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TWO - COLOUR - LIGHTCURVE AND PRELIMINARY ELEMENTS FOR AL Leo

[BAV-Mitteilung Nr.53]

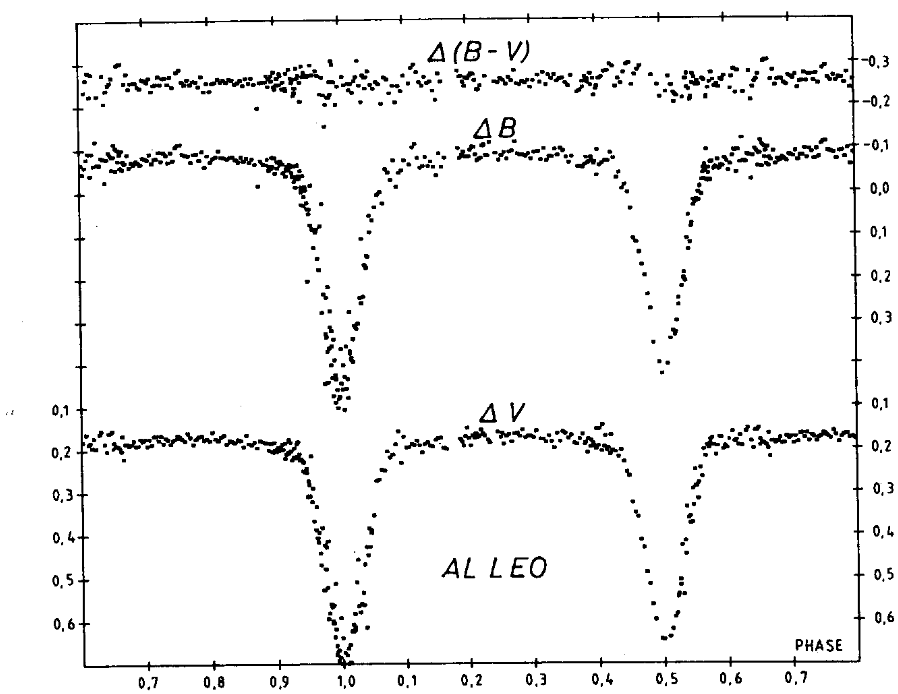
AL Leo = SAO 098873 = BD+18°2297 [9.1] = 354.1934 = CSV 1536 = P 3369 was discovered by Hoffmeister (1934) as probably rapidly changing eclipsing binary star. Sandig (1947) reported, that on 80 plates he inspected, only two minima were found. The variable was also investigated by Kurochkin (1948), who reported 14 photographic brightness measurements and derived from them first elements with a period of $4^{d}.1444$ and a range of brightness between $10^{m}.1$ and $10^{m}.5$. These elements were confirmed by Vasilyanovskaya (1955), who corrected the epoch by $-0^{p}.185$ and the limits of lightchange to $10^{m}.28$ - $10^{m}.70$. The small extent of the observational material made us put AL Leo on our program.

AL Leo was observed during 15 nights in spring and autumn 1989 in B and V magnitudes with a single-channel photometer (which utilizes an uncooled EMI 9781 B photomultiplier tube). The telescope used was a 0.35 m Schmidt-Cassegrain at the private Observatory of one of us, which operates fully automatically. For a description see Agerer (1988). SAO 098898 = BD+18°2306 was chosen as a comparison star and SAO 098890 = BD+18°2302 was used

Table 1. Observed times of minima for AL Leo, epochs and residuals computed with respect to the ephemeris derived in this paper

No.	JD helioc.	Min	Type	Epoch	(O-C)	Source
1	2419829.36	I	p::	-17437	+0.092	Kurochkin (1948)
2	20894.47	II	p	-16773.5	-0.057	
3	26116.39	I	p	-13521	-0.071	
4	2447609.473	I	E:	-134	+0.0041	Agerer
5	47613.4941	II	E	-131.5	+0.0032	
6	47654.429	I	E	-106	-0.0025	
7	47824.619	I	E	0	+0.0030	

p denotes pg plate min. (weight 2), E photoelectrical min. (weight 100 or 25). The minimum marked ":" received reduced weight, while those marked "::" were discarded.



Differential B and V light and B-V colour curves of AL Leo.

to check its constancy. Measurements showed that the differences in magnitude between comparison and check star were constant at

(comparison - check) $\Delta V = 0\overset{m}{.}135 \pm 0\overset{m}{.}046$

$\Delta (B-V) = -0\overset{m}{.}395 \pm 0\overset{m}{.}041$

Instrumental magnitude differences were converted to the international UBV-System by observations of 27 LMi and 28 LMi. Our observations showed AL Leo to be a short-period Algol-type eclipsing variable (EA). The depth of the secondary minimum differs only marginally from that of the primary. Moreover, many measurements were made at large zenith distances and under not always satisfying atmospheric conditions. Therefore the variations between observations where the light ought to be constant are of the same order as the difference between primary and secondary eclipse brightness. Further observations are recommended and planned in order to confirm the relation of primary to secondary minimum and to improve the ephemeris. Little or no colour change could be detected during all phases. From our observations we derive the following preliminary elements:

$$\text{Min I} = \underset{\pm 1}{2447824.616} + \underset{\pm 1}{1\overset{d}{.}605514} * E$$

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CCD PHOTOMETRY OF V1500 CYGNI IN 1987 AND 1989

Seventy-one "V" CCD images of V1500 Cygni (Nova Cygni 1975) were obtained by D. Pascu, R. E. Schmidt, and P. K. Seidelmann in 1987 and 1989 using the U. S. Naval Observatory 1.55-meter astrometric reflector at Flagstaff, Arizona. The Caltech Mark IV 800 x 800 charge-coupled device (CCD) camera, with a Space Telescope F569W wide "V" filter was used. Comparison stars were C1, C2, and C3, as defined by Kaluzny and Semeniuk (1987). The following expressions were used in the reductions:

$$\text{Max (HJD)} = 2443369.7169 + 0.1396131 * E. \quad (1)$$
$$\text{Min (HJD)} = 2443369.6546 + 0.1396131 * E. \quad (2)$$

Differential magnitude light curves were constructed with phase given by equation (1). Instrumental magnitudes of the nova were converted to "V" magnitudes using the Kaluzny and Semeniuk (1987) values for C1 and C3. Figure 1 shows the light curve for 5 August, 1989. Vertical bars are standard errors of DAOPHOT aperture photometry (Stetson, 1987). Horizontal bars indicate length of exposures (200 seconds). The nova's mean "V" magnitude was 17.75 on 5 August, 1989, continuing its slow decline at the present rate of 0.23 magnitude per year. The maximum "V" magnitude was 17.17 +/- 0.03 and the minimum was 18.55 +/- 0.05. Flickering of amplitude 0.2 "V" magnitude at maxima and minima was observed.

Times of maxima and minima obtained by Pogson's method are compared to the above ephemerides (Table I). Figures 2 and 3 show our times of maximum and minimum (solid dots) with all known observations in the literature (crosses). The following references contributed times of observed maxima or minima: Semeniuk et al. (1977), Patterson (1979), Lanning and Semeniuk (1981), Pavlenko and Prokof'eva (1981), Pavlenko (1982,1983), Kruszewski (1983), Kaluzny and Semeniuk (1987). A least-squares fit of all positive cycles indicates corrections of -0.0053 day to the epoch of maximum in equation (1), and of -0.0056 day to the epoch of minimum in equation (2), yielding the following linear ephemerides:

$$\text{Max (HJD)} = 2443369.7116 + 0.1396131 * E. \quad (3)$$
$$\text{Min (HJD)} = 2443369.6490 + 0.1396131 * E. \quad (4)$$

No significant change to the period was detected.

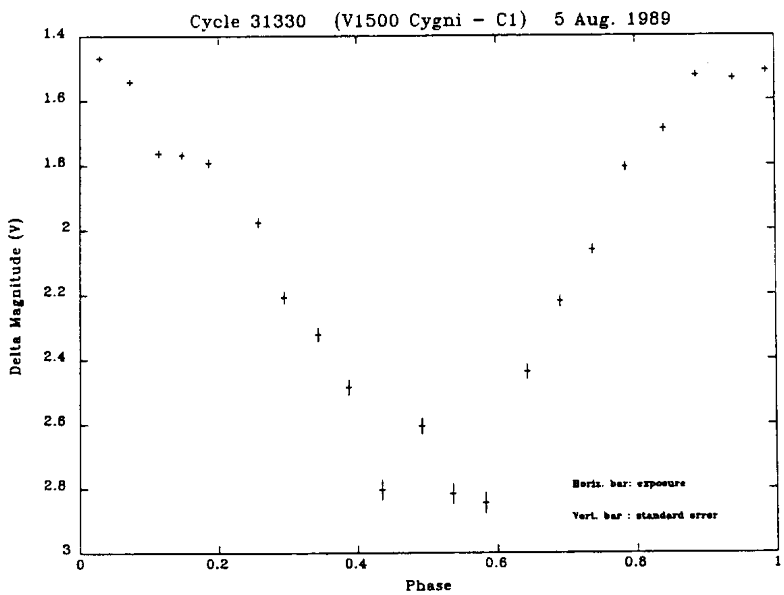

Figure 1

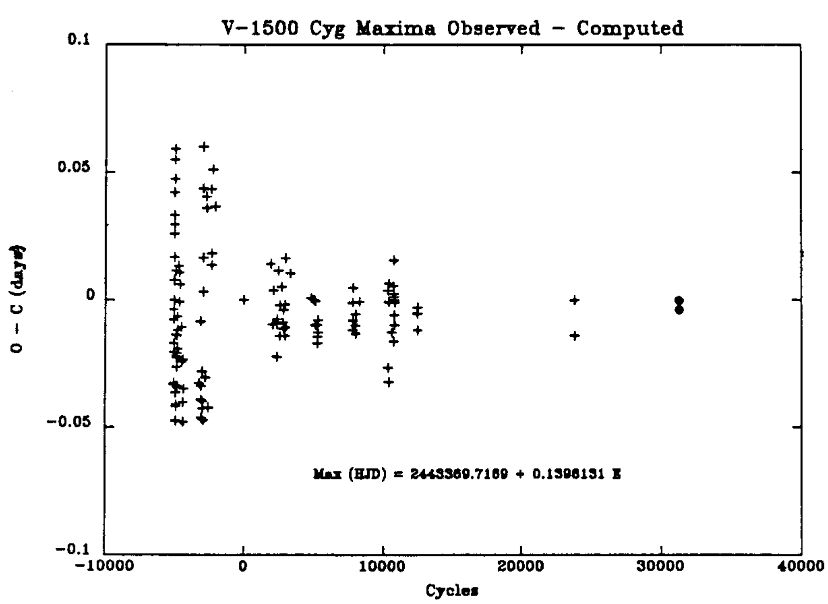

Figure 2

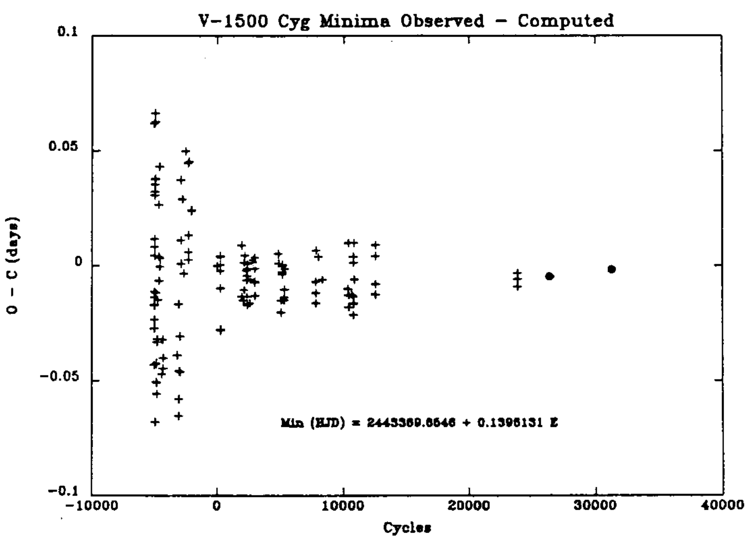

Figure 3

Table 1. Observed epochs of maximum and minimum

HJD Maximum	HJD Minimum	Cycle	(O-C)
	2447055.715	26401	-0.005
	2447743.871	31330	-0.002
2447743.931		31330	-0.004
2447744.912		31337	-0.000

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1988 LIGHT CURVES OF RX HERCULIS

RX Her (HD 170757, GC 25274) is a detached eclipsing binary with algol type light curves. It was listed by Popper (1959) as one of four early spectral type eclipsing binaries with well determined properties. Wood (1948) obtained one unfiltered light curve and determined a solution using the Russell-Merrill method. Other light curves obtained were never solved because no significant differences were noticed between new and old light curves (Popper, 1959). Olson(1975) and Hill and Hilditch (1975) observed the system at five different phases in Strömgren filters. From these observations the C index indicates a B9.5 spectral type, while the M index for both primary and secondary stars shows nothing peculiar in the metal abundance (Jeffreys, 1980). Jeffreys (1980) obtained a V light curve and determinea a solution using Wood's (1971) WINK computer model. He found that RX Her is a binary system with similar components (B9.5 primary and AO secondary). He also found some asymmetry during ingress of the secondary due to a small eccentricity ($e = 0.022$).

We obtained new differential photoelectric observations in each U, B, V filters during May and August 1988. An EMI 9789QB photomultiplier attached to the 30 cm Maksutov telescope of the Ankara University Observatory has been used to secure the data. Differential observations in three colors were made with respect to the comparison star BD+12°3547. BD+11°3518 was used as the check star. The differential brightness measurements of the comparison with respect to the check star were found to be sensibly constant during the observations. The individual differential brightness determinations were corrected for differential atmospheric

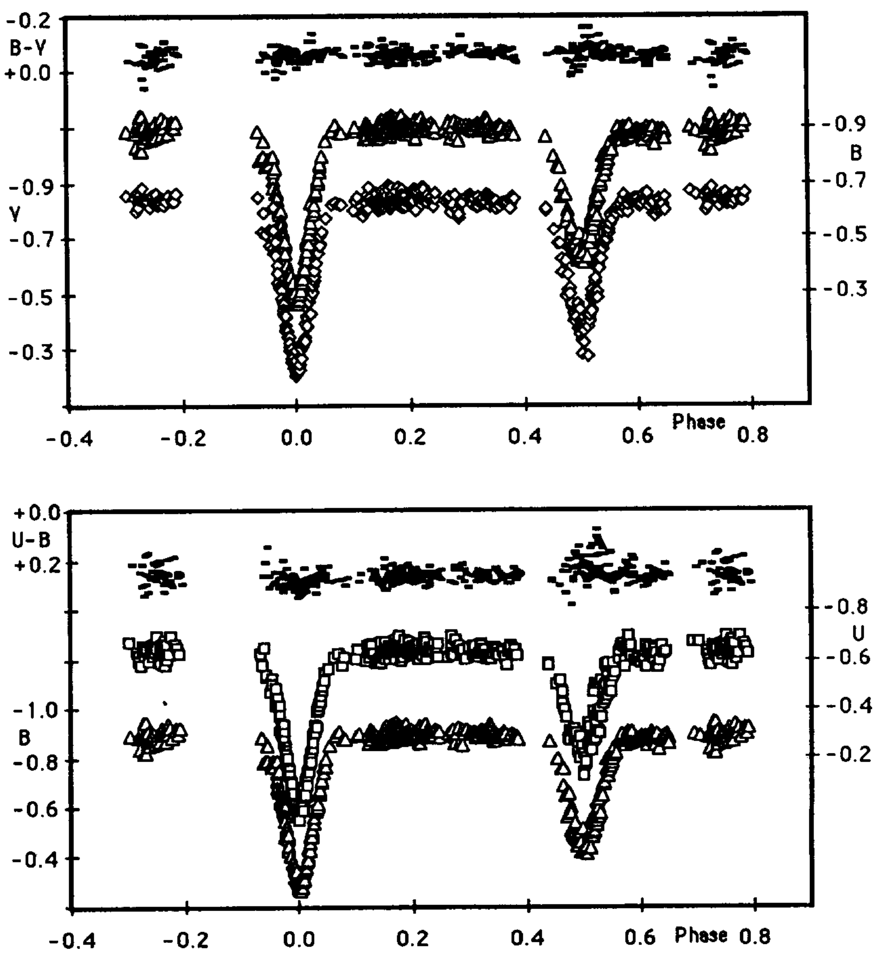

Figure 1. The UBV observations of RX Herculis.

extinction. The observations in the sense variable minus comparison are plotted in Figure 1 together with color curves. The light elements used in phase calculation were given in GCVS 1985 as

$$\text{Hel. JD Min I} = 2433170.398 + 1^{d}.7785724 \cdot E.$$

Table 1. The new times of minima of RX Her

Hel. Min. 2447300+	No. of Obs.	Filter	E	O-C	Remark
39.3930 ± 0.0020	11	U	7966	-0.0020	Min. II
39.3947 ± 0.0009	16	B	7966	-0.0004	Min. II
39.3946 ± 0.0010	16	V	7966	-0.0004	Min. II
47.3989 ± 0.0006	15	U	7971	+0.0003	Min. I
47.3991 ± 0.0008	15	B	7971	+0.0005	Min. I
47.4003 ± 0.0013	13	V	7971	+0.0017	Min. I
71.4032 ± 0.0031	9	U	7984	-0.0062	Min. II
71.4072 ± 0.0002	9	B	7984	-0.0021	Min. II
71.4078 ± 0.0030	11	V	7984	-0.0015	Min. II
79.4139 ± 0.0004	32	U	7989	+0.0010	Min. I
79.4141 ± 0.0003	30	B	7989	+0.0012	Min. I
79.4139 ± 0.0005	32	V	7989	+0.0010	Min. I
88.3067 ± 0.0009	20	U	7994	+0.0009	Min. I
88.3059 ± 0.0005	20	B	7994	+0.0001	Min. I
88.3068 ± 0.0013	20	V	7994	+0.0010	Min. I

During the observations we secured three primary and two secondary minima. The new minimum times (see Table 1) confirm the apsidal motion and thus eccentric orbit of the system.

We thank to B. Gürol for the generous help during the observations and their reductions.

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1989 LIGHT CURVES OF BH VIRGINIS

BH Virginis (BD-0°2769,HD121909) is a double-lined spectroscopic eclipsing binary with cool components. The spectral types of the components have been determined as GOV+G2V by Abt (1965) and as F8IV-V+G2V by Koch(1967). Having late type magnetically active components, the system's total light at maxima and/or minima is expected to vary in time (Hoffmann, 1982; Budding and Gimenez, 1982). It has been observed photometrically by Kitamura et al. (1957), Koch (1967), Šadık (1978), Hoffmann (1982) and Scaltriti et al.(1985). In addition to ellipticity and reflection effects outside the eclipse phases, an irregular fluctuation as a characteristic property of RS CVn type systems has been noted as early as 1957 by Kitamura et al. (1957). Scaltriti et al. (1985) have noted by comparing the existing observations that the distortion wave is variable and migrates in time, while Budding and Zeilik (1987) found a distortion wave of about same shape with two minima at about the same phases from Sadık (1978) and Scaltriti et al.'s (1985) data. True interpretation of the light variations at different time scales requires a continuous monitoring of the binary. Thus, we have included BH Vir in our program of the photometric observations of short period binaries.

The present observations of BH Vir were made on seven nights in 1989 using an EMI 9789QB photomultiplier attached to the 30 cm Maksutov telescope of the Ankara University Observatory. The differential observations in U, B and V colors were made with respect to the comparison star BD-0°2770. Altogether 188, 190 and 187 differential magnitudes of BH Vir in V, B and U bandpass, respectively,

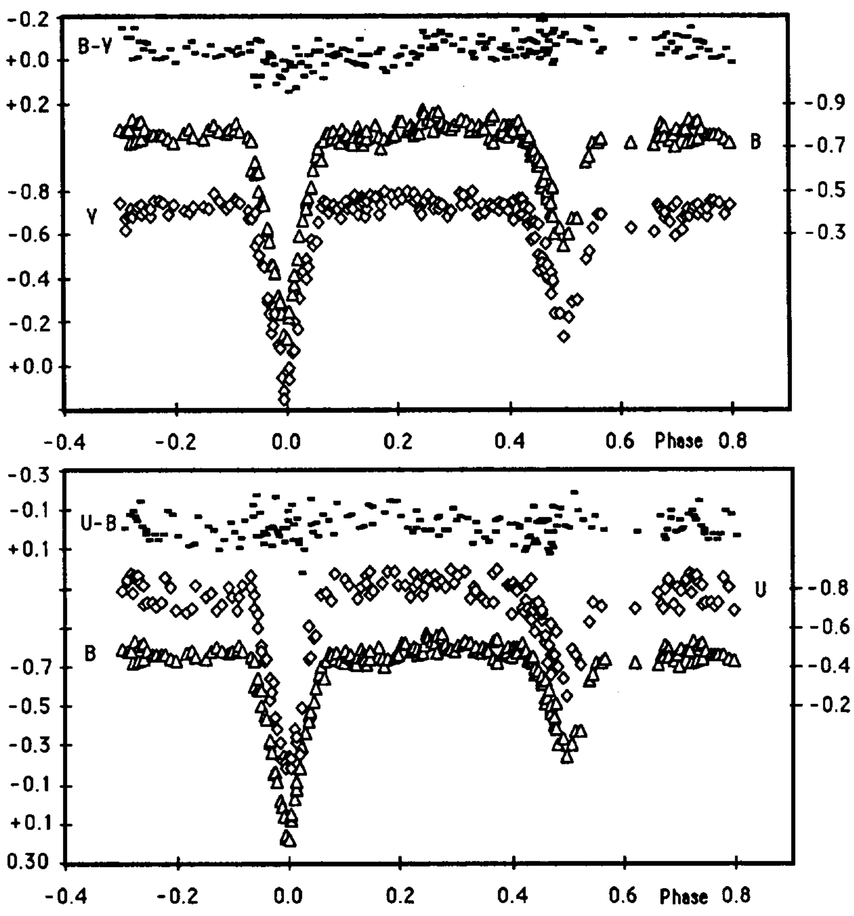

Figure 1. The UBV observations of BH Vir in 1989

were obtained. The individual differential magnitude determinations were corrected for differential atmospheric extinction. The observations (in the sense variable minus comparison) are shown in Figure 1 together with the color curves. The phases were calculated by using the light element from GCVS (1985), as

$$\text{Hel. JD Min I} = 2443230.609 + 0.816877161 * E$$

Two primary and one secondary eclipse minima have been secured during the observations. The new times of the minima are given in Table 1.

Table 1. The new times of minima of BH Vir

Hel. Min. 2447600+	Filter	E	O-C	Remark
15.5743 ± 0.0006	U	11640	0.0093	Min. I
15.5732 ± 0.0005	B	11640	0.0082	Min. I
15.5734 ± 0.0013	V	11640	0.0084	Min. I
20.4754 ± 0.0018	U	11646	0.0092	Min. I
20.4738 ± 0.0004	B	11646	0.0076	Min. I
20.4738 ± 0.0013	V	11646	0.0076	Min. I
58.4604 ± 0.0027	U	11692	0.0097	Min. II
58.4580 ± 0.0018	B	11692	0.0073	Min. II
58.4579 ± 0.0013	V	11692	0.0072	Min. II

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REMARK ON THE TWO DWARF NOVAE V 632 CYGNI AND V 630 CYGNI

The two dwarf novae V 630 and V 632 Cygni were discovered by Hoffmeister (1949) on Sonneberg plates taken with the 40 cm astrograph. He already recognized the type of variability, which was confirmed later by Rohlfs (1951).

V 632 Cygni

Only the following three eruptions described by Hoffmeister and Rohlfs are mentioned in the literature:

J.D. 242 9244 ($13^{m}.9$),
242 9571 (12.8), and
242 9794 (pg. brightness indefinite).

Scattered observations by members of the AAVSO, AFOEV and SVSO obviously did not result in detecting further maxima, and Romano (1966) found only fluctuations in minimum light. Unfortunately the star is situated beyond the edge of our post-war astrographic plates. A sample of 110 far reaching sky patrol exposures of the years 1962 to 1965 (limiting magnitude $14^{m}.5$) did not show any maximum. According to the POSS charts 806 the star is blue in minimum.

All findings and the statistical considerations pursuant to the paper of Wenzel and Richter (1986) point to a cycle length of 100 days or longer.

It should be noted that the remark of Darsenius (1966) concerning the existing charts for this star is not correct: In reality the map of Hoffmeister (1957) is quite good, whereas that of Brun and Petit (1957) shows the variable at a (wrong) position 6 mm to the right (west) of the exact one and without any star of the near surroundings. Furthermore, in the listings of observations of the AFOEV in Bull. 38; 42; 43 the star has been given the wrong position 2031+39 instead of 2131+39.

V 630 Cygni

When checking 117 astrograph plates of the years 1961 to 1989 (centred at rho Cygni) for the small possibility of containing, contrary to expectation, V 632 Cygni at the edge of the field, I noticed the following 6 eruptions of the nearby V 630 Cygni, in addition to those given by Rohlfs (1951) from former Sonneberg plates:

J.D.	brightness	number of plates
243 8204.5	$14^{m}.0$	4
8290.6	14.7	3
9776.5	15.2	1
244 0839.4	15.1	1
3044.5	15.6	1
4117.5	14.4	2

The first eruption seems to have been a supermaximum: it lasted 4 days at least. The minimum brightness is below $16^{m}.3$.

Romano (1966) derived from his dense series of photographic observations a cycle length of 40 days. Our observations do not grossly contradict this result.

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REVISED ELEMENTS AND LIGHT CURVE FOR LS DELPHINI

The small amplitude W UMa type eclipsing binary LS Del (= BD+19°4574, HD 199497, SAO 106694) was discovered by Bond (1976) on spectroscopic and photoelectric observations. According to Kholopov et al. (1981) the visual magnitude varies from 8.61 to 8.76.
The period given by Bond (1976), 0.3638 days, was improved by Ruyou et al. (1987). Based on photoelectric observations of 4 nights these authors of the Beijing Astronomical Observatory noted the period to be 0.3639207 days.

To test the new elements, we did an observing run on LS Delphini in the years 1987 and 1989. The telescope used was a 0.34 m Cassegrain, equipped with a 1P21 phototube. All measurements were done in V colour.

As a result the ephemeris given by Ruyou et al. (1987) fails to represent our observations and the quoted period turned out to be spurious.
Indeed the true period is 7.2 seconds shorter, so the O-C against the ephemeris of Ruyou et al. (1987) will add up to 0.5 cycles within about 2 years. Therefore the quoted ephemeris will seem roughly correct in an even year, but will clear up as erroneous in odd years. Unfortunately all yet published observations were done in even years. Subsequently primary and secondary minima will be mixed up.

Table: Times of photoelectric minima of LS Delphini. O-C values are calculated against the elements of this paper.

JD hel.	E	O-C	Observer	Reference
42687.418	-13992.5	+.002	Bond	IBVS 1214
46668.1609	-3051.5	-.006	Ruyou et al.	IBVS 2982
46670.1686	-3046	+.001	Ruyou et al.	IBVS 2982
46671.0744	-3043.5	-.003	Ruyou et al.	IBVS 2982
47028.362	-2061.5	-.004	Wunder	this paper
47729.486	-134.5	+.004	Wieck	this paper
47737.490	-112.5	+.004	Wieck/Wunder	this paper
47778.421	0	+.003	Wieck/Wunder/ Skaberna	this paper
47790.423	33	-.002	Wunder	this paper

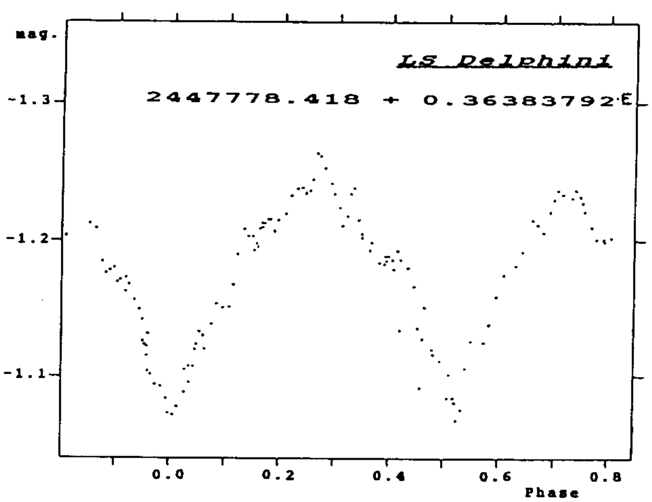

Figure 1

On base of the data shown in the table we calculated the new ephemeris, namely:

$$\text{JDhel. MinI} = 2447778.4180 + 0.36383792 \cdot E$$
$$\pm 16 \qquad \pm 16$$

The time of minimum published by Bond (1976) is not, as Ruyou et al. (1987) stated, a primary but a secondary minimum. Finally, a minimum published by Diethelm (1987) turned out to be incorrect and is therefore omitted.

A light curve in V colour of LS Delphini was made from selected data in 1989 and is illustrated in the figure.

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RADIAL VELOCITIES OF SOME BRIGHT SOUTHERN STARS

The Bright Star Catalogue (Hoffleit 1982) is a widely used publication that is often referenced. Most of the data columns are fairly complete, but there are gaps in the photometric, radial velocity and stellar duplicity columns. The most common radial velocity data omissions are of course for early spectral types, which are typically difficult to measure either because of the very broad lines commonly caused by high stellar rotation or the relatively few lines in the spectra of these stars. However there are quite a number of stars with a spectral type of F or later and it was thought to be useful to obtain their radial velocities. The edition of the catalogue used here contains data compiled through 1979, so it is possible that some of these values have already been obtained elsewhere and are not known to this author.

The data in Table 1 were obtained when a list was drawn up to act as a fill-in program between other program requirements. There is no astrophysical significance in the structure of the list. The criteria for selection from the Bright Star Catalogue were as follows:-

1. mag 6 (V) or brighter,
2. south of the Equator,
3. F5 or later spectral type,
4. no radial velocity entry in the Catalogue,
5. any companion noted that would not be excluded from the spectrograph slit width must be too faint to contaminate the brighter spectrum. (However, any physical companion would still be contributing to the brighter star's radial velocity.)

Two observations were made of each object. Most spectra were obtained centered at Hα (λ6563Å), but some of the earlier observations were made centered at λ5010Å. This means that some pairs of spectra are not directly comparable, but since only radial velocities, and not line profile information, were being determined, the same spectral region was not required.

The observations were made at the Mount John University Observatory, Lake Tekapo, New Zealand. All observations at λ6563Å were made with a 1872 element Reticon detector (MacQueen 1986) operated at -130°C using a Cassegrain échelle spectrograph (Hearnshaw 1977; 1978) mounted on the McLellan 1-m telescope operating at f/8. At λ6563Å the dispersion is 2.28Å mm^{-1}. With 15 micron pixels, this corresponds to 66 pixels mm^{-1} or about 1.5 km s^{-1} per pixel. The free spectral bandwidth between the end masks of the Reticon is just over 60Å at this position. All observations at λ5010Å were made with the spectrograph located in the dataroom adjacent to the dome, where it was thermally and mechanically stable. In these cases the spectrograph utilised a 105 micron single fibre feed (Kershaw & Hearnshaw 1989). A hollow cathode Thorium-Argon calibration lamp was used for all frames. This is built into the spectrograph. The observations at λ5010Å used the same lamp type, but built into the telescope end of the fibre feed module.

All the radial velocities were extracted from the data using a cubic dispersion solution on the Thorium-Argon frame, after the customary flat-field and fixed-pattern manipulations were applied.

All pre-existing data in Table 1 were obtained verbatim from the Bright Star Catalogue. The exposure date column is in day-month-year format. The exposures times are in minutes. (The exposure times may seem long for a 1-m telescope, but this is due to the high dispersion of the spectrograph, and also the approximately 50% light loss in the fibre-feed.) All radial velocities (in km s^{-1}) are with respect to the Sun. (The radial velocities obtained are listed to 0.01 km s^{-1}. Obviously it is not being claimed that this is the degree of accuracy. The last digit has been rounded already and has only been included so users can evaluate the rest of the number as they wish.) The 'rms mÅ' column refers to the root mean square uncertainty (in mÅ) in the dispersion solution from the Thorium-Argon calibration lamp, whereas the standard deviation ('Std.dev') is that obtained from the scatter in velocities over the number of lines ('# lines') used in the stellar frame.

Special attention is drawn to stars HR 5617, 6207, 6648 and 6818. These stars show distinct velocity differences at their two epochs.

Table 1. Program Star Data

HR	HD	V	Sp. Type	Date	Exp.	HJD 2440000+	Region	RV	rms mA	# lines	Std.dev	Del.mag	Sep.*
5391	126241	5.85	K3 III	4-4-89	60	7621.072	5010	-18.14	3.25	16	.69		
				6-8-89	45	7685.859	6563	-19.16	2.23	15	.69		
5389	126209	6.07	K0-1III	3-4-89	90	7620.217	5010	- 8.28	3.14	16	.53		
				8-6-89	35	7685.900	6563	- 9.47	2.77	14	.65		
5408	126862	5.83	K1III	4-4-89	90	7621.172	5010	+78.29	3.83	15	1.23	8.2	35.4
				8-6-89	42	7685.933	6563	+78.58	2.93	13	.40		
5547	131425	5.93	G8II	9-4-89	105	7626.030	5010	+0.66	2.85	12	1.36		
				8-6-89	40	7686.014	6563	+0.48	1.20	9	.59		
5585	132604	5.89	K2-3III	9-4-89	120	7626.122	5010	+42.01	1.56	17	1.03		
				8-6-89	40	7686.050	6563	+42.71	2.73	14	.72		
5525	130650	5.65	G8-K0III	11-4-89	90	7627.869	5010	+14.60	3.59	11	.63		
				8-7-89	60	7715.846	6563	+13.92	1.87	16	.55		
5617	133631	5.77	G8III	11-4-89	90	7628.039	5010	-10.42	1.43	16	.82		
				10-7-89	60	7717.879	6563	- 3.39	3.62	13	.74		
5636	134255	5.98	G8III	11-4-89	100	7628.115	5010	-34.30	1.67	18	1.16		
				27-7-89	30	7734.965	6563	-34.86	0.16	10	.21		
5725	137066	5.71	K5-M0III	12-4-89	90	7628.957	5010	- 9.18	3.18	15	1.23		
				27-7-89	20	7735.052	6563	-10.47	2.49	12	.52		
5767	138505	5.82	M2III	12-4-89	120	7629.038	5010	-38.70	2.92	12	1.26		
				27-7-89	40	7734.995	6563	-40.15	2.77	12	.67		
5929	142691	5.80	K0-1III	7-5-89	126	7654.059	5010	- 3.45	2.43	10	.74		
				27-7-89	30	7735.031	6563	- 3.63	2.46	13	.61		
5955	143346	5.70	K1IIICNII	11-4-89	90	7627.951	5010	+49.57	2.19	18	1.00		
				27-7-89	30	7735.142	6563	+49.60	3.92	14	.65		
6044	145833	5.92	K0III	13-5-89	81	7660.219	6563	-22.02	1.41	16	.52		
				25-7-89	30	7733.007	6563	-23.15	1.40 *	11	.38		
6073	146690	5.77	K0III	15-5-89	60	7733.038	6563	- 1.10	2.52	17	.67		
				25-7-89	40	7661.900	6563	- 0.52	2.85	14	.62		

Table 1 (cont.)

HR	HD	V	Sp. Type	Date	Exp.	HJD 2440000+	Region	RV	rms mA	# lines	Std.dev	Del.mag	Sep."
6085	147225	5.88	G3II	15-5-89	60	7661.994	6563	-11.27	2.04	16	.91	3.8	40.7
				26-7-89	30	7733.870	6563	-11.43	2.69	12	.50		
6122	148247	5.79	K1IIICNII	15-5-89	50	7622.037	6563	-14.16	2.19	17	.84		
				26-7-89	30	7733.895	6563	-14.19	1.79	13	.65		
6207	150576	5.96	G8III	17-5-89	40	7664.045	6563	-13.75	2.79	17	.88	6.0	40
				26-7-89	32	7733.921	6563	-17.17	1.89	10	.42		
								-15.88		4	.26		
6221	151078	5.48	K0III	17-5-89	35	7664.151	6563	- 9.48	3.24	17	.94		
				26-7-89	30	7733.951	6563	- 9.86	2.42	13	.66		
6266	152293	5.88	F5Ib-II	17-5-89	30	7664.178	6563	-37.62	1.40	18	2.72		
				26-7-89	30	7733.976	6563	-37.33	0.63	7	.57		
6288	152820	5.48	K5III	27-5-89	40	7674.005	6563	-78.08	2.68	12	.52		
				26-7-89	20	7733.998	6563	-77.62	3.09	15	.79		
6311	153368	5.97	K2IIICNII	27-5-89	30	7674.033	6563	+17.63	3.71	12	1.29		
								+15.52		7	.58		
				26-7-89	30	7734.019	6563	+16.99	3.76	14	.71		
6374	155035	5.84	M1-M2III	15-5-89	50	7662.173	6563	+20.68	1.80	15	.66		
				10-7-89	30	7718.071	6563	+21.96	1.36	15	.50		
6404	155970	5.99	K1III	15-5-89	32	7662.206	6563	- 0.96	3.99	15	1.08	5.1	4.2
				24-7-89	30	7731.974	6563	- 2.96	2.75	12	.82	7.0	20
6408	156091	5.91	K2IIICN	15-5-89	40	7662.235	6563	- 5.19	3.74	17	.88	8.4	20.2
				10-7-89	30	7718.111	6563	- 4.15	2.45	13	.48		
6456	157097	5.93	K1III	30-5-89	40	7676.950	6563	-36.79	2.14	16	.51	3.6	2.0
				24-7-89	45	7732.006	6563	-37.22	3.40	13	.53		
6438	156768	5.88	G8Ib-II	17-5-89	40	7663.915	6563	-10.07	4.30	17	.93		
				10-7-89	30	7718.135	6563	-10.12	2.96	11	.52		
6442	156854	5.80	G8-K0III	27-5-89	40	7674.250	6563	- 6.84	2.50	14	.67		
				10-7-89	30	7718.163	6563	- 5.29	1.49	10	.52		
6648	162391	5.84	G8III	30-5-89	40	7676.998	6563	-15.44	2.57	15	.62		
				24-7-89	45	7732.043	6563	-25.07	2.54	11	.61		
6643	162189	5.96	M2III	27-5-89	30	7674.221	6563	-85.08	2.09	11	.64	6.5	23.6
				24-7-89	40	7732.079	6563	-84.80	0.88	11	.73	7.2	30
6624	161814	5.78	K0III	27-5-89	30	7674.279	6563	+16.34	2.43	14	.54		
				8-7-89	45	7716.143	6563	+17.83	3.24	18	.66		
6691	163652	5.74	G8III	27-5-89	30	7674.195	6563	-88.08	1.52	15	.61	2.4	51.7
				24-7-89	40	7732.110	6563	-88.56	2.51	15	.61		
6818	167096	5.46	G8-K0III	27-5-89	30	7674.170	6563	-27.54	1.94	15	.86		
				8-7-89	30	7716.176	6563	-19.84	1.94	17	.76		
6837	167714	5.95	K2III	8-6-89	45	7686.191	6563	-14.07	2.97	15	.64		
				10-7-89	30	7718.188	6563	-12.97	2.72	16	.84		

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TIMES OF MINIMUM LIGHT FOR 16 ECLIPSES OF 8 APSIDAL MOTION BINARIES

We report here on the continuation of a program of observing eclipsing binary systems suggested by Gimenez and Delgado (1980), and by Giminez (1985), as candidates for possible detection of general-relativistic apsidal motion.

The observations were made with the 46-cm reflector at Appalachian State University's Dark Sky Observatory. The photometer is a Kitt Peak National Observatory single-channel design employing a thermoelectrically cooled EMI 9865QB photomultiplier tube with matching UBVR filters. An Astronomical Time Mechanisms Model 240V amplifier provides a voltage-to-frequency output that is integrated by a microcomputer.

The observations for a given eclipse were made through one filter only, to maximize the number of data points. The observations have not been transformed to the Johnson system, since they were only intended for timing analysis. The observations are available from the IAU Archives, file number 212.

The times of minimum light and standard errors given in Table I were calculated using the method of Kwee and van Woerden (1956), using a program written by Ghedini (1982). This algorithm has been shown by Caton (1989) to give the most accurate estimation of time of conjunction for asymmetric light curves.

Table I.

System	Type of Eclipse	Heliocentric JD (-2400000)	Comparison Star	Filter
TV Cet	Primary	47147.58576 ±0.00022	BD +01° 566	V
EK Cep	Primary	46724.79762 ±0.00013	BD +68°1239	R
	Primary	47499.66257 ±0.00012	" " "	V
CO Lac	Primary	47084.64270 ±0.00050	(see Note 2)	V
	Secondary	47097.74215 ±0.00015	" " "	V
	Secondary	47495.63488 ±0.00022	" " "	V
	Primary	47502.57676 ±0.00019	" " "	V
RR Lyn	Secondary	47220.67251 ±0.00049	BD +56°1136	V
	Secondary	47568.75226 ±0.00038	" " "	V
V451 Oph	Primary	47307.73282 ±0.00035	BD +10°3526	V
	Primary	47654.79386 ±0.00028	" " "	V
FT Ori	Primary	47132.84835 ±0.00024	BD +21°1161	V
	Primary	47507.74782 ±0.00012	" " "	V
AG Per	Secondary	47480.67474 ±0.00024	BD +33° 776	V
	Primary	47495.79985 ±0.00030	" " "	V
IQ Per	Primary	47102.72767 ±0.00029	BD +47° 923	V

Notes

1) It was noted in preparation for observing EK Cep that this system is misidentified in A Finding List for Observers of Interacting Binary Stars (Wood, et al., 1980). EK Cep is incorrectly identified as BD +69°1197 (their entry number N = 3255), with BD +69°1191 entered as entry number N = 3254, a system of unknown period. Apparently these are the same system EK Cep = BD +69°1191.

2) For CO Lac, the star marked "C" in the finding chart, (Figure 1), was used for the comparison. It also appears that CO Lac itself is incorrectly identified in A Finding List for Observers of Interacting Binary Stars (Wood, et al., 1980), with BD +56° 2857, which is a few minutes to the north-west of the variable. This star was initially tried as a comparison but seemed to be varying on a short time scale. The star marked "K" was used for the check.

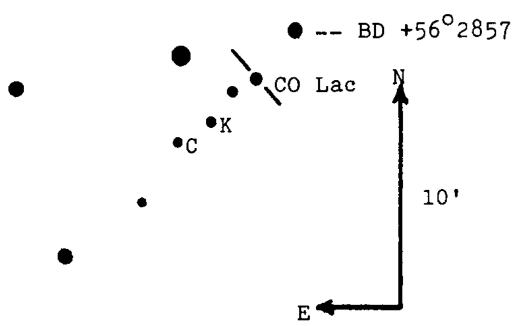

Figure 1

We gratefully acknowledge the assistance of F. B. Wood and G. Fitzgibbons in providing reference material from the University of Florida Card Catalogue of Eclipsing Binaries. We also thank J. T. Pollock for the CCD image used for the finder chart production and in the identification of CO Lac. This project was also partially supported by NSF Grant AST-8705770.

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PHOTOELECTRIC OBSERVATIONS OF UW Ori

UW Ori was discovered by Luther (1911), who, however, suggested an incorrect period of $0^h.407902$. Subsequent period studies were reported, on the basis of photographic observations, by Whitney (1959), Ahnert (1960) and Todoran (1962), who gave different values as 2.038127, 2.038101 and 1.0080525 days respectively. So far, no photoelectric data of this star have been published.

From October 1986 to February 1987 and from October 1987 to January 1988 this star was observed photoelectrically in BV colours at Xinglong station, Beijing observatory with the 60 cm reflector.

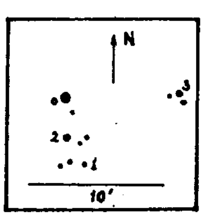
BD+20°1172 was used as the check star and the coordinates for the comparison star are $05^h54^m58^s(\alpha_{1987})$ and $20^\circ05'12''(\delta_{1987})$, as is shown in Figure 1.

A total of 567 photoelectric observations was obtained on 18 nights and three times of minima were determined by Kwee and Van Woerden's (1956) method. 27 times of minima were used to compute the period of this star.

The following ephemeris was derived by weighted least squares method:

$$\text{JD.Hel(Min I)} = 2447172.2684 + 2^d.03812913 \cdot E$$
$$\pm 50 \qquad\qquad 47$$

Light curves for this star in BV colours are given in Figure 2. O-C residuals of times of minima are given in Table I and the O-C diagram is shown in Figure 3. Over this interval no obvious variation of the period was found.



o: UW Ori
1: comp. star
2: check star
3: BD+20°1169

Fig. 1. Finding chart for the binary UW Ori

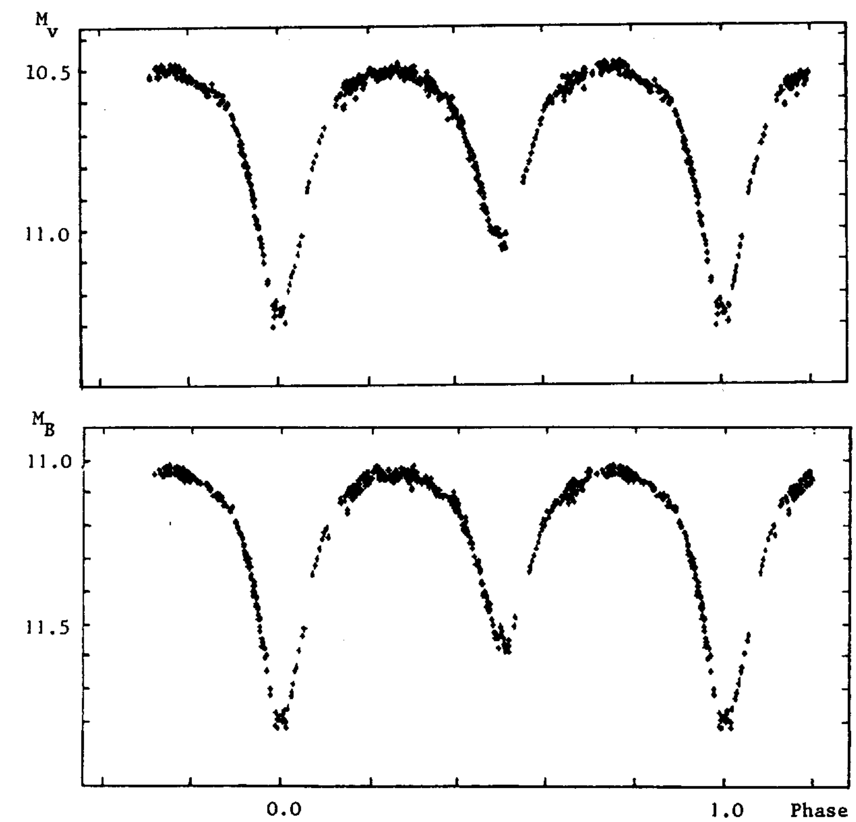


Fig. 2. The light curves of UW Ori in BV colours

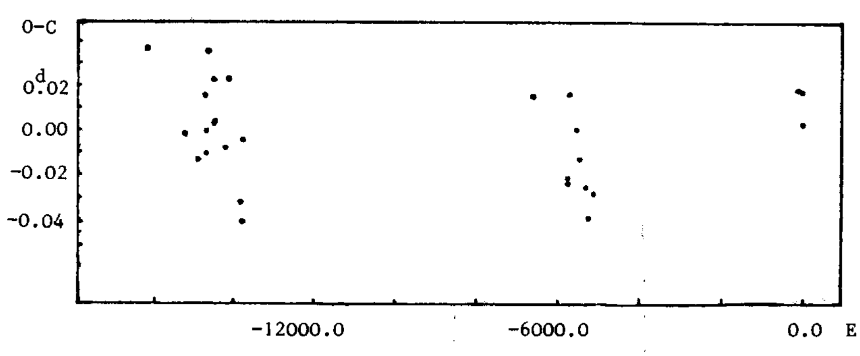


Fig. 3. The O-C diagram of times of minima for UW Ori

Table I. Times of minima of UW Ori

JD(hel) 2400000+	E	o-c (days)	weight	method	observer
14307.4730	-16125.0	0.0367	1	pg.	Luther
16172.3240	-15210.0	-0.0004	1	pg.	"
16871.3910	-14867.0	-0.0117	1	pg.	"
17198.5130	-14706.5	-0.0095	1	pg.	"
17235.2430	-14688.5	0.0342	1	pg.	"
17242.3420	-14685.0	-0.0002	1	pg.	"
17297.3880	-14658.0	0.0163	1	pg.	"
17614.3040	-14502.5	0.0032	1	pg.	"
17668.3340	-14476.0	0.0228	1	pg.	"
17670.3530	-14475.0	0.0037	1	pg.	"
18264.4570	-14183.5	-0.0070	1	pg.	"
18361.2970	-14136.0	0.0219	1	pg.	"
19013.4450	-13816.0	-0.0314	1	pg.	"
19058.2740	-13794.0	-0.0413	1	pg.	"
19068.5020	-13789.0	-0.0039	1	pg.	"
33657.4500	- 6631.0	0.0158	1	pg.	Ahnert
35428.5480	- 5762.0	-0.0204	1	pg.	Whitney
35432.6220	- 5760.0	-0.0227	1	pg.	"
35483.6140	- 5735.0	0.0161	1	pg.	"
35808.6800	- 5575.5	0.0005	1	pg.	"
35910.5730	- 5525.5	-0.0130	1	pg.	"
36287.6150	- 5340.5	-0.0248	1	pg.	"
36558.6720	- 5207.5	-0.0390	1	pg.	"
36561.7410	- 5206.0	-0.0272	1	pg.	"
46794.2144	- 185.5	0.0189	2	pe.	Zhang et al.
47172.2861	0.0	0.0177	2	pe.	"
47173.2917	0.5	0.0042	2	pe.	"

From the light curves the star is to be an eclipsing binary of Beta Lyrae type with $0^m.78$ and $0^m.54$ deep primary and secondary eclipses respectively.

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THE PERIOD OF KO Aur

KO Aur (BD+48°1340) was discovered by Weber (1963) and this star was reported by Berthold (1978) to be an eclipsing binary with a period of 1.31793028 days and with $0^m.75$ and $0^m.70$ deep primary and secondary eclipses respectively. The ephemeris given by Berthold is as follows:

$$\text{Min. (hel.)} = \text{JD}.2436607.472 + 1^d.31793028 \cdot E$$

From December 1988 to March 1989 this star was observed photoelectrically in UBV colours at Xinglong station, Beijing observatory with the 60 cm reflector.

The stars BD+48°1342 and BD+48°1344 were used as the comparison and the check star respectively.

The light curves with 614 UBV photoelectric observations were obtained on nine nights and six times of minima were determined by Kwee and Van Woerden's (1956) method. The results reveal that during the interval of our observation some minima times predicted according to the ephemeris given by Berthold (1978) were detected and some were not. It is interesting to note that the minima times detected just coincide with those minima times predicted according to an ephemeris with a triple of the old period given by Berthold (1978).

17 times of minima are listed in Table I, six of which are given by us and 11 of which were given by Berthold. Six times of minima are excluded from the moments given by Berthold, because the O-C residual of those minima times is over $0^d.5$.

The ephemeris deduced by the weighted least squares method is as follows:

$$\text{JD.Hel(Min I)} = 2447512.0677 + 3^d.9538047 \cdot E$$
$$\pm 23 \qquad 28$$

The light curves in BV colours are given in Figure 1. The O-C diagram of minima times is shown in Figure 2. The O-C residuals of minima times show that the period for this binary seems to be constant over the time interval covered.

It is interesting to note that the binary system may be an RS CVn-type

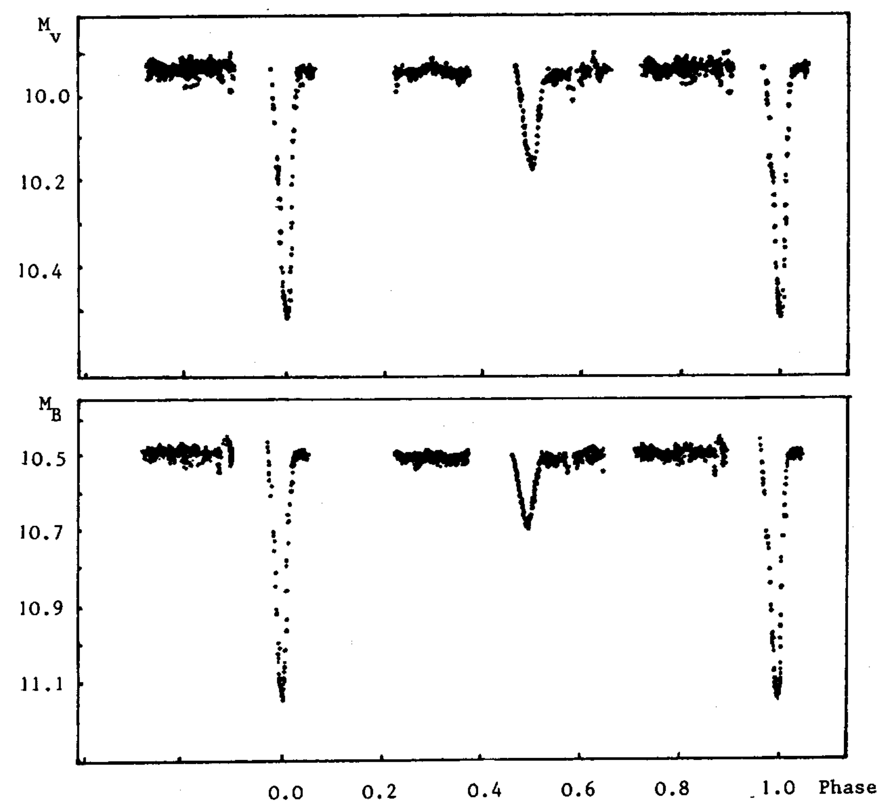

Fig. 1. The light curves of KO Aur in BV colours

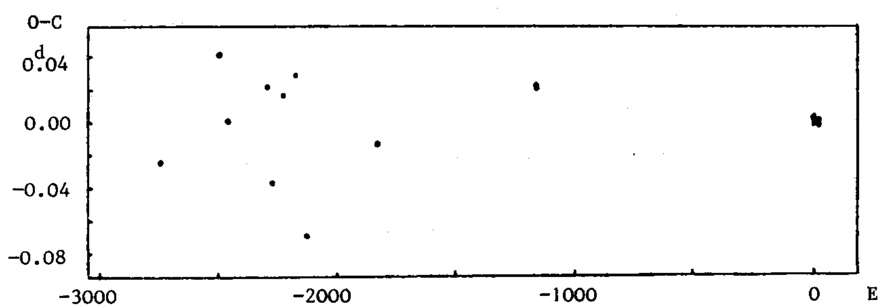

Fig. 2. The O–C diagram of times of minima for KO Aur

Table I. Times of minima of KO Aur

JD.(hel) 2400000+	E	O-C (days)	weight	observer
36607.4500	-2758.0.	-0.0244	1	Berthold
37639.4590	-2497.0	0.0416	1	"
37730.3560	-2474.0	0.0011	1	"
38406.4780	-2303.0	0.0225	1	"
38495.3800	-2280.5	-0.0361	1	"
38651.6100	-2241.0	0.0186	1	"
38849.3110	-2191.0	0.0294	1	"
39070.6270	-2135.0	-0.0677	1	"
40205.4250	-1848.0	-0.0116	1	"
42866.3680	-1175.0	0.0208	1	"
42870.3230	-1174.0	0.0220	1	"
47506.1378	-1.5	0.0008	10	Zhang et al.
47510.0894	-0.5	-0.0014	10	"
47512.0687	0.0	0.0010	10	"
47595.0973	21.0	-0.0003	10	"
47597.0717	21.5	-0.0028	10	"
47599.0522	22.0	0.0008	10	"

eclipsing binary with a distortion wave outside the eclipses of the light curve but, in order to reveal other RS CVn characteristics, spectroscopic observations of this system are necessary.

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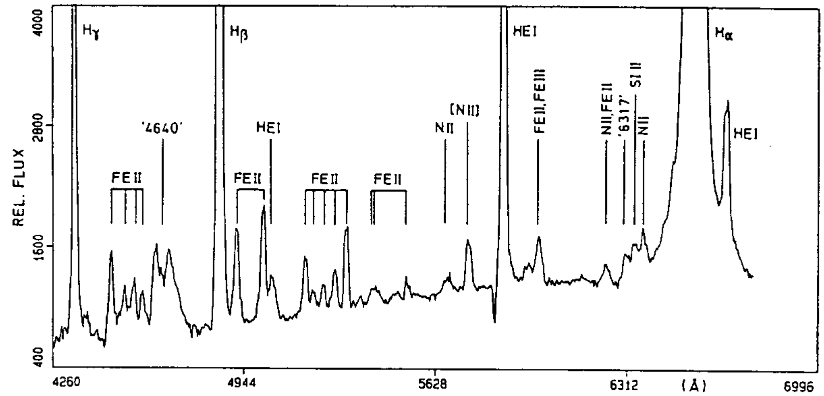
NOVA OPHIUCHI 1988 MONITORED 2.5 MONTHS AFTER OUTBURST

During the nights of June 21 and 22, 1988 (about 2.5 months after outburst) 12 spectrograms (resolution 4Å) of Nova Ophiuchi 1988 (V 2214 Oph) were obtained using the Boller & Chivens spectrograph and a CCD detector attached to the 1.52m telescope of the European Southern Observatory at La Silla / Chile. The dominant lines in the recorded wavelength region are Balmer emissions (H_α to H_γ) and He I λ 5876. H_α is extremely strong and is blended with He I and presumedly with N II and [N II] lines. Weaker emissions are mostly due to Fe II but also N II and [N II] are present. All Balmer lines as well as He I λ 5876 exhibit asymmetric profiles with a pronounced red peak whereas the faint lines are more symmetric. The following values of heliocentric radial velocity (uncertainty about 10 km/s), FWHM, FWZI (all in km/s) and equivalent width (Å) were derived for the prominent lines: H_α: -144, 1060, 15 000:, 6500:; H_β: -71, 950, 3950, 510; H_γ: -28, 985, 3525, 150; He I λ 5876: -167, 1045, 2760, 90. The five strongest Fe II lines yield a radial velocity of -220 ± 17 km/s. The results for He I λ 6678 and [N II] λ 5755 are -247 km/s and -294 km/s respectively. The absorption feature at the blue side of He I λ 5876 has a velocity of -1840 km/s.



Average spectrum of Nova Ophiuchi 1988 based on observations obtained on June 21 and 22, 1988. It has been truncated to show the weak emission lines.

A few photoelectric measurements obtained on June 23.029 UT using the single-channel standard photometer at the ESO 50cm telescope gave V=10.915, U-B= -0.335, B-V=+0.664, V-R=+1.822, V-I=+1.115 (uncertainty 0.045 mag in V-I, otherwise less than 0.02 mag).

This note may complement spectroscopic and photometric measurements performed by Jablonski et al. (1988) about one week prior to these observations.

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Jablonski, F.J., Kirhakos, S.D., Diaz, M.P., Baptista, R.: IAU Circular No. 4619, 1988

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THE PERIOD OF GAMMA DORADUS

Recent observations made by F. Marang and F. van Wyk at the Sutherland Observatory show conclusively that the period (or half-period) of Gamma Doradus is close to 0.74 days. While the mean light curve is sinusoidal with an amplitude of about 0.05 mag, individual curves have amplitudes varying from 0.03 to 0.08 mag, making it difficult to find and refine the period.

This star has frequently been observed here in the past and those observations should be useful for refining the period when the annual aliases can be resolved. Details will be published elsewhere.

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VARIABLE POLARIZATION IN A COMPARISON STAR OF V3885 Sgr

In 1983 polarimetric measurements of the novalike system V3885 Sgr were performed at the European Southern Observatory (Metz, 1989). In order to determine the interstellar polarization of the system (Haefner, Metz, 1982) the linear as well as the circular polarization of several comparison stars neighbouring V3885 Sgr was determined several times. Whereas V3885 Sgr did not show any indication of intrinsic polarization (Metz, 1989), one of the measured comparison stars proved to be variable in both, its linear and circular polarization. The star (with the internal designation 11 on the finding chart, used during the observation) is separated by roughly 10 arcminutes from V3885 Sgr (the coordinates of the latter are: $\alpha_{2000} = 19^h 47^m 40^s$, $\delta_{2000} = -42^o 00'10''$). Star No. 11 was also measured by Bond (1978) and is described in the literature as "Bond's star" with a brightness of m = 10.6 and a spectral type of F2. Its position can be seen from the finding chart of V3885 Sgr (Fig. 1). After eliminating all erroneous measurements - caused above all by a heavy snow storm at La Silla - altogether 43 linear and 33 circular polarization determinations of the comparison star No. 11 remained for evaluation.

The result of the determination of the linear polarization is:
Mean intensity in arbitrary units I = 60026, SDV (I) = 3972 (SDV is the standard deviation for a single measurement)

$\bar{P}_x = -0.0041$, SDV ($\bar{P}_x$) = 0.0010
$\bar{P}_y = -0.0038$, SDV ($\bar{P}_y$) = 0.0012
$\bar{P} = 0.0057$ SDV ($\bar{P}$) = 0.0011

($\bar{P}_x$, $\bar{P}_y$, $\bar{P}$ are the means of 43 single determinations of P_x, P_y, P)

The result of the 33 circular polarization measurements is:
Mean intensity I = 57917, SDV (I) = 3621
$\bar{P}_v = -0.0002$, SDV (P_v) = 0.0018.

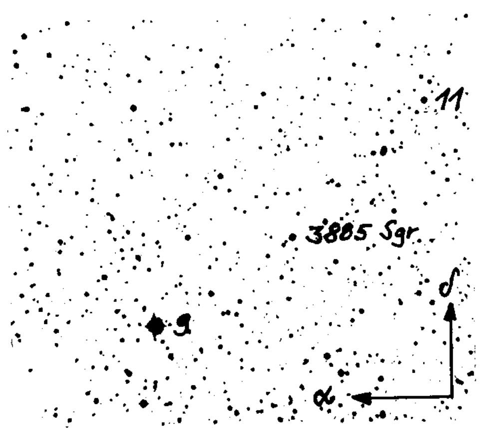

Figure 1. The finding chart used for V3885 Sgr and its comparison stars

Since each single measurement was the result of 16 rotation steps of the phase plates used in the old double beam ESO polarimeter and since the integration lasted 10 sec for each of the steps the error of a single measurement caused only by photon statistics was of the order of 0.0007. This is about a factor of 15 smaller than the derived standard deviations of the measurements.

The measurements of V3885 Sgr and its comparison stars lasted for 33 days and were interrupted two times by a break of more than a week. Therefore it was clear that the number of measurements of star No. 11 would not be sufficient to carry out a precise periodogram analysis or to make further reductions. However one thing was striking immediately after a short inspection of the data:

Completely in contradiction to V3885 Sgr and all other comparison stars the polarimetric errors of star No. 11 were much higher than derived from the photon statistics. The high standard deviations in both the linear and the circular polarizations indicated that star No. 11 was variable. Though the quantity of data was rather small to make any further statements concerning the comparison star, which had only occasionally been measured, a periodogram was performed in order to find (with all precautions described above!) any periodicity in the observed variations of the polarization. To detect most of the pseudo periodicities necessarily caused by numerous observational gaps, above all in observing the comparison stars, the polarization values were replaced by random numbers with the same standard deviation as registered for the star No. 11 and analysed in the same way. The instantaneous linear polarization degree P and the circular polarization degree PV were inspected in the range 1^h - 120^h with time intervals of one hour. The reason for selecting this time interval for the periodogram was that a preliminary plot gave indications that, if at all, a periodic variation should lie in that interval. For the original as well as the artificial data a Fourier analysis was made and gave the following result for comparison star No. 11:

In the linear polarization a period of 86 hours was present whereas the circular polarization varied with a period of 87^h. With respect to the selected time resolution and considering further the small quantity of data the results seem to be identical. Quite evidently this result has to be checked by a sufficient number of further measurements.

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BV PHOTOELECTRIC PHOTOMETRY OF SN 1987A IN SOUTH BRASIL

We present, in the Table I, the BV photometric observations of SN 1987A carried out at the Morro Santana Observatory, Porto Alegre, Brasil, during 1987, from 8 through 277 days after the core collapse.

The observations were made in the Johnson's B and V filters, by a photometer attached to the 0.50 m Zeiss Cassegrain telescope operated by Departamento de Astronomia, Instituto de Fisica, UFRGS.

As comparison stars we have used HD 38617 (spectral type K5 III, V = 7.52, B-V = +1.22), HD 36584 (F0, 6.02, +0.35), and Delta Doradus (A6 IV, 4.34, +0.22). Standard deviations of the measurements have typically varied from 0.01 through 0.14 magnitudes. Time has been counted from the observed Kamiokande-IMB neutrino pulse (e.g., Hirata, et al. 1987, Svoboda et al., 1987).

Table I: BV data

TIME (DAYS)	V	B-V	TIME (DAYS)	V	B-V
8.672	$4^m.45$	$1^m.01$	105.628	$3^m.39$	$1^m.74$
9.694		1.04	106.638	3.46	1.62
11.772	4.35	1.32	108.634	3.53	1.74
12.762	4.36	1.31	113.638	3.93	1.75
19.683	4.24		117.640	4.07	
20.764	4.20	1.52	122.630	4.33	
60.663		1.61	123.628	4.28	1.79
63.677		1.58	179.946	4.86	1.57
65.804	3.16	1.63	189.998	4.99	1.60
75.667	2.96	1.55	208.907	5.25	1.57
76.637	2.92	1.62	211.888	5.24	1.52
77.705	3.07		238.755	5.40	1.47
81.705	3.04	1.57	241.976	5.50	
92.670	3.01	1.62	249.838	5.59	1.39
103.613	3.38	1.67	250.843	5.54	
104.641	3.39	1.70	277.721	5.75	1.42

The observations summarized here constitute an additional independent although smaller photometric dataset for SN 1987A, others being those by Hamuy et al. (1988), Menzies et al. (1987), Catchpole et al. (1987a,b), and Dopita et al. (1988).

I wish to thank to all observers who have contributed with observations: S.O. Kepler, S.H.B. Livi, C. Bevilacqua, C. Winge, H.A. Dottori, and I. Menna. I am also grateful to C. Bevilacqua, I. Menna, G. Bello and W. Marques, for their technical and logistic support. This paper has been supported by CNPq and FINEP.

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Light Curves for AE Phoenicis

Since the discovery of its variable nature in 1964 (Strohmeier et al., 1964) the bright EW binary AE Phe has been the object of intense study. Recently Van Hamme and Wilson (1985) presented the results of a Wilson-Devinney (1971) analyses of Grønbech's (1976) uvby light curves and Duerbeck's (1977) radial velocity curves simultaneously. A contact model was reached, in which the asymmetry of the light curves (see Figure 1) was explained by a "Hot Spot", which was taken to arise from mass being transfered from the primary component. This bulletin details a preliminary analysis which assumes that the light curve asymmetry is due to a maculation ("Star spot") wave. The method and programs outlined by Budding and Zeilik (1987) were employed on the unpublished synthesized V band data obtained at the Canterbury University (NZ) Mount John Observatory in September 1985 by Dr Denis Sullivan and Mr M. Walkington (V.U.W.), who used the V.U.W.- Scanner. This instrument is documented by Sullivan (1976) and 'scans' a star's light across a multitude of fine bands, some of which can be judiciously combined to synthesize a wide band filter.

