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VY	4321	RS	4321
VZ	4321	RT	4321
WW	4321	RU	4321
WX	4321	RW	4321
WY	4321	RX	4321
WZ	4321	RZ	4321
XX	4321	SS	4321
XY	4321	ST	4321
XZ	4321	SU	4321
YY	4321	SW	4321
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Star	IBVS No.
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PULSATION OF HD 83041 AND HD 221756

We present two new variable λ Bootis stars as a result of our survey to detect variability among λ Bootis stars (Paunzen, 1995). The general properties of this group are described in Weiss et al. (1994).

HD 83041 was classified as A2II/III(w) by Houk (1982). The Strömgren and Geneva colors (Gray & Olsen, 1991 and Rufener, 1988) on the other hand are typical for a MS star and very similar to HD 142994 (Hauck, 1986 and Weiss et al., 1994). Recent spectroscopic observations seem to confirm the λ Bootis character of HD 83041. The photometric observations were performed in the night of 02/03 May 1995 with the 0.6 meter Lowell telescope at CTIO (observer: E. Paunzen). An integration time of 20 seconds in Strömgren v and b was chosen. We used HD 82709 (V = 7.7, A9V) as comparison star. Figure 1 shows the light curves of both stars in Strömgren b. Pulsation of HD 83041 is evident although the data set is rather short. We estimate a period of 95 minutes and an amplitude of 7 mmag in Strömgren b (Figure 2).

HD 221756 was classified by Gray (1988) as: "The K line and the metallic-line spectrum are similar to the A1 standards, except that Mg 4481 appears weak. The hydrogen lines show very broad wings with slightly weak cores". Stürenburg (1993) derived for the elements Mg, Ti, Cr, Fe and Ba an underabundance of a factor 5 compared to the Sun. Iliev & Barzova (1995) estimated the following stellar parameters:

$$\log Age = 8.65 \qquad T_{eff} = 9000 \text{ K} \qquad \log g = 3.9$$

The observations were made with the 0.9 meter telescope at McDonald observatory (observer: G. Handler) during the nights of 06/07 and 11/12 Aug 1995. An integration time of 50 seconds in Strömgren v and b was chosen. We used HD 220575 (V = 6.7, Hg-Mn star) and HD 223636 (V = 6.7, F8) as comparison stars. Both proved to be constant.

HD 221756 was suspected to be variable by Rufener & Bartholdi (1982). They gave an upper limit for constancy of 24 mmag in V. Figure 3 shows the light curves of all stars for the second night in Strömgren b. There are still some sky variations at the end of the night. The intrinsic light variations are very small, but there is no doubt about variability of HD 221756. We infer a period of 63 minutes and an amplitude of 6.6 mmag in Strömgen b. Figure 4 shows the amplitude spectra for HD 221756, HD 220575 and the differential data.

The periods determined for HD 83041 and HD 221756 are consistent with expected periods for A type stars at the MS (Stellingwerf, 1979). An age determination with the tools of asteroseismology would be very helpful to establish the evolutionary stage of λ Bootis stars.

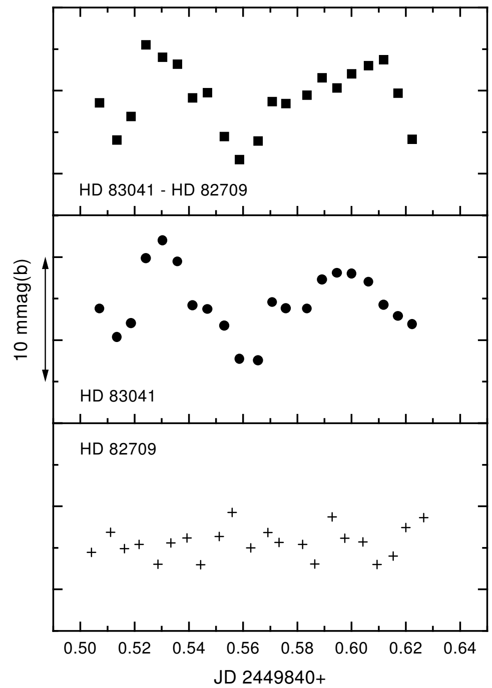

Figure 1. Light curves for HD 83041, HD 82709 and the differential data in Strömgren b

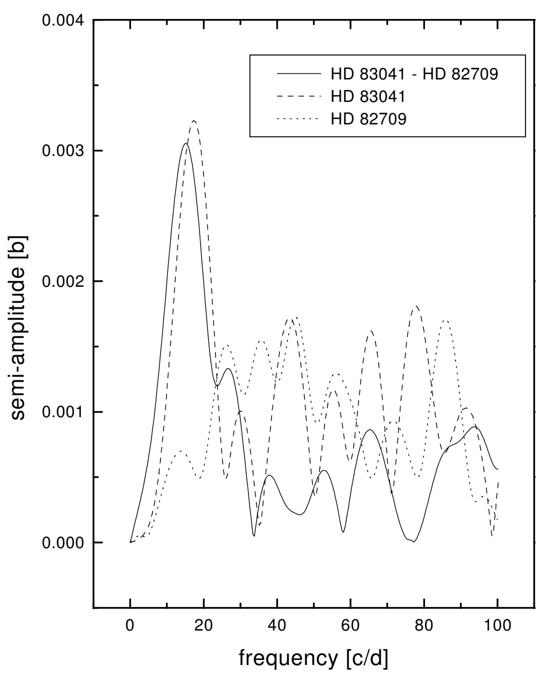

Figure 2. Amplitude spectrum for HD 83041, HD 82709 and the differential data as shown in Figure 1

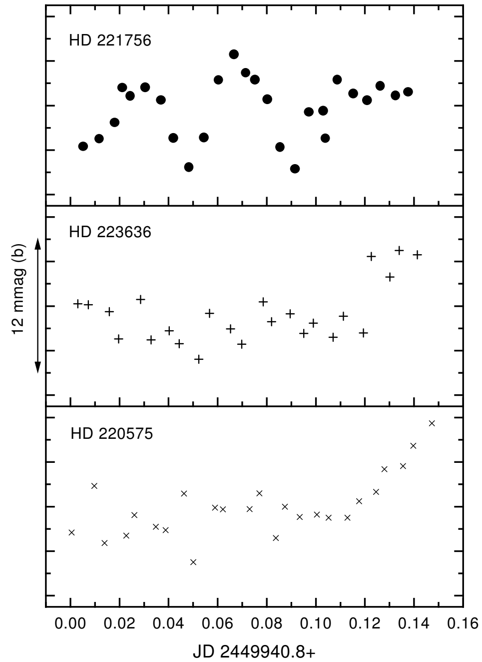

Figure 3. Light curves for HD 221756, HD 220575 and HD 223636 for the second night in Strömgren b

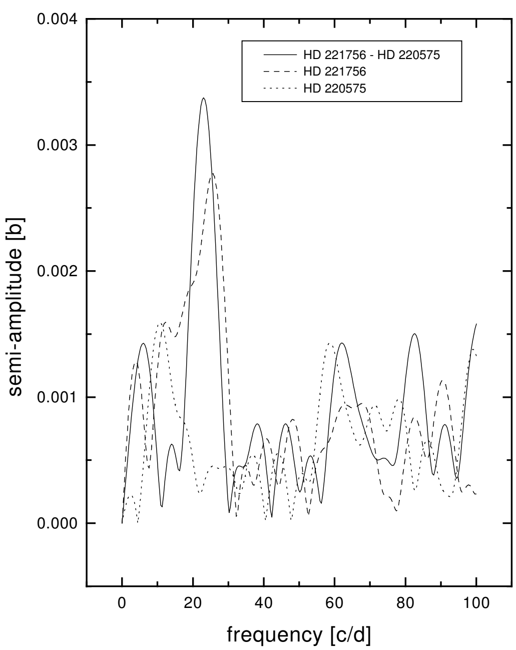

Figure 4. Amplitude spectrum for HD 221756, HD 220575 and the differential data as shown in Figure 3

Acknowledgement: 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 *S 8303-AST*) and the Hochschuljubiläumsstiftung der Stadt Wien (λ Bootis Sterne). GH acknowledges partial financial support by the Austrian Zentrum für Auslandsstudien. This research has made use of the Simbad database, operated at CDS, Strasbourg, France.

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NONVARIABILITY AMONG λ Boo STARS I.: ESO 1993 AND 1994 DATA

In 1993 we started an extensive survey for pulsation in λ Bootis stars. The λ Bootis stars are a group of metal poor, population I, A-type stars (Weiss et al., 1994) with broad and often shallow hydrogen lines, which are probably caused by a gas shell. Two theories exist concerning the evolutionary status of this group. In the first case diffusion would be the determining mechanism and the stars are at the end of the ZAMS phase. In the other hypothesis accretion and/or mass-loss would be responsible for the low metallicity and the stars would be just arriving at the ZAMS (Turcotte & Charbonneau, 1993).

Therefore their location in the Hertzsprung–Russell diagram, and hence their evolutionary status, is still controversial (Iliev & Barzova, 1995). Keeping these contradicting theories in mind, it is important to discover pulsation among λ Bootis stars, because pulsation allows to derive stellar structure parameter by applying the tools of asteroseismology. We have chosen for our survey candidates from Renson et al. (1990) and Gray & Corbally (1993). These stars were observed with the classical technique, using at least one comparison star and two filters (Strömgren v and b). All observations were corrected for the sky background, deadtime and extinction. Up to now we found 11 new pulsating λ Bootis stars (e.g. Paunzen, 1995). In a series of IBVS notes we want to present data of all photometrically constant λ Bootis candidates.

In this paper we discuss data observed at the 50 cm ESO telescope (observer: E. Paunzen) from June 25th to July 8th 1993 and July 19th to July 31st 1994. Table 1 lists all observed λ Bootis and comparison stars with the night and duration of the observations. The amplitude spectra and spectral window (Figures 1 to 5) were calculated with a standard Fourier technique (Breger, 1990). Due to the limitation of the IBVS format we present in these figures the amplitude spectra and spectral windows for the differential photometry of the λ Bootis and *one* comparison star up to the Nyquist frequency. The other comparison star (if observed) was constant as well. In case of observations in more than one night, we merged the data of all nights. The upper level of nonvariability is typically 4 mmag in Strömgren b.

It is evident from Table 1 and the figures that the nights have been of different quality. Due to the noise and the limitation of the data set we cannot exclude variability on a low amplitude level because we can only give an upper limit for it. However, until proven otherwise, we assume these stars to be constant. The periods of variable λ Bootis stars detected so far range typically from 50 to 140 minutes. From the PLC-relation of Stellingwerf (1979) we would expect a fundamental period of a radial mode for early A-type stars at the MS of about 45 to 120 minutes (30 to 10 c/d).

Table 1. Program and comparison stars, ⋆ this comparison star is used for the figure

Star	Durchm.	JD	hours	m_V	Spec.		Upper level [b]
HD 319	CD −23°13	2449166	2	5.93	λ Boo		0.004
HD 203	CD −3°4			6.18	F2IV	⋆	
HD 141851	CD −023°4058	2449168	4	5.10	λ Boo		0.004
		2449175	5				
HD 140775	CD −03°3829			5.52	A5IV	⋆	
HD 140837	CD −01°3092			5.39	B8III		
HD 143148	CD −31°12442	2449560	4	7.39	λ Boo(?)		0.004
HD 142542	CD −31°12407			6.29	F5V	⋆	
HD 142851	CD −31°12426			7.13	A0V		
HD 145782	CP −57°7716	2449166	4	5.71	λ Boo(?)		0.006
HD 144480	CP −57°7613			5.57	B9.5V	⋆	
HD 154153	CD −43°11396	2449175	3	6.18	λ Boo(?)		0.004
HD 153234	CD −44°11339			6.51	F3V		
HD 154025	CD −45°11188			6.28	A2V	⋆	
HD 179791	BD +05°4081	2449166	3	6.51	λ Boo(?)		0.006
HD 178596	BD +05°4040			5.22	F0III	⋆	
HD 180482	BD +04°4045			5.59	A3IV		
HD 188164	CP −69°3073	2449173	3	6.35	λ Boo(?)		0.004
		2449174	6				
HD 188097	CP −69°3072			5.75	Am	⋆	
HD 193256	CD −29°16980	2449560	5	7.70	λ Boo		0.002
		2449563	3				
		2449564	5				
HD 193281	CD −29°16981	2449563	3	6.61	λ Boo		0.004
		2449564	5				
HD 194170	CD −29°17046			8.27	A4V	⋆	
HD 204041	CD −00°4215	2449568	3	6.45	λ Boo		0.002
HD 203405	CD +00°4714			6.78	F2		
HD 204121	CD +00°4726			6.13	F5V	⋆	

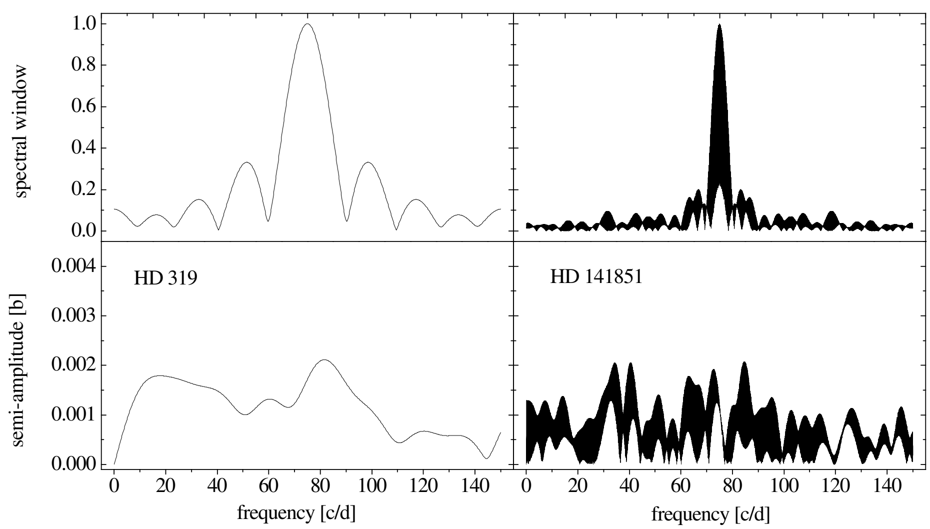

Figure 1. Amplitude spectrum and spectral window for the differential data of HD 319 and HD 141851 in Strömgren b.

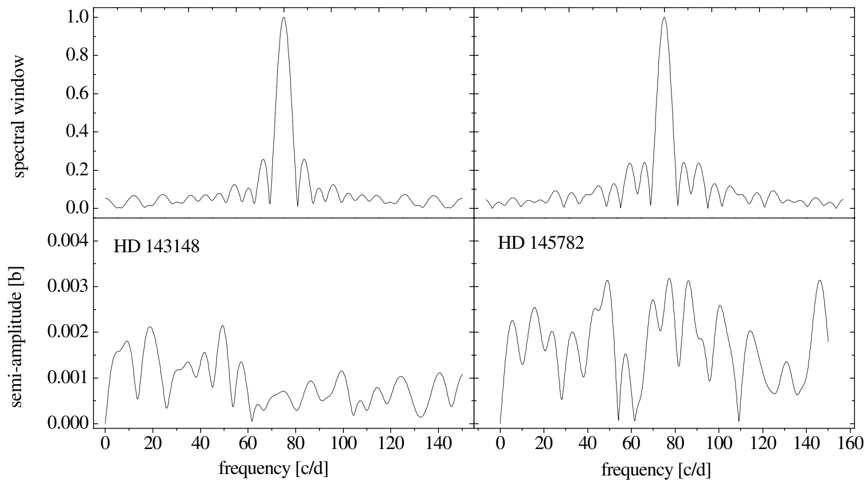

Figure 2. Amplitude spectrum and spectral window for the differential data of HD 143148 and HD 145782 in Strömgren b

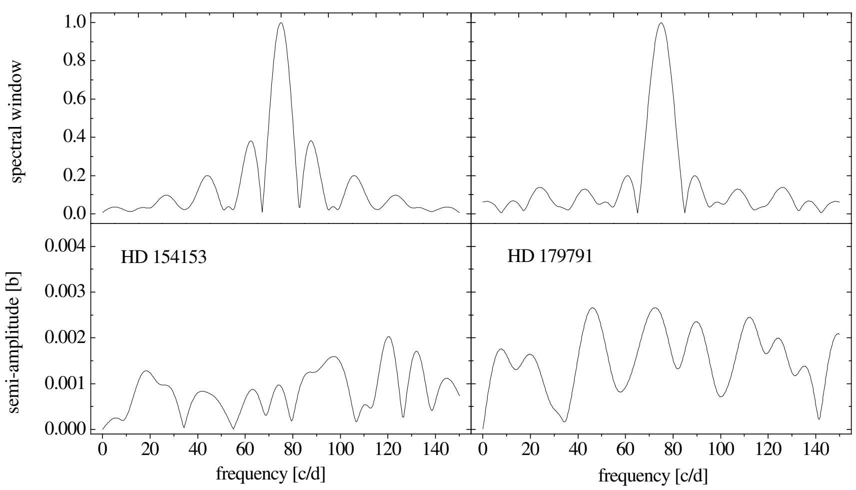

Figure 3. Amplitude spectrum and spectral window for the differential data of HD 154153 and HD 179791 in Strömgren b.

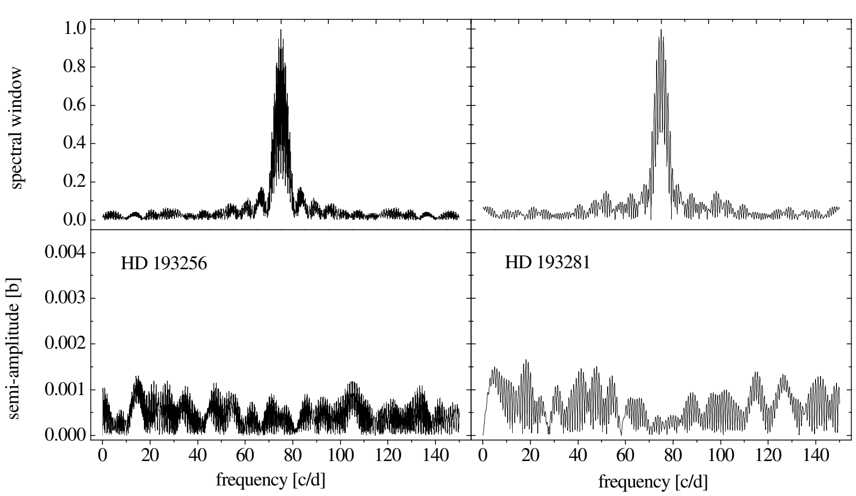

Figure 4. Amplitude spectrum and spectral window for the differential data of HD 193256 and HD 193281 in Strömgren b.

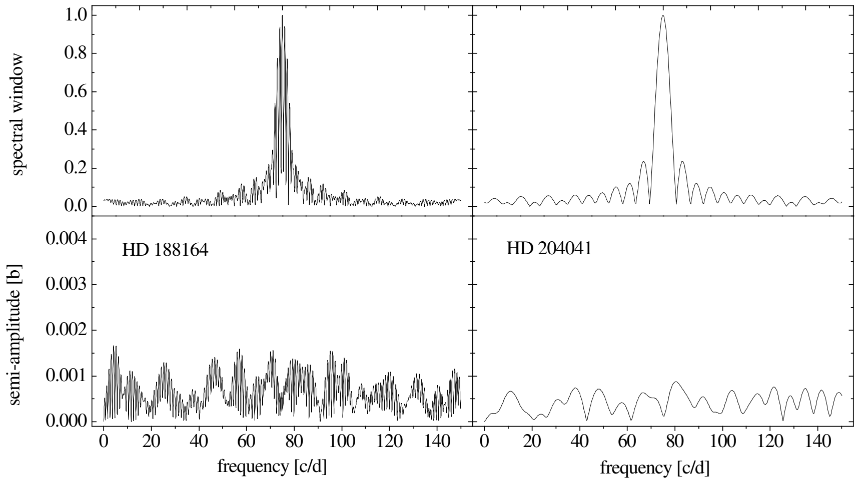

Figure 5. Amplitude spectrum and spectral window for the differential data of HD 188164 and HD 204041 in Strömgren b.

Acknowledgement: 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 *S 8303-AST*) and the Hochschuljubiläumsstiftung der Stadt Wien (λ Bootis Sterne). This research has made use of the Simbad database, operated at CDS, Strasbourg, France.

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Weiss, W.W., Paunzen, E., Kuschnig, R., Schneider, H., 1994, *A&A*, **281**, 797

ERRATUM

In Table 1 of the IBVS No. 4302 several cross-identifications have been erroneously given. The correct version of the Table is given below.

Table 1. Program and comparison stars, ⋆ this comparison star is used for the figure

Star	Durchm.	JD	hours	m_V	Spec.		Upper level [b]
HD 319	CD −23° 13	2449166	2	5.93	λ Boo		0.004
HD 203	CD −23° 4			6.18	F2IV	⋆	
HD 141851	BD −02° 4058	2449168	4	5.10	λ Boo		0.004
		2449175	5				
HD 141378	BD −03° 3829			5.52	A5IV	⋆	
HD 140873	BD −01° 3092			5.39	B8III		
HD 143148	CD −31° 12442	2449560	4	7.39	λ Boo(?)		0.004
HD 142542	CD −31° 12407			6.29	F5V	⋆	
HD 142851	CD −31° 12426			7.13	A0V		
HD 145782	CP −57° 7716	2449166	4	5.71	λ Boo(?)		0.006
HD 144480	CP −57° 7613			5.57	B9.5V	⋆	
HD 154153	CD −43° 11396	2449175	3	6.18	λ Boo(?)		0.004
HD 153234	CD −44° 11339			6.51	F3V		
HD 154025	CD −45° 11188			6.28	A2V	⋆	
HD 179791	BD +05° 4081	2449166	3	6.51	λ Boo(?)		0.006
HD 178596	BD +05° 4040			5.22	F0III	⋆	
HD 180482	BD +04° 4045			5.59	A3IV		
HD 188164	CP −69° 3073	2449173	3	6.35	λ Boo(?)		0.004
		2449174	6				
HD 188097	CP −69° 3072			5.75	Am	⋆	
HD 193256	CD −29° 16980	2449560	5	7.70	λ Boo		0.002
		2449563	3				
		2449564	5				
HD 193281	CD −29° 16981	2449563	3	6.61	λ Boo		0.004
		2449564	5				
HD 194170	CD −29° 17046			8.27	A4V	⋆	
HD 204041	BD −00° 4215	2449568	3	6.45	λ Boo		0.002
HD 203405	BD +00° 4714			6.78	F2		
HD 204121	BD +00° 4726			6.13	F5V	⋆	

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1995 PHOTOMETRY OF SV CAMELOPARDALIS

SV Camelopardalis (= SAO 1038 =#65 in the catalog of Strassmeier et al. 1993) is a member of the short period group of eclipsing RS CVn systems. Budding and Zeilik (1987) first modeled the starspots on this system and Zeilik et al. (1988) modeled the starspots for data available over the previous half century. Sarma et al. (1991) have also modeled the spots on this system. Continuing this work, I obtained BVRI light curves during 1995 and modeled the starspot structure. I observed SV Cam on the nights of 22, 28, 30, and 31 January and 1 and 4 February 1995 with the San Diego State University 61-cm telescope on Mt. Laguna. The photometer has a Hamamatsu R943-02 tube cooled to −15°C and operated at −1450V. Following Patkós (1982), I used SAO 1020 (=BD +82°168 = HD 43883) as the comparison star. In over seven years of photometry of SV Cam, Patkós found no evidence of variability of this comparison star. Using Landolt standard stars, I transformed the data into differential magnitudes in the standard Johnson Cousins system. Figures 1 and 2 show the differential (star–comparison) magnitudes in the BVRI bands. I modeled the data with the Information Limit Optimization Technique (ILOT) of Budding and Zeilik (1987). I started with the various stellar and orbital parameters from Budding and Zeilik (1987) and Zeilik et al. (1988) to perform initial fits to the data. The ILOT programs then subtract eclipse effects from the data and fit starspots to the remaining distortion wave. These SV Cam data fit best with two spots. Figure 3 shows the V band spot fit. The results in degrees are:

Spot fits

	B band	V band	R band	I band
Longitude_1	289.8±1.8	300.0±3.3	299.2±3.9	302.3±5.2
Latitude_1	−0.1±12.1	−0.5±18.8	−1.5±27.4	0(fixed)
Radius_1	11.6±0.4	9.0±0.4	9.1±0.5	8.3±0.5
Longitude_2	81.6±2.5	62.5±4.0	60.0±5.4	61.9±8.3
Latitude_2	0.0±14.5	0.2±20.0	−1.4±44.4	−0.2±29.2
Radius_2	10.6±0.4	8.0±0.5	7.3±0.6	5.8±0.8
χ^2	168.2	176.0	123.2	118.8

The spot models of Zeilik et al. (1988) show that over a 50 year span one fairly large high latitude spot tends to fit the data. These 1995 data are fit best with two low latitude spots, an apparently unusual occurrence for this system. Both spots are however located in the active longitude belts (ALBs) at roughly 90° and 270° noticed by Zeilik et al. (1988). After finding the best spot fits, the ILOT programs allow one to subtract the spot effects to perform clean fits to the data. Figure 4 shows the initial and clean fits for the V band. For the clean fits, I get:

Clean fits

	B band	V band	R band	I band
U	1.022±0.001	0.991±0.001	0.973±0.002	0.979±0.001
L_1	1.018±0.005	0.968±0.005	0.898±0.016	0.905±0.005
$k(=r_2/r_1)$	0.635±0.004	0.625±0.006	0.846±0.047	0.618±0.006
r_1	0.355±0.004	0.348±0.004	0.316±0.009	0.347+0.004
i(deg)	87.6±1.7	87.1±1.3	77.7±0.7	86.8±1.4
L_2	0.004±0.006	0.023±0.006	0.075±0.018	0.074±0.007
$q(=M_2/M_1)$	0.439±0.028	0.449±0.034	0.865±0.114	0.517±0.050
χ^2	69.4	65.9	84.8	80.5

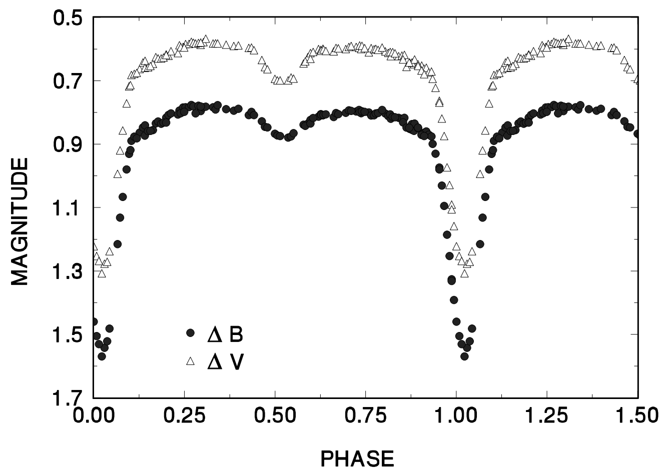

Figure 1. B and V light curves of SV Cam in Jan/Feb 1995.

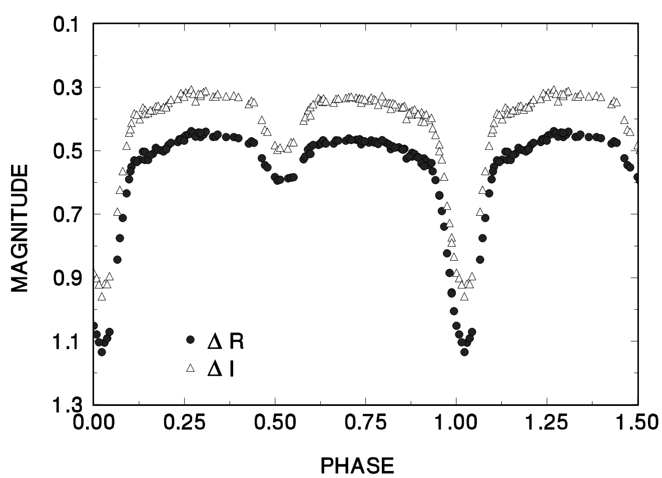

Figure 2. R and I light curves of SV Cam in Jan/Feb 1995.

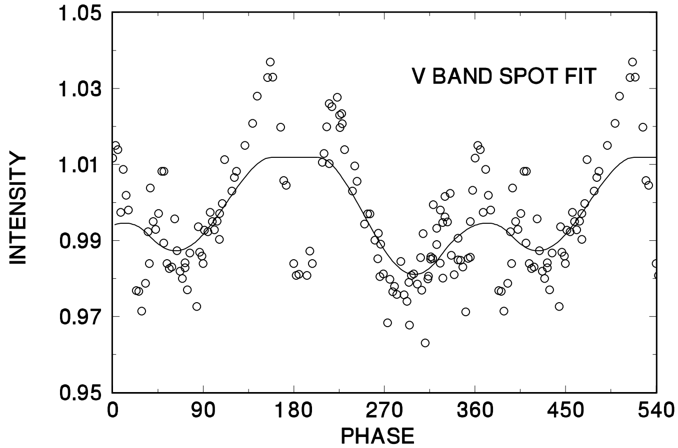

Figure 3. V band spot fit for Jan/Feb 1995.

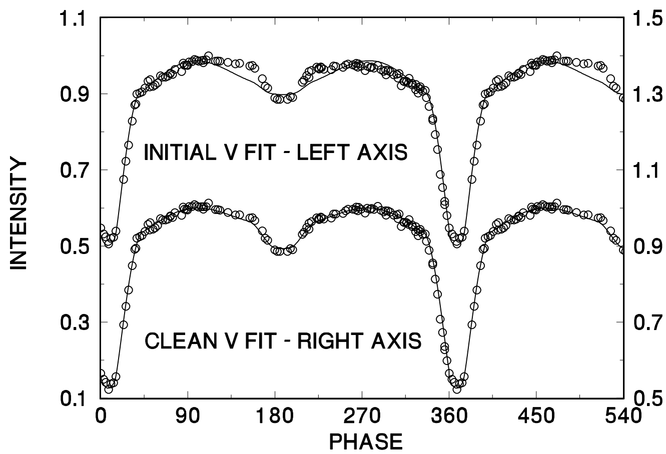

Figure 4. SV Cam - Jan/Feb 1995. Initial and clean fits for the V band.

The clean fit parameters are as defined by Budding and Zeilik (1987). L_1 and L_2, the fractional luminosities of the primary and secondary stars, sum to the unit of light, U, in the absence of a third light. Rainger et al. (1991) and Sarma et al. (1989, 1991) find evidence for a third component in this system, but I was unable to find evidence for a third light from my data. Note that the secondary is much fainter than the primary; if the third component were fainter than the secondary, it would not be detectable with this photometry. The primary and secondary radii, r_1 and r_2, are in units of the semi-major axis of the orbit, and i is the orbital inclination. The mass ratio from these models is somewhat lower than the usual value of 0.6 to 0.7 (Budding and Zeilik 1987, Sarma et al. 1989, Patkos and Hempelmann 1994) Otherwise these clean fits agree fairly well with the values found by Zeilik et al. (1988).

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PERIOD CHANGES IN V839 OPHIUCHI

The eclipsing binary V839 Oph (BD +09°3584 = HD 166231 = GSC 1009.264, α_{2000} = $18^h9^m21^s.4$, $\delta_{2000} = 9°9'4''.3$, Sp. F8V, $V_{max} = 8.7$ mag) is a relatively well-known W UMa type binary system with a period of 0.4090 day. This bright variable star belongs to the nearest binaries and therefore it was also included into the Hipparcos program of parallax measurement from space (Dworak & Oblak 1987, 1989). It was discovered to be a variable star by Rigollet (1947), the first photoelectric measurements were presented by Binnendijk (1960). Later on, photometric measurements were obtained by Wilson & O'Toole (1965), Lafta & Grainger (1985) and Niarchos (1988, 1989). The recent photoelectric times of minima were published by Hanžl (1990, 1991), Demircan et al. (1994) and Agerer & Hübscher (1995).

Our new CCD photometric observations of V839 Oph were carried out during August and October 1995 at Ondřejov Observatory, Czech Republic, using a 65cm reflecting telescope with a CCD-camera (SBIG ST-6) at the primary focus. The measurements were done using the standard Johnson V filter with 20 s exposure time. One additional time of primary minimum was obtained in October 1995 at the R. Szafraniec Observatory, Metzerlen, Switzerland, using a 35cm Cassegrain telescope with the same CCD-camera and without any filter.

The star GSC 1009.464 = BD +09°3578 (V = 9.04 mag) – used also by Binnendijk (1960) and other observers – on the same frame as V839 Oph served as a comparison star. All CCD data were reduced using a software developed at Ondřejov Observatory by P. Pravec and M. Velen (Pravec et al. 1994). The times of primary minima and their error were determined as mean values the Kwee–van Woerden (1956) method and the parabolic fit into the data file. They are presented in Table 1. In this table N stands for the number of measurements used for the determination of minimum time. The epochs were calculated using the linear light elements given in GCVS (Kholopov et al. 1985):

$$\text{Pri. Min.} = \text{HJD}\,24\,40448.4129 + 0.40899532 \times \text{E}.$$

The period changes of V839 Oph were studied by means of O$-$C diagram analysis. We took into consideration all photoelectric times of minima found in the literature as well as the first visual minimum obtained by the discoverer ($E = -21664.5$). The other numerous visual estimations were not included due to the large scatter of the data.

Table 1. New precise times of primary minima of V839 Oph

JD Hel.– 24 00000	Error (10^{-4}d)	N	Epoch	Observatory
49954.3939	0.0001	45	23242.0	Ondřejov
49995.2942	0.0001	82	23342.0	Ondřejov
50013.2907	0.0003	31	23386.0	Metzerlen

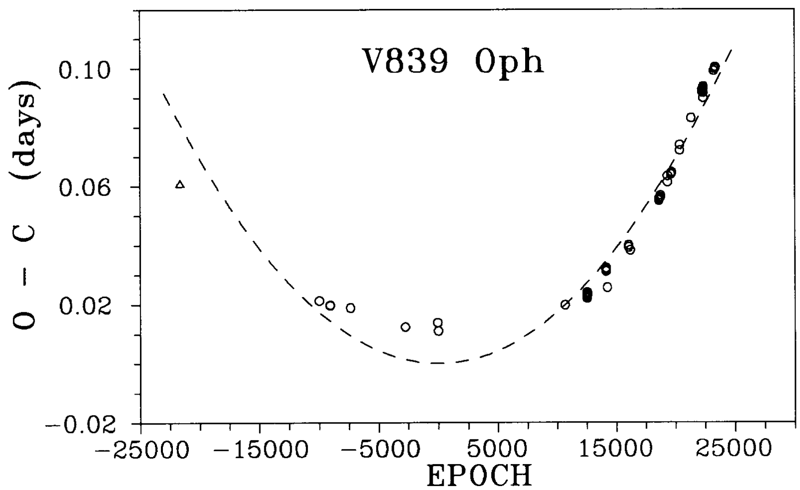

Figure 1. O−C residuals for the times of minima of V839 Oph with respect to the linear light elements. The dashed curve represents the parabolic approximation. The individual primary and secondary photoelectric times are denoted by circles, the first visual estimation by triangle.

A total 52 times of minimum light were incorporated in our analysis, with 23 secondary eclipses among them. We derived new quadratic light elements by the least squares method:

$$\text{Pri. Min.} = \text{HJD } 24\ 40448.4019 + 0.40899634 \times \text{E} + 1.73 \times 10^{-10} \times \text{E}^2.$$

$$\pm 8 \qquad \pm 23 \qquad \pm 0.12$$

It indicates, that the period of V839 Oph is increasing. From these elements we obtained $\frac{\Delta P}{P} = 8.46 \cdot 10^{-10}$. The O−C residuals for all times of minimum with respect to the linear ephemeris are shown in Figure 1. The non-linear fit, corresponding to the calculated elements is plotted as a dashed curve.

Subtracting the parabolic term in light elements, which could be caused by a mass transfer or mass loss from the system, the $O - C_2$ diagram can be plotted. Significant quasi-sinusoidal variation of these residuals are easily seen in Figure 2. This additional phenomenon can be caused by the presence of a third body in this system (light-time effect) or by magnetic activity of the components, which was described recently by Applegate (1992). The preliminary period of a third body orbit or a magnetic cycle could be $P_3 \simeq 11000$ days = 30 years.

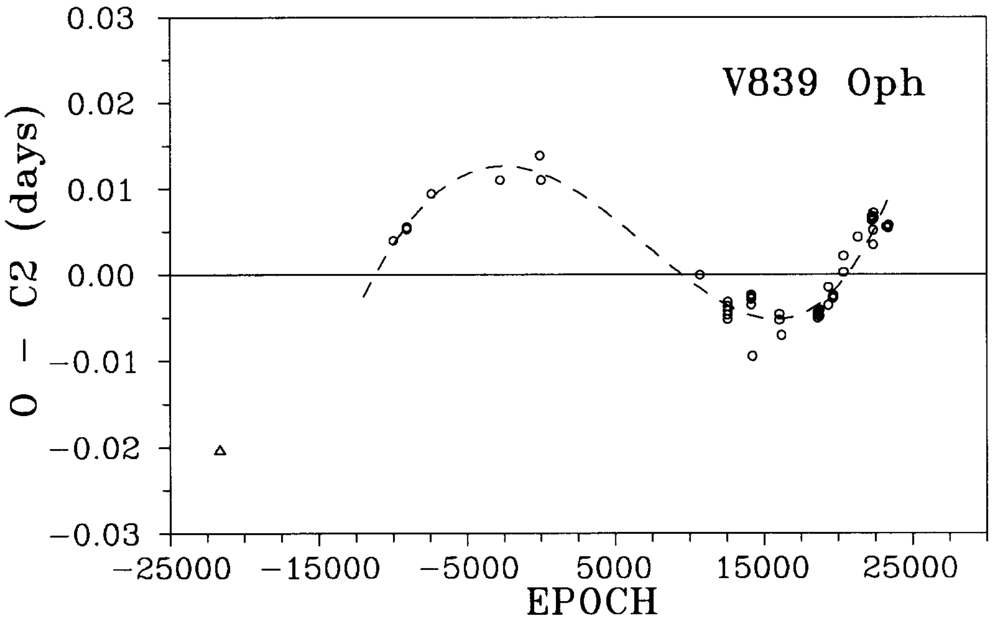

Figure 2. O$-$C$_2$ residuals for the times of minimum of V839 Oph after subtracting the parabolic term in light elements. The quasi-sinusoidal profile with the period of about 30 years is remarkable.

No firm solution of the present $O - C_2$ diagram could be given because the predicted period is not covered sufficiently by precise photoelectric measurements. More high accuracy timings of this eclipsing binary are necessary in the future to expand the time span for better analysis of both of these phenomena.

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OPTICAL OBSERVATIONS OF THE ACTIVE STAR FF CANCRI

The star FF Cancri = GSC 1383_600 was discovered to be an eclipsing binary by Pravec (1993), who found it to have a color of (V−R)=0.48 and a brightness V=10.83-11.40.

The automated 0.5-m. telescope, Cousins R filter and CCD camera of the Climenhaga Observatory of the University of Victoria (Robb and Honkanen, 1992) were used to make photometric observations of FF Cancri. 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 7 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=$08^h29^m43^s$, Dec=$17°15'38''$, V=10.6 and of the check star are RA=$8^h30^m09^s$, Dec=$17°16'19''$, V=12.5 (J2000). The standard deviation of the difference between the check and the comparison star during a night ranged from $0\overset{m}{.}008$ to $0\overset{m}{.}024$. The mean and standard deviation of the six nightly mean differential R magnitudes are $-1\overset{m}{.}284 \pm 0\overset{m}{.}006$ 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 R magnitude to a standard system.

Photometric observations were made between the 2nd and the 16th of February 1996 UT. By the method of Kwee and Van Woerden (1956) Heliocentric Julian Dates of primary minima were found to be $2450124\overset{d}{.}6402$, $2450125\overset{d}{.}9613$ and $2450129\overset{d}{.}9304$ and secondary minima occurred at $2450123\overset{d}{.}9750$ and $2450126\overset{d}{.}6235$. The uncertainty in the times of minima were formally about $0\overset{d}{.}0005$ days, but this estimate does not include an allowance for the asymmetry in the minimum, and thus the true uncertainty is larger. These minima unambiguously determine the orbital period to be about $1\overset{d}{.}32$. Pravec's 1992 data include the sharp shoulder at the end of the primary eclipse at a time we estimate to be $2448985\overset{d}{.}5006$. We have similar observations at $2450124\overset{d}{.}7099$ and $2450130\overset{d}{.}0158$; requiring an integral number of cycles to have elapsed gives us the following ephemeris:

$$\text{HJD of Primary Minima} = 2450123\overset{d}{.}3152 + 1\overset{d}{.}32313 \times E$$
$$\pm\overset{d}{.}0012 \quad \pm 0\overset{d}{.}00004$$

[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

Plots of the light curve for periods corresponding to one cycle less and one cycle more than this period look significantly noisier.

A plot of the 831 differential R magnitudes phased at this period is shown in Figure 1 with different symbols for each of the different nights. The obvious out-of-eclipse modulation of the light curve indicates that one or both of the stars are spotted, since proximity effects would be symmetrical about the minima. The points marked with a + represent data from a night 8 days earlier than the other data and show a shift of a few hundredths of a magnitude in the depth of the secondary minimum and at the beginning of the secondary minimum, indicating that the cool spots are probably on the primary star.

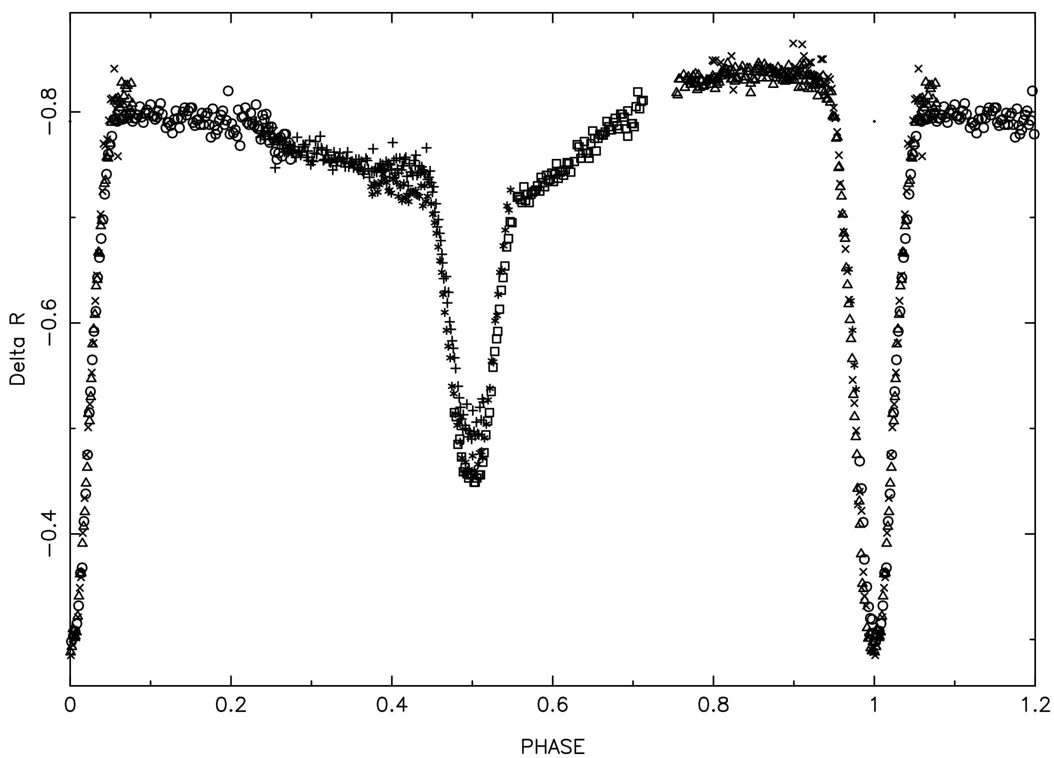

Figure 1. Light curve of 1996 differential R data of FF Cancri

The (V−R) color of Pravec (1993) and a cursory inspection of a spectrum taken with the Dominion Astrophysical Observatory 1.8m telescope indicate approximately a K0V spectral type for the primary star. Using "Binmaker2" (Bradstreet 1993) and a temperature of 4900 K for the primary star of the system, we have constructed a model light curve which fits our observed light curve and can be seen in Figure 2. Using albedo and limb darkening coefficients appropriate for the assumed spectral types the best fit we found was for an approximately K5V secondary star in an orbit inclined at 83°. Two large spots on the primary star are necessary to fit the out-of-eclipse variations, and this is consistent with a presumably synchronous rotation period and the temperature of the stars. A 3-dimensional diagram of the system is shown in Figure 3. Note that this is not a unique solution; in particular the spot latitude is not well determined.

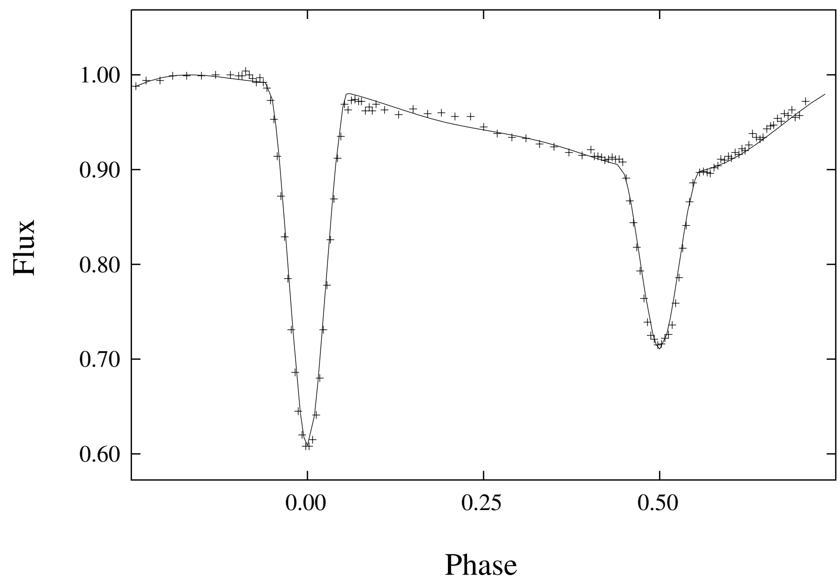

Figure 2. Light curve and a possible Binmaker2 model for FF Cancri

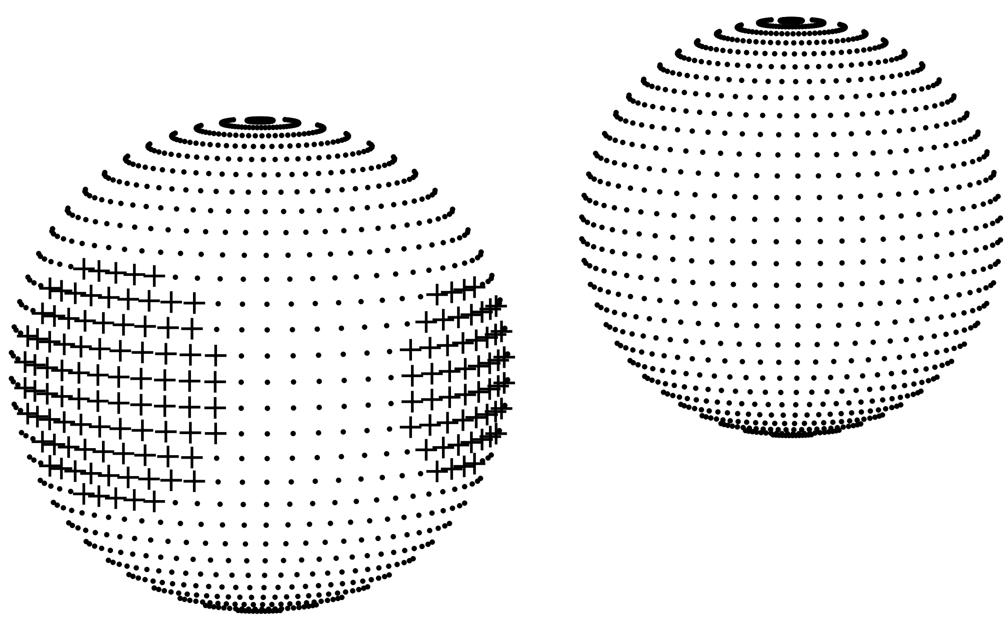

Figure 3. Three dimensional diagram of a possible Binmaker2 model of FF Cancri at phase 0.43

Further measurements will be very valuable to increase our knowledge of this important system. Photometric monitoring will be of interest since the changes in the light curve shape are probably due to differential rotation or active region evolution. Radial velocity measurements will be very important for the determination of the absolute dimensions of the system, the distance, and the gamma velocity. A careful spectral classification would confirm the temperature of the primary star and check for the presence of Ca H & K emission. We note that the star is in the direction of Praesepe in the sky and current estimates of its distance are too uncertain to rule out membership in that cluster, so proper motion and the radial velocity measurements will test for the star's membership in the cluster. Although FF Cancri has not been detected in X-rays or the extreme ultraviolet (EUV) (Pounds et al. 1993, Malina et al., 1994), it should be expected to be a source since it has large active regions. The eclipse of these active regions by the secondary star would help to measure the spatial extent of the emitting region.

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CONFIRMATION OF THE CLASSIFICATION OF A NEW TYCHO VARIABLE: HD 32456 IS A 3.3-DAY CEPHEID

The Hipparcos mission of ESA is mainly an astrometric project. Its photometric component, however, is expected to discover thousands of new variables. For a description of the mission see Perryman (1989) and references therein. A first list of 35 bright stars which were discovered to be variable in the course of the data reductions for the Tycho experiment on the Hipparcos satellite was published in IBVS No. 4118 (Makarov et al., 1994). HD 32456 = GSC 3738-234 is one of them. In IBVS No. 4118 the star GSC 8353-620 was erroneously included in the list of newly discovered variables. In fact its variability had already been known. It is RY Arae. (This error was pointed out by H. Mauder, Tübingen.)

The Tycho observations of any particular star are very unevenly distributed in time. Therefore it is usually difficult to derive the type and light curve elements for a newly-discovered variable. This is why in the fall of 1995 a call for observations of the 35 new variables was issued to amateurs.

Within a few weeks visual observations by M. Dahm and E. Born showed that HD 32456 is a Cepheid with a period of about 3.29 days. This information prompted photoelectric observations by F. Agerer, from which the light curves in Figure 1 resulted, along with an improved estimate of the period: 3.295 ± 0.001 days. The Tycho observations in the B_T photometric band, folded with this period, are shown in Figure 2. They, too, confirm the classification and period determination. The Tycho observations were collected between 1989 and 1993. Small groups of nearly simultaneous Tycho observations were binned before plotting in Figure 2, in order to reduce the scatter. The photoelectric data in Figure 1 were collected around the end of 1995. Combining the two normal epochs for the maxima from these two widely separated data sets, we find the following light curve elements for HD 32456:

$$\begin{array}{rcl} \mathrm{JD\ (max)} = 2450015.46 & + & 3.2942 \times \mathrm{E} \\ \pm 2 & & \pm 3 \end{array}$$

These values were derived from a combination of the B and V data. The maximum occurs almost simultaneously in the two channels. Formal standard errors are given in the line below the light curve elements. The normal epoch given refers to Agerer's data (Fig. 1). The corresponding normal maximum epoch from the Tycho data is JD 2448276.14 ± 0.15.

The variability of HD 32456 = HIP 23768 was independently discovered from the data of the Hipparcos main instrument. Compared to Tycho, this instrument gives photometry with much higher precision and a somewhat higher number of individual measurements. Therefore it was possible to independently derive a type and period. Thus, Turon & van Leeuwen (1995) also announced HD 32456 to be a Cepheid of about 3.3 day period, but without giving complete light curve elements. According to van Leeuwen (private communication), best-fit elements from the Hipparcos main instrument alone are:

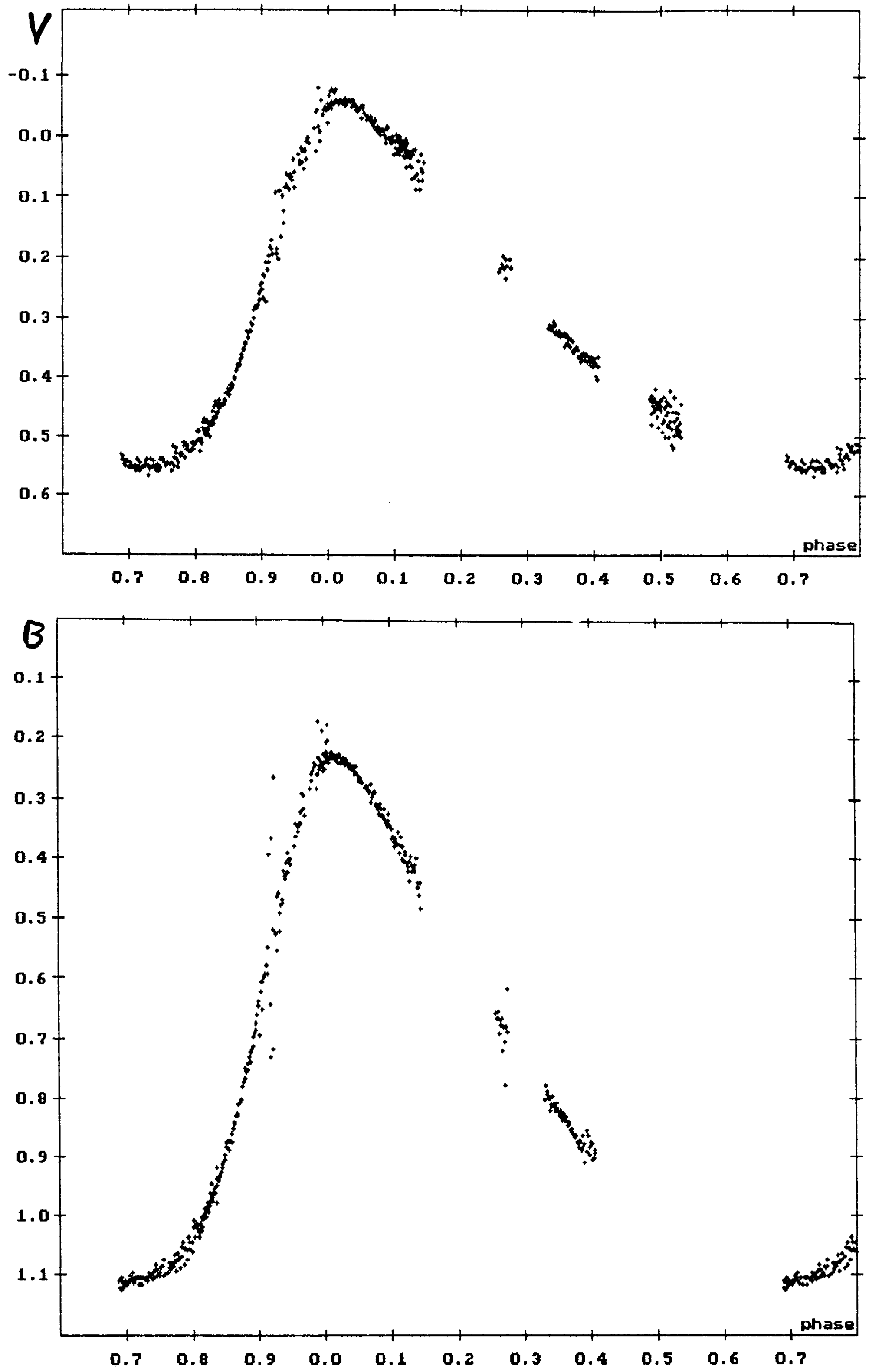

Figure 1. Photoelectric B and V light curves of HD 32456, collected around the end of 1995. The observations were done with F. Agerer's private 0.35m automatic telescope. The photometer was equipped with an uncooled EMI 9781A tube and Schott filters for B and V. The diaphragm was 32" in diameter. PPM 29633 (F8) served as comparison star and PPM 29635 (K0) to check its constancy.

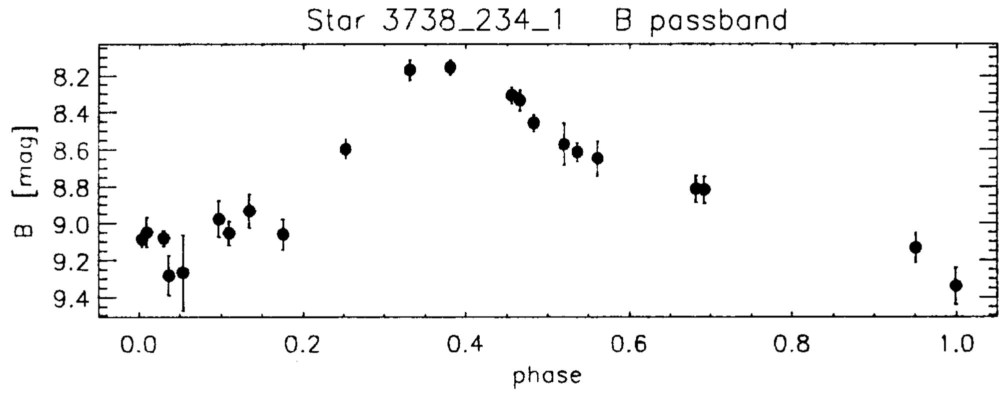

Figure 2. The TYCHO data in the B_T channel, collected between 1989 and 1993. Figures 1 and 2 are folded light curves, based on an assumed period of 3.295 days.

$$\text{JD (max)} = \underset{\pm 5}{2448503.21} + \underset{\pm 5}{3.29473} \times \text{E}$$

Combining the reference epoch from the Hipparcos main instrument with the normal epoch from the ground-based photometry we find as the currently best estimate of the elements of HD 32456:

$$\text{JD (max)} = \underset{\pm 2}{2450015.46} + \underset{\pm 4}{3.29471} \times \text{E}$$

It is surprising that such a bright, continuously variable star, with an amplitude as large as 0.6 mag in V and 0.9 mag in B, has remained undetected for so long.

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NEW TIMES OF MINIMA OF THE ECLIPSING BINARIES 44i BOOTIS AND VW CEPHEI

The eclipsing variable stars 44i Boo and VW Cep are two well observed active close binaries of W UMa type. Here, we present new times of minima for these two systems determined from our photoelectric observations made during 1995.

44i Bootis

The eclipsing binary 44i Boo is the fainter companion (B+C) of the close visual binary ADS 9494. Its light curves are characterized by "active" and "quiet" intervals and its period is variable (e.g. Bergeat et al., 1972; Rovithis and Rovithis-Livaniou, 1990, Oprescu et al., 1989 & 1991; Gherega et al., 1994).

New photoelectric observations of the system were made during two nights in April, as well as during one in May and two in August 1995. The observations in April were made with the two-beam, multi-mode, nebular-stellar photometer of the National Observatory of Athens, attached to the 48-inch Cassegrain reflector at the Kryonerion Astronomical Station; while, those in May and August with an EMI 9502 B type photocell, attached to the 50cm Cassegrain telescope of the Bucharest Observatory.

From our observations of 44i Boo six new minima times were derived and are presented in Table I.

Table 1. Photoelectric minima of 44i Bootis

Hel JD 2440000+	Min	Filter	$(O-C)_I$ days	$(O-C)_{II}$ days	$(O-C)_{III}$ days
9812.4825	II	V	0.0528	0.0155	−0.0068
.4827	II	B	0.0530	0.0157	−0.0066
.6152	I	V	0.0516	0.0143	−0.0080
.6148	I	B	0.0512	0.0139	−0.0084
9813.4184	I	V	0.0513	0.0140	−0.0073
.4188	I	B	0.0517	0.0144	−0.0069
9866.4487	I	V	0.0541	0.0164	−0.0051
.4468	I	B	0.0522	0.0145	−0.0070
.4471	I	U	0.0525	0.0148	−0.0067
9938.3678	II	V	0.0646	0.0265	+0.0048
.3683	II	B	0.0651	0.0270	+0.0053
.3646	II	U	0.0614	0.0233	+0.0016
9943.3130	I	V	0.0552	0.0171	−0.0047
.3128	I	B	0.0550	0.0169	−0.0049
.3139	I	U	0.0561	0.0180	−0.0038

In Table 1 the residuals $(O-C)_I$, $(O-C)_{II}$ & $(O-C)_{III}$ have been calculated using Kwee & Van Woerden's method (1956) and according to the following ephemeris formulae:

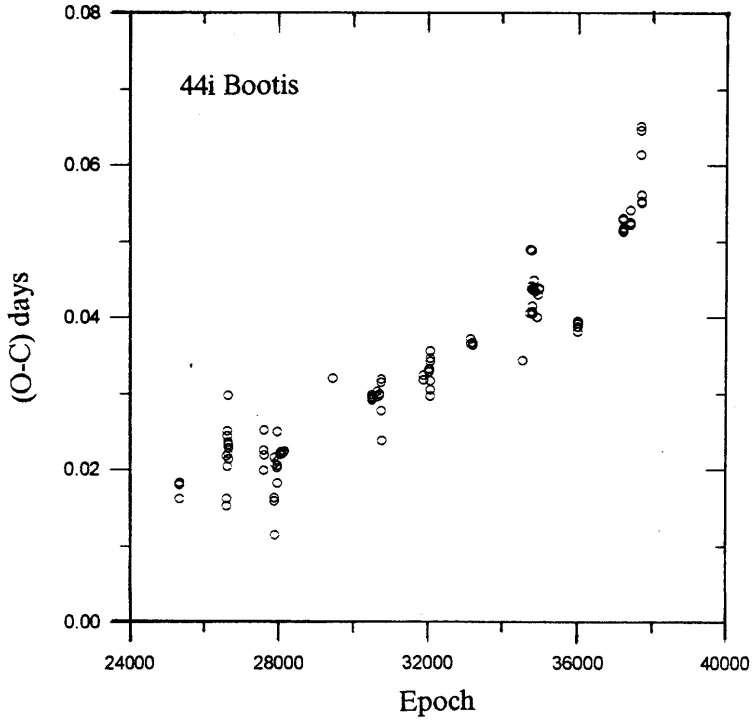

Figure 1. The latest part of the (O−C) diagram of 44i Boo, based on Duerbeck's (1975) ephemeris formula.

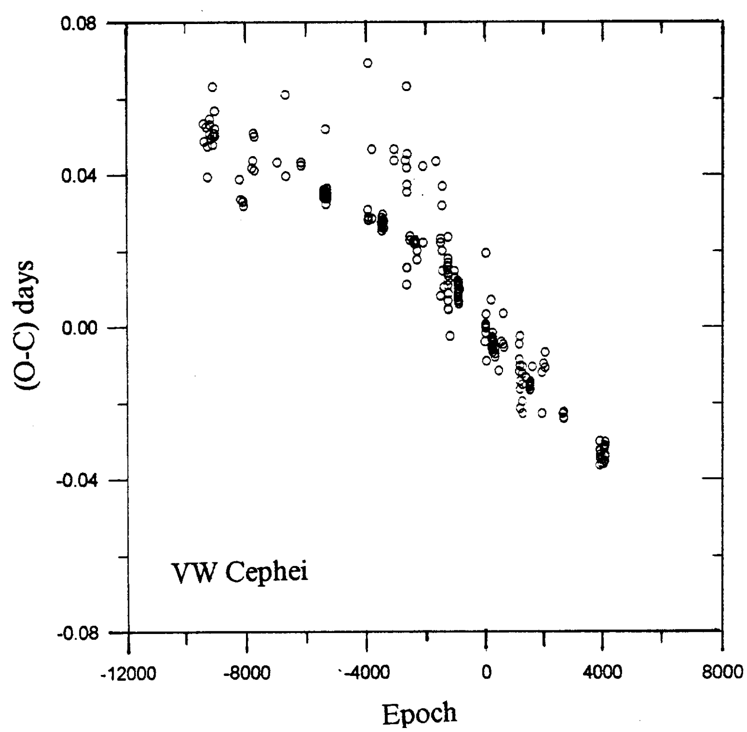

Figure 2. The latest part of the (O−C) diagram of VW Cep, based on Navratil's (1994) ephemeris formula.

(I): Min I = J.D. 2439852.4903 + 0.2678159 × E
(Duerbeck, 1975)

(II): Min I = J.D. 2439852.4644 + 0.2678176 × E
(Rovithis and Rovithis-Livaniou, 1990)

(III): Min I = J.D. 2443604.5880 + 0.26781856 × E
(Oprescu et al., 1991)

From the recent part of the O−C diagram of 44i Boo, which is presented in Figure 1 – based on Duerbeck's (1975) ephemeris and corresponding to the last years – and from a comparison of the O−C values presented in Table 1, with those of Rovithis-Livaniou et al. (1995), we can see that the period of 44i Boo is continuously increasing.

VW Cephei

The eclipsing binary VW Cep is a member of a triple system (Hershey, 1975). Its light curves show temporal variation on short time scales (from night to night; e.g. Kwee, 1966; Kreiner & Winiarski, 1981), as well as on long time scales (e.g. Karimie, 1983; Kotarska & Glownia, 1983; Bradstreet & Guinan, 1990).

Photoelectric observations of VW Cep were made during nine nights (1 in August, 3 in September and 5 in October 1995), at the Bucharest Observatory using the same instruments as for the observations of 44i Bootis.

Table 2. New minima of VW Cephei

Hel.JD 2400000+	Min. Type	Filter	E	$(O-C)_I$ days	$(O-C)_{II}$ days
49953.3496	II	V	3919.5	−0.0299	+0.0010
.3473	II	B		−0.0322	−0.0013
.3431	II	U		−0.0364	−0.0055
.4851	I	V	3920	−0.0336	−0.0026
.4843	I	B		−0.0344	−0.0034
.4862	I	U		−0.0325	−0.0015
49975.3304	II	V	3998.5	−0.0360	−0.0045
.3324	II	B		−0.0340	−0.0025
.3316	II	U		−0.0348	−0.0033
49994.2599	II	V	4066.5	−0.0319	+0.0001
.2600	II	B		−0.0318	+0.0002
.2558	II	U		−0.0360	−0.0040
49996.3481	I	V	4074	−0.0310	+0.0010
.3472	I	B		−0.0319	+0.0001
.3475	I	U		−0.0316	+0.0004
50003.3057	I	V	4099	−0.0313	+0.0017
.3067	I	B		−0.0303	+0.0027
.3034	I	U		−0.0336	−0.0006
50004.2770	II	V	4102.5	−0.0340	−0.0000
.2758	II	B		−0.0352	−0.0022
.2775	II	U		−0.0335	−0.0005

From our observations seven new minima times were derived and are presented in Table 2; where the residuals have been found using Kwee & Van Woerden's method (1956) and the C's have been calculated according to the ephemeris:

$$\text{Min I} = \text{J.D.}\,2448862.5255 + 0.27831460 \times \text{E} \qquad \text{(I)}$$

(Navratil, 1994)

and its improvement:

$$\text{Min I} = \text{J.D.}\,2448862.5220 + 0.2783076 \times \text{E} \qquad \text{(II)}$$

(Aluigi et al., 1994)

From the recent part the O−C diagram of VW Cep, presented in Figure 2 – corresponding to the last years and based on Aluigi et al.'s (1994) ephemeris – it is clear that the orbital period of the system is decreasing.

Moreover, from the O−C values of Table 2, one can notice that better results are obtained from the improved ephemeris – that of Navratil's (1994) – which corresponds to a smaller period for VW Cep, indicating again that the period of the system is continuously decreasing.

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NEW ELEMENTS FOR THE ECLIPSING BINARY ZZ Cnc

ZZ Cnc = HD 65025 (A0) = BD +11°172 (8.7) = BV 361 was discovered an as Algol-type eclipsing binary by Strohmeier (1961). The GCVS (Kholopov et al., 1985) contains first elements derived by Strohmeier (1962a,b):

$$\text{Min} = \text{J.D.}\,2426770.350 + 25.5950 \times \text{E} \qquad (1)$$
$$(\text{EA } 9.40 - 10.90\ \text{m}_{pg})$$

Since the period is rather long, further photometric observations of the star were not numerous. Only one minimum has been published up to now (Isles, 1986).

Brightness of ZZ Cnc was estimated using the photographic plates of the Sonneberg Sky Survey to check the validity of the above elements. These elements were found to be not correct. In the paper of Strohmeier only minima with even numbers of epoch were listed.

The magnitude values determined from 195 plates covering the years 1975-1995, have pointed out to double the value of the period found by Strohmeier. The light curve folded on the new period is shown in Figure 1. Period analysis of that material by means of a method published by Renson (1978) has been done (Figure 2) confirming the above conclusion.

A weighted least squares fit yields the following linear ephemeris:

$$\text{Min} = \text{J.D.}\,2444635.44 + 51\overset{d}{.}1894 \times \text{E} \qquad (2)$$
$$\pm 3 \qquad\qquad \pm 2$$
$$(\text{EA } 10.10 - 11.55/10.20(:)\ \text{m}_{pg};\ \text{D}=0.07\times\text{P})$$

Table 1. Observed times of minima for ZZ Cnc, epochs and residuals

Minimum JD 2400000+	Epoch	$(O-C_2)$	Weight	Observer
26770.35	−349	0.005	1	Strohmeier
27538.33	−334	0.145	1	
27896.334	−327	−0.177	1	
37315.47	−143	0.114	1	
44635.378	0	−0.059	2	Berthold
45403.367	15	0.090	2	
45761.401	22	−0.202	2	
47860.530	63	0.163	2	
48679.389	79	−0.008	2	
48986.507	85	−0.027	2	

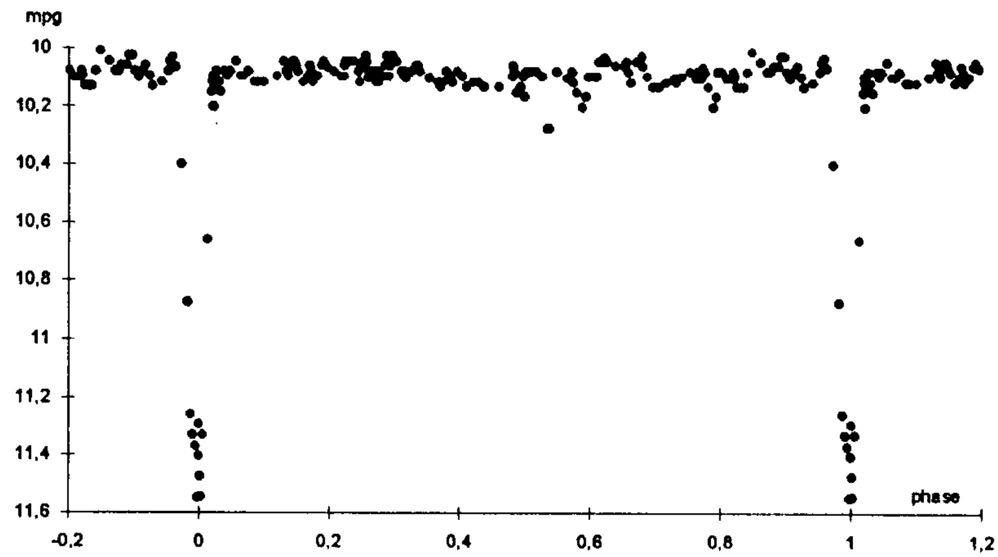

Figure 1. Photographic light curve of ZZ Cnc plotted using the elements (2). Photographic magnitudes were obtained by a photographic photometer and refer to the Harvard-Groningen SA 76.

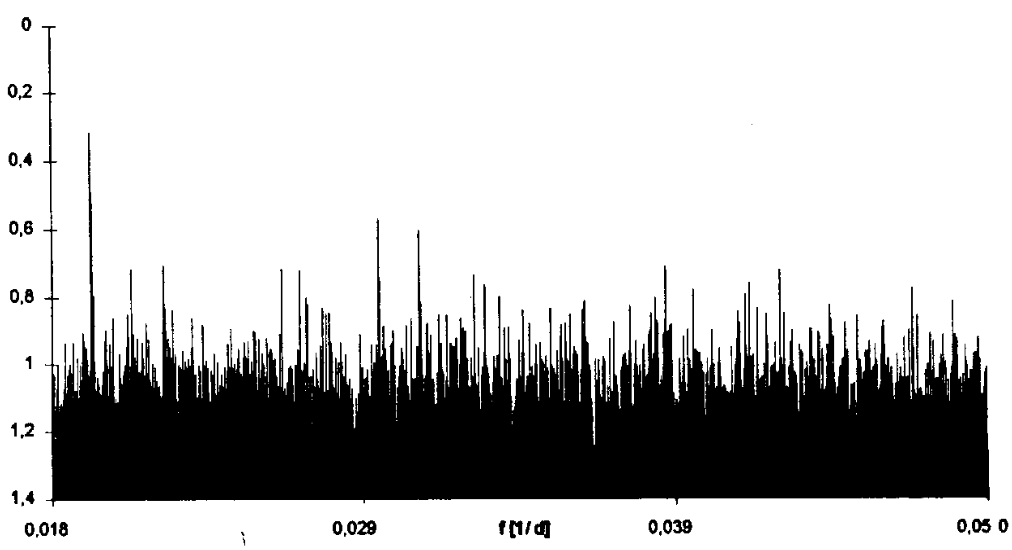

Figure 2. Periodogram (20-55 days) of ZZ Cnc.

The minimum of Isles (derived from 6 visual observations) has not been considered.

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MINIMUM TIMES AND PERIOD BEHAVIOUR OF THE NEGLECTED ECLIPSING BINARY WZ CYGNI

The variable star WZ Cyg (BD +38°4262) is an eclipsing binary exhibiting a β Lyrae-type light curve. It is a poorly observed system (Koch et al. 1979) and for this reason it was included in our observational program of 1993 and 1994.

WZ Cyg was observed photoelectrically with the two-beam, multi-mode, nebular-stellar photometer attached to the 1.20m Cassegrain reflector at the Kryonerion Astronomical Station of the National Observatory of Athens, Greece.

Observations were made during 5 nights (24/25, 25/26, 28/29, 29/30 June and 30 June/1 July 1993) and 7 nights (11/12, 15/16 & 17/18 May, 25/26 & 26/27 June; 11/12 & 12/13 September) in 1994.

From our observations seven new minima times were derived which are given in Table 1, where the C's have been computed using Kholopov's (1985) ephemeris formula:

$$\text{MinI} = \text{J.D.}\,2440825.475 + 0\overset{d}{.}5844659 \times \text{E} \qquad (1)$$

and are the mean values of our B and V observations.

Table 1

Hel JD 2440000.+	Min Type	Filter	E	O−C days
9163.5002	I	B,V	14266	0.0347
9164.3800	II	B,V	14267.5	0.0378
9168.4685	II	B,V	14274.5	0.0350
9169.3457	I	B,V	14276	0.0355
9490.5083	II	B,V	14825.5	0.0341
9529.3778	I	B,V	14892	0.0366
9530.5466	I	B,V	14894	0.0364

Moreover, from the photographic and photoelectric minima times of WZ Cyg found in the literature (Kurzemniece, 1950; Hanzl, 1991) and our new ones, given in Table 1, the O−C diagram of the system was constructed and is presented in Figure 1. Most of the minima times presented in this figure are primaries. From the data available up to now both primaries and secondaries seem to behave in a similar way.

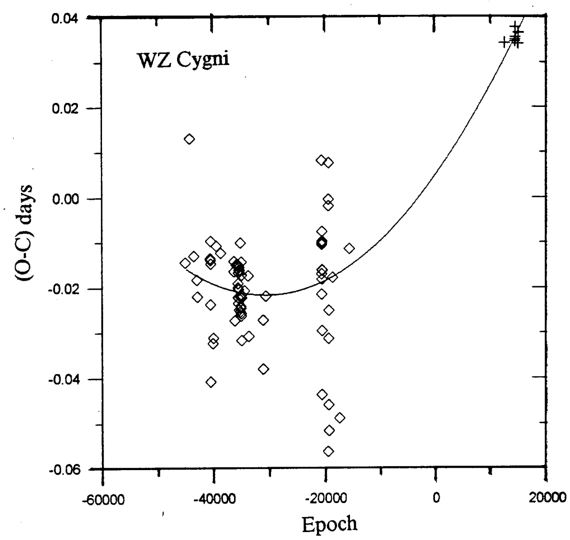

Figure 1. The O−C diagram of WZ Cyg based on photographic (diamonds) and photoelectric (crosses) minima times only. The C's have been calculated according to ephemeris given in the GCVS. The continuous line presents the quadratic least squares fitting.

As it was pointed out, WZ Cyg is a poorly observed system and much more data are needed for a complete study of its orbital period, which has been certainly increasing. Here, we only try to fit a least squares second order polynomial and improve Kholopov's (1985) ephemeris, although there are not much data for long periods of time. We find:

$$\text{Min I} = \text{J.D.}\,2440825.47999 + 0\overset{d}{.}58446763 \times \text{E} + 2.82 \times 10^{-11} \times \text{E}^2 \qquad (2)$$

considering the photographic data with the weights given by Kurzemniece (1950). Figure 1 presents the quadratic least squares fitting, as well.

Acknowledgements: P. & H. Rovithis are indebted to Dr. N. Samus, who provided them the copy of the old paper of Kurzemniece, containing valuable data. Moreover, A. K. thanks the Research Com. of Athens University for financial support (No. 70/4/2448).

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NONVARIABILITY AMONG λ BOOTIS STARS II.: SAAO (1994, 1995), CTIO (1994) AND IAA (1996) DATA

This is the second compilation of results, which revealed photometric stability within our extensive survey for pulsation in λ Bootis stars. The scientific background of this program is described by Weiss et al. (1994). The first list of 'constant' results was presented recently in this journal (Paunzen et al., 1996). The photometric results shown in this paper are based on four observing runs at three different sites obtained by the observers R. Kuschnig (RK) and M. Gelbmann (MG). The measurements were performed with the 50cm telescope of the South African Astrophysical Obs. (SAAO), the 60cm Lowell telescope at Cerro Tololo Inter-American Obs. (CTIO) and the 90cm telescope of the Instituto Astrofisica Andalucia (IAA). Table 1 lists all observed, confirmed or candidate (see question mark), λ Bootis and comparison stars with the date and the duration of the observations. The time series analysis was done with a standard Fourier technique (Breger, 1990) and applied to the differential photometry. The last column gives the noise level in the amplitude spectrum obtained from differential photometry (the actual comparison star is marked with an asterisk in Table 1) and is hence the upper limit of an eventual variability in the frequency range from 0 to 150 c/d.

Acknowledgement: 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 *S 8303-AST*) and the Hochschuljubiläumsstiftung der Stadt Wien (λ Bootis Sterne). This research has made use of the Simbad database, operated at CDS, Strasbourg, France.

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Table 1. Program and comparison stars

Star	Site/Observer	JD	hours	m_V	Spec.		Upper limit [v]
HD 31295	SAAO/RK	2449741	2.2	4.74	λ Boo		0.006
HD 31283				5.31	A3V	$\star$	
HD 30913				7.21	F2		
HD 38545	CTIO/MG	2449692	3.3	5.76	λ Boo		0.004
		2449693	5				
		2449697	3				
HD 39317				5.54	B9	$\star$	
HD 66920	SAAO/RK	2449741	1.2	6.33	λ Boo(?)		0.004
HD 64142				7.6	F3V	$\star$	
HD 66168				7.9	F8V		
HD 74873	IAA/RK	2450095	2.4	5.87	λ Boo		0.007
HD 74228				5.62	A3V	$\star$	
HD 74521				5.66	A1p		
HD 79025	CTIO/MG	2449695	3.6	6.65	λ Boo(?)		0.003
HD 78326				7.9	A0IV	$\star$	
HD 79622				8.13	K5III		
HD 82573	SAAO/RK	2449468	2.4	5.74	λ Boo(?)		0.003
HD 81712				6.8	A7V	$\star$	
HD 82724				6.8	A0V		
HD 83277	SAAO/RK	2449476	3.6	8.31	λ Boo(?)		0.004
HD 83547				8.3	A0V	$\star$	
HD 82709				7.7	A9V		
HD 91130	IAA/RK	2450097	3	5.93	λ Boo		0.009
HD 91365				5.58	A2Vn	$\star$	
HD 90840				5.77	A4V		
HD 179791	SAAO/RK	2449475	3.6	6.49	λ Boo(?)		0.003
HD 180482				5.59	A3IV		
HD 178596				5.22	F0III		

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ON THE PECULIAR FLICKERING ACTIVITY OF HR 2492[1]

Be stars are known to be variable with periods of the order of one day and with amplitudes of a few percent in light and radial velocity. Baade (1984) mentions HR 2492 = HD 48917 = 10 CMa as an example displaying prominent short-period spectroscopic variations ($P = 1\overset{d}{.}36$). Associated periodic photometric variations with $P = 1\overset{d}{.}35$ were reported by Dachs & Lemmer (1989) and also by Balona et al. (1992), who obtained a period twice as much, viz. $P = 2\overset{d}{.}63$.

Photometric variability on time scales between a few days and several years with typical amplitudes of $0\overset{m}{.}1$–$0\overset{m}{.}2$ in *uvby* are reported by Sterken et al. (1996). Two types of variability are seen, viz. a quasi-regular oscillation with $P = 87\overset{d}{.}9$ (increasing amplitude towards redder wavelengths), and a superimposed very-long-term trend that, if it is periodic, has a cycle length of the order of several years. Moreover, random short-term variability is added on the $87\overset{d}{.}9$ oscillation.

All measurements of HR 2492 discussed here were obtained by one observer in a single observing run using a stable instrumental configuration (Danish 50cm telescope at La Silla) in the framework of the Long-term photometry of variables project (LTPV, Sterken 1993). The measurements were obtained differentially using two nearby comparison stars (see Table 1 for the details). Each measurement consisted of one uninterrupted integration of 40 s (simultaneously in the u, v, b and y bands); for the sky background one single 25-s integration was secured for the program star and for both comparison stars (sequence APB). The night when the flare was observed occurred close to full moon, however, all sky background measurements have very consistent values and the deviating point can not readily be attributed to spurious light coming from the moon. HR 2492 has the highest count rate of the three stars, still it displayed the highest internal variance throughout the whole observing run, indicating the presence of steady high-frequency variations in the photon flow that could be characterised by flickering with (very occasional) flaring. It would be interesting to undertake high-speed photometric measurements of this star.

Figure 1 shows a differential $b-y$, c_1 diagram for HR 2492 and three other Be stars investigated by Sterken et al. (1996). Except for HR 2492, the variations in $b-y$ and c_1 are moderate (but not small, see the scale in c_1). The variations of both indices are huge in the case of HR 2492, with a most interesting single excursion in $b-y$ on HJD 2446425.66, where the $b-y$ index suddenly becomes $0\overset{m}{.}2$ redder. This effect is solely due to a spike that is visible in the y band as a sudden brightening of $0\overset{m}{.}13$; this jump can also be seen in the non-differential data in the instrumental system (Figure 2), and is—according to the low mean errors on the successive integrations—without any doubt of non-instrumental origin (note that evident observational mistakes—such as centering errors or observing in cloudy weather—tend to diminish light in all passbands rather than produce spikes). We

[1]BASED ON OBSERVATIONS OBTAINED AT THE EUROPEAN SOUTHERN OBSERVATORY, LA SILLA, CHILE

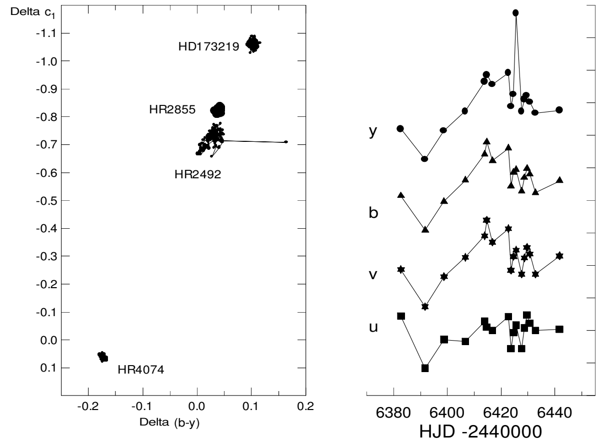

Figure 1. Differential $b-y$, c_1 diagram for HR 2492 and three other Be stars (indices relatively to their respective comparison stars) with similar records of observation (left). *uvby* differential magnitudes of HR 2492 around JD 2446425 causing the outlying $b-y$ data point; tick marks on the magnitude axis are $0^{\mathrm{m}}.05$ apart (right)

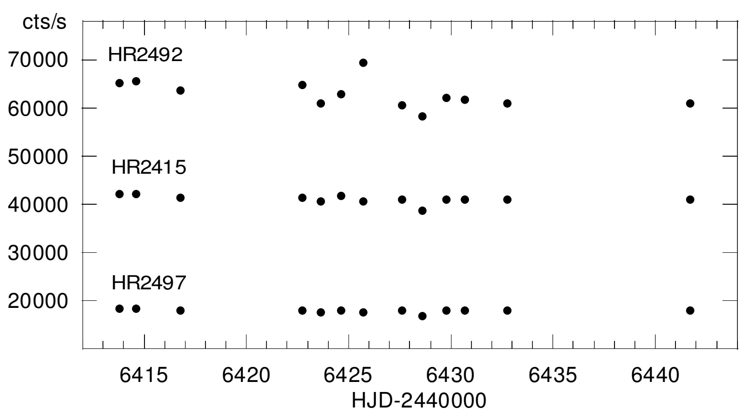

Figure 2. y count rates of HR 2492 and comparison stars HR 2415 and HR 2497

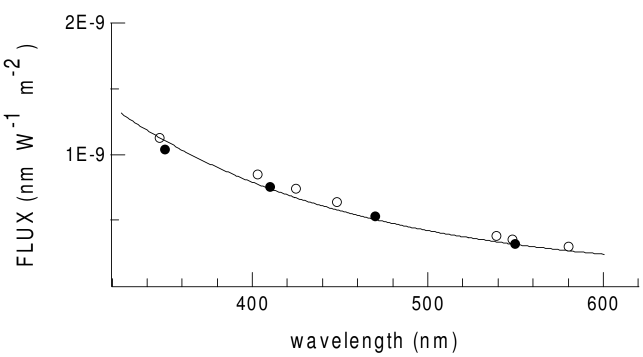

Figure 3. 17 500 K blackbody energy distribution for HR 2492. Filled circles are from (dereddened) *ubvy* data, open circles represent $UBVB_1B_2V_1$G photometry (see text)

find additional support for our conclusion from an investigation of the amount of variance seen in the counts of successive 1–second integrations recorded during observations. That variance, as a rule, is a very good indicator of the goodness-of-sky quality and should be of the same order of magnitude for the comparison stars as for the program star, provided that the sky transparency is stable and that the photon noise is similar for all stars involved. In the case of HR 2492 this internal dispersion amounts to more than twice the overall mean error obtained from comparison-star data covering more than 8 years. Note that the peculiar measurement on HJD 2446425.66 is not listed in Manfroid et al. (1991) because it was removed by an automatic filtering procedure checking for occasional outliers in the data.

The interpretation of the observed phenomenon is not straightforward, especially because the flare has been seen in one passband only. One could, for example, compare the observed $0\overset{m}{.}2$ excursion in $b-y$ with the strong and abrupt reddening $\delta(b-y) = 0\overset{m}{.}7$ of 28 CMa reported by Mennickent et al. (1994), though that case is different, since the flare was related to a strong fading. An example of an equally unexplainable but opposite situation is given by Ventura et al. (1995), who observed a strong U-band flare (with associated micro-activity) in the light output of the dM3.5e star V 1054Oph, whereas no flare in V was seen.

Using $E_{B-V} = 0.236$ derived from Geneva colours, we dereddened our mean $uvby$ data (Table 1) and the Geneva photometry from Rufener (1988). Figure 3 shows the results, together with a blackbody energy distribution corresponding to 17500 K (Waters et al. 1987). There is no sign of the presence of a red companion, and unpublished $JHKLM$ photometry collected by one of us (C.S.) confirms that in the near-infrared region there is no excess radiation of the sort expected from a cool companion. Waters et al. (1987) discussed the infrared excesses at 12, 25 and 60 μm of a total of 59 Be stars. For 57 stars in this sample—among which HR 2492—the infrared excesses can be completely attributed to a circumstellar equatorial disk.

In spite of the absence of a red companion HR 2492 could be a binary containing a close compact secondary (white dwarf or neutron star). This companion should be surrounded by a classical accretion disk which always acts as an effective reprocessor of energy from short to longer wavelengths. Therefore, the observed flare could be caused by a reprocessed X-ray burst into optical wavelengths (through the procedure of absorption of part of the infalling X-rays and consequent heating with emission of most of its energy beyond λ540–560nm, the y passband). Transient X-ray radiation is liberated whenever potential energy is released in an strong accidental accretion event onto the surface of a compact companion.

Table 1. Program (P) and comparison stars (A, B): average $y(V)$, $b-y$, m_1, c_1 magnitudes and their overall standard deviations σ based on the non-differential nightly mean values for each star. N denotes the total number of observations of each star. The results are based solely on data belonging to System 7 taken during a time interval of more than 8 years (Sterken et al., 1993, see also Sterken, 1993)

LTPV	HR	MK	$y(V)$	$b-y$	m_1	c_1	N	σ_y	σ_{b-y}	σ_{m_1}	σ_{c_1}
P4004	2492	B2III(e)	5.235	−0.008	0.040	−0.039	139	.051	.016	.013	.025
A4004	2415	B8V	5.626	−0.031	0.115	0.871	226	.007	.003	.005	.006
B4004	2497	B8IV	6.537	−0.046	0.121	0.492	192	.008	.003	.004	.007

Note that strong wavelength-dependence of spectral features is not uncommon in systems with accretion disks. An extreme example is β Lyrae, where a disk is present together with—at right angles to it—supplementary elongated clouds of ionised material, as inferred Nordsieck et al. (1995) and—independently—by Harmanec et al. (1996). In the β Lyrae system the visual and ultraviolet light emissions are shifted in polarisation angle, consequently disabling detection of flare events in different passbands.

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OPTICAL OBSERVATIONS OF SN 1996C IN MCG+08-25-47

Supernova (SN) 1996C in MCG+08-25-47 was discovered on 1996 Feb. 15 (UT) by J. Mueller (1996) on a IV-N plate obtained by herself and K. M. Rykoski in the course of the second Palomar Sky Survey. Precise positions were measured by Sicoli (1996) on UT Feb. 22.99 and by Balam (1996) on UT Feb. 24.47. The offset from the center of the galaxy was determined to be 13$''$.4 north and 1$''$.6 west of the galaxy's nucleus. Garnavich et al. (1996) provided confirmation of SN 1996C from an image obtained by J. Luu with the 1.2-m telescope at Mt. Hopkins on UT Feb. 17.5. The supernova was estimated to be V = 16. In addition, a spectrogram of SN 1996C was obtained by D. Koranyi (1996) using the 1.5-m Tillinghast telescope, showing SN 1996C to be a type-Ia supernova near maximum. Weak Hα emission from the host galaxy indicated a redshift of z = 0.027.

Photometric and astrometric observations of SN 1996C were obtained on four nights using the 1.82-m Plaskett telescope and SITe-1 charge-coupled device (CCD) of the Dominion Astrophysical Observatory. All CCD frames were bias subtracted and flat fielded,

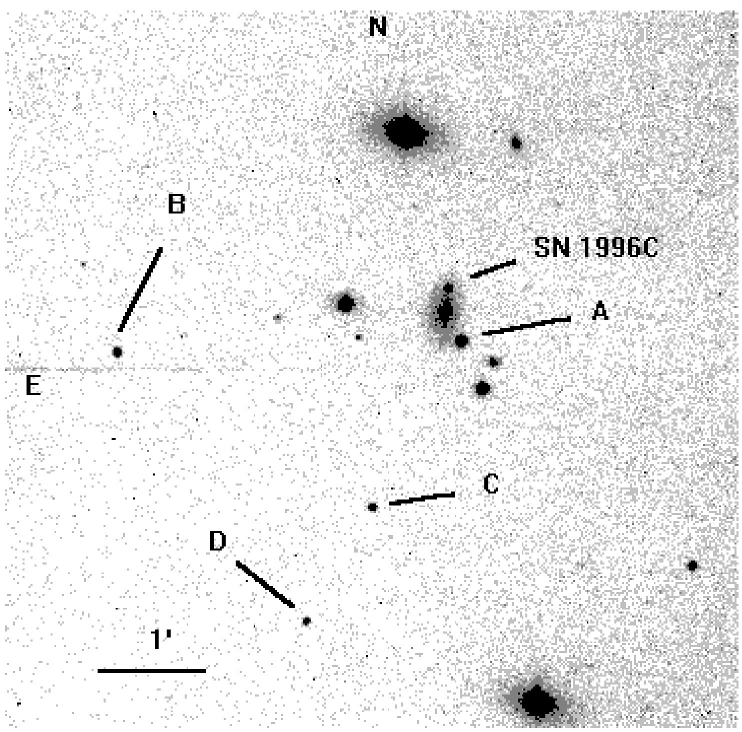

Figure 1. Secondary standard stars near MCG+08-25-47

Table 1. Photometric standard stars near MCG+08-25-47

Star	(2000)	(2000)	V	B−V
A	$13^h50^m47^s.81$	$+49°18'38''.9$	14.93 (0.01)	+0.56 (0.01)
B	$13^h51^m07^s.46$	$+49°18'28''.9$	16.76 (0.01)	+0.55 (0.02)
C	$13^h50^m52^s.79$	$+49°17'05''.5$	16.59 (0.03)	+1.00 (0.03)
D	$13^h50^m56^s.47$	$+49°16'01''.0$	17.31 (0.06)	+0.93 (0.06)

using median filtered twilight flats, in the usual manner using IRAF[1]. Local photometric standard stars from the Guide Star Photometric Catalog (Lasker et al., 1988) were observed at the same airmass as the supernova field. The data has been brought to the standard system using color transformation coefficients that were determined by observation of the M92 standard stars of Christian et al. (1985).

A photometric sequence of secondary standard stars (Figure 1) was established in the field of MCG+08-25-47 and are listed in Table 1. The astrometric positions of the secondary standard stars were calculated from a frame constants solution involving six Guide Star Catalog (GSC) stars (Jenkner et al., 1990). The mean error, within the polygon of GSC stars, was determined to be $0''.6$. A detailed description of our astrometric reduction techniques can be found in Tatum et al. (1994).

Differential magnitudes and colors of SN 1996C are listed in Table 2 for four nights (UT Feb. 24, 25, March 1, and March 14). The photometry was performed using the (IRAF) PHOT routine with a measuring aperture of $2''.8$ and sky annulus of 19" radius. The FWHM of the stars was determined as $2''.4$. The comparison and check stars are labelled as stars A and B in Table 1 and Figure 1. The standard deviation of all nightly comparison − check star differential magnitudes was 0.012 and 0.011 magnitudes in the B and V filter images.

Supernova 1996C is located 14" north of the core of its host galaxy. The host galaxy can be detected as far as 23" north of the galaxy core. Contamination of the supernova observations by the host galaxy has been minimized by building models of the host galaxy using elliptical isophotal fitting (Jedrzejewski, 1987), as implemented with the IRAF routines ELLIPSE and BMODEL in the STSDAS package, and subtracting the model galaxies from the original images. Errors, induced by the modelling process, have been estimated by placing artificial SNe in areas of the host galaxy that have similar surface brightness and gradient to the region containing SN 1996C. The mean error induced by the modelling process is 0.02 in the B images and 0.01 in V images. The resultant galaxy subtracted observations are listed in Table 2 as V_{sub} and $B - V_{sub}$.

Preliminary fitting (Figure 2) of the V band light curve template of Leibundgut (1988) to the galaxy-modelled observations of Table 2 implies that (B) maximum occurred on UT 1996 Feb. 15 (JDT 2450128) when SN 1996C was apparent magnitude V = 16.65.

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

Table 2. Observations of SN 1996C

JDE	V_{Sub}	$B - V_{Sub}$	V	B−V
(2450000+)				
137.97	16.87 (0.01)	+0.08 (0.02)	16.72 (0.02)	+0.11 (0.02)
138.90	16.91 (0.02)	+0.14 (0.03)	16.73 (0.02)	+0.16 (0.03)
143.89	17.21 (0.01)	+0.33 (0.02)	17.00 (0.02)	+0.37 (0.03)
156.90	18.09 (0.01)	+0.81 (0.05)	17.94 (0.02)	+0.92 (0.04)

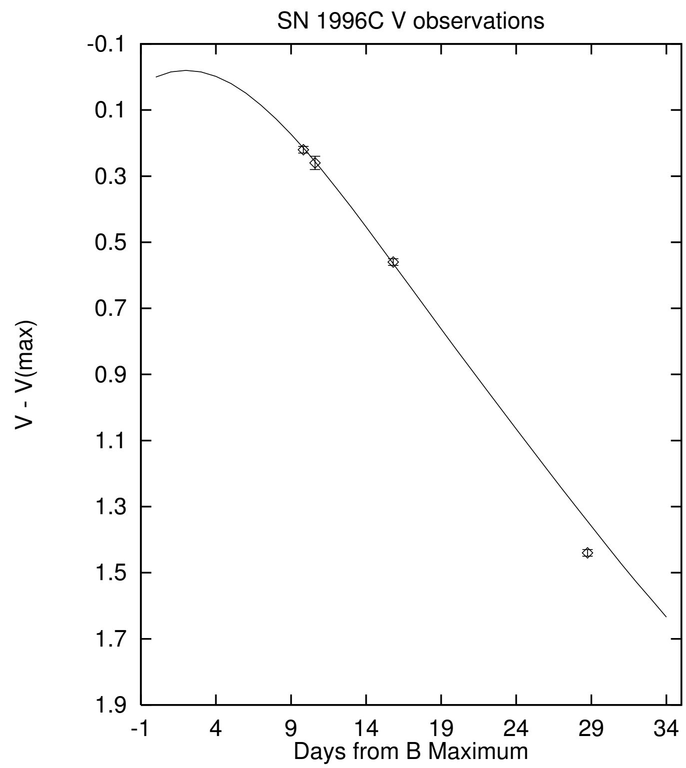

Figure 2. Light curve (V) of SN 1996C

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THE PULSATION FREQUENCIES OF β CMa

β CMa is one of the brightest β Cep stars in the sky. As such, it is a difficult object to observe without the use of neutral density filters or other techniques of preventing saturation of the photomultiplier. This perhaps explains why there are no photometric observations since those of Shobbrook (1973).

β CMa is the second brightest object in the sky in the spectral range 500 - 700 Å (the brightest being ϵ CMa). Observations of ϵ CMa in the EUV are presented by Cassinelli et al. (1995); results of observations of β CMa in the EUV by the same group are in press. It turns out that there are several anomalies regarding the continuum of β CMa at these short wavelengths. It is possible that this may have something to do with the re-distribution of pulsational energy. The link between the EUV excess and pulsation is being studied further by Cassinelli and co-workers. Since the EUV and the optical portions of the spectrum form at different heights in the atmosphere, it is important to obtain contemporaneous optical photometry for the star.

Strömgren *uvby* photometry of β CMa was obtained in 1996 January 2 – 15 using the 0.5-m reflector of the SAAO. A total of 106 data points in all four colours was obtained. A 2.5 mag neutral density filter was employed. As comparison stars we used the nearby B-type stars HR 2266 and HR 2271. These were observed without neutral density filters to maximise the signal. The ND filter was calibrated by observing one of these stars with and without the filter through each of the four bands. In addition, we included in the analysis 40 *uvby* measurements made with the same telescope and equipment in 1987 November 5 – 15. The same comparison stars were used.

A periodogram of the 1987 data shows the main pulsation at $f_2 = 3.99$ cycles d^{-1} having a semi-amplitude of 11.0 ± 1.2 mmag. There is no sign of additional periods in our data with semi-amplitudes in excess of 3.5 mmag. The results for the 1996 data are the same: there is a strong peak in the periodogram at $f_2 = 3.98$ d^{-1}, but nothing further with a semi-amplitude in excess of 3 mmag. The periodograms of the b data for the two seasons are shown in Fig. 1. Shobbrook (1973) obtains the following frequencies and semi-amplitudes: $f_2 = 3.979331(\pm5), A_2 = 10.5; f_1 = 3.9995(\pm6), A_1 = 2.2; f_3 = 4.1834(\pm7), A_3 = 1.5$ (cycles d^{-1} and mmag respectively). The time span within our two separate runs is too short to resolve f_1 and f_2, but is sufficient to resolve f_3. Evidently, our observations are of too short a duration to reduce the noise level to a point where f_1 and f_3 become visible.

