July 20–22 and 22–23, respectively. Note that WX Cet was at I_c=15.5 on July 23, which was $\sim$ 2.0–2.5 mag brighter than quiescence.] Similar phenomenon was also observed in CT Hya (Nogami et al., 1995). Phenomenologically this feature seems to be related to a poorly understood long-fading tail observed in the terminal stages of superoutbursts of WZ Sge (Patterson et al., 1981), although its explanation should await further observational and theoretical works.

The author is grateful to Yoshiyuki Sekine for helping the observations. Part of this work is supported by a Research Fellowship of the Japan Society for the Promotion of Science for Young Scientists.

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

Number 4257

Konkoly Observatory
Budapest
4 October 1995

HU ISSN 0374 – 0676

THE OVERCONTACT BINARY SYSTEM NSV 05798

The variability of NSV 05798 (HV 10097, GSC 4951.0769, CSV 001901) was announced by Hughes Boyce (1939) in a photographic survey carried out by the Harvard College Observatory in 1939 with the 10-inch Metcalf triplet in South Africa. According to her measurements, she preliminarily classified the star as an overcontact binary star with a photographic range from $12^{m}_{.}2$ to $12^{m}_{.}8$. The star was catalogued as NSV 05798 (Kholopov, 1982) awaiting for further confirmation of Hughes' results. No ephemeris was given and type F is the only spectral information available.

During 18 nights, from March 21 to April 18, 1995, NSV 05798 was observed in the V band using a LYNXX-2 CCD camera, attached to the Newton focus of the 0.4-m telescope at Observatorio de Mollet (Spain). SAO 138882 was used as comparison star (see Figure 1).

The result of this surveillance program proved that NSV 05798 is an overcontact or nearly overcontact eclipsing binary star with a period slightly shorter than 9 hours. Figure 2 shows the obtained light curve in the V band. NSV 05798 fades 0.63 and 0.61 magnitudes at the primary and secondary minima respectively.

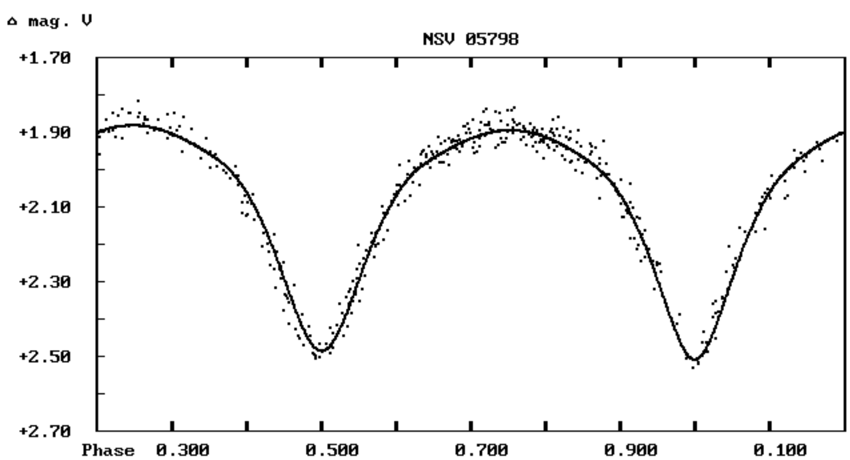

Figure 1

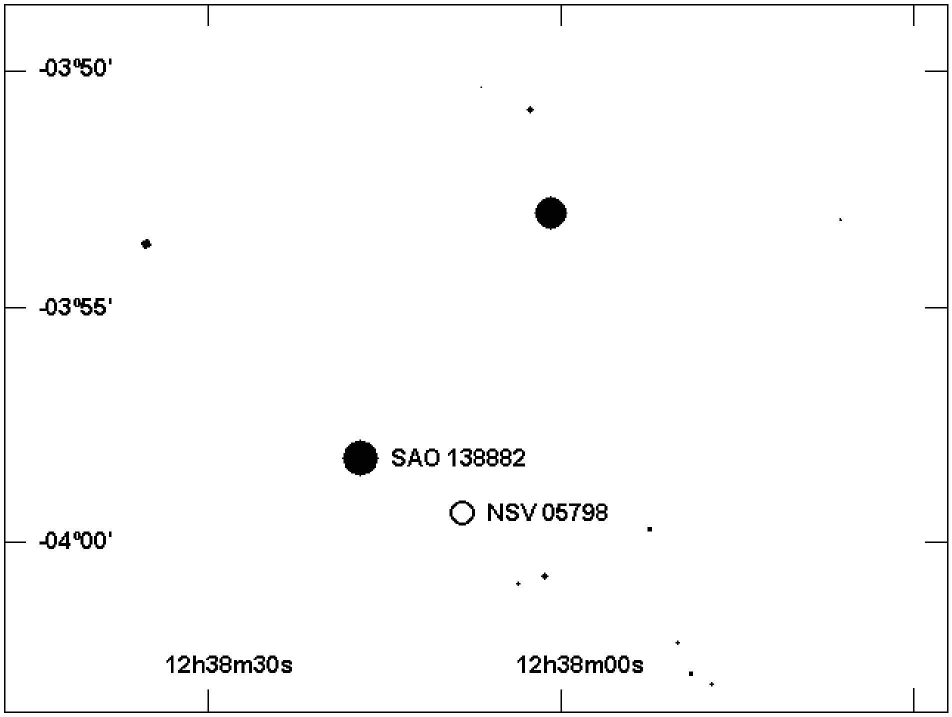

Figure 2. Light curve of NSV 05798 in the V band (points) and superimposed synthetic light curve (solid) for the given physical parameters.

From our set of data we computed the following ephemeris for the primary minimum:

$$\text{Min. I} = \text{HJD}\,2449825.54948 \;+\; 0^{\mathrm{d}}\!.36942\times\text{E}$$
$$\pm 50 \qquad\qquad \pm 6$$

Although both minima are almost identical in depth, they are different in shape. The primary minimum is sharper than the secondary one, suggesting that during the primary we observe a transit while during the secondary we observe an occultation.

We used Binary Maker 2.0 (Bradstreet, 1993) to obtain the physical elements for the light curve (Figure 2). For an assumed spectral type F5V, we adopted a limb darkening coefficient of 0.6 for both stars and a gravity darkening coefficient of 0.32. We also adopted a value of 0.5 for the reflection coefficient. The physical elements in the V band are:

mass ratio	q : 0.55 ± 0.05
fillout	f : 0.02 ± 0.02
	i : $79^\circ\!.8 \pm 0^\circ\!.2$
$a_g = 0.46 \pm 0.01$	$a_s = 0.36 \pm 0.01$
$b_g = 0.43 \pm 0.01$	$b_s = 0.32 \pm 0.01$
$c_g = 0.41 \pm 0.01$	$c_s = 0.31 \pm 0.01$
$d_g = 0.56 \pm 0.01$	$d_s = 0.44 \pm 0.01$
$L_1 = 0.64 \pm 0.02$	$L_2 = 0.36 \pm 0.02$
$g_1 = 0.32$	$g_2 = 0.32$
$x_1 = 0.60$	$x_2 = 0.60$
$A_1 = 0.5$	$A_2 = 0.5$
$T_1 = 6620\text{K} \pm 50\text{K}$	$T_2 = 6600\text{K} \pm 50\text{K}$

To have a deeper understanding of this binary system, it is important that future research on this star be directed to perform multicolor photometry, spectroscopic analysis to exactly determine its spectral type, and search for radial velocities.

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

Number 4258

Konkoly Observatory
Budapest
20 October 1995

HU ISSN 0374 – 0676

THE DETECTION OF NARROW ABSORPTION COMPONENTS (NACS) IN FX Lib = 48 Lib[1]

We report on observations of optical shell lines in FX Lib = 48 Lib = HR 5941 (B3IV e-sh, $v \sin i = 400$ km s^{-1}), a well-known equatorial shell star studied since decades (see Guo 1994 for further references). We have detected in some of these shell lines satellite absorption features which, though quite conspicuous at sufficiently high resolution, apparently have never been observed before.

The observations were carried out in three runs in 1995: March 07–10 (period I) at the 1.4m Coudé Auxiliary Telescope of ESO at La Silla/Chile (observer: RWH). Attached to the telescope was the Coudé Echelle Spectrograph CES, operated with the Long Camera, and a UV-coated LORAL 2048 × 2048 CCD with 15μ pixel size. The effective resolving power as determined from the width of thorium emission lines was $R = 50\,000 - 120\,000$.

The second run (period II) was on April 10–18 (observer: RWH) at the 1.52m telescope of the Observatoire de Haute Provence at St. Michel/France, equipped with the Coudé spectrograph *Aurélie* and a one-column CCD (double barette Thomson) with 2048 pixels of 13 μ size each. The effective resolving power was $R \approx 45\,000$.

The third run (period III) was on April 26 – May 01, 1995 (observer: MV), again at the OHP 1.52m telescope with the same instrumentation.

All data were reduced in the standard way and binned on a heliocentric radial velocity scale ($V_{\rm hc}$).

We have measured the spectral region of three important shell lines in 48 Lib: Hα, Fe II λ5317 (together with several other fainter Fe II lines including the λ5276 feature), and Na I$-D_1, D_2$ including the He I λ5876 line.

We have covered by our extensive spectroscopic survey timescales between hours (in series of integrations with a single exposure time of 15–30 minutes) and two months (gap between periods I and III).

The Hα profile (Figure 1a) consists of two asymmetric emission humps with ratio $V/R = (2.65-1)/(4.22-1) = 0.51$ (ratio of continuum-subtracted fluxes in violet peak and red peak, resp.), separated by a deep central shell trough of residual intensity $0.08F_{\rm c}$. There is no evidence for any small-scale fine-structure in the line profile, contrary to the observation of Guo (1994) who reported moving bumps at Hα in April 1994.

The Fe II lines offer a completely different picture. One such λ5317 measurement from period I is shown in Figure 1b, a larger subset on an extended scale in Figure 1c. The line structure is dominated by an asymmetric blueshifted shell feature of typical width (FWHM) = 90 km s^{-1}, centred at $V_{\rm hc} = -52$ km s^{-1}. This dominant absorption feature is flanked by faint extended emission on its red side. More conspicuous, however, are

[1]Based on observations obtained at the European Southern Observatory, La Silla, Chile, and at the Observatoire de Haute-Provence (CNRS), St. Michel, France

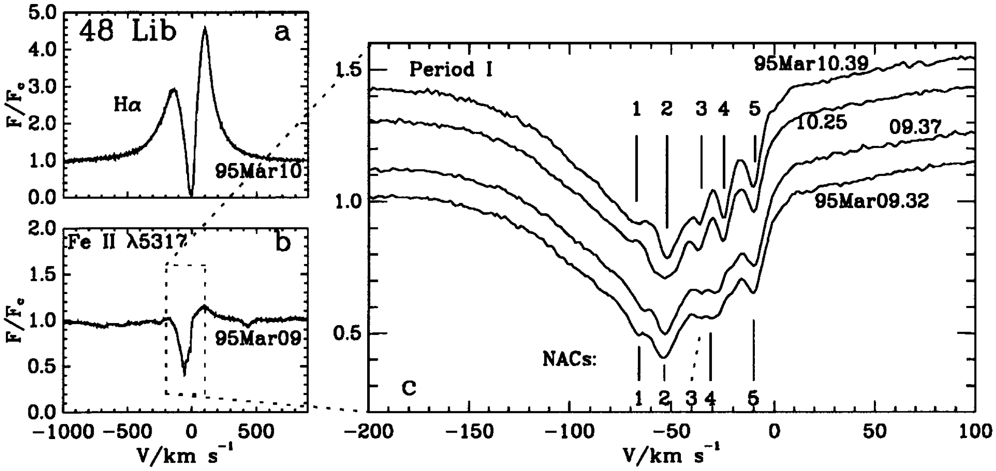

Figure 1a. Hα profile of 48 Lib. **1b**: Fe II λ5317 profile. **1c**: Close-up of some Fe II profiles. The NACs are numbered 1...5. We show four spectra out of 9 measured in period I.

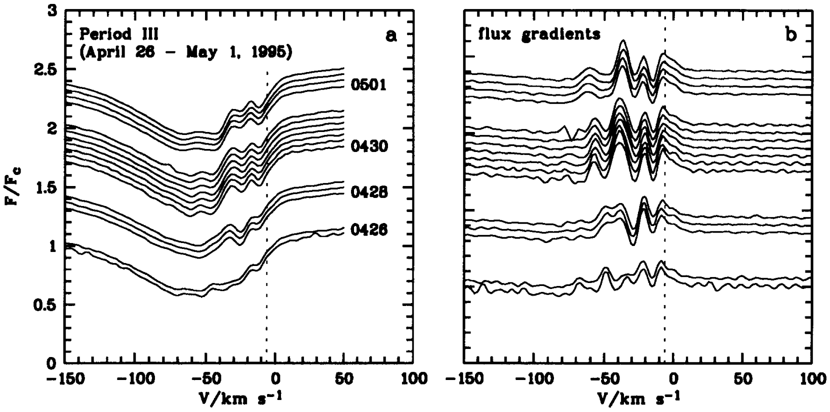

Figure 2. Close-up of our Fe II λ5317 data from period III. **2a**: Line profiles. **2b**: normalized flux gradients $(\Delta F/\Delta v)/F$ (where F denotes the flux and v the radial velocity), chosen to enhance the visibility of the NACs. The dotted line marks the stellar rest velocity.

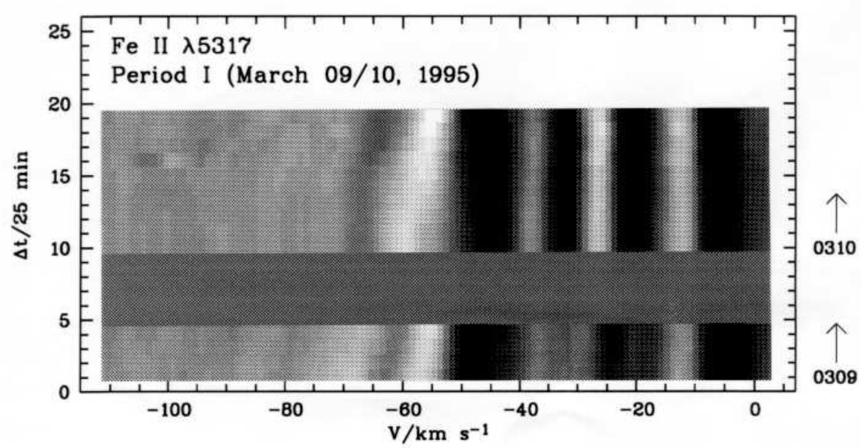

Figure 3. Gray-scaled plot of the NAC evolution during period I. We show the flux gradient on a linear timescale with one time-step Δt equivalent to 25 minutes. Lags between actual measurements are filled by interpolation. The total time interval represented here is 100 min for March 9, and about 3 hours for March 10.

several subordinate absorptions embedded into the central part of the shell trough and its low-velocity flank (Figure 1c). These will be called *narrow absorption components* (NACs) in the following.

They are characterized by the following properties:

Number. In the spectra from period I, we count 5 NACs, while in the later periods only 4 are visible at any time with certainty (Figure 2). They only show up in the subrange V_{hc} = –80 and –10 km s^{-1} of the shell trough.

Width. Their width decreases from the bluemost NAC to the that one with the smallest velocity. Typical values are about 10 km s^{-1} for the bluemost NAC. The NAC with lowest velocity has width ΔV= 4 km s^{-1} (FWHM) in the CAT spectra with highest resolution (period I, R = 120 000 or instrumental FWHM = 2.5 km s^{-1}) and are well resolved. In periods II and III, we measure $\Delta V\approx$ 7 km s^{-1} which corresponds to the instrumental FWHM, i.e. the NACs are unresolved then.

Depth. The depth of the deepest resolved NACs from period I is about 0.11–0.13 continuum units.

Time variability. In those nights with multiple exposure we find slow variability of the NAC features both in RV and depth on a timescale of hours (see Figure 3). RV changes, if present, are always such that a feature moves *from larger to smaller blueshifted velocities.* The bluemost NACs move fastest, while those with smallest radial velocity are stationary. Most rapid changes observed occur in period I, with $\geq$ 20 km s^{-1} per day. "Acceleration" is generally lower at later times. This rate is large enough to modify the overall appearance of the NACs from night to night considerably.

Beyond any doubt, the NACs are true spectroscopic structures rather than noise since their depth is considerable. Moreover we find the same features, with the same RV and relative depths, in the Fe II λ5276 line, as well as at Na I. In the latter line, the NACs are even deeper than at Fe II.

In the stellar He I profile, neither broad shell feature nor NACs are visible.

Due to their depth and to the fact that no small-scale structure is visible in He I, we conclude that the NACs have nothing to do with profile fluctuations induced by non-radial pulsations (e.g., Baade & Balona, 1994). Furthermore their relatively small radial velocity, their drift to *smaller* velocities, their extreme narrowness and their occurrence in optical lines of species with low ionization degree (rather than in UV lines of high ionization stages) clearly distinguishes them from the well-known DACs in stellar wind lines (Prinja 1994, Henrichs et al. 1994).

There are only a few earlier observations of 48 Lib which show related behaviour: Aydin & Faraggiana (1978) report night-to-night variability in the Na I-D lines in 1970–74. Their photographic material, however, has much lower S/N quality than ours. Guo (1994) reports Hα variability in 1994, with not fully resolved spectra of unknown reliability. Our own overview of earlier Hα and Fe II data in 48 Lib (Hanuschik et al., 1995) does not show any such fine structure in 1987–1993. In absence of any reliable previous observation of NACs we believe that we have found a new spectroscopic phenomenon in Be star disks which occurs only rarely and transiently.

The NACs are likely to be caused by regions of higher density, or lower temperature, as compared to the surrounding gas. These regions must be very small in comparison to the disk dimensions, $\Delta R/R_{\rm d} \ll 1$, since their observed RV width of 4–10 km s^{-1} is only slightly more than the *thermal width* of iron at 10^4 K (2.9 km s^{-1} FWHM), and much less than the RV width of the shell volume (about 90 km s^{-1}).

However, if the NACs were simply caused by local clumps moving across the stellar disk in elliptical Keplerian orbits, their observed RV change during a night would be too small (typical time scale for crossing the shell volume at 5 stellar radii is half a day). It seems more likely that they are due to higher-order components of the density wave which causes the cyclically changing line profile asymmetries in 48 Lib (see Hanuschik et al. 1995).

The shell volume mainly traces the *radial component* of the velocity field in a small part of the circumstellar disk (Hanuschik, 1995). The detection of NACs in 48 Lib therefore provides highly valuable, otherwise unaccessible information about the structure of the disk in 48 Lib. We strongly urge other observers with access to a medium-sized telescope with Coudé spectrograph equipment to continue observations of these conspicuous features, which are best observable at Fe II λ5317.

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

Number 4259

Konkoly Observatory
Budapest
24 October 1995

HU ISSN 0374 – 0676

IMPROVEMENT OF THE PERIOD OF CQ UMa

CQ UMa (HD 119 213, HR 5153) is a cool CP2 star demonstrating strong periodic light and spectrum variations caused by the presence of large spectroscopic and photometric spots on the surface of the rotating star. The first correct value of the period: P = 2.451 days, was found by Wolff & Morrison (1975) on the basis of their Strömgren *uvby* photometry. Shapes and amplitudes of light curves are wavelength-dependent. The largest variations (about 0.1 mag) take place in the *v* color. Longwards of 520 nm light variations are in the antiphase with variations in the blue region exceeding the amplitude of 0.02 mag.

Modelling of photometric spots on the stellar surface requires very good knowledge of light curves in various colors (Mikulášek, 1994). As the published measurements of the star brightness taken by many authors were obtained within the time interval of 25 years, their exploitation is possible only if the period of the star is known with satisfying accuracy.

In the search for the precise period of CQ UMa we have used all the available photometric observations in Johnson's B, Strömgren's *v* and the Shemakha Observatory's X filters, in which the S/N ratio is the best. The last of the filters is very similar to that of Strömgren's *v* filter (Schöneich & Staude, (1976), Musielok et al. (1980)). Nine sets of photometry used, cover 3720 revolutions of the star – see the list in the Table. The last set of photometry taken in the *v* filter was recently obtained by the team involving one of us (J. Ž.) by means of the photoelectric photometer attached to the 0.6 m telescope of the Skalnaté Pleso Observatory.

Source	col	N	cycles	Mean Epoch	$(O–C)_{new}$
Burke & Howard (1972)	B	26	0 – 158	84	+0.007 ± 0.036
Winzer (1974)	B	18	145 – 291	198	+0.006 ± 0.016
Wolff & Morrison (1975)	*v*	25	401 – 443	427	–0.007 ± 0.015
Musielok et al. (1980)	X	29	604 – 894	761	+0.003 ± 0.008
Mikulášek et al. (1978) + Pavlovski (1979)	B	28	441 – 1215	969	+0.011 ± 0.017
Pyper & Adelman (1985)	*v*	24	1465 – 2057	1834	–0.005 ± 0.015
Jetsu et al. (1991)	B	143	2954 – 3138	3029	–0.001 ± 0.007
This paper	*v*	24	3638 – 3720	3670	+0.012 ± 0.018

The period improvement has been carried out using special iterative least squares method (details in Mikulášek et al., 1995). The basic assumptions of the analysis of data were: the light curves in B and *v* colors are constant (but generally unequal) and the periods of these variations are the same. On the contrary to the previous papers dealing

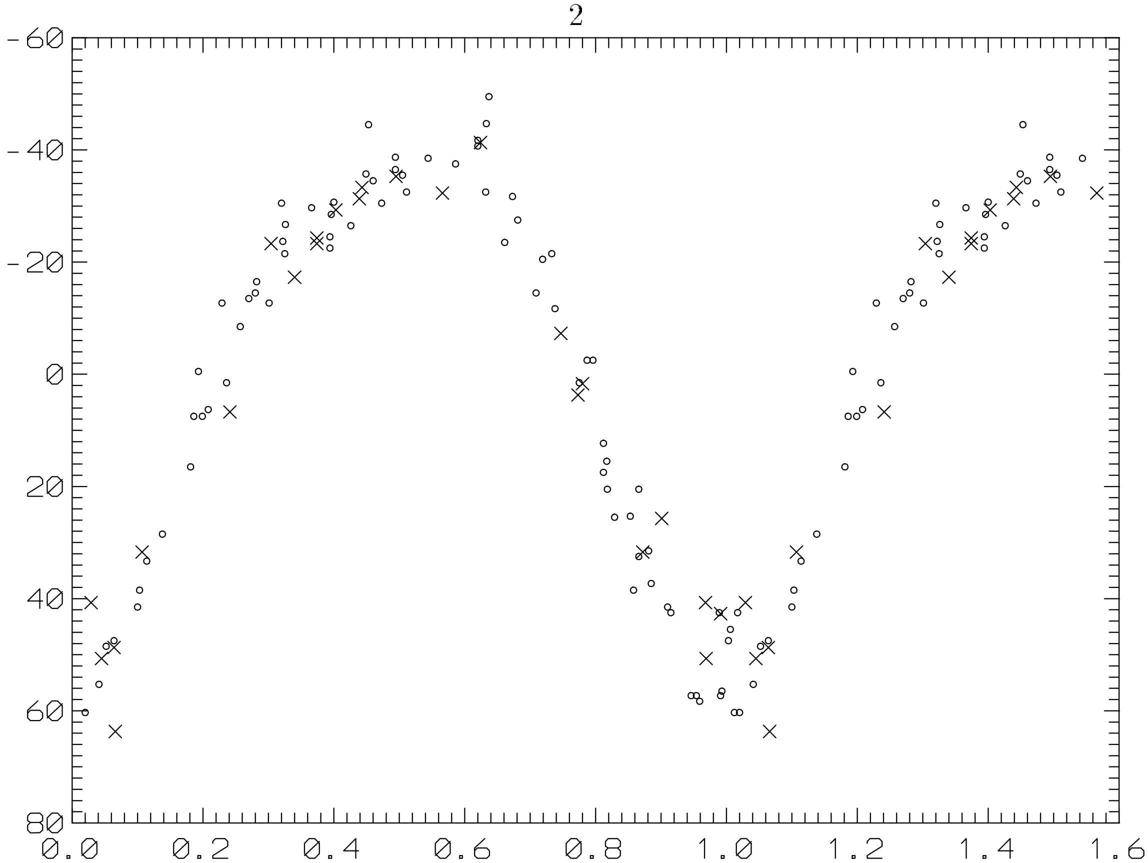

Figure 1. Light curve of CQ UMa in X and v filters. Circles – data from literature, crosses – this paper, brightness in millimagnitudes relative to the mean value. Phases were calculated according to the ephemeris given in this paper.

with the CQ UMa light elements, we put the beginning of counting of cycles at the light minimum of the v color. The minimum of the v light curve is sharp, symmetric and so well defined, while the maximum in both colors used before is both flat and asymmetric.

Altogether 215 measurements in B and 102 in v colors were used and the following ephemeris has been derived:

$$\mathrm{JD_{hel}}(\mathrm{Min}\ v) = 2\ 445\ 349.7263 + (\mathrm{E}{-}1878)\ 2\overset{\mathrm{d}}{.}4499141$$
$$\pm 0.0047 \qquad\qquad \pm 0.0000038$$

where the epoch E was chosen so, that E = 0 corresponds to the v light minimum immediately preceding the first of published photometric observations of CQ UMa.

(O–C) values listed in the Table indicate that the period of the variations of the star was stable within the last 25 years, what confirms the expected extreme stability of photometric patterns on the stellar surface. Accuracy of the period determination enables one to find the phase of observations during the last 25 years with an uncertainty not exceeding 0.003, what is the basic requirement for further light curve analysis and mapping of the star's atmosphere. The phase ϕ can be computed according to the following relation:

$$\phi = \mathrm{frac}[(\mathrm{JD_{hel}} - 2\ 440\ 748.7876)/2.4499141]$$

The observed v light curve minimum is at the phase $\phi = 0.000 \pm 0.007$, but in the B one finds the minimum at $\phi = -0.021 \pm 0.006$(!). On the contrary, the flat maxima of light curves occur at the same phases: 0.581 ± 0.011 and 0.574 ± 0.023 in v and B colors, respectively (see Figure 1). Detailed analysis of light curves will be published elsewhere. Photometric observations from Skalnaté Pleso Observatory would be at your disposal via e-mail: ziga@ta3.sk.

This work was supported, in part, by Grant Agency for Science (grant No. 2/62/95).

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4260

Konkoly Observatory
Budapest
31 October 1995

HU ISSN 0374 – 0676

OUTBURST OBSERVATION OF PU Per

PU Per is a faint dwarf nova discovered by Hoffmeister (1967). Romano and Minello (1976) examined Asiago plates and found two outbursts: the first short one (JD 2440644) reached a magnitude of 17.4, and the second long one (JD 2441295 – 2441303) reached a magnitude of 15.2. These data seem to suggest existence of different types of outbursts in PU Per. Busch and Häussler (1979) reported two long outbursts (JD 2439052 – 2439056, 2439380 – 2439390) from Sonneberg plate collection. Further positive outburst observation was reported by Bruch et al. (1987). The object is at or below the plate limit of POSS, suggesting a large outburst amplitude.

The variable was again caught in outburst by Iida (VSNET message) on 1995 Oct. 13.549 UT at unfiltered CCD magnitude of 17.6. The outburst was subsequently confirmed at Ouda Station, Kyoto University. The observations were carried out using a CCD camera (Thomson TH 7882, 576 $\times$ 384 pixels) attached to the Cassegrain focus of the 60 cm reflector (focal length=4.8 m) at Ouda Station, Kyoto University (Ohtani et al., 1992). To reduce the readout noise and dead time, an on-chip summation of 2$\times$2 pixels to one pixel was adopted. An interference filter was used which had been designed to reproduce the Johnson V band. The exposure time was 120 s on Oct. 13 and 240 s on Oct. 14. The frames were first corrected for standard de-biasing and flat fielding, and were then processed by a personal-computer-based PSF photometry package developed by one of the authors (T.K.). The differential magnitudes of the variable were determined against a local standard star marked as C1 in Figure 1. The constancy of the comparison was checked against several stars in the same field. By comparison with GSC stars, we adopted a magnitude of C1 as 13.4.

An accurate position was determined by Iida (private communication) from a CCD image taken at Ouda. He gave a position of $02^h42^m16^s.14$ $+35°40'46''.4$ (J2000.0) based on 10 GSC stars with a mean residual of $0''.1$. This position is $17''$ north to that given by Downes and Shara (1993), but is in good agreement with that given by Bruch et al. (1987) measured from an outburst photograph.

Figure 2 shows the overall light curve of PU Per by our CCD photometry. The magnitudes are given relative to C1. The star showed a very rapid decline with a rate of 1.9 $\pm$ 0.1 mag d^{-1}. This behavior closely resembles the first outburst recorded by Romano and Minello (1976). Figure 3 shows an enlarged light curve of Oct. 13. Low-amplitude hump-like features seem to exist in the light curve. Owing to the relatively large scatter in the light curve especially in the later half, we have chosen to estimate the period from the times of hump maxima. The resultant period was 0.058 $\pm$ 0.002 day. Although the identification of this period as a possible orbital one is very tentative due to large observational scatter, this dwarf nova would be a good candidate of ultrashort orbital period SU UMa-type dwarf novae related to WZ Sge-type stars (Bailey, 1979; Downes, 1990). The rate of decline also seems to support this idea. The second outburst observed in

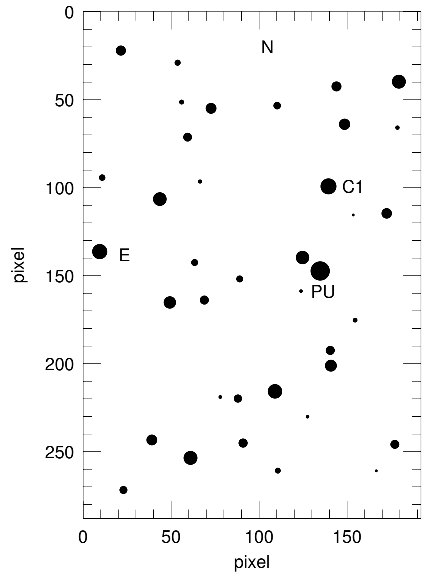

Figure 1. Finding chart of PU Per drawn from a CCD image. North is up, and the field of view is about 10×7 arcmin. The primary comparison star (C1) and PU Per are marked.

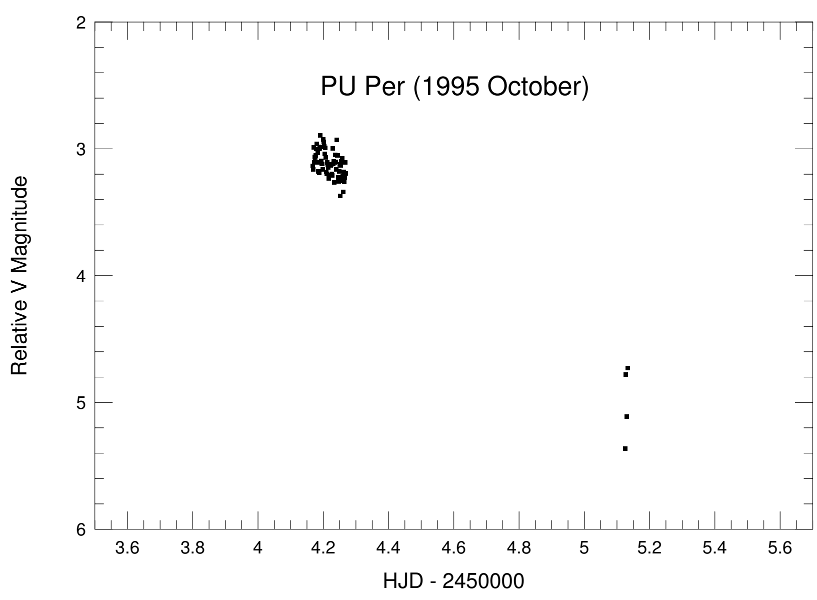

Figure 2. *V*-band light curve of PU Per during 1995 Oct. outburst. Note the very rapid decline with a rate of 1.9 ± 0.1 mag d^{-1}.

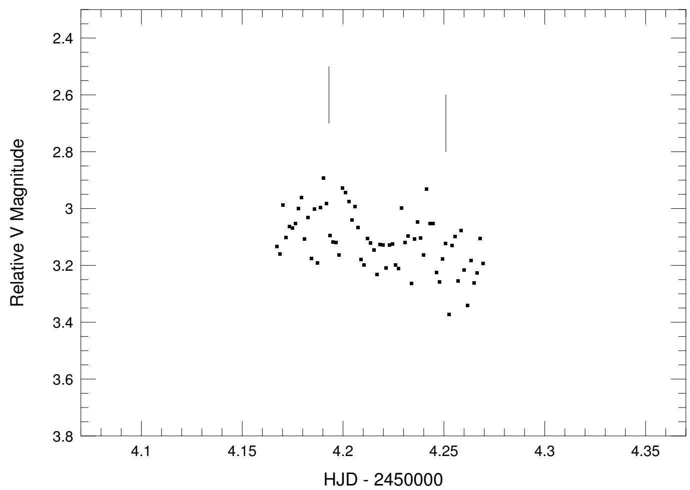

Figure 3. Enlarged light curve on Oct. 13. Low-amplitude hump-like features are visible. From times of maxima (marked by ticks), a period of 0.058 $\pm$ 0.002 day is suggested.

Romano and Minello (1976) and two outbursts reported by Busch and Häussler (1979) could then be identified as superoutbursts. From the shortest interval of these suspected superoutbursts, the supercycle length might be estimated to be $\sim$ 330 d. Further close monitoring to detect superoutbursts and superhumps is recommended.

The authors are grateful to Makoto Iida for notifying them about the outburst and providing the astrometry. Part of this work is supported by a Research Fellowship of the Japan Society for the Promotion of Science for Young Scientists.

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

Number 4261

Konkoly Observatory
Budapest
1 November 1995

HU ISSN 0374 – 0676

THE SMALL-AMPLITUDE VARIABLE STAR HD 191495 IN THE OPEN CLUSTER NGC 6871

The young open cluster NGC 6871 (r = 1.8 kpc) is one of the nuclei of the O,B association Cyg OB3. In this cluster, we observed nine stars as doubles in an attempt to detect the eclipsing effects by means of photoelectric B,V photometry (Zakirov and Petrov, 1988). The observations were obtained in 1986/87 with the 48 cm and 60 cm telescopes at Mt. Maidanak Observatory. After a careful analysis of our monitoring data, one of the stars, HD 191495 (Sp: B8V) was discovered to exhibit small amplitude variations. The light-curve of the star is shown in Figure 1 (Max = 8.40 V, A = 0.028 V, P = 0.789 d). The average signal-to-noise ratio for the curve is 4.5. We suggest that periodic sinusoidal variations of the variable are connected with axial rotation of the magnetic star (Ap), as in α^2 CVn.

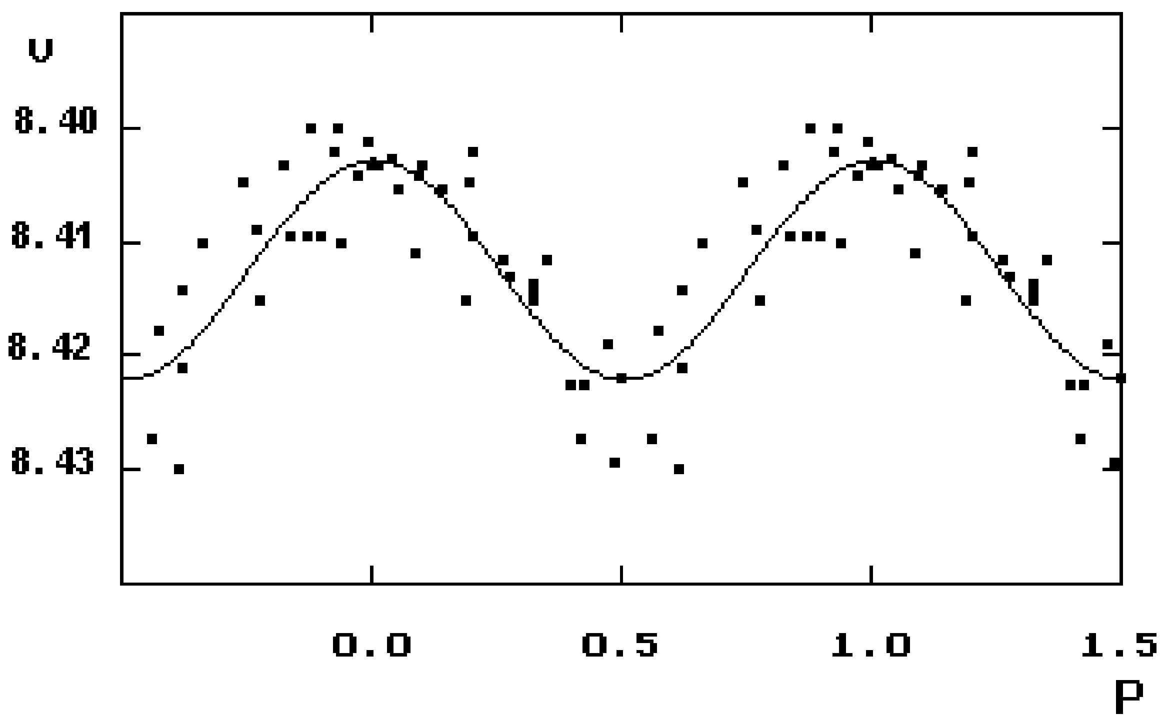

Figure 1. The light curve for HD 191495

One of us (MMZ) was supported by Fundamental Researches Fund of Uzbekistan (Contract 33).

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

Number 4262

Konkoly Observatory
Budapest
7 November 1995

HU ISSN 0374 – 0676

PHOTOELECTRIC OBSERVATIONS OF SZ Psc DURING 1993-1994

SZ Psc (HD 219113, $\alpha_{2000} = 23^h13^m24^s$, $\delta_{2000} = +02°41'30'', m_v = 7.2 - 7.7$) is a totally eclipsing double line spectroscopic binary of the RS CVn type. It consists of an F8 V primary with a K1 IV subgiant companion. This system exhibits continuous period changes of very large magnitude (Kalimeris et al., 1995). Very few photometric observations exist for the system, as its period is very close to four days. The most recent light curve is given by Tunca (1984), who gives the last accurate eclipse timing from 1981. Doyle et al. (1994), based on spectroscopic data noted that the minimum in 1991 occurred approximately 0.025 phase earlier than the time calculated from the ephemeris by Tunca (1984). Such a phase shift is in good agreement with the findings of Kalimeris et al. (1995), who undertook a detailed study of the orbital period variation for this system. It was obvious hence, that a new light curve was necessary and so we included SZ Psc in our observing list for the last two years. In this paper we present new BV photoelectric observations, carried out with the 1.2 telescope at the Kryonerion astronomical station from July 1993 to September 1994. The equipment used is a single channel photon counting photometer described by Dapergolas and Korakitis (1987). The photometer employs a high gain 9789QB phototube and conventional UBV filters. The star HD 219018 ($\alpha_{2000} = 23^h12^m39^s$, $\delta_{2000} = +02°41'18'', m_v = 7.7$) was used as comparison. The filters used are in close accordance with the international UBV system. Each observation is the average of four successive measurements, and the corresponding phase was calculated using the linear ephemeris by Tunca (1984) mentioned earlier:

$$\mathrm{Min\,I} = \mathrm{HJD}\,2444827.0047 + 3\overset{d}{.}9657889 \times \mathrm{E}$$

where the primary minimum corresponds to the position where the hotter F8 V component is occulted.