The effective stellar temperatures and mass ratio of Van Hamme and Wilson's final fit were adopted for our initial fit, modelling just the features expected in a standard eclipsing binary's light curve. The following photometric parameters were produced :

Primary Luminosity $L_1 = 29.7 \pm 1.7$ %

Primary Radius $r_1 = 0.308 \pm 0.008$

Secondary Radius $r_2 = 0.568 \pm 0.057$

Inclination $i = 86.4 \pm 3.3^\circ$

We then examined the difference curve obtained by subtracting this initial model from the light curve, and attempted to model it as a maculation wave. A single high latitude (75 °) dark spot of angular radius 37 ± 2 ° and longitude 276 ± 6 ° was found to fit the data best. The ratio of the spot flux to that of the surrounding photosphere was set to zero, thus producing a minimum area spot (Budding and Zeilik, 1987). High latitudes were clearly preferred by our relative χ^2 fitting procedure - the χ^2 values for an equatorial spot was double that of the best fit, with a clear χ^2 gradient in between (Banks, 1989).

High latitude spots appear to be a feature of chromospherically active stars (Rhodes, 1989) indeed II Peg (Vogt and Penrod, 1982) seems to have possessed a polar cap similar to that derived here for AE Phe. As stellar magnetic fields are dynamo dependent, it is not unreasonable to expect

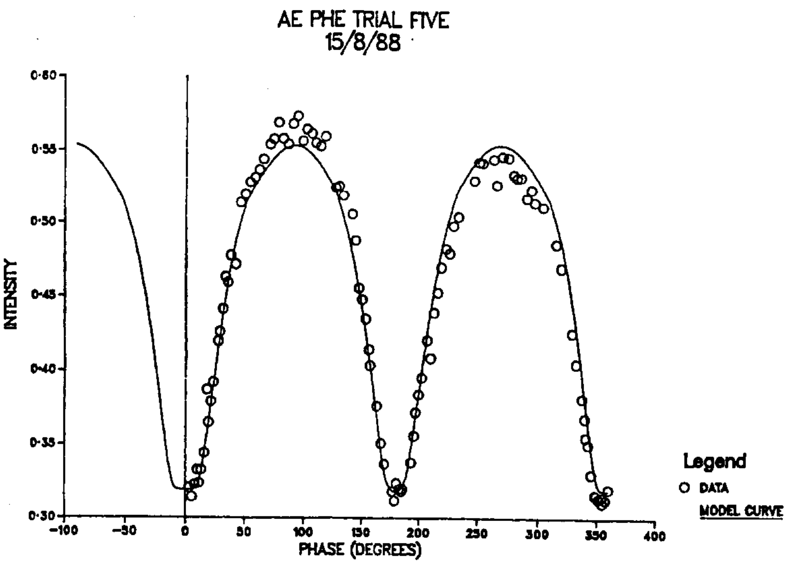

Figure 1: The "V band" data is plotted (dot symbols) against the light curve produced by the initial fit parameters (the smooth line).

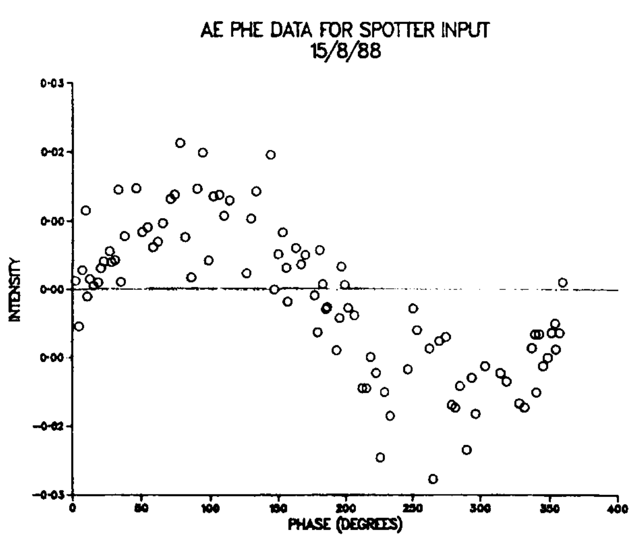

Figure 2: The difference curve resulting from the initial fit.

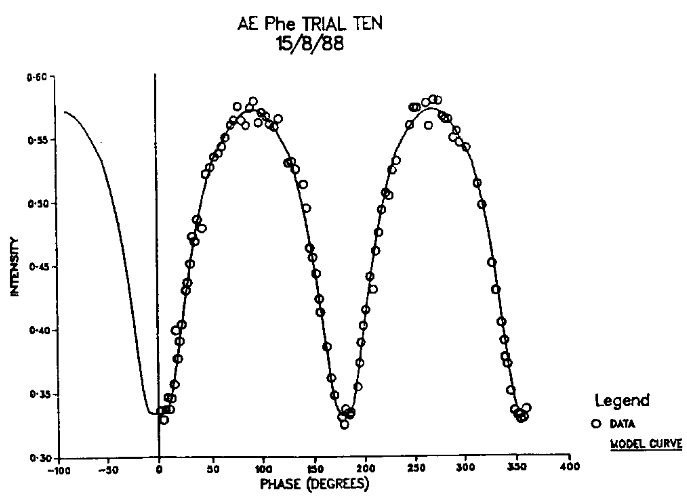

Figure 3: The final fit is plotted against the spot "corrected" data.

starspots, an indicator of such activity, in such short period cool (tidally locked) systems such as EW binaries (Eaton, 1986). However, we note that the existence of a common envelope complicates the matter somewhat.

The hot spot derived by Van Hamme and Wilson was equatorial, at longitude 140 °, and of angular radius 30 °. The parameters were set arbitrarily as these authors considered them not to be critical, as long as the light curve asymmetry was removed. The hot spot is essentially opposite our postulated dark spot, which could be expected as a sinusoidal distortion wave (see Figure 2) can be explained either by a hot spot or a dark region on opposite sides of the star.

The final light curves were formed by subtracting the calculated maculation effects from our original data. The basic parameters specifying this fit are :

Primary Luminosity $L_1 = 28.3 \pm 1.3$ %

Primary Radius $r_1 = 0.308 \pm 0.044$

Secondary Radius $r_2 = 0.483 \pm 0.082$

Inclination $i = 84.8 \pm 0.5$ °

These results are not different to the average parameters derived by Van Hamme and Wilson for their final fit incorporating the hot spot.

Primary Luminosity $L_1 = 31.3 \pm 1.0$ %

Side Primary Radius $r_1 = 0.303 \pm 0.016$

Side Secondary Radius $r_2 = 0.475 \pm 0.013$

Inclination $i = 86.3 \pm 0.3$ °

This result is pleasing, further supporting the contention (Banks and Budding, 1989) that the Wilson-Devinney codes are equivalent to our procedures. The final parameters should agree as they are independent of the method of accounting for the light curve asymmetry.

The 1975 - 1977 UBV observations of Walter and Duerbeck (1988) displayed marked, and relatively fast, variations with time, that could perhaps be explained in terms of spot evolution. An alternative explanation lies in fluctuations of the mass exchange rate postulated by Van Hamme and Wilson, although such a model requires a Coriolis "force" deflection of some 125 ° in a contact system! Indeed, Van Hamme and Wilson estimate 19% over-contact for AE Phe. To test either hypothesis would require further light curves of AE Phe to be obtained frequently in as short an observational period as possible, allowing similar analyses to these two studies to be performed.

Finally, we would like to note that such a sinusoidal difference wave resulting in an initial fit for a contact system, as we have seen here, might be better explained by a shock wave, presumably originating at the connecting neck between the components. Theoretical work on such an idea appears yet to be performed, and could prove rewarding.

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1988 AND 1989 BV PHOTOMETRY OF WY Cnc

Among the short-period group of RS CVn stars, WY Cnc (=BD 27° 1706; #58 in the catalog of Strassmeier et al., 1988) has been infrequently observed. In order to understand the magnetic activity of binary systems of cool stars, a long time base of continuous, high-quality observations is required. We report here on new BV observations that complement those of Zeilik et al. (1989).

We observed WY Cnc on the nights 10-15, 19-21 May 1989, and 8, 13, 18, 19 May 1988 using the 61-cm telescope operated by San Diego State University on Mt. Laguna, California. The photoelectric photometer, which uses an EMI 6256 phototube operated at -1300 V and cooled to -10° C, was equipped with V and B filters matching the Johnson system. Each observation consisted of two separate 40-second integrations in the sequence VBBV through a 19" aperture or a 26" one on a few nights of poorer seeing. SAO 80583 was the comparison and SAO 80598 the check star for all observations. Our reported data (Figures 1 and 2) are in the instrumental B and V band system. These instrumental differential magnitudes (comparison-variable) are sufficient to model the geometrical starspot parameters; so, we did not convert to the Johnson UBV system. The open circles are the observed points in 1988; the filled squares, 1989. Statistical errors in a single set of data were rarely greater than 0.01 mag, with most between 0.005 and 0.008 mag. Both years are plotted on the same scale so that the distortion wave changes are readily apparent. Clearly, the distortion wave has migrated to increasing longitude between 1988 and 1989.

Using the technique of Budding and Zeilik (1987), we optimized fits to the observed data to extract the distortion wave. Figures 3 and 4 show the binary model fits (solid lines) at V-band for unspotted stars; the open circles are the data transformed to normalized

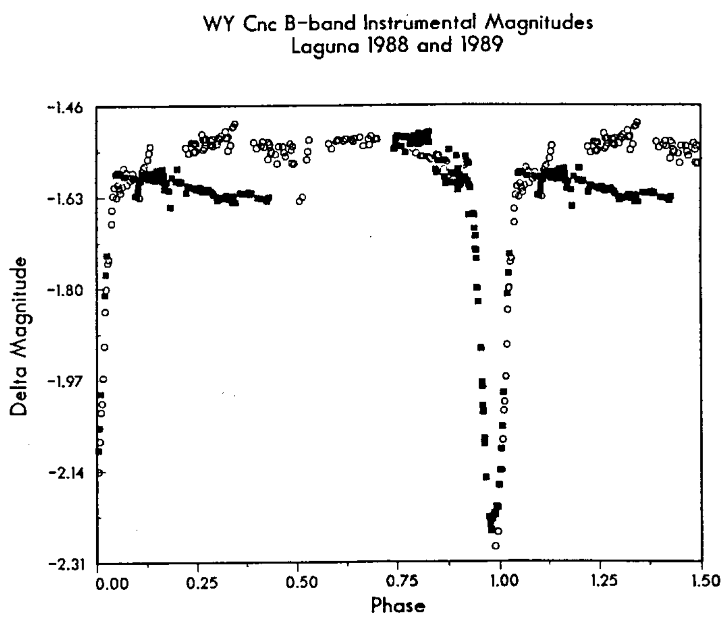

Figure 1

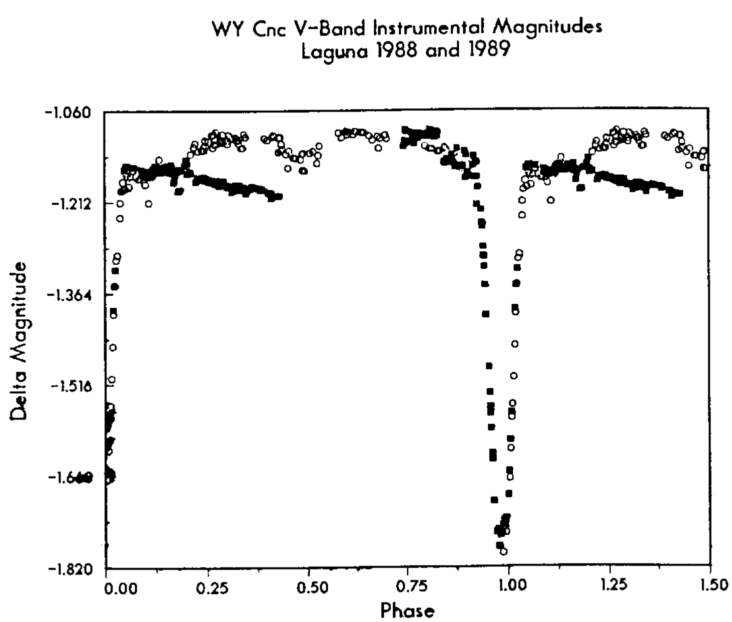

Figure 2

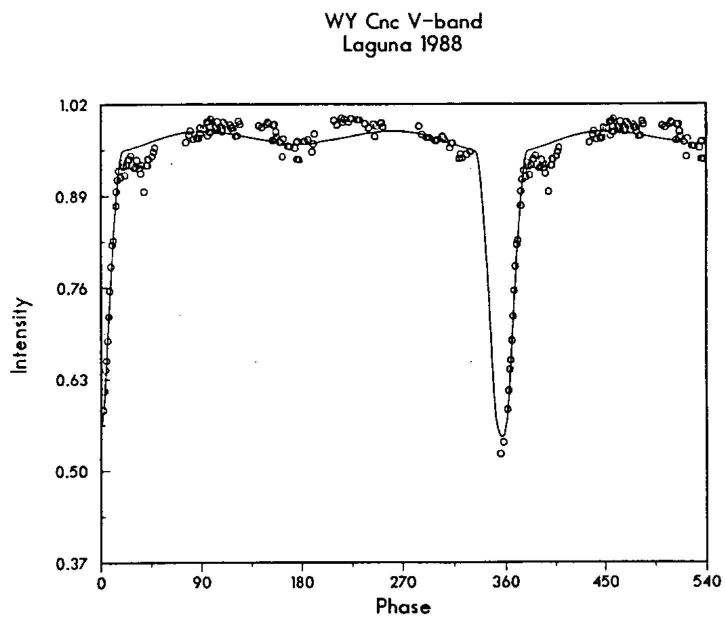

Figure 3

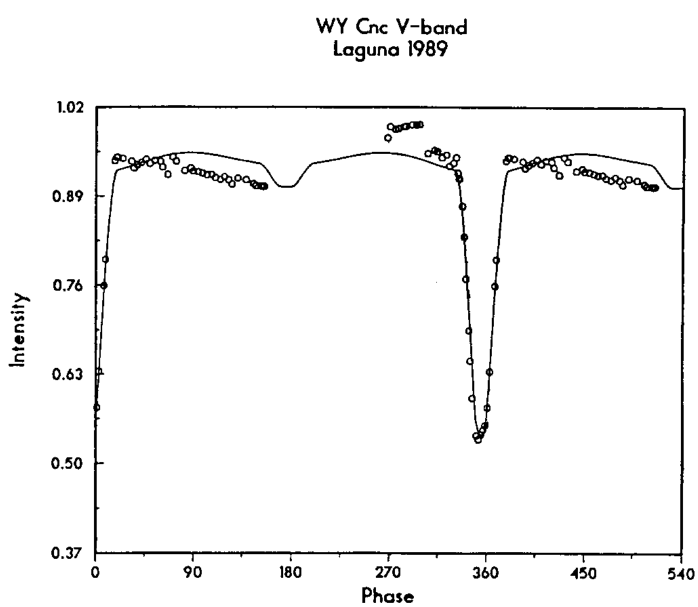

Figure 4

intensity units. Though the 1989 data are sparser than 1988, we still were able to extract a distortion wave. We then calculated optimized solutions for a black (T = 0 K), circular spotted region to account for the maculation effects. The results were:

	1988 V-band	1988 B-band	1989 V-band	1989 B-band
Longitude	36.2° ± 4.0°	35.7° ± 4.8°	115.7° ± 3.4°	105° ± 2°
Latitude	0°	0°	0°	0°
Radius	8.0° ± 0.3°	6.9° ± 0.4°	12.5° ± 0.4°	13.3° ± 0.7°

We were not able to find determinate solutions for the latitude; however, the χ^2-minimized values indicate a low latitude for the spotted regions. So we set the latitude equal to 0° for each fit. We note that, despite the incomplete light curve in 1989, we were still able to extract most of the distortion wave and generate a good fit. We can compare the spot parameters derived here to those of Zeilik et al. (1989), who completed a light curve at V-band. Their 1989 data results in a longitude of 107.7° ± 2.6° and a radius of 11.7° ± 2.4°; within the formal errors, the parameters are the same. The active region has migrated about 80° and increased in area a little more than a factor of 2 from 1988 to 1989. The B-band observations give essentially the same results.

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A T TAURI STAR WITH STRONG [S II] EMISSION LINES

The forbidden lines are important in T Tauri stars because they probe the outer parts of the stellar wind and they also give indirect evidence for the presence of disks around the star.

We have secured spectra in the vicinity of NGC 7000 (the North America Nebula) and IC 5070 (the Pelican Nebula), as part of a multifrequency study of young pre-main sequence stars in star forming regions. The spectroscopic observations have been carried out from August 24 to 27, 1989 with the CARELEC spectrograph (plus an RCA CCD detector) attached to the 1.93 m telescope of the Haute-Provence Observatory. The dispersion was 260 Å/mm in the $\lambda\lambda$ 3700-7500 Å range. The 3".2 width slit led to a spectral resolution of about 8 Å. For details of the reduction techniques and spectral classification scheme *cf.* Mendoza *et al.* (1990). We report herein only the spectrum of *LkHα 155* (in the Pelican Nebula).

This spectrum (spectral type K3, approximately) shows strong hydrogen lines (W(Hα) =98.8 Åand W(Hβ) = 36.7 Å) and forbidden lines. He I ($\lambda\lambda$ 5876 and 7065 Å), [O II] (λ 3727-9 Å) and Na I (D) are present. The TiO bands are weak. Fe II(λ 4924 Å) is most likely absent and Fe II (λ 5018 Å)is very weak, if any. The telluric bands ($\lambda\lambda$ 6277, 6872 and 7192-7272 Å) are present; the O I line (λ 5577 Å) is present. The most outstanding spectral feature are the [S II] (λ 6717 plus λ 6731 Å) emission lines (W([S II]) = 16.7). The Balmer emission lines, Fe II (42) and the [S II]-doublet do not display clear evidence of P-Cygni profiles (see Fig. 1).

There is no H_2O Maser known nearby to LkHα 155 (see Cesaroni *et al.*, 1988). However, there exists an IRAS source close to this object ($\simeq$ 1' N), 20496+4354; however, LkHα 155 lies outside of the uncertainty ellipse of this IRAS point sosurce. Under the assumption that LkHα 155 is embedded in this IRAS source, then the luminosity, derived from the infrared fluxes is around 74 $L_\odot$. A value higher than typical bolometric luminosities of classical T Tauri stars (Imhoff and Mendoza, 1974).

LkHα 155 deserves further study, in particular CCD imaging in U, B, V, Hα and [S II] will decide about the T Tauri star and the infrared source. To have a good model of this object it is necessary to acquire high spectral resolution for both the forbidden and the hydrogen lines.

One of us (E.M.) wishes to thank to DGICYT of the Education and Science Ministry (Spain) which has made possible his stay at the Instituto de Astrofisica de Andalucia.

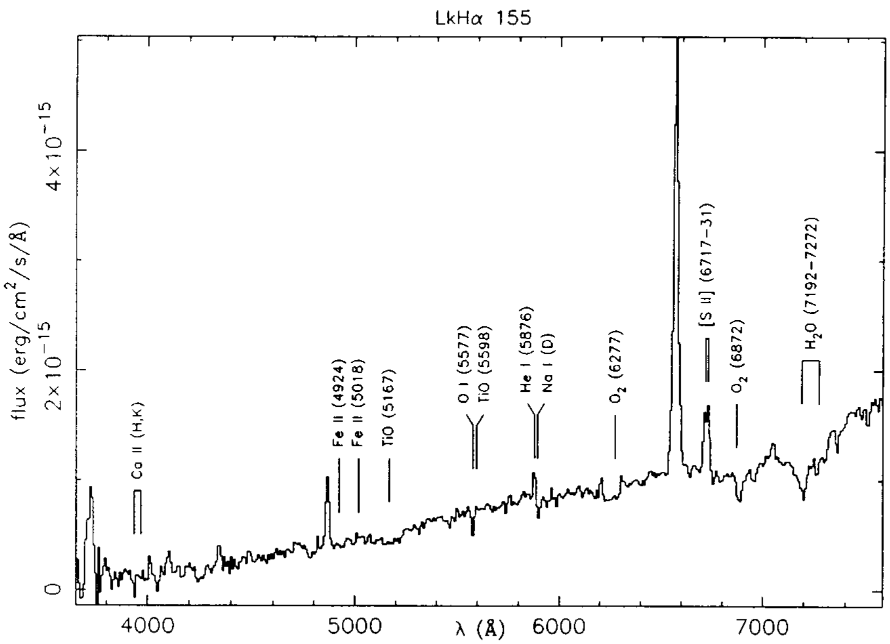

Fig. 1.- The spectrum of LkHα 155

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V1129 Cyg IS NOT AN OPTICAL COUNTERPART OF IRC+30374=AFGL 2417

In the AFGL infrared survey (Price and Walker, 1976) the source AFGL 2417 = IRC+30374 is, erroneously as shown below, identified with the Mira star V1129 Cyg. On the other hand, in the New Catalogue of Suspected Variables (NSV) the infrared source IRC+30374 is designated by a number 12165 according to the correct idea, that V1129 Cyg is not its optical counterpart (Kukarkin et al., 1982). Nevertheless, the misidentification has been repeated in several papers as well as in the Catalog of Infrared Observations (Schmitz et al., 1987).

Trying to stop such a confusion we present observational data obtained with the Baldone Schmidt telescope giving evidence that the star V1129 Cyg and the infrared source IRC+30374=AFGL 2417 are different objects.

1. On the Kodak IN infrared spectral plate taken 1986 Sept 13/14 nearly 20 arcsec SSW off the position of variable star 112.1906 (=V1129 Cyg) shown on finding chart in the paper of Wachmann (1964) is seen a spectrum of a red star with absorption features characteristic for spectral type M. Nearly 5 arcmin to the east there is another very red object (Fig.1) the spectrum of which has features typical for carbon stars. Evidently, the last one corresponds to the infrared source IRC+30374, because IRC+30374 is classified by Vogt (1973) as a carbon star. Besides, Altamore et al. (1980) identified IRC+30374 with the star No.2754 of the General Catalogue of Cool Carbon Stars (Stephenson, 1973).

2. Equatorial coordinates of both objects marked in Fig. 1 we determined from direct infrared Kodak IN plate:

V1129 Cyg	$19^h29^m50^s.2$:	$+27^\circ51'54''.8$	(1900.0)
"	19 31 51.1	+27 58 21.8	(1950.0)
IRC+30374	19 30 7.9	+27 51 4.5	(1900.0)
"	19 32 9.0	+27 57 32.6	(1950.0)

The necessary reductions were performed by the Turner method using seven stars from AGK 3 catalogue. The rms scatter of each coordinate is not greater than $0''.7$.

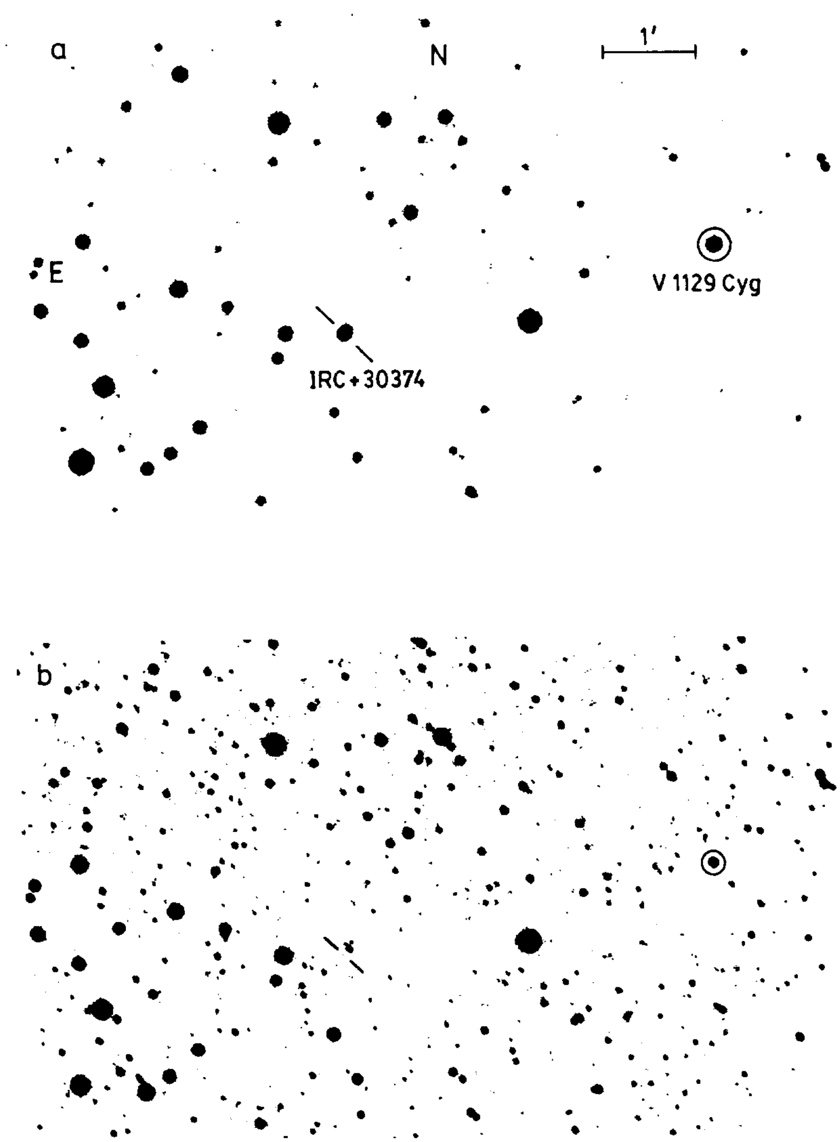

Figure 1. Finding charts of V1129 Cyg and IRC+30374 = NSV 12165 in a) infrared and b) visual light from the negatives taken with the Baldone Schmidt telescope. On the V chart the object IRC+30374 is seen ∿0.1 arcmin SE from a much brighter star.

The above position of V1129 Cyg is in a good agreement with the coordinates of the star given in the GCVS. In the case of IRC+30374 the difference between the above position and those given in IRC and AFGL are larger, but does not exceed one arcmin. The disagreement with the coordinates of No.2754 in GCCCS (Stephenson, 1974) is larger - 1.5 arcmin, which might be attributed to lower precision of the coordinates in the GCCCS. In any case we could not find another sufficiently red star near the position of IRC +30374.

3. From the brightness estimates of these two objects on a dozen of direct infrared plates and from published data on infrared photometry we can judge that the star of spectral type M is a long-period variable with a cycle length similar to that noted in the GCVS for V1129 Cyg but the other - carbon star - is a variable with a cycle length of about 430 days.

Thus, V1129 Cyg is a Mira star of spectral type M and NSV 12165 = IRC +30374=AFGL 2417 a long-period variable carbon star. NSV 12165 is also identified with the IRAS point source 19321+2757 and classified from IRAS Low Resolution Spectra as 43 or 30 like some other dust-enshrouded carbon stars (Cheeseman et al., 1989).

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A LIGHT CURVE FOR HD 46282 = V683 MON

Originally intended as a comparison star for the Be star HD 46380, HD 46282 was discovered to be unusable for that purpose due to its own variability. This author has found the system to be an eclipsing binary of Algol type with partial eclipses. Rufener & Bartholdi (1982) noted two V magnitudes differing by 0.40 which suggested variability. HD 46282 was assigned the designation V683 Mon in the 69th Name-list of Variable Stars (Kholopov et al., 1989), evidently on the strength of a statement by Halbedel (1986) in a paper on HD 46380. Previously published spectral types all appear to derive from the HD catalog type of B9. No emission has ever been reported for HD 46282.

Photometry for HD 46282 was gathered in diverse photometric systems and with different instruments. BV differential photometry was obtained primarily with the Corralitos Observatory 0.6-m. telescope and single channel photon-counting photometer (utilizing an EMI 9924A tube) and also with the #2 0.9-m. telescope of the Kitt Peak Observatory and its automated filter photometer and 1P21 phototube. This same Kitt Peak telescope also contributed Stromgren uvby photometry during one particular eclipse which was then transformed to BV colors. Also, eleven coudé spectra centered on Hα were obtained with the Kitt Peak coudé feed telescope and RCA2 CCD camera. This system has a resolution of 0.89 Å per two pixel line width.

Insofar as photometry was concerned, only a single comparison star was utilized: HD 46283 (V = 7.27; B-V = +0.25). Although this is not generally recommended behavior, the constancy of the HD 46282 system outside of eclipse would seem to indicate that HD 46283 is legitimately non-variable. As an indication of the accuracy of the photometry, the standard errors for comparison stars in V and B-V for other variables taken during the same nights have been found to hover around 0.015 magnitudes as a general rule. In total, 306 observations on 112 nights were obtained for HD 46282 over JD range 2446025 - 7593. The results of the photometry appear in Figure 1. HD 46282 is seen to be an Algol-type eclipsing variable with unequal minima. The preliminary ephemeris for primary minimum is as follows:

$$\text{Prim. Min.} = \text{JD } 2446755.9500 + 3.39274 * E$$

The range of primary eclipse is 0.43 V magnitudes and that of secondary eclipse, 0.33, implying a slightly later spectral type or lesser luminosity for the secondary star. The orbit would seem to be circular since there is no displacement of secondary minimum in phase. No marked asymmetries appear in either secondary or primary eclipse profiles, and the star appears to remain at constant magnitude when not in eclipse. No color changes of any significance appear to take place during either eclipse. Outside of eclipse the mean values for V and B-V appear to be 8.211 and +0.006 respectively.

Spectroscopically, HD 46282 is seen to be a double-lined spectroscopic binary in the region of Hα. Figure 2 shows a representative spectrum at non-eclipse, clearly indicating the stronger primary's contribution to Hα disturbed by a weaker secondary line. No certain features other then Hα are visible. There seems no a priori reason to object to the HD assigned spectral type of B9. The eleven spectra obtained reveal the expected displacements of the two lines during the orbital period. Figure 3 gives a somewhat unconventional representation of the radial velocity variation of the star. The ordinate ("Difference") displays the difference in arbitrary units measured between the centers of the primary and secondary line profiles on the

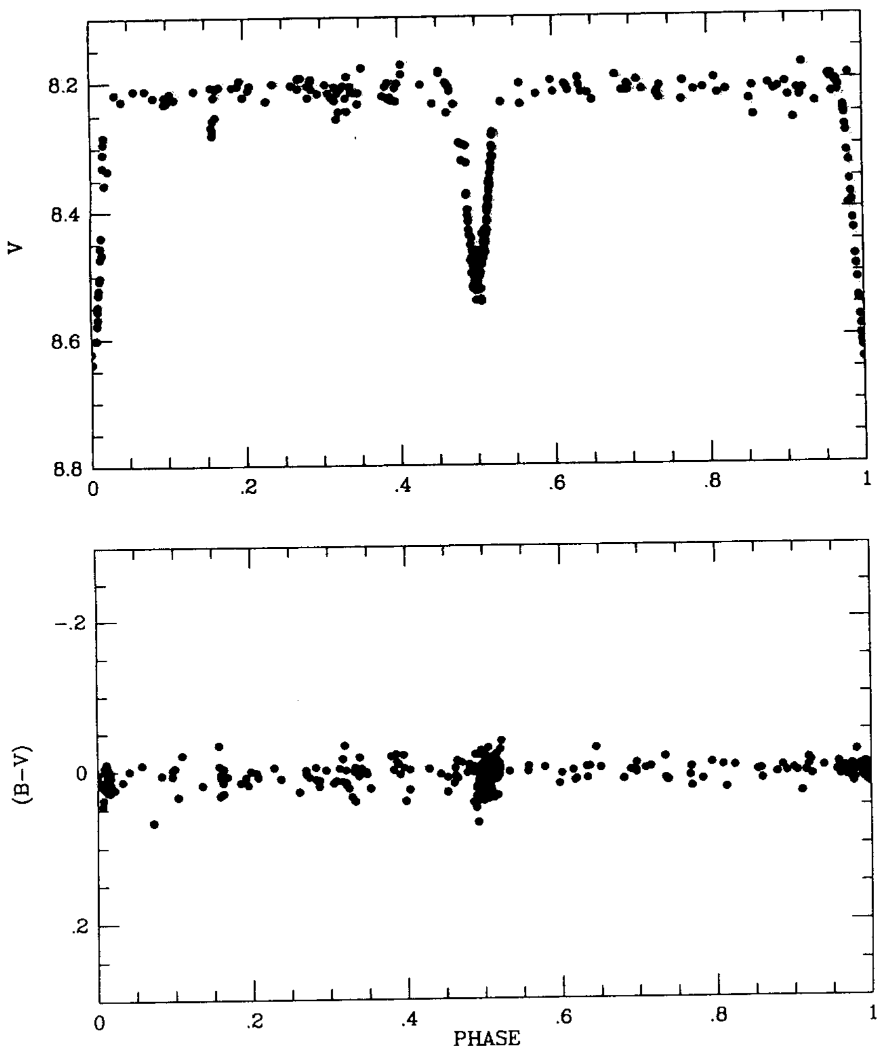

FIGURE 1: V and B-V Light Curves for HD 46282 = V683 Mon.

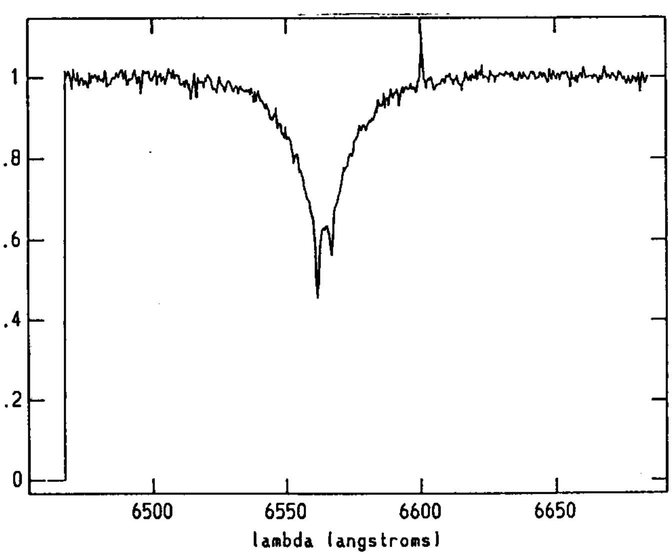

FIGURE 2: Non-eclipse spectrum of HD 46282 centered on Hα. The peak at approximately 6600 Å is a noise spike.

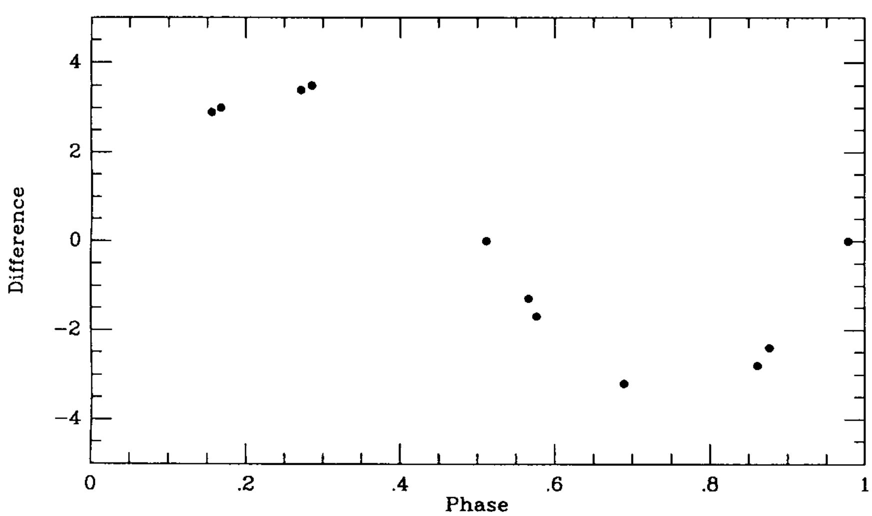

FIGURE 3: Graphic representation of the velocity variation of HD 46282. Explanation of the ordinate is in the text.

reduced spectra with the primary to shortward counting as positive. This serves to show that the displacements fit the period obtained from the light curve rather well.

Insofar as the secondary star contributes an Hα line profile only slightly less intense than the primary and photometrically is marginally less luminous, it would seem likely that it is an early main-sequence A-type star.

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THE NATURE OF THE VARIABILITY OF HD 177559

While engaged in a photometric monitoring program of Be stars, it was soon noted by the author that one of the comparison stars used (HD 177559) was in itself a variable star (Halbedel, 1986). A literature search soon revealed that variability for the star had been previously suggested. HD 177559 is listed as BV 888 (Strohmeier, 1967) with a range in the photographic of 0.4 magnitudes. Also, it is NSV 11722 in the CATALOGUE OF SUSPECTED VARIABLE STARS (Kholopov, 1982) with a smaller range of 0.2 V magnitudes, information probably derived from Kilkenny & Hill (1975). The star's variability in radial velocity has long been known. Neubauer (1943) found a range of 200 km/sec from six plates and remarked that the lines were wide and shallow. Spectral types for the star range from B2/3 V(n) (Houk & Smith-Moore, 1988) to B5 I (Abt & Biggs, 1972) to B6 Vn (Hill et al., 1975). No emission has ever been noted in the spectrum.

Consequently, HD 177559 was determined to be sufficiently interesting to observe on its own merit. 382 BV observations on 21 nights over HJD range 2446313 - 7839 were made with the Corralitos Observatory 0.6-m. telescope and single channel photon-counting photometer which utilizes an EMI 9924A photomultiplier tube. The comparison stars used were HD 177290 (V = 8.33; B-V = +.18) and HD 177423 (V = 7.977; B-V = -.009). The average standard errors in V for the standard stars were 0.020 and 0.019 in B-V, not unreasonable for observations of southerly stars generally observed by necessity at high air masses.

It soon became evident that HD 177559 was an eclipsing variable of reasonably short period. Figure 1 shows that both minima are of approximately the same depth and that there is little or no color change throughout the orbital cycle. The preliminary elements found are:

$$\mathrm{Min} = \mathrm{HJD}\ 2447794.66258 + 0.7148 * E$$

Both stars are probably nearly identical in spectral type and luminosity. The orbit is likely to be circular since there is no displacement of the minima in phase. However, there are evidently non-sphericity or reflection effects since the minimum placed arbitrarily at phase 0.5 is definitely asymmetric. Unfortunately, few observations of the maxima were obtained. Therefore, the range in variability was tentatively assigned to be 0.6 V magnitudes for both minima.

The short period and relative brightness of the star as well as its large ranges in optical and radial velocity variations would seem to suggest that HD 177559 would be a profitable system to study both photometrically and spectroscopically in the future.

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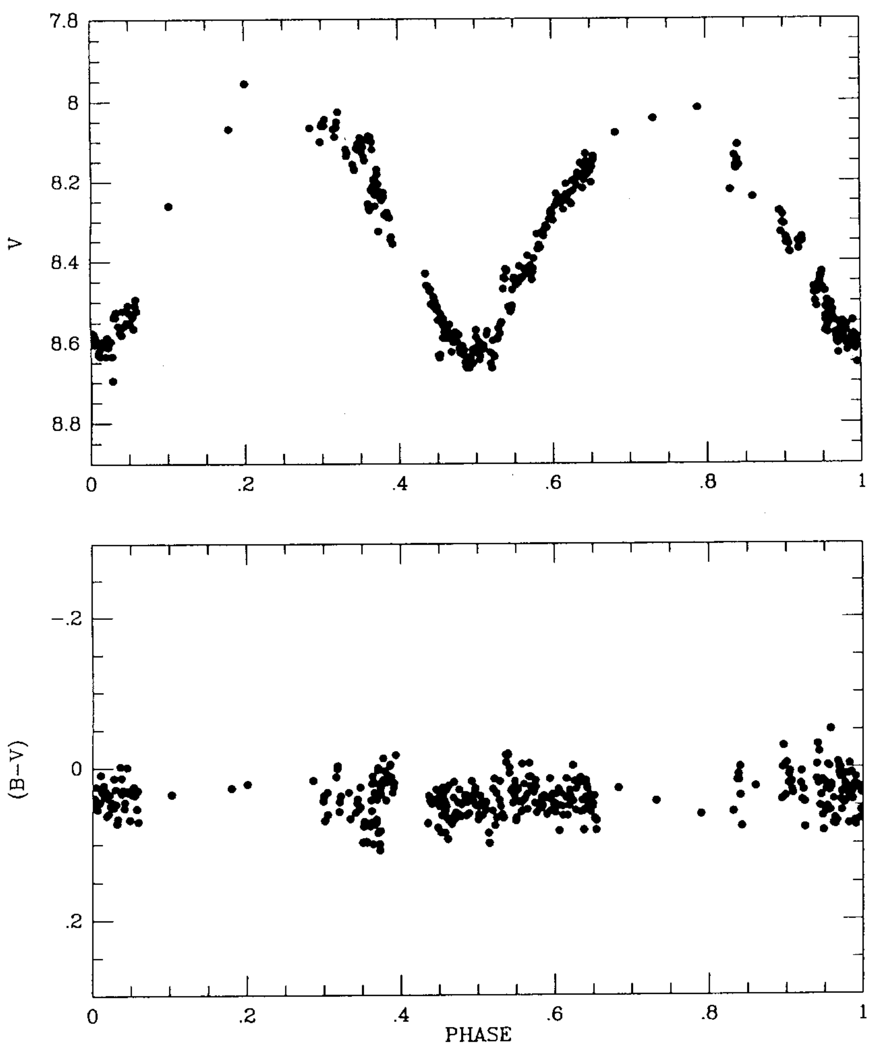

FIGURE 1: V and B-V Light Curves for HD 177559.

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NEW PERIOD OF CT TAURI

The eclipsing system CT Tau containing stars of B2 spectral type belongs to the small group of contact binaries with hot components. This unusual system has not been analysed in detail yet, so we decided to observe it.

The observations in B and V Johnson passbands were made on the 0.6 m telescope at Mt. Suhora Astronomical Observatory. We used the double beam photometer donated by ESO thanks to initiative of Prof. E.H. Geyer. This photometer was described by Szymański and Udalski (1989).

We obtained BV light curves during two consecutive nights 25/26 and 26/27 January 1989. In observing runs BD+26°917 was used as the comparison star. The integration times in both filters were fixed at 20 seconds.

During the final reduction we found that the present observations could not be phased with the period P = $0^d.6668303$ determined in 1983 and given in GCVS. So, we have examined the data with the Kwee method to determine the times of minima and the new orbital period. The times of minima calculated from B and V light curves are slightly different.
For B we obtained:

minI = HJD 2447553.5486 $\pm$ 0.0004
minII = HJD 2447552.5462 $\pm$ 0.0003

and for V:

minI = HJD 2447553.5443 $\pm$ 0.0004
minII = HJD 2447552.5432 $\pm$ 0.0008

These differences are caused by small asymmetry of eclipse profiles. To calculate the new orbital period the mean times of minima were used. We obtained the following linear ephemeris:

$$\text{minI} = \text{HJD } 2447553.5464 + 0^d.6678537 * E$$

The observations phased with the new ephemeris are presented in Figure 1. Our result was strongly confirmed by Kałużny (1989) who found minI =

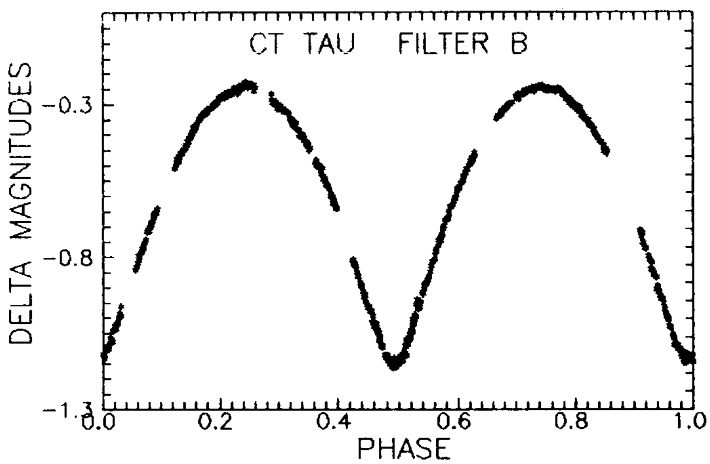

Figure 1. The observations of CT Tau in B filter phased with the new ephemeris

HJD 2447507.4622 in December 1988. So, we can conclude that the period of CT Tau has increased by 1.47 minutes during the last six years. This indicates that the rate of period change $\dot{P} = 4.76 \times 10^{-7}$.

This work was carried out under the Polish Research Program RPBR I-11.

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IAU ARCHIVES OF UNPUBLISHED OBSERVATIONS OF VARIABLE STARS: ELECTRONIC STORAGE AND RETRIEVAL OF DATA

New data can now be submitted to the IAU Archives electronically by means of tape, diskette or electronic mail. Copies of certain files already existing in the the Archives can also be sent to astronomers in electronic form.

1. Introduction

The Archives of Unpublished Observations of Variable Stars was created to provide permanent archives in different parts of the world. The Archives can replace lengthy and expensive tables in scientific publications by a single reference to the archival file number. Furthermore, many valuable observations are never used for scientific publications, and the Archives makes such observations available to other astronomers at a time when they might become very important. Information on existing files can be found in the *Publ. Astron. Soc. Pacific* (e.g. Breger 1988) and *Bull. Inform. CDS* (e.g. Jaschek and Breger 1988). Paper copies of existing files can be obtained from one of the three archives:

Dr. P. Dubois
Centre de Données Stellaires
Observatoire de Strasbourg
11, rue de l'Université
F-67000 Strasbourg
France

P. D. Hingley, Librarian
Royal Astronomical Society
Burlington House
London, W1V 0NL
Great Britain

Dr. Yu. S. Romanov
Odessa Astronomical Observatory
Shevchenko Park
Odessa 270014, USSR

New files can be submitted by mailing five copies of the cover sheet (listing a reference to a published paper or details of the data) as well as three paper copies of the data to the coordinator (Michel Breger at the address given at the end of this announcement).

2. How to submit new files by electronic means.

Astronomers wishing to submit new files electronically should contact the coordinator in order to obtain a file number. After the file number has been received, the astronomer can submit the contents of the cover sheet as well as the data to the Centre de Données Stellaires by magnetic tape, diskette or electronic mail. The Centre requests that a copy of the data should also be sent to the Centre in paper form. Information on how to communicate with the Centre is given below.

The Centre de Données Stellaires will mail paper copies of both the cover sheet and the data to the other two branches of the Archives in Great Britain and USSR as well as the coordinator.

3. How to obtain copies of existing files electronically.

Copies of some existing files can be obtained electronically free of charge by contacting the Centre de Données Stellaires (see below). Lists of the available files in the Archives are announced regularly (*IBVS, Bull. Inform. CDS*) and detailed reports on the file contents are published in the *Publ. Astron. Soc. Pacific.* In the future these lists will contain information on which files are also available by electronic means.

Copies of all existing files can, of course, still be requested in paper form from the three archives.

4. How to communicate with the Centre de Données Stellaires.

Data can be submitted to the Centre on paper as well as in machine-readable form. The following specifications should be observed:

Files: pure ASCII,

Text processor file: None or standard Latex only,

Magnetic tape: Nolabel. A description of the tape should be provided (number of files, block size, LRECL, content etc.),

Diskette: MS/DOS format only, 5¼ inch: densities 360K or 1.2M, 3½ inch: density 720K only,

Electronic Mail: SPAN CDSXB1::IAU27.

Furthermore, a paper copy of the cover sheet and the data should also be provided to the Centre de Données Stellaires in order to check the electronic file received for possible problems of truncation, character transformations etc.

Michel Breger (1), Carlos Jaschek (2), Pascal Dubois (2)

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PHOTOELECTRIC MINIMA OF ECLIPSING BINARIES

The following table gives the photoelectric minima obtained in the years 1987 - 1989 at the N. Copernicus Observatory and Planetarium in Brno (Czechoslovakia) by means of the Nasmyth type 40-cm telescope.

Measurements are made in the UBV-system, but as the signal-to-noise ratio in the U-range is not sufficient, we use the reduced BV-system.

Table I gives the type of filter, the heliocentric times of minima, different values of O-C, and abbreviations of the observer's name.

These abbreviations are as follows:

DH : Dalibor Hanžl

PS : Petr Svoboda

TH : Tomáš Hudeček

PP : Petr Pravec

Data for calculating the O-C residuals are taken from the following literature:

O-C (I) : SAC 60, Krakow 1988.

O-C (II) : GCVS, Moscow 1985 - 1987.

Moments of the secondary minima are labeled by "s". As far as the data for calculating the times of the secondary minima were not found in the literature, we use the phase 0.5 for calculating the O-C of the secondary minima (the secondary minimum is supposed to be in mid-phase between the primary ones).

In case the elements in both sources are equal, the O-C 's are also equal (this is indicated by the sign =).

Table I

Star	Filt.		Min.hel. 24...	O-C (I) [d]	O-C (II) [d]	Observer
RT And	V	s	47381.4988	-0.0012	-0.0001	DH/PS
	B	s	47381.4974	-0.0026	-0.0013	DH/PS
AB And	V		47063.3371	-0.0130	-0.0107	PS
	B		47063.3371	-0.0130	-0.0107	PS
	V		47413.4897	-0.0067	-0.0043	DH

Table I (cont.)

Star	Filt.		Min.hel. 24...	O-C (I) [d]		O-C (II) [d]	Observer
	B		47413.4903	-0.0061		-0.0037	DH
	U		47413.4903	-0.0061		-0.0037	DH
DS And	V		47770.4524	+0.0093	=	+0.0093	DH
	B		47770.4531	+0.0099	=	+0.0099	DH
OO Aql	V		47061.3846	-0.0002	=	-0.0002	PS/PP
	B		47061.3853	-0.0005	=	-0.0005	PS/PP
ST Aqr	V		47819.3133	-0.0112	=	-0.0112	DH
	B		47819.3119	-0.0126	=	-0.0126	DH
RX Ari	V		47780.5104	-0.0395		-0.0114	DH/PS
	B		47780.5111	-0.0388		-0.0107	DH/PS
SS Ari	V		47512.3685	-0.0013		-0.0748	DH
	B		47512.3664	-0.0034		-0.0769	DH
TY Boo	V		47687.4503	+0.0084		+0.0436	DH
	B		47687.4509	+0.0090		+0.0442	DH
i Boo	V		46916.4221	-0.0008		+0.0904	PS
	B		46916.4207	-0.0006		+0.0182	PS
	U		46916.4165	-0.0048		+0.0140	PS
PV Cas	V	s	47760.5309	+0.0099		-0.0203	DH
	B	s	47760.5323	+0.0113		-0.0189	DH
GS Cep	V		47414.4346	-0.0149	=	-0.0149	DH
	B		47414.4346	-0.0149	=	-0.0149	DH
	U		47414.4359	-0.0137	=	-0.0137	DH
	V		47776.4546	-0.0639	=	-0.0639	DH
	B		47776.4539	-0.0646	=	-0.0646	DH
V787 Cyg	V		47862.2934	-0.0018	=	-0.0018	DH
	B		47862.3029	+0.0077	=	+0.0077	DH
	U		47862.3002	+0.0050	=	+0.0050	DH
DM Del	V		47791.3634	-0.0249		-0.0401	DH
	B		47791.3648	-0.0236		-0.0387	DH
BV Dra	V		47398.4240	-0.0270		-0.0135	DH
	B		47398.4254	-0.0256		-0.0121	DH
TW Dra	V		47782.4061	-0.0242		+0.0168	DH
	B		47782.4068	-0.0235		+0.0175	DH
u Her	V		47611.5207	+0.0171	=	+0.0171	DH
	B		47611.5166	+0.0130	=	+0.0130	DH
V839 Oph	V		47006.4936	+0.0372		+0.0456	PS
	B		47006.4929	+0.0365		+0.0449	PS
	V		47062.3199	+0.0416		+0.0437	PS/DH
KW Per	V		47415.4417	+0.0106		+0.0059	DH
	B		47415.4410	+0.0099		+0.0052	DH
	U		47415.4410	+0.0099		+0.0052	DH
GR Tau	V		47827.5148	-0.0162		-0.0055	DH
	B		47827.5134	-0.0176		-0.0069	DH
	V		47849.4363	-0.0172		-0.0066	DH/TH
	B		47849.4363	-0.0172		-0.0066	DH/TH
	V	s	47856.5454	-0.0104		-0.0021	DH/TH
	V	s	47862.5502	-0.0139		-0.0032	DH
	V		47889.4089	-0.0209		-0.0102	DH
	B		47889.4069	-0.0229		-0.0112	DH
RW Tau	V		47525.4486	-0.0103		-0.0311	DH
	B		47525.4486	-0.0103		-0.0311	DH
W UMa	V		46852.3907	-0.0048		-0.0051	PS
FR Vul	V		47713.4343	-0.0083		-0.0091	DH

Remarks:

GR Tau:

In 1989 we gained the complete light curve which, however, has not been treated yet. The first measurement showed that the information given in SAC 60, D = $1\overset{h}{.}4$, might be incorrect (the light curve combined of six nights is shown in Figure 1).

GS Cep:

Elements given in SAC 60 and GCVS are probably incorrect. Some of the forecasted minima do not appear at all. This fact was found out in 1988 when the star was measured very often. We succeeded in gaining two minima only (both are given in Table I). The star is included in the Brno programme of visual observation of the eclipsing binaries but the measured fall in the range V (0.46 mag), B (0.48 mag) and U (0.47 mag) shows the inconvenience of this star for such observation.

The main features of our measurement survey for this star are summarized in Table II.

Table II

measurement begin 2447..	measurement end 2447..	forecasted minimum 2447..	remarks
387.385	387.597	387.4295	No minimum appeared, constant brightness.
388.364	388.599	(388.202)	Constant brightness.
391.378	391.597	(391.290)	Constant brightness.
392.381	392.599	(392.062)	A part of rising branch at the beginning of measurement, then constant.
393.384	393.531	(393.606)	Constant brightness.
398.504	398.538	(398.236)	Constant brightness.
401.368	401.424	(401.326)	Constant brightness.
405.519	405.563	(405.186)	Constant brightness.
413.394	413.416	(413.678)	Constant brightness.
414.382	414.535	414.449	Minimum appeared - see the table I.
431.316	431.391	(431.434)	Constant brightness.
432.404	432.436	(432.206)	Constant brightness.
439.458	439.496	(439.154)	A part of rising branch (uncertain measurement because of bad wheather).
451.263	451.440	(451.507)	Constant brightness.
485.384	485.444	(485.474)	Constant brightness.
716.441	716.572	(716.302)	Falling branch.
729.359	729.453	729.426	Rising branch (a part).
770.288	770.328	(770.343)	Constant brightness.
776.386	776.538	776.519	Minimum appeared - see the table I.

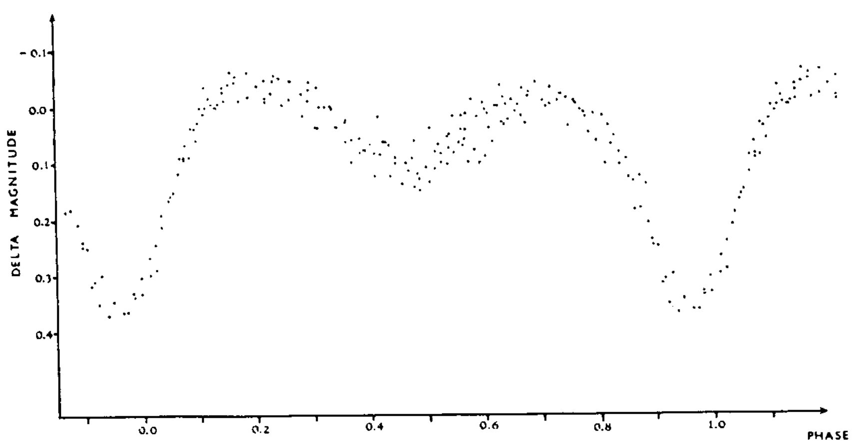

Figure 1. GR Tau , V-range , BRNO 1989 (M0=44982.334 ; P=0.429853)

The forecasted minima which are not included in the interval of measurements are given in brackets. Up to the present time the obtained data have not been published anywhere. They may be obtained directly at the Brno observatory.

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RAPID SHELL LINE VARIATIONS IN THE Be STAR ω Ori

The Be star ω Ori (HD 37490, according to Slettebak, 1982: B2 IIIe, v sin i = 160 km/sec), has a long history of irregular variability in Balmer line emissions (Dachs et al., 1977, 1981; Slettebak and Reynolds, 1978; Hubert-Delplace and Hubert, 1979; Andrillat and Fehrenbach, 1982). In the framework of our interest in short-period variability of Be stars, we performed 36 spectroscopic Reticon observations of this object during two nights (Dec. 11 and Dec. 12, 1986), using a B and C mod. 31523 grating spectrograph combined with the 182 cm telescope of the Osservatorio Astronomico di Asiago. We chose a spectral range including Hα and the HeI 6678 A line, and an inverse dispersion of about 18 A/mm.

In Hα the shell components covered the photospheric one, while only two faint emission features affected the HeI line wings. Anyway, both in Hα and in HeI line, the shell profiles showed unequivocal variations during our observational period. Figure 1 and Figure 2 represent the evolution of Hα and HeI line profiles respectively during our second observation night (for reasons of graphic clearness, we include in these pictures only 10 spectrograms out of 23). The behaviour of some line parameters is also shown in Table I (the wavelength difference between emission component and shell absorption, with the respective equivalent widths, for Hα : the absorption equivalent width and the V/R ratio of the emission features for the HeI line). Typical error bars are about 0.015 A for $\lambda_e - \lambda_a$, 0.05 A for $E.W._e$ (Hα), 0.025 A for $E.W._a$ (Hα), 0.015 A for $E.W._a$ (HeI) and 0.08 for V/R: all the detected variations have to be considered real. Moreover, all the patterns shown in Table I are consistent with the probable 1^d photometric period proposed by Balona et al. (1987).

The detection of possible rapid shell variations in Be stars is not a novelty: we can consider, for instance, the case of ζ Tau (Bossi et al., 1987). Nevertheless, our good signal-to-noise ratio allows us, perhaps for

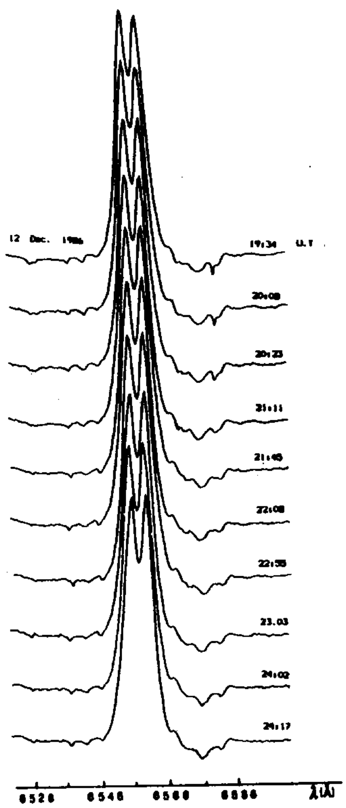

Figure 1

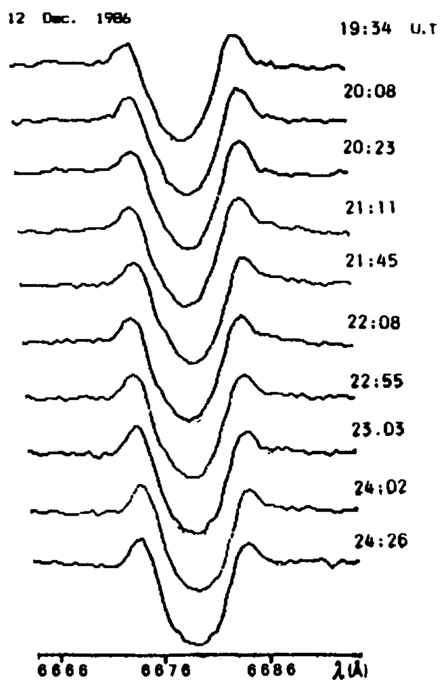

Figure 2

the first time, to be sure about the reality of this phenomenon. The time scales of this kind of variability are consistent with the hypothesis of high order pulsations only. On the other hand, if we consider again ζ Tau, only high order shell pulsations can explain the Hα profiles shown by Hanuschik et al. (1988).

Table I

JD 2440000+	H_α λ_e-λ_a (Å)	EW_e (Å)	EW_a (Å)	He I 6678 EW_a (Å)	V/R
6776.4227	0.009	9.963	1.621	0.724	1.07
6776.4331	0.000	9.983	1.631	0.675	0.86
6776.4387	0.004	9.925	1.632	0.670	0.91
6776.4491	0.004	9.992	1.622	0.674	1.01
6776.4553	-0.003	9.994	1.603	0.690	0.83
6776.4651	-0.004	9.973	1.572	0.643	0.86
6776.4713	-0.003	9.951	1.579	0.661	0.83
6776.4984	0.002	10.021	1.591	0.647	0.97
6776.5081	0.001	10.065	1.621	0.645	0.92
6776.5144	0.002	10.047	1.600	0.645	0.79
6776.5248	0.005	10.029	1.642	0.719	0.78
6776.5303	0.005	10.013	1.631	0.672	1.24
6776.5408	0.000	10.048	1.665	0.626	1.15
6777.3102	-0.029	9.906	1.748	0.539	0.61
6777.3206	-0.032	9.929	1.739	0.515	0.75
6777.3276	-0.030	9.954	1.719	0.514	0.70
6777.3380	-0.028	9.918	1.743	0.537	0.73
6777.3442	-0.029	9.946	1.769	0.530	0.61
6777.3546	-0.022	9.965	1.764	0.517	0.82
6777.3616	-0.017	9.979	1.762	0.517	0.67
6777.3720	-0.018	9.964	1.765	0.508	0.62
6777.3776	-0.017	9.973	1.774	0.515	0.68
6777.3880	-0.014	9.988	1.763	0.526	0.72
6777.4116	-0.006	9.967	1.757	0.580	0.79
6777.4220	-0.005	9.997	1.771	0.585	0.81
6777.4276	-0.006	10.020	1.784	0.600	0.85
6777.4380	-0.003	10.021	1.766	0.599	0.88
6777.4498	-0.002	10.046	1.772	0.644	0.88
6777.4602	0.001	10.086	1.822	0.638	1.08
6777.4658	-0.003	10.088	1.814	0.664	1.00
6777.4762	0.005	10.100	1.811	0.646	0.91
6777.4824	0.010	10.135	1.825	0.700	1.04
6777.4935	0.019	10.136	1.809	0.700	1.01
6777.5067	0.021	10.174	1.847	0.688	1.08
6777.5171	0.024	10.158	1.839	0.704	1.10
6777.5234	0.027	10.178	1.859	0.755	1.12

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SS URSAE MINORIS: A NORMAL U Gem TYPE DWARF NOVA

SS Ursae Minoris was discovered as an X-ray source E1551+718 and identified then with an uncataloged dwarf nova by Mason et al. (1982). In quiescence, the star is usually around 17 magnitude, in outbursts it reaches 13 magnitude. The spectra of the star taken in quiescence (Mason *et al.* 1982) show Balmer and helium emission lines which are common for dwarf novae. The HeII 4686 emission is weak which suggests that the star does not have strong magnetic field and is typical unmagnetized dwarf nova.

All emission lines in the SS UMi spectrum are very broad (FWHM $\approx$ 2000 km/s emission superposed on FWHM $\approx$ 7000 km/s feature). Moreover, they reveal a clear, double peaked structure. Therefore, inclination of the system is probably high and one can expect presence of optical variability caused by changing visibility of the "hot spot" on accretion disk around primary component, or even eclipses.

The possibility of light variation has been strengthened to some extent by Andronov (1986). He observed SS UMi photographically and found variability in the range of 1 magnitude. Moreover, he claimed that the orbital period of the star is slightly longer than 2 hours. If so, SS UMi would be an ultra-short period dwarf nova – presumably of the SU UMa type. The suggested period would fall almost exactly at the short period boundary of the 2 – 3 hours "period gap" in the orbital period distribution of cataclysmic variables. Therefore, if this period is indeed the correct one, the star could be a very important object for study evolution of the cataclysmic binaries. The CCD photometry of SS UMi which is reported here has been performed to resolve these issues.

The CCD photometric observations of SS UMi were carried out on two nights (June 2/3 and 3/4, 1989) at the Dominion Astrophysical Observatory, Victoria. The 122-cm telescope equipped with the CCD camera and RCA CCD chip was used. The observations consisted of series consecutive, V-filter images of the SS UMi field. At least one B frame per night was also obtained to check colour of the variable and comparison stars. The exposure times were equal to 120 sec. in V and 180 sec. in B filters.

Table 1. Positions of the Comparison Stars.

Star	R.A.	Dec.
l	60"E	55"N
r	25"W	15"N
s	25"W	30"S

The images were de-biased and flat-fielded using the standard procedures within the IRAF package. All measurements were carried out with the DAOPHOT photometry package (Stetson 1987). Differential magnitudes of the variable were determined relative to star *l* on Andronov (1986) finding chart. Stars *r* and *s* served as secondary comparison stars. Positions of the comparison stars relatively to SS UMi are given in Table 1. The accuracy of individual, differential magnitude is of the order of 0.02 magnitude based on measurements of two comparison stars.

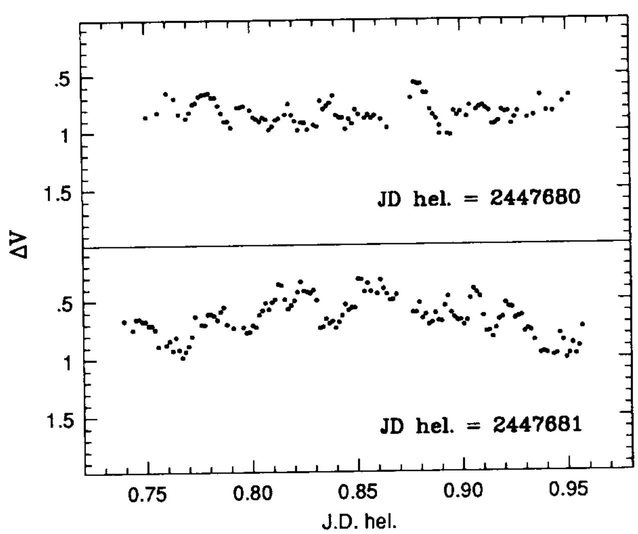

Figure 1.

Figure 1 shows the differential light curves from both runs. SS UMi was apparently at quiescence during observations at a mean brightness level of 16.6 magnitude (estimated accuracy of the zero point is about 0.2 mag). The variability has two obvious components:

a minute time-scale flickering and an hour-scale variability. The flickering activity of SS UMi seems to be very strong. Brightness increases amounting up to 0.4 magnitude and lasting several minutes are often present. The relatively large scatter of observations in some parts of the light curves is evidently caused by the short time-scale variability, smeared by the longer integration time.

The more interesting, orbital variability seems to be present as well. The hump observed during the second night looks like a typical orbital hump in dwarf novae (e.g. U Gem, Warner and Nather 1971). The large amplitude of this hump, 0.6 mag, suggests that the inclination of the system is indeed high. However, it is not high enough to cause eclipses; no evidence of eclipses can be found in our data. It is clear from Figure 1 that the orbital period must be much longer than 2 hours suggested by Andronov (1986). Unfortunately, because of short duration of the night we were not able to obtain runs longer than 5 hours. We did not catch two evident maxima or minima on any single night to establish the orbital period more precisely. We can only give its lowest limit at 5 hours.

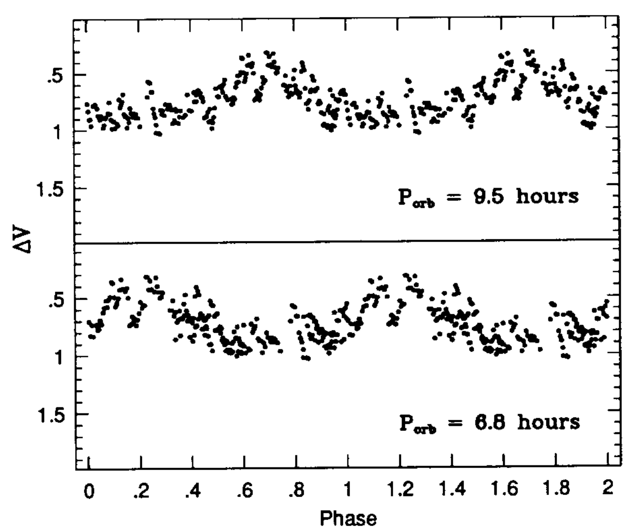

Figure 2.