The frequency of f_2 determined by Shobbrook (1973) fits the combined data from 1987 and 1996 very well if the frequency is revised slightly to $f_2 = 3.979326$ d^{-1}. We obtain the following ephemeris for maximum light in all four colours (there is no appreciable phase shift between any two colours): $T_{max} = JD\,2450000.0591 + 0\overset{d}{.}2512988E$. The following semi-amplitudes are obtained (in mmag): $A_y = 8.8 \pm 0.7$; $A_b = 10.3 \pm 0.8$; $A_v = 11.2 \pm 0.9$; $A_u = 23.4 \pm 2.9$. There is a very large increase in amplitude in the u-band, but at the

Table 1. Strömgren photometry of β CMa

HJD	V	b	v	u	HJD	V	b	v	u
2447104.3852	1.991	1.878	1.849	1.813	2447114.5511	1.993	1.887	1.863	1.822
2447104.4252	1.997	1.880	1.854	1.827	2447114.5695	1.989	1.883	1.858	1.817
2447104.4597	1.997	1.893	1.868	1.821	2447114.5874	1.982	1.888	1.859	1.814
2447104.4965	1.992	1.885	1.866	1.812	2450085.3337	1.994	1.908	1.881	1.740
2447104.5513	1.981	1.874	1.853	1.797	2450085.3666	2.002	1.907	1.885	1.736
2447104.5815	1.982	1.873	1.847	1.800	2450085.4016	1.999	1.905	1.890	1.758
2447104.5985	1.970	1.874	1.848	1.798	2450085.4350	1.995	1.897	1.878	1.745
2447105.4095	1.984	1.886	1.869	1.823	2450085.4676	1.989	1.895	1.872	1.738
2447105.4336	1.994	1.895	1.864	1.810	2450086.3619	1.999	1.907	1.895	1.780
2447105.4728	1.988	1.893	1.873	1.821	2450086.3895	1.994	1.900	1.879	1.767
2447106.3517	2.013	1.863	1.847	1.807	2450086.4642	1.980	1.888	1.865	1.731
2447106.3907	1.973	1.875	1.864	1.831	2450086.4885	1.988	1.890	1.869	1.741
2447107.3600	1.982	1.861	1.836	1.829	2450086.5121	1.978	1.889	1.859	1.727
2447107.3851	1.985	1.864	1.856	1.806	2450086.5387	1.988	1.894	1.867	1.708
2447107.4094	1.988	1.868	1.857	1.804	2450086.5758	2.007	1.915	1.883	1.683
2447107.4376	1.989	1.883	1.865	1.823	2450087.4432	2.002	1.912	1.897	1.759
2447107.4621	1.996	1.898	1.866	1.822	2450087.4677	1.983	1.886	1.867	1.722
2447107.4902	1.999	1.896	1.873	1.829	2450087.4891	1.981	1.889	1.861	1.739
2447107.5163	1.997	1.885	1.869	1.823	2450087.5298	1.974	1.881	1.863	1.688
2447107.5446	1.988	1.885	1.859	1.821	2450087.5618	1.996	1.901	1.893	1.711
2447107.5699	1.984	1.876	1.855	1.808	2450088.3642	1.990	1.897	1.870	1.771
2447107.6046	1.973	1.878	1.851	1.796	2450088.3877	1.998	1.905	1.880	1.743
2447113.3505	2.013	1.858	1.833	1.814	2450088.4105	1.996	1.901	1.885	1.734
2447113.3765	1.978	1.876	1.853	1.810	2450088.4319	1.992	1.906	1.877	1.754
2447113.4013	1.982	1.876	1.865	1.804	2450088.4540	2.011	1.912	1.887	1.767
2447113.4278	1.979	1.875	1.853	1.796	2450088.4760	1.986	1.891	1.868	1.735
2447113.4530	1.995	1.879	1.855	1.813	2450088.4965	1.986	1.888	1.861	1.732
2447113.4788	1.997	1.887	1.863	1.815	2450088.5191	1.996	1.895	1.862	1.716
2447113.5031	1.999	1.897	1.866	1.820	2450088.5406	1.990	1.892	1.863	1.701
2447113.5269	1.999	1.888	1.869	1.818	2450088.5572	1.988	1.890	1.866	1.703
2447113.5501	1.992	1.886	1.869	1.815	2450088.5731	1.999	1.901	1.871	1.683
2447114.3537	1.968	1.880	1.851	1.826	2450089.2962	1.973	1.883	1.857	1.681
2447114.3765	1.983	1.878	1.850	1.812	2450089.3157	1.984	1.895	1.862	1.681
2447114.3997	1.972	1.880	1.850	1.800	2450089.3418	1.992	1.895	1.862	1.714
2447114.4236	1.990	1.885	1.857	1.813	2450089.4320	2.000	1.903	1.877	1.747
2447114.4474	2.007	1.891	1.859	1.822	2450089.4701	1.995	1.894	1.866	1.699
2447114.5327	1.999	1.886	1.867	1.826	2450089.4932	1.991	1.892	1.864	1.703

Table 1 (continued)

HJD	V	b	v	u	HJD	V	b	v	u
2450089.5146	1.990	1.892	1.858	1.673	2450095.3130	1.981	1.883	1.857	1.679
2450089.5306	1.987	1.884	1.850	1.655	2450095.3339	1.984	1.889	1.865	1.711
2450089.5441	1.977	1.871	1.850	1.654	2450095.3828	1.999	1.896	1.873	1.736
2450089.5577	1.984	1.890	1.859	1.678	2450095.4033	2.007	1.905	1.879	1.734
2450090.2922	1.972	1.873	1.854	1.665	2450096.3565	1.988	1.889	1.866	1.743
2450090.3135	1.988	1.889	1.869	1.707	2450096.3830	1.997	1.907	1.880	1.752
2450090.3362	1.995	1.899	1.870	1.698	2450096.4089	2.002	1.907	1.883	1.748
2450090.3593	2.000	1.904	1.871	1.720	2450096.4682	1.992	1.903	1.876	1.736
2450090.3788	2.002	1.902	1.879	1.720	2450096.4907	1.989	1.888	1.871	1.714
2450090.4074	2.003	1.902	1.871	1.753	2450096.5097	1.985	1.885	1.864	1.689
2450090.4350	2.002	1.900	1.867	1.743	2450096.5234	1.982	1.881	1.860	1.693
2450090.4543	1.995	1.895	1.864	1.700	2450096.5401	1.984	1.882	1.859	1.660
2450090.4722	1.996	1.891	1.850	1.714	2450096.5573	1.994	1.882	1.866	1.667
2450090.4921	1.991	1.890	1.855	1.685	2450097.3112	1.976	1.886	1.859	1.734
2450090.5177	1.990	1.885	1.847	1.681	2450097.3584	1.986	1.898	1.873	1.670
2450090.5333	1.988	1.884	1.845	1.664	2450097.3826	1.996	1.899	1.875	1.740
2450090.5457	1.991	1.876	1.850	1.654	2450097.4060	1.997	1.914	1.887	1.752
2450090.5591	1.988	1.872	1.854	1.653	2450097.4679	1.992	1.901	1.867	1.720
2450090.5761	1.994	1.889	1.872	1.647	2450097.4929	1.998	1.899	1.860	1.726
2450091.3059	1.981	1.881	1.854	1.706	2450097.5171	1.994	1.896	1.863	1.705
2450091.3676	1.999	1.909	1.877	1.732	2450097.5322	1.981	1.887	1.853	1.662
2450091.4199	2.005	1.902	1.868	1.725	2450097.5459	1.990	1.923	1.893	1.740
2450091.4449	1.998	1.897	1.862	1.693	2450098.3078	1.970	1.882	1.867	1.728
2450091.4732	1.993	1.896	1.859	1.706	2450098.3256	1.976	1.881	1.857	1.721
2450091.5027	1.986	1.888	1.852	1.684	2450098.3427	1.981	1.893	1.864	1.720
2450091.5235	1.997	1.892	1.857	1.644	2450098.3603	1.987	1.891	1.867	1.726
2450091.5362	1.993	1.888	1.852	1.666	2450098.3803	1.989	1.892	1.872	1.738
2450091.5540	1.989	1.883	1.853	1.658	2450098.4006	1.997	1.902	1.880	1.760
2450091.5713	1.995	1.901	1.855	1.638	2450098.4237	2.003	1.905	1.880	1.753
2450092.4729	2.001	1.897	1.868	1.732	2450098.4440	2.001	1.906	1.882	1.764
2450092.5187	1.995	1.889	1.865	1.705	2450098.4640	2.003	1.907	1.880	1.705
2450092.5595	1.992	1.891	1.862	1.649	2450098.4845	1.997	1.901	1.876	1.718
2450093.4104	2.003	1.912	1.887	1.731	2450098.5037	1.996	1.895	1.855	1.682
2450093.4597	2.008	1.915	1.891	1.759	2450098.5250	1.989	1.891	1.856	1.666
2450093.4969	1.988	1.894	1.863	1.695	2450098.5485	1.984	1.887	1.855	1.692
2450093.5530	1.988	1.885	1.853	1.670					

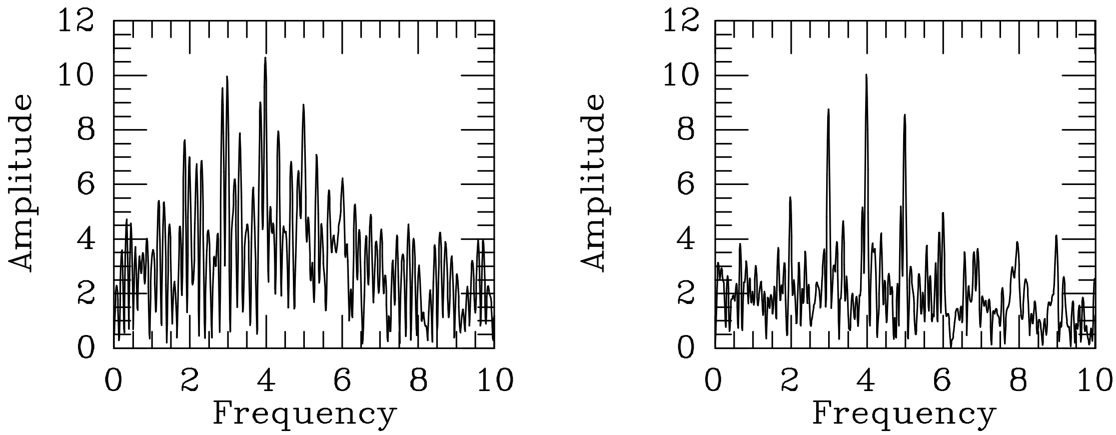

Figure 1. Periodograms of the b data for β CMa. Left panel: the 1987 data; right panel: the 1996 data. The frequency is in cycles d^{-1} and the amplitude in mmag.

same time the photometric accuracy is much worse owing to the poor properties of the ND filter.

One can also adopt the three periods as known components and attempt to fit the combined 1987 and 1996 data with these periods. In that case we find semi-amplitudes of 1 – 2 mmag for f_1 and f_3 in the y, b and v bands. However, the amplitude of f_1 increases to 20.6 mmag in u and is in fact larger than f_2 (16.7 mmag). Because f_1 and f_2 are not resolved in either of the two seasons, we view this result with suspicion. It is possible that the large rise in amplitude of f_2 in the u-band may not be entirely real, but could be aided by an even steeper rise in the unresolved component f_1. It is interesting to note that while f_2 has a much larger amplitude than f_1 in optical photometry, the two have comparable radial velocity amplitudes (Kubiak 1980).

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MULTIPERIODICITY IN PULSATING LAMBDA Boo STAR 29 Cyg (HD 192640, V1644 Cyg)

The first and firm detection of pulsation phenomena in λ Boo type stars was made for classical λ Boo star 29 Cyg by Gies & Percy (1977). Gies & Percy (1977) (G&P) reported about the 45 min variability of 29 Cyg with an amplitude of about 0.03 mag. They suggested that, in contrary to Am and Ap stars lying in the δ Scuti instability strip, the moderate amplitude pulsations cannot be an exclusion in λ Boo group. Until the early 90-ies few attempts were carried out for investigation of pulsational activity of this group of stars or the attempts were made for nonclassified members of this group as for suspected δ Sct-type stars. At present, up to 10 pulsating members are known (Kuschnig et al. 1994).

The new observations of 29 Cyg were obtained during eight nights of July-September 1995 within the frames of collaborative program of the Odessa Astronomical Observatory (Ukraine), the Sternberg State Astronomical Institute (Russia) and Tien Shan High Altitude Observatory (Kazakhstan) for the search and investigation of pulsating northern chemically peculiar and δ Scuti type stars. We used a 4-channel W,B,V,R photometer (Kornilov & Krylov, 1990) attached to the 0.48m telescope of the Tien-Shan High Altitude Observatory. The integration time was 10 seconds simultaneously in the four filters and the data were binned in 40 second time intervals prior to the analysis. The comparison stars HD 192661 (G8 III, V=6.567) and HD 192538 (A0V, V=$6^m_.468$) were used.

This brief note represents the periodicity analysis of B−R index data less affected by the influence of the marginal weather conditions, the atmospheric scintillation noise and extinction variations. This technique is based on the fact that the atmospheric scintillation noise is strongly coherent in different wavelength bands, and amplitudes of variability are maximal in the blue region of spectra of A stars and decrease at the long wavelengths.

Figure 1 shows the resulting instrumental B−R data, for JD 2449920, JD 2449943, JD 2449949, JD 2449955, JD 2449956, JD 2449957, JD 2449963, and JD 2449969 reduced to the mean level. The analysis of separate nights shows that the main periodicity at the frequency near 37.5 c/d is present in the B−R data.

The amplitude spectra of B−R data combined for 8 nights of photometry are given in Figure 2. The highest peak with semi-amplitude of about 6 mmag is present at frequency 37.43 c/d (38.47 min). After the application of consecutive prewhitening procedure and frequency analysis we have resolved up to 7 frequencies. The amplitudes of frequencies are slightly variable from night to night. The frequencies f6 and f7 can be the artifacts produced by the variability of main frequencies 37.43 and 29.43 c/d. Frequencies, amplitudes and phases were corrected by the application of the simultaneous 7-frequency iterative sine-wave least-squares fitting procedure.

The resulting frequencies and amplitudes are given in Table 1. The 7-frequency synthetic curve is shown in Figure 1 by the solid line.

Table 1. Frequency fit for JD 2449943 - 2449969 (B−R) and G&P V data sets

	(B−R) data Freq. (c/d)	(Present paper) Semi-ampl.(mag)		V data Freq.(c/d)	(Gies & Percy, 1977) Semi-ampl.(mag)
f1	37.43	0.0051	f1	29.59	0.0085
f2	29.43	0.0031	f2	37.86	0.0069
f3	5.73	0.0024	f3	20.09	0.0041
f4	26.19	0.0032	f4	12.02	0.0036
f5	12.85	0.0025	f5	28.86	0.0030
f6	31.71	0.0024			
f7	38.03	0.0018			

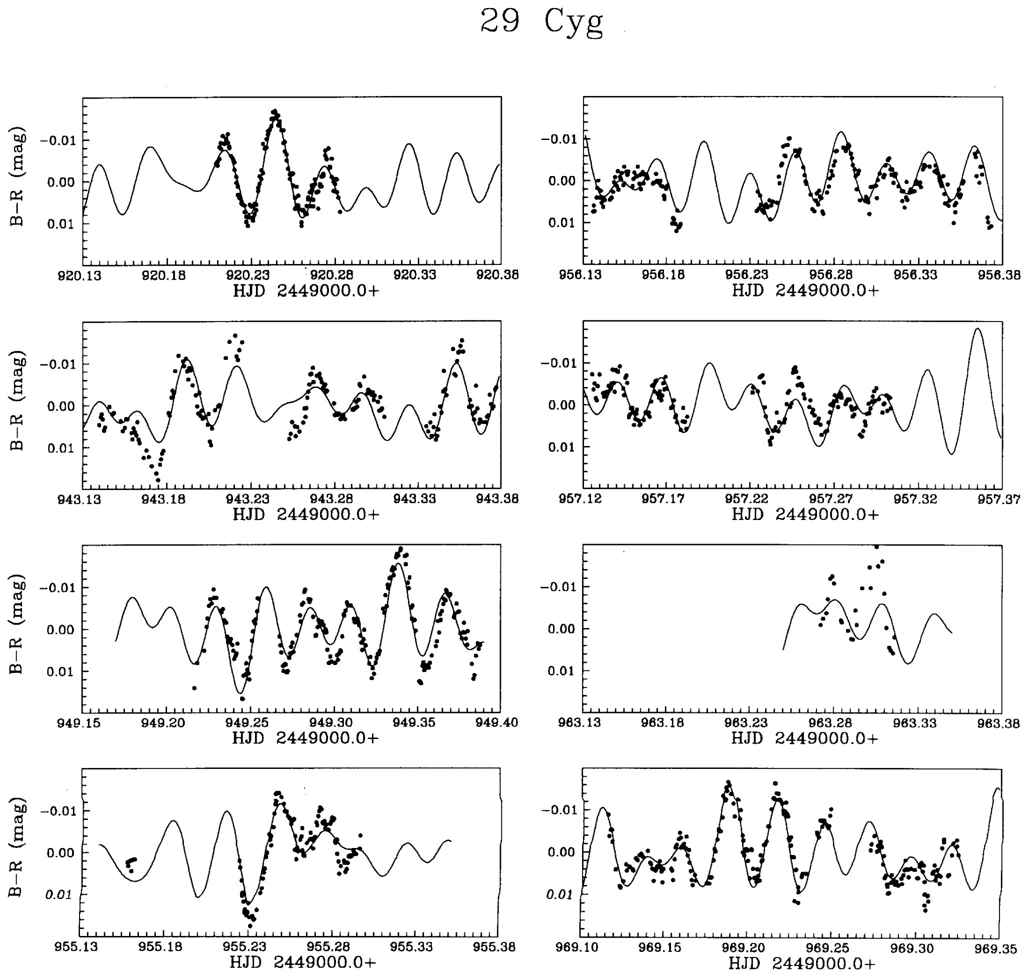

Figure 1. The B−R light curves for 29 Cyg. The solid line is the 7 frequency fit (see Table 1)

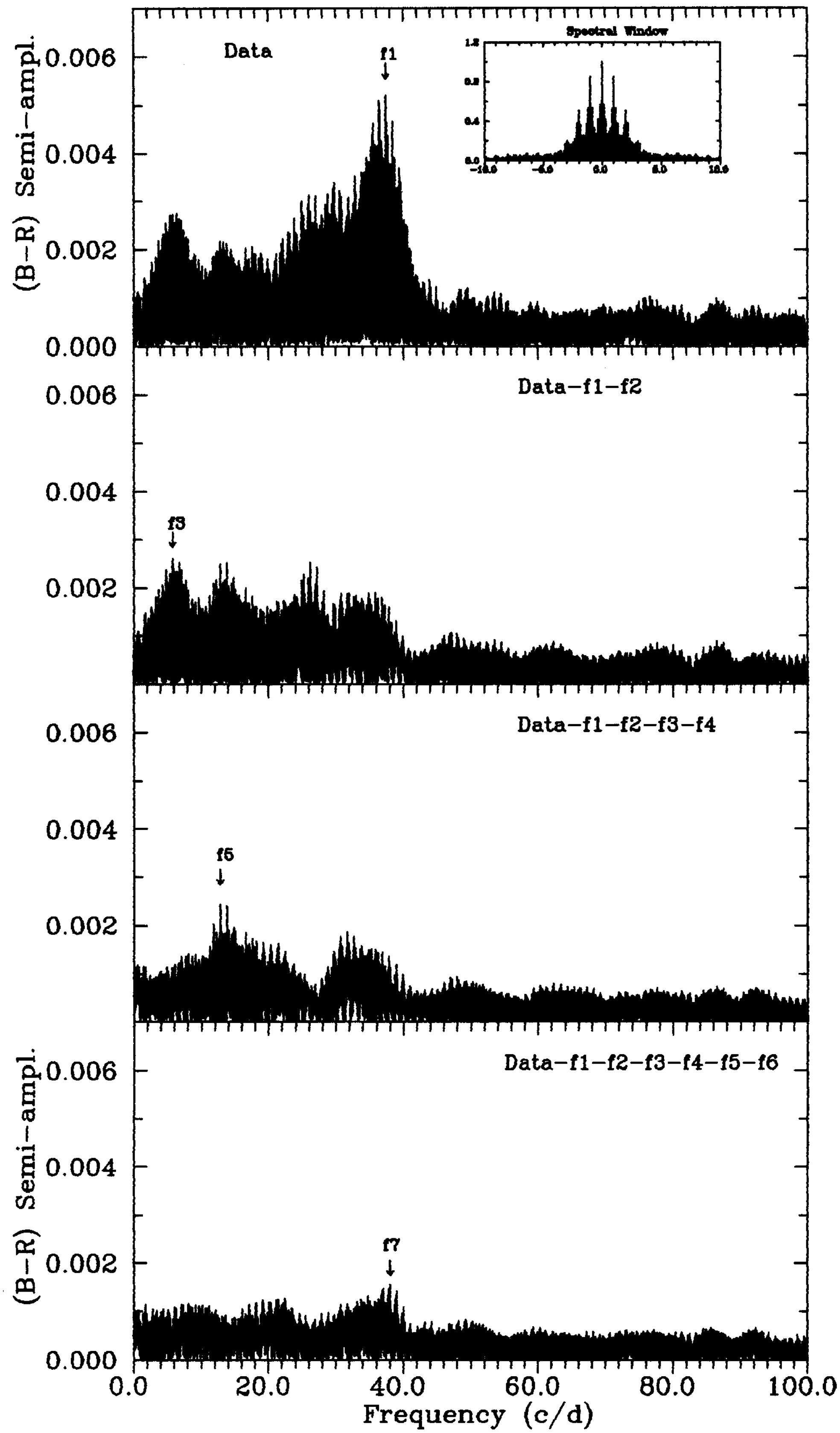

Figure 2. The amplitude spectra of B−R data shown in Figure 1

In order to confirm the frequencies detected we re-analysed the Gies and Percy's 1976 year data set (Gies and Percy, 1977). Our analysis of the G&P V filter data after removing the trends produced by the 1.54 c/d variability of comparison Be star 28 Cyg (Pavlovski et al., 1993) gives the 5 frequency solution also presented in Table 1. The comparison of two solutions shows that at least 3 frequencies in our data set are close to those presented in G&P data. In contrary to our 1995 year observation, the maximal amplitude of variability of G&P data set is at frequency of 29.59 c/d (48.7 min). For G&P data set the amplitude ratio for the mean amplitudes of two frequencies 37.5 and 29.5 c/d is equal to 0.81. For our data set this ratio is equal to 1.65, i.e. this result is a confirmation of amplitude variability of excited modes in 29 Cyg, and this fact of amplitude variability is not an exclusion for stars which occupy the blue edge of instability strip (see the extreme case of mode variability in HD 74292 (A2V) in paper of Kusakin & Goranskij, 1995).

The main results of our brief note are as follow:

- 29 Cyg is a pulsating λ Boo star with a multiperiodic structure of excited modes, the two highest amplitude excited modes have the frequencies near 37.5 and 29.5 cycles per day.
- We confirm at least 3 of detected frequencies by the re-analysis of 3 nights of Gies & Percy (1977) V data for 29 Cyg.
- The amplitudes of the excited modes are variable.

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NEW DEEP MINIMUM OF THE CATACLYSMIC BINARY KR Aur IN 1994-1995

KR Aur, whose variability was discovered by Popova (1960), is a member of the nova-like subclass, known as anti-dwarf novae. Its spectroscopic observations revealed that it is a close binary system, consisting of a white dwarf (0.7 $M_{\odot}$) and a red dwarf (0.48 $M_{\odot}$) with orbital period of 3.907 hours and inclination angle smaller than 40 degrees (Shafter, 1983). The brigthness of KR Aur is usually between 12-14^{m} (predominant value $13^{m}_{.}5$), with occasional decreases to $15^{m}_{.}5$, but it drops to 18^{m} episodically. Rapid variations with amplitude up to $0^{m}_{.}4$ and time-scales seconds and minutes (flickering) are typical for the star in its bright state. The last deep minimum was observed in 1981-1982, when the star dropped to approximately 17^{m} (Popov, 1982; Popova et al., 1982).

We present photometric and spectral observations of KR Aur in the period September 1993-November 1995.

The photometric observations were carried out through B-filter, using 60cm Cassegrain telescopes with identical one-channel photoelectric photometers at the National Astronomical Observatory - Rozhen (NAO) and at the Astronomical Observatory - Belogradchik (AOB), and the 50/70cm Schmidt telescope at NAO with ZU 21 plates and B-filter. The integration time was 10 seconds and the exposure time was 20 minutes for all observations, respectively. The magnitudes of the variable were estimated on the basis of the standards, published by Popova (1965). The accuracy was $\leq 0^{m}_{.}1$ for the photoelectric observations and $\leq 0^{m}_{.}3$ for the photographic ones. U-monitoring for flickering search was carried out for 8 nights. The observational data are presented in Table 1 and Figure 1.

One spectrum with 4 Å resolution was obtained on February 9, 1994 in the region 3460 - 5470 Å (Figure 2). The 6m telescope of the Special Astrophysical Observatory of the Russian Academy of Sciences with 1000 channel TV-scanner was used (Afanas'ev et al., 1991). The data processing was done by means of the package ETAM (Knyazev & Lipovetskii, 1994).

Our observations revealed that KR Aur underwent a minimum again. We think a pre-drop state of the star has appeared since January 1994. The star displayed an unstable brightness – from $13^{m}_{.}8$ in December 1993 to $14^{m}_{.}6$ on January 20, 1994 (Antov & Popov, 1994). On January, 1994 KR Aur was fainter than 15^{m}. In all observations up to January 20, 1994 flickering was present, however, on January 22, 1994 it seems to be absent. The last measurement is a little bit uncertain, because the object was too faint then.

An interesting fact is that in the beginning of February 1994 KR Aur increased its brightness to maximum light again ($13^{m}_{.}1$ average value) and our estimates showed fast changes in B-light up to $0^{m}_{.}42$ amplitude. Our measurements in this period are in an agreement with the visual estimates of Verdenet & Mizner (1994).

Table 1

Date	H.J.D. (2440000+)	m_B	Obs.	Telescope	Flickering
21/22.09.1993	9252.544	13.2	AOB	Cassegrain	
22/23.09.1993	9253.549	13.0	AOB	Cassegrain	
23/24.09.1993	9254.541	12.9	AOB	Cassegrain	Yes
27/28.10.1993	9288.510	13.3	AOB	Cassegrain	
17/18.12.1993	9339.467	13.8	AOB	Cassegrain	
18/19.12.1993	9340.458	14.0	AOB	Cassegrain	
19/20.12.1993	9341.429	13.9	AOB	Cassegrain	Yes
19/20.01.1994	9372.526	14.6	NAO	Cassegrain	Yes
22/23.01.1994	9375.385	≥ 15	NAO	Cassegrain	No?
01/02.02.1994	9385.260	13.1	NAO	Cassegrain	
01/02.02.1994	9385.265	13.1	NAO	Cassegrain	
01/02.02.1994	9385.271	12.8	NAO	Cassegrain	
03/04.02.1994	9387.381	13.2	NAO	Cassegrain	
03/04.02.1994	9387.389	13.4	NAO	Cassegrain	
03/04.02.1994	9387.397	13.0	NAO	Cassegrain	
04/05.02.1994	9388.400	12.8	NAO	Cassegrain	
04/05.02.1994	9388.408	13.2	NAO	Cassegrain	
04/05.02.1994	9388.415	13.0	NAO	Cassegrain	
10/11.03.1994	9422.316	14.7	AOB	Cassegrain	
12/13.03.1994	9424.317	14.7	AOB	Cassegrain	No
15/16.03.1994	9427.293	15.2	AOB	Cassegrain	No
13/14.04.1994	9456.292	14.0	AOB	Cassegrain	
14/15.04.1994	9457.316	14.3	AOB	Cassegrain	
09/10.10.1994	9635.484	14.7	AOB	Cassegrain	
12/13.10.1994	9638.489	14.6	AOB	Cassegrain	
15/16.10.1994	9641.490	14.4	AOB	Cassegrain	
04/05.12.1994	9691.492	15.0	AOB	Cassegrain	No
28/29.12.1994	9715.304	14.9	NAO	Cassegrain	
02/03.02.1995	9751.519	15.5	NAO	Schmidt	
01/02.03.1995	9778.416	18.1:	NAO	Schmidt	
27/28.09.1995	9988.585	18:	NAO	Schmidt	
19/20.10.1995	10010.508	19:	NAO	Schmidt	
24/25.11.1995	10046.692	14.5:	NAO	Schmidt	
25/26.11.1995	10047.477	14.8	AOB	Cassegrain	Yes

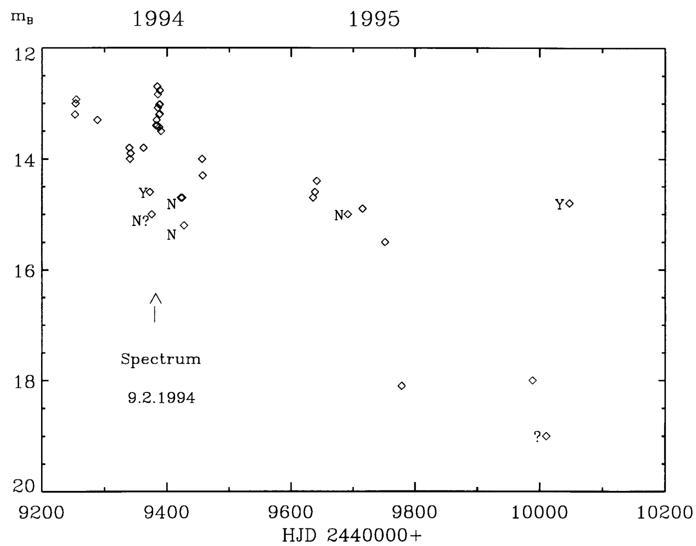

Figure 1. The photometric behaviour of KR Aur. "Y" denotes presence of flickering with amplitude $\geq 0^{m}.15$, "N" - absence of it.

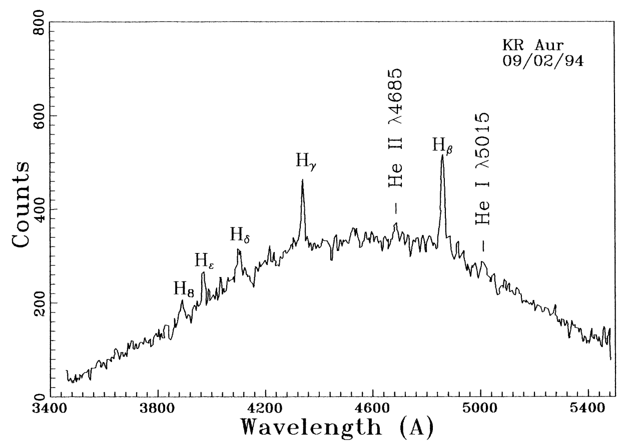

Figure 2. The spectrum of KR Aur, obtained on February 9, 1994 with the 6m telescope of the Special Astrophysical Observatory.

In a month the star dropped again to $14^{m}.7$. Its spectrum, obtained on February 9, 1994 is closer in time to the maximum light state, and resembles those observed with the same equipment by Popov & Kraitcheva (1990). The detected Balmer emission lines – H_β, H_γ, H_δ and H_ϵ – have a two-component structure with a redward-shifted second component. In so far as these lines are considered to originate from the accretion disk material (Shafter, 1983) we suggest that the disk still exists in the system.

In the period March 1994 - October 1994 KR Aur varied in the interval $14^{m}.0$ - $15^{m}.2$. The star has begun to decrease its brightness since October 1994 and approximately in 4 months (March 1, 1995) reached $18^{m}.1$, which is in an agreement with the observations of Honeycutt & Robertson (1995).

The deep minimum state lasted approximately 8 months. The faintest magnitude of the star, detected on October 20, 1995, was 19^m. However, this measurement is uncertain because the object was near the plate limit. From October 20, 1995 to November 25, 1995 KR Aur became 4^m brighter and a flickering with an amplitude of $0^m.15$ in U-filter was detected again on November 25, 1995.

We think, that the star had an unusually unstable mass transfer in a period 10 months before its fading to a deep minimum. It is possible, that a pre-minimum state exists for KR Aur. A slow decrease of the mass transfer followed and it seems, the object spent a long time in an intermediate state. KR Aur faded from its intermediate state to the minimum for 4 months. It spent 8 months in minimum state. The star went out of the minimum relatively quickly – for a little more than a month.

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ROTATION PERIODS FOR FOUR LOW-MASS STARS IN THE TAURUS–AURIGA REGION WITH Ca II EMISSION

We present the results of a long-term photometric monitoring campaign for four stars in the Taurus–Auriga region that were found to have strong Ca II H and K emission by Herbig et al. (1986). The BVR observations were obtained during four runs from August 22, 1992 to December 29, 1995, at the Mt. Maidanak Observatory, Uzbekistan, using a 0.48m telescope equipped with a pulse counting FEU-79 photomultiplier tube. The mean error of one observation of a program star is typically $\pm$ $0^{m}_{.}01$ in V, B−V, and V−R. The interval of observations, number of observations in V and B−V, limits of the light variations in V filter, mean magnitude and colours are listed in Table 1. Maidanak BVR photometry Data Bank is at Tashkent Astronomical Institute and available to anyone interested in.

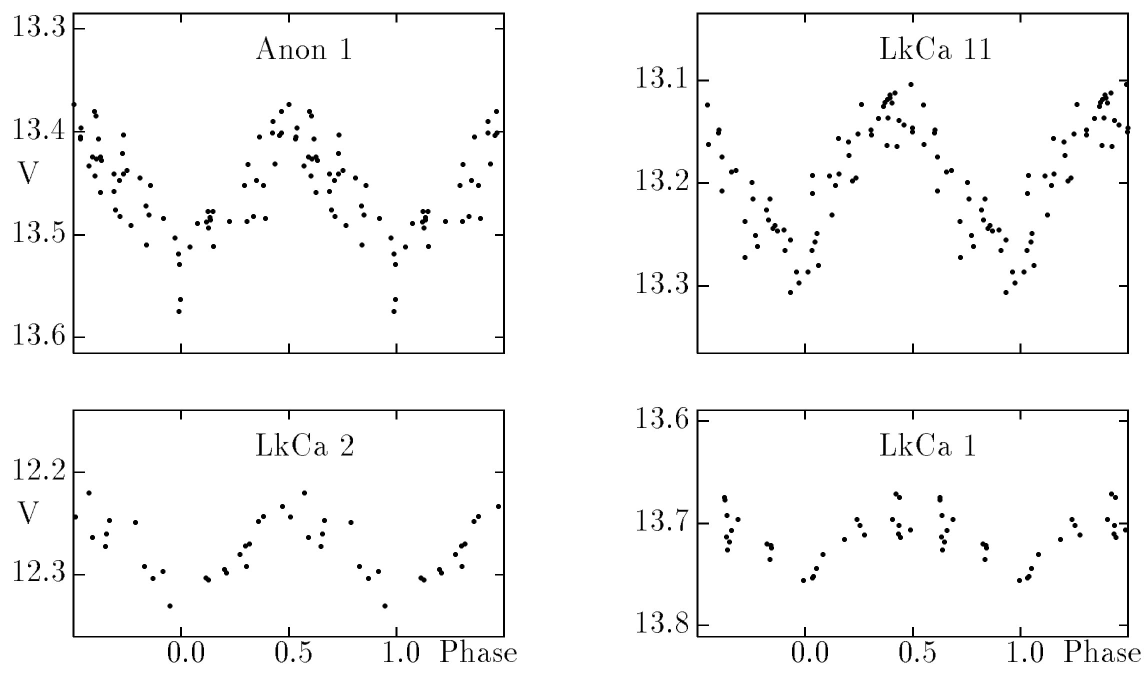

Figure 1. Phase diagrams for light curves in the V filter for 4 stars.

We report first detections of periodic light variations for Anon 1, LkCa 1, LkCa 2, and LkCa 11. A periodogram analysis reveals that all the Ca II stars have significant peaks in their power spectra. The most probable periods of these stars and their epoch of observations are listed in Table 1. Phase diagrams for light curve in the V filter for four stars are displayed in Figure 1.

Table 1

Name	Obs. Interval	n1	V_{max}	V_{min}	<V>	<B−V>	n2	<V−R>	Period (day)	Epoch of observ.
Anon 1	1992–95	60	13.37	13.58	13.45	1.85	38	1.84	6.493	1992–95
LkCa 1	1993–95	51	13.67	13.76	13.71	1.45	33	1.71	2.497+	1993–94
LkCa 2	1992–95	68	12.22	12.37	12.29	1.39	44	1.34	1.364*	1995
LkCa 11	1992–95	62	13.10	13.31	13.19	1.52	44	1.57	1.5396	1992–95

n1 - number of observations in V and B−V;
n2 - number of observations in V−R;
+ - two periods ($0^{d}.713$ and $1^{d}.661$) can be present, which produce fully equivalent folded light curves with P=$2^{d}.497$;
* - another period ($3^{d}.71$) produces fully equivalent folded light curve with P=1.364 day.

It should be noted that there are several other significant peaks in the power spectra for LkCa 1 and LkCa 2. The periods, which correspond to these peaks, are listed in the notes to Table 1. The spacing of the observations in time (one day) causes "false" periods. These periods can be calculated from the equation: $|\frac{1}{P} - \frac{1}{P_f}| = 1.0027\ (day^{-1})$; where: P - is "true" period, P_f - are "false" periods. One of the periods is "true", the others are "false" periods. Both "true" and "false" periods produce fully equivalent folded light curves. In order to choose "true" period it is necessary to carry out further monitorings with observations more frequent than once a night.

The periodic variability of these objects can be interpreted as the rotational modulation of the stellar flux by a group of dark surface spots. These four Ca II stars, together with LkCa 3 ($7^{d}.2$), LkCa 4 ($3^{d}.3745$), LkCa 7 ($5^{d}.6638$), LkCa 14 ($3^{d}.35$), LkCa 15 ($5^{d}.85$), LkCa 16 ($5^{d}.6$), and LkCa 19 ($2^{d}.236$) monitored by Grankin (1992, 1993, 1994), Vrba et al. (1993), and Bouvier et al. (1993, 1995), form a sample of eleven objects from Herbig et al.'s list with known rotational periods. Thus, there is a high detection rate of rotational periods amongst Ca II stars in the sample considered. It should be noted that Anon 1, LkCa 4, LkCa 7, and LkCa 11 keep their rotational periods in intervals from 4 to 6 years (see also Grankin, 1994). The stability of rotational periods over several years indicates that the active region in each Ca II star remains on a definite meridian over this time scale. Properties of the active regions for these stars are similar to those of RS CVn stars.

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PHOTOMETRIC OBSERVATIONS OF THE NEW BRIGHT CLASSICAL CEPHEID SAO 25009 = HD 32456

The star SAO 25009 (HD 32456, BD +55°0956, PPM 29610, AGK +55°0438, GSC 3738.0234) of spectral type G5 is one of the variables discovered by the TYCHO Instrument of the ESA Hipparcos Satellite. It was announced to have a magnitude variation range between 7.73 and 8.51 in T magnitudes (TYCHO magnitudes) with a possible 90 day period (Makarov et al., 1994). As a result of an observational program proposed by Bastian (1995), Born (1995) observed visually the star indicating that it should be a new delta Cephei star with a 3.25 day period.

Without previous knowledge of the work by Born we proceeded, from 29 October 1995, to visually monitor SAO 25009. Initial observations indicated that the period of the light variation was much shorter than the announced value of 90 days. For this reason, we decided to continue our monitoring work photometrically. Due to the fact that we had to deal with a rather bright star, and also the need to work with a wide field to include suitable comparison stars in terms of brightness and color index, from 30 December 1995 to 24 February 1996 we undertook the task of observing SAO 25009 in the V band at Piera Observatory (Spain) using a 6-cm finder telescope and a LYNXX-2 CCD camera. We chose SAO 25029 (HD 32606, BD +55°0958, PPM 29633, GSC 3739.0913) as a comparison star.

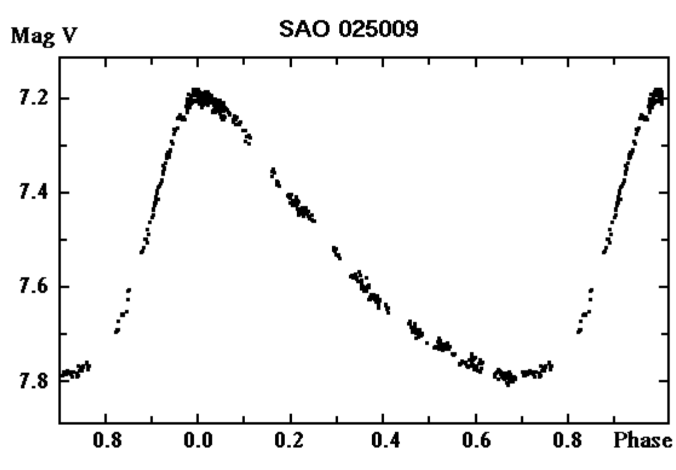

Figure 1

At the same time, we took some brightness measurements using the 0.41-m telescope at Mollet Observatory (Spain) and an Optec SSP-3 photometer. We also determined the V and B magnitudes of the comparison star SAO 25029 using HR 1511, HR 1546, and HR 1561 as reference stars.

Our observations allowed us to conclude that SAO 25009 is a bright cepheid (V=7.19 ±0.05 magnitudes at maximum light) with a period close to 3.295 days, and an asymmetry factor (M−m)/P=0.30 ±0.02 with a variation range of 0.60 ±0.01 magnitudes in the V band (Figure 1). According to light curve shape, SAO 25009 can be classified as a classical cepheid. Nevertheless this last statement should be confirmed by other observational means.

We derived the following ephemeris:

$$\text{Max.} = \text{HJD}\,2450117.597 + 3^{\rm d}.2951 \times \text{E}$$
$$\pm 0.004 \pm 0.0008$$

Photographic archival plates stored at various observatories should be analysed to refine the above given ephemeris, as well as reconstruct the past years' light curve of this new cepheid.

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NEW PHOTOMETRIC DATA FOR HD 142703 AND HD 192640

We present new photometric data for HD 142703 and HD 192640, two λ Bootis stars which were found to be variable in former publications. The λ Bootis stars are a group of metal poor, population I, A-type stars (Weiss et al., 1994).

HD 142703 ($m_V = 6.1$) was found to be variable in 1994 (Paunzen & Weiss, 1994) with a period of 46 minutes and an amplitude of 10 mmag in Strömgren v and b. Additional observations were published in 1995 (Paunzen et al., 1995). They result in a period of 87 minutes and an amplitude of 7 mmag in Strömgren v and b. At this stage we were only able to confirm variability in HD 142703 but could not decide between the two proposed periods. Therefore we reobserved HD 142703 to determine its period and amplitude.

The observations were made in the night of 02/03 May 1995 by E. Paunzen with the 0.6 meter Lowell telescope at CTIO with an integration time of 10 seconds in Strömgren v and b. HD 142640 ($m_V = 6.4$, F6V) was used as comparison star. The lightcurves of both stars are shown in Figure 1. The result of a Fourier analysis (period = 80 minutes, amplitude(b) = 8 mmag) seems to confirm the results of 1995.

HD 192640 (29 Cygni, HR 7736, $m_V = 5.0$) is one of the 'classical' and best studied λ Bootis type stars. Its peculiarity was discovered by Slettebak (1952). Abundance analysis of this star (Venn & Lambert, 1990 and Stürenburg, 1993) gave a metal deficiency of about a factor of 50 compared to the Sun.

Pulsation was first reported by Gies & Percy (1977). They analysed 3 nights of photometry and determined a multiperiodic variation of about 45 minutes with an amplitude of about 10 to 30 mmag in Johnson V. They used 28 Cygni as comparison star. 28 Cygni is known as a variable Be star. Its frequency pattern is quite complicated and the periods range from 3 to 18 hours (Peters & Penrod, 1988 and Bossi et al., 1993). Therefore we reobserved HD 192640 to confirm its variability.

The observations were made in the nights of 07/08 and 11/12 Aug. 1995 by G. Handler at the 0.9 meter telescope of the McDonald Observatory with an integration time of 50 seconds in Strömgren v and b. We have chosen HD 195050 (HR 7826, $m_V = 5.6$, A3V) and HD 188892 (HR 7613, $m_V = 4.9$, B6III) as comparison stars. The second one turned out to be variable. Figure 2 shows extinction corrected instrumental magnitudes for the second night and indicates multiperiodic variations for HD 192640. The amplitude spectrum for the merged data indicates two periods of 38 and 43 minutes with an amplitude of about 26 and 13 mmag in Strömgren b. This result is consistent with Gies & Percy (1977).

We encourage further observations of HD 142703 and HD 192640 to apply the tools of asteroseismology.

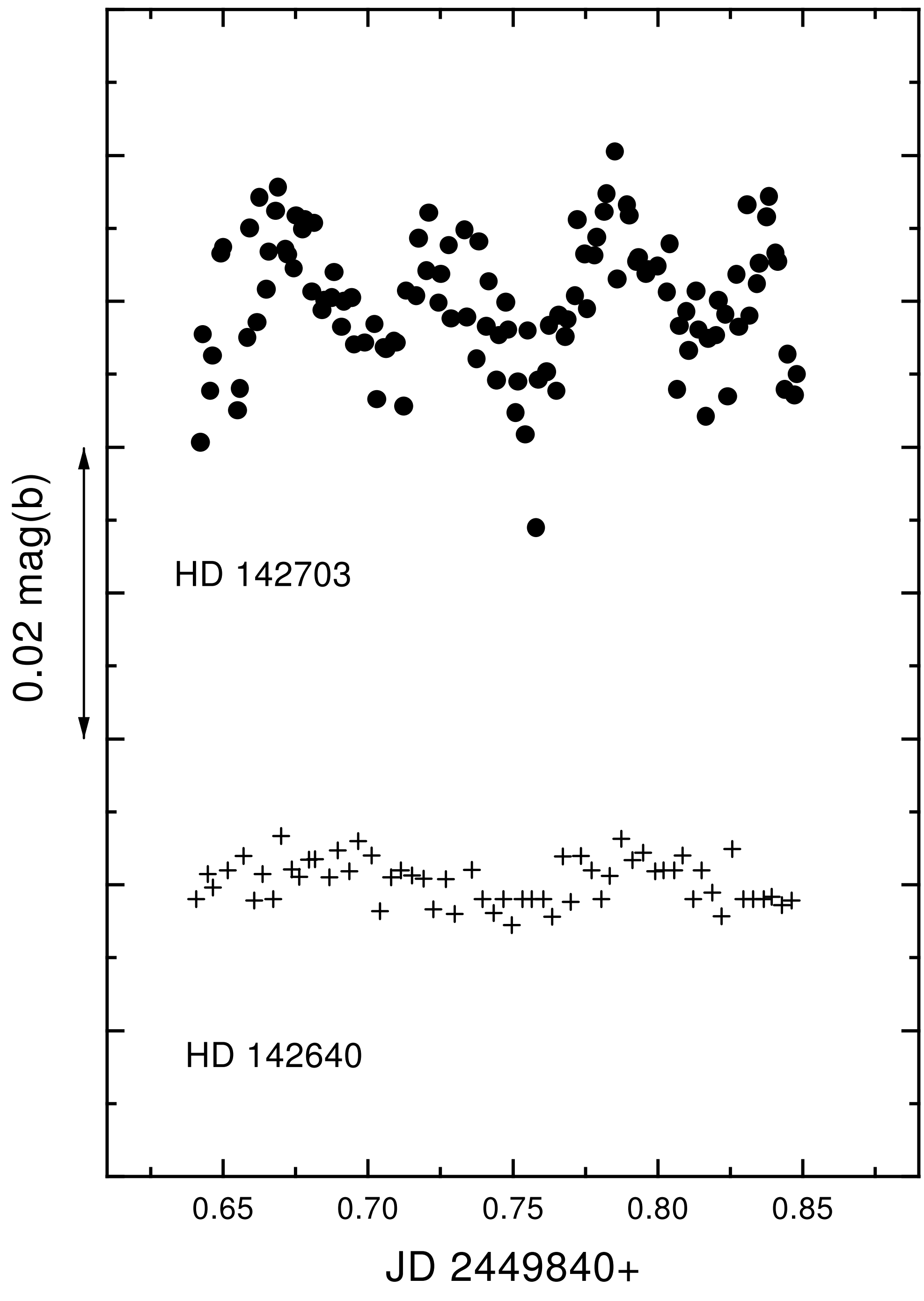

Figure 1. Lightcurves for HD 142703 (•) and HD 142640 (+) in Strömgren b.

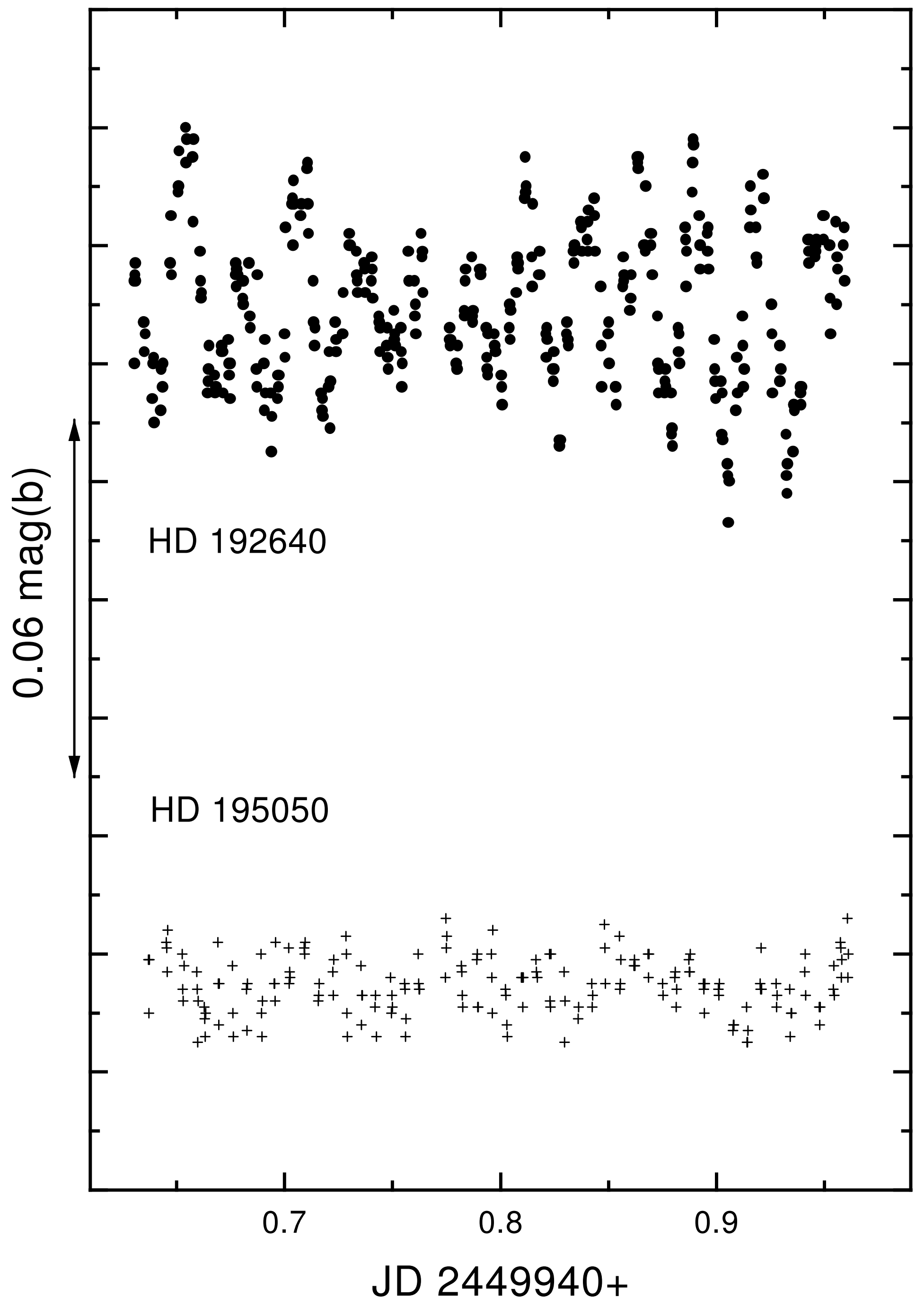

Figure 2. Lightcurves for HD 192640 (•) and HD 195050 (+) in Strömgren b for the second night.

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NSV 12597 AND RX J1957.0+2005

NSV 12597 = 59.1928 Sagittae was discovered by Baade (1928) as a variable star of unknown type in the range $15^{\rm m}\!.0$–[$16^{\rm m}\!.7$. The NSV catalogue (Kukarkin et al. 1982) lists type E for this object. The source of this information is unknown, however: we could not find any other publication on NSV 12597 than the one of Baade (1928). So, the statement E may be a private communication or possibly a misprint.

Unfortunately, no finding chart was given, and the published coordinates transform to

$$\mathrm{R.A.} = 19^{\rm h}57^{\rm m}01^{\rm s}\!.4,\ \mathrm{Dec.} = 20^\circ05'53''.$$

(equinox 2000.0). This is about 7″ north of the eastern star of the unresolved pair denoted with "v" in Figure 1. This unresolved pair has a brightness of $B\approx17^{\rm m}$ on the blue sensitive Sonneberg plates, and $R\approx14^{\rm m}\!.5$ ($B-R\approx2.2$) on the POSS plate E372 taken in 1951. (Neither B nor R magnitudes given here are "international" values, they rather mean blue and red sensitive photographic magnitudes.)

We checked 310 archival plates of the 400/1600 mm and 400/2000 mm Sonneberg astrographs (limiting magnitude $\approx18^{\rm m}$) and 190 plates of the astrograph 170/1400 ($\approx17^{\rm m}$) for variability of NSV 12597. Though difficult to investigate because of its faintness, this star (pair) seems to be slightly variable between about $16^{\rm m}\!.5$ and $17^{\rm m}$ (B band) during the time span 1938–1995. Occasionally, we find indications of flat waves ($\approx$40 days) of small amplitude (<0.3 mag). We do not find eclipses, but given the typical exposure times of 20 min. eclipses might easily be undetectable in our data if they are of short duration and/or of small amplitude. Though we did not observe any typical flare, the red colour indicates the possibility that Baade observed a flare-up of NSV 12597.

We got interested in NSV 12597 due to the nearby X-ray source RX J1957.0+2005 discovered during the ROSAT all-sky survey. This X-ray source with best fit coordinates

$$\mathrm{R.A.} = 19^{\rm h}57^{\rm m}02^{\rm s}\!.6,\ \mathrm{Dec.} = 20^\circ05'14'',$$

(2σ error of $\pm30''$) was found at a countrate of 0.039±0.010 cts/s. The hardness ratios $HR1 = (N_{52-201} - N_{11-41})/(N_{11-41} + N_{52-201}) = -0.35\pm0.30$ (where N_{a-b} denotes the number of counts in ROSAT's position sensitive proportional counter between channel a and channel b) and $HR2 = (N_{91-200} - N_{50-90})/N_{50-200}) = 0.42\pm0.64$, though admittedly purely constrained due to the low number of counts, are consistent with coronal emission from a late-type star. Thus, the brightest object inside the X-ray error circle (see Fig. 1), with $B\approx13^{\rm m}$ and located at R.A. = $19^{\rm h}57^{\rm m}03^{\rm s}\!.1$, Dec. = $20^\circ05'10''$ is a viable counterpart candidate nearly independent of its spectral type. Only spectral types later than about M0 are less probable due to their implied low X-ray to optical flux ratio, and their intrinsic colours being redder than the $B-R\approx1.5$ of this $B\approx13^{\rm m}$ star.

A check of this $B\approx13^{\rm m}$ star on the same plate material as described above revealed no hint for any kind of variability. This makes a possible mis-identification of this $B\approx13^{\rm m}$ star with NSV 12597 rather unlikely.

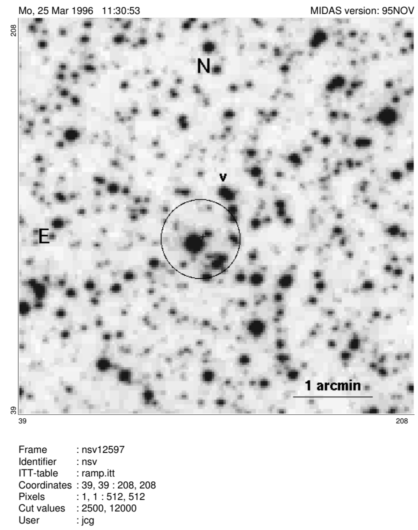

Figure 1. A finding chart showing the position of NSV 12597 on the E band Palomar Observatory Sky Survey plate. "v" marks the pair of stars, the eastern of which is thought to be NSV 12597. The circle marks the 30″ error radius around the X-ray position (cross) of RX J1957.0+2005.

NSV 12597 is about 45″ off the position of RX J1957.0+2005. With the present knowledge we think that NSV 12597 is unrelated to this X-ray source and that the B≈$13^{\rm m}$star is the optical counterpart of RX J1957.0+2005. Spectroscopic observations of this B≈$13^{\rm m}$ star in the X-ray error box as well as of NSV 12597 are needed to prove our conclusions and to determine the type of NSV 12597.

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NEW INFORMATION ON V 558 Cas: TYPE AND PERIOD

New photoelectric measurements show that V558 Cas is likely an EB-type eclipsing binary varying from magnitude 8.70 (V) to 8.91 (V) with a period of approximately 3.16 days. The variability of V558 Cas = HD 12762 was discovered by Strohmeier et al. (1962) using the photographic plates from Bamberg. The star was mentioned as an eclipsing star of magnitude 8.1 (p) with an amplitude of $0\overset{m}{.}6$ and A-type spectrum. In 1969 and 1970, at the Lund observatory, Bern et al. (1971) measured the star photoelectrically. They catalogued it ranging from $8\overset{m}{.}7$ to $8\overset{m}{.}9$ in V with B−V colour index of 0.72 and U−B colour index of 0.21. They simply confirmed the variability of the star. In the GCVS (Kholopov et al., 1985), V558 Cas is listed as an eclipsing star (E) varying from 9.0 to 9.6 (B) with an A to F spectrum.

32 new photoelectric measurements of V558 Cas (see Table 1) were obtained during several GEOS missions, at the Jungfraujoch station, with the photometer equipped with filters of the Geneva system, attached to the 76-cm telescope. These measurements were carried out from December 1992 to August 1995. These data confirm the results published by Bern et al. (1971): the star varies from 8.70 to 8.91 in V with almost constant B−V colour index of 0.70.

Period search was performed using four different methods. The theta statistic function of Renson (1978) gave the best results due to the limited set of measurements, the low amplitude and the shape of the light curve.

For the light curve (Figure 1), the epoch was chosen close to the instant of dimmest magnitude and adjusted using a spline function:

$$\text{Min I} = \text{HJD}\,2448978.706 + 3.1605 \times \text{E}$$

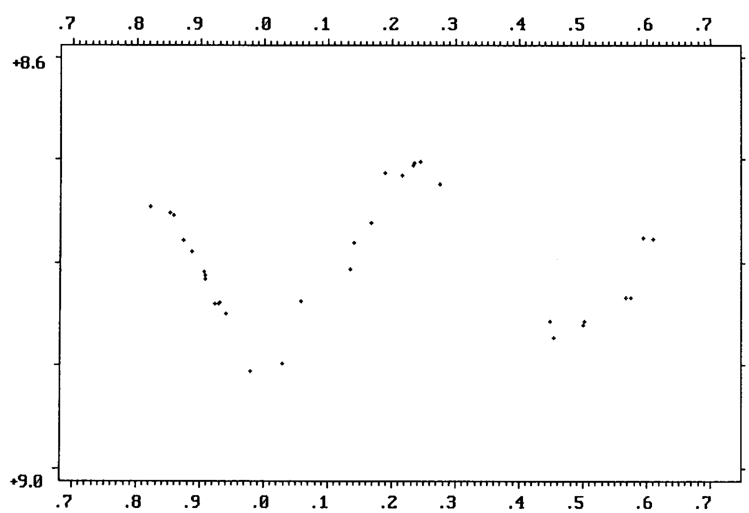

Figure 1. Folded light curve with 32 measurements in V of V558 Cas

Table 1. New photoelectric measurements of V558 Cas

HJD (2400000+)	V	$(B-V)_G$
48620.2904	8.775	−0.110
48620.3390	8.776	−0.099
48621.2834	8.815	−0.113
48621.3320	8.839	−0.112
48621.3494	8.839	−0.119
48621.3834	8.849	−0.113
48622.3104	8.705	−0.117
48622.3438	8.701	−0.122
48623.3673	8.833	−0.126
48623.3916	8.833	−0.115
48624.2652	8.751	−0.118
48624.2819	8.753	−0.116
48624.3305	8.777	−0.121
48978.4178	8.811	−0.114
48978.6400	8.905	−0.096
48981.3038	8.745	−0.126
48981.5093	8.789	−0.106
48981.5697	8.808	−0.095
48981.6496	8.838	−0.071
48982.3135	8.780	−0.118
48982.3989	8.760	−0.120
48982.5509	8.714	−0.102
48982.6086	8.703	−0.092
48983.3051	8.872	−0.128
49721.5158	8.897	−0.113
49721.6082	8.837	−0.091
49722.2950	8.723	−0.126
49807.3544	8.712	−0.096
49810.3442	8.806	−0.096
49811.3337	8.856	−0.119
49950.5604	8.860	−0.119
49950.5680	8.856	−0.111

with primary minimum at 8.91 (V) and secondary one at 8.87 (V), the shape of the light curve looks like the EB type.

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ACCURATE POSITIONS OF VARIABLE STARS NEAR THE SOUTH GALACTIC POLE

Positions for 264 variable stars located around the South Galactic Pole were obtained by measuring the first-epoch plates of the Yale-San Juan Southern Proper Motion Survey. The average error of the new positions is $0\farcs7$ in R.A. and Dec. as referenced to the system of the SRS.

This project is a continuation of a program started by Lopez and Girard (1990). The authors, under the guidance of Girard and following the procedures developed by Lopez and Girard have measured variables and suspected variables in a region around the South Galactic Pole (SGP). The region centered on a R.A. of 0^h extends approximately 2^h on either side. The declination extends approximately from $-20°$ to $-45°$. The derived positions of the suspected variables in this region will be presented in a subsequent bulletin.

In a conversation with Dr. Hoffleit, it was suggested that the bright stars without a finder chart could be located relative to the field stars on the Cordoba Atlas. Using a cutoff magnitude of 10, along with the published position and the references as printed in the GCVS IV (Kholopov et al., 1985a, 1985b, 1987a) the stars were located on the CoD charts. Six variable stars were located in this manner and are indicated in the table by the letter (p) under comments.

Three variables need further study, due to the fact that their finding charts and published positions (GCVS) left a few questions. The published position for AO Aquarii caused the survey machine to center on a star that was labeled b on the finder chart (Tsessevitch, 1954). One of the authors (Predom, 1993) found another chart by Shapley and Swope (1931) that did identify this star as AO Aquarii. The chart by Shapley and Swope was used for determining the position for this variable. DS Aquarii had a problem similar to AO Aquarii, but no charts were found to decide which star was the comparison star and which was the variable. Wahlgren (1992) also called for further study of this star to clarify the inconsistency between the published position and the finding chart. The authors have supplied both positions and labeled them DS Aqr until further study indicates which star is the variable. The chart of VW Gru did not show the variable as a double star; however, the plate image showed two blended images. The published position in this paper is for the center of mass for this plate image.

The results listed in Table 1 are organized by constellation and contain the following information: Variable name, newly determined R.A. and Dec. (Equinox B1950 with epochs in the range of 1965.6 to 1973.8), the differences between our new positions (B1950) and those quoted in the GCVS IV in minutes of time in right ascension and arc minutes in declination ($\Delta\alpha$, $\Delta\delta$), and comments.

Table 1. Positions of Variable Stars

Variable		α (1950) h m s	δ (1950) ° ′ ″	Δα m	Δδ ′	Comments
S	Aqr	22 54 25.841	−20 36 38.31	−0.003	−0.038	
X	Aqr	22 15 54.404	−21 9 6.93	0.007	−0.016	
RT	Aqr	22 20 27.719	−22 18 35.73	−0.005	0.005	CoD −22°15868
SZ	Aqr	22 40 7.720	−21 26 27.89	−0.005	0.035	
WX	Aqr	22 7 32.637	−16 54 33.13	0.011	−0.052	
AF	Aqr	22 1 39.148	−21 50 27.57	0.019	0.541	
AG	Aqr	22 2 44.601	−22 44 37.43	0.010	−0.124	
AH	Aqr	22 2 49.000	−23 57 11.17	0.000	−0.086	
AI	Aqr	22 4 15.960	−20 57 11.08	−0.034	−0.285	
AK	Aqr	22 6 47.281	−19 29 10.04	−0.045	−0.467	
AL	Aqr	22 7 59.560	−22 1 39.01	0.243	−0.750	
AM	Aqr	22 8 22.579	−19 46 21.98	−0.057	−0.766	
AN	Aqr	22 8 26.979	−18 56 0.48	−0.067	−0.408	
AO	Aqr	22 8 45.095	−23 2 6.45	0.002	−0.008	see text
AP	Aqr	22 9 28.435	−23 34 16.34	0.007	−0.072	
AQ	Aqr	22 10 5.226	−21 24 43.80	−0.013	−0.030	
AR	Aqr	22 10 30.892	−24 57 57.55	0.032	0.041	
AS	Aqr	22 15 15.264	−18 39 11.82	−0.029	0.403	
AU	Aqr	22 18 50.336	−25 1 56.27	0.039	−0.038	
AW	Aqr	22 22 8.958	−23 53 57.59	0.016	−0.360	
AX	Aqr	22 22 56.536	−18 29 38.64	−0.041	−0.844	
AY	Aqr	22 24 8.850	−19 40 28.13	−0.052	−0.469	
AZ	Aqr	22 24 26.919	−24 59 0.51	0.032	−0.009	
BB	Aqr	22 24 48.494	−22 35 44.27	−0.008	−0.038	
BC	Aqr	22 28 47.939	−18 19 39.05	−0.084	−0.551	
BD	Aqr	22 30 36.750	−23 52 37.16	−0.004	0.181	
BE	Aqr	22 32 51.284	−18 13 48.95	−0.079	0.184	
BF	Aqr	22 33 17.570	−19 35 6.93	−0.074	−1.416	
BG	Aqr	22 34 44.303	−18 37 54.39	−0.028	−0.706	
BH	Aqr	22 36 16.518	−20 4 5.10	−0.008	−0.385	
BI	Aqr	22 37 27.554	−23 29 20.50	0.009	−0.042	
BV	Aqr	22 0 7.070	−21 46 2.90	0.001	0.052	
DN	Aqr	23 16 37.797	−24 29 23.57	0.013	0.107	
DS	Aqr	22 50 36.660	−18 51 29.83	−0.006	0.003	see text
DS	Aqr	22 50 45.036	−18 50 33.59	0.134	0.940	see text
DX	Aqr	21 59 42.368	−17 12 23.23	−0.011	0.013	
EE	Aqr	22 31 59.170	−20 7 5.97	0.003	0.001	
ER	Aqr	23 2 45.001	−22 45 25.11	0.000	−0.019	CoD −23°17733
ES	Aqr	23 35 44.008	−23 49 56.64	0.000	−0.044	CoD −24°17778
ET	Aqr	23 48 46.585	−19 11 10.13	0.010	0.031	BD −19°6522
FI	Aqr	22 21 48.256	−23 37 16.95	0.004	0.017	CoD −24°17160
FK	Aqr	22 36 2.019	−20 52 52.38	0.017	−0.073	
FL	Aqr	22 36 1.799	−20 52 27.86	0.013	−0.064	(NSV 14256)
T	Cet	0 19 14.578	−20 20 5.69	−0.007	0.005	
RT	Cet	1 14 28.653	−24 6 27.58	−0.006	0.040	
SV	Cet	0 32 26.129	−22 55 18.32	0.002	−0.005	
TW	Cet	1 46 31.923	−21 8 27.72	−0.001	−0.262	(p) CPD −21°00167
UU	Cet	0 1 31.508	−17 16 33.21	0.008	−0.054	
UV	Cet	1 36 30.260	−18 12 29.81	0.071	0.203	
VW	Cet	1 36 39.536	−18 6 0.02	−0.008	−0.100	

(Table 1. continued)

Variable		α (1950) h m s	δ (1950) ° ′ ″	Δα m	Δδ ′	Comments
VY	Cet	1 47 10.810	−19 52 22.04	−0.003	0.233	BD −20°0345
YY	Cet	1 57 49.245	−18 26 57.67	0.004	0.039	BD −18°0349
YZ	Cet	1 10 0.845	−17 16 7.71	−0.003	0.071	
AA	Cet	1 56 40.730	−23 9 41.33	−0.004	0.011	(p) CoD −23°00737
AC	Cet	0 8 25.144	−18 51 2.88	0.002	−0.048	BD −19 0007
AE	Cet	0 12 6.028	−19 12 36.40	0.000	−0.007	BD −19°0027
AF	Cet	0 17 51.798	−23 39 37.07	−0.003	0.182	CoD −24°00100
AH	Cet	0 35 35.562	−21 41 4.74	−0.007	0.021	BD −22°0105
AL	Cet	1 6 11.145	−17 19 47.40	0.002	0.010	BD −17°0198
AU	Cet	0 0 5.660	−19 43 20.39	−0.022	0.060	BD −20°6700
AX	Cet	0 19 28.349	−22 1 54.08	0.022	0.299	
BB	Cet	0 36 1.587	−20 34 18.84	−0.007	−0.014	BD −21°0084
SS	For	2 5 36.124	−27 6 8.43	0.002	−0.041	
SV	For	1 56 6.392	−24 37 18.05	0.007	−0.001	CoD −24°00833
TT	For	1 55 39.901	−26 43 30.27	−0.002	−0.005	
R	Gru	21 45 18.532	−47 8 49.15	−0.008	−0.019	
T	Gru	22 22 46.224	−37 49 24.17	0.004	−0.003	
V	Gru	21 48 46.918	−42 36 30.48	−0.001	−0.008	CoD −42°15664
W	Gru	22 38 22.802	−44 6 9.49	−0.003	−0.058	
Y	Gru	22 44 22.652	−48 10 47.98	0.028	−0.100	(p) CoD −48°14311
RT	Gru	21 48 47.334	−46 13 12.71	0.039	−0.312	
RU	Gru	22 24 6.309	−37 26 36.53	0.005	−0.009	CoD −37°14788
RV	Gru	22 36 25.415	−47 8 8.96	0.007	−0.149	CoD −47°14285
RW	Gru	22 39 10.993	−44 24 54.08	0.000	0.299	
RX	Gru	22 55 26.451	−42 5 39.04	0.008	0.049	
RY	Gru	23 16 41.448	−40 33 51.96	−0.009	0.434	CoD −40°150106
RZ	Gru	22 44 18.378	−43 0 28.73	−0.010	0.121	
ST	Gru	21 47 46.695	−46 25 49.83	0.012	−0.131	
SU	Gru	21 55 36.484	−43 9 38.80	0.008	−0.447	
SV	Gru	21 55 42.241	−44 33 51.93	0.054	1.034	(NSV 13981)
SW	Gru	21 56 3.885	−44 35 26.84	0.048	0.053	
SX	Gru	22 1 14.267	−45 39 39.44	0.004	−0.357	
SY	Gru	22 1 40.707	−43 57 10.08	−0.038	−0.468	
SZ	Gru	22 5 14.816	−42 51 15.90	−0.053	−0.265	
TV	Gru	22 11 3.035	−43 52 41.82	−0.083	0.303	
TW	Gru	22 12 3.441	−45 5 8.91	−0.009	−0.148	
TX	Gru	22 13 17.466	−41 55 35.48	−0.059	0.009	
TY	Gru	22 13 40.796	−40 11 16.94	−0.003	−0.282	
UV	Gru	22 16 48.386	−47 56 42.07	0.023	0.499	
UX	Gru	22 22 23.984	−46 25 44.92	−0.017	0.451	
UY	Gru	22 23 22.970	−41 14 46.68	−0.051	−0.178	
UZ	Gru	22 23 59.155	−40 47 1.50	−0.047	0.175	
VW	Gru	22 26 4.149	−43 44 20.83	0.069	−0.447	see text
VY	Gru	22 29 29.471	−47 8 40.92	0.008	0.518	
WW	Gru	22 34 4.260	−47 26 42.08	−0.046	0.499	
WX	Gru	22 39 4.891	−44 48 15.89	−0.002	0.435	
WY	Gru	22 39 53.926	−46 20 56.54	0.065	0.358	
WZ	Gru	22 41 51.938	−42 37 29.28	−0.018	0.312	
XZ	Gru	22 44 43.583	−39 19 23.36	0.010	0.411	CoD −39°14830
ZZ	Gru	22 47 1.876	−47 48 1.10	0.048	0.382	

(Table 1 continued)

Variable		α (1950) h m s			δ (1950) ° ′ ″			Δα m	Δδ ′	Comments
AA	Gru	22	47	0.262	−46	37	22.14	0.004	0.731	
AB	Gru	22	48	9.971	−47	34	35.83	0.050	0.703	
AD	Gru	22	50	8.481	−44	48	37.55	0.008	0.474	
AE	Gru	22	53	1.670	−40	56	17.77	0.028	0.204	
AF	Gru	22	53	34.722	−47	37	50.44	0.029	0.259	
AG	Gru	22	55	43.243	−45	29	52.60	0.021	−0.377	
AI	Gru	22	56	26.366	−44	5	22.82	0.006	0.220	
AK	Gru	23	2	12.255	−44	12	21.13	0.038	0.048	
AM	Gru	23	2	56.247	−46	59	50.78	−0.013	−0.046	
AN	Gru	23	5	4.488	−47	41	56.12	0.008	−0.735	
AQ	Gru	23	19	33.989	−42	21	51.23	0.000	0.846	
AR	Gru	22	33	48.770	−38	33	43.56	0.030	0.074	
AS	Gru	22	57	49.535	−41	46	59.55	0.026	−0.092	CoD −42°16163
AU	Gru	22	7	1.151	−42	53	20.66	−0.014	0.056	
AZ	Gru	22	32	9.575	−45	33	7.25	0.010	−0.221	
BB	Gru	22	36	29.884	−45	51	7.71	0.015	0.272	
BE	Gru	22	47	46.286	−44	55	41.21	−0.012	0.413	
BI	Gru	22	18	9.074	−44	19	1.09	0.001	−0.418	(NSV 14123)
BK	Gru	22	21	40.982	−39	22	53.36	0.000	0.011	CoD −39°14697
BN	Gru	23	2	0.924	−45	27	34.45	0.032	−0.174	(NSV 14415)
BO	Gru	23	4	9.567	−44	10	51.97	0.026	0.034	(NSV 14425)
PI	Gru	22	19	41.465	−46	12	2.97	0.008	−0.050	
T	Phe	0	28	1.471	−46	41	6.98	0.025	0.084	
V	Phe	23	29	44.644	−46	15	52.55	0.011	−0.176	
RR	Phe	23	56	20.851	−39	42	45.18	0.164	0.247	
RU	Phe	23	25	24.205	−47	43	59.69	−0.030	−0.495	
RV	Phe	23	25	47.029	−47	43	45.15	0.000	−0.053	
RW	Phe	0	27	51.566	−46	44	32.54	0.009	−0.042	
SW	Phe	23	57	56.074	−39	54	11.40	0.018	−0.090	
SX	Phe	23	43	54.682	−41	51	9.71	0.011	−0.262	
SY	Phe	1	28	20.502	−42	57	52.05	0.008	0.033	CoD −43°00461
SZ	Phe	1	31	54.568	−43	29	50.71	−0.007	0.055	
TV	Phe	1	2	25.386	−45	24	32.38	0.006	−0.040	
TW	Phe	1	2	37.734	−43	23	16.87	0.029	0.119	
TX	Phe	1	4	25.246	−46	49	42.82	−0.029	0.386	
TY	Phe	1	4	44.399	−42	13	26.40	−0.027	0.260	
TZ	Phe	1	7	42.467	−42	23	41.90	−0.026	0.102	
UU	Phe	1	7	57.457	−45	40	29.47	0.024	−0.191	
UV	Phe	1	9	54.803	−41	29	21.45	−0.037	−0.058	
UX	Phe	1	14	38.953	−39	47	33.89	−0.017	−0.065	
UY	Phe	1	20	58.636	−42	34	13.14	−0.006	0.181	
UZ	Phe	1	22	21.588	−45	12	19.59	0.010	−0.627	
VV	Phe	1	22	46.052	−45	49	4.80	0.001	−0.380	
VW	Phe	1	23	21.548	−42	4	9.17	0.009	0.047	
VX	Phe	1	24	7.047	−39	46	41.85	0.017	−0.397	
VY	Phe	1	25	27.434	−43	15	50.71	−0.026	−0.145	
VZ	Phe	1	26	1.803	−45	40	4.68	−0.003	−0.078	
WW	Phe	1	28	57.828	−44	15	0.20	−0.003	−0.203	
WX	Phe	1	31	33.749	−44	4	45.56	0.012	−0.059	
WY	Phe	1	35	16.360	−41	31	43.55	−0.111	−0.626	

(Table 1 continued)

Variable		α (1950) h m s	δ (1950) ° ′ ″	Δα m	Δδ ′	Comments
WZ	Phe	1 36 40.740	−46 10 6.18	0.012	0.197	
XX	Phe	1 37 2.450	−39 43 48.47	−0.009	0.192	
XY	Phe	1 38 16.299	−41 53 10.17	0.022	−0.569	
XZ	Phe	1 38 44.655	−46 32 5.43	0.011	0.709	
YY	Phe	1 38 51.456	−47 47 27.99	−0.042	−0.267	
YZ	Phe	1 40 21.822	−46 12 9.77	−0.003	−0.163	
ZZ	Phe	1 43 20.793	−46 29 19.46	−0.003	−0.324	
AA	Phe	1 43 39.848	−45 40 58.27	−0.019	0.229	
AC	Phe	1 54 46.967	−44 35 42.60	−0.017	−0.210	
AD	Phe	1 14 22.322	−39 58 20.49	0.005	−0.042	
AG	Phe	0 24 27.215	−40 9 30.38	0.004	−0.006	
AI	Phe	1 7 21.005	−46 31 54.34	0.000	−0.006	
AK	Phe	1 17 24.615	−47 33 16.54	−0.006	0.024	CoD −47°00389
AL	Phe	1 23 5.009	−46 11 10.04	0.000	0.033	CoD −46°00394
AM	Phe	1 47 45.798	−43 13 1.93	−0.003	0.168	CoD −43°00565
AN	Phe	23 31 10.341	−45 19 35.14	−0.011	−0.086	
AO	Phe	1 4 48.885	−46 51 46.99	−0.035	0.417	
AP	Phe	1 17 15.363	−46 50 28.15	0.006	−0.469	
AQ	Phe	1 17 23.002	−47 30 55.22	−0.017	−0.120	
AR	Phe	1 21 42.828	−41 45 38.75	−0.020	0.154	
AS	Phe	1 27 52.237	−41 45 46.92	−0.046	0.118	
AT	Phe	1 33 55.204	−42 16 45.46	0.003	−0.158	
AU	Phe	1 48 22.672	−47 13 18.41	−0.005	−0.107	
AV	Phe	1 10 43.572	−44 8 24.36	−0.024	−0.106	
AW	Phe	1 27 23.543	−47 0 52.16	−0.008	0.031	CoD −47°00440
AX	Phe	1 4 39.131	−46 24 57.27	−0.048	1.045	
AY	Phe	23 35 9.280	−45 50 45.21	0.005	−0.053	CoD −46°14721
AZ	Phe	0 47 42.951	−43 39 59.76	−0.001	0.004	CoD −44°00216
R	PsA	22 15 9.787	−29 51 15.75	−0.004	0.038	
S	PsA	22 0 54.450	−28 17 36.13	−0.009	0.098	
U	PsA	21 59 38.025	−28 7 36.59	0.017	−0.310	
V	PsA	22 52 35.073	−29 52 45.02	0.001	−0.050	(p) CoD −30°19355
W	PsA	22 5 3.241	−33 4 41.95	0.004	0.601	CoD −33°15917
X	PsA	22 3 14.243	−25 8 27.67	0.004	0.239	
Y	PsA	22 4 49.819	−25 30 20.11	0.297	−0.735	
Z	PsA	22 11 34.373	−26 8 24.61	0.006	0.090	
RR	PsA	22 12 13.076	−26 54 29.44	0.035	−1.091	
RS	PsA	22 12 51.535	−25 59 40.25	−0.008	0.029	
RT	PsA	22 17 15.844	−25 24 43.33	0.014	0.078	
RU	PsA	22 17 36.602	−26 23 16.71	0.010	−0.578	
RW	PsA	22 6 56.980	−27 18 47.79	0.033	−0.097	CoD −27°15798
RX	PsA	22 10 20.376	−27 31 1.90	−0.010	0.068	
RZ	PsA	22 38 35.348	−33 36 11.82	0.039	0.203	
SS	PsA	22 50 44.274	−33 11 38.30	0.005	−0.038	CoD −33°16275
ST	PsA	22 51 31.662	−34 39 26.24	−0.006	0.063	
SU	PsA	22 53 50.977	−35 52 8.84	0.000	0.353	
SW	PsA	22 3 17.629	−29 47 32.68	−0.006	0.055	
SZ	PsA	22 48 56.061	−28 7 10.08	−0.016	−0.068	
TT	PsA	22 0 22.736	−31 41 13.54	−0.004	−0.026	
TU	PsA	22 49 25.685	−25 34 3.22	−0.005	−0.654	CoD −25°16142

(Table 1 continued)

Variable		α (1950) h m s	δ (1950) ° ′ ″	Δα m	Δδ ′	Comments
TV	PsA	22 55 5.620	−26 26 3.51	0.010	−0.059	CoD −26°16396
TW	PsA	22 53 37.985	−31 49 53.63	0.016	−0.094	CoD −32°17321
TX	PsA	22 42 11.383	−33 31 9.41	−0.144	−0.157	
R	Scl	1 24 40.041	−32 48 7.31	0.001	−0.022	
S	Scl	0 12 51.009	−32 19 23.63	0.000	0.006	
T	Scl	0 26 44.733	−38 11 5.16	−0.004	0.014	
U	Scl	1 9 14.328	−30 22 23.75	0.039	0.404	
V	Scl	0 6 5.339	−39 29 46.74	−0.011	0.621	
W	Scl	0 30 45.816	−33 9 2.25	0.047	−0.038	(p) CoD −33°00185
X	Scl	0 47 5.523	−35 11 6.18	−0.008	0.297	
Y	Scl	23 6 23.020	−30 24 18.47	0.000	−0.008	CoD −30°19448
Z	Scl	0 37 31.052	−34 14 5.06	0.001	0.016	
RR	Scl	0 27 4.639	−38 20 52.03	0.077	−1.067	
RT	Scl	0 33 59.182	−25 56 53.88	0.003	0.002	CoD −26°00179
RU	Scl	0 0 14.475	−25 13 25.50	0.008	−0.025	
RV	Scl	1 17 20.267	−27 7 37.54	0.021	−0.226	
RX	Scl	1 24 3.303	−27 45 34.40	−0.012	0.727	
RY	Scl	1 31 5.171	−30 45 14.48	0.003	−0.141	
RZ	Scl	1 39 38.054	−26 27 59.95	−0.049	0.001	
SS	Scl	1 39 54.231	−30 14 27.35	0.004	0.144	
ST	Scl	1 40 19.278	−30 16 44.43	0.005	−0.041	
SU	Scl	1 41 18.150	−29 45 41.81	0.019	0.403	
SV	Scl	1 42 42.894	−30 18 33.64	−0.002	0.039	
SW	Scl	0 3 41.329	−33 5 40.82	0.005	0.020	
SZ	Scl	0 13 15.402	−31 22 24.07	0.023	0.199	
TU	Scl	23 48 50.501	−29 23 51.91	−0.192	3.335	
TV	Scl	23 50 0.758	−30 26 50.72	−0.304	0.255	
TW	Scl	23 52 6.511	−33 45 34.00	0.025	−0.667	
UV	Scl	0 53 32.720	−26 39 13.23	0.012	−0.020	
UW	Scl	1 0 43.101	−25 46 23.01	−0.182	0.816	
UY	Scl	0 12 15.140	−39 31 16.72	0.002	0.021	
UZ	Scl	23 20 6.705	−30 23 37.26	−0.022	0.079	
VV	Scl	1 13 47.753	−34 24 46.23	−0.004	0.030	CoD −34°00483
VW	Scl	1 15 59.160	−39 28 29.27	0.003	0.112	
VX	Scl	1 33 8.657	−35 23 0.66	−0.006	−0.011	(NSV 560)
VY	Scl	23 26 21.317	−30 3 18.08	0.005	−0.001	
VZ	Scl	23 47 33.831	−26 39 33.94	−0.003	−0.066	
WW	Scl	0 3 29.220	−37 10 56.85	0.087	0.053	
WX	Scl	0 47 2.578	−27 39 34.41	0.043	−0.573	
WY	Scl	0 58 3.186	−28 28 29.87	0.036	−0.698	
WZ	Scl	1 26 26.631	−34 1 18.39	0.011	−0.006	CoD −34°00576
XX	Scl	1 27 8.895	−33 34 41.79	−0.002	0.003	CoD −33°00541
XY	Scl	0 4 3.050	−32 52 16.77	0.001	0.020	CoD −33°00003
XZ	Scl	0 4 3.309	−38 3 17.96	0.005	−0.299	
YY	Scl	0 5 56.458	−26 15 24.22	0.008	−0.004	CoD −26 00022
YZ	Scl	0 25 0.018	−35 59 43.60	−1.000	−0.027	CoD −36°00144
ZZ	Scl	0 33 20.926	−25 9 11.16	−0.001	0.014	CoD −25°00212
AA	Scl	0 34 1.218	−30 36 31.80	0.004	−0.030	CoD −31°00228
AB	Scl	0 42 4.776	−33 55 39.46	−0.004	−0.058	CoD −34°00263
AC	Scl	0 53 52.615	−25 49 27.02	−0.006	−0.050	CoD −26°00300

(Table 1 continued)

Variable		α (1950) h m s	δ (1950) ° ′ ″	Δα m	Δδ ′	Comments
AD	Scl	1 3 6.345	−31 57 40.98	0.006	0.017	
AE	Scl	1 5 4.155	−32 34 35.44	0.003	0.509	
AF	Scl	23 4 43.287	−25 51 58.63	0.005	0.023	CoD −26°16483
AG	Scl	23 5 25.031	−35 53 24.66	0.001	−0.011	CoD −36°15725
AH	Scl	23 25 48.085	−31 40 41.37	0.001	0.010	CoD −32°17539
AI	Scl	1 10 27.478	−38 7 12.90	0.008	0.085	CoD −38°00420
AK	Scl	23 34 17.300	−37 38 56.47	0.005	0.059	
AL	Scl	23 52 42.073	−32 11 54.99	0.001	0.084	(p) CoD −32°17723
AM	Scl	1 6 47.623	−28 37 52.60	−0.006	0.623	
AN	Scl	1 10 17.951	−29 26 40.13	−0.001	0.031	CoD −29°00376
AO	Scl	1 17 38.093	−33 41 8.59	0.018	−0.043	

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ACCURATE POSITIONS OF SUSPECTED VARIABLE STARS NEAR THE SOUTH GALACTIC POLE

Positions for 142 suspected variable stars located around the South Galactic Pole were obtained by measuring the first-epoch plates of the Yale-San Juan Southern Proper Motion Survey. The average error of the new positions is 0''.7 in R.A. and Dec. as referenced to the system of the SRS.

This project is a continuation of a program started by Lopez and Girard (1990). The authors have measured variables and suspected variables in a region around the South Galactic Pole (SGP). The region centered on a R.A. of 0 hours extends approximately 2 hours on either side. The declination extends approximately from $-20°$ to $-45°$. Derived positions of the variables in this region are presented in the previous issue of the IBVS.

In a conversation with Dr. Hoffleit, it was suggested that the bright stars without a finder chart could be located relative to the field stars on the Cordoba Atlas. Using a cutoff magnitude of 10, along with the published position and the references as printed in the NSV catalogue (Kukarkin et al., 1982) the stars were located on the CoD charts. A total of 73 suspected variables were located in this manner and are indicated in the table by the letter (p) under comments.

The results, listed in Table 1, contain the following information: Suspected variable name, newly determined R.A. and Dec. (Equinox B1950 with epochs in the range of 1965.6 to 1973.8), the differences between our new positions (B1950) and those quoted in the NSV in minutes of time in right ascension and arc minutes in declination ($\Delta\alpha$, $\Delta\delta$), and comments.

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Table 1. Positions of Suspected Variable Stars

Variable NSV	α (1950) h m s	δ (1950) ° ′ ″	$\Delta\alpha$ m	$\Delta\delta$ ′	Comments
00014	0 2 2.006	−18 48 9.56	0.000	0.141	(p) (264.1932)
00029	0 3 48.133	−35 33 55.38	−0.048	−0.923	
00046	0 5 13.817	−22 47 14.19	0.014	−0.037	(p) CoD −23°00013B
00051	0 6 0.444	−17 51 20.83	0.007	−0.047	(p) BD −18°0115
00056	0 6 43.375	−46 49 10.15	0.040	0.131	
00096	0 11 10.209	−26 18 0.37	0.003	−0.106	(p) CoD −26°00056
00113	0 14 10.224	−20 29 15.27	0.004	0.045	(p) BD −21°0024
00139	0 18 51.789	−46 1 0.46	−0.004	−0.208	
00198	0 31 11.938	−44 5 46.86	0.016	0.019	(p) CoD −44°00135
00199	0 31 19.963	−17 47 15.09	−0.001	0.148	
00207	0 31 53.800	−43 16 35.45	−0.403	−1.591	
00215	0 32 53.382	−21 17 14.54	0.090	−0.242	
00216	0 32 54.577	−22 1 10.94	0.010	−0.082	(p) CoD −22°00177
00232	0 35 26.792	−40 8 28.84	−0.003	0.119	
00252	0 37 55.351	−21 51 1.42	0.006	−0.024	
00254	0 37 53.727	−37 6 57.86	−0.038	0.136	
00272	0 41 4.561	−18 15 36.68	−0.007	−0.011	(p) (Beta Cet)
00282	0 42 7.216	−19 13 17.39	0.004	0.110	(p) BD −19°0111
00285	0 42 36.658	−19 10 39.39	0.028	−0.256	
00294	0 44 22.624	−18 25 17.26	−0.006	0.012	
00336	0 51 12.680	−41 36 49.94	−0.039	0.168	
00341	0 52 1.684	−35 40 19.84	−0.005	0.069	(p) CoD −36°00312
00370	0 58 51.158	−44 32 29.01	−0.014	1.017	
00383	1 1 1.129	−43 24 50.61	−0.048	−0.244	(p) CoD −43°00297
00390	1 1 59.217	−25 52 12.72	0.004	−0.112	(p) CoD −26°00348
00398	1 3 40.947	−26 20 54.30	−0.001	0.195	
00404	1 4 38.152	−29 52 56.79	0.003	−0.047	
00420	1 7 35.003	−44 34 51.71	−0.100	−0.162	
00431	1 8 59.498	−42 56 44.79	−0.008	0.053	(p) CoD −4300346
00441	1 11 3.760	−47 15 23.26	−0.021	0.112	
00443	1 11 15.961	−26 33 0.86	−0.017	0.086	
00455	1 14 20.469	−40 5 43.55	−0.042	−0.326	
00456	1 14 25.855	−45 35 45.72	−0.002	−0.262	
00464	1 16 3.872	−25 26 35.50	−0.002	0.008	(p) CoD −25°00517
00465	1 16 31.592	−43 35 45.54	0.010	0.041	(p) CoD −43°00386
00483	1 19 17.921	−41 54 50.67	0.032	−0.244	(p) CoD −42°00469
00488	1 20 12.506	−43 51 48.09	0.008	0.098	(p) CoD −44°00388
00500	1 22 24.627	−45 58 52.88	0.010	−0.081	(p) CoD −46°00391
00503	1 23 9.158	−26 43 2.66	0.003	0.056	(p) CoD −27°0478
00508	1 23 32.876	−40 11 44.74	−0.085	−0.746	
00518	1 25 32.080	−23 17 12.86	0.001	0.086	
00546	1 30 28.509	−19 17 42.30	−0.008	0.195	
00556	1 32 42.451	−30 9 59.13	0.008	0.015	
00562	1 33 27.309	−17 47 9.73	0.005	−0.062	
00570	1 34 56.696	−35 14 33.82	−0.022	−0.064	
00576	1 36 8.028	−23 10 24.23	0.017	−0.104	(p) CoD −23°00604
00577	1 36 30.231	−18 12 30.44	0.087	0.193	
00579	1 36 58.256	−29 16 32.45	0.004	−0.041	(p) CoD −29°00542
00581	1 37 6.776	−33 19 32.74	−0.004	−0.046	
00595	1 39 28.493	−45 40 17.13	0.008	0.014	(p) CoD −46°00473

Table 1 (cont.)

Variable NSV	α (1950) h m s	δ (1950) ° ′ ″	Δα m	Δδ ′	Comments
00601	1 40 5.616	−22 31 35.12	0.044	−0.285	
00605	1 40 20.602	−46 55 58.29	−0.007	0.028	(p) CoD −47°00513
00617	1 43 9.054	−18 8 40.91	0.001	0.018	
00634	1 48 10.038	−17 53 50.38	0.001	−0.240	(p) BD −18°0316
00639	1 49 31.168	−43 25 23.33	0.003	0.111	
00643	1 50 11.562	−41 50 30.60	0.009	−0.010	(p) CoD −42°0654
00665	1 53 7.754	−36 2 51.37	−0.004	0.044	(p) CoD −36°00732
00673	1 54 13.268	−34 37 2.50	−0.029	0.158	
00675	1 54 28.722	−21 26 20.03	0.012	0.066	
00677	1 54 52.716	−17 55 13.30	0.012	−0.022	(p) BD −18°0336
00690	1 57 16.851	−31 43 48.65	0.014	0.289	
00703	1 59 9.947	−37 19 15.40	−0.001	−0.057	(p) CoD −37°00777
00708	2 0 9.255	−31 37 22.34	0.004	0.028	(p) CoD −31°00827
00712	2 1 30.956	−17 45 10.35	−0.001	−0.073	(p) BD −18°0356
00716	2 1 55.513	−45 39 10.87	0.009	0.019	(p) CoD −46°00604
00732	2 6 23.361	−18 0 55.35	0.006	−0.023	(p) BD −18°0374
00750	2 10 27.923	−17 55 19.34	0.015	0.078	(p) Yale 456.1
00757	2 11 42.226	−32 16 22.76	0.037	−0.379	(p) CoD −32°0828
13881	21 44 54.731	−40 29 7.40	−0.004	−0.123	(p) CoD −40°14498
13885	21 46 21.208	−34 26 18.64	0.020	−0.511	(p) CoD −34°15271
13890	21 47 42.358	−28 2 39.11	0.006	0.148	(p) CoD −28°17474
13893	21 48 20.226	−41 49 7.13	0.037	−0.119	
13956	21 52 38.335	−23 31 36.51	0.006	−0.009	(p) CoD −23°17167
13977	21 55 28.432	−45 58 59.96	−0.009	0.001	
13981	21 55 42.241	−44 33 51.93	0.087	−1.566	(SV Gru)
14019	22 2 36.963	−47 38 57.23	0.033	−0.254	
14027	22 3 38.797	−45 38 3.54	0.013	−0.159	(p) CoD −45°14576
14073	22 10 29.155	−40 58 23.88	0.003	−0.198	
14108	22 15 42.449	−23 34 55.40	0.007	−0.123	(p) CoD −23°17361
14123	22 18 9.069	−44 19 0.53	0.018	−0.409	(BI Gru)
14141	22 20 46.288	−20 34 0.65	0.005	−0.011	
14151	22 22 51.322	−37 47 44.30	−0.011	−0.038	
14155	22 23 8.392	−47 31 4.77	0.023	−0.080	(p) CoD −47°14194
14156	22 23 24.601	−37 46 36.85	0.043	0.386	
14174	22 26 51.001	−36 1 6.09	0.017	−0.302	
14175	22 26 58.616	−27 21 49.51	−0.006	−0.025	(p) CoD −27°15932
14176	22 27 19.704	−28 25 35.09	0.028	−0.385	
14180	22 28 7.304	−26 19 48.97	0.005	−0.016	(p) CoD −26°16175
14184	22 28 28.733	−23 15 13.72	−0.004	−0.029	(p) CoD −23°17470
14190	22 29 0.283	−43 48 18.89	0.005	−0.015	(p) CoD −44°14949
14192	22 29 20.953	−22 32 13.90	0.099	−2.732	(p) CoD −22°15937
14211	22 31 39.515	−44 2 48.73	0.009	0.688	
14217	22 32 11.529	−39 48 22.19	0.009	0.030	
14231	22 32 45.955	−17 30 59.58	−0.017	0.007	(p) BD −18°6151
14256	22 36 1.795	−20 52 28.07	0.013	−0.468	(FL Aqr)
14266	22 37 35.030	−30 55 5.62	0.001	−0.094	(p) CoD −31°18920
14277	22 39 37.799	−47 28 9.16	−0.003	−0.153	(p) CoD −47°14307
14278	22 39 47.050	−44 30 36.33	0.001	−0.006	(p) CoD −44°15017
14283	22 40 17.811	−41 47 43.66	−0.003	−1.728	(p)
14291	22 40 53.831	−19 5 34.59	−0.003	−0.077	(p) BD −19°6324

Table 1 (cont.)

Variable NSV	α (1950) h m s	δ (1950) ° ′ ″	Δα m	Δδ ′	Comments
14301	22 41 53.938	−32 13 53.35	−0.018	−0.689	
14302	22 42 5.733	−45 8 25.65	−0.004	−0.028	(p) CoD −45°14790
14314	22 44 20.473	−41 42 1.01	0.041	0.583	
14316	22 44 32.005	−45 13 44.55	0.000	−0.042	
14328	22 46 55.474	−27 22 46.85	−0.009	3.019	
14335	22 49 22.100	−27 56 9.46	−0.032	0.842	
14338	22 49 45.004	−33 8 28.27	0.000	0.029	(p) CoD −33°16270
14367	22 53 27.239	−34 8 50.69	0.004	−0.145	(p) CoD −34°15824
14377	22 55 29.333	−43 41 51.67	−0.044	−0.261	
14385	22 58 30.141	−44 43 18.71	0.002	0.488	
14389	22 58 44.040	−20 6 44.89	0.001	0.452	
14405	23 0 55.883	−27 4 58.93	−0.002	0.018	(p) CoD −27°16160
14415	23 2 0.930	−45 27 34.35	0.032	−0.272	(BN Gru)
14420	23 2 48.473	−36 8 5.70	0.175	0.305	(p) CoD −36°15693
14425	23 4 9.582	−44 10 51.98	0.026	0.034	(BO Gru)
14441	23 7 23.158	−40 51 46.32	0.003	−0.072	(p) CoD −41°15163
14470	23 12 58.962	−24 47 32.01	0.016	−0.434	(p) CoD −25°16357
14476	23 13 48.576	−42 28 50.13	0.010	−0.036	(p) CoD −42°16259
14480	23 14 51.883	−42 27 52.84	0.015	0.019	(p) CoD −42°16263
14507	23 17 32.625	−34 52 57.69	−0.023	−0.062	(p) CoD −35°15744
14530	23 20 0.709	−46 58 0.43	−0.155	−3.007	
14532	23 20 32.009	−37 47 21.12	0.000	−0.052	(p) CoD −38°15466
14558	23 23 41.484	−31 21 26.68	−0.042	0.355	
14602	23 29 39.110	−43 53 21.99	−0.015	−0.167	(p) CoD −44°15273
14603	23 29 41.535	−17 40 24.85	−0.074	0.886	
14630	23 32 52.445	−47 13 8.68	−0.009	−0.145	(p) CoD −47°14628
14643	23 34 43.094	−33 52 58.66	−0.015	−0.078	
14655	23 38 27.501	−42 25 27.65	1.342	0.139	
14661	23 38 0.999	−32 21 1.05	0.000	−0.017	(p) CoD −32°17621
14664	23 37 44.280	−38 35 35.67	−0.695	0.006	
14665	23 38 30.520	−24 26 15.23	−0.008	0.046	(p) CoD −24°17796
14671	23 39 9.978	−18 5 38.13	0.000	0.064	(p) (104 Aqr)
14682	23 40 59.498	−32 23 18.85	−0.025	0.086	(p) CoD −32°17640
14697	23 43 25.946	−35 52 0.09	0.016	−0.602	
14701	23 43 48.114	−45 1 40.88	0.002	0.019	(p) CoD −45°15126
14722	23 47 8.415	−43 33 48.45	0.007	−0.008	(p) CoD −43°15514
14750	23 52 5.100	−31 2 48.88	0.002	−0.015	(p) CoD −31°19504
14772	23 54 33.729	−26 54 6.96	−0.005	−0.016	(p) CoD −27°16494
14780	23 55 20.726	−42 12 24.84	−0.005	−0.514	

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NSV 05256, A LOW AMPLITUDE RRab STAR IN CAMELOPARDALIS

NSV 05256 (= BD +82°0338 = SAO 001900 = AGK +81°0344 = PPM 2002 = GSC 4556.0251 = BV 0367 = CSV 006845), was announced as a variable star by Strohmeier and Knigge (1962). They indicated that it was an eclipsing binary with a photographic variation range from $10^{m}_{.}1$ to $10^{m}_{.}6$, without giving any further information about type and period. According to NSV (Kholopov, 1982), the spectral type for NSV 05256 is F6 although it appears as F2 in the PPM catalog.

Following a surveillance program of poorly studied variable stars, NSV 05256 was observed for 12 nights, from 16 December 1995 to 24 February 1996, from L'Estelot Observatory in L'Ametlla de Mar (Spain), in the B and V bands using a 0.3-m telescope and a Starlight Xpress CCD camera. As comparison star SAO 001899 (= BD +82°0337 = PPM 2001 = AGK +81°0343 = GSC 4556.0246) was used, and GSC 4556.0256 served as check star. According to PPM the magnitude of the comparison star, SAO 001899, is 10.30 and its spectral type is F0.

In order to determine the magnitude of SAO 001899, the star was observed in the B and V bands using an Optec SSP-5A photoelectric photometer attached to the focus of the 0.4-m telescope at Mollet Observatory (Spain).

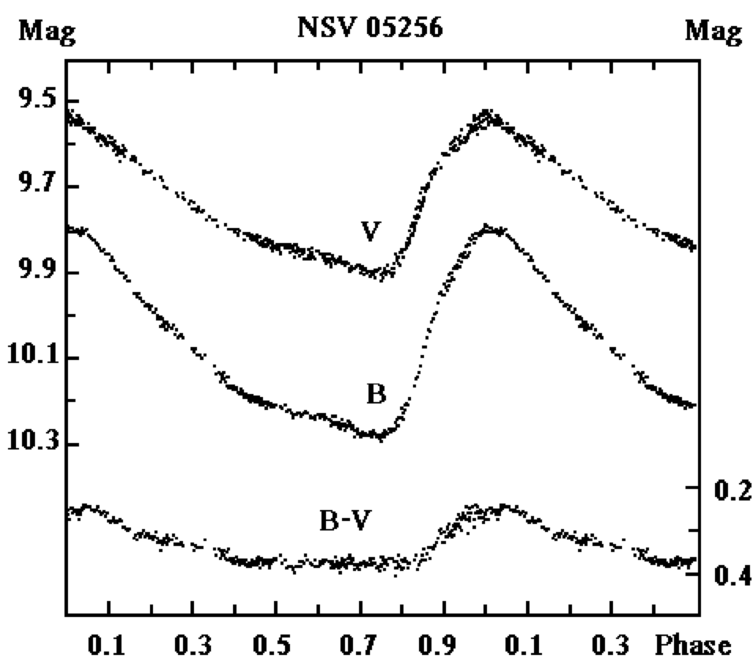

Figure 1

Observations showed that NSV 05256 is not an eclipsing binary but an RR Lyrae star with an asymmetric light curve ($\epsilon = 0.24$). The photometric work confirmed the magnitude and spectral type of SAO 01899. This and CCD observations indicate that the magnitude of NSV 05256 at maximum light is 9.53 in V and 9.80 in B, which places this star among the brightest objects of its class. The amplitude is $0\overset{m}{.}350 \pm 0\overset{m}{.}005$ magnitudes in V and $0\overset{m}{.}474 \pm 0\overset{m}{.}004$ in B.

The observed B$-$V color index for this RR Lyr ranges from $+0\overset{m}{.}26$ to $+0\overset{m}{.}38$, which means an approximate spectral type variation from A9 to F3. V, B, and B$-$V phase curves are depicted in Figure 1. After checking a set of over two hundred bright RR Lyr (Lub 1976, Fitch et al. 1966, Zakrzewski 1993, Eggen 1994), it was found that NSV 05256, FW Lup and ST Pic are, in this order, the bright RRab Lyrae stars with the smallest amplitude in V band.

After performing a least-squares fit to the observed maxima, we determined the following ephemeris:

$$\begin{aligned} \text{Max.} = \text{HJD}\, 2450080.588 &+ 0\overset{d}{.}6214 \times \text{E} \\ \pm 0.002 &\pm 0.0001 \end{aligned}$$

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THE NEW OVERCONTACT SYSTEM GSC 3273.0761 IN ANDROMEDA AND A STAR SHOWING AN OPTICAL TRANSIENT

Following a variable star search program, the variability of GSC 3273.0761, a 12.6 photovisual (PAL-V1) magnitude star according to Guide Star Catalogue, was found when taking CCD frames of the field of PPM 43860.

In the New Catalogue of Suspected Variable Stars (Kholopov, 1982), NSV 00461 = WR 97, a Cepheid with a photographic variation range between 12.9 and 14.0, is about 4 arcminutes to the west of GSC 3273.0761. However, in the identification chart originally published by Weber (1962), WR 97 can be unambiguously identified with GSC 3276.1206 which is about 1 degree to the north of the position given by Kholopov. Therefore, GSC 3273.0761 and NSV 00461 are different objects. Figure 1, prepared from the Palomar-National Geographic Society Sky Survey, shows the region of GSC 3273.0761. No other catalogued object was found in the position of GSC 3273.0761.