In Figure 1 we have plotted the differential magnitudes (variable minus comparison) against phase for the two colours. It is clear, from the light curves that, relative to the primary minimum calculated from the above linear ephemeris, a shift of the primary minimum towards decreasing phase is observed. This is in good agreement with the analysis of Kalimeris et al. (1995), who find that the orbital period of the system is currently decreasing. Also, the secondary minimum is broad, while the primary is sharp and deep, in agreement with the light curves given by Jakate et al. (1976) and Tunca (1984).

Because of the very peculiar shape of the light curve, neither Budding–Zeilik analysis curve programme nor Wilson–Devinney code can be fitted. The very broad secondary minimum can be explained assuming that at this phase we are looking at the subgiant's hemisphere facing the companion. Since we expect this hemisphere to be heavily spotted, this could be the reason for the asymmetries in the light curves which make it unfittable.

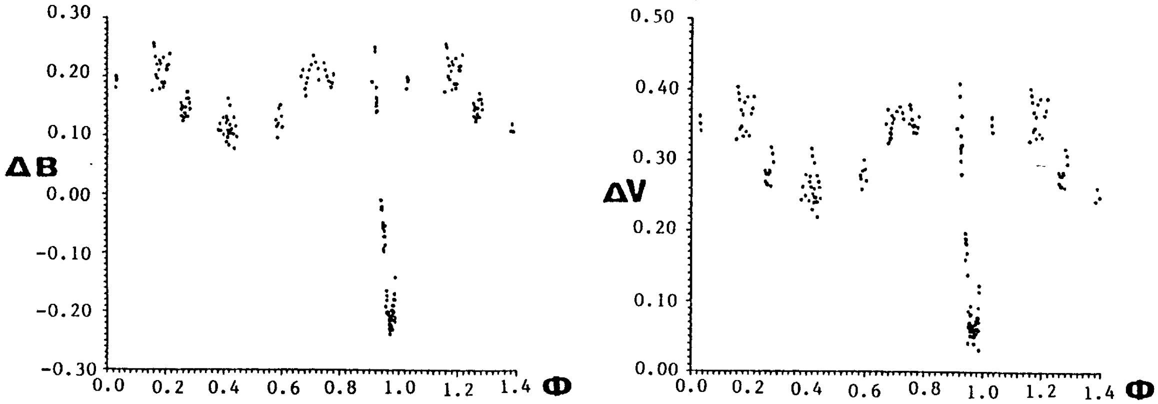

Figure 1. Light curve of SZ Psc. Δ is the differential magnitude in the sense HD 219018−SZ Psc.

We cannot estimate the extent of spot coverage, but if the filling factor is high and the spots are asymmetrically distributed over the surface, the peculiar observed light curves from the system can be expected.

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

Number 4263

Konkoly Observatory
Budapest
8 November 1995

HU ISSN 0374 – 0676

PHOTOELECTRIC MINIMA OF ECLIPSING BINARIES

The following table lists the unpublished photoelectric times of minima of several binaries observed at Mt. Suhora Observatory of the Cracow Pedagogical University between 1988 and 1995. The observations were made using a double channel photometer (Szymański & Udalski, 1989) exchanged in August 1991 (Kreiner et al., 1993), attached to the 0.6/7.5 m Cassegrain telescope. They were reduced in usual way and left in the instrumental system (near to the UBVR).

The times of minima were determined using Kwee and van Woerden (KW) method or by parabola fitting (PF) or by Kordylewski's tracing paper (TP) graphic method. O−C values were computed using elements given in the General Catalogue of Variable Stars (IV edition) Moscow 1985-87.

The table gives the name of variable star, filter, heliocentric time of minimum, corresponding error, O−C values, type of minimum (I-primary, II-secondary), method of minimum determination and abbreviation of observer's name.

These abbreviations are as follows:

GP	Gabriel Pajdosz	MK	Małgorzata Kaczor
JG	Joanna Glenc	PN	Paweł Nastaj
JK	Jerzy Krzesiński	SZ	Stanisław Zoła
JMK	Jerzy M. Kreiner	WO	Waldemar Ogłoza
MD	Marek Drożdż		

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Star	Filter	HJD 2400000+	Error	O−C	Type	Method	Observ.
KP Aql	V	48116.4455	±0.0010	0.0073	II	TP	GP
SS Ari	U	49688.4464	±0.0037	−0.1225	I	PF	MD
	B	49688.4427	±0.0027	−0.1262	I	PF	MD
	V	49688.4461	±0.0034	−0.1228	I	PF	MD
	R	49688.4454	±0.0033	−0.1235	I	PF	MD
	B	49287.5387	±0.0001	−0.1116	I	IKW	MD
	U	49689.4628	±0.0009	−0.1211	I	IKW	MD
	B	49689.4625	±0.0005	−0.1214	I	IKW	MD
	V	49689.4627	±0.0003	−0.1212	I	IKW	MD
	R	49689.4618	±0.0011	−0.1221	I	IKW	MD
CK Boo	B,V	47659.4177	±0.0010	0.1565	II	TP	JK
	B	47982.4295	±0.0010	0.1593	I	TP	GP,SZ
YY CMi	V	47947.4457	±0.0015	0.0119	I	TP	GP,JK
AS Cam	V	48193.3173	±0.0004	−0.2133	II	KW	GP
	V	48306.5392	±0.0002	−0.2135	II	PF	SZ
	V	48308.4501	±0.0002	−0.018	I	PF	SZ
CW Cep	V	47897.4465	±0.0020	−0.027	I	TP	GP
EK Cep	V	48004.4315	±0.0001	0.0052	I	KW	GP,JK
CC Com	B	49787.5419	±0.0001	−0.0084	I	KW	PN,WO
	V	49787.5422	±0.0002	−0.0081	I	KW	PN.WO
	R	49787.5422	±0.0001	−0.0081	I	KW	PN,WO
	B	49787.4311	±0.0001	−0.0088	II	KW	PN,WO
	V	49787.4312	±0.0004	−0.0088	II	KW	PN,WO
	R	49787.4316	±0.0003	−0.0084	II	KW	PN,WO
V477 Cyg	V	48066.4895	±0.0015	−0.0029	I	TP	GP
RW Gem	U	49390.4272	±0.0006	−0.0078	I	KW	GP,JG
	B	49390.4256	±0.0005	−0.0069	I	KW	GP,JG
	V	49390.4263	±0.0006	−0.0088	I	KW	GP,JG
	R	49390.4253	±0.0020	−0.0069	I	KW	GP,JG
TX Gem	U	49374.5521	±0.0009	−0.0075	I	KW	GP,JG,MK
	B	49374.5513	±0.0007	−0.0083	I	KW	GP,JG,MK
	V	49374.5513	±0.0008	−0.0083	I	KW	GP,JG,MK
	R	49374.5528	±0.0008	−0.0068	I	KW	GP,JG,MK
DI Her	V	48128.4594	±0.0001	2.8430	II	KW	GP
SW Lac	V	47406.5285	±0.0001	−0.0099	I	KW	GP
	V	47455.4368	±0.0002	−0.0112	II	KW	GP
AR Lac	U	49292.3887	±0.0021	−0.0759	I	KW	MK,WO
	B	49292.3868	±0.0042	−0.0769	I	KW	MK,WO
	V	49292.3887	±0.0014	−0.0751	I	KW	MK,WO
	R	49292.3872	±0.0016	−0.0766	I	KW	MK,WO
TZ Lyr	-	47384.3868	±0.0007	0.0001	II	KW	GP
V508 Oph	B,V	47371.4489	±0.0005	0.0088	II	TP	SZ
	B,V	47402.3110	±0.0010	0.0066	I	TP	GP
FT Ori	V	47898.3999	±0.0002	0.0034	I	KW	GP
β Per	-	49317.4174	±0.0001	0.0198	I	KW	MD,WO
DR Vul	B	47368.4321	±0.0003	0.0495	I	KW	JM
	V	47368.4319	±0.0004	0.0493	I	KW	JMK

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

Number 4264

Konkoly Observatory
Budapest
8 November 1995

HU ISSN 0374 – 0676

NEW PHOTOMETRY OF THE HYADES δ SCUTI STAR V777 Tau (71 Tau)

71 Tauri (= BS 1394 = vB 141 = V777 Tau) is a rapidly rotating, F0 IV–V member of the Hyades cluster. It is the second brightest X-ray source in the cluster, after V471 Tauri, and an intensely bright coronal EUV source (Stern *et al.* 1995). It is a lunar occultation binary, but the secondary star (estimated by Peterson *et al.* 1981 to be a G4 V star in possibly a 53 day orbit) has never been seen directly. As pointed out by Stern *et al.*, the tremendous X-ray luminosity of 71 Tau, $L_x = 10^{30}$ erg s^{-1}, is not the result of a flare. It is not easily explained as the coronal emission of an individual star, or even as the combination of emission from several stars, considering that most F–M Hyades stars are detected at levels of only $L_x \sim$ few $\times 10^{29}$ erg s^{-1} (or in some cases, much less). The X-ray properties of 71 Tau are more in line with those of a very much younger star, but would still be considered remarkable even for a coronally active star in the ≈80 Myr old Pleiades cluster (Stauffer *et al.* 1994). 71 Tau has been observed a number of times by IUE and has been shown to be variable by as much as 30 % at ultraviolet wavelengths near 1700–2000Å (Simon and Landsman, in preparation).

Horan (1979) discovered that 71 Tau was a δ Scuti star with an amplitude of 0.01 to 0.02 mag. To our knowledge no other optical photometry of 71 Tau has ever been published. Horan gives a principal period of 3.9 hours (f = 6.15 d^{-1}) and suggests that 71 Tau may be excited in more than one mode. However, his conclusions are based on only 38 points obtained on two nights which were two months apart. From Horan's Figure 5 it seems much more likely that the principal period is near 4.4 hours if the decline in brightness occurs at the same rate as the increase of brightness.

We have obtained new photometry of 71 Tau, observed differentially with respect to BS 1422, amounting to 58 points on 5 nights during a 7 night run with the 0.6-m telescope at Mauna Kea. Observations of BS 1432 (the check star) vs. BS 1422 indicated that both were constant, so any variations in the differential magnitude of 71 Tau vs. BS 1422 may be attributed to 71 Tau. The individual data points can be obtained by requesting file 307E from IAU Commission 27, Archives of Unpublished Photometry (see Breger *et al.* 1990).

Figure 1 shows a power spectrum of the photometry of 71 Tau vs. BS 1422, using the Lomb-Scargle algorithm as presented by Press and Teukolsky (1988). Clearly, many aliases are present. On the basis of Horan's Figure 5 and folded plots of our data we believe the frequency near 5.5 cycles per day is more likely to be the true principal frequency, not its one-day alias at 6.5 d^{-1}. (Note that the frequency corresponding to Horan's period is between these two values.) Having settled on a principal period of 0.1823 day, we subtracted a properly phased least-squares sinusoid with that period from the data to see if other frequencies are present. That power spectrum is shown in Figure 2. We note that if $f_1 \approx 6.5$, essentially the same power spectrum of residuals results.

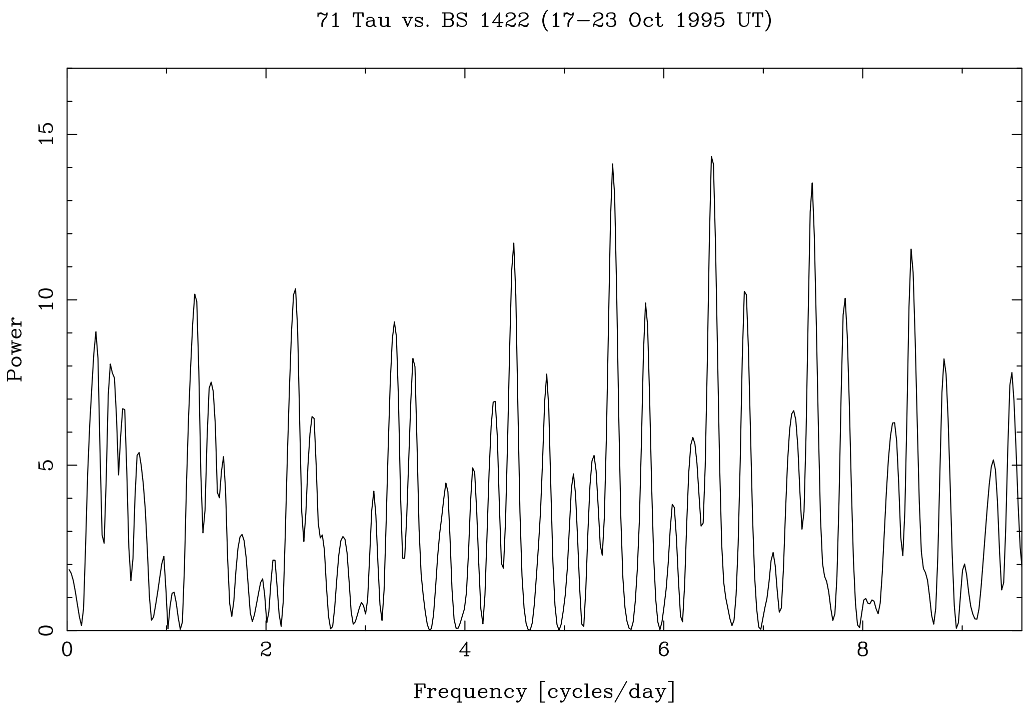

Figure 1 – Power spectrum of V-band differential photometry of 71 Tau vs. BS 1422.

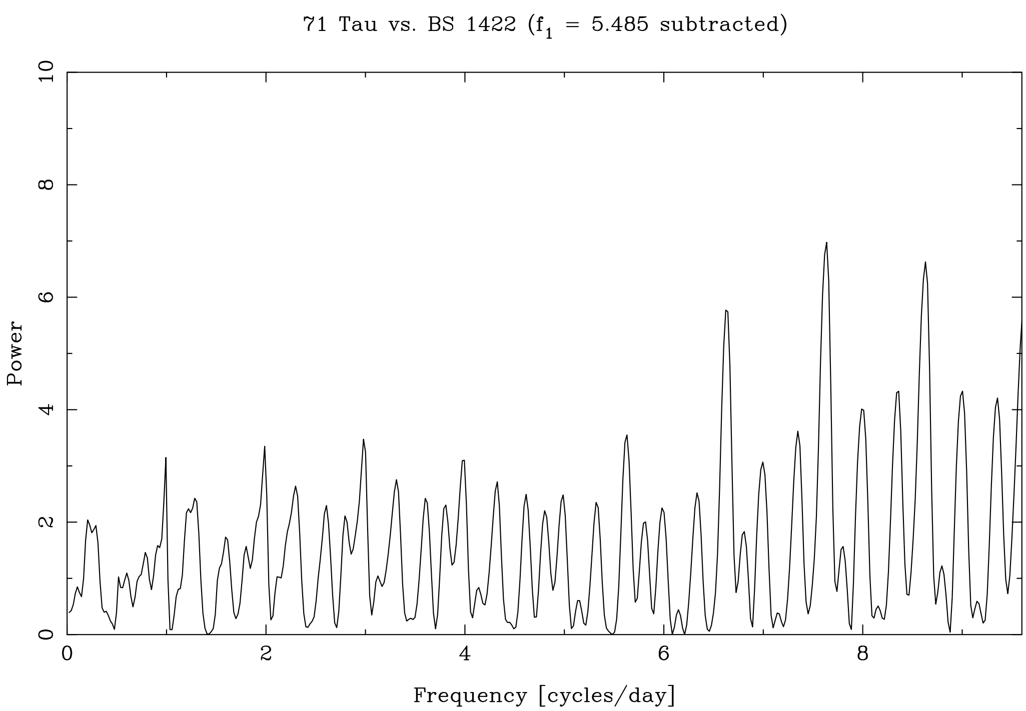

Figure 2 – Power spectrum of the data after prewhitening the data by a least-squares sinusoid with $f_1 = 5.485$ d^{-1}.

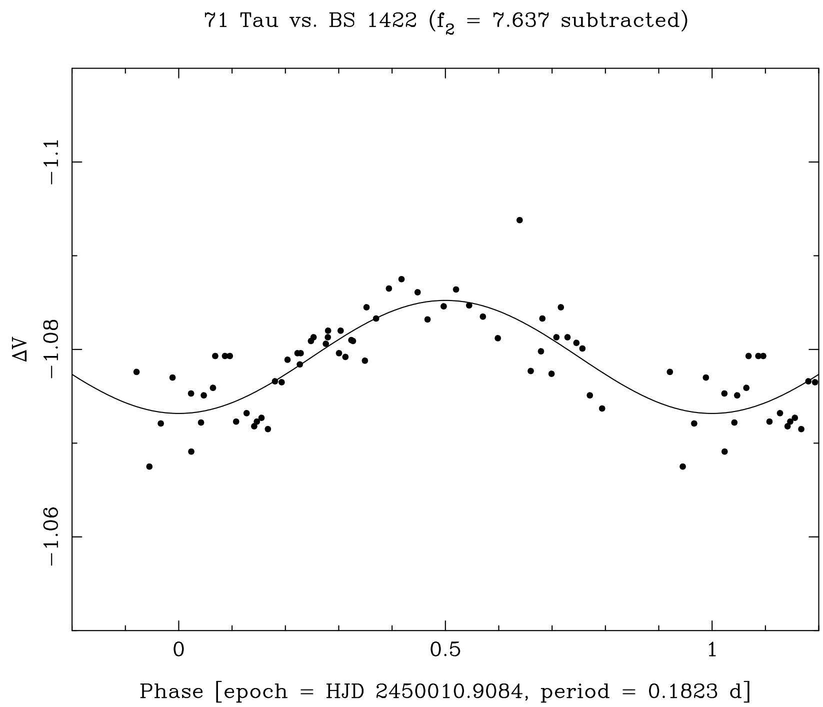

Figure 3 – Folded light curve of 71 Tau vs. BS 1422 V-band data, after prewhitening by the secondary sinusoid with $f_2 = 7.637$ d^{-1}.

One might assume that one of the peaks in Figure 1 represents pulsation in the fundamental radial mode, while one of the peaks in Figure 2 represents the first overtone radial mode. However, the period ratio of first overtone to fundamental should be close to the observed value of 0.773 (Breger 1993) – essentially equal to the theoretical value of 0.772 (Guzik and Bradley 1995). The closest we can come is $1/8.63 \div 1/6.49 \approx 0.752$. But given the small number of data points, we do not feel that this is the best method for choosing which peaks in the power spectrum are true and which are aliases.

Using an epoch of HJD 245 0000, we believe the following is the best two-frequency fit to the data: $f_1 = 5.485$ d^{-1}, amplitude = 6.0 ± 0.7 mmag, phase = 0.171 ± 0.016; $f_2 = 7.637$ d^{-1}, amplitude = 3.4 ± 0.7 mmag, phase = −0.439 ± 0.030. Thus, we find a principal period of 0.1823 days (4.38 hours), and a secondary period of 0.1309 days (3.14 hours). The ratio of the latter to the former is 0.718. Given the amplitudes of the two frequencies, we can account for a range in brightness up to 0.02 mag in V, and we can also account for the differing amplitudes observed by Horan on the two nights he measured the star.

Figure 3 shows our data folded by the principal period after the data have been prewhitened by the secondary frequency.

A definitive solution to the photometric behavior of 71 Tau could only be obtained from a more extensive data set than ours. In light of the unusual properties of this star at X-ray and ultraviolet wavelengths, such further study seems amply warranted.

Acknowledgments
KK thanks the University of Hawaii for telescope time on the 0.6-m telescope and thanks the Joint Astronomy Centre for observing support. MR's observing expenses were paid for by a University of Hawaii at Hilo fund endowed by William Albrecht. Luis Balona kindly provided the program for obtaining least-squares Fourier fits to the data.

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

Number 4265

Konkoly Observatory
Budapest
14 November 1995

HU ISSN 0374 – 0676

HS2324+3944: A NEW H–RICH PULSATING PG 1159 WHITE DWARF

With an effective temperature of (130 000 ± 10 000) K, and a surface gravity corresponding to $\log g = 6.2 \pm 0.2$, HS 2324+3944 is a peculiar PG 1159 star: it is the only star of this class, not surrounded by a nebula, showing H Balmer absorptions in its spectrum (Dreizler et al., 1995). If the pulsation mechanism based on the C/O cyclic ionization, proposed by Starrfield et al. (1984), is at work, the high H abundance found in the atmosphere (He/H = 0.5 by number) should drop to zero very quickly in the driving regions. Such a strong decrease of hydrogen looks quite unlikely; for this reason the presence of pulsations in HS 2324+3944 seems to be a very interesting phenomenon.

I observed HS 2324+3944 with the 2-head photoelectric photometer of the 1.5 m Loiano telescope (Bologna Astronomical Observatory) on October 19 and 20, 1995, with no moon. The tubes used, two EMI 9784 QB, have a maximum sensitivity in the B band. Both observations were done without filter, with an integration time of 2 s. The original light curves are shown in Figure 1 and 2, whereas in Figure 3 and 4 the magnitudes corrected for extinction are presented. The comparison stars of the two observations are different. In the first observation the comparison star (RA=$23^h27^m33^s$, D=+39°48.′9 (1950.0)) is about 0.5 mag fainter than HS 2324+39 whose V-magnitude is about 14.8. The sharp light increment between BJD 0.317 and 0.410 in October 19 is not due to any instrumental failure or astronomical reason. This effect disappears almost completely taking the difference of magnitude (Figure 3) (not completely because the diaphragms of the 2 channels of the photometer are different). In the second observation the comparison star (RA=$23^h27^m35^s(\pm18^s)$; D=+39°43.′6 (±3.′5) (1950.0)) is about 2 magnitudes brighter than HS 2324+39. For this reason there is almost no difference between channel 1 and (1–2) in Figure 4. Near BJD 0.41 (October 20) the comparison was close to the border of the aperture. In both light curves we can see several arc features with a mean period of about half an hour. In Figure 5 the data distribution for both nights is shown, folding the two light curves with a period of 35 min. In the power spectra of the two nights the amplitudes of the 35 min pulsation are 9 mmag (19/10/95) and 15 mmag (20/10/95). Apart from the 35 min periodicity, there are not other peaks with amplitude higher than 5 mmag in both power spectra. Probably more data are required to find other possible pulsation frequencies. In any case further and more detailed analysis of these data will be performed.

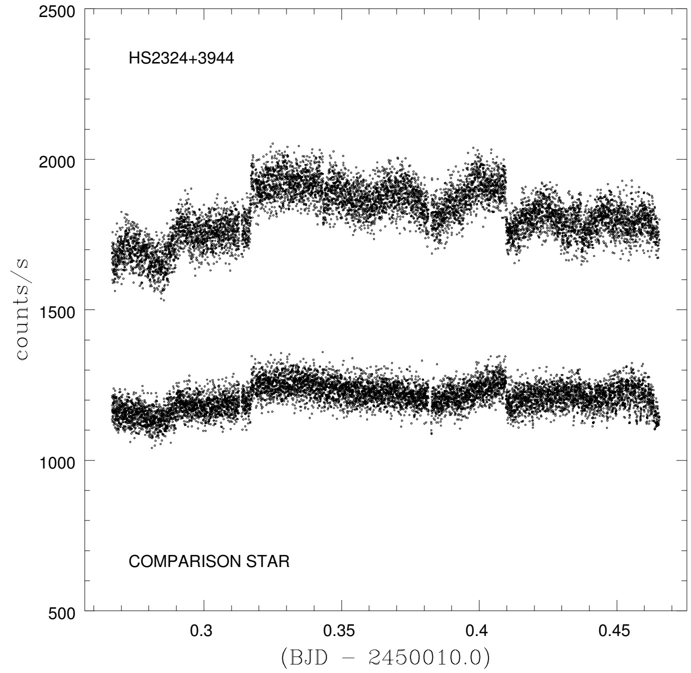

Figure 1. Counts light curve of HS 2324+3944 in October 19, 1995.

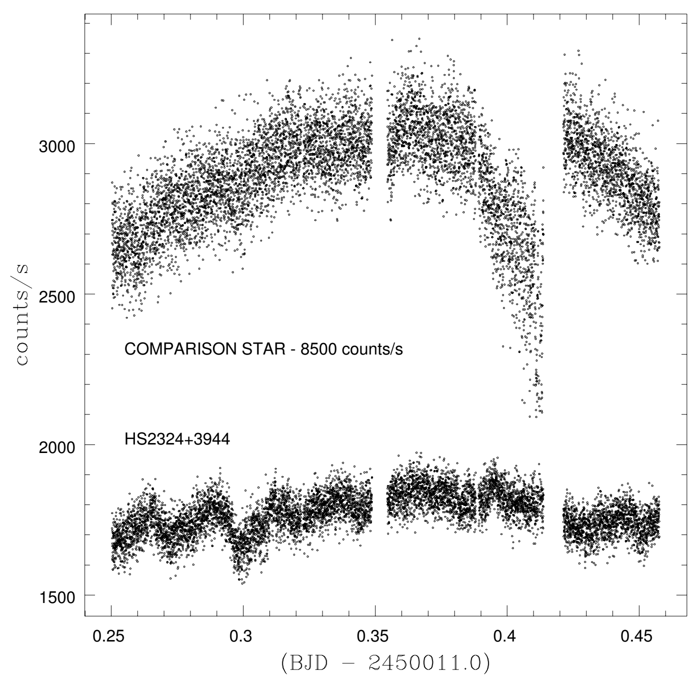

Figure 2. Counts light curve of HS 2324+3944 in October 20, 1995.

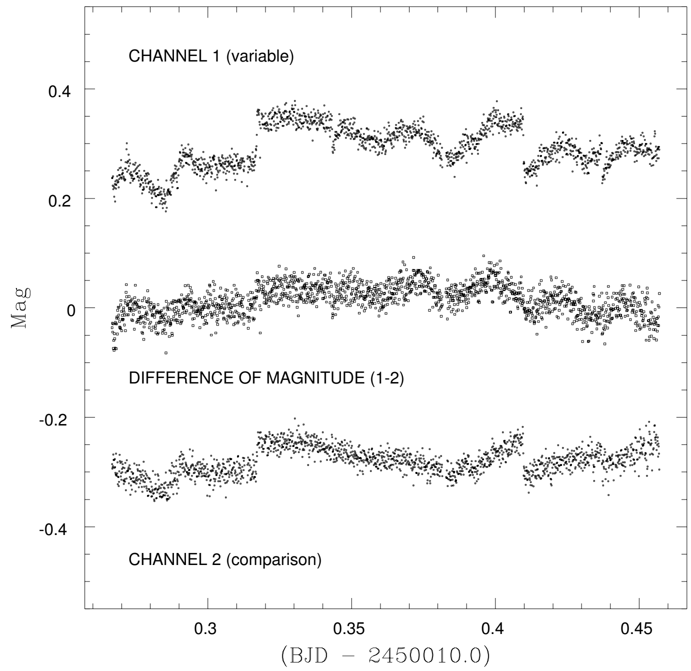

Figure 3. Magnitude light curve of HS 2324+3944 in October 19, 1995. The spurious light increment in channel 1 and channel 2, from about BJD 0.317 to 0.410, disappears almost completely considering the difference of magnitude.

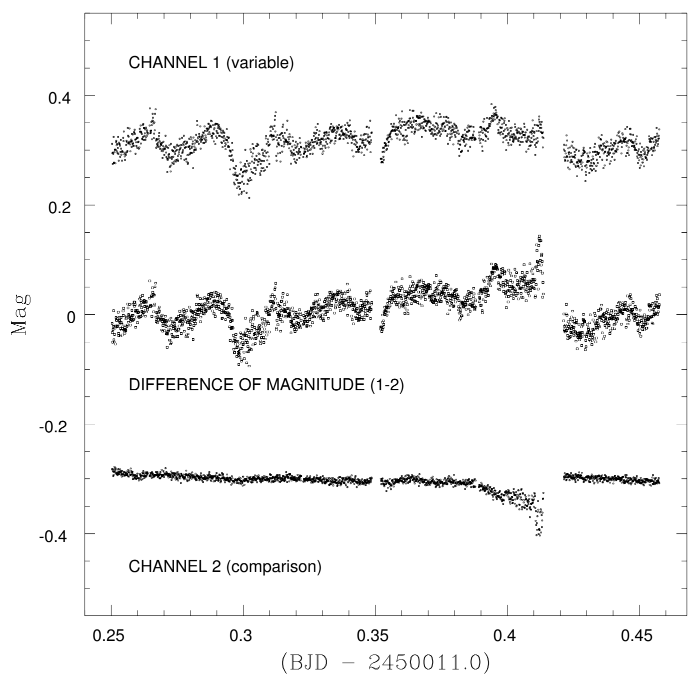

Figure 4. Magnitude light curve of HS 2324+3944 in October 20, 1995. The comparison star has been recentered in the aperture near BJD 0.413.

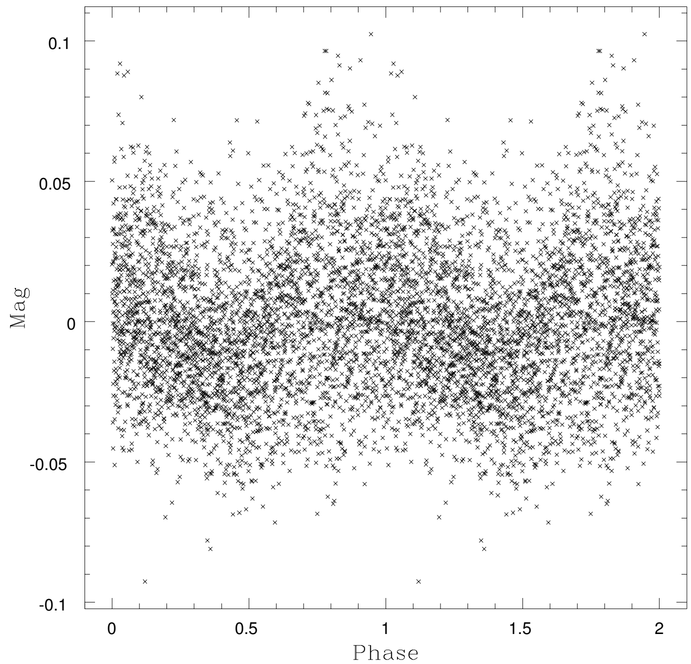

Figure 5. Distribution of the data of both nights, folded with a period of 35 min.

I am pleased to acknowledge Klaus Werner, who suggested to observe this star and provided me the finding chart.

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

Number 4266

Konkoly Observatory
Budapest
15 November 1995

HU ISSN 0374 – 0676

BX DRACONIS : NEW EPHEMERIS AND LIGHTCURVE

[BAV-Mitteilung Nr. 82]

In this paper we report on our photographic and CCD photometry on the β Lyrae variable BX Dra.

BX Dra = BV 228 = GSC 4192.0448 was announced as a short period variable by Strohmeier (1958) with a brightness range between $11^{m}_{.}5$ and $12^{m}_{.}2$. Strohmeier et al. (1965) classified the star as an RR Lyrae type variable, gave 7 times of maximum light, calculated from them an ephemeris as

$$\mathrm{Max} = \mathrm{HJD}\,2427216.410 \; + \; 0^{d}_{.}561192 \times \mathrm{E} \qquad (1)$$

and published a first photographic light curve. With these data BX Dra was included in the GCVS (Kholopov et al. 1985). Satyvaldiev (1966) also investigated this variable on photographic plates and gave 150 estimates of brightness, but was not able to determine the period or the type of variability.

The rather long period for an RRc-type variable and the lack of further observations made BX Dra an interesting object to us. One of us (MD) investigated this variable on 227 plates of the Sonneberg Sky Patrol. The observations by the other were made with an SBIG ST6 camera without filters attached to a 20cm SC telescope. His minima times were calculated using the Kwee–van Woerden (1956) method. GSC 4192.516 was used as comparison star. From these measurements we found the variable to be of β Lyrae type (see Figure 1) and got a first period of $0^{d}_{.}578$. This result is independently confirmed by Schmidt et al. (1995) who give one further minimum based on their CCD photometry.

Instantaneous elements, computed from CCD measured minima only, are

$$\begin{array}{l} \mathrm{Min\,I} = \mathrm{HJD}\,2449810.5924 + 0^{d}_{.}57902552 \times \mathrm{E} \\ \qquad\qquad\qquad\qquad\quad \pm 1 \qquad\qquad\quad \pm 6 \end{array} \qquad (2)$$

Using all available times of maxima by Strohmeier et al. (1965) we calculated the times of the subsequent minima by adding P/4. The resulting O−C's seem to confirm the period found (Table 1). The best description is a least squares fit to quadratic elements which led to the following ephemeris :

$$\begin{array}{l} \mathrm{Min\,I} = \mathrm{HJD}\,2449810.5925 + 0^{d}_{.}5790282 \times \mathrm{E} + 5.56 \times 10^{-10} \times \mathrm{E}^2 \\ \qquad\qquad\qquad\qquad\quad \pm 11 \qquad\qquad \pm 12 \qquad\qquad \pm 42 \end{array} \qquad (3)$$

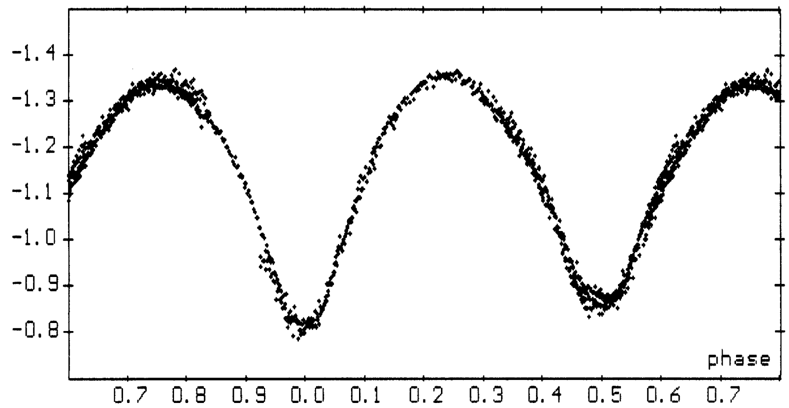

Figure 1: Differential light curve of BX Dra against GSC 4192.516 phased with the new ephemeris (2).

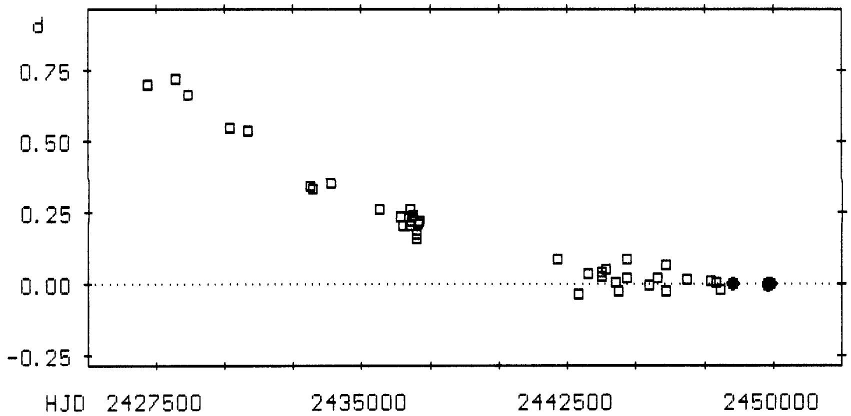

Figure 2: O–C diagram for BX Dra computed with respect to the new ephemeris (2) using all available minimum timings. • represents photoelectric, and ▫ photographic plate minima.

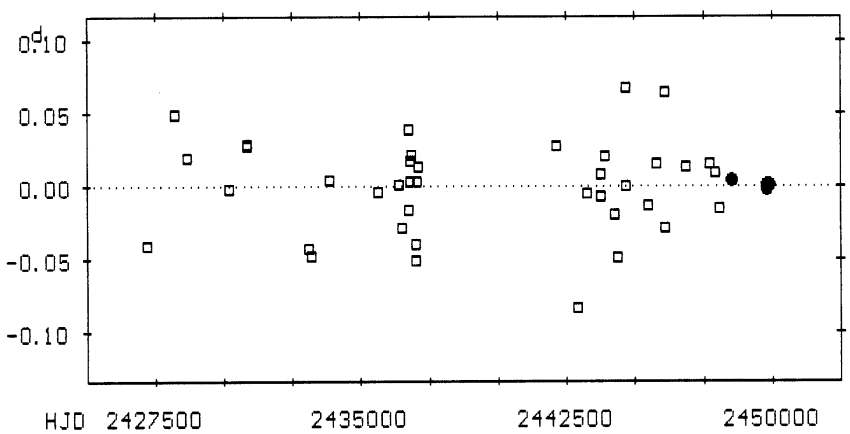

Figure 3: O–C diagram for BX Dra computed with respect to the new ephemeris (3).

Table 1. Observed times of minima for BX Dra, epochs and residuals computed with respect to the ephemeris (3) derived in this paper.