However, having data from two nights, we can speculate about the value of the period. The first run evidently covered the minimum, whereas the second one the maximum of light. Assuming that the mean level of light did not change between the runs, we tried to fold the data from both nights together to get the smoothest combined light curve i.e. we applied the phase dispersion minimization method of Stellingwerf (1978). The searched periods were limited to be shorter than 12 hours, as is typical for cataclysmic variables. The periods giving best results are 9.5 hours and its 1-day alias, 6.8 hours. We prefer the second value because if the period were 9.5 hours, one could expect clear evidences of secondary in the spectrum of SS UMi. This results from the strict relation between the size and mass of secondaries and the orbital period in cataclysmic variables (Warner 1976). Examination of the red part of the spectrum (Mason *et al.* 1982) indicates that the shape of the spectrum is more consistent with the shorter 6.8 hours period. Figure 2 presents observational data folded with the periods 9.5 and 6.8 hours and repeated twice for clarity. The zero-phase moments have been chosen arbitrarily on this figure.

Summing up, SS UMi is a normal dwarf nova, probably of the U Gem type. It has a relatively high orbital inclination which is, however, insufficient for eclipses. It is not an ultra-short period system, as it was suggested by Andronov (1986). The orbital period of SS UMi is apparently longer than 5 hours, most probably equals 6.8 hours.

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FG Vir, Additional Photoelectric Observations

In a study of blue stragglers stars of old disk population, Eggen (1971), detected four additional variables that presented behaviour like δ Scuti stars. One of them was FG Vir (HD 106384) where, with one night of observation, Eggen proposed a period of $0.^d07$ and an amplitude of $0.^m05$ in V (measured peak to peak). Later on, López de Coca et al. (1984) confirmed the pulsational character of this star where, with three nights of observation, they confirmed the δ Scuti behaviour for FG Vir (they showed in their figures, for example, that the maximum light appears together with the maximum temperature). Additionally, they found, with Fourier analysis, that there existed at least one period of about $0.^d079$ that lead M_v of $1.^m73$ approximately (via P-L-C of Breger, 1979). However, they pointed out that more observations are needed, in order to find the whole period content of the star. Hence, with the aim to obtain in the future the whole periodic content of FG Vir, we present in this paper additional photoelectric observations for this δ Scuti star, although more photometric observations are considered in the near future.

FG Vir was observed on March 28, 1986 in the V Johnson's filter using the 84 cm telescope of San Pedro Mártir Observatory, Baja California, México, a refrigerated 1P21 photomultiplier was used, C_1=BD -4° 3219 and C_2=BD -5° 3487 where chosen as comparison stars, the observational sequence was C_1, V, C_2, V, C_1,... and this was followed through the whole night, with an internal average between successive observations of the variable star of 5 minutes. Each observation consisted at least of 5 integrations of 10 seconds of the star, followed by one 10-seconds integration of the sky.

Table I shows the differential photometry obtained for FG Vir minus BD -4° 3219 in the V filter, the accuracy of each observation is better than $0.^m003$, time is given in Heliocentric Julian Day, and its precision is $0.^d001$; these values are shown plotted in Figure 1

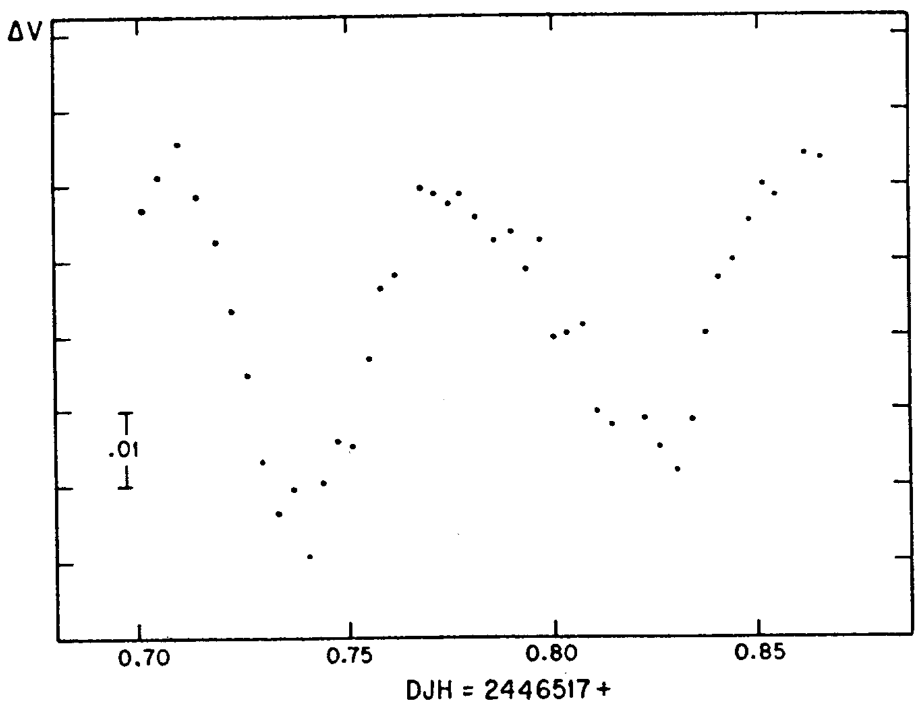

Fig. 1.- Differential photoelectric photometry for FG Vir - (BD -4° 3219)

TABLE I.- Differential photometry of FG Vir

HJD	ΔV	HJD	ΔV	HJD	ΔV
2446517. +					
0.701	-0.691	0.758	-0.681	0.810	-0.664
0.705	-0.696	0.762	-0.682	0.814	-0.662
0.710	-0.700	0.765	-0.691	0.822	-0.663
0.714	-0.693	0.768	-0.694	0.826	-0.659
0.718	-0.687	0.772	-0.693	0.830	-0.656
0.722	-0.678	0.775	-0.692	0.834	-0.663
0.726	-0.669	0.778	-0.693	0.837	-0.675
0.729	-0.658	0.782	-0.690	0.841	-0.682
0.733	-0.651	0.786	-0.687	0.844	-0.684
0.736	-0.654	0.790	-0.688	0.848	-0.690
0.740	-0.645	0.794	-0.683	0.851	-0.694
0.744	-0.655	0.797	-0.687	0.854	-0.693
0.747	-0.660	0.800	-0.674	0.857	-0.705
0.751	-0.660	0.803	-0.675	0.861	-0.698
0.755	-0.671	0.807	-0.676	0.865	-0.698

(the photometric behaviour of the comparison stars was highly constant, the sigma for the difference C_2 - C_1 was $0.^m005$). In this figure we can see that the amplitude is approximately the same than that reported by Eggen. A Fourier analysis of this data, indicate a period of $0.^d079$ in agreement with the period given by López de Coca et al. (1984).

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Period change in AD CMi

A period change of AD CMi was first reported by Jiang (1987) and, in an independent way by Rodríguez et al. (1988). Although the two calculated values $\dot{P} = 1.9(\pm 0.1) * 10^{-8}(d/yr)$ and $\dot{P} = 1.1(\pm 0.2) * 10^{-8}(d/yr)$ respectively, are slightly different, it is clear that the period is now increasing.

In order to establish the ephemeris for AD CMi we have put together all the times of maxima reported by the above mentioned authors. Furthermore, we have also considered one new light maximum from Langford (1976). Furthermore, a new set of observations was collected on February 1988, at the Sierra Nevada Observatory, in Spain, and two new times of light maximum have been obtained by using the method described in Rodríguez et al. (1989).

In column 2 of Table 1 are listed all the times of maxima available up to date. In the last column, the references are: 1) Abhyankar (1959), 2) Anderson et al. (1961), 3) Langford (1976), 4) Epstein et al. (1973), 5) Balona et al. (1983), 6) Jiang (1987), 7) Rodríguez et al. (1988) and 8) our new maxima (1988). In total, times of 37 maxima (from 1959 to 1988) were used for the determination of the ephemeris of the light curve of AD CMi using the classical O-C method. We adopted an initial epoch of $T=2436601^d.8226$ and an initial period of $P=0^d.12297431$ (from Rodríguez et al., 1988). Resulting cycles E_i are listed in the third column of the Table. A least square fit of a linear ephemeris leads to the following elements:

$$T_0 = 2436601^d.8217$$
$$P_0 = 0^d.12297447$$

Residuals $(O\text{-}C)_l$ with respect to this linear ephemeris are shown

TABLE 1. Times of maxima of AD CMi

i	T_i (HJD) 2400000. +	E_i (cycle)	$(O-C)_l$ (day)	$(O-C)_q$ (day)	Ref
1	36601.8227	0	0.0010	0.0002	1
2	36602.8066	8	0.0011	0.0003	1
3	36602.9296	9	0.0011	0.0003	1
4	36604.8971	25	0.0011	0.0002	1
5	36627.7700	211	0.0007	-0.0001	1
6	36628.7538	219	0.0007	-0.0001	1
7	36629.7373	227	0.0004	-0.0004	1
8	36629.8602	228	0.0003	-0.0004	1
9	36931.762	2683	-0.0002	-0.0004	2
10	36932.747	2691	0.0010	0.0008	2
11	36934.836	2708	-0.0005	-0.0008	2
12	36969.762	2992	0.0007	0.0005	2
13	39202.729	21150	-0.0028	-0.0002	3
14	41010.6985	35852	-0.0040	-0.0005	4
15	43182.4297	53512	-0.0020	0.0011	5
16	43536.3494	56390	-0.0029	0.0000	5
17	43536.4727	56391	-0.0025	0.0003	5
18	44645.0877	65406	-0.0024	-0.0006	6
19	45766.3713	74524	-0.0001	0.0003	7
20	45768.3377	74540	-0.0013	-0.0009	7
21	45768.4606	74541	-0.0013	-0.0009	7
22	45771.4134	74565	0.0001	0.0005	7
23	45772.3961	74573	-0.0010	-0.0006	7
24	45772.5187	74574	-0.0014	-0.0010	7
25	46417.3991	79818	0.0009	0.0002	6
26	46418.2596	79825	0.0005	-0.0001	6
27	46418.3825	79826	0.0005	-0.0002	6
28	46419.2434	79833	0.0006	-0.0001	6
29	46419.3663	79834	0.0005	-0.0002	6
30	46443.1010	80027	0.0011	0.0004	6
31	46443.2243	80028	0.0014	0.0007	6
32	46443.3470	80029	0.0012	0.0005	6
33	46444.0850	80035	0.0013	0.0006	6
34	46444.2082	80036	0.0015	0.0008	6
35	46444.3312	80037	0.0016	0.0009	6
36	47219.4395	86340	0.0018	-0.0004	8
37	47220.4228	86348	0.0013	-0.0009	8

in the fourth column of the Table, and plotted in Figure 1. From this figure it appears that a quadratic fit as

$$T_{max} = T_0 + P_0.E + A.E^2$$

and the following coefficients

$$T_0 = 2436601^d.8225(\pm 0.0002)$$

$$P_0 = 0^d.12297426(\pm 0.00000002)$$

$$A = 2^d.7 * 10^{-12}(\pm 0.2)$$

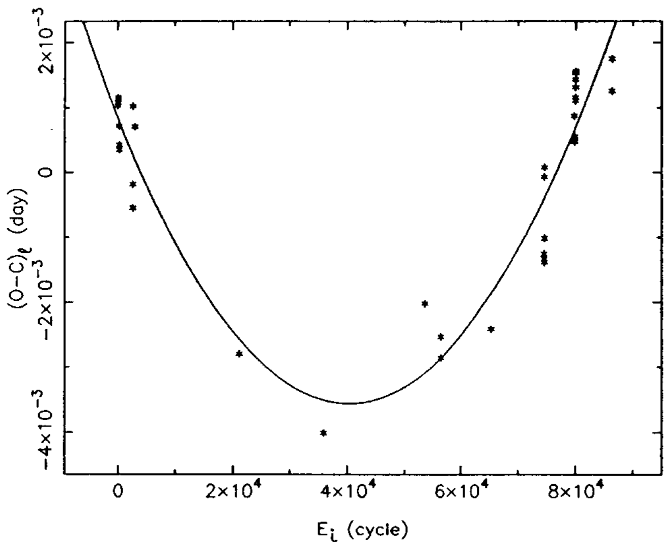

Figure 1. O-C versus epoch diagram using the linear ephemeris

fit the data much better than the linear ephemeris in according with earlier results obtained by Jiang (1987) and Rodríguez et al. (1988). Second residuals $(O\text{-}C)_q$ listed in the fifth column in the Table appear to be randomly distributed around zero showing that the residuals $(O\text{-}C)_l$ can be well fitted by a parabola, indicating that the pulsation period of this star is increasing at a rate of $\dot{P} = 1.6(\pm 0.1) \star 10^{-8}(d/yr)$.

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New times of maxima for CY Aqr, DY Peg and BL Cam[1]

CY Aqr and DY Peg are two of the most observed stars belonging to the SX Phe type stars. There are some doubts about their period variations and different interpretations can be found in the literature. In order to facilitate this interpretation new times of maxima are presented here, together with other new ones for the star BL Cam.

These new photoelectric observations were secured for CY Aqr and DY Peg in August 1986 at the Sierra Nevada Observatory in Spain, using the 75 cm telescope with simultaneous observations of uvby Strömgren filters. A new set of observations was carried out for BL Cam in October 1988 at Calar Alto Observatory in Spain using the 1.52 m telescope and, this time, a sequential uvby Strömgren filters were used and a classical cooled single-channel photometer.

TABLE 1. Times of maxima of CY Aqr, DY Peg and BL Cam.

	CY Aqr	DY Peg	BL Cam
i	T_i (HJD) 2400000. +	T_i (HJD) 2400000. +	T_i (HJD) 2400000. +
1	46648.4872	46653.4688	47439.6597
2	46648.5479	46653.5419	47440.6760
3	46648.6095	46653.6150	47441.5360
4	46649.4631	46654.4168	47441.5759
5	46649.5242	46654.4901	47442.5529
6	46649.5856	46654.5619	—
7	46650.5617	46654.6352	—
8	46650.6231	46655.6571	—
9	46651.4176	46656.4581	—
10	46652.5156	46656.5313	—
11	46652.5765	46656.6052	—
12	46652.6375	—	—

[1]Partially based on observations collected by using the 1.5 m telescope from the Observatorio Astronómico Nacional at Calar Alto Observatory, Almería, Spain

These new times of maxima have been calculated using the method described in Rodríguez et al. (1989). In total, 28 new times of maxima have been obtained for the three stars and they are listed in Table 1 in Heliocentric Julian Day.

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PHOTOELECTRIC OBSERVATIONS OF THE FLARE STAR UV Cet IN 1983

Photoelectric monitoring of the flare star UV Cet has been carried out at the Stephanion Observatory (λ=+22° 49' 44", φ=+37° 45' 15", H=800 m) during the year 1983 using the 30-inch Cassegrain reflector of the Department of Geodetic Astronomy, University of Thessaloniki. Observations were made with a Johnson dual channel photoelectric photometer in the B colour of the international UBV system. The telescope and photometer used were described elsewhere (Mavridis et al., 1982). The transformation of our instrumental ubv system to the international UBV system is given by the following equations:

$$V = v_o + 2.722 - 0.104\ (b-v)_o$$
$$B-V = 0.448 + 1.084(b-v)_o \quad .$$

The monitoring intervals in UT as well as the total monitoring time for each night are given in Table I. Any interruption of more than one minute has been noted.

During the 6.25 hours of monitoring time one flare was observed, the characteristics of which are given in Table II. In this table following characteristics (Andrews et al., 1969) are given: a) the date and universal time of flare maximum, b) the duration before and after the maximum (t_b and t_a, respectively), as well as the total duration of the flare, c) the value of the ratio $(I_f-I_o)/I_o$ corresponding to flare maximum, where I_o is the intensity deflection less sky background of the quiet star and I_f is the total intensity deflection less sky background of the star plus flare, d) the integrated intensity of the flare over its total duration, including preflares, if present, $P = \int(I_f-I_o)/I_o dt$, e) the increase of the apparent magnitude of the star at flare maximum $\Delta m(b) = 2.5 \log (I_f/I_o)$, where b is the blue magnitude of the star in the instrumental system, f) the standard deviation of random noise fluctuations $\sigma(mag) = 2.5 \log (I_o+\sigma)/I_o$ during the quiet-state phase immediately preceding the beginning of the flare, and g) the air mass at flare maximum.

The light curve of the observed flare in the b colour is shown in Figure 1.

Table I

Date 1983 October	Monitoring Intervals (UT)	Total Monitoring Time
3-4	22^h00^m - 22^h 29^m, 22^h 35^m - 22^h 44^m ,	
	22 49 - 23 06 , 23 10 - 23 39 ,	
	23 43 - 00 07 , 00 21 - 00 36 ,	
	00 43 - 01 13 , 01 16 - 01 46	3^h 03^m
4	21 49 - 22 19 , 22 24 - 22 54 ,	
	22 58 - 23 37 .	1 39
5	21 54 - 22 23 , 22 27 - 23 00 ,	
	23 05 - 23 36 .	1 33
	Total	6^h 15^m

Table II

Characteristics of the flare observed

Date 1983 Oct.	U.T. max	t_b min	t_a min	Duration min	$(I_f-I_o)/I_o$ max	P min	Δm mag	σ mag	Air mass
4	00^h $21^m.37$	≧ 1.16	7.64	≧ 8.80	3.46	≧ 5.21	1.62	0.09	1.91

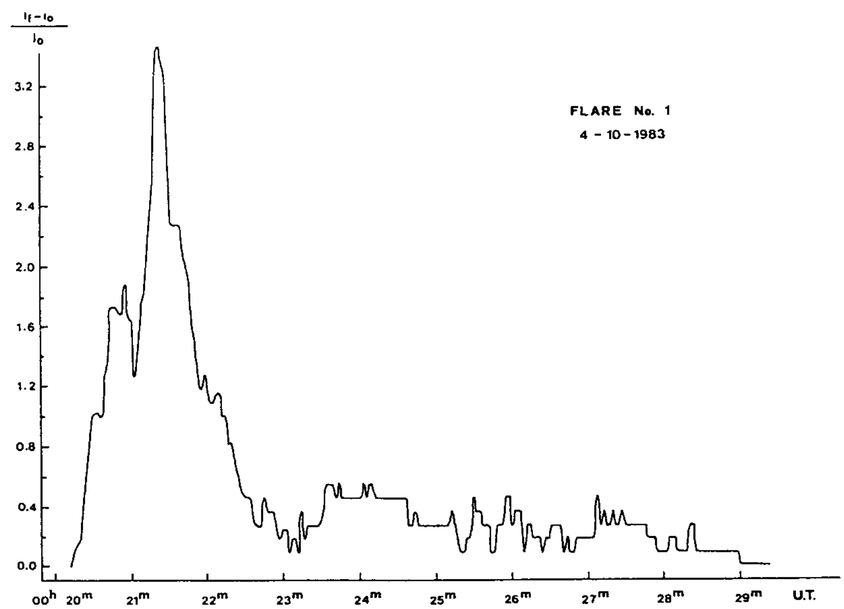

Figure 1

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The X-Ray Source 1E2119.7+1655 Is A W UMa System

From an examination of the Einstein Observatory Extended Medium Sensitivity Survey, Fleming et al. (1989) compiled a list of seven stars expected to be W UMa systems. In a continuing effort to model these systems we have observed two of these stars, 1E1654.0+3515 (Robb 1989) and 1E1806.1+6944 (Robb and Scarfe 1989). This is a preliminary report of my observations of another of the stars on the list. Its position at Right Ascension 21:19:43.8 and Declination +16:55:32 (Epoch 1950), brightness of 11.7 in the V band and spectral class of F6 were given by Fleming et al. (1989). A finder chart adapted from Papadopoulos et al. (1980) is given for this star in figure 1.

1E2119.7+1655 was observed using the 0.5 meter reflector of the Climenhaga Observatory at the University of Victoria on eighteen nights between 23 August 1989 and 03 October 1989. Computer control of the telescope allows us to point it at each of the stars at the beginning of the night and then leave it to follow a program of observations until dawn. Due to the proximity of the variable, comparison and check stars both in position and color, mean extinction and transformation coefficients were used to correct the differential magnitudes to the Johnson V and Cousins R system (Landolt 1983). The observations of the variable star were bracketed by observations of the comparison star SAO 107070, whose constant brightness was monitored with 23 observations of the check star, SAO 107064. The mean check star minus comparison star magnitude was 0.087 ± 0.019 in V and 0.285 ± 0.009 in (V-R). The errors are standard deviations about the mean, and assure the constancy of the comparison and check stars at this level.

Times of minimum and maximum brightness were found using a program based on the method of Kwee and Van Woerden (1956) and checked using the tracing paper method. Observations in each color were treated individually, but since there were no significant differences between the times obtained, they were combined in a mean, weighted inversely by the error in each color's determination. The heliocentric times of extrema based on all points within 0.06 days of the extrema are given in Table 1. The times of maximum light are included, to help determine the period of the system by removing the aliases. The period found from the times of maximum and minimum light was 0.45789 ± 0.00010 with a root mean square residual of about thirteen minutes. Asymmetry in the maxima and minima and the small amplitude of the light curve are probably responsible for these large residuals and the lack of precision in the determination of the period by this method.

Another estimate of the period was also found using a method based on the Phase Dispersion Minimization method of Jurkevich(1971). Plotted in figure 2 is the sum of the variances of twenty phase bins as a function of the period. The deep minimum at 0.458 days is the orbital period of the system and the shallow minimum at 0.423 days is an alias. The period given below is found from the parabolic fit to the deep minimum. A precise estimate of the epoch is the minimum of the light curve based on all the data points folded on the period below. The ephemeris best fitting the light curve is found to be:

$$\text{Helio. J. D. of Primary Minimum} = 2447762.7516(13) + 0.45774(4)\text{E}.$$

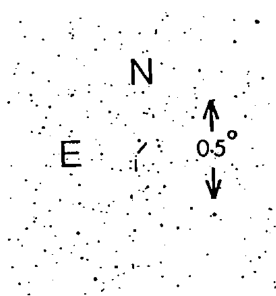

Figure 1. - Finder chart for X-Ray source, 1E2119.7+1655; centered on Right Ascension 21:19:43.8 and Declination 16:55:32 (1950.0)

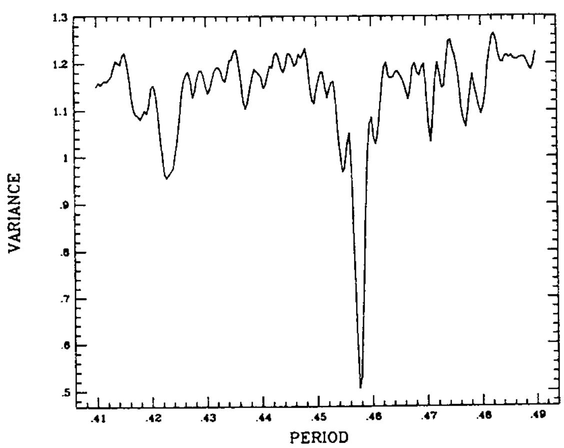

Figure 2. - Sum of the variances of twenty phase bins versus period.

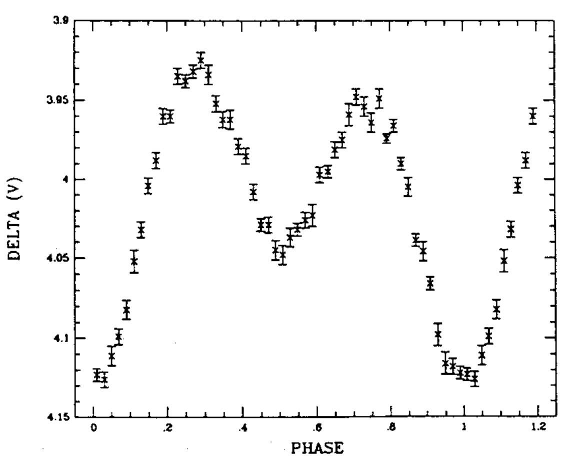

Figure 3. - V filter light curve plotted with PHASE=(JULIAN DATE - 2447762.7516) / 0.45774 .

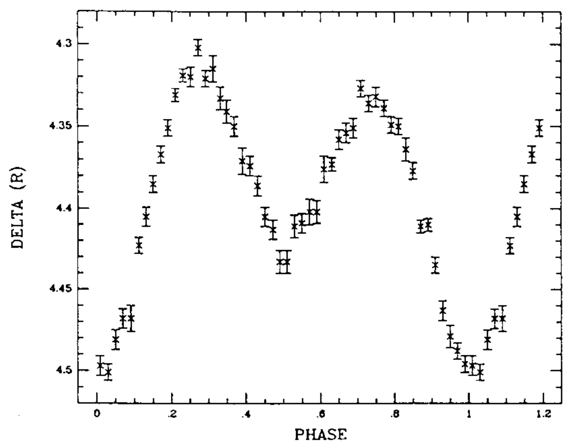

Figure 4. - R filter light curve plotted with PHASE=(JULIAN DATE - 2447762.7516) / 0.45774 .

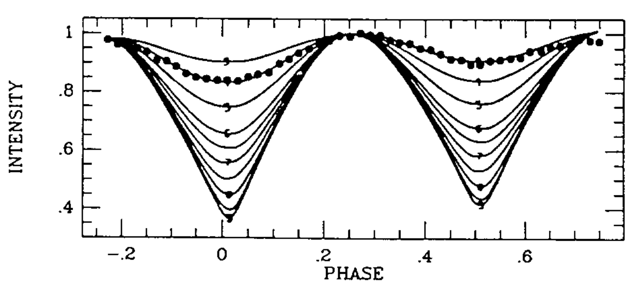

Figure 5. - Average of V and R normal points plotted with theoretical light curve form Anderson and Shu (1979) for a convective atmosphere with full limb darkening, a mass ratio of 0.8 and a filled fraction of 1.0. Curves are plotted in ten degree increments of inclination.

Table I.
Heliocentric Julian Date of Extrema - 2440000.0.

Primary Minima	Secondary Minima	Second Maxima	First Maxima
7772.8227	7775.7997	7765.8323	7763.7918
6	16	19	26
7773.7518		7777.7388	7768.8341
12		12	16
7777.8680			7801.7924
9			18
			7802.7055
			24

This period is in good agreement with the period-color relation of Eggen (1967) for contact binaries and agrees with the period found from the times of maxima and minima.

Due to the relative faintness of the star, modest size of our telescope and low declination, the errors of individual observations are large especially in comparison with the small amplitude of the light curve. Therefore the 974 observations have been combined into the fifty V and R band normal points plotted in figures 3 and 4. The error bars represent one standard deviation of the mean. This curve clearly shows the variation expected for a W UMa system as predicted by Fleming et al. (1989). The (V-R) color curve shows no reddening at the primary minimum, consistent with the system being a W UMa system.

An atlas of theoretical light curves of contact binary stars has been published by Anderson and Shu (1979), for different mass ratios, filled fraction, orbital inclination, and type of atmosphere. Since 1E2119.7+1655 has a F6 spectral type (Fleming et al. 1989), a convective envelope with full limb darkening was assumed. As shown in figure 5 the best match was found for a filled fraction f of 1.0, mass ratio q of 0.8 and an inclination of 35 degrees. If this inclination is correct then most if not all of the observed light variation must be due to aspect changes and not to any eclipse. However these numbers must be regarded as very preliminary values, since the theoretical light curves are for bolometric intensity and the data are the average of the V and R band normal points. The observed light curve also shows some asymmetry in the brightness of the maxima and minima.

The X-ray source 1E2119.7+1655 is a W UMa system with a period of 0.458 days and an amplitude of 0.2 magnitudes. Spectroscopic observations of this system will be important to find the component masses and mass ratio. Further photometric observations will be important to refine the orbital period and to permit a more detailed solution than has been attempted here. Photoelectric observations of the remaining stars on the list published by Fleming et al. (1989) are planned.

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K1040 - A NEW 4.3 HOUR RED GIANT VARIABLE STAR IN M15

It has been reported that G512, a star located at the top of the red giant branch of the C-M diagram in the globular cluster M4, has light variation with a quasi period of about 66 minutes (Yao Bao-an et al. 1981). We believe that the short-period variation is a common phenomenon among this kind of stars, so other globular clusters are being searched for.

Here we report the variation of another similar star K1040 (Küstner 1921) = S6 (Sandage 1970) in the globular cluster M15.

K1040 is located at the top of the red giant branch too (see Fig.1). The magnitude and colors of this star given by Sandage are V=13.35, B-V=1.21, U-B=0.84. The proper motion study (Cudworth 1976) shows that K1040 is a cluster member (Pc=0.99).

The star was observed by us with the RCA CCD at the Cassegrain focus of the Zeiss 1-m reflector (f/13.3) at the Yunnan Observatory in November 1988. This detector contains 320 X 512 pixels at a scale of $0\farcs47$/pixel, thus covering a $2\farcm5$ X 4' field. Two series of 590-second exposures taken in rapid succession over an interval of about 3.4 and 3.7 hours were obtained on 1988 November 12 and 15 (36 yellow, 4 blue). The seeing was between $1\farcs2$ and $2\farcs5$ (FWHM). The red star K1073 was used as the comparison star, it is constant to at least $<$ 0.01 mag by comparing with other stars within the nights we observed. Because the distance between K1040 and K1073 is only 67" and the difference of the instrumental color index B-V between them is only 0.13 mag, so the differential extinction correction can be neglected. The CCD frames were reduced by DAOPHOT (Stetson 1987) in IRAF which is mounted in the Vax8350 computer of the Yunnan Observatory. Due to the fact that there are several faint nearby stars around K1040, though they are 5 magnitudes fainter than K1040 in brightness, the CCD magnitudes of K1040 are less accurate than that of K1073. The standard error of V(K1073) - V(K1040) is about 0.006 mag.

From the "real time " light curve it can be seen directly that the star has a period value between 0.12 and 0.5 day. In addition, it may have long-term period behavior because the mean magnitude of the star on 12 November is fainter than that on 15 November by 0.014 mag. However, aiming at the short-period variation, the zero point shift of different nights was adjusted by adding a constant and the period was searched for within the range $0\overset{d}{.}12$ - $0\overset{d}{.}5$.

The folded light curve got by P=0.1787 day with the peak to peak amplitude about 0.04 mag is given in Fig.2.

Further observations are needed to monitor the possible long-term variation.

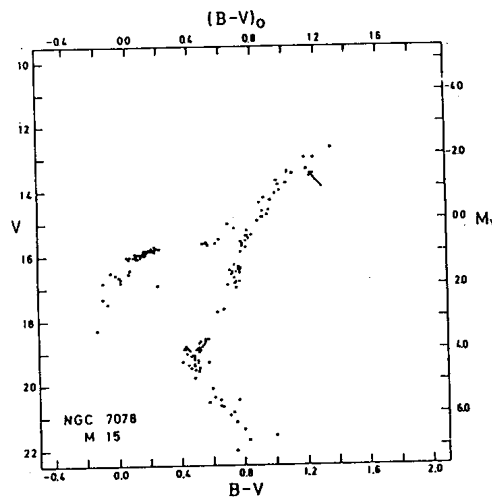

Figure 1

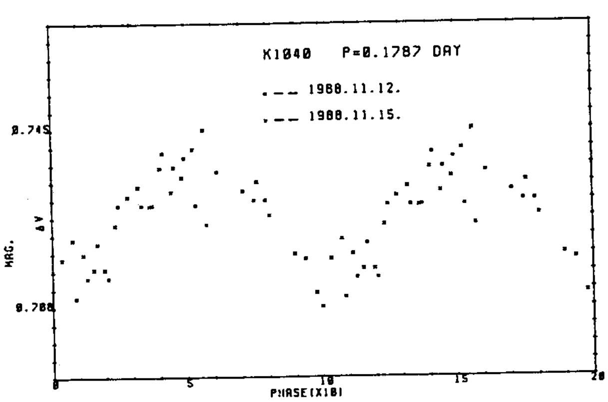

Figure 2

I thank Chen Fu-xiang for help with observing. I am indebted to Lou En-rui for help with running IRAF.

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LONG-TERM LIGHT-CURVE OF THE IRREGULAR VARIABLE OR ANDROMEDAE

The variability of OR And (206.1940 = NSV 14419) was announced by Hoffmeister (1940), who described the star provisionally as "slowly varying, probably irregular, with long standstills". Huth (1956) discovered non-periodic short-term fluctuations of small amplitude (0.6 mag) and a time scale of hours: in the time interval covered by 224 plates available to him (242 7955...243 3977) the star did not exhibit large long-term variations (see also the upper part of Figure 1).

Downes (1986), without knowing these findings, independently detected the outstanding nature of the object in the course of a spectroscopic survey for potential novae. He found narrow H α, β, γ and He II 4686 emission lines and a fairly flat Balmer decrement which is typical of cataclysmic variables: for the Harvard plate collection the star proved to be too faint to be investigated properly.

Kurochkin (1987) observed the variable on 83 Moscow 40cm astrograph plates and found three conspicuous minima and also short-term variations of several time-scales: unfortunately, however, the exposures are rather irregularly spaced.

In the course of a routine investigation of variables in the Sonneberg field 23^h09^m $+52^\circ.5$ (Häussler 1990) OR And again attracted attention. With the help of nearly 450 plates a fairly dense long-term light-curve from 242 7955 to 244 7770 (gaps are from 243 4200 to 5700 and from 244 2400 to 5600) could be constructed and thus the photometric pattern, described by the above authors, greatly improved. The light-curve resembles that of MV Lyr prior to its great minimum (Wenzel and Fuhrmann 1983) or of V 425 Cas (Wenzel 1987): The star was bright with minor changes from 1935 to 1952. It was very active from 1956 to 1974 with alternating bright and low states: the latter lasted several years in general and were as deep as some magnitudes below "normal" light. A much narrower minimum (duration 50 days) hap-

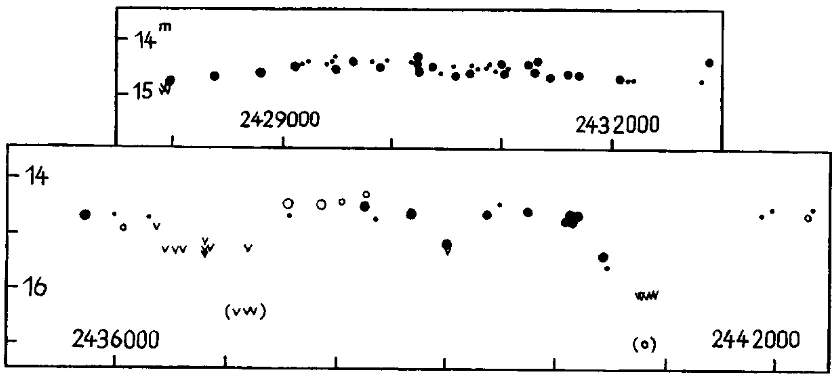

Figure 1

pened in the autumn of 1985 (Kurochkin 1987), with a subsequent high state till summer 1989. The comparison stars were linked to Mt. Wilson Selected Area 42.

Figure 1 shows two representative parts of the light-curve. Observations of Kurochkin are included (open circles). Larger signs denote average brightness data composed from up to 10 individual values. The four signs in brackets are derived from Kurochkin's data, whose magnitudes in the lower part seem to be too faint by about 1 mag.

We conclude that our light-curve supports the supposition first expressed by Downes that the star is a cataclysmic variable. Spectroscopic and photoelectric observations are strongly recommended.

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A NEW SUSPECTED POLARIZATIONAL VARIABLE IN CYGNUS

Two stars, N2 (cl) and N3 (sv-suspected variable) in Fig.1, were used as comparison stars during the R-band photometry and spectropolarimetry of the Wolf-Rayet star HD 191765 (WR) in October 1989. The measurements were carried out with the 0.6m telescope of Mid-Asia expedition of the Main astronomical observatory. The N3 star was found to have highly variable first three Stokes parameters: I, q_R, u_R (Fig.2.). The standard deviation of the R-band flux ratio F(sv)/F(cl) was σ_R=3.2%, and simultaneously σ_R(F(WR)/F(cl)) = 1.9%. There were one-measurement-accuracies σ_q=0.19%, σ_u=0.21%, but σ_q (sv)=0.79%, σ_u (sv)=0.60%. There are obvious systematical night-to-night variations on q,u-plane (Fig.3). The star N3 may be a binary system with $P > 12^d$, because on q,u-plane we can see roughly less than a half of full q,u-locus.

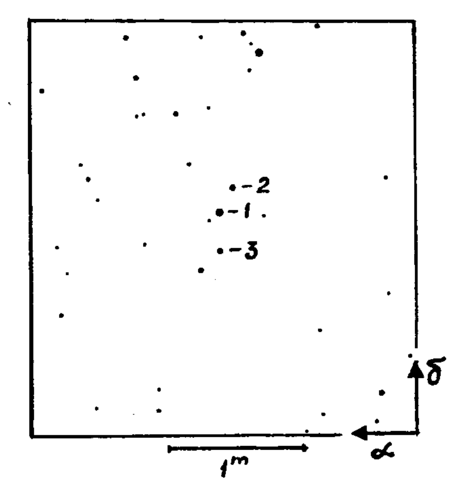

Fig.1. Finding chart. 1 - HD 191765 (WR), α (1950)=$20^h08^m22^s$, δ (1950) = $36^o01'40''$; 2 - BD+35^o4000 (cl); 3 - the suspected variable (sv).

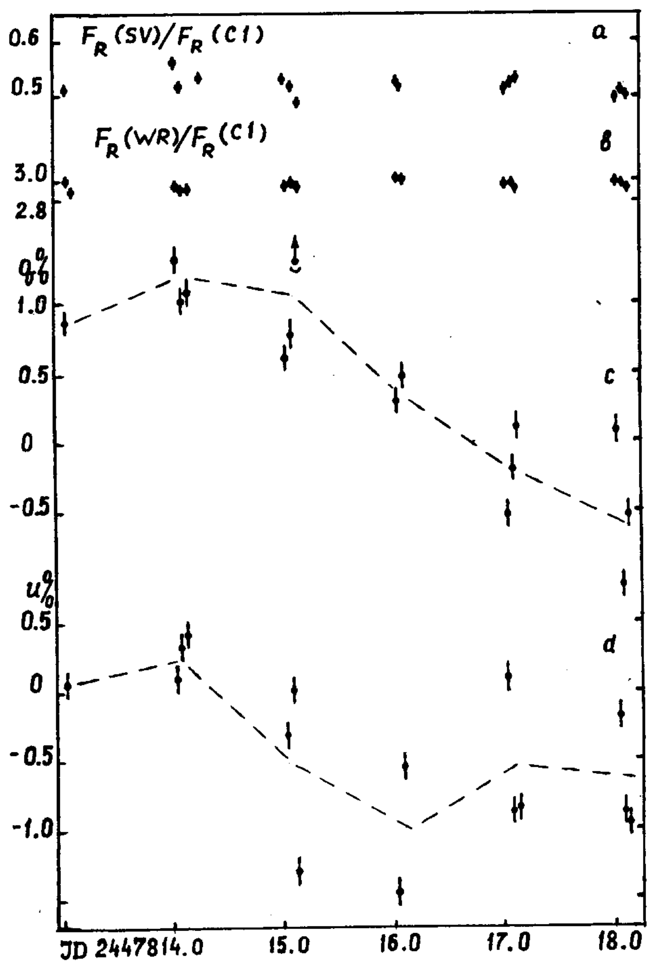

Fig.2. The variations of R-band flux and polarization. a) $F_R(sv)/F_R(cl)$; b) $F_R(WR)/F_R(cl)$. The variations of the Stokes parameters; c) q %; d) u %.

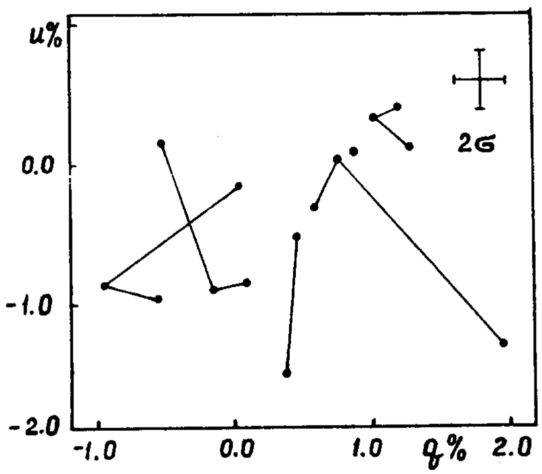

Fig.3. Polarimetric observations of the suspected variable. Consecutive observations (during one night) are joined by a line.

Table I. The observations of the suspected variable

JD	F_R(sv/cl)	p%	q%	σ_q%	u%	σ_u%	θ^o	σ_θ
244 7800.+								
13.101	0.510	0.86	0.86	0.20	0.06	0.22	182.1	9.9
14.098	0.561	1.32	1.32	0.18	0.11	0.21	182.3	6.5
14.201	0.515	1.06	1.01	--	0.32	--	188.8	--
14.278	0.531	1.24	1.16	--	0.42	--	189.9	--
15.098	0.527	0.67	0.59	0.16	-0.32	0.21	165.5	6.0
15.197	0.517	0.77	0.77	--	0.02	--	180.9	--
15.299	0.491	2.38	1.99	--	-1.30	--	163.5	--
16.096	0.525	1.51	0.39	0.17	-1.46	0.18	127.4	6.3
16.192	0.519	0.72	0.47	--	-0.54	--	155.5	--
17.085	0.512	0.54	-0.53	0.16	0.12	0.20	83.6	9.6
17.176	0.520	0.89	-0.17	--	-0.87	--	129.4	--
17.269	0.529	0.85	0.10	--	-0.84	--	131.4	--
18.091	0.494	0.18	0.07	0.24	-0.16	0.26	146.8	11.9
18.190	0.509	1.28	-0.94	--	-0.87	--	111.3	--
18.282	0.504	1.10	-0.54	--	-0.96	--	120.3	--

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A CCD LIGHT CURVE OF THE ECLIPSING CATACLYSMIC VARIABLE PG0027+260

Ultraviolet extra object PG0027+260(B=$14^m_.8$) was reported by Green et al. (1982) as cataclysmic variable candidate. Light curve evidence is necessary to confirm it.

The CCD light curve of PG0027+260 was observed in R color on 30 November, 1989 with the 60/90/180 cm Schmidt telescope at Beijing Observatory, using the BAO CCD light curve survey photometer system(Wei Mingzhi et al. 1989). We chose two stars within the CCD field as comparison and check stars respectively, denoted by C1 and C2. Figure 1 shows the light curves of check star minus comparison and variable minus comparison. Each point in the light curves is a one-hundred-second integration and the interval between each integration is 12 seconds.

The light curve shows definitely that PG0027+260 is an eclipsing cataclysmic binary system. The depth of primary minima is about $0^m_.5$. Like other cataclysmic variable system, the rapid changes in the brightness, which is considered to be caused by mass transfer from the secondary, can be seen in the light curve. The amplitude of rapid changes reach to $0^m_.2$. The secondary minima is too weak to be distinguished from the strong rapid variations. This object is the second eclipsing cataclysmic variable confirmed by the BAO Schmidt telescope CCD light curve survey photometer system, the other one is PG0818+513(Chen Jiansheng et al. 1989).

Two times of primary minima were obtained, they are:

JD2447861.0689

JD2447861.2154

The orbital period is about $0^d_.146$. We gave the ephemeris as follows,

$$\text{Min.I.}=\text{JD}2447861.0689 + 0^d_.146\text{E}$$

The further observation and detailed study on physical model of this object is in process.

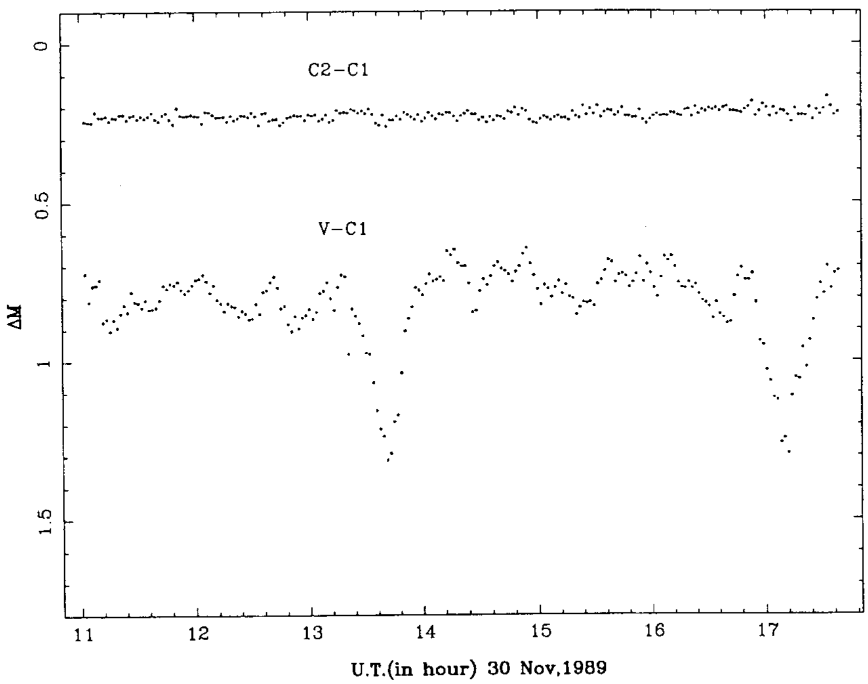

Figure 1

CCD light curves in R color, upper is light curve of C2-C1, lower is that of V-C1. Each point is a one-hundred-second integration, the interval between each integration is 12 seconds. The uncertainty of each point is $0^m.01$.

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PHOTOELECTRIC MINIMA OF ECLIPSING BINARIES

Photoelectric observations of the eclipsing binaries 44i Boo, RZ Cas, U Cep and U Sge have been made with the 0.5-m reflector at the Odessa Observatory for the purpose of determining times of minima for the period studies. The comparison stars were GC 20111 for 44i Boo, GC 3075 for RZ Cas, HD 6006 for U Cep and HD 180242 for U Sge.

The moments of minima were determined by the chord bisection method for 44i Boo, RZ Cas and by the mean light curve method for U Cep, U Sge.

The heliocentric times of the observed minima in yellow filter are given in Table I, along with the epoch number (E), the O-C values and the number of estimates used for each minimum (n).

Table I

Star	Min HJD	E	O - C	n
44i Boo	2447359.3920	28030	$+0\overset{d}{.}0221$	10
	364.3469	28048.5	+0.0224	20
	365.4180	28052.5	+0.0223	14
	371.4438	28075	+0.0222	14
	375.3270	28089.5	+0.0220	15
	388.3163	28138	+0.0223	19
	393.4050	28157	+0.0225	33
RZ Cas	370.5336	25112	-0.0554	19
	376.5099	25117	-0.0554	22
	382.4868	25122	-0.0547	26
	394.4394	25132	-0.0547	25
U Cep	361.2810	15833	+0.8922	26
	366.2650	15835	+0.8904	28
U Sge	383.5632	8949	+0.0002	27
	390.3250	8951	+0.0008	29

The O-C values have been calculated from the ephemeris:

44i Boo Min I HJD = 2439852.4903 + $0\overset{d}{.}2678159$ E

RZ Cas Min I HJD = 2417355.4233 + $1\overset{d}{.}1952519$ E

U Cep Min I HJD = 2407890.2957 + $2^{d}.4929005$ E

U Sge Min I HJD = 2417130.4090 + $3^{d}.3806184$ E

I thank the Director and the staff of the Odessa Observatory for observing time and assistance.

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V 3903 SAGITTARII: ANOTHER O-TYPE ECLIPSING BINARY

V 3903 Sgr (HD 165921, CD -24°13962, SAO 186366) is located in the region of the open cluster Collinder 367 (Clariá, 1976) and is a possible member of the R association Simeis 188 (Herbst et al., 1982). It is classified as a spectroscopic binary (Conti and Alschuler, 1971) with components of early spectral type (O7 and O9, Niemela and Morrison, 1988). Cousins (1973) and Clariá (1976) have both found variations in the brightness of the system with amplitude of 0.16 mag in V, but no light curve has been published.

As a part of a Brazilian-Danish-Spanish project of studies

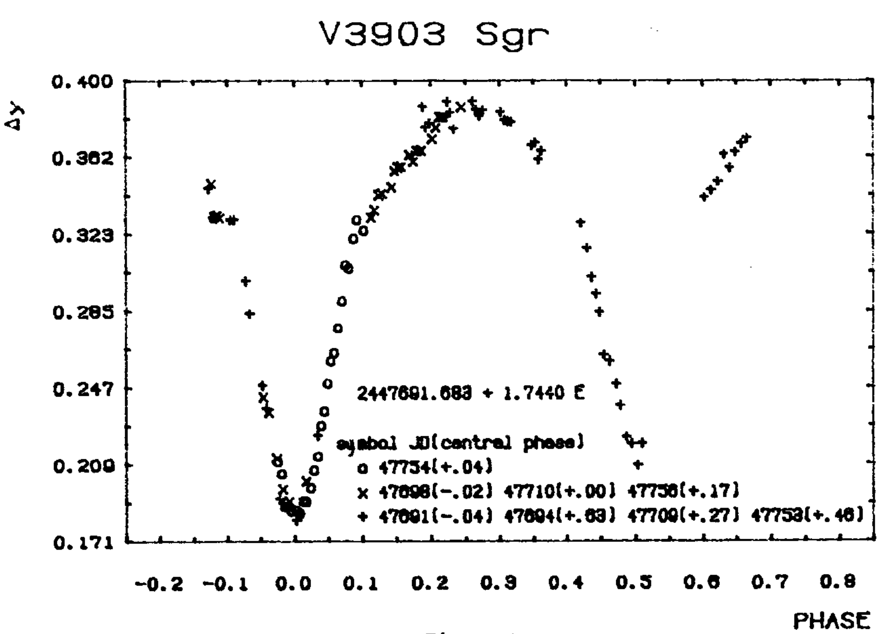

Figure 1

of eclipsing binaries this star was observed on 8 nights, from June to August 1989, using a conventional one-channel photoelectric photometer with the ZEISS (JENA) 60 cm telescope of the Laboratório Nacional de Astrofísica (LNA-CNPq-SCT), Brasópolis, MG, Brazil. The light curve shown in the figure was obtained using the following ephemeris, with the period determined using the method of Lafler and Kinman (1965, with all 4 colours), and the time of minimum determined by means of a 2nd degree polynomial :

$$\mathrm{Min\ I} = 2447691.683 + 1^{d}.7440\ E$$
$$\pm 1 \qquad\qquad \pm 1$$

The period determined from our photometric observations is not very different from the spectroscopic one given by Niemela and Morrison (1988), of 1.744215±0.000005 day.

More observations are being reduced, and we plan to obtain further photometric data for a complete study (period, times of minima and photometric elements), which will appear elsewhere.

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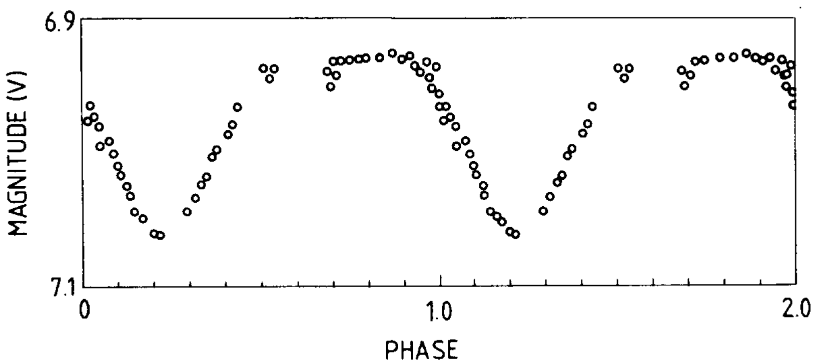
CHANGES IN THE LIGHT CURVE OF AB DORADUS (HD 36705)

The rapidly rotating single star HD 36705 (AB Dor) has been under observation by the Monash group for approximately ten years. Presented here (see fig.1) are the V and B-V light curves recorded during October/November 1989 at Siding Spring observatory. Results were obtained with a cooled extended-red S-20 tube and a motorized filter box on the 0.6 m Boller and Chivens telescope. Calculated phases for AB Dor are in accordance with epoch and period HJD 2444296.575 and 0.51479 day as discussed by Innis et al. (1988), with the main comparison star being HD 35537. The data were transformed to the standard UBV system via a set of calibration equations obtained by the author in June 1989 on the same instrument.

From fig.1(a) it can be seen that the light curve is dominated by a large decrease in brightness at an approximate phase of 0.2, presumably due to the effect of a large starspot (or group of smaller spots) at this phase of the star's rotation. The portion of the curve between phases 0.7 and 0.9 is unusually flat, possibly indicating either the immaculate (unspotted) surface of the star, or a uniformly spotted section of the stellar surface. There may also be a small dip in the light curve at phase 0.6, but a lack of complete phase coverage prevented confirmation of this. The B-V curve in 1(b) shows that AB Dor is slightly redder at minimum light.

The most interesting aspect of these data becomes apparent when it is compared with previous light curves from



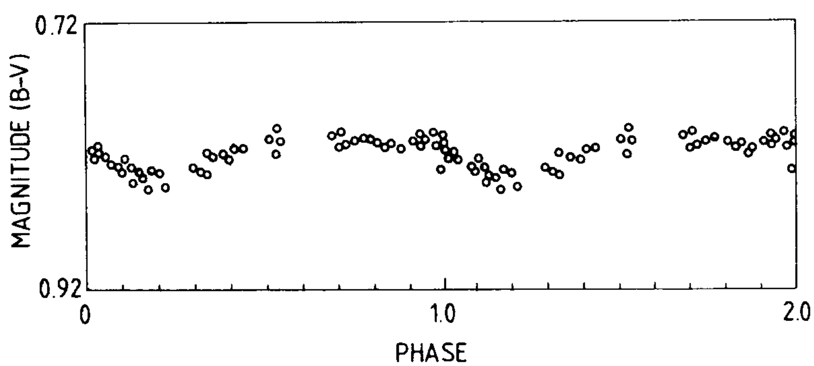


Figure 1 (a),(b) : The light curves in V and B-V for AB Dor in Oct/Nov. 1989. Phases calculated with respect to period 0.51479 d and epoch 2444296.575.

1986,1987 and 1988 (see fig.2). From the March/April 1986 data, it can be seen that the light curve is quite flat, possessing little modulation due to starspot activity. In September/November 1986 and January 1987, however, a definite minimum is seen to emerge at a phase of about 0.5. The December 1988 data shows a significant change from this, in that the curve now exhibits a peak at phase 0.4 and a minimum at phase 0.7 (Thompson and Thompson 1988). The 1989 data, taken only 10 months later, shows quite a dramatic change in the shape of the light curve, with a deep minimum now at phase (approximately) 0.2. Since the migration of a starspot by 0.5 phase in less than a year is quite unlikely, one must

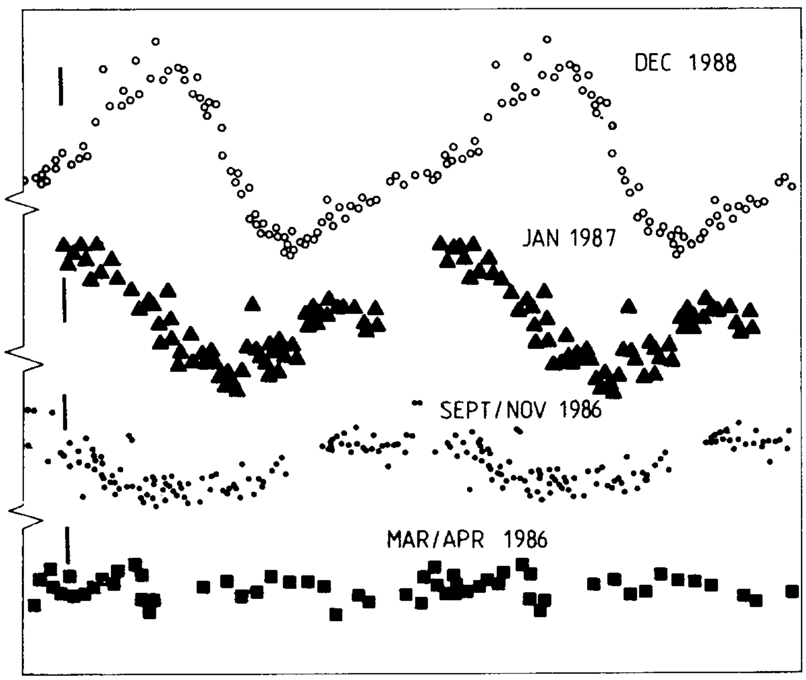


Figure 2 Light curves in V for AB Dor since March 1986. The vertical scale is given by the bar at the side of each curve which represents 0.02 mag. All data shown were collected by the Monash group, and cover two complete rotation cycles.

assume (after verifying that each set of data was correctly reduced) that the change in the shape of the curve is the result of the formation and decay of one or more spotted regions on the star.

The level of the flat portion of the 1989 light curve is quite similar to the level of the peak in the 1988 data, implying perhaps that the spot causing the minimum at phase 0.7 (1988) has completely disappeared in 1989, and a new spot has formed at phase 0.2. There was some hope that the flat part of the 1989 light curve may be indicative of the unspotted star brightness, but AB Dor has been observed as being up to 0.15 magnitudes brighter in previous years (see fig.3). The mean light level of AB Dor in 1989 further emphasizes the continual dimming of the star over the past

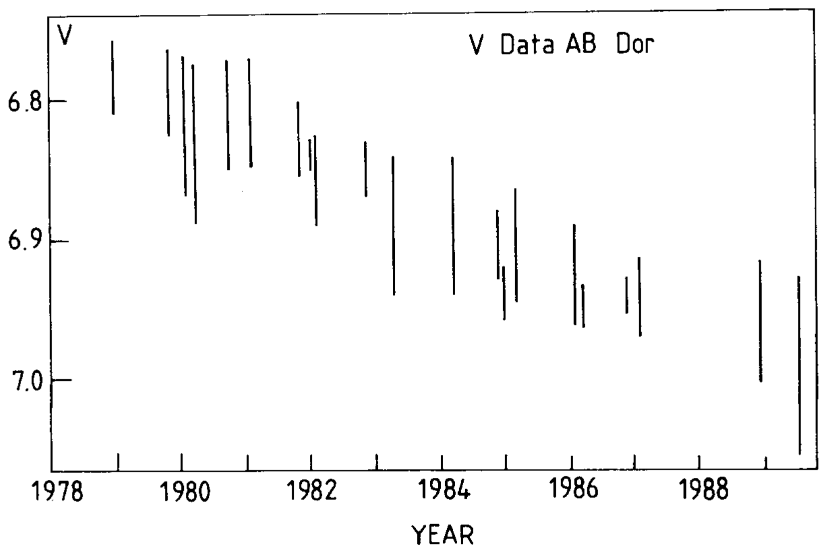


Figure 3 The variation of mean light level in V for AB Dor since 1979. The data was collected from many different sources (for references see Innis et al., 1988)

ten years, however it is yet to be seen whether this is evidence of a solar-type spot cycle.

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ON THE PERIOD OF THE W UMA STAR YZ PHOENICIS

From several timings of minima of the W UMa system, YZ Phoenicis, Gessner & Meinunger (1976) derive a period of $0^d.3052$. Spencer Jones (1989) however, has shown that the period is near $0^d.225$, close to the observed lower limit for periods of W UMa binaries.

Photoelectric observations of YZ Phe were made in 1989 Sep - Nov with the 0.5m and 1.0m telescopes of the South African Astronomical Observatory at Sutherland. Regular observations of the comparison stars used by Spencer Jones (1989) were made and all data were transferred to the $UBV(RI)_C$ system using observations of E-region standard stars (Menzies, Cousins, Banfield & Laing 1989). The mean values for colours and magnitudes of the comparison stars are given in Table 1 together with standard deviations of the means. The results for HD 10521 are in very good agreement with the values given by Spencer Jones (1989) but for HD 10839, the differences in V, (B-V) and (U-B) are +0.02, -0.08 and +0.06 (Spencer Jones minus this paper) and it is possible that HD 10839 is a long-period variable. There is, however, no evidence in the 1989 data for any variation as big as 0.01 in magnitude or colours and so the YZ Phe data were corrected to the mean values of both Table 1 stars.

A phase-dispersion minimisation technique was applied to the YZ Phe data and gave a period of $0^d.234726 \pm 0.000002$ where the error is estimated from the range of results obtained by binning the data in different sized phase intervals. The V magnitudes from the 1989 data, phased with the above period are shown in Fig.1. The light curve clearly has unequal maxima and minima and is typical of a W UMa star. Using the best primary minimum from the 1989 data and the accurate determination of primary minimum by Spencer Jones (1989) results in a period $0^d.23472715 \pm 0.0000001$ where the error corresponds to an error of $0^d.001$ in the 9492 cycles between the two primary minima

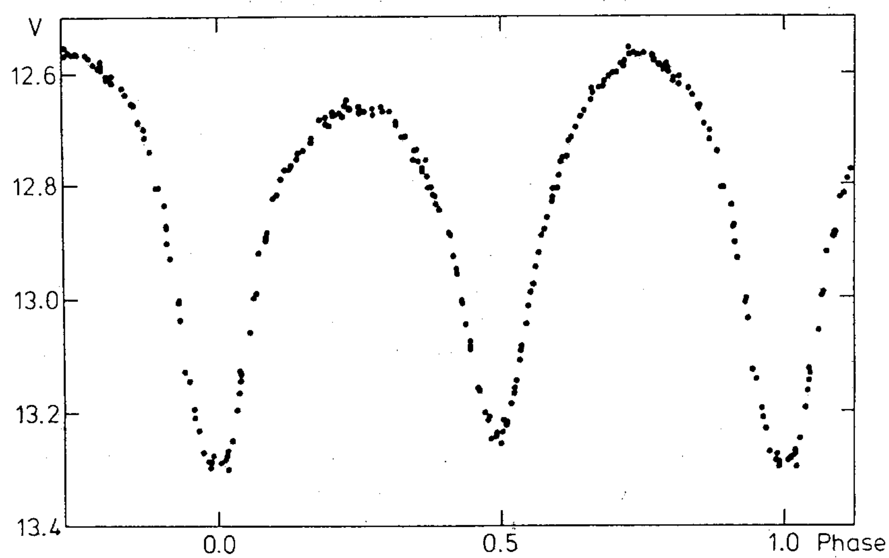

Figure 1. V light curve for YZ Phe from 1989 data.

used. The one cycle aliases ($0^d.23475$ and $0^d.23470$) can be ruled out because adopting these periods results in obvious drift in the phased magnitudes for the 1989 data.

The times of minima measured in 1989 are listed in Table 2 and a linear least-squares solution, including the Spencer Jones (1989) minimum for which we adopt n=0, gives an ephemeris:

$$T(\text{primary minimum}) = 244\ 5621.39679 + 0.23472700.n$$
$$\pm 0.00008 \quad \pm 0.00000008$$

The observed-calculated (O-C) residuals from this ephemeris are also listed in Table 2.

Applying the above period to the Gessner & Meinunger (1976) timings of minima enables a redetermination of the cycle numbers for those minima and then a linear least-squares fit to that data gives a period $0^d.23472 \pm 0.00003$. It does not seem possible to link the Gessner & Meinunger data to the Table 2 data with great certainty because of the large separation (~ 37000 cycles) and because many of the W UMa stars are known to have variable periods (see, for example, Kreiner 1977) which could cause aliasing errors. Comparison of the periods derived from the

Table 1. Magnitudes & colours of the comparison stars

	V	B-V	$V-R_C$	$V-I_C$	n	U-B	n
HD 10521	8.383	0.367	0.219	0.438	29	0.024	15
	±0.004	0.003	0.003	0.005		0.005	
HD 10839	9.052	1.235	0.650	1.226	24	1.301	11
	0.004	0.004	0.002	0.003		0.006	

Table 2. Times of minima of YZ Phe

n	HJD	(O-C)	
0	2445621.39683	0.0000	(Spencer Jones 1989)
9250	7792.6220	+0.0004	
9253.5	7793.4425	-0.0006	
9254	7793.5610	+0.0005	
9258.5	7794.6160	-0.0007	
9296.5	7803.5355	-0.0009	
9313.5	7807.5260	-0.0007	
9437	7836.5165	+0.0010	
9440.5	7837.3370	-0.0001	
9492	7849.4265	+0.0010	

1989 data and the Gessner & Meinunger data, however, suggest that the period might be fairly stable on a timescale of years.

The derived period of $0^d.234727$ for YZ Phe makes it one of the shortest period eclipsing binaries known; according to Mochnacki (1983, Table 2) only CC Com has a shorter period ($0^d.221$).

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POLARIMETRY OF R CORONAE BOREALIS TYPE STARS AND RELATED OBJECTS

During the 1988-89 period polarimetric observations of some R Coronae Borealis type stars (RCB), several hydrogen-deficient carbon stars (HdC) and related objects were obtained with the 60-cm reflectors of Soviet - Bolivian Observatory Santa Ana (Tarija, Bolivia) and Middle Asia Expedition of the Main Astronomical Observatory of the Academy of Sciences of Ukrainian (Mount Maidanak, Uz.SSR) using a spectrophotopolarimeter (Bugaenko and Guralchuk, 1985) and standard UBVR filters.

The observations are given in Table I. From left to right the data tabulated are: star name, the epoch of observations in Julian date, the colour-excess E(B-V), percentage polarization P and position angle θ and their standard errors in the bands U,B,V,R and integral light (Int.) respectively.

UBVR photometric observations were also obtained for several stars. The results are given in Table II. The typical photometric errors are about $0\overset{m}{.}01$ in V, $0\overset{m}{.}02$ in (B-V), $0\overset{m}{.}03$ in (U-B) and $0\overset{m}{.}02$ in (V-R). All the stars were at the maximum brightness or near it.

A detailed analysis of the results of polarimetric observations of RCB and related stars show absence of the intrinsic polarization at the maximum light and when weakening of brightness is about 2 mag. Thus, the polarization has interstellar origin. From here we evaluated the colour-excesses of these stars (Allen,1977). They are comparable to values found by Rosenbush (1982) for some stars using intrinsic colours (in Table I values E(B-V) in the brackets are from Rosenbush (1982)). Following Rosenbush (1982) we added and defined more precisely the position of the studied stars on the Hertzsprung-Russell diagram (Rosenbush, 1986).

UW Cen should be attributed to group I of stars (UV Cas, V CrA, R CrB, RY Sgr, SU Tau and members of LMC); AE Cir belongs to group II (S Aps, U Aqr, WX CrA, RT Nor, SV Sge, GU Sgr, RS Tel). However, according to Kilkenny (1989), AE Cir should be excluded from the list of R CrB stars. Y Mus has to be displaced in the region of extreme helium stars, near MV Sgr.

Table I

Name	JD 2440000+	E(B-V)	U P%, θ°	B P%, θ°	V P%, θ°	R P%, θ°	Int. P%, θ°
				RCB			
S Aps	7568.8	0.10 (<.13)	-	-	0.9±0.2 64±6	-	-
	7600.7		-	-	.9±.3 67±9	-	-
U Aqr	7834.1	.06	-	-	.5±.2 158±8	-	-
UV Cas	7832.4	.4 (.66)	-	-	3.5±.2 56±1	-	-
	7833.2		-	-	3.7±.2 58±1	-	-
UW Cen	7507.8	.14	-	-	-	-	1.2±.4 56±10
DY Cen	7568.8	.15	-	-	-	-	1.3±.8 57±6
AE Cir	7623.8	.07	-	-	-	-	.6±.4 49±18
V482 Cyg	555.5	.31*	-	-	2.8±.1 36±1	-	-
V CrA	7411.6	.04 (.05)	-	-	.3±.4 162±12	-	-
	7600.8		-	-	.5±.2 172±11	-	-
WX CrA	7600.8	.11 (.05)	-	-	1.0±.2 164±6	-	-
Y Mus	7647.6	.27	-	-	2.4±.1 85±2	-	-
RT Nor	7600.8	.14 (.2)	-	-	1.2±.2 36±5	-	-
RY Sgr	7348.5- -7438.5	.06 (.06)	.50±.28 176±16	.54±.07 180±4	.47±.07 179±4	.42±.12 174±8	-
MV Sgr	7623.9	.15	-	-	-	-	1.3±1.1 172±8
				CW			
RU Cam	7205.2	.05	-	.24±.12 69±14	.42±.07 72±5	.35±.08 73±6	-
V553 Cen	7614.8	.02	-	-	.1±.2 168±94	-	-
				EB			
nu Sgr	7624.9	.10	.60±.10 173±5	.90±.18 174±2	.82±.06 167±2	.85±.06 174±2	-

Table I (cont.)