The star was observed for 20 nights, from 17 November 1995 to 23 February 1996 in the V and B bands with the 0.4-m telescope of Monegrillo Observatory (Spain) and a CCD Starlight Xpress camera. GSC 3273.0992 was used as comparison star and GSC 3273.0330 as check star. Figure 2 shows the B, V, and B−V phase curves.

Observations show that GSC 3273.0761 is an overcontact eclipsing binary system. The average amplitude in the V band is of $0\overset{m}{.}45$ for minimum I and $0\overset{m}{.}44$ for minimum II. The light curve in the V band also shows an O'Connell effect (O'Connell, 1951), that amounts to Δm = Max. I−Max. II = −0.037 ±0.003, where Max. I is at phase 0.25 and Max. II at phase 0.75.

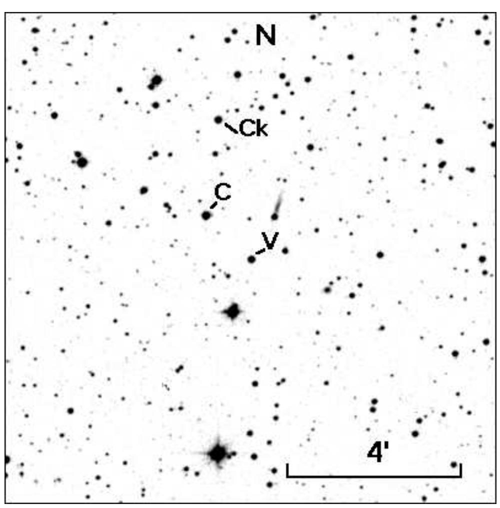

Figure 1. V = GSC 3273.0761, C = Comparison star, Ck = Check star

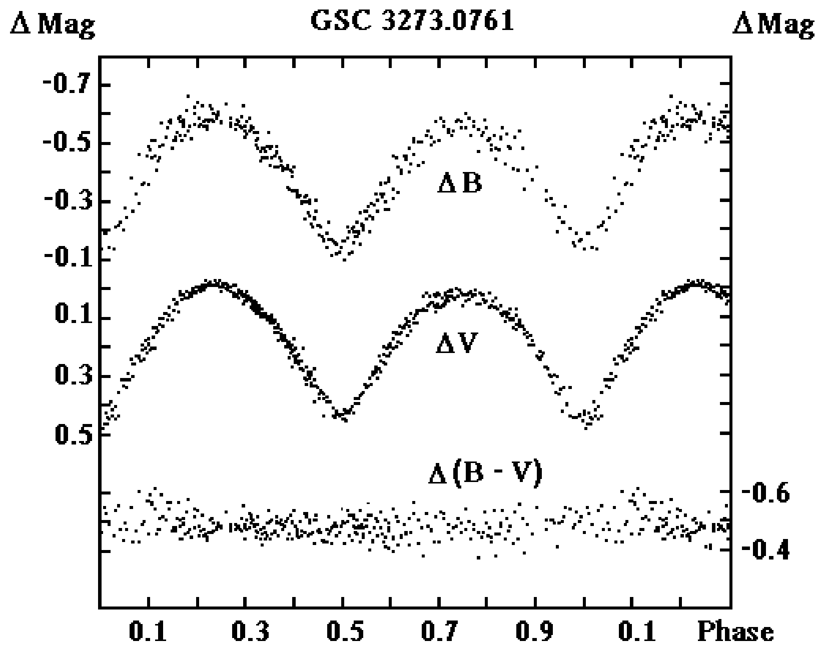

Figure 2. ΔV, ΔB and Δ(B−V) phase curve of GSC 3273.0761

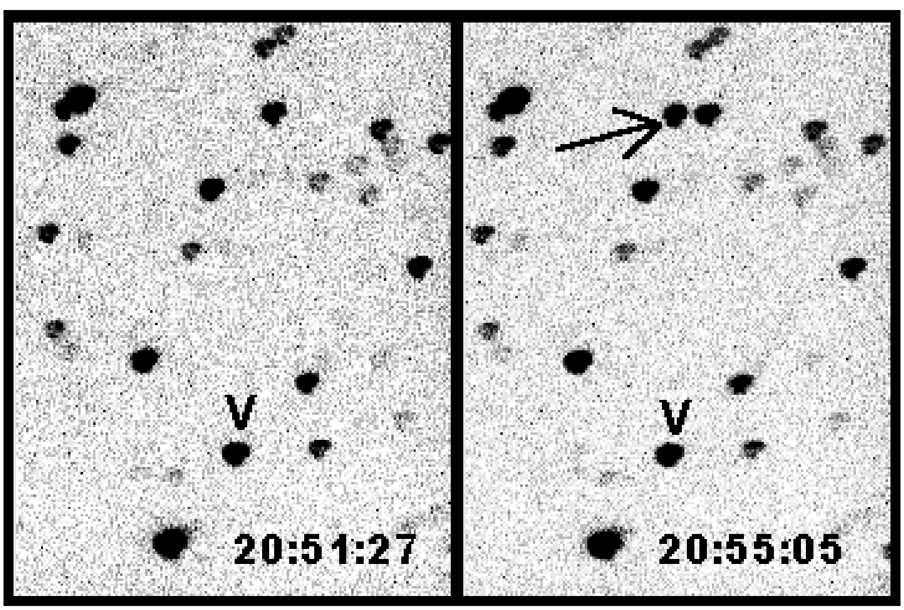

Figure 3. V = GSC 3273.0761 and the transient optical source. North is on top

From the timing of six minima (see Table 1) obtained according to the Kwee–Van Woerden method (1956), the following ephemeris was derived:

$$\text{Min. I} = \text{HJD}\,2450053.4277 + 0^{\rm d}.49188 \times \text{E}$$
$$\pm 0.0015 \pm 0.00004$$

Table 1

HJD 2450000+	Minimum	Epoch	O−C	Filter
53.4277	I	0.0	0.0023	V
57.3603	I	8.0	−0.0002	V
69.4096	II	32.5	−0.0019	V
80.4772	I	55.0	−0.0016	V
116.3858	I	128.0	−0.0003	B
130.4065	II	156.5	0.0019	B

In the last CCD frame from the image series obtained on 15 February 1996, a previously unseen starlike object was recorded with an estimated V magnitude of 13. Figure 3 shows the frame which records the object and the frame before (hours are in UT). A thorough examination of the image shows that it is affected by the same telescope driving inaccuracy as the rest of the stars in the same frame, which indicates that it is not an image artifact. During the observation of GSC 3273.0761, about 800 CCD images were recorded but this optical transient does not appear in any other one. A CCD survey to detect the object at minimum light was undertaken. Although the reached limiting magnitude was about 20, nothing was recorded at the position of this optical source whose coordinates are (J2000.0):

$$\text{R.A.} = 01^{\rm h}18^{\rm m}52^{\rm s} \pm 3^{\rm s}$$
$$\text{Dec.} = +49°43'52'' \pm 10''$$

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HAS THE DELTA SCUTI STAR AD CMi A COMPANION?

AD CMi is a δ Scuti type variable with an amplitude of 0.30 magnitude and stable light curve. Jiang (1987) and Rodríguez et al. (1988) published many observations and suggested an increasing period change. Rodríguez et al. (1990) and Yang et al. (1992) reported some new times of light maxima, with the linear and quadratic solutions.

To check how the star's period varies with time, the authors observed AD CMi again in three nights, from 15 to 17 February, 1994, in Yunnan Astronomical Observatory. The telescope used is a 1 meter reflector with a conventional single-channel photoelectric photometer plus a Johnson V filter. From the new observational data, three new maximum times of AD CMi were determined. Table 1 lists all the times of light maxima collected from the literature and derived from our new observations. For all the data, the linear fit is used to determine the calculated times of light maxima, $T_{max} = T_{01} + P_{01} \times E$. The results of fitting are: T_{01} = HJD 2436601.8210, $P_{01} = 0.12297449$ *days*. And the $(O-C)_l$ are listed in table 1. Then a parabolic curve is used to fit the data as: $T_{max} = T_{02}+P_{02}\times E+0.5\beta\times E^2$. Thus, we got the fitting parameters as: T_{02} = HJD 2436601.8223 *days*, $P_{02} = 0.12297433$ *days*, $\beta = 1.7 \times 10^{-12}$ *days/cycle*. Figure 1 shows the $O-C$ diagram and the fit curve using the parabolic function.

Because many groups of data point distribute above or below the fit curve in Figure 1, which seems to suggest that there is a trigonometric function type variation, we tried to use the following formula to fit the individual maxima, $T_{max} = T_{03}+P_{03}\times E+0.5\beta\times E^2 + A\sin\varphi+B\cos\varphi$. The last two terms correspond to possible light-time effect caused by the orbital motion, whereas φ is the solution of the equation: $\varphi - e\sin\varphi = 2\pi f(P_{03}\times E-\tau)$, in which e is the eccentricity of the elliptical orbit; f, the orbital frequency; τ , the time of periastron. Figure 2 shows the derived $O-C$ residuals and the fit curve using both the parabolic and the trigonometric function. The related parameters thus obtained are as below:

T_{03}(HJD)	P_{03}(days)	β(day/cycle)	A(days)	B(days)	f(day^{-1})	e	res(days)
2436601.8203	0.12297446	4.6×10^{-13}	0.0010	0.0026	0.0000912	0.5898	2.6×10^{-3}

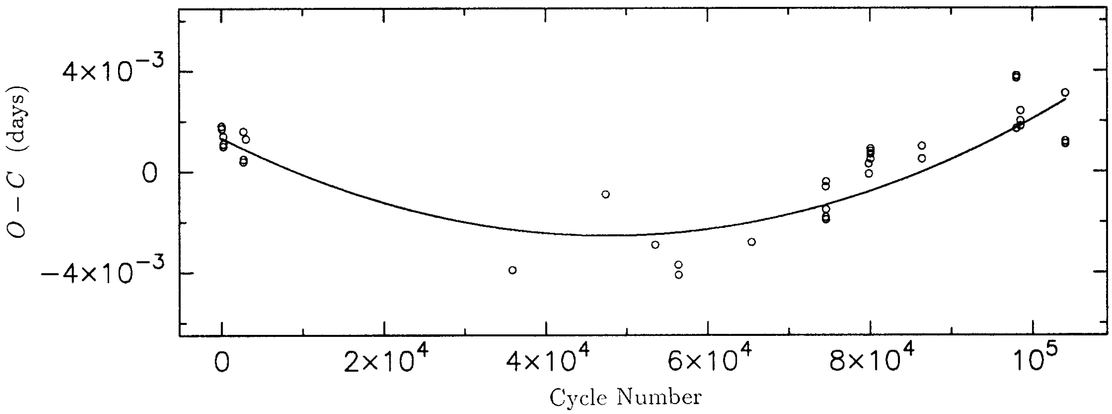

Figure 1. The O−C diagram and the fit curve using the parabolic function

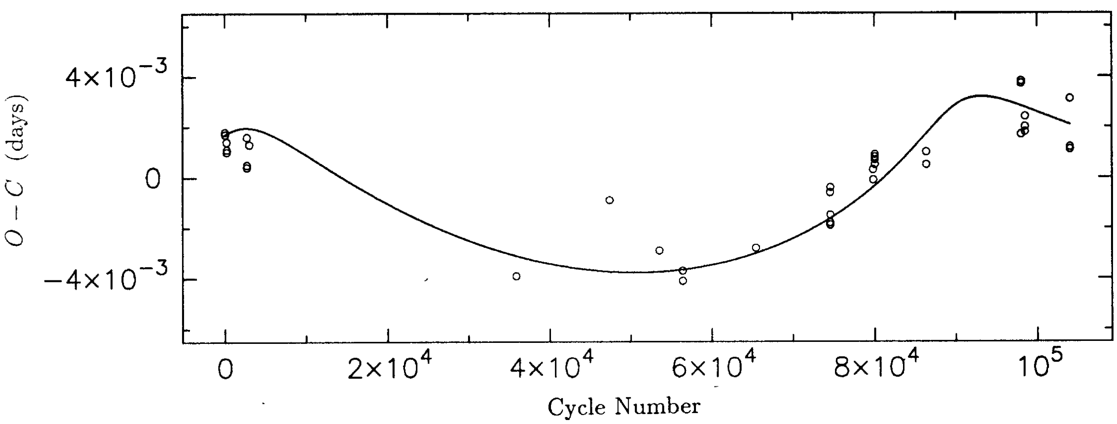

Figure 2. The O−C diagram and the fit curve using the parabolic function and the trigonometric function

Based on the fit above, the authors tend to think that the model of explaining the discrepancies between the observed and calculated times of maximum light as the consequence of a continuously changing (increasing) period, combined with the light-time effect caused by the orbital motion of AD CMi around the mass center of a binary system with an unseen companion, is reasonable. The orbital period here obtained is about 30.0 years. The rate of the period change, β, is now in agreement with the forecast of the stellar evolution theory, both in the direction of the period changes (increase) and the value of the rate of change ($\sim 0.46 \times 10^{-12}$ day/cycle). However, we should mention that due to the limitation of the number of data points, the solution provided here corresponds to that with the smallest residual among many possible solutions with different parameter values. It is necessary to obtain more observations, especially radial velocity information, to check our new model and determine the parameters in the end.

Table 1. Times of light maxima of AD CMi

i	E_i	T_i	$(O-C)_l$	W	Ref	i	E_i	T_i	$(O-C)_l$	W	Ref
1	0	36601.8228	0.0018	1.0	Ab	24	74574	45772.5187	−0.0019	1.0	R8
2	8	36602.8066	0.0018	1.0	Ab	25	79818	46417.3991	0.0003	0.5	Ji
3	9	36602.9296	0.0018	1.0	Ab	26	79825	46418.2596	−0.0001	2.0	Ji
4	25	36604.8971	0.0017	1.0	Ab	27	79826	46418.3825	−0.0001	2.0	Ji
5	211	36627.7700	0.0014	1.0	Ab	28	79833	46419.2434	−0.0001	2.0	Ji
6	219	36628.7538	0.0014	1.0	Ab	29	79834	46419.3663	−0.0001	2.0	Ji
7	227	36629.7373	0.0011	1.0	Ab	30	80027	46443.1010	0.0005	1.0	Ji
8	228	36629.8602	0.0010	1.0	Ab	31	80028	46443.2243	0.0008	2.0	Ji
9	2683	36931.7620	0.0004	1.0	An	32	80029	46443.3470	0.0005	2.0	Ji
10	2691	36932.7470	0.0016	1.0	An	33	80035	46444.0850	0.0007	1.0	Ji
11	2708	36934.8364	0.0005	1.0	An	34	80036	46444.2082	0.0009	2.0	Ji
12	2992	36969.7620	0.0013	1.0	An	35	80037	46444.3312	0.0009	2.0	Ji
13	35852	41010.6985	−0.0039	0.5	La	36	86340	47219.4395	0.0010	2.0	R9
14	47389	42429.4582	−0.0009	0.1	Ep	37	86340	47220.4228	0.0005	2.0	R9
15	53512	43182.4290	−0.0029	2.0	Ba	38	97999	48653.2017	0.0037	1.0	Ya
16	56390	43536.3488	−0.0037	2.0	Ba	39	98023	48656.1511	0.0017	2.0	Ya
17	56391	43536.4714	−0.0041	2.0	Ba	40	98024	48656.2762	0.0038	2.0	Ya
18	65406	44645.0877	−0.0028	2.0	Ji	41	98486	48713.0884	0.0018	1.0	Ya
19	74524	45766.3713	−0.0006	1.0	R8	42	98494	48714.0724	0.0020	1.0	Ya
20	74540	45768.3377	−0.0018	1.0	R8	43	98518	48717.0242	0.0024	1.0	Ya
21	74541	45768.4606	−0.0019	1.0	R8	44	104065	49399.1625	0.0012	2.0	pp
22	74565	45771.4134	−0.0004	1.0	R8	45	104073	49400.1462	0.0011	2.0	pp
23	74573	45772.3961	−0.0015	1.0	R8	46	104081	49401.1320	0.0031	1.0	pp

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*Ya Yang, D.W., Tang, Q.Q., and Jiang, S.Y., 1992, *IBVS*, No. 3770
*pp present paper

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A Hα FLARE ON UV PISCIUM

UV Psc (=HD 7700, $m_v=9.^m2$, P=0.86 days) is an eclipsing spectroscopic system classified with the short-period group of RS CVns. This system has been studied in several papers, but its properties are still not well-established: e.g. for the spectral types of the components Barden (1985) determined G2/K0IV, while Popper (1991) suggested G5V/K2V. The spectroscopic observations of UV Psc made by Popper (1976, 1991) indicate that the system is a double-line binary with emissions from both components in the H and K lines of CaII, though the cooler component contributes only weakly to the spectrum (the contribution from the hotter component is $L_1/(L_1+L_2)=0.80$ in V). The presence of a prominence in UV Psc was revealed by spectral subtraction in the Hα order (Hall and Ramsey, 1992).

We observed UV Psc in the Hα region during November, 1993 with the aim of studying the rotational modulation at chromospheric levels. The observations were carried out with the All-Fiber-Coupler grating spectrograph of the 2.16 m telescope at Beijing Observatory. The reciprocal linear dispersion was 50 Å/mm at Hα, and the detector was a CCD array with 512×512 pixels. The pixel-to-pixel resolution of the detector comes to 1.15Å. A signal-to-noise ratio (S/N) of about 100-150 in the Hα continuum was reached with typical exposure times of 15 minutes. The spectra, extracted from the CCD images with a standard reduction procedure, and calibrated in wavelength using a comparison neon lamp, were normalized to the continuum through a polynomial fit.

We have measured the net Hα equivalent width (WH) after subtracting an average spectrum of the single non-active star ζ Cas A from our spectra. The reference spectrum was appropriately shifted in wavelength in order to account for orbital Doppler shifts of the visible component in the spectrum. This method allows us to get a better estimate of the emission equivalent width, even when the observed line profile is only marginally filled-in by emission.

UV Psc has been observed for five nights, from November 17 to 22, 1993 when 76 spectra were obtained. These cover most of the orbital phase except an interval of the phase from 0.31 to 0.54. The phases were computed according to the ephemeris given by Jassur and Kermani (1994):

$$T=2444932.2985 + 0.86104771 \times E$$

Figure 1 shows the secondary order spectra around Hα for UV Psc and the reference star, which were obtained on the 22nd Nov. The net Hα emission equivalent width computed from the observations obtained on the 22nd are plotted against the orbital phases in Figure 2.

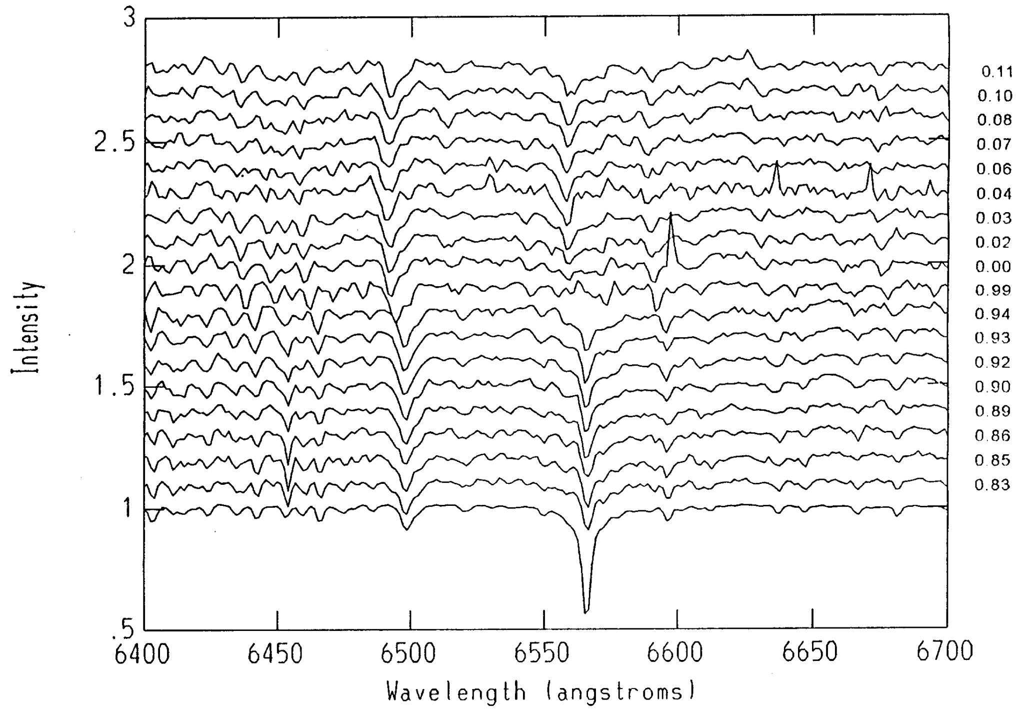

Figure 1. Hα spectra of UV Psc obtained on 22nd Nov. 1993. The spectrum of the reference star ζ Cas A is presented in the bottom of the plot.

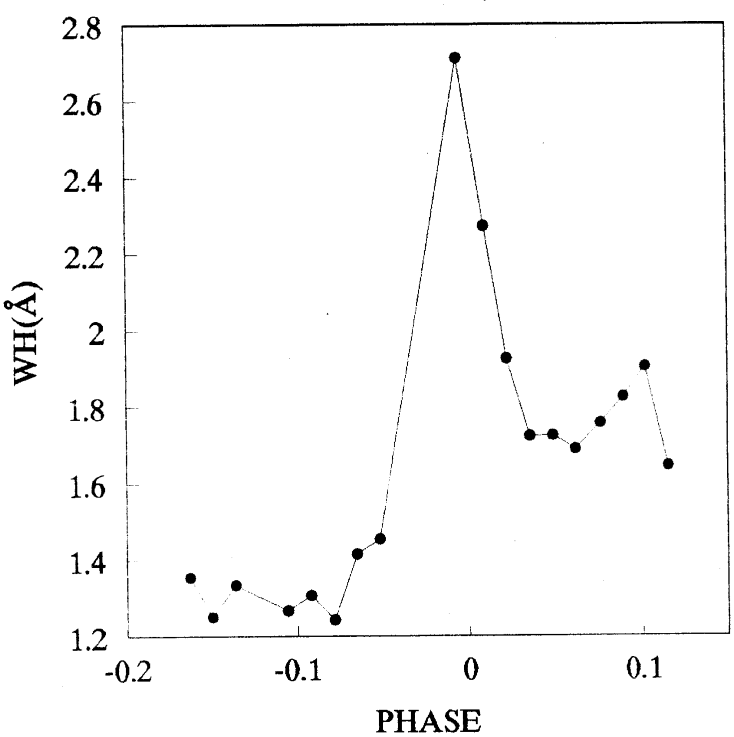

Figure 2. Hα emission equivalent width as a function of the orbital phase.

In our observations, Hα line appears to be an absorption feature filled-in by some emission, but remarkable variations in the Hα profile are clearly displayed in the plots. Especially, it is possible that such variations in the Hα profile and the net emission equivalent width values suggest a complete development of a Hα flare in UV Psc. The flare curve is characterized by a fast rising phase lasting about 1.1 hours and a slow decay phase lasting about 2.4 hours. Before rising, a small concave seems to occur near the phase 0.9 and after the first decay, a small hump clearly occurred near the phase 0.1. This behaviour indicates that the flare is composed of at least two events. Multiple events are often seen in other RS CVn systems as well as in UV Cet type stars. This long duration (3.5 hours) is shorter than the typical duration of single flare in RS CVn stars (15-17 hours), and may be compared with the solar two ribbon flare duration (5-7 hours).

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UBV PHOTOMETRY OF V511 Per

V511 Per (DHK 9) is an Algol type system discovered by Kaiser et al. (1990). Very little is known about the system. Photoelectric observations reveal a primary minimum of $\approx 0\overset{m}{.}4$ and the secondary minimum is almost insignificant.

New observation of V511 Per were made on 30 nights during 1990/1991 observing season with the 30 cm Maksutov telescope of Ankara University Observatory. Differential observations were secured by using an EMI 9789QB photomultiplier. All observations were made with Johnson's UBV filters. The comparison star was BD+39°0782 and check stars were BD+40°0748 and BD+40°0729. The standard deviations of the comparison minus check stars measurements are $0\overset{m}{.}11(U)$, $0\overset{m}{.}035(B)$ and $0\overset{m}{.}039(V)$. These values were averaged over the all comparison minus check measurements. The light and colour curves of V511 Per are plotted in Figure 1 by using the ephemeris given by Kaiser et al. (1990), as

$$\text{Min. I} = \text{HJD}\,2435988.336 + 3\overset{d}{.}0452976 \times \text{E}$$

One minimum time is obtained from our own observations by using Kwee and van Woerden's (1956) method:

$$\text{Min. I} = \text{HJD}\;\; 2448169.5174 \pm 0.0024$$

The observational data can be obtained from the authors.

Figure 1 shows that phasing and thus the light elements by Kaiser et al. (1990) do not need any revision. The phases outside eclipse are not well covered in Figure 1, and no appreciable proximity effect is visible. We therefore attempted the solution of the B and V light curves by using a simple spherical model assumption (see Kopal and Demircan 1978, and Demircan 1978). The mean solution, as given in Table 1, indicates that the system is highly interacting with relatively large fractional radii of the components, and thus the proximity effects would not be negligible. We therefore think the system deserves further photometric and spectroscopic study.

The observational data can be obtained from authors.

Table 1. Some orbital parameters of V511 Per

	r_1 (fractional)	r_2 (fractional)	L_1 (fractional)	U_1	i(°)	K^2 (E-5)
B	0.375	0.240	0.97	0.24	81.6	6.5
V	0.389	0.235	0.93	0.25	80.9	9.0
Av.	0.382	0.238	0.95	0.25	81.25	7.75

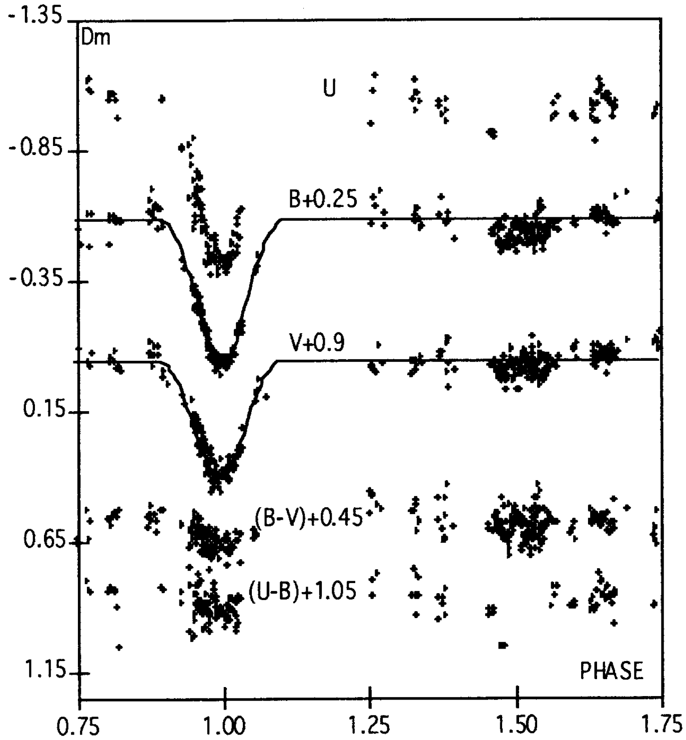

Figure 1. The light and colour curves of V511 Per. Solid line represents theoretical light curve

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OBSERVATIONS OF THE FLARE STAR V 1929 CYGNI

V1929 Cyg was discovered during the monitoring campaign for flare star search based on the photographic patrol observations with the Asiago 60/92 cm Schmidt telescope in the region of the NGC 7000 nebula. This star with coordinates R.A. (1950.0) = $20^h55\overset{m}{.}8$, Dec. (1950.0) = 43°46' got first designation A5 (Rosino et al., 1987). According to the 69th Name list of Variable Stars (Kholopov et al., 1989) the star is named V1929 Cygni. During the flare event on September 4, 1972 the star increased its brightness up to $14\overset{m}{.}5$ (pg). V1929 Cyg is obviously located near the V521 Cyg (LkHα 188) group of Hα-emission and flare stars in the star-forming region of the dark nebula "Gulf of Mexico" in the North America nebula. In Figure 1 the identification map of the star from an 8 minute exposed V-plate (Kodak 103aD+GG495) obtained with the 100/131 cm Byurakan Schmidt telescope on April 24, 1974 is given.

Here we present results of spectroscopic and photometric observations of V1929 Cyg in quiescence.

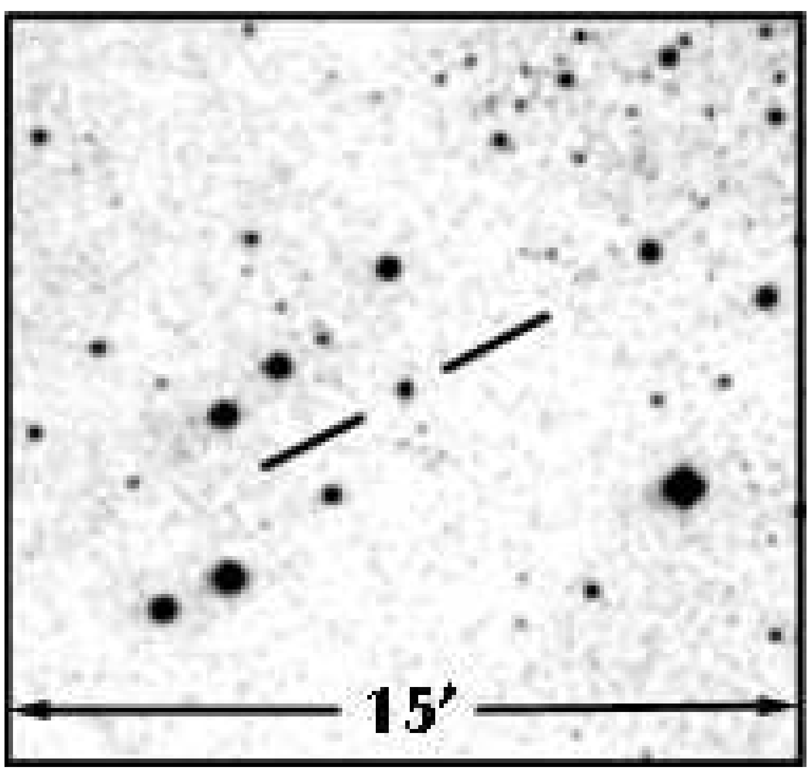

Figure 1. The identification map of V1929 Cyg. North is up, east is to the left

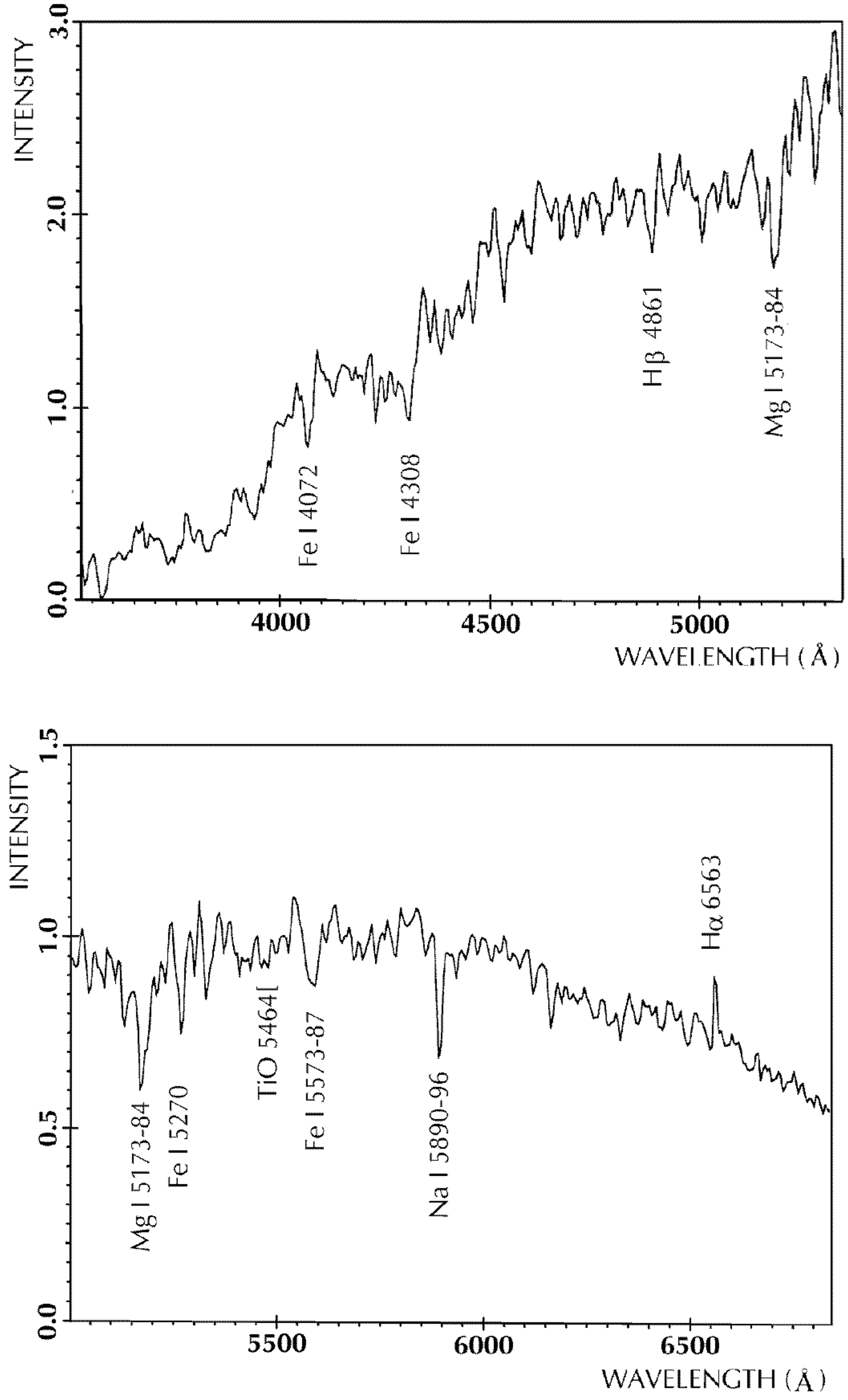

Figure 2. The spectra of the flare star V1929 Cyg in the blue (top) and red (bottom)

Here we present results of spectroscopic and photometric observations of V1929 Cyg in quiescence.

The spectroscopic observations were made with the 6-m telescope of the Special Astrophysical Observatory of the Russian Academy of Sciences and the 1000-channel television spectrophotometer scanner with SP-124 spectrograph (Drabek et al. 1985) during the night of October 15, 1988. The 600 lines/mm diffraction grating with effective resolution of about 5 Å was used. The standardization of the spectra by observing a well known standard star following the work of Bares and Hayes (1984) was done. A preliminary analysis of the spectra (subtraction of the sky background, correction for inhomogeneities in the photocathode sensitivity, construction of dispersion curves, and linearization of the wavelength scale was carried out according to Somov (1985). Further analysis of the spectra – correction for spectral sensitivity of the system, smoothing by means of gaussians, calculations of physical parameters, was done using the Byurakan Astronomical Data Analysing system (ADA – Zaratsyan and Maghakyan 1985). The observed two flare star spectra cover the visible region of the spectrum 3500-6800 A. In Figure 2 the spectra of V1929 Cygni in the blue and red spectral ranges are shown.

The CCD photometric observations were made in the Rozhen Observatory of the Institute of Astronomy, Bulgarian Academy of Sciences with the 2-m RCC telescope and ST-6 CCD camera on November 25, 1995. A series of two 120-sec exposures in B and V and 60-sec exposures in R and I (Kron) was obtained. The photometric reductions were made with a software package according to Georgiev et al. (1994) with the WFPDB computer complex. The magnitudes and colours of the star derived from the photometric BVRI observations after the extinction corrections are:

$$V = 15\overset{m}{.}24;\ B-V = 0\overset{m}{.}92;\ V-R = 0\overset{m}{.}64;\ V-I = 1\overset{m}{.}28.$$

According to this data V1929 Cyg is one of the brightest flare stars in the field of NCG 7000 nebula.

V1929 Cyg is included neither in the list of IRAS point sources nor in X-ray (ROSAT) catalogue. This fact could be due to the faintness of the star and does not exclude the respective requirements for registration in these catalogues.

The spectroscopic observations suggest that the star is of spectral type dK2-dK5 (with Hα-line in emission) having in mind the strong relation of the TiO 5464 spectral band with the spectral type of the stars of spectral classes dK2-dM2 (Pritchet and van den Bergh 1977, Pettersen and Hawley 1987).

The photometric values indicate estimation of the spectral class dK2e according to Zombeck's (1990) standard colours $B-V = 0\overset{m}{.}92$, $V-R = 0\overset{m}{.}74$ and $V-I = 1\overset{m}{.}22$ for stars of dK2 spectral type. Using the data for absolute magnitudes and colours for dK2 stars we obtained a distance modulus of $(m-M)_v = 8\overset{m}{.}64$. The maximum distance to V1929 Cyg would be 540 pc with the assumption for lack of interstellar absorption. As the average value of A_v for some near situated Hα-emission stars (like LkHα 189) is estimated by Cohen and Kuhi (1979) to be about $1\overset{m}{.}0$ we derived about 33 pc for the distance to the flare star. Taking into account that the distance to the NGC 7000 aggregate is 630 pc (Tsvetkov, 1976) we conclude that V1929 Cyg belongs to the nearest part of this star-forming region.

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NEW VARIABLE STARS IN CYGNUS, LACERTA AND ANDROMEDA

The following is an evaluation of an area of $20° \times 15°$ centered at 20^h40^m, $+45°$(1950) in my series of 32 fields in the Milky Way. Three fields have been previously described. (Dahlmark 1982, 1986, 1993).

Eighteen plate pairs (Kodak 103aD+GG 11 and 103aO) were exposed between 1967 and 1982 and 42 were exposed on Kodak TechPan 4415 + Schott 495 filter in the years 1987 to 1995. All exposures were made with f=305 mm optics. They are examined in the same way as described by Dahlmark (1982, 1993). Magnitude estimations of comparison stars were transferred from the sequences in NGC 7209 and 7243 published by Hoag et al. (1961).

In this survey 35 stars are published of which 32 are new variables. The results are based on about 65 magnitude estimates for each star. The lightcurves have been used to determine the provisional variability type, epoch and period for 20 long-period variable stars.

The finding charts are based on 200/210/300 mm Schmidt camera photographs obtained in August 1987.

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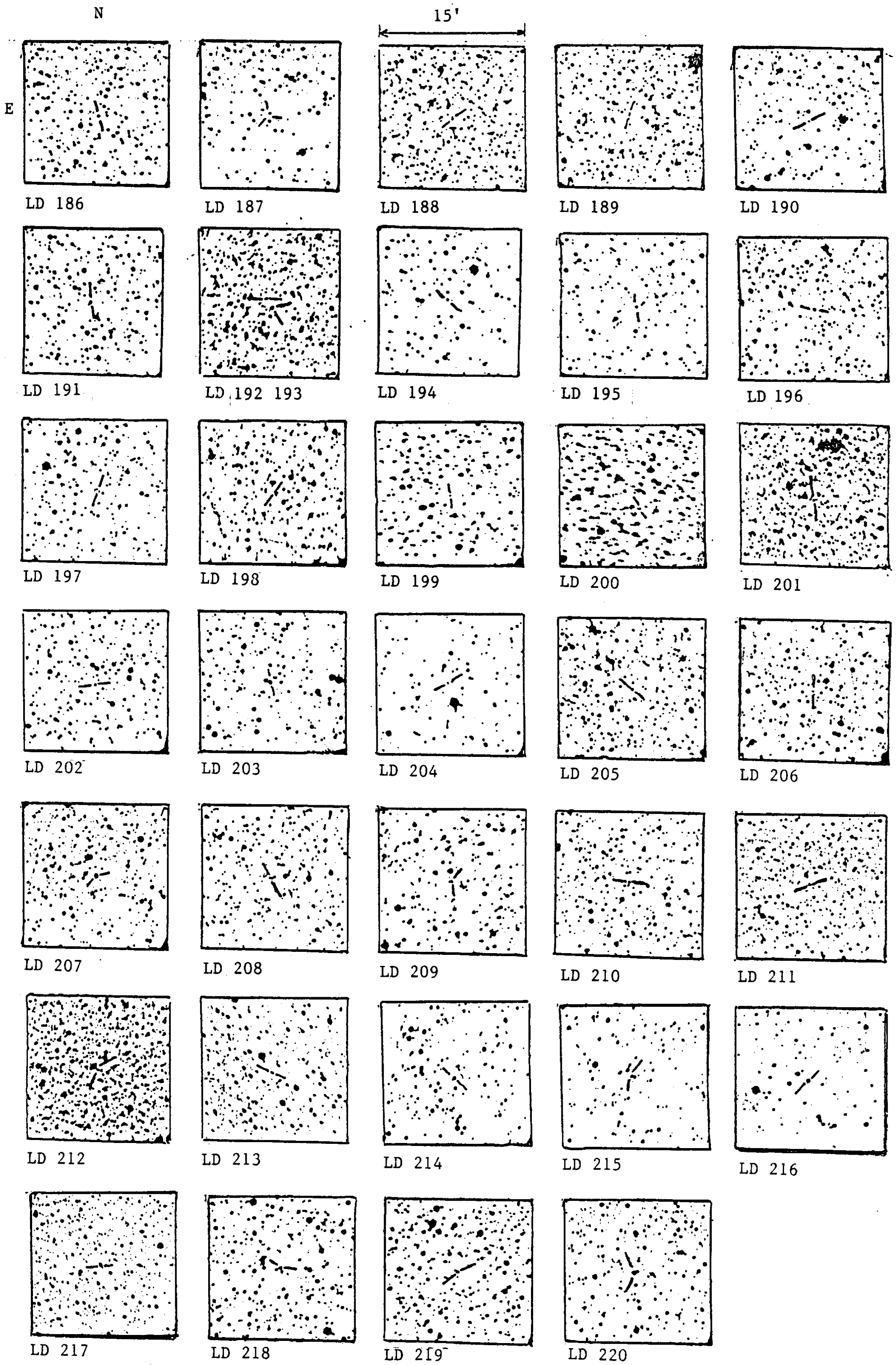
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Figure 1

Table 1. New variables in And, Cyg and Lac. Plate centre $22^h40^m+45°$

No.	R.A. (1950)	Decl. (1950)	m_v max	m_v min	B−V	Type	Epoch 2440000+	Period d	Notes
LD 186	$21^h51^m29^s$	+43°50'.7	12.5	14.2	1.0	SR	9190	239	1,3
LD 187	21 55 24	+38 10.0	12.3	15.2	0.5	SRD	9326	260?	
LD 188	21 56 58	+49 57.7	13.8	(15.1	-		–	–	1
LD 189	22 04 34	+47 52.8	13.9	14.6	0.3		–	–	
LD 190	22 05 48	+40 50.7	12.1	15.2	1.3	M	9842	380	1
LD 191	22 07 03	+45 15.6	12.9	14.6	1.0		–	–	1
LD 192	22 07 41	+51 56.3	11.8	14.0	>2		–	–	
LD 193	22 07 45	+51 57.7	13.6	14.4	−0.2		–	–	
LD 194	22 08 06	+38 01.3	11.7	15.1	1.2	M	9984	380	1
LD 195	22 11 43	+43 39.6	11.9	12.9	0.4		–	–	
LD 196	22 12 43	+46 40.0	11.8	13.5	>2		–	–	
LD 197	22 13 55	+42 08.2	12.5	(16.2	>1.3	NL	–	–	1,9
LD 198	22 17 34	+47 58.0	12.3	14.1	0.4	SR	9251	200?	1
LD 199	22 21 25	+47 29.6	13.8	15.2	>0.5	SR	9652	322	
LD 200	22 22 49	+47 34.6	13.8	14.5	0		–	–	
LD 201	22 23 41	+50 02.9	12.2	15.6	> 0.5	M	9866	500	1,2
LD 202	22 24 21	+48 09.1	13.5	14.6	1.0		–	–	
LD 203	22 26 10	+44 12.5	11.9	12.5	1.5		–	–	2
LD 204	22 27 48	+45 31.8	12.5	15.0	>1.5	M	9995	321	
LD 205	22 29 29	+48 01.3	11.0	14.6	>2	M	9480	363	1
LD 206	22 39 00	+40 19.1	10.6	15.2	3.0	M	9250	185	4
LD 207	22 41 08	+41 01.9	9.7	14.0	2.5	M	9480	258	1
LD 208	22 43 10	+50 36.3	12.8	(15.2	>0.4	M	9981	370	1,2
LD 209	22 44 21	+51 58.6	13.3	14.4	>1		–	–	2,5
LD 210	22 47 29	+52 02.1	11.8	15.2	>0.7	M	8868	344	1
LD 211	22 48 10	+53 09.0	12.2	14.3	>1.5	M:	9948	362	1,6
LD 212	22 56 50	+48 52.2	12.9	15.0	–	SR	9680	367?	2
LD 213	22 58 47	+37 35.1	13.5	15.0	1		–	–	
LD 214	22 59 45	+39 43.6	11.8	14.5	2.0	M	9540	280	1,7
LD 215	23 00 08	+41 27.7	11.6	(15.0	0?		9520	270	2
LD 216	23 04 06	+37 59.0	11.3	12.8	0.7		–	–	1
LD 217	23 14 05	+38 27.4	11.3	14.4	0.5	SRD	9820	362	1,2
LD 218	23 23 20	+45 25.6	12.0	(14.0	>2	M	9520	348	1,2
LD 219	23 28 46	+49 46.2	13.0	13.8	>0.6		–	–	2
LD 220	23 31 44	+46 02.7	11.3	(15.0	1.6	M	9981	325	2,8

Notes
1. IRAS star.
2. Close (5"-30") faint star, may influence magnitude estimates at minimum.
3. Could be V677 or V1093 Cyg.
4. Period increasing.
5. FK Lac?
6. Period variable?
7. Period increased from 271 to 280 days, 1972-95.
8. NSV 14621, period varies from 320 to 325 d.
9. Maxima only in 1968 and 1993.

(15.2 in "min." column means that star is fainter than $15^m.2$.

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UBV OBSERVATIONS OF AB Dor, LATE 1995

Monitoring of the rapidly rotating, cool (early K type) and relatively bright dwarf AB Dor (= HD 36705, SAO 249286) is needed for a fuller account of the properties of electrodynamically active stars (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 to calculate phase values for reference purposes.

The star was observed in B and V ranges on 5 good nights in 1995: Sep 9 and 12, and Dec 18 and 27, with the 20 cm F10 S-C telescope and DC photometer of the Mt Molehill Observatory (cf. Bos, 1994); and Oct 22 with the automated photometer ('APT') at the Kotipu Place Observatory (KPO), using the UBV filters provided with the SSP 5 'Optec' photometer (cf. Hudson *et al.*, 1993).

Standard reduction procedures have been followed (cf. e.g. Budding, 1993). The main comparison star was again HD 37297 ($V = 5.34$, $B - V = 1.04$, $U - B = 0.85$, spectral type K0III — cf. SIMBAD). This comparison was regularly checked against HD 36876 at Mt Molehill (Table 1). Measurements were made every 15-20 minutes, depending on conditions. At KPO HD 37297 was checked against HD 35537, also a K0III star (Budding *et al.*, 1994). The vagaries of the check against comparison are typically ∼0.01 mag in the data sets presented, although sometimes reaching 0.02. The scatter of individual points is somewhat greater for the KPO data, and also greater in B than in V data.

These data sets are shown in Figures 1 and 2. Figure 1 combines the Mt Molehill (Bos) and KPO data, since there appears to be a general continuity for the September-October period. Figure 2 shows the December data. The U-data from KPO for Oct 22 follows the trend of the other two (B, V) data sets, but it is not plotted here. The U magnitude ranges from about 7.98 at phase 0.5 to 8.07 at phase 0.32, with a typical scatter of 0.02 mag.

Table 1. Variability of AB Dor — amplitude and minimum phase

	Max.	Min.	Amplitude	Phase
Figure 1a	6.77	6.88	0.11	0.08
Figure 1b	7.60	7.71	0.11	∼0.1
Figure 2a	<6.81	6.88	>0.07	∼0.0, 0.7
Figure 2b	<7.62	7.70	>0.08	∼0.0, 0.7

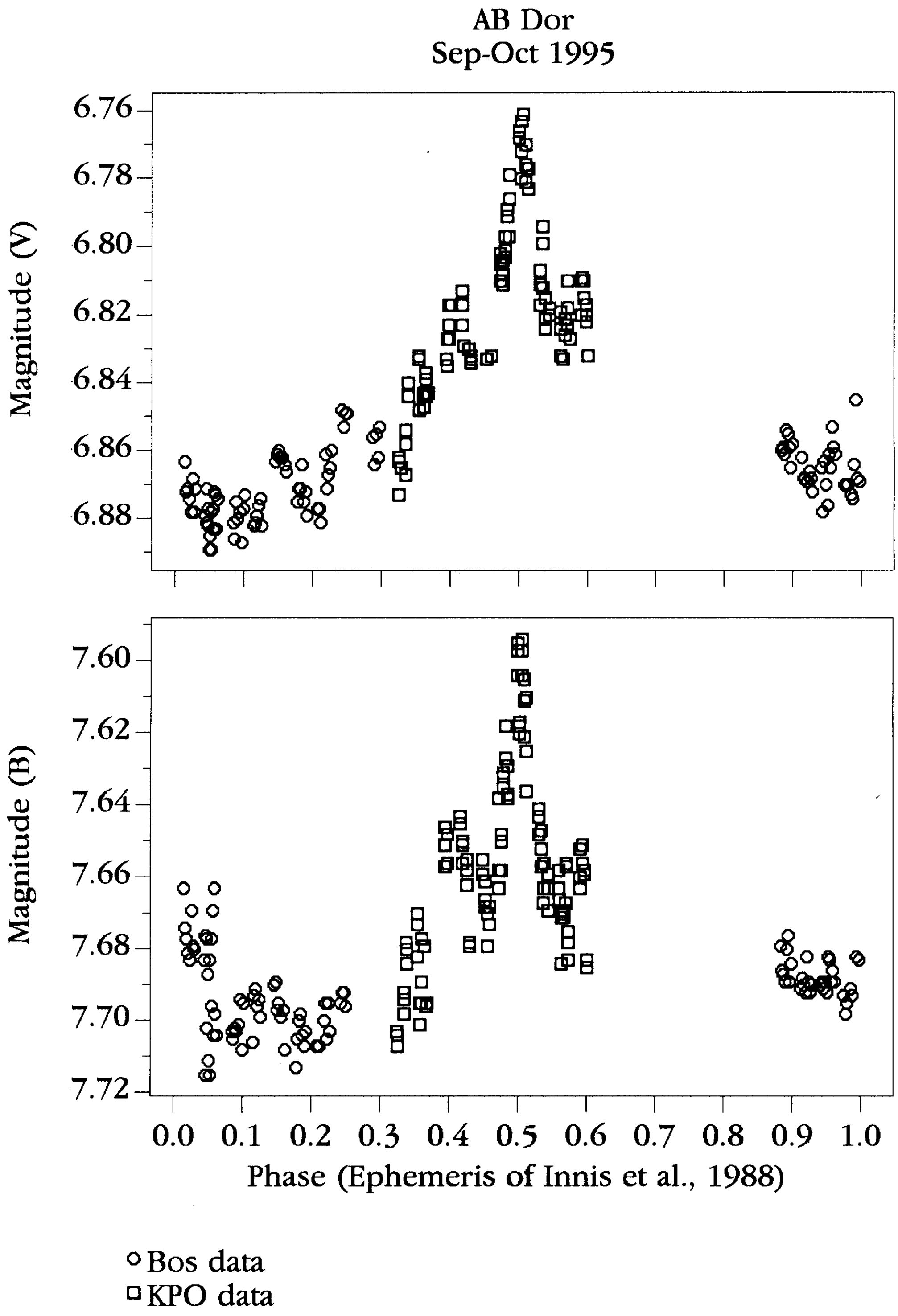

Figure 1. AB Dor: B, V light curves for Sep-Oct, 1995

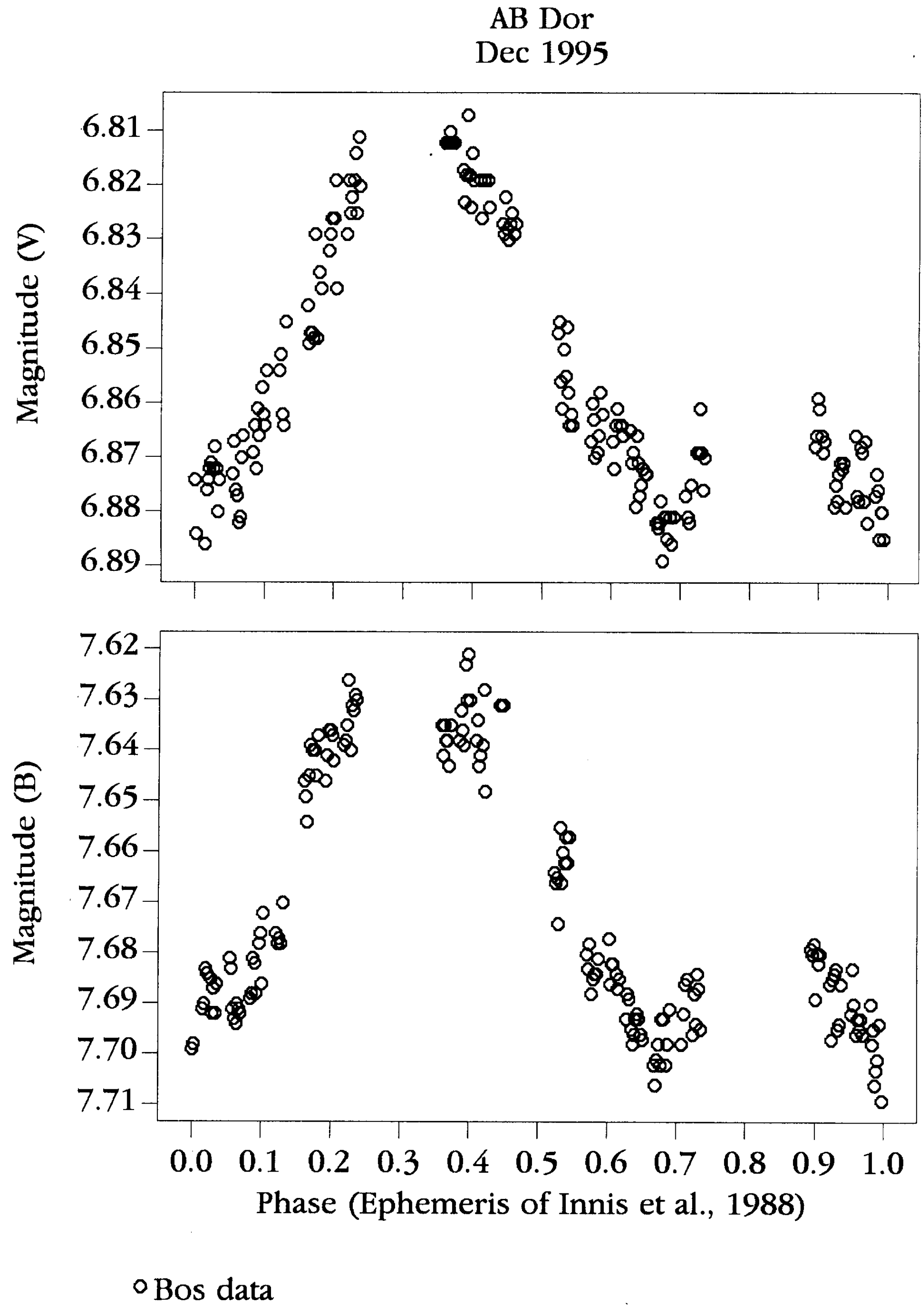

Figure 2. AB Dor: B, V light curves for Dec, 1995

The observed minima may be related to spot A of Innis *et al.* (1988), rather than spot B, but in view of the apparent tendency of the minima to move downward in phase, reported before (Bos *et al.*, 1995), and evident in the trend for late 1995 indicated in this article, the old scheme of Innis *et al.* is rather placed in doubt. One possibility is that another value of the period will give a better general representation of the variation resulting from maculæ which would be at fixed longitudes. A shorter period of 0.5138d has been suggested by Bos (1994). This period produces a well repetitive light curve, with a steady minimum at phase 0.5 through 1995.

The maximum brightness of AB Dor increased slightly (up to 6.77 in V) since the 1993 and 1994 observations. The relatively longer proportion of darkened time on the 1995 data sets cannot be reproduced with just one large starspot, however. Spottedness must cover an appreciable range of longitude in the September-October period, though the relatively unspotted, cusp-like phase range has widened out somewhat by December.

Observations have continued from late 1995 into 1996, and the more recent data retains a consistent phasing of the minima with 1995, using the shorter period of Bos (1994). These newer data will be reported separately later.

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HD 194378 – A NEW ECLIPSING BINARY IN THE OPEN CLUSTER M 29(= NGC 6913)

We carried out time-series CCD photometry of M 29 for five nights from August 12 to September 13, 1994. The observations were made with a Photometrics PM512 CCD camera and Johnson V filter, which were attached to the 61cm Ritchey–Chrétien telescope at Seoul National University Observatory (SNUO). The size of the field in the CCD image is 8.′1×8.′1 (0.945 arcsec pixel^{-1}) at the f/7 Cassegrain focus of the telescope. The exposure time and the duty cycle were 30 sec and 75 sec, respectively. The photometric seeing was typically 4.″5 during the observation period. The finding chart is shown in Figure 1. We monitored 178 stars of M 29, dividing into four fields.

The preprocessing of CCD images was made with the IRAF/CCDRED package. Defective pixels of our CCD chip (Sung 1995) were corrected and the trimming of unreliable subsection was applied. Then, we proceeded with the bias, dark and flat field corrections. We adopted simple aperture photometry to obtain instrumental magnitudes, using the IRAF/APPHOT package (Massey & Davis, 1992). Total probable errors are estimated to be about 7.6 mmag for $9^{m}.0 \sim 10^{m}.0$ stars.

We applied the classical two-star differential photometry to get standard magnitudes. Instrumental magnitudes were scaled comparing with the comparison star (HD 229239, No.4 in Figure 1) as follows;

$$V_i = v_i + (V_4 - v_4)$$

where v_i is the instrumental magnitude of the i-th star and the magnitude of the comparison star, V_4=8.927, was calculated from previously known values (Mermilliod 1986). It corresponds to the standard magnitude if the difference of the color correction term between the comparison star and the others, $\alpha_V \times \Delta(B-V)$, is negligible; the color coefficient, α_V, of our filter system is nearly zero (Sung 1995) and the color difference between the stars is mostly smaller than $0^{m}.5$.

Table 1. Photometric properties of observed stars

ID_{OURS}	$ID^{\dagger}_{S73}$	Star Name	$V^{\ddagger}$	$B-V^{\ddagger}$	$U-B^{\ddagger}$	Remark
1	135	HD 194378	8.58	0.41	0.06	Variable star
2	157	HD 229238	8.88	0.88	−0.11	Check star
3	149	HD 229234	8.91	0.75	−0.24	Check star
4	159	HD 229239	8.99	0.82	−0.18	Comparison star

† : Sanders, 1973 ‡ : Massey *et al.* (1995)

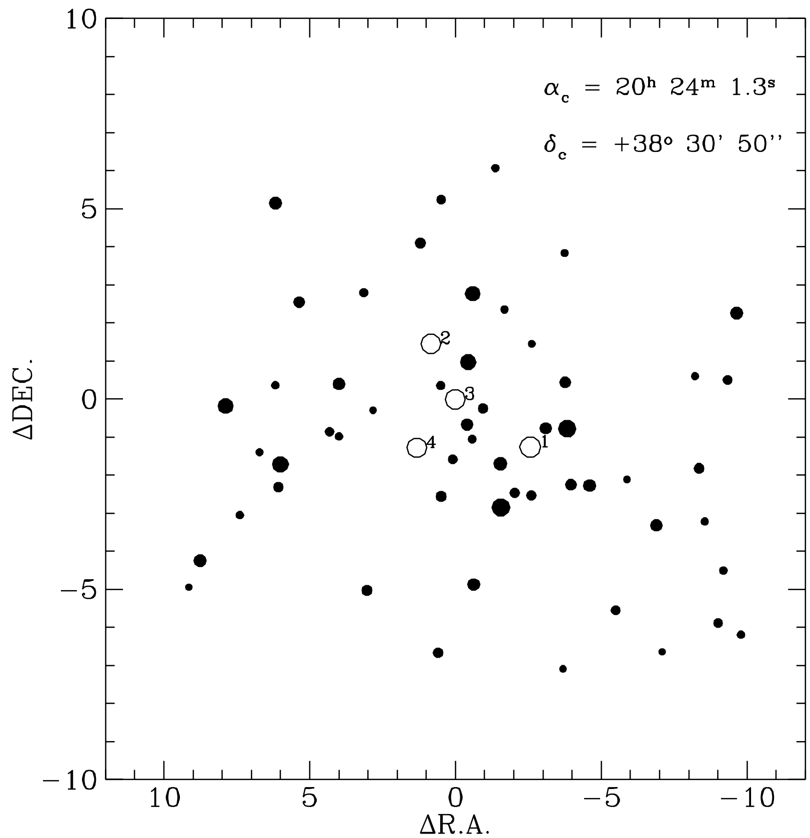

Figure 1. Finding chart of M 29. The new eclipsing binary (1) and three comparison stars (2,3,4) are denoted as open circles.

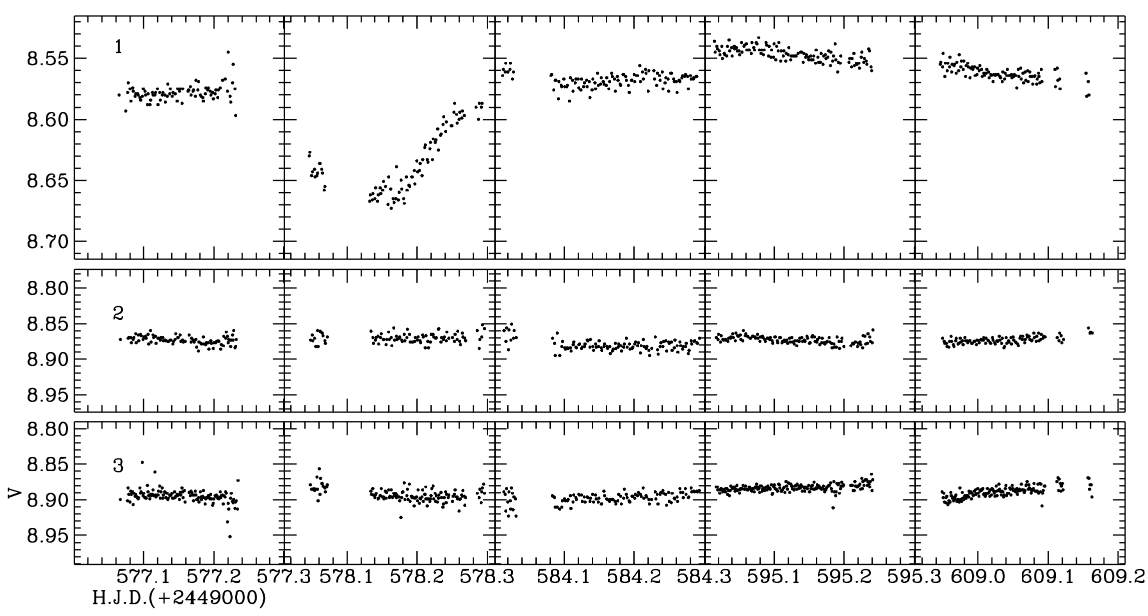

Figure 2. Light variations of HD 194378 and two check stars.

HD 194378 has a high value (79%) of membership probability, which was deduced from the proper motion (Sanders 1973). But it does not locate in the normal evolution sequence at the C-M diagram, indicating that it is a evolutionary peculiar star (Joshi *et al.* 1983) or a non-member star (Crawford & Barnes 1977). From the radial velocity measurements, it was known as a spectroscopic binary (Liu *et al.* 1989). We detected clearly its light variation for one night (J.D. 2449578.0). Its light curves (Figure 2) are similar to that of an Algol-type eclipsing binary (Hoffmeister *et al.*, 1985). Though it is the brightest star in M 29, its light variation has not been reported so far (Kholopov *et al.*, 1985–1988). Our observations suggest that it is an eclipsing binary with a minimum brightness near HJD 2449578.13, and an amplitude of at least $0\overset{m}{.}12$.

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V470 CASSIOPEIAE IS AN RR LYRAE TYPE VARIABLE

[BAV Mitteilungen Nr. 87]

V470 Cas = S8459 Cas was discovered by Hoffmeister (1964) on photographic plates of the Sonneberg Observatory. He classified this star as a short period variable in the range between $12^{m}_{.}5$ and 13^{m}, possibly eclipsing. First investigation of this variable was performed by Meinunger (1968). She determined the range of variability between $13^{m}_{.}0$ to $13^{m}_{.}5$ and gave first elements as:

$$\mathrm{Min\,I} = \mathrm{HJD}\,2429231.369 + 0^{d}_{.}444692 \times \mathrm{E} \qquad (1)$$

V470 Cas was cited again as eclipsing variable in a paper by Gessner and Meinunger (1973), in which the authors note that the investigation of this variable was handicapped by its relative high brightness and small amplitude. They gave eight times of minima and mentioned that the above elements may not be regarded as ascertained. With these data V470 Cas is listed in the fourth edition of the GCVS (Kholopov et al., 1985).

For a quarter of a century the variable had not been observed, when we put V470 Cas on our observing program. The CCD observations were made with SBIG ST6 cameras without filters, attached to a 32cm RC telescope (W.M.) and a 20cm SC telescope (F.A.). GSC 3678.1232 ($11^{m}_{.}84$) served as comparison star.

A period analysis program, based on the algorithm of Schwarzenberg-Czerny (1989) resulted in a period roughly double as long as the GCVS period. As our CCD observations show, the variable is of RR Lyr type with a rather long period and small amplitude. In our instrumental system the amplitude of variability is $0^{m}_{.}35$ and M$-$m = $0^{P}_{.}35$.

To expand our knowledge of period changes to the past, one of us (E.S.) investigated this star on 721 plates of the Sonneberg Sky Patrol.

The timespan covered by these plates (1957 – 1993) was divided into several parts. Using a first ephemeris, for each of these parts a mean lightcurve was calculated and the time of the normal maximum was derived (W.K., see Table 1). From that, 23 moments of normal maximum light resulted. The O$-$C residuals are shown plotted in Figure 2.

Obviously the period did not remain constant in the investigated interval of time. Considering the accuracy of estimates on photographic plates the period probably changed at about JD 2445000.

Least squares fits in each of these intervals yield the following linear elements:

$$\mathrm{Max\,I} = \mathrm{HJD}\,2436200.588 + 0^{d}_{.}874356 \times \mathrm{E} \qquad (2)$$
$$\pm 25 \qquad\qquad \pm 5$$

(valid between JD 2436200 and JD 2445000), and

Table 1. Times of maxima for V470 Cas, epochs and residuals computed with respect to the ephemeris (3) derived in this paper

N	JD hel. 2400000+	W	T*	Epoch	O−C	Observer
1	36200.613	2	P	−14833	+1.040	[1]
2	37558.455	2	P	−13280	+0.838	[1]
3	37871.528	2	P	−12922	+0.852	[1]
4	38233.474	2	P	−12508	+0.769	[1]
5	38413.621	2	P	−12302	+0.776	[1]
6	38974.812	2	P	−11660	+0.561	[1]
7	39765.286	2	P	−10756	+0.518	[1]
8	40318.762	2	P	−10123	+0.457	[1]
9	41192.386	2	P	−9124	+0.490	[1]
10	41897.052	2	P	−8318	+0.337	[1]
11	42631.510	2	P	−7478	+0.244	[1]
12	43431.382	2	P	−6563	−0.020	[1]
13	44816.563	2	P	−4979	+0.008	[1]
14	45204.812	2	P	−4535	−0.005	[1]
15	46271.676	2	P	−3315	+0.011	[1]
16	46648.542	2	P	−2884	−0.018	[1]
17	46763.152	2	P	−2753	+0.037	[1]
18	47392.762	2	P	−2033	+0.032	[1]
19	47776.617	2	P	−1594	−0.003	[1]
20	47939.302	2	P	−1408	+0.031	[1]
21	48503.249	2	P	−763	−0.052	[1]
22	48600.399	2	P	−652	+0.032	[1]
23	48862.626	2	P	−352	−0.080	[1]
24	49170.529	60	E	0	+0.011	[2]
25	49213.36	30	E:	49	−0.01	[2]
26	49226.467	60	E	64	−0.017	[2]
27	49588.520	30	E:	478	+0.008	[3]
28	49644.491	30	E:	542	+0.013	[3]
29	49658.5005	60	E	558	+0.0308	[2]
30	49659.3690	60	E	559	+0.0248	[2]
31	49693.478	60	E	598	+0.030	[3]
32	49978.561	30	E:	924	+0.037	[3]
33	49979.449	60	E	925	+0.051	[3]
34	50013.525	60	E	964	+0.022	[3]

*) E denotes CCD observed maxima, P are photographic. Those marked with ':' got reduced weight.

[1]: E. Splittgerber, W. Kleikamp, [2]: W. Moschner, [3]: F. Agerer

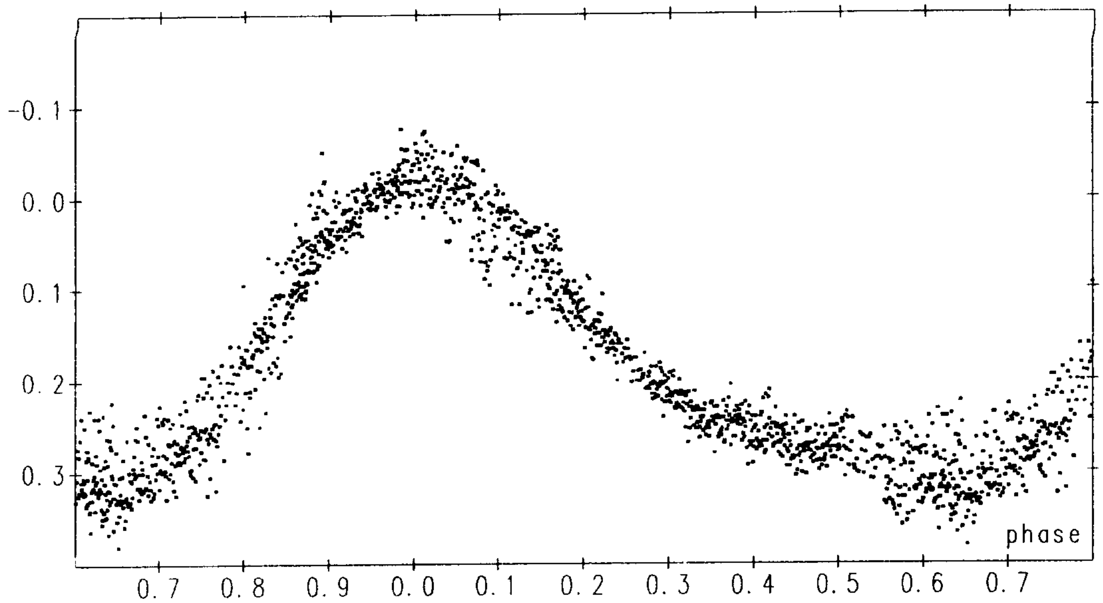

Figure 1: Differential light curve of V470 Cas with respect to the new ephemeris (3).

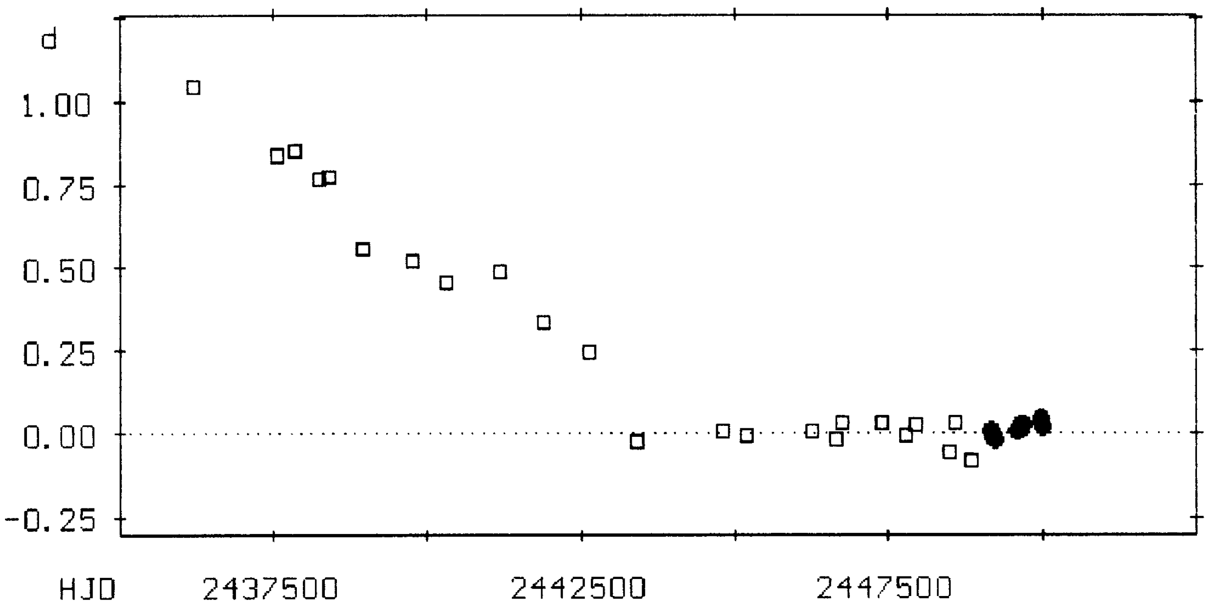

Figure 2. O−C diagram for V470 Cas computed with respect to Max = HJD 2449170.518 + 0.8744654 × E using all available maximum timings. • represents photoelectric and ▫ photographic normal maxima.

$$\text{Max I} = \text{HJD}\,2449170.518 + 0\overset{d}{.}8744654 \times \text{E} \qquad (3)$$
$$\pm 1 \qquad\qquad \pm 14$$

(valid after JD 2445000)

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GSC 4767.894 - A NEW W UMa TYPE ECLIPSING BINARY IN THE FIELD OF GG Ori

During our observational project initiated in 1993 with the main purpose to monitor eclipsing binaries with eccentric orbit, we found in the field of GG Ori that the star GSC 4767.894 is a new eclipsing binary of W UMa type with a period of about 0.47 days.

The variability of this star was discovered at the R. Szafraniec Observatory, Metzerlen, Switzerland, in October 24, 1995 using a 35cm Cassegrain telescope equipped with an SBIG ST-6 CCD camera. The coordinates of this star are: $\alpha = 5^{\rm h}42^{\rm m}57\overset{\rm s}{.}7$ s, $\delta = -0^\circ 42'$ 46" (equinox 2000.0), its V magnitude given in the Guide Star Catalogue is 12.93 mag.

The next precise CCD photometry of this star was carried out during 12 nights from December 27, 1995 to February 24, 1996 at Ondřejov Observatory, Czech Republic. A 65cm reflecting telescope with the same type of CCD-camera was used. The measurements were done using the standard Cousins R filter with exposure time between 30 and 180 s. The nearby stars GSC 4767.927 ($V = 12.8$ mag) and GSC 4767.727 ($V = 10.9$ mag) on the same frame as the new variable served as the comparison and check stars, respectively. No variations in the brightness of these stars were detected exceeding the standard errors of the measurements in R during observations. Altogether 376 frames of this field were obtained and analyzed. The CCD data were reduced using the software developed at Ondřejov Observatory by P. Pravec and M. Velen (Pravec et al. 1994). The precise times of minima and their errors were determined using the Kwee–van Woerden (1956) method. These moments are listed in Table 1. In this table, N stands for the number of observations used in the calculation of the minimum time. Figure 1 gives the finding chart, Figure 2 shows the composite R light curve. According to our measurements, the amplitude is 0.27 ± 0.01 mag. The light curve was solved using a new method of treating photometric data described by Mikulášek et al. (1995). This method is a weighted LSM iterative procedure, where the model function for the light curve of the W UMa eclipsing binaries has a form

$$K(f) = \overline{m} + \sum_{i=1}^{3} A_i \cos(4\pi i f) + A_4\, G(f), \tag{1}$$

where

$$G(f) = \frac{5}{8}(\cos(2\pi f) + 0.5\cos(6\pi f) + 0.1\cos(10\pi f)), \tag{2}$$

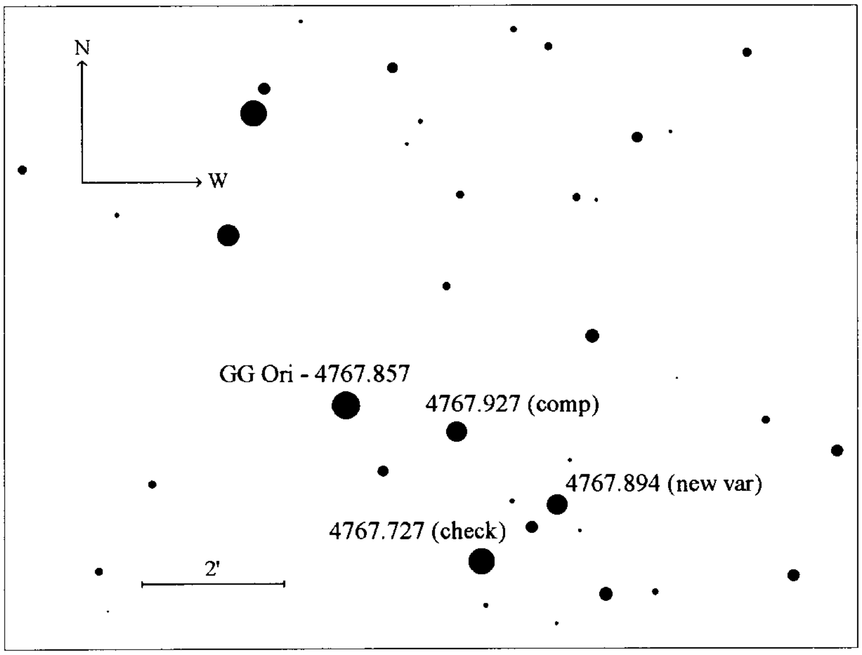

Figure 1. Finding chart of GSC 4767.894. The eclipsing binary GG Ori and the comparison and check stars are also plotted

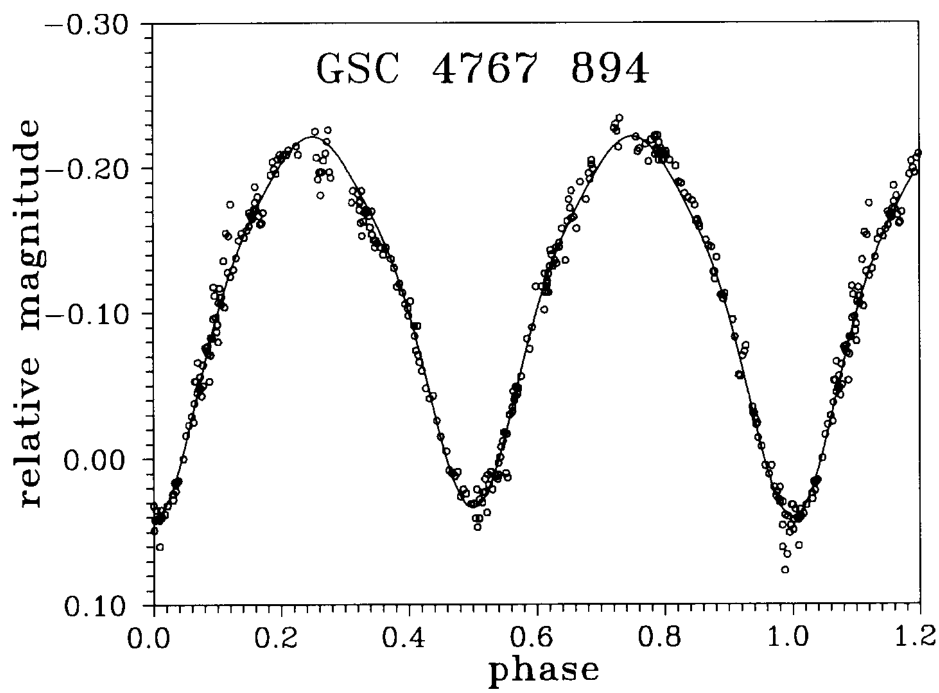

Figure 2. Composite R light curve of GSC 4767.894

Table 1. Moments of minima of GSC 4767.894

JD Hel.– 24 00000	Epoch	Error (days)	N
50081.4033	−40.0	0.0002	27
50098.3755	−4.0	0.0008	38
50120.2969	42.5	0.0002	40

where f is the photometric phase and $\overline{m}$ is the average magnitude of the star. The coefficients A_1, A_2, A_3 describe the light curve with equal depths of primary and secondary minimum (see the paper mentioned above for more details). Using this method we derive the following linear light elements for the current use:

$$\begin{array}{ll} \text{Pri.Min.} = \text{HJD } 24\ 50100.26059 + 0\overset{d}{.}4714399 \times \text{E.} \\ \qquad\qquad\qquad\qquad\qquad \pm 0.00008\ \pm 0.0000022 \end{array}$$

As a reference time we have chosen the approximate midpoint of the observation interval.

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LIGHT CURVES AND PERIODS OF THE RR LYRAE STARS SU Cha AND SW Cha

A system of dark clouds in the constellation Chamaeleon was first investigated by Hoffmeister (1962) who detected a large number of variable stars, many of which being members of what is now called the Cha T1 association. In a search for flare events in this region (Winterberg 1995, Winterberg et al. 1995), we found two variables which were identified with Hoffmeister's variables SU Cha (classified as RR Lyr star) and SW Cha, which is misclassified in the GCVS (Kholopov et al., 1985) as being of type Is: and which many authors regard as a member of the Cha T1 association. However, we unambiguously identify it as another RR Lyr star, unrelated to the association.

During four observing runs in 1985, 1986, 1989 and 1990 a total of 45 multiple exposure plates in 22 nights were obtained on IIa–O plates at ESO's 40cm–GPO telescope at La Silla. Each plate contains chains of (in general) 6 exposures of 10 minutes each.

An automatized routine was used to separate the individual exposures on each plate and to determine magnitudes. The coordinate transformation, based on 22 PPM stars (Röser & Bastian 1988, Bastian et al. 1991), is accurate to within $0''\!.3$. Magnitudes were determined using methods developed by Cunow (1993). Since all standard stars are rather bright, an extrapolation was required for the fainter stars on the photographic plate. Thus, in addition to statistical uncertainties faint magnitudes may suffer from systematic errors. Therefore, not much weight should be given to the absolute values of the magnitude scale. Period determination is, however, not affected by these errors. For further details concerning the reduction procedures, see Aniol (1989) and Winterberg (1995).

SU Cha

SU Cha was detected as a variable star of RR Lyr type by Hoffmeister (1962) who gave it the preliminary designation S6316. He derived a period of 0.618757 days. The finding chart published by Hoffmeister (1963) leaves no doubt that the star we detected in our observations is identical to SU Cha. Improved coordinates are: $\alpha = 10^{\rm h}50^{\rm m}14^{\rm s}$ (2000.0) and $\delta = -78°24'51''$ (2000.0). A light curve was published by Gessner (1980), confirming the original classification. She found the period to be 0.6189 days. No further observations of SU Cha have come to our knowledge.

Our observations are distributed over a time base of 5 years. An Analysis-of-Variance periodogram (AoV) (Schwarzenberg-Czerny 1989) was calculated from our data and yielded a highly significant peak. The light curve folded on the corresponding period is shown in Figure 1. It is typical for RRab type stars. We derived a period and an epoch of maximum as given by the ephemeris:

$$\text{Max} = \text{HJD}\,2447914.755 + 0\overset{\text{d}}{.}618858 \times \text{E}$$
$$\pm\ 31 \qquad\qquad \pm\ 10$$

Here, the error of the period is arbitrarily and conservatively fixed to a value which would lead to an easily recognizable phase shift of 0.05 over the entire time base of the observations. Similarly, the error of the zeropoint is fixed at 5% of the pulsation period.

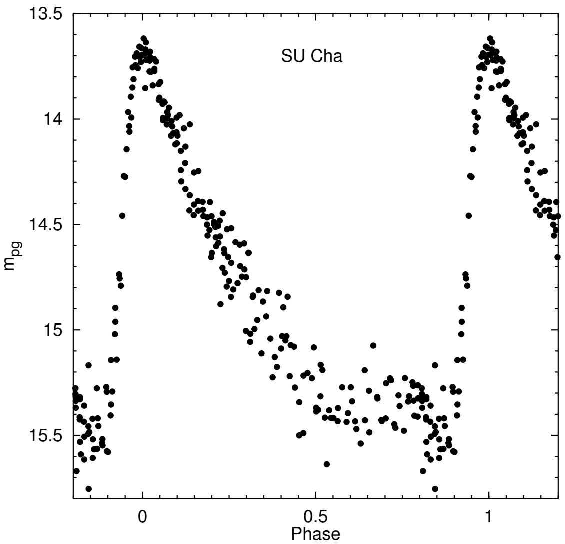

Figure 1. Light curve of SU Cha folded on the pulsation period 0.618858 days

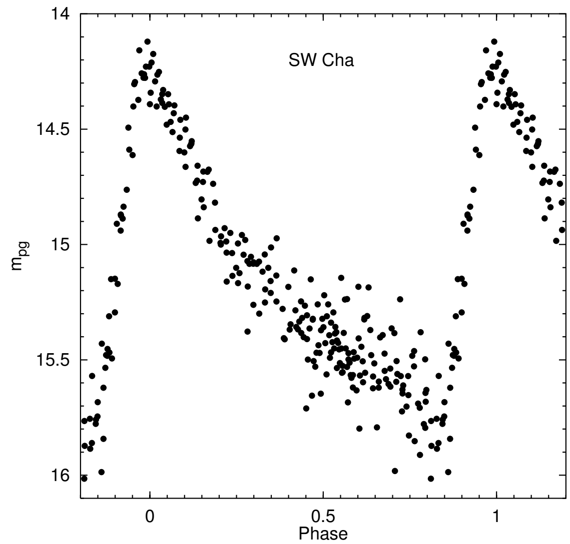

Figure 2. Light curve of SW Cha folded on the pulsation period 0.458430 days

The period is practically identical with that found by Gessner (1980) but more accurate. She quotes 8 times of maximum for the 1959 observing season of SU Cha. This permits to calculate $O - C$ values over a long time base, using the above period and maximum epoch. The mean value is as small as 0.005 ± 0.024 days (0.013 ± 0.022 days, assuming that Gessner did not apply the heliocentric correction) indicating that the derived period leads to negligible phase errors over a time base of more than 30 years. Taking the mean $O - C$ value and its statistical error as indicative of the true uncertainty of the period, a more realistic error should then be 2×10^{-6} days instead of the conservative estimate of 1×10^{-5} days quoted above.

SW Cha

The literature on SW Cha is somewhat more extensive than that of SU Cha, albeit not much. SW Cha was also discovered by Hoffmeister (1962) who gave it the preliminary designation S6319. The chart published by Hoffmeister (1963) again leaves no doubt that the star discussed here is indeed SW Cha. Improved coordinates are: $\alpha = 10^{\text{h}}54^{\text{m}}13^{\text{s}}$ (2000.0) and $\delta = -77°55'9''$ (2000.0). It was originally classified as similar to RW Aur, while according to the GCVS it is of type Is:. Gessner (1980) suspected SW Cha to be an RR Lyr star. She quotes four epochs of brightenings but does not show a light curve.

Rydgren (1980) took a single photometric measurement in $UBVri$ (r and i being non-standard bands). Assuming that SW Cha is a member of the Cha T1 association he found it to lie below the main sequence. He concluded that SW Cha is probably a background object unrelated to the association. This is also supported by the fact that unlike many other members of the Cha T1 association SW Cha was not detected by *IRAS* (Gauvin and Strom 1992). However, for reasons which are not quite obvious, Whittet et al. (1987) classify it as a member, and subsequent publications (Gregorio-Hetem et al. 1990, Gauvin and Strom 1992, Schwartz 1991, Hartigan 1993) do not put the membership into question.

However, we show beyond any reasonable doubt that SW Cha is not a member of the Cha T1 association and that Hoffmeister's (1962) original classification was erroneous. In contrast, Gessner's (1980) suspicion was correct.

Using the same procedure as in the previous case we unambiguously found a periodic variation in the brightness of SW Cha. The AoV periodogram showed also in this case a highly significant peak. The light curve, folded on the corresponding period, is shown in Figure 2. The shape of the light curve together with the value of the period leave no doubt about the classification of SW Cha as an RRab type star. The ephemeris for the maxima is:

$$\begin{array}{lll} \mathrm{Max} = \mathrm{HJD}\,2446093.862 & + \; 0\overset{\mathrm{d}}{.}458430 & \times \; \mathrm{E} \\ \qquad\qquad\qquad\qquad \pm \;\; 23 & \quad \pm \;\;\; 6 & \end{array}$$

The errors are defined in the same way as in the case of SU Cha.

Interpreting the four epochs of brightening quoted by Gessner (1980) as genuine maxima, the above ephemeris leads to a mean $O - C$ value of 0.133 ± 0.056 days. Taken at face value this would indicate that the true period (assuming a constant period) is $(6.5 \pm 2.7)\,10^{-6}$ days shorter, just consistent with the (conservative) error. However, the observed brightenings need not necessarily correspond to the true maxima but to nearby epochs (with a higher probability for lying after a maximum than before, considering the shape of the light curve). Then, the true period may be somewhere between the one given in the ephemeris and a period shorter by $\approx 6.5 \times 10^{-6}$ days.

Schwartz (1991) lists in his Table 1 a spectral type of M0: for SW Cha. The source of this classification remains unclear. It does not fit in with the colours $B - V = 1.14$ and $U - B = 0.78$ measured by Rydgren (1980). In contrast, the colours are consistent with those of a highly reddened ($E_{B-V} \approx 0.9$) star of type A7 III – F0 II (Schmidt-Kaler 1982). This is well in the range of RR Lyr stars, and the dereddened colours also correspond to an RR Lyrae star (Clube et al., 1969).

Our clear detection of an RR Lyr type variability in SW Cha is at odds with the magnitude estimates of Mauder and Sosna (1975) performed on the basis of 91 photographic plates taken over a time base of 31 days. The light curve constructed from their table was also subjected to an AoV analysis. No indications of a periodic variation on time scales above an hour were detected. It is not clear why Mauder's and Sosna's data do not show any sign of periodic variability which is so clearly present in our observations.

We have obtained light curves of two RRab type variable stars, SU Cha and SW Cha. While the former was already known as an RR Lyr star, the latter was previously classified as being of type Is:. However, the light curve observed here leaves no doubt about the correct classification. The pulsation period of SU Cha could be derived to a significantly higher precision than hitherto known; that of SW Cha could also be determined with a sufficiently high precision to permit secure cycle counts for several decades. Although the unknown interstellar extinction and the errors of our photographic photometry do not allow us to make useful statements about the distance of both stars, it is obvious that SW Cha cannot be a member of the Cha T1 association (which is at a distance of only 140 pc; Whittet et al., 1987) and should be discarded from corresponding lists in the literature. Astrometric measurements lead to positions which are significantly improved compared to the original coordinates determined by Hoffmeister (1962) and quoted in the GCVS.

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OBSERVATIONS OF LOW-AMPLITUDE LATE-TYPE VARIABLES

The low-amplitude red-giant variables UX Dra, δ^2 Lyr, VY UMa and RR UMi have been observed almost continuously since mid-1994 as part of a programme to investigate known and suspected red variables. UX Dra and VY UMa are very similar stars; they are both luminous carbon stars with Tc (Little et al. 1987) while RR UMi and δ^2 Lyr are less evolved AGB stars (Jorissen et al. 1993, Eggen 1993).

The observations were made using an SSP3 photometer and nominal V filter on a 20-cm Newtonian reflector. Each observation consisted of 2 or 3 sets of 3×10 second integrations. Differential extinction corrections were applied but these are small. Details of the comparison stars are given in Table 1. For further information please contact the authors.

UX Dra (HD 183556, SAO 9404, BD +76°734) has a spectral type of C5 II and according to the GCVS (Kholopov et al. 1985) is an SRa with a period of 168 days. From times of minimum, Vetesnik (1983) found a constant increase of the period but more extensive photographic data suggested that this was part of a long term cycling of the period between 155 and 185 days, over about 5000 days. In the light curve of UX Dra (Figure 1) the largest variations have a period of 168 days superimposed on a large gradient. However, the earliest observations show a variation of only ∼0.1 mag on a time scale of 50–100 days. As the published 168 day period appears in these data, it seems unlikely that

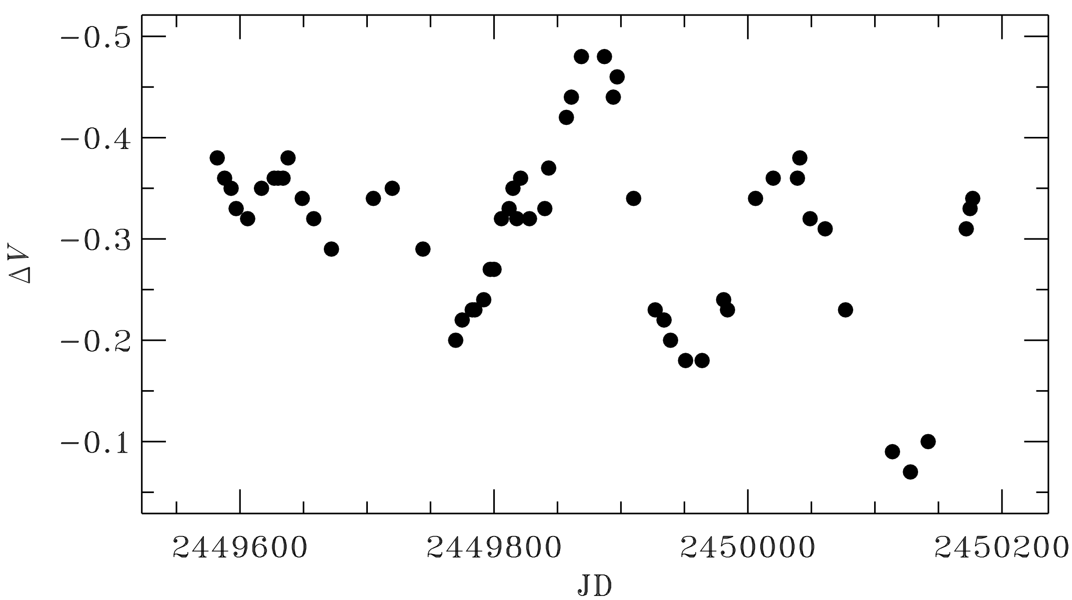

Figure 1. Light curve of UX Dra

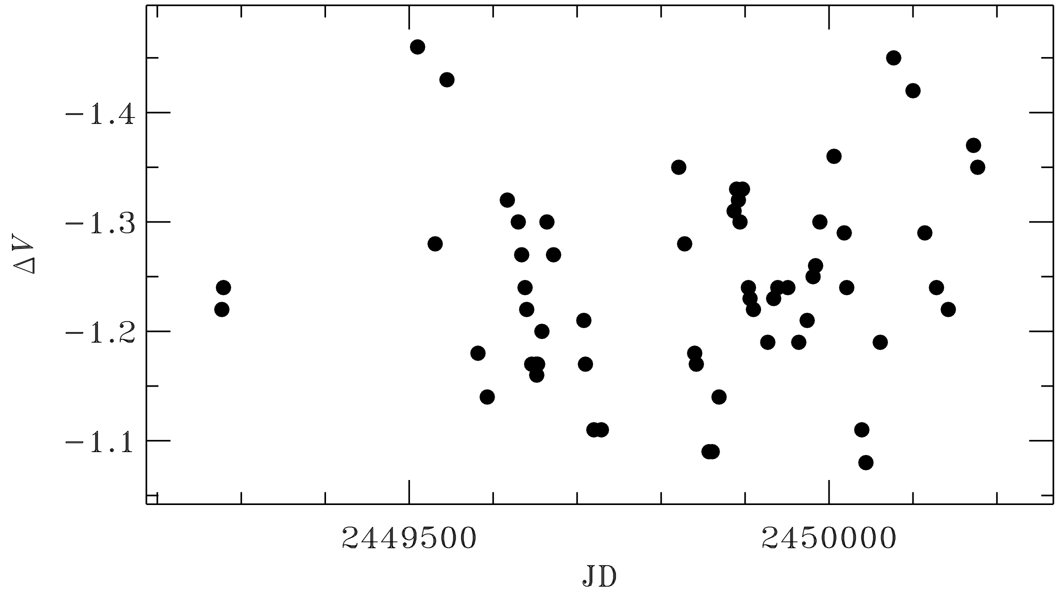

Figure 2. Light curve of δ^2 Lyr

the period is variable. The time of lower activity may indicate that the behaviour suggested by Vetesnik is due to phase changes in this relatively stable period.

δ^2 Lyr (HR 7139, HD 175588, SAO 67559) is a fourth magnitude star of spectral type M4 II. Photometry during the 1980's led Bakos & Tremko (1990) to conclude that it is a semi-regular variable with a characteristic time scale in the range 50–100 days. Superimposed on this are longer term variations in the mean magnitude and shorter term excursions of similar amplitude. On the basis of the variation in the annual light curves Bakos & Tremko were unable to suggest a single period but concluded that the period was variable. The dominant feature of the new observations (Figure 2) is a strong periodicity at 70–80

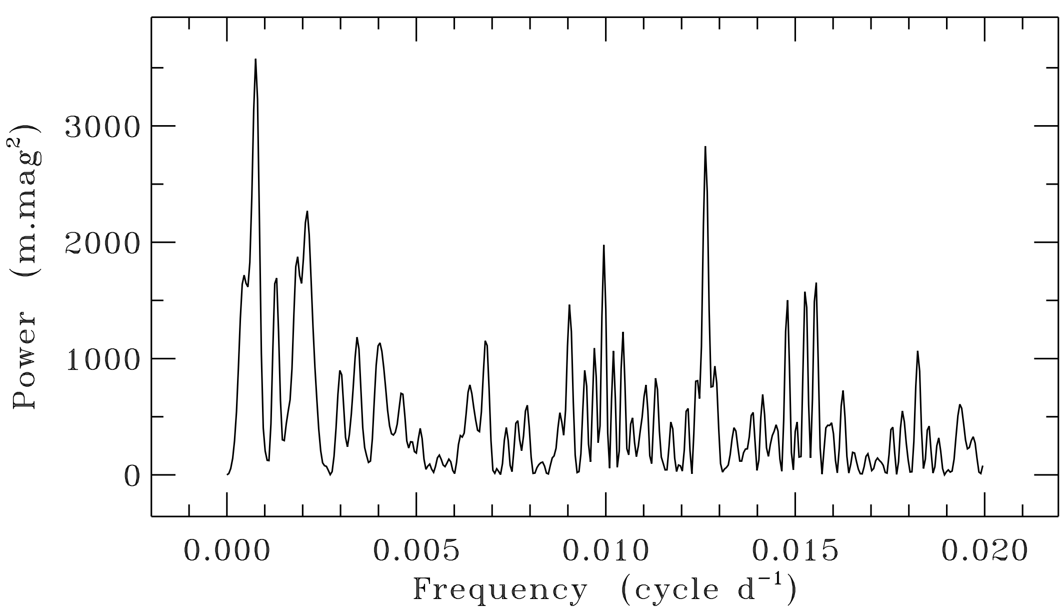

Figure 3. DFT power spectrum of the new photometry of δ^2 Lyr combined with that of Bakos & Tremko

Table 1. Comparison star information

Variable	Comparison	V	$B-V$	Sp	ΔV	σ
UX Dra	HR 7199 = HD 176795	6.22:		A1 V	−0.233	0.016
	HR 7247 = HD 178089	6.47	0.45	F2 V		
δ^2 Lyr	HR 7131 = HD 175426	5.58	−0.15	B2.5 V	0.302	0.022
	HR 7174 = HD 176318	5.89	−0.17	B7 IV		
VY UMa	HR 4176 = HD 92523	5.75	1.30	K3 III	−0.740	0.017
	HR 4181 = HD 92523	5.00	1.38	K3 III		
RR UMi	HR 5691 = HD 136064	5.13	0.53	F9 IV	1.065	0.018
	HR 5629 = HD 133994	6.13:		A2 Vs		

days, but many of the characteristics seen previously are also visible. The periodogram of the combined photometry (Figure 3) is dominated by a long term variation, which is not necessarily periodic and a period of 79 days ($f = 0.01267$ cycles day^{-1}), together with their one year aliases. δ^2 Lyr has a complex light curve with many time scales, but the 79 day period is sufficiently stable to appear in observations covering the past 10 years and is the dominant short-term feature of the data.

VY UMa (HR 4195, HD 92839, SAO 15274, BD +68°617) is of spectral type C5 II and is given by the GCVS as an Lb variable. Analysis of visual data covering 1990–1993 shows a period of 120 days (Ofek, Shemmer & Gabzo 1995). The AAVSO photoelectric observations, which are admittedly rather sparse, suggest a variation on a time scale of ~200 days (Percy et al. 1996) but these cover the years 1986–1992 when the behaviour may have been different. The periodogram of the new data in Figure 4 shows a clear period at 118 days, and this is a remarkably good fit to most of the data. The amplitude is clearly variable but, for the most part, the period is relatively stable, and even after there is some disruption the phasing is retained. As there is no overlap between these data and the visual observations it seems likely that the 118 day period dominated for most of the past six years. However, the absence of this period in the AAVSO data suggests that it was probably not dominant before that.