N	JD hel. 2400000+	W	T*	Epoch	O−C	Lit	N	JD hel. 2400000+	W	T*	Epoch	O−C	Lit
1	27216.560	2	P	−39022.0	−0.041	[1]	24	43250.558	2	P	−11329.5	−0.006	[3]
2	28245.797	2	P	−37244.5	+0.049	[1]	25	43776.318	2	P	−10421.5	+0.008	[3]
3	28656.558	2	P	−36535.0	+0.019	[1]	26	43789.331	2	P	−10399.0	−0.007	[3]
4	30195.2	2	P	−33877.5	−0.0	[2]	27	43926.585	2	P	−10162.0	+0.020	[3]
5	30842.253	2	P	−32760.0	+0.028	[2]	28	44289.589	2	P	−9535.0	−0.020	[3]
6	30871.203	2	P	−32710.0	+0.028	[2]	29	44371.491	2	P	−9393.5	−0.049	[3]
7	33114.444	2	P	−28835.5	−0.043	[2]	30	44693.474	2	P	−8837.5	−0.000	[3]
8	33179.286	2	P	−28723.5	−0.049	[2]	31	44702.516	2	P	−8822.0	+0.067	[3]
9	33858.212	2	P	−27551.0	+0.003	[2]	32	45488.454	2	P	−7464.5	−0.013	[3]
10	35654.26	2	P	−24449.0	−0.00	[2]	33	45816.497	2	P	−6898.0	+0.015	[3]
11	36394.229	2	P	−23171.0	+0.000	[2]	34	46113.584	2	P	−6385.0	+0.064	[3]
12	36485.103	2	P	−23014.0	−0.029	[2]	35	46121.597	2	P	−6371.0	−0.029	[3]
13	36763.326	2	P	−22533.5	−0.017	[2]	36	46850.628	2	P	−5112.0	+0.013	[3]
14	36773.224	2	P	−22516.5	+0.038	[2]	37	47717.428	2	P	−3615.0	+0.015	[3]
15	36815.166	2	P	−22444.0	+0.002	[2]	38	47945.557	2	P	−3221.0	+0.009	[3]
16	36821.26	2	P	−22433.5	+0.02	[2]	39	48067.417	2	P	−3010.5	−0.016	[3]
17	36837.187	2	P	−22406.0	+0.021	[2]	40	48528.63	20	E:	−2214.0	+0.00	[4]
18	37017.775	2	P	−22094.0	−0.040	[1]	41	49810.5926	40	E	0.0	+0.0001	[5]
19	37026.738	2	P	−22078.5	−0.051	[1]	42	49811.4614	40	E	1.5	+0.0004	[5]
20	37080.639	2	P	−21985.5	+0.002	[1]	43	49812.3275	20	E:	3.0	−0.0021	[5]
21	37107.573	2	P	−21939.0	+0.013	[1]	44	49840.4122	40	E	51.5	−0.0003	[5]
22	42152.49	2	P	−13226.0	+0.03	[3]	45	49866.4682	40	E	96.5	−0.0005	[5]
23	42891.49	2	P	−11949.5	−0.08	[3]	46	49888.4720	40	E	134.5	+0.0002	[5]

[1]: Strohmeier et al. (1958) P/4 added, [2]: Satyvaldiev (1966) [3]: Dahm: this paper, [4]: Schmidt et al. (1995), [5]: Agerer: this paper.
* P denotes pg plate min. and E CCD measured min. Those marked with ':' got reduced weight.

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ERRATUM

In IBVS No. 4230, the spectral type of ST Mon was incorrectly given due to an unfortunate typographic error. The new spectral type of ST Mon is M5e.

The editors

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

Number 4267

Konkoly Observatory
Budapest
16 November 1995

HU ISSN 0374 – 0676

NSV 11802 – A NEW ALGOL-TYPE ECLIPSING BINARY

According to the New Catalogue of Suspected Variables Stars (Kholopov et al., 1982), NSV 11802 (HD 179376) is a star suspected to be an eclipsing binary. We have chosen and included the star to the list of stars observed within the framework of general program of astrophysical final works execution by students of high schools of Israel at the astrophysical observatory of Jordan Valley Academic College.

NSV 11802 was observed with a 16" Meade LX200 telescope and ST-6 CCD photometer. The expositions were done 2-3 times every night during June-August 1995. The field of view of the CCD camera with focal reducer f/6.3 is about $8' \times 6'.5$, so we are able to obtain an image of NSV 11802, comparison stars and cepheid V 1344 Aql simultaneously in the same field (Figure 1).

For image processing we have used the Mira Professional 3.1 software and aperture photometry method. The observational results as instrumental magnitude differences between NSV 11802 and comparison star C1 are shown in Table l. Standard deviation of a single measurement is about 0.010 - 0.015 mag.

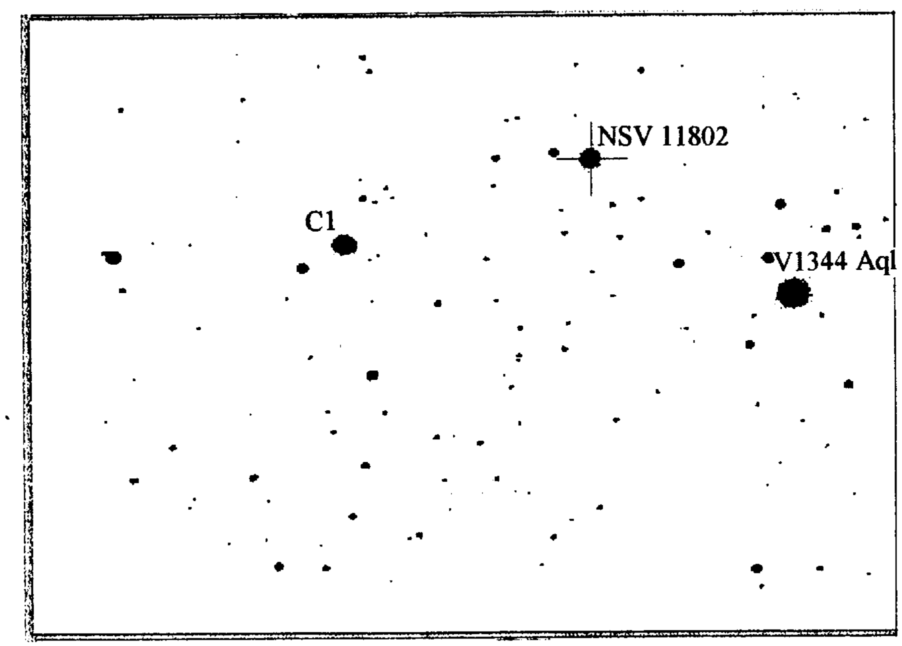

Figure 1. Field of NSV 11802 drawn using an ST-6 CCD-picture. North is at the top.

Table 1. Differences of instrumental magnitudes: NSV 11802 − comparison star.

JDhel +2,449,000	ΔB	ΔV	ΔR
896.457	−0.098	0.366	0.696
897.430	−0.094	0.339	0.656
901.408		0.311	0.620
904.360	−0.122	0.300	0.613
905.353	−0.116	0.317	0.628
908.500	−0.133	0.304	0.6?2
909.422	−0.092	0.323	0.622
910.394	−0.095	0.336	0.648
911.355	−0.149	0.299	0.609
912.350	−0.099	0.328	0.645
915.410	−0.124	0.302	0.618
916.348	−0.014	0.448	0.778
917.346	−0.116	0.311	0.628
919.496	−0.098	0.298	0.616
922.341	−0.113	0.310	0.639
923.340	−0.062	0.402	0.701
924.321	−0.141	0.296	0.620
925.326	−0.123	0.301	0.638
926.323	0.297	0.688	0.998
929.320	−0.041	0.384	0.717
930.323	−0.001	0.319	0.629
932.308	−0.107	0.323	0.655
933.339	0.121	0.530	0.863
937.303	−0.133	0.291	0.621
938.314	−0.098	0.299	0.620
940.306	−0.099	0.324	0.633
943.316	−0.070	0.359	0.704
944.286	−0.138	0.279	0.618
945.275	−0.126	0.310	0.622
946.290	0.273	0.692	0.997
947.288	−0.091	0.282	0.628

The data were examined for periodicity with a standard phase-dispersion minimization program, and we found the greatest reduction of the residuals at a period of 6.567 ± 0.050 days. There is also another possible period equal to about 2.86 days. For the second period the sum of residual squares is a little more than that for the first period. As it seems to us, the first period (6.567 days) is more suitable. It is possible that these periods are commensurable. The elements of main eclipse are:

$$\text{JD hel (Primary Min.)} = 2{,}449{,}926.427 + 6.567 \times E$$

The light curves phased with these elements are shown in Figure 2. As it is seen from the light curves, NSV 11802 is really an Algol-type eclipsing binary system. The depth of the primary minimum is approximately the same in all three spectral bands.

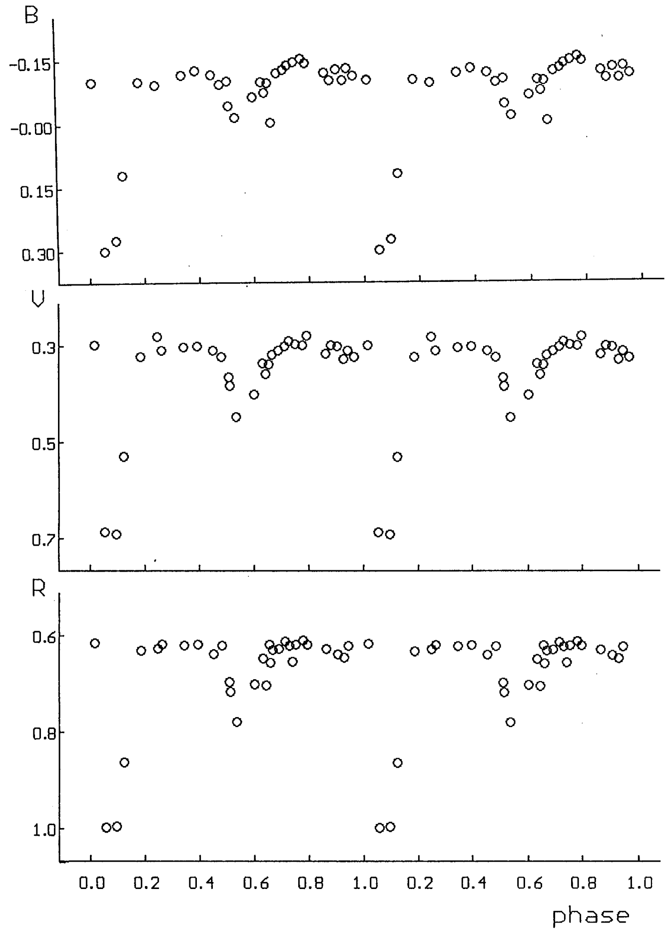

Figure 2. Light curves of NSV 11802 phased with the period of 6.567 days.

We thank Mrs. S. Pustil'nik for her accurate CCD-image processing work. This work has been supported by grant of the Ministry of Science and Arts of Israel.

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Reference:

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

Number 4268

Konkoly Observatory
Budapest
16 November 1995

HU ISSN 0374 – 0676

NEW OUTBURST OF V1118 Ori

Since 1983, when V1118 Ori became known as a new EXor (Herbig, 1990, refer to this species as EXors, after the example first recognized, EX Lupi or Subfuor, Parsamian and Gasparian, 1987) and entered into an active stage of fuor-like outbursts, two outbursts have been observed. As of now we have information concerning outbursts during the period 1983-84 (Chanal, 1983, Parsamian and Gasparian, 1987) and 1988-90, when another outburst of the star was observed (Parsamian et al., 1993).

Table 1 shows the stellar magnitudes during minimum light (Parsamian et al., 1992).

Table 1

U	B(pg)	V	R
$\geq$ 18.8	17.6-18.2	16.3-17.3	15.2-15.8

We report here the results of new observations taken over the region of the Orion association, and carried out at Instituto de Astrofisica, Optica y Electronica (INAOE, Tonantzintla), at Instituto de Astrofisica de Canarias and in Sevilla [1]. The observations (in V) were carried out at Instituto de Astrofisica, Optica y Electronica (INAOE, Tonantzintla) with the 26″ Schmidt telescope on Kodak 103aD plates, in Sevilla with 20cm Schmidt-Cassegrain telescope with CCD camera and infrared observations were performed during service time at the 1.5m Carlos Sánchez Telescope (Tenerife, Spain). A two mirror focal plane chopper was used and a liquid N2 cool InSb detector, together with standard J, H and K filters. A set of standard stars was used for atmospheric extinction correction and flux calibration (Arribas and Martinez, 1987).

A new outburst of the star was observed in V beginning in January 1993, when the V magnitude reached 14.7. According to further spectral observations of V1118 Ori taken with the 2.1 m telescope at the Guillermo Haro observatory in Cananea (Mexico), the star was already undergoing an outburst phase on 30 Nov. 1992 (E.P.). The spectrum was characteristic of an emission line star (T Tau type), as was indeed observed during the 1989 outburst (Gasparian et al., 1990). In Figure 1 the light curve of the star V1118 Ori is given.

Brightness fluctuations, which were observed during the previous outburst, were also observed during this period. The amplitude of the outburst in V could be larger than 2 mag, given that our observations were performed subsequent to the period of maximum outburst activity. In that case, the duration of the outburst might be longer than 2.5 yrs. Errors in the measurements are ± 0.1 mag.

[1] Private telescope

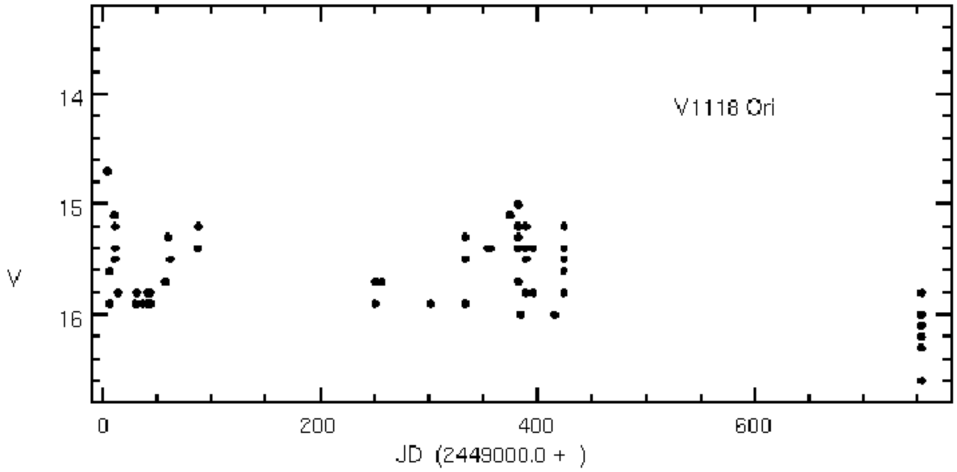

Figure 1. The light curve of V1118 Ori

Infrared magnitudes of the star during the outburst:

Julian Date	J	H	K
2449426.9420	8.52±0.05	8.04±0.04	7.94±0.03

The authors are grateful to Dr. Mark Kidger for performing the infrared observations and to C. Escamilla for help with the observations in INAOE.

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

Number 4269

Konkoly Observatory
Budapest
16 November 1995

HU ISSN 0374 – 0676

NEW OUTBURST OF V1143 Ori

Since 1982 four outbursts in the EXor V1143 Ori were observed (Sugano, 1983, Natsvlishvili, 1984, Verdenet, 1985, Parsamian and Gasparian, 1987, Parsamian et al., 1991, 1992).

In Table 1 the stellar magnitudes in the minimum light are given (Parsamian et al., 1991).

Table 1

U	B(pg)	V	R
17.6-18.6	17.5-18.2	16.3-17.1	15.0-16.0

We report here the results of new observations of an outburst during 1993-95. The observations (in V) were carried out at Instituto de Astrofisica, Optica y Electronica (INAOE, Tonantzintla) with the 26″ Schmidt telescope on Kodak 103aD plates when the star was already its maximum light. Infrared observation was performed during service time at the 1.5m Carlos Sánchez Telescope (Tenerife, Spain). A two mirror focal plane chopper was used and a liquid N2 cool InSb detector, together with standard J, H and K filters. A set of standard stars was used for atmospheric extinction correction and flux calibration (Arribas and Martinez, 1987).

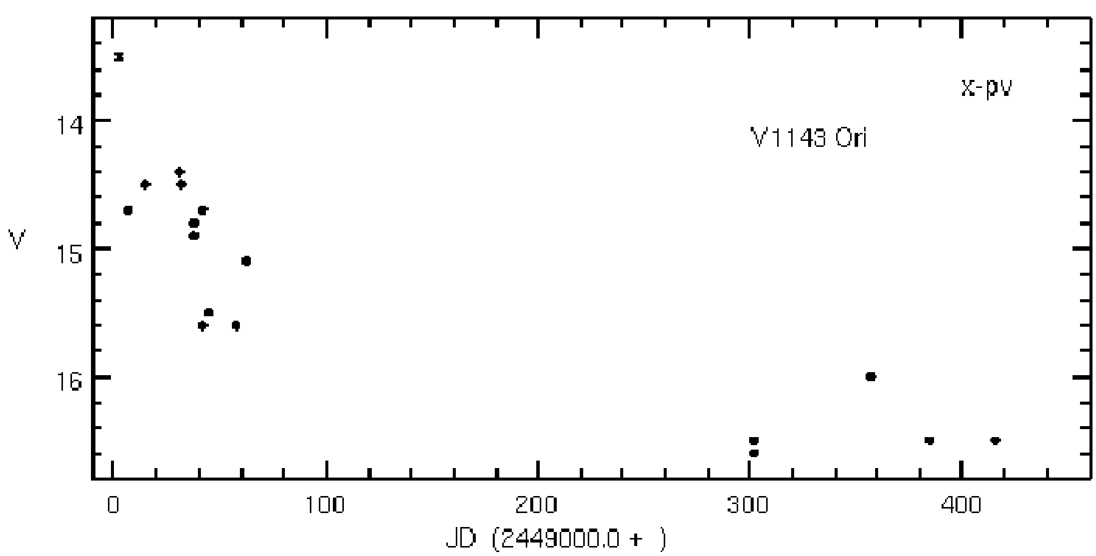

Figure 1. The light curve of V1143 Ori.

In Figure 1 the light curve of V1143 Ori is given. The first two observations were made on 15 Jan. 1993 without filter, when the star's visual magnitude already was 13.5. The amplitude in V could be larger than 3 mag. According to further spectral observations of V1143 Ori taken with the 2.1 m telescope at the Guillermo Haro observatory in Cananea (Mexico), the star was in its minimum light or very near to it on 27 Nov. 1992 (E.P.). The spectrum of the star was typical of an M type, with Balmer emission lines and TiO bands, as it was observed earlier, at minimum during the "active" stage (Peimbert et al., 1991). Therefore, the star undergoes an outburst phase after 21 Nov. 1992. Our first observations were made on 15 Jan. 1993, therefore the interval of increase to the maximum was less than two months if we suppose that the increase of brightness began in December 1992. In the first two outbursts the duration of increase was about three months (Parsamian et al., 1991). Our observations show that until 16 March 1993 the star was in outburst, then there are not observations till 10 Nov., when star already was in its minimum light.

Infrared magnitudes of the star after outburst :

Julian Date	J	H	K
2449426.9191	12.51±0.17	11.79±0.12	11.41±0.12

The authors are grateful to Dr. Mark Kidger for performing the infrared observations and to C. Escamilla for help with the observations.

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

Number 4270

Konkoly Observatory
Budapest
24 November 1995

HU ISSN 0374 – 0676

OPTICAL OBSERVATIONS OF THE ACTIVE STAR RE J1816+541

The sky was surveyed in the extreme ultraviolet (EUV) region of the spectrum by the EUVE satellite (Malina et al., 1994) and the ROSAT satellite (Pounds et al. 1993) and catalogs of the sources included RE J1816+541 = EUVE J1816+541. The star's brightness was 11.83 in V and colors were (B−V)=1.45, (V−R)=0.96, (R−I)=1.05 (Schwartz et al., 1995). The star was the subject of an extensive investigation by Jeffries et al. (1995), who concluded the star was a "single, rapidly rotating dM1-2e star with a v sin i of 61km/sec" and was "one of the most magnetically active stars in the solar neighbourhood".

The automated 0.5-m. telescope, Johnson V filter and CCD camera of the Climenhaga Observatory of the University of Victoria (Robb and Honkanen, 1992) was used to make photometric observations of RE J1816+541. The frames were bias subtracted and flat fielded in the usual manner using IRAF [1]. The magnitudes were found from aperture photometry using the PHOT package. The x y pixel coordinates of each star for photometry were found from inspection of a few frames taken at the beginning, middle and end of the night. These positions were used as starting points for the Gaussian centering option which precisely centered the 6 arc second aperture on each star for each frame.

From the Hubble Space Telescope Guide Star Catalog (Jenkner et al., 1990) the coordinates and magnitudes of the comparison star are RA=$18^h16^m29^s$, Dec=$54°07'44''$, V=11.1 and of the check star are RA=$18^h16^m07^s$, Dec=$54°10'54''$, V=13.1. The standard deviation of the difference between the check and the comparison star during a night was about $0^m.014$. The mean and standard deviation of all the nightly mean differential V magnitudes are -1.844 ± 0.006 ensuring the constancy of both comparison and check stars at this level. The precision of the differential variable star minus comparison star measurements are expected to be at this level. Due to the small field of view first order differential extinction effects were negligible and no corrections have been made for them. No corrections have been made for the colour difference between the stars to transform the V magnitude to a standard system.

Photometric observations were begun 28 July 1995 UT and continued on five nights in the following week and three nights a month later. Brightness variations were evident both during a night and from night to night. A "Phase Dispersion Minimisation" routine modelled after that of Jurkevich (1971) reveals a minimum average sigma at a period of 0.4588 ± 0.0012 days, as seen in Figure 1. The other deep minima are aliases of the true period and the diurnal period of the observations. A least squares fit of a single sine wave to the data also shows a deep minimum in chi squared at a period of $0^d.458$. Times of

[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

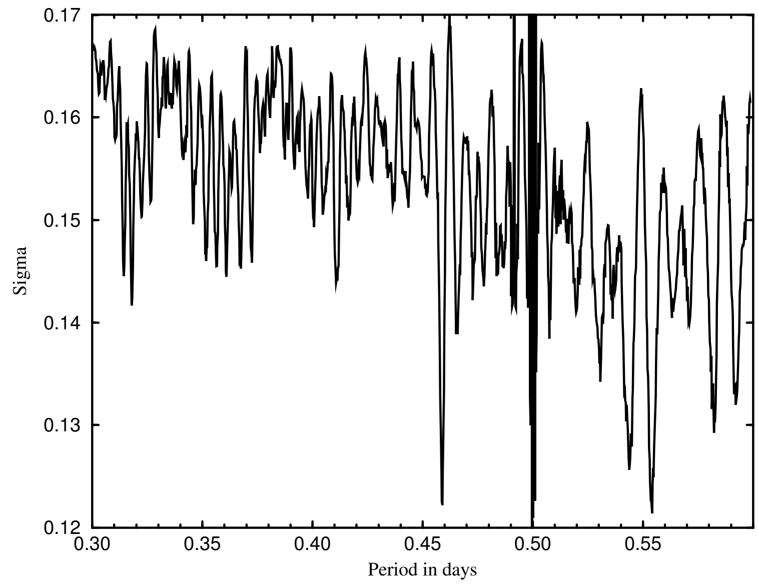

Figure 1. Average of standard deviations for various periods for RE J1816+541 for 1995

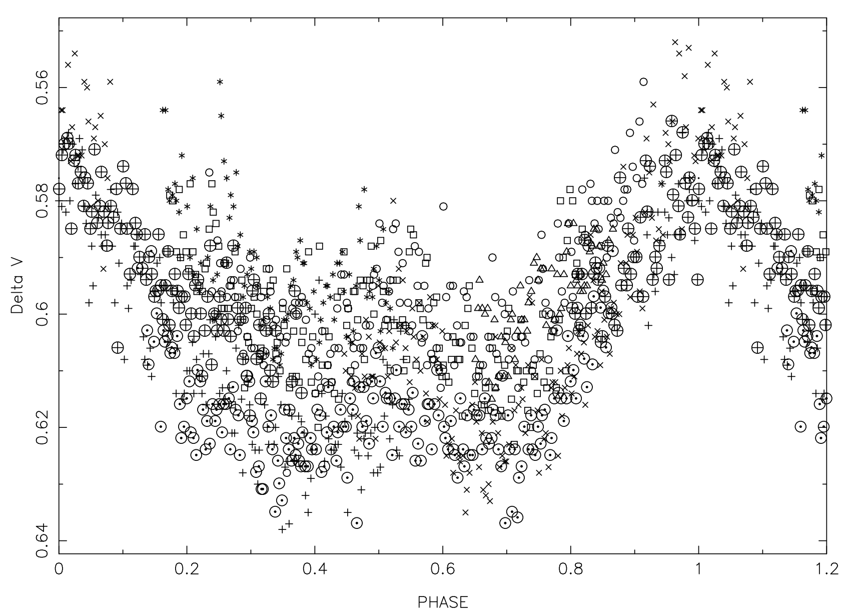

Figure 2. Light curve of 1995 differential V data of RE J1816+541

maximum light have been estimated from the light curve to be 2449927.752, 2449930.958 and 2449954.842. A plot of the light curve also shows a secondary maximum and its times of occurrence are estimated to be 2449929.823, 2449930.75, and 2449962.854. All these estimates have an uncertainty of about ±0.02 days. So the best ephemeris from our data is:

$$\text{HJD of Maxima} = \underset{\pm .020}{2449927.752} + \underset{\pm .0008}{0.4589} \times \text{E}$$

A plot of the 1202 differential V magnitudes phased at this period is shown in Figure 2 with different symbols for each of the different nights. Close inspection of the "⋆" points at phase 0.25 shows a small flare, which was ignored during the period finding runs. The light curve also shows shifts of 0.01 magnitudes in mean level from night to night.

From the $v\sin i$, spectral type, and our period we find the inclination of the axis of rotation to be $66° \pm 4°$. From the unusual W shape of the light curve, the flare, the spectral type, and the brightness in the EUV, we conclude that this star has large active regions on it causing the brightness variations. The shape also implies that there are at least two large spots or groups and further photometric observations will be interesting to detect any changes in the light curve shape due to differential rotation or spot evolution.

REJ1816+541 is a variable star with active regions on its surface causing brightness variations with a period of 0.459 days.

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

Number 4271

Konkoly Observatory
Budapest
27 November 1995

HU ISSN 0374 – 0676

UBV PHOTOMETRY OF W Ser STARS

A long term project was initiated in 1993 with the main purpose to monitor long period interacting Algols (W Ser stars). Unfortunately, it turned out that all program stars cannot be observed continuously because of the weather conditions of our observatory. So, some of them have been cancelled from the programme. The photometric data of these stars are published here, in order to make this information available for future studies.

The observations were made by two different instruments: (a) an unrefrigerated DC *UBV* photometer attached to the 50cm Cassegrain telescope on the Mátra Mountain Station of the Konkoly Observatory, (b) a similar photometer attached to the 60 cm Newtonian telescope of the observatory in Budapest (data denoted by an asterisk in Table 2). More information about these photometers and filter combinations are available in Szabados (1977). The observations were generally made with two comparison stars in each colour according to the sequence $C_1C_2BVVC_1C_2BVV$..., where C_i indicate the comparison stars, B the background, V the variable, respectively. Comparison stars (see Table 1) were chosen within one degree from the variables in order to neglect the first–order extinction coefficients. The values for V and colour indices were taken from the literature (see reference column) or if there are no published measurements, the comparisons were tied to standards referred to in Table 1.

Table 2 contains the observational data. Each value of them was determined by 8–12 individual integrations. The integration time was about 10 sec. Average extinction coefficients were included in the reduction process implicitly through the applied telescope constants, only. The colour–dependent extinction was omitted. The estimated internal errors of the measurements are about $0\overset{m}{.}005$ in V and B while in U about $0\overset{m}{.}01$. Naturally, the intrinsic error might be more than the internal one. Thus, the third digits in the Table 2 serve to make perceptible trends, only.

Table 1. Comparison stars for *UBV* measurements

variable	comparison	V	$B-V$	$U-B$	reference
SY And	BD+42°27	9.55	0.14	0.126	HR 56
	BD+42°29	10.09	0.98	0.25	
	BD+43°23	10.58	0.41	−0.28	
UU Cnc	HD 66372	9.24	−0.19	−0.55	HD 66553
	BD+15°1732	9.74	0.73	0.33	
RX Gem	HD 49929	9.57	0.07	0.034	Hall & Walter (1975)
	HD 49805	8.47	−0.06	−0.31	Hall & Weedman (1971)
HD 37453	HD 37352	7.709	0.115	−0.147	Landolt (1983)
HD 43246	HD 43495	7.735	−0.192	−0.138	Dempsey et al. (1990)

Table 2. UBV measurements of W Ser stars

variable	HJD 2400000+	V	$B-V$	$U-B$
SY And	49609.5225	10.481	0.176	−0.012
	49682.3584	10.494	0.155	−0.143
	50001.4473	11.062	−0.237	0.400
	50002.4229	10.538	0.119	−0.210
	50005.3076	10.444	0.176	−0.218
UU Cnc	49047.3828	9.374	1.105	0.846
	49066.4287	8.706	1.443	1.417
	49682.5947	9.328	1.134	0.632
	49718.6064	9.351	1.096	0.995
RX Gem	49041.5469	9.050	0.032	−0.018
	49047.3359	9.283	0.173	0.112
	49066.3984	9.265	0.136	0.060
	49682.5508	9.222	0.201	0.160
	49718.5703	9.232	0.206	0.082
	49735.3516	9.245	0.149	0.121
HD 37453	49047.2910	8.199	0.748	0.236
	49066.3564	8.129	0.795	0.424
	49067.3496	8.189	0.826	0.412
	49682.4941	8.186	0.729	0.250
	49735.3135	8.121	0.749	0.226
HD 43246	49047.3164	7.366	0.216	−0.161
	49066.3799	7.455	0.202	−0.177
	49375.3477*	7.406	0.207	−0.193
	49682.5205	7.433	0.217	−0.193
	49718.5244	7.406	0.223	−0.221
	49734.4404	7.408	0.206	−0.170
	49735.3320	7.432	0.214	−0.198

Next, we briefly review the photoelectric photometric history of the stars involved in the paper.

SY And (P=34$^{\rm d}_{\cdot}$908, A0+K1) is a neglected star from photometric point of view. Although, there are some marks of its photoelectric observations in the literature (Hall, 1971; Nha, 1988), there is no available UBV measurement of the star. Consequently, there were no tested comparisons. The used comparisons were tied to the international system in two steps. HR 56 (= HD 1185A) served as a primary standard to the stars HD 915, HD 775 and HD 982 with the parameters $V=6.15$, $B-V=0.05$ and $U-B=0.03$ (see Hoffleit, 1982). With the help of their determined values can be obtained photometric parameters for the used comparisons (Table 1).

UU Cnc (P=96$^{\rm d}_{\cdot}$69, ?+K4II–III) has an extended literature compared to its long period. The first non–complete photometry was published by Eggen (1973) using $UBVRI$ system. The first complete light curve was obtained from a 13–year monitoring in colours B and V by Winiarski & Zoła (1987). Other numerous, partly available, but thus far unpublished observations have been made in Tallinn (see Kalv, 1983) and at Yonsei Observatory (see Lee, 1988) in UBV, moreover, by an APT (see Zoła et al., 1994) in BV. In this work HD 66553 was used as a primary standard with the values $V = 8.48$, $B - V = 0.85$ and $U - B = 0.51$ (see Mermilliod, 1987).

RX Gem ($P = 12\overset{d}{.}21$, A0+K2:) was observed photometrically by Hall & Walter (1975) in the frame of a comprehensive study. Since then, there were not any UBV measurements to publish, although they would be useful for detecting some possible period changes.

HD 37453 ($P = 66\overset{d}{.}75$, F5II+Be) was recognised as an interesting star based on the studies performed with the IUE satellite (see Parsons et al., 1984), only. As far as we know, there are about 200 unpublished observations (see Bopp, 1992) obtained by an APT, but they were made in colour V.

HD 43246 ($P = 23\overset{d}{.}1755$, B8V+F8II) has a similar history as HD 37453. The IUE satellite showed (ref. see above) its strange spectroscopic behaviour. The only photometric study was made by Dempsey et al. (1990) in the UBV system.

Acknowledgments. I would like to thank Dr L. Szabados, who turned my attention to W Ser stars and for his continuous help. This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France. The work was partly supported by Hungarian OTKA Grant T007438.

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

Number 4272

Konkoly Observatory
Budapest
28 November 1995

HU ISSN 0374 – 0676

IMPROVED EPHEMERIS AND PHOTOMETRIC ELEMENTS FOR HY VIRGINIS

HY Vir (SAO 139174, HD 114125, BD $-1°2777$) was originally announced as a variable star by Rodriguez et al. (1988). Additional observations carried out at Observatorio del Teide (Instituto de Astrofisica de Canarias) by Casas and Gomez-Forrellad (1989) confirmed the variable nature of HY Vir. They also showed that the star is a detached eclipsing binary system and gave the following preliminary ephemeris:

$$\begin{array}{rl} \text{HJD Min. I} = & 2447240.97128 + 2\overset{d}{.}73236 \times E \\ & \pm 0.00006 \quad \pm 0.00002 \end{array}$$

This ephemeris and the original physical elements were obtained during a short time interval and from a reduced number of minimum timings. As a consequence, they could be affected by inaccuracies. To test the above mentioned ephemeris and elements, we observed HY Vir during several nights in April 1995 using the 0.4-m telescope at Observatorio de Mollet equipped with a LYNXX-2 CCD camera at and the 0.4-m telescope in conjunction with a ST-4 CCD camera at Observatorio de Monegrillo (Spain). Both CCD cameras were operated in the V band. HY Vir is also a visual binary (South 647). The optical companion (PPM 178970, AGK3 $-02°0782$) was used as the comparison star.

From the original set of data obtained in 1989 and the new data gathered now, we computed a list of O$-$C residuals for one Min.I and three Min.II. Times of minima were derived using the Sliding Integration Method (Ghedini, 1982). Table 1 summarizes the resulting O$-$C values.

Table 1

HJD 2440000+	Minimum	Epoch	O$-$C
7239.6051	II	-0.5	0.0000
7627.60069	II	141.5	$+0.00047$
9813.47041	II	941.5	-0.01781
9817.56624	I	943.0	-0.02052

After performing a least-squares linear fit on the O$-$C residuals we found the following improved ephemeris for HY Vir:

$$\begin{array}{rl} \text{HJD Min. I} = & 2447240.96964 + 2\overset{d}{.}732338 \times E \\ & \pm 0.00009 \quad \pm 0.000002 \end{array}$$

Although the observed minima during 1995 clearly indicate a shorter period for HY Vir, it is still too early to discern whether it is due to a lack of accuracy in the initial period estimate or true period changes. Therefore more timings of minima are needed.

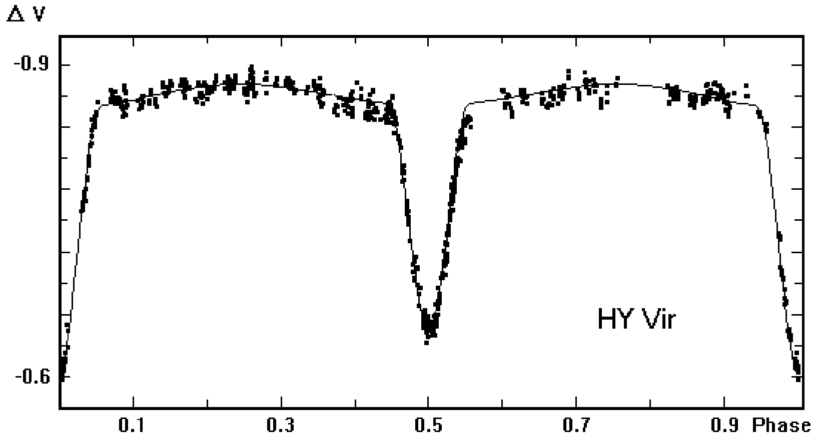

Figure 1. Synthetic light curve superimposed to observations.

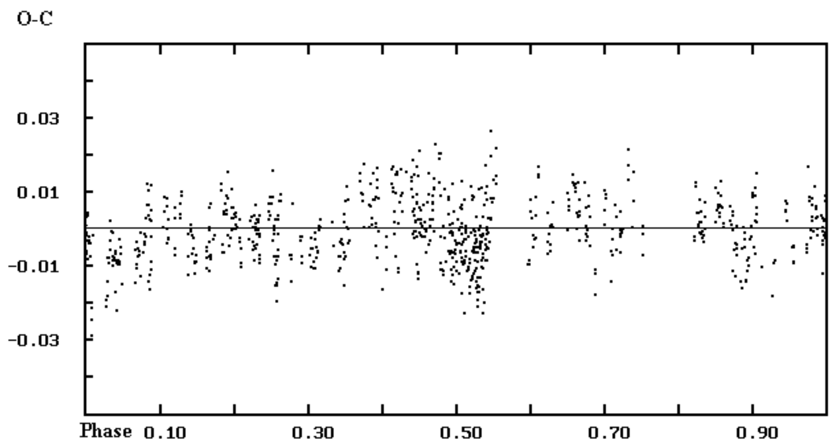

Figure 2. Computed residuals after subtracting the synthetic light curve from observations. Vertical scale is in magnitudes

Table 2

mass ratio = 0.95 ± 0.05	
i = $80^\circ\!.6 \pm 0^\circ\!.1$	
$a_g = 0.230 \pm 0.005$	$a_s = 0.140 \pm 0.005$
$b_g = 0.227 \pm 0.004$	$b_s = 0.139 \pm 0.005$
$c_g = 0.224 \pm 0.004$	$c_s = 0.139 \pm 0.005$
$d_g = 0.231 \pm 0.006$	$d_s = 0.140 \pm 0.005$
$g_1 = 0.32$	$g_2 = 0.32$
$x_1 = 0.60$	$x_2 = 0.60$
$A_1 = 0.5$	$A_2 = 0.5$
$T_1 = 7200K \pm 40K$	$T_2 = 6900K \pm 20K$
$L_1 = 0.76 \pm 0.01$	$L_2 = 0.24 \pm 0.01$

Also, from the original photoelectric observations obtained in 1989, we derived new physical elements using Binary Maker 2.0 (Bradstreet, 1993), based on a preliminary set of elements computed by Alvaro Gimenez and Casas (1990) who used the computer program EBOP developed by Etzel (Popper, 1984). Taking into account that the combined spectrum of the system is F2V, the values of 0.32, 0.6 and 0.5 were assumed for the gravity darkening, limb darkening, and reflection coefficients respectively (Figure 1). Table 2 summarizes these results.

In Figure 2 residuals are depicted after subtracting the synthetic light curve from the photometric observations.

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

Number 4273

Konkoly Observatory
Budapest
29 November 1995

HU ISSN 0374 – 0676

HD 161223 – A NEW VARIABLE IN THE FIELD OF IC 4665

At the end of June 1995 the open cluster IC 4665 was observed on seven nights with the 0.90 m telescope at Sierra Nevada observatory by means of a Strömgren six-channel simultaneous photometer. The main aim of these observations was to find γ Dor stars, a new type of long period variables located in the lower part of the Cepheid instability strip. Some of these stars have been detected before in the young open cluster NGC 2516 (Mantegazza et al., 1995) whose age is similar to IC 4665, approximately 3.6×10^7 year (Lyngå, 1981).