Name	JD 2440000+	E(B-V)	U P%, θ°	B P%, θ°	V P%, θ°	R P%, θ°	Int. P%, θ°
				HdC			
HD137613	7644.6	.08	-	.64±.10 78±4	.80±.10 62±4	.39±.10 76±7	-
				Unique			
V348 Sgr	7624.8	.24	-	-	-	-	2.2±.3 149±4
rho Cas	7834.2	.16	1.51±.14 62±3	1.26±.06 57±2	1.36±.02 53±1	1.32±.06 51±1	-

* - Observations were obtained together with N.N. Kiselev at the 1-m telescope of the Institute of Astrophysics of the Academy of Sciences of Tadzhik SSR.

Table II

Name	JD 2447000+	V	B-V	U-B	V-R
U Aqr	839.3	$11^m.04$	$^m.96$	-	$^m.87$
RY Sgr	351.7	6.50	.75	$^m.21$	.55
	371.6	6.19	.47	-.17	.42
	372.7	6.18	.51	-.14	.42
	380.7	6.44	.70	.13	.63
	640.8	6.13	.51	-.03	-
	647.9	6.27	.66	.07	-
SV Sge	839.3	11.93	2.20	-	1.88
HD 182040	372.7	6.94	1.05	.49	.83

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OBSERVATIONS OF THE DWARF NOVA CI GEMINORUM

Hoffmeister (1943; 1947) described CI Geminorum as nova-like or possibly of U Geminorum type. He could find only one eruption on 166 plates of the time interval 1935 Nov. 1 to 1944 Feb. 24. He excluded Mira type because of the "unconspicuous" (not red) colour, which was later confirmed by Duerbeck (1987), who observed the minimum state of the star on the POSS charts. I checked the region of this variable on 129 additional plates of the Sonneberg 40/160 cm GC astrograph, taken mainly by G.A. Richter and G. Hacke in 70 nights of 1962.9 to 1966.7 and 1980.0 to 1989.2. On this material, supplemented by 19 good plates taken at the 17/120 cm astrograph from 1958 to 1966 in 19 nights, three additional eruptions are present:

1963 Oct. 15	J.D. 243 8318.5	$16\overset{m}{.}5$ (2 plates)
1966 Feb. 23	243 9180.4	16.5
1986 Dec. 3	244 6768.6	14.5

Unfortunately the duration of these maxima cannot be estimated, because suitable plates of adjacent dates are not available. Therefore we do not know whether the eruption of February 1940 observed by Hoffmeister, when the star was brighter than $16\overset{m}{.}0$ for at least 16 days, was an exception or not. Because the old paper of Hoffmeister (1947) might no longer be available in the reader's library, Fig. 1 shows a drawing of his observations.

The minimum brightness was estimated by Duerbeck on the POSS charts as $B = 18\overset{m}{.}5$; two plates taken by Börngen and Ludwig at the 134 cm Schmidt telescope of Tautenburg Observatory yield $B \approx 19\overset{m}{.}0$. An amplitude of CI Gem of 4.2 mag may therefore be assumed.

If the long eruption observed by Hoffmeister was a supermaximum of an SU Ursae Maioris variable, then the orbital period

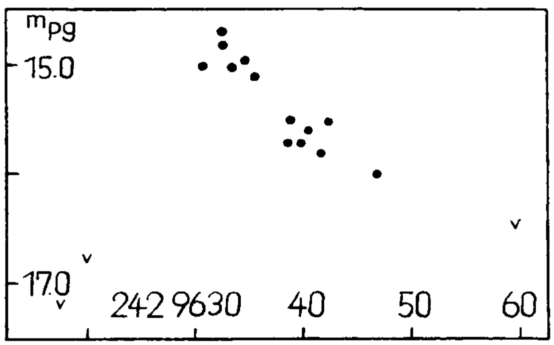

Figure 1

should be around P = 1.5 h and, according to Richter and Bräuer (1989, equation 2a), the mean cycle length C_1 = 111 d.

Another extreme assumption would be that the three maxima found on GC plates were "normal" ones, say of mean duration L_n = 4 d ± 2 d. The statistics (see Wenzel and Richter 1986) then leads to a mean cycle length of

$$C_2 = L_n \cdot \frac{\text{number of checked nights}}{\text{number of observ. eruptions}} = 119 \text{ d} \pm 59 \text{ d},$$

which is in good agreement with C_1.

We conclude that CI Gem might be an SU Ursae Maioris type dwarf nova with a cycle length of the order of 100 days. To investigate the orbital period and the possible presence of superhumps would be of interest.

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GROUND-BASED OBSERVATIONS TO SUPPORT ASTRO-1

According to the current schedule, the Astro-1 payload (the Broad Band X-Ray Telescope (BBXRT), the Hopkins Ultraviolet Telescope (HUT), the Ultraviolet Imaging Telescope (UIT), and the Wisconsin Ultraviolet PhotoPolarimeter Experiment (WUPPE)) will be carried, by shuttle, into orbit on 9 May 1990 for what is expected to be a 10-day mission.

The target list for these instruments (about 300 targets for BBXRT, about 100 each for HUT, UIT, and WUPPE) includes stars (normal and super- giant), cataclysmic variables (CVs), Low-Mass X-Ray Binaries (LMXRBs), High-Mass X-Ray Binaries (HMXRBs), SuperNova Remnants (SNRs), globular cluster sources, normal galaxies, Active Galactic Nuclei (AGNs), and galaxy clusters. Good quality optical and infrared imaging, photometry, spectroscopy, spectrophotometry, polarimetry, and spectropolarimetry, as well as radio observations, will enhance the scientific usefulness of the data obtained. Some of the targets are time-variable, and multi-wavelength studies will be needed to help disentangle the physics of these sources. As an example, a recent result of a simultaneous, multi-wavelength campaign on several CVs has shown that the accretion disks present in these systems flare in the optical BEFORE showing the flare's effects in the UV. This result is a big clue in understanding the accretion disk behavior. Not all of the targets need be studied with simultaneous, ground-based observations. The SNRs, for example, will benefit from more complete wavelength coverage, but quasi-simultaneous observations will be quite sufficient.

All observers who are interested are encouraged to contact the Astro-1 coordinator listed below. Please be advised that this IS a shuttle mission, and the observing timeline may change with VERY short notice. As such, I am requesting that any observer interested in this program please supply an e-mail address. Rapid communication will be essential, particularly for any simultaneous observations which will be made. Furthermore, the timeline is specified in MET (Mission Elapsed Time), and the zero point in a useful time frame (e.g., GMT) will have to be distributed. Finally, when contacting the coordinator, please send a list of the types of observations you can make, or a subset of the target list in which you are interested.

To make this coordinated observation effort at all successful, I request that observers be prepared to summarize, VERY briefly, their observations immediately after the shuttle mission ends. I intend to e-mail a suggested format to all participants, thereby allowing me to collate who observed what. This will aid the individual scientists who are part of the mission. Specifically, I intend to assemble all the observation summaries so that an individual on any of the instrument teams can find out what other observations have been made, and who to contact.

There is the issue of data rights. The data obtained from the shuttle instruments will be retained by each team for the exclusive period stipulated in the instrument proposal (for example, for BBXRT, the exclusive data rights period works out to be about 20 months: 12 months for data analysis, 6 months for instrument calibration checks, and 2 months in the immediate post-shuttle return phase). Collaborations between the various instrument scientists and any ground-based observers contributing data at other bandpasses will undoubtedly occur, and will be encouraged. Such collaborations cannot be guaranteed. A prime purpose of the post-mission observation summary will be to connect the mission scientists with the corresponding ground-based observers.

All observers are encouraged to participate. The value of multi-wavelength studies cannot be emphasized too strongly (see, for example, *Multiwavelength Astrophysics*, ed. F. Cordova).

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FAX: (301) 286-3391

Accessing the On-line Mission List

FTP

```
ftp nssdca.gsfc.nasa.gov
username anonymous
cd astro-1
ls
get astro_1.timeline
get astro_1.news
quit
```