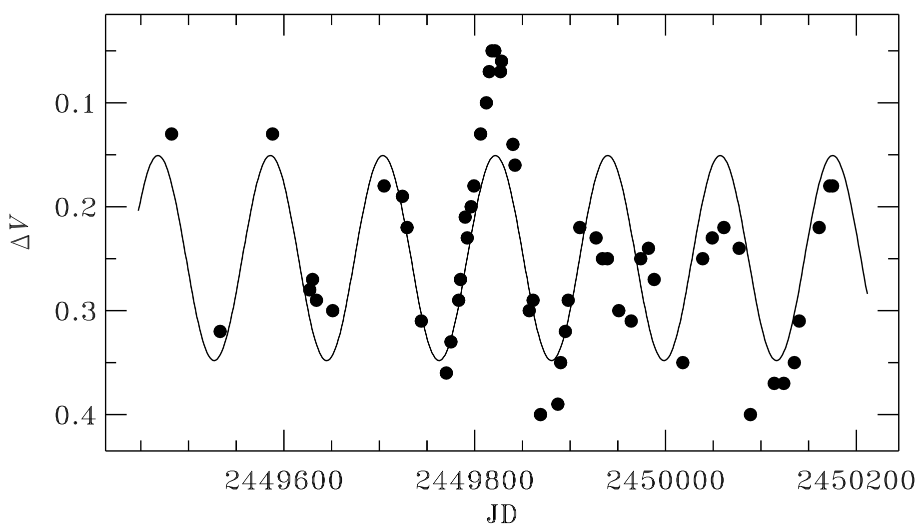

Figure 4. Light curve of VY UMa with the 118 day period superimposed

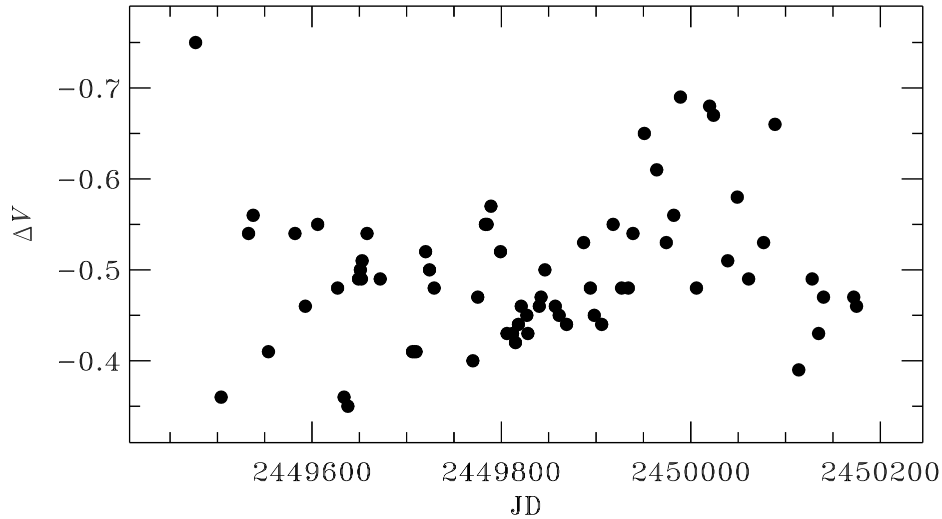

Figure 5. Light curve of RR UMi

RR UMi (HR 5589, HD 132813, SAO 16558, BD +66°878) has a spectral type of M4.5 III and is one of the few semi-regular variables in a binary with a known orbit (Batten & Fletcher 1986). The period is 749 days but there is no indication of the secondary. RR UMi is listed in the GCVS as an SRb with a period of 43.3 days but variations on a range of time scales from 30–50 days have been found by Percy et al. (1994). The periodogram of the light curve in Figure 5 shows no dominant period, although periods of ∼61 and ∼34 days are present. A suggestion of the 61 day period can be followed through the first half of the data but then becomes quickly lost. During the second half of the data the time scale of the variation halves which is probably responsible for the 34 day period in the periodogram. RR UMi shows variation on the 30–60 day time scale with no dominant period in the present data. There is no indication of a variation with a period of 43 days.

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PHOTOMETRY OF THE 1994–1995 ACTIVE PHASE OF AG Dra

The high-velocity, symbiotic star AG Dra (α_{2000}=16^{h}01^{m}41^s.1, δ_{2000}=+66°48′10″) in mid 1994 entered a new active phase which was characterized by a rapid brightening from the quiescent magnitude of V=9^m.8/9^m.9 in May 1994 to V=8^m.3 in July (Mattei, 1995). Then the star faded back to minimum in November 1994. Similarly (but unexpectedly) to the previous active phases of 1980-82 and 1985-86, a secondary light maximum occurred in July 1995, followed by a gradual decrease to quiescence. Because of the uniqueness of the event, and for being AG Dra known to be an intense supersoft X-ray source, a campaign of multiwavelength observations was organized, and optical photometry was collected in coordination with space IUE and ROSAT observations (Greiner et al., 1996).

Broad–band BVRI photometry of AG Dra was obtained during July 1994–January 1996 with the 30 cm, F/4.5 telescope at Greve (Firenze), and with the 50 cm, F/4.5 telescope at Vallinfreda (Roma). Both telescopes are equipped with an SBIG ST6 CCD detector. The photometric accuracy was excellent during most nights, the m.s. errors being of 0^m.03 in B, 0^m.02 in V, 0^m.03 in R, and 0^m.02 in I. As for the photometric sequence we have used the secondary standards listed in Table 1, whose photometric data were obtained using stars from Landolt's (1992) catalogue.

In addition, three colour UBV photometry was obtained during December 1993–February 1996 with a single channel photoelectric photometer, mounted at the Cassegrain focus of the 60 cm, F/12.5 telescope of the National Astronomical Observatory "Rozhen". The star BD +67°925 having V=9^m.88, B–V=0^m.56 and U–B=–0^m.04 (Skopal & Chochol 1994) was used as a comparison star. The m.s. errors are not larger than 0^m.02 in U and B, and 0^m.01 in V. The observational data are listed in Table 2.

Figure 1 gives the five-colour light curve of AG Dra during its 1994–1995 active phase. The observations cover mainly the declining phases following the primary (June 1994) and secondary (July 1995) light maxima. No U–band observations were obtained during the 1994 maximum but that phase was also covered by the UBV observations of Skopal and Chochol (1994). The figure shows that AG Dra varied in all the colours, but the amplitude of the variation was larger (and the decline steeper) for the shorter wavelengths. In particular, the variation of the U magnitude during the 1995 outburst – when compared to its value during quiescence – indicates an increase by a factor larger than 5 of the radiation near the Balmer jump. The variation was quite large also in B, with a flux increase (with respect to quiescence) of more than 2.1 and 1.3 magnitudes for the 1994 and 1995 outbursts, respectively. It should be noted that during the minimum phase, i.e. between the two light maxima, the U and B fluxes were well above their quiescent values.

Table 1. The BVRI photometric sequence

Star	α_{2000}	δ_{2000}	B	σ	V	σ	R	σ	I	σ
a	$16^h03^m25^s$	$+66°37'31''$	11.93	.02	11.13	.02	10.74	.03	10.34	.01
b	02^m54^s	$41'34''$	11.83	.02	11.12	.02	10.75	.03	10.37	.02
c	03^m27^s	$45'16''$	10.99	.02	10.43	.02	10.10	.03	9.82	.01
d	04^m09^s	$40'02''$	11.67	.03	11.04	.02	10.71	.03	10.39	.01
e	00^m41^s	$39'33''$	12.45	.03	12.00	.01	11.66	.03	11.39	.01
f	01^m41^s	$38'50''$	12.22	.02	11.72	.01	11.37	.03	11.05	.03
g	00^m56^s	$42'57''$	13.20	.09	12.27	.02	11.78	.03	11.32	.01

Finally, we remark that unexpectedly during the light maxima AG Dra significantly varied also in the I–band which is near the maximum of the energy spectrum of the cool stellar component.

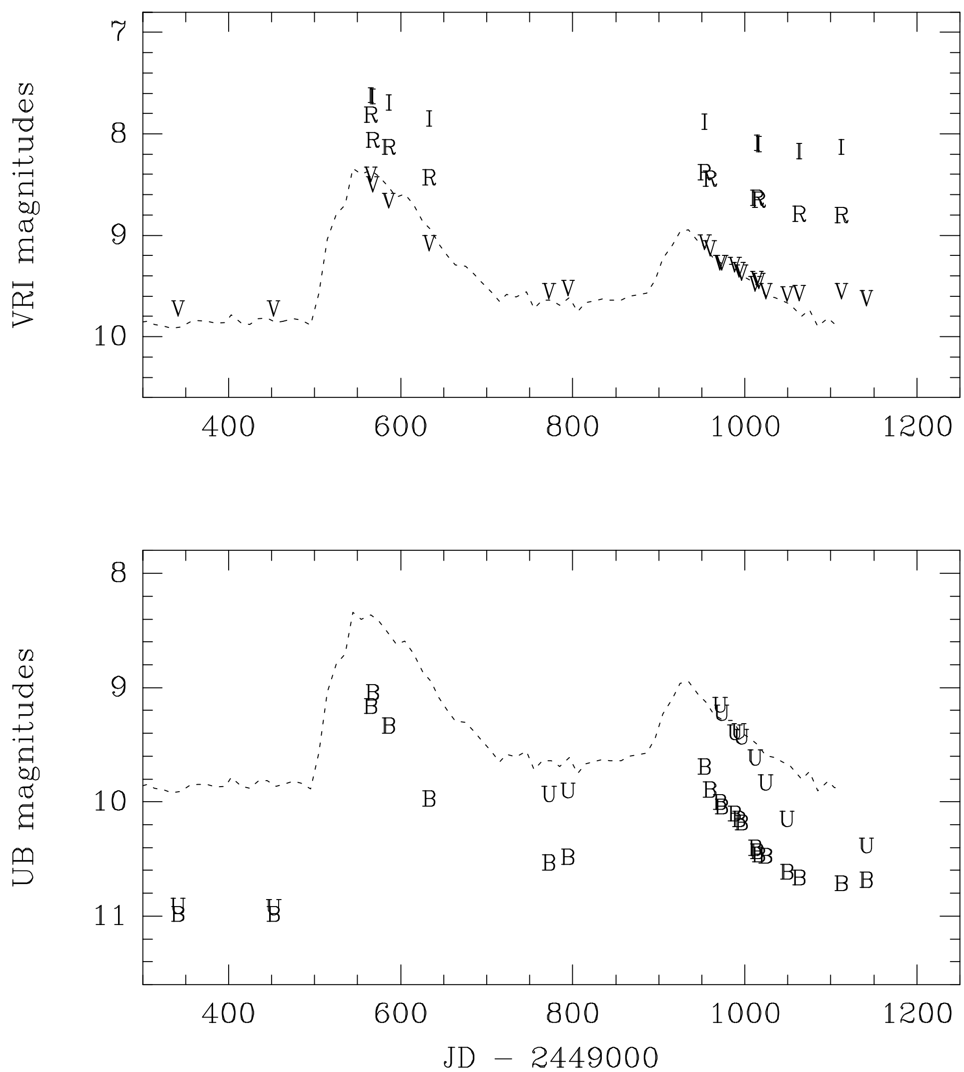

Figure 1. The five–colour light curve of AG Dra from December 1993 to February 1996. For comparison, the AAVSO visual light curve (10-day means, Mattei 1995) is shown as a dotted line

Table 2. Photometric observations of AG Dra

Date	JD−2400000	n	U	B	V	R	I
19 Dec 93	49341.2	3	10.92	10.99	9.73	—	—
10 Apr 94	49452.5	2	10.93	10.99	9.73	—	—
31 Jul 94	49565.4	1	—	9.17	8.41	7.82	7.63
2 Aug 94	49567.4	1	—	9.05	8.51	8.07	7.64
21 Aug 94	49586.4	1	—	9.34	8.67	8.14	7.70
7 Oct 94	49633.4	1	—	9.98	9.09	8.44	7.86
24 Feb 95	49772.6	2	9.94	10.54	9.56	—	—
18 Mar 95	49794.6	4	9.91	10.49	9.53	—	—
23 Aug 95	49953.4	1	—	9.70	9.08	8.39	7.89
29 Aug 95	49959.5	1	—	9.90	9.14	8.45	—
10 Sep 95	49971.3	2	9.16	10.01	9.28	—	—
12 Sep 95	49973.3	3	9.23	10.05	9.28	—	—
27 Sep 95	49988.4	2	9.40	10.11	9.30	—	—
2 Oct 95	49993.2	3	9.39	10.16	9.35	—	—
5 Oct 95	49996.4	3	9.44	10.19	9.38	—	—
21 Oct 95	50012.2	2	9.62	10.41	9.49	—	—
23 Oct 95	50014.3	2	—	10.44	9.44	8.64	8.10
24 Oct 95	50015.3	1	—	10.44	9.44	8.65	8.12
25 Oct 95	50016.3	4	—	10.47	9.46	8.66	8.11
2 Nov 95	50024.3	3	9.84	10.48	9.56	—	—
27 Nov 95	50049.3	2	10.16	10.62	9.59	—	—
11 Dec 95	50063.3	4	—	10.67	9.58	8.80	8.18
29 Jan 96	50112.3	1	—	10.72	9.56	8.81	8.14
27 Feb 96	50141.6	3	10.39	10.69	9.63	—	—

These results can be interpreted in the light of a three spectral component model of AG Dra, in which the red and near IR is dominated by the cool star spectrum, while the blue and near UV radiation arises from the circumstellar nebula ionized by the radiation of the hot star (whose contribution to the near UV is thought to be negligible).

In this model the optical outbursts should be associated with the increase of the size of the nebula, which is the result of the increased flux of UV photons from the outbursting hot source. The U–band excess of AG Dra is therefore due to the nebular Balmer continuum, which has largely increased during the outbursts. The nebular emission appears also to contribute to the longer wavelengths, and the amplitude of the variation at different wavelengths can be in principle used to determine the relative contribution of the nebular and cool star components. In this regard, it is of particular interest that during the light maxima AG Dra largely varied also in the I–band (900 nm). This implies that at the light maximum the "nebular spectrum" should have contributed to at least 40% of the red/near-IR radiation of AG Dra. This contribution rises to more than 70% in V, and to $>\sim$85% in B. We also argue that the contribution of the nebular emission to the red might possibly be not negligible also during the quiescent phase of AG Dra. Therefore, some care should be taken when using the VRI colours (and the photospheric spectral line depth as well) for the determination of the red star's spectral type and luminosity class.

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GT AQUARII: NEW ELEMENTS

GT Aquarii = SVS 2659 = GSC 5226.00945 ($\alpha_{1950.0}$: $22^h25^m44^s.$; $\delta_{1950.0}$: $-01^\circ\ 14'.8$) was reported by Kurochkin (1986) as a variable star with a range of variation from $13^m_.1$ to $14^m_.1$. He found a possible pulsational variation with an uncertain period of $1^d_.1901204$. In view of this finding, this star warrants some further investigation as it might be a new member of the AHB1 class of pulsating variables (see Sandage, Diethelm and Tammann, 1994). No other source of data is known to the author.

During the 1995 season, GT Aquarii was observed with the 35cm RC telescope at R. Szafraniec Observatory in Metzerlen, Switzerland, by the author. An unfiltered ST-6 CCD camera was employed. A total of 101 observations in 22 nights could be secured. As comparison star GSC 5226.01225 ($13^m_.97$), lying very close to the variable, was used. The comparison star showed no variation exceeding the accuracy of the photometry. Due to the proximity of the comparison star to GT Aqr as well as to the limited accuracy of the photometry (see below), no correction for differential extinction was allowed for.

With the period given by Kurochkin (1986) our data do not yield a satisfactory light curve. A coarse period finding algorithm leads to a most likely value of P = $0^d_.3516$. In Figure 1, the observations are presented, folded with the elements:

$$\mathrm{Max}_{JD,hel} = 2449898.505 + 0.3516 \times \mathrm{E}\ . \qquad (1)$$

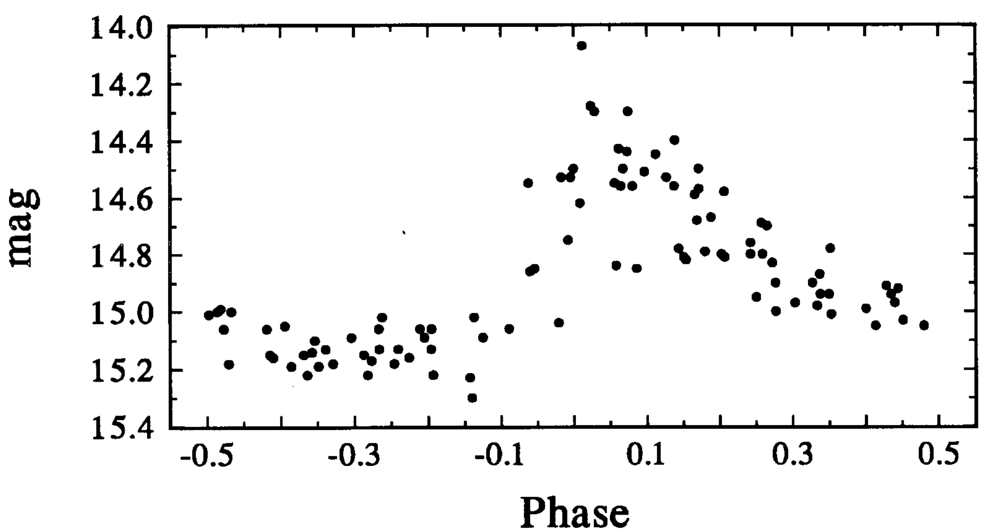

Figure 1. Unfiltered CCD light curve of GT Aqr, folded with the elements given above

The rather large scatter seen in Figure 1 is primarily due to two circumstances. The star is about one magnitude fainter than given by Kurochkin ($14^{m}.1$ - $15^{m}.2$). In addition, due to the negative declination of the variable, the air mass was relatively large for an observer at the latitude of Switzerland. Therefore, the signal to noise ratio of our CCD frames was smaller than hoped for. Nevertheless we dare to state that some of the scatter might be caused by some intrinsic variability in the light curve.

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CI AQUILAE*

CI Aql (=AN 23.1925) was discovered due to a $\Delta m \approx 4.6$ mag outburst recorded on two Heidelberg plates in June 1917 (Reinmuth, 1925). It was much fainter on 6 other pairs of Heidelberg plates taken between 1909–1920 (Reinmuth, 1925), as well as 6 Moscow plates taken between 1909–1929 (Parenago, 1931). This and the small outburst amplitude led to the classification as a nova or dwarf nova with long cycle length (Duerbeck, 1987).

Though there are three objects of 16^m–18^m with $10''$ separation at the position of the outburst object, the identification was possible due to the large scale of the discovery plates (as shown in Duerbeck, 1987). A spectrum of the candidate object, taken in the 4300–8000 Å range on May 31, 1990, did not reveal the expected Balmer emission lines (Szkody and Howell, 1992) and casts doubts on the identification. Similarly, two spectra taken on May 20, 1991 and August 3, 1991 between 5000–8500 Å only showed an absorption line spectrum (Mennickent and Honeycutt, 1995). The resolution of these spectra was too low to determine the spectral type of this object, but Na D and KI λ7696 Å lines as well as the TiO bands suggested a K–M type star.

We observed spectroscopically all three objects (the candidate star plus the two neighbouring objects) on two occasions in 1992 and 1993 with the 3.5 m telescope at the Calar Alto Observatory. On September 28, 1992 the Cassegrain spectrograph equipped with a 1024×640 RCA chip (pixel size 15 μm) was used with a 240 Å/mm grating, resulting in a mean resolution of 10 Å (FWHM), in the 3800–7200 Å range. The exposure time was 20 min. and 30 min., respectively, starting at UT = 20:02 and 20:35. On September 29, 1992 we used a 60 Å/mm grating which allowed to cover the 6200–7100 Å with a resolution of 2.5 Å (FWHM). The exposure time was 30 min. starting at UT = 21:36. On June 15, 1993 the double spectrograph was used with 36 Å/mm gratings for both the red and blue arm which results in a resolution of slightly above 1 Å (FWHM), and a coverage of 3500–6000 Å and 5500–9000 Å. The detectors were 1080×1024 TEK mosaics with 24 μm pixel size. The exposure time was 30 min. starting at UT = 2:15. Helium-Argon spectra were taken immediately after the science exposures, and the stars Feige 110 (September 1992) and Wolf 1346 (June 1993) were used for the flux calibration. Standard MIDAS procedures were applied for the reduction of the data.

The two objects near the candidate object of CI Aql are late-type stars and do not show any emission lines. In contrast, all three spectra of the candidate object marked in Duerbeck (1987) show the high-excitation lines HeII λ4686 and NIII/CIII λ4650 in emission (see top and bottom panel of Figure 1) while Balmer emission lines are not present.

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*Based on observations collected at the German-Spanish Astronomical Centre, Calar Alto, operated by the MPI für Astronomie, Heidelberg, jointly with the Spanish National Commission for Astronomy.

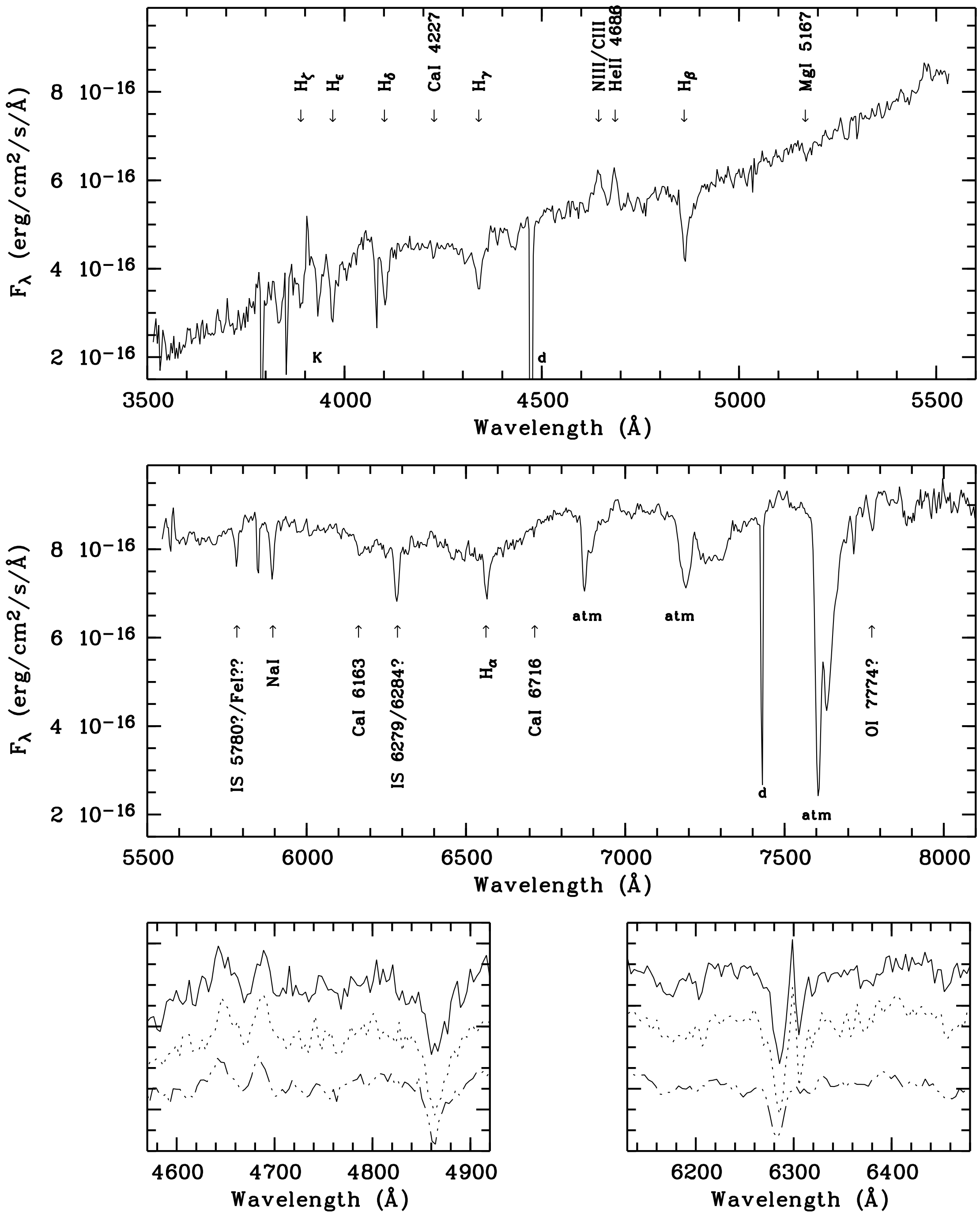

Figure 1. Medium-resolution spectra of CI Aql from June 1993 (top and middle panel). The letter K denotes the CaII K band, CaII H enhances Hε while the symbol "d" denotes a detector flaw and "atm" stands for atmospheric absorption bands. The bottom panel shows a blow-up of the emission line regions at the same intensity scale. Spectra are ordered in time from top to bottom. Note that the [OI] $\lambda\lambda$ 6300 line is absent in June 1993

Also, we find an emission line at 6299 Å in the two September 1992 spectra, which we interpret as [OI] ($\lambda\lambda$ 6300 Å). Even at the highest spectral resolution these emission lines only show a marginal double peak structure which implies a velocity amplitude smaller than 200 km/s. We therefore conclude that the identification of CI Aql as given in Duerbeck (1987) is correct, and that CI Aql is presently in a state of low interaction.

Recently, Mennickent and Honeycutt (1995) reported the discovery of $0\overset{m}{.}6$ deep eclipses in the lightcurve of CI Aql with a period of $0\overset{d}{.}618355(9)$ with an additional $0\overset{m}{.}2$ amplitude secondary minimum shifted by 0.5 in phase with respect to the eclipse. The shape of the light curve is typical for a contact system of two components with differing surface brightness, and excludes the presence of a compact object in CI Aql, as would be implied by the previous nova or dwarf nova interpretation. This is also supported by the shape of the spectrum which does not show any blue component down to 3500 Å and no Balmer lines in emission.

At the given orbital period and due to the weak mass dependence of the semi-major axis of the orbit ($a = 3.63 \times (M_1 + M_2)^{1/3} R_\odot$), a is of the order of 3–4 $R_\odot$ for a reasonable range of masses M_1 and M_2 of the two components. This excludes the presence of a giant as suggested in Mennickent and Honeycutt (1995). Thus, the binary system in CI Aql has to contain two stars with different surface brightness being either main-sequence stars or subgiants.

All our spectra were taken in the phase interval 0.3–0.6, i.e. around the secondary minimum and thus are dominated by the bright component. The determination of the spectral type of the bright component appears nevertheless to be difficult. We cannot use the hydrogen Balmer lines because they are affected by the fainter, late-type component. Similarly, the NaI D (λ 5890 Å) absorption blend is due to a superposition of the contributions of both components. The presence of the Balmer absorption lines and of CaII H,K on the one side and of CaI g and the G band on the other side confirm the existence of two bodies of differing effective temperature.

This combination of early- and late-type star might suggest some unusual RS CVn type binary. In addition to the spectroscopic observations we have therefore searched 1050 Sonneberg sky patrol plates taken mainly by Huth and Fuhrmann between 1926–1991 for additional eruptions of CI Aql. The combined impression of CI Aql and the two neighbouring stars mentioned at the beginning is visible only on the very best plates at $m_{pg} \approx 14\overset{m}{.}8$ (transformed to Mt.-Wilson system using Selected Area 110), and no further eruption was found.

CI Aql has also been in the field of view of three ROSAT PSPC pointings (at different off-axis angles) performed on 1992 October 8–12, 1993 April 2–7 and 1993 September 21 – October 5, but was not detected in any of these (energy range 0.1–2.4 keV). The deepest upper limit on the X-ray flux is 7×10^{-4} cts/s. Dempsey et al. (1993) have investigated the soft X-ray emission of 136 nearby RS CVn systems using the ROSAT all-sky survey data. Using their conversion factor of 6×10^{-12} erg/cm^2/count we get an upper limit X-ray luminosity of 5×10^{29} erg/s (D/1 kpc)^2. This would imply a rather large extinction if CI Aql is indeed a RS CVn system. This is not inconsistent with the heavy interstellar effects in this direction (Neckel and Klare 1980), but the lack of CaII (H and K) emission argues against a standard RS Canum Venaticorum type binary, and so does the contact type lightcurve.

Summarising, the lack of a blue continuum and the Balmer series as well as the shape of the orbital light curve of CI Aql clearly argue against a dwarf nova classification. As argued above, also a standard RS CVn nature seems unlikely. With the present data we cannot offer an alternative classification. Since CI Aql is an eclipsing object, time-resolved spectroscopy is needed to allow the determination of more accurate spectral types of the two components as well as the velocity amplitudes.

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PHOTOGRAPHIC AND CCD PHOTOMETRY OF V350 CEPHEI

The variability of V350 Cep was discovered by Gyulbudaghian and Sarkissian (1977) comparing their photographic observations in NGC 7129 with the Palomar Observatory Sky Survey charts. They found the star to be brighter in 1977 with more than 4^m in B colour in comparison with the brightness in 1952. The following photometric observations of V350 Cep (Gyulbudaghian and Sarkissian, 1978; Hakverdian and Gyulbudaghian 1978; Shevchenko and Yakubov (1989); Pogosyants 1991; Semkov 1993) demonstrated changes of brightness, which are typical for T Tauri type stars with amplitude of about $1\overset{m}{.}5$ in B-light. The recent spectral observations of V350 Cep made in 1989 (Miranda et al., 1994) confirmed that its spectrum is also of a T Tauri type star with a number of emission lines and P Cygni profile of Hα line.

Table 1. Photographic observations of V350 Cep in the period December 1992 - August 1994

J.D. 244...	U mag	B mag	V mag	J.D. 244...	U mag	B mag	V mag
8982.2	–	–	15.9	9151.4	–	17.1	15.8
9002.3	–	17.4	16.1	9152.4	–	17.1	15.8
9005.2	–	17.3	16.3	9184.5	16.3	17.1	15.6
9006.2	16.8	17.0	15.8	9185.5	16.4	16.8	15.6
9007.2	–	17.2	–	9186.4	–	16.9	–
9008.2	–	17.3	–	9187.5	–	16.7	–
9009.2	16.8	–	–	9224.4	16.3	17.0	–
9029.3	–	17.1	16.2	9267.4	16.9	17.0	15.5
9036.3	–	17.3	–	9300.3	–	16.7	–
9036.6	–	17.4	–	9354.3	–	16.5	–
9038.6	–	17.0	–	9452.5	–	16.4	–
9063.5	–	–	16.1	9456.5	16.7	17.2	–
9067.5	–	16.7	15.7	9507.4	–	17.4	16.3
9096.6	–	17.3	16.3	9576.4	–	17.3	15.9
9120.5	–	17.1	16.5	9577.3	–	17.3	–
9149.4	–	–	16.0	9579.4	–	17.3	16.7
9150.4	–	16.8	15.9				

The present photometric data are a continuation of our investigation of V350 Cep which has been carried out since 1984 (Semkov, 1993). The UBV photographic observations were made with the 50/70/172 cm Schmidt telescope of the National Astronomical Observatory Rozhen (Bulgaria) in the period December 1992 - August 1994 (Table 1). The B-light

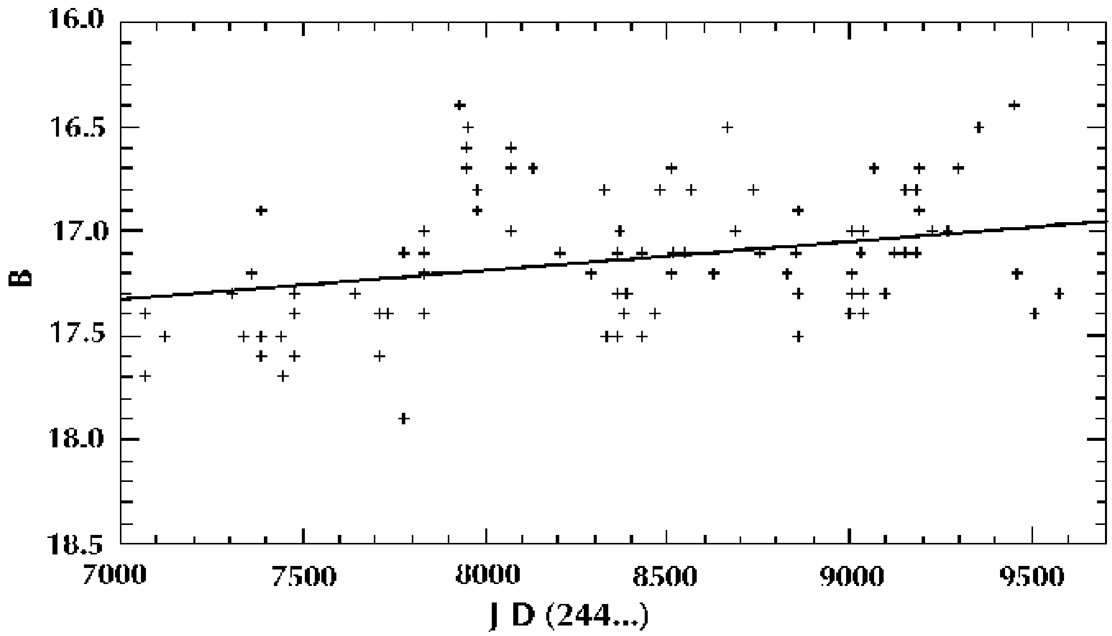

Figure 1. Light curve in B-light of V350 Cep during the period July 1987-August 1994 (Semkov 1993 and this paper)

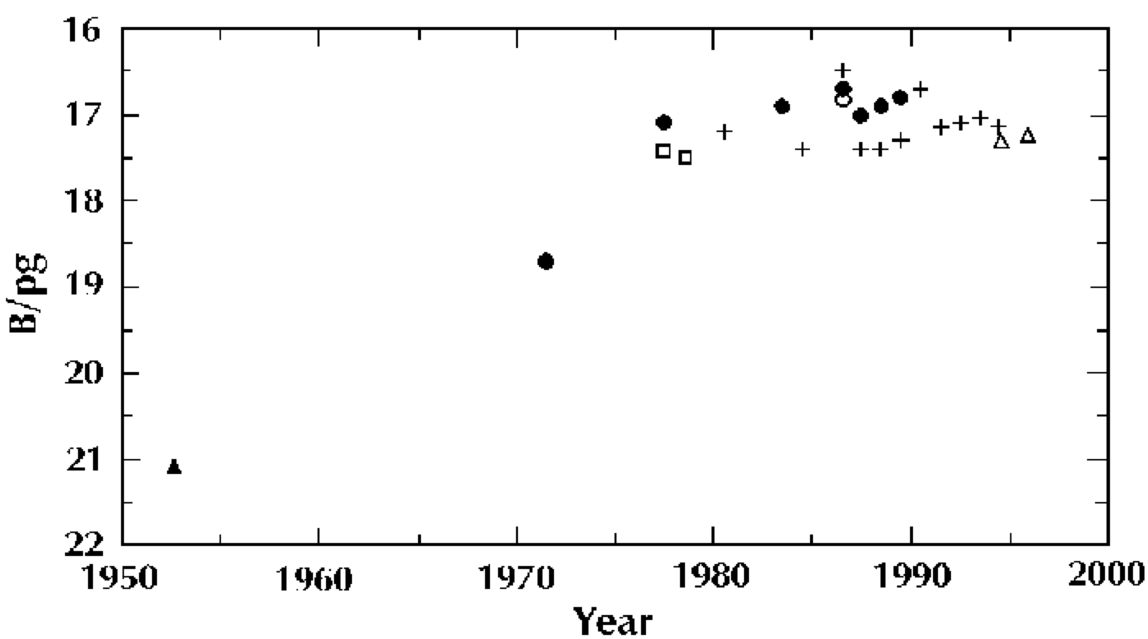

Figure 2. Light curve of V350 Cep from all known observations

curve only from our observations during the period July 1987 - August 1994 is presented in Figure 1. The increase in B-light has continued over the period December 1992 - August 1994. The BVRI(Kron) CCD photometric observations were made with an SBIG ST-6 camera attached to the Rozhen 2m RCC telescope (Table 2). The reductions to the standard BVRI system were made according to Georgiev et al. (1994).

Table 2. BVRI(Kron) CCD photometry of V350 Cep

J.D. (24...)	V	B − V	V − R	V − I
49215.379	16.88	–	0.97	2.04
49573.481	16.32	0.98	0.85	1.98
50047.399	16.14	1.05	0.98	2.10
50048.441	16.11	1.21	0.89	2.05

Using all known observations we composed the light curve in B/pg-band of V350 Cep presented in Figure 2. The mean value of the stellar magnitude for each year from all photographic data is taken. In Figure 2 the crosses denote our photographic data (Semkov 1993 and this paper), the filled circles: photographic data from Pogosyants (1991), the squares: photographic data from the Byurakan Schmidt telescope (Gyulbudaghian and Sarkissian 1977, 1978; Hakverdian and Gyulbudaghian 1978), the filled triangle: visual estimation from the Palomar Observatory Sky Survey Prints, the circles: the mean photoelectric data from Shevchenko and Yakubov (1989), the triangles: our CCD photometric data. From Figure 2 the gradual increase of brightness of V350 Cep resembling the FU Ori type star V1515 Cyg (Herbig, 1977) can be seen.

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PHOTOELECTRIC MINIMA OF 30 ECLIPSING BINARY SYSTEMS

We present 70 minima observations of 30 eclipsing binary systems, not yet published anywhere. Most of the observed systems are apsidal motion stars (or at least eccentric or candidate stars) selected from the listing of Hegedüs (1988). Some minima observations are part of complete light curve coverages.

One part of the observations was carried out at Piszkéstető Mountain Observing Station of the Konkoly Observatory of the Hungarian Academy of Sciences with a 20 in. f/15 Cassegrain telescope. The photometer used was equipped with an unrefrigerated EMI9058QB photomultiplier tube and Schott UG2 (for U), BG12+GG13 (for B) and GG11 (for V) filters. This system is referred to as Pi50 in Table 1. Another part of the observations was made at Konkoly Observatory (Budapest Szabadsághegy). The photometer was equipped with an unrefrigerated EMI9502B tube, Schott UG1 (for U), BG12+GG13 (for B) and GG11 (for V) filters, and mounted in the f/6 Newtonian focus of the 24 in. telescope (see eg. Szeidl et al. 1992). This system is marked as Bp60 in Table 1. Most of the measurements were made at Baja Astronomical Observatory with a Starlight-I photometer, equipped with an unrefrigerated EMI9924A multiplier tube and Schott filters UG1 (matching Johnsonian U), GG400+BG25 (matching B) and OG515 (matching V), mounted on the 16 in. Cassegrain f/14 telescope of JATE (Szeged) and later on the 20 in. f/8.4 Ritchey-Chrétien telescope (Ba40 and Ba50 in Table 1, respectively). The system signed as Ba40 was described by Hegedüs (1987). The XZ And and CC Her minima were measured with an ST-5 unfiltered CCD camera installed on the 20 in. RC telescope.

The observations were made between 1987-1996. Reduction of the photoelectric data was made by standard procedures. For the reduction of the CCD frames we used the IMAGINE-32 software. All the minima times were computed using the parabolic fitting method. The times are heliocentric-corrected ones.

Table 1 presents the derived minima times. The content of the first two columns is self-explaining. In the third column the types of minima are marked (I for primary, and II for secondary ones), while in the fourth column the number of individual data involved in the parabolic fit is given. The columns from fifth to seventh describe the filters used, the first three letters of the observers' names and the codes of the instrumentation. The last column contains the comparisons (and occasional check stars) used, identified by their BD or GSC numbers. This work was partly supported by the National Grants OTKA-T4330 and OTKA-F007318 and the Local Government of Bács-Kiskun County.

Table 1

Star	Min. HJD +2400000	Min. type	Points used	Filter	Obs.'s name	Instr.	Comp.	Check
XZ And	49651.4992	I	22	-	Bor	Ba50 (ST5)	2824+1544	
	49655.5713	I	16	-	Bor	Ba50 (ST5)		
V889 Aql	48755.4814	II	74	V	Heg	Pi50	BD+15°3754	
	48755.4849	II	74	B	Heg	Pi50		
	48755.4793	II	74	U	Heg	Pi50		
SS Ari	50043.2785	I	21	V	Bor	Pi50	BD+23°284	BD+23°277
	50043.2774	I	21	B	Bor	Pi50		
	50043.4792	II	34	V	Bor	Pi50		
	50043.4812	II	34	B	Bor	Pi50		
	50045.5112	II	29	V	Bor+Bir	Pi50		
	50045.5113	II	34	B	Bor+Bir	Pi50		
AS Cam	47524.2763	II	32	V	Heg	Ba40	BD+69°317	
	47524.2753	II	32	B	Heg	Ba40		
	48639.3418	II	50	V	Heg	Pi50		
	48639.3421	II	50	B	Heg	Pi50		
	49749.4581	I	59	V	Bor	Pi50		
	49749.4586	I	54	B	Bor	Pi50		
	49749.4576	I	54	U	Bor	Pi50		
	50001.4341:	II	72	V	Bor	Ba50		
	50001.4337:	II	72	B	Bor	Ba50		
	50003.3399	I	72	V	Bor	Ba50		
	50003.3406	I	72	B	Bor	Ba50		
RZ Cas	48854.4354	II	97	V	Heg+Bor	Pi50	BD+67°215	
	48854.4270	II	97	B	Heg+Bor	Pi50		
	48857.4195	I	24	V	Heg+Bor	Pi50		
	48857.4197	I	25	B	Heg+Bor	Pi50		
	49956.4592	II	50	V	Bor	Ba50		
	49956.4609	II	112	B	Bor	Ba50		
	49956.4622	II	112	U	Bor	Ba50		
	49968.4105	II	47	V	Bor	Ba50		
	49968.4038	II	47	B	Bor	Ba50		
	49968.4127	II	47	U	Bor	Ba50		
	49984.5487	I	40	V	Bir	Ba50		
	49984.5485	I	40	B	Bir	Ba50		
	49990.5260	I	32	V	Bor	Ba50		
	49990.5259	I	31	B	Bor	Ba50		
	50142.3223	I	40	V	Bir	Ba50		
	50142.3224	I	41	B	Bir	Ba50		
TV Cas	50096.4287:	I	45	V	Bor	Ba50	BD+58°024	
	50096.4238:	I	46	B	Bor	Ba50		
TW Cas	50088.4010	I	61	V	Bir	Ba50	BD+64°337	
	50088.3987	I	108	B	Bir	Ba50		
	50095.5448	I	65	V	Bir	Ba50		
	50095.5454	I	63	B	Bir	Ba50		
VW Cep	47153.2969	II	88	V,B	Heg	Ba40	BD+75°765	
	47153.4303	I	33	V,B	Heg	Ba40		
	47263.3656	I	81	V,B	Heg	Ba40		
	47263.5057	II	97	V,B	Heg	Ba40		
	47293.4235	I	33	V,B	Heg	Ba40		
	47352.4255	I	52	V,B	Heg	Ba40		
	47353.3999	II	57	V,B	Heg	Ba40		

Table 1 (cont.)

Star	Min. HJD +2400000	Min. type	Points used	Filter	Obs.'s name	Instr.	Comp.	Check
XX Cep	50047.3571	I	56	V	Bir	Pi50	BD+63°2030	
	50047.3559	I	56	B	Bir	Pi50		
EK Cep	47393.3960	I	30	V	Heg	Ba40	BD+68°1239	
	47393.3959	I	30	B	Heg	Ba40		
	47444.5074	II	91	V	Heg	Ba40		
	47444.5087	II	92	B	Heg	Ba40		
	47911.4469	I	24	V	Heg	Ba40		
	47911.4467	I	24	B	Heg	Ba40		
	48429.4992	I	30	V	Heg	Ba40		
	48429.4975	I	30	B	Heg	Ba40		
	48500.3451	I	28	B	Heg	Ba40		
	48500.3453	I	28	V	Heg	Ba40		
	48511.5957	II	30	V	Heg	Ba40		
	50138.6288	I	27	V	Bor	Ba50		
	50138.6285	I	27	B	Bor	Ba50		
GK Cep	50033.5048:	I	26	V	Bir	Ba50	BD+70°1182	
	50033.5055:	I	26	B	Bir	Ba50		
CG Cyg	48840.5135	I	24	V	Par	Bp60	BD+34°4224	BD+34°4232
	48840.5139	I	21	B	Par	Bp60		
	48840.5153	I	17	U	Par	Bp60		
DK Cyg	48841.5024	I	30	V	Par	Bp60	BD+34°4465	
	48841.5028	I	35	B	Par	Bp60		
MR Cyg	50044.3227:	I	27	B	Bir	Ba50	BD+47°3622	
	50044.3258:	I	18	B	Bor	Pi50		
V836 Cyg	48833.4300	I	42	V	Par	Bp60	BD+35°4461	BD+35°4460
	48833.4291	I	42	B	Par	Bp60		
V1143 Cyg	48409.4176	I	41	V	Heg	Ba40	BD+55°2213	
	48409.4175	I	42	B	Heg	Ba40		
	48430.3590	II	54	B	Heg	Ba40		
	48537.2846	II	53	V	Heg	Ba40		
	48537.2885	II	52	B	Heg	Ba40		
TZ Dra	49120.5168	I	31	V	Par	Bp60	BD+47°2626	BD+47° 2624
	49120.5169	I	32	B	Par	Bp60		
	49120.5189	I	16	U	Par	Bp60		
RW Gem	50046.6214	I	32	V	Bir	Pi50	BD+23°1161	BD+23° 1154
AK Her	49818.5410	I	31	V	Bor	Pi50	BD+16°3123	
	49818.5424	I	31	B	Bor	Pi50		
	49818.5425	I	31	U	Bor	Pi50		
	49867.4375	I	32	V	Bor	Ba50		
	49867.4383	I	32	B	Bor	Ba50		
	49886.4069	I	29	V	Bor	Ba50		
	49886.4063	I	26	B	Bor	Ba50		
CC Her	49876.5413	I	38	-	Par	Ba50 (ST5)	0956+1166	
DI Her	48128.4574	II	31	V	Heg	Ba40	BD+24°3555	
	48128.4555	II	32	B	Heg	Ba40		
	48856.4202	II	15	V	Heg+Bor	Pi50		
	48856.4201	II	15	B	Heg+Bor	Pi50		
	48856.4132	II	31	U	Heg+Bor	Pi50		
HS Her	49811.5528	II	72	V	Bor	Ba50	BD+24°3545	
	49811.5456:	II	74	B	Bor	Ba50		
	49861.5015	I	64	V	Bor	Ba50		
	49861.5004	I	64	B	Bor	Ba50		

Table 1 (cont.)

Star	Min. HJD +2400000	Min. type	Points used	Filter	Obs.'s name	Instr.	Comp.	Check
AR Lac	49998.4063:	I	110	V	Bor	Ba50	BD+47°3711	
	49998.4084:	I	111	B	Bor	Ba50		
UV Leo	50080.5871	I	32	V	Bor	Ba50	BD+14°2277	
	50080.5872	I	32	B	Bor	Ba50		
	50139.3935	I	51	V	Bir	Ba50		
	50139.3932	I	46	B	Bir	Ba50		
FT Ori	47482.5449	I	22	V	Heg	Ba40	BD+22°1250	
	47482.5451	I	22	B	Heg	Ba40		
	50138.3534:	I	29	V	Bor	Ba50		
	50138.3508:	I	29	B	Bor	Ba50		
U Peg	49979.5645	II	38	V	Bor	Pi50	BD+15°4903	
	49979.5653	II	38	B	Bor	Pi50		
AG Per	47118.4536	I	34	V	Heg	Ba40	BD+32°714	
	47529.3656	II	41	V	Heg	Ba40		
	47529.3666	II	55	B	Heg	Ba40		
	47530.2869	I	36	V	Heg	Ba40		
	47530.2860	I	37	B	Heg	Ba40		
	47897.4892	I	38	V	Heg	Ba40		
	47897.4858	I	38	B	Heg	Ba40		
	50018.6111	II	72	V	Bor	Ba50		
	50018.6088	II	72	B	Bor	Ba50		
	50080.4111	I	80	V	Bor	Ba50		
	50080.4086	I	80	B	Bor	Ba50		
IQ Per	50047.6185	I	64	V	Bir	Pi50	BD+47°0923	
	50047.6172	I	64	B	Bir	Pi50		
	50061.5687	I	62	V	Bir	Ba50		
	50061.5687	I	52	B	Bir	Ba50		
	50061.5685	I	54	U	Bir	Ba50		
b Per	50022.5429:	I	53	V	Bir	Ba50	BD+49°1155	BD+49°1154
TX UMa	50141.4519	I	68	V	Bir	Ba50	BD+47°1797	
	50141.4515	I	73	B	Bir	Ba50		

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PHOTOELECTRIC UBV OBSERVATIONS OF EG ANDROMEDAE

One of the patterns of the photometric variability of symbiotic binary systems is that, caused by the orbital motion. Orbital variability is observed in the EG And system, consisting of an M2 III giant and a hot subdwarf. The period is about 480^{d} and UBV measurements have been obtained practically at all orbital phases. According to the observations during the last years (Hric et al. 1991, Hric et al. 1993, 1994, Skopal et al. 1995) two minima are present in the orbital photometric variations — a primary, when the giant is towards the observer and a secondary one, remote from the primary approximately at the half orbital period. The data scattering is a sign of light fluctuations, which become most apparent in the area of the secondary minimum in U band (Skopal et al. 1995).

Two different models are proposed for an explanation of the variations. According to the first of them, a reflection effect has place in this system and the primary minimum occurs when the unheated part of the giant's atmosphere is oriented towards the observer (Munari 1993). The hot component of EG And, however, has a low luminosity (Murset et al. 1991) which is insufficient (see Belyakina 1970) for the heating of the giant. Moreover, the Lyman luminosity is spent entirely for ionization of a portion of the wind of the giant and according to the approach of Taylor and Seaquist (1984) the boundary between the ionized and the neutral portions is far away from its photosphere. Skopal (1995) has critically considered the possibility for reflection effect and has shown that the light variations of many symbiotic systems with low luminosity hot components require an explanation of principle.

According to the second model (Skopal et al. 1993, Skopal 1995) a common envelope, having geometry of the equipotential surface containing the Lagrangian point L_2, is responsible for the existence of the two minima in the orbital light curve. In this model, however, the giant's continuum, which is dominant in the BV region (Kenyon 1986), is not taken into account. This model meets, also, the next difficulty. In accordance with Kenyon's (1986) colour – colour diagnostic the UV continuum of EG And does not indicate the presence of an optically thick accretion disk, such as that formed as a result of mass transfer via L_1. That is why the view that the giant in this system does not fill its Roche lobe and loses mass by means of stellar wind is widely accepted (Oliversen et al. 1985, Vogel 1991, Vogel et al. 1992, Vogel 1993, Munari 1993, Tomov 1995). The existence of the envelope described is not compatible with the existence of the giant's wind, expected in accordance with the theory of stellar evolution. Having in mind the difficulties of the interpretation as well as the light fluctuations pointed we consider that a large amount of observational data is required for comparison with the future models.

Table 1. Differential photometry of EG And against HD 3914, in magnitudes

Julian day	Δ V	Δ B	Δ U		Julian day	Δ V	Δ B	Δ U
2448582.354	0.07	1.25	2.79		2449971.395	0.13	1.34	2.70
2448609.229	0.02	1.26	2.77		2449973.390	0.14	1.37	2.87
2448636.260	0.08	1.26	2.86		2449988.450	0.19	1.45	3.06
2449046.240	0.11	—	—		2449993.401	0.12	1.37	3.00
2449173.561	0.11	1.33	3.11		2449996.393	0.11	1.34	2.92
2449178.572	0.14	1.37	3.19		2450012.291	0.16	1.40	3.02
2449248.454	0.16	1.41	3.32		2450024.301	0.09	1.29	2.95
2449340.196	0.10	1.32	3.12		2450049.326	0.09	1.31	2.95
2449573.512	0.07	1.26	2.84		2450092.210	0.05	1.27	2.96
2449598.500	0.12	1.34	2.81					

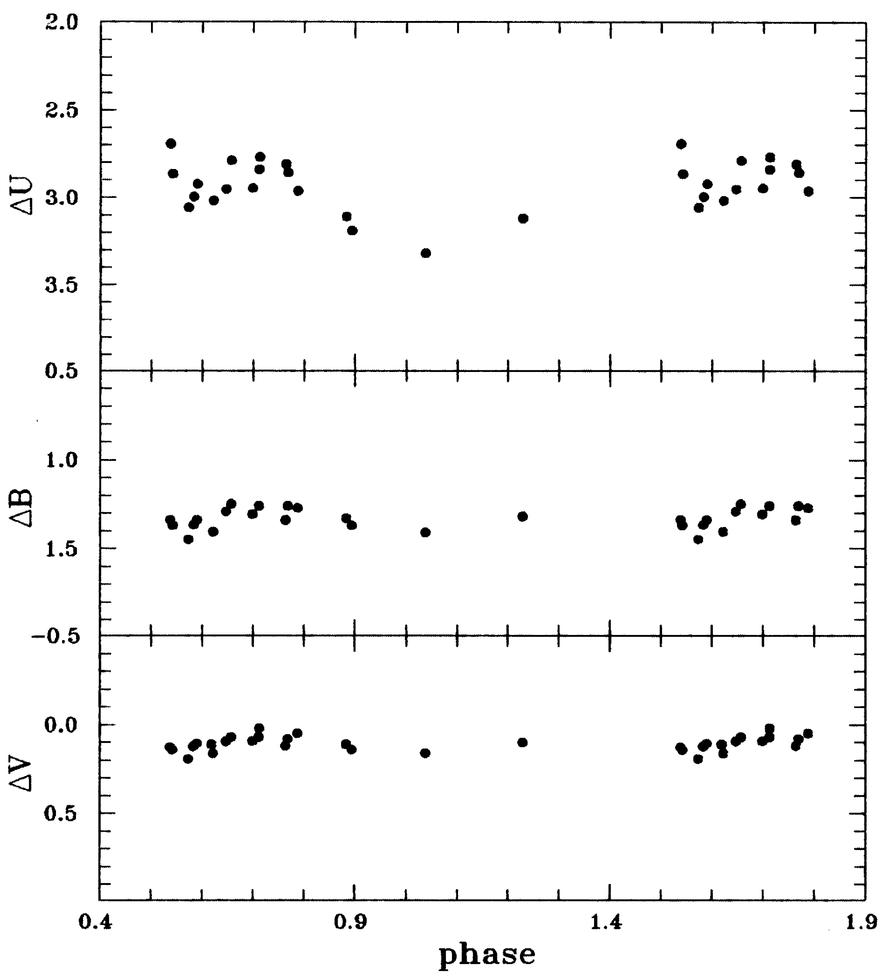

Figure 1. Orbital UBV light variations of the EG And system

Here we present nineteen photoelectric estimates in the three colour UBV system, obtained after November 1991. They were carried out with a single channel photoelectric photometer, mounted at the Cassegrain focus of the 0.6 m telescope of the National Astronomical Observatory "Rozhen". The data on JD 2450012.291 have been taken using the similar telescope and equipment of the Astronomical Observatory Belogradtchik. The star HD 3914 (V = 7.0, B − V = 0.44) has been used as the comparison star. The data derived has been processed by means of a photoelectric data software (Kirov et al., 1991), using the reduction coefficients (Zamanov, private communication) for both atmospheric extinction and standard UBV system. The differential photometry $\Delta m = m(\mathrm{EG\,And}) - m(\mathrm{HD\,3914})$ in the three colours is presented in Table 1.

Our photometric data indicate orbital variations (Figure 1). The phases have been reckoned using the elements $\mathrm{JD_{min}} = 2446336.7 + 482.2 \times \mathrm{E}$ where the zero phase is at the epoch of the primary minimum (Skopal et al., 1993). The kind of the variations detected as well as the amplitudes in the different bands are in agreement with the results of the other observers (Hric et al. 1991, 1993, 1994, Skopal et al. 1992, 1995), although the phase range of the secondary minimum has not well been covered.

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NEW VARIABLE STARS IN THE η HERCULIS FIELD

This paper continues the study begun in my previous publication (Antipin, 1994). Eight new variables were discovered in the field $10^\circ \times 10^\circ$ centered on η Her (Var 11–18). This study is based on Moscow collection plates taken with the 40 cm astrograph in Crimea.

Table 1 contains coordinates and GSC identifications of new variables. Coordinates for GSC stars were taken from the Guide Star Catalog; for the rest of the stars, they were measured relative to neighbouring GSC stars. The accuracy is about $\pm 1''$. Table 2 presents for each star: number of observations, time interval (JD), type of variability, maximum and minimum brightness (in B band), $M - m$ or D. Table 3 contains light elements (epoch and period) for periodic variables. Like in my previous publication, the standard near M13 (Arp and Johnson, 1955; Forbes and Dawson, 1986) was used to obtain the magnitudes of comparison stars (Table 4). Finding charts and phased light curves are shown in Figures 1 and 2, respectively.

Table 1. Coordinates and Identifications of Variable Stars

Var	α(2000.0)	δ(2000.0)	GSC
Var 11	$16^h38^m04^s.3$	$34^\circ20'32''$	2585.2215
Var 12	16 48 19.8	40 28 44	
Var 13	17 06 54.5	39 22 11	
Var 14	17 00 50.4	36 08 51	
Var 15	16 31 37.1	34 32 23	2584.0550
Var 16	16 22 46.3	39 11 23	
Var 17	16 38 27.8	41 11 41	
Var 18	16 44 03.8	39 23 33	3074.0305

Remarks on individual stars

Var 11. EA classification is also possible for this variable. *Min II* 15.40.
Var 15. *Min II* 15.80.

Table 2. Data on New Variable Stars

Var	N	JD24...	Type	Max	Min	$M - m$ or D
Var 11	523	37080–48778	EB	14.70	15.80	
Var 12	257	41750–48778	RRab	15.10	16.50	0.15
Var 13	245	41750–48778	RRab	15.50	17.30	0.15
Var 14	243	41750–48778	RRab	15.90	17.30	0.20
Var 15	518	37080–48778	EB	14.90	16.30	
Var 16	269	37080–48778	RRab	15.80	17.10	0.20
Var 17	252	41750–48778	RRab	15.20	17.30	0.12
Var 18	311	37080–48778	EA	12.80	13.80	0.10

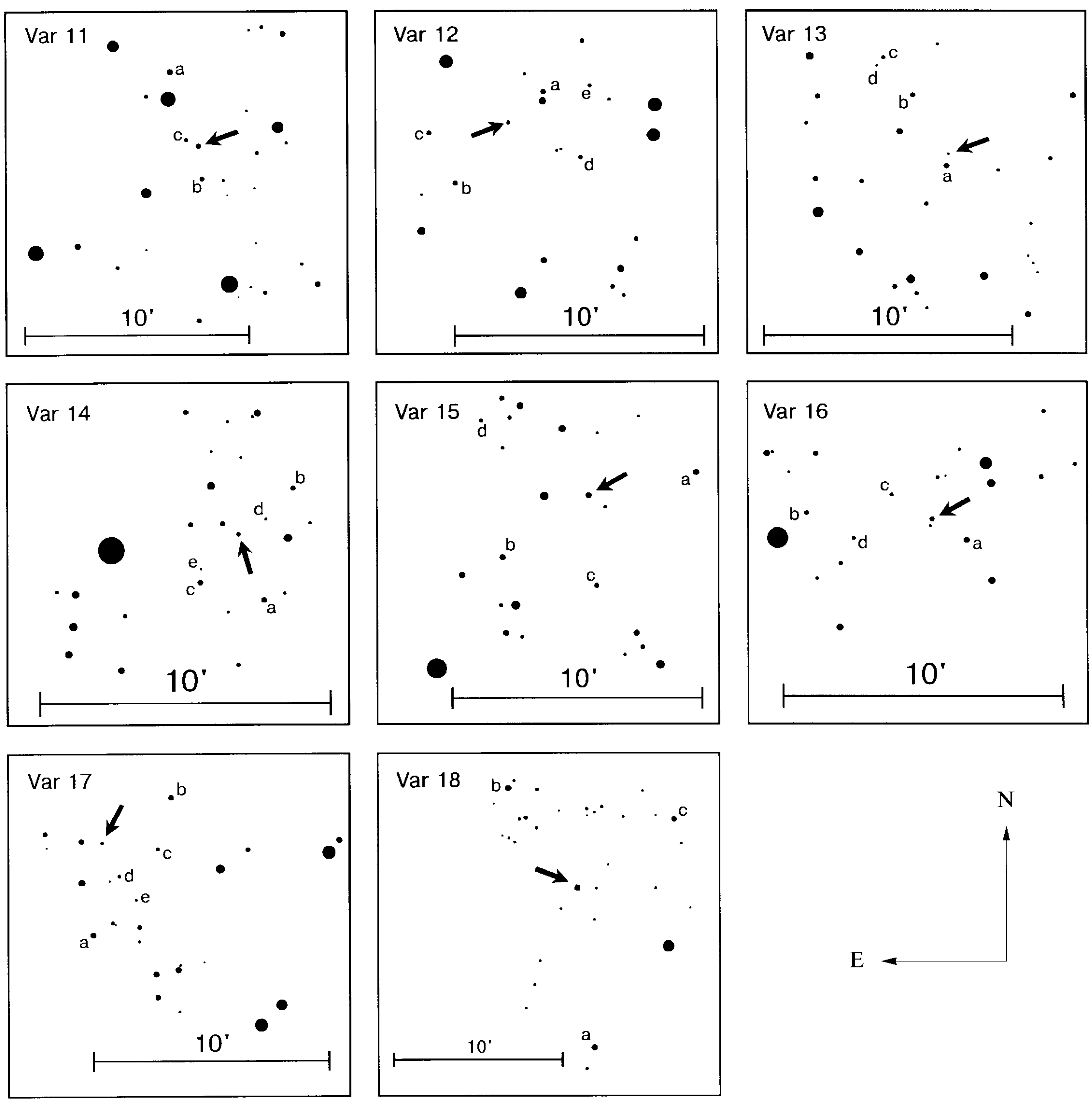

Figure 1. Finding charts

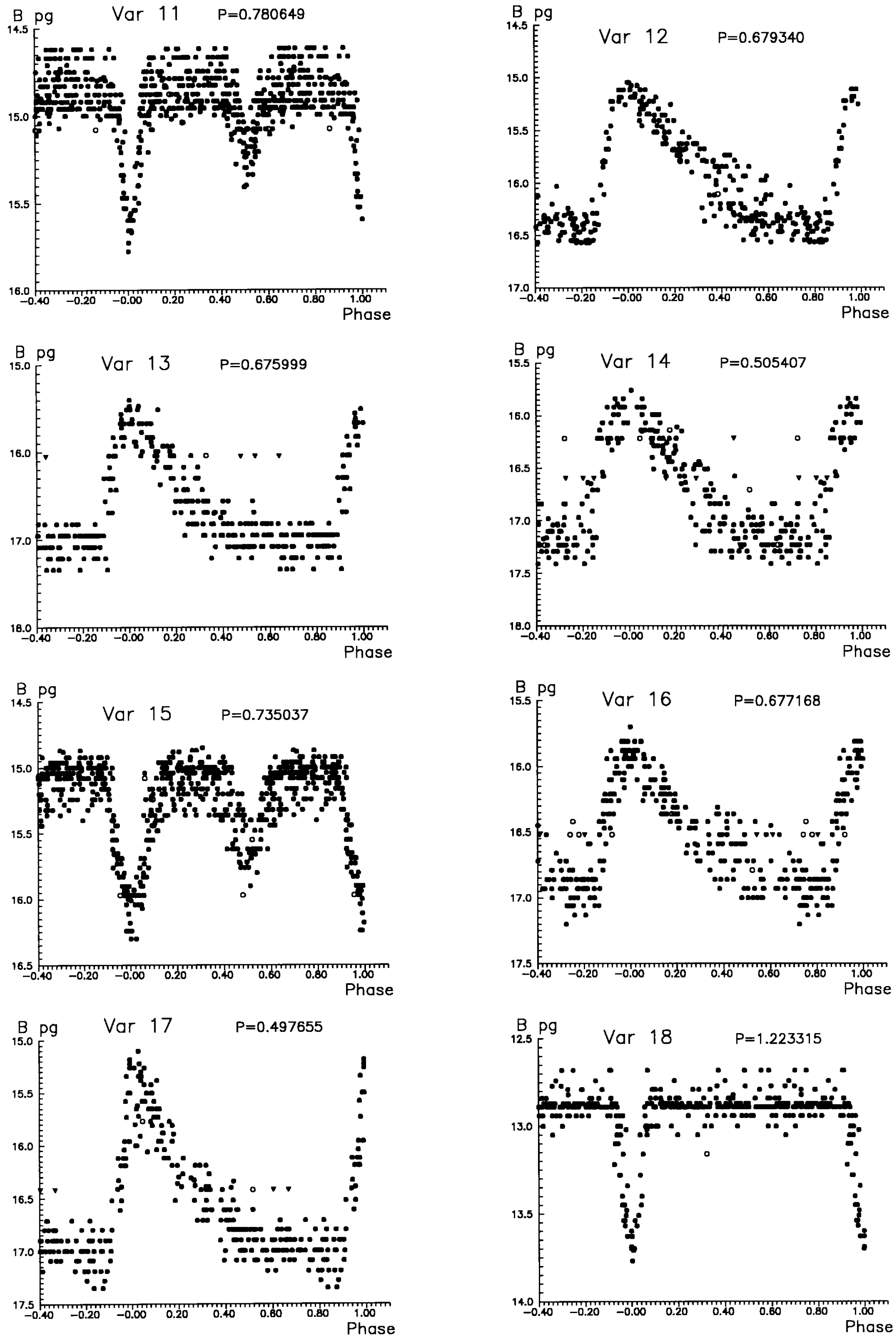

Figure 2. Light curves

Table 3. Light Elements

Var	Max (Min), JD	Period
Var 11	2441947.33	$0\overset{d}{.}780649$
Var 12	2445589.26	0.679340
Var 13	2441974.21	0.675999
Var 14	2442302.31	0.505407
Var 15	2442635.43	0.735037
Var 16	2441926.36	0.677168
Var 17	2441829.49	0.497655
Var 18	2442949.45	1.223315

Table 4. Comparison Stars

Var	a	b	c	d	e
Var 11	14.67	15.08	15.73		
Var 12	14.94	15.30	15.85	16.29	16.55
Var 13	15.10	15.51	16.04	17.34	
Var 14	15.46	16.22	16.48	17.23	17.82
Var 15	14.85	15.08	15.48	16.18	
Var 16	15.38	16.00	16.52	17.20	
Var 17	14.69	15.50	16.27	16.42	17.38
Var 18	12.58	13.10	13.69		

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NEW VARIABLE STARS IN THE ξ CORONAE BOREALIS FIELD

This paper continues the study announced in IBVS No. 4125 and deals with the search and investigation of new variable stars using positive-negative method. Six new variables were discovered in the field $10° \times 10°$ centered on ξ CrB (Var 19–24). This study is based on Moscow collection plates taken with the 40 cm astrograph in Crimea.

The data in Tables 1 - 4 and Figures 1, 2 are as in Antipin (1996). The photoelectric standard near V596 Her was used to obtain the magnitudes of comparison stars (Shugarov, unpublished).

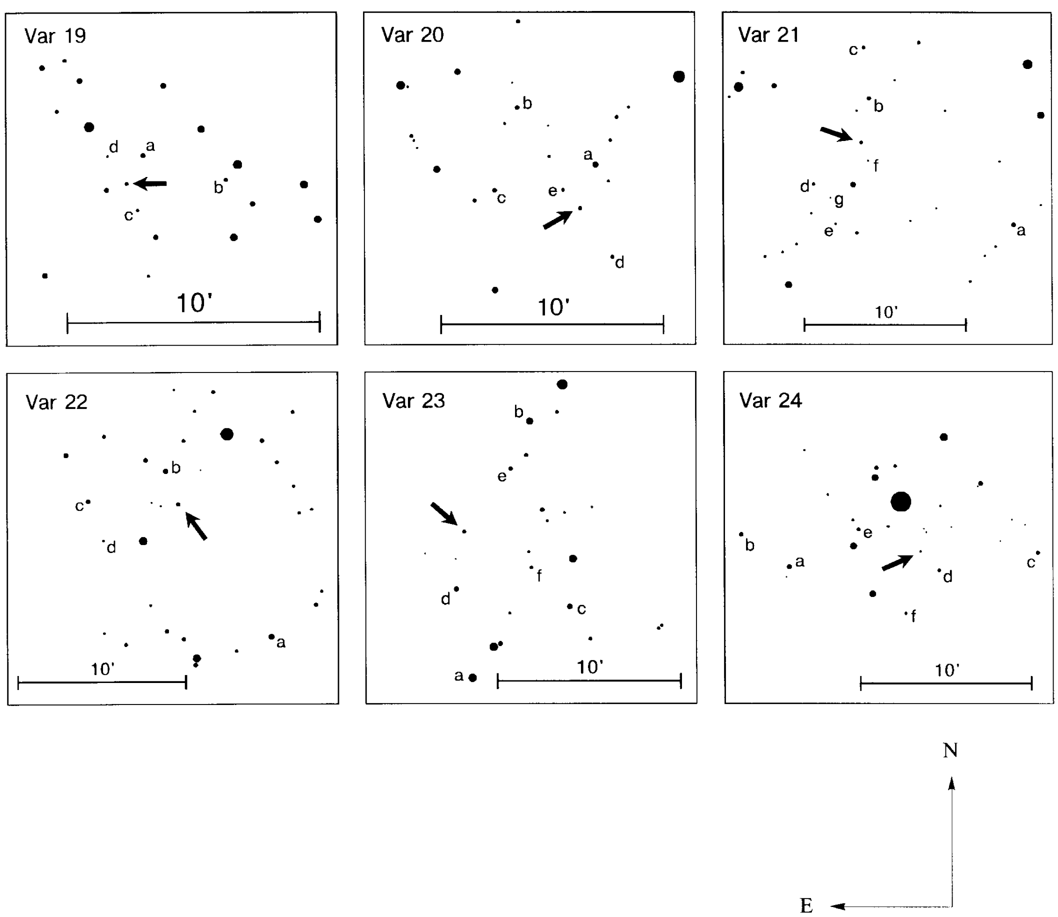

Figure 1. Finding charts

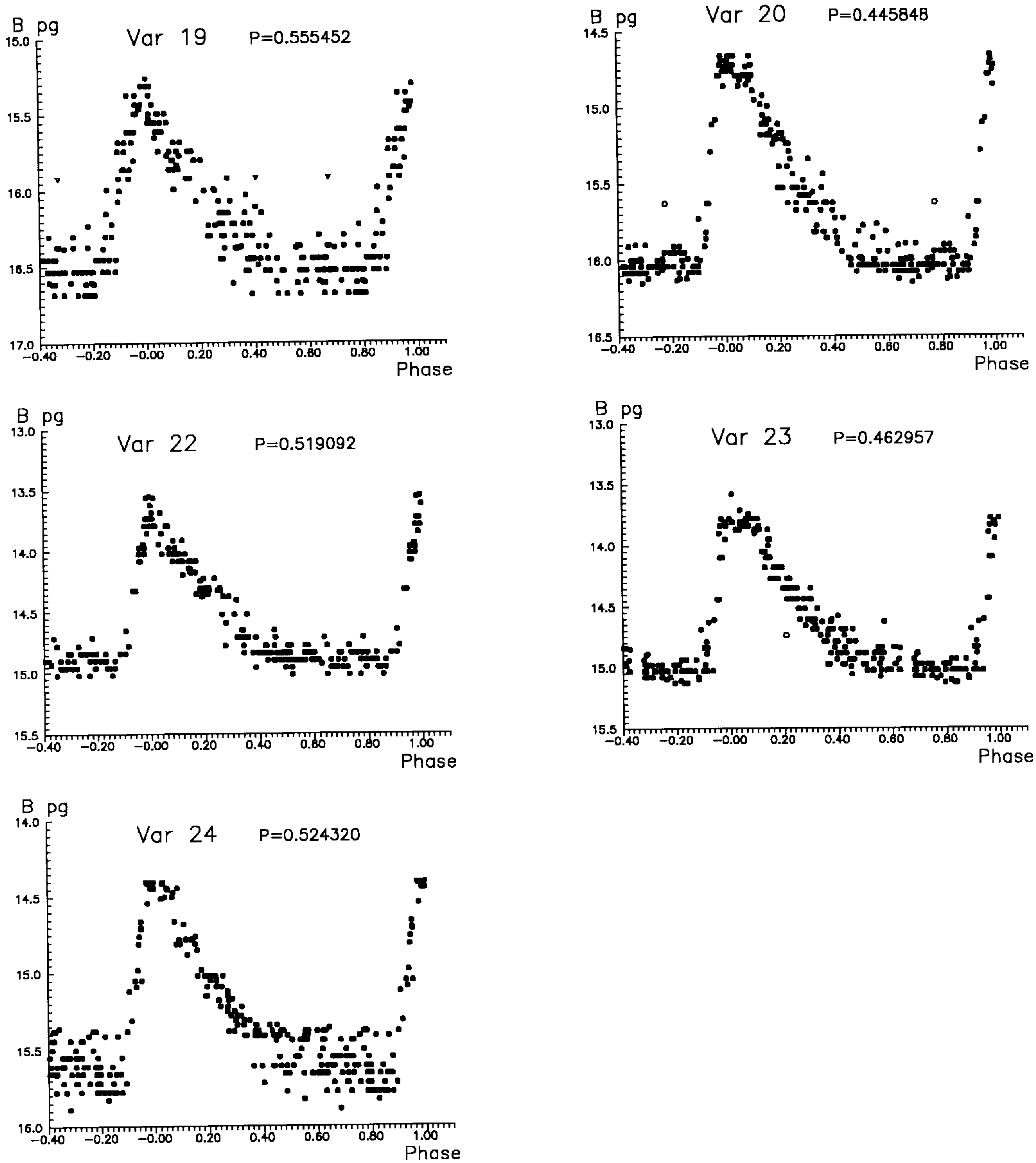

Figure 2. Light curves

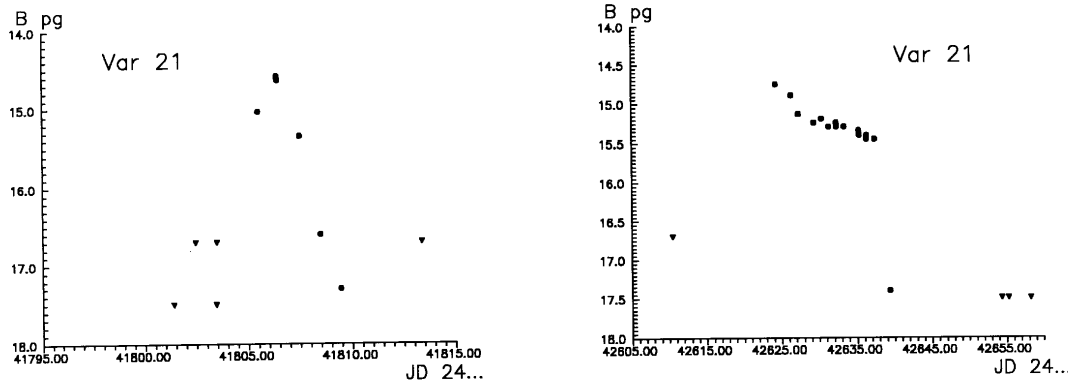

Figure 3. Light curve of variable No. 21

Remarks on individual stars

Var 21. Blue on Palomar prints. The star was seen on 42 plates. Nine outbursts were observed. Two kinds of outbursts, with duration less than 10 days (Figure 3a) and longer than 15 days (Figure 3b), were revealed. Outbursts (JD 24...):

1	41805.491	15.03	6	42624.318	14.75	7	42865.455	14.58
	41806.385	14.58		42626.356	14.89		42867.469	14.72
	41806.419	14.63		42627.297	15.13		42868.383	14.97
	41807.476	15.34		42627.335	15.13		42870.447	15.08
	41808.473	16.60		42629.349	15.24		42874.465	15.24
	41809.443	17.30		42629.386	15.24		42875.498	15.27
				42630.358	15.19			
2	41860.385	15.03		42630.393	15.19	8	43695.322	14.72
	41867.433	15.19		42631.349	15.29			
	41868.441	15.45		42632.322	15.24	9	44042.349	14.80
	41869.423	15.50		42632.357	15.29			
				42633.389	15.29			
3	41923.334	16.80		42635.321	15.34			
	41924.351	15.24		42635.409	15.40			
	41925.302	16.01		42636.342	15.45			
				42636.380	15.40			
4	42196.391	14.86		42637.407	15.45			
	42197.434	15.24		42639.367	17.40			
5	42303.279	14.50						

Table 1. Coordinates and Identifications of Variable Stars

Var	$\alpha(2000.0)$	$\delta(2000.0)$	GSC
Var 19	$16^h21^m29^s.2$	$29°20'02''$	
Var 20	16 16 28.9	29 56 19	
Var 21	16 00 03.7	33 11 15	
Var 22	16 00 03.5	34 58 21	2576.0466
Var 23	16 06 11.6	33 22 16	2576.0980
Var 24	16 37 42.4	27 00 02	2053.0776

Table 2. Data on New Variable Stars

Var	N	JD24...	Type	Max	Min	$M-m$
Var 19	212	41750–48394	RRab	15.30	16.60	0.20
Var 20	213	41750–48394	RRab	14.70	16.10	0.12
Var 21	205	41750–48394	UG	14.50	<17.5	
Var 22	202	41750–48394	RRab	13.60	15.00	0.14
Var 23	214	41750–48394	RRab	13.70	15.10	0.11
Var 24	209	41750–48394	RRab	14.40	15.80	0.12

Table 3. Light Elements

Var	Max JD	Period
Var 19	2441838.40	$0^d.555452$
Var 20	2442609.40	0.445848
Var 22	2442637.41	0.519092
Var 23	2441776.41	0.462957
Var 24	2442926.44	0.524320

Table 4. Comparison Stars

Var	a	b	c	d	e	f	g
Var 19	14.84	15.31	15.92	16.68			
Var 20	14.27	14.92	15.24	15.73	16.17		
Var 21	14.16	14.63	14.92	15.45	15.71	16.70	17.50
Var 22	13.56	14.14	14.40	15.02			
Var 23	13.17	13.59	13.90	14.41	14.69	15.18	
Var 24	14.50	14.66	14.78	15.12	15.44	16.00	

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NEW VARIABLE STARS IN THE 66 OPHIUCHI FIELD

This paper continues the series of studies dealing with the search of new variables based on Moscow collection of plates. Nine new variables were discovered in the field $10° \times 10°$ centered on 66 Oph (Var 25–33).

The variables were estimated on plates taken on JD 2442812–2448092. The data on the new variable stars are presented in Tables 1–3. Finding charts and phased light curves are shown in Figures 1 and 2. The standard sequence near NGC 6426 was used to obtain the magnitudes of comparison stars (Shugarov, unpublished).

Remarks on individual stars

Var 25. Not present or very faint on the Palomar blue print. The star was seen on 14 plates. Three outbursts were observed. Their duration is more than 6 but less than 28 days (Figure 3). Outbursts (JD 24...):

1	42957.338	15.40	42957.499	15.14	2	44131.297	15.68
	42957.370	15.35	42961.323	15.35			
	42957.403	15.35	42961.499	15.46	3	48090.305	14.93
	42957.437	15.40	42963.332	15.63		48091.305	15.29
	42957.469	15.14	42963.505	15.57		48092.427	15.32

Var 30. Periods about 486 and 242 days are possible (Figure 2 for Var 30). Epoch JD 2443282. Red on Palomar prints. The star is a strong enough IRAS source.

Var 31. Double. Very close, non-coloured southwestern component is present on Palomar prints, but the image on our plates is single. It is possible that the neighbouring star was estimated in minima.

Var 32. RRb type.

Var 33. The cycle of variability is about $70-80^d$. Minimum brightness varies (Figure 4).

Table 1. Coordinates and Identifications of Variable Stars

Var	α(2000.0)	δ(2000.0)	GSC	IRAS
Var 25	$18^h04^m17\overset{s}{.}3$	$4°43'44''$		
Var 26	18 12 30.1	8 36 35	1009.1098	18101+0835
Var 27	18 13 26.6	8 52 28	1009.0361	18110+0851
Var 28	18 04 15.0	6 04 13		
Var 29	17 50 56.0	7 18 27		
Var 30	18 07 07.9	8 22 46	1008.1326	18047+0822
Var 31	18 02 16.6	8 56 56	1008.0492	
Var 32	18 04 34.4	8 19 49		
Var 33	18 05 25.1	8 15 09	1008.1491	

Table 2. Data on New Variable Stars

Var	N	Type	Max	Min	$M-m$	Max, JD	Period
Var 25	234	UG	15.00	< 21.0			
Var 26	225	M	13.80	< 17.3		2448090.3	$269^{d}.1$
Var 27	229	SRa	13.40	15.60	0.35	2445203.3	156.8
Var 28	228	RRab	14.90	16.50	0.12	2443726.32	0.438655
Var 29	223	RRab	15.20	17.10	0.12	2442951.35	0.438333
Var 30	231	SRa	14.30	16.50			
Var 31	233	M	13.30	16.10:		2443987.5	200.0
Var 32	229	RRab	14.00	15.00	0.30	2444397.41	0.638544
Var 33	234	SRb	13.90	16.50			

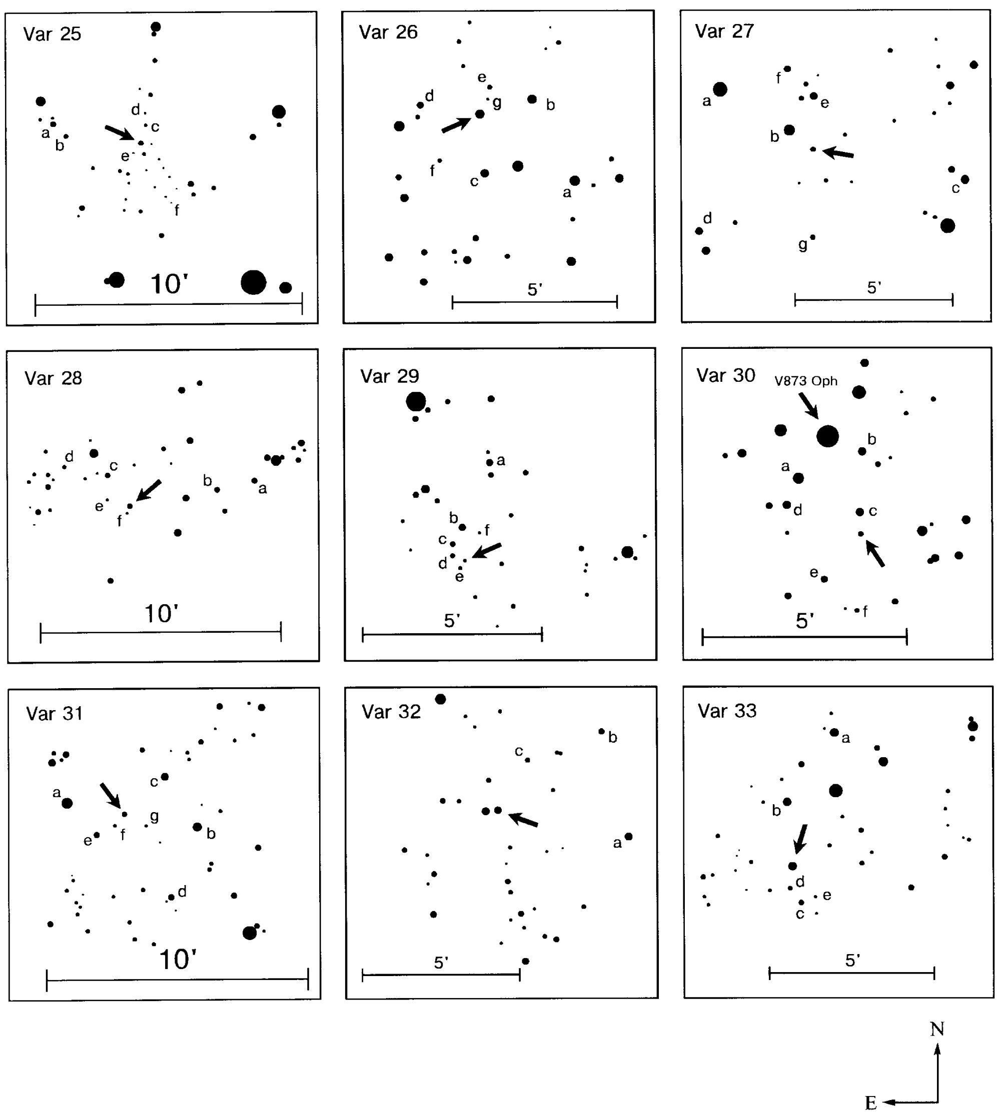

Figure 1. Finding charts

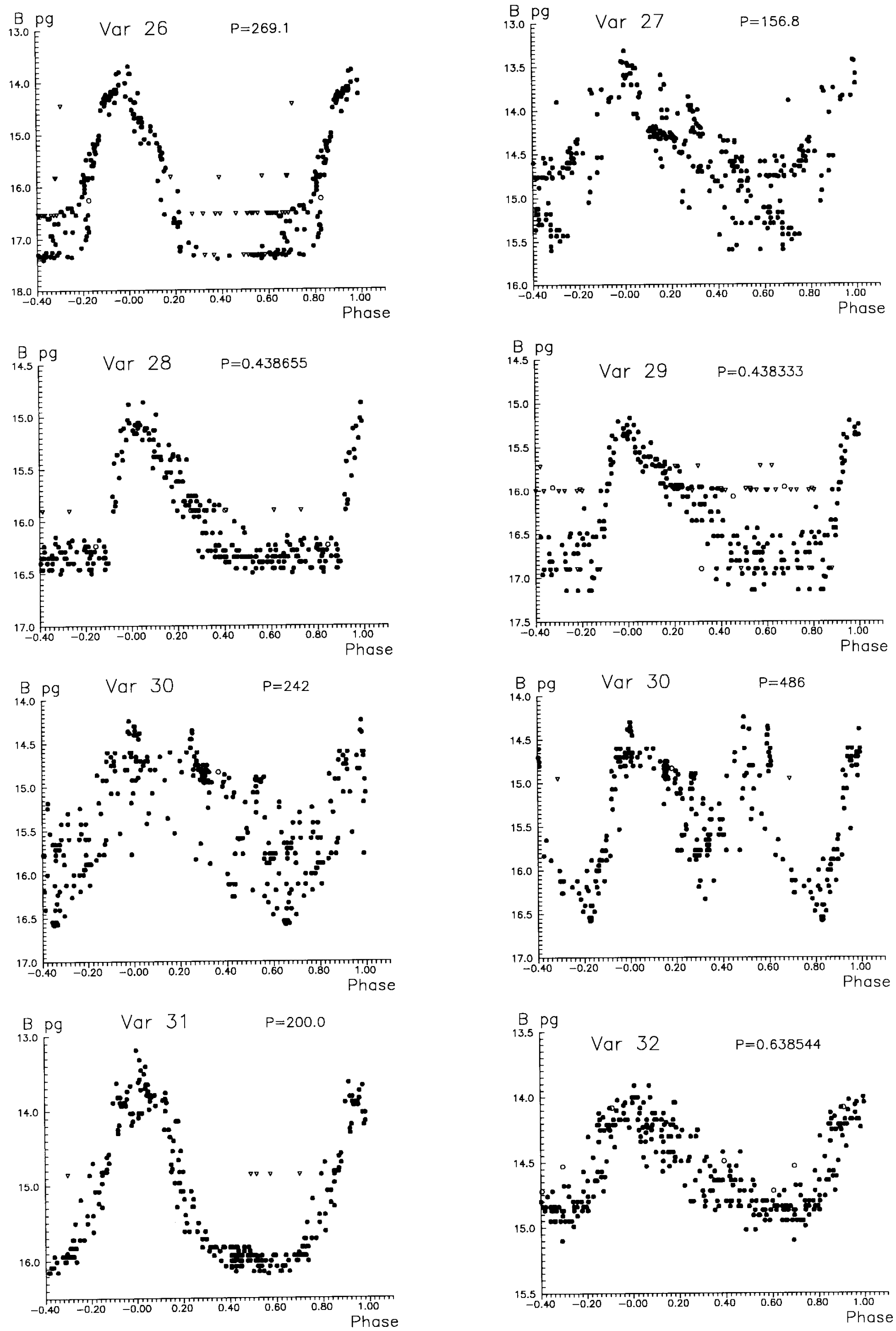

Figure 2. Light curves

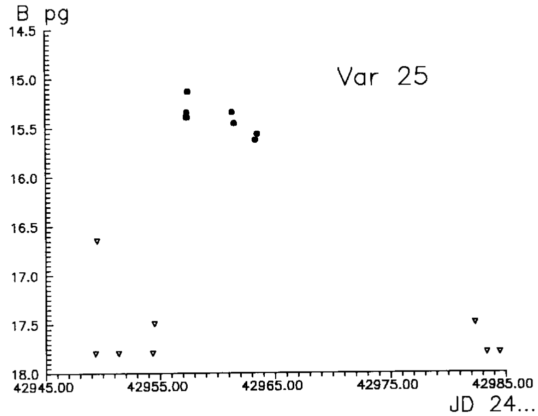

Figure 3. Light curve of Var. No. 25

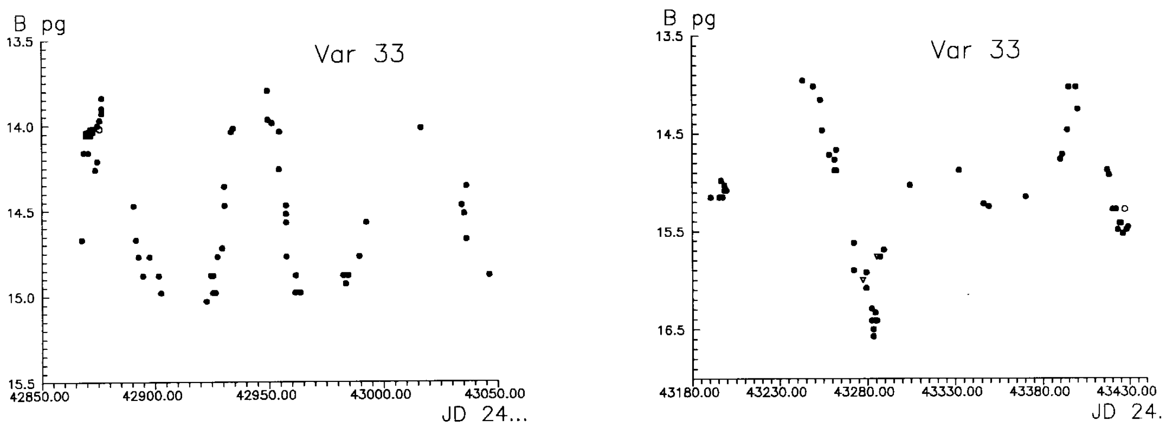

Figure 4. Light curve of Var. No. 33

Table 3. Comparison Stars

Var	a	b	c	d	e	f	g
Var 25	14.82	15.18	15.74	16.65	17.50	17.82	
Var 26	13.71	13.84	14.45	15.26	15.83	16.54	17.33
Var 27	12.82	13.38	13.66	14.14	14.38	14.93	15.55
Var 28	14.88	14.98	15.16	15.44	15.90	16.46	
Var 29	15.05	15.45	15.72	15.98	16.90	17.50	
Var 30	13.80	14.43	14.85	14.94	16.12	16.82	
Var 31	12.80	13.46	13.93	14.46	14.86	15.94	16.16
Var 32	13.91	14.34	15.10				
Var 33	13.84	14.06	15.08	15.76	16.57		

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NINE NEW VARIABLES IN THE 66 OPHIUCHI FIELD

This paper continues the study begun in my previous publication (Antipin, 1996). Nine more new variables were discovered in the field $10^\circ \times 10^\circ$ centered on 66 Oph (Var 34–42). This study is based on Moscow collection plates taken with the 40 cm astrograph in Crimea.

The data in Tables 1–4 contain information on the new variables. Figures 1, 2 and the photometric standard are as in the previous paper.

This series of four studies was supported in part by the Russian Foundation for Basic Research through grant No. 95-02-05189. Thanks are due to Dr. N.N. Samus for his attention to this investigation, to N.A. Gorynya and M.I. Antipina for their assistance during the preparation of the figures, and to S.Yu. Shugarov for permission to use his unpublished standard sequences.

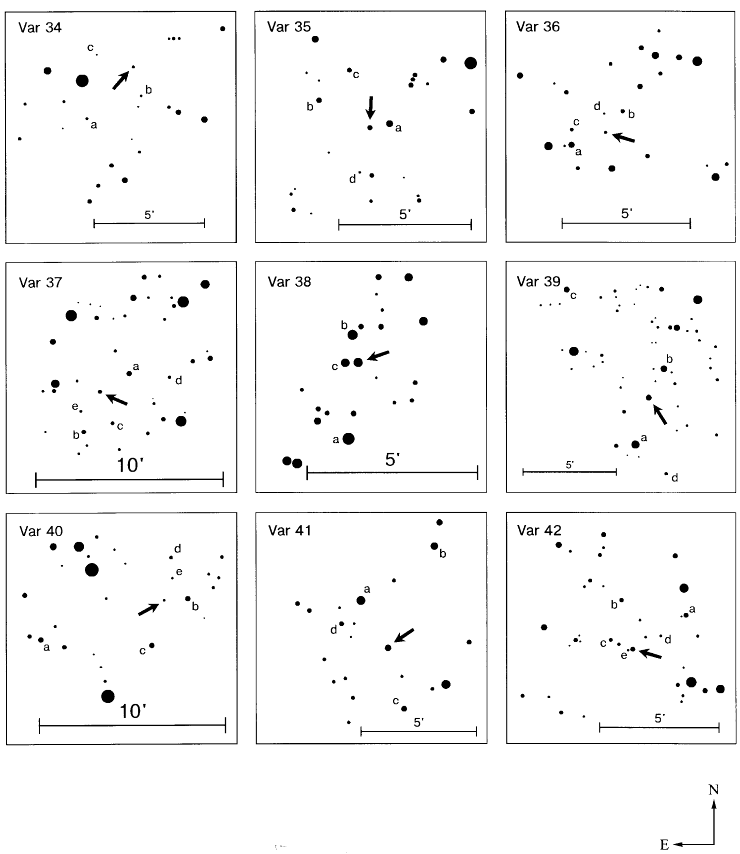

Figure 1. Finding charts

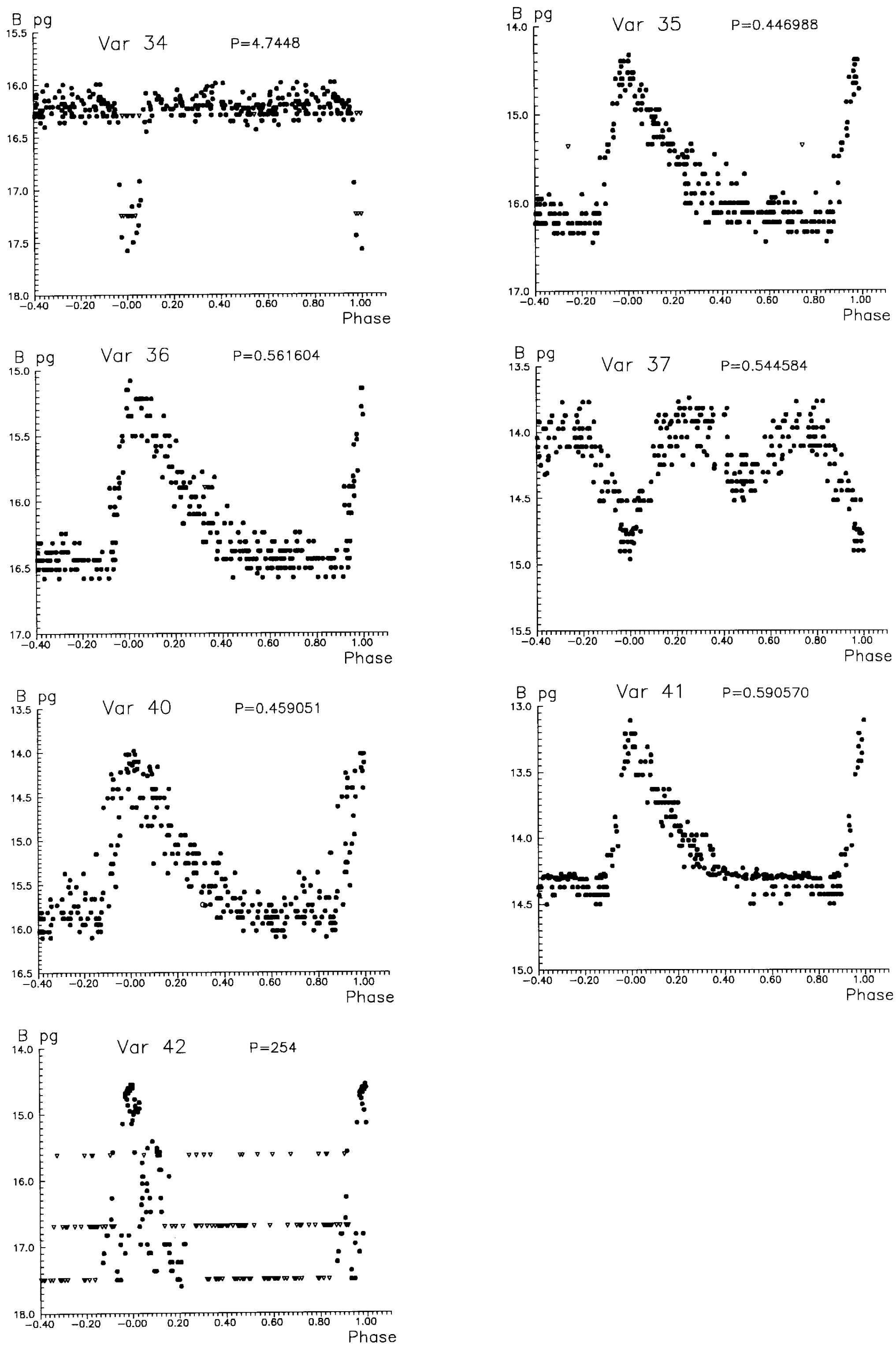

Figure 2. Light curves

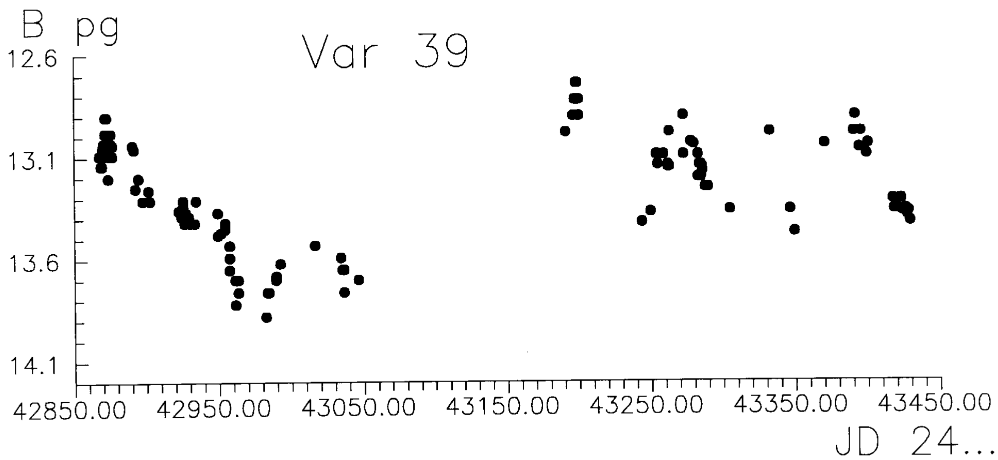

Figure 3. Light curve of Var. No. 39

Remarks on individual stars

Var 37. *Min II* 14.50.

Var 38. Red, fast enough, irregular variable.

Var 39. Red on Palomar prints. The fragment of the light curve is given in Figure 3.

Var 42. Very unstable light curve. Maximum brightness varies. The identification with IRAS catalog is uncertain. The difference between coordinates from IRAS and those based on GSC stars is about 16″.

Table 1. Coordinates and Identifications of Variable Stars

Var	α(2000.0)	δ(2000.0)	GSC	IRAS
Var 34	$17^h52^m19^s.5$	3°37′49″		
Var 35	17 59 44.7	8 31 50		
Var 36	18 01 02.5	8 43 36		
Var 37	18 01 48.9	8 35 45	1008.1752	
Var 38	18 05 48.5	7 27 40	442.0118	18033+0727
Var 39	18 07 09.4	7 20 10	442.0113	18047+0719
Var 40	18 13 52.5	9 04 40		
Var 41	18 18 34.6	8 05 41	1010.2541	
Var 42	18 12 48.3	7 52 31		18103+0751 ?

Table 2. Data on New Variable Stars

Var	N	JD24...	Type	Max	Min	$M-m$ or D
Var 34	217	42867–48091	EA	16.10	17.50	0.12
Var 35	228	42812–48092	RRab	14.40	16.30	0.15
Var 36	222	42867–48092	RRab	15.10	16.50	0.09
Var 37	232	42812–48092	EB	13.80	14.90	
Var 38	231	42812–48092	Isb	13.50	14.30	
Var 39	235	42812–48092	Lb	12.80	13.80	
Var 40	226	42812–48092	RRab	14.00	16.00	0.15
Var 41	230	42812–48092	RRab	13.20	14.50	0.12
Var 42	233	42812–48092	M:	14.60	<17.5	

Table 3. Light Elements

Var	Max (Min), JD	Period
Var 34	2443272.38	$4\overset{d}{.}7448$
Var 35	2443197.62	0.446988
Var 36	2444102.27	0.561604
Var 37	2443729.30	0.544584
Var 40	2442869.52	0.459051
Var 41	2443696.32	0.590570
Var 42	2446979	254:

Table 4. Comparison Stars

Var	a	b	c	d	e
Var 34	16.00	16.30	17.25		
Var 35	14.13	14.80	15.36	16.45	
Var 36	14.16	15.50	15.90	16.58	
Var 37	13.72	13.97	14.66	14.77	15.40
Var 38	13.38	13.49	14.34		
Var 39	12.18	12.98	13.53	14.11	
Var 40	13.32	14.11	14.30	15.37	16.10
Var 41	12.80	13.84	14.20	14.31	
Var 42	14.64	15.09	15.62	16.70	17.50

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Reference:
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THE SPECTRUM OF FG SAGITTAE IN 1995

The temporal behaviour of the remarkable variable star FG Sge has received much attention in the recent years due to its unusual activity after its sudden fading in 1992 (Papoušek, 1992). We have routinely obtained some spectra of FG Sge every year, trying to detect possible changes in its spectrum. All our spectra from 1992 and onwards were obtained with the echelle spectrograph "Lynx" of the 6 m telescope of the Special Astrophysical Observatory (Panchuk et al., 1993). These spectra cover the spectral region $\lambda\lambda 5000 \div 7200$.

In the spectra obtained in 1992 just few weeks before the dimming started, we identified C_2 Swan bands clearly indicating that FG Sge has become a carbon star (Kipper & Kipper, 1993). Iijima & Strafella (1993) have found C_2 bands in low resolution spectra taken much earlier, in 1981. In our spectra obtained in 1994 the C_2 bands were still present and in NaI D doublet a P Cygni–type emission has appeared. This allowed us to estimate some parameters of the expanding shell around FG Sge (Kipper et al., 1995). The intensities of emission components of the doublet changed in 1994 on the time scale of weeks. There were no low–excitation heavy–element lines in emission, which, however, were visible in the spectra obtained near the deep minimum in 1992 by Smith et al. (1995).

In 1995 FG Sge changed in brightness in a quite sporadic manner from $V \sim 10.5$ to $V \sim 13.0$ according to the data by Hungarian Astronomical Association–Variable Star Section. During the spectral observations on 9/10 and 10/11 August FG Sge was very faint (HAA-VSS data: $V \approx 12.5 \div 13.0$, according to Variable Stars Observers' League of Japan: $V \approx 13.3$) and therefore erroneously the visual companion $8''$ apart from FG Sge was actually observed. This is probably the first high resolution spectrum of the companion ever obtained. The spectrum turned out to correspond to a quite normal giant with the spectral type around K0. For more detailed classification some blue classification spectra should be obtained. Adopting CI= +1.50 (Herbig & Boyarchuk, 1968) one could estimate with this spectral type (K0III) the distance of the companion (3.3 kpc) close or larger to that of FG Sge. The radial velocity of the companion is -34 km s^{-1} (that of FG Sge itself is 38 km s^{-1}). The emission lines of [OI], [NII], and H_α originated in the planetary nebula He 1–5, surrounding FG Sge, are clearly visible in the spectrum of the companion.