During this campaign about thirty stars with $V<9^m_.0$ were checked out. C1=HD 161677, C2=HD 161572 and C3=HD 161603 or Kopff (K) numbers (Kopff, 1943) K73, K58 and K64, respectively, were used as comparison stars. During these observations, the star HD 161223 (K28), with $V=7^m_.43$ (Nicolet, 1978), turned to be a new variable with a period of about 3.5 hours and amplitude of some hundredth of magnitude. This amplitude was variable from night to night. In addition, the colour indices $b-y$ and c_1 presented also variation phased with the light curve, suggesting that this star is a new multiperiodic pulsating δ Sct star. A frequency analysis was performed on the observed *uvby* data, using the Discrete Fourier transform method, as described in López de Coca et al. (1984). As result a main period of 0.144 days was found. Figure 1 shows the observed light curve and variations in the colour indices for the night of July 2.

In order to derive its physical parameters, the photometric Strömgren indices of $b-y=0^m_.243$, $m_1=0^m_.105$, $c_1=0^m_.972$ and $\beta=2^m_.772$ (Hauck & Mermilliod, 1990) were used with the method described in Philip et al. (1976) using the reference lines of Philip & Egret (1980) with the appropriate corrections for gravity and metallicity (Crawford 1975, Philip et al. 1976). Thus, the following values of $0^m_.092$, $0^m_.058$ and $0^m_.225$ were obtained for the colour excess, δm_1 and δc_1, respectively. This last value of δc_1 indicates that HD 161223 is an evolved δ Sct star. With the corresponding dereddening indices of $(b-y)_0=0^m_.151$ and $c_0=0^m_.949$, the values for $T_e=7560$ K and $\log g=3.59$ were obtained using the ($\log g$, T_e) grids of Lester et al. (1986) for [Me/H]=0.0. Then the mass, luminosity and age of the star have been derived from the evolutionary tracks from Schaller et al. (1992) for Z=0.020. When a main sequence stage is considered, $M=2.35M_\odot$, Age=7.1×10^8 years and $M_v=0^m_.51$ were found while a mass of $2.17M_\odot$, an age of 9.4×10^8 years and M_v of $0^m_.59$ can be obtained if we place the star on post-main sequence. The position of HD 161223 in the H–R diagram can be seen in Figure 2 where are also shown the sample of δ Sct stars and the observational edges of the instability strip in the δ Sct region from Rodríguez et al. (1994). The value of Q=0.027 days for the pulsation constant was obtained, using the equation derived by Petersen & Jørgensen (1972). This value suggests that this star pulsates in the first overtone.

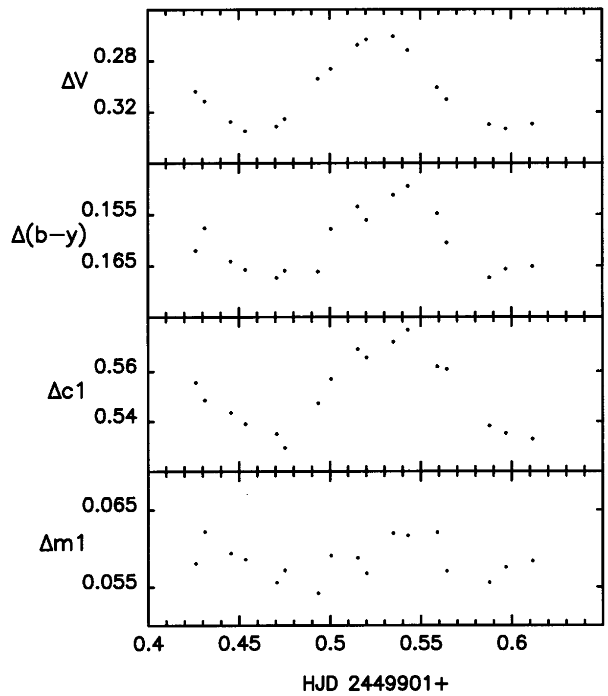

Figure 1. Differential light and colour index curves of HD 161223 with respect to C1=HD 161677 versus Heliocentric Julian Day during the night July 2^{nd}, 1995.

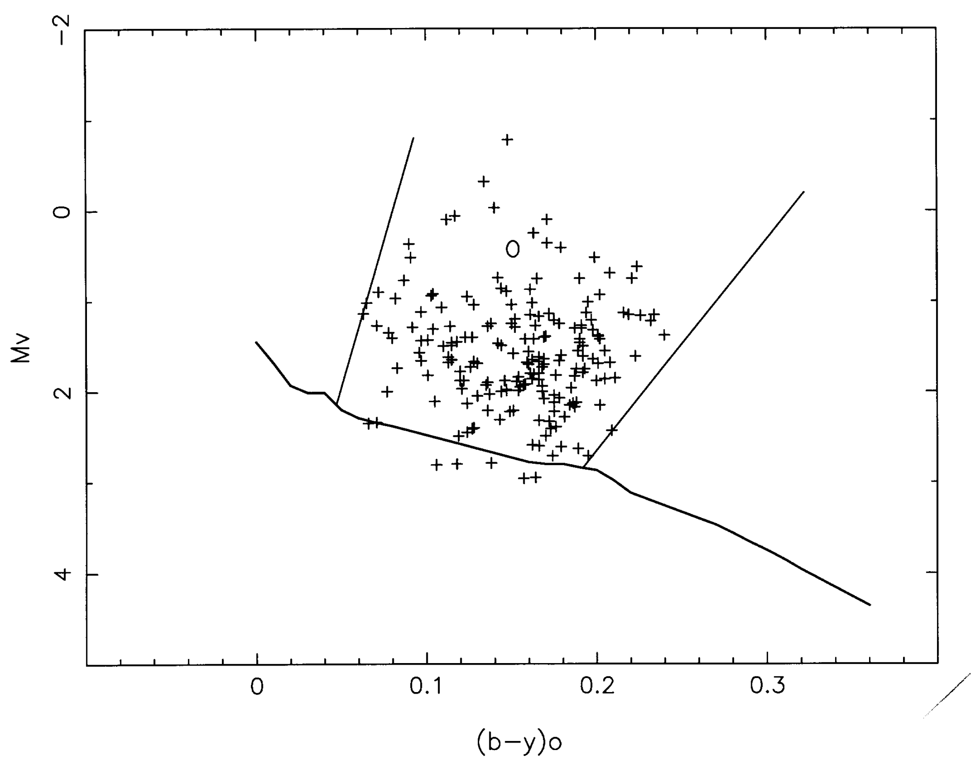

Figure 2. Position of δ Sct stars in the H−R diagram. HD 161223 is shown with the symbol O.

However, the δm_1 value obtained for this star suggests that HD 161223 is slightly deficient in metal content. In fact, using δm_1 and knowing that for this star $2\overset{m}{.}72<\beta<2\overset{m}{.}88$, the value of [Me/H]=−0.53 was obtained using the Smalley's (1993) calibration for metal abundances, that is, three times lower than the solar one. Furthermore, Figure 1 shows that the m_1-index varies significantly in the same sense as the light curve, indicating that the metallicity is low as compared with δ Sct stars. In fact, using the (Δm_1^*, β) grids from Rodríguez et al. (1991) for log g=3.5, $\beta=2\overset{m}{.}77$ and [Me/H]=−0.5 we find an expected m_1-index variation of about $0\overset{m}{.}004$ in the same sense of the light curve. This value is in very good agreement with the observed m_1 variation in Figure 1. So, taking into account these results, the real physical parameters of this star must be slightly different from the above calculated. Moreover, due to the fact that the metal content is low this star could be classified as an SX Phe star rather than a normal (Population I) δ Sct star. In this case, HD 161223 would be a field SX Phe star with the longest period known to date.

After the observations, we have revised the bibliography about the cluster IC 4665 finding that there are some reasons to consider HD 161223 (K28) as not belonging to this cluster. A study about which stars are members or nonmembers was made by Crawford & Barnes (1972). They found that this star is much less reddened and has a smaller distance modulus than the cluster average values. Moreover, the proper motion is discordant. Then, they suggest that HD 161223 does not belong to IC 4665. Furthermore, the value for the colour excess E(b−y)=$0\overset{m}{.}092$ obtained in the present work agrees well with Crawford & Barnes's (1972) results. In addition, the metal content of HD 161223 is too low as compared with that expected for the stars belonging to the cluster. In fact, the mean value of [Me/H] obtained for the members listed in the Crawford & Barnes' (1972) work is of −0.06 applying Nissen's (1988) and Smalley's (1993) calibrations for metal abundances. Finally, the age derived for HD 161223 indicates that this star is much older than the cluster.

Acknowledgements. This research was supported by the Junta de Andalucía and the Dirección General de Investigación Científica y Técnica (DGICYT) under project PB93-0134. Acknowledgements are specially made to A. López-Giménez for their help during the run of observations.

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

Number 4274

Konkoly Observatory
Budapest
1 December 1995

HU ISSN 0374 – 0676

TWO NEW VARIABLE STARS

My continuing photographic patrol has resulted in the discovery of 2 more variable stars that are not listed in the General Catalogue of Variable Stars (Kholopov et al., 1985) or the subsequent Name Lists of Variable Stars (Kholopov et al., 1985, 1987, 1989; Kazarovets and Samus, 1990, Kazarovets et al., 1993; Kazarovets and Samus, 1995). Nor are they listed in the New Catalogue of Suspected Variable Stars (Kholopov et al., 1982). Positions and preliminary magnitude ranges, types, and periods are given in Table 1, which continues the list in Kaiser (1994). Figures 1 and 2 are finder charts for DHK 42 and 43 respectively.

Table 1

Var. Designation	RA (1950)	Dec (1950)	Range	Type	P (days)
DHK 42=GSC 1272:0567	$4^h18^m29^s$	$20°8'55''$	12.5-<15.5p	M	~322
DHK 43=GSC 2759:1984	$23^h\ 8^m\ 1^s$	$34°30'1''$	11.7-12.4p	SR	~60

Both variables were discovered using photographs taken with the Automatic Photographic Patrol (APP). David B. Williams has examined both DHK 42 and 43 on the Harvard patrol plates and has confirmed variability and determined preliminary periods. DHK 42 was also visually confirmed by Tim Hager, who reported it as <14.2 in March of 1995 and as bright as 11.3 in August, 1995. It is a mira variable located in Taurus on the far side of the Hyades star cluster. DHK 43 is a semiregular variable in Pegasus. Both photographic and ongoing photoelectric observations will be published when analysis is completed.

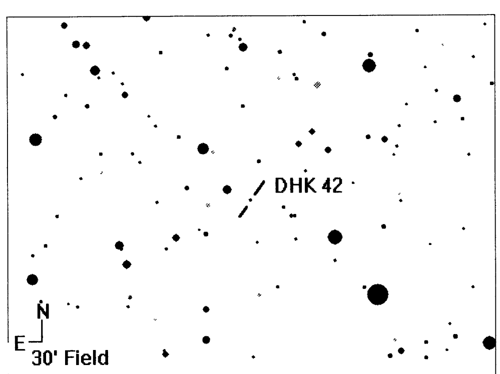

Figure 1

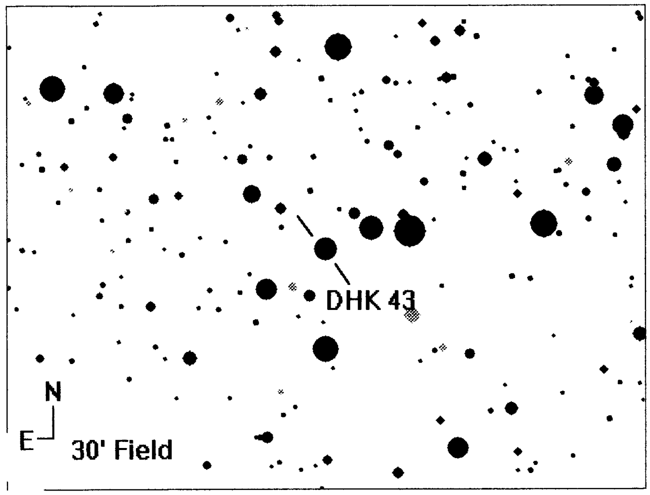

Figure 2

The construction of the APP was supported by a grant from NASA administered by the American Astronomical Society to whom I'm most grateful. I would also like to thank David B. Williams and Tim Hager for helping confirm the variability of these stars. The variables were detected using a projection blink comparator (PROBLICOM) as described by Mayer (1977).

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

Number 4275

Konkoly Observatory
Budapest
5 December 1995

HU ISSN 0374 – 0676

PHOTOMETRIC OBSERVATIONS OF NSV 13368

The variability of NSV 13368 was initially announced by Thorndike (1942). According to the New Catalogue of Suspected Variable Stars (Kholopov, 1982), NSV 13368 (HV 10648, CSV 005292) is an RR Lyrae variable star with a photographic magnitude variation range between 13.4 and 14.3. NSV 13368 can unambiguously be identified with star GSC 0524.0645.

From August 3 to October 29, 1995, the star was observed on 18 nights in the V band, using a Starlight Xpress CCD camera attached to the Newtonian focus of the 0.41-m telescope at Observatorio de Mollet (Spain). GSC 0524.0669 was used as comparison star, and GSC 0524.0839 and GSC 0525.1384 as check stars (see Figure 1).

These observations show that NSV 13368 is in fact an RR Lyrae star with an asymmetric light curve ((M−m)/P=0.12), an amplitude in the V band of 0.8 magnitudes, and a period close to 13 hours and 36 minutes (Figure 2). We derived the following ephemeris:

$$\text{Max.} = \text{HJD}\,2449957.418 + 0.56684 \times E$$
$$\pm 0.005 \quad \pm 0.00015$$

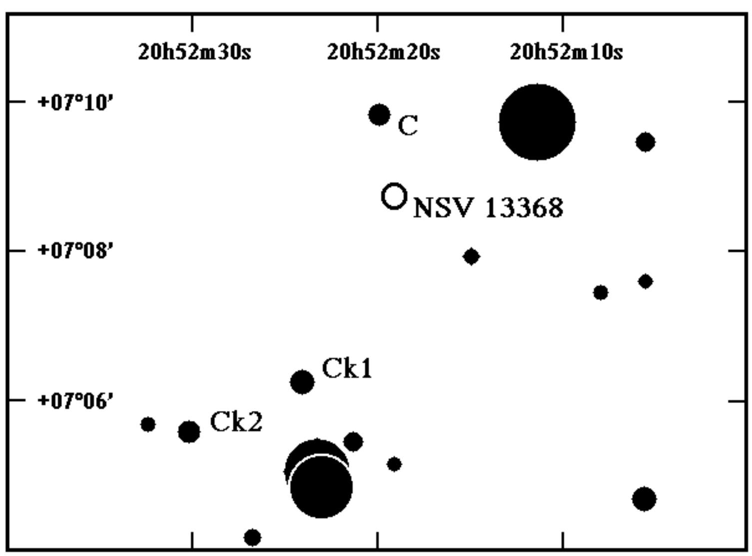

Figure 1. C = Comparison star, Ck_1 and Ck_2 = Check stars.

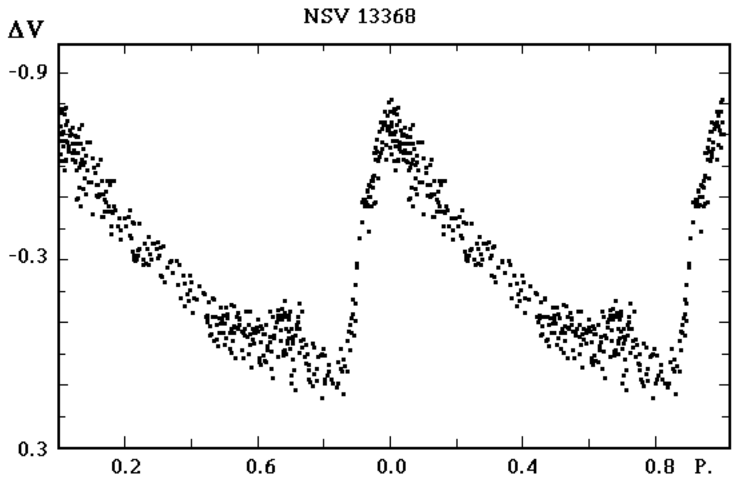

Figure 2. Light curve of NSV 13368 in the V band.

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

Number 4276

Konkoly Observatory
Budapest
11 December 1995

HU ISSN 0374 – 0676

HY Com REVISITED

The variable star HY Com (BD +16°2356, R.A. = $12^h18^m16^s$), Decl. +16°09′16″, 2000.0, according to the HIPPARCOS Input Catalogue (1992)) was discovered during routine UBV observation at the Kvistaberg Observatory in 1977. It was found to be an RRc variable with the unusually long period 0.448614 days (Oja, 1981). Variations of the period were observed, but during at least three years the shape of the light-curve remained the same within accuracy of the observations. Later Kurochkin (1982) determined 16 epochs of maximum during the years 1904-1929 and 1950-1975 from the Moscow plate archives; he suggests an abrupt increase of the period with about 0.9 second at about 1950 (from 0.4485955 days to 0.4486055 days).

The star was observed again (in UBV) in the springs of 1994 and 1995 with the 60 cm Cassegrain telescope of the Royal Swedish Academy of Sciences at Observatorio Astrofisico del Roque de los Muchachos, La Palma, mainly to see what possible changes of the period or light-curve might have taken place since the last observations in 1980. Between April 11th and April 15th 1994, 51 observations were obtained, and 29 observations between March 30th and April 4th 1995. The observations have been sent to the I.A.U. Archives of Unpublished Variable Star Observations (file No 309E; this file also contains the photoelectric Kvistaberg observations from the years 1977-80, giving corrected Julian Dates for those – the dates published earlier (Oja, 1981) have to be corrected by +.007 days).

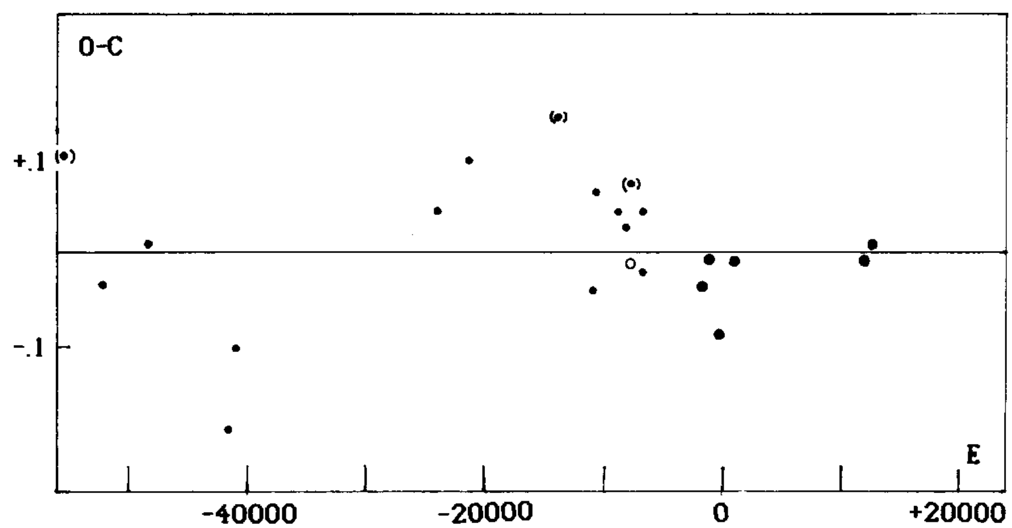

Figure 1. Observed epoch of maximum minus calculated according to eq. (1). Small points represent photographic determinations by Kurochkin (1982), large points the maxima determined photoelectrically in this paper.

Table 1. Epochs of maximum of HY Com

Year	HJD	E
1970	2 440 664.83:	−7560
1977	2 443 329.094±.011	−1621
1978	2 443 613.091±.004	−988
1979	2 443 962.031±.001	−210
1980	2 444 294.976±.001	+532
1994	2 449 456.221±.001	+12037
1995	2 449 809.294±.001	+12824

Table 2. The light-curve of HY Com
(The phase (p) is counted from maximum.)

p	V	B−V	U−B	p	V	B−V	U−B
.000	10.253	.192	.117	.500	10.672	.323	.045
.025	10.256	.192	.118	.525	10.675	.322	.046
.050	10.267	.194	.110	.550	10.671	.319	.046
.075	10.281	.200	.103	.575	10.661	.316	.046
.100	10.295	.210	.098	.600	10.647	.312	.047
.125	10.319	.221	.097	.625	10.619	.301	.048
.150	10.344	.229	.094	.650	10.557	.283	.049
.175	10.375	.238	.092	.675	10.486	.267	.050
.200	10.411	.247	.090	.700	10.448	.256	.051
.225	10.448	.256	.088	.725	10.418	.250	.052
.250	10.483	.265	.084	.750	10.398	.244	.053
.275	10.515	.276	.079	.775	10.387	.238	.054
.300	10.543	.285	.072	.800	10.378	.231	.056
.325	10.573	.295	.065	.825	10.370	.224	.059
.350	10.597	.303	.059	.850	10.362	.218	.063
.375	10.620	.311	.055	.875	10.345	.212	.070
.400	10.636	.318	.050	.900	10.324	.207	.080
.425	10.647	.322	.046	.925	10.289	.201	.090
.450	10.656	.324	.045	.950	10.268	.197	.099
.475	10.666	.324	.045	.975	10.256	.194	.110

From the observations in 1994 a master light-curve was drawn, using the period of 0.448614 days determined in 1981. Light-curves were also drawn individually for the observations of every other year. Within the errors of the measurements the shape of the light-curve is the same for all the years (1977, 1978, 1979, 1980, 1994, and 1995). Phase differences are, however, present, and from those an epoch of maximum, representing the observations of each year, was derived, see Table 1 (E is the number of periods counted from the same zero-point as in Kurochkin's (1982) table; the sign is reversed). The maximum of 1970 is supported by one single measurement by Häggkvist at the Lowell Observatory (Häggkvist and Oja, 1973) the magnitude of which happens to be close to the magnitude at maximum as found later.

The data in Table 1 combined with Kurochkin's data cover a time interval of about 90 years and allow some conclusions. The two most recent observations have positive O−C residuals when using Kurochkin's eq. (2). This means that a parabolic formula could be used to represent the observations, the period would be increasing with time. This is, however, not the only possibility. A rather nice linear fit to the observations is possible, if one adds 1 to the epochs (taken with a negative sign) of Kurochkin's first five observations (N.B. that the J.D. of Kurochkin's third observation very probably should read 22455.36). A least-squares solution gives (when giving weight 3 to the photoelectrically determined maxima 1977-95, 0.5 to Kurochkin's uncertain maxima, and 1 to the others)

$$\begin{array}{rl} \mathrm{HJD(max)} = & 2\,444\,056.322 + 0.4486090 \times \mathrm{E} \\ & \pm.009 \quad \pm.0000006 \end{array} \qquad (1)$$

The result is rather insensitive to the weighting procedure. The O−C's are shown in Figure 1. The dispersion corresponding to unit weight is 0.0073, a value appreciably larger than the observational error, at least for the photoelectric data (the mean errors of Kurochkin's data are not known). This clearly demonstrates that there are short-term variations of the period, the nature of which is still unknown.

All photoelectric observations of the years 1977-1995 have been combined into one light-curve that is tabulated in Table 2. The phase is counted from maximum. The accuracy of the entries is estimated to be about 0.002-0.003 in V and B−V, about 0.005 in U−B.

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4277

Konkoly Observatory
Budapest
11 December 1995
HU ISSN 0374 – 0676

V-BAND PHOTOMETRY OF XY UMa IN 1993 AND 1995

XY UMa (= SAO 27143 = BD+55°1317, G2V + K5V) is a chromospherically active, close, eclipsing binary system, with a period of 0.48 days. It has been the subject of close scrutiny recently, at both optical and X-ray wavelengths, where the eclipses can be used to spatially probe magnetic structures on and above the surface (Bedford et al. 1990; Hilditch & Bell 1994 – hereafter HB94). Hilditch & Collier Cameron (1995 – hereafter HC95) have developed a model to explain the changing optical light curve of XY UMa in terms of starspots covering a wide range of latitudes on the surface of the primary star. The most recent analysis of the O−C times of minima was performed by Pojmański & Geyer (1990 – hereafter PJ90). They find evidence for a quasi-sinusoidal variation in the O−C's, which can be explained if there is a third low-mass star in the system, with an orbital period of either 25 or 40 years. Arévalo et al. (1994) claim to have detected a third body about 2 arcseconds away from the close binary system. As a further contribution to the wealth of historical data that is accumulating for this fascinating object, we present two V-band light curves obtained in 1993 and 1995.

Both data sets were taken with a CCD camera attached to the University of Birmingham 0.4-m telescope. A V-band filter manufactured by Murnaghan Instruments was used. This had a peak throughput at 525 nm and a FWHM of 110 nm. The 1993 data were taken at the f/19 Cassegrain focus on the nights of the 19 February, 8/9 March and 13/14 March. The 1995 data were taken at the f/5 prime focus on 26/27 February, 3 March, 15 March and 17 March. The CCD frames were bias subtracted, flat-fielded and counts were integrated using a 24 arcsecond radius aperture. The comparison star used in each case was BD+55° 1320AB. Both components were included well inside the software aperture. The derived V-band differential magnitude light curves are shown in Figures 1 and 2. Phases were calculated according to the least squares linear ephemeris of HJD 2435216.5018 + 0.47899493E from PJ90. The full heliocentric observation times and differential magnitudes can be obtained from the authors. Two new epochs of primary minima were derived by fitting parabolas to the bottom half of the primary eclipses. We obtain HJD 2449055.6183 $\pm$ 0.0004 and HJD 2449775.5469 $\pm$ 0.0008 where the quoted errors are 68% confidence limits. The O−C values are −0.0050 days and −0.0058 days respectively.

A comparison with the various attempts to explain the O−C variations in PJ90, reveals that neither their short or long period, circular or eccentric third body hypotheses adequately fit our times of minima. In both cases (and also for the times of minima in 1992 given by HB94) the O−C's are significantly positive (by 0.003 to 0.006 days). The short period ($\sim$ 25 yrs) hypothesis is marginally worse than the long period ($\sim$ 40 yrs) solution. A complicating factor may be errors in the minima determinations caused by light curve asymmetries, but both our 1993 light curve and HB94's 1992 light curve have

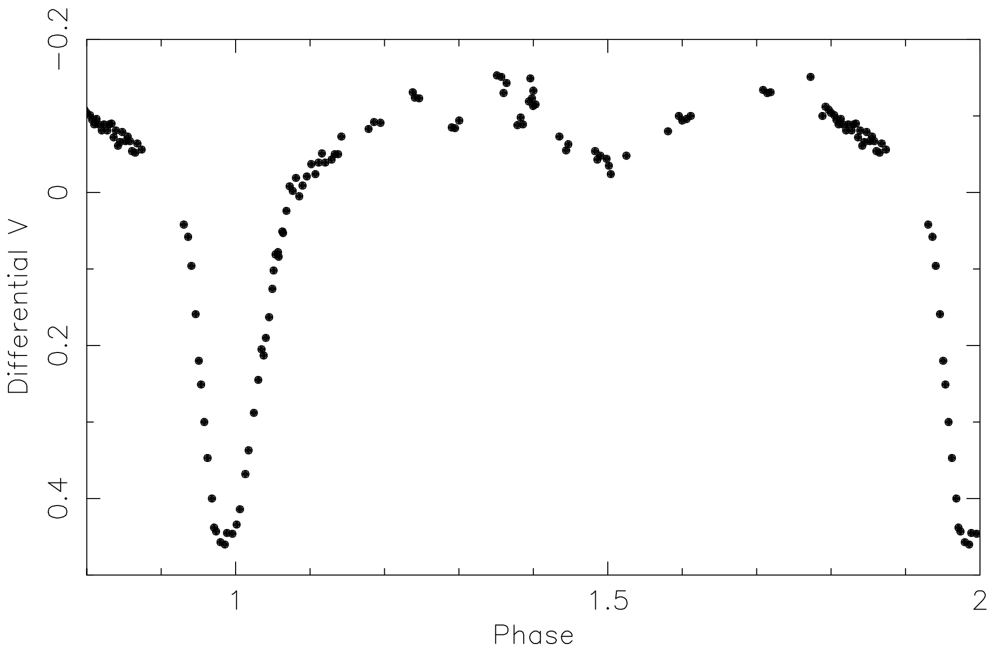

Figure 1. Phased differential V-band light curve of XY UMa taken during February/March 1993.

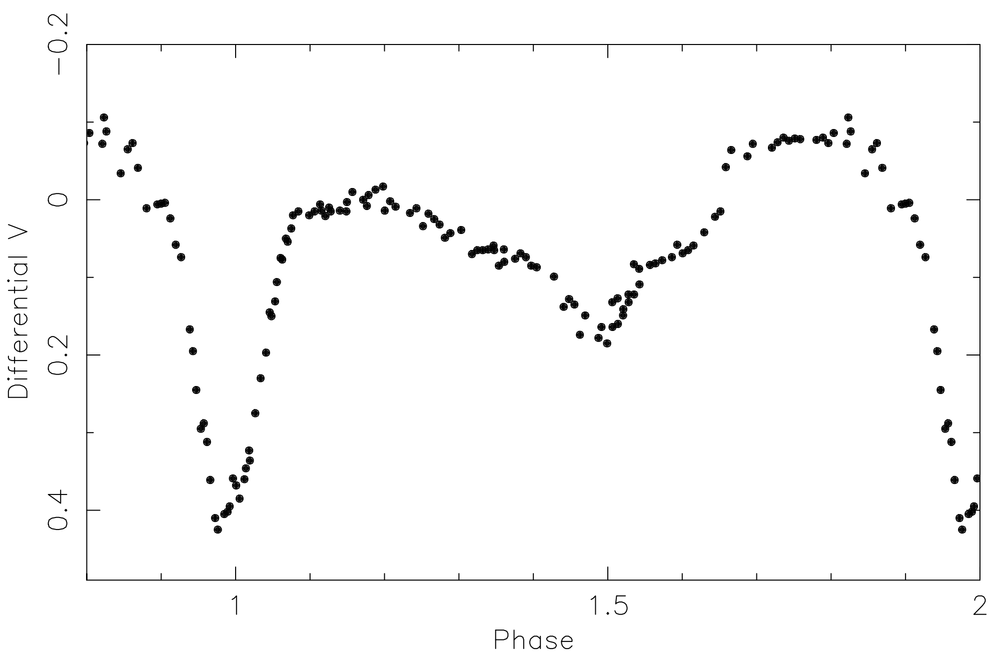

Figure 2. Phased differential V-band light curve of XY UMa taken during February/March 1995.

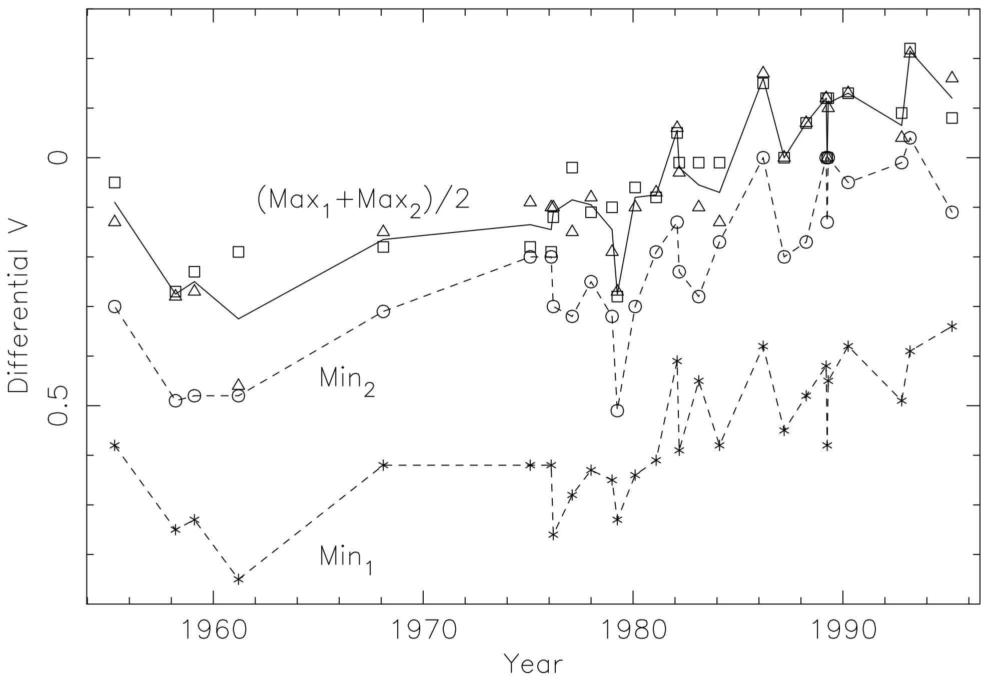

Figure 3. Historical brightness of XY UMa relative to SAO 27139 at primary minimum (stars), secondary minimum (circles), maximum after primary eclipse (squares), maximum after secondary eclipse (triangles). The solid line is the mean of the two maxima.

relatively symmetric primary minima. Thus our eclipse timings *do not* necessarily support the third body hypothesis for XY UMa, although a longer period might be indicated.

The appearance of the light curve has changed markedly between 1993 and 1995, with the secondary minimum becoming more prominent with respect to primary minimum. The scatter apparent in the 1993 light curve from phases 0.2 and 0.4 seems to be genuine variation of the light curve, between data taken on different nights (see also HB94). We have parameterised the light curves by estimating the differential V magnitudes of primary and secondary minima (Min_1 and Min_2) and the maxima between phases 0 and 0.5 (Max_1) and between phases 0.5 and 1.0 (Max_2). These estimates should be accurate to ± 0.02 and are with respect to BD $+55°$ 1320.

Year	Min_1	Min_2	Max_1	Max_2
1993	0.46	0.03	−0.15	−0.14
1995	0.41	0.18	−0.01	−0.09

To compare our results with previous work, we standardise the differential magnitudes above to what they would be had the more commonly used SAO 27139 been the comparison star. This is simply achieved by subtracting 0.07 magnitudes, because SAO 27139 is 0.07 magnitudes fainter than BD $+55°$ 1320 (HB94). Data from our two light curves is added to the data in HC95 along with a compilation of differential magnitudes of maxima and minima taken between 1955 and 1984, from Lee (1985). The full dataset is shown in Figure 3. As suggested by Lee (1985) and HC95 there is a definite trend in the data indicating that the whole system has been getting brighter, in a phase independent way, since about 1961. We interpret this in terms of the model developed by HC95, where long term system brightness changes over decades, are likely to be caused by changes in the area covered by both high and low latitude spots, visible both in and out of eclipse. Short term changes from year to year are more likely caused by changes in the coverage and axial symmetry of low latitude spots which may be obscured during primary eclipse, as the system inclination is 82°(HB94). If a magnetic cycle, similar to the Sun's exists, then it appears to be at least 40 years in length.

HC95 also suggest that, having gone through a period of low spot activity in the last ten years, XY UMa may now be commencing a period of increasing spot activity. Some interesting, but inconclusive evidence for this comes from our 1995 light curve. Figure 3 shows that while the primary minimum brightness is still increasing, the hemisphere facing away from the secondary appears to be growing darker. Such anti-correlations do not seem common in Figure 3. A possible interpretation is that while the area covered by high latitude spots is still decreasing, and thus the brightness at primary eclipse increasing, there has been an eruption of spots at lower latitudes, causing a decrease in system brightness at phases other than primary eclipse. It maybe that these will then migrate towards higher latitudes, presaging a new cycle of overall decreasing system brightness and increasing spot activity. An alternative explanation would be that the low latitude spots have simply become highly asymmetric, favouring the hemisphere facing away from the secondary. Further observations over the next couple of years should provide some answers.

Historical brightness of XY UMa relative to SAO 27139 at primary minimum (stars), secondary minimum (circles), maximum after primary eclipse (squares), maximum after secondary eclipse (triangles). The solid line is the mean of the two maxima.

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

Number 4278

Konkoly Observatory
Budapest
13 December 1995

HU ISSN 0374 – 0676

V961 CYGNI

The detached eclipsing binary V961 Cygni (HBV 258 = GSC 2660.3699; $\alpha(2000) = 19^h43^m58^s.3$, $\delta(2000) = +32°52'14"$, $V = 11.7$ mag) is a neglected, rather faint binary with an orbital period of about 2.04 days. It was supposed as a possible system for the study of the apsidal motion (Hegedüs, 1988). It was discovered to be a variable star photographically by Wachmann (1961), who obtained also the first photographic light curve and determined an orbital period of 2.0378 days. Unfortunately, this system has not been studied in detail for more than 30 years.

Our new CCD photometry of V961 Cyg was carried out on 26 and 29 July 1995 at the Ondřejov Observatory using a 65cm reflecting telescope with a CCD-camera (SBIG ST-6) in the primary focus. The measurements were done using the standard Johnson R filter with 45 or 60 s exposure time. The stars GSC 2660.2383 ($V = 11.1$ mag) and GSC 2660.1867 ($V = 11.5$ mag) on the same frame as V961 Cyg served as a comparison and check stars. The CCD data were reduced using software developed at Ondřejov Observatory by P. Pravec and M. Velen. No correction was applied for differential extinction, due to the proximity of the comparison star to the variable (1.1 arcmin) and the resulting small differences in the air mass. The moments of minimum and their error were determined using the Kwee–van Woerden (1956) method. These times are presented in Table 1. In this table, N stands for the number of observations used in the calculation of the minimum time. The epochs were calculated using the linear light elements given by Wachmann (1961):

$$\text{Pri. Min.} = \text{HJD } 2\,434\,237.401 + 2.0378068 \times \text{E}.$$

Figure 1 shows the differential R-magnitudes during the primary minimum observed at JD 2 449 928 (circles). Our measurements of secondary minimum (crosses) were shifted exactly by 1.5 period (+ 3.0567 d) and are also plotted to the same date. The light amplitude in R colour for primary minimum according to our measurement is $A_1 = 0.63 \pm 0.02$ mag, for secondary minimum $A_2 = 0.28 \pm 0.02$ mag. The duration of both minima D_1, D_2 seems to be almost identical.