default DECnet

```
directory nssdca::[anonymous.astro-1]
copy nssdca::[anonymous.astro-1]astro_1.timeline *.*
copy nssdca::[anonymous.astro-1]astro_1.news *.*
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Instrument-specific Descriptions

BBXRT

BBXRT will cover the 0.3 to 12keV band, with an effective area of 765 cm^2 at 1.5keV, and 300 cm^2 at 7keV. The energy resolution is 0.09keV at 1.5keV, and 0.15keV at 6keV. The typical observing time will be about 2 to 4 ksecs.

The observing list for BBXRT is the largest of the Astro-1 instruments, and includes a representative of nearly every class of x-ray emitting objects. A current mission list should be consulted for the targets. Time-variable targets should be monitored at ground-observable wavelengths to provide a broader wavelength coverage.

HUT

HUT is a UV spectroscopy experiment, covering the 850Å to 1850Å range in first order (425Å to 925Å in second order) at a spectral resolution of 3Å. The telescope has a 0.9m f/2 primary.

The target list for HUT is varied, including bright stars, cataclysmic variables and other interacting binary stars, supernova remnants, galaxies, and quasars. A current mission list should be consulted for the targets.

UIT

UIT is a UV photography experiment, covering the 1400Å to 3200Å range. It has a magnitude limit of about 25 (maximum exposure time ~30 minutes), with its 38 cm, f/9 mirror. The field of view is 40 arcmin, and the angular resolution is 2 arcsec.

As might be expected, the UIT mission list contains objects which will show extended emission in the UV (galaxies, SNRs, etc.). Images of the same objects, taken at other bandpasses with a comparable image scale, would be valuable for comparative studies.

WUPPE

WUPPE is a UV polarimetry experiment, covering the 1400Å to 3200Å range at a resolution of about 6Å. The magnitude limit is about 16, with a primary area of 1800 cm^2 (mirror diameter is 50 cm). The field of view is 3.3 by 4.4 arcmin.

Monitoring observations of variables on the WUPPE target list are urged. The targets include cataclysmic variables, symbiotic stars, pulsators, and Be stars in both hemispheres. In addition, photometry of selected BL Lac objects will be necessary. WUPPE is capable of observing these faint objects only in outburst.

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SEVEN MORE UNDESIGNATED VARIABLE STARS

A photographic sky patrol by Kaiser has resulted in the discovery of seven more variable stars that are not included in the General Catalogue of Variable Stars (Kholopov et al. 1985) or the subsequent Name Lists of Variable Stars (Kholopov et al. 1985, 1987, 1989). The positions and the preliminary magnitude ranges, types, and periods are given in Table I, which continues the list in Kaiser et al. (1989).

Table I .

Var. designation	RA (1950)	Dec (1950)	Range	Type	P (days)
DHK 6 = NSV 12178	19^h 32^m 36^s	$+23^o$ 46.7'	9.7-10.9 b	Lb	-
DHK 7	-	-	- -	cst.	-
DHK 8	21 37 45	-02 00.8	9.7-11.0 b	SR	343
DHK 9	03 23 08	+40 17.0	8.1- 8.6 v	EA	3.045
DHK 10 = NSV 2622	05 42 57	-04 15.6	12.0-12.6 b	SR:	200:
DHK 11	02 17 46	+54 16.9	6.9- 7.4 v	EA	2.111
DHK 12 = NSV 12387	19 43 44	+30 08.8	7.5- 7.9 v	SRb:	60:
DHK 13	19 58 28	+07 16.4	8.2- 8.6 v	E:	?

(The designation DHK 7 was used prematurely in AAVSO Eclipsing Binary Bulletin No. 46 to refer to a suspected eclipsing variable. However, Kaiser has re-examined the original plates and finds that the initial impression of variability was erroneous.)

In this report, we present observational results for the three eclipsing systems. The four red variables will be discussed by Williams (1990).

DHK 9 = BD +39°784, HD 21155, SAO 38830 (Per)

The spectral type is B8. Following discovery by Kaiser, regular visual monitoring by Baldwin found additional minima at 3.05-day intervals (Baldwin and Kaiser 1989). Kaiser and Baldwin have estimated this star on 365 Harvard plates of the AI, FA, and Damon series, 1905-1948 and 1975-1989. Table II gives the times when the star was estimated to be at minimum on these plates and the Kaiser discovery photo, as well as the times of Baldwin's faintest visual estimates.

Table II -- DHK 9

HJD		O-C	HJD		O-C
2423088.478	H	$+0\overset{d}{.}023$	2430981.796	H	$-0\overset{d}{.}071$
26051.518	H	-0.012	45227.756	H	-0.013
27680.841	H	+0.077	46488.523	H	+0.001
27799.517	H	-0.014	47383.841	H	+0.001
28478.656	H	+0.024	47502.610	K	+0.004
28484.743	H	+0.020	47505.664	H	+0.012
28877.553	H	-0.013	47636.590	B vis	-0.009
30296.595	H	-0.080	47718.839	B vis	+0.017
30573.811	H	+0.014			

H = Harvard, K = Kaiser, B = Baldwin

The O-C residuals refer to preliminary light elements derived from these data by the least-squares method, with mean errors:

$$\text{Min. I} = \text{HJD } 2435938.336 + 3\overset{d}{.}0452976 \text{ E}$$
$$\pm.009 \quad \pm.0000029$$

Two photoelectric measures by Williams near phase 0.5 of this period do not reveal a secondary minimum greater than 0.03 V. We therefore cannot eliminate the possibility that the alternate minima are primary and secondary eclipses of nearly equal depth, and the true period could be 6.09 days. The photoelectric observations are continuing.

DHK 11 = BD +53°507, HD 14384, SAO 23229 (Per)

The spectral type is F5V. Kaiser and Baldwin have estimated this star on 137 Harvard plates of the AI and FA series, 1938-1948, as well as Kaiser's patrol photos. The small amplitude and overexposed images make minima difficult to recognize on the long-exposure Harvard plates. Table III also includes visual timings of a predicted eclipse by each of us, derived from individual series of estimates by the tracing paper method.

Table III -- DHK 11

HJD		O-C	HJD		O-C
2429535.713	H	$+0\overset{d}{.}009$	2447808.594	W vis	$+0\overset{d}{.}001$
29898.776	H	-0.021	47808.606	K vis	+0.013
30240.798	H	+0.017	47808.608	B vis	+0.015
47736.826	K	+0.008	47922.570	K	-0.017
47789.586	K	-0.008			

H = Harvard, K = Kaiser, W = Williams, B = Baldwin

The O-C residuals refer to the preliminary least-squares light elements:

$$\text{Min. I} = \text{HJD } 2436324.707 + 2^{d}.1110084 \text{ E}$$
$$\pm.006 \quad \pm.0000012$$

Photoelectric observations by Williams show an amplitude of 0.54 V. The eclipses are partial and 5 hours in duration. The secondary eclipse has not been observed, so the true period may be 4.2 days with equal primary and secondary minima. Photoelectric photometry by Williams and others will be reported at the end of the observing season.

DHK 13 = BD +7^{o}4335, HD 189676, SAO 125354 (AQL)

The spectral type is B9. Williams has examined 429 Harvard plates of the AI, FA, and Damon series, 1903-1910, 1930-1946, and 1973-1988. Again, the small amplitude and long exposures makes minima very difficult to detect on the Harvard plates. The star was estimated within 0.1 magnitude of maximum on almost all plates, but five showed the star 0.4 magnitude fainter. Table IV gives these times and that of Kaiser's discovery photo.

Table IV -- DHK 13

HJD		HJD	
2417366.755	H	2443280.798	H
18495.781	H	47356.716	H
27062.478	H	47684.848	K

H = Harvard, K = Kaiser

Perhaps because of the small number of minima and large time intervals, we have not been able to determine an unambiguous period from these data. Williams obtained V-band photoelectric photometry for one to two hours on eight nights at the end of the 1989 observing season. The star was 0.15 magnitude fainter than maximum on one occasion and showed systematic changes of 0.03 - 0.05 magnitude on the other nights, suggesting cycles of about 0.2 day. We assume that DHK 13 is an eclipsing binary, but another type of variability may be occuring instead of, or in addition to, eclipses. Extensive photometry is planned for the next observing season to reveal the true nature of this variable.

* * *

We are most grateful to curator Martha Hazen for use of the Harvard College Observatory photographic plate collection, without which most of these results would not have been possible. Some of the information in this report was obtained from the SIMBAD data retrieval system, database of the Strasbourg, France, Astronomical Data Center, for which we thank Joyce Rey-Watson of the

Harvard-Smithsonian Center for Astrophysics and Elizabeth Waagen of the AAVSO staff. The variables were detected by Kaiser using a projection blink comparator (PROBLICOM) as described by Mayer (1977).

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Williams, D. B., 1990, Inform. Bull. Var. Stars No. 3443.

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OBSERVATIONS OF FOUR DHK RED VARIABLES

Kaiser has found light variations in a number of stars not officially designated as variables (Kaiser et al. 1990; see that reference for positions, magnitudes, etc.). I have used the Harvard College Observatory photographic plate collection to investigate the light changes of the red variables DHK 6, 8, 10, and 12. Figure 1 is a finding chart for DHK 10, which is not included in the BD or SAO atlases. Light curves for all four stars appear in Figure 2.

DHK 6 = BD +23°3694, HD 344531, IRC +20415, NSV 12178 (Vul)

DHK 6 is an independent discovery by Kaiser of a variable first reported by Strohmeier et al. (1956) as BV 142. The spectral type is M0. Estimates on 116 blue plates of the Damon patrol series from 1972-1988 produce a light curve with significant variations but no clear periodicity, supporting the tentative NSV classification of type Lb (Kholopov et al. 1982).

DHK 8 = BD -2°5597, SAO 145577, IRC +00507 (Aqr)

The spectral type is M5. Estimates on 124 blue plates of the Damon patrol series, 1970-1988, indicate that this variable is type SR. Seven pairs of maxima or minima yield a well-defined mean period of 343 $\pm$12 days (standard deviation).

DHK 10 = IRC 00085, NSV 2622 (Ori)

This is an independent discovery of a variable first reported by Neugebauer and Leighton (1969) as varying from 6.10-6.69 in the I band. The spectral type is M4. Estimates on 89 blue plates of the Damon patrol series, 1972-1988, suggest periodic behavior, but each cycle differs in shape, amplitude, and length. This variable is probably type SR, but the period is poorly defined at about 200 $\pm$100 days.

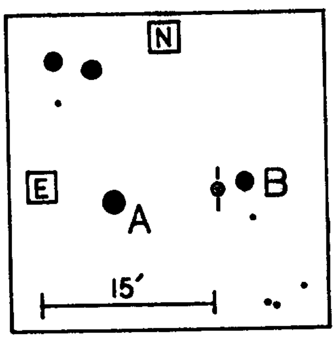

Figure 1. Finding chart for DHK 10.
A = BD $-4^{\circ}1235$, SAO 132515, 6.4 m_v
B = BD $-4^{\circ}1233$, SAO 132509, 9.0 m_v

DHK 12 = BD +29°3730, HD 18680, SAO 68801, IRC +30391, NSV 12387 (Cyg)

This is an independent discovery by Kaiser of a variable first reported by Lee (1970), who measured a mean magnitude of 7.62 V, +1.70 B-V, and spectral type of M4.0 III. Estimates on 114 blue plates of the Damon patrol series, 1972-1988, do not show variations significantly greater than the observational scatter.

However, variability is confirmed by my photoelectric measures (Table I) with a 28-cm Schmidt-Cassegrain telescope and Optec SSP-3 photometer, using Phi Cyg (4.69 V, +0.97 B-V) as the comparison star. Each observation is the mean of three or four differential measures, corrected for extinction and transformed to the Johnson V system.

Table I

HJD 2447796.550	+2.992 ΔV	±0.011 σ_1
802.538	+3.009	±0.015
810.594	+3.039	±0.011
821.547	+3.138	±0.004
861.503	+2.820	±0.003
869.505	+2.890	±0.012

Together, the photoelectric and photographic observations suggest that the amplitude does not exceed $0^{m}.4$. The above observations show the star dimming by

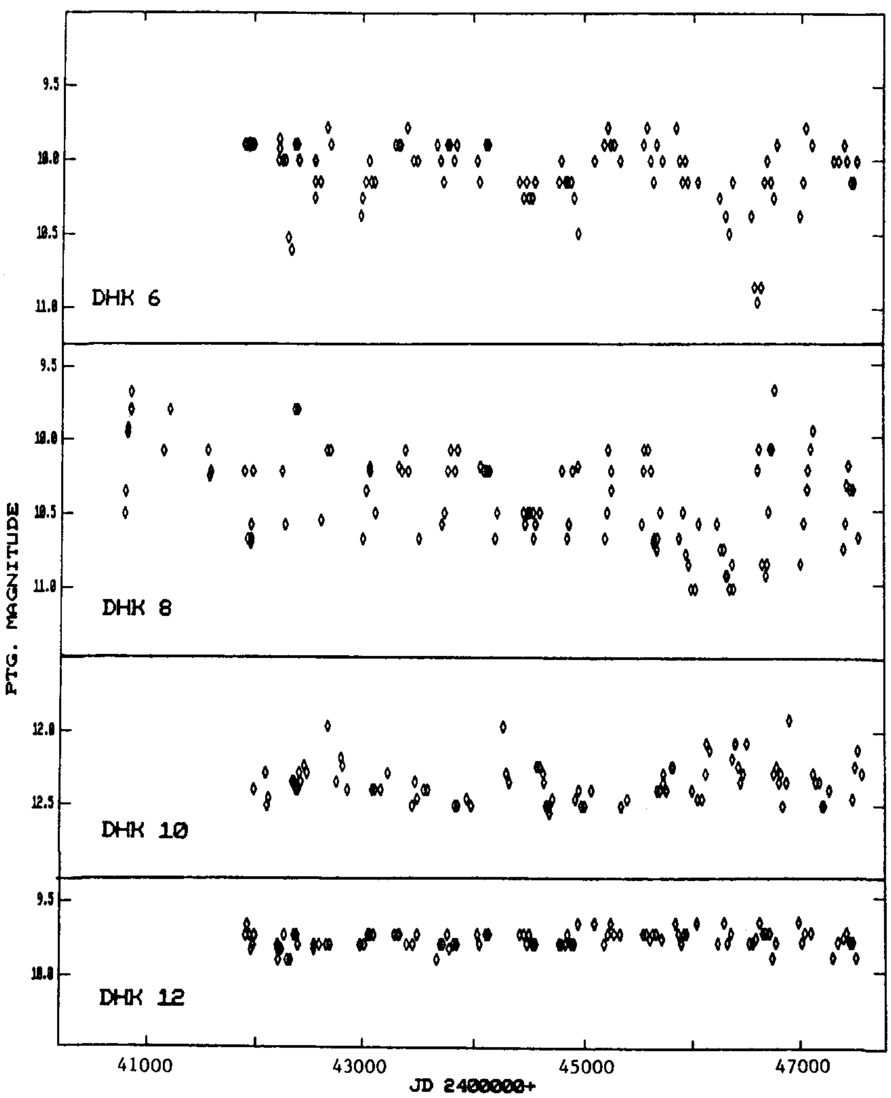

Figure 2. Photographic light curves for DHK 6, 8, 10, 12.

$0^m_{\cdot}15$ in 25 days and brightening by $0^m_{\cdot}32$ during the 40-day observational gap, after which it was dimming again. This suggests that the type is SRb with a period of about 60 days, rather than the slow, irregular variation of type Lb. However, more extensive photoelectric observations are needed to confirm the classification and define the period.

* * *

Some of the information in this report was obtained from the SIMBAD data retrieval system, database of the Strasbourg, France, Astronomical Data Center. I wish to thank curator Martha Hazen for extensive use of the Harvard College Observatory photographic plate collection, for this and other variable star projects. Daniel H. Kaiser, the discoverer, provided computer graphing of the light curves.

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Pulsation period of CY Cnc[1]

Breger (1970) in a study of Praesepe cluster (NGC 2632) observed CY Cnc (KW 114, HD 73345, m_v=8.14, F0V) during 2.2 hours and remarks "small variability possible". Later Jackish (1972) classified it as probable δ Scuti type variable, he estimated a period around 2-3 hours.

The observing run was carried out during one night in December, 1989, with the 1.5m spanish telescope in the Calar Alto Observatory (Almería, Spain). The variable and both comparison stars (C_1=HD 73294 and C_2=HD 73430) were measured in uvby filters. The light curve in filter b is shown in figure 1 as magnitude differences (CY Cnc-C_1) in instrumental system, the solid line was calculated from the obtained frequency.

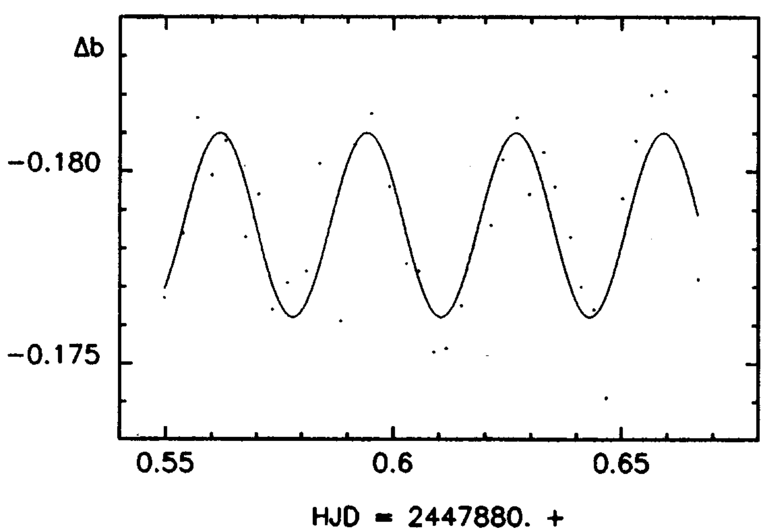

Figure 1

[1]Based on observations collected by using the 1.5 m telescope from the Observatorio Astronómico Nacional at Calar Alto Observatory, Almería, Spain

The Fourier analysis carried out for our data (López de Coca et al., 1984), showed a dominant frequency at 30.8 c/d and an amplitude of $0.^m005$.

For the photometric calibration (López de Coca et al., 1990), we have used the indices given by Hauck and Mermilliod (1985) and we obtained the following physical parameters for this star: M_{bol}=2.06; log T_e=3.902 and log g=4.074. With these values, we can calculate the pulsational constant Q with the classical Petersen and Jørgensen (1972) formula, thus, Q=0.016 that should correspond to the third overtone.

Therefore, we can conclude that CY Cnc can be considered as a normal δ Scuti variable, although more observations are needed.

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HR 8062 A NEW VARIABLE IN CYGNUS

Photoelectric photometry of HR 8062 = HD 200527 = SAO 50381 = GC 29388 obtained between November 3, 1989 and January 24, 1990 indicates a range of $6^m.18$-$6^m.36$ V and a period of 36 days between maximum. Only two cycles of minima light were obtained, (Figure 1) and it can be seen the amplitude of the variation of luminosity appears to be fluctuating, increasing by $0^m.04$. Due to this phenomena over a characteristic time interval we might conclude HR 8062 is a semiregular giant variable with probable multiple periods.

HR 8062 is listed as $6^m.38$ V, spectral type Mb, Buscombe spectral type = M4 III, (RA = $21^h00^m37^s$, D = $+44^o$ 35.6' (1950) in the Yale Bright Star Catalogue (Hoffleit and Jaschek 1982). Sky Catalogue 2000.0 list HR 8062 at magnitude $6^m.19$ V, B-V = 1.69, spectral type M3 Ib-II, (RA = 21^h02^m 23.9^s, D = $+44^o47'28''$ (2000). (Hirshfeld and Sinnott 1982). The two listed magnitudes correspond to the brightest and minimum magnitudes obtained during the sequence. When it was anticipated the period might be around 36 days one measurement or normal point per night was necessary.

A search of the General Catalogue of Variable Stars (Kholopov et al. 1985), the New Catalogue of Suspected Variable Stars (Kholopov et al. 1982) and the 67th, 68th and 69th Name-List of Variable Stars (Kholopov et al., 1985, 1987, 1989) indicates that it is not known as a variable. HR 8062 was selected as a potential variable star because the spectra is similar to those of other known variable stars of mainly small amplitude (Hoffleit 1979).

The observations were made using a Optec 3 photometer attached to the 0.56m (22 Inch) telescope at the MacLean Observatory and the 0.25m (10 Inch) telescope at the Tahoe Observatory. Altogether 38 and 29 differential magnitudes of HR 8062 in V and B bandpass, respectively, were obtained. The delta magnitudes have been corrected for extinction and transformed to the standard BV system. Each delta magnitude was calculated from three delta magnitudes in the sense V - C (Table 1). The comparison star was HD 200407 = SAO 50368, A2, $6^m.72$ V, B-V = 0.30, and the check star was HD 200560 = SAO 50388, K2, $7^m.68$ V, B-V = 0.97 (Figure 2).

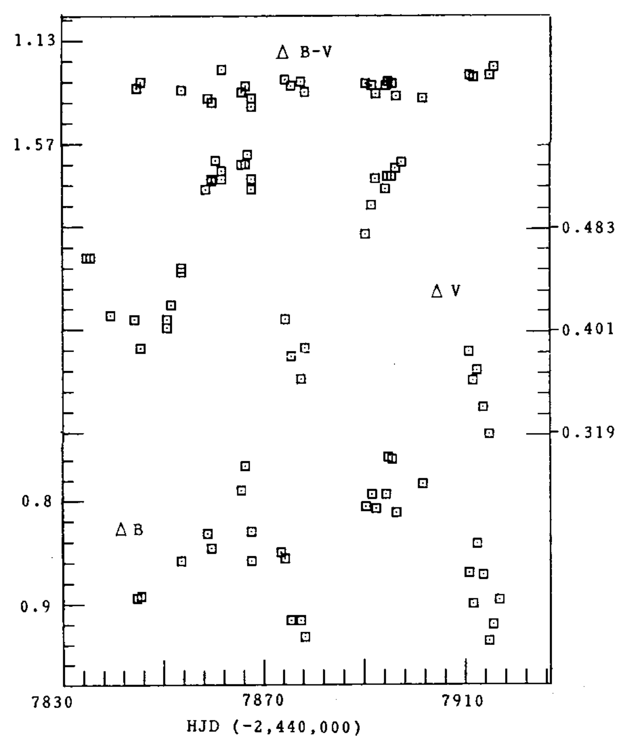

Figure 1.
Differential V, B and B-V colour curves of
HR 8062

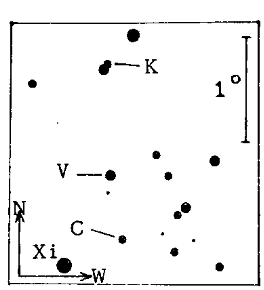

Figure 2.
Finding chart.
V= HR 8062
C= Comparison
K= Check

TABLE 1 HR 8062

HJD -2447...	DELTA V	sd	HJD -2447...	DELTA B	sd
834.6251	−0.459	.021	844.6009	0.894	.005
835.6124	−0.458	.008	845.5914	0.893	.077
839.6087	−0.412	.004	853.5939	0.859	.022
844.5881	−0.409	.017	858.6085	0.832	.030
845.5799	−0.386	.003	859.6508	0.845	.040
850.6518	−0.409	.003	865.5893	0.790	.051
850.7193	−0.403	.003	866.5766	0.765	.000
851.5854	−0.421	.007	867.5880	0.857	.021
853.5819	−0.451	.012	867.7197	0.830	.007
853.6094	−0.447	.006	873.5839	0.849	.041
858.5928	−0.512	.007	874.5841	0.856	.005
859.5882	−0.521	.001	875.5835	0.917	.021
859.6762	−0.519	.003	877.5794	0.916	.097
860.5787	−0.536	.015	878.5834	0.932	.041
861.5783	−0.521	.016	890.5969	0.806	.014
861.6176	−0.527	.015	891.5905	0.795	.019
865.5880	−0.532	.006	892.5912	0.809	.032
866.5753	−0.532	.014	894.5921	0.795	.020
866.6130	−0.540	.014	894.6261	0.758	.054
867.5867	−0.521	.004	895.5922	0.759	.028
867.7181	−0.512	.003	896.5950	0.812	.040
874.5829	−0.410	.009	901.5909	0.785	.009
875.5824	−0.380	.014	910.6049	0.869	.008
877.5783	−0.362	.016	911.5992	0.899	.053
878.5823	−0.386	.007	912.5991	0.842	.022
890.5958	−0.476	.012	913.6003	0.871	.015
891.5892	−0.499	.019	914.6043	0.935	.035
892.5902	−0.520	.014	915.6030	0.919	.070
894.5906	−0.513	.008	916.6044	0.897	.031
894.6251	−0.522	.023			
895.5912	−0.523	.011			
896.5941	−0.529	.008			
897.6057	−0.534	.005			
910.6040	−0.383	.017			
911.5980	−0.360	.009			
912.5980	−0.368	.012			
913.5990	−0.338	.013			
914.6032	−0.317	.011			

I would like to acknowledge my gratitude to Mr. Gordon MacLean for the use of the MacLean Observatory and the 0.56m telescope, and to the Sierra College, Rocklin, California for providing the necessary photometry equipment.

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1988 AND 1989 UBV PHOTOMETRY OF BD+61°1211

BD +61°1211 (=DM UMa = #75 in the catalog of Strassmeier et al. 1988) is a very active long period (7.492 days) RS CVn system. This noneclipsing system displays rapid changes in its light curve on time scales from about a year to a few months in 1987 (Kimble et al. 1981, Mohine et al. 1985, Heckert et al. 1988). The evolving light curves indicate both a high level of chromospheric activity and rapid changes in the level of this activity. To follow the continued evolution of this system, I performed UBV photometry during 1988 and 1989.

I made the observations in May 1988 and in March, May, June, and July 1989 on the 24" telescope operated by San Diego State University at Mt. Laguna, CA. I used the same instrument, techniques, and comparison stars as Heckert et al. (1988). The data are in the Johnson UBV system.

Figures 1 and 2 show the 1988 and 1989 ΔV light curves. Figures 3 and 4 show the 1988 and 1989 color curves (ΔB-V and ΔU-B). The differential magnitudes are in the sense comparison - star. Errors are typically less than 0.01 mag in ΔV, about 0.015 mag in Δ(B-V), and about 0.02 - 0.04 mag in Δ(U-B). The higher Δ(U-B) errors are in 1989. Observations of the check star show no evidence for variability in the comparison. I computed the orbital phase using ϕ=JD 2443881.4+7.492E (Crampton et al. 1979).

The 1988 and 1989 ΔV light curves (Figs. 1, 2) show the single peaks similar to the 1979, 1980, 1983, 1984, 1986, and 1987 curves rather than the double peaks of the 1981 and 1982 curves. The 1988 ΔV curve varies with an amplitude of a little over 0.15 mag; however, a gap at minimum light makes an accurate estimate of the amplitude difficult. The amplitude of the 1989 light curve (0.16 mag) is roughly the same but easier to estimate reliably. These amplitudes increase with decreasing wavelength to about 0.25-0.3 mag at U. The 1988 and 1989 amplitudes of the ΔV curves are larger than the historic minimum amplitude of 0.05 mag during June and July 1987 (Heckert et al. 1988), but not as high as the historic maximum amplitude of 0.32 mag observed in 1979 (Kimble et al. 1981).

The phases of minimum brightness during 1988 and 1989 are roughly 0.00 and 0.03. These phases compare to 0.57 during 1986 and about 0.6 during 1987. Gaps in the light curves make these estimates difficult for 1987 and 1988. Mohin et al. (1985) tabulate the phase of minimum light for the years from 1979 to 1984. They find the phase of minimum light migrating from 0.47 in 1979 to 0.03 in 1982. A second phase of minimum light migrates from 0.7 in 1981 to 0.32 in 1984. The overlap in 1981 and 1982 represents the double peaked light curves in those years. At this time, the spot visible from 1979 to 1982 broke up and a new spot formed that was visible between 1981 and 1984. The phase of minimum light during 1986 and 1987 is not consistent with the trend between 1982 and 1987. Hence, the spot group visible in 1986 that spread out during 1987 was a different shorter lived group than that visible between 1982 and 1984. Unfortunately, I have no 1985 data.

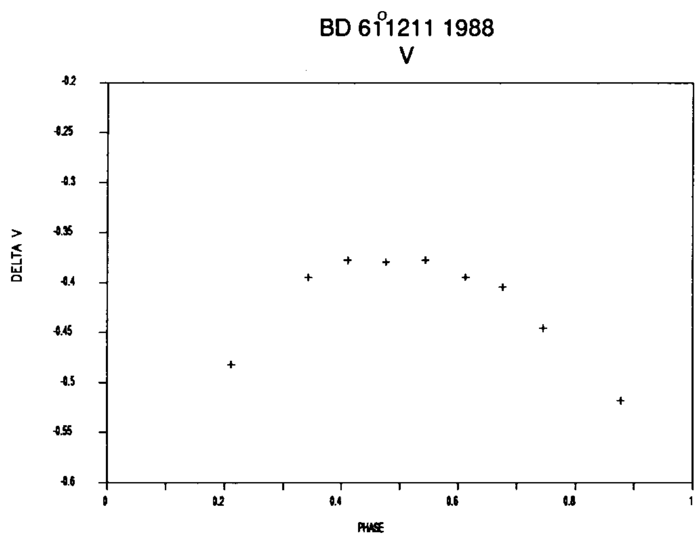

Figure 1

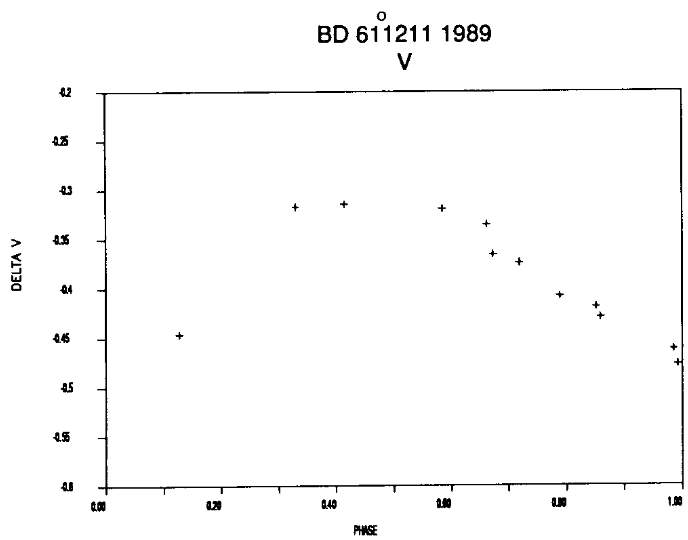

Figure 2

The 1988 and 1989 data show that a new spot group formed at a different phase, and that the same spot group was visible these two years. The migration rate for this spot group is much smaller than for the two spot groups seen by Mohin et al. (1985). As the spot migration is likely caused by differential rotation, the 1988, 1989 spot group is

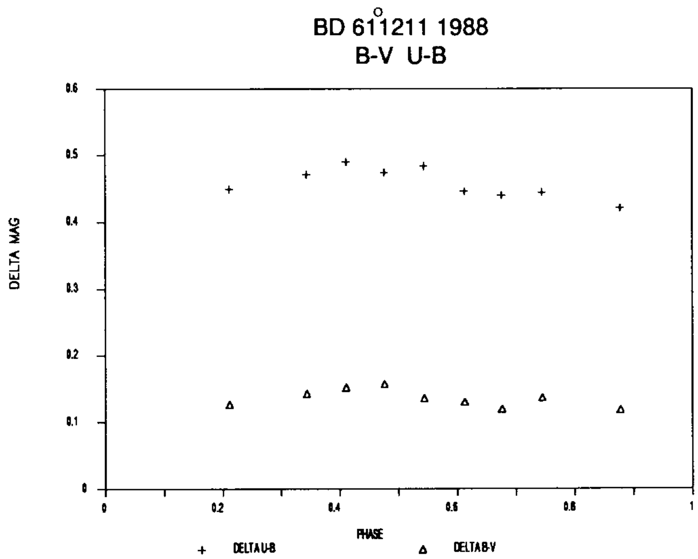

Figure 3

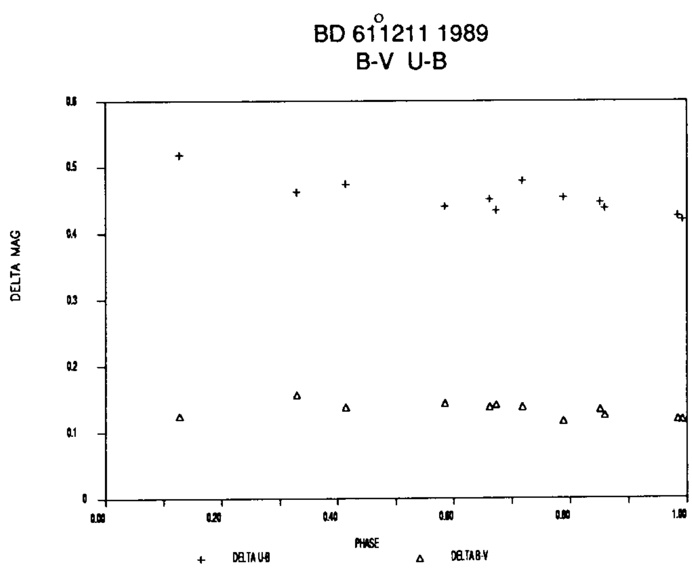

Figure 4

at a different latitude than the previous groups. Note that from 1988 to 1989 the phase of minimum light appears to increase with time rather than decrease as observed by Mohine et al. (1985). However the change is so small that additional data are needed to verify this trend. In any case the different migration rates for the 1979 - 1982, 1981 - 1984, and 1988 - 1989 spot groups suggest a latitudinal drift from one spot group to the next as well as a longitudinal drift for each group.

Between 1988 and 1989 ΔV at maximum light brightened from roughly 0.37 to 0.30 while the amplitude variability changed minimally. During late 1987, the spots were spread out over the star rather than clustered at one longitude (Heckert et al. 1988). The 1988 data show that in addition to the new spot group there were residual spots from 1987 spread out over the surface. During 1989 the spot cluster remained roughly the same but the residual spots either disappeared or decreased significantly.

The 1988 and 1989 color curves show roughly the same behavior as the 1979 color curve (Kimble et al. 1981) and the 1986 curves (Heckert et al. 1988). As for the ΔV curves the 1988 color curves are of intermediate amplitude. They are at maximum when ΔV is at maximum indicating that BD+61^{o}1211 is bluest at maximum light. This color behavior is consistent with the hypothesis that the brightness variations are caused by spotted regions at a lower temperature than the rest of the star. The 1989 Δ(B-V) curve appears consistent with this trend, but has more scatter in the data. The 1989 Δ(U-B) curve does not appear to follow this trend. However, owing to slightly less stable atmospheric conditions in 1989, there is more scatter in the data for both the variable and check star. The larger errors make this curve difficult to interpret.

BD+61^{o}1211 continues to display rapid evolution in its light curves. During 1988 and 1989 the starspots that spread out during 1987 regrouped at a different longitude. The changing migration rate also shows a latitudinal drift between different spot groups. I plan to continue monitoring this system to look for long term cycles in the starspot activity.

Ron Angione scheduled very generous amounts of time on the Mt. Laguna 24" telescope for this work. Western Carolina University provided travel funds for this work through a faculty research grant and additional funds. Mary Ann Hickman helped collect the May 1989 data.

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SAO 23229: A NEW DOUBLE-LINED SPECTROSCOPIC ECLIPSING BINARY

The discovery of eclipses of the bright star SAO 23229 (HD 14384; V=6.9; Spectral Type F5 V) by Indiana observer Dan Kaiser was described in a recent article in Sky and Telescope magazine (MacRobert, 1990). Photoelectric observations by H. Landis and D. Williams, reproduced in that article, show eclipses of 0.55 mag depth and period of 2.111 days. No secondary eclipses are reported, leaving open the question of whether the system contains a very dim secondary or whether it consists of two identical stars with an actual period of 4.2 days. We report here observations that favor the latter interpretation.

We have observed SAO 23229 spectroscopically, using echelle spectrographs on the 1.5 m Wyeth reflector at Oak Ridge Observatory and the 1.5 m Tillinghast reflector at Fred L. Whipple Observatory. High-resolution (10 km/sec) spectra, each covering a region 45 Angstroms wide centered on 5187 Angstroms were reduced by cross-correlating them with a high-signal-to-noise template spectrum of the twilight sky. The procedure is standard for spectra reduced at the Center for Astrophysics, and details of the reduction and velocity-measurement techniques have been documented elsewhere in the literature (Latham 1985).

Two spectra observed in February, 1990, along with the corresponding cross-correlations, are shown in Figure 1. The correlations appear double-peaked, evidence that two components are present in the binary system. Velocities derived from these peaks for two nights are presented in Table 1. We have here a

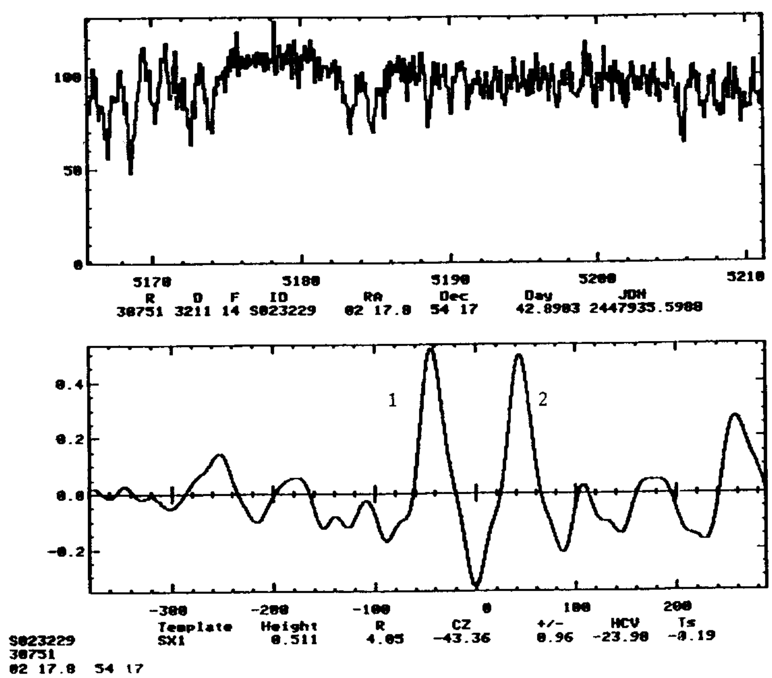

Figure 1a: Spectrum and cross-correlation of SAO 23229 observed at Oak Ridge Observatory, H.J.D. 2447935.5988. Two nearly equal peaks are observed, labeled 1 and 2. Velocities for these components are given in Table 1.

TABLE 1

Radial Velocity Observations of SAO 23229

Heliocentric Julian Date	V1(km/sec)	V2(km/sec)
2447935.5988	-43.4	+43.3
2447942.5089	+85.6	-86.9

clearly separated double-lined spectroscopic binary with a velocity semi-amplitude of at least 85 km/sec for each component. The nearly equal height of the correlation peaks indicates that the two components of the system are close to one another in luminosity (Marschall and Mathieu, 1988), while the symmetry of the velocity excursions around the mean suggests that the com-

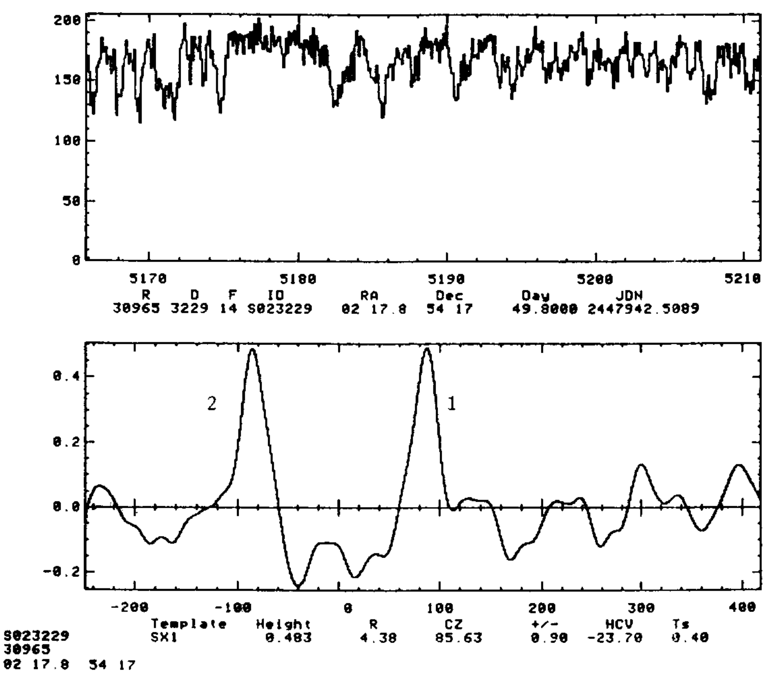

Figure 1b: Spectrum and cross-correlation of SAO 23229 observed at Oak Ridge Observatory, H.J.D. 2447942.5089. Two nearly equal peaks are observed, labeled 1 and 2. Velocities for these components are given in Table 1 .

ponents are of nearly equal mass. Finally, the velocity semi-amplitude is consistent with that expected for two F5 V components of period 2 to 4 days seen in the plane of the orbit.

Thus it seems likely that primary and secondary eclipses are nearly equal in depth and that the 2.1-day period of recurring eclipses is actually the half the true period of the binary system. Photometric observers of SAO 23229 should therefore exercise care to see if one eclipse can be distinguished from another, allowing precise determinations of the photometric characteristics of the individual components of the system.

The two reduced spectra presented here only give a qualitative estimate of the relative masses of the components. A full characterization of the masses of this binary system requires a determination of the spectroscopic orbital elements along with precise photometry. We continue to obtain radial velocity measurements of SAO 23229 with the aim of deriving the full velocity curve and the orbital elements of the system.

Thanks to Joyce Rey-Watson for making the resources of the SIMBAD database available to us for this study.

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NEW DOUBLE-LINED ECLIPSING BINARIES

High-resolution coudé spectrometric observations have been continued during the past 5 years as part of a program to determine accurate absolute properties of eclipsing binary stars. Previous progress reports (Lacy and Evans 1979, Lacy 1984, Lacy 1985) have discussed 45 of the stars in this program. Observations of an additional 8 eclipsing binaries are discussed here. These observations were obtained with either the 2.1 m reflector or the coudé feed telescope at Kitt Peak National Observatory (N.O.A.O.) and the coudé CCD spectrometer. Typically 100 Å in the blue (4500 Å) or red (6430 Å) were observed at a resolution of 0.2-0.3 Å. The individual binaries are discussed below.

Double-Lined Eclipsing Binaries

Name	V	Spec	P(days)	Name	V	Spec	P(days)
WW Cep	10.63	G3*	1.53*	RW Lac	10.65	F2*	10.37
EY Cep	9.79	A5*	5.52	V530 Ori	9.87	G0	6.11
NN Cep	8.10	A5*	2.06	V523 Sgr	9.56	A5*	2.32
V498 Cyg	9.83	B1:III:	3.49	TY Tau	12.01	K0V	1.08

* See notes below.

Only V523 Sgr and NN Cep have good photoelectric light curves. Photoelectric observers are encouraged to observe these systems in at least two well-calibrated colors in order to make possible the most accurate determinations of absolute stellar properties.

The V magnitudes listed above are preliminary results of UBV all-sky photometry obtained at Mt. Laguna Observatory in the Fall of 1989, except for V523 Sgr (see below). The spectral types and orbital periods are those listed in the *General Catalogue of Variable Stars* (1985). Notes on the individual systems are listed below.

<u>WW Cep</u>: Double lines were first detected in a spectrogram taken July 2, 1985. Preliminary color indices are consistent with a slightly reddened G9 main-sequence star.

If unreddened, the B-V index points to a K1 spectral type. Popper (1989) has found strong emission at the Ca II H and K lines. He hypothesizes that the system is of the RS CVn type. Narrow lines are seen in the red with a line depth ratio of about 6:1. Lines of both components have about equal widths. The ephemeris listed in the GCVS (1985) is inconsistent with my spectrograms.

EY Cep: Double lines were first detected in a spectrogram taken Sept. 8, 1989. The appearance of the available spectrograms and preliminary color indices are consistent with an unreddened F3 main-sequence star. The GCVS type, A5, is definitely too early. Narrow lines are seen in the blue with a line depth ratio near 1:1. Lines of both components have about equal widths. The spectroscopic near-equality of the two components is surprising since the eclipse depth ratio is about 2:1, but the light curve is very poorly known.

NN Cep: Double lines were first detected in a spectrogram taken Sept. 9, 1989. The appearance of the available spectrograms and preliminary color indices are consistent with a slightly-reddened F1 main-sequence star. The GCVS type, A5, is definitely too early. Moderately broad lines of the primary and narrower lines of the secondary are seen in the blue with a line depth ratio of about 3:1. A good photoelectric light curve has been obtained and analyzed by Güdür et al. (1983).

V498 Cyg: Double lines were first detected in a spectrogram taken Sept. 10, 1989. The appearance of the spectrum and preliminary color indices are consistent with a highly-reddened (E(B-V) = 1.28 mag) B1.5 main-sequence star. Broad 4471 Å He I lines are seen in the blue with line depth and width ratios near 1:1.

RW Lac: Double lines were first detected in a spectrogram taken Sept. 11, 1989. The appearance of the spectrum is that of late-F or G type stars. The preliminary color indices are somewhat anomalous - the B-V index points to G4 if unreddened, but the U-B index points to F8. No amount of assumed interstellar reddening can remove this anomaly.

Narrow, deep lines are seen in the red with a line depth ratio of about 2:1. Lines of both components have about equal widths.

V530 Ori: Double lines were first detected in a spectrogram taken Mar. 31, 1985. The appearance of the spectrum is that of late-F or early-G type stars. The preliminary color indices are somewhat anomalous - similar to, but less severe than, with RW Lac (see above). The B-V index points to G2 if unreddened, but the U-B index points to F9. Narrow, deep lines of the primary are seen in the red. Lines of the secondary are very shallow - the line depth ratio is about 12:1. The lines of the secondary appear to have about the same width as those of the primary.

V523 Sgr: Double lines were first detected in a spectrogram taken May 8, 1989. The appearance of the spectrum and color indices of Woodward and Koch (1989) are consistent with a slightly reddened A9 main-sequence star, significantly later than the GCVS type, A5. Moderately broad lines are seen in the blue with a line depth ratio of about 1.5:1. The widths of the secondary's lines are slightly less than those of the primary. Woodward and Koch (1989) has published and analyzed a photoelectric light curve.

TY Tau: Double lines were first detected in a spectrogram taken Dec. 2, 1985. The appearance of the spectrum and preliminary color indices are consistent with a main-sequence K star, but the color indices are somewhat anomalous. The B-V index points to K4, but the U-B index points to K1. There is a faint companion about 10 arcsec from TY Tau and about 2.5 mag fainter. This may have an effect on the color indices. Moderately narrow lines are seen in the red with a line depth ratio of 2.5:1 and nearly equal line widths.

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R CrB AT THE BEGINNING OF THE VISUAL LIGHT MINIMUM

During August-September 1988 and February-March 1989 a number of polarimetric and photometric observations of R Coronae Borealis at the beginning of minimum brightness were made using the 60-cm telescope of Soviet-Bolivian Observatory Santa Ana (Tarija, Bolivia) with the spectrophotopolarimeter (Bugaenko and Guralchuk, 1985) and the standard UBVR filters. The photometric results are given in Table I. Typical photometric errors are 0.01-0.03 mag. The polarimetric observations in the bands U, B, V, R and integral light (Int.) are given in Table II, where P - percentage polarization, Θ - position angle and σ_P, σ_Θ are their standard errors respectively.

Colour variations of R CrB at this light minimum are similar to those observed during the rapid (by rate of brightness decrease) minimum of 1972 (Rao, 1974). This assumes also likeness of other observational characteristics at this phase of the brightness curve. Really, wavelength dependence of polarization (for the first two dates) is comparable to that found for the minimum of 1972 (Rosenbush, 1986).

Table I

Date, JD 2447000+	V	B–V	U–B	V–R
372.53	$7^m.80$	$0^m.53$	$-0^m.16$	$0^m.50$
379.48	9.78	.37	- .58	.53
380.56	10.00	.35	- .58	.53

Table II

Date JD 2447000+	U P± σ_p,% θ ± σ_θ,deg	B P± σ_p,% θ ± σ_θ,deg	V P± σ_p,% θ ± σ_θ,deg	R P± σ_p,% θ ± σ_θ,deg	Int. P± σ_p,% θ ± σ_θ,deg
380.5	2.2±.4 110±5	2.0±.2 107±2	1.3±.2 110±3	1.2±.2 92±8	-
381.5	1.0±.4 106±11	0.8±.2 96±7	1.4±.2 102±4	0.3: 91	-
408.5	-	-	-	-	1.6±.2 70±3
411.5	-	-	2.1±.3 91±4	-	-
569.9	-	0.46±.20 135±12	0.57±.06 115±3	0.63±.14 122±6	-
574.9	-	0.69±.14 122±6	0.46±.06 125±4	0.54±.14 127±7	-

: - it is doubtful.

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A PERIOD DETERMINATION FOR M28 V7

In two papers (Wehlau and Sawyer Hogg, 1984; Wehlau et al. 1986) on the variable stars in the globular cluster M28 (NGC 6626, C1821-249) it was reported that V7 was visible on only a few of the more than 300 plates taken from 1939 through 1985 and could possibly be a U Gem star. Subsequent spectra of the variable taken by Smith and Stryker (Smith and Wehlau, 1985) and by Margon and Anderson (1985) showed it to be a probable Mira variable. Because the star was usually below the plate limit on the earlier plates we decided to take a series of deeper plates of the cluster over as many months each year as possible.

Table I lists the magnitudes for V7 determined from 41 plates taken with the 61 cm telescope of the University of Toronto at the Las Campanas Observatory from 1980 through 1989. Also listed are magnitudes from five plates taken when the star was near maximum brightness with the 1.2 m telescope of the University of Western Ontario. These are indentified with an asteriskin the table. Magnitudes from both sets of plates, all of which were 103a-O + GG385, were determined at the University of Western Ontario by means of iris photometry (given to 0.01 mag in the table) or eye estimates (given to 0.05 mag). We estimate the uncertainty in the iris photometry to be ±0.08 mag when the star is brighter and ±0.15 when it is faint and that of the eye measures as ±0.10 mag. The photoelectric sequence of Alcaino (1981) was used as a standard. The values given here may differ slightly from those listed in Table IX of Wehlau et al. (1986) because the plates were remeasured. In addition magnitudes have been estimated from a few plates taken in 1982 and 1985 which were not included in the earlier table.

Table I. Blue magnitudes for M28 V7

JD 2440000+	B	JD 2440000+	B	JD 2440000+	B
4371.9	16.55	6294.7*	16.15:	6942.8	16.71
4426.8	17.2 :	6323.6*	15.9	6973.8	16.83
4428.9	17.25:	6328.6	15.9	6973.8	17.10
4431.7	17.4 :	6354.5*	16.35	7285.8	16.75:
4432.7	17.4 :	6552.9	18.8 :	7289.9	16.53
5118.9	18.6	6600.7	17.7	7297.9	16.98
5120.8	18.8 :	6600.9	17.5	7626.9	16.96
5163.8	18.85	6613.6	16.72	7627.9	17.07
5169.5	18.8 :	6613.6	16.72	7628.9	17.34
5169.6	18.5 :	6613.7	16.65	7680.7	18.5 :
6181.9	18.6	6613.8	16.75	7680.7	18.5 :
6183.8	18.8 :	6613.8	16.65	7681.8	18.53
6200.9	18.65	6613.9	16.7	7706.7	18.6 :
6208.8	18.65	6652.6*	16.2	7707.7	18.6 :
6228.9	18.8 :	6676.6*	16.55	7709.7	18.6 :
6229.9	18.65				

*Indicates plates taken with the University of Western Ontario telescope

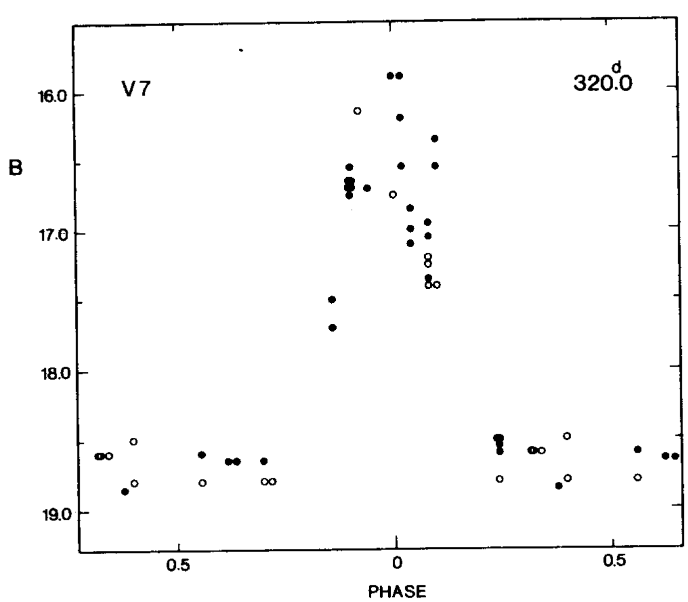

Fig. 1. Blue light curve for M28 V7.

The magnitudes listed in Table I are plotted in Fig. 1 where phases have been computed from an epoch of maximum of JD = 2446321 and the open circles represent observations of lower weight. It can be seen that a period of 320.0 days fits these observations well. The estimated magnitude of 18.8 near minimum may well be too bright due to blending of the image of the variable with that of a nearby faint star. Because of this it is not possible to obtain a good mean blue magnitude for the variable. However, Clement et al. (1982) found that, in blue light, Mira stars at maximum should be about one to two and a half magnitudes brighter than the horizontal branch. Since B_{HB} for M28 is near 16 mag, we conclude that V7 is too faint to be a cluster member.

Although the magnitudes plotted in Fig. 1, all of which represent data from 1980 to 1989, fit well, some of the values listed by Wehlau et al. for dates earlier than 1957 appear to be too bright. This can probably be attributed to the poorer quality of some of the older northern hemisphere observations. In 1952 the star, which certainly did reach a blue magnitude near 15, appears to have had both a brighter and longer maximum than usual. A period of 320.0 days predicts maximum at JD 2434161 for that year, 20 days earlier than the date of the first plate of 1952 listed in Wehlau et al. It should be noted that the date is incorrectly listed there as 31181.827 and should be 34181.827. Another incorrect date given in the same table is that for plate A1692 which is given as 46295.607 when it should be 46294.679.

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Confusion concerning the variability of HR 5492 (=DL Dra) and HR 5437

HR 5492 was observed by Percy (1973) using HR 5437 and HR 5608 as comparison stars. It was only suspected to be a variable star with an amplitude of $\sim$ 0.03 mag and a period of $\sim$ 3 or 7 hours based on five hours of photoelectric observations. Later, Guerrero et al.(1978) confirmed the light variation using HD 130173 as the comparison star. The check stars were HD 129226 and HD 129865. The data from three nights were analysed resulting in two periods (P_1 = 0.0825 days and P_2 = 0.0837 days) with a high period ratio suggesting non-radial pulsational modes. A more extensive study using the same comparison and check stars was performed by Bossi et al.(1981). According to their findings, HR 5492 does not show any light variation with an amplitude larger than 0.01 mag. In spite of the small light variation, two statistically significant periods, P_1 = 1.29 and P_2 = 0.044 days, were found. However, they are not sure that the period P_1 = 1.29 days is attributable to HR 5492. The second frequency is regarded as the radial fundamental mode. Comparing the amplitude of the light variation observed by Percy and by them, a possible variation in the pulsational amplitude on a very long time-scale is indicated.

In an effort to clarify the nature of HR 5492, photoelectric observations were carried out between 1986 and 1988 in Hungary and China. The following equipment was used:

(i) The 60 cm reflector of the Xinglong Station of Beijing Observatory. The photometer is a single-channel type working in the DC mode and controlled by microcomputer (Shi et al. 1987).

(ii) The 50 cm telescope of Piszkéstető, the mountain station of Konkoly Observatory. The telescope is equipped with a data acquisition system, phototube and filters (Patkós,1982) providing photoelectric data close to the Johnson UBV system.

All of the observations were obtained in the Johnson V band. In our study, almost all of the previously used comparison and check stars were observed in different combinations on different nights. The available photoelectric and spectroscopic data of the observed stars are listed in Table 1.

TABLE 1

	Star	V	B-V	U-B	R-I	Sp	ADS number
1	HR 5492	6.25	+0.41	-0.01	+0.20	F2V	9357
2	HR 5437	6.24R				F0III	
3	HD 130173	6.60				F2	9371
4	HD 129865	8.0				F0	
5	HD 129226	8.4				F5	

The data are taken from The Bright Star Catalogue (Hoffleit and Jaschek 1982), the SAO Catalogue and the Index Catalogue of Visual Double Stars (Jeffers et al. 1963). HR 5492 is a very close binary system; the fainter component is 8.5 mag and the separation is 4″.1. In the previous studies (Guerrero et al. 1978, Bossi et al. 1981) the systematically used comparison, HD 130173, is a visual triple system. The separation of the B component from A is 12″.2 and the P component from A is 9″.1. The fainter components are 8.3 and 10.4 mag, respectively. The application of the same diaphragm for this triple system as used for HR 5492 gives data with considerably higher scatter. The journal of the observations is shown in Table 2 containing the observed stars in the last column. The number of stars is taken from Table 1.

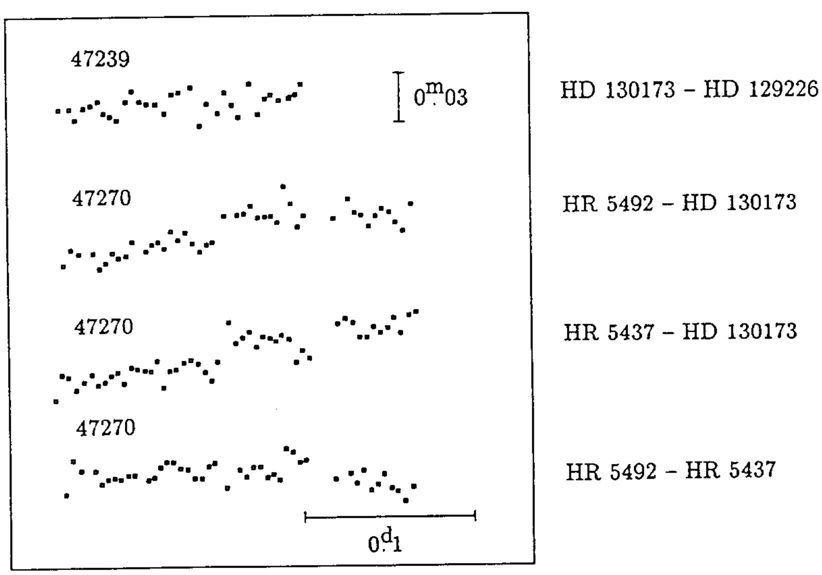

Figure 1.

TABLE 2

Date (UT)	2400000+	H.J.D. (days)	Length	Number	Site	Observed stars
March 17/18	1986	46507	.2367	85	H	1,3
March 18/19	1986	46508	.2524	61	H	1,2
Jan. 20/21	1987	46816	.1520	42	H	1,2
Febr. 5/6	1987	46832	.2188	62	H	1,2
Apr. 29/30	1987	46915	.2170	67	H	1,2
Apr.30/May 1	1987	46916	.2286	71	H	1,2
Febr. 1/2	1988	47193	.1570	54	CH	1,2,3,4,5
Febr. 2/3	1988	47194	.2063	81	CH	1,2,3,4,5
Febr. 3/4	1988	47195	.2462	77	H	1,2
Febr. 14/15	1988	47206	.1642	51	H	1,2
March 6/7	1988	47227	.1298	25	H	1,2,4
March 18/19	1988	47239	.1427	32	H	1,3,5
Apr. 13/14	1988	47265	.1364	33	CH	1,2,3,4,5
Apr. 18/19	1988	47270	.2084	49	H	1,2,3
Apr. 24/25	1988	47276	.2311	52	H	1,2,3
May 11/12	1988	47293	.1791	31	CH	1,2,3,4,5
June 11/12	1988	47324	.2163	38	CH	1,2,3,4,5
June 12/13	1988	47325	.1685	27	CH	1,2,3,4,5

As a result of the present study, the confusion concerning HD 130173, HR 5492 and HR 5437 seems to be resolved.

HD 130173: Because of the complexity of the system, unusual behaviour is to be expected making it unsuitable as a comparison star. In Figure 1. the light curves for HD 130173 obtained on two different nights are plotted. For the night of JD 2447239, in addition to the large scatter, it does not show any regular variation. However, for the night of JD 2447270 the light curves of HR 5492 and HR 5437 relative to HD 130173 have the same long term variation, while in the light variation of HR 5492 relative to HR 5437 no similar trend exists. The differential extinction correction was used in the same way on each night and for each light curve. The trend in the two middle curves in Figure 1. can be attributed to the (long term variation of) HD 130173. The period of 1.29 days found by Bossi et al.(1981) in the analysis of HR 5492 using HD 130173 as a comparison, is perhaps due to HD 130173.

HR 5492: Since HR 5437 was discovered by Jiang et al. (1988) to have a variable light curve, the observations in 1988 and the first night in 1986 can only be used to check the light variation of HR 5492. Some of the light curves are shown in Figure 2. According to our observations we may conclude, in agreement with Bossi et al. (1981), that if there is

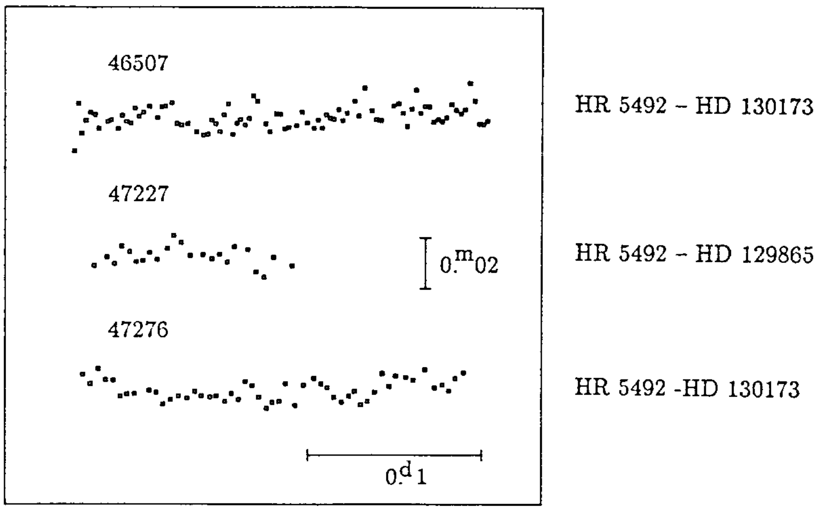

Figure 2.

any regular variation in HR 5492 it has an amplitude not larger than 0.01 mag. Moreover, the 0.03 mag light variation of HR 5492 in the survey done by Percy (1973) is questionable because HR 5437, used as a comparison, turned out to be variable and the other comparison, HR 5608, was observed with considerable scatter. HR 5492 was referred to in the literature (Bossi et al.1981) as an interesting object lying beyond the cold border of the instability strip and showing light variation. The uvbyβ photometric data (Hauck, 1980) and some physical parameters of HR 5437 after the calibration of Philip et al. (1976) are listed in Table 3.

TABLE 3

Star	b-y	m_1	c_1	β	M_v	Θ	log g	T_e
HR 5492	.266	.165	.461	-	2.3	-	-	-
HR 5437	.150	.180	.956	2.790	1.16	.65	3.78	7755

The absolute magnitude of HR 5492 is taken from Halprin & Moon's catalogue (1983). While HR 5492 is in fact situated beyond the cold border of the instability strip based on the published b-y and M_v data, HR 5437 can be located in the middle of the instability strip (Breger, 1979) according to the unreddened $(b-y)_0 = 0.136$ and $M_v = 1.16$ values. We conclude that HR 5492 is a normal F type star which lies beyond the instability strip and does not show any light variation.

HR 5437: turned out to have light variation of $\sim$ 0.03 mag amplitude. According to the spectral type and the pulsational period it seems to be a Delta Scuti

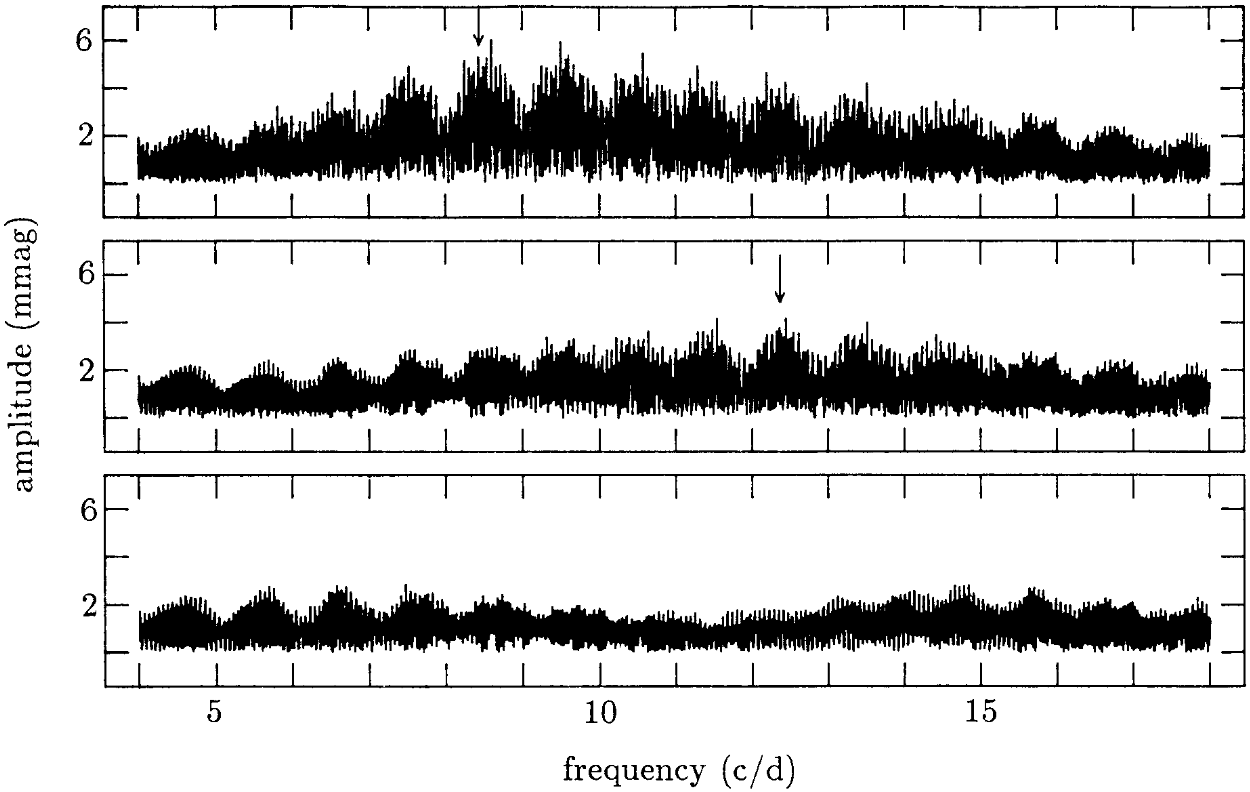

Figure 3.

type star. Eight tracks of observations were obtained for HR 5437 in 1988 covering a period of 130 days.(The data will be published elsewhere.) A frequency analysis was carried out keeping in mind the poor quality of the data distribution and the complex structure of the spectral window. Deeming's standard method (1975)

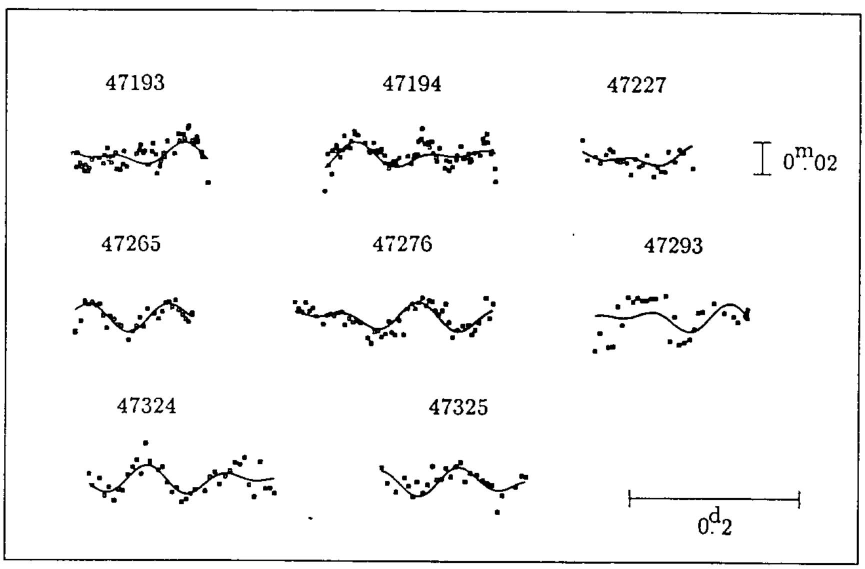

Figure 4.

was used to get the spectrum. In Figure 3. the original spectrum and the pre-whitened spectrum with one and two frequencies can be seen. The accepted values of the frequencies are listed in Table 4.

TABLE 4

The compact dataset in 1988

Freq. c/d	Ampl. (mag.)	Phase (deg.)
8.437	.00488	291
12.362	.00449	186

All of the data supposing HR 5492 is constant

Freq. c/d	Ampl. (mag.)	Phase (deg.)
8.5367	.00335	206
11.3759	.00404	272

Because the least-squares method was used to determine the precise values of frequencies, the accepted frequencies may have smaller power values than the highest peak in the spectrum. After prewhitening with the first frequency some doubt appeared around the next frequency.

The 12.362 c/d frequency and its 1 c/d alias, 11.544 have almost the same power. On the basis of the smaller dispersion of the least-squares fit, the value 12.362 c/d was finally accepted, however, a better and longer data distribution may prove the 1 c/d alias to be correct frequency. The spectrum in the third panel prewhitened with two frequencies still has some structure suggesting the existence of several more frequencies or the incorrectness of our frequencies. The observed and the synthetic light curves with the accepted frequencies are plotted in Figure 4. Supposing that HR 5492 does not have regular variability, the observations of HR 5437 to HR 5492 in 1986 and 1987 were used to check the frequencies obtained from the dataset in 1988.

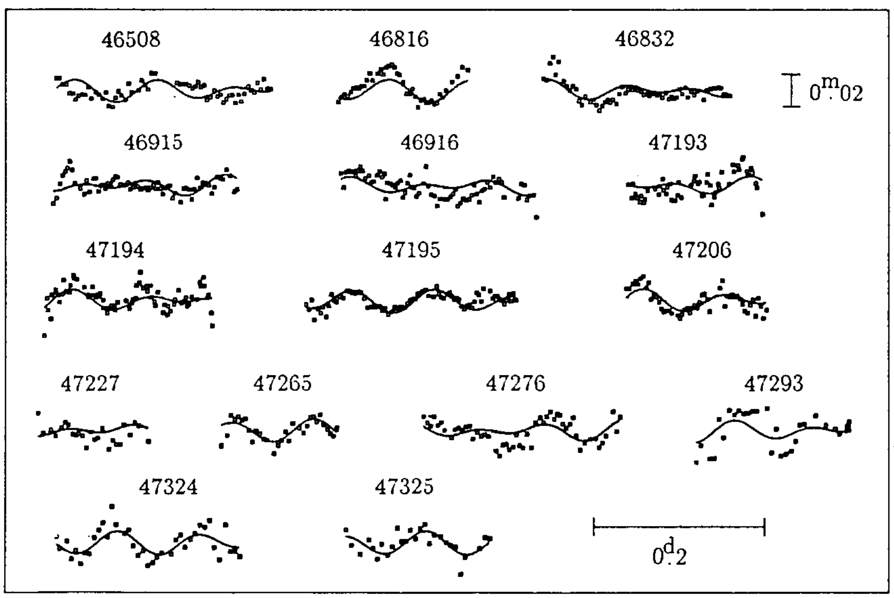

Figure 5.

Because of the long time-base the least-squares method was used near the accepted frequencies and their aliases. The finally accepted frequencies for the whole dataset of HR 5437 are listed in Table 4, too. The main features of the light curves obtained over three years can be fitted by these frequencies (Figure 5).Although the precise values of frequencies are not found, the frequencies seem to have remained stable for three seasons.

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TV Nor, ANOTHER ECLIPSING Ap STAR

In a previous paper (Renson and Mathys 1984) the attention of the spectroscopists has been drawn to a few Ap stars known as eclipsing variables. The study of the changes undergone by their spectra during the eclipses may establish the existence of inhomogeneous physical and chemical conditions over their surfaces, thus providing a valuable test of the oblique rotator model. Indeed according to this model the variations exhibited by an Ap star are explained by the presence of patches with various chemical abundances and different values of the physical parameters, which appear successively when the star rotates.

However there is an eclipsing Ap star that was not quoted in that paper (nor in Renson 1984), i.e. HD 143654. Its Ap nature has been discovered by N. Houk (1978), who gives for the observed spectral type (with quality 1) Ap Eu Cr Sr. But it was already known as an eclipsing binary long ago. Its variability has been discovered by H. van Gent (Kruytbosch 1930). Because its luminosity was almost always at its maximum value, it was immediately believed to be an eclipsing variable. By examining this object on hundreds of plates, E. Hertzsprung (1937) established that the period is

$$8.524406 \text{ d} \pm 0.000017 \text{ d}.$$

The data are the following ones, in the same order as in I.B.V.S. 2522, i.e. HD number (A) and other identifications (B), variable star name (C), coordinates for the epoch 1950 (D and E), magnitude (F), spectral type (G), period in days (H), depth of the primary and secondary minima (I and J) :

A	B	C	D	E	F	G	H	I	J
143654	CoD-51°9739 =CpD-51°8888	TV Nor	$16^h00^m.4$	-51°24'	8.9:	A0 EuCrSr	8.5244	0.6:	0.2:

This star is somewhat brighter than the other eclipsing binaries quoted by Renson and Mathys (1984) and Renson (1984) except 17 Aur. But 17 Aur belongs to the group of Mn-Hg stars, the spectral variations of which are always very small, which implies that there are no large inhomogeneities over their surfaces. Thus TV Nor is probably the more suited star for the above mentioned purpose.

Therefore observers are called on to study in detail this star and especially the evolution of its spectrum during the eclipses.

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NO MAJOR PERIOD CHANGE FOR CT TAURI

Recently, Wlodarczyk and Drozdz (1990) reported photoelectric observations of the B2 + B2 contact system CT Tau, P = $0^{d}.6668$. From their times of primary and secondary minima, spanning 1.5 orbital cycles, they found an extraordinary period increase of 1.47 minutes. This result appeared to be confirmed by a photoelectric time of minimum earlier in the same season by J. Kaluzny, reported to them in a private communication.

However, numerous recent visual timings of minima do not support this period change. Figure 1 is an O-C plot of minima timings published by the Eclipsing Binary Observers of the Swiss Astronomical Society (BBSAG 1972 et seq.) and unpublished timings in the files of the AAVSO Eclipsing Binary Committee. The O-C residuals were calculated using the light elements in the General Catalogue of Variable Stars (Kholopov et al. 1985).

The diagram shows that the photoelectric timings by Wlodarczyk and Drozdz and the visual timings are consistent, while Kaluzny's time of minimum is discordant. Perhaps a typographical error occurred in the communication of this timing, or a calculating error in the decimals of a Julian Day.

Least-squares analysis of the 39 visual timings after JD 2443000 results in a period identical with the GCVS value, $0^{d}.6668303$, but indicates that the initial epoch of the GCVS elements requires a small correction. The photoelectric time of primary minimum by Wlodarczyk and Drozdz is within $0^{d}.001$ of the time predicted by this analysis, so revised light elements can be based on this timing and the period confirmed by the visual data:

$$\text{Min I} = \text{HJD } 2447553.5464 + 0^{d}.6668303 \text{ E} \qquad (1)$$
$$\pm 4 \qquad\qquad \pm 8$$

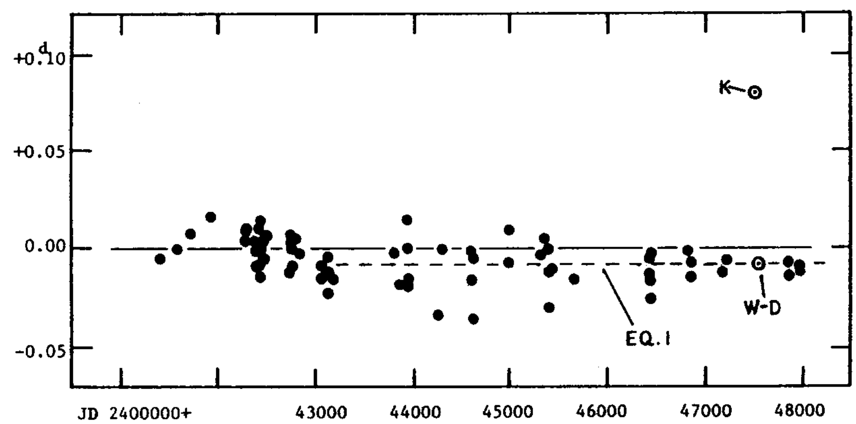

Figure 1. CT Tau, O–C diagram calculated from the GCVS light elements Min. I = HJD 2445404.359 + $0^d.6668303$ E.

The remarks section of the GCVS notes that the period of CT Tau is variable. Chugainov (1965) found P = $0^d.6668276$ beginning in 1952, and Ahnert (1965) found P = $0^d.6668274$, a virtually identical value for 1948–1965. Figure 1 also suggests that the period was shorter than the current value before JD 2443500.

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PACIFIC RIM COLLOQUIUM ON NEW FRONTIERS IN BINARY STAR RESEARCH

Seoul, Korea, October, 1990

<u>scope of the Colloquium</u>

This conference will focus on contemporary techniques for investigating both close and wide binary stars systems, with emphasis on new approaches in acquiring data, deriving fundamental quantities, and interpreting and modeling binary systems.

<u>Sponsorship</u>

The Colloquium is to be sponsored jointly by the Korean Science and Engineering Foundation, KOSEF, and the US National Science Foundation, NSF (pending).

<u>Scientific Organizing Committee</u>

H. A. Abt (USA), M. S. Chun (ROK), B. Hidayat (ROI), K. C. Leung (USA, Co-Chair), S. H. Moon (ROK), I. S. Nha (ROK, Co-Chair), R. F. Webbink (USA), R. E. Wilson (USA), A. Yamasaki (ROJ), H. S. Yun (ROK), D. S. Zhai (PRC).

<u>Location</u>

The scientific sessions will be held at Yonsei University, Seoul, and at the Institute for Space Science and Astronomy, Taejon, Korea.

<u>Participants</u>

Those who are interested in attending the Colloquium please contact one of the following Co-Chairs or a member of the Scientific Organizing Committee:

Professor Kam-Ching Leung
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LIGHT CURVES FOR R ARAE

R Arae has recently been the subject of considerable effort, including the work of Nield (1987), Nield *et al.* (1986), Forbes *et al.* (1988), Forbes (1990a,b), Banks (1989a,b), and the recent international observing campaign organised by Dr. Guinan. Light curve modelling of this system is complicated by third light (HD 47930B being only 4" distant), and broadband light curve fluctuations of about 0.1 magnitudes, which possess timescales of the order of a night (Nield, 1987). The latter, in addition to other irregularities such as abnormal radial velocities, apparent Balmer line doubling (Sahade, 1952), and a gradual period increase (Forbes, 1990b) are now considered to be typical indicators of Interactive Algols.