The spectrum of FG Sge itself was obtained on 12/13 December when the star was relatively bright ($V \approx 10.5$). From February 1996 a new very steep fading of FG Sge started again (Mattei, 1996). There are no drastic changes in the absorption spectrum compared with the spectra obtained in 1992 and 1994. The C_2 Swan bands are still present and the C/O abundance ratio is around 3.2. This value corresponds to the case when the solar O abundance and the effective temperature of 5500 K are assumed for modelling and spectrum synthesis. Like a year before the only emission lines are the P Cygni–type emission components of NaI D lines.

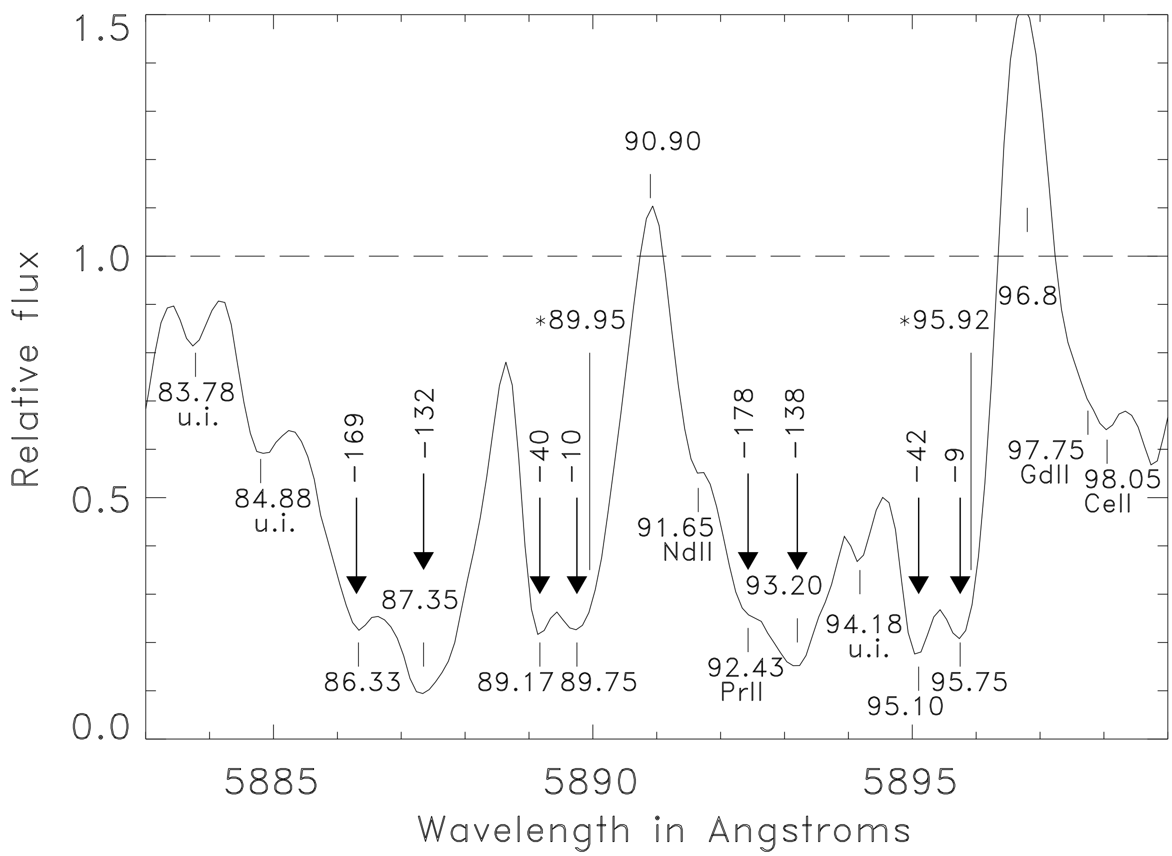

Figure 1. The NaI D lines in the spectrum of FG Sge obtained on 12/13 Dec. 1995. The positions of zero-velocity photospheric lines are indicated by asterisks. Some of the lines from the earlier line–lists (Kipper & Kipper, 1993; Wallerstein, 1990) are indicated with their identifications or noted as unidentified (u.i.). The relative radial velocities of components are indicated with arrows

As in 1994 the most drastic changes appeared in the profiles of NaI D doublet shown in Figure 1. The wavelength scale in this Figure takes into account the mean radial velocity $V_{\rm rad} = 38$ km s^{-1} found for the spectral region $\lambda\lambda 5800 \div 5920$. The continuum level was estimated for the same region. We expect the error in $V_{\rm rad}$ to be less than 3 km s^{-1}. The sharp components at nearly -41 km s^{-1} were also observed in 1981, 1992, and 1994 and correspond most probably to the interstellar gas. In the spectrum of the companion these lines are not fully resolved, causing only some extra absorption in the red wings of the doublet. These components have the $V_{\rm rad}$ relative to the Sun about -3 km s^{-1}. According to Langer et al. (1974) there is an interstellar cloud in the line of sight with $V_{\rm rad} = -6$ km s^{-1}. Taking into account the possible errors in radial velocities it is obvious that the IS lines correspond to that cloud.

The absorption components at -10 km s^{-1} could correspond to expanding higher levels of the photosphere, but the apparent blueward shift could well be the result of the blending with the emission part of the profile.

The circumstellar absorption components at –135 and –173 km s^{-1} correspond to the shells ejected at different times. The complicated structure of the doublet does not allow the quantitative analysis we performed for 1994 spectrum.

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IMPROVED POSITIONS OF VARIABLE STARS IN ARA, I

As a part of a program conducted to revise and improve the coordinates of southern variable and suspected variable stars, accurate positions of confirmed variables in Ara are herein presented.

The methods, general description as well as goals of this project can be found in López and Girard (1990). For some of the stars (variables and suspected variables) so far reported, including the ones in this note, we have improved their positions by measuring the first epoch plates of the Yale – San Juan astrometric survey of the southern hemisphere (see López and Girard 1990 López 1991; López and Mira 1994). In some other cases, the program stars have been identified in the Hubble Space Telescope Guide Star Catalogue (GSC)(López 1993; López and Lépez 1993).

Table 1 contains the newly determined positions. For each star we have listed the name of the variable, the new RA and Dec (equinox B1950.0) – epoch between 1966.54 and 1970.59 – and average standard error of $0\farcs7$ for both coordinates), and the differences between our new positions and those quoted in the GCVS IV (in the sense new positions *minus* GCVS IV coordinates).

Considering the 91 stars in Table 1 plus the 1126 already published in different notes of this program, the total number of variable stars for which we have been able to improve their coordinates is now 1217.

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López, C.E., and Mira, H., 1994, *Inf. Bull. Var. Stars*, No. 4006

Table 1. Improved Positions of Variable Stars in Ara

Star	RA (1950.0) DEC						Δ RA	Δ DEC
	h	m	s	°	′	″	m	′
T	16	58	26.98	−54	59	58.6	0.000	+0.023
U	17	49	39.35	−51	40	37.3	+0.006	−0.022
W	17	53	07.90	−49	47	43.3	−0.002	−0.122
X	16	32	20.90	−55	18	47.9	−0.002	−0.798
Y	16	34	44.59	−59	42	27.6	−0.007	−0.159
RU	17	24	33.62	−60	51	30.7	−0.006	−0.011
RW	17	30	32.74	−57	06	51.8	−0.004	+0.036
RX	16	48	03.35	−60	59	43.1	−0.011	+0.182
RY	17	17	09.17	−51	04	16.6	−0.014	−0.077
SW	17	15	35.10	−58	20	16.0	+0.085	−0.066
SX	18	06	00.87	−54	23	24.0	+0.048	+0.601
SY	16	31	19.57	−54	39	09.6	−0.007	−0.159
SZ	17	06	31.40	−61	53	33.7	−0.010	+0.039
UW	17	43	44.72	−48	43	48.0	−0.005	+0.000
UX	16	51	27.17	−51	51	29.5	−0.014	−0.092
UY	17	25	01.11	−59	51	40.6	+0.018	+0.023
UZ	16	32	46.15	−56	12	19.9	−0.014	−0.133
VV	16	33	19.23	−53	04	49.7	−0.013	+0.071
VW	16	31	51.44	−56	31	03.1	+0.007	−0.251
VZ	16	33	14.91	−58	17	48.2	−0.001	−0.104
WW	16	33	41.86	−58	05	33.9	+0.048	−0.165
WY	16	34	37.68	−59	30	24.5	+0.011	+0.091
WZ	16	35	00.37	−57	46	48.3	+0.106	+0.794
XX	16	35	06.80	−59	25	54.3	+0.013	−0.005
XY	16	35	11.69	−57	48	25.5	+0.162	+1.774
YY	16	36	58.84	−59	46	45.5	−0.003	+0.241
YZ	16	38	21.56	−60	01	15.9	−0.007	+0.035
AA	16	36	20.18	−56	26	34.3	+0.036	−0.072
AB	16	37	57.62	−57	13	01.4	+0.210	+0.977

Table 1 (cont.)

Star	RA (1950.0) DEC						Δ RA	Δ DEC
	h	m	s	°	′	″	m	′
AC	16	39	12.97	−56	21	40.0	−0.001	+0.233
AD	16	41	44.46	−55	42	16.7	−0.126	−0.778
AF	16	33	11.78	−55	37	54.9	−0.037	+0.185
AH	16	37	58.26	−53	47	55.9	−0.062	+1.731
AT	17	26	51.28	−46	03	42.1	+0.005	−0.102
AX	17	29	12.78	−46	11	37.8	−0.054	+0.670
BF	17	34	35.82	−47	08	59.0	+0.180	+0.017
BW	16	44	45.18	−59	06	35.2	+0.036	+0.413
BY	16	45	37.48	−58	48	03.4	+0.041	+0.044
BZ	16	45	56.35	−58	40	00.7	−0.044	+0.089
CC	16	46	04.00	−58	41	50.8	−0.033	−0.046
CF	16	49	32.85	−59	04	51.6	+0.014	−0.060
CH	17	02	26.23	−58	59	21.8	+0.004	+0.037
CL	17	05	41.09	−58	06	25.6	+0.018	−0.026
CM	17	06	58.90	−62	47	44.6	−0.052	−0.244
CN	17	06	48.24	−60	17	02.7	−0.096	+0.654
CO	17	06	47.84	−58	19	07.1	−0.003	−0.018
CP	17	07	57.38	−62	47	38.4	+0.023	−0.340
CQ	17	07	47.85	−58	30	45.4	−0.003	+0.043
CS	17	08	06.34	−60	25	31.6	−0.111	+0.673
CT	17	08	18.81	−57	20	38.0	−0.003	+0.166
CU	17	08	30.86	−60	16	30.6	−0.019	−0.310
CV	17	08	44.44	−61	08	56.1	+0.057	−0.534
CX	17	10	04.42	−60	20	49.6	+0.007	−0.527
CY	17	10	37.74	−55	41	53.2	−0.004	+0.114
DE	17	11	17.80	−57	01	41.1	−0.020	+0.315
DF	17	11	38.35	−56	58	03.6	−0.011	−0.060
DG	17	11	51.56	−59	52	08.6	−0.007	−0.244
DI	17	13	13.82	−60	57	38.6	−0.003	+0.056
DK	17	13	35.25	−55	55	25.4	+0.004	−0.023
DL	17	14	54.40	−59	10	24.2	−0.027	−0.103

Table 1 (cont.)

Star	RA (1950.0) DEC						Δ RA	Δ DEC
	h	m	s	°	′	″	m	′
DM	17	15	01.16	−57	18	25.8	+0.003	−0.029
DO	17	15	41.93	−58	41	54.2	+0.015	−0.003
DP	17	16	57.08	−58	47	53.2	−0.015	−0.086
DS	17	17	31.29	−56	50	14.8	+0.005	+0.054
DT	17	17	36.25	−57	17	12.1	−0.013	−0.402
DW	17	18	00.55	−57	15	10.8	+0.009	+0.220
DX	17	18	23.17	−58	01	23.1	−0.030	+0.215
DZ	17	18	48.51	−58	49	25.9	+0.008	−0.131
EE	17	19	07.78	−56	19	30.8	−0.020	−0.014
EF	17	19	32.38	−57	46	29.4	+0.006	+0.011
EG	17	19	58.96	−61	41	19.2	+0.016	+0.180
EI	17	20	02.26	−59	41	19.3	−0.062	+0.379
EK	17	20	23.49	−59	38	37.5	+0.008	−0.024
EL	17	20	51.91	−59	41	10.3	+0.132	+0.528
EM	17	20	41.69	−56	57	49.8	−0.005	−0.029
EN	17	20	55.94	−55	03	30.6	−0.018	+0.090
EO	17	21	34.34	−60	12	15.8	−0.011	+0.136
EQ	17	22	23.54	−55	14	45.9	−0.008	−0.065
ES	17	23	16.07	−55	56	33.1	+0.001	+0.048
ET	17	24	01.70	−57	35	21.5	−0.005	+0.242
EU	17	24	21.84	−54	01	22.0	−0.003	−0.067
EW	17	24	55.37	−54	06	42.7	+0.006	−0.012
EX	17	25	19.33	−57	02	39.0	−0.011	+0.049
EY	17	25	16.83	−56	17	58.1	−0.019	+0.031
FF	17	25	33.81	−59	26	58.1	−0.070	+0.132
FI	17	27	10.56	−60	57	39.6	+0.009	+0.041
FL	17	27	15.26	−59	25	26.6	+0.004	+0.256
FM	17	27	11.57	−58	35	08.0	−0.024	+0.066
FN	17	27	06.52	−56	11	03.3	−0.008	+0.244
FO	17	27	03.84	−55	02	52.0	−0.003	+0.133
FP	17	27	17.61	−57	22	21.6	+0.010	+0.040

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DISCOVERY OF 30-MIN OSCILLATIONS IN THE Ap Sr(EuCr) STAR HD 75425

Using the Strömgren photometry of Martinez (1993) as a guide, we have been searching for rapidly oscillating Ap (roAp) stars in the southern hemisphere. The roAp stars are cool, magnetic, chemically peculiar A-type stars (typically classified as Ap SrCrEu) that pulsate with periods in the range 6–16 minutes and Johnson B semi-amplitudes ≤ 0.008 mag. There are currently 28 accepted members in the class (Martinez 1993). This Bulletin announces the discovery of 30-minute oscillations in the candidate roAp star HD 75425. Although this star is indisputably variable, it is not clear that it is a roAp star, as we discuss below.

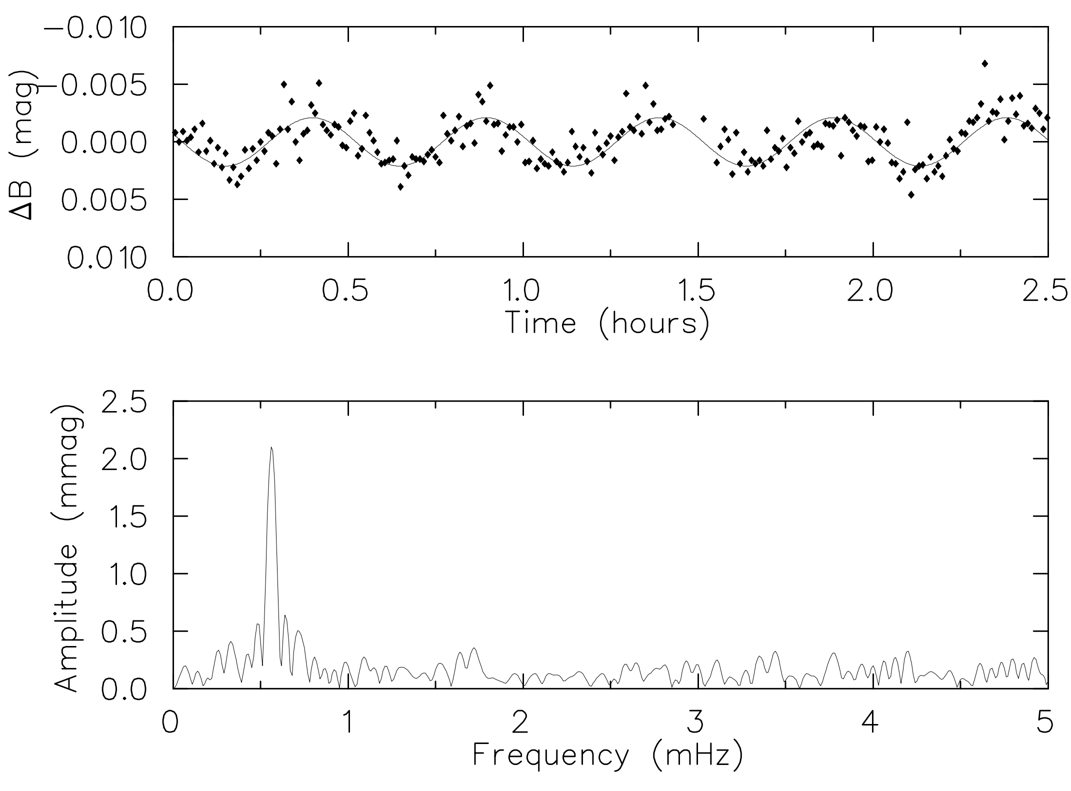

Figure 1

HD 75425 is classified as Ap Sr(EuCr) by Houk (1978), who remarks "weak case; undetected visual double, P=288°, D=0.″4, mags 9.9, 10.0." Martinez (1993) measured the Strömgren indices to be V=9.584, $b - y = 0.112$, $m_1 = 0.247$, $c_1 = 0.805$ and $\beta = 2.864$. The calculated dereddened metallicity and luminosity indices are $[\delta m_1] = -0.064$ and $[\delta c_1] = -0.116$, which indicate strong metallicity and heavy line blocking in the Strömgren v band, characteristics which we associate with roAp stars.

On the night of 18/19 March 1996 (JD 2450161) we observed HD 75425 for 4.92 hr using the Radcliffe People's Photometer attached to the 1.0-m telescope of the South African Astronomical Observatory in Sutherland. The data were acquired as continuous 10-s integrations in Johnson B light. A half-hour oscillation was evident at the telescope, as confirmed by subsequent analysis of the light curve. The data were corrected for coincidence counting losses, sky background and extinction. Some low-frequency ($\nu \leq$ 347 μHz) sky transparency variations were then removed and the data were binned to 40-s integrations. Figure 1 shows a $2\frac{1}{2}$-hour portion of this light curve and the discrete Fourier transform of the full light curve. The tallest peak in the Fourier transform is at 560 μHz (P = 29.8 min) and has an amplitude of 2.10 mmag. These oscillations have been confirmed by subsequent observations acquired using the Modular Photometer attached to the SAAO's 0.5-m telescope. Comparison of the available light curves for this star indicates that the amplitude is modulated. This may be caused by rotation and/or by beating of two or more independent pulsation frequencies.

The interpretation of the oscillations in HD 75425 is not straightforward. A period of 30 min is rather long for a roAp star, but also rather short for a δ Sct star. It would be interesting to demonstrate the existence of δ Sct-type oscillations in an Ap star, but it is not clear that Houk's Ap Sr(EuCr) classification is correct. The m_1 index suggests a high metallicity indicative of Ap stars. Given the 0.″4 separation and the apparent brightness of this double the possibility that this system comprises a chemically normal star and a magnetic, chemically peculiar star cannot be excluded. Since the stars comprising this double have such a small magnitude difference, both stars are probably inside the instability strip, making it difficult to establish which is the variable.

I acknowledge a fruitful discussion with Don Kurtz and thank him for his helpful comments.

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COMMISSIONS 27 AND 42 OF THE IAU
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PHOTOMETRIC VARIABILITY OF THE λ BOOTIS STAR HD 30422

HD 30422 was classified by Gray & Corbally (1993) as a λ Bootis star with peculiar hydrogen line profiles. With an age of $3.8 \times 10^8 yr$ (Iliev & Barzova, 1995) it is one of the youngest λ Bootis stars. The peculiar nature of this group leads to a severe uncertainty to establish their location in the Hertzsprung–Russell diagram. The importance of discovering pulsation among λ Bootis stars was discussed by Weiss et al. (1994). As part of our global survey for pulsating λ Bootis stars, we observed HD 30422 for two nights in January 1994 with the Lowell 0.6m telescope at CTIO (observer: M. Gelbmann). Table 1 lists the observing log. The light curves of the first night are plotted in Figure 1. The variation of HD 30422 compared to the measurements of the comparison star is clearly visible. The amplitude spectrum of the differential data in Strömgren b and the spectral window derived by a standard Fourier technique is shown in Figure 2. The highest peak appears at 47 c/d, which corresponds to a period of 30 minutes, and with an amplitude of about 10 mmag. This is the second star we found to be variable with such a high frequency (Kuschnig et al., 1994).

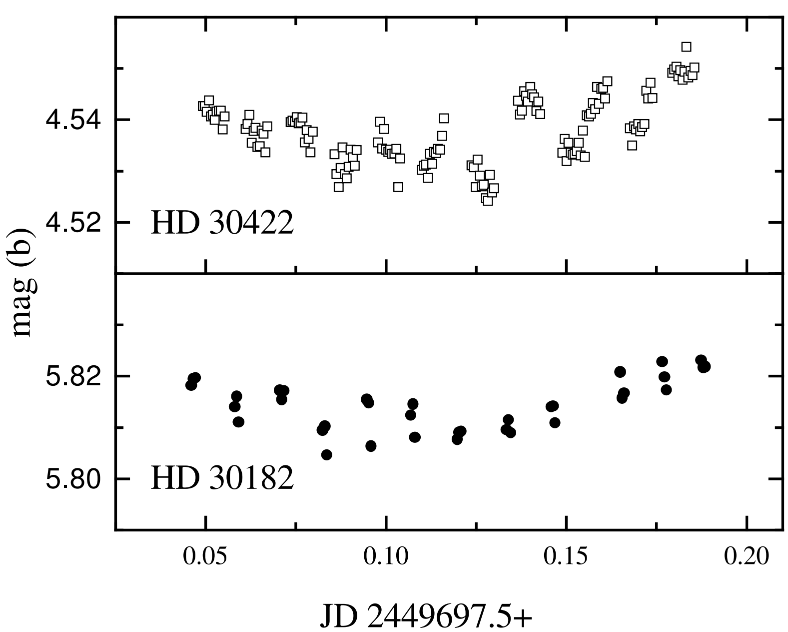

Figure 1. Light curve for HD 30422 and the comparison star HD 30182 in Strömgren b for the second night

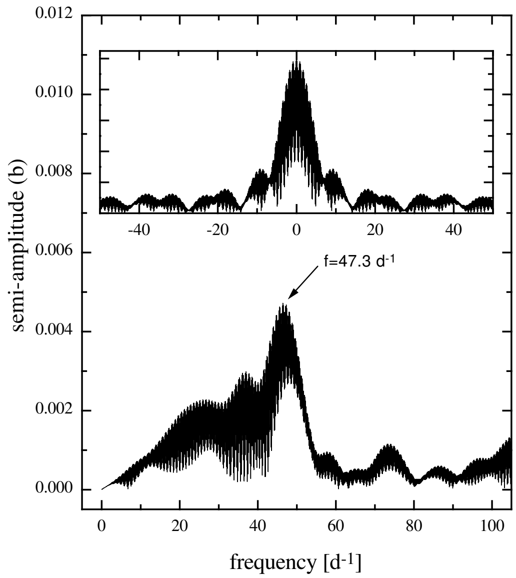

Figure 2. Amplitude spectrum and spectral window for the differential data of HD 30422 and HD 30182 in Strömgren b for both nights

Table 1. Observing log for the program and comparison star

Star	Durchm.	JD	hours	m_V	Spec.
HD 30422	CD $-28°$ 1735	2449690	2	6.2	λ Boo
		2449697	3.5		
HD 30182	CD $-27°$ 629			6.8	K4III

Acknowledgement: 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 *S 8303-AST*) and the Hochschuljubiläumsstiftung der Stadt Wien (λ Bootis Sterne). This research has made use of the Simbad database, operated at CDS, Strasbourg, France.

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ERRATUM

In Table 1 of the IBVS No. 4302 several cross-identifications have been erroneously given. The correct version of the Table is given below.

Table 1. Program and comparison stars, ⋆ this comparison star is used for the figure

Star	Durchm.	JD	hours	m_V	Spec.		Upper level [b]
HD 319	CD −23° 13	2449166	2	5.93	λ Boo		0.004
HD 203	CD −23° 4			6.18	F2IV	⋆	
HD 141851	BD −02° 4058	2449168	4	5.10	λ Boo		0.004
		2449175	5				
HD 141378	BD −03° 3829			5.52	A5IV	⋆	
HD 140873	BD −01° 3092			5.39	B8III		
HD 143148	CD −31° 12442	2449560	4	7.39	λ Boo(?)		0.004
HD 142542	CD −31° 12407			6.29	F5V	⋆	
HD 142851	CD −31° 12426			7.13	A0V		
HD 145782	CP −57° 7716	2449166	4	5.71	λ Boo(?)		0.006
HD 144480	CP −57° 7613			5.57	B9.5V	⋆	
HD 154153	CD −43° 11396	2449175	3	6.18	λ Boo(?)		0.004
HD 153234	CD −44° 11339			6.51	F3V		
HD 154025	CD −45° 11188			6.28	A2V	⋆	
HD 179791	BD +05° 4081	2449166	3	6.51	λ Boo(?)		0.006
HD 178596	BD +05° 4040			5.22	F0III	⋆	
HD 180482	BD +04° 4045			5.59	A3IV		
HD 188164	CP −69° 3073	2449173	3	6.35	λ Boo(?)		0.004
		2449174	6				
HD 188097	CP −69° 3072			5.75	Am	⋆	
HD 193256	CD −29° 16980	2449560	5	7.70	λ Boo		0.002
		2449563	3				
		2449564	5				
HD 193281	CD −29° 16981	2449563	3	6.61	λ Boo		0.004
		2449564	5				
HD 194170	CD −29° 17046			8.27	A4V	⋆	
HD 204041	BD −00° 4215	2449568	3	6.45	λ Boo		0.002
HD 203405	BD +00° 4714			6.78	F2		
HD 204121	BD +00° 4726			6.13	F5V	⋆	

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DISCOVERY OF THE NEW RR LYRAE STAR GSC 2576_466

During pointing tests of our telescope it was noticed that the star GSC 2576_466, at a position of $RA_{J2000}=16^h00^m04^s$, $Dec_{J2000}=34°58'21''$, V=14.5 (Jenkner et al. 1990) had changed in brightness.

The automated 0.5-m. telescope, Cousins R filter and CCD camera of the Climenhaga Observatory of the University of Victoria (Robb and Honkanen, 1992) were used to make photometric observations of this star. 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 6 arc second aperture on each star for each frame.

From the Hubble Space Telescope Guide Star Catalog (Jenkner et al., 1990) the coordinates (J2000) and magnitudes of the stars observed are given Table 1. GSC 2576_186 was chosen as the comparison star and all differential magnitudes are given in the sense other star minus comparison star. The standard deviation of the difference between the brightest check star and the comparison star during a night ranged from $0\overset{m}{.}006$ to $0\overset{m}{.}017$. For each check star the mean and standard deviation of the seven nightly mean differential R magnitudes are given in Table 1. The standard deviations give us estimate of the precision of the differential variable star minus comparison star measurements. 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 R magnitude to a standard system.

Photometric observations were made 25 March 1996 to 29 May 1996 UT. Brightness variations were evident both during a night and from night to night. On the longest night the whole ascending branch was observed and when combined with the slope of the descending branch we find that the period must be longer than $0\overset{d}{.}42$. Two times of maximum light were found by the method of Kwee and van Woerden (1956) to be 2450172.9838 and 2450212.9543. This method is not appropriate for asymmetrical extrema unless the range of data searched is the same for all nights. In this case the range was 0.019 days. The uncertainty in the times of maximum is estimated to be ±0.0014 days. The times of maximum light place strong limits on what the period could be since an integer number of cycles must occur in the interval. Plots of the light curve at all allowed periods from $0\overset{d}{.}4$ to $0\overset{d}{.}6$ days were inspected. The only plot to give a reasonable light curve was the one with the ephemeris:

$$\begin{array}{rl}\text{HJD of Maxima} = & 2450168.8310 + 0.519097 \times E \\ & \pm.0018 \pm 0.000024\end{array}$$

[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

Table 1. Stars Observed

GSC Number	Right Ascension J2000	Declination J2000	GSC Mag.	Differential R Magnitude
2576_466	$16^h00^m04^s$	$34°58'21''$	14.5	-
2576_186	$16^h00^m13^s$	$34°56'11''$	11.5	-
2579_1696	$16^h00^m07^s$	$35°00'18''$	13.1	$1.785 \pm .006$
2579_1928	$16^h00^m13^s$	$35°00'54''$	13.6	$2.312 \pm .016$
2576_368	$16^h00^m29^s$	$34°58'33''$	13.6	$2.259 \pm .007$
2576_369	$16^h00^m25^s$	$34°56'15''$	14.1	$2.869 \pm .004$

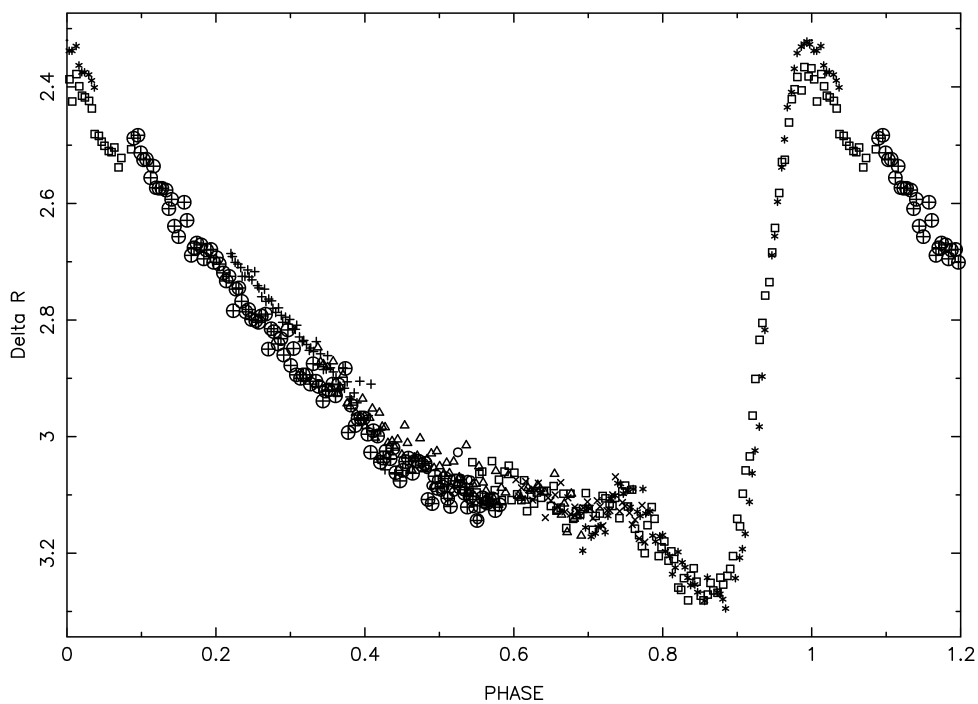

Figure 1. Differential R data light curve of GSC 2576_466

A plot of the 511 differential R magnitudes phased at this period is shown in Figure 1 with different symbols for each of the different nights. Despite some nights of poor quality, the standard deviations in Table 1 show that the expected errors from night to night are far smaller than the differences seen in the light curve. Note that the height of the maximum is not the same, while the minima are the same brightness.

A spectrum of GSC 2576_466 was obtained using the Dominion Astrophysical Observatory 1.8-m. telescope and 21(3/2)1 spectrograph on 28 March 1996 UT with a dispersion of approximately 120 Angstroms per mm. In Figure 2 this spectrum is shown below a spectrum of RR Lyrae taken with the same instrument configuration. The similarity is obvious. From the spectrum and the shape of the light curve we conclude that this star is an RR Lyrae of sub-type ab.

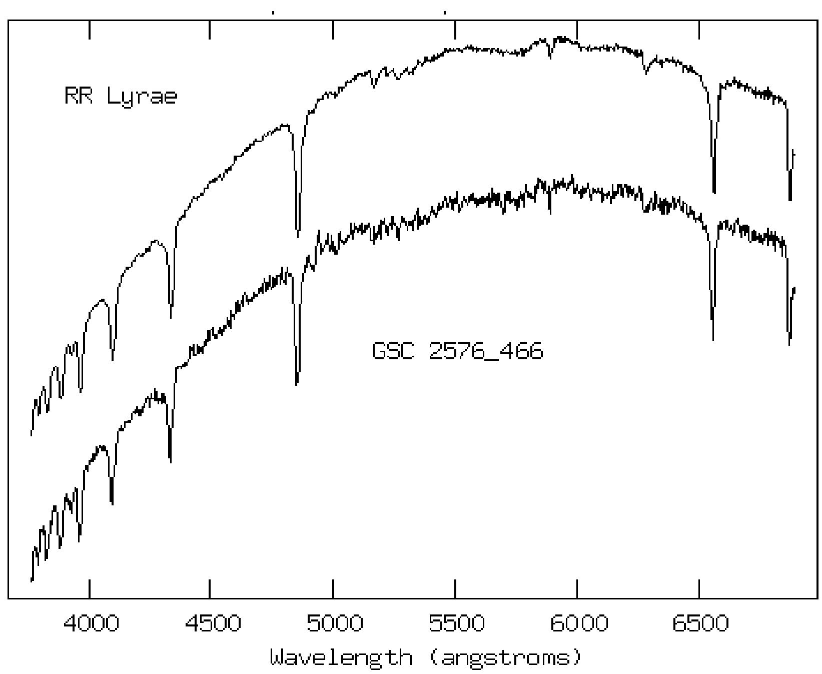

Figure 2. Spectrum of GSC 2576_466 below and RR Lyrae above

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NONVARIABILITY AMONG λ BOOTIS STARS III.: CTIO (1995) AND McDONALD (1995) DATA

This is the third and last paper on constant λ Bootis stars from our survey (Paunzen et al. 1996 and Kuschnig et al. 1996). Up to now we have presented 18 λ Bootis stars with an upper limit for nonvariability. In this paper we add 6 new λ Bootis stars.

The observations were performed at CTIO in April 1995 (observer: E. Paunzen) with the 0.6m Lowell telescope and at McDonald Observatory in August 1995 (observer: G. Handler) with the 0.9m telescope. The data were corrected for the sky background, deadtime and extinction. The upper limit for nonvariability was derived by a standard Fourier technique using the differential data of the program and one comparison star (the latter marked with an asterisk in Table 1). Table 1 lists the results for both observing runs.

Table 1. Program and comparison stars

Star	Site/Observer	JD	hours	m_V	Spec.		Upper limit [b]
HD 81290	CTIO/EP	2449842	4	8.9	λ Boo		0.002
HD 82517				7.7	A2V	*	
HD 125162	McD/GH	2449936	3	4.2	λ Boo		0.008
		2449940	2				
HD 124675				4.5	A8IV	*	
HD 149303	McD/GH	2449939	3	5.6	λ Boo		0.003
HD 149081				6.5	A1V	*	
HD 149630				4.2	B9V		
HD 156954	CTIO/EP	2449839	4	7.7	λ Boo		0.003
HD 156392				8.2	F2V	*	
HD 171948	McD/GH	2450008	4	6.7	λ Boo		0.003
HD 171569				7.1	A0	*	
HD 171739				7.6	A0		
HD 192424	McD/GH	2449939	4	7.1	λ Boo		0.004
HD 193668				7.0	B9	*	

We also present data on the prototype of this group, λ Bootis (HD 125162) itself. The upper level of nonvariability is quite high (8 mmag in Strömgren b) due to the rather poor quality of both nights. Recent spectroscopy indicates nonradial pulsation with a very low amplitude (Bohlender 1996).

From the results of all three papers we conclude a typically achieved limit for nonvariability in the relevant frequency range (0 to 150 c/d) of about 3 mmag in Strömgren b.

Our survey is still ongoing. Nevertheless we are preparing a detailed analysis on the pulsation behaviour of λ Bootis stars.

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HBV 479: A NEW VARIABLE STAR IN HERCULES

An emission-line star near the PN Hu 2-1 (PK 51+9.1) in Hercules, denoted as HBV 479, was found to be a long period variable (Mira Ceti type) during photographic observations of the "Stellar ring No. 373". The Schmidt camera (80/120, f=240 cm) of the Hamburg Observatory in Bergedorf was used. The position of HBV 479 is: $\alpha = 18^h50^m17^s.05$, $\delta = +20°50'39''.4(1950)$.

Altogether 14 direct Schmidt plates were taken in V (Kodak 103a-D +GG11) between May 1971 and June 1975. Seven comparison stars are shown together with the variable in Figure 1; their V-magnitudes (measured at least on 5 plates) are presented in Table 1; the accuracy of these magnitudes varies between ±0.04 mag and ±0.10 mag with the exception of the star No. 7. Individual measurements of HBV 479 are given in Table 2 with the accuracy of about ±0.05 mag. The plates were measured with the Haffner iris photometer (Haffner, 1953). The star varies between 12.1 and 16.6 mag. Assuming in the first approximation a sine-like light curve we have derived period of 277.5 days and an amplitude $\Delta V = 4.8$ mag (V between 11.8 and 16.6 mag).

The photoelectric sequence of Isserstedt and Schmidt-Kaler (1970) was exposed on the plates with nearly the same distance from the centre as in the case of the variable.

Table 1. Comparison stars

Comparison star	V [mag]	n
1	$11^m.92$	5
2	12.08	5
3	12.95	14
4	13.62	5
5	14.51	13
6	14.73	5
7	15.9	5

Table 2. Brightness of HBV 479

Plate No. (GS)	JD 2440000+	V [mag]
4759	1073.6	$14^m.33$
4782	1180.4	13.64
4816	1209.4	15.27
4846	1240.3	15.87
4997	1476.5	14.39
5019	1511.5	16.1 :
5091	1562.3	16.55
5133	1592.3	15.81
5321	1831.5	16.3 :
5357	1922.4	14.27
5541	2269.4	12.54
5723	2493.7	12.12
5752	2545.6	12.39
5764	2568.5	13.72

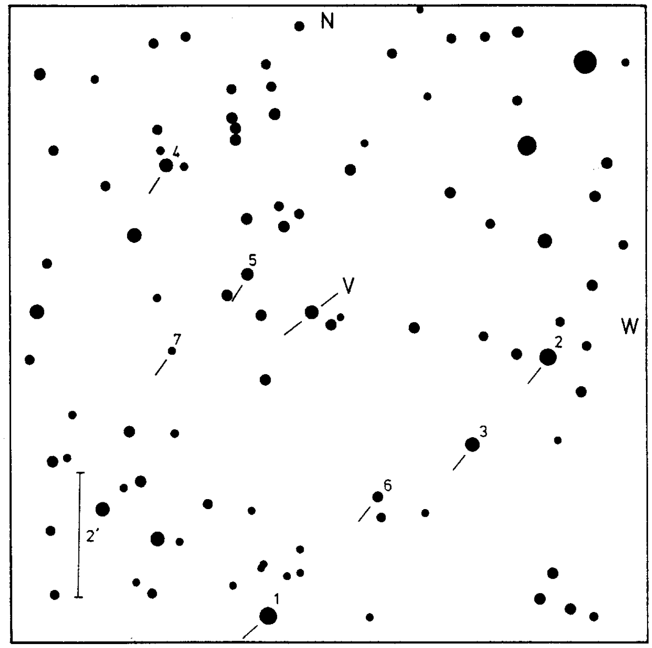

Figure 1. Identification chart of the variable and the comparison stars

The spectral characteristics of the variable star are typical for a long period variable of the spectral type Me: there are 6 Schmidt spectral plates in the region 3600 - 6400 Å which show a medium strong continuum and the emission lines Hδ, Hγ and probably Hβ, as well as TiO bands 4761, 4955, 5838 and 6148 Å.

Acknowledgements: I am grateful to *U. Haug* for his contribution to the discovery of the variable, especially for having taken some plates which belong to our observations concerning the stellar ring No. 373.

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CCD PHOTOMETRY OF CN Tau, V427 Lyr, V926 Cyg, AND GS Lyr

CCD observations of the variable stars CN Tau, V427 Lyr, V926 Cyg, and GS Lyr using the CCD/Transit Instrument (CTI) and Capilla Peak Observatory are reported. The CTI is a stationary, meridian pointing optical telescope that images a narrow strip of the sky at all right ascensions (McGraw et al. 1980, 1983, 1986, Wetterer 1995). The 1.8 meter, f/2.2 telescope is rigidly mounted to point at a single declination and relies on the Earth's rotation to bring different parts of the sky into view. The photometry of a selection of nonvariable stars distributed throughout the survey area and acquired during several nights throughout the year were used to calibrate the data from all nights of observations (Cawson et al. 1986, Wetterer 1995). All stars in the CTI survey are calibrated in this consistent instrumental magnitude system and so any variable star within the CTI survey will have many nearby calibrated comparison stars. To establish the conversion between instrumental and standard magnitudes, a number of stars within the CTI survey were also calibrated to the standard Johnson magnitude system (McGraw et al. 1989).

The photometric data for all stars within the survey area were analyzed to discover RR Lyrae variable stars (Wetterer et al. 1996). In this search, we excluded the portion of the CTI survey area near the Galactic plane due to the excessive and unknown reddening caused by dust in the Galactic disk. Three stars previously classified as RR Lyrae stars (CN Tau, V427 Lyr, and V926 Cyg) within the excluded region were observed by the CTI. We included these stars in subsequent CCD observations with Capilla Peak Observatory's 61-cm telescope (Laubscher et al. 1988). Despite being listed as a slow irregular type variable star, we also included GS Lyr in the observation program because, upon initial inspection, its light curve had RR Lyrae characteristics. Table 1 lists the name, right ascension and declination (epoch 1987.5), the number of CTI and the number of Capilla Peak (CAP) observations through the V filter for each star.

Table 2 summarizes the results. After the star's name, the next five columns list the maximum, minimum, and flux averaged standard V magnitudes; the amplitude of variation in V (ΔV), and; the B$-$V at minimum light. Wetterer et al. (1996) details the transformation from instrumental to standard magnitudes and how the flux averaged magnitude was calculated. The final four columns list the rise time in fraction of a period (m$-$M); the period in days (found using a standard period finding algorithm); the heliocentric Julian Date of maximum light (minus 2440000 days), and the type of variability for each star. Finder charts, light curves and photometry for these stars can be found in Wetterer (1995).

Table 1. Variable Stars

Star	α	δ	CTI	CAP
CN Tau	$05^h57^m22.1^s$	$28°02'31''.0$	50	32
GS Lyr	19 03 50.3	28 00 44.9	23	94
V427 Lyr	19 13 11.8	28 00 51.5	24	21
V926 Cyg	19 38 06.6	27 59 09.9	25	22

Table 2. Photometry results

Star	V_{Max}	V_{Min}	V_{Mean}	ΔV	B−V	m−M	Period	HJD	Type
CN Tau	12.56	12.92	12.755	0.35	0.89	0.25	1.79325	9366.384	Cδs
GS Lyr	12.57	13.51	13.076	0.96	1.70	-	-	-	L
V427 Lyr	15.90	17.44	16.694	1.54	0.69	0.20	0.424599	9540.933	RRab
V926 Cyg	15.03	15.63	15.258	0.60	0.69	0.45	0.306999	9554.837	RRc

Table 3. V observations of GS Lyr

HJD	V	HJD	V	HJD	V	HJD	V
7303.93896	12.528	9194.94816	13.018	9275.71731	12.880	9546.96366	13.130
7320.89075	12.651	9194.95419	13.019	9277.56787	12.847	9547.95647	13.197
7321.88855	12.646	9240.64127	12.674	9277.57821	12.881	9547.96141	13.203
7323.88245	12.713	9240.64459	12.689	9283.57228	12.855	9553.96097	13.363
7324.88000	12.744	9240.70824	12.689	9283.57512	12.835	9553.96652	13.359
7329.86572	12.822	9240.71076	12.690	9289.57200	12.871	9554.94510	13.383
7335.84888	12.897	9240.76854	12.689	9289.57500	12.866	9554.95063	13.369
7358.78589	12.749	9240.77112	12.686	9297.53984	12.835	9582.85203	13.315
7383.71802	12.793	9241.65927	12.694	9297.54227	12.819	9582.85844	13.313
7678.91113	12.904	9241.66198	12.698	9311.55296	12.777	9605.81082	13.363
7679.90930	12.895	9241.71331	12.689	9311.55541	12.780	9605.81365	13.327
7681.90247	12.886	9241.71667	12.684	9328.54604	12.791	9606.75402	13.315
7682.89990	12.957	9247.63738	12.763	9328.54909	12.807	9606.75642	13.334
7683.89697	12.963	9247.64028	12.758	9519.95773	12.909	9611.75561	13.361
7686.88916	12.960	9253.76846	12.848	9519.96034	12.932	9611.75803	13.366
7687.88599	12.939	9253.77245	12.840	9529.95193	13.040	9612.60463	13.409
7689.88123	13.011	9260.61109	12.972	9529.95450	13.013	9612.64065	13.372
8063.85669	13.003	9260.61510	12.961	9530.92060	13.023	9629.59566	13.348
8101.75195	12.472	9261.58742	12.981	9530.92308	13.014	9629.60124	13.345
8102.74902	12.511	9261.59162	12.980	9531.93816	13.041	9635.56156	13.385
8123.69263	12.956	9267.61190	13.001	9531.94073	13.037	9635.56748	13.400
8127.68188	12.993	9267.61491	12.984	9534.94858	13.041	9672.53446	13.232
8128.67920	12.976	9269.63775	12.965	9534.95112	13.044	9672.54005	13.221
9163.80752	12.800	9270.58464	12.939	9535.85637	13.112	9673.52934	13.246
9192.94201	13.018	9270.58787	12.944	9535.85890	13.044	9673.53528	13.205
9192.94794	13.001	9271.61973	12.914	9539.96199	13.064	9688.52802	12.829
9192.95542	13.011	9271.62303	12.913	9539.96472	13.075	9688.53510	12.836
9194.90031	13.045	9272.58091	12.922	9540.95876	13.055		
9194.90653	13.042	9272.58347	12.906	9540.96377	13.045		
9194.94182	13.023	9275.70890	12.875	9546.95883	13.129		

The calculated period for CN Tau is significantly different than that listed in the General Catalog of Variable Stars (GCVS) (Kholopov et al. 1985-88). The GCVS period turns out to be a sidereal day alias of the true period. In light of the longer period calculated from CTI and Capilla Peak data and the star's location near the Galactic plane, it is likely that CN Tau is actually a short period Cepheid instead of an RR Lyrae variable star.

The calculated period for V427 Lyr using the CTI and Capilla Peak data is nearly identical (0.26 s shorter) to that listed in the GCVS. The current classification as an RR Lyrae type ab is confirmed. Due to the image scale, V427 Lyr was combined with two other fainter stars during CTI photometry. The Capilla Peak data was used to estimate the magnitudes of these stars (V $= 18.008 \pm 0.056$ and V $= 19.497 \pm 0.133$). The standard magnitudes in Table 2 reflect the fact that the contribution from these fainter stars were removed.

Table 4. B observations of GS Lyr

HJD	B	HJD	B	HJD	B	HJD	B
7303.94080	14.201	8037.93078	14.369	9553.96339	15.053	9635.56748	14.974
7334.85551	14.604	8039.92555	14.409	9554.94750	14.979	9672.53693	14.844
7686.89238	14.601	9540.96142	14.691	9582.85529	14.930	9673.53213	14.492
7711.82418	14.779	9546.96122	14.770	9612.60797	14.968	9688.53169	14.113
7712.82087	14.816	9547.95896	14.781	9629.59840	14.955		

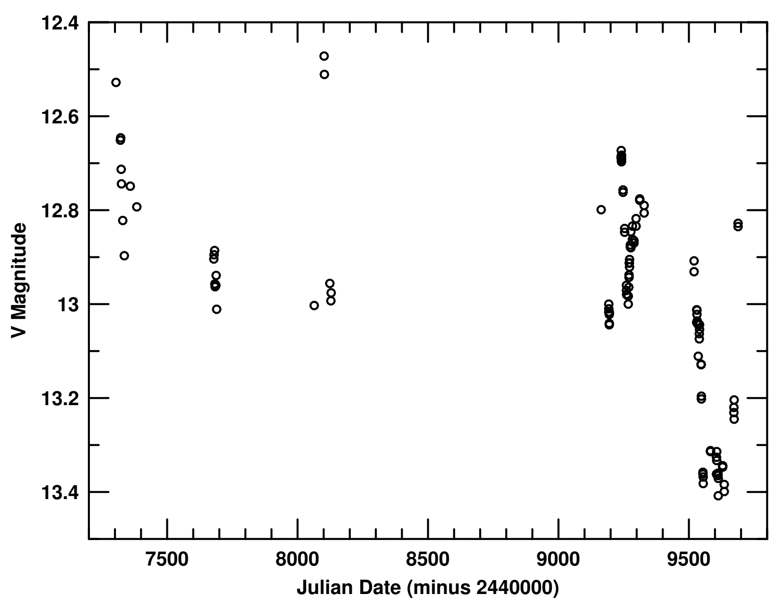

Figure 1. V magnitude of GS Lyr versus HJD

The calculated period for V926 Cyg using the CTI and Capilla Peak data is approximately 2 seconds longer than that listed in the GCVS. The light curve has a slight asymmetry, and with its current period and color, a classification as an RR Lyrae type c seems reasonable. Again, due to the image scale, V926 Cyg was combined with two other stars during CTI photometry. As in the previous case, the Capilla Peak data was used to estimate the magnitudes of these stars ($V = 18.273 \pm 0.040$ and $V = 18.093 \pm 0.025$) which we took into account when calculating the standard magnitudes in Table 2.

With the additional observations at Capilla Peak, it became quickly apparent that the RR Lyrae-like light curve for GS Lyr was due to the limited number of CTI observations and the sidereal day aliasing present in the CTI data. Further observations, however, were conducted in an attempt to obtain an accurate classification. Tables 3 and 4 list the heliocentric Julian date (minus 2440000 days) and the instrumental V and B magnitudes respectively for all observations of GS Lyr.

Data before JD 2449000 is from the CTI while data after is from Capilla Peak. The Capilla Peak data has been transformed to CTI instrumental magnitudes. The average error in the CTI V magnitude is 0.004 while the average error in the Capilla Peak V magnitude is 0.012. The average error for both the CTI and Capilla Peak B magnitudes is 0.020. Figure 1 plots the instrumental V magnitude as a function of time for all observations. The instrumental $B - V \approx 1^{\mathrm{m}}_{.}6$, resulting in standard V magnitudes 0.1 fainter than the instrumental magnitudes. GS Lyr was previously classified as a slow irregular variable in the GCVS. This classification remains appropriate in view of the fact that variations took place over several days and no periodicity could be found in the present data.

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IDENTIFICATION OF DAHLMARK VARIABLES

In his latest list of new variable stars, Dahlmark (1996) suggested a number of identifications with known variable stars. In addition to Dahlmark's proposed identifications (LD186 = V677 Cygni or V1093 Cygni, LD209 = FK Lacertae and LD220 = NSV 14621), the current author suspected that LD199 = NSV 14144 and that LD208 = HL Lacertae.

To confirm these possible identifications, comparisons were made between Dahlmark's finding charts and the original finding charts for the known variables: V677 Cygni, Hoffmeister (1957a); V1093 Cygni, Hoffmeister (1964); FK Lacertae, Hoffmeister (1957b); HL Lacertae, Hoffmeister (1967); and NSV 14144, Hoffmeister (1965). There was no finding chart given for NSV 14621 by Ross (1926).

The finder-chart comparisons show that the identification of LD209 with FK Lacertae is incorrect, but that the other four LD objects can be identified with known variable stars, noting that LD186 = V1093 Cygni.

Accurate coordinates and identifications from the Guide Star Catalogue (GSC) are given in Table 1. Discrepancies with GCVS positions are noted. Positions without GSC identifications were measured on the Digital Sky Survey. The number of comparison stars used in the reduction is given in the table; the (internal) r.m.s. residual of the comparison stars was $0\farcs2$ for all the reductions. Although no confirming chart is available the newly-determined position for LD220 is in excellent agreement with the GCVS position for NSV 14621.

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Table 1. Accurate coordinates and GSC identifications

Object	R.A. (2000)	Decl. (2000)	GSC id	LD id	Note
V677 Cyg	$21^h53^m17^s.69$	$+44°03'23''.0$	3197.00163		
V1093 Cyg	21 53 29.32	+44 05 05.0	3197.00543	LD186	1
LD209	22 46 20.97	+52 14 34.6	3633.02601		
FK Lac	22 46 33.45	+52 09 29.2	3633.02237		2
HL Lac	22 45 15.10	+50 51 53.9		LD208	3
NSV 14144	22 23 28.94	+47 44 32.3		LD199	4
LD220	23 34 07.65	+46 20 02.7			5

Note:

1. GCVS R.A. in error by $+12^s$.
2. GCVS R.A. in error by -9^s.
3. 9 GSC comparison stars. GCVS R.A. in error by $+16^s$.
4. 13 GSC comparison stars. GCVS R.A. in error by $+5^s$, Decl. by $-3'$.
5. 12 GSC comparison stars. J2000.0 GCVS position (R.A. $23^h34^m08^s$, Decl. $+46°20'.4$).

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PHOTOMETRY OF α ORIONIS (OCTOBER 1994 TO APRIL 1996)

We present another two year summary of V-band photometry of α Orionis (Betelgeuse). For previous data see Krisciunas (1994) and references therein. The comparison star, as before, was ϕ^2 Ori ($V = 4.09$, $B - V = 0.95$). Transformation to the UBV system was accomplished by means of observations of red-blue pairs (Hall 1983).

In Table 1 and Figure 1 we give the data points. The nightly means are typically the mean of three differential measures. Luedeke's data were taken with a 25-cm reflector situated at Albuquerque, New Mexico, and an Optec SSP-3 photometer. Krisciunas's data of November 1994 (Julian Dates 2449675 and 2449680) were obtained with the Lowell 0.6-m reflector at Cerro Tololo, stopped down to a smaller aperture, and using a dry ice cooled photometer, standard V filter and a 4.5 magnitude neutral density filter. His data of Julian Dates 2450128 to 2450191 were obtained with a 15-cm reflector at the 2800-m elevation of Mauna Kea, Hawaii, using the system described by Krisciunas (1996).

Table 1. Photometry of Betelgeuse. Observers: L = Luedeke, K = Krisciunas. The given internal errors do not include the uncertainties attributable to the adopted extinction coefficients or the transformation coefficient

Julian Date	V	$\pm$	Observer	Julian Date	V	$\pm$	Observer
2449656.7973	0.452	0.011	L	2449802.6947	0.831	0.006	L
666.7642	0.461	0.002	L	803.6323	0.831	0.006	L
671.7731	0.487	0.001	L	808.6166	0.830	0.004	L
675.6942	0.493	0.001	K	819.6496	0.841	0.006	L
680.7669	0.498	0.001	K	820.6159	0.791	0.005	L
684.7434	0.518	0.001	L	832.6117	0.814	0.002	L
685.7564	0.520	0.001	L	2450017.7919	0.353	0.004	L
687.7012	0.502	0.004	L	18.8099	0.371	0.003	L
696.7644	0.543	0.004	L	28.7748	0.405	0.001	L
736.6483	0.663	0.005	L	30.7372	0.389	0.003	L
746.6263	0.683	0.002	L	54.7179	0.452	0.001	L
748.5894	0.682	0.005	L	103.5812	0.509	0.002	L
750.6193	0.702	0.006	L	106.5515	0.537	0.004	L
752.6095	0.701	0.001	L	128.8424	0.562	0.016	K
754.5968	0.709	0.001	L	129.6139	0.533	0.003	L
755.5713	0.702	0.003	L	153.8236	0.556	0.029	K
761.6019	0.723	0.003	L	163.7917	0.460	0.019	K
765.5867	0.735	0.001	L	191.7604	0.503	0.002	K
791.7196	0.813	0.006	L				

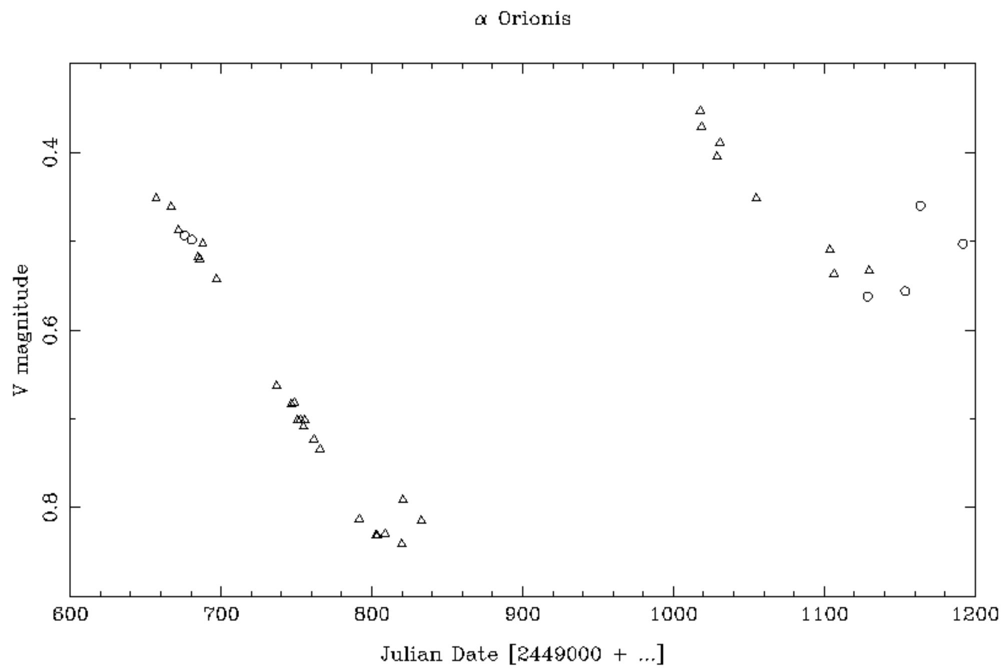

Figure 1. V-band photometry of Betelgeuse. Triangles: data of Luedeke. Circles: data of Krisciunas. Except for the Krisciunas data at the right hand side, the internal errors of the individual points are on the order of, or smaller than, the size of the points

Krisciunas also observed γ Ori as a check star, in spite of the fact that it appears to be slightly variable. The mean of those measurements gives $V = 1.635 \pm 0.010$ for γ Ori.

Bester *et al.* (1996) have recently correlated this and previous photometry of Betelgeuse with mid-infrared measurements of the diameter of the star. Further photometric monitoring is warranted.

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NSV 09136, AN RR LYRAE TYPE STAR IN OPHIUCHUS

NSV 09136 (= HV 10972 = CSV 003258 = GSC 0996.0190) was announced as a variable star by Hughes-Boyce and Huruhata (1942). According to Kholopov (1982), this object is an RR Lyrae star with a photographic magnitude variation from $13^{m}_{.}5$ to $14^{m}_{.}3$. No additional information is given.

For 18 days, from 14 May 1996 to 10 June 1996, NSV 09136 was observed in the V band using a Starlight Xpress CCD camera attached to the Newtonian focus of the 0.5-m telescope at l'Ametlla del Valles Observatory (Spain). GSC 0996.1153 and GSC 0996.1153 were used as comparison and check stars respectively (Figure 1).

Observations showed that NSV 09136 is, in fact, an RR Lyrae star with an amplitude of $0^{m}_{.}95$ in the V band, an asymmetry factor (M−m)/P=0.12, and a period over 16.5 hours (Figure 2). Photometric measurements may be slightly affected by crowding due to the fact that there is a faint star close to the variable, which not always could be satisfactorily excluded in the synthetic aperture reduction process.

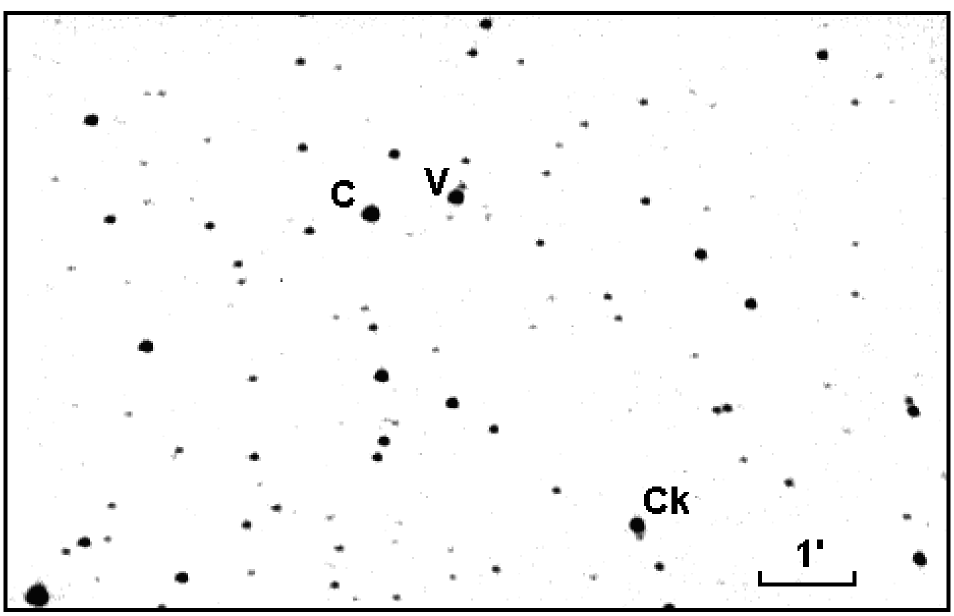

Figure 1. V=NSV 09136, C=Comparison star, Ck=Check star. North is on top

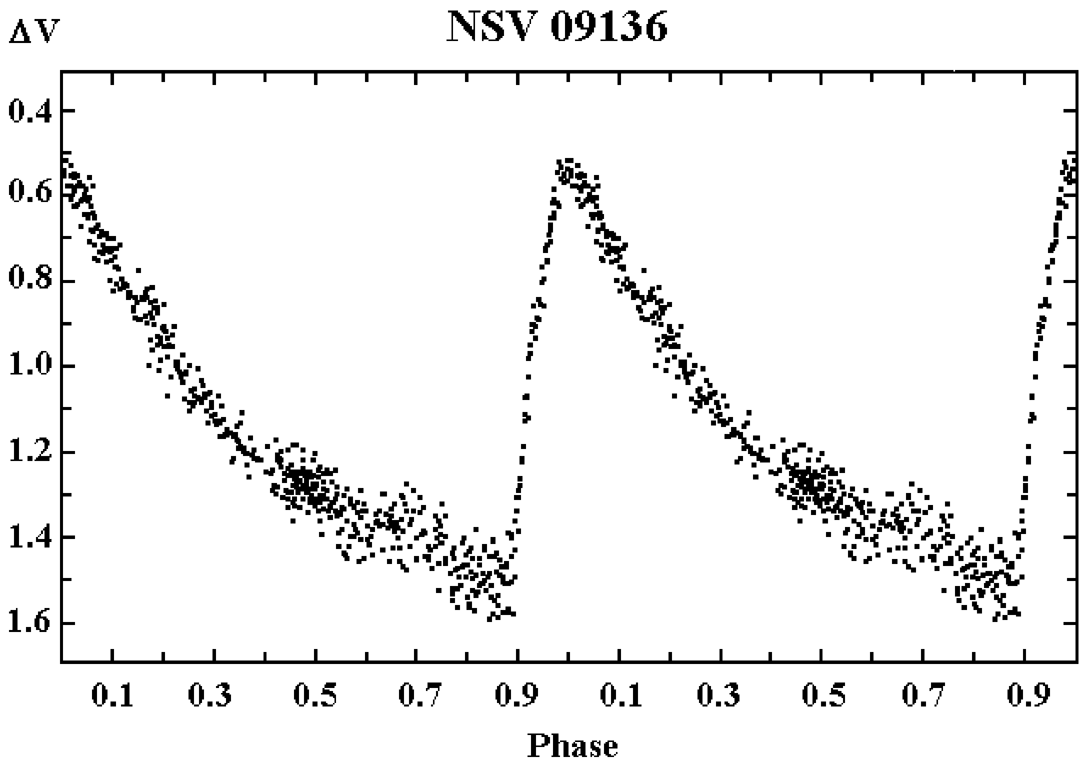

Figure 2

The following ephemeris has been also derived:

$$\text{Max.} = \text{HJD } 2450241.467 + 0^{\text{d}}.6966 \times E$$
$$\pm 0.002 \quad \pm 0.0003$$

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GREAT OPTICAL OUTBURST OF A0535+26=V725 TAURI

The recurrent transient X-ray source A0535+26 (HDE 245770, identical to V725 Tau optical variable, was first detected by the satellite Ariel V (Rosenberg et al., 1975). This Be and neutron star binary system is actively observed in frequency range from X-ray to infrared (see, for example, Giovannelli & Graziati, 1992; Gnedin et al., 1988, Motch et al., 1991). Photometric behaviour of HDE 245770 was traced in detail in the paper by Lyutiy et al., 1989). Hao et al. (1986) investigated the semiregular secular variation of brightness of the system by using Fourier analysis. They noted also some evidence of low amplitude (less than $0\overset{m}{.}01$) variation of the brightness on hours' time scale. Besides observers mentioned sudden short-time rises in brightness (the so called "blue flares") with large ($\Delta V = 0\overset{m}{.}15$) amplitudes: Rössiger (1978) in December 1977, Gnedin et al. (1988) in April 1983, Maslennikov (1986) in April 1985, Berdnik et al. (1990) in November 1986.

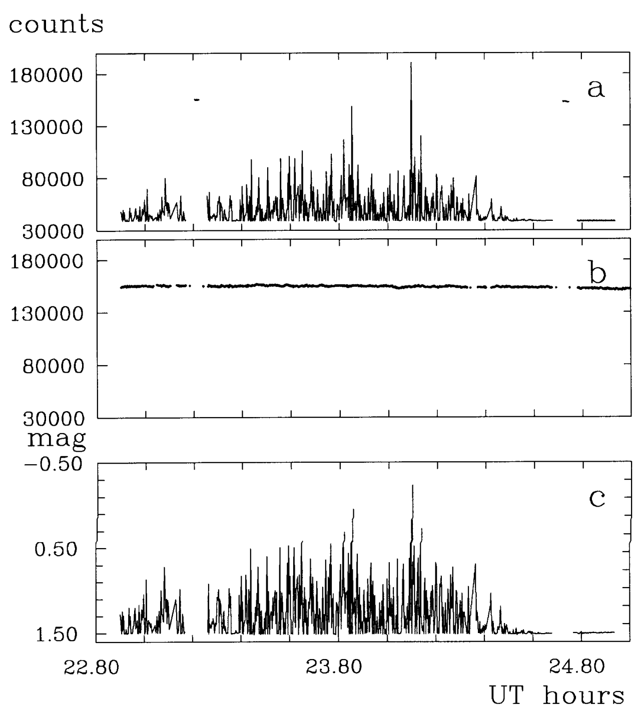

Figure 1. The data of dual-channel observations on 28/29 Oct. 1995 in Johnson's B filter: a - the counts of A0535+26 in channel 1 (comparison star counts obtained for the channel reduction, are seen at UT=23.2 and 24.7 hours); b - the count of the comparison star in channel 2, reduced to the sensitivity level of channel 1; c - V−C data in relative magnitudes

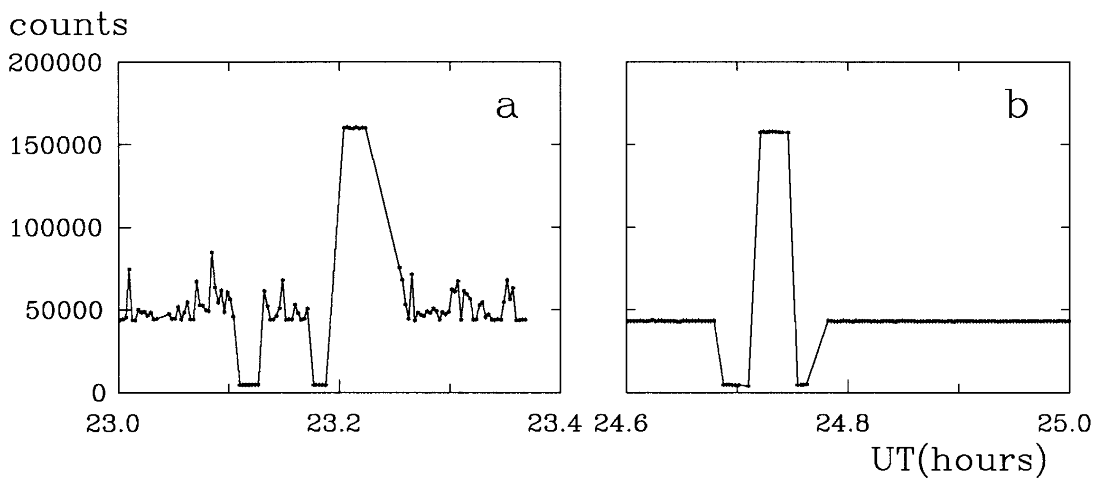

Figure 2. Observations in channel 1 which demonstrate stability of the photometer's work (a - during the outburst; b - after the outburst). The sky background counts are seen below, and the comparison star's count above. The points are linked by a connecting line

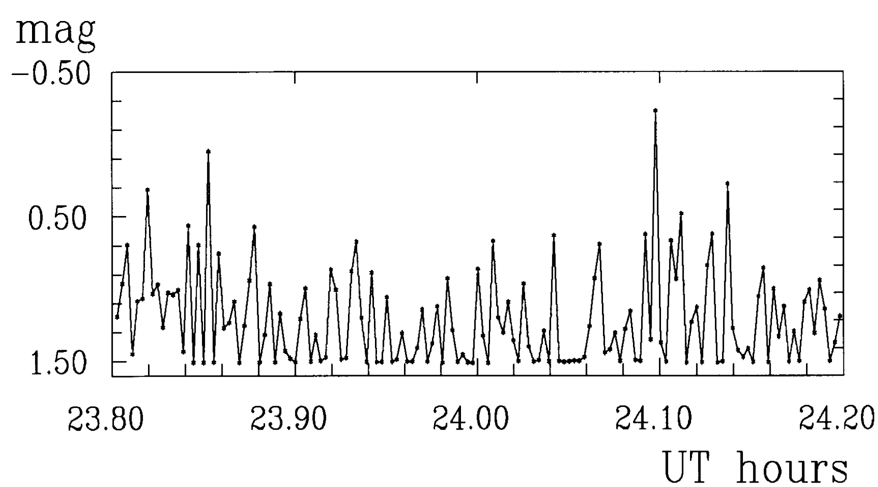

Figure 3. An enlarged part of Figure 1c between two of the brightest individual pulses

Our observations in the nights 27/28 (V filter), 28/29 October (B filter) and 20/21 November 1995 (B filter) were the part of the Program "Monitoring of Unique Astrophysical Objects" of the Russian Ministry of Science. The 2-3 hours' observational runs were done with dual channel photometer attached to 0.8 m Ritchey-Chretien telescope at the Mt. Dushak-Erekdag observational station of Odessa Astronomical Observatory (Dorokhov et al., 1985). The integration time was 10 seconds. HD 37170 (m=8.4 mag, A2) was used as a comparison star. Then the data were reduced to 1 sec. integration time.

The great outburst was recorded in the night 28/29 Oct. 1995 (JD 2450019) from UT=22.90 to 24.61 hours. The date of the outburst is close to periastron passage of the pulsar within the error limits if the orbital parameters by Margoni et al. (1988) are adopted: T_0=2443056 $\pm$ 3 days; P=55.73 $\pm$ 0.31 days. But when we used more recent orbital solution (Finger et al., 1994) derived from X-ray observations, such a coincidence was not revealed.

The data of two channel mode are presented in Figure 1. The observations started after the outburst had begun. The outburst consists of a great number of transient individual pulses. The intensity at the burst's peak was about five times as large as that on the bottom level this night (Δm=$1^{m}_{.}73$).

In Figure 2 the stability of the photometer's primary channel work is shown in two parts of the observational run. The detailed character of the outburst is better seen in Figure 3 which is an enlarged part of Figure 1. Duration of one fast brightening amounts to 10-20 sec. only which is comparable to the integration time. The bottom brightness level between the pulses was stable during the outburst. The observed "undisturbed" magnitude difference variable–comparison was 1.49 mag in 28 Oct. 1995, the system became brighter by 0.1 mag in 20 Nov. 1995 in filter B.

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U,B,V LIGHT CURVES AND PERIOD BEHAVIOR FOR THE SOLAR-TYPE ECLIPSING BINARY, V417 AQUILAE

As a part of our continuing study of short period, solar-type binaries, we have obtained well-covered UBV light curves of V417 Aquilae [$\alpha(2000) = 19^h35^m24\overset{s}{.}1$, $\delta(2000) = 5°50'17"$, GSC 4904.531, PPM 168201, BD +05°4202]. V417 Aql was discovered by Hoffmeister (1935). Soloviev (1937) classified it as a W UMa variable, gave 4 times of minimum light, and found it to have a period of $0\overset{d}{.}37$. One set of B, V light curves, formed from normal points, has been published (Faulkner 1983). A later paper (Faulkner 1986) gave the following improved ephemeris:

$$\text{JD Hel Min. I} = \underset{\pm 1}{2445554.7240} + \underset{\pm 30}{0\overset{d}{.}37031142} \times \text{E} \qquad (1)$$

Some 70 epochs of minimum light are available in the literature, including four photoelectric timings by Agerer and Hübscher (1995), six by Faulkner (1983, 1986), and many visual/photographic timings by BAV members (see, for instance, Kämper 1984).

Our present observations were obtained from July 19 to 24, 1995 at Lowell Observatory in Flagstaff, Arizona. A thermoelectrically cooled EMI 6256S (S-13 cathode) PMT was used in conjunction with the 0.78-m Lowell reflector. A finder chart is included as Figure 1. The variable is denoted as "V" while the comparison [$\alpha(2000) = 19^h34^m55\overset{s}{.}8$, $\delta(2000) = 5°47'36"$] and check [$\alpha(2000) = 19^h35^m30\overset{s}{.}8$, $\delta(2000) = 5°44'27"$] stars are denoted as "C" and "K", respectively. About 850 observations were taken in each passband.

Seven mean epochs of minimum light were determined from the observations made during two primary and five secondary eclipses using bisection of chords. These minima are given in Table 1 accompanied by their probable errors in parentheses.

Inspection of the O−C residuals of a full linear fit to all the timings revealed two eras of constant, but different, periods connected by what may be a smooth transition (see Figure 2). We calculated a period of $0\overset{d}{.}3703142(2)$ for the first era (before JD 2433000) and the following improved ephemeris for the modern era:

$$\text{JD Hel Min. I} = \underset{\pm 11}{2449546.4979} + \underset{\pm 1}{0\overset{d}{.}3703119} \times \text{E} \qquad (2)$$

The data indicates a period change $\sim -0\overset{s}{.}16$, statistically significant at the 12σ level. We find that our identification of primary and secondary eclipses are reversed relative to those in recent publications. This is not surprising since the eclipse depths are nearly equal.

The linear ephemeris for late timings (equation 2) was used to calculate the O−C residuals in Table 1 and the phases of the present observations. More timings of minimum light are needed, both from photographic archives and future observations.

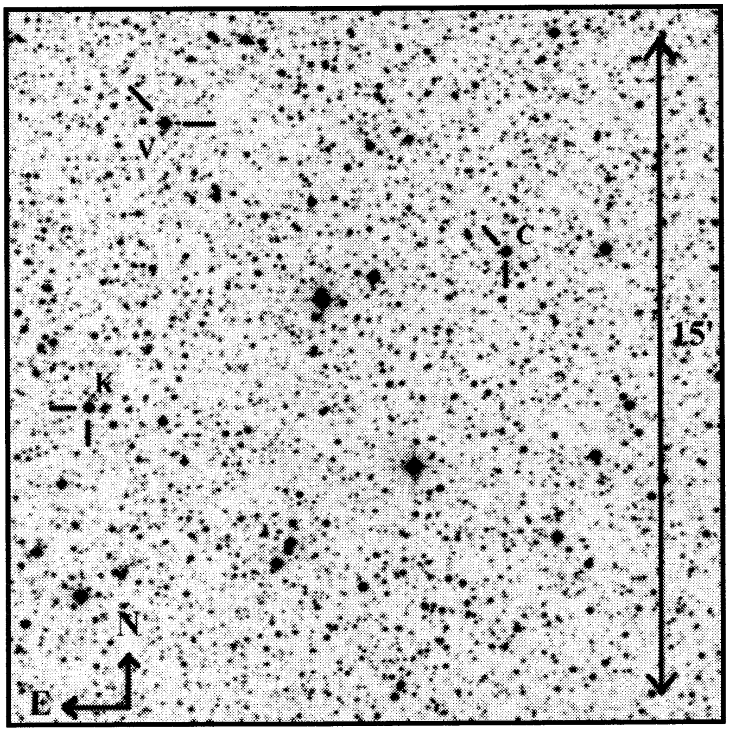

Figure 1. Finding chart (modified from a Digitized Sky Survey image) of V417 Aql (V), the comparison star (C), and the check star(K)

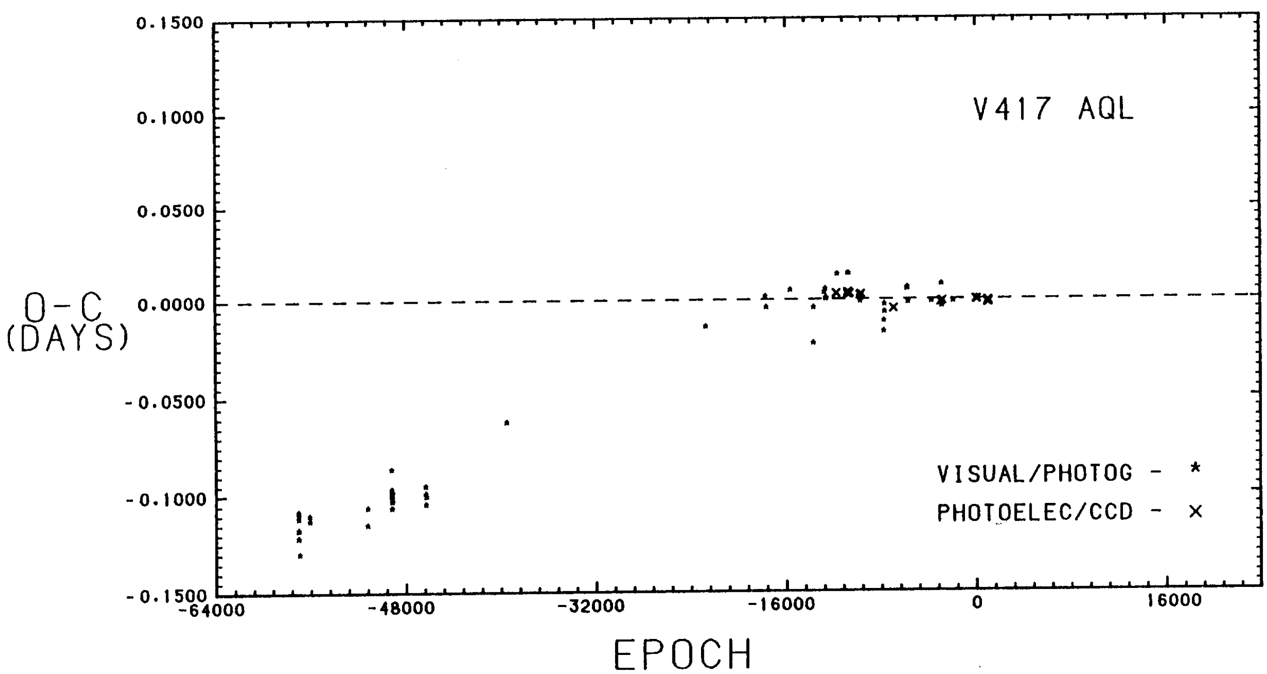

Figure 2. O−C residuals for all available times of minimum light as calculated from equation 2

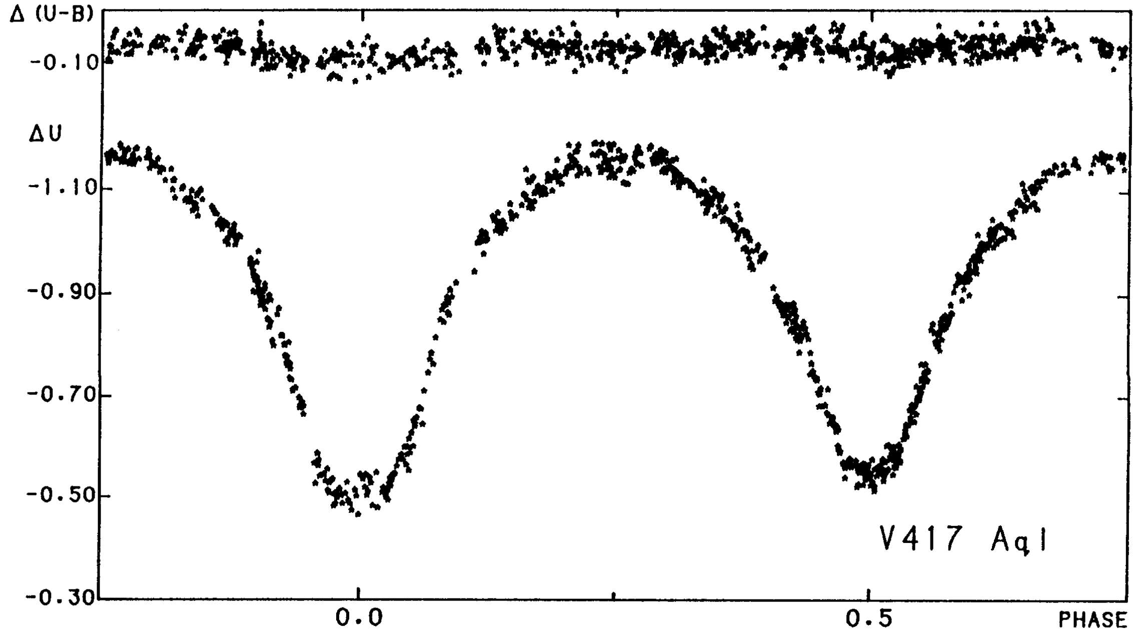

Figure 3. U light curve and U−B color curve for V417 as magnitude differences, variable minus comparison star

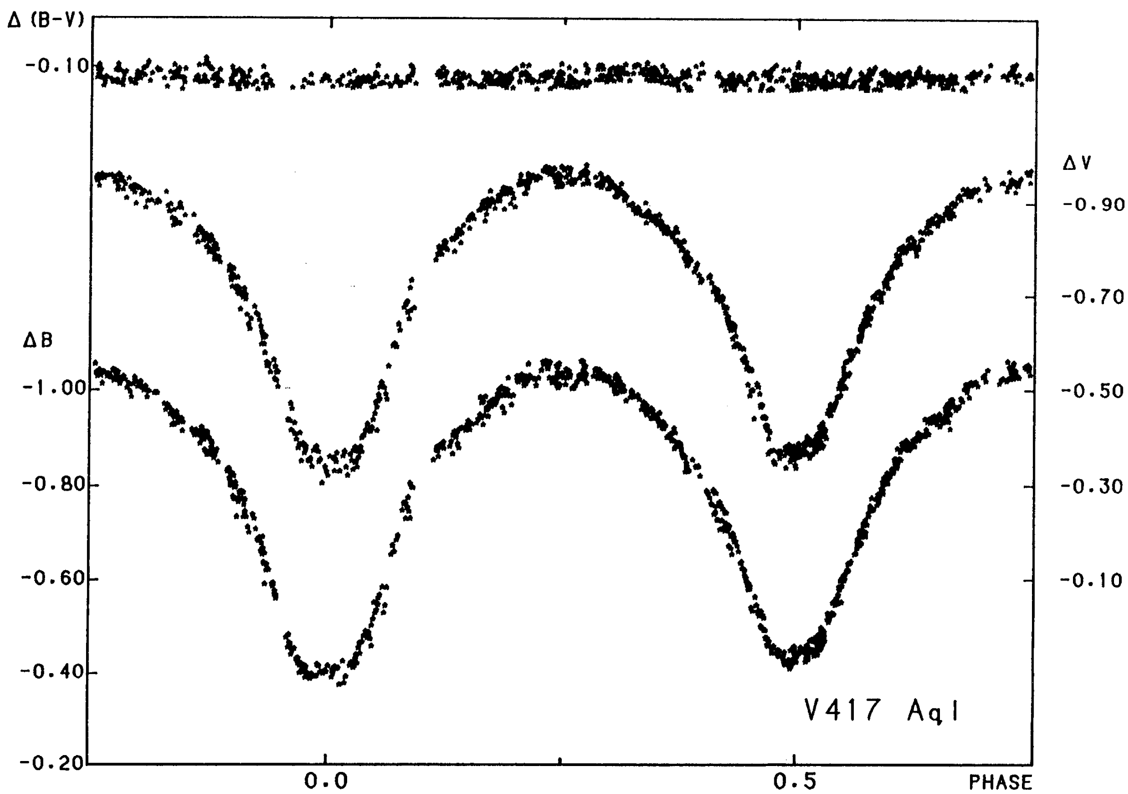

Figure 4. B and V light curves and B−V color curve for V417 Aql as magnitude differences, variable minus comparison star

Table 1. Epochs of Minimum Light, V417 Aquilae

JD Hel. 2449000+	Min	Cycles	(O-C)	Source
546.4979(5)	I	0.0	−0.0003	AH
917.9200(6)	I	1003.0	−0.0010	PO
918.8454(7)	II	1005.5	−0.0014	PO
919.9563(6)	II	1008.5	−0.0014	PO
920.6964(9)	II	1010.5	−0.0020	PO
920.8826(10)	I	1011.0	−0.0009	PO
921.8081(5)	II	1013.5	−0.0012	PO
922.9183(3)	II	1016.5	−0.0019	PO

Sources: AH: Agerer and Hübscher (1995), PO: present observations

The U, B, V light curves and U−B, B−V color curves of V417 Aql, as defined by their individual observations, are shown in Figure 3 and 4 as differential standard magnitude (variable–comparison) versus phase. Our light curve solutions reveal that V417 Aql is a W-type W UMa binary with a mass ratio of 0.37, and a fill-out of 19%. A total eclipse of ∼25 min duration occurs in the primary minimum. Reductions and analyses were largely done by BP as a part of her spring and summer undergraduate research project at Millikin University. RGS and BC acted as her advisors.

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1991 B,V,R_C ,I_C LIGHT CURVES OF THE SOUTHERN VERY SHORT PERIOD ECLIPSING BINARY V676 CENTAURI

The very short period (VSP) eclipsing binary V676 Centauri, (S4995, CoD −38°9520, $\alpha_{(2000)} = 14^{h}37^{m}50^{s}.8$, $\delta_{(2000)} = -38°50'46''$, galactic latitude: 19°.5) was discovered by Hoffmeister (1949) while conducting a massive photographic survey of Sonneberg plates. The variable was listed only as being short period with an amplitude of 0.5 magnitude. He later (Hoffmeister 1956) published photographic light curves, 83 timings of minimum light, and the following orbital elements:

$$\text{JD Hel Min. I} = 2434425.555 + 0^{d}.292397 \times \text{E}. \quad (1)$$

He classified the system as a W UMa contact binary with primary and secondary eclipse depths of $0^{m}.7$ and $0^{m}.6$, respectively. After nearly thirty years of being observationally neglected, V676 Cen was added to a study of short period eclipsing binaries (Gomez et al. 1988). Gomez and Lapasset (1988) published an informative IBVS note which included a partial photoelectric V light curve, 19 timings of minimum light from six eclipses, and an updated ephemeris.

$$\text{JD Hel Min. I} = 2446971.6152 + 0^{d}.2923901 \times \text{E} \quad (2)$$

They state that the system is a contact binary and that the difference in eclipse depths is ∼0.15 magnitude. In a report on seven such systems (Gomez and Lapasset, 1988), complete B and V photoelectric light curves as well as an improved ephemeris were published.

$$\text{JD Hel Min. I} = 2446971.6152 + 0^{d}.29239057 \times \text{E} \quad (3)$$

Gomez et al. (1990) concluded their work on V676 Cen with a parameter search and solution. They found that the system had a (ΔT ∼320 K, inclination ∼84° and a fillout ∼13%. No further work has been published on this system. V676 Centauri was observed as part of a continuing effort to obtain complete multiband photoelectric light curves of short period, solar type eclipsing binaries. The present observations were made in May 1991 at Cerro Tololo Inter-American Observatory (Chile). The Yale 1-m reflector was used in conjunction with B, V, R_C, I_C filters of the Johnson-Cousins' system and a dry-ice-cooled photomultiplier. A modified Digitized Sky Survey (DSS) image of the field is shown as Figure 1, in which the variable, comparison ($\alpha_{(2000)} = 14^{h}37^{m}50^{s}.1$, $\delta_{(2000)} = -38°51'14''.0$), and check ($\alpha_{(2000)} = 14^{h}37^{m}.58^{s}.2$, $\delta_{(2000)} = -38°56'44''.4$) stars are designated V, C, and K, respectively. Our comparison star provided the best color-match to the variable, with Δ(B−V) averaging $0^{m}.15$. Check minus comparison star measurements indicate that the comparison star's light output remained constant during the observing interval.

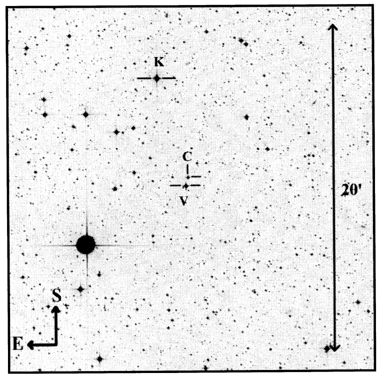

Figure 1. Finding chart (modified from a Digital Sky Survey image) of V676 Centauri (V), the Comparison star (C), and the Check star (K)

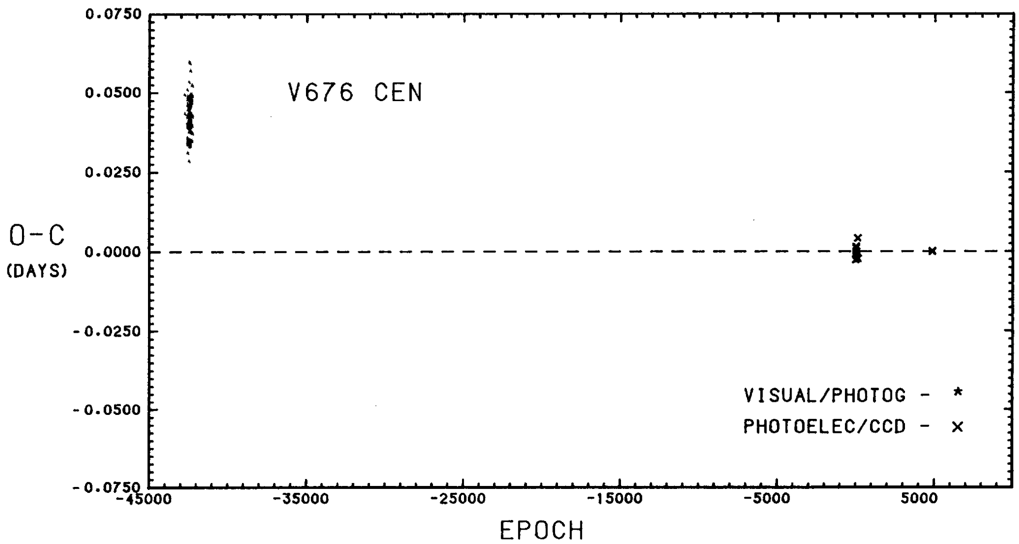

Figure 2. O−C residuals of V676 Centauri from Equation 4 (linear ephemeris)

Two new precision epochs of minimum light were determined from observations made during primary eclipses. The bisection of chords technique (Henden and Kaitchuck 1990) was used to determine both minima. Approximately 100 timings of minimum light, spanning ~35 years, were collected from the literature. We have listed the new photoelectric epochs of minimum light in Table 1. The new minima are reported as mean times from the four passbands. All available epochs of minima were introduced into a weighted least squares calculation. Photographic and visual minima were included with assigned weights of 0 allowing residuals to be calculated. From this, we obtained the following improved linear ephemeris:

$$\text{JD Hel Min.} = \underset{\pm .0006}{2446971.6154} + \underset{\pm .00000024}{0\overset{d}{.}29239197} \times E \qquad (4)$$

The residuals are given as $(O-C)_1$ in Table 1 and shown in Figure 2. A quadratic ephemeris was also calculated (using weights of 0.1 and 1.0 for photographic/visual and photoelectric minima respectively) and found to be marginally significant ($\sim 2.5\sigma$):

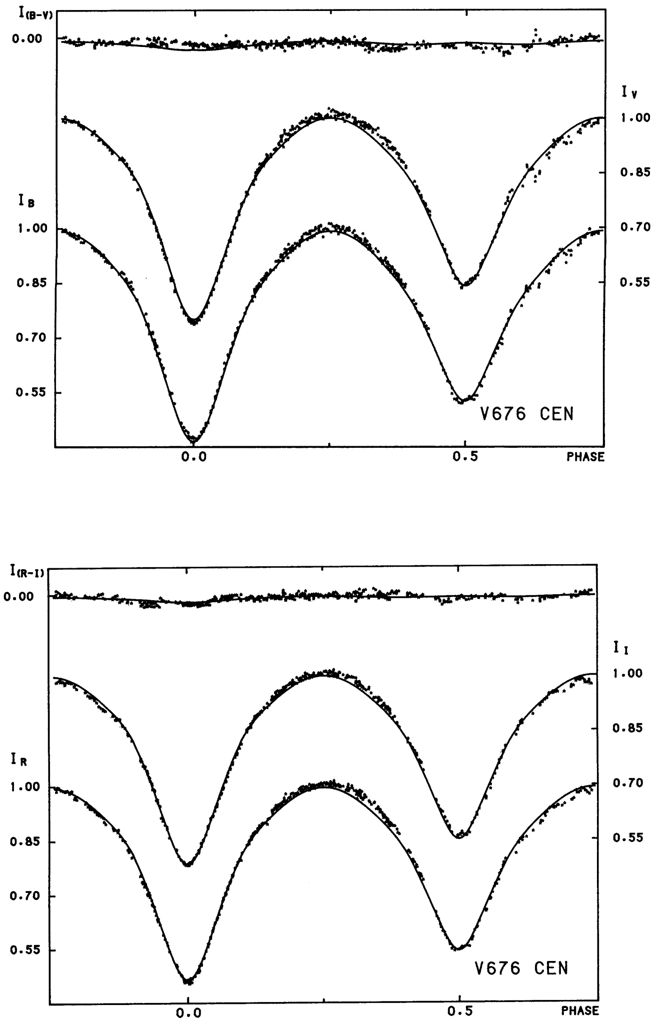

Figure 3. B, V, R_C, and I_C light curves of V676 Cen as defined by the individual observations with preliminary solution overlaid

$$\text{JD Hel Min.} = \underset{\pm .0005}{2446971.6154} + \underset{\pm .00000020}{0.29239185} \times E + \underset{\pm 1.0}{4.1} \times 10^{-11} \times E^2 \qquad (5)$$

The residuals from Equation 5 are given as $(O-C)_2$ in Table 1. The high scatter in the early timings and lack of good observational coverage precludes determination of long-term period variability at this time. New observations as well as recovery of plate minima are keys to understanding the period behavior of this system.

Table 1

JD Hel. 2400000+	Eclipse Type	Cycles	$(O-C)_1$	$(O-C)_2$
49695.8924(3)	I	4863.0	0.0034	−0.0001
49696.8232(1)	I	4867.0	0.0036	0.0002

The light curves reveal that V676 Cen is in a state of contact or near contact with continuous changes in light in the out-of-eclipse portions of the light curve. There is an O'Connell effect with the maximum at phase 0.25 (Max I) being higher than that at phase 0.75. The light curves of Gomez et al. (1990) indicate the opposite (phase 0.75 is higher than phase 0.25). Thus the region of enhanced activity has moved around the star. Our preliminary solution (Wilson 1990, 1994; Wilson and Devinney 1971) shows the system to be in a state of shallow contact (fillout of ~9%) with a rather high mass ratio (M_2/M_1) ~0.72 and an inclination ~82°. The primary and secondary component temperatures are 4550 K and 4819 K, respectively, with a phase shift of 0.50. A graphical representation of the preliminary solution fit to our observations is given in Figure 3. A thorough analysis of the observations is in progress and will be reported on elsewhere.

We would like to thank Dr. Kwan-Yu-Chen of the University of Florida for allowing our continued use of the Catalog of Interacting Binaries. Thanks also go to Mr. Franz Agerer for giving us the opportunity to access the BAV Database (Lichtenknecker 1990) in our search for complete period histories. We would like to acknowledge the Space Telescope Science Institute and all its affiliates for the use of DSS images in our work. Our gratitude goes to Mrs. Brenda Corbin and Mr. Gregory Shelton of the U.S. Naval Observatory Library for all their help in literature histories.

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ERRATUM

In IBVS No. 4359 issue, Table 1 contains incorrect data on the minima of V676 Cen. The revised table is as follows:

JD Hel 2400000+	Eclipse Type	Cycles	$(O-C)_1$	$(O-C)_2$
48393.5174(1)	I	4863.0	−0.0001	0.0001
48394.6872(1)	I	4867.0	0.0001	0.0002

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NINE NEW VARIABLES IN THE η HERCULIS FIELD

This paper continues the study begun in my previous publication (Antipin, 1994). Nine more new variables (Var 43–51) have been discovered in the $10° \times 10°$ field centered on η Her. So the number of new variable stars in this field has increased to 27, mostly RR type variables (17 stars) and eclipsing systems (7 stars). This study is based on Moscow collection of photographic plates taken with the 40 cm astrograph in Crimea.

Tables 1–2 contain information on the new variable stars. The standard sequence near M13 (Arp and Johnson, 1955; Forbes and Dawson, 1986) was used to obtain magnitudes of comparison stars given in Table 3. Finding charts and phased light curves are shown in Figures 1 and 2, respectively.

This study was partially supported by the Russian Foundation for Basic Research through grant No. 95-02-05189. Thanks are due to Dr. N.N. Samus for his attention to this investigation, and to S.Yu. Shugarov for help during photoelectric observations.

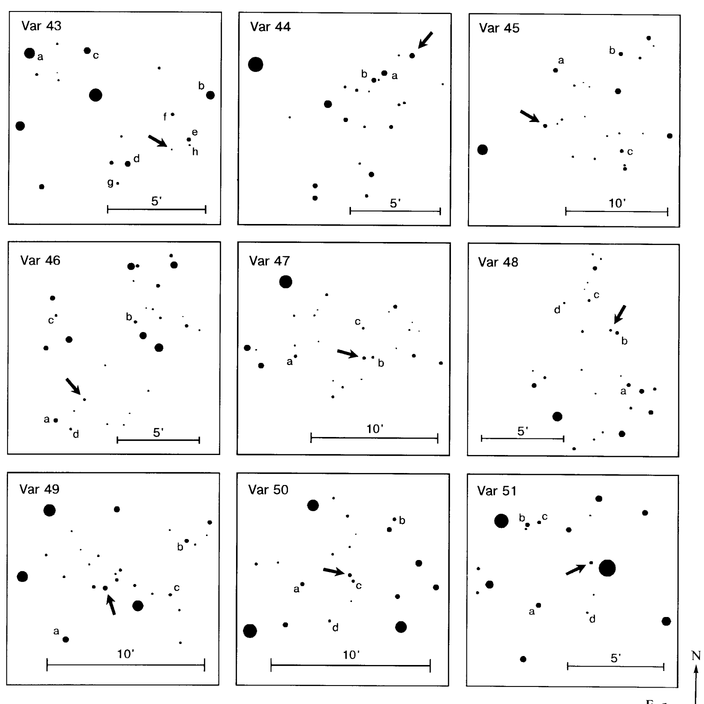

Figure 1. Finding charts

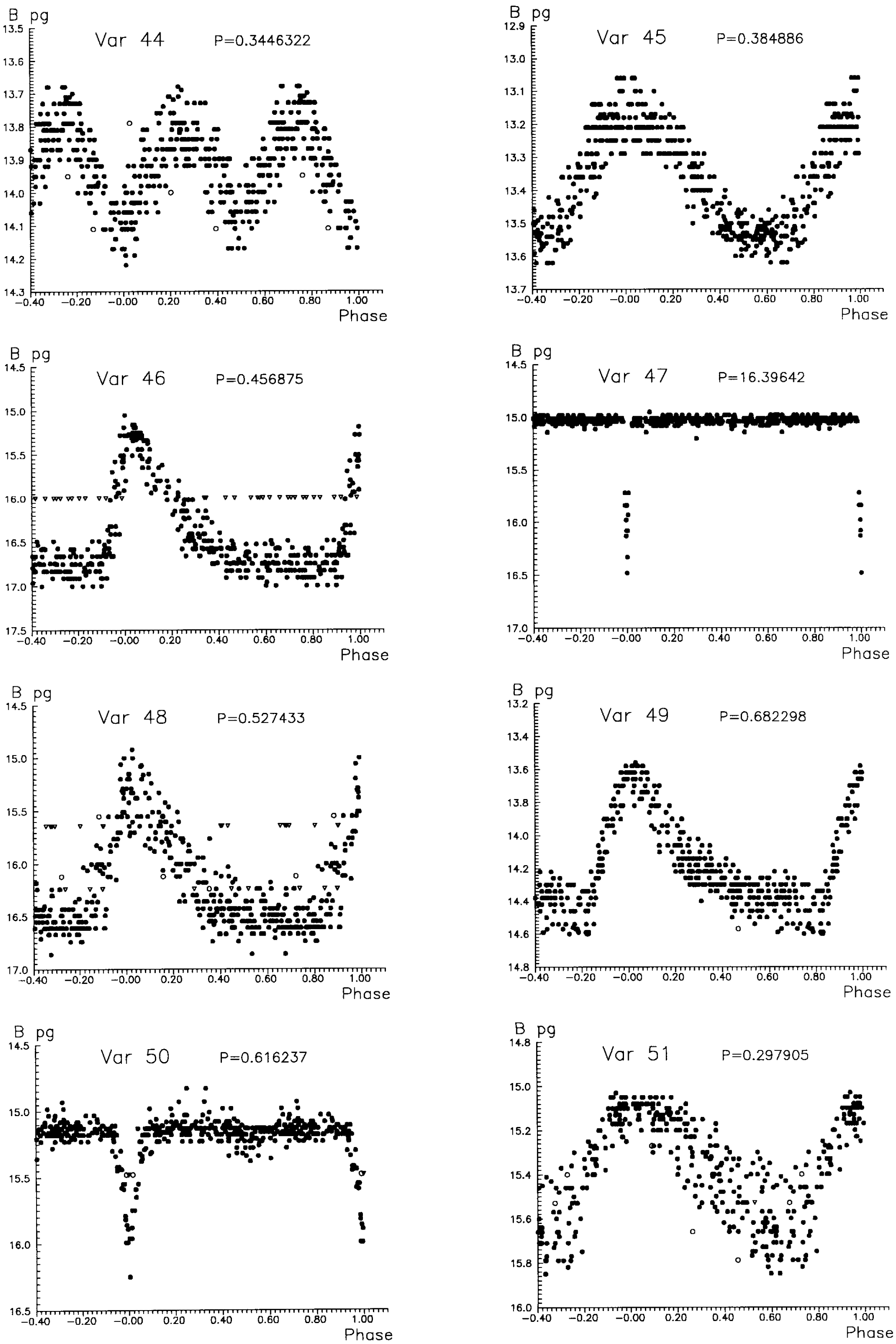
B pg
Var 44
P=0.3446322
Phase
Var 45
P=0.384886
Var 46
P=0.456875
Var 47
P=16.39642
Var 48
P=0.527433
Var 49
P=0.682298
Var 50
P=0.616237
Var 51
P=0.297905

Figure 2

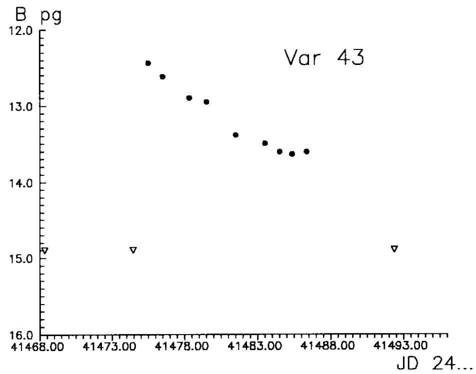

Figure 3

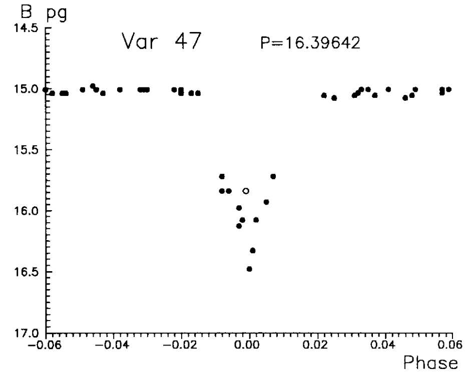

Figure 4

Remarks on individual stars

Var 43. Blue on Palomar prints. In minimum brightness, the star is apparent on good plates. The duration of the best-observed outburst is between 12 and 18 days (Figure 3). Outbursts (JD 24...):

#1	41475.489	12.44	41483.505	13.50	#2	43693.355	13.28
	41476.494	12.62	41484.504	13.61		43700.386	14.14
	41478.323	12.90	41485.350	13.64	#3	45144.378	13.39
	41479.506	12.95	41486.350	13.61	#4	49564.341	16.72
	41481.506	13.39					

Var 44. The star was observed photoelectrically during three nights in July 1995 (JD 2449921–25). Sixteen observations in B and V bands were obtained. The observations were made with a photoelectric photometer at the 60 cm reflector in Crimea. The magnitude ranges are B=$13^{\rm m}.69$-$14^{\rm m}.09$, V=$13^{\rm m}.09$-$13^{\rm m}.44$, and average $B-V$ is 0.63 mag. The primary minimum was not covered. These observations are in good agreement with photographic light elements. The phased light curve (Figure 2 for Var 44) includes photoelectric observations in B band.