Table 1. New times of minimum of V961 Cyg

JD Hel.– 2400000	Epoch	Error (days)	N
49925.3961	7698.5	0.0005	45
49928.4523	7700.0	0.0002	47

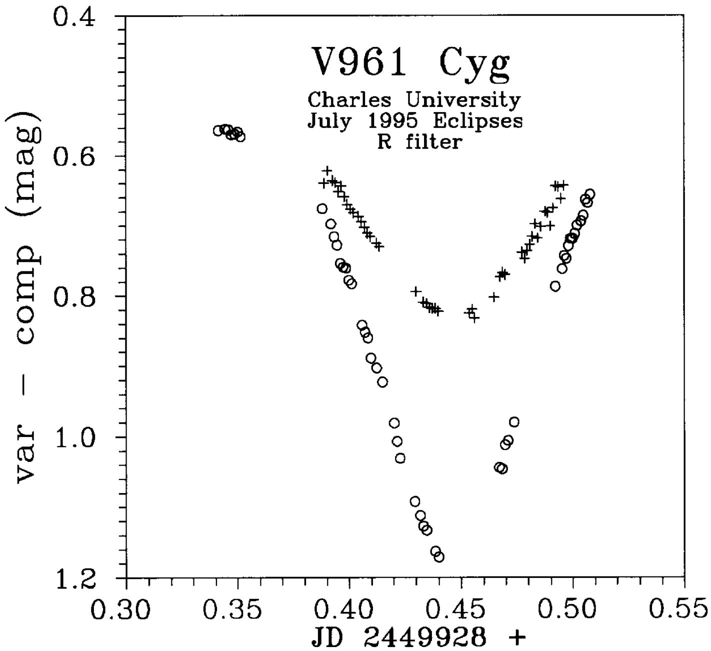

Figure 1. A plot of differential R-magnitudes obtained during primary eclipse of V961 Cyg on 29 July 1995 (circles). The measurements of the secondary minimum were shifted in time by 1.5 period and are plotted as crosses together with the primary minimum.

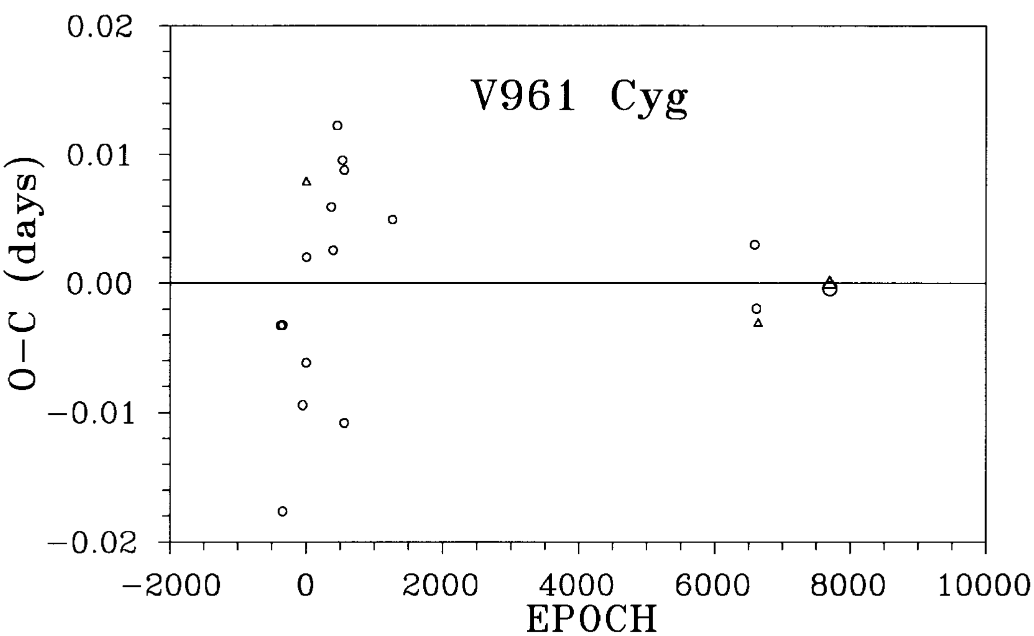

Figure 2. O−C residuals for the times of minimum of V961 Cyg. The individual primary and secondary minima are denoted by circles and triangles, respectively. Larger symbols correspond to the CCD measurements.

The change of period and possible apsidal motion of V961 Cyg was studied by means of an O−C diagram analysis. We took into consideration the photographic measurements obtained by Wachmann (1961) as well as the photographic times of minimum obtained by the BAV observers (Moschner 1990, Frank 1992). The time of primary minimum published by Moschner (1989) was not taken into consideration because the large O−C deviation (0.02 days). The photographic times of minimum were weighted with a weight of 1, 2 or 3 according to Wachmann (1961). Our times of minimum were used with a weight of 10.

The O−C residuals for all moments of minimum are shown in Figure 2. The original 13 times of primary minimum obtained by Wachmann (1961), as well as the mean time of secondary minimum for this epoch 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 significantly eccentric orbit. The secondary minimum occurs exactly at the phase 0.5 and the duration of primary and secondary eclipses is practically identical. Therefore, this system could be excluded from the list of possible candidates for apsidal motion study.

For the current use we derive the following linear light elements:

$$\begin{array}{rl} \text{Pri.Min.} = \text{HJD}\ 2\,449\,928.4527 & + \ 2.0377986 \times \text{E.} \\ \pm.0005 & \pm.0000008 \end{array}$$

Acknowledgement. This work has been supported in part by the Grant Agency of the Czech Republic, grant No. 205-95-1498 and by the ESO C&EE Programme, grant No. A-02-069. This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France.

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

Number 4279

Konkoly Observatory
Budapest
14 December 1995

HU ISSN 0374 – 0676

THE 1995 OUTBURST OF DV Dra

DV Dra is a dwarf nova discovered during its 1984 outburst by Pavlov and Shugarov (1985). Their inspection of POSS could not show the quiescent counterpart down to 21^{st} mag. This outburst was studied by Wenzel (1991) using Sonneberg plate collection. The combined data showed that the 1984 outburst reached B=15.0, and the object was suggested to be brighter than B=17.3 for at least 28 days. No further outbursts were detected other than the 1984 one. From the shape and long duration of the outburst, low outburst frequency, Wenzel (1991) suggested the classification of DV Dra as a WZ Sge-type dwarf nova (cf. Bailey, 1979; Downes and Margon, 1981). This outburst was further discussed by Richter (1992) on the presence of a "dip" during outburst.

The object was caught probably first time since discovery by Iida on 1995 Oct. 30.398 UT at an unfiltered CCD magnitude of 17.8. Further CCD observations were undertaken by Iida using a 20-cm reflector with an unfiltered ST−6, and at Ouda Station, Kyoto University (for description of instruments cf. Ohtani et al. 1992) using a 60-cm reflector with a CCD camera (Thomson TH 7882, 576 × 384 pixels). For Ouda observations, an interference filter was used which had been designed to reproduce the Johnson *V* band.

The Ouda frames were first corrected for standard de-biasing and flat fielding, and were then processed by a personal-computer-based PSF photometry package developed by one of the authors (T.K.). The frames by Iida were processed by a similar personal-computer-based photometric program developed by Iida. Differential magnitudes of the variable were determined against a local standard star marked as C1 (Ouda) and C2 (Iida) in Figure 1. The constancy of the comparison was checked against several stars in the same field. From the Ouda frames, we measured the difference between C1 and C2 as 3.55 mag. By comparison with GSC stars, we adopted a magnitude of C1 as 12.5. In Table 1, we list all available magnitudes reduced using these values.

Table 1. List of observations for the 1995 outburst. The abbreviation 'CU' in the 'System' column represents unfiltered CCD magnitudes. Exposure times are given in seconds.

Date (JD)	Mag.	System	Observer	Exposure
2450020.898	17.8	CU	Iida	120
2450020.905	17.5	CU	Iida	120
2450020.911	17.2	CU	Iida	180
2450021.872	17.8::	CU	Iida	120
2450022.894	17.5	CU	Iida	240
2450034.888	18.6	V	Ouda	240
2450046.879	18.6	V	Ouda	360

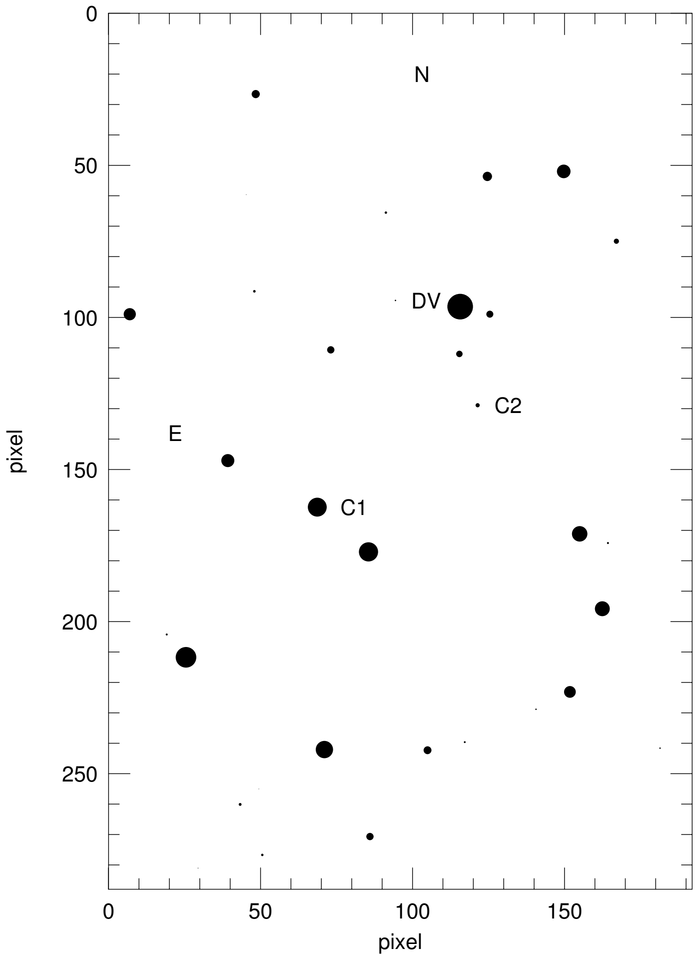

Figure 1. Finding chart of DV Dra drawn from a CCD image. North is up, and the field of view is about 10×7 arcmin. The comparison stars (C1,C2) and DV Dra are marked.

An accurate position was determined from frames taken at Ouda and frames by Iida independently. The Ouda frames gave $18^h17^m24^s.44$ $+50°48'16''.6$ (J2000.0) based on 5 GSC stars with a mean residual of $0''.3$, and frames by Iida gave end figures of $24^s.44$ and $16''.3$ (with a possible error of $1''.0$). These values are slightly different from those given in Downes and Shara (1993).

The present observations indicate that DV Dra has shown an outburst ∼2 magnitudes fainter than the 1984 one, but seemingly staying brighter than V=18.6, which is at least 2 mag above quiescence reported by Pavlov and Shugarov (1985), for more than 26 days. Assuming the WZ Sge-type nature, the present outburst may represent a faint superoutburst sometimes detected in large-amplitude SU UMa systems like WX Cet, SW UMa, VY Aqr and BC UMa (e.g. see Kato, 1995) rather than a normal outburst.

Part of this work is supported by a Research Fellowship of the Japan Society for the Promotion of Science for Young Scientists.

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

Number 4280

Konkoly Observatory
Budapest
19 December 1995

HU ISSN 0374 – 0676

SMALL-AMPLITUDE VARIABLES IN THE OPEN CLUSTER IC 4665

The open cluster IC 4665 (r = 364 pc) is known to have a high percentage of spectral binaries among its bright members (Abt et al., 1972; Grampton et al., 1976). With the purpose of detecting these binaries eclipsing variables, we performed in 1984 a photoelectric B,V monitoring, using the 60-cm telescope of the Maidanak Observatory. However, no sign of light weakening was detected in the moments of expected minima (Zakirov, 1987). This photoelectric material has been recently used by us to search for periodic small-amplitude variations in the brightness of the observed binaries. As a result, the periods of light variations have been discovered for five stars, which are given in Table 1. Here, star names are taken from the list of Kopff (1943), and in the column P(Sp), spectroscopic period is given according to Abt et al. (1972). The value k is the average signal-to-noise ratio. Light curves of these stars are displayed in Figures 1-5. The periods of the binaries are close to, or multiple of, P(Sp). We conclude that these light variations are related to the effect of axial rotation or orbital motion of the components rather than of eclipse in the double systems.

Table 1

Kopff	HD	Max	A	k	⟨B−V⟩	P	P(Sp)	Sp
32	161261	$8^m_.290$	$0^m_.017$	$2^m_.19$	$0^m_.057$	$1^m_.60$	$8^m_.23$	B8+Shell
64	161603	7.366	0.021	2.82	0.040	41.5	43.5	B5IV
72	161660	7.759	0.017	2.15	0.012	15.61	15.58	B7V
76AB	161698	8.214	0.028	2.69	0.120	15.42	7.25	B8.5p
105	162028	7.517	0.022	1.95	0.027	15.05	8.01	B6V

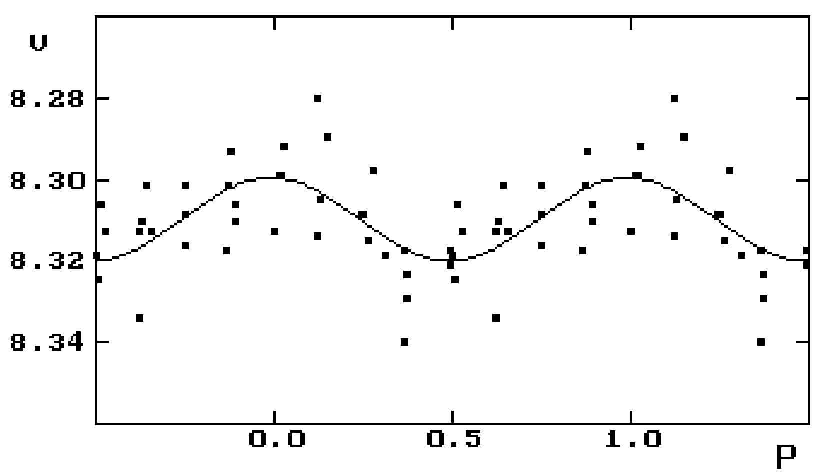

Figure 1. The light curve for star 32.

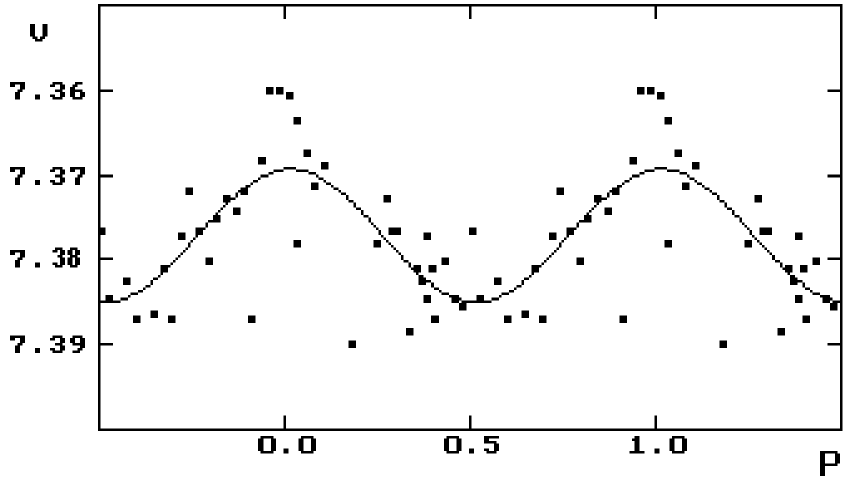

Figure 2. The light curve for star 64.

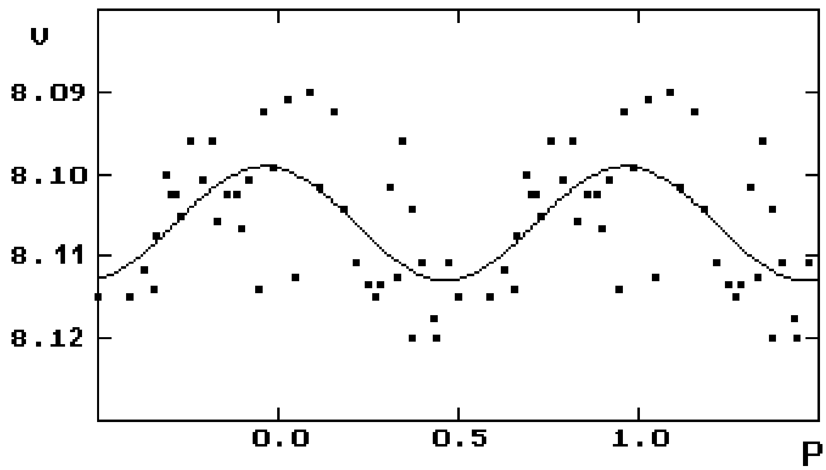

Figure 3. The light curve for star 72.

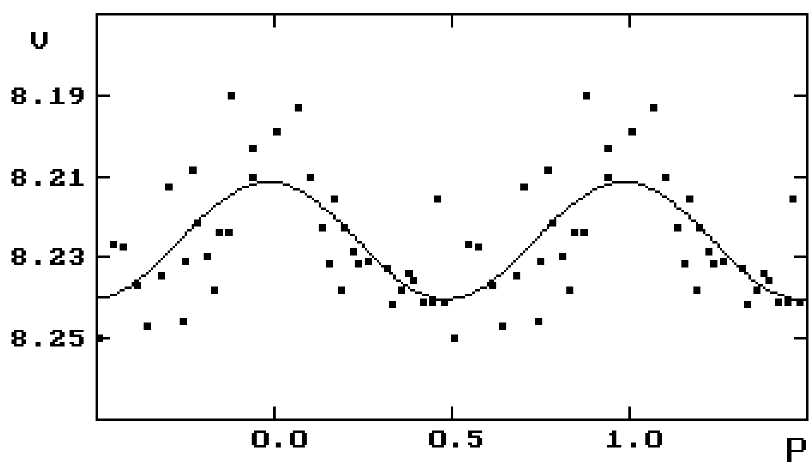

Figure 4. The light curve for star 76.

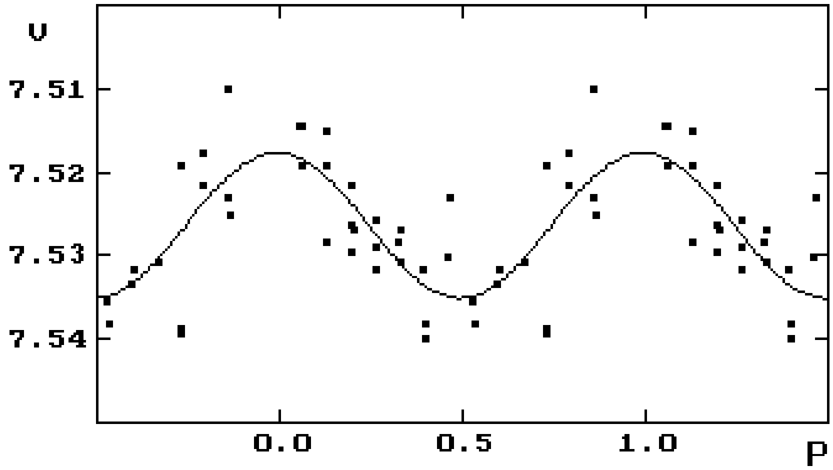

Figure 5. The light curve for star 105.

One of us (MMZ) was supported by Fund for Fundamental Research of Republic Uzbekistan (Contract 33).

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

Number 4281

Konkoly Observatory
Budapest
20 December 1995

HU ISSN 0374 – 0676

OPTICAL OBSERVATIONS OF THE ACTIVE STAR RE J2220+493

The sky was surveyed in the extreme ultraviolet (EUV) region of the spectrum by the EUVE satellite (Malina et al., 1994) and the ROSAT satellite (Pounds et al. 1993) and catalogs of the sources included RE J2220+493 = EUVE J2220+49.5 = SAO 51891 = BD +48°3686. The star was one of the subjects of an investigation by Jeffries (1995), who concluded it was a "single, rapidly rotating K0V-IV star with a v sin i of 15 km/sec".

The automated 0.5-m. telescope, Johnson V filter and CCD camera of the Climenhaga Observatory of the University of Victoria (Robb and Honkanen, 1992) were used to make photometric observations of RE J2220+493. The frames were bias subtracted and flat fielded in the usual manner using IRAF [1]. The magnitudes were found from aperture photometry using the PHOT package. The x y pixel coordinates of each star for photometry were found from inspection of a few frames and these positions were used as starting points for the Gaussian centering option which precisely centered the 5 arc second aperture on each star for each frame.

From the Hubble Space Telescope Guide Star Catalog (Jenkner et al., 1990) the coordinates and magnitudes of the comparison star are RA=$22^h19^m38^s$, Dec=49°32′20″, V=9.6 and of the check star are RA=$22^h19^m38^s$, Dec=49°28′07″, V=8.9 (J2000). The standard deviation of the difference between the check and the comparison star during a night ranged from $0\overset{m}{.}003$ to $0\overset{m}{.}007$. The mean and standard deviation of the eleven nightly mean differential V magnitudes are $0\overset{m}{.}429 \pm 0\overset{m}{.}005$ ensuring the constancy of both comparison and check stars at this level. The precision of the differential variable star minus comparison star measurements are expected to be at this level. Due to the small field of view first order differential extinction effects were negligible and no corrections have been made for them. No corrections have been made for the colour difference between the stars to transform the V magnitude to a standard system.

Photometric observations were made 22 to 25 September and 29 October to 4 November 1995 UT. Brightness variations were evident both during a night and from night to night. A "Phase Dispersion Minimisation" routine modelled after that of Jurkevich (1971) reveals a minimum average sigma at a period of 2.43±0.02 days. A least squares fit of a single sine wave to the data also shows a deep minimum in chi squared at a period of $2\overset{d}{.}43$ as seen in Figure 1. The other deep minima correspond to periods of $2\overset{d}{.}58$ and $2\overset{d}{.}29$ and inspection of the light curves at these periods show rather unlikely discontinuities.

So the best ephemeris from our data is:

$$\text{HJD of Maxima} = \underset{\pm .20}{2449981.94} + \underset{\pm 0.01}{2.43} \times E$$

[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

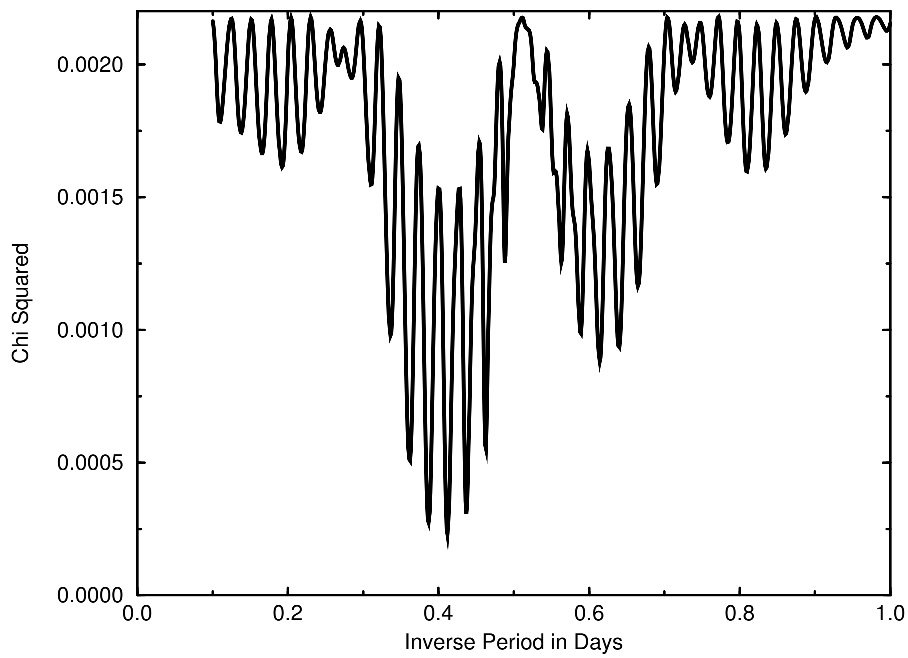

Figure 1. Chi squared of a single sine curve fit for various periods for RE J2220+493 for 1995

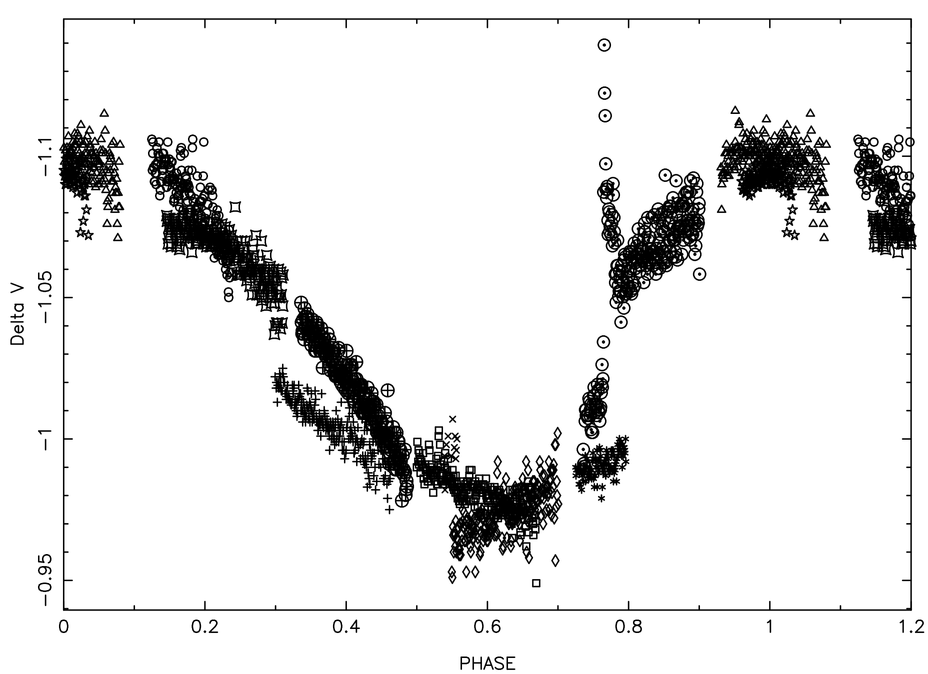

Figure 2. Light curve of 1995 differential V data of RE J2220+493

A plot of the 2112 differential V magnitudes phased at this period is shown in Figure 2 with different symbols for each of the different nights. Close inspection of the "⊙" points at phase 0.75 (HJD = 2450022.68) shows a small flare, which was ignored during the period finding runs. The flare had an amplitude of approximately $0\overset{m}{.}1$ and a duration of an hour. The light curve also shows shifts of a few hundredths of a magnitude in mean level from night to night.

From our period, the $v\sin i$ and assuming a radius (Allen 1973), appropriate for the spectral type K0V we find the inclination of the axis of rotation to be $58°\pm7°$. A luminosity class of IV is unlikely since it implies an inclination of approximately 20°, so the area on the star passing in and out of view is small compared to the amplitude of the light curve. From the shape of the light curve, the changes in the shape of the light curve, the flare, the spectral type, Hydrogen α emission (Mulliss and Bopp, 1994), and the brightness in the EUV, we conclude that this star has large active regions on it causing the brightness variations. The changes in the light curve shape are likely due to differential rotation or active region evolution and could be studied by further photometric observations.

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

Number 4282

Konkoly Observatory
Budapest
27 December 1995

HU ISSN 0374 – 0676

PHOTOMETRIC OBSERVATIONS OF NSV 01651 AND THE NEW VARIABLE STAR GSC 0669.0468

Variability of NSV 01651 (HV 10389, CSV 000418) was announced by Hanley and Shapley (1940) based on plates of the MF series taken with the 10-inch Metcalf triplet in South Africa. They indicated that the object might be an RR Lyrae star with a photographic variation range from 13.0 to 13.6 magnitudes. NSV 01651 can unambiguously be identified with star GSC 0669.1442.

During 18 nights, from 28 August to 13 November 1995, NSV 01651 was observed in the V band using a Starlight Xpress CCD camera attached to the Newton focus of the 0.41-m telescope at Observatorio de Mollet (Spain). GSC 0669.1279 was used as the comparison star, and GSC 0669.1167 and GSC 0669.1030 as check stars (Figure 1).

The result of this surveillance program proved that NSV 01651 is not an RR Lyrae star but an overcontact eclipsing binary star with a period close to 10 hours and 10 minutes. Figure 2 shows the obtained light curve in the V band. Light curve dispersion did not allow us to determine the exact shape and depth of the primary and secondary minima. Nevertheless we observed a systematic magnitude difference between both minima, resulting in an average variation range of 0.52 magnitudes for minimum I and 0.50 magnitudes for minimum II. We also derived the following ephemeris:

$$\text{Min. I} = \text{HJD}\,2450006.3486 + 0.42382 \times \text{E}$$
$$\pm 0.0001 \pm 0.00003$$

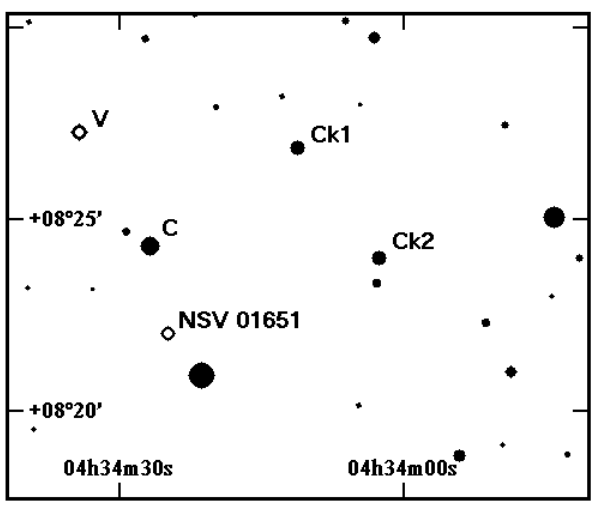

Figure 1. C = Comparison star, Ck1 and Ck2 = Check stars, V = GSC 0699.0468.

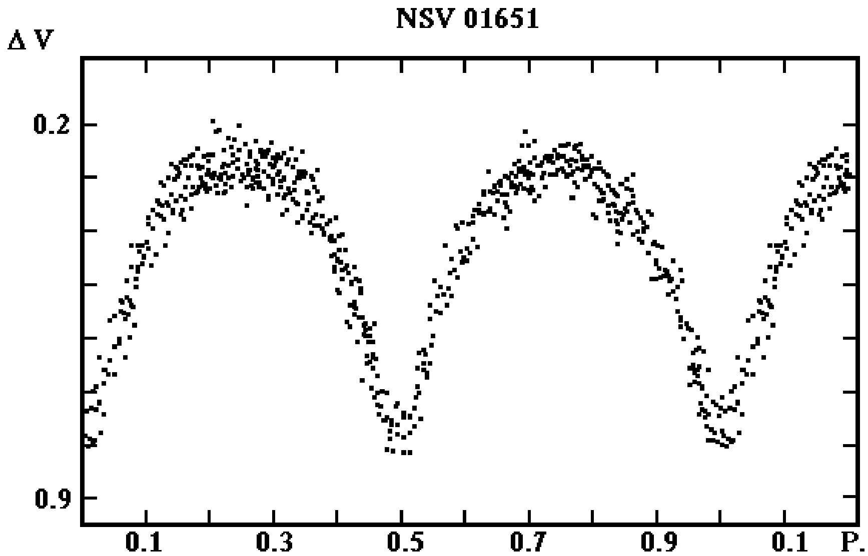

Figure 2

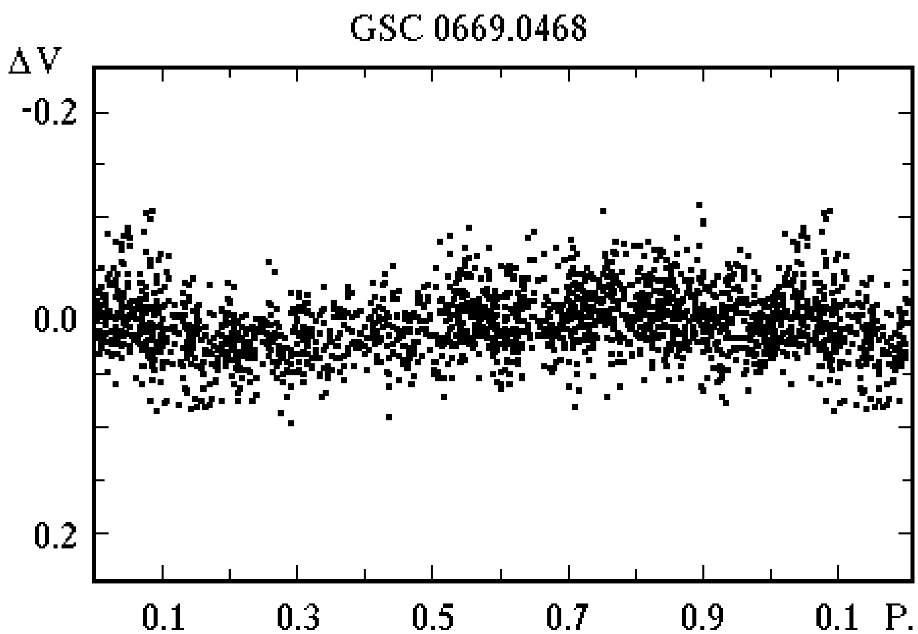

Figure 3

As part of the observing program of NSV 01651, we initially used another comparison star: GSC 0669.0468, a 12.7 yellow photographic magnitude star (PAL-V1 filter) according to the Guide Star Catalog, but when it was checked against C, Ck1 and Ck2 (see Figure 1), it became evident that this star did not present a constant light. Although almost 2,000 photometric measurements of GSC 0669.0468 were obtained, light curve dispersion did not allow us to determine the type of variability. The variation range is about 0.04 magnitudes and there is evidence for a period shorter than 2 days. In Figure 3 we represent the light curve folded on a period of 0.6195 days after performing a periodogram analysis between 0.0 and 1.0 days using Scargle's (1982) methods. It cannot be ruled out, however, that the true period is different from the value we utilized.

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

Number 4283

Konkoly Observatory
Budapest
2 January 1996

HU ISSN 0374 – 0676

THREE NEW VARIABLE PLANETARY NEBULA CENTRAL STARS: M 2-54, M 4-18 AND NGC 2392

We are presently engaged in a search for variable central stars of young planetary nebulae in order to shed more light on the cause of the variability of these stars. Previously, this has increased the number of known variables to 12 (Handler, 1995). In this note we report the discovery of three further related objects.

Our observations were carried out in August to December 1995 with the Texas two-channel photometer attached to the 0.9m and 2.1m telescopes at McDonald Observatory, respectively. We employed only channel 1 to acquire differential photometry. To prevent variable influence of the nebular background caused by variable seeing or poor guiding, we always included the whole nebula in the aperture.

We measured two comparison stars (C1 and C2) together with the the planetary nebula (PN) in the order: C1–PN–C2–C1–PN–C2–... The comparison stars, typically of 9–10 mag, were integrated for about 60 seconds, the planetary nebula about 120–240 seconds, depending on its magnitude. In order to minimize the nebular contribution to the data, Johnson V or Strömgren y filters were used.

All data were corrected for sky background and for extinction. No dead-time correction was applied. The relative zeropoints of the measurements of the different stars were calculated for the first night and subtracted from the data except for a small offset for plotting purposes. These relative zeropoints were applied for all other nights of observation. The resulting light curves were analysed for variability. To allow the reader to judge the quality of the data, we did not compensate for variations in sky transparency or for possible tube drifts.

M 2-54: All the observations of this object were acquired with the 0.9m telescope through a Johnson V filter. We first measured the star on August 30, 1995. The light curve (Figure 1, left panel) was not of very good quality. However, a drift in the magnitudes of M 2-54 was visible, leading us to suspect that the central star could be variable. Consequently, we obtained a second run on October 23, 1995 under much better photometric conditions. Fortunately, the star also co-operated and became fainter by almost 0.2 magnitudes in 6 hours (Figure 1, right panel).

Needless to say, we conclude that M 2-54 is variable. However, from the present data we cannot infer the timescale of the light modulations. More extensive observations, preferably from at least two sites, are necessary.

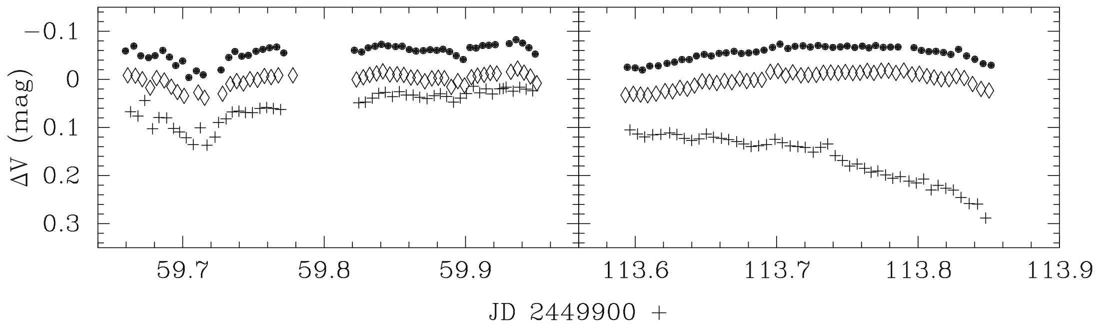

Figure 1: Light curves of M 2-54 (crosses) relative to the comparison stars SAO 34899 (dots) and SAO 34900 (diamonds)

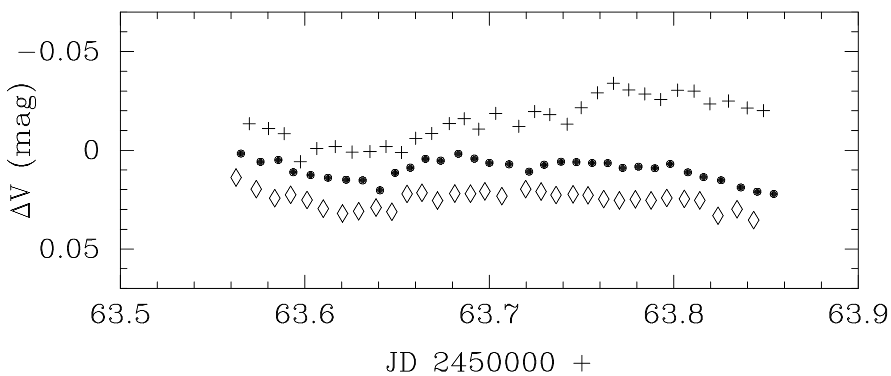

Figure 2: Time-series photometry of M 4-18 (crosses) relative to the comparison stars BD+60°806 (dots) and SAO 13101 (diamonds)

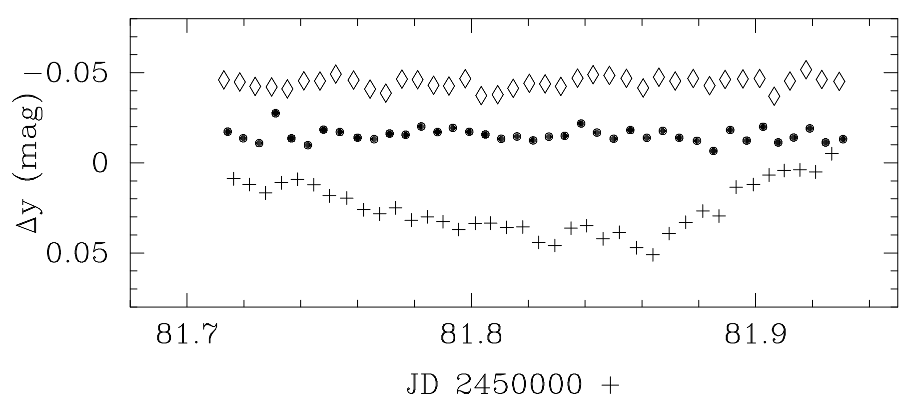

Figure 3: Light curve of NGC 2392 (crosses) relative to the comparison stars BD+21°1613 (dots) and SAO 79446 (diamonds)

We are careful to note that the gap in the August data was not caused by bad photometric conditions, but by a temporal failure of telescope tracking. The trend in the comparison star data taken in October is due to tube drift and is not caused by a wrong choice of the extinction coefficient.