Nield (1987) modelled UBV light curves using Budding's (1972) eclipsing binary computer program, finding that the secondary component's radius appeared to be well within its Roche Lobe, although increasing the third light contribution helped slightly, enlarging the radius. Banks (1989b) attempted unsuccessfully, in a Budding and Zeilik (1987) style analysis, to reach a semi-detached status using a mass transfer stream impact "hot spot" to account for the light curve asymmetry. The purpose of the present bulletin, a continuation of this previous effort, is to demonstrate that a light curve solution of the desired status can be reached by the introduction of orbital eccentricity (although see Kondo *et al.* (1984)). It is hoped that this brief analysis will be of benefit to the current work by other researchers on R Arae.

The final effective stellar temperatures of Nield (1987) and Sahade's (1952) mass ratio were adopted for an initial fit of the amalgam V band of Nield's (1987) and Forbes' (1990a) data, binned in the manner described by Budding and Zeilik (1987). Only the features expected in a standard eclipsing binary's light curve were modelled in this fit (see Figure 1). The following photometric parameters were reached :

Primary Radius $r_1 = 0.214 \pm 0.029$
Secondary Radius $r_2 = 0.282 \pm 0.068$
Inclination $i = 86.2 \pm 6.8^\circ$
Primary Luminosity $L_1 = 32.6 \pm 6.5$ %
Secondary Luminosity $L_2 = 15.3 \pm 7.5$ %
Eccentricity $e = 0.43 \pm 0.06$
Mean Anomaly at Phase zero $= 2.4 \pm 1.1^\circ$

The difference curve (see Figure 2), obtained by subtracting this initial model from the original light curve, was then modelled as being due to a mass transfer stream "hot spot". The ratio of the spot flux relative to the primary component's photosphere was arbitrarily set to double, while the

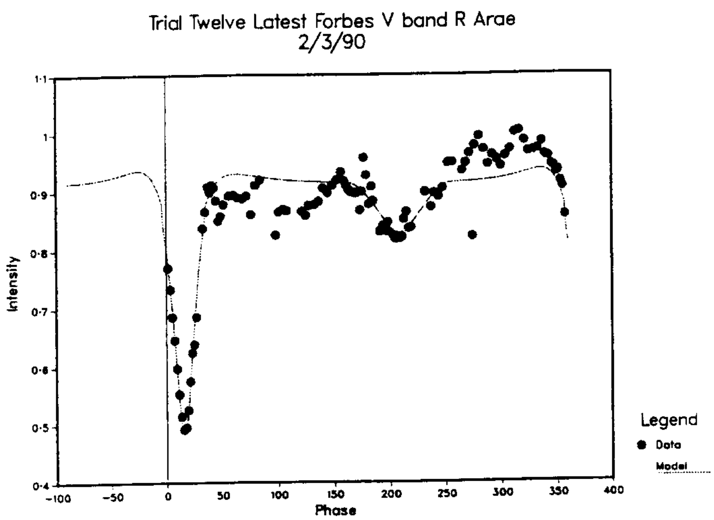

Figure 1: The binned data points (circles) are plotted with the best initial fit model (the line).

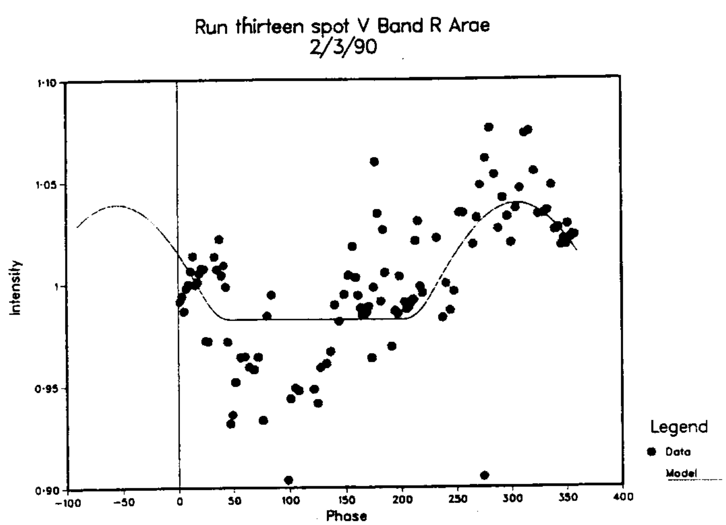

Figure 2: The residuals from the inital fit (circles) were modelled by a mass transfer impact site hot spot (the smooth line).

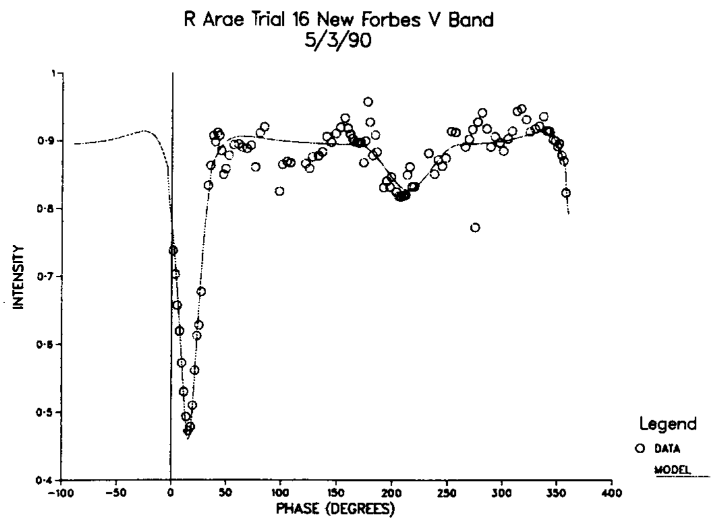

Figure 3: The final light curve data and best fit model.

spot's latitude was set to zero, being the likely region for impact.

The resulting equatorial spot parameters were longitude 304.9 ± 6.3 ° and radius 13.9 ± 0.8°, slightly smaller than Banks' (1989b) results which did not account for eccentricity. The azimuthal extension lends support to the existence of a circumstellar disk.

The final light curve (see Figure 3) was then formed by removing the calculated spot effects from the orginal data. This was then modelled as a standard eclipsing binary producing the following parameters :

Primary Radius $r_1 = 0.214 \pm 0.005$

Secondary Radius $r_2 = 0.277 \pm 0.011$

Inclination $i = 84.1 \pm 6.2\,^\circ$

Primary Luminosity $L_1 = 36.66 \pm 0.05$ %

Secondary Luminosity $L_2 = 14.03 \pm 0.07$ %

Eccentricity $e = 0.43 \pm 0.05$

Mean Anomaly at Phase zero = $7.1 \pm 3.8\,^\circ$

These generally better constrained values are not dramatically different from those of the initial fit, which could be expected as the "spot" is located around second quadrature. The eclipsing binary synthetic light curve program therefore runs a "mean" line through the spot's influence on the light curve. This bulletin's results are more physically possible for the system than previous work, as the secondary component reaches its Roche Lobe (see Kopal, 1959), and could now be responsible for the mass transfer.

R Arae's eccentricity will result in its Roche Geometry altering during an orbit, presumably along with the mass transfer rate, that could help explain the rapid light curve variations noted above (see also Banks, 1989b). However there is an urgent need for observations of this bright system, especially around the rather elusive secondary minimum, which would aid considerably further synthetic light curve modelling. In addition the question of third light needs to be definitively addressed. Nield (1987) estimated the V band contribution to be about 40% of the total system's light. This estimate was obtained by moving R Arae out of the telescope diaphragm, and taking readings of the companion star alone. CCD Imaging, at a longish focal ratio perhaps, could be the best method of resolving this issue.

The author acknowledges discussions with Dr Edwin Budding on this topic, and also would like to thank Murray Forbes for his kind permission to use his data.

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AN OPTICAL FLARE OF THE RS CVn SYSTEM V711 TAU IN 1989

The non-eclipsing system V711 Tau(=HR 1099) is a famous solar-like active binary star. In the 1989 observing season, the RS CVn star V711 Tau was selected as one of the main targets by the MUSICOS (Multi-site Continuous Spectroscopy) program and its probable flare activity was monitored simultaneously by photometry and spectroscopy. At Beijing Astronomical Observatory, photoelectric photometry of the system was carried out in UBV and H_β bands with the 60-cm telescope from early November to the end of 1989. Three nights, from December 14 to 17, were among the MUSICOS program and the photoelectric photometry was made simultaneously with the high S/N spectroscopic H_α observations at the newly installed 2.16 m telescope of Beijing Observatory. An unusual optical flare was detected in the UBV bands by us on the very night of joint observing, December 14/15.

The photoelectric photometry started on 9 November but the data distribution was insufficient to cover effectively the whole orbital cycle of V711 Tau until 26 December. A total of data secured on 8 nights was synthesized into the light curves using the ephemeris given by Fekel (1983):

$$Min.I(J.D.Hel.) = 2442766.080 + 2.^d83774 * E. \qquad (1)$$

The light curves obtained with 12 Tau (V=5.57, gG6) as the comparison star have been transformed into the UBV system as shown in Figure 1 and 2. The H_β observations were performed with the H_β wide (190 Å) and narrow (32 Å) interference filters of the Strömgren system. The observed β' index has been transformed into β through a linear formula:

$$\beta = 1.119\beta' + 0.474 \qquad (2)$$

, where the coefficients were determined by using 10 standard stars, while the $\triangle\ H_\beta$ light curves (Figure 2) are given as the magnitude difference between the variable and the comparison star 10 Tau in the local photometric system.

In addition to the migrating distortion wave, a conspicuous new feature is a flare event towering aloft near the bottom of the distortion wave. The unusual optical flare happened on one single night of observing, 14/15 December, and the amplitudes of it are 0.18, 0.27 and 0.61 mag in V,B and U, respectively. The largest flare variation is in the u band as is usual with dM_e flare stars. However, the wide-band flare events are rarely observed in RS CVn systems because of the high brightness level in the continuous spectrum of G and K

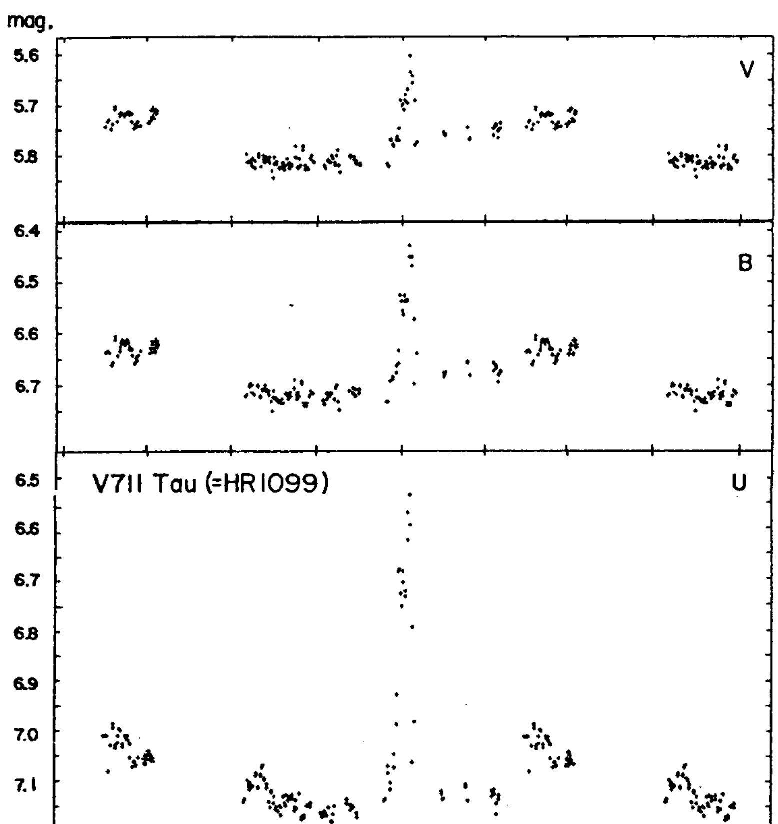

Figure 1. An optical flare of V711 Tau on December 14/15, 1989

Table 1. Characteristics of the flare of V711 Tau

U.T. (Dec.12,1989)	band	T_a (h)	T_d (h)	D (h)	Ampl. (mag.)
15:30	U	2.31	0.75	4.75	0.61
	B	2.40	0.73	4.13	0.27
	V	2.40	0.73	4.38	0.18

stars as pointed out by Agrawal et al.(1988). The large flare observed by us may be the first one to be caught in HR 1099 . Table 1 lists the characteristics of the flare of V711 Tau on 14/15 Dec. 1989.

Though there is a phase gap of about 0.2 in the light curves without observations, the distortion wave is clearly presented which shows an amplitude of about 0.12 mag in V with the minimum brightness at around phase 0.18 and the maximum near phase 0.80, respectively. The distortion wave has been shifted towards smaller phases since 1986 when Joshi et al.(1989) observed this system. The distorted light curve of V711 Tau is usually

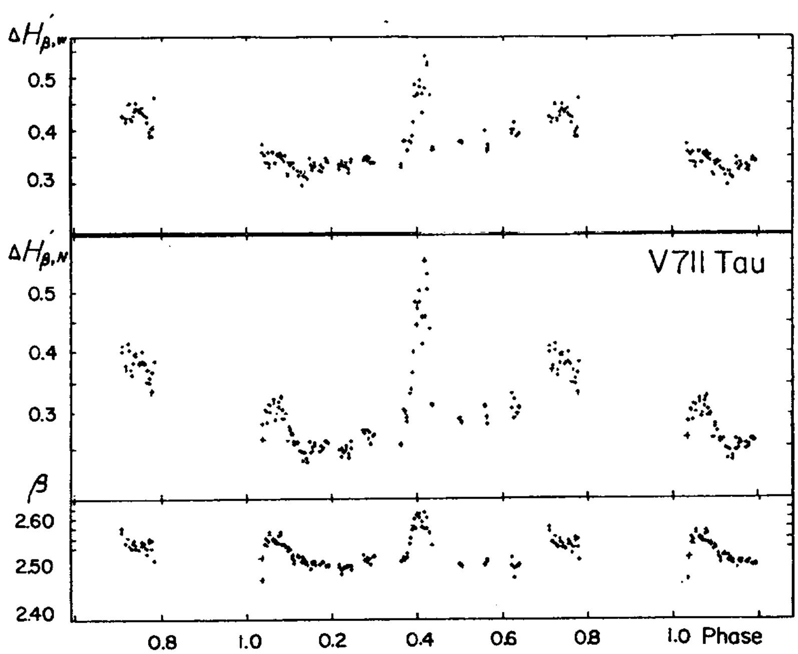

Figure 2. Hβ light curves and the optical flare of V711 Tau in 1989

explained by researchers (Rodono et al.,1986 and so on) based on spot model. The obvious asymmetry in the light curves obtained by us implies that it could be caused by more than a single spot on the K IV component. The position of the optical flare on the light curves is closer to the minimum than to the maximum light. It suggests that the flare happened just after the largest spot had passed the meridian and the flare activity region may be located in or near the spotted area on the component. A detailed analysis of the spot solution is necessary to understand better the nature of the variations in the light curves of V711 Tau.

The simultaneous high S/N CCD spectrogram obtained by Catala and Zhai reveals that the equivalent width of the H_α emission line had increased much on 14/15 December at the same time when the large optical flare appeared in the UBV wide bands. The detailed results of the spectroscopic and photometric observations of this flare event will be given in another paper in the near future.

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STRÖMGREN PHOTOMETRY OF A POSSIBLE VARIABLE STAR NEAR NGC 663

A possible unknown variable star has been found in the vicinity of the highly reddened open cluster NGC 663.* After the final reduction of the photometric data the star turned out to be a 10th magnitude foreground star. The star numbered as No. 12 in our observing list, has been identified as No. 8 in the table of the photographic data for NGC 663 in the atlas of Hoag (1961) with plate coordinates x = -6.50 and y = 7.78. Hoag gives a photographic V magnitude of $m_V = 10.06$.

From an inspection of the BD chart we identified the star as BD +60°330 which is equivalent to SAO 11965 with coordinates

$$(1950.0) = 1^h\ 42^m\ 30\overset{s}{.}148$$
$$(1950.0) = 61^\circ\ 01\ \ 52\overset{''}{.}41.$$

The r.m.s. scatter of the reduced mean photoelectric y magnitudes of the star is more than three times larger than for the other stars in our list. BD +60°330 was observed 10 times between October 25, 1989, and February 22, 1990. Table I contains the y magnitude, the uvby colour indices, and Julian date (JD). Our results seem to indicate a period in the order of one day and an amplitude of variability in the y magnitude of 0.4 mag. From the mean uvby colour indices we derived a spectral type of F5. More observational data are needed to confirm the variability found, and to make a classification of this suspected variable star possible.

* Based on observations collected at Gothard Astrophysical Observatory of Eötvös University, Hungary

Table I

Julian date	y	b-y	m1	c1
2447825.4957	10.126	0.310	0.151	0.456
825.5568	9.941	0.411	0.031	0.343
826.4597	9.891	0.369	0.140	0.435
826.5050	10.078	0.508	0.122	0.584
827.4030	10.216	0.305	0.156	0.373
828.4392	10.034	0.435	0.069	0.437
901.4152	9.855	0.512	0.034	0.466
911.4136	10.252	0.361	0.104	0.459
915.3487	10.127	0.360	0.117	0.525
2447945.3948	10.225	0.320	0.152	0.472

The last observation was obtained with the 90 cm telescope of Jena University at Großschwabhausen observing station GDR.

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Reference:

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PHOTOELECTRIC OBSERVATIONS OF XY LEONIS AND ITS PERIOD CHANGES

XY Leo (BD+18^{o}2307) is a W UMa-type binary (subtype W). Its spectral type is K0n (Hill et al., 1975). Hrivnak (1985) collected all available, photoelectric times of minimum light. The O-C diagram has a sine-like shape.

Hrivnak (1985) admitted among others the possibility that period changes were abrupt more or less every 10 years with the period remaining constant between them. Such behaviour was documented for 15 W UMa systems by Kreiner (1977). Gehlich et al. (1972) first proposed that the variations in the O-C values may be due to a third body. This was confirmed by Barden (1986). He found a BY Draconis-like binary companion to the contact binary XY Leo. Because the next minimum of the "third body sinusoid" was predicted in 1990, we carried out observations of this star in B and V filters, close to the UBV system. The observations were made using the 0.6 m telescope equipped with a two-channel photometer (Szymanski and Udalski, 1989) at Mt. Suhora Observatory of Cracow Pedagogical University, and with the 0.5 m Cassegrain telescope of the Jagiellonian University Observatory in Cracow equipped with a one-channel photometer, during the 1989-1990 season. The differential observations were made with respect to the comparison star BD+18^{o}2306 and were corrected for the atmospheric extinction using the mean extinction coefficients for the observatories. The observations allowed us to determine the times of minima by parabolic fitting to the observational points, making use of the least-squares method. New times of minimum light for XY Leo are given in Table I.

Adding all times of photoelectric minima available in the literature and a few visual minima observed before JD hel. 2434500 (the ratio of the weight of the photoelectric minimum to the visual one is equal to 5) and assuming that the period of XY Leo exhibits sinusoidal changes, a new ephemeris of minimum times is derived as follows:

$$\text{Min I JD hel.} = 2435484.0222 + 0.28410273\,E + 0.0213\,\sin(0.000243\cdot E + 0.56)$$

$$\text{m.e.} \quad \pm 6 \qquad \pm 2 \qquad \pm 4 \qquad \pm 13 \qquad \pm 2$$

Table I. New light minima for XY Leo

JD hel 2440000+	filter	minimum type	notes
7868.6082±0.0002	V	I	Cracow
7891.6214±0.0002	B	I	Suhora
7896.5933±0.0004	V	II	Cracow
7897.5881±0.0003	V	I	Cracow
7898.5811±0.0002	B	II	Suhora
7899.4337±0.0014	B	II	Suhora
7899.5763±0.0003	V	I	Suhora
7928.5545±0.0004	V	I	Cracow
7928.5551±0.0002	V	I	Suhora
7928.6963±0.0006	V	II	Suhora
7948.4425±0.0003	V	I	Cracow
7968.3300±0.0004	V	I	Cracow
7968.4712±0.0004	V	II	Cracow
7969.3215±0.0008	B	II	Cracow
7969.3226±0.0005	V	II	Cracow
7969.4653±0.0004	B	I	Cracow
7969.4664±0.0004	V	I	Cracow

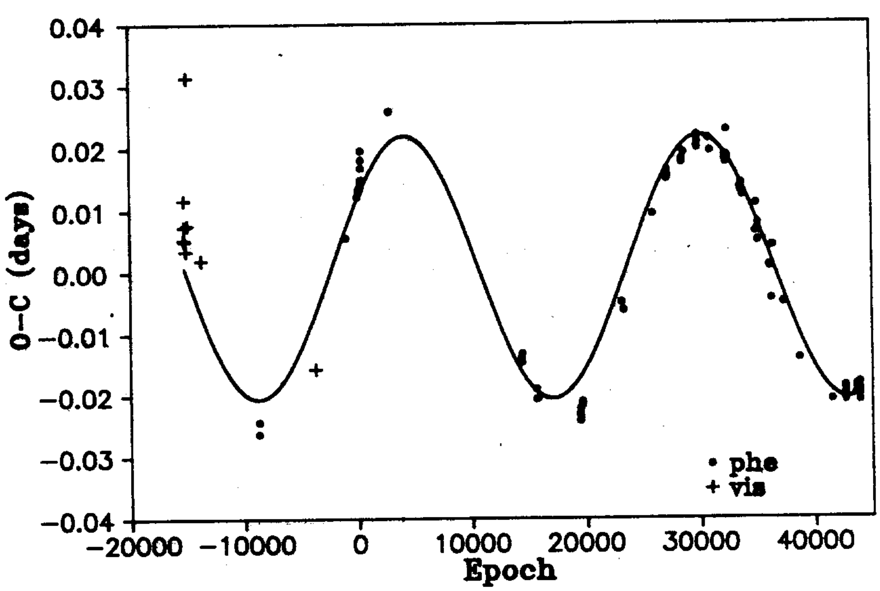

Fig. 1. O−C diagram of the times of minimum light for XY Leo

The period indicated by the sinusoidal term is about 20 ± 1 years (what is equal to 25866 epochs - see Fig. 1.). The ephemeris for the prediction of forthcoming minima can be derived from the photoelectric observations made after JD hel. 2447000, as follows:

$$\text{Min I} = \text{JD hel } 2447612.34748 + 0.2841034\ E$$
$$\text{m.e.} \quad \pm 16 \qquad\qquad \pm 2$$

We computed the orbital parameters of the third body, making use of the gradient-expansion algorithm (Bevington, 1969). Taking into account observations before JD hel. 2442000 the results were practically the same as those obtained by Gehlich, but for observations made after JD hel. 2440000 both the computed period, and the amplitude of theoretical O-C are smaller, and value of e is near zero, so changes of period of XY Leo are sinusoidal in quite good approximation.

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COMMISSION 27 REPORT 1987 - 1990

The Commission 27 report, to be published in the next volume of the IAU Transactions, will contain summaries of the scientific developments during the last three years. These summaries provide one of the best means for the astronomer inside and outside the field to find out about new results and discoveries.

A number of active researchers in the various subfields have been chosen (and have kindly agreed) to write the reports. These reports are traditionally based on literature searches. In addition, all active workers in the field are invited to send preprints and brief summaries of recent results directly to the relevant co-authors listed below. These should be received by August 1.

Topic	Author
General, Archives	M. Breger
Information Bulletin	B. Szeidl & L. Szabados
General Catalog Var. Stars	N. N. Samus
Cepheids	E. Schmidt
Compact Objects	D. Winget
Delta Scuti & Ap stars	D. Kurtz
Early-type variables	L. Balona
Flare Stars	R. E. Gershberg
Mira	M. Feast
RR Lyrae Stars	T. Barnes
Theory	A. N. Cox & S. Morgan
T Tauri Stars	G. Basri
Variables in globular clusters	A. Wehlau

Michel Breger
President, IAU Commission 27

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ROTATIONAL VELOCITIES OF G AND K GIANTS

Rotational velocities, $v\sin i$, are often helpful in determining the properties of ellipsoidal variables and other rapidly rotating stars by providing a measurement of the absolute radius (e.g., Hall 1990). With this in mind, I have obtained high-dispersion spectra for a large number of late-type stars during 6-11 February 1990 (UT) with the stellar spectrograph of the National Solar Observatory's McMath Solar Telescope on Kitt Peak in Arizona. While most of these stars were slowly rotating giants observed for another purpose, a number of known or suspected rapid rotators and binaries containing a cool giant were included in the program as ancillary targets. The spectra covered the range 6520-6600 Å, at 0.09 Å/pixel, and were taken with an 800×800 pixel TI CCD. All the data were reduced with the standard computer programs available at the telescope.

Rotational velocities were determined by artificially broadening spectra of slowly rotating comparison stars of appropriate spectral type by various amounts and comparing such spectra calculated for a range of $v\sin i$ with a spectrum of the star in question. This technique can be quite accurate because rotational broadening has pronounced, characteristic effects on the many line blends in the Hα region. Results are given in Table 1. The numbers in parentheses refer to the references listed below the table. References to existing rotational velocities are generally to Uesugi and Fukuda, who gave much more extensive information than I can justify including here. Most of the spectral types have been taken from the Bright Star Catalogue. Unfortunately, it was impossible to classify the stars with these Hα spectra, since the metallic lines seem to be only mildly dependent on T_{eff} but are more sensitive to differences in abundance and turbulence.

There are caveats to be applied to the results of this technique. First, we must not apply spectra for giants to supergiants, which have such intrinsically broad line profiles that they would all be thought rapidly rotating. Several of the stars in Table 1 (notably 5 Cet, ζ And, and UU Cnc, which are ellipsoidal binaries) have sizes rather large for K giants and might be expected to have greater turbulence than in normal giants. This effect is generally not a problem, however: for the *strengths* of the broad shallow lines of these

Table 1. Rotational Velocities and Spectral Types

	Star	No. of Spectra	Spectral Type	Comparison Star	*vsini* (km/s)	Other Values (km/s)
5 Cet	HD 352	2	K3 III (1)	α Tau	23±1	22±3 (1)
α Cas	HD 3712	1	K0 III	δ CrB	≤5	20 (2)
β Cet	HD 4128	1	K0 III	δ CrB,56 And	≤5	3.0 (3)
ζ And	HD 4502	1	K1 IIe	56 And	41±1	40,36 (2,4)
HR 439	HD 9352	1	K0 Ib+B9 V	α Tau	≤5	≤50 (2)
56 And	HD 11749	2	K0 III	Jupiter	<5	<25 (2)
μ Cet	HD 17094	1	F0 IV	χ Leo	<25	55 (2)
HR 958	HD 19926	2	K1 IIIep+A6	α Tau	17±2	≤50 (2)
58 Per	HD 29094	1	K4 III+A3 V	α Tau	8±2	<25 (2)
HR 2137	HD 41162	1	K0 III+A2	Jupiter,56 And	<5	
μ CMa	HD 51250	1	G5 III+A5	Jupiter	≤5	
σ Gem	HD 62044	1	K1 III	56 And	27±1	25 (2)
30 LMi	HD 90277	1	F0 IV	Jupiter,δ CrB	30-40	35 (2)
72 Leo	HD 97907	1	K3 III	α Tau	<5	<20 (2)
HR 4430	HD 99967	2	K2 III	56 And	17±1	16 (5)
93 Leo	HD 102509	1	G5 III+A7 V	Jupiter+δ CrB	5±2	
12 Com	HD 107700	1	G0 III+A	Jupiter+δ CrB	<5	
24 Com	HD 109511	1	K2 III	α Tau	<5	≤25 (3)
γ Vir	HD 110380	1	F0 V	Jupiter	30±5	30 (2)
31 Com	HD 111812	1	G0 IIIp	Jupiter,δ CrB	63±5	57 (5)
35 Com	HD 112033	1	G8 III+F6 V	δ CrB	<5	<15 (2)
FK Com	HD 117555	4	G5 III	Jupiter,δ CrB	160±10	165±5 (6)
κ Her	HD 145000	1	K1 III	56 And	11±2	10 (2)
HR 6136	HD 148513	1	K4 III	α Tau	<5	≤20 (2)
β Oph	HD 161096	1	K2 III	α Tau	<5	1.6 (3)
UU Cnc	...	8	K4 III (7)	α Tau	25±1	23±3 (7)

References: 1. Eaton and Barden, 1987; 2. Uesugi and Fukuda 1982; 3. Gray 1989; 4. Huisong and Xuefu 1987; 5. Strassmeier et al. 1990; 6. Buzasi 1987; 7. Eaton, 1990.

objects agree very well with the broadened profiles of K giants. Likewise, HR 439 which is classified K0 Ib has only an upper limit on *vsini* presumably incorporating any elevated turbulence. Second, *very* rapidly rotating stars such as FK Com will be flattened and gravity darkened, and this may result in systematic errors from an analysis with a rotating spherical model star. Again, this does not seem to be a problem. To explore this question, I used a computer program that calculates profiles of contact binaries to form the profile of a distorted star with V_{rot} = 130 km/s. The calculated profile (for the backside of the larger component) was indistinguishable from one calculated for a spherical star.

A second purpose of this program was to explore the possibility of using Doppler

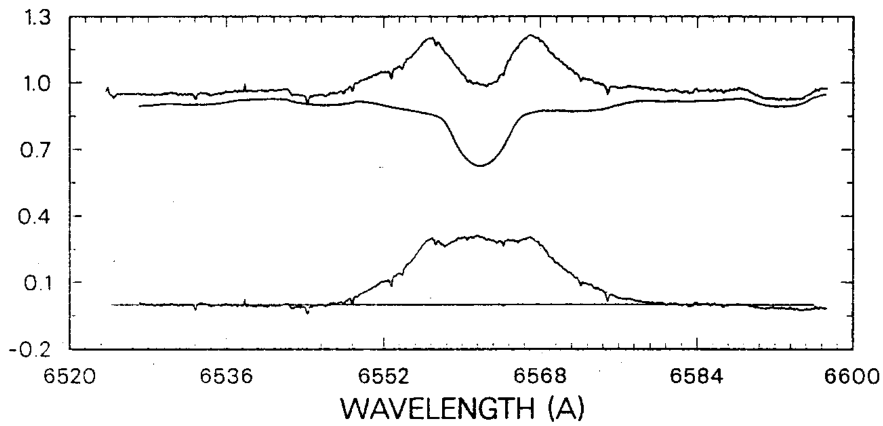

Figure 1. Composite of spectra of FK Com on three nights. A spectrum of δ CrB (G3.5 III-IV), artificially broadened to *vsini* = 160 km/s and displaced to lower intensity, is shown for comparison. Below is shown the difference between these two spectra.

images to map the surface brightness of stars rotating moderately or very rapidly. Cool, spotted stars studied to date with this technique (HR 1099, Vogt and Penrod 1983; HD 199178, Vogt 1988; and HD 26337, Strassmeier 1990) have all been found to have large *polar* spots from the abnormally shallow centers of their line profiles. The observation of σ Gem (*vsini* = 27 km/s) did not reveal a perceptible distortion of the sort revealing a large polar spot. Spectra of FK Com (~ 160 km/s) in the blend at 6595 Å appear slightly flatter than expected from a rapidly rotating star without a polar spot. The difference (see Figure 1) is very slight, making any conclusions suspect, but they do suggest FK Com has a polar spot, as might be suspected, and that it should be possible to form conclusive Doppler images of more appropriate lines, such as Ca I λ6439 or the blend at 6463 Å.

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UBVR PHOTOMETRY OF THE ZZ CETI STAR G185-32

We observed the ZZ Ceti variable white dwarf star G185-32 (= GR277 = PG1935+276) during eight nights between 11 June 1989 and 31 July 1989, U.T. Our observations were made with the 24-inch (0.6 m) Cassegrain telescope at Jet Propulsion Lab's Table Mountain Observatory in the San Gabriel Mountains, near Wrightwood, California, U.S.A. A light curve for this star was constructed with the unfiltered measurements obtained from a single-channel photometer containing a dry-ice cooled (-78°C) RCA 1P-21 photomultiplier tube. The measurements of U, B, V, and R were made using the same photometer with a dry-ice cooled Hamamatsu 943-02 photomultiplier tube. Each of our measurements of program star, comparison stars, and sky brightness was made with a ten-second integration. We used either a 16" or 20" diameter aperture, depending on nightly seeing conditions.

The extinction of a large sample of standard stars was measured with the Hamamatsu 943-02 tube in early June of 1989. From this data we calculated transformation coefficients to convert our results to the Johnson magnitude scale, using the methods outlined in Henden and Kaitchuck (1).

A light curve for G185-32 was obtained in 1981 by McGraw, et al. (2). Our curve is a composite obtained from data taken on three nights of observing: 12 June, 10 July, and 11 July. Figure (1) shows the difference in the magnitudes of G185-32 and comparison star SAO 087458, plotted against an arbitrary time

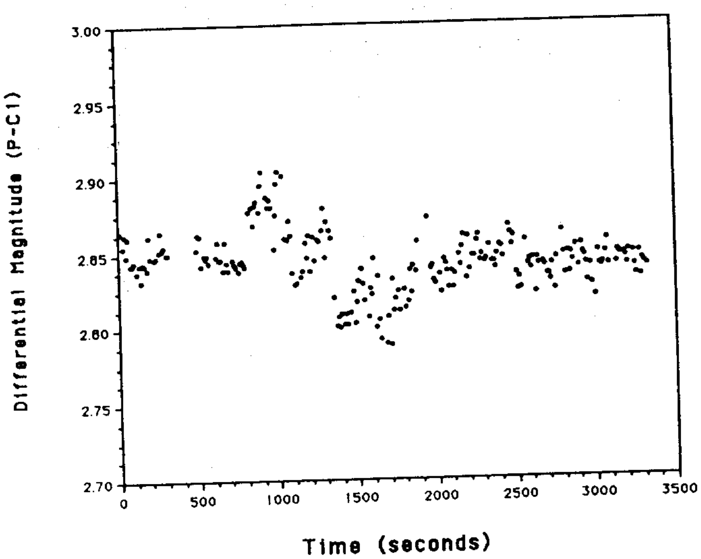

Figure 1 - Light curve for G185-32 from unfiltered measurements.

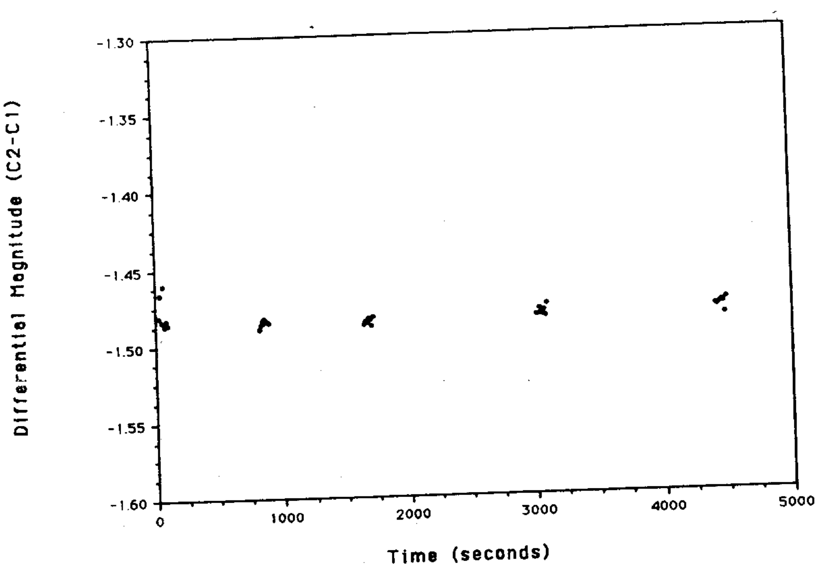

Figure 2 - System noise level from unfiltered measurements.

scale. Figure (2) shows the difference in the magnitudes of SAO 087458 and our second comparison star, SAO 087405. The fluctuations in the curve of Figure (1) are well above the noise level determined by Figure (2).

Our light curve for G185-32 does not show substantial differences from that of McGraw. Both the erratic 200-second quasi-period and 0.02 to 0.05 magnitude change seen by McGraw are apparent in Figure (1).

Our first two nights of observing were dedicated to obtaining accurate color magnitudes of G185-32. The values of U, B, V, and R were calculated by averaging two sets of 16 continuous measurements of each color from each night. The instrumental magnitudes were then transformed to the Johnson system. The value of the experimental uncertainty is the standard deviation of each set of 32 color measurements, carried through our transformation equations.

The colors of G185-32 are as follow:

$$U = 13.26 \pm 0.23$$
$$B = 13.50 \pm 0.10$$
$$V = 13.21 \pm 0.03$$
$$R = 13.18 \pm 0.10$$
$$(U-B) = -0.24 \pm 0.13$$
$$(B-V) = +0.29 \pm 0.07$$
$$(V-R) = +0.03 \pm 0.07$$

G185-32 was observed in 1967 by Eggen (3), as part of a survey of 500 faint, blue stars. Our results show that this star has become dimmer over the last 22 years. Eggen established a value of V = 13.00 for G185-32; this is brighter by a factor of approximately 1.2 than our measurements indicated. We also notice that while our value for (B-V) does not show a significant change, within our experimental uncertainty, from Eggen's value of (B-V) = +0.17, our value for (U-B) shows a definite increase from the 1967 value of (U-B) = -0.57. This would seem to indicate that while the effective temperature of G185-32 has remained relatively unchanged, there has been a change in the structure of its outer atmosphere. Such an alteration in the nondegenerate stellar exterior could also account for the decreased brightness of this star.

Because of the small amplitude and erratic behavior of the light curve of G185-32, further observations are needed to determine whether the changes in the color magnitudes have affected the white dwarf's oscillation behavior.

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TIME OF ECLIPSE FOR THE BINARY SYSTEM PV Cas

We observed an eclipse of the binary system PV Cassiopeiae (1950: RA=$23^h07^m53^s$, dec = +58° 08′) on 27 August 1989, UT. Our observations were made with the 24-inch (0.6 m) Cassegrain telescope at Jet Propulsion Lab's Table Mountain Observatory in the San Gabriel Mountains near Wrightwood, California, U.S.A. Measurements of brightness were made through wide-band U, B, and V filters. Unfiltered brightness measurements were also obtained. We used a single-channel photometer containing a dry-ice cooled (-78°C) RCA 1P-21 photomultiplier tube. Each of our measurements of program star, comparison stars, and sky brightness was made with a five-second integration through a 20" aperture.

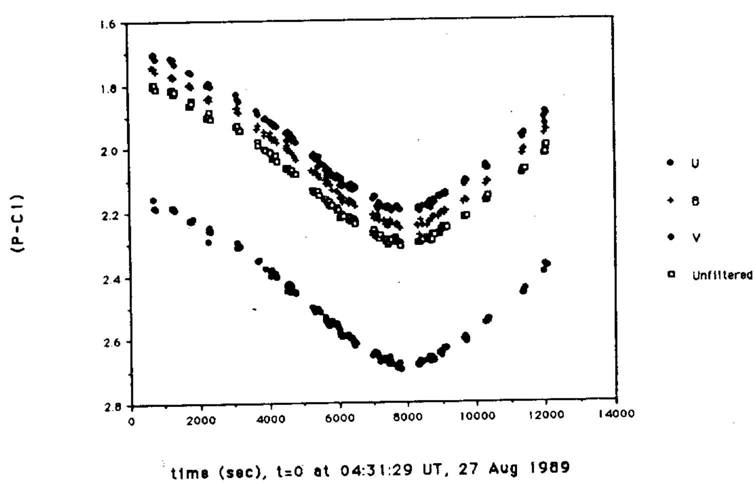
Figure (1) is the light curve of PV Cas obtained on 27 August 1989. It shows the difference in magnitude between PV Cas and our first comparison star, SAO 035187, on the vertical axis. The scale on the horizontal axis is time, in seconds, after 04:31:29 UT. We note from Figure (1) that the light curves in each color are of approximately the same depth and shape. Figures (2a)-(2d) show plots of the difference in magnitude between our second comparison star, SAO 035190, and SAO 035187 versus time, in seconds, after 04:31:29 UT. The noise-level fluctuations in the comparison stars are, for the most part, less than 0.05 magnitude. (Values of (P-C1) and (C2-C1) were calculated by subtracting a second order polynomial fitted to the

TABLE 1

("time" is in seconds after 04:31:29, 27 August 1989, UT)

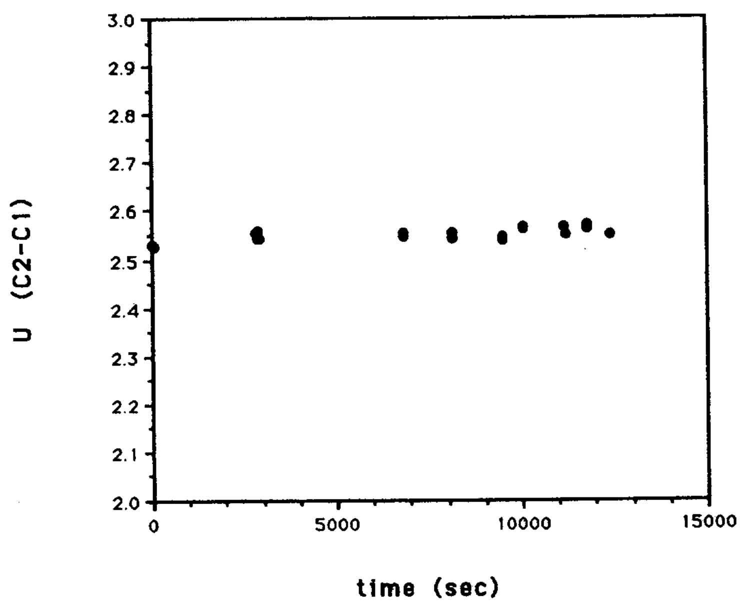
time	U(P-C1)	time	B(P-C1)	time	V(P-C1)	time	Open(P-C1)
7705	2.687	7712	2.241	7719	2.184	7725	2.297
7732	2.687	7739	2.249	7746	2.186	7752	2.299
7766	2.676	7773	2.251	7780	2.197	7786	2.304
7793	2.699	7800	2.256	7807	2.197	7813	2.311
8284	2.681	8291	2.245	8298	2.189	8304	2.299
8311	2.685	8318	2.247	8325	2.196	8331	2.297
8339	2.680	8346	2.246	8353	2.191	8359	2.300

Figure (1)



data of sky-brightness-corrected C1 magnitudes versus time from the sky-brightness-corrected magnitudes measured for P and C2.)

We are primarily interested in the time of minimum for PV Cas. Table (1) shows a section of our data around the point of minimum on 27 Aug 1989. From this data we get the time of minimum as 7800 seconds after our reference time, 04:31:29 UT. The uncertainty in this number is less than 60 seconds, but due to a clock drift of 1 millisecond per second in our computer, we will assign the uncertainty an upper limit of ± 60 seconds.


3.0
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2.0
U (C2-C1)
0
5000
10000
15000
time (sec)

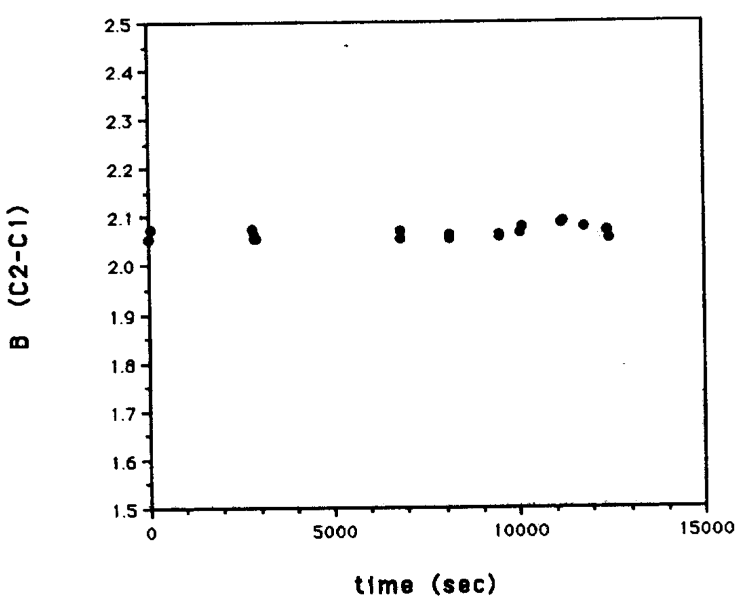

2.5
2.4
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
B (C2-C1)
0
5000
10000
15000
time (sec)

Figure 2(a,b)

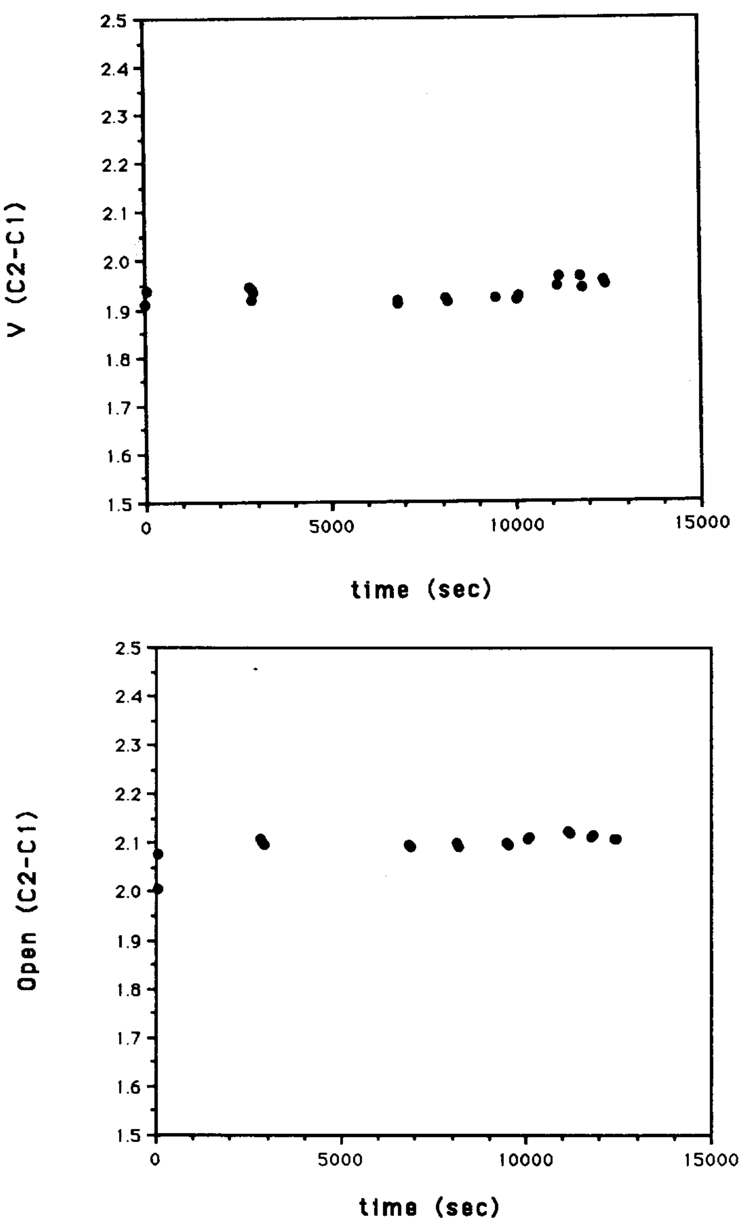


Figure 2 (c,d)

Thus, the eclipse we observed occurred on

JD 2447765.7788 ± 0.0007.

Using the method described by Hall and Genet (1), we converted this time to the heliocentric Julian day,

HJD 2447765.7808 ± 0.0007.

The ephemerides of Gimenez and Margrave (2) predict an eclipse for PV Cas on

HJD 2447765.7840 ± 0.0153.

Our observed time of eclipse agrees, to within the uncertainty, of their predicted time. We also note that the difference in the two times is only 0.0032 days, or about 4.6 minutes! Considering that Gimenez and Margrave calculated their ephemerides from observations made prior to seven years ago, this is a remarkable degree of agreement with the presently observed behavior of PV Cas.

We conclude that the ephemerides calculated by Gimenez and Margrave accurately predict the times of minimum of PV Cas, within a reasonable uncertainty, for present as well as past eclipses.

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PHOTOELECTRIC OBSERVATIONS OF THE O+O ECLIPSING BINARY V3903 Sgr

V3903 Sgr = HD 165921 = SAO 186366 is a massive and early type (O7V + O9V; Niemela and Morrison, 1988) eclipsing binary in the R association Simeis 188 (Herbst et al., 1982) and in the open cluster Collinder 367 (Claria, 1976). The light variability and an amplitude of light variation of 0.16 mag in V was reported by Cousins (1973).

V3903 Sgr was included as part of a program devoted to observe southern close binaries. In this note we present 7 times of minimum light derived from about 160 UBVRI observations, a linear ephemeris and a partial I light curve of the object.

Observations were secured in 1989 at the Estacion Astronomica Carlos U. Cesco of Felix Aguilar Observatory (San Juan, Argentina) with the 76 cm reflecting telescope, refrigerated RCA 31034A photomultiplier and photon counting techniques. The usual symmetrical pattern was followed during the measurements through the UBVRI filters in alternative sequences variable - comparison star and sky readings. HD 166192 (B0.5V:n) in Simeis 188 was used as the comparison star while HD 165999 (A1V) was used as the check star. The mean error of an observation is 0.08 mag.

The times of minimum light were obtained analytically in the framework of Guarnieri's et al. (1975) and Kwee and Van Voerden's (1956) methods; while the minimum on JD 7752.7612 was obtained by the tracing paper method. In Table I the photoelectric minima determined here are listed together with two spectrographic determinations of Niemela and Morrison (1988). The standard errors given in parenthesis follow from the output of the analytical methods and were estimated for the rest of the minima. Cycles were determined from the elements given by Niemela and Morrison (1988).

A least squares linear ephemeris using the values listed in the Table gives

$$\text{Min I} = \text{HJD } 2445191.349 + 1^{d}.744228 * E$$
$$\pm.020 \qquad \pm.000014$$

Weights were calculated from the formula weight=$(10*\text{SIGMA})^{-1}$ where sigma

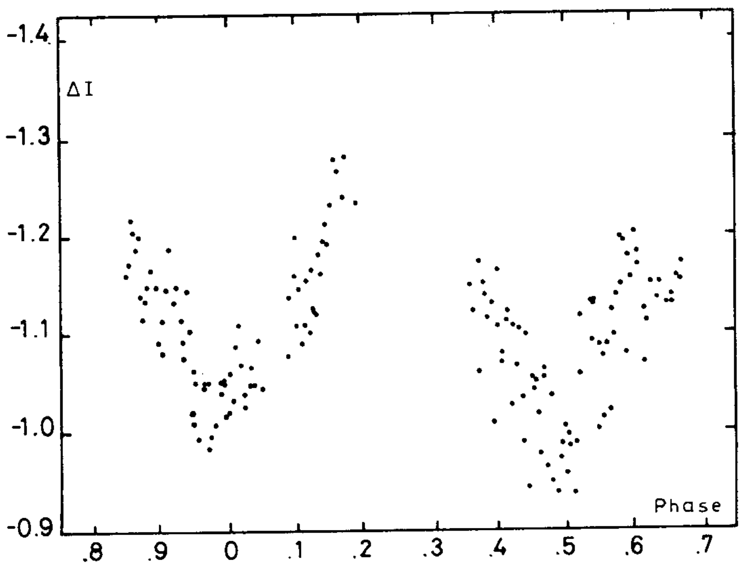

Fig. 1 Differential I light curve of V3903 Sgr

Table I
Times of minima and residuals for linear ephemeris

Min	Band	HJD(sigma) 2400000+	E(w)	(O-C)
II	sp	45187.0030(0.0500)	-2.5(2.0)	0.0146
I	sp	45191.3340(0.0500)	0.0(2.0)	-0.0150
II	I	47747.5311(0.0051)	1465.5(19.6)	0.0159
II	I	47752.7612(0.0050)	1468.5(20.0)	0.0133
I	U	47753.6164(0.0007)	1469.0(142.9)	-0.0036
I	B	47753.6213(0.0017)	1469.0(58.8)	0.0013
I	V	47753.6183(0.0008)	1469.0(125.0)	-0.0017
I	R	47753.6208(0.0019)	1469.0(52.6)	0.0008
I	I	47753.6204(0.0019)	1469.0(52.6)	0.0004

stands for the standard errors. The column labeled (O-C) in the table shows the departure between observed and calculated times of minimum light.

The partial light curve in I is depicted in Figure 1. It displays a high dispersion inside and outside minima. The amplitude of the minima estimated from the light curve is 0.25, a value somewhat greater than that determined previously. The orbit of the system appears to be circular and perhaps with a high degree of contact. There is a hint that the minimum at phase 0.50 could be the primary one, but only further observations would confirm this. A rough estimate of the inclination of the orbit would be 70 degrees. Differential B-V colors between primary and secondary minima suggest that the hotter star is in front of its mate during primary minimum. Further observations of V3903 Sgr are planned. We wish to express our thanks to the Director and Staff of the OAFA.

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GM SAGITTARII: STRANGE LIGHT CHANGES IN A BINARY SYSTEM

GM Sgr (HV 4048) was discovered by Luyten (1927) and classified as a long period variable star with the range 15.2-(17^m. No chart was published. The co-ordinates (converted to the equinox 1950.0) were $18^h16^m17^s$ $-25^o26'.8$.

In June 1978 Goranskij (1978) discovered the outburst of a star in the same sky region. Its peak brightness was about two magnitudes over the mean quiet level. Evident rapid variations were seen in the quiet state at 14^m.2 B. The star was classified as a possible nova-like variable. The accurate position of this star is $18^h16^m16^s.2$ $-25^o25'43''$, 1950.0.

Dr. P.N.Kholopov, the late chief editor of GCVS, identified Goranskij's star with GM Sgr in spite of principle difference in descriptions and classifications. Note that the variability ranges of these stars did not overlap. This identification must be verified with old photographic observations or tested immediately in the discovery Bruce proper motion plate.

Present investigation was carried out on the base of 345 Moscow collection plates obtained with the Crimean 40-cm astrograph in J.D.2437109-47741. No other strong outbursts were found. The eye estimates of the star in June 1978 outburst are the following.

J.D.2443659.505	B=14.35	43672.463	B=13.70
668.460	12.4	686.395	13.86
669.474	13.20	692.427	14.33

The total range of variability is 12.4-15.3 B.

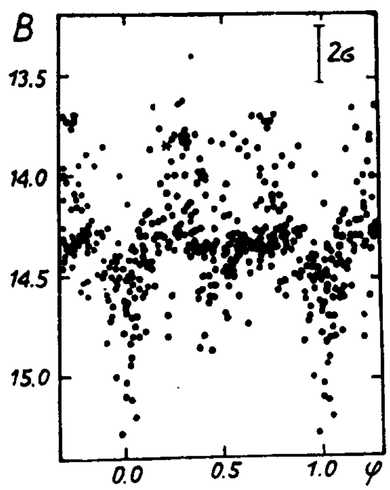

Figure 1. The light curve of GM Sgr. Phases are computed with the formula $C = 2447707.454 + 0^{d}.7365483 \cdot E$

The observations of GM Sgr were also tested for periodicity. The computer program was a realization of the well known Lafler-Kinman method in S.Yu.Shugarov's modification without phase sizing procedure. ϑ statistics shows a set of very shallow dips, the amplitude of periodic component in the light curves being less than $0^{m}.5$ with the total amplitude of the rapid variability of $1^{m}.9$. The possible periods found between 0.05 and 500 days are given in the Table.

Frequency	Single wave		Double wave	
cycle/day	period (days)	ϑ	period (days)	ϑ
1.7127	0.5838874	1.32	1.1677828	1.40
2.7151	0.3682688	1.37	0.7365483 *	1.20
3.7181	0.2689528	1.40	0.5379031	1.58
4.7209	0.2111825	1.50	0.4236508	1.31
5.7209	0.1747990	1.46	not found	

Here we faced the known problem of day aliasing. This southern object may be observed from Crimea only during a few

Figure 2. Visual chart of GM Sgr. Lower left is a 2'x2' fragment of the blue Palomar Sky Survey chart. Image of GM Sgr is in the center. Photographic magnitudes of comparison stars are the following: b=12.90, c=13.71, d=14.48, e=15.43.

hours in a night. A final choice of the orbital period can be made by monitoring at southern observatories.

The best period marked with an asterisk gives the lowest dispersion light curve shown in Figure 1. Zero phase is at J.D.hel. 2447707.454 (Min I). Other double wave curves resemble this one. The double wave periods are more preferable than the single ones because the alternate minima have nonequal depth.

The light curve shows pronounced changes of the light level. The depth of the primary minimum varies from $0^m.2$ to $1^m.0$. The deepest eclipses below $15^m.0$ were observed twice in August 1971 and in July 1989.

The finding chart in visual light is given in Figure 2. The star is located in a very dense star field but outstands from neighbour stars with intense blue colour. Its image of 16^m (!) in the blue Palomar Sky Survey plate is blended with several faint companions (see a square fragment of plate in the left lower corner of Figure 2, the image of GM Sgr is in the center of the fragment). The accurate measurement reject assumption that one of companions is responsible for June 1978 outburst.

A single photoelectric observation of GM Sgr relatively to the star 'a' was obtained at the 1-m reflector of Mt.Sanglock observatory of Tadjik Academy of Sciences. The star 'a' was later calibrated through Alcaino's (1981) photoelectric standard in M 26. The photoelectric measurement is plotted with an asterisk in Figure 1. These are the magnitudes and colours of the variable and the comparison star.

	Date	V	B-V	U-B
GM Sgr	2446708.108	13.48	0.37	0.26
a	47681.5	11.62	0.20	0.08

Apparently GM Sgr does not have ultraviolet excess, and its classification as a nova-like variable is wrong. With given UBV colours the object remains an early A type star having a small colour excess $E(B-V)\sim 0^m.3$.

It seems that the star may be an interesting object for further investigations including multiwavelength and spectral observations, monitoring and archival search.

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SUPERNOVA IN ANONYMOUS GALAXY

By comparing the Schmidt-plates of the Konkoly Observatory obtained during the regular supernova patrol, a supernova has been found in a very faint anonymous galaxy. The plates were taken on 30.0875 UT November, 1989. The brightness of the SN is about 17.5, the galaxy is 17 mag. The distance of the SN from the galaxy center is 5".8 to SW. The exact coordinates are: RA.= $07^h\ 23^m\ 34^s.5$; Decl.: $+64^\circ\ 0'\ 29''.8$ (1950.0).

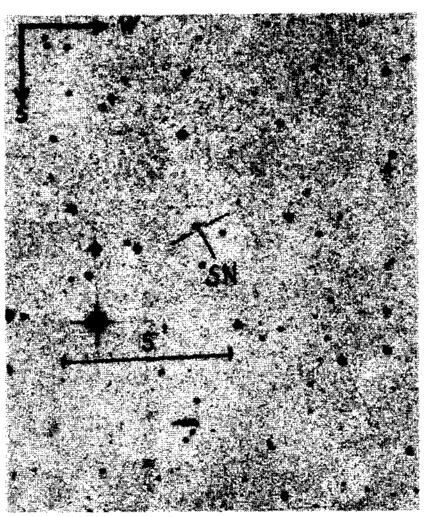

Figure 1

MIKLÓS LOVAS

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RECENT PHOTOMETRIC BEHAVIOUR OF MWC 560

MWC 560 is an unusually interesting star which has not been paid enough attention to till now. After having been discovered as emission line object (Merrill and Burwell, 1943), quite little but very interesting observational data have been published. From spectra taken with objective prism, Sanduleak and Stephenson (1973) noticed very strong violet-shifted absorption and variable emission components of Balmer lines. In the visual and near infrared spectral regions they observed strong TiO bands, which they considered as belonging to the spectrum of M4ep star. Their rough estimation of the visual brightness of MWC 560 is about $12^{m}_{.}5$.

The observations of Bond et al. (1984) show absorptions of H_{β} and highest members of the Balmer series, widened at least up to 3000km/s, while near H_{α} the M spectrum dominates. They observe a strong ultraviolet continuum on which low-excitation absorption lines are superposed. They have estimated the visual star brightness about 11^{m} and reported a flickering of amplitude up to about $0^{m}_{.}2$ and a time scale of some minutes. They suppose MWC 560 is a symbiotic-like system consisting of an M giant and a compact companion. Because of the very high mass transfer rate a part of the transferred matter is ejected from the system as a strong variable high-speed wind.

Nevertheless MWC 560 has been neglected by the observers. Only after the announcement of Tomov (1990) something like a new era in the observational history of the star began. A lot of astronomers in different observatories began intensive photometric and spectral observations (Michalitsianos, Maran and Oliversen, 1990a,b; Feast and Marang, 1990; Maran, Michalitsianos and Oliversen, 1990; Kontizas et al. 1990; Michalitsianos et al.1990; Buckley et al. 1990; Dapergolas et al. 1990; Szkody and Mateo 1990; Mochnacki and Thomson 1990; Sanduleak, 1990; Maran and Michalitsianos, 1990). The goal of the present paper is to draw attention to the photometric behaviour of the star in the period February-May 1990 on the basis of all ours as well as the published observations until now.

We carried out observations of MWC 560 in the standard UBV system (Table 1) using two identical one-channel photometers attached to 60cm telescopes in the National

Astronomical Observatory Rozhen and Belogradchik Astronomical Observatory. HD59380 ($V=5^m.86$, $B-V=0^m.48$, $U-B=-0^m.04$) was used as a comparison star and the check star has coordinates $\alpha_{1950}= 7^h\ 23^m\ 22^s$ and $\delta_{1950}= -7^\circ 30\ 15$ ($V\sim10^m.2$, $B-V\sim0^m.05$, $U-B\sim0^m.10$). The data processing has been made by the Kirov, Antov and Genkov's (1990) program.

Table 1.

DATE	JD2447000+	V	(B-V)	(U-B)	OBS.
8 Feb 1990	931.440	10.1:	0.3:	-0.3:	R
24 Feb	947.479	9.65	0.28	-0.48	B
25 Feb	948.380	9.83	0.31	-0.41	B
26 Feb	949.365	9.93	0.29	-0.51	B
26 Feb	949.381	9.83	0.27	-0.52	R
28 Feb	951.354	9.80	0.26	-0.56	B
3 Mar	954.265	9.66	0.34	-0.54	B
4 Mar	955.384	9.54	0.31	-0.50	B
5 Mar	956.351	9.65	0.28	-0.51	B
5 Mar	956.346	9.62	0.30	-0.46	R
10 Mar	961.370	9.4:	0.2:	-0.5:	R
14 Mar	965.274	9.82	0.33	-0.43	R
14 Mar	965.351	9.84	0.35	-0.46	R
19 Mar	970.303	9.58	0.27	-0.54	R
24 Mar	975.308	9.64	0.28	-0.52	B
1 Apr	983.291	9.29	0.29	-0.41	B
2 Apr	984.256	9.21	0.24	-0.41	R
27 Apr	1009.282	9.46	0.34	-0.36	R
5 May	1017.288	9.45	0.35	-0.29	B

In Fig.1 the V, B-V and U-B curves of MWC 560 are shown. The most remarkable is the rising of the star brightness in V by about 1^m reaching a maximum of about $9^m.1$ at the end of March - the beginning of April. The scattering of the points is considerable and we regard it to be due to real brightness variations from night to night, as well as to the observed flickering of an amplitude in U about $0^m.3$ and characteristic times from <10 minutes to ≥1 hour (Tomov et al., 1990; Buckley et al., 1990). The changes in the B-V and U-B colours are smaller. B-V values are practically constant with an average value about $0^m.3$. The scattering of the U-B data is larger but in our opinion it may result from the observational conditions. These colours are not corrected for the interstellar reddening, so we can not determine precisely the star temperature and the spectral class in the optical region.

But it is obvious that the contribution of the M star to the brightness in the UBV system region is negligible, while the observations of Buckley et al. (1990) show that the red giant is the main light source in the infrared.

The photometric behaviour of MWC 560 is the evidence of its increased activity at the moment. Unfortunately, the period of regular observations is rather short and almost nothing is known about the brightness variations before the beginning of 1990.

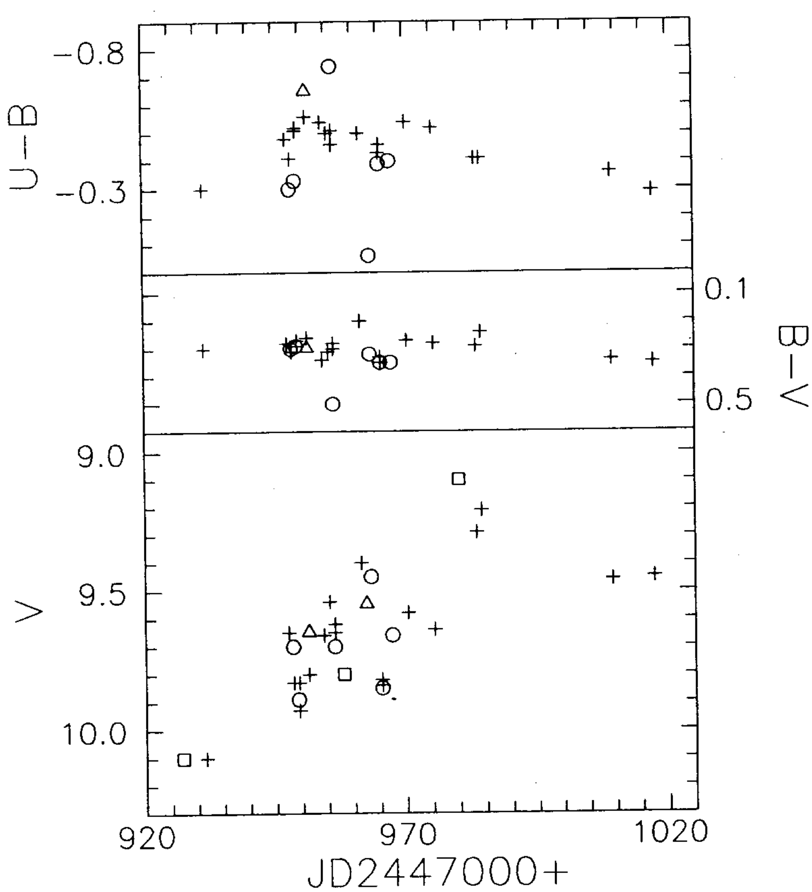

Fig.1: V, B-V and U-B curves of MWC 560 in February-May 1990. (crosses - our data; circles - Kontizas et al. 1990, Dapergolas et al. 1990; triangles - Feast and Marang 1990, Buckley et al. 1990; squares - Michalitsianos, Maran and Oliversen 1990, Michalitsianos et al. 1990)

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HD 93044: A NEW DELTA SCUTI VARIABLE?

This note announces a possible new delta Scuti variable discovered in a photometric survey near the declination 40°.

The Cassegrain focus of the 0.6-m reflector at Xinglong Station of Beijing Observatory was used for this survey. The star light passes through the Johnson's V filter which consists of BG12(1mm) + GG13(4mm) filters and enters a photoelectric photometer in DC mode (Shi et al.,1987). The signal is then real-timely recorded by a micro-computer DATAMAX-8000, which can also display the observed light curve at any time and print out the observed data.

On the night of April 8, 1990, we observed HD 93044 (SAO 043461), HD 92370 (SAO 043428) and HD 92221 (SAO 043420). With the high voltage of photoelectric amplifier being 2.7 kV, and the step of preamplifier high resistance being $10^7\Omega$, and the diaphragm aperture being 1 mm (23"), these stars were observed in the order of sky, HD 93044, HD 92370 and HD 92221 for five hours. The integration time was 20, 30, 40 and 60 seconds, respectively. From the differential light curves presented in Figures 1a-b, it can be seen that the variation in brightness of HD 93044 is obvious. Because the uncertainty in the magnitude differences of the other two stars was as large as $0\overset{m}{.}032$ (2σ), the observed variability needed to be confirmed.

We continued to observe these stars on April 9, 1990. But the reference star HD 92221 which is the faintest ($8\overset{m}{.}9$) in the group was abandoned and two other stars, HD 93457 (SAO 043475, $6\overset{m}{.}9$) and HD 93664 (SAO 043482, $7\overset{m}{.}8$) were added. The observing conditions were the same as those on the night of April 8. We performed six-hour differential observation in the order of sequence sky, HD 92370, HD 93044, HD 93664 and HD 93457, with the integration time of 20, 40, 30, 40 and 30 seconds, respectively. The light curves, no matter which of HD 93457 or HD 93664 was used as comparison, show the same periodic variations as presented in Figures 1c-d. The amplitude and period are about $0\overset{m}{.}09$ and $2\overset{h}{.}0$, respectively. The light curves of

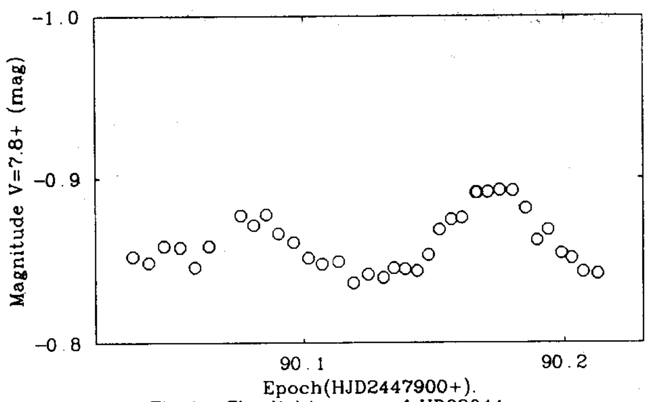

Fig 1:a The light curve of HD93044

using HD 92370 as comparison star.

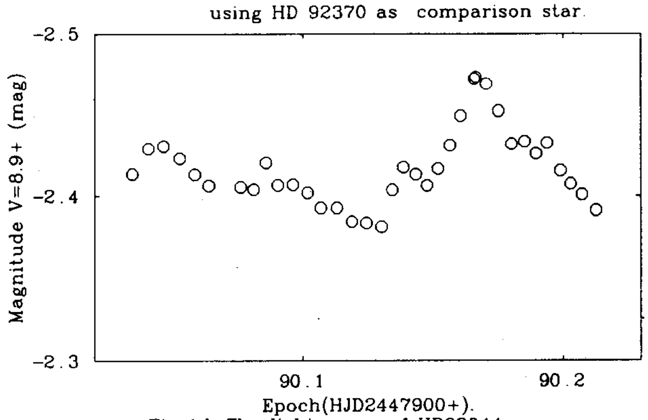

Fig 1:b The light curve of HD93044

using HD 92221 as comparison star.

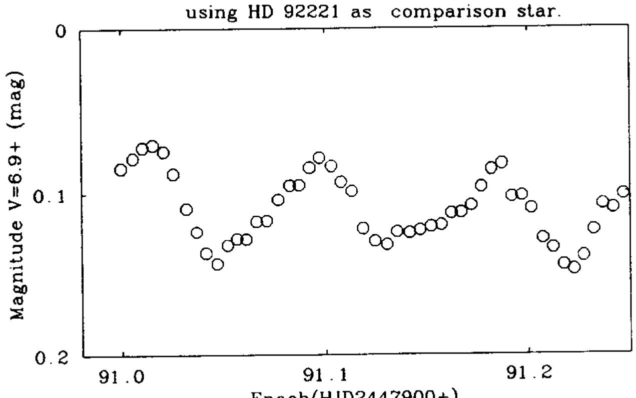

Fig 1:c The light curve of HD93044

using HD93457 as comparison star.

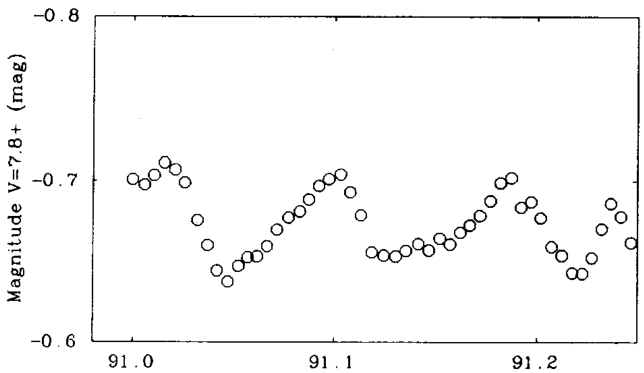

Fig 1:d The light curve of HD93044 using HD93664 as comparison star.

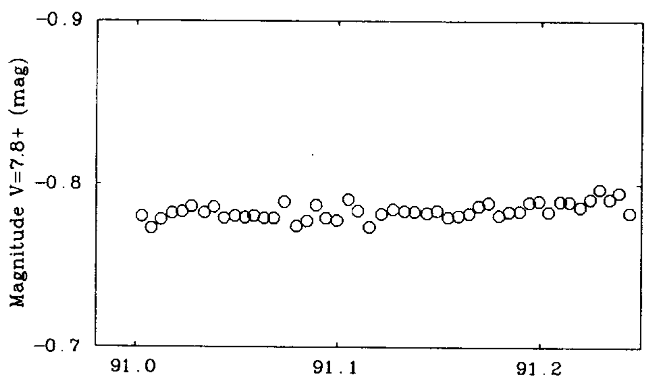

Fig 1:e The differential curve of HD 93457-HD 93664

HD 93044 obtained on April 8 seem to have similar regularity. The observations of April 9 were of high quality. Figure 1e shows the magnitude difference HD 93457 - HD 93664 which is constant within $0^m.01$ and gives σ = $0^m.0049$. So, using these two stars as comparisons did not affect the basic feature of the light variation in HD 93044.

In comparison with the eclipsing binaries, the light variation in HD 93044 is more complex. As the spectral class of HD 93044 is A7III, and its light variation is short-periodic and of low-amplitude, we classify it tentatively as a δ Scuti variable. In Figure 1, the m_V of the comparison stars, with some errors, are taken from the SAO Catalogue.

This work was directed by Jiang Shi-yang, professor of Beijing Observatory. In analyzing the nature of the variable, professors Huang Lin, Shen Liang-zao and Zhang Ron-xian gave much help. Here we gratefully acknowledge their kindness.

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Reference:

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THE SYSTEM OF EQUIVALENT WIDTHS OF FeI-ABSORPTION LINES FOR DETERMINING REGIONAL TEMPERATURES IN PHYSICAL VARIABLE STARS

A number of peculiarities of absorption spectra of physical variable stars do not permit to obtain unambiguous physical-chemical parameters of their atmospheres in separate phases of light variation. The temperature determination of a spectrum-forming layer by different methods (the level of a continuous spectrum, ionization temperature) does not give us any conformity results. It is practically impossible to construct "the curve of growth" by a classical method even having a rather reliable system of oscillators' forces. As is known at maximum light in the short-periodic cepheids and stars of RR Lyrae-type (Bappu and Raghavan, 1969, Rautela et al., 1981, Rodgers and Bell, 1963, Romanov et al., 1980, Romanov and Fenina, 1981, 1983) there is an anomalous intensity of heavy elements' lines observed in the spectra. Some authors suppose that this may be due to the short temperature decrease before maximum light (Whitney, 1967). Besides the profiles of hydrogen lines are distorted by emission, i.e. there occurs a drastic heating up of upper layers of the atmosphere. It is obvious that the temperature distribution in the levels of different lines formation does not correspond to the standard one at light maximum in cepheids. In connection with this, one can assume that the ratio of emission coefficients and atmospheric gas absorption is given by Planck's function in the regional kinetic temperature. This is known as the assumption of a regional thermodynamic equilibrium. In the absence of scattering this is equivalent to the assumption on the possibility of calculating the microscopic gas state by equations of thermodynamic equilibrium in the regional kinetic temperature. The RTE is not valid in the outer layers but it is the best approximation in the layers forming a continuous spectrum.

In the present work a method is shown for determining regional kinetic temperature from equivalent widths of absorption lines of neutral iron. It is based upon the property of equivalent widths of FeI-absorption lines to increase with the temperature excitation decrease irrespective of the ob-

Table I

The system of equivalent widths of FeI-absorption lines for determining regional temperature

N	λ	θ_{ex} / 0.70	0.85	1.00	1.19
		$-\lg W_\lambda/\lambda$			
1	4005.24	4.74	-	4.24	-
2	4044.61	5.10	4.64	4.40	4.05
3	4045.24	4.44	-	3.88	-
4	4063.60	4.42	4.18	3.98	3.74
5	4071.74	4.86	4.40	4.12	3.80
6	4072.52	5.42	4.74	4.62	4.25
7	4079.85	5.20	4.65	4.68	4.21
8	4112.35	-	4.96	-	4.30
9	4143.87	4.65	4.37	4.08	3.82
10	4147.67	4.96	4.58	4.31	3.87
11	4174.94	5.00	4.71	4.44	4.08
12	4175.64	4.82	4.59	4.36	4.08
13	4187.04	4.96	4.62	4.30	3.96
14	4199.97	5.74	5.27	4.77	4.13
15	4206.71	-	4.89	-	3.97
16	4233.61	4.68	4.70	4.31	3.80
17	4250.79	4.66	4.43	4.21	3.93
18	4260.48	4.68	4.41	4.15	3.78
19	4265.26	5.70	5.36	4.95	4.44
20	4267.83	5.70	5.09	4.57	3.86
21	4271.76	4.88	-	4.06	-
22	4276.68	5.72	5.25	4.80	4.26
23	4325.56	4.54	-	4.00	-
24	4383.56	4.53	4.37	4.00	3.70
25	4387.90	5.40	5.05	4.66	4.20
26	4389.24	5.72	5.16	4.70	4.15
27	4392.58	-	5.84	-	4.60
28	4404.75	-	4.44	-	3.68
29	4430.62	4.96	4.70	4.46	4.15
30	4432.57	5.76	5.37	4.98	4.48
31	4433.22	5.00	4.94	4.70	4.27
32	4442.34	4.89	4.59	4.32	3.98
33	4447.72	5.18	4.76	4.44	3.93
34	4466.55	5.02	4.66	4.33	3.92
35	4485.68	5.10	4.85	4.62	4.33
36	4489.74	-	4.90	-	4.01
37	4517.53	-	5.21	-	4.29
38	4587.13	5.48	5.24	4.88	4.45
39	4602.94	-	4.70	-	4.04
40	4611.28	5.16	4.83	4.70	4.10
41	4625.05	4.93	4.73	4.53	4.26
42	4637.51	4.96	4.78	4.58	4.33
43	4638.02	5.50	-	4.63	-
44	4647.44	5.26	-	4.50	-

Table II

Temperature parameters of stationary stars

Star name	Θ_{ex}(regional)		$T_{reg.}$		Θ_{ex} of other authors
γ Cyg	1.08 ± 0.01		5690		0.969 ± 0.05
41Cyg	1.01 ± 0.01	0.926 ± 0.01	6085	6630	0.926
ν Her	0.927 ± 0.01	0.813 ± 0.01	6640	7560	0.85

ject studied, a stationary or a variable one. Linear dependences of $(-\lg W_\lambda / \lambda)$ -value upon the parameter of excitation temperature θ_{ex} for 44 lines of neutral iron have been found by the analysis of equivalent lines of FeI in three cepheids RT Aur, T Vul, $\varkappa$ Pav (Bappu and Raghavan, 1969, Rautela et al., 1981, Rodgers and Bell, 1963). In Table I there are given four $(-\lg W_\lambda / \lambda)$ -values for each of the lines depending upon θ_{ex}. The The detailed procedure of obtaining Table I is presented in the work by Fenina et al., 1988. The validity of θ_{ex}-determination was estimated from the equivalent widths of stationary stars with known parameters of temperature: γ Cyg (Zeinalov, 1970), 41 Cyg and ν Her (Kipper, 1967). In case of the star not having spectral peculiarities, for instance, γ Cyg, the regional kinetic temperature in the level of absorption line formation is determined as precisely as $\pm$ 50° K.

$$T_{ex} \text{ (reg.)} = 4670^\circ \pm 50^\circ \text{ K}$$

With that the "curve of growth" constructed for γ Cyg from all the FeI lines is uniquely approximated by a Wrubel theoretical "curve of growth". 41 Cyg and ν Her proved to be the stars having a mixed spectrum. In this case in each of the stars there are distinguished two layers with different optimum regional temperatures. In Table II the data are given for stationary stars obtained by using Table I. The transition from θ_{ex} to the regional temperature is carried out by means of the formula $T_M = 5040^\circ\ (0.82\ \theta_{ex})^{-1}$.

The use of Table I for determining the regional temperature permits to find out spectral pecularities not only of physical variable stars (Fenina et al., 1988) but also of stationary stars having a mixed spectrum as well as of peculiar stars.

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1989 BVR LIGHT CURVES OF RT And

We have observed the short-period RS CVn system RT And (= BD +52° 3383A = #163 in the catalog of Strassmeier *et al.*, 1988) at Capilla Peak Observatory since 1981. We have analyzed these and other observations in the context of a starspot model (Zeilik *et al.*, 1989a). These data indicate that a single, large spotted region at a latitude near 45° and at active longitudes of either 90° or 270° accounts for the maculation effects in the light curves. The active region had a lower temperature than the photosphere by about 1200 K in 1987. We have decided to monitor RT And from Capilla at least annually to track the evolution of its magnetic activity.

Our new BVR observations were made with the 61-cm telescope on clear and partially clouded nights of 10, 11, and 13 November 1989 and 12 December 1989 UT. the CCD camera (Laubscher *et al.*, 1988) is equipped with a new filter set that transforms easily to the Johnson UBV Kron-Cousins RI systems (Beckert and Newberry, 1989). The variable, sky, and comparison star (BD + 52° 3384) were observed simultaneously in a multichannel mode. Data were reduced with a software mask with an effective aperture of 30 arcsec.

Figures 1-3 show the data (in normalized intensity units calculated from the instrumental differential magnitudes). Here we display only the normal points (open circles) made by binning the data in 2° intervals outside of the eclipses. Also shown in the figures are optimized model fits (solid lines) for $i = 88.4°$, $T_1 = 6250$ K, and $T_2 = 4900$ K. RT And is peculiar in that it has an eccentric orbit. We use $e = 0.026$ and M_0 (mean

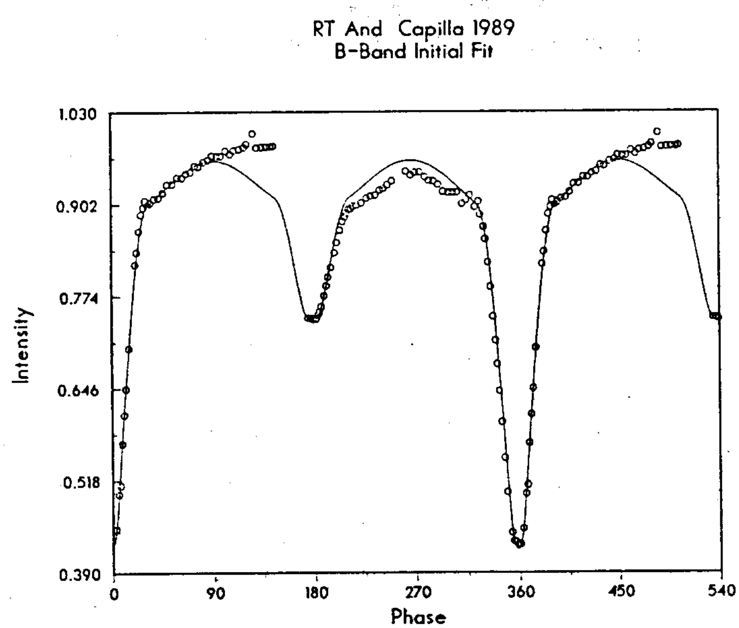

Figure 1.

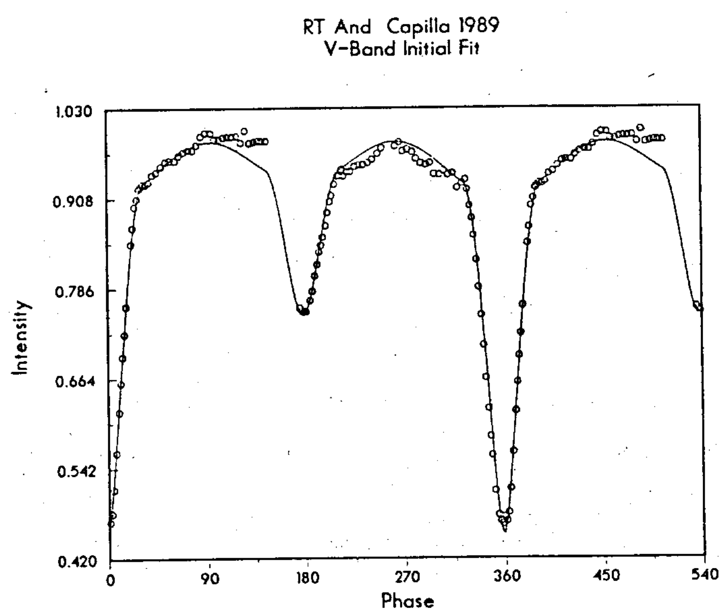