Var 47. The minimum is shown in Figure 4. Primary minima (JD 24...):

37115.347	16.08	41952.228	15.84	42247.451	15.84:
37115.377	16.48	41952.362	16.08	42362.187	15.98
41837.423	15.84	41985.202	15.93	42952.460	16.13
41919.396	15.72	41985.225	15.72	45592.348	16.33

Var 50. *Min II* 15.20.

Table 1. Coordinates and Identifications of Variable Stars

Var	α(2000.0)	δ(2000.0)	GSC
Var 43	$16^h25^m01\overset{s}{.}7$	39°09'26"	
Var 44	16 51 12.8	41 17 58	3079.0201
Var 45	16 56 03.6	40 09 02	3075.0885
Var 46	16 37 38.2	36 31 57	
Var 47	17 02 17.2	38 36 24	3072.0441
Var 48	17 00 23.6	38 16 38	
Var 49	16 57 34.5	41 31 45	3079.0460
Var 50	17 08 23.6	39 57 49	3076.0951
Var 51	16 24 04.9	41 15 06	3065.1355

Table 2. Data on New Variable Stars

Var	N	JD 24...	Type	Max	Min	$M-m$ or D	Max (Min) JD 24...	Period, days
Var 43	419	37080–49571	UG	12.50	17.50			
Var 44	377	37080–49571	EW	13.80	14.15		43684.325	0.3446322
Var 45	389	37080–49564	RRc	13.15	13.55	0.40	41945.36	0.384886
Var 46	318	37080–49564	RRab	15.20	16.80	0.10	40744.41	0.456875
Var 47	384	37080–49564	EA	15.05	16.40	0.03	37115.38	16.39642
Var 48	354	37080–49564	RRab	15.20	16.60	0.20:	42867.51	0.527433
Var 49	350	37087–49564	RRab	13.60	14.50	0.18	41948.29	0.682298
Var 50	355	37080–49564	EA	15.10	16.20	0.10	42311.24	0.616237
Var 51	299	37103–49564	RRc	15.10	15.70	0.30	42992.39	0.297905

Table 3. Comparison Stars

Var	a	b	c	d	e	f	g	h
Var 43	12.20	13.14	13.86	14.10	14.92	16.15	16.65	17.4
Var 44	13.68	14.22						
Var 45	12.65	13.40	13.60					
Var 46	15.07	15.37	16.00	16.83				
Var 47	15.06	15.88	16.38					
Var 48	15.20	15.64	16.24	16.86				
Var 49	13.74	14.54	14.84					
Var 50	14.78	15.28	15.48	16.16				
Var 51	14.70	15.20	15.53	16.17				

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References:

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Arp, H.C. and Johnson, H.L., 1955, *ApJ*, **122**, 171
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NEW SUPERNOVA 1983 ON MOSCOW PLATES

A new supernova was found in the course of the search for variable stars using the positive-negative method. Moscow collection plates taken with the 40 cm astrograph in Crimea were used for this study. The discovery was reported in IAU Circ. No 6439, where the supernova was designated as SN 1983ab.

The finding chart is given in Figure 1. The parent galaxy is not included in the major catalogues of bright galaxies (NGC, IC, UGC, MCG), but it has a Guide Star Catalogue designation (GSC 2586.0540, non-stellar object, α=16^{h}22^{m}34^{s}.5, δ=+36°45′20″, J2000.0). Moreover, coordinates of the galaxy's center and of the supernova were measured on our plates relative to GSC stars. The coordinates of the galaxy are in good agreement with those in the GSC, and the coordinates of the supernova are α = 16^{h}22^{m}34^{s}.0, δ = +36°45′25″ (J2000.0). So the distance from the center of the galaxy to the supernova is 6″W and 5″N.

The supernova was seen and estimated on 24 plates. The results are given in Table 1. A standard sequence near M13 (Arp and Johnson, 1955; Forbes and Dawson, 1986) and a CCD standard (Field 2) from Crampton et al. (1988) were used to obtain the magnitudes of the comparison stars (Table 2). The light curve is shown in Figure 2. Open circles are uncertain observations. The maximum was reached on JD2445582 (September 4, 1983) and its brightness was 16.35B with an error of about ±0.15 mag.

It is not possible to classify the supernova with certainty. Our observations are only near the maximum, and the author cannot say anything about the light curve's shape on the descending branch and about the rate of the brightness decrease.

Finally, note that no object on Palomar prints was seen at the supernova position. The author has looked through about 310 plates that include the investigated region. No sign of this star was found except the announced case.

The author is grateful to Dr. N.N. Samus and N.E. Kurochkin for their attention to this investigation, and to N.N. Pavlyuk for discussion of the results.

Table 1. Observations of the supernova

JD 2445...	B	JD 2445...	B	JD 2445...	B
563.373	< 17.7	582.299	16.32	588.348	16.71
574.260	17.07	582.344	16.29	589.260	16.66
576.291	16.81	583.256	16.55	589.300	16.58
578.268	16.71	583.298	16.42	589.336	16.76
580.300	16.60	584.271	16.66	590.310	16.74
581.271	16.39	586.265	16.76	591.350	16.71:
581.321	16.50	587.265	16.60	592.348	16.86:
581.365	16.47	588.262	16.55	605.218	< 17.7
582.259	16.34	588.308	16.63		

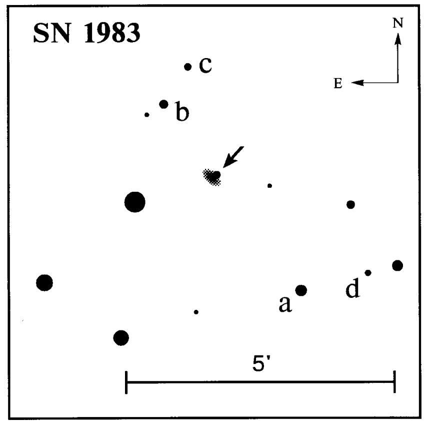

Figure 1

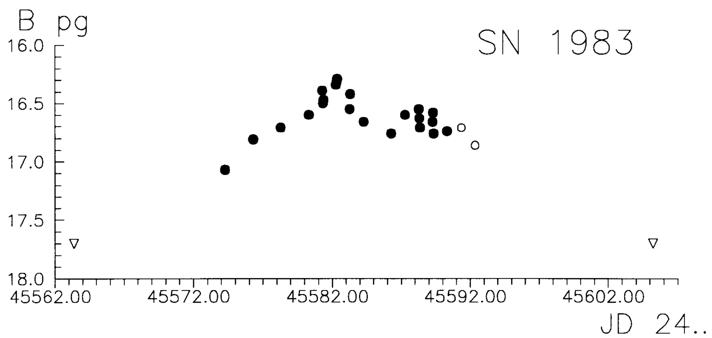

Figure 2

Table 2. Comparison Stars

Star	B
a	16.34
b	16.86
c	17.1
d	17.7

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ECCENTRIC ECLIPSING BINARY STARS AS TEST OF GENERAL RELATIVITY: THE CASE OF V541 CYGNI

V541 Cyg (BD+30°3704; V_{max} = +10.35; B−V = +0.035) is a detached eclipsing binary consisting of a pair of B9.5 V stars having an eccentric orbit (e = 0.474) and an orbital period of P_{orb} = 15.34 days. Khaliullin (1983; 1985) was the first to show that this binary could be an important test case for General Relativity (GR) because the apsidal motion expected from GR is significantly larger than the classical apsidal motion arising from the tidal and rotational distortions of the component stars. He found that the rate of apsidal motion expected from GR is $\dot{\omega}_{GR} = 0.^{\circ}82/100\text{yr}$, while the contribution to apsidal motion from classical effects is $\dot{\omega}_{cl} = 0.^{\circ}15/100\text{yr}$. Moreover, the relativistic apsidal motion expected for V541 Cyg is large — about 70 times greater than the corresponding relativistic apsidal motion of Mercury-Sun of $\dot{\omega}_{GR} = 43''/100\text{yr}$.

From the data available at that time, Khaliullin (1985) found good agreement between the observed apsidal motion rate of V541 Cyg of $\dot{\omega}_{obs} = 0.^{\circ}90/100\text{yr} \pm 0.^{\circ}15/100\text{yr}$ and the theoretical combined relativistic and classical apsidal motion of $\dot{\omega}_{GR+cl} = 0.^{\circ}97/100\text{yr}$. However, this determination of apsidal motion was based on only two epochs: very accurate eclipse timings from his photoelectric photometry made in 1981–83 and less accurate photographic minima determinations of Karpowicz (1961), made during 1955–59. Since 1985, several accurate times of primary and secondary minima have been determined from photoelectric or CCD photometry. Recently Wolf (1995) re-determined the apsidal motion using Khaliullin's data as well as more recent eclipse timings and derived a more refined apsidal motion rate of $\dot{\omega}_{obs} = 0.^{\circ}53/100\text{yr} \pm 0.^{\circ}11/100\text{yr}$. However, this revised apsidal motion rate is significantly smaller than expected from theory. Using updated values for the internal structure constant (see Claret and Gimenez 1992), theory predicts relativistic effects of $\dot{\omega}_{GR} = 0.^{\circ}77/100\text{yr} \pm 0.^{\circ}05/100\text{yr}$ and classical effects of $\dot{\omega}_{cl} = 0.^{\circ}10/100\text{yr} \pm 0.^{\circ}02/100\text{yr}$, resulting in a combined apsidal motion rate of $\dot{\omega}_{GR+cl} = 0.^{\circ}87/100\text{yr} \pm 0.^{\circ}07/100\text{yr}$. This result is particularly interesting because in V541 Cyg most of the apsidal motion is expected to arise from GR.

Starting in the Spring of 1995, UBVR photoelectric photometry of V541 Cyg has been conducted on the Villanova-Fairborn 0.8m Automatic Photoelectric Telescope (APT), at Mt. Hopkins, Arizona. During 1995, differential photometry of the star was obtained on 63 photometric nights. Nearly complete light curves have been obtained and new eclipse timings have been made from these data. The photoelectric observations were carried out using the usual observing sequence of sky-comparison-check-variable-comparison-sky and an integration time of 10 seconds. Because of the relative faintness of V541 Cyg, blind-offsets from the position of the comparison star were used to acquire the star. Initially HD 332470 (SAO 68749; m_v = +8.4; K3 III) was used as the primary comparison star and HD 331210 (SAO 68756; m_v = +9.6; G8 III) served as the check star. However, after a few months into the observing program, HD 332170 began to show evidence of small systematic changes in brightness especially in the U and B bandpasses.

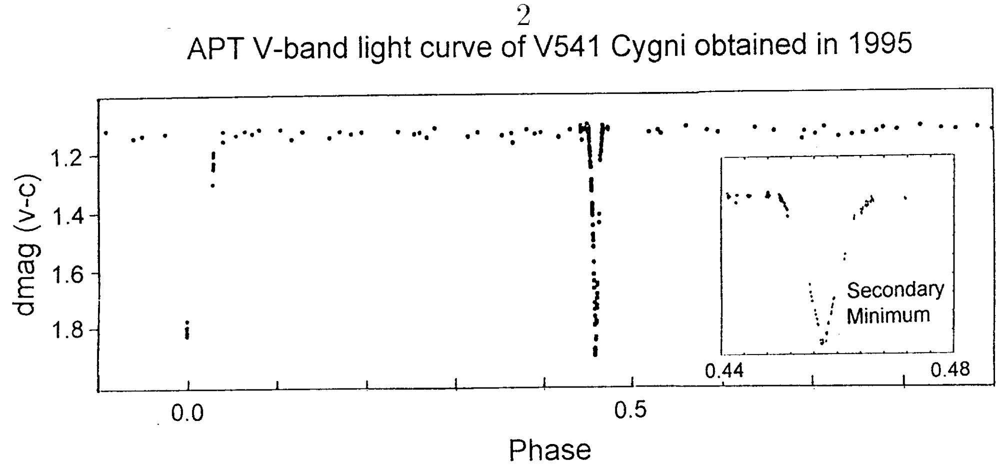

Figure 1. A plot of the the V-band light curve showing the secondary minimum in an expanded phase scale

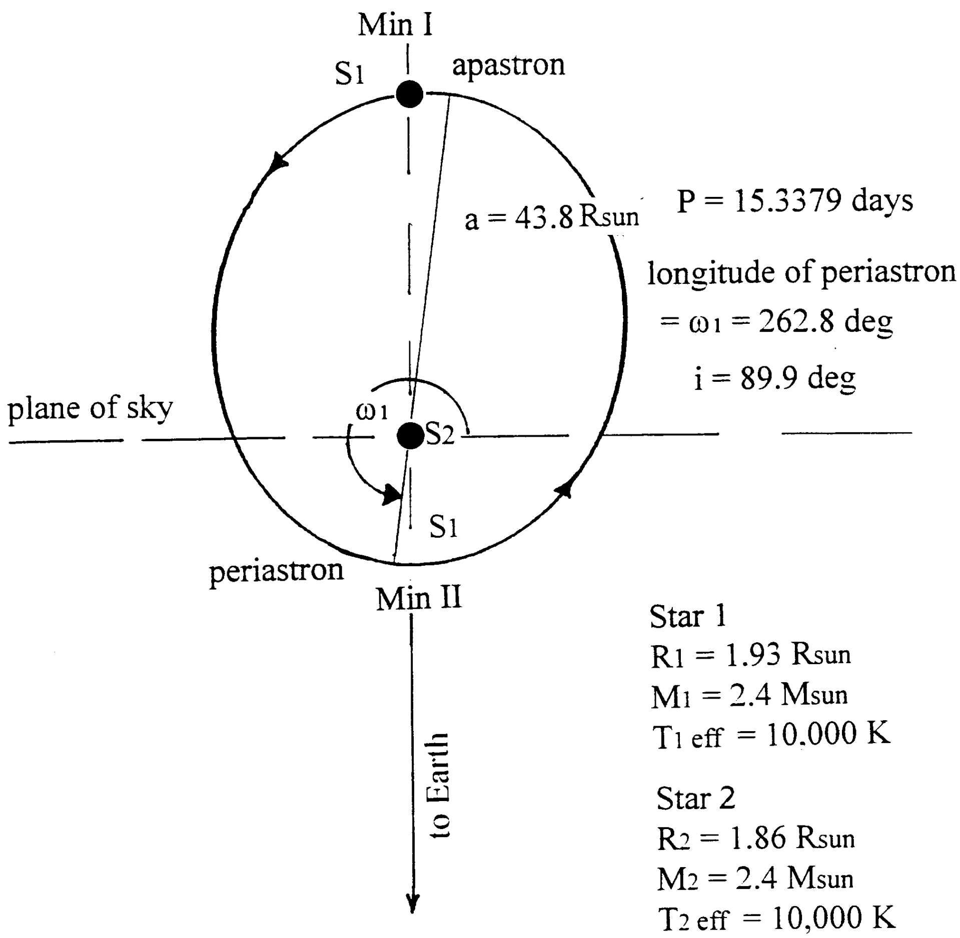

Figure 2. A scale model of the system, showing the orientation of the orbit and the stars drawn to approximate scale

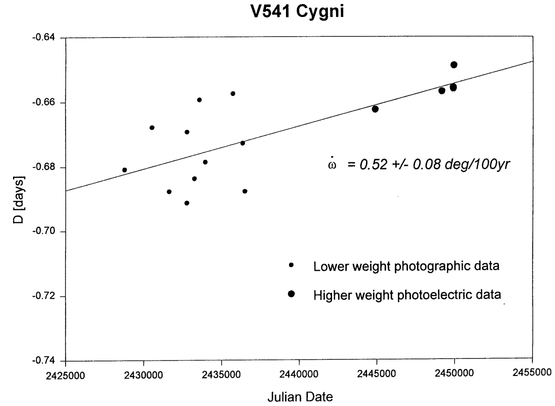

Figure 3. A plot of the apsidal motion rate determination showing the change in the displacement of the secondary eclipse (D = $(t_1 + t_2 - 0.5P)$) with time

Fortunately, frequent observations of the check star were made which enabled us to use HD 331210 as the primary comparison star for the entire 1995 data set. The observations were reduced in the usual way in which times were converted to Heliocentric Julian Day Numbers and the magnitudes were corrected for differential atmospheric extinction. Because of angular proximity of the variable, comparison, and check stars, the differential extinction corrections were very small. Nightly means were formed from the observations outside of the eclipses; typically 3–5 observations comprise each normal point per filter. The observations inside the eclipses were not averaged.

Figure 1 shows the V-band light curve in which the phases were computed from the light elements of Khaliullin (1985); the secondary minimum in an expanded phase scale is also shown in the figure. The eclipses are deep and very narrow; secondary minimum is well defined and occurs near 0.4575 phase, but primary minimum is poorly covered and needs further observations before it is satisfactorily defined. As shown by Khaliullin's photometry, the primary minimum is much broader than the secondary minimum because of the orientation of the orbit ($\omega = 263°$), in which periastron and apastron occur near to the times of the secondary and primary eclipses, respectively. A scale model of the system, showing the orientation of the orbit and the stars drawn to approximate scale is shown in Figure 2.

A very accurate determination of the time of secondary minimum was made from UBVR photometry, obtained near the lower portions of the minimum on the night of 7 July 1995 UT. The time of mid-eclipse was found from least squares fits of the data and by the bisecting cord method. Independent determinations of mid-eclipse were made from the different bandpasses. No systematic differences were found so that a mean timing was calculated from the four data sets:

$$\text{T (Min II)} = \text{HJD } 2449904.7145 \pm 0\overset{\text{d}}{.}00012$$

A new determination of apsidal motion was made using this timing along with timings given by Khaliullin (1985) and Wolf (1995). In addition to these, the photoelectric and CCD eclipse timings obtained by Lacy and Fox (1992) and Diethelm (1995) were also included. The photographic timings of Karpowicz (1961) were also included, but assigned lower weights than the photoelectric or CCD observations. The analysis of the timings yielded an apsidal motion rate of $\dot{\omega}_{obs} = 0\overset{\circ}{.}52/100\text{yr} \pm 0\overset{\circ}{.}14/100\text{yr}$. This apsidal motion rate is very nearly the same as found by Wolf (1995), which was based on fewer observations. A plot of the apsidal motion rate determination is shown in Figure 3 in which the change in the displacement of the secondary eclipse with time is shown. The older photographic timing estimates were not used in the least squares determination of the apsidal motion, but the apsidal motion found from the modern data fits the older data quite well. More interestingly, this study confirms that V541 Cyg has an observed rate of apsidal motion that is significantly less than the theoretically expected apsidal motion. This smaller than expected apsidal motion found for V541 Cyg is difficult to explain and the discrepancy is in the same sense as found for two other eclipsing binaries, DI Her and AS Cam, in which the relativistic contributions to apsidal motion are also significant (see Guinan and Maloney 1985; Maloney *et al.* 1991; Guinan *et al.* 1994).

Spectroscopic observations of V541 Cyg have been obtained several years ago (by EFG) which indicate approximate stellar masses for the system of about $M_1 = M_2 = 2.4 \pm 0.2 M_{\odot}$ and projected rotational velocities of the components of $v_1\ sin(i) = v_2\ sin(i) = 20 \pm 5$ km/s. Ultraviolet spectrophotometry (1150 – 3200Å) has also been obtained with the IUE satellite and the preliminary analysis of this data indicates a mean temperature for the two stars of about $T_1 = T_2 = 9900 \pm 400$K. These temperatures correspond to spectral types of about B9.5 V – A0 V. These spectral types and temperatures are in good agreement with the B−V and U−B indices measured recently by Lacy (1992), after the color indices are corrected for interstellar reddening.

We plan to continue photometry of the star with the APT during 1996 to complete the UBVR light curves, in particular, to cover fully the primary eclipse. Also, we are aware that spectroscopic radial velocity observations of V541 Cyg are currently being conducted at San Diego State University by Paul Etzel (priv. commun.). Once the light and radial velocity curves are complete, a more thorough study of this important binary can be made and a more definitive determination of its orbital and physical properties can be obtained.

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NEW APSIDAL MOTION DETERMINATION OF THE ECCENTRIC ECLIPSING BINARY V1143 CYGNI

The eclipsing binary V1143 Cyg (HR 7484; HD 185912; BD+54°2193; V_{max} = +5.86; B−V = +0.46) consists of a pair of F5 V stars moving in an eccentric orbit (e = 0.54) and having an orbital period of P_{orb} = 7.64075 days. The system is detached with both components residing well inside their respective Roche lobes. The orbital and stellar properties of V1143 Cyg are very well determined from the careful study of Andersen *et al.* (1987). One of the interesting aspects of this binary, that apparently has been overlooked, is that its U, V, W space velocity components, as given by Andersen *et al.* (1987) of +31, −16, −2 km/s, are very close those of the Hyades cluster (+40, −17, −3) km/s (Eggen 1960; Eggen 1970). (Note that the U, V, W velocity components are measured relative to the Sun and that the Eggen system is adopted in which a positive U-velocity is in the direction of the Galactic anti-center.) Although the similarity between the space motions of the binary and the Hyades Moving group could be a coincidence, it is more likely that V1143 Cyg is a member. If this is true, then the binary would be coeval with the Hyades, thus having an age of about 600 Myr. Knowing the age of a binary, vastly increases its importance for testing stellar structure, opacity laws, and evolution models (*e.g.* Guinan 1993).

Because of V1143 Cyg's eccentric orbit and deep, narrow eclipses, its apsidal motion can be accurately determined from an analysis of the timings of primary and secondary eclipses. The apsidal motion rate is determined from the change in the displacement of the secondary eclipse relative to the primary eclipse (*e.g.* Guinan and Maloney 1985). Independent determinations of the apsidal motion of V1143 Cyg have been made by Khaliullin (1983) and Gimenez and Margrave (1985); they are in good agreement, Khaliullin observing an apsidal motion rate of $\dot{\omega}_{obs} = 3.^{\circ}49$/100yr $\pm 0.^{\circ}38$/100yr while Gimenez and Margrave observe $\dot{\omega}_{obs} = 3.^{\circ}36$/100yr $\pm 0.^{\circ}19$/100yr. However, Andersen *et al.* (1987) calculate a somewhat faster theoretical apsidal motion of $\dot{\omega} = 4.^{\circ}25$/100yr $\pm 0.^{\circ}72$/100yr in which the expected relativistic and classical contributions to apsidal motion are $\dot{\omega}_{GR} = 1.^{\circ}86$/100yr and $\dot{\omega}_{cl} = 2.^{\circ}39$/100yr, respectively. The apsidal motion due to classical mechanics results from the component stars' departures from spherical symmetry which arises from the tidal and rotational deformations of the stars. The classical term depends on the fractional stellar radii, stellar masses, rotation, and orbital period, as well as on the distribution of mass inside the stars. The masses, radii, and rotation velocities of the components are well known. The internal mass distribution of the stars is parameterized by the internal structure constants (k2) which are computed from stellar interior and evolution models (*e.g.* Claret and Gimenez 1992). The relativistic apsidal term arises as a consequence of General Relativity as in the case of Mercury's 43"/100yr relativistic apsidal motion.

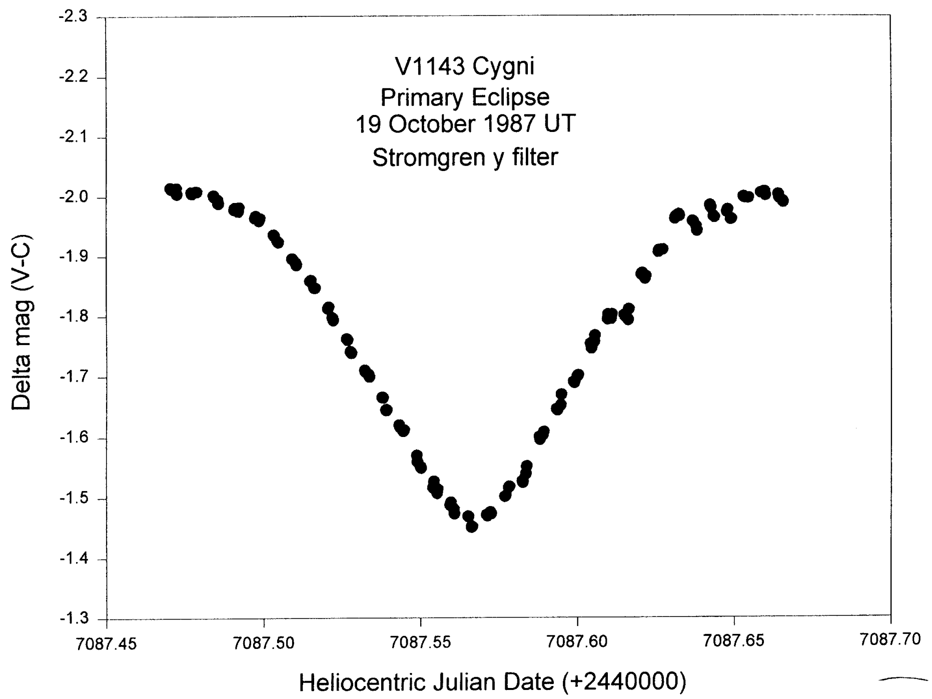

Figure 1. A plot of the primary eclipse of 19 October 1987 taken with the Strömgren "y" filter

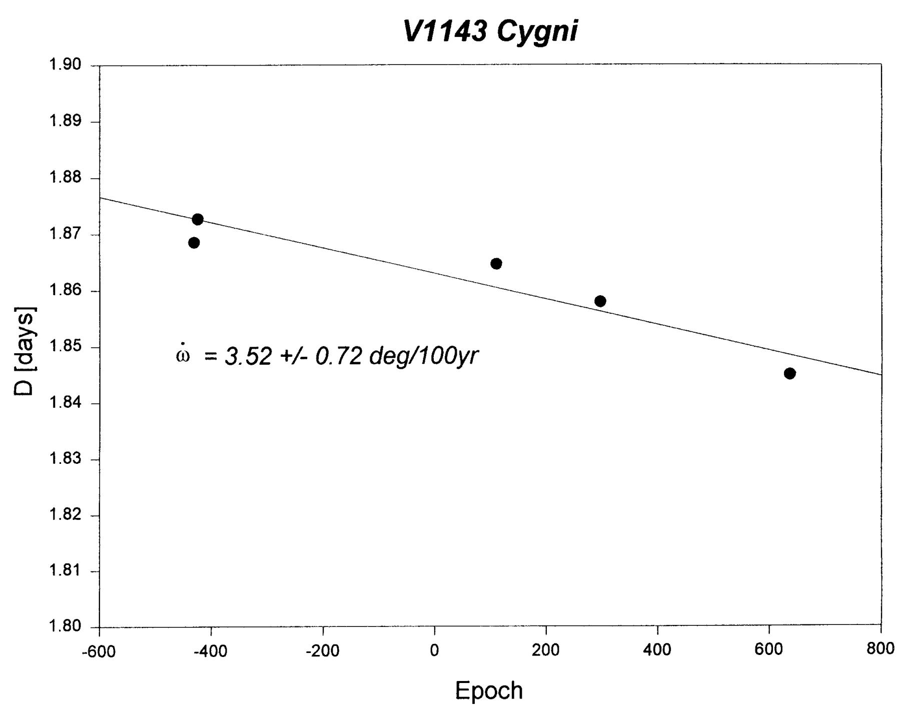

Figure 2. A plot of the displacement of secondary minimum from the half period point vs. epoch showing the observed apsidal motion rate

Photoelectric photometry of V1143 Cyg was conducted with the Jenkins 38-cm reflector at Villanova University Observatory. The observations reported here were made on the nights of 17 and 19 October 1987 UT, using intermediate-bandpass blue (λ_{max} = 4530Å) and yellow (λ_{max} = 5500Å) interference filters. These were nights on which the secondary and primary minima occur, respectively. The yellow filter has characteristics closely matched to the Strömgren "y" filter. Differential photometry was carried out in the usual manner using HD 185978 (F8; $m_V = +7^{\rm m}_{.}8$). This star had been used in previous photometric studies of the system and appears constant in light. The observations were corrected for differential extinction and the times were converted to Heliocentric Julian Day Number (HJD). The photometry was reduced using a program developed by G. P. McCook.

For illustration, the observations of the primary minimum is presented in Figure 1 in which the differential magnitudes, in the sense variable minus comparison star (V−C), are plotted against HJD for the yellow observations. The mid-times of the secondary and primary eclipses were determined by least squares fits of the minima with parabolas and also by bisecting cords (see Guinan *et al.* 1994). The two methods yield similar results for the blue and yellow data sets of each eclipse. The measured eclipse timings are:

$$\mathrm{T\ (Min\,I) = HJD\ 2447087.5669} \pm 0^{\rm d}_{.}0001$$
$$\mathrm{T\ (Min\,II) = HJD\ 2447085.5910} \pm 0^{\rm d}_{.}0001$$

These eclipse timings are very close to the times predicted using the light elements of Gimenez and Margrave (1985). Thus indicating that the ephemerides given by them are essentially correct.

We added these timings to the photoelectric eclipse timings already available (see Koch 1977; Khaliullin 1983; Gimenez and Margrave 1985; Guinan *et al.* 1987; Caton and Burns 1993; Lacy and Fox 1994). However, the last two timings were only of primary eclipse. We then recomputed the rate of apsidal motion for the system. This was done following the procedure of Guinan and Maloney (1985). Independent linear least squares solutions were made of the primary and secondary eclipses, respectively, yielding periods of P (min I) = 7.64075095 ± 0.00000082 days and P (min II) = 7.64072932 ± 0.00000359 days. The period determination from the primary eclipses is better determined than secondary eclipses because the primary eclipse has twice as many timings. A plot of the change of the displacement of secondary minimum from the half period point ($D = t_1 + t_2 - 0.5P$) is shown in Figure 2. This slow variation in the displacement of secondary minimum is due to advance of the line of apsides of the orbit and the data yields an apsidal motion rate of $\dot{\omega}_{obs} = 3^{\circ}_{.}52$/100yr $\pm 0^{\circ}_{.}72$/100yr. This value is nearly identical to those determined previously. The reason for the relatively large error is explained in two ways. First, there are only five independent timings of secondary minima and therefore the apsidal motion rate is still not well defined. Also, in calculating the errors, we took the uncertainties in both of the periods determined from the analysis of primary and secondary eclipses and propagated them through the equations to calculate the total uncertainty in the apsidal motion rate. More timings, in particular of secondary eclipses, are necessary to help define the apsidal motion rate more precisely, so we plan to obtain additional photometry of V1143 Cyg. In particular, we hope to obtain additional timings of the secondary minimum.

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NSV 07968 IS AN OVERCONTACT ECLIPSING BINARY STAR

The variability of NSV 07968 (BV 105, CSV 007493) was announced by Geyer et al. (1955) who indicated that this star was a possible Cepheid with a photographic magnitude variation from $10^{m}_{.}9$ to $11^{m}_{.}5$. According to Kholopov (1982), the spectral type of this object is A6. NSV 07968 can be unambiguously identified with GSC 3070.0345, a star with a photovisual magnitude (PAL-V1 filter) of 9.92 ± 0.40.

For 10 nights, from 6 May 1996 to 21 May 1996, NSV 07968 was observed in the V band using the 0.4-m telescope at Mollet del Valles Observatory (Spain) and a Starlight Xpress CCD camera. As comparison star was used GSC 3070.0265 with a photovisual magnitude (PAL-V1 filter) of 10.11 ± 0.40.

Observations show that NSV 07968 is not a Cepheid but an overcontact eclipsing binary star with a period over 8 hours. Phase curve shows that primary minimum is a transit with a $0^{m}_{.}28$ depth and secondary minimum is an occultation with an average depth of $0^{m}_{.}25$. It was also observed that Min. I has a distorted shape whereas shape and depth of Min. II changed from cycle to cycle during the observational period.

The following ephemeris was derived:

$$\begin{array}{rl} \text{Min. I} = \text{HJD}\, 2450219.5238 & +\ 0^{d}_{.}3825 \times E \\ \pm 0.0010 & \pm 0.0002 \end{array}$$

Light curve was preliminary solved using Binary Maker 2.0 (Bradstreet, 1993). For this purpose, the phase curve was reduced to 100 normal points by dividing it into 100 non overlapping identical intervals, and averaging individual observations within each interval. Average points were finally converted to flux. In computing the photometric solution the following parameters were initially adopted: a mean surface temperature T_1=8300K according to the spectral type of the system, and gravity darkening coefficients $g_1 = g_2 = 1$ and bolometric albedos $A_1 = A_2 = 1$, which correspond to stars with radiative external layers. Limb darkening coefficients x_1 and x_2 were set to 0.5.

Since there is no spectroscopic information about mass ratio, a search for the solution was carried out from q=0.13 to q=0.07, in mass ratio steps of 0.01 between q=0.13 and q=0.10, 0.005 between q=0.1 and q=0.08, and 0.0025 between q=0.08 and q=0.07. Simple inspection showed that there were no adequate solutions out of the search interval. As best fit criterion, minimum scatter of residual values obtained by subtracting the synthetic flux curve from normals points was used. Elements of the best solution are given in Table 1. Figure 1 shows superimposed phase and synthetic curves.

Solution of the light curve of NSV 07968 indicates that this object is an A-type W UMa system with one of the smallest known mass ratios. Additional spectroscopic and photometric observations should be carried out in order to more accurately determine the physical parameters of this binary star.

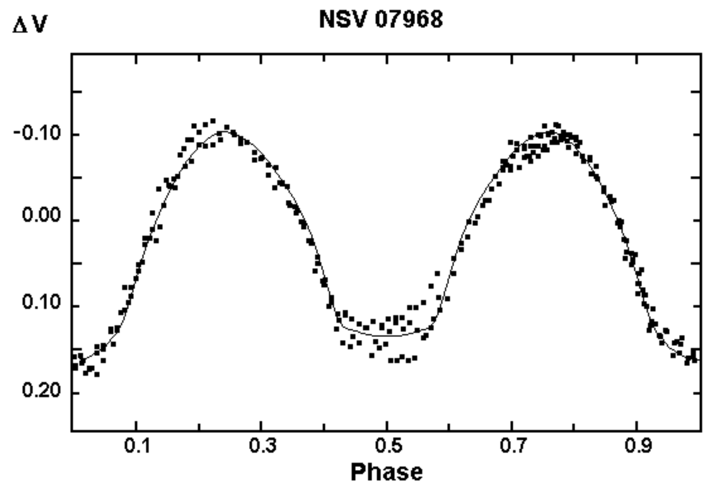

Figure 1

Table 1

mass ratio=0.0725±0.050
i=90°±10°
fill out=0.80±0.10

$Omega_1$=$Omega_2$=1.832±0.010
a_g=0.665±0.005 a_s=0.261±0.010
b_g=0.646±0.006 b_s=0.198±0.007
c_g=0.565±0.004 c_s=0.188±0.007
d_g=0.742±0.013 d_s=0.258±0.005
g_1=g_2= 1.0
x_1=x_2= 0.5
A_1=A_2= 1.0
T_1=8300K T_2=7950K±350K
L_1=0.9095±0.0010 L_2=0.0905±0.008

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THE NEW OVERCONTACT ECLIPSING BINARY STAR NSV 07457

Following the program initiated by the Grup d'Estudis Astronomics in 1995 in co-operation with the Esteve Duran Observatory Foundation, for observing poorly studied variable stars, NSV 07457 was monitored in the V band for 13 nights, from 24 March 1996 to 26 May 1996, using a CCD camera attached to the 0.3-m telescope at L'Estelot Observatory in L'Ametlla de Mar (Spain). To perform differential photometry, GSC 3497.0310 and GSC 3497.0239 were chosen as comparison and check stars, respectively.

Geyer et al. (1955) indicated that NSV 07457 (=BD $+50°2255$ = CSV 007268 = BV 0103) was a possible RR Lyrae type variable with a photographic magnitude variation from $9^{m}_{.}7$ to $10^{m}_{.}4$. The star can be unambiguously identified with GSC 3497.0263, an object with a photovisual magnitude (PAL-V1 filter) of 10.07 ± 0.40.

The present observations allowed to determine that NSV 07457 is not an RR Lyrae but an overcontact eclipsing binary star with a period over 11 hours. Primary minimum is an occultation with a depth of $0^{m}_{.}54$ and secondary minimum is a transit with a depth of $0^{m}_{.}51$. An O'Connell effect that amounts to Δm=Max. I$-$Max. II=-0.03 was also detected, where Max. I is at phase 0.25 and Max. II at phase 0.75.

The following ephemeris was also derived:

$$\text{Min. I} = \text{HJD}\,2450177.4767 + 0^{d}_{.}41906 \times E$$
$$\pm0.0004 \quad \pm0.00003$$

A preliminary model of NSV 07457 was computed using Binary Maker 2.0 (Bradstreet, 1993), applying the same analysis method described by Gomez-Forrellad and Garcia-Melendo (1996) after converting the phase curve to 200 normal points. The O'Connell effect and light curve asymmetries that frequently appear in overcontact binary systems are currently interpreted as bright or dark areas on the binary components. In this case, an initial unspotted solution was obtained, and finally a spotted model was recomputed.

Initially the following parameters were fixed to obtain the photometric solution: a mean surface temperature T_1=6000K, according to the spectral type G0 given by Kholopov (1982), and gravity darkening coefficients $g_1=g_2=0.32$ and bolometric albedos $A_1=A_2=0.5$, which correspond to stars with convective external layers. Limb darkening coefficients x_1 and x_2 were set to 0.6. Due to the lack of spectroscopic information about mass ratio, a search for the solution was carried out from q=3.0 to q=4.8 in mass ratio steps of 0.2.

Once the unspotted solution was reached, it was refined invoking a single spot. No further attempt was made to introduce more spots to improve light curve fitting. A co-latitude of 90° was fixed. Spot radius, colongitude and temperature factor were adjusted. It was found that light curve was best modeled with a hot spot on the secondary component. Elements of the best solution are given in Table 1. Table 2 lists spot parameters. Figure 1 shows the light curve of NSV 07457, and Figure 2 depicts the synthetic light curve superimposed on normal points.

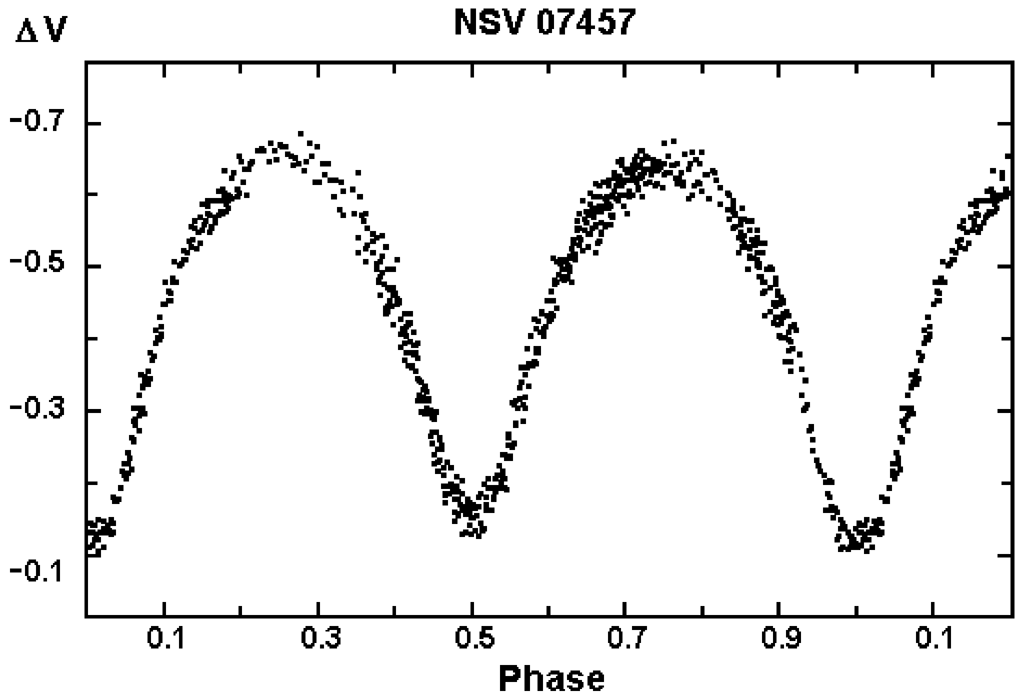

Figure 1

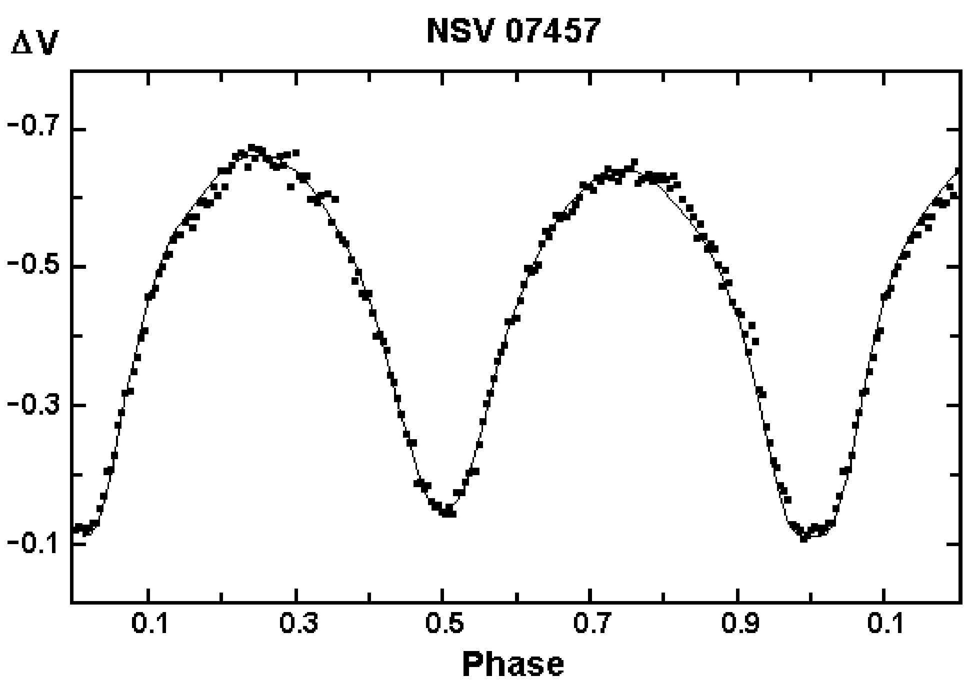

Figure 2

Table 1

mass ratio = 3.8 ± 0.2
i = 79.°0 ± 2.°0
fillout = 0.25 ± 0.10

$Omega_1$=$Omega_2$=7.499±0.200
a_g=0.543±0.011 a_s=0.315±0.001
b_g=0.515±0.010 b_s=0.274±0.001
c_g=0.475±0.008 c_s=0.262±0.001
d_g=0.633±0.005 d_s=0.367±0.005
g_1=g_2=0.32
x_1=x_2=0.6
A_1=A_2=0.5
T_1=6000K T_2=6280K±100K
L_1=0.720±0.01 L_2=0.280±0.007

Table 2

Colatitude = 90°
Colongitude = 45°
Spot Radius = 20°
T_f=1.14

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CCD PHOTOMETRY OF EIGHT SUSPECTED CATACLYSMIC VARIABLES

Several CV candidates were selected from the Palomar–Green Catalog (Green et al. 1986) and the New Catalogue of Suspected Variable Stars (Kholopov 1982) to confirm or reject photometrically their proposed CV nature and to search for orbital variability and eclipses. The observations were performed using the CCD camera on the Danish 1.5m telescope at the European Southern Observatory in Dec. 1988 / Jan. 1989 (Table 1). Differential instrumental magnitudes were then derived relative to nearby comparison stars on the same CCD image. We present here results for eight targets which are unlikely to be CVs.

PG0240+066

Spectrophotometry of this object (Zwitter and Munari 1995) revealed a hot continuum with Balmer absorption lines. An absorption line spectrum is often seen during an outburst of a CV, replacing the prominent emission lines at quiescence. But PG0240+066 showed its usual brightness. Photometric observations by Misselt and Shafter (1995) covering more than three hours did not show obvious variability exceeding a 0.02 mag level. Our photometry confirms their result. PG0240+066 is certainly a misidentification as a CV.

PG0248+054

This object showed spectrophotometrically (Zwitter and Munari 1995) the same behaviour as PG0240+066. Our photometric observations cover slightly more than two hours and give no evidence for any variability (scatter less than 0.01 mag). Also PG0248+054 is certainly not a CV.

PG0947+036

This object also proved to be constant in brightness during the nearly three hour observing run (scatter less than 0.03 mag) and is very probably not a member of the CV class.

NSV 00870

Haro and Luyten (1960) suggested this blue star (Var 10) to be a variable of the SS Cyg type. The photometry covering nearly three hours did not reveal variability above a 0.02 mag level. Therefore, our observations do not support the identification of NSV 00870 as a CV.

NSV 02853

Hoffmeister (1949) classified this star (S 3962) as a short period variable. A possible CV nature is assigned in the NSV catalogue. We observed this object for nearly two hours and found it to be constant in brightness (scatter less than 0.01 mag). NSV 02853 is very probably a misclassification as a CV.

NSV 03775

The variability of this star was detected by Hoffmeister (1949). The object is listed as a potential CV or RR Lyr star in the NSV catalogue. Our photometry demonstrates that it is an RR Lyr star. NSV 03775 dimmed steadily by approx. 0.44 mag during the 4.75 hours observing run (Figure 1).

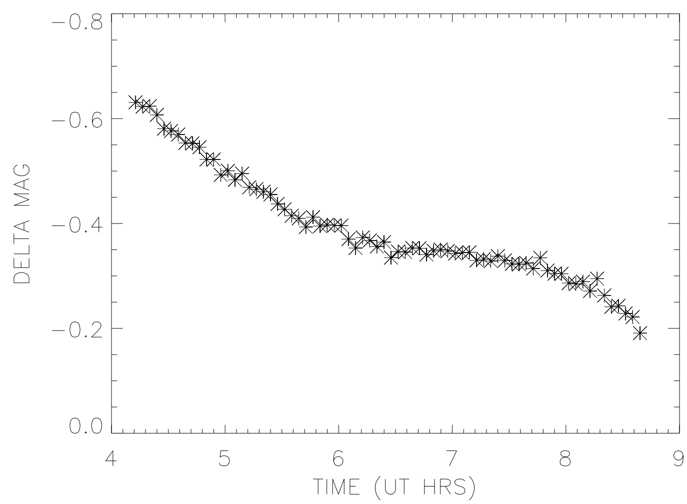

Figure 1. Light curve of NSV 03775 obtained on 1988 Dec. 31

NSV 04498

Luyten et al. (1968) regarded this blue object (LB 10776) as a U Gem star or, possibly, nova. Since no finding chart is available and no star could be found at the given position we probed several stars in the vicinity (in fact nearly all stars in the sparse field). None of them turned out to be variable. We conclude that either the coordinates from the literature are wrong or the magnitude of NSV 04498 is now beyond the detection limit of our frames (approx. 23–24 mag).

NSV 04884 = V411 Car = N Car 1953

Perek (1960) detected this nova as an emission line object on objective prism plates. Duerbeck (1984, 1987) traced its outburst history on Harvard plates and identified it on the corresponding ESO/SERC chart with a 19 mag star. Our two observing runs for this star (three nights apart, covering approx. three hours each) do not show any periodic or non–periodic variability. The star was constant within 0.02 mag and its relative brightness was the same for the two runs, an unexpected behaviour for a postnova. Assuming the identification as being correct we had a closer look at a three–dimensional representation of the brightness–profile of the star and found two bumps in the wings, one about 1.″5 towards NE and one about 2″ towards NW. Application of PSF techniques isolated two stars of approx. 21 and 22 mag respectively. One of these is presumed to be the postnova. From the scatter of the combined brightness of the three stars we place an upper limit on the variability of the two fainter ones at an approx. 0.1 and 0.3 mag level respectively.

Table 1. Journal of observations. Start is the time for the midpoint of the first exposure. Duration includes also gaps due to any interruption of the exposure series. Magnitudes (photographic) are from the literature. Observations were performed in integral light except for NSV 03775 where a Johnson B filter was used.

Object	Date	Start (UT)	Duration (h)	Int.Time (s)	Frames (No.)	Mag
PG0240+066	1988 Dec. 28	1:50	1.27	180	23	16.5
PG0248+054	1988 Dec. 30	1:09	2.23	180	35	16.2
PG0947+036	1988 Dec. 29	5:51	2.94	180	45	16.8
NSV 00870	1988 Dec. 27	2:11	2.75	180	45	18.1/19.5
NSV 02853	1988 Dec. 29	3:22	1.87	120/90	43	15.3/15.9
NSV 03775	1988 Dec. 31	4:13	4.44	180	73	13.8/16.0
NSV 04498	1989 Jan. 01	5:50	1.67	180	27	18.5
NSV 04884	1988 Dec. 27	5:29	2.84	120	63	19
	1988 Dec. 30	4:04	3.22	180	50	

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NEW OBSERVATIONS OF FOUR GALACTIC CEPHEIDS

We have obtained CCD observations of a number of Cepheid variables which have been mostly ignored, probably because they are unreachable with moderate size telescopes and photoelectric equipment. We have employed 14-bit CCD systems to obtain results for several Cepheids which did not have photoelectric light curves or had not been observed during the past 30 years or so.

We have chosen a series of comparison stars for differential observations and we include here simple statistics on their variability. Finder charts for the fainter Cepheids are sometimes difficult to obtain and we have included CCD finder charts of these Cepheids and comparison stars. Our finder charts should facilitate identification for future observations of these stars.

CCD observations were obtained with the Virginia Military Institute's 0.5 m DFM telescope, with a 14-bit Photometrics CCD system, and the U.S. Air Force Academy's 0.4 m DFM telescope, also with a 14-bit Photometrics CCD system. V and R filters were chosen to match the Johnson standard system with the CCD spectral response (Bessell, 1990). We obtained CCD images of a standard field in M67 (Schild, 1983) and have obtained satisfactory transformations to the Johnson system. Our observations have been transformed to the Johnson V and R system. (We had problems with some of the early V observations because of a bad filter; therefore, we have more R observations than V observations.)

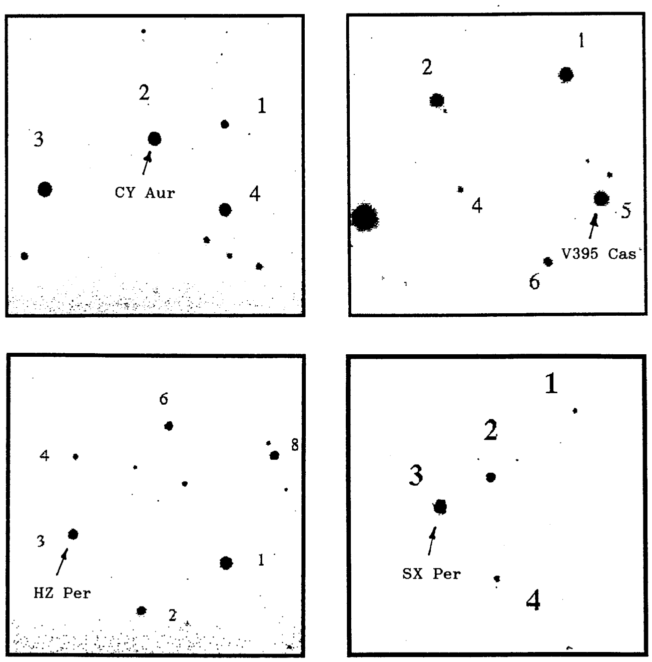

Figure 1. CCD finder chart for CY Aur, V395 Cas, HZ Per and SX Per. North is at top, east is at left. The image size is approximately 5' on each side

All CCD images have been flat fielded, and all but a couple of images have had bias and dark counts subtracted before flat fielding (no dark counts were discernible on the USAFA images). Exposures were standardized at four minutes for the VMI images, and six minutes for the USAFA images. Magnitudes were obtained at VMI with DAOPHOT, and at USAFA by summing counts inside a square aperture.

CCD finder charts for each of the Cepheids discussed below are shown in Figure 1. For some of these stars, we were unable to unambiguously identify the variable until we had a few images centered on the variable's coordinates, even using the Hubble Guide Star Catalog and GCVS positions. The R bandpass light curves are shown in Figures 2–5. The field of view of these finder charts (VMI images) is approximately 5 arcminutes; the original scale is 30"/mm. We found it difficult to compare our fields with some of the original finder charts from 30 or 40 years ago, since those finder fields (generally hand drawn or traced) often covered up to one degree and fainter stars were not shown. The effective bandpass was also generally different.

All stars on our images which were reasonably non-variable and bright enough for good statistics were used to form an average for each field (2 to 4 stars), which was then used to obtain a differential magnitude with the variable star.

Our light curves have been graphed at an arbitrary epoch to place maximum light at phase 0.0. The ephemeris used to calculate this phase is shown in the caption of each graph, where the zero epoch corresponds to the new normal maximum to aid in checking long-term period changes, or for comparison of peak light with other data. The periods used to calculate the phase in these graphs were obtained from the GCVS.

CY Aur. The finder chart appears to agree with that given in the GCVS. We could not find any photoelectric photometry of this Cepheid as we began this project, although we have now found observations from Berdnikov (1986) and Schmidt et al. (1995). A photographic light curve and the original finder chart are given in Kurochkin (1951). We graphed our R differential magnitudes in addition to R magnitudes from Berdnikov (these data were obtained from the Welch Cepheid database); see Figure 2. We shifted our differential measures arbitrarily (in magnitude) to correspond with his Johnson values. We found good agreement with his data, although some sections of the phase diagram are still inadequately covered.

V395 Cas. This Cepheid shows an exceptionally well-behaved light curve, especially in the R band. Although our light curve is poorly covered just before peak light, the rest of the curve is well defined. The comparison stars are also very stable. Our finder chart agrees with the original chart. We have also graphed the R data from Berdnikov (1992; data from Welch database); our differential data have been shifted by an arbitrary amount to coincide with Berdnikov's data. See Figure 3.

HZ Per. We located the original finder chart for HZ Per and there were no problems in identifying this star. We also graphed Berdnikov's (1993) data for comparison. The light curve is shown in Figure 4, and although the comparison stars we used are well behaved with a standard deviation of $0\overset{m}{.}04$ (in V), the light curve of the Cepheid is noisy, particularly on rising light on the red image.

SX Per. We have some misgivings about agreement with the original finder chart on this star, although there seems to be no doubt about having the correct star, since the period agrees. The light curve is shown in Figure 5. A light curve and finder chart are given by Kurochkin (1951); Henden (1980) also published photoelectric data for SX Per.

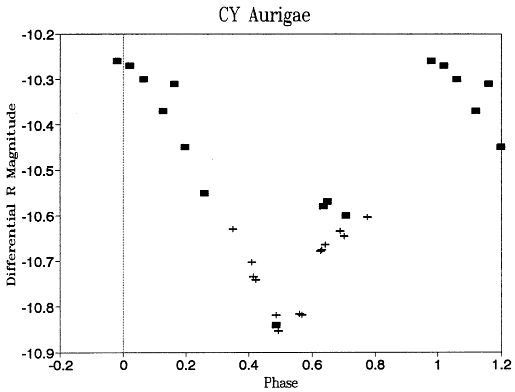

Figure 2. Light curve for CY Aur (R bandpass). Initial epoch is $\phi_0 = 2445643.0$ (Julian day), and the GCVS period is $13^{\mathrm{d}}.85$. Squares are our data, plus marks denote Berdnikov's observations

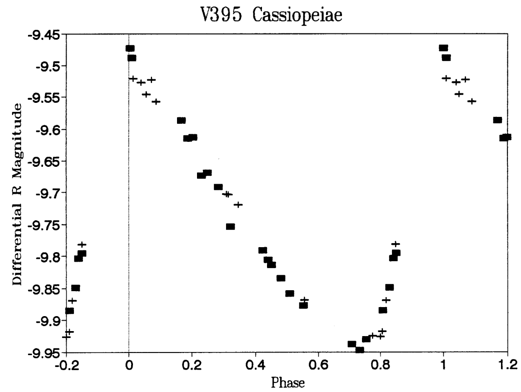

Figure 3. Light curve for V395 Cas (R bandpass). See Figure 2 for details. $\phi_0 = 2448099.0$ and GCVS period is $4^{\mathrm{d}}.038$

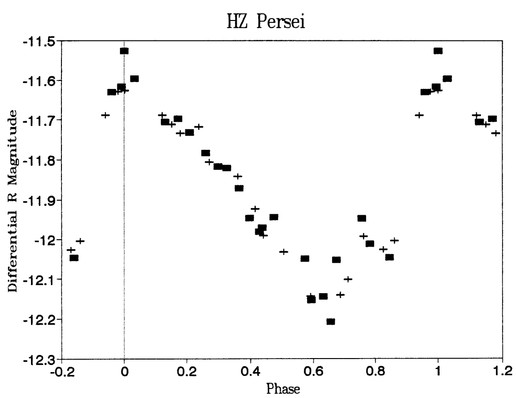

Figure 4. Light curve for HZ Per (R bandpass). See Figure 2 for details. $\phi_0 = 2448635.5$ and GCVS period is $11^{\mathrm{d}}.28$

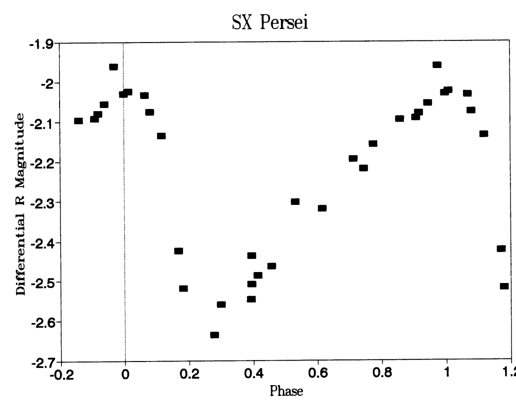

Figure 5. Light curve for SX Per (R bandpass). $\phi_0 = 2448646.0$ and GCVS period is $4^{\mathrm{d}}.289967$

Table 1. Standard Deviations of Comparison Star Differences

CY Aur		V395 Cas		HZ Per		SX Per	
Stars #1,3,4,5,7		Stars #1,2,6		Stars #1,2,4,6,8		Stars #1,2,4	
#1,3	$0^{\mathrm{m}}.030$	#1,2	$0^{\mathrm{m}}.006$	#1,2	$0^{\mathrm{m}}.029$	#1,2	$0^{\mathrm{m}}.048$
#1,4	0.029	#1,6	0.013	#1,4	0.023	#1,4	0.058
#1,5	0.092	#2,6	0.009	#1,6	0.015	#2,4	0.034
#1,7	0.102			#1,8	0.017		
#3,4	0.019			#2,4	0.044		
#3,5	0.084			#2,8	0.025		
#3,7	0.095			#4,6	0.021		
#4,5	0.075			#4,8	0.031		
#4,7	0.098			#6,8	0.023		
#5,7	0.124						

We have included a summary of our results with the comparison stars in our 5' CCD fields. In Table 1 is a listing of the standard deviations of our magnitude differences of comparison stars which we used to obtain differential magnitudes (R bandpass). We used the comparison stars shown in Table 1 to derive an average magnitude, which was then subtracted from the magnitude of the Cepheid. The V and R data have been deposited in the Welch Cepheid database (http://www.physics.mcmaster.ca/Cepheid/).

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CH CYGNI – A TENTH MAGNITUDE STAR!

CH Cygni is a peculiar binary system in which a magnetic white dwarf accretes matter from the M giant's wind moving on a long period highly eccentric orbit (Mikołajewski et al. 1996 and references therein). It is known as the brightest symbiotic star. During 1981–1984 its V brightness was about 5^m, and the star was seen even by the naked eye. Recently, its brightness dropped significantly and reached almost 10^m in visual, the dimmest value ever observed. Several periods of high activity separated by quiet ones have been observed since 1963. During the outbursts a hot F–A continuum and numerous emission lines dominated in the UV and optical. The late M giant in the system dominates the spectrum between active phases and shows different kinds of variability.

Photoelectric UBVRI and UBV observations were continued using the 60cm and 48cm telescopes at Toruń and Tartu observatories, respectively (see Leedjärv, Mikołajewski 1995, Mikołajewski et al. 1992). The UBVRI light curves covering the last decade are shown in Figure 1. After the 1985 eclipse (Mikołajewski et al. 1987), the star reached a quiet inactive state by the end of 1987, during which a pure M giant's 100^d pulsations with an amplitude of $0\overset{m}{.}7$ started to dominate the BV bands. During 1989–1991 the star showed some transitory (1–3 months) episodes of activity clearly visible in U light. Starting from the early 1992 a relatively strong and long activity period has been developing with two gaps in the ends of 1992 and 1994. An additional F–type supergiant continuum from the hot component (Kuczawska et al. 1992) has modified the light curves in all wavelengths. Kuczawska et al. have also demonstrated evidence of a flickering down to the RI bands in July 1992.

In the mid–1995 the hot continuum dropped rapidly. During the last three-four 100^d pulsations of the M giant, which are of a similar shape and amplitude as were previously observed between 1987 and 1990 (Mikołajewski et al. 1992), those pulsations became the main features in the BV light curves.

Another pronounced variability of the M giant is probably connected with occupation of the star's surface by large cool spot (or spots) and the rotation of the star with a period of about 760 days (Mikołajewski et al. 1992). We have found all observed broad minima of this periodicity using all available photoelectric data (Mikołajewski et al. 1990, 1992 and references therein). In BV filters minima were observed during inactive phases, only. Only two out of 12 minima (Table 1) are not compatible with this periodicity. At least the last one (JD 2449785) is probably caused by drop of earlier observed F–type continuum of the active component. From the other minima in Table 1 we have obtained the following ephemeris:

$$\begin{array}{ll} \text{JD Min}(760) = 2446549 + 746.8\times\text{E} & \quad (1) \\ \qquad\qquad\qquad\quad \pm30 \qquad \pm3.5 & \end{array}$$

The O−C values for this ephemeris are also listed in Table 1. The 747^d period is practically the same as the value of 749 days found by Hinkle et al. (1993) which they interpreted as an orbital period of an inner symbiotic pair on eccentric orbit in their triple–star model of CH Cygni.

Table 1. Observed minima of the 747^d periodicity

E	Min JD2400000+	Filters	O − C days	E	Min JD2400000+	Filters	O − C days
−9	39820	BV	−8	0	46535	VRI	−14
−8	40535	BV	−40	1	47295	BVRI	−1
(?)	(41135)	BV	(−186)	2	48030	BVRI	−13
−7	41355:	BV	+34	3	48735	RI	−54
−6	42080	BV	+12	4	49595	RI	+59
−5	42840	BVI	+25	(?)	(49785)	RI	(+249)

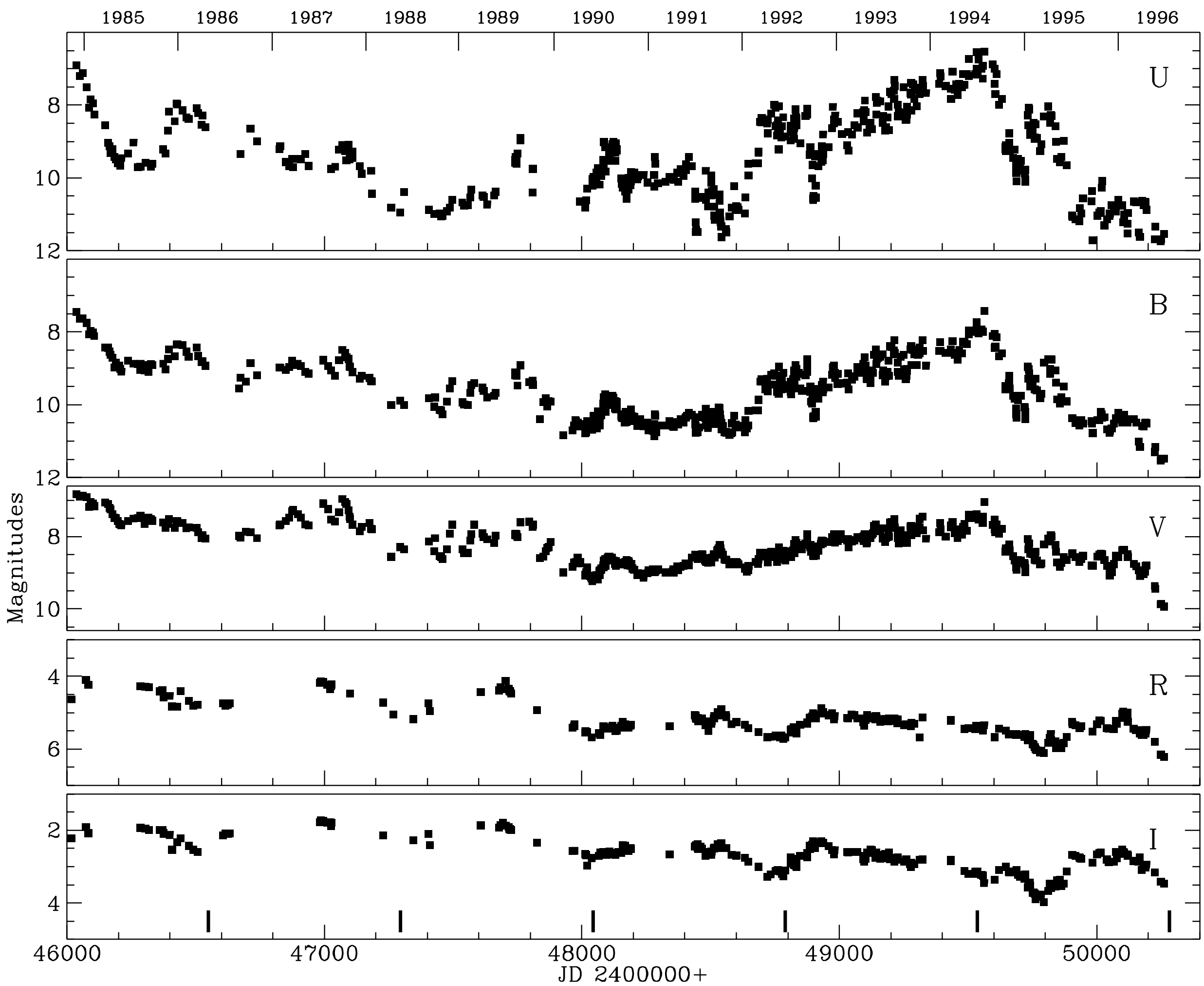

Figure 1. The UBVRI light curves of CH Cygni including the last minimum in June 1996. In the lowest box the calculated minima from ephemeris (1) are marked.

Apart from an increasing period of pulsation, Mikołajewski et al. (1990, 1992) have found another evidence of a luminosity pulse produced by a helium–flash on the AGB for the M giant in CH Cyg — a systematic decrease in the optical light on the time scale of hundred years. The rate was estimated to be about $0^{m}.60$/100yr in the visual from historical data, and seems to achieve at least 1^{m}/100yr during the last decade.

In conclusion, the minimum of brightness observed in June 1996 is a result of (1) inactivity of the hot component, (2) secular decline of the M giant's brightness, and (3) coincidence of the minima of 747^{d} periodicity (rotation) and 100^{d} pulsation. In Figure 2 we show V magnitudes, together with U−B and B−V indices during last two years. We have marked two last minima with epoch $E = 4$ and $E = 5$ calculated from Eq. 1 and last four (from $e = 87$ to $e = 90$) minima predicted by the quadratic ephemeris:

$$\text{JD Min}(100) = 2440935.3 + 102.41e + 0.0140e^2 \qquad (2)$$

for the M giant's pulsations (Mikołajewski et al. 1992). The last three pulsation minima are evidently visible in the V light. Observed minima confirm the systematic increase of the pulsation period, which reaches now almost 105^{d}. Taking into account the secular decrease of brightness in the optical we can predict from Eqs. (1) and (2) the next coincidence of minima in July 1998, when an even deeper minimum should be observed (if the hot component remains inactive).

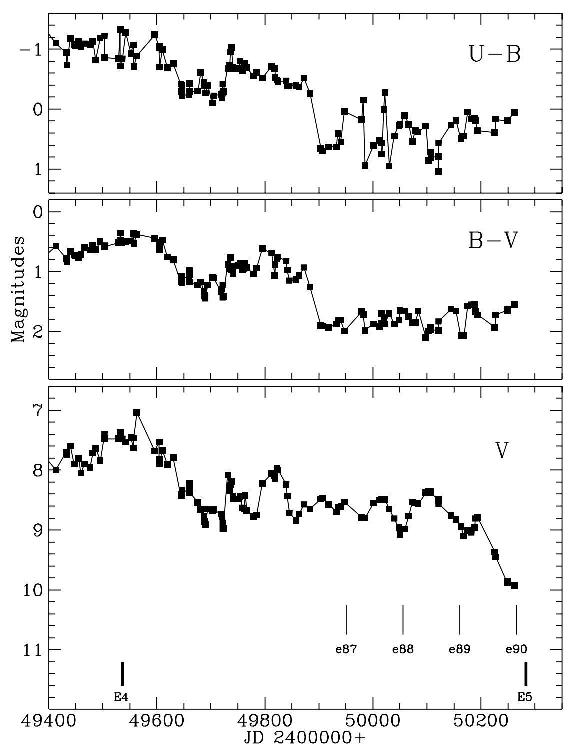

Figure 2. The V light curve and U−B and B−V indices of CH Cyg during last 2.5 years. Last epochs of minima from ephemerides (1) and (2) are marked as E and e, respectively.

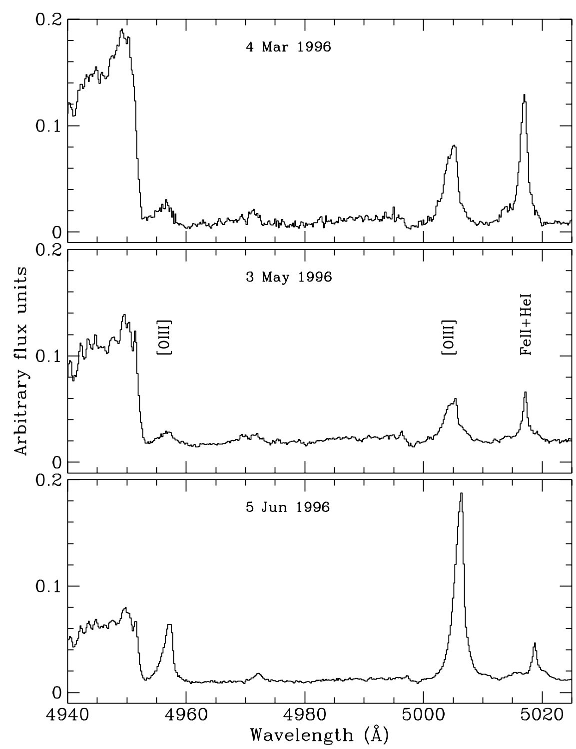

Figure 3. The [OIII] 4959 Å and 5007 Å region in the spectrum of CH Cygni.

Spectral observations during the last three years were carried out with a CCD–camera mounted in the coudé-spectrograph of the 2m telescope at NAO Rozhen. In Figure 3 the behaviour of the nebular lines of [OIII] 4959 Å and 5007 Å as well as the changes in the hot veiling continuum, during the drop of star's brightness in May–June 1996 are shown. It is obvious, that the flux in the continuum decreases during all the time and that the [OIII] nebular lines reached a maximum intensity coinciding with the light minimum in June 1996. At the same time, a nebula extended to about $30''$ was observed in the optical by Corradi & Schwarz (1996). Variations in the intensity, profile shapes and strong dependence on the slit orientation for the nebular lines of [OIII] were observed in 1994 (Tomov et al. 1996). So, it is evident that there is a significant amount of relatively low density matter around the CH Cyg system, which may be responsible for the origin of the nebular lines.

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THE 1994 SUPEROUTBURST OF RZ SAGITTAE

RZ Sge has been known as an SU UMa-type dwarf nova since the discovery of superhumps during the 1981 superoutburst (Bond et al. 1982). Since no further photometric study of this object has been published so far, we undertook time-resolved CCD photometry during the 1994 August superoutburst in order to refine our knowledge on this object.

Observations were carried out using a CCD camera (Thomson 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 dead time, an on-chip summation of 2×2 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 40 and 100 s depending on the brightness of the object; the read-out and data-saving time was typically 13 s. A total of 725 useful object frames were obtained on 6 nights between 1994 August 11 and 18.

Table 1. Journal of observations of RZ Sge

Date			Start		End		Exposure	Frames
			h	m	h	m	(s)	
1994	August	11	12	44	16	49	40	102
		12	10	21	15	12	40	168
		13	13	09	13	42	40	34
		14	10	22	13	25	40	205
		15	10	18	13	27	40	167
		18	13	21	14	55	100	49

These frames were, after corrections for standard de-biasing and flat fielding, processed by a microcomputer-based aperture photometry package developed by the author. The differential magnitudes of the variables were determined using the local standard star (C1 in Figure 1) whose magnitude was given as V=12.83 by Misselt 1996). 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 0.01 mag for a single frame on ideal nights. Heliocentric corrections to the observed times were applied before the following analysis.

The overall light curve constructed from our observations is shown in Figure 2. The light curves shows a slow linear decline with a rate of 0.097 mag day^{-1}, characteristic to a superoutburst of an SU UMa-type dwarf nova, followed by a rapid decline on August 18. Detailed light curves on individual nights are shown in Figure 3, clearly demonstrating the existence of superhumps with amplitudes of 0.20 – 0.25 mag, and recurring every 0.070 day. The amplitude of superhumps seem to have attained a maximum on August 14, four days before the termination of the superoutburst. Such a late growth of superhumps may be related to a similar phenomenon observed in a large-amplitude SU UMa-type dwarf nova, V1028 Cyg (Baba et al., in preparation).

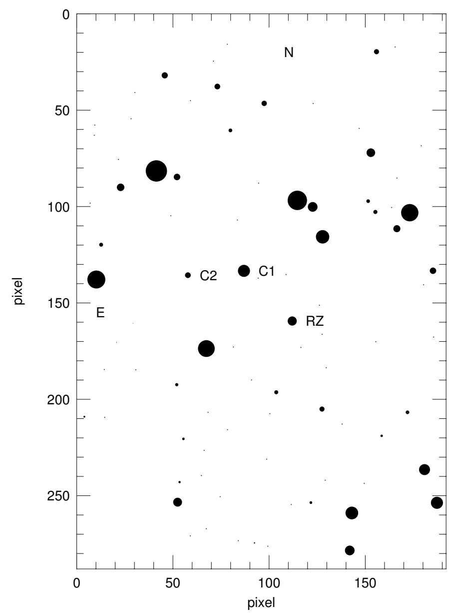

Figure 1. Finding chart of RZ Sge drawn from a CCD image. North is up, and the field of view is about 10×7 arcmin. The comparison stars (C1, C2) and RZ Sge (RZ) are marked.

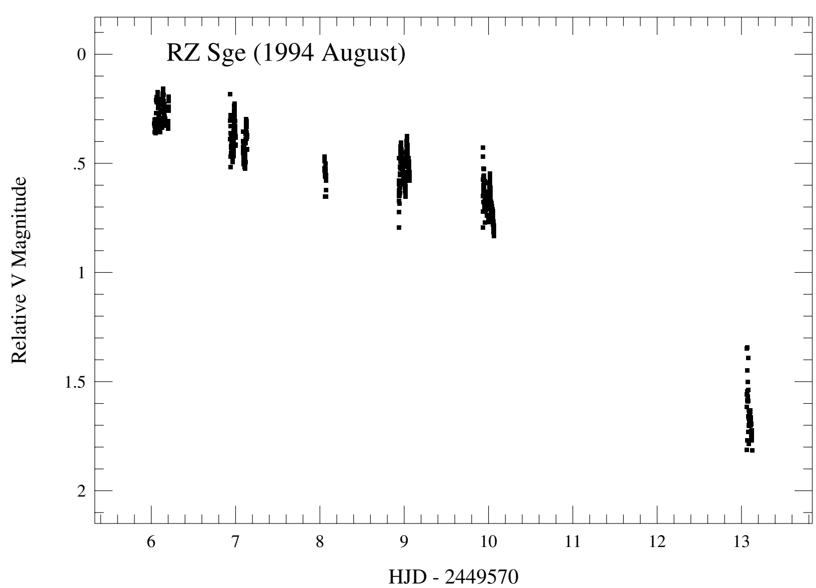

Figure 2. Overall *V*-band light curve of RZ Sge during the 1994 August superoutburst. The zero corresponds to V=12.83

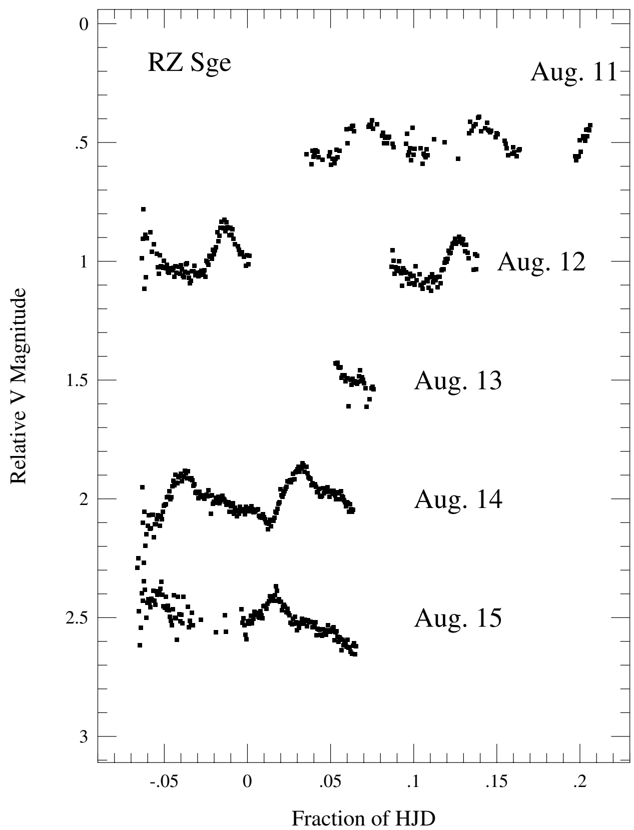

Figure 3. Detailed V-band light curves of RZ Sge. Each light curve is offset by 0.5 mag

After removing a linear trend of decline, a period analysis was applied to observations using the Phase Dispersion Minimization (PDM) method (Stellingwerf 1978) for the August 11 – 15 data. The resultant theta-diagram is shown in Figure 4. The lowest minimum at a frequency of 14.200 day^{-1} corresponds to a period of 0.07042 $\pm$ 0.00002 day (=101.4 min), giving a slightly longer period than published by Bond et al. (1982). This value is slightly different from that determined by the maxima times of superhumps (cf. Table 2, caption). This is because the PDM uses data points distributed in all phases whereas maxima times rely only on points around maxima. The periods determined using these two methods may be systematically different when the profile of (semi-)periodic signals varies, as is usual for superhumps. We have adopted the PDM value since this method usually gives better statistics than the other.

Table 2. Observed superhump maxima of RZ Sge. O$-$C$_1$ and O$-$C$_2$ are calculated by equations of $Max(HJD) = 2449576.986 + 0.07053E$ and $Max(HJD) = 2449576.985 + 0.07081E - 7.0 \times 10^{-6}E^2$, respectively

HJD	E	O$-$C$_1$	O$-$C$_2$
2449576.985	0	-0.001	0.000
49577.127	2	0.000	0.000
49578.962	28	0.001	0.000
49579.033	29	0.002	0.000
49580.017	43	-0.002	0.000

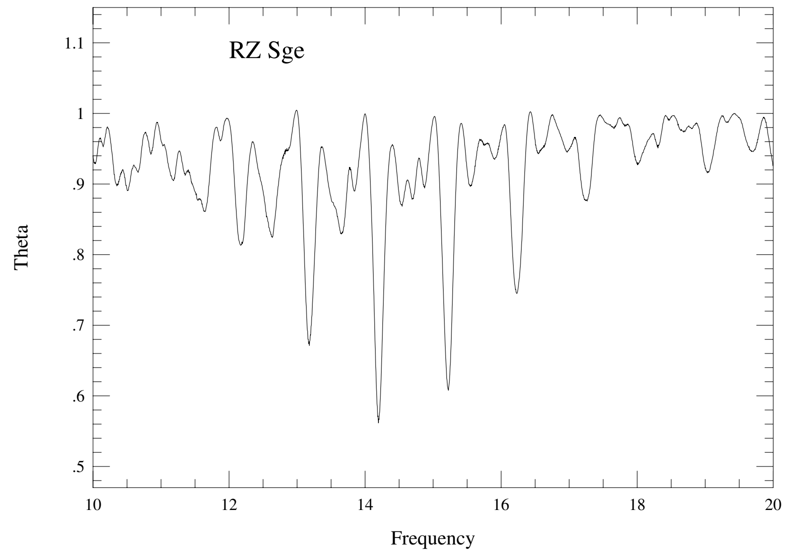

Figure 4. Theta diagram (Stellingwerf 1978) of period analysis

By applying least-squares fitting to five well-observed maxima times of superhumps, we obtained the following ephemeris of maxima times:

$$Max(HJD) = 2449576.985 + 0.07081E - 7.0 \times 10^{-6}E^2,$$

which corresponds to $\dot{P}$ of $-10(\pm 2) \times 10^{-5}$. This value is within the usual range of period changes of superhumps in SU UMa-type dwarf novae (Patterson et al. 1993).

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PHOTOMETRY AND ASTROMETRY OF VARIABLE STARS

The Carlsberg Automatic Meridian Circle on the Canary Island of La Palma makes thousands of measurements of star positions and V magnitudes each year and the results have been published in a series of catalogues (CMC4 1989; CMC5 1991; CMC6 1992; CMC7 1993; CMC8 1994). Amongst these stars are several thousand variable stars. A specific programme of measuring the positions of variable stars with maxima in the range V=12 to 14 was started in 1995. This range was chosen to include stars which are too faint to be observed by the HIPPARCOS satellite.

This note is to draw the attention of those interested in both astrometry and photometry of variable stars that the compilation of these results will be available soon from the CAMC group and also to point out that a substantial archive of variable star photometry is already available in the Carlsberg Meridian Catalogues.

Photometry is carried out through a Johnson V filter (see Helmer and Morrison (1985) for full details of the passband). Nightly calibration is made using about 50 photoelectric standards. A colour equation is derived for each annual catalogue allowing corrections to be made if the spectral type of the star is known. If no spectral type is available the star is assumed to have a B$-$V colour index of $+0\overset{m}{.}5$. Mean errors range from about 0.05 magnitude for a single observation at the zenith of stars of V = 10^m or brighter, to about $0\overset{m}{.}40$ for a star near the limiting magnitude of V=15. The results presented in an Appendix in each Carlsberg Meridian Catalogue give the observed V magnitude on each photometric night for all stars known to be variable.

Positions are made by reducing observations differentially with respect to a grid of FK5 stars. The accuracy of the position also depends on the brightness, the zenith distance and the number of observations made. A typical value for a star of V = 13^m observed at the zenith on 6 nights is $0\overset{''}{.}07$ in RA and $0\overset{''}{.}08$ in Dec. The CAMC can observe stars from $+90°$ to $-40°$ declination. Proper motions are also listed in the catalogues when first epoch positions are available (usually from the Astrographic Catalogue). The data taken by the CAMC between 1984 and 1995 is being prepared for inclusion on a CD-ROM which will be available in the near future. It will contain entries on 138,603 stars of which 2,457 are recognised variables. The total number of photometric observations of these stars is 33,406. An additional 175 observations of 15 recent novae and supernovae are also included. In the meantime the CAMC group below will be glad to deal with any enquiries for data from individuals.

For further information contact the author at the address below or by E-mail to: merlp@ast.cam.ac.uk

The CAMC project also has a WWW page at http://www.ast.cam.ac.uk/ dwe/SRF/camc.html

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Carlsberg Meridian Catalogue No 7. Observations of positions of stars and planets: Jan 1991 to Aug 1992. (CMC7), 1993. Copenhagen University Observatory, Royal Greenwich Observatory and the Real Instituto y Observatorio de la Armada en San Francisco.

Carlsberg Meridian Catalogue No 8. Observations of positions of stars and planets: Aug 1992 to Dec 1993. (CMC8), 1994. Copenhagen University Observatory, Royal Greenwich Observatory and the Real Instituto y Observatorio de la Armada en San Francisco.

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1995 BVRI PHOTOMETRY OF CG CYGNI

CG Cygni (# 177 in the catalog of Strassmeier et al. 1993) is a member of the short period eclipsing RS CVn class of stars. Zeilik et al. (1994) model the spot structure for available data from 1922 to 1993 and review the literature on this star. Heckert (1994) models 1994 BVRI data. Continuing with this work, I observed CG Cyg on the nights of 13, 14, 15, and 16 August 1995 with the San Diego State University 61-cm telescope on Mt. Laguna. The instrument and procedure were the same as described in Heckert (1994). The data, plotted in Figures 1 and 2, are differential magnitudes (variable−comparison) in the standard Johnson-Cousins system. The data files may be obtained from the author. I modeled the data using the Information Limit Optimization Technique (ILOT) described in detail by Budding and Zeilik (1987). I extracted a distortion wave from the initial binary star fit, then fit the distortion wave for the longitude, latitude, and radius of a 0K circular spot. Figures 3 and 4 show these fits for the V band. Performing the fits for each wavelength independently, I get the spot fits summarized in Table 1.

Table 1. Spot fits

	B band	V band	R band	I band
Longitude	260.2±2.7	260.4±2.8	258.7±3.3	256.5±3.4
Latitude	55.4±8.9	55.7±8.6	53.0±20.7	51.9±15.2
Radius	19.2±2.9	18.3±2.5	16.7±4.6	15.1±2.8
χ^2	266.6	188.6	175.4	136.6

Table 2. Clean fits

	B band	V band	R band	I band
U	0.923±0.003	0.942±0.002	0.949±0.002	0.963±0.002
L_1	0.701±0.040	0.690±0.038	0.693±0.040	0.694±0.017
$k(=r_2/r_1)$	0.881±0.094	0.837±0.077	0.800±0.079	0.778±0.074
r_1	0.259±0.013	0.266±0.011	0.270±0.011	0.271+0.010
i(deg)	82.6±1.0	82.5±0.9	82.6±1.0	82.5±1.0
L_2	0.223±0.042	0.252±0.040	0.256±0.042	0.269±0.041
$q(=M_2/M_1)$	0.828±0.199	0.782±0.173	0.817±0.182	0.825±0.188
χ^2	219	144	127	87

The models in the different bands agree to within the errors. Zeilik et al. (1994) find that the spots for CG Cyg tend to cluster in Active Longitude Belts (ALBs) at 90° and 270°. These models show the same phenomenon. Compare the 1995 spots to those in 1994. Heckert (1994) finds two spots in 1994. The spot that was in the 90° ALB during

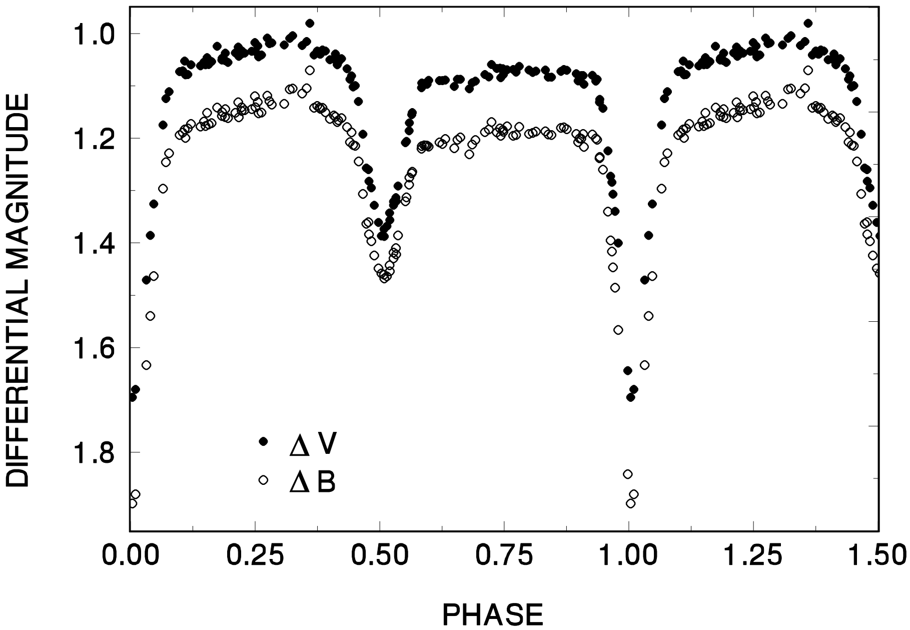

Figure 1. CG Cyg 1995 B and V light curves

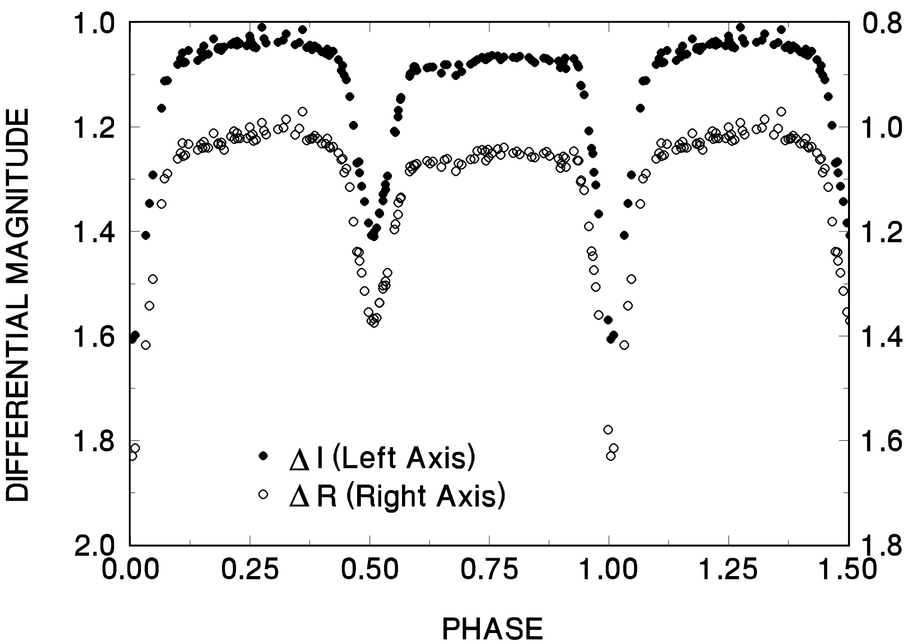

Figure 2. CG Cyg 1995 R and I light curves

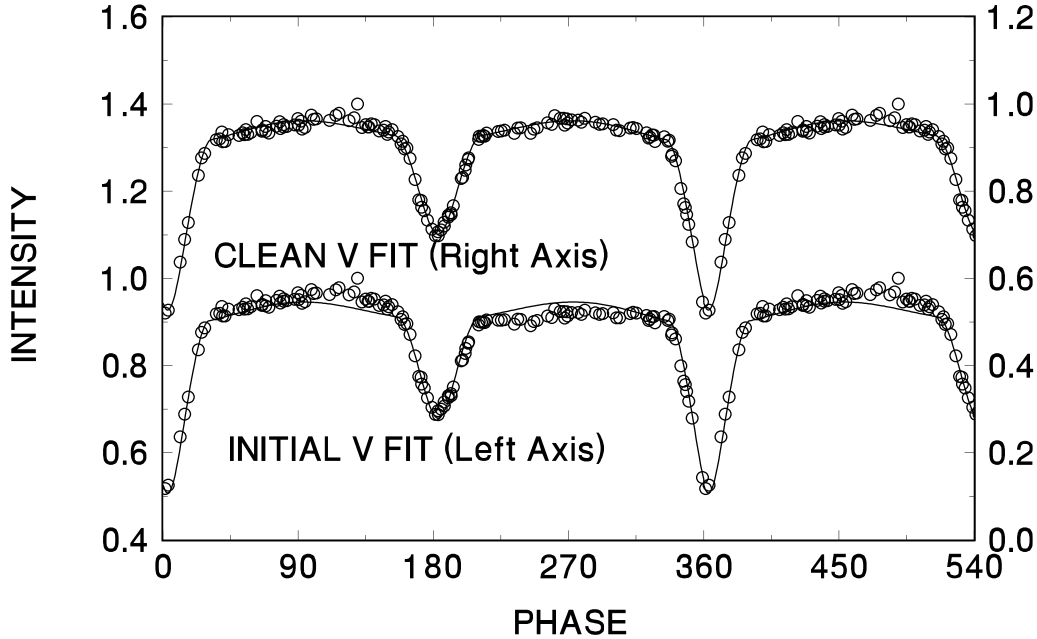

Figure 3. CG Cyg 1995 V band initial and clean fits

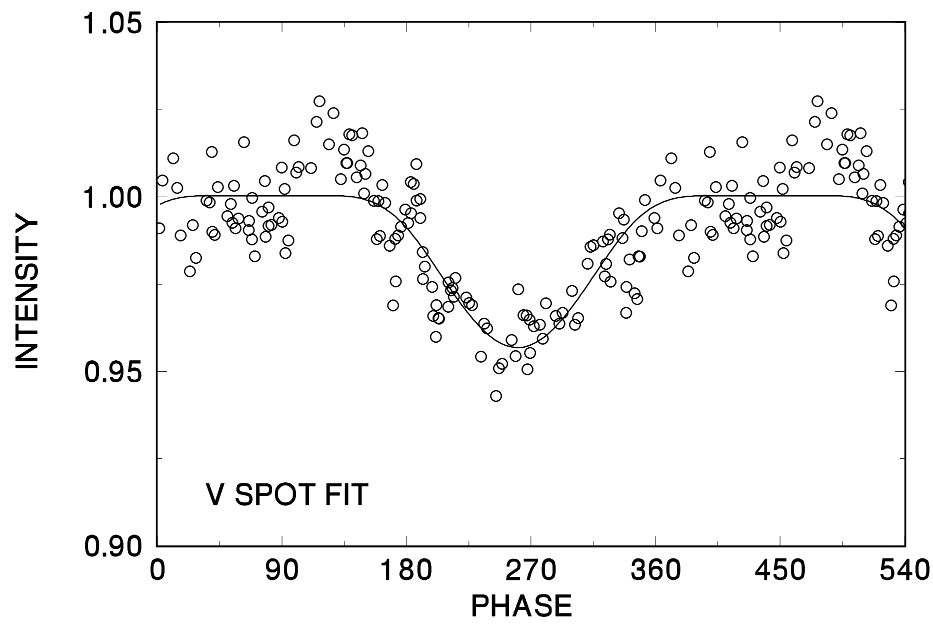

Figure 4. CG Cyg 1995 V band spot fit

1994 disappeared. At the same time, the spot in the 270° ALB roughly doubled in radius (from 9° to 18° at V). It however remained, to within errors, at the same longitude and latitude. After performing the spot fits, the effects of the distortion wave were removed and clean fits were made to the corrected light curve. I get the clean fits summarized in Table 2.

For easy comparison, Table 3 shows the average values of the clean fits for the color independent parameters from this work, Heckert (1994), and Zeilik et al. (1994). The errors quoted are the standard deviations of the values averaged rather than the errors returned from the ILOT program. Most previous values of the mass ratio are 1.0 (Naftilan and Milone 1985, Sowell et al. 1987). Jassur (1980) gets 0.95 and Popper (1993) gets 0.84. Zeilik et al. (1994) adopted 1.0 and did not fit for the mass ratio. This work and Heckert (1994) lend credence to the lower value of the mass ratio found by Popper (1993).

Table 3. Means for Clean Fits

	$k(=r_2/r_1)$	r_1	i(deg)	$q(=M_2/M_1)$
This Work	0.826±0.048	0.267±0.006	82.6±0.1	0.813±0.022
Heckert (1994)	0.864±0.068	0.252±0.012	82.8±1.3	0.530+0.070
Zeilik et al. (1994)	0.939±0.074	0.239±0.010	83.0±1.8	1.0(fixed)

The ILOT program also makes a best fit correction to the phase of primary minimum. From this information averaged over 4 wavelengths, I find that the eclipses are observed 0.0054±0.0002 days after they are computed to occur during this epoch.

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HD 112082: A NEW SEMIREGULAR VARIABLE

We report the discovery of the variability of the star HD 112082. The object has been observed as a comparison star for the semiregular variable TU CVn, but turned out to be variable.

Although HD 112082 is a rather bright object ($m_V = 7^{m}_{.}45$) its variability was unknown. Schild (1973) found a spectral type of M3III while the SAO catalogue gives M0. The General Catalogue of Radial Velocities lists a radial velocity of −25.6 km/s. The star has been observed by IRAS. Its [12]−[25] colour index of $0^{m}_{.}11$ indicates that this object has no circumstellar dust.

The observations were obtained by using the Phoenix 10 Robotic Telescope at Mt.Hopkins in spring 1996. The telescope observes in the Johnson *UBV* system using a diaphragm of 60″ in diameter. The internal standard error of the data lies below 20 mmag. As check star for our comparison star we used HD 112570, a K0 giant with $m_V = 6^{m}_{.}12$.

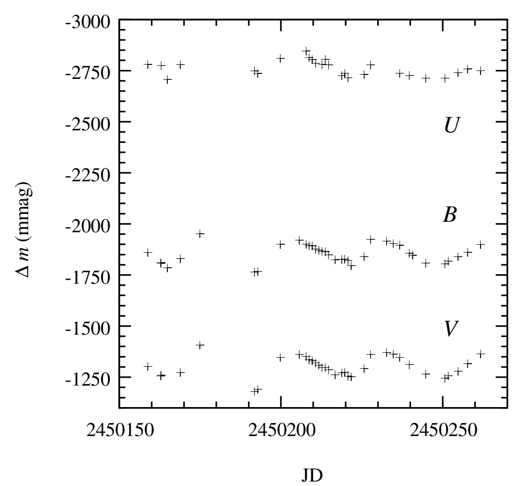

Figure 1. Observed light changes of HD 112082 relative to HD 112570 in Johnson *U, B* and *V*

Without having a second nonvariable star for comparison we can only suspect that HD 112082 is the variable object. The six published values for the *V* brightness of the K-giant differ by less than $0^{m}_{.}04$ and in addition, Eggen (1992) found that most of the M-type giants are variable. Thus the variability of HD 112082 seems to be very likely. Due to the absence of an observer at the telescope we had to check the possibility of a misidentification.

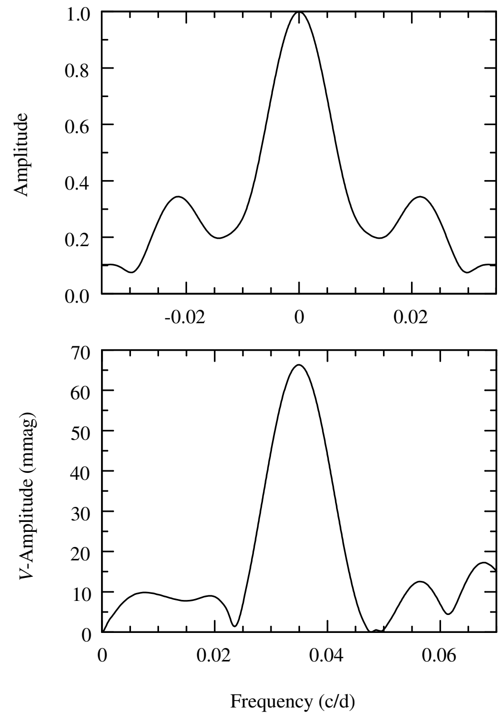

Figure 2. Results of the Fourier analysis of the observational data. The upper plot shows the spectral window, the lower plot the amplitude spectrum

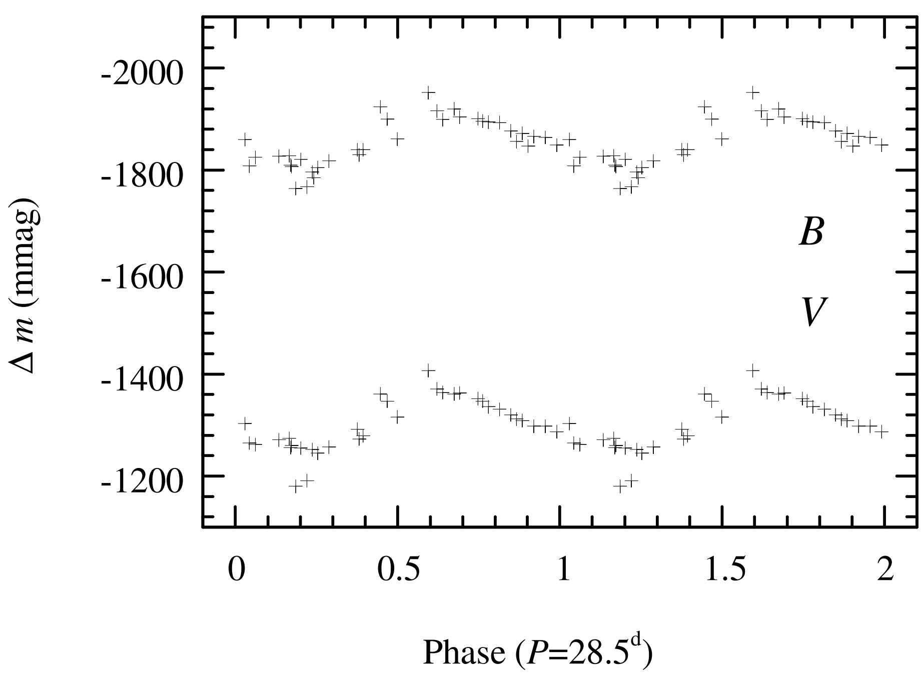

Figure 3. Phase diagram for HD 112082 based on a period of 28.5 days. For a better illustration of the variation the data points have been repeated for a second cycle

Influence by a nearby object or a wrong pointing of the telescope can be excluded: No nearby object is bright enough to disturb the measurement. The measured $B-V$ value of about $1\overset{m}{.}55$ for the variable is typical for early M-type stars and is very close to the data found in the literature (Schild 1973). But there is no M-type star within 1 degree, except the 'original' program star, TU CVn. Therefore we are convinced that the correct star has been observed.