M 4-18: We observed this object with the McDonald Observatory 2.1m telescope in the night of December 12, 1995 through a Johnson V filter (Figure 2). The central star brightened by about 0.03 mag during the 7 hours of observation. Thus, it is the lowest amplitude variable we discovered so far. Due to the good photometric conditions, under which the measurements were acquired, we consider the variability of M 4-18 to be well established.

Similarly to our conclusion for M 2-54, we recommend more observations of M 4-18 to unravel the timescale of its light modulations. However, due to the faintness of the star ($V \approx 13.9$), CCD observations or a large telescope are required.

NGC 2392: We measured this planetary nebula on December 30, 1995 with the 0.9m telescope. Since the object consists of both a bright central star (HD 59088) and a large nebula (the famous Eskimo Nebula), we acquired our data through the Strömgren y filter. The resulting light curve is shown in Figure 3.

The timescale of the light modulations seems to be near 4–5 hours. However, since the variability of this kind of central stars is not strictly periodic (e.g. Handler et al., 1996), that value can be in error. NGC 2392 would be an object very well suited for both spectroscopic and photometric multisite observations.

Acknowledgements: This research was partially supported by the Austrian Fonds zur Förderung der wissenschaftlichen Forschung under grant S-7309 and by the Austrian Zentrum für Auslandsstudien.

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

Number 4284

Konkoly Observatory
Budapest
4 January 1996

HU ISSN 0374 – 0676

THE PERIOD OF ECLIPSING BINARY DHK 40

Eclipses of the F8 type star SAO 46698 = BD +49°2630 were reported by Kaiser (1994), who gave it the designation DHK 40 in his discovery list. We have observed this variable during the past two seasons with photoelectric and CCD photometry. DHK utilized a 35-cm Schmidt-Cassegrain telescope, Optec SSP-5 photometer, and SBIG ST-6 CCD camera, and GL used a 28-cm Schmidt-Cassegrain and SBIG ST-6 CCD camera. A light curve compiled from DHK's photoelectric observations (Figure 1) shows variations of Beta Lyr type with a range of 9.41 - 9.87 V.

Table 1. Minima of DHK 40= SAO 46698

HJD 2400000+	Obs.	Min.	E	O−C
43759.582	H ptg	I	−11640.0	+0.002
43777.558	H ptg	I	−11606.0	−0.025
44512.510	H ptg	I	−10218.0	+0.012
44733.813	H ptg	I	− 9800.0	−0.007
45161.657	H ptg	I	− 8992.0	+0.018
46590.700	H ptg	I	− 6293.0	+0.001
46669.598	H ptg	I	− 6144.0	+0.005
46757.468	H ptg	I	− 5978.0	−0.018
46879.815	H ptg	I	− 5747.0	+0.019
47466.464	H ptg	I	− 4639.0	+0.006
49637.5821 ±.0009	K pep	II	− 538.5	−0.0011
49917.6769 ±.0001	K ccd	II	− 9.5	−0.0003
49922.7073 ±.0002	L ccd	I	0.0	+0.0001
49927.7383 ±.0006	L ccd	II	+ 9.5	+0.0011
49983.5979 ±.0002	K ccd	I	+ 115.0	+0.0007
50001.5979 ±0002	L ccd	I	+ 149.0	−0.0016

H = Harvard plate, K = Kaiser, L = Lubcke

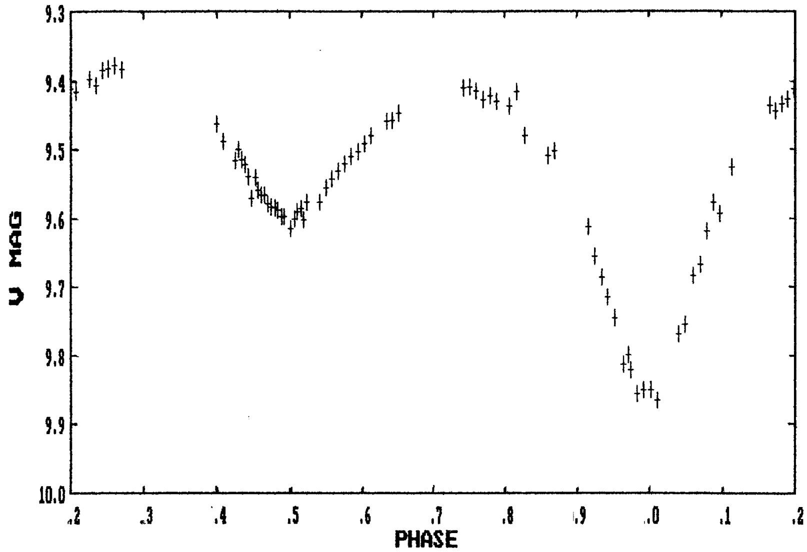

Figure 1. Photoelectric V observations of DHK 40 by Kaiser, 1994 season.

DBW examined 175 Harvard College Observatory patrol plates for the interval 1976-1989 to obtain additional times of minima. Table 1 lists 10 Harvard plate minima and 6 high-precision PEP/CCD minima. The PEP/CCD minima were reduced by the Kwee–Van Woerden method, and the internal error of each timing is listed. These times were introduced into a least-squares solution, with weight 1 for the photographic data and weight 10 for the PEP/CCD data, to derive the following light elements:

$$\text{Min. I} = \text{HJD}\,2\,449\,922.7072 + 0\overset{d}{.}52947826 \times E \qquad (1)$$
$$\pm 7 \qquad\qquad \pm 11$$

The light curve shows strong proximity effects, and Maximum I (Phase 0.25) is slightly brighter than Maximum II. DHK 40 appears to be a thermally decoupled binary of W UMa or "near contact" type. The reported spectral type is rather late for a binary with such unequal minima and needs to be confirmed. We are continuing observations to obtain a complete light curve for solution. We wish to thank Dr. Martha Hazen for the opportunity to examine the Harvard plates.

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Kaiser, D. H., 1994, *Inform. Bull. Var. Stars*, No. 4119

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

Number 4285

Konkoly Observatory
Budapest
4 January 1996

HU ISSN 0374 – 0676

OPTICAL MINIMUM OF V1057 Cyg IN 1995

V1057 Cyg is a member of the FU Orionis-type eruptive variables or Fuors (Herbig 1977, 1989; Hartmann et al., 1993). Since the time of its flare-up, V1057 Cyg has shown more dynamic large-scale photometric changes in comparison with other Fuors (e.g., Kolotilov 1990). In the course of ROTOR project carried out in Mt.Maidanak observatory a detailed study of the photometric behavior of V1057 Cyg was performed. The observations of the star were obtained using Mt.Maidanak 0.6-m Zeiss telescope with Johnson UBVR pulse counting photometer. A total of 1420 observations of the Fuor were recorded which cover 15 observing seasons between 1981 and 1995 and the log of observations is listed in Table 1. A small sample of the observations obtained at the same conditions in 14 nights 1978 is included in the Table as well. Table 1 is organized as follows. The season characteristics are given in first two columns. Averaged seasonal brightness and colors and their r.m.s. values are given in next four columns. In the last four columns, N_v, N_{ub}, N_{bv} and N_{vr} represent the corresponding number of the observations. Light curves of the Fuor in U, B, V and R bands plotted using the Maidanak observations are shown in Figure 1.

As one can see, in 1978-1990 the brightness of V1057 Cyg smoothly decreased from 10.89 to 11.59 mag in V. In 1991-1994 the Fuor showed zigzag-like light variations. The amplitude of these variations increased each year. At the same time colors changed in antiphase to brightness: higher brightness corresponded to redder colors and vice versa. Early 1995 observations showed that the star suddenly dimmed by 0.7 mag in B. The minimum brightness B = 14.58 was reached on 10 August 1995. The full amplitudes of the 1995 fading related to the 1994 average brightness of the star are 1, 0.8, 0.6 and 0.5 mags in U, B, V and R respectively. The optical minimum of V1057 Cyg in 1995 is very similar to the minimum of V1515 Cyg in 1980. In this case a considerable increase in the brightness of V1057 Cyg brightness may be expected in the nearest future. Spectral observations in wide region as well as infrared and polarimetric observations will be important in this minimum stage of the star.

I wish to acknowledge Dr. S.Yu. Melnikov for providing active help in observations. This work has been partially supported by ISF (MZA000) and ISO C&EE (A-02-048) grants.

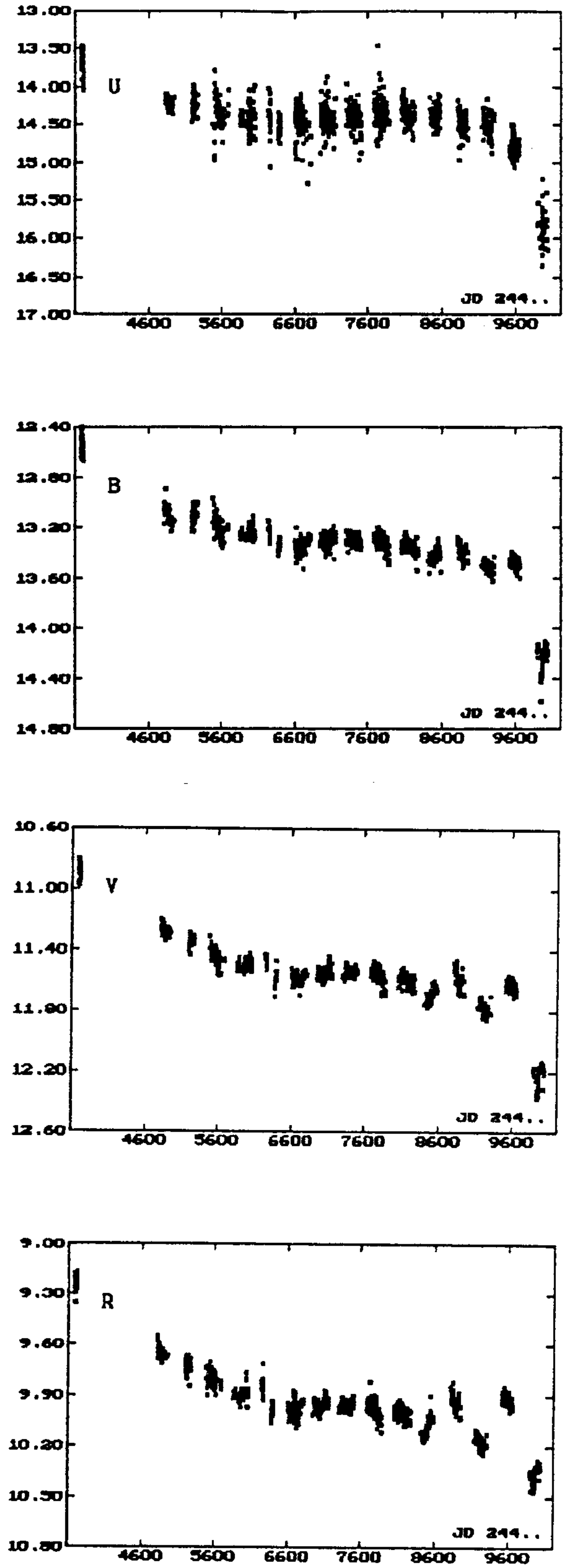

Figure 1. Light curve of V1057 Cyg in U, B, V and R bands during 1978 and 1981-1995.

Table 1. Maidanak monitoring of V1057 Cyg in 1978, 1981-1995

Year	JD	⟨V⟩	⟨U−B⟩	⟨B−V⟩	⟨V−R⟩	N_v	N_{ub}	N_{bv}	N_{vr}
	(2440000)	σ_v	σ_{ub}	σ_{bv}	σ_{vr}				
1978	3693-	$10\overset{m}{.}889$	$+1\overset{m}{.}171$	$+1\overset{m}{.}667$	$+1\overset{m}{.}666$	56	30	56	41
	3716	38	167	34	47				
1981	4812-	11.269	+1.117	+1.819	+1.622	78	41	76	77
	4942	31	052	42	18				
1982	5200-	11.354	+1.138	+1.753	+1.637	50	43	50	50
	5272	26	097	32	25				
1983	5489-	11.451	+1.169	+1.748	+1.645	76	71	75	74
	5696	47	162	38	35				
1984	5864-	11.508	+1.179	+1.745	+1.614	70	66	68	67
	6061	28	140	25	20				
1985	6241-	11.537	+1.179	+1.759	+1.610	38	37	38	38
	6402	71	180	39	39				
1986	6607-	11.592	+1.149	+1.748	+1.606	106	97	102	106
	6806	28	188	39	36				
1987	6955-	11.558	+1.102	+1.755	+1.594	107	101	107	107
	7152	36	153	34	17				
1988	7309-	11.546	+1.083	+1.762	+1.585	136	130	136	136
	7507	22	125	27	16				
1989	7683-	11.559	+1.030	+1.756	+1.587	139	100	138	137
	7887	42	173	31	19				
1990	8049-	11.589	+1.032	+1.756	+1.592	133	83	133	133
	8279	35	115	27	15				
1991	8419-	11.689	+0.987	+1.741	+1.600	100	50	100	94
	8586	42	121	30	22				
1992	8815-	11.588	+1.134	+1.804	+1.654	80	68	79	79
	8954	53	114	21	16				
1993	9141-	11.782	+0.993	+1.737	+1.613	109	81	109	109
	9310	32	113	24	13				
1994	9514-	11.628	+1.324	+1.852	+1.707	91	66	91	90
	9647	34	110	26	14				
1995	9882-	12.237	+1.595	+2.022	+1.869	51	36	51	51
	10022	72	239	43	33				

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4286

Konkoly Observatory
Budapest
4 January 1996

HU ISSN 0374 – 0676

STARSPOTS ON THE YOUNG SINGLE K0V STAR HD 82443

HD 82443 (Gl 354.1; K0V; V= $+7^{m}_{.}00$; B−V = +0.76) is a single, main-sequence K−star with very strong chromospheric and transition-region line emissions, most likely arising from strong magnetic activity (Soderblom, 1985). It is a high proper motion star with a relatively large parallax of $\pi = 0\rlap{.}''054$ (Gliese, 1969). High precision radial velocity measures carried out on the CORAVEL program (Duquennoy et al., 1991; Duquennoy & Mayor, 1991) show HD 82443 to have a constant radial velocity of Vr = +8.2 ± 0.24 km/s, indicating that HD 82443 is probably not a member of a close binary system. Independent radial velocity measures of the star obtained by Griffin (1994) yield a mean value of Vr = +8.9 ± 0.5 km/s and also show no indication of variability. The projected rotational velocity of the HD 82443 has been measured by Benz and Mayor (1991) as vsin i = 4.6 ±1.0 km/s; while Soderblom (1995) estimates a slightly larger value of vsini = 7.0 ± 2 km/s. As pointed out by Soderblom and Clements (1987), HD 82443 has U,V,W space velocity components (−14, −24, −1) (km/s) that are very close to those of the Pleiades star cluster (−9, −29, −12). This indicates that it is a probable member of the Pleiades moving group with an age of about 70 Myr. The implied young age of HD 82443 is consistent with the observed high levels of chromospheric, transition-region and coronal emissions. Activity-Period-Age relationships for cool stars indicate that HD 82443 should have a rotation period of a few days (Soderblom & Clements, 1987).

The photometric observations of HD 82443 reported here were obtained on 67 nights from 10 February through 21 May, 1989 using the Phoenix-10 automatic photoelectric telescope (APT), located on Mt. Hopkins, AZ. The Phoenix-10 APT is a 25-cm reflecting telescope which is completely computer controlled (see Boyd & Genet, 1986). The photometer is equipped with standard U, B, V filters and the observations were made using HD 82191 (A0 V; V=+6.58; B−V= +0.08) as the comparison star while HD 81146 (K5 III; V= +4.46; B−V= +1.22) served as the check star. Ten second integrations were used and the usual observing sequence of sky-comparison-check-variable-comparison- sky was employed. The observations were corrected for atmospheric extinction and the instrumental differential magnitudes were converted to the standard UBV system. Because of the close angular separations between the comparison and the variable and check stars, the atmospheric corrections were very small. No significant light variations were detected from the differential measures of the comparison and check stars, indicating that the comparison star is constant in light to within about ± 0.015mag.

To determine the photometric period, the data in each filter were analyzed using a Scargle-Press period search routine (Scargle, 1982). These period searches revealed a period of P = 5.400 ± 0.012 days. The observations from the first two months (February-March) are plotted against phase in Figure 1 using this period; the phases are reckoned from the first observed light minimum at HJD 2447573.78. The observations were split

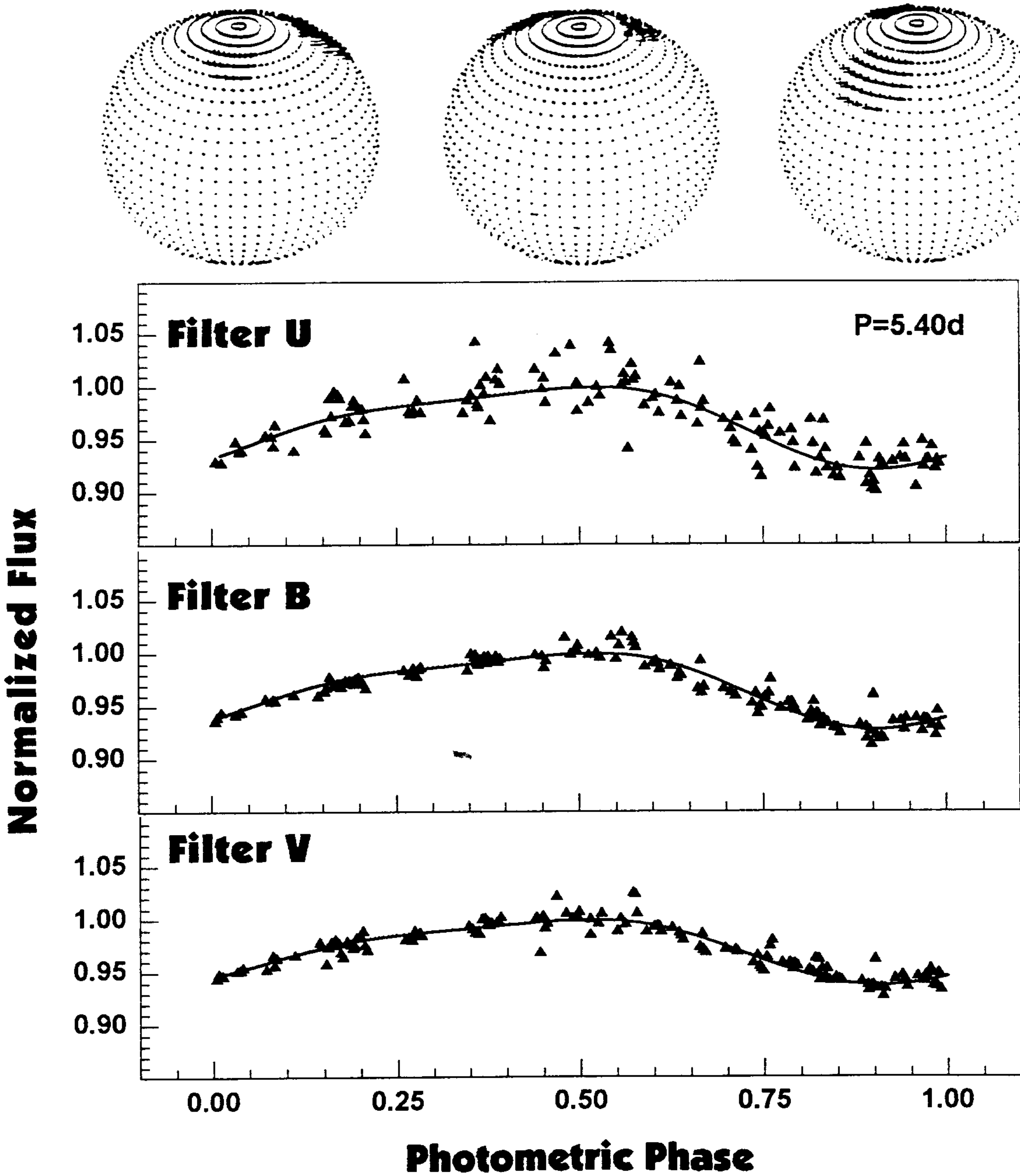

Figure 1. The normalized fluxes from UBV photometry of HD 82443 are plotted versus photometric phase. These observations cover the interval from 10 February through 31 March 1989. The phases were computed with the photometric period of 5.40d. The best fitting spot model curves (see Table 1) are shown among the observations and the corresponding 3-dimensional representation of the spot configuration on the star's surface is depicted at three different phases: 0.25P, 0.50P and 0.75P.

Table 1

HD 82443 Spot parameters:					
Rotational period = 5.40d					
Effective temperature = 5370K					
Inclination = 60°					
Limb Darkening					
0.68 (λ = 5500Å) – 0.81 (λ = 4500Å) – 0.83 (λ = 3700Å)					
02.10.1989 – 03.31.1989					
Spot	Longitude	Colatitude	Radius	Area	Temperature
1	80°	25°	10°	5.6%	4300±100K
2	320°	38°	17°	9.5%	4300±100K
Total spotted surface = 15.1%					
04.02.1989 – 05.21.1989					
Spot	Longitude	Colatitude	Radius	Area	Temperature
1	80°	25°	10°	5.6%	4300±100K
2	332°	38°	16°	8.9%	4300±100K
Total spotted surface = 14.5%					

into two time intervals because the light curve slowly changed with time. As shown in the figure, the light variations are quasi-sinusoidal and show a wavelength dependence; the light amplitudes in the UBV bandpasses are: $0^m.11$, $0^m.09$, and $0^m.09$, respectively. The theoretical spot model fits are also shown in Figure 1 along with the 3-dimensional representations of the star with starspots depicted at three different rotational phases. The periodic 5.400 day light variation is interpreted to arise from the presence of starspots, unevenly distributed over the surface of the chromospherically-active K-dwarf. The photometric period is assumed to be the star's rotational period.

We analyzed the light curves on the assumption that the light variations arise from dark starspots. The light curves were modelled using Binary Maker V 2.0 (Bradstreet, 1994) in which the second component is essentially "turned off" (i.e. assigned a near zero mass and luminosity) in order to model a single rotating star. Circular, cool spots of uniform temperature were assumed and the light curves were fit by manual iteration. For the modelling we adopted a temperature of T_{eff}= 5370K for the unspotted photosphere of the star, inferred from its B−V index and K0 V spectral type (see Novotny, 1973); the limb-darkening coefficients of Al-Naimy (1978) were also adopted. The inclination of the star's rotational axis (relative to our line of sight) was assumed to be 60°. This value was obtained from the measured rotation period, assuming a mean vsini = 6 km/s and adopting a stellar radius of R $\simeq$ 0.80 $R_{\odot}$, appropriate for its spectral type. After a number of iterations, we were able to obtain satisfactory fits to the U, B, V light curves. The best fits to the February-March observations are shown in Figure 1 along with the geometric model of the star with starspots. Because of the asymmetries in the light curves, it was necessary to model them with two dark (cool) spots, separated in longitude by 120° for the February-March 1989 data; the best fit to the April-May observations was achieved by adopting a longitudinal separation of 132°. The temperatures of the starspots were found to be about 1100K cooler than the photospheric temperature. The two spots were located within 40° of the rotational pole and the total spotted area was about 15%. Table 1 gives a summary of the modelling results for both data sets along with the input parameters used in the analysis. The values given for the spot properties are not unique, however, but should be considered as representative of spot areas, distributions and temperatures.

Additional photoelectric photometry of HD 82443 has been obtained in subsequent years. These observations indicate systematic year-to-year changes in the light amplitude and mean light level, possibly arising from a starspot cycle. We plan to present these results in the future in a more detailed paper.

This research was partially supported under NSF grant 86-16362 and Catania University fellowship which we gratefully acknowledge.

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

Number 4287

Konkoly Observatory
Budapest
12 January 1996

HU ISSN 0374 – 0676

NSV 10183 IS A NEW CEPHEID VARIABLE STAR

NSV 10183 (S 9291; GSC 1008.1699, $\alpha = 18^h05^m28^s.95$, $\delta = +7°54'21''.1$, Epoch 2000) was discovered by Hoffmeister (1966) and classified by him as a possible eclipsing variable with a short period and an amplitude of about 0.5 mag in the photographic band.

The star was estimated by one of us (SVA) on 241 plates taken from JD 2442812 to 8832 with the 40 cm astrograph in Crimea. Each plate was estimated twice. The finding chart is presented in Figure 1, and magnitudes of the comparison stars are given in Table 1.

Our data show that NSV 10183 is a Cepheid variable with light elements:

$$\text{Max JD hel} = \underset{\pm .52}{2444942.37} + \underset{\pm .0051}{13.6299} \times E.$$

The variability range is 12.4–13.2 pg. The study of the $O - C$ residuals (Table 2 and Figure 2), obtained with our version of Hertzsprung's method (Berdnikov, 1992), clearly shows variations in the period. The final light curve (Figure 3) was plotted taking into account seasonal shifts derived from the $O - C$ curve; thus it is corrected for period changes.

As to classification of this variable, the distinct bump on the ascending branch of the light curve shows that it may be a classical Cepheid, but, because of the rather flat curve in maxima, it may be a W Vir type star. It is necessary to obtain a photoelectric light curve for certain classification.

Table 1

Comparison Star	*Mag pg*
a	11.86
b	12.48
c	12.93
d	13.45

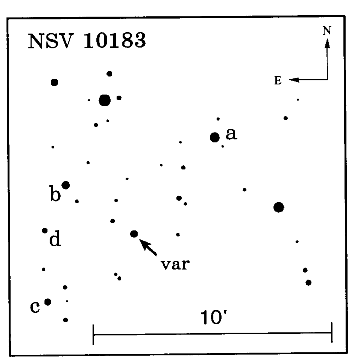

Figure 1

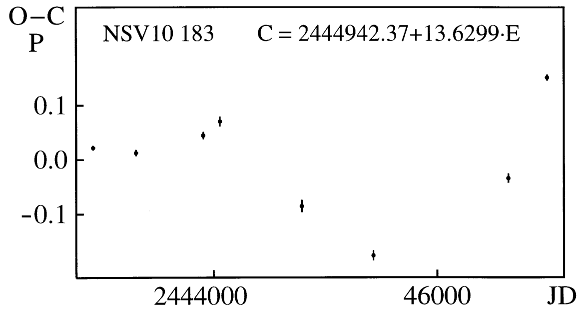

Figure 2

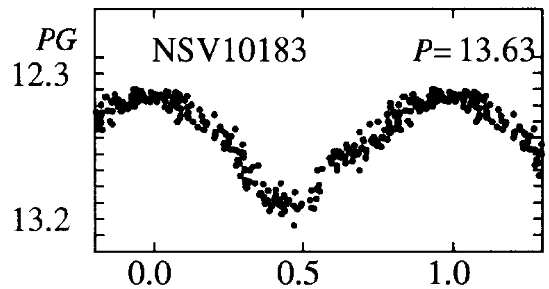

Figure 3

Table 2

Max JD hel 2400000+	Error	E	O−C	Number of observations
42925.44	.05	−148	.31	76
43306.95	.08	−120	.18	60
43907.10	.08	−76	.61	27
44057.37	.12	−65	.96	24
44791.27	.15	−11	−1.17	10
45430.64	.12	36	−2.41	13
46632.00	.11	124	−.48	15
46975.27	.07	149	2.04	16

This work was partially supported by the Russian Foundation for Basic Research through grant No. 95-02-05189 to one of us (SVA).

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

Number 4288

Konkoly Observatory
Budapest
16 January 1996

HU ISSN 0374 – 0676

UPDATE ON THE ECLIPSING BINARY V514 Per

The eclipsing binary V514 Per was originally identified by Prosser (1993), who provides a finding chart for the system. V514 Per is located at RA = $3^h16^m4^s\!.6$, DEC = $49°56'3''$ and has magnitude approximately V≃11.4. The observations by Prosser (1993) suggested a relatively short period of 21.6 hrs for the system. In order to check the reality of this solution, intensive monitoring of the system was undertaken over a seven night period in early October 1995. The CCD photometry was obtained with the Whipple Observatory 48inch telescope on Mt. Hopkins, Arizona. Relative photometry was obtained using the same set of comparison stars as in Prosser (1993). Approximately 140 observations were obtained and are available upon request.

Working with this larger dataset of observations, a new period of P ≃ 1.8 days has been found using estimates of the times of primary and secondary minima; essentially double the initial period reported in Prosser (1993). The corresponding light curve is shown in Figure 1, phased at primary minimum that occurred at JD ≃ 2449996.7.

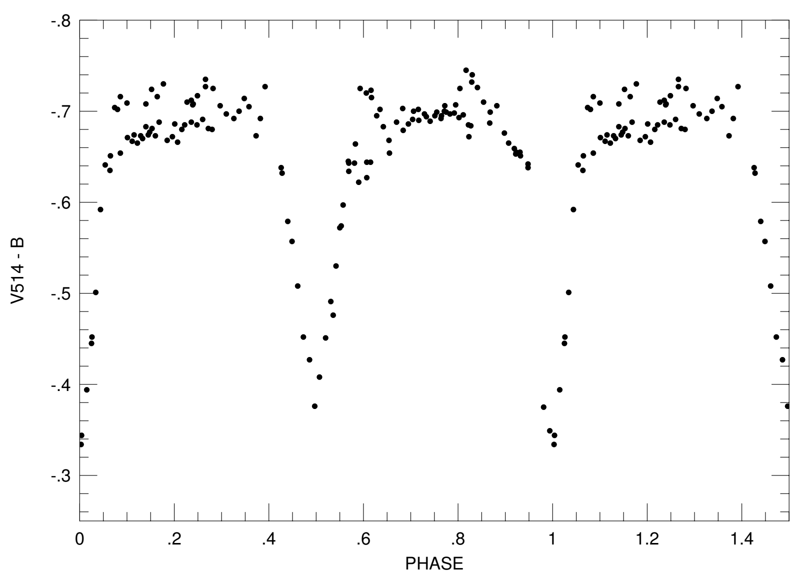

Figure 1

The available observations indicate that the primary and secondary eclipses are very similar, with primary eclipse being only ~ 0.04 mag fainter than that for secondary eclipse. This longer period concurs with information from Popper (1994), in which echelle spectral observations indicated that the system contained approximately equal components having a period double that initially reported in Prosser (1993). Popper notes that the spectral type in this near equal mass system is roughly F5 and that the interstellar (or circumstellar) Na D lines are unusually strong and broader than usual for interstellar lines.

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

Number 4289

Konkoly Observatory
Budapest
17 January 1996

HU ISSN 0374 – 0676

HD 116475: A NEW LATE-TYPE VARIABLE IN CANES VENATICI

HD 116475 (SAO 44590, BD +47°2053) is a poorly observed sixth magnitude star of spectral type M4 III. The main interest in the star has been as a comparison for visual observations of nearby variables. It appears as star 69 on the BAA chart for Y, TU and V CVn (1984 Apr 12) and has been suspected of variability for a number of years by several observers but no coherent behaviour has emerged (West, 1996). It is also an IRAS source, 13209+4715, and the infrared spectra suggest that it is a first red-giant branch star (Volk et al., 1991).

HD 116475 has been observed photoelectrically over the past two years as part of a programme to monitor known and suspected red variables. The observations were made using an SSP3 photometer and nominal V filter on a 20-cm Newtonian reflector. The comparison stars used were HD 116172 (V = 7.0, $B-V$ = 1.1, K0) and HD 116957 (V = 5.88, $B-V$ = 0.97, K0 III). Each observation consisted of usually 2, but up to 8 sets of 3 $\times$ 10 second integrations of the variable and HD 116172, while HD 116957 was observed about half as frequently. The mean Δm between the two comparison stars is 1.09 with σ = 0.02 mag, giving V = 6.97 for HD 116172. Further details of the procedures are given by West (1996).

The magnitude of HD 116475 relative to HD 116172 is given in Table 1 and the light curve is plotted in Figure 1.

Table 1. Relative V mag HD 116475 – HD 116172

JD	ΔV	JD	ΔV	JD	ΔV	JD	ΔV
2449482	–0.24	2449783	–0.21	2449818	–0.20	2449904	–0.13
2449503	–0.12	2449785	–0.21	2449821	–0.19	2449906	–0.13
2449531	–0.50	2449789	–0.21	2449827	–0.15	2449913	–0.08
2449538	–0.53	2449792	–0.16	2449828	–0.15	2449918	–0.08
2449545	–0.48	2449796	–0.19	2449840	–0.09	2449927	–0.06
2449582	–0.32	2449797	–0.20	2449842	–0.07	2449934	–0.05
2449588	–0.34	2449799	–0.19	2449857	–0.05	2449939	–0.03
2449593	–0.34	2449800	–0.24	2449861	–0.04	2449951	–0.07
2449630	–0.25	2449802	–0.25	2449869	–0.08	2449964	–0.31
2449634	–0.27	2449804	–0.23	2449887	–0.14	2449980	–0.29
2449770	–0.22	2449806	–0.25	2449890	–0.13	2449984	–0.22
2449775	–0.25	2449812	–0.28	2449894	–0.13	2449989	–0.19
2449778	–0.23	2449814	–0.24	2449897	–0.13	2450001	–0.19
2449782	–0.22	2449815	–0.24	2449898	–0.14	2450021	–0.24

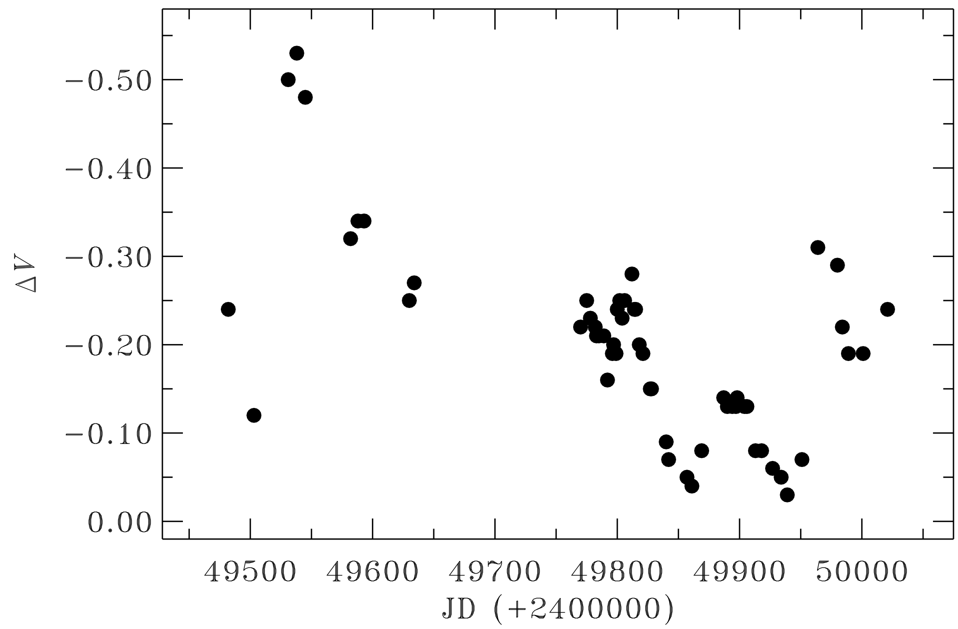

Figure 1. Light curve of HD 116475 relative to HD 116172.

During the first season the star brightened rapidly and faded progressively by ∼ 0.4 mag but was only sparsely observed. Coverage in the second season was much better but the activity was not as high. Nevertheless the behaviour of the star is much more clearly defined. The characteristic time scale of the variation seems to lie in the 50 – 100 day range; the best period is ∼ 87 days, but the amplitude is clearly variable and there may be long term trends superimposed. There is also some indication of coherent shorter-term activity around JD 2449800 and on two occasions the variations are quite rapid, ∼ 0.2 mag in 10 days.

On the basis of the spectral type, the time scale and general character of the variation the star should most likely be classified as an SRb. It is probably a rather extreme example of the small amplitude variables that are found among the red giants and shares some similarities with BQ Gem (Percy et al., 1994). Its brightness and level of activity make it an ideal candidate for studying the behaviour of these stars but good coverage will be required to follow the variation.

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

Number 4290

Konkoly Observatory
Budapest
19 January 1996

HU ISSN 0374 – 0676

PHOTOELECTRIC OBSERVATIONS AND NEW CLASSIFICATION OF V4061 Sgr

V4061 Sgr was included in our program of photoelectric observations of Cepheids because it was listed in GCVS–IV as a possible Cepheid variable with light elements:

$$\text{Max JD}_{hel} = 2441842 + 92.2 \times \text{E}.$$

Our photoelectric $BV(RI)_c$ measurements were carried out at CTIO, Las Campanas, and Mt. Maidanak observatories from 1991 to 1995. Everywhere 60–cm reflectors were used, and 109 observations were obtained. Most of these observations have already been published (Berdnikov, 1992; Berdnikov and Vozyakova, 1995; Berdnikov and Turner, 1995a,b; Berdnikov, Vozyakova and Ignatova, 1996), and the rest is listed in Table 1, where the accuracy of the individual data is near 0.02 mag in all filters.