Figure 2.

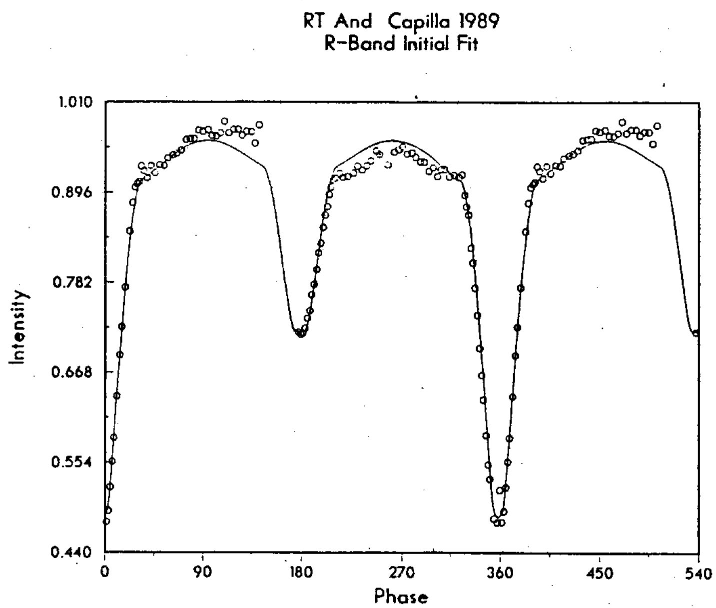

Figure 3.

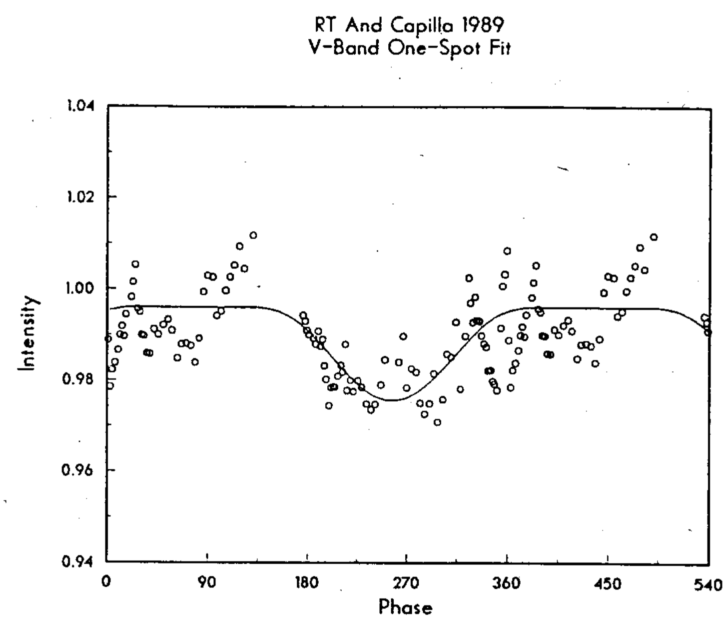

Figure 4.

anomaly at phase zero) = 3.03 (Zeilik *et al.*, 1989a) for the optimized fits. Figure 4 shows the maculation effect at V-band (open circles) with an optimized one-spot fit (solid line). The optimized starspot parameters are: longitude = 256.8° ± 8.0°, latitude = 63.1° ± 16.8°, and radius = 13.3° ± 4.8°. We can also use the difference in the depths of the maculation effects at B and R to calculate an average value of the temperature difference between the spotted region and the photosphere. For these data, we find ΔT_{spot} = 700K ± 370K. Within the errors, these values somewhat lower than those calculated from V/R-band observations in January 1989 (Zeilik *et al.*, 1989b). Hence, in a time span of a little less than a year, the only significant change has been a warming of the starspot region on the primary star.

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FURTHER BV PHOTOMETRY OF V1727 Cyg IN A LOW STATE

V1727 Cyg was identified as an optical counterpart of the X-ray source 4U2129+47 by Thorstensen et al. (1979), who found a large amplitude (1.5 mag in the B band) light variations with a period of 5.2 hr. EXOSAT observations of 4U2129+47 made in October 1983 showed no detectable X-ray flux (Pietsch et al. 1986), while coordinated optical observations indicated that the source no longer showed any large amplitude modulation. Its optical flux faded below the minimum value observed in the active state. Several groups of observers attempted to detect ellipsoidal variations in the light curve of V1727 Cyg during the extended low state of this system (Thorstensen et al. 1988; Kaluzny 1988, Chevalier et al. 1989; Cowley and Schmidtke 1990). All of them failed to detect any light variations, although variations of several tenths of a magnitude were expected. Moreover, spectroscopic studies show no evidence for the expected radial-velocity variations of the F star, which now dominates the optical light (Chevalier et al. 1989, Garcia et al. 1989, Cowley and Schmidtke 1990). It is rather unlikely that the star presently visible is the 5.2 hr companion of the x-ray source, although it has been suggested that it may be the third star in a hierarchical triple system.

In this note we present further CCD photometry of V1727 Cyg collected in a low state of this system. Observations were obtained during two observing runs on the #1 0.9-m telescope at the Kitt Peak National Observatory. The telescope was equipped with the RCA #3 camera during the first run (June 1989) while TEK #2 camera was used during the second run (December 1989). Initial processing of the images was done at KPNO. The photometry was extracted with the DAOPHOT package (Stetson 1987). Our BV photometry of V1727 Cyg is given in Table 1. The zero points of the transformation from the instrumental to the standard BV system were derived using magnitudes and colors of the reference stars No. 2 and No. 3 published by Cowley and Schmidtke (1990). The remaining transformation coefficients were derived based on the observations of several standard stars. For the reference star No. 1 we derived B and V magnitudes which are fainter by about 0.05 than the magnitudes published by Cowley and Schmidtke. The source of this discrepancy remains unclear for a moment (variable star?). The available data indicate that the optical flux of V1727 Cyg has been remarkably stable during the last few years. The average B and V magnitudes derived on June 1989 and on Dec 1989 agree to within 0.015 mag with the photometry derived in 1986 and 1988 by

Table 1
BV photometry of V1727 Cyg. The probable errors of the individual observations range from 0.015 to 0.040 mag.

HJD 244 7000+	mag	Filter	HJD 244 7000+	mag	Filter
678.965	17.912	V	862.581	17.896	V
679.804	17.902	V	864.574	17.898	V
679.953	17.902	V	870.578	17.936	V
679.961	17.889	V	678.962	18.826	B
680.972	17.872	V	679.796	18.844	B
680.975	17.899	V	679.957	18.834	B
682.979	17.897	V			

Cowley and Schmidtke (1990). Also the average magnitudes derived by Thorstensen et al. (1988) and Kaluzny (1988) agree to within observational uncertainties with the values given in this note if we make slight adjustments reflecting usage of different comparison stars by different groups of observers.

Observations reported in this paper have been reduced on a DELL-310 computer on loan from Princeton University Observatory.

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B, V, R, I LIGHT CURVES OF EH HYDRAE

As a part of our current study of very short period eclipsing binary systems, we have obtained complete B,V,R,I light curves of the fourteenth magnitude W UMa variable, EH Hya (HV 11665). The system was discovered by Ashbrook (1942) in her study of fifty-nine variable stars in Milky Way field #355. The finding chart for this variable is found in the atlas by Tsesevich and Kazanasmas (1971). No further references are available on this neglected system. The ephemeris given by Ashbrook is:

$$\text{Jd Hel Min. I} = 2427870.515 + 0.29691\text{d} \cdot E$$

The present observations of EH Hya were made on 5 - 9 May, 1989 inclusive. The Yale 1M Ritchey-Cretien Telescope at Cerro Tololo Inter-American Observatory was used. The photometry was done in the Johnson-Cousins' system with standard B,V,R,I filters using the Automated Single Channel Aperture Photometer with a dry-ice-cooled Hamamatsu R943-02 (Ga-As) photomultiplier tube. The coordinates of the check, comparison and the variable star are given in Table I. Neither the check nor the comparison star has a catalogue identification. An average of 425 observations were obtained at each effective wavelength.

TABLE 1

Star	R. A. (1950)	Dec. (1950)
EH Hya	$12^h\,02^m\,17^s$	$-32^\circ\,52'\,54''$
Comparison	$12^h\,02^m\,16^s$	$-32^\circ\,50'\,35''$
Check	$12^h\,02^m\,16^s$	$-32^\circ\,52'\,20''$

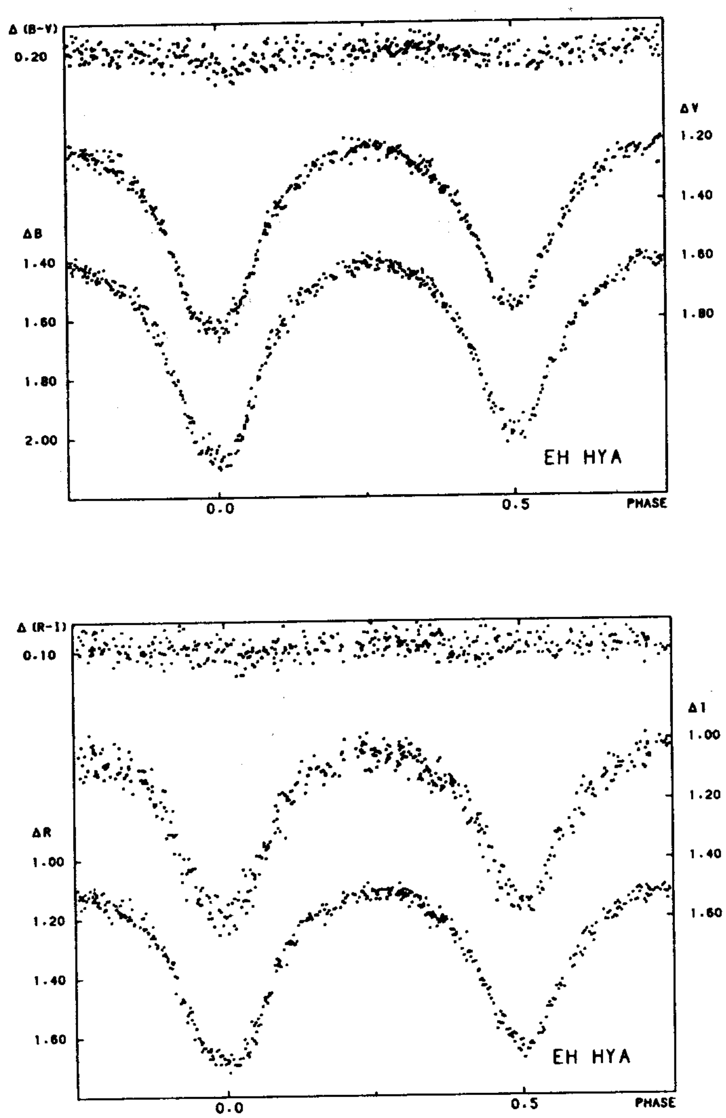

Fig. 1 - Light curves of EH Hya as defined by the individual observations.

Five mean epochs of minimum light were determined from the observations made during three primary and two secondary eclipses. Most epochs were determined from an iterative technique based on the Hertzsprung method (1928). The bisection-of-chords method was used to determine the earliest secondary epoch in I, and the latest primary epoch in B and V. The tracing paper method was used to obtain the latest primary epochs in R and I due to high scatter in these particular observations. The times of minimum light are given in Table II along with the epoch of Ashbrook (1942).

TABLE II

JD HEL. 2400000+	Minimum	Cycles	(O-C)
27870.515	I	-66644.0	0.0000
47655.6455(6)	I	-7.0	-0.0007
47656.5358(3)	I	-4.0	-0.0012
47656.6864(11)	II	-3.5	0.0010
47657.5770(8)	II	-0.5	0.0009
47657.7246(1)	I	0.0	0.0001

These times of minimum light along with a starting ephemeris consisting of the period by Ashbrook (1942) and our last epoch were introduced into a least squares solution to obtain the following ephemeris:

$$\text{JD Hel Min. I} = 2447657.7246 + 0.29690909\text{d} \cdot E$$

This ephemeris was used to calculate the O-C's in Table II and the phases of the present observations.

The B, V, R, and I light curves of EH Hya defined by the individual observations are shown in Figure 1 as Δm versus phase. Preliminary analyses of the observations reveal that this system is of W-type in shallow physical contact with a difference in component temperatures of $\Delta T \sim 300$ K and a small mass ratio, $q \sim 0.3$. Much of the preliminary analyses was done by Stephen

Charlesworth as a part of his undergraduate honors thesis. Further results and a complete analysis of the observations will be published elsewhere.

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THE UNIQUE MANIFESTATION OF THE MATTER OUTFLOW IN THE ECLIPSING BINARY SYSTEM V 361 Lyr

The variable star V 361 Lyr was mentioned as an ordinary RR Lyr type star in the third edition of the General Catalogue of Variable Stars. Its period was unknown at that time. The photographic light curve obtained by one of us (M.G.) revealed the eclipsing nature of this object with periodic light variations ($P=7^{h}.5$). The shape of the light curve of V 361 Lyr is similar to that of β Lyr systems but in the case of V 361 Lyr the light maxima differ by $0^{m}.5$ from each other what is incompatible with our knowledge about β Lyr type and similar systems. Light curves with different maxima are observed in the case of eclipsed cataclysmic variables (CV) but the "hump" on CV light curves is observed just before the primary minimum and is due to the bright spot on an accretion disk around the white dwarf. On the contrary, the more prominent maximum on the light curve of V 361 Lyr is Max I after the primary minimum. As to our knowledge, there are no other binaries with similar light curves. So we decided to carry out photoelectric photometry of the object to clarify the situation.

Classical CVs are specified by an UV excess in their energy distribution and Hα emission in the spectrum. Observations of V 361 Lyr have not revealed such peculiarities. Colour indices of V 361 Lyr indicated a spectrum $\sim$ K.

During the last 4 years detailed B, V light curves and a somewhat worse U light curve have been obtained (see Fig. 1). The light curve of V 361 Lyr can be presented by a sinusoidal wave with the superimposed minima due to eclipses. The difference in maxima heights is then due to the fact that Max I occurs almost in the maximum phase of the sinusoid whereas Max II - in the end of decline.

The colour index in the primary minimum ($B-V=0^{m}.92$) is very close to those in the secondary one ($B-V=0^{m}.85$). In the "hump" (Max I) the colour indices are $B-V=0^{m}.59$, $U-B=-0^{m}.10$. The light in both eclipses (Min I and Min II) seems to come from the same, more luminous companion. The secondary compan-

V 361 Lyr

Min I = 2444461.3865 + $0^{d}.3096149$ · E

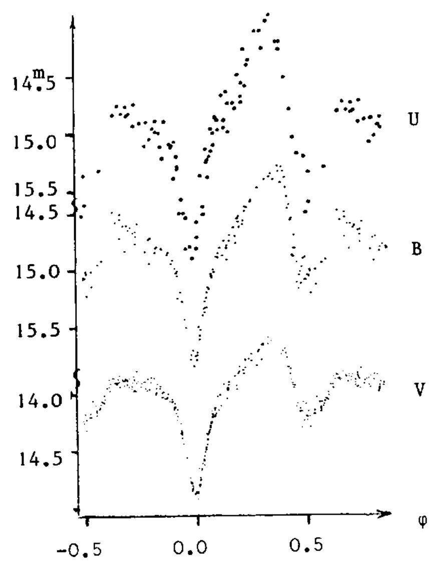

Figure 1. The light curves of the binary V 361 Lyr

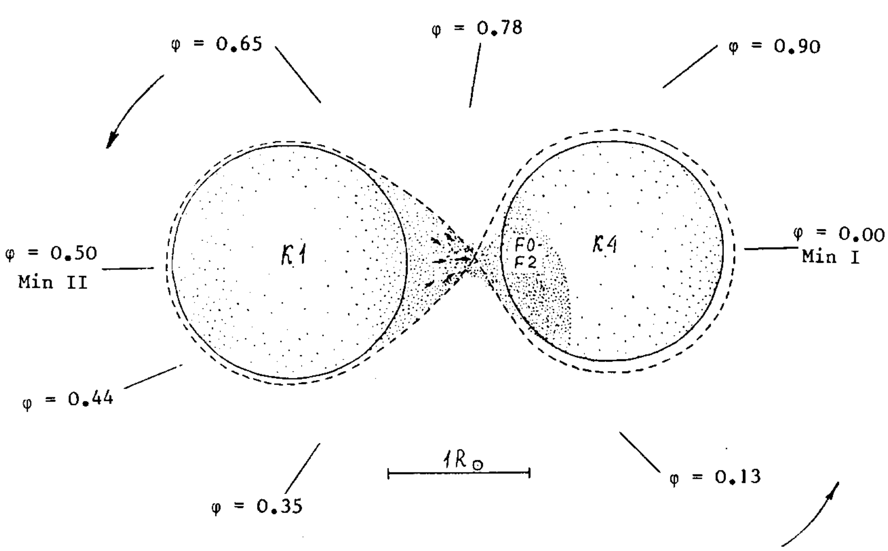

Figure 2. The model of the binary system V 361 Lyr

ion is assumed to be more evolved (less luminous), with nonuniform temperature distribution on the surface. The simplified scheme of the binary model is shown in Fig. 2 where the secondary component (on the right) is accreting matter from the primary component, and a bright spot is formed as a result of this accretion in the place of accreting matter shock onto the surface. The bright spot can explain a sinusoidal shape of the light curve (Fig. 1). During the primary minimum ($\Phi = 0\overset{P}{.}0$) the spot and the main part of the luminous companion are hidden from the observer (see Fig. 2). Further, on the ascending branch, the bright star appears gradually from behind its companion, conditions for the spot appearance become better and better and at the phase $\Phi = 0\overset{P}{.}35$ of the orbital period we can see the spot in the best way (Max I). After this an occultation of the spot by the bright star begins and becomes total at the orbital phase $\Phi = 0\overset{P}{.}5$. Subsequently, the spot appears again and becomes brightest at the phase $\Phi = 0\overset{P}{.}65$ (Max II). At the phase $\Phi = 0\overset{P}{.}80$ the spot disappears again.

Let us remember that CVs have a hump before the primary minimum which is explained by the spot on an accretion disk around the white dwarf. In the case of CVs the matter flows from the secondary companion (red dwarf) to the primary one (white dwarf surrounded by the accretion disk). On the contrary, in the binary system V 361 Lyr matter flows from the more luminous star to its companion and forms on it an extended spot being responsible for an extraordinary shape of the light curve of the binary V 361 Lyr.

We have placed both components on the colour-colour diagram (see Fig. 3). The magnitude of the bright star is $V=14\overset{m}{.}25$, the colour indices are $B-V=+0\overset{m}{.}85$, $U-B=+0\overset{m}{.}50$ which correspond to the spectrum K1. The companion ($V=16\overset{m}{.}1$) with the colour index $B-V=+1\overset{m}{.}1$ is apparently classified as K4V. The mean spot colour indices are $B-V=+0\overset{m}{.}3$, $U-B=-0\overset{m}{.}2$, its temperature is 7000 - 8000 K.

The binary system V 361 Lyr is assumed to be observed at the first mass exchange evolutionary stage when the brighter and more massive star is outflowing to its low-mass companion. A number of such binaries must be considerably less than those at the second mass exchange stage (i.e., CVs), after the common envelope phase and shrinkage of the system. The first mass exchange can be realized only in the binaries with initially small separations between the components. Hence it is rather serendipitous chance to observe such a system.

V 361 Lyr is obviously a binary system worthy of further photometric and detailed spectroscopic investigation.

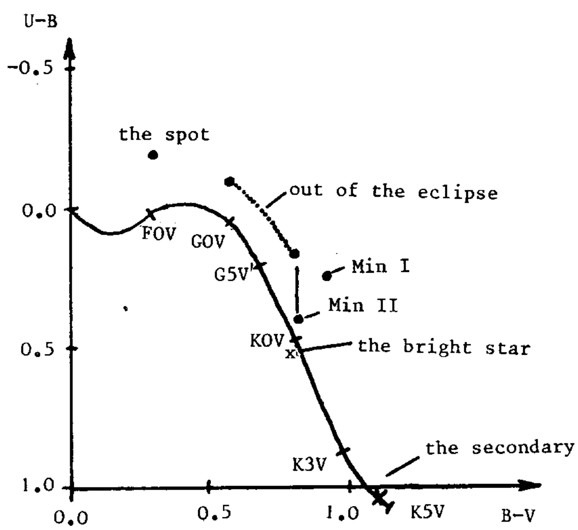

Figure 3. The colour-colour diagram

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A CALL FOR OPTICAL PHOTOMETRY AND SPECTROSCOPY OF ACTIVE COOL STARS TO COMPLEMENT ROSAT X-RAY OBSERVATIONS

The ROSAT project is an international collaboration between the United Kingdom, West Germany and the USA. The satellite is due to be launched on a Delta-II rocket from Cape Canaveral on May 31st 1990 and consists of two co-aligned imaging telescopes: The German X-ray telescope (XRT) operating in the soft X-ray band (6-100 Å), and the UK Wide Field Camera (WFC) operating at extreme ultra-violet (XUV) wavelengths (60-600 Å). ROSAT has two main mission objectives to achieve during its 2-3 year lifespan. Firstly, a six month all-sky survey of soft X-ray sources with a higher sensitivity than previously possible, extending into the XUV region of the electromagnetic spectrum which has so far remained largely unexplored. Secondly, there will be a programme of pointed observations for detailed studies of hundreds of individual targets.

The purpose of this communication is to solicit optical photometry and spectroscopy of some of the active cool stars which will be monitored by ROSAT during the all-sky survey. Simultaneous optical/XUV observations will be valuable in mapping the magnetically defined structures which exist in these stars in their photospheres, chromospheres and coronae. The ROSAT survey is in many ways ideal for such an investigation. The scanning method employed means that objects will be observed for about a minute once every ninety minute satellite orbit over the duration of their visibility to ROSAT. This duration varies from 5 days to several months, depending on the positions of the objects.

Targets to be included in this campaign are members of the BY Dra class (BY Dra, CC Eri e.t.c.), the RS CVn class (AR Lac, CF Tuc e.t.c.) and rapidly rotating single dwarfs (AB Dor, PZ Tel). The target timeline is moderately well known and some of the potential study objects will be visible to ROSAT for several weeks enabling a detailed study of the correlation between XUV emission from active coronal regions and starspot locations found by cotemporal optical diagnostics.

Observers interested in participating in a coordinated campaign should in the first instance contact the undersigned giving details of facilities and particular objects of interest.

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CH CYGNI: A VERY DEEP MINIMUM ACCOMPANIED BY AN EPISODE OF ACTIVITY

CH Cygni is known as a semiregular variable star of spectral type M6 - M7III (Kholopov, 1985), occasionally exhibiting symbiotic features. The last conspicuous active phase, which took place from 1977 to 1987, has been extensively studied (e.g. Luud et al., 1986, Mikolajewska et al., 1987, Mikolajewski et al., 1990a,b etc.). Since 1987 the star has been in an inactive state showing semiregular variations in V magnitude and color index B-V about $1^{m}.5$ - $1^{m}.8$. A short-time episode of activity occurred in summer 1989 with the appearance of flickering in U filter and changes in the spectrum (Skopal, 1989, Tomov et al., 1989, Mikolajewski et al., 1990b).

Photoelectric UBV observations of CH Cyg with a 0.5m telescope have been carried out at Tartu Observatory since 1968 (see Luud et al., 1977 for the description of observational equipment and methods). Latest observations in 1990 have revealed that the star has become fainter than ever in this century. There is no evidence of V brightness below the 9th magnitude (Mikolajewski et al., 1990a), but now, on JD 2448025 we have measured V=$9^{m}.19$ and on JD 2447941, with some uncertainty V=$9^{m}.21$. In the table we present our UBV observations since September 1989. U, B and V magnitudes are presented in the figure as well. HD 182691 is used as a comparison star with V=$6^{m}.54$, B-V=$-0^{m}.05$, U-B=$-0^{m}.24$. For every night the mean of 4-8 measurements is given. Errors of those mean values may be about $0^{m}.02$ - $0^{m}.05$ (increasing from V to U).

TABLE I

UBV observations of CH Cyg at Tartu Observatory

JD	V	B−V	U−B
2447791.340	7.53	1.68	0.83
806.255	7.71	1.68	0.81
814.349	7.92	1.79	0.90
815.313	7.96	1.72	0.91
851.417	8.50:	1.44:	0.32:
858.292	8.48	1.52	0.27
864.166	8.34:	1.60:	0.42:
866.210	8.30	1.60	0.57
876.319	8.14	1.76	0.66
895.251	8.30	1.73	0.69
906.193	8.58	1.67	0.76
941.238	9.21:	1.56:	-
945.242	9.15	1.59	0.56
957.428	9.06	1.61	0.32
964.423	8.95	1.64	0.38:
969.574	8.81	1.69	0.68
978.564	8.69	1.71	0.63
987.435	8.73	1.70	0.49
990.539	8.79	1.71	0.52
994.424	8.82	1.56	-0.01
999.417	8.80	1.38	-0.19
8005.425	8.80	1.22:	-0.34:
006.417	8.93	1.43	-0.20
010.447	9.06	1.56	0.00
014.407	9.15	1.46	-0.05
018.419	9.16	1.28:	-0.24:
021.435	9.18	1.35	-0.33
025.427	9.19	1.34	-0.45

In the figure variations in V magnitude can be detected with a characteristic time of about 100 days. This time coincides with the dominant period which has been observed over the whole photometric history of CH Cyg (Muciek and Mikolajewski, 1989, Mikola-

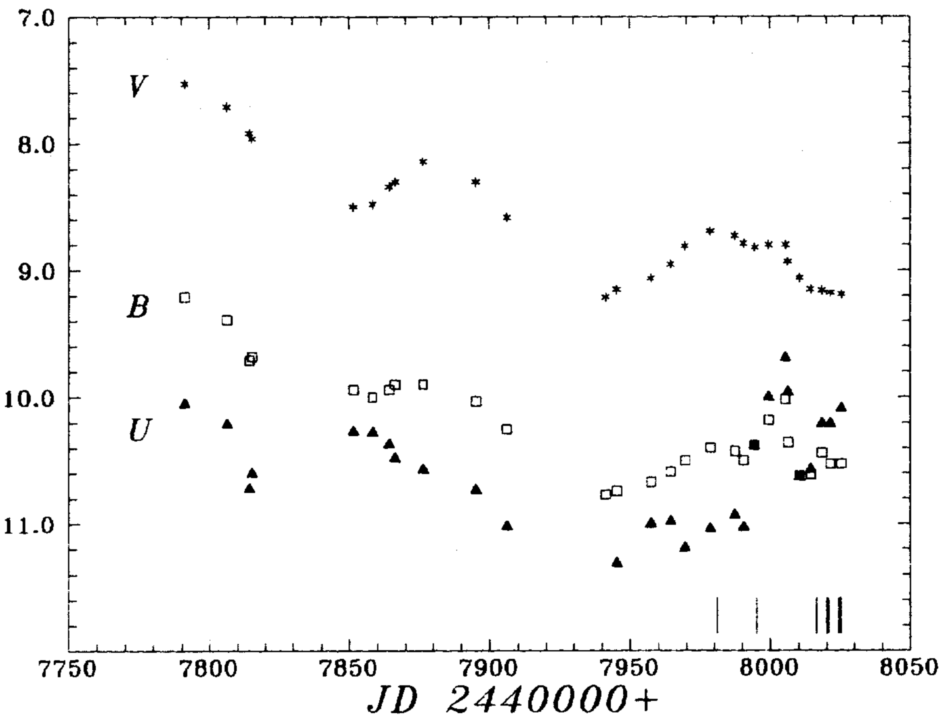

Figure 1. U, B and V magnitudes of CH Cyg from September, 1989 to May, 1990. Vertical bars mark moments when spectra with emission lines have been obtained. Thin bars mark emission line of H_α, thick bars - H_β and H_γ.

jewski et al., 1990a), but now variations take place on a very low level of brightness. Variations in B are similar to those in V, but not so prominent. In U we can find a rapid brightening by $\sim 1^m$ at about JD 2447992. After a short-time decrease the U brightness has again attained the 10th magnitude. There are some hints that flickering in U filter may be present, but our equipment does not enable to fix it firmly. At the same time emission lines have reappeared in the spectrum of CH Cyg. Our observations with a 1.5m telescope and a Cassegrain spectrograph have revealed one-component emission lines of H_α, H_β and H_γ. The moments of spectroscopic observations are shown in the figure.

Hence, CH Cyg has again surprised observers. Further analysis of the described events remains for forthcoming papers. Continuing observations of CH Cyg in all spectral regions are urgently needed.

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PHOTOMETRIC OBSERVATIONS OF THE WR STAR ROBERTS 93

Presently more than 10 WR stars are known which are "WR + compact companion" system candidates (cf. Cherepashchuk and Aslanov, 1984 and references therein). The detection of strong enough ($\sim 10^{36}$erg/s) X-ray radiation due to accretion on the companion would be an important argument for binarity. However, for all the stars of this type observed with Einstein, X-ray luminosity is less than $\sim 10^{33}$erg/s (Moffat et al., 1981, Sanders et al., 1981).

Recently Hertz and Grindlay (1988) reported the detection of high X-ray flux of the WC5 star Roberts 93. The X-ray to optical flux ratio is f_x/f_o(0.15-4.5keV)=$10^{-1.7}$. The authors have suggested that this star is a probable candidate to binary of considered type. However Pollock (1987) has obtained the X-ray luminosity of this star L_x(0.2-4 keV)=$1.4 * 10^{33}$erg/s (which is a typical value for single WR stars) from the same X-ray flux due to the large interstellar extinction.

Moffat and Shara (1986) carried out photometric observations of Roberts 93 in B filter (13 estimates on 13 nights in 1984) and made no direct conclusion on the optical variability. The amplitude was $< 0\overset{m}{.}04$, a period of $4\overset{d}{.}6$ fits the data best, but its significance is small.

Our photometric observations of Roberts 93 were obtained on 29 nights during a 42 day interval in 1989 June-August using the 60 cm telescope of Sternberg Institute Maidanak Station. 151 individual light estimates were obtained in V filter with a pulse counting photoelectric photometer. The comparison stars c1, c2, c3 were used (Fig.1) with UBV magnitudes presented in Table 1. The data are available on request from I.I.A. The light curve is shown in Figure 2. The instrumental scatter was $\sim 0\overset{m}{.}03$ owing to the relatively small size of the telescope. A search for periodic variability in the frequency range 0-2 day^{-1} was made. The power spectrum was calculated as described in Doroshenko et al. (1985) and is shown in Figure 3. The maximum at ν_1 = 0.017 day^{-1} (P=59^d) and its aliases (arrows) arise due to a small

Table I

Name	V	B	U	n
c1	12.69	13.89	-	11
c2	10.42	12.23	-	11
c3	10.21	10.64	10.82	3
1	13.39	14.16	14.39	1
2	13.36	14.46	-	1
3	13.49	14.84	15.72	1

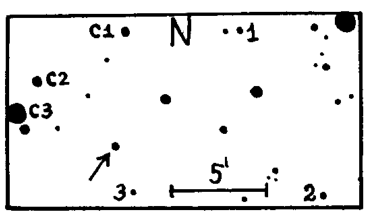

Figure 1

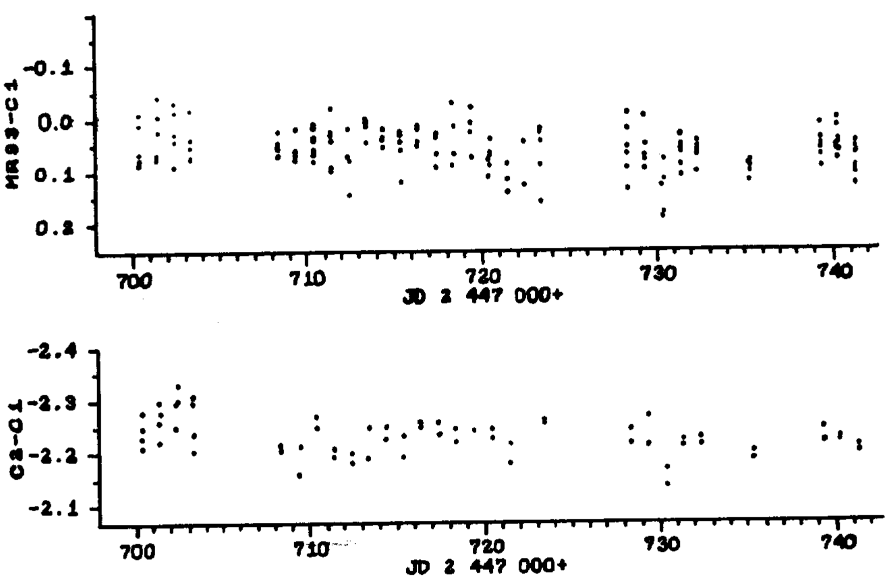

Figure 2. V magnitude difference versus time for Roberts 93

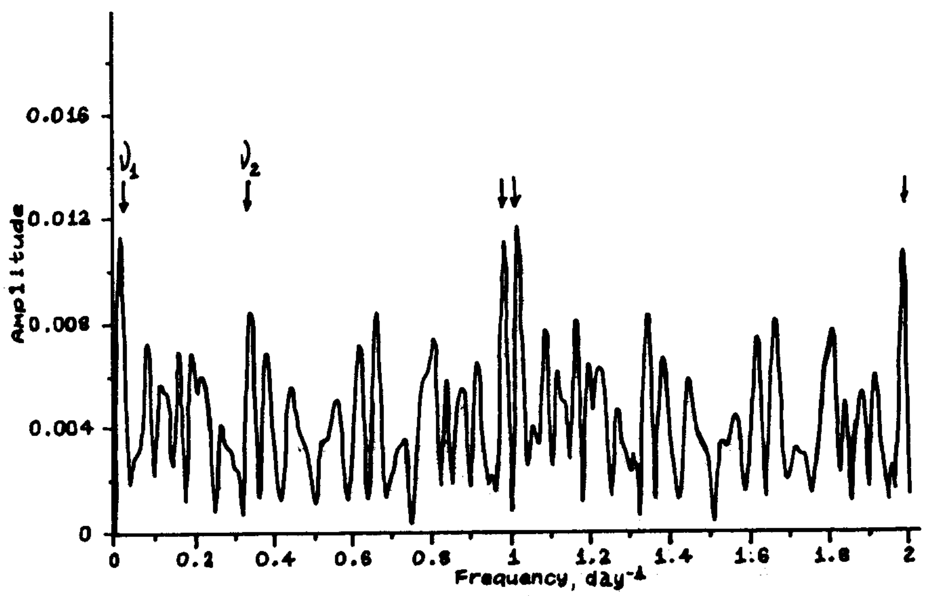

Figure 3. Periodogram of Roberts 93

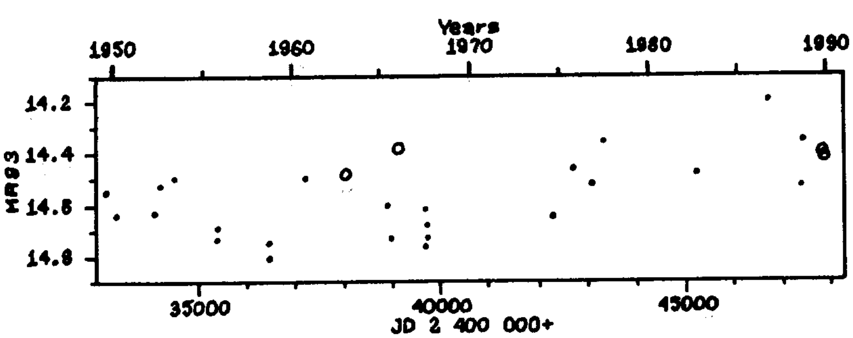

Figure 4. B magnitude versus time for Roberts 93. Open circles are photoelectric magnitudes.

trend in the brightness of c1 (cf. curves Roberts 93 - c1 and c2 - c1 in Fig.2). The same peaks are also visible in the c2 - c1 spectrum. c1, probably, is slightly variable. The maximum of the remaining peaks, at $\nu_2 = 0.34$ day^{-1}, shows the confidence level of 4% if calculated according to Doroshenko et al. (1985). It means that in the case of a pure white noise process the probability of occurrence of such powerful a peak is $\sim$4%. Evidently, this and other maxima are not significant with a usual confidence level of 1%. The amplitude of the corresponding harmonic component $a(\nu_2)=0^{m}_{.}016$. Hence the full amplitude of regular variability is less than $\sim 0^{m}_{.}03$.

The analysis of 25 plates from photographic archive of Sternberg Institute (the comparison stars 1, 2, 3 were used, cf. Fig.1, Table 1) has shown that the light of the star was $\sim 14^{m}_{.}6-14^{m}_{.}8$ (B) in 1949-1968 and became slightly brighter after 1973 ($14^{m}_{.}3-14^{m}_{.}5$ (B)), (cf. Fig.4). Probably, this points to the existence of long-term variability. One can note however, that photoelectric magnitudes of Hiltner et al. (1964) $B=14^{m}_{.}48$, Pyper (1966) $B=14^{m}_{.}38$ and our value (1989, $B=14^{m}_{.}41$) are in satisfactory agreement.

Thus the lack of optical variability of Roberts 93 does not confirm the Hertz and Grindlay's assumption.

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AS 296 IS IDENTICAL TO FG SERPENTIS

At the time of chart-drawing for the symbiotic star AS 296, it appeared that this star is identical to the variable star FG Serpentis, cataloged as a semi-regular variable.

Their coordinates differ only slightly:

AS 296 $\alpha = 18^h\ 12^m\ 33^s$ $\delta = -00^\circ\ 20'$

FG Ser $\alpha = 18^h\ 12^m\ 28^s$ $\delta = -00^\circ\ 16\overset{'}{.}2$ (Eq. 1950)

but the identification charts are similar.
The identification chart for FG Ser = S 10363 (Fig. 1) was published by C. Hoffmeister in AN 290, 286, 1968 and the chart for AS 296 (Fig. 2) by D.A. Allen in Proc. ASA 5 (3), 369 - 421, 1984.

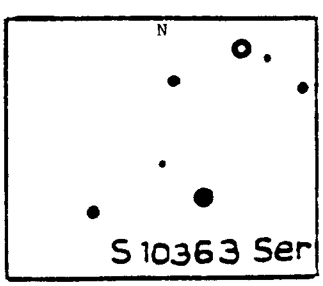

Figure 1.

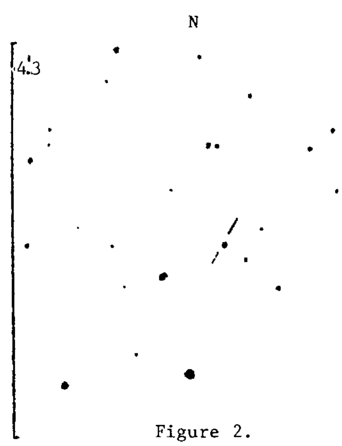

Figure 2.

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Editor's note:
The fourth edition of the GCVS assigns the following coordinates to FG Ser:

$\alpha = 18^h\ 12^m\ 30^s$ $\delta = -00^\circ\ 17'$ (1950.0)

"placing" it even closer to AS 296, leaving no room to doubt their identity.

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PHOTOMETRY OF ALPHA Ori (SEP 1988 TO APR 1990) AND A REASSESSMENT OF SOME PREVIOUSLY PUBLISHED DATA

We present photometry of alpha Ori (Betelgeuse), carried out differentially with respect to phi-2 Ori (V = 4.09, B-V = 0.95). The data were obtained using a 15-cm f/5.82 reflector and photometer employing an RCA 931A photomultiplier tube, operated at -1050 volts, and standard UBV filters. Other recent data are published by Krisciunas (1986) and Krisciunas and Fisher (1988), which we shall refer to as Paper I and Paper II.

In Table I we give the local date at sunset/UT date, the mean Universal Time of the observations, the geocentric Julian Date, the mean observed V magnitude and B-V color, and the numbers of differential v and b-v observations made. Differential extinction corrections were calculated with measured values of extinction when the stars were at high air mass and either measured or mean extinction values when the stars were high in the sky. On two of the nights (JD's 2447879 and 7880) the data were obtained at a site at elevation 75-m, 25 km south-southeast of Hilo. All other data were obtained at the 2800-m level of Mauna Kea. The mean V-band extinction at the 2800-m level is k_v = 0.18 mag/air mass. The mean reddening coefficients are k'_{bv} = 0.11, k''_{bv} = -0.07.

The coefficients for transformation to the UBV system were obtained from all-sky observations of UBV standards, and also from differential photometry of 27 and 28 LMi, for which Δ V = 0.378, Δ (B-V) = -1.03. Observations of 27 and 28 LMi from March 1986 through March 1990 give a mean V-band transformation coefficient of ϵ_v = -0.054 $\pm$ 0.003. All-sky results give ϵ_v = -0.062 $\pm$ 0.005. The mean B-V transformation coefficient is μ = 0.94.

In Fig. 1 we present the data of Table I. The check star was gamma Ori. From JD 2447415 to 7574 for gamma Ori we find < V > = 1.614, and from JD 2447599 to 7978 we find < V > = 1.647. The variations of about 0.08 mag in V for gamma Ori (see Paper II) are not confirmed.

In Paper II we mentioned that data of Fisher was 0.153 mag fainter

Table I

Photometry of alpha Ori (comp star phi-2 Ori)

Date	<UT>	Julian Date	V		B-V	n_v	n_{bv}
9/10 Sep 1988	1344	2447415.07	0.739 ±	0.010	1.862	4	1
12/13 Nov 1988	0940	7478.90	0.757	0.009	1.893	3	1
1/2 Dec 1988	0851	7497.87	0.810	0.012	1.908	3	1
10/11 Dec 1988	0831	7506.85	0.838	0.007	1.865	3	1
16/17 Feb 1989	0647	7574.78	1.003	0.008		3	
13/14 Mar 1989	0806	7599.84	0.931	0.007		3	
25/26 Mar 1989	0717	7611.80	0.846	0.005		2	
3/4 Sep 1989	1430	7774.10	0.702	0.027		3	
11/12 Sep 1989	1446	7782.12	0.732	0.008	1.852	3	1
20/21 Sep 1989	1353	7791.08	0.723	0.015		3	
8/9 Nov 1989	1012	7839.93	0.831	0.010	1.832	3	1
4/5 Dec 1989	0824	7865.85	0.750	0.008		3	
18/19 Dec 1989	0726	7879.81	0.689	0.013		3	
19/20 Dec 1989	0831	7880.85	0.630	0.037		2	
11/12 Feb 1990	0729	7934.81	0.574	0.008		2	
20/21 Mar 1990	0654	7971.79	0.550	0.013		3	
27/28 Mar 1990	0746	7978.82	0.590	0.015		4	
17/18 Apr 1990	0620	7999.76	0.606	0.006		3	

than data presented in Paper I which was obtained during the same months by Krisciunas. This was due in part to a systematic error in Krisciunas' gain table of 0.057 mag (Paper II). I believe that the rest of the discrepancy is due to a systematic error in the adopted value of ε_v used to reduce the data from JD's 2446379 to 6533. $\varepsilon_v = -0.094$ had been used, a value obtained from all-sky measurements. However, $\varepsilon_v = -0.052$ was also obtained on 8/9 March 1986 from differential measurements of 27 and 28 LMi, which is close to the long-term average of -0.054 found from that pair. The data from Paper I from JD's 2446379 to 6533 may then be systematically in error by $(-0.094) - (-0.054) = 0.040$ times $\Delta(B-V) = 2.061$ (the color difference of alpha Ori minus gamma Ori from Paper II), or an additional 0.082 mag. We give in Fig. 2 the data from September 1982 to April 1986, reduced differentially with respect to gamma Ori, using $\varepsilon_v = -0.054$ for all nights, and using our updated gain table. Fisher's data from Paper II are also shown in Fig. 2. The agreement is now very good.

In Paper I and previously published papers we reduced the alpha Ori data using gamma Ori as the comparison star. The great difference in color of these two stars leaves open the possibility of large systematic errors in the results owing to any error in the transformation coefficient. Using

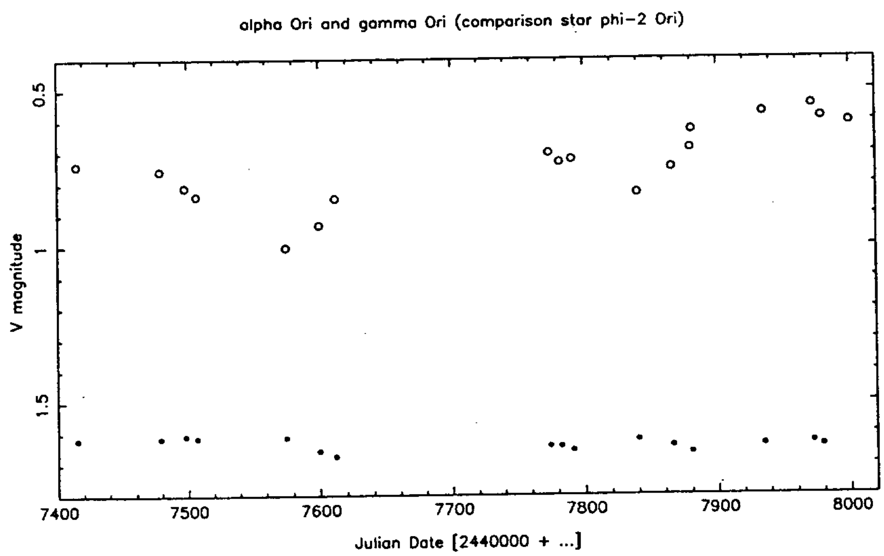

Figure 1. Photometry of alpha Ori (open circles) and gamma Ori (large dots). Comparison star was phi-2 Ori.

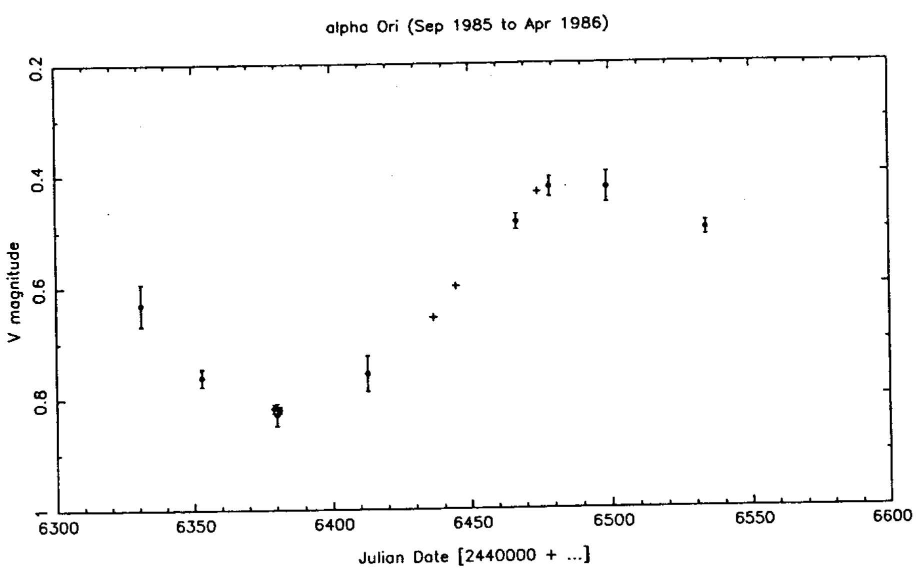

Figure 2. Dots: photometry of alpha Ori reduced with respect to gamma Ori. Pluses: data of Fisher from Paper II (reduced with respect to phi-2 Ori).

phi-2 Ori as the comparison star, as was done in Paper II and here, cuts any such systematic error in half.

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FIRST BV LIGHT CURVE FOR THE ECLIPSING BINARY PP LACERTAE

PP Lac was discovered by Miller on photographic plates taken in 1948 - 1955 at Castel Gandolfo. Miller and Wachmann (1971) found an amplitude of 0.9 mag. (11.1 - 12.0 p) and a period of about $0^d.5$. The type of variation proposed was EW or RR.

Figer and Rolland (1976 and 1977), from visual estimates made by GEOS members, classified it as an EW-type variable, with a period of $0^d.4011$. They could not discriminate the primary minimum from the secondary one, so a doubt still remained on the type of variation of the star.

The GCVS (Kholopov et al., 1985) classifies the star as EW/KW, and gives the following elements:

11.1 - 12.0 p; min II 12.0;

Min I = JD Hel 2445595.438 + $0^d.401163 \cdot E$

Recently, Maraziti (1989) reexamined all visual observations made by GEOS members from 1976 to 1988. Collecting 128 minima from 17 observers, plus 18 other minima published by Locher (1977, 1978, 1979), he found the following ephemeris:

$$\text{Min I (or II)} = \text{JD Hel } \underset{\pm 2}{2442903.235} + \underset{\pm 48}{0^d.40116150} \cdot E \qquad (1)$$

(95% level of confidence for error bars).

He was not able to distinguish between primary and secondary minimum.

In order to check this result by means of photoelectric measures, PP Lac was selected as one of the targets of GEOS missions at Jungfraujoch Observatory. Four missions were performed in 1985, 1986, 1988 and 1989, though most of observations were made during the last one. The GEOS members who took part in the different missions were M. Dumont, J. Remis, J.C. Misson, S. Ferrand, P. Louis, Ph. Rousselot, E. Joffrin, R. Boninsegna, R. Lecocguen.

The observations were made using a photometer attached to the 76 cm telescope. B and V filters of the Geneva system were used, and the B-V values were turned into Johnson and Morgan system. 132 measures in each colour were obtained in 4 nights.

Table I

PP Lac - photoelectric observations

JD (hel) 2440000+	V	B-V	phase (1)	JD (hel) 2440000+	V	B-V	phase (1)
6266.4390	11^m.576	0^m.769	0.666	7775.4154	11^m.591	0^m.745	0.184
6266.4626	11.496	0.775	0.725	7775.4390	11.523	0.734	0.243
6266.4939	11.536	0.758	0.803	7775.4411	11.529	0.728	0.248
6266.5195	11.660	0.781	0.867	7775.4425	11.522	0.743	0.252
6266.5550	12.045	0.780	0.955	7775.4453	11.541	0.733	0.259
6266.5793	12.186	0.839	0.016	7775.4467	11.550	0.724	0.262
7378.5694	12.017	0.754	0.942	7775.4480	11.547	0.730	0.266
7378.5721	12.077	0.762	0.949	7775.4494	11.547	0.728	0.269
7378.5735	12.061	0.795	0.952	7775.4529	11.542	0.743	0.278
7378.5742	12.108	0.775	0.954	7775.4543	11.534	0.752	0.281
7378.5756	12.097	0.795	0.957	7775.4557	11.556	0.726	0.285
7378.5763	12.146	0.773	0.959	7775.4571	11.570	0.707	0.288
7378.5791	12.168	0.789	0.966	7775.4585	11.554	0.736	0.292
7378.5812	12.161	0.851	0.971	7775.4779	11.616	0.747	0.340
7378.5937	12.193	0.848	0.003	7775.4793	11.621	0.750	0.344
7378.5951	12.199	0.812	0.006	7775.4807	11.622	0.757	0.347
7383.4603	11.617	0.741	0.134	7775.4821	11.632	0.744	0.351
7383.4652	11.628	0.743	0.146	7775.4855	11.655	0.767	0.359
7383.4673	11.622	0.752	0.151	7775.4869	11.653	0.758	0.363
7383.4694	11.612	0.748	0.156	7775.4883	11.658	0.769	0.366
7383.4714	11.594	0.750	0.161	7775.4897	11.666	0.764	0.370
7383.4888	11.508	0.735	0.205	7775.4911	11.677	0.760	0.373
7383.4909	11.504	0.733	0.210	7775.4925	11.695	0.748	0.377
7383.4930	11.508	0.732	0.215	7775.4953	11.712	0.745	0.384
7383.4971	11.500	0.728	0.226	7775.4967	11.709	0.759	0.387
7383.4999	11.504	0.719	0.232	7775.4980	11.728	0.752	0.390
7383.5020	11.508	0.727	0.238	7775.4994	11.749	0.744	0.394
7383.5069	11.518	0.725	0.250	7775.5008	11.746	0.766	0.397
7383.5096	11.514	0.740	0.257	7775.5043	11.776	0.769	0.406
7383.5124	11.521	0.736	0.264	7775.5057	11.772	0.774	0.410
7383.5152	11.520	0.739	0.271	7775.5071	11.789	0.779	0.413
7383.5201	11.520	0.734	0.283	7775.5085	11.808	0.769	0.416
7383.5221	11.535	0.736	0.288	7775.5098	11.819	0.773	0.420
7775.3779	11.775	0.758	0.091	7775.5112	11.849	0.765	0.423
7775.3828	11.735	0.752	0.103	7775.5126	11.907	0.750	0.427
7775.3855	11.724	0.751	0.110	7775.5175	11.936	0.755	0.439
7775.3897	11.696	0.744	0.120	7775.5189	11.949	0.765	0.442
7775.3911	11.698	0.743	0.124	7775.5203	11.966	0.755	0.446
7775.3925	11.682	0.743	0.127	7775.5217	11.984	0.763	0.449
7775.3939	11.680	0.735	0.131	7775.5230	12.005	0.760	0.453
7775.3980	11.626	0.759	0.141	7775.5244	12.016	0.775	0.456
7775.3994	11.629	0.751	0.145	7775.5272	12.123	0.740	0.463
7775.4008	11.626	0.752	0.148	7775.5286	12.107	0.781	0.467
7775.4022	11.623	0.741	0.152	7775.5300	12.116	0.779	0.470
7775.4036	11.614	0.756	0.155	7775.5314	12.112	0.792	0.474
7775.4050	11.623	0.745	0.158	7775.5328	12.111	0.791	0.477
7775.4092	11.603	0.746	0.169	7775.5369	12.169	0.788	0.487
7775.4105	11.597	0.741	0.172	7775.5390	12.167	0.787	0.493
7775.4119	11.597	0.745	0.176	7775.5439	12.125	0.784	0.505
7775.4133	11.596	0.749	0.179	7775.5460	12.104	0.799	0.510

Table I (cont.)

JD (hel) 2440000+	V	B-V	phase (1)	JD (hel) 2440000+	V	B-V	phase (1)
7775.5480	$12^m.081$	$0^m.789$	0.515	7775.5897	$11^m.675$	$0^m.748$	0.619
7775.5494	12.071	0.787	0.518	7775.5918	11.648	0.760	0.624
7775.5598	11.920	0.805	0.544	7775.5932	11.643	0.756	0.628
7775.5619	11.897	0.799	0.550	7775.5973	11.625	0.761	0.638
7775.5633	11.884	0.792	0.553	7775.5987	11.626	0.745	0.641
7775.5647	11.872	0.785	0.557	7775.6001	11.609	0.755	0.645
7775.5696	11.828	0.778	0.569	7775.6154	11.538	0.766	0.683
7775.5710	11.796	0.776	0.572	7775.6168	11.531	0.759	0.686
7775.5723	11.781	0.786	0.576	7775.6189	11.548	0.744	0.692
7775.5744	11.769	0.762	0.581	7775.6210	11.530	0.752	0.697
7775.5779	11.747	0.769	0.589	7775.6251	11.521	0.753	0.707
7775.5793	11.721	0.774	0.593	7775.6272	11.526	0.744	0.712
7775.5814	11.716	0.765	0.598	7775.6286	11.527	0.741	0.716
7775.5828	11.688	0.776	0.602	7775.6307	11.524	0.748	0.721
7775.5842	11.673	0.770	0.605	7775.6328	11.527	0.747	0.726
7775.5876	11.686	0.745	0.614	7775.6342	11.528	0.743	0.730

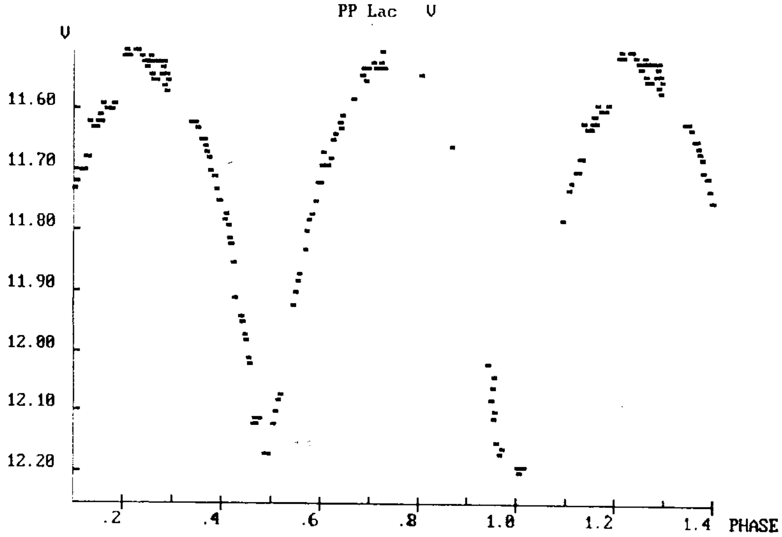

Figure 1a.

All observations are listed in Table I. Figure 1 shows the V and B-V light curves obtained according to ephemeris (1). One can note a good agreement with this ephemeris.

The shape of light curves is typical of an EW-type variable, with nearly equal minima and quasi-constant B-V index. One can note a slight increase

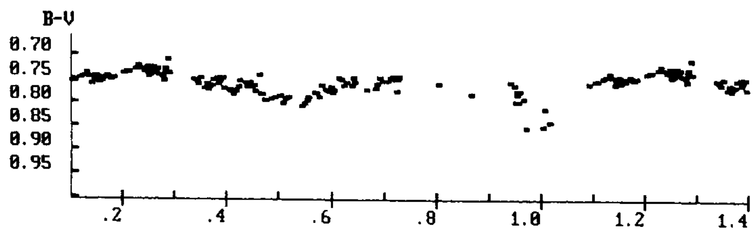

Figure lb.

of B-V index during both minima. This might be due to the disappearance, during minima, of the contact zone between the two stars, which has a higher temperature than the rest of their surfaces.

It is apparent a slight difference in the V magnitude between the two minima: min I is 12.20 while min II is 12.17. This difference, however, is too small to be considered significant. More precise observations are needed to establish the magnitudes of minima.

The mean B-V, not corrected for reddening, is 0.76.

On the night of September 5, 1989, it was possible to observe a complete secondary minimum, at JD Hel 2447775.5380 $\pm$ 0.0010; the time of minimum was calculated using the technique described by Gaspani (1988).

The O-C calculated from (1) is $-0^{d}.0042$, which is a further confirmation of the above GEOS ephemeris (1).

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PHOTOMETRY OF THE ECLIPSING BINARY DHK 11 = SAO 23229

Kaiser discovered that the 6th-magnitude F5V star SAO 23229 (BD +53°507, HD 14384) is an eclipsing binary, designated DHK 11 in his discovery list (Kaiser et al. 1990). The eclipses were found to occur at intervals of 2.111 days. Marschall et al. (1990) reported that the variable is a double-lined spectroscopic binary with nearly equal line strengths, indicating that the period is probably 4.222 days and the alternate minima are primary and secondary eclipses of nearly equal depths.

Our photoelectric observations support this conclusion. We have obtained a total of 100 differential measures in the V band, mostly during the two eclipses. Williams observed with a 28-cm Schmidt-Cassegrain and Optec SSP-3 photometer; Landis used a 20-cm Newtonian and 1P21-based photometer; and Pray used a 25-cm Newtonian and Optec SSP-3 photometer. All observations have been corrected differentially for extinction and transformation to V of the UBV system.

Figure 1 shows the observations phased to the period 4.222 days. The mean differential magnitudes measured by Williams and Pray near phases 0.45, 0.55, and 0.75 are equal within $\pm 0\overset{m}{.}005$. The observations at phase 0.75 would be at phase 0.5 if the period were 2.111 days, but there is no decrease in magnitude at this point. Since the spectrum is double-lined with nearly equal strength, there must be a detectable secondary eclipse and these observations confirm the 4.222-day period.

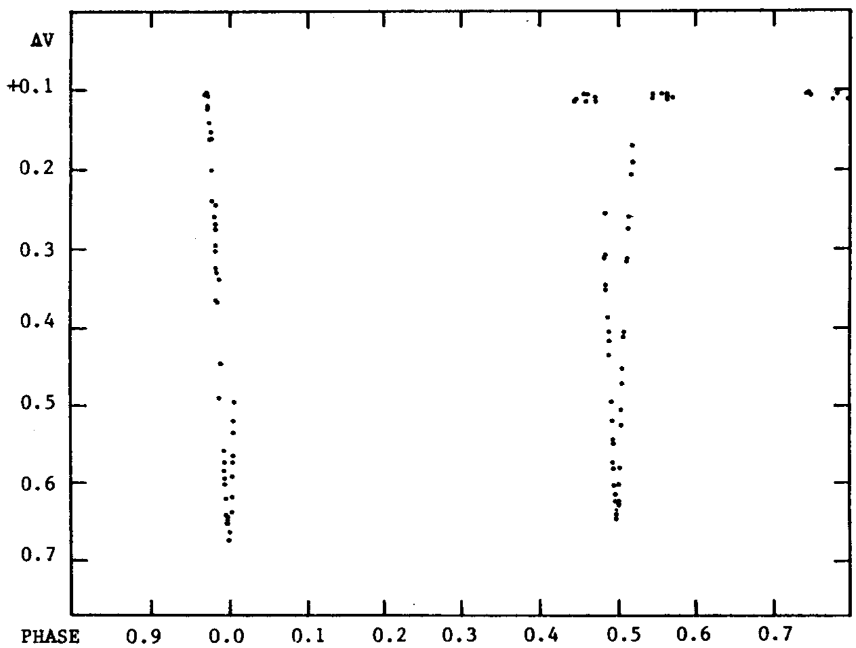

Figure 1. SAO 23229, V-band photometry phased according to Eq. 1. Differential magnitudes refer to the comparison star SAO 23407.

Times of mid-eclipse determined from our observations by the tracing paper method are listed in Table I, which also includes a photoelectric timing by F. Agerer (1990). We have adopted the initial epoch in the light elements of Kaiser et al. (1990) and subsequent alternate minima as the nominal primary eclipses.

TABLE I.

HJD	E	O–C	Obs'r
2447808.5994 $\pm$0.0006	-13.0	$-0^d.0002$	Landis
810.7099 $\pm$0.0008	-12.5	-0.0007	Williams
922.5949 $\pm$0.0004	+14.0	+0.0008	Agerer

The cycle numbers and O–C residuals refer to Equation 1, in which the initial epoch is a normal time of minimum from the three photoelectric timings and the period is twice the value from Kaiser et al. (1990):

$$\text{Min. I} = \text{HJD } 2447863.4858 + 4\overset{d}{.}222017 \text{ E} \qquad (1)$$
$$\pm.0008 \quad \pm.000002$$

The primary and secondary eclipses are nearly equal in depth. Landis and Williams observed consecutive eclipses (Table I) but used different comparison stars: Landis SAO 23389, Williams SAO 23407. Landis did not obtain any observations outside of eclipse, so the differential magnitude of maximum relative to his comparison star, and therefore the total amplitude of the eclipse he observed, cannot be determined directly from his observations. The eclipse observed by Williams was $0\overset{m}{.}54 \pm 0\overset{m}{.}01$ deep.

Williams happened to use Landis' comparison star SAO 23389 as a check star, so the two sets of observations can be reduced to the same differential scale relative to Williams' comparison star SAO 23407. When this is done, the primary minimum observed by Landis is $0\overset{m}{.}02$ – $0\overset{m}{.}03$ deeper than the secondary minimum observed by Williams. However, SAO 23389 has a faint companion that may have affected the results of one or both observers.

Agerer (1990) has published a photoelectric light curve of a primary minimum using yet a third comparison star, SAO 23283, which we note is the variable V440 Per, a Cepheid with amplitude $0\overset{m}{.}14$ V, P = 7.57 days. These observations remain useful, however, because V440's average rate of variation would be less than $0\overset{m}{.}005$ during the 2.5 hours of the eclipsing binary's decline to minimum.

The depth of the primary minimum observed by Agerer is $0\overset{m}{.}54$ or $0\overset{m}{.}55$ V (estimated from the printed light curve), almost indistinguishable from the secondary minimum observed by Williams, so the two eclipses may be virtually equal. More observations made in a consistent photometric system are clearly needed. For now, we can say that the primary and secondary minima are nearly identical and differ by no more than $0\overset{m}{.}03$.

Based on differential measures with 11 Persei, $5^{m}.77$ V, -0.13 B-V, in the Bright Star Catalogue (Hoffleit and Jaschek 1982), the variable at maximum is $6^{m}.87$ V, B-V +0.43 (the color expected for an unreddened F5V star).

As noted, the observations outside of eclipse are constant to $\pm 0^{m}.005$, so there are no indications of ellipticity or re-radiation effects. The first observations on the descending branch of the primary minimum at phase 0.975 (Figure 1) are equal to the observations outside of eclipse and mark the first contact. The duration of primary eclipse is therefore 0.050 P = 5.1 hours. The shoulders of the secondary minimum were not observed, but the last observation at maximum preceding the secondary minimum is at phase 0.474, setting an upper limit to the duration of secondary eclipse at 0.052 P. The secondary minimum occurred at phase 0.5 within the error of the timing.

In summary, our observations indicate that the components of the binary system SAO 23229 are very similar in luminosity. The orbit appears to be circular, and no tidal or re-radiation effects are evident.

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THREE NEW VARIABLE STARS

A continuing photographic patrol has resulted in the discovery of three more variable stars brighter than 10th magnitude. The positions and preliminary ranges, types, and periods are presented in Table I, which continues the list in Kaiser et al. (1990).

TABLE I.

Var. designation	RA (1950)	Dec (1950)	Range (v)	Type	P (days)
DHK 14	$4^h\ 55^m\ 50^s$	$+24^\circ$ 25.2'	8.0 - 8.5	EB	1.385
DHK 15	9 51 18	+10 29.7	7.8 - 8.0	SR:	?
DHK 16	9 41 22	+25 35.1	9.2 - 9.9	EA	1.374

DHK 14 = BD +24°719, HD 31679, SAO 76868 (Tau)

The spectral type is B5. The light curve shows continuous variation, with the primary minimum about $0^m_.5$ deep and the secondary $0^m_.3$. Photoelectric observations are reported by Williams et al. (1990).

DHK 15 = BD +10°2067, HD 85720, SAO 98835 (Leo)

The spectral type is M7. Variability within the given magnitudes has been confirmed by photoelectric measures, which are continuing and will be reported when the period (if type SR) and full amplitude are better defined.

DHK 16 = BD +26°1996, SAO 80992 (Leo)

The spectral type is G0. Photoelectric observations show a primary minimum $0^m_.7$ deep and secondary about $0^m_.6$. The eclipses are three hours in duration. A full report will be published at the end of the observing season.

Some of the information in this report was obtained from the SIMBAD data retrieval system, database of the Strasbourg, France, Astronomical Data Center, for which I thank Joyce Rey-Watson of the Harvard-Smithsonian Center for Astrophysics and Elizabeth Waagen of the AAVSO staff. The variables were detected with a projection blink comparator (PROBLICOM) as described by Mayer (1977). I am grateful to Marvin E. Baldwin, David B. Williams, and James E. Wood for observations to confirm variability and determine periods and types. Their observations will be presented more fully in later reports on each star.

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PHOTOMETRY OF THE NEW ECLIPSING BINARY DHK 14 = HD 31679

Kaiser (1990) discovered eclipses of the 8th-magnitude star BD +24°719 = HD 31679 = SAO 76863, which was designated DHK 14 in his discovery list. The spectral class is B5, the position is RA 4h 55m 50s, Dec. 24° 25' 14" (1950).

Following discovery, Williams and Wood obtained photoelectric observations in the V band on several nights and found continuous variation. A discrete Fourier transform analysis by Kaiser showed a likely period of 0.69 days, which proved to be the half-period of a Beta Lyrae-type eclipsing binary (Figure 1).

Neither observer was able to obtain a continuous series of observations with sufficient phase coverage to determine a time of mid-eclipse. However, Williams observed a portion of the descending branch of a primary minimum and Wood observed much of the ascending branch on the same night. The time of minimum determined by combining these observations, HJD 2447942.655, and the time of the discovery photo, HJD 2447151.652, were used to refine the period. Preliminary light elements are:

$$\text{Min. I} = \text{HJD } 2447942.655 + 1^{d}.38529 \text{ E} \qquad (1)$$

The comparison star was 98 Tau. Based on its magnitude, 5.81 V, 0.00 B-V, in the Bright Star Catalogue (Hoffleit and Jaschek 1982), the variable is 7.95 V, +0.34 B-V, at the maxima. The depths of the two minima remain somewhat uncertain, but the secondary eclipse is close to $0^{m}.28$ and the primary eclipse may be $0^{m}.45$–$0^{m}.50$.

Some of the information in this report was obtained from SIMBAD, data retrieval system of the Strassbourg, France, Astronomical Data Center, for

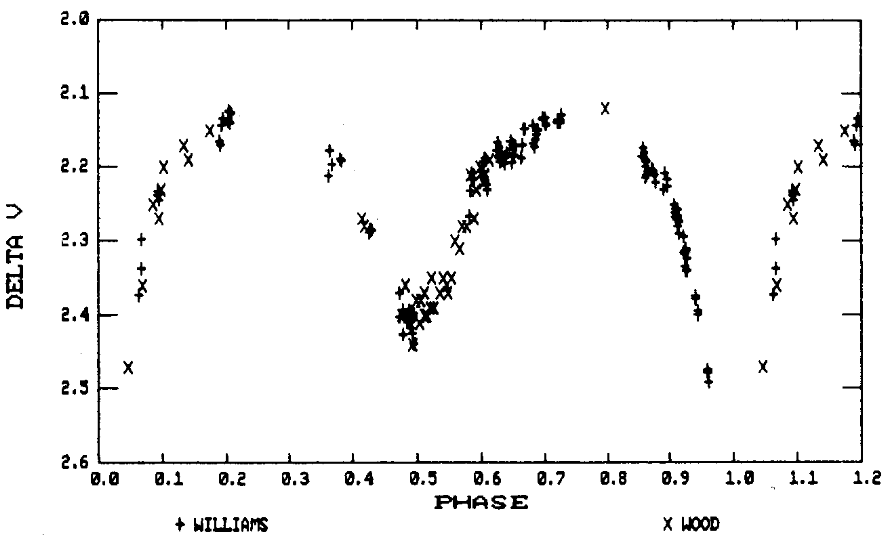

Figure 1. DHK 14, V-band differential photometry by Williams (28-cm Schmidt-Cassegrain) and Wood (25-cm Schmidt-Cassegrain); both used Optec SSP-3 photometers. The phases are calculated according to Equation 1.

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which we thank Joyce Rey-Watson of the Harvard-Smithsonian Center for Astrophysics and Elizabeth Waagen of the AAVSO staff.

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FLARE STAR OBSERVATIONS IN THE NGC 7000 – IC 5070 REGION

As part of a programme of flare star search in stellar aggregates of different ages, 11 monitoring plates of the NGC 7000 - IC 5070 region, taken with the 0.53/0.53/1.80 m Schmidt telescope of the Byurakan Astrophysical Observatory during the period June 1976 - July 1978, were analyzed. The field centre is the same as in the investigation of Erastova and Tsvetkov (1974). The observational material with an effective time of observations 10^h50^m in Pg-light (emulsion ORWO ZU2 or ORWO ZU21, without filter) contains 65 exposures of 10 minutes duration. By visual inspection two flares were discovered (see Table 1).

Table 1. New flare events discovered in the NGC 7000 – IC 5070 region

Designation	R.A. (2000)	D. (2000)	V min	B–V min	U–B min	Date of flare up	Δm Pg
B 59	$20^h50^m58^s.2$	43°58′05″	$16^m.36$	$1^m.4$	$-0^m.24$	22 June 1977	$2^m.97$
V 1497	21 00 09.1	43 31 19	16.52	2.14	–	22 June 1977	2.35

B 59 is a new flare star (a finding chart is presented in Fig. 1), whose current designation is in accordance with the accepted one for flare stars discovered at the Byurakan Astrophysical Observatory in the investigated region. The star is listed with this designation also in the Catalogue of Flare Stars in the Cygnus Region (Tsvetkov and Tsvetkova, 1990).

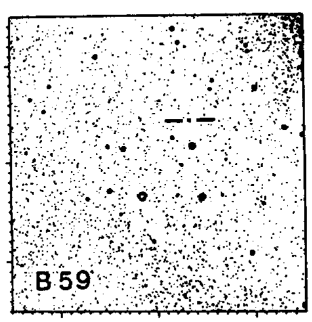

Figure 1. Finding chart for B 59 as a two-dimensional contour plot from a Byurakan 1 m Schmidt telescope B- plate with 10 minutes exposure. The size of the frame is 10′x10′. North is up, East is to the left.

The registered flare-up of V1497 Cyg is the fifth one detected in this flare star, which was discovered as Tonantzintla No. 5 (T5) by Haro and Chavira (1973). The Julian Date of the moment of maximum light of both flare events is JD = $2443317^{d}.4583$.

The coordinates of the flare stars in the Table 1 were determined with an accuracy of 1 arcsec from the direct V-plate with the 1.0/1.3/2.1 m Byurakan Schmidt telescope using the astrometric package "SCHMIDT" of the Astronomical Institute of the Muenster University (AIM) which makes use of the PPM Catalogue (Bastian and Röser, 1990). The photometric data for the flare stars at minimum and maximum brightness (Table 1 and Table 2) were obtained by an automatic processing of the direct UBV plates with the PDS 2020 GM^{plus} of the AIM using the photometric programme "HMAG". The photometric value for V 1497 Cyg at minimum brightness according to Tsvetkov (1976) is given.

Table 2. Photometric data for the flare events observed in B 59 and V 1497 Cyg

Intervals of monitoring (U.T.) (26 June 1977)	B 59 max Pg	B 59 Δm Pg	V 1497 max Pg	V 1497 Δm Pg
$22^h45^m.00$ – $22^h55^m.00$	$17^m.4$:	$0^m.11$:	$17^m.4$:	$1^m.3$:
22 55.25 – 23 05.25	14.63	2.97	16.31	2.35
23 05.50 – 23 15.50	17.09	0.52	16.98	1.86
23 15.75 – 23 25.75	17.22:	0.39:	17.4:	1.3:
23 26.00 – 23 36.00	>17.4	–	>17.4	–

In Fig. 2 the two-dimensional contour plots and density tracings of the flare events of B 59 and V 1497 Cyg are shown. The photometric data of V 1497 Cyg show that the star is rather red and probably has a spectral type M5 or later (B–V = $2^m.14$). The suggestion that this star is a member of the aggregate Cyg T1 (the distance to the front part of this aggregate is estimated to be about 600 pc, Tsvetkov, 1976), is in contradiction with its photometric parallax ~ 70 pc. The comparatively high flare frequency of the star (5 detected conspicuous flare events) leads us also to the conclusion that it is a foreground star.

From the position of B 59 in the U–B/B–V - and V/B–V diagrams for flare stars in the region of NGC 7000 – IC 5070, we derive a spectral type G8–K0. B 59 has thus one of the earliest spectral types for flare stars in this aggregate with an age estimated to be 10^6 years (Tsvetkov, 1976). This is in good agreement with the conclusion of Haro (1968) for the spectral type of the brightest flare star for a given aggregate corelating with its age. Assuming that the star has a spectral type K0, its photometric parallax is about 750 pc, thus it probably belongs to

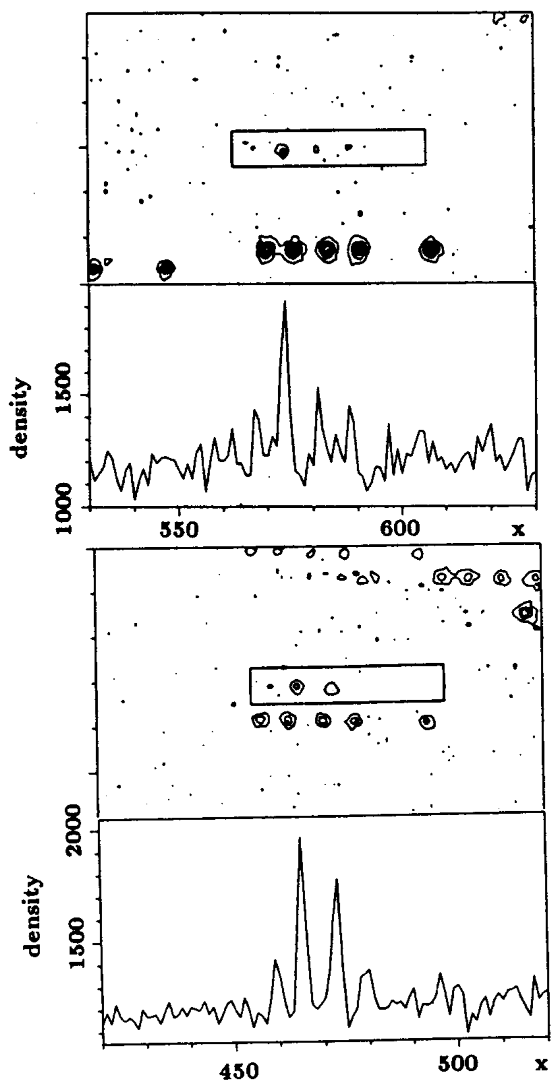

Figure 2. The flare events in chains of B 59 and V 1497 shown as two-dimensional countour plots and density tracings.

the aggregate Cyg T1. B 59 is situated in the nebula IC 5070 wich contains a relatively large number of young objects - Hα- and T Tauri stars; the investigated star, however, was not listed as a Hα-emission star in the deep Hα-surveys of this field made by Herbig (1958), Tsvetkov (1975, 1979) and Marcy (1980). Our new check for Hα-emission in this star showed that there is an overlap of its objective prism spectrum by a spectrum of a bright star in the Hα-region. Thus the question of Hα-emission is still not settled. In order to determine more accurately the spectroscopic parallax of both stars and to check the presence of Hα-emission in B 59, more detailed spectroscopy is needed.

We would like to thank the members of the Astronomical Institute of the Muenster University for useful suggestions and comments, to Dr. L. K. Erastova for the observational material base of this work and to the Alexander von Humboldt-Foundation for support.

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PHOTOGRAPHIC PHOTOMETRY OF RT CEP

RT Cep is a long period variable of the Mira Ceti type. Its period is 621.55 days and its brightness varies between $11^{m}.7$ pg and $\geq 14^{m}.7$ pg (Kholopov et al., 1985). RT Cep is located near the open cluster NGC 7142 and the emission nebula NGC 7129, but is probably not connected to them. On objective prism plates the star was recognized as a very strong Hα-emission star (Semkov and Tsvetkov, 1986).

The photographic observations in the UBV system were made with the 50/70/172 cm Schmidt telescope of the National Astronomical Observatory of the Bulgarian Academy of Sciences (Tsvetkov et al., 1987). As photometric standards we used stars in the open cluster NGC 7142 (Hoag et al., 1961). During the period 1980-1990 two new epochs of maximum of brightness [J.D. 2447208 and J.D. 2447773] were observed (Tab. 1).

Table 1. Photometric behavior of RT Cep in the period 1980-1990

J.D. 244...	U mag	B mag	V mag	J.D. 244...	U mag	B mag	V mag
4492	–	>18.0	–	7387	–	16.0	–
4494	–	–	16.0	7442	>18.5	>18.0	–
4496	>18.5	–	–	7447	–	>17.5	–
5959	14.7	–	–	7473	–	>17.5	15.6
5960	–	13.8	–	7626	–	>17.5	–
6563	–	13.6	11.1	7643	–	>17.5	–
6711	–	–	13.3	7706	–	>17.5	–
6999	–	–	15.1	7732	–	>17.5	–
7000	–	>17.5	–	7773	15.0	13.8	11.4
7001	–	–	14.8	7776	–	14.2	–
7064	>18.0	17.1	14.3	7828	15.2	14.0	–
7122	–	15.1	–	7829	15.3	14.1	–
7207	–	12.5	–	7830	–	14.1	11.6
7208	–	12.3	–	7923	16.3	15.4	12.9
7304	–	15.0	–	7925	–	16.1	–
7333	–	15.4	–	7946	–	16.4	–
7361	–	15.7	–	7947	17.3	–	–
7383	>18.0	16.6	14.2	7955	–	16.6	–
7384	17.0	16.8	14.2	7978	–	16.8	–
7385	–	16.9	–				

The light curve of the star around the observed maxima is shown in Fig. 1. Because RT Cep is fainter than 18^m in B-light in the minimum, it can be registered only in case of good atmospheric conditions.

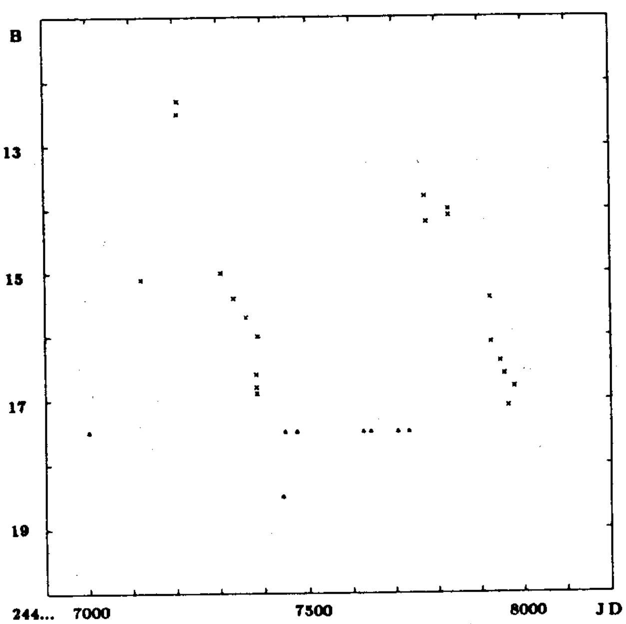

Figure 1. Light curve of RT Cep during observational period September 1987 - March 1990 in B-light. The values of brightness when the star is below the limit of our plates are marked with Δ.

All known epochs of maximum (Schneider, 1959) and those observed during our campaign are given in Table 2.

Table 2. Observed epochs (J.D.) of corresponding maxima (E) of RT Cep and calculated differences with (O–C) with the GCVS's period ÷ Max = J.D. 2439724.0 + 621.55 E

Max. J.D. 24...	E No.	O–C days	Max. J.D. 24...	E No.	O–C days
16720	-37	-7	27300	-20	7
17920	-35	0	29170	-17	12
24800	-24	-7	34130	-9	0
25425	-23	-3	39724	0	0
26059	-22	9	47208	12	25
26675	-21	4	47773	13	-31

According to the variable star parameters from the GCVS the deviations between the observed and the calculated maxima are shown in Fig. 2. The shifts of the two new maxima are probably due to nonperiodic small changes.

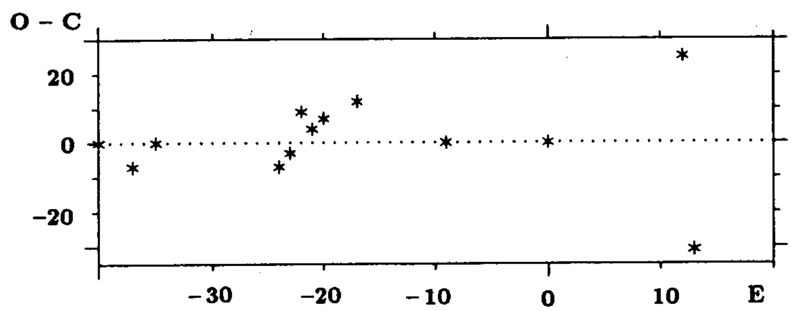

Figure 2. Relation between observed maxima (E) of RT Cep and calculated differences with (O–C) with the GCVS's period.

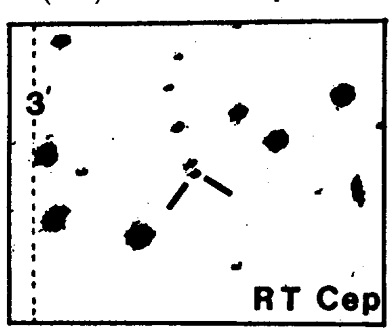

Figure 3. Identification chart of RT Cep as a reproduction from the 30 minute exposure photographic plate in B-light obtained with 50/70 cm Schmidt telescope of Rozhen observatory on September 26, 1987. North is on the top, East - on the left.

The observations on September 26, 1987 in the minimum showed that RT Cep is a double star. The distance between the two components is about 5 arcsec. On the blue reproduction (O–1165) of the Palomar Sky Survey Atlas the two components are also distinguishable, and RT Cep has been in minimum - the magnitude is $B_{poss} = 19\overset{m}{.}5$. The southern component of the pair, which is the redder one, is certainly RT Cep. In this case the observed amplitude of variability reaches about $7\overset{m}{.}2$ (pg) which is consistent with the relationship between amplitudes and periods for long period variables (Duerbeck and Seitter, 1982).