Figure 1 shows the variations measured relative to HD 112570 in U, B and V. The star varies cyclically with a full amplitude of about $0\overset{m}{.}14$. Two light cycles are well defined, a third one is sampled more sparsely. The light curve shows a strong asymmetry which seems to change after JD 2450250. The $B-V$ color index is changing irregularly only up to about $0\overset{m}{.}02$, and these variations are within the observational errors.

In order to derive a period for the light variations we did a Fourier analysis of the data. The results for the V measurements are plotted in Figure 2. From this analysis we found a period of about 28.5 days. The B data lead to a very similar result. With this period we plotted a phase diagram for the B and V measurements (Figure 3).

We think that HD 112082 is a semiregular variable of type SRb due to its small amplitude although its light changes seem to be rather regular. Using the classification for SRVs defined by Kerschbaum and Hron (1992) we classify this star as 'blue' SRV. This classification is based on the amplitude, the period and the IRAS [12]–[25] color. All these values found for HD 112082 are typical for 'blue' SRVs.

The fact that the variability of such a bright star has not been discovered earlier is very interesting for the investigation of semiregular variables, because it indicates that even samples of bright SRVs are not complete.

Acknowledgements:
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LONG-TERM BEHAVIOR OF THE ECLIPSING BINARY PX CEPHEI

PX Cep is an eclipsing binary whose variability was discovered by Romano (1958a, 1958b) and was given the preliminary name GR31 (Kholopov 1978). According to the GCVS its photographic magnitude varies between $12^{m}_{.}2$ and $13^{m}_{.}7$. The position of the variable is given as $21^{h}34^{m}54^{s}+65°36'00''$ (B1950.0), but at this location no star brighter than 15^{m} can be found, neither on the Sonneberg astrograph plates, nor in the POSS database[1] (see Figure 1).

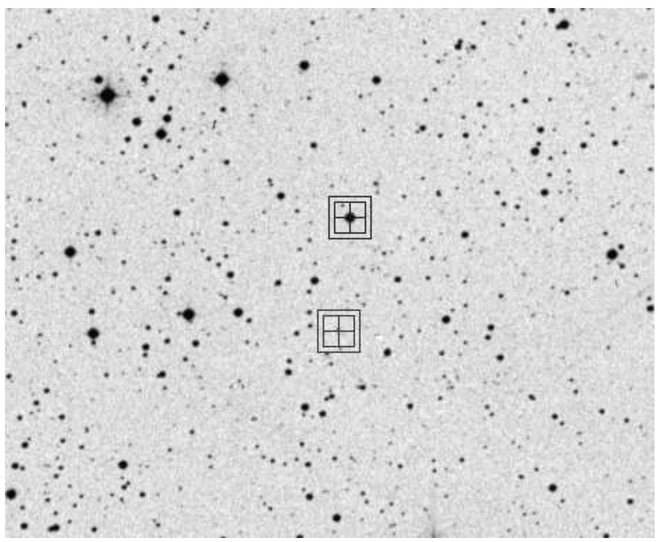

Figure 1. POSS section containing PX Cep (upper box) and its position as given in GCVS (lower box). The size of the field is approximately $13' \times 11'$. North at the top, East to the left.

Using the discoverer's finding chart, PX Cep was found at the coordinates

$$21^{h}34^{m}51^{s}_{.}8 \quad +65°38'14'' \quad (B1950.0)$$
$$\text{or} \quad 21^{h}35^{m}58^{s}_{.}1 \quad +65°51'43'' \quad (J2000.0), \quad \text{respectively,}$$

and is identical with GSC 4261_1335.

[1] http://arch-http.hq.eso.org/cgi-bin/dss

In Table 1 we summarize the elements for PX Cep as given in the literature.

Table 1. Elements for PX Cep

epoch (HJD)	period (d)	mag	reference
2436098.33	unknown	12.2–13.7 (pg)	GCVS
2446270.440	3.126993	12.24–14.64 (V)	Boninsegna (1987)
2446680.402	3.126905	—	Borovička (1995)

Borovička (1995) collected all minima given in the literature. There is a large gap between 1959 and 1985, for which time interval no observations have been published so far. Borovička found an O−C, that suggested a changing period.

In an attempt to fill the gap in the data, PX Cep was measured on about 600 photographic plates from the Sonneberg plate collection, taken between 1957 and 1995. For the determination of the target's minima, Argelander's method was applied using the comparison stars as given by Romano (1958a, 1958b). On 48 plates PX Cep was found to be fainter than $13^{m}_{.}0$ (see Table 2). As can be stated from inspection of the light curve published by Boninsegna (1987), the star reaches this magnitude approximately $0^{d}_{.}1$ before minimum. Thus, any detection of the target to be fainter than $13^{m}_{.}0$ provides the time of minimum within an accuracy of $0^{d}_{.}1$, this is $\varphi = \pm 0.031$ (see dotted lines in Figure 2).

Table 2. Times of minima found on Sonneberg plates (HJD)

2436814.464	2439053.391	2441983.345	2446270.497
2436839.410	2439350.521	2442602.497	2446320.405
2437577.421	2439597.569	2442627.483	2446714.376
2438243.511	2439672.498	2443340.472	2448093.498
2438268.544	2440066.508	2444172.261	2448096.505
2438290.449	2440088.430	2444541.293	2448512.403
2438315.383	2440457.488	2444816.464	2448534.366
2438587.506	2440504.398	2444985.236	2448537.390
2438709.354	2440504.428	2445138.501	2448559.300
2438709.384	2440507.413	2445163.439	2448559.360
2438753.271	2441517.479	2445676.273	2449250.379
2439031.501	2441567.451	2445973.341	2449688.252

In order to obtain the period, all data points of the orbital light curve were analysed using the 'Analysis of Variance' algorithm adopted from Schwarzenberg-Czerny (1989). The epoch was derived from the resulting O−C values. The following elements were obtained:

$$\begin{array}{rl} \mathrm{Min} = \mathrm{HJD}\,2450163.486 & +\ 3^{d}_{.}126959 \times \mathrm{E} \\ \pm 15 & \qquad \pm 23 \end{array}$$

The O−C curve for these elements is given in Figure 2. Our own data are in agreement with the assumption of a constant period within the accuracy of the measurement. The three O−C values below the confidence interval were measured by Romano (1962). From the information provided in the literature it cannot be decided with certainty what the reason for these deviations might be. Two of these points obviously lie only on the shoulder

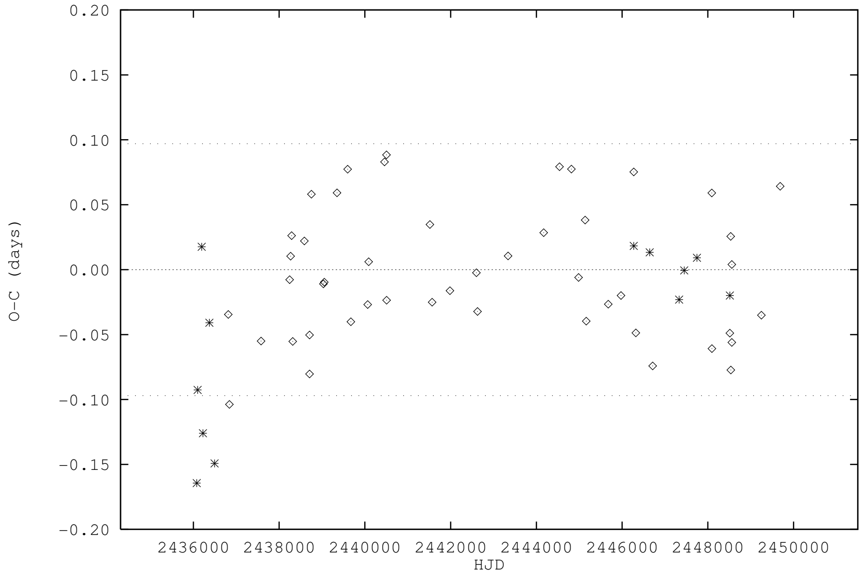

Figure 2. O−C for new elements. Minima found on Sonneberg plates are plotted with diamonds, star symbols are the times of minima as collected by Borovička (1995). The dotted lines mark the width of the light curve below $13^{m}.0$, as described in text.

of the minimum with magnitudes given as $12^{m}.8$ and $12^{m}.7$. The third one, $13^{m}.3$, cannot be explained assuming a constant period. Considering only the data collected by Borovička, a changing period is indeed suggested, but there is no convincing indication for that in the Sonneberg data.

Even if the individual error of one single intensity measurement derived from a photographic observation is quite large, the sheer number of our measurements and, moreover, the long time interval covered enable us to derive rather reliable elements, that can explain the behavior of PX Cep in the past 40 years within an accuracy of about $0^{d}.1$.

The author thanks Constanze la Dous for arranging this interesting project and Peter Kroll (both Sonneberg Observatory) for lots of help.

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A NEW EPHEMERIS FOR ER CEPHEI

On June 20-22, 1995, two of the authors (RMB and RJH) used the Southeastern Association for Research in Astronomy (SARA) 0.9 m telescope at Kitt Peak National Observatory to test the newly acquired Axiom Research, Inc., AX-4 CCD camera equipped with a Kodak KAF 4200 (2048 × 2048) chip. Observations of the galactic cluster NGC 188 were made using a Cousins R filter. The images were reduced using the MIRA Image Processing Software, developed by Axiom Research, Inc. Differential aperture photometry was performed, resulting in light curves for ER, ES, EQ Cep, and the variables V5 and V8 defined by Kaluzny & Shara (1987). Our ER Cep light curve is shown in Figure 1. Some intrinsic night-to-night variations appear to be present. A presentation and discussion of all the observations will be forthcoming. After phasing the ER Cep data using the zero-epoch HJD 2446696.8432 and period 0.2857299 days listed in Kaluzny (1990), we noticed that primary minimum occurred at phase $0\overset{\mathrm{p}}{.}235$. This indicated the need to determine a new ephemeris for ER Cep, which we present in this note.

Using the method of Kwee & van Woerden (1956), one primary and two secondary minima were determined from our observations. We also computed minima from the observations by Kaluzny & Shara (1987) and Kaluzny (1990). These are listed in Table 1, together with estimates for their mean errors. $(O-C)_1$ residuals are computed with respect to the Kaluzny (1990) ephemeris. The zero-epochs listed in Worden et al. (1978) and Kholopov & Sharov (1967) were also added to the list, as well as the minimum by Kholopov & Sharov (1966).

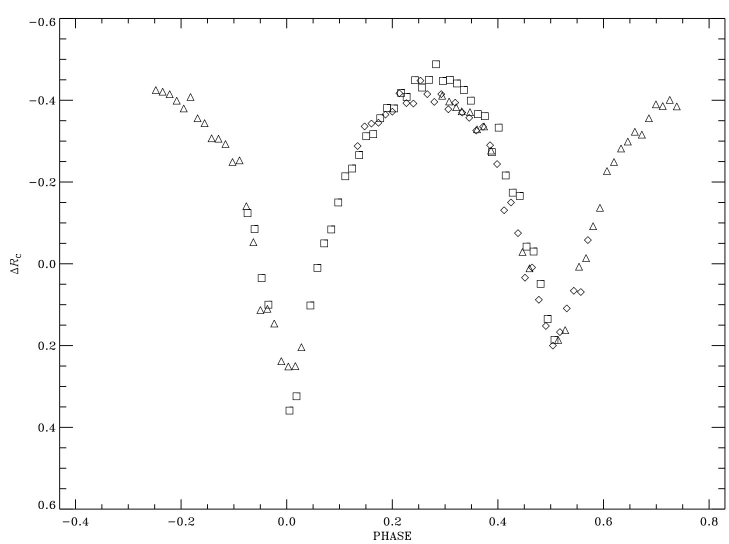
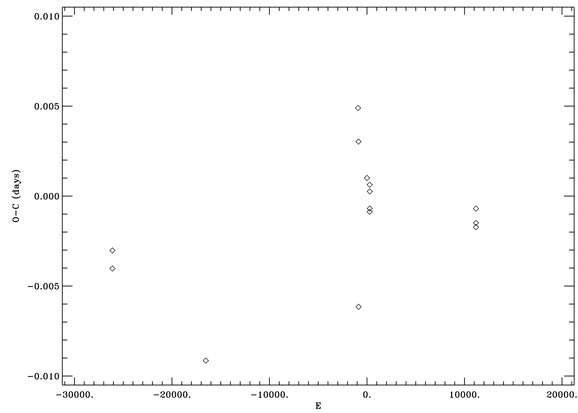


Figure 1. ER Cep differential R_{C} magnitudes observed on June 20 (squares), June 21 (triangles) and June 22 (diamonds), 1995



A weighted linear least squares fit to these minima yields the new ephemeris

$$\text{Min.}\,(\text{HJD}) \;=\; \underset{\pm\,33}{2446696.84215} + \underset{\pm\,12}{0.28573616} \times E \qquad (1)$$

The residuals, with respect to this ephemeris, are listed as $(O-C)_2$ in Table 1 and shown plotted in Figure 2. The orbital period of ER Cep appears to have remained secularly constant over the past 30 years. This is unusual given the short period of this moderately late spectral type $[(B-V)_0 \approx 0\overset{\mathrm{m}}{.}74]$ W-type W UMa binary.

Table 1. Minima for ER Cep

E	$(O-C)_1$	HJD	Error	$(O-C)_2$	Reference
−26106.0	−0.167	39237.411	0.001	−0.003	Kholopov & Sharov (1966)
−26106.0	−0.168	39237.410	0.001	−0.004	Kholopov & Sharov (1967)
−16525.0	−0.114	41975.043	0.001	−0.009	Worden et al. (1978)
−917.5	−0.00189	46434.68413	0.00066	0.00490	Kaluzny & Shara (1987)[a]
−868.5	−0.00345	46448.68333	0.00081	0.00303	Kaluzny & Shara (1987)[a]
−861.5	−0.0126	46450.6743	0.0012	−0.0062	Kaluzny & Shara (1987)[a]
0.5	−0.00004	46696.98603	0.00007	0.00101	Kaluzny (1990)
276.0	−0.00019	46775.70446	0.00007	−0.00087	Kaluzny (1990)
276.5	0.00131	46775.84883	0.00058	0.00063	Kaluzny (1990)[a]
286.5	0.00100	46778.70582	0.00019	0.00026	Kaluzny (1990)
287.0	0.00006	46778.84774	0.00031	−0.00069	Kaluzny (1990)[a]
11171.0	0.06714	49888.79905	0.00028	−0.00172	this paper
11174.5	0.06819	49889.80016	0.00065	−0.00069	this paper
11178.5	0.0674	49890.9423	0.0012	−0.0015	this paper

[a] Determined in this paper from observations listed in the reference.

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PHOTOELECTRIC BVR_C OBSERVATIONS AND NEW ELEMENTS OF THE CEPHEID HD 32456

Recently Bastian et al. (1996) and Campos-Cucarella et al. (1996) published light curves in B and V filters and light elements, based on a short time span, for the bright Cepheid HD 32456 found by Makarov et al. (1994).

To refine the published ephemeris, we have analysed photographic archival plates at Sternberg Astronomical Institute of Moscow (80 estimates) and at Astronomical Institute of Tashkent (28 estimates). We also observed HD 32456 photoelectrically at Mt. Maidanak observatory in August 1996, where the 60-cm reflector was used and 17 BVR_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 (Figure 1) is $0^{\mathrm{m}}.59$ in V, $0^{\mathrm{m}}.27$ in $B-V$ and $0^{\mathrm{m}}.13$ in $V-R_c$.

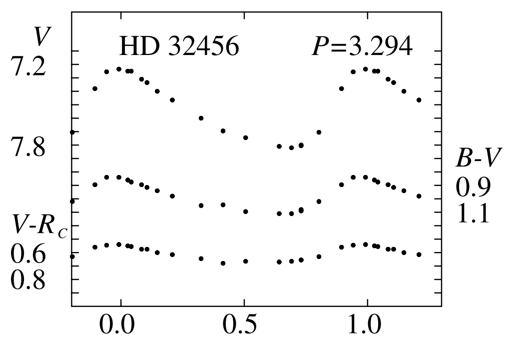

Figure 1

Table 1

JD hel 2450000+	Phase	V	$B-V$	$V-R_c$	JD hel 2450000+	Phase	V	$B-V$	$V-R_c$
312.3420	.084	7.304	0.890	.572	319.3408	.208	7.458	0.974	.612
314.3428	.691	7.814	1.102	.664	320.3198	.505	7.738	1.087	.665
314.4746	.731	7.795	1.081	.653	321.3042	.804	7.699	1.011	.628
315.3352	.992	7.227	0.833	.537	322.3015	.107	7.328	0.909	.573
315.4506	.027	7.241	0.852	.549	322.4339	.147	7.390	0.935	.595
316.4355	.326	7.593	1.041	.643	323.3132	.414	7.688	1.037	.677
317.4789	.643	7.801	1.102	.670	324.3567	.731	7.791	1.072	.652
318.3112	.896	7.372	0.888	.557	325.3814	.042	7.243	0.869	.552
318.4680	.943	7.245	0.833	.543					

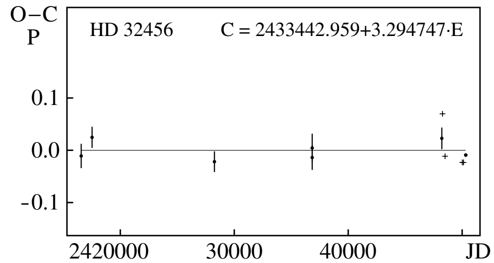

Figure 2

Table 2

Max JD hel 2400000+	Error	Filter	E	$O-C$	Number of observations
16567.2012	0.0766	PG	−5122	−0.0637	12
17522.7952	0.0667	PG	−4832	0.0537	13
28260.2223	0.0654	PG	−1573	−0.0997	23
36839.7696	0.0780	PG	1031	−0.0736	14
36839.8578	0.0899	PV	1031	0.0146	14
48216.6518	0.0681	PG	4484	0.0473	32
50318.5951	0.0029	B	5122	−0.0580	17
50318.6230	0.0042	V	5122	−0.0301	17

All observations obtained were analysed with Hertzsprung's method; the derived epochs of maxima are given in Table 2. These epochs of maxima, together with those published by Bastian et al. (1996) and Campos-Cucarella et al. (1996), were introduced into a linear least-squares solution which resulted in the following improved ephemeris formula:

$$\text{Max JD hel} = \underset{\pm.031}{2433442.959} + \underset{\pm.72}{3.2947470} \times \text{E}$$

This ephemeris was used in calculating the phases in Table 1 and the $O-C$ values in Table 2 as well as for plotting our observations in Figure 1 and $O-C$ diagram in Figure 2, where the above mentioned published epoches of maxima are marked by crosses.

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PHOTOELECTRIC BVR_c OBSERVATIONS OF THE PECULIAR CEPHEID V473 Lyr

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

We observed V473 Lyr at Mt. Maidanak observatory in August 1996. The 60–cm reflector was used and 79 BVR_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 0.09 mag in V.

The phases are calculated with the elements:

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

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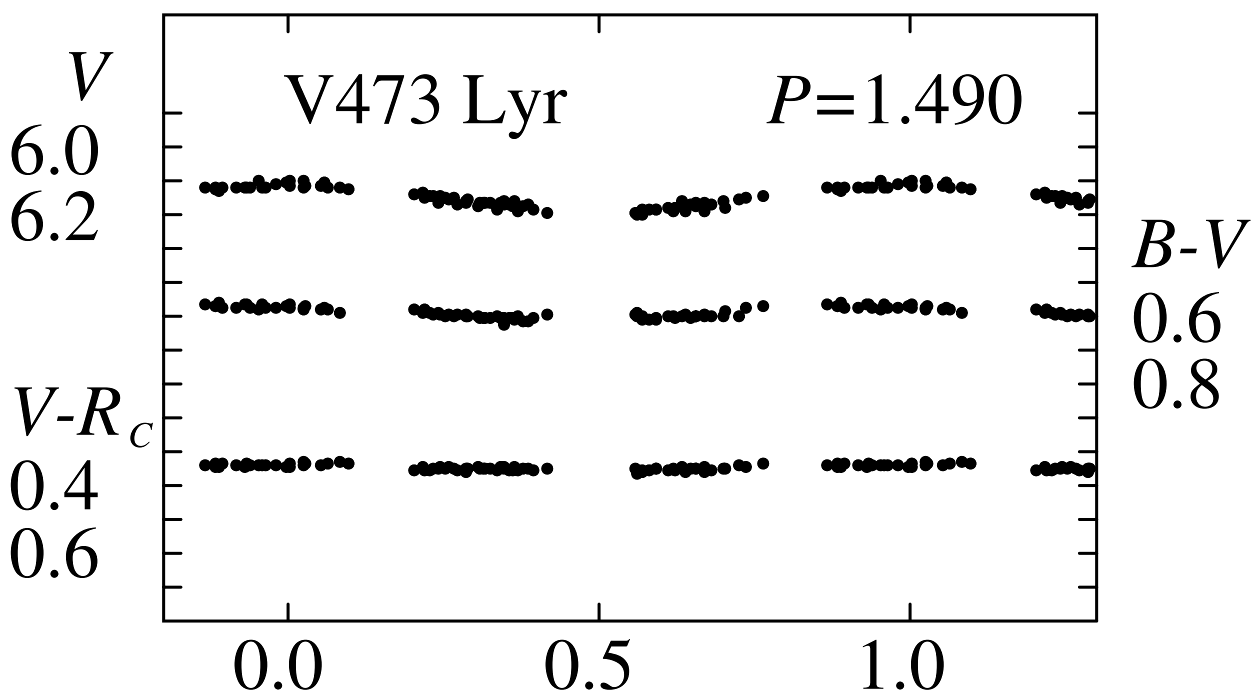

Figure 1

Table 1

JD hel 2450000+	*Phase*	V	$B-V$	$V-R_c$	JD hel 2450000+	*Phase*	V	$B-V$	$V-R_c$
305.1712	.203	6.131	.579	.357	312.3209	.999	6.096	.570	.346
305.2111	.230	6.139	.590	.357	312.3615	.026	6.095	.578	.334
305.2474	.254	6.144	.597	.351	312.4033	.054	6.106	.576	.342
305.2991	.289	6.146	.599	.353	312.4469	.083	6.113	.588	.334
305.3440	.319	6.159	.602	.354	313.1559	.559	6.186	.594	.351
305.3870	.348	6.152	.622	.346	313.1736	.571	6.179	.608	.357
305.4144	.366	6.154	.609	.349	313.2046	.592	6.175	.607	.353
305.4317	.378	6.167	.611	.355	313.2528	.624	6.170	.601	.358
306.1627	.868	6.115	.564	.343	313.2997	.655	6.167	.596	.353
306.1882	.885	6.110	.567	.340	313.3381	.681	6.162	.596	.356
306.2582	.932	6.114	.561	.346	314.1405	.219	6.143	.579	.356
306.2919	.955	6.092	.577	.341	314.1606	.233	6.136	.594	.351
306.3307	.981	6.101	.571	.344	314.1998	.259	6.148	.592	.350
306.3638	.003	6.094	.563	.348	314.2432	.288	6.156	.596	.354
306.3972	.025	6.110	.575	.343	314.2835	.315	6.160	.600	.352
306.4479	.059	6.098	.573	-	314.3310	.347	6.163	.602	.353
307.1971	.562	6.189	.589	.362	314.3537	.362	6.168	.605	.356
307.2282	.583	6.178	.608	.356	314.4044	.396	6.177	.605	.357
307.3268	.649	6.165	.600	.353	315.1417	.891	6.124	.559	.348
307.3601	.671	6.157	.591	.349	315.2067	.935	6.111	.561	.337
307.4042	.701	6.151	.596	.351	315.2449	.960	6.111	.564	.341
310.2229	.592	6.176	.602	.355	315.3078	.002	6.107	.574	.335
310.2514	.611	6.172	.598	.358	315.3460	.028	6.109	.569	.338
310.2861	.634	6.153	.595	.349	315.4011	.065	6.112	.576	.339
310.3180	.655	6.155	.597	.353	315.4522	.099	6.118	-	.340
310.4237	.726	6.146	.597	.341	316.1413	.561	6.193	.598	.365
311.1554	.217	6.129	.586	.348	316.1541	.570	6.192	.595	.363
311.1973	.245	6.139	.593	.349	316.2294	.621	6.182	.598	.354
311.2317	.268	6.143	.598	.351	316.2571	.639	6.183	.592	.364
311.2614	.288	6.154	.592	.363	316.3024	.670	6.181	.598	.361
311.2926	.309	6.155	.601	.352	316.3522	.703	6.171	.585	.351
311.3192	.327	6.160	.600	.352	316.4041	.738	6.144	.574	.348
311.3423	.342	6.157	.604	.346	316.4459	.766	6.135	.569	.339
311.3640	.357	6.163	.603	.358	317.1557	.242	6.157	.586	.355
311.4070	.386	6.164	.613	.354	317.2010	.272	6.164	.591	.356
312.1500	.884	6.118	.568	.347	317.2501	.305	6.166	.598	.348
312.1682	.896	6.114	.572	.339	317.2983	.338	6.175	.596	.357
312.2015	.919	6.111	.572	.345	317.3489	.371	6.181	.598	.358
312.2335	.940	6.111	.572	.344	317.4158	.416	6.187	.592	.352
312.2721	.966	6.110	.572	.341					

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PHOTOELECTRIC BVR_c OBSERVATIONS AND CLASSIFICATION OF NSV 10183

Recently Antipin and Berdnikov (1996) found that NSV10183 (S9291; GSC 1008.1699, α=18^{h}05^{m}28.^{s}95, δ=+7°54′21.″1, Epoch 2000) was a Cepheid variable with light elements:

$$Max JDhel = 2444942.37 + 13.6299 \times E.$$

But it was difficult to define a type of this Cepheid because there were no photoelectric observations then.

We observed NSV 0183 at Mt. Maidanak observatory in August 1996. The 60-cm reflector was used and 28 BVR_c measurements (Table 1) were obtained. The accuracy of the individual data is near 0.01 mag in all filters. Light and color curves (Figure 1), constructed with the above elements, show that NSV 10183 is obviously a CWA type variable.

Figure 1 shows also that our observations do not satisfy the above elements. Using the new epoch of maximum (JD 2450321.23 $\pm$ 0.10) together with the published ones (Antipin and Berdnikov, 1996) there are three variants of O−C diagram due possible miscalculation in the number of epochs (Figure 2). It is necessary to use plate collections to fill in the gap between JD 2447000 and 2450000, in order to improve light elements.

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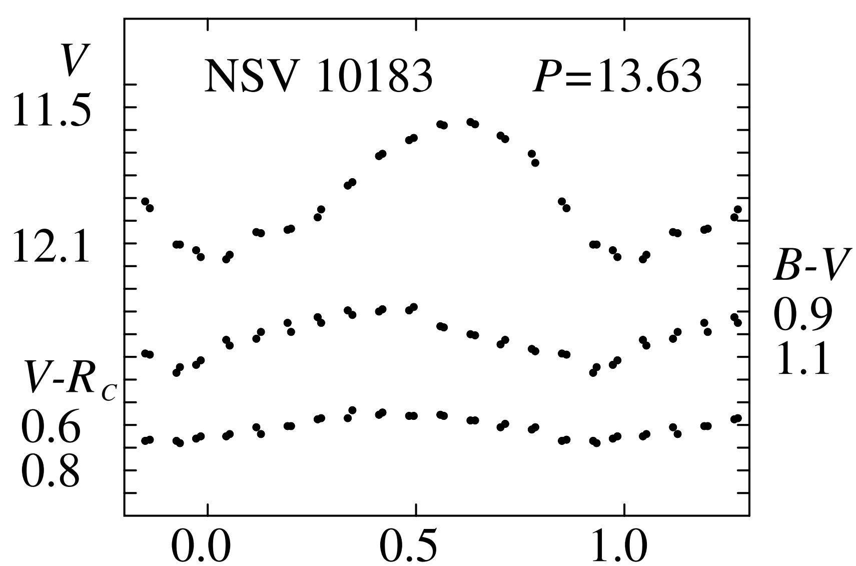

Figure 1

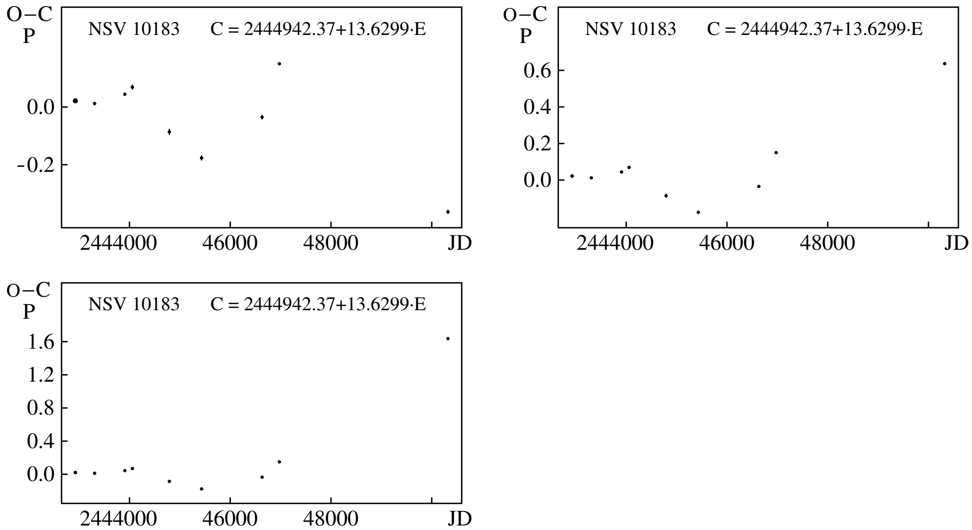

Figure 2

Table 1

JD hel 2450000+	*Phase*	V	$B-V$	$V-R_c$	JD hel 2450000+	*Phase*	V	$B-V$	$V-R_c$
312.1726	.972	12.121	1.130	.658	0319.1702	.485	11.638	.887	.558
312.3365	.984	12.153	1.109	.647	0319.2905	.494	11.629	.874	.557
313.1876	.046	12.161	1.018	.648	0320.1721	.559	11.566	.957	.554
313.3034	.055	12.140	1.043	.636	0320.3035	.568	11.575	.964	.560
314.1637	.118	12.044	1.013	.607	0321.1587	.631	11.557	.995	.578
314.3073	.128	12.045	.983	.640	0321.2988	.641	11.566	.997	.576
315.1685	.192	12.032	.945	.600	0322.1529	.704	11.619	1.039	.609
315.2797	.200	12.030	.981	.601	0322.3008	.715	11.631	1.020	.593
316.1630	.265	11.979	.919	.573	0323.1558	.778	11.700	1.058	.619
316.2712	.272	11.942	.941	.566	0323.2988	.788	11.738	1.069	.610
317.1624	.338	11.838	.887	.566	0324.1618	.851	11.910	1.076	.666
317.3024	.348	11.822	.906	.533	0324.2956	.861	11.936	1.084	.660
318.1684	.412	11.707	.894	.555	0325.1590	.925	12.097	1.165	.667
318.2885	.420	11.698	.883	.545	0325.2878	.934	12.099	1.138	.679

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Reference:
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PHOTOELECTRIC PHOTOMETRY OF THE RED SUPERGIANT α^1 Her

The α Herculis star system (Rasalgethi = ADS 10418) is a visual binary that consists of a variable M5 Ib-II primary (α^1 Her; HR 6406; HD 156014) and a less luminous secondary (α^2 Her; HR 6407, HD 156015) which itself is a spectroscopic binary. Smith et al. (1989) carried out an analysis of AAVSO visual estimates made over the last 60 years and found α^1 Her to be a semi-regular variable star with a brightness range from about 3rd to 4th magnitude. They also found the star to have light variations on the short (30-100 day) and long (several years) time scales with variations that range from less than 0.1 mag to about 0.7 mag; however, the smaller 0.1 mag variations are more common. α^2 Her is a spectroscopic binary with an orbital period of P = 51.6 days which consists of G8 III and A9 V-IV stars; its combined visual magnitude is V=+5.39 (Deutsch, 1956; Thiering and Reimers, 1993). α^1 Her and α^2 Her have an angular separation of $4''\!.7$ and the star system is at a distance of about 70 pc (Thiering and Reimers, 1993). There is no evidence that α^2 Her is a light variable. Speckle interferometry by McAlister et al. (1989) has suggested that α^1 Her itself may be a binary with a fainter component $0''\!.19$ away, but this result is still tentative.

During the past several years pulsational variability studies have been conducted of α^1 Her, along with two other bright red supergiants, α Ori and α Sco A (Smith et al., 1989, 1995). Smith et al. (1989) reported a probable fundamental pulsational period for α^1 Her of 350 $\pm$ 40 days, obtained from radial velocity measures made at the McMath telescope (see Smith et al. 1995). Working with Smith, we carried out UBV photoelectric photometry of the star from 1989 and onwards to determine the characteristics of its light variations. Up to this time no systematic photoelectric study had been made on this important star. As pointed out by Smith et al. (1995), α^1 Her is an interesting star because it may be expected to exhibit hybrid features, falling between "normal" red supergiants (those classified spectroscopically by "I" like α Ori and α Sco A) and lower mass, highly evolved luminous red giants such as the Miras, located near the upper end of the red giant branch (Smith et al., 1995). In addition, the recent study of α^1 Her by Thiering and Reimers (1993) and Danchi et al. (1994) indicates that it has an extended circumstellar shell and a relatively large mass loss rate of about 1 to 3×10^{-7} $M_\odot$/yr.

UBV photoelectric photometry of α Her was carried out from 1989 to 1995 using the Phoenix-10 APT and the Four College Consortium 0.8m APT on Mt. Hopkins in Arizona; V-band photometry was also carried out by Wasatonic starting in 1993 using a 20-cm Schmidt-Cassegrain (SCT) located first in Maryland and then later in Pennsylvania. The photometry was carried out relative to nearby and check stars, adopting the usual observing sequence of sky-comp.-var.-comp.-sky-check-comp.-sky. The common comparison star was HD 154494 (A4 IV; V=+4.91 and B−V=+0.12); HD 154143 (M3 III; V=+4.98 and B−V=+1.60) served as the primary check star and was observed at least once on most nights. Several UBV standard stars were also observed. Typically the stars

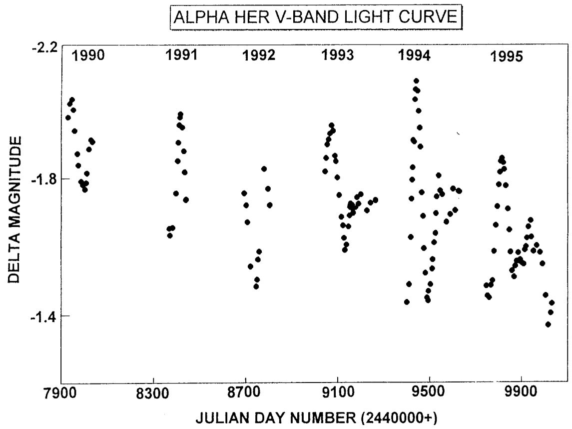

Figure 1. Visual light curve

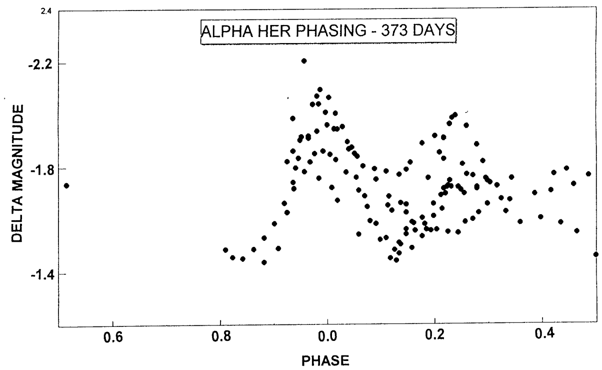

Figure 2. Phasing using 373 day period; scatter due to amplitude variation

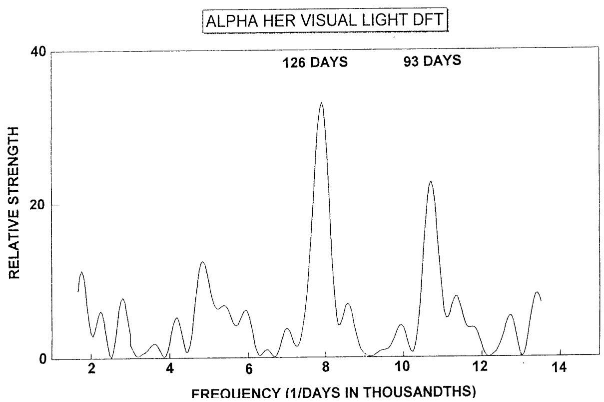

Figure 3. Discrete Fourier transform; note detected periods at frequencies 0.0079 and 0.0108 (126 and 93 days)

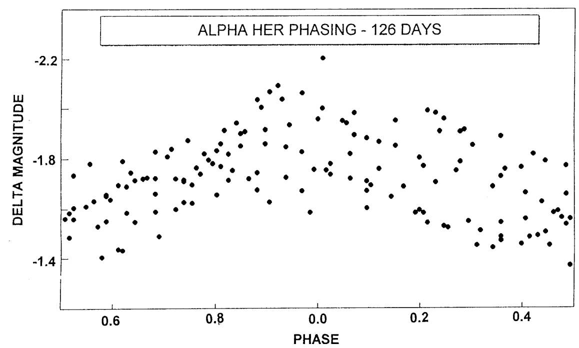

Figure 4. Phasing using 126 period; scattered due to amplitude variation

were observed for about 30 minutes each night. Other than what appears to be random scatter, the relative brightness of the comparison and check stars remained basically constant to within about ± 0.02 mag (V-band) over the time interval of the photometry. If small light variations do occur, they would be expected more from the M3 III check star rather than the A4 IV comparison star. For all the observations 10-sec integrations were used and the effects of differential atmospheric extinction were removed and heliocentric corrections were applied to the local times. Because of the relatively small angular separation of α^1 Her and α^2 Her, both stars were, out of necessity, included within the diaphragms of the photometers. Because of the large quantity of data, nightly means were computed to alleviate light curve clumpiness. The APT V-band observations were combined with the SCT photometry and are given in Table 1. The ΔV-magnitudes (in the sense of variable minus comparison star) are plotted against Julian Day number in Figure 1.

As shown in Figure 1, α^1 Her has a complicated light curve with short term (a few months) and long-term (several years) light variations. It displays irregular sinusoidal-like light variations on a time scale of about 90-130 days, and with brightness amplitudes that range from less than $0\overset{m}{.}1$ up to $0\overset{m}{.}7$. Because of the inclusion of α^2 Her in the light mea-

Table 1. Photometric data

JD244+	ΔV	JD244+	ΔV	JD244+	ΔV	JD244+	ΔV
7928.06	−1.982	8795.82	−1.769	9420.92	−1.740	9766.55	−1.486
7936.54	−2.023	8802.83	−1.721	9423.07	−1.795	9773.89	−1.500
7946.01	−2.036	9043.89	−1.820	9424.02	−1.832	9780.92	−1.585
7952.00	−2.004	9047.90	−1.860	9427.40	−1.913	9788.89	−1.662
7958.00	−1.942	9052.97	−1.900	9431.81	−1.908	9793.91	−1.717
7969.94	−1.873	9057.74	−1.915	9434.83	−2.035	9801.84	−1.781
7973.96	−1.839	9065.42	−1.933	9437.81	−2.066	9805.85	−1.818
7986.40	−1.791	9072.43	−1.957	9439.87	−2.091	9808.88	−1.850
7994.14	−1.781	9078.90	−1.941	9445.04	−2.061	9814.83	−1.859
8002.85	−1.768	9085.12	−1.866	9451.19	−2.000	9819.83	−1.846
8008.22	−1.787	9090.81	−1.850	9455.83	−1.950	9823.77	−1.826
8010.88	−1.815	9095.64	−1.795	9458.78	−1.893	9831.98	−1.778
8019.26	−1.887	9105.32	−1.751	9465.33	−1.758	9840.28	−1.710
8027.78	−1.914	9114.54	−1.687	9470.51	−1.689	9846.00	−1.648
8034.18	−1.908	9122.28	−1.662	9475.28	−1.594	9851.80	−1.583
8368.36	−1.653	9127.37	−1.625	9483.02	−1.522	9858.67	−1.528
8371.35	−1.633	9131.53	−1.589	9488.74	−1.450	9867.83	−1.510
8382.49	−1.656	9139.03	−1.605	9892.73	−1.441	9872.69	−1.542
8396.58	−1.756	9146.04	−1.659	9494.65	−1.469	9879.32	−1.556
8403.44	−1.852	9150.71	−1.691	9503.94	−1.489	9885.79	−1.561
8406.77	−1.906	9152.63	−1.716	9510.71	−1.534	9890.30	−1.556
8410.80	−1.958	9154.85	−1.722	9513.61	−1.561	9893.60	−1.560
8413.25	−1.981	9155.67	−1.726	9518.72	−1.611	9901.58	−1.551
8415.32	−1.991	9157.71	−1.723	9524.61	−1.639	9909.12	−1.569
8422.87	−1.951	9161.87	−1.722	9526.78	−1.697	9913.58	−1.589
8429.76	−1.881	9164.73	−1.711	9530.19	−1.746	9918.58	−1.599
8434.06	−1.818	9166.59	−1.698	9538.65	−1.808	9922.60	−1.624
8439.24	−1.737	9176.08	−1.715	9545.34	−1.764	9928.59	−1.657
8692.96	−1.756	9182.60	−1.744	9554.58	−1.753	9938.62	−1.676
8701.94	−1.721	9189.59	−1.725	9572.08	−1.672	9942.05	−1.627
8705.93	−1.672	9199.58	−1.753	9588.56	−1.694	9951.55	−1.585
8721.23	−1.542	9226.06	−1.705	9600.05	−1.769	9966.03	−1.602
8745.82	−1.483	9244.06	−1.728	9610.52	−1.706	9979.51	−1.582
8750.31	−1.503	9262.50	−1.736	9625.52	−1.762	9990.49	−1.547
8753.81	−1.532	9400.88	−1.436	9746.93	−1.485	10003.15	−1.455
8758.18	−1.585	9410.87	−1.489	9751.91	−1.455	10015.47	−1.368
8779.75	−1.828	9417.35	−1.627	9758.93	−1.450	10026.46	−1.404
						10031.45	−1.432

surement of the variable star, the light amplitudes (for the V-bandpass) are about 1.25 times larger than observed. Also, the star shows an irregular decrease in mean brightness from 1989 to 1995 of about 0.3 mag. This could be related to the long-term light variations seen in the earlier visual estimates. Observations obtained during the spring of 1996 indicate that the downward trend in brightness continues.

During 1993 to 1995 the addition of Wasatonic's photometry permitted the observing season to be extended from about 4 months with the APTs to over 8 months, revealing what appears to be a cyclic light variation with a period about 1 year. Based on the longer observing intervals, the light curve can be characterized by a large sinusoidal light pulse followed by smaller pulses in which the interval between successive maxima and minima is usually about 120-130 days. Examination of all the photometry indicates that the average interval between the occurrence of primary maxima is about 373 $\pm$ 30 days. This value is very close to the spectroscopic period of 350 $\pm$ 40 days from Smith et al. (1989), based on radial velocity observations. Thus, it could be related to the fundamental pulsation mode of the star. In Figure 2, the 1993/94 and 1994/95 photometry are plotted against phase using the 373 day period. Phasing with the 350 day spectroscopic period yields similar results.

To characterize quantitatively the possible periods in the light curve, a Discrete Fourier Transform (DFT) program from Sinnot (1988) was used to analyze the observations. Figure 3 shows the results of the DFT analysis in which two significant periodicities in the data were found, the most pronounced at about 126 days (frequency ≈ 0.0079) and a slightly less prominent period of 93 days (frequency ≈ 0.0106). Smith (1996) also found these periods in the photometry using the CLEAN periodogram routine (Roberts et al., 1987). In Figure 4 we show the data phased with the 126 day period. We did not correct the data for the long-term light decrease but the 126 day period is easily seen in the plot. Neither method showed a significant period near 373 days (or 350 days); this can be explained because the beat period from $P_1=126^d$ and $P_2=93^d$ is $P_{12}=355^d$, which is close (within the uncertainties) to the observed 373 day photometric period. The observed light curve is, however, more complex than can be represented by just these two periods. As noted by Bowen (1992) and Smith et al. (1995), shocks generated by the pulsations in the stellar atmosphere could produce further complex short term light variations. The long term light variations seen in our data and the earlier visual estimates could be a result of the growth and decay of supergranulations on or near the surface of the star.

With continued photometry (and radial velocity measures by Smith), we should be able to determine whether the 126 day and 93 day periods are persistent and stand the test of time. Also continued photometry may shed more on the nature of the long-term luminosity variations.

The authors wish to thank Dr. Emilia Belserene for her assistance in translating the DFT program from BASIC to FORTRAN. We also thank Dr. Myron Smith for his analytical support by executing the CLEAN periodogram. For this research we utilized the SIMBAD database, operated by CDS, Strasbourg, France. This research, in part, is sponsored by a grant from the National Science Foundation (Grant Number AST-9315365) which we gratefully acknowledge.

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PHOTOMETRIC INVESTIGATION OF Y CANUM VENATICORUM

The carbon star Y CVn (BD +46°1817 = HD 110914, $\alpha_{2000} = 12^h45^m07^s.8$, $\delta_{2000} = 45°26'25''$) was discovered as a variable star by Cannon (Pickering 1910). Zverev (1936) was the first who determined a periodicity in its variations described by the light elements:

$$T_{\rm max} = 2426117 + 160.0 \times E$$

The most systematic photometric investigation has been carried out by Gaposhkin who studied the star on plates of the Harvard Observatory taken at the beginning of this century. He has found the period P = 157±23 days (Gaposhkin 1952). This is the period given in the General Catalogue of Variable Stars (Kholopov 1985). Gaposhkin derived the mean maximum brightness $8^m.71 \pm 0^m.19$ and the mean minimum brightness $9^m.33 \pm 0^m.16$ and the extreme maximum and minimum brightnesses $8^m.18$ and $10^m.00$ as well.

Nevertheless, the recent observations give evidence that mean period is longer and the character of the light variations is somewhat more complicated. The star was observed photoelectrically by Dzervitis and Vetesnik from 1979 to 1982. Vetesnik (1983) estimated the period of the star P=251.8 days and new light elements for the times of the minimum:

$$T_{min} = 2436097.5 + 251.8 \times E$$

The BV photoelectric observations of Y CVn presented in this paper were performed by Jiri Papousek at the Brno University Observatory in the course of the years 1979–1994. The photometer attached to the 60 cm telescope was equipped with an EMI 9656 photomultiplier and its filter combinations ensured the measurements in the BV colours of the Johnson standard photometric system. The data reduction method was the standard one. The comparison star and the check one was HD 110 834 and HD 110 450, respectively. The mean standard deviation of one observation was better than 0.04 mag, most of them even smaller than 0.007 mag. The total number of all observations was 138 in V band and 135 in B band. The original data will be provided by the author upon request.

The resulting light curves are plotted in Figures 1 and 2. The data used may represent the longest continuous light curve of Y CVn obtained up to now.

The data shows that mean maximum brightness of Y CVn $5^m.35$ and the mean minimum brightness $5^m.61$ in V band, while the corresponding values are $8^m.33$ and $8^m.73$ in B band. The extreme maximum and minimum brightnesses are $5^m.18$ and $6^m.02$ in V band and $7^m.97$ and $9^m.76$ in B band. The colour index B−V varies from $2^m.73$ to $3^m.75$.

After thorough treatment of data we have concluded:

- The period of light variations determined by Date-Compensated Discrete Fourier Transform (Kleczek 1987) is 267.8 days.

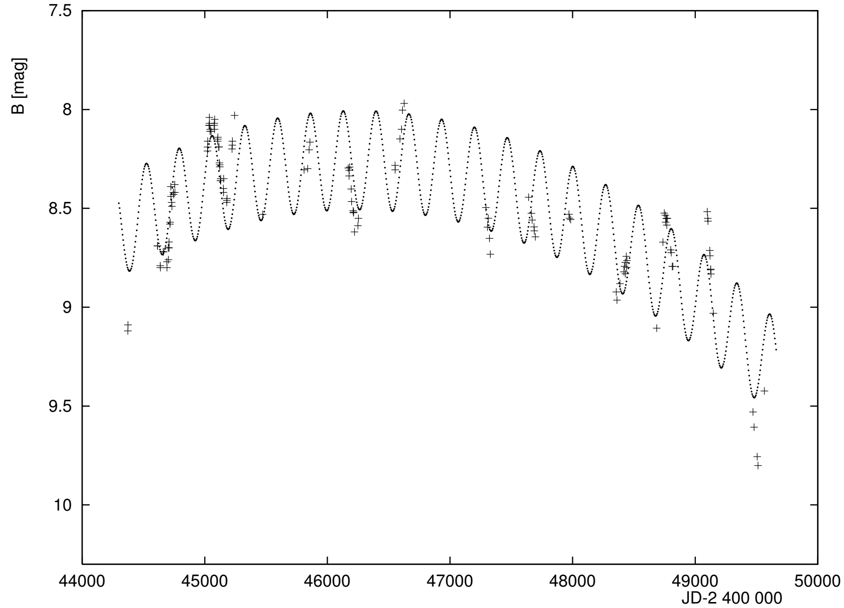

Figure 1. The light curve of Y CVn in photometric band B between the years 1979–1994. The data have been fitted by the curve described by the formula (1).

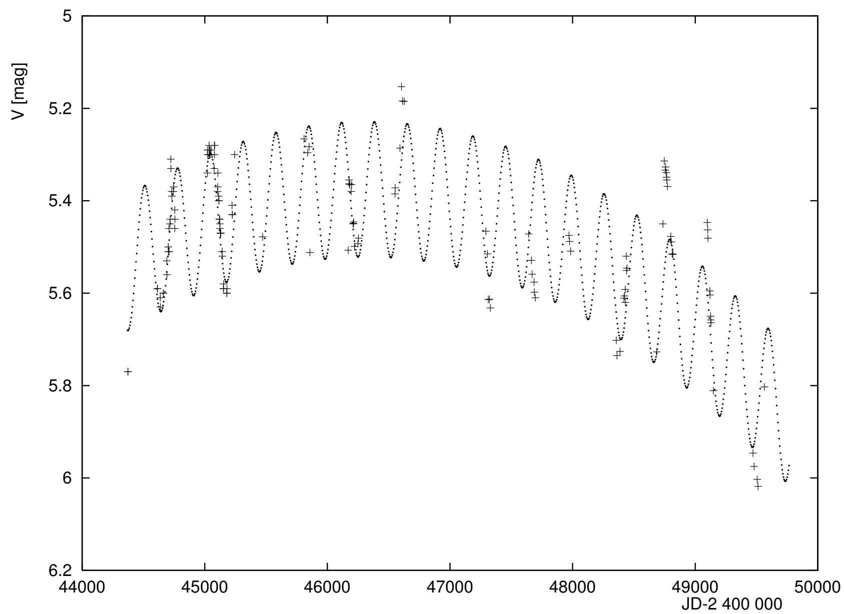

Figure 2. The light curve of Y CVn in photometric band V between the years 1979–1994. The data have been fitted by the curve described by the formula (1).

Table 1. The coefficients of the light curves (1)

band	a_0 [mag]	a_1 [mag]	a_2 [mag]	a_3[mag]	$\Delta\phi$
V	5.376±0.014	0.003±0.002	0.003±0.001	0.146±0.009	-0.027 ± 0.011
B	8.261±0.026	0.011±0.003	0.007±0.001	0.250±0.022	0.025±0.013

- There is a pronounced secular change.
- Some additional irregularities typical for this type of star are present.

The observed variations of Y CVn can be described by secular change of the mean brightness, which may be represented by a part of a parabola, superimposed on nearly sinusoidal variations of constant amplitude and the period $P = 267.8$ days.

Hence, the light curve in particular colour may be expressed by the following formula with five parameters:

$$m = (a_0 + a_1\,E + a_2\,E^2) + a_3\,\sin[2\pi(E + \Delta\phi)], \qquad (1)$$

where $E = (JD_{hel} - 2446458)/P$ and $\Delta\phi$ is a phase shift of the zero point of the sinusoidal component. The coefficients have been found using a sophisticated least-squares method (Mikulasek 1995). The coefficients found for B and V colours are presented in Table 1.

As is seen from Table 1, the phase shifts $\Delta\phi$ in B a V band are not too different, so we could consider them to be the same and being equal to zero. This conclusion is quite natural from the physical point of view, too. So, we can write

$$m = a_0 + a_1\,E + a_2\,E^2 + a_3\,\sin(2\pi E) \qquad (2)$$

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PHOTOELECTRIC MINIMA OF SOME ECLIPSING BINARIES

We present 127 minima observations of 25 eclipsing binaries, not yet published anywhere. These stars were observed during several seasons and most of minima observations are part of complete light curve coverages. All observations were obtained with the 30 cm Maksutov telescope at the Ankara University Observatory. Differential observations were secured by using an EMI 9789QB photomultiplier before 29 September 1991 (HJD 2448528.5) and an OPTEC SSP-5A photometer head which contains a side on R-1414 Hamamatsu photomultiplier after that date. The filters used are in close accordance with the standard Johnson's UBV and reductions of the observations have been performed in the usual way (Hardie, 1962).

The moments of minima and their standard errors for each filter were calculated using the method of Kwee & van Woerden (1956). The algorithm of this method was applied to the computer by Müyesseroğlu and Gürol. Weighted average values of times of minima of these system are given in Table 1, together with their minimum types, filters and observers. Weighted averages and their mean errors for the minima times in different filters were calculated with the formula given in Gürol & Selam (1994).

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Table 1: Times of minima of observed systems

System	Min HJD 2400000+	mean error	Min type	Filter	Observers
RT And	49972.3730	0.0002	II	UBV	Sl
	49973.3144	0.0001	I	UBV	Gr
	50000.3592	0.0001	I	UBV	Sl
	50001.3001	0.0003	II	BV	Gr
XZ And	50008.4732	0.0001	I	UBV	Gr
SS Ari	48928.4421	0.0003	I	UBV	My
	49341.3288	0.0006	I	UBV	Al
	49342.3464	0.0008	II	UBV	Sl
	49625.3171	0.0015	II	BV	My
	49625.5210	0.0001	I	BV	My
CK Boo	49500.3766	0.0010	I	UBV	Hk
	49502.3353	0.0008	II	UBV	Öd
	50248.3374	0.0010	I	UBV	My
	50260.4143	0.0015	I	UBV	Gr
KR Cyg	50266.4764	0.0013	I	BV	My
V1073 Cyg	47761.4060	0.0010	II	UBV	Sl
	47763.3764	0.0008	I	UBV	Sl
	47767.3453	0.0009	II	UBV	Ör
	48106.3953	0.0015	II	UBV	Kh
	48132.3293	0.0027	II	UBV	Sl
	48145.2951	0.0010	I	UBV	Öd
	48482.4272	0.0028	I	BV	Öd
	48484.3966	0.0036	II	BV	Sl
	48488.3169	0.0014	II	BV	Al
	48489.4935	0.0018	I	BV	Dn
	48864.3487	0.0008	I	UBV	Dr
	48865.5247	0.0013	II	UBV	Öd
	49236.4492	0.0014	II	UBV	Al
RX Her	49588.4010	0.0001	I	UBV	Gr
	49532.3732	0.0001	II	UBV	Gr
TX Her	49930.4693	0.0005	I	BV	Sl
HS Her	49509.4548	0.0018	I	UBV	Öd
	49523.3757	0.0028	II	UBV	My
	49545.4726	0.0010	I	UBV	Sl
	49559.3891	0.0024	II	UBV	Sl
	49961.3763	0.0011	I	BV	Sl
FG Hya	47530.5958	0.0007	I	BV	Sl
	47532.5624	0.0010	I	UBV	Ör
	47952.3476	0.0010	II	BV	Ör
	47953.3374	0.0009	II	UBV	Gr
	47968.2512	0.0005	I	UBV	Ör
	48308.3705	0.0011	II	BV	My
	49007.4727	0.0008	I	UBV	Al
	49046.3152	0.0002	II	UBV	My

Table 1: Continued

System	Min HJD 2400000+	mean error	Min type	Filter	Observers
FG Hya	49387.4305	0.0011	I	BV	My
	49401.3518	0.0012	II	BV	My
	49772.2926	0.0010	I	BV	My
	49772.4570	0.0023	II	BV	My
	49779.3410	0.0010	II	BV	My
SW Lac	47766.5308	0.0008	II	BV	My
	47769.4210	0.0004	II	BV	Ör
	47771.3440	0.0005	II	BV	Gr
	47771.5097	0.0004	I	BV	Gr
	47775.3574	0.0005	I	BV	Kh
	48158.2975	0.0006	I	BV	My
	48158.4553	0.0003	II	BV	My
	48159.4169	0.0005	II	BV	My
	48504.3532	0.0005	I	BV	Gr
	48504.5116	0.0003	II	BV	Gr
	48505.3102	0.0005	I	BV	My
	48505.4746	0.0004	II	V	My
	48537.3889	0.0002	I	BV	Öd
	48887.2921	0.0003	I	UBV	Öd
	48887.4511	0.0003	II	UBV	Öd
	49242.3249	0.0003	I	UBV	Ör
	49242.4838	0.0003	II	UBV	Ör
	49975.3209	0.0005	II	UBV	My
	49975.4803	0.0003	I	UBV	My
	50010.2777	0.0001	II	BV	My
UV Leo	47538.6165	0.0006	I	BV	My
	47557.5204	0.0002	II	UBV	My
	47559.6206	0.0004	I	UBV	My
	48277.6275	0.0002	II	BV	Ör
	48308.5314	0.0001	I	BV	Öd
	48339.4340	0.0002	II	BV	Ör
	49099.4448	0.0001	I	BV	Öd
	49103.3475	0.0001	II	UBV	Gr
XY Leo	47969.3225	0.0007	II	BV	Ör
	47969.4655	0.0003	I	BV	Ör
	47970.3185	0.0006	I	BV	My
	47970.4587	0.0004	II	BV	My
	49063.4202	0.0008	II	UBV	Al
	49069.3865	0.0006	II	UBV	Sl
	49101.3497	0.0006	I	UBV	Ak
	49360.6000	0.0004	II	BV	Dn
	49432.3373	0.0004	I	UBV	Al
	49446.4022	0.0004	II	BV	My

Table 1: Continued

System	Min HJD 2400000+	mean error	Min type	Filter	Observers
V451 Oph	49560.3397	0.0004	II	UBV	Gr
	50269.3834	0.0002	I	BV	My
	50274.4634	0.0001	I	UBV	Gr
	49539.3775	0.0001	II	BV	Gr
	49546.4921	0.0002	II	BV	Gr
	49567.3290	0.0001	I	UBV	Gr
BB Peg	49243.4462	0.0011	II:	UBV	Öd
	49244.3490	0.0013	I	UBV	My
	49273.2689	0.0008	I	UBV	Gr
	49275.2600	0.0010	II	UBV	Sl
DI Peg	48935.3002	0.0008	II	BV	Öd
	48939.2161	0.0003	I	UBV	Sl
	49246.3631	0.0006	II	BV	Hk
	49248.4963	0.0005	II	BV	Ak
	49276.2546	0.0007	II	V	Dn
	49277.3259	0.0001	I	UBV	Ak
	49553.5085	0.0001	I	UBV	Gr
	50050.3564	0.0001	I	UBV	Gr
RT Per	49634.4624	0.0003	I	BV	Dr
	49739.3638	0.0006	II	BV	Yc
IQ Per	48546.4067	0.0011	I	UBV	Öd
	48926.5043	0.0006	I	UBV	Ak
	49023.2577	0.0010	II	UBV	Sl
AQ Psc	49283.3250	0.0010	I	UBV	Dn
	49326.3696	0.0011	II	UBV	Öd
	49327.3203	0.0015	II	UBV	Öd
V505 Sgr	48858.3253	0.0004	I	UBV	Öd
W UMa	49797.3908	0.0003	I	UBV	Sl
TX UMa	49804.4760	0.0008	I	BV	Sl
AW UMa	48644.5117	0.0006	I	UBV	Dr
	48649.5555	0.0008	II	UBV	Dr
	49029.4962	0.0014	II	UBV	Al
	49074.4635	0.0011	I	UBV	Dn
	49105.3933	0.0008	II	UBV	Al
	49411.4063	0.0008	I	BV	Ak
	49412.2867	0.0007	I	BV	Al
	49412.5015	0.0011	II	BV	Sl
AW UMa	49432.4636	0.0009	I	UBV	Al
HW Vir	50155.3946	0.0001	I	BV	Gr
	50155.5119	0.0001	I	BV	Gr

Observers:

My: Z. Müyesseroğlu, Sl: S. O. Selam, Gr: B. Gürol, Ak: A. Akalın, Dr: İ. E. Derman, Ör: F.F. Özeren, Dn: H. Dündar, Kh: G. Kahraman, Öd: S. Özdemir, Al: B. Albayrak, Yc: K. Yüce, Hk: H. Ak

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NEW ELEMENTS OF V628 CYGNI

[BAV Mitteilungen Nr. 89]

V628 Cyg = S 4554 Cyg was discovered by Hoffmeister (1949) on photographic plates of the Sonneberg Observatory. He classified the star as an Algol-type variable in the range between $13^{\mathrm{m}}_{\cdot}0$ and $13^{\mathrm{m}}_{\cdot}5$. First investigation of this variable was performed by Rohlfs (1950, 1951). She provided a photographic light curve, reclassified the variable as a W UMa-type and determined first elements as:

$$\mathrm{Min\,I} = \mathrm{HJD}\,2427955.138 + 0^{\mathrm{d}}_{\cdot}651650 \times \mathrm{E} \qquad (1)$$

A few years later Romano (1967) investigated V628 Cyg again. He derived 9 minima and improved the elements of Rohlfs as follows:

$$\mathrm{Min\,I} = \mathrm{HJD}\,2427955.138 + 0^{\mathrm{d}}_{\cdot}651652 \times \mathrm{E} \qquad (2)$$

Moreover Romano determined the range of variability between $12^{\mathrm{m}}_{\cdot}2$ and $12^{\mathrm{m}}_{\cdot}7$ (phg) in the primary and between $12^{\mathrm{m}}_{\cdot}2$ and $12^{\mathrm{m}}_{\cdot}5$ (phg) in the secondary minimum.

With this data V628 Cyg is listed in the fourth edition of the GCVS (Kholopov et al. 1985). For a quarter of a century the variable had remained obviously unobserved, when we put V628 Cyg on our observing program. The CCD observations were made with SBIG ST6 cameras without filters, attached to a 32cm RC telescope (W.M.) and a 20cm SC telescope (F.A.). GSC 3595.1630 served as comparison star and several other stars in the same field were used to check its constancy. In our instrumental system the amplitude of variability is $0^{\mathrm{m}}_{\cdot}60$ for the primary minima and $0^{\mathrm{m}}_{\cdot}52$ for the secondary minima.

A period analysis program, based on the algorithm of Schwarzenberg–Czerny (1989) showed that the period given in the GCVS is a spurious one with the relation

$$\frac{1}{\mathrm{p}'} - \frac{1}{\mathrm{p}} = \frac{1}{2}$$

Using all available minima a weighted least squares fit led to the new elements:

$$\mathrm{Min\,I} = \underset{\pm 4}{\mathrm{HJD}\,2449177.4629} + \underset{\pm 5}{0^{\mathrm{d}}_{\cdot}96659115} \times \mathrm{E} \qquad (3)$$

All our times of minimum light were determined with the Kwee–van Woerden (1956) method.

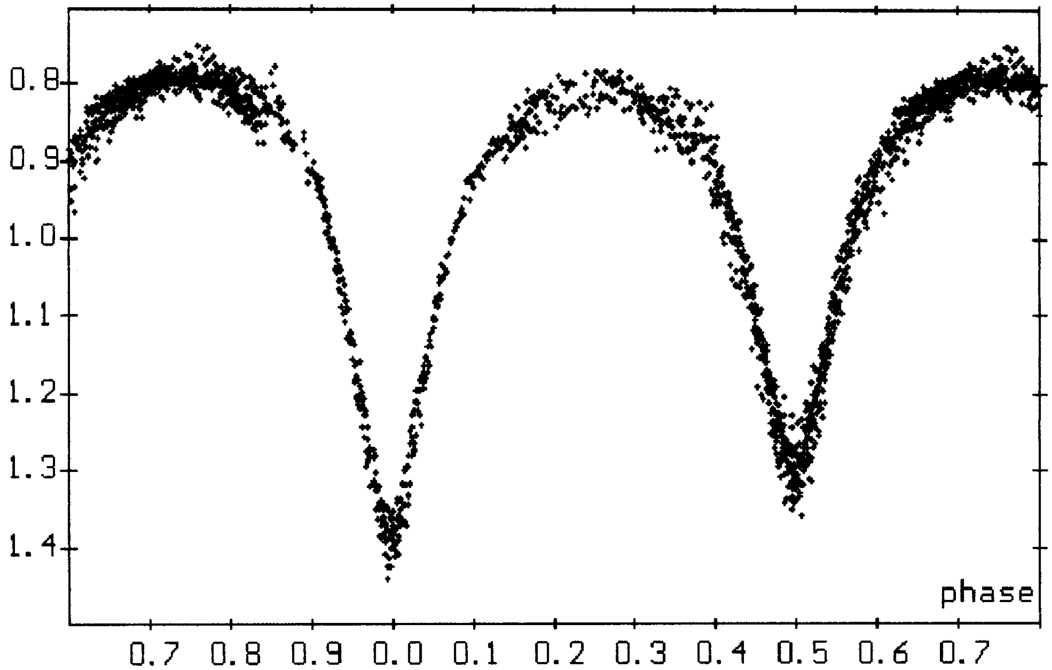

Figure 1. Differential light curve of V628 Cyg drawn with the new ephemeris (3)

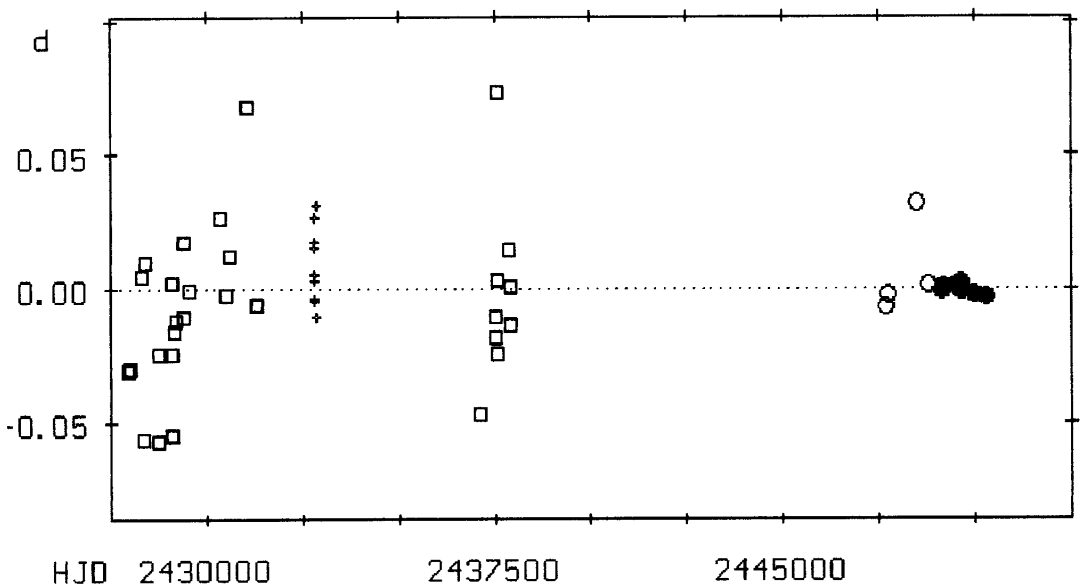

Figure 2. O−C diagram for V628 Cyg using the new ephemeris (3).
• represents photoelectric, ∘ photographic series, + visual observations and □ photographic plate minima.

Table 1. Observed times of minima for V628 Cyg, epochs and residuals computed with respect to the linear ephemeris (3) derived in this paper.

JD hel. 2400000+	W	T*	Epoch	(O−C)	Lit	JD hel. 2400000+	W	T*	Epoch	(O−C)	Lit
27955.439	1	P	−21956.5	−0.032	[1]	32862	359.3	V	−16879.0	−0.012	[2]
27983.471	1	P	−21927.5	−0.031	[1]	32865	301.3	V	−16876.0	+0.030	[2]
28285.565	1	P	−21614.0	+0.003	[1]	37130	489.1	P	−12454.0	−0.048	[3]
28344.467	1	P	−21553.0	−0.057	[1]	37517	455.1	P	−12063.0	−0.019	[3]
28404.461	1	P	−21491.0	+0.009	[1]	37530	511.1	P	−12050.5	−0.012	[3]
28778.465	1	P	−21104.0	−0.058	[1]	37547	440.1	P	−12032.0	+0.002	[3]
28779.464	1	P	−21103.0	−0.026	[1]	37549	444.1	P	−12030.0	+0.073	[3]
29109.525	1	P	−20762.5	−0.056	[1]	37560	462.1	P	−12019.5	−0.025	[3]
29111.515	1	P	−20760.5	+0.001	[1]	37848	545.1	P	−11721.5	+0.014	[3]
29112.455	1	P	−20759.5	−0.026	[1]	37936	491.1	P	−11630.5	−0.000	[3]
29158.376	1	P	−20711.0	−0.018	[1]	37938	410.1	P	−11628.5	−0.014	[3]
29187.378	1	P	−20681.0	−0.013	[1]	47671	507.5	F	−1558.0	−0.007	[4]
29401.479	1	P	−20460.5	−0.012	[1]	47744	489.1	F:	−1483.5	−0.003	[4]
29431.472	1	P	−20429.5	+0.016	[1]	48500	398.1	F:	−701.5	+0.032	[5]
29579.342	1	P	−20276.5	−0.002	[1]	48801	460.5	F	−389.0	+0.001	[5]
30378.257	1	P	−19449.0	+0.025	[1]	49119	4667.10	E	−60.0	−0.0007	[6]
30516.451	1	P	−19306.0	−0.003	[1]	49177	4637.10	E	0.0	+0.0008	[6]
30587.510	1	P	−19233.5	+0.011	[1]	49555	4011.10	E	391.0	+0.0011	[7]
31074.244	1	P	−18729.0	+0.067	[1]	49568	4489.10	E	404.5	−0.0001	[7]
31327.417	1	P	−18467.0	−0.007	[1]	49630	3112.10	E	468.5	+0.0003	[7]
32820.350	3	V	−16923.5	+0.026	[2]	49637	5596.10	E	476.0	−0.0007	[7]
32827.569	3	V	−16915.0	−0.005	[2]	49639	4933.10	E	478.0	−0.0002	[7]
32830.490	3	V	−16912.0	+0.017	[2]	49658	3437.10	E	497.5	+0.0017	[7]
32831.442	3	V	−16911.0	+0.002	[2]	49688	3052.10	E	528.5	−0.0011	[8]
32832.411	3	V	−16910.0	+0.004	[2]	50000	5127.10	E	851.5	−0.0026	[7]
32833.387	3	V	−16909.0	+0.014	[2]	50291	4563.10	E	1152.5	−0.0029	[8]
32835.301	3	V	−16907.0	−0.005	[2]						

* P denotes photographic minima, V visually observed,
E CCD observed minima and F photographic series.
Those marked with ':' got reduced weight.

[1]: E. Rohlfs: VSS 1, 487, [2]: C. Hoffmeister: VSS 1, 487, [3]: G. Romano: MSAI 38, 16, [4]: W. Moschner & W. Kleikamp: BAVM, No. 56, [5]: W. Moschner & W. Kleikamp: BAVM, No. 68, [6]: W. Moschner: BAVM, No. 68, [7]: W. Moschner: this paper, [8]: F. Agerer: this paper.

The individual measurements can be requested and will be sent via e-mail.

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EDITORS' NOTE

Mr. Anton Paschke called our attention that the new RR Lyrae-type variable GSC 2576_466 discovered by Gladders and Robb (see IBVS No. 4350) is identical with the new variable No. 22 discovered by Antipin (IBVS No. 4343). The two notes have been published so close in time that they are undoubtedly independent discoveries.

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PHOTOELECTRIC MINIMA AND MAXIMA OF SELECTED ECLIPSING AND PULSATING VARIABLES

(BAV Mitteilungen No. 90)

In this 30th compilation of BAV results, photoelectric observations obtained in the years 1995 and 1996 are presented on 92 variable stars giving 148 minima and maxima. All times of minima and maxima are heliocentric. The error of margins are tabulated in column '±'. The values in column 'O−C' are determined without incorporation of nonlinear terms. The references are given in the section 'remarks'. All information about photometers and filters are specified in the column 'Rem'. The observations were made at private observatories 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	GCVS	Rem
KP	Aql	49931.4953		L	BK	−0.0144 s	GCVS 85	6)
OO	Aql	49924.4856		L	BK	−0.0020 s	GCVS 85	6)
V337	Aql	49919.54 :		L	KI	+0.10	GCVS 85	3)
V343	Aql	49940.4011		L	KI	−0.0193	GCVS 85	3)
V688	Aql	49938.4609		L	KI	+0.0077	GCVS 85	3)
V1096	Aql	49899.4748	.0013	L	AG	+0.2151 s	GCVS 85	3)
		49924.4847	.0007	L	AG	+0.2187	GCVS 85	3)
		49929.4812	.0005	L	AG	+0.2139 s	GCVS 85	3)
V1353	Aql	49888.5172	.0010	LV	AG	+0.0319	GCVS 85	4)
		49888.5181	.0013	LB	AG	+0.0328	GCVS 85	4)
		49922.4734		L	KI	+0.0329	GCVS 85	3)
AR	Aur	50043.3451		L	BUS	−0.0719 s	GCVS 85	2)
IM	Aur	49735.4974	.0006	LV	AG	−0.0611	GCVS 85	4)
		49735.4995	.0005	LB	AG	−0.0590	GCVS 85	4)
		50123.4053	.0008	LB	AG	−0.0623	GCVS 85	4)
		50123.4065	.0007	LV	AG	−0.0611	GCVS 85	4)
KO	Aur	49789.4544	.0003	L	AG	+0.0437	GCVS 85	3)
MN	Aur	50013.3958		L	MS	−0.0532 s	GCVS 85	3)
		50080.3689		L	MS	+0.0059	GCVS 85	3)
XY	Boo	49859.4101		L	KI	−0.0045	GCVS 85	3)
AC	Boo	49793.5608	.0003	LV	AG	−0.0548 s	GCVS 85	4)
		49793.5609	.0002	LB	AG	−0.0547 s	GCVS 85	4)

Table 1 (cont.)

Variable		Min JD 24..	+/−	Ph	Obs	O–C	GCVS	Rem
TU	Cam	49734.5241	.0016	LB	AG	+0.0502	GCVS 85	4)
AW	Cam	50147.4369	.0002	LB	AG	−0.0056	GCVS 85	4)
		50147.4370	.0002	LV	AG	−0.0055	GCVS 85	4)
BI	CVn	49761.4371	.0015	LB	AG	+0.0840 s	GCVS 85	4)
		49761.4375	.0013	LV	AG	+0.0844 s	GCVS 85	4)
		49761.6308	.0005	LV	AG	+0.0856	GCVS 85	4)
		49761.6313	.0011	LB	AG	+0.0861	GCVS 85	4)
		50152.3673	.0017	LV	AG	−0.0607 s	GCVS 85	4)
		50152.3678	.0013	LB	AG	−0.0602 s	GCVS 85	4)
		50152.5583	.0006	LB	AG	−0.0618	GCVS 85	4)
		50152.5589	.0007	LV	AG	−0.0612	GCVS 85	4)
BO	CVn	49763.4798	.0004	LV	AG			4)
		49763.4803	.0005	LB	AG			4)
BH	CMi	50138.3806	.0009	LV	AG			4)
		50138.3810	.0007	LB	AG			4)
GT	Cas	49938.5186		L	MS	+0.1550	GCVS 85	3)
OX	Cas	49647.5440	.0012	LB	AG	+0.0256 s	GCVS 85	4)
		49647.5468	.0017	LV	AG	+0.0284 s	GCVS 85	4)
V344	Cas	49660.2910		L	MS	−0.0845	GCVS 85	3)
AH	Cep	49644.3903	.0007	LB	AG	−0.0146 s	GCVS 85	4)
		49644.3908	.0006	LV	AG	−0.0141 s	GCVS 85	4)
CW	Cep	49952.4872	.0007	LB	AG	−0.0283	GCVS 85	4)
		49952.4884	.0005	LV	AG	−0.0271	GCVS 85	4)
		49978.4665	.0008	LV	AG	+0.0242 s	GCVS 85	4)
EF	Cep	49735.2891	.0002	L	AG	−0.1384	GCVS 85	3)
		49763.4757	.0005	L	AG	−0.1341 s	GCVS 85	3)
		50120.4702	.0004	L	AG	−0.1161 s	GCVS 85	3)
EM	Cep	49935.4816	.0024	LB	AG	−0.0664	GCVS 85	4)
		49935.4816	.0012	LV	AG	−0.0664	GCVS 85	4)
RW	CrB	49896.5076	.0004	LV	AG	−0.0157	GCVS 85	4)
		49896.5077	.0007	LB	AG	−0.0156	GCVS 85	4)
TX	Her	49932.5312		L	BK	+0.0050	GCVS 85	6)
AK	Her	49930.4590		L	BK	+0.0074 s	GCVS 85	6)
SW	Lac	49928.4976		L	BK	−0.0293 s	GCVS 85	6)
		49929.4567		L	BK	−0.0324 s	GCVS 85	6)
		50013.4845		L	FR	−0.0335 s	GCVS 85	3)
		50013.6449		L	FR	−0.0334	GCVS 85	3)
V364	Lac	50013.5782		L	FR	+0.0499	GCVS 85	3)
V501	Oph	49906.4484		L	KI	−0.0052	GCVS 85	3)
V506	Oph	49898.4931		L	KI	+0.0246	GCVS 85	3)
V508	Oph	49894.4721		L	KI	+0.0101	GCVS 85	3)
V839	Oph	49912.4721		L	KI	−0.0925	GCVS 85	3)
CP	Ori	49644.5388		L	MS	−0.0484	GCVS 85	3)
ER	Ori	50115.3638		L	KI	+0.0166 s	GCVS 85	3)
U	Peg	50034.2816		L	KI	−0.0631 s	GCVS 87	3)
BB	Peg	50001.3351		L	KI	+0.0060	GCVS 87	3)
		50026.2785		L	KI	+0.0057	GCVS 87	3)
BN	Peg	50003.3540		L	KI	+0.0059	GCVS 87	3)
BO	Peg	50014.2900		L	KI	−0.0149	GCVS 87	3)
DI	Peg	50008.3599		L	KI	−0.0097	GCVS 87	3)
GH	Peg	50005.3224		L	KI	+0.0053	GCVS 87	3)
HW	Vir	49496.397 :		L	HAS DEI			

Table 2. RR Lyrae/Delta Scuti type stars

Variable		Max JD 24..	+/−	Ph	Obs		O–C	GCVS	Rem
BK	And	50047.2994		L	BK		+0.1038	GCVS 85	6)
DK	And	50042.4988		L	BK		−0.1116	GCVS 85	6)
SX	Aqr	50012.3249		L	KI		−0.0401	BAVM 75	3)
CY	Aqr	50027.2749		L	KI		+0.0091	GCVS 85	3)
		50027.3360		L	KI		+0.0092	GCVS 85	3)
V341	Aql	49947.4950		L	BK		+0.0130	GCVS 85	6)
V793	Aql	49951.422		L	KI		+0.184	GCVS 85	3)
RV	Ari	50047.3975		L	BK		+0.0077	GCVS 85	6)
		50047.4871		L	BK		+0.0041	GCVS 85	6)
RW	Ari	50105.4089		L	BK		−0.0400	GCVS 85	6)
AH	Cam	50112.4733		L	BK		+0.1782	GCVS 85	6)
VW	CVn	49471.528	.005	L	AG		+0.000	BAVM 74	3)
		49472.382	.005	L	AG		+0.004	BAVM 74	3)
		49474.517	.005	L	AG		+0.014	BAVM 74	3)
		49480.464	.002	L	AG		+0.012	BAVM 74	3)
		49511.487	.005	L	AG		+0.011	BAVM 74	3)
		49734.610	.001	L	AG		+0.021	BAVM 74	3)
		49786.464	.002	L	AG		+0.027	BAVM 74	3)
		50114.612	.002	L	AG		+0.092	BAVM 74	3)
X	CMi	49689.7096		L	PS		−0.0237	GCVS 85	5)
		49811.410		L	PS		−0.104	GCVS 85	5)
AA	CMi	49722.4997		L	PS		+0.0235	GCVS 85	5)
HY	Com	49799.4123		L	MS				3)
SZ	CrB	49761.6831		L	MS		+0.2202	GCVS 85	3)
		49771.5558		L	MS		+0.2233	GCVS 85	3)
XZ	Cyg	49933.5209		L	BK		+0.0660	GCVS 85	6)
DM	Cyg	49948.4596		L	BK		+0.0298	GCVS 85	6)
DX	Del	49945.4877		L	KI				3)
EG	Del	49941.39 :		L	KI		−0.07	GCVS 85	3)
SW	Dra	48087.4154		LV	WU	GZI	+0.0352	GCVS 85	1)
		48513.5310		LV	WC		+0.0377	GCVS 85	1)
		48651.3896		LV	WU	MSL	+0.0362	GCVS 85	1)
		49130.4853		LV	WU	GZI	+0.0395	GCVS 85	1)
		49788.4544		LV	WU	TRB	+0.0398	GCVS 85	1)
VZ	Dra	49935.4350		L	BK		−0.0317	GCVS 85	6)
		49944.4264		L	BK		−0.0291	GCVS 85	6)
XZ	Dra	49934.4547		L	BK		−0.0219	GCVS 85	6)
RT	Equ	50007.4311		L	PS		−0.1632	GCVS 85	5)
BK	Eri	50079.252		L	KI				3)
SZ	Gem	50096.4355		L	BK		−0.0307	GCVS 85	6)
KV	Gem	50080.4327		L	BK		+0.0051	GCVS 85	6)
VZ	Her	49938.4492		L	BK		+0.0395	GCVS 85	6)
DL	Her	49895.466		L	KI		+0.021	GCVS 85	3)
DY	Her	49890.4357		L	KI		−0.0148	GCVS 85	3)
LS	Her	49868.4337		L	KI		−0.0044	GCVS 85	3)
CZ	Lac	50052.3314		L	BK		+0.0276	GCVS 85	6)
ST	Leo	49834.3805		L	KI		−0.0158	GCVS 85	3)
AA	Leo	48674.5554		L	PS		−0.1147	GCVS 85	5)
EH	Lib	49865.4371		L	KI		+0.0017	GCVS 85	3)
RW	Lyn	50113.5302		L	BK		+0.0076	BAVM 75	6)
TV	Lyn	50098.3384		L	BK		+0.0240	GCVS 85	6)
RZ	Lyr	49939.4771		L	BK		+0.0043	GCVS 85	6)

Table 2 (cont.)

Variable		Max JD 24..	+/−	Ph	Obs	O–C	GCVS	Rem
V567	Oph	49896.5428		L	KI	+0.0514	GCVS 85	3)
VV	Peg	50013.3348		L	KI	−0.0238	GCVS 87	3)
VZ	Peg	50081.2957		L	BK	+0.1391	GCVS 87	6)
BF	Peg	50034.4465		L	BK	+0.1763	GCVS 87	6)
BP	Peg	49677.3602		L	PS	+0.0249	GCVS 87	5)
		50080.2642		L	BK	+0.0284	GCVS 87	6)
DH	Peg	49941.4803		L	BK	+0.0218	GCVS 87	6)
		50015.3242		L	BK	+0.0232	GCVS 87	6)
		50016.3491		L	KI	+0.0261	GCVS 87	3)
DY	Peg	50052.1988		L	KI	−0.0004	GCVS 87	3)
		50052.2710		L	KI	−0.0011	GCVS 87	3)
KN	Per	50113.3642		L	BK	+0.1287	GCVS 87	6)
RU	Psc	50012.3535		L	BK	+0.0180	GCVS 87	6)
		50015.493 :		L	BK	+0.034	GCVS 87	6)
		50026.4219		L	BK	+0.0326	GCVS 87	6)
RY	Psc	50027.4279		L	BK	+0.2543	GCVS 87	6)
SS	Psc	50014.447 :		L	BK	−0.051	GCVS 87	6)
		50016.4625		L	BK	−0.0493	GCVS 87	6)
		50068.2877		L	KI	−0.0268	GCVS 87	3)
		50114.3049		L	BK	−0.0565	GCVS 87	6)
CW	Ser	49888.4551		L	KI	+0.0222	GCVS 87	3)
BC	Vir	49844.387 :		L	KI	−0.003	GCVS 87	3)

Remarks:

AG	Agerer, F.	Zweikirchen	MS	Moschner, W.	Lennestadt
BK	Birkner, C.	Hagen	MSL	Meisel, S.	Nürnberg
BUS	Busch, H.	Hartha	MSR	Moschner, J.	Lennestadt
DEI	Deininger, H.	Karlsruhe	PS	Paschke, A.	Rueti (CH)
FR	Frank, P.	Velden	TRB	Traub, J.	Nürnberg
GZI	Garzarolli, M.	Hoechstadt	WC	Wieck, M.	Nürnberg
HAS	Hase, F.	Karlsruhe	WU	Wunder, E.	Heidelberg
KI	Kleikamp, W.	Marl			

:	=	uncertain
s	=	secondary minimum
L	=	photoelectric observation - without filter
LB	=	as above - filter: B
LV	=	as above - filter: V
1)	=	photometer 1P21 - filter: V = GG11 / B= BG3+GG13
2)	=	photometer Schnitzer
3)	=	photometer CCD 375x242 uncoated - without filter
4)	=	photometer EMI 9781A - filter: V = GG495,1mm / B = BG12,1mm+GG385,2mm
5)	=	photometer Cryocam 89A - without filter
6)	=	photometer ST-7 - without filter
GCVS nn	=	Gen. Cat. of Variable Stars, 4th ed., 1985/87
BAVM 74	=	BAV Mitteilungen No. 74 = IBVS No. 4134
BAVM 75	=	BAV Mitteilungen No. 75

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PHOTOELECTRIC MINIMA OF SELECTED ECLIPSING BINARIES

(BAV Mitteilungen No. 91)

In this 31th compilation of BAV results, photoelectric observations obtained in the years 1995 and 1996 are presented on 71 variable stars giving 141 minima. All times of minima are heliocentric. The error of margins is tabulated in column '±'. The values in column 'O0−C' are determined without incorporation of nonlinear terms. The references are given in the section 'remarks'. All information about photometers and filters are specified in the column 'Rem'. The observations were made at private observatories 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		GCVS	Rem
V417	Aql	49921.4385		L	KI		−0.0390	s	BAVR 13)	3)
V609	Aql	49931.4188		L	KI		−0.0214		GCVS 85	3)
		49978.4151		L	MSR		−0.0224		GCVS 85	3)
AH	Aur	49739.3193	.0002	L	AG		+0.0673	s	BAVR 16)	3)
AP	Aur	49722.6186		L	MS		+0.0019		BAVM 67	3)
		50043.4567	.0007	LB	AG		+0.0008	s	BAVM 67	4)
		50043.4595	.0008	LV	AG		+0.0036	s	BAVM 67	4)
GX	Aur	49688.4760		L	MS		−0.0113		BAVM 69	3)
		49721.6283		L	MS		−0.0133		BAVM 69	3)
		50043.4541		L	MS		−0.0127	s	BAVM 69	3)
TY	Boo	50081.6168		L	MS		−0.0049		BAVM 68	3)
TZ	Boo	49784.5496	.0002	L	AG		+0.0040	s	BAVM 68	3)
		50150.514 :	.002	L	AG		+0.020		BAVM 68	3)
VW	Boo	49786.4458		L	MS		−0.0218		BAVR 12)	3)
FF	Cnc	49810.4029	.0014	LV	AG		−0.0223	s	BAVM 65	4)
		49810.4047	.0014	LB	AG		−0.0205	s	BAVM 65	4)
V445	Cas	50033.3014		L	MS		+0.0024		BAVM 69	3)
WW	Cep	50152.4327	.0005	L	AG		−0.0011	s	BAVM 71	3)
SS	Com	50140.4423	.0002	L	AG		+0.0297		BAVR 13)	3)
UX	Com	49787.3742		L	MS	MSR	−0.0218		BAVM 69	3)
CC	Com	49839.4038		L	KI		−0.0078		GCVS 85	3)
DK	Cyg	49918.4470	.0003	LB	AG		+0.0176		BAVR 15)	4)
		49918.4475	.0004	LV	AG		+0.0181		BAVR 15)	4)
GO	Cyg	49647.3328	.0003	LB	AG		+0.0528		GCVS 85	4)
		49647.3330	.0003	LV	AG		+0.0530		GCVS 85	4)

Table 1 (cont.)

Variable		Min JD 24...	+/−	Ph	Obs	O–C		GCVS	Rem
GO	Cyg	49907.5249	.0013	LV	AG	+0.0555	s	GCVS 85	4)
		49907.5269	.0013	LB	AG	+0.0575	s	GCVS 85	4)
V366	Cyg	49646.3819	.0008	LV	AG	−0.0482		GCVS 85	4)
		49646.3826	.0005	LB	AG	−0.0475		GCVS 85	4)
V382	Cyg	49947.4150	.0009	LV	AG	+0.0352		GCVS 85	4)
		49947.4164	.0013	LB	AG	+0.0366		GCVS 85	4)
V478	Cyg	49905.4969	.0020	LV	AG	+0.0208		GCVS 85	4)
		49905.4973	.0011	LB	AG	+0.0212		GCVS 85	4)
V885	Cyg	49906.5094	.0019	LV	AG	−0.0642		GCVS 85	4)
		49906.5096	.0010	LB	AG	−0.0640		GCVS 85	4)
V909	Cyg	49936.467 :	.002	LV	AG	+0.645	s	BAVR 11)	4)
V1061	Cyg	49941.4566	.0004	LV	AG	−0.0159		GCVS 85	4)
		49941.4572	.0003	LB	AG	−0.0153		GCVS 85	4)
V1191	Cyg	49644.2651	.0002	L	AG	+0.0005	s	GCVS 85	3)
		49644.4228	.0002	L	AG	+0.0016		GCVS 85	3)
V2021	Cyg	49632.3637	.0005	LB	AG				4)
		49940.5084	.0002	LV	AG				4)
		49940.5088	.0002	LB	AG				4)
TT	Del	49932.3948		L	KI	−0.0460		GCVS 85	3)
TY	Del	49939.4912		L	KI	+0.0426		GCVS 85	3)
YY	Del	49947.4493		L	KI	+0.0019		GCVS 85	3)
EX	Del	49925.4716	.0004	L	AG	−0.0598		GCVS 85	3)
		49935.4020		L	KI	−0.0505		GCVS 85	3)
FZ	Del	49944.3929		L	KI	−0.0325		GCVS 85	3)
GG	Del	49929.4395		L	KI	−0.0120		GCVS 85	3)
BX	Dra	50147.5838	.0003	L	AG	+0.0269	s	GCVS 85	3)
CV	Dra	49860.4446	.0004	LV	AG	−0.0006		BAVM 69	4)
		49860.4454	.0005	LB	AG	+0.0002		BAVM 69	4)
EF	Dra	49763.6371	.0011	LB	AG	+0.0020		BAVM 63	4)
		49763.6379	.0006	LV	AG	+0.0028		BAVM 63	4)
UX	Eri	50096.3969		L	KI	+0.0831		GCVS 85	3)
		50105.3017		L	KI	+0.0823		GCVS 85	3)
YY	Eri	50098.3840		L	KI	+0.0585		GCVS 85	3)
		50113.3321		L	KI	+0.0571	s	GCVS 85	3)
BL	Eri	50114.2715		L	KI				3)
BV	Eri	49726.192 :	.004	LV	AG	−0.033	s	GCVS 85	4)
		49734.3132	.0011	LV	AG	−0.0347	s	GCVS 85	4)
		49735.3304	.0026	LV	AG	−0.0329	s	GCVS 85	4)
		49749.2882	.0006	LV	AG	−0.0358		GCVS 85	4)
UX	Her	49899.4475		L	KI	+0.0263		GCVS 85	3)
CT	Her	49877.4356		L	KI	−0.0015		GCVS 85	3)
HS	Her	49929.4485	.0012	LB	AG	−0.0149	s	GCVS 85	4)
		49929.4507	.0009	LV	AG	−0.0127	s	GCVS 85	4)
		49979.3943	.0008	LV	AG	−0.0109		GCVS 85	4)
PW	Her	49899.6221	.0007	LB	AG	−0.0070		BAVM 68	4)
		49899.6248	.0008	LV	AG	−0.0043		BAVM 68	4)
AV	Hya	49778.3328	.0004	LB	AG	−0.0405		GCVS 85	4)
		49778.3340	.0008	LV	AG	−0.0393		GCVS 85	4)
		49784.4829	.0004	LB	AG	−0.0410		GCVS 85	4)
		49784.4832	.0004	LV	AG	−0.0407		GCVS 85	4)
FG	Hya	49772.453 :	.004	LV	AG	−0.037	s	GCVS 85	4)
		49772.454 :	.004	LB	AG	−0.036	s	GCVS 85	4)
EM	Lac	49935.5264	.0004	L	AG	+0.0337		GCVS 85	3)

Table 1. (cont.)

Variable		Min JD 24...	+/−	Ph	Obs		O–C		GCVS	Rem
UZ	Leo	49734.5686		L	MS		+0.0847	s	GCVS 85	3)
		49778.450 :	.002	L	AG		+0.085	s	GCVS 85	3)
VZ	Leo	49810.3943		L	KI		−0.0335		GCVS 85	3)
XY	Leo	49756.3626	.0009	LB	AG		−0.0449		GCVS 85	4)
		49756.3649	.0005	LV	AG		−0.0426		GCVS 85	4)
		49778.5232	.0004	LV	AG		−0.0439		GCVS 85	4)
		49778.5237	.0003	LB	AG		−0.0434		GCVS 85	4)
		50137.6365	.0008	LB	AG		−0.0291		GCVS 85	4)
		50137.6372	.0007	LV	AG		−0.0284		GCVS 85	4)
XZ	Leo	49756.4048	.0006	LV	AG		+0.0163		GCVS 85	4)
		49756.4053	.0005	LB	AG		+0.0168		GCVS 85	4)
		50137.3277	.0015	LB	AG		+0.0181		GCVS 85	4)
		50137.5702	.0022	LV	AG		+0.0167	s	GCVS 85	4)
		50137.5715	.0024	LB	AG		+0.0180	s	GCVS 85	4)
AG	Leo	49788.4730	.0005	L	AG		+0.0016		GCVS 85	3)
AL	Leo	49688.6231		L	MS		+0.0053		BAVM 53	3)
		49778.5311	.0008	LV	AG		−0.7982	s	BAVM 53	4)
		49778.5322	.0017	LB	AG		−0.7971	s	BAVM 53	4)
		50137.3612	.0008	LB	AG		+0.0023	s	BAVM 53	4)
		50137.3639	.0020	LV	AG		+0.0050	s	BAVM 53	4)
AP	Leo	49832.3942		L	KI		−0.0230		GCVS 85	3)
RT	LMi	49786.3694		L	MS		+0.0010		GCVS 85	3)
		49788.4303		L	MS	MSR	−0.0001	s	GCVS 85	3)
		49796.3028		L	MS		−0.0009	s	GCVS 85	3)
		50080.6786		L	MS		−0.0004		GCVS 85	3)
V404	Lyr	49787.5943		L	MS	MSR	−0.0657	s	GCVS 85	3)
		49799.6564		L	MS		−0.0642		GCVS 85	3)
		49857.3968		L	MS		−0.0685		GCVS 85	3)
		49865.4441		L	MS		−0.0616		GCVS 85	3)
V406	Lyr	49787.5855	.0002	L	AG		−0.0018		BAVM 72	3)
AQ	Mon	50144.2699		L	KI		−0.0471		GCVS 85	3)
NS	Mon	49739.2755	.0009	LB	AG		+0.0001	s	BAVM 76	4)
		49739.2768	.0008	LV	AG		+0.0014	s	BAVM 76	4)
		50146.3531		L	KI		+0.0038	s	BAVM 76	3)
V532	Mon	50043.5729		L	MS		+0.0906		GCVS 85	3)
		50068.5549		L	MS		+0.0890	s	GCVS 85	3)
		50079.5289		L	MS		+0.0888		GCVS 85	3)
BP	Per	49645.3909	.0004	L	AG		−0.0123	s	GCVS 87	3)
		50113.4070	.0002	L	AG		−0.0094		GCVS 87	3)
IM	Per	49679.3692		L	MS		+0.0582		GCVS 87	3)
		49688.3858		L	MS		+0.0579		GCVS 87	3)
		50087.3845	.0003	L	AG		+0.0597		GCVS 87	3)
V450	Per	49658.6466		L	MS		+0.0218		GCVS 87	3)
V482	Per	49761.3037	.0021	LV	AG		+0.0175		BAVM 68	4)
		49761.3048	.0011	LB	AG		+0.0186		BAVM 68	4)
		50047.5745		L	MS		+0.0302		BAVM 68	3)
		50079.3873		L	MS		+0.0365		BAVM 68	3)
VZ	Psc	50042.3178		L	KI		+0.0110	s	GCVS 87	3)
CU	Sge	49918.4824		L	KI		+0.0170		GCVS 87	3)
CW	Sge	49924.4898	.0008	LB	AG		−0.0935		GCVS 87	4)
		49924.4902	.0015	LV	AG		−0.0931		GCVS 87	4)
		49925.4754	.0011	LB	AG		−0.0984	s	GCVS 87	4)
		49925.4774	.0008	LV	AG		−0.0964	s	GCVS 87	4)

Table 1 (cont.)

Variable		Min JD 24...	+/−	Ph	Obs	O–C		GCVS	Rem
RS	Sct	49924.4408		L	KI	+0.0016		GCVS 87	3)
CC	Ser	49870.4733		L	KI	+0.1104		GCVS 87	3)
GR	Tau	49734.3334	.0004	L	AG	−0.0127		BAVR 15)	3)
		49760.344	.003	LV	AG	−0.008	s	BAVR 15)	4)
		49760.349	.003	LB	AG	−0.003	s	BAVR 15)	4)
UY	UMa	49776.541	.001	L	AG	+0.055	s	GCVS 87	3)
		50113.6407	.0002	L	AG	+0.0561		GCVS 87	3)
AX	Vir	49857.3913		L	KI	+0.0061		BAVR 11)	3)
AZ	Vir	49840.4102		L	KI	−0.0137		GCVS 87	3)
BK	Vul	49905.4633		L	MS	+0.1073		GCVS 87	3)

R e m a r k s :

AG	Agerer, F.	Zweikirchen	MS	Moschner, W.	Lennestadt
KI	Kleikamp, W.	Marl	MSR	Moschner, J.	Lennestadt

:	=	uncertain
s	=	secondary minimum
L	=	photoelectric observation - without filter
LB	=	as above - filter: B
LV	=	as above - filter: V
3)	=	photometer CCD 375x242 uncoated - without filter
4)	=	photometer EMI 9781A - filter: V = GG495,1mm / B = BG12,1mm+GG385,2mm
GCVS nn	=	Gen. Cat. of Variable Stars, 4th ed., 1985/87
BAVM nn	=	BAV Mitteilungen No. nn
BAVM 53	=	BAV Mitteilungen No. 53 = IBVS No. 3401
BAVM 63	=	BAV Mitteilungen No. 63 = IBVS No. 3811
BAVM 65	=	BAV Mitteilungen No. 65 = IBVS No. 3859
BAVM 67	=	BAV Mitteilungen No. 67 = IBVS No. 3942
BAVM 71	=	BAV Mitteilungen No. 71 = IBVS No. 4131
BAVM 72	=	BAV Mitteilungen No. 72 = IBVS No. 4132
BAVM 76	=	BAV Mitteilungen No. 76 = IBVS No. 4143
BAVR 11)	=	BAV Rundbrief 32, 36 ff
BAVR 12)	=	BAV Rundbrief 32,122 ff
BAVR 13)	=	BAV Rundbrief 33,152 ff
BAVR 15)	=	BAV Rundbrief 35, 1 ff
BAVR 16)	=	BAV Rundbrief 35, 41 ff

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1996 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. Zeilik et al. (1989) modeled the spot structure for available data from 1920 to 1989 and reviewed previous work. Heckert (1995) model the spots on RT And during 1995. Building on the above work we model the spot structure during 1996. We observed RT And on the nights of 2, 3, 4, and 8 January 1996 using the San Diego State University 61-cm telescope on Mt. Laguna. We used the same instrument, technique, and calibration as described by Heckert (1995). The light curves contain a few gaps, most noticeably just before the eclipses and during the first half of the primary eclipse. The data are however sufficient to model the spots. Figures 1 and 2 show differential magnitudes (star−comparison) in the standard Johnson–Cousins system. The data are available in digital form from PAH. Budding and Zeilik (1987) describe in detail the Information Limit Optimization Technique (ILOT) that we used to model the data. We performed the initial fits, starting with the orbital parameters found by Zeilik et al. (1989). Unlike most of the short period RS CVns, RT And has an elliptical orbit. However, we were unable to fit the ellipticity parameters and kept them fixed at the initial values. From the initial fits, we extracted a distortion wave and fit it to the longitude and radius of a single circular spot at 0K. With the exception of the B band, we were unable to fit for the latitude simultaneously with the other parameters and used a fixed latitude of 45°. The fits for each wavelength are performed independently. We get:

Spot Fits

	B band	V band	R band	I band
Longitude	217.5±3.6	223.1±4.3	213.6±5.2	209.8±5.8
Latitude	38.9±16.6	45	45	45
Radius	11.7±2.3	12.2±0.6	11.7±0.7	11.7±0.8
χ^2	112.1	58.0	73.6	119.5

Figures 3 and 4 show the initial and spot fits in the V band. We did not attempt to do clean fits to remove the spot effects and find the binary star parameters because the incompleteness of the primary eclipse would reduce the confidence in such solutions. These results are similar to the previous long term trend found by Zeilik et al. (1989). A single spot in one of two Active Longitude Belts fits the data well. Comparing these results to those of Heckert (1995), we find that the spot in 1996 was roughly the same size as in 1995 but was in the opposite active longitude belt. We also note that in 1996 the spot was near the edge of the 270° active longitude belt. In both this and previous work the spots seem to be at middle latitudes, but the latitude fits generally have low confidence and were usually fixed at 45° rather than fit to the data.