Table 1

JD hel 2400000+	V	$B-V$	$(V-R)_c$
48854.2256	11.380	1.729	0.944
48856.2081	11.438	1.645	0.958
48858.2059	11.433	1.654	0.941
48860.1985	11.441	1.685	0.903
48870.1877	11.409	1.666	0.915
48874.1417	11.314	1.795	0.852
48876.1505	11.390	1.680	0.892
48877.1457	11.465	1.667	0.963
48878.1704	11.381	1.726	0.924
48880.1404	11.391	1.697	0.918
48881.1362	11.395	1.666	0.932
48882.1459	11.453	1.633	0.956
48883.1455	11.404	1.632	0.935
48884.1446	11.492	1.651	0.919
48885.1439	11.371	1.639	0.944
48886.1443	11.419	1.647	0.926
48888.1451	11.382	1.688	0.901
48889.1634	11.496	1.619	0.910
48890.1358	11.439	1.632	0.974
48891.1356	11.366	1.640	0.900
48892.1360	11.445	1.701	0.883
48893.1332	11.375	1.691	0.879
48894.1433	11.427	1.631	0.899

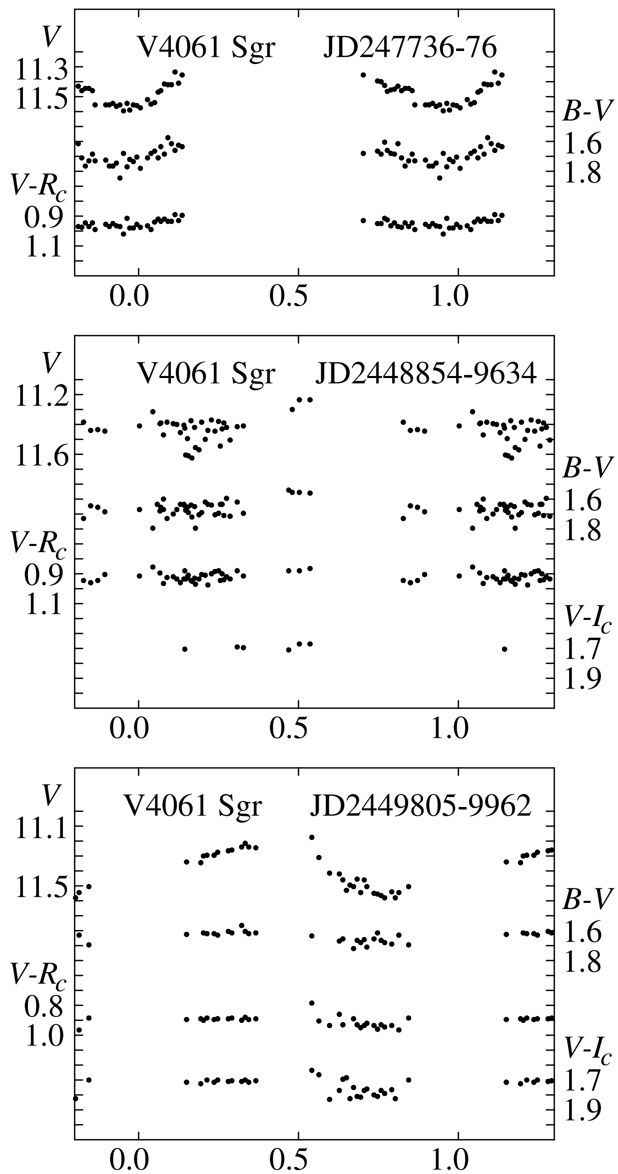

Figure 1

Moreover, the star was estimated by one of us (ENP) on 278 plates taken from JD 2441132 to 2448540 with the 40 cm astrograph in Crimea.

Both photoelectric and photographic light curves, constructed with the above elements, are shown in Figures 1 and 2 correspondingly. These Figures clearly show variations of the light curve shape. Therefore V4061 Sgr cannot be a Cepheid variable star. Most likely, it is a semiregular variable or an RV Tau type star. It is necessary to obtain more observations for certain classification.

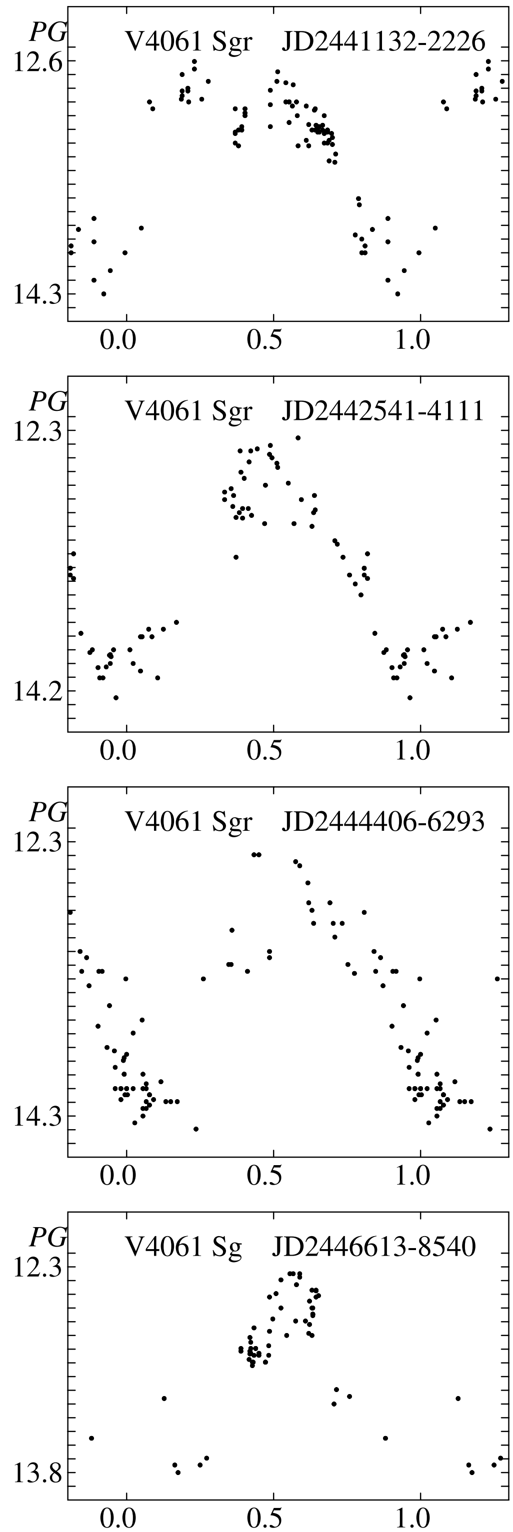
PG
V4061 Sgr JD2441132-2226
12.6
14.3
0.0
0.5
1.0
PG
V4061 Sgr JD2442541-4111
12.3
14.2
0.0
0.5
1.0
PG
V4061 Sgr JD2444406-6293
12.3
14.3
0.0
0.5
1.0
PG
V4061 Sg JD2446613-8540
12.3
13.8
0.0
0.5
1.0

Figure 2

The research described in this publication was made possible in part by grants No. 95–02–05276 and 95–02–05189 from the Russian Foundation for Basic Research and No. 3–182 from the Federal program “Astronomy”.

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

Number 4291

Konkoly Observatory
Budapest
22 January 1996

HU ISSN 0374 – 0676

SPECTRAL CLASSIFICATIONS FOR FIFTEEN RED VARIABLES

A search through our files has revealed unpublished spectral classifications for the variables listed in Table 1; none have spectral data in the GCVS or NSV. The types were determined many years ago from low-dispersion visual-region objective-prism spectra, but were not published at the time because of a suspicion–almost certainly unfounded–that the objects showed non-hydrogen-line emissions. Bright H_α is not seen in any of our plates of these stars, but hydrogen emission in the blue has been reported for V867 Aql by Smak and Preston (1965).

Table 1

Name	Spectral Type	Remarks
V867 Aql	M7e	
V1210 Aql	M5	
V1282 Aql	M5	
V1354 Aql	M5	
V1384 Aql	M4	NSV 12334
V1397 Aql	M3	NSV 12497
EV Mon	M8	
V531 Mon	M5	
YZ Oph	M5	
AQ Oph	M6	
V786 Oph	M6	
V2074 Oph	M4	
V602 Sco	M	
V371 Sct	M5	
NSV 3647	M4	

In passing, a comment concerning the GCVS spectral types taken from Table 1 of Nassau, Stephenson, and Caprioli (1964) is in order. Most of these stars are designated as of luminosity class III in the GCVS, though not in the original table. The origin of this is no doubt the statement in the paper that "the spectra of all of the M stars resemble giants on our blue plates." Although this is certainly true, it is also quite clear that a truly meaningful luminosity class cannot be assigned to these stars from the objective-prism material utilized in that paper, and the use of the Roman III symbol may give an unwarranted impression of the accuracy of the implied absolute magnitude. It is recommended that the luminosity indicator be deleted for these objects in future editions of the GCVS. It should be emphasized, however, that the above recommendation does *not apply* to the vast majority of GCVS spectral types for red stars determined from higher-quality spectroscopic material.

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

Number 4292

Konkoly Observatory
Budapest
31 January 1996

HU ISSN 0374 – 0676

CCD PHOTOMETRY OF THE ECLIPSING BINARY HP AURIGAE

The detached eclipsing binary HP Aurigae (HDE 280 603 = GSC 2401.1263 = BV 185; $\alpha_{2000} = 5^{\rm h}10^{\rm m}21\overset{\rm s}{.}8$, $\delta_{2000} = +35°47'47''$, Sp. G0 + G8, $V_{max} = 10.9$ mag) is a relatively well-known binary with a short orbital period of about 1.42 days. This binary was selected as a possible system for the study of the apsidal motion (Giménez, 1994) and thus it was also included in our observational project of eclipsing binaries with eccentric orbit (e.g. Wolf & Šarounová, 1995).

HP Aur was discovered to be a variable star by Strohmeier (1958), who obtained also the first photographic light curve and determined an orbital period of 1.422818 days. The first UBV photoelectric observations were made by Meinunger (1980), who found that its orbital period is 1.4228132 days and its secondary minimum is shifted to phase 0.502. These B and V lightcurves were later analyzed using Wood's (1972) model by Giuricin et al. (1983). The next UBV photoelectric photometry was obtained by Liu et al. (1989). They derived a photometric solution using the Wilson–Devinney method and discussed also the quasi-periodic transient variability of brightness. Analysing light fluctuations, they concluded that HP Aur has a transient disk in its system. Recently multi-colour $WBVR$ photoelectric observations were carried out by Kozyreva (1990). Using the light-curve solution in two different epochs with difference $\Delta T \approx 7$ years, she derived the rate of apsidal motion $\dot{\omega} = 0.93$ deg yr^{-1}, which was almost three times smaller than predicted theoretically.

Our new CCD photometry of HP Aur was carried out during four nights in October 1995 and January 1996 simultaneously at the Ondřejov Observatory, Czech Republic and R. Szafraniec Observatory, Metzerlen, Switzerland. At Ondřejov Observatory a 65cm reflecting telescope with a CCD-camera SBIG ST-6 was used. The measurements were done using the standard Johnson R filter with 60 or 90 s exposure time. At R. Szafraniec Observatory a 35cm Cassegrain telescope with the same type of CCD camera without filter was used. The nearby stars GSC 2401.1128 ($V = 11.7$ mag) and GSC 2401.268 ($V = 11.1$ mag) on the same frame as HP Aur served as comparison and check stars, respectively. The CCD data were reduced using software developed at Ondřejov Observatory by P. Pravec and M. Velen (Pravec et al., 1994). The precise times of minimum and their error were determined using the Kwee–van Woerden (1956) method. These new times are presented in Table 1. In this table, N stands for the number of observations used in the calculation of the minimum time. The measurements of primary and secondary minimum published by Kozyreva (1990) were recalculated according to her original data and are also given in Table 1. The epochs were calculated using the linear light elements given by same author:

$$\text{Pri. Min.} = \text{HJD}\,24\,46353.2351 + 1.4228192 \times \text{E}.$$

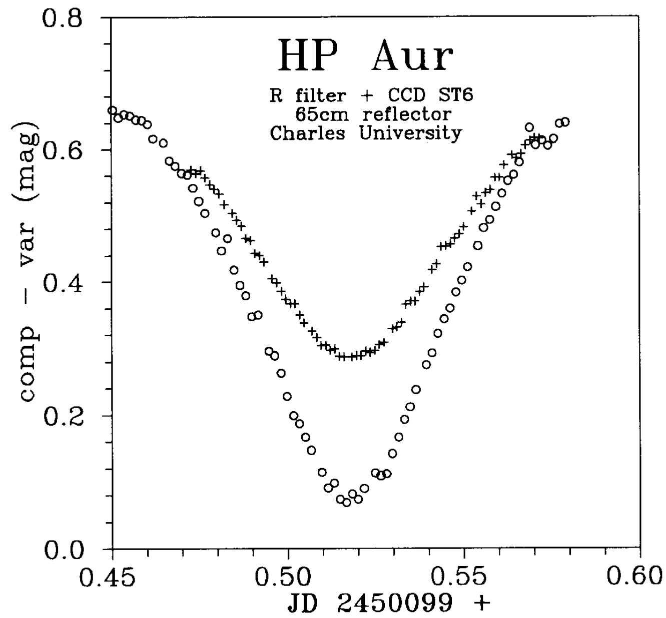

Figure 1. A plot of differential R magnitudes obtained during primary eclipse of HP Aur on 16 January 1996 (circles). The measurements of secondary minimum obtained on 19 October 1995 were shifted in time by +62.5 periods and are plotted as crosses together with primary minimum.

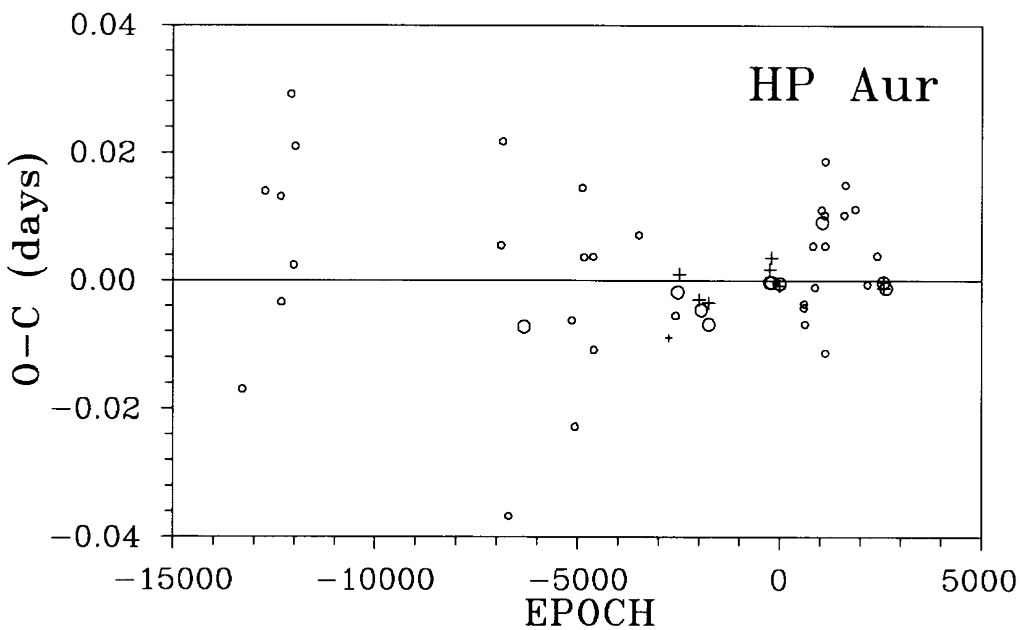

Figure 2. $O-C$ residuals for the times of minimum of HP Aur. The individual primary and secondary minima are denoted by circles and crosses, respectively. Larger symbols correspond to the photoelectric or CCD measurements and two precise photographic data.

Table 1. New precise times of minimum of HP Aur

JD Hel.– 24 00000	Epoch	Error (days)	N	Observatory
46353.2355*	0.0	0.0004	31	Tien-Shan
46355.3694*	1.5	0.0003	64	Tien-Shan
50008.4580	2569.0	0.0002	46	Metzerlen
50010.5913	2570.5	0.0001	71	Ondřejov
50013.4379	2572.5	0.0004	69	Metzerlen
50099.5175	2633.0	0.0001	72	Ondřejov

* *recalculated original data of Kozyreva (1990)*

Figure 1 shows the differential R magnitudes during the primary minimum observed at JD 2450099 (circles). Our measurements of secondary minimum (crosses) were shifted exactly by 62.5 periods (+ 88.9262 d) and are also plotted to the same date. The light amplitude in R colour for primary minimum according to our measurement is $A_1 = 0.60 \pm 0.02$ mag, for secondary minimum we found $A_2 = 0.38 \pm 0.02$ mag. The duration of both minima seems to be almost identical, $D_1 \simeq D_2 \simeq 0.13$ days = 0.092 phase.

The change of period and possible apsidal motion of HP Aur were studied by means of an O–C diagram analysis. We took into consideration all photoelectric measurements found in the literature as well as the photographic times of minimum obtained by Splittgerber (1971) and Frank (1994). The $O - C$ residuals for all times of minimum are shown in Figure 2. The photographic times or visual estimations obtained by Perova (1960), Mallama et al. (1977) 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 significantly eccentric orbit. According to our timings, the secondary minimum occurs in 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. Nevertheless, the remarkable deviation of the $O - C$ values in Meinunger's (1980) results ($E \approx -2000$) could be caused by a light-time effect. Such phenomenon with an orbital period of a third body about 7300 day (20 years) and an amplitude about 0.01 days cannot be ruled out.

For the current use we propose the following linear light elements:

$$\text{Pri.Min.} = \text{HJD } 24\,46353.2360 + 1.4228191 \times \text{E}.$$
$$\pm 5 \qquad\qquad \pm 7$$

Acknowledgement. This work has been supported in part by the Grant Agency of the Czech Republic, grant No. 205-95-1498 and by the ESO C&EE Programme, grant No. A-02-069. One of us (MW) is very grateful for the use of the facilities and the hospitality at the Astronomical Institute of University Basel during the stay in October 1995. We gratefully acknowledge the assistance of Dr. Roger Diethelm in providing our CCD observations. This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France.

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

Number 4293

Konkoly Observatory
Budapest
31 January 1996

HU ISSN 0374 – 0676

CONFIRMATION OF THE PERIOD OF GW Cep FOUND BY HOUGH TRANSFORM

In two previous papers (Ragazzoni & Barbieri 1993, 1994, RB94), we have shown how the application of the Hough Transform HT (Hough 1962, Ballester 1991, Leavers 1992) can help to detect cycle–numbering errors in sparsely observed time series, leading to incorrect values of the periods and to spuriously high time derivatives. Whilst the correct value of the period is *per se* not of utmost physical importance, a spurious time derivative can led to incorrect conclusions about for instance the mass loss rate or the geometrical variations of the system. As an example, we applied those considerations to the eclipsing binary GW Cep, showing that an error of one cycle every ≈ 16600 could have lead to a wrong period, the commonly accepted one being 0.31885 days, and the most likely one given by the HT, and that at the same time minimizes the time derivative, being 0.31883 days. In the present paper, using the new observations, we reinforce those conclusions and add further weight to the value of the HT to handle this class of problems. The recent determination by Agerer and Hübscher (1995, AH95) of the time of an eclipse provides the opportunity to verify our prediction. The data by AH95 were taken at $(JD - 2400000) = 49592.545$ whilst the latest available ones by Landolt (1992, L92) were at $(JD - 2400000) = 48544.871$; using the commonly accepted period of 0.31885 days, the number of cycles between the two dates is estimated as:

$$\left[\frac{49592.545 - 48544.871}{0.3188}\right] = [3286.305] = 3286 \tag{1}$$

where $[x]$ is the nearest integer of x, and the expected time difference between the observed and the calculated minimum (in the present case, a delay) after one cycle is lost is therefore approximately given by:

$$\frac{3286}{16600} \times 0.3188 = 0.0631\,\mathrm{days} = 1.51\,\mathrm{hours} \tag{2}$$

Notice that the delays in the observations are of this order, being 0.048 days at the date of L92, and of 0.054 at the date of AH95, thus reinforcing our determination.

As a further check, we report in Table 1 the O−C for the *General Catalogue of Variable Stars* GCVS, Hoffman 1992 (H92), L92 and RB94. Whilst they show an erratic behaviour in the three first papers, they are consistent with the constant $dP/dt = -2.327 \times 10^{-10}$ as given in RB94 (see Figure 1).

Finally the sum of their squares is one order of magnitude smaller in RB94. We conclude therefore that the application of HT can be very beneficial to the proper analysis of sparsely sampled light curves, helping to put the physics of the phenomena on sounder grounds.

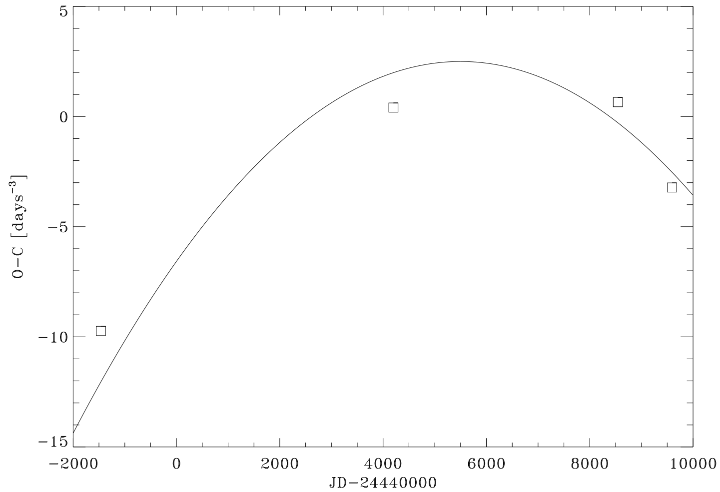

Figure 1. The $O-C$ for the grouped data available in the literature fitted by the 1^{st} order ephemeris given in RB94. The 2^{nd} order given in RB94 is here shown as a fitting parabola.

Table 1. O−C residuals for four different ephemerides of GW Cep, without any second order term.

	GCVS	H82	L92	RB94
Epoch (JD−2 400 000)	38383.711	38651.545	38651.5445	38651.550
Period [days]	0.31885	0.31884945	0.318851065	0.31883082
$< O-C >_{MW65}$ [days]	0.0022	0.0019	0.0030	−0.0097
$O-C_{H82}$ [days]	−0.0095	0.0000	−0.0276	0.0004
$O-C_{L92}$ [days]	0.0483	0.0653	0.0156	0.0007
$O-C_{AH95}$ [days]	−0.0186	0.0002	−0.0547	−0.0032
$\sum(O-C)^2$ [days$^2 \times 10^{-6}$]	2771	4263	4011	105.7

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

Number 4294

Konkoly Observatory
Budapest
7 February 1996

HU ISSN 0374 – 0676

PHOTOMETRY OF THE ACTIVE STAR UZ LIBRAE

We present new UBV photometry for the RS CVn binary UZ Librae (BD $-08°3999$, $V = 9.3$ mag). This star is one of the most active binary systems of the RS CVn class. In the past UZ Librae showed photometric variations with an amplitude of up to 0.35 mag in V. Evans & Bopp (1974) suggested that UZ Lib was most probable a spotted flare star. Further photometry of UZ Librae was presented by Heckert & Hickman (1991) from 1988, 1989 and by Heckert (1992, 1993) from 1990 to 1992. Its photospheric line-profile variability was first detected by Bopp et al. (1984) confirming that the stellar surface is indeed covered by large starspots. Grewing et al. (1989) discovered the – optically unseen – companion star in the ultraviolet spectrum ($T_{\rm eff} \approx 8000$ K and $R \approx 1R_\odot$). They also concluded that the binary-system properties fit well the evolutionary scenario of a coalescing binary with almost bound rotation. Table 1 summarizes the stellar parameters for UZ Librae from the papers by Grewing et al. (1989) and Strassmeier (1996).

Parameter	Adopted
Spectral type	K0III
$\log g$	2.5
$T_{\rm eff}$	4800 K
$v \sin i$	67 km s^{-1}
Inclination i	30°
Rotation period	4.73574 days
Orbital period	4.76864 days

Our new observations were made with the 50cm ESO-telescope at ESO, La Silla (observer E. Paunzen) in the nights between July 22nd and July 30th, 1994. We chose BD $-07°4044$ as the comparison star and BD $-08°3998$ as the check star. All measurements were transformed to the Johnson UBV system. Integration times of 40 seconds were used for B and V, respectively and 90 seconds for U. All data were corrected for sky background and extinction. Phases were computed with the photometric ephemeris of Grewing et al. (1989)

$$T[\phi{=}0] = \mathrm{HJD}\ 2445426.122 + 4.73574 \times E\ .$$

Figure 1 shows the differential data in the sense UZ Librae $-$ BD $-07°4044$) in V, $(B-V)$ and $(U-B)$. The data of the comparison minus check star show no variability above the uncertainties and we conclude that both are constant as reported before.

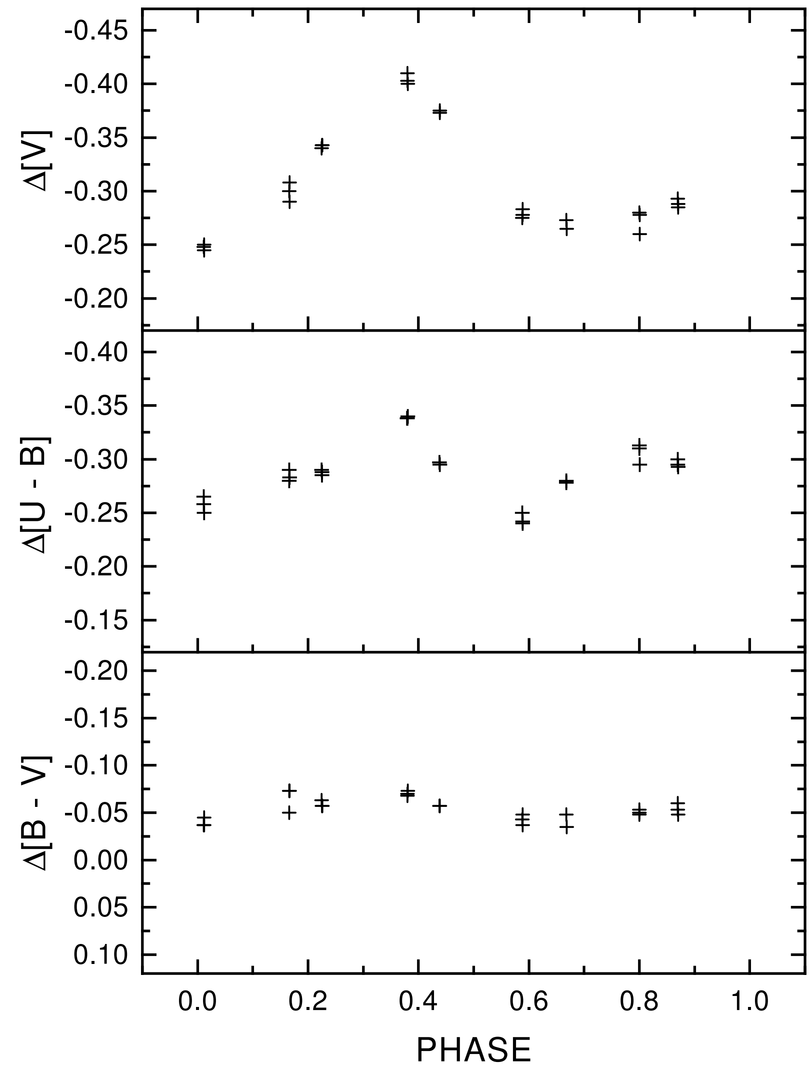

Figure 1. *UBV* light and color curves for UZ Librae. The data are plotted with the photometric ephemeris T[ϕ=0] = HJD 2445426.122 + 4.73574×E

We used a standard period-finding program to confirm the four-day period; the formal value from our small data set is 4.9±0.2 days. The full amplitude in V is 0.16±0.01 mag, and 0.06±0.02 mag and 0.10±0.02 mag in $(B-V)$ and $(U-B)$, respectively. We note that the $(U-B)$ color curve is in phase with the V-light curve, as is the $(B-V)$ color curve, and shows a well-defined and large amplitude as already indicated by Heckert (1992). Compared to previous observations, however, UZ Librae seems to be in a low-amplitude state but maintained its “two-spot” character.

Acknowledgement: Work on stellar activity at the University of Vienna is supported by grants FWF-S7301 and ÖAW-OWP40 to KGS and by the Hochschuljubiläumsstiftung der Stadt Wien to EP.

Table 1. Johnson UBV photometry for UZ Librae

UZ Librae – BD $-07°4044$					
HJD 2440000+	ΔV	HJD 2440000+	$\Delta(U-B)$	HJD 2440000+	$\Delta(B-V)$
9556.47355	−0.300	9556.47256	−0.280	9556.47306	−0.050
9556.47506	−0.290	9556.47405	−0.290	9556.47455	−0.073
9556.47654	−0.308	9556.47554	−0.283	9556.47604	−0.073
9557.48613	−0.403	9557.48516	−0.338	9557.48565	−0.070
9557.48822	−0.410	9557.48722	−0.338	9557.48772	−0.068
9557.49029	−0.400	9557.48929	−0.340	9557.48979	−0.073
9558.47230	−0.275	9558.47130	−0.250	9558.47179	−0.043
9558.47438	−0.278	9558.47338	−0.240	9558.47388	−0.048
9558.47644	−0.283	9558.47546	−0.242	9558.47595	−0.037
9559.47554	−0.280	9559.47453	−0.313	9559.47502	−0.050
9559.47762	−0.278	9559.47662	−0.310	9559.47712	−0.053
9559.47968	−0.260	9559.47869	−0.295	9559.47712	−0.048
9560.47589	−0.248	9560.47492	−0.258	9560.47541	−0.037
9560.47796	−0.250	9560.47699	−0.265	9560.47748	−0.037
9560.48003	−0.245	9560.47904	−0.250	9560.47953	−0.045
9561.48771	−0.340	9561.48670	−0.290	9561.48720	−0.063
9561.48976	−0.343	9561.48877	−0.288	9561.48926	−0.057
9561.49182	−0.343	9561.49082	−0.285	9561.49132	−0.057
9562.49892	−0.373	9562.49814	−0.297	9562.49853	−0.057
9562.50039	−0.375	9562.49965	−0.295	9562.50001	−0.057
9563.58574	−0.273	9563.58499	−0.280	9563.58537	−0.048
9563.58722	−0.265	9563.58647	−0.278	9563.58685	−0.035
9564.54091	−0.293	9564.53990	−0.300	9564.54041	−0.060
9564.54292	−0.288	9564.54200	−0.295	9564.54240	−0.053
9564.54497	−0.285	9564.54398	−0.293	9564.54448	−0.048

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

Number 4295

Konkoly Observatory
Budapest
8 February 1996

HU ISSN 0374 – 0676

UBV PHOTOMETRY OF NOVA Cas 1995 AT PREMAXIMUM PHASE

Nova Cas 1995 was discovered at R.A. = $01^h05^m05\overset{s}{.}4$, Dec. = $+54°00'41''$ (equinox 2000.0) by Yamamoto (1995) on August 24, 1995 UT. *UBV* photoelectric photometry reported here was made from three days after the discovery to mid-January 1996. The equipments used were two same type photon counting photometers attached to Schmidt-Cassegrain telescopes whose apertures are 28-cm and 35-cm at different personal observatories of two of the authors (H.A. and N.O.) respectively. The photometers developed by one of the authors are same type instrument described in Ohshima (1988).

Actual observations were made differentially with respect to SAO 21974 = HD 6250 as a comparison star, and the comparison was also checked with SAO 22031. The integration time was 20-seconds for each band. No variation of the comparison star was detected. Obtained magnitude and colors of the comparison star are $V = 6.81$, $B-V = 0.54$ and $U-B = 0.00$ which were differentially measured with μ Cas ($V = 5.12$, $B-V = 0.69$, $U-B = 0.09$, Johnson and Morgan, 1953). In the data reduction the dead time corrections of the photon counter and the atmospheric extinction correction were carried out. The transformation coefficients to the *UBV* standard system used were obtained from observation of the standard stars.

The magnitudes and colors which are mean values obtained during one night are given in Figure 1a and 1b. The long premaximum halt was seen during about a hundred days. The magnitude and color curves at premaximum phase are very similar to that in HR Del (Duerbeck, 1981). The maximum in U band was earliest. In our data, the maximum is $V = 7.08$ at December 19, 1995 UT (HJD 2450071), $B = 7.60$ and $U = 7.69$ at December 17 UT (JD 2450069).

In color variation, the reddening pulse at the maximum is obviously observed as same as in other novae (Duerbeck 1981, van den Bergh and Younger 1987). The bottom of reddening pulse in $B-V$ is later than that in $U-B$ i.e. $B-V = +0.80$ on December 21 (JD 2450073) and $U-B = +0.52$ on December 19 UT (HJD 2450071).

The color-color diagram is given in Figure 2. The color track of nova light at premaximum halt and at maximum are situated at narrow linear region on the diagram. The set of colors at post-maximum light are situated at separated region.

In the case of this nova at premaximum halt, the behavior of color in *UBV* photometry was attributed to almost continuum light of the nova. Because emission lines in the photometric passbands at the phase of this nova are very weak and narrow. Even though in B band which is the most affected by emission lines, the contribution from emission to the band during premaximum halt is less than a few percent, according to our low dispersion spectra obtained at Bisei Astronomical observatory (Ohshima et al. 1995) and at Okayama Astrophysical Observatory (Norimoto, 1996).

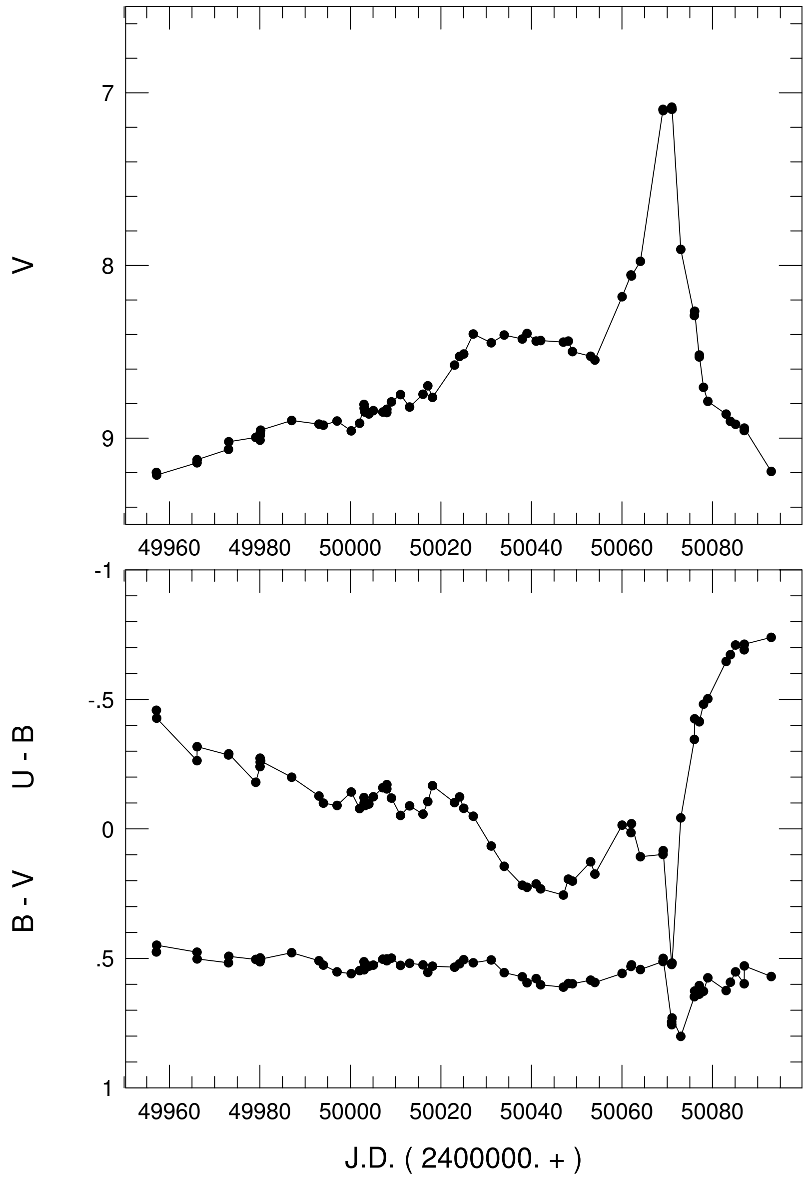

Figure 1. Magnitude and color curve of Nova Cas 1995

According to Gonzalez-Riestra et al. (1996), the color excess $E(B-V) = 0.6$ is obtained from UV observation with IUE. Using this value, the reddening corrected track on the color-color diagram is very similar to those of early type supergiants. These colors are consistent with observed premaximum spectra of classical novae (Seitter 1989).

The UBV photometric data reported here are available on request from the authors via E-mail (address given at the affiliation).

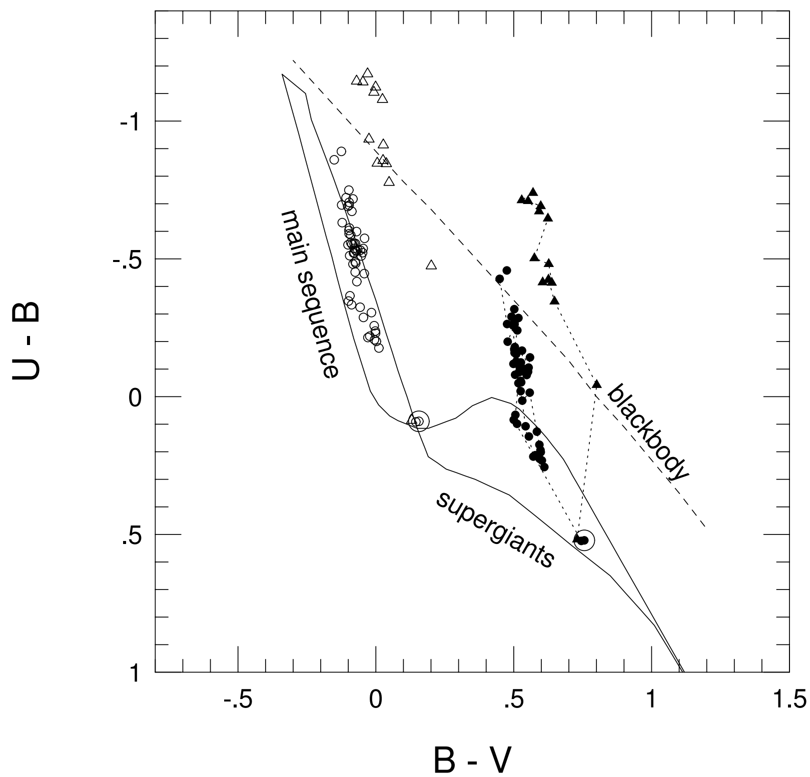

Figure 2. Color-color diagram of Nova Cas 1995. Filled circles are indicated premaximum halt light, filled triangles are post maximum light and large open circle is at V maximum light. Dotted line indicates progress of time. Open symbols are after correction of interstellar reddening which corresponds to E(B−V)=0.6. Colors at premaximum halt are situated narrow region on the diagram. Reddening corrected colors of light at premaximum halt and at maximum are very similar to those of early type supergiants.