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PHOTOELECTRIC OBSERVATIONS OF VZ CANCRI 1988 - 1990

(BAV-Mitteilungen No. 58)

From spring 1988 to spring 1990 BAV members photoelectrically observed 16 maxima of this delta Scuti-star. Their heliocentric times are listed in Table I, column 1.

Column 2 and column 3 of this table contain epoch and O-C calculated with the linear elements of Todoran (1976).

$$\text{Max hel} = \text{JD } 24\ 33631.8655 + 0^{d}.178\ 36367 \cdot E.$$

Column 4 contains the phase Ψ_b of the maxima calculated with Todoran's (1976) elements for the beat period P_b

$$\text{Max hel}(P_b) = \text{JD } 24\ 33631.8605 + 0^{d}.716\ 292 \cdot E_b.$$

Column 5 names the observers and column 6 is a literature source in case times of maxima have been previously published. Observers and their instruments are

QU = W. Quester, 200 mm Newton, 931B multiplier with GG495(1 mm) for V
RI, SH = P. Ringe and O. Schall, 150 mm Refr., EMI 9781B multiplier without filter
SG = P. Sterzinger, 200 mm Schmidt-Cassegr. with SSP-3, V filter
WU = E. Wunder, 345 mm Cassegrain, 1P21, V filter.

Ringe and Schall observed at the Dortmund Public Observatory, Wunder at the Nuremberg Observatory, and the two others with their private equipment.

The O-C values show that Todoran's elements still represent maximum times very well. To check the beat period, O-C's were plotted into Todoran's original Figure 1. This figure is duplicated here with crosses denoting the O-C from Table I. They deviate from the main track of older observations much more than those by Cester et al. (1977) who remarked that "the O-C's fall on the upper border of the strip shown in his (Todoran's) Fig. 1". Cester's O-C's are included here as open circles.

A period search with maximum times later than JD 24 40620 published by Popovici (1971), Hahn et al. (1975), Todoran (1976), Cester et al. (1977) and the observations from Table 1 resulted in a range in days for the beat period: $0.716\ 280 \leq P_b \leq 0.716\ 288$.

Table I

Max. hel. JD 2400000+	E	O-C	Ψ_b	Obs.	Source
47205.5221	76101	0.0029	0.900	QU	BAV-Mitt 50 (1988)
47213.3708	76145	0.0036	0.857	QU	BAV-Mitt 50 (1988)
47240.2974	76296	-0.0027	0.449	SG	BAV-Mitt 50 (1988)
47530.4926	77923	-0.0052	0.584	QU	BAV-Mitt 52 (1989)
47555.4657	78063	-0.0030	0.449	QU	BAV-Mitt 52 (1989)
47565.4570	78119	-0.0000	0.397	QU	BAV-Mitt 52 (1989)
47566.5302	78125	0.0030	0.895	RI, SH	BAV-Mitt 52 (1989)
47591.3154	78264	-0.0044	0.498	QU	BAV-Mitt 52 (1989)
47591.4907	78265	-0.0074	0.742	QU	BAV-Mitt 52 (1989)
47612.3673	78382	0.0006	0.888	QU	BAV-Mitt 52 (1989)
47928.4400	80154	0.0129	0.150	QU	this note
47943.4192	80238	0.0095	0.062	QU	this note
47945.3705	80249	-0.0012	0.786	WU	this note
47968.3838	80378	0.0032	0.915	QU	this note
47974.4461	80412	0.0012	0.378	QU	this note
47975.3291	80417	-0.0077	0.611	QU	this note

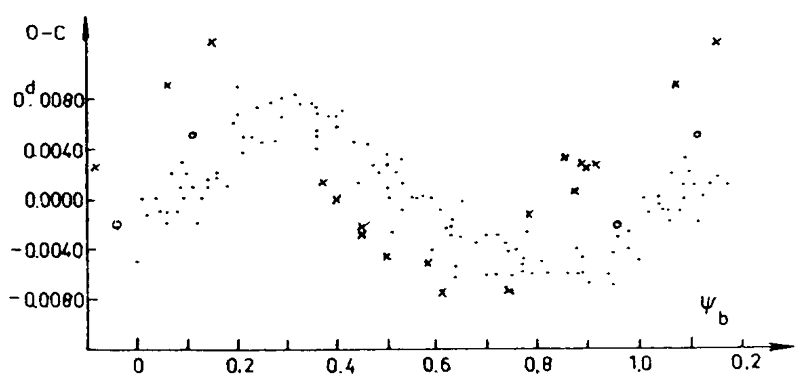

Figure 1

WOLFGANG QUESTER

Berliner Arbeitsgemeinschaft
für Veränderliche Sterne e.V. (BAV)
Munsterdamm 90, D-1000 Berlin 41

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PERIOD VARIATIONS OF SS ARIETIS

The aim of this work is to provide an argument for the need of to continuing to monitor the minima of the eclipsing binary system SS Ari by photoelectric observations.

The variability of this W UMa-type variable was found by Hoffmeister (1934). The history of the first observations is presented by Kałużny, Pojmański (1984). The observations of SS Ari were performed in the Astronomical Observatory of Jagiellonian University at Cracow using a 50 cm Cassegrain telescope with a single channel photometer and, in the last two seasons, at Mt. Suhora Astronomical Observatory of the Cracow Pedagogical University using a 60 cm Cassegrain telescope coupled with a two-channel photometer. The times of minima determined from our observations are presented in Table I. They were found as the minimum of a parabola fitted into the observational points by means of least-squares method.

Table I. New photoelectric minima of SS Ari.

JD hel. 2440000.+	m.e. 0.0001	Type	Colour	Observer	JD hel. 2440000.+	m.e. 0.0001	Type	Colour	Observer
2727.4083	10	I	B	MKW	6716.4360	10	II	V	MKW
2727.4088	9	I	V	"	6745.4636	8	I	V	"
2758.2638	8	I	V	"	6761.2955	5	I	B	"
2758.2645	12	I	B	"	7143.3294	4	I	V	"
2759.2790	8	II	V	"	7439.4952	3	II	V	BZ
2759.2792	9	II	B	"	7439.4960	2	II	B	"
3455.3481	6	I	V	"	7439.4962	5	II	V	MKW
3815.4581	15	I	V	"	7444.5695	6	I	V	"
3927.3091	8	II	V	"	7449.4414	2	I	V	BZ
4146.5426	10	II	B	"	7449.4416	2	I	B	"
4469.5074	6	I	V	"	7449.4420	5	I	V	MKW
4605.3103	6	II	V	"	7450.4569	5	II	V	"
4642.2567	11	II	V	"	7452.4872	5	II	V	"
4823.5267	10	I	V	"	7561.2904	6	II	V	"
5295.2840	12	I	V	"	7823.5573	5	II	V	"
5593.4817	8	II	V	"	7823.5580	6	II	V	BZ
5609.5174	5	I	V	"	7828.4289	5	II	V	MKW
5698.2264	7	II	V	"	7834.3148	4	I	V	"
6714.6062	6	I	V	"	7848.3226	5	II	V	"

MKW - M.Kurpińska-Winiarska, Cracow, BZ - B.Zakrzewski, Suhora

From Table 1, together with the other 161 minima (26 phe, 130 vis, 5 pg) collected from the literature up to Dec. 1989, the average period of SS Ari was found to be $0^{d}.4059909$. A complete list of minima is available on request. Figure 1 presents the O–C diagram of the epochs of minimum light based on the ephemeris

$$\text{Min. I} = \text{JD hel. } 2444469.50\underset{\pm 6}{74} + 0^{d}.40599\underset{\pm 6}{09} \cdot E$$

where one of the minima from table I is adopted as an epoch.

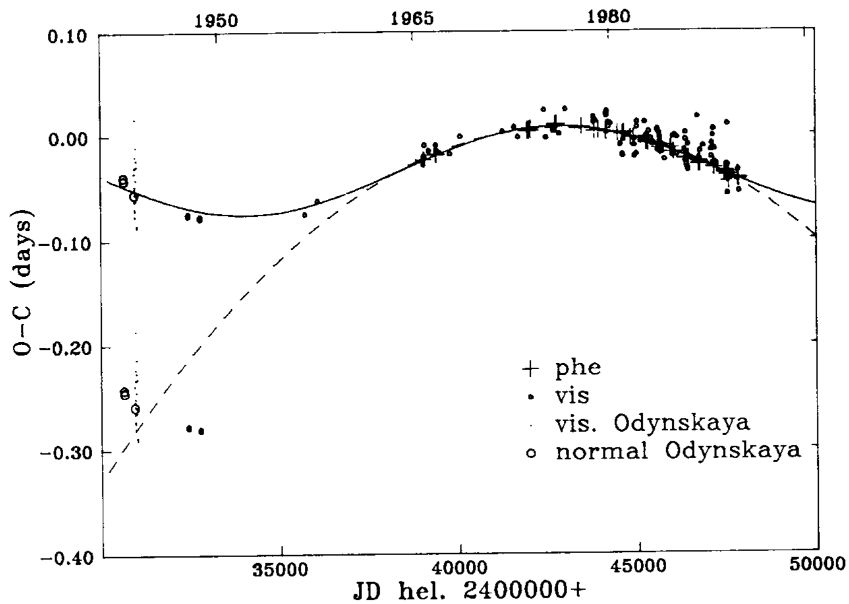

Figure 1. Period variations of SS Arietis

It is clearly visible that the period of SS Ari is variable. However, the interpretation of the character of this variability affords difficulties. At first sight the O–C diagram has a sine - like shape (Kałużny, Pojmański, 1984) resulting from the positions of minima observed before 1965, ie. 7 visual minima (3 normal ones included) and 2 photographic ones. Some estimation of the accuracy of these minima can be obtained from the 23 individual minima, marked in Fig. 1 as small dots, determined by Odynskaya (1948) from Tsessevitch's observations. The same observations were used by Odynskaya in the determination of the normal minimum JD hel. 2430948.329. As can be seen, the scattering attains the value of $\pm 0^{d}.05$. Similarly the visual minima after 1965 reveal a dispersion of the same order around the photoelectric ones. This probably results from the application of Argelander's method to the observations of a star with a small amplitude (about $0^{m}.5$ in V) and a short period, as well as from a small number of estimates of brightness, which has not exceeded 10 for 50% of visual minima.

So, in further discussion, we take only the photoelectric minima. This part of the O–C diagram can be fitted by a sine-like curve (solid line), as well as a parabola (dashed line). For this calculation the non-linear least squares method's algorithm of Bevington (1969) was used. The best-fit sine curve was found under the condition that the sine period is longer than 30 years and e = 0, as Fig. 1 indicates. The derived ephemeris of times of mimimum is

$$\mathrm{Min.\ I} = \mathrm{JD\ hel.}\ \underset{\pm 14}{2444469.4732} + \underset{\pm 6}{0^{d}.4059909} \cdot E + \underset{\pm 14}{0^{d}.0417} \cdot \sin(\underset{\pm 8}{0.000358} \cdot t_{min} + \underset{\pm .34}{4.34})$$

and gives a period of about 49 years. The parabolic ephemeris gives

$$\mathrm{Min.\ I} = \mathrm{JD\ hel.}\ \underset{\pm 4}{2444469.5065} + \underset{\pm 5}{0^{d}.40598804} \cdot E - \underset{\pm 8}{0^{d}.338} \cdot 10^{-9} \cdot E^2$$

The dispersions of the two fits are of the same order, of $\pm 0^{d}.001$. However, their comparison may be treated as qualitative only, because of a different number of unknowns for each of the fits. All data presented in Fig. 1 fit well the sine curve, but also, a parabolic fit of minima before JD 2435000 is almost acceptable (see above — visual minima accuracy), if the O–C values are diminished by $\frac{1}{2}$P.

The obtained results do not definitely settle the problem of geometrical interpretation of O–C diagram. The representation of the O–C diagram in the form of fragments of straight lines separated by fragments of parabolae as suggested by Kreiner (1977) does not reproduce the diagram. A computation indicates a continuous change of the straight lines' slope.

It is obvious that different geometrical interpretations of the O–C diagram for SS Ari give completely different physical mechanisms underlying the period variations. Future photoelectric observations of times of minima would throw some light on this problem.

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ATMOSPHERIC ECLIPSE OF δ SGE

The long period (P=3720 days) bright spectroscopic binary δ Sge exhibits complex spectroscopic phenomena shortly before and after the conjunction times (McLaughlin et al. 1952; Batten and Fisher, 1981). Such phenomena were thought to be due to an atmospheric eclipse in the system during the conjunction times. Based on the timing of such phenomena and the period of the system the last conjunction must have occurred around the beginning of May 1990. However, the improved parameters of the system by Reimers and Schröder (1983) suggest no eclipse during the conjunction times. Because the longitude of periastron is very close to 270°, conjunctions are expected to be very near to periastron passage. The last periastron passage was expected to be in the second week of April 1990.

It is possible that the B9 V component may be eclipsed by the extended atmosphere of the M2 II component at conjunction. If so, then any eclipse (total or partial) in the system could be detected photometrically in short wavelengths, because the contribution of the early-type component to the total light from the system is only a few percent, but it increases towards shorter wavelengths.

We have observed the system with UBV filters on 21 nights in 1988, and 85 nights in 1989. The differential observations with respect to the comparison star β Sge were made by using an EMI 9789 QB photomultiplier attached to the 30 cm Maksutov telescope of Ankara University Observatory. The differential brightness measurements of β Sge with respect to the check star α Sge were found to be sensibly constant during the observations : $\Delta V=-0.00\pm0.01$, $\Delta B=-0.27\pm0.02$, and $\Delta U=-0.73\pm0.04$. The individual differential magnitude determinations were corrected for differential atmospheric extinction, and light time effect. The 1988 observations were already reported (Derman, et al., 1989). The 1989 observations in the sense variable minus comparison are plotted in Figure 1 against the heliocentric Julian date.

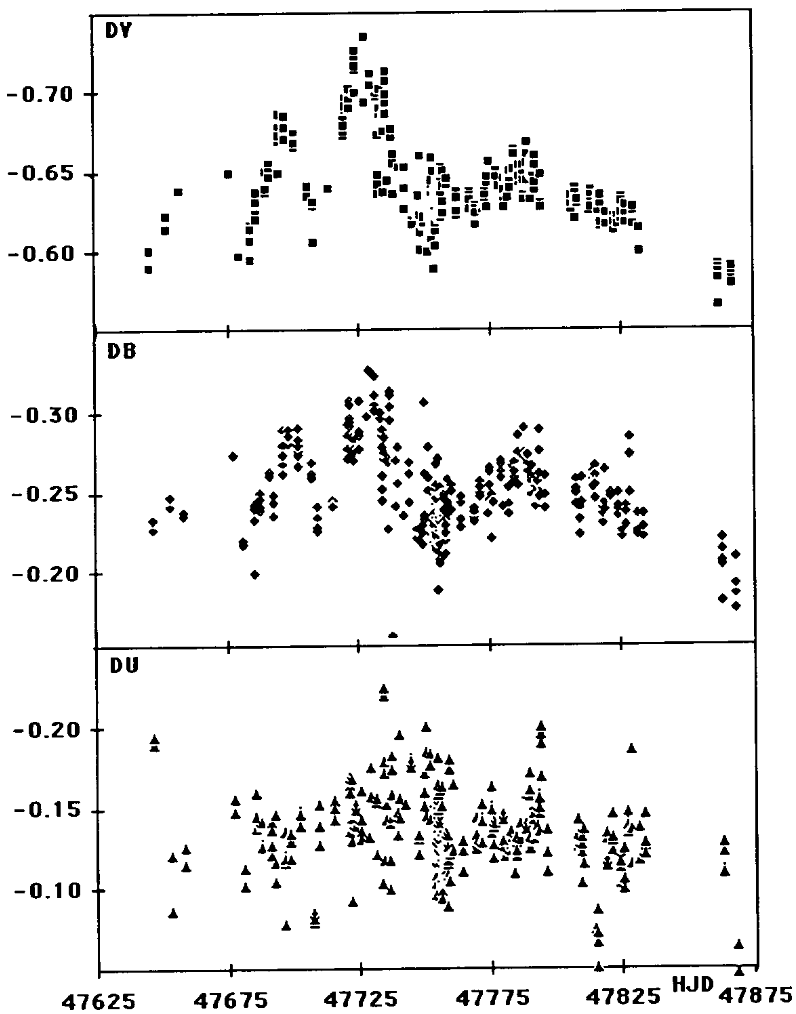

Figure 1. The differential U, B and V observations of δ Sge against heliocentric Julian date (HJD +2400000) in 1989

New observations in Figure 1 verify the periodic nature of the light variation. The amplitude of the variation seems to decrease first until May 1989 and then increases until the end of July 1989, while the period decreases steadily from about 60 days to 28 days. Three cycles of the light variation are clearly seen in V and B observations in Figure 1. The U observations show almost no sign of periodic variation. Thus, the periodic variations should be related to the late type giant component, because this component has large contribution in V and B but less in U magnitudes. Three cycles observed between May and August 1989 have decreasing periods of about 37, 30 and 28 days, respectively. Total mean light from the system increases steadily from May to August 1989, then drops sharply to a lower level, indicating the beginning of an atmospheric eclipse. Contrary to the expectation such behavior of the light variation is better observed in longer wavelengths (see V and B light curves in Figure 1). If the loss of light starting from August 1989 is due to an atmospheric eclipse then the eclipse duration may be as large as 18 months, because the eclipse begins about nine months before the estimated conjunction time. In this case the inclination of the orbit or the size of the giant component ought to be much larger than the predicted values. Otherwise the period of the system may be shorter than 3720 days as suggested by Batten (1989). Figure 1 suggests that the hotter component is eclipsed from the beginning of August 1989 by the extended atmosphere of the cool giant component. The periodic oscillations of the total light fade but do not disappear completely during the eclipse phases. Further observations may reveal the duration of eclipse phenomena which will bring important constraints on the system parameters.

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THE DISAPPEARANCE OF MINIMA OF ECLIPSING BINARY SS Lac IN OPEN CLUSTER NGC 7209

The eclipsing binary SS Lac = BD+45^{o}3782(9.4) = 125.1907 is situated in open cluster NGC 7209. The variability of the star was found by Hoffmeister (1921), more exact light elements are given by Dugan and Wright (1935):

$$\text{Min I} = 2415900.76 + 14\overset{d}{.}41629 \cdot E$$

The change of brightness of the variable happens in the interval 10.28 - 10.69 m(pg) with identical minima. The orbit of the system is eccentric, e = 0.11. All observations were made photographically and visually. The photometric parameters were derived from the photographic light curve by Dugan and Wright (1935).

UBVR photoelectric observations were carried out during 1984-89 on Mt. Maidanak in the Uzbek SSR. Stars N1 and N3 from Hoag et al.'s (1961) catalogue were used as standard stars. We have got 192 measurements of the binary. The probable error of a single observation in V is $0\overset{m}{.}012$, for U-B: $0\overset{m}{.}017$, for B-V: $0\overset{m}{.}012$, for V-R: $0\overset{m}{.}020$. The light curve of SS Lac based on the above elements is shown in Figure 1. It shows full absence of the expected brightness weakening in both minima. For comparison the photographic light curve of SS Lac is given in the lowest part of the Figure. The survey of all observations of the star showed, that the minima were persistently observed in 1890-1950. We have concluded that the minima of the binary began to disappear in about 1952. The most probable reason of the disappearance of the minima can be a sudden change in the orbital plane inclination or, less probably, the disintegration of the binary. Both may be caused by the passage of a cluster member star near SS Lac. But this is not at all certain, only a tantalizing possibility.

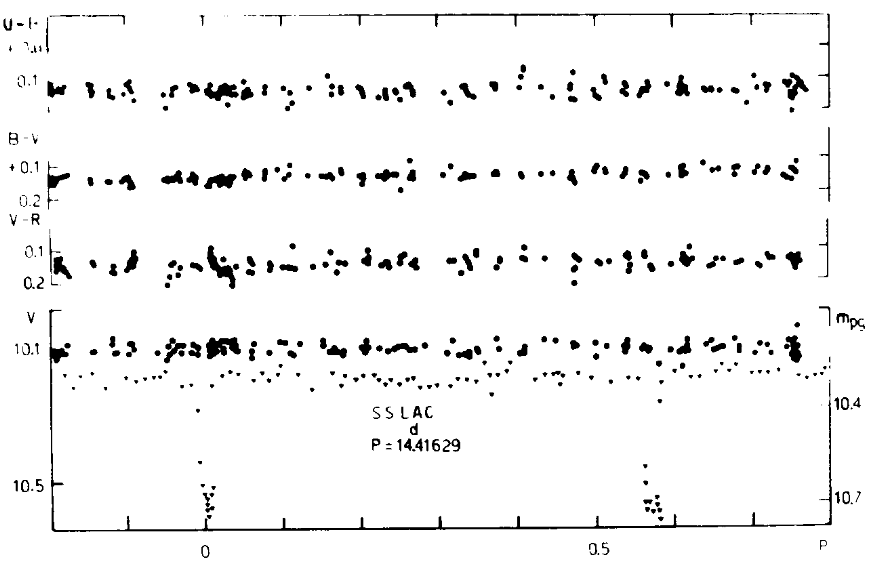

Figure 1.

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NEW VARIABLE STARS IN THE OPEN CLUSTER NGC 6882/5

In a research program to detect new variable stars in open clusters (Peniche and Pena, 1987) a few stars in the direction of the open cluster NGC 6882/5 ($\alpha = 20^h\ 9^m.8$, $\delta = 26^o\ 26'$, 1960) were observed. The criterion followed in the selection of the stars was that they lie within the limits of the instability strip since, according to Breger (1979), one third of the stars found there would be variable.

The observations were carried out at the San Pedro Martir Observatory during the nights of September 3 and 4, 1986. The 0.84 m telescope was utilized provided with a pulse counting photomultiplier with a 1P21 cooled phototube, Johnson's V filter was used. The integration time for both sky and star measurements was of 10 s in a series of six measurements of the star and one of the sky. Table I lists the observed stars, the ID number which, in this case, follows the notation of Hoag et al. (1961), the V magnitude and the color index of each star. The last column lists the stellar spectral type that was obtained from the calibration of (B-V) given by Hoag et al. (1961) and the spectral type from Mihalas (1981).

The technique followed for determining which stars were variable and which constant was through the use of differential photometry and can briefly be summarized as follows: in order to obtain the instrumental magnitude, the flux of the sky was subtracted from the average flux of the star measurements and the instrumental magnitude was derived. Light curves for each star were constructed and a mean curve was established. The stars that did not conform to the average pattern defined by two or more stars were considered to be variable and the mean curve was subtracted. A zero base-line was established by subtracting the mean amplitude variation for each star. The final results are presented in Tables II and III and shown schematically in Figures 1 and 2. The accuracy of each figure is of $0^d.0035$ in time and 0.003 in magnitude.

As can be seen from Figure 1, the amplitude of variation of star 19 is 0.034 mag. with an interval of time between two consecutive maxima being

Table I

Parameters of the Observed Stars

ID	V	B-V	Spectral type	Comments
9	9.26	.280	A9	Constant
5	7.60	-.090	B8	Constant
19	10.23	.440	F6	Variable
25	10.49	.420	F5	Variable
8	9.18	.480	F7	Constant

Table II

Differential Photoelectric Photometry of Star 25

HJD 2440000+	V (mag)	HJD 2440000+	V (mag)
6677.7036	.008	6678.6878	.017
6677.7127	-.007	6678.6944	.002
6677.7211	-.013	6678.7023	.003
6677.7295	.005	6678.7098	-.002
6677.7378	.001	6678.7169	.014
6677.7453	-.007	6678.7315	.014
6677.7611	-.008	6678.7382	-.004
6677.7690	.000	6678.7473	.003
6677.7857	.005	6678.7557	-.004
6677.7932	.002	6678.7694	-.004
6677.8015	-.001	6678.7795	.001
6677.8099	-.012	6678.7836	.002
6677.8174	.006	6678.7911	-.009
6677.8253	.003	6678.7957	-.010
6677.8328	.018	6678.8073	-.015
		6678.8140	-.010
		6678.8215	-.007

Table III

Differential Photoelectric Photometry of Star 19

HJD 2440000+	V (mag)	HJD 2440000+	V (mag)
6677.7107	-.017	6678.6861	.000
6677.7194	-.008	6678.6932	-.001
6677.7279	.001	6678.7007	-.003
6677.7357	.001	6678.7153	.000
6677.7440	-.006	6678.7236	.001
6677.7599	-.010	6678.7307	.008
6677.7674	-.006	6678.7378	-.002
6677.7757	-.009	6678.7471	-.002
6677.7841	.009	6678.7544	-.003
6677.7920	-.003	6678.7682	.001
6677.8002	-.005	6678.7757	.001
6677.8086	-.001	6678.7828	.006
6677.8153	.015	6678.7898	-.009
6677.8228	.013	6678.7982	-.010
6677.8315	.014	6678.8057	-.006
		6678.8132	.003
		6678.8203	.002

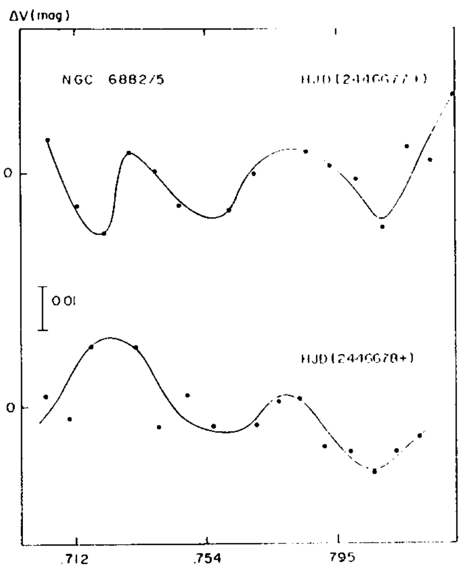

Figure 1. Light curve of star 25.

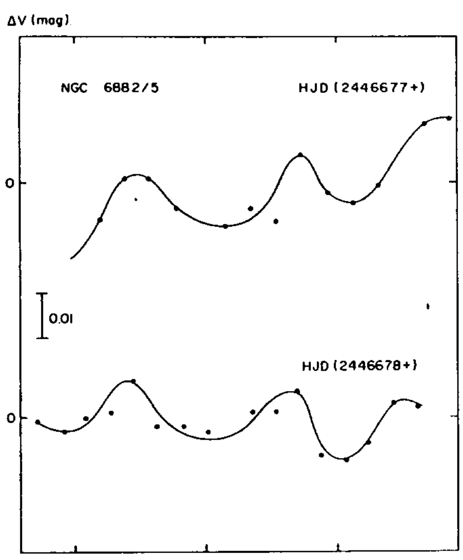

Figure 2. Light curve of star 19.

Table IV

Amplitude of Variation of the Observed Stars

	ΔV HJD2446677	ΔV HJD2446678
$V_5 - V_8$	0.000	0.000
$V_{25} - \langle V \rangle$	0.013	0.014
$V_{19} - \langle V \rangle$	0.016	0.009

$0^{\mathrm{d}}.056$, whereas for star 25 (Figure 2), the amplitude is 0.032 mag with an estimated period of $0^{\mathrm{d}}.053$.

We might conclude that two new variable stars in the direction of the open cluster NGC 6882/5 have been found. Due to the photometric characteristics of these stars, namely, that they are within the instability strip limits, their spectral types are F6 and F5, they show low amplitude variation and short periods of pulsation, it might be concluded that these are Delta Scuti type variables.

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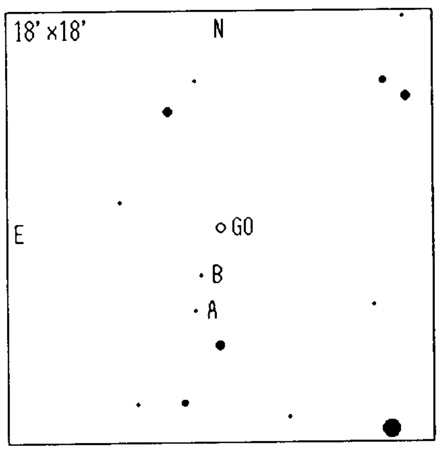
CCD PHOTOMETRY OF GO Com

A sub-group of the dwarf novae, namely WZ Sge type dwarf novae has been proposed as systems with characteristics of long-lasting outbursts of large amplitudes and long intervals between them (Bailey, 1979). Vogt and Bateson (1982) and Downes (1990) published a list of candidates of WZ Sge type dwarf novae. However, many of them recently turned to be of normal SU UMa category, since they have been later shown to have short faint outbursts, recurring with a time-scale of a year or so, e.g., VY Aqr (Hurst et al. 1987, McNaught et al. 1987), RZ Leo (Narumi et al. 1989), and WX Cet (Watanabe and Kato 1990). This is a short report on GO Com, a proposed WZ Sge type, which was not well observed in the past.

Observations were done with Thomson CCD (576x384 pixels, binned to 288x192) attached to the Cassegrain focus of the 60cm reflector at the Ouda Station on April 30, 1990. The Johnson V filter was employed and the exposure time was mostly 240 seconds. The frames were processed with the aperture photometry package developed by Y.Tomita. The magnitudes were calculated differentially to the nearby stars in the same frame. Differential atmospheric extinction was negligible because the variable and the comparisons were located within a few minutes of arc.

Figure 1 illustrates the field map of the variable and the comparisons. The resulting differential magnitudes are shown in



A = GSC1995-01151 V=14.39
B = GSC1995-00790 V=14.82

Figure 1.

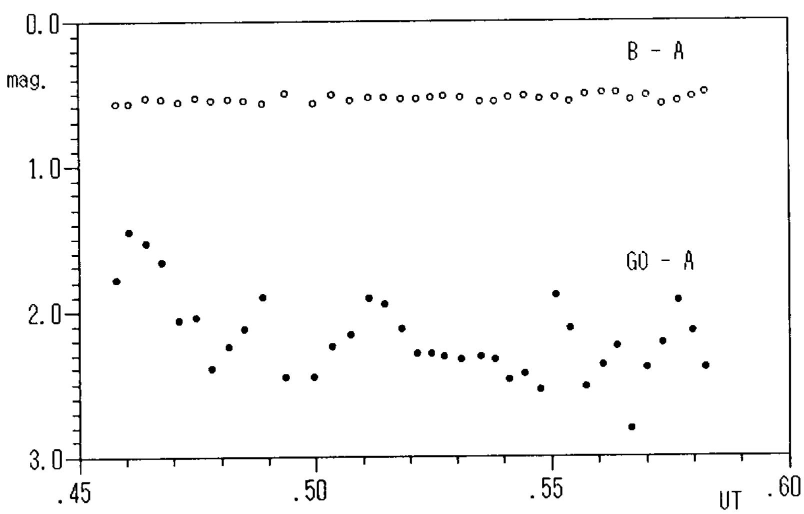


Figure 2.

Table 1. The r.m.s. error of the check star is 0.024 magnitude, and the r.m.s. error of the variable is expected to be 0.08 magnitude.

Adopting the V magnitudes of the comparison stars given in the Hubble Space Telescope Guide Star Catalog (Lasker et al. 1988), the brightness of GO Com in this run was between 16.0 and 17.2 mag., and the star was slowly fading at 0.15 mag./hour. It was significantly brighter than quiescent brightness: mp~20 (Oke and Kowal 1973) or B~18.1 (Usher 1981). It is most likely that the variable was at the declining phase of a minor outburst. The star was previously observed at a major outburst (mv~13.2) on May 30, 1989 (Watanabe and Kato 1989). Such short recurrence time of outbursts is not characteristic of WZ Sge type.

Quasi-periodic modulation with an amplitude of about 0.5 mag. is seen in the light curve (Figure 2). Fourier analysis yields the strongest periodicity of 0.023 days, without any trace of periodicity in the normal range of 0.05 and 0.10 days for the orbital periods of cataclysmic binaries below the period gap.

This modulation is possibly caused by the rotation of the white dwarf or by the orbital motion of the double degenerate system, just as proposed for AL Com and AH Eri (Howell and Szkody 1988, Szkody et al. 1989). Possibility of flickering activity is less likely because flickering usually becomes less prominent during an outburst of a dwarf nova, while the amplitude of the present variation is large.

More observation is required to clarify the nature of the periodicity.

Table I

UT(Geo) 1990 April	(B)-(A) m	(GO)-(A) m	UT(Geo) 1990 April	(B)-(A) m	(GO)-(A) m
30.4580	0.58	1.78	30.5273	0.52	2.32
30.4606	0.58	1.46	30.5308	0.53	2.34
30.4643	0.53	1.53	30.5349	0.56	2.32
30.4674	0.54	1.67	30.5379	0.56	2.33
30.4711	0.56	2.07	30.5411	0.53	2.47
30.4748	0.53	2.04	30.5442	0.52	2.43
30.4779	0.55	2.40	30.5478	0.54	2.54
30.4816	0.54	2.24	30.5509	0.53	1.90
30.4849	0.55	2.13	30.5541	0.56	2.13
30.4887	0.58	1.91	30.5572	0.51	2.53
30.4935	0.50	2.45	30.5607	0.50	2.38
30.4997	0.58	2.46	30.5638	0.50	2.24
30.5036	0.51	2.24	30.5669	0.55	2.81
30.5075	0.55	2.16	30.5700	0.52	2.40
30.5114	0.53	1.92	30.5736	0.59	2.22
30.5146	0.53	1.96	30.5767	0.56	1.94
30.5182	0.54	2.13	30.5798	0.53	2.15
30.5214	0.54	2.29	30.5824	0.50	2.40
30.5245	0.53	2.29			

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PHOTOELECTRIC PHOTOMETRY OF RHO CASSIOPEIAE

This paper represents a continuation of previous photoelectric work done on the variable star ρ Cassiopeiae (Leiker, et al., 1989, 1988, 1987). ρ Cassiopeiae (ρ Cas, HR 9045, HD 224014, SAO 035879) is a supergiant (F8pIA) star (Percy & Keith, 1985). It was discovered to be a variable in 1900 by Louise D. Wells (Pickering 1901). Much of the time this star was confined to a brightness between 4.1m and 5.1m (Bailey, 1978). However, between August 1945 and June 1947 ρ Cas decreased in brightness more than a magnitude (Gaposchkin, 1949). After it recovered from this minimum, ρ Cas continued its irregular variation in brightness between 4.1m and 5.1m.

ρ Cas was observed by Leiker and Hoff at the University of Northern Iowa's Hillside Observatory from June 1989 through February 1990. A 0.4 meter Cassegrain telescope and a STARLIGHT-1 photon counting photometer with standard B and V filters was used. HR 9010 (HD 223173, SAO 35761, K3 II, V = 5.51 m, B-V = 1.65) was used as the comparison star. These delta magnitudes are not corrected for color or extinction. Standard deviation (σ) was calculated in the usual manner. Table 1 lists the ΔV and ΔB magnitudes. Figures 1 and 2 are graphical representations of the data presented in Table 1.

This work was supported in part by a computer equipment grant from a Theodore Dunham, Jr. Grant of the Fund for Astrophysical Research.

Table I. ΔV and ΔB magnitudes of ρ Cas obtained by Leiker and Hoff

HJD	ΔV mean	σ	#	HJD	ΔB mag	σ	#
2447703.678	-0.981	0.051	3				
2447771.616	-0.902	0.006	3				
2447803.628	-0.866	0.004	3	2447803.643	-1.078	0.002	3
2447819.611	-0.847	0.005	3	2447819.625	-1.077	0.002	3
2447823.646	-0.846	0.008	3	2447823.664	-1.065	0.002	3
2447833.687	-0.843	0.003	3				
2447839.690	-0.830	0.005	3				
2447844.542	-0.829	0.001	3	2447844.558	-1.056	0.004	3
2447850.521	-0.842	0.006	3	2447850.536	-1.096	0.001	3
2447854.535	-0.857	0.005	3	2447854.551	-1.111	0.003	3
2447860.669	-0.852	0.004	3	2447860.682	-1.118	0.007	3
2447864.605	-0.855	0.005	3				
2447872.602	-0.850	0.006	3	2447872.618	-1.105	0.007	3
2447893.624	-0.888	0.001	3	2447893.636	-1.175	0.007	3
2447897.597	-0.875		1				
2447904.530	-0.920	0.005	3	2447904.548	-1.207	0.009	3
2447906.589	-0.921	0.003	3	2447906.595	-1.211	0.007	3
2447922.536	-0.940	0.001	3				
2447928.528	-0.959	0.009	3				

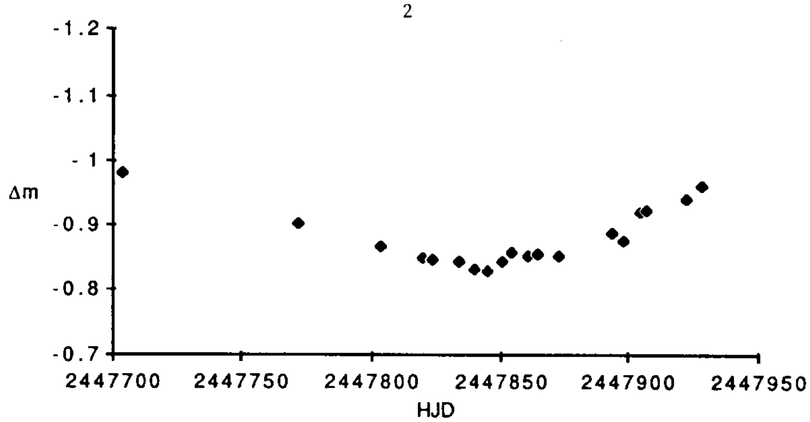

Figure 1. ΔV magnitudes of ρ Cas obtained by Leiker and Hoff

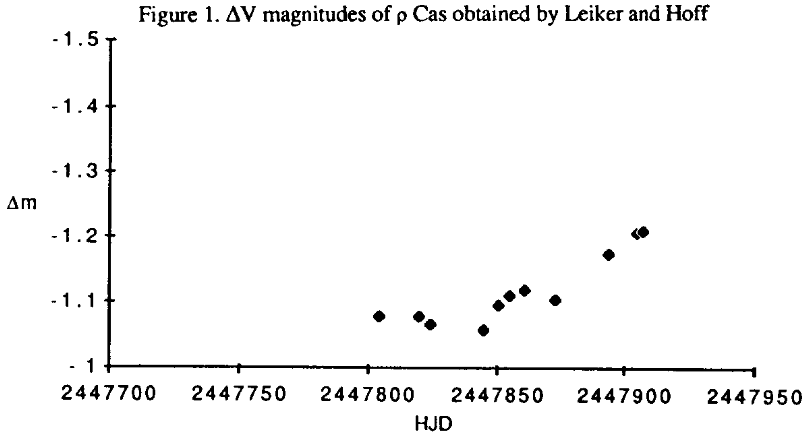

Figure 2. ΔB magnitudes of ρ Cas obtained by Leiker and Hoff

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NEW PHOTOELECTRIC OBSERVATIONS OF THE ECLIPSING BINARY FO Vir

The light variation of FO Vir star was discovered by Jackisch (1972). It was initially thought to be an RRc type variable star with a period of less than one day (Jackisch 1972, Poretti 1977 and Eggen 1983). It is also a member of visual binary J2091. Recently Schmidt and Fernie (1984), Antonello, Mantegazza and Poretti (1984) found independently its period being 0.775567 days. Mochnacki et al. (1986) disclosed that FO Vir is a precontact binary. The A7V primary component very nearly fills its Roche lobe.

The UBV photoelectric observations of FO Vir were made in March and May 1986, and in March 1987, $H_{\beta w}$ and $H_{\beta n}$ were observed in April 1988 using the 60 cm reflector equipped with a photoelectric photometer at Beijing Observatory. HR 5037 and HR 5059 were chosen as the comparison star and check star respectively.

The UBV light curves of FO Vir (Figure 1) show that the amplitude increases with the decreasing wavelength, about 0.88 magnitude in U band, about 0.56 magnitude in B band and 0.52 magnitude in V band.

The U-B and B-V color index curves (Figure 2) show that there is an obvious dip near the minimum, especially in U-B curves.

The light minimum time of FO Vir and the O-C values are as follows:

Minimum time	E	O-C (days)
JD(hel) 2446863.3214 (I) ± 5	1833	-0.0039
JD(hel) 2446565.1126 (II) ± 4	1448.5	-0.0072

The O-C values of light minimum are calculated according to the ephemeris which was given by Mochnacki et al. (1986). They noted the individual data imply changes in the shape of the V light curves at different epochs at the level of several hundredths of a magnitude.

In order to test the short-time-scale light fluctuation of FO Vir, we analysed all our data using autoregressive (AR) power spectral and harmonic analysis method for FO Vir. We did not find any short-time-scale light var-

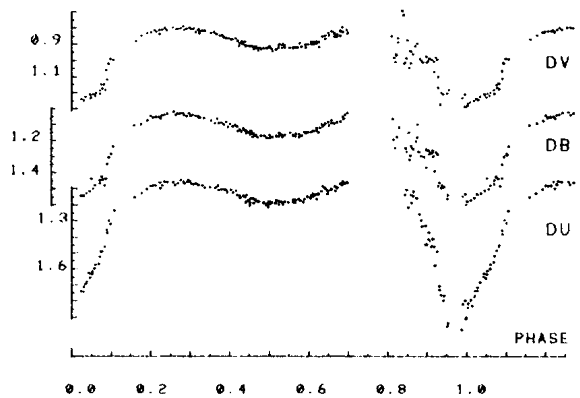

Figure 1. The UBV Light Curves of FO Vir

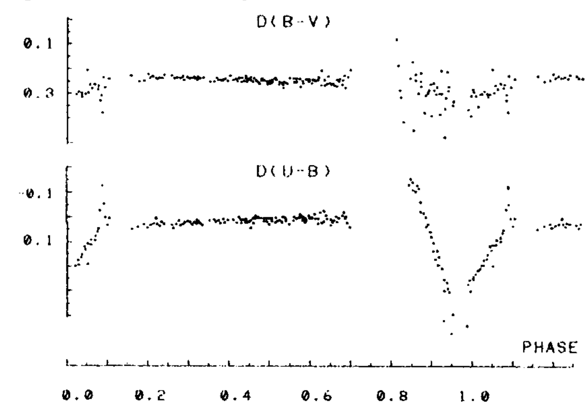

Figure 2. The Color Index D(B−V) and D(U−B) Curves of FO Vir

iation, the amplitude of which is larger than the observed error ($\pm$ 0.01 mag.).

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A Catalog of Contact and Near-Contact Binary Stars

We have compiled a catalog of 1346 contact and near-contact binary system including the class of binaries with the light curves of W UMa and β Lyr types. Some eclipsing systems and systems with Algol type light curves have also been included in the catalog if both components of the system are close in size to their inner critical Roche surfaces, or if the system is similar by physical properties to W UMa type.

The catalog has five tables and individual notes. Stars appear in the catalog in order of their variable star names as in the "General Catalogue of Variable Stars". The first two tables were almost exclusively extracted from the fourth edition of the "General Catalogue of Variable Stars". The first table contains cross references, equatorial coordinates for the equinox 1950.0, the annual precession in the equatorial coordinates for the same equinox, and the type of variability. The second table contains the spectral type, maximum and minimum brightness, and light elements. The remaining part of the catalog contains in three tables information on the available photometric, spectroscopic, orbital and physical properties of the systems. Unfortunately such properties are available only for a small fraction of the known contact and near-contact binary systems. A bibliography and notes for each star are included to direct interested workers to primary references for each of the system.

The catalog is available on request from the authors in Macintosh diskettes.

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V 577 Oph - AN ECLIPSING BINARY WITH A DELTA Sct TYPE PRIMARY COMPONENT

The eclipsing variable V 577 Oph = BD +6°3679 was included in our observational program due to its considerable eccentricity e = 0.22 (Shugarov, 1985). The observations were carried out in Tian-Shan Observatory (altitude 3000 m) using a photoelectric photometer (EMI 9863) attached to the 19" reflector in 1987 - 1990. Three nearby stars were selected as comparison stars: BD +6°3678 = "K" (prime standard), BD +6°3680 = "C1", BD +6°3677 = "C2". The differential observations were transformed to the WBVR system using HD 165401 standard star (Khaliullin et al., 1985). All observations were corrected for atmospheric extinction. The mean observational error in "V" is ± 0^m.005. The comparison stars are constant within ± 0^m.008 interval.

The pulsations were detected after previous processing of the photoelectric data. So we have undertaken special patroling of the star in quadratures. The analysis of all observations with our computer programs has revealed the presence of stable in 2.5 year interval period:

$$JDhel_{max} = 2447620.379 + 0^d.0694909 \underset{\pm 3}{} * E$$

Light curve in quadratures folded with this period is given in Figure 1. Observations in other filters are in good agreement with this value of the period. The amplitudes of light variation in different filters are: "W" - 0^m.055, "B" - 0^m.070, "V" - 0^m.052, "R" - 0^m.040. The amplitude is largest in "B" and decreases to "R". The pulsations just disappear in the primary minimum and have almost double amplitude in the secondary one. This indicates that the primary (brighter) component of the system is a delta Sct variable.

As the pulsations do not completely disappear in primary minimum, we have averaged all available points near mid-eclipse, where physical variability is less. Then we derived the individual moments of primary minima by fitting this mean curve to the observational points in computer memory. These moments are presented in Table I. The mean error is ± 0^d.0004. The

Table I. Photoelectric times of primary minimum of V 577 Oph

JD_{hel}	E	O-C
2400000.0 +		
47023.21267	-63	-0.00054
47272.4560	-22	0.00035
47327.16767	-13	0.00026
47345.40402	-10	-0.00064
47406.19552	0	0.00002

Table II. Mean magnitudes of the stars

Star	V	B-V	W-B	B-R
K	9.417	0.554	0.102	1.056
C1	9.693	0.212	0.022	0.405
C2	9.756	1.118	0.925	2.040
V 577 Oph:				
quadrature	10.978	0.488	0.085	0.932
Min I	11.621	0.504	0.000	0.991
Min II	11.487	0.509	0.080	0.977

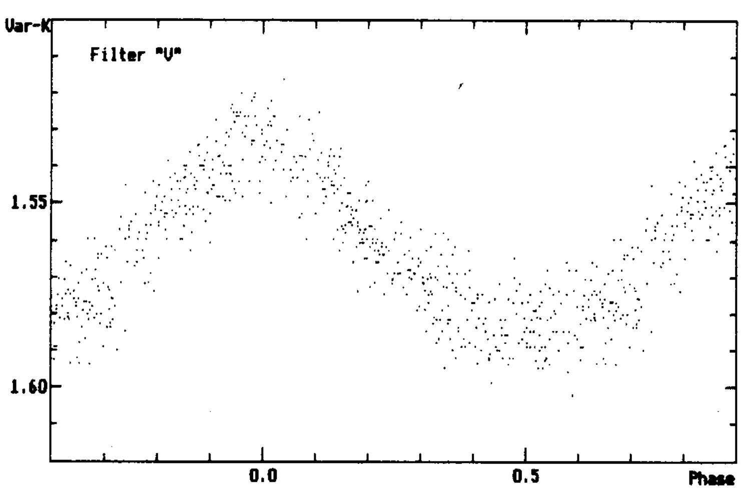

Figure 1. Light curve in quadratures of V577 Oph

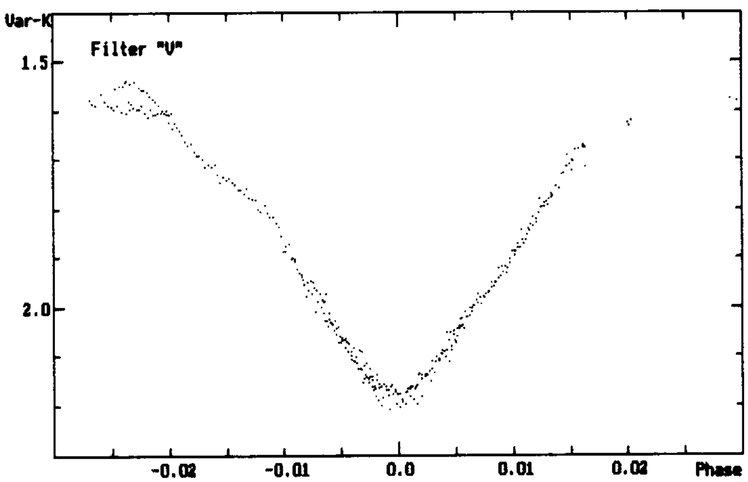

Figure 2. Primary minimum

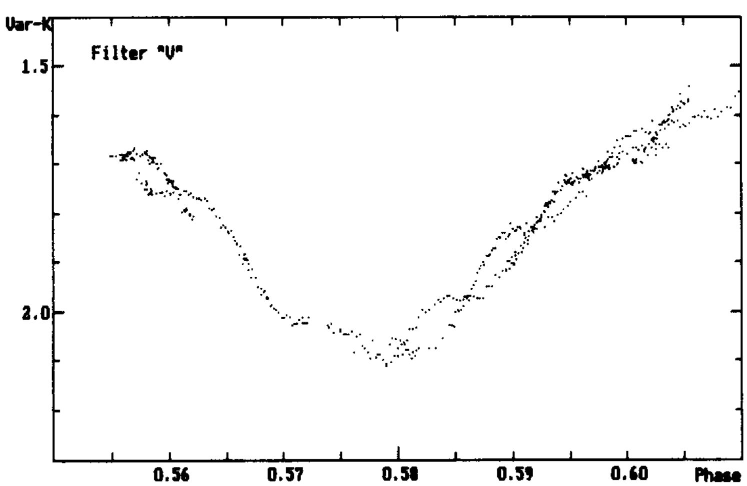

Figure 3. Secondary minimum

following formula for primary minima was obtained from this Table, making use of the least-squares method:

$$\text{Min I} \quad JD_{hel} = \underset{\pm 2}{2447406.1955} + \underset{\pm 4}{6\overset{d}{.}079084} * E$$

The moments of the secondary minimum cannot be obtained precisely because of the significant distortion of the light curve in the minimum due to pulsations. The phase of this minimum derived from all our observations is $\phi = 0\overset{p}{.}578$. The durations of minima are: DI = $0\overset{p}{.}0468$, DII = $0\overset{p}{.}0538$. Assuming $i = 90^{\circ}$ we can estimate the eccentricity $e = 0.14$ and $\omega = 29\overset{\circ}{.}6$. Both minima are presented in Figures 2 and 3. Mean magnitudes and colours of the variable in quadratures and in minima and those of comparison stars are presented in Table II. It is interesting to note that the variable becomes redder in both minima. So one can suppose a faint red companion not farther than 6" from the main components (third body?), as the angular diameter of diaphragm in use was 12".

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APSIDAL MOTION OF IQ PERSEI

IQ Persei (BD+47°920, HD 24909) is a bright (V_{max} = +7^m.7) eclipsing system consisting of two main sequence stars (B8+A6) with a slightly eccentric orbit (e = 0.075) and an orbital period of 1.74 days. The very accurate orbital and stellar properties of the system have been recently determined by Lacy and Frueh (1985) on the basis of new photometric and spectroscopic observations. The results of their studies yield among other things a value for the observed apsidal motion period of U_{obs}=140±30 yr.

Because Lacy's and Frueh's calculations of apsidal rotation were based only on two different epochs (about 13 years apart) of available data, we have decided to include IQ Per to our observational program to verify the value of apsidal motion of the system.

The apsidal motion of an eclipsing binary is well measured from the times of primary and secondary minima. We made photoelectric observations of minima of IQ Per during the period 1988-1990. They were observed using 60-cm Cassegrain telescope of the Mt. Suhora Observatory of the Cracow Pedagogical University. The observations were carried out using a one-channel photometer (Pajdosz and Zola 1989) in 1988 and a double-beam photometer (Szymanski and Udalski 1989) in years 1989-1990. Both BD+47°918 and BD+47°923 have been served as a comparison stars. Heliocentric times of minima (listed below) were determined using well known Kwee and van Woerden (KW) and graphical tracing-paper (TP) methods.

Year	HJD Min	Type	Filter	Notes
1988	2447268.366 ±0.001	I	V	(TP)
	47268.367 ±0.002	I	B	(TP)
1989	47783.5866±0.0006	II	V	(KW) normal
	47783.5867±0.0009	II	B	(KW) normal
1990	47948.3595±0.0010	I	B	(TP)
	47975.3810±0.0009	II	B	(KW)

In order to investigate the period behaviour of IQ Per we have collected all minima available in the literature. Minima observed in different filters but in the same epoch were averaged. The final list of minima of IQ Per used in the present analysis is given in Table 1, where a weight (WGT) has been arbitrarily assigned to each minimum.

If we assume that the period changes are due to apsidal motion of the system only and because of low eccentricity of the orbit of IQ Per, we can express the moments of primary and secondary minima by the approximate formulae (Martynov 1971):

$$\text{HJD Min} = M_0 + P\cdot E + \begin{cases} -A\cdot\cos(\dot{\omega}\cdot E + \omega_0) & \text{– for primary min. (E is integer)} \\ +A\cdot\cos(\dot{\omega}\cdot E + \omega_0) & \text{– for secondary min. (E is halfed)} \end{cases} \quad (1)$$

where: $A = P\cdot e\cdot(1 + \mathrm{cosec}^2 i) / 2\cdot\pi$. According to this equation we computed the values of M_0, P, A, $\dot{\omega}$, ω_0 using the least squares method, were sinusoidal curve (1) was *simultaneously* fitted to both primary and secondary minima. The result is as follows :

$$\text{HJD Min}=2444290.3640 + 1^{d}.7435619\cdot E \mp 0^{d}.042\cdot\cos(0^{\circ}.0145\cdot E + 63^{\circ}.6) \quad (2)$$

$$\pm 4 \qquad \pm 2 \qquad \pm 2 \qquad \pm 12 \qquad \pm 2.0$$

The theoretical O–C curves for obtained parameters along with the observed O–C computed according to the linear elements given in eq.(2) are shown in Figure 1. From the relation $U=360^{\circ}P/\dot{\omega}$ we estimated the value of apsidal motion period to be $U_{obs}=119\pm9$ yr and from the value of A the eccentricity of the system (assuming $i=89^{\circ}.3$) to be $e=0.076\pm0.004$. The value of e is in a good agreement with the value known from spectroscopic observations (given at the top of this paper). The theoretical estimations of U_{theo} using masses and radii published by Lacy and Frueh (1985) and the apsidal coefficients $k_1= 0.0056$ and $k_2=0.0047$ (Hejlesen 1987) yield the value 103 ± 10 yr.

3

Table I

No	HJD-2400000.	TYPE	M	WGT	REF
1	33513.396	I	:vis	1	1
2	33546.500	I	vis	1	1
3	33900.449	I	vis	1	1
4	39859.933	I	pe	10	2
5	39866.911	I	pe	10	2
6	39873.885	I	pe	10	2
7	40222.597	I	pe	10	2
8	40223.5424	II	+‡pe	10	2
9	40555.618	I	pe	10	2
10	40630.592	I	pe	10	2
11	40637.567	I	pe	10	2
12	40644.541	I	pe	10	2
13	41040.332	I	:vis	1	1
14	41230.389	I	vis	1	1
15	41244.338	I	:vis	1	1
16	41249.567	I	vis	1	1
17	41373.358	I	vis	1	1
18	41603.504	I	vis	1	1
19	41673.266	I	vis	1	3
20	41699.391	I	vis	1	3
21	41753.455	I	:vis	1	3
22	41781.354	I	vis	1	1
23	41971.394	I	vis	1	3
24	42060.338	I	vis	1	1
25	42074.275	I	vis	1	3
26	42262.576	I	vis	1	3
27	42283.498	I	vis	1	1
28	42283.513	I	vis	1	1
29	42414.250	I	vis	1	1
30	42433.447	I	vis	1	4
31	42461.318	I	vis	1	3
32	42461.334	I	vis	1	4
33	42740.304	I	vis	1	3
34	42787.390	I	vis	1	3
35	43141.351	I	vis	1	4
36	43174.462	I	pe	10	1
37	43399.385	I	vis	1	4
38	43460.407	I	vis	1	4
39	43481.306	I	vis	1	1
40	43512.716	I	vis	1	4
41	43596.399	I	vis	1	4
42	43772.503	I	vis	1	4
43	43936.371	I	vis	1	3
44	43957.335	I	vis	1	3
45	44140.405	I	:vis	1	4
46	44166.563	I	vis	1	4
47	44290.3461	I	pe	10	5
48	44637.303	I	vis	1	4
49	44853.5193	I	pe	10	1
50	44925.907	II	+pe	10	6
51	44926.749	I	pe	10	6
52	45622.425	I	vis	1	4
53	45636.401	I	vis	1	4
54	45983.359	I	vis	1	4
55	46112.3767	I	pe	10	4
56	46405.293	I	vis	1	1
57	46717.391	I	vis	1	1
58	46731.348	I	vis	1	1
59	46764.486	I	vis	1	1
60	47029.490	I	vis	1	1
61	47057.388	I	:vis	1	1
62	47064.348	I	vis	1	1
63	47102.7277	I	pe	10	7
64	47151.551	I	vis	1	1
65	47207.328	I	vis	1	1
66	47207.334	I	:vis	1	1
67	47207.345	I	vis	1	1
68	47268.3665	I	pe	10	8
69	47783.5867	II	‡pe	10	8
70	47948.3595	I	pe	10	8
71	47975.3810	II	pe	10	8

Notes: (:)-uncertain, (‡)-normal minimum, (+)-derived from original observations

(1) B.A.V. observers, (2) Hall et al. (1970), (3) B.B.S.A.G. observers,
(4) B.A.A.V.S.S. observers, (5) Pohl et al. (1982), (6) Lacy and Frueh (1985),
(7) Caton et al. (1989), (8) this paper

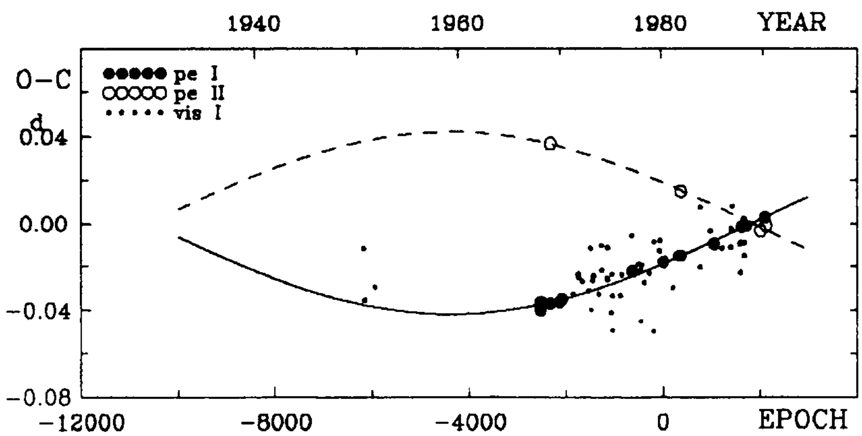

Figure 1

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APSIDAL MOTION OF AS CAMELOPARDALIS

AS Cam (BD+69°325, HD 35311, V_{max} = +8^m.6) is a detached eclipsing binary consisting of two components of spectral types B8V and B9.5V in an eccentric orbit (e=0.135) and with orbital period equal to 3.43 days.

The spectroscopic orbit of this system was determined by Hilditch (1972). The last photometric studies have been made by Khaliullin and Kozyreva (1983). The apsidal motion of AS Cam has been recently discussed by Maloney et al. (1989). The authors used all the published timings of primary and secondary minima from 1899 to 1986 and confirmed a significant discrepancy between the observed value of periastron motion U_{obs} = 2400±850 yr and the theoretical one predicted by classical and general relativistic effects of U_{theo} = 815±61 yr. The cause of this discrepancy remained an unsolved problem (Maloney et al. 1989).

We observed AS Cam during two nights in January and April 1990. The observations were carried out at Mt. Suhora Astronomical Observatory of the Cracow Pedagogical University using the 60-cm Cassegrain telescope with a double-beam photometer (Szymanski and Udalski 1989). BD+69°323 was chosen as the comparison star. Two heliocentric moments of minima were computed using the Kwee and van Woerden method:

HJD Min	Type	Filter
2447898.2528 ± 0.0002	II	V
47982.5118 ± 0.0004	I	B

In order to investigate the period changes of AS Cam we have collected all minima available in the literature. Minima observed in different filters but in the same epoch were averaged. The final list of minima of AS Cam used in the present analysis is given in Table 1, where a weight (WGT) has been arbitrarily assigned to each minimum.

In the next step we have assumed that the period changes are due to apsidal motion of the system only. The moments of both primary and secondary minima can be expressed by the approximate formulae (Martynov 1971):

$$\text{HJD Min} = M_0 + P\cdot E + \begin{cases} -A\cdot\cos(\dot{\omega}\cdot E + \omega_0) & \text{- for primary min. (E is integer)} \\ +A\cdot\cos(\dot{\omega}\cdot E + \omega_0) & \text{- for secondary min. (E is halfed)} \end{cases} \quad (1)$$

where: $A = P\cdot e\cdot(1 + \mathrm{cosec}^2 i) / 2\cdot\pi$. In the equation (1) we omitted terms of the order of e^2 and higher because of the low eccentricity of the orbit of AS Cam as well as a small interval of the observations in relation to the apsidal motion period. The values of M_0, P, A, $\dot{\omega}$, ω_0 were adjusted *s i m u l t a n e o u s l y* for both primary and secondary minima by means of the least squares method. The following parameters were obtained:

$$\text{HJD Min} = 2440204^{d}.4062 + 3^{d}.4309691\cdot E \mp 0^{d}.111\cdot\cos(0^{\circ}.0037\cdot E + 198^{\circ}) \quad (2)$$

$$\pm 10 \qquad \pm 7 \qquad \pm 7 \qquad \pm 18 \qquad \pm 10$$

The theoretical O–C curves for obtained parameters along with the observed O–C computed according to the linear elements given in eq.(2) are plotted in Figure 1 where only points with non-zero weight were presented. From the relation $U=360^{\circ}P/\dot{\omega}$ we estimated the value of apsidal motion period to be $U_{obs}=920\pm470$ yr and from the value of A the eccentricity of the system (assuming $i=89^{\circ}$) to be $e = 0.10 \pm 0.01$. In fact, a real value of e can be different from the presented value due to omission of the last terms in eq. (1). Nevertheless, our estimation showed that this difference should not be greater than 10%. The obtained value of e is significantly lesser than those known from photometric investigations (e=0.17) by Khaliullin and Kozyreva (1983) and used by Maloney et al. (1989) in their analysis of apsidal motion of AS Cam and those determined spectroscopically (e=0.135) by Hilditch (1972). The

Table I

No	HJD-2400000.	TYPE	M	WGT	REF	No	HJD-2400000.	TYPE	M	WGT	REF
1	15120.678	I	ptg	0	1	36	32937.702	I	ptg	1	1
2	15770.643	II	ptg	1	1	37	36612.310	I	ptg	1	1
3	16166.718	I	ptg	0	1	38	39859.4902	II	pe	10	1
4	16359.309	I	*ptg	1	2	39	39890.3692	II	pe	10	1
5	16360.754	II	*ptg	1	2	40	39924.6814	II	pe	10	1
6	16456.772	II	ptg	0	1	41	40132.4604	I	pe	10	1
7	16537.619	I	ptg	1	1	42	40204.5137	I	pe	10	1
8	16775.745	II	ptg	0	1	43	40269.6996	I	pe	10	1
9	17259.639	II	ptg	1	1	44	40626.5223	I	pe	10	3
10	18284.810	I	ptg	0	1	45	40911.297	I	pe	10	4
11	18431.585	I	ptg	1	1	46	40957.393	II	pe	10	4
12	18592.837	I	ptg	1	1	47	40959.327	I	pe	10	4
13	18750.564	I	ptg	1	1	48	40988.276	II	pe	10	4
14	20226.021	I	*ptg	1	2	49	40990.202	I	pe	10	4
15	20227.459	II	*ptg	1	2	50	40995.138	II	pe	10	4
16	20901.706	I	ptg	0	1	51	41007.3600	I	pe	10	3
17	21577.777	I	ptg	1	1	52	41547.5278	II	pe	10	5
18	22380.615	I	ptg	1	1	53	41578.4065	II	pe	10	5
19	22920.719	II	ptg	1	1	54	41580.3334	I	pe	10	5
20	23042.746	I	ptg	1	1	55	42460.4200	I	:vis	0	6
21	24648.596	I	ptg	1	1	56	44939.2415	I	pe	10	7
22	24991.572	I	ptg	1	1	57	44940.7526	II	pe	10	7
23	26000.306	I	ptg	1	1	58	45002.514	II	pe	10	8
24	26238.450	II	ptg	1	1	59	46397.4085	I	pe	10	9
25	26303.770	II	ptg	1	1	60	46500.331	I	pe	10	6
26	26422.379	I	ptg	1	1	61	46771.3810	I	pe	10	10
27	26751.617	I	ptg	1	1	62	47138.4956	I	pe	10	11
28	26753.583	II	ptg	0	1	63	47270.3851	II	pe	10	6
29	26988.454	I	ptg	1	1	64	47443.8483	I	pe	10	12
30	27187.554	I	ptg	0	1	65	47465.9520	II	pe	10	12
31	28127.474	I	ptg	1	1	66	47553.6410	I	pe	10	13
32	29194.531	I	ptg	1	1	67	47893.314	I	pe	10	6
33	29204.819	I	ptg	1	1	68	47898.2528	II	pe	10	14
34	30381.870	I	ptg	0	1	69	47982.5118	I	pe	10	14
35	32275.546	I	ptg	1	1						

Notes: (:)-uncertain, (*)-normal minimum

(1) Hilditch (1969), (2) Maloney et al. (1989), (3) Battistini et al. (1974), (4) Padalia and Srivastava (1975), (5) Gulmen et al. (1976), (6) B.B.S.A.G. observers, (7) Khaliullin and Kozyreva (1983), (8) Pohl et al. (1983), (9) B.A.A.V.V.S. observers, (10) Guinan et al. (1987), (11) B.A.V. observers, (12) Lines et al. (1989), (13) Couls (1989), (14) this paper

theoretical estimations of U_{theo} using our value of e=0.10 yield the period of apsidal motion equal to 900 ± 70yr. Our analysis shows no differences between theory and observations. The cause of the anomalies obtained in earlier determinations of apsidal rotation of AS Cam might be due to the incorrect

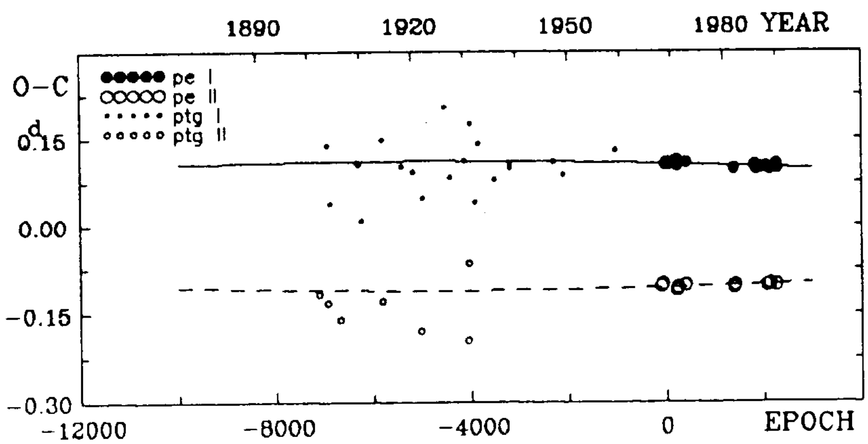

Figure 1

value of the orbital eccentricity of the system. It may be interesting to check our result by new spectroscopic and photometric observations.

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HN Cyg: A MISCLASSIFIED U Gem

HN Cyg is listed in the 1985 edition of the GCVS as UG: (doubtful classification among U Gem stars). It appears in the atlas and catalogue of northern dwarf novae by Bruch et al. (1987, Astron.Astrophys.Suppl. 70, 481) who reported outbursts on April 17, 1980 and Sept. 27, 1981. On these bases we included HN Cyg in our spectroscopic monitoring of dwarf novae with the Asiago 1.8 m telescope equipped with a Boller & Chivens spectrograph and CCD.

On July 8, 1990 we detected HN Cyg very bright with respect to its appearance on the Buch et al. finding chart. We took low resolution spectra (7.7 Ang/pixel, range 3200-7600 Ang) that showed a late type spectrum with strong TiO bands. Reobserving HN Cyg the following night with the same equipment we found it still very bright and again it showed a late type spectrum. From the depth of the TiO bands at 6200 and 7100 Ang (see figure) a spectral type of M 6.5 can be derived using the calibration of Kenyon & Fernandez-Castro (1987, Astron.J. 93, 938). For the luminosity class the determination is somewhat more uncertain, also if we favour a III class.

Thus, HN Cyg does not seem to be a U Gem star. What is more probable, considering the large amplitude of variation and the optical spectrum at maximum, is a classification of HN Cyg among the Mira variables.

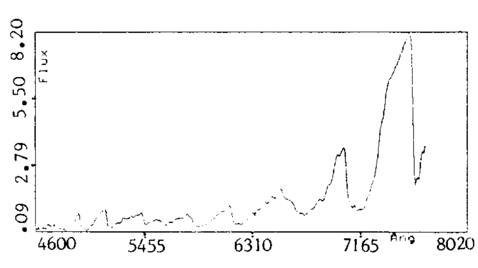

Figure 1. Absolute spectrophotometry of HN Cyg on July 8 and 9, 1990. The flux is in unit of 10^{-14} erg $\cdot$ cm^{-2} $\cdot$ sec^{-1} $\cdot$ A^{-1}.

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Number 3497

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ANOTHER SUPERNOVA IN M83 (NGC 5236)

During a search for supernovae in nearby galaxies using plates from the Harvard College Observatory collection, I found an unrecorded supernova in the SBc spiral galaxy M83 (NGC 5236). The image was discovered on blue photographic plates taken in Bloemfontein, South Africa, with a 3-inch Ross-Fecker lens with a focal length of 530 mm.

The supernova, located 97" west and 175" south of the nucleus, had the following B (photographic) magnitudes as estimated from the sequence published by McElroy and Humphreys (1982):

1945	U.T.	B
June	13.0	>15
July	1.9	>14.5
	13.9	14.2
	30.9	13.7
Aug	1.9	14.0
	7.9	14.5

No further plates were taken of the region in 1945, and no other images could be found to approximately 15th magnitude thereafter. The photographic patrol of that region of the sky recommenced in March 1946.

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Reference:

McElroy, D.B. and Humphreys, R.M.: 1982, Publ. Astr. Soc. Pac., 94, 828.

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FLARE STAR T 176

In Orion association there are few flare stars with high frequency of flare-ups. Among them T176 = V909 Ori ($\alpha_{1900}=5^h38^m.1$, $\delta_{1900}=-7^\circ21'$) shows the highest frequency. As it was noted by Haro (1976) the flare star T176 cannot be a member of the association because of the large outburst incidence, the spectral type M2e-M3e and the kind of delta m observed during several flare-ups. During the re-examination of the photographic material of Tonantzintla Observatory 16 new flare-ups of that star were found (Table I) which confirmed that T176 is a foreground flare star.

Table I

New flare-ups of T176 = V909 Ori

No.	m_u	Δm_u	date
1.	15.8pg	0.8pg	07.03.1962
2.	16.4	2.0	27.12.1964
3.		0.5	26.01.1965
4.		3.0	17.12.1965
5.		1.5	23.12.1965
6.		1.3	29.12.1965
7.		1.0	17.02.1966
8.		1.0	24.02.1968
9.		2.5	22.01.1969
10.		4.0	20.02.1969
11.		1.3	06.12.1972
12.		0.5	11.02.1978
13.		0.5	04.03.1978
14.		2.5	07.03.1978
15.		0.5	08.03.1978
16.		3.2	27.11.1981

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Byurakan Observatory
Armenia, USSR

E. CHAVIRA

Instituto de Astronomia,
Optica y Electronica,
Tonantzintla, Mexico

Reference:

Haro, G.: 1976, Bol. Inst. de Tonantzintla, 2, 3, 1976.

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HU ISSN 0374 - 0676

RECENT Hα SPECTROSCOPY OF CH CYGNI

Recently the symbiotic star CH Cygni has been reported to be declining in brightness. Leedjarv (1990) reports that on JD 2448025 (13 May 1990) and on JD 2447941 (18 February 1990) the V magnitude of CH Cyg was near 9.2, the faintest it has been in this century. Between September 1989 and May 1990 CH Cyg dimmed by 1.5 mag in V. This fading may have been a portent that a new episode of activity in CH Cyg was about to begin, as Hack and Ferluga (1990) note that strong permitted and forbidden emission lines have recently (July 1990) become visible.

CH Cyg has been observed spectroscopically on several occasions at Ritter Observatory during the last few years. Our Reticon and CCD scans at Hα have recorded the (usually) small and gradual emission profile variations that have been by, e.g., Oliversen and Anderson (1982). During 1986, for example, our data showed the Hα line in CH Cyg to be a strong emission feature with intensity 5-6 times that of the local continuum; there was a deep central reversal in the profile, and slow changes were seen in the relative intensity of the red and blue emission peaks. During 1987 the Hα emission was still double-peaked but only twice the intensity of the continuum. In 1988 the emission was still weaker but had only a single peak. Our recent (1989-1990) spectroscopic observations indicate that very significant changes have taken place in the profile and intensity of the Hα feature; these changes

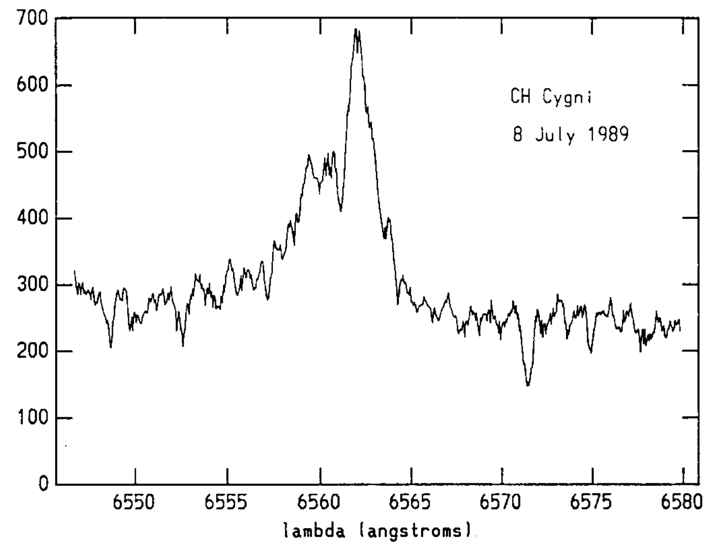

Figure 1: The Hα region in CH Cyg in July 1989 recorded with 0.3 Å resolution.

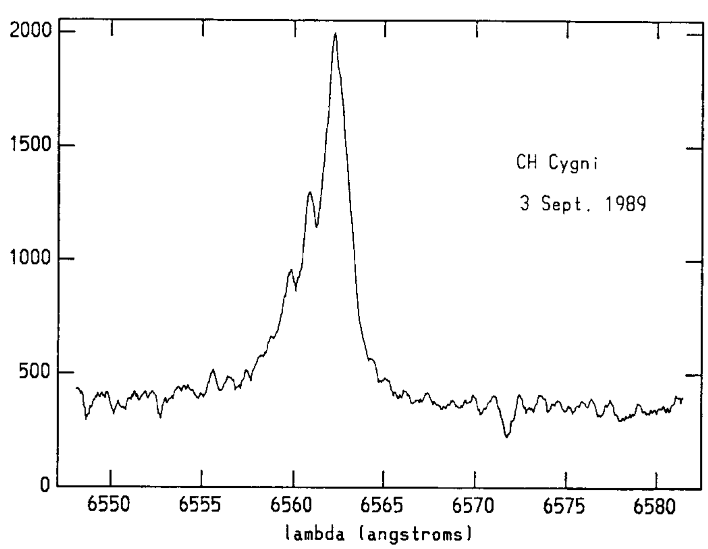

Figure 2: Hα in CH Cyg in September 1989.

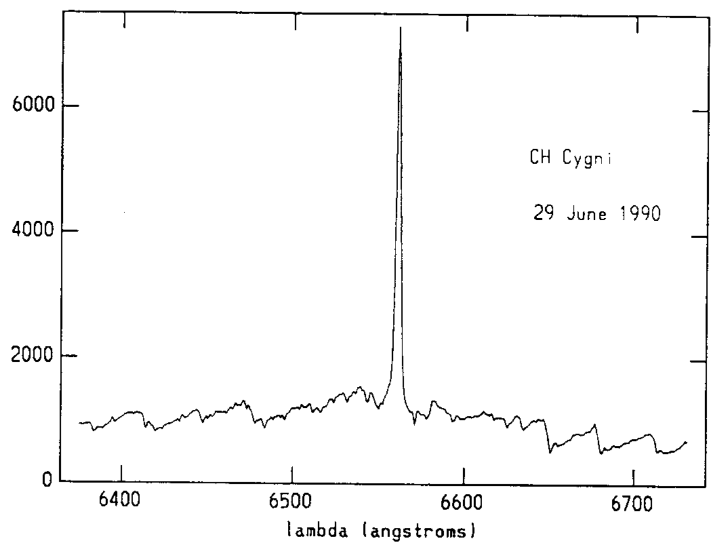

Figure 3: The Hα region in CH Cyg on 29 June 1990, recorded at 1.2 Å resolution.

may well be related to the fading of the star noted by Leedjarv (1990).

In July and September 1989 CCD observations of the red region of CH Cyg were obtained at Ritter Observatory with 0.3 Å resolution. The July 1989 profile (Figure 1) shows a broad, complex emission profile, quite different from what is illustrated by Oliversen and Anderson (1982) or what we observed during 1986-1988. There appear to be three peaks in the Hα line at radial velocities of -152, -104 and -32 km s^{-1}; the strong central absorption reversal is absent. By September 1989 (Figure 2) the Hα line had become stronger, about four times the continuum intensity. The Doppler shifts of the three Hα components had not changed appreciably.

The most recent Hα observation of CH Cyg at Ritter Observatory was obtained with a new fiber-fed spectrograph, mounted on an optical table. CCD scans with this spectrograph had a resolution of 1.2 Å, with about 350 Å wavelength coverage. Figure 3 shows that the Hα line continued to increase in strength, and in late June 1990 had reached an intensity nearly six times the local continuum. The profile appears to be symmetric, with a single peak (V_r = -75 km s^{-1}), at this resolution. No other emission features are detected, suggesting that this observation took place before the start of the outburst reported by Hack and Ferluga (1990).

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Optical monitoring of the 60 ms X-ray pulsar candidate Wackerling 2134

Observations with the *Einstein Observatory* by Caraveo *et al.* (1989) have led to the identification of the relatively bright variable X-ray point source IE1024.0-5732 with the emission line early-type star Wack 2134 (Wackerling, 1969). Their timing analysis has shown that the X-ray source has a periodicity P ~ 60 ms, and optical spectra indicates the star in Wack 2134 is probably of O5 type. Hence Caraveo *et al.* infer indirectly that the Wack 2134 system is a binary, with the hot massive star losing matter to a spinning neutron star. The observed period then would make this system the fastest X-ray pulsar to date.

With this short period in mind, we have examined Wack 2134 for the possible presence of optical pulsations. The system has been observed on three separate occasions in white light, using a photometer sampling at a rate of 1 kHz on the University of Tasmania's 1 m telescope. In each case, the data train was examined using several 2048K point Fast Fourier Transforms. Both single FFT's of the data reduced to 3 ms time resolution, and the average FFT of several overlapped data segments at 1ms were generated. The low frequency end of the single FFT spectrum from the best data run, 105 min of data obtained on 19 December 1989, is shown in Figure 1. The plot in Figure 1 was generated by grouping the power spectrum into blocks of 128 points, and determining the maximum and mean power in each block. Here the maxima are shown in the upper plot while the relatively smoother means are shown underneath. The minima from each of the 128 point blocks lie along the frequency axis. As can be seen in Figure 1, no significant spikes are evident..

To place a 90 percent confidence level upper limit on the amplitude of any modulation, the method described by Lewin *et al.* (1988) has been used. In the frequency range of 10 Hz to 20 Hz, the 19 December 1989 data set an upper limit,

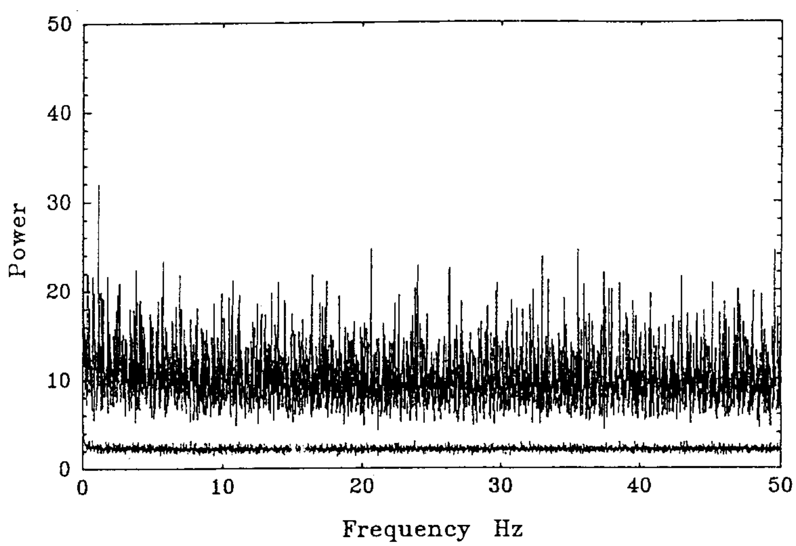

Figure 1: The average FFT power spectrum of Wack 2134 obtained on 19 December 1989, as discussed in the text.

for any pulsed optical component, of ~ 7.1 mag fainter than the white light flux from Wack 2134. Since the apparent visual magnitude of Wack 2134 is ~ 12.6, this implies an upper limit around magnitude 19.7 for any optical pulsations.

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