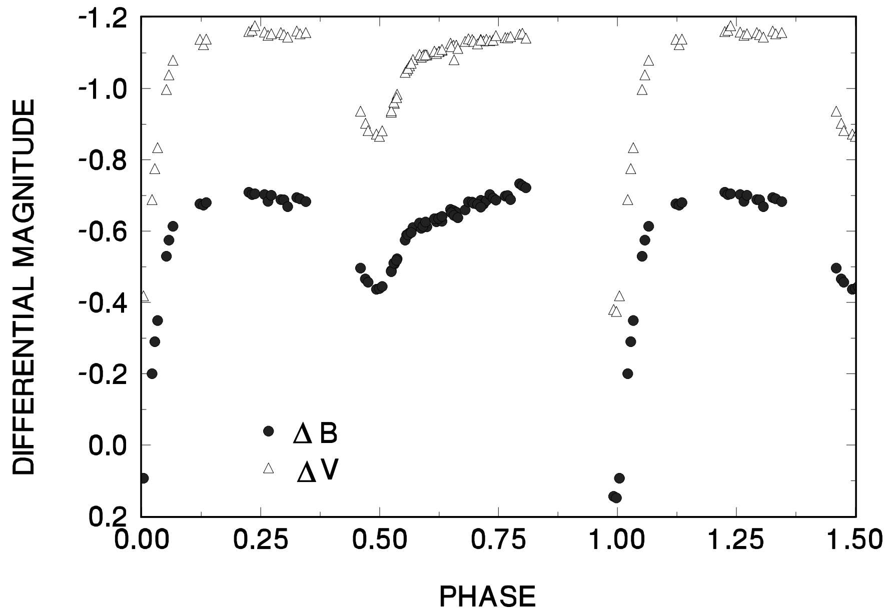

Figure 1. RT And 1996 B and V light curves

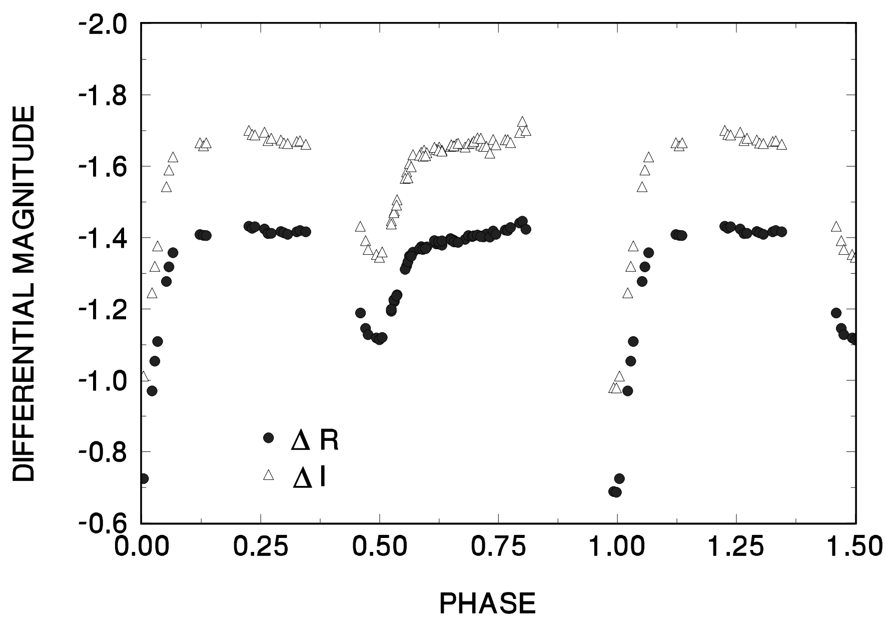

Figure 2. RT And 1996 R and I light curves

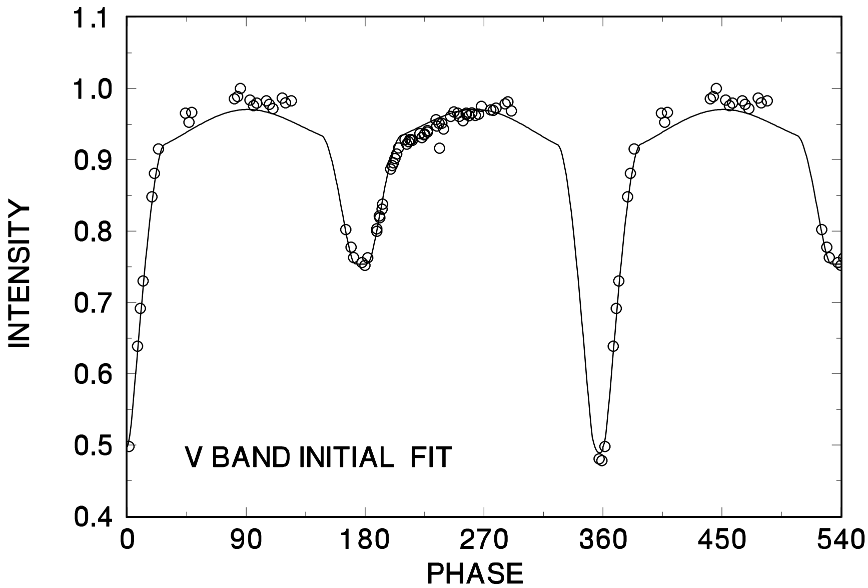

Figure 3. RT And 1996 V band initial fit

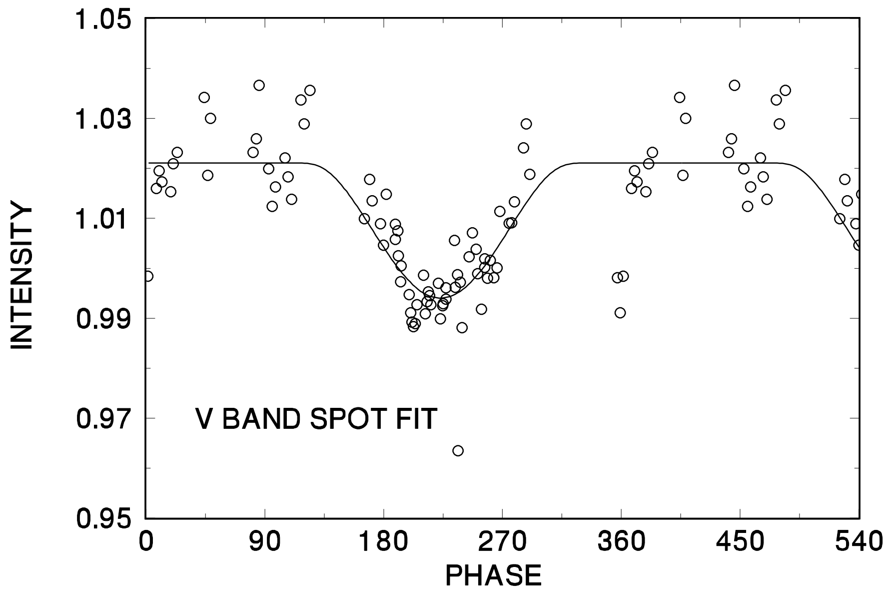

Figure 4. RT And 1996 V band spot fit

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XZ Lac = NSV 14114

During the preparation of finding charts for many neglected RR Lyr-type variable stars located in the northern hemisphere, I have found that the suspected variable NSV 14114 coincides in position with XZ Lac. This star is listed in the GCVS (Kholopov et al., 1985) as a member in the RRAB sub-class with a range of variation: 12.8-13.9 (P) and with the following coordinates (1950.0):

$$\text{R.A.: } 22^h16^m58^s \quad \text{Decl.: } +49^\circ29'.8$$

these values can be precessed to the epoch 2000.0 as follow:

$$\text{R.A.: } 22^h18^m58^s \quad \text{Decl.: } +49^\circ44'.9$$

the most recent information about XZ Lac was published by Gessner (1966).

NSV 14114 was discovered by Brun (1964) during the analysis of the photographic investigation of the stars in the "4 Lac" field carried out by Weber. In his paper Brun listed NSV 14114 as the No. 41 of his own catalogue of newly discovered variables and classified it as a suspected RR-type star with a range of variation: 12.7-13.8 (P); for the epoch 1900.0 he gave the following coordinates:

$$\text{R.A.: } 22^h15^m03^s \quad \text{Decl.: } +49^\circ15'.0$$

precessed to the epoch 2000.0 being:

$$\text{R.A.: } 22^h19^m02^s \quad \text{Decl.: } +49^\circ45'.1$$

No final designation was accepted for "Brun 41" and, on the basis of these pieces of information, it was included in the NSV Catalogue (Kholopov et al., 1982). Checking literature on variable stars, I could not find any other publication on NSV 14114 than Brun's (1964) paper.

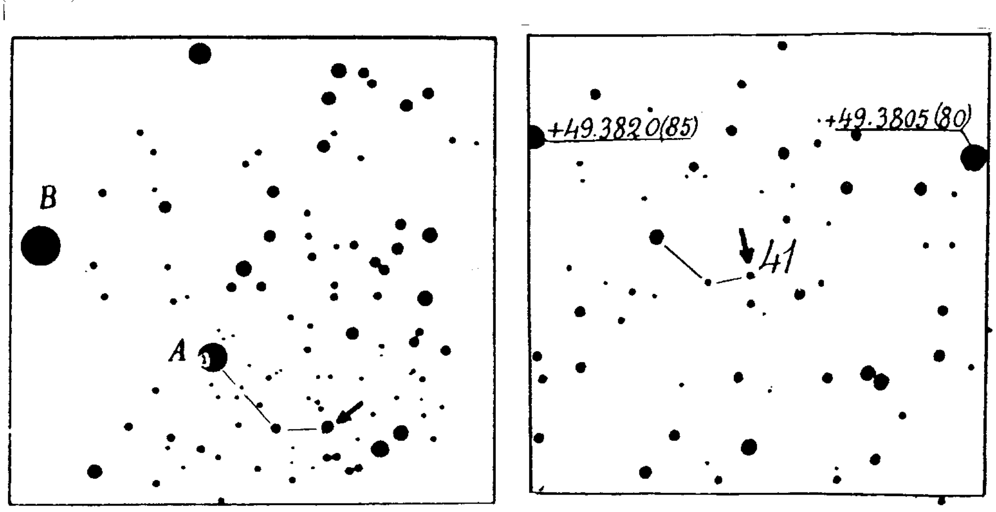

Figure 1. Identification charts for XZ Lac (left) and NSV 14114 (right)

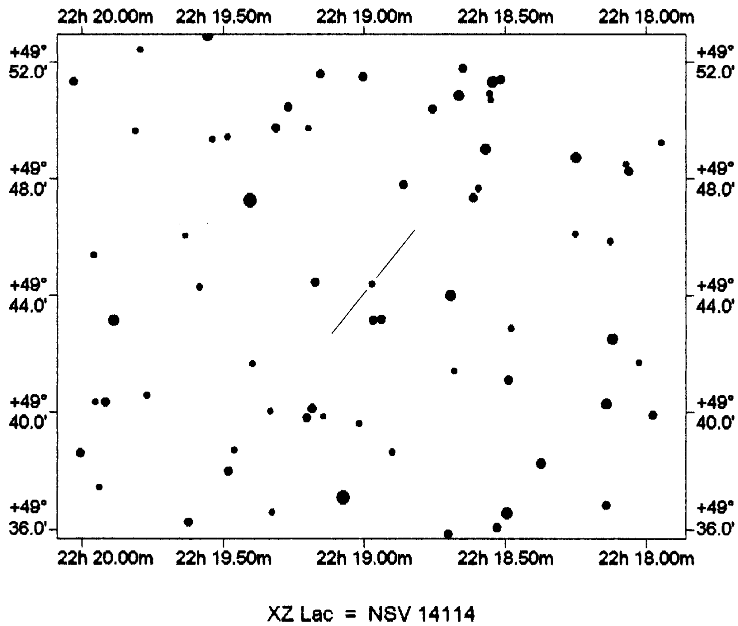

Figure 2. Field of XZ Lac = NSV 14114 = GSC 3615.2911 printed from the Guide Star Catalogue

The identification chart for XZ Lac quoted in the GCVS (Kholopov et al., 1985) was published by Hoffmeister (1928) but the original work was not available for me, so for the purposes of the present study, I used the chart published by Tsesevich and Kazanasmas (1971) reproduced in Figure 1 together with the finding chart published by Brun (1964) for NSV 14114. Comparing these two charts, it seems clear that XZ Lac is identical with NSV 14114.

The third chart presented here (see Figure 2) shows the same field reproduced from the Guide Star Catalogue (GSC).

The star marked between two lines is GSC 3615.2911 and it coincides with XZ Lac; the following coordinates for the epoch 2000.0 are given:

$$\text{R.A.: } 22^{\rm h}18^{\rm m}58\overset{\rm s}{.}24 \qquad \text{Decl.: } +49°44'22\overset{''}{.}5$$

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NSV 6177: FIRST ELEMENTS AND LIGHTCURVE

[BAV Mitteilungen Nr. 88]

NSV 6177 = SVS 1257 was discovered by Kurochkin (1959) in an investigation of new variables on 9 photographic plates of the field SA 57, centered at $13^h04^m+30°$ (1900). In this search 10 new variables were found with SVS 1257 among them. It was classified as a possibly RR Lyrae type variable with a brightness range between $12\overset{m}{.}3$ and $13\overset{m}{.}0$. An identification chart was given but no light-curve. Since elements were not published, SVS 1257 is listed as NSV 6177 in the New Catalogue of Suspected Variable Stars (Kholopov et al. 1982).

Almost 40 years later we put NSV 6177 on our observing program. The CCD observations were made with SBIG ST6 cameras without filters, attached to a 32-cm Ritchey-Chretien telescope with f = 1740 mm (W. Moschner) and a 12-cm astrograph with f = 509 mm (P. Frank). The integration time was 45 seconds at the RC-telescope and 90 seconds at the astrograph. Our CCD observations cover 44 days.

The shape of the light-curve reveals NSV 6177 surprisingly as variable of β Lyrae type (Figure 2). All minima times were calculated with the Kwee – van Woerden method (Kwee, van Woerden 1956). In the instrumental system of our CCD observations the depth of the primary and the secondary minima were found to be $0\overset{m}{.}48$ and $0\overset{m}{.}28$, respectively.

Based on our conclusion that NSV 6177 is of β Lyrae type, we reinterpreted Kurochkin's individual estimations in the following way: Each observation fainter than $12\overset{m}{.}85$ was considered to be a minimum. Weighting CCD minima 10 times higher than Kurochkin's photographic data, we obtained the following ephemeris:

$$\text{Min I} = \text{HJD}\,2450186.398 \underset{\pm 1}{} + 0\overset{d}{.}4068974 \underset{\pm 1}{} \times E \qquad (1)$$

The resulting O−C diagram (Figure 3) shows a large scattering of the photographic data. This is caused by the interpretation of dim magnitudes as minima (the related moments may not be the exact minima times) as well as the rather long exposure times of the photographic plates (not given by Kurochkin, but we assume some 60 minutes) compared to the short period of the star.

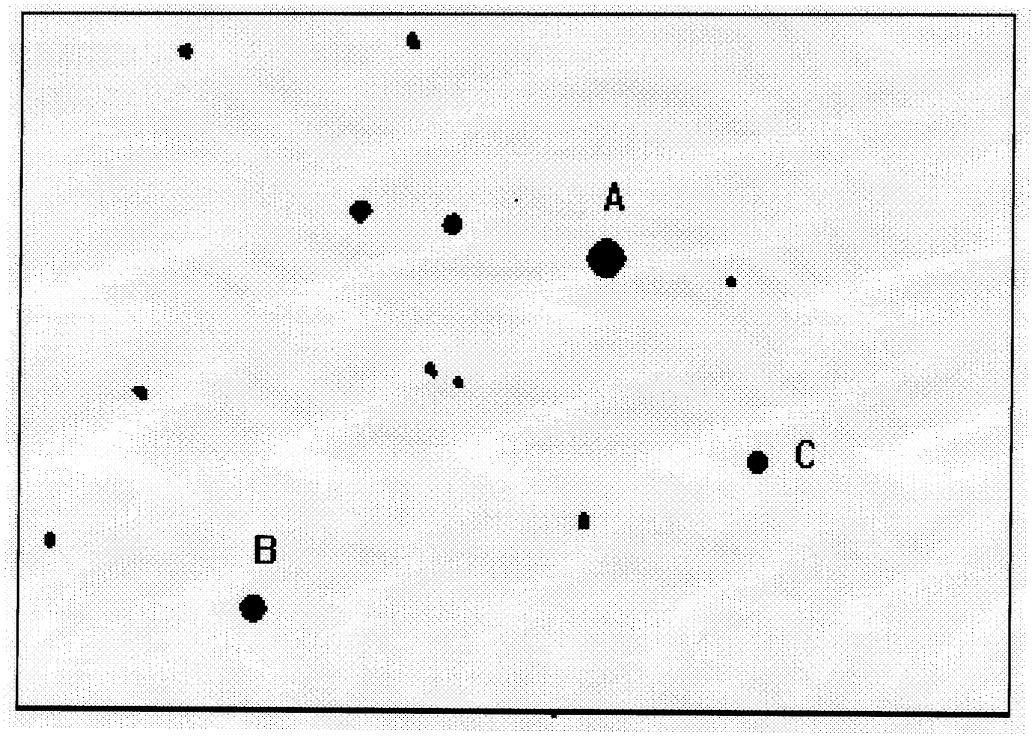

Figure 1. Identification chart for NSV 6177 (A), comparison (B) and check star (C). The size of the frame is 12×16 arcmin, North is on top.

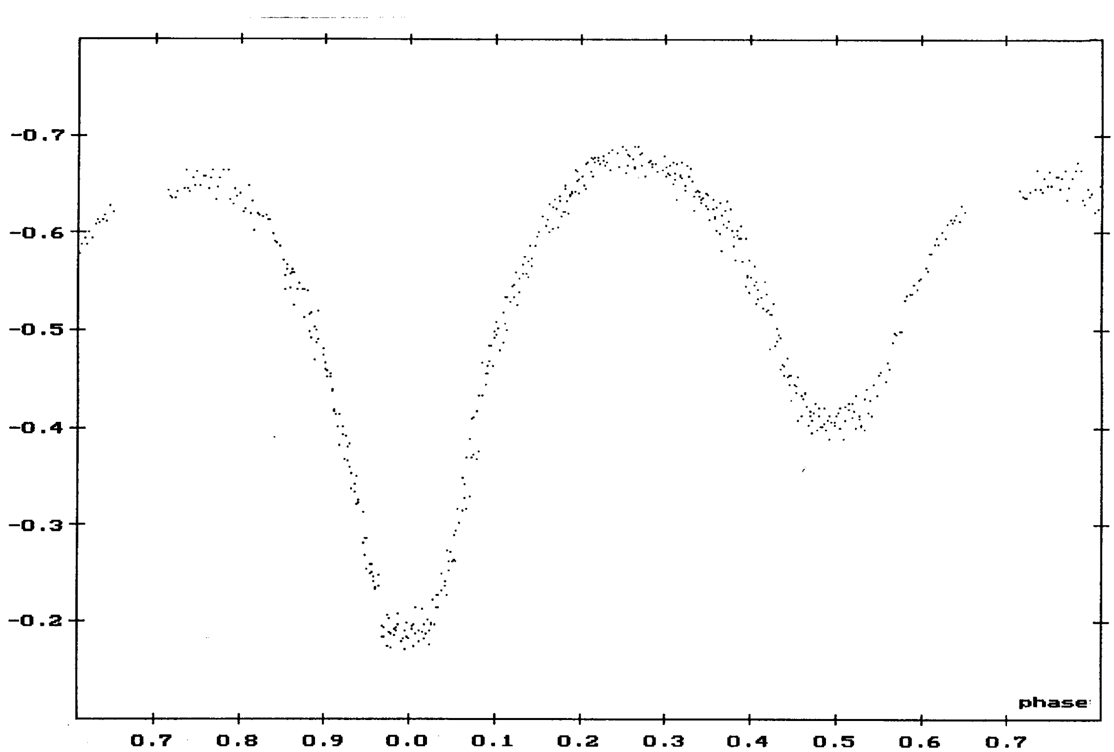

Figure 2. Differential light curve of NSV 6177 computed with respect to the first elements

Table 1. Observed times of minima for NSV 6177, epochs and residuals computed with respect to the ephemeris derived in this paper

N	JD hel 2400000+	W	T*	Epoch	O−C	Observer
1	18062.431	1	P	−78949.5	−0.028	[1]
2	18446.394	1	P	−78005.0	+0.028	[1]
3	19116.370	1	P	−76359.5	+0.047	[1]
4	19122.387	1	P	−76344.5	−0.039	[1]
5	19153.377	1	P	−76268.5	+0.026	[1]
6	33034.425	1	P	−42153.0	−0.027	[1]
7	34116.361	1	P	−39494.0	−0.031	[1]
8	34117.362	1	P	−39492.5	−0.047	[1]
9	34118.411	1	P	−39489.0	−0.016	[1]
10	34126.324	1	P	−39470.5	−0.037	[1]
11	34127.361	1	P	−39467.0	−0.017	[1]
12	34130.377	1	P	−39460.5	−0.053	[1]
13	34420.542	1	P	−38747.5	−0.006	[1]
14	34472.405	1	P	−38619.0	−0.022	[1]
15	34477.334	1	P	−38607.0	+0.024	[1]
16	34485.446	1	P	−38587.0	−0.002	[1]
17	34826420	1	P	−37749.0	−0.008	[1]
18	34834552	1	P	−37729.0	−0.014	[1]
19	35219486	1	P	−36783.0	−0.005	[1]
20	35246368	1	P	−36717.0	+0.022	[1]
21	35540541	1	P	−35994.0	+0.008	[1]
22	35547439	1	P	−35977.0	−0.011	[1]
23	35550.290	1	P	−35970.0	−0.009	[1]
24	35598.307	1	P	−35852.0	−0.005	[1]
25	35907.563	1	P	−35092.0	+0.009	[1]
26	35907.394	1	P	−35093.5	+0.043	[1]
27	35923.419	1	P	−35053.0	−0.004	[1]
28	35929.544	1	P	−35038.0	+0.017	[1]
29	35930.340	1	P	−35036.0	−0.001	[1]
30	35930.354	1	P	−35036.0	+0.013	[1]
31	35932.382	1	P	−35031.0	+0.007	[1]
32	35933.408	1	P	−35029.5	+0.016	[1]
33	35954.350	1	P	−34977.0	+0.002	[1]
34	35956.379	1	P	−34972.0	−0.003	[1]
35	35956.401	1	P	−34972.0	+0.019	[1]
36	50157.5094	10	E	−71.0	+0.0011	[2]
37	50163.4073	10	E	−57.5	−0.0010	[2]
38	50180.4990	10	E	−15.5	+0.0010	[3]
39	50186.3980	10	E	0.0	+0.0000	[3]
40	50188.4319	10	E	5.0	−0.0006	[3]
41	50189.4515	10	E	7.5	+0.0018	[3]
42	50199.4185	10	E	32.0	−0.0002	[3]
43	50201.4534	10	E	37.0	+0.0002	[3]

* E denotes CCD observed maxima, P are photographic; W – relative weight.

[1]: Kurochkin (1959),
[2]: P. Frank: this paper,
[3]: W. Moschner: this paper.

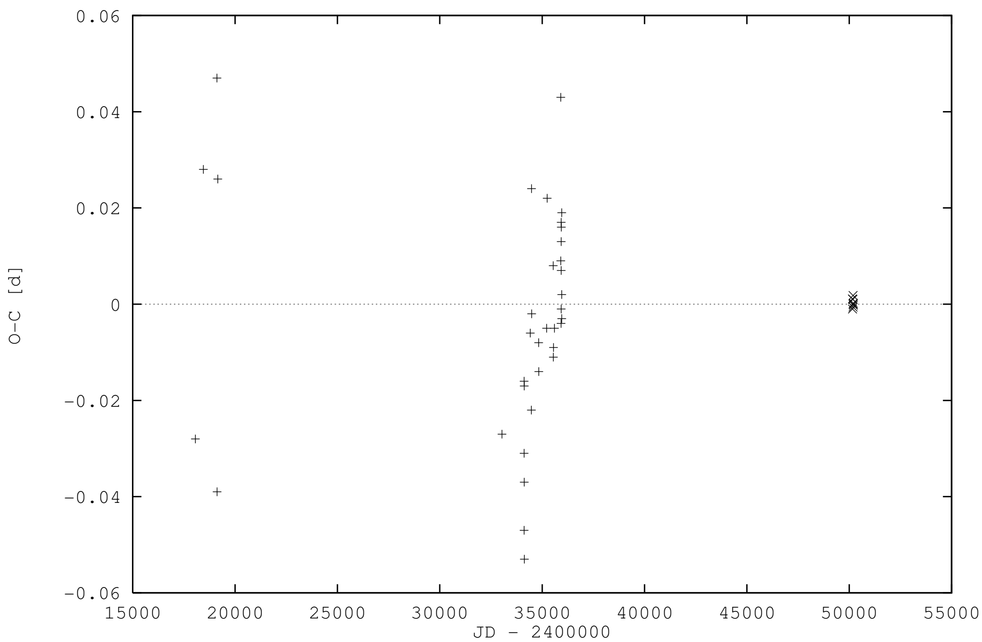

Figure 3. O−C diagram of NSV 6177. + – photographic minima by Kurochkin, × – CCD by the authors

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NEW EPHEMERIS AND LIGHT CURVES OF DD MONOCEROTIS

The first ephemeris of DD Mon (HD 292319) was given by Ahnert et al. (1947). Wachmann (1968) later published a photographic light curve and obtained a revised ephemeris :

$$\text{Min.I} = \text{HJD}\,2430321.453 + 0^{\text{d}}.56801193 \times \text{E} \qquad (1)$$

Yamasaki et al. (1990) gave the first photoelectric light curves, but they did not publish their times of light minima. They used Wachmann's light elements to compute the phases of their observations and applied the correction of $-0^{\text{p}}.108$ in their analysis.

New photoelectric observations of DD Mon were carried out with the 1.0 m telescope at Yunnan Observatory, Academia Sinica, during seven nights in January and February 1996. The B and V filters approximate Johnson's standard UBV system. HD 292321 and HD 48867 were chosen as comparison and check stars, respectively (the same stars were used by Yamasaki et al. 1990). Nightly extinction coefficients were determined from the observations of the comparison star. The observational accuracy throughout the observing period as derived from the magnitude difference between the check star and the comparison star is $0^{\text{m}}.012$. (V) and $0^{\text{m}}.013$ (B). Altogether, 403 V observations and 358 B observations have been obtained for DD Mon.

From Yamasaki et al.'s and our observations, seven times of light minima have been determined by using quadratic fitting method, and have been listed in Table 1. All available times of light minima were introduced into a least squares solution to derive the new ephemeris:

$$\text{Min.I} = \text{HJD}\,\underset{\pm 17}{2450099.7888} + 0^{\text{d}}.\underset{34}{56802738} \times \text{E} \qquad (2)$$

In Table 1 the $(\text{O}-\text{C})_2$ residuals were calculated by using this new formula and the $(\text{O}-\text{C})_1$ were calculated by using Wachmann's ephemeris. The determined light minima are too few to study the period change of the system. More observations for DD Mon are necessary to know the period behaviour of this binary.

Table 1. Moments of light minima and O−C residuals of DD Mon

JD.Hel.	Filter	Min.	$(\text{O}-\text{C})_1$	$(\text{O}-\text{C})_2$
2446411.3042(14)	B,V	II	+0.0613	+0.0011
2446420.1085(9)	B,V	I	+0.0614	+0.0011
2446443.1111(9)	B,V	II	+0.0607	−0.0012
2446443.9643(19)	B,V	I	+0.0595	−0.0014
2450099.7908(4)	B,V	I	+0.1624	+0.0020
2450123.6447(4)	B,V	I	+0.1598	−0.0012
2450127.6213(4)	B,V	I	+0.1603	−0.0008

(The first four times of minima were determined from Yamasaki et al.'s (1990) observations)

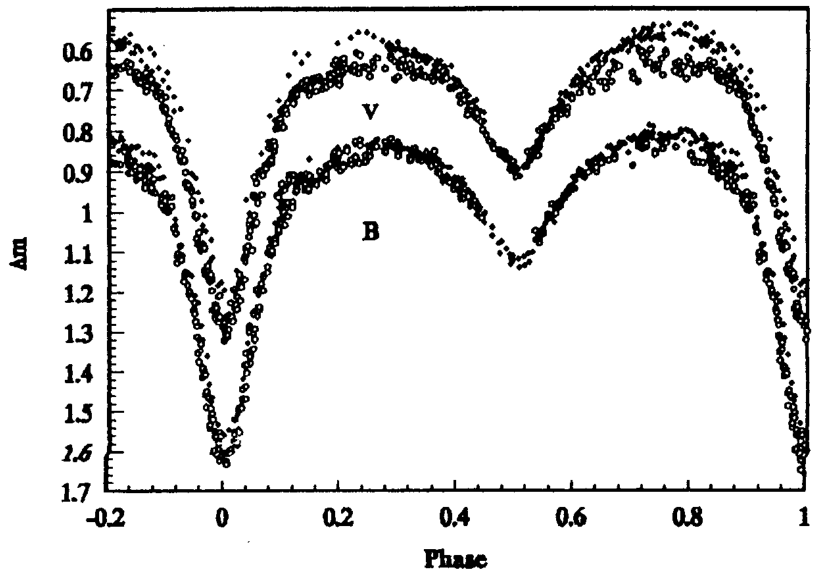

Figure 1. B and V light curves of DD Mon. The open circles show the present observations and the filled circles indicate Yamasaki et al.'s observations in 1985 and 1986

The light variations of DD Mon relative to HD 292321, in the sense variable minus comparison are shown in Figure 1 as open circles. The filled circles indicate the 1985/1986 observations published by Yamasaki et al. (1990). The maximum brightness of our light curves was fainter by $0\overset{m}{.}03$ (B) and $0\overset{m}{.}08$(V), and the minimum brightness was also fainter by $0\overset{m}{.}08$ (B) and $0\overset{m}{.}12$ (V) as compared with the 1985/1986 observations. The photometric asymmetries (O'Connell effect) on Yamasaki et al.'s (1990) light curves are not seen on our light curves. The photometric disturbances between 0.25-0.36 phases on their light curves were shifted to phases 0.16-0.25. The variation of the light curves may be caused by the evolution of the system and/or the stellar activity. The light curve analysis using WD synthesis method will be published elsewhere.

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THE PERIOD BEHAVIOUR OF BL ERIDANI

The ephemeris of BL Eri given in the General Catalogue of Variable Star (Kholopov et al. 1985) is

$$\mathrm{Min.I} = \mathrm{HJD}\,2429232.082 + 0\overset{\mathrm{d}}{.}1462 \times \mathrm{E} \qquad (1)$$

Later, from the first photoelectric observations Kern and Bookmyer (1986) improved the ephemeris as

$$\mathrm{Min.I} = \mathrm{HJD}\,2444606.5914 + 0\overset{\mathrm{d}}{.}41696010 \times \mathrm{E} \qquad (2)$$

The orbital period of the system has been discussed in various studies. Yamasaki et al. (1988) suspected that the orbital period of BL Eri likely changed between 1980 and 1986. Recently, Qingyao et al. (1996) pointed out that the orbital period increased, but property of the period changes is unclear.

The eclipsing binary BL Eri was observed in January 1996 with the 1.0m telescope at Yunnan Observatory in China. BD−12°0814 and BD−12°0821 were chosen as the comparison and check stars, respectively. From our observations two moments of secondary minima were determined, which are listed in Table 1.

With the ephemeris given by Kern and Bookmyer (1986), we have computed the $(\mathrm{O-C})_1$ values of a number of times of minima we found in references and have listed in Table 2. Using these $(\mathrm{O-C})_1$ values we derived the O−C diagram displayed in Figure 1. In Figure 1 a systematic trend is seen: the period has been increasing continuously. In order to determine the rate of period change, all the minimum times were introduced into a quadratic least squares solution which resulted in:

$$\begin{array}{ll}\mathrm{Min.I} = \mathrm{HJD}\,2444606.5833 + 0\overset{\mathrm{d}}{.}41691786 \times \mathrm{E} + 0\overset{\mathrm{d}}{.}000000004286 \times \mathrm{E}^2 & (3)\\ \qquad\qquad\qquad\qquad \pm 3 \qquad\qquad\quad \pm 6 \qquad\qquad\qquad\qquad \pm 5 & \end{array}$$

and the rate of period change: dP/dE=0.000000004286 day. With this latter ephemeris we computed the $(\mathrm{O-C})_2$ values in Table 2. Comparing the $(\mathrm{O-C})_1$ values with the $(\mathrm{O-C})_2$ values in Table 2 the quadratic ephemeris (3) has smaller deviation

Table 1. Moments of minimum light of BL Eri

JD(Hel.)	Error(day)	Min.	Filters
2450096.6707	0.0004	II	B,V
2450099.5889	0.0005	II	B,V

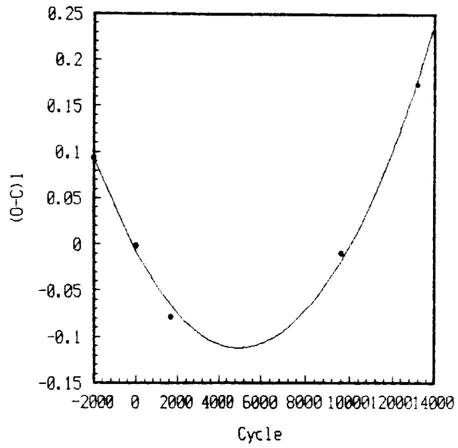

Figure 1. The O−C diagram plotted using the linear ephemeris (2), the solid curve represents the quadratic fit

Table 2

JD(Hel.) 2400000+	E	$(O-C)_1$	$(O-C)_2$	Source
44603.6709	−7.0	−0.0018	+0.0060	Kern and Bookmyer(1986)
44604.7146	−4.5	−0.0008	+0.0075	Kern and Bookmyer(1986)
44606.5894	0.0	−0.0020	+0.0061	Kern and Bookmyer(1986)
44607.6328	2.5	−0.0010	+0.0072	Kern and Bookmyer(1986)
45298.8745	1660.5	−0.0791	−0.0127	Yamasaki et al.(1988)
45299.9170	1663.0	−0.0790	−0.0125	Yamasaki et al.(1988)
45300.9599	1665.5	−0.0785	−0.0120	Yamasaki et al.(1988)
48602.1026	9582.5	−0.0090	+0.0103	Qingyao et al.(1994)
48603.1452	9585.0	−0.0090	+0.0010	Qingyao et al.(1994)
50096.6707	13166.5	+0.1714	−0.0047	Present paper
50099.5889	13173.5	+0.1736	−0.0057	Present paper

than the linear one (2), this point could also be seen from the sums of square of the deviations: $\sum_i W^2_{(O-C)_{1i}} = 0.07928, \sum_i W^2_{(O-C)_{2i}} = 0.00091.$

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PHOTOELECTRIC BVI$_C$ OBSERVATIONS AND NEW ELEMENTS FOR THE RR LYRAE STAR SU Col

SU Col was included in our program of photoelectric observations for Cepheids because it is classified in GCVS-IV as a type II Cepheid with a period of P = 21.55 days. We observed the star at CTIO in September and October 1996 using the 0.6–m reflector. A total of 75 BVI_c measurements were obtained (Table 1), the accuracy of the individual data being near $\pm 0^m.01$ in all filters.

As observations were accumulated it became clear that SU Col is not a Cepheid. Gessner (1985) suggested previously that SU Col is an RR Lyrae star with the elements:

$$\text{Max JD}_{hel} = 2428763.655 + 0.487361 \times \text{E}.$$

Those elements are used in Figure 1 for plotting our new observations. The data indicate that SU Col is indeed an RR Lyrae variable and that the amplitude of the light curve is at present $0^m.77$ in V, $0^m.29$ in $B-V$ and $0^m.33$ in $V-I_c$, while the epoch of maximum light is JD 2450363.870 ± 0.005.

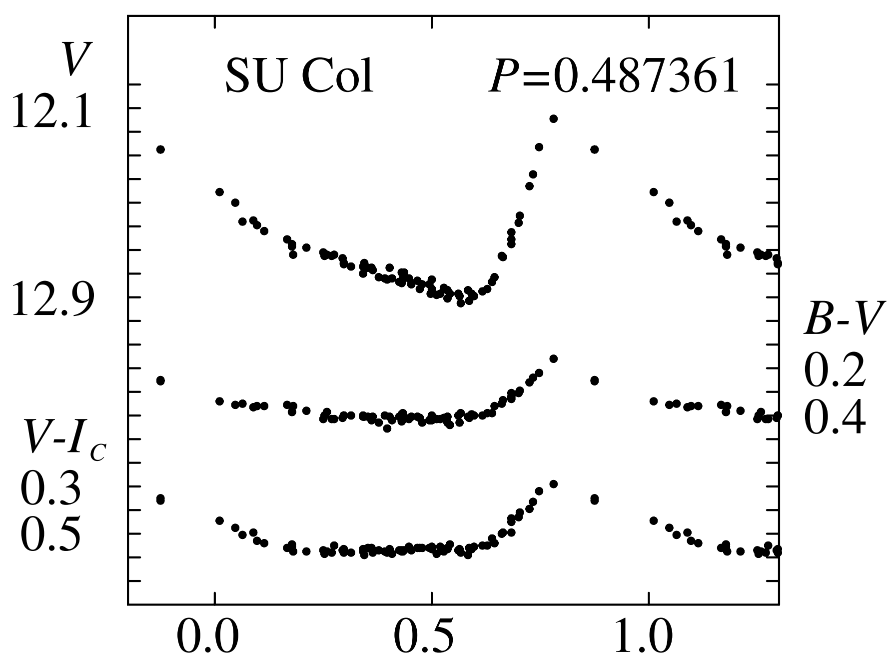

Figure 1

Table 1

JD_{hel} 2450300+	V	$B-V$	$V-I_c$	JD_{hel} 2450300+	V	$B-V$	$V-I_c$
51.7380	12.266	0.249	0.350	61.7894	12.859	0.399	0.562
52.7967	12.493	0.352	0.472	61.8065	12.864	0.427	0.562
53.6872	12.268	0.255	0.356	61.8341	12.878	0.393	0.564
54.7276	12.446	0.335	0.444	61.8595	12.807	0.357	0.536
54.7705	12.588	0.358	0.529	61.8785	12.647	0.319	0.449
55.7282	12.573	0.347	0.501	62.6872	12.795	0.403	0.574
55.7856	12.711	0.358	0.574	62.7051	12.806	0.425	0.568
57.6904	12.570	0.361	0.495	62.7201	12.812	0.418	0.581
57.7278	12.647	0.352	0.560	62.7278	12.830	0.401	0.570
57.7492	12.683	0.377	0.571	62.7408	12.837	0.402	0.567
57.7693	12.702	0.414	0.567	62.7478	12.822	0.402	0.560
57.7805	12.714	0.411	0.547	62.7613	12.840	0.416	0.560
57.7899	12.730	0.409	0.566	62.7743	12.878	0.414	0.554
57.8005	12.761	0.398	0.576	62.7838	12.876	0.436	0.544
57.8131	12.763	0.398	0.564	62.7947	12.889	0.426	0.562
57.8435	12.766	0.404	0.561	62.8109	12.888	0.398	0.551
57.8590	12.786	0.403	0.566	62.8205	12.866	0.398	0.545
58.6772	12.615	0.359	0.535	62.8323	12.827	0.389	0.519
58.7077	12.676	0.384	0.552	62.8428	12.718	0.347	0.496
58.7475	12.714	0.382	0.575	62.8535	12.668	0.300	0.490
58.7524	12.717	0.412	0.579	62.8618	12.577	0.301	0.425
58.7888	12.748	0.401	0.587	62.8775	12.372	0.237	0.365
58.8315	12.790	0.393	0.575	63.6884	12.819	0.452	0.578
58.8659	12.818	0.418	0.553	63.7045	12.835	0.422	0.570
59.6831	12.667	0.383	0.544	63.7256	12.856	0.410	0.556
59.7200	12.719	0.397	0.584	63.7381	12.880	0.411	0.560
59.7409	12.749	0.397	0.564	63.7443	12.881	0.415	0.582
59.7685	12.766	0.401	0.557	63.7564	12.900	0.404	0.559
59.7736	12.777	0.400	0.580	63.7717	12.920	0.389	0.580
59.8069	12.810	0.390	0.572	63.7809	12.906	0.408	0.556
59.8541	12.854	0.405	0.573	63.8017	12.859	0.390	0.545
59.8696	12.877	0.395	0.569	63.8181	12.721	0.333	0.490
59.8806	12.864	0.403	0.587	63.8287	12.618	0.326	0.433
61.6903	12.757	0.395	0.581	63.8379	12.548	0.292	0.408
61.7222	12.768	0.416	0.559	63.8484	12.423	0.259	0.391
61.7362	12.816	0.394	0.577	63.8588	12.257	0.218	0.319
61.7631	12.814	0.414	0.552	63.8752	12.140	0.157	0.288
61.7792	12.842	0.425	0.557				

$Max JD_{hel}$ 2400000+	Uncertainty	E	O−C
28763.659	±0.01	−44321	0.001
28783.636	±0.03	−44280	−0.003
28785.643	±0.03	−44276	0.054
28787.597	±0.03	−44272	0.059
28848.458	±0.03	−44147	0.000
28849.519	±0.03	−44145	0.086
28874.342	±0.03	−44094	0.054
28891.357	±0.03	−44059	0.012
28893.327	±0.03	−44055	0.032
28930.325	±0.01	−43979	−0.009
28933.314	±0.03	−43973	0.056
34303.488	±0.03	−32954	0.027
34325.437	±0.03	−32909	0.045
38374.403	±0.03	−24601	0.037
38377.379	±0.03	−24595	0.089
38697.521	±0.03	−23938	0.037
38785.291	±0.03	−23758	0.082
39150.286	±0.03	−23009	0.046
39409.570	±0.03	−22477	0.055
39410.558	±0.03	−22475	0.068
50363.870	±0.05	0	0.000

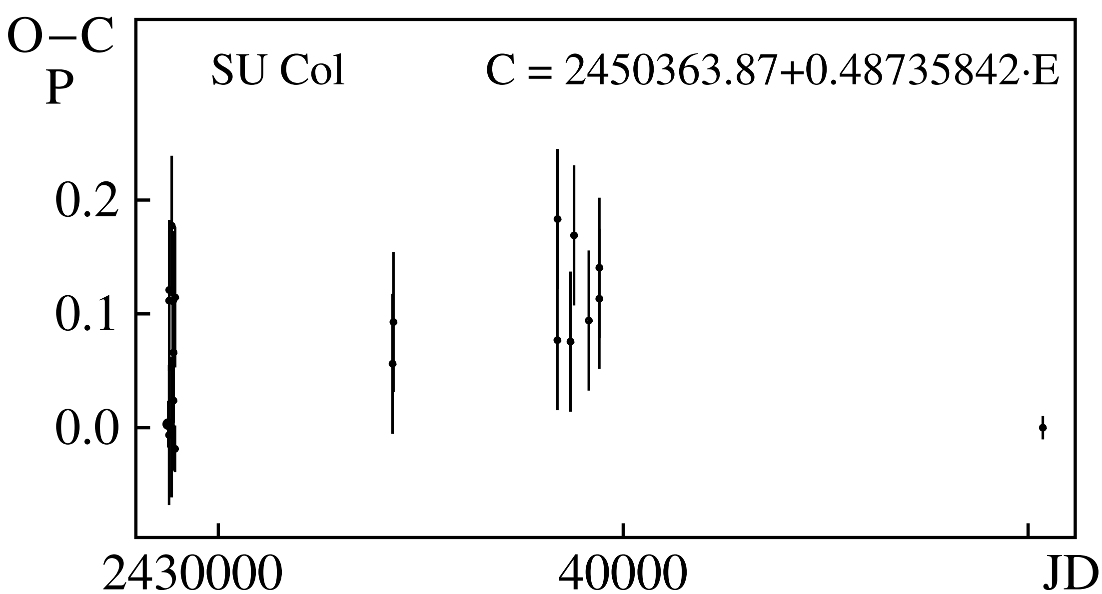

Figure 2

The slight offset in phase of the light curve in Figure 1 implies that Gessner's elements do not satisfy our observations. In order to derive a more reliable period, we searched Gessner's data for times near maximum photographic brightness and combined the epochs with the present results. Two epochs taken from Gessner's data appear to lie very close to true light maximum since the star was brighter at those times than at others. Those epochs were assigned an uncertainty of $\pm 0\overset{d}{.}01$, while the remaining 20 instants near maximum photographic brightness published by Gessner (1985) were assigned an uncertainty of $\pm 0\overset{d}{.}03$ (Table 2). The latter appear to be displaced slightly towards the declining light portion of the light curve, and result in the somewhat skewed distribution of data points in the O−C diagram (Figure 2). A linear least squares analysis of the resulting O−C data (with weights inversely proportional to the squares of the associated uncertainties) gave the following improved ephemeris:

$$\begin{array}{rl} \text{Max JD}_{hel} = & 2450363.870 + 0.48735842 \times \text{E}. \\ & \pm 0.002 \quad \pm 0.00000011 \end{array}$$

The new elements were used to calculate the O−C values listed in Table 2.

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PHOTOMETRIC AND POLARIMETRIC OBSERVATIONS OF SEVEN MIRAS

Photometric and polarimetric observations of red giants and supergiants have been carried out at the Byurakan Astrophysical Observatory since 1957. In 1994, Magnan suggested to include in that program systematic photometric observations of Mira Ceti type long period variables. Preliminary results of those observations are given in this paper.

Seven long period Mira-type variables were observed in Byurakan Observatory during April-September 1996. The observations have been made with the photopolarimeter attached to the AZT-14 50cm-telescope. That photopolarimeter works in the regime of intensification of the direct current. It can be used either as a photoelectric photometer (without the polaroid) or as a photopolarimeter (with the polaroid). The maximum of sensitivity of the photomultiplier lies in the wavelength interval 4000–4400 Å. The observations have been done in the U, B, V, R bands, sometimes without the filter ("filter 0"). A more detailed description of the method and instruments has already been given elsewhere (Eritsian and Nersisian, 1984).

The results of polarimetric observations for the Mira variables are presented in Table 1. The columns of the table successively give (i) the name of the star from the General Catalogue of Variables Stars (GCVS), (ii) the date of the observation, (iii) the observed degree of polarization P in the U, B, V, R bands (when the observations have been done without any filter, this is indicated by the term "filter 0") and (iv) the angle of polarization θ. The uncertainties in the photometric and polarimetric measurements respectively are $\sigma_{UBV} = 0\overset{m}{.}02$ - $0\overset{m}{.}04$, $\sigma_P(UBV) = 0.1$ - 0.2%. The uncertainty in the determination of the polarization angle is $\sigma_\theta = 1° - 3°$.

As can be seen from Table 1, a light polarization has been detected for the stars R Aql, RT Cyg and S UMi. In those three cases, the variable character of the polarization has been confirmed.

As a noteworthy result, a rapid light variation of the star T Cep has been found about two months after the maximum of brightness. The corresponding data in the B and V bands are given in Table 2. The light variations are drawn in Figure 1. The solid straight line represents the mean light-curve in V-color, which has been obtained from the data of the GCVS (1985) by knowing the epoch of maximum and the phase. One can see that the whole event lasted less than 20 days but the duration of the peak itself represents only a few days.

Table 1. Polarimetric observations of 7 Mira Ceti type stars

star	date	$P(\%)$				$\theta(^\circ)$			
(GCVS)	(UT)	U	B	V	R	U	B	V	R
R Aql	14.07.96	filter 0			2.2	130			
	08.08.96	–	–	–	≤ 0.3	–	–	–	–
	09.09.96	–	–	≤ 0.3	0.6	–	–	–	31
	15.09.96	≤ 0.3	≤ 0.3	≤ 0.3	1.0	–	–	–	35
T Cep	20.05.96	≤ 0.3	≤ 0.3	≤ 0.3	≤ 0.3	–	–	–	–
	21.05.96	≤ 0.3	≤ 0.3	≤ 0.3	≤ 0.3	–	–	–	–
	22.05.96	≤ 0.3	≤ 0.3	≤ 0.3	≤ 0.3	–	–	–	–
	09.06.96	≤ 0.3	≤ 0.3	≤ 0.3	≤ 0.3	–	–	–	–
	10.09.96	≤ 0.3	≤ 0.3	≤ 0.3	≤ 0.3	–	–	–	–
RT Cyg	15.07.96	–	1.5	1.2	0.9	–	65	35	40
	16.07.96	5.0	1.5	1.3	1.2	45	35	45	60
	10.09.96	≤ 0.3	≤ 0.3	≤ 0.3	≤ 0.3	–	–	–	–
	15.09.96	≤ 0.3	≤ 0.3	≤ 0.3	≤ 0.3	–	–	–	–
R Dra	14.07.96	–	≤ 0.3	≤ 0.3	≤ 0.3	–	–	–	–
	15.09.96	–	≤ 0.3	≤ 0.3	≤ 0.3	–	–	–	–
X Oph	09.06.96	≤ 0.3	≤ 0.3	≤ 0.3	≤ 0.3	–	–	–	–
	13.07.96	≤ 0.3	≤ 0.3	≤ 0.3	≤ 0.3	–	–	–	–
	16.07.96	≤ 0.3	≤ 0.3	≤ 0.3	≤ 0.3	–	–	–	–
	09.09.96	≤ 0.3	≤ 0.3	≤ 0.3	≤ 0.3	–	–	–	–
S UMi	15.07.96	–	≤ 0.5	≤ 0.5	0.9	–	–	–	45
	15.09.96	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5	–	–	–	–
R Vir	22.04.96	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5	–	–	–	–

Table 2. Rapid variation of T Cep

Date	B	V
20 May 1996	8.72	7.06
21 May 1996	8.12	6.67
22 May 1996	8.56	6.91
09 June 1996	9.11	7.80

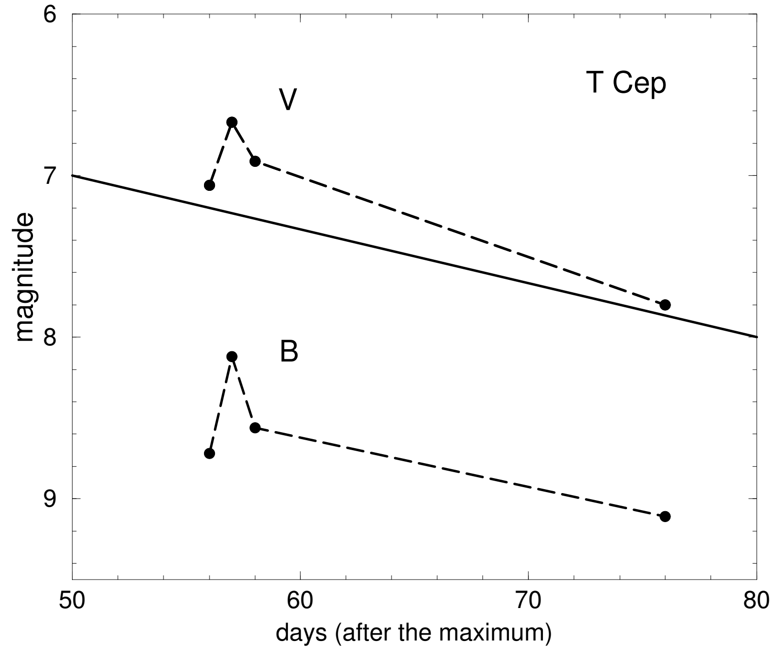

Figure 1. Rapid variation of T Cep

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ERRATUM

In IBVS No. 4359 issue, Table 1 contains incorrect data on the minima of V676 Cen. The revised table is as follows:

JD Hel 2400000+	Eclipse Type	Cycles	(O−C)$_1$	(O−C)$_2$
48393.5174(1)	I	4863.0	−0.0001	0.0001
48394.6872(1)	I	4867.0	0.0001	0.0002

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NEW TYPE AND ELEMENTS FOR V939 CYGNI

[BAV Mitteilungen Nr. 92]

V939 Cyg = S 7821 Cyg was discovered by Hoffmeister (1963) on photographic plates of the Sonneberg Observatory. The first investigation of this variable was performed by Gessner (1966) on photographic plates taken with the Heidelberg Bruce-Astrograph in the years 1958 and 1959 and with Sonneberg astrographs after 1960. She classified the variable as a W UMa-type in the range between $12\overset{m}{.}1$ and $12\overset{m}{.}5$ and determined first elements as:

$$\mathrm{Min\,I} = \mathrm{HJD}\,2437917.62 + 0\overset{d}{.}558 \times \mathrm{E} \qquad (1)$$

With these data V939 Cyg is listed in the fourth edition of the GCVS (Kholopov et al. 1985). Since then the variable has not been observed, until we put V939 Cyg on our observing program. The observations were made with SBIG ST6 CCD-cameras without filters, attached to a 32 cm RC telescope (W.M.) and a 20 cm SC telescope (F.A.). GSC 3942.1581 served as comparison star and several other stars in the same field were used to check its constancy. The individual measurements can be requested via e-mail.

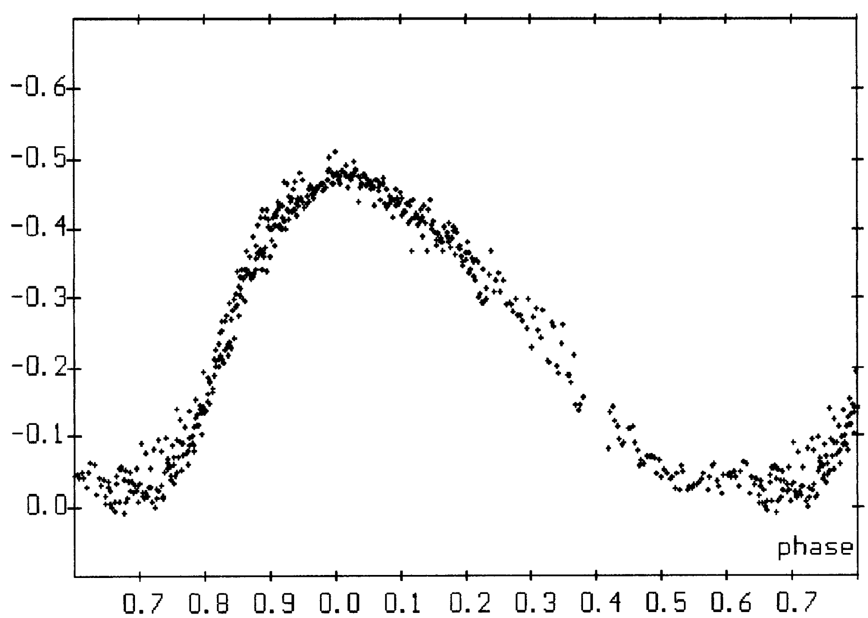

Figure 1. Differential light curve of V939 Cyg drawn with the new ephemeris (2)

Table 1. Heliocentric times of CCD-measured maxima for V939 Cyg, epochs and residuals computed with respect to the ephemeris (2) derived in this paper

JD hel.	Epoch	O−C	Observer
2449788.5612	0	+0.0026	Moschner
49789.7173	3	−0.0039	Moschner
49793.599	13	+0.002	Agerer
49800.572	31	−0.000	Agerer
49933.502	374	+0.005	Agerer
50027.2695	616	−0.0104	Moschner
50152.4536	939	+0.0000	Moschner
50195.4748	1050	+0.0049	Moschner
50300.4915	1321	−0.0003	Agerer

A period analysis program, based on the algorithm of Schwarzenberg–Czerny (1989) resulted in a period much shorter than the GCVS period. As our CCD observations show, the variable is of RR Lyr type (see Figure 1). In our instrumental system the amplitude of variability is $0\overset{\rm m}{.}45$ and M−m = $0\overset{\rm P}{.}32$.

On the basis of maxima observed in the years 1995 and 1996 (listed in Table 1), using a least squares fit, we calculated the new, preliminary elements:

$$\begin{array}{rl} \mathrm{Max} = \mathrm{HJD}\,2449788.5586 & +\ 0\overset{\rm d}{.}3875346 \times \mathrm{E} \\ \pm 3 & \qquad\quad \pm 5 \end{array} \qquad (2)$$

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THE NEW RR LYRAE STAR NSV 00461 IN ANDROMEDA

NSV 00461 (Wr 97, CSV 100100) was found to be variable by Weber (1962). He pointed out that this object could be a Cepheid with a photographic magnitude variation from $12^{m}_{.}9$ to $14^{m}_{.}0$. The position given for this object in the NSV catalogue (Kholopov, 1982) is erroneous (Vidal-Sainz et al., 1996). In the original finding chart by Weber, the suspected variable can be unambiguously identified with GSC 3276.1206, a star of 13.0 photovisual magnitude located about one degree to the North of the position given by Kholopov.

In order to confirm the variability of NSV 00461, the star was observed for 9 nights in the V band from 17 August to 13 September 1996. As comparison stars, GSC 3277.1096 was used, and GSC 3276.1106, GSC 3276.1187, and GSC 3277.0873 served as check stars. Observations were carried out from Monegrillo Observatory (Spain), using a CCD camera and a 0.4-m telescope.

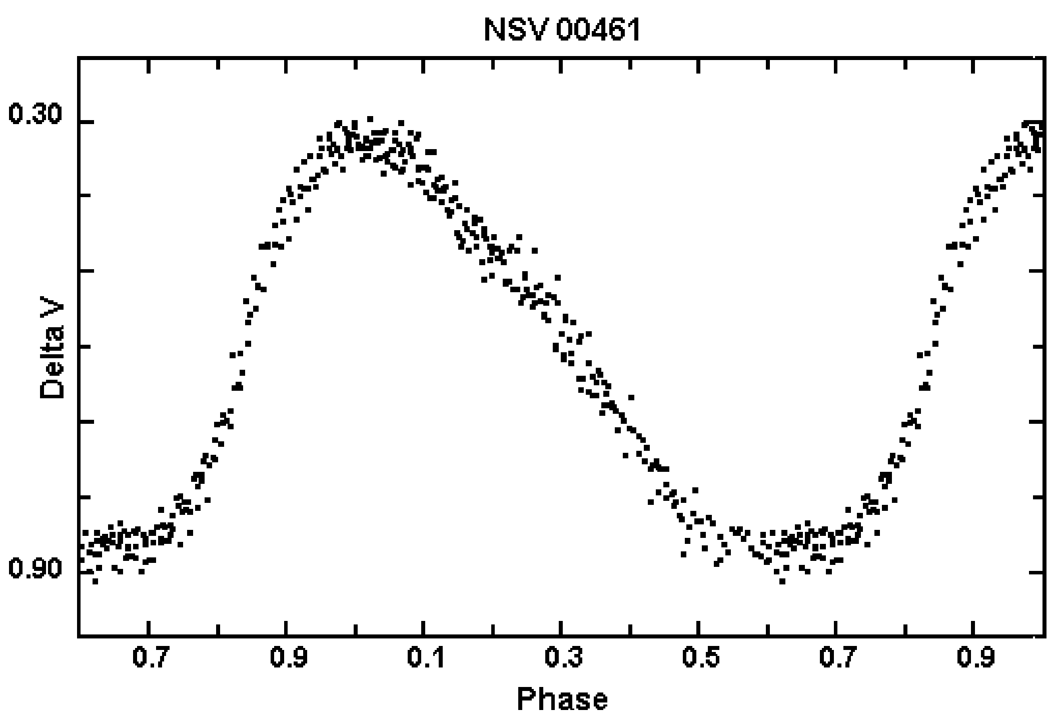

Figure 1

The gathered data showed that NSV 00461 is not a Cepheid but an RR Lyrae star with a period close to 9 hours. The phase curve (Figure 1) indicates that the amplitude of the variation is $0\overset{m}{.}55$, and the asymmetry factor ((M−m)/P) is 0.31±0.02. The following ephemeris has been derived:

$$\begin{array}{rl} \text{Max.} = \text{HJD}\,2450330.475 & + \; 0\overset{d}{.}37350 \times \text{E} \\ \pm 0.003 & \pm \; 0.00006 \end{array}$$

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NSV 04411, A NEW ECLIPSING BINARY SYSTEM IN CANCER

Light variations of NSV 04411 (=CSV 006694) were initially observed by Rigollet (1953), who reported that this object was an RR Lyrae star. According to his measurements NSV 04411 showed a photographic magnitude variation from $13^{m}_{\cdot}1$ to $13^{m}_{\cdot}7$.

From 9 March to 23 May 1996, NSV 04411 was observed for 14 nights in the V band from Monegrillo Observatory (Spain). A 0.4-m telescope and a Starlight Xpress CCD camera were utilized. Differential photometry was performed using GSC 1954.0153 as the comparison star and GSC 1954.0574 as check the star.

Observational data show that NSV 04411 is not an RR Lyrae object but an eclipsing binary system with a period over 10 hours. It can be unambiguously identified with GSC 1954.0180, a star with a photovisual magnitude (PAL-V1 filter) of 12.4. The light curve shows both minima to be partial, with depths of $0^{m}_{\cdot}88$ and $0^{m}_{\cdot}79$ for the primary and secondary minima respectively. There is also detectable an O'Connell effect (O'Connell, 1951) that amounts to Δm=Max. I$-$Max. II=$-0^{m}_{\cdot}035\pm0.005$. Max. I is at phase 0.25 and Max. II at phase 0.75.

From the timing of seven minima (see Table 1) obtained according to the Kwee–Van Woerden (1956) method, the following ephemeris was derived:

$$\text{Min. I.} = \text{HJD}\,2450154.2091 + 0^{d}_{\cdot}42228 \times E$$
$$\pm 0.0005 \pm 0.00002$$

Table 1

HJD 24500000+	Minimum	Epoch	O−C
154.4206	II	0.5	0.0004
159.4876	II	12.5	0.0000
164.3426	I	24.0	−0.0011
165.3996	II	26.5	0.0002
207.4174	I	120.0	0.0016
218.3948	I	152.0	−0.0001
226.4173	I	171.0	−0.0009

The light-curve suggests that NSV 04411 is a near contact binary system whose components have very similar luminosity. The light-curve was preliminarily solved using Binary Maker 2.0 (Bradstreet, 1993). Although the O'Connell effect was modeled as a dark spot on one of the components, an initial solution was computed with no spots, and then a final spotted solution was obtained. There was no information about spectral type, for this reason it was not possible, a priori, to choose between a convective or radiative model.

Nevertheless, a better fit was achieved with a convective model. Additional photometric and spectroscopic data should clarify this point. The solution was then computed on a convective model assuming a spectral type of F5, where a mean surface temperature a convective model T_1=6500K, gravity darkening coefficients $g_1=g_2=0.32$, bolometric albedos $A_1=A_2=0.5$, and limb darkening coefficients $x_1=x_2=0.6$ were adopted.

Elements of the best solution are given in Table 2, where Ω_1 and Ω_2 are the modified surface potentials, L_1 and L_2 are the normalized luminosities, and a, b, c, and d are, respectively, the fractional back, side, polar, and point radii, where the unit distance is defined as the distance between star centers.

Once the unspotted solution was reached, it was refined invoking a single spot. No further attempt was made to introduce more spots to improve light curve fit. It was found that a dark area on the primary component might be responsible for the observed O'Connell effect. Spot radii between 30° and 50° yielded very similar solutions. The intermediate value of 40° was finally chosen. The rest of spot parameters, spot's colatitude and colongitude were fixed to 90° and 270° respectively. Table 3 lists the spot parameters, where T_f is the effective temperature coefficient. Figure 1 shows the light-curve of NSV 04411 superimposed on the theoretical one.

Table 2

mass ratio = 0.90 ± 0.10	
i = 86.°0 ± 1°	
Ω_1=3.59 ±0.20	Ω_2=3.65 ±0.20
a_g=0.413 ±0.010	a_s=0.382 ±0.025
b_g=0.383 ±0.010	b_s=0.355 ±0.025
c_g=0.364 ±0.010	c_s=0.339 ±0.020
d_g=0.494 ±0.010	d_s=0.427 ±0.070
$g_1=g_2$=0.32	
T_1=6500K	T_2=6350K ±50K
L_1=0.558 ±0.040	L_2=0.442 ±0.040

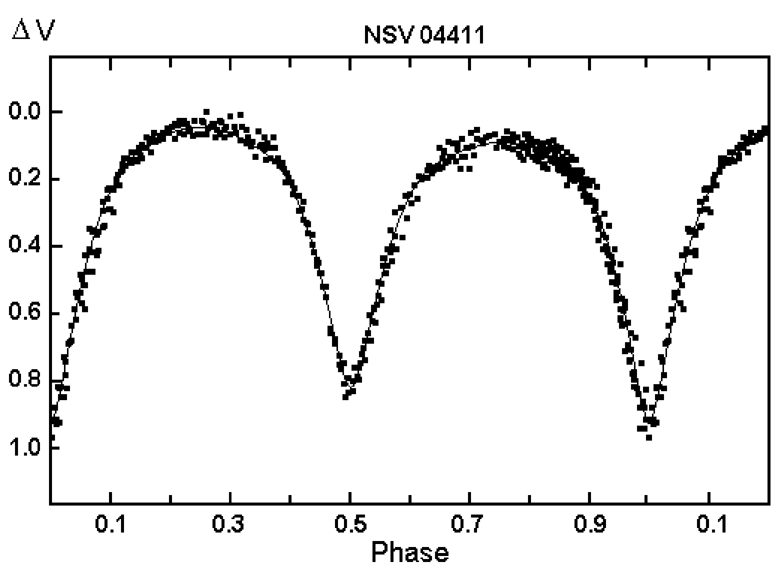

Figure 1

Table 3

Colatitude	=	90°
Colongitude	=	270°
Spot Radius	=	40°
T_f	=	0.96
Spot is on primary star		

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DISCOVERY OF AN SX Phe STAR IN NGC 5897

NGC 5897 is a globular cluster of low concentration in which both Sarajedini (1992) and Ferraro et al. (1992) have located many blue straggler (BS) candidates. The present paper reports on the results of a search for variable blue stragglers in the central region of the cluster carried out using 62 B and 35 V CCD frames obtained on four nights in 1989 with the Las Campanas 1 m Swope telescope. One new variable was identified, an SX Phe star which is the ninth known variable in the cluster.

The position of this star V9 as well as that of V2, an RR Lyrae star are shown in Figure 1. The numbers used to identify other stars in the figure are those from the paper by Sandage and Katem (1968) in which a chart of the entire cluster can be found. Both variables fall just outside the region surveyed by Ferraro et al. so no cross identification can be made with their observations. X and Y coordinates for V9 relative to the cluster center as shown by Sandage and Katem and on the system of the Third Catalogue of Variable Stars in Globular Clusters (Sawyer Hogg, 1973) are $X = -55''$, $Y = -118''$.

B and V magnitudes for both V2 and V9, determined using DAOPHOT (Stetson 1990) and calibrated with the photometry of Sarajedini, are given in Tables 1 and 2. A period for V9 of 0.05062 day was found using a periodogram program.

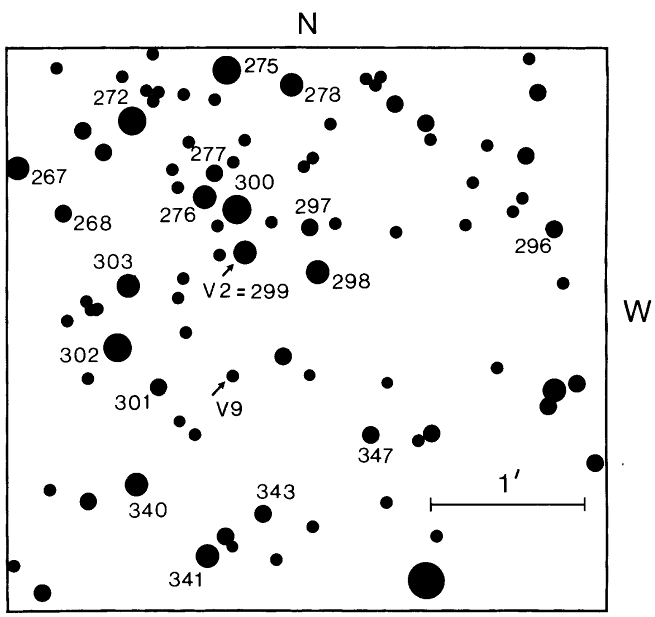

Figure 1. Finding chart for V9 in NGC 5897

Table 1. B magnitudes for V2 and V9

JD 2400000+	V2	V9	JD 2400000+	V2	V9
47682.554	16.51	19.32	47684.623	16.88	19.44
47683.577	16.62	19.16	47684.634	16.88	19.37
47683.584	16.62	18.83	47684.647	16.82	19.01
47683.602	16.76	19.30	47684.659	16.75	19.18
47683.622	16.90	19.52	47684.665	16.77	19.34
47683.634	16.84	18.77	47684.671	16.78	19.41
47683.670	16.90	19.32	47684.679	16.72	19.42
47683.682	16.85	18.98	47684.686	16.70	19.32
47683.701	16.90	19.35	47684.693	16.70	18.92
47683.715	16.78	19.39	47684.699	16.70	18.78
47683.721	16.79	19.27	47684.705	16.67	19.13
47683.727	16.76	19.06	47684.711	16.64	19.27
47683.739	16.77	18.96	47684.718	16.62	19.38
47683.745	16.79	19.13	47684.726	16.61	19.39
47683.752	16.87	19.35	47684.733	16.62	19.39
47683.758	16.72	19.42	47684.745	16.59	18.93
47684.610	16.86	19.24	47684.751	16.59	18.97
47684.616	16.80	19.36	47686.556	16.58	19.32

Table 2. V magnitudes for V2 and V9

JD 2400000+	V2	V9	JD 2400000+	V2	V9
47682.564	16.11	18.70	47682.682	16.24	18.65
47682.576	16.11	18.56	47682.693	16.26	18.91
47682.582	16.13	18.72	47682.699	16.28	18.95
47682.588	16.13	18.87	47682.705	16.30	18.97
47682.594	16.13	18.93	47682.711	16.29	18.90
47682.600	16.13	18.93	47682.718	16.32	18.66
47682.613	16.14	18.85	47682.724	16.31	18.46
47682.619	16.15	18.65	47682.730	16.30	18.59
47682.625	16.14	18.62	47682.736	16.31	18.78
47682.632	16.17	18.71	47682.742	16.34	18.91
47682.639	16.16	18.85	47684.599	16.33	18.60
47682.645	16.19	18.96	47686.529	16.21	18.67
47682.651	16.18	18.94	47686.536	16.19	18.82
47682.658	16.22	18.96	47686.542	16.18	18.91
47682.668	16.22	18.68	47686.548	16.18	18.92
47682.675	16.24	18.53			

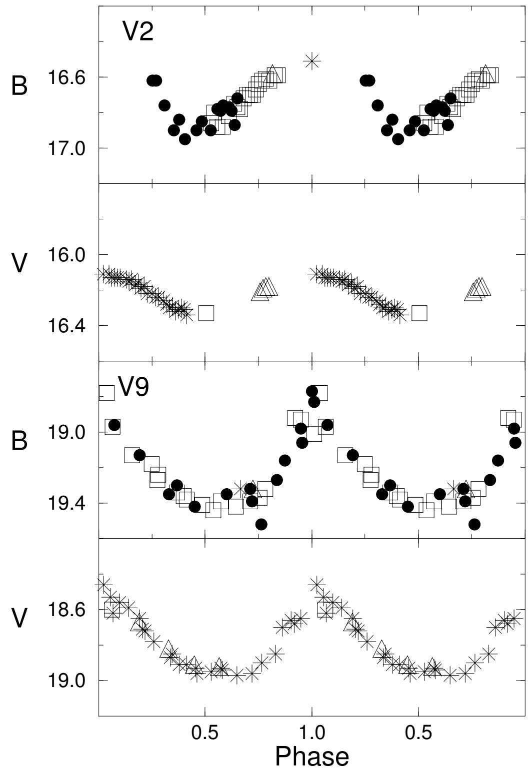

Figure 2. The B and V light curves for V2 and V9 in NGC 5897 constructed from the CCD observations made on four nights in June, 1989

Light curves in B and V for both variables are shown in Figure 2. The period used for V2 is that given by Wehlau (1990). The various symbols used in the plots represent observations on each of the four nights. The epochs of maximum were chosen from the present data so that the folded light curves of V2 are plotted with the ephemeris:

$$\text{HJD of maximum} = 2447682.554 + 0.45393 \times \text{E} \tag{1}$$

and those for V9 with the ephemeris:

$$\text{HJD of maximum} = 2447683.634 + 0.05062 \times \text{E} \tag{2}$$

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HBV 479 = V745 Her

The new variable star reported by Kohoutek (1996) was recorded independently during the course of the UK Nova Patrol on hypered Kodak TechPan 2415 film exposed on 1996 August 21.9 UT. An approximate position was determined using the star AD Her as reference on the True Visual Magnitude Photographic Star Atlas and a reasonably confident identification with the known variable V745 Her was recorded in the patrol notes. The object appeared on the patrol film to be slightly defocused and diffuse, which is typical of stars of Mira type, the classification suggested by both the GCVS (for V745 Her) and by Kohoutek (for HBV 479). The patrol notes also record a magnitude estimate of 10.9 which is certainly exaggerated by the red sensitivity of the TP2415 emulsion. Rechecking the film, the object seen bright in 1996 August agrees exactly with the finder given by Kohoutek, although only the brighter stars in the field are visible.

The position given by Kohoutek for HBV 479 agrees very well with the position of IRAS 18502+2050 at RA = $18^h50^m17^s.1$, Dec. = +20°50'39" (1950). This seems to be the only bright IR source in the area listed in the IRAS Point Source Catalog. It seems likely therefore that there is only one Mira in this field.

V745 Her was originally found by Otto Morgenroth (1934) which was given the discovery designation AN 85.1934. Morgenroth gave a position RA = $18^h46^m03^s$, Dec. = +20°44'.3 (1855.0). However, Morgenroth's finder chart is in excellent agreement with Kohoutek's finder confirming that HBV 479 = V745 Her but that the position given in the GCVS, presumably based on the 1855 position, requires correction. This would not be the first time that a positional error has been found in Morgenroth's work despite his very reliable, and sometimes very deep, finders.

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PHOTOELECTRIC BVR_C OBSERVATIONS OF THE NEW CEPHEID VARIABLE STAR GSC 4019.3103

Recently Antipin (1996) has analysed photographic archival plates at Sternberg Astronomical Institute of Moscow and found that the star GSC 4019.3103 is a Cepheid variable with the elements:

$$\text{Max JD}_{hel} = 2441188.53 + 5.35047 \times \text{E}$$

We observed this Cepheid photoelectrically at Mt. Maidanak observatory in August 1996 using the 60-cm reflector; a total of 32 BVR_c measurements were obtained (Table 1), the accuracy of the individual data is near $\pm\ 0\overset{\text{m}}{.}01$ in V and near $\pm 0\overset{\text{m}}{.}02$ in $B-V$ and $V-R_c$. Above elements are used in Figure 1 for plotting our observations. According to our data, the amplitude of the light curve is $0\overset{\text{m}}{.}39$ in V, $0\overset{\text{m}}{.}22$ in $B-V$ and $0\overset{\text{m}}{.}15$ in $V-R_c$.

The research described here was made possible in part by grants No. 95–02–05276 and No. 94–02–04347 from the Russian Foundation of Basic Research.

Table 1

JD_{hel} 2450300+	V	$B-V$	$V-R_c$	JD_{hel} 2450300+	V	$B-V$	$V-R_c$
12.2110	11.164	-	-	18.3726	11.299	1.362	0.885
12.3549	11.229	1.339	0.867	19.2074	11.358	1.382	0.884
13.2549	11.327	1.353	0.874	19.3359	11.362	1.445	0.877
13.3113	11.304	1.399	0.858	19.3829	11.344	1.442	-
14.2079	11.354	1.384	0.867	20.3137	11.343	1.345	0.876
14.2986	11.355	1.392	0.896	20.4143	11.289	1.338	0.867
14.4123	11.359	1.399	0.880	21.1878	11.057	1.192	0.787
15.2647	11.237	1.330	-	21.3745	11.033	1.278	0.828
15.3469	11.191	1.351	0.867	22.1977	11.069	1.251	0.790
15.3734	11.163	1.356	0.844	22.3651	11.131	1.307	0.835
16.1767	11.033	1.187	0.770	23.2156	11.224	1.362	0.846
17.2715	11.153	1.313	0.830	23.4506	11.251	1.365	0.879
17.3538	11.130	1.360	0.814	24.2137	11.342	1.390	0.856
17.4264	11.164	1.328	0.854	24.4007	11.344	1.403	0.887
18.2107	11.275	1.385	0.839	25.1884	11.346	1.411	0.829
18.3055	11.285	1.362	0.854	25.3371	11.361	1.376	0.883

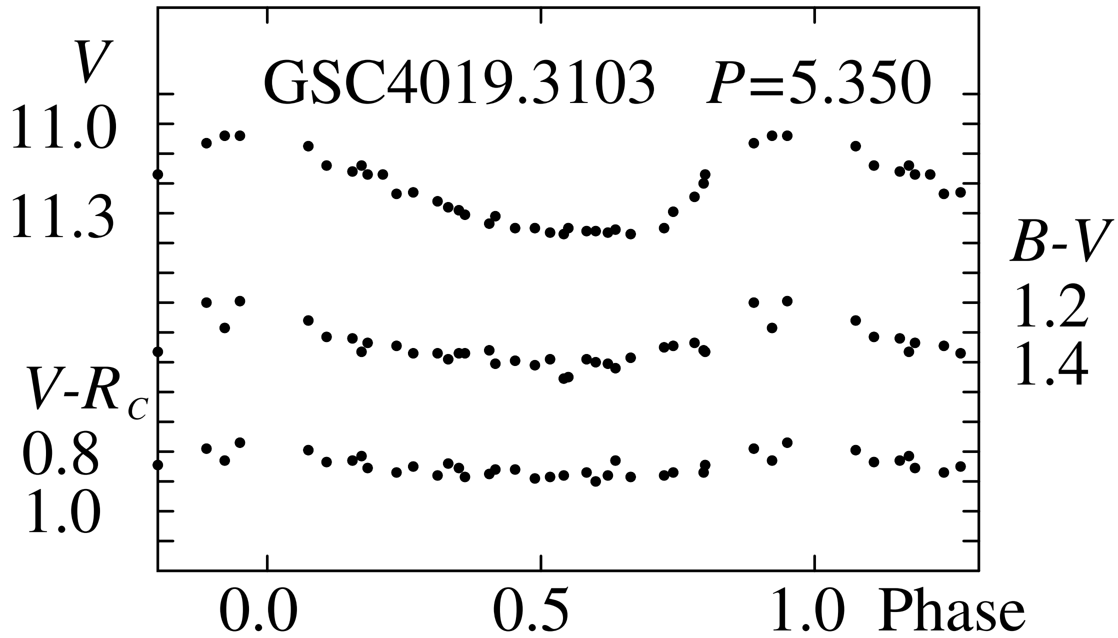

Figure 1. The light curve

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Reference:

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PHOTOELECTRIC BVR_C OBSERVATIONS FOR THE NEW CEPHEID VARIABLE STAR GSC 3596.0433

Recently Antipin (1996) has analysed photographic archival plates at Sternberg Astronomical Institute of Moscow and found that the star GSC 3596.0433 is a Cepheid variable with the elements:

$$\text{Max JD}_{hel} = 2447450.22 + 2.41827 \times \text{E}$$

We observed this Cepheid photoelectrically at Mt. Maidanak observatory in August 1996 using the 60-cm reflector; a total of 39 BVR_c measurements were obtained (Table 1), the accuracy of the individual data is near $\pm 0^m.01$ in V and near $\pm\ 0^m.02$ in $B-V$ and $V-R_c$. Above elements are used in Figure 1 for plotting our observations. According to our data, the amplitude of the light curve is $0^m.57$ in V, $0^m.25$ in $B-V$ and $0^m.13$ in $V-R_c$.

The research described here was made possible in part by grants No. 95–02–05276 and No. 94–02–04347 from the Russian Foundation of Basic Research.

Table 1

JD_{hel} 2450300+	V	$B-V$	$V-R_c$	JD_{hel} 2450300+	V	$B-V$	$V-R_c$
11.3125	11.894	1.525	0.938	20.4433	12.168	1.550	0.952
11.3541	11.909	1.495	0.922	21.1616	11.985	1.498	0.939
12.2279	12.282	1.685	1.004	21.2458	12.032	1.558	0.941
12.2941	12.280	1.699	0.983	21.3020	12.039	1.583	0.929
13.1827	12.151	1.572	0.955	21.3478	12.060	1.561	0.952
13.2858	12.007	1.528	0.915	21.4882	12.137	1.599	0.964
14.1664	12.102	1.631	0.974	22.1558	12.313	1.669	0.997
14.3116	12.151	1.629	1.009	22.1956	12.321	1.672	1.008
15.1712	12.343	1.691	-	22.2341	12.351	1.716	1.006
15.3374	12.327	1.713	1.018	22.2974	12.340	1.730	0.999
16.1656	11.893	1.528	0.878	22.3488	12.351	1.678	0.987
16.2731	11.974	1.543	0.916	22.4821	12.371	-	1.019
18.2924	11.861	1.501	0.854	23.1587	11.822	1.497	0.874
19.1749	12.170	1.629	0.974	23.3018	11.834	1.470	0.896
19.3500	12.202	1.631	0.984	23.4410	11.911	1.556	0.909
20.1698	12.337	1.740	1.000	24.1714	12.235	1.663	0.996
20.2141	12.328	-	0.988	24.3991	12.278	1.657	1.005
20.2659	12.326	1.693	0.979	25.1763	12.238	1.575	0.972
20.3059	12.273	1.620	0.956	25.3291	12.083	1.550	0.943
20.3479	12.232	1.629	0.946				

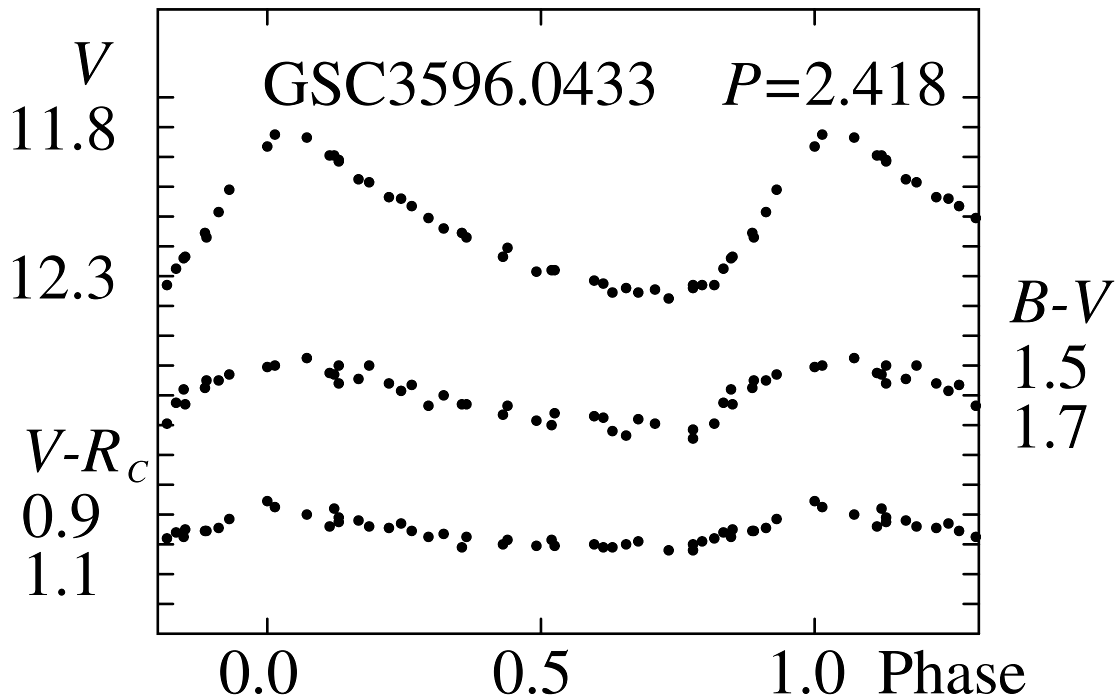

Figure 1

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Reference:
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PHOTOELECTRIC BVR_c OBSERVATIONS OF THE CEPHEID V553 Cas

Recently Shugarov (1996) has analysed photographic archival plates at Sternberg Astronomical Institute of Moscow and found that V553 Cas is a Cepheid variable with the elements:

$$\text{Max JD}_{hel} = 2450323.60 + 4.90039 \times \text{E}$$

We observed this Cepheid photoelectrically at Mt. Maidanak observatory in August 1996 using the 60-cm reflector; a total of 31 BVR_c measurements were obtained (Table 1), the accuracy of the individual data is near $\pm0\overset{\text{m}}{.}01$ in V and near $\pm0\overset{\text{m}}{.}02$ in $B-V$ and $V-R_c$. Above elements are used in Figure 1 for plotting our observations. According to our data, the amplitude of the light curve is $0\overset{\text{m}}{.}85$ in V, $0\overset{\text{m}}{.}38$ in $B-V$ and $0\overset{\text{m}}{.}24$ in $V-R_c$.

The research described here was made possible in part by grants No. 95–02–05276 and No. 94–02–04347 from the Russian Foundation of Basic Research.

Table 1

JD_{hel} 2450300+	V	$B-V$	$V-R_c$	JD_{hel} 2450300+	V	$B-V$	$V-R_c$
12.2153	13.739	-	-	19.2132	13.090	1.526	0.951
12.4655	-	-	1.134	19.3402	13.136	1.651	0.983
14.2106	13.038	1.592	0.949	19.4169	13.132	1.670	0.990
14.3009	13.126	1.534	1.025	20.3198	13.405	1.790	1.062
14.4355	13.163	1.597	1.022	20.4014	13.400	1.804	1.068
15.2670	13.356	1.763	-	21.1947	13.538	-	1.083
15.3500	13.348	1.802	1.081	21.4214	13.576	1.886	1.098
15.3930	13.369	1.786	1.073	22.2075	13.715	-	1.069
16.1790	13.498	-	-	22.4710	13.783	1.840	1.131
16.3874	13.566	1.905	1.112	23.2221	13.285	1.605	0.992
17.2735	13.740	1.908	1.093	23.4582	13.031	1.593	0.933
17.3553	13.713	1.983	1.076	24.2215	13.148	-	0.952
17.4068	13.737	1.982	1.117	24.4056	13.178	-	0.999
18.2191	13.360	1.649	1.023	25.1947	13.363	-	1.054
18.3108	13.295	1.615	0.988	25.3389	13.423	1.740	1.082
18.4024	13.187	1.620	0.978				

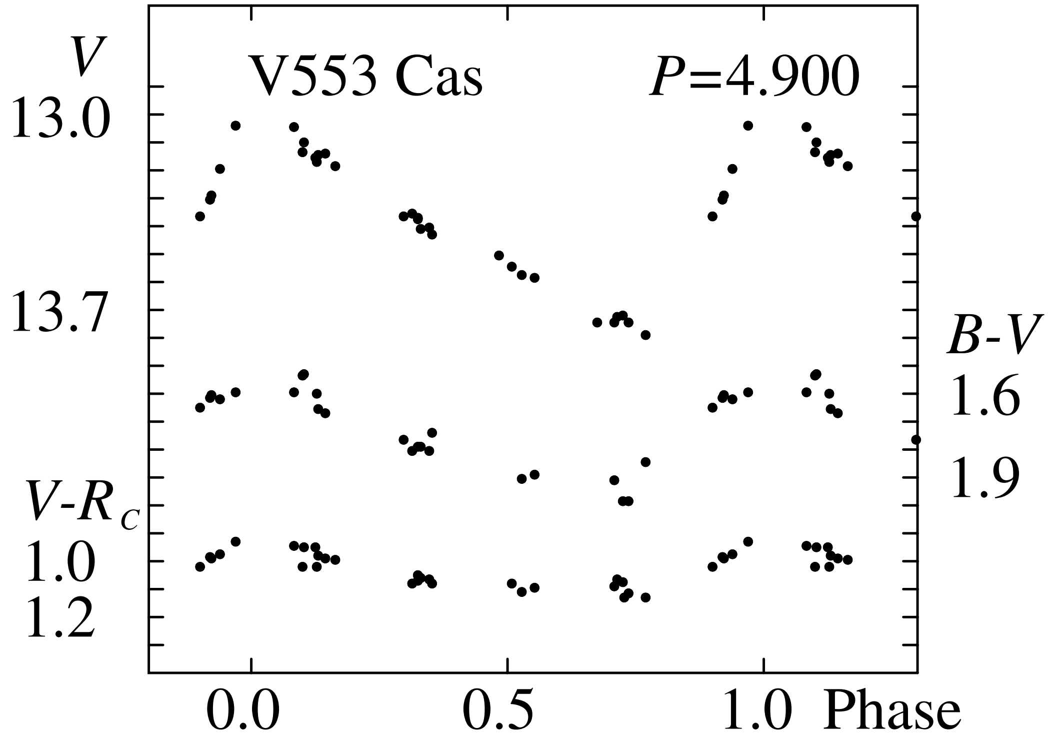

Figure 1

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Shugarov S.Yu., 1996, private communication

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PHOTOELECTRIC MINIMA OF FOUR RS CVn TYPE BINARY SYSTEMS: RT And, SV Cam, WY Cnc, AND Z Her

We present 23 moments of minima observations of four RS CVn type binary systems made with 30 cm Maksutov telescope (for RT And, WY Cnc and Z Her) and with the 30 cm Cassegrain telescope (for SV Cam) of the Ankara University Observatory. Both telescopes are equipped with an SSP-5A photometer containing a side-on R1414 Hamamatsu photomultiplier, but R4457 Hamamatsu photomultiplier for the Cassegrain telescope. Individual measurements for RT And and WY Cnc and Z Her were obtained in B and V filters, for SV Cam were obtained in B and V and R filters. The reduction of the photoelectric data was made by standard procedures for differential extinction and light-time effect. The comparison stars used in observations of the four systems are listed in Table 1. All minimum times were computed using the method of Kwee and van Woerden (1956). The results are listed in Table 2 with their mean errors.

We would like to thank to Dr. Z. Müyesseroğlu for his help.

Table 1. The comparison stars used

Variable	Comparison
RT And	BD +52°3382
SV Cam	BD +82°0176
WY Cnc	BD +27°1708
Z Her	BD +14°3378

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Reference:
Kwee, K.K. and van Woerden, H., 1956, *Bull. Astron. Inst. Neth.*, **12**, 327

Table 2. Brightness minima of RT And, SV Cam, WY Cnc and Z Her

Star	Min Type	Min. HJD +2400000	Mean err.	Filter
RT And	I	49981.4916	0.0007	B
	I	49981.4913	0.0055	V
	II	50004.4447	0.0018	B
	II	50004.4471	0.0018	V
SV Cam	I	50259.4743	0.0014	B
	I	50259.4833	0.0009	V
	I	50259.4841	0.0011	R
	I	50268.3777	0.0007	B
	I	50268.3781	0.0018	V
	I	50268.3816	0.0003	R
	II	50257.4228	0.0001	B
	II	50257.4163	0.0050	V
	II	50257.4068	0.0035	R
	II	50273.4243	0.0034	B
	II	50273.4337	0.0038	V
	II	50273.4310	0.0047	R
WY Cnc	I	50184.3595	0.0010	B
	I	50184.3586	0.0013	V
Z Her	I	50247.3567	0.0040	B
	I	50247.3554	0.0012	V

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PHOTOMETRY OF THE ACTIVE-CHROMOSPHERE ECLIPSING BINARY, HD 9770

The visual triple system HD 9770 comprises two K dwarf stars (A and B) in a well-determined 4.559-year orbit, together with a third star (C), an M dwarf, with an orbital period of 111.8 years. The semi-major axes are $0\farcs171$ for AB and $1\farcs419$ for AB-C (Hirshfeld & Sinnott, 1985). The parallax is given as $0\farcs052 \pm 0\farcs007$ by Jenkins (1963). The spectral types according to Edwards (1976) are K3 V (A), K4 V (B) and M2 V (C). The M dwarf is more than 4 magnitudes fainter in V than the combined light from AB. According to the compilation of Hirshfeld and Sinnott (1985) the visual magnitudes of the three stars are 7.8, 7.9 and 11.5 for A, B and C respectively, although the angular proximity of the objects in the sky must make these figures approximate only.

The system ABC contains at least one active chromosphere star, as shown by EUV emission from both the ROSAT (Pounds et al., 1993; Pye et al., 1995) and EUVE all-sky surveys (Malina et al., 1994; Bowyer et al. 1994). The definitive identification of the ROSAT WFC source 2RE013501–295430 with the star HD 9770 (Gliese 60 A,B,C) was made by Mason et al. (1995), based in part on 1-Å resolution spectra recorded in 1991–92 on the SAAO 1.9-m telescope at the H and K lines, which show some H and K emission (approximate equivalent width of emission 0.2 Å). The emission may be variable both in strength and radial velocity. On the other hand the Michigan Spectral Catalogue (Houk, 1982) gives a spectral type of K1 V and there is no mention of H and K emission — presumably because of lower resolution.

The galactic (U, V, W) velocity components for HD 9770 calculated by Eggen (1962) are $(+22.2, -5.3, -31.6)$ km/s. Such velocity components are typical of old disk stars, so we do not infer any chromospheric emission arising from extreme youth.

HD 9770 appears in a list of suspected variable stars by Petit (1980), but neither the magnitude range nor the type of variability are specified. Cutispoto et al. (1995) subsequently found an amplitude in V of about 0.07 mag. and a period of 6.29 ± 0.24 days.

Photoelectric photometry has been carried out in the $UBV(RI)_C$ system since 1992 Nov. 3 on the SAAO 0.5-m telescope at Sutherland, S.A. and on the two 0.61-m telescopes at MJUO, Tekapo, N.Z. The comparison and check stars selected were respectively HD 9349 and HD 9576.

Our observations have confirmed that the system is indeed variable, with an amplitude from maximum to minimum of about 0.25 mag. in V. We have found that one of the visual binary components is itself an eclipsing binary for which the ephemeris of primary eclipse is

$$HJD = 2448930.6448 + 0.476525 \times E$$

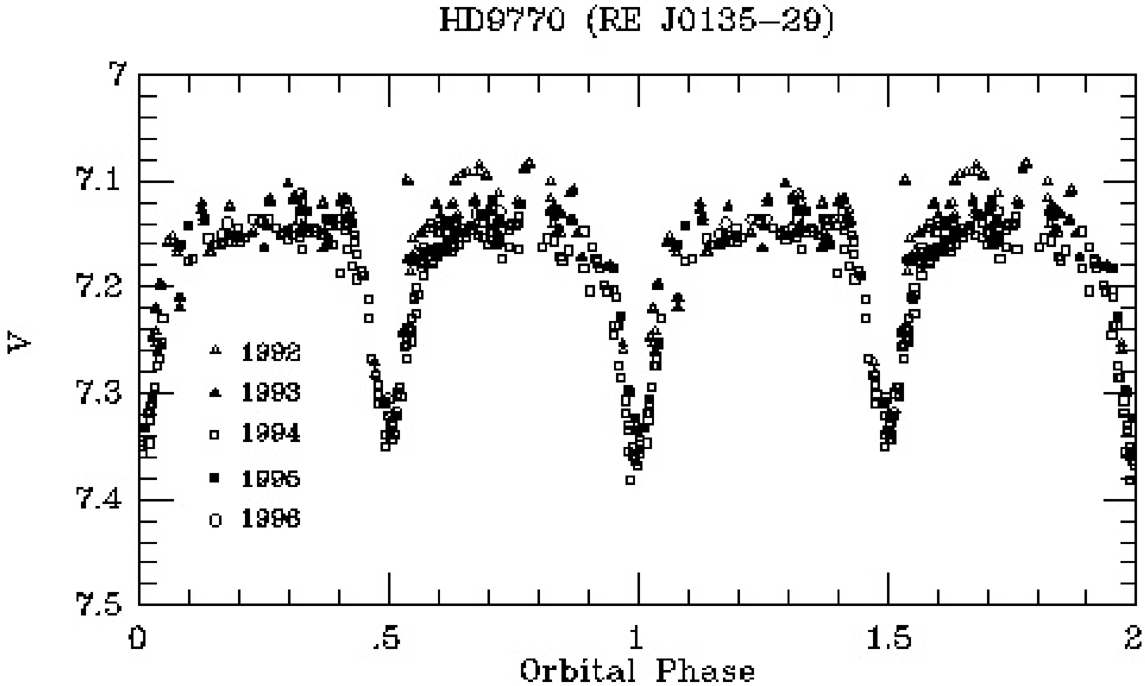

Figure 1. Phased V light curve from SAAO and MJUO photometry of HD 9770

Our phased light curve (Figure 1) shows that the primary eclipse has a depth of about $0^{\rm m}\!.22$, whereas the secondary eclipse is about $0^{\rm m}\!.20$. We therefore prefer the above ephemeris to one in which the period is only half as long and the secondary eclipse is not visible. The orbit appears to be close to circular, as the phase of central secondary eclipse is 0.50 and the eclipses are of comparable duration. We therefore deduce that the two stars in the eclipsing binary system are of very similar spectral type, presumably both K dwarfs. Hence the visual binary system AB must contain three K dwarfs all of comparable mass. If the stars were of equal magnitude and the third star not participating in the eclipses were absent, then the primary eclipse depth would be $0^{\rm m}\!.35$ instead of $0^{\rm m}\!.22$, suggesting that the eclipses are not total.

In addition to the variability due to the eclipses, there is considerable scatter over the four years of our observations in the out-of-eclipse magnitudes. The combined magnitude of the system ABC was as bright as 7.10 in 1992, but about 7.14 in 1994. Such variations are typical in active-chromosphere binary stars, because of the variation in spot numbers on timescales of years. Some of the scatter may also arise because of the drift in orbital phase of the rotationally modulated spot wave.

Much of our data came from 1994 observations at MJUO. The scatter for this year is clearly less than for all the photometric data considered together (see Figure 1).

We find no evidence for the 6.29-day variation reported by Cutispoto et al. (1995).

It is noted that the orbital period of $11^{\rm h}26^{\rm m}\!.2$ found for the eclipsing binary system is the shortest of any active-chromosphere binary listed in the catalogue of Strassmeier et al. (1993), although several have periods of about half a day.

Although the AB visual binary has a well-determined orbit, the uncertain parallax renders a mass with quite large error bars. It is

$$M_{\rm A} + M_{\rm B} = 1.71^{+0.93}_{-0.54} M_{\odot}$$

The higher mass limit is $2.64M_{\odot}$, corresponding to a parallax of about $0\farcs045$. Since we anticipate that the AB system in practice contains three K dwarfs of spectral type about K3 V or K4 V, whose masses should therefore each be about $0.75M_{\odot}$, a total mass of about $2.25M_{\odot}$ might be expected for the AB system. This total mass is entirely consistent with the AB orbit and the parallax, given the rather large parallax uncertainty. The Hipparcos parallax will soon constrain the total mass of this system to a much narrower range. The orbit of the AB-C system is not well enough determined to add much useful information to the total mass.

A programme of high dispersion échelle spectroscopy using the 1-m McLellan telescope at MJUO has been undertaken on HD 9770 since 1993 March. Most of the data are at Hα, which shows a fairly normal K dwarf profile without obvious Balmer emission, but the central depth is only 0.45, consistent with the presence of the two other stars which may have some chromospheric emission (Figure 2). Radial velocities have been measured from the Hα and metallic lines, and the results will be reported in a subsequent paper (Watson et al., 1997). The velocities show only small variations around +32.5 km/s, showing that the sharp-lined spectrum being measured is from the third K star which is not part of the eclipsing binary system.

IUE spectra were also recorded in 1996 August, from both the long wavelength camera at high dispersion and the short wavelength camera at low dispersion. These spectra show chromospheric emission lines consistent with the EUV emission and the chromospheric emission at H and K. They will also be discussed in our subsequent publication.

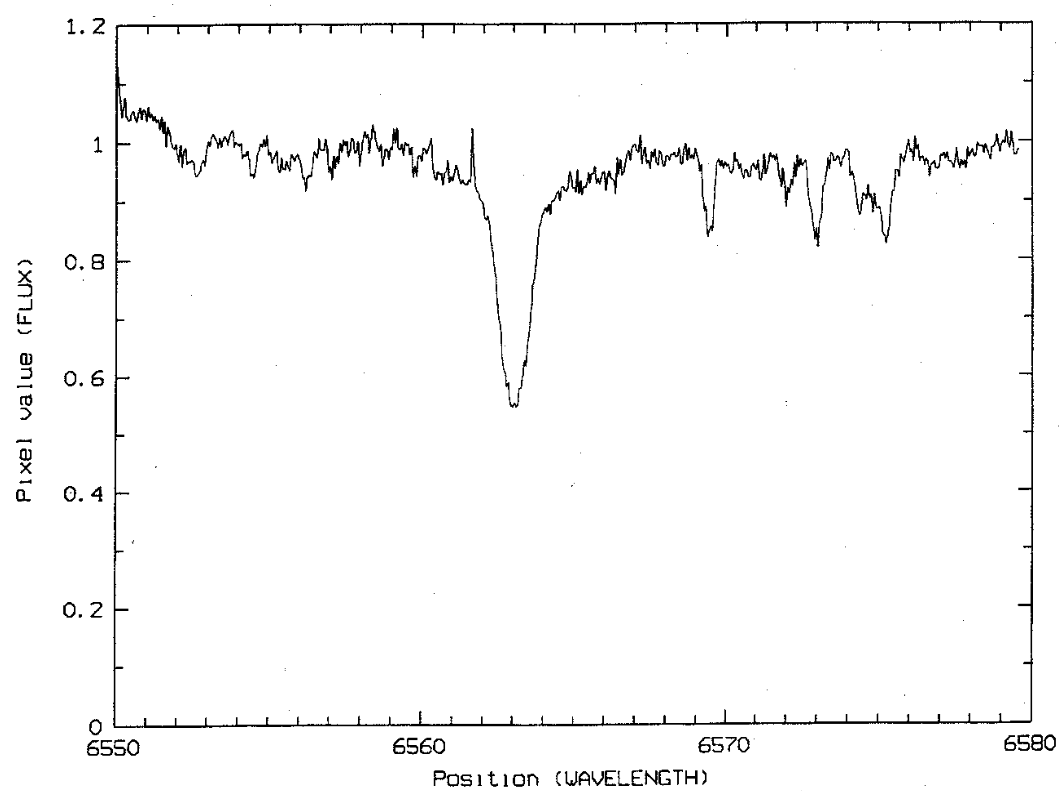

Figure 2. Typical MJUO Hα échelle spectrum of HD 9770

We note that the two eclipsing K stars are expected to show a radial-velocity amplitude of about 340 km/s and, assuming they are tidally locked, rotational line broadening in each star of about 80 km/s. Such broad diffuse lines may be present in our échelle spectra, but we need to study the spectra further to be certain of this. Figure 2 shows the dominant sharp lines, which are clearly those of the third K dwarf outside the eclipsing binary.

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