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

Number 4296

Konkoly Observatory
Budapest
9 February 1996

HU ISSN 0374 – 0676

NEW POSSIBLE VARIABLES IN THE GLOBULAR CLUSTER NGC 6229

We present a list of 12 new possible variable stars in the core of the halo globular cluster NGC 6229.

The Third Catalog of Globular Clusters (Sawyer Hogg, 1973) lists 22 variable stars in this cluster. One of them is Population II cepheid, others are RR Lyrae type variables.

In order to search for not yet detected variables the method proposed by Kadla and Gerashchenko (1982) was used. It is based on an analysis of a color-magnitude diagram obtained from measurements of two images taken "simultaneously". Thus the variables are at identical phase and the RR Lyrae stars are located in the RR Lyrae gap.

We have at our disposal two pairs of CCD images in B and V colors covering the central 1.5 $\times$ 1.2 arcmin of the cluster taken with SBIG ST-6 CCD camera attached at the 2 meter telescope in NAO "Rozhen", kindly granted by ESO. The scale is 0.32 arcsec/pixel. In the central part of the cluster the crowding prevented accurate photometry. However, by using the positions of stars determined from frames after noise suppression, through wavelet transform (details will be reported elsewhere) we were able to obtain reasonable photometry at 1.5 mag below the HB.

Table 1. Possible variable stars in the core of NGC 6229

NGC 6229: $\alpha = 16^h45^m\!.6$ $\delta = +47°37'$

Number	X (arcsec)	Y (arcsec)	V	B – V	R (arcmin)
1	−7.30	−4.09	18.47	0.46	0.13
2	−2.55	12.62	18.18	0.45	0.20
3	4.64	−3.86	17.90	0.36	0.20
4	11.54	6.94	17.29	0.34	0.21
5	7.76	−10.29	18.56	0.44	0.24
6	−0.91	−15.71	18.40	0.34	0.29
7	7.77	−16.83	17.57	0.15	0.34
8	−4.03	−21.29	18.12	0.45	0.40
9	−7.10	23.69	18.22	0.43	0.40
10	27.49	5.46	18.17	0.44	0.44
11	28.72	17.97	18.18	0.42	0.54
12	−22.02	24.35	18.18	0.42	0.52

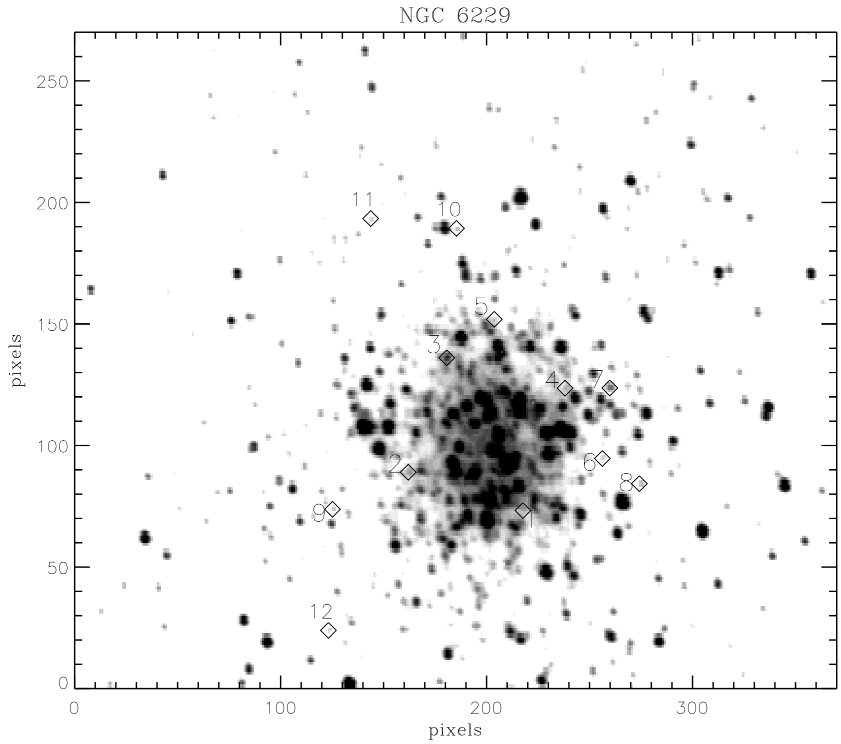

Figure 1

Among the 22 known variables in the cluster 8 were detected on our frames because of our small field of view: V5, V6, V8, V11, V12, V15, V16 and V20.

12 new suspected variables have been found and information of them is given in Table 1. In columns 2 and 3 of Table 1 the coordinates in arcsec of the new possible variables in the Sawyer Hogg (1973) system are listed. The next two columns contain V and B−V values, determined by only one image pair. R is the projected radial distance in arcmin from the cluster center.

This research was supported by the Bulgarian National Scientific Foundation grant under contract No F-328/1993 with the Bulgarian Ministry of Education and Sciences.

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

Number 4297

Konkoly Observatory
Budapest
14 February 1996

HU ISSN 0374 – 0676

PHOTOMETRIC VARIATIONS OF THE MARGINAL Am STAR HD 143232

HD 143232 (SAO 207224, $m_V = 7.1$) was chosen as comparison star for a survey to detect variability in λ Bootis stars (Paunzen et al., 1995) because of its classification as Am star (Houk, 1982). The photometric observations were done with the ESO 50cm telescope at La Silla (observer: E. Paunzen) during the nights of 25/26 and 27/28 July 1994. An integration time of 15 seconds in Strömgren v and b was chosen. HD 143181 (SAO 207215, $m_V = 7.3$, B9V) was used as comparison star. In addition, spectroscopic observations (observer: B. Duffee) were performed with the 24-inch Helen-Sawyer-Hogg telescope located at Las Campanas.

We classify HD 143232 as kA7hA5mF2 which corresponds according to Jaschek & Jaschek (1987) to a marginal Am star. Figure 1 shows the spectrum with a resolution of 109 Å/mm. We performed the basic CCD reduction steps (correcting for bias and flat field) and normalization with standard IRAF-routines.

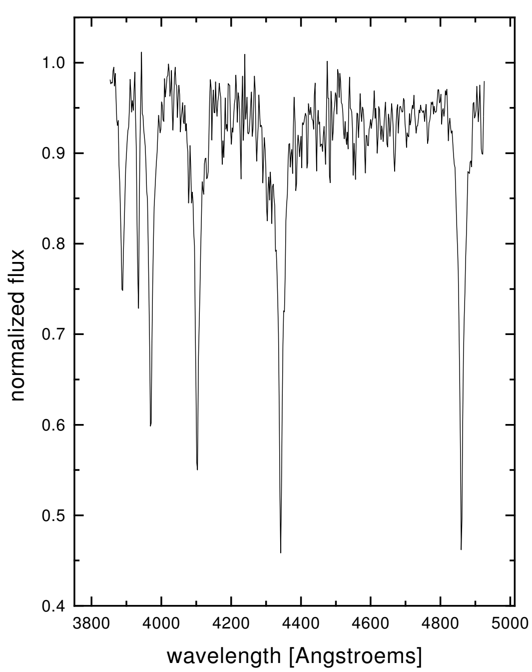

Figure 1. Classification spectrum of HD 143232

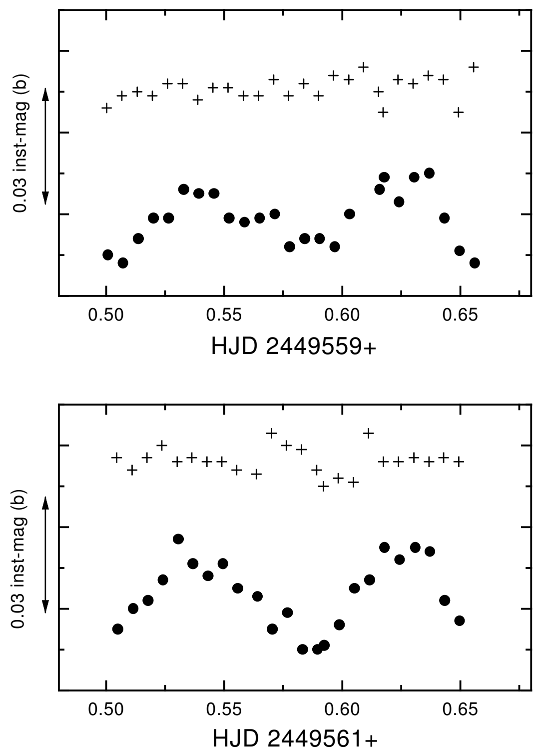

Figure 2. The lightcurves of HD 143181 (+) and HD 143232 (•) for both nights in Strömgren b

The following photometric indices were found in the literature (Hauck & Mermilliod, 1990 and Rufener, 1988):

b − y	m_1	c_1	β
0.142	0.199	0.951	2.815

B2 − V1	m_2	d	g
0.033	−0.476	1.306	0.104

The dereddening procedure and calibration in the Strömgren system uses the results of Moon & Dworetsky (1985), comprises calibrations given by Crawford (1979) and the iteration procedure described by Hilditch et al. (1983). The bolometric correction was calculated with the values given by Balona (1994). It results in B.C. = 0.04, $M_V = 1.49$, $T_{eff} = 7800\,\mathrm{K}$, $\log g = 3.82$ and E(b−y) = 0.025. In the Geneva photometric system we applied the calibration of Hauck & North (1993) and get $T_{eff} = 7700\,\mathrm{K}$. Both results are comparable within the error bars. Stellingwerf (1979) derived a PLC-relation for stars at the MS:

$$\log P = -0.29\, M_B - 3.23 \log T_{eff} + 11.96$$

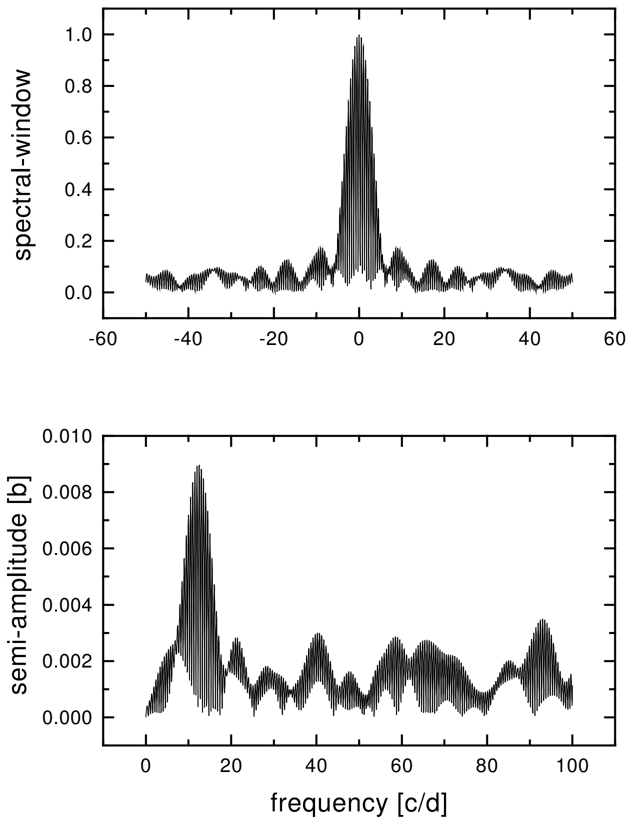

Figure 3. Amplitude spectrum and spectral window for the merged data of both nights in Strömgren b

With the calibrated values for HD 143232 we get a theoretical period of $P_{th} = 130$ minutes. Figure 2 shows the lightcurves of HD 143232 and HD 143181 for both nights in Strömgren b. We computed an amplitude spectrum with a standard Fourier technique (Breger, 1990) resulting in a period of $P_{obs} = 115$ minutes and a semi-amplitude of 9 mmag in Strömgren b (Figure 3).

Variability in marginal Am stars has been found before (Kurtz, 1984). The controversy of variability in Am stars is still not settled (Wolff, 1983). The absence of pulsation in classical Am stars is usually attributed to diffusion. The helium content in the HeII ioniziation zone, which is the primary mechanism for the pulsation, may be reduced to the point that the star becomes stable against pulsation. At the same time, other elements that are strongly supported by radiation pressure may be concentrated in the outer portion of the atmosphere, thus producing the abundance anomalies characteristics of Am stars. The tools of asteroseismology would be very powerful to understand the interior and physical processes of Am stars.

Acknowledgement: This research was done within the working group *Asteroseismology-AMS.* and was supported by the Hochschuljubiläumsstiftung der Stadt Wien (λ Bootis Sterne). We acknowledge receipt of telescope time at ESO and UTSO.

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

Number 4298

Konkoly Observatory
Budapest
16 February 1996

HU ISSN 0374 – 0676

PHOTOMETRY OF THE MIRA VARIABLE χ CYGNI AT MAXIMUM[1]

χ Cyg (HR 7564, V = 3.3–14.2, S6,2e–S10,4e) is a Mira-type long period variable and one of the oldest known variable stars. Discovered as a variable in 1686 by G. Kirch, and notorious for having one of the largest visual amplitudes among the Miras, extensive series of visual-magnitude estimates of this S-type Mira exist. Except for some occasional measurements—see, for example, Landolt (1967) for UBV and Lockwood & Wing (1971) for infrared photometry—the star has received very little attention from photoelectric observers. This is partially due to its large amplitude of variability exceeding 10 magnitudes, possibly also as a result of its long cycle of $\sim$ 410 days. In particular, virtually no photoelectric data at maximum light are available in the literature. Light curves are characterised by cycle-to-cycle differences, and by alternating occurrences of bright and faint maxima with differences between subsequent maxima that may exceed several magnitudes in the visual. The spectrum of χ Cyg has intense emission and absorption lines, especially during post-maximum phases, see Fujita (1954).

We report multicolour photometric observations of χ Cyg obtained in July, August and September 1995 at Jungfraujoch Observatory. In July 1995 two measurements were obtained in the 7 filters of the Geneva photometric system, additional observations were secured in V and V_1 only. The comparison star used was HD 186377 (V = 5.94, A5III). Unfortunately, the weather conditions did not allow us to carry out a complete sequence of standard star and extinction star measurements. In July, in particular, only the standard star HD 187923 could be measured twice. These data, in combination with the measurements of HD 186377—a star with known Geneva colour indices, see Rufener (1988)—allowed for an approximate standardisation of the results.

Table 1 gives the differential results for the V_1 magnitude measurements (note that the V_1 data are relatively free from detrimental colour effects that may show up in the broader V band). These results are useful in any discussion of the (more abundantly available) visual estimates that are being published elsewhere. Figure 1 shows the photoelectric V_1 magnitudes of χ Cyg and the light curve based on visual estimates provided by several visual observers of the VVS (Vereniging voor Sterrenkunde, Belgium). A least-squares parabolic fit to the visual data in the interval JD 2 449 850–950 yields a time of maximum $T_{\max} = HJD$ 2 449 903.6 that coincides fairly well with our first photoelectric data point.

Within the constraints set by the very meagre degree of standardisation, we obtained the following Geneva colours near maximum: $U = 2.26, V = -1.23, B_1 = 1.14, B_2 = 1.28, V_1 = -0.42, G = -0.28$ and visual magnitude $m_v = 5.40$ (on HJD 2449906.5–9.5), yielding the reddening-free parameters $X = 0.83, Y = 0.23, Z = 0.25\,(\pm 0.01)$. Due to the large positive value of Z, application of the Geneva photometry calibrations (Cramer 1994) is not permitted. Note, however, that the magnitude at maximum varies so strongly from

[1]BASED ON OBSERVATIONS COLLECTED AT THE HOCHALPINE FORSCHUNGSSTATION JUNGFRAUJOCH (SWITZERLAND)

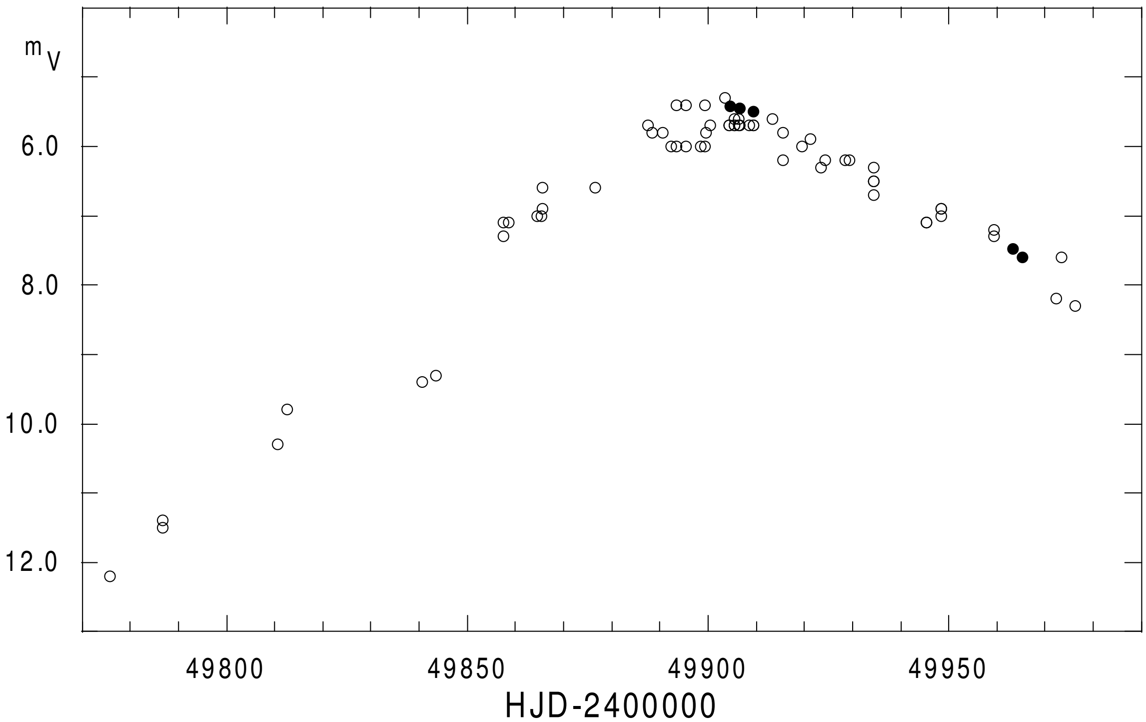

Figure 1. Visual estimates of χ Cyg (o) and Geneva V_1 (•) magnitudes (relatively to the V_1 magnitude of HD 186377 taken from Rufener's catalogue). The two data points around JD 2 449 840 appear off because they coincide with the hump on the ascending branch of the light curve

cycle to cycle, that any photometrically-derived M_v must remain a very poorly known quantity of this star. In addition, photometric indices alone will in no way lead to accurate estimates of the effective temperature or radius due to the contamination of the spectrum by emission lines.

Table 1. V_1 differential magnitudes (χ Cyg minus HD 186377)
HJD is Heliocentric Julian Date minus 2,440,000

HJD	ΔV_1
9904.55	-0.522
9906.56	-0.482
9909.53	-0.445
9963.40	1.531
9965.30	1.653

It is worth noting that, though χ Cyg is a most interesting star that is at times easy to observe, its observational log is characterised by an extreme paucity of data.

This work was supported by a research grant from the Belgian Fund for Scientific Research (NFWO). The authors are indebted to Mr. Tom Sterken for assistance during the observations, and to Messrs. Alfons Diepvens, Guido Gubbels, Dirk Van Hessche, Frans Van Loo and Johan Van Der Looy for providing the visual estimates reproduced in Figure 1.

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

Number 4299

Konkoly Observatory
Budapest
22 February 1996

HU ISSN 0374 – 0676

OBSERVATIONS OF THE SUPEROUTBURST OF VW HYDRI, NOVEMBER 1995

In recent issues of this Bulletin, Taichi Kato and his colleagues at Kyoto University have reported on CCD photometry of a number of SU UMa variables. In November 1995 a well-known member of this class, VW Hydri, underwent a prolonged superoutburst during which time CCD observations of it were made on 14 consecutive nights. It seems appropriate to detail here its behavior so that a comparison of its characteristics can be conveniently made with the results reported by Kato et al.

According to the catalogue of Ritter (1995), the V magnitude of VW Hyi at minimum light hovers close to 14 while during eruption, it climbs to V = 9.5 (during outburst) or V = 8.5 (during superoutburst). VW Hyi is a single-line spectroscopic binary with a period of 0.074271 days, and its superhump period is listed as 0.07714 days. Its superhump period excess, SPE = (Psh−Porb)/Porb, is 3.9% placing VW Hyi near the middle of the SPE range of other SU UMa-type variables. (See Howell & Hurst, 1994; Molnar, 1992). The beat period, $P_{sh} \times P_{orb}/(P_{sh} - P_{orb})$, is close to 2.00 days.

The observations reported on here were made with a CCD camera that uses a TC255 chip with 9 micron pixels. It is mounted at the "Newtonian" focus of a 20 cm Schmidt camera (focal length 30 cm, f/1.5) operating at the author's observing station in Vina del Mar, Chile. When used with a Corion "minus-IR" filter, this combination defines a high throughput passband centered approximately on the standard V band. Observations of standard stars show that the resulting instrumental magnitudes closely approximate that of the V-system; the color correction, $k_{(B-V)}$, nearly always falls in the range $0 < k_{(B-V)} < 0.10$.

Dark-subtraction and flat-fielding of the frames were conveniently handled with Santa Barbara Instrument Group's CCDOPS 1.06 software, and magnitudes were measured using square apertures of 5×5 or 7×7 pixels depending on image size. The primary comparison star, marked "94" on the RASNZ/AAVSO finding chart, lies 6.′3 to the southeast; it was used for all reductions when VW Hyi was brighter than CCDV = 10. Otherwise, several fainter stars (chart magnitudes of 10.4, 12.0 and 12.4) were used.

According the AAVSO records kindly provided by Janet Mattei, VW Hyi began its outburst on JD 2450033 when J. Smit and D. Overbeek reported it to be on the rise. Weather conditions permitted me to make a few observations two nights later, and detailed superhump observations began on JD 2450037. The total number of useful CCD frames taken was 601.

Figure 1 shows the overall light curve of VW Hyi including some selected AAVSO observations and a number of CCD measurements made before and after the superoutburst. Here it has been assumed that the V magnitude of the star labelled 94 is, in fact, 9.40. (The Hubble Guide Star Catalogue gives its magnitude as 10.1.) As can be seen from Figure 1, the total duration of the superoutburst was close to two weeks.

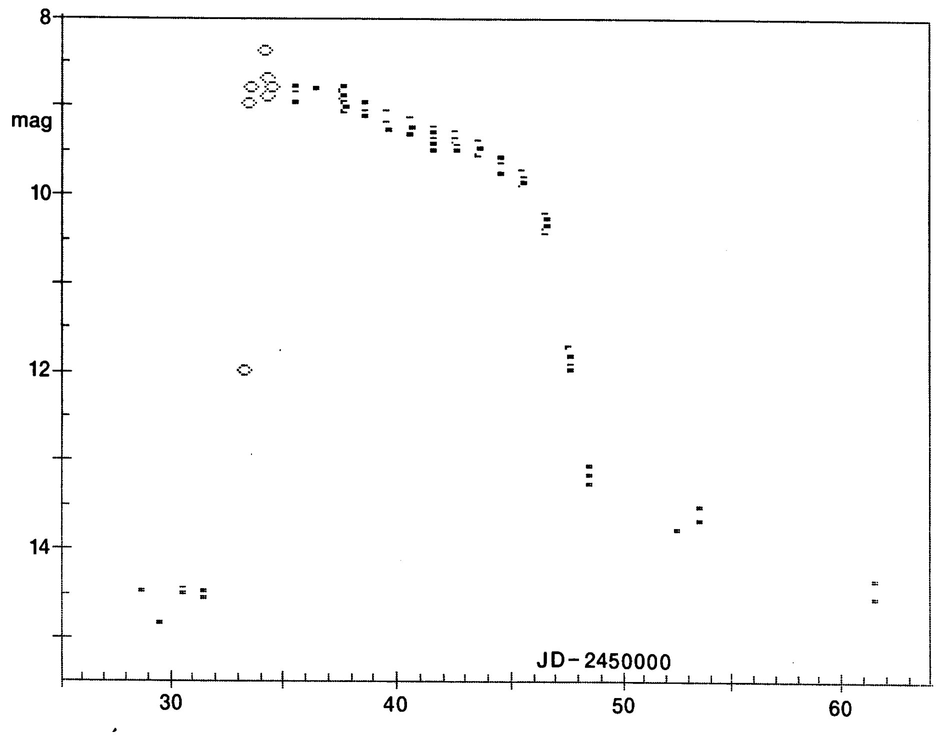

Figure 1. The light curve of VW Hydri during its November 1995 superoutburst. AAVSO observations are indicated by open circles.

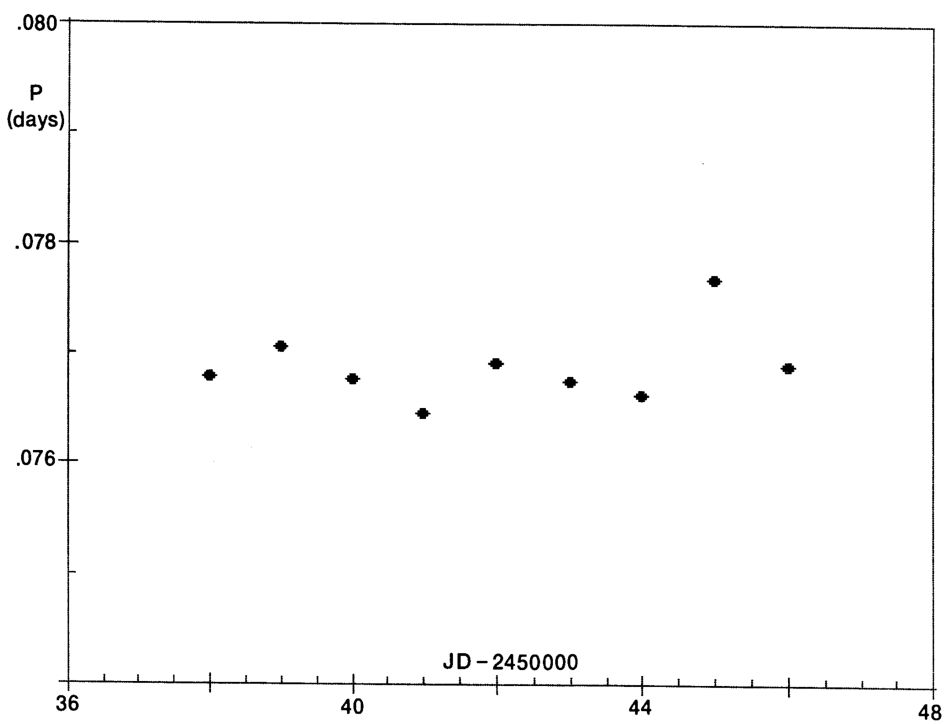

Figure 2. The periods of the superhumps of VW Hydri. The uncertainties average about ±0.0003 except for the last two nights when the smaller amplitudes raised the uncertainty.

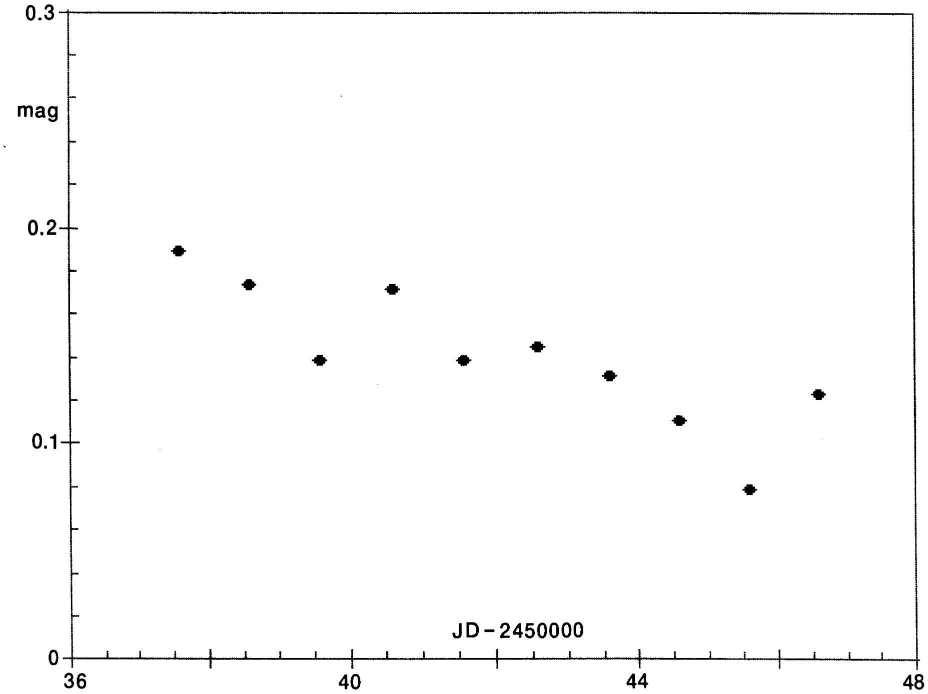

Figure 3. The amplitudes of the superhumps of VW Hydri. The uncertainties average about ± 0.02 magnitudes.

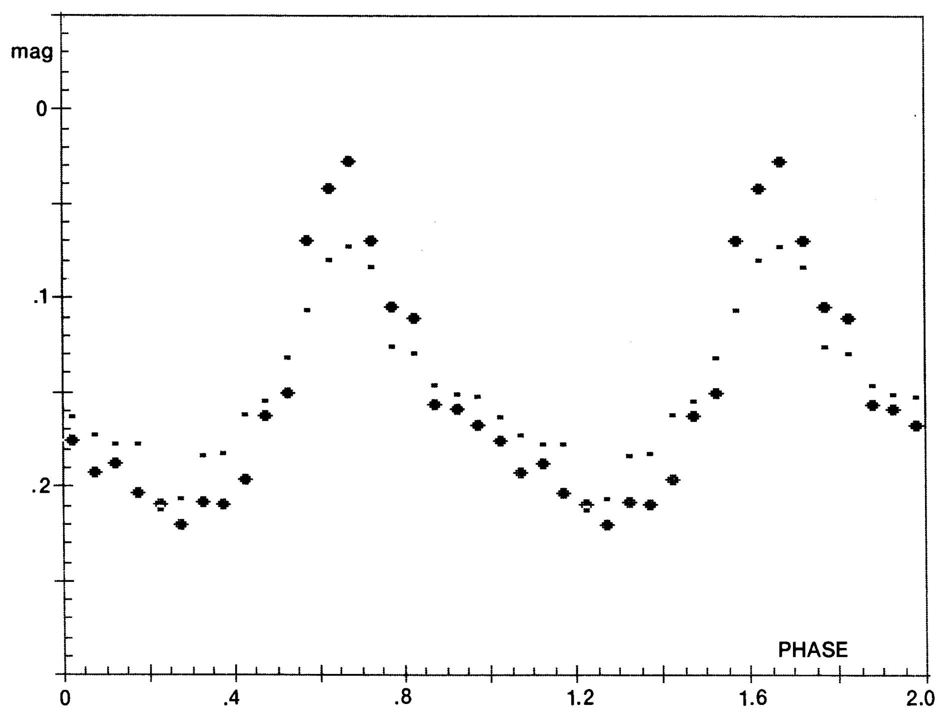

Figure 4. Average light curves of the superhumps of VW Hydri derived from the first five full nights of observations (filled circles) and from the last five full nights of observations (dots).

The period of the superhumps changed little if any during the time of superoutburst. Figure 2 depicts the period derived from each successive pair of nights using the discrete Fourier transform method described by Belserene (1988) and modified by the author. After application of a small heliocentric correction, the best period derived from all the data was found to be 0.076646 days with an estimated uncertainty of ± 0.00003 days.

That the amplitude decreased rather steadily during the run can be seen in Figure 3 where the full amplitudes of the best-fit sine curves are plotted against Julian date. (The true amplitudes are approximately 50% greater.) Shown in Figure 4 are the average folded light curves using the data from the first five photometric nights (JD 2450037-041) and from the last five photometric nights (JD 2450043-047). No evidence was found for variability at or near the beat period, here determined to be 2.40 days.

On one night (JD 2450045), VW Hyi was monitored for a full light cycle using a filter system approximating the B system (a blue dichroic plus a minus-IR filters). As has been noted elsewhere (see O'Donoghue 1992 for example), the amplitude of variability for SU UMa variables is less at shorter wavelengths indicating that the temperature of the emitting region on the accretion disk is cooler than that of the system as a whole. On this night the the sinusoidal amplitude in the blue was 0.029 mag compared to the CCDV amplitude of 0.078 mag.

Because VW Hyi appears frequently on observing lists of space telescopes, the star has been under observation from here in Vina del Mar for some while thanks to the encouragement of the AAVSO and its capable Director Janet A. Mattei. A more detailed report on my own observations will be published elsewhere.

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

Number 4300

Konkoly Observatory
Budapest
29 February 1996

HU ISSN 0374 – 0676

TIMES OF MINIMA OF FIVE ECLIPSING BINARIES

We report photoelectric times of minima of double-lined detached eclipsing binaries derived from photometric observations made with a six channel Strömgren photometer attached to the 0.9m reflector at Observatorio de Sierra Nevada (Granada, Spain), and a single channel Strömgren photometer attached to the 1.52m reflector at Observatorio Astronómico Nacional (Calar Alto, Almería, Spain). The observations, performed in u, v, b, y, H_{β_w} and H_{β_n} filters in the case of PV Cas, V442 Cyg and V477 Cyg, and in H_{β_w} and H_{β_n} in the case of CW Cep and U Oph, were corrected for system deadtime and atmospheric extinction. The adopted heliocentric times of minima were computed from the weighted average over all filters, which were in all cases concordant. Uncertainties in the times of minima are the standard deviation of the computed values for the various filters used.

PV Cas, CW Cep, V477 Cyg and U Oph have been included in a published list of eccentric eclipsing binaries to be eclipse monitored (Giménez, 1995).

In order to compute the values O$-$C we have selected precise ephemeris especially because the observed systems are detached and some of them eccentric, showing a substantial amount of apsidal motion. In general, the rotation of the apsidal line, considering only secular terms, produces a sinusoidal displacement of both primary and secondary eclipse with respect to linear predictions. The most general expression to compute times of minima taking into account this effect, considers an infinite Fourier series as a function of the true anomaly. The coefficients of the series can be computed by means of the eccentricity, the orbital inclination and the anomalistic period. In fact, a fifth order equation is usually sufficient regarding the precision of the photoelectric measurements, since it includes powers of eccentricity up to 5. This fifth order equation gives the times of minima of the eclipsing binary as a function of a reference time T_0, the sidereal period P_s, the anomalistic period P, the periastron longitude ω, the orbital inclination i and the eccentricity e. Light curve analysis provides good values of e and i, and times of minima can be used to obtain the rest of parameters. A detailed discussion about the determination of nonlinear ephemeris can be found in Giménez & García-Pelayo (1983). For three of the observed systems, complete studies of apsidal motion have been performed, leading to more accurate expressions than linear ephemeris.

The ephemerides were adopted as follows:

PV Cas:

$$T_{min,j} = HJD\ 2441729.2905 + P_s E + 0.5(j-1)P + 0.01795(2j-3)\cos\omega + 0.00022\sin 2\omega$$

With $P_s = 1.750470$ d, $P = 1.750562$ d and $\omega = 197.0 + 0.0189\ E$ in degrees. The index j is 1 for primary eclipses and 2 for secondaries. The ephemeris was taken form the apsidal motion study performed by Giménez & Margrave (1982), and the obtained parameters are in excellent agreement with those computed in the recent studies of Barembaum & Etzel (1995) and Wolf (1995). The adopted expression was tested with recent times of minima, showing a low dispersion ($\simeq 0^d.0015$) and no systematic deviations.

CW Cep:

$$T_{min,j} = HJD\ 2441669.5722 + P_s E + 0.5(j-1)P + 0.02581(2j-3)\cos\omega + 0.00029\sin 2\omega$$

With $P_s = 2.729139$ d, $P = 2.729588$ d and $\omega = 201.6 + 0.0593\ E$ in degrees. The index j is 1 for primary eclipses and 2 for secondaries. The apsidal motion parameters for this system were obtained by Giménez *et al.* (1987) and the final expression was computed using the previously described method (Giménez & García-Pelayo, 1983).

V442 Cyg:

Min I =HJD 2444919.561+2.3859437 × E (Lacy & Frueh, 1987)

The secondary minimum was assumed to be at phase 0.5.

This system is known to be eccentric although no detailed studies of apsidal motion have been performed. The adopted linear ephemeris does not show a very good agreement with recent times of minima, although the value O−C in our case is outstandingly low.

Table 1

System	Type of eclipse	HJD (−2400000)	O−C (days)	Comparison Stars
PV Cas	Secondary	50048.4031	−.0012	HD 220760
		±0.0003		BD +60°2509
CW Cep	Primary	50045.2793	.0029	HD 218342
		±0.0007		HD 217035
V442 Cyg	Secondary	50043.3757	.0006	BD +31°3924
		±0.0025		HD 188725
V477 Cyg	Secondary	50043.3598	−.0144	BD +31°3924
		±0.0019		HD 188725
U Oph	Secondary	49905.5077	.0060	HD 156208
		±0.0006		HD 154445

V477 Cyg:

$$T_{min,j} = HJD\,2439762.6724 + P_s E + 0.5(j-1)P + 0.22986(2j-3)\cos\omega + 0.02698\sin 2\omega$$

$$-0.00380(2j-3)\cos 3\omega - 0.00054\sin 4\omega + 0.00008(2j-3)\cos 5\omega$$

With $P_s = 2.3469768$ d, $P = 2.3470199$ d and $\omega = 145.6 + 0.00661\ E$ in degrees. The index j is 1 for primary minima and 2 for secondaries. The most recent apsidal motion study of this system was undertaken by Giménez & Quintana (1992), and we adopted the nonlinear ephemeris proposed in that work. The agreement with recent times of minima is not very good, showing O−C significantly negative for secondary minima. The same trend is shown in our observation presented in Table 1.

U Oph:

Min I $= HJD\,2440484.6890 + 1.67734598\ \times E$ (GCVS, Kholopov, 1985-87)

The secondary minimum was assumed to be at phase 0.5.

This system is known to be eccentric and shows apsidal motion, but the adopted linear ephemeris shows a better agreement with recent times of minima than the nonlinear ephemeris computed from the apsidal motion parameters given in Kämper (1986).